South East Water
Customer Engagement Research for PR14

Final WTP Report – Main Stage
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ABBREVIATIONS

CBA	Cost benefit analysis
CV	Contingent valuation
DCE	Discrete choice experiment
PpP	Phone-post/email-phone
PR14	Price Review 2014
SEG	Socio-economic grade
SP	Stated preference
SQ	Status quo
SEW	South East Water
UKWIR	UK Water Industry Research
WTA	Willingness to accept
WTP	Willingness to pay

The research was undertaken in compliance with the market research standard ISO 20252:2006

1. EXECUTIVE SUMMARY

1.1 Introduction

Accent has conducted a large scale stated preference (SP) study on behalf of South East Water (SEW), with the aim of understanding customers' priorities across a wide range of potential service improvements, and their willingness to pay (WTP) for them. The intention is that the results from this survey will be used within cost benefit analyses (CBA) of proposed schemes for inclusion in SEW's business plan for the 2014 price review (PR14).

This document is our final report on the study. It provides a full description and explanation of the survey design and methodology, and reports all results from the survey including a detailed analysis of SEW customers' WTP for service level changes. We recommend that SEW use these results for CBA. A copy of the final 'sign-off' of the report from peer reviewer Prof. Richard Carson is contained in Appendix D.

1.2 Survey Design and Development

The questionnaire was designed and implemented in the context of several sources of focussed guidance, including in particular, the UKWIR (2011) report – "Carrying out WTP surveys".[1] In line with UKWIR (2011) guidelines, the survey questionnaire was developed around the use of discrete choice experiments (DCE) and contingent valuation (CV) questions to explore customer priorities across service measures, and their willingness to pay for improvements.

DCE questions offer respondents a series of choices between two or more alternative packages of service levels. The questions require the respondent to make a trade-off, with some service measures better in one alternative and some better in the other. In comparison with more traditional and well-known methods of market research, such as importance ratings and proposition agreement scales, DCE methods have the advantage that they are explicitly theoretically consistent with the use of CBA as a means of decision making. The choices made by the respondents indicate how they value each of the service measures in relation to one another, in accordance with established principles of random utility theory[2]. No other market research methods have claim to this feature.

The survey instrument was developed through consultation with SEW, taking account of UKWIR guidelines, and was peer reviewed by Prof. Richard Carson prior to two phases of pre-testing: a series of cognitive (depth) interviews and a pilot survey. The

[1] The UKWIR (2011) study introduced common guidelines to companies and practitioners concerning how WTP surveys should be designed and implemented in the UK water industry. The guidelines were developed to take account of the academic literature, stakeholders' views – via industry stakeholder workshops and a survey of water company asset planners, leading stated preference (SP) practitioners' views, and customers' views via a series of focus groups and depth interviews. The guidelines gained widespread acceptance amongst all the major stakeholders, including Ofwat, the Consumer Council for Water (CCWater), the Environment Agency (EA), the Drinking Water Inspectorate (DWI) and the UK water companies themselves. The UKWIR guidelines were therefore an important part of the context when developing the survey instrument.

[2] See for example Train, K. (2003) "Discrete Choice Methods with Simulation", Cambridge University Press.

Customer Challenge Group (CCG) set up by SEW also had an opportunity to comment on the survey instrument, and their comments were taken into account and responded to.

Service Measure Selection and Definition

The service measures to be valued in the survey were agreed with SEW at the outset of the study based in part on customer research conducted prior to the start of the present study, and on the considerations set out in UKWIR (2011). The final set of service measures used in the main survey, along with their show card descriptions, is shown in Table 1.

Table 1: Service Measures - Definitions and Descriptions

Service measure	Description on survey show card
DISCOLOURED WATER at your property for a couple of hours at a time. The chance that this happens in any one year.	Tap water may occasionally be discoloured although running the tap for several minutes will often cause the problem to go away. When it occurs, this problem usually lasts a couple of hours, but occasionally the problem can last for a few days. Although the water is unlikely to be harmful, you may not want to use it in your household.
WATER SUPPLY INTERRUPTIONS lasting an average of 2 and a half hours. The chance that this happens in any one year.	Interruptions to your water supply can happen at any time and at any property. They typically last around 2 and a half hours. The number of water supply interruptions can be reduced by increased maintenance which would reduce bursts.
HOSEPIPE BANS from May to September. The chance that this happens in any one year.	Hosepipe bans are put in place during extended dry spells to help manage demand for water. When they are put in place, they typically last for 5 months beginning in May and ending in September. When a ban is in place, hosepipes cannot be used for domestic gardening, cleaning, or recreational uses such as filling home swimming pools. Exemptions apply for commercial users and activities, and vulnerable customers.
PERSISTENT LOW WATER PRESSURE affects the taps, showers and boilers at some customers' properties. The proportion of properties that are affected.	Low water pressure means it takes longer to fill the bath or a kettle than you would like, and it may affect how well a combi boiler works. Persistent means the property is affected every day, though the problem may come and go during the day. It can be caused by the age and condition of the water company's pipes rather than problems with internal plumbing which the customer is responsible for. Properties at the tops of hills and the end of lines are most at risk . If you don't currently suffer, or have never suffered from persistent low water pressure, then your property is not at risk. Customers that do suffer from this problem regularly are entitled to a rebate of £50 off their annual water bill.

Choice Exercise Formats

The above set of service measures were combined in a single initial choice exercise, which offered the respondent two alternative packages of service levels. The service level for each service measure in each alternative was either at its current level (Level 0), a decrement level (Level -1), an intermediate improvement level (Level +1), or at a stretch target improvement level (Level +2).

A second choice exercise followed, which focussed on water supply interruptions and included three attributes:

- Supply interruption duration.
- Notice given.

- The frequency that this happens at your property.

Finally, a "contingent valuation" (CV) exercise was included after the two choice exercises which contained all the service measures shown in the first exercise, plus the customer's annual bill from SEW. Inclusion of the bill allowed us to obtain estimates of willingness to pay (WTP) for improvements or decrements to each of the service measures as a whole. This WTP value could then be split between the individual service measures using the results from the choice exercises to obtain values for unit improvements or decrements to each service measure.

Consistent with UKWIR guidelines, the bill was presented as a monetary amount for household customers and as a percentage deviation from current bills for business customers.

Prior to the start of the pilot survey, SEW were made aware that Thames Water had sent leaflets to all SEW customers that were supplied sewerage by Thames Water. The leaflets contained information concerning the proposed Thames Tideway Tunnel (TTT), including the expected change in their sewerage bill that this would cause. This amounted to a £70-£80 increase in household bills.

A key decision was taken at this point in the survey development to include explicit reference to the TTT, and to point out that sewerage companies were also making plans for other service changes which could also cause bills to rise. Furthermore, we agreed with SEW that we would split the instrument into six versions – two for Southern Water sewerage customers and four for Thames Water sewerage customers. Each version would include a specific sewerage bill change assumption, and a tailored contextual sentence to support that assumption. The reason for this approach was that it would allow testing of the impact of sewerage bill changes on WTP for water service improvements. The reason more versions were required for Thames Water customers than for Southern Water customers was that it was desired that we would test sensitivity over a much greater range of sewerage bill change levels, in light of the TTT proposal.

The experimental designs for each of the exercises were generated using an algorithm which sought to maximise the statistical precision (the "D-efficiency criterion") of the estimates, whilst avoiding choice pairs where one option dominated the other one (i.e., was better on all service aspects). This algorithm incorporated prior estimates from the pilot results to calibrate the design.

Overall, the survey design conformed to the best practice principles laid out by UKWIR (2011). A notable innovation introduced to the survey design, however, was the inclusion of a visual depiction of service levels using green triangles drawn to scale on each of the choice cards. The aim of the triangles was to address one of the key issues with this type of stated preference work, which is whether customers can effectively process risk levels and make choices reflective of their true preferences when risk levels are small. There is academic evidence that well-designed visual representations result in more theoretically consistent preferences being expressed.[3]

Diagnostic questions in the cognitive interviews we conducted as part of the testing and refinement phase of the study demonstrated that respondents either found the images helpful or were ignored in favour of the text. Our experience has therefore supported

[3] Corso, Hammitt and Graham (2001) Valuing mortality-risk reduction: using visual aids to improve the validity of contingent valuation, *Journal of Risk and Uncertainty*, **23**(2), 165-184

the inclusion of the green triangles to communicate risk and we would recommend it as an important innovation in the design of stated preference surveys for water company business planning.

Relatedly, an additional innovation introduced to the survey design was to include shading of the levels of the worse option for every service measure in every choice situation. This shading was introduced to help respondents quickly see which was better and which was worse, thereby giving them a simpler task to deal with and helping to prevent respondents making mistakes. Our cognitive testing of this approach has also resulted in favourable findings, suggesting that it has indeed help to reduce the cognitive burden of the instrument.

1.3 Survey Administration

The household survey was implemented via the phone-post/email-phone (PpP) method, which allowed show material to be sent to respondents between recruitment and survey completion tailored to the size of their current SEW bill.

The sample was designed, via the setting of quotas, to enable representative weighting of the data by age, SEG and income.

A broad and representative sample was obtained of 1103 households. This included the 100 respondents from the pilot survey to maximise the available data for analysis.

For business customers, a total of 600 interviews were completed, also via the phone-post/email-phone method, and this also included the pilot sample of 100. The target respondent was whoever was responsible for paying their organisation's water bills and/or for liaising with SEW.

The sample plan for businesses deliberately over-weighted the largest users on the basis that these organisations were expected to attach a higher monetary value to water service measures than smaller users. Due to difficulties in recruiting sufficient numbers of the largest users, weights were applied in the econometric analysis to correct for a shortfall in the number of large user respondents in comparison with the optimal sample plan.

1.4 Key Findings

The choice data were analysed using best practice econometric methods, including mixed logit models for the DCE analysis and random effects probit models for the CV analysis. Details of the modelling methodology and all interim findings are reported in Appendices B and C for households and businesses respectively.

The models estimated on the CV responses allowed different values to be obtained, in absolute terms, for improvements in services in comparison to deteriorations of the same degree. This is because there is a substantial literature suggesting that people might be less willing to accept reductions in service in exchange for reduced bills, than they would be willing to pay for the same service change in reverse. We would therefore expect willingness to accept (WTA, the value of a deterioration) to be greater, in absolute terms, than WTP (the value of an equivalent improvement).

Our findings from this modelling showed clearly that this was the case. Respondents' choices were much less sensitive to the size of a bill reduction on average than they were to the size of a bill increase. As a consequence, no realistic bill reduction (up to 6% of current bills) would lead households or businesses, on average, to choose a widespread service deterioration.

Our modelling also explored the extent to which the assumed size of the sewerage bill change affected WTP for water service improvements. This analysis found that the differences were all insignificant, which indicates that the assumed sewerage bill increase had no effect on respondent's willingness to pay for improved water services. This result is consistent with expectation. The amounts being varied were small relative to respondents' incomes and so we would expect WTP to be relatively insensitive to even the larger sewerage bill sizes. It cannot be ruled out, however, that a larger sample size may have picked up a statistically significant effect.

Our main findings are given in the following two tables. First, Table 2 shows our central estimates of average current willingness to pay for customers, per year, for a range of service packages. The figures in this table show the maximum amounts extra from 2019/20 that customers are willing to pay for the package shown, where the actual cost gradually adjusts over five annual increments. For example, a value of £10 would correspond to a £2 increment per year for five years from 2014, leading to a total change of +£10 from 2019.

The table shows that our central estimate of the maximum household customers would be prepared to pay for the service package where all measures improve to their maximum feasible extent, would be an increment of £18.06 per year on to their bills by 2019/20. For business customers, the comparable estimate is £24.06 per year for this package. These figures are in real terms, i.e., excluding inflation, which respondents were aware would be added on top.

For deteriorations, the amounts shown by service measure are the threshold prices around which beneficial trades could take place in relation to improvements in other services in the context of stable or increasing bills overall. Our modeling results suggested that household and business respondents were unwilling to accept widespread deteriorations in service for any size of bill reduction shown. There are therefore no values reported for all services deteriorating to Level -1.

Table 2: Willingness to Pay for Packages of Service Level Changes, by Customer Type

	Willingness to pay (£/customer/year)		
	Services worsen to Level -1	**Services improve to Level +1**	**Services improve to Level +2**
Households			
Discoloured water	-12.56	4.19	6.28
Supply interruptions	-12.48	4.16	6.24
Hosepipe ban	-10.83	3.61	5.41
Persistent low pressure	-6.90	0.06	0.13
All service measures		**12.01**	**18.06**
Businesses			
Discoloured water	-13.31	4.44	6.65
Supply interruptions	-25.50	8.50	12.75
Hosepipe ban	-8.82	2.94	4.41
Persistent low pressure	-13.43	0.11	0.25
All service measures		**15.99**	**24.06**

Figures show average willingness to pay for customers in each segment, per year, for each package of service levels. Values shown for the "Base to -1" columns are based on packages where some of the service measures are improving and hence the overall service level is not deteriorating. Respondents made it clear that they would require much higher compensation to accept widespread deteriorations; however they were prepared to trade off deteriorations in some service measures for improvements in others. The results in this column show the threshold prices around which beneficial trades could take place.

The results presented here are meaningful measures of customers' priorities and WTP for the packages of service level change that SEW identified as being feasible for each service measure. However, the scope of change is unequal across service measures, and so the service measure values cannot validly be compared as if they represent the relative cost to customers of each type of service failure. For example, we cannot infer from Table 2 that a hosepipe ban is worse for customers than persistent low water pressure. To compare incidents on a like-for-like basis, it is necessary to look at unit values, which show, for example, the value of one avoided discoloured water incident, one avoided water supply interruption, etc. These values are shown in Table 3.

Table 3 presents unit values for each service measure contained in the survey, for households, businesses and for all customers. In all cases, the tables show "central" estimates as well as a sensitivity range around this estimate. The central estimates are based on the full sample for each customer type; they are calibrated to an assumed real cost of maintaining base service levels up to 2020 of +5.3%, where this assumption was provided by SEW; and they are based on respondents' mean valuation of the whole package of service level change from Level -1 to Level 2, cascaded down to a unit level change for each service measure.

The ranges around the central values encompass a collection of sensitivity checks, including values based on assumed costs of maintaining base service levels of +4% and +8%, and values for low income households and for a sample that excludes respondents that had difficulty answering the choice questions. For household customers, the lower bound of the recommended range is based on results for a low income sample and the upper bound is based on the upper bound of the 95% confidence interval. For business

customers, the recommended range is based purely on the 95% confidence interval as this encompassed all other sensitivity check values.

We would recommend that the central estimate be applied in the first instance when performing CBA on business plan proposals. The sensitivity range should be later applied as a means of testing the sensitivity of the proposals deriving from the CBA in relation to the inevitable uncertainty surrounding the valuation estimates used.

Unit values for the "All customers" group are calculated as the weighted average of the relevant household and business values, using total revenue weights.

By way of illustration of how the results are to be applied, consider the following examples.

- A reservoir expansion will lower the expected frequency of hosepipe bans for all customers from 1 in 10 years to 1 in 20 years. Considering that the number of household and business customers is respectively 820,427 and 67,497, the benefit of this investment would be calculated as (1/10-1/20)*(£108.25*820,427 + £88.24*67,497) = £4.738 million per year. In this calculation, £108.25 is the central household estimate of the value of avoiding one hosepipe ban, from Table 3, and £88.24 is the corresponding business estimate, from the same table.

- A proposed mains renewal will lead to 1000 fewer 3-6 hour unexpected interruptions per year in future, but 2000 more 3-6 hour planned interruptions in the year that the work is carried out. Using the values shown in Table 3, the benefit of the investment would be calculated as £0.947 million (1,000*£947.0) per year for the avoided unexpected interruptions, and in addition to the financial costs of the proposal, there would be an additional cost of £0.220 million (2,000*£110.16) in the year that the work was carried out. In these calculations, £947.0 is the central "All customers" estimate of the value of avoiding one 3-6 hour unexpected water supply interruption, and £110.16 is the corresponding estimate of the value of avoiding one 3-6 hour planned water supply interruption.

Table 3: Unit Values for Service Measures, by Customer Type

Service measure	Unit	Unit value (£/unit/year)								
		Households			Businesses			All customers		
		Central	Range		Central	Range		Central	Range	
Discoloured water	1 incident	125.63	87.59	144.88	133.06	106.67	159.46	127.51	92.43	148.58
Hosepipe ban	1 incident	108.25	75.48	124.84	88.24	70.74	105.75	103.18	74.28	120.00
Persistent low pressure	1 incident	1407.83	981.57	1623.55	2741.46	2197.61	3285.31	1745.91	1289.84	2044.82
Supply interruptions	1 incident	416.16	290.15	479.92	849.97	681.35	1018.59	526.13	389.32	616.48
No notice										
Less than 3 hours	1 incident	249.69	174.09	287.95	509.98	408.81	611.15	315.68	233.59	369.89
3 to 6 hours	1 incident	749.08	522.28	863.86	1529.94	1226.44	1833.45	947.03	700.78	1109.66
6-12 hours	1 incident	1498.16	1044.55	1727.73	3059.89	2452.87	3666.91	1894.06	1401.57	2219.32
12-24 hours	1 incident	2996.32	2089.10	3455.46	6119.77	4905.74	7333.81	3788.13	2803.13	4438.64
24-48 hours	1 incident	5992.64	4178.21	6910.91	12239.55	9811.48	14667.62	7576.26	5606.27	8877.28
24h notice										
Less than 3 hours	1 incident	28.38	19.79	32.73	63.31	50.75	75.87	36.72	27.17	43.03
3 to 6 hours	1 incident	85.15	59.37	98.19	189.94	152.26	227.62	110.16	81.52	129.08
6-12 hours	1 incident	170.29	118.73	196.39	379.88	304.52	455.24	220.33	163.04	258.16
12-24 hours	1 incident	340.58	237.46	392.77	759.76	609.04	910.48	440.65	326.07	516.32
24-48 hours	1 incident	681.17	474.93	785.55	1519.53	1218.08	1820.97	881.31	652.15	1032.65

Figures show average willingness to pay (to 4 significant figures) for customers in each segment, per year, for each unit of service level change. Values for "All customers" are derived as weighted averages of household and business values, using total revenue weights.

1.5 Conclusions and Recommendations

This report presents valuation estimates for use in cost benefit appraisals by SEW for PR14, and provides a range of supporting evidence to validate these estimates.

The results have shown that customers do not want to see widespread deteriorations in service in exchange for lower bills, and that there is some willingness to pay for improvements in relation to each of the service measures. Furthermore the results have shown that willingness to pay for water service improvements is not significantly affected by the size of future sewerage bill changes.

The WTP results cannot be used in isolation to infer customer support for any service improvement, or lack of improvement, since this judgement must be made with consideration to the cost of those improvements. Whether willingness to pay outweighs the cost of any improvements is a separate matter that is not examined in this report.

In summary, confidence in the results presented in this report can be gained from the following.

- The design of the questionnaire is consistent with best practice (e.g. UKWIR, 2011), and was fully tested via cognitive interviews and pilot tests with households and businesses.

- The vast majority of responses were assessed as valid, taking into account respondent and interviewer feedback, and the reasons respondents gave for their choices.

- When we removed the small minority of responses that we assessed as potentially invalid, we found that the results for the population were not materially affected.

- Results are consistent with expectation in many areas and there were no anomalous findings.

Overall, the valuation estimates presented can be considered to be meaningful measures of SEW customers' values for the range of services, and service levels, contained within the survey, and we believe they are suitable for use by SEW within cost benefit appraisals of proposed service changes for PR14.

2. INTRODUCTION

2.1 Background

South East Water (SEW) commissioned Accent to conduct a programme of research exploring customers' willingness to pay (WTP) for a range of possible service level changes, and to support the application of the WTP values in cost benefit analysis (CBA). The results from the CBA will ultimately inform the development of the company's 2015-20 business plan and support its legitimacy to the regulators and other stakeholders.

The present research is undertaken in the context of the following sources of guidance:

- Ofwat's customer engagement policy for the 2014 price review (PR14);
- UKWIR reports on "Customer involvement in price-setting", "Review of CBA and benefits valuation", and "Carrying out WTP surveys";
- DEFRA / DECC guidance on carbon valuation;
- experience and best practice from other sectors; and
- the wider academic literature on CBA and benefits valuation.

2.2 Objectives

The main research objective for the study as a whole was to determine business and household investment priorities and willingness to pay (WTP) for potential programmes of work over the 2015-2020 period.

SEW needs to understand the following for both domestic and business customers to help it prepare a customer focused business plan at PR14:

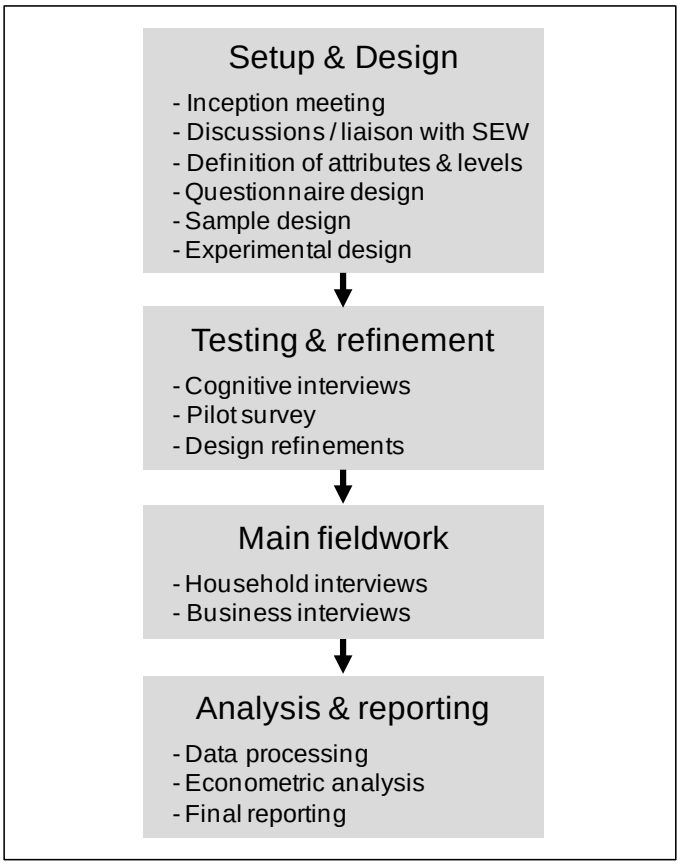
- what do customers believe are the most important areas of service provided by SEW;
- what improvements, if any, would customers like to see to these services; and
- what is customers willingness to pay (and willingness to accept remuneration for some potential service deteriorations) for specific aspects of the service SEW offers.

2.3 Overview of the Study

The stated preference (SP) survey methodology was adopted to achieve the objectives of the study. An SP survey was designed and implemented so as to obtain estimates of customers' marginal values for a range of service measures.

Figure 1 provides an overview of the research programme. This document is our final report on this survey. It provides a full description and explanation of the survey design and methodology, and reports all results including a detailed analysis of SEW customers' WTP for service level changes. We believe these results are suitable for SEW to use for CBA.

Figure 1: Overview of the research programme



2.4 Report Structure

The remainder of this report is structured as follows. In section 3, we report on the survey design and development. Section 4 provides details of the survey administration, and a description of the weights applied. In section 5 we present and summarise findings from the sample on all non-SP questions from the survey. This includes information on household and business demographics, current bill levels and attitudes towards them, experiences of water and sewerage service failures and perceptions of the chances of experiencing them, respondent and interviewer feedback on various aspects of the survey, respondents' views on the most important service measures to improve, and respondents' reasons for their SP choices.

Section 6 then presents the valuation results, and section 7 presents our conclusions and recommendations. In summary, we conclude that the values presented are valid measures of customers' WTP for incremental changes to service levels. As such they should be considered legitimate by stakeholders and regulators for use within CBA.

The appendices to this report contain useful supporting documentation. The household questionnaire and show cards that were used in the survey are contained in Appendix A. Appendix B contains the detailed econometric analysis for households, and Appendix C contains the econometric analysis for businesses. Appendix D contains a copy of the final 'sign-off' of the report from peer reviewer Prof. Richard Carson.

In addition to this report, an accompanying compact disk (CD) contains further related materials to complete the audit trail for the work. This includes the main survey datasets (in Excel and Stata[4] formats), the household and business questionnaires, the pilot report and testing materials, and the analysis programs and Excel workbooks used to derive the results presented in this report.

[4] Stata is a statistical software package. It was used for all the analysis of the SP data presented in this report.

3. SURVEY DESIGN AND DEVELOPMENT

3.1 Introduction

The SP survey conducted for this study was designed and implemented in the context of several sources of focussed guidance, including in particular, the UKWIR (2011) report – "Carrying out WTP surveys". Additionally, Accent has accumulated recent experience in applying the recommendations set out in UKWIR (2011) for other UK water companies for PR14 business planning. The starting point for development of the survey instrument was therefore quite advanced at the outset of the study.

In this section, we begin in 3.2 by summarising the core design features of the instrument. The remainder of the section then proceeds through the key aspects of the survey instrument and describes how design decisions were reached, taking account of the preliminary qualitative research and testing results along the way.

The study includes separate versions of the questionnaire for households and businesses. The household questionnaire and show cards are included as Appendix A, and on the accompanying CD; the business questionnaire and show cards are included on the accompanying CD only.

3.2 Core Design Features

In line with UKWIR (2011) guidelines, the survey instrument was developed around the use of discrete choice experiment (DCE) questions as the means of eliciting customer priorities and willingness to pay. DCE questions offer respondents a series of choices between two or more alternative packages of service levels. The questions require the respondent to make a trade-off, with some service measures better in one alternative and some better in the other.

In comparison with more traditional and well-known methods of market research, such as importance ratings and proposition agreement scales, DCE methods have the advantage that they are explicitly theoretically consistent with the use of CBA as a means of decision making. The choices made by the respondents are treated as indicating how he/she values the service measures in relation to one another, in accordance with established principles of random utility theory[5]. No other market research methods have claim to this feature.

The second core design feature decided upon at the outset was that the interviews would be conducted via the phone-post/email-phone (PpP) method. This involves an initial screening and recruitment phone call, followed by either posting or emailing a set of (tailored) show material to the recruit, and then following up with a second phone call to conduct the interview once the show material has been received. When show materials are sent by email, the second phone call often followed immediately on from the recruitment phone call.

In comparison with a face-to-face survey with the same cost, the PpP mode will tend to result in a more geographically diverse sample because interviews can be drawn

[5] See for example Train, K. (2003) "Discrete Choice Methods with Simulation", Cambridge University Press.

randomly from across the region rather than from a small number of areas, or clusters, as is necessarily the case with face-to-face surveys due to the very large cost of implementing a geographically dispersed sampling plan. Telephone interviewing is also particularly advantageous for business interviews as – in addition to enhancing the representativeness of the sample – it offers business respondents the flexibility to schedule the interview for a time that best suits them, and to re-schedule at short notice if necessary.

The third core design feature was that the structure of the questionnaire would include the following components:

- Screening and recruitment
- Introduction to main survey
- Usage, experience and attitude questions
- Background information, including service measure definitions
- Choice exercises / contingent valuation
- Follow-up questions, including reasons for choices, ability to choose, perceived realism of the service levels shown, and understanding of the service measures
- Demographics
- Interviewer debriefing on respondents' understanding, effort and concentration.

This structure is typical for SP questionnaires, and is consistent with UKWIR (2011) guidelines.

3.3 Service Measure Selection and Definition

One of the key tasks in the development of the SP survey instrument was to select and define the service measures to be valued. At the outset of the study, we consulted with SEW on the selection of service measures to be put forward for the survey. The selection agreed upon was based on UKWIR (2011) recommendations, and SEW's view of the potential areas where customer values could influence investment decisions at PR14. This view was itself informed by a qualitative research phase conducted by a third party for SEW prior to the start of the present study.

The final selection of service measure definitions and descriptions used in the survey is shown in Table 4. (NB these are the household versions. Business versions were very similar, but see the accompanying CD for the precise wording.)

Table 4: Service Measures: Definitions and Descriptions

Service measure	Description on survey show card
HOSEPIPE BANS from May to September. The chance that this happens in any one year.	Hosepipe bans are put in place during extended dry spells to help manage demand for water. When they are put in place, they typically last for 5 months beginning in May and ending in September. When a ban is in place, hosepipes cannot be used for domestic gardening, cleaning, or recreational uses such as filling home swimming pools. Exemptions apply for commercial users and activities, and vulnerable customers.
DISCOLOURED WATER at your property for a couple of hours at a time. The chance that this happens in	Tap water may occasionally be discoloured although running the tap for several minutes will often cause the problem to go away. When it occurs, this problem usually lasts a couple of hours, but occasionally the problem can last for a few days. Although the water is unlikely to be harmful, you may not want to

any one year.	use it in your household.
WATER SUPPLY INTERRUPTIONS lasting an average of 2 and a half hours. The chance that this happens in any one year.	Interruptions to your water supply can happen at any time and at any property. They typically last around 2 and a half hours. The number of water supply interruptions can be reduced by increased maintenance which would reduce bursts.
PERSISTENT LOW WATER PRESSURE affects the taps, showers and boilers at some customers' properties. The proportion of properties that are affected.	Low water pressure means it takes longer to fill the bath or a kettle than you would like, and it may affect how well a combi boiler works. Persistent means the property is affected every day, though the problem may come and go during the day. It can be caused by the age and condition of the water company's pipes rather than problems with internal plumbing which the customer is responsible for. Properties at the tops of hills and the end of lines are most at risk . If you don't currently suffer, or have never suffered from persistent low water pressure, then your property is not at risk. Customers that do suffer from this problem regularly are entitled to a rebate of £50 off their annual water bill.

In addition to these service measures, a second "stage 2" exercise was included in the survey which focussed on water supply interruptions. This exercise aimed to explore the relative value of planned and unplanned interruptions over a range of different durations. The supply interruption attributes included in this second exercise were:

- Supply interruption duration;
- Notice given; and
- The frequency that this happens at your property.

3.4 Service Levels

The levels assigned to each of the main service measures, and to the second exercise attributes, were provided by SEW, and are shown in Table 5. Consistent with UKWIR (2011) guidelines, the main service measure levels include a "Base" level, a deterioration level (-1), an intermediate improvement (+1) and a stretch improvement (+2).

Table 5: Service Measures and Levels

	Level				
	-1	**Base**	**+1**	**+2**	
Water services					
Discoloured water (chance)	1 in 5	1 in 10	1 in 15	1 in 20	
Water supply interruptions (chance)	1 in 20	1 in 50	1 in 100	1 in 200	
Hosepipe bans (chance)	1 in 5 years	1 in 10 years	1 in 15 years	1 in 20 years	
Persistent low pressure (chance)	500 in 100,000	10 in 100,000	6 in 100,000	1 in 100,000	
	1	**2**	**3**	**4**	**5**
Supply interruptions					
Frequency	1 in 20	1 in 10	1 in 5	1 in 2	Once per year
Duration	Less than 3 hours	3 - 6 hours	6 - 12 hours	12 - 24 hours	24 - 48 hours
Notice	No notice	24 hours notice			

The format of presentation of the attribute levels broadly followed UKWIR (2011) guidelines. The formatting rule adopted was that attributes containing chance levels greater than 0.01 should be presented as "1 in X", and smaller chances should have the smallest common denominator that is a multiple of 10, i.e., 1000, 10,000, 100,000, etc., with the numerator varying across service levels for the attribute. The numbers were rounded in places to facilitate comprehension. Cognitive testing conducted as part of the UKWIR (2011) study found that this approach was preferable to any other format, including use of the number of properties in the company's supply area as the common denominator for all attributes, use of percentages, and use of "1 in X" for all levels including those for chances smaller than 0.01.

It remains the case that the attribute levels used in the survey are likely to test the limits of many respondents' processing capabilities. A notable innovation introduced to the survey design adopted for the study is the inclusion of a visual depiction of the attribute levels using green triangles drawn to scale on each of the choice cards. The aim of the triangles was to address one of the key issues with this type of stated preference work, which is whether customers can effectively process risk levels and make choices reflective of their true preferences when risk levels are small. There is academic evidence that well-designed visual representations result in more theoretically consistent preferences being expressed.[6]

Diagnostic questions in the cognitive interviews we conducted as part of the testing and refinement phase of the study demonstrated that respondents either found the images helpful or were ignored in favour of the text. Our experience has therefore supported the inclusion of the green triangles to communicate risk and we would recommend it as an important innovation in the design of stated preference surveys for water company business planning.

Relatedly, an additional innovation introduced to the survey design was to include shading of the levels of the worse option for every service measure in every choice situation. This shading was introduced to help respondents quickly see which was better and which was worse, thereby giving them a simpler task to deal with and helping to prevent respondents making mistakes. Our cognitive testing of this approach has also resulted in very favourable findings, suggesting that it has indeed help to reduce the cognitive burden of the instrument.

3.5 Choice Exercise Formats

Overall Structure of Choice Exercises

Respondents were asked to make four choices in each of the two choice experiments described above. All choices were between two alternatives, neither of which, in the case of the first exercise, was necessarily the current package of service levels.

Following these two exercises, all respondents were asked to make a choice between all service measures in the water services block deteriorating to Level -1, and all improving to Level +2. The latter option was always associated with a higher bill level than the first option. We refer to this choice as the contingent valuation (CV) question.

[6] Corso, Hammitt and Graham (2001) Valuing mortality-risk reduction: using visual aids to improve the validity of contingent valuation, *Journal of Risk and Uncertainty*, **23**(2), 165-184

Following the CV question, a follow-up question was asked of the form:

Keep looking at Choice Card P. If the cost of Option B was £X from 2019 onwards, would you still choose Option A or would you now choose Option B?

For this follow up question, the differential between the costs of A and B would be doubled if they had chosen option B in the CV question, and would be halved if they had chosen option A.

The inclusion of the follow up question potentially allows for more statistical precision to be obtained on the WTP estimates, but it is not valid to treat the follow up responses as being independent of the initial question. This is because the cost shown to respondents in the first question can influence beliefs about what the true cost is, so that when respondents answer the follow up question, they take into account the initial cost as well as the subsequent cost. Our econometric analysis allows for this dependence following the approach of Alberini, Kanninen and Carson (1997)[7]. Full details are reported in Appendix B.

No Cost Attribute in First Exercise

A notable feature of the survey design adopted for the study is that the first choice exercise did not include a cost variable. UKWIR (2011) did not recommend either that it should or that it should not include a cost variable, and there are good reasons why one might wish to exclude cost from the lower level exercises.

Firstly, excluding cost helps to avoid strategic behaviour. In SP surveys, there is sometimes a tendency for respondents to choose a lower cost option even when they would prefer the higher cost option as a means of strategically trying to minimise the amount they have to pay for any improvements.[8] By excluding cost from the first exercise we prevent this from happening.

Additionally, it can be off-putting to respondents to be given choices about the bill in several separate exercises. Some might feel that they are continually being asked to put their hand in their pocket for more service improvements, and resent this. Others may try and work out how the company will use the information gained from their answers, and find this confusing.

Since the CV questions were designed to obtain our main measures of WTP, it was not necessary to include a cost variable in the first exercise. For the reasons cited above it was therefore not included.

No Status Quo Option

Each choice question in the first two exercises offered the respondent two alternative packages of service levels, neither of which was necessarily the current service package, or status quo (SQ).

[7] Alberini, Kanninen and Carson (1997) "Modeling Response Incentive Effects in Dichotomous Choice Contingent Valuation Data", *Land Economics*,**73**(3), 309-324.

[8] For a full discussion of these issues, see Carson and Groves (2007) "Incentive and informational properties of preference questions," *Environmental & Resource Economics*, **37**, 181-210.

The decision not to include an SQ option in every choice question may be considered somewhat contentious. The main arguments in favour of including an SQ option in every choice situation are the following:

(i) it avoids 'forced choice' as people can simply opt out;
(ii) it mimics a real-world market setting, wherein everyone is free not to buy; and
(iii) it provides a helpful reference point against which respondents can compare the offered alternatives.

In our view, none of these arguments are compelling. Firstly, there is strong evidence to suggest that inclusion of no-opinion options in attitude measures do not enhance data quality, as expected under the 'forced choice' argument, but instead preclude measurement of meaningful opinions. (Krosnick et al., 2002)[9] . The fact that excluding an SQ option forces choices may therefore be considered an advantage rather than a disadvantage.

Secondly, the aim of the survey is not to mimic a market setting, but to parallel a referendum setting. This is because the survey is being conducted as part of a public choice process where the outcome is a public good that all customers will consume whether they voted for it or not. In our view, aiming to mimic a market setting is therefore inappropriate for the present exercise.

Lastly, we agree that there may be some value in knowing the current position to use as a reference point; as such the present survey tells respondents what the current levels of service are with respect to each service measure prior to asking them to make any choices, and gives them the opportunity to look back at those service levels at any time during the choice exercises. Respondents therefore do have a reference point against which to compare the offered alternatives in the choice exercises; they just do not have the opportunity to choose this option at every question.

The principal reason for not including an SQ option in every exercise is in order to prevent respondents from opting out of making the difficult choices required of them to understand their preferences. Surveys that include an SQ option often find an excessive proportion choose this option, consistent with the notion that many are simply opting out from making preference-reflecting choices.

The consequences of this are twofold. Firstly, it is wasteful, as it reduces the sample size of useable responses. More importantly, however, is that it potentially leads to biased estimates. This is because the chance that someone chooses the SQ option is not random, but instead is likely to be correlated with their willingness to pay. If those with lower willingness to pay are more likely to choose the SQ when it is offered to them, then using usual methods of analysis, one would obtain an overestimate of willingness to pay. [10]

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[9] Krosnick J. A., Holbrook, A. L., Berent, M. K., Carson, R. T., Hanemann, W. M., Kopp, R. J., Mitchell, R. C., Presser, S., Ruud, P., Smith, V. K., Moody, W. R., Green, M. C. and Conaway, M. (2002) The Impact of "No Opinion" Response Options on Data Quality: Non-Attitude Reduction or an Invitation to Satisfice, *Public Opinion Quarterly*, **66**, 371-403.

[10] Usually, researchers account for the excessive tendency to choose the SQ option by including an alternative-specific constant to capture the effect, and then disregard this constant when calculating WTP. It is referred to as simply a bias that should be factored out of the WTP calculation altogether. However, if the tendency to choose the SQ option is not random, but is instead (negatively) correlated with WTP, then disregarding the estimated SQ constant will introduce a (positive) bias to the estimate of WTP.

For the reasons set out here, and consistent with the majority view of practitioners surveyed as part of the UKWIR (2011) study, the present survey does not include an SQ option in each choice situation.

3.6 Payment Vehicle, Context and Levels

Consistent with UKWIR (2011) guidelines, the cost amounts were developed to be expressed in real terms, as a phased change over the five year price control period, and remaining constant thereafter.

For household customers, cost levels were included as percentage amounts (of the respondent's current bill) in an underlying experimental design, and were converted into monetary amounts using the respondent's current bill that they stated during the recruitment screener. Using the recruitment information, a set of show cards was sent to households, either by email or by post, that was tailored to their current bill, but based around percentage changes drawn from the experimental design.

For business customers, the amounts shown were given directly in percentage terms, ie no conversion was applied from their current bill as previous research suggests that business customers prefer to respond in percentage terms than in monetary terms.[11]

For example, one option's cost amount might have read (for a household):

Increase of £2 every year for 5 years, from £238 in 2014 to **£248 from 2019**

For the CV question, the cost of the deterioration level choice took values -6% or 0% of respondents' 2014/15 bill level (which was the same as the 2012/13 bill given SEW's assumption of stable bills in real terms. The cost of the improved level option took values 0%, 6%, 12%, 18% or 24%. For businesses, the cost range was restricted to {0%, 6%, 12%} on the basis of evidence from the pilot survey that this range captured the appropriate percentiles of the WTP distribution. (The combinations of {0%, 0%} and {-6%, 24%} were never offered.) These percentages relate to the total change in the annual bill between 2014/15 and 2019/20, where the new bill was said to gradually change over the course of the five years, and then continue at its new level thereafter. The figures were expressed in monetary terms for households and in percentage terms for businesses.

For the follow up CV question, the differential between the costs of A and B was doubled if the respondent chose option B in the CV question, and halved if they had chosen option A. Since the original cost differential between options was either 6%, 12%, 18% or 24%, combining data from these two questions therefore gives responses at costs of 3%, 6%, 9%, 12%, 18%, 24%, 36% and 48%. As before, these percentages relate to the total change in the annual bill between 2014/15 and 2019/20, and the figures were expressed in monetary terms for households and in percentage terms for businesses.

Prior to the start of the pilot survey, SEW were made aware that Thames Water had sent leaflets to all SEW customers that were supplied sewerage by Thames Water. The

[11] See UKWIR (2011) Carrying Out Willingness to Pay Surveys" for details.

leaflets contained information concerning the proposed Thames Tideway Tunnel (TTT), including the expected change in their sewerage bill that this would cause. This amounted to a £70-£80 increase in household bills.

A key decision was taken at this point in the survey development to include explicit reference to the TTT, and to point out that sewerage companies were also making plans for other service changes which could also cause bills to rise. Furthermore, we agreed with SEW that we would split the instrument into six versions – two for Southern Water sewerage customers and four for Thames Water sewerage customers. Each version would include a specific sewerage bill change assumption, and a tailored contextual sentence to support that assumption. The reason for this approach was that it would allow testing of the impact of sewerage bill changes on WTP for water service improvements.

The reason more versions were required for Thames Water customers than for Southern Water customers was that it was desired that we would test sensitivity over a much greater range of sewerage bill change levels, in light of the TTT proposal. For Southern Water customers, increases of £0 and £40 were included for households, and 0% and 15% for businesses; for Thames customers, increases of £0, £40, £80 and £120 were included for households, and 0%, 30%, 60% and 90% for businesses.

The assumed sewerage bill change was included as an additional attribute to the CV show card, but the level it took was the same for both options shown. It was the variation over the sample that we sought to exploit in the analysis, not variation across the options for individual respondents.

3.7 Discrete Choice Experiment Design

The experimental design for each of the two discrete choice experiments consisted of eight sets of four choice questions from which each respondent would be allocated one set. Therefore, every eighth respondent received the same set of choice cards for an exercise.

For the main stage survey, experimental designs were generated using an algorithm which sought to maximise the statistical precision (the "D-efficiency criterion") of the estimates, whilst precluding choice pairs where one option dominates the other one (ie is better on all service aspects). This algorithm required prior assumptions about the coefficients to be estimated in order to calibrate it, and we used the pilot results to supply these priors.

For the pilot survey, the experimental designs were created randomly with the only criteria being that each of the levels should be identifiable, that there should be an approximately equal number of each of the levels across the design as a whole, and that no choice situation should be dominated by one of the two options – ie there should be some element of trade off in every choice.

The CV question was always the same for each respondent except for the cost levels and sewerage bill changes which varied randomly.

3.8 Peer Review

The survey instrument was peer reviewed by Prof. Carson prior to field testing.

3.9 Testing and Refinement

Two phases of pre-testing of the survey instrument were carried out prior to the main fieldwork. The first phase consisted of 16 cognitive interviews (10 with household customers and 6 with business customers), in which respondents were encouraged to "think aloud" and give feedback on the questionnaire as they worked their way through it. These interviews were conducted between 21 September and 8 October 2012.

The second phase of pre-testing consisted of a pilot of 100 interviews with household customers and 100 interviews with business customers, conducted between 2 and 20 November 2012.

Cognitive interviews

The main objectives of the cognitive interviews were to test:

- the clarity and flow of the questionnaire
- the appropriateness of the language used
- ease of use of the show material
- the stated preference design and understanding of the stated preference exercises.

Respondents were recruited by telephone, then posted or emailed some show material, and then telephoned again to complete the survey interview.

Respondents were taken through the survey instruments as they would in the main fieldwork. However, further questions were inserted throughout the interview to probe and test levels of understanding and where improvements could be made.

The results from the cognitive testing showed that overall, participants were able to complete the survey, with a high degree of comprehension, and no major issues with the design were uncovered.

A series of minor points were raised which led to some small amendments to improve the clarity and flow of the questionnaire. This involved some small changes in text and/or re-arrangement of the text.

Pilot surveys

Following on from the cognitive phase, the questionnaire was pilot tested via telephone interviews with 100 household and 100 business customers.

In all cases, respondents were recruited by telephone, then posted or emailed some show material, and then telephoned again to complete the survey interview.

The pilot survey was conducted in order to test:

- the recruitment process
- the clarity and flow of the questionnaire
- the appropriateness of the language used
- the accuracy of all routings
- ease of use of the show material

- the stated preference design and understanding of the stated preference and contingent valuation exercises
- the interview duration
- the survey hit rate.

As the core deliverables of the study are concerned with customer priorities and willingness to pay data, the targets for this research were customers with responsibilities for paying bills.

Screening questions were used to ensure that the most appropriate target was selected for invitation to take part. Various quotas were used for the pilot phase to ensure the issues in question were explored with a full range of participants. For household customers, region, age and socio-economic grouping quotas were applied. For business customers, region, bill size and sector quotas were applied.

The key findings from the pilot were:

- The vast majority of respondents felt able to make comparisons between the options presented to them, found the service areas easy to understand, and believed that the levels shown were plausible.

- Interviews assessed respondents as generally showing very good levels of understanding, effort and concentration.

- Reasons given by respondents for the choices they made in the stated preference exercises were valid, in that there were no cases of a significant number of respondents incorporating invalid beliefs or inferences when making their choices.

- All the econometric choice models satisfied the minimum theoretical standards for validity, in that they indicated respondents preferred better service levels to worse service levels, and preferred lower bills to higher bills, all else equal. Moreover, the levels of precision were good for the sizes of the pilot samples used in the analysis.

Following the pilot, the cost levels used for the CV question in both household and business surveys were not changed as they seemed appropriate given the pilot responses.

Additionally, results from an econometric analysis of the pilot data were used to calibrate the experimental designs for the choice experiments for the main stage.

We recommended to SEW that the pilot survey instrument was adopted for the main stage of the survey with only very minor changes to the wording in a few places and that customers with cesspits either need to be screened out of the survey or a tailored route through the questionnaire designed for them, depending on SEW's preference as to whether to include them or not. Following guidance from SEW, the decision was taken to include households with cesspits and so the routing was amended accordingly to take account of this customer group. The amendments, as with all other amendments, were submitted to SEW for approval prior to the main fieldwork commencing.

4. SURVEY ADMINISTRATION

4.1 Sampling and Quota Controls

Household

Sample for the household survey was sourced from Accent's preferred list supplier, Sample Answers, who provided 'random digit dialling' (RDD) and 'lifestyle' sample for householders across the South East Water region.

RDD sample is created by selecting a known, existing telephone number and randomising the last couple of digits to generate a new telephone number that may or may not exist. Checks are made to ensure, firstly that the number is valid, and, so far as is possible, that the number is not a business number. The main advantage of RDD is that all households in a given geographical area are given equal opportunity to participate in the research. The main disadvantage is that there is no information known about the person on the other end of the phone before the call.

Lifestyle sample comes from a database of people based on a questionnaire covering all or some aspects of their lives including age, number of people in household, income, housing, family, education, sports and activities etc. This has the advantage of enabling specific targeting for quotas.

The overall target number of interviews to achieve was 1,000 for the main stage of the research. The total achieved including pilot interviews was 1,103.

Quotas were set to try to ensure that the overall dataset was representative of SEW customers in terms of age, SEG, and area. Age and SEG quotas were set on the basis of 2001 Census data for the South East region, using Household Reference Person (HHRP) as the proxy for bill payer. Quotas for region were based on customer data provided by SEW.

The quotas and achieved interviews are as follows:

Table 6: Achieved Quotas

Demographic	Target	Achieved
AGE		
18-29	9%	4%
30-44	30%	23%
45-64	35%	40%
65-74	14%	19%
75+	12%	12%
Refused	-	1%
SEG		
AB - Higher and intermediate managerial/ administrative/ professional	25%	26%
C1 - Supervisory, clerical, junior managerial/ administrative/ professional	33%	31%
C2 - Skilled manual workers	13%	14%
D/E - Semi-skilled and unskilled manual workers /On state benefit, unemployed, lowest grade workers	29%	27%
Refused	-	2%
Area		
Thames sewerage area	40%	42%
Southern sewerage area	60%	58%

Base=all household respondents: 1,103

The achieved interviews broadly matches the population structure with regard to age and SEG as set out in Table 6, and no weighting was applied.

Business

The business sample for this survey was supplied by South East Water. The target respondent was whoever was responsible for paying their organisation's water bills and/or for liaising with SEW.

The overall target number of interviews to achieve was 500 for the main stage of the research. The total achieved including pilot interviews was 600.

The principal criterion used to develop the business sample plan was bill size. Our prior expectation was that WTP would be approximately equal across customers as a percentage of their current bills. This premise leads to an optimal sample plan where businesses are sampled by bill size category in proportion to total revenue attributable to that category as a whole. This approach stands in stark contrast to an approach based on representing each size band by the proportion of customers in the band, as is shown in Table 7.

Table 7 shows the proportion of customers and the proportion of revenue accounted for by three bill size categories, by service segment. The table clearly shows that the vast majority of customers are in the "Less than £1k" band, but the majority of revenue is accounted for by the "£5k+" band.

The target set for the sample was to try and capture as many larger users as feasible, given that it would never be possible to recruit an optimal balance of respondent numbers across the bill size categories because of the lack of sufficient numbers of customers in the population in the largest size categories. The "Achieved sample" column shows the proportions that were obtained in each size band in the main survey sample by following this approach. It over-represents larger users based on customer numbers, but under-represents them based on revenue contribution.

Since it is revenue contribution that indicates the importance of an observation under our premise (that WTP is expected to be approximately equal across size bands as a proportion of current bills), we apply weights to the data so that the weighted proportions of respondents in the sample are equal to the revenue proportions. This leads to small weights being applied to the small users and large weights applied to the large users.

All results for businesses are based on these weights except where otherwise indicated.

Table 7: Business Sample Structure

Bill size	Proportion of customers (%)	Proportion of revenue (%)	Achieved sample (%)	Weight
Less than £1k	79	12	50	0.2487
£1k-£5k	15	21	33	0.6469
£5k+	6	66	17	3.8612

Base = all business respondents: 600

An area target was also set based on the split in the database provided by SEW. This was broadly matched.

Table 8: Business Sample Structure – Region

Area	Target	Achieved
Thames sewerage area	33%	36%
Southern sewerage area	66%	64%

Base = all business respondents: 600

4.2 Fieldwork Methodology

The fieldwork for household customers was undertaken using a phone-post/email-phone method, where respondents are recruited by telephone, sent show materials by post or email, and then re-contacted by phone for the main interview to be administered. This method allows interviews to be drawn randomly from across the SEW region rather than from a small number of areas, or clusters, as would be the case with face-to-face interviewing. This well-established method also allows for high levels of quality control and interviewer administration to ensure respondent comprehension is maximised.

Fieldwork for business customers also used the phone-post/email-phone method. A telephone-based approach suits businesses as it offers respondents the flexibility to schedule the interview for a time that best suits them, and to re-schedule at short notice if necessary. The method is preferable to other options such as online interviewing because it allows for higher levels of quality control, and interviewer administration ensures respondent comprehension is maximised.

The interviews were completed by experienced interviewing teams, trained to ISO 20252 standards, from Accent's telephone unit in Edinburgh. Computer-aided interviews were undertaken using Accent's proprietary software *Accis*.

All telephone work was fully supervised, and interviews were monitored on a regular basis in line with Accent's quality system requirements.

The main stage business and household survey was conducted between 23 January and 7 February 2013.

All research was undertaken in line with the requirements of the market research quality standard ISO 20252:2006.

5. SAMPLE CHARACTERISTICS

5.1 Introduction

This section presents descriptive charts and statistics from all the non-SP questions in the survey. This includes information on: household and business demographics; current bill levels; experiences of water service failures; respondent and interviewer feedback on the survey; and respondents' reasons for their SP choices. The section concludes by discussing the analysis samples that we use for the SP analysis in the remainder of the report.

5.2 Household Demographics

Quotas were set on age and socio-economic group (SEG) to ensure the achieved sample reflected the known profile for the region. The demographics achieved for the householders surveyed for this research can be compared to the demographics in Table 6 shown in section 4.

Some 19% of households interviewed have an income below £300 per week, normally considered 'low income' households.

Table 9: Household Income

Household income	% of Households
A. Up to £100 Per Week (Under £5,200 Per Year)	2
B. £101-£200 Per Week (£5,201-£10,400 Per Year)	7
C. £201-£300 Per Week (£10,401 - £15,600 Per Year)	10
D. £301-£400 Per Week (£15,601 - £20,800 Per Year)	7
E. £401-£500 Per Week (£20,801,-£26,000 Per Year)	7
F. £501-£600 Per Week (£26,001-£31,200 Per Year)	7
G. £601-£800 Per Week (£31,201-£41,600 Per Year)	9
H. £801-£1000 Per Week (£41,601 - £52,000 Per Year)	9
I. £1001-£1200 Per Week (£52,001 - £62,400 Per Year)	7
J. £1201-£1400 Per Week (£62,401 - £72,800 Per Year)	5
K. £1401-£1600 Per Week (£72,801 - £83,200 Per Year)	4
L. More than £1601 Per Week (More than £83,201 Per Year)	6
Prefer not to say	22

Base=all household respondents: 1,103

Over half (54%) of respondents are economically active (employed full- or part-time or self-employed). Over a third (34%) are educated to at least degree level; 13% have no qualifications.

Table 10: Employment Status

Employment Status	% of Respondents
Self employed	10
Employed full-time (30+ hours)	32
Employed part time (up to 30 hours)	12
Student	1
Unemployed – seeking work	2
Unemployed – other	2
Looking after the home/children full time	4
Retired	36
Unable to work due to sickness or disability	1
Other	1

Base=all household respondents: 1,103

Table 11: Level of Education Achieved

Level of Education	% of Respondents
O levels/ CSEs/ GCSEs	24
A levels/ AS level/ higher school certificate	14
NVQ (Level 1 and 2). Foundation/ Intermediate/ Advanced GNVQ/ HNC/ HND	9
Other qualifications (e.g. City and Guilds, RSA/OCR, BTEC/Edexcel)	6
First degree (e.g. BA, BSc)	20
Higher degree (e.g. MA, PhD, PGCE, post graduate certificates and diplomas)	9
Professional qualifications (teacher, doctor, dentist, architect, engineer, lawyer etc.)	5
No qualifications	13

Base=all household respondents: 1,103

A quarter (27%) of households have children aged under 16 in residence. Almost half have adults over the age of 60 in residence.

Table 12: Household Structure

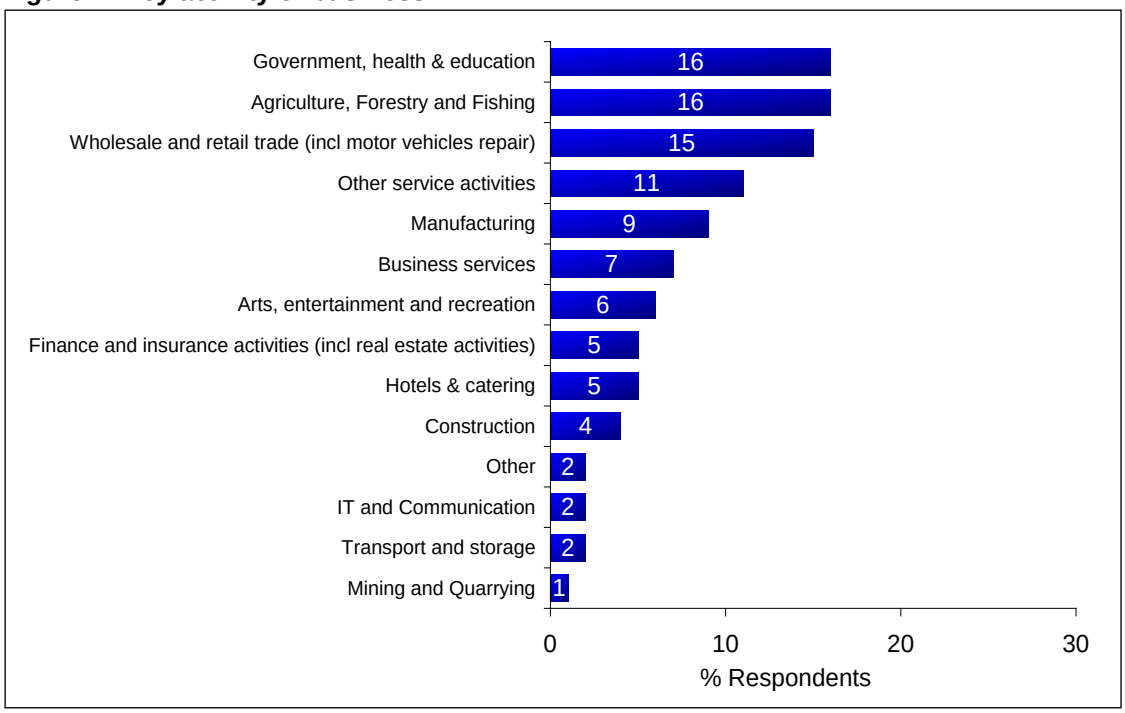
Age band	Frequency, by number in age band (%)				
	0	1	2	3	4+
0-15	74	12	11	3	1
16-60	35	18	31	9	6
61+	56	23	21	0	0

Base=all household respondents: 1,103

5.3 Business Demographics

The main business activities of businesses in the sample are agriculture, forestry and fishing (16%); wholesale and retail trade (15%); and public sector activities (16%).

Figure 2: Key activity of business



Base = all business respondents: 600 (unwieghted)

Most of the businesses covered were relatively small with just under half (46%) having fewer than 10 employees.

Table 13: The Number of Employees at the Business Premises

Number of employees	% of Businesses
0 to 4	26
5 to 9	20
10 to 19	16
20 to 49	18
50 to 99	8
100 to 249	6
250 to 499	2
500 to 999	0
1,000 +	2
Don't know/ not stated	3

Base = all business respondents: 600 (unweighted)

5.4 Current Bill Levels

All household respondents were asked to indicate the size of their South East Water bill, if they knew it. They were able to provide figures on a monthly, quarterly, six monthly or annual basis, whichever they felt appropriate, and a total annual figure was calculated from this. Just over half (54%) of customers were able to provide a figure for their bill.

For customers who received sewerage services from Thames Water, and whose South East Water bill therefore includes sewerage charges, the water services portion of the bill was calculated at 59% of their total bill. This was based on figures provided by South East Water for average water and sewerage bills in the Thames sewerage area. This calculated water services figure was stated back to respondents in the interview in

this form: *"Previously you told me that your annual bill from South East Water is [VALUE] That includes both water and waste services, and of that amount, [VALUE*0.59] goes to South East Water for water services."*

For customers who did not know their bill, they were informed that the average annual bill for water services in the South East Water area was £204.

Table 14 shows the values of the annual water services bill for all respondents.

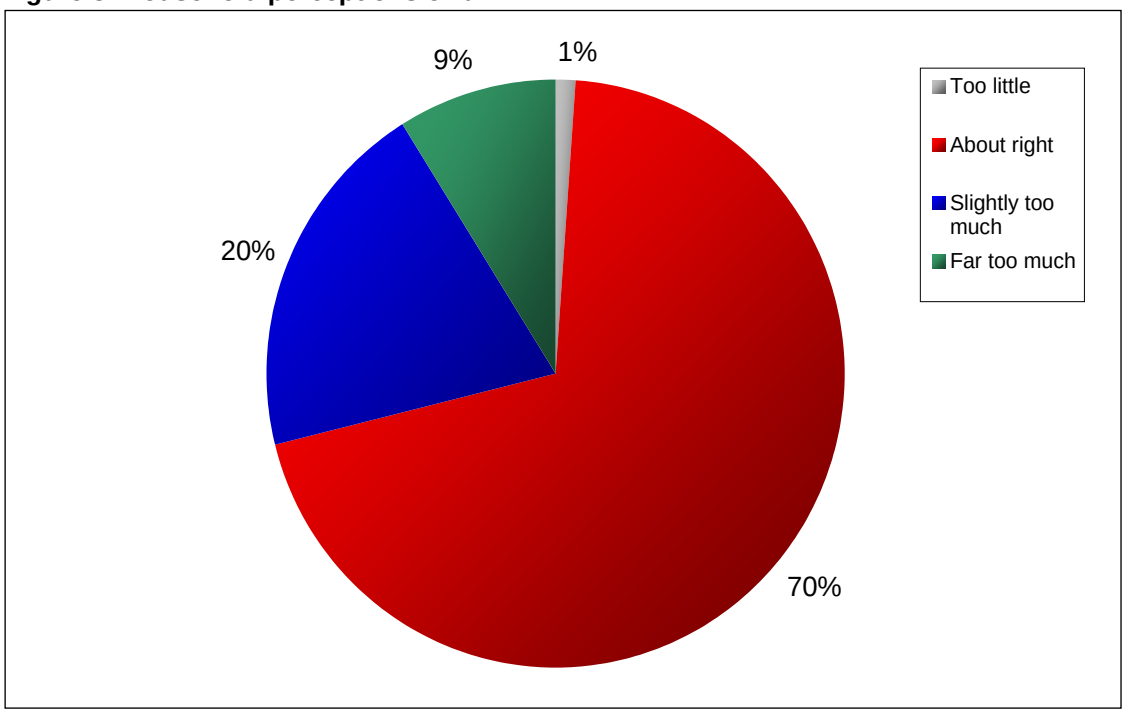
Table 14: Annual water bill – Household Respondents

Annual bill size	% of Household Respondents
0 to £100	4
£101 to £200	13
£201 to £300	19
£301 to £400	9
£401 to £500	6
£501 +	4
Don't know	46

Base=all household respondents: 1,103

The majority of domestic customers (70%) think what they pay is 'about right' but more than a quarter think they pay too much for water services.

Figure 3: Household perceptions of bill



Base=all household respondents: 1,103

Half of businesses (50%) are paying less than £1000 per annum.

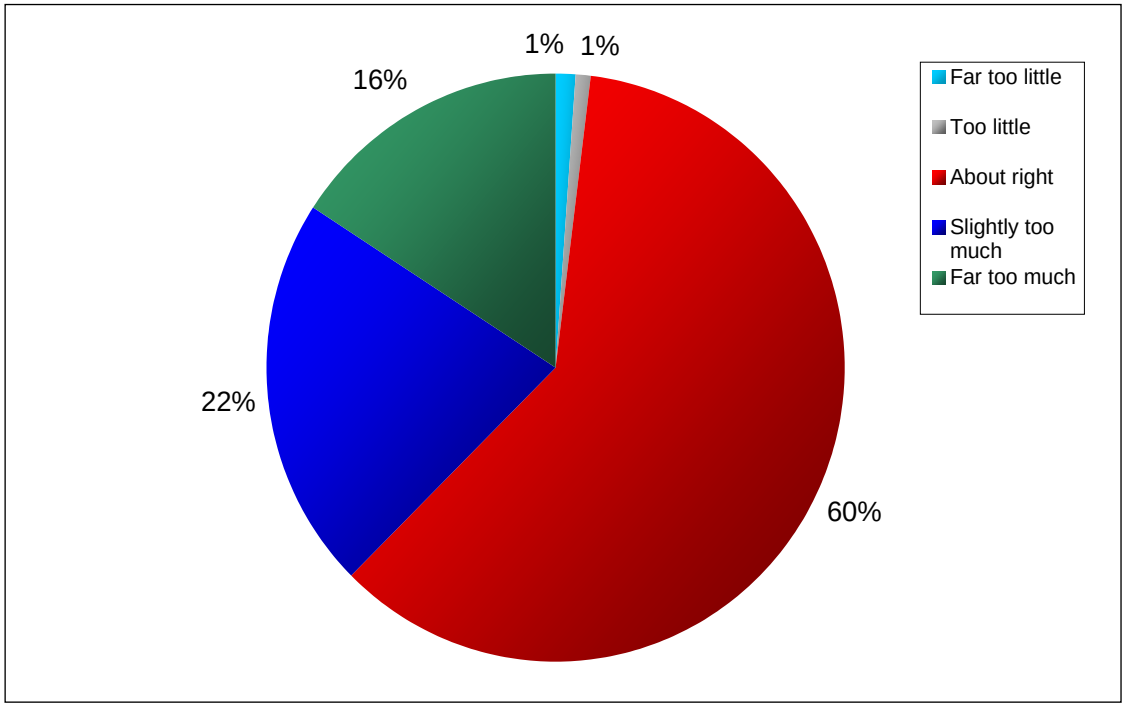
Table 15: Business Annual Bill

Annual bill	% of Businesses
Less than £1,000	50
£1,000 - £5,000	33
£5,001 - £20,000	14
£20, 001 - £100,000	3
Over £100,000	0

Base = all business respondents: 600 (unweighted)

Businesses are more likely to feel they are paying too much for their water services than households: 60% think the amount they are paying is 'about right', 38% think it is too much.

Figure 4: Business perceptions of bill

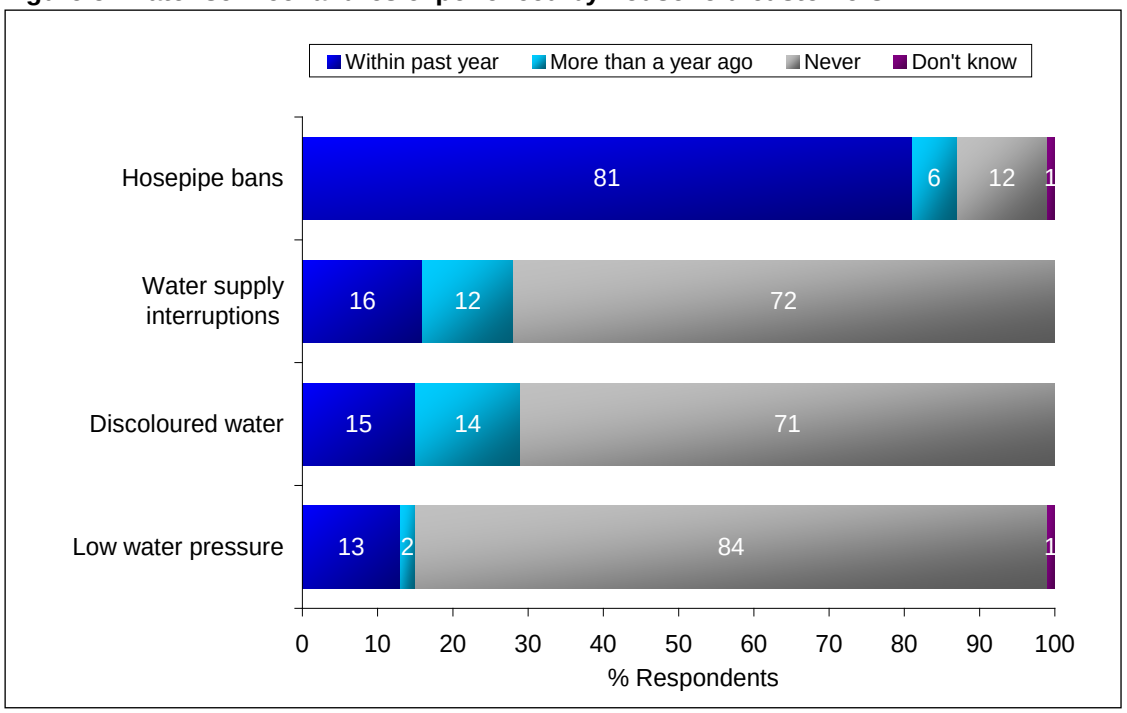


Base = all business respondents: 600 (unweighted)

5.5 Experience of Water Service Failures

A large majority of household customers (81%) say they have experienced a hosepipe ban in the last year. (There was a hosepipe ban in force in the South East Water area from April to early July 2012). 29% per cent say they, or friends and relatives, have ever experienced discoloured water, 15% in the last year; and 28% say they or friends and relatives have experienced water supply interruptions, 16% of them recently. Experience of low water pressure is somewhat lower with 15% saying they or a friend or relative have experienced this, 13% in the past year.

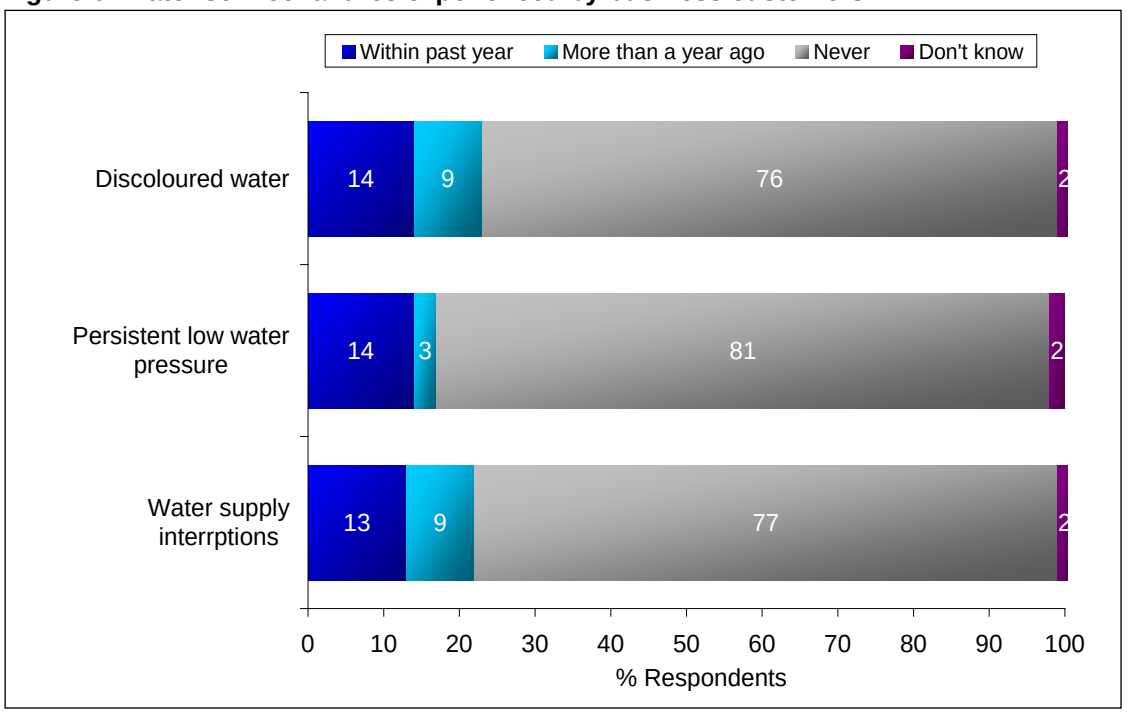
Figure 5: Water service failures experienced by household customers



Base=all household respondents: 1,103

Just under a quarter (23%) of business customers have experienced discoloured water, 14% in the last year; similar proportions say they have experienced supply interruptions; and a lower proportion say they suffer from low water pressure (14% in the last year).

Figure 6: Water service failures experienced by business customers

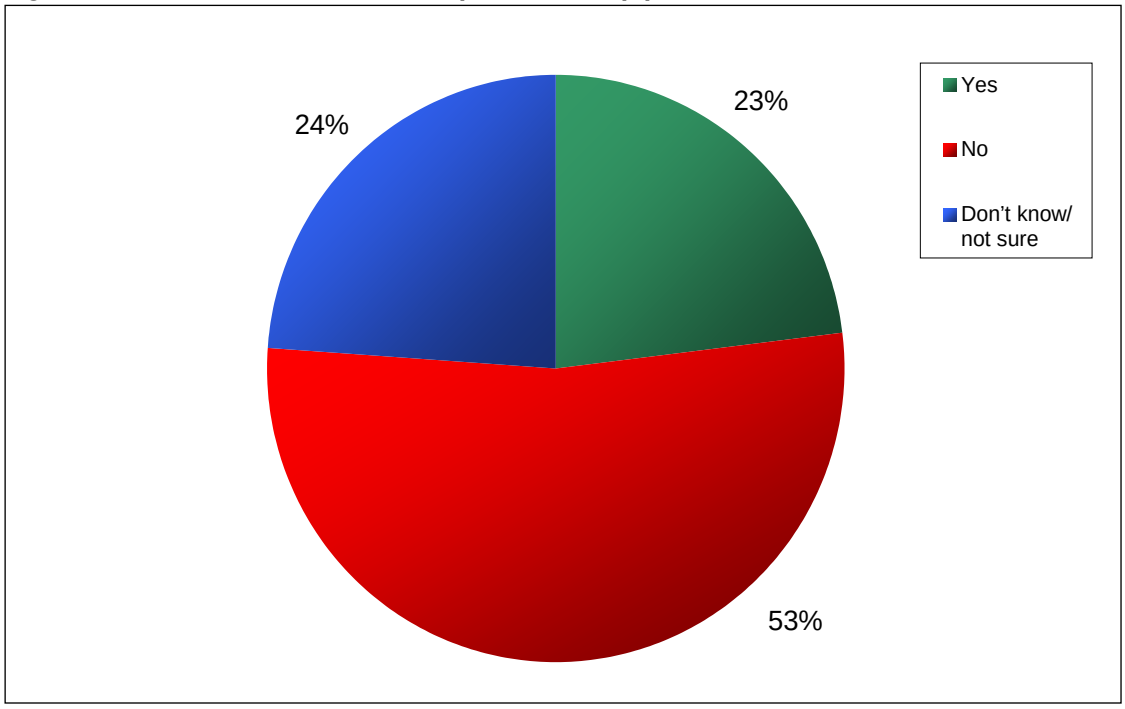


Base = all business respondents: 600 (unweighted)

A quarter (23%) of businesses say they are exempt from hosepipe bans, though there is a lot of uncertainty, with a further quarter (24%) unsure.

The majority (57%) of businesses say their business depends on water for its main activity.

Figure 7: Business customers exempt from hosepipe bans



Base = all business respondents: 600 (unweighted)

5.6 Priorities for Water Service Improvements

After learning about the different service measures and the current levels of service, but before moving into the first choice exercise, respondents were asked: "*Which of these service failures on the card, if any, would you most like to see improved in the future?*". Respondents could give multiple responses if they chose to, or could say "None" if they would rather not see any improvements.

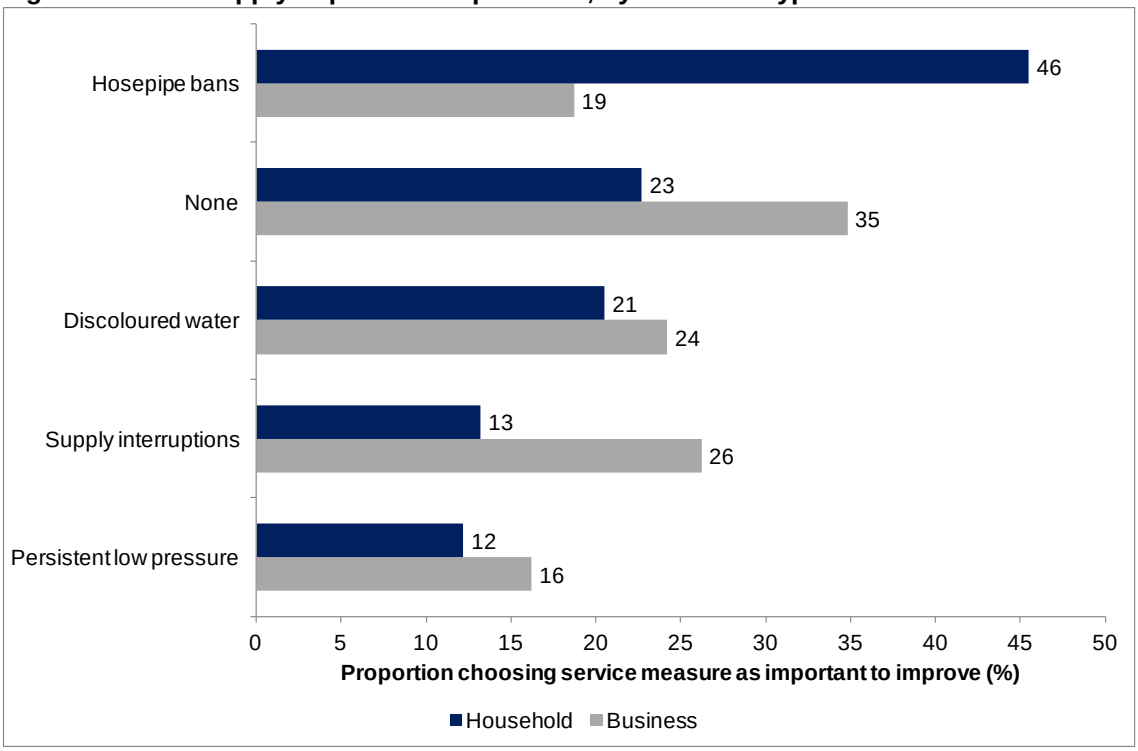
As shown in Figure 8, hosepipe bans were indicated as a priority for improvement by more households than any other service measure (46%), while persistent low pressure and supply interruptions were indicated by the fewest (12% and 13% respectively). For businesses, the most popular response was "None" (35%) although all of the service measures commanded at least 16% support each as priorities for improvement.

We refer to the results shown in Figure 8 as respondents' 'simple priorities', which distinguishes them from the truer priorities that will emerge from application of CBA using the main WTP results obtained from the choice responses. These simple priorities do not factor in the extent of any improvement, the cost of that improvement, or the context in which the improvement is to be applied with respect to the overall package composition and cost. All of these factors are accounted for when applying CBA with the main WTP results obtained from the choice responses.

The most useful application of these results is as a means of cross-checking the answers that emerge from the main choice exercise analysis. This is done by introducing the answers to these simple priority questions as explanatory factors in the econometric

models based on the choice data to verify that they are correlated in the expected way, namely that those choosing a particular service measure as the most important to improve tend to give that measure a greater weight than other respondents when making their choices. This analysis is reported on in section 6.4.

Figure 8: Water supply improvement priorities, by customer type



5.7 Respondent and Interviewer Feedback

The SP element of the survey is fairly complex, in that there are a number of service measures being valued and some of them will be unfamiliar to respondents. It is therefore important to carry out validity checks on respondents' understanding and ability to make comparisons.

Table 16 shows results from four respondent feedback questions. This shows that the majority of household and business respondents felt able to make comparisons between the SP choices presented to them and found the levels of service easy to understand, and the service levels were plausible.

Table 16: Respondent Feedback, by Customer Type

Question		Frequency, by customer type (%)	
		Households	Businesses
Q44/48	**Did you generally feel able to make comparisons between the two options I presented to you?**		
	Yes	93	92
	No	7	8
Q46/50	**Did you find each of the levels of service we described easy to understand?**		
	Yes	95	94
	No	5	6
Q48/52	**Were any of the service levels so low or so high that they were unrealistic?**		
	No	88	91
	Yes	12	9

Base= household respondents: 1,103; business respondents: 600 (unweighted)

Table 17 shows results from three feedback questions completed by interviewers immediately following completion of each survey. The levels of understanding shown are very good for an SP survey in our experience. Levels of effort and concentration do not appear to be a problem, with the vast majority of both households and businesses giving the questions careful consideration, and managing to maintain concentration throughout the survey.

Table 17: Interviewer Feedback, by Customer Type

Question		Frequency, by customer type (%)	
		Households	Businesses
Q57/56	**In your judgement, did the respondent understand what he/she was being asked to do in the questions?**		
	Understood completely	67	63
	Understood a great deal	25	27
	Understood a little	7	9
	Did not understand very much	2	1
	Did not understand at all	0	0
Q58/57	**Which of the following best describes the amount of thought the respondent put into making their choices?**		
	Gave the questions very careful consideration	69	55
	Gave the questions careful consideration	23	35
	Gave the questions some consideration	7	10
	Gave the questions little consideration	1	2
	Gave the questions no consideration	0	0
Q59/58	**Which of the following best describes the degree of fatigue shown by the respondent when doing the choice experiments?**		
	Easily maintained concentration	76	77
	Maintained concentration with some effort	20	17
	Maintained concentration with a deal of effort	4	4
	Lessened concentration in the later stages	1	1
	Lost concentration in the later stages	0	0

Base= household respondents: 1,103; business respondents: 600 (unweighted)

5.8 Reasons for Choices

After their initial decision in each choice exercise, respondents were asked why they had made the selection they had. Analysis of these responses gives a good indication of whether the respondents were making their decisions on the basis of the information shown to them, as intended by the design, or were incorporating unintended inferences or reasoning.

Below are the responses given by household and business customers for each choice exercise. The vast majority of the reasons people gave were coded into one or more of valid reasons. Respondents generally cited the reason for their choice as being that one option was better than the other on the basis of the service levels that were shown to them in the corresponding choice situation. There were no cases of a significant number of respondents (>5%) incorporating any specific invalid beliefs or inferences.

Table 18: Reasons for Choices, by Customer Type

	Frequency, by customer type (%)	
	Household	**Business**
Reasons for choice in exercise 1		
Less chance of (better for) hosepipe bans	27	12
Less chance of (better for) discoloured water	22	18
Less chance of (better for) water supply interruptions	15	27
Less chance of (better for) persistent low water pressure	12	14
Overall better service/option	27	31
Hosepipe bans not as important	3	2
Discoloured water not as important	0	1
Less chance (unspecified)	2	1
None are applicable to us/no experience	1	2
Don't know	0	0
Other	4	4
Reasons for choice in exercise 2		
Less chance of (better for) supply interruption duration	31	28
Less chance of (better for) notice given	41	38
Less chance of (better for) frequency this happens at property	24	22
Overall better service/option	5	8
Less chance of (better for) interruptions (unspecified duration or frequency)	2	4
No experience	0	1
Don't know	0	0
Other	4	3
Reasons for choice in CV exercise		
Overall better service/option	36	27
Better for bill/Cheaper (unspecified)	35	39
Happy to pay increase in bill/for better service/need to pay for investment in infrastructure	26	19
Less chance of (better for) water supply interruptions	4	6
None are applicable to us/no experience/happy with current levels	4	5
Less chance of (better for) hosepipe bans	2	2
Less chance of (better for) discoloured water	2	2
Less chance of (better for) persistent low water pressure	1	2
No change in annual water bill	0	1
Don't know	0	0
Other	8	11

Base= household respondents: 1,103; business respondents: 600 (unweighted)

6. VALUATION RESULTS

6.1 Introduction

The core purpose of the WTP survey research is to obtain estimates of marginal customer valuations of unit changes in service levels for each of the service areas included in the survey. These are the values that will be input into SEW's CBA for investment planning. An additional aim of the analysis was to obtain a range of results exploring the variation in values across respondents - for a richer understanding of customers' preferences, and for checking that WTP varies in line with expectation.

The remainder of this section presents the valuation results in three parts. Section 6.2 presents customers' values for packages of service level changes, between, for example, Base and Level +2, for each of the service measures. These show how much customers were willing to pay for the service measure improvements that were shown to them in the survey. Section 6.3 then presents the results converted into a per-unit basis, for example per avoided discoloured water incident or avoided interruption. The final part of this section summarises the results from our multivariate analyses of the variation in values across respondents. This part reports on the effect of the sewerage bill assumption on values, as well as the extent to which choices were consistent with expectation across the sample.

Full technical details of how these results were derived, including all supporting results, are contained in Appendix B for households and Appendix C for businesses.

6.2 Package Values

This section begins by presenting descriptive statistics from the CV responses, in the form of a chart showing the proportions of household and business customers choosing the Level +2 package instead of the Level -1 package at varying levels of cost. We then present our main estimates of the values of packages of service change, as derived from the econometric analysis reported in Appendix B for households and Appendix C for businesses.

Descriptive Statistics

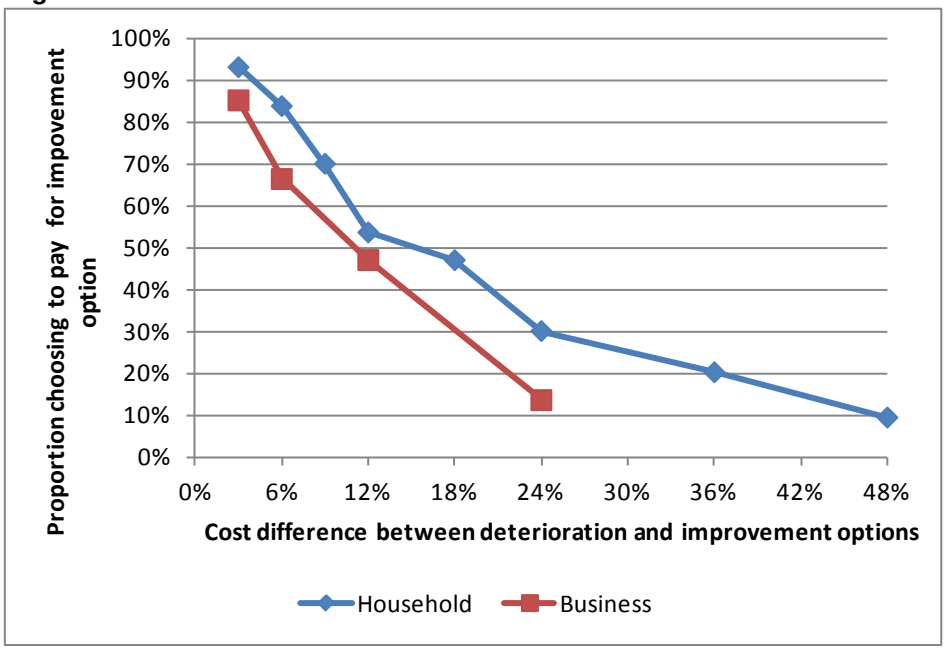
Figure 9 and the corresponding table beneath show the proportions of household and business respondents choosing the maximum improvement package, rather than the deterioration package, when asked directly via the CV questions. The proportions are calculated such that if a respondent said "yes" to, say "24%", s/he is also included in the proportion shown as being willing to pay all amounts less than 24%. Likewise, if a respondent said "no" to, say "3%", s/he is also included in the proportion shown as being unwilling to pay all amounts greater than 3%.

The chart in Figure 9 shows very clearly that SEW's customers attached a high value to the range of service level changes spanned by the whole package, and that businesses are willing to pay substantially less than households. The median WTP for households is between 12% and 18% of their current bill, and the median WTP for businesses is between 6% and 12% of their current bill.

If the numbers seem somewhat higher than might have been expected, then this may be influenced by the fact that costs appeared in the survey as cumulative changes; for example 12% would appear as "an increase of 2.4% per year each year for 5 years from 2015, i.e., a 12% total increase from 2019". This form of presentation represents a departure from the approach taken at PR09 where bills were presented as one-off changes, rather than gradually adjusting profiles. It is likely that this change in presentation makes bill impacts appear less onerous to customers than previously, and so might have caused customers to be willing to pay more, with respect to the total cumulative change, than was observed at PR09.

Furthermore, this "whole package" corresponds to the range from Level -1 (deterioration) to Level +2 (maximum improvement) for all service areas. It is therefore, importantly, of a significantly greater scope than any service change under consideration by SEW - the maximum change that could be valued robustly using the results of this survey would be either the improvement from Level 0 (Base) to Level +2, or the deterioration from Level 0 to Level -1 in all service measures. This approach is conservative, in that, by construction, cost-benefit analysis (CBA) of feasible schemes should never result in a package of changes that exceeds respondents' total willingness to pay.

Figure 9: Proportions choosing improvement over deterioration option, by customer segment and cost difference



Base for households: 1,103; base for businesses: 600. Figures show the proportions choosing the improvement option rather than the deterioration option at each cost difference between deterioration and improvement options shown in the contingent valuation questions, expressed as a percentage of the respondent's 2014/15 water and sewerage bill amount. Notes: (1) costs appeared in the survey as cumulative changes; for example 12% would appear (to businesses) as "an increase of 2.4% per year each year for 5 years from 2014, i.e., a 12% total increase by 2019". (2) Proportions are calculated as the number choosing the improvement option at the cost difference shown, or any amount higher than this, divided by this plus the number choosing the deterioration option at the cost difference shown or any amount lower.

Table 19: Proportions Choosing Improvement over Deterioration Option, by Customer Segment and Cost Difference

Cost difference[1]	Proportions choosing improvement over deterioration option[2]	
	Households	Businesses
3%	93%	85%
6%	84%	66%
9%	70%	-
12%	54%	47%
18%	47%	-
24%	30%	14%
36%	20%	-
48%	9%	-

Base for households: 1,103; base for businesses: 600; The symbol "-" indicates that respondents were not offered a choice at the corresponding cost difference. Notes: (1) Figures show the cost difference between deterioration and improvement options in the contingent valuation questions, expressed as a percentage of the respondent's 2014/15 water and sewerage bill amount. (2) Figures are calculated as the number choosing the improvement option at the cost difference shown, or any amount higher than this, divided by this plus the number choosing the deterioration option at the cost difference shown or any amount lower.

Econometric Estimates

The choice data were analysed using best practice econometric methods, including mixed logit models for the DCE analysis and random effects probit models for the CV analysis. Details of the modelling methodology and all interim findings are reported in Appendices B and C for households and businesses respectively.

The models estimated on the CV responses allowed different values to be obtained, in absolute terms, for improvements in services in comparison to deteriorations of the same degree. There is a substantial literature suggesting that people might be less willing to accept reductions in service in exchange for reduced bills, than they would be willing to pay for the same service change in reverse. We would therefore expect willingness to accept (WTA, the value of a deterioration) to be greater, in absolute terms, than WTP (the value of an equivalent improvement).

Our findings from this modelling showed clearly that this was the case. Respondents' choices were much less sensitive to the size of a bill reduction on average than they were to the size of a bill increase. As a consequence, no realistic bill reduction (up to 6% of current bills) would lead households or businesses, on average, to choose a widespread service deterioration.

The next table presents WTP results for individual service measures where each service measure moves from its base service level to either one of the other three levels. The figures in this table show the maximum extra from 2019/20 that customers are willing to pay, on average, for the package shown, where the actual cost gradually adjusts over five annual increments. For example, a value of £10 would correspond to a £2 increment per year for five years from 2015/16 to 2019/20 inclusive, leading to a total change of +£10 from 2019/20 onwards.

The figures shown are based on an overall PR14 package involving stable or increasing bills. They are not valid in the context of a declining bill because the models on which the figures are based indicate that in this case values would be much higher (and not well estimated). For deteriorations, the amounts shown by service measure are the threshold prices around which beneficial trades could take place in relation to

improvements in other services in the context of stable or increasing bills overall. Our modeling results suggested that household and business respondents were unwilling to accept widespread deteriorations in service for any size of bill reduction shown. There are therefore no values reported for all services deteriorating to Level -1.

The table shows "central" estimates as well as a sensitivity range around this estimate. The central estimates are based on the full sample for each customer type, and are calibrated to an assumed real cost of maintaining base service levels up to 2020 of +5.3%, where this assumption was provided by SEW. The ranges around the central values encompass a collection of sensitivity checks, including values based on assumed costs of maintaining base service levels of +4% and +8%, and values for low income households and for a sample that excludes respondents that had difficulty answering the choice questions. For household customers, the lower bound of the recommended range is based on results for a low income sample and the upper bound is based on the upper bound of the 95% confidence interval. For business customers, the recommended range is based purely on the 95% confidence interval as this encompassed all other sensitivity check values.

The results in Table 20 show that the central case maximum value that household customers would be prepared to pay by 2019/20 for the service package where all measures improve to Level +1 would be an increment of £12.01 to their annual bill, and the maximum they would be prepared to pay for the maximum improvement package (Level +2) would be an increment of £18.06 per year on to their bills. For business customers, the comparable estimates are £15.99 per year and £24.06. These figures are in real terms, i.e., excluding inflation, which respondents were aware would be added on top.

Table 20: Willingness to Pay for Packages of Service Level Changes, by Customer Type

	Willingness to pay (£/customer/year)					
	Base to Level -1		Base to Level +1		Base to Level +2	
	Central	Range	Central	Range	Central	Range
Households						
Discoloured water	-12.56	(-8.76, -14.49)	4.19	(2.92, 4.83)	6.28	(4.38, 7.24)
Water supply interruptions	-12.48	(-8.70, -14.40)	4.16	(2.90, 4.80)	6.24	(4.35, 7.20)
Hosepipe ban	-10.83	(-7.55, -12.48)	3.61	(2.52, 4.16)	5.41	(3.77, 6.24)
Persistent low pressure	-6.90	(-4.81, -7.96)	0.06	(0.04, 0.060	0.13	(0.09, 0.15)
All service measures			**12.01**	**(8.38, 13.85)**	**18.06**	**(12.59, 20.83)**
Businesses						
Discoloured water	-13.31	(-10.67, -15.95)	4.44	(3.56, 5.32)	6.65	(5.33, 7.97)
Water supply interruptions	-25.50	(-20.44, -30.56)	8.50	(6.81, 10.19)	12.75	(10.22, 15.28)
Hosepipe ban	-8.82	(-7.07, -10.57)	2.94	(2.36, 3.52)	4.41	(3.54, 5.29)
Persistent low pressure	-13.43	(-10.77, -16.10)	0.11	(0.09, 0.13)	0.25	(0.20, 0.30)
All service measures			**15.99**	**(12.81, 19.16)**	**24.06**	**(19.29, 28.83)**

Figures show average willingness to pay (£/customer/year) for customers in each segment, per year, for each package of service levels, based on an overall PR14 package involving stable or increasing bills. Figures are not valid in the context of a declining bill because the models on which the figures are based indicate that in this case values are unboundedly high. The values shown here relate to the cumulative increment in bills by 2019/20 where this total is arrived at via a sequence of five annual increments of 1/5 of the total each. For example, a figure of £10 in this table would relate to a sequence of five annual £2 increments from 2015/16 to 2019/20 inclusive.

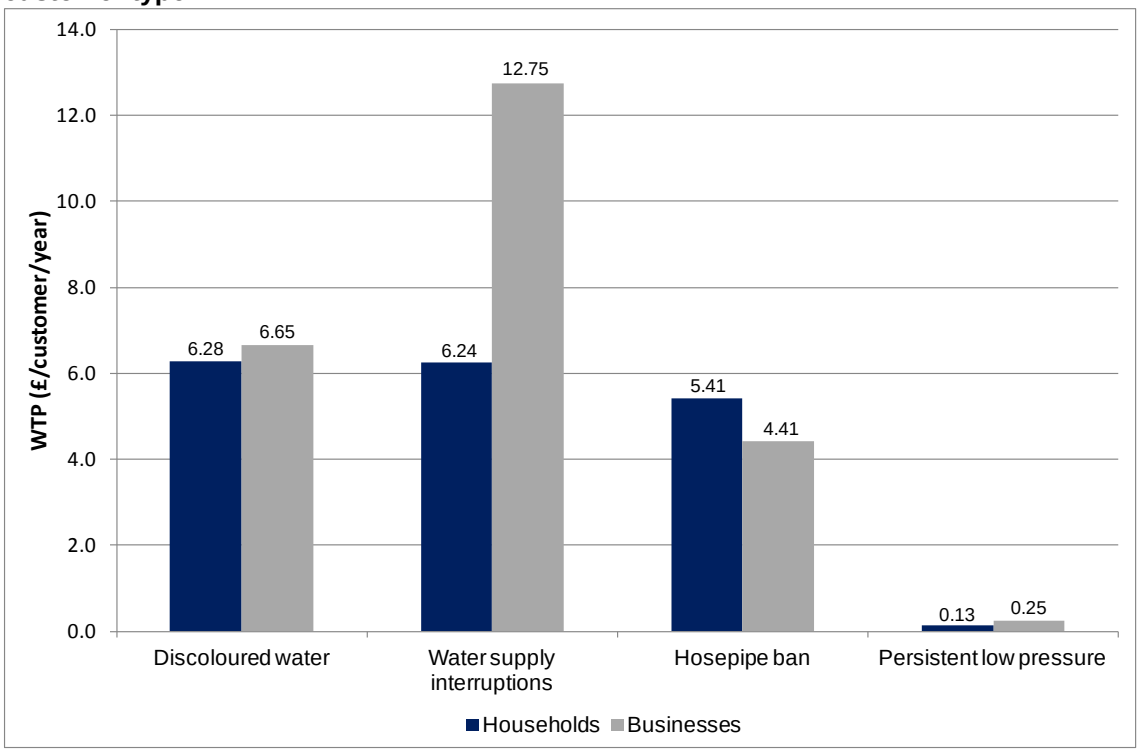
All service measures commanded some willingness to pay, but the variation was large. Figure 10 plots the WTP values from the table for the "Base to +2" package, by service measure, for both household and businesses. The service measures are ordered in this figure according to their rank amongst households. From the chart it is clear to see that

the discoloured water service measure is given the highest priority for improvement by households on this basis, very closely followed by water supply interruptions, and also closely followed by hosepipe bans. Persistent low pressure commanded the lowest WTP on this basis. The business valuations are ordered similarly to those of households, except that the water supply interruptions service measure was valued significantly more highly than in the case of households.

The results presented here are meaningful measures of customers' priorities and WTP for the packages of service level change that SEW identified as being feasible for each service measure. The scope of change is unequal across service measures, however, and so the service measure values cannot validly be compared as if they represent the relative cost to customers of each type of service failure. For example, we cannot infer from Figure 10 that a hosepipe ban is worse for customers than having persistent low pressure. To compare incidents on a like-for-like basis, it is necessary to look at unit values, which show, for example, the value of one avoided water taste and smell incident, one avoided sewer flooding incident, etc. These values are shown in section 6.3.

It is also not valid to expect these WTP estimates in themselves to dictate the types of improvement that SEW should focus on in its PR14 business plan. This is because the values only indicate the benefits of the improvements and do not take account of costs. The CBA work undertaken by SEW will incorporate the cost estimates alongside the benefits estimates shown here.

Figure 10: Willingness to pay for "Base to +2" improvement, by service measure and customer type



Source: Table 20 (above).

6.3 Unit Values

Unit values represent the value of a one unit change in the level of each service measure; for example, the value of one avoided interruption or one avoided discoloured

water incident. The values are also summed over all customers using customer base data supplied by SEW, and shown in Table 21 below.

Table 21: South East Water Customer Numbers, By Customer Type

	Number of customers (2012/13)
Households	820,427
Businesses	67,497

Source: SEW

Table 22 shows unit values for each service measure contained in the survey for all households, all businesses and all customers. The table also includes distinct values for supply interruptions of different durations and types (planned and unexpected). These values were obtained via analysis of the supply interruptions exercise, which obtained a model of how values vary for the different types of supply interruptions from the choice responses. (See Appendices B and C for details of this analysis.)

The table shows "central" estimates as well as a sensitivity range around this estimate. The central estimates are based on the same central case assumptions described in the context of the package value results above; and likewise, the lower and upper bounds of the range are also defined on the same basis. We would recommend that the central estimate be applied in the first instance when performing CBA on business plan proposals. The sensitivity range should be later applied as a means of testing the sensitivity of the proposals deriving from the CBA in relation to the inevitable uncertainty surrounding the valuation estimates used.

The results in Table 22 seem reasonable to us overall, and not out of line with findings from other companies that we have seen. By way of illustration of how the results are to be applied, consider the following examples.

- A reservoir expansion will lower the expected frequency of hosepipe bans for all customers from 1 in 10 years to 1 in 20 years. Considering that the number of household and business customers is respectively 820,427 and 67,497, the benefit of this investment would be calculated as (1/10-1/20)*(£108.25*820,427 + £88.24*67,497) = £4.738 million per year. In this calculation, £108.25 is the central household estimate of the value of avoiding one hosepipe ban, from Table 22, and £88.24 is the corresponding business estimate, from the same table.

- A proposed mains renewal will lead to 1000 fewer 3-6 hour unexpected interruptions per year in future, but 2000 more 3-6 hour planned interruptions in the year that the work is carried out. Using the values shown in Table 3, the benefit of the investment would be calculated as £0.947 million (1,000*£947.0) per year for the avoided unexpected interruptions, and in addition to the financial costs of the proposal, there would be an additional cost of £0.220 million (2,000*£110.16) in the year that the work was carried out. In these calculations, £947.0 is the central "All customers" estimate of the value of avoiding one 3-6 hour unexpected water supply interruption, and £110.16 is the corresponding estimate of the value of avoiding one 3-6 hour planned water supply interruption.

Table 22: Unit Values for Service Measures, by Customer Type

Service measure	Unit	Unit value (£/unit/year)								
		Households			Businesses			All customers		
		Central	Range		Central	Range		Central	Range	
Discoloured water	1 incident	125.63	87.59	144.88	133.06	106.67	159.46	127.51	92.43	148.58
Hosepipe ban	1 incident	108.25	75.48	124.84	88.24	70.74	105.75	103.18	74.28	120.00
Persistent low pressure	1 incident	1407.83	981.57	1623.55	2741.46	2197.61	3285.31	1745.91	1289.84	2044.82
Supply interruptions	1 incident	416.16	290.15	479.92	849.97	681.35	1018.59	526.13	389.32	616.48
No notice										
Less than 3 hours	1 incident	249.69	174.09	287.95	509.98	408.81	611.15	315.68	233.59	369.89
3 to 6 hours	1 incident	749.08	522.28	863.86	1529.94	1226.44	1833.45	947.03	700.78	1109.66
6-12 hour	1 incident	1498.16	1044.55	1727.73	3059.89	2452.87	3666.91	1894.06	1401.57	2219.32
12-24 hours	1 incident	2996.32	2089.10	3455.46	6119.77	4905.74	7333.81	3788.13	2803.13	4438.64
24-48 hours	1 incident	5992.64	4178.21	6910.91	12239.55	9811.48	14667.62	7576.26	5606.27	8877.28
24h notice										
Less than 3 hours	1 incident	28.38	19.79	32.73	63.31	50.75	75.87	36.72	27.17	43.03
3 to 6 hours	1 incident	85.15	59.37	98.19	189.94	152.26	227.62	110.16	81.52	129.08
6-12 hour	1 incident	170.29	118.73	196.39	379.88	304.52	455.24	220.33	163.04	258.16
12-24 hours	1 incident	340.58	237.46	392.77	759.76	609.04	910.48	440.65	326.07	516.32
24-48 hours	1 incident	681.17	474.93	785.55	1519.53	1218.08	1820.97	881.31	652.15	1032.65

Figures show average willingness to pay for customers in each segment, per year, for each unit of service level change. Values for "All customers" are derived as weighted averages of household and business values, using total revenue weights.

6.4 Summary of Covariate Findings

As a means of exploring the validity of the results obtained, a suite of multivariate econometric models have been estimated to explore correlations with the choices that respondents made. The findings from this analysis, which are reported in detail in Appendices B and C, are strongly supportive of the consistency of the results with expectation. In summary, we have found:

- For households and businesses, the "simple priorities" -stated by respondents when asked immediately after presentation of the service measures and current levels which they would most like to see improved - are generally significantly correlated with the choices that respondents made in the first choice exercise, and with the correct sign. This gives some reassurance that the choice models are capturing the same preferences expressed via a different form of questioning elsewhere in the survey.

- In the CV model:

  - higher income (more than £1000 per week) and medium income (£300 to £1000 per week) households were willing to pay significantly more than lower income (less than £300 per week) households

  - those households and businesses saying their current bill was "Too much" or "Far too much" are found to be willing to pay significantly less than others.

Overall, the results from the explanatory models are uniformly supportive of the validity of the main findings obtained.

An additional important finding from our multivariate analysis was that the size of the sewerage bill change shown to respondents was found to have no statistically significant on WTP. This is an important result as it indicates that WTP will be the same for water service improvements however much sewerage bills change by, between a £0 and £120 increase.

This result is consistent with expectation. The amounts being varied were small relative to respondents' incomes and so we would expect WTP to be relatively insensitive to even the larger sewerage bill sizes. It cannot be ruled out, however, that a larger sample size may have picked up a statistically significant effect.

7. CONCLUSIONS AND RECOMMENDATIONS

This report has presented valuation estimates of water service level changes for use in cost benefit appraisals by SEW for PR14, and has provided a range of supporting evidence to validate these estimates.

The results have shown that customers do not want to see widespread deteriorations in service in exchange for lower bills, and that there is some willingness to pay for improvements in relation to each of the service measures. Furthermore the results show that willingness to pay for water service improvements is not significantly influenced by an already planned sewerage bill increase in the range (£0-£120) considered.

The WTP results cannot be used in isolation to infer customer support for any service improvement, or lack of improvement, since this judgement must be made with consideration to the cost of those improvements. Whether willingness to pay outweighs the cost of any improvements is a separate matter that is not examined in this report.

The results generally seem reasonable to us however it is usual to carry out a range of validity checks to gauge how much weight ought to be given to SP-based results in decision making. In summary, the following results have been found.

- The vast majority of households (93%) and businesses (92%) stated that they felt able to make comparisons between the SP choices presented to them. (See Table 16.)

- Likewise, the vast majority of households (95%) and businesses (94%) stated that they found all of the service levels easy to understand. (See Table 16.)

- Only a small minority of households (12%) and businesses (9%) stated they felt some of the service levels to be implausibly high or low. (See Table 16.)

- The levels of understanding shown, as assessed by interviewers, were very good for an SP survey in our experience with 92% of households and 90% of businesses assessed as understanding either “completely” or “a great deal”. (See Table 17.)

- Similarly, levels of effort and concentration were very good, with the vast majority of both households and businesses assessed by interviewers as having given the questions careful consideration (92% households, 90% businesses), and managing to maintain concentration throughout the survey (99% households, 99% businesses). (See Table 17.)

- After their initial decision in each choice exercise, respondents were asked why they had made the selection they had. The vast majority of the reasons people gave were coded into one or more of valid reasons. Respondents generally cited the reason for their choice as being that one option was better than the other on the basis of the service levels that were shown to them in the corresponding choice situation. There were no cases of a significant number of respondents incorporating invalid beliefs or inferences. (See Table 18.)

- When we remove the minority of responses that we assessed as potentially invalid – those stating that they felt unable to make comparisons, or those assessed by interviewers as having understood the questionnaire less than “a little”, we find that

the results for the population are not significantly affected at all. (See Table 29 and Table 41.)

- Results are consistent with expectation in many areas and there are no anomalous results.
    - Higher income households had lower cost sensitivity than low income households; and cost sensitivity was found to be higher for those stating their current bill level is "too much" or "far too much" than for other customers (See Table 33 and Table 45).
    - Choice behaviour was found to correlate well with customers' simple priorities as questioned before they began the choice exercises (See Table 32 and Table 44. This is good evidence of the consistency of preferences elicited across question types.

Overall, the evidence described here fully supports the validity of the WTP estimates presented. Confidence in the results presented in this report can be gained from the following:

- The design of the questionnaire is consistent with best practice, and fully tested via cognitive interviews and pilot tests with households and businesses.
- The vast majority of responses are assessed as valid, taking into account respondent and interviewer feedback, and the reasons respondents gave for their choices.
- When we remove the minority of responses that we assessed as potentially invalid, we find that the results for the population are not materially affected.
- Results are consistent with expectation in many areas and there are no anomalous results.

The valuation estimates presented in this report can therefore be considered to be meaningful measures of SEW customers' values for the range of services, and service levels, contained within the survey, and as such are suitable for use in cost benefit analysis of proposed service changes for PR14.

A separate study is currently in progress that is conducting a detailed comparison of WTP estimates across companies and between PR09 and PR14. This research will further assist in establishing the validity of the results. It will be reported on separately in due course.

APPENDIX A

Household Questionnaire and Showcards (Main version)

2464
SEW PR14
SEW Household Questionnaire – Draft 20 (Main)

Interviewer name: | **Date:** | **Time:**

Recruitment Section

Good morning/afternoon/evening. My name is ..... Could I please speak to whoever is responsible – either jointly or solely – for paying your household's water bills? **(WHEN SPEAKING TO APPROPRIATE CONTACT CONTINUE WITH EXPLANATION)**

My name is ..... from Accent, an independent research consultancy, and we are carrying out an important research study for South East Water to investigate what is most important for customers in the coming years. This is a *bona fide* market research exercise. It is being conducted under the Market Research Society Code of Conduct which means that any answers you give will be treated in confidence. Could you please spare a couple of minutes to see if you are the type of customer we need to speak to for this research?

Q1. Can I just check that you are responsible, either jointly or solely, for paying your household's water and waste bills?

Yes

No **THANK & CLOSE**

Q2. Do you or any of your close family work or have worked in the past in any of the following professions: marketing, advertising, public relations, journalism, market research or the Water Industry (including working for South East Water)?

Yes **THANK & CLOSE** No

Q3. What is the job title of the chief wage earner of your household or, if you are the chief wage earner, your own job title? if retired, probe whether state or private pension. if state only code as 'E'. If private ask what their occupation was prior to retirement. probe

What are/were his/her/your qualifications/responsibilities? **PROBE**

WRITE IN AND CODE SEG .....

1. A
2. B
3. C1
4. C2
5. DE
6. Not stated

Q4. Which of the following age groups do you fall into?

1. 18-29
2. 30-44
3. 45-64
4. 65 to 74
5. 75 or older
6. Refused

Q5. Do you have a water meter?

1. Yes
2. No
3. Don't Know

Q5B Does your property have a septic tank or cess pit? IF REQUIRED If you do have one, this would mean that your property is not connected to the main sewer and you would periodically arrange to have the septic tank emptied.

1. Yes
2. No
3. Don't Know

Q6. What is your postcode?

First part Second part

Q7. HIDDEN QUESTION: LOOKUP POSTCODE TO IDENTIFY:

1. Thames Water area
2. Southern Water area

Q8. **IF Q5B=1, SKIP TO Q9 IF Q7=1** According to our records, you receive a bill from South East Water that includes billing for your sewerage services on behalf of Thames Water **ELSE IF Q7=2** According to our records, you receive a bill from South East Water for your water services and a separate bill from Southern Water for sewerage services **END IF** Is that correct?

1. Yes **PROCEED**
2. No **CHECK POSTCODE, IF STILL NO, CLOSE**
3. Don't know **PROCEED**

Q9. Do you pay your South East Water bill …(**READ OUT**)

1. Monthly
2. Quarterly (every three months)
3. Every six months
4. Annually
5. Other
6. Don't know

Q10. How much is your bill from South East Water IF Q5B=1 SAY for your water supply ELSE **IFQ7=1 THEN SAY** for your water supply and sewerage services from Thames water combined **ELSE IF Q7=2** for your water supply? You can say how much a month, a quarter, every six months or a year – whichever is easiest for you. If you're not sure, please give your best estimate.

1. £ per month
2. £ per quarter
3. £ per six months
4. £ per year
5. Don't know **GO TO RECRUITMENT**

Q11. Please say if that is an estimate or not

1. Estimate
2. Exact amount

Q12. Hidden question: Calculate annual BILL from Q10

£ per year

Q13. That would make your total annual bill from South East Water IF Q5B=1 SAY for your water supply **ELSE IF Q7=1 THEN SAY** for your water supply and sewerage services from Thames water combined **ELSE IF Q7=2** for your water supply **END IF £ INPUT BILL FROM Q12** Does that sound right to you?

1. Yes **GO TO RECRUITMENT**
2. No

Q14. What would be a more accurate figure for your annual bill from South East Water?

£ per year

Recruitment

RECRUITMENT Thank you for answering those questions. As I mentioned, we are carrying out an important research study for South East Water to investigate what is most important for customers in the coming years. I would be very grateful if you could spare another **15-20** minutes – either now or at a more convenient time – to run through some questions with me. This is your opportunity to influence the company's future plans. You do need to have some materials in front of you which I can either email to you now and we can carry on or I can email or post them to you and we can make an arrangement to talk at a convenient time for you.

email, now **SEND EMAIL THEN AND PROCEED**
cannot continue with interview now **SEND EMAIL THEN RECORD APPOINTMENT ON NEXT SCREEN**
do not have access to email **BRING UP APPOINTMENT/ADDRESS BOX**
no **ATTEMPT TO REASSURE & PERSUADE; IF STILL NO, THANK & CLOSE**
continue without sending email (practise/design/completes)

Date: ..... Time:.....

Name: .....

Address: .....

Email Address: .....

Tel No.

Introduction to Main Survey

Thank you for agreeing to take part in this survey. As I said previously, we are conducting research for South East Water looking at what is important for customers in the coming years.

The questionnaire will take 15-20 minutes. You do not have to answer questions you do not wish to and you can terminate the interview at any point.

Can I check that you have your materials ready to refer to? These will have either been sent in the post or by email. And what is the reference number on the materials? **INTERVIEWER: CHECK THE NUMBER IS CORRECT AND PROCEED OR RE-SCHEDULE AS APPROPRIATE.**

Correct – **PROCEED**
Incorrect – **GO TO APPOINTMENTS SCREEN AND RE-SCHEDULE, RE-SENDING MATERIALS**

Background Questions

Q15. **DO NOT READ OUT: Bill size [INPUT FROM Q12 or Q14]**

READ OUT: As you may know, South East Water only supplies drinking water and other companies provide waste water sewerage.

IF Q10= DON'T KNOW:
The average annual household water bill in your area is £204

ELSE: Previously you told me that your annual bill from South East Water is **[INPUT FROM Q15].**

IF Q5B=1 SKIP TO Q16

IF Q7=1 That includes both water and waste services, and of that amount, [**VALUE FROM Q15*0.59**] goes to South East Water for water services.

ELSE IF Q7=2 That covers water services, and you pay another company separately for sewerage services

END IF
END IF

Q16. How do you feel about the amount that you pay for water services? Is it**:**

1. Far too little
2. Too little
3. About right
4. Slightly too much
5. Far too much

Choice Experiment Intro

You are now going to be shown information about service levels that you could experience from South East Water.

Choice Experiment: Water Service Failures

Please now look at Showcard W1 (Water Service Failures). **[INTERVIEWER CHECK THAT RESPONDENT HAS SHOWCARD W1 IN FRONT OF THEM]**

This is about 4 things that can go wrong with your water service.

The first thing on Showcard W1 is "**Discoloured water"**.

- Tap water may occasionally be discoloured although running the tap for several minutes will often cause the problem to go away. When it occurs, this problem usually lasts a couple of hours, but occasionally the problem can last for a few days.
- Although the water is unlikely to be harmful, you may not want to use it in your household.

Please now read the rest of Showcard W1 yourself.

[INTERVIEWER WAIT A FEW MOMENTS, THEN ASK:]
Would you like more time? **[IF YES, ALLOW MORE TIME. IF NO, CONTINUE]**

Q17. **FOR COGNITIVE TESTING ASK:** Was any of the information shown on this card unclear to you, or difficult to understand? What was unclear or difficult to understand?

RECORD VERBATIM

Q18. To your knowledge, have you – or any of your relatives or close friends– experienced, noticed or been aware of any of the following service failures in the past year, or more than a year ago?

		Within past year	More than a year ago	Never	DK
A	Discoloured water				
B	Water supply interruptions				
C	Hosepipe bans				
D	Persistent low water pressure				

Please now look at Showcard W2 (Current chance of water service failures). **[INTERVIEWER CHECK THAT RESPONDENT HAS SHOWCARD W2 IN FRONT OF THEM.]**

This card shows the current chance of experiencing different water service failures.

Some types of failure, such as a hosepipe ban, occur once every few years but when they occur they affect a wide area. Other types of failure, such as a water supply interruption, happen more frequently, but affect only a small number of properties at a time.

The chances shown on this card reflect both the chance of the failure itself, and the number of households affected.

The green triangles are shown to compare the relative chances of each failure. The triangles are drawn to scale with the largest triangle at the top representing a 100% chance per year of a failure happening at your property.

The first row beneath the large green triangle at the top shows that the current chance of a hosepipe ban is 1 in 10 years. This means that in 1 out of every 10 years there is likely to be a hosepipe ban at your property.

Q19. **FOR COGNITIVE TESTING ASK:** Is there anything you find difficult to understand about this Showcard, or about the explanation I have just given? What was difficult to understand? **PROBE.**

Q20. **FOR COGNITIVE TESTING ASK:** Do you find any of the chances shown on this card to be significantly higher or lower than you would have expected? Which ones? Why? **PROBE.**

Q21. Which of these service failures on the card, if any, would you most like to see improved in the future? **IF REQUIRED: PROMPT TO LOOK AT SHOW CARD W2.**

Hosepipe bans
Discoloured water
Water supply interruptions
Persistent low water pressure
None
Don't know/not sure

Q22. **FOR COGNITIVE TESTING ASK:** Why did you say that?

RECORD VERBATIM

Please leave Showcard W2 aside for now.

These next four questions will each ask you to choose between two options of service levels for the areas you have read just read about. In each case, service levels are defined in terms of the chances of your home experiencing each type of failure. An improvement means that there is a lower chance of you experiencing a service failure like this.

Some service levels will be better in one option and some will be better in the other. The aim of this exercise is to encourage you to consider your preferences carefully and decide which option is best for you overall. You may not like all the parts of an option, but you still need to decide overall which one you would prefer.

Please look at Choice Card W1. **[INTERVIEWER CHECK THAT RESPONDENT HAS CHOICE CARD W1 IN FRONT OF THEM]**

The 4 service failures from Showcard W1 are presented alongside two options for the future level of service in each case. Read down each column to see all the service levels in each option.

The triangles are drawn to scale, as before, to help you compare the chances of these things happening. Where the chance in option A or option B is shaded it means that it is worse than the alternative option shown; where neither the option A nor the option B level is shaded, this means that both options are the same for that service.

Please take a moment to review these options.

Q23. Looking at Choice Card W1, please take a moment to review the options and tell me which option you prefer, A or B?

A
B

Q24. Why did you choose the option you did?

RECORD VERBATIM

Q25. Now turn to Choice Card W2. Which option do you prefer, A or B?

A
B

Q26. Now turn to Choice Card W3. Which option do you prefer, A or B?

A
B

Q27. Now turn to Choice Card W4. Which option do you prefer, A or B?

A
B

Choice Exercise 2 – Water Supply Interruptions

This next set of choices focuses on water supply interruptions – how long they typically last, whether you are notified in advance, and the frequency with which supply interruptions happen. These questions aim at trying to understand how important each of these aspects are to your household.

The questions will ask you to choose which of two options you prefer.

Please look at Choice Card SI1. **[INTERVIEWER CHECK THAT RESPONDENT HAS CHOICE CARD SI1 IN FRONT OF THEM]**

This card shows two options.

- In Option A, you would experience an interruption to your tap water supply lasting 3 to 6 hours, with no notice given, once every 20 years.
- In Option B, you would experience an interruption lasting less than 3 hours, with no notice given, once per year.

FOR PROGRAMMERS: PLEASE DRAW THE CORRECT LEVEL TEXT FOR THE HIGHLIGHTED SECTIONS IN THIS PARAGRAPH FROM THE EXPERIMENTAL DESIGN - FIRST CHOICE QUESTION FOR THIS EXERCISE.

Q28. Please take a moment to review the options and tell me which option you prefer, Option A or Option B?

A
B

Q29. Why did you choose the option you did?

RECORD VERBATIM

Q30. Now turn to Choice Card SI2. Which option do you prefer, A or B?

A
B

Q31. Now turn to Choice Card SI3. Which option do you prefer, A or B?

A
B

Q32. Now turn to Choice Card SI4. Which option do you prefer, A or B?

A
B

Choice Experiments – Package

In the last exercise I would like you to consider all of the service failures shown in the first set of choices, but this time you will also see the associated change in your annual water bill from South East Water from 2014 to 2019.

IF Q7=1 The amounts shown refer to the water part of your bill only, the amount that goes to South East Water and covers the services they provide **END IF**

When making your choices between the different service packages please bear in mind the following:

- that your bill would also changes by the rate of inflation each year;
- that any extra money you decide to pay for better service levels here will not be available for you to spend on other things;
- how your income may change in the next few years; and
- that the new bill level will gradually adjust over five years and stay the same after that. Your South East Water bill will not drop back to the level it was prior to changes in service levels.

IF Q5B=1, SKIP TO *CHOICE CARD INTRO
Your sewerage company is also making plans for its services for the next few years, and this may lead to a change in the amount you pay for this.

PROGRAMMING NOTE: IF SOUTHERN CUSTOMER, RANDOMLY ASSIGN TO SEWERAGE VALUE £0 OR £40; IF THAMES CUSTOMER, RANDOMLY ASSIGN TO SEWERAGE VALUE £0, £40, £80 OR £120.

[IF SOUTHERN CUSTOMER (Q7=2), AND VALUE = £0]
We have made an assumption, however, that your sewerage bill from Southern Water will stay the same as it is now, except for increases in line with the general rate of inflation.

[IF SOUTHERN CUSTOMER (Q7=2), AND VALUE = £40]
We have made an assumption that your sewerage bill will need to increase by £8 each year for five years, from 2014 to 2019, a total change of £40 from 2019 onwards, on top of further increases in line with the general rate of inflation, to pay for expected investments by Southern Water.

IF THAMES CUSTOMER (Q7=1)
One possible feature of Thames Water's plans may be a major new sewer, to be called the Thames Tideway Tunnel. This sewer will capture tens of millions of tonnes of untreated sewage that currently overflows in to the tidal River Thames from London's Victorian sewers after as little as 2mm of rain. You may have received a leaflet in the post from Thames Water about this.

IF THAMES CUSTOMER (Q7=1) AND VALUE = £0
We have made an assumption, however, that your sewerage bill from Thames Water will stay the same as it is now, except for increases in line with the general rate of inflation. This estimate is made on the basis that the
Thames Tideway Tunnel is not built, and that no additional expenditures are planned which would cause sewerage bills to rise.

IF THAMES CUSTOMER (Q7=1) AND VALUE = £40
We have made an assumption that your sewerage bill from Thames Water will need to increase by £8 each year for five years, from 2014 to 2019, a total change of £40 from 2019 onwards, on top of further increases in line with the general rate of inflation. This estimate is made on the basis that the Thames Tideway Tunnel is **not** built, but that additional expenditures planned for other purposes will cause sewerage bills to rise.

IF THAMES CUSTOMER (Q7=1) AND VALUE = £80
We have made an assumption that your sewerage bill from Thames Water will need to increase by £16 each year for five years, from 2014 to 2019, a total change of £80 from 2019 onwards, on top of further increases in line with the general rate of inflation. This estimate is made on the basis that the Thames Tideway Tunnel is built, but that no additional expenditures are planned which would cause sewerage bills to rise further.

IF THAMES CUSTOMER (Q7=1) AND VALUE = £120
We have made an assumption that your sewerage bill from Thames Water will need to increase by £24 each year for five years, from 2014 to 2019, a total change of £120 from 2019 onwards, on top of further increases in line with the general rate of inflation. This estimate is made on the basis that the Thames Tideway Tunnel is built, and that additional expenditures planned for other purposes will cause sewerage bills to rise still further.

Take a moment to review these options.

END IF

[* CHOICE CARD INTRO]

Please look at Choice Card P **[INTERVIEWER CHECK THAT RESPONDENT HAS CHOICE CARD IN FRONT OF THEM.]**

As in the previous exercises, you are shown two different options. This time, in Option A, all services are at their worst levels and in Option B they are all at their best levels. **IF Q5B=2 OR 3, SAY** The associated water and sewerage bill changes are shown at the bottom of the table. **ELSE IF Q5B=1, SAY** The associated water bill changes are shown at the bottom of the table.

Take a moment to review these options.

Q33. Looking at Choice Card P. Which option do you prefer, A or B?

A
B **GO TO Q35**

PROGRAMMER INSTRUCTION – MAKE SURE CORRECT TEXT AND LEVELS ARE INSERTED IN THE FOLLOWING QUESTIONS BASED ON THE EXPERIMENTAL DESIGN.NB IF Q5B=1, NO SEWERAGE CHARGE TO BE SHOWN

Q34. Keep looking at Choice Card P. If the cost of option B was an increase of £6.50 each year for 5 years, from £209 in 2014 to £241.50 from 2019 onwards, would you still choose option A or would you now choose option B?

A **GO TO Q42**
B **GO TO Q36**

Q35. Keep looking at Choice Card P. If the cost of option B was an increase of £32 each year for 5 years, from £209 in 2014 to £369 from 2019 onwards, would you still choose option B or would you now choose option A?

A **GO TO Q38**
B **GO TO Q40**

Q36. For the cost of providing option B you have said you would be willing to pay an increase of £6.50 each year for 5 years, from £209 in 2014 to £241.50 from 2019 onwards. Remember this does not include any increases due to inflation which would be added on top. Do you still agree with this?

Yes **GO TO Q42**
No
Not sure/don't know

Q37. I'll just ask that question again so I'm sure I understand what you would be willing to pay. Look back at Choice Card P. Option B would lead to an increase in your water bill of £6.50 each and every year for 5 years, from £209 in 2014 to £241.50 from 2019 onwards. Remember this does not include any increases due to inflation which would be added on top. Based on this would you choose Option A or Option B?

A **GO TO Q42**
B **GO TO Q42**

Q38. For the cost of providing option B you have said you would be willing to pay an increase of £15 each and every year for five years, taking the bill from £209 in 2014 to £284 from 2019 onwards. Remember this does not include any increases due to inflation which would be added on top. Do you still agree with this?

Yes **GO TO Q42**
No
Not sure/don't know

Q39. I'll just ask that question again so I'm sure I understand what you would be willing to pay. Look back at Choice Card P. Option B would lead to an increase in your water bill of £15 each and every year for 5 years, from £209 in 2014 to £284 from 2019 onwards. Remember this does not include any increases due to inflation which would be added on top. Based on this would you choose Option A or Option B?

A **GO TO Q42**
B **GO TO Q42**

Q40. For the cost of providing option B you have said you would be willing to pay an increase of £32 each and every year for five years, taking the bill from £209 in 2014 to £369 from 2019 onwards. Remember this does not include any increases due to inflation which would be added on top. Do you still agree with this?

Yes **GO TO Q42**
No
Not sure/don't know

Q41. I'll just ask that question again so I'm sure I understand what you would be willing to pay. Look back at Choice Card P. Option B would lead to an increase in your water bill of £32 each and every year for 5 years, from £209 in 2014 to £369 from 2019 onwards. Remember this does not include any increases due to inflation which would be added on top. Based on this would you choose Option A or Option B?

A
B

Q42. Why did you choose the option you did?

RECORD VERBATIM

Q43. **DELETED**

Follow-up Questions

I would now like to ask you a few questions about the choices you have just made.

Q44. Did you generally feel able to make comparisons between the two options I presented to you?

1. Yes **GO TO Q46**
2. No

Q45. Why weren't you able to make the comparisons in the choices?
RECORD VERBATIM

Q46. Did you find each of the levels of service we described easy to understand?

1. Yes **GO TO Q48**
2. No

Q47. Which levels did you feel were not easy to understand?
RECORD VERBATIM

Q48. Were any of the service levels so low or so high that they were unrealistic?

1. Yes
2. No **GO TO Q50**

Q49. Which levels did you feel were unrealistic?
RECORD VERBATIM

Demographics

Q50. Which of these statements best describes your current employment status?

Self employed	1
Employed full-time (30+ hrs)	2
Employed part-time (up to 30 hrs)	3
Student	4
Unemployed – seeking work	5
Unemployed – other	6
Looking after the home/children full-time	7
Retired	8
Unable to work due to sickness or disability	9
Other (please specify)……	10

Q51. At what level did you complete your education? If still studying, which level best describes the highest level of education you have obtained until now?

O levels / CSEs / GCSEs (any grades)
A levels / AS level / higher school certificate
NVQ (Level 1 and 2). Foundation / Intermediate / Advanced GNVQ / HNC / HND
Other qualifications (e.g. City and Guilds, RSA/OCR, BTEC/Edexcel))
First degree (e.g. BA, BSc)
Higher degree (e.g. MA, PhD, PGCE, post graduate certificates and diplomas)
Professional qualifications (teacher, doctor, dentist, architect, engineer, lawyer, etc.)
No qualifications

Q52. Thinking about all the people in your household, including yourself, please indicate how many people there are in each of these age groups:

Up to 15 years	0	.....	1	.....	2	.....	3	.....	4 ..... 5+
16 to 60 years	0	.....	1	.....	2	.....	3	.....	4 ..... 5+
61+	0	.....	1	.....	2	.....	3	.....	4 ..... 5+

Q53. To help us analyse your responses can you tell me which band on showcard Z1 best describes your total annual household income, before tax and other deductions? [**PROGRAMMER: PLEASE SHOW THE LETTERS OF EACH BAND ON SCREEN**]

	Per Week	Per Year
A	Up to £100	Under £5,200
B	£101-£200	£5,201-£10,400
C	£201-£300	£10,401 – £15,600
D	£301-£400	£15,601 - £20,800
E	£401-£500	£20,801,-£26,000
F	£501-£600	£26,001-£31,200
G	£601-£800	£31,201-£41,600
H	£801-£1000	£41,601 - £52,000
I	£1001-£1200	£52,001 - £62,400
J	£1201-£1400	£62,401 - £72,800
K	£1401-£1600	£72,801 - £83,200
L	£1601+	£83,201+
M	Prefer not to say	

Q54. Are you a member of any of the organisations shown on showcard Z2?

Yes
No

Local community or volunteer group	
RSPB (Royal Society for Protection of Birds)	
Surfers Against Sewage/Marine Protection Society	
Canoeing/Boating/ Windsurfing club or similar	
Angling club	
Ramblers Association	
Friends of the Earth/Greenpeace	
National Trust	
Local wildlife trust or environmental organisation	
Other national or international environmental organisation	
Other	
Not a member of any similar organisations	

Q55. **DO NOT READ OUT RECORD RESPONDENT GENDER**

Male Female

That was the last question. Thank you very much for your help in this research

Please can I take a note of your name and telephone number for quality control purposes?

Respondent name: .....

Telephone: home: ..... work: .....

Q56. We really appreciate the time that you have given us today. Would you be willing to be contacted again for clarification purposes or be invited to take part in other research for South East Water?

Yes, for both clarification and further research
Yes, for clarification only
Yes, for further research only
No

Thank you

I confirm that this interview was conducted under the terms of the MRS code of conduct and is completely confidential

Interviewer's signature: .....

Debriefing Questions – to be completed by the interviewer when interview is over

Q57. In your judgement, did the respondent understand what he/she was being asked to do in the questions?

Understood completely
Understood a great deal
Understood a little
Did not understand very much
Did not understand at all

Q58. Which of the following best describes the amount of thought the respondent put into making their choices?

Gave the questions very careful consideration
Gave the questions careful consideration
Gave the questions some consideration
Gave the questions little consideration
Gave the questions no consideration

Q59. Which of the following best describes the degree of fatigue shown by the respondent when doing the choice experiments?

Easily maintained concentration throughout the survey
Maintained concentration with some effort throughout the survey
Maintained concentration with a deal of effort throughout the survey
Lessened concentration in the later stages
Lost concentration in the later stages

SHOWCARD W1 WATER SERVICE FAILURES

1. DISCOLOURED WATER

- Tap water may occasionally be discoloured although running the tap for several minutes will often cause the problem to go away. When it occurs, this problem usually lasts a couple of hours, but occasionally problem can last for a few days.
- Although the water is unlikely to be harmful, you may not want to use it in your household.

clear

discoloured

2. WATER SUPPLY INTERRUPTIONS

- Interruptions to your water supply can happen at any time and at any property. They typically last around 2 and a half hours.
- The number of water supply interruptions can be reduced by increased maintenance which would reduce bursts .

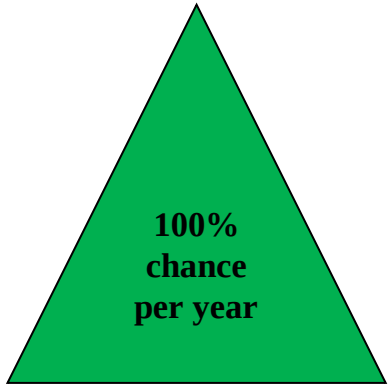
3. HOSEPIPE BANS

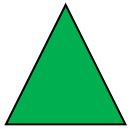
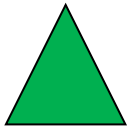
- Hosepipe bans are put in place during extended dry spells to help manage demand for water. When they are put in place, they typically last for 5 months beginning in May and ending in September.
- When a ban is in place, hosepipes cannot be used for domestic gardening, cleaning, or recreational uses such as filling home swimming pools. Exemptions apply for commercial users and activities, and vulnerable customers.

4. PERSISTENT LOW WATER PRESSURE

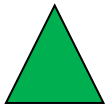
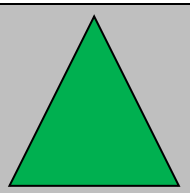
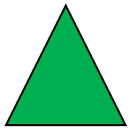
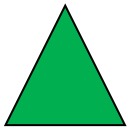
- Low water pressure means it takes longer to fill the bath or a kettle than you would like, and it may affect how well a combi boiler works. Persistent means the property is affected every day, though the problem may come and go during the day. It can be caused by the age and condition of the water company's pipes rather than problems with internal plumbing which the customer is responsible for.
- Properties at the tops of hills and the end of lines are most at risk . If you don't currently suffer, or have never suffered from persistent low water pressure, then your property is not at risk.
- Customers that do suffer from this problem regularly are entitled to a rebate of £50 off their annual water bill.

SHOWCARD W2 CURRENT CHANCE OF WATER SERVICE FAILURES

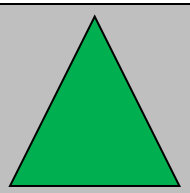


SERVICE AREA		CURRENT CHANCE OF OCCURRING
Hosepipe bans		**1 in 10**
Discoloured water.		**1 in 10**
Water supply interruptions.		**1 in 50**
Persistent low water pressure		**10 in 100,000**

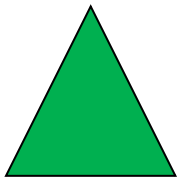
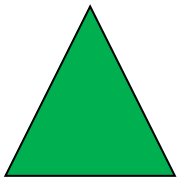
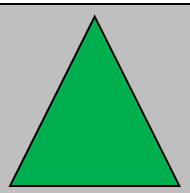
CHOICE CARD W1 WATER SERVICE FAILURE OPTIONS

	OPTION A	OPTION B
HOSEPIPE BANS from May to September. The chance that this happens in any one year.	 **1 in 15**	 **1 in 5**
DISCOLOURED WATER at your property for a couple of hours at a time. The chance that this happens in any one year.	 **1 in 10**	 **1 in 10**
WATER SUPPLY INTERRUPTIONS lasting an average of 2 and a half hours. The chance that this happens in any one year.	 **1 in 50**	 **1 in 20**
PERSISTENT LOW WATER PRESSURE affects the taps, showers and boilers at some customers' properties. The proportion of properties that are affected.	**10 in 100,000**	**1 in 100,000**
Which option do you prefer?	☐	☐

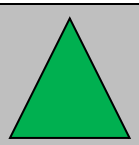
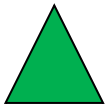
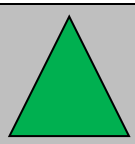
CHOICE CARD W2 WATER SERVICE FAILURE OPTIONS

	OPTION A	OPTION B
HOSEPIPE BANS from May to September. The chance that this happens in any one year.	 **1 in 20**	 **1 in 20**
DISCOLOURED WATER at your property for a couple of hours at a time. The chance that this happens in any one year.	 **1 in 5**	 **1 in 15**
WATER SUPPLY INTERRUPTIONS lasting an average of 2 and a half hours. The chance that this happens in any one year.	 **1 in 50**	 **1 in 20**
PERSISTENT LOW WATER PRESSURE affects the taps, showers and boilers at some customers' properties. The proportion of properties that are affected.	 **500 in 100,000**	 **10 in 100,000**
Which option do you prefer?	☐	☐

CHOICE CARD W3 WATER SERVICE FAILURE OPTIONS

	OPTION A	OPTION B
HOSEPIPE BANS from May to September. The chance that this happens in any one year.	 **1 in 5**	 **1 in 5**
DISCOLOURED WATER at your property for a couple of hours at a time. The chance that this happens in any one year.	 **1 in 5**	 **1 in 15**
WATER SUPPLY INTERRUPTIONS lasting an average of 2 and a half hours. The chance that this happens in any one year.	 **1 in 100**	 **1 in 200**
PERSISTENT LOW WATER PRESSURE affects the taps, showers and boilers at some customers' properties. The proportion of properties that are affected.	 **6 in 100,000**	 **10 in 100,000**
Which option do you prefer?	☐	☐

CHOICE CARD W4 WATER SERVICE FAILURE OPTIONS

	OPTION A	OPTION B
HOSEPIPE BANS from May to September. The chance that this happens in any one year.	 **1 in 10**	 **1 in 15**
DISCOLOURED WATER at your property for a couple of hours at a time. The chance that this happens in any one year.	 **1 in 20**	 **1 in 10**
WATER SUPPLY INTERRUPTIONS lasting an average of 2 and a half hours. The chance that this happens in any one year.	 **1 in 20**	 **1 in 20**
PERSISTENT LOW WATER PRESSURE affects the taps, showers and boilers at some customers' properties. The proportion of properties that are affected.	**6 in 100,000**	**6 in 100,000**
Which option do you prefer?	☐	☐

CHOICE CARD SI1 - WATER SUPPLY INTERRUPTION OPTIONS

	OPTION A	**OPTION B**
Supply interruption duration.	3-6 hours.	Less than 3 hours.
Notice given.	No notice.	No notice.
The frequency that this happens at your property.	1 in 20 years.	Once per year.
Which option do you prefer?	☐	☐

CHOICE CARD SI2 - WATER SUPPLY INTERRUPTION OPTIONS

	OPTION A	**OPTION B**
Supply interruption duration.	Less than 3 hours.	6-12 hours.
Notice given.	No notice.	24 hours notice.
The frequency that this happens at your property.	1 in 5 years.	1 in 10 years.
Which option do you prefer?	☐	☐

CHOICE CARD SI3 - WATER SUPPLY INTERRUPTION OPTIONS

	OPTION A	OPTION B
Supply interruption duration.	12-24 hours.	24-48 hours.
Notice given.	24 hours notice.	No notice.
The frequency that this happens at your property.	Once per year.	1 in 20 years.
Which option do you prefer?	☐	☐

CHOICE CARD SI4 - WATER SUPPLY INTERRUPTION OPTIONS

	OPTION A	OPTION B
Supply interruption duration.	24-48 hours.	12-24 hours.
Notice given.	24 hours notice.	No notice.
The frequency that this happens at your property.	1 in 2 years.	Once per year.
Which option do you prefer?	☐	☐

CHOICE CARD PWhich option would you prefer?

	OPTION A	OPTION B
HOSEPIPE BANS (chance)	1 in 5	1 in 20
DISCOLOURED WATER (chance)	1 in 5	1 in 20
WATER SUPPLY INTERRUPTIONS (chance).	1 in 20	1 in 200
PERSISTENT LOW WATER PRESSURE (proportion of properties affected)	500 in 100,000	1 in 100,000
THE CHANGE IN YOUR ANNUAL WATER BILL to provide the service above The new bill level will also apply in all later years and excludes inflationary changes.	Decrease of £2 every year for 5 years, from £209 in 2014 to **£199 from 2019**	Increase of £15 every year for 5 years, from £209 in 2014 to **£284 from 2019**
THE CHANGE IN YOUR ANNUAL SEWERAGE BILL The new bill level will also apply in all later years and excludes inflationary changes.	Increase of £24 every year for 5 years, in total £120 higher from 2019	Increase of £24 every year for 5 years, in total £120 higher from 2019

SHOWCARD Z1

	Per Week	Per Year
A	Up to £100	Under £5,200
B	£101-£200	£5,201-£10,400
C	£201-£300	£10,401 – £15,600
D	£301-£400	£15,601 - £20,800
E	£401-£500	£20,801,-£26,000
F	£501-£600	£26,001-£31,200
G	£601-£800	£31,201-£41,600
H	£801-£1000	£41,601 - £52,000
I	£1001-£1200	£52,001 - £62,400
J	£1201-£1400	£62,401 - £72,800
K	£1401-£1600	£72,801 - £83,200
L	£1601+	£83,201+

SHOWCARD Z2

Local community or volunteer group
RSPB (Royal Society for Protection of Birds)
Surfers Against Sewage/Marine Conservation Society
Canoeing/Boating/ Windsurfing Club or similar
Angling Club
Ramblers Association
Friends of the Earth/Greenpeace
National Trust
Local Wildlife Trust or Environmental Organisation
Other national or international environmental organisation

APPENDIX B

Household Econometric Analysis

APPENDIX B - HOUSEHOLD ECONOMETRIC ANALYSIS

Introduction

The main valuation estimates presented in this report are derived by combining estimates from econometric models based on the two choice exercises, with estimates from a separate econometric model based on responses to the CV questions, along with data on the SEW customer base to aggregate to the population. This appendix reports in full how these estimates are obtained including all intermediate results.

An additional objective of our econometric analysis was to explore the determinants of respondents' choices as a means of establishing the extent to which they vary in line with expectation. For example, we would expect higher income households to be willing to pay more than low income households. This appendix also reports on this component of our analysis.

The appendix is structured as follows. First, we explain our approach for obtaining the main valuation estimates presented in this report. Then, we proceed to report on each of the intermediate components of this approach in turn. Finally, we report on our analysis of the determinants of respondents' choices and show how WTP varies by household segment.

Methodology for Obtaining Core Valuation Estimates

Figure 11 illustrates the way in which the components of our analysis are combined to obtain unit values. This figure shows that the unit value for a service measure is derived as the product of a "whole package value" and a "service measure weight", divided by the change in the number of units of that service measure between its deterioration level (-1) and its maximum improvement level (+2).

The whole package value is obtained via analysis of responses to the CV questions, which determines mean WTP for the sample. This mean is then multiplied by the number of customers and the average customer bill to obtain a monetary estimate for the whole package value.

The service measure weight is obtained via analysis of responses to the first DCE which covers all the water service measures. This analysis investigates the trade-offs that respondents were prepared to make between each of them, and thereby reveals their relative values. The service measure weight is simply equal to the relative value, scaled to sum to 100% when all service measures change from Level -1 to Level +2.

A further part to the analysis aims to obtain values for each of a range of interruption durations via analysis of the second DCE. This analysis investigates the trade-offs that respondents were prepared to make between planned and unexpected interruptions of different durations, and obtains the relative value of each type of interruption. The value for an *x*-hour interruption is then obtained by multiplying the relative value of an *x*-hour interruption to an average duration interruption, as obtained from this analysis, by the unit value of an average duration interruption, as obtained from the analysis already performed.

Consistent with this approach, there are a series of analytical steps that we take.

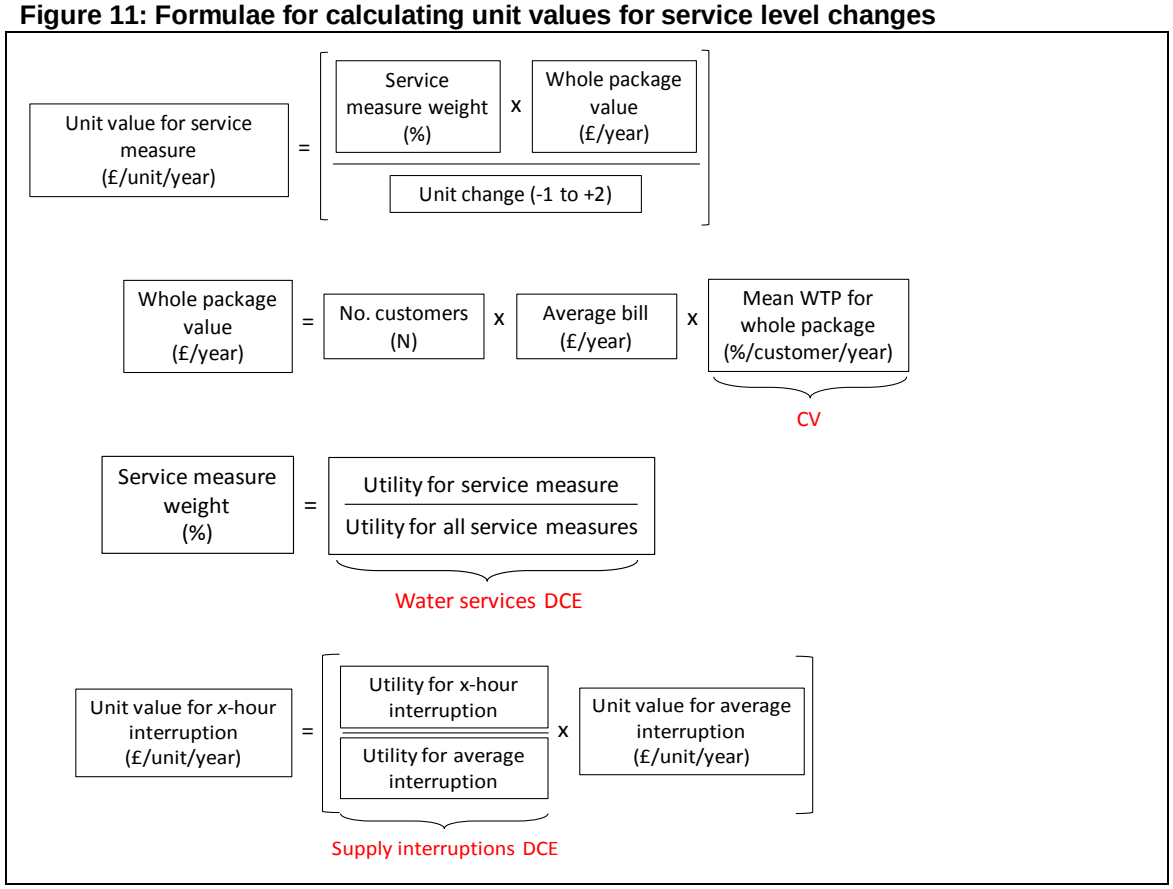
- First, we calculate service measure weights, which are the relative values of each of the four service measure changes within the whole package. The results for service measure weights are derived from responses to the first DCE.

- Next, we calculate whole package valuations. These valuations are based on CV responses.

- Thirdly, we obtain service measure unit values by multiplying the whole package values by the service measure weight, and then dividing through by the change in units over the relevant range. These values are aggregated to the SEW customer base using information on numbers of customers and average bill levels supplied by SEW.

- Finally, we obtain values for unexpected and planned supply interruptions of different durations based on results from analysis of the supply interruptions DCE.

Figure 11: Formulae for calculating unit values for service level changes



The following sections proceed as follows. First we derive the service measure preference weights, which involves analysing responses to the water services DCE. The next section then presents an analysis of the CV exercise. Here we present our core models, and then explain our approach to using these results to derive the whole package valuations. The various sensitivities around the whole package valuations are also derived and explained in this section. Following this, we present our analysis of the water supply interruptions DCE responses, which gives rise to estimates of the relative value of interruptions of different types.

The final section in this appendix presents multivariate models exploring the determinants of respondents' choices to each exercise, and reports results for willingness to pay by household segment.

Water Services DCE Analysis

Core Models

Table 23 presents the results from the core models from the first lower level exercise, relating to water service measures. Two main types of model are estimated – conditional logit and mixed logit models. The conditional logit models are estimated with robust (Huber-White) standard errors which allow for correlation within individuals' responses. The mixed logit models are estimated under the assumption of normal distributions for all three service measures.

Both models fit the data well, as evidenced by the precision of the estimates and the pseudo R^2 statistics. We select the mixed logit results to take forward for calculating service measure weights because of the fact that this estimator takes better account of the correlation of utilities within individuals than the conditional logit estimator.

Table 23: Household Water Service DCE Models

Variable	Unit	Conditional logit	Mixed logit	
			Mean	S.D.
Discoloured water	Chance	-6.001	-8.633	9.834
		(0.403)***	(0.674)***	(1.114)***
Interruptions	Chance	-20.102	-28.598	33.899
		(1.726)***	(2.742)***	(4.354)***
Hosepipe bans	Chance	-4.582	-7.439	13.027
		(0.527)***	(0.884)***	(1.538)***
Persistent low pressure	Chance	-63.431	-96.746	100.884
		(12.427)***	(18.004)***	(60.411)*
Observations		8824	8824	
LL		-2838.23	-2777.94	
Pseudo R2		0.072	0.092	

*Dependent variable for both models = choice, a {0,1} dummy variable indicating that the option was chosen. Standard errors in parentheses; (robust for cond. logit models); * significant at 10%; ** significant at 5%; *** significant at 1%. Estimated mixed logit model assumes normal distributions for all variables.*

Service Measure Preference Weights

Table 24 shows the workings involved in the calculation of the water service preference weights for household customers. These weights are used to represent the relative value of each service level change (from its worst level to its best level), within the lower level block.

The coefficient column in the tables contains the mixed logit estimates from Table 23. The unit change column is the difference between Level +2 and Level -1 for the service measure in question. Utility change is calculated as coefficient*unit change. Finally, the lower level weight is calculated as the utility change for the service measure in question divided by the sum of utility changes over all the service measures.

Table 24: Household Water Service Preference Weights

Service measure	Coefficient	Unit change (-1 to +2)	Utility change	Lower-level weight
Discoloured water	-8.633	-0.150	1.295	31.0%
Interruptions	-28.598	-0.045	1.287	30.8%
Hosepipe bans	-7.439	-0.150	1.116	26.7%
Persistent low pressure	-96.746	-0.005	0.483	11.5%
TOTAL				*100%*

*Coefficients are drawn from the mixed logit models in Table 23. Unit changes are drawn from Table 5. Utility change is calculated as coefficient * unit change, and lower level weight is calculated as utility change divided by the sum of utility changes within the corresponding service measure block.*

Contingent Valuation Analysis

A key aspect of our approach to obtaining unit values for service level changes by service measure is the use of an estimated 'whole package value'. This value is apportioned to the individual service measures and service measure level changes via the preference weights derived above.

We derive estimates of the whole package value via the following process.

- First, we estimate econometric models on the CV responses to fit a distribution to the data and hence allow for calculation of mean WTP. A random effects probit model is adopted for this purpose, and we estimate linear and loglinear (in cost) versions of this model, which correspond to normal and lognormal distributional assumptions respectively.[12] We also estimate models on various restricted samples for sensitivity checking.

- Using the CV models, we then derive estimates of WTP that are conditional on the cost of Option A, ie the deterioration option, in the survey. Costs of this option in the survey took values of either -6% or 0%.

- Given estimates of WTP that are conditional on the cost of Option A, the next step is to calibrate the estimates to the assumed cost of maintaining base service levels up to and beyond 2020. To do so, we calculate the implied threshold cost of Option A such that respondents would, on average, be indifferent between base service costing +5.3% (SEW's central assumption) and a deterioration package costing this implied threshold amount. The resulting unit valuations would then be consistent with the expected 5.3% actual cost of maintaining current service levels. (We also calibrate to values of +4% and +8% to explore sensitivity to this factor.)

The remainder of this section proceeds as follows. First, we present the CV econometric models. Next we show the WTP values conditional on the cost of Option A. Then we derive calibration weights consistent with the assumed costs of maintaining base service levels in the central case and in the sensitivity scenarios. Finally we present the calibrated whole package values that are taken forward to the derivation of unit values.

[12] The random effects probit model was proposed for CV analysis by Alberini, Kanninen and Carson (1997) Modeling Response Incentive Effects in Dichotomous Choice Contingent Valuation Data, *Land Economics*, **73**(3), 309-24.

Core Models

Table 25 presents random effects probit models based on CV data, including follow-up. Four models are presented. The first two are log-linear and linear (in cost) models estimated on the full sample. The remaining two are log-linear models estimated on restricted samples for sensitivity testing. These include a "Valid" sample, which excludes respondents identified by the interviewer as having understood less than "A little" and those identifying themselves as having been unable to make comparisons between the choices presented to them; and a "Low income" sample which excludes respondents reporting a household income of over £300 per week.

Each model includes a constant term and a dummy variable indicating the second question, ie the follow up, for each respondent, as well as two cost variables. One cost variable measures the cost of Option A, and the other measures the cost of Option B.

If there was a constant marginal utility of money over the range that cost varied then we would expect the coefficients to be opposite in sign but equal in magnitude. They would be opposite in sign because the dependent variable is an indicator for whether or not Option B was chosen, ie it equalled 1 if Option B was chosen and 0 if Option A was chosen.

The fact that the cost of Option A coefficients tend to have smaller magnitudes than the cost of Option B coefficients indicates that respondents were less cost sensitive over the negative range of costs associated with Option A than over the positive range of costs associated with Option B. This finding seems plausible, as it indicates that households would need to be compensated by more to accept a service deterioration than they would be prepared to pay for an equivalent-sized improvement in services.

Comparing the first two models customers, the results suggest that the log-linear model fits the data marginally better than the linear model, as evidenced by the slightly higher log likelihood statistic for the first model in comparison with the second. The pseudo R^2 values are fairly low for all models; however this is to be expected since few variables are included to explain the variance in the data and this is not the purpose of the model in any case – the purpose of the model is to fit a distribution so as to estimate mean WTP.

Finally, it is worth noting that the *Q2 dummy* coefficients are statistically insignificant in all models. Since responses to an initial CV question are generally held to be more valid than responses to follow up questions[13], we derive WTP values in the following that are all conditional on setting *Q2 dummy* equal to 0.

[13] See, for example, Carson, R.T. and Groves, T. (2007) Incentive and informational properties of preference questions, *Environmental and Resource Economics*, **37**(1), 181-210

Table 25: Household CV Models

Variable	Label	Coefficient (std error)			
		Full (linear)	Full (log)	Valid (log)	Low income (log)
Constant	a	1.033	1.217	1.251	0.773
		(0.187)***	(0.232)***	(0.241)***	-0.491
Cost of Option A	c_A	1.602			
		(2.158)			
Log(1 + Cost of Option A)	γ_A		2.254	2.473	1.799
			(2.319)	(2.385)	(5.385)
Cost of Option B	c_B	-5.104			
		(0.947)***			
Log(1 + Cost of Option B)	γ_B		-6.766	-6.69	-6.99
			(1.339)***	(1.366)***	(3.414)**
Q2 dummy	d	0.069	0.06	0.069	0.062
		(0.078)	(0.08)	(0.083)	(0.184)
Observations		2206	2206	2032	400
LL		-1433.55	-1432.13	-1317.06	-264.05
DF		5	5	5	5
Pseudo R2		0.049	0.05	0.048	0.043

*Model = Random effects probit. Dependent variable = choice, a {0,1} variable indicating whether Option B, the improvement option, was chosen. Standard errors in parentheses; * significant at 10%; ** significant at 5%; *** significant at 1%; (1) "Cost of Option A" is measured as the proportional deviation from 2014 bills, and is either -0.06 or 0. "Cost of Option B" is measured as the proportional deviation from 2014 bills, and varies from -0.03 to 0.48. "Valid" sample excludes respondents satisfying any of the following two conditions: (i) those identified by the interviewer as having understood less than "A little"; and (ii) those identifying themselves as having been unable to make comparisons between the choices presented to them. The "Low income" sample includes only respondents reporting a household income of less than £300 per week.*

Whole Package Values by Cost of Option A

Mean WTP values for the whole package from Level -1 to Level +2 are calculated from the models in Table 25 using the formula appropriate for each model. For the case where the *Q2 dummy* is set equal to zero, and the *Cost of Option A* =0%, and using the labels shown in Table 25 to refer to the relevant coefficients, the formulae used for the linear and log models are the following.

- **Linear:** $WTP = \frac{-a}{c_B}$
- **Log:** $WTP = \exp\left[\frac{-a}{\gamma_B}\right]\exp\left[\frac{1}{2\gamma_B^2}\right] - 1$

Table 26 shows mean household whole package values derived from the results in Table 25 for the two costs of Option A shown in the survey. They represent the mean threshold difference between the costs of Option A and Option B, as a proportion of respondents' 2015 bill that would cause households to be indifferent between the two options. In other words, the values are compensating surplus measures of value.

The results also show, as expected, that low income households have lower monetary valuations than others for the whole package of service level changes.

Table 26: Household Whole Package Values, By Model, Sample and Cost of Option A Shown in Survey

Model & Sample	Cost of Option A = -6%		Cost of Option A = 0%	
	Mean	95% Conf Interval	Mean	95% Conf Interval
Full sample, log	27.0%	(22.9%, 31.2%)	21.0%	(16.9%, 25.2%)
Full sample, linear	24.4%	(20.1%, 28.6%)	20.2%	(16.4%, 24.1%)
Valid sample, log	27.9%	(23.5%, 32.3%)	21.9%	(17.5%, 26.3%)
Low inc. sample, log	18.8%	(11.2%, 26.5%)	12.8%	(5.2%, 20.5%)

*Whole package values are derived from the CV models presented in Table 25. They represent the proportion of the 2014 bill that households would be willing to pay to have Option B in the CV question, rather than Option A, when the cost of Option A is as shown in the corresponding column header of this table. Whole package values are evaluated at "*Q2 dummy*=0".*

Calibration Weights

The next step is to identify weights to be applied to the "Cost of A=-6%" and "Cost of A=0%" conditioned values such that the weighted average "Level -1 indifference cost" is equal to the same-weighted average of -6% and 0%.

The "Level -1 indifference cost" is the threshold cost for the deterioration package at which customers are indifferent to the base package at the fixed base package cost amount. So if the base package costs +1%, then we seek to find the amount that the Level -1 package would need to cost for customers to be indifferent, on average, between the base package and the Level -1 package.

This amount is straightforward to calculate. First we identify the proportion of the whole package value pertaining to the "Base to -1" segment. This is found by multiplying the service measure weights from Table 24 by the unit changes between each of the levels: Base to -1, Base to +1 and Base to +2, and summing over the service measures. This gives the package level weights shown in Table 27 below.

We then multiply the relevant package level weight for "Base to -1" by the whole package value, and add on the assumed base cost change of +5.3%. The resulting value is the threshold cost for the deterioration package at which customers are indifferent to the base package at the fixed base package cost amount of +5.3%.

Since there are two whole package values, one corresponding to each of the "Cost of A=-6%" and "Cost of A=0%" conditioned values, there will also be two "Level -1 indifference costs". The final step is to find the weights to apply to the two "Level -1 indifference costs" such that the weighted average "Level -1 indifference cost" is equal to the same-weighted average of -6% and 0%.

The principle in operation here is that at the point where the two weighted averages coincide, the resulting indifference curve through the fixed base cost of +1% leads back to a Level -1 cost amount equal to a same-weighted average of the Level -1 cost amounts that customers were shown in the survey.

To find weights, w, $(1-w)$, that ensure that the weighted average of a and b equals the weighted average of c and d, ie $wa+(1-w)b = wc+(1-w)d$, we use the expression:

$w = (d-b)/(a-c+d-b)$;

where *a* and *b* are the Level -1 indifference costs associated with "Cost of A=-1%" and "Cost of A=0%" respectively, and *c* and *d* are -6% and 0% respectively.

Table 27 presents the package level weights, from which we see that, crucially, the "Base to -1" package weight is equal to -70.3%.

Table 28 then presents the Level –1 indifference costs based on these package level weights, and on the base cost assumptions shown, and shows the calibration weight obtained by applying the expression above. The table shows that the weight has been constrained not to exceed 1 in all cases. This finding suggests that the values we have obtained may be conservative because they are based on a higher cost of Option A than customers would chosen at a base cost of anywhere between 4% and 8%.

The result also precludes the sensitivity comparison between base cost assumptions. This is because at both ends of the range, 4% and 8%, the calibration weight is constrained to equal 1. The whole package values are therefore the same for 4% and 8% assumed base costs, but this is only true because the constraint bites.

Table 27: Household Package Level Weights

Package Weight (As % of Whole Package Value)		
Base to -1	**Base to +1**	**Base to +2**
-70.3%	19.7%	29.7%

Package level weights are calculated as the sum over all service measures of the product of service measure weight (from Table 24) and unit change (from Table 5), for the relevant package level change.

Table 28: Household Calibration Weights, By Sample, CV Model and Assumed Base Cost

Sample, CV Model & Assumed Base Cost	Level -1 Indifference Cost, by Cost of Option A Shown in Survey		Calibration Weight (on -6% cost)
	-6%	0%	
Full sample, log, base cost = +5.3%	-13.7%	-9.5%	1.00*
Full sample, log, base cost = +4%	-15.0%	-10.8%	1.00*
Full sample, log, base cost = +8%	-11.0%	-6.8%	1.00*
Full sample, linear, base cost = +5.3%	-11.8%	-8.9%	1.00*
Valid sample, log, base cost = +5.3%	-14.3%	-10.1%	1.00*
Low inc. sample, log, base cost = +5.3%	-8.0%	-3.7%	1.00*

"Level – 1 indifference costs" are the costs of the "Level -1" package (all services at Level -1) at which respondents are inferred to be indifferent between that and the base package (all services at Base level), when the base package costs the amount assumed (+4%,+5.3% or +8%). These Level -1 indifference costs are derived by multiplying the relevant whole package value from Table 26 by the "Base to -1" weight from Table 27. The calibration weight is the value of w *which, in most cases, equates* wa+*(1-*w*)*b = w*(-6%)+(1-*w*)(0%), where* a *and* b *are the Level -1 indifference costs for the "Cost of Option A = -6%" and "Cost of Option A = 0%" treatments respectively. The value of* w *is constrained to lie between 0 and 1, however, in order not to extrapolate values outside of the range of treatments shown in the survey. * indicates that the calibration weight is constrained.*

Calibrated Whole Package Values

Table 29 applies the calibration weights from Table 28 to the two sets of values in Table 26 to obtain calibrated whole package values. Furthermore, the table applies the package level weights from Table 27 to calculate the values of three packages of service level changes from the Base starting point. Here we see, for example, that, based on the Full sample, log, model, with assumed base cost = +5.3%, household customers are willing to pay 8.0% on top of their annual water and sewerage bill for an improvement of all services up to Level +2.

Table 29: Household Package Values, By Sample, CV Model & Assumed Base Cost

Model, Assumed Base Cost & Sample	Whole package value		Sub-package values		
	Mean	95% Conf Interval	Base to -1	Base to +1	Base to +2
Full sample, log, base cost = +5.3%	27.0%	(22.9%, 31.2%)	-19.0%	5.3%	8.0%
Full sample, log, base cost = +4%	27.0%	(22.9%, 31.2%)	-19.0%	5.3%	8.0%
Full sample, log, base cost = +8%	27.0%	(22.9%, 31.2%)	-19.0%	5.3%	8.0%
Full sample, linear, base cost = +5.3%	24.4%	(20.1%, 28.6%)	-17.1%	4.8%	7.2%
Valid sample, log, base cost = +5.3%	27.9%	(23.5%, 32.3%)	-19.6%	5.5%	8.3%
Low inc. sample, log, base cost = +5.3%	18.8%	(11.2%, 26.5%)	-13.3%	3.7%	5.6%

Mean whole package values are derived by the formula: w*wpv_low *+(1-*w*)**wpv_high, *where* w *is the calibration weight from Table 28 and* wpv_low *and* wpv_high *are the whole package values from Table 26 for the "Cost of Option A = -6%" and "Cost of Option A = 0%" respectively. Sub-package values are derived by multiplying the mean whole package value from this table by the relevant package level weight from Table 27.*

The values in Table 29 are those that are used, in combination with the service measure preference weights presented in Table 24, to calculate the package values and the unit values shown in the main body of the report.

Water Supply Interruptions DCE Analysis

Core Models

Table 30 presents models from the water supply interruptions choice exercise. Conditional logit and mixed logit models are estimated, and with the same features as for the water services DCE models.

In these models, there are two variables. The first is equal to the frequency of interruptions multiplied by their duration. Equivalently, this can be referred to as the expected number of hours of interruptions per year. The second variable is equal to the first, multiplied by a dummy variable indicating whether or not the interruption was planned. The coefficient on the first variable measures the marginal disutility of 1 expected hour of unexpected interruptions, and the sum of the two coefficients indicates the marginal disutility of 1 expected hour of planned interruptions.

The specification of the model was chosen to conform to expected utility theory, in that frequency and duration of interruptions are entered into the models only in an interacted way, and not as explanatory variables in their own right. This reduces the goodness of fit somewhat in comparison with models that include main effects, but gives the models a more theoretically reasonable interpretation. A specification that included *freq**log(*duration*) was tested but was found to perform less well than the linear model shown.

Table 30: Household Supply Interruptions DCE Models

Variable	Unit	Conditional logit	Mixed logit	
			Mean	S.D.
frequency x duration	chance x hours	-0.139	-0.398	0.363
		(0.011)***	(0.037)***	(0.038)***
frequency x duration x notice	chance x hours x (dummy variable)	0.117	0.352	0.332
		(0.011)***	(0.033)***	(0.038)***
Observations		8824	8824	
LL		-2891.28	-2829.33	
Pseudo R2		0.055	0.075	

*Dependent variable for both models = choice, a {0,1} dummy variable indicating that the option was chosen. Standard errors in parentheses; (robust for cond. logit models); * significant at 10%; ** significant at 5%; *** significant at 1%. Estimated mixed logit model assumes normal distributions for all variables.*

Overall, the results in Table 30 are as expected. The models show that longer and more frequent interruptions are perceived negatively by respondents, and that notification is valued positively. Furthermore, the models fit the data reasonably well, with small standard errors in comparison with the size of the coefficients and reasonable pseudo-R^2 values.

Preference Weights

The linking service measure for this exercise in the 'water services' DCE is "Water supply interruptions, lasting an average of 2.5 hours". We therefore take 2.5 hours as the calibration duration point for deriving value weights, and conservatively assume that the linking service measure value corresponded to an unplanned interruption.

The weights taken forward from this model are shown in Table 31. They are calibrated to a 2.5-hour unplanned interruption, and so this takes the value of 1 in the table. The ratio of planned to unplanned is calculated as the sum of the two coefficients in the model divided by the coefficient on *freq*duration*. The model from which the weights are derived is linear in duration, which is why the weights are proportional to duration.

Table 31: Water Supply Interruptions Preference Weights, by Customer Type

	Households	
Duration (hours)	Unplanned	Planned
Less than 3	0.60	0.068
2.5	**1.00**	**0.114**
3 – 6	1.80	0.205
6 – 12	3.60	0.409
12 – 24	7.20	0.818
24 – 48	14.40	1.637

Figures denote the relative values of an avoided interruption of each type, expressed as a proportion of the value of an avoided 2.5 hour interruption. The midpoint of each duration band is used to value interruptions in that band.

Covariate Analysis

As a means of exploring the validity of the results obtained, we have developed multivariate econometric models to explore correlations with the choices that respondents made. The following focuses first on the water services DCE, followed by the CV exercise. The final part of this section presents results for household segments.

Water Services DCE Explanatory Models

The priors we had for the water services explanatory model included that relative values should be positively correlated with the non-SP responses concerning which service measures respondents would most like to see improved between 2015 and 2020 (*improvement* variables). These questions were asked immediately following presentation of the service measure descriptions and current service levels. We would expect respondents choosing a particular service measure as being most worthy of improvement to assign a higher value to this service measure in the choice exercises than other respondents.

A further issue to explore in these models, in relation to the validity of the core results, was in respect of respondents' *experiences*. Respondents were asked if they had experienced any of the service failures comprising the service measures prior to answering the SP choice questions. If experience of the service measure were found to be significant in explaining respondents' choices, then caution may be warranted in interpreting the main results. This is because, in the extreme, those who have not experienced the issue before may be assigning naive valuations based on limited understanding. On the other hand, however, higher values could be a sign that the respondent feels their risk is greater than average, in which case the core results would still be valid.

In addition to these variables, we also include household *demographics*, where significant, to control for any confounding effects these might cause. These included region, age, SEG, income, education, household composition and bill size.

We began with a general specification that included all the variables described, interacted with the service measure variables. The *demographics* variables were interacted with all the service measures, while *importance* and *experiences* variables were each only interacted with the variable they corresponded to. For example, we included *Discoloured water*Importance Discoloured water*, but not *Interruptions*Importance discoloured water*, etc. Joint tests of significance were applied to the *demographics* interactions; those groups that were jointly insignificant at the 10% level were dropped. Similarly, individual *improvement* and *experiences* interactions were dropped when t-tests of their individual non-significance were not rejected at the 10% level.

The following table show all five lower level explanatory models for households – one for each exercise for each customer segment. To summarise the results, we find the following:

- Experience of a service failure was insignificant ($p<.10$) for all four service measures;
- All four *importance* variables were significant at at least the $p<.05$ level, and with the expected sign.

Overall, these findings are supportive of the validity of the results.

Table 32: Water Service DCE Explanatory Models (Households)

Variable	Coefficient	Standard error
discoloured water	-7.430	0.856***
interruptions	-19.206	3.898***
hosepipe bans	-1.788	1.086
persistent low pressure	-54.329	27.372**
discoloured water x [Household: single adult + children]	4.152	2.747
interruptions x [Household: single adult + children]	-27.463	19.585
hosepipe bans x [Household: single adult + children]	0.100	3.613
persistent low pressure x [Household: single adult + children]	-166.562	98.598*
discoloured water x [Household: 2+ adults, no children]	1.993	1.014**
interruptions x [Household: 2+ adults, no children]	2.964	4.499
hosepipe bans x [Household: 2+ adults, no children]	-1.041	1.303
persistent low pressure x [Household: 2+ adults, no children]	19.859	32.409
discoloured water x [Household: 2+ adults + children]	2.736	1.197**
interruptions x [Household: 2+ adults + children]	-1.963	5.264
hosepipe bans x [Household: 2+ adults + children]	2.657	1.502*
persistent low pressure x [Household: 2+ adults + children]	1.708	37.128
discoloured water x [Septic tank/ Cess pit]	4.445	1.663***
interruptions x [Septic tank/ Cess pit]	-1.377	6.480
hosepipe bans x [Septic tank/ Cess pit]	0.972	2.058
persistent low pressure x [Septic tank/ Cess pit]	-47.282	57.435
discoloured water x importance of discoloured water	-3.746	1.060***
interruptions x importance of interruptions	-11.590	5.160**
hosepipe bans x importance of hosepipe bans	-6.629	1.067***
persistent low pressure x importance of persistent low pressure	-95.053	35.101***
Observations	8824	
LL	-2774.424	
DF	24	
Pseudo R2	0.093	

**** Significant at the 1% level, ** Significant at the 5% level, * Significant at the 10% level*

CV Explanatory Models

As in the case of the lower level water services DCE model, we investigate the determinants of CV choices via the development of a multivariate model. We expected that income would explain choices in that higher income households would have lower cost sensitivity than low income households. We also expected cost sensitivity to be affected by responses to the question in the survey asking "How do you feel about the amount that you pay for the service and supply that you receive from South East Water?" Responses to this question are translated to a dummy variable *Judgement on amount paid: too much.* We expect that people saying "Too much" or "Far too much", and therefore coded as 1 on this dummy variable, will be more cost sensitive than those saying "About right" or "Too little".

A further issue to explore in this explanatory modelling was the extent to which the assumed sewerage bill increase impacted on cost sensitivity. Since a higher sewerage bill would leave respondents with less money to spend on other things, we would expect that cost sensitivity would be greater at higher sewerage bill levels than at lower levels.

The full range of demographic variables was tested for inclusion to control for the effects of any of these factors that were found to be significant. The specification search eliminated *demographics* variables that were jointly insignificant at the 10% level.

The final model is shown in Table 33 as "Model 2". The results show that both income and *Judgement on amount paid: too much* have the expected effect on cost sensitivity. These findings are supportive of the validity of the results.

"Model 1" in Table 33 presents results from a preliminary model that includes the sewerage bill interaction variables. A likelihood ratio test of Model 2 versus Model 1 gives a p value of 0.19, which verifies that the sewerage bill interaction variables are all jointly insignificant. This result indicates that the assumed sewerage bill increase had no effect on respondent's willingness to pay for improved water services. This finding can be explained by the observation that the amounts being varied were small relative to respondents' incomes and so income effects may have been negligible.

Table 33: Household CV Explanatory Models

Variable	Model 1		Model 2	
	Coef.	Std error	Coef.	Std error
Constant	1.221	0.224***	1.218	0.223***
Log(1+Cost of Option A)	1.771	4.582	4.110	4.093
Log(1+Cost of Option B)	-7.756	1.703***	-7.413	1.586***
Q2 dummy	0.031	0.079	0.029	0.079
*Log(1+Cost of Option A) * [Income: Medium]*	-10.107	4.594**	-9.329	4.553**
*Log(1+Cost of Option A) * [Income: High]*	-9.916	5.306*	-9.606	5.261*
*Log(1+Cost of Option A) * [Income: Not Stated]*	2.421	4.89	2.624	4.852
*Log(1+Cost of Option B) * [Income: Medium]*	1.612	1.104	1.644	1.102
*Log(1+Cost of Option B) * [Income: High]*	3.697	1.238***	3.697	1.235***
*Log(1+Cost of Option B) * [Income: Not Stated]*	-0.207	1.261	-0.298	1.259
*Log(1+Cost of Option A) * [Judgement on amount paid: too much]*	9.923	3.686***	9.425	3.655**
*Log(1+Cost of Option B) * [Judgement on amount paid: too much]*	-3.022	0.926***	-3.047	0.923***
	1.153	3.649		
	14.260	5.907**		
	6.734	5.654		
	0.015	0.857		
	2.222	1.293*		
	0.326	1.337		
Observations	2206		2206	
LL	-1389.3		-1393.6	
DF	17		11	
Pseudo R2	0.056		0.053	

**** Significant at the 1% level, ** Significant at the 5% level, * Significant at the 10% level. Estimation is based on the random effects probit model, with a lognormal distribution*

Willingness to Pay Variation by Customer Segments

The following table shows differences in whole package valuations across household segments. The approach to obtaining these results was exactly the same as for the full sample analysis, except that the models were estimated only on data for the segment shown.

Table 34: Household Whole Package Values, By Customer Segment

	N	Mean	95% Conf Interval	
Full sample				
All	1103	27.0%	22.9%	31.2%
Area				
Thames Water Area	458	33.1%	24.7%	41.4%
Southern Water Area	645	23.1%	18.6%	27.7%
Age(1)				
18 – 44	303	32.1%	21.8%	42.5%
45 - 64	441	30.5%	22.1%	38.9%
65 plus	350	19.8%	14.5%	25.1%
SEG(2)				
AB	282	34.5%	26.8%	42.2%
C1/C2	505	28.8%	20.4%	37.2%
DE	295	18.8%	11.3%	26.2%
Education				
No qualifications	403	16.1%	11.3%	21.0%
A levels and similar	319	34.4%	21.4%	47.5%
Degree	381	34.5%	26.3%	42.6%
Household composition				
1 adult	268	21.2%	13.1%	29.2%
1 adult, w/children	34	11.3%	-0.7%	23.4%
2+ adults	547	28.0%	22.7%	33.3%
2+ adults, w/children	254	37.3%	18.4%	56.3%
Employment(3)				
Working	594	30.8%	24.4%	37.2%
Not working	486	22.0%	16.4%	27.5%
Income (monthly)				
<300	200	18.8%	11.2%	26.5%
300-1000	427	29.1%	21.5%	36.7%
>1000	232	43.9%	31.9%	55.8%
Not stated	244	13.3%	5.0%	21.6%
Bill (monthly)				
Low (<209)	281	28.7%	19.5%	37.9%
Don't know	507	29.3%	22.2%	36.3%
High (>209)	315	22.8%	16.7%	28.8%
Sewerage Bill				
£0	459	24.4%	18.9%	29.9%
£40	426	26.2%	19.1%	33.4%
£80	102	35.6%	22.8%	48.4%
£120	116	28.7%	17.3%	40.0%
Water meter				
Yes	617	34.3%	24.9%	43.6%
No	466	21.6%	17.0%	26.2%
Septic tank or cess pit				
Yes	64	15.2%	0.5%	29.9%
No	932	28.8%	23.9%	33.8%

**** Significant at the 1% level, ** Significant at the 5% level, * Significant at the 10% level. Estimation is based on the random effects probit model, with a lognormal distribution (1) Observations with missing values for age were excluded from analysis (2) Observations with missing values for SEG were excluded from analysis (3) Observations for students and respondents with "other employment status" were excluded.*

APPENDIX C

Business Econometric Analysis

APPENDIX C - BUSINESS ECONOMETRIC ANALYSIS

Introduction

This appendix contains all the models and interim calculations used to derive the core business priorities and valuation results presented in the main body of this report. It follows a similar structure to Appendix B, which contained econometric analyses of the household choice data, willingness to pay calculations, and segmentation results. Much of the methodological discussion is left out of this section and the reader is referred to the household section in Appendix B for further details.

Water Services DCE Analysis

Core Models

The models fit the data well, with the expected signs and reasonably precisely estimated coefficients.

Table 35: Business Water Service DCE Models

Variable	Unit	Conditional logit	Mixed logit	
			Mean	S.D.
Discoloured water	Chance	-5.045	-8.012	10.652
		(0.917)***	(1.000)***	(1.785)***
Interruptions	Chance	-29.508	-51.179	58.299
		(4.615)***	(5.755)***	(8.160)***
Hosepipe bans	Chance	-2.83	-5.313	13.893
		(1.108)**	(1.266)***	(2.261)***
Persistent low pressure	Chance	-91.455	-165.069	224.169
		(30.003)***	(32.813)***	(64.780)***
Observations		4800		4800
LL		-1528.86		-1482.83
Pseudo R2		0.081		0.109

*Dependent variable for both models = choice, a {0,1} dummy variable indicating that the option was chosen. Standard errors in parentheses; (robust for cond. logit models); * significant at 10%; ** significant at 5%; *** significant at 1%. Estimated mixed logit model assumes normal distributions for all variables.*

Preference Weights

Table 36: Business Water Service Preference Weights

Service measure	Coefficient	Unit change (-1 to +2)	Utility change	Lower-level weight
Discoloured water	-8.012	-0.150	1.202	23.4%
Interruptions	-51.179	-0.045	2.303	44.9%
Hosepipe bans	-5.313	-0.150	0.797	15.5%
Persistent low pressure	-165.069	-0.005	0.824	16.1%
TOTAL				*100%*

*Coefficients are drawn from the mixed logit models in Table 35. Unit changes are drawn from Table 5. Utility change is calculated as coefficient * unit change, and lower level weight is calculated as utility change divided by the sum of utility changes within the corresponding service measure block.*

Contingent Valuation Analysis

Core Models

Each model in the table below includes a constant term and a dummy variable indicating the second question, ie the follow up, for each respondent. It also includes a single cost variable, which measures the cost of Option B only; that is, it constrains the cost of Option A to have zero impact on utility. This constraint was imposed on the basis that unconstrained models found the anomalous result that respondents tended to prefer Option A when Option A cost 0% than when it cost -6%. This implies a negative marginal utility of money, which is theoretically unreasonable. The difference was insignificant, however, and so we imposed the theoretically motivated restriction that the marginal utility of money should not be negative. The implication of this constraint is that WTP is perfectly correlated with the cost of Option A on which it is conditioned.

Table 37: Business CV Models

Variable	Full (linear)	Full (log)	Valid (log)
Constant	0.908	1.008	1.242
	(0.241)***	(0.281)***	(0.371)***
Cost of Option B	-11.665		
	(3.112)***		
Log(1 + Cost of Option B)		-13.758	-14.979
		(3.867)***	(4.745)***
Q2 dummy	-0.076	-0.066	-0.184
	(0.110)	(0.114)	(0.122)
Observations	1200	1200	1098
LL	-784.58	-783.37	-705.35
DF	4	4	4
Pseudo R2	0.045	0.047	0.053

*Model = Random effects probit. Dependent variable = choice, a {0,1} variable indicating whether Option B, the improvement option, was chosen. Standard errors in parentheses; * significant at 10%; ** significant at 5%; *** significant at 1%; (1)* "Cost of Option A" *is measured as the proportional deviation from 2014 bills, and is either -0.06 or 0.* "Cost of Option B" *is measured as the proportional deviation from 2014 bills, and varies from -0.03 to 0.24. "Valid" sample excludes respondents satisfying <u>any</u> of the following two conditions: (i) those identified by the interviewer as having understood less than "A little"; and (ii) those identifying themselves as having been unable to make comparisons between the choices presented to them.*

Whole Package Values by Cost of Option A

Table 38 shows mean household whole package values derived from the results in Table 37 for the two costs of Option A shown in the survey. The results show, as previously asserted, that mean values are perfectly correlated with the cost of Option A – they are 6% higher when the cost of Option A is -6% than when it is 0%.

Table 38: Business Whole Package Values, By Model, Sample and Cost of Option A Shown in Survey

Model & Sample	Cost of Option A = -6%		Cost of Option A = 0%	
	Mean	95% Conf Interval	Mean	95% Conf Interval
Full sample, log	13.9%	(12.1%, 15.7%)	7.9%	(6.1%, 9.7%)
Full sample, linear	13.8%	(12.0%, 15.6%)	7.8%	(6.0%, 9.6%)
Valid sample, log	14.9%	(12.9%, 16.9%)	8.9%	(6.9%, 10.9%)

*Whole package values are derived from the CV models presented in Table 37. They represent the proportion of the 2014 bill that households would be willing to pay to have Option B in the CV question, rather than Option A, when the cost of Option A is as shown in the corresponding column header of this table. Whole package values are evaluated at "*Q2 dummy=*0".*

Calibration Weights

Table 39 presents the package level weights. Here we see that the "Base to -1" package weight is equal to -71.7% for business customers.

Table 40 then presents the Level –1 indifference costs based on these package level weights, and on the base cost assumptions shown, and shows the calibration weight obtained by applying the expression above. The table shows that in one case, the weight has been constrained not to lie below 0. In the four other cases, an interior solution is found.

The finding that weights are constrained to 0 in the 8% base cost case suggests that the sensitivity comparison between base cost assumptions is invalid. Because of this, we do not report sensitivities to the base cost assumption in the main body of the report.

Table 39: Business Package Level Weights

Package Weight (As % of Whole Package Value)		
Base to -1	Base to +1	Base to +2
-71.7%	18.8%	28.3%

Package level weights are calculated as the sum over all service measures of the product of service measure weight (from Table 36) and unit change (from Table 5), for the relevant package level change.

Table 40: Business Calibration Weights, By Sample, CV Model and Assumed Base Cost

Sample, CV Model & Assumed Base Cost	Level -1 Indifference Cost, by Cost of Option A Shown in Survey		Calibration Weight (on -6% cost)
	-6%	0%	
Full sample, log, base cost = +5.3%	-4.7%	-0.4%	0.21
Full sample, log, base cost = +4%	-6.0%	-1.7%	0.98
Full sample, log, base cost = +8%	-2.0%	2.3%	0.00*
Full sample, linear, base cost = +5.3%	-4.6%	-0.3%	0.17
Valid sample, log, base cost = +5.3%	-5.4%	-1.1%	0.63

"Level – 1 indifference costs" are the costs of the "Level -1" package (all services at Level -1) at which respondents are inferred to be indifferent between that and the base package (all services at Base level), when the base package costs the amount assumed (+4%,+5.3% or +8%). These Level -1 indifference costs are derived by multiplying the relevant whole package value from Table 38 by the "Base to -1" weight from Table 39. The calibration weight is the value of w *which equates* wa+*(1-*w*)*b = w*(-6%)+(1-*w*)(0%), where* a *and* b *are the Level -1 indifference costs for the "Cost of Option A = -6%" and "Cost of Option A = 0%" treatments respectively. The value of* w *is constrained to lie between 0 and 1, however, in order not to extrapolate values outside of the range of treatments shown in the survey. * indicates that the calibration weight is constrained.*

Calibrated Package Values

Table 41 applies the calibration weights from Table 40 to the two sets of values in Table 38 to obtain calibrated whole package values for central, low and high base cost assumptions.

Furthermore, the table applies the package level weights from Table 39 to calculate the values of three packages of service level changes from the Base starting point. Here we see, for example, that, based on the Full sample, log, model, with assumed base cost = +5.3%, business customers are willing to pay 7.3% on top of their annual water and sewerage bill for an improvement of all services up to Level +2.

The results in Table 41 suggest that the whole package value at base cost = +4% is 13.8% while the whole package value at both base cost = 5.3% and base cost = +8% is 9.2%. This finding appears implausible and suggests that the results with respect to the base cost sensitivity should be discounted.

Table 41: Business Package Values, By Sample, CV Model & Assumed Base Cost

Model, Assumed Base Cost & Sample	Whole package value		Sub-package values		
	Mean	95% Conf Interval	Base to -1	Base to +1	Base to +2
Full sample, log, base cost = +5.3%	9.2%	(7.3%, 11.0%)	-5.2%	1.4%	2.2%
Full sample, log, base cost = +4%	13.8%	(11.9%, 15.6%)	-8.3%	2.3%	3.5%
Full sample, log, base cost = +8%	7.9%	(6.1%, 9.7%)	-5.2%	1.4%	2.2%
Full sample, linear, base cost = +5.3%	8.8%	(7.0%, 10.6%)	-6.2%	1.7%	2.6%
Valid sample, log, base cost = +5.3%	12.7%	(10.7%, 14.7%)	-7.4%	2.1%	3.1%

Mean whole package values are derived by the formula: w*wpv_low *+(1-*w*)**wpv_high, *where* w *is the calibration weight from Table 40 and* wpv_low *and* wpv_high *are the whole package values from Table 38 for the "Cost of Option A = -6%" and "Cost of Option A = 0%" respectively. Sub-package values are derived by multiplying the mean whole package value from this table by the relevant package level weight from Table 39.*

Water Supply Interruptions DCE Analysis

Core Models

Table 42: Business Supply Interruptions DCE Models

Variable	Unit	Conditional logit	Mixed logit	
			Mean	S.D.
frequency x duration	chance x hours	-0.151	-0.778	0.760
		(0.026)***	(0.089)***	(0.098)***
frequency x duration x notice	chance x hours x (dummy variable)	0.123	0.681	0.826
		(0.024)***	(0.082)***	(0.099)***
Observations		4800	4800	
LL		-1562.81	-1478.85	
Pseudo R2		0.061	0.111	

*Dependent variable for both models = choice, a {0,1} dummy variable indicating that the option was chosen. Standard errors in parentheses; (robust for cond. logit models); * significant at 10%; ** significant at 5%; *** significant at 1%. Estimated mixed logit model assumes normal distributions for all variables.*

Preference Weights

Table 43: Water Supply Interruptions Preference Weights, by Customer Type

Duration (hours)	Businesses	
	Unplanned	Planned
Less than 3	0.60	0.074
2.5	**1.00**	**0.124**
3 – 6	1.80	0.223
6 – 12	3.60	0.447

12 – 24	7.20	0.894
24 – 48	14.40	1.788

Figures denote the relative values of an avoided interruption of each type, expressed as a proportion of the value of an avoided 2.5 hour interruption. The midpoint of each duration band is used to value interruptions in that band.

Covariate Analysis

Water Services DCE Explanatory Models

Two out of the four importance variables were statistically significant, and both had the expected negative sign. This supports the validity of the results.

Table 44: Business Water Service DCE Explanatory Model

Variable	Coefficient	Standard error
discoloured water	-3.301	3.848
interruptions	-39.081	28.307
hosepipe bans	-2.786	3.91
persistent low pressure	-257.175	195.296
discoloured water x [Southern Water area]	-1.763	2.777
interruptions x [Southern Water area]	-2.557	13.071
hosepipe bans x [Southern Water area]	9.569	3.745**
persistent low pressure x [Southern Water area]	-14.14	95.813
discoloured water x [Sector: services]	0.919	3.353
interruptions x [Sector: services]	29.117	27.309
hosepipe bans x [Sector: services]	-8.373	3.378**
persistent low pressure x [Sector: services]	270.684	174.445
discoloured water x [Sector: other]	-7.863	3.903**
interruptions x [Sector: other]	27.794	28.748
hosepipe bans x [Sector: other]	-13.255	3.908***
persistent low pressure x [Sector: other]	341.022	185.891*
discoloured water x [Sewerage bill=15%]	-1.584	2.48
interruptions x [Sewerage bill=15%]	-3.675	11.908
hosepipe bans x [Sewerage bill=15%]	-6.344	2.726**
persistent low pressure x [Sewerage bill=15%]	-65.768	71.139
discoloured water x [Sewerage bill=30%]	-4.416	4.54
interruptions x [Sewerage bill=30%]	-20.359	15.745
hosepipe bans x [Sewerage bill=30%]	10.38	5.205**
persistent low pressure x [Sewerage bill=30%]	-98.083	119.968
discoloured water x [Sewerage bill=60%]	-2.496	3.767
interruptions x [Sewerage bill=60%]	-22.021	18.295
hosepipe bans x [Sewerage bill=60%]	11.044	3.913***
persistent low pressure x [Sewerage bill=60%]	52.468	121.141
discoloured water x [Sewerage bill=90%]	-5.313	3.069*
interruptions x [Sewerage bill=90%]	-21.271	22.041
hosepipe bans x [Sewerage bill=90%]	9.601	5.868
persistent low pressure x [Sewerage bill=90%]	-122.571	134.244
discoloured water x [Septic tank/ Cess pit]	6.98	2.9**
interruptions x [Septic tank/ Cess pit]	-6.276	11.347
hosepipe bans x [Septic tank/ Cess pit]	6.303	2.81**
persistent low pressure x [Septic tank/ Cess pit]	-235.354	81.066***
interruptions x importance interruptions	-35.893	8.324***
persistent low pressure x importance persistent low pressure	-179.748	74.981**
Observations	4800	
LL	-1436.456	
DF	38	
Pseudo R2	0.137	

Model = conditional logit; dependent variable = choice, a {0,1} dummy variable indicating that the option was chosen.
*Robust standard errors in parentheses; * significant at 10%; ** significant at 5%; *** significant at 1%.*

CV Explanatory Models

As expected, businesses stating that their current bill was "too much" or "far too much" were more cost sensitive than other businesses. As with the household analysis, no statistically significant effects were found with respect to the assumed sewerage bill changes.

Table 45: Business CV Explanatory Model

Variable	Coefficient	Standard error
Constant	0.909	0.226***
Log(1+Cost of Option B)	-9.937	2.965***
Q2 dummy	-0.128	0.104
*Log(1+Cost of Option B) * [Judgement on amount paid: too much]*	-6.394	2.108***
Observations	1200	
LL	-779.265	
DF	3	
Pseudo R2	0.046	

**** Significant at the 1% level, ** Significant at the 5% level, * Significant at the 10% level. Estimation is based on the random effects probit model, with a lognormal distribution*

Willingness to Pay Variation by Business Segment

Table 46: Business Whole Package Values, By Customer segment

	N	Mean	95% Conf Interval	
Full sample				
All	600	7.9%	6.1%	9.7%
Area				
Thames Water Area	216	9.1%	5.8%	12.4%
Southern Water Area	384	6.9%	4.9%	8.9%
Sector				
Manufacturing	53	-0.6%	-14.4%	13.2%
Services	450	7.9%	5.8%	10.0%
Other sector	97	9.6%	5.5%	13.7%
Employees (1)				
<10	275	6.9%	0.3%	13.5%
10-50	200	7.3%	4.7%	9.9%
>50	109	9.2%	6.7%	11.8%
Bill				
<1000	299	7.0%	3.3%	10.8%
1000-5000	198	6.8%	2.1%	11.4%
>5000	103	8.4%	6.1%	10.8%
Sewerage Bill				
£0	247	8.7%	6.8%	10.6%
£15	200	4.4%	-0.9%	9.7%
£30	47	-0.9%	-11.2%	9.5%
£60	60	7.6%	-6.9%	22.1%
£90	46	10.6%	7.0%	14.2%
Water meter				
Yes	429	9.2%	6.6%	11.9%
No	113	2.6%	-2.1%	7.3%
Septic tank or cess pit				
Yes	103	12.0%	7.1%	16.8%
No	376	7.6%	4.8%	10.3%

(1) Observations with missing values for number of employees were excluded from analysis.

APPENDIX D

Peer Review

APPENDIX D – Peer Review Final 'Sign-Off'

TO: Paul Metcalfe

FROM: Richard Carson

DATE: 2 October 2013

RE: South East Water Customer Engagement Research Report

I have finished reviewing the Accent report, South East Water Customer Engagement Research for PR14: Final WTP Report—Main Stage (September 2013). I reviewed earlier drafts of this report and pointed out several places where the report needed more elaboration on exactly what was done and suggested changes that would improve the report. I find that all of the issues raised in my reviews have now been addressed to my satisfaction.

This report should be of considerable use to South East Water as it considers options for possible changes in the quality of the service it provides. Changing service quality levels is often an expensive proposition and it is important to have high quality estimates about how such changes are valued by customers in making decisions. This report provides such estimates for a wide range of options.