

Preparing for the impacts of floods and droughts

Professor Jim Hall FREng

24th April 2013

Adaptation Sub-Committee

How well prepared is the
UK for climate change?

Adaptation Sub-Committee
September 2010

Adapting to climate change
in the UK
Measuring progress

Adaptation Sub-Committee
Progress Report 2011

Climate change – is the
UK preparing for flooding
and water scarcity?

Adaptation Sub-Committee
Progress Report 2012



Lord John Krebs
Chairman



Sir Graham
Wynne



Dr Sam
Fankhauser

Prof Martin
Parry

Prof Jim Hall

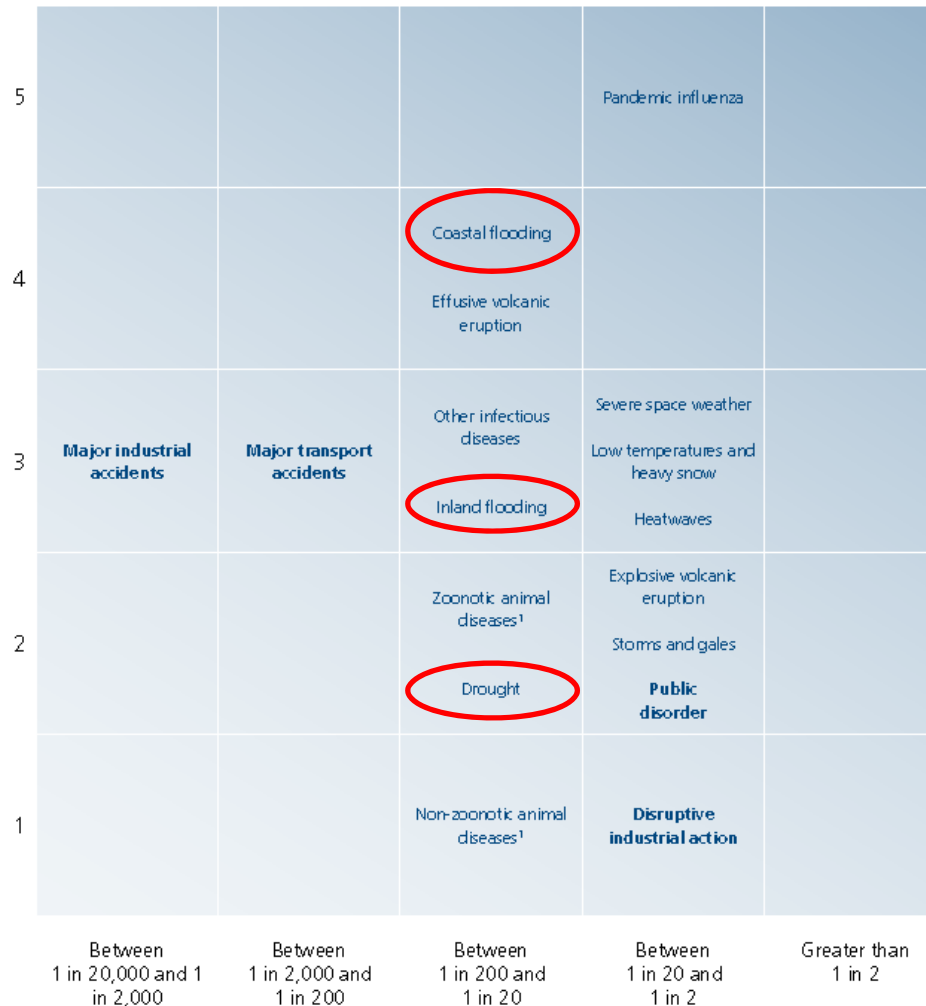
Prof Anne
Johnson



Established by Climate Change Act:

- **advise on** preparedness of UK for climate change
- **monitor** progress in adaptation

Figure 2: Risks of natural hazards and major accidents



Responding to flood risk

Reducing flood waters: flood abatement
Keeping the water out of harms' way:

- Flood storage
- Flood conveyance
- Flood defence

Reducing the damage potential

- Land use planning
- Property-level protection
- Flood warning and evacuation

Enabling recovery from damaging floods

- Insurance



Reducing runoff in urban areas: SuDS

Figure 2.8: Change in area of permeable and impermeable surfaces for urban areas in England (2001 to 2011)

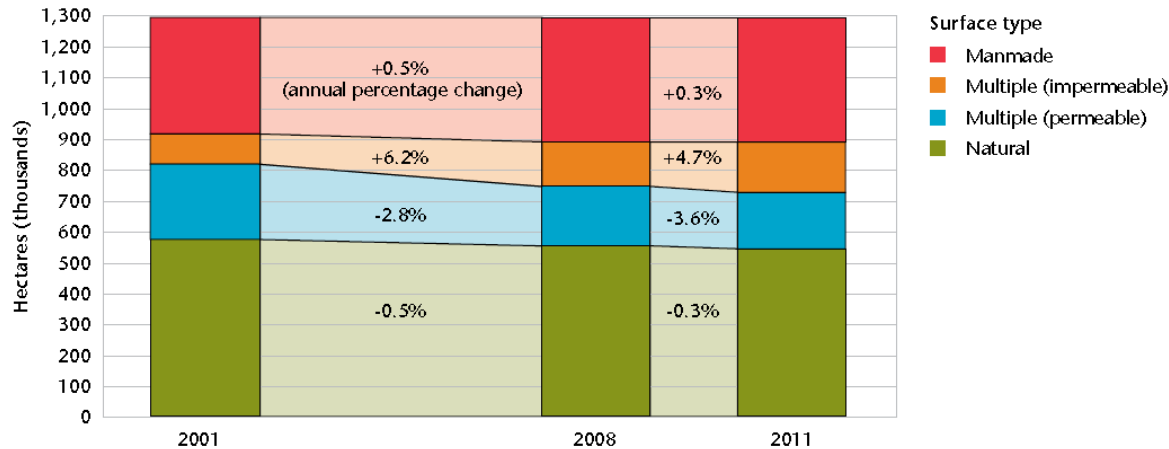
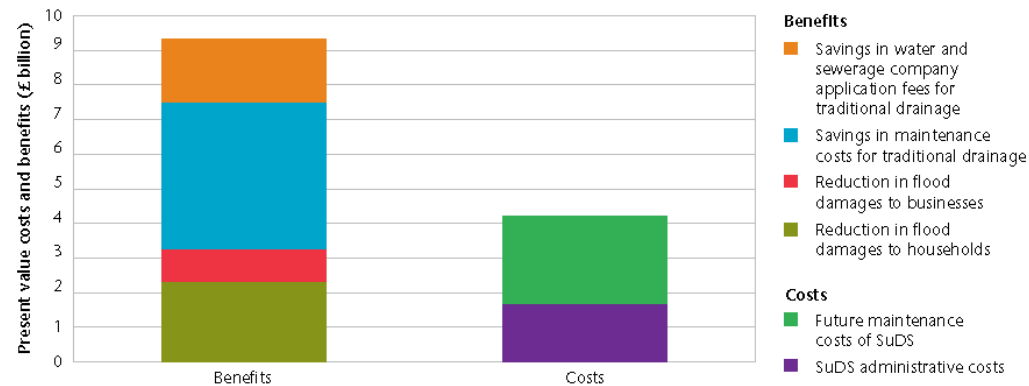
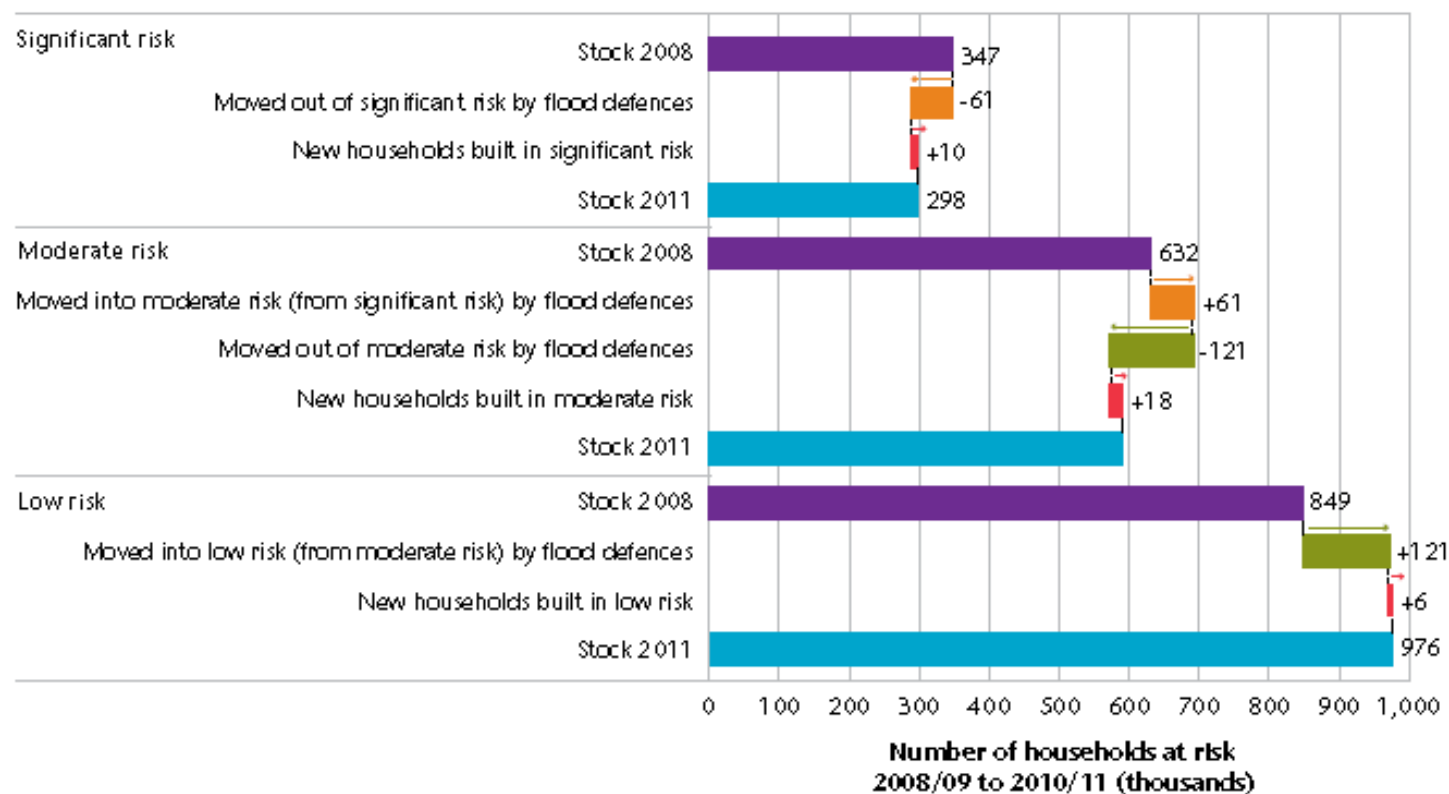


Figure 2.9: Total costs and benefits of incorporating SuDS schemes for all new developments across England



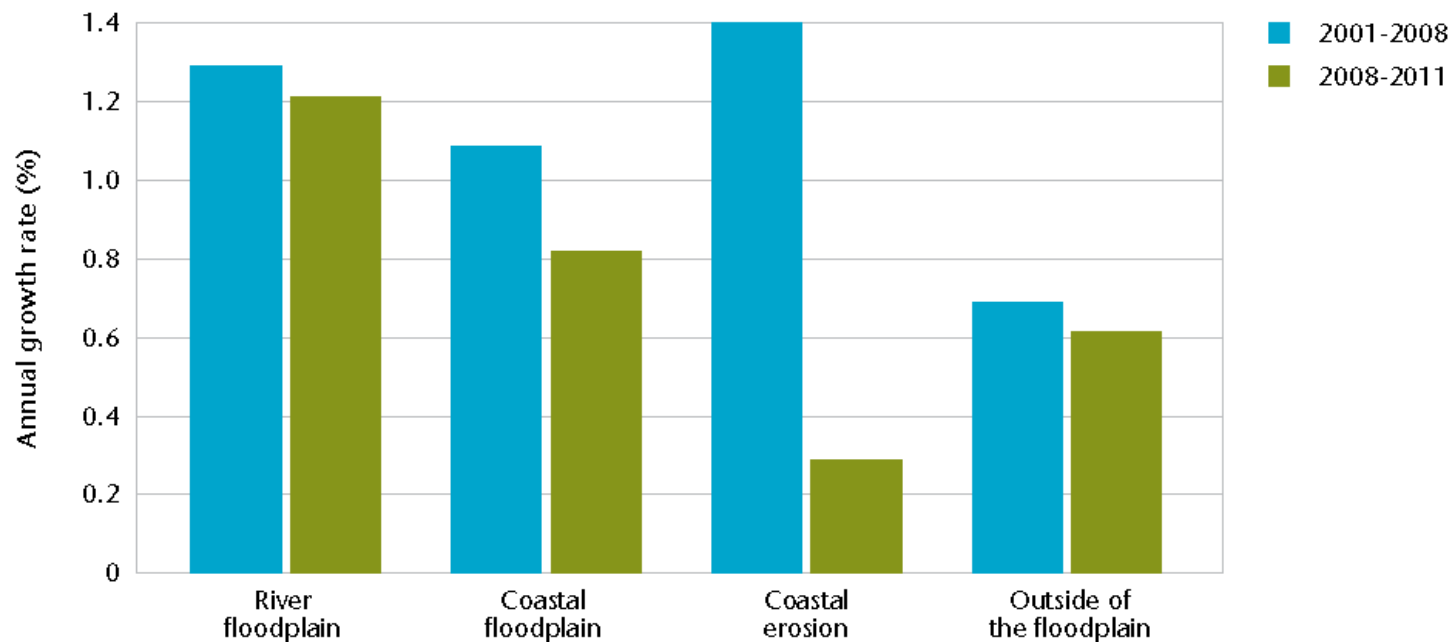
How is flood defence reducing risk?

Figure 2.4: Change in number of households in each flood risk category due to investment in new flood defences and new development (2008/09 to 2010/11)



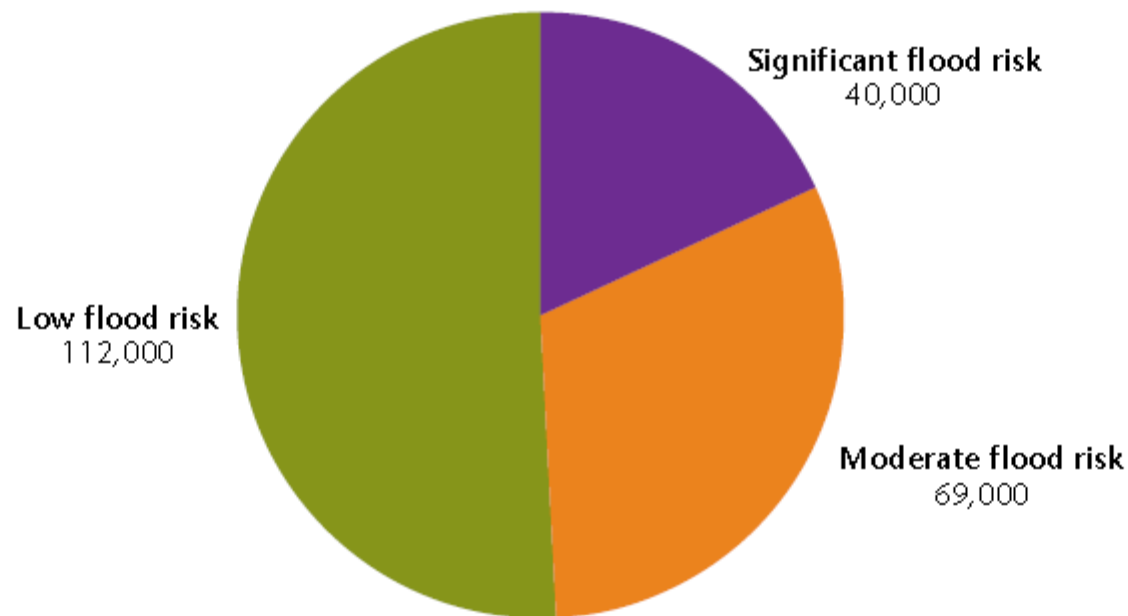
Controlling (?) development in floodplains

Figure 2.1: Development in the river and coastal floodplain and in areas at risk from coastal erosion, compared with all development in England outside the floodplain, shown as:
(a) annual growth rate for two time periods (2001-2008 and 2008-2011)



Development in high risk floodplains

Figure 2.2: Number of properties built in the floodplain over ten years (2001 to 2011), by flood risk category (defined in Box 2.1), accounting for the presence of flood defences



Controlling (?) development in floodplains

Figure 2.3: Outcomes of Environment Agency advice on planning applications on flood risk grounds (2005/06 to 2010/11)

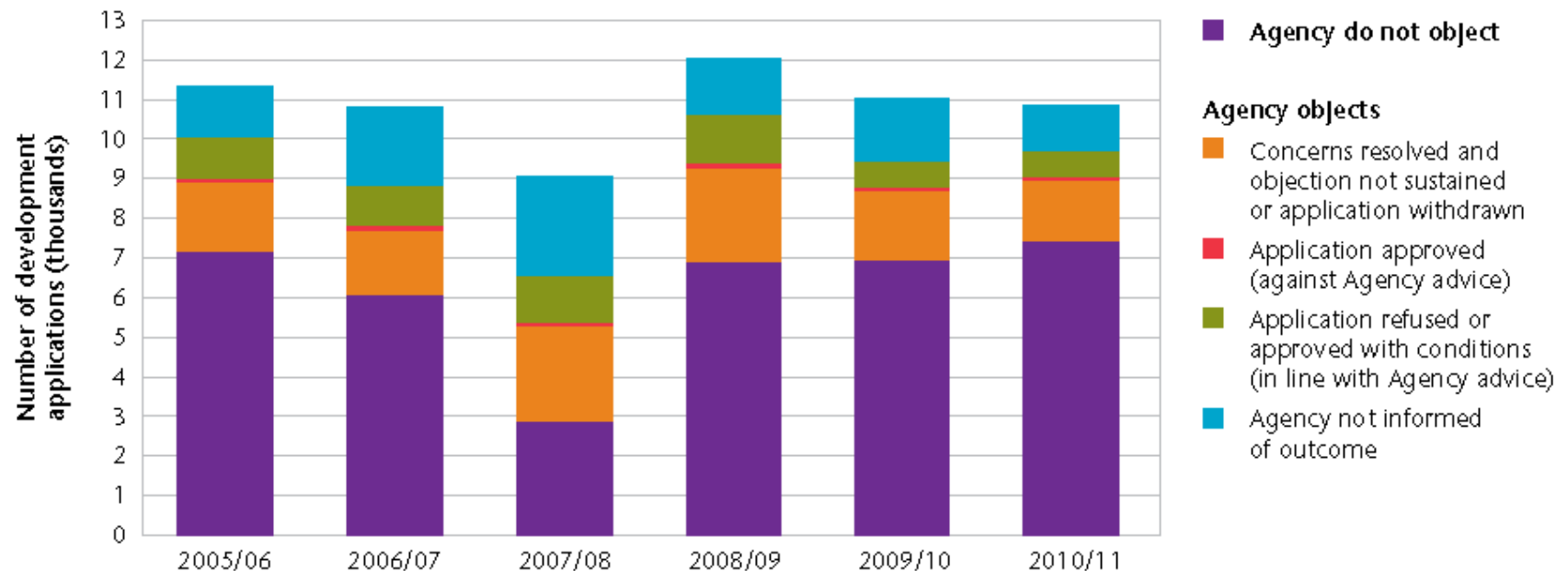


Table 2.2: Results of review of local authority development plans in relation to flood risk

(a) Demonstration of application of sequential test in the 42 plans assessed	Number of plans
Separate technical paper documenting application of sequential test	10
Sequential test is referred to in other development plan documents (Strategic Flood Risk Assessment or Sustainability Appraisal), but not explicitly applied	14
Not explicitly documented	18

(b) Types of policies to manage flood risk in the 32 plans that were informed by a Strategic Flood Risk Assessment	Number of policies
Avoid development in strategically identified areas of flood risk	2
Within a development, locate vulnerable uses in areas of lower flood risk	17
Require flood resilience measures in new dwellings	24
Require developer contributions for flood defences	5
Require compensatory flood storage areas to reduce risk down stream	1

Source: Arup (2012) for ASC

Note: Some plans had more than one policy. There were a total of 49 separate flood risk policies in the 32 development plans that had been informed by a Strategic Flood Risk Assessment.

What the future holds

Climate Hazard	Current risk			Future risk		
	Number of properties at risk	Expected annual damages to properties ¹¹	Average insured losses to properties (all UK) ¹²	Climate change effect	Level of confidence	Impact of climate change
River flooding	1.2 million (5% of stock in England) Significant risk: 230,000 ¹³	£690 million	£350 million (all flooding types)	Increase in peak river flows (7 – 60% by 2080s)	Medium	Increase in properties at significant risk, from 230,000 today to between 320,000 and 580,000 in 2080s purely due to climate change. With population growth this could increase to between 350,000 and 1,100,000. ¹⁴ Increase in expected annual damages from £0.7 billion today to between £0.9 billion and £6.9 billion by 2080s (2011 prices).
Coastal flooding	1 million (4% of stock in England) Significant risk: 100,000 ¹⁵	£310 million		Sea level rise (13 – 76cm by 2080s) Storm surges	High Low	Increase in properties at significant risk, from 100,000 today to between 310,000 and 570,000 in 2080s purely due to climate change. With population growth this could increase to between 330,000 and 840,000. ¹⁶ Increase in expected annual damages from £0.3 billion today to between £1 billion and £3.7 billion by 2080s (2011 prices).
Surface water flooding	1.9 million ¹⁷ (8% of stock in England) Of these, 50,000 are at 1 in 30 annual chance or greater	£320 million ¹⁸		Increase in rainfall intensity (15 – 30% in annual maximum daily rainfall by 2080s)	Medium-High	Not estimated by CCRA. Defra estimate increase in expected annual damages from £320 million to between £510 million and £1 billion over the next 50 years. ¹⁹
Sewer flooding	4,700 at 1 in 10 annual chance (<0.1% of stock in England)	£16 million ²⁰		Increase in rainfall intensity	Medium-High	Not estimated by CCRA. Ofwat estimate properties at 1 in 10 annual chance could increase from 4,700 today to between 4,700 and 8,100 the 2040s purely due to climate change. With population growth and urban creep, this could increase to between 5,500 and 8,900. ²¹

Risk of water shortages

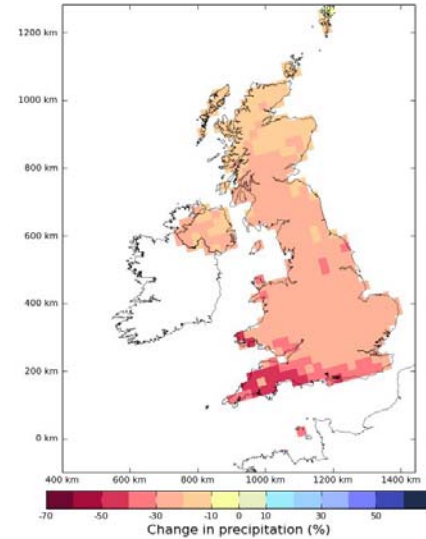
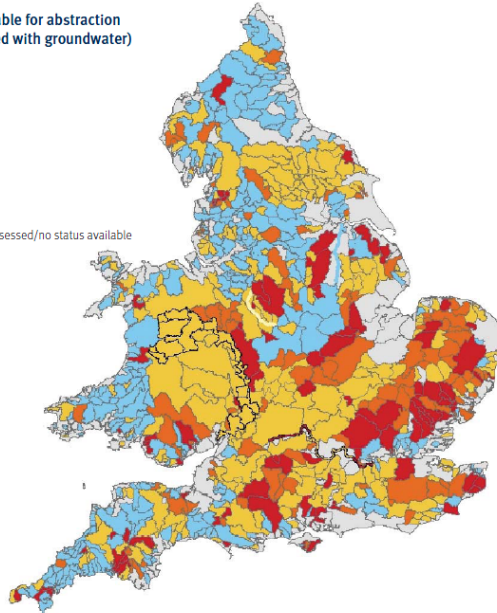


Plot Details:
 Data Source: Probabilistic Land
 Future Climate Change: True
 Variables: precip, stream, linear_perm
 Emissions Scenario: High
 Time Period: 2070-2099
 Temporal Average: JJA
 Spatial Average: Grid Box 25km
 Location: -11.87, 47.86, 3.56, 60.60
 Percentiles: 50.0
 Probability Data Type: cdf

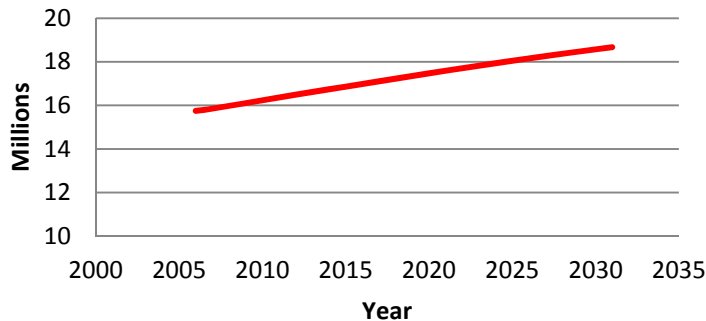
Figure 1.2: Water available for abstraction (surface water combined with groundwater)

Resource availability status:

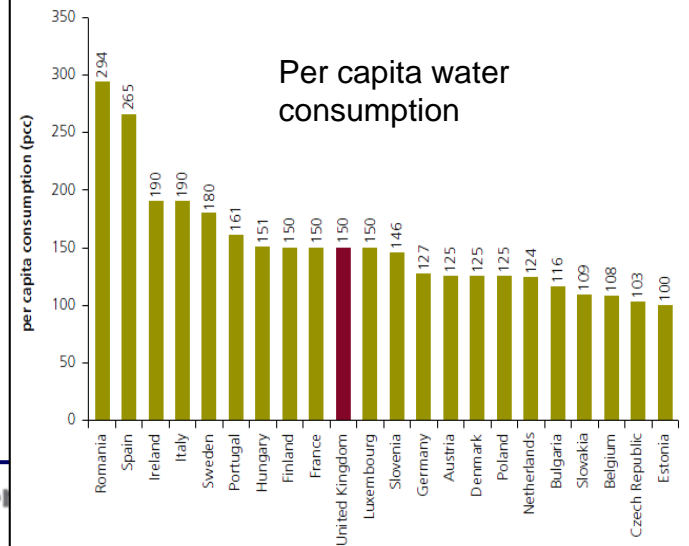
- Water available
- No water available
- Over licensed
- Over abstracted
- Groundwater only/not assessed/no status available



ONS Population projections: London and the Southeast



Per capita water consumption



Responding to risks of water shortage

Increasing water supply:

- Reservoirs
- Transfers
- Groundwater
- Desalination
- Direct reuse



Reducing water demand

- Leakage
- Domestic
- Industrial
- Agricultural

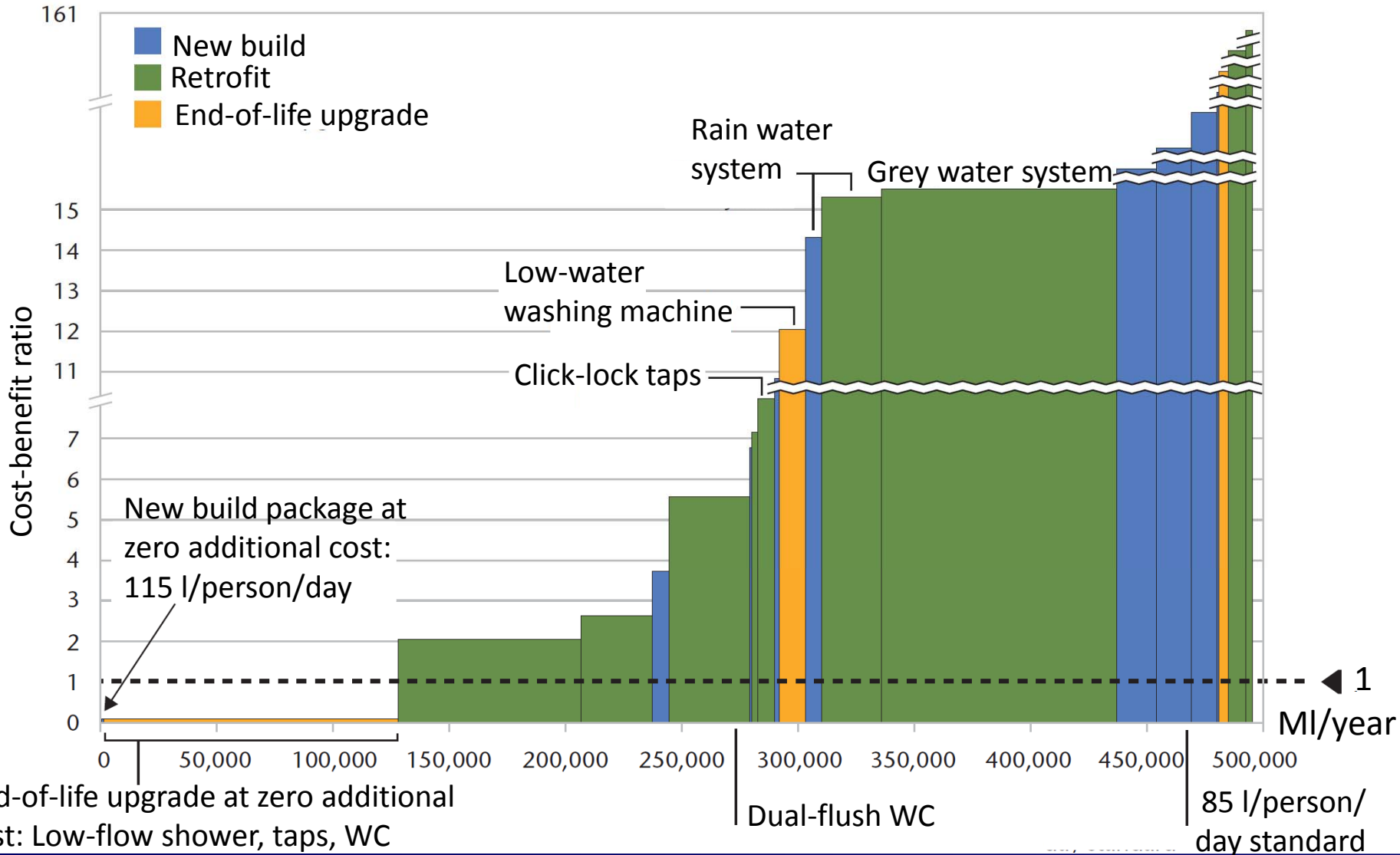


Water companies plan to address supply demand deficits

Water Company	Preferred measures to close deficit (%)	
	Demand (of which leakage)	Supply
Anglian and Hartlepool	30 (14)	70
Bristol	52 * (6)	48 *
Essex and Suffolk	18 (6)	82
Severn Trent	46 (19.5)	54
South East Water	25 (3.1)	75
Sutton and East Surrey	40 (0)	60
Thames	51 (32)	49

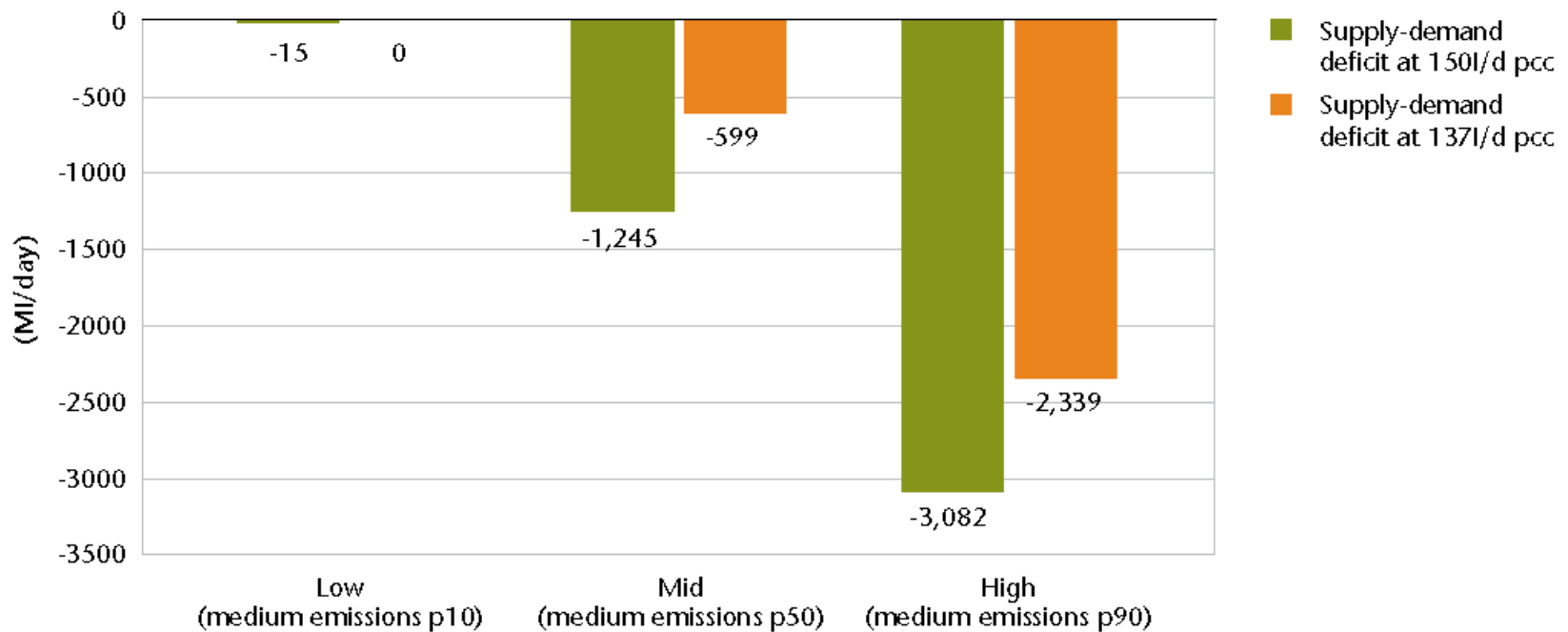
There is greater scope to improve resilience by reducing demand

Action: Low-regret opportunities for adaptation – water efficiency measures



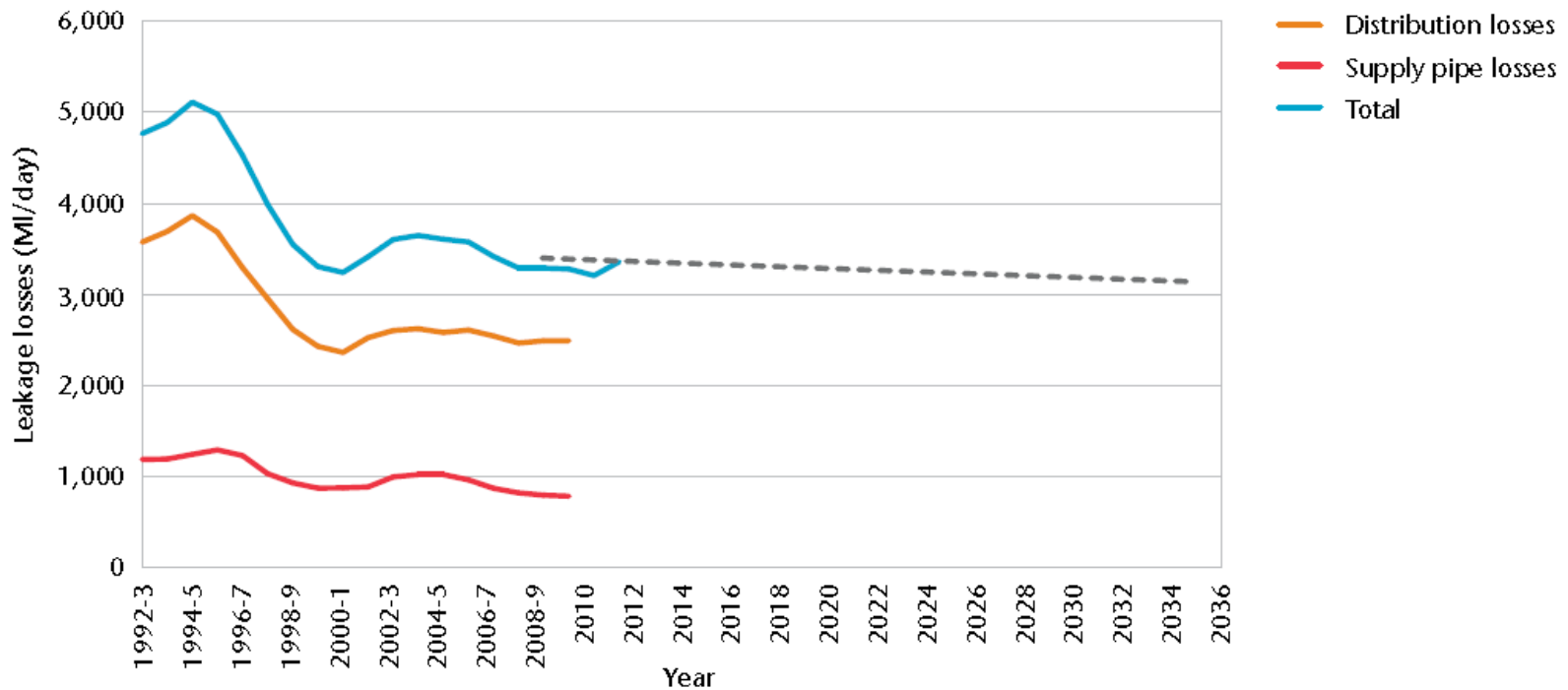
How significant could demand management be?

Figure 3.5: The effects on supply-demand deficit of a reduction in per capita consumption (pcc) from 150l/d to 137l/d for England and Wales (2010-2039)

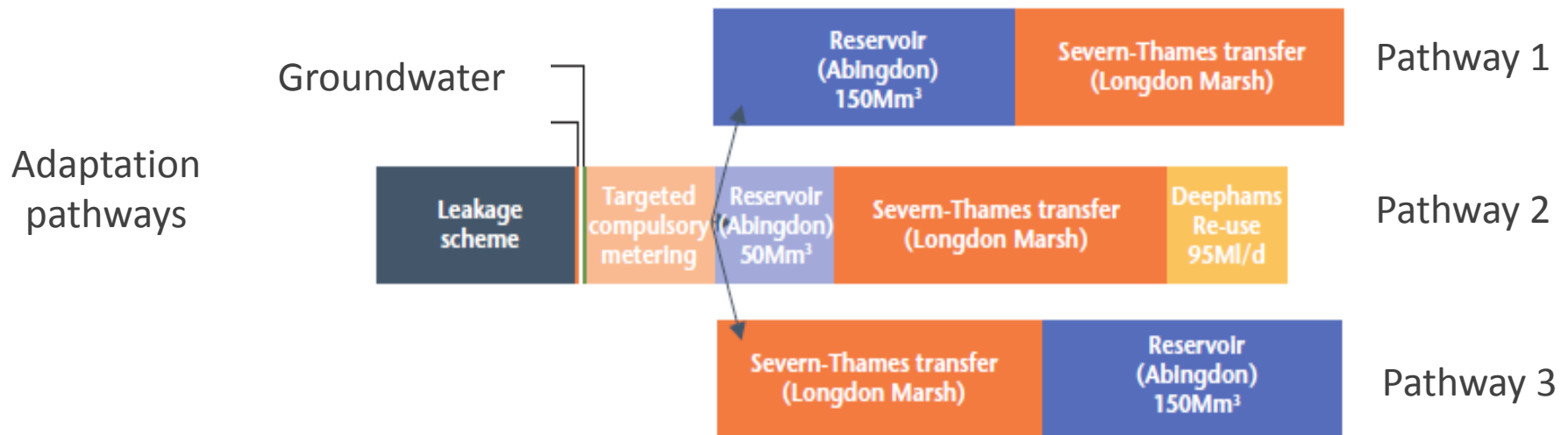
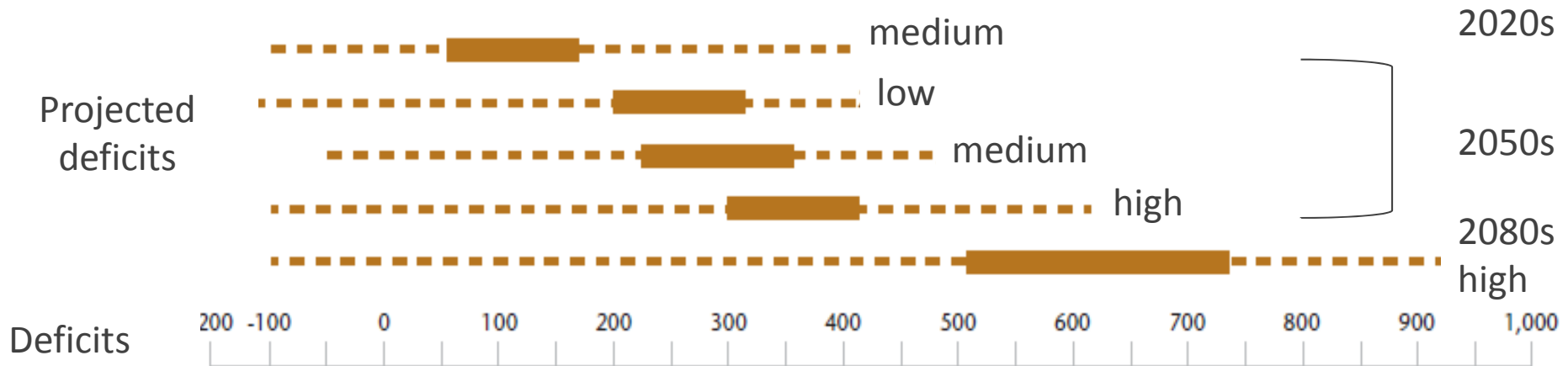


Leakage

Figure 3.8: Measured leakage losses for England and Wales (1992-2011) and projected leakage out to 2035

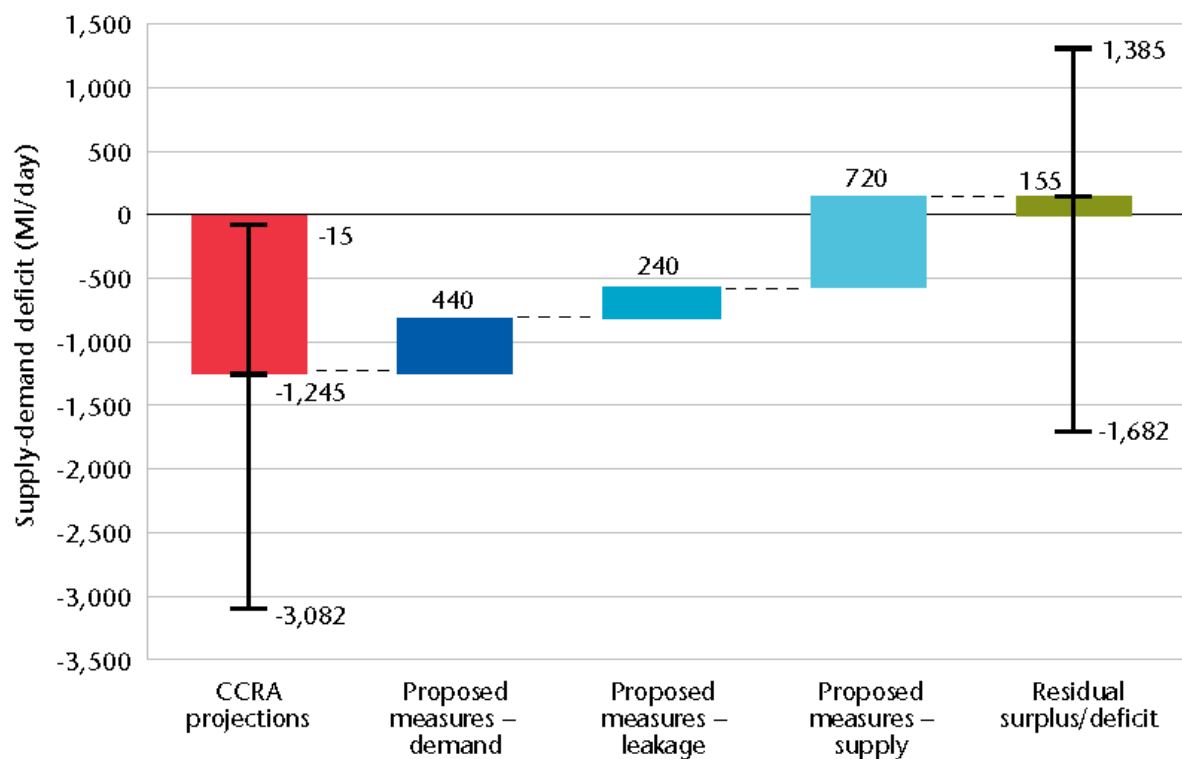


Adaptive planning of supplies













Can we fill the gap?


Figure 3.2: Comparison of CCRA projected supply-demand deficit risk (left) with water company proposals out to 2035 for supply and demand measures to reduce the deficit (middle three columns).



Monitoring progress: the ASC's approach

Indicator of	Indicator name	Source	Trend	Time series
Indicators of risk (exposure and vulnerability)				
Number of properties (houses and businesses) in areas of flood or coastal erosion risk (not accounting for defences)	Number of properties in river floodplain	Environment Agency		2001, 2008 and 2011
	Number of properties in coastal floodplain			
	Number of properties in areas at risk of coastal erosion	OS MasterMap		
	Number of properties in areas at risk from surface water flooding (1 in 200 year event)			
Annual rate of development (houses and businesses) in areas of flood or coastal erosion risk (not accounting for defences)	Rate of development in river floodplain	Environment Agency		2001, 2008 and 2011
	Rate of development in coastal floodplain			
	Rate of development in areas at risk of coastal erosion	OS MasterMap		
	Rate of development in areas at risk from surface water flooding (1 in 200 year event)			
Number of properties (houses and businesses) built in floodplain, accounting for defences	Proportion of floodplain development in areas at significant risk of river/coastal flooding	Environment Agency OS MasterMap		2001, 2008 and 2011
Change in hard surfacing	Area of impermeable surfaces in urban areas	OS MasterMap		2001 – 2011


Next steps for the ASC



June 2013: Fourth ASC annual report, focusing on the natural environment, including catchments and coasts



November 2013: Defra publishes the first National Adaptation Programme (NAP)

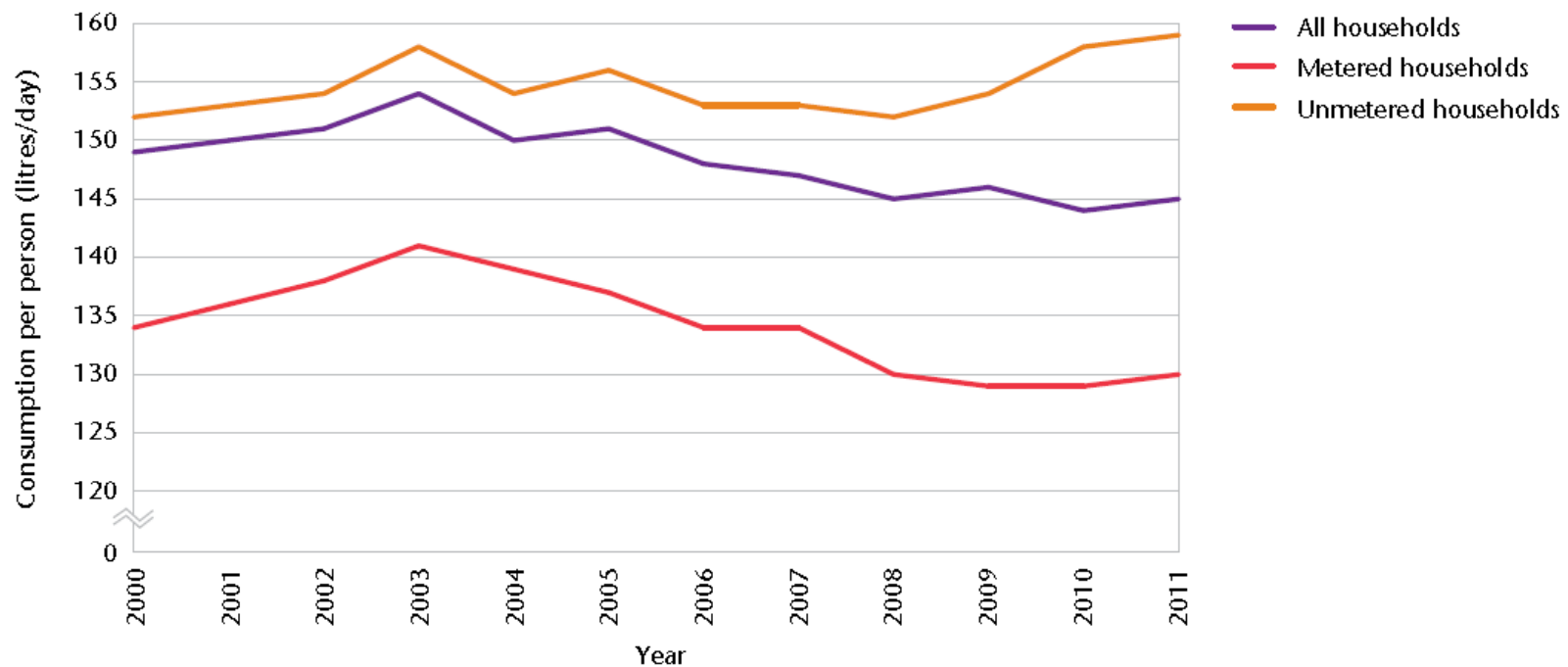


2015: ASC makes its first statutory assessment to Parliament on progress made in implementing the NAP



Domestic water demand

Figure 3.3: Trends in consumption per person – England (2000-2011)



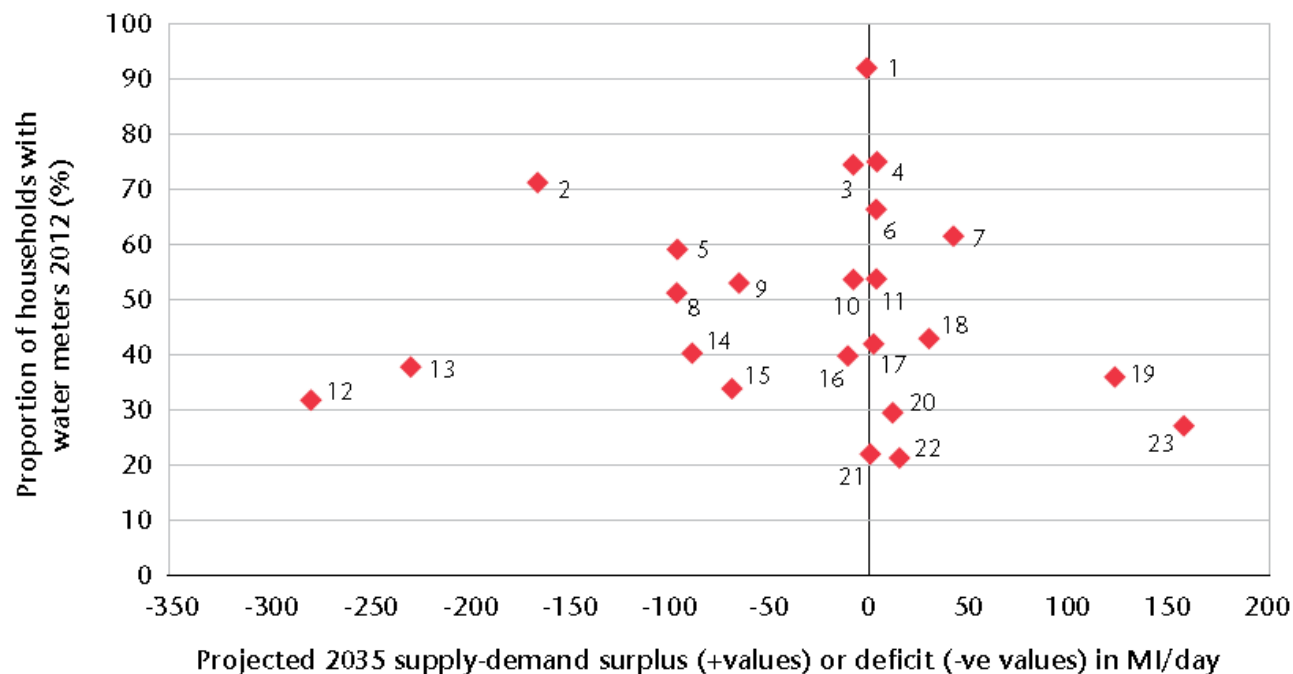
Percentage of households with meters

Figure 3.6: Percentage of households with Water Meters in England and Wales



Are we metering where it matters?

Figure 3.7: Percentage of households with meters in 2012 compared to 2035 supply-demand balance projections from 2009 water resource management plans, by Water Company (England and Wales)



Risks of water shortage (CCRA)

Table 3.1: CCRA regional projections of supply-demand deficit (MI/day) for England and Wales

UKCP09 river basin region	Surplus (positive values) or Deficit (negative values) in MI/day			
	Baseline (2009/10)	CCRA low projection 2010-2039	CCRA mid-projection 2010-2039	CCRA high projection 2010-2039
Anglian	96	-13	-212	-429
Dee	8	no deficit	-4	-24
Humber	105	-2	-305	-643
Northumbria	212	no deficit	no deficit	no deficit
North West England	63	no deficit	-95	-461
Severn	106	no deficit	-138	-357
South East England	162	no deficit	no deficit	-26
South West England	68	no deficit	-13	-75
Thames	59	no deficit	-478	-1040
Western Wales	50	no deficit	no deficit	-27
Total (England and Wales)	No Deficit	-15	-1245	-3082

