

NRA-WATER RESOURCES 78

Water NATURE'S PRECIOUS RESOURCE

*An Environmentally
Sustainable Water Resources
Development Strategy for
England and Wales*

SUPPLEMENTARY REPORT



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National Rivers Authority

MARGINAL DEMANDS
Supplementary Report No 3
March 1994

NATIONAL RIVERS AUTHORITY

**WATER RESOURCES DEVELOPMENT STRATEGY
DERIVATION OF MARGINAL DEMANDS**

Supplementary Report No. 3

March 1994 Version 1

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Preface

This report is the third in a series of nine supplementary reports which provide supporting information for the National Rivers Authority, Water Resources Development Strategy document;

"An environmentally sustainable water resources development strategy for England and Wales".

The other reports in the series are as follows:

1. Methodology and Assumptions for Public Water Supply Demand Scenarios.
2. Review of Public Water Supply Yields.
4. Other Options.
5. Hydrological Modelling.
6. Resource Scheme Costings.
7. The RESPLAN Model.
8. Environmental Assessment of Strategic Options.
9. National Strategic Overview.

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ANNEX 1 - Marginal demand spreadsheet outputs

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THE DERIVATION OF MARGINAL DEMANDS

1. INTRODUCTION

An important element of the work involved in the data generation process for the water resources development strategy is to define the magnitude of the demands which are to be met from the resource options being considered in the strategy. In order to perform this assessment accurately, and to provide information in an appropriate format for the resource allocation model RESPLAN, it is necessary to consider the resource/demand balance in terms of *demand centres*.

A demand centre is a discrete area of public water supply demand in which specific sources of supply can be used to meet demand within that area.

A demand centre could constitute:

- An entire company distribution network.
- A combination of zones within one or more companies.
- An individual company zone.
- A combination of one or more entire company distribution networks and zones.

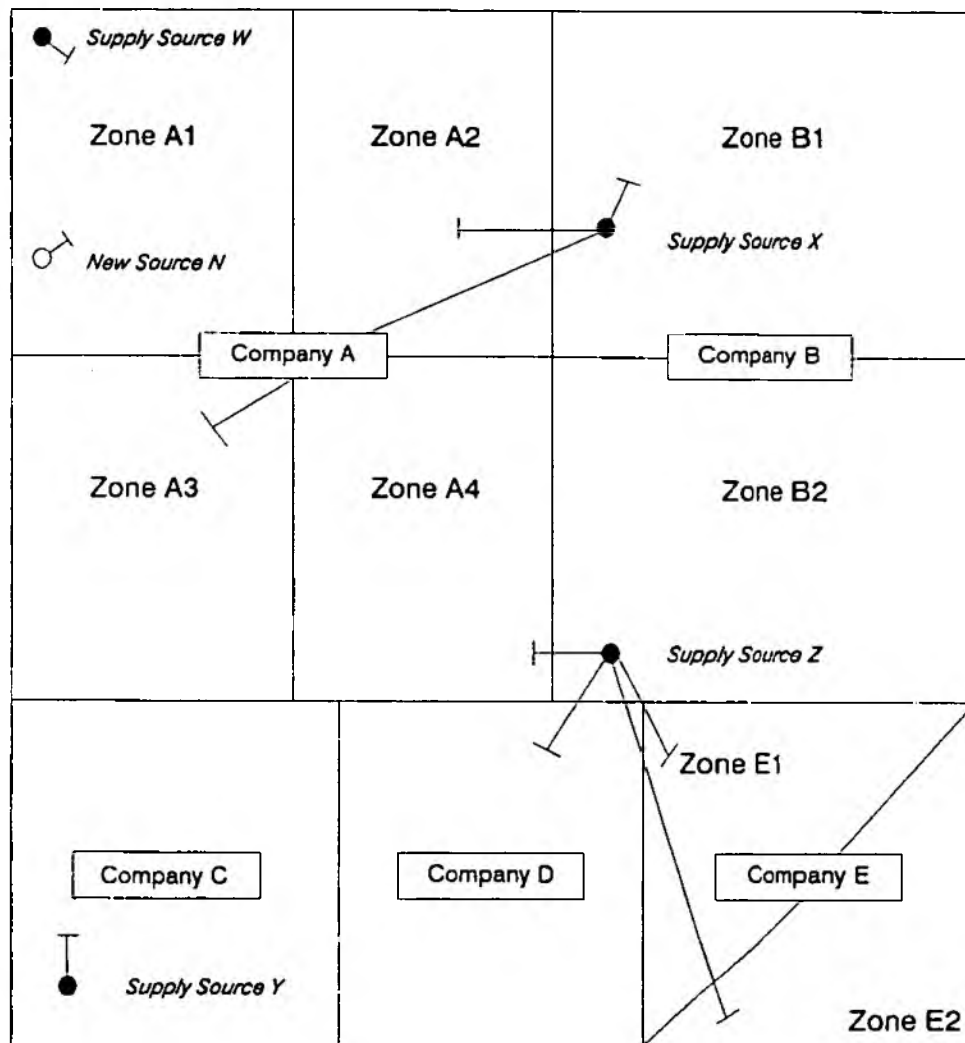
Figure 1 shows the variety of ways in which demand centres can be specified, and how specific sources of supply can be attributed to specific demand centres.

In assessing the future demand/resource balance account needs to be taken of the yield available from existing sources together with that which can be supplied by small non-strategic capacity developments or reallocations local to the centres of demand. These *local developments* can often only be allocated to specific demand centres. For example, in figure 1 an increase in the capacity of supply source W, or the construction of a new source N, may give extra yield available only to company A within zone A1.

In the case of reallocation of existing resources, these can either take place within a demand centre or between demand centres. For example, in figure 1 the proportion of source Z allocated to zone E1 could be increased by decreasing the proportion allocated to E2. The potential for such reallocations is implicit in the amalgamation of yield and demand data necessary to specify a demand centre, however, the specification of a demand centre does not imply that such reallocations will take place in all cases. Reallocation between demand centres may occur by redirecting specific sources of supply. Such reallocations are treated as a "local development".

Any demand which cannot be satisfied by the sum of existing yield, local development and/or reallocation is termed a *marginal demand* and is the deficit which needs to be met from strategic developments. Marginal demand data is the format required by RESPLAN.

Figure 1: The Variations in Specifying a Demand Centre



Demand Centre I = Zone A4, Zone B2, Company D, Zone E1, E2

Demand Centre II = Zone A1

Demand Centre III = Company C

Demand Centre IV = Zone A3, A2, B1

Key:

○ - New Source

● - Existing Source

— | - Direction & Termination of Supply Network

2. SIMPLE DERIVATION OF A MARGINAL DEMAND

In order to calculate a marginal demand for a particular demand centre the following data is required:

	Existing yield available to the demand centre
<i>plus</i>	Future yield expected from any local development
<i>less</i>	An allowance for operational failure (outage)
<i>less</i>	Any foreseeable future loss of yield due to other factors
<i>less</i>	Total demand for public water supply (potable and bulk supplies)

Figure 2 shows the concept of a marginal demand. This figure demonstrates that at point A any increase in total demand will generate a marginal demand. As the demand increases between A and B the marginal demand can be seen to increase.

3. CALCULATION OF MARGINAL DEMANDS

During April of 1993 NRA regions were supplied with information on the specification of demand centres and the derivation of marginal demands together with a request to supply a first set of data. The variations inherent in this preliminary data set were recognised and built into a common spreadsheet format from which further data could be produced in response to changes in demand figures.

The results from these spreadsheets is attached at annex 1. In most cases the marginal demands included in annex 1 were input to the RESPLAN model. In some instances assumptions were made about the inclusion or alteration of specific marginal demands and where this resulted in a change in data from that in annex 1 the difference was documented and is included at appendix 1 in the RESPLAN supplementary report No. 9.

4. STANDARD ASSUMPTIONS ON YIELD REDUCTIONS

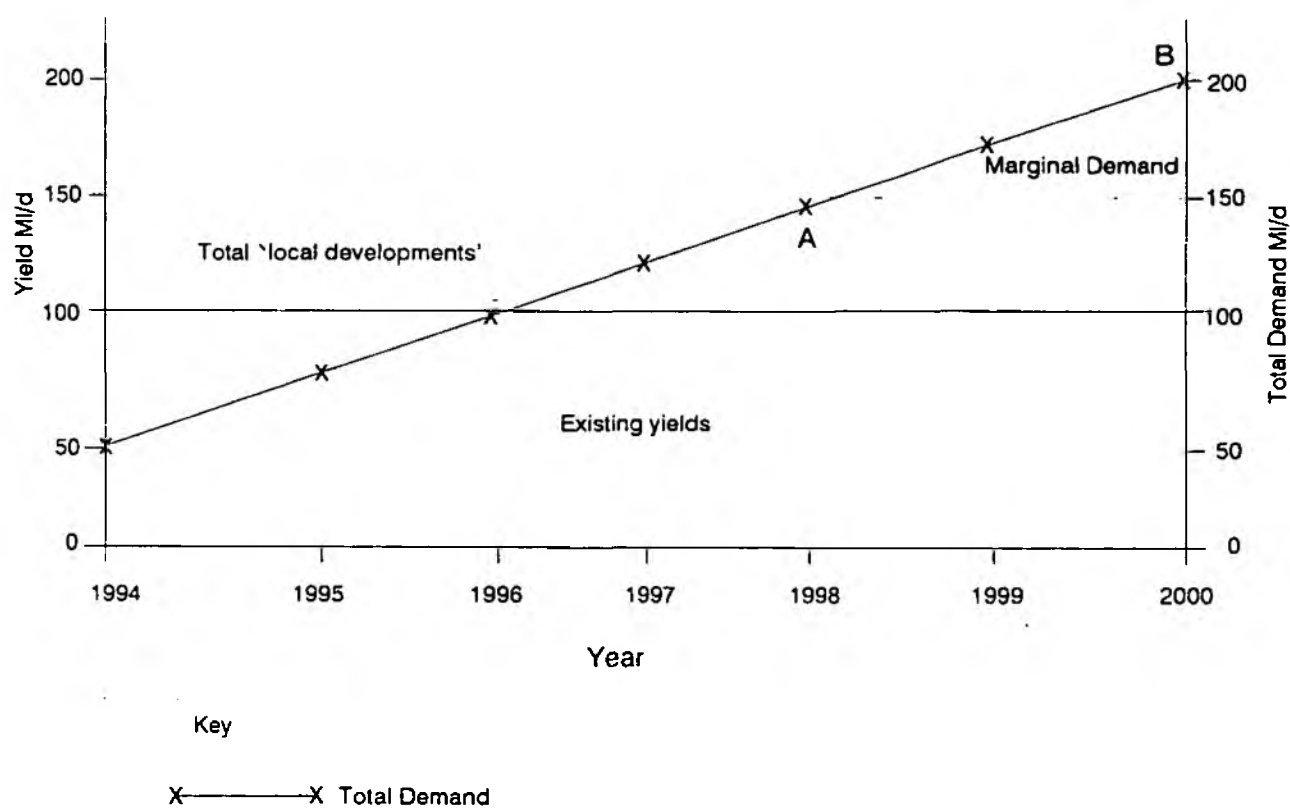
4.1 Outage

A reduction in existing and future yields of 2.5% was allowed to account for safeguards against possible operational failure of sources.

4.2 Environmental cutbacks

Possible reductions in total yield due to low flow alleviation or other reductions on environmental grounds have been included where appropriate. These reductions are indicated on the outputs at annex 1.

Figure 2: The Concept of a Marginal Demand



4.3 Other cutbacks

Potential future loss of yield due to the decommissioning of unreliable or polluted sources has also been accounted for. Where such reductions occur they are identified on the outputs at annex 1.

5. VYRNWY REDEPLOYMENT

Because of the need to represent the redeployment of Vyrnwy reservoir correctly within the RESPLAN model the marginal demand for the model was calculated separately and excluded the Ribble and Huntington local developments. Instead these were included as sources for allocation within RESPLAN. However both Ribble and Huntington are to be regarded as local developments and the output for North West at annex 1 includes them as such. The annex 1 results for North West therefore show the maximum marginal demand given the requirement for redeploying Vyrnwy whilst maintaining a zero deficit within the Southern Command Zone. (NB. This assumes constrained borehole output at 171 Ml/d).

6. AUDIT

The marginal demand results were audited independently and checked for accuracy. The audit report outlines variations which have been build into the calculations because of differences in approach inherent in the original marginal demand submissions from NRA regions. For this reason it represents a useful source document and is included at annex 2.

ANNEX 1

MARGINAL DEMANDS CALCULATION

REGION: Anglian

DEMAND CENTRE	YIELDS OF EXISTING AND PLANNED SOURCES (M/d)							TOTAL DEMANDS (M/d)							MARGINAL DEMANDS (M/d)						
	1991	1996	2001	2006	2011	2016	2021	1991	1996	2001	2006	2011	2016	2021	1991	1996	2001	2006	2011	2016	2021
Grimsby/Scunthorpe																					
High	304.2	304.2	304.2	304.2	304.2	304.2	304.2	250.1	254.3	260.3	271.4	280.5	290.1	295.2	0	0	0	0	0	0	0
Low	304.2	304.2	304.2	304.2	304.2	304.2	304.2	250.1	241.2	240.3	243.2	247.2	253.3	258.7	0	0	0	0	0	0	0
Med	304.2	304.2	304.2	304.2	304.2	304.2	304.2	250.1	248.3	251.2	258.4	263.4	270.7	277.1	0	0	0	0	0	0	0
Lincoln/Grantham																					
High	146.25	146.25	146.25	146.25	146.25	146.25	146.25	104.5	119.6	123.4	130.0	136.1	142.9	146.1	0	0	0	0	0	0	0
Low	146.25	146.25	146.25	146.25	146.25	146.25	146.25	104.5	112.3	112.2	114.2	117.3	122.0	125.3	0	0	0	0	0	0	0
Med	146.25	146.25	146.25	146.25	146.25	146.25	146.25	104.5	116.3	118.3	122.7	126.5	131.9	135.8	0	0	0	0	0	0	0
Anglia (West)																					
High	523.575	541.13	558.68	576.23	593.78	611.33	628.88	399.1	440.1	495.6	533.4	570.9	600.2	618.4	0	0	0	0	0	0	0
Low	523.575	541.13	558.68	576.23	593.78	611.33	628.88	399.1	413.2	450.8	468.6	492.2	512.3	530.3	0	0	0	0	0	0	0
Med	523.575	541.13	558.68	576.23	593.78	611.33	628.88	399.1	427.7	475.3	503.5	530.6	553.9	574.8	0	0	0	0	0	0	0
Anglia (East)																					
High	306.15	306.15	306.15	306.15	306.15	306.15	306.15	238.6	245.5	253.9	267.2	281.4	298.0	308.2	0	0	0	0	0	0	2
Low	306.15	306.15	306.15	306.15	306.15	306.15	306.15	238.6	230.5	231.0	234.7	242.6	254.4	264.3	0	0	0	0	0	0	0
Med	306.15	306.15	306.15	306.15	306.15	306.15	306.15	238.6	238.6	243.5	252.2	261.5	275.1	286.4	0	0	0	0	0	0	0
North Essex																					
High	216.45	216.45	216.45	216.45	216.45	216.45	216.45	183.7	192.5	200.9	210.9	227.1	237.8	244.2	0	0	0	0	11	21	28
Low	216.45	216.45	216.45	216.45	216.45	216.45	216.45	183.7	180.7	182.7	185.3	195.8	203.0	209.4	0	0	0	0	0	0	0
Med	216.45	216.45	216.45	216.45	216.45	216.45	216.45	183.7	187.1	192.7	199.1	211.1	219.5	226.9	0	0	0	0	0	3	10
Essex																					
High	430.95	430.95	430.95	430.95	430.95	430.95	430.95	405.0	426.0	447.0	470.0	493.0	511.0	521.0	0	0	16	39	62	80	90
Low	430.95	430.95	430.95	430.95	430.95	430.95	430.95	405.0	404.0	411.0	417.0	429.0	443.0	451.0	0	0	0	0	0	12	20
Med	430.95	430.95	430.95	430.95	430.95	430.95	430.95	405.0	419.0	433.0	448.0	463.0	479.0	489.0	0	0	2	17	32	48	58
Cambridge																					
High	121.875	121.88	121.88	121.88	121.88	121.88	121.88	74.0	80.0	87.0	94.0	102.0	110.0	118.0	0	0	0	0	0	0	0
Low	121.875	121.88	121.88	121.88	121.88	121.88	121.88	74.0	77.0	81.0	84.0	90.0	96.0	102.0	0	0	0	0	0	0	0
Med	121.875	121.88	121.88	121.88	121.88	121.88	121.88	74.0	79.0	84.0	90.0	96.0	102.0	109.0	0	0	0	0	0	0	0
Tendring																					
High	42.9	42.9	42.9	42.9	42.9	42.9	42.9	32.0	35.0	37.0	40.0	43.0	47.0	51.0	0	0	0	0	0	4	8
Low	42.9	42.9	42.9	42.9	42.9	42.9	42.9	32.0	34.0	36.0	37.0	39.0	42.0	44.0	0	0	0	0	0	0	1
Med	42.9	42.9	42.9	42.9	42.9	42.9	42.9	32.0	34.0	36.0	39.0	41.0	44.0	46.0	0	0	0	0	0	1	3
Suffolk																					
High	115.05	115.13	115.13	115.13	115.13	115.13	115.13	77.0	82.0	87.0	92.0	97.0	102.0	108.0	0	0	0	0	0	0	0
Low	115.128	115.13	115.13	115.13	115.13	115.13	115.13	77.0	80.0	82.0	84.0	86.0	89.0	92.0	0	0	0	0	0	0	0
Med	115.128	115.13	115.13	115.13	115.13	115.13	115.13	77.0	81.0	85.0	88.0	91.0	95.0	99.0	0	0	0	0	0	0	0

MARGINAL DEMANDS CALCULATION

Anglia (West) Existing Yield	691
Less Export to ST	18
Less Export to 3Vs	91
Total	582
Less inc to 3Vs in future	45
Total	537
Increased Effluent	108 (18 MI/d per 5 years for 30 years)
Futruue Total	645

DEMAND CENTRE	MARGINAL DEMANDS (MI/d)						
	1991	1996	2001	2006	2011	2016	2021
Grimsby/Scunthorpe							
High	0	0	0	0	0	0	0
Low	0	0	0	0	0	0	0
Med	0	0	0	0	0	0	0
Lincoln/Grantham							
High	0	0	0	0	0	0	0
Low	0	0	0	0	0	0	0
Med	0	0	0	0	0	0	0
Anglia (West)							
High	0	0	0	0	0	0	0
Low	0	0	0	0	0	0	0
Med	0	0	0	0	0	0	0
Anglia (East)							
High	0	0	0	0	0	0	2 (Anglia East + Suffolk)
Low	0	0	0	0	0	0	0
Med	0	0	0	0	0	0	0
Cambridge							
High	0	0	0	0	0	0	0
Low	0	0	0	0	0	0	0
Med	0	0	0	0	0	0	0
North Essex							
High	0	0	0	0	11	25	36 (North Essex + Tendring)
Low	0	0	0	0	0	0	1
Med	0	0	0	0	0	4	14
South Essex							
High	0	0	18	39	62	80	90 (Essex)
Low	0	0	0	0	0	12	20
Med	0	0	2	17	32	48	58

MARGINAL DEMANDS CALCULATION

Scheme	MI/d
Increased abstraction from Chalk (Suffolk)	20
Increased abstraction from Chalk (Anglia East)	20
Increased abstraction from Trent (Lincoln/Grantham)	36
TOTAL	76

Bulk supply and other commitments (MI/d)

Supply From Elsham WTW to Humberside (Industrial) 39

Proportion of distribution input in each supply division (From NRA Anglian)

	1991	1996	2001	2006	2011	2016	2021
AWS Grimsby/Scunthorpe	0.1857	0.1775	0.1709	0.1692	0.1657	0.1641	0.1628
AWS Lincoln/Grantham	0.09192	0.0986	0.0953	0.0946	0.0934	0.0934	0.0929
AWS Anglia (West)	0.35097	0.3628	0.3827	0.3882	0.3919	0.3923	0.3931
AWS Anglia (East)	0.20984	0.2024	0.1961	0.1945	0.1931	0.1948	0.1959
AWS North Essex	0.16156	0.1587	0.1551	0.1535	0.1559	0.1554	0.1552

Existing yields (MI/d)

Total planned yield (MI/d)

Yield less contingency
Factor: 0.975

AWS	1524.0	1643.0	1601.9
EW	442	442.0	430.95
CAM	125	125	121.88
THW	44	44	42.9
SW	98	118	115.05

MARGINAL DEMANDS CALCULATION

REGION: Northumbria

DEMAND CENTRE	YIELDS OF EXISTING AND PLANNED SOURCES (M/d)							TOTAL DEMANDS (M/d)							MARGINAL DEMANDS (M/d)						
	1991	1996	2001	2006	2011	2016	2021	1991	1996	2001	2006	2011	2016	2021	1991	1996	2001	2006	2011	2016	2021
Hartlepoons																					
High	49.725	57.525	57.525	57.525	57.525	57.525	57.525	44	45	47	48	49	50	51	0	0	0	0	0	0	0
Low	49.725	57.525	57.525	57.525	57.525	57.525	57.525	44	44	45	45	45	45	45	0	0	0	0	0	0	0
Med	49.725	57.525	57.525	57.525	57.525	57.525	57.525	44	45	46	47	47	48	49	0	0	0	0	0	0	0
Northumbrian																					
High	965.25	965.25	965.25	965.25	965.25	965.25	965.25	667	679	693	706	720	735	742	0	0	0	0	0	0	0
Low	965.25	965.25	965.25	965.25	965.25	965.25	965.25	667	664	667	671	674	679	684	0	0	0	0	0	0	0
Med	965.25	965.25	965.25	965.25	965.25	965.25	965.25	667	674	682	689	697	707	716	0	0	0	0	0	0	0
North East																					
High	484.58	484.58	484.58	484.58	484.58	484.58	484.58	395	407	420	435	451	468	485	0	0	0	0	0	0	0
Low	484.58	484.58	484.58	484.58	484.58	484.58	484.58	395	400	405	412	420	428	437	0	0	0	0	0	0	0
Med	484.58	484.58	484.58	484.58	484.58	484.58	484.58	395	402	411	420	430	442	454	0	0	0	0	0	0	0

SUPPORTING INFORMATION

Local Schemes included in existing sources

Environmental cutbacks (M/d)

Existing yields (M/d)

Total planned yield (M/d)

Yield less contingency
Factor: 0.975

Scheme	M/d
Magnesian Limestone SE Durham (Hartlepoons)	8
Unallocated Kielder (NEW)	13
TOTAL (by 1996)	21

None

HW	51	59	57.525
NW	990	990	965.25
NEW	484	497	484.58

Bulk supply and other commitments (M/d)

Northumbrian Water	232 Bulk supply to industry
Hartlepoons	5 Bulk supply to industry
North East Water	38 Bulk supply to Northumbrian Water

MARGINAL DEMANDS CALCULATION

REGION: North West

DEMAND CENTRE	YIELDS OF EXISTING AND PLANNED SOURCES (M/d)							TOTAL DEMANDS (M/d)							MARGINAL DEMANDS (M/d)						
	1991	1996	2001	2006	2011	2016	2021	1991	1996	2001	2006	2011	2016	2021	1991	1996	2001	2006	2011	2016	2021
NWW (RR)																					
High	2009.0	2009.0	2009.0	2009.0	2009.0	2009.0	2009.0	1845.0	1818.8	1875.4	1933.4	1990.0	2049.4	2111.0	0	0	0	0	0	40	102
Low	2009.0	2009.0	2009.0	2009.0	2009.0	2009.0	2009.0	1845.0	1668.1	1629.2	1653.3	1674.5	1700.7	1727.6	0	0	0	0	0	0	0
Med	2009.0	2009.0	2009.0	2009.0	2009.0	2009.0	2009.0	1845.0	1781.3	1716.3	1730.4	1764.4	1803.3	1843.6	0	0	0	0	0	0	0
NWW (SCZ)																					
High	840.0	840.0	840.0	840.0	840.0	840.0	840.0	730.0	719.2	742.6	766.6	790.0	814.6	840.0	0	0	0	0	0	0	0
Low	840.0	840.0	840.0	840.0	840.0	840.0	840.0	730.0	656.9	640.8	650.7	659.5	670.3	681.4	0	0	0	0	0	0	0
Med	840.0	840.0	840.0	840.0	840.0	840.0	840.0	730.0	703.7	676.7	682.6	696.6	712.7	729.4	0	0	0	0	0	0	0

SUPPORTING INFORMATION

Local Schemes included in existing sources

Scheme	M/d
Ribble	40
Huntington	74
Lake District	10
LCUS	80
Improvement to existing schemes	17.5
TOTAL	221.5

Proportion of Distribution Input into Command Zones

SCZ	730	0.293
RR	1765	0.707

2495

Environmental cutbacks (M/d)

Lowther & LCUS 50

Existing yields (M/d)

RR 2003
SCZ 816.5

Total planned yield (M/d)

2060.5
861.5

Yield less contingency
Factor: 0.975

2009
839.96

Other Cutbacks (M/d)

Volume of Vymwy redistributed 69

Bulk supply and other commitments (M/d)

Industrial from Dee yield 80

MARGINAL DEMANDS CALCULATION

REGION:

Severn Trent

Company	YIELDS OF EXISTING AND PLANNED SOURCES (M/d)							TOTAL DEMANDS (M/d)							MARGINAL DEMANDS (M/d)						
	1991	1996	2001	2006	2011	2016	2021	1991	1996	2001	2006	2011	2016	2021	1991	1996	2001	2006	2011	2016	2021
STW - W. Shropshire																					
High	75.9	105.3	105.3	105.3	105.3	105.3	105.3	64.1	68.6	73.5	77.2	81.2	85.3	89.6	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Low	75.9	105.3	105.3	105.3	105.3	105.3	105.3	64.1	61.3	63.7	64.8	66.8	69.1	71.4	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Med	75.9	105.3	105.3	105.3	105.3	105.3	105.3	64.1	63.6	67.4	69.9	72.4	75.2	78.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00
STW - E. Shropshire																					
High	84.50	92.53	91.85	91.07	90.38	89.70	88.82	74.1	76.6	80.6	85.6	90.8	95.2	99.6	0.00	0.00	0.00	0.00	0.41	5.46	10.83
Low	84.50	92.53	91.85	91.07	90.38	89.70	88.82	74.1	68.5	69.9	71.8	74.7	77.1	79.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Med	84.50	92.53	91.85	91.07	90.38	89.70	88.82	74.1	71.1	73.9	77.4	81.0	83.9	86.8	0.00	0.00	0.00	0.00	0.00	0.00	0.00
STW - Wolverhampton																					
High	137.80	140.30	132.60	130.55	128.51	126.46	124.31	107.3	111.9	116.3	119.5	122.9	126.9	131.0	0.00	0.00	0.00	0.00	0.00	0.42	6.70
Low	137.80	140.30	132.60	130.55	128.51	126.46	124.31	107.3	100.1	100.9	100.2	101.1	102.8	104.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Med	137.80	140.30	132.60	130.55	128.51	126.46	124.31	107.3	103.9	106.7	108.1	109.5	111.8	114.1	0.00	0.00	0.00	0.00	0.00	0.00	0.00
STW - Birmingham																					
High	351.20	342.42	342.42	342.42	342.42	342.42	342.42	303.7	321.6	333.6	343.8	354.6	366.4	379.6	0.00	0.00	0.00	1.40	12.23	23.99	37.16
Low	351.20	342.42	342.42	342.42	342.42	342.42	342.42	303.7	287.7	289.3	288.4	291.9	296.9	302.7	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Med	351.20	342.42	342.42	342.42	342.42	342.42	342.42	303.7	298.5	306.0	311.1	316.2	322.9	330.6	0.00	0.00	0.00	0.00	0.00	0.00	0.00
STW - Worcester																					
High	108.70	103.74	102.77	101.79	100.82	99.84	99.06	94.8	97.8	104.1	109.6	115.4	120.3	126.5	0.00	0.00	1.29	7.77	14.55	20.47	27.47
Low	108.70	103.74	102.77	101.79	100.82	99.84	99.06	94.8	87.5	90.3	91.9	95.0	97.5	100.9	0.00	0.00	0.00	0.00	0.00	0.00	1.85
Med	108.70	103.74	102.77	101.79	100.82	99.84	99.06	94.8	90.8	95.5	99.1	102.9	106.0	110.2	0.00	0.00	0.00	0.00	2.06	6.20	11.13
STW - Gloucester																					
High	175.30	175.11	175.11	175.11	175.11	175.11	175.11	157.6	171.4	181.6	191.0	200.8	208.9	218.3	0.00	0.00	6.47	15.84	25.72	33.80	43.23
Low	175.30	175.11	175.11	175.11	175.11	175.11	175.11	157.6	153.3	157.5	160.2	165.3	169.3	174.1	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Med	175.30	175.11	175.11	175.11	175.11	175.11	175.11	157.6	159.1	166.6	172.8	179.1	184.1	190.1	0.00	0.00	0.00	0.00	3.87	9.02	15.04
STW - S. Warks/Cov																					
High	249.80	264.32	264.32	264.32	264.32	264.32	264.32	220.1	226.9	237.7	247.8	258.5	266.9	275.4	0.00	0.00	0.00	0.00	0.00	2.56	11.12
Low	249.80	264.32	264.32	264.32	264.32	264.32	264.32	220.1	202.9	206.2	207.9	212.8	216.2	219.7	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Med	249.80	264.32	264.32	264.32	264.32	264.32	264.32	220.1	210.6	218.1	224.2	230.5	235.2	239.9	0.00	0.00	0.00	0.00	0.00	0.00	0.00
STW - E. Midlands																					
High	815.50	777.86	754.36	744.22	735.44	726.67	717.60	792.2	821.7	866.1	902.6	941.1	984.4	1027.9	0.00	43.89	111.73	158.37	205.67	257.73	310.28
Low	815.50	777.86	754.36	744.22	735.44	726.67	717.60	792.2	735.0	751.2	757.0	774.7	797.6	819.7	0.00	0.00	0.00	12.78	39.27	70.93	102.14
Med	815.50	777.86	754.36	744.22	735.44	726.67	717.60	792.2	762.7	794.5	816.7	839.2	867.6	895.1	0.00	0.00	40.19	72.45	103.76	140.93	177.54
STW - Stoke																					
High	196.80	205.14	204.65	204.17	203.68	203.19	203.19	165.0	177.5	185.7	192.0	198.7	206.7	215.0	0.00	0.00	0.00	0.00	0.00	3.54	11.79
Low	196.80	205.14	204.65	204.17	203.68	203.19	203.19	165.0	158.7	161.0	161.0	163.6	167.5	171.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Med	196.80	205.14	204.65	204.17	203.68	203.19	203.19	165.0	164.7	170.3	173.7	177.2	182.2	187.2	0.00	0.00	0.00	0.00	0.00	0.00	0.00
East Worcester																					
High	68.20	63.66	58.78	55.86	52.93	50.01	46.99	74.0	78.5	83.1	88.0	93.2	98.7	104.5	5.80	14.84	24.32	32.14	40.27	48.69	57.51
Low	68.20	63.66	58.78	55.86	52.93	50.01	46.99	74.0	67.2	64.5	66.2	69.0	72.1	75.3	5.80	3.54	5.72	10.34	16.07	22.09	28.31
Med	68.20	63.66	58.78	55.86	52.93	50.01	46.99	74.0	72.4	73.5	71.8	74.2	78.0	82.0	5.80	8.74	14.72	15.84	21.27	27.99	35.01
South Staffs																					
High	356.90	379.18	374.30	369.43	364.55	359.68	354.80	358.0	372.0	386.0	401.0	417.0	425.0	430.0	1.10	0.00	11.70	31.57	52.45	65.32	75.20
Low	356.90	379.18	374.30	369.43	364.55	359.68	354.80	358.0	337.0	340.0	342.0	349.0	357.0	358.0	1.10	0.00	0.00	0.00	0.00	0.00	3.20
Med	356.90	379.18	374.30	369.43	364.55	359.68	354.80	358.0	349.0	359.0	367.0	376.0	385.0	388.0	1.10	0.00	0.00	0.00	11.45	25.32	33.20

MARGINAL DEMANDS CALCULATION

SUPPORTING INFORMATION

Local Schemes included in existing sources

Scheme	S&C		MI/d
STW - W.Shropshire			34
STW - E.Shropshire			12.2
STW - Wolverhampton	13.6	0	13.6
STW - Birmingham	0	0	0
STW - Worcester			2
STW - Gloucester	5.8	0	5.8
STW - S.Warks/Cov	21.3	0	21.3
STW - E. Midlands	0	0	0
STW - Stoke			15.1
S.Staffs	37	0	37
TOTAL			141

Note:
1. In strategy document shropshire and coarington included as local options
2 This is because they were treated as such in RESPLAN

NRA AMP2 Reductions	MI/d						
	1991	1996	2001	2006	2011	2016	2021
STW - W.Shropshire	0	0	0	0	0	0	0
STW - E.Shropshire	0	0.8	1.5	2.3	3	3.7	4.6
STW - Wolverhampton	0	2.1	4.2	6.3	8.4	10.5	12.7
STW - Birmingham	0	0	0	0	0	0	0
STW - Worcester	0	2	3	4	5	6	6.8
STW - Gloucester	0	0	0	0	0	0	0
STW - S.Warks/Cov	0	0	0	0	0	0	0
STW - E.Midlands	0	0	8	16	25	34	43.3
STW - Stoke	0	0.5	1	1.5	2	2.5	2.5
E.Worcester	0	0	0	3	6	9	12.1
S.Staffs	0	3	8	13	18	23	28
Total	0	8.4	25.7	46.1	67.4	88.7	110
Lost Yield							
STW - W.Shropshire	0	1.9	1.9	1.9	1.9	1.9	1.9
STW - E.Shropshire	0	1	1	1	1	1	1
STW - Wolverhampton	0	5.4	11.2	11.2	11.2	11.2	11.2
STW - Birmingham	0	0	0	0	0	0	0
STW - Worcester	0	2.3	2.3	2.3	2.3	2.3	2.3
STW - Gloucester	0	1.5	1.5	1.5	1.5	1.5	1.5
STW - S.Warks/Cov	0	0	0	0	0	0	0
STW - E.Midlands	0	17.7	33.8	36.2	36.2	36.2	36.2
STW - Stoke	0	1	1	1	1	1	1
E.Worcester	0	2.91	7.91	7.91	7.91	7.91	7.91
S.Staffs	0	2	2	2	2	2	2
Total	0	35.71	62.61	65.01	65.01	65.01	65.01
TOTAL	0	44.11	98.31	111.1	132.41	153.71	175.01

MARGINAL DEMANDS CALCULATION

Proportion of distribution input in each supply division (From NRA Severn Trent)

	1991	1996	2001	2006	2011	2016	2021
STW - W.Shropshire	0.032	0.0331	0.0337	0.0340	0.0343	0.0347	0.0350
STW - E.Shropshire	0.037	0.0369	0.0370	0.0377	0.0384	0.0387	0.0389
STW - Wolverhampton	0.054	0.0540	0.0534	0.0527	0.0520	0.0516	0.0511
STW - Birmingham	0.153	0.1551	0.1531	0.1515	0.1500	0.1489	0.1481
STW - Worcester	0.048	0.0472	0.0478	0.0483	0.0488	0.0489	0.0494
STW - Gloucester	0.08	0.0826	0.0833	0.0842	0.0850	0.0849	0.0852
STW - S.Works/Cov	0.111	0.1094	0.1091	0.1092	0.1094	0.1084	0.1075
STW - E.Midlands	0.4	0.3962	0.3975	0.3978	0.3981	0.4000	0.4010
STW - Stoke	0.083	0.0856	0.0852	0.0846	0.0840	0.0840	0.0839

MARGINAL DEMANDS (M/d) FOR DEMAND CENTRE

West Midlands							
High	1.10	0.00	11.70	72.23	139.41	195.26	258.40 *
Low	1.10	0.00	0.00	0.00	0.00	0.00	3.20
Med	1.10	0.00	0.00	0.00	11.45	25.32	58.07
East Midlands							
High	0.00	43.89	111.73	158.37	205.67	257.73	310.28
Low	0.00	0.00	0.00	12.78	39.27	70.93	102.14 (STW East Midlands)
Med	0.00	0.00	40.19	72.45	103.78	140.93	177.54
Upper Trent							
High	0.00	0.00	0.00	0.00	0.00	3.54	11.79 (STW Stoke)
Low	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Med	0.00	0.00	0.00	0.00	0.00	0.00	0.00

* = East & West Shropshire Linked
 plus Wolverhampton and Birmingham linked
 plus Worcester, Gloucester, S.Works/Coventry & E.Worc linked
 plus South Staffs

MARGINAL DEMANDS CALCULATION

REGION: Southern (Southern Water only)

DEMAND CENTRE	YIELDS OF EXISTING AND PLANNED SOURCES (M/d)							TOTAL DEMANDS (M/d)							MARGINAL DEMANDS (M/d)						
	1991	1996	2001	2006	2011	2016	2021	1991	1996	2001	2006	2011	2016	2021	1991	1996	2001	2006	2011	2016	2021
SWS Hampshire																					
High	319.8	319.8	319.8	319.8	319.8	319.8	319.8	183.2	194.2	204.4	214.2	224.4	235.1	246.4	0	0	0	0	0	0	0
Low	319.8	319.8	319.8	319.8	319.8	319.8	319.8	183.2	169.7	174.2	176.5	181.5	187.5	193.7	0	0	0	0	0	0	0
Med	319.8	319.8	319.8	319.8	319.8	319.8	319.8	183.2	178.2	183.0	189.7	196.5	203.8	211.1	0	0	0	0	0	0	0
SWS IoW																					
High	50.12	50.12	50.12	50.12	50.12	50.12	50.12	35.4	37.5	39.4	41.3	43.3	45.4	47.5	0	0	0	0	0	0	0
Low	50.12	50.12	50.12	50.12	50.12	50.12	50.12	35.4	32.7	33.6	34.1	35.0	36.2	37.4	0	0	0	0	0	0	0
Med	50.12	50.12	50.12	50.12	50.12	50.12	50.12	35.4	34.4	35.3	36.6	37.9	39.3	40.7	0	0	0	0	0	0	0
SWS Sussex East																					
High	40.46	40.46	40.46	40.46	40.46	40.46	40.46	30.3	32.1	33.8	35.4	37.1	38.9	40.7	0	0	0	0	0	0	0
Low	40.46	40.46	40.46	40.46	40.46	40.46	40.46	30.3	28.1	28.8	29.2	30.0	31.0	32.0	0	0	0	0	0	0	0
Med	40.46	40.46	40.46	40.46	40.46	40.46	40.46	30.3	29.5	30.2	31.4	32.5	33.7	34.9	0	0	0	0	0	0	0
SWS Sussex Central																					
High	204.26	204.26	204.26	204.26	204.26	204.26	204.26	150.8	159.8	168.2	176.3	184.7	193.5	202.8	0	0	0	0	0	0	0
Low	204.26	204.26	204.26	204.26	204.26	204.26	204.26	150.8	139.7	143.4	145.2	149.4	154.3	159.4	0	0	0	0	0	0	0
Med	204.26	204.26	204.26	204.26	204.26	204.26	204.26	150.8	146.6	150.6	156.1	161.7	167.7	173.8	0	0	0	0	0	0	0
SWS Sussex West																					
High	91.65	91.65	91.65	91.65	91.65	91.65	91.65	67.1	71.1	74.8	78.4	82.1	86.1	90.2	0	0	0	0	0	0	0
Low	91.65	91.65	91.65	91.65	91.65	91.65	91.65	67.1	62.1	63.8	64.6	66.5	68.6	70.9	0	0	0	0	0	0	0
Med	91.65	91.65	91.65	91.65	91.65	91.65	91.65	67.1	65.2	67.0	69.5	71.9	74.6	77.3	0	0	0	0	0	0	0
SWS Kent Medway																					
High	175.26	175.26	175.26	175.26	175.26	175.26	175.26	130.0	137.8	145.0	152.0	159.2	166.8	174.8	0	0	0	0	0	0	0
Low	175.26	175.26	175.26	175.26	175.26	175.26	175.26	130.0	120.4	123.6	125.2	128.8	133.0	137.4	0	0	0	0	0	0	0
Med	175.26	175.26	175.26	175.26	175.26	175.26	175.26	130.0	126.4	129.8	134.6	139.4	144.6	149.8	0	0	0	0	0	0	0
SWS Kent Thanet																					
High	72.44	72.44	72.44	72.44	72.44	72.44	72.44	53.4	56.6	59.5	62.4	65.4	68.5	71.8	0	0	0	0	0	0	0
Low	72.44	72.44	72.44	72.44	72.44	72.44	72.44	53.4	49.4	50.7	51.4	52.9	54.6	56.4	0	0	0	0	0	0	0
Med	72.44	72.44	72.44	72.44	72.44	72.44	72.44	53.4	51.9	53.3	55.3	57.2	59.4	61.5	0	0	0	0	0	0	0

MARGINAL DEMANDS CALCULATION

SUPPORTING INFORMATION

Local Schemes included in existing sources

Scheme	M/d
Yalding (SWS Kent Medway by 1991)	21.75
Chillerton res (SWS loW by 1991)	9
Darwell (SWS SE by 1991)	21
Rother-Medway Lk (SWS SE by 1991)	2.5
Test GW scheme (SWS Hants by 1991)	25
R Itchen devt (SWS Hants by 1991)	48
Testwood lakes (SWS Hants by 1991)	5
Hardham (SWS SW)	0
Local reallocations using Itchen Yield (SWS Medway)	22
TOTAL	154.25

Proportion of distribution input in each supply division (From NRA Southern)

SWS Hampshire	0.2819
SWS loW	0.0544
SWS Sussex East	0.0466
SWS Sussex West	0.1032
SWS Sussex Central	0.232
SWS Kent Medway	0.2
SWS Kent Thanet	0.0821

Environmental cutbacks (M/d)

Wallop Brook (SWS Hants)	5
Hamble (SWS Hants)	5
Little Stour (SWS Kent Thanet)	10

Existing yields (M/d)

SWS (H)	322.0	328.0	319.8
SWS (loH)	42.4	51.4	50.115
SWS(SE)	25	41.5	40.463
SWS(SC)	174.5	209.5	204.26
SWS(SW)	67	94	91.65
SWS(KM)	182	179.75	175.26
SWS(KT)	62.3	74.3	72.443

Yield less contingency
Factor: 0.975

Bulk supply and other commitments (M/d)

SWS Hampshire BS to SWS Sussex West	27
SWS Hampshire BS to SWS Sussex Central	35
SWS Sussex East BS to MKW	7
SWS Kent Medway BS to SWS Kent Thanet	25
SWS Kent Medway to MKW	21
SWS Kent Thanet to FDW	3

MARGINAL DEMANDS CALCULATION

REGION: Southern

DEMAND CENTRE	YIELDS OF EXISTING AND PLANNED SOURCES (M/d)							TOTAL DEMANDS (M/d)							MARGINAL DEMANDS (M/d)						
	1991	1996	2001	2006	2011	2016	2021	1991	1996	2001	2006	2011	2016	2021	1991	1996	2001	2006	2011	2016	2021
Portsmouth																					
High	285.19	285.19	285.19	285.19	285.19	285.19	285.19	202	213	225	235	240	245	251	0	0	0	0	0	0	0
Low	285.19	285.19	285.19	285.19	285.19	285.19	285.19	202	208	212	215	217	219	221	0	0	0	0	0	0	0
Med	285.19	285.19	285.19	285.19	285.19	285.19	285.19	202	210	218	225	229	232	235	0	0	0	0	0	0	0
Mid Kent																					
High	184.23	184.23	184.23	184.23	184.23	184.23	184.23	155	162	169	176	184	192	197	0	0	0	0	0	8	13
Low	184.23	184.23	184.23	184.23	184.23	184.23	184.23	155	143	145	146	150	155	159	0	0	0	0	0	0	0
Med	184.23	184.23	184.23	184.23	184.23	184.23	184.23	155	149	153	157	162	167	173	0	0	0	0	0	0	0
Folkestone																					
High	53.24	53.24	53.24	53.24	53.24	53.24	53.24	55	58	61	65	69	73	76	2	5	8	12	16	20	23
Low	53.24	53.24	53.24	53.24	53.24	53.24	53.24	55	51	47	48	50	52	54	2	0	0	0	0	0	1
Med	53.24	53.24	53.24	53.24	53.24	53.24	53.24	55	54	53	52	54	57	59	2	1	0	0	1	4	6
South East																					
High	202.02	202.02	202.02	202.02	202.02	202.02	202.02	158	165	173	181	189	198	204	0	0	0	0	0	0	2
Low	202.02	202.02	202.02	202.02	202.02	202.02	202.02	158	158	160	162	166	171	176	0	0	0	0	0	0	0
Med	202.02	202.02	202.02	202.02	202.02	202.02	202.02	158	163	168	173	178	184	190	0	0	0	0	0	0	0

SUPPORTING INFORMATION

Local Schemes included in existing sources

Scheme	M/d
Havant Thicket Res (PW) by 1991	30
Yalding (Mid Kent by 1991)	7.25
Local GW (Mid Kent - by 1991)	6
Darwell (SE Water by 1991)	21
Rother-Medway Lk (SE Water by 1991)	2.5
Crowhurst Bridge (SE Water by 1991)	4
TOTAL	70.75

Environmental cutbacks (M/d)

None

Existing yields (M/d)

PW	262.5
MKW	147.7
FDW	51.6
SEW	179.7

Total planned yield (M/d)

292.5
189
54.6
207.2

Yield less contingency
Factor: 0.975

285.19
184.23
53.235
202.02

Bulk supply and other commitments (M/d)

To Mid Kent From SWS(SE)	7
To Mid Kent From SWS(KM)	21
To Folkestone From SWS(KT)	3

MARGINAL DEMANDS CALCULATION

REGION: South West

DEMAND CENTRE	YIELDS OF EXISTING AND PLANNED SOURCES (M/d)							TOTAL DEMANDS (M/d)							MARGINAL DEMANDS (M/d)						
	1991	1996	2001	2006	2011	2016	2021	1991	1996	2001	2006	2011	2016	2021	1991	1996	2001	2006	2011	2016	2021
South West																					
High	717.5	717.5	717.5	717.5	717.5	717.5	717.5	499	525	560	598	636	676	715	0	0	0	0	0	0	0
Low	717.5	717.5	717.5	717.5	717.5	717.5	717.5	499	470	493	517	540	567	594	0	0	0	0	0	0	0
Med	717.5	717.5	717.5	717.5	717.5	717.5	717.5	499	490	512	540	569	599	631	0	0	0	0	0	0	0

SUPPORTING INFORMATION

Local Schemes included in existing sources

Environmental cutbacks (M/d)

Existing yields (M/d)

Total planned yield (M/d)

Yield less contingency
Factor: 0.975

Scheme	M/d
Wimbleball pumped storage	30
Roadford pumped storage	50
Colliford pumped storage	50
TOTAL	130

None

605.9

735.9

717.5

MARGINAL DEMANDS CALCULATION

REGION: Thames (Thames Water Utilities only)

DEMAND CENTRE	YIELDS OF EXISTING AND PLANNED SOURCES (M/d)							TOTAL DEMANDS (M/d)							MARGINAL DEMANDS (M/d)						
	1991	1996	2001	2006	2011	2016	2021	1991	1996	2001	2006	2011	2016	2021	1991	1996	2001	2006	2011	2016	2021
Oxford & Swindon																					
High	291.5	291.5	291.5	291.5	291.5	291.5	291.5	240.0	258.9	274.9	293.2	311.3	322.8	332.0	0	0	0	2	20	31	40
Low	291.5	291.5	291.5	291.5	291.5	291.5	291.5	240.0	245.9	255.7	263.3	273.8	284.0	289.0	0	0	0	0	0	0	0
Med	291.5	291.5	291.5	291.5	291.5	291.5	291.5	240.0	252.8	263.9	280.0	292.0	305.0	312.0	0	0	0	0	0	13	20
Slough, Wyc & Ayles																					
High	192	192.08	192.08	192.08	192.08	192.08	192.1	158.0	158.2	178.0	189.6	199.9	207.0	214.0	0	0	0	0	8	15	22
Low	192	192.08	192.08	192.08	192.08	192.08	192.1	158.0	144.5	138.1	142.3	147.5	153.0	156.0	0	0	0	0	0	0	0
Med	192	192.08	192.08	192.08	192.08	192.08	192.1	158.0	155.6	152.2	153.3	159.0	166.0	170.0	0	0	0	0	0	0	0
London																					
High	2126	2126	2126	2126	2126	2126	2126	2113.0	2219.0	2313.0	2423.9	2536.0	2612.0	2678.0	0	94	188	298	411	487	553
Low	2126	2126	2126	2126	2126	2126	2126	2113.0	1910.0	1817.9	1843.9	1894.6	1950.0	1972.0	0	0	0	0	0	0	0
Med	2126	2126	2126	2126	2126	2126	2126	2113.0	2054.4	1991.0	1987.0	2053.0	2124.0	2161.0	0	0	0	0	0	0	36
Guildford																					
High	65.3	65.3	65.3	65.3	65.3	65.3	65.3	48.0	50.2	52.3	54.2	56.8	58.0	59.0	0	0	0	0	0	0	0
Low	65.3	65.3	65.3	65.3	65.3	65.3	65.3	48.0	42.7	42.6	43.0	44.1	45.3	45.3	0	0	0	0	0	0	0
Med	65.3	65.3	65.3	65.3	65.3	65.3	65.3	48.0	46.1	44.6	46.3	47.7	49.0	49.0	0	0	0	0	0	0	0
Reading																					
High	256.91	256.91	256.91	256.91	256.91	256.91	256.9	179.0	190.1	202.0	213.2	224.7	234.0	242.0	0	0	0	0	0	0	0
Low	256.91	256.91	256.91	256.91	256.91	256.91	256.9	179.0	162.4	162.2	165.6	171.4	179.0	183.0	0	0	0	0	0	0	0
Med	256.91	256.91	256.91	256.91	256.91	256.91	256.9	179.0	175.3	172.0	178.0	185.0	194.0	199.0	0	0	0	0	0	0	0

SUPPORTING INFORMATION

Local Schemes included in existing sources

Scheme	M/d
Thames side GW Harpsden (TWU(R))	10
Thames side GW Reading (TWU(R))	20
Thames side GW Remenham (TWU(SWA))	5
Thames side GW West Marlow (TWA(SWA))	10
Rising GW London (London)	30
Artificial recharge North (London)	90
Artificial recharge South (London)	90
Thames side GW Remenham (TWU(R))	5
TOTAL	260

Environmental cutbacks (M/d)

Pang (Thames West)	9
(included in existing yield)	
Darent (London)	30
(included in existing yield)	
Misbourne (Slough, Wyc & Ayles)	8

Existing yields (M/d)		Total planned yield (M/d)	Yield less contingency Factor: 0.975
TWU(OS)	299.0	299.0	291.53
TWU(SWA)	190	197	192.08
TWU(L)	1970	2180	2125.5
TWU(G)	67	67	65.325
TWU(R)	228.5	263.5	258.91

MARGINAL DEMANDS CALCULATION

REGION: Thames

DEMAND CENTRE	YIELDS OF EXISTING AND PLANNED SOURCES (M/d)							TOTAL DEMANDS (M/d)							MARGINAL DEMANDS (M/d)						
	1991	1996	2001	2006	2011	2016	2021	1991	1996	2001	2006	2011	2016	2021	1991	1996	2001	2006	2011	2016	2021
East Surrey																					
High	129.7	129.7	129.7	129.7	129.7	129.7	129.7	108.0	114.0	119.0	121.0	123.0	126.0	128.0	0	0	0	0	0	0	0
Low	129.7	129.7	129.7	129.7	129.7	129.7	129.7	108.0	102.0	102.0	101.0	102.0	103.0	104.0	0	0	0	0	0	0	0
Med	129.7	129.7	129.7	129.7	129.7	129.7	129.7	108.0	106.0	107.0	109.0	110.0	111.0	113.0	0	0	0	0	0	0	0
North Surrey																					
High	176.48	176.48	176.48	176.48	176.48	176.48	176.48	139.0	142.0	148.0	155.0	163.0	169.0	172.0	0	0	0	0	0	0	0
Low	176.48	176.48	176.48	176.48	176.48	176.48	176.48	139.0	127.0	129.0	130.0	134.0	139.0	141.0	0	0	0	0	0	0	0
Med	176.48	176.48	176.48	176.48	176.48	176.48	176.48	139.0	131.0	135.0	140.0	145.0	150.0	153.0	0	0	0	0	0	0	0
Sutton District																					
High	67.3	67.3	67.3	67.3	67.3	67.3	67.3	66.0	69.0	72.0	76.0	79.0	81.0	81.0	0	2	5	9	12	14	14
Low	67.3	67.3	67.3	67.3	67.3	67.3	67.3	66.0	66.0	67.0	68.0	70.0	72.0	72.0	0	0	0	1	3	5	5
Med	67.3	67.3	67.3	67.3	67.3	67.3	67.3	66.0	68.0	70.0	72.0	75.0	77.0	77.0	0	1	3	5	8	10	10
Mid Southern																					
High	295.43	295.43	295.43	295.43	295.43	295.43	295.43	222.0	237.0	250.0	264.0	277.0	284.0	292.0	0	0	0	0	0	0	0
Low	295.43	295.43	295.43	295.43	295.43	295.43	295.43	222.0	206.0	205.0	209.0	217.0	223.0	227.0	0	0	0	0	0	0	0
Med	295.43	295.43	295.43	295.43	295.43	295.43	295.43	222.0	220.0	216.0	224.0	233.0	240.0	245.0	0	0	0	0	0	0	0
Three Valleys																					
High	854.1	854.1	897.98	897.98	897.98	897.98	897.98	702.0	738.0	774.0	809.0	846.0	876.0	892.0	0	0	0	0	0	0	0
Low	854.1	854.1	897.98	897.98	897.98	897.98	897.98	702.0	632.0	639.0	648.0	666.0	688.0	702.0	0	0	0	0	0	0	0
Med	854.1	854.1	897.98	897.98	897.98	897.98	897.98	702.0	682.0	674.0	696.0	717.0	741.0	758.0	0	0	0	0	0	0	0

SUPPORTING INFORMATION

Local Schemes included in existing sources

Scheme	M/d
Increase in existing supply from Grafham (TVW by 2001)	45
TOTAL (by 1996)	45

Environmental cutbacks (M/d)

Ver (Three Valleys)	12
Misbourne (Three Valleys)	8

Existing yields (M/d)

ESW	133.0
NSW	181
SDW	69
MSW	303
TVW	896

Total planned yield

133.0
181
69
303
921

Yield less contingency
Factor: 0.975

129.68
176.48
67.275
295.43
897.98

Bulk supply and other commitments (M/d)

None

MARGINAL DEMANDS CALCULATION

REGION: Welsh

DEMAND CENTRE	YIELDS OF EXISTING AND PLANNED SOURCES (M/d)							TOTAL DEMANDS (M/d)							MARGINAL DEMANDS (M/d)						
	1991	1996	2001	2006	2011	2016	2021	1991	1996	2001	2006	2011	2016	2021	1991	1996	2001	2006	2011	2016	2021
Chester																					
High	44.9	44.9	44.9	44.9	44.9	44.9	44.9	30.0	32.0	34.0	37.0	40.0	43.0	45.0	0	0	0	0	0	0	0
Low	44.9	44.9	44.9	44.9	44.9	44.9	44.9	30.0	31.0	33.0	35.0	37.0	39.0	41.0	0	0	0	0	0	0	0
Med	44.9	44.9	44.9	44.9	44.9	44.9	44.9	30.0	31.0	33.0	35.0	38.0	40.0	42.0	0	0	0	0	0	0	0
Wrexham																					
High	61.718	61.718	61.718	61.718	61.718	61.718	61.718	45.0	47.0	50.0	53.0	56.0	60.0	62.0	0	0	0	0	0	0	0
Low	61.718	61.718	61.718	61.718	61.718	61.718	61.718	45.0	46.0	48.0	50.0	52.0	54.0	57.0	0	0	0	0	0	0	0
Med	61.718	61.718	61.718	61.718	61.718	61.718	61.718	45.0	47.0	49.0	51.0	54.0	56.0	59.0	0	0	0	0	0	0	0
DC NE Wales																					
High	92.82	92.82	92.82	92.82	92.82	92.82	92.82	50.7	50.8	51.6	53.8	56.0	58.1	60.0	0	0	0	0	0	0	0
Low	92.82	92.82	92.82	92.82	92.82	92.82	92.82	50.7	46.7	44.8	45.8	46.9	48.0	48.9	0	0	0	0	0	0	0
Med	92.82	92.82	92.82	92.82	92.82	92.82	92.82	50.7	49.7	48.7	48.0	49.5	51.0	52.3	0	0	0	0	0	0	0
DC NW Wales																					
High	171.84	171.84	171.84	171.84	171.84	171.84	171.84	124.5	124.8	126.8	131.9	137.4	142.7	147.4	0	0	0	0	0	0	0
Low	171.84	171.84	171.84	171.84	171.84	171.84	171.84	124.5	114.6	110.0	112.5	115.1	117.8	120.0	0	0	0	0	0	0	0
Med	171.84	171.84	171.84	171.84	171.84	171.84	171.84	124.5	122.0	119.6	117.9	121.5	125.1	128.3	0	0	0	0	0	0	0
DC SW Wales																					
High	477.95	477.95	477.95	477.95	477.95	477.95	477.95	352.6	353.2	358.1	370.7	384.0	396.9	408.4	0	0	0	0	0	0	0
Low	477.95	477.95	477.95	477.95	477.95	477.95	477.95	352.6	328.4	317.2	323.2	329.6	336.2	341.7	0	0	0	0	0	0	0
Med	477.95	477.95	477.95	477.95	477.95	477.95	477.95	352.6	346.6	340.5	336.5	345.1	354.0	361.8	0	0	0	0	0	0	0
DC SE Wales																					
High	833.09	833.09	833.09	833.09	833.09	833.09	833.09	695.8	696.9	706.1	730.1	755.2	779.8	801.6	0	0	0	0	0	0	0
Low	833.09	833.09	833.09	833.09	833.09	833.09	833.09	695.8	650.0	628.7	640.2	652.2	664.7	675.1	0	0	0	0	0	0	0
Med	833.09	833.09	833.09	833.09	833.09	833.09	833.09	695.8	684.3	672.9	665.2	681.6	698.5	713.2	0	0	0	0	0	0	0

MARGINAL DEMANDS CALCULATION

SUPPORTING INFORMATION

Local Schemes included in existing sources

Scheme	M/d
Local supplies in Hereford & Radnor (DCSE)	20
Local supplies in north Dyfed area (DCSW)	10
Local supplies in Merionnydd (DCNW)	20
LLyn Celyn (DCNE)	20
Dee developments (Chester)	10
Dee developments (Wrexham)	11
Brianne phase II (DCSE)	127
TOTAL	218

Environmental cutbacks (M/d)

ALFClywedog (Wrexham) 1.7

Other Cutbacks (M/d)

Reduction of sources <2 M/d - DCNW 16.75

Reduction of sources <2 M/d - DCNE 14.6

Reduction of sources <2 M/d - DCSW 13

Reduction of sources <2 M/d - DCSE 15.75

Abandoned sources DCSE 39

Abandoned sources DCSW 2

Schwyl decommissioning - DCSW 21.8

Bulk supply and other commitments (M/d)

Great Spring - Industrial DCSE 10.9

Streams to Lisvane - Industrial DCSE 5.5

Cwn Lliedi - Industrial DCSW 4.4

Non potable supply DCSE 103

Non potable supply DCSW 44

Proportion of distribution input in each supply division (From NRA Welsh)

DC NE Wales	0.048
DC NW Wales	0.1178
DC SW Wales	0.2878
DC SE Wales	0.5453

Existing yields (M/d)

Total planned yield (M/d)

Yield less contingency

Factor: 0.975

Chester	36.0	46.0	44.85
Wrexham	54	63.3	61.718
DCNE	89.8	95.2	92.82
DCNW	173	176.3	171.84
DCSW	517	490.2	477.95
DCSE	762.2	854.5	833.09

MARGINAL DEMANDS CALCULATION

REGION: Wessex

DEMAND CENTRE	YIELDS OF EXISTING AND PLANNED SOURCES (MI/d)							TOTAL DEMANDS (MI/d)							MARGINAL DEMANDS (MI/d)						
	1991	1996	2001	2006	2011	2016	2021	1991	1996	2001	2006	2011	2016	2021	1991	1996	2001	2006	2011	2016	2021
Wessex																					
High	440.7	446.8	446.8	500.4	500.4	500.4	500	403	426	452	478	507	538	571	0	0	5	0	7	38	71
Low	440.7	446.8	446.8	500.4	500.4	500.4	500	403	374	357	365	379	396	413	0	0	0	0	0	0	0
Med	440.7	446.8	446.8	500.4	500.4	500.4	500	403	399	396	393	411	431	452	0	0	0	0	0	0	0
Bristol																					
High	360.8	360.8	360.8	360.8	360.8	360.8	361	344.3	360.3	377.3	394.3	409.3	418.3	427.3	0	0	17	34	49	58	67
Low	360.8	360.8	360.8	360.8	360.8	360.8	361	344.3	353.3	358.3	362.3	372.3	377.3	380.3	0	0	0	2	12	17	20
Med	360.8	360.8	360.8	360.8	360.8	360.8	361	344.3	355.3	367.3	378.3	390.3	397.3	403.3	0	0	7	18	30	37	43
Bournemouth WH																					
High	221.3	221.3	221.3	221.3	221.3	221.3	221	154	161	169	177	182	186	191	0	0	0	0	0	0	0
Low	221.3	221.3	221.3	221.3	221.3	221.3	221	154	157	159	160	162	163	164	0	0	0	0	0	0	0
Med	221.3	221.3	221.3	221.3	221.3	221.3	221	154	159	164	169	172	175	178	0	0	0	0	0	0	0
Cholderton																					
High	0.751	0.751	0.751	0.751	0.751	0.751	0.75	0.6	0.61	0.61	0.62	0.63	0.63	0.63	0	0	0	0	0	0	0
Low	0.751	0.751	0.751	0.751	0.751	0.751	0.75	0.6	0.64	0.48	0.43	0.37	0.33	0.34	0	0	0	0	0	0	0
Med	0.751	0.751	0.751	0.751	0.751	0.751	0.75	0.6	0.57	0.54	0.52	0.49	0.47	0.44	0	0	0	0	0	0	0

SUPPORTING INFORMATION

Local Schemes included in existing sources

Scheme	MI/d
R. Avon at Bath WxW (by 2006)	55
Wimbleball WxW (by 1996)	10
Bristol Shropshire GW	0
TOTAL (by 2006)	65

Environmental cutbacks (MI/d)

Piddle @ Alton Pancras	3.7
(WxW)	
(From 1996)	

Existing yields (MI/d)

WxW	452
BWW	370
CDWC	0.77
BDWH	227

Total planned yield (MI/d)

513.3
370
0.77
227

Yield less contingency
Factor: 0.975

500.4
360.8
0.751
221.3

Bulk supply and other commitments (MI/d)

Bristol Water supply to ICI at Avonmouth	23
Bristol Water bulk supply to WxW	11.3

Note: In the strategy document Shropshire GW is included as a local option with a value of 55 MI/d. This is because RESPLAN treats Shropshire GW as a local option.

MARGINAL DEMANDS CALCULATION

REGION: Yorkshire

DEMAND CENTRE	YIELDS OF EXISTING AND PLANNED SOURCES (M/d)							TOTAL DEMANDS (M/d)							MARGINAL DEMANDS (M/d)						
	1991	1996	2001	2006	2011	2016	2021	1991	1996	2001	2006	2011	2016	2021	1991	1996	2001	2006	2011	2016	2021
Yorkshire Water																					
High	1528.8	1528.8	1816.4	1816.4	1816.4	1816.4	1816.4	1458	1507	1558	1613	1670	1729	1790	0	0	0	0	0	0	0
Low	1528.8	1528.8	1816.4	1816.4	1816.4	1816.4	1816.4	1458	1326	1348	1371	1394	1422	1451	0	0	0	0	0	0	0
Med	1528.8	1528.8	1816.4	1816.4	1816.4	1816.4	1816.4	1458	1404	1406	1441	1477	1517	1558	0	0	0	0	0	0	0
York Waterworks																					
High	93.6	93.6	93.6	93.6	93.6	93.6	93.6	48	51	54	57	60	64	66	0	0	0	0	0	0	0
Low	93.6	93.6	93.6	93.6	93.6	93.6	93.6	48	50	52	54	56	58	60	0	0	0	0	0	0	0
Med	93.6	93.6	93.6	93.6	93.6	93.6	93.6	48	50	52	55	57	60	63	0	0	0	0	0	0	0

SUPPORTING INFORMATION

Local Schemes included in existing sources

Scheme	M/d
Local Groundwater Developments (YW)	20
Groundwater developments - York (YW)	35
River Ouse Licence Changes (YW)	30
River Aire (YW)	50
Washburn Valley (YW)	50
Operational changes	50
Tees transfer from Kielder	60
TOTAL	295

Environmental cutbacks (M/d)

None

Existing yields (M/d)

YW	1568
YWS	96

Total planned yield (M/d)

1863
96

Yield less contingency
Factor: 0.975

1816.4
93.6

Bulk supply and other commitments (M/d)

None

ANNEX 2

WATER RESOURCES PROJECT MANAGEMENT

MARGINAL DEMAND AUDIT

1 INTRODUCTION

Marginal demands calculations have been undertaken by NRA-HQ, for each NRA Region (Ref 1) to forecast the deficits in yield under three demand scenarios for each water company and, in certain cases, zones within water companies.

Data for the calculations originate from various sources including:

- "Methodology and assumptions for Public Water Supply Demand Scenarios" NRA-HQ October 1993. (Ref 2);
- "Water resources Strategy Review of Public Water Supply Source Yields" Halcrow Draft Report, April 1993 (Ref 3);
- June 1993 "Water Company Consultation Paper" (Ref 4);
- Correspondence between NRA Regions and NRA-HQ.

A spreadsheet computer program has been used to calculate the marginal demands for each water company or zone of a water company.

OBJECTIVES

The purpose of the audit was to:

- 1) Check the source data;
- 2) Check that transcription errors have not occurred between the source documents and the spreadsheet;
- 3) Check the methodology used within the spreadsheet to calculate the marginal demands.

NRA regions whose marginal demands will have a particular bearing upon the RESPLAN study were examined to a greater level of detail than others. These regions include Anglian, North West, Severn Trent, Southern, Thames and Wessex.

In certain cases, audit trails only led as far as information sent from NRA Regions. To check this information further would require auditing each region separately.

METHODOLOGY

The audit was broken down into the following areas:

- a) Existing yield data;
- b) Demand forecast data;
- c) Local schemes, bulk supplies to industry, transfers and yield cutbacks (due either to environmental or operational reasons);
- d) The method of calculation.

Comments on the marginal demand calculations are provided for each NRA region and on the calculations as a whole. These comments were then discussed at a meeting between Mark Sitton of NRA-HQ and Brian Darling of Halcrow on the 1 December 1993. The following audit report details the comments made and the appropriate response required. The responses fall into three categories as shown below:

Category	Response
(i)	Significant action
(ii)	Insignificant action
(iii)	No change

NOTE: In (i) and (ii) above the difference between a significant and insignificant action is whether the action will impact the final marginal demands figures. Actions which are insignificant are still important but may involve a cosmetic change to the tables to make them clearer rather than a change to the final numbers. Other insignificant actions may regard changes to other documents such as the Halcrow yield tables (Ref 5).

AUDIT FINDINGS

In most cases the findings of the audit will make little difference to the final marginal demand figures. Most of the findings relate to the way the information is presented in the spreadsheet and the information supporting the calculations.

Findings which will change, or could potentially change, the final marginal demands have been labelled as category (I) in the response section for easy reference.

Findings which relate to the marginal demand calculations in general are outlined in Table 1. Those which relate to specific NRA Regions are listed under each individual region in Table 2.

Table 1

GENERAL AUDIT FINDINGS

WATER RESOURCES PROJECT MANAGEMENT - MARGINAL DEMAND CALCULATIONS AUDIT			
NO	FINDING	RESPONSE	ACTION
1	For many regions the complete list of potential local schemes has been included for the marginal demand calculations regardless of how promotable the scheme is perceived to be.	(i) Significant Action. It is suggested that a run of RESPLAN is undertaken assuming marginal demands based on a reduced contribution from local schemes.	NRA-HQ
2	For many regions the calculations assume that the local schemes or transfer works can be constructed immediately regardless of planning horizons.	(i) Significant Action. The Local Schemes should be classified into time scales of possible promotion and new marginal demands derived for use in a sensitivity analysis.	NRA-HQ
3	The definition of what is included in Distribution Input has a significant impact on the way bulk supply demands from industry are dealt with.	(ii) Insignificant Action. The OFWAT definition of Distribution Input (DI) includes all potable water distributed by a water company. Certain bulk supplies to industry such as Fawley Oil Refinery in the Wessex Region have been included in the DI, where it could be argued that the water is not of potable standard. These anomalies need to be identified and accounted for.	

WATER RESOURCES PROJECT MANAGEMENT - MARGINAL DEMAND CALCULATIONS AUDIT			
NO	FINDING	RESPONSE	ACTION
4	The format of the calculations change between region. In particular, the meaning of bulk supplies differs between regions. In some cases it means an industrial transfer which is only added to the demand figures, whereas in others it relates to an inter-company transfer which is added and subtracted from yield figures.	(II) Insignificant Action. Define more clearly what is meant by bulk supplies.	NRA-HQ
5	Inter-zonal transfers are assumed in certain regions such as Southern and Severn Trent but not in others such as Thames.	(III) No change. Deficits in the Thames region are assumed to be met by the strategic schemes assigned by RESPLAN.	
6	There are minor discrepancies of about + or - 2 Ml/d in the final marginal demand figures.	(III) No change. This is considered to be sufficiently accurate.	

Table 2

REGIONAL AUDIT FINDINGS

WATER RESOURCES PROJECT MANAGEMENT - MARGINAL DEMAND CALCULATIONS AUDIT			
NO	FINDING	RESPONSE	ACTION
ANGLIAN REGION			
1	The existing yield figures for Anglian Water Services (AWS) and Essex Water Company each differ by 2 MI/d from the yields quoted in the latest Halcrow yield tables (Ref 5)	(ii) Insignificant Action. The 2 MI/d difference is within the accuracy limits of the study. However, Halcrow should update the yield tables for consistency.	Halcrow
2	The local schemes for Anglian Region include 40 MI/d increased abstraction from chalk. Is this included in the original yield figures provided by NRA Anglian Region?	(iii) No change. No, the 40 MI/d yield is additional to the existing yield figures provided.	
3	The total planned yield figure for Anglian Water Services should be 1643 MI/d rather than 1607 MI/d. 1643 MI/d includes the additional yield from the Trent of 36 MI/d.	(ii) Insignificant Action. Total planned yield figure to be corrected. However, calculations actually used the correct figure so this has no impact on final marginal demands.	NRA-HQ
NORTHUMBRIA REGION			
1	North East Water (NEW) provides a 38 MI/d bulk supply to Northumbrian Water. The 38 MI/d is included as a demand on North East Water but is not added to Northumbrian Water's yield figure.	(i) Significant Action. M Sitton to ring D. Archer to check where the 38 MI/d goes.	NRA-HQ
2	The 13 MI/d Unallocated Kielder Local Scheme for NEW is the additional amount of Kielder surplus required by NEW by 2021.	(iii) No change	
NORTH WEST REGION			
1	Constraining the SCZ boreholes from 239 MI/d to 171 MI/d is open to question.	(iii) No change. The 171 MI/d has been used by NRA-North West Region for the MOSPA modelling and is therefore assumed to be reasonable.	

WATER RESOURCES PROJECT MANAGEMENT - MARGINAL DEMAND CALCULATIONS AUDIT			
NO	FINDING	RESPONSE	ACTION
2	Why is the 80 MI/d bulk supply from the River Dee added to the RR zone demand figures rather than the SCZ figures?	(iii) No change. The 80 MI/d Industrial demand has been included in the RR zone on purpose to remove the 80 MI/d bulk supply from the redeployment equation. An equivalent yield has been included in the RR zone to cover this demand.	
3	The LCUS increase in yield by 80 MI/d is in considerable doubt since the existing level of abstraction is already leading to environmental problems.	(iii) No change. NRA propose no change. However, it is suggested that this should be considered further - it is a specific example of the first point raised in Table 1.	
SEVERN TRENT REGION			
1	Discrepancies occur between the existing yield figures adopted for each Severn Trent zone and those given in the latest Halcrow yield tables (Ref 5).	(ii) Insignificant Action. Halcrow to update the existing yield tables to conform with the latest Severn Trent information.	Halcrow
2	The 2.5% outage allowance is not deducted from the 1991 Severn Trent yield figures, as is done for other regions.	(iii) No change. Outage is not included for 1991, because the data is now historic and it is therefore unrepresentative of reality to have a marginal demand which never occurred.	
3	What does S and C stand for in the Local Scheme Table?	(iii) No change. S = Shropshire Groundwater Scheme C = Carsington Reservoir deployment of yield.	

WATER RESOURCES PROJECT MANAGEMENT - MARGINAL DEMAND CALCULATIONS AUDIT			
NO	FINDING	RESPONSE	ACTION
4	There is an addition error on year 2021 column of the AMP2 and lost yield reductions tables. It reads 65.01 instead of 175.01.	(ii) Insignificant change. Table to be corrected.	NRA-HQ
SOUTHERN REGION			
1	Proposed yield figures are adjusted from the existing yields by transfers between water companies and water company zones. These transfers are entered under 'Bulk supply and other commitments' and balance the surpluses and deficits within the region.	(iii) No change.	
2	The transfers in 1) above assume that water companies with surpluses co-operate in supplying transfers to neighbouring water companies with deficits.	(iii) No change This assumption is made following initial negotiations within the Southern Region.	
3	The promotability and time scale of promotion of certain local schemes is in doubt. The Halcrow Yield Report (Ref 3) comments that Local Groundwater for Mid Kent Water Company is unlikely to be approved for development and that Havant Thickett and Chillerton Reservoirs would not be developed before 2021.	(iii) No change. A sensitivity analysis is thought necessary to test RESPLAN for marginal demands based on a reduced contribution from local schemes. (see General Audit Findings).	
4	The 'High demand scenario' demand figures for Mid Kent Water Company in 2016 and 2021 disagree with the figures given in the 'PWS Demand Scenario Report' (Ref 2).	(i) Error to be corrected.	NRA-HQ
SOUTH WEST REGION			
	No comments.		

WATER RESOURCES PROJECT MANAGEMENT - MARGINAL DEMAND CALCULATIONS AUDIT			
NO	FINDING	RESPONSE	ACTION
THAMES REGION			
1	The demand factors used to derive the proportion of demand within each zone of TWUL are not shown on the spreadsheet.	(iii) No change. Individual demand calculations were undertaken for each zone using the NRA-HQ method as described in Ref 2. The proportion of the total demand was then used to pro-rata the overall demand figures to give the demand in each zone.	
2	If existing yield figures for the London zone are compared with the demands in 1991 a deficit for the zone is shown.	(iii) No change. In reality, historic existing yields were greater due to the 2.5% outage not being required.	
3	Transfers between zones within TWUL would reduce deficits for the 'high' and 'medium' demand scenarios. For example surpluses within the Guilford and Reading zones could offset deficits in the Oxford and Swindon, or London zones.	(iii) No change. The transfer infrastructure is assumed not to exist between zones.	
4	Environmental cutbacks for the Darent and Cray sources have already been included in the yield figures. This should be made clear the Halcrow yield report.	(ii) Insignificant Action. Halcrow to change yield report.	Halcrow

WATER RESOURCES PROJECT MANAGEMENT - MARGINAL DEMAND CALCULATIONS AUDIT			
NO	FINDING	RESPONSE	ACTION
WELSH REGION			
1	Are the new Dee developments for Chester and Wrexham Water Companies already included in the Dee developments for NWW to replace Vyrnwy?	(ii) No change. NWW already have a licence for future Dee abstraction. Dwr Cymru have applied for a licence for the 70 MI/d surplus yield from the Dee, however, the licence has not yet been granted. The 10 and 11 MI/d Dee abstraction Local Schemes for Chester and Wrexham are assumed to be available from the 70 MI/d surplus and are designed to meet forecast deficits.	
WESSEX REGION			
1	The 11.3 MI/d bulk supply from Bristol Water to Wessex Water, is included in the yield figures of both Bristol Water and Wessex Water and as a demand to both Bristol and Wessex Water companies. Hence if the yield or demand figures are taken separately then the 11.3 transfer would be double accounted. Also the 2.5% outage is removed twice from the 11.3 MI/d.	(ii) Insignificant Action. To conform with the accounting method adopted in the Halcrow Yield Report the 11.3 MI/d should not be included in Bristol Water's yield or demand figures.	NRA-HQ
2	The existing yield figures used are different to the latest Halcrow yield tables.	(ii) Insignificant Action. Halcrow to alter the yield tables so that they conform with the latest yield information provided by NRA Wessex Region.	Halcrow
3	Bournemouth and West Hants Water Company industrial supply to Fawley Oil Refinery has not been included as a bulk supply in the marginal demand calculations.	(iii) No change. The supply to Fawley has been included in the Distribution Input by Bournemouth and West Hants Water Company and therefore is included in the PWS demands.	

WATER RESOURCES PROJECT MANAGEMENT - MARGINAL DEMAND CALCULATIONS AUDIT			
NO	FINDING	RESPONSE	ACTION
YORKSHIRE REGION			
1	The existing yield figures used are different to the latest Halcrow yield tables.	(I) Significant Action. The existing yield figures for the Yorkshire Region may change. The Marginal Demand Calculations and the latest Halcrow yield tables should be updated when new yield data is received from NRA Yorkshire Region.	NRA-HQ Halcrow
2	The Washburn Valley and Operational Changes Local Schemes each have a yield of 50 MI/d in the Marginal Demand Calculations. These have both been estimated to have a yield of 32 MI/d each in the Halcrow Water Resources Study of the Yorkshire Region.	(I) Significant Action. NRA Yorkshire Region to be consulted to obtain the correct yield figures for these schemes.	NRA-HQ
3	The environmental cutbacks for the Selby Boreholes and Derwent Agreement of 40 MI/d until 2001 should be noted under the environmental cutback section.	(II) Insignificant Action. A note of explanation is to be added to the marginal demand calculations.	NRA-HQ
4	The existing yield figures for Yorkshire Water in 1991 and 1996 do not include the 2.5% outage contingency.	(II) Insignificant Action. Yields of Yorkshire Water in 1991 and 1996 are to be altered.	NRA-HQ

RECOMMENDATIONS

The audit findings which require action are indicated in Tables 1 and 2. Findings which have a category (I) in the response column require action before the marginal demand figures can be used for the final RESPLAN runs. Category (II) findings in the response column should be implemented before the reporting stage of the project to ensure the consistency of the calculation tables.

In their present state the calculations on their own could be misinterpreted if used in the future. It is therefore recommended that this audit report is attached to the calculations when filed and that supporting documentation for the calculations is fully referenced.

REFERENCES

- 1) 'Marginal Demand Calculation' Spreadsheet Printouts. NRA-HQ, 17 December 1993 to 11 December 1993.
- 2) 'Methodology and Assumptions for Public Water Supply Demand Scenarios' NRA-HQ, October 1993.
- 3) 'Water Resources Strategy Review of Public Water Supply Source Yields' Halcrow Draft Report, April 1993.
- 4) 'Water Company Consultation Paper' NRA-HQ, June 1993.
- 5) Latest Halcrow yield tables updated with comments from water companies.