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ASSET HEALTH INVESTMENT CASE – GRAVITY SEWERS INSPECTIONS

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1. EXECUTIVE SUMMARY

1. In its Gravity Sewers Assessment Guidance (March 2026), Ofwat explained the benefits of a larger scale proactive survey of sewers, to provide a greater understanding of the overall health of the sewer network. It said that it would issue a data request to all wastewater companies to provide visual inspection data on a random, representative sample of gravity sewers. Companies would have the opportunity to submit an investment proposal through the cost change process to request additional allowances to deliver these surveys, where they consider existing base expenditure allowances are insufficient to do so.

2. In this document, we set out our case for the need for an adjustment to base expenditure to deliver this random representative sample. We propose an adjustment of **£794,254 (in 2022/23 prices)** to deliver 148km of sewer inspections (0.5%), to be applied at PR29. We confirm that we do not ask for funding for other proactive inspections, only for the random sample.

3. Although we do collect, store, and analyse the condition of our assets, our surveys instead focus on the areas of highest risk (that is, where we think specific intervention is likely). It would not be possible to provide a random sample drawn from existing sewer inspection data because this would not provide the required representative sample. Instead, we propose a separate survey exercise to provide the random sample that is required.

4. In this document, we consider the following (as set out in section 2.2.4 of Ofwat's guidance[1]):

   - **What does base buy?** We explain why we consider that there is currently no allowance in base expenditure for this activity.
   - **What is the efficient unit cost?** We provide our own costs of sewer inspections, to support Ofwat's assessment of the efficient unit cost.
   - **How will we select a representative sample?** We explain our preferred approach to undertaking surveys of a representative sample of sewers, and how we might do this. This includes the options we considered for undertaking surveys, and our preferred option.

5. We have already provided feedback separately on the methodology for gravity sewer inspections, and so we do not repeat this here. In section 6, we discuss how we will go about data analysis. In section 7, we note that the timing will be difficult, and we propose an alternative approach.

[1] Ofwat-gravity-sewers-assessment-guidance-final.pdf

2. WHAT DOES BASE BUY?

6. Base expenditure allowances do not include funding for a random sample of sewer inspections in order to assess asset health at a sector wide level. This type of random sample has not been carried out historically, and so is not in any of the expenditure data used to assess and set base expenditure allowance at any price review.

7. Although we carry out proactive gravity sewer inspections now, we use this programme to target sewers that have issues or are at risk. This will continue through AMP8, and we do not propose additional base allowances to do this. There is no overlap with the random sample of sewer inspections because we cannot use these inspections for the random sample (as they will not have been selected randomly). This also cannot be replaced by the random sample.

8. Similarly, as the random sample only targets 0.5% of gravity sewers, we would expect any additional information on high-risk sewers to be minimal. We can illustrate this using a simplified probability calculation – if we already planned to survey 150km of high-risk gravity sewers, a random sample of 150km would be expected to include on average just 0.75km of overlap (this can be estimated as 150*150/30000, with 30,000km being an approximation for the total population). This would be approximately just a 0.5% benefit to the high-risk sewer inspection programme.

9. So, our estimate for “what base buys” for the random sample of gravity sewers is zero.

10. We currently undertake inspections in three different programmes – our longstanding “flooding other causes” programme; our more recent “sewers near watercourses” programme; and our most recent “infiltration” programme. All of these are targeted programmes looking at specific risks. This is unlikely to be a complete list of all inspections, because sometimes this might be needed outside these programmes too.

11. In our “flooding other causes” programme, we have carried out an average of 145.5km per year over the last five years. This has increased since AMP6, when we carried out an average of 46.6km per year, and reflects our commitment to inspection and improvement across our network. In addition to this, our “sewers near watercourses programme” has carried out at least an average of 25.2km of sewers per year since it started in 2017; and our “infiltration” programme inspected 346km in 2025/26 (this only started in 2025).

3. WHAT IS THE EFFICIENT UNIT COST?

3.1. DETERMINING COSTS

12. Figures 1 and 2 below shows our rates per metre for different types of CCTV inspections and sewer cleaning, broken down into different diameters of sewers. We can use this historical data to create a bottom-up estimate of the cost of inspecting sewers using CCTV.

FIGURE 1 - UNIT COSTS PER METRE (2025/26, NOMINAL PRICES)

Diameter of sewer	Forward facing camera cost (2025/26 per metre)	Pan and tilt camera cost (2025/26 per metre)	Averaged cleaning cost (2025/26 per metre)
100mm	£3.17	£3.17	£4.61
150mm	£3.17	£3.17	£4.61
200mm	£3.56	£3.56	£4.61
225mm	£3.56	£3.56	£8.29
250mm	£3.56	£3.56	£8.29
300mm	£3.56	£3.56	£8.29
375mm	£3.79	£3.79	£8.29
400mm	£3.79	£3.79	£8.29
450mm	£3.79	£3.79	£8.29
525mm	£3.98	£3.98	£26.16
600mm	£3.98	£3.98	£45.19
750mm	£3.98	£3.98	£45.19
900mm	£3.98	£3.98	£45.94
1200mm	£3.97	£3.97	£45.94
1500mm	£4.26	£4.26	£45.94
Averaged (2025/26 prices)	£3.74	£3.74	-
Averaged (2022/23 prices)	£3.31	£3.31	-

13. Following engagement with subject matter experts and data analysis from our historical CCTV sub-programmes, we have calculated the estimated costs for this inspection programme. As the rates vary by diameter of the sewers, for a bottom-up estimate we applied an average cost per metre – using the average unit costs across a range of sewer diameters. This approach seems appropriate because although there are a range of diameters, the costs do not vary much.

14. This bottom-up calculation includes the costs of jet washing and suction. We estimate that this is required before inspections around 25% of the time, otherwise the inspection cannot take place. Our “VAPAR” system is an AI

powered cloud platform which automates the condition of sewer and stormwater pipes using CCTV footage and is an essential part of deriving condition from inspections.

FIGURE 2 - BOTTOM-UP COST CALCULATION FOR 148KM (2022/23 PRICES)

Component	Unit cost	Total cost
CCTV inspection	£3.31 (per metre)	£489,560.49
Jet washing & suction (25% of all sewers)	£3.43 (per metre)	£126,644.32
VAPAR	£0.35 (per metre)	£52,359.41
Permits/Estates/Ecology	8%	£53,485.14
Project management	10%	£72,204.94
Total	**-**	**£794,254.30**

15. These calculations include the cost for project management and other enabling activities such as street works permits, estates and ecology. We have historically allowed a budget for these items of 10% for project management and 8% for permits, estates and ecology. We have applied these percentages to our unit rates to calculate a full cost. We have also applied jet washing and suction to 25% of the cohort, which has been included in the total.

16. To get a more representative estimate of the costs we asked Turner and Townsend to undertake a bottom-up and top-down exercise using our contractor framework rates and to apply appropriate adjustments to these to get a total cost for the activity. Turner and Townsend estimated an average rate for CCTV inspections of £3.34 per metre using a top-down method (using the Water Sector Benchmarking Club), and £5.31 using a bottom-up method (using supply chain tendered rates).[2]

FIGURE 3 - TURNER AND TOWNSEND BENCHMARK COSTS (2022/23 PRICES)

	Per metre	Total
Bottom-up CCTV	£5.31	£785,880.00
Top-down	£3.34	£494,320.00
Average	£4.33	£640,840.00

Note: these costs do not include cleansing costs, so this is comparable to the first row of Figure 2; however, it does show that our costs are below the benchmark.

17. Our benchmarking report also looks at jetting and suction costs, and provides an average bottom-up benchmark rate of £26.22 (unweighted) and £7.92 (weighted rates), as well as a top-down benchmark of £9.36. Again, we are efficient compared to this benchmark.

[2] NWL Asset Health Benchmarking report, Cost Change Submission Appendix 1, page 17.

4. PRICE CONTROL DELIVERABLE

18. In the asset health roadmap workshop on 13 April, Ofwat asked companies to propose a PCD for inspections. We include this as a PCD, but (as we did in the workshop) we note that:

- Rather than setting a PCD, Ofwat could instead simply make the funding adjustment at PR29 conditional on meeting the requirements of the survey sample in period. This would reduce complexity in setting (and reporting on) a PCD, and allows for flexibility – for example, in the delivery date or the information provided. Since this area cannot be funded in-period and is only a commitment to account for funding in RCV at the end of the period, it is not clear that a PCD would provide any additional protection to customers (because there is no funding until then anyway, so there is nothing to remove on non-delivery).
- If Ofwat were to set a PCD, this should be common for all companies that are contributing to the sample. So, the proposed PCD should be taken as simply a guide to the type of PCD that could be set. We think other companies will have good ideas about how best to protect customers too, and a common PCD should take into account this feedback.

19. We set out one possible PCD, based on the headers used in the Ofwat PCD appendix, below.

4.1. DELIVERABLE

20. The company is required to deliver gravity sewer inspections in line with those specified in Ofwat's base PCD model. This PCD relates only to those inspections for which the results are provided to the industry dataset as a random sample, not to the wider inspection programme. This should seek to meet the guidance set by Ofwat, including the cohorts defined.

21. The length reported is the actual distance inspected, rather than the distance between the manholes either side of the pipe inspected. The full length of the gravity sewer reported must be inspected.

FIGURE 5 - PCD OUTPUTS (CUMULATIVE)

PCD outputs (cumulative)	Unit	2025-26	2026-27	2027-28	2028-29	2029-30
Gravity sewer length inspected for random sample	km	-	-	148	148	148

22. The non-delivery PCD payment rate is based on the unit costs for delivery set in Ofwat's determination (note, we have not adjusted these for RPEs and frontier shift as we assume this will be applied in Ofwat's models).

FIGURE 6 - PCD NON-DELIVERY PAYMENTS

Non-delivery PCD payment	Unit	Payment rate
Gravity sewer length inspected for random sample	£/km	6,068

4.2. DELIVERY PROFILE

23. We propose that there should be no time incentive applied to this PCD. That is because late delivery to the sample means that the random sample cannot be used for its intended purpose (for Ofwat to assess asset health during PR29). This means that any inspections not delivered in time should be considered "not delivered". There should be no incentive for delivery on time.

4.3. MEASURING AND REPORTING

24. The company should report progress against deliverables as per the common reporting requirements set out in Ofwat's PCD appendix.

4.4. ASSURANCE

25. We do not consider that this PCD requires independent third-party assurance on outturn and forecast data (that is, against the number of surveys delivered) as set out in the PCD appendix. This would be disproportionate to the benefit of carrying out such assurance, and to the cost of the programme.

26. Instead, Ofwat should consider assurance requirements on the sample itself. For example, rather than prescribing the common PCD assurance requirements, Ofwat could require that independent third-party assurance should be provided on the programme of inspections and the data provided to the sample to test that this meets the agreed methodology.

4.5. PAYMENTS

27. Non-delivery payments will apply where the company does not deliver gravity sewer inspections as reported in the Base PCD model (and as set out above). These will be applied in line with the formula:

$$Non-delivery\ PCD\ payment = Payment\ rate * (PCD\ target_t - PCD\ performance_t)$$

5. HOW WILL WE SELECT A REPRESENTATIVE SAMPLE?

5.1. SAMPLE SELECTION

28. To assist with creating a representative sample, we have produced a database of gravity sewers that fall within scope where each row represents a potential inspection. Sewers that exceed 1500mm diameter, exceed 10m depth, were flagged as crossings in PR14, or located under buildings were excluded in line with OFWAT guidance[1].

29. The "population" dataset is made up of sewers with varying levels of data maturity:

- fully mapped sewers (including s105a sewers),
- verified s105a sewers (inferred from properties, location verified by operator, no attributes), and
- unmapped s105a Sewers (inferred from properties).

30. Unmapped sewers were subsampled, at random, to "top-up" the length of s105a sewer such that the "population" more closely aligns with estimates currently reported in APR 7C.22.

31. To assist with data completeness, we use data imputation techniques to infill "year laid" for all sewers (including verified and unmapped s105A). Similarly, we have used imputation techniques to establish diameter and material for fully mapped sewers where not available. Sewer type and s105a status are known directly.

32. Discrepancies between the sewer "population" and lengths in CWW21 tables are expected due to an ever-changing sewer network, updates to data held in our GIS system, differences in scope and exclusions, and improved data imputation methodologies.

33. The random sample is determined through stratified sampling:

- Partition the "population" into **composite cohorts**, each defined by a combination of key characteristics (s105a status, diameter, material, type, and year laid).
- Shuffle each partition so that the ordering is completely randomised.
- For each composite cohort:
  - Calculate the total length of sewers within the cohort.
  - Define a target survey length to be proportional to the combined length of the composite cohort relative to the combined length of the "population" (a composite cohort that is 10% of the population, by length, has a target survey length of 10% of the overall target of 148km).
  - Sewers are selected sequentially from the randomised list until the next "boundary sewer" would cause the cumulative sample length to exceed target length.
  - If the composite cohort contains 25 or fewer sewers, the boundary sewer is included. Otherwise, the boundary sewer is excluded.

- Combine all selections from respective composite cohorts to produce a final "sample".

34. If we were to exclude all boundary sewers, the inspection length would fall short of 148km. Conversely, including all boundary sewers results in a total inspection length exceeding 148km. The above solution favours inspections on more esoteric assets, with the caveat that the 25 is arbitrarily chosen to obtain a sample length close to 148km.

35. Due to the stochastic nature of the sampling methodology, inspection length may differ from 148km. We executed the sampling methodology with 1000 different seed values and found inspection lengths ranged between 146.946km (5th percentile) and 148.411km (95th percentile). We present the sample with inspection length closest to 148km as an exemplar sample (seed: 285) to assess adequacy against the primary cohorts in the following tables.

S105a	Unit	Population Length	Target Length	Sample Length
No	km	13,951	75.56	74.92
Yes	km	13,431	72.74	73.08

Diameter	Unit	Population Length	Target Length	Sample Length
<=165mm	km	6,300	34.12	33.51
>165mm and <=320mm	km	6,531	35.37	34.34
>320mm and <=625mm	km	2,071	11.22	11.95
>625mm and <=1500mm	km	900	4.87	5.63
Unknown	km	11,581	62.72	62.58

Material	Unit	Population Length	Target Length	Sample Length
Concrete (CON)	km	3,432	18.59	17.50
Polyvinyl Chloride (PVC)	km	965	5.23	5.03
Vitrified Clay (VC)	km	11,158	60.43	59.53
Brick (BR)	km	133	0.72	1.22
Polyethylene (PE)	km	51	0.27	1.11
Pitch Fibre (PF)	km	62	0.33	1.03
Unknown	km	11,581	62.72	62.58

Type	Unit	Population Length	Target Length	Sample Length
Combined	km	7,587	41.09	40.18
Surface	km	4,627	25.06	25.21
Foul	km	3,587	19.43	20.04
Unknown	km	11,581	62.72	62.58

Year Laid	Unit	Population Length	Target Length	Sample Length
pre-1880	km	1,096	5.94	5.79
1881 to 1900	km	1,540	8.34	8.31

Year Laid	Unit	Population Length	Target Length	Sample Length
1901 to 1920	km	1,588	8.60	8.61
1921 to 1940	km	5,933	32.13	32.00
1941 to 1960	km	6,090	32.98	32.14
1961 to 1980	km	7,170	38.83	38.62
1981 to 2000	km	1,891	10.24	10.93
2001 to 2020	km	1,981	10.73	11.10
Unknown	km	94	0.51	0.50

36. **Additional surveys.** As highlighted in the above tables, we would expect fewer than 5km inspections for several small cohorts (brick, polyethylene, pitch fibre, and “>625mm and <= 1500mm”) from the proposed methodology; we have assumed any small “Unknown” cohorts would not be a requirement.

37. Similarly, some marginally small cohorts (PVC, pre-1880, 1881 to 1900, 1901 to 1920) are at risk of holding fewer than 5km sewers by random chance.

38. Across the four small cohorts, we would expect to require 13.81km of surveys in addition to our proposed stratified sampling, but this number may differ due to randomness and the distribution of unknown assets.

39. To assist with sector-wide analysis, we would want additional surveys to meet the 5km minimum criteria following the stratified sample.

5.2. OPTIONS CONSIDERED FOR UNDERTAKING SURVEYS

40. The surveys will be part of a sector wide data collection exercise, so it is important to ensure consistency in the approach to obtain a consistent and comparable dataset that can be used to conduct sector wide analysis. We will be conducting the surveys [3]. The standard specifies that the following inspection techniques can be used:

- remotely controlled CCTV camera;
- man entry;
- mirrors;
- photographic camera.

41. We have discounted three of the techniques (man entry, mirrors and photographic camera) as these techniques increase health and safety risks and limit the range and quality of the data that can be collected. CCTV is the primary method of sewer inspection that is used across the sector and this is reflected in the availability of the supply chain. One of the key risks within our delivery risk register is the availability of the supply chain to deliver the surveys.

[3] https://knowledge.bsigroup.com/products/investigation-and-assessment-of-drain-and-sewer-systems-outside-buildings-visual-inspection-coding-system

Whichever technology is used will require specialist contractors with specific equipment and technical skills and there will be a significant increase in the amount of survey work that is planned to be carried out across the sector. The mitigation of this risk requires the surveys to be carried out using the techniques that have the most availability in the supply chain, which is **CCTV**.

42. We also considered innovative alternatives. Pipebot Patrol[4] is a project that has been funded by the Ofwat Water Breakthrough Challenge, which is an alternative technology that has the capability to carry out inspections. Pipebot Patrol is designed to navigate and inspect miles of pipeline over a 30-day period, identifying the exact location of blockages as they start to form. It is equipped with mobile sensors and collects real-time data as it moves through the network so that we can intervene before sewer flooding occurs. The technology is still in the early stages. On 18 December, the Pipebot Patrol team successfully completed the first on-site trial of Pipebot in a live sewer environment. This milestone was to understand how the robot moves and gather sensor data under real pipeline conditions. As the inspection data needs to be returned within a short period of time it would be too early to use this technology to carry out the surveys, although it would be a useful tool for increasing the amount of proactive surveys in future AMPs.

6. DATA ANALYSIS

43. Assessment of sewer condition will be undertaken using manually coded CCTV inspection data in accordance with the MSCC5 standard. This provides a robust and auditable baseline for understanding asset condition across the sampled cohorts.

44. To further enhance confidence in the evidence base, and to support more targeted rehabilitation decisions, we will also utilise the Artificial Intelligence platform VAPAR, where appropriate, to validate traditional coding outputs and improve consistency, efficiency, and insight generation from CCTV data.

45. We have successfully deployed VAPAR across multiple CCTV find-and-fix and condition assessment programmes since 2023, processing approximately 40 km of CCTV footage annually. The platform has demonstrably strengthened our ability to make timely, data-driven decisions relating to asset risk, maintenance prioritisation, and long-term investment planning. This has ensured that rehabilitation activity is increasingly focused on those sewer assets where intervention delivers the greatest benefit in terms of service risk reduction and value for money.

46. Importantly, the use of AI does not replace established governance, assurance, or engineering judgement. All defects identified through AI analysis are subject to manual technical review, and any discrepancies in automated coding are corrected prior to decision-making. However, the platform significantly accelerates the overall inspection and assessment process by reducing the requirement for engineers to review extensive CCTV footage of assets in

[4] https://pipebotpatrol.co.uk/

good condition. This enables technical resource to be re-focused on the poorest-conditioned sewers and those presenting the highest operational, environmental, or customer risk.

47. Operational experience over the past three years shows that only around 20% of AI-coded defects require amendment following manual review, demonstrating an approximate 80% accuracy rate. This level of performance provides confidence that AI-assisted assessment can be used as a reliable screening and prioritisation tool, supporting a more efficient pipeline from inspection to rehabilitation delivery.

48. By combining assured manual inspection processes with AI-enabled analytics, NWG can increase the volume and quality of condition intelligence without a commensurate increase in inspection cost or programme duration. This approach directly supports the case for increased sewer rehabilitation by:

- improving confidence that investment is targeted at the highest-risk assets,
- reducing time from defect identification to intervention,
- enabling more efficient use of skilled engineering resources, and
- strengthening the evidence base underpinning long-term rehabilitation planning.

49. We are also committed to sharing learning and best practice with the wider industry to support the responsible adoption of AI-enabled inspection technologies and to help drive further efficiencies across the sector.

7. TIMING

50. We note that in section 4 we have included the survey samples in a single year, as Ofwat has requested. We think this will be challenging, and would prefer to spread this out so that inspections can be carried out beyond March 2028. This would need to be agreed for the whole sector together. It may be possible to spread this sample over two years, with the first half of the data used for company business plans and the full dataset used for PR29.

51. We note that in any case, investment plans for PR29 will need to be developed before December 2027 in order to have time for customer engagement and consequential changes to the plan (assuming that business plans will be due for submission in October 2028). This means that the sector wide data sample would not be available for developing business plans in any case.

52. The sample size of these random inspections directly relates the confidence in any data analysis. To fully understand deterioration over a short-term (say, 5 years), we would require a higher rate of inspections so that a change in asset health can be detected. Alternatively, data sharing between companies, or contribution to a national-level dataset could alleviate these issues.