Appendix B: CONSULTATION REQUIREMENTS

There have now been three phases of the consultation process for this WRMP.

Pre-consultation

Firstly, in accordance with Section 37A (8) of The Water Industry Act 1991, water companies must undertake pre-consultation with Ofwat, the Environment Agency, the Secretary of State and any licensed suppliers in its supply area. Southern Water took the opportunity to widen the scope of this pre-consultation phase to include a number of other bodies, namely, neighbouring water companies, RSPB, the Wildlife Trusts and the Consumer Council for Water (CCW). A copy of the pre-consultation letter and full list of pre-consultation parties is given in this Appendix.

Full public consultation

In accordance with the requirement for full public consultation, the draft WRMP was sent to those parties prescribed in Section 2(2) of The Water Resources Management Plan Regulations 2007 (SI 2007/ 727), in accordance with the requirements of Section 37B of The Water Industry Act 1991. Southern Water again took the opportunity to widen the basis of its consultation, and a full list of consultees is given in this Appendix.

The company published the draft WRMP on 1st May 2008, and the twelve week consultation period lasted from then until 25th July 2008.

The draft WRMP was published for consultation in a variety of formats to ensure that it was available for both technical review/comment and also for wider public consultation.

The draft WRMP was published as:

- The main consultation document, being the Main Report and the Appendices, and a 14-question questionnaire;
- The Technical Summary, giving an overview of the draft WRMP; and
- A brochure giving the high level summary of the draft WRMP.

The draft WRMP was also available on the website, at www.southernwater.co.uk.

As part of the consultation process, a letter was sent to more than 900 stakeholders to advise them that the consultation period had started and that the draft WRMP was available on the internet.

An Environmental Report that described the outcomes from a Strategic Environmental Assessment (SEA) of the draft WRMP was published for public consultation at the same time as the draft WRMP.

Statement of Response to Consultations

Southern Water received 125 representations to the consultation, all forwarded via Defra.

In accordance with Section 4 of the Water Resources Management Plan Regulations 2007, water companies have to prepare and publish a Statement of Response to the representations received during the consultation process. Southern Water published its Statement of Response to the representations received, according to the Water Resources Management Plan Direction (England) 2008, on 29th January 2009. The Statement of Response was available on the internet. A link to the site was emailed to all those respondents who had provided an email address. A letter and CD were sent to all respondents who had provided an address, with the offer of a paper copy of the Statement of Response if requested.

The Statement of Response is also available on the website, at www.southernwater.co.uk.

B.1 Pre-Consultation

Pre-consultation letter

Your Ref:

Our Ref:
MG/clk

Date:
30th May 2007

Contact:
Tel: 01903 272533
Fax: 01903 272010

Dear

Section 37A(8) of the Water Industry Act 1991
Water Resources Management Plan – Pre consultation

This letter forms the pre-consultation stage, required under the provision of the above Section of the Water Industry Act, with the Secretary of State, Environment Agency, Ofwat and any licensed water supplier in our area.

This letter sets out our intention in the formulation of the draft Water Resources Management Plan (WRMP). It is not intended to be exhaustive, but it will provide an early view of some of the issues that we will be addressing in the formulation of our plan, which we recognise must be undertaken within the timescales set out in the Act. We can confirm that we have received a copy of the above Direction, and note the additional matters to be addressed.

We have received a copy of the **Water resources planning guideline April 2007** from the Environment Agency. This useful document will provide an overall structure within which the various elements of the Plan will be formulated. However, we note that there are still some important additions to the Guideline, and welcome their early issue. With regard to some of the aspects within the guidance we have set out our intention under each of the sub-headings below with regard to potential reviews or updates.

Water resource Zones

The fundamental building blocks within the plan are undertaken at a water resource zone level. Within Southern Water our supply area has been segregated into 9 water resource zones. However, we intend to increase the number of Water Resource Zones to ten, by splitting the current Sussex Coast WRZ into Sussex Worthing WRZ and Sussex Brighton WRZ. We are doing this as we believe that it better reflects the limited inter-connectivity between the two areas that currently exists.

Deployable Outputs

During the recent drought in the South East of England we highlighted the intention to undertake a full re-assessment of the deployable outputs of all our sources, using information collected during the recent drought event as well as updating our historic flow sequences. We believe that

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this analysis in conjunction with the improved water resource modelling using an integrated source / network model will help inform our design parameters for the supply demand balance.

Levels of service, design condition and Target Headroom

We will be undertaking a review of our recent performance against our stated levels of service. Initial indications are that we need more resilience in our supply side capability. We will also be investigating the sensitivity of the Plan to varying levels of Target Headroom, as we believe that this will inform us as to the stability of our proposals in the face of increasing uncertainty.

Sustainability reductions, Habitats Directive and Water Framework Directive

We are acutely aware that these areas constitute a source of severe future uncertainty, and have previously stated that we do not feel that the Guideline offers sufficient scope to account for the potential effects of reduction in deployable output in our planning scenarios. We have been informed by the Agency that it will provide figures to be included for our sites that are subject to Habitats Review of Consents. However, we will only be provided with "definitive sustainability reductions" figures for the River Itchen site in May this year, although indications to date are that this timeframe will slip.

There will be no figures, even for "indicative sustainability reductions", for the remaining investigation sites. Definitive sustainability reductions will be available for a further four sites in December 2008. There will be no figures available for a further two sites for inclusion in the Plan. In view of the potential reductions from these remaining sites, for which data will not be available until December 2008, or not at all, we could envisage that a major change in Plan could become necessary between the draft, and final Plans. This, in turn could have serious implications on the value of the consultation process itself.

We find the guidance given for dealing with the potential impact of the Water Framework Directive to be far from constructive. It is suggested that a view is gained from consideration of the first round of CAMS reports, which we believe are acknowledged to considered as "first sighters" at best. However, the Guideline tends to mention that WFD should be recognised with regards to options. It does not specify that any recognition should be taken on the baseline condition. We feel this is unsatisfactory particularly as the Water framework Directive risk assessment maps have highlighted that most of our sources are at risk from some further review of abstraction limits.

We strongly urge that more guidance is given, even at a Company specific level, as to how to deal with the potential impact of these major sources of uncertainty. However, we are considering making our own estimates of the potential impact of reductions, and including them within the Plan, possibly as a sensitivity test.

Water management options

We will be considering a wide range of supply and demand side water management options. We will also be considering how different options can increase the drought resilience in various zones, and whether they represent more suitable solutions which might be chosen purely from a "least cost only" derived strategy.

We have continued to take an active and supportive role with in the Water Resources in South East England Group, and have supporting the modelling work that has been undertaken under its auspices. We have, though, expressed our concern about some of the more ambitious transfer schemes, as we believe that they involve making many assumptions on the potential of other companies to successfully promote and construct schemes of the right magnitude by due dates. We also have concerns as to whether these have properly been costed within the global model. We will be investigating a range of transfer schemes, which will, of necessity, include those which involve the cessation of existing transfers.

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Effluent reuse and desalination options will feature in our options list. We are disappointed that the effluent reuse study undertaken by the Agency appears to have been subject to delay. This is unfortunate, as it means that the full extent of discharge consent conditions, and thus design requirements and associated costs, are still the subject of some uncertainty. We will be discussing what potential assumptions can be made in this area with the Agency.

We trust that we have given an indication of some of the main areas in which we will be formulating our draft WRMP.

We would welcome any observations which you may have, and also the chance to discuss any of the issues raised should you so wish.

Naturally, if there are any other areas which you would like to bring to our attention, we trust that you will make them known to us.

We would appreciate if you could respond to us by the 27th July to ensure that we can take on board any of your comments in time for the formulation of the draft water management plans.

Yours sincerely

MEYRICK GOUGH
Water Planning & Strategy Manager

Southern Water, Southern House, Yeoman Road, Worthing, BN13 3NX. www.southernwater.co.uk

OFWAT response to pre-consultation

Centre City Tower
Hill Street
Birmingham
B5 4UA

Meyrick Gough
Water Planning & Strategy Manager
Southern Water
Southern House
Yeoman Road
Worthing
BN13 3NX

12 July 2007

Dear Meyrick

CONSULTATION ON PRE-DRAFT WATER RESOURCES MANAGEMENT PLAN

Thank you for the opportunity to comment on the preparation of your draft water resources management plan. Please accept my apologies for the delay in responding.

We expect you to follow the framework provided by the water resources planning guideline when preparing your draft plan. We would also like to draw your attention to a number of specific areas of consideration which are set out below.

Communication with customers

You should explain clearly what your draft water resources plan is, namely that its shows how you intend to maintain the balance between supply and demand over the next 25 years. And you should set it in the context of your drought plan, which sets out the short term operational steps you will take in response to a drought.

Your draft plan must be readily understandable by your customers, with a summary written in plain English minimising the use of technical terms, and must be easily accessible to your customers. We suggest that you inform your customers of the consultation, perhaps through information sent with bills, to comply with section 37B(3)(a), which states that you should publish your draft plan 'in a way calculated to bring it to the attention of persons likely to be affected by it'.

Consultation with key stakeholders

You should consult key stakeholders that may have influence on, or be influenced by, your water resources plan proposals. For example, you may provide a bulk supply of water to or receive a bulk supply of water from a neighbouring water company, or you may have large users or inset appointments in your area.

.../...

Helen Twelves, Head of Supply Demand Balance Team
Direct line: 0121 625 1307 Fax: 0121 625 1382
e-mail: helen.twelves @ofwat.gsi.gov.uk Website: www.ofwat.gov.uk

Levels of service

Your draft plan should set out clearly the levels of service you propose and explain what those levels of service mean in terms of possible frequency of different types of supply restrictions and the circumstances in which restrictions might be necessary.

You should ensure that the levels of service on which your draft water resource plan reflect a sound understanding of your customers' views. You should explain the steps you have taken to establish your customers' views on:

- the acceptability of the frequency of hosepipe restrictions and other restrictions such as non-essential use drought orders;
- the balance between restrictions on water use by customers and the need to safeguard the environment; and
- willingness to pay for the levels of service that you propose.

Research undertaken by the Consumer Council for Water for the Water Saving Group showed that customers' views on demand management measures and supply restrictions vary depending on whether the company is perceived as doing all it can to secure supplies. In carrying out your research, it is therefore important that you explain the steps you are taking to manage leakage, reduce demand or develop new supplies and the contributions these activities are expected to make to securing supplies.

You should explain clearly how you have reflected your customers' views in your draft plan. In particular we expect you to explain how you have balanced conflicting priorities or where you have put forward proposals which are not in line with customers' preferences, or are in line with customers' preferences, but not least cost.

Metering, water efficiency and tariffs

All water companies have a statutory duty to promote the efficient use of water and we expect you to explore ways of managing the demand for water as part of a twin track approach to maintaining the supply demand balance.

.../...

Helen Twelves, Head of Supply Demand Balance Team
Direct line: 0121 625 1307 Fax: 0121 625 1382
e-mail: helen.twelves @ofwat.gsi.gov.uk Website: www.ofwat.gov.uk

Meyrick Gough
12 July 2007
Page 3

In your draft plan you should take a holistic approach when you consider the costs and benefits of the options available to balance supply and demand. In particular, it is important that when assessing any enhanced metering programmes you should also consider the impact of enhanced water efficiency programmes and innovative tariffs, such as rising block.

You should include in your plan an assessment of the robustness and sustainability of the projected water savings. It should also describe the supply-side resource options that have been offset or obviated as a result of water efficiency measures.

As part of our Water Saving Group work, we are currently developing a proposal to provide incentives to developers to install increasing levels of water efficiency in new buildings, based on rebates/waivers against the infrastructure charge and linked to the levels within the Code for Sustainable Homes. We will be writing to you separately about this, and we expect you to consider the impact this could have on your forecast demand.

Target headroom and minimisation of uncertainty

We expect you to provide a breakdown of the components of your target headroom related to the individual sources of supply and demand uncertainty that you assume. Further, we would like a more detailed breakdown of the uncertainty you have assumed for new resource developments and demand management measures. For example, we would like to understand the individual contributions to target headroom of any water efficiency, metering and leakage reduction activity.

You should carry out work to minimise the sources of uncertainty that you assume in your target headroom. We expect you to use actual experience to determine the level of uncertainty and to carry out trials to gain experience where this is limited, for example in relation to water efficiency.

I hope you find these comments helpful. However, if you would like to discuss them further, please contact David McGrath on 0121 625 1398 or at david.mcgrath@ofwat.gsi.gov.uk who leads on these issues.

Yours sincerely

Helen Twelves
Head of Supply Demand Balance Team

Helen Twelves, Head of Supply Demand Balance Team
Direct line: 0121 625 1307 Fax: 0121 625 1382
e-mail: helen.twelves @ofwat.gsi.gov.uk Website: www.ofwat.gov.uk

The Environment Agency response to pre-consultation

Mr Les Dawson
Managing Director
Southern Water Services Ltd
Southern House
Yeoman Road
Worthing
West Sussex BN13 3NX

Our ref:
Your ref:

Date: (due to SWS by July 27th)

Dear Les

Water resources management plan preliminary consultation - Section 37A(8) Water Industry Act 1991

Thank you for your letter dated 30 May 2007 from Meyrick Gough to Ian Barker asking for the Environment Agency's preliminary views on the content of your draft water resources management plan. Our response is quite long but we have tried to answer all your questions. We hope it will help you plan appropriately for customers and the environment.

When developing your plan, we would like you to consider:

- The Environment Agency's final water resources planning guideline
- Our comments on the water resources plan you submitted in 2004
- The open letter from our Chief Executive to all MDs setting out general principles for the plans.

We have outlined below our views on the areas you detailed in your letter:

Water resources planning guideline, supplementary guidance
Since we received your preliminary consultation we have updated our April 2007 water resources planning guideline with the following supplementary guidance:

- The cost of carbon, included within section 11.4.7 of our guideline
- Sensitivity analysis, section 5.8 of our guideline

We hope to be able to issue further guidance on metering soon, on climate change later this summer and on leakage targets and cost-benefit analysis when these are agreed with Ofwat.

Water resource zones
We were aware you have been considering splitting your Sussex Coast water resources planning zone into two. Your preliminary consultation letter confirms you

Guildbourne House, Chatsworth Road, Worthing, West Sussex, BN11 1LD.
Customer services line: 08708 506 506
Email: enquiries@environment-agency.gov.uk
www.environment-agency.gov.uk

intend to create "Sussex Worthing" and "Sussex Brighton" planning zones. We agree to this change based on the concerns about the present single zone you have described to us. Please could you provide us with a written note of the reasoning for the change, detailing the new boundaries. Please could you also provide us with an electronic version of the new boundaries, to replace the version we have for the existing zone. We expect you to develop and present water resources planning data specific to each of the new zones with your draft water resources plan.

Deployable outputs
You have submitted your reassessment of groundwater deployable outputs for five of your nine resource zones. As a fundamental 'building block' of the plan, we want to understand in detail any proposals to change your existing source deployable outputs because of the implications this has for investment and the environment. We are currently reviewing the information you have provided and we will respond with comments as soon as we can, within the schedule we have indicated to you. We need to reach agreement on these figures before you alter the baseline position of your water resources plan. We also trust that, where any agreed reductions are due to newly identified constraints that can be removed, you will seek means to remove these constraints urgently.

We understand you will provide an updated '2006' groundwater deployable output assessment later this year which will cover all your resource zones, though you have indicated this is unlikely to include much further proposed change compared to your 2005 reassessment. Please can you inform us when we can expect to see the 2006 reassessments and when your 2005 and 2006 surface water reassessments will be provided.

Levels of service, design condition and target headroom
We consider that you, in common with many companies, need to further understand the actual 'level of service' and security of supply provided to your customers, relative to your stated levels. This review needs to recognise the forecast (water resources planning) deficits you have been operating through in some of your zones in the last few years, the need to ensure your sources are operational, subject to outage allowances and timely implementation of funded improvements. You should also recall that prior to1997 the company was planning and investing to a lower design-standard than the current approach. Your on-going MISER 'source to demand' modeling should also provide you with a much better understanding of system constraints than you have had before. We encourage you to seek means to remove such constraints.

We encourage your commitment to investigate the sensitivity of your water resources plan to varying levels of target headroom. We would welcome sight of this work as soon as you can make it available for comment.

Sustainability reductions, Habitats Directive and Water Framework Directive
Our guideline indicates that companies should not make any allowances for sustainability reductions in target headroom. We do not think it is necessary to include an allowance for uncertainty for this as we will inform you of any required licence changes as soon as we can.

We have given you some indication of sustainability reductions in my letter of June 11th. Once we agree the impact licence changes will have on deployable output, they should be applied in your plan as reductions from this, not as target headroom allowance.

We will be able to provide you with definite sustainability reductions for the River Itchen, Solent and Southampton Water, Solent Maritime and Arun Valley SPA this year, earlier than previously indicated. In the meantime we provided you with our best indications where we were able to. This means you will be able to include our indicated or definite reductions for these sites within your draft plan.

We will not be able to provide a definite outcome for the North Kent Marshes site before your draft plan, but, as indicated in my letter of June 11th, we do not think there will be an impact on your deployable output from this site.

We will not be able to provide figures in time to include in your final plan for the Wingham river and Little Stour sites. However, we do not expect you to include an allowance for possible reductions here as we will give you enough time to adequately plan and implement solutions to deal with any reductions, if they arise subsequent to your plan or PR09.

My letter of June 11th gave you more indicative figures than we had previously said we would at this stage, so I believe we have gone some way to remove some of the uncertainties you express concern about in your preliminary consultation letter.

You have also expressed concern about the implications of the Water Framework Directive. We recognize this is an uncertainty for planning. Opinions vary on its likely impact. Some feel it could introduce a raft of further impacts on source deployable outputs. Others feel that we are already dealing with a number of designated sites and abstraction concerns, so that most implications for deployable output reductions are already under review.

We note you are considering including your own estimate of potential reductions and you may include these as sensitivity tests within your plan. If you do, we ask that you make it explicit in your draft plan consultation that they are sensitivities and not a direct consideration within your preferred plan. In this way your preferred plan will remain with our guidance.

Water management options

We encourage your consideration of all water resource management options and we encourage you to consider those that can improve drought resilience relative to pure 'least cost' principles. We trust you will include demand management and water efficiency options positively in these considerations. We also trust you will review the expected outputs of current resources and future resource options with respect to climate change.

My water resources planning team recently responded to your initial review of demand management options. We encourage you to be more positive towards demand management as you formulate your plan.

We have recently written to you to provide our view of the shared resource options you should consider in seeking a shared regional water resources strategy for the South East. We expect you to include these options in your full appraisal of all options as you develop your draft water resources management plan. You will need to discuss them in detail with the relevant other companies. Please involve us in these discussions as necessary.

We note your comments concerning uncertainty of some of the other companies resource development schemes and your concerns at setting a plan that might include some transfers from them. We believe a strategy for the South East should

allow wider considerations than the preferences of each individual company. We hope to progress the search for a shared regional strategy using improved data and assumptions, to help you and other companies have more trust in the outcome. We welcome any further comments you may have on specific assumptions for resource developments and transfers and will consider them with the other companies to improve overall confidence.

In your letter you said 'we will be investigating a range of transfer schemes, which will, of necessity, include those which involve the cessation of existing transfers' We expect you to communicate any such options with the receiving company or companies so they can account for this possibility in their plans. Such options should only progress to the preferred plan with the agreement of both companies. We will want to understand the overall reasoning and consequences of any such decisions.

We encourage the inclusion of effluent reuse and desalination options within your options appraisal. We have provided you with the phase one report of our review of Southern Region effluent reuse potential. Our review is due to report again in October as scheduled. The project will include some work on discharge consent conditions, but it will not be exhaustive. We encourage you (and other companies) to continue to pursue your options to the level of detail required for you to consider these options seriously in your water resources plan. You have written to us enquiring about possible discharge consent conditions and we are working to respond to your enquiries.

We would also like you to address the following issues:

As you should be aware, in south east England we expect to see rapid progress towards full metering in the next decade. We expect you to explore every opportunity to rapidly increase metering within your draft water resources management plan. We also want you to explore the future tariff developments that you could implement as metering levels grow.

We expect you to extend your consultation to neighbouring companies.

My supra-regional water resources planning team will be leading our review of your draft water resources management plan. It would be helpful if you could provide them with a schedule of work for the preparation of your plan.

If you have any questions or if there is anything that you would like to discuss in more detail, please contact Martin Townsend on 01189 535412.

Yours sincerely

Howard Davidson
Regional Director

Direct dial 01903 832001

cc Ian Barker

4

Defra response to pre-consultation

Water Supply & Regulation Division
Room 304, 55 Whitehall
c/o 3-8 Whitehall Place
London SW1A 2HH

Telephone 020 7082 8351
Website www.defra.gov.uk

CORPORATE

25 JUL 2007

STRATEGY

Meyrick Gough
Water Planning & Strategy Manager
Southern Water
Southern House
Yeoman Road
Worthing
BN13 3NX

Your ref: MG/clk

Date: 20 July 2007

Dear Meyrick

Water Resources Management Planning: Pre- Draft Consultation

Thank you for your letter dated 30 May 2007 seeking views on what is to be included in your draft water resources management plan, pursuant to your obligation to consult the Secretary of State required under section 37A (8)(c) of the Water Industry Act 1991 (as amended by the Water Act 2003).

The contents of water resources management plans have been specified in s37A(3) of the Act and paragraph 3 of the Water Resources Management Plans Direction 2007.

In addition to using the Environment Agency's guidance on the new process, contents, and the outline timetable for completion of water resources management plans, the Secretary of State also expects you to have considered any comments that the Agency has previously made specifically on your current (non-statutory) water resources management plan and also any generic comments that it made on plans in its 2005 advice to Ministers in the "Fifth annual review of water company water resources 2004". You should also take note of any subsequent information provided by the Environment Agency on water supply and demand in your area in preparing your water resources management plan.

You will be aware of the recent concurrent consultations on water metering in areas of serious water stress, and identifying areas of serious water stress held by Defra and the Environment Agency respectively, which ended on 24 April.

In the Defra consultation it is proposed that the Secretary of State will direct water companies for which whole or part of its area is determined to be seriously water stressed to include an assessment of the costs and benefits of compulsory water metering alongside the costs and benefits of other water supply and demand measures in their water resources management plans (WRMP). The consultation also proposes to introduce a new regulation 4 of the Prescribed Conditions Regulations 1999. Where a company has a compulsory metering programme in its WRMP the effect of the new regulation would be to enable a water company in an area of serious water stress to proceed with compulsory water metering, once the WRMP was adopted, and provided it was a cost effective solution to the problem.

A final decision on the proposed new regulation will not be made until all consultation responses have been considered fully. It is expected that this decision will be announced in the period over you which you are drawing up your draft plan, and you may need to take account of that change in your plan. Because Essex & Suffolk Water was classified as an area of serious water stress in the Environment Agency's consultation document, you may wish to consider the extent to which water metering can be used as a supply and demand option under the current regulatory framework (optant and change of use metering and metering under water scarcity status) and any revised framework.

Finally, your plan should also take account of the letter from Richard Wood, Head of Water Supply & Regulation, dated 13 June 2007, to your Regulatory Director about the revised policy on dealing with the impacts of unsustainable abstractions on Natura 2000 sites.

I am copying this letter to Ian Barker at the Environment Agency and Helen Twelves at Ofwat.

Yours sincerely

Mike Walker
Direct Line 020 7082 8351 **GTN** 3544 8351
Fax 020 7082 8343
Email mike.walker@defra.gsi.gov.uk

Portsmouth Water Company response to pre-consultation

2nd August 2007

Mr M. Gough,
Southern Water,
Southern House,
Yeoman Road,
Worthing,
West Sussex.
BN13 3NX

Registered Office:
Portsmouth Water Ltd
PO Box 8
Havant
Hampshire PO9 1LG

Tel: 023 9249 9888
Fax: 023 9245 3832
Web: www.portsmouthwater.co.uk

Please ask for Mr Neve
Our Ref ARN/CH/WRMP2009
Your Ref

Dear Meyrick,

DRAFT WATER RESOURCES MANAGEMENT PLAN
PRE-CONSULTATION

Thank you for your pre-consultation letter dated 30th May. We are grateful for the opportunity to comment and I truly apologise for the long delay in replying.

Like you, we will be relying upon the Water Resources Planning Guidelines issued by the Environment Agency to help us prepare our Plan.

Water Resources Zone
Your proposal to split your current Sussex Coast Zone is noted.

Deployable Outputs
We fully appreciate your desire to reassess outputs in light of the recent drought events. If there is any data that we have which would help, then I will try to make it available.

Levels of Service, etc
I am sure that the experience of the last two years will indeed impact upon your review of service levels. Having been on the sidelines (but very much involved in the game!) we shall take note of the experiences of those in the South East in preparing our Plan.

Sustainability Reductions
You will know that the Environment Agency's Howard Davidson wrote to us on 11th June 2007 enclosing a table showing "indicative changes to abstractions in your water company area". It was suggested that:

- a likely hands off flow condition would be imposed for our abstraction at Gaters Mill of 194 Ml/d.
- Monthly abstraction maximums would be imposed for June, July, August, and September.
- The annual licence maximum would be reduced.

Their conclusion to the above changes to our licence was that our deployable output could be reduced by 15 Ml/d. They added the caveat: "assuming Chickenhall WWTW contributes 30 Ml/d to flows between Otterbourne and Gaters Mill.

We are aware that the Environment Agency is proposing to reduce your own licensed abstraction at Otterbourne by a significant amount. It is probable that your own proposals for making up the deficit will affect our abstraction at Gaters Mill to a greater extent than the 15 Ml/d anticipated by the Environment Agency.

We have a meeting with the Environment Agency's Nick Price scheduled for 9th August at which we may be able to resolve issues such as operation of the River Augmentation boreholes.

Cont./...

It is quite clear that the proposals for both companies will have significant impacts upon both our Water Resources Management Plans and I am trying to urge the Environment Agency to work collaboratively with both of us to mitigate those impacts. So far I have not made much progress.

At other sites we are advised that there are 'unlikely to be any impacts upon deployable outputs' but it is for us to make that assessment, not the Environment Agency, and until we see definitive advice upon licence changes we cannot do so. Inevitably, impacts upon deployable outputs could have an influence upon our ability to maintain the bulk supply to Hardham WTW. Again we shall try to make some early progress.

We share your concerns on the Water Framework Directive.

Water Management Options
Like you, we shall be considering a number of supply and demand side water management options, whilst we continue to support the regional modelling work being conducted by the WRSE Group.

The Bulk Supply Agreement is due to expire in 2013 and, whilst we are willing to consider its renewal, that will inevitably be driven by the assessments in our Water Resources Management Plan. Its use for ten months in 2006 certainly was much greater than we had anticipated when the original agreement was negotiated. Operationally it did place a considerable burden on our sources and it may be that we will want to consider the possibility of trying to vary the Eastergate Group Licence in due course. I think you know that we believe that considerable groundwater is constrained by the Agency's views on that part of the Chichester Chalk Block and any support you can offer might well benefit your sources in that area too.

I am sure that there will be much more private and public debate during the preparation of our Plan.

Please accept my sincere apologies for missing the deadline for our response.

Yours sincerely,

A.R. NEVE
Technical Director

South East England Regional Assembly (SEERA) response to pre-consultation

SOUTH EAST ENGLAND Regional Assembly

COUNCILS AND COMMUNITIES IN PARTNERSHIP

CORPORATE

- 3 AUG 2007

STRATEGY

Meyrick Gough
Water Planning and Strategy Manager
Southern Water
Southern House
Yeoman Road
Worthing BN13 3NX

Tuesday 31 July 2007

Dear Meyrick

WATER RESOURCES MANAGEMENT PLAN - PRE CONSULTATION

Thank you for your letter of 30 May seeking our views. I must apologise for the delay in replying and hope that the following points are useful.

First of all we are grateful for being kept informed of progress and the issues that you face and confirm that we wish to assist you in the development of your water resource management plans wherever possible. In this regard, we welcome your positive approach to the work of the WRSE group and its input to the South East Plan.

As you will be aware, the report of the South East Plan Examination in Public Panel is due out in August and we will all need to consider the implications of their recommendations, and in due course, the next draft of the Plan especially f the overall quantum or distribution of new housing is changed dramatically. As you may also have picked up, the government is proposing that by 2010 Regional Assemblies are phased out and our regional planning functions taken over by Regional Development Agencies, with a single regional strategy prepared to replace separate Regional Spatial Strategies and Regional Economic Strategies. We need to ensure continued close and constructive working between spatial planers and water resource planners in this period of transition.

Finally, with regard to some of the uncertainties about the Water Framework Directive, there will be a need to ensure as far as possible, and timetables allowing, that the issues and actions arising from the South East River Basin Management Plan inform the Water Resource Management Plan.

Yours sincerely

David Payne
Planning Manager

South East England Regional Assembly Berkeley House Cross Lanes Guildford Surrey GU1 1UN
T: 01483 555200 F: 01483 555250 E: secretariat@southeast-ra.gov.uk W: www.southeast-ra.gov.uk
Chairman: Councillor Keith Mitchell Chief Executive: Paul Bevan

Water for Wildlife response to pre-consultation

30th July 2007

FAO Meyrick Gough

Response to Southern Water's pre-consultation document on water resources management plans

We welcome the opportunity to response to your consultation, and appreciate your open approach to taking this forward.

We are pleased to see that improved modeling is being used to help inform Southern Water's use of its water resources. We would hope that biodiversity / impact on natural river and wetland systems formed part of this analysis. We would like to see impacts assessed not only on economic grounds, but including environmental issues. We would also highlight that whilst impacts on designated sites are important, impacts on wetland systems generally should be taken into account.

We agree that lack of guidance from EA on impacts of abstraction on habitats / sites could result in missing of targets for AMP5, but we would urge a 'precautionary principle' approach to be taken. Given uncertainty about climate change and Water Framework Directive, we support Southern Water's request for more information, but would also urge that alternative methods of water management in the wider environment be explored. Catchment management and wetland restoration can result in benefits for water resources and quality, and the Wildlife Trusts would be keen to explore opportunities for joint work.

Regarding the resilience of supply, habitat restoration provides the potential means for increasing groundwater recharge, floodwater storage, water purification benefits as well as habitat benefits. This could include floodplain woodland or reedbed (slows water, removes pollutants and improves infiltration rates in the right location), river restoration (removing embankments and allowing more natural flood regimes and wetter floodplain which could help water resources) or wider catchment management (e.g. grassland management on chalk aquifers to reduce agricultural inputs and thus safeguard / improve groundwater quality).

Supply and demand options chosen on a 'least cost only' basis would not appear to be consistent with long-term, sustainable solutions. Ofwat's new duty to sustainability should be encouraging a longer-term, broader solution than just economic. We would also point out that low-tech options such as land management may well provide water resource benefits that are cheaper than high tech approaches. For instance, have the energy costs of something like desalination been considered? These could be countered by the use of renewable energy sources, which would reduce carbon emissions and cost in the longer-term, although would be expensive to install in the short-term.

How much will encouraging sustainable water-use / metering feature in water demand management? We see the reduction of water use as a crucial approach in managing water resources in what is a highly populated, water-stressed area, with predictions of population increase making more demands for water. Aiming to increase water availability, rather than reduce water consumption, does not seem like a sustainable approach in this situation, and will certainly have a negative impact on biodiversity.

Water transfer schemes use large amounts of energy to move water from one place to another, and can also have impacts on transmitting species, particularly invasive non-native species, from one river to another. We are skeptical of the benefits of water transfer schemes, and would prefer to see better use of existing resources, or if needs be to look at developing storage capacity through natural and / or man-made systems.

How much has the environmental impact of effluent re-use been considered (in terms of alterations in river flows), and will there be any effort to incorporate environmental solutions in to the management of waste water? Effluent re-use would reduce the strain on freshwater sources, and could provide compensation flows for rivers with summer low-flows. However, the question of water quality needs to be addressed to ensure rivers remain suitable for sensitive species and habitats.

I hope that these comments are a useful aid to your planning, and once again thank you for the opportunity to feed into the process.

Best regards,

Chris Rostron, Water for Wildlife UK Manager

B.2 Full Public Consultation

B.2.1 List of Consultees

Water Resources Management Plan

Environment Agency
Natural England
English Heritage
OFWAT
DEFRA
Consumer Council for Water
DWI
Water UK

Relevant licensed suppliers

Thames Water
Wessex Water
South East Water
Folkestone & Dover Water
Sutton & East Surrey Water
Bournemouth & West Hampshire Water
Portsmouth Water

Littlehampton Harbour Board
River Medway Navigation Authority (Env Agency)
Port of Medway Authority
Wey & Arun Canal Trust

SEEDA
SEERA

Adur District Council
Arun District Council
Ashford Borough Council
Basingstoke and Deane Borough Council
Brighton and Hove City Council

Canterbury City Council
Chichester District Council
Crawley Borough Council
Dartford Borough Council
Dover District Council
East Hampshire District Council
East Sussex County Council
Eastbourne Borough Council
Eastleigh Borough Council
Fareham Borough Council
Gosport Borough Council
Gravesham Borough Council
Hampshire County Council
Hart District Council
Hastings Borough Council
Havant Borough Council
Horsham District Council
Isle of Wight Council
Kent County Council
Lewes District Council
Maidstone Borough Council
Medway Council
Mid-Sussex District Council
New Forest District Council
Portsmouth City Council
Rother District Council
Rushmoor Borough Council
Sevenoaks District Council
Shepway District Council
Southampton City Council
Swale Borough Council
Test Valley Borough Council
Thanet District Council
Tonbridge and Malling Borough Council
Tunbridge Wells Borough Council
Wealden District Council
West Sussex County Council
Winchester City Council
Worthing Borough Council

New Forest National Park Authority

Non-Technical Summary

MPs, MEPS, Lord-Lieutenants, Lords

Parish & Town Councils

Arundel Wildfowl and Wetlands Trust

Aylesford Newsprint Ltd
BAA Gatwick
Blake Lapthorn Tarlo Lyons
Brighton & Hove Bus & Coach Company
Brighton & Hove Business Forum
Brighton & Hove Economic Partnership
Brighton and Hove Albion Football Club
Brighton and Hove Business Forum
Brighton and Hove Chamber of Commerce
Brighton Community & Voluntary Sector Forum
Brighton Dome & Brighton Festival
Brighton Festival
CAE (UK) plc
CBI
CGG Veritas
CPRE Hampshire
CPRE Sussex
CPRE Kent
Chichester College
City College - Brighton & Hove
Consumer Council for Water
Coral Brighton and Hove Greyhound Stadium
Darcy Products
Drinking Water Inspectorate (DWI)
e-on UK plc
Ewhurst Parish Council
ExxonMobil Chemical Limited
Fontwell Park Racecourse
Forestry Commission
Friends of Chichester Harbour

Gillingham Football Club

GlaxoSmithKline

Government Office for the South East

Grain Power Station

Group 4 Securicor plc

Hampshire and Isle of Wight Wildlife Trust

Hampshire Economic Partnership

Harbour Economic Development Forum

Harveys

Hornet Engineering Ltd

IBM United Kingdom Ltd

Inspire Leisure

IoD

IoD

IPPR

Island 2000

Isle of Wight AONB Partnership

Isle of Wight Ornithological Group

Isle of Wight Tourism

Jacobs Babtie

Jiskoot Ltd

Kent Wildlife Trust

Medway Renaissance

National Farmers Union

National Trust

Pfizer Ltd

Platon Medical Ltd

Portsmouth and SE Hants Chamber of Commerce

Portsmouth City Museums

Portsmouth Climate Action Network (PCAN)

Portsmouth Society

RSPB

Sencio Leisure

Shepherd Neame Ltd

Solent Enterprise Hub

South and South East in Bloom

South Downs Joint Committee

Southern Trains

Sussex Community Partnership

Sussex Wildlife Trust

University of Brighton

University of Brighton Business School

University of Kent

University of Portsmouth

University of Winchester

University of Southampton

West Southsea Neighbourhood Forum

Wight Wildlife

YellowFin Ltd

To Add:

Fishery and Angling groups and societies

River based recreation bodies

Appendix C: WATER RESOURCE ZONES

Water resource planning takes place at the level of the Water Resource Zone (WRZ), which represent the largest area in which all customers bear the same amount of risk of restrictions in the event of drought events. There are ten WRZs in the Southern Water area. However, some of these WRZs are, or will be, connected by means of treated or raw water supplies. Therefore, for the purposes of strategic planning, where actions in one WRZ can have an impact in connected WRZs, it is possible to amalgamate some of these WRZs into larger, sub-regional Areas.

Thus, the hierarchy of water resource planning within the Southern Water supply area can be summarised as follows:

Western sub-regional Area (Western Area), which includes the following WRZs:

- Isle of Wight WRZ;
- Hampshire South WRZ;
- Hampshire Andover WRZ; and
- Hampshire Kingsclere WRZ.

Central sub-regional Area (Central Area), which includes the following WRZs:

- Sussex North WRZ;
- Sussex Worthing WRZ; and
- Sussex Brighton WRZ.

Eastern sub-regional Area (Eastern Area), which includes the following WRZs:

- Kent Medway WRZ;
- Kent Thanet WRZ; and
- Sussex Hastings WRZ.

The number of WRZs has been increased since the previous WRMP in 2004, with the division of the previous Sussex Coast WRZ into the Sussex Worthing and Sussex Brighton WRZs. This division resulted from the capacity of the only interconnection between the two areas, known as the “V6” valve, being identified as a constraint on the ability to move water freely between the areas. When this transfer capacity is increased, the two WRZs can again be treated as a single WRZ.

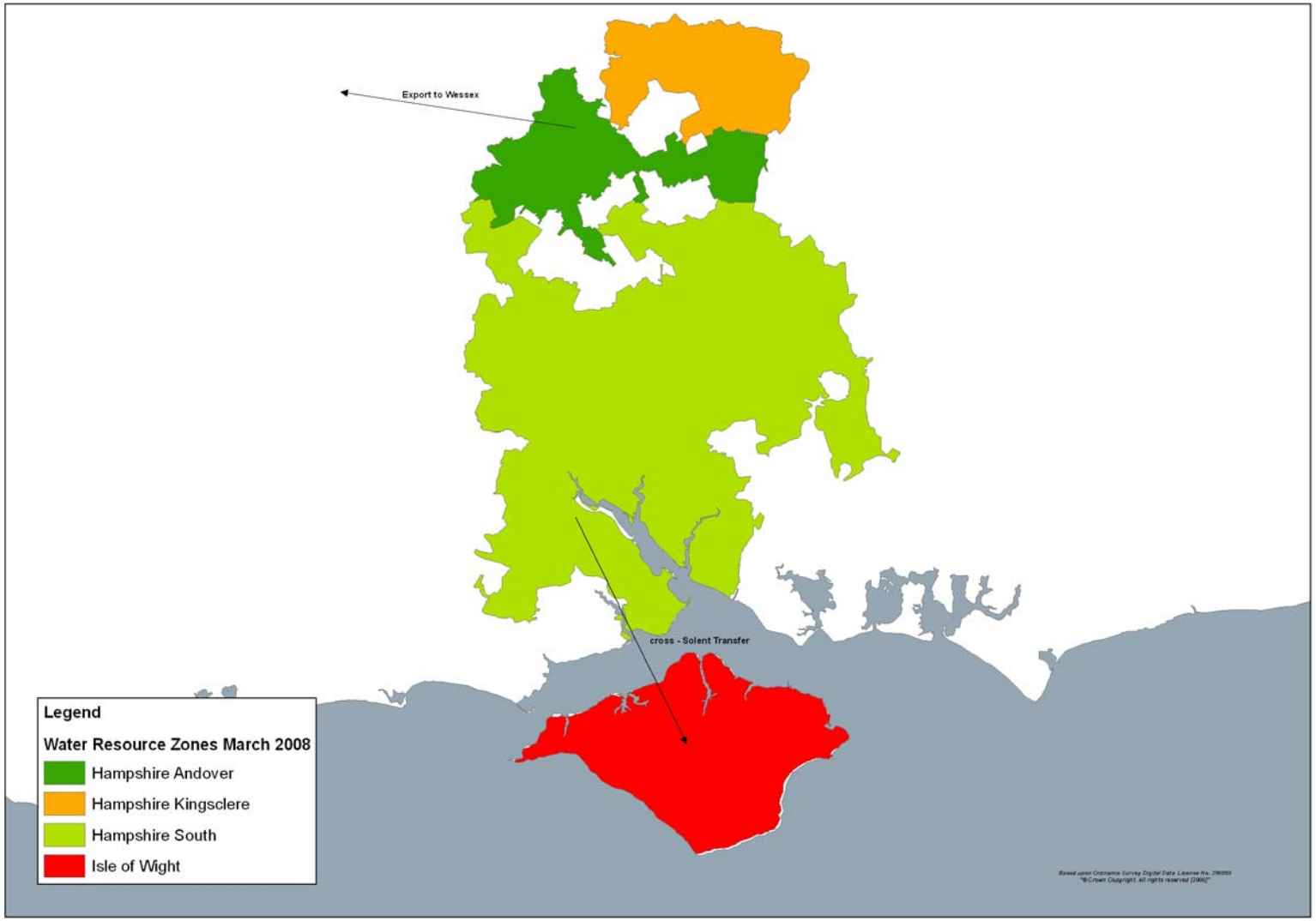

Figure C.1 Schematic of Water Resource Zones in the Western Area

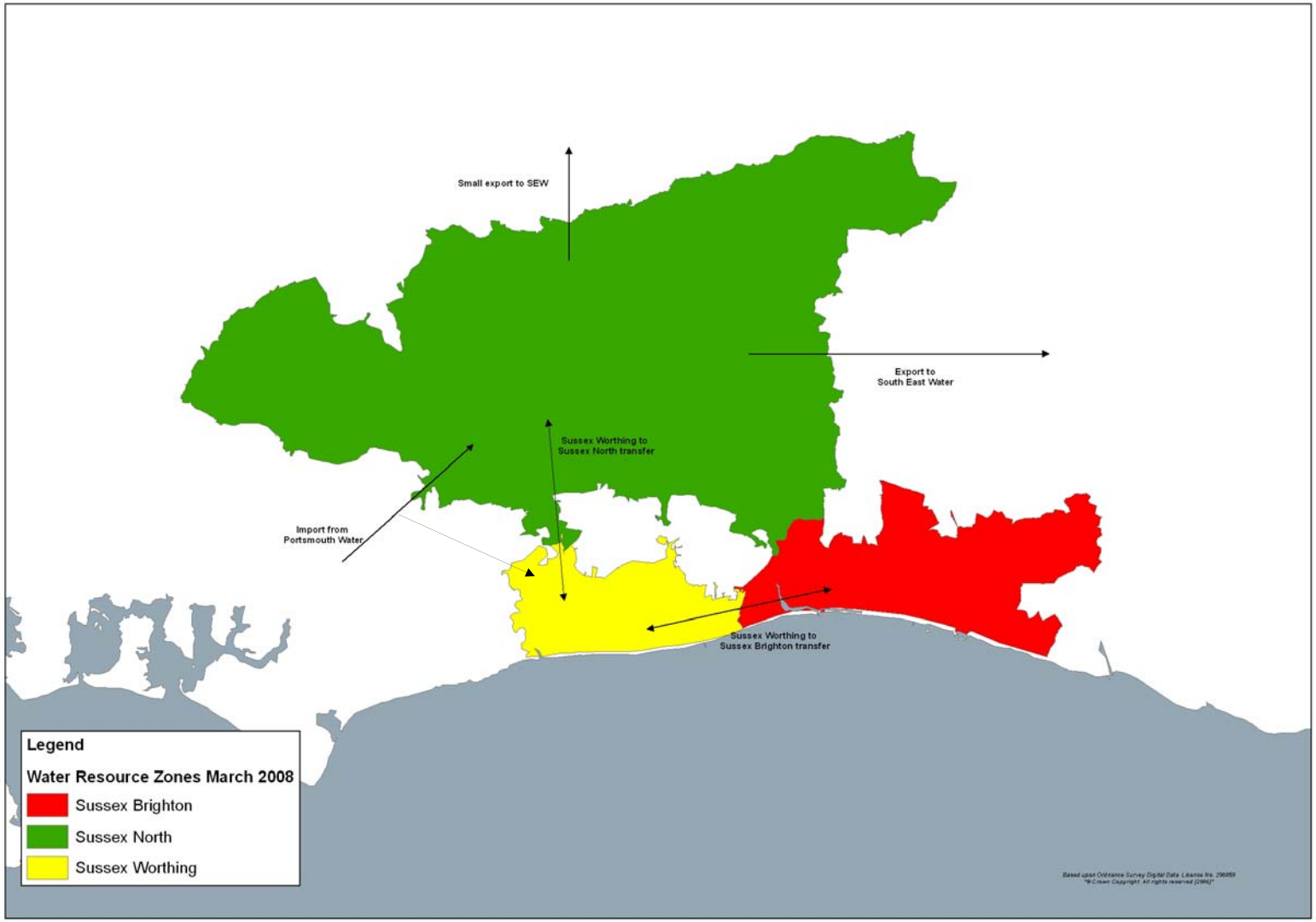

Figure C.2 Schematic of Water Resource Zones in the Central Area

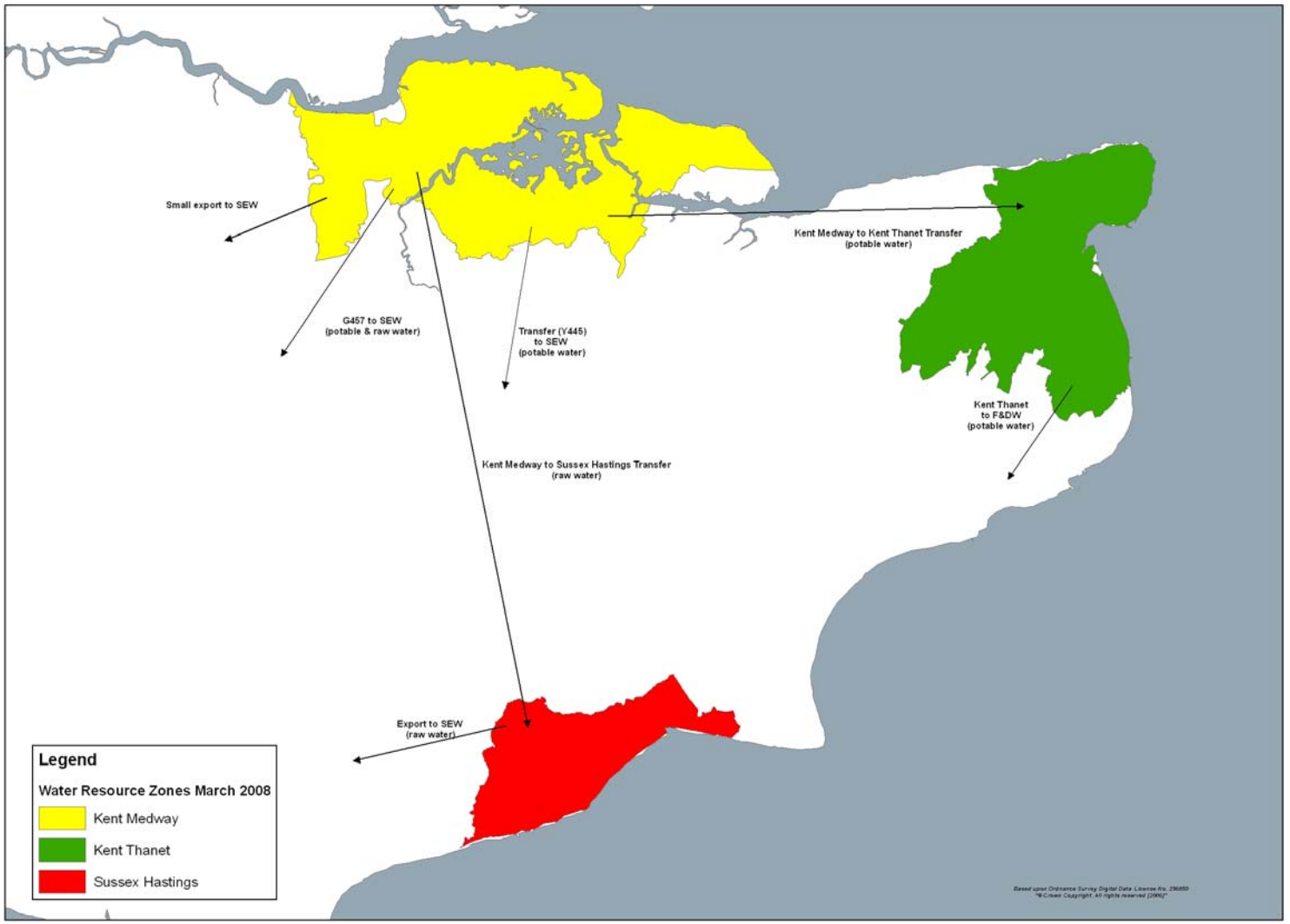

Figure C.3 Schematic of Water Resource Zones in the Eastern Area

Appendix D: SUPPLY FORECAST

D.1 Deployable Outputs

D.1.1 Overview of Deployable Output Re-assessments

Water resource modelling capability was developed as part of the AMP4 Water Resources Investigations. In order to carry out a robust options appraisal process it was considered necessary to carry out a complete re-evaluation of the water resource capability of the supply system in each of the three sub-regional areas: Western; Central; and Eastern.

Each area relies on varying combinations of groundwater sources, reservoir storage, and surface water sources. These different sources have different resource capabilities and different vulnerability to drought, and so the combined (or conjunctive) potential output from the system is not the same as the sum of the individual sources. There are also some key intra-zonal and inter-company transfers which are used to support each of the three sub-regional areas during drought conditions. Therefore, as well as a re-evaluation of surface water flows and yield, water resource models were built in order to assess the 'conjunctive use' and transfer capability of the system as a whole.

The derivation of deployable output for each WRZ is made up of up to three parts:

- Assessment of groundwater deployable output;
- Where the WRZ also has surface water storage reservoirs, an assessment of the yield of the reservoir system as a stand-alone system; and
- For those WRZ with combined surface water storage reservoirs and groundwater sources, assessment of the conjunctive use deployable output.

MISER models were used to provide an assessment of both surface water and groundwater deployable outputs on the basis of the same hydrological event, i.e. application of the Unified Methodology.

As part of the AMP4 Water Resources Investigations, the company undertook a reassessment of the deployable output of all its surface water sources. These values, together with the results of the 2005 review of groundwater source deployable output were used in the draft WRMP. The methodologies for the reassessments were circulated to the EA. The EA comments were taken into account together with the results of the 2006 review of groundwater sources to produce the deployable output for this WRMP.

An audit of the company's approach to the assessment of deployable output was undertaken in September 2008 (Halcrow, 2008). The summary of the audit states:

- We strongly support the overall approach of using conjunctive use deployable outputs in an extended period simulation with the objective of enabling Southern Water to meet its stated levels of service with the defined frequencies over the long term. The company, probably in common with many others, has clearly not met its water availability LoS objective with the required frequency. The company is, therefore, to be commended on the work it is doing to address this issue.
- In arriving at revised deployable outputs, the company has attempted to address the discrepancy between the stated service levels relating to the imposition of restrictions and the historic frequency of such restrictions in practice.
- By avoiding the analytical problems engendered by using different design droughts for evaluation of surface and groundwater sources and by optimising conjunctive use outputs, the company's reassessment is undoubtedly more robust than would otherwise be the case.
- There has been no change from the draft WRMP submission to the surface water deployable outputs. We note that the revised groundwater deployable output have yet to be integrated for the conjunctive use aspects. However, we consider that any

changes due to this integration are likely to be insignificant in the context of the overall surface water deployable output.

- We are satisfied that the company has followed the UKWIR methodology to assess groundwater deployable output. The 2006 study represents a significant improvement with respect to:
  - An increase in the amount of data used to generate drought curves in summary diagrams, as 2006 represented a drought year.
  - Further studies carried out since the 2005 Assessment, into constraints, including the SIOS studies and improved information from within Southern Water.
  - An updated methodology for assessing Sustained Peak and Minimum deployable output. The summary diagram plots water levels against 30 day running mean abstraction, rather than using monthly average abstraction (as used in the 2005 Assessment). The company explains that this is because antecedent pumping conditions are better represented and the greater spread of data allows improved definition of drought curves. We are satisfied that this is an improvement on the 2005 methodology.
- An update to the methodology for assessing Minimum Deployable Output through the use of dry months from the observation boreholes in a given WRZ to show sufficient data to define the drought curve. We are satisfied that this is consistent with the UKWIR methodology.
- We have not located any material areas of concern during our audit of the deployable output reassessment data.

D.1.2 Surface water

A summary of the approach used to derive surface water deployable outputs for each of the three sub-regional areas in Southern Water is given in a separate Technical Note (Atkins, 2008). The note does not re-iterate previous work, but provides an overview of the process followed. Where relevant, the note signposts the reader to relevant sections of previous reports which set out in detail the methodologies, assumptions and results. Much of the work was undertaken as part of the AMP4 Water Resources Investigations; the technical reports produced for Southern Water under the AMP4 Water Resources Investigations were signed-off by the Environment Agency. The focus of the AMP4 investigations was Peak Deployable Output (PDO) and Minimum Deployable Output (MDO). Estimates of Average Deployable Output (ADO) were made for the draft WRMP.

D.1.3 Groundwater

The company has progressively improved its approach to the assessment of deployable output of groundwater sources. The most recent assessment was completed in the summer of 2008 and was based on operational data up to and including 2006.

The work is reported in a series of reports by Scott Wilson (Scott Wilson, 2008 etc.). The water level data and assessment diagrams from the Scott Wilson studies have been used for the application of the UKWIR unified methodology to the company's groundwater sources. All deployable outputs presented in this document have been based on "2006 assessments" carried out by Scott Wilson (2008) i.e. the most recent deployable output assessments, which include data from 2006.

For some areas, analysis of severe drought impact and/or climate change impact had previously been carried out using earlier versions of groundwater source deployable output: these analyses have been updated and the results superseded for this WRMP.

Baseline deployable output assessments are derived for drought conditions for which operational data are available. The consequence is that drought conditions on which the current baseline deployable outputs have been based may vary from source to source, depending on the operational data available. The deployable outputs may therefore not be a robust representation of source output available during the most severe droughts under current climatic conditions.

In order to compile a more robust assessment of groundwater deployable outputs, an assessment has been made of the impact on groundwater availability of different drought scenarios within the historical record. This takes into account the effect of droughts similar to those examined for surface water sources and therefore allows a more robust assessment of overall deployable output to be made. The approach is consistent with that enshrined in the UKWIR Unified Methodology.

D.1.4 Conjunctive use

The worst historic drought for surface water sources was identified. In the Eastern Area, this was the 1900-03 period; while for the Central and Western areas, it was based on the 1920-22 drought scenario, where a very dry winter was followed by a prolonged spring, summer and autumn drought with little effective rainfall in 1921. An assessment of the hydrogeological conditions associated with the worst drought period was made and applied to the deployable output of all groundwater sources. This approach offers a much more realistic and prudent approach to developing a robust prediction of deployable output during the design drought event.

D.1.5 Review of Drought Design Principles

HR Wallingford were asked to conduct a review of the justification of planning on droughts that occurred before 1920. The focus of this review was in Kent, as analysis had shown that the critical drought for the area occurs in 1900-03, while for the Central and Western areas, the critical drought starts in 1920-21. A summary of the findings of this analysis is presented below.

Appendix 1 Summary statement for Draft Water Resources or Drought Plan

Introduction

Water resources in the south east are dependent upon adequate rainfall to recharge aquifers and maintain river flows for public water supply, agriculture and protecting the environment. Droughts are a natural feature of the region's climate when lower rainfall and higher evaporation reduces river flows and groundwater levels. Storage of winter rainfall in both aquifers and surface water reservoirs, such as the Bewl reservoir provides resources to meet the demand for water during the summer months. Improvements in water supply infrastructure, such as transfers between reservoirs, as well as demand management measures mean that it is now easier to manage very local or short drought periods. However, shortages of winter rainfall over successive years, like in the winters of 2004/5 and 2005/6, can threaten public water supplies.

In England and Wales, most companies base their Water Resources Plans on data from the 1920s to the present. There is considerable evidence that there were major 'long droughts' in the 19th century, some lasting two decades, which included many dry winters. These events have been studied by the Environment Agency[1] and Southern Water have reviewed the evidence in order to understand how today's water supply infrastructure would cope with the droughts that occurred in the late 19th century and early 20th century. Annual rainfall in the Medway catchment is approximately 762 mm per year and the average runoff is equivalent to 278 mm per year or 36 percent of rainfall[2].

Southern Water has developed computer models of river catchments and their water supply system that extend rainfall and their assessment of resource yield back to 1880. This model showed that the 1904 to 1909 period was critical for the Bewl-Darwell reservoir system. An independent analysis was carried out by HR Wallingford to review the evidence of 19th century droughts, which reconstructed monthly regional rainfall and Medway flows back to 1801. This shows that the 1904 to 1909 drought period formed part of a much longer drought, which started in 1890 and was only 'broken' by heavy rainfall in October 1903. It had some similarities to the 1921/22 drought but the timing of rainfall and flow shortages was more critical for the company's reservoir system. In addition, this review found evidence of much more severe long droughts, which Southern Water have not considered in their detailed modelling and Draft Water Resources Plan.

Figure A1 shows the long term average regional precipitation and runoff for the Medway at Teston for the period 1801 to 2007. Figures A2 and A3 show how different periods compare to he long term average precipitation and runoff. These show that the recent period 1991 to 2007 was characterised by wetter than average winters (Oct-Dec) and that periods in the 19th century were, on average, much drier with lower runoff, particularly in late winter and spring.

[1] Marsh, Cole and Bloomfield, 2007. Major droughts in England and Wales from 1800 and evidence of impact. Environment Agency Science Report SC040068/SR1.
Wade, S.D. Jones, P.D. and Osborn, T. 2007. The impacts of climate change on severe droughts. Implications for decision making. Environment Agency Science Report SC040068/SR3.
Jones, P.D. Lister, D.H. and Kostopoulou, E. 2003. Reconstructed river flow series from 1860s to present. Updating previously reconstructed series to 2002. Environment Agency research project SC03/02.
[2] Based on the Hydrometric Register for the period 1956 to 2000.

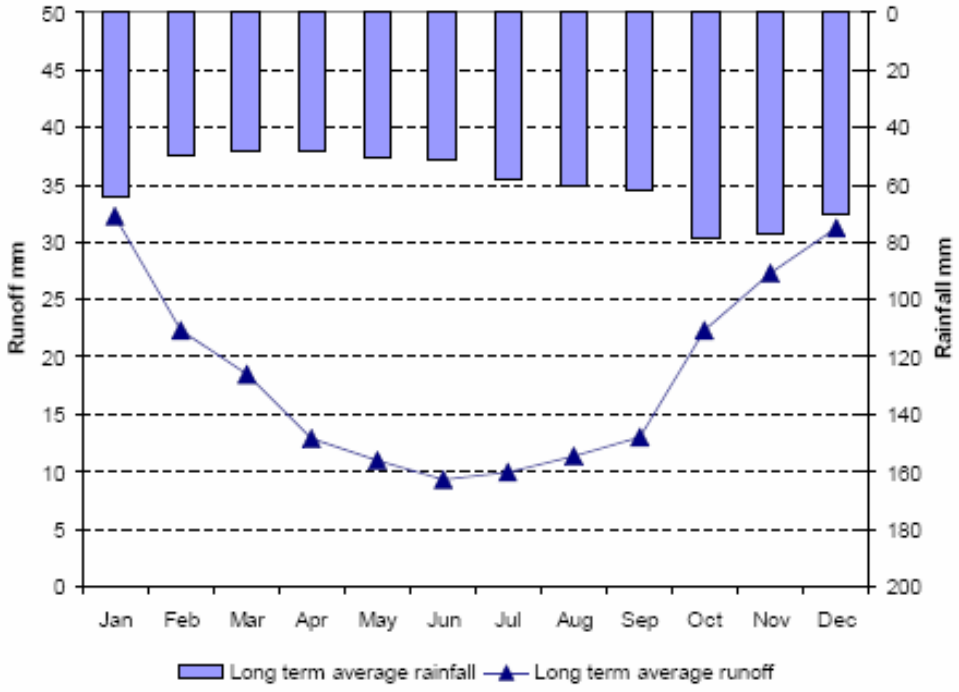

Figure A1. Long term average monthly precipitation in the South East of England and runoff for the Medway at Teston 1801 to 2007

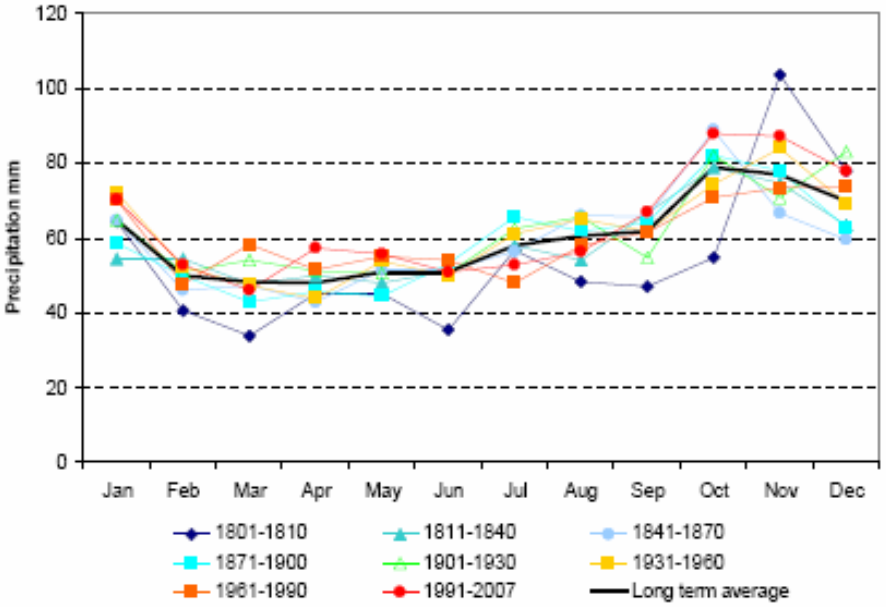

Figure A2. Long term average monthly precipitation in the South East of England for different time periods

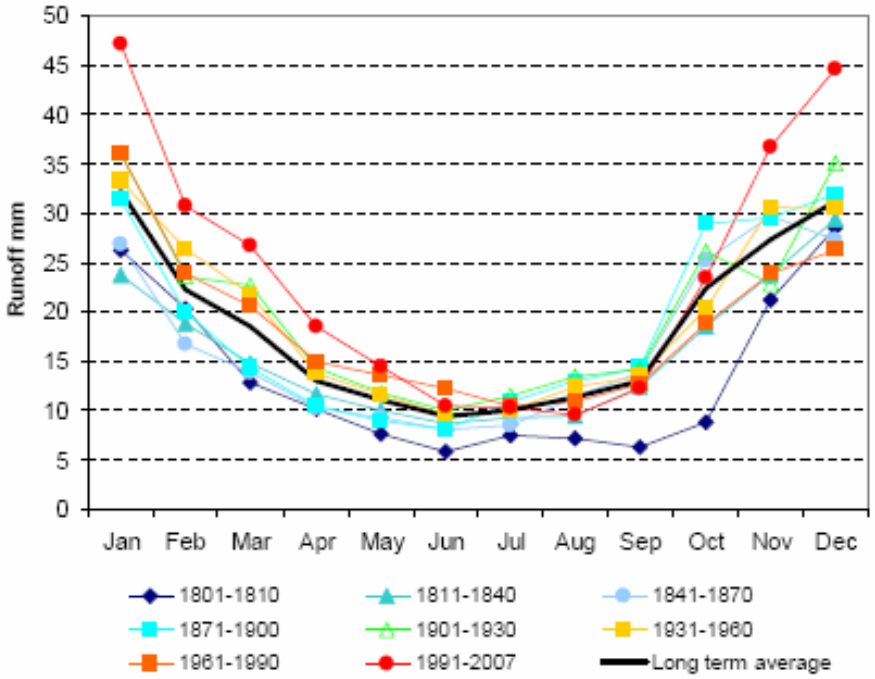

Figure A3. Long term average monthly runoff in the Medway for different time periods

The vulnerability of the Medway system to long droughts

Large reservoir systems, such as the Medway scheme are vulnerable to long droughts (2 years or more) including multiple dry winters whereas smaller systems are vulnerable to single or multiple season droughts over medium term durations (6 months to 2 years). Southern Water's detailed modelling has shown that the 1921/22 drought is the critical for some catchments, such as the Western Rother, but the 1890-1909 drought and specifically the 1904-1909 period would have a far greater impact on the Medway system.

Drought indicators based on rainfall and river flows can be used to place historical droughts in context, to estimate how often droughts will occur and to understand the consequences for public water supplies. The analysis of droughts is complex because the timing and duration of drought periods can be more important than the absolute rainfall deficit. For the Medway system the most relevant indicators of drought are winter rainfall deficits over two or more subsequent winters.

Table A1 shows the 'top ten' of long duration droughts. The 1920-23 and 1931-33 periods feature in these lists but most of the top ranking long droughts are from the 19th century. Figures A4 and A5 show long term two year and two winter rainfall deficits, clearly indicating drier periods in the 19th century. In Figure A6 the key difference between 1921/22 and the 1890-1910 is illustrated, showing that although 1921/22 had very similar two year rainfall deficits it had wetter winters than 1904/5 and 1905/6.

Table A1 Top ten 'Long Droughts' over 3 and 4 years based on reconstruction of South East rainfall, 1800-2007

	Hydrological Years (end year is indicated)		November to April	
Rank	3 yrs	4 yrs	3 yrs	4 yrs
1	1803	**1901**	**1893**	**1893**
2	1934	1816	**1892**	1858
3	1923	1864	1856	1859
4	1815	1805	1859	1857
5	**1900**	1923	1934	**1894**
6	1804	1804	1815	1892
7	1865	1992	1858	1816
8	1816	1808	1860	1860
9	1808	1806	1816	1861
10	1944	1815	1891	1817

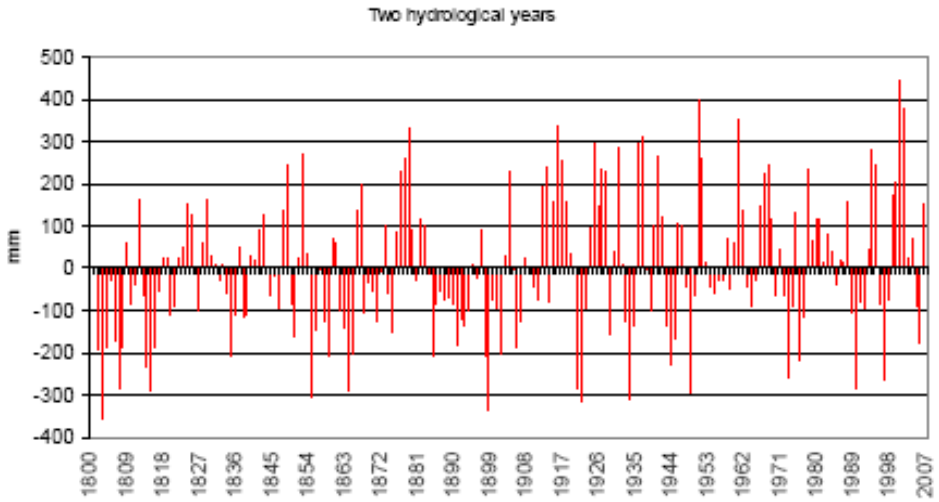

Figure A4 Time series of two year rainfall anomalies in South East England from 1800 to 2007

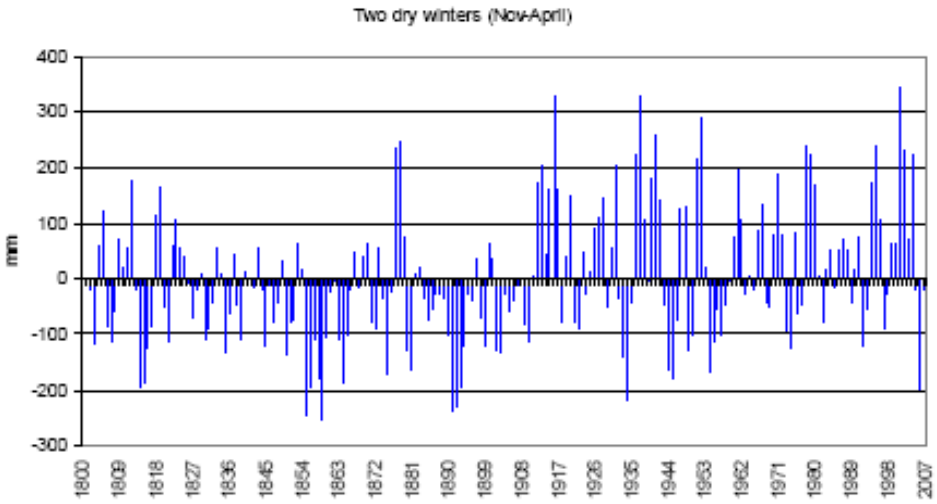

Figure A5 Time series of two winter rainfall anomalies in South East England from 1800 to 2007

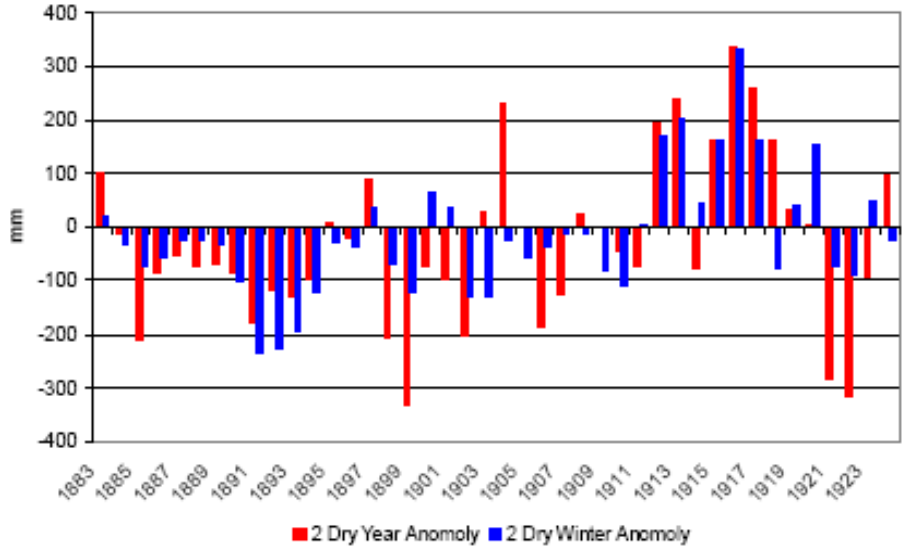

Figure A6 Time series of two year and two winter rainfall anomalies from 1883 to 1925

Conclusions

HR Wallingford's independent analysis has shown that there were more severe long droughts in the 19th century than in the contemporary record (1920-2007) normally used for water resources planning.

- The Environment Agency's research identified 1802-1803, 1854-1860, 1873-1875 and 1890 to 1909 as major droughts along with familiar years in the contemporary record, including 1921-22, 1990-1992 and 1995-1997[1].
- During the 'Long Drought' of 1890 to 1909 winters were drier than the long term average for 16 out of 19 years. The 1904 to 1909 period was particularly notable for the

occurrence of two or more subsequent dry winters, which makes this drought more severe for water resources than the 1921/22 drought period.

- A longer term reconstruction from 1800 to 2005 has showed these conditions were not exceptional and occurred several times in the 19th century. Southern Water has not selected the worst drought on record but has selected a realistic drought scenario that could reoccur in future, even without climate change.

In future climate change will affect the average balance of winter and summer rainfall and these affects are included in the company's water resources plan based on the outputs and analysis of climate change scenarios. Despite the scenarios suggesting wetter winters and drier summers, the region has suffered from dry winters in 2004-2006 followed by severe summer flooding in July 2007. Research studies have indicated that short droughts will become more frequent and that long drought periods will still be a feature of the future climate[3].

It is prudent for Southern Water to include the 1890 to 1910 drought within their water resources plan as a critical scenario for planning or for some form of sensitivity analysis. The 1904 to 1909 period within this drought was not exceptional and the long term analysis suggests that it would occur more frequently than events such as the short drought of 1975/76, which are used routinely for water resources planning.

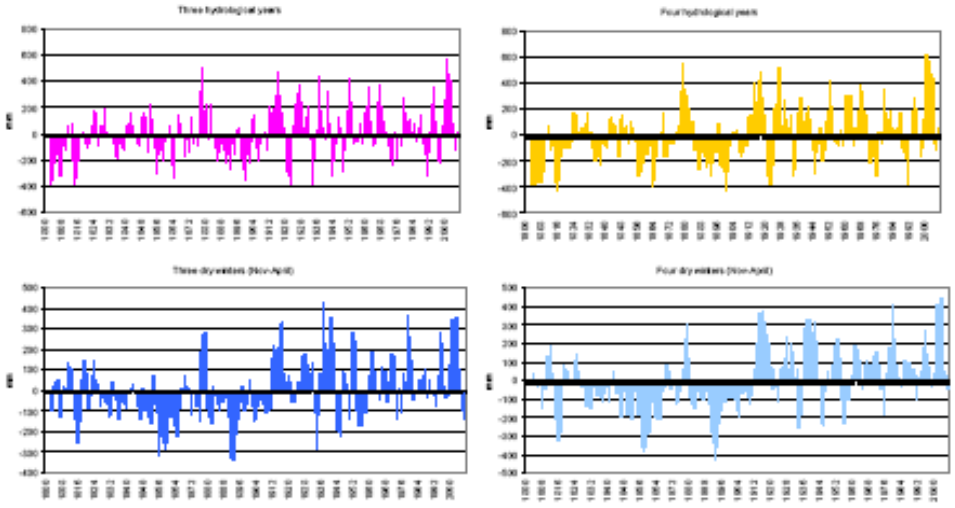

Figure A7 Time series of annual and winter rainfall anomalies for 'long droughts' of 3 and 4 years duration in South East England from 1800 to 2007

[3] Vidal, J.P. and Wade, S.D. A multimodel assessment of future climatological droughts in the UK. Int. J. Climatology. (Submitted JOC 07-0335)

D.1.6 Deployable Output Summary Tables

WRZ	Isle of Wight	Previous Assessments of DO				PR09 DO Assumptions								
		PR04		2006		PR09 Baseline		PR09 FINAL						Baseline
Type	Name	MDO	PDO	MDO	PDO	MDO	PDO	MDO	PDO		Ave Annual Licence	Daily Licence	PR04 ADO	Calc'd PR09 ADO
Groundwater	L536	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.55	1.10	0.00	0.00
	U433	0.00	5.40	1.50	4.00	1.50	4.00	1.75	4.25		8.33	13.50	0.00	2.12
	G227	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.49	0.90	0.00	0.00
	K628	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		1.06	1.10	0.00	0.00
	K253	0.99	2.34	0.87	0.95	0.87	0.95	0.97	1.05		2.47	3.00	0.99	0.89
	K453	7.02	11.32	9.96	10.96	9.96	10.96	10.46	11.96		15.40	22.37	7.02	10.21
	H614	0.90	1.80	0.90	1.13	0.90	1.13	1.00	1.23		3.11	5.40	0.90	0.96
	O335	1.80	2.56	1.40	2.00	1.38	1.97	1.38	1.97		3.83	5.02	1.80	1.53
	T868	4.47	4.60	4.35	4.35	4.35	4.35	4.45	4.45		4.47	9.12	4.30	4.35
	R162	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.12	0.14	0.00	0.00
	Q442	0.16	0.25	0.20	0.21	0.20	0.21	0.20	0.21		0.33	0.43	0.16	0.20
	V434	0.39	0.79	0.15	0.37	0.13	0.33	0.13	0.33		1.21	2.06	0.39	0.18
	T464	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.19	0.33	0.00	0.00
	R558	0.31	0.46	0.28	0.39	0.28	0.39	0.28	0.39		0.49	0.77	0.31	0.31
	L443	1.31	1.87	1.15	1.20	1.15	1.20	1.15	1.20		3.29	3.79	1.31	1.16
	Total	**17.35**	**31.39**	**20.76**	**25.56**	**20.72**	**25.49**	**21.77**	**27.04**		**45.34**		**17.18**	**21.90**

WRZ	Isle of Wight	Previous Assessments of DO				PR09 DO Assumptions								
		PR04		2006		PR09 Baseline		PR09 FINAL						Baseline
Type	Name	MDO	PDO	MDO	PDO	MDO	PDO	MDO	PDO		Ave Annual Licence	Daily Licence	PR04 ADO	Calc'd PR09 ADO
Surface water	N472	8.81	10.81			10.00	12.00	10.00	12.00		15.00	18.00	8.81	10.50
	Total	**8.81**	**10.81**			**10.00**	**12.00**	**10.00**	**12.00**		**15.00**		**8.81**	**10.50**
	Total WRZ	**26.16**	**42.20**	**29.57**	**36.37**	**30.72**	**37.49**	**31.77**	**39.04**		**60.34**		**25.99**	**32.40**

WRZ	Hants South	Previous Assessments of DO				PR09 DO Assumptions								
		PR04		2006		PR09 Baseline		PR09 FINAL						Baseline
Type	Name	MDO	PDO	MDO	PDO	MDO	PDO	MDO	PDO		Ave Annual Licence	Daily Licence	PR04 ADO	Calc'd PR09 ADO
Groundwater	I131	1.12	1.82	1.12	1.82	1.12	1.82	1.12	1.82		1.12	1.80	1.12	1.12
	R176	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		1.00	1.18	0.00	0.00
	R764	18.17	27.30	18.17	27.30	18.17	27.30	18.17	27.30		18.18	27.30	18.17	18.17
	B136	2.88	2.88	1.50	1.50	1.50	1.50	5.00	5.00		5.00	5.00	2.88	1.50
	O641	54.16	67.58	50.00	60.00	44.00	46.00	48.00	53.50		54.76	68.18	54.16	44.49
	O541	9.50	13.00	9.50	10.80	9.50	10.80	10.00	11.80		13.68	13.64	9.50	9.82
	J672	4.54	4.55	4.54	4.55	4.54	4.55	4.54	4.55		4.55	4.55	4.54	4.54
	S517	18.00	23.00	18.00	23.00	17.50	22.80	17.50	22.80		36.49	36.37	18.00	18.81
	Total	**108.37**	**140.13**	**102.83**	**128.97**	**96.33**	**114.77**	**104.33**	**126.77**		**134.78**		**108.37**	**98.46**
Surface water	Y841	42.71	42.71	-	-	44.46	44.46	44.46	44.46		45.58	45.46	42.71	66.20
	B513	101.86	101.86	-	-	105.00	105.00	105.00	105.00		136.75	136.40	101.86	105.00
	Total	**144.57**	**144.57**	-	-	**149.46**	**149.46**	**149.46**	**149.46**		**182.33**		**144.57**	**171.20**
	Total WRZ	**252.94**	**284.70**	**247.40**	**273.54**	**245.79**	**264.23**	**253.79**	**276.23**		**317.14**		**252.94**	**269.66**

WRZ	Hants Andover	Previous Assessments of DO				PR09 DO Assumptions								
		PR04		2006		PR09 Baseline		PR09 FINAL						Baseline
Type	Name	MDO	PDO	MDO	PDO	MDO	PDO	MDO	PDO		Ave Annual Licence	Daily Licence	PR04 ADO	Calc'd PR09 ADO
Groundwater	J827	16.00	19.88	16.02	19.88	16.02	19.88	16.02	19.88		16.02	19.89	16.00	16.02
	G812	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49		0.50	0.49	0.49	0.49
	Y438	0.15	0.45	0.00	0.00	0.00	0.00	0.00	0.00		0.82	1.18	0.15	0.00
	S748	2.94	4.26	2.94	4.75	2.94	4.75	2.94	4.75		5.71	6.55	2.94	3.39
	U155	1.64	1.64	1.40	1.46	1.38	1.44	1.58	1.64		1.64	1.64	1.64	1.39
	X856	1.64	1.64	1.64	1.64	1.64	1.64	1.64	1.64		1.64	2.64	1.64	1.64
	Total	**22.86**	**28.36**	**22.49**	**28.22**	**22.47**	**28.20**	**22.67**	**28.40**		**26.33**		**22.86**	**22.93**

WRZ	Hants Kingsclere	Previous Assessments of DO				PR09 DO Assumptions								
		PR04		2006		PR09 Baseline		PR09 FINAL						Baseline
Type	Name	MDO	PDO	MDO	PDO	MDO	PDO	MDO	PDO		Ave Annual Licence	Daily Licence	PR04 ADO	Calc'd PR09 ADO
Groundwater	J358	3.00	3.50	3.00	3.80	3.00	3.80	3.00	5.00		3.00	5.00	3.00	3.00
	V175	5.68	5.68	5.68	5.68	5.68	5.68	5.68	5.68		5.70	5.70	5.68	5.68
	Total	**8.68**	**9.18**	**8.68**	**9.48**	**8.68**	**9.48**	**8.68**	**10.68**		**8.70**		**8.68**	**8.68**

WRZ	Sussex North	Previous Assessments of DO				PR09 DO Assumptions								
		PR04		2006		PR09 Baseline		PR09 FINAL						Baseline
Type	Name	MDO	PDO	MDO	PDO	MDO	PDO	MDO	PDO		Ave Annual Licence	Daily Licence	PR04 ADO	Cald'd PR09 ADO
Groundwater	S466	13.39	24.47	16.00	27.00	13.00	27.00	13.00	27.00		33.75	33.75	13.39	16.45
	Q256	0.59	0.59	0.80	0.80	0.80	0.80	0.80	0.80		2.49	3.14	0.59	0.80
	I838	2.14	2.43	2.14	2.43	2.14	2.43	2.14	2.43		2.14	2.43	2.14	2.14
	G453	2.26	2.25	1.60	1.96	1.60	1.96	1.60	1.96		2.28	2.27	2.26	1.69
	T168	2.19	2.88	2.19	2.88	2.19	2.88	2.19	2.88		2.19	1.91	2.19	2.19
	W754	3.21	3.30	3.12	3.12	3.12	3.12	3.22	3.32		3.41	4.36	3.21	3.12
	B882	1.44	1.46	1.20	1.35	1.00	1.10	1.00	1.20		1.63	2.27	1.44	1.02
	Total	**25.22**	**37.38**	**27.05**	**39.54**	**23.85**	**39.29**	**23.95**	**39.59**		**47.89**		**25.22**	**27.42**
Surface water	R648	28.82	29.73			7.5	7.5	7.50	7.50		41.25	41.25	28.82	29.82
	G282	8.64	15.34			8.7	17	8.70	17.00		21.82	21.82	8.64	6.49
	Total	**37.46**	**45.07**			**16.20**	**24.50**	**16.20**	**24.50**		**63.07**		**37.46**	**36.31**
	Total WRZ	**62.68**	**82.45**	**64.51**	**84.61**	**40.05**	**63.79**	**40.15**	**64.09**		**110.96**		**62.68**	**63.73**

WRZ	Sussex Brighton	Previous Assessments of DO				PR09 DO Assumptions								
		PR04		2006		PR09 Baseline		PR09 FINAL						Baseline
Type	Name	MDO	PDO	MDO	PDO	MDO	PDO	MDO	PDO		Ave Annual Licence	Daily Licence	PR04 ADO	Calc'd PR09 ADO
Groundwater	A768	7.80	12.00	12.89	19.18	11.60	17.2	11.60	17.20		Brighton group licence	34.00	7.80	12.89
	N312	5.52	7.49	5.00	5.18	2.40	3.50	2.40	3.50			22.00	5.52	2.67
	W515	12.62	19.00	12.00	13.50	10.00	11.50	11.00	12.50			20.00	12.62	10.37
	U354	2.50	6.20	3.79	6.00	2.60	6.00	2.60	6.25			6.70	2.50	3.12
	C817	3.36	7.00	3.30	3.30	3.30	3.30	4.30	4.30			7.00	3.36	3.14
	R771	8.70	11.00	10.00	11.00	9.75	10.75	9.75	10.75			17.50	8.70	10.00
	N244	2.50	3.50	3.30	3.30	1.80	2.57	1.80	2.57			4.50	2.50	1.80
	E357	14.75	14.75	14.75	14.75	13.20	14.75	13.20	14.75			14.80	14.75	12.82
	J485	7.40	9.05	8.10	8.70	8.10	8.70	10.10	10.70			17.50	7.40	8.25
	K532	5.80	5.86	6.00	8.30	5.20	7.80	5.45	7.80			10.00	5.80	5.84
	S666	14.42	17.75	11.45	11.45	11.45	11.45	12.45	12.45			25.00	14.42	11.45
	S377	3.50	4.63	2.10	2.80	1.70	2.80	2.20	3.30			7.60	3.50	1.69
	X844	11.31	11.50	8.20	8.20	8.20	8.20	9.70	9.70		11.82	11.50	11.31	8.20
	Brighton group licence										104.11		88.87	84.04
	Total	**100.18**	**129.73**	**100.88**	**115.66**	**89.30**	**108.52**	**96.55**	**115.77**		**115.93**		**100.18**	**92.24**

WRZ	Sussex Worthing	Previous Assessments of DO				PR09 DO Assumptions								
		PR04		2006		PR09 Baseline		PR09 FINAL						Baseline
Type	Name	MDO	PDO	MDO	PDO	MDO	PDO	MDO	PDO		Ave Annual Licence	Daily Licence	PR04 ADO	Calc'd PR09 ADO
Groundwater	E351	3.55	4.00	3.90	4.00	3.90	4.00	3.90	4.00		Worthing group licence	4.00	3.55	3.35
	A163	3.13	4.32	4.50	4.50	4.50	4.50	4.50	4.50			4.50	3.13	3.95
	S216	18.00	18.00	13.00	15.50	10.00	11.50	11.00	12.50			22.50	18.00	10.37
	I747	5.29	7.69	9.30	14.00	8.20	12.30	8.20	12.30			25.00	5.29	9.21
	V281	3.00	3.30	2.30	2.80	2.30	2.30	3.05	3.05			4.50	3.00	2.21
	D758	4.29	7.97	6.25	8.68	6.15	8.68	6.15	8.68			11.50	4.29	6.56
	O516	4.46	4.46	4.50	4.50	4.50	4.50	4.50	4.50			13.50	4.46	4.50
	M584	2.31	5.59	4.50	7.00	4.50	7.00	7.00	7.00			7.00	2.31	4.25
	X862	2.00	3.10	2.79	2.90	2.10	2.20	2.10	2.20			9.00	2.00	2.12
	X574	5.55	7.00	7.00	7.00	7.00	7.00	7.00	7.00			7.00	5.55	6.26
	I831	5.00	5.00	5.00	5.00	4.70	5.00	4.70	5.00			5.00	5.00	4.77
	Worthing group licence										71.23		67.89	65.75
	Total	**56.58**	**70.43**	**63.04**	**75.88**	**57.85**	**68.98**	**62.10**	**70.73**		**71.23**		**56.58**	**57.55**

WRZ	Kent Medway	Previous Assessments of DO				PR09 DO Assumptions								
		PR04		2006		PR09 Baseline		PR09 FINAL						Baseline
Type	Name	MDO	PDO	MDO	PDO	MDO	PDO	MDO	PDO		Ave Annual Licence	Daily Licence	PR04 ADO	Calc'd PR09 ADO
Groundwater	S171	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		Faversham group licence	5.00	0.00	0.00
	Y445	10.95	11.30	11.70	11.70	11.70	11.70	11.70	11.70			18.00	10.95	11.70
	J516	0.00	4.52	0.00	4.10	0.00	4.05	0.00	4.95			5.00	0.00	0.00
	T454	0.00	4.16	0.00	5.00	0.00	5.00	0.00	5.00			5.00	0.00	0.00
	V482	10.20	15.40	13.60	13.60	13.30	13.30	14.05	14.05			22.00	10.20	13.30
	X652	7.10	7.15	7.00	9.50	6.60	9.50	6.60	9.50			10.00	7.10	6.70
	Bapchild	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		Sitting-bourne group licence	0.00	0.00	0.00
	S271	3.40	5.00	3.40	4.70	3.40	4.65	3.40	4.95			5.00	3.40	3.40
	I585	3.10	3.10	4.00	4.00	4.00	4.00	4.00	4.00			7.00	3.10	4.00
	H674	9.18	9.18	7.00	7.00	4.00	4.00	6.00	6.00			17.00	9.18	4.00
	O878	1.27	1.60	1.30	1.55	1.30	1.53	1.30	1.53			6.00	1.27	1.30
	D871	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00			4.00	0.00	0.00
	F871	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00			4.00	0.00	0.00
	C552	15.82	19.15	10.50	10.50	10.10	10.20	12.60	12.70			28.00	15.82	10.12
	F364	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00			1.50	0.00	0.00
	D284	0.00	3.90	0.00	4.40	0.00	4.33	0.00	4.33			5.00	0.00	0.00
	H358	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00			1.50	0.00	0.00
	N578	3.50	3.80	2.80	2.80	2.80	2.80	3.80	3.80		Chatham group licence	10.00	3.50	2.80
	B416	1.40	1.40	1.40	1.40	1.40	1.40	1.40	1.40			3.00	1.40	1.40
	T314	5.10	5.10	6.30	6.30	6.30	6.30	7.30	7.30			15.00	5.10	6.30

WRZ	Kent Medway	Previous Assessments of DO				PR09 DO Assumptions								
		PR04		2006		PR09 Baseline		PR09 FINAL						Baseline
Type	Name	MDO	PDO	MDO	PDO	MDO	PDO	MDO	PDO		Ave Annual Licence	Daily Licence	PR04 ADO	Calc'd PR09 ADO
	C815	5.20	5.20	4.60	4.60	4.50	4.50	5.00	5.00			11.00	5.20	4.50
	N366	0.70	0.75	0.00	0.00	0.00	0.00	0.00	0.00			5.00	0.70	0.00
	H685	4.82	5.40	4.20	5.00	2.60	3.00	2.60	3.00			7.00	4.82	2.70
	O555	6.70	6.70	5.10	9.00	4.80	9.00	4.80	9.30		Northfleet group licence	21.00	6.70	4.87
	S355	6.28	7.40	5.60	5.80	5.30	5.75	5.30	5.75			9.00	6.28	5.37
	J273	0.82	0.84	0.73	0.80	0.63	0.66	0.63	0.66			3.00	0.82	0.64
	N322	0.00	0.00	4.80	4.90	4.65	4.80	4.65	4.80			0.00	0.00	4.69
	Q156	3.00	3.00	2.90	2.90	2.90	2.90	2.90	2.90			6.50	3.00	2.90
	W513	1.38	1.58	1.60	1.60	1.60	1.60	1.60	1.60			2.50	1.38	1.60
	V421	8.52	8.74	7.20	7.50	7.00	7.45	8.00	8.45			20.00	8.52	7.05
	E762	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00			4.00	0.00	0.00
	V174	2.75	4.00	3.45	3.45	2.80	2.80	2.80	2.80			13.00	2.75	2.80
	O655	0.70	0.80	0.45	0.70	0.45	0.70	0.45	0.70			2.00	0.70	0.45
	C458	0.00	0.00	1.02	3.10	1.02	2.65	1.02	2.65			7.00	0.00	1.02
	I124	6.83	7.88	6.83	7.40	6.83	7.10	6.83	7.10		6.83	9.01	6.83	6.83
	Northfleet group licence					31.15	38.31	32.15	39.61		48.49	88.00	30.15	31.39
	Chatham group licence					17.60	18.00	20.10	20.50		25.48	51.00	20.72	17.70
	Sittingbourne group					22.80	28.71	27.30	33.51		40.99	75.50	32.77	22.82
	Faversham group					31.60	43.55	32.35	45.20		36.71	60.00	28.25	31.70

WRZ	Kent Medway	Previous Assessments of DO				PR09 DO Assumptions								
		PR04		2006		PR09 Baseline		PR09 FINAL						Baseline
Type	Name	MDO	PDO	MDO	PDO	MDO	PDO	MDO	PDO		Ave Annual Licence	Daily Licence	PR04 ADO	Calc'd PR09 ADO
	Total	**118.72**	**147.05**	**117.48**	**143.30**	**109.98**	**135.67**	**118.73**	**145.92**		**158.50**		**118.72**	**110.44**
Surface water	G457	46.73	47.51	-	-	34.60	46.90	34.60	46.90		103.29		46.73	30.90
	Total	**46.73**	**47.51**			**34.60**	**46.90**	**34.60**	**46.90**		**103.29**		**46.73**	**30.90**
	Total WRZ	**165.45**	**194.56**	**164.21**	**190.81**	**144.58**	**182.57**	**153.33**	**192.82**		**261.79**		**165.45**	**141.34**

WRZ	Kent Thanet	Previous Assessments of DO				PR09 DO Assumptions								
		PR04		2006		PR09 Baseline		PR09 FINAL						Baseline
Type	Name	MDO	PDO	MDO	PDO	MDO	PDO	MDO	PDO		Ave Annual Licence	Daily Licence	PR04 ADO	Calc'd PR09 ADO
Groundwater	P338	6.03	6.13	2.50	4.50	1.75	4.00	1.75	4.00		Thanet group licence	14.77	6.03	2.30
	U222	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00			0.00	0.00	0.00
	Q773	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00			5.68	0.00	0.00
	F565	1.50	1.50	2.00	2.50	2.00	2.20	2.00	2.20			5.00	1.50	2.05
	M841	5.50	5.50	5.80	5.90	5.80	5.90	5.80	5.90			6.82	5.50	5.82
	Q376	3.00	3.40	4.32	4.32	4.30	4.30	4.30	4.30		6.23	9.09	3.00	4.30
	R168	8.60	9.05	8.85	9.00	8.45	8.85	8.45	8.85		9.34	11.37	8.60	8.55
	G772	1.00	1.25	1.00	1.20	1.00	1.08	1.00	1.08		2.18	2.73	1.00	1.02
	I446	5.50	5.50	6.82	6.82	6.82	6.82	6.82	6.82		6.84	6.82	5.50	6.82
	E161	3.64	4.55	3.64	4.30	3.64	4.30	3.64	4.30		3.64	4.55	3.64	3.64
	A374	4.40	4.40	5.00	5.00	5.00	5.00	5.00	5.00		6.84	6.82	4.40	5.00
	X868	20.00	20.40	13.50	21.50	13.50	17.00	13.50	17.00		25.01	31.82	20.00	14.36
	A853	2.49	2.73	2.49	2.73	2.49	2.73	2.49	2.73		2.49	2.73	2.49	2.49
	Thanet Group licence					9.55	12.10	9.55	12.10		19.87	41.36	13.03	10.18
	Total	**61.66**	**64.41**	**52.14**	**62.88**	**50.97**	**57.29**	**50.97**	**57.29**		**82.44**		**61.66**	**56.36**
Surface water	T656	3.26	3.26	-	-	3.50	3.50	3.50	3.50		9.21		3.26	4.51
	Total	**3.26**	**3.26**			**3.5**	**3.5**	**3.50**	**3.50**		**9.21**		**3.26**	**4.51**

WRZ	Kent Thanet	Previous Assessments of DO				PR09 DO Assumptions								
		PR04		2006		PR09 Baseline		PR09 FINAL						Baseline
Type	Name	MDO	PDO	MDO	PDO	MDO	PDO	MDO	PDO		Ave Annual Licence	Daily Licence	PR04 ADO	Calc'd PR09 ADO
	Total WRZ	64.92	67.67	55.40	66.14	54.47	60.79	54.47	60.79		91.65		64.92	60.87

WRZ	Sussex Hastings	Previous Assessments of DO				PR09 DO Assumptions								
		PR04		2006		PR09 Baseline		PR09 FINAL						Baseline
Type	Name	MDO	PDO	MDO	PDO	MDO	PDO	MDO	PDO		Ave Annual Licence	Daily Licence	PR04 ADO	Calc'd PR09 ADO
Groundwater	L832	2.23	3.77	2.00	2.00	1.20	1.50	1.20	1.50		2.27	8.73	2.23	1.27
	A272	0.00	0.00	-	-	0.00	0.00	0.00	0.00		0.93	2.27	0.00	0.00
	S556	0.00	0.00	-	-	0.00	0.00	0.00	0.00		1.00	1.59	0.00	0.00
	S416	0.61	1.99	0.62	2.00	0.62	2.00	0.62	2.25		0.62	2.55	0.61	0.62
	S638	0.00	0.00	-	-	0.00	0.00	0.00	0.00		0.06	0.07	0.00	0.00
	Total	**2.84**	**5.76**	**2.62**	**4.00**	**1.82**	**3.50**	**1.82**	**3.75**		**4.88**		**2.84**	**1.89**
Surface water	G587	15.72	23.11	-	-	34.4	33.5	34.40	33.5		30.66	34.00	15.72	35.40
	O451	4.21	10.82	-	-	4.26	9.35	4.26	9.35			10.91	4.21	2.68
	Total	**19.93**	**33.93**			**38.66**	**42.85**	**38.66**	**42.85**		**30.66**		**19.93**	**38.08**
	Total WRZ	**22.77**	**39.69**	**22.55**	**37.93**	**40.48**	**46.35**	**40.48**	**46.60**		**35.54**		**22.77**	**39.97**

D.1.7 References

Atkins (June 2007), *Sussex North Water Resource Investigations - Phase 1 Options Appraisal Report*, ref: 5036056/70/DG/31

Atkins (September 2007), *Sussex North Water Resource Investigations - Phase 2 Options Appraisal Report*, ref: 5036056/70/DG/70

Atkins (December 2007), *Sussex North Water Resource Investigations - Phase 3 Options Appraisal Report*, ref: 5036056/70/DG/122

Atkins (June 2006), *Kent and Sussex Hastings Water Resources Investigations - Phase 1 Options Appraisal Report*, ref: 5036266/70/DG/55

Atkins (November 2007), *Kent & Sussex Hastings Water Resources Investigations - Southern Water Phase 2 Options Report*, ref: 5036266/70/DG/145

Atkins (March 2007), *Hampshire and Isle of Wight Water Resources Investigations - Phase 1 Options Appraisal Report*, ref: 5035386/70/DG/29

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Atkins (July 2008) *Surface water Deployable Output (DO)*, ref 5050675/70/DG/036

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HR Wallingford, (2007), *The 'Long Drought' in South East England 1890 to 1909: Evidence and reasons for inclusion in Southern Water's Draft Water Resources Plan, Technical Note*

Scott Wilson, 2008, *Reassessment of Water Company Yields, Hampshire North Resource Zone, 2006 Groundwater Deployable Outputs.*

Scott Wilson, 2008, *Reassessment of Water Company Yields, Hampshire South Resource Zone, 2006 Groundwater Deployable Outputs.*

Scott Wilson, 2008, *Reassessment of Water Company Yields, Isle of Wight Resource Zone, 2006 Groundwater Deployable Outputs.*

Scott Wilson, 2008, *Reassessment of Water Company Yields, Kent Medway Resource Zone, 2006 Groundwater Deployable Outputs.*

Scott Wilson, 2008, *Reassessment of Water Company Yields, Kent Thanet Resource Zone, 2006 Groundwater Deployable Outputs.*

Scott Wilson, 2008, *Reassessment of Water Company Yields, Sussex Coast Resource Zone, 2006 Groundwater Deployable Outputs.*

Scott Wilson, 2008, *Reassessment of Water Company Yields, Sussex Hastings Resource Zone, 2006 Groundwater Deployable Outputs.*

Scott Wilson, 2008, *Reassessment of Water Company Yields, Sussex North Resource Zone, 2006 Groundwater Deployable Outputs.*

D.2 Process Losses

Southern Water have reviewed the process and operational losses from all their Water Supply Works. The results of this review are presented below.

TREATMENT WORKS OPERATIONAL USE
SURFACE WATER TREATMENT

Name of Works	PR04		Current		FWRMP		Notes	Process Loss at MDO Ml/d	Process Loss at PDO Ml/d
	Fixed Losses Ml/d	Variable Losses %	Fixed Losses Ml/d	Variable Losses %	Fixed Losses Ml/d	Variable Losses %			
Isle of Wight									
Sandown	1.18			0.5%		0.5%	Assumed time based backwash independent of throughput. PR04 scheme to include process loss recovery for completion 31/03/08. Sludge to be dewatered and thickened sludge to sewer. Assume sludge at 2% and raw water and initial solids at 50mg/l	0.05	0.06
							Total	**0.05**	**0.06**
Hampshire South									
Testwood	1.36	1.7	1.36	1.7%	0	0.5%	Apply to total output, including Esso and Island volume. PR09 scheme to include process loss recovery. FWMRP: scheme completed by March 2013	0.22	0.22
Otterbourne SW	1.1	1.7		0.1%		0.1%	Wastewater recovery now installed. Data show .6m3/hr sludge to waste. Allowing for outage estimate at 0.1% to waste	0.11	0.11
							Total	**0.33**	**0.33**
Hampshire Andover									
Hampshire Kingsclere									
Sussex North									
Hardham High		0.8		0.5%		0.5%		0.04	0.04
Weir Wood	0.52	0.9		0.5%		0.5%	Include supply to S.E. water in variable loss calculation. Sludge plant refurbished as part of Weir Wood scheme. Completion 31/03/08. Note: PDO is demand constrained, so no process loss	0.04	0.00
							Total	**0.08**	**0.04**
Sussex Worthing									
Sussex Brighton									
Sussex Hastings									
Beauport		0.8		1.0%		1.0%	Additional processes increase losses. Not reducible without large capex and overcome of disposal constraints to environment	0.19	0.23
Brede		0.8		1.0%		1.0%	Additional processes increase losses. Not reducible without large capex and overcome of disposal constraints to environment	0.15	0.15
							Total	**0.34**	**0.38**
Kent Medway									
Burham		0.8		0.5%		0.5%	Recycling installed. Include Mid Kent supply in variable loss calculation	0.15	0.15
							Total	**0.15**	**0.15**
Kent Thanet									
Plucks Gutter		5.5		5.5%		5.5%	Based on 200 cu.m. per unit. Assume that new plant for PR09 will include process recovery after date of completion according to WRMP need. FWRMP: might change but unlikely to be funded. Use Current rather than Proposed values (MP, Nov 08)	0.19	0.19
							Total	**0.19**	**0.19**

TREATMENT WORKS OPERATIONAL USE
GROUNDWATER WORKS - DISINFECTION PROCESS ONLY

	PR04 Ml/d	Current	PR09	FWRMP	CRIT 0.01	Cond 0.01	Turbidity 0.01	Plumbo 0.01	Nitrate 0.01	Other	Comments
ISLAND											
Carisbrooke	0.043	0.05	0.05	0.05	1		3	1			
Bowcombe	0.01	0.02	0.02	0.02	1		1				
Chillerton	0.01	0.02	0.02	0.02	1		1				
Ventnor	0.01	0.03	0.03	0.03	1		1	1			
St Lawrence	0.001	0.03	0.03	0.03	1		1	1			
Calbourne	0.003	0.03	0.03	0.03	1		1	1			
Shalcombe	0.005	0.03	0.03	0.03	1		1	1			
Niton	0.005	0.03	0.03	0.03	1		1		1		
Total	**0.087**	**0.24**	**0.24**	**0.24**							
HAMPSHIRE SOUTH											
Timsbury	0.01	0.03	0.03	0.03	1		1	1			
Twyford	0.01	0.04	0.04	0.04	1		1	1	1		
Twyford Moors	0.01	0.03	0.03	0.03	1		1	1			
Easton	0.01	0.02	0.02	0.02	1		1				
Totford	0.01	0.03	0.03	0.03	1		1	1			
Barton Stacey	0.01	0.02	0.02	0.02	1		1				
Total	**0.06**	**0.17**	**0.17**	**0.17**							
HAMPSHIRE ANDOVER											
Horsebridge	0.01	0.02	0.02	0.02	1		1				
Chilbolton	0.01	0.02	0.02	0.02	1		1				
Whitchurch	0.01	0.02	0.02	0.02	1		1				
Ibthorpe	0.01	0.02	0.02	0.02	1		1				
Faberstown	0.01	0.03	0.03	0.03	1		1		1		
Total	**0.05**	**0.11**	**0.11**	**0.11**							
HAMPSHIRE KINGSCLERE											
Kingsclere	0.01	0.02	0.02	0.02	1		1				
Woodhay	0.01	0.02	0.02	0.02	1		1				
Total	**0.02**	**0.04**	**0.04**	**0.04**							
SUSSEX NORTH											
Steyning	0.02	0.03	0.03	0.03	1		1	1			
Lodsworth	0.02	0.02	0.02	0.02	1		1				
Total	**0.04**	**0.05**	**0.05**	**0.05**							
SUSSEX WORTHING											
Angmering	0.01	0.02	0.02	0.02	1		1				
Clapham	0.02	0.02	0.02	0.02	1		1				
Patching	0.01	0.03	0.03	0.03	1		1	1			
Stanhope Lodge	0.01	0.03	0.03	0.03	1		1	1			
Total	**0.05**	**0.1**	**0.1**	**0.1**							
SUSSEX BRIGHTON											
Newmarket	0.01	0.06	0.06	0.06	2		3	1			
Shoreham	0.02	0.04	0.04	0.04	1	1	1	1			
Mile Oak	0.01	0.03	0.03	0.03	1		1	1			
Goldstone	0.01	0.04	0.04	0.04	1		1	1	1		Nitrate process losses ignored as unlikely to be in service at times of
Housedean	0.01	0.03	0.03	0.03	1		1	1			
Mossy Bottom	0.01	0.04	0.04	0.04	1		1	1	1		
Southover	0.01	0.03	0.03	0.03	1		1	1			
Balsdean	0.01	0.04	0.04	0.04	1	1	1	1			
Total	**0.09**	**0.31**	**0.31**	**0.31**							

	PR04 Ml/d	Current	PR09	FWRMP	CRIT 0.01	Cond 0.01	Turbidity 0.01	Plumbo 0.01	Nitrate 0.01	Other	Comments
SUSSEX HASTINGS											
Total	**0**	**0**	**0**	**0**							
KENT MEDWAY											
Northfleet Chalk	0.01	0.04	0.04	0.04	2		1	1			
Hazells	0.01	0.02	0.02	0.02	1		1				
Higham	0.01	0.02	0.02	0.02	1		1				
Three Crutches	0.01	0.02	0.02	0.02	1		1				
Strood	0.01	0.03	0.03	0.03	2		1				
Cuxton	0.01	0.04	0.04	0.04	1		3				
Lower Bush (in Cuxton)	0.01	0.05	0.05	0.05	1	1	2		1		Organics plus nitrate
Fawkham	0.01	0.04	0.04	0.058	2		2	1		0.008	scheme by 2012
Nashenden	0.01	0.04	0.04	0.04	1	1	2				
Snodhurst	0.01	0.02	0.02	0.02	1		1				
Luton	0.01	0.05	0.05	0.05	2		2	1			
Capstone Chalk)	0	0	0	0							Treated at Luton
Capstone Greensand)	0.01	0	0	0							Treated at Luton
Rainham Mark	0.01	0.02	0.02	0.02	1		1				
Keycol	0.01	0.04	0.04	0.04	2		1	1			
Highsted	0.01	0.03	0.03	0.03	2		1				
Matts Hill	0.02	0.05	0.05	0.075	2		4	1		0.005	by JR10/AMP4
Gore	0.01	0.02	0.02	0.02	1		1				
Danaway	0.01	0.02	0.02	0.02	1		1				
Trundle Wood	0.01	0.03	0.03	0.03	2		1				Treated at Bottom Pond
Belmont	0.01	0.04	0.04	0.04			4				Treatment at Eastling
Throwley	0.01	0.04	0.04	0.04			4				Treatment at Eastling
Selling	0.02	0.06	0.06	0.06	1		5				Treatment at Eastling
Hockley Hole		0.01	0.01	0.01			1				Treatment at Eastling
Kettle Hill	0	0.03	0.03	0.03			3				Treatment at Eastling
Eastling	0.01	0.04	0.04	0.04	1		2	1			
Total	**0.25**	**0.8**	**0.8**	**0.843**							
KENT THANET											
Rumfields	0.01	0.02	0.02	0.02	1		1				Assumed chlorination only, when return
Sparrow Castle	0.01	0.03	0.03	0.03	1		1	1			
Minster B	0.01	0.02	0.02	0.02	1		1				
Flemings	0.01	0.02	0.02	0.02	1		1				
Woodnesborough	0.01	0.02	0.02	0.02	1		1				
Wingham	0.01	0.03	0.03	0.03	1		1	1			
Martin Mill	0.01	0.03	0.03	0.03	1		1	1			
Deal	0.01	0.03	0.03	0.03	1		1	1			
Martin Gorse	0.01	0.02	0.02	0.02	1		1				
Sutton	0.01	0.02	0.02	0.02	1		1				
Ringwould	0.01	0.03	0.03	0.03	1		1	1			
Total	**0.11**	**0.27**	**0.27**	**0.27**							

General Note
Increases in flow to waste due to increase in instrumentation at GW sources.

TREATMENT WORKS OPERATIONAL USE
GROUNDWATER WORKS - DISINFECTION AND ADDITIONAL PROCESSES

	PR04 Ml/d	Current	PR09 Ml/d	FWRMP	CRIT 0.01	Cond 0.01	Turbidity 0.01	Plumbo 0.01	Other	Comments
ISLAND										
Knighton	0.17	0.17	0.17	0.17			1	1		See details in folder D1, for Iron removal plus others
Niton	0.01	0.03	0.03	0.03	1		1		0.010	Nitrate monitor. No GAC backwash
Total	**0.18**	**0.20**	**0.20**	**0.20**						
HAMPSHIRE SOUTH										
Overton	0.01	0.03	0.03	0.03	1		1	1	0.002	GAC plant. Backwash 45l/sec for 10 min each 28 days, 2 filters
Otterbourne GW	0.00	0.65	0.65	0.65					0.650	Microfiltration
Total	**0.01**	**0.68**	**0.68**	**0.68**						
HAMPSHIRE ANDOVER										
Andover	0.01	0.02	0.02	0.02	1		1		0.003	GAC plant. Backwash 45l/sec for 10 min each 28 days, 3 filters
Total	**0.01**	**0.02**	**0.02**	**0.02**						
HAMPSHIRE KINGSCLERE										
Total	**0.00**	**0.00**	**0.00**	**0.00**						
SUSSEX NORTH										
Haslingbourne	0.02	0.04	0.04	0.04	1		1	1	0.006	Pressure filter backwash @ 6cu.m. per day
Rogate	0.04	0.07	0.07	0.07	3		2		0.018	Filter wash at 18 cu.m. per day
Smock Alley	0.20	0.20	0.20	0.20					0.200	Filter washing at 200cu.m. per day. Instrument water is recycled
Total	**0.26**	**0.30**	**0.30**	**0.30**						
SUSSEX WORTHING										
Madehurst	0.07	0.08	0.08	0.08	1	1	1	1	0.040	Pressure filter backwash. 7 filters backwash at 40cu.m. each week.
Burpham	0.15	0.16	0.16	0.16	2	1	11	1	0.005	Pressure filter backwash. 9 filters backwash with 1cu.m. each 40 hrs.
Findon	0.05	0.07	0.07	0.07	1		2	1	0.029	5 pressure filters backwash with 40 cu.m. once per week.
Broadwater	0.01	0.05	0.05	0.05	3		1	1	0.005	GAC plant. Backwash 5 shells at 27cu.m. each 30 days
Northbrook	n/a	0.10	0.10	0.10	1	2	5	1	0.008	Assume future use as 2 shells at 27cu.m. washed weekly
Sompting	0.02	0.04	0.04	0.04	1	1	1	1	0.004	GAC plant. Backwash 4 shells at 27cu.m. each 30 days
Total	**0.30**	**0.50**	**0.50**	**0.50**						
SUSSEX BRIGHTON										
Falmer	0.02	0.04	0.04	0.04	1		1	1	0.005	GAC plant. Backwash 1 shells at 72cu.m. each 14 days
Patcham	0.01	0.03	0.03	0.03	1		1	1	0.004	GAC plant. Backwash 4 shells at 27cu.m. each 30 days
Lewes Road	0.01	0.03	0.03	0.03	1		1	1	0.003	GAC plant. Backwash 1 shells at 43cu.m. each 14 days
Arundel	0.01	0.09	0.09	0.09	2		3	1	0.030	Microfiltration Plant assumed at 5% pending confirmation
Total	**0.05**	**0.19**	**0.19**	**0.19**						
SUSSEX HASTINGS										
Total	**0.00**	**0.00**	**0.00**	**0.00**						
KENT MEDWAY										
Luddesdown Chalk	0.00	0.03	0.03	0.03	1		1	1		
Luddesdown Greensand	0.04	0.03	0.03	0.03			1		0.018	Iron removal as Rogate plant
Windmill Hill	n/a	0.15	0.15	0.15	1	3	2	1	0.075	Nitrate removal plant plus GAC,plus hydro and 2xnitrate monitors
Total	**0.04**	**0.20**	**0.20**	**0.20**						
KENT THANET										
Lord of Manor/Whitehall	0.13	0.15	0.15	0.15	1		1	1	0.120	Nitrate removal plant. Based on output of 4.5 Ml/d
Total	**0.13**	**0.15**	**0.15**	**0.15**						

D.3 Outage

Outage is defined as a temporary loss of deployable output (UKWIR 1995). Each outage event at any given source is thus limited to a maximum of 90 consecutive days to meet the 'temporary' status of the outage event. Where a source suffers an outage event lasting longer than 90 days it is considered to be out of service (rather than having an outage) until it can be re-introduced.

The total outage allowances for each WRZ used for the PR04 regulatory submission was based on the pragmatic approach as the lower of either the average groundwater source MDO / PDO within the zone or 5 Ml/d. The outage allowances that were thus used in the PR04 Water Resources Plan are presented below.

	PR04 MDO/ Average	PR04 Peak
Hampshire Andover	2.0	2.0
Hampshire Kingsclere	1.0	1.0
Hampshire South	5.0	5.0
Isle of Wight	3.2	3.2
Kent Medway	5.0	5.0
Kent Thanet	5.0	5.0
Sussex Hastings	1.1	1.1
Sussex North	2.0	3.0
Sussex Coast	5.0	5.0
SWS Total	29.3	30.3

Table D.1 Outage Allowances Used in PR04 WRP

D.3.1 Approach to PR09 Outage Re-assessment

An assessment of outage can be carried out based on estimates of duration, frequency and magnitude for each outage event for each source within the supply area. However, it was not possible to do this given the relatively short datasets available, therefore, the approach adopted was to calculate the total outage in each WRZ on each day for which data was available. This was achieved using data which described whether a source was operating or not on any given day, together with the deployable output of the source (using the best estimate of source deployable output at the time of assessment).

On any given day it is possible to have more than one outage event in a WRZ. It is therefore considered to be prudent to make allowances for potential outages arising from combinations of simultaneous outage events in a WRZ – i.e. where more than one outage event occurred in each WRZ simultaneously on any given day.

The critical MDO period is generally considered to last for approximately two months (e.g. October to November), although it can last longer. Therefore, to assess outage affecting the MDO period (which was also assumed to apply to the annual average period), the rolling 60 day average of the daily total outage volumes in a given WRZ was derived. This effectively determined the average outage condition that might be expected during the two month MDO period. The approach assumes that outages are random events which can occur at any time during the year, and so are equally likely to

occur during the MDO period as in the rest of the year. It is therefore considered applicable to use a rolling average for the whole data period to estimate the MDO outage.

A similar approach was used for assessing PDO outage. However, in this case the rolling 7 day average of the daily outage volumes was used. Ideally, planned outage events should be excluded from the analysis. However, historic data did not always distinguish between planned and unplanned outages, so this approach was not possible. Outages are assumed to occur randomly, and therefore deemed to have the same probability of occurring during the peak period as in the whole year.

This assessment enabled a cumulative distribution function of outage events to be developed for the 60-day rolling average scenario and for the 7-day rolling average scenario. These cumulative distribution functions were subsequently used to derive percentiles of certainty for the outage allowances.

In order to derive an outage value for each WRZ, it is necessary to define the appropriate outage percentile. However, the number of groundwater sources varies significantly between WRZs. In WRZs with few groundwater sources an outage event at one source could result in a significant loss of supply within that zone – i.e. an outage event could present a high risk to the company's ability to meet demand in that zone. Therefore, it is prudent for the outage percentile to be relatively high for planning purposes. Conversely, in WRZs with a large number of sources, the supply risk from an outage at one source is likely to be low, and therefore it is considered reasonable to accept a lower outage percentile when determining the outage allowance.

A pragmatic approach was developed to aid percentile choice based on the number of groundwater sources in each zone. The assumed relationship between number of groundwater sources in the WRZ and the appropriate outage percentile is presented in Figure D.1.

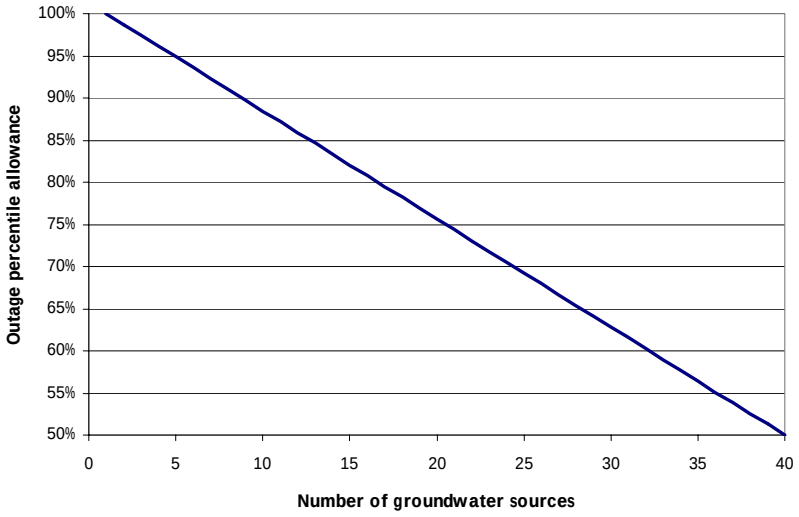

Figure D.1: Relationship of Percentile Outage Allowance to Number of Groundwater Sources for Planning Purposes

D.3.2 Results of Outage Re-assessment

A risk-based approach to the calculation of outage has been adopted for this re-assessment. The outage allowance for each WRZ, based on the methodology outline above, is presented in the table below.

Area	WRZ	Percentile Used	Outage Allowance (Ml/d)	
			MDO	PDO
Western	IoW	*Not used*	1.93	2.34
	HS	94%	4.59	6.54
	HK	99%	0.77	1.49
	HA	92%	1.52	2.44
	Total	**-**	**8.81**	**12.80**
Central	SN	90%	2.34	2.30
	SW	87%	3.07	4.39
	SB	85%	3.63	5.18
	Total	**-**	**9.04**	**11.87**
Eastern	SH	96%	1.62	3.94
	KM	54%	4.06	5.90
	KT	78%	3.62	4.64
	Total	**-**	**9.29**	**14.48**
Company total		**-**	**27.15**	**39.16**

Table D.2 Summary of Outage Allowances by WRZ

Outage events have not been observed at surface water sources in recent years, hence the estimates presented in Table D.2 are based on groundwater outage events only, with the sole exception of Sussex Hastings where estimates take into account known outages to surface water sources.

Periods of analysis for each WRZ have varied depending on the availability of historic data. In the Sussex Hastings WRZ for example, there have been no recorded outage events since 2001, and so values are based on data from 1992-2000. For the Hampshire Andover and Hampshire Kingsclere WRZs, there have been very few outage events during the period under consideration, so the calculated figures are based on the Sussex Coast cumulative distribution function, but with the percentile calculated using the number of groundwater sources in each WRZ.

For the Isle of Wight WRZ, the previous pragmatic approach was followed because the calculated outage value was considered to be high, especially at peak, and does not reflect recent operational practice. Thus, it is calculated as the average of the MDO and PDO groundwater deployable outputs.

Sussex Coast WRZ has been split into two new WRZs for this WRMP: Sussex Brighton and Sussex Worthing. However, historic data is only available for the Sussex Coast WRZ as a whole. The outage allowances for the two new zones is therefore based on that of the former Sussex Coast WRZ but apportioned according to the number of groundwater sources in each zone.

D.3.3 References

UKWIR, (1995), Outage Allowances for Water Resources Planning

D.4 Sustainability Reductions

Southern Water received three letters from the Environment Agency regarding proposed Sustainability Reductions:

- Water Resource Planning & Restoring Sustainable Abstractions, 21 March 2007;
- Sustainability Reductions for Statutory Water Resources Plans, 11 June 2007;
- PR09 National Environment Programme, 28 November 2008.

These are reproduced below.

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Environment Agency

Mr Les Dawson
Managing Director
Southern Water
Southern House
Yeoman Road
Worthing West Sussex
BN13 3NX

Our ref:

Date: 21 March, 2007

10 APR 2007
RECEIVED

Dear Mr Dawson Les

Water Resource Planning & Restoring Sustainable Abstraction

You will be starting your work on a statutory water resource plan in April. We said in our consultation on the draft water resources planning guideline that we would let you know when we will provide information on the sustainability reductions.

To help you plan your work we have now collated that information and a table is attached showing the information for your water company.

The information does not show the actual reductions but shows when we expect the information will be available. It is based on our current best information; we will update the timetable if there are any significant changes.

We are working hard to complete our responsibilities under Restoring Sustainable Abstraction and to provide the information water companies need. Many water resources investigations are being carried out by water companies as part of the AMP4 Programme and I would encourage you to make sure you support the timely completion of the work.

More information will be available from your Environment Agency Area RSA contacts and from your colleagues working on the AMP4 programme.

Yours sincerely

Howard

Howard Davidson
Regional Director

Direct dial 01903 832001
Direct fax 01903 210921
Direct e-mail howard.davidson@environment-agency.gov.uk

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RSA and Southern Water - v0.5 March 2007

Context

This is a high level 'snapshot' analysis to show when we expect information on sustainability reductions to be available on a scheme and company basis. It is based on the assumptions listed below. Where appropriate these have been supplemented by local knowledge. **Companies will be closely involved with the majority of these schemes, particularly those in the AMP4 programme**.

- Completion of an investigation [completion of Stage 3 Review of Consents] will give an **indicative sustainability reduction**. This may be limited to the licences that will need to be modified.
- Completion of an options appraisal study will give a **definitive sustainability reduction**
- 'Sustainability reduction' is taken to include a reduction in a licensed quantity [which can be translated into deployable output], requirement to change the operation of a source(s) or agreement of the need to construct a fish screen etc. At the minimum it will be the identification of the required licence change or construction of a fish screen/pass etc..
- 'Sustainability reduction' can also be taken to mean '0', i.e. following investigation no further action is required
- May 2007 and December 2008 have been selected by Environment Agency strategic planners as key dates in the statutory Water Resources Management Plan process

The site names highlighted in yellow are AMP4 funded schemes.

When quoting RSA schemes in plans water companies **should** use the same reference as given in the PR04 Final Determination (Table 20W). Where this reference is not available the company should use a reference provided by their local Environment Agency RSA contact.

SOUTHERN WATER				We will have:				We will not have SR to include in the plan
Site name	**Driver**	**Priority**	**Current status**	**Definite SR by May 2007**	**Indicative SR by May 2007**	**Definite SR by December 2008**	**Indicative SR by December 2008**	
River Itchen cSAC	HD	High	Options Appraisal s.52 Pilot	✓(we intend to complete stage 4 site action plan by May 2007)				
North Kent Marshes	HD	Medium	Investigation			✓		
Solent Maritime cSAC	HD	High	Options Appraisal			✓		
Solent and Southampton Water SPA	HD	High	Options Appraisal			✓		
Arun Valley SPA, Ramsar, SSSI	HD	Medium	Investigation			✓		

SOUTHERN WATER				We will have:				We will not have SR to include in the plan
Site name	**Driver**	**Priority**	**Current status**	**Definite SR by May 2007**	**Indicative SR by May 2007**	**Definite SR by December 2008**	**Indicative SR by December 2008**	
Little Stour	BAP	-	Investigation					✓
Wingham River	BAP	-	Investigation					✓

Back to contents.

creating a better place

Mr Les Dawson
Managing Director
Southern Water Services Ltd
Southern House
Yeoman Road
Worthing
West Sussex BN13 3NX

Environment Agency

Our ref: HD/ejc

Date: 11 June, 2007

14 JUN 2007

Dear Les,

Sustainability Reductions for Statutory Water Resources Plans

I am writing to advise you of abstraction and sustainability reductions for your statutory water resources management plan as promised in my letter of 21 March 2007.

I enclose a table that shows indicative changes to abstractions in your water company area for those schemes where we identified information would be available by May 2007. Where possible we have provided information on additional schemes.

In most cases the reductions described in the table show how we expect abstractions to change. You will need to use the information to decide the impact on deployable output. Where we feel we can indicate an impact on deployable output we have done so, though we recommend you still make your own assessment of the impact of the proposed licence change. If your assessment differs from ours, your team should discuss this with my water resources planning team.

The information we have provided is for schemes to reduce abstraction at sites designated under the Habitats Directive, SSSIs and other sites. We are still discussing with Defra and Ofwat which schemes will be funded through the next periodic review of water company prices and which will be dealt with through revocation of licences and associated compensation. When we have had confirmation of the schemes which can be funded we will write to you again.

We will be updating the tables between now and December 2008 and will provide more information as it becomes available. Many water resources investigations and option appraisal studies are being carried out by water companies as part of the AMP4 Programme and I would ask you to ensure the timely completion of the work.

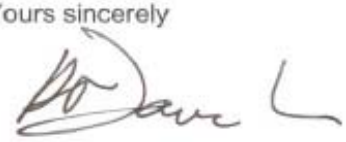
There may be additional schemes or investigations that do not affect the supply-demand balance. These will be included in our National Environment Programme proposals as part of PR09. We will contact you separately about this.

Page 1

Other companies have a role in the investigations of the North Kent Marshes and Little Stour. Please liaise with Mid Kent Water and Folkestone and Dover Water in respect of these investigations, to progress them together and as soon as possible. We have indicated deployable output reductions for the River Itchen, we hope you will work with Portsmouth Water to resolve the best solution to these reductions.

My water resources planning team should be your primary contact to discuss the application of sustainability reductions in your water resources plan. Please liaise through water resources planning contacts for more information on the schemes or for discussion of deployable output reductions.

Yours sincerely



Howard Davidson
Regional Director
Environment Agency Southern Region

SOUTHERN WATER				DATE: May 2007
Site name	**Driver**	**Priority**	**Current status**	**Indicative**
River Itchen SAC Licences: 11/42/22.6/92 (Twyford) 11/42/22.7/94 (Otterbourne Groundwater, including Twyford Moors) 11/42/22.6/93 (Otterbourne Surface Water)	HD	High	Options Appraisal s.52 Pilot	The Itchen SAC Habitats Regulations Stage 4 Site Action Plan (SAP) is undergoing final internal QA and is due for external release in June. Expected outcomes have been shared with you. Although the SAP is not yet published, we do not foresee the position changing. The proposed outcome for Twyford, Otterbourne Groundwater (including Twyford Moors) and Otterbourne Surface Water licence is a reduction in summer monthly abstraction and imposition of a hands off flow condition of 198 Ml/day. The aggregate monthly abstraction maximums proposed for the three licences named above are 4,110 Ml (June), 3,940 Ml (July), 3,445 Ml (August) and 2,280 Ml (September). The annual licence maximum is to be reduced to 51,138 Ml. Based on sight of Atkins work for Southern Water, we understand there will be an impact on your deployable output of 107 Ml/d at MDO (in January, in the worst drought years) and 86 Ml/d at critical period (in July/August, in the worst drought years). However, we need to discuss how you translate Atkins assessment into your water resources planning scenarios. For example, for the dry year annual average, and relative to other seasonal demand variations.
North Kent Marshes Licences: 9/40/02/0237/G (Sittingbourne Group) 9/40/02/0236/G (Luton, Nashenden, Capstone, Snodhurst) 9/40/02/0238/G (Belmont, Throwley, Selling, Kettle Hill, Hockley Hole and Beacon Hill)	HD	Medium	Investigation	In our March 2007 letter we detailed that we will provide a definite sustainability reduction by December 2008. Although the investigation is not complete, we do not think there will be an impact on your deployable output.
Arun Valley SPA, Ramsar, SSSI Licence: 10/41/431002 (Hardham groundwater)	HD	Medium	Investigation	In our March 2007 letter we detailed that we will provide a definite sustainability reduction by December 2008. The AMP4 investigation / options appraisal aims to report summer 2007. We will wait until then to suggest licence variation figures. However, we do not think there will be an impact on your deployable output.
Little Stour Licence: 9/40/04/0058/GR (Wingham)	BAP	-	Investigation	We do not think the investigation will be sufficiently progressed in time to allow us to provide figures to include in your plan.
Wingham River Licences: 9/40/04/0056/GR (Flemings) 9/40/04/0057/GR (Woodnesborough) 9/40/04/0058/GR (Wingham)	BAP	-	Investigation	We do not think the investigation will be sufficiently progressed in time to allow us to provide figures to include in your plan.

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Environment Agency

01 DEC 2008
RECEIVED

Mr Les Dawson
Chief Executive Officer
Southern Water Services
Southern House
Yeoman Road
Worthing, West Sussex
BN13 3NX

Our ref: JG/SW/FBP1

Your ref:

Date: 28 Novemeber 2008

Dear Les

PR09 NATIONAL ENVIRONMENT PROGRAMME

I am pleased to provide you with the Final National Environment Programme (NEP) for Southern Water Services Ltd.

The NEP is our list of environmental improvements that we want you to include in your Final Business Plans. All of these measures are supported by robust evidence and represent where work is required by Southern Water to meet its future environmental obligations.

The contents of the NEP

The Final NEP consists of two spreadsheets of measures: one on water resources and one on water quality. Any changes from our Initial NEP are explained in more detail in the respective annexes.

The Water Framework Directive (WFD) measures include proposed schemes and investigations. In line with the Directive, we have assessed WFD schemes in relation to technical feasibility and cost benefit (based on water companies' costs). All schemes included here are technically feasible. Finalisation of WFD measures will be taken forward in 2009 and involves consultation on the draft River Basin Management Plan with final decisions being taken by Ministers. We will keep you updated on progress, but in the meantime I will ask John Gower to share the outcome of our recently completed impact assessments on WFD schemes with John Spence.

We welcomed the inclusion of all our water quality initial NEP schemes in your Draft Business Plans. I was also very pleased when we resolved the outstanding issues around the river Itchen Habitats Directive sustainability reductions which now enable

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you to include all of our water resources NEP schemes into your Final Business Plan. The annexes to this letter highlight some specific comments you might also find useful regarding which growth schemes we can support in the Quality Enhancement Programme of your Final Business Plan.

We support catchment management approaches, where they fulfil Ofwat's criteria[1] and meet the environmental objectives set out in Defra's Statement of Obligations. We are working closely with Ofwat, the Drinking Water Inspectorate and Natural England on schemes that come forward under water company Quality Enhancement Programmes. Although you have not included any catchment schemes in your DBP we would like to work with you further on this and hope that schemes can be developed in time for your Final Business Plan in April 2009.

Over the course of the last year, I have been very pleased with the positive open working relationship between our teams. This has helped to resolve the difficulties around the river Itchen sustainability reductions and build one of the largest water quality NEPs for any region. I am keen to maintain this productive dialogue. Please do not hesitate to get in touch if we can help to clarify any requirement in the Final NEP.

Yours sincerely

HARVEY BRADSHAW
Regional Director

[1] Setting price limits for 2010-15: Framework and approach, Ofwat, March 2008

Cont/d..

Southern Water

Annex B: Water Resources NEP

Contents of the Water Resources Final NEP
This part of the NEP has been identified from our Restoring Sustainable Abstraction (RSA) Programme, and includes the following drivers:

- Habitats Directive;
- Countryside and Rights of Way (CRoW) Act 2000 (Sites of Special Scientific Interest);
- Biodiversity Action Plans;
- Water Framework Directive

In the context of this letter the NEP is taken to include supply-demand and non supply-demand requirements.

Changes between the Initial NEP and Final NEP
The Final NEP only includes items where we are 'certain' that an investigation, options appraisal or implementation scheme is required. We would like these to form part of your Final Business Plan.

We have also provided, for information at this stage, a list of 'uncertain' items where requirements will not be known until after November 2008. We will be in touch with you should any further requirements become known. As such, we do not expect you to include these in your Final Business Plan.

Only 'definite' [Habitats Directive] sustainability changes, previously communicated via the water resource management process, are included in the 'certain' list and therefore form part of Final NEP. Where we have differing opinions over whether licence changes impact upon deployable output, we have included these in the 'uncertain' list. If you prove an impact on deployable output, with our agreement, before your final water resources management plan and final business plan, we will move these to the certain list.

The post implementation monitoring work required to support renewal applications for licences within Solent Maritime SAC and Solent & Southampton Water SPA has been removed from our NEP. Following discussions with Ofwat we have been informed that this work would not be funded through PR09, rather it should be undertaken as part of your base service. This post implementation monitoring is important to support renewal licence applications and we will continue to help you progress it where we can and look forward to seeing your continued commitment to this work.

The NEP reaffirms the reductions required for HD that companies were informed about earlier in the year, and continues to ensure that the PR09 and WRMP

processes are aligned. We will also send you our sustainability change table within the next two weeks.

Each list has been divided into two cost drivers:

1. **Supply Demand Balance**

   This includes Habitats Directive (HD) Implementation schemes that will affect the supply demand balance and non-HD Options appraisals.

2. **Quality Enhancement**

   This includes non-HD Investigations.

   WFD investigations have been proposed where there is the greatest risk from water company abstractions to contribute to or cause a WFD water body to fail 'Good Status' (band 3 non-compliant), and where existing RSA work will not resolve the issue.

WFD Hydromorphology Project
As part of the River Basin Management Plans, we will be putting forward a national hydromorphology research project to improve our understanding of the hydrological and ecological impacts of water supply impoundments on Heavily Modified/Artificial Water Bodies (HMWB/AWB).

This is listed under the "uncertain" items, as we are still in the process of developing a joint research project. Once agreed, this project will go through to implementation. The project will identify those water bodies where a more detailed investigation is necessary and to develop the science required to achieve 'Good Ecological Potential', more efficiently than could be achieved by individual investigations at every site.

We are proposing that the cost of this work be shared between the Environment Agency and water companies, using the proportion of HMWBs/AWBs within each water company boundary.

Following discussion with the water industry, we will finalise the project details. They will then form part of the draft River Basin Management Plans that will be consulted on from December and be considered for approval for Ministers in late 2009.

This research is likely to involve further field trials at selected sites that will be identified part way through AMP5. As the final list of field trials has yet to be identified and agreed this item is shown as 'uncertain'. The cost of subsequent field trials will be allocated on a similar basis to the original research project.

Please find enclosed a WFD Heavily Modified Water Body briefing note. This explains the programme of work required to better understand the impacts of HMWB and achievement of Good Ecological potential and supports the HMWB projects included in your uncertain list.

Stage Plans
A stage plan is available for each investigation and options appraisal included in the certain Final NEP. The stage plan provides:

- robust justification for their inclusion in PR09
- information necessary to cost the work required in your final business plan
- an outline of the work required on which to base your more detailed plan.

Delivery Timelines
Investigations should aim to be completed in sufficient time to allow an options appraisal to be delivered within AMP5, if required. The project timelines for investigations and options appraisal are included in the stage plans.

Draft Business Plan issues
Following agreement over the options to be implemented to mitigate the River Itchen Habitats Directive sustainability reductions we look forward to seeing all of our certain Final NEP schemes in your final business plan.

If you wish to discuss any of these issues in more detail, please contact Julie Morris in our Regional Water Resources team on 01903 832333.

Environment Agency **Certain** **Southern Water**
Final WR PR09 NEP

Water Body ID	River Basin District / Waterbody Name	Region / Area	Site Name	Driver	PR09 Scheme stage	Proposed Work	Easting	Northing
Cost Driver: Supply Demand								
3POSW5106	River Itchen - PWS	Southern - Solent & South Downs	River Itchen SAC	Hw1	Implementation (supply demand) PR09 funding is required to implement licence changes identified from Stage 4 of the Habitats Directive Review of Consents process. Southern Water has been sent a copy of the Site Action Plan. The Habitats Directive Stage 4 outcome for Twyford, Otterbourne groundwater and Otterbourne surface water licences is the introduction of an annual aggregate licence maximum of 51,138 Ml, along with a reduction in summer monthly abstraction and imposition of a hands off flow condition of 198 Ml/day. The aggregate monthly abstraction maximums for the three licences named above are 4,110 Ml (June), 3,940 Ml (July), 3,445 Ml (August) and 2,280 Ml (September). Impacted licences: 11/42/22.6/92 (Twyford), 11/42/22.7/94 (Otterbourne Groundwater, including Twyford Moors), 11/42/22.6/93 (Otterbourne Surface Water)	Southern Water implement the requirements of the Habitats Directive Site Action Plan. Based on sight of Atkins work for Southern Water, we understand there will be an impact on your deployable output of 107 Ml/d at MDO (in January, in the worst drought years) and 86 Ml/d at critical period (in July/August, in the worst drought years).	447000	123000
3SO3000301	AMP assessment	Southern - Kent & East Sussex	Little Stour	BAPw1	OPTIONS APPRAISAL PR09 funding is required for options appraisal. This options appraisal will be more complex due to the fact that there are three water companies involved. The options appraisal should be managed together with the Wingham scheme. Impacted licence: 9/40/04/0058/GR	See Little Stour stage plan	621500	157500

Environment Agency **Certain** **Southern Water**
Final WR PR09 NEP

Water Body ID	River Basin District / Waterbody Name	Region / Area	Site Name	Driver	PR09 Scheme stage	Proposed Work	Easting	Northing
4SO300101	4SO300101	Southern - Kent & East Sussex	Wingham River	BAPw1	OPTIONS APPRAISAL PR09 funding is required for options appraisal. This should be managed together with the Little Stour scheme. Impacted licences are: 9/40/04/0056/GR, 9/40/04/0057/GR and 9/40/04/0058/GR.	See Wingham River stage plan	624486	157660
Cost Driver: Quality Enhancement								
RSA-SOHA0003	Lower Test	Southern - Solent & South Downs	Lower Test	Iw3	INVESTIGATION PR09 funding is required to undertake an investigation into the abstraction at Testwood on the Lower Test. Impacted licence: 11/42/18.16/546 (Testwood)	See Lower Test stage plan	435390	115260
GB107041012450	Lewes Winterbourne	Southern - Kent & East Sussex	Lewes Winterbourne	WFwp3	Investigation	See Lewes Winterbourne stage plan	542005	110110

D.5 Climate Change Impact on Supplies

This section summarises the climate change impacts that have been incorporated in the supply side of Southern Water's Water Resources Management Plan (WRMP). Further details on the analysis for surface water and for groundwater sources are given in the summary deployable output reports (Atkins 2008 and Atkins 2009). The impacts of climate change on demand are presented in Appendix E.3.

D.5.1 Method Used in Assessing Surface Water Impacts

The following surface water sources were assessed:

- Western Area:
  - Eastern Yar;
  - Test; and
  - Itchen.
- Sussex North:
  - Western Rother;
  - Arun; and
  - Weir Wood.
- East Sussex and Kent:
  - Inflow at Bewl Reservoir;
  - Brede;
  - Inflow at Darwell Reservoir;
  - Medway;
  - Inflow to Powdermill Reservoir;
  - Rother; and
  - Teise.

D.5.1.1 Western Area

Output from the improved Test and Itchen Groundwater Model for the "standard period" (1970 to 2002) was used by the Agency for its investigations for the Habitats Directive Stage 4 Review of Consents. The same model was used as one of the case studies for the recent UKWIR work (UKWIR, 2007b), but used the period 1965 to 2005. The flow time series from the groundwater model were then used to assess whether climate change impacts would reduce the deployable output from these run-of-river sources.

The results for the River Test suggest that the impacts of climate change would not be sufficient to cause abstraction to be constrained by the existing MRF, and therefore the impact on deployable output is zero. At present there is no MRF constraint on abstraction from the Lower Itchen sources – the analysis suggests that there would still be sufficient water in the river to allow abstraction to continue at the licensed rate, and therefore the impact on deployable output is zero. However, the residual flow in the Itchen would be less than the Minimum Residual Flow proposed by the Agency following the Habitats Directive Stage 4 Review of Consents.

For Sandown WSW, on the Isle of Wight, a rainfall-runoff model of the Eastern Yar has been used to provide a naturalised flow sequence, which is then used as input to the augmentation scheme model. As the low-flow regime at Sandown WSW is strongly influenced by the groundwater augmentation scheme and the order in which the augmentation boreholes are operated, a flow factor approach (UKWIR method 1b) has been applied to the baseline sequence, and the perturbed outputs input to the augmentation scheme model to provide climate change perturbed and augmented flows.

D.5.1.2 Central and Eastern Areas

The Sussex North and East Sussex and Kent catchments were assessed using the RR1 method of UKWIR (2006a). This is the simplest of the rainfall-runoff methods and involves using rainfall and PET factors from several climate models created by institutions in Canada, USA, Germany, Japan, Australia and the UK. These factors, provided by HR Wallingford in relation to the UKWIR CL/04/C project (UKWIR, 2007a), were created from model output based on the A2 SRES scenario. This scenario describes a very heterogeneous world where economic development is primarily regionally oriented and per capita economic growth and technological change are fragmented (Hulme et al., 2002).

In addition to the six GCM-based factors, three emissions scenarios (Low, Medium and High) of the Hadley Centre Regional Climate Model (RCM) were also used to create three additional factors. The method used therefore considered GCM uncertainty (the largest source of uncertainty in the 2020s; UKWIR, 2005), natural variability and also a limited assessment of downscaling uncertainty (dynamic only) from the RCM factors.

Long-term records of areal rainfall and PET had been established for the catchments using standard hindcasting and spatial interpolation approaches. This yielded rainfall back to 1888 (daily) and PET back to 1880. Overall this provided a consistent record of baseline climate data from 1888 onwards, with a nominal end date of 1990 (after which it is commonly assumed that climate change can affect the record). Perturbed future climate series were then produced by multiplying the baseline record by the rainfall and PET factors. The resulting rainfall and PET timeseries were then formatted ready for input to Catchmod (Catchmod is a lumped rainfall runoff model which takes inputs of rainfall and PET and outputs flow; Miser is then used to calculate deployable output).

The latest fully calibrated and validated version of Catchmod was used to model the baseline and climate change scenarios. No adjustments were made to parameters to account for possible impacts on land use or soil characteristics, as there was no information available on which to base estimates of potential changes in behavioural parameter sets (UKWIR, 2006b). No adjustments were made to abstractions or discharges (all at zero anyway, i.e. naturalised) i.e. an assumption was made for the purposes of the investigations that there will be no climate-induced changes in abstractions or discharges. For the climate change investigations, all starting conditions were set to zero and the warm-up period to 1460 days to allow for a full warm-up from a ‘cold’ start.

Ignoring the first 4 model warm-up years, a perturbed record of 99 years was produced for each climate change scenario. These records represent the climate of the 2020s, the GCM model timeslice of the 30 year period from 2011 to 2040. The additional years (69 in this case, following warm-up) provided a more robust estimate of natural variability and reduces this uncertainty. However, this method does not provide for different sequencing of events or for changes in natural variability caused by climate change. These problems could be overcome using more advanced methods e.g. statistical downscaling, stochastic weather generation or re-sampling of the historic meteorological series.

Output from each Catchmod run was imported into a single spreadsheet for each catchment, to allow production of hydrographs, volumetric curves, flow duration curves and associated statistics. Results for each catchment were discussed in individual summary reports.

D.5.2 Method Used in Assessing Groundwater Impacts

The simplest approach to estimating future performance of sources under new climatic conditions, as predicted by GCMs, is to apply change (or perturbation) factors to recent weather sequences and examine the consequences for groundwater levels and source outputs. The last few decades (specifically 1970 to 2007), for which reasonable rainfall and PE data are available, are taken to represent a typical sequence of drought and non-drought events within the current climate conditions. Current climate conditions are conventionally based on the last three complete decades (i.e. at present 1970 to 2000). The climate perturbation factors describe the difference between baseline climate and future climate (in this case the 2020s, the average climate of the period from 2011 to 2040, and approximately representative of the mid-2020s) as percentage change to monthly rainfall and PE.

Note that the baseline climate used in generating climate change scenarios is 1961 to 1990, with climate post-1990 generally assumed to be (increasingly) influenced by climate change. This

assumption is relaxed here in favour of using the best data and model calibration period. The current deployable outputs are assumed to capture the present situation as monitored during recent (1990-2006) droughts. In applying the predicted water level impact to the current drought curve/deployable output assessment, it is assumed that baseline deployable output is unaffected by climate change. However, with climate change effects usually assumed to have started in 1990, deployable outputs based on data from say 1997 will already include some climate change effect. The analysis therefore results in an element of double-counting. (Excluding 1990-2007 data would allow little information for baseline deployable output assessments.) However, given that the cumulative climate change effect by 1997 would be small and that droughts of similar severity to 1997 are known to have occurred in the pre-climate change period (e.g. 1973), the approach is considered reasonable, particularly given uncertainties elsewhere in the method.

By applying the change factors to the historic 1970-2007 meteorological data and re-estimating water levels and source outputs, the situation through the historic sequence of droughts and non-droughts in the future climate can be estimated.

For the assessment there are three key steps. Having derived the new rainfall and PE datasets, the approach is the same as for the severe drought analysis:

- Derivation of new meteorological data – new rainfall and PE data, appropriate to each resource area, are required for each climate scenario under test. These are derived from analysis of GCM outputs. In most areas, analysis has been carried for only three of the GCMs, representing dry, medium and wet conditions;
- Estimate changes in drought groundwater level – groundwater models / recharge models / regression models, as available for each area, have been used with the perturbed rainfall and PE to estimate groundwater levels at each SWS borehole. The difference in drought water level between each climate scenario and a baseline run has been calculated for each groundwater source; and
- Re-assessment of deployable output – the effects of the calculated changes in groundwater level on source deployable output, under average and peak demand conditions, are estimated from the relationship between drought curves and output constraints in the existing deployable output assessments. The climate change impacts have been applied to the severe drought deployable outputs (not to the baseline deployable outputs).

D.5.3 Differences in the Method Used Compared with that of the Environment Agency Supplementary Guidance

Much of the detailed impact assessment, which formed part of the AMP4 Water Resources Investigations, was completed before the Environment Agency published its draft Supplementary Guidance on Climate Change in July 2007; further updates to the guidance, which are essentially the same as the draft, were published in November 2007 and November 2008. The guidance states that the best approach is to use catchment or groundwater models and where not available flow or recharge factors should be applied to historic flow or recharge series. This approach has been followed.

The guidance draws on outputs from the UKWIR project CL/04/C, which includes the UKWIR06 scenarios. However, the guidance uses information provided by the scenarios in a way not intended by the UKWIR project and which are less coherent and defensible scientifically. For the reasons given below it was recommended that the guidance on the selection of scenarios was inappropriate and should not be followed.

The construction of 'mid', 'wet' and 'dry' scenarios in the Environment Agency guidance (Section 2.2.2) provides a sensitivity test only and while apparently conceptually intuitive there are problems with the detail which may result in unrealistically large uncertainties (and therefore headroom uncertainty). The problems are two-fold: firstly, the standard deviations produced are large because of the big differences between models; secondly, the method suggests coupling of low rainfall factors to high PET factors and high rainfall factors to low PET factors. The first problem leads to sensitivity factors which are large and sometimes beyond the range of individual models (once subtracted or added to

the means as appropriate). The second problem leads to couplings that are not reflected by the models - a comparison of rainfall and PET factors is very noisy due to monthly variation, but if anything there is a trend for coupling of higher rainfall factors / higher PET factors. The combined effect of these two problems is a very large sensitivity envelope - much larger than the model envelope - and potentially unrealistic physically.

In comments back to the Environment Agency (via the company and Water UK) on the original guidance it was recommended that actual model output was used, as in the AMP4 Water Resources Investigations. Alternatively, the low and high factors could be based on 0.5 of a standard deviation and / or a more realistic coupling of rainfall and PET. The updated guidance states that outliers results could be excluded, but there is no hydrological or climatological basis for doing this.

In relation to baseline period (Section 3.1) there is no recommendation with regards to a cut-off with respect to climate change influence. The UKWIR06 factors are based on differences between the 2020s (2011-2040) and the 1970s (1961-1990). Applying factors to data post-1990 could lead to over estimation of the impacts of climate change and while this is less of a problem for the early 1990s, continuing to apply factors to more recent data is questionable. Although trends in river flows may not detect climate change signals yet (and for a few decades), other indicators - particularly those related to temperature - suggest that the climate variation is now moving beyond that due to natural variability alone. In comments back to the Environment Agency (via the company and Water UK) on the original guidance it was recommended that a cut-off of 1990 was applied, with some thoughts on use of post-1990 data where little other data exists. In the AMP4 WRI a cut-off of 1990 was applied, although this may not be feasible for groundwater assessments e.g. where deployable output is based on a more recent drought.

In terms of interpolation (Section 4.1) the use of two different scale factors can lead to a higher reduction in deployable output in the first period than in the second period (as in Example 5), which is unrealistic (under climate change you would anticipate an increasing rate of deployable output reduction, or at least a constant linear rate in the short-term). This situation occurs if current deployable output is greater than the value obtained from a linear extrapolation between 1975 and 2025 and can be accentuated by assuming that deployable output remains at the current value until 2010-11. In comments back to the Environment Agency (via the company and Water UK) on the original guidance it was recommended that one linear scale factor is used either based on true baseline deployable output and interpolated over 50 years or based on current deployable output and interpolated between now and 2025 (a linear approximation being a good enough approximation for the short-term). In the Southern Water AMP4 Water Resources Investigations, no interpolation factor was used as the timing of investment was less critical than the overall impact. For PR09 a single linear factor has been used.

The approach adopted for PR09 will in any case need to be reviewed and if necessary revised in the light of the UKCP09 climate change scenarios and any updated guidance from UKWIR and/or the Environment Agency.

D.5.4 Results: Surface Waters

D.5.4.1 Impact on Hydrology

Patterns seen across all catchment assessments include substantial reduction in surface flows compared to the baseline in the summer months, becoming more pronounced in later summer, and an increase in flows in winter months. Comparatively, spring and autumn flows were not seen to be affected considerably. Total annual flows were increased under two GCMs, remained much the same under three, and were substantially reduced under one (the German model, ECHAM4). All three scenarios of the RCM produced reduced total annual flows. Flow duration curves showed the most obvious reduction in flow was under low flow conditions, while high flow conditions remained similar to the baseline. The findings of this study appear to be consistent with those of Hulme et al. (2002), thus supporting the accuracy of the results. Results for each catchment were discussed in individual summary reports. A summary of the results is given in Table D.3.

WRZ	MDO reduction (Ml/d)			PDO reduction (Ml/d)		
	Headroom			Headroom		
	Min	Most Likely	Max	Min	Most Likely	Max
Isle of Wight	0.0	0.0	0.0	1.40	2.09	2.77
Hants South	0.0	0.0	0.0	0.0	0.0	0.0
Sussex North	0.0	0.0	0.0	0.0	0.0	0.0
Kent Medway	4.57	8.46	13.16	10.61	17.68	24.51
Sussex Hastings	2.71	5.02	6.90	3.41	5.68	7.83

Table D.3 Reduction in Surface Water Deployable Output due to Climate Change by the mid-2020s

Note that if the proposed Habitats Directive Sustainability Reductions are imposed in full, there will be significant reductions in deployable output; some further reductions are likely under climate change.

D.5.4.2 Final Application of Climate Change with regards to Deployable Output and Headroom

It is recommended that the middle model is used as the central reduction in deployable output, with the maximum and minimum models providing the bounds for headroom using a triangular distribution for simplicity. Impacts on deployable output and headroom limits will be interpolated linearly, as discussed above, providing an incremental impact and increase in headroom over the planning period.

D.5.5 Results: Groundwater

Given the current uncertainty around climate change groundwater impacts, effects are included within Headroom and in calculating net deployable output. A summary of the results for each WRZ (reported in full in Atkins 2009) is given in Table D.4.

WRZ	MDO Reduction (Ml/d)			PDO Reduction (Ml/d)		
	Headroom			Headroom		
	Min	Most Likely	Max	Min	Most Likely	Max
Isle of Wight	-0.07	0.08	0.29	-0.06	0.09	0.31
Hants South	-1.25	0.00	1.50	-1.10	0.05	2.05
Hants Andover	-0.04	-0.01	0.02	-0.04	0.00	0.04
Hants Kingsclere	0.00	0.00	0.00	0.00	0.00	0.00
Sussex North	-0.05	0.03	0.05	-0.05	0.03	0.05
Sussex Worthing	-0.69	0.18	0.69	-0.92	0.23	0.92
Sussex Brighton	-1.54	0.39	1.54	-0.95	0.24	0.95
Kent Medway	0.00	3.89	6.43	0.00	2.71	5.92
Kent Thanet	-1.20	2.58	6.00	-3.09	3.28	10.03
Sussex Hastings	-0.10	0.20	0.40	-0.10	0.25	0.50

Table D.4 Impact of Climate Change on Groundwater Deployable Output by the mid-2020s

D.5.6 Recommendations

The impacts of climate change on surface water and groundwater sources have been assessed using existing climate change data and methodologies. Following release of the UKCP09 scenarios, it is expected that there will be a period of review, interpretation and analysis. In the fullness of time new guidance and methodologies may be issued.

The work undertaken for this WRMP provides a good starting point for from which the UKCP09 scenarios can be applied.

D.5.7 References

Atkins (July 2008) *Surface water Deployable Output (DO)*, ref 5050675/70/DG/036

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UKWIR (2006b) *Effect of Climate Change on River Flows and Groundwater Recharge: A Practical Methodology – Interim report on rainfall-runoff modelling*. UKWIR Report 06/CL/04/7. United Kingdom Water Industry Research, London.

UKWIR (2007a) *Effect of Climate Change on River Flows and Groundwater Recharge: Guidelines for Resource Assessment and UKWIR06 Scenarios*. UKWIR Report 06/CL/04/8. United Kingdom Water Industry Research, London.

UKWIR (2007b) *Effect of Climate Change on River Flows and Groundwater Recharge, A Practical Methodology: Recharge and Groundwater Level Impact Assessment*. UKWIR Report 07/CL/04/9. United Kingdom Water Industry Research, London.

Appendix E: DEMAND

E.1 Demand Scenarios

The WRMP presents demand forecasts for a range of design scenarios which are specified in the Environment Agency's WRMP guidance. The required scenarios are:

- **Normal Year Annual Average demands (NYAA)** – developed by normalising the base year (2007-08), where necessary, to compensate for the influence of weather and demand restrictions. The idea is to derive estimates of demand that would occur under 'normal' conditions;
- **Dry Year Annual Average demands (DYAA)** – the annual average demand in a year with low rainfall, but without any demand restrictions in place. This demand is used with the Average Deployable Output (ADO) supply scenarios;
- **Dry Year Critical Period demands (DYCP)** – a scenario to look at the peak week demand during summer in a dry year. Peak week demand is the average daily value in the seven day period for which the largest demand is seen. This demand is used with the Peak Deployable Output (PDO) supply scenarios; and
- **Dry Year MDO demand (MDO)** – the autumn demand in a dry year. Autumn is the period when ground water levels and river flows are generally at their lowest and sources are operating close to their minimum Deployable Outputs (MDO). Whilst demand in this period is generally not as high as in the summer, it is important to investigate this scenario because the available supplies are generally vulnerable.

All water companies are required to provide forecasts for the NYAA and DYAA scenarios because this allows comparison between the various companies. However, the dry year peak week demand (DYCP) or the MDO demand may be the more important investment driver in some WRZs; depending on local characteristics, (for example: the volume of storage available in the zone or the relative mix of surface water and groundwater sources) . For this reason forecasts for these two periods are also presented.

E.2 Base Year Demands

E.2.1 Base Year Distribution Input

During 2007-08 the company supplied an average of 564 Ml/d of water each day, with a peak week demand of 628 Ml/d recorded in May and a minimum weekly demand of 540 Ml/d recorded in October Figure E.1 below shows the daily demands at the company level, while Figure E.2 shows the corresponding data for each water resource zone during the year.

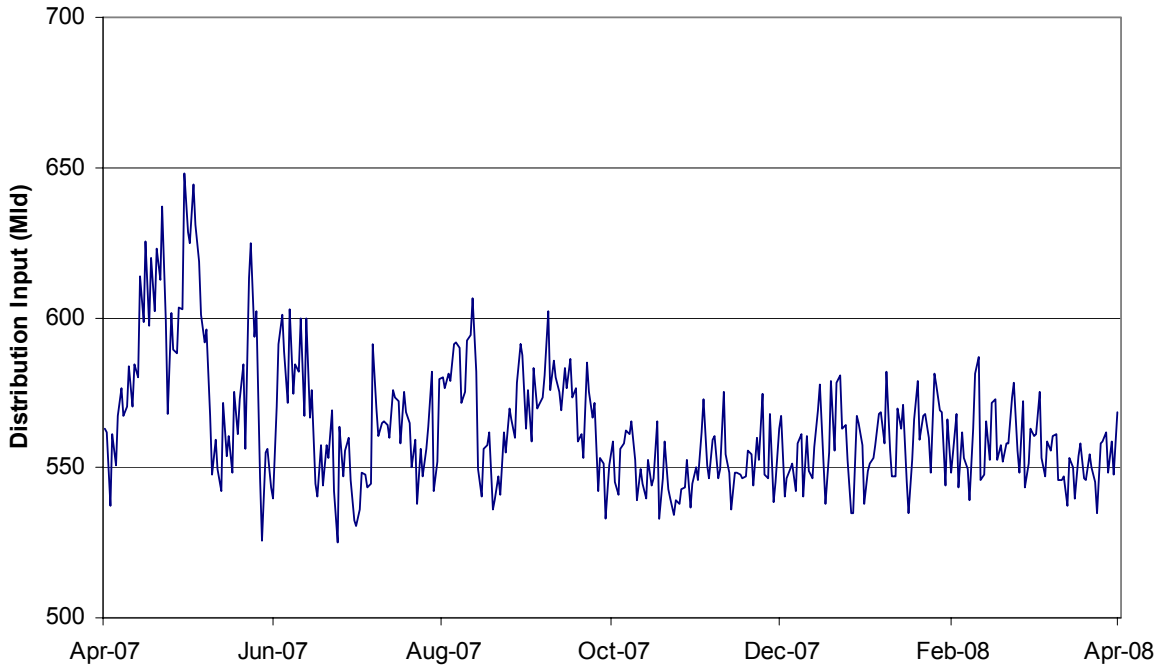


Figure E.1 Company Distribution Input during 2007-08

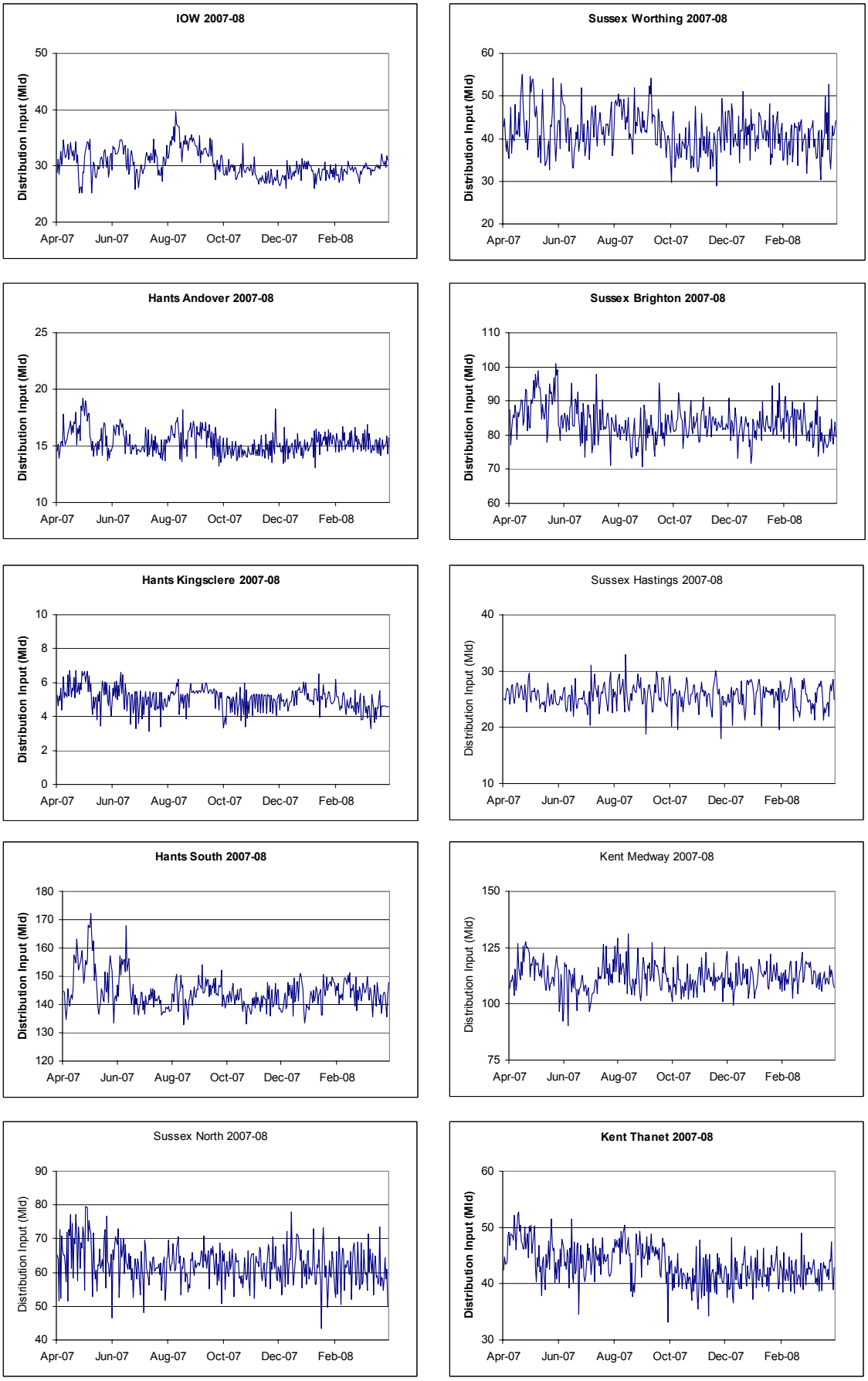


Figure E.2 Distribution Input during 2007-08 for each WRZ

E.2.2 Normalisation of the Base Year Demand

Demand, particularly that used by households, is influenced by rainfall and temperature. During the summer months rainfall reduces the demands from garden watering and other outside activities. Conversely, drought conditions, particularly when accompanied by sustained periods of high temperature, can lead to rapid increases in demand. Comparison of seasonal rainfall and temperature records with the long term average for the south east (Eastbourne) (see Figure E.3 below) shows that the summer of 2007-08 was warmer than average but received only slightly less than average rainfall. However, July was unusually wet and demands in that month were less than those observed earlier in the year with the peak week demand of 628 Ml/d being observed in May. On balance it is considered that in demand terms, at least, the year was not exceptional and the recorded demands have not been adjusted to compensate for unseasonal consumption. Thus we assume that 2007-08 was a normal or typical year, and the average daily demand during the year (the Normal Year Annual Average or NYAA) was 564 Ml/d.

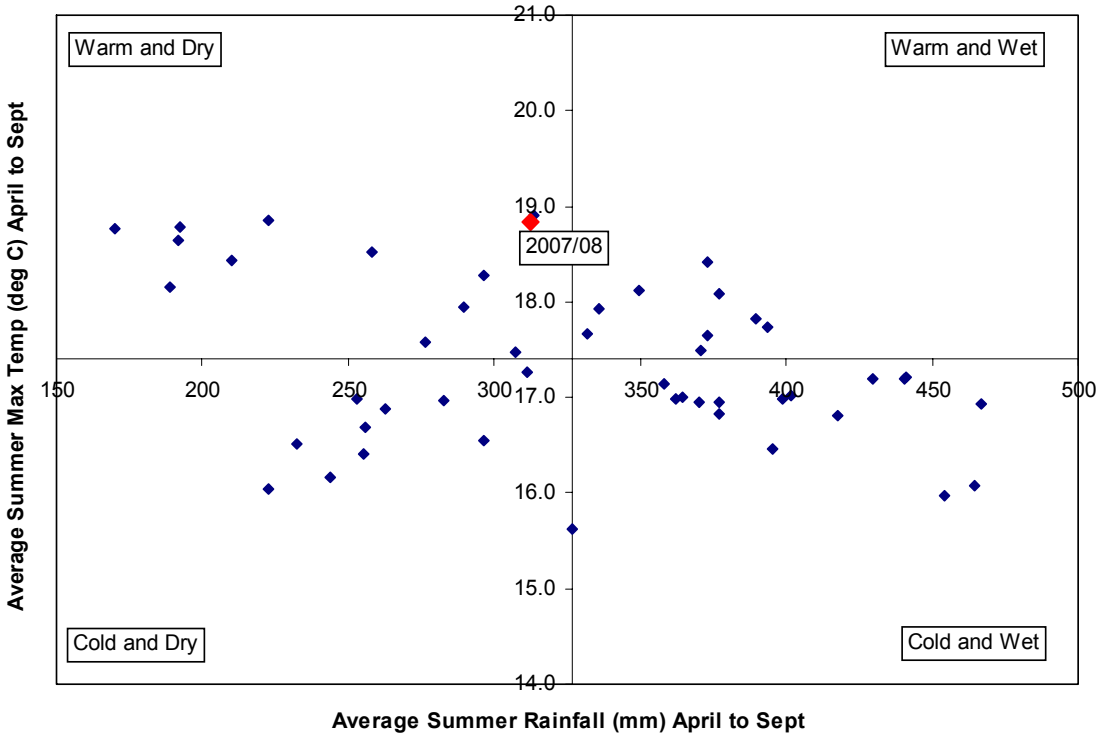


Figure E.3 Comparison of Seasonal Weather Statistics, 1959-60 to 2007-08

E.2.3 Dry Year Demands

Distribution input data, available for the period 1989-90 to 2007-08, has been reviewed to determine the dry year demand. But data from the early 90's is now considered to be less robust than current data and is also less representative of current conditions, therefore a truncated data set, from 1995-96 to 2007-08, has been used in the subsequent analysis. A technique known as rebasing has been used to estimate the demand that would have been experienced in each year throughout this period if the base year conditions (i.e. current levels of meter penetration and customer numbers) had been in place. This allows fair comparison of historic demands. Rebasing of household demand in each WRZ has been undertaken assuming the published suppression effects of metering, (viz. a 10% reduction on average and a 15% reduction on peak consumption), on the actual un-metered customer base.

A dry year is defined as a year with low summer rainfall but unconstrained demand (i.e. it is a year without demand restrictions in place). The company level of service for introducing demand restrictions is once in ten years. Dry year annual average (DYAA) demand therefore has been determined in each

WRZ as the 90th percentile of the annual average series of rebased demands. This is considered equivalent to the 1 in 10 year demand.

Historic peak and MDO demands have also been rebased, but using the maximum average day peak week demand observed in each year, and the maximum rolling 30 day average demand over the period October to November respectively. The 90th percentile of the rebased historic peak and MDO demands has been used to provide the estimate of the dry year (unconstrained) demands for these two periods. Thus, the rebased peak week and MDO demands are considered to represent the 1 in 10 year demand and these are presented in Table E.1.

Area	WRZ	Base year Dry Year Demand (Ml/d)	Base year Peak Period Demand (Ml/d)	Base year MDO Period Demand (Ml/d)
Western	IoW	34.96	44.36	33.70
	HS	157.83	206.41	152.33
	HK	5.24	7.13	4.95
	HA	16.62	21.30	17.51
Central	SN	67.57	85.20	65.92
	SW	42.95	51.57	41.94
	SB	86.47	103.80	84.39
Eastern	SH	26.95	32.69	26.69
	KM	122.33	148.95	116.47
	KT	46.39	59.81	43.67

Table E.1 Summary of Dry Year Demands in the Base Year

E.2.4 Base Year Per Capita Consumption

The company wide estimate of the Per Capita Consumption (PCC) of unmeasured customers in 2007-08 was 159 l/h/d, while that of metered customers was around 13% lower at 138 l/h/d. The unmeasured customer PCC is currently derived from data obtained from the Southern Area Group Control Area Monitoring Programme which is a collaborative data sharing exercise involving several of the water companies in the south east. The metered customer PCC is derived from consumption data held on the company's billing system.

Unmeasured and measured PCCs differ between WRZs and indeed across the country because of differing socio-economic, climatic and geographic factors (Tynemarch, 2007). The base year (2007-08) estimates of PCC at the water resource zone level, which are considered representative of normal year (NYAA) consumption, are given in Table E.2 below.

Factors have been derived to adjust household consumption to increase the normal year annual average (NYAA) in the base year, to the dry year annual average (DYAA), the dry year peak week (DYCP) and the MDO demands in each WRZ. The resulting DYAA, DYCP and MDO estimates of PCC are also shown in Table E.2.

Area	WRZ	Unmeasured Household PCC (2007-08)				Measured Household PCC (2007-08)			
		NYAA	DYAA	DY MDO	DYCP	NYAA	DYAA	DY MDO	DYCP
Western	IoW	138.5	179.3	168.2	273.6	120.1	155.4	145.8	225.3
	HS	153.6	177.6	167.7	267.4	136.9	158.3	149.5	226.4
	HA	158.2	181.5	196.8	266.3	140.1	160.7	174.3	224.0
	HK	159.2	171.2	152.1	302.8	159.6	171.6	152.4	288.4
Central	SN	151.6	173.5	166.6	251.9	148.4	169.9	163.1	234.3
	SW	168.1	177.4	170.8	237.2	145.3	153.2	147.6	194.7
	SB	168.5	178.3	171.2	240.2	139.9	148.0	142.1	189.4
Eastern	SH	168.0	182.5	179.6	249.3	138.8	150.7	148.4	195.6
	KM	157.9	182.8	168.5	246.8	146.1	168.5	155.8	216.9
	KT	158.3	175.8	159.8	257.3	142.8	158.5	144.1	220.4
SWS		**158.5**	**178.4**	**168.9**	**253.7**	**138.1**	**158.2**	**150.3**	**216.5**

Table E.2 Base Year (2007-08) PCC Comparisons

Base year PCC estimates have been validated by breaking the measured and unmeasured consumption down into a set of micro-component categories of demand, on a WRZ basis. The categories identified are based on work carried out by WRc (2005). This study involved taking flow measurements over several weeks in some 450 unmetered domestic properties located across England and Wales and was carried out as a collaborative project involving sixteen companies, including Southern Water.

The assembled dataset was derived using WRc's Identiflow® software which categorises the volume of water flowing into a household by appliance use. The resulting analysis gives a breakdown of the total recorded consumption in the household by component, yielding the frequency of operation of each appliance, and the volume of water used during that operation. Figure E.4 below shows the breakdown of consumption in a typical household by component of demand, as recorded during the study.

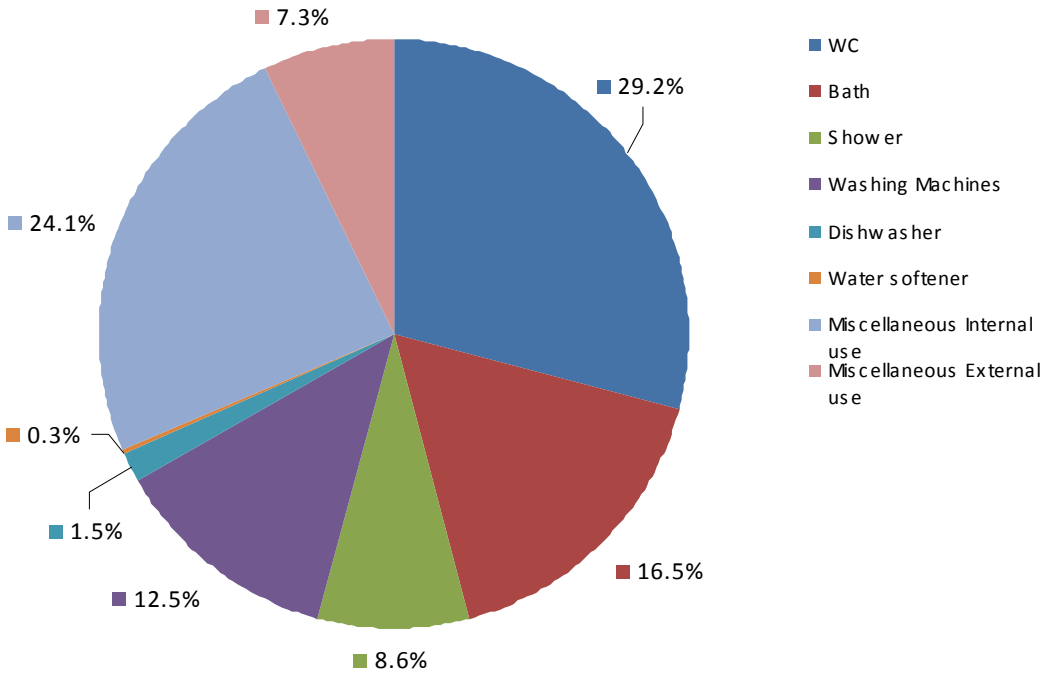


Figure E.4 Proportions of Microcomponent Use in Unmetered Households on Average Days (after WRc, 2005)

The frequency of appliance operation and the consequent household consumption as recorded by WRc are as given in Table E.3 below.

Device	Ownership (%)	Frequency of Use (uses/prop/day)	Volume per Use (litres)	Household Consumption (litres/prop/day)	% of Total Consumption
WC	100.0	11.52	9.4	108.3	29.2
Bath use	88.1	37.90	73.3	61.4	16.5
Showers	85.2	1.46	25.7	32.0	8.6
Washing machines	93.7	0.81	61.0	46.3	12.5
Dish washers	37.0	0.71	21.3	5.6	1.5
Water softeners	1.6	0.39	182.5	1.1	0.3
Internal miscellaneous use	100	37.9	2.3	89.3	24.1
External miscellaneous use	65.2	0.89	46.7	27.1	7.3
Total				371.1	100.0

Table E.3 Average Ownership, Frequency and Volume of Use in Unmeasured Households (after WRc 2005)

The average volume per use recorded in the above table, which has been taken from the WRC report, is specific to the properties surveyed and is now considered, in some cases, to be unrepresentative of appliances currently on the market. Consequently data from a more recent survey (Waterwise, 2008) has been used to update the information. Waterwise surveyed the marketplace in 2007 and have published figures giving the volume per use of the majority of washing machines and dishwashers available in the UK at that time (there were around 200 different models in each category). For this WRMP micro-component forecast, the upper 75th percentiles of the published consumption figures as taken from these surveys have been used in place of the figures listed in the above. Thus we now assume that washing machines and dishwashers use 58 litres per use and 16 litres per use respectively, rather than the 61 litres per use and the 21.3 litres per use as listed in Table E.3.

A change has also been made to the average flush volume listed in the table since that volume reflects the average of the cisterns actually surveyed. But the maximum flush volume now permitted under the Water Fittings Regulations (WRAS, 1999) is 6 litres. So taking into account new and refurbished properties, the average flush volume is now likely to be less than the 9.4 litres/flush recorded during the study. Consequently a revised figure has been developed, based on an assessment of the likely proportions of older, larger cisterns still in use across the entire customer base. The average flush volume is now estimated at 8.7 litres/flush and is assumed to reduce to around 6.5 litres/flush by the end of the planning period, without further changes to the Water Supply (Water Fittings) Regulations.

Southern Water undertook a large-scale customer survey into appliance ownership in 2002. Responses from over 24,000 properties were received and from these replies a picture of appliance ownership by WRZ and between metered and un-metered customers has been established.

Estimates of Per Capita Consumption for both measured and unmeasured customers in each WRZ have been built up based on the frequency of appliance use given in the WRc dataset, volume and ownership in each WRZ from the SWS survey and household occupancy rates in each WRZ as reported in the JR08 returns. These estimates tend to underestimate the published WRZ PCC figures, but have been reconciled to them using the maximum likelihood estimation (MLE) methodology. Table E.4 below gives the assumed volumes of use for each appliance and the assumed 95% confidence intervals around these volumes as used for the MLE adjustments.

Device	Volume per Use (litres)	95% Confidence Level (as %)
WC	8.7	2.5
Bath	73.3	5.0
Shower	25.7	5.0
Washing machine	58.0	5.0
Dishwasher	16.0	10.0
Water softener	182.5	100.0
Miscellaneous Internal use	46.7	20.0
Miscellaneous External use	20.4	50.0

Table E.4 Device Volumes per Use (2007-08) and 95% Confidence Interval

E.3 Population and Property Forecasts

In September 2005, the Environment Agency commissioned Experian Business Strategies to review the different methods of estimating and projecting future population and occupancy with a view to reaching an established approach that could be used within the Agency and potentially be adopted by the water companies (EA 2007). Experian Business Systems were subsequently commissioned by Southern Water to produce household and population forecasts based on this "best practice" methodology. Two forecasts for each WRZ were provided by Experian: one based on current trends and an alternative forecast based on policy as presently promulgated in draft regional plans. Following this work, Experian were further commissioned by several companies, including Southern Water, (Experian 2007), to provide the most likely scenario based on a combination of the population growth from the policy based projections but constrained to the total national trend based projection. This work has now been updated to take account of recently published regional data (Experian, 2008). The most likely population growth within the company supply area, as derived from this study, is illustrated in Figure E.5 below, while the data for the WRZs are given in Figure E.7.

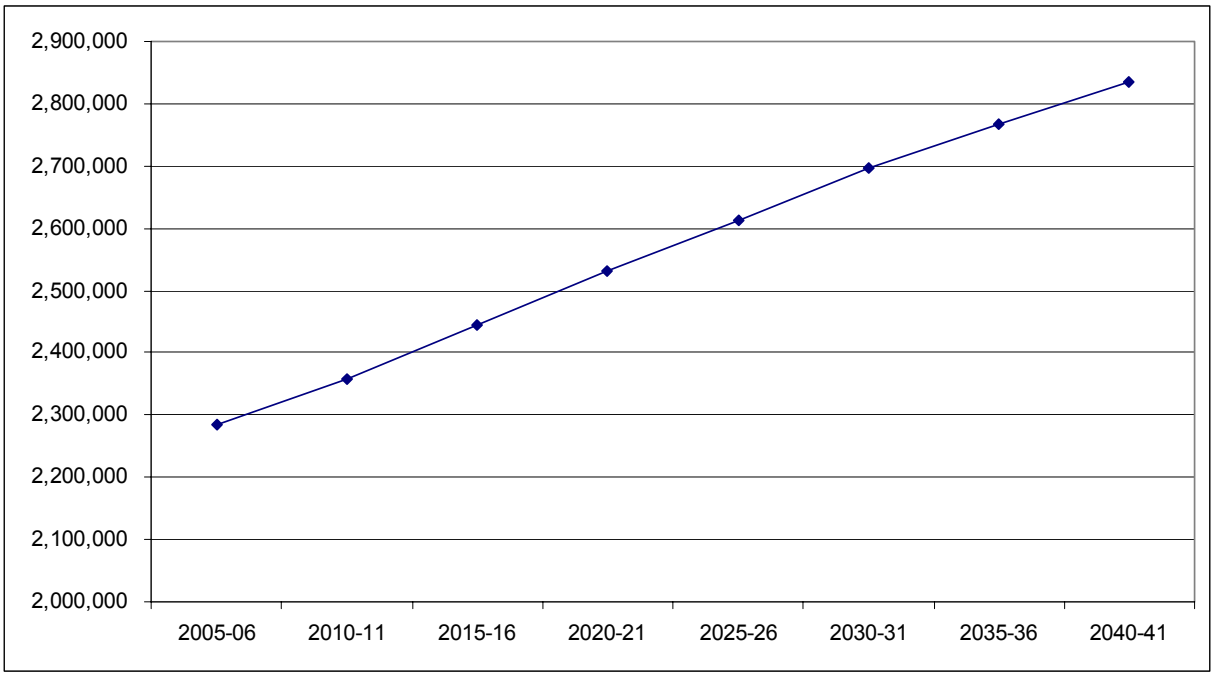


Figure E.5 Most Likely Total Population Forecast

The most likely scenario suggests that the total population supplied by the company will grow by approximately 444,000 from 2,257,000 in 2007-08 to 2,701,000 in 2034-35, while over the same period the number of properties connected to the company's distribution system is predicted to rise by 285,000. The company level connected property forecast is shown in Figure E.6 while the individual WRZ connected property forecasts are shown in Figure E.8.

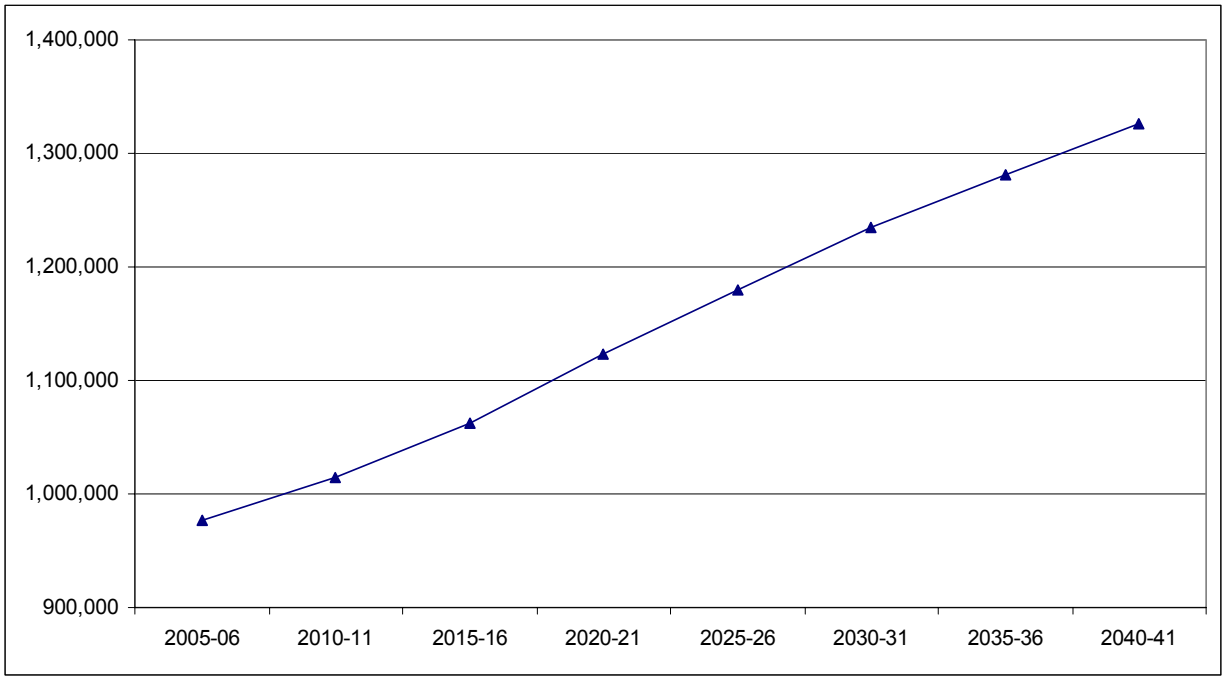
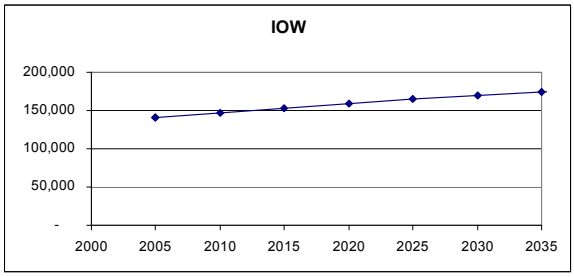
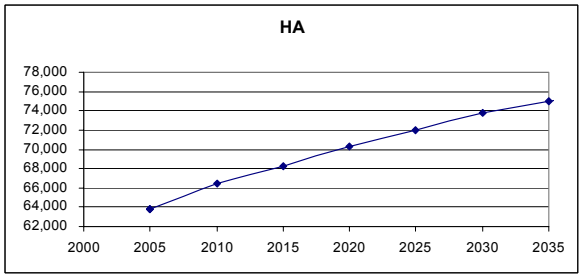
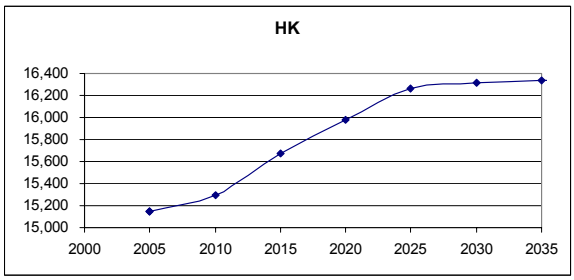
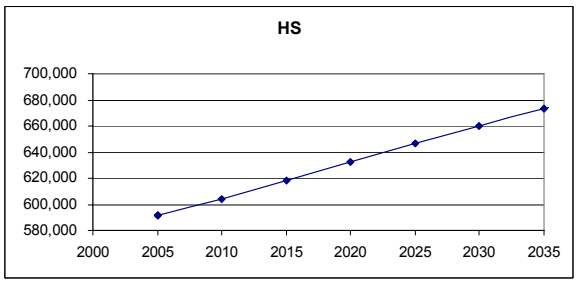


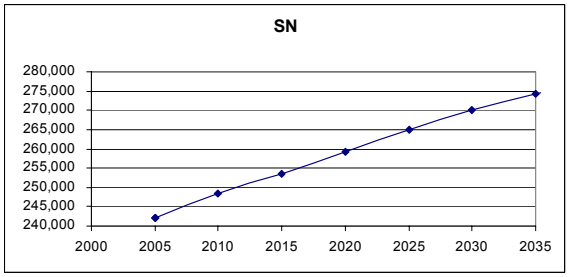
Figure E.6 Most Likely Property Forecast

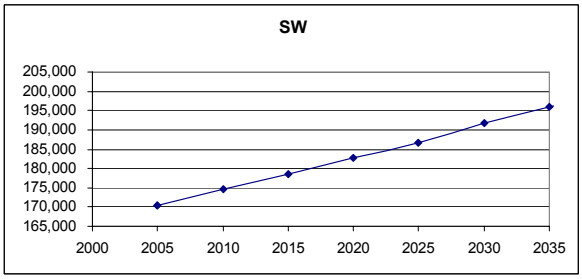


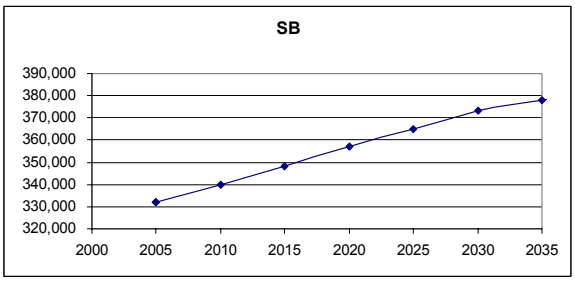


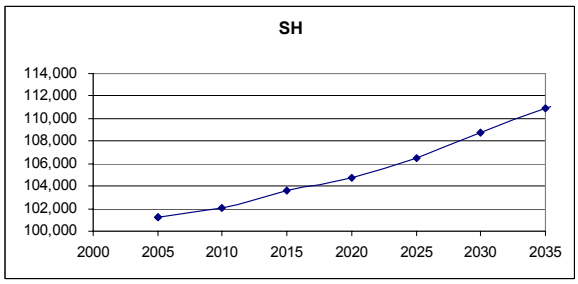


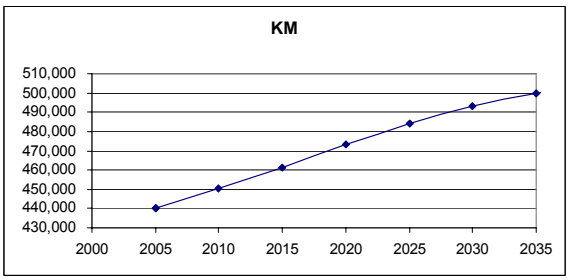












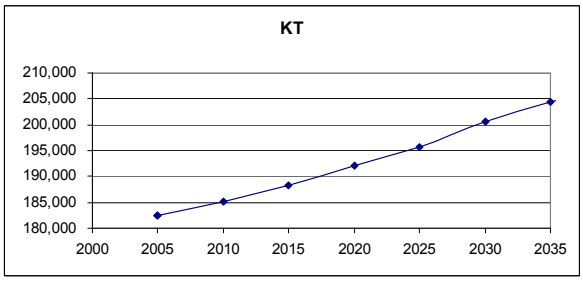


Figure E.7 Population Forecast by WRZ

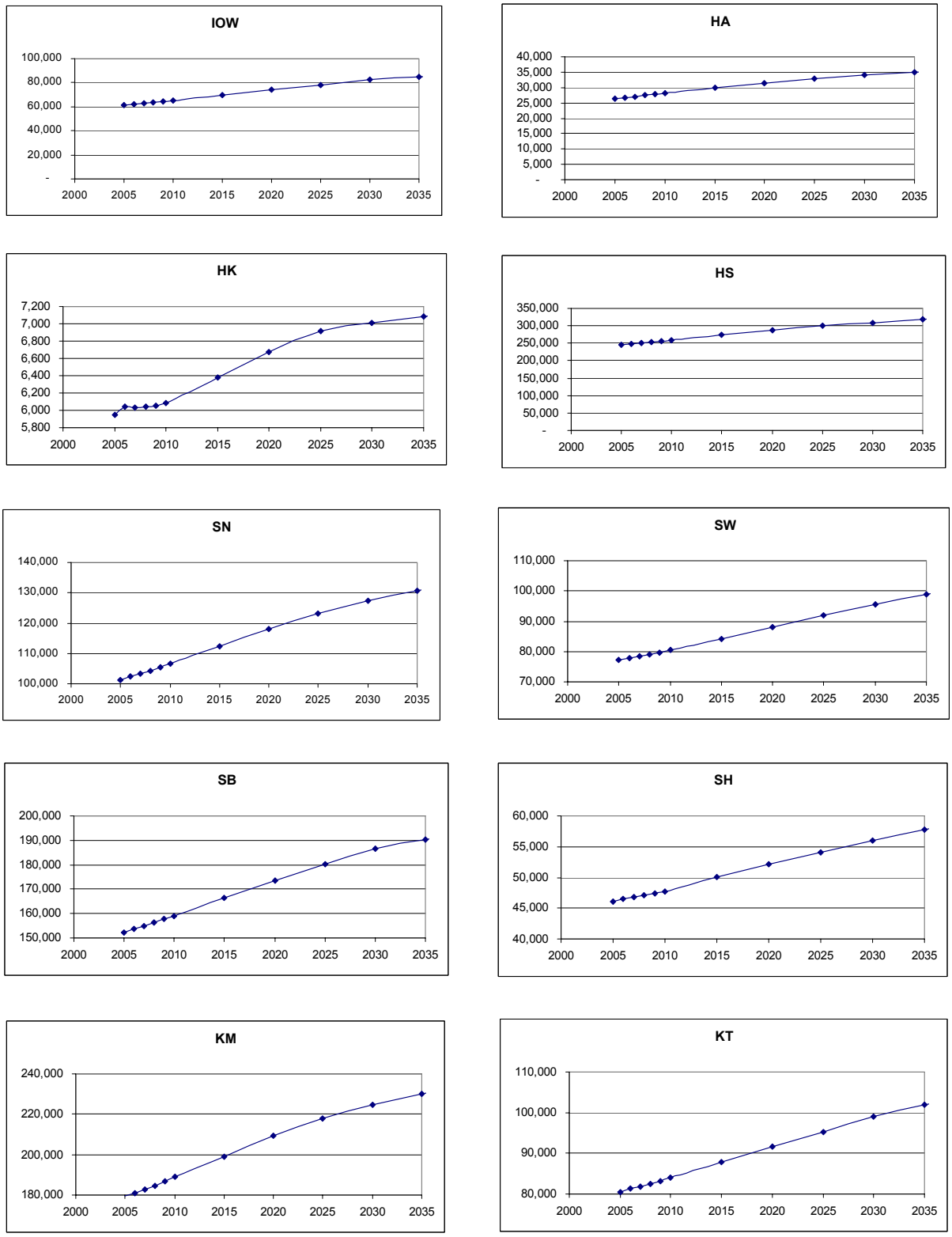


Figure E.8 Property Forecast by WRZ

E.4 The Demand Forecast

The demand forecast is built up from population and property forecasts, assumptions on changes in PCC and in commercial activities over the planning period, together with the company proposals on household metering and on further leakage reduction.

E.4.1 Base Year Water Balance

The components of demand comprise household and non-household customer use, operational use; losses from the company's distribution system and other non billed losses. Table E.5 below lists the components, at the water resource zone level as reported to Ofwat in January, 2009, being a re-statement of the corresponding Table10b(1) from the JR08 returns to Ofwat, reflecting the up to date property and population forecasts described earlier and minor changes to other components.

Component of Demand (Ml/d)	**IOW**	**HA**	**HK**	**HS**	**SN**	**SW**	**SB**	**SH**	**KM**	**KT**	**Company**	**As %DI**
Unmeasured households	1.8	6.6	1.9	66.4	25.0	17.3	37.7	10.6	55.9	21.2	**244.3**	43%
Measured households	14.0	2.6	0.5	19.5	10.9	8.6	11.8	4.7	11.3	5.8	**89.7**	16%
Unmeasured non-households	0.1	0.1	0.0	0.9	0.8	0.6	1.3	0.6	0.7	0.6	**5.7**	1%
Measured non-households	10.1	2.9	1.3	37.4	14.6	7.6	17.9	5.2	25.0	9.6	**131.6**	23%
Distribution system losses	2.7	2.6	1.2	14.6	8.9	4.9	9.9	2.7	13.9	4.0	**65.3**	12%
Customer supply pipe losses	0.9	0.4	0.1	3.6	1.4	1.6	2.9	1.0	3.0	1.4	**16.2**	3%
Operational use and non-billed losses	0.6	0.2	0.1	2.1	0.8	0.9	2.1	0.9	2.1	0.9	**10.7**	2%
Total Demand = Distribution Input (DI)	**30.3**	**15.3**	**5.1**	**144.4**	**62.4**	**41.5**	**83.6**	**25.6**	**112.0**	**43.4**	**563.6**	**100%**

Table E.5 Water Balance at WRZ Level, 2007-08

E.4.2 Household Demand

Household demand can be forecast by either of two approaches:

- Extrapolating long-term historical trends in PCC; and
- Developing a model which builds PCC from forecast changes in the underlying micro-components of demand.

Both approaches have limitations because there is uncertainty in predicting how customers' water use may change over the long term. Extrapolation on the basis of historical trends has the benefit of providing a reasonably realistic short-term forecast, but doesn't allow for any long term changes in regulations or customer behaviour. Nor does it allow consideration of technological advances in water using appliances.

Micro-component modelling, on the other hand, can be used to predict future changes in demand, although the accuracy of this approach is highly dependent on the validity of the assumptions made about the likely impact of technological change on appliance water use, of the nature and timing of any regulatory controls and of behavioural changes in water using activities by the customer. Clearly there will be a significant degree of uncertainty in any forecasts developed using the approach. Nevertheless, following the requirements of the WRMP Guidelines, predictions of future PCC have been based on the micro-component approach.

The micro-component forecast is based on the NYAA demand and uses the JR08 PCC values for both measured and unmeasured customers in each WRZ as the base from which to build the estimates for future years.

The key assumptions and principles involved in the micro-component modelling are:

- Technological development of appliances will lead to significant reductions in water use such that "best practice today will be the norm of tomorrow". Specifically we assume that by the end of the planning period, the average consumption of washing machines and dishwashers will be no more than the 10 percentile level of today's models (45 litres per use and 12 litres per use respectively) as determined from the Waterwise survey;
- The average flush volume will reduce to around 6.5 litres/flush by the end of the planning period because of the installation of 6 litre and/or dual flush cisterns in new properties and the continuing replacement of older and larger cisterns across the customer base; and
- There will be a change to the Building Regulations requiring more water efficient fixtures and fittings to be installed.

A significant number of new homes are proposed for the south east during the planning period, many of which are expected to be flats or smaller dwellings, with a lower occupancy level than existing properties. From April 2008, it has been mandatory for all new socially funded housing to meet the *Code for Sustainable Homes* code level 3 of 105 litres per person per day (Defra 2008). In the demand forecast, therefore it is assumed that from the start of the planning period (2010-11) residents in all newly built socially funded housing will have a PCC no greater than 105 litres per person per day. The proportion of new build social housing in 2007-08 is estimated to be 14%, based on an analysis of recently published regional data from the Department for Communities and Local Government. This percentage is assumed to increase to 25% of all new build properties by 2026, which accords with the regional target for social housing set out in *The South East Plan* (SEERA 2006).

It is also assumed that the remainder of the new build properties will meet the equivalent of a code level 0 property, which has an equivalent design standard of 125 litres per person per day. It is unclear, however, how such a consumption target will be sustained over time without regulation and enforcement in the marketplace.

The forecast for optant and selective measured PCC is based on the assumed saving from the unmeasured household micro-component PCC forecast. Selective PCC in this case refers to the PCC of customers metered under change of occupancy, company selective (high water users), and universal metering programmes. It is assumed, based on the available literature (UKWIR 2005), that

the average saving for optants is 8% of unmeasured PCC, while the equivalent for selective customers is assumed to be 10%.

The normal year PCC forecasts are multiplied by derived factors, in order that the base year distribution input matches the calculated demand in each WRZ under each demand forecast scenario, as presented in Table E.1. During peak periods (the DYCP design scenario), an additional 5% saving is attributed to all measured PCC forecasts, to account for documented additional reductions in demand due to metering in summer periods. However, this has not been applied to new build properties, which are assumed to incorporate measures to reduce PCC in summer periods in their base level of PCC.

It is further assumed that the micro-component based PCC forecast applies to all newly metered customers in the year immediately following meter installation. Assumptions regarding the baseline water efficiency target and climate change impacts are also incorporated into the calculation of measured household demand and these are discussed in Sections E.5 and E.6 respectively.

The sensitivity of the forecast to assumptions surrounding PCC growth have been tested and included in the headroom component of the Supply Demand Balance.

E.4.2.1 Meter Installation Policy

Meter installation is generally considered to be one of the best means of reducing household demand because it enables customers to monitor their consumption through their water bill. It also helps the company to develop a better understanding of demands on the distribution system which in turn helps tackle leakage. The impact of metering on domestic demand is dependent upon a range of factors including: property type, customer demographics, the number of occupants in the property, whether the meter installation was voluntary or has been universally applied, the season of the year and the amount of external water use. The impact of metering on demand is also dependent on the location of the meter, which can be sited either within the property, or external to it. Installing the meter externally has the benefit of helping to alert customers to any leakage associated with their supply pipes; and timely repairs to leaking supply pipes helps to reduce overall losses from the distribution system.

It has long been Southern Water policy to require meters to be installed in new build properties, while metering on change of occupier has been the company policy in Sussex since 2005. Meters are installed externally wherever possible.

The company supply area has now been designated by the Environment Agency as an area of serious water stress. This has been an important consideration in the drive towards the company preferred approach of universal metering, with the installation programme proposed to be carried out between 2010 and 2015, by which time it is expected that all households will be metered. However, a range of future metering policies have been examined for this Water Resources Management Plan:

- Optant metering policy – assumes optants, selectives (high water users), and new properties are metered;
- Universal Change of occupier metering – extends the existing policy of metering on change of occupier throughout the Sussex WRZs to all other WRZs. This would be in addition to the baseline policy for optant, selective, and new property metering; and
- Universal metering in AMP5 – assumes all properties in all WRZs will be metered in the period 2010-2015. Under this policy, optant and selective properties, but not Change of occupiers properties, would continue to be metered ahead of the universal metering programme, and a likely programme is illustrated in Table E.6 below.

Area	WRZ	AMP5				
		2010-11	2011-12	2012-13	2013-14	2014-15
Western	IoW					✓
	HS		✓	✓	✓	
	HK	✓				
	HA	✓				
Central	SN	✓				
	SW					✓
	SB		✓			
Eastern	SH			✓		
	KM			✓	✓	✓
	KT				✓	

Table E.6 Likely Profile of Universal Metering Programme

A further scenario which has been considered is the introduction of a new tariff structure in conjunction with the universal metering policy (because it achieves a very high rate of meter penetration early in the planning period). Introducing variable tariffs is generally considered to result in reduced demand, over and above the savings from metering alone. This scenario is discussed in more detail in Appendix G. It is assumed that tariff changes could be implemented from AMP6 onwards (following on from the universal metering programme), and that a tariff profile could be introduced, which would result in an additional 5% reduction in annual demand and 10% reduction in peak demand, over and above the effect of metering alone. There is however great uncertainty associated with the potential impact of any new tariff options.

E.4.3 Non-Household Demand

Non household consumption is largely unaffected by weather. This is illustrated in Figure E.9 which shows that there has been relatively little annual variation in this component of demand in recent years despite the variable summer weather conditions that have been experienced. Consequently the dry year, MDO and peak factors for non-household demands have been taken as unity and the base year demands set equal to the JR08 out turn figures.

Analysis of historic non-household consumption data derived from published June Returns shows that demand in this sector is decreasing over time, albeit relatively slowly. This view is supported by an analysis of customer use, sub-grouped into the main Standard Industrial Classification (SIC) categories as published by the Office of National Statistics (2007).

Table E.7 below lists the 17 category groups specified in the Water Resources Planning Guideline and their SIC (2007) codes, and gives a breakdown of the company's commercial customer base against this classification. Unfortunately, customer records are incomplete, and only around 60% of non-household customers have a valid SIC code recorded on the company's billing system. In total, the consumption recorded by this group of customers in 2006-07, (being the latest year for which this level of detail was readily available) amounted to some 80 Ml/d and Table E.7 lists the out-turn consumption figures in each category during that year. Consumption data are recorded against each of the 17 categories, but eleven account for less than 5 Ml/d each during the year.

Customer billing records back to 1995 have also been accessed and the annual billed volumes in each SIC category accumulated. Figure E.9 below shows the variation from 1995 to date in each of the six largest categories, while Figure E.10 shows the variation of the total SIC coded consumption over the same period.

It is assumed that the gradual decline in non-household demand will continue at least until the end of AMP6, after which it is assumed to remain at that level until the end of the planning period.

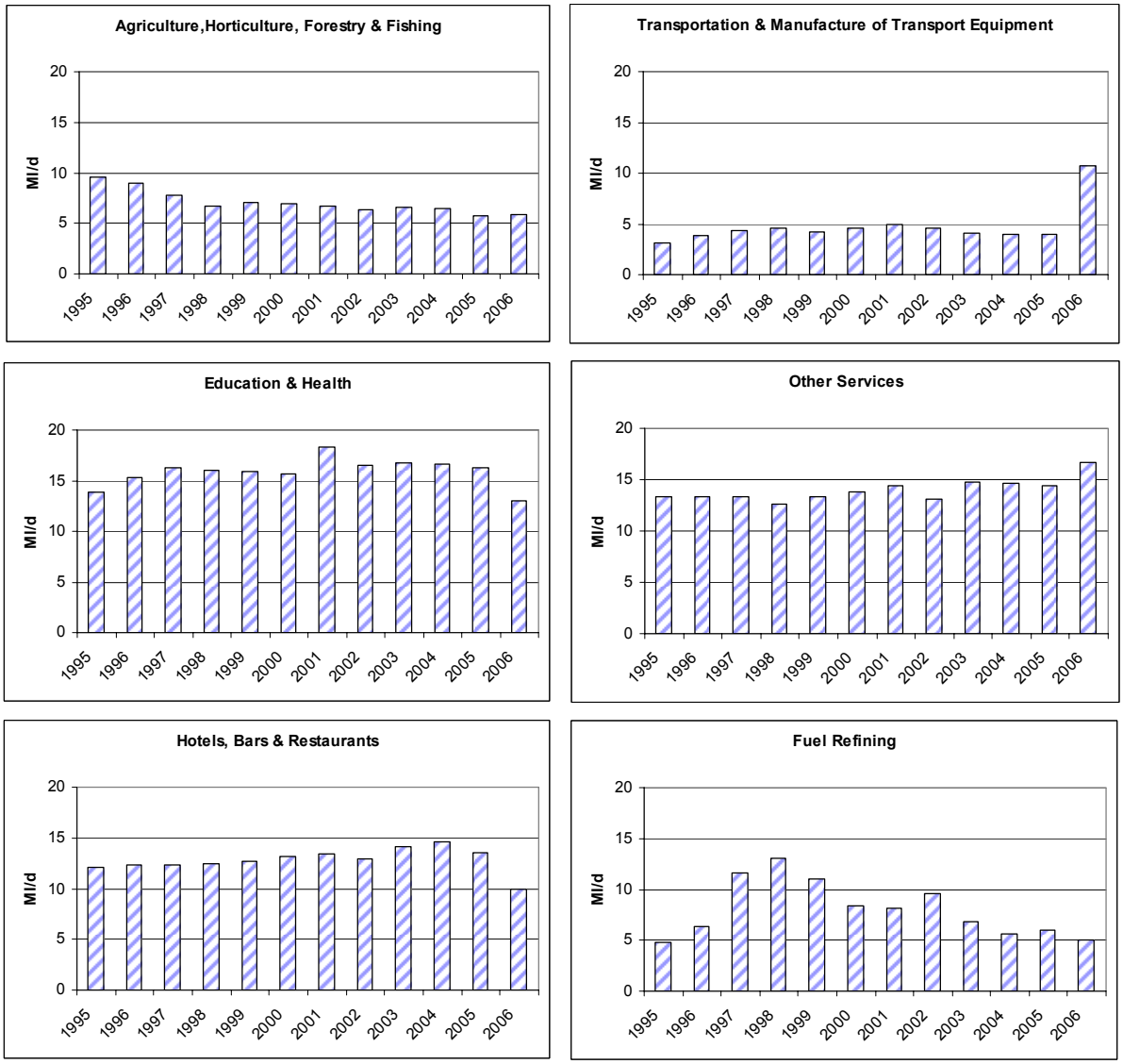


Figure E.9 Annual Billed Volumes in Six Industrial Categories

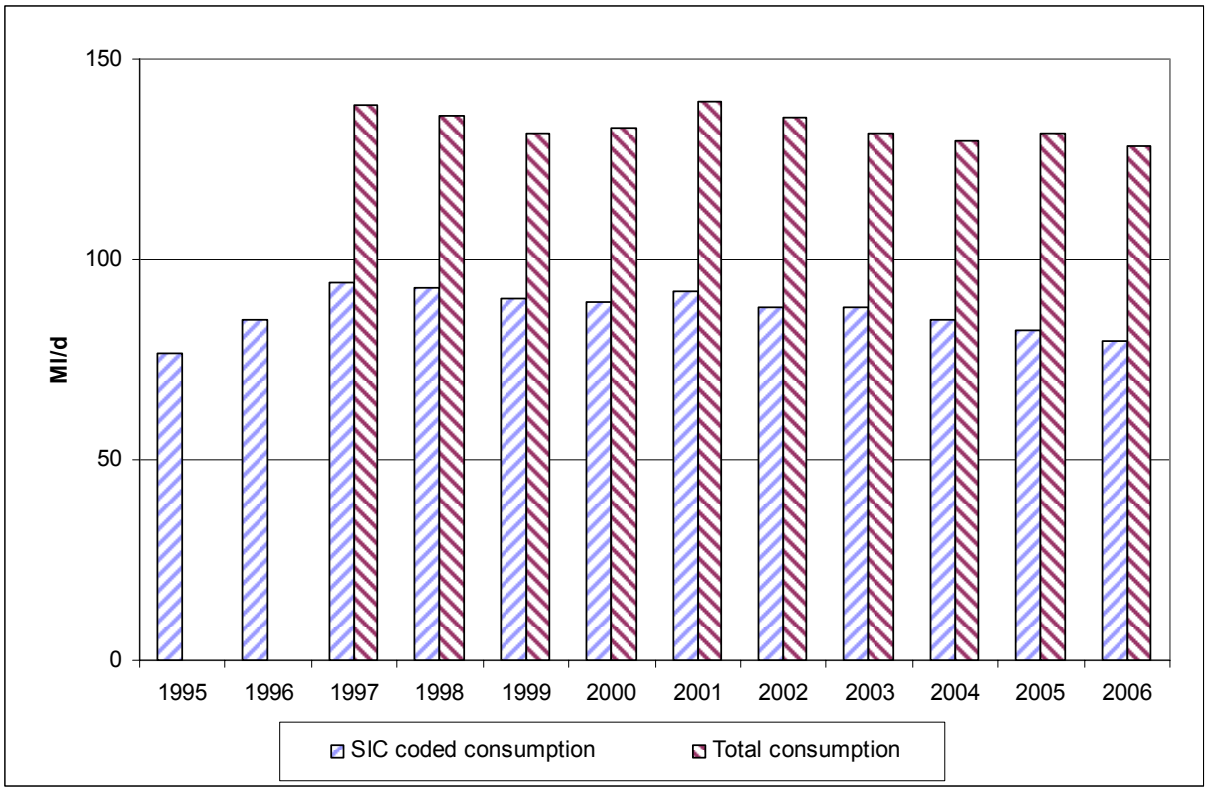


Figure E.10 Non-Household Consumption, 1995-2007

Description	SIC Code (ONS,2007)	% Non-Household Customers	2006-07 Metered Consumption (Ml/d)
Agriculture, horticulture, forestry & fishing	A1,A2,A3	8.0	5.9
Extraction of metals, minerals and energy producing materials	B5,B6,B7,B8,B9	0.1	0.9
Food and drink (manufacture)	C10,C11,C12	0.4	1.1
Textile, fur and leather (manufacture)	C13,C14,C15	0.2	0.1
Other manufacturing	C16,C26,C27,C31	2.1	1.6
Paper (manufacture)	C17,C18	0.6	0.2
Fuel refining	C19	0.0	5.0
Chemicals, rubbers, plastics and man-made material (manufacture)	C20,C21,C22	0.3	2.7
Manufacture of non-metallic minerals	C23	0.2	0.2
Manufacture of base metals, fabricated metal products and machinery	C24,C25,C28,C29	1.1	3.5
Transportation and manufacture of transport equipment	C30,H49,H50,H51	2.0	10.8
Electricity, gas and water supplies	D35,E36,E37,E38	0.1	2.9
Construction	F41,F42,F43	3.7	1.5
Wholesale and retail	G45,G46,G47	13.6	3.8
Hotels, bars and restaurants	I55,I56	8.5	10.0
Other services	J,K,L,M,N,O,R,S	12.5	16.6
Education and Health	P,Q	7.9	13.0
Unclassified	-	38.8	50.0

Table E.7 SIC (2007) Codes and 2006-07 Consumption

E.4.4 Minor Components of Demand

Distribution system operational use and unbilled supplies, (including both legal and illegal use) may be termed minor components of demand because they only account for around 2% of distribution input (Table E.5). It is assumed that the value of both of these components (10.7 Ml/d in 2007-08) will remain constant throughout the planning period.

E.5 Water Efficiency Targets

Ofwat have recently published their proposals regarding water efficiency targets (Ofwat, 2008). These targets aim to build on water companies' existing duty to promote the efficient use of water to their customers to ensure that companies play their part in achieving the Government's aspirational target, set out in *Future Water* (Defra 2008) of reducing individual water usage to 130 litres per person per day by 2030.

Each company must meet a minimum target for water saved in relation to the number of properties served. Ofwat has proposed that the annual base service target of saving shall be one litre of water per billed property per day through approved water efficiency activity. In addition, companies are required to provide information to consumers on how to use water more wisely, and to take an active part in improving the evidence base for water efficiency.

The second element of the Ofwat targets is termed the sustainable economic level of water efficiency (SELWE), by which companies are expected to propose additional water efficiency activity above the base level water efficiency target. This is to form part of a sustainable, economic approach to balancing supply and demand over the full planning period. Feasible options that are not included in the baseline strategy are therefore considered in the investment model alongside other supply and demand side options as part of the 'twin track' approach.

Southern Water's proposed water efficiency target for AMP5 (from 2010-11 to 2014-15), based on a saving of one litre per property per day, amounts to 1.01 Ml/d and this target is to be met through both household and non-household activity.

A review of potential water efficiency options was carried out using the latest literature available, including that from Ofwat and Waterwise. Feasible options were assessed in terms of their estimated costs and water savings, and any practical considerations that have been identified which could impact on their implementation, and the schemes were ranked by their AISC to indicate their cost effectiveness, (see Appendix G for further details). The results of this analysis were used to aid formulation of the least cost strategy to achieve Ofwat's baseline water efficiency target.

In line with current best practice, the deterioration in the effectiveness of each water efficiency measure over time due to factors such as mechanical failure, poor maintenance and removal or replacement, was modelled assuming a time varying yield, based on an exponential decay curve and the expected asset life of the measure (Waterwise 2008). Thus, although the proposed programme will meet the 1.01 Ml/d target in each year of AMP5, the total water efficiency saving will not reach 5 Ml/d over the five year period from 2010-11 to 2014-15, due to decreasing yield assumptions. Figure E.11 shows, at the company level, the schemes selected to meet the baseline water efficiency target and their relative contributions toward the water efficiency targets.

The breakdown of company level water efficiency activity into household and non-household savings, by WRZ, are presented in Figure E.12 and Figure E.13 respectively.

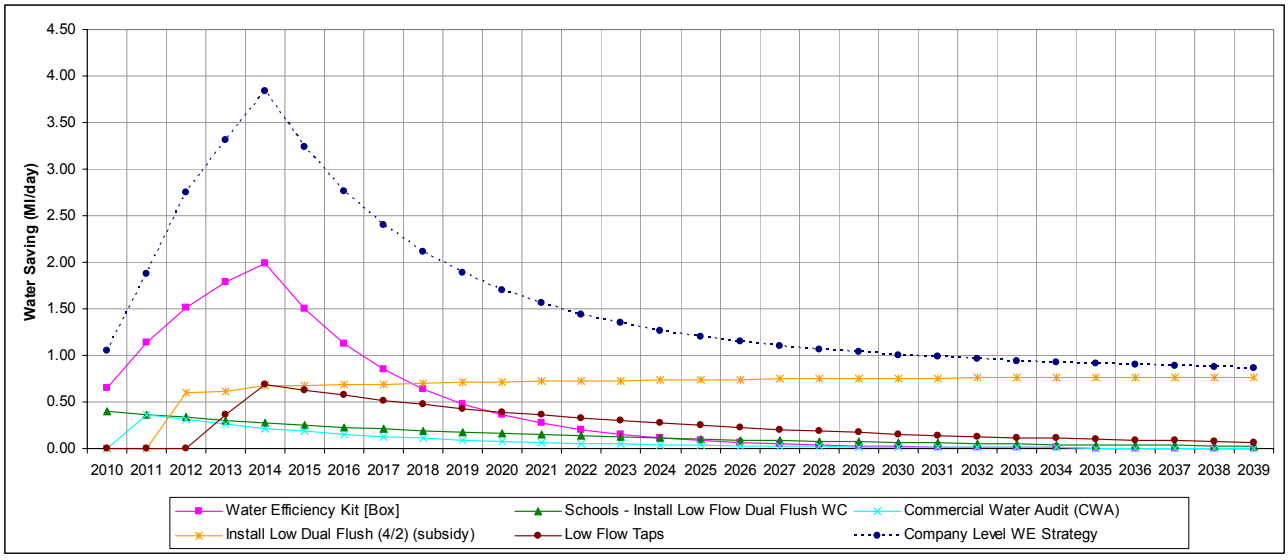


Figure E.11 Company Level Ofwat Target Water Efficiency Activity

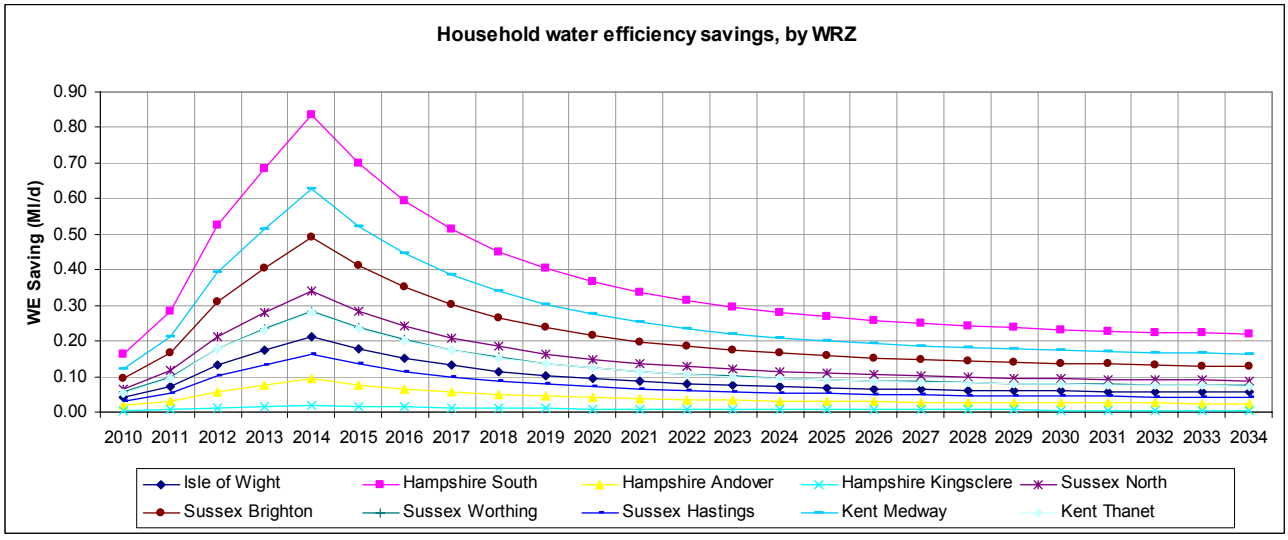


Figure E.12 Total Ofwat Target Household Water Efficiency Savings in Each WRZ

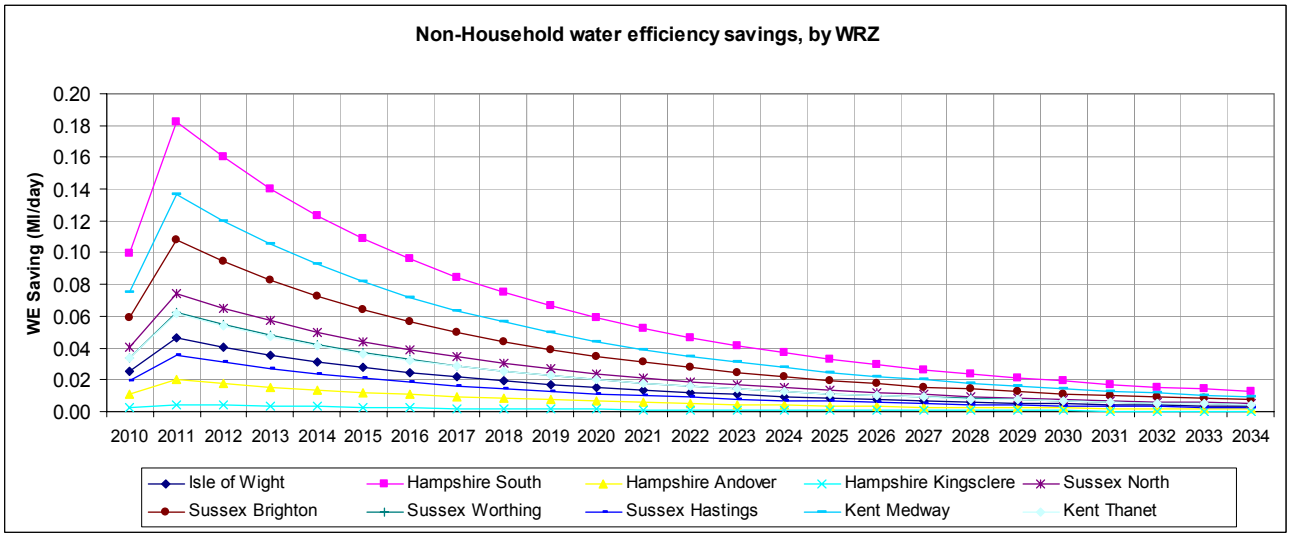


Figure E.13 Total Ofwat Target Non-Household Water Efficiency Savings in Each WRZ

E.6 Climate Change Impact on Demand

The effects of climate change on demand have been estimated using the results from the *Climate Change and Demand for Water (CCDeW)* report, which was published in February 2003 as an update to a benchmark study by Herrington in 1996. The key climate variables of interest in the study were temperature (monthly maximum, minimum and mean), precipitation, radiation, potential evapotranspiration, relative humidity and wind speed. The mean changes in the climate variables for the 2020s (2011-2040) and the 2050s (2041-2070) were used. These relate to changes from the average of the climate model simulated baseline period, 1961-1990.

The CCDeW study used the UKCIP02 climate scenarios and a number of socio-economic scenarios to provide a range of potential impact factors. The UKCIP02 climate scenarios were referred to as either: Low (L), Medium-High (MH) or High (H). While alpha (α), beta (β), gamma (γ) and delta (δ) refer to socio-economic scenarios created as plausible and consistent descriptions of possible futures, representing provincial enterprise, world markets, global sustainability and local stewardship scenarios respectively.

Table E.8 below presents a regional estimate of climate change impact on domestic demand, as percentage change relative to the same socio-economic scenario with no climate change.

Low 2020s		Medium-High 2020s		Medium-High 2050s	
α and β	**γ and δ**	**α and β**	**γ and δ**	**α and β**	**γ and δ**
1.33%	0.99%	1.45%	1.07%	2.92%	1.81%

Table E.8 Climate Change Impact on Household Demand (After CCDeW, 2003)

Estimates of climate change impacts on industrial and commercial demand, as percentage change relative to the same socio-economic scenario with no climate change, are presented in Table E.9 below.

Low 2020s	Medium-High 2020s				Med-High 2050s
γ	**α**	**β**	**γ**	**δ**	**β**
2.5%	2.4%	2.7%	2.8%	2.4%	5.7%

Table E.9 Climate Change Impact on Non-Household Demand (After CCDeW, 2003)

E.6.1 Approach to Applying Factors

CCDeW climate change impact factors are unconventional in that they are applied to a reference scenario in the future rather than a baseline value in the present day. Therefore, demand in each year of the forecast must first be calculated without climate change and then the percentage increase for that year for the appropriate climate change scenario should be applied.

For a scenario that is most similar to conventional development, the Beta socio-economic scenario, entitled 'World Markets', can be used (in some cases this is combined with the Alpha Scenario, 'Provincial Enterprise'). There is little difference between the climate change scenarios for the 2020s, and so the medium-high emissions scenario is recommended because most information is provided on this within CCDeW. For domestic demand, this gives a 1.45% mean increase in the 2020s, with a minimum 0.94% and maximum 2.19%. Where the 2050s factors are used, the minimum, mean and maximum increases are 1.74%, 2.92% and 5.03% respectively.

For non-domestic demand, there are no WRZ figures provided in CCDeW and so it is difficult to derive a measure of uncertainty. However, it is recommended that a lower band of zero is used, with an upper band of around 4% in the 2020a, and a mean of 2.7%; this reflects the spread of uncertainty in sectors (from 0.0% to 6.4%) whilst recognising the potential for over-estimating the climate change impact. The equivalent upper and lower bands for the 2050s are zero and 8.5% respectively (reflecting an uncertainty across sectors from 0.0% to 13.6%), with a mean of 5.7%.

To work through some examples, we will use the Beta socio-economic scenario (or a combined Alpha and Beta scenario) for domestic demand using the maximum factors for climate change – i.e. 2.19% in the 2020s, and 5.03% for the 2050s.

The Water Resources Planning Guideline state that the CCDeW factors for the 2020s should be scaled back to the base year to give an annual percentage increase. With a base year of 2007-08, there are 17 years between the base year and 2025 (the mid-point of the 2020s), so this would give an annual maximum increment of 0.129% for domestic demand (2.19% ÷ 17). This should then be scaled back and forward from 2025, to give annual (cumulative) percentages.

However, it is not clear from CCDeW which year should be used to scale back the change factor to get an annual increment. If the 1961-90 period is used (after which it is commonly assumed that climate change would have an impact on the baseline), then 1975 – as the mid-point in this 30-year period – would seem appropriate. For domestic demand this would result in a linearly-average increment of 0.044% accumulating from 1975 to 2025 (i.e. starting at 0 and increasing in 0.044% increments to 2.19% – see blue line in Figure E.14). In contrast, the approach based on WRMP guidance gives a yearly-averaged increment of 0.129%, which is almost 3 times the factor scaled back to 1975 (see green line in Figure E.14).

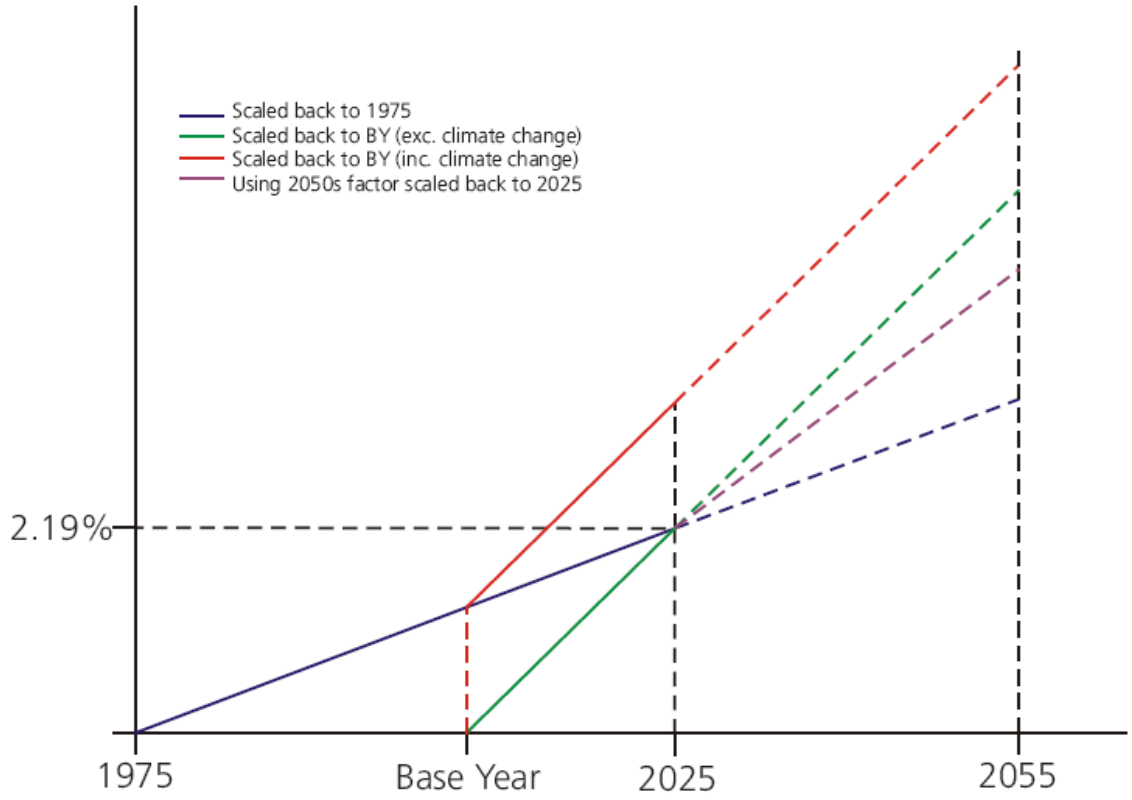


Figure E.14 Indicative Graph of Different Scaling Methods (Example Used: Max Value)

By not scaling from 1975, there is a risk of over-estimating the impact of climate change after 2025 as the annual increments are too large (as shown by green line above). Also, there is an assumption that the base year, and therefore the forecast based on this, is unaffected by climate change. But if the base year already includes climate change, the future impact of climate change will then be significantly overestimated (see red line in Figure E.14 above, which assumes a linear realisation of climate change to date).

One way of avoiding this over-estimation after 2025 is to use the factors for the 2050s and scale back to 2025. This is shown as the purple line in Figure E.14; a step-change can be seen, identifying a reduced annual factor than the green line, but a greater factor than the blue line. In theory, the annual impact should be greater for the 2050s than the 2020s, which suggests that the WRP guidance method (green line) is illogical.

To determine the best approach, an investigation was conducted on four potential approaches (colours relate to lines on Figure E.15), with annual factors calculated for each:

- Green method: The WRP guidance; scaling forward and back from 2025 (to base year) (approach as already discussed);
- Blue method: Scaling forward and back from 2025 (to 1975) (approach as already discussed);
- Pink method: As Green, but scaling back from 2055 for post-2025 factors; and
- Orange method: As Blue, but scaling back from 2055 for post-2025 factors.

The Pink and Orange methods follow the Green and Blue methods respectively up until 2025, but then use annual factors derived from the 2050s for the years after 2025. In this respect they follow the same method, i.e. dividing the additional climate change impact for the 2050s (over and above the impact up to the 2020s) by 30 years, which gives an annual factor of 0.095%.

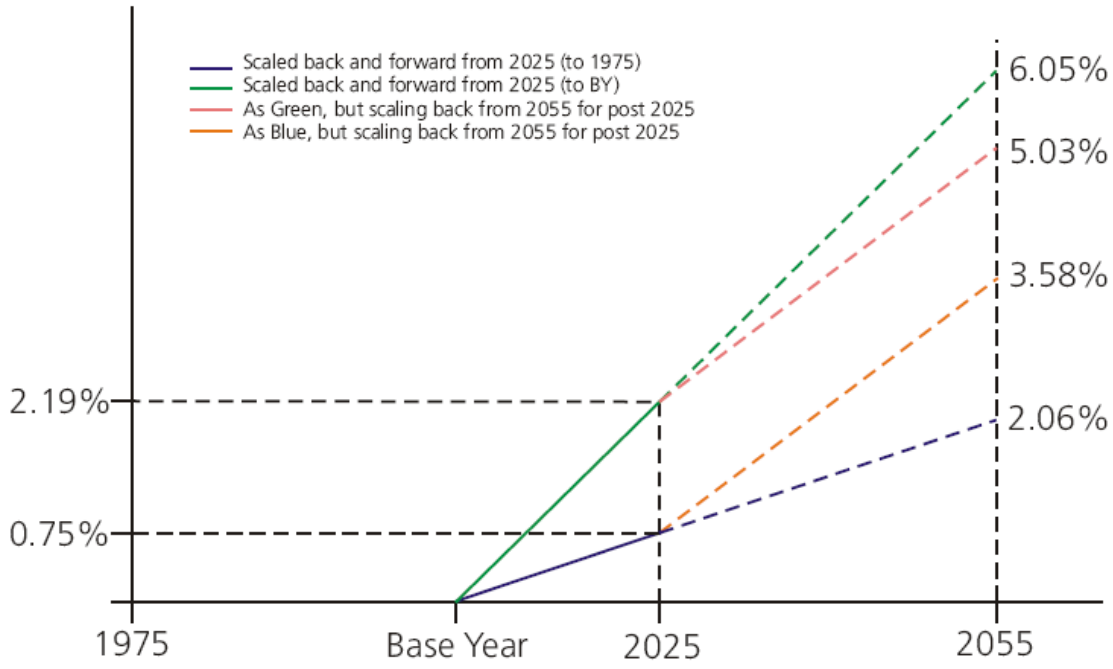


Figure E.15 Indicative Graph of Four Different Scaling Methods (Example Used: Max Value)

Figure E.15 shows an indicative graph of the four different methods with results presented as cumulative annual climate change factors from the base year, through 2025, to 2055 (the mid-point of the 2050s). Although the 2050s is not within the water resource planning period, showing the impact at 2055 emphasises the difference between the four methods. The four outcomes are explained individually below:

- Green method: as with Figure E.14;
- Blue method: as with Figure E.14; however, the line begins at zero so as not to double count climate change, which is assumed to already affect the baseline (as discussed previously);

- Pink method: by scaling back to the base year (as per the Green method), and then from 2055 to 2025; there is a decrease in the rate of climate change impact from 2025; and
- Orange method: by scaling back to 1975 (as per the Blue method), and then from 2055 to 2025, the profile shows an increase in the rate of climate change impact after 2025.

From the results presented here, the Orange method is clearly the most reasonable approach. It provides a profile of annual climate change factors for demand that most accurately portrays the likely profile of climate change over the first half of the 21st century and avoids double-counting.

E.6.2 Summary of Factors Used

The method for calculating annual factors has therefore been based on the Orange approach, outlined above. The impact of climate change on domestic and industrial / commercial demands uses factors based on the CCDeW medium-high climate change scenario and the Beta socio-economic scenario (which is similar to conventional levels of development). These are presented in Table E.10 (domestic) and Table E.11 (industrial / commercial). Note that these factors are applied to the in-year demand.

Year Number	Year	% Demand Increase		
		Min	**Mean**	Max
0	2007-08	0.0000	0.0000	0.0000
1	2008-09	0.0188	0.0290	0.0438
2	2009-10	0.0376	0.0580	0.0876
3	2010-11	0.0564	0.0870	0.1314
4	2011-12	0.0752	0.1160	0.1752
5	2012-13	0.0940	0.1450	0.2190
6	2013-14	0.1128	0.1740	0.2628
7	2014-15	0.1316	0.2030	0.3066
8	2015-16	0.1504	0.2320	0.3504
9	2016-17	0.1692	0.2610	0.3942
10	2017-18	0.1880	0.2900	0.4380
11	2018-19	0.2068	0.3190	0.4818
12	2019-20	0.2256	0.3480	0.5256
13	2020-21	0.2444	0.3770	0.5694
14	2021-22	0.2632	0.4060	0.6132
15	2022-23	0.2820	0.4350	0.6570
16	2023-24	0.3008	0.4640	0.7008
17	**2024-25**	0.3196	**0.4930**	0.7446
18	2025-26	0.3463	0.5420	0.8393
19	2026-27	0.3729	0.5910	0.9339
20	2027-28	0.3996	0.6400	1.0286
21	2028-29	0.4263	0.6890	1.1233
22	2029-30	0.4529	0.7380	1.2179
23	2030-31	0.4796	0.7870	1.3126
24	2031-32	0.5063	0.8360	1.4073

Year Number	Year	% Demand Increase		
		Min	**Mean**	Max
25	2032-33	0.5329	0.8850	1.5019
26	2033-34	0.5596	0.9340	1.5966
27	2034-35	0.5863	0.9830	1.6913

Table E.10 Domestic Demand Scaled Factors (Med-High; Alpha & Beta): Orange Method

Year Number	Year	% Demand Increase		
		Min	**Mean**	Max
0	2007-08	0.0000	0.0000	0.0000
1	2008-09	0.0000	0.0540	0.0800
2	2009-10	0.0000	0.1080	0.1600
3	2010-11	0.0000	0.1620	0.2400
4	2011-12	0.0000	0.2160	0.3200
5	2012-13	0.0000	0.2700	0.4000
6	2013-14	0.0000	0.3240	0.4800
7	2014-15	0.0000	0.3780	0.5600
8	2015-16	0.0000	0.4320	0.6400
9	2016-17	0.0000	0.4860	0.7200
10	2017-18	0.0000	0.5400	0.8000
11	2018-19	0.0000	0.5940	0.8800
12	2019-20	0.0000	0.6480	0.9600
13	2020-21	0.0000	0.7020	1.0400
14	2021-22	0.0000	0.7560	1.1200
15	2022-23	0.0000	0.8100	1.2000
16	2023-24	0.0000	0.8640	1.2800
17	**2024-25**	0.0000	**0.9180**	1.3600
18	2025-26	0.0000	1.0180	1.5100
19	2026-27	0.0000	1.1180	1.6600
20	2027-28	0.0000	1.2180	1.8100
21	2028-29	0.0000	1.3180	1.9600
22	2029-30	0.0000	1.4180	2.1100
23	2030-31	0.0000	1.5180	2.2600
24	2031-32	0.0000	1.6180	2.4100
25	2032-33	0.0000	1.7180	2.5600
26	2033-34	0.0000	1.8180	2.7100
27	2034-35	0.0000	1.9180	2.8600

Table E.11 Industrial & Commercial Demand Scaled Factors (Med-High; Beta): Orange Method

E.7 Leakage

E.7.1 Current Performance

The company's reported leakage in 2007-08 was 82 Ml/d. Ofwat have set leakage targets for all water companies covering the period 2005-10 and Southern Water's target for this period is 92 Ml/d (Ofwat 2004). During 2006-07 and 2007-08 the company outperformed the target by 9 Ml/d and 10 Ml/d respectively and now has the lowest leakage level per property of all the UK water and sewerage companies.

The level of leakage at which it would cost more to make further reductions than to produce the water from another source is known as the Economic Level of Leakage (ELL). There is now also a requirement for water companies to focus on ensuring that leakage levels are set to fully reflect the preferences of society. In order to achieve this, costs and benefits included in the Economic Level of Leakage (ELL) calculations must include not only the impacts borne directly by the water companies, but also the "external" impacts (i.e. the environmental and social impacts) of leakage control activities. This approach ensures that leakage targets are set at a level that is optimal for customers and society as a whole. In this case, ELL becomes the Sustainable Economic Level of Leakage (SELL).

WRc were commissioned to conduct an assessment of SELL for 2007-08. WRc adopt a marginal cost of water approach, in which the company's short-run ELL was calculated to be 118.5 Ml/d, while the short-run SELL was slightly less, at 116.5 Ml/d. Based on steady state analysis, they determined that the long term (25 year) leakage target for the company should be 89.5 Ml/d, based on SELL. The long run ELL was estimated to be close to the existing target level, at 92.9 Ml/d (WRc 2009). All these levels are above the company's current level of leakage.

The leakage / cost relationships derived from this work are illustrated in Figure E.16 below.

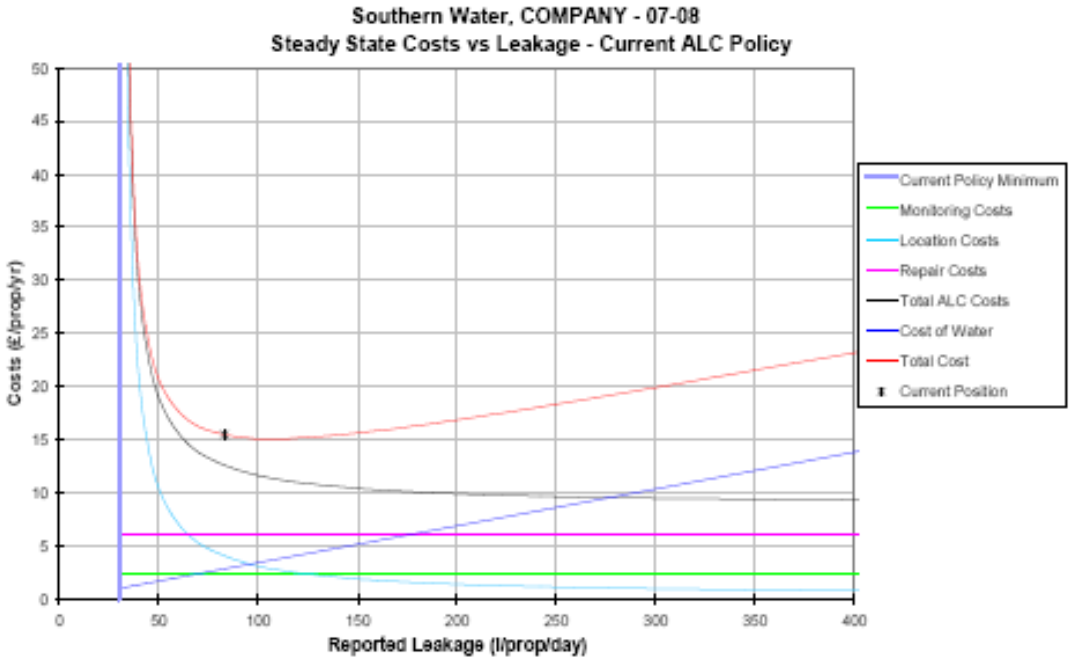


Figure E.16 Steady State SELL Calculation Using the Marginal Cost of Water (WRc 2009)

Both short-run and long-run SELL are above the current level of leakage. Therefore allowing leakage to rise, particularly in resource zones in which there is no Supply Demand Balance deficit, is an option to be considered. But, in general, it is not economic to do so as leakage would need to be reduced

back down to near current levels within the short to medium term to again balance supply and demand. Consequently, due to the risks and uncertainties surrounding both the savings that could be achieved by allowing leakage to rise and the costs of bringing it back down, WRc considered it prudent for the company to maintain leakage at the current level (WRc 2008).

E.7.2 Future Leakage Reduction Scenarios

Notwithstanding the comments above, the company has investigated a number of policy options which will maintain or indeed could reduce leakage below current target levels:

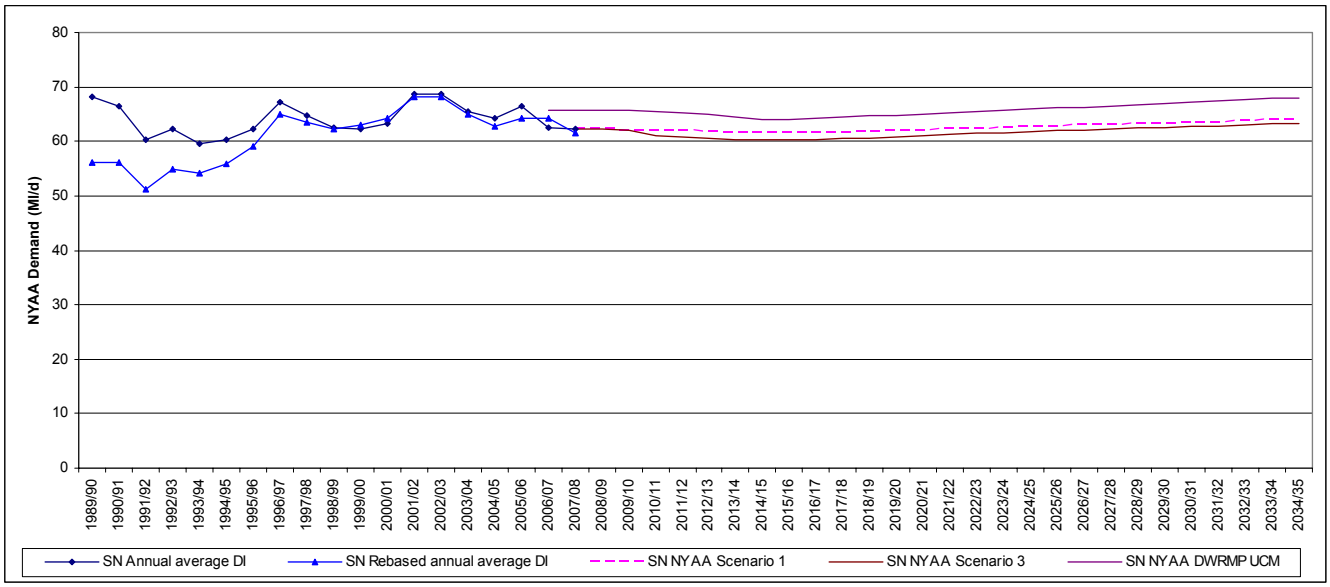
- Maintain leakage at the 2007-08 out-turn level of 82 Ml/d throughout the planning period;
- Reduce leakage in conjunction with the proposed programme of universal metering by carrying out supply pipe repairs. This is expected to result in a reduction in leakage down to approximately 76 Ml/d by the start of AMP6 (Atkins 2009);
- Allow leakage levels in each WRZ to rise to the Ofwat target (calculated on a WRZ basis); and
- Through a combination of either of the above leakage policies, allow investment modelling to select further leakage reduction schemes on a WRZ by WRZ basis, whereby, if selected, such schemes would form part of the least cost strategy to balance supply and demand, in conjunction with water efficiency and other resource development options.

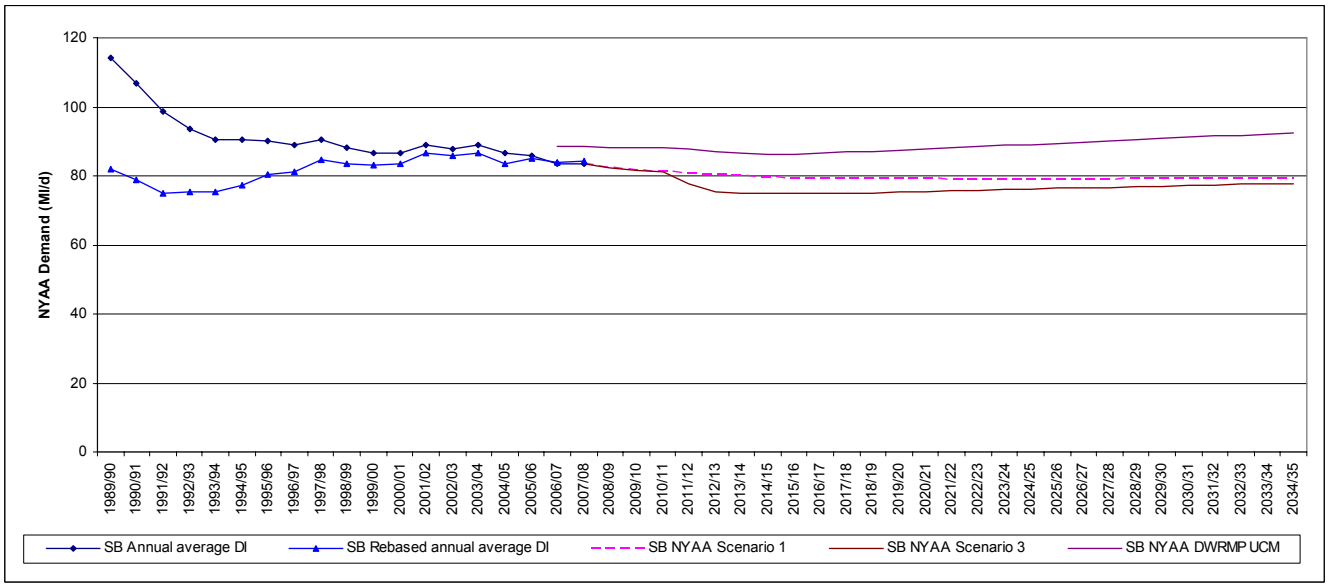
This last option could lead to further overall reductions in leakage, because in some WRZs it may still be economic to drive down leakage further so offsetting the need for additional resource developments. However in those WRZs which do not have a Supply Demand Balance deficit, or already operate below their own ELL, this may not necessarily be the case.

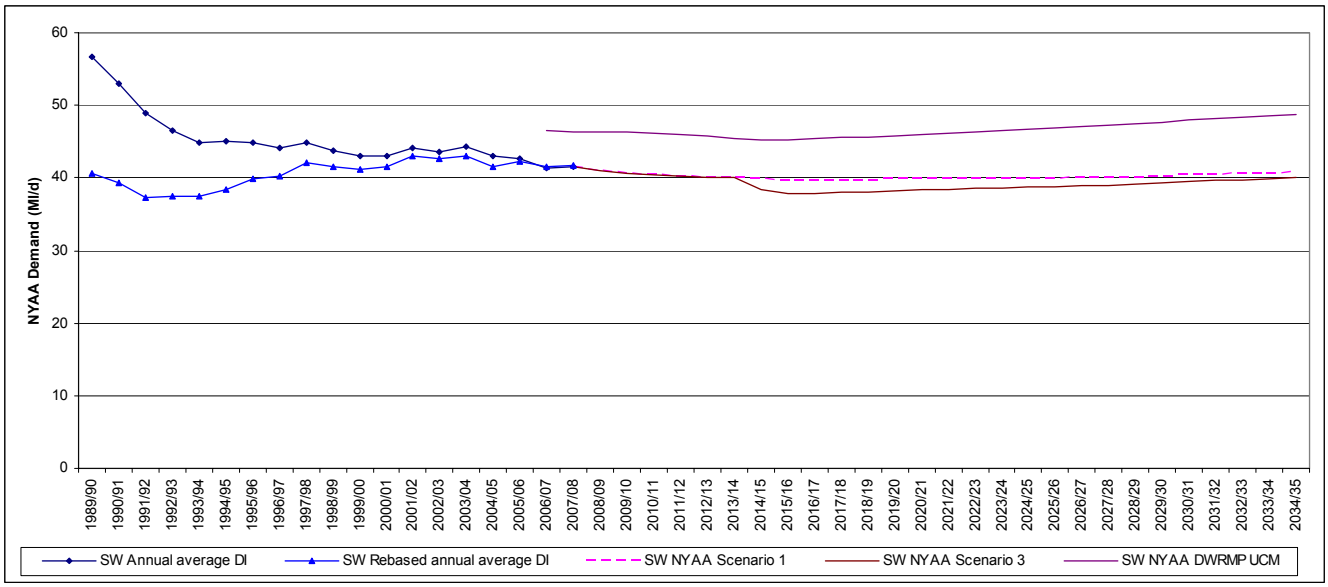
E.8 Historical and Forecast Demand

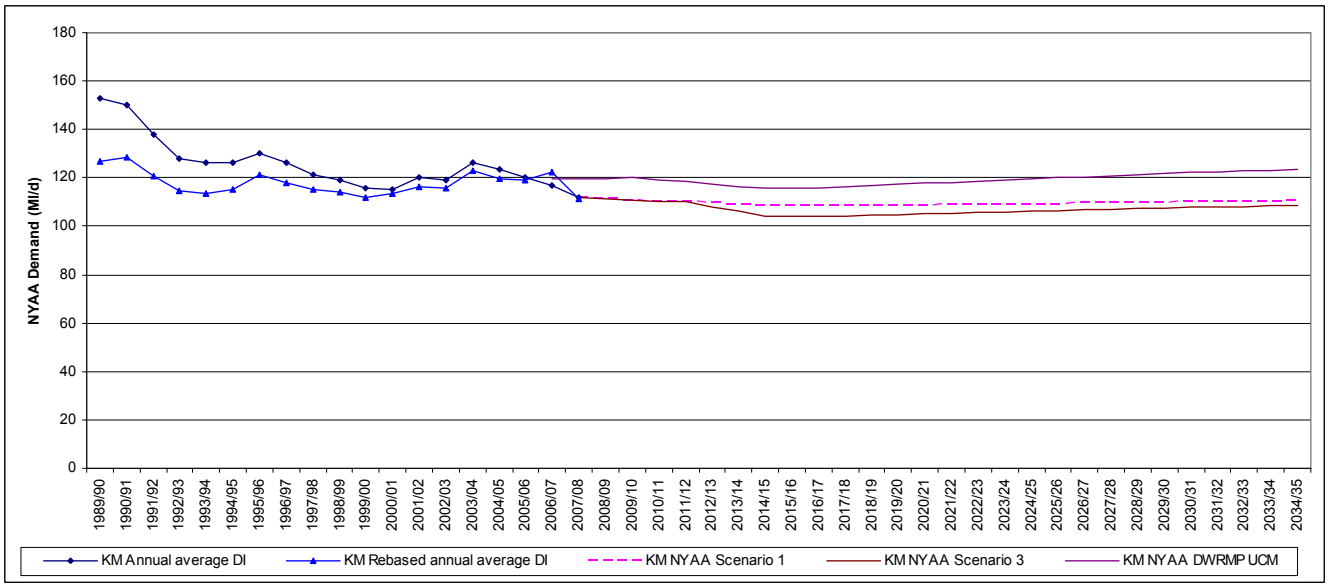
The following plots demonstrate, for each WRZ, how the actual and rebased historical demand compares to the modelled demand forecast, based on the dry year base demands derived in Section E.2. Two demand forecasts are presented in each case: the first is the optant scenario (i.e. optant and selective (large water users) only); and the second is with universal metering and consequent reductions in supply pipe leakage.

E.8.1.1 Normal Year Annual Average Demand






NYAA Demand (Ml/d)
0
10
20
30
40
50
60
1989/90
1990/91
1991/92
1992/93
1993/94
1994/95
1995/96
1996/97
1997/98
1998/99
1999/00
2000/01
2001/02
2002/03
2003/04
2004/05
2005/06
2006/07
2007/08
2008/09
2009/10
2010/11
2011/12
2012/13
2013/14
2014/15
2015/16
2016/17
2017/18
2018/19
2019/20
2020/21
2021/22
2022/23
2023/24
2024/25
2025/26
2026/27
2027/28
2028/29
2029/30
2030/31
2031/32
2032/33
2033/34
2034/35
SW Annual average DI
SW Rebased annual average DI
SW NYAA Scenario 1
SW NYAA Scenario 3
SW NYAA DWRMP UCM


NYAA Demand (Ml/d)
0
20
40
60
80
100
120
140
160
180
1989/90
1990/91
1991/92
1992/93
1993/94
1994/95
1995/96
1996/97
1997/98
1998/99
1999/00
2000/01
2001/02
2002/03
2003/04
2004/05
2005/06
2006/07
2007/08
2008/09
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2013/14
2014/15
2015/16
2016/17
2017/18
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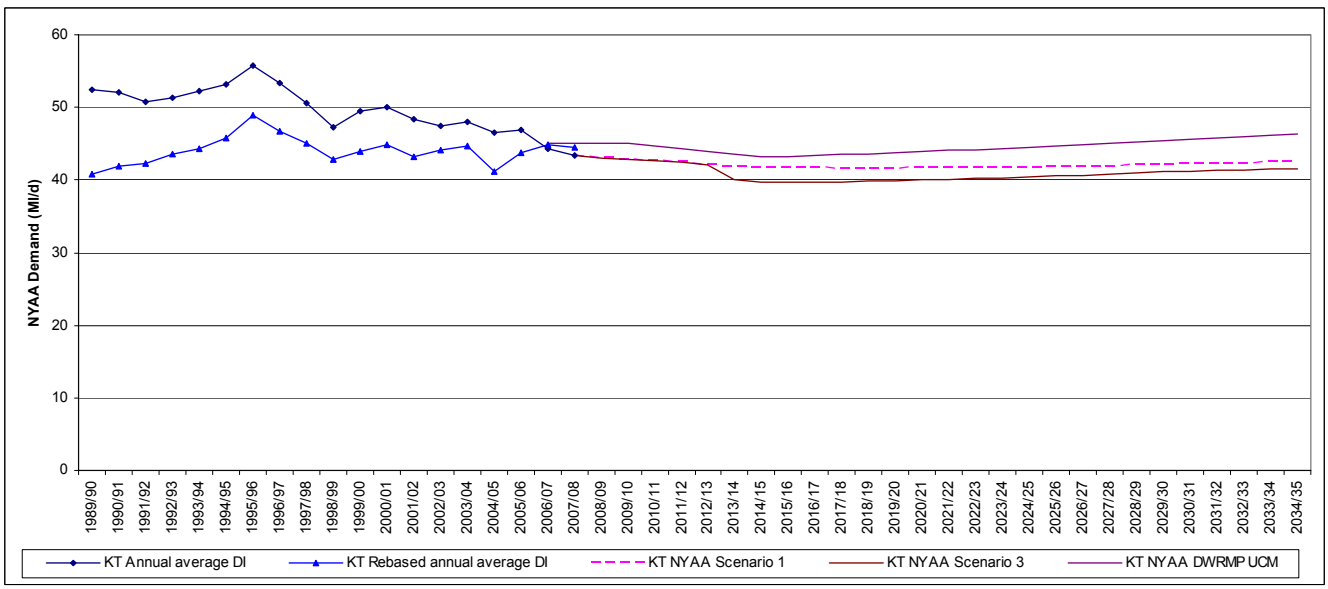
2019/20
2020/21
2021/22
2022/23
2023/24
2024/25
2025/26
2026/27
2027/28
2028/29
2029/30
2030/31
2031/32
2032/33
2033/34
2034/35
KM Annual average DI
KM Rebased annual average DI
KM NYAA Scenario 1
KM NYAA Scenario 3
KM NYAA DWRMP UCM


NYAA Demand (Ml/d)
0
10
20
30
40
50
60
1989/90
1990/91
1991/92
1992/93
1993/94
1994/95
1995/96
1996/97
1997/98
1998/99
1999/00
2000/01
2001/02
2002/03
2003/04
2004/05
2005/06
2006/07
2007/08
2008/09
2009/10
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2014/15
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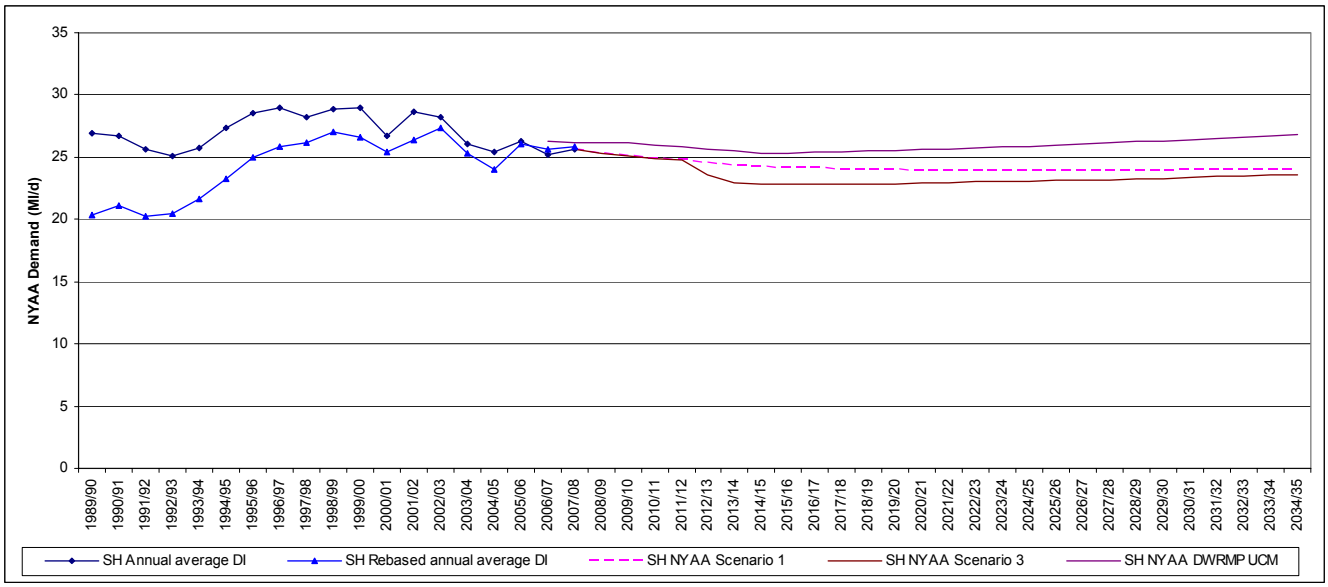
2023/24
2024/25
2025/26
2026/27
2027/28
2028/29
2029/30
2030/31
2031/32
2032/33
2033/34
2034/35
KT Annual average DI
KT Rebased annual average DI
KT NYAA Scenario 1
KT NYAA Scenario 3
KT NYAA DWRMP UCM


NYAA Demand (Ml/d)
0
5
10
15
20
25
30
35
1989/90
1990/91
1991/92
1992/93
1993/94
1994/95
1995/96
1996/97
1997/98
1998/99
1999/00
2000/01
2001/02
2002/03
2003/04
2004/05
2005/06
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2023/24
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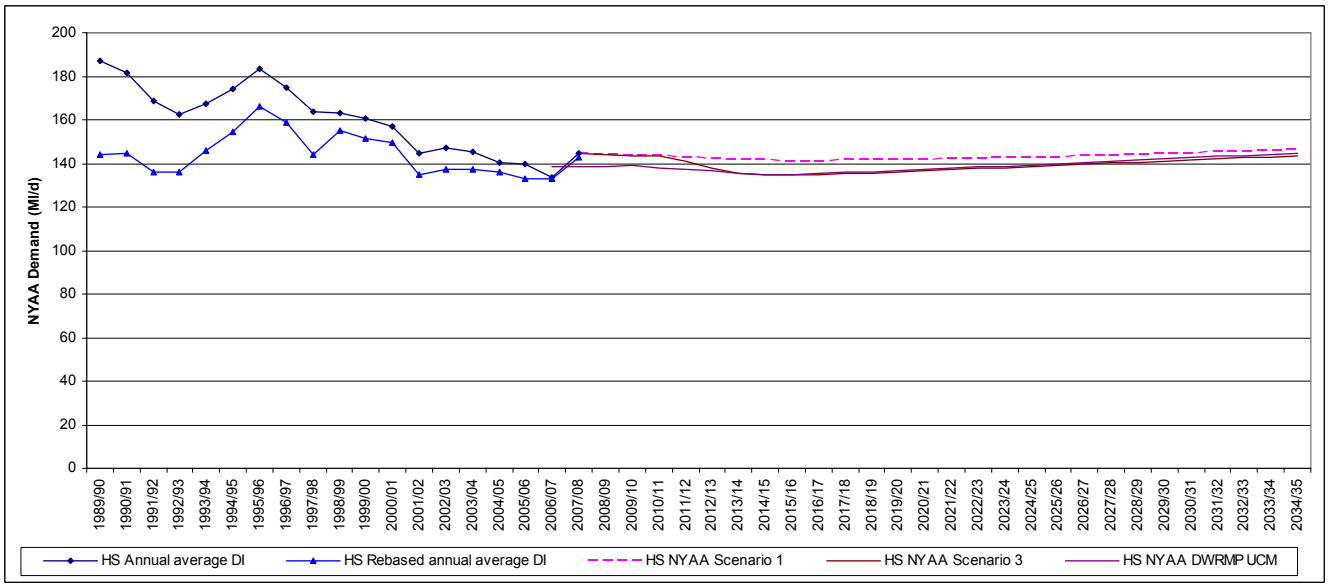
2025/26
2026/27
2027/28
2028/29
2029/30
2030/31
2031/32
2032/33
2033/34
2034/35
SH Annual average DI
SH Rebased annual average DI
SH NYAA Scenario 1
SH NYAA Scenario 3
SH NYAA DWRMP UCM


NYAA Demand (Ml/d)
0
20
40
60
80
100
120
140
160
180
200
1989/90
1990/91
1991/92
1992/93
1993/94
1994/95
1995/96
1996/97
1997/98
1998/99
1999/00
2000/01
2001/02
2002/03
2003/04
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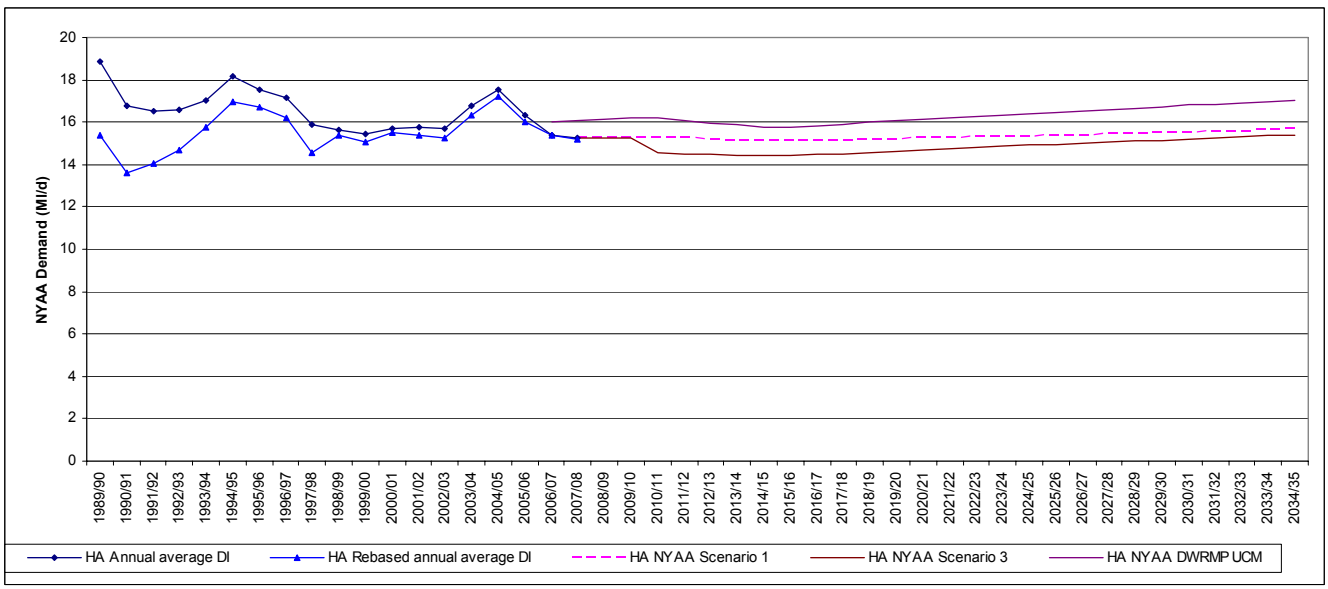
2014/15
2015/16
2016/17
2017/18
2018/19
2019/20
2020/21
2021/22
2022/23
2023/24
2024/25
2025/26
2026/27
2027/28
2028/29
2029/30
2030/31
2031/32
2032/33
2033/34
2034/35
HS Annual average DI
HS Rebased annual average DI
HS NYAA Scenario 1
HS NYAA Scenario 3
HS NYAA DWRMP UCM


NYAA Demand (Ml/d)
0
2
4
6
8
10
12
14
16
18
20
1989/90
1990/91
1991/92
1992/93
1993/94
1994/95
1995/96
1996/97
1997/98
1998/99
1999/00
2000/01
2001/02
2002/03
2003/04
2004/05
2005/06
2006/07
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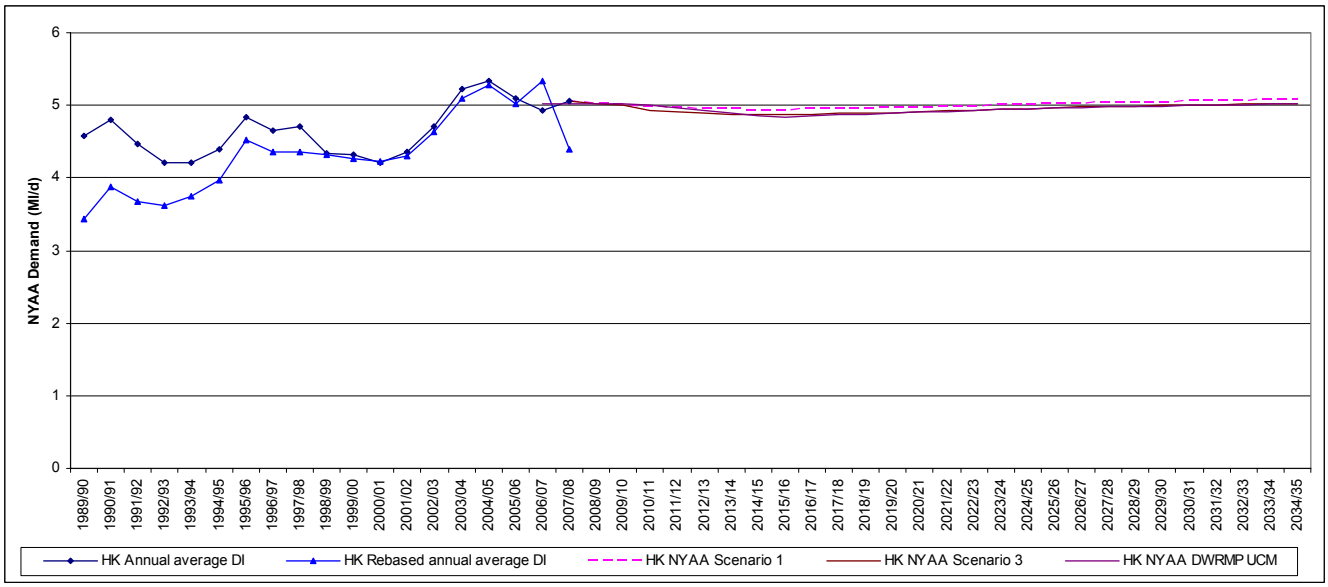
2020/21
2021/22
2022/23
2023/24
2024/25
2025/26
2026/27
2027/28
2028/29
2029/30
2030/31
2031/32
2032/33
2033/34
2034/35
HA Annual average DI
HA Rebased annual average DI
HA NYAA Scenario 1
HA NYAA Scenario 3
HA NYAA DWRMP UCM


NYAA Demand (Ml/d)
0
1
2
3
4
5
6
1989/90
1990/91
1991/92
1992/93
1993/94
1994/95
1995/96
1996/97
1997/98
1998/99
1999/00
2000/01
2001/02
2002/03
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2022/23
2023/24
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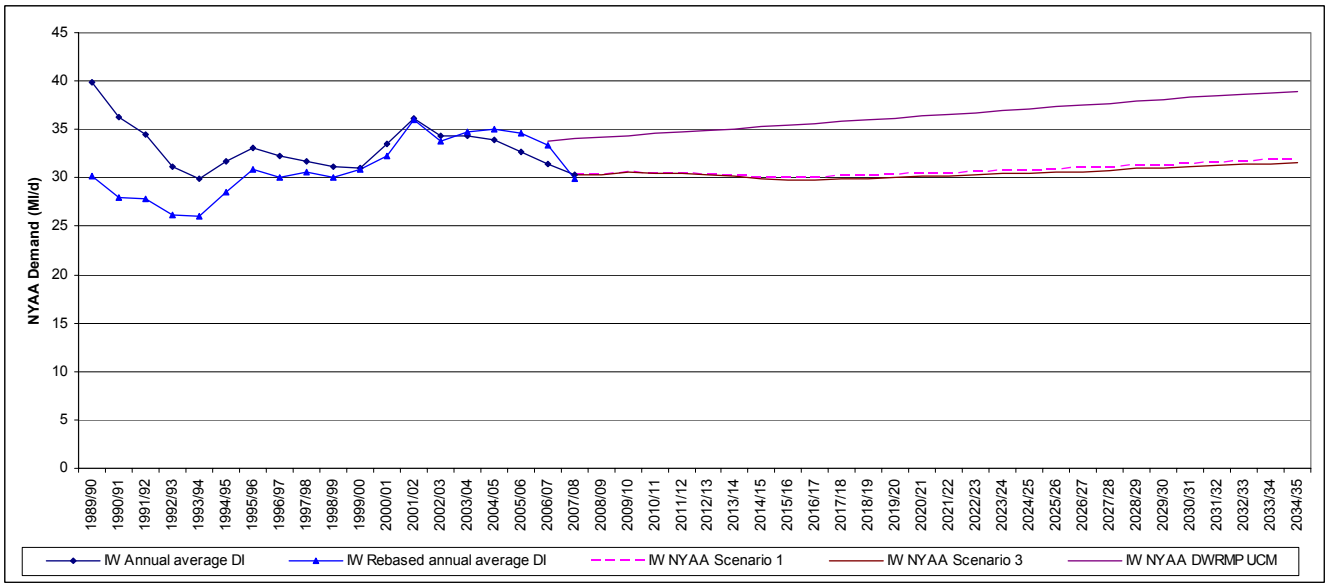
2025/26
2026/27
2027/28
2028/29
2029/30
2030/31
2031/32
2032/33
2033/34
2034/35
HK Annual average DI
HK Rebased annual average DI
HK NYAA Scenario 1
HK NYAA Scenario 3
HK NYAA DWRMP UCM


NYAA Demand (Ml/d)
0
5
10
15
20
25
30
35
40
45
1989/90
1990/91
1991/92
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1993/94
1994/95
1995/96
1996/97
1997/98
1998/99
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2000/01
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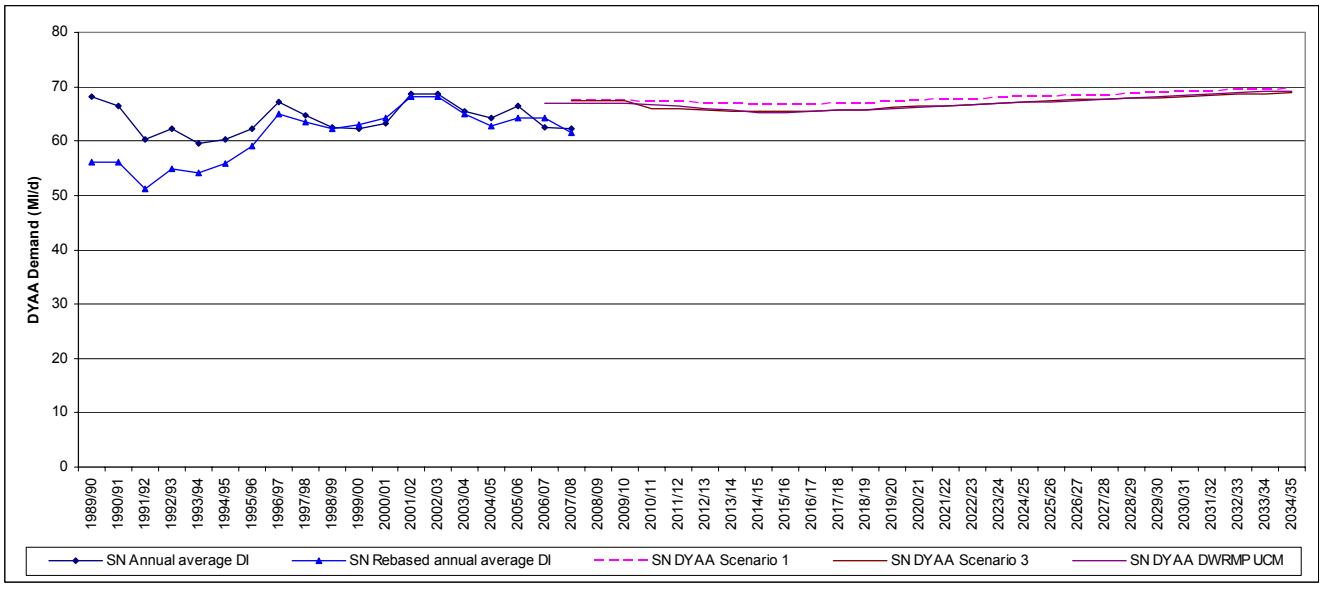
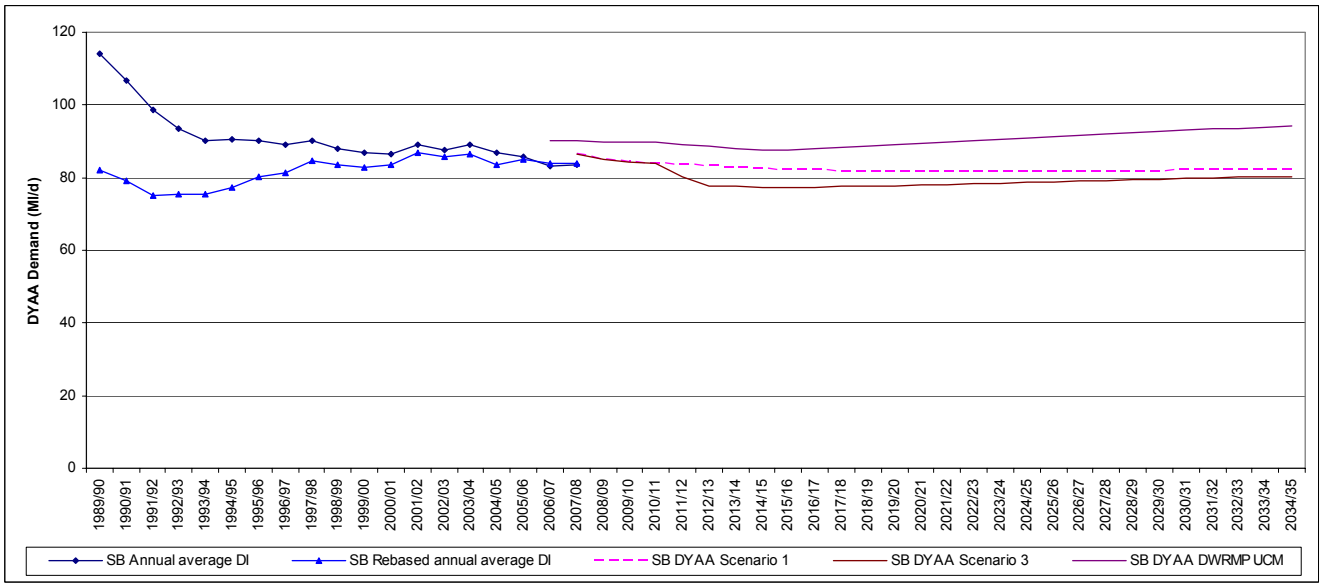
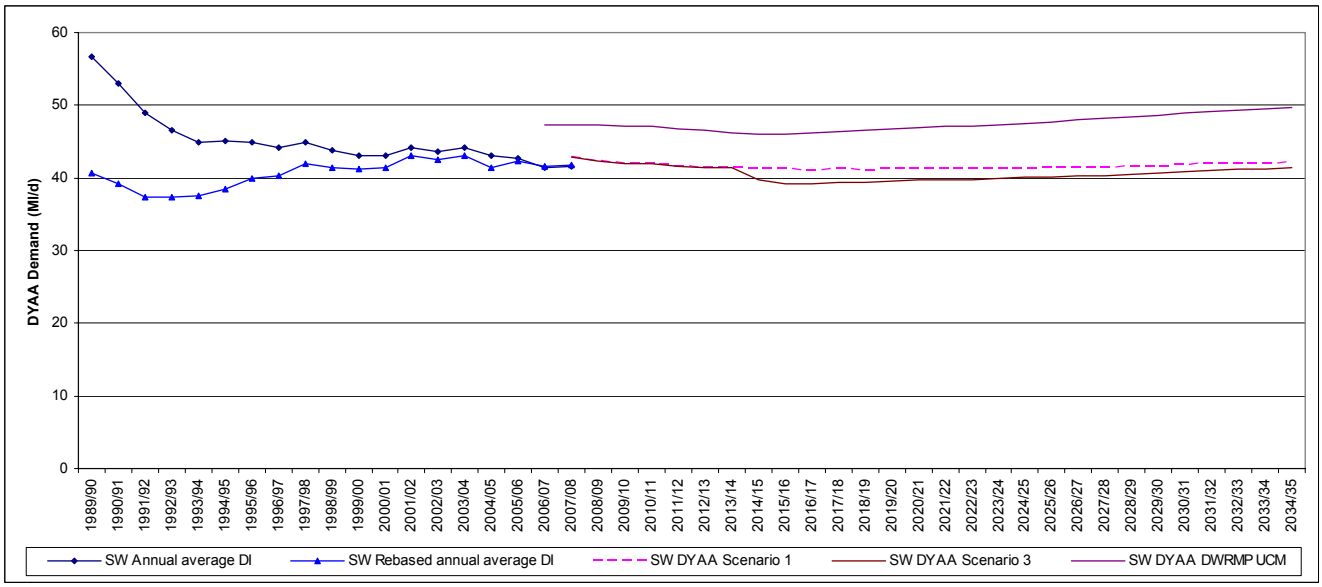
2023/24
2024/25
2025/26
2026/27
2027/28
2028/29
2029/30
2030/31
2031/32
2032/33
2033/34
2034/35
IW Annual average DI
IW Rebased annual average DI
IW NYAA Scenario 1
IW NYAA Scenario 3
IW NYAA DWRMP UCM

E.8.1.2 Dry Year Annual Average Demand






DYAA Demand (Ml/d)
0
10
20
30
40
50
60
1989/90
1990/91
1991/92
1992/93
1993/94
1994/95
1995/96
1996/97
1997/98
1998/99
1999/00
2000/01
2001/02
2002/03
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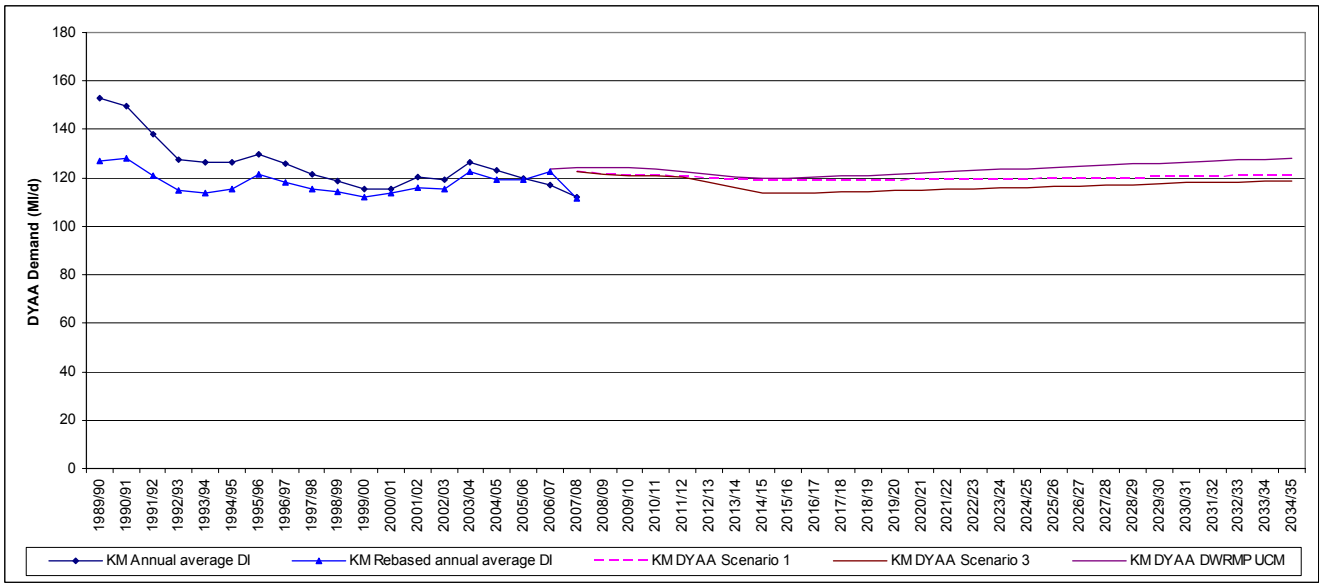
2021/22
2022/23
2023/24
2024/25
2025/26
2026/27
2027/28
2028/29
2029/30
2030/31
2031/32
2032/33
2033/34
2034/35
SW Annual average DI
SW Rebased annual average DI
SW DYAA Scenario 1
SW DYAA Scenario 3
SW DYAA DWRMP UCM


DYAA Demand (Ml/d)
0
20
40
60
80
100
120
140
160
180
1989/90
1990/91
1991/92
1992/93
1993/94
1994/95
1995/96
1996/97
1997/98
1998/99
1999/00
2000/01
2001/02
2002/03
2003/04
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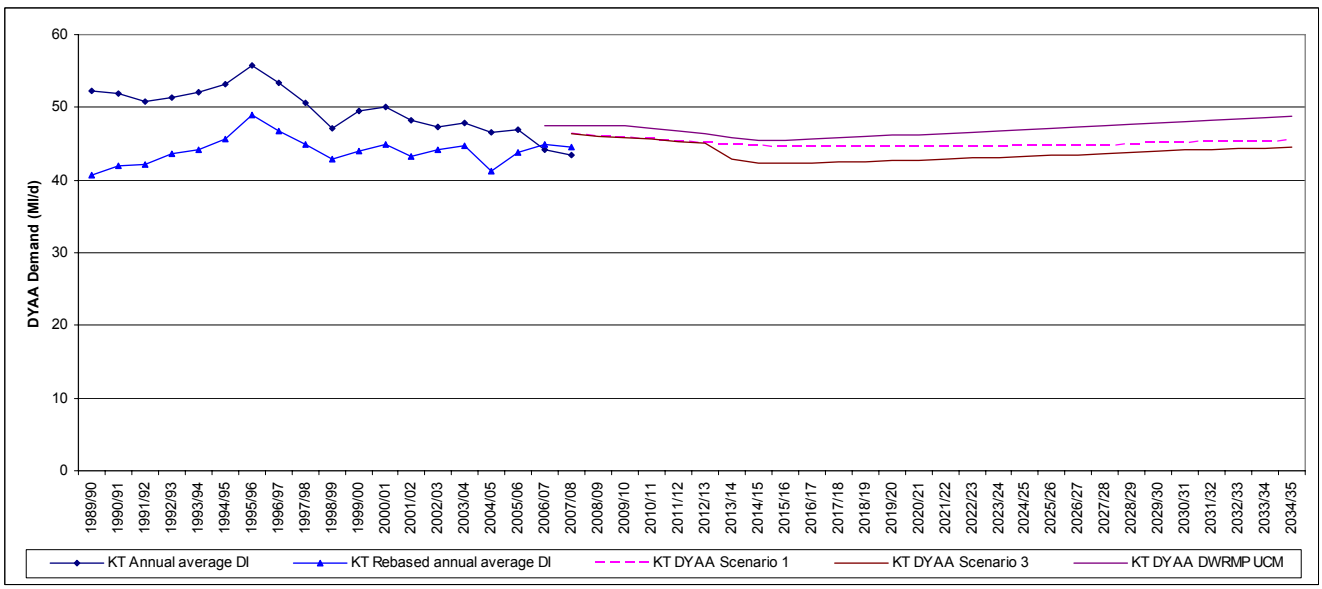
2022/23
2023/24
2024/25
2025/26
2026/27
2027/28
2028/29
2029/30
2030/31
2031/32
2032/33
2033/34
2034/35
KM Annual average DI
KM Rebased annual average DI
KM DYAA Scenario 1
KM DYAA Scenario 3
KM DYAA DWRMP UCM


DYAA Demand (Ml/d)
0
10
20
30
40
50
60
1989/90
1990/91
1991/92
1992/93
1993/94
1994/95
1995/96
1996/97
1997/98
1998/99
1999/00
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2001/02
2002/03
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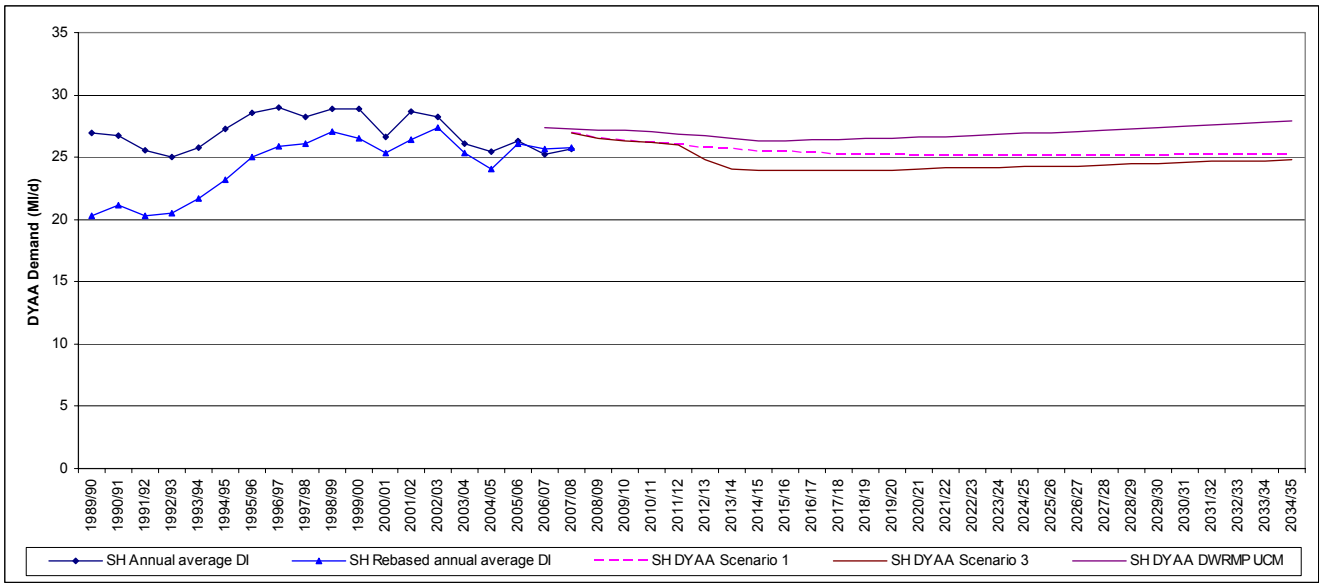
KT Annual average DI
KT Rebased annual average DI
KT DYAA Scenario 1
KT DYAA Scenario 3
KT DYAA DWRMP UCM


DYAA Demand (Ml/d)
0
5
10
15
20
25
30
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1989/90
1990/91
1991/92
1992/93
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1994/95
1995/96
1996/97
1997/98
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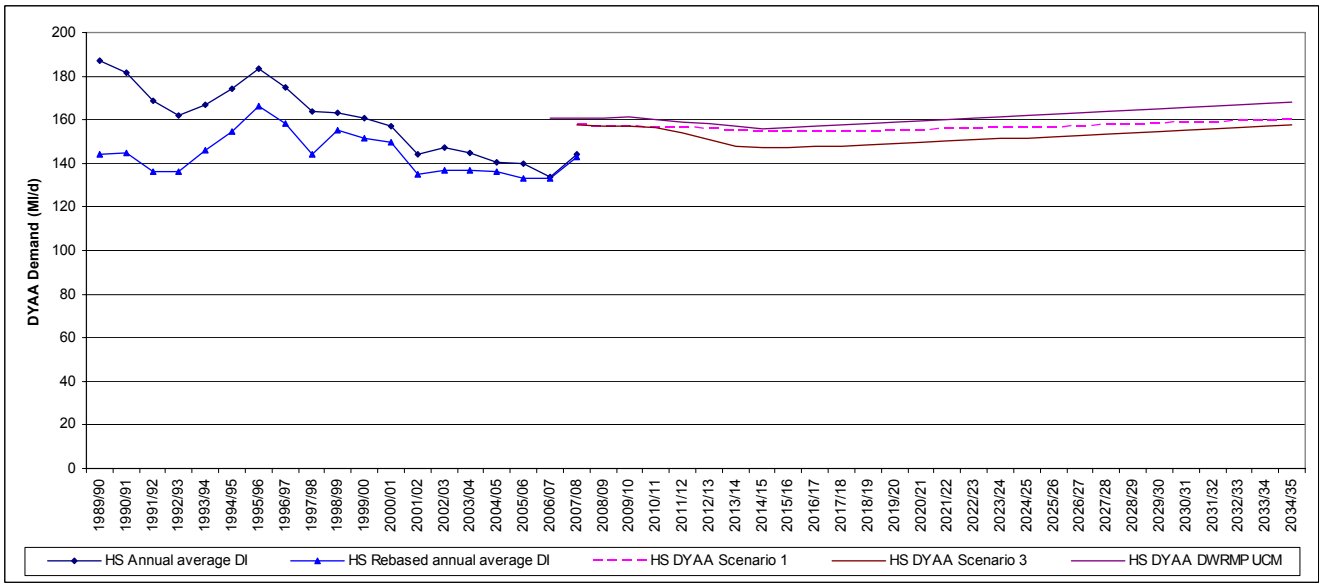
SH Annual average DI
SH Rebased annual average DI
SH DYAA Scenario 1
SH DYAA Scenario 3
SH DYAA DWRMP UCM


DYAA Demand (Ml/d)
0
20
40
60
80
100
120
140
160
180
200
1989/90
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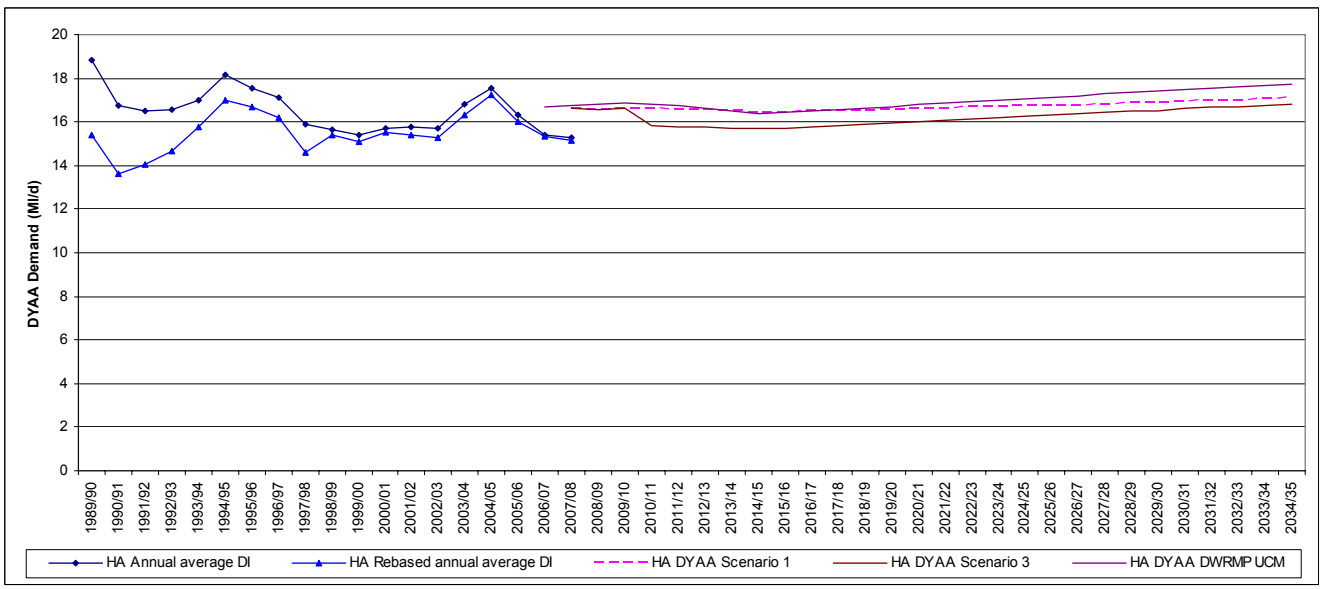
HS Annual average DI
HS Rebased annual average DI
HS DYAA Scenario 1
HS DYAA Scenario 3
HS DYAA DWRMP UCM


DYAA Demand (Ml/d)
0
2
4
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1989/90
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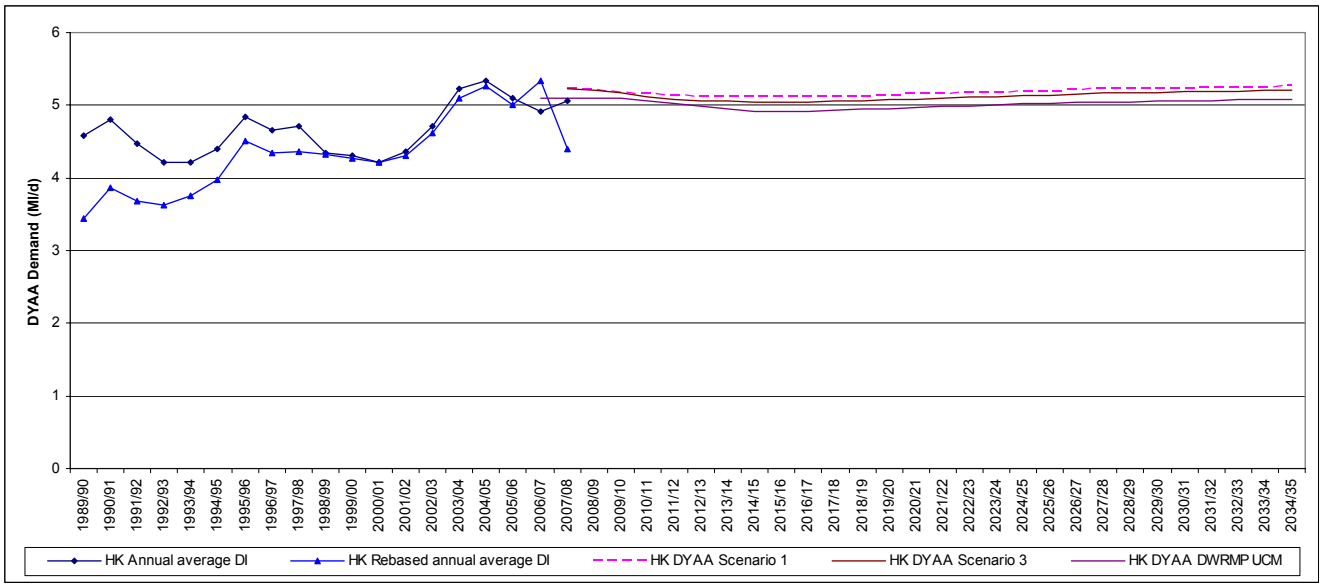
2033/34
2034/35
HA Annual average DI
HA Rebased annual average DI
HA DYAA Scenario 1
HA DYAA Scenario 3
HA DYAA DWRMP UCM


DYAA Demand (Ml/d)
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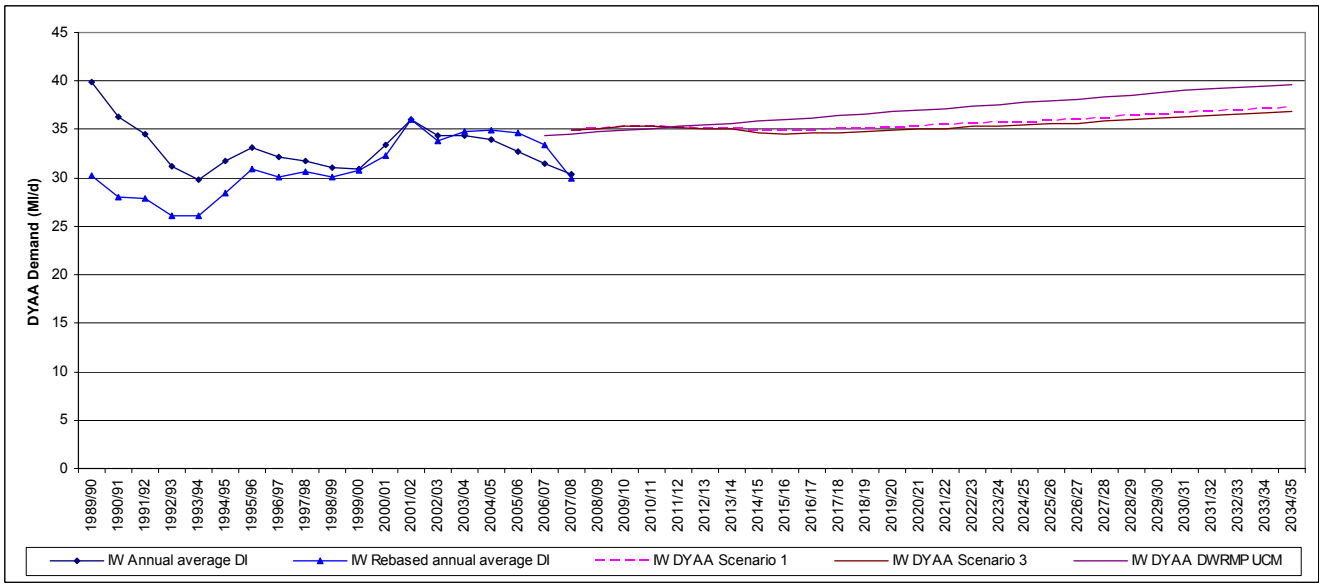
2034/35
HK Annual average DI
HK Rebased annual average DI
HK DYAA Scenario 1
HK DYAA Scenario 3
HK DYAA DWRMP UCM


DYAA Demand (Ml/d)
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1990/91
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1993/94
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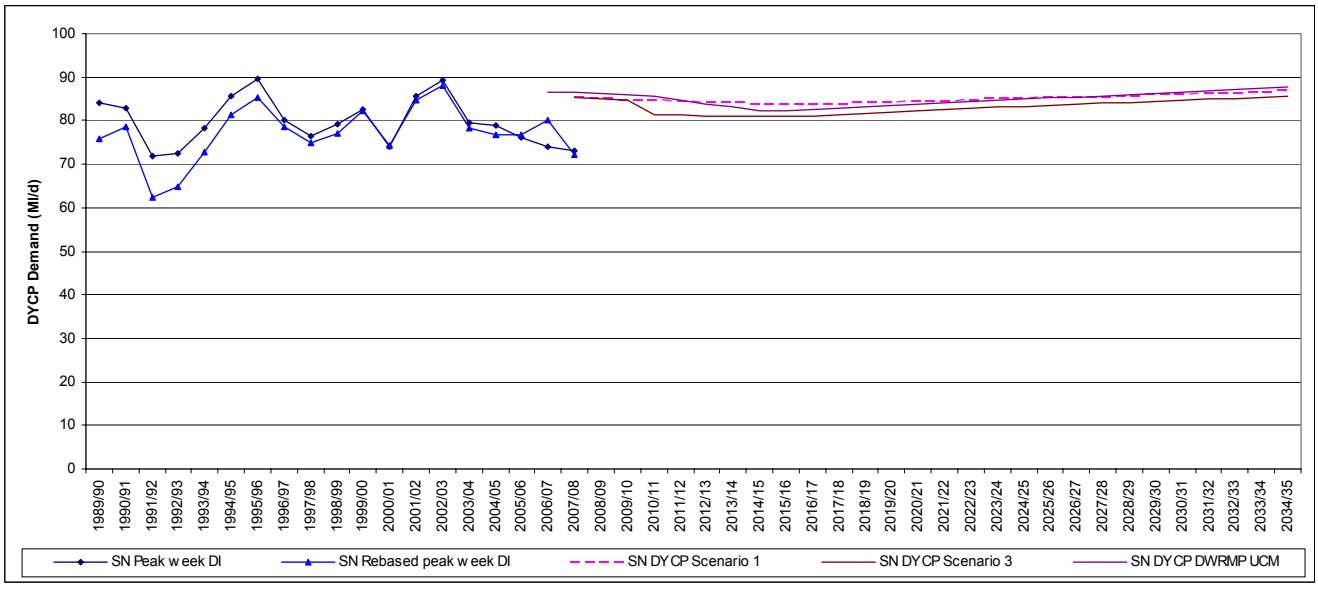
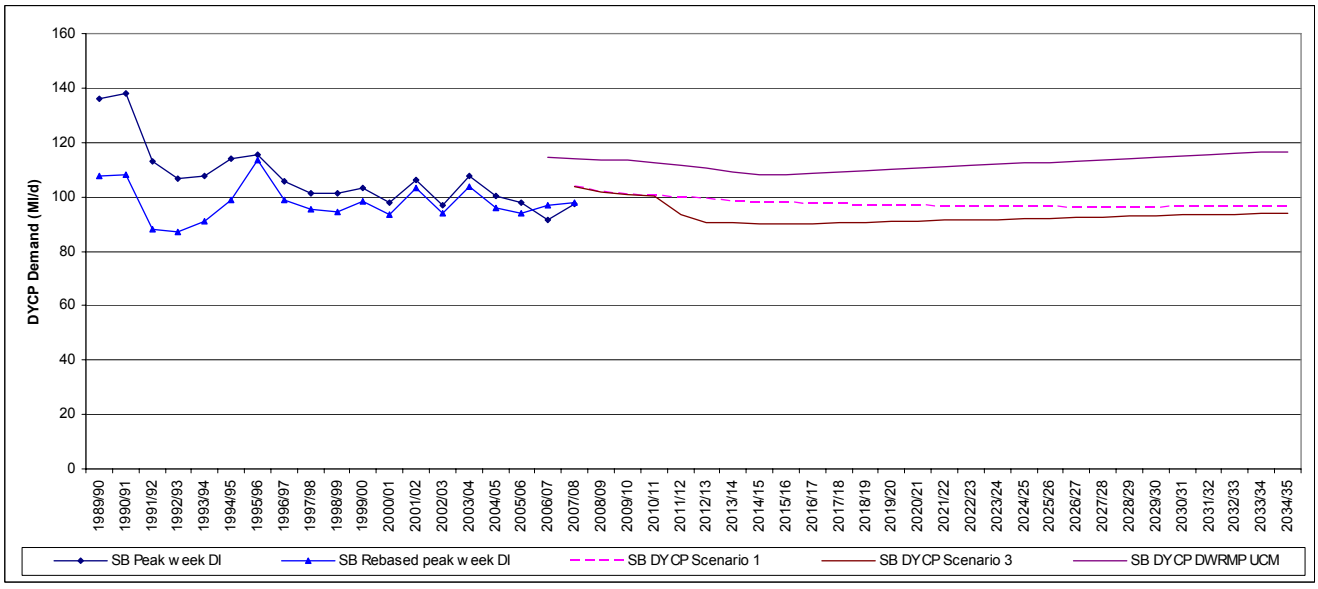
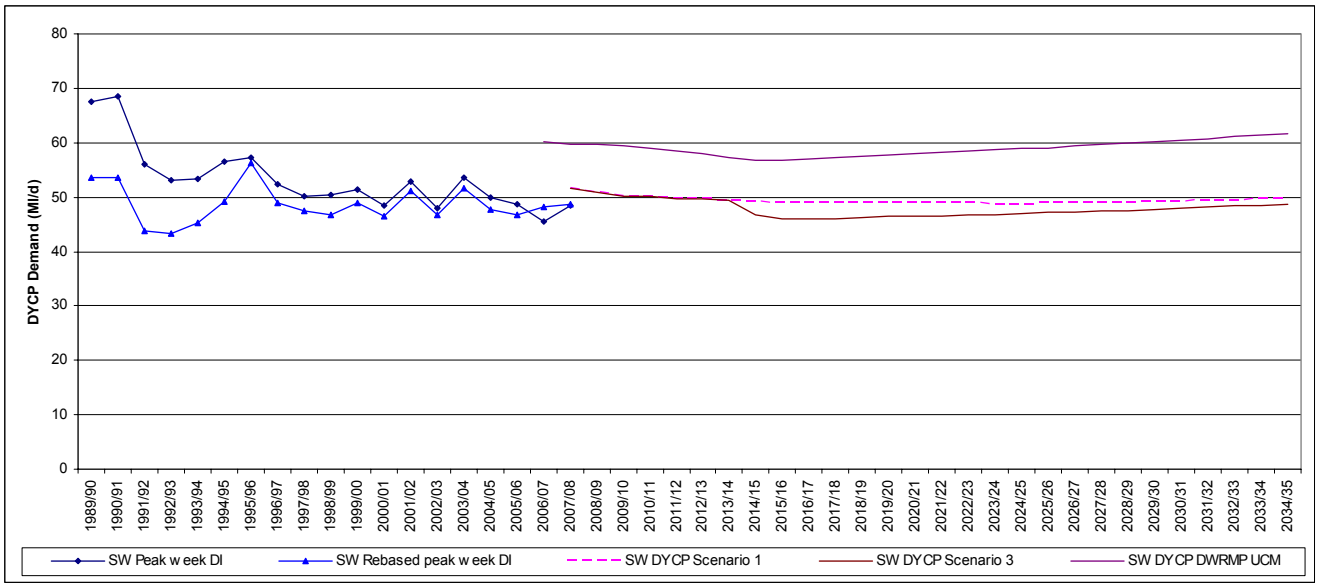
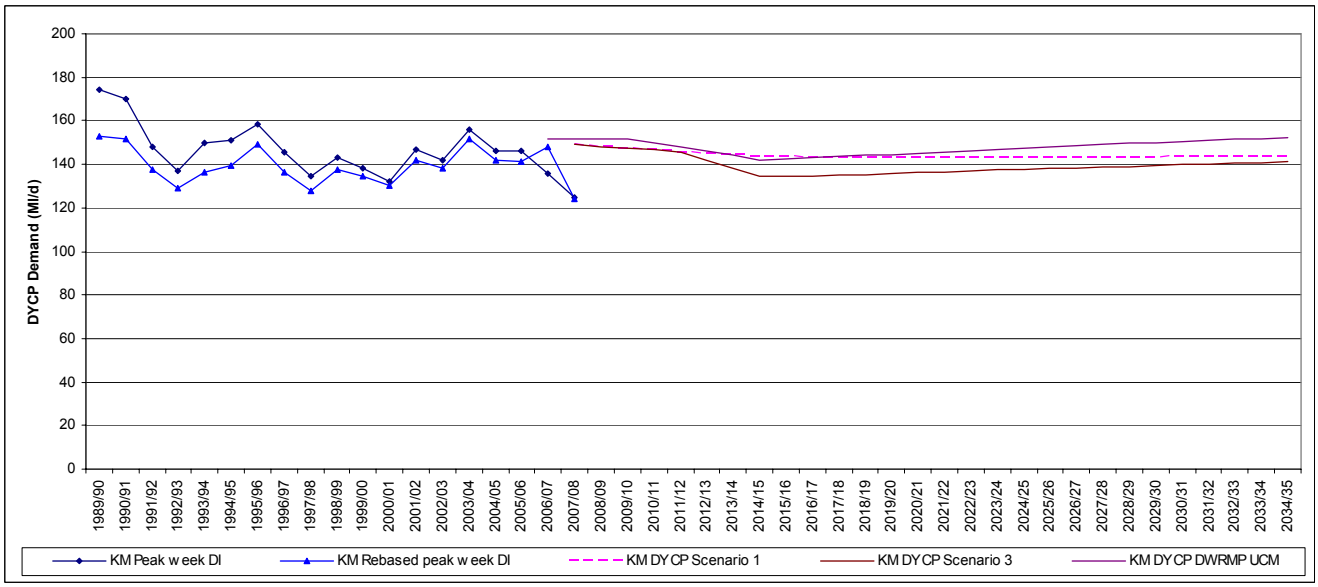
2034/35
IW Annual average DI
IW Rebased annual average DI
IW DYAA Scenario 1
IW DYAA Scenario 3
IW DYAA DWRMP UCM

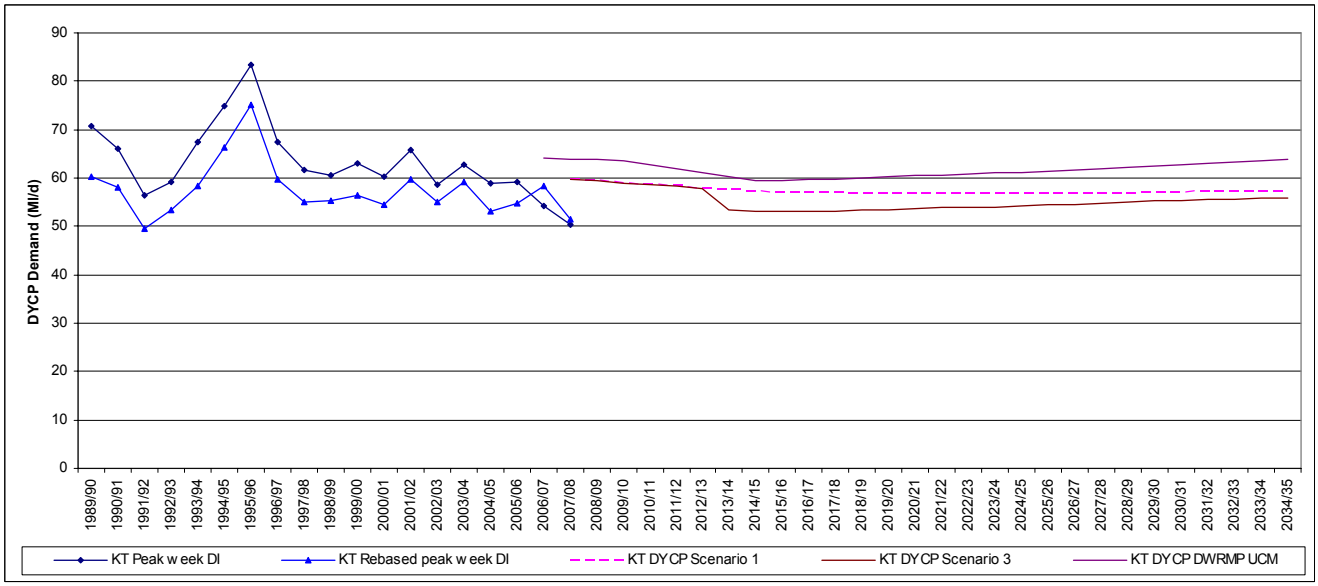
E.8.1.3 Dry Year Critical Period Demand

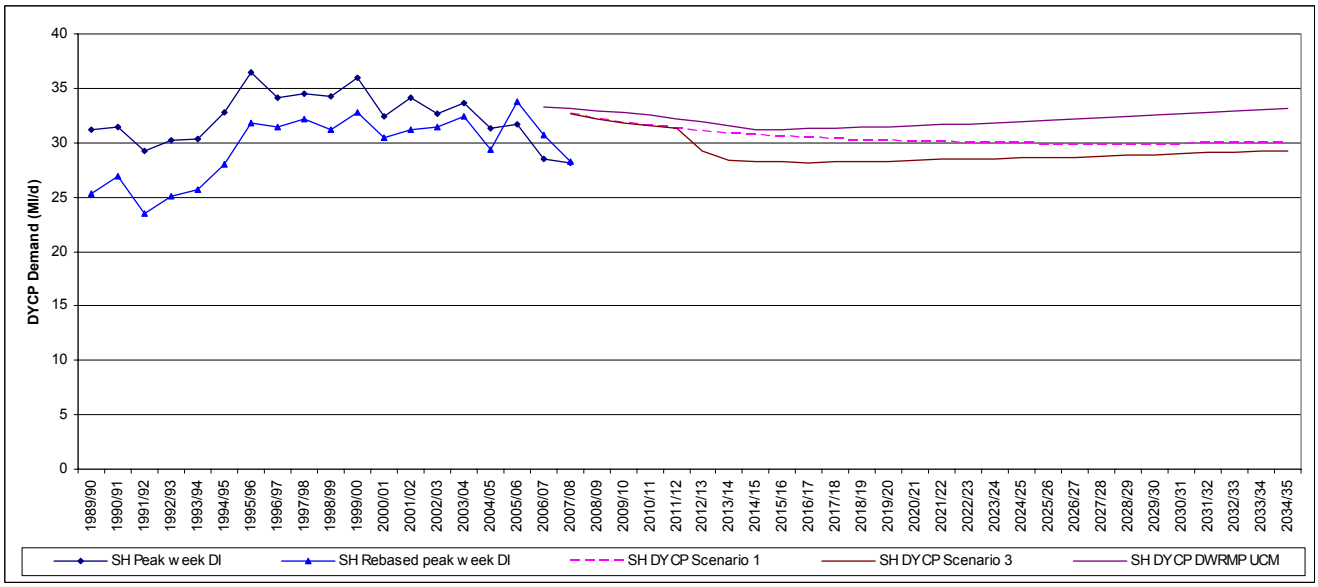


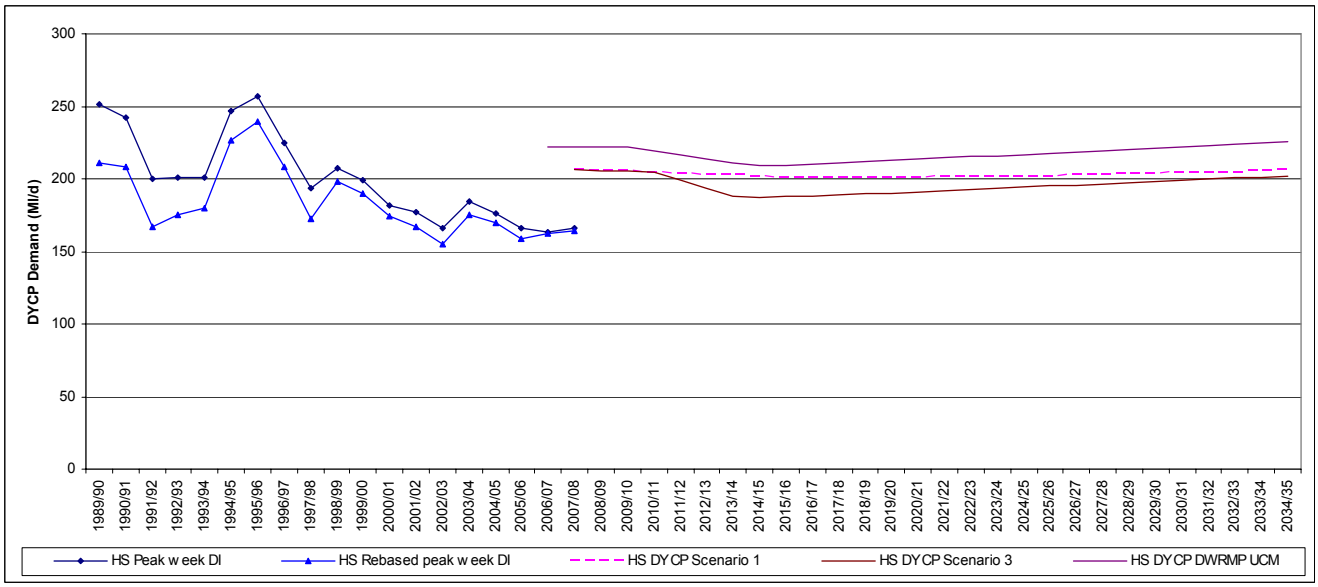


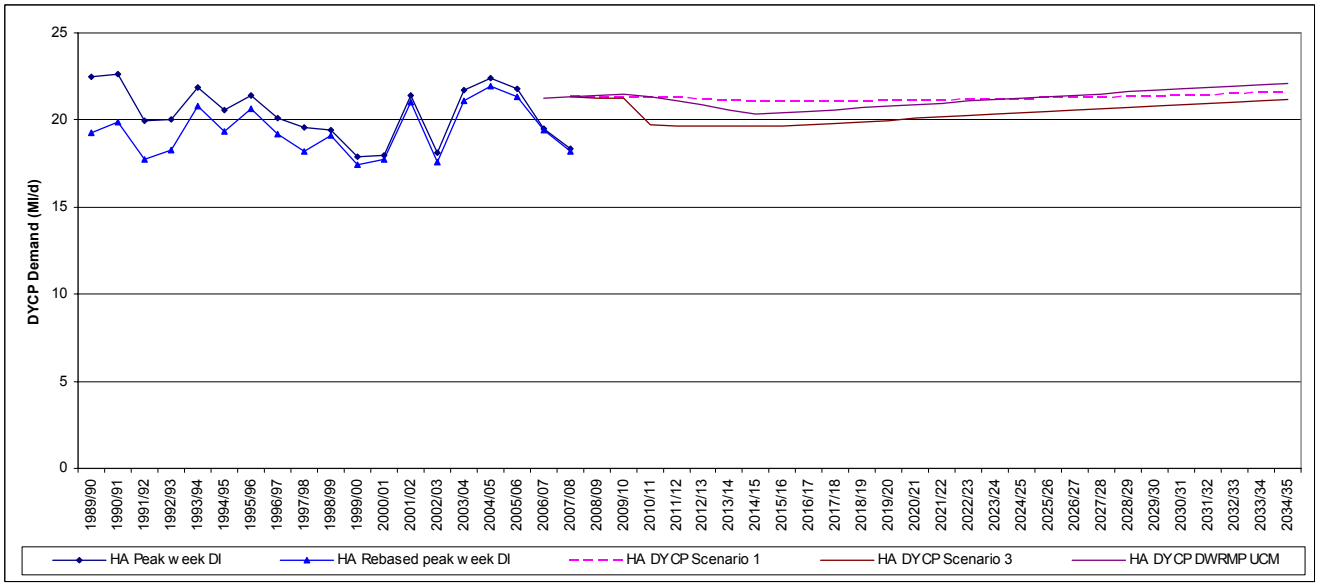

DYCP Demand (Ml/d)
SW Peak week DI
SW Rebased peak week DI
SW DYCP Scenario 1
SW DYCP Scenario 3
SW DYCP DWRMP UCM

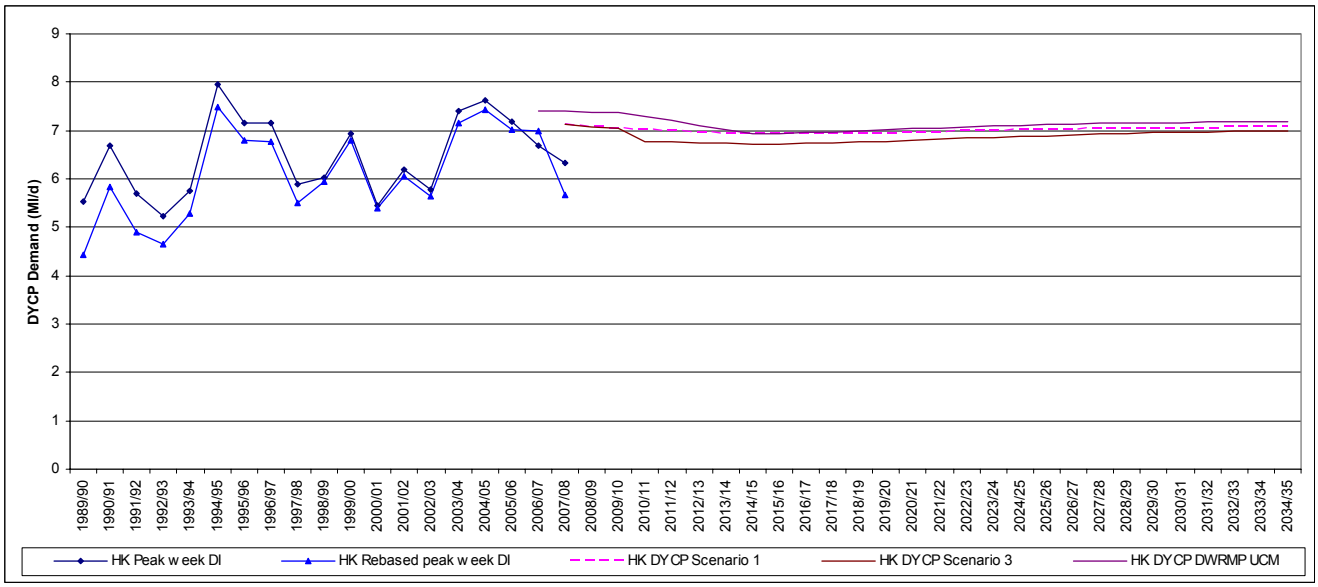

DYCP Demand (Ml/d)
KM Peak week DI
KM Rebased peak week DI
KM DYCP Scenario 1
KM DYCP Scenario 3
KM DYCP DWRMP UCM


DYCP Demand (Ml/d)
KT Peak week DI
KT Rebased peak week DI
KT DYCP Scenario 1
KT DYCP Scenario 3
KT DYCP DWRMP UCM


DYCP Demand (Ml/d)
SH Peak week DI
SH Rebased peak week DI
SH DYCP Scenario 1
SH DYCP Scenario 3
SH DYCP DWRMP UCM


DYCP Demand (Ml/d)
HS Peak week DI
HS Rebased peak week DI
HS DYCP Scenario 1
HS DYCP Scenario 3
HS DYCP DWRMP UCM


DYCP Demand (Ml/d)
HA Peak week DI
HA Rebased peak week DI
HA DYCP Scenario 1
HA DYCP Scenario 3
HA DYCP DWRMP UCM


DYCP Demand (Ml/d)
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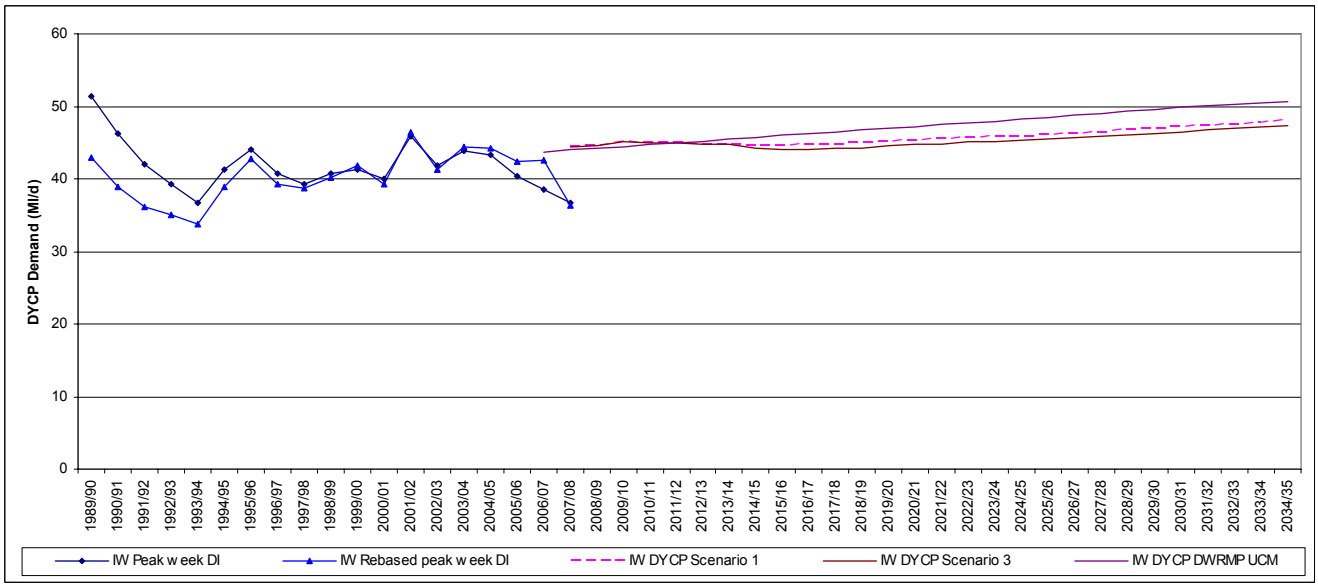
2034/35
HK Peak week DI
HK Rebased peak week DI
HK DYCP Scenario 1
HK DYCP Scenario 3
HK DYCP DWRMP UCM


DYCP Demand (Ml/d)
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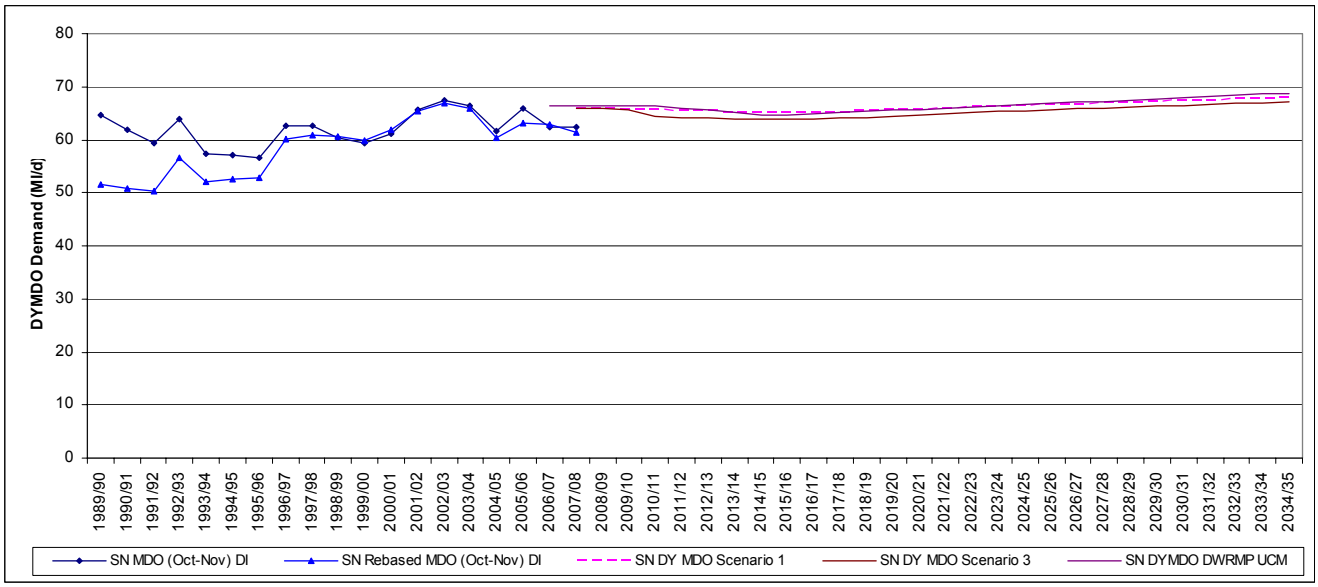
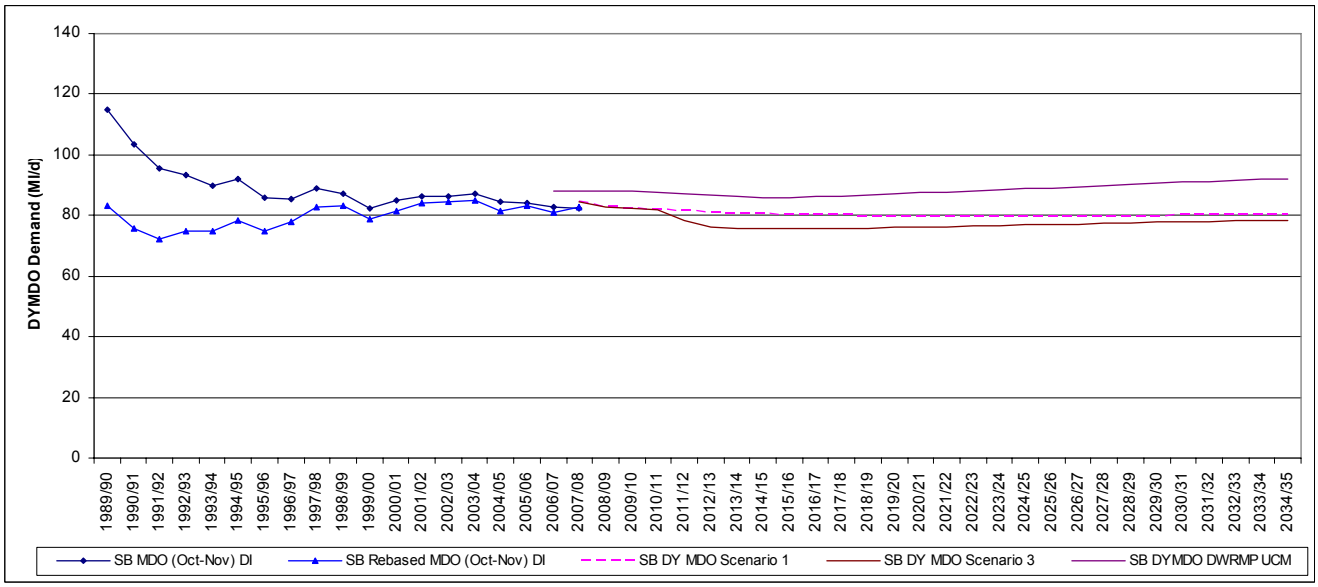
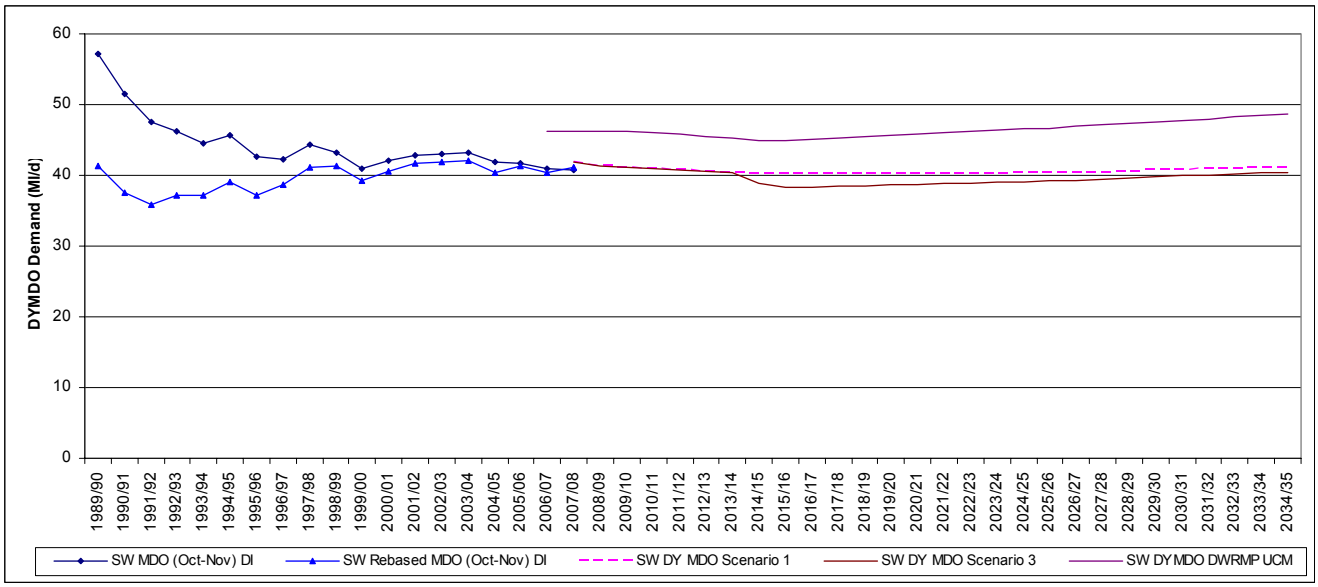
2033/34
2034/35
IW Peak week DI
IW Rebased peak week DI
IW DYCP Scenario 1
IW DYCP Scenario 3
IW DYCP DWRMP UCM

E.8.1.4 Dry Year MDO Period Demand






DYMDO Demand (Ml/d)
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1990/91
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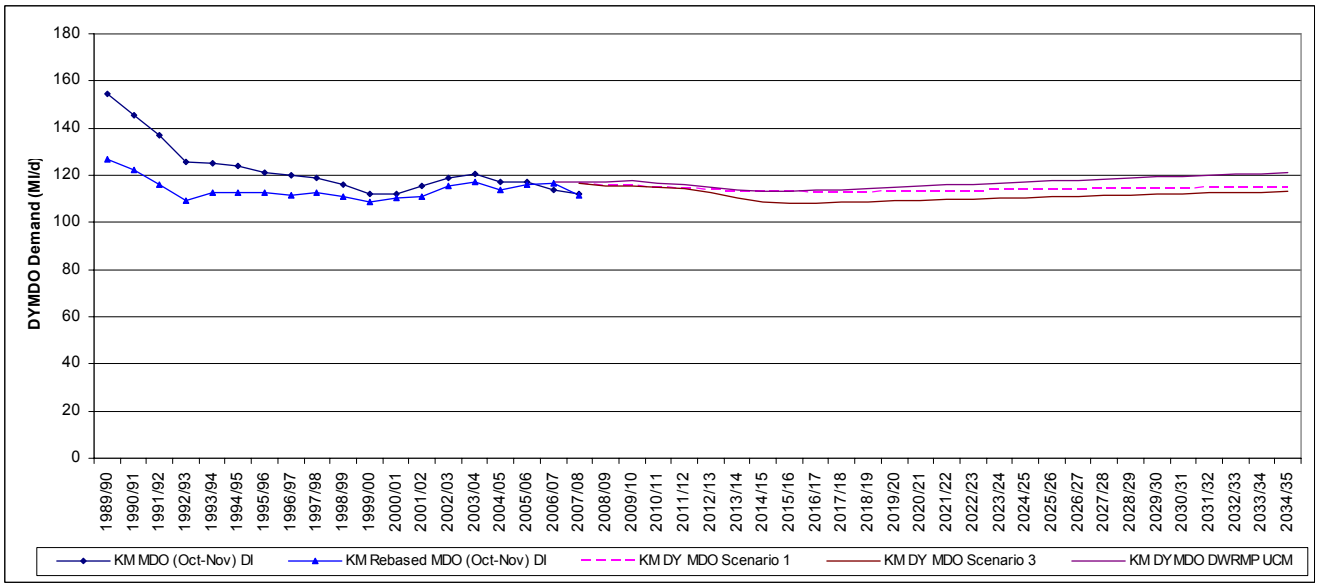
2033/34
2034/35
SW MDO (Oct-Nov) DI
SW Rebased MDO (Oct-Nov) DI
SW DY MDO Scenario 1
SW DY MDO Scenario 3
SW DY MDO DWRMP UCM


DYMDO Demand (Ml/d)
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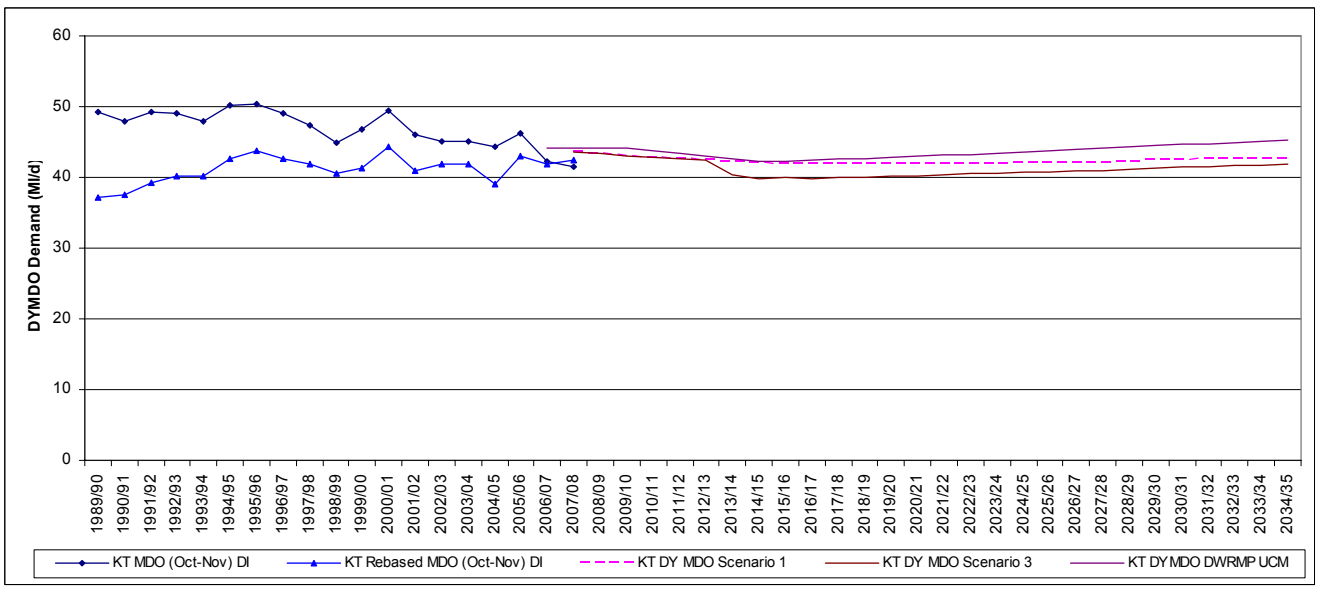
2034/35
KM MDO (Oct-Nov) DI
KM Rebased MDO (Oct-Nov) DI
KM DY MDO Scenario 1
KM DY MDO Scenario 3
KM DY MDO DWRMP UCM


DYMDO Demand (Ml/d)
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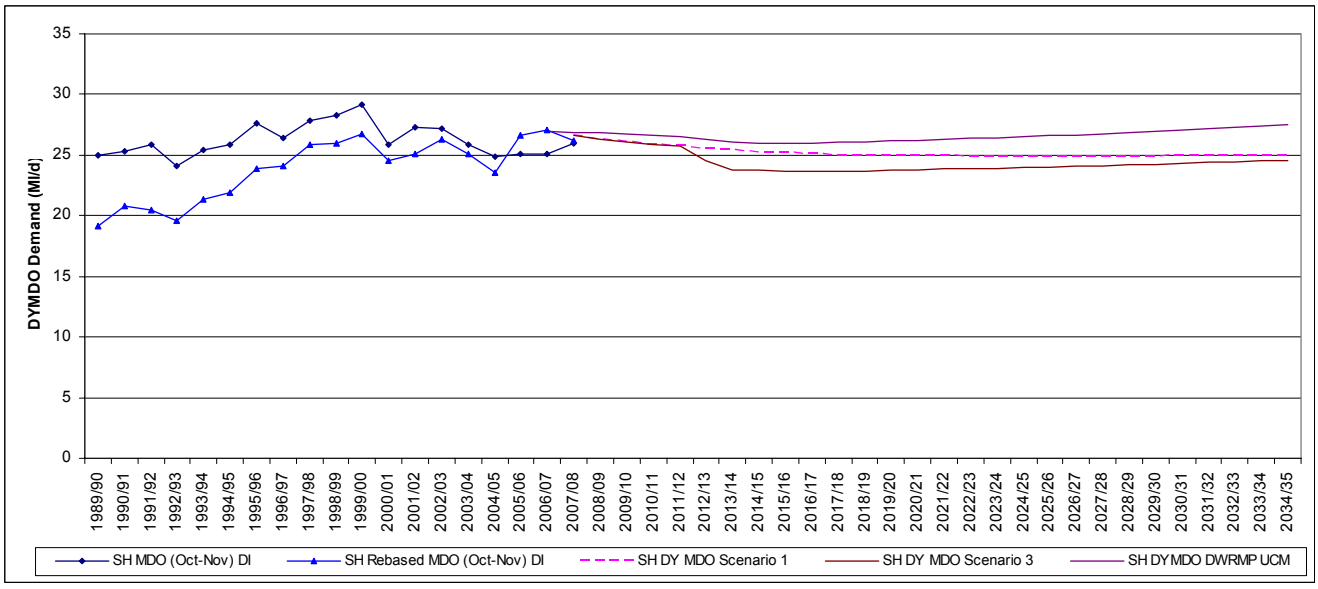
2034/35
KT MDO (Oct-Nov) DI
KT Rebased MDO (Oct-Nov) DI
KT DY MDO Scenario 1
KT DY MDO Scenario 3
KT DY MDO DWRMP UCM


DYMDO Demand (Ml/d)
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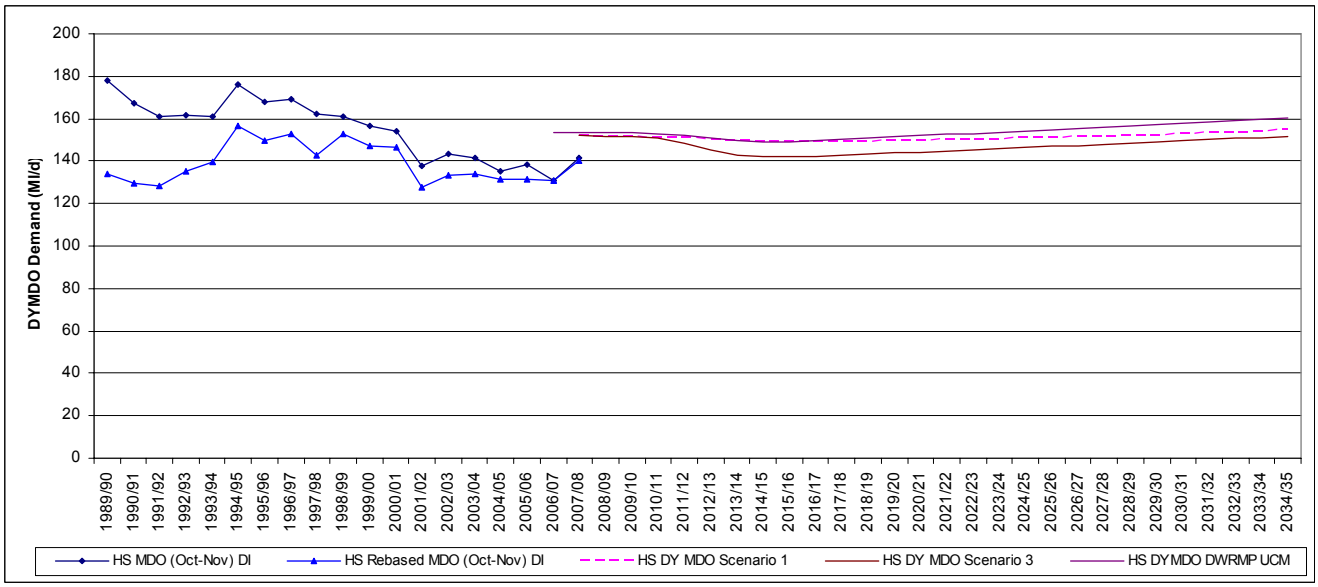
SH MDO (Oct-Nov) DI
SH Rebased MDO (Oct-Nov) DI
SH DY MDO Scenario 1
SH DY MDO Scenario 3
SH DYMDO DWRMP UCM


DYMDO Demand (Ml/d)
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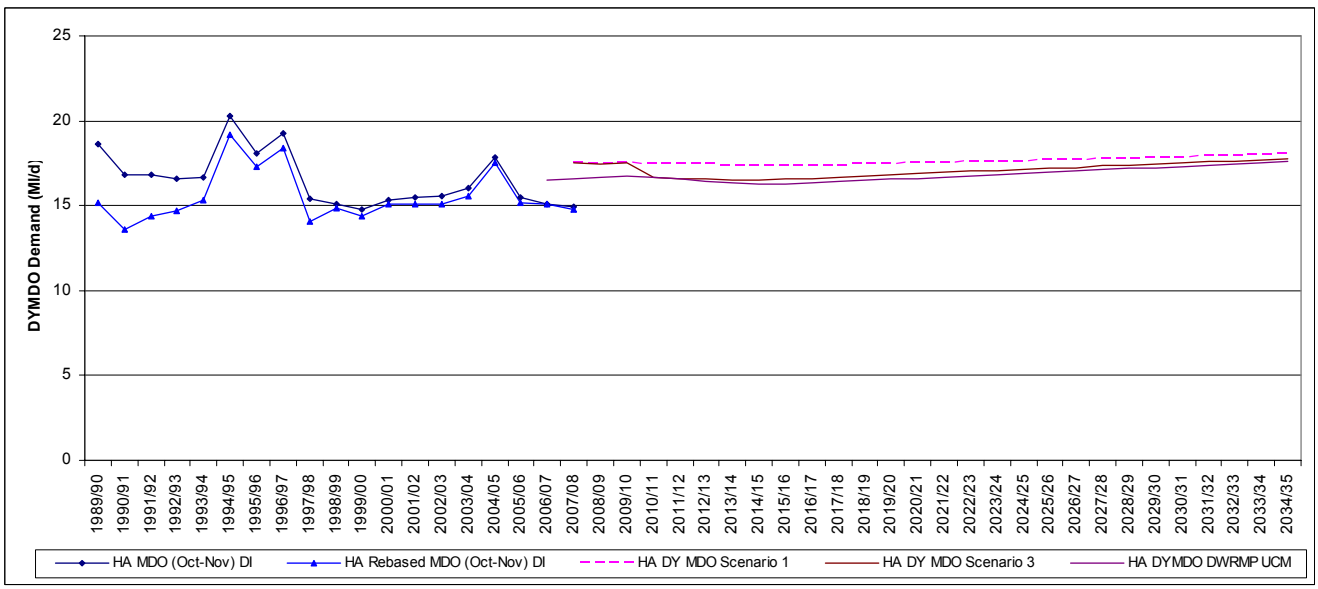
HS MDO (Oct-Nov) DI
HS Rebased MDO (Oct-Nov) DI
HS DY MDO Scenario 1
HS DY MDO Scenario 3
HS DYMDO DWRMP UCM


DYMDO Demand (Ml/d)
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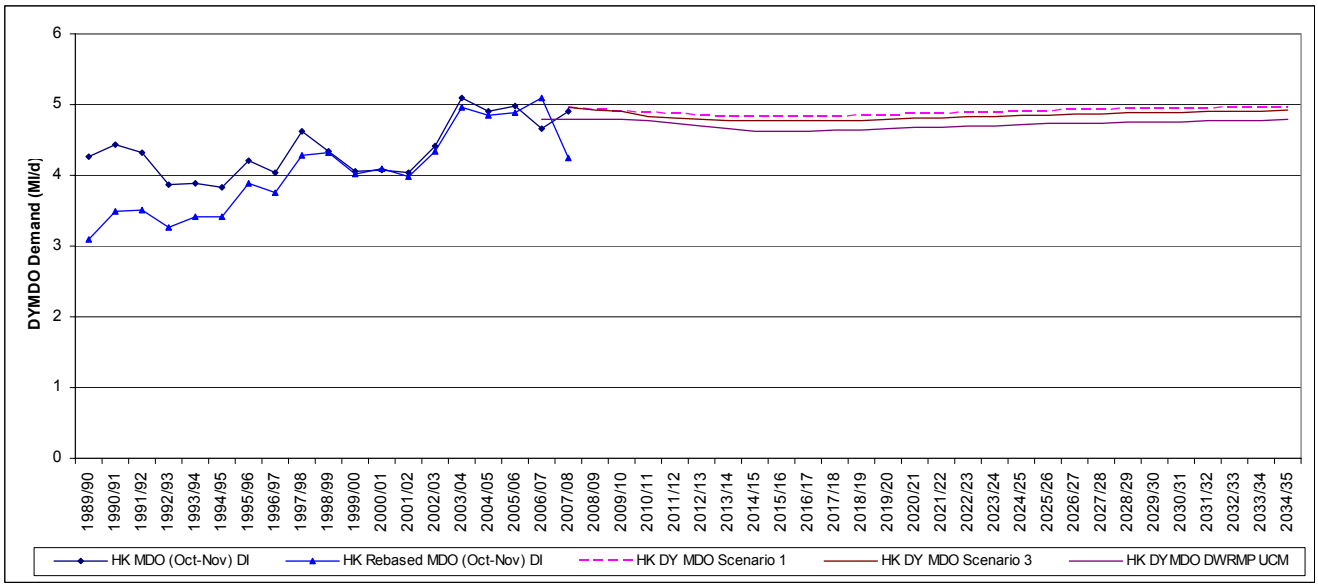
HA MDO (Oct-Nov) DI
HA Rebased MDO (Oct-Nov) DI
HA DY MDO Scenario 1
HA DY MDO Scenario 3
HA DYMDO DWRMP UCM


DYMDO Demand (Ml/d)
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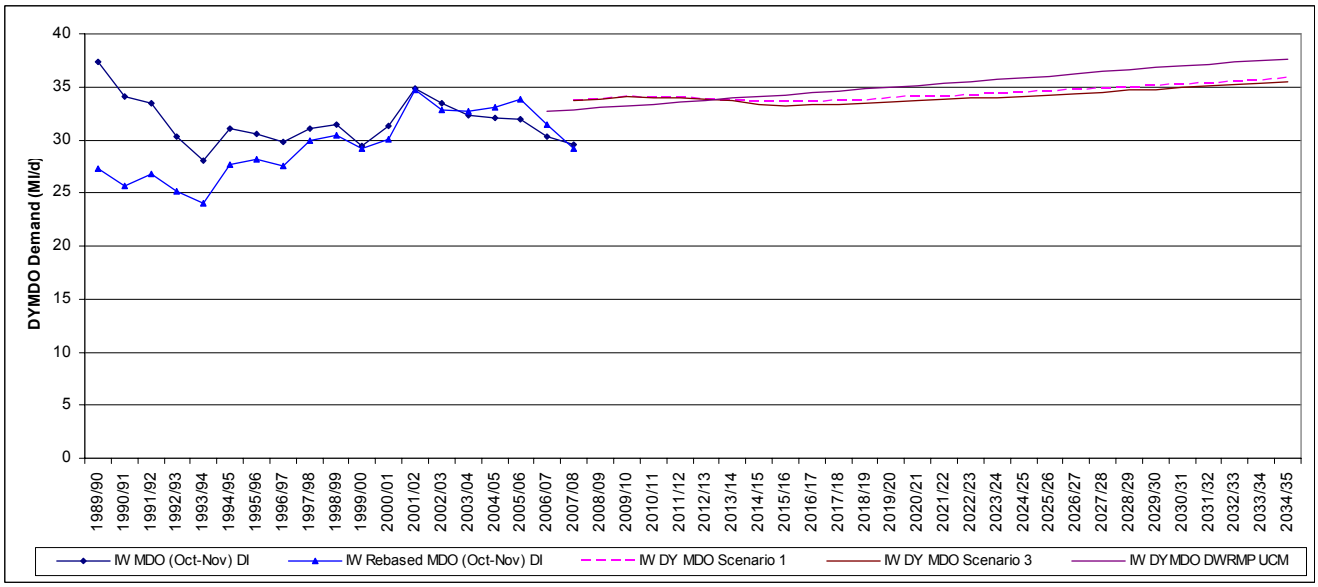
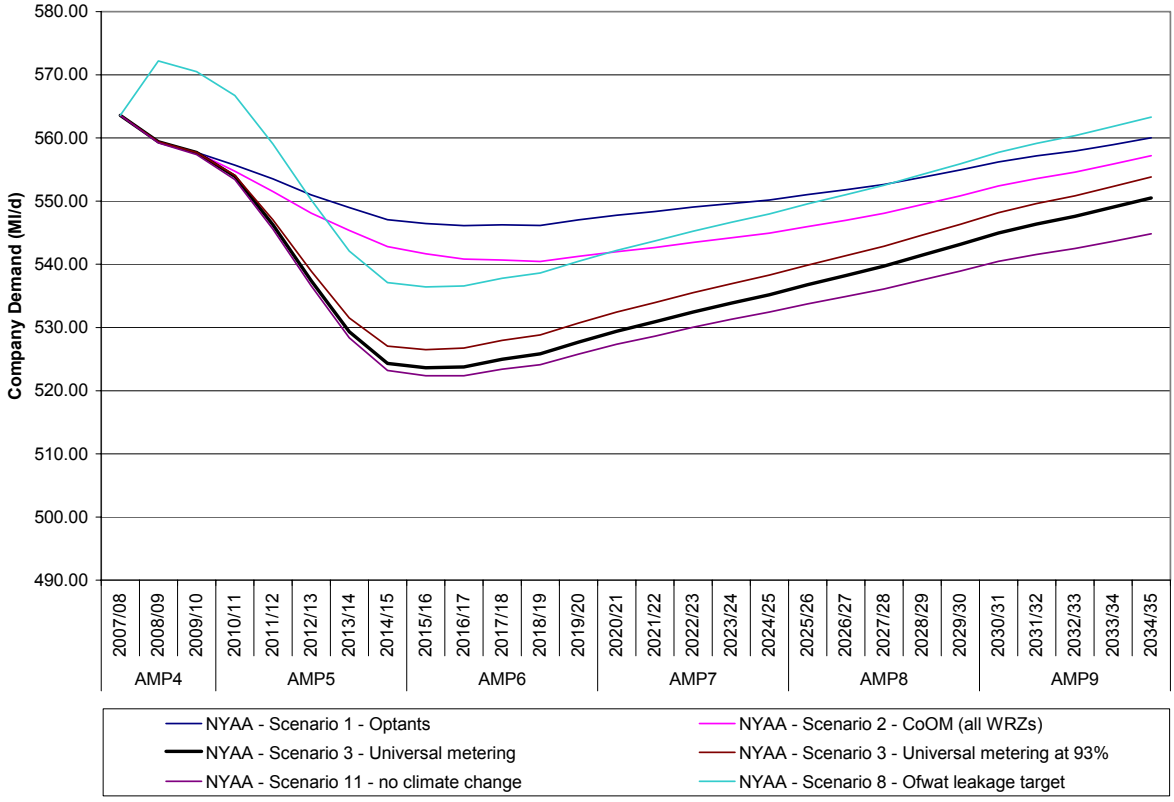
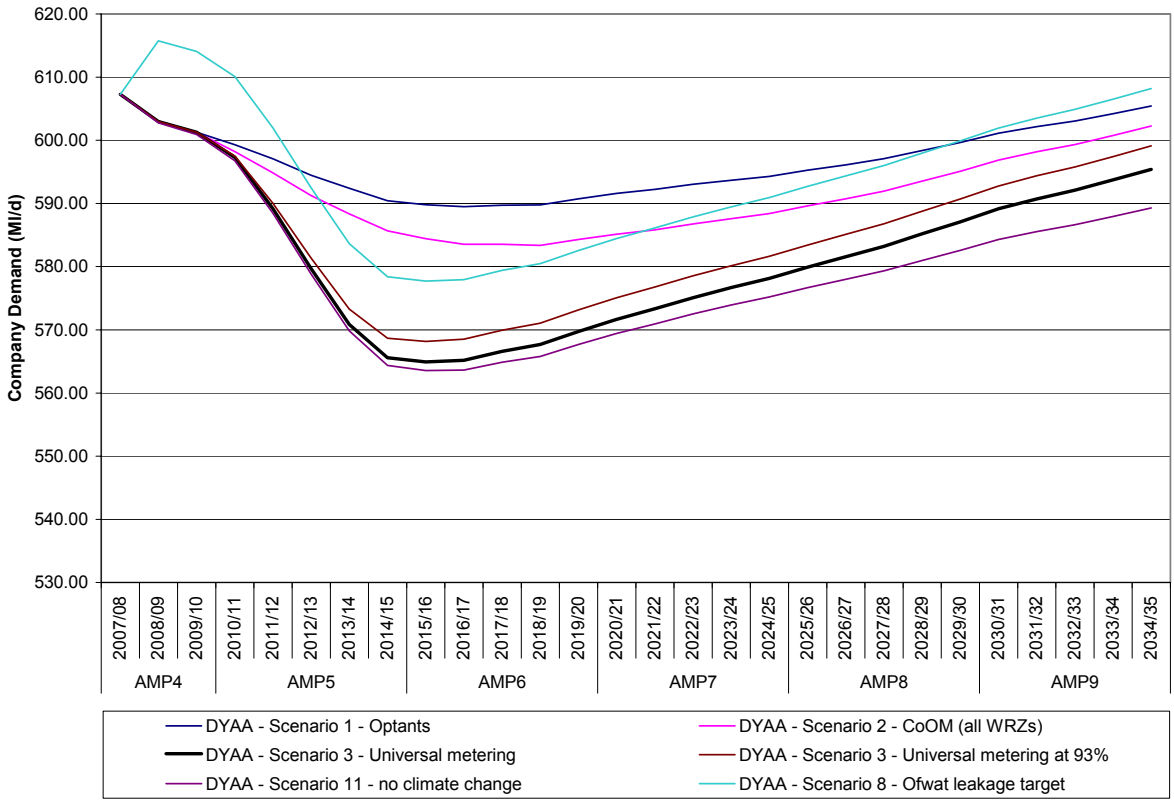
2033/34
2034/35
HK MDO (Oct-Nov) DI
HK Rebased MDO (Oct-Nov) DI
HK DY MDO Scenario 1
HK DY MDO Scenario 3
HK DY MDO DWRMP UCM

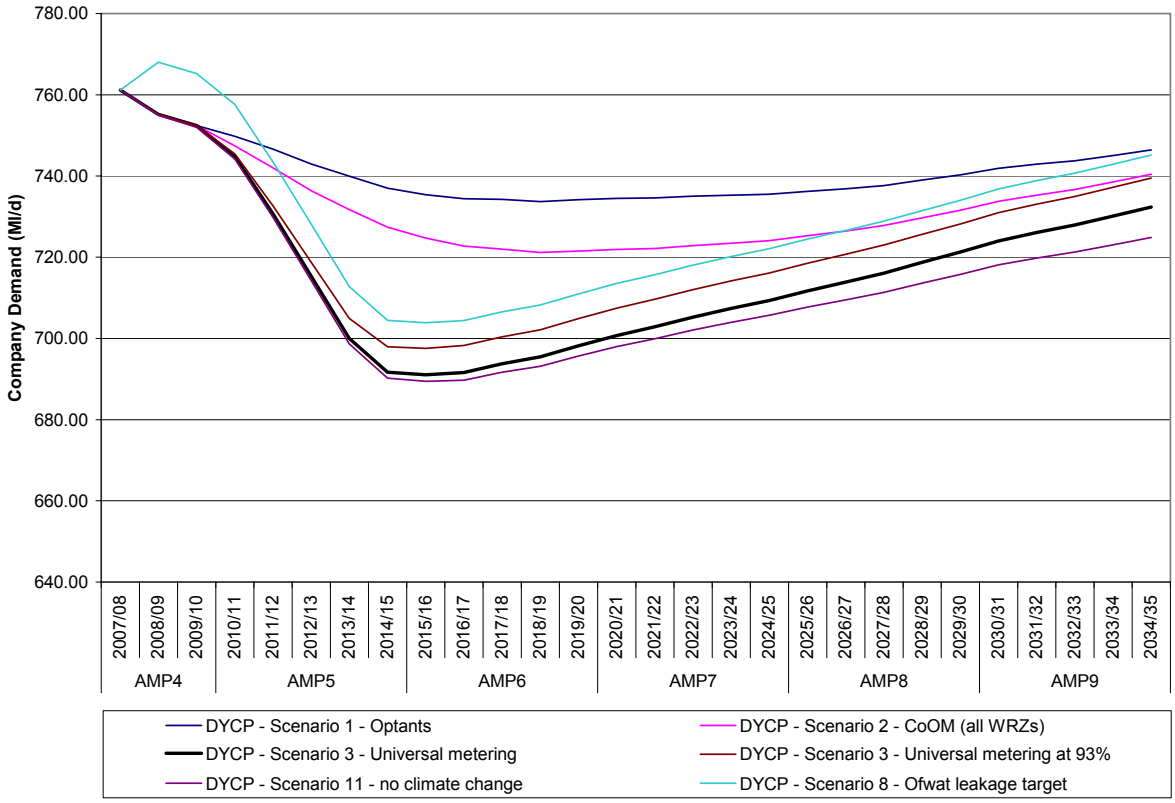

DYMDO Demand (Ml/d)
0
5
10
15
20
25
30
35
40
1989/90
1990/91
1991/92
1992/93
1993/94
1994/95
1995/96
1996/97
1997/98
1998/99
1999/00
2000/01
2001/02
2002/03
2003/04
2004/05
2005/06
2006/07
2007/08
2008/09
2009/10
2010/11
2011/12
2012/13
2013/14
2014/15
2015/16
2016/17
2017/18
2018/19
2019/20
2020/21
2021/22
2022/23
2023/24
2024/25
2025/26
2026/27
2027/28
2028/29
2029/30
2030/31
2031/32
2032/33
2033/34
2034/35
IW MDO (Oct-Nov) DI
IW Rebased MDO (Oct-Nov) DI
IW DY MDO Scenario 1
IW DY MDO Scenario 3
IW DY MDO DWRMP UCM

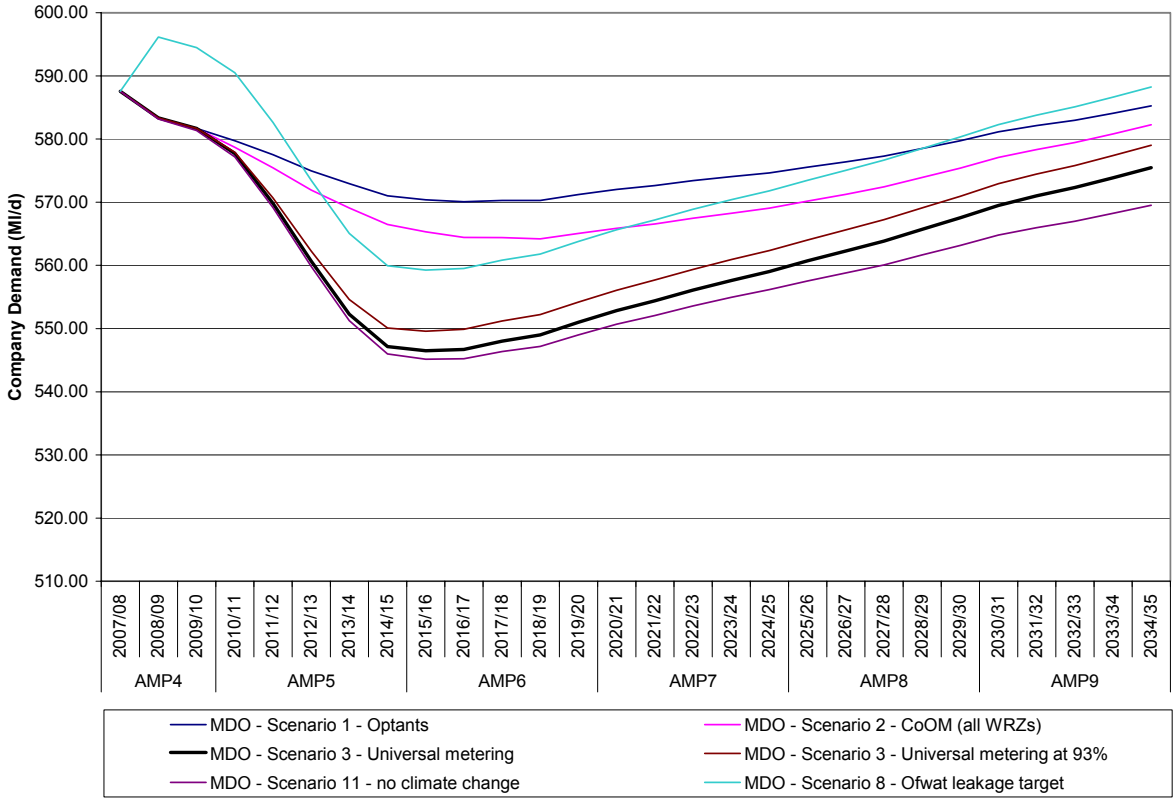
E.8.1.5 Forecasts for All Scenarios

The plots below present, at the company level, the demand forecasts for each of the metering scenarios investigated as part of this WRMP






780.00
760.00
740.00
720.00
700.00
680.00
660.00
640.00
Company Demand (Ml/d)
2007/08
2008/09
2009/10
2010/11
2011/12
2012/13
2013/14
2014/15
2015/16
2016/17
2017/18
2018/19
2019/20
2020/21
2021/22
2022/23
2023/24
2024/25
2025/26
2026/27
2027/28
2028/29
2029/30
2030/31
2031/32
2032/33
2033/34
2034/35
AMP4
AMP5
AMP6
AMP7
AMP8
AMP9
DYCP - Scenario 1 - Optants
DYCP - Scenario 2 - CoOM (all WRZs)
DYCP - Scenario 3 - Universal metering
DYCP - Scenario 3 - Universal metering at 93%
DYCP - Scenario 11 - no climate change
DYCP - Scenario 8 - Ofwat leakage target


600.00
590.00
580.00
570.00
560.00
550.00
540.00
530.00
520.00
510.00
Company Demand (Ml/d)
2007/08
2008/09
2009/10
2010/11
2011/12
2012/13
2013/14
2014/15
2015/16
2016/17
2017/18
2018/19
2019/20
2020/21
2021/22
2022/23
2023/24
2024/25
2025/26
2026/27
2027/28
2028/29
2029/30
2030/31
2031/32
2032/33
2033/34
2034/35
AMP4
AMP5
AMP6
AMP7
AMP8
AMP9
MDO - Scenario 1 - Optants
MDO - Scenario 2 - CoOM (all WRZs)
MDO - Scenario 3 - Universal metering
MDO - Scenario 3 - Universal metering at 93%
MDO - Scenario 11 - no climate change
MDO - Scenario 8 - Ofwat leakage target

E.9 References

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