Basingstoke Water Cycle Study

Phase 1 Technical report

March 2007

Halcrow Group Limited

Basingstoke Water Cycle Study - Phase 1

Technical Report

March 2007

Version 1 Revision 6

Halcrow

Contents Amendment Record

This report has been issued and amended as follows:

Issue	Revision	Description	Date	Approved by
1	1	Interim draft report for comment only	3/01/07	EJG
1	2	Draft report for comment only	31/01/07	EJG
1	3	Draft report for comment only	04/02/07	EJG
1	4	Draft final report version 4	16/02/07	EJG
1	5	Draft final report version 5	27/02/07	EJG
1	6	Final report	01/03/07	EJG

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Contents

1 The Water Cycle

Figure 1 below summarises the Water Cycle and shows how water enters, leaves and returns to the river system.

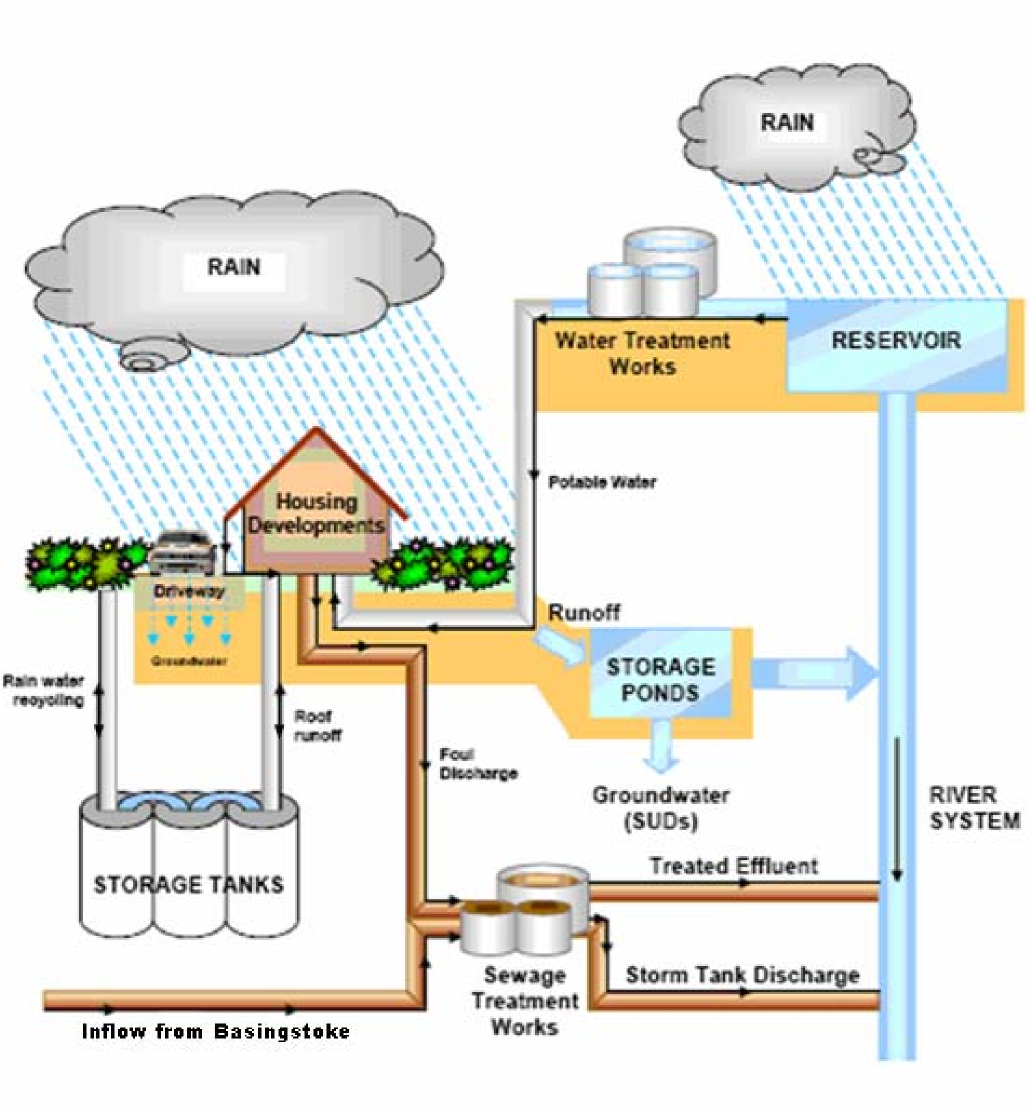

Figure 1.1 The Water Cycle

2 Proposed Developments and Planning Process

Phase 1 of the Basingstoke water cycle study is to assess the strategic capacity to accommodate development at Basingstoke. The specific detail of delivering the scale of growth should be considered through further technical work to assist the delivery of the Local Development Framework (LDF).

In accordance with Planning Policy Statement 11 (PPS11) the Draft Regional Spatial Strategy (dRSS) should indicate the broad scale and location of growth, but not identify specific locations. This will be for the appropriate LDF to determine. Consequently, the understanding of the Water Cycle Group is that the focus of the Examination in Public (EiP, also known as the Public Examination) Panel will be on the overall capacity of the wider area to accommodate development, not site specifics. This approach lends itself with regard to waste water treatment and water quality, and water resources, but is more difficult when quantifying river and urban flooding. Whilst clean water and sewage can be moved around a network, ensuring sufficient lead in time to provide the necessary infrastructure, flood risk cannot.

The water cycle study looked at three different development scenarios to quantify the implications:

a) Scenario 1 - 740 dwellings/annum – This scenario is based on Basingstoke and Deane Borough Council's preferred level of development for the Borough as established in 2006 as the Council's response to consultation on alternative levels of future growth for inclusion in the RSS.
b) Scenario 2 - 825 dwellings/annum – This scenario is based on the proposed level of housing provision in the dRSS.
c) Scenario 3 - 990 dwellings/annum – This is a notional higher growth scenario based on increasing the dRSS by 20%

Of this, the majority of the increase in dwellings occurs within the Blackwater and Western Corridor area, and only a small increase occurs within the Basingstoke & Deane borough outside of this area. To calculate the impact of these scenarios on the water cycle, they must be converted into population estimates. This was carried out by Hampshire County Council on behalf of Basingstoke & Deane Borough Council using the Chelmer model.

Water Company planning

There are three water companies with a stake in this water cycle strategy. Thames Water is responsible for providing sewerage and wastewater treatment for Basingstoke. South East Water is responsible for providing clean water to the east of the Basingstoke & Deane Borough Council area, and Southern Water responsible for providing clean water to the west of the area as shown in Figure 3.1. The water companies responsible for providing water supply and wastewater collection and treatment, are funded in 5 year planning periods. The money they have available to spend on infrastructure is determined by OFWAT in consultation with government, the Environment Agency and consumer organisations amongst others. The consultation process is known as the Periodic Review (PR), and the next review PR09, which will determine how much money they have to spend between 2010 and 2015 will start in 2008 and conclude in November 2009. The water companies are currently drafting their business plans with detailed strategies and costs for new infrastructure. These business plans will be sent to the regulator for first submission in June 2008, with the final submissions following in early 2009. Once funding has been obtained for new or upgraded infrastructure, there can be a significant lead in time for planning and construction before the infrastructure can be used (see Table 2.1). Therefore the water companies require detailed information on likely housing developments up to 2016 well in advance of 2008 if they are to plan and provide the infrastructure required to meet those levels of growth.

Table 2.1 Thames Water estimate of infrastructure lead in times

Resource	Lead in time
Wastewater treatment works upgrade	3 – 5 years
Sewerage network upgrades	1 – 3 years
Major resource development (new reservoir, new STW etc)	8 – 10 + years

3 Water Resources and Water Supply

That part of the Basingstoke & Deane Borough Council area within the Western Corridor and Blackwater Valley sub-region falls within two water resource zones (WRZ) as shown in Figure 3.1. These are:

- Hants-Kingclere – Southern Water (SWS)
- Northern Zone – South East Water (SEW)

Southern Water and South East Water have previously assessed the impact of forecast population and housing growth on water resources as part of the strategic water resource planning exercise in 2004. For the purposes of this water cycle we have used the information in these Water resource plans (WRP04), along with the Water Resources in the South East Group (WRSE) report (May 2006) on the latest South East Plan housing provision and distribution received from SEERA, to look at the impact of additional forecast growth beyond that assessed by the water companies.

The water cycle study has used the information presented in the water companyies' 2004 water resources plan and updated the population figures with the latest known population figures obtained from the Office of National Statistics and Communities and Local Government. The method used is explained more fully in the Appendix G.

The study has looked at three water efficiency and demand management scenarios alongside the three population forecast scenarios discussed in chapter 2 (Scenarios 1, 2 and 3). The water resource scenarios assessed are aspirational, and may not be achieved without a change in regulation and legislation. These scenarios have been assessed as testing scenarios to look at the limits of what may be achieved and how that would affect water resources in the Basingstoke & Deane Borough Council Area. The WRSE report previously mentioned has suggested that an 8% decrease in per capita consumption can be achieved with a twin track approach and without a change in legislation In the Basingstoke and Deane area this would reduce average per capita consumption (pcc) to around 138litres per head per day (l/hd/d) for new homes, compared to the 120l/hd/d used in the water resource scenarios in this study.

The Environment Agency has looked at how water efficiencies of up to 47% can be obtained in new housing in the May 2006 WRSE report. Therefore the pcc of 120l/hd/d used in this study for new developments, which only represents an efficiency saving of 20% is an aspirational but entirely achievable target although it may need to be supported with a change in legislation. The Environment Agency state that:
"With suitable enabling mechanisms and incentives in place, the achievable range of water efficiency savings probably lies between 8% and 21% relative to water companies forecast per capita consumption. Higher savings should not be ruled out but will be more challenging still. To achieve them significant regulatory, financial and behavioural changes would be required."

- ***Water resource scenario A***
  All new properties in Basingstoke and Deane district have per capita consumption rates of 120 litres per person per day, all other developments and existing properties have per capita consumption rates as stated in the SEW and SWS 2004 Water Resource Plans.

- ***Water resource scenario B***

  All new properties in Basingstoke and Deane district have per capita consumption rates of 120 litres per person per day, all other metered properties have per capita consumption rates of 150 litres per person per day (post 2008). Unmetered properties have per capita consumption rates as stated in the SEW and SWS 2004 Water Resource Plans.

- ***Water resource scenario C***

  All new properties in Basingstoke and Deane LA have per capita consumption rates of 120 litres per person per day; all other metered properties have per capita consumption rates of 150 litres per person per day. Unmetered properties have per capita consumption rates as stated in the SEW and SWS 2004 Water Resource Plans. In addition, a planned meter program to install meters in all houses in Basingstoke and Deane district by 2018 is simulated.

Water resource scenario C, refers to a planned meter program to install meters in all houses in the study area. This cannot be achieved without a change in current legislation, and has been introduced as a testing scenario to look at the benefits of a change in legislation.

Water resource planning is undertaken to ensure that sufficient resources are available for both dry year annual average demands and also for dry year critical period (usually peak week) demands. A deficit in the dry year annual average scenario implies that either a new resource is required (if existing sources are fully utilised and not constrained) or that demand management saving measures need to be introduced. A deficit that is only shown to occur in a peak week can be due to operational constraints, either due to distribution, storage, treatment capacity or licences, are restricting the supply of water within the zone, or can indicate that there is insufficient resource.

Target headroom in this study, to represent risk and uncertainty in the supply-demand balance, was assumed to be the same as used by the water companies in their 2004 water resources plans. This target headroom includes the water companies' assessment of total risk and uncertainty in their plans. It does not however include an uncertainty for potential sustainability reductions that may be required by the Environment Agency if it is determined that a source is causing environmental damage. The target headroom does include risk and uncertainty due to climate change.

This study has looked at both dry year peak week and annual average demands, and compared the water resource plans 2004 demand forecasts with updated population and occupancy figures to match the best current knowledge of the study area. Figures 3.2 and 3.3 show the dry year annual average scenario demands. The solid red line is the water companies' WRP04 demand forecast. The dashed black line uses the same PCC figures used by the water companies, but has updated the population and occupancy figures to the best current estimates. This shows that changes in population forecast and occupancy estimates since the plans were drawn up in 2003/2004 have meant that the WRP demand forecasts are, in the opinion of the water cycle study, over-estimates. This is seen most clearly in Figure 3.2, where the current demand based on the WCS study is less that that assumed in WRP04, and the difference increases over the plan period.
The WCS 2006 current demand in the Hants Kingclere zone is the same as WRP04, although the forecast demand in WRP04 over the plan period diverges slightly from that of the WCS (figure 3.3). Again this difference is due to differences in forecast occupancy rates and population.

The impact of the RSS population growth and higher and lower testing scenarios (housing development scenarios 2, 3 and 1 respectively) are described as such in the chart legends. The water resources scenarios, A, B and C are described as WRA, WRB and WRC respectively.

It can be seen from the dry year annual average demand forecast figures that the water resources scenarios have a much greater impact on the demand for water than the development scenarios. For example in RZ4, there is a difference in demand of only 0.65% between the development scenarios 1 and 3, whereas the difference between WRP04 pcc rates and WRC reduces forecast demand in development scenario 2 in 2026 by 3.4%.

Figures 3.4 to 3.7 show how the increasing demand over the WRP period will be met.
The vertical bars show the water available for use within the water resource zones for both dry year annual average and critical period scenarios, and the lines show forecast demand including target headroom for each of the development scenarios and water resource scenarios. The solid black line shows the water company estimates of demand as per the WRP04. This shows that there is sufficient WAFU provided the schemes identified in the WRP04 go ahead. The broken black line in each of the chart legends is an assessment of the draft RSS population demand above the most recent assessment of current occupancy rates and population for each of the water resource zones. This uses the water company's estimates of per capita consumption and does not assume any additional water efficiency measures beyond those proposed in WRP04. For each of the graphs, this line is below the demand forecast by the water companies in WRP04.
The graphs show that there is sufficient resource to meet the forecast demand for all of the development scenarios assessed provided the schemes identified in WRP04 go ahead. The water resource scenarios show how the forecast demand is decreased by enforcing more stringent water efficiency measures than currently planned. As has been stated already, some of these water efficiency measures may not be achieved without a change in legislation, and some cannot be achieved without a change in legislation.

Figures 3.4 and 3.5 show water available for use increasing in SEW RZ4 towards the end of the plan period without additional resources being identified. This additional resource is to be made up by bulk transfers from neighbouring water resource zones. This may not be necessary if water resource efficiencies can be enforced with tighter legislation. Whilst there is water available for use in neighbouring resource zones according to the WRP04; it may be more sustainable for a resource zone's demand to be met from within the confines of that resource zone.

The additional resource schemes identified in the WRP04 do not involve additional resource being abstracted from either from the River Loddon surface catchment, or from groundwater in the aquifer serving River Loddon. Therefore the planned schemes will not affect the hydrology of the Loddon. However, the additional resources may have an environmental impact on other catchments outside of the scope of this study.

There are no planned sustainability reductions for the two water resource zones in question. However, the East Woodhay source serving the Hants Kingclere zone is currently subject to an investigation as part of the Kennet and Lambourn floodplain sustainability investigation, and the Maidenhead groundwater abstraction identified in the RZ4 plan is subject to an investigation to determine what the sustainable yield is likely to be.

Therefore a twin track approach of reducing demand for water alongside ensuring additional resources are provided where necessary is needed to ensure that the impact on the water environment will be minimised.

The key conclusions of the assessment of water resources are:

- Planned growth can be supplied without extra resource development, beyond that currently planned in WRP04.

- There is some uncertainty over the sustainable yield of some of the additional resources identified in the WRP04, and these are still subject to investigation.

- Additional resources identified in the WRP04 will not impact on the hydrology of the River Loddon, therefore do not need to be considered within the flood risk or water quality sections of this report.

- A twin track approach to water resources is recommended via demand management, to constrain demand, in parallel with developing additional resources when required.

- The need for new resources could be offset by adopting greater water efficiency and demand management measures, but this would need to be supported with strong enabling mechanisms and incentives, and may need a change in legislation covering water companies and planning authorities.

- The scenario testing has shown that the demand management measures have a greater impact on water resources than the development scenarios assessed, and reinforces the need for strong enabling mechanisms to support the twin track approach, irrespective of the development scenario chosen.

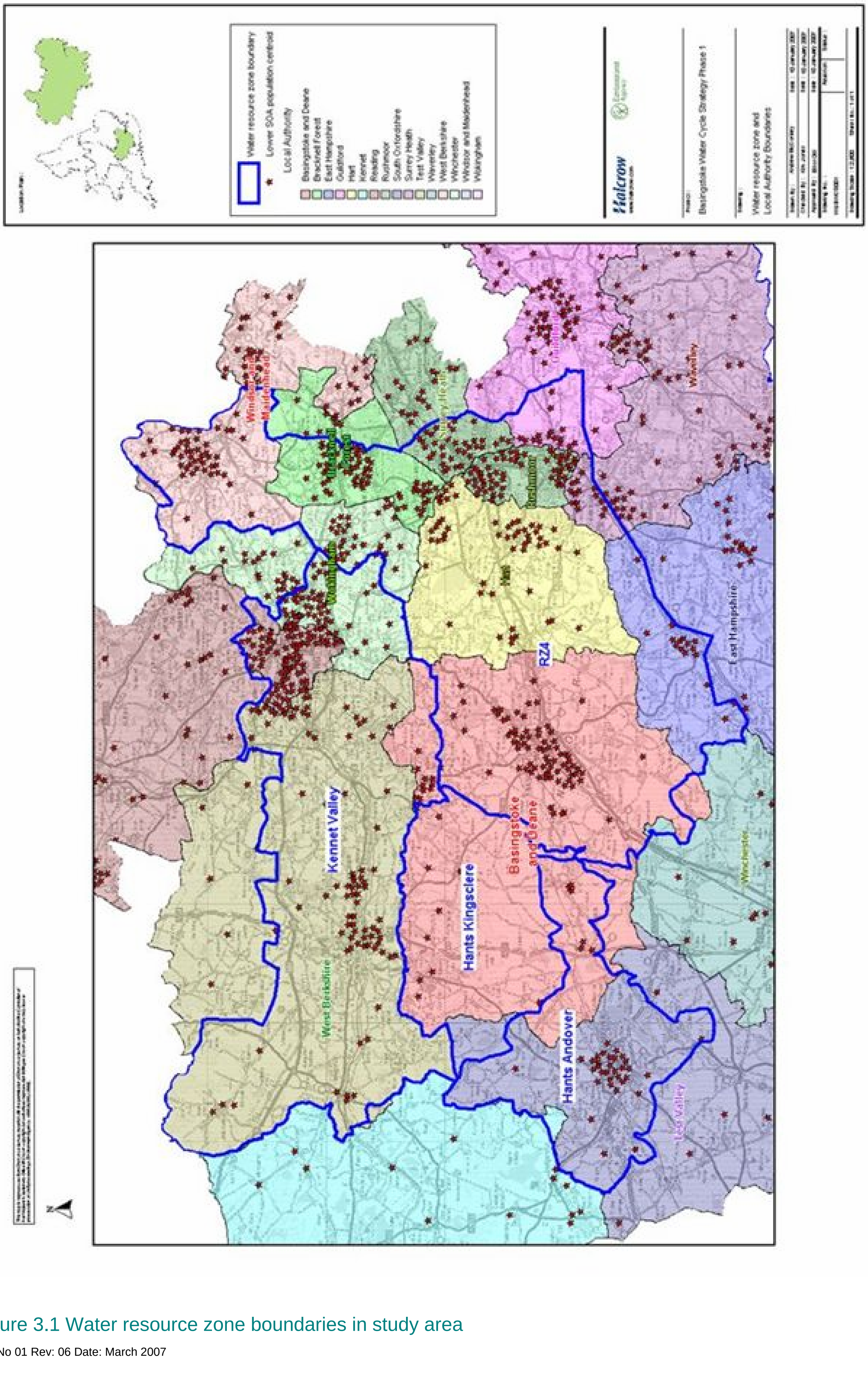

Figure 3.1 Water resource zone boundaries in study area

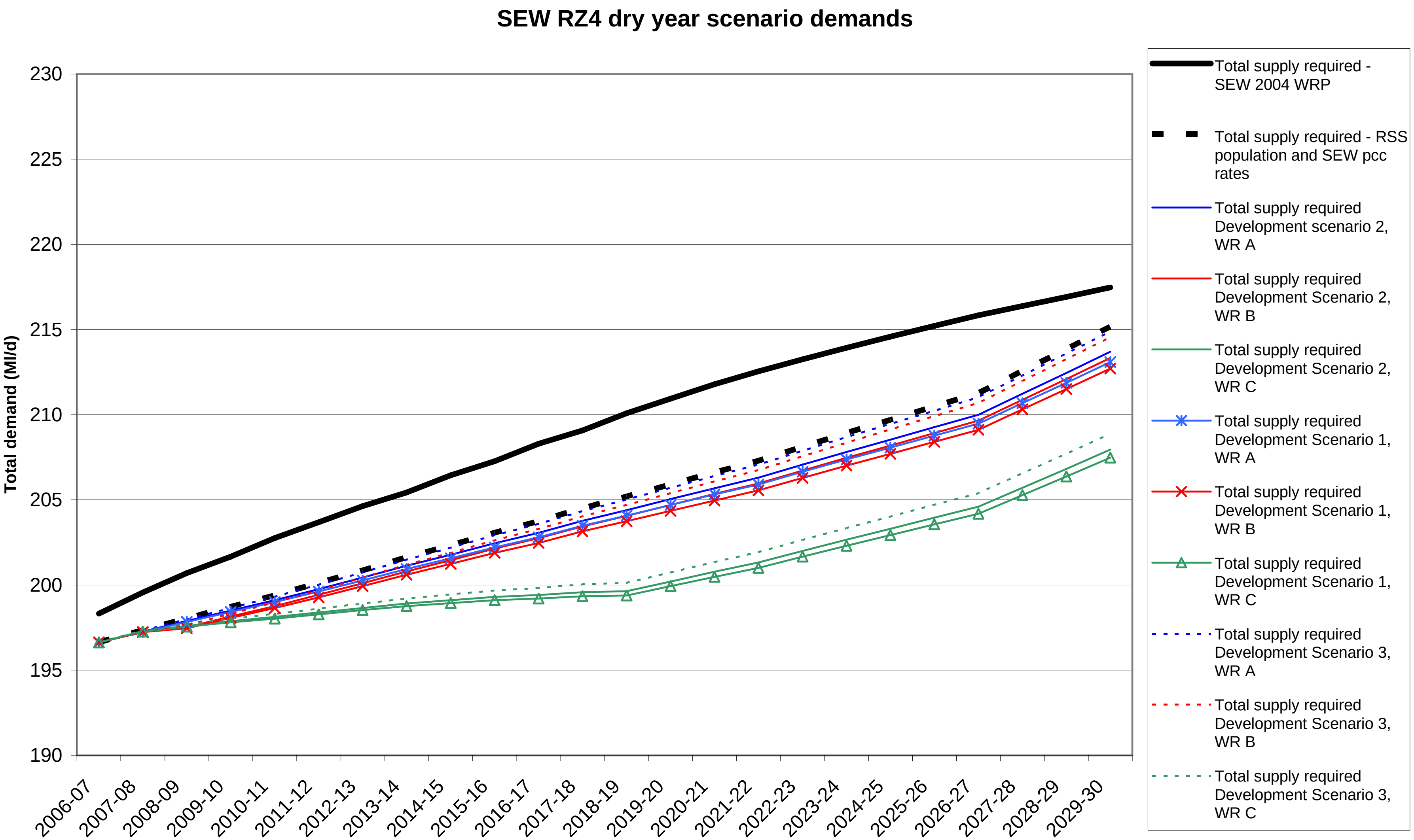

Figure 3.2 Water Resource zone 4 dry year demand forecast

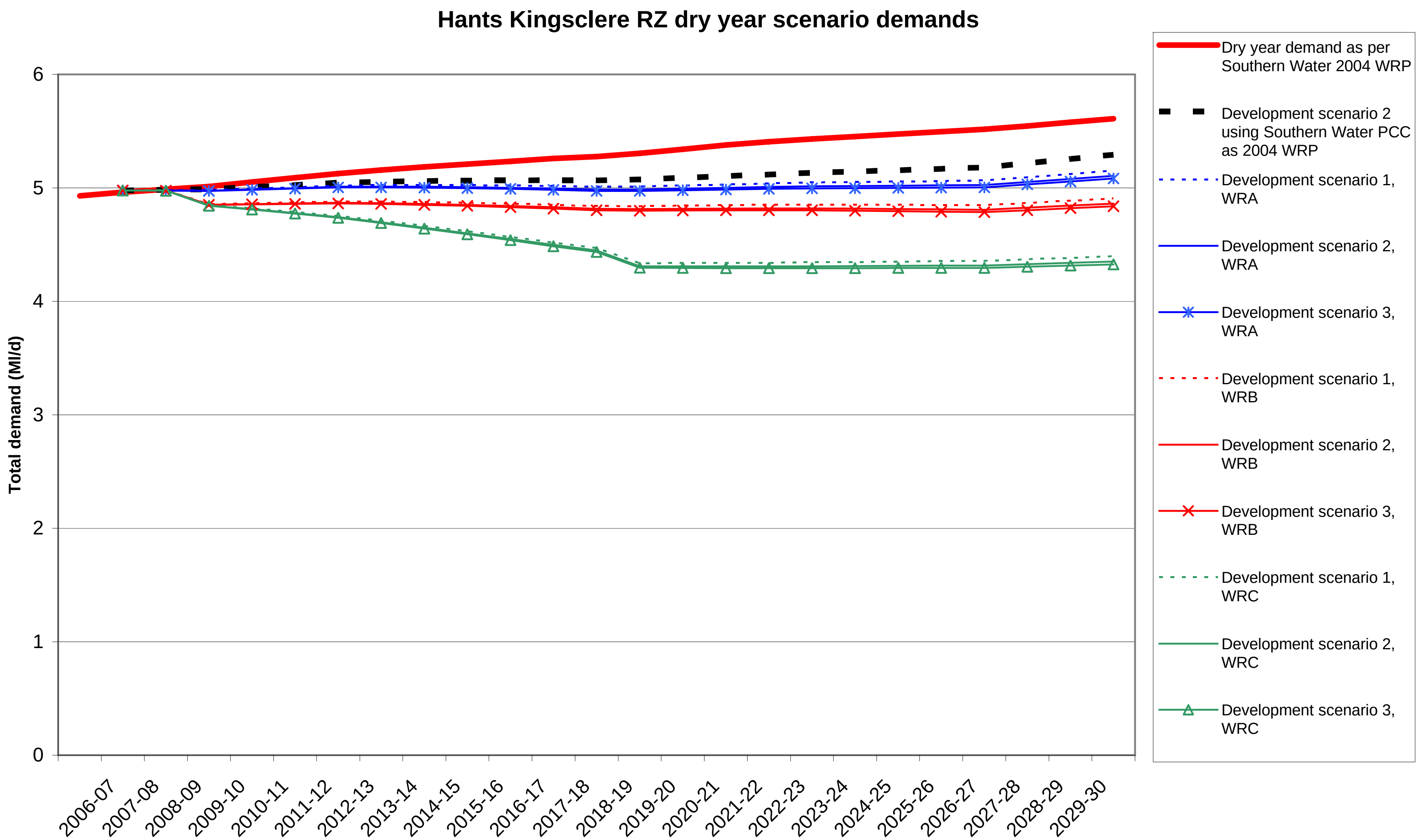

Figure 3.3 Hants Kingclere WRZ dry year demand forecast

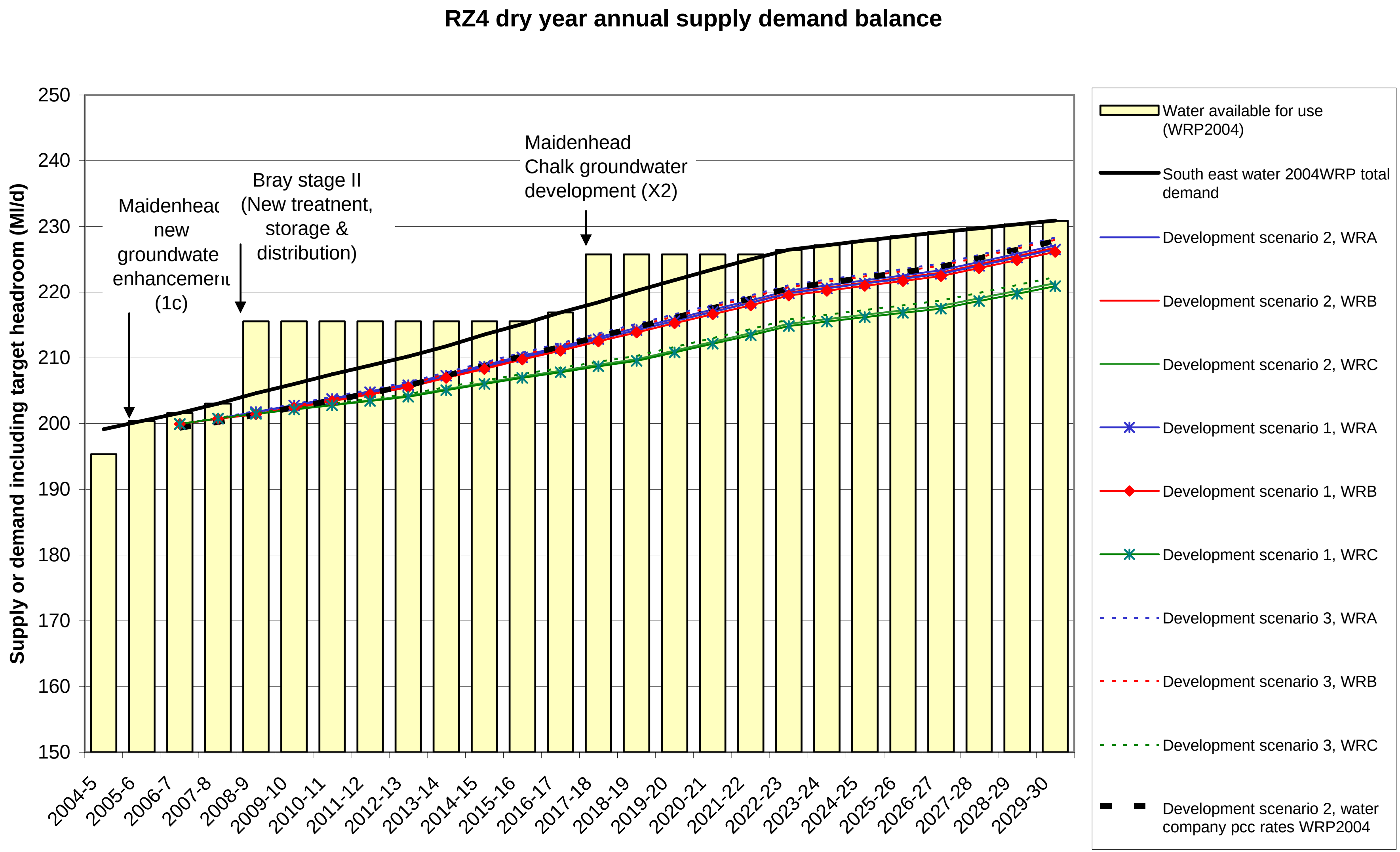

Figure 3.4 Dry year supply balance graph for RZ4

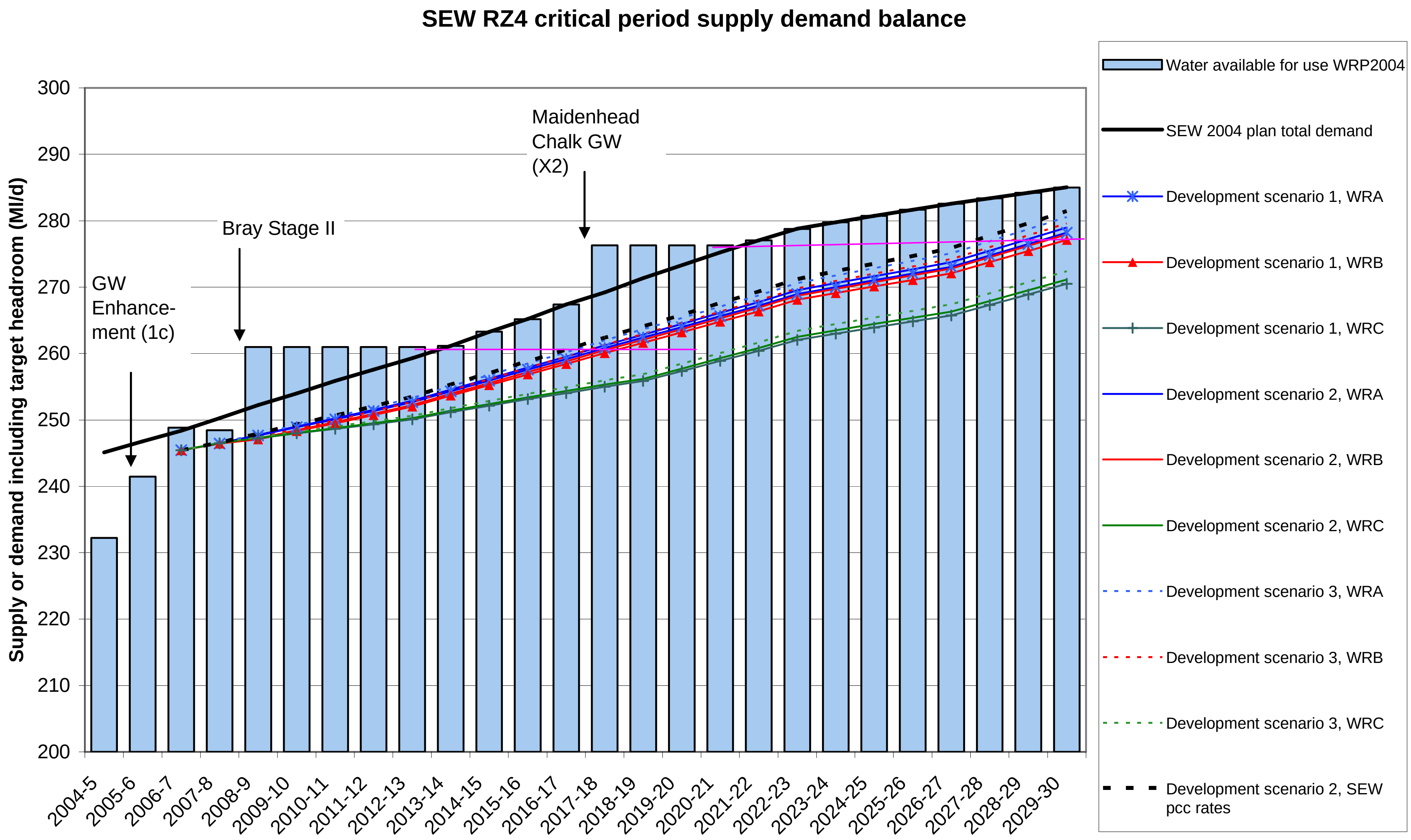

Figure 3.5 Critical period supply demand balance for RZ4

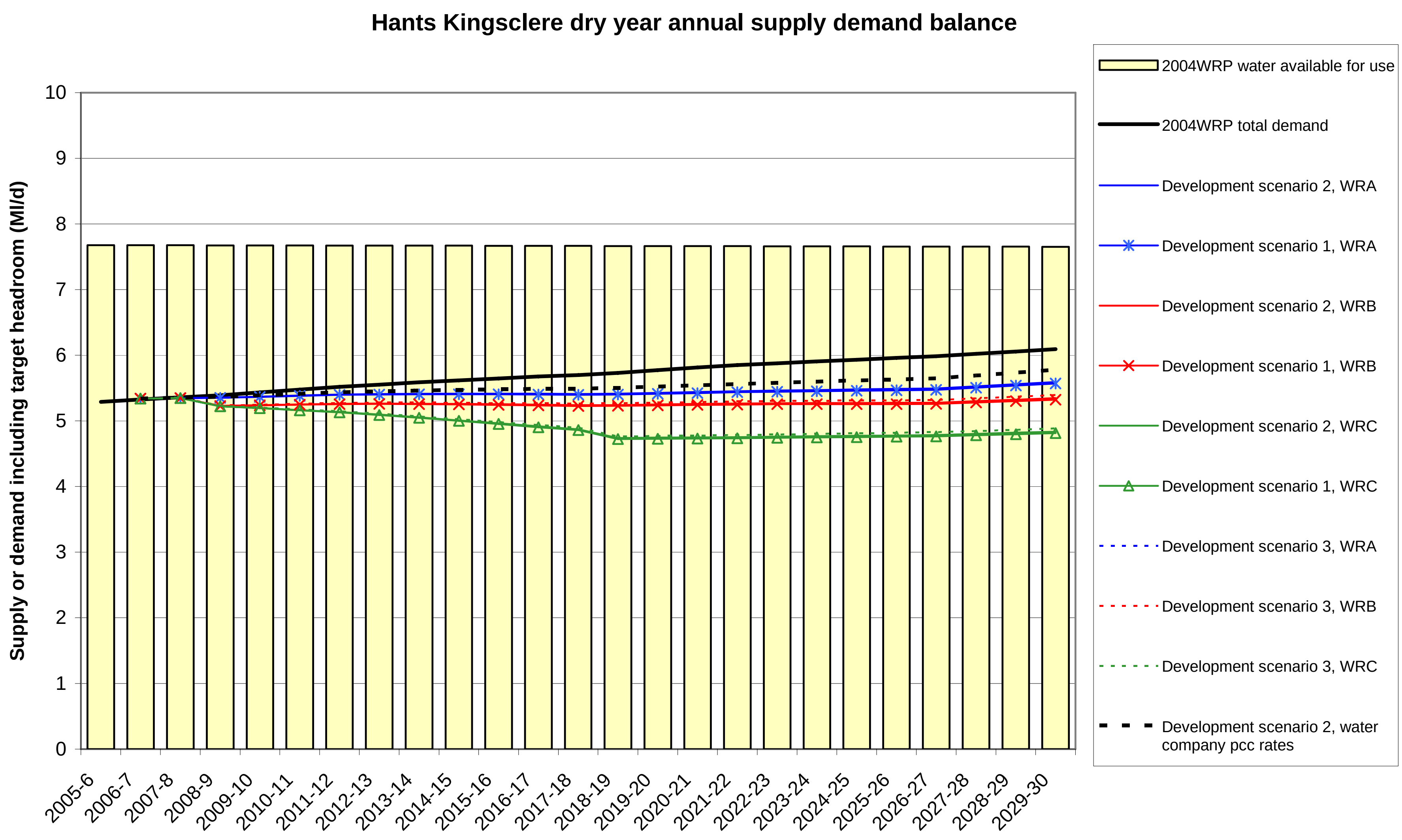

Figure 3.6 Dry year supply demand balance for Hants Kingclere WRZ

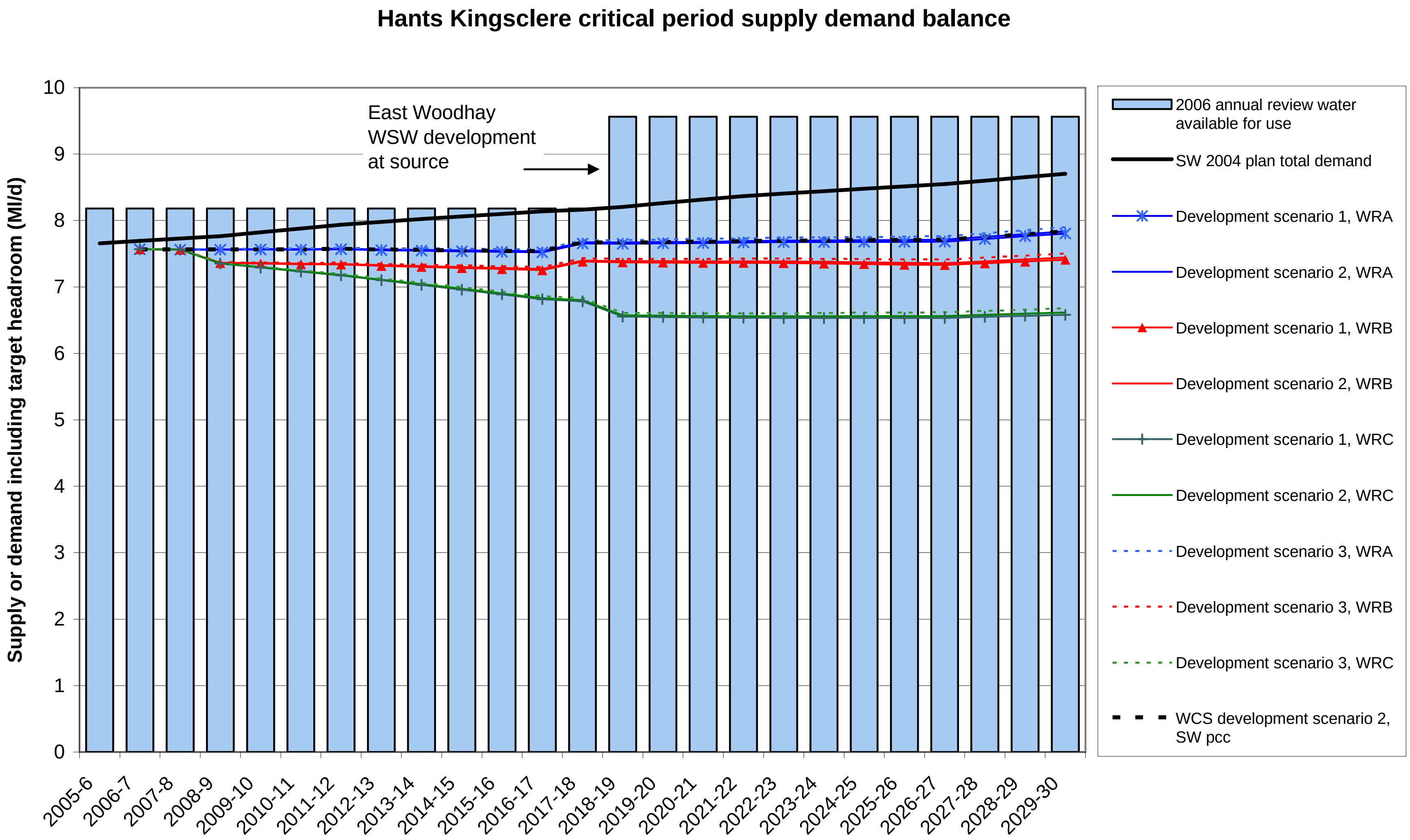

Figure 3.7 Critical period supply demand balance for Hants Kingclere WRZ

4 Wastewater treatment and disposal

4.1 Introduction

The receiving water environment in the Basingstoke and Deane Borough area is shown in Figure 5.2. The two main receiving water systems are the River Test and the River Loddon systems. Both of these river systems are classed as high quality chalk river systems which warrant special protection of the water quality and ecology to protect the sensitive habitat. A detailed appraisal of the current water quality and ecology of the area can be found in the supporting report 'Basingstoke Water Cycle Study ecological appraisal' in Appendix I. This chapter will build on the information in that report, and look at the impact of the development scenarios identified in Chapter 2 on wastewater treatment options and on the receiving water quality and ecology. The aim of this study is to identify if there an absolute environmental barrier to any of the development scenarios assessed, looking at both conventional STW technology, and more innovative technologies as necessary.

4.2 Water quality targets and standards

The current statutory water quality objectives for the receiving waters are shown in Figure 5.2. The River Quality Objectives (RQOs) were agreed by Government as targets for all rivers in England and Wales when the water industry was privatised in 1989. The targets specify the water quality needed in rivers if we are to be able to rely on them for water supplies, recreation and conservation.

The RQOs are expressed in terms of the River Ecosystem (RE) class, with an RQO of RE1 signifying a river a high chemical quality objective, and RE5 signifying a low or poor objective. The compliance with the RQO is assessed by the Environment Agency based on their river quality sampling and monitoring programme (General Quality Assessment or GQA programme). The GQA monitoring data is published every year by the Environment Agency. The latest results published by the Environment Agency, for the period 2003 – 2005 show that all river reaches within the Borough area are compliant with the RQO. The accompanying report 'Basingstoke WCS ecological appraisal' (Appendix I) discusses current and historic compliance with the RQOs in detail.

There are other water quality guidelines, targets and standards that are not statutory, but which are assessed in this study. The RQO does not monitor or assess compliance for all substances that may exert an impact on ecological water quality, for example nutrients such as phosphorus and nitrates, and hazardous or priority list substances. There is no evidence that the River Loddon catchment is at risk of priority substances causing a deterioration in water or ecological quality, therefore they will not be assessed further in this report. However the River Loddon currently suffers from elevated nutrient levels which may be increased further by additional development in Basingstoke. There are currently no statutory targets or standards for nutrient in rivers, although much research has been carried out in recent years to try and develop standards.

The Joint Nature Conservation Committee have proposed standards for chalk streams[1]. The Environment Agency, Natural England (formally English Nature) and Countryside Council for Wales have agreed on guideline standards for Special Areas of Conservation (SAC) designated under the Habitats Directive. These standards are guidance only, and non-statutory, and can be found in the supporting document 'Basingstoke Water Cycle Study ecological appraisal' (Appendix I). However, given the ecological importance and sensitivities of the River Loddon as a chalk river, an assessment has been made of how the river system currently compares against the guidelines.

The statutory RQO scheme is likely to be replaced at some point in the dRSS period by standards brought in to meet the Water Framework Directive, which came into law in December 2000. A cross body technical advisory group (UKTAG) has recently published a set of draft environmental standards on which a public consultation has recently closed. Whilst there is no certainty that these standards will become statutory in the current form, they form the best current knowledge of how the standards may change. Therefore an assessment of the impact of development against these standards has also been carried out.

4.3 Impact of development on water quality

There are two main ways in which new development in Basingstoke can affect river quality.

1. Altered surface runoff flow and quality impacting on the ecology of the River Loddon & Test systems

2. Increase in treated foul effluent from Basingstoke STW affecting the hydrology and quality of the River Loddon

The first problem can be mitigated by the use of SuDS techniques to ensure that development does not affect or has mininimal impact on the water quality or drainage characteristics of water quality. This will be covered in more detail in chapters 5 and 6.

This chapter will focus on the second issue - the impact of additional development increasing treated effluent discharge to the River Loddon.

4.4 Headroom for development

Headroom, with respect to sewerage and wastewater infrastructure can mean many different things. At the highest level, headroom means the available environmental capacity to accommodate additional treated foul effluent load without causing environmental deterioration. Discharges from STWs are controlled by discharge consents set by the Environment Agency, which detail a flow and effluent quality that the STW has to achieve to meet water quality targets. As population connected to a sewage treatment works increases, the amount of treated sewage being discharged to the receiving water generally increases in proportion to the population increase. The STW consent is generally set to a certain design horizon and there is often an amount of population and flow headroom available in the effluent consent which will not cause a failure of water quality objectives or of the effluent consent.

If population increase causes effluent flow to increase above the consented flow, then there is a risk of failing to meet the water quality objectives unless the effluent quality consent is tightened. However, there comes a point where it may not be

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[1] Common standards for Chalk Rivers

These are non statutory standards prepared by the Joint Nature Conservation Committee (JNCC) for designated sites (www.JNCC.gov.uk).
The orthophosphate standards contained in the common standards was derived from Environment Agency proposed standards (as presented in the EA Eutrophication Strategy, 2000), and are closely aligned with Environment Agency guideline phosphorus standards for SAC rivers and emerging Water Framework Directive standards.

feasible, or sustainable to remove more load from the STW. If for example, reducing the load further would require a significant increase in the energy required to treat the effluent, or if the technology is not yet available to treat to such a standard. The Environment Agency currently considers this limit to be 5mg/l for biochemical oxygen demand[1] (BOD), 1mg/l for total ammonia, and 1mg/l for phosphate. The current consent at Basingstoke is 10mg/l BOD, 1mg/l Ammonia and 1mg/l phosphate, therefore the STW is currently operating at the limits of conventional STW technology for Ammonia and phosphate, although not for BOD. These consented values therefore could be an absolute environmental limit, and could constrain development unless decisions are taken to permit failures of water quality objectives, or to pursue novel and untested treatment techniques.

There can be other headroom issues, relating purely to the infrastructure in place. For example, a STW may be consented to discharge more flow, but cannot physically treat the consented flow. This is not an absolute constraint because there is environmental capacity, however the STW will need to be extended or possibly rebuilt, which requires a certain lead in time. Therefore there may be a temporary or local constraint to development whilst the infrastructure is upgraded.
This study looks at the different kinds of headroom and identifies when there are mis-matches between forecast development and the available headroom.

4.4.1 Consented headroom

Thames Water have recently updated the flow and load calculations for Basingstoke STW taking into account South East Water's estimates for per capita consumption in the Basingstoke Area. These figures identified that there was more capacity for growth than was previously believed. However, the flow forecasts provided by Thames Water did not include an allowance for unaccounted for flows, such as future misconnections from new properties and additional infiltration. The flow figures provided by Thames Water have therefore been updated by Halcrow to include an additional flow from new properties using standard Thames Water assumptions.

Figure 4.1 below shows how current population forecast may impact on forecast STW flows. Two types of population forecast have been looked at in the wastewater assessment:

- Current estimates by Thames Water, which include the committed developments according to the local plan, suggest that the STW will breach its current consented flow limit by 2013. Any development beyond that will require the Environment Agency to agree to modification or variation of the consent to allow additional flow.

- Altering the profile of population increase, (by reducing the local plan allocation commitments for 2006 – 2011) can mean that the consent is not breached until after 2016.

Section 2 details the lead in times that Thames Water estimate for obtaining funding and upgrading infrastructure. It can be seen from this that if Basingstoke STW is to be upgraded, decisions need to be made on population and development options in the near future to allow time for the upgrade works to be included in the draft business plan in currently being prepared for submission June 2008 for delivery during the 2010 – 2015 period

4.4.2 STW process and hydraulic capacity

Even if the development profile is flattened as described in section 4.4.1 and shown in Figure 5.1 it does not mean that there is process capacity at the

[1] Biochemical Oxygen Demand – a measure of the concentration of biodegradable organic matter present in a sample of water. It can be used to infer the general quality of the water and its degree of pollution by biodegradable organic matter.

STW to treat the maximum consented flows to the consented quality. Thames Water have carried out a process gap audit to assess the amount of headroom at the STW. This has indicated that there is insufficient process capacity (primarily in the secondary biological treatment and tertiary treatment units) for growth greater than 2000 population equivalent (PE). This capacity is forecast to be beaten by 2011. Thames Water are currently designing an upgrade scheme to increase the capacity of the STW to the 2016 south east plan design population. However, further upgrade will then be needed for all development scenarios assessed beyond 2016. This means that Thames Water need to ensure that funding is available in PR09 to further upgrade these units, and that a clear indication of population growth forecast, and consent standards is provided in the near future to allow the upgrade to be fully developed and costed in time for the submission of their business plan by June 2008.

4.5 Environmental and ecological headroom for development

As discussed in section 4.4, increasing population should not have an impact on water quality objectives until the effluent flow reaches the consented flow. At this point, either the consent needs to be tightened to ensure the STW removes more of the effluent load, or there is a risk of non-compliance with the water quality objectives.

This study has looked at the Environment Agency's statutory RQO, the Common Standards for chalk river sites, and the draft UKTAG water framework directive environmental standards to determine the impact of development.

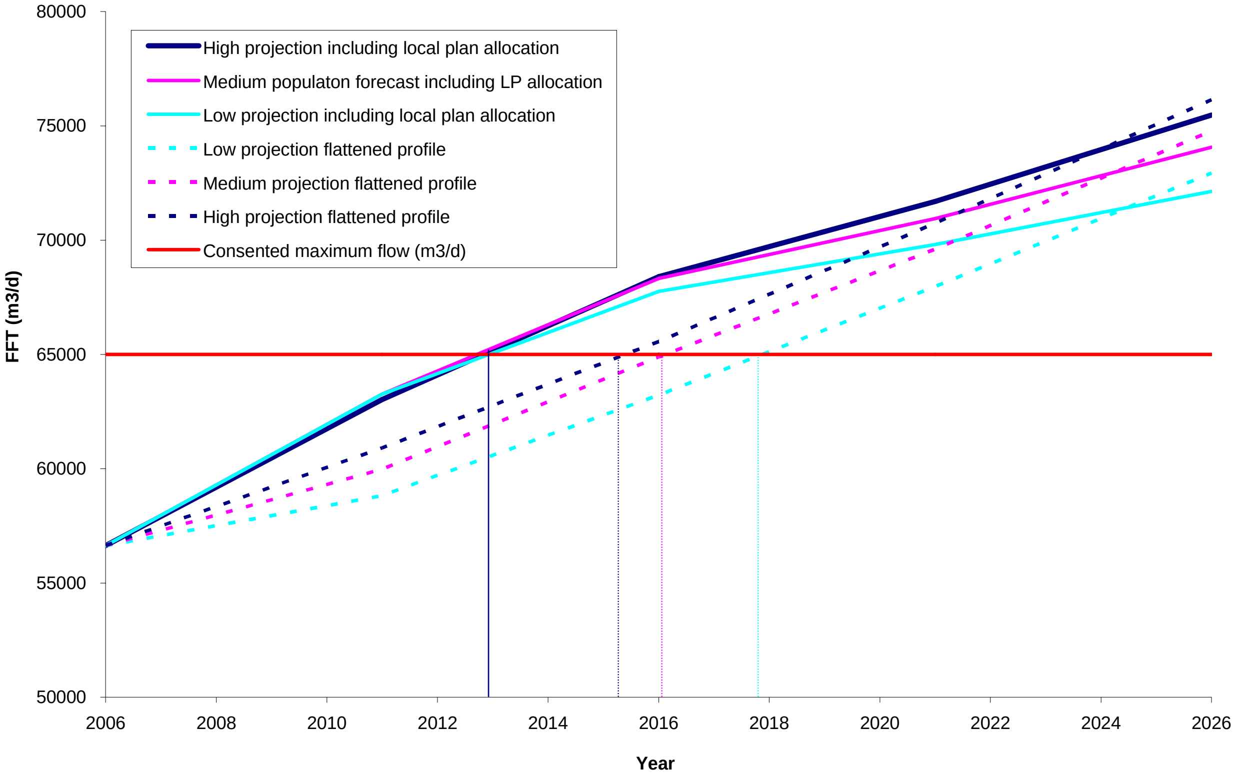


Figure 4.1 Forecast consented flow exceedence

4.6 Compliance with EA RQO

Figure 5.2 shows the existing river system draining Basingstoke and the RQO of each River reach.

All reaches are currently compliant with this RQO.

Appendix F shows how different population scenarios and different water efficiency scenarios impact on river quality in the River Loddon, if the consent is tightened to the best achievable with conventional STW technology.

The WCS study has identified that all additional population scenarios and water resource scenarios can be accommodated within the existing RQO without effluent consent standards needing to be tightened to a standard beyond that currently achievable with conventional STW technology.

Previous SIMCAT modelling work carried out by WRc suggests that the BOD consent will need to be tightened to 6mg/l by 2026 to ensure that the RQO is achieved. This modelling does not identify exactly when this will be required, and it is recommended that modelling is revisited in light of the amended population and flow calculations in recent work, to provide a date when the consent would need to be tightened.

4.7 Compliance with chalk river standards

The existing effluent causes the River Loddon immediately downstream of the discharge to fail the RE1 value described in the guideline chalk river standards, as shown in Appendix F. Any additional effluent discharged from the STW will have the impact of making this failure worse, although there are no significant differences between the three development scenarios assessed. Additionally the river currently significantly fails the orthophosphate target, both immediately downstream of the discharge and within the SSSI

It can be seen in Figure 4.1 that the actual orthophosphate concentrations in the River Loddon, immediately downstream of the STW are significantly higher than the levels recommended in the common standards for chalk rivers.

Also it can be seen that the value immediately upstream of the SSSI at Stanford End Mill is also higher than the guideline value.

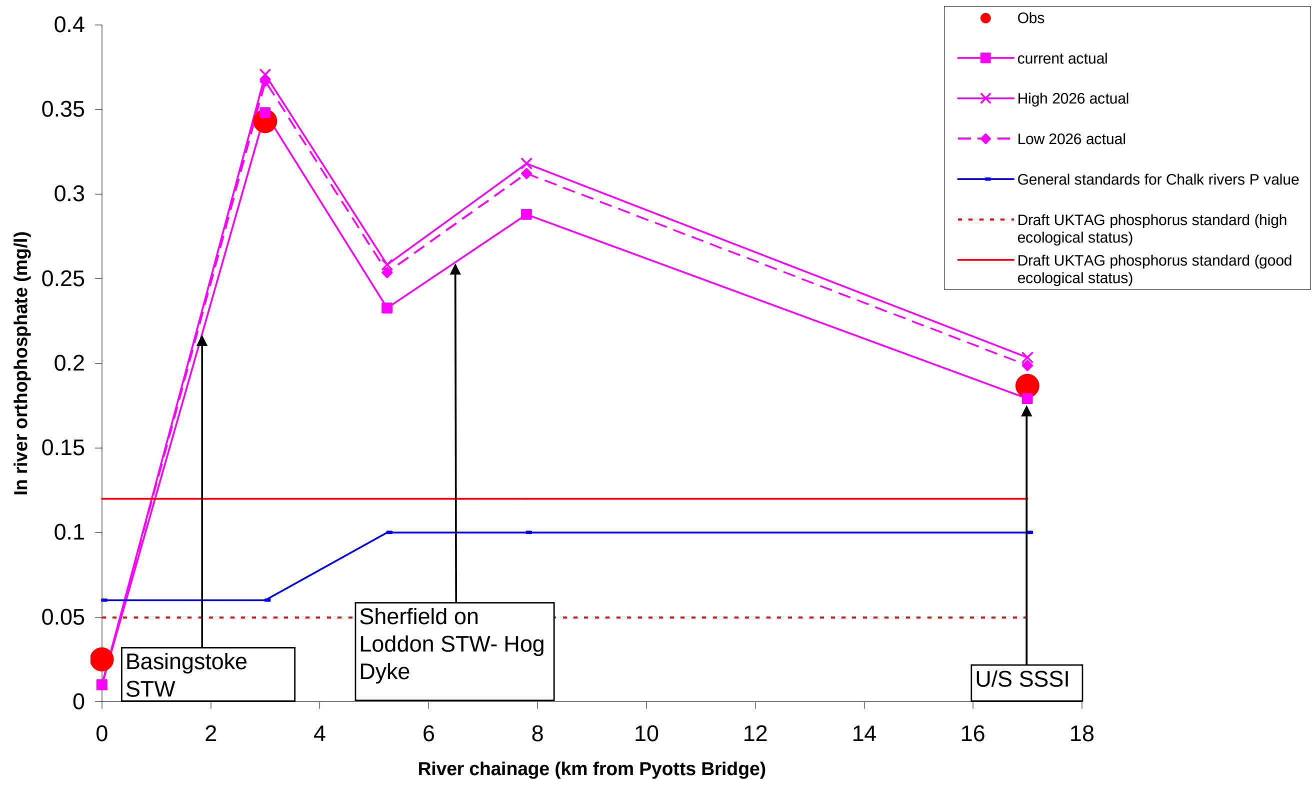


Figure 4.1 Orthophosphate concentrations in the River Loddon

Table 4.1 – Draft UKTAG WFD standards for the River Loddon

Ecological status	BOD (mg/l)[1]	Ammonia (mg/l)[1]	Orthophosphate (mg/l)[2]
High (RE1)[3]	4 (2.5)	0.3 (0.25)	0.05
Good (RE2)	5 (4)	0.6 (0.6)	0.12

[1] expressed as 90%iles
[2] expressed as an annual average
[3] Figures in brackets are for current RE1 and RE2 RQO. The Loddon is RE2, therefore it is most likely that it fall into the good ecological status.

4.8 Water framework directive – UKTAG draft environmental standards

The draft environmental standards proposed by UKTAG depend upon a complex mix of geological, geographical and ecological assessments, which will not be discussed here. A characterisation has been made of the Loddon catchment by this study, and it has been identified that the standards in Table 4.1 would be applicable if draft standards were to become statutory.

The Loddon is currently compliant with RE2 for BOD and ammonia, therefore the future application of the UKTAG draft standards do not pose a risk for these parameters, for the river to meet the good ecological status. Should a target of high ecological status be required for the Loddon, the current and future development scenarios would fail for ammonia without tightening the consent beyond what is currently achievable with conventional STW technology.

However, the river significantly fails the proposed phosphorus standards, both for good and high ecological status at present (see observed water quality and standards Figure 4.1), and all of the future development scenarios assessed will make this failure worse.

4.9 Ecological impact of increased orthophosphate

The ecological appraisal carried out has not found any evidence that the elevated phosphorus levels have had an impact on the ecology. However, many of the indicators used to determine ecological condition may be considered to be inadequate indicators in light of the recent work by UKTAG to determine ecological water quality standards, and hence there us uncertainty over the current ecological quality.

Phosphate concentrations in the Loddon are currently of the order of 0.35 mg/l in the chalk river reach downstream of Basingstoke sewage treatment works. This is a factor of 6 higher than the Common Standard for chalk rivers, and 3 times higher than the proposed WFD standard for good ecological quality. Vegetation changes away from *Ranunculus* communities typical of chalk rivers would be expected at this elevated concentration. However, the *Ranunculus* community is dominant here[1] and does not appear to be suffering competitive disadvantage as a result of the elevated phosphorus.

There is some evidence that the indicators that have been used historically are out of date, and the draft standards are representative of the best current scientific knowledge. Therefore, there is still considerable uncertainty in the current ecological status of the River Loddon

It is possible that the exact hydrological and quality regime of the Loddon means that the ecology can withstand elevated orthophosphate levels without visible signs of eutrophication. Maintaining natural chalk river flow conditions will increase the competitive advantage of characteristic chalk river plant species such that they are less likely to be out-competed by the more vigorous species associated with higher phosphate concentrations. However, should the hydrology of the river change, for example by a decrease in base flow because of climate change or altered runoff because of land use changes, the elevated phosphorus levels could mean that the river is at risk of ecological deterioration.

The study has found that it is unlikely that any of the development scenarios assessed will cause a significant change in the river chemistry, with the orthophosphate levels increasing from 0.35 to 0.37mg/l. However, because of the uncertainty in the current ecological condition of the river and the

[1] Nigel Holmes, Alconbury Consultants, pers.comm., 2007

existing significantly elevated phosphorus levels, further survey work will be required to establish the current ecological quality. It therefore cannot be determined whether the present levels of phosphorus have caused harm to the river's ecology or whether there are threshold levels of phosphorus above which significant, or even catastrophic adverse impacts would occur. If such thresholds exist it is not known how close they are to being breached.

4.10 Impact of other discharges in the catchment

There is a significant input of phosphate from the Bow Brook. Whilst there is a known discharge at Sherfield-on-Loddon STW that contributes some of this phosphate, the phosphate quality upstream of Sherfield-on-Loddon STW is significantly worse than that expected for a rural brook. Therefore it is likely that there is an unidentified point source discharge upstream of Sherfield-on-Loddon STW, or that the river is affected by diffuse agricultural pollution.

There also appears to be a significant input immediately upstream of Basingstoke STW that cannot currently be attributed to a source. One explanation could be mis-connections from the urban area into surface water sewers that discharge in the urban area, or other diffuse inputs such as agriculture. Whilst it is not possible to identify these sources, the mitigation options assessed in section 4.11 has studied the water quality impact of identifying these sources and removing them as potential options.

4.11 Mitigation and alternative options

A number of solutions and options have assessed to address the failure of the orthophosphate failure of the common standards for rivers and the UKTAG draft standards and these are described later. However, a number of options have been discounted from further scrutiny without needing further modelling. These are:

New discharge to the West of Basingstoke

There are no watercourses to the west of Basingstoke that could be used for a discharge, and the Environment Agency have already stated that a new discharge to ground to the west of Basingstoke would be unacceptable.

Move Basingstoke STW discharge point

The current discharge point could be moved further downstream to a point where there is greater dilution. However this would move the discharge closer to the SSSI conservation area and would reduce the length of watercourse available for self-purification of the effluent. Therefore this is unacceptable. It may be possible for the entire discharge to be moved to a remote catchment. However, this would remove a large proportion of the flow of the river, to which the ecology has naturalised. Chalk river habitats are more sensitive to flow than any other parameter, therefore moving the entire discharge point would not be acceptable.

It might be possible to transfer the additional discharge to a different catchment. This would have the benefit of preventing any deterioration in the Loddon, and retaining flows as they currently are. However the lack of adjacent river catchments which could accept the discharge without suffering the equivalent deterioration as the River Loddon, and the energy costs that would be required to transfer the discharge to a different catchment means that this has been discounted as a sustainable option.

The five options assessed in this study are shown in Table 4.2 and Figure 4.3 below.

Table 4.2 Orthophosphate reduction options assessed

Option 1	Treat Sherfield-on-Loddon to 1 mg/l
Option 2	Transfer Sherfield-on-Loddon STW to Basingstoke STW
Option 3	As above but Basingstoke STW treated to 0.15mg/l
Option 4	Basingstoke STW treated to 0.15mg/l, Sherfield-on-Loddon treated to 1mg/l
Option 5	Reduce load US of Basingstoke STW, Reduce load US of Sherfield STW, Sherfield-on-Loddon STW treated to 1mg/l

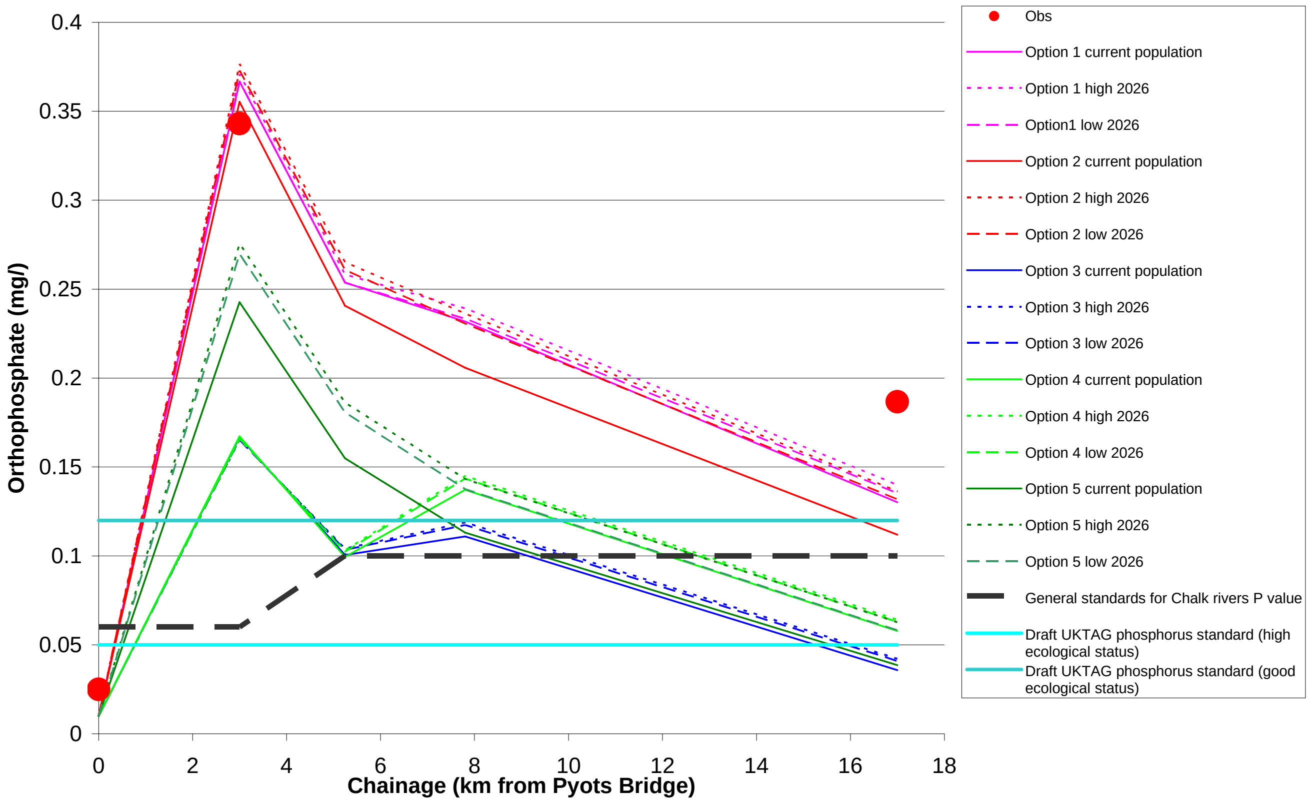


Figure 4.3 Options for Orthophosphate reduction in the River Loddon

It can be seen from the range of options studied, that even treating to standards significantly higher than that currently possible with conventional STW technology as in option 3, the River Loddon still does not meet either the common standards for chalk rivers or the UKTAG draft standards for the entire length.

In order to meet the standards, it would be necessary to treat both Sherfield-on-Loddon and Basingstoke STWs to very high levels and reduce the background load from the sources identified in section 4.10.

4.12 Novel treatment techniques

Some of the options identified in section 4.11 are currently outside what the water companies and the Environment Agency believe to be achievable with conventional STW technology. However, that does not mean that better standards cannot be achieved.

It may be possible for novel techniques to be applied at the existing Basingstoke STW to remove more of the pollutants than is currently achieved. For example a membrane bioreactor designed for biological nutrient removal (BNR) or a combination of BNR and chemical dosing could potentially remove a higher proportion of the load than process traditionally applied by Thames Water. Alternatively, constructed wetland systems could be created downstream of the STW. However, these techniques are currently untested on a large scale in this country, and would probably need further research before Thames Water would be willing to accept them, therefore it is likely that they would require this process to be treated as a pilot. Planning for this option would need to be completed in advance of June 2008 to allow the proposal to be included in Thames Water's PR09 business plan submission. This would require clear indication of the levels of growth and consent standards in the very near future.

Additional treatment and pollutant removal could potentially be achieved through the use of SuDS structures which FRAs have identified as necessary for flood risk reasons. For example, attenuation ponds could be used as additional treatment by retaining the effluent within the flow balancing pond, thereby allowing additional settlement. This could be further facilitated by the addition of coagulants or the use of filters between structures to reduce the load being discharged into the watercourse. WSP, representing developers with an interest in Basingstoke have suggested that such an approach may be used to facilitate development in Basingstoke, although modelling has not yet been able to confirm this.

There are many regulatory & legislative issues to this option, such as responsibility for maintenance of the structures, difficulties with monitoring and consenting a discharge from the structures. There are also impacts on the efficiency of the structures themselves if they are used for wastewater treatment and stabilisation, with the volume available for runoff attenuation being reduced.

Provided the levels of treatment are effective in protecting the watercourse, none of these issues are in themselves insurmountable. However, it will require Thames Water and the Environment Agency to approach the issue innovatively, and will require close cooperation with the third party developer responsible for the structures. It is also possible current legislation will hinder this option, and both the Environment Agency and Thames Water would have to accept an increased element of risk in adopting an untested solution. It would need to be understood and accepted by all parties that the risk is real, and that any untested solution could fail, or cost too much to be successfully implemented and regulated.

4.13 Conclusions

There is limited capacity at Basingstoke STW for additional growth, although Thames Water are currently designing an upgrade solution to allow population increase up to the 2016 dRSS population. This is likely to increase flows above the current consent, and therefore Thames Water may need to apply for a variation to the existing consent by 2016.

Further upgrade work will be required after 2016 to allow for further population growth. It is also likely that the STW will need to meet a tighter BOD within the 2016 to 2026 design horizon.

There is an existing significant problem with phosphorus levels in the Loddon. In the chalk river stretch downstream of the Basingstoke STW, the level is 0.35 mg/l, around six times higher than the Common Standard for chalk rivers (0.06mg/l) and the water framework directive standard for high ecological status, and around three times higher than the water framework directive proposed standard for good ecological status (0.12mg/l).

Basingstoke and Sherfield-on-Loddon both discharge about 30% of the total orthophosphate load in the River Loddon, therefore point source STW discharges make up about 60% of the total orthophosphate load.

It is not a statutory requirement to meet any of the phosphorus standards looked at – although they have been agreed by authoritative bodies as appropriate. The standards could become statutory within the South East Plan period when the environmental standards for the WFD are set.

Any increase in development will compound the already very high levels of phosphorous.

The scales of development tested in the study (740, 825 and 990 homes per annum) would slightly increase the levels of phosphorus from 0.35 mg/l to around 0.37 mg/l. The higher levels of development tested would result in proportionally higher levels of phosphorous than the lower level, although it is recognised that these differences are very small relative to the overall levels predicted.

The overall picture of the Loddon's ecological health is not known. Some indicators show good condition, however these indicators have limited scope and therefore there should be caution attached to the current rudimentary assessments. At present it is not possible to assess whether there are already any adverse effects from the levels found. Further survey work will be required before the present level of ecological health can be established.

It is not possible to assess whether there are any threshold levels of phosphorus above which the ecology of the river would be significantly (perhaps catastrophically) harmed, or how close any such thresholds are to being breached.

There are technical processes (biological nitrate removal and chemical dosing) that could be used to lower phosphorus levels within the STW discharge. They are not yet in use for sewage treatment and so are effectively untested, and could have unacceptably high energy requirements and/or other environmental implications that make them unsustainable.

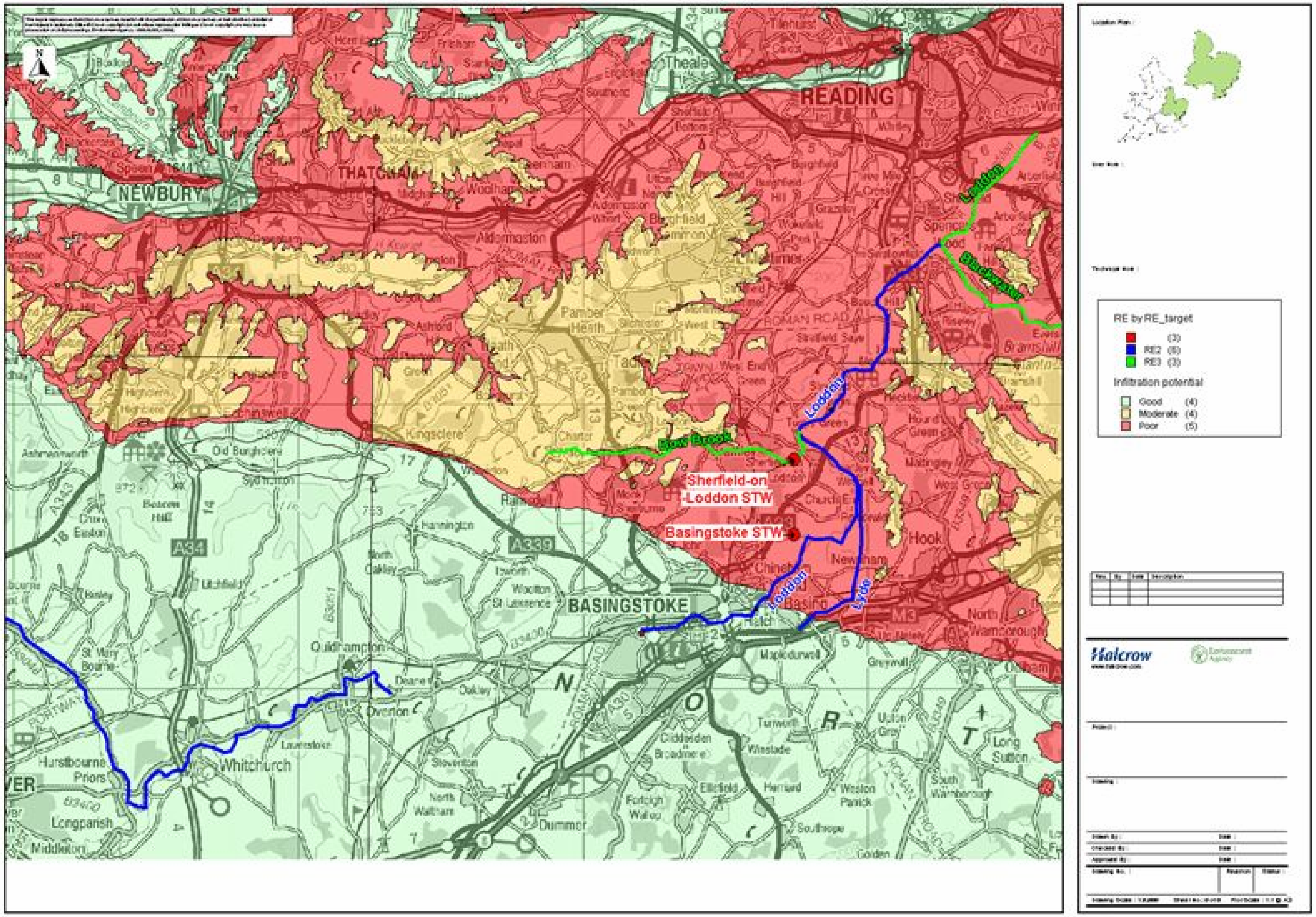


Figure 5.2 River RQO and infiltration potential

5 Flood risk assessment

5.1 Overview of River Catchments – Test and Loddon

The study area (Basingstoke & Deane Borough) is intersected by the River Loddon (east of Basingstoke), and the River Test (to the west); see Figure 5.1.

The River Test emerges from chalk springs (Upper Chalk aquifer), and eventually flows into Southampton Water at Red Bridge next to Totton. The upper Test area is predominantly rural.

The River Loddon rises at West Ham Farm, Basingstoke, and flows in a north-easterly direction for approximately 45km to its confluence with the River Thames to the west of Wargrave. In the upper Loddon catchment, which falls within the study area, the river is fed by springs which have their source in the permeable Upper Chalk aquifer.

The flood history of the rivers Test and Loddon is characterised by high groundwater-fed baseflow, which combined with storms may lead to overtopping of river banks. Localised groundwater flooding has been reported in the upper parts of the Loddon catchment as a result of high groundwater levels around North Warnborough in the River Whitewater sub-catchment, at Basingstoke town centre, and in the upper reaches of the River Lyde and the Upper Loddon. Similar problems affect the River Test.

High groundwater levels and emerging spring flows are a major source of flooding, particularly in the upper parts of the Test catchment. Several properties in Hampshire villages were affected by flooding in the winter of 2000/01 (See Figure 5.1). Flash flooding is rare in both catchments, but Basingstoke & Deane Borough Council informed that two separate floods with 0.1% annual exceedance probabilities affected Tadley (north of Basingstoke) in the late 1980s.

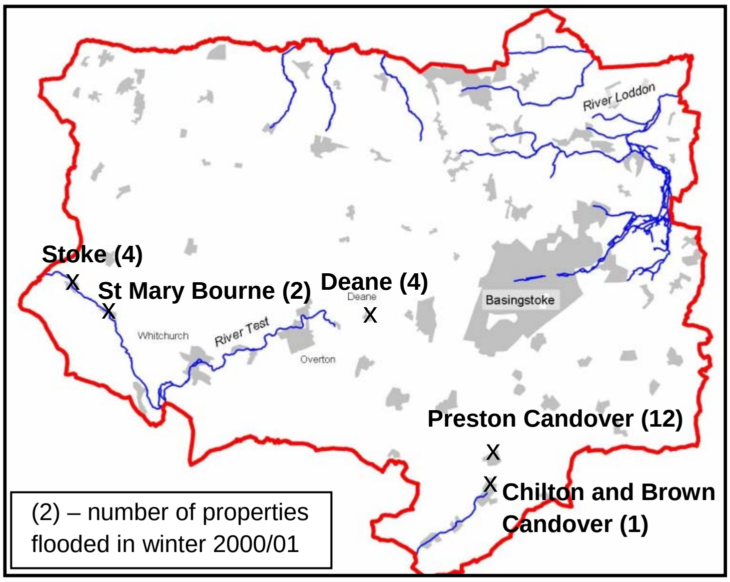


Figure 5.1 Flooding incidents in 2000/2001

5.2 Flood Risk Areas Identified

Four basic flooding mechanisms that affect permeable catchments can be defined:

- High groundwater levels producing high baseflow in the river channels which exceeds channel capacity;
- High groundwater levels which rise above the ground surface locally;
- Localised surface water runoff (direct from overland flow)
- Sewer flooding

Groundwater flooding is prevalent. This was demonstrated during the autumn/winter 2000/2001 flood event, when prolonged heavy rainfall occurred and the elevated water table was considered to be the largest cause of flooding. The long duration rainfall over the duration of the event was considered to be greater than a 1 in 100-year event (<1% annual exceedance probability), whereas the short duration rainfall during the event was considered to have a 1 in 5 to 10 years (c. 10% to 20% annual exceedance probability).

Notable catchment-wide flood events on the River Loddon include September 1968, June 1971, November 1974, February 1990, October 1993 and Autumn/winter 2000.

Records of flooding for Deane (River Test) indicate 3 properties were affected in the period February to March 1995 due to high groundwater levels followed by fluvial flooding, and 4 properties between December 2000 and May 2001, again resulting from high groundwater levels/spring flows. It is claimed that flooding problems were exacerbated by storm runoff and poorly maintained/inadequate drainage network.

A further assessment of direct groundwater flooding problems is covered by a separate technical note (Groundwater and Sustainable drainage).

There is potential for fairly extensive out-of-bank flooding on the Loddon through Basingstoke, as illustrated by the Flood Zone mapping published by the Environment Agency. Flood risk 'hot-spots'

where the Flood Zone mapping extends across properties are indicated by the red markers in Figure 5.2.

Several areas suffer from occasional overloading of the surface and foul water sewerage systems at times of very heavy rainfall. Thames Water are responsible for these sewerage systems, and improvements schemes are being promoted at some locations. However, foul and surface drainage incapacity should not be regarded as an absolute constraint to development. Subject to capacity at the wastewater treatment works (for foul water, see section 4.4) and receiving water capacity (for surface water), incapacity can be resolved with new infrastructure. However, it is essential that the new infrastructure is fully funded and delivered before development proceeds. Flood risk from drainage can therefore affect the timing and location of development, and should be considered as part of the preparation of the LDF.

The overall picture of flood risk 'hot-spots' highlights the concern that progressive development has encroached on the natural floodplain. It also reinforces the need to take a more holistic approach to flood risk management and identify opportunities to reduce the overall flood risk in future development. This is seen as a key objective for the planned Strategic FRA, not only land allocation.

Table 5.1 gives details of the fluvial flood risk areas that lie within Zone 2 and Zone 3 and the approximate property numbers at risk. Based on these flood envelopes some 2,158 properties are currently at risk of river flooding in a 1% annual probability (1:100-year) event.

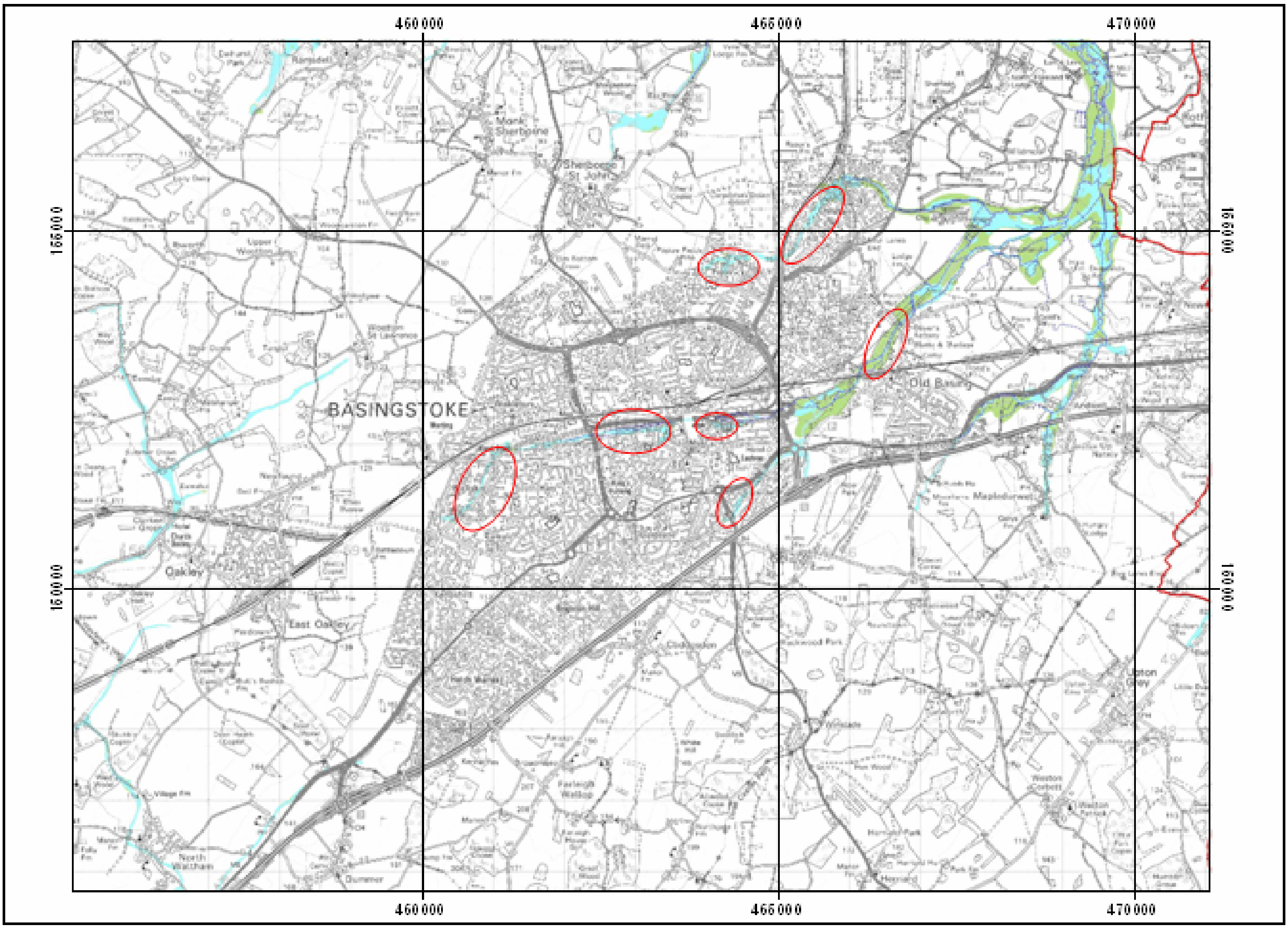


Figure 5.2 Flood risk hotspots

Table 5.1: *Main Fluvial Flood Risk Areas*

River System	Properties at Risk Count*		
	FZ2	FZ3	**Total**
River Loddon	292	991	1,288
River Test	72	376	448
Other	37	156	193
Total	**406**	**1,523**	**1,929**

**calculated using the Flood Zone Mapping & National Property Dataset*

At this stage, the standard of flood protection has not been determined, i.e. threshold at which fluvial flooding of property starts for the different flood risk areas. It can be noted that within Basingstoke the minimum target standard of flood protection, as classified by the Environment Agency, is likely to be 1:50-year (2% annual probability). This target may not be met in areas that experienced recent flooding.

5.3 High Level Assessment of Impact of Flood Risk on Development (and vice versa)

Flood risk is a material consideration in spatial planning, with government policy to ensure that floodplains are used for their natural purposes. Any development on a floodplain may reduce the ability of the river corridor to convey and store flood waters. While recognising that the impact of a single development may be relatively small, if development is not properly controlled there will be a cumulative detrimental effect; and no development should increase the risk to life.

Uncontrolled development would lead to unacceptable adverse impact on flood risk. It must be assumed that application of PPS25 and adequate design that incorporates SuDS will prevent this.

PPS25 sets a sequential approach to the allocation of land for development that considers flood risk and planning constraints as follows:

- Flood Zone 1 – areas of little or no risk (<0.1% AP) with no planning constraints in respect of flood risk;
- Flood Zone 2 – areas of low to medium risk (0.1%–1% AP) may require flood resilient construction of buildings and suitable warning/evacuation procedures.
- Flood Zone 3 – areas of high risk (1% AP or greater) where development may be feasible subject to appropriate mitigation and in the absence of alternative areas of lower flood risk.

There is the greatest potential for adverse impact from development in the vicinity of the River Loddon within and upstream of Basingstoke. This is because any loss of floodplain and/or increase in runoff (due to hard surfaces) could exacerbate flooding problems, as recently experienced. This conclusion favours development away from the River Loddon.

As a first pass on sequential land allocation, the following 'ballpark' figures (derived using the GIS datasets) are based on the available 'greenfield' area surrounding Basingstoke – as indicated in Figure 5.3. This 'greenfield' area covers some 580 km^2, i.e. excluding the developed area (50 km^2 approx.). Some 17 km^2 of this outer area is floodplain based on the Flood Zone mapping (FZ2 and FZ3).

If the full housing requirement for the Borough was provided on planned extension to Basingstoke to accommodate 15,000 to 20,000 properties, the total land area required for built development would be of the order of 5-7 km^2 (assumes an average density of 30-40 dwellings per hectare). The actual amount of greenfield land required for development will depend on the extent to which housing requirements can be met from within existing urban areas through the use of brownfield land. Expansion within the Borough needs to be accommodated, where there are no planning constraints on development arising from flood risk, and built development within Flood Zone 3 (high risk) can be avoided. A key output from the SFRA will be to confirm that this is the case.

5.4 High Level Mitigation Options to Facilitate Development

Development and its sequencing will inevitably impact on the Loddon/Test river systems, as will climate change. In line with PPS25 and the sequential approach, flood risk problems should be avoided by directing development outside of floodplain, incorporating SuDS for runoff control and promoting the green corridor concept highlighted.

Flood risk management options that reduce the overall flood risk should also be investigated alongside directing flooding away from flood risk areas. When considering a flood risk assessment for a third party development, or even an Environment

Agency scheme, the Environment Agency is looking for betterment in terms of floodplain storage wherever possible and would expect compensatory storage based on a present day 100-year flood event as a minimum. Also, the Environment Agency is looking for compensation on a level for level basis, and it is not unusual for it to take a hard line on this requirement.

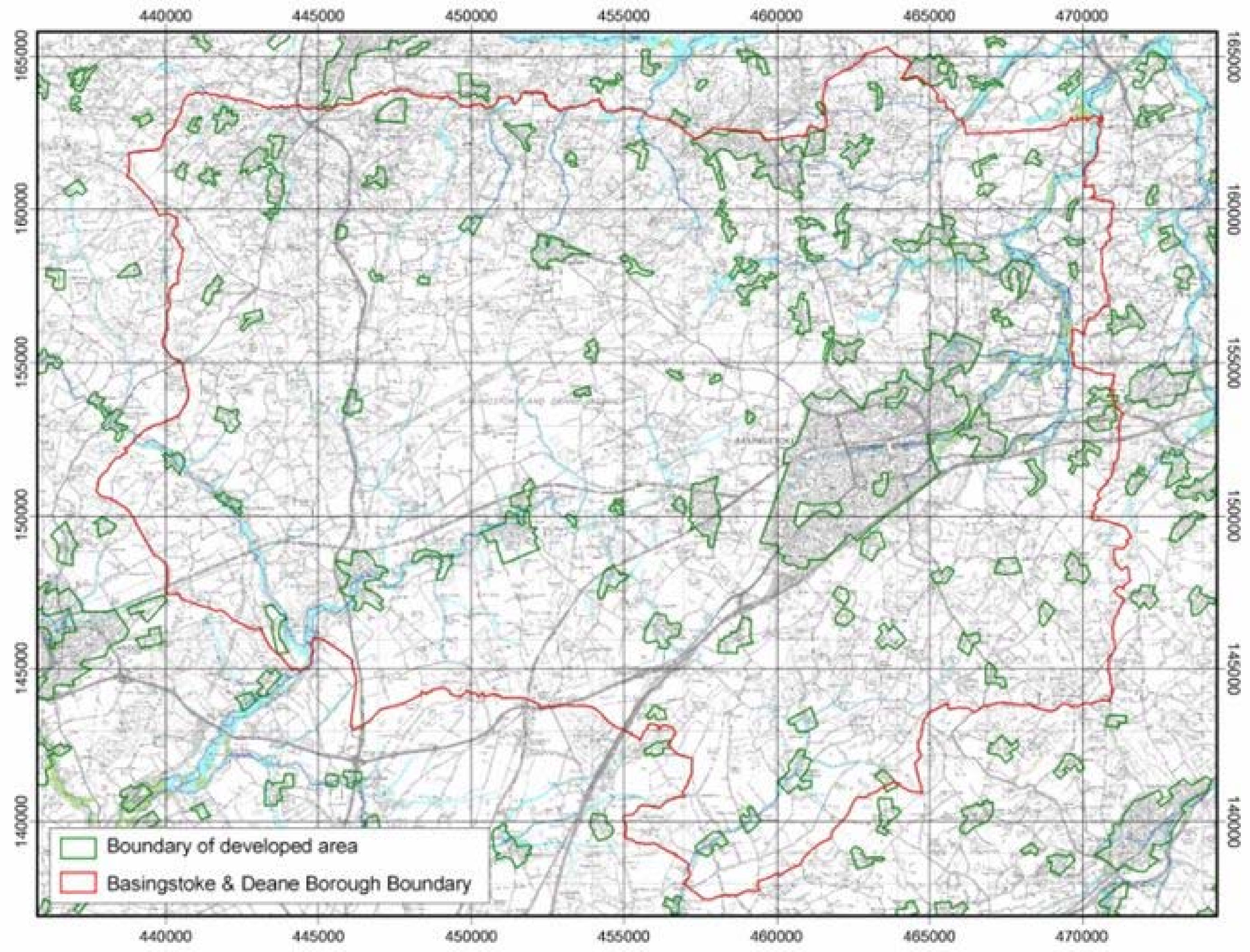


Figure 5.3 Basingstoke & Deane BC boundary

Any development that increases hard standing area can impact on river hydrology and groundwater levels. Even developments remote from river floodplain areas can affect river hydrology. Therefore all developments should be required to ensure that runoff rates and infiltration rates from the development do not change from the current. This will ensure that discharges to surface water sewer, groundwater and surface water.

Options to be considered (in combination) include:

- Increase floodplain storage consistent with Environment Agency initiatives – Catchment Flood Management Plans, Making Space for Water;
- SuDS guidelines to achieve no net increase in runoff as a result of the development proposals;
- Possibility of developer contributions to fund local improvement schemes elsewhere;
- Flood resilient and resistant building design;
- Flood incident management (flood warning) and emergency planning.

The following should also be considered:

- Opportunity for integrated Urban Drainage schemes at those locations where there is mutual benefit in relation to reducing overall flood risk (to existing and proposed developments).
- Possibility of changing land use (agricultural practice), though the scope for this appears limited.

Thus a range of potential mitigation options to facilitate development should be investigated further, encompassing river engineering, rural land and urban (fabric) management, and managing flood event and flood losses; see checklist included in Appendix D (highlighted those options particularly relevant to this study).

Best practice should be applied to limit development runoff to 'greenfield' rates, using SUDS principles and techniques from a variety of applications and recent innovative solutions. The applicability of the two main types of SUDS techniques, infiltration type and attenuation type SUDS depends on the local hydrogeology. In areas where there is potential for infiltration, infiltration type SUDS should be promoted to protect recharge to ground, subject to adequate controls to protect groundwater quality and an assessment of the impact on groundwater flooding. The potential for infiltration type SUDS is explored further in Chapter 6. Where ground conditions preclude the use of infiltration type SUDS, attenuation type SUDS should be used to reduce the runoff rates from new development to that pre-development.

Examples include the attenuation of road runoff using permeable surfaces and rainfall harvesting techniques.

5.5 Conclusions

The impact of development on flood risk, and the impact of flood risk on development can be reduced by following the sequential approach of PPS25, and by ensuring that any development in the study area is subject to runoff control.

The estimated development area of 5-7km^2 is small in comparison to the total Borough area.

A strategic FRA should be carried out to direct development away from flood risk areas where possible, and ensure that any development in high risk only conforms to the PPS25 exception test

Development should incorporate runoff control via SUDS to ensure runoff and infiltration rates do not change with development.

Based on recent flood events, related to high groundwater levels after prolonged periods of winter rainfall, it appears that only a limited number of properties are at risk from fluvial and sewerage related problems. However, the last major river flood event occurred in 1947, and according to the Flood Zone mapping there could be as many as 1,929 properties vulnerable in a 1:100-year (1%) flood event.

The need for the Strategic FRA is reinforced by the findings of this initial study. Appendix E provides further information on the requirements of PPS25 and the likely requirements of the SFRA. The key objectives for this study will be:

(a) Gathering further information to further understand flood risk in the Borough:

(b) Determine land allocation for development following the PPS25 sequential approach (and exception test where necessary);
(c) Identify of both structural and non-structural options that reduce the overall flood risk;

(d) Inform the preparation of the Borough's Local Development Framework and sustainability appraisal.

6 Groundwater protection & Sustainable drainage

6.1 Groundwater protection

The EA has recently revised its "Groundwater Protection: Policy and Practice (GP3). The stated EA core groundwater policy is "To protect and manage groundwater resources for present and future generations in ways that are appropriate for the risks we identify."

Thus, broadly, for any particular development, the potential effects on groundwater quality (and also quantity) should be balanced with the potential benefits, and evaluated according to risk. In this context, the use of SuDS type infiltration drainage may constitute both a threat (e.g. to groundwater quality) and a benefit (e.g. maintenance of natural recharge) and must be assessed using a risk based approach.

At a strategic level the approach to risk assessment is based primarily on "groundwater vulnerability" - i.e. the susceptibility of a groundwater body to pollution. This susceptibility depends upon:

- The presence and nature of overlying soils
- The presence and nature of overlying drift deposits
- The nature of the geological strata
- The depth of the unsaturated zone

i.e. – the same general processes that dictate infiltration capacity. Ground conditions that are favourable for infiltration drainage often occur over highly vulnerable aquifers. Thus where infiltration drainage is to be considered, the vulnerability of the underlying groundwater must be considered – using a risk based assessment.

Under both current regulation (the Groundwater Regulations 1998) and soon to be introduced legislation (the Groundwater Daughter Directive of WFD) the groundwater resource as a whole is subject to protection and management.

For the purposes of this study it must be recognised that the most vulnerable aquifers are also those with the greatest potential for infiltration – thus any development incorporating infiltration drainage must, subject to appropriate risk assessment, ensure that groundwater is protected and measures to "treat" discharges introduced where necessary.

Thus, for example, whilst it is likely that roof drainage may be drained to ground without treatment, drainage from car parks may require (subject to risk assessment) some pollutant attenuation and control measures to be put in place. In both such cases the effects of such drainage on groundwater levels and flow must also be considered.

Further specific protection is applied to individual groundwater sources (wells, springs, boreholes etc). All such sources require protection. However public water supply sources (and sources for food and drink production) require "bespoke" source protection zones.

Three zones are defined as shown in Table 6.1

Zone I	**Inner Source Protection**	**Any pollution that can travel to the borehole within 50 days from any point within the zone is classified as being inside zone 1. This applies at and below the water table. This zone also has a minimum 50 metre protection radius around the borehole. These criteria are designed to protect against the transmission of toxic chemicals and water-borne disease.**
Zone II	**Outer Source Protection**	**The outer zone covers pollution that takes up to 400 days to travel to the borehole, or 25% of the total catchment area – whichever area is the biggest. This travel time is the minimum amount of time that we think pollutants need to be diluted, reduced in strength or delayed by the time they reach the borehole.**
Zone III	**Source Catchment**	**The total catchment is the total area needed to support removal of water from the borehole, and to support any discharge from the borehole.**

Table 6.1: Source Protection Zones and their definition (EA Website)

The EA will object in principle to or refuse to permit "most soakway systems" within Zone I because of the high risk to the source. In Zone II, there may be a presumption against the use of soakaway drainage, although, in a similar manner to groundwater vulnerability mapping, the SPZs are considered as screening tools and site specific risk assessment may demonstrate that soakaway or infiltration drainage is acceptable. Figure 6.1 shows the Source Protection Zones within the study area

6.2 Groundwater flooding

As identified in Chapter 5 groundwater flooding is the predominant cause of flooding within the B&DBC area, and therefore must be included in any strategic flood risk assessment. As discussed in Chapter 5 this need not be an absolute environmental constraint, but the exact location of proposed development and mitigation options should be development further with an SFRA supporting the preparation of the local development framework.

6.3 Potential for infiltration SuDS

The underlying geological strata will dictate the potential for infiltration drainage to disperse. This potential is dependant upon the hydrogeological characteristics of these strata. Table A2 in the Groundwater Technical note summarises these generic characteristics and categorises infiltration drainage potential on a three point scale of good/ moderate/ poor. This is turn has been used to develop a constraints map (Figure 5.4) of infiltration drainage potential for the study area and its immediate environs.

In addition to these characteristics, depth to groundwater is a major constraint. Where groundwater is shallow, there is little capacity to absorb and store drainage waters. To date, no data has been evaluated on depth to groundwater. Particularly in the lower lying areas, where groundwater does occur, it may be at relatively shallow depth, perhaps within a few metres of the surface – which would tend to significantly reduce infiltration drainage potential.

To maximise the benefits of SuDS these should be integrated into the development 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[1].

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.

Failure to manage and maintain SuDS sufficiently can lead to increased risk of flooding and cause a 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.

1. Sustainable Drainage Systems – Hydraulic, structural and water quality advice.CIRIA Report C609. CIRIA 2004.

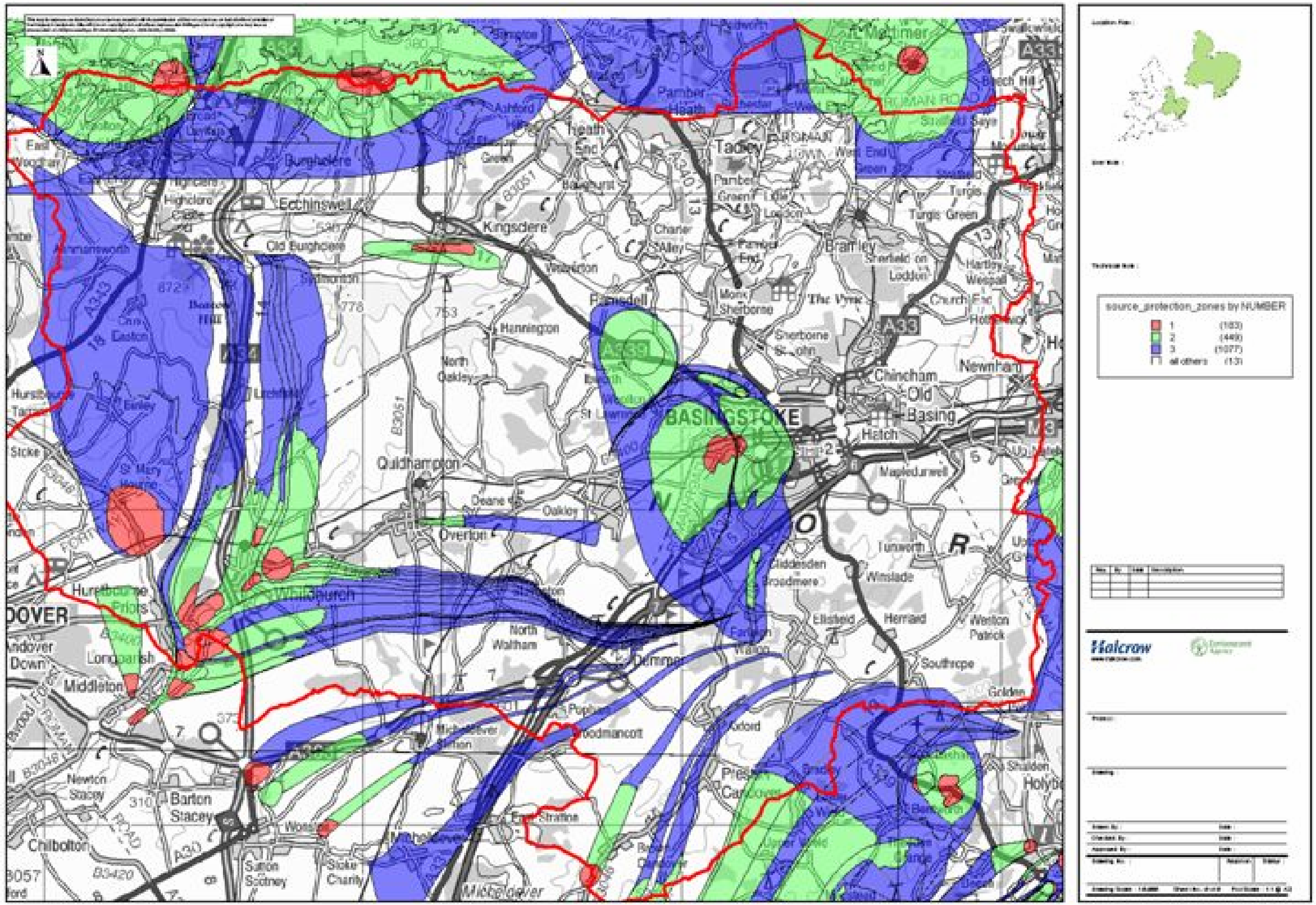


Figure 6.1 Source protection zones

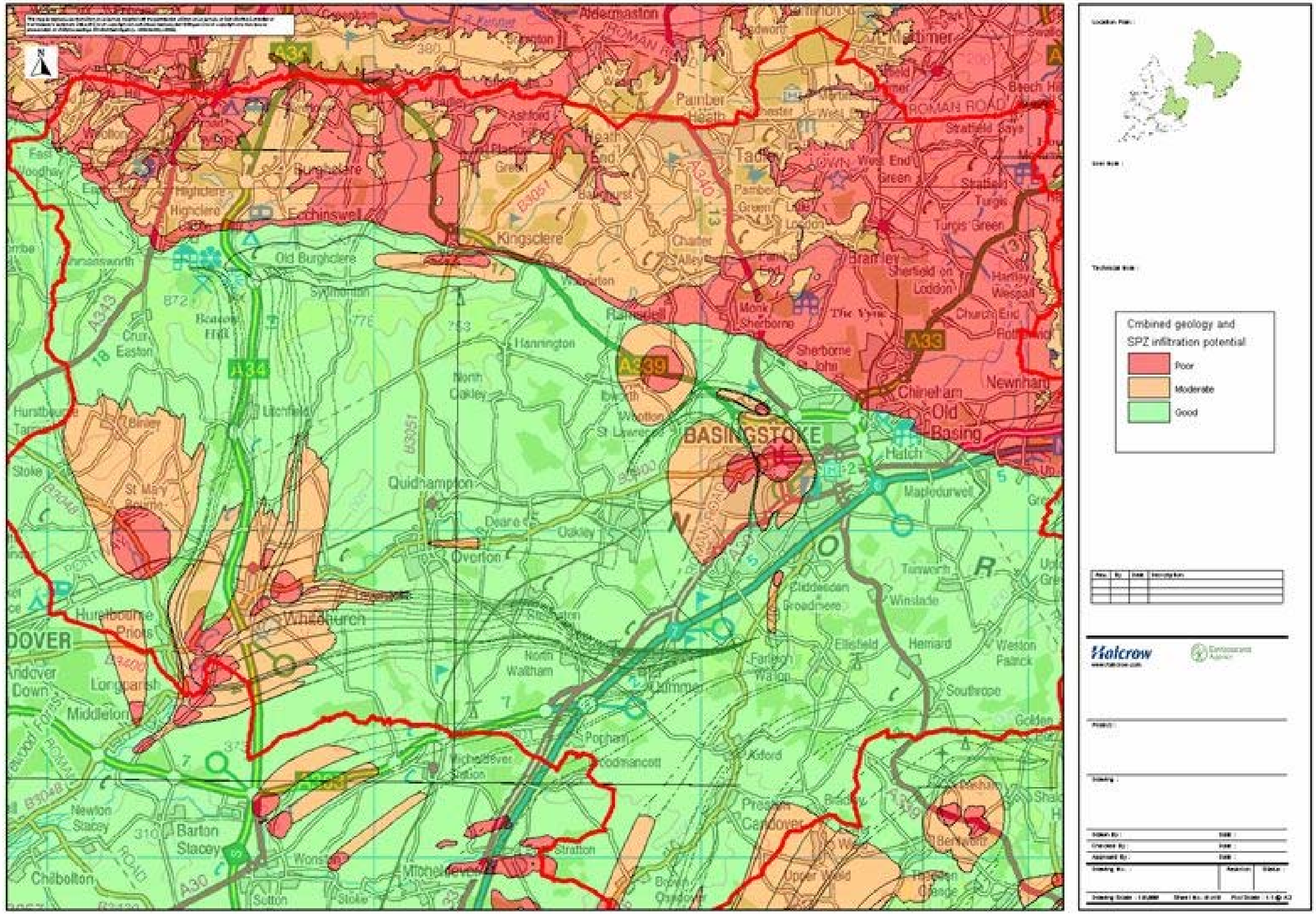


Figure 6.2 Geology and SPZ combined SuDS infiltration potential

7 Conclusions

- Additional resources identified in the WRP will not impact on the hydrology of the River Loddon, therefore do not need to be considered within the flood risk or water quality sections of this report.

- All development scenarios assessed can be supplied without extra water resource development, beyond that currently planned by the water companies strategic water resource plans.

- The need for new resources could be offset by adopting greater water efficiency and demand management measures, but this would need to be supported with strong enabling mechanisms and incentives, and may need a change in legislation covering water companies and planning authorities.

- A twin track approach to demand management is therefore recommended via demand management, to constrain demand, in parallel with developing additional resources when required.

- The current statutory water quality objective (RQO) of the River Loddon can be maintained for any of the development scenarios assessed, with a future tightening of the consent to levels deemed feasible. The BOD consent will need to be tightened, but the current ammonia consent will ensure compliance with the RQO and Freshwater fish directive standards for all of the development scenarios.

- The River Loddon currently fails proposed standards for nutrients in a river of this type to meet good ecological status under proposed WFD standards. It is not known whether the ecology has been harmed by the current high levels of phosphorus. The development scenarios assessed cause only a minor increase in the modelled nutrient levels in the river.

- The extent to which water quality and ecology should be seen as a barrier to development in Basingstoke is not yet known. It is recommended that further work be carried out to identify all sources of orthophosphate in the catchment, to assess the long term feasibility of reducing nutrient levels in the catchment

- Flood risk need not be an absolute barrier to any of the development scenarios assessed. A strategic flood risk assessment needs to be carried out alongside the preparation of the local development framework to ensure that development does not increase flood risk.

- New impermeable area within chalk catchments, ie where infiltration potential is good should use where possible infiltration type SuDS to reduce the impact on groundwater recharge. However, this needs to be balanced with the impact on groundwater flooding and on groundwater quality.

- Where infiltration is poor the runoff from any new impermeable area should be attenuated with SuDS solutions to ensure that the runoff is equivalent to the pre development runoff rate and volume.

Glossary

BOD	Biochemical Oxygen Demand
CFMP	Catchment flood management plans
CRoW	Countryside and Rights of Way Act
dRSS	Draft Regional Spatial Strategy
FRA	Flood risk assessment
FZ	Flood zone
GQA	General Quality Assessment
LDF	Local Development Framework
OFWAT	Office of Water Services
pcc	per capita consumption
PE	Population Equivalent
PPS25	Planning policy statement 25
PR09	Periodic Review 2009
RE	Rivers ecosystem (Class)
RQO	River Quality Objective
SEERA	South East England Regional Assembly
SEW	South East Water
SFRA	strategic flood risk assessment
SSSI	Site of Special Scientific Interest
STW	Sewage treatment works
SuDS	Sustainable urban drainage system
SWS	Southern Water
UKTAG	UK Technical Advisory Group
WRP	Water Resource Plan
WRSE	Water resources in the south east group
WRZ	Water resource zone

Appendix A Environment Agency Datasets Available

Data available for Basingstoke Water Cycle Study (January 2007):

- Flood zones
- GIS datasets
- Test & Itchen CFMP (at scoping stage)
- Rivers Lodden & Blackwater Flood Defence Strategy Plan
- Park View Flood Risk Assessment
- North Waltham Business Centre Flood Risk Assessment
- Crockford Land Flood Risk Assessment

Appendix B FRA Details provided by Basingstoke & Deane Borough Council

Ref	Receipt by Environment Agency	Flood Risk	Sent by	Reason for FRA	Site	Reviewed for WCS
	24/04/06	Fluvial	Stuart Michael Associates	Residential development	Park View, Wells Lane, Whitchurch, Hampshire	✓
	02/10/06	Fluvial	BWB Consulting Ltd	Warehouse and car park	TT Tents, North Waltham Business Centre, Basingstoke	✓
	No date	Fluvial	Waterman Civils	Office, buildings, landscaping and car park	Crockford Lane, Basingstoke	✓

Appendix C Flood Risk Mitigation Options

Principal Measures	Structural Options	Non-Structural Options	Effectiveness[1]	Type[4]
A. River Engineering				
• Increase flood conveyance (affects downstream)	Channelisation, channel restoration, dikes and embankments, by-pass and diversion channels, structure upgrade/improvement		Major	R
• Increase flood storage**	Dams, floodplain/wetland storage, floodplain restoration, temporary channel storage		Marked	R
• Flood defences	Flood defence along river, ring dikes for key areas, special structures		Major	R
• Flood water transfer**	Bypass or diversion across river/tributary catchments – if feasible?		Marked/Major	R
B. Manage Flood Events				
• Operational measures		Coordinated plan to cover the operation of key flow control structures by riparian owners, Environment Agency, others.	Marked	S,R
• Pre-flood measures[2]		Preparedness planning; major incident plans, flood risk mapping, education/awareness raising; community flood plans	Marked	S,R
• Real-time forecasting & warning[2]		Forecast systems (incl. modelling), warning systems	Marked	R
• Flood fighting[2]	Demountable defences, water level control structures (weirs, sluices)	Emergency repair, emergency diversions	Marked	S,R
• Collective/individual scale damage avoidance	Demountable defences, temporary flood proofing	Evacuation of floodplain, moving assets to safety	Marked	S,R
C. Manage Flood Losses				
• Reduce exposure by land-use management		Managed retreat, relocate exposed infrastructure	Minimal	M,S,R
• Reduce exposure through flood proofing		Retro-fit flood proofing – self help programmes	Marked	R
• Limit increased exposure by land-use planning		Planning of land use, financial measures (floodplain charging), locate critical facilities out of floodplain	Minor	S,R
• Limit increased exposure with better construction	Flood proofing	Property/structure designs	Minor	R
• Facilitate economic and financial recovery		Insurance, state aid and compensation, tax relief on losses, self insurance	n/a	S,R
• Lessen health, social and practical impacts[2]		Target health/counselling services, practical aid (clean up)	n/a	S,R
D. Urban (Fabric) Management				
• Increase urban storage	Detention ponds, underground storage, temporary flood storage (parkland), storage along flood system	Building design, urban development design, source control, g/w management, design of drainage/ sewerage systems	Minor	M,S,R
• Increase infiltration		Building design, permeable land cover	Minimal	S,R
• Manage land surface conveyance	Separate storm and foul sewers, alter river channels to improve outfalls, reopen culverted watercourses (daylighting).	Design of building drainage, multiple drainage systems, roads and gully pots.	Minimal	S,R
E. Rural Land Management				
• Increase retention/infiltration	Increase field drainage storage	Change tillage practice, extensification, afforestation, buffer strips/zones	Minimal[3]	M,S,R
• Water retention/ storage schemes	Detention pond/bunds	Wetlands/washlands, riparian zone management, rainwater harvesting	Minimal[3]	M,S,R
• Manage conveyance	Realign channels	Maintain channels, manage hillslope connectivity	Minimal[3]	

[1]*Effectiveness in terms of the potential for flood risk reduction, ranked as minimal/minor/marked/major;* [2]*Applicability at catchment level;*
[3]*Reflects the current view at catchment scale for high order events, though possibly effective at local level if lower order - requires further research, with output from Defra project FD2114 directly relevant (Section 3.5.3)*

[4] *Type: M = Maintain current mitigation measures; S = Sustain by progressively improving current measures to maintain flood impacts at current level;* R = *Reduce flood risk through structural/non-structural options;*
I = Increase flood risks to a controlled level in specified areas to gain benefits locally or elsewhere; FW = improve flood warning; DC = development control working with local authorities to influence development

Appendix D PPS25 Sequential Approach

PPS25 SEQUENTIAL APPROACH					
Stage One Identify Flood Zone (EA Maps)	**Stage Two** Zone 3a, 3b (SFRA maps)	**Stage Three** Consideration of land use vulnerability	**Stage Four** Exception Test		
1 **Low Probability** Annual probability of flooding: River, tidal and coastal <0.1%	→	All uses of land are appropriate, but consideration should still be given to flooding from other sources as well as from river and sea. Their effect on surface water runoff should also be addressed.	→	→	Undertake flood risk assessment and consider climate change and surface runoff increase Proceed to allocation
2 **Medium Probability** Annual probability of flooding: River 0.1 - 1.0% Tidal and coastal 0.1 - 0.5%	→	The water compatible, less vulnerable and more vulnerable uses of land and essential infrastructure are appropriate in this zone.	The Exception Test be carried out for the highly vulnerable land uses.	→	
3 **High Probability** Annual probability of flooding, with defences where they exist: River 1.0% or greater Tidal and coastal 0.5% or greater	a	The water-compatible and less vulnerable uses of land are appropriate in this zone.	Highly vulnerable and essential infrastructure should only be permitted if the Exception Test is passed.	→	
	b Functional Floodplain	The water-compatible and less vulnerable uses of land are appropriate in this zone. The less vulnerable and highly vulnerable uses should not be permitted in this zone.	Water-compatible and essential infrastructure should only be permitted if the Exception Test is passed **and** design and construction adheres to the specific guidance given.	→	

Appendix E Strategic Flood Risk Assessment

E.1 Implications of PPS25

Government policy is one of discouraging inappropriate development in areas at risk of flooding. The Planning Policy Statement 25: Development and Flood Risk (PPS25) was published in December 2006, and replaces the Planning Policy Guidance Note 25: Development and Flood Risk (PPG25), published July 2001. PPS25 sets out advice to planning authorities on how to consider flood risk at all stages of the planning and development process:

- PPS25 aims 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 of highest risk. Where new development is, exceptionally, necessary in such areas, policy aims to make it safe, without increasing flood risk elsewhere, and, where possible, reducing flood risk overall.
- PPS25 recommends that local planning authorities adopt a strategic approach to flood risk and apply the principles of the sequential test to ensure that any development is safe and not unnecessarily exposed to flooding but it accepts that to stop all development in floodplains would be unrealistic. It provides advice upon the use of flood risk assessments and suggests that authorities consider available data on the nature of flood risk in the local area and its possible consequences for new site allocations.

The guidance states that: *'…local planning authorities should prepare and implement planning strategies that help deliver sustainable development by… preparing Strategic Flood Risk Assessments (SFRAs), as freestanding assessments that contribute to the Sustainability Appraisal of their plans'.*

E.2 Strategic Flood Risk Assessment (SFRA)

A SFRA provides a detailed and robust assessment of the extent and nature of flood risk for the area under a local authorities control and its implications for land-use planning. An SFRA also sets out the need for planning applications for future developments and guides development control decisions. The SFRA looks at flood risk at the strategic level on a local planning authority scale. SFRAs do not look at individual sites.

Basingstoke & Deane Borough Council are responsible for carrying out a SFRA under PPS25. It is the responsibility of those allocating land for development to demonstrate the flood risk to and caused by development will be acceptably safe throughout the lifetime of the proposed development, taking account of climate change. This high level initial assessment of flood risk, as reported herein, will form the background for the SFRA and will help in defining its scope. The SFRA will enable the planning authorities to:

- Make informed decisions on the impact of emerging growth proposals and allocation of land for the Local Development Framework (LDF);
- Inform the consideration of these matters in the Regional Spatial Strategy (RSS);
- Guide developers in flood risk assessments as part of the development control process.

The SFRA should identify the following related to flood risk, and deliver net benefit across the Basingstoke area by reducing flood risk:

- Extent of all potential flood risk both for the present day and allowing for the effects of climate change including the potential impact of increased storminess) over the next 100 years taking account of new advice recently published by Defra;
- An assessment of the existing flood management infrastructure
- Potential impact of development on flood risk, i.e. planned growth of 35,000 properties over 20 years;
- Viable mitigation measures to reduce flood risk and advice on sustainable funding of the appropriate measures, including the identification of costs and the scale of the measures required;
- Impact of increased surface water runoff on receiving watercourses.

These findings should be used primarily for the purpose of development control, and also distributed to the wider community (education/awareness is key).

Key components of PPS25 are the Sequential and Exception Tests. These determine the suitability of land for development which is categorised based on the Environment Agency's Flood Risk Zones and refined based on SFRA assessments as appropriate. These are termed Zones 1, 2, 3a and 3b. The definitions of these and their implications for planning are:

- Zone 1 – This zone comprises land assessed as having a less than 1 in 1000 annual probability of river or sea flooding in any year (<0.1%). All uses of land are appropriate in this zone. Development proposals for large sites (> 1 ha.) within this zone should be accompanied by a FRA.
- Zone 2 - This zone comprises land assessed as having between a 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. Highly vulnerable uses of land are only appropriate in this zone if the 'Exception Test' is passed. All development proposals in this zone should be accompanied by a FRA.
- Zone 3a – This zone comprises land assessed as having a 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. Only water-compatible and less-vulnerable uses of land are appropriate in this zone. Highly vulnerable uses of land should not be permitted in this zone. The more vulnerable and essential infrastructure uses should only be permitted in this zone if the 'Exception Test' is passed. Essential infrastructure permitted in this zone should be designed and constructed to remain operational and safe for users at times of flood. All development proposals in this zone should be accompanied by a FRA.
- Zone 3b (The Functional Floodplain) – This zone comprises land where water has to flow or be stored in times of flood. SFRA's are required to identify this flood zone (this is usually taken as land which has a 5% probability of flooding in any year). Only water-compatible uses and essential infrastructure should be permitted in this zone. All development proposals in this zone should be accompanied by a FRA.

Guidance notes published by the Environment Agency further advise that SFRAs can:

- Reduce the risk of the Environment Agency objecting to the LDF or planning applications;
- Identify high-risk areas unsuitable for development;
- Inform the site allocation process;
- Identify infrastructure weak-spots;
- Help with emergency planning for the area;
- Speed up the development control process.

Identify the level of detail required for individual Flood Risk Assessments (FRA)

E.3 Strategic Flood Risk Assessment for Hampshire County Council

Halcrow are currently undertaking a SFRA for the Hampshire County Council to ensure it meets its obligations under PPS25, by:

- identifying areas of Hampshire where mineral and waste activities are to be avoided due to flood risk;
- identifying sites where proposed and existing land for industrial estates / other types of employment should be avoided on flood risk grounds;
- providing guidance on the need for FRA's by developers as part of the development control process.

These aims are being achieved by sub-dividing Flood Zone 3 into Zones 3a and 3b, and by identifying the sites where the 'Exception Test' cannot be applied. A key deliverable of this work will be the production of strategic flood maps illustrating these zones.

Hydraulic modelling is not anticipated for areas outside specific sites identified for the needs detailed above, as the pre-cautionary principle through the adoption of 'buffer zones' can be taken at locations where:

- there are uncertainties about the nature and extent of flood risk
- the investigation required is too detailed for a study that needs to be carried out at a strategic level

E.4 Planned Strategic Flood Risk Assessment for Basingstoke and Deane Borough Area

The planned SFRA will provide a detailed and robust assessment of the extent and nature of the risk of flooding to specific growth areas within Basingstoke and Deane Borough and its implications for land use planning. In addition this SFRA, will review and refine the current flood zones published by the Environment Agency (www.environment-agency.gov.uk) where appropriate, thereby defining the requirement for the submission of planning applications across BDBC area and for guiding subsequent development control decisions.

A SFRA specific to the BDBC area (as required by PPS25) will provide an appraisal of all types of flood risk to inform land use planning decisions. It will allow BDBC to:

- Prepare appropriate policies for the management of flood risk within Local Development Documents
- Identify the level of detail required for site specific Flood Risk Assessments in key locations
- Determine the acceptability of flood risk in relation to emergency planning capability
- Allocate appropriate sites for development
- Identify opportunities for reducing flood risk

The approach to SFRA work in line with PPS25 (Section 6.2) is as follows:

- Data collection & review – Several reports have already been collated and reviewed and issues identified through discussions with the Environment Agency and the BDBC. Any further information that becomes evident at a later stage will be reviewed.
- Hydrology & hydraulic modelling – This will include a review of any modelling work undertaken or planned. Where possible, existing models will be used to review and refine (if deemed necessary) the boundaries Environment Agency flood zone maps, and to subdivide Zone 3 into Zones 3a and 3b.
- Unmodelled areas – Screening will be carried out to establish areas with a history of flooding, which are located in areas of existing or planned development. The assessment of flood risk in these areas will be based on site investigation work to delineate the boundary for the area with a 1% probability of flooding in any year (i.e. to identify the boundary between Zones 2 and 3). This will be based on information available and may include: historical flooding records, local information and catchment details. Similarly, site investigation work will identify the functional floodplain and, hence, sub-divide Zone 3 into 3a, 3b.
- Mapping & reporting – A series of flood risk maps will be produced in accordance with PPS25. These will subdivide BDBC into Flood Risk Zones 1, 2, 3a and 3b. These flood maps will enable consistent and sustainable decisions to be made regarding the allocation of sites and control of development.
- Planning advice – The implications of the flood zones for land use planning will be investigated. This will include the application of the Sequential and Exception Tests where necessary, to determine the implications for existing and planned developments.

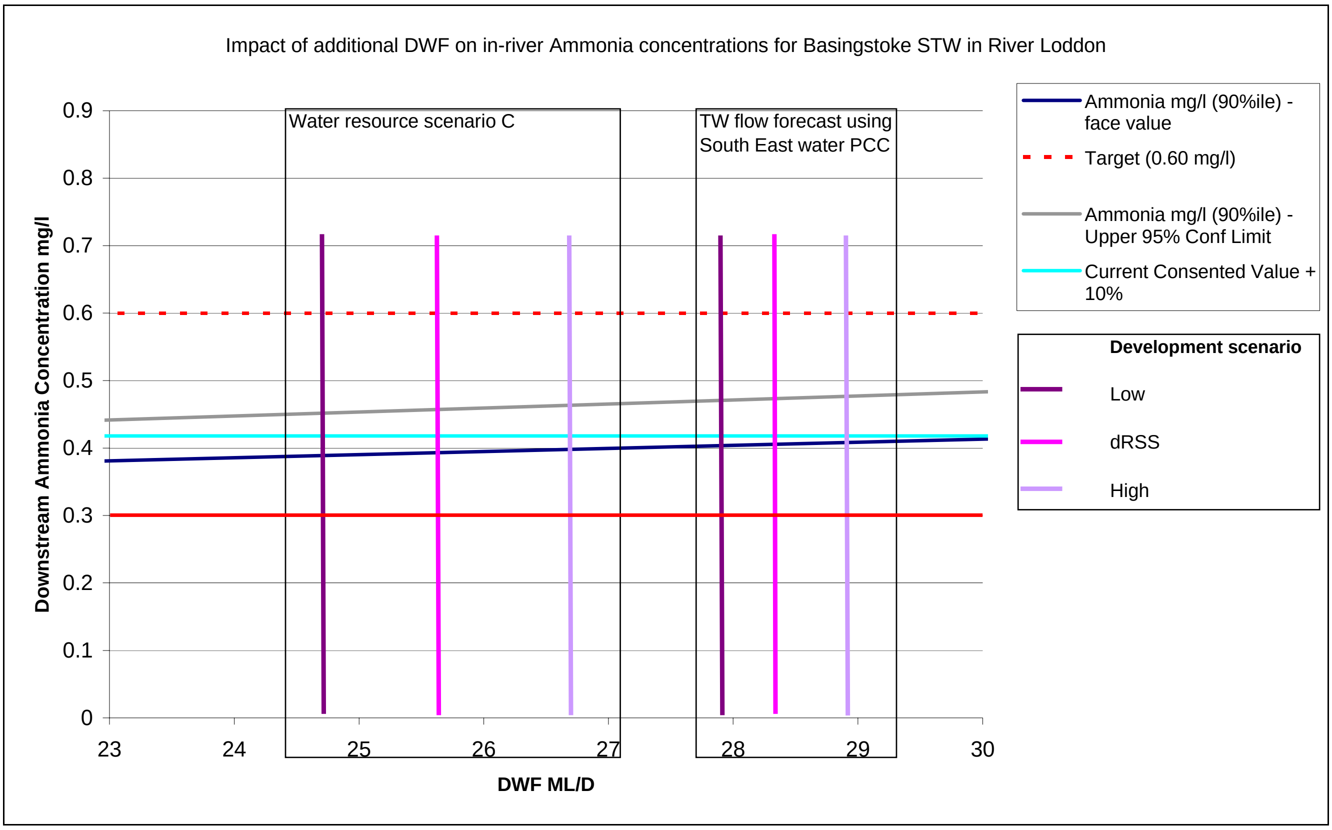
Appendix F Impact of development on water quality objectives.

The following graphs show how increasing population over time can affect compliance with the RQO.

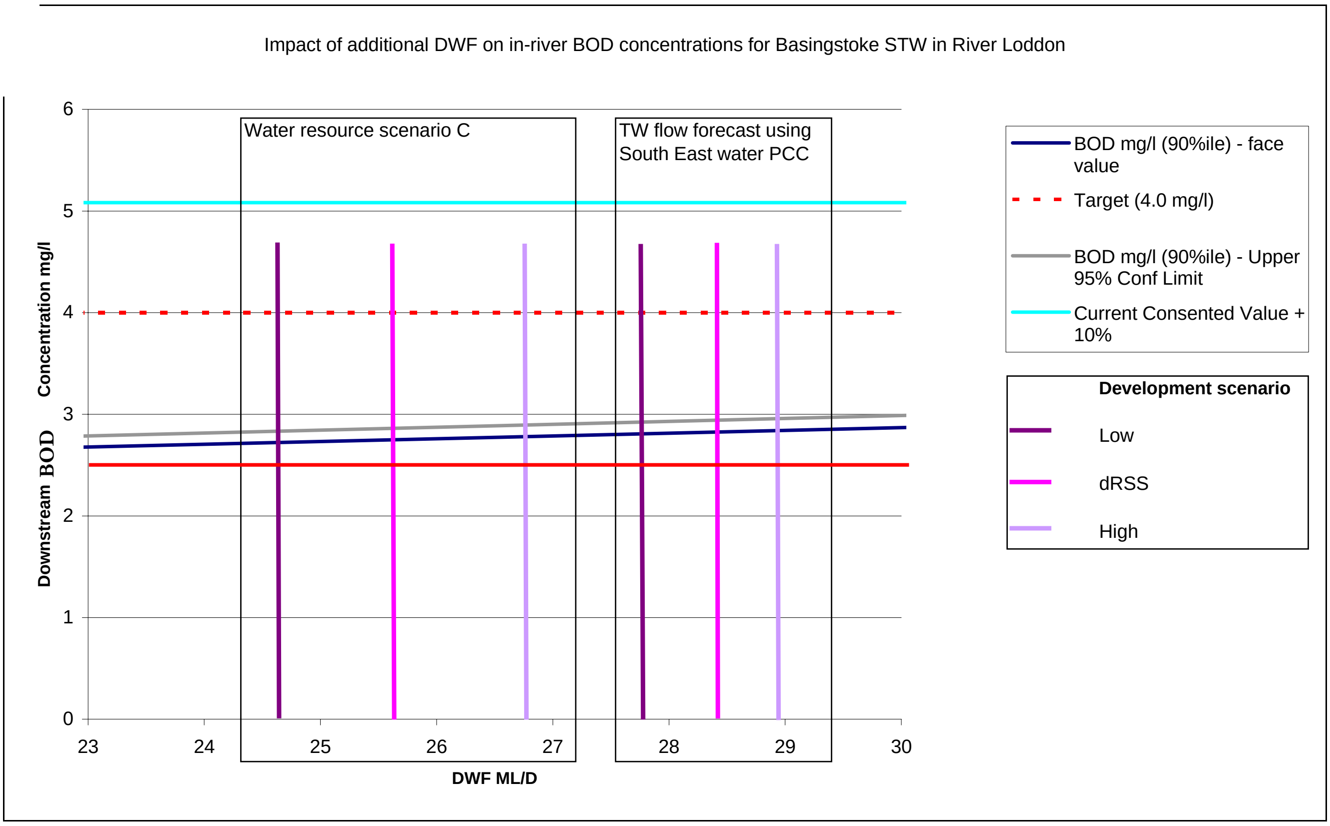
The graphs show dry weather flow along the horizontal axis with river quality on the vertical axis. Dry weather flow will increase in time as function of population increase, therefore for each development scenario it is possible to forecast a DWF for any point in time. The graphs below show the DWF for 6 different scenarios for 2026, represented by the vertical lines. The purple vertical lines represent the low development scenario (scenario 1), the pink line represents scenario 2 – or the level of development in the dRSS, and the light purple line shows the higher development scenario or scenario 3. There are also two water resources scenarios plotted on the graphs to shows how water efficiency measures may impact on river water quality. The baseline scenario, using the pcc rates used by SEW and TW is compared against the most onerous water resources scenario to highlight the extremes.

The horizontal lines show the water quality objectives for the River Loddon – the higher dashed red line is the statutory RQO, and the lower solid line is the non-statutory guideline value for chalk rivers proposed by Natural England. The forecast quality in the River Loddon is shown by the grey (pessimistic value) and the blue lines.

It can be seen from the both graphs, that at current consented effluent quality, none of the development scenarios cause a failure of the statutory RQO, although the guideline value for chalk rivers which is being failed by the current effluent discharge shows further minor deterioration



Impact of additional DWF on in-river Ammonia concentrations for Basingstoke STW in River Loddon
Downstream Ammonia Concentration mg/l
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
23
24
25
26
27
28
29
30
DWF ML/D
Water resource scenario C
TW flow forecast using South East water PCC
Ammonia mg/l (90%ile) - face value
Target (0.60 mg/l)
Ammonia mg/l (90%ile) - Upper 95% Conf Limit
Current Consented Value + 10%
Development scenario
Low
dRSS
High



Impact of additional DWF on in-river BOD concentrations for Basingstoke STW in River Loddon
Downstream BOD Concentration mg/l
6
5
4
3
2
1
0
23
24
25
26
27
28
29
30
DWF ML/D
Water resource scenario C
TW flow forecast using South East water PCC
BOD mg/l (90%ile) - face value
Target (4.0 mg/l)
BOD mg/l (90%ile) - Upper 95% Conf Limit
Current Consented Value + 10%
Development scenario
Low
dRSS
High

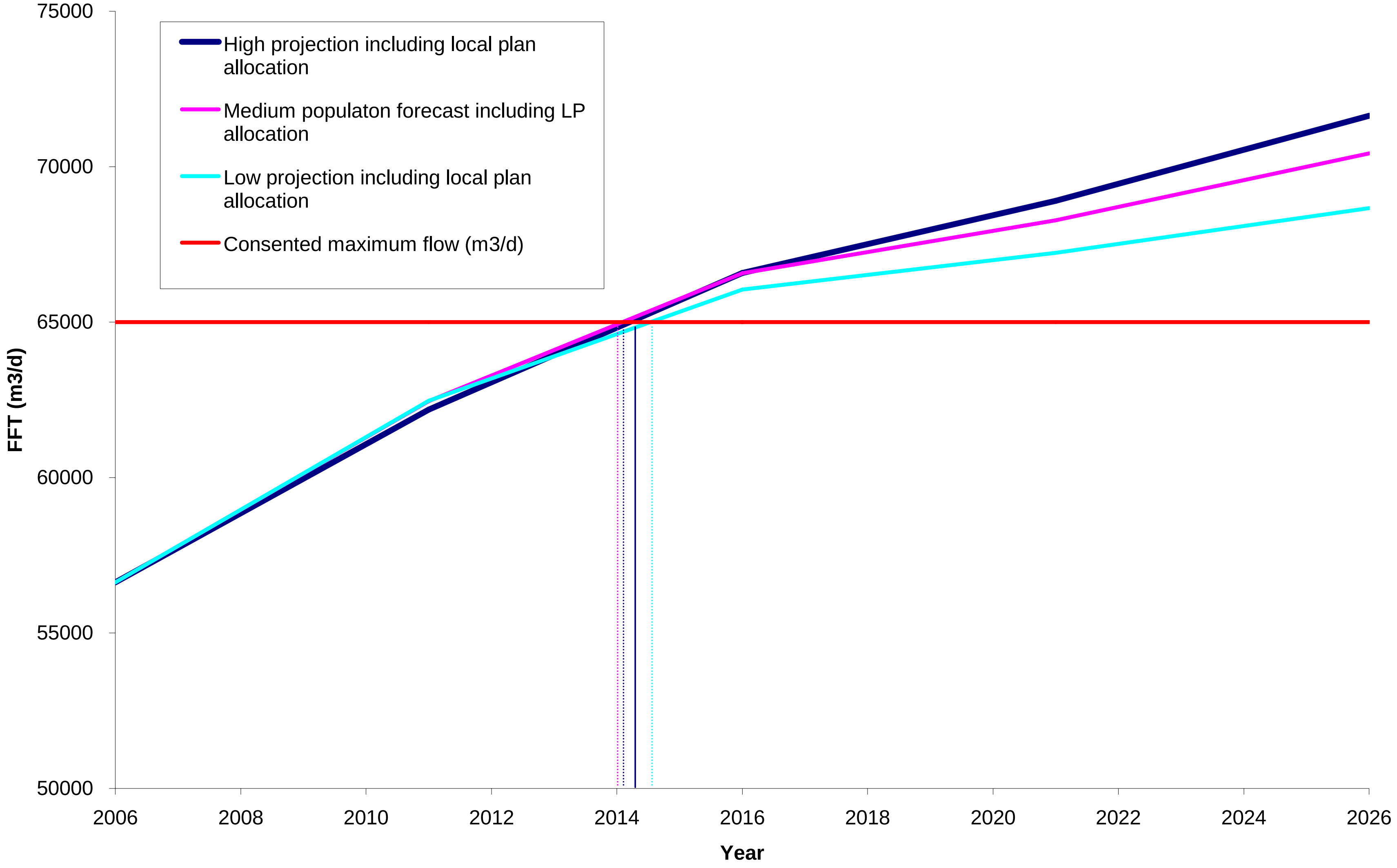
Appendix G Impact of water resource efficiencies on STW flow consent failure

An assessment has been made of how water resource scenarios can impact on the point at which development causes the STW flow consent to be breached. By reducing the amount of effluent discharged it is possible to delay the point at which the STW breaches its flow consent, thereby providing additional consented headroom before environmental capacity is breached.

However, this is only true if the current consent is set correctly to prevent failure of standards. The current consent does ensure that the RQO in the River Loddon is not threatened as indicated in Chapter 5. However, it also indicates that the guideline standard for phosphate within a chalk river, and the guideline phosphate standard for the SSSI are already being breached. However, these standards are only guideline and not statutory. Therefore the WR scenarios can delay the point at which the current consented flow is exceeded, but cannot necessarily prevent deterioration in the River Loddon with respect to phosphorus

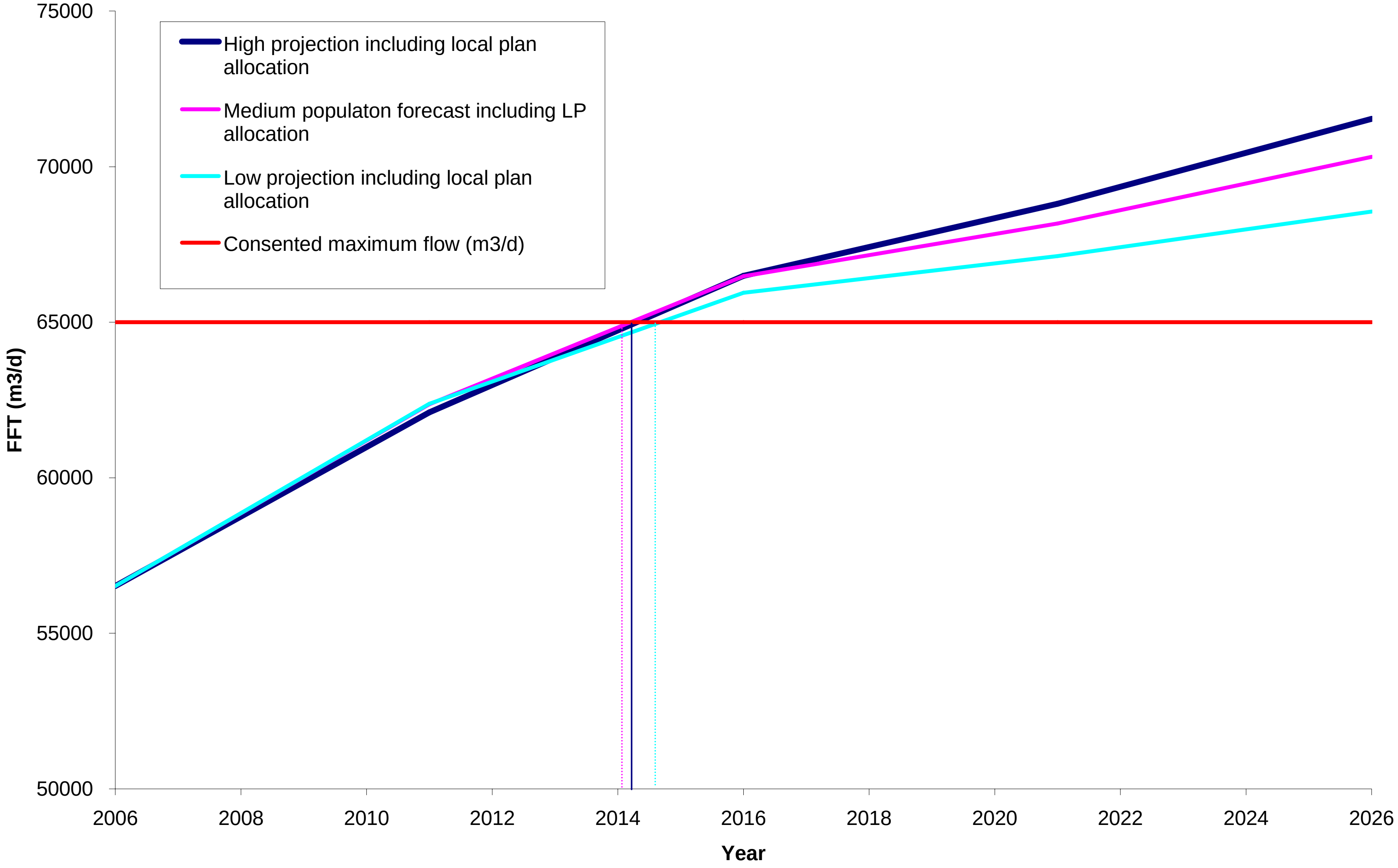
It must also be noted that this does not take into account process headroom at the STW. It is not always the case that the STW process is capable of treating the consented flow if the current flow is substantially below that consented.

Water resource scenario A

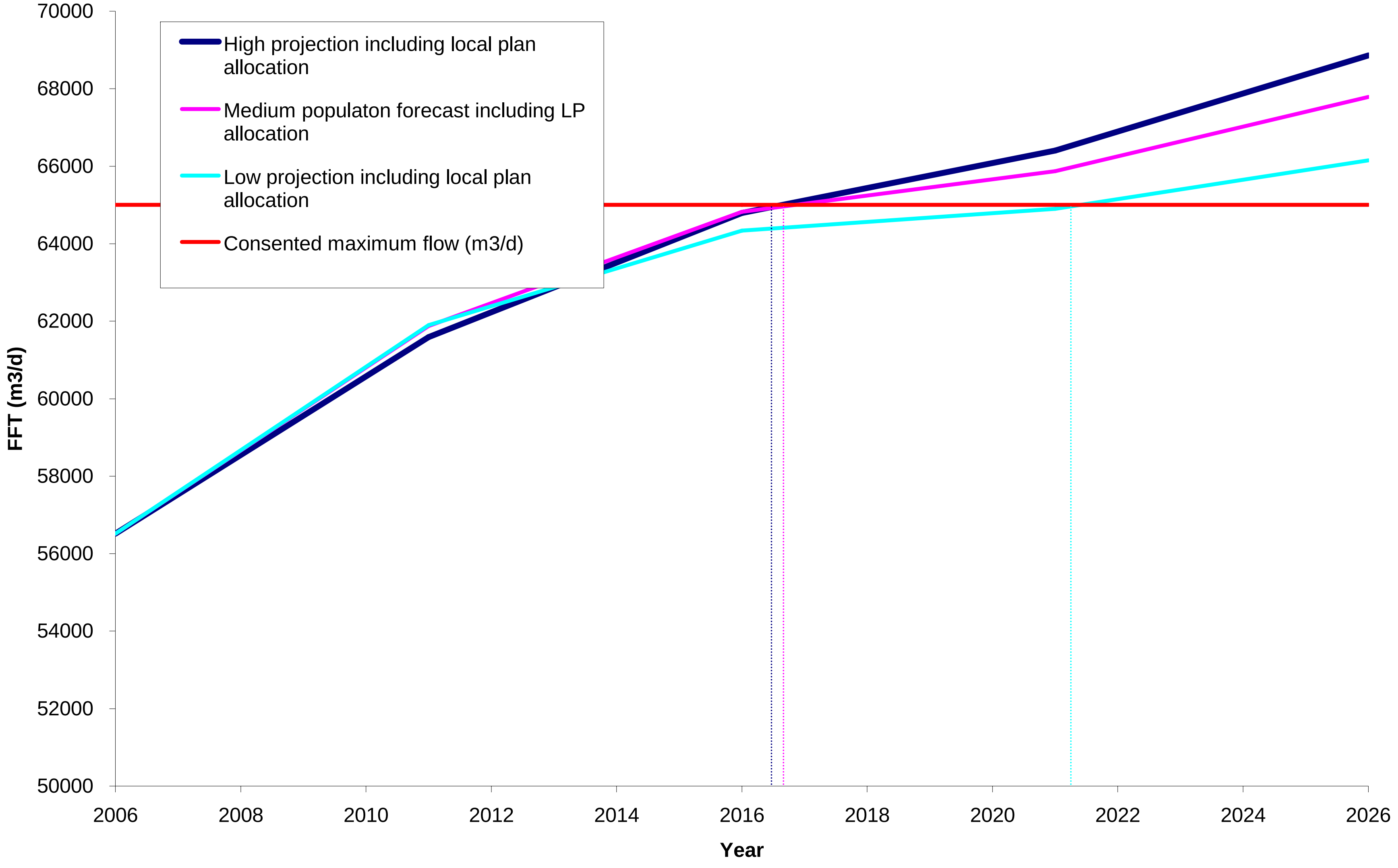


Water resource scenario

B



Water resource scenario C



Appendix H Water resources and water supply in Basingstoke Deane Borough Council area

H.1 Water resource zones serving Basingstoke

A water resource zone (RZ) represents an area within which all resources can be shared and in which all customers experience the same risk of failure from a resource shortfall; they are used for strategic planning by water companies.

If a resource zone is shown to have a surplus of water supply over demand then strategic distribution mains will allow the planned demand to be met. Supplies to new developments will be subject to local distribution schemes that will depend on the precise location of any development. Local distribution networks have not been assessed in this study due to its strategic focus.

The public water supply to the east of Basingstoke and Deane district is provided by South East Water (SEW) and the public water supply to the west is provided by Southern Water Services (SWS). South East Water supplies the area as part of its resource zone 4 (RZ4) and Southern Water Services supplies it as part of the Hampshire Kingsclere resource zone.

The SEW RZ4 covers parts of Hampshire and Surrey. It includes all or part of the local authority districts of Basingstoke and Deane, East Hampshire, Guildford, Hart, Rushmoor, Surrey Heath and Waverley as well as the unitary authorities (UA) of Bracknell Forest, Windsor and Maidenhead, and Wokingham.

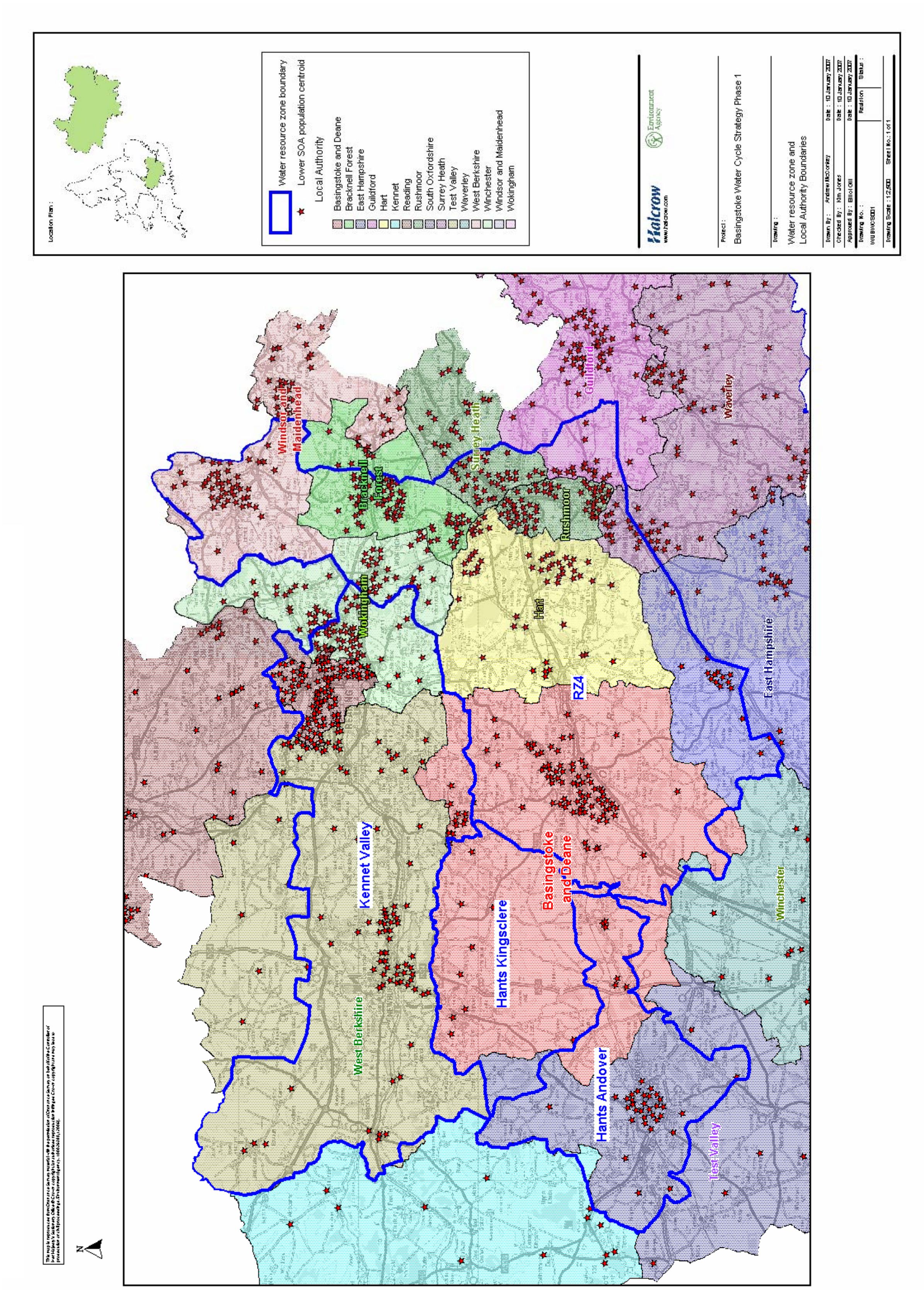
The SWS Hants Kingsclere resource zone is in Hampshire. The majority of its area is covered by the west of Basingstoke and Deane district.

Figure H.1 shows the locations of the water resource zones and local authority boundaries.

H.2 Existing population distribution

The Office of National Statistics (ONS) publishes mid-year population estimates for local authority areas on an annual basis. The most recent data is for June 2005 and was published in August 2006. These have been used to estimate the current resource zone populations.

Figure H.1: Locations of water resource zones and local authority boundaries



For the local authority areas that only partially lie within a resource zone, the proportion of the district current population has been estimated using the ONS lower-layer super output area

(LSOA) population data. The LSOA data, which is consistent with the ONS published district population totals, allows a population-based determination of the proportion of a district that lies within a specific water resource zone; this is more accurate than the commonly used method of deriving a population estimate based on the relative geographical areas. The most recent LSOA data, for 2004, has been used to assess the proportions of the 2004 local authority area populations within a resource zone; the same proportions are then assumed to apply to the more recent 2005 mid-year estimate population data.

RZ4 contains all or part of 10 local authority areas but is covered by 417 LSOAs, each of which contain an average population of 1,512. Proportions of districts in RZ4 derived using both LSOA data and geographical areas are shown in H.1. The use of LSOA derived population data results in substantial changes to the district proportions allocated to SEW RZ4 when compared to the geographical proportions. Basingstoke and Deane increases from 45% to 74%, Bracknell Forest from 65% to 91%, Surrey Heath from 33% to 66% and Waverley from 5% to 17%. There is a reductions in the population allocation to the SEW RZ4 zone in the Wokingham district from 61% to 32%.

Local authority	Geographical proportion in RZ4	LSOA population in RZ4
Basingstoke and Deane	44.7%	74.2%
Bracknell Forest UA	65.1%	91.3%
East Hampshire	19.3%	21.7%
Guildford	12.2%	17.4%
Hart	100.0%	100.0%
Rushmoor	100.0%	100.0%
Surrey Heath	33.3%	65.5%
Waverley	5.5%	16.9%
Windsor and Maidenhead UA	58.6%	51.6%
Wokingham UA	60.6%	32.0%

Table H.1: Local authority population distribution in SEW RZ4

The Hants Kingsclere zone contains part of Basingstoke and Deane district and is covered by 11 LSOAs. The difference between the LSOA derived proportion and that derived using geographical area is a reduction to the district population proportion allocated to the zone from 34% to 10% of Basingstoke and Deane district.

H.3 Housing data

The number of households in Basingstoke and Deane district in 2006 is estimated to be 66,879[1]. Assuming their locations are the same as the population distribution, 74.2% (49,644) of these lie

[1] Gosling, G., Basingstoke & Deane Borough Council, *Pers Comms* 13/12/06

within RZ4 and 10.3% (6,892) lie within the Hants Kingsclere resource zone. The remaining 15.5% of households within the Basingstoke and Deane district are contained within Kennet Valley RZ (supplied by Thames Water) and Hants Andover RZ and Hants South RZ (both supplied by Southern Water). These areas have not been examined because they are either rural and outside the Western Corridor and Blackwater Valley development zone or, in the case of the supply from Thames Water, would need to be considered in conjunction with development in the Kennet Valley district area.

The number of households in 2006 in the other districts in RZ4 were derived from population and occupancy data as follows. The ONS 2004-based trend population projections for 2006 are adjusted for differences observed between the 2005 projections and the 2005 mid-year estimates (see Table H.2); these are then multiplied by the South East regional 2006 occupancy rates, as published by the Department for Communities and Local Government (DCLG) for the 2003-based household projections.

Basingstoke and Deane district lies entirely within the South East Regional Assembly region. Housing growth provisions are specified for local authorities in the draft Regional Spatial Strategy (RSS), the Draft South East Plan[1]. The mean annual housing growth within the RZ4 and Hants Kingsclere resource zones are shown in Table H.2. Apart from the Basingstoke and Deane district allocations, these have been estimated using the same proportions derived for the population data; this assumes an equal occupancy distribution throughout a district and future growth in proportion to current population locations. In Basingstoke and Deane district, 95% of new housing has been allocated to RZ4 and 5% to Hants Kingsclere RZ (rather than the current 74% and 10% proportions respectively), because most of the future Basingstoke and Deane growth is expected to occur in the east of the district.

RSS household projections for SEW RZ4 zone are shown in Figure H.2 and for the Hants Kingsclere zone in H.3. Also displayed are the water company projections from the 2004 Water Resources Plans[2,3] and the 2004-based DCLG household projections, which are derived from recent trends rather than taking policy development decisions into account.

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[1] South East England Regional Assembly, Draft South East Plan, March 2006

[2] South East Water, Water Resources Plan 2004, April 2004

[3] Southern Water Services, Water Resources Plan 2004, April 2004

Local Authority	Total RSS housing	RSS in RZ4	RSS in Hants Kings-clere	RSS in other water resource zones (not in this study)
Basingstoke and Deane	825	784	41	0
Bracknell Forest UA	539	278	0	261
East Hampshire	260	83	0	177
Guildford	322	239	0	83
Hart	200	200	0	0
Rushmoor	310	310	0	0
Surrey Heath	187	41	0	146
Waverley	230	40	0	190
Windsor & Maidenhead UA	281	184	0	97
Wokingham UA	523	88	0	435

Table H.2: Mean annual housing growth (2006-2026)

The water company household projections are expected to be slightly lower than the other household projections because they do not include properties where there is a single water-meter to a building containing multiple households, such as blocks of flats; these are classed as non-household within Water Resources Plans.

For RZ4, the SEW estimate for the total number of households is slightly lower than the estimated DCLG total for RZ4 but both are substantially lower than the RSS projected data. The individual local authority projections by 2026 are all greater than the DCLG trend based projections except for Guildford and East Hampshire districts.

For the Hants Kingsclere resource zone both the RSS and DCLG household projections are greater than those forecast by Southern Water Services.

Figure H.2: Household projections in SEW resource zone 4

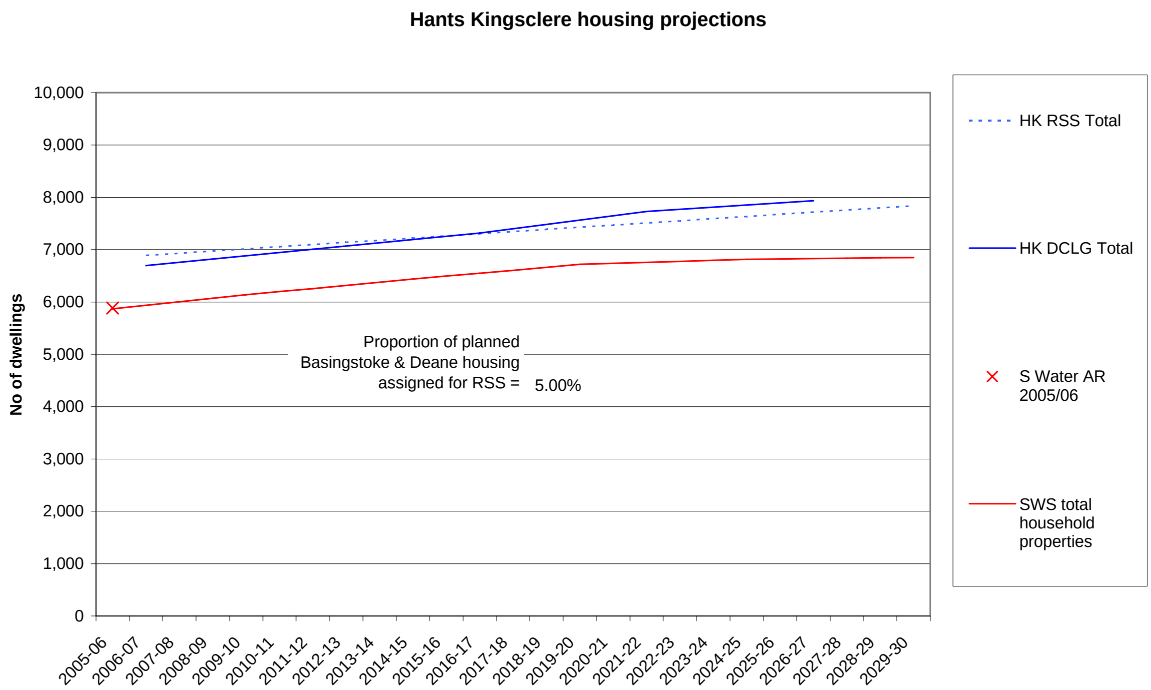

Figure H.3: Household projections in Hampshire Kingsclere resource zone

H.4 Occupancy rates

Future mean occupancy rates (OR) for Basingstoke and Deane district in both resource zones have been calculated using data from the Chelmer regional model[1]. The mean ORs assumed for the other districts within RZ4 are the average South-East regional household sizes published by DCLG with the 2004-based household projections. The Chelmer model and the SE region occupancy rates are similar and decline from 2.35 to 2.12 people per household between 2006 and 2026, as shown in Figure H.4.

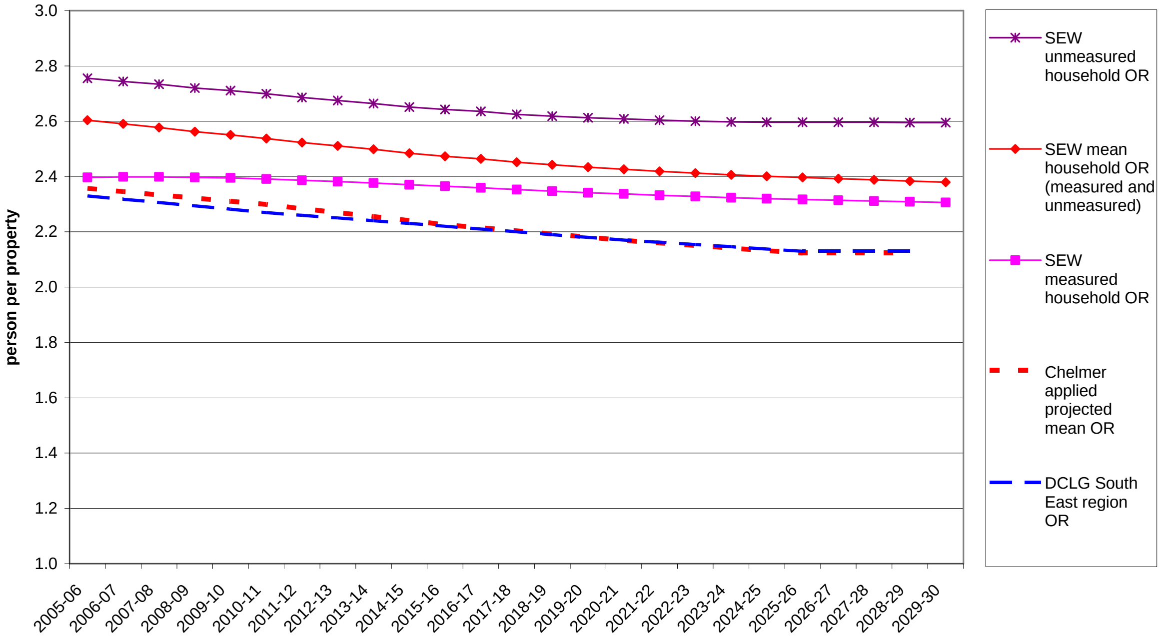

Figure H.4: Occupancy rates in SEW RZ4

In SEW RZ4, the water company mean household occupancy rate**Error! Bookmark not defined.** declines from 2.60 in 2006 to 2.40 people per household in 2026, as shown in Figure H.4, which is high when compared to the Chelmer figures. SEW use measured ORs from survey data but calculate the unmeasured OR from the resulting population split into measured and unmeasured. The SEW 2006 Annual Review states that a large re-survey of customers took place in 2002-3. This data, however, which showed a measured OR of only 1.96 for RZ4, was not used in the 2004 plan; a higher rate of 2.39 was used to mitigate the impact from the previous higher estimate. A revision by SEW to these lower measured ORs may produce an overall OR similar to the Chelmer projections used in this study.

In Hants Kingsclere, the water company average OR**Error! Bookmark not defined.** declines from an average 2.72 in 2006 to 2.64 people per household in 2019/20 before rising again to 2.67 in

[1] Gosling, G., Basingstoke & Deane Borough Council, *Pers Comms* 13/12/06

2026, as shown in Figure H.5. This figure also shows the occupancy rates assumed by the water company for the various types of properties. The water company mean household ORs are high when compared to those in the Chelmer projections, mainly due to the high unmeasured OR applied. The water company values for new and measured properties have been used in this study with the unmeasured occupancy rates estimated (shown in Figure H.5) to make the mean rate equivalent to those in the Chelmer projections.

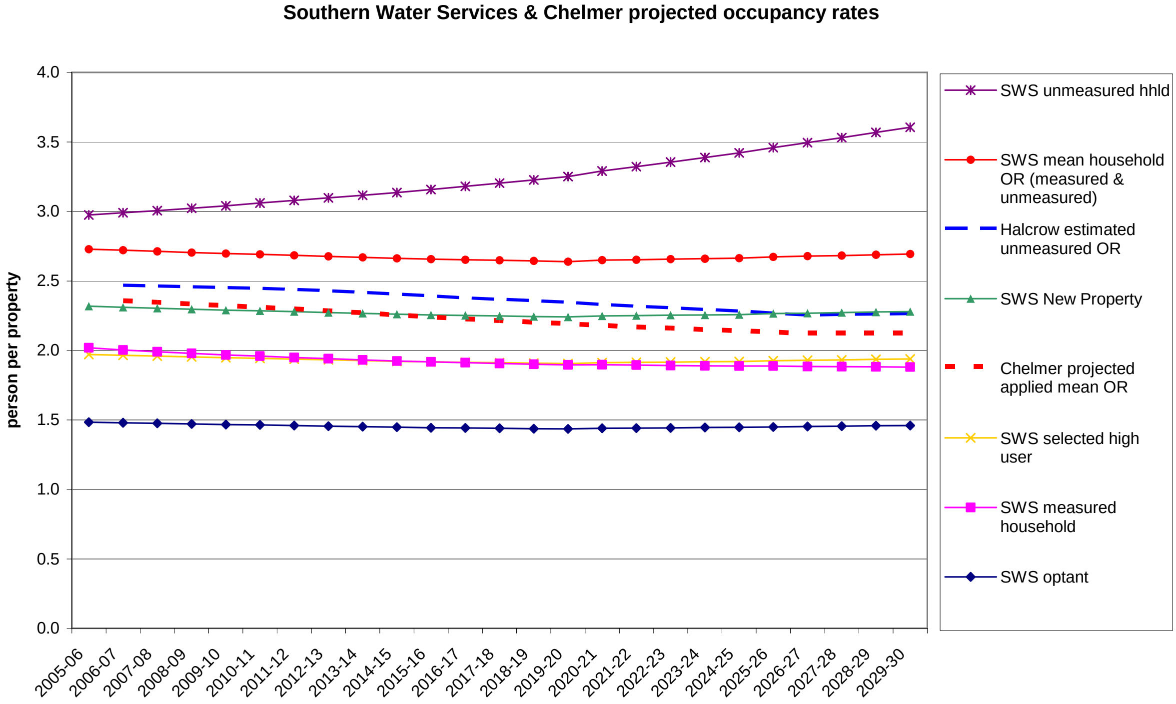

Figure H.5: Occupancy rates in Hants Kingsclere

SWS carried out OR surveys during 2006 in which unmeasured household ORs were generally found to be 'slightly lower than those reported in previous surveys'[1]. The unmeasured household OR value in the 2005/06 Annual Review of 2.93 for Hants Kingsclere, is lower than the 2.97 for 2005/6 in the 2004 Water Resources Plan. For measured households, the 2005/06 OR estimate of 2.02 remains unchanged. These result in a revised mean OR of 2.66 in the 2006 Annual Review, which is closer to the 2.35 assumed in this study.

H.5 Population data

For the local authorities within RZ4, comparisons of the most recent ONS 2005 mid-year population estimates with the previous 2004-based ONS trend projections for 2005, show that the projected data under-estimated the associated RZ4 total population growth by 1,388 (0.22%), as detailed in Table H.3 Most of the additional growth occurred in the Rushmoor, Bracknell Forest

[1] Southern Water Services Annual Review 2005/06, June 2006

and Basingstoke and Deane areas. The LSOA-based 2005 population estimate for RZ4 is 635,831.

Local authority	% population in RZ4	2004-based ONS 2005/06 projection in SEW RZ4	2005 LSOA-based MYE in SEW RZ4	2005/06 ONS under-estimate (MYE - ONS)
Basingstoke and Deane	74.2%	116,169	116,466	297
Bracknell Forest UA	91.3%	101,085	101,542	457
Windsor & Maidenhead UA	51.6%	71,360	71,515	155
Wokingham UA	32.0%	49,061	49,125	64
Hart	100.0%	87,900	87,800	-100
Rushmoor	100.0%	88,700	89,200	500
East Hampshire	21.7%	24,119	24,098	-22
Guildford	17.4%	22,973	23,025	52
Surrey Heath	65.5%	53,444	53,379	-65
Waverley	16.9%	19,633	19,684	51
Totals		**634,443**	**635,831**	**1,388**

Table H.3: SEW RZ4 population in 2005

The SEW 2005/06 Annual Review[1] total population for RZ4 of 633,532 excludes population of 12,000, principally in the Farnham area, as a result of a water resource zone boundary change. Including the additional 12,000 population, the SEW 2005/6 Annual Review population equivalent for the original RZ4 boundary of 645,532 is an over-estimate of 9,701 (1.5%) when compared with the 2005 ONS mid-year based estimate of 635,831. The annual review estimate is also higher than that assumed in the 2004 Water Resources Plan for 2005/06. The SEW population estimate is based on ward-level population forecasts that are totalled up to resource zone level.

1 South East Water, Annual Review 2005/06, June 2006

For Hants Kingsclere zone, the population difference for the associated proportion of the Basingstoke and Deane district shows that the 2004-based ONS population projection underestimates the 2005 mid-year estimated population of 16,168 by only 41 people (0.25%). The SWS 2005/6 Annual Review total population of 15,765 is an underestimate of 403 (2.5%) when compared to the 2005 ONS mid-year estimate of 16,168. The SWS population estimates are based on ward projections based on 2001 census data.

For the current study, population growth data has been derived from occupancy rates (see Section H4) and increases in households, as specified in the Draft South East Plan[1]. The resulting population growth is shown in Figure H.6 and Figure H.7, together with both the trend population growth derived from ONS projection data and the water company total population projections.

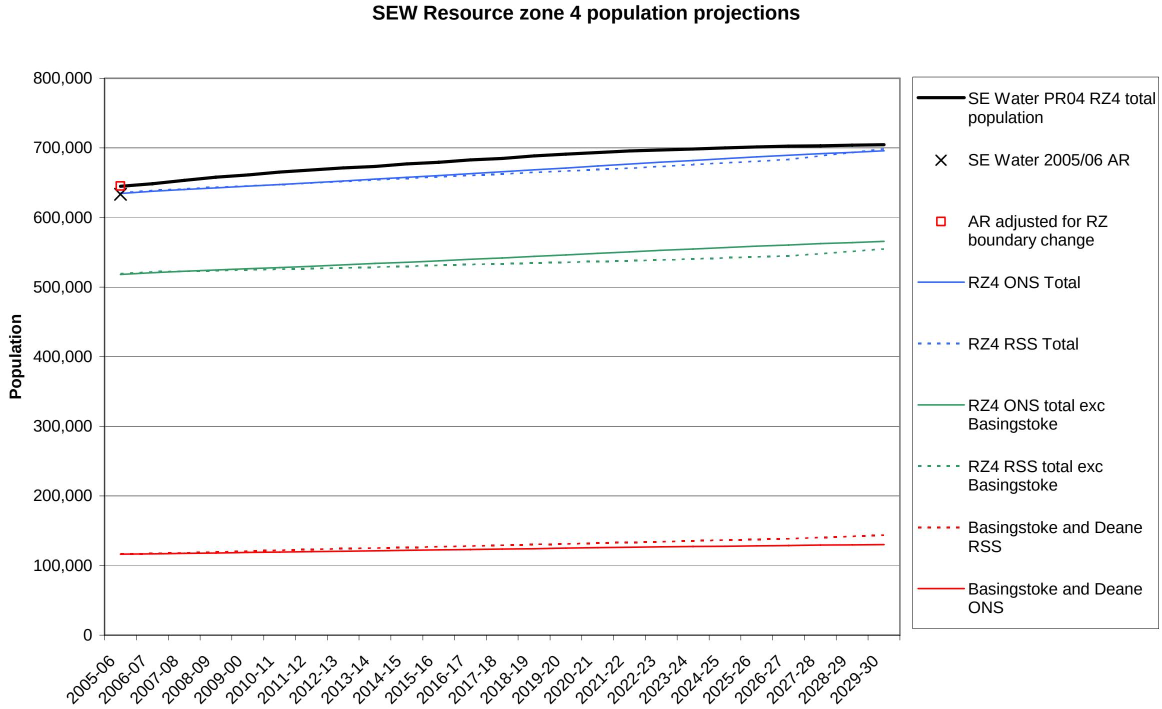

Figure H.6: Population projections in SEW RZ4

For RZ4, Figure H.6 shows the RSS projection for Basingstoke and Deane district population rises slightly more than the trend based ONS data but the total population of all other districts within RZ4 is lower than previously projected. When all the districts are combined, the total RSS population for RZ4 is slightly lower than the 2004-based ONS trend projections. Basingstoke and Deane district currently contains approximately 18.1% of the total RZ4 population (assuming the boundary in 2004), which increases to 20.3% by 2026. The graph also shows that the SEW populations are higher than both the ONS and the RSS projections. By 2025/26 the SEW estimate is 20,383 (3%) higher than the RSS projected data.

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[1] South East England Regional Assembly, Draft South East Plan, March 2006

Figure H.7 shows population projections for Hants Kingsclere resource zone. The SWS 2004 Water Resources Plan forecast is similar to that based on ONS data; both however overpredict population when compared with the RSS forecast, which is based on 5% of the total Basingstoke and Deane district planned housing being built within the Hants Kingsclere resource zone. By 2026, the SWS population estimate is 18,062, 9% higher than the RSS projected data.

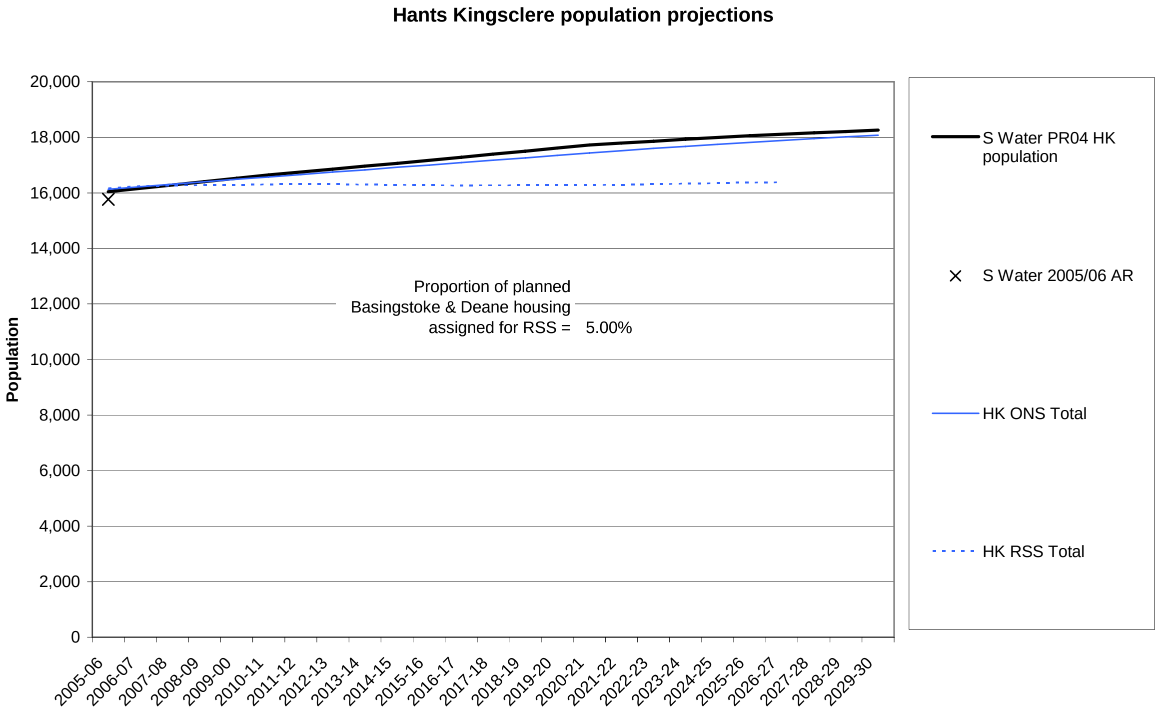

Figure H.7: Population projections in Hants Kingsclere

H.6 Per capita consumption

The South East of England has some of the highest per capita consumption (pcc) values in the UK. A typical pcc rate for measured households in the South East is 155 litres per head per day. The metering of a household is generally considered to reduce water consumption by approximately 10%. Additional savings can be achieved, especially in new houses, by the installation and use of water efficient appliances. These can reduce consumption to 120 litres per head per day or less.

The pcc rates that are assumed in the SEW 2004 Water Resources Plan are shown in Figure H.8. This shows that the overall average household consumption rate over the planning period is at a relatively high rate and rises from 184 to 194 litres per head per day. This is derived from a combination of the relative demands from measured and unmeasured households. SEW does not provide pcc rates for various categories of measured households but the mean measured household rate is approximately 160 litres per head per day. The unmeasured pcc growth is due to increased garden watering and power showering.

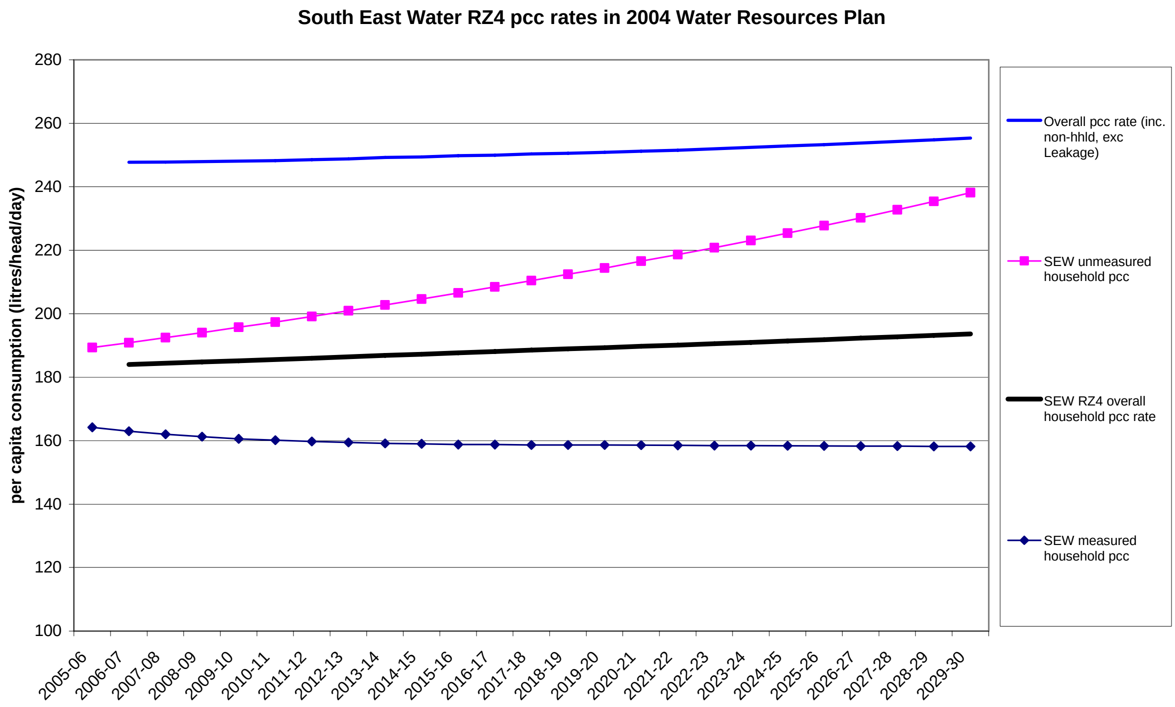

Figure H.8: South East Water per capita consumption rates

The pcc rates that are used in the SWS 2004 Water Resources Plan are shown in Figure H.9. This shows that the overall household average consumption rate over the planning period rises from 190 to 199 litres per head per day. This is derived from a combination of the relative demands from new households, optants, properties that are selectively metered and unmeasured households. The measured household rate is high and ranges from 184 to 195 litres per head per day. This is partly due to the high SWS planned pcc rate for new houses (191 to 206 litres per head per day) which is approximately the same as the SWS unmeasured rate. The new house rate would be expected to be lower than the existing measured rate due to improved water efficiencies in new houses.

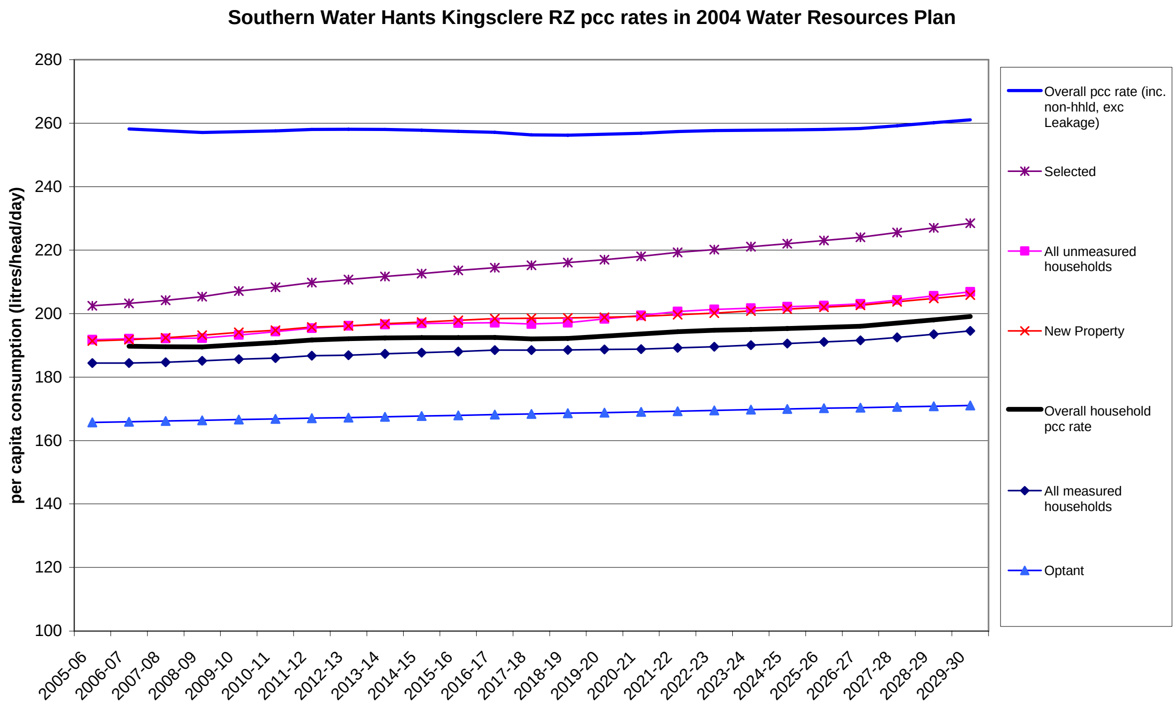

Figure H.9: Southern Water Services per capita consumption rates

H.7 Scenarios examined

For this study, the water supply-demand balance for Basingstoke has been assessed for three development and three water resource scenarios.

The demands have been appraised in accordance with the planned development in the Draft South East Plan, which specifies 825 new properties per year within the Basingstoke and Deane district (RSS scenario). We have assumed that 95% of new houses will be built within the SEW RZ4 resource zone and 5% will be within the Hants Kingsclere RZ. The impacts from two development scenarios higher and lower than this provision have also been examined. The higher development, Scenario 1, incorporates 990 new houses being built per year in the district while the lower Scenario 2 assumes 740 new houses per year.

For each development scenario, the impacts of three water resource scenarios, applied to households in Basingstoke and Deane district only, were assessed as follows:

- Water resources scenario A – All new properties in Basingstoke and Deane district have per capita consumption rates of 120 litres per head per day. All other district developments and all existing properties have per capita consumption rates as stated in the SEW and SWS 2004 Water Resources Plans.
- Water resources scenario B – All new properties in Basingstoke and Deane district have per capita consumption rates of 120 litres per head per day, all other metered properties in the district have per capita consumption rates of 150 litres per head per day applied after 2008. All other district metered and all unmetered properties have per capita consumption rates as stated in the SEW and SWS 2004 Water Resources Plans.

- Water resources scenario C – As Scenario B and in addition a planned meter program to install meters in all houses in Basingstoke and Deane district by 2018 is simulated.

The planned metering of all households in Basingstoke and Deane district by 2018, as assumed in water resource scenario C, results in the metering of 56% of the total RZ4 households and 100% of the total Hants Kingsclere households (as Basingstoke & Deane district is the only district in Hants Kingsclere resource zone). This compares to a SEW plan to meter 45% of RZ4 and SWS plan to meter 43% in Hants Kingsclere by 2018.

Currently, in addition to the metering of all new properties and optants, both SEW and SWS only select customers in RZ4 and Hants Kingsclere respectively to have water meters fitted if they use large amounts of water for unattended garden watering or large recreational pools.

H.8 Water demand components

Total water consumed comprises several components apart from household consumption. There is also non-household use, leakage, operational use and unbilled water. For this study, leakage and non-household use is assumed to be the same as in the water company plans, with adjustments for non-household populations. Figure H.10 and Figure H.11 show the relative sizes of these components in the RZ4 and Hants Kingsclere zones, as planned by SEW and SWS respectively, and as modelled with the simulated RSS development strategy and the most efficient water resource scenario C.

In RZ4 the SEW total planned demands are higher than those using the revised new development and water resource efficiency scenario. The total household consumption (measured and unmeasured) accounts for approximately 60% of the total supply, the non-household use is 22% and the leakage is 18%.

In Hants Kingsclere the SWS total planned demand is also greater than that using the revised new development and water resource efficiency scenario C. The total household consumption (measured and unmeasured) accounts for approximately 64% of the total supply, the non-household use is 21% and the leakage is 15%.

The total leakage in SEW RZ4, as shown in Figure H.10, is constant at 36.2Ml/d[1]. Between 2006/7 and 2025/26 this is equivalent to a leakage decrease from 139 to 119 litres per property per day. This is a decrease from 18% to 17% of the planned total distribution input. SEW has a leakage reduction strategy which focuses on actively detecting and repairing leaks and pressure reduction, with replacement of mains in sections where repeated leaks occur.

In Hants Kingsclere, the total leakage is constant at 0.8 Ml/d. Between 2006/7 and 2025/26 this is equivalent to a leakage decrease from 122 to 107 litres per property per day. This is a decrease

[1] South East Water, Annual Review 2005/06, June 2006

from 16% to 14% of the planned total distribution input. SWS have active leakage reduction strategies similar to those mentioned for SEW even though SWS states its leakage is below the economic level that would require further reductions to be implemented[1].

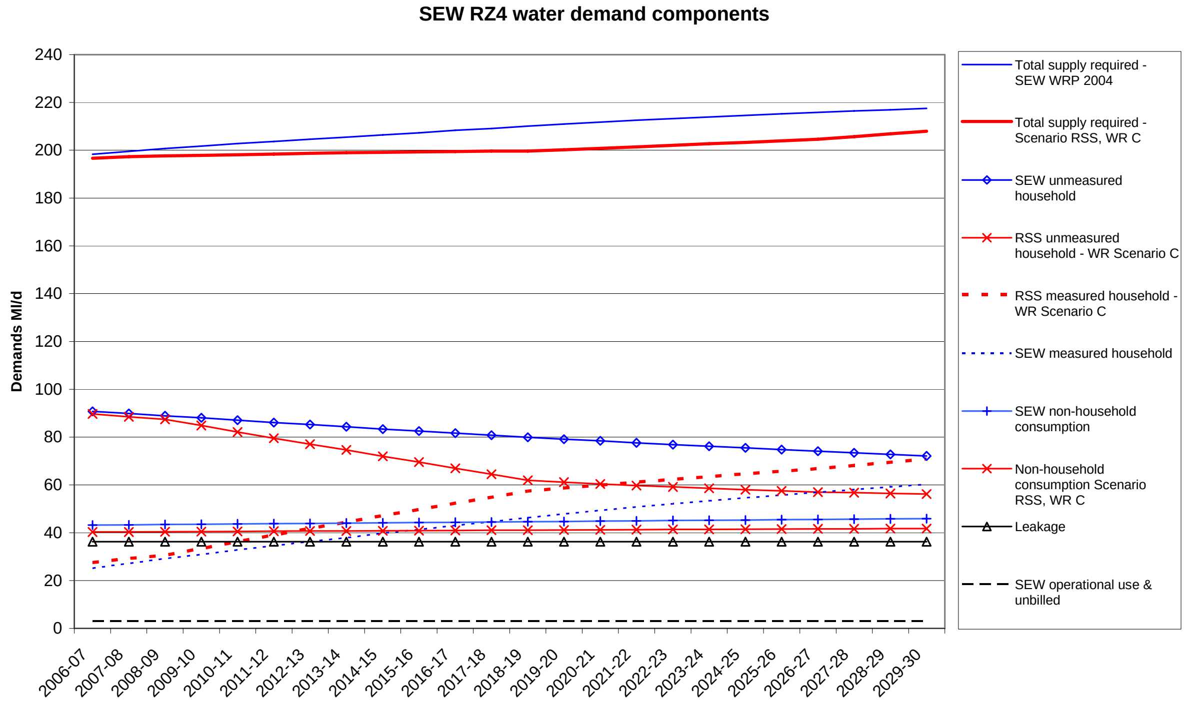

Figure H.10: Components of water demand in SEW RZ4

[1] Southern Water Services Annual Review 2005/06, June 2006

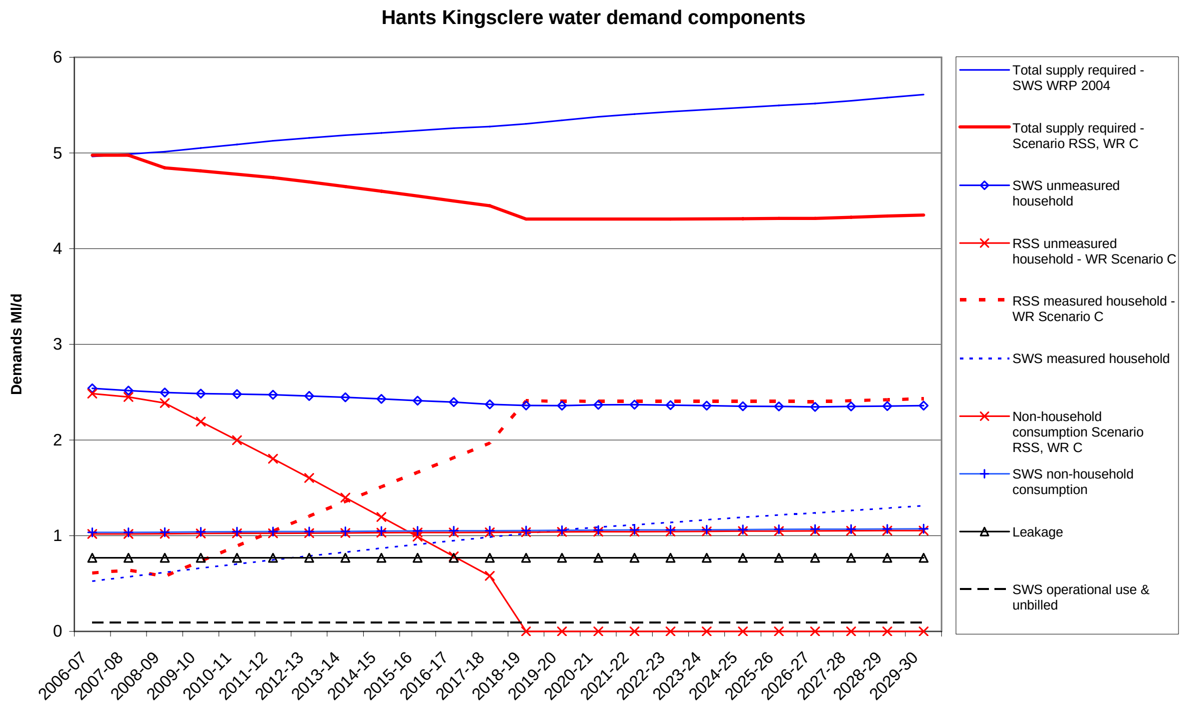

Figure H.11: Components of water demand in Hants Kingsclere

H.9 Peak period demands

In the 2004 Water Resources Plans, the individual consumption components have different peak week demand factors. These are shown in H.4 below. They represent the peak week demands as proportions of the dry year average demands.

	SEW	SWS
Measured household	1.38-1.45	1.62
New properties	n/a	1.39
Unmeasured household	1.34-1.38	1.55-1.62
Non-household	1.10	0.92-1.02
Leakage	0.95	1.00
Unbilled	0.96	1.00
Operational use	1.00	1.00

Table H.4: Peak week demand factors

The water company measured household peak factors have been used in this study to inflate the dry year annual planned per capita consumption rates for the simulated peak week critical period scenarios. H.5 below shows the impacts on the property pcc rates.

	SEW	SWS
Dry year per capita consumption (l/h/d)	Peak week per capita consumption (l/h/d)	
120 (used in scenarios A, B and C for new properties)	165 (1.38 x 120)	166 (1.39 x 120)
150 (used in scenarios B and C for existing metered properties)	206 (1.38 x 150)	243 (1.62 x 150)

Table H.5: Peak week per capita consumption

H.10 Total water demands

The total estimated average dry year consumption for each of the modelled scenarios for RZ4 and Hants Kingsclere resource zones are shown in Figure H.12 and Figure H.13 respectively.

In RZ4, the highest simulated demands, using development scenario 2 and water resources scenario A, results in mean annual dry year demands that are 5.0Ml/d (2%) lower by 2025/26 than those in the SEW 2004 water resources plan. There is a maximum difference (in 2025/26) of 6.7Ml/d between the minimum demands using development scenario 2 with water resources scenario A and the maximum demands using the development scenario 1 with the water resources scenario C. This difference is approximately 3% of the total water demand.

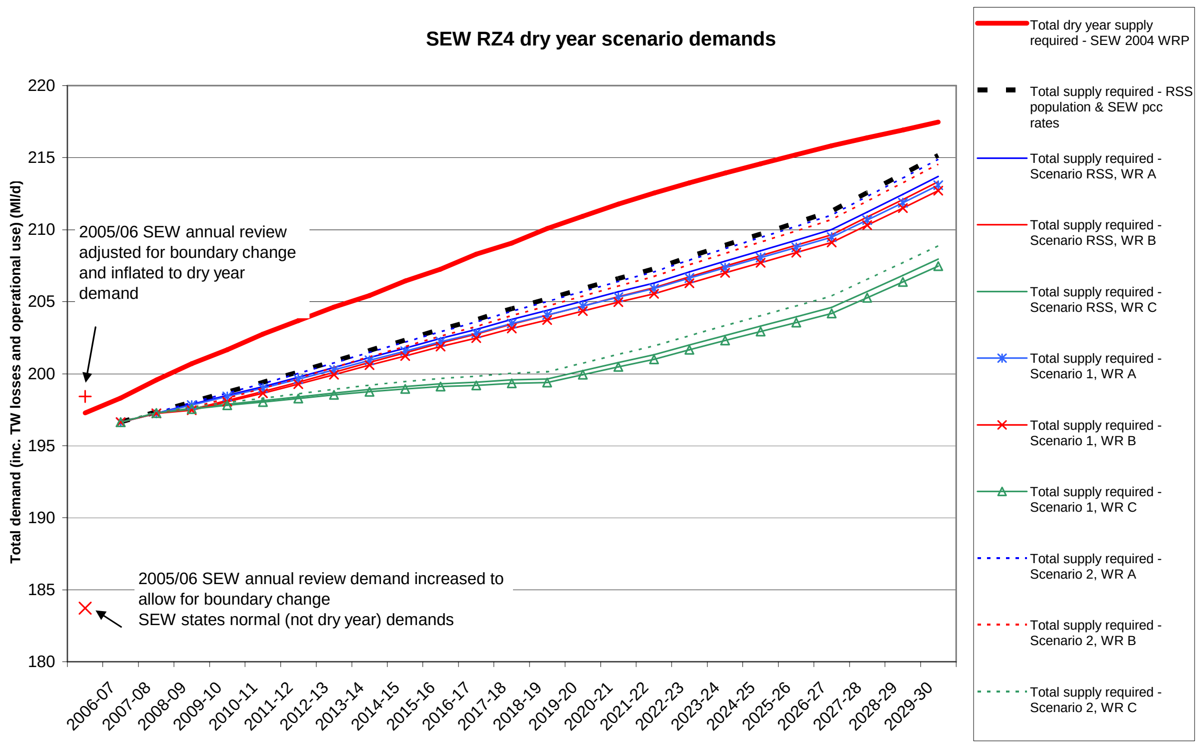

Figure H.12: SEW RZ4 scenario modelled dry year demands

Figure H.12 also shows the demands that would occur assuming the population projections in this study but SEW pcc rates (thick dashed line). This results in demands that are similar to those for scenario 2, water resources scenario A.

The base-year demand has a significant impact on the projected variance with the SEW data. For 2006/07, the demand in this study is 1.7Ml/d less than that planned by SWS in 2004. Figure H.12 also shows the 2005/06 annual outturn demand data, after adjustments due to the zonal boundary change. Although this was a dry period, the company states that this was a 'normal' year in terms of demand. When the dry year factor is applied then the value becomes 1.1Ml/d (0.6%) more than planned in 2004. The main reason for the lower 2006/07 baseline demands in this study is because of lower population estimates than those assumed by SEW.

In Hants Kingsclere, the highest simulated demands, using development scenario 2 and water resources scenario A, results in mean annual demands that are 0.4 Ml/d (8%) lower than the SWS estimates by 2025/26. There is a maximum additional saving (in 2025/26) of 0.8Ml/d between the minimum and maximum demands for the modelled scenarios. This difference is approximately 14% of the total water demand.

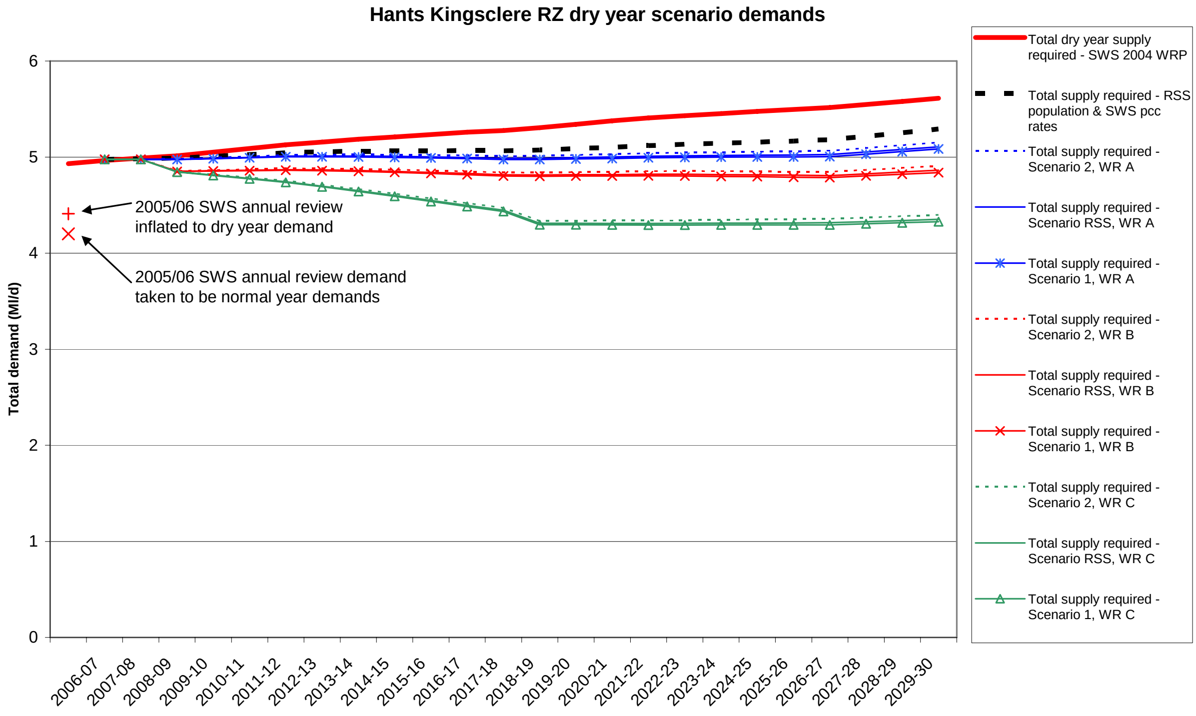

Figure H.13: Hants Kingsclere scenario modelled dry year demands

Figure H.13 also shows the demands that would occur assuming the population projections in this study but SEW pcc rates (thick dashed line). This results in demands that are slightly higher than all the modelled scenario demands.

The Hants Kingsclere base-year demand in this study, for 2006/07, is only 0.01Ml/d more than that planned by SWS in 2004. Figure H.13 also shows the 2005/06 annual outturn demand data and, assuming this to be a 'normal' year in terms of demand, an equivalent dry year demand following the application of the dry year factor. The estimated 2005/06 dry year demand is still 0.5Ml/d (10.5%) lower than planned in 2004 and lower than assumed in this study for 2006/07.

For both zones, all the scenario demands are lower than the water company projections. This is due to the following:

- the high population and/or occupancy rates used by the water companies - even though the water company projected number of households are too low, the population projection appears to be too high;
- the high per capita consumption rates – the overall companies household pcc rates are in excess of 180 l/h/d, and the measured household pcc rates are in excess of 158 l/h/d. New houses and water efficient ‘existing’ measured households are likely to have lower consumption rates than these.

H.11 Resource availability

Water resource planning is undertaken to ensure that sufficient resources are available for both dry year annual average demands and also for critical period (usually peak week) demands. A deficit in the dry year annual average scenario implies that either a new resource is required (if existing sources are fully utilised and not constrained) or that demand management saving measures need to be introduced. A deficit that is only shown to occur in a peak week implies that sufficient resources are available but that operational constraints, either due to distribution, storage, treatment capacity or licences, are restricting the supply of water within the zone.

The water available for use (WAFU) for a resource zone is determined by the deployable output (DO) of sources (as constrained by licences or treatment or distribution capacities) plus or minus any imports or exports from other zones, less an outage allowance. For both annual average and critical period scenarios, the base deployable output has been taken to be that in 2004/05, which is then subjected to additions and subtraction from planned schemes.

In order to balance demands, SEW imports up to 36Ml/d from Egham water treatment works in the Three Valleys Water supply area and up to 5.9Ml/d from Weir Wood reservoir in the SWS RZ5 supply area.

Table H.6 (for a dry year) and Table H.7 (for a peak week) show the impacts on the WAFU for the resource schemes selected by SEW in the 2004 Water Resources Plan.

No schemes are planned by SWS in the Hants Kingsclere resource zone over the planning period for the dry year scenario due to the existing surplus. For the critical period scenario the company plans to develop East Woodhay groundwater source which will produce an additional 1.40Ml/d annually from 2018/19 onwards.

		Annual WAFU changes		Cumulative WAFU	
	Dry year average WAFU	Schemes Ml/d	Total Ml/d	Ml/d	year

2004/5	DO 2004/05 Annual Review	173.98			
	Plus net imports	36.00			
	Less net exports	0.00			
	Less outage	-16.83			
	WAFU 2004/05		193.15	193.15	2004/5
2006 changes	Groundwater enhancement	2.00	2.00	195.15	2006/7
2008 changes	Bray Stage II	18.20	18.20	213.35	2008/9
2017 changes	Maidenhead chalk GW (X2)	10.00	10.00	223.55	2017/18

Table H.6: Dry year water available for use in SEW RZ4

		Annual WAFU changes		Cumulative WAFU	
	Dry year average WAFU	Schemes Ml/d	Total Ml/d	Ml/d	year
2004/5	DO 2004/05 Annual Review	208.91			
	Plus net imports	36.00			
	Less net exports	0.00			
	Less outage	-16.83			
	WAFU 2004/05		228.08	228.08	2004/5
2006 changes	Groundwater enhancement	7.69	7.69	235.77	2006/7
2008 changes	Bray Stage II	23.00	23.00	258.77	2008/9
2017 changes	Maidenhead chalk GW (X2)	15.32	15.32	274.09	2017/18

Table H.7: Peak week water available for use in SEW RZ4

H.12 Supply/demand balance in resource zone 4

To assess the supply/demand balance, a target headroom is used in water resource planning. This is an allowance that is necessary to accommodate the uncertainties in the estimation of the demand and supply components. For this study, the target headroom values applied are the same as those in the SEW and SWS 2004 Water Resources Plans.

In the 2004 Water Resources Plan, SEW states there has been a deficit in the supply/demand balance in RZ4 since 2000. They state that the target headroom will be achieved, and the deficit removed by 2006, as result of the first development of the Maidenhead groundwater source. As reported in the 2006 Annual Review, this scheme is only at the initial project planning stage. It is now planned for completion in 2007/8. In order to reduce the remaining deficit until 2008, SEW plans to transfer water from the neighbouring SEW resource zone 5; 5.1Ml/d (2005/6), 4.3Ml/d (2006/7) and 5.7Ml/d (2007/8) are required. In 2008/9, Bray WTW enhancements provide a surplus until 2016/17, when a transfer of 1.4Ml/d from RZ5 is again required to maintain the balance. SEW plan to further develop the Maidenhead chalk groundwater source by 2017/18 providing a surplus until 2022/23. From then until 2025/26 transfers from RZ5 are again required; increasing yearly from 0.7Ml/d in 2022/23 to 2.7Ml/d. These are shown in Figure H.14.

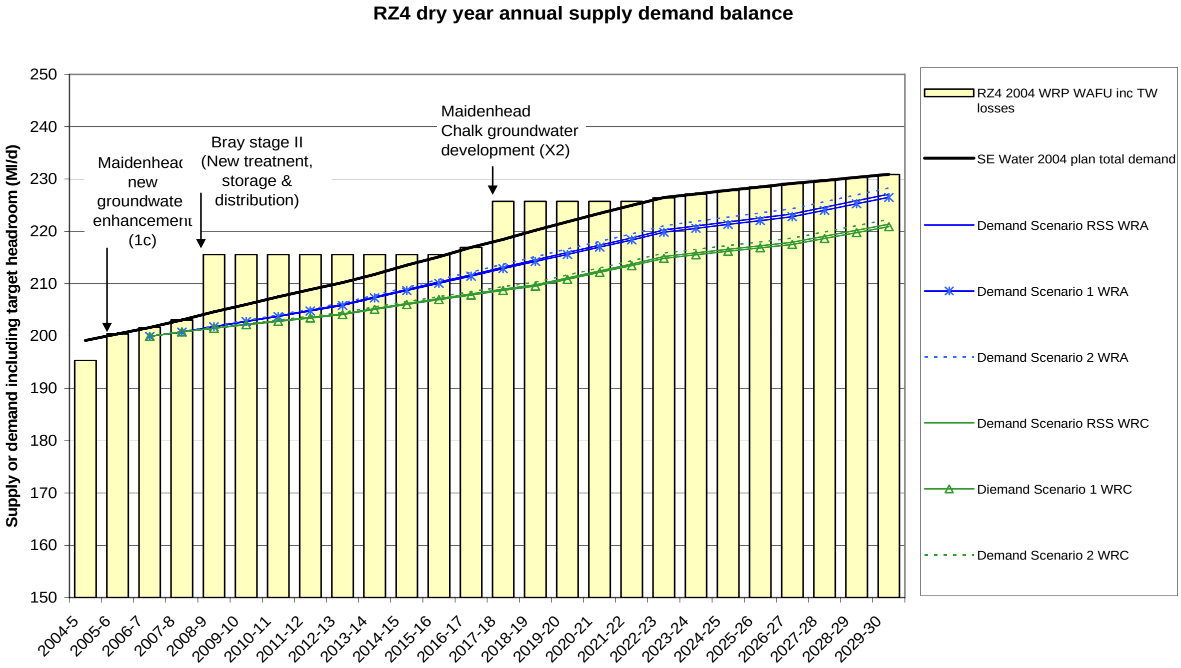

Figure H.14: Dry year supply-demand balance in SEW RZ4

All of the dry year annual average demand scenarios examined in this report are less than that planned by SEW and, therefore, they all maintain a surplus throughout the planning period and reduced transfers from RZ5 may be required, as shown in Figure H.14. For water resource scenario A, the development of Bray stage II may be delayed by three years until 2010/11 and Maidenhead groundwater development may be delayed until 2019/20. If scenario C is used, the developments of Bray stage II may be delayed by four years until 2011/12 and Maidenhead groundwater development may be delayed by 5 years until 2022/23

For peak week demands, the supply is not sufficient to meet the SEW planned demand until 2008/9, although transfers from RZ5 between 2004 and 2008 and enhancements of Maidenhead groundwater in 2006 was planned. The deficit is planned to decrease since the maximum of -2.9Ml/d in 2004/5. Between 2008/9 and 2012/13, the Bray stage II scheme maintains the balance but between 2013/14 until 2017/18 increased transfers from RZ5 are required. Further development of the Maidenhead chalk groundwater source provides a surplus until 2021/22, after which further transfers from RZ5 are used to maintain the balance for the remainder of the planning period. These resources are shown in Figure H.15.

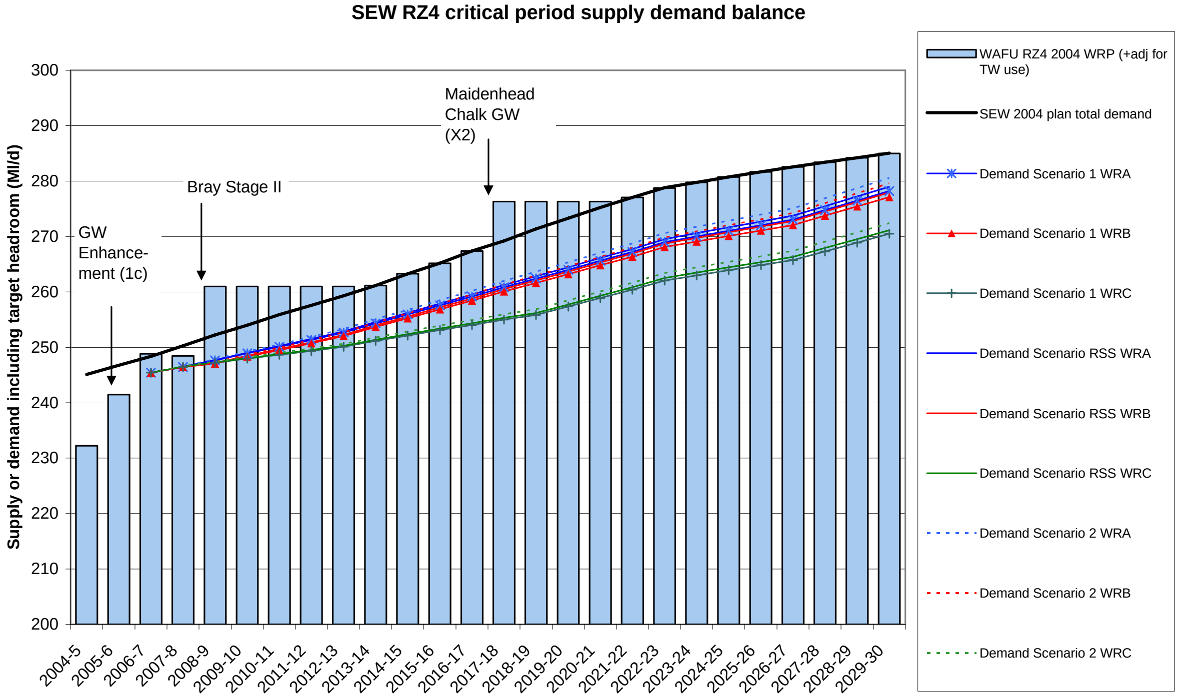

Figure H.15: Peak week supply-demand balance in SEW RZ4

For all the peak week demand scenarios examined, a surplus would be maintained for the length of the planning period with the planned schemes, as shown in Figure H.15. The Bray stage II scheme could be delayed by a year to 2009/10. This scheme would maintain a balance until 2017/18 if scenarios A or B were employed or 2021/22 if scenario C were employed. The second Maidenhead groundwater scheme would then maintain the demand-supply balance until the end of the planning period with transfers from RZ5 for scenarios A and B of 1 Ml/d or less in 2028/29 and 2029/30.

H.13 Supply/demand balance in Hampshire Kingsclere

In Hants Kingsclere a surplus of water is available regardless of whether the demand is that planned by SWS or any of the water resource scenarios, as shown in Figure H.16. By 2025/26 savings under water resources scenario A, B or C of upwards of 0.4, 0.7 Ml/d or 1.2 Ml/d respectively are possible.

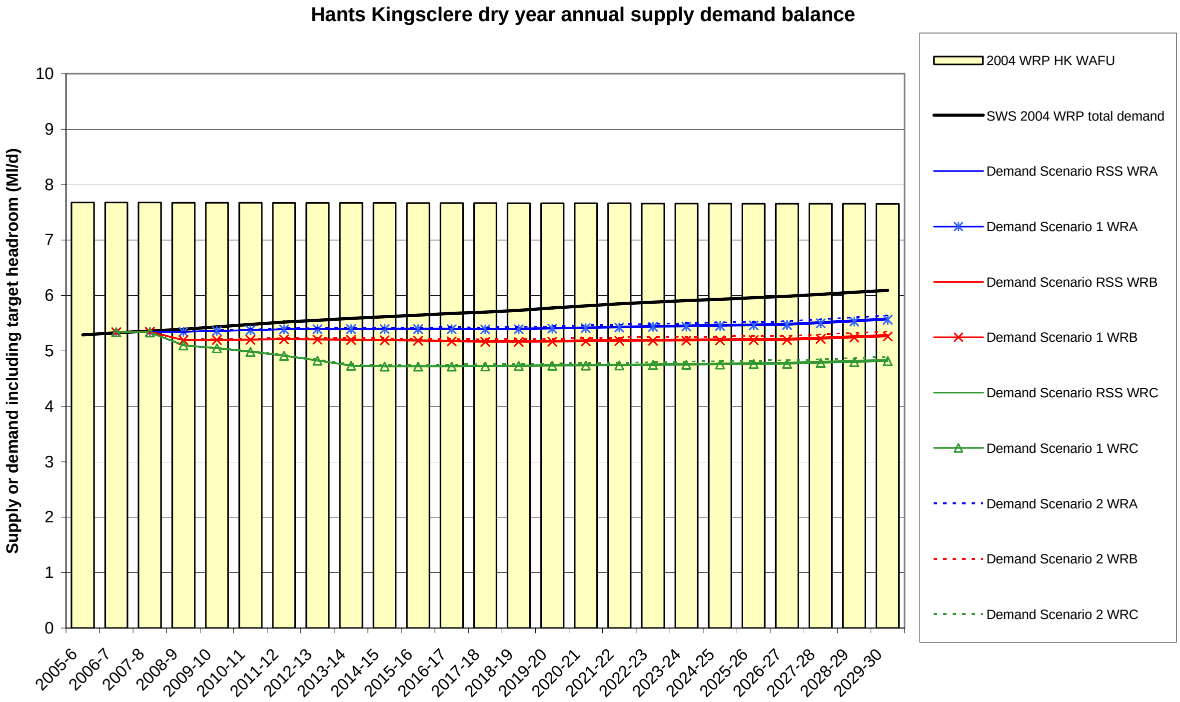

Figure H.16: Dry year supply-demand balance in Hants Kingsclere

Figure H.17 shows the water supply surplus during a peak week period in the Hants Kingsclere resource zone. SWS have planned to develop the East Woodhay groundwater source in 2018/19 in order to maintain the demand supply balance in a peak week. All the water resources scenarios examined eliminate the need to develop this source.

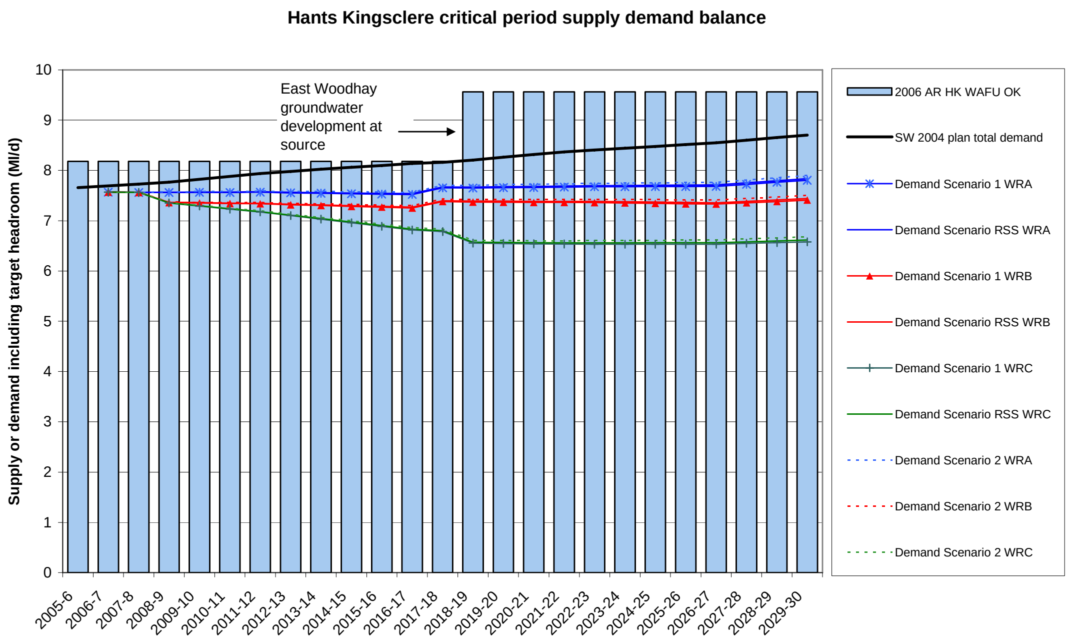

Figure H.17: Peak week supply-demand balance in Hants Kingsclere

H.14 South East Water options in resource zone 4

In order to maintain a supply-demand balance, SEW considered a wide range of schemes. Firstly, determining all possible options resulted in the production of an unconstrained option list. Further investigation resulted in this list being narrowed to the constrained option list as some options were discarded for reasons of feasibility. Finally the constrained list was further narrowed to produce selected schemes which are costed and may be planned to occur within the current planning period. The constrained and unconstrained options are briefly described below The final selected options are listed in Table H.8 together with their costs.

H.14 1. The constrained list of options considered for SEW RZ4 is as follows:

Expansion of Bray water treatment works:

Expansion of Bray water treatment works (stage II) – Scheme includes a new pipeline, additional storage and increased capacity.

Groundwater:

Maidenhead Chalk GW enhancement – Phase 1 (1c) and Phase 2 (X2) - Scheme includes improvements to existing infrastructure, increasing pump and mains capacities, drilling of new boreholes and existing borehole rehabilitation.

Wey Lower Greensand GW enhancement – Phase 1 (1a) and Phase 2(Y3) - Scheme includes the same aspects as the Maidenhead option.

Storage

Beech Hill Reservoir – Blackwater scheme includes construction of a new intake from the River Blackwater and a raw water reservoir.

Fair Cross reservoir – Loddon scheme includes a new river intake from the River Loddon, construction of raw water reservoir and a water treatment works.

Malthouse Reservoir – Wey scheme includes a new intake on the River Wey, construction of raw water reservoir and a water treatment works.

Sandhurst Reservoir – Eversley Cross scheme includes a link between two proposed reservoir sites and construction of one water treatment works.

H.14 2. The additional unconstrained options considered for RZ4 which were eliminated for various reasons were as follows:

Expansion of Bray water treatment works:

Bray stage III (outage reduction) - rejected due to expense when compared to other options

Bray stage IV (WTW expansion) - rejected due to the need to apply for a new abstraction licence

Groundwater - all rejected due to the need to apply for new abstraction licences:

Alice Holt GW (Y2)

Frimley Springs

Basingstoke Chalk

Storage - rejected because they were not acceptable on the grounds of yield certainty, public acceptability and relative cost when compared with other options, particularly other reservoir options:

Frithend reservoir – Wey

Runfold reservoir

Sandhurst reservoir – Moore Green

Frimley reservoir

Other - rejected on cost grounds:

Desalination at Newhaven harbour, Portsmouth scheme would involve construction of a sea inlet, pre-treatment stages, reverse osmosis treatment works and effluent outfall.

Extension of Desalination at Newhaven harbour, Portsmouth

Aquifer Storage and Recovery

Water savings from demand management schemes planned in RZ4 are included in the SEW 2004 Water Resources Plan demands. The planned water saved by these options is shown in Figure H.17 and their cost details are given in Table H.9.

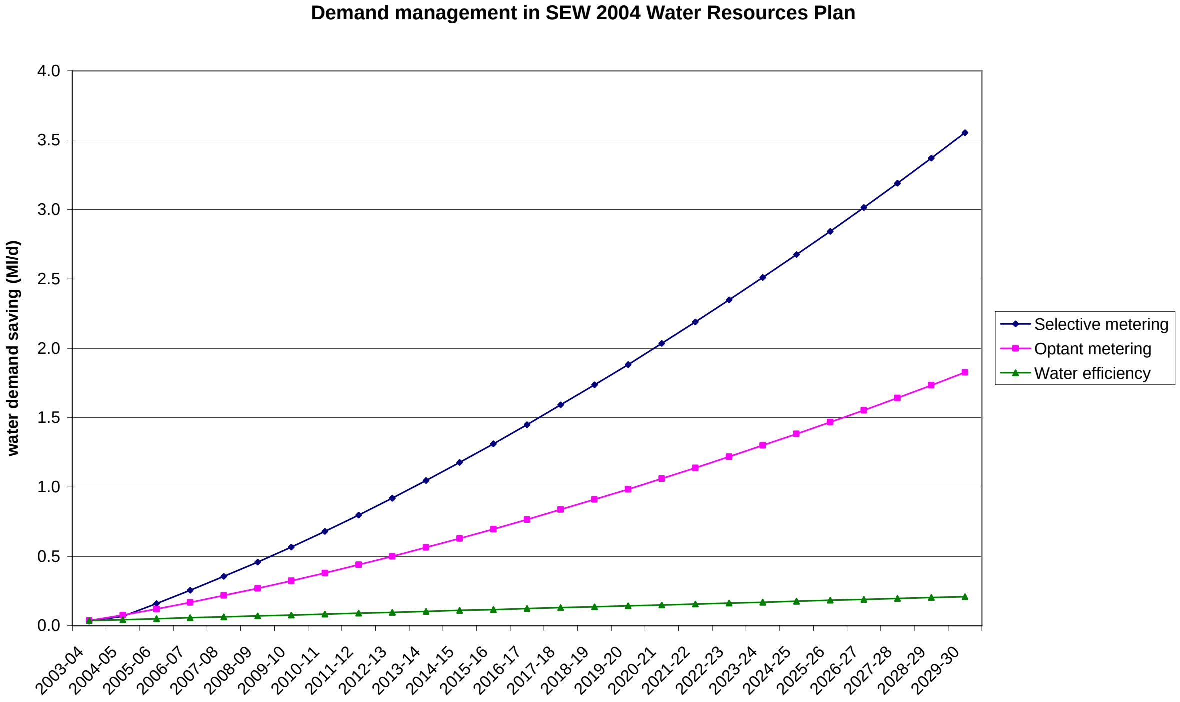

Figure H.17: SEW planned demand management savings

							Net present discounted costs			
AISC rank	**Resource Scheme**	**SEW reference**	**Annual WAFU gain (Ml/d)**	**Peak week WAFU gain (Ml/d)**	**AISC (pence per cubic metre)**	**Net present value of discounted WAFU (Ml)**	**Capital CAPEX (£M)**	**Operating OPEX (£M)**	**Social & environmental (£M)**	**Total Cost (£M)**
1	BRAY II	RZ4-1	18.2	23.0	20	101,175	12.66	7.12	0.14	19.92
2	Maidenhead Chalk GW (X2)	RZ4-3	2.0	7.7	20	71,098	10.70	3.59	0.00	14.29
3	GW Enhancement (1c)	RZ4-2	10.2	15.3	25	37,651	6.92	2.43	0.00	9.35
4	Beech Hill Embankment - Blackwater	RZ4-4	0	0	51	31,272	13.52	2.19	0.18	15.89

Table H.8: Resource options in SEW RZ4

Note: AISC - Average incremental social cost

							Net present discounted costs			
AISC rank	Demand Management Scheme	SEW reference	Annual WAFU max gain (Ml/d)	Peak week WAFU max gain (Ml/d)	AISC (pence per cubic metre)	Net present value of discounted WAFU (Ml)	Capital CAPEX (£M)	Operating OPEX (£M)	Social & environmental (£M)	Total Cost (£M)
4	Leakage Reduction to ELL	LEAKRED	1.83	23	224	2,289.80	3.68	1.45	0.00	5.13
7	Selective Metering	SELMET	3.55	5.12	110	4,921.33	4.03	1.37	0.00	5.40
8	Optant Metering	OPTMET	0.21	0.21	46	317.07	0.13	0.01	0.00	0.15

Table 2H.9: Demand management options in SEW RZ4

							Net present discounted costs			
AISC rank	Resource Scheme	SEW reference	Annual WAFU max gain (Ml/d)	Peak week max WAFU gain (Ml/d)	AISC (pence per cubic metre)	Net present value of discounted WAFU (Ml)	Capital CAPEX (£M)	Operating OPEX (£M)	Social & environmental (£M)	Total Cost (£M)
	East Woodhay groundwater – Development at Source	HK18	0	1.40	1216	43.38	0.50	0.02	0.00	43.88

Table H.10: Resource options in Hants Kingsclere resource zone

H.15 Southern Water Services options in Hampshire Kingsclere resource zone

The option selected in the SWS Hants Kingsclere resource zone is as follows:

HK18: East Woodhay groundwater development at source - This scheme will increase the yield of the Woodhay groundwater source within the existing licence by removing the present constraint imposed by mains leaving the site. Works comprise a dedicated 7.7km pipe from East Woodhay pumping station to Beacon Hill Reservoir, minor modifications to pipework and valves at East Woodhay and Beacon Hill reservoir, 2 new pressure relief valves, and the uprating of pump capacity at East Woodhay from 4.9Ml/d to 5Ml/d. Cost details for this scheme are shown in Table H.10

The alternative option considered but not selected in this zone was:

HK17: Connection of Andover Reservoir to Beacon Hill Reservoir - This scheme comprises a pipeline to convey 5Ml/d, a new booster station to lift flow into Beacon Hill reservoir and a pipeline from Beacon Hill reservoir to Kingsclere pumping station, to facilitate distribution to the existing Cottington Hill, Kingsclere & Bishops Green reservoirs.

No demand management schemes (beyond those planned within the SWS business as usual WRP including optant metering and sustaining the economic level of leakage) are planned by SWS for Hants Kingsclere zone.

H.15 1. Catchment Abstraction Management Strategies and sustainability reductions

Environment Agency Catchment Abstraction Management Strategies (CAMS) have been developed to manage water resources at a local level. The river Loddon flows through Basingstoke and its catchment is assessed in the Loddon CAMS[1] as having *no water available,* i.e. no water is available for further abstraction licensing at low flows although water may be available at higher flows with appropriate restrictions.

To the north west of Basingstoke, tributaries feed the river Kennet. This area is covered by the Kennet and Pang CAMS[2] and the tributaries include the following conditions:

- *over-licensed* i.e. current actual abstraction is resulting in no water available at low flow periods. If existing abstraction licences were used to their full allocation they would have the potential to cause unacceptable environmental impact at low flows but water may be available at high flows with appropriate restrictions.
- *over-abstracted* i.e. existing abstraction is causing unacceptable environmental impact at low flows. Water may still be available at high flows with appropriate restrictions.

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[1] Environment Agency, Lodden Catchment Abstraction Management Strategy, September 2004

[2] Environment Agency, Kennet and Pang Catchment Abstraction Management Strategy, May 2004

- *no water available* as per definition above.

The SWS scheme to develop the existing groundwater abstraction at East Woodhay is located within the Kennet Valley Alderwoods Special Area of Conservation (SAC). The Habitats Directive and the Environment Agency's National Environment Programme require investigations to be carried out into the impact of water company abstractions on the Kennet Valley. The Kennet Valley Alderwoods is a SAC designated for alder and ash woodland and is believed to be dependent to some degree on groundwater levels and spring fed surface water streams. There are a number of nearby groundwater abstractions, which could have an impact upon the water table and groundwater fed surface watercourses within the Kennet Floodplain and Alderwoods SAC, of which Southern Water's East Woodhay abstraction is one.

A sustainability investigation is proposed for the Kennet and Lambourn Floodplain within the AMP4 period. The SWS 2004 Water Resources Plan stated that the possible reduction at East Woodhay was not yet known. Option identification and assessment are planned for 2008, with actions implemented in March 2010. If abstractions are found to be unsustainable as a result of an investigation, licences may be varied continuously or during low flow periods, thereby reducing the water supply available annually or during peak week conditions respectively.

H.16 Conclusions

In the resource zones supplying the Basingstoke and Deane district, water company planned households are underestimated when compared to the recent data in the Draft South East Plan.

Due to high water company population projections, the occupancy rates are high when compared with those in the Chelmer regional projections and those produced by DCLG.

SEW and SWS have assumed high per capita consumption rates compared to typical rates for households in the South East of England. Newly built more water efficient homes would use even less water.

The supply/demand results assume that the schemes currently planned, as shown in Table H.11, are implemented.

			DO provision	
Company	**Year**	**Scheme**	**Annual Ml/d**	**Peak Ml/d**
SEW	2006	Maidenhead GW Enhancement (1c)	2.00	7.69
	2008	BRAY II	18.20	23.00
	2017	Maidenhead Chalk GW (X2)	10.00	15.32
SWS	2018	East Woodhay groundwater	0.00	1.40

TableH.11: Schemes assumed to occur within present planning period

In a **dry year** and **peak week**, the water resources planned for Basingstoke are **sufficient** to meet the demands of all the assessed development scenarios, including those in excess of the planned growth in the Draft South East Plan. The planned schemes may be delayed with improved efficiency in houses and increased metering.

Sustainability reductions may be applied in the future for the SWS East Woodhay source and those in the Kennet and Lambourn floodplain. Provision is not made for these in the current plans, as directed by the Environment Agency.

Appendix I Basingstoke Water Cycle Study Ecological Appraisal

See Separate Document