Asset Health Engineering Justification Framework

Non-Mandatory Distribution Mains Replacement Programme

Legal Notice

This paper forms part of Wales & West Utilities Limited Regulatory Business Plan. Your attention is specifically drawn to the legal notice relating to the whole of the Business Plan, set out on page 3 of Document 1 of WWU Business Plan Submission. This is applicable in full to this paper, as though set out in full here

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1. Summary Table

<table>
<tr><td>Name of Project</td><td colspan="3">Non-Mandatory Distribution Mains Replacement Programme</td></tr>
<tr><td>Scheme Reference</td><td colspan="3">WWU.20</td></tr>
<tr><td>Primary Investment Driver</td><td colspan="3">Safety and environmental emissions</td></tr>
<tr><td>Project Initiation Year</td><td colspan="3">2026</td></tr>
<tr><td>Project Close Out Year</td><td colspan="3">2031</td></tr>
<tr><td>Total Installed Cost Estimate (£)</td><td colspan="3">[redacted]</td></tr>
<tr><td>Cost Estimate Accuracy (%)</td><td colspan="3">Based on very detailed costing model - +-5%</td></tr>
<tr><td>Project Spend to date (£)</td><td colspan="3">[redacted]</td></tr>
<tr><td>Current Project Stage Gate</td><td colspan="3">Not started</td></tr>
<tr><td>Reporting Table Ref</td><td colspan="3">BPDT CV6.01, CV6.02, CV6.07, CV6.08,CV6.11 and M8.04</td></tr>
<tr><td>Outputs included in RIIO-GT3 and RIIO-GD3 Business Plan</td><td colspan="3">NARMs metrics for all mains. Shrinkage forecasts will reflect the planned replacement types and volumes</td></tr>
<tr><td rowspan="2">Spend apportionment 23/24 prices</td><td>GD2</td><td>GD3</td><td>GD4</td></tr>
<tr><td></td><td>[redacted]</td><td></td></tr>
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2. Executive Summary

This paper sets out the investment case for replacement of non-mandatory iron and steel mains. We plan to spend [redacted] per annum to replace 105.6km of aging metallic mains. We forecast the replacement or transfer of 1,932 Services fed from these mains.

The table below gives the comparison of GD2 to GD3 in 2023/24 prices

Price control	First Year Spend	Final Year Spend	Intervention Volume (km)	Investment Design Life	Total Installed Cost	Cost per m
GD2	[redacted]	[redacted]	206.9	60+ years	[redacted]	[redacted]
GD3	[redacted]	[redacted]	105.6	60+ years	[redacted]	[redacted]

Table 1 – GD2 vs. GD3 cost comparison

This investment will lower safety risk, reduce methane emissions and prevent gas escapes and associated disruption to the public.

There are two drivers for including pipes in this programme:

- Condition of the pipe leading to a high volume of repairs and the associated methane emissions, high operating costs in repairing any leaks, and stakeholder feedback from Local Authority and local residents.
- Pipes that have many connections to Tier 1 pipes we plan to replace in GD3, this enables large areas of iron mains to be fully replaced with PE, leaving the area free from emissions, future repairs, and the associated disruption to the community.

In addition, the non-mandatory programme is justified using Cost Benefit Analysis (CBA).

The Cost Benefit Analysis (CBA) demonstrates when it is more cost effective to replace a main rather than continue to repair. Methane emissions from metallic mains are the largest contributor to our Business Carbon Footprint (BCF) which is another significant factor in the CBA and any subsequent decision to replace.

CBA shows our preferred non-mandatory mains and services combined programme option pays back before the end of the GD3 period.

3. Introduction

Wales & West Utilities own and operate a population of circa 33,000km buried main (as reported in RRP for 2023), transporting gas to our consumers at pressures ranging from 21mbar to 7bar. There are 3 distinct operating pressure tiers; Low Pressure (LP) 21-75mbar, Medium Pressure (MP) 75mbar–2bar and Intermediate Pressure (IP) 2-7bar.

The IP network is subject to the Pressure Systems Safety Regulations 2000 (PSSR) as they are operating in excess of 2bar pressure. These assets total 1,550km and are constructed in either steel or polyethylene (PE). As mandated by PSSR, the steel is protected by Cathodic Protection (CP) systems and well maintained. These assets rarely fail, and investment is primarily in maintaining the CP systems in good health. This investment is described in the Steel Distribution Pipelines Engineering Justification Paper (EJP).

The MP and LP networks total 31,400km and are a mix of PE, steel and iron. PE is very reliable and rarely fails. The steel and iron, however, are at the end of or beyond their expected life and we respond to circa 7,000 leaks per annum from these assets. The distribution network also has a population of Special Crossings, these are above and below ground and are included in the overall length of the Network described above. The associated investment required for these is also described in the Steel Distribution Pipelines EJP.

There are circa 2.5m customers connected to the WWU network individual gas services. They terminate at an Emergency Control Valve (ECV) which is generally situated at the inlet to a consumer's gas meter. WWU's network ends at the ECV and we do not own or manage the gas meter.

Services are predominantly constructed in either Polyethylene (PE) or steel. PE services are very reliable, and a leak is extremely rare. We have laid services in PE since the 1970s. Steel services were generally installed prior to this so they are mostly over 40 years old with many much older. They are at end of their life and we experience circa 7,000 leaks per annum.

A large proportion of our MP and LP iron mains are subject to a replacement programme mandated by the Health & Safety Executive (HSE). This requires all iron mains up to and including 8" in diameter and within 30m of a building to be decommissioned by 2032. This is a 30-year programme, and we have delivered it successfully since 2002.

Pipes that do not qualify as HSE mandated are considered for replacement based on a cost benefit assessment.

This paper sets out the work we plan to do and the associated costs. It expands on the drivers for us to invest and the benefits of investment.

4. Equipment Summary

At the start of RIIO-GD2, Ofgem, the HSE and the GDNs agreed to define these assets using six categories and this paper will use these throughout.

Category	Population forecast at start of GD3 (km)	Description	Investment driver
Tier 2	949	CI, DI and SI mains with a diameter of between 9" – 17" / 225mm – 425mm	Any main passing a risk threshold agreed across GDNs and with HSE are mandated to be replaced in a reasonable time frame. These are classed as Tier 2a. The remaining population are replaced if CBA or stakeholder feedback makes a compelling case. These are classed as Tier 2b
Tier 3	159	CI, DI and SI mains with a diameter greater than 17" / 425mm	Mains are replaced if CBA or stakeholder feedback makes a compelling case.
Iron outside 30m of a building	412 (226 are Tier 1)	CI, DI and SI mains of all diameters	All Iron mains outside 30m of a building are not mandated by HSE to be replaced, however we are required to ensure these are maintained in line with Regulation 13 of the Pipeline Safety Regulations (PSR).
Services (Steel, mixed PE/Steel, other)	225,086 services	Metallic, part metallic or "other" services feeding domestic premises	ST services up to and including 2" diameter must be replaced entirely with PE whenever encountered either on a mains replacement project, connections work, or repair work. This includes "steel tailed" services.
Steel >2"	2,502 (Special crossings are included in this length)	Steel with a diameter greater than 2".	Mains are replaced if CBA or stakeholder feedback makes a compelling case.
PE	26,566	Polyethylene mains of any diameter	These very rarely leak and are showing little sign of deterioration. The only replacement is on short sections if they suffer from significant third-party damage

Table 2 – Asset Details

Special crossings are maintainable assets, they are split into above and below ground. An above ground crossing is a section of pipeline that crosses a railway, road or watercourse. These sections are often self-supported but can also be contained within bridge structures or they may have purpose-built pipe bridges. Below ground crossings are a below ground sections of pipeline that crosses under a railway, road or watercourse. We have 1,396 and 5,786 of these crossings respectively. The details of their associate workload are included in a separate Engineering Justification Paper for Steel Distribution Pipelines.

The HSE are currently reviewing their enforcement policy for Iron Mains replacement. They have indicated that there would be "no change to the general approach" to Tier 2 mains (see ***Appendix 2***), however there is still work to be done to ensure a consistent approach across the GDNs. WWU currently have no pipes qualifying above the GD2 mandatory Tier 2a risk threshold. As the HSE are currently reviewing the process for establishing consistent risk action threshold for non-mandatory iron mains WWU expect an uncertainty mechanism to mitigate against a future requirement for WWU to replace these mains. Should the HSE update their Enforcement Policy WWU would need to ensure that any additional length of mandatory main is replaced within an agreed timeframe. This would potentially result in the movement of workload form the non-mandatory to the mandatory category.

5. Problem/Opportunity Statement

Our population of buried iron and steel distribution mains are nearing the end or are beyond their expected asset life. There are regular failures, and we respond to, and repair circa 7,000 mains and 7,000 service leaks per annum.

Each leak requires our operatives to attend, make safe and then repair or replace. Each leak results in emissions of methane to atmosphere which has a carbon equivalent impact circa 25x that of CO_2. Total emissions from the UK gas networks are circa 1% of the UK's total emissions and mains failures are a significant contributor.

We review mains and service fault and failure data, to assess health and condition of individual distribution networks. We give consideration of the benefits on reducing methane emissions across network areas where there is the opportunity to make networks all PE, enabling a reduction in operating costs associated with pressure management and telemetry equipment required to keep emissions to a minimum.

In addition, there is a safety risk following a gas escape of the gas tracking underground and entering a building. The gas can collect and if volumes are significant enough and there is an ignition source, such as switching on a light, this can result in an explosion. There are many examples of this in the UK. Thankfully, these are now rare due to the success of the mains replacement programmes to date.

We are bound by our legal obligation to manage and replace these mains. We have a mandatory replacement Programme required by the HSE under the Pipeline Safety Regulations (PSR) section 13a. For pipe outside the mandatory programme, we still have duties under the Pipelines Safety Regulations (PSR) to ensure that "a pipeline is designed, constructed and operating safely, provide a means of securing pipeline integrity, thereby reducing risks to the environment". Pipes that do not qualify as HSE mandated are considered for replacement based on a cost benefit assessment.

Our stakeholders have told us they want us to maintain the current levels of safety and reliability from our network and do not want to see this degrade. Stakeholders also want us to reduce methane emissions which relies on older metallic mains being replaced with low emission Polyethylene. General consumers have told us they would like to see the mains replacement programme accelerated to improve safety and deliver environmental benefits. This is countered by feedback from local authorities who do not want an increase in replacement works due to disruption. Our plan balances these stakeholder requirements.

One thing that the public and Local Authorities agree on is that when we replace mains in an area, we should do this in one visit and not return year after year. To achieve this, we group mains into larger, more efficient projects and clear all metallic mains from an area.

In summary, we need to invest in our mains replacement programme to:

- Meet our stakeholder's requirements to reduce our carbon footprint, maintain our safety performance and reduce disruption from gas escapes,
- comply with our legal requirements under PSR, and
- reduce Opex costs associated with unplanned repairs

Failure to deliver our planned programme would fail to meet the needs of our stakeholders, would see rising Opex costs and would not enable us to meet our emissions targets and deliver our contribution to the UK net zero target.

We will measure the success through various metrics:

- Length of metallic mains abandoned,
- volumes of gas escapes, occurrences of gas entering a building
- Methane emission reductions calculated though our Leakage Reporting Monitoring Model (LRMM). This model is Ofgem approved and common across GDNs
- Network Asset Risk Metrics (NARM).

We will continue to engage with our stakeholders as we deliver the mains replacement programme. HSE will regularly inspect delivery of the plan and review and feedback on the key metrics that demonstrate the success of the investment.

5.1 Narrative Real Life Example of Problem

This section provides a summary of actual replacement projects, to demonstrate the challenges faced in managing these assets and the assessment process to arrive at a decision to invest.

Example 1: Feeder Road, Bristol

The first example is a 12-inch cast iron main in Feeder Road, Bristol. This pipe is not subject to the mandatory HSE replacement programme so justification to replace is based on CBA and stakeholder feedback. The pipe is highlighted in yellow in figure 1 below:

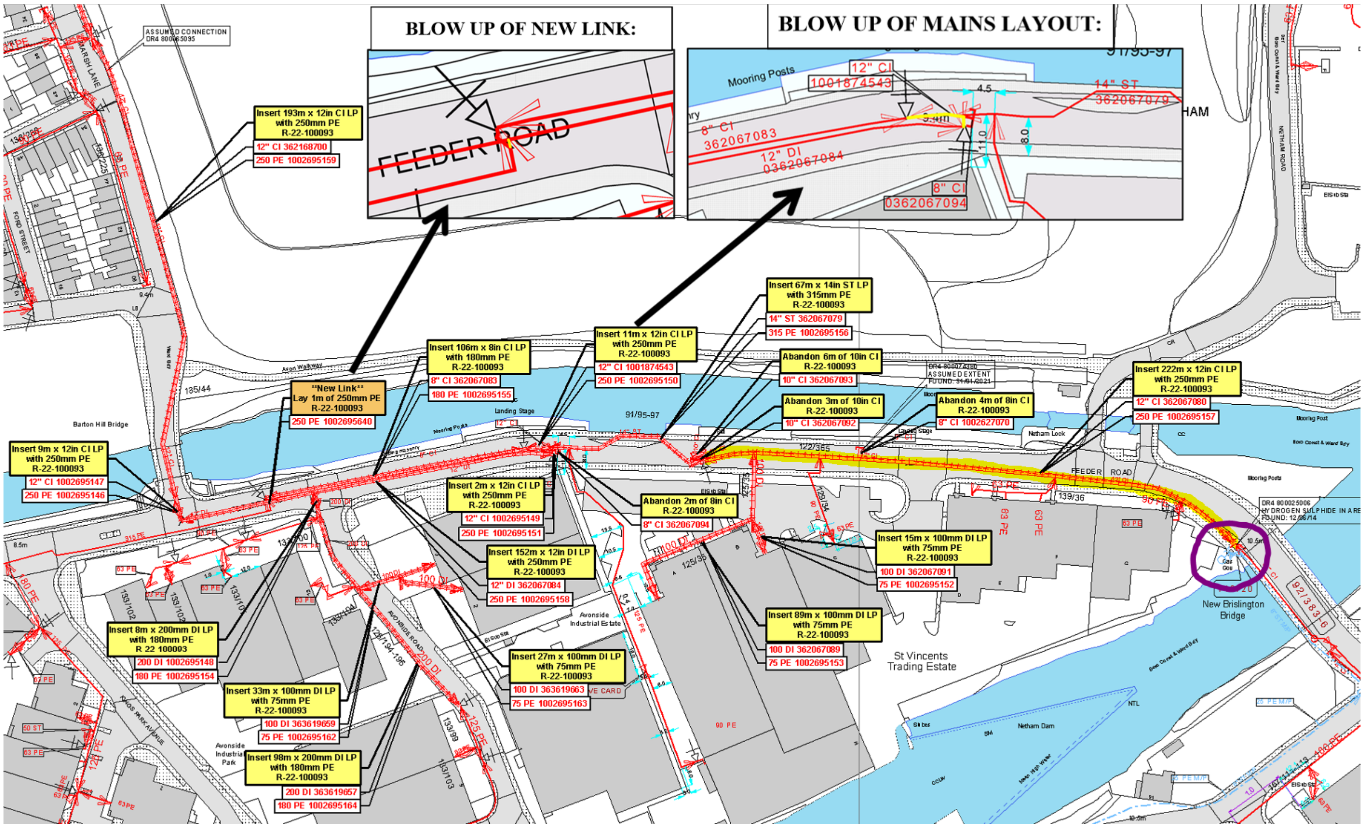

Figure 1: Shows the area of Feeder Road, in the center of the City of Bristol. The main pipe to be replaced is highlighted in yellow with other surrounding LP pipes part of the project annotated with text boxes.

It can be seen that this is in a built-up area with many non-domestic supplies in an industrial estate. This pipe is a significant feed into the centre of Bristol, connecting a Pressure Reduction Station (circled in purple) feeding circa 950 industrial, domestic, and commercial consumers. Thie integrity of this pipe is critical for the supply of gas to the customers it supplies.

The case to consider intervention

The low-pressure main has had 49 recorded failures of a joint, each resulting in the public reporting a smell of gas and our engineers attending and repairing an escape.

Figure 2: The above screenshot shows the street where the main is situated, it includes a busy junction with a set of traffic lights.

The screenshot above is the street in which the main is situated. This road is a major traffic route in Bristol and reactively responding to a gas escape in this road causes significant disruption to the community and road users. We have had a number of complaints from residents, the public and the Local Authority as a result of gas leaks and subsequent repairs. This stakeholder feedback has been considered in the decision to replace the main.

Figure 3: The above image shows Feeder Road highlighted where the main is situated adjacent to a busy Industrial Park, situated between two areas of densely populated housing.

The assessment process

Our CBA considers the cost of replacement and a forecast of ongoing operating costs and methane emissions if we do not act. This is based on previous failure history and statistically generated deterioration rates. There are no available remediation techniques for this type of main.

The main has a recorded installation date of 1950, with a total length of 221m.

Scoping the scheme

Whilst the 12" CI main is the driver for the project, we take a holistic view of the metallic pipes in the area. The scope of this project was expanded to include 351m of associated Tier 1 main and some 68m of steel. This creates a more efficient project to deliver and clears the area of metallic mains.

To determine replacement sizes, we use network analysis modelling. Our models are an accurate reflection of the pipe network as it stands and are regularly updated with consumer demand data from Xoserve for every single gas meter in our region. This enables us to predict gas flows and pressures today and in the future.

We can then make changes to pipes in the model and assess the impact on flows and pressure to ensure any changes do not create a capacity issue and compromise security of supply.

Our preference is to abandon a main with no replacement as this is lowest cost to consumers. This is only possible if a main has no services attached and if its removal from the network does not result in capacity issues and poor pressures. For these reasons, this not often a credible option.

If a replacement main is required, the most efficient technique is mains insertion. This is a replacement technique where the new PE pipe is inserted inside the metallic pipe to be replaced. This avoids digging a long trench as the operation can be achieved by pushing the new pipe into the old using an excavation at both ends. The replacement is generally quicker, lower cost and results in lower methane emissions during the operation. There are also shorter planned interruption times for consumers using this technique and reduced excavations is considerably less disruptive to the public.

The challenge is that the new main must be smaller to fit, so capacity in the network is reduced. By carrying out network analysis we can assess whether this will create a capacity issue. If it does, we re-analyse with other diameters to find the optimum size.

We design a network that's fit for today and for the future. To do this, we estimate future network demand by interrogating Local Authority Development plans and by looking at other intelligence on future gas use. This process ensures the new main is future proof and avoids reinforcement as demand on the network changes.

In this case, we were able to design the project to be all insertion. The network analysis is reviewed to see if any additional benefits can be achieved whilst working in the area. In this example, small links between pipes not currently linked were planned to help maintain network minimum pressures, allowing the design to be all insertion.

Costing

The designed project was costed by our surveyors. The table below shows the output of our detailed cost estimation.

[redacted]

Figure 4 – Detailed project costs – Feeder Road

Future benefits

We forecast future leakage using current rate of failures of the pipe, the number of joints left to fail, and a view of future deterioration rates based on historic failures and their increase over time. This gives us a forecast of future operating costs. We also assess likely emissions from these mains and calculated the amount of CO_2e saved by replacing these pipes. This was just over 631 tonnes of carbon dioxide equivalent (tCO2e) over 10 years.

Example 2: Gambles Lane, Woodmancote, Cheltenham

Our second example is a 10" spun iron medium pressure main in Woodmancote, Cheltenham. The main was laid in 1955, with a total length of 246m.

This medium pressure main has experienced 45 failures of a joint, 11 failures of pipe fittings and 11 corrosion leaks, the majority of which had occurred within the last six years. We use predictive analytics to forecast future leaks and associated cost of repair and rank these compared to other pipes in the asset group. This pipe ranked in the top 5%.

Figure 5: Shows the pipe to be replaced highlighted in yellow.

The main is highlighted in yellow on the plan above and shown below, it would be situated in the verge.

Figure 6: The above photograph shows the "B" road where the main is situated.

Scoping and costing the scheme

This pipe had adjoining pipes that we decided to include within the scope of the project, taking the total planned length to 810m. This decision was made considering leakage on the adjoining pipes and the fact that it was very low cost to include the adjoining pipes as we would already have traffic management in place and excavations for insertion pushes. It was more efficient to complete the project in one visit, rather than complete over several visits. We have therefore avoided future mobilisation costs which are significant. This removed all iron within that section of the MP network, removing the risk of future escapes and needing to return to the same area causing unwanted disruption.

Open cut and insertion techniques were considered. Open cutting this project in the highway had a cost estimate using RIIO-GD2 prices in the region of [redacted] including costs for reinstatement, traffic management, etc. Re-routing in private land would save cost of reinstatement, however there would still be requirements for traffic management to connect to the existing mains. We estimated costs to landowners and legal cost to lay in private land would be in the vicinity of [redacted]

Network analysis determined that the mains could be inserted with 180mm polyethylene pipe but with a reduction in capacity. Minimum pressures could still be maintained at the network extremities, ensuring security of supply to the surrounding areas. The decision was made to insert after balancing costs and reduced capacity in the network.

The project was delivered through mains insertion at a cost of [redacted] a saving of [redacted] compared to delivery via open cut.

Future benefits

The main is operating at medium pressure so the methane emissions from leakage will be a lot greater as the pressure inside the main will be forcing more gas through any failed joint/component/pipe failure. The main is in a rural location meaning that the escape could likely go undetected for a longer period due to the lack of people in the vicinity to report a suspected leak.

We forecast future leakage and associated Opex cost using current rate of failures and a view of deterioration rate based on trends of historic failures. Emissions avoided were forecast at around 337 tCO_2e over 10 years.

5.2 Project Boundaries

The workload and associated expenditure proposed in this justification paper is for mains replacement in RIIO-GD3 for the following categories

- Tier 2 iron
- Tier 3 iron
- Iron outside 30m
- Other steel
- Services

In addition to these categories, we have PE mains. We are not proposing investment in replacing PE as there is no current justification due to incredibly low failure rates and emission levels.

The exception is “First Generation PE”, which is also known as “Imperial PE” because it generally has imperial diameters. There are challenges making connections to imperial PE so there may be short lengths requiring replacement in RIIO-GD3 if they are connected to iron and steel pipes in the programme.

Above and below ground Steel crossings, whilst they are included in the asset lengths for non-mandatory distribution pipelines, there is no workload described in this paper it is included in Steel Distribution Pipelines EJP.Risers on MOBs are included in the Multiple Occupancy Buildings & Complex Distribution Systems EJP.

6. Probability of Failure

Predicting future performance of assets is critical to the assessment of operating costs, customer outcomes and safety risk to inform a meaningful CBA. To forecast future failures, we assess:

- Probability of failure for services/each individual main, and
- Rate of deterioration for services/mains.

There are four modes of failure for distribution mains, joint failure, fractures, corrosion defects, and interference damage. We feed our Network Asset Risk Metric (NARMs) assessment and CBAs using asset bespoke forecasts for each of these modes.

The rates of failure have been calculated using actual repair data going back to 2006. We record the cause, component and repair type for every leak we experience on the network. Some typical examples are illustrated in the table below:

Cause	**Component**	**Repair type**
Fracture	Pipe	Repair Clamp
Failure	Joint	Encapsulation
Corrosion	Pipe	Cut out

Table 3: Shows examples of failure, component and repair type

This detail is recorded in our asset repository (SAP) against the individual asset with the exact co-ordinate of where that failure occurred. This enables us to calculate the annual rate of failure for every pipe in our network. We use trends over time to derive a deterioration rate to predict future performance.

The majority of pipes are repairable, with only a small number requiring the pipe to be immediately removed and replaced due to the magnitude of the failure. Appendix 1 shows the current failure rates as used in CBA and NARMs for service pipes and all combinations of material, diameter and pressure tier for mains.

6.1. Probability of Failure Data Assurance

We have many system validations built into our asset repository to ensure this data is accurate and we employ a data quality team to investigate exceptions. For example, if a leak was recorded by a field operative as corrosion on a PE main, this fails as an unacceptable combination as PE doesn’t corrode. This flags an exception, and the data team will contact the operative to understand exactly what was done on site and correct the record. We are therefore highly confident in the accuracy of our pipe failure data and its use to calculate probability of failures.

This data is fed into our Asset Investment Manager (AIM) software. This is an industry leading tool that puts the data through statistical assessment to derive the appropriate deterioration rates and then forecast future performance at a pipe-by-pipe level.

The charts below show the forecast for gas escapes per km for the different mains categories. It can be clearly seen how network performance would deteriorate without investment to manage these ageing assets.

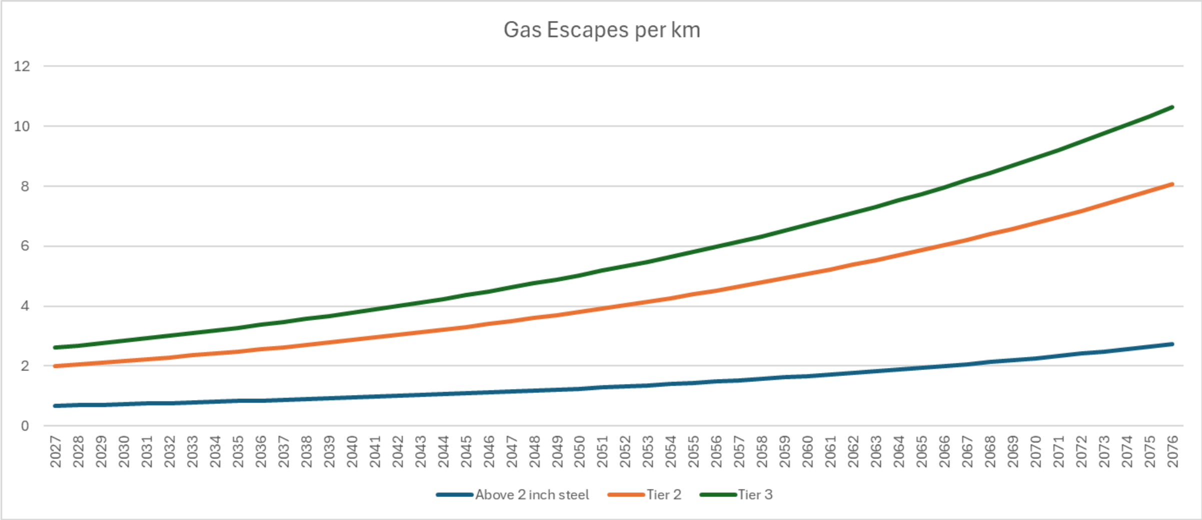

Figure 7: Gas escapes per Km without intervention

7. Consequence of Failure

For each failure mode, we assess the potential consequences. We record actual consequences in our asset repository for every single leak, so we can assess a probability of a consequence occurring on future leaks. This is critical to assessing the impact and associated costs.

As an example, we know how many leaks resulted in gas entering a building, how many occurrences of gas in building resulted in explosion and how many explosions resulted in fatalities or injuries. Using probability of asset failure combined with probabilities of resulting consequences, we have an accurate assessment of the risk of our assets.

The most significant consequence resulting from a failure on a gas distribution pipe is a gas escape leading to gas ingress in a building, which in turn leads to an explosion causing fatalities or major injuries. This is devastating to those impacted and is an event not tolerated by society. This could also lead to large legal penalties being issued, and huge reputational damage to the company.

An example of the consequences of a failure on a distribution main or service as modelled in our event tree analysis is illustrated below:

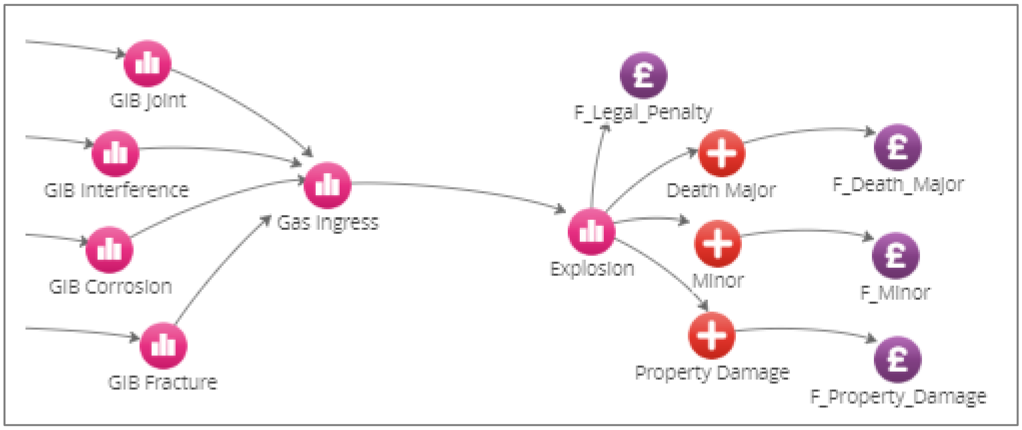

Figure 8: Risk map for Distribution Mains and Services showing the health and safety branch

The likelihood of a Gas in Building event (GIB) is calculated based on historical WWU data held in our asset data repository. For a GIB Joint, this is calculated as **0.0383 GIBs** for every joint failure (based on analysis of historical WWU data). For each GIB, there are calculated to be **0.00076 explosions** (based on analysis of national data sets). For each explosion, there are calculated to be **0.45 deaths** (based on analysis of national data sets). We value a fatality at [redacted], an agreed figure for risk assessment of gas incidents. Multiplying the above probability of consequences (CoF) by probability of failures (PoF) give a likelihood of a death. Applying this likelihood to the [redacted] gives a monetised risk value of fatalities.

The illustration above is one branch of an event tree. For each asset group, there are many branches of failure, consequence and cost combinations assessing safety, reliability, environment and disruption. When all branches are summed together, we get a value of monetised risk for the asset. We can then assess the impact of our intervention plan on reducing PoF or CoF and produce a new monetised risk value for the asset. The delta in monetised risk before and after intervention gives a value to the intervention. Our AIM software provides a powerful optimisation tool that assesses hundreds of thousands of intervention combinations to produce the optimum investment plan to manage risk on our assets at minimum whole life cost.

Failures of gas distribution mains and services could also lead to customer interruptions and complaints, which seriously inconvenience consumers, would incur costs through the Guaranteed Standards of Service penalties and through operations to restore supply. Our monetised risk assessment considers these impacts.

There are environmental consequences of mains failures, due to emissions of methane into the atmosphere. Methane is circa 25x more damaging to the atmosphere than carbon. We value this impact using DESNZ published cost of carbon. We use emission rates from a national leakage model, developed through collaborative testing across the GDNs and approved by Ofgem to inform our risk assessment.

Additionally, every failure results in an opex cost to attend and risk assess the leak and make a repair. This is also factored into our risk assessment.

8. Options Considered

For mains not subject to mandatory replacement under the Iron Mains Risk Reduction Programme (IMRRP), we can look to repair and extend the life as well as replace. The options available are:

- Replacement with PE (via insertion or open-cut techniques)
- refurbishment with robotics that travel inside the main and seal joints, and
- fix on failure.

Technology using robotics has advanced in recent years, benefitting from innovation funding. We have explored options to deploy this technology in WWU. This refurbishment option involves sending robots through mains to seal joints. It has been developed for larger diameters (>18") and can seal joints but does not reduce likelihood of mains fracturing or slow/prevent corrosion. We have had a number of quotations to refurbish mains using this technique. As a result of limited opportunity due to WWU having a small population of large diameter mains, we cannot leverage economies of scale. However, we continue to correspond with suppliers and neighbour GDNs to see if advances can be made to reduce cost.

The quotations received have been in excess of the cost of replacing these mains with PE. An example is provided below. As such, <u>we have discounted this as a viable option.</u>

Case Study - A detailed CBA was carried out for the use of CISBOT on a job in Lynne Road, Newport. This job was chosen due to the complexities of its location. To complete the job using robotics we were quoted [redacted]. This did not include the time for WWU staff and other costs such as backfill and plant. When this was accounted for the total came to [redacted]. This would have repaired and refurbished the joints but provide no structural improvement to the pipe. For comparison we costed full replacement of the main with PE. The total cost for this work was calculated as [redacted]. It would have been [redacted] cheaper to replace the main rather than repair it and the benefits of replacement are significantly higher. This is one example of a number of schemes we've assessed for remediation and the conclusion on all is there would have to be significant reduction in robotics for it to be a viable alternative.

Replacement of metallic mains with PE is a proven intervention option and has been extremely successful in avoiding future Opex costs and environmental emissions. This is our preferred intervention where financially viable. Fix on failure is deployed widely in our network and is a key element in our management plan as submitted to HSE.

8.1 First Option Summary (PSR compliance and efficient Tier 1 deliver)

Steel is not deemed to have the high safety risk of iron due to its common failure modes not resulting in significant instantaneous releases of gas. That is primarily corrosion holes and not mains fractures.

Tier 2/3 iron and steel are exhibiting increasing failure rates and are coming under increased HSE scrutiny. There is currently nothing in HSEs Enforcement Policy mandating specific lengths of replacement for Tier 2b or Tier 3. That said, there is an expectation from HSE that we will deal with assets exhibiting signs of high deterioration through replacement. This is evidenced by correspondence from their inspectors regarding GSMR leakage reports we have submitted. An example is in appendix 6.

We have included Tier 2/3 iron and steel replacement in our plan based on 2 key drivers:

1. Pipes with multiple connections to Tier 1 iron mains in a RIIO-GD3 project.

2. Pipes justified by Cost Benefit Analysis (CBA) - mainly due to excessive leakage.

We have analysed our RIIO-GD3 Tier 1 replacement projects to identify the volume of Tier 2/3 iron and steel with significant connections to mandatory Tier 1 iron mains projects. Replacement cost of these mains is good value as we are working in the street already and need to dig down on these mains to make the connections to the replacement Tier 1 mains. The additional cost of replacing the non-Tier 1 main is marginal compared to going out to just replace the non-Tier 1 main on its own. This also allows us to clear out metallic mains from an area, meaning we will never have to return to make repairs and disrupt the community in the future.

We have also forecast the length of poor condition Tier 2/3 and steel that needs to be replaced to keep leak rates from increasing. HSE generally expect us to manage assets so that the condition of populations does not deteriorate.

These 2 pots result in a programme of 23km of Tier 2 Iron, 72km of >2 steel, 1km of Tier 3 iron, along with 9km of Iron >30m across the GD3 period, which we have included in our proposed workload.

Replacement of these mains also requires the replacement or transfer of 1,932 steel services. The total installed cost of this programme is [redacted].

These pipes are all justified using CBA with the results shown in following sections of this paper.

In summary, combined non-mandatory mains and services CBA pays back before the end of RIIO-GD3.

8.2 Second Option Summary (Delivering an all-PE network by 2040)

This includes increased Tier 2/3 and steel workloads with a goal of replacing all metallic mains (Low and Medium Pressure only) by 2040 in line with our net-zero ready ambitions. This option would include replacement of 417km of main, replacement or transfer of 8,820 associated services at a total cost of [redacted].

We have had clear feedback from general consumers and local authorities that they want us to replace whole geographic areas of metallic mains in one visit and avoid leaving metallic pipes that result in further escapes and disruption from unplanned repairs. There is also a UK government commitment to significantly reduce methane emissions. This option will support these stakeholder requirements.

We are considerate of the consumer bill and Ofgem's direction to complete the mandatory IMRRP but limit additional spend on repex above and beyond this.

There are significant benefits with this option, including continuity or work over price controls leading to stability in the supply chain, developing operative competence for the future and reducing emissions at a higher rate than the IMRRP.

The two options above have been evaluated using CBA, the outputs of which are detailed in Section 9 of this document.

8.3 Options Technical Summary Table

This table summarises the investment options described above:

[redacted]

Table 4: Summarises investment Options (2023/24 prices)

Options Cost Summary

Cost

We have developed and validated a very detailed costing model that uses the concept of cost components to build up a programme cost. The model has been independently assured by Turner and Townsend. Our goal is to ensure we have the most robust cost driver information to inform our forecasts. Further details on how we build up the cost components are available in Appendix 5.

The following table details the unit costs for each pipe size and how the programme is built up. Further details regarding the cost difference between replacement method (open cut / Insertion) are included in Appendix 4.

[redacted]

Table 5 – Unit cost for preferred programme (23/24 prices)

9. Business Case Outline and Discussion

9.1 Key Business Case Drivers Description

The results of the CBA show that all investment options considered above for the non-mandatory programme will pay back before the end of the RIIO-GD3 price control period.

The primary driver for the whole life cost savings compared with the baseline scenario is through reduced shrinkage and leakage costs. The integrity of PE mains is very high compared to metallic mains so there are significant reductions in emissions following replacement.

The second most significant factor is reduced repair expenditure. PE leaks are rare so replacing a metallic main with PE dramatically reduces the cost of operating the main.

Other key factors impacting the CBA are likelihood of gas explosion and likelihood of customer interruptions following gas escapes.

9.2 Business Case Summary

Our CBAs have been completed in line with Treasury Green Book Guidance and they are in an Ofgem issued model that is compliant with the Treasury guidance.

The graph below compares the options considered by our proposed investment programme to an accelerated programme. It can be seen that both payback by before 2031, and that accelerating mains replacement increases the benefits. Our plan has had to balance this with stakeholder needs and resourcing constraints.

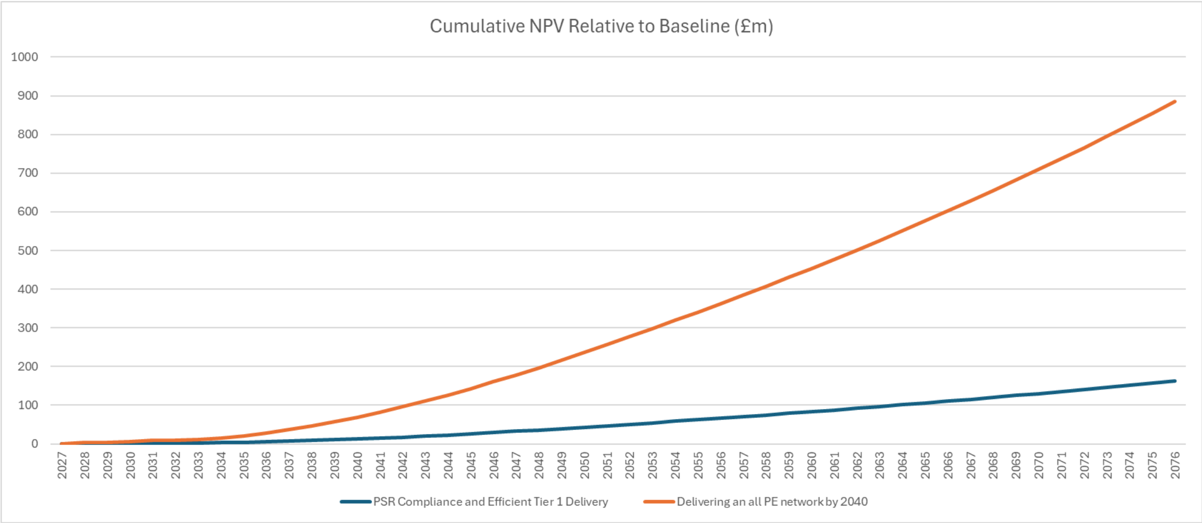

Figure 9: This graph shows a comparison between proposed options considered with Central cost of carbon.

The tables below are extracted from the Ofgem issued CBA model, populated for our assets and the programmes of work considered. For further detail please see the corresponding CBA models as submitted to Ofgem with the GD3 business plan.

Combined non-mandatory programme CBA results - mains and services

[redacted]

Table 6: Shows combined non-mandatory mains and services CBA results

The Combined Non-mandatory mains and services CBA shows both scenarios pay back before the end of the GD3 price control period, using the Central and High CO_2 price estimates. This moves out to 2041 and 2042 using the low CO_2 price estimate for the “Delivering an all PE network by 2040” and PSR Compliance and efficient Tier 1 delivery” scenarios respectively.

Tier 2 CBA results – combined mains and associated services

[redacted]

Table 7: Shows Combined Tier 2 mains and services CBA results.

The Tier 2 CBA shows both scenarios pay back by 2047 and 2048 using the Central CO_2 price estimate for the “PSR Compliance and efficient Tier 1 delivery” and “Delivering an all PE network by 2040” scenarios respectively. Using the High CO_2 price estimate both scenarios pay back in the early 2040s. Using the Low cost of CO_2 both scenarios pay back before 2057s.

Tier 3 CBA results - combined mains and associated services

[redacted]

Table 8: Shows Combined Tier 3 mains and services CBA results.

The Tier 3 CBA shows that using the Central cost of CO_2, both scenarios pay back by 2051. Using the Low CO_2 cost the “Delivering and all PE network by 2040” scenario that date goes out to 2062 and 2065 for the “PSR Compliance” Scenario. Using the High cost of CO_2 both scenarios pay back by 2044.

Steel >2” CBA results - combined mains and associated services

[redacted]

Table 9: Shows Combined Steel >2” mains and services CBA results.

The combined >2” steel mains and services CBA shows both scenarios pay back using all CO_2 cost estimates before the end of the GD3 price control period.

10. Preferred Option Scope and Project Plan

10.1 Preferred Option

In summary, our preferred option would be the “PSR compliance and Efficiency” scenario. Our Cost Benefit Analysis (CBA) assessment shows a clear case to replace large diameter iron and steel due to Opex costs of repair and the significant environmental impact of methane emissions. We have included 21km of mains and circa 400 services per annum in our preferred plan, with an average annual cost of approximately [redacted]. This will allow us to manage the worst condition mains and will offset the deterioration of these asset groups. More work could be justified through CBA, however stakeholder feedback from Local Authorities on disruption and from consumers on the gas bill has been taken into account. We also note Ofgem’s guidance to keep RIIO-GD3 costs to a minimum.

10.2 Asset Health Spend Profile

The expected spend profile of the preferred option is as follows:

[redacted]

Table 10: details the expected spend profile (2023/24 prices)

10.3 Investment Risk Discussion

Chosen Workload

- The workload has been selected using sophisticated predictive analytics, supported by our Asset Investment Manager (AIM) application. This has the latest assessments of health and condition and forecasts deterioration rates and future condition and failures. This enables forecast of future operating costs, safety risk and environmental impact. We then use AIM to optimise our programme, recommending groupings of pipes and an order of replacement to minimise delivery cost and achieve the maximum safety and environmental benefits as early as possible. Any changes to workload during RIIO-GD3 would be primarily driven by 3rd party activities e.g. new housing developments in the vicinity of pipes impacting the safety risk assessment.
- It should be noted that HSE are reviewing their Enforcement Policy for iron mains replacement. The outcome of this could impact the workload required to maintain compliance, moving some Tier 2 pipes into the mandatory programme. We believe an uncertainty mechanism is required to manage any changes as a result of HSE policy due to timing taking us beyond business plan submission.
- Our AIM risk modelling software, in addition to optimising on whole-life cost, allows for modelling uncertainty in base assumptions and provides confidence bands on key outputs e.g. Monetised Risk:

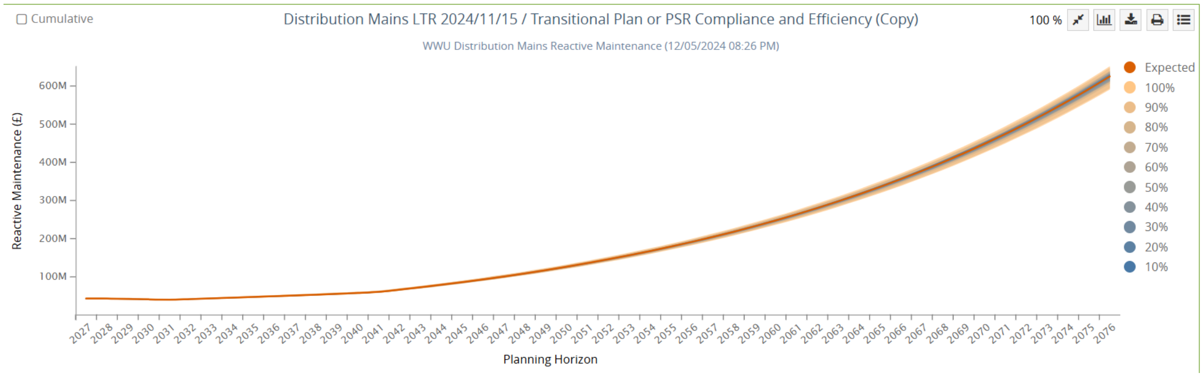

Figure 10: Shows the confidence levels on our forecasts of cost and benefits over time

The chart above is an output of the sensitivity analysis provided by the AIM software. This software has tested our planned intervention programme against input sensitivities and has confirmed that within a 90% level of confidence, our plan is robust and would not change due to any errors in input data.

Programme Risks

- The table below highlights other risks and mitigations associated with our proposed mains replacement programme

Risk Description	Impact	Likelihood	Mitigation/Controls
Programme does not manage risk to required levels	WWU would not be meeting agreed targets for RIIO-GD3	<=20%	We have invested in data and analytics. Probability of failure and deterioration curves have been validated against reality. As long as the physical programme is delivered, this risk is minimal
Risk to delivery timescales	Increased cost to recover programme if falling behind. Benefits to consumers not realised in a timely manner. Wouldn't comply with HSE mandated requirements	<=20%	We have established processes in place to deliver programmes such as this and have successfully delivered in RIIO-GD2. We have a robust workforce resilience strategy as documented in our RIIO-GD3 workforce and supply chain strategy. Delivery of our investment plans are monitored at Exec / CEO level in our organisation
Risk to planned costs	Consumers and WWU paying more than planned for work making it less cost beneficial. If cost is below planned cost, then consumers and WWU benefit from Total Expenditure (Totex) sharing incentive	<=20%	We hold excellent data on these assets and replacement costs. We have used a very detailed cost component model to forecast RIIO-GD3 costs. This has been validated against experience in RIIO-GD2. We have an excellent track record in delivering programmes of this nature. Therefore, risk is minimal

Table 11: Summary of the risks and impacts of the delivery plan.

- **Cost Assumptions**
  - Costs have been derived at a very granular a level. For every single main we have assessed the replacement size, the replacement technique, the location (road, verge, pavement), the number of services and even the number of excavations requires and

the types of connection to be made in these excavations. Due to this granular cost assessment, we have a high level of confidence in our forecasts.

10.4 Project Plan

This is a programme of works that is a continuation of RIIO-GD2. There are hundreds of projects each year that are managed by a Project Management Office (PMO) function and tracked at Exec level. Design of work happens circa 18 months prior to delivery so the early RIIO-GD3 programme will be fully designed in 2025.

The following tables illustrate the communication and associated activities that happen before, during and after a typical project.

Communications prior to work start

What	Who -> Whom	When
High level 2 to 5 year works programme	Programme Controller (PC) / Design Team -> Highway Authority (HA)	Yearly
Forward planning notice - 1 year work	Design Team -> HA	Yearly
Coordination schedules - 1 year work	Planner -> HA	Quarterly
Manage external stakeholder risk / expectations (in discussion with HA, if required)	PC -> HA	Programme level basis - considered by PC, then discussed / agreed with HA
Pre-works site engagement with HA Inspector	PC / Operations -> HA inspector	3.5 to 4 months before work starts
NRSWA Notices, Permits & Lane Rental (3 months / 10 days)	Planner -> HA	Minimum of 3 months before work start
Identification of High-Profile Projects (HPPs)	Programme Surveyor / PC -> Performance Improvement Officer (PIO)	HPPs identified by the Programme Surveyor and reviewed with PC
Identify addresses impacted and identify customers on Priority Service Register (PSR) Send GSOP13 advance notification of interruption letter	Planner via Design Team -> Customer	3 weeks prior to start.

Planning Notification sent to Customer Support Officer (CSO) to plan into workload	Planner -> CSO	3 weeks prior to start (via confirmation of letters sent email)
Booklet with step-by-step guide goes out with GSOP13	Planner via Design Team -> Customer	Sent with GSOP13 letter
HPP Drop-in Centre	PMO / Corporate Affairs (CA) -> Customer	typically 3-4 weeks before start but arranged months in advance
HPP project specific newsletter	PMO / CA -> Customer	Same as GSOP letter timescale
Any high impact traffic management, including road closure application	Planner -> HA	Minimum of 6 weeks, but checks must be undertaken with the individual HA
Projects impacting adjacent HA, e.g. due to diversionary routes	Planner -> Adjacent HA	Suitable time before work starts
HPP - Press releases / local radio/ social media	PMO / CA -> Press	Approximately 2 weeks before work starts
Traffic light (TL) applications	Planner -> HA	HA Specific - expected minimum of 1 month before start
CSO will pre knock affected doors with priority on PSR domestic customers and businesses	CSO	1-2 weeks before start
CSO to use Xoserve data to obtain contact details and call PSR customers who were not in on pre knock	CSO	Day or two after pre knock / one week before works
HPP - Update of works on WWU website	PMO -> CA	At different stages of project cycle via HPP meeting
Weekly HPP meeting	PMO & CA	Weekly
CSO provides secure list of PSR customer details and needs to the FLM / Team	CSO>FLM	1 week before start
Provide info to EMS on reruns and u40+ etc.	Operations / CSO -> Emergency and	At any stage of finding out individual property specifics

	Meterwork Services team (EMS)	

Table 12: Communications prior to work start .

External communications onsite during work execution

What	Who -> Whom	When
Advance warning signs near work location, including any diversionary routes	Planner -> Operations	2 weeks before work start
Streetworks Permit Info Board (England only)	Streetworks team / Planner -> Operations	Prior to works start onsite
Information boards onsite about the works	PMO / CA -> Operations	For duration of project
48 hours card notice delivered by Team onsite	Operations	48 hrs before gas off
Alternative heating and cooking offered and supplied to customers	CSO / Operations	Before gas off
CSO will knock doors and speak to customers during the project	CSO	After project is live
Updates to information boards onsite	CSO / Operations	If there are any updates or change in works that needs communicating
Project signage on barriers explaining reasons for not occupying site	Operations	If site is unoccupied
HPP update & midpoint review	PMO / CA -> Press	Determined / reviewed by the PC (generally agreed pre commencement)

Table 13: External communications onsite during work execution.

Communications following work completion

What	Who -> Whom	When
Post works joint site meeting with HA inspector	Operations -> HA inspector	If required, will happen in the last week, prior to site clearance

Post door knock conversation. Check customers are back on gas and private excavations completed	CSO	After gas interruption and area made good
Formal Customer Satisfaction Surveys (postal)	Explain Market Research	4 weeks after work completion
Works stop notice	Planner -> HA	Within 2 hours of site clearance
Registration notice	Streetworks Team / Planner -> HA	Within 10 days of site clearance
HA feedback	PC -> HA	Within 2 weeks following works completion
Press release / key stakeholder letter (KSL) / Newsletter / social media following works completion	PMO & CA	Within 1 week of Works Completion/ site clear

Table 14: External communications onsite during work execution.

10.5 Key Business Risks and Opportunities

Future Energy Scenarios

The future of energy in the UK is not certain over the long term. Future Energy Scenarios (FES) offer a number of pathways to 2050. We have considered these pathways when testing the robustness of our investment plan against future uncertainty, ensuring that it supports all credible pathways and avoids the risk of asset stranding.

The mains assets identified for proactive intervention have been tested using CBA. This gives a view on the time-period over which an investment pays back i.e. at what point in time it becomes lower cost to invest than to not invest. Our test is whether this point in time at which the investment pays back is within the useful lifespan of the asset. If an asset was expected to be needed as part of the UK energy network until 2040 but not beyond, investment paid back by 2035 remains beneficial to bill payers. If the investment didn't pay back until 2042 then we would consider options to extend asset life within the expectations on us to keep the public safe.

The ongoing role of the gas network and the importance of maintaining resilience and security of supply is widely recognised beyond government, even taking longer term uncertainty into account. For example, all Future of Energy (FES) 2024 scenarios involve at least 20% of homes still on natural gas in 2045, even as many transition to electrification or hydrogen4,5 and NESO's Clean Power 2030 advice on the required gas generation capacity referenced above. As the gas system needs to meet peak demands, substantial infrastructure for safe, reliable supplies will be required even in scenarios where annual throughput may have significantly dropped.

If Hydrogen for heating does not proceed, then it is important to note that the gas network does not decommission in line with fuel switching of users to electrification, i.e. it is not a linear reduction as it will depend on where and when full electrification takes place.

All Future Energy Scenarios show a decrease in gas volumes albeit over different time periods and to different scales. If 50% of consumers in a street disconnected from the gas network, the pipes feeding the street would still be required to service the other 50% of consumers, as would the district governors feeding the street, the higher pressure pipes feeding the governor, the PRIs feeding the higher pressure pipes and so on.

This challenge is exacerbated by government policy and approach to electrifying heat, where the decision is left to consumers rather than a mandated approach targeting regions. With this approach, it is incredibly unlikely whole areas will leave the gas network in the short and medium term. If it does happen, it will be a much more sporadic move from gas, resulting in a requirement to operate our assets until the last consumer in a region makes a decision to transfer.

Another challenge is FES gives UK wide pathways and does not provide a view and data on the individual GDN regions. This presents significant limitations in its usefulness with very broad assumptions required to influence regional plans.

- The chart below shows how previous FES scenarios have not reflected the experienced reality

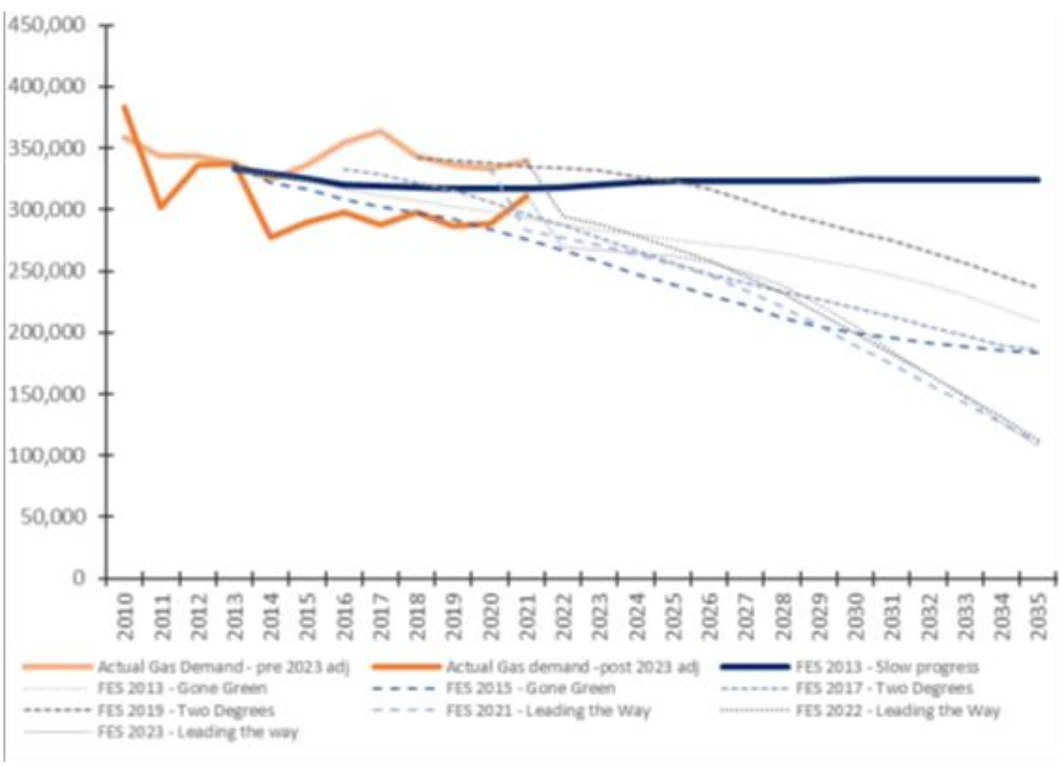

Figure 11 historical residential gas demand against the most optimistic scenario in every 2nd year of publication dating back to 2013

It should be noted that in the 2023 FES scenarios there was an adjustment to historical gas demand figures, as such we have shown historical data both before and after the adjustment to maintain comparability with the original 2013 forecast. ***What is noticeably clear from these graphs is that, to date, the most accurate forecast appears to be the 2013 slow progress. As such it is difficult to have confidence that future forecasts will be any more reliable.***

Due to slower and geographically dispersed take-up of heat pumps, and whilst we wait for the Heat Policy decision, moving to a short payback period cut-off for investments is not compatible with ensuring a safe, resilient, and efficient gas network while we transition to Net Zero. The gas sector collectively believes 25 years as a payback period is more realistic across all scenarios and prudent given the sector's legislative duties.

To manage sensitivities in delivery costs and benefits, we are using a prudent 20-year period to assess cost and benefits. This means investments paying back within this period can be justified with a high level of confidence.

Our mains replacement programme is built up of Tier 1 pipes required to be decommissioned by 2032 and pipes to be justified by CBA.

- Tier 2 and Tier 3 iron mains and services in our proposed programme pay back in 2047 and 2051 respectively. These assets are the feeder mains in towns and cities so in an electrification scenario would be the last pipes to be decommissioned. Most of the pipes selected are attached to Tier 1 projects and enable us to clear areas of metallic pipes. This prevents us from having to return to areas to fix leaks on single pipes after residents and the public have been already had disruptions from a large replacement project in their area.
- Steel pipes in our proposed programme all pay back <5 years due to significant environmental benefit.

These payback periods are well within the most pessimistic views on the future requirement of the gas network. As such, investment in replacement offers value for money and extremely low risk of stranded assets.

10.6 Outputs included in RIIO-GD2 Plans

There are no outputs for delivery in RIIO-GD2 that will not be delivered in the period and that require deferral into RIIO-GD3. This is primarily mains replacement lengths, NARMs and environmental emissions for this paper.

We will come within the caps and collars for lengths by diameter bands and service numbers,

APPENDICIES

Appendix 1 - Current failure rates as used in CBA and NARMs (Mains & Services)

MAINS	Joint Failure Rate per m	Fracture Failure Rate per m	Corrosion Failure Rate per m	Interference Rate per m
Tier 1 CI Low Pressure	0.134862325	0.004174568	0.012518322	0.000516446
Tier 1 CI Medium Pressure	0.255963723	0.007312902	0.035863534	0.001314908
Tier 2 CI Low Pressure	0.295622077	0.003135281	0.020826899	0.000461087
Tier 2 CI Medium Pressure	0.365746286	0.004506261	0.029647624	0.001006689
Tier 3 CI Low Pressure	0.001328935	0.00013039	0.000104131	1.13776E-05
Tier 3 CI Medium Pressure	0.001328935	0.00013039	0.000104131	1.13776E-05
Tier 1 DI Low Pressure	0.032729883	0.000971375	0.008236917	0.000404185
Tier 1 DI Medium Pressure	0.096012529	0.001828671	0.043860431	0.001447119
Tier 2 DI Low Pressure	0.042962416	0.000704646	0.007206294	0.000395442
Tier 2 DI Medium Pressure	0.11063933	0.001558695	0.020124065	0.000944905
Tier 3 DI Low Pressure	0.000334345	8.6926E-07	8.22595E-05	5.16981E-06
Tier 3 DI Medium Pressure	0.000334345	8.6926E-07	8.22595E-05	5.16981E-06
Tier 1 SI Low Pressure	0.074342451	0.00758972	0.007928432	0.000425634
Tier 1 SI Medium Pressure	0.36436859	0.020092792	0.033248595	0.00183949
Tier 2 SI Low Pressure	0.153376333	0.007551126	0.013958604	0.000594069
Tier 2 SI Medium Pressure	0.288270452	0.009865079	0.023822551	0.001285922
Tier 3 SI Low Pressure	0.000928509	0.000146945	6.09378E-05	7.37082E-06
Tier 3 SI Medium Pressure	0.000928509	0.000146945	6.09378E-05	7.37082E-06
Tier 1 ST Intermediate Pressure	0.000235689	1.85624E-07	0.000216756	6.49683E-06
Tier 1 ST Low Pressure	0.015564494	0.001577961	0.016132166	0.00035768
Tier 1 ST Medium Pressure	0.024713247	0.001620183	0.017788351	0.000607712
Tier 2 ST Intermediate Pressure	0.000235689	1.85624E-07	0.000216756	6.49683E-06
Tier 2 ST Low Pressure	0.056639844	0.001045132	0.019064239	0.000348663
Tier 2 ST Medium Pressure	0.059764967	0.001379982	0.022925188	0.000582574
Tier 3 ST Intermediate Pressure	0.000235689	1.85624E-07	0.000216756	6.49683E-06
Tier 3 ST Low Pressure	0.000235689	1.85624E-07	0.000216756	6.49683E-06
Tier 3 ST Medium Pressure	0.000235689	1.85624E-07	0.000216756	6.49683E-06

SERVICES	Joint failures per service per year	Fractures per service per year	Corrosion failures per service per year	Interference per service per year
Metallic	0.003273322	6.60521E-07	0.006990293	0.00026641
PE	0.000795968	0	3.01307E-06	0.00054014

Appendix 2 – "PROPOSED REVISIONS TO THE IRON MAINS ENFORCEMENT POLICY 2026 – 2032"

PROPOSED REVISIONS TO THE IRON MAINS ENFORCEMENT POLICY 2026 – 2032

Note:
Before implementation the proposed revisions to the Iron Mains Enforcement Policy, will be subject to HSE internal governance procedures and approval – this could result in further changes being made.

It is anticipated that the networks will be advised of the approved revised enforcement policy late January 2025.

Tier 1 – no change (other than to introduce additional flexibility, if required to accommodate potential net zero).

> *Whilst the Iron Mains review does indicate that there has been a slight increase in per/km failure rates, all "at risk" Tier 1 pipe should be addressed by 2032 (but see changes to Condition Monitoring below which will facilitate the identification of deteriorating Tier 1 pipes).*

Tier 2 – no change to general approach regarding decommissioning or other suitable measures above a defined risk threshold **but revision** to the risk assessment methodology to ensure its more appropriate to the assessment of absolute risk as applied to individual Tier 2 pipes.

> *See the section on "Concerns about methodology to prioritise Tier 2 pipes" in the previously circulated Iron Mains Review Presentation.*

Tier 3 – no change

Condition Monitoring - Extend the use of conditioning monitoring using Advanced Leakage Detection Technologies (ALD) **<u>for all iron pipes</u>** any distance.

Recognising that, resourcing constrains may require a programmed adoption:

- **Phase 1** (April 2026) "at risk" Tier 2 & 3 pipes as per the current enforcement policy
- **Phase 2** all remaining "at risk" Tier 1 pipes
- **Phase 3** – all remaining iron pipes (i.e. those iron pipes more than 30m from the building line

The objective is to ensure that by an agreed date within Approved Programmes all remaining iron mains are subject to condition monitoring regime using ALD.

The current enforcement policy states "HSE expects the GDN operators to take advantage of innovative techniques that may allow them to pro-actively monitor the condition of pipes in Tier 2 scoring above the risk-action threshold and pipes in Tier 3 to predict the likelihood of failure and to improve asset integrity data."

Whilst to date the focus of the Iron Mains Enforcement Policy has been on managing the risk presented by the highest risk pipes, PSR Regulations 11 & 12 applies to all pipes.

Regulation 11

The operator shall ensure that—

> *(a) no fluid is conveyed in a pipeline unless the safe operating limits of the pipeline have been established; and*
>
> *(b)a pipeline is not operated beyond its safe operating limits, save for the purpose of testing it.*

and Regulation 13

> *The operator shall ensure that a pipeline is maintained in an efficient state, in efficient working order and in good repair.*

For example – if a pipe is leaking; then it is clearly operating outside its safe operating limits (or they have been incorrectly set); and if its leaking then it's not being maintained in an efficient state, in efficient working order and good repair.

The adoption of ALD techniques and it's use across the wider gas network, presents an opportunity for the networks to take measures to help ensure compliance with their Reg 11 and 13 duties in a way that has not been previously practicable.

Appendix 3 – HSE Request for Information - Mains on Private Land (25th April 2023)

Health and Safety Executive

Energy Division

ED Unit 3 Section 2
Ty Myrddin,
Old Station Road,
Carmarthen,
Carmarthenshire, SA31 1LP

Tel: +44(20) 3028-4737
Email:
mark.leadbetter@hse.gov.uk

http://www.hse.gov.uk/

Principal Inspector
Mark Leadbetter

Sarah Williams
Wales and West Utilities
Wales and West House
Spooner Close
Coedkernew
Newport
NP10 8FZ

Reference 2023/82803

Date: 25 April 2023

Dear Sarah,

COMPLIANCE WITH:

THE HEALTH & SAFETY AT WORK ETC. ACT 1974, SECTION 3(1)

Mains on Private land - Gas Mains Within Private Property

I am writing to operators of Gas Distribution Networks (GDNS) and Independent Gas Transporters (iGTs) following HSE's investigation of incidents and subsequent inspection into matters relating to the risk assessment, management and maintenance of mains located in private land.

As you are aware significant discussion has taken place over the last 12-18 months between HSE and a number of GDNs as well as at industry forums such as GTOSG regarding these assets and their associated risk.

HSE is concerned that the approach to the management of risk associated with mains in private property may not meet the requirements as documented in the legislation stated above in relation to risk assessment, design, management operation and maintenance, particularly when replaced either as part of the iron mains replacement program or due to leakage. At a high level the issue comes where the decision making, or risk assessment process for whether mains should be replaced in situ or relocated to the public highway is not formally documented or recorded and where suitable and sufficient systems are not employed to mitigate risk.

Action Required

In order to gain further understanding of the assets that would fall within the definition of mains within private property and the potential risks associated with these assets and to help inform future discussions, leading to an agreed industry approach. Please provide the following information in respect of your network to your lead inspector by the **23 May 2023**

1. Length, material and diameter of IP, MP and LP mains located within domestic private land (i.e., residential property) utilising available records

2. Length, material and diameter of IP, MP and LP mains located within domestic private land (i.e., residential property) identified via works undertaken on site e.g., replacement or leakage each year for the 5-year period 1st January 2016 – 31st December 2020

3. Number of 3rd party damages to IP, MP and LP resulting in a loss of containment for mains by material, diameter and pressure tier reported each year for the 5-year period 1st January 2016 – 31st December 2020 located within domestic private land (i.e., residential property)

4. Number of escapes not resulting from 3rd party damage to IP, MP and LP mains resulting in a loss of containment by material, diameter and pressure tier reported each year for the 5-year period 1st January 2016 – 31st December 2020 located within domestic private land (i.e., r)

5. Recording and management of these specific mains i.e., any additional considerations, communication with landowners etc. including any procedural documents already in place

6. General approach to replacing/maintaining these mains, i.e., relocate to road/footpath or leave in-situ and insert, with a brief overview of any risk assessment process, including any procedural documents already in place

7. The policy and procedural process that has been adopted by your network to manage the risk associated with mains located within domestic private land.

Information for employees

Section 28(8) of the Health and Safety at Work etc. Act 1974 requires me to give information to your employees about matters affecting their health and safety. To this end, please ensure that a copy of this letter is passed on to your employee representatives.

Meanwhile, should you require any further information or advice, or are unclear about what you are required to do then please do not hesitate to contact me.

Yours sincerely

Mark Leadbetter
HM Principal Inspector of Health and Safety

Appendix 4 – Breakdown of cost per meter (Preferred Option)

Total non-mandatory programme – Open cut and Insertion (not including additional cost of Stubs)

[redacted]

Non-mandatory programme – Insertion

[redacted]

Non-mandatory programme – open cut

[redacted]

Appendix 5 – Cost Modelling Process.

Cost

We have developed and validated a very detailed costing model that uses the concept of cost components to build up a programme cost. Our goal is to ensure we have the most robust cost driver information to inform our forecasts.

Workload Identification

Pipes are identified for the entire RIIO-GD3 programme and out to 2032 when the 30/30 programme completes

These pipes are grouped into projects and each pipe has detailed specific information to inform our cost model

- Existing diameter and material
- Replacement diameter and method
- Surface category
- Number and type of services attached to the pipe
- Region

Additional Parameters

We run the workload through our purpose-built ‘Python Programme’ which produces the following;

- Connection points of each pipe based on a pre-set criteria, this produces a connection type which is a key cost driver.
- Grid Ref of each activity (Connection, Service, Main Laying) which is then used in a spatial query to identify the surface categories and road classification.

Below is an example of the Python Programme Connection output for a live mains insertion scheme;

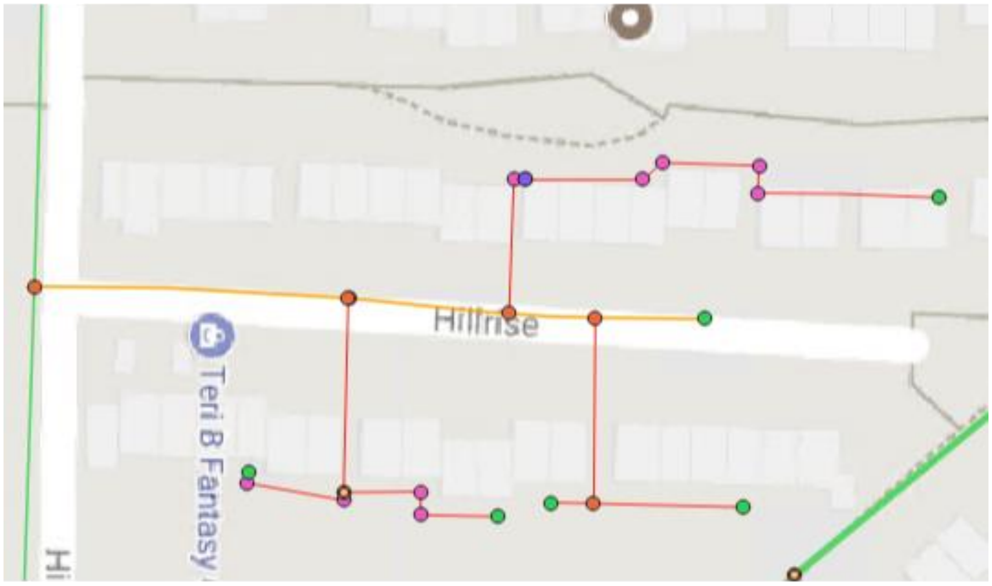

Figure 1: Example of the Python Programme Connection Output

Each dot indicates that a connection is required and the colours represent the connection type. These are produced in a list format based on the existing and replacement mains diameters for each pipe. Using the above scheme as an example, the pink dots represent a bend radius greater than what is possible to insert through therefore requiring us to Retrieve the live head and insert after the obstruction. See schematic below and a list of options available based on the existing diameter.

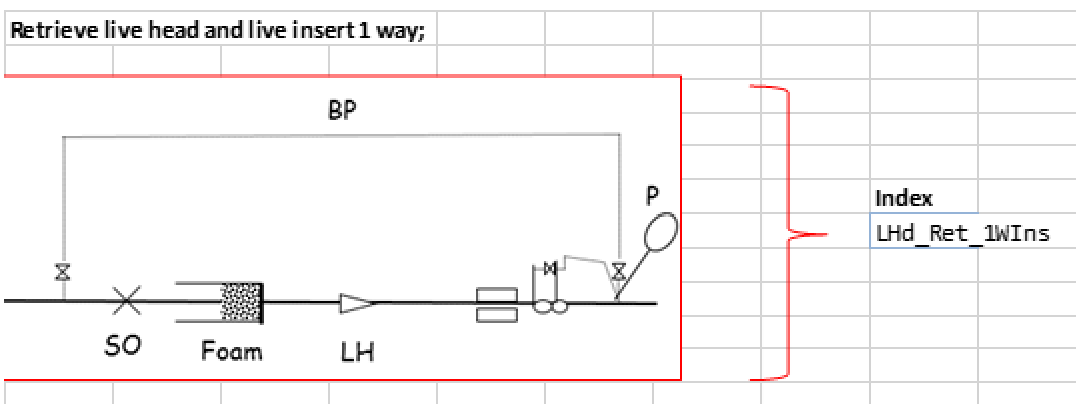

Figure 2: Schematic of live head retrieval

Index	Existing Dia
LHd_Ret_1WIns_LP_3_	3
LHd_Ret_1WIns_LP_4_	4
LHd_Ret_1WIns_LP_5_	5
LHd_Ret_1WIns_LP_6_	6
LHd_Ret_1WIns_LP_7_	7
LHd_Ret_1WIns_LP_8_	8
LHd_Ret_1WIns_LP_9_	9
LHd_Ret_1WIns_LP_10_	10
LHd_Ret_1WIns_LP_12_	12
LHd_Ret_1WIns_LP_14_	14
LHd_Ret_1WIns_LP_16_	16
LHd_Ret_1WIns_LP_18_	18
LHd_Ret_1WIns_LP_24_	24

Figure 3: Index codes for connection types

The Index codes above are for a specific connection type, in this example we are showing the connection set for an activity of Retrieving a Live head during a mains insertion operation and re-setting for another insertion push. This normally occurs at an obstruction such as a bend in the pipe or a syphon.

Other connection types, service types and main laying techniques follow the same process as above to produce the most accurate and robust information to forecast using our cost components.

Cost Components

The cost components are reflective of the application of industry and WWU's policies and procedures, providing us with vital safety factors such as minimum excavation size for a given Engineering Operation:-

- WW/PR/ML/1 (Work Procedure for Pipe System Construction)
- WW/PR/GR/1 (Work Procedure for Main Laying - General Requirements)
- WW/PR/SL/1 (Work Procedure for Service Laying)

There are 3 main Cost Components in Mains Replacement;

- Mains Connections – Connection types for all mains arrangements and sizes
- Main Laying – Open Cut and insertion across all diameters
- Services – a suite of service types rolled up into relays of steel services and transfers of PE services

As the components are built from very specific cost drivers which include;

- Excavation size
- Pipe & Fittings
- Aggregate Quantities

Cost component	Method of calculating workload	Method of calculating cost
Pipe and fittings	Based on workload and connection/service type	Rate per metre/component from current procured contracts
Excavation size	Based on industry policies and procedures - standards	Cost is linked to aggregate quantities
Aggregate quantities	Based on excavation size	Rate per tonne from current procured contracts – including regional rate differences
Connection types	Current working practices for each connection type established	Each connection type has a different cost based on Pipe and fittings, excavation sizes, aggregates and labour time required.
Number services	Based on workload – see design section	Rate per service type based on current working practices
Replacement technique	Based on workload – see design section	Time to excavate for different techniques, aggregate requirements and plant necessary to support technique

Outputs

Through multiplying the workload and additional parameters against the specific cost component we can estimate the costs at a very granular level by region, this is especially important to take account of the differing rates for activities such as 3rd party services for Reinstatement, Quarry costs etc. across our geography.

Outputs process map

This demonstrates a simplified process flow of our Mains Replacement costing model, The top (1st) section is the Services flow, 2nd is the Mains Connections, 3rd is the Dynamic Growth Connections and 4th is the Main Laying flow.

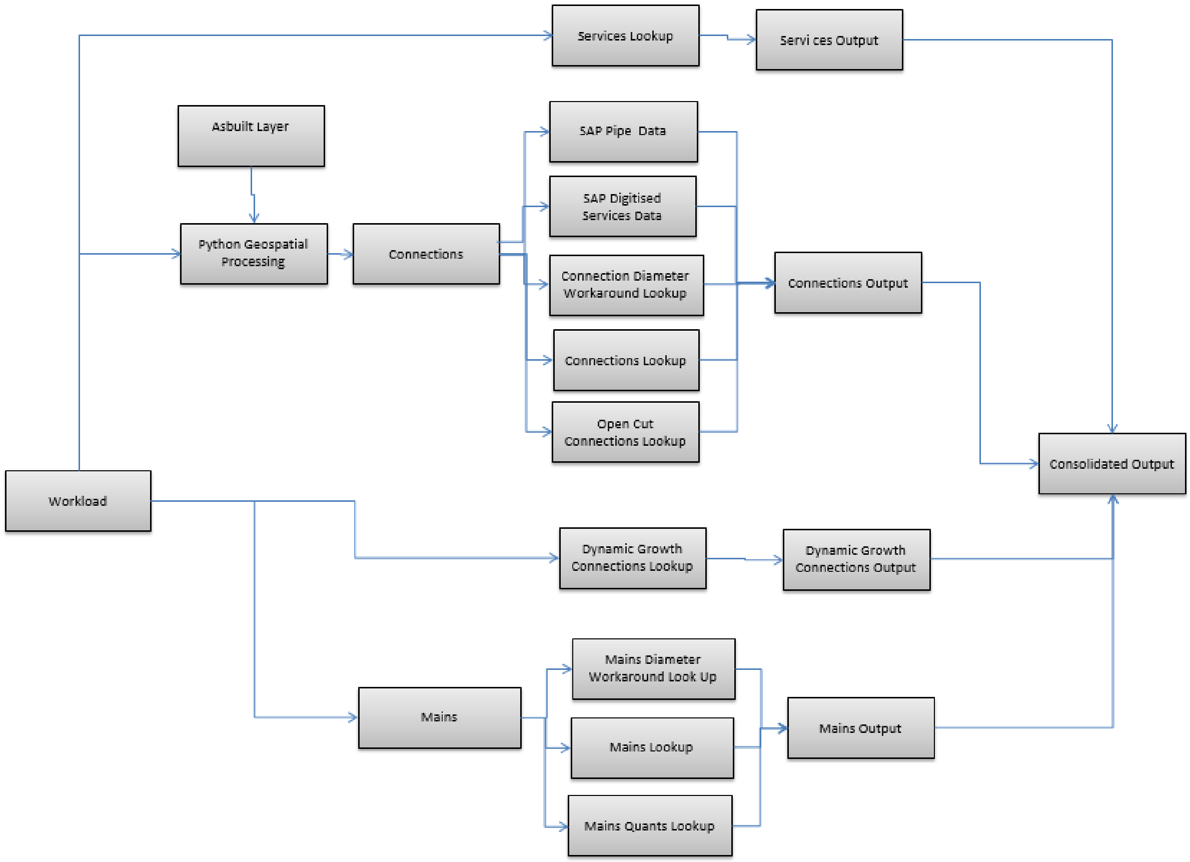

Figure 4: Process Flow for Mains Replacement Costing

Appendix 6 – Example of HSE correspondence on leaking mains

From: Steven Gill <Steven.Gill@hse.gov.uk>
Sent: 30 October 2024 13:21
To: Martin Keith Cook <Martin.K.Cook@wwutilities.co.uk>
Cc: Mark Leadbetter <Mark.Leadbetter@hse.gov.uk>
Subject: RIDDOR report: F1A8165DC1 Date Submitted: 23/08/2024

[Caution: This email has been sent from outside Wales & West Utilities]

Thanks for your email Martin

I have discussed with Mark and we remain concerned about this pipeline given the large numbers of recent failures. Particularly given these are related to corrosion. Whilst the pipeline may not be subject to replacement via the MRPS it still remains a pipeline and as such is subject to Regulation 13 of the Pipelines Safety Regulations around maintenance.

We are going to follow up more widely around the topic of condition monitoring during the intervention plan inspection later in the work year, however in the interim we do need to get more assurance around the plans in place for this specific section of pipeline.

Please can you confirm:

1. The timeframe for any planned replacement
2. What additional condition monitoring do WWU propose to undertake in the interim given the high numbers of recent failures on this section of pipeline.

Should we be unable to confirm that these issues are being addressed then we may need to consider enforcement action in relation to these matters.

I also note that you are reviewing the reporting requirements associated with these incidents.

Please can you respond by 7th November 2024.

Steven Gill | HM Inspector of Health and Safety | Gas Pipelines & Wind and Marine Energy | Energy Division |
Health & Safety Executive | Rosebery Court, St Andrews Business Park, Norwich NR7 0HS
| (: **0203 028 2745**
| *: Steven.gill@hse.gov.uk
HSE Website: www.hse.gov.uk