
COMPARING SEWERAGE SERVICE OPERATING EXPENDITURE

An overview of research into the impact of operating conditions
on companies' operating expenditure in 1992-93

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Summary and Conclusions

The ability to compare the costs of companies offers considerable potential benefits for the regulation of the water and sewerage industry. This possibility does not exist to the same extent in the other utilities.

Ofwat has published the unit costs of sewage collected.¹ These costs show large differences. The unit total costs of the most expensive company are twice those of the least expensive. The average total cost of sewage collected is 68 pence per cubic metre (p/m³) and the interquartile range is 8 p/m³.

Simple comparisons of cost are, however, insufficient. Companies' costs will be influenced by differences in the operating environments - both natural and as a result of historical circumstances. It is desirable to make allowance for such factors - so far as is practicable - before comparing the residual differences in cost.

This paper reports on the results of analysis of data specially collected to explore the impact of differences in operating environments on the costs of the sewerage service. The main factors found to be important include the density of the collection network, the need for sewage to be pumped to the place of treatment, the volume and strength of trade effluent relative to domestic effluent, and the level and type of treatment provided.

The analysis is performed on operating expenditure (ie operating costs excluding the costs of capital maintenance). Operating expenditure accounts for only around one-half of total cost. Any full comparison of the relative performance of companies must include analysis of the efficiency of their capital maintenance and capital enhancement programmes, and of their ability to raise capital cheaply.

The analysis in this paper has attempted to identify the key explanatory factors for differences in operating expenditure. Other influences on cost may, however, still remain unidentified. It should not be assumed that full account has been taken of all differences in operating environment. Companies are invited to provide evidence on any factors they think have been omitted from the analysis.

There is a danger in allowing too many explanatory factors, as well as too few. If everything that influenced costs were recorded, excuses for inefficiency as well as genuine differences in operating environments could be accepted.

Sewerage service costs have been analysed in several categories. Most of the work has been related to the collection and treatment of sewage, where data disaggregated below the company level has been used. This has been combined with rather less sophisticated analysis of the cost of treating and disposing of sludge and other business activities.

¹ The Cost of Water Delivered and Sewage Collected, Ofwat, November 1993.

The results reported in this paper would permit companies to be placed into broad bands as far as operating expenditure is concerned. Other evidence is also relevant, however, to an overall judgement on operating efficiency. This evidence includes the level of total costs faced by customers and their movement over time, performance on standards of service, and comparisons of actual costs against expectations when price limits were initially set. Evidence provided by the companies themselves will be particularly important.

Objectives

This paper summarises the results of the comparative analysis carried out so far on sewerage service operating expenditure, and explains how the various components of the analysis fit together. Further details on the major components are contained in Ofwat Research Paper No 3 Modelling Sewerage Costs 1992-3, and Research Paper No 4 Modelling Sewage Treatment Costs 1992-3.

The paper describes work in progress. Remaining data anomalies are being investigated with companies. Conclusions at the Periodic Review will be based upon the most reliable data available.

Ofwat will consider carefully any reliable evidence provided by companies on factors which they think have been omitted from the analyses described in this paper, and which they regard as having a significant influence on their operating expenditure.

Sewerage Service Costs and Operating Conditions

Impact of operating conditions

The ability to compare the costs of companies offers considerable potential benefits for the regulation of the water and sewerage industry. However, comparative work is inhibited by differences in companies' operating environments.

These differences reflect both circumstances determined entirely beyond the control of companies within the water industry (such as facts of geography and geology) and the legacy of past decisions made within the industry (for instance on the size and location of treatment works).

In principle, comparisons should seek to distinguish between the two kinds of circumstance. It is, however, difficult to draw this distinction in practice, in view of the problems that arise in trying to measure the truly exogenous factors directly.

The analysis reported in this paper has sought to identify the main influences on companies' operating expenditure. In a number of cases, the measures used are

ones that may reflect both truly exogenous factors and decisions made within the water industry in the past.

In each area of analysis described in this paper, unexplained residuals are reported for the companies. These residuals may contain the effects of any factors omitted from the analysis, as well as differences in efficiency. In making a judgement on relative efficiency, it is therefore important to take account of any evidence provided on omitted factors, and to assess the likely scale of their effects. Ofwat welcomes such evidence from companies, and will consider it in reviewing their Strategic Business Plans.

Comparisons of unit costs

The difficulties arising from differences in operating environment are compounded by the problems that occur in defining a robust quantitative measure of the output provided for customers, and by the limited number of comparators within the sewerage service (ten companies).

Table 1 Sewage Collected Unit Costs 1992-3				
	Cost to customers p/m3	Cost of operations p/m3	Capital maintenance p/m3	Return on capital p/m3
Thames	51	23	11	17
Northumbrian	64	28	17	19
Yorkshire	66	26	20	20
Severn Trent	69	24	22	23
North West	71	24	17	29
Southern	73	31	28	15
Dwr Cymru (Welsh)	74	27	19	27
Wessex	75	29	22	24
Anglian	87	35	16	36
South West	107	35	12	60

Notes
 1 Cost of operations is total operating expenditure
 2 Capital maintenance is current cost depreciation plus the infrastructure renewals charge
 3 Return on capital is current cost operating profit

The volume of sewage collected is a suitable measure for high level summary indicators of relative costs, and for the monitoring of costs through time. Companies' relative costs per unit of sewage collected are detailed in table 1².

² These figures were included in the Cost of Water Delivered and Sewage Collected, published by Ofwat in November 1993.

The measurement of sewage collected, however, is not fully precise. Neither does sewage collected capture all the relevant influences on cost, such as the size of the collection network and the level of treatment provided.

For these reasons, the 1993 July Return collected data provided on the basis of sewerage sub-areas, individual large treatment works, groups of smaller works, and sludge treatment routes. The data was collected for one year only.

It has not proved possible to obtain relevant and reliable measures of total cost, particularly at a sub-company level. The issues are explained more fully in the research papers which describe the analysis in detail. The results reported here are therefore based on comparisons of the cost of operations (ie operating expenditure).

Methods of analysis

The approach has been to use econometric modelling to investigate operating expenditure for sewerage and for large sewage treatment works. The quality of the data in this area has permitted a rigorous and systematic exploration of the influences on operating expenditure.

For smaller works (where companies informed us it was impractical to obtain reliable cost data on the basis of individual works) and for sludge treatment and disposal, the approach in each case has been to compare the unit costs of similar treatment methods. The analysis here has been limited by the quality of the data, and is less comprehensive. It is, however, important for the reasons discussed below to be able to bring together the results for the sewerage service as a whole.

Cost Inter-dependencies

The approach of examining separate activities could, whilst simplifying the analysis, also give rise to its own problems. First there may be technical reasons for costs being inter-dependent. This difficulty is avoided by identifying the appropriate explanatory factors. Thus smaller works may add to treatment costs but reduce sewerage costs. The effects will be captured by measures of scale in sewage treatment and measures of the size of the network and of pumping in sewerage.

Second, companies may differ in the policies they adopt for cost allocation. This is despite the presence of regulatory accounting guidelines designed to minimise this problem. There is evidence that the attribution of operating costs to activities varies more than might be expected to result from differences in operating conditions alone (see Table 2).

For these reasons, it is necessary to consider together the results from the various areas of analysis.

Table 2

Proportions of Sewerage Service Operating Expenditure

	Sewerage %	Sewage Treatment %	Sludge Treatment & Disposal %	Business Activities %
Thames	34	38	19	9
Northumbrian	38	22	19	22
Yorkshire	20	41	21	18
Severn Trent	20	41	21	18
North West	26	39	20	15
Southern	26	36	18	20
Dw r Cymru (Welsh)	36	48	7	9
Wessex	28	41	15	15
Anglian	26	44	13	16
South West	29	38	22	11

Notes

1 Business activities comprise scientific services, customer services and regulation.

Results of Cost Comparisons

Econometric modelling

Table 3 summarises results obtained from the econometric modelling described in detail in Research Papers 3 and 4. A negative residual indicates that costs are below what would be expected, given the included explanatory factors. A positive residual indicates costs above what would be expected. The figures given are central estimates, and should be treated with caution.

The results reported are those produced when the residuals for individual sewerage areas or treatment works are weighted together. The weights used are the contributions of the areas or works to the total costs reported by the company for the activity in question. The use of weighted results is most appropriate when there are concerns about the reliability of cost allocation, and when results are being combined for activities of varying scale³. These issues are considered further in the final section.

³ Results obtained by producing unweighted averages of residuals are also reported in the research papers.

Table 3 Cost Modelling: Main Results		
	Residuals	
	Sewerage %	Sewerage Treatment %
Thames	13	17
Northumbrian	24	17
Yorkshire	-23	10
Severn Trent	-22	2
North West	-19	-12
Southern	-10	-19
Dwr Cymru (Welsh)	6	42
Wessex	14	15
Anglian	5	-1
South West	-10	-17

Note
 1) A negative residual indicates costs below what would be expected given the included explanatory factors, a positive residual indicates costs above what would be expected.

Additional information on the econometric modelling is given in Annex 1.

Sewerage Service activities and costs

This section describes one way in which the results of different pieces of analysis may be brought together, so that all of the operating expenditure incurred in providing the sewerage service is incorporated.

The approach is to combine the unexplained residuals from each of the individual analyses covering all of the activities carried out within the sewerage service. This is done by expressing the residuals in expenditure terms and summing the results. (This is broadly equivalent to taking a weighted average of the percentage residuals, with the weights being the proportions of total operating expenditure accounted for by the activities in question.)

This approach takes account of differences in cost allocation and of possible cost inter-dependencies, and permits an assessment of the sensitivity of the overall results to variations in the residuals for any individual component.

Table 4 summarises the main results obtained on the basis of the data submitted in the 1993 July Return (as amended following discussions with companies over anomalous data).

A negative number again indicates that costs are lower than expected given the included explanatory factors, a positive number that costs are higher than expected.

	1	2	3	4	5	6
	Sewerage	Sewerage Treatment - Large works	Sewerage Treatment - Small works	Sludge T & D	Business Activities	Sewerage Service
	(%)	(%)	(%)	(%)	(%)	(%)
Thames	13	17	33	20	-85	9
Northumbrian	24	17	-1	53	40	29
Yorkshire	-23	10	-15	-28	16	-8
Severn Trent	-22	2	6	-2	16	-0
North West	-19	-12	-53	-1	-30	-18
Southern	-10	-19	27	17	33	10
Dwr Cymru (Welsh)	6	42	-13	-58	-61	-4
Wessex	14	15	-21	-2	9	4
Anglian	5	-1	-0	-72	27	-4
South West	-10	-17	-8	51	-6	4

Notes

1 Business activities comprise scientific services, customer services and regulation.

2 A negative residual indicates costs below what would be expected given the included explanatory factors, a positive residual indicates costs above what would be expected.

The first 5 columns in Table 4 show for each activity within the sewerage service the percentage of each company's operating expenditure that remain unexplained by the main influences on cost identified within the analysis. Columns 1 and 2 detail the residuals from the preferred models described in the research papers, and reproduced in Table 3. Columns 3 to 5 summarise the results from the analysis carried out on small sewage treatment works, sludge treatment and disposal, and business activities. Details of the methods adopted in these areas are contained in Annex 2. Column 6 provides the overall residual for each company.

Interpretation of results

The numbers in column 6 of Table 4 suggests that for some of the companies, the results reported in Table 3 (and, therefore, in the Research Papers) need to be interpreted with care. For several companies, relatively good results in the econometric modelling appear to be offset by comparatively poor results for other activities, or vice versa.

The overall results reported in Table 4, however, weight together several pieces of analysis, some of which may be more robust than others. It is therefore important to look at the reliability of the results of the individual pieces of analysis as well as the overall results. Table 4 should be examined alongside both Table 1 and the more detailed results in the research papers themselves. This inevitably involves a measure of judgement.

Annex 1

Econometric Modelling

The econometric modelling of sewerage costs was carried out on the basis of sub-areas, with the boundaries of the sub-areas selected by companies, but subject to various constraints. One constraint was that the sum of the sub-areas had to equal the whole sewerage area.

Most companies provided data on the basis of 6 sub-areas, but two companies elected to provide data on a greater number of sub-areas, and a further two smaller companies by agreement submitted data on a reduced number of sub-areas.

The preferred model for sewerage costs, described in detail in Research Paper No 3, is one in which costs per length of sewer depend on the density of sewered population, the geographical dispersion of the sewerage network, the average capacity of pumping stations, and the length of coastline relative to the total length of sewer.

The econometric modelling of sewage treatment costs was performed on the basis of data submitted by companies on individual large works⁴. Companies provided information on all their works with an average daily loading of over 1500 kg BOD⁵. Such works generally account for between 40% and 80% of companies' sewage treatment costs. (South West, however, is an outlier, and large works account for only around 20% of its costs.) Companies advised Ofwat that reliable data was not available for smaller works on an individual basis.

The preferred model for sewage treatment costs, described in detail in Research Paper No 4, is one in which costs are a function of the total load treated, the proportions of load derived from trade effluent and tankers, the average strength of trade effluent, the level and type of treatment provided, and a measure of the geographical dispersion of works.

⁴ Costs at works include both direct costs and an allocation of general and support expenditure. Most companies had already apportioned sewage treatment general and support expenditure pro-rata to direct costs. For consistency, this approach was adopted for all companies, and adjustments made where appropriate.

⁵ Equivalent to a population of around 25,000.

Annex 2

Analysis of Small Works, Sludge Treatment & Disposal, and Business Activities

A straightforward analysis was carried out on the summary data provided by companies for smaller works. This data includes loads and cost for all works within a matrix of size bands and treatment levels. The approach has been to calculate industry average unit costs for each combination of size-band and type of works⁶. This information has then been used with the load figures to determine for each company predicted total costs for the smaller works taken as a group. This predicted figure has then been used as a comparator for companies' actual costs, with differences, expressed as percentages, reported in column 3 of Table 4..

Column 4 of the same table shows the results of performing a similar analysis for sludge treatment and disposal. Here, industry average unit cost has been calculated for each disposal route, and this used to determine each company's predicted operating cost⁷. These predicted figures have then again been used as comparators for companies' actual costs, with differences, expressed as percentages, reported in column 4.

Column 5 of Table 4 provides details on unit costs for sewerage service 'business activities'. These comprise scientific services, customer services, and the cost of regulation. The costs associated with these activities taken as a group have been expressed relative to the total number of customers billed for sewerage. Again, an industry average has been determined, and used to create predicted total costs for each company, with the reported figures being the difference between actual and predicted costs.

The results reported in columns 3, 4 and 5 of Table 4 are not derived on as statistically rigorous a basis as those in columns 1 and 2. The data provided by companies will not, however, support a more developed analysis.

⁶ All sludge treatment costs have been removed, and general and support expenditure has been apportioned pro-rata to direct costs.

⁷ General and support expenditure has been apportioned pro-rata to direct costs.