Adapting to climate change impacts on water resources in England and Wales

- an assessment of draft Water Resources Management Plans

Matt Charlton and Nigel Arnell

Walker Institute for Climate System Research,
University of Reading

Climate change impacts and adaptation: Dangerous rates of change
University of Exeter, September 22-24th 2008

Research questions

1. How did the companies go about assessing the impact of climate change?

2. What do companies estimate is the magnitude of the climate change problem?

3. How does climate change compare to other resource pressures?

4. How do the companies plan to deal with the estimated impacts of climate change?

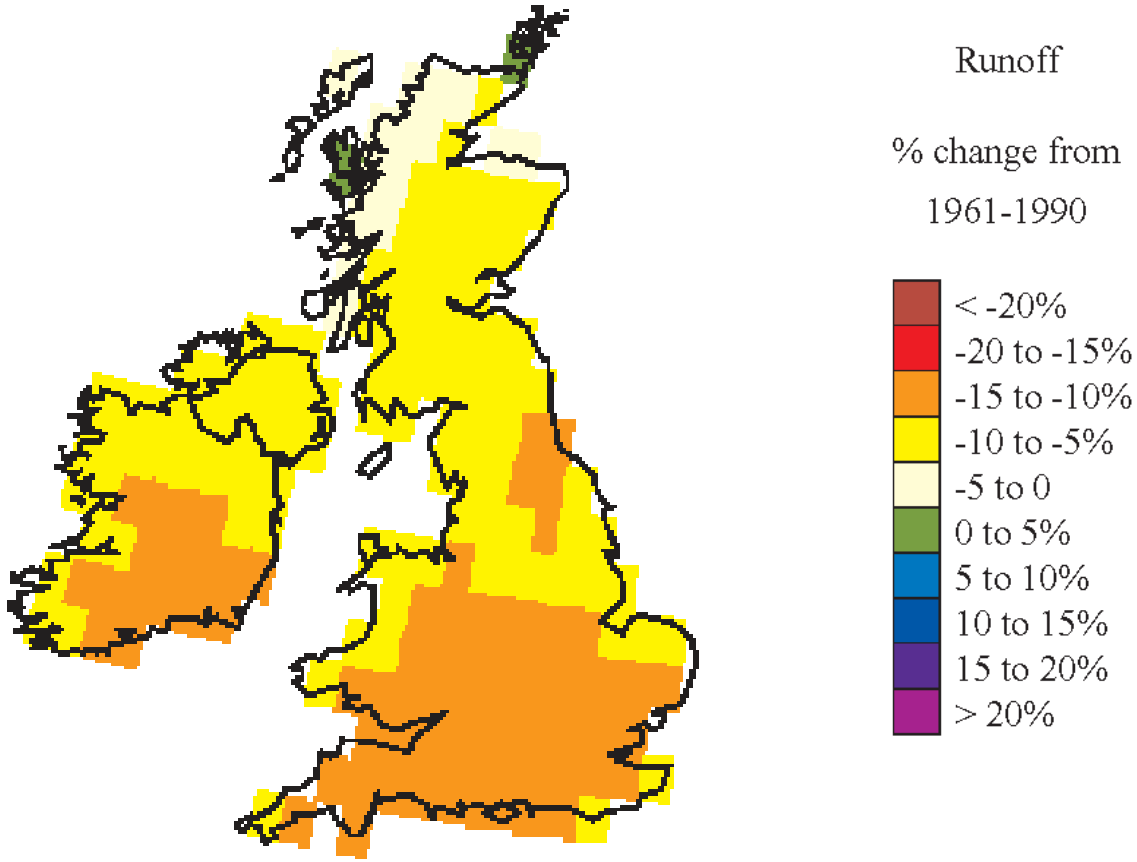
Outline

- Climate change and water resources
- Water resources planning in England and Wales
- Estimates of climate change impact
- Comparison with other resource pressures
- Climate change uncertainty
- Climate change as a driver to adaptation

Climate change and water resources

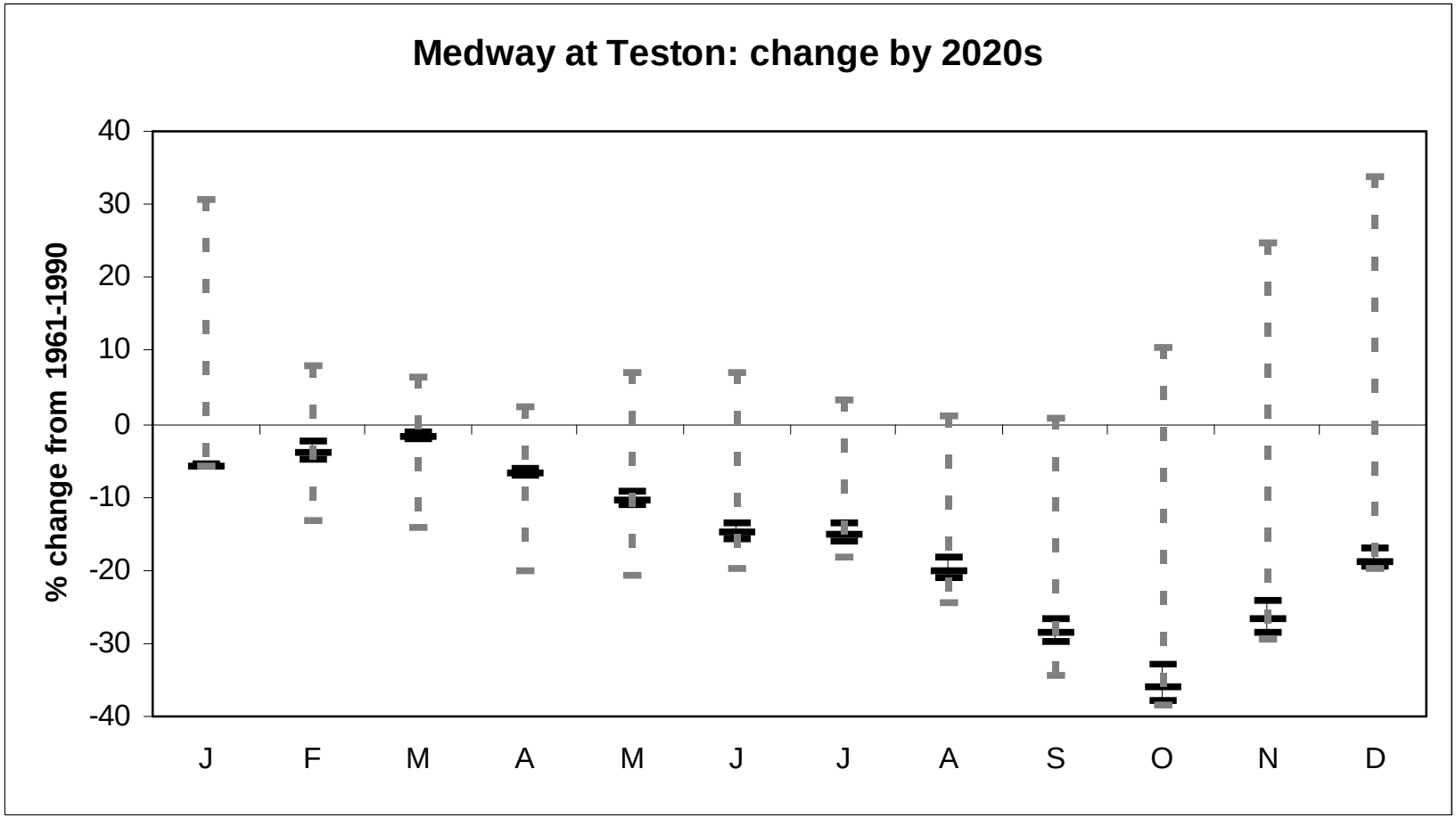
Walker INSTITUTE

Change in summer runoff, UKCIP02 medium-high scenario, 2020s



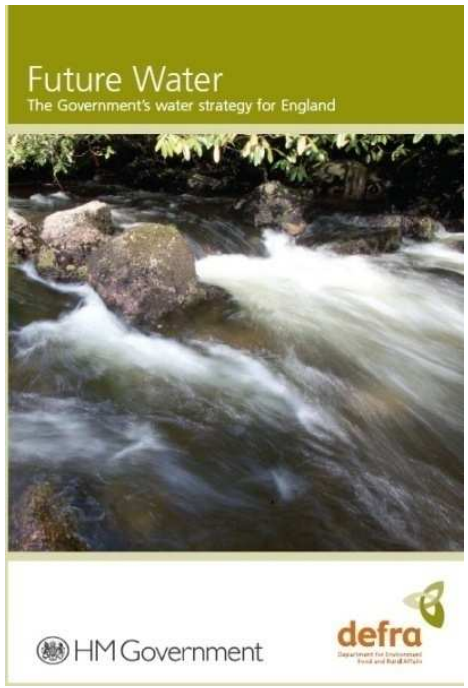
University of Reading

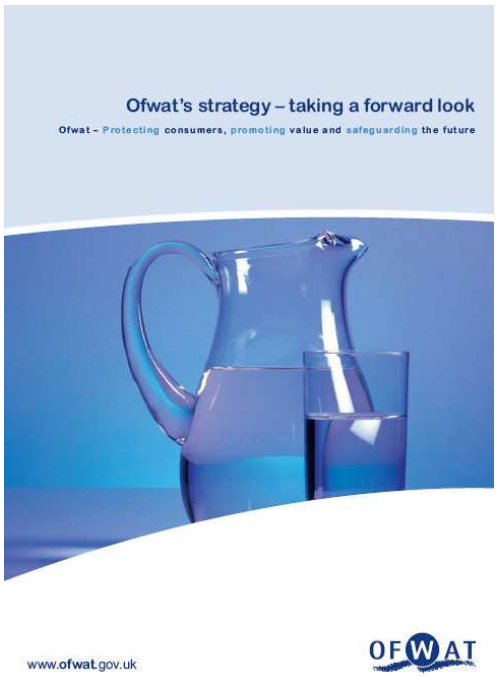
Change in the catchment



Change by the 2020s

Water resources planning





Chapter 8 and supplementary guidance

"A water resources plan shows how a water company intends to maintain the balance between supply and demand for water over the next 25 years."

21 draft Water Resource Management Plans online

Estimates of climate change impact

1. 80 Resource zones

2. Extract ‘own water’ component values from WRP1-BL or WRP1a-BL:

Deployable Output (DO)

Reductions:
Climate change
Sustainability reductions
Others

Operational:
Outage allowance
Process losses

2009/10 2034/35

Table WRP1-BL: Baseline Supply Demand Components

ROV Ref.	DERIVATION	DESCRIPTION	UNITS	Scenario Year 2006-07	2007-08	2008-09	2009-10	2010-11	2011-12	2033-34	2034-35
BASIC RESOURCES BASELINE											
1_{BL}	Input	Deployable Output (Specify individual Source Yields on Table WRP5)	Ml/d	648.46	638.46	644.16	658.46	658.46	658.46	658.46	658.46
2_{BL}	WRP1a-BL $2a_{BL}$	Reductions in Deployable Output	Ml/d	0.00	0.00	0.00	0.00	12.46	15.90	43.33	43.65
3_{BL}	Input	Outage Allowance	Ml/d	19.45	19.45	19.45	19.45	19.45	19.45	19.45	19.45
4_{BL}	$9_{BL}+11_{BL}$	Process Losses	Ml/d	17.21	17.21	17.21	17.21	17.21	17.21	17.21	17.21
5_{BL}	$1_{BL}-(2_{BL}+3_{BL}+4_{BL})$	Water Available For Use (own sources)	Ml/d	611.80	601.80	607.50	621.80	609.34	605.90	578.47	578.15
RAW WATER BASELINE											
6_{BL}	Input	Raw Water Abstracted	Ml/d	639.75	642.68	640.79	619.72	619.94	619.99	636.56	637.61
7_{BL}	WRP1a-BL $7a_{BL}$	Raw Water Exported (existing)	Ml/d	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8_{BL}	WRP1a-BL $8a_{BL}$	Raw Water Imported (existing)	Ml/d	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
9_{BL}	Input	Raw Water Losses and Operational Use	Ml/d	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10_{BL}	WRP1a-BL $10a_{BL}$	Non Potable Supplies (existing)	Ml/d	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20
POTABLE WATER TO POINT OF DELIVERY BASELINE											
11_{BL}	Input	Treatment Works Losses and Operational Use	Ml/d	17.21	17.21	17.21	17.21	17.21	17.21	17.21	17.21
12_{BL}	WRP1a-BL $12a_{BL}$	Potable Water Imported	Ml/d	15.00	15.00	15.00	35.00	35.00	35.00	35.00	35.00
13_{BL}	WRP1a-BL $13a_{BL}$	Potable Water Exported	Ml/d	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
14_{BL}	Input	Distribution Input	Ml/d	637.34	640.27	638.38	637.31	637.53	637.58	654.15	655.20
15_{BL}	Input	Distribution Losses	Ml/d	115.89	115.89	113.89	112.89	112.89	112.89	112.89	112.89
16_{BL}	Input	Distribution System Operational Use	Ml/d	1.33	1.33	1.33	1.33	1.33	1.33	1.33	1.33
17_{BL}	$14_{BL}-15_{BL}-16_{BL}$	Water Delivered	Ml/d	520.12	523.05	523.16	523.09	523.31	523.36	539.93	540.98
POTABLE WATER CUSTOMER USE BASELINE											
18_{BL}	Input	Unmeasured Household - Population	000's	1653.479	1643.038	1616.382	1590.069	1564.571	1539.465	1058.155	1037.842
19_{BL}	Input	Unmeasured Household - Properties	000's	678.820	668.831	658.843	648.854	638.865	628.877	409.125	399.136
20_{BL}	$18_{BL}/19_{BL}$	Unmeasured Household - Occupancy Rate	h/pr	2.44	2.46	2.45	2.45	2.45	2.45	2.59	2.60
21_{BL}	Input	Measured Household - Population	000's	682.115	723.473	757.906	791.813	825.462	858.702	1524.288	1552.066
SUPPLY DEMAND BALANCE BASELINE											
50_{BL}	$5_{BL}+(8_{BL}+12_{BL})-(7_{BL}+13_{BL})$	Total Water Available For Use	Ml/d	626.80	616.80	622.50	656.80	644.34	640.90	613.47	613.15
51_{BL}	Input	Available Headroom	Ml/d	-10.53	-23.47	-15.88	19.49	6.81	3.32	-40.68	-42.05
52_{BL}	Input	Target Headroom	Ml/d	41.13	42.02	41.14	41.18	44.18	45.47	56.67	54.56
53_{BL}	$51_{BL}-52_{BL}$	Supply Demand Balance	Ml/d	-51.66	-65.49	-57.02	-21.70	-37.36	-42.15	-97.35	-96.61

3. Extract other supply-side values and calculate total Water Available for Use:

Raw and potable water imports and exports

Estimates of climate change impact

1. Companies used a range of methods to derive climate change impact estimate (e.g. Flow factor vs. Hydrological modelling)

2. Climate change impact incorporated in four different ways:

No consideration of climate change impacts (7.5% of resource zones (RZs)).

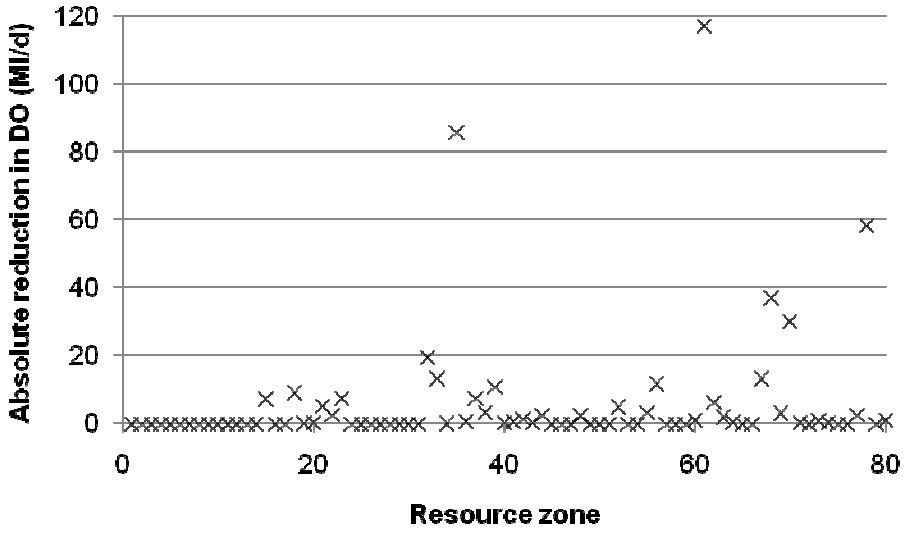
Mid-scenario climate change impact deducted before inclusion in WRP Table 1 and uncertainty included in the Headroom assessment (45% of RZs).

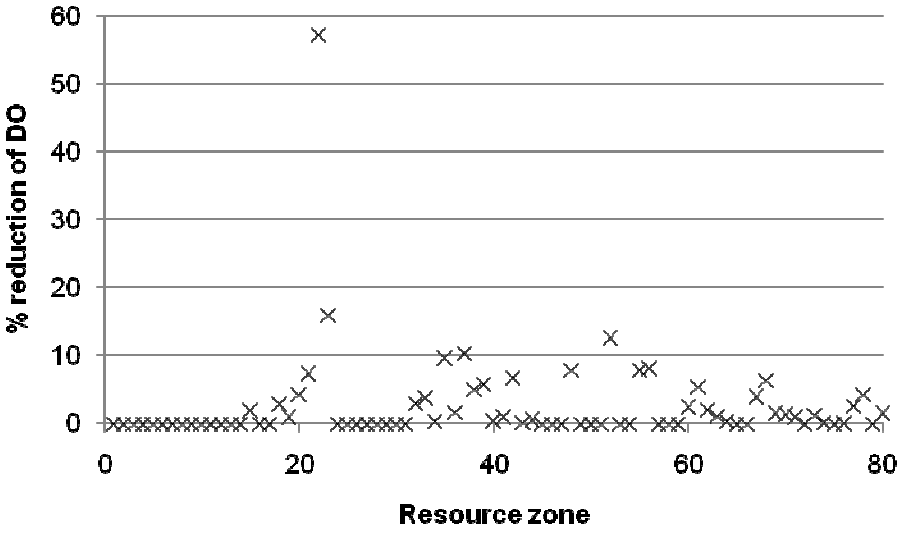
Mid-scenario climate change impact deducted in row 2 of WRP1 and uncertainty included in the Headroom assessment (43.75% of RZs)

Headroom uncertainty only (3.75% of RZs)

3. Guidance ambiguous?

Estimates of climate change impact





Variability of impact:

Geographic location
Dominant source type
Temporal aspects
Data and modelling
Existing infrastructure

Issues:

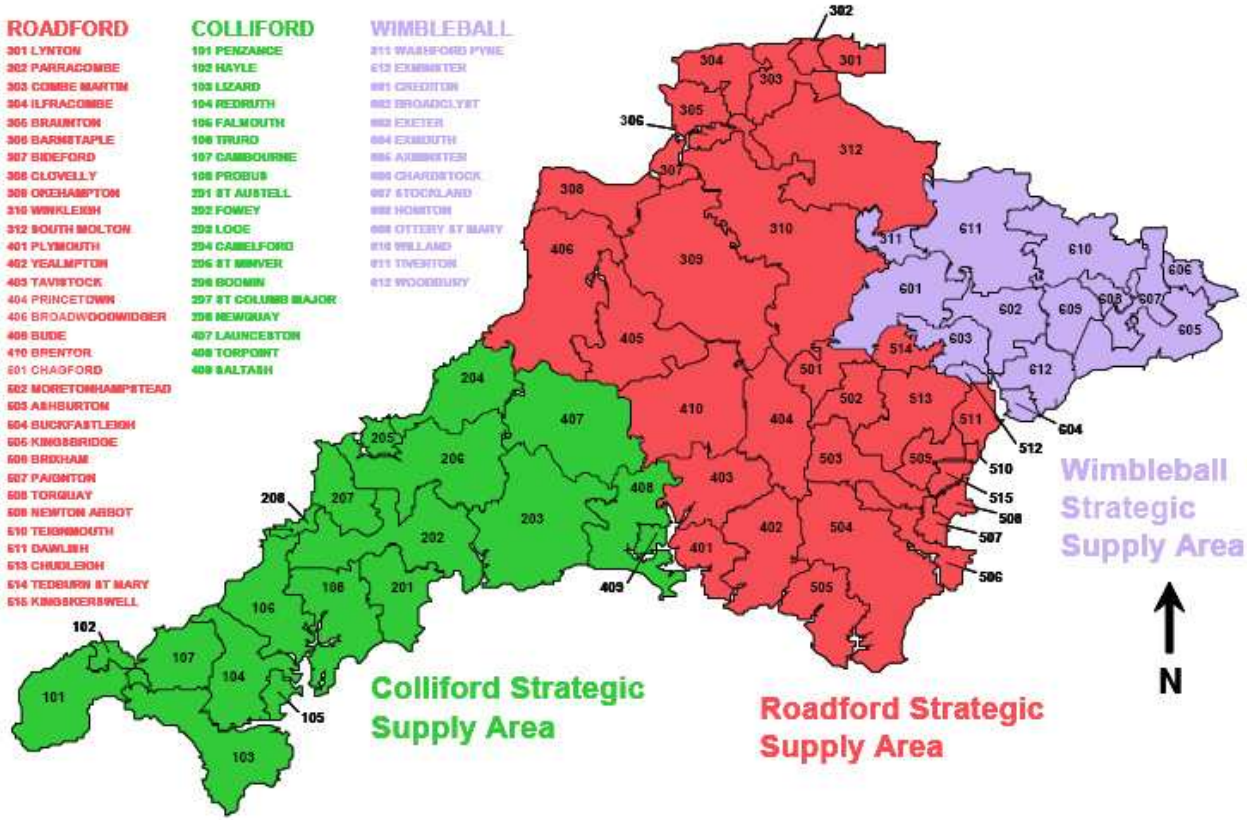
What constitutes a significant impact?
Asymmetrical loss function.

Estimates of climate change impact

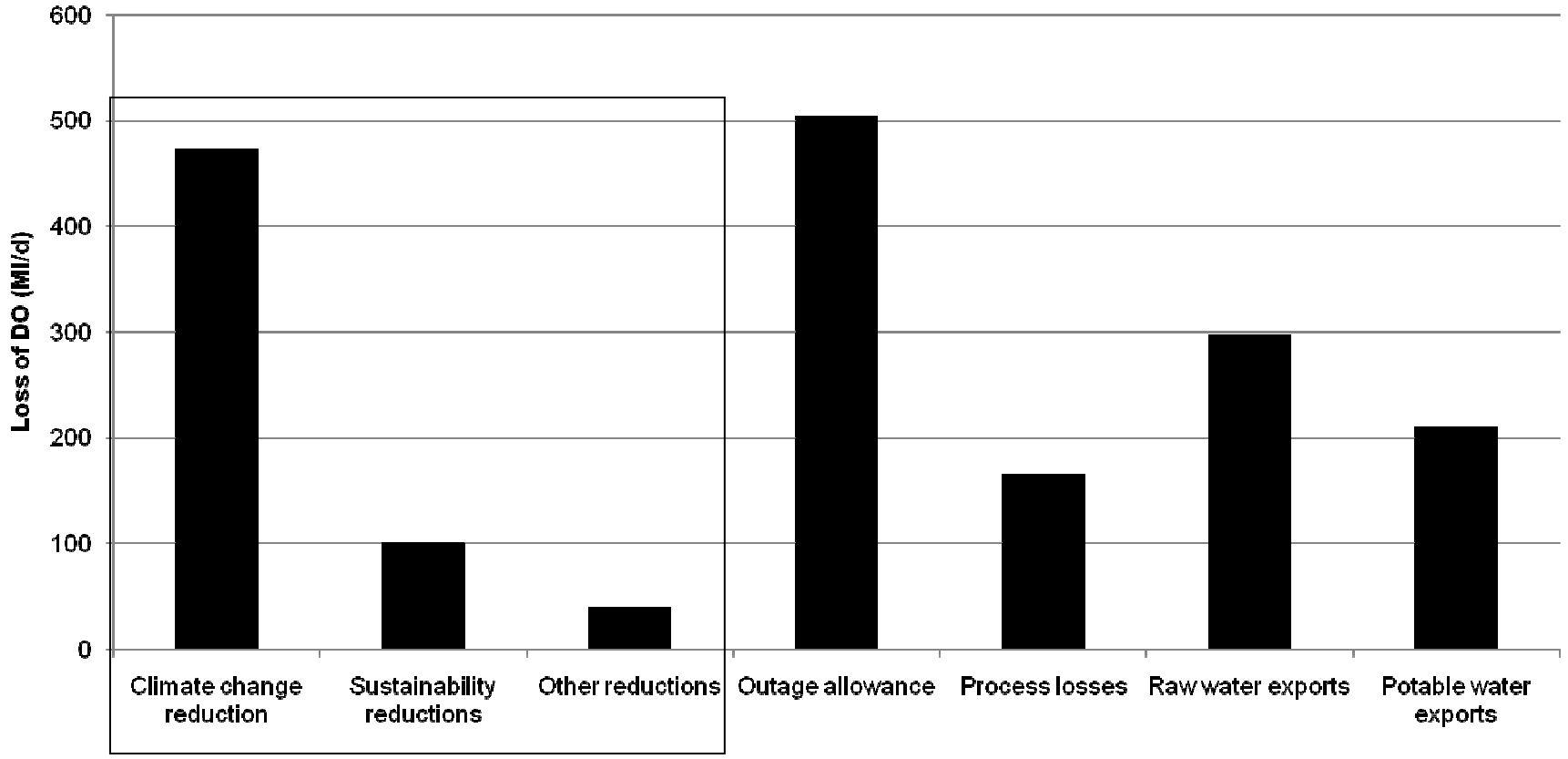
National loss in DO due to climate change by 2034/35:

498 Ml/d (~3%)

Figure 1.1: South West Water Strategic Supply Areas and WIS Zones

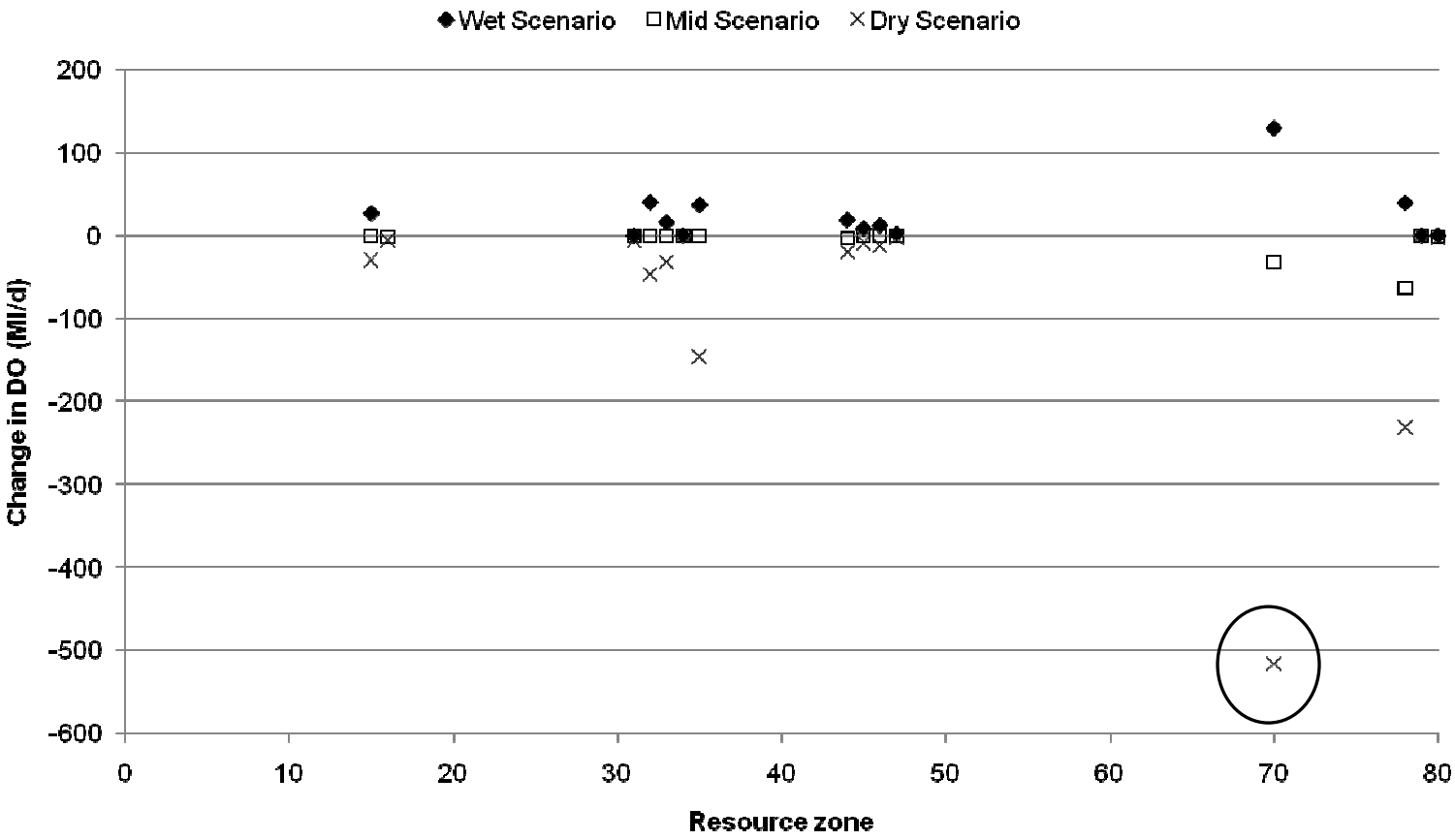


Comparison of resource impacts



Nationally, climate change has the greatest impact on DO when compared against other supply-side reductions

Climate change uncertainty



Although the data are limited, resource zone level uncertainty can equal the total national loss of DO

Adapting to climate change

Three options:

- Climate change has no planning implications
- Climate change needs to be explicitly considered
- Climate change is considered amidst the range of drivers

Important considerations:

- Timing of adaptation
- Preferred supply-side option (reservoirs)
- Limitation / barriers to adaptation
- Uncertainty of climate change impacts and other sources of reductions

Summary

- Differences exist in the approaches adopted to assess the impact of climate change
- Climate change impacts can be very large and are subject to considerable variability and uncertainty
- These impacts are greater than most other pressures on water availability
- In general, climate change impacts and their uncertainty are considered in adaptation strategies along with other pressures

Walker INSTITUTE

Thank you

www.walker-institute.ac.uk

University of Reading