YORKSHIRE WATER SERVICES LTD

PERIODIC REVIEW 2009

PART C6 – SEWER FLOODING (SEWERAGE SERVICE)

CONTENTS

1. INTRODUCTION

This section sets out our proposals for Base Maintenance, Enhanced Levels of Service and Supply Demand programmes in respect of Sewer Flooding as required by Part C6 of the Business Plan Information Requirements for PR09.

1.1. OVERVIEW

1. We are proposing to address a significant number of sewer flooding problems by 2015 by investing £163m to:

   - Maintain 620 properties on the DG5 overloaded sewer 1 in 10, 2 in 10 and 1 in 20 at risk register in order to maintain the level of service and a stable risk register.
   - Invest at a further 65 properties to reduce the number of properties at risk of internal flooding due to overloaded sewers more than once in 10 years
   - Resolve external flooding problems at 130 locations at risk of flooding due to overloaded sewers more than once in 10 years
   - Complete 37 drainage area plans
   - Carry out three surface water studies for Hull, Leeds and Sheffield
   - Reduce DG5 'other causes' internal incidents by 73 from 213 to 140 incidents per year

2. The primary influence for our sewer flooding proposals, due to overloaded sewers, is due to customer priority, and the support of customers from our cost benefit analysis, with a total £100m positive net benefit. 89% of the proposed sewer flooding problems to be addressed have a positive net benefit. Our proposals include addressing:

   - Significant customer impact of internal and external flooding due to overloaded sewer, where mitigation is either infeasible or ineffective (para 6.2 & 6.3).

3. Our proposals align with customer priorities and work towards our 2035 Strategic Direction Statement aspirations of:

   - Zero flooding of homes
   - Providing a customer experience second to none

4. CCWater support our sewer flooding proposals, and we have received written support for our drainage area planning and surface water proposals from the EA.

5. Details on DG5 other causes can be found in Part B3 (Section 7) for the expenditure allocated to 'capital maintenance and Part B6 (3.2) for the expenditure allocated to enhanced service levels. We have not repeated the commentary in C6.

1.2. CHANGES FROM DRAFT BUSINESS PLAN

1.2.1. Summary of changes

6. There are six significant changes from our draft business plan submission. These are:

- At the draft business plan submission the proposed investment for DG5 Internal Sewer Flooding (maintaining service levels) was allocated 40% to the capital maintenance programme and 60% to the supply demand programme. After company specific feedback on our draft business plan (Annex 20) the total investment associated with maintaining DG5 internal sewer flooding service levels has been allocated to supply demand.
- Additional high priority External Flooding projects have been included in our final business plan submission.
- Drainage Area Plan investment has been re-allocated from the ELoS Programme to the Capital Maintenance programme following our company specific feedback on our draft business plan (Annex 12)
- Investment proposed at DBP for a Multi Agency Study at Hull has been re-allocated to supply demand following the company specific feedback (Annex 12). Further studies have also been added since DBP to reflect the Critical Flood Areas agreed with the Environment Agency.
- There is an increase in the forecast of new flooders over the AMP5 period due to statistical predictions.
- At the DBP we identified that we currently use FSR (Flood Studies Report) rainfall during our capital delivery process but intended changing our design standard to stipulate that the rainfall series which are used in solution development should be FEH (Flood Estimation Handbook). This has increased the overall proposed programme.

1.2.2. Changes to Planned Expenditure

Service Area	Investment Driver	Draft Business Plan Submission £m	Final Business Plan Submission £m	Changes to FBP from DBP £m
Base	DG5 Internal Flooding	17.5	0.0	**-17.5**
	External Flooding	8.4	16.2	**+7.8**

	Drainage Area Plans	0.0	15.8	**+15.8**
	Total	**25.9**	**32.0**	**-6.9**
ELoS	DG5 Internal Flooding	23.1	27.0	**+3.9**
	DG5 Other Causes Internal	14.2	34.0	**+19.8**
	Drainage Area Plans	19.9	0.0	**-19.9**
	Total	**57.2**	**61.0**	**+3.8**
Supply Demand	DG5 Internal Flooding	26.0	59.6	**+33.6**
	Multi Agency Studies	0.0	10.1	**+10.1**
	Total	**26.0**	**69.7**	**+43.7**
Total programme	DG5 Internal Flooding	**66.6**	**86.6**	**+20.0**
	External Flooding	**8.4**	**16.2**	**+7.8**
	DG5 Other Causes	**14.2**	**34.0**	**+19.8**
	Drainage Area Plans	**19.9**	**15.8**	**-4.1**
	Multi Agency Studies	**0.0**	**10.1**	**+10.1**
	Total	**109.1**	**162.7**	**53.6**

Table 1: Changes in Expenditure between Draft and Final Business Plan

1.2.3. Changes to Planned Outputs

Service Area	Output Type	Draft Business Plan Submission	Final Business Plan Submission	Changes to FBP from DBP
Base	2 in 10 Internal	26	0	**-26**
	1 in 10 Internal	112	0	**-112**
	1 in 20 Internal	34	0	**-34**
	External Only	125	130	**+5**
	Drainage Area Plans	0	37	**+37**
ELoS	2 in 10 Internal	20	20	**-**
	1 in 10 Internal	66	45	**-21**
	1 in 20 Internal	1	2	**+1**
	External Linked	20	33	**+13**
	DG5 O/C Internal reduction	94	73	**-21**
	Drainage Area Plans	37	0	**-37**
	Multi Agency Studies	1	0	**-1**
Supply Demand	2 in 10 Internal	39	140	**+101**
	1 in 10 Internal	168	385	**+217**
	1 in 20 Internal	51	95	**+44**
	Multi Agency Studies	0	3	**+3**
Total programme	**2 in 10 Internal**	**85**	**160**	**+75**
	1 in 10 Internal	**346**	**430**	**+84**
	1 in 20 Internal	**86**	**97**	**+11**
	External Only	**125**	**130**	**+5**
	External Linked	**20**	**33**	**+16**
	DG5 O/C Internal reduction	**94**	**73**	**-21**

	Drainage Area Plans	**37**	**37**	**-**
	Multi Agency Studies	**1**	**3**	**+2**

Table 2: Changes in Outputs between Draft and Final Business Plan

2. OUR ASPIRATIONS FOR 2035

7. In our Strategic Direction Statement (SDS) we set out our ten priorities for the next 25 years. One of these is dedicated to our proposals in respect of sewer flooding as set out below.

2.1. SERVICE – STOPPING OUR SEWERS FLOODING HOMES AND BUSINESSES

2.1.1. Our Aspiration

By 2035 our aspiration is to have zero flooding of homes and businesses as a result of our assets failing

2.1.2. Our Service

8. 95% of our customers and stakeholders surveyed have said that eliminating the sewage flooding of people's homes should be a top priority. Over the past 20 years we have reduced the number of properties flooded internally with sewage by over 1,000. However, there are still too many properties where customers suffer from this extremely unpleasant experience.

2.1.3. Our Journey

9. The major impact on customers from the failure of the sewerage system is the flooding of their homes and places of work. The impact of such events is both devastating and distressing.

10. We currently maintain the sewerage network to prevent flooding in homes for a 1 in 10 year intensity rainfall event. By 2035, we will invest in our assets to prevent flooding in homes for a 1 in 30 year intensity rainfall event. Should climate change alter the frequency and/or intensity of flooding events, these design standards will be reviewed. Our aim will be to agree standards within a national framework. To ensure compliance with new standards, the required investment will be detailed within appropriate five yearly reviews.

2.1.4. Timescale

11. Our work over the next 25 years will involve major improvement and upgrading of key elements of the sewerage system. A major programme of proactive 'next generation' modelling and investigations will be initiated in AMP5 to ensure that we target investment efficiently.

12. To understand flood protection approaches for Hull, Leeds and Sheffield we will be contributing to investigations for these catchments along with other key organisations, as part of a multi-agency approach.

13. The investment required to contribute to these studies is described in B5 – Supply / Demand (Section 4.6.1).

3. AMP4 OUTTURN

3.1. EXPENDITURE AND OUTPUTS IN AMP4

14. In AMP4 we are forecasting to have invested a total of £27.9m to maintain the number of 'at risk' properties on the Internal Sewer Flooding registers (for 2 in 10 and 1 in 10) at the same level as at the start of the period.

15. We are also forecasting to have invested £11.1m to reduce the 'at risk' Internal Sewer Flooding register (2 in 10 and 1 in 10) overall by 36 properties.

16. We are forecasting to invest a total of £5.4m to remove external flooding incidents at locations identified in the AMP4 Final Determination, and investigate all other known external flooding incidents at the start of the AMP4 period.

17. The above investment, totalling £44.4m, is forecast to deliver the following outputs in the current AMP4 period:

- 131 properties removed from the 2 in 10 at risk register.
- 354 properties removed from the 1 in 10 at risk register.
- 94 external area only flooding problems.
- 156 external area linked area flooding problems.
- Regional external area flooding investigation.

3.2. FORECAST FLOODING REGISTER POSITION AT MARCH 2010

18. The forecast outturn register positions at March 2010 are:

- Properties at risk of flooding (2 in 10) - 63
- Properties at risk of flooding (1 in 10) -149
- Properties at risk of flooding (1 in 20) -185

- External (area) flooding (at risk 1 in 10, 2 in 10 and 1 in 20) – 1621

19. The number of properties internally flooded in the year due to overloaded sewers, excluding severe weather, is forecast to be 124. The reduction in the period has been masked by the inclusion in the calculation of properties at risk of flooding once in 20 years which has been added in for JR08 regulatory reporting.

20. The JR06 identified 203 properties flooded in the year due to overloaded sewers. This excluded the properties at risk of flooding once in 20 years.

21. The number of properties forecast to be at risk of flooding once in 20 years in 2009/10 is 19. Therefore when comparing the start and end position, excluding these, there is a reduction of 98 properties flooded in the year (from 203 down to 105).

4. THE VIEWS OF OUR CUSTOMERS AND STAKEHOLDERS

22. We asked our customers, stakeholders and young people and children (our customers of tomorrow) what our priorities should for the next 25 years. The results of our research are detailed in section C1 of our submission, but the outcomes relevant to this business area are highlighted below.

4.1. DOMESTIC CUSTOMERS

4.1.1. Qualitative Study

23. The qualitative study found that six, out of the eight, focus groups considered dealing with internal sewer flooding as ‘essential’ with the remaining two groups viewing it as ‘nice to have’. Overall internal flooding ranked joint 7th out of the 26 areas considered.

4.1.2. Quantitative Study

24. The quantitative study found that domestic customers were regionally willing to pay £41,789 per annum to reduce sewer flooding for one property. Analysis between low income groups and the remaining respondents showed no significant difference.

4.2. BUSINESS CUSTOMERS

4.2.1. Qualitative Study

25. The qualitative study found that six out of the eight businesses considered dealing with internal sewer flooding as 'essential'. One of the businesses viewed dealing with internal flooding as 'nice to have' with the remaining businesses assessing dealing with internal sewer flooding as 'not important'. Overall, businesses ranked sewer flooding joint 10th out of 26 areas.

4.2.2. Quantitative Study

26. The quantitative study found that each business was willing to increase their bills by 0.03% per annum to reduce sewer flooding for one property. For the average business this is equivalent to £56,875 regionally per annum.

4.2.3. National research on the Draft Business Plan

27. After Companies submitted their Draft Business Plans, Ofwat carried out its own research into what customers thought about Companies' proposals. This research was carried out by independent consultants MVA Consultancy, with BMG Research, on behalf of Ofwat and a group of water industry stakeholders which included the Department for Environment and Rural Affairs, the Welsh Assembly Government, CCWater, the EA, the DWI, NE and Water UK.

28. Face-to-face interviews were carried out with customers, including 315 Yorkshire Water customers, during September and November 2008. The aims of the research were:

- To obtain views on water issues in the wider context of other social issues and household bills
- To determine customers' understanding of water and sewerage services
- To understand customers' priorities for maintaining or improving service, with reference to the proposed bill impacts
- To obtain customers' views on their company's DBPs, including service levels, bill impacts, phasing of increases and any omissions

29. The results of this research showed strong customer support for our DBP proposals, with 97% of customers reporting that they found our plan and the proposed impact on their bill either "acceptable" or "very acceptable" and 91% feeling the plan offered either "fairly good" or "very good" value for money.

30. Customers were asked whether they felt our DBP offered good value for money in each of fourteen key service areas. Our plan was well received, with at least 80% of customers feeling our proposals represented either

"fairly good" or "very good" value for money in every service area (See B3 Section 3 para 39-41). It is important to note that the % of respondents viewing our proposals as 'fairly poor' or 'very poor' was minimal.

31. These results provide an indication of 'value for money' of our FBP proposals but are not directly comparable with the our customer research. We have not used this as a replacement for cost benefit analysis.

32. Customers were asked about our proposals to 'Avoid risk of homes and gardens being flooded with sewage'. In response, 93% felt that our proposals offered 'very good' or 'fairly good' value for money. 1% thought they offered 'very poor' or 'fairly poor' value for money.

33. Customers were also asked about our proposals to 'Avoid risk of properties being flooded with sewage outside the home" 91% felt that our proposals offered 'very good' or 'fairly good' value for money. 1% thought they offered 'very poor' or 'fairly poor' value for money.

34. This national research demonstrates a broad support for our proposals.

4.3. CONSUMER COUNCIL FOR WATER

35. After the submission of our Draft Business Plan in August 2008, we sent copies of Part A to all the regulators, and invited them to meet in October 2008 to discuss our submission. At this meeting we presented the key messages from our Draft Business Plan and asked the regulators to provide their feedback.

36. CCWater said that resolving sewer flooding is a key priority and provided positive feedback on our proposals.

37. As part of our consultation we discussed the prioritisation process for sewer flooding and how cost benefit analysis influences those proposals.

38. CCWater were also interested in how much investment it would take to resolve all existing problems, i.e. to calculate the costs to clear the backlog of the sewer flooding register. The results of our estimates are as follows:

- For the 1 in 10 & 2 in 10 register, we expect to have 212 properties remaining at 2010, and a further 185 on the 1 in 20 register.
- Our FBP proposal totalling £27m is to invest in 65 of those from the 1 in 10 & 2 in 10 register, plus 2 properties from the 1 in 20s (which are included as they are co-delivered with other 1 in 10 & 2 in 10 properties).
- To clear the remainder of the 1 in 10 & 2 in 10 register it would cost £95-100m, with the remaining 1 in 20s £55-60m.

39. We have been working, for some AMPs, to reduce the 1 in 10 & 2 in 10 register and, therefore, it is the very high cost problems that remain. For 1 in 20s, as we have only previously addressed these as co-delivered outputs, there is a more varied mix of costs.

40. This analysis, demonstrates that it would take significantly more investment to resolve all known problems, and go further towards our SDS aspiration of 'Zero flooding in customers homes' therefore we have limited our AMP5 proposals to those which have a positive net benefit or have significant customer impact, as part of a balanced programme.

4.4. OTHER STAKEHOLDERS

41. We have worked with the EA and local authorities on understanding the priorities for surface water management. We have received written support for our surface water study proposals from the EA and will work collaboratively with them. (Appendix 1)

42. The EA also support our proposals for drainage area plans, recognising that they will not only help in resolving sewer flooding but also in improving understanding of pollution risks.

4.4.1. Hull Integrated Strategic Partnership

43. We have set up a new partnership with Senior representatives from Hull City and East Riding of Yorkshire Councils and the Environment Agency to plan and co-ordinate future investment to improve Hull's flood defences. Our representative is Kevin Whiteman, our Chief Executive.

44. The four organisation have been working together for the past 15 months. The group will work together on a joint long term approach to better management of the whole water drainage system for Hull and the surrounding area. This is in line with recommendations in the Pitt Review, which suggested a board of this type would facilitate better joint working and the development of a co-ordinated strategy for water management.

45. Hull City Council Chief Executive, Kim Ryley, confirmed that, "There is long term commitment here – some of the work may take 10 or 15 years, but it's important to get the right framework in place for this as soon as possible. We need to build long term resilience into the system. We've come together to build a strong, effective partnership, and we are committed to working in an open and collaborative way, sharing the information we have, as well as working on a joint research study."

46. The city's boundaries are tightly drawn, so it is important to work closely with the East Riding Council, because there are many issues which cross boundaries in relation to rivers and water courses draining into the estuary from The Wolds, as well as a shared interest in coastal flooding.

47. The new, multi-agency group will review the improvement work already completed and in progress since the floods, and ensure any immediate work necessary is carried out. An initial 2-3 year work plan will then be produced.

48. This will be prepared alongside a vital, detailed hydro-geological survey of the whole area, which will be produced for the first time. A comprehensive map of all of the local drainage systems, including those in the East Riding which flow into Hull, will be completed, alongside the surface water studies into the company's assets.

49. This work will assist the agencies to make informed judgements about where further improvements are needed. It will also include a full review of current flood defences, looking at how they stand up to events such as the 2007 summer floods. This will give the new partnership a complete picture and assist them in producing shared risk analysis, on which to base priorities for future improvements and investment.

50. The group has already agreed to invest time, resources and energy into completing the major research study as quickly as possible. This will identify where additional funding will be required.

4.4.2. Leeds Strategic Flood Risk Management Board

51. The Leeds Strategic Flood Risk Management Board is a newly established board which comprises of our representative, Graham Dixon, Director of Environmental Business Unit, and other senior representatives from the local authority and the Environment Agency. The group met for the first time in July 2008 to address Flood Risk Management in Leeds. It is a partnership that shares the investment.

52. This partnership is still being developed and agreements are being finalised to ensure that formal sharing of information and a collaborative approach to addressing flood risk in Leeds is administered.

4.4.3. Sheffield Integrated Catchment Management

53. We have been in discussion with the EA to review integrated catchment management in Sheffield.

54. As part of the AMP5 NEP (National Environment Programme), there is an agreed obligation with the EA for assessing the water quality implications, via an Urban Pollution Management study. (Part B4, section 4.19.2).

55. However, understanding the water quality impacts of the Company assets will not give the full picture required for integrated catchment management which, therefore, requires additional work to understand the surface water management.

56. We have agreed this approach with the EA, who have provided written support on our proposals. (Appendix 1).

5. REASONS FOR PROPOSING ENHANCEMENTS

57. As stated earlier, 95% of our customers and stakeholders surveyed said that eliminating the sewage flooding of people's homes should be a top priority. Over the past 20 years we have reduced the number of properties flooded internally with sewage by over 1,000. However, there are still too many properties where customers still suffer this extremely unpleasant experience, some for the first time. In addition, the fear of flooding every time heavy rain falls, is a distressing and worrying experience for the occupants of properties known to be at risk.

58. These customer priorities drive our Strategic Direction Statement aspirations to have 'zero flooding of homes as a result of failure of our assets'. This is a stretching target and our direction of travel towards this will include:

- working towards national standards to respond to climate change
- implementation of 'next generation' hydraulic modelling
- increasing sewerage network maintenance investment

59. We currently maintain the sewerage network to prevent flooding in homes for a '1 in 10' year rainfall event. However, by 2035, we aim to have invested in our assets to prevent flooding in homes for a '1 in 30' year rainfall event.

60. Our cost benefit analysis indicates that we are below the economic level of service for internal flooding, due to overloaded sewers or other causes. **Customer priorities and willingness to pay is the primary influence upon our enhancement proposals**.

61. Where there is not a positive net benefit at scheme level we have balanced significant customer impact of internal flooding due to overloaded sewer,

where mitigation is either infeasible or ineffective at a limited number of problems, within a sub-programme with an overall positive net benefit.

6. PROPOSED HYDRAULIC SEWER FLOODING PROGRAMME

6.1. METHODOLOGY FOR DETERMINING THE SEWER FLOODING PROGRAMME

62. Projects to resolve known flooding issues are designed, costed and given a post solution risk score (which takes into account any post-investment residual risk). The cost of solving any problem is identified from outline engineering solutions costed from our comprehensive unit cost database.

63. Investigations into the majority of the known flooding issues, has already been carried out by our AMP4 Contract Partners, using hydraulic modelling to understand the problem and develop robust solutions.

64. We propose to continue our policy of identifying and constructing a wide range of solutions and in AMP4 we are currently discussing the possibility of using CSO's to relieve the sewer network where water quality will not be compromised, rather than creating extensive storage on our networks.

65. Where possible we will endeavour to look for 'holistic' solutions and deal with 'clusters' of problems. This will be easier at the beginning of the AMP period when we are looking to resolve ELoS problems. Once these are resolved it will become more difficult to link solutions as we become more focussed on dealing with newly arising flooders.

66. The risk reduction is calculated as the scheme original risk score minus the post-investment risk score for each specific sewer flooding issue. The value, or 'benefit', of the reduction in risk is derived from our research into customer's willingness to pay stated preference study as detailed in Part C1. For each sewer flooding scheme, a cost benefit assessment is derived.

67. The Enhanced Levels of Service programme includes known internal flooding problems with significant customer impact which will not be resolved within AMP4 where the problem is understood and solutions have been developed. A number of locations have not been included. At these locations, either further information is required or the cost is considered prohibitive.

6.1.1. Severity of flooding impact

68. When sewers have insufficient capacity to carry peak storm flows, then sewage can escape and flood either properties or external areas. The severity of each incident may vary and any one incident can affect varying numbers of properties and/or areas.

69. Flooding risks are measured against our AMP5 risk matrix (which categorises the severity of the flooding impact) using the severity definitions in the figure 1 below:

Severity	Internal Flooding	External Flooding
Very High	Standing water in living accommodation (including cellar).	Flooding resulting in standing water affecting schools, hospitals, health centres or causing disruption to major road.
High	Standing water in underfloor space, utility cellar, cellar at business premises, cellar used for low value storage, integral attached garage.	Flooding resulting in standing water affecting access to property, parks, playgrounds, car parks and business premises or causing disruption to minor road
Medium	Standing water in unused cellar	Flooding resulting in standing water on garden, field, woodland or minor road but not affecting access to property.
Low	Damp patch (no standing water) in unused cellar or used for low value storage only. Frequent restricted toilet use.	Flow from a manhole cover but not ponding
Very Low	Damp patch (no standing water) in unused cellar. Occasional restricted toilet use.	Damp patch / seepage

Figure 1 - Flooding risk matrix severity definitions

6.2. INTERNAL FLOODING

6.2.1. Enhanced levels of Service Investment

70. The 'enhanced level of service' investment is required to reduce the number of properties 'at risk' on the register.

71. We are proposing an internal flooding alleviation programme of £27m as part of our enhanced levels of service programme to reduce flooding at 67 properties.

72. In the proposed draft final programme there are 32 site specific 'ELoS' projects identified. These address a range of flooding problems which have existed for some time, and all the locations are currently on the 'at risk' flooding register.

73. The proposed ELoS programme has an overall net benefit of over £55m i.e. where the benefit outweighs the cost.

74. Of the 32 solutions proposed, 23 solutions have an individual positive net benefit removing 57 properties from the flooding register. The remaining 9 solutions proposed have a negative net benefit. These solutions remove 10 properties from the flood register, and are promoted for investment due to them being identified as High or Very High impact on our severity scale identified above in Figure 1.

75. Attached is a spreadsheet (Appendix 2) for all 32 proposed projects with the above supporting information for each project, justifying:

- the need for the proposed investment and
- whether mitigation has been considered as an option

76. Prioritisation of each 'at risk' property, or area flooding problem, for investment to resolve a specific sewer flooding issue is based upon:

- Severity of flooding impact - using the five levels above.
- Probability/frequency of occurrence.
- Quantity of properties/areas affected.
- The severity, probability and quantity of other impacts e.g. pollution

77. The above criteria are then combined to give a total 'risk' score.

78. In AMP4 we use FSR (Flood Studies Report) rainfall during our capital delivery process but intend changing our design standard to stipulate that the rainfall series which are used in solution development should be FEH (Flood Estimation Handbook)

79. There are a number of reasons for this change in standard:

- FEH rainfall data is used to determine the status of 'at risk' properties when new incidents occur
- The FEH methodology is based on a greater quantity of historical rainfall than the FSR methodology, and values can be derived with greater accuracy.
- The use of FEH rainfall events is widespread in other areas of hydrology and it is hard to defend the use of FSR methodology indefinitely
- FEH rainfall is becoming accepted as the industry standard

80. To understand the impact of this change external consultants, MWH, have carried out a study assessing a number of different completed capital schemes.

81. The study concluded that this change in the design standard leads to larger and more expensive solutions. However, the study identified large variations in the percentage cost increases on the individual solutions.

82. In order to develop a 'generic methodology' for increasing proposed solution costs a working group including members of the Network Asset Team and PR09 team was established. The group reviewed the external consultants' report and made recommendations for updating solution design as appropriate.

83. The measure values of any solution elements relating to 'storage volume' would be increased by 25% and then recosted using the appropriate AMP5 UCDs. i.e. detention tank volumes have been increased by 25% and pipe diameters have been increased by 10%.

84. Solutions/solution elements which did not include 'upsizing' e.g. 'cut and pump' solutions have not been updated during this exercise.

85. These changes have been applied to all proposed internal hydraulic flooding solutions.

86. This has resulted in an increase in proposed ELoS investment from draft business plan to include for this change.

87. Our enhanced level of service proposals are all site specific problems and have been costed using our unit cost database or using feasibility studies undertaken by our contract partners.

88. Our proposals result in, on average, a unit cost of £403k per output for the enhanced levels of service programme. This reflects the increasing number of higher unit cost projects remaining after AMP4 prioritisation which selects those on the basis of cost benefit.

89. The table below identifies the change in ELoS unit costs over the last two AMP periods:

Service Area	AMP3 unit costs	AMP4 unit costs	AMP5 proposed unit costs
ELoS	77k per property	89k per property	403k per property
Pre CMS projects		626k per property	

Table 3: ELoS Unit cost analysis

90. This reflects the increased proportion of high unit cost problems remaining on the register after successive AMP periods to reduce the number of properties at risk from internal flooding due to overloaded sewers.

91. It is likely, until the backlog of problems is addressed, that there will be an increasing cost of unresolved problems left behind on the at risk register. This is illustrated in table 4 below.

92. The table illustrates the impact of delivering a programme based on cost benefit over time. High unit cost represents those projects with a unit cost greater than £150k per property whilst low unit cost projects are lower than £150k per property our AMP4 prioritisation criteria.

Service Area	% High Unit cost	% Low unit cost
AMP2 Programme	-	100
AMP3 Programme	5	95
AMP4 Programme	8	92
Proposed AMP5 Programme	15	85

Table 4: High / Low unit cost analysis

6.2.1.1. Mitigation

93. Properties on the 1 in 10 and 2 in 10 registers, for which we don't have cost beneficial capital projects, have been reviewed for the Final Business Plan to establish what mitigation can be offered to reduce the risk, or mitigate the impact of sewer flooding.

94. There are 9 solutions proposed in the final business plan that have a negative net benefit but are still being promoted for investment as these have been identified as having a High or Very High impact on our severity scale. They have all been reviewed to see if a mitigation solution is possible and would be effective.

95. As identified in Appendix 2, at 8 out of the 9 sites mitigation has either been provided and is not effective, or is not possible. The only site which is an exception and already has mitigation fitted (Non return valve) to prevent cellar flooding is Grape Lane, Whitby. The property in Grape Lane is a restaurant and although an NRV (non return valve) has been fitted we view this only as a temporary solution. This is because the balance of protecting the property from flooding and maintaining service is not fully understood.

96. There are three identified flooding locations which have not been included in the proposed investment programme.

97. Flooding at each of these locations is mitigated, either by Yorkshire Water interventions or by the customers own action.

98. This mitigation solution still requires Yorkshire Water to continue to deploy pumps as required to facilitate the speedy reduction of flooding in the areas around the building. This enables work in the buildings to be resumed as quickly as possible after rainfall and minimises damage to the loading areas.

99. The disadvantages of the mitigation provided are:

- Relies on the owner to deploy the system
- Potential future claims for damage to loading areas (as is situation)
- Difficult to guarantee level of protection
- YW to provide flood pumping support (as is situation)

A full resolution of this problem would cost around £4.9M. As mitigation is effective to a certain degree, and the full resolution is such high cost, we are not promoting a full scheme resolution within AMP5.

100. A full resolution of this problem would cost around £2.3m. As mitigation is effective to a certain degree with no recent reports of flooding, and the full resolution is such high cost, we are not promoting a full scheme resolution within AMP5.

6.2.2. Supply/Demand Investment

101. The supply/demand investment programme is required to ensure that the register position is maintained between the start and end of the AMP period. As such it requires us to predict the number of properties which will flood for the first time during the AMP period.

102. In the draft business plan submission this investment was allocated 40% to the Base programme and 60% to the supply demand programme to align with the AMP4 Final Determination.

103. Following company specific feedback on our draft business plan (Annex 20) all investment to maintain the register position has been allocated to the supply demand programme.

104. In order to understand how many new properties will be identified as 'at risk' in the future, statistical analysis has been carried out. This analysis has been undertaken by our own statisticians and the predictions reviewed and agreed by a cross business unit team.

105. The statistical analysis has been carried out using historic information and, therefore, cannot accommodate where a step change in information availability could identify previously unidentified 'at risk' properties. These newly identified properties may have always been 'at risk', but not have previously flooded (due to the specific rainfall event not having occurred at that location). This may be particularly prevalent for 1 in 20 at risk properties.

106. We are therefore proposing to maintain service levels where newly emerging properties arise in a similar manner to those previously, on the basis of reported flooding, and the subsequent local site specific investigation which may identify adjacent properties. Detailed and extensive flood studies that are likely to be developed as part of the move towards surface water management, may identify previously unidentified 'at risk' properties. If this occurs we would propose a change to the register positions and that the investment to address them is recognised accordingly via logging up or other appropriate regulatory mechanisms.

107. As already set out in 109 above, we are experiencing an increased unit cost over time due to the lack of prioritisation choices in a decreasing pool of problems.

108. The bar chart below identifies the change in unit costs over the last two asset management periods and our AMP5 proposed unit cost:

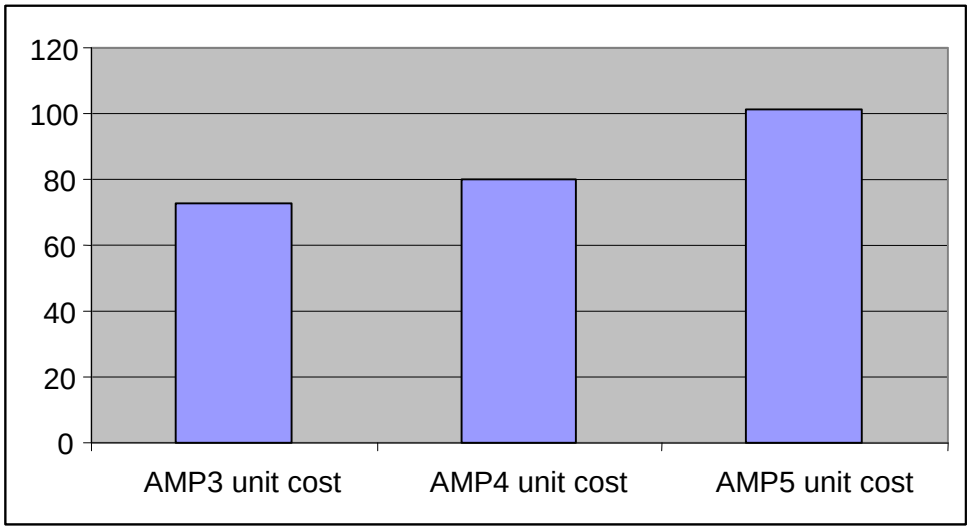

Table 13: Base Unit cost analysis (£k)

109. Unit costs to maintain service levels have increased over time. The increase in the forecast unit cost for AMP5 is due to a higher proportion of high unit cost properties being required to maintain service levels in future AMP periods

110. As can be seen in the above table we are proposing an increase in unit cost to that delivered in previous AMP periods.

111. From the AMP3 to AMP4 period, the unit costs increased by 10% to reflect the fact that, as we have used cost benefit, we are delivering the lowest unit cost solutions to maintain the register positions. However, this unfortunately does lead to increasingly higher unit cost solutions being left on the register. The average unit cost of those that will remain on the register at the end of AMP4 is currently forecast at £626k per property.

112. Over the AMP4 period the number of simple lower unit cost solutions, e.g. cut & pump solutions, have been harder to identify which has led to additional investment over and above that identified in the AMP4 Final Determination.

113. Our unit costs reflect that, when resolving problems, we also count those properties which may not have reported flooding, but were set at risk following hydraulic modelling investigation into flooded properties in the same locality.

114. As the register has reduced over time, this has and will continue to reduce prioritisation choice. This increases the cost of maintaining stable register positions, as a more costly mix of problems must be resolved.

115. In addition, there will also be a small impact on the unit cost due to the change from using the current design standard, of 1 in 30 year rainfall event as assessed by FSR, to FEH criteria. This has been revised from the DBP based upon consultant analysis for standards associated with rainfall events as assessed by both criteria.

6.2.2.1. Summary of Results of the Statistical Analysis to identify new flooders

116. We have reviewed the number of new flooders which have arisen over the last 10 years, in conjunction with the number of those in each year that were subsequently removed due to better information.

117. Using this information, we used statistical modelling to assess annual profiles of new flooders and tested best fit of our results:

- **Internal Properties at risk of flooding more frequently than once in 10 years'** - Forecasting methodology using a moving average (length 3) i.e. 77 events p.a. 2008/9 – 2014/15 inclusive, yielding a total of 385 events during AMP5.
- **Internal Properties at risk of flooding more frequently than twice in 10 years'** - Forecasting methodology using a moving average (length 3) predicts 28 events p.a. 2008/9 – 2014/15 inclusive, yielding a total of 140 events during AMP5.
- **Total '1 in 10' plus '2 in 10'** - Above results yield a total of 105 events p.a. 2008/9 – 2014/15 inclusive.
- **Internal Properties at risk of flooding more frequently than once in 20 years'** - Forecasting methodology using exponential smoothing predicts 19 events p.a. 2008/9 – 2014/15 inclusive, yielding a total of 95 events during AMP5.
- **Proportion of transfers '1 in 10' to '2 in 10'** - Modelling the proportion of '1 in 10's' to '2 in 10's' has been done using linear regression with time as an explanatory variable. The proportion of '1 in 10's' transferring to '2 in 10's' year on year is forecast to decline from 2.56% in 2008/9 to 1.72% in 2014/15. This is based on using a forecast of 77 '1 in 10' events p.a. during the period 2007/08 to 2014/15.

118. Although the method used to predict new flooders has not changed, the number of new flooders predicted over the AMP5 period has increased from that identified at the draft business plan due to the continuing increase in actual new flooders identified in the current AMP period.

119. At the draft business plan a total of 69 events for Total '1 in 10' plus '2 in 10' was used, this has now increased to 105. This is aligned to the number of new flooders identified to date in the current year 2008/09.

120. Our predicted numbers for additions to the 'at risk' register align with our business as usual processes of:

- properties which have flooded for the first time – 'new flooders'
- those in the vicinity of the 'new flooders' which following investigation and hydraulic modelling are confirmed as at risk of flooding

121. The historic data used to predict new flooders are net of better information removals.

6.3. EXTERNAL FLOODING

122. External flooding investment is proposed as 'atypical' for the following reasons:

- It is not a serviceability indicator
- It has an identified sub-programme of outputs
- The justification for the external flooding sub-programme is via cost benefit analysis and customer impact of known problems, in common with the DG5 overloaded sewer enhanced level of service programme.
- Had the proposals been to maintain a register of external flooding, then it would have been allocated to the supply demand programme, in common with the DG5 overloaded sewer programme to maintain register levels.
- It has not previously been allocated to capital maintenance, and is unlikely to be allocated to capital maintenance in future programmes when the approach for both internal and external sewer flooding due to overloaded is consistent.

123. Although we are not proposing to maintain the level of service for external flooding the investment proposed has been allocated to the base programme.

124. ARUP (one of our AMP4 Framework Consultants) was appointed in AMP4, to conduct a problem understanding exercise and assessment of over 900 external flooding entries on our flooding register.

125. Where hydraulic models already exist, notional solutions have been developed in line with the objective of ensuring that flooding risks are visible to the LEADA+ systems for inclusion in the AMP5 Business Plan.

The primary output of this work is the population of BRM+ with external flooding risks.

126. Each external flooding location represented in BRM+ is supported by a report outlining key details e.g. modelled flooding frequency, predicted flooding volumes, proposed solution etc, including a location diagram and hydraulic gradient diagram.

127. Where multiple locations can be resolved by a single solution this is represented in BRM+ as multiple failure scenarios (one for each location) linked to a single solution.

128. We are proposing an external flooding programme of a total of 50 projects, which has an overall positive net benefit at programme level of over £6m.

129. Within the proposed programme 20 projects have individual positive net benefits.

130. Although not all the projects within the proposed programme have a positive net benefit on an individual basis, the additional 30 solutions are being promoted as the flooding problems have been assessed as having significant customer impact.

131. Our experience with external flooding is that in the majority of instances mitigation is ineffective, it does not prevent the escape, and can only divert the flooding problem elsewhere.

132. Attached is a spreadsheet (Appendix 3) for all 50 proposed projects with the above supporting information for each project, justifying the need for the proposed investment.

133. Prioritisation of each 'at risk' area flooding problem for investment to resolve a specific sewer flooding issue is based upon:

- Severity of external flooding impact - using the five levels (shown in Fig.1).
- Probability/frequency of occurrence.
- Quantity of areas affected.
- The severity, probability and quantity of other impacts e.g. pollution or health and safety.

134. The above criteria are then combined to give a total 'risk' score.

135. External sewer flooding is the only exception to the approach of stable service levels. It is not currently being maintained and the data, analysis and industry definitions are at this stage too immature to accurately plan.

136. The 'base capital maintenance' investment proposed programme will not ensure that the register position is maintained between the start and end of the AMP period.

137. We have reviewed the costs to maintain the external flooding register throughout the AMP5 period but this is in excess of £170m and has, therefore, been ruled out on cost benefit and affordability grounds.

138. In addition, and importantly, this is an area where customers do not value the benefits sufficiently to maintain service levels. However, as a consequence of the internal flooding programme for properties flooding for the first time in AMP5, we will seek out opportunities to deliver area flooding improvements at zero cost where possible as part of those projects.

6.4. MODELLING / INVESTIGATIONS

6.4.1. Modelling / Investigations in response to a flooding incident

139. Our clearly documented DG5 investigation procedures ensure that the appropriate level of investigation and modelling is carried out in response to flooding incidents, and that the staff involved in the process are clearly aware of their roles and responsibilities throughout.

140. We deal with most hydraulic flooding problems reactively, although if neighbouring properties are identified as 'at risk' during investigation into a known problem we endeavour to resolve those at the same time. Again there is a clearly documented procedure for identifying additional 'at risk' locations ensuring a consistent approach.

141. Once a property has been identified as 'at risk' of internal flooding an investigation is carried out to understand the problem, identify a notional solution and allow population of our Business Risk Model plus, so that the problem can be considered for capital investment.

142. We involve our Capital Partners at this stage to review existing hydraulic models and undertake a problem understanding exercise. If a suitable hydraulic model is not available a desktop exercise will be undertaken to assess the complexity and extent of the problem.

6.4.2. New Development

143. We have a clear and documented process for responding to planning and development enquiries. This includes process maps detailing actions and responsibilities both internally and externally (e.g. planning authority and developer) from receipt of an enquiry to grant of planning.

144. We currently undertake a desktop study to assess the impact of new development on our sewer network. This includes reviewing the hydraulic capacity of sewers in the vicinity of the proposed development and assessing whether the proposed discharge would impact on our service to customers.

145. For brown field sites it is usual to limit flow from the proposed site to that of the previous discharge.

146. For green field sites an assessment will be undertaken. Foul only connections are usually accepted. However, for surface water connections if our assessment suggests an issue with capacity we set a nominal discharge limit of 5 l/s or undertake a more detailed receiving sewer check.

147. When considering combined connections, if our investigations suggest a problem with capacity our proposed outcome would be to accept only foul flows into the combined sewer and get the developer to construct or 'requisition' a surface water sewer and outfall.

148. As we complete our proposed programme of drainage area planning, the hydraulic models developed will be used to inform this process.

6.4.3. Drainage Area Planning

149. A programme of Drainage Area Planning is proposed for AMP5 and beyond. It is recognised that it is only by understanding the condition and behaviour of our networks, and the assets within them, that we can properly understand the risk of impacts on our customers and respond to new development appropriately.

150. The drainage area plans are also key in understanding our strategic risk of climate change, as they will provide a benchmark from which to monitor and model climate change scenarios.

151. The proposed Drainage Area Plans (DAP's) will include network modelling of the foul, combined and surface water network, review of operational performance, historical verification, and CCTV surveys of a proportion of critical the sewers network. The DAP's will be undertaken to WAPUG Type II standards with enhancement around known or anticipated problem locations, e.g. existing DG5 properties.

152. The Drainage Area Zones which will be modelled during AMP5 will be selected by a prioritisation process using parameters such as known flooding problems, number of assets and inter-relationship with other areas of the Business Plan e.g. the Quality programme.

153. The outputs of the DAP's of particular relevance to the risk of flooding will include:

- Surcharge level and frequency during specific rainfall events.
- Spill volumes and frequency during specific rainfall events.
- Identification of operational network problems e.g. structural restrictions on capacity.
- An understanding of the condition grade of the network assets.

154. Using this information it is proposed that areas showing a high risk of flooding will be modelled in further detail and further using additional tools e.g. 'overland flood risk tool' will be used to identify the predicted impact on our customers and identify locations 'at risk' of flooding.

155. This is a new approach for us to embark on more extensive and best practice drainage area planning. It is a key enabler towards our strategic goals of eliminating sewer flooding, in addition to climate change analysis and preparation for playing our part in future surface water planning requirements.

156. We have received a letter of support for our Drainage Area Plan proposals identifying that they are keen to work with us to ensure they are focussed on identifying real environmental outcomes. (letter from Dominic Shepherd – Regional Water Quality Planning Manager dated the 3rd March 2009).

6.5. APPROACH TO INTEGRATED URBAN DRAINAGE

157. Following the consultation exercise for Making Space for Water (Defra 2004), the Integrated Urban Drainage Management (IUDM) approach was developed by Defra in recognition of two important aspects of flood risk management in England:

- Mechanisms of flooding are complex, with floodwater originating from a variety of sources, and being transmitted via complex flood pathways, to impact at a wide range of locations and properties.
- The legacy of drainage development has resulted in the responsibilities for urban flood risk management falling across a range of diverse stakeholders, from individual property owners through to large public and private bodies.

158. It can often be very difficult to determine the flood mechanisms that lead to specific flooding incidents and consequently identify who is responsible for managing the associated flood risk. It is not always clear who is responsible for ensuring an appropriate level of flood protection in any

particular circumstance, and flood mitigation measures are developed in a piecemeal and uneconomic fashion.

159. We support moving towards a joined-up approach to the planning of improvements and the potential to provide integrated catchment benefits for urban areas (reducing flood risk, improving water quality and water resources management). Within AMP4, we have been involved in two of the fourteen, pilots promoted by Defra. These have been carried out in the Aire Valley, Bradford and at West Garforth, Leeds. Findings from these studies are currently being reviewed by Defra, along with the results of the other pilots.

160. We will incorporate learning from these IUDM (Integrated Urban Drainage Management) pilots in our drainage area planning and, with those proposed in the final business plan, this will enable us to work with other agencies towards a more integrated surface water management approach. This will provide a broader range of solutions to be considered. Additionally, further refinements may be required upon conclusion of Defra's consultation into Surface Water Management.

6.6. HULL , LEEDS AND SHEFFIELD MULTI AGENCY STUDIES

161. We are proposing investment in AMP5 in three multi-agency studies at Hull, Leeds and Sheffield.

162. These studies will look into the interactions between the different drainage systems within the cities, identify locations at risk of flooding and pollution and propose notional solutions.

163. It is as yet, uncertain what the full requirements of Defra's consultation into Surface Water Management Plans (SWMPs) will bring, but we believe these plans will provide the mechanism for producing holistic drainage solutions that go beyond the current practice of each organisation providing solutions in isolation.

164. It is clear that water companies have a significant role to play in terms of information provision and potential solutions, to improve surface water drainage as part of an integrated stakeholder approach, as set out in section 4.4.

165. We have received a letter of support from the Environment Agency for our Surface Water Studies proposal at all three sites stating they see themselves working closely with us and other stakeholders to bring these to completion (letter from Dominic Shepherd – Regional Water Quality Planning Manager dated the 3rd March 2009).

166. In June 2007, Hull and adjoining areas of the East Riding experienced unusually high rainfall. Subsequent flooding caused widespread disruption with damage to over 8,600 residential properties and over 1,300 businesses (these figures are unconfirmed).

167. Hull is in a geographical basin and, as a result of past drainage projects, the drainage system in Hull has become atypical of sewerage networks as it accepts a large proportion of surface waters which are eventually pumped out of the system.

168. Other parts of the United Kingdom also experienced severe weather problems during 2007 and as result a number of other investigations, studies and reports have been carried out e.g. 'The Pitt Review – Learning Lessons from the June 2007 floods' leading to an increased awareness of the problems posed by flooding.

169. As a result of this increased awareness, and a need to fully understand how surface water impacts on network performance, we are proposing to be part of a multi – agency study which will look into the interactions between the different drainage systems within the city, identify locations at risk of flooding and propose notional solutions.

170. Although the requirements, and national priorities, are as yet unclear for the whole of the UK, it is already evident that, due to the unusual nature of its topography and legacy surface water drainage issues, a multi-agency approach is required in Hull, and more detailed surface water drainage studies need to be completed before an integrated long term solution can be defined.

171. We are committed to building upon all currently available information in this study, but sophisticated modelling and extensive new surveys will be required. A study of this scale has never previously been undertaken in Yorkshire and we will seek best practice from elsewhere. Learning from the Glasgow strategic study (undertaken following significant flooding in 2002) and the outcome of the IUDM pilots will play a key role.

172. The Hull multi-agency approach is likely to develop concurrently with the guidance for integrated surface water management and as such will be a useful test case to support and pilot newly emerging guidance.

173. We have, therefore, committed to working with Hull City Council (in conjunction with East Riding of Yorkshire Council and North East Environment Agency) on a multi-agency study for an integrated approach to surface water planning. We have included the costs associated with playing our part in this approach at £3.5M in our DBP.

174. Subsequently we have revised the investment proposed in the FBP after feedback in the CIS baseline document identified that, in this instance, it was felt that only 50% of the total study costs would be recognised for the Hull catchment. The investment proposed has, therefore, been reduced by 50% (to reflect this feedback) to £1.7m (Table B5.5, line 11).

175. In addition to the Hull Multi Agency study, we have, after consultation with the Environment Agency, included two additional studies in our FBP to address the critical flood areas that the EA have agreed need further investigation. These are for Leeds and Sheffield and we are, in total, proposing additional investment of £8.4m for these studies (Table B5.5, line 11).

176. Proposals arising from the multi-agency study will be considered for solutions and these will be addressed via appropriate regulatory mechanisms, as suggested in Part A.

6.7. PROPOSED EXPENDITURE AND ACTIVITY

6.7.1. Sewer flooding

Cost Allocation £m			
Output	**Base**	**ELoS**	**Supply Demand**
DG5 Hydraulic Known Internal Programme	-	27.0	**-**
DG5 Hydraulic Known External Programme	16.2	-	**-**
DG5 Hydraulic Internal Additions	-	-	**59.6**
DG5 Other Causes Internal		34.0	**-**
Mitigation	-	-	**-**
Drainage Area Plans	15.8	-	**-**
Multi Agency Studies	-	-	**10.1**
TOTAL	**32.0**	**61.0**	**69.7**

Table 5. AMP5 Proposed Sewer Flooding Programme Allocation

177. The above table summarises the total proposed investment of £162.7m by output and allocation in the final business plan submission.

6.7.2. Internal flooding

178. We are proposing a total investment of £59.6m to maintain the at risk internal flooding register for (2 in 10), (1 in 10) and (1 in 20). This cost has been derived by using unit costs derived from historic costs and future predictions.

179. Within the capital maintenance programme we are proposing a programme of £16.2m to remove 163 known external flooding problems, 33 of which are linked to internal flooding projects proposed in our enhancement programme and the remaining 130 external only projects.

180. The increase on AMP4 expenditure is due to the inclusion of maintaining the '1 in 20 at risk' register. We have forecast a total of 95 new '1 in 20 at risk' properties to be identified over the AMP5 period using statistical analysis of the previous data collected in AMP4.

181. Further investment of £27.0m is proposed as our ELoS programme to further reduce the '1 in 10, 2 in 10 and 1 in 20 at risk' flood registers by a total of 67 properties.

182. In addition, sewerage schemes have been reviewed against the recent Ofwat guidance issued in June 2008 (PR09/13: Sewerage system and design and climate change) for sewerage design.

183. Climate change additions have not been incorporated in the Final Business Plan as we consider the impact too uncertain for AMP5. There are often uncertainties that may also arise from the Floods and Water Bill which may further impact surface water management. We have agreed this approach with the EA.

6.7.3. External flooding

Within the capital maintenance programme we are proposing a programme of £16.2m to remove 163 known external flooding problems, 33 of which are linked to internal flooding projects proposed in our enhancement programme and the remaining 130 external only projects.

6.7.4. Modelling/Investigations

184. We are proposing a DAP investment programme of £15.8m in the AMP5 period to enable us to understand our network and, in the future, allow us to prevent internal sewer flooding, as identified in our SDS by 2035. This investment is proposed under our capital maintenance programme as identified in B3.

185. The proposed programme will allow us to complete studies for 37 out of our 300 drainage area zones.

186. Sewer modelling has previously only been undertaken to support other investment programmes, primarily the unsatisfactory intermittent discharge programme in AMP3 and AMP4.

187. It is intended that this will be an ongoing programme of works and further expenditure in future AMP periods will be required.

188. Although not directly supported by cost benefit the proposed drainage area planning investment is a key enabler to us delivering our SDS aspirations to stop internal sewer flooding and deliver future service improvements.

6.7.5. Surface Water studies

189. Our FBP proposal for £10.1m is to complete three surface water studies. This is included within Table B5.5, line 11. A further £1.8m will be funded by out-performance towards the full cost of the Hull study.

190. We will work collaboratively with the EA and local authorities to complete our surface water management studies for Hull, Leeds and Sheffield.

6.8. IMPACT OF PROPOSED EXPENDITURE AND ACTIVITY ON SERVICE

6.8.1. Sewer flooding

191. The proposed supply demand programme will maintain the at risk flood register for 1 in 10, 2 in 10 and 1 in 20 properties at AMP4 forecast outturn.

192. We are also proposing, under the base maintenance programme, to remove a total of 130 external flooding incidents from the flooding register, however this will not maintain the register position over the AMP5 period.

193. The proposed enhancement programme will reduce the at risk flood register for:

- 1 in 10 reduced by 45
- 2 in 10 reduced by 20
- 1 in 20 reduced by 2

194. The reduction in properties internally flooded in the year due to overloaded sewers, excluding severe weather, is masked by the inclusion of 1 in 30 at risk properties in the calculation.

195. We will collect information on properties at risk of flooding once in 30 years but will not maintain a stable position over the AMP5 period.

196. The forecast outturn register positions at March 2015 are:

- Properties at risk of flooding (2 in 10) - 43.
- Properties at risk of flooding (1 in 10) - 104.
- Properties at risk of flooding (1 in 20) -183.
- External (area) flooding (at risk 1 in 10, 2 in 10 and 1 in 20) – 2393.

6.8.2. Modelling/Investigations

197. The proposed DAP investment programme will enable us to better understand the condition and behaviour of our network and the risk of impacts on our customers. This is essential to the achievement of our aspirations as outlined in Section 2.

6.8.3. Hull, Leeds and Sheffield strategic Multi agency studies

198. These proposed studies are essential to the understanding of the flooding risk in Hull, Leeds and Sheffield and to enable cost effective solutions to be developed.

6.9. COST BENEFIT ANALYSIS

199. Appendix 2 and Appendix 3 attached identify all the projects proposed as part of our hydraulic sewer flooding programme. Each project is identified with its individual net benefit.

6.10. IMPACT ON CUSTOMERS' BILLS

200. The impact on customer bills of achieving the improved service to customers on Sewer flooding (1 in 10, 2 in 10, 1 in 20 and area) would be reflected in a bill increase of £1.11 over the AMP5 period.

201. The impact on customer bills of the proposed DAP programme would be reflected in a bill increase of £0.96 over the AMP5 period.

7. SUMMARY

Cost Allocation £m			
Output	**Base**	**ELoS**	**Supply Demand**
DG5 Hydraulic Known Internal Programme	-	27.0	**-**
DG5 Hydraulic Known External Programme	16.2	-	**-**
DG5 Hydraulic Internal Additions	-	-	**59.6**

DG5 Other Causes Internal		34.0	**-**
Mitigation	-	-	**-**
Drainage Area Plans	15.8	-	**-**
Multi Agency Studies	-	-	**10.1**
TOTAL	**32.0**	**61.0**	**69.7**

Table 6:- Cost Allocation

Output Type	Base	ELoS	Supply Demand	Total
2 in 10 Internal		20	140	**160**
1 in 10 Internal		45	385	**430**
1 in 20 Internal		2	95	**97**
External Linked		33		**33**
External Only	130			**130**
Drainage Area Plans	37			**37**
Multi Agency Studies			3	**3**
DG5 Other Causes		73		

Table 7: Output Types