Appendix 13a:
RoRE Risk Analysis

YorkshireWater

Contents

Introduction

This appendix provides details explaining our approach for undertaking the RoRE risk analysis used to populate table App26. We firstly provide an overview of our approach and the 'risk framework' we developed to underpin our analysis. We then provide details of our approach to assessing:

- revenue risk;
- totex risk;
- retail risk (residential and business);
- ODI related risk;
- WaterworCX performance risk;
- Water trading risk; and
- financing risk.

Finally, we set out a summary of the overall RoRE risk range across the above scenarios.

Overview of our approach and summary of key points

We have implemented a thorough and robust approach to appraising the risks associated with our Plan - and specifically, the modelling of the RoRE risks scenarios specified by Ofwat in table App26. We have taken care, not only to ensure that the analysis we have undertaken is fully consistent with Ofwat's methodology, but also that the depth and breadth of our evidence is comprehensive. Key features of our approach include:

- Our work started from a 'risk framework' (developed in conjunction with Arup) to **ensure that the full spectrum of financial risks have been included.**
- We have **taken into account risk mitigation** and our **efficient management responses.**
- High and low risk scenarios are specified in terms of **P10 and P90** values at the appointee level (i.e. where risk impacts are shown by price control area, this still reflects 'appointee level' risk, rather than simply summing individual risks, which as Ofwat notes, is inappropriate). All impacts are reported **relative to our base case** and are in **2017/18 prices.** Values for 'high case' scenarios are always entered as positive values and reflect outperformance (e.g. in relation to cost scenarios, they capture underspend) – and vice-versa for 'low case' scenarios. Where RoRE ranges are reported, these reflect **notional gearing**, as specified by Ofwat.
- We have drawn on **a range of evidence, including both 'bottom-up' and 'top-down' analysis** – using a combination of historical and forward-looking data.
- Our approach to modelling ODI risk has been especially detailed, drawing on a **Monte Carlo simulation model** developed by Economic Insight.
- We have applied a **thorough assurance process** across our risk analysis.
- The overall **RoRE risk range arising from our Plan is in line with Ofwat's published guidelines** and assurance advice received from our consultants.

Risk framework

Our work began from a 'risk framework' – developed by Arup, in consultation with our resilience team. The purpose of this was to identify the full range of risks and appraise their applicability across the scenarios we needed to model. Consistent with Ofwat's methodology, care was taken to ensure that this was comprehensive, so that the full spectrum of financial risks was considered. Our

framework included 34 *shortlisted* categories of risk types, within which a *longlist* of some 114 subcategories were identified. The following table sets out the shortlisted risks we considered, alongside the definitions used.

Table 1: Summary of risk framework developed in conjunction with Arup

Risk type	Definition
Financial crisis	Events in the financial system causing short-run fluctuations and/or significant changes in long-run economic growth.
Industrial and trade disputes	Strikes, mass refusal of employees to work, or picketing by aggrieved workforce to prevent commercial activity and/or events causing widespread change or disruption to international trading conditions.
Supply chain failure	Disruptions to supply chain and supply networks (materials, natural and human resources).
Environmental pollution	Pollution is the introduction of substances or energy into the environment, resulting in deleterious effects of such a nature as to endanger human health, harm living resources and ecosystems, and impair or interfere with amenities and other legitimate uses of the environment.
Infectious disease – flora and fauna	Disease outbreak affecting animals and/or plants (including invasive species).
Storm and high wind	Climatic anomalies or extremes causing severe weather conditions (storm and high wind).
Extreme cold	Abnormally cold weather conditions.
Extreme rainfall	River flood from high rainfall/sudden water release across one or more river systems. Coastal flood from sea surge, caused by low pressure weather systems, exceptional tides and winds.
Natural disasters	Naturally occurring phenomena, causing widespread damage and disruption (including earthquake, windstorm, tsunami, and volcanic eruption).
Space weather	Threats originating from outside the earth's atmosphere, including astronomical objects and space weather.
Political and Macro industry change	Structural changes to the water industry, such as: Brexit; policy and regulatory changes; nationalisation of the Water Sector; or changes to the abstraction licences.
Political violence and terrorism	Acts or threats of violence by individuals or groups, for political ends.
Harassment and discrimination	Offensive (verbal or physical) behaviour or hostility on the basis of race, colour, gender, national origin, religion, age, physical or mental disability, and sexual orientation.
Infectious disease – human	Disease outbreak affecting humans (e.g. influenza pandemics, emerging infectious diseases and re-emergent disease epidemics).
Vandalism	Action involving deliberate destruction or damage to company property.
Asset failure	Inability of an asset to fulfil one or more intended functions due to deterioration, telecommunication, internet or IT system failure - or false positive alarms.
Cyber attacks	Computer networks, communications and information technology systems destabilised by computer virus, hacking, denial of service attacks or other cyber-security issues (including data fraud and theft).
Major industrial and / or transport incidents	Accidental industrial events affecting company assets and/or local stakeholders such as nuclear and chemical industry incidents. It also includes major transport incidents (e.g. transport crashes).
Power failure	A power outage (short-term or long term) that could impact the company operations.
Bad debt	High levels of debt that is not recoverable.
Costs increase	Increased cost of energy, fuel and commodities and/or financial borrowing.
Recession	Period of temporary economic decline identified by a fall in GDP in two successive quarters.
Climate change	A change in the state of the climate that persists for an extended period, typically decades or longer.
Heatwave and drought	Extended period of below-average precipitation.
Environmental change	A change or disturbance of the environment most often caused by human influences and natural ecological processes.
Erosion	Coastal or river erosion due to natural processes.
Land use change	Changes in land use and catchments that could impact the company operations.
Change in customer behaviour and expectation	Changes in customer behaviour that could impact company operations.
Population growth	Increases in population growth that could impact company operations.
Urban creep	Loss of permeable surfaces within urban areas creating increased runoff which contributes to flooding and other problems.
Skills shortage	Lack of suitably skilled workforce that could impact the company operations.
Vulnerable communities and customers	Vulnerable communities and customers (e.g. low-income families, ethnic minority communities, refugees).
Disruptive technologies	Innovation that creates a new market and disrupt the company operations (e.g. digital technologies).
Ageing infrastructure	Increasing average age of infrastructure that could impact the functionality and performance of assets.

For each risk category, we then appraised its relevance and likely impact across the key RoRE risk scenarios. This was done for all 114 subcategories of risk, identified in our longlist. Once this mapping of risks to scenarios was complete, we used this as the starting point to develop 'bottom-up' analyses of financial impacts under high and low cases. For some risk scenarios, this was supplemented by a range of additional evidence, including 'top-down' analysis.

In the following sections, we now expand on our approach to each risk scenario in turn.

Revenue risk

Key issues regarding our approach to revenue risk

As noted by Economic Insight in their initial advice to us on RoRE risk, the form of price control regulation means that the only 'revenue' risk in the water sector relates to demand.[1] Furthermore, the extent of this demand risk is expected to be low (as also noted by PwC[2]). Specifically, as the majority of the value chain is subject to 'total revenue' controls, recovered revenues are typically expected to be close to allowed revenues.

Notwithstanding this, at PR19 we are exposed to some demand related revenue risk as follows:

- Both the bioresources control and the household retail control are set on an 'average revenue' basis. As such, demand related revenue risk will apply in these two elements.
- In the water resource control, whilst a 'total revenue' approach is being applied, Ofwat's methodology also includes a 'within-period' demand risk adjustment mechanism. This mechanism is intended to adjust revenues only to reflect the difference between projected and required capacity arising from (bilateral) competition. As such, there will be some degree of demand risk in this element of the value chain.
- In the water resources, water network plus, and wastewater network plus controls, Ofwat will further apply a revenue forecasting incentive mechanism. Under this mechanism, Ofwat will apply a penalty, within period, to differences between forecast and actual revenues, where those differences are greater than 2%. Accordingly, we face a degree of demand related revenue risk through this mechanism.
- In the water resources and water network plus controls, recovered revenues can further be impacted by water trading incentives.

[1] 'RoRE Risk Analysis: framework, preliminary analysis and advice to Yorkshire Water.' Economic Insight (March 2018).
[2] 'Balance of risk and reward across the water and sewerage value chain.' PWC (December 2015).

Our approach to assessing revenue risk

We have assessed the 4 areas of revenue risk, defined by the different revenue controls, which were included within the initial advice provided by Economic Insight:

Bioresources control and the household retail control

The implementation of the household retail control relies on the inputs that are used for the wholesale price controls the forecast of the categories of household customers.

Within table R9 of the PR19 submission we have reported our actual and forecast under and over recovery of the retail household revenue, this shows that for the current price control we are showing a range of 0% to 2.75%, with an average of 1.1%.

The Bioresources control is new to the next control period and the demand risk will be experienced through the changes in the forecast sludge treatment and the allowed adjustments to the average £/ tds anticipated to be recovered. This forecasting will be tied to the forecasting of the wastewater network plus price control, so we would anticipate same levels as within the wastewater network plus control.

Water resource control

We recognise that the within period adjustment is intended to adjust revenues only to reflect the difference between projected and required capacity arising from (bilateral) competition, we currently see this as a low risk area which we do not anticipate any material impacts arising.

Network plus and water resources controls

We have operated under a wholesale revenue forecasting incentive mechanism within the current price control period, with a 2% 'tolerance target' before any penalties were introduced. This was developed and consulted on in April 2014, along with the proposal to introduce the wholesale revenue forecasting incentive mechanism.

Within our PR14 accounting for past performance submission, table WS13 and WWS13, we have shown that our performance against our total wholesale revenue controls has been between 0.71% (2017-18) and 2.69% (2019-20) for water and -0.88% (2017-18) to 1.32% (2018-19) for waste water.

We have not observed any impacts of the water trading incentive within the current price control and we are not forecasting any within the next control.

Overall revenue risk

As approximately 95% of the revenue is collected through the 4 wholesale price controls, we have assessed a prudent approach to revenue risk is to assume that the +/- 2% tolerance target is appropriate to be applied across them.

We have also applied the same range of +/- 2% to the retail price controls as we did not find any compelling evidence to use a different range.

Results of revenue risk analysis

The following tables summarise the results of our 'bottom-up' analysis of revenue risk, reported in £m (impact relative to base case) and in 2017/18 CPIH prices. Consistent with Ofwat's requirements, the 'high case' scenario reflects outperformance relative to allowed revenue and the 'low case' represents underperformance relative to allowed revenue.

Table 2: Water resources: high and low case revenue impacts

	2020/21	2021/22	2022/23	2023/24	2024/25	Total over AMP	Average over AMP
High RoRE case	£1.33	£1.33	£1.33	£1.33	£1.34	£6.66	£1.33
Low RoRE case	-£1.33	-£1.33	-£1.33	-£1.33	-£1.34	-£6.66	-£1.33

Table 3: Water network plus: high and low case revenue impacts

	2020/21	2021/22	2022/23	2023/24	2024/25	Total over AMP	Average over AMP
High RoRE case	£7.88	£7.83	£7.80	£7.88	£7.94	£39.32	£7.86
Low RoRE case	-£7.88	-£7.83	-£7.80	-£7.88	-£7.94	-£39.32	-£7.86

Table 4: Wastewater network plus: high and low case revenue impacts

	2020/21	2021/22	2022/23	2023/24	2024/25	Total over AMP	Average over AMP
High RoRE case	£8.80	£9.38	£9.68	£10.06	£10.21	£48.21	£9.64
Low RoRE case	-£8.80	-£9.38	-£9.68	-£10.06	-£10.21	-£48.21	-£9.64

Table 52: Bioresources: high and low case revenue impacts

	2020/21	2021/22	2022/23	2023/24	2024/25	Total over AMP	Average over AMP
High RoRE case	£1.69	£1.74	£1.75	£1.75	£1.72	£8.64	£1.73
Low RoRE case	-£1.69	-£1.74	-£1.75	-£1.75	-£1.72	-£8.64	-£1.73

Table 63:Household retail: high and low case revenue impacts

	2020/21	2021/22	2022/23	2023/24	2024/25	Total over AMP	Average over AMP
High RoRE case	£1.16	£1.14	£1.10	£1.06	£1.04	£5.50	£1.10
Low RoRE case	-£1.16	-£1.14	-£1.10	-£1.06	-£1.04	-£5.50	-£1.10

Table 74: Non-household retail: high and low case revenue impacts

	2020/21	2021/22	2022/23	2023/24	2024/25	Total over AMP	Average over AMP
High RoRE case	£0.19	£0.19	£0.16	£0.15	£0.15	£0.83	£0.17
Low RoRE case	-£0.19	-£0.19	-£0.16	-£0.15	-£0.15	-£0.83	-£0.17

Further evidence on revenue risk

As part of their early assurance support to us on RoRE risk, Economic Insight developed some 'top-down' evidence on the extent of revenue risk we may be exposed to.[3] In particular, they calculated the percentage difference between 'allowed' and 'actual' revenues for 2015/16 and 2016/17 respectively (i.e. PR14) across the industry. They then adjusted to reflect K factor profiling and then interpreted the underlying % variation as 'risk'. Assuming that revenue risk is symmetrical, this evidence implies:

- for wholesale revenues, high and low case scenarios of + / - 1.4% of base case revenues; and
- for retail revenues, high and low case scenarios of + / - 4.5% of base case revenues.

Table 8: Low and High case revenue risk scenarios implied by 'top-down' evidence

	P10 (low case)	**P90 (high case)**
Wholesale revenue (% variation from base case revenues)	-1.4%	1.4%
Retail revenue (% variation from base case revenues)	-4.5%	4.5%

[3] For further details, see 'RoRE Risk Analysis: framework, preliminary analysis and advice to Yorkshire Water.' Economic Insight (March 2018).

Totex risk

In relation to the financial impact of totex risk, we made use of both 'bottom-up' and 'top-down' evidence. The former was ultimately used to support our Plan numbers and, therefore, the relevant sections of table App26. The latter was developed primarily for assurance purposes and to ensure we had a breadth of evidence to draw upon.

Bottom-up evidence on totex risk

Our approach to assessing the financial impact of totex risk began with a consideration of the key relevant risk factors. This included both drawing on our risk framework (as previously described); and also, risks identified and modelled by us at PR14. Following from this, the two main risks we identified were:

- under / over performance, relative to assumed efficiency; and
- variation in input price inflation, relative to our base case (real price effects).

We also considered the following additional risks:

- changes in household demand, due to changes in population and number of properties;
- changes in energy consumption, due to rainfall;
- mains bursts, due to changes in temperature;
- revaluation of business rates; and
- costs to recover service.

Having identified the appropriate risks, we then undertook *'bottom-up' analysis* to calculate their financial impact under high and low case scenarios. In the following subsections, we briefly expand on our method for each of the above.

To reflect the fact that being at the 'extremes' on any of the above risk factors simultaneously is 'unlikely', we applied a Monte Carlo analysis to 'randomly draw' impacts for each – then calculated the 'combined' £m impact at the appointee level. We describe this further subsequently.

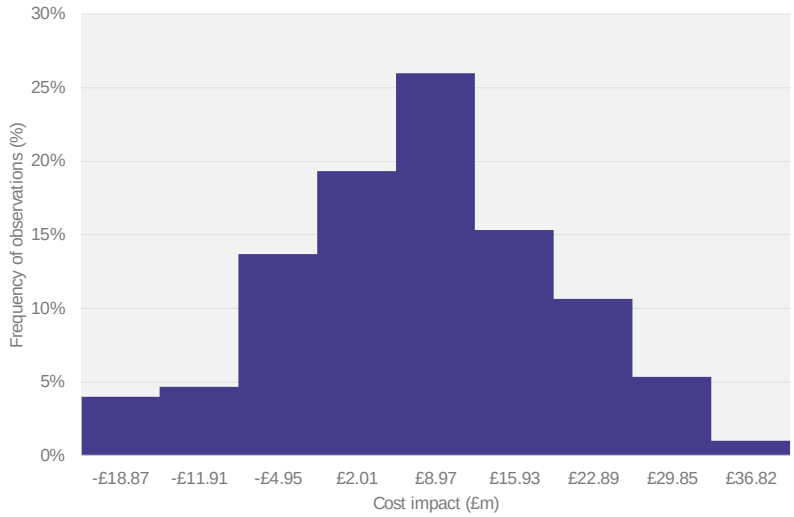
Assessing the impact of over / under performance on assumed efficiency

A key driver of totex risk relates to the potential for us to over or underperform against the efficiency savings targeted in our base case plan. We asked Economic Insight to provide an analysis of this on our behalf. Their method and results are set out in Appendix 13d enclosed with this document: *'Estimating totex risk from efficiency savings and input price inflation'.* However, in summary their approach was as follows:

- To inform the 'extent' of efficiency risk, Economic Insight identified the 'range' of plausible efficiency savings implied by our totex cost benchmarking work. Here, the rationale is that the 'true' potential to achieve efficiencies is highly uncertain – and therefore, any robust benchmarking model 'may' plausibly provide a reasonable estimate of this. As such, one might assume that the model(s) that imply the most 'demanding' efficiency savings provide an indication of the maximum we can achieve; and conversely, the model(s) that imply the 'least' demanding savings, provide an indication of the minimum we can achieve.
- Using this approach Economic Insight found that the overall 'range' of efficiency totex risk was in the region of 40% (although this varied by price control area).

- The regulatory framework, by its design, should ensure that the extent of efficiency performance risk is broadly 'symmetrical'. That is to say, if our own cost assessment work is robust – our baseline should be calibrated such that upside and downside risk is similar. Equally, Ofwat's own approach to cost assessment and totex incentives should also result in efficiency totex risk being close to symmetrical. Consistent with the above, Economic Insight found the evidence suggested that the overall scope for efficiency savings was broadly 'symmetrical' (although again, this varied a little by control area).
- Using the above, Economic Insight then estimated a triangular probability distribution in relation to % out and underperformance. A distribution of potential totex impacts was then derived by multiplying these numbers by our base case totex in £m. The following figure illustrates this in relation to the water network plus control.

Figure 1: distribution of scope for totex efficiency out and underperformance (water network plus)



Input price inflation (real price effects)

The Yorkshire Water PR19 Business Plan includes real price effects (RPE) on opex and capex for each of the price control areas over AMP7. Here we consider what the range might be for being *above* or *below* the forecast RPE baseline included in the Business Plan.

Here we modelled uncertainty in RPEs in terms of uncertainty in our underlying gross input price inflation. To do this, we drew on our existing work on RPEs for PR19 and assumed a central case of gross inflation consistent with that for each price control area. To then determine a 'maximum' and 'minimum' value, we looked at the range of forecasts implied by our RPE work[4] (which showed a relatively wide range, depending on the forecast method used). The selection of a range is somewhat subjective, as it depends on what 'weight' one attaches to each forecast method. However, broadly it showed that the underlying gross inflation risk could be higher or lower by around 1.5% pa. We therefore applied this assumption across each price control area – and derived triangular probability distributions accordingly. The advantage of using our existing RPE work as the basis for this analysis is that it ensures internal consistency with other components of our Plan. In addition, our RPE work ensured that our forecasts are also consistent with official Government (OBR) forecasts for the UK economy.

[4] 'PR19 Real Price Effects: Input Price Inflation Forecasting: a report for Yorkshire Water.' Economic Insight (2018)

By adopting the above approach, we are assuming that movements in underlying gross inflation translate directly to equivalent movements in RPEs. This is unlikely to be the case (as CPIH, by which a high proportion of our revenues are indexed, will be correlated with our underlying gross inflation pressure). However, we consider that it nonetheless provides a reasonable basis for understanding the scope of risk.

To translate the above into financial impacts, we subtracted the difference between values derived from our distributions from the 'central case' for underlying gross input price pressure - and multiplied them by our totex values in the relevant financial years by price control area.

Changes in household demand due to changes in population and number of properties

Variation in household demand (due to population) can impact both opex and capex related costs. To capture this, our approach was as follows:

*Opex impact = change in population (relative to base case) * per capita consumption * unit cost of service*

*Capex impact = change in no of new connections (relative to base case) * unit cost per connection*

The assumptions applied, and data sources used, to implement the above are summarised in the following two tables.

Table 9: Assumptions applied in modelling scenarios

Scenario	Population	New connections
Low	Yorkshire Water's 2019 Water Resources Management Plan (WRMP19)	Yorkshire Water's 2019 Water Resources Management Plan (WRMP19)
Baseline		
High	Office of National Statistics (ONS) high population variation scenario for England	

Table 10: Data sources used

Description	Source
Clean water per capita consumption	Yorkshire Water's 2016/17 Annual Report and Financial Statements.
Equivalent wastewater per capita	No value reported; but checked and used assumption in PR14: 0.95 l of wastewater produced per 1 l of clean water used.
Cost per Ml of water	Yorkshire Water modelled cost.
Cost per Ml of waste	No value modelled/reported; checked and used assumption in PR14: cost of treating Ml of waste relative to cost of treating Ml of clean water is proportional to the value of an average customer bill for sewerage services relative to the value of the bill for clean water services.
Cost per new clean/waste connection	Dividing reported values on capex for new connections and growth (for clean/waste) net of grants and contributions with the total number of new connections.

Changes in energy consumption due to rainfall

Here, we focused on the impact on costs arising from changes in energy consumption *within our operations*, due to rainfall (we excluded the potential impacts arising from *damage to assets*). Our approach separately considered these operational impacts across the following asset categories:

- clean water pumping stations;
- wastewater pumping stations;
- clean water treatment works; and
- wastewater treatment works.

For each 'type' of operational asset, we estimated a linear-log model for annual energy consumption, against annual average rainfall. In practice, this resulted in robust results for three out of the above four categories – but for wastewater treatment, no robust relationship was found (and therefore no cost impact was included).

Following from the above, the annual totex impact of rainfall was calculated as follows:

*Annual cost due to rainfall = modelled annual energy consumption due to rainfall scenario * unit cost of energy*

The following table summarises the key assumptions made when applying the above approach in practice.

Table 11: Assumptions applied in determining energy consumption impacts

Scenario	Assumption	Source
Baseline rainfall	Mean annual rainfall value over a 25-year period.	MORECS gridded rainfall data for Yorkshire Water region.
Low/high rainfall	A range of potential future rainfall values were generated, from which percentiles were calculated.	By defining a normal probability distribution for rainfall given, using the above data.
Unit cost of energy (£/kWh)	Dividing the total energy cost by total energy use over a period of 16 years, giving an effective energy rate of £0.10 per kWh.	Yorkshire Water energy use and cost data.

Mains bursts due to changes in temperature

Here, the scope of our analysis focused on the impacts on totex (via opex) arising from the water main bursts due to 'temperature'. To derive a totex impact, we estimated a linear regression model for the number of repairs per month against average monthly temperature in the Yorkshire region.

Having done this, we estimated a triangular distribution for mains bursts – which in turn was translated into financial impacts, as summarised below.

Table 12: key variables and approach

Variable	Treatment in simulation
Monthly average temperature (used as baseline temperature for the month)	A normal probability distribution for the temperature in each month was defined given monthly data over a 17-year period, giving simulated minimum and maximum values.
Unit cost of a mains burst repair	A triangular probability distribution for the unit cost of a mains repair given the range of cost to repair, giving the implied cost impacts.
Monthly total repair cost under different temperature scenarios relative to the baseline	Derived from distributions above.
Total annual cost value	Sum of January to December simulated repairs cost.

This cost only applies to the water networks plus price control area.

Revaluation of business rates

Here, we focused on the potential cost impact arising from uncertainties in the factors which, in turn, affect the likely business rates liability we will face over PR19. Different scenarios (or factors) that affect business rates were developed and assumed probabilities attached to them. These were based on the knowledge and expectations of relevant experts within the business.

We identified 729 possible combinations of uncertain 'factors' alongside the associated probabilities with which we expect each of these combinations to occur. We also included an additional scenario: the baseline scenario, which is equal to the business rates scenario that is assumed in the business plan. To calculate the cost impact arising from uncertainty in business rates, we undertook the following steps:

- We firstly ranked the scenarios in terms of the size of 'business rates liability', from smallest to largest.
- We then calculated a cumulative probability distribution, by adding the combined probabilities of the ranked scenarios.
- We then calculated the difference between the implied liabilities and those assumed under our base case.

To apportion the above financial impacts by price control area, we applied the following steps. We firstly assumed that estimated 'clean' rateable value bill impact was assigned to the water resources and water network-plus price controls (with the 'waste' impact assigned to the bioresources and wastewater network plus controls). Within each of the 'clean' and 'waste' areas, the impacts were further apportioned between the relevant controls based on data on rates payable by control, as contained in our Annual Performance Report (APR).

Monte Carlo analysis to derive overall totex risk

Using the methodologies above, we arrived at a set of 'potential' totex impacts for each underlying risk factor – each underpinned by probability distributions. To derive the overall risk impact in £m we then applied a Monte Carlo analysis (for further details, see Appendix 13d: *'Estimating totex risk from efficiency savings and input price inflation', Economic Insight).* This is to reflect the fact that these risks are non-independent and that the chances of being at the 'extremes' on multiple risk factors simultaneously is low. As such, simply "adding" the P10s or P90s for individual risk factors would, in our view, be inappropriate.

The Monte Carlo analysis 'randomly drew' totex impacts from each of the above individual risk factors. From this, an overall distribution of £m totex impacts was calculated. This was then used to identify the P10 and P90 values necessary to define the high and low case scenarios. For the purpose of populating table App26, impacts were further split by price control area either by: (i) using the overall totex split for PR19; or where appropriate; (ii) risk specific methods, as noted above where applicable.

Results of bottom-up totex risk analysis

The following tables summarise the results of our 'bottom-up' analysis of totex risk, reported in £m (impact relative to base case) and in 2017/18 CPIH prices. Consistent with Ofwat's requirements, the 'high case' scenario reflects an underspend relative to allowed totex and the 'low case' represents an overspend relative to allowed totex.

Table 13: Water resources: high and low case totex impacts

	2020/21	2021/22	2022/23	2023/24	2024/25	Total over AMP	Average over AMP
High RoRE case	£4.09	£5.39	£5.49	£5.04	£4.20	£24.20	£4.84
Low RoRE case	-£6.08	-£5.35	-£5.96	-£6.31	-£4.28	-£27.98	-£5.60

Table 14: Water network plus: high and low case totex impacts

	2020/21	2021/22	2022/23	2023/24	2024/25	Total over AMP	Average over AMP
High RoRE case	£34.35	£58.52	£56.60	£59.62	£59.25	£268.33	£53.67
Low RoRE case	-£35.18	-£41.05	-£45.96	-£42.37	-£40.44	-£205.00	-£41.00

Table 15: Wastewater network plus: high and low case totex impacts

	2020/21	2021/22	2022/23	2023/24	2024/25	Total over AMP	Average over AMP
High RoRE case	£48.87	£58.28	£51.31	£35.70	£32.77	£226.92	£45.38
Low RoRE case	-£72.34	-£74.84	-£60.70	-£48.74	-£35.79	-£292.42	-£58.48

Table 16: Bioresources: high and low case totex impacts

	2020/21	2021/22	2022/23	2023/24	2024/25	Total over AMP	Average over AMP
High RoRE case	£7.33	£7.24	£5.86	£5.91	£5.81	£32.15	£6.43
Low RoRE case	-£9.48	-£10.74	-£8.93	-£8.30	-£7.35	-£44.79	-£8.96

Top-down evidence on totex risk

In addition to our own 'bottom-up' evidence on totex risk, we have used 'top-down' evidence to further validate our risk analysis. In particular, as part of a package of broader assurance on our approach to risk, Economic Insight provided an independent assessment of the scope for totex risk exposure, using a top-down approach. Their approach and analysis is set out in full within Appendix 13j: *'RoRE Risk Analysis: framework, preliminary analysis and advice to Yorkshire Water.'* However, in summary the methodology involved the following:

- The variation between 'actual' and 'allowed' totex was calculated for each company for the years 2015/16 and 2016/17. The former was sourced from regulatory accounts, the latter from the PR14 Final Determinations.
- The variations were then converted into percentages.
- Probability distributions (for the % deviation between actual and allowed values) were then derived – alongside the corresponding P10 and P90 values.

In relation to 'totex risk' this top-down / historical analysis implied the following P10 and P90 values (the table below shows the adjusted results from Economic Insight's analysis, to reflect the assumed 'symmetry' in totex risk – their report also shows unadjusted impacts). Economic Insight note that the method used most likely overstates the forward-looking totex risk we face.

Table 57: Summary of P10 and P90 totex risk impacts implied by top-down evidence from Economic Insight

	P10 (high case)	P90 (low case)
Water totex risk (% variation in actual totex relative to base case)	-9.5%	+9.5%
Wastewater totex risk (% variation in actual totex relative to base case)	-19.2%	19.2%

By applying the above percentage impacts to our base case totex figures by price control area, we can derive the implied £ high and low case scenario impacts. These are set out in the following tables. Please note, however, that we have populated App26 using our 'bottom-up' approach and that these are provided as a further source of evidence.

Table 68: Water resources: high and low case totex impacts

	2020/21	2021/22	2022/23	2023/24	2024/25	Total over AMP	Average over AMP
High case	£4.65	£4.23	£4.89	£4.32	£3.37	£21.45	£4.29
Low case	-£4.65	-£4.23	-£4.89	-£4.32	-£3.37	-£21.45	-£4.29

Table 79: Water network plus: high and low case totex impacts

	2020/21	2021/22	2022/23	2023/24	2024/25	Total over AMP	Average over AMP
High case	£34.68	£34.75	£34.95	£33.85	£31.87	£170.09	£34.02
Low case	-£34.68	-£34.75	-£34.95	-£33.85	-£31.87	-£170.09	-£34.02

Table20: Wastewater network plus: high and low case totex impacts

	2020/21	2021/22	2022/23	2023/24	2024/25	Total over AMP	Average over AMP
High case	£119.12	£119.58	£100.52	£80.61	£61.93	£481.75	£96.35
Low case	-£119.12	-£119.58	-£100.52	-£80.61	-£61.93	-£481.75	-£96.35

Table21: Bioresources: high and low case totex impacts

	2020/21	2021/22	2022/23	2023/24	2024/25	Total over AMP	Average over AMP
High case	£16.56	£17.12	£15.20	£12.93	£11.12	£72.93	£14.59
Low case	-£16.56	-£17.12	-£15.20	-£12.93	-£11.12	-£72.93	-£14.59

The above impacts are on shown on a 'gross basis' before applying the 50% customer sharing rate for totex (consistent with Ofwat's table guidelines). However, when reporting % RoRE impacts relating to totex, Ofwat does apply the sharing rate. Consequently, the implied RoRE % impact would be the 'average' figures * 50% / regulatory equity.

Residential and business retail

Our method

In relation to cost risk for our residential and retail businesses, we have identified the RoRE risk associated with costs being 'higher' or 'lower' than in our base case. Given their cost structure, for both retail businesses we considered the two most material risks to be:

- the impact of variation in UK economic performance on bad debt related costs; and
- the impact of variation in labour markets on staff related costs.

In relation to the above, we asked Economic Insight to develop an analysis of the underlying risk; and related P10 and P90 values. In addition, we identified a range of further risk factors, using our risk framework, which we quantified using bottom up methods. As per our approach to totex above – to ensure that our analysis properly reflected the non-independence of risk, we did not simply 'sum' P10s and P90s for each individual risk factor. Rather, having calculated a distribution of potential cost impacts for each factor, we again used a Monte Carlo method to properly identify the £m high and low scenarios consistent with 'overall' risk.

Risk from variation in UK economic performance impact bad-debt related costs

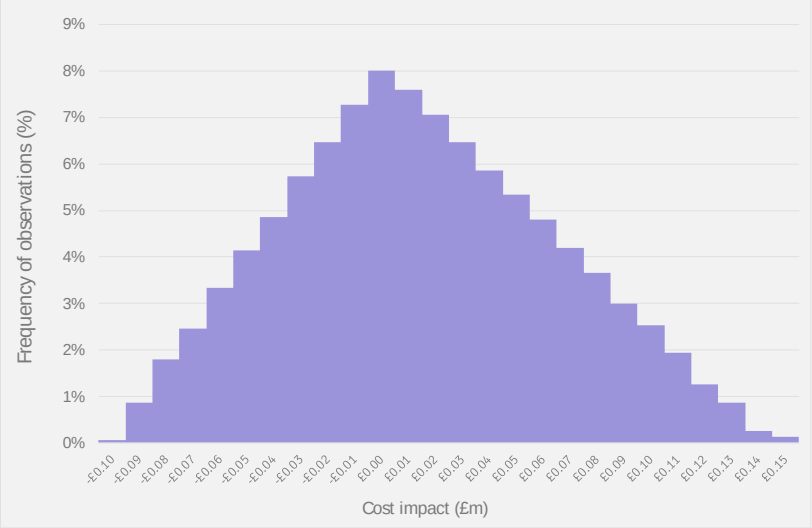
Within the context of retail cost assessment, it is well established that the propensity of customers to pay bills can vary depending on socio-economic characteristics across a company's customer base. So too, it logically follows than changes in socio-economic performance over time will similarly impact the likelihood of customers paying their bills.

To address this, Economic Insight developed an analysis that examined how 'uncertainty' regarding UK economic performance over PR19 could translate into impacts on our debt-related costs for the residential and business retail segments. Their method is set out in full within Appendix 13c: *'Estimating retail cost risk from economic and labour market performance'.* However, in summary, the key steps were as follows:

- A probability distribution for UK GDP and GVA was derived, based on the OBR's latest forecasts (which identify 'percentile' values).
- The variation in economic performance was translated into a £ totex using a regression analysis, which identified the impact of variance in economic performance on our debt related costs over time.
- The risk 'impact' of this was then calculated as the 'difference' between the predicated and baseline totex – thus giving a distribution of totex impacts arising from bad-debt risks.

Consistent with the above, the following figure shows the underlying probability distribution of impacts implied by the analysis.

Figure 2: Distribution of (debt related) residential retail cost impacts arising from variation in UK economic performance



Risk from variation in UK labour market performance on staff-related retail costs

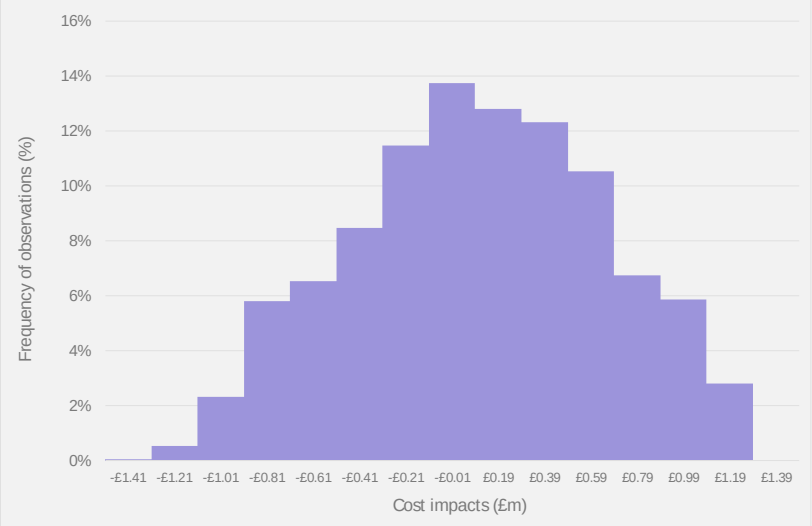
Labour costs are a material proportion of total costs within our retail businesses. There is no direct 'link' between underlying labour market performance (e.g. wage inflation) and our costs, because our costs are a function of the contracts we put in place and our particular business model (e.g. our arrangements with Loop). Nonetheless, over time, we consider that underlying labour inflation does drive our retail costs. As such, uncertainty regarding this is a key cost risk we need to assess and manage within our Plan.

Within the same scope of work as described above, Economic Insight similarly developed analyses for us to understand the 'extent' of underlying labour market cost risk we face in our retail businesses. Key steps in their method included:

- Economic Insight identified the potential 'spread' of underlying labour cost risk, drawing on our real price effects analysis.
- This was then used to define a triangular probability distribution for underlying labour inflation.
- In turn, this was translated: (i) first, into £ retail costs by multiplying the %s from the distribution by our assumed residential and business retail costs; and (ii) second, by deducted those cost levels from our base case numbers in our Plan.

The following figure shows the underlying probability distribution of impacts implied by the analysis (for residential retail).

Figure 3: Distribution of (labour related) retail cost impacts arising from variation in labour inflation – residential retail



'Bottom-up' assessment of addition retail cost risk factors

Whilst 'economic' (debt) and 'labour market' related risks are the two most material relating to retail costs, we further identified a range of 'additional' retail cost factors that needed to be taken into account. As set out previously, our starting point for these was our risk framework, which we used to identify the key 'risk types' relevant to impacting our retail costs.

For each risk identified, we then estimated the potential 'cost impact' using a bottom-up approach (where the precise method used differed by type of risk). For example, in relation to industrial and trade disputes, we calculated the financial impact of a strike as follows:

*Total cost impact of £120k = [No of people on strike = (Loop employees * 30% union membership) = 100 FTEs] * [10 days disruption * £12k per day]*

A suitable bottom up calculation was used for each risk – and the table below summarises the resultant impacts (for residential retail).

Table 22: Estimated cost impacts of residential retail risks

Risk type	high prob of occurring- monetised values	medium prob of occurring- monetised values	low prob of occurring- monetised values
Industrial and trade disputes			£132,000.00
Supply chain failure			£600,000.00
Environmental pollution		£13,750.00	
Extreme cold	£187,000.00		
Extreme rainfall	£132,000.00		
Political and Macro industry change		£0.00	
Infectious disease – human			£149,600.00
Asset failure			£1,038,000.00
Cyber attack			£1,082,000.00
Power failure			£176,000.00
Population growth		£93,500.00	
Skills shortage			£110,000.00
Vulnerable communities and customers			£137,500.00

For business retail a similar approach was used and additional risks quantified included: loss of people; loss of buildings; loss of IT; and loss of supplier meter readings. We then derived 'distributions' of potential cost impacts (for all of the above listed cost risks).

Monte Carlo analysis to derive overall retail cost risk

Using the methodologies above, we arrived at a set of 'potential' cost impacts for each underlying risk factor. To derive the overall risk retail cost impact in £m, we then applied a Monte Carlo analysis. Again, this is to reflect the fact that the chances of being at the 'extremes' on multiple risk factors simultaneously is low. For further details of the Monte Carlo analysis, see Appendix 13c: *'Estimating retail cost risk from economic and labour market performance', by Economic Insight.*

The Monte Carlo analysis 'randomly drew' cost impacts from each of the above individual risk factors. From this, an overall distribution of £m retail cost risks impacts was calculated (for residential and business retail separately).

Results

The following tables summarise the overall results of the retail cost risk analysis and the implied outputs for App26.

Table 23: Residential retail: retail costs high and low case scenarios - £m 2017/18 prices

	2020 / 21	2021 / 22	2022 / 23	2023 / 24	2024 / 25	Total over AMP	Average over AMP
Residential retail cost impact - high RoRE case	£0.81	£0.78	£0.72	£0.78	£0.65	£3.74	£0.75
Residential retail cost impact - low RoRE case	-£0.84	-£0.61	-£0.68	-£0.75	-£0.74	-£3.62	-£0.72

Table 24: Business retail: retail costs high and low case scenarios - £m 2017/18 prices

	2020 / 21	2021 / 22	2022 / 23	2023 / 24	2024 / 25	Total over AMP	Average over AMP
Business retail cost impact - high RoRE case	£0.17	£0.15	£0.17	£0.15	£0.17	£0.81	£0.16
Business retail cost impact - low RoRE case	-£0.18	-£0.16	-£0.17	-£0.17	-£0.17	-£0.85	-£0.17

ODIs

Our method for assessing ODI RoRE risk

We commissioned Economic Insight to provide a comprehensive assessment of the extent of ODI performance risk we face at PR19. Economic Insight's approach – and the results of their analysis - are set out in detail within Appendix 13b: *'ODI RoRE Risk Analysis: A Report for Yorkshire Water.'* We do not, therefore, repeat the method 'in full' here – save for highlighting the key aspects, which are as follows:

- To calculate the potential financial impact arising from ODI performance differing from our PC levels, Economic Insight developed the *'ODI RoRE Risk and Scenario Model'* (ORRSM). The ORRSM accurately replicates all of the details associated with the determination of ODI out or underperformance payments (i.e. whether ODIs are revenue or RCV; in-period or end-of-period; penalty only or reward and penalty; and the application of deadbands, caps and collars for specific ODIs).
- A key feature of the ORRSM is a Monte Carlo simulation, which can iterate through a large number of possible performance outcomes for each ODI individually – from which overall financial impacts are calculated at the appointee level. From this distribution of overall impacts, appointee level P10 and P90 financial impacts are then calculated. This addresses a key requirement of Ofwat's methodology: namely, that ODI risk analysis should reflect the fact that it is unlikely for a company to be at the 'extremes' of performance across multiple ODIs simultaneously (i.e. this is why one should not derive the risk impacts for App26 simply by 'adding' P10 and P90 values across individual ODIs).
- An important input into the Monte Carlo analysis is assumed probability distributions for each ODI. Here, the analysis drew on two sources: (i) Economic Insight undertook a historical analysis of outturn ODI performance at PR14 and used this to derive probability distributions; (ii) we held an internal workshop in which we drew on 'expert views' regarding out an underperformance scope to generate additional probability distributions. Our final analysis draws on a combination of both approaches.
- Importantly, we used the modelling iteratively to help (i) calibrate both our ODI package itself; and (ii) calibrate overall ODI risk in the context of broader Plan risk. Specifically, because the ORRSM outputs both RoRE impacts and bill impacts, we were able to run simulations on draft proposals and then reflect on their implications. Where we considered the balance of risk to be inappropriate (e.g. because bill impact potential was 'too high') we could then make revisions to our ODI design and re-run the simulation – and so on.

Our ODI risk analysis was subject to a high degree of quality assurance. Economic Insight's assurance included:

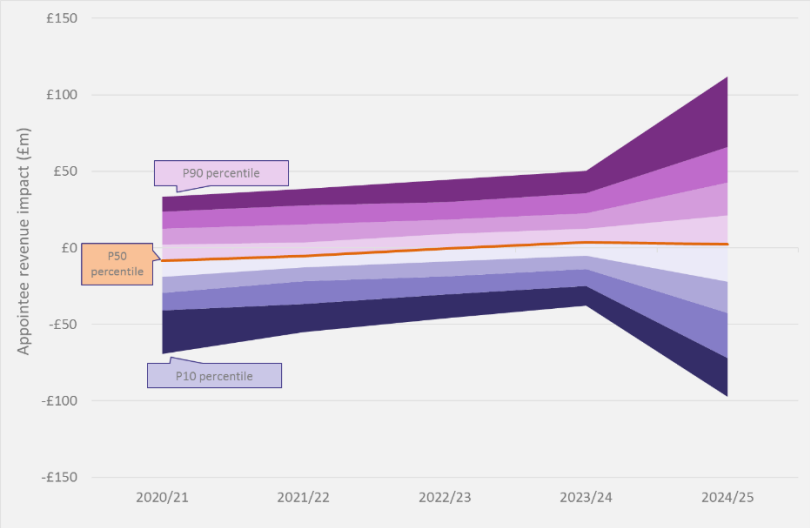
- Developing a model development plan prior to work beginning.
- Keeping a log of all model changes.
- Three full internal audits during model development.
- A detailed full internal audit of the finalised model.
- Challenge and review by Yorkshire (i.e. various versions of the model were shared with Yorkshire during development, allowing the company to review and request changes, where required).

In addition, our own audit and assurance processes were applied. This included presenting details of the modelling to our shareholder and Chairman.

Results of analysis

Following the methodology described above, Economic Insight's Monte Carlo modelling provides us with a spread of appointee level ODI financial impacts. These are illustrated in the fan chart below.

Figure 4: fan chart of appointee level financial impacts



Following from the above, the respective P10 and P90 values also drop out of the modelling. These are reported by price control area (but are consistent with appointee level risks). The following tables summarise the high and low case scenarios respectively.

Table 25: Summary of ODI High RoRE case scenario impacts

	2020 / 21	2021 / 22	2022 / 23	2023 / 24	2024 / 25	Total over AMP	Average over AMP
Total water network plus outcome delivery incentives (ODI) impact	£21.04	£25.16	£30.64	£35.96	£38.86	£151.65	£30.33
Total water resources outcome delivery incentives (ODI) impact	£0.07	£0.08	£0.09	£0.10	£7.83	£8.17	£1.63
Total wastewater network plus outcome delivery incentives (ODI) impact	£12.17	£13.20	£13.81	£14.31	£57.63	£111.12	£22.22
Total bioresources outcome delivery incentives (ODI) impact	£0.00	£0.00	£0.00	£0.00	£7.66	£7.66	£1.53
Total residential retail outcome delivery incentives (ODI) impact	£0.00	£0.00	£0.00	£0.00	£0.00	£0.00	£0.00
Total direct procurement for customers incentives (ODI) impact	£0.00	£0.00	£0.00	£0.00	£0.00	£0.00	£0.00
Total impact - all ODIs	£33.28	£38.45	£44.53	£50.37	£111.98	£278.59	£13.93

Table 26: Summary of ODI low RoRE case scenario impacts

	2020 / 21	2021 / 22	2022 / 23	2023 / 24	2024 / 25	Total over AMP	Average over AMP
Total water network plus outcome delivery incentives (ODI) impact	-£44.54	-£32.48	-£22.54	-£16.32	-£13.26	-£129.14	-£25.83
Total water resources outcome delivery incentives (ODI) impact	-£0.11	-£0.11	-£0.12	-£0.12	-£6.91	-£7.38	-£1.48
Total wastewater network plus outcome delivery incentives (ODI) impact	-£24.62	-£22.69	-£23.48	-£21.46	-£70.22	-£162.47	-£32.49
Total bioresources outcome delivery incentives (ODI) impact	-£0.01	-£0.01	-£0.01	-£0.01	-£7.07	-£7.10	-£1.42
Total residential retail outcome delivery incentives (ODI) impact	£0.00	£0.00	£0.00	£0.00	£0.00	£0.00	£0.00
Total direct procurement for customers incentives (ODI) impact	£0.00	£0.00	£0.00	£0.00	£0.00	£0.00	£0.00
Total impact - all ODIs	-£69.27	-£55.29	-£46.15	-£37.91	-£97.46	-£306.08	-£15.30

Economic Insight's modelling suggests that the RoRE % risk range associated with our ODI package is +1.9% to -2.1%. Overall, we note that:

- Our RoRE range for ODIs is within Ofwat's guidelines of more than +/- 1% and less than +/- 3%.
- Our RoRE range is slightly skewed to the downside. As explained in Economic Insight's report, this reflects: (i) economic theory, whereby the rationale for underperformance

payments is stronger than that for outperformance; and (ii) the fact that our ODI package is intentionally ambitious and stretching – such that, whilst we are confident that our target PCs can be delivered, to do so we will have to perform well for our customers.

The following figures show how the RoRE range impact is split across price control area, for the 'upside' and 'downside' scenarios respectively.

Figure 5: RoRE upside

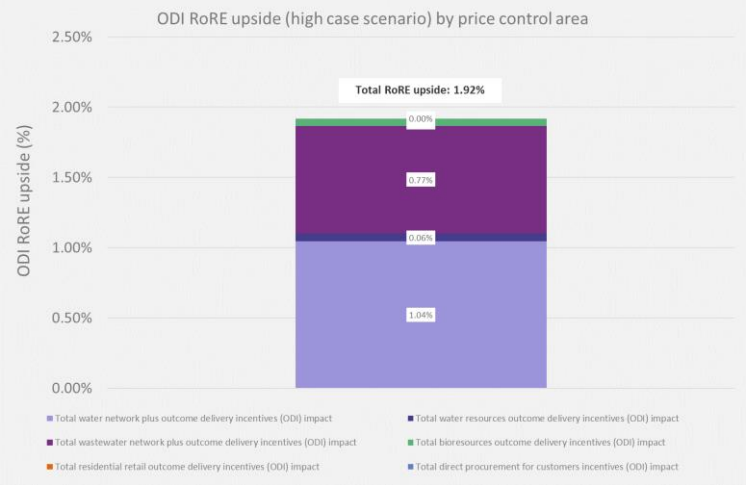
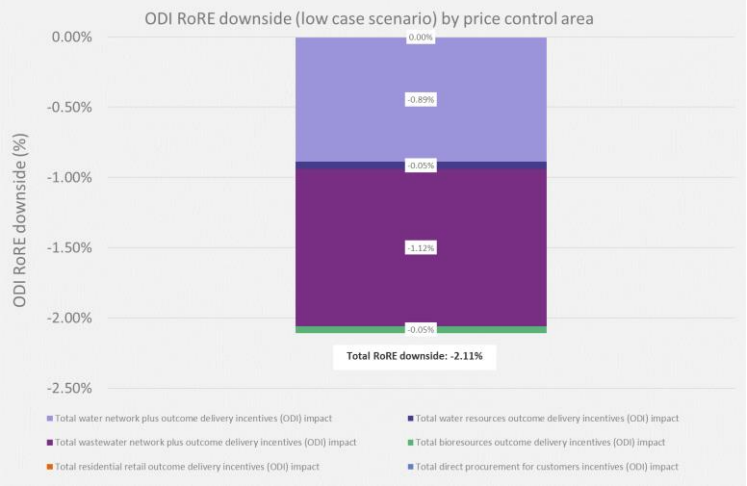


Figure 6: RoRE downside



WaterworCX

As any financial under and outperformance payments relating to C-MeX and D-MeX will be based on 'relative performance' (i.e. rankings) our starting point for evaluating the scenarios was to develop probability distributions for our relative rank. To do this, for both C-MeX and D-MeX, we reached a view on:

- our most likely ranking;
- our lowest possible rank; and
- our highest possible rank.

Our views on the above were, in part, informed by our historical performance in relation to SIM and developer services. However, because both C-MeX and D-MeX are new measures, we primarily relied upon internal expert judgement to ensure consistency with the ambitions of our Plan. The table below summarises our assumptions.

Table 27: Assumed ranks for WaterworCX risk analysis

	C-MeX	D-MeX
Most likely rank	3	4
Lowest possible rank	14	10
Highest possible rank	1	1

Using this, we then derived triangular probability distributions for our relative performance. To then translate this into potential financial impacts under high and low case scenarios, we applied the following steps:

C-Mex

- Ofwat's method states that the top 3 companies will earn an outperformance incentive of 1.2% of residential retail revenues - and so this is applied in all instances whereby we rank within the top 3 within industry.
- Ofwat's method further states that 'bottom performing' companies receive a penalty of 2.4% of residential retail revenues. As 'bottom performing' is not defined, this is applied in all instances whereby we rank in the bottom 3.
- Ofwat further states that companies that outperform an (as yet undefined) wider sector benchmark will receive an outperformance incentive of 2.4% of residential retail revenues - we therefore assume this applies only if we are ranked 1st in the industry.
- Having calculated a spread of potential financial impacts using the above approach, we then calculated the P10 and P90 values, drawing from our estimated probability distribution.

D-Mex

- Ofwat's method indicates that outperformance and penalties will apply based on company rankings - however no cut-off points are defined, nor is the measure that will be used. Consequently, we assume that the outperformance rate applies if we are ranked in the top 3; and that the penalty rate applies if we are ranked in the bottom 3.
- An outperformance incentive of 2.4% of developer services is used where appropriate; the penalty rate is 5% of developer services revenues.
- As per the approach for C-Mex, the above is combined with our probability distribution, from which P10 and P90 financial impacts are derived.

- Finally, as App2 further requires us to report the impact of D-MeX separately for water and wastewater, we apportioned the overall impact based on the forecast revenue split.

Results

The analysis above results in a high RoRE case, but a zero low RoRE case, as any potential penalty fell outside of the P10, P90 scenario.

We do not consider it appropriate to report a nil low RoRE case scenario; therefore we also looked at the maximum potential penalty that could be applicable if we were one of the worst performing companies. Based on our past performance, plus the impact of mitigating actions that we would put in place if we were one of the worst performers, we have considered that an appropriate low RoRE case scenario would be equivalent to 50% of the maximum potential penalty that would be applicable across the five-year period.

The following tables show the resultant impacts of the high and low case scenarios for WaterworCX.

Table28: WaterworCX – high RoRE case

	2020/21	2021/22	2022/23	2023/24	2024/25	Total over AMP	Average over AMP
C-MeX	£10.39	£10.83	£11.17	£11.61	£11.93	£55.93	£11.19
D-MeX (water)	£0.32	£0.32	£0.32	£0.32	£0.32	£1.62	£0.32
D-MeX (wastewater)	£0.32	£0.32	£0.32	£0.32	£0.32	£1.62	£0.32

Table 29: WaterworCX – low RoRE case

	2020/21	2021/22	2022/23	2023/24	2024/25	Total over AMP	Average over AMP
C-MeX	-£10.39	-£10.83	-£11.17	-£11.61	-£11.93	-£55.93	-£11.19
D-MeX (water)	-£0.32	-£0.32	-£0.32	-£0.32	-£0.32	-£1.62	-£0.32
D-MeX (wastewater)	-£0.32	-£0.32	-£0.32	-£0.32	-£0.32	-£1.62	-£0.32

Water trading

As we have not proposed any new water trades within our Business Plan, in line with Ofwat's guidance, we have reported a £nil value in relation to water trading.

Financing Performance

Key types of financial risks

In relation to financial performance risks, Ofwat states: *"we proposed that the performance against the cost of debt should consider the variation of the cost of new debt, taking account the range of expected performance against the proposed indexation mechanism."* [5]

In relation to 'new' debt, Ofwat is proposing to move to an indexation approach, where allowed debt costs will be set with reference to the evolution of the iBoxx. Ofwat has further stated that: *"we consider that a 50:50 mix of A and BBB rated indices reflects an appropriate range of credit profile for the notional company. We also believe that the iBoxx constitutes an appropriate reference point as a benchmark, representing a range of different companies and sectors. We also confirm that we will use our long-term view of CPIH (2.0%) to derive real-terms inputs to our calculations from the index."*[6]

Ofwat will not mechanistically apply an index that varies year-by-year. Rather, the regulator will set the cost of new debt using the above index and will then apply an 'end of period' reconciliation that adjusts for the difference between its 'assumed' cost of debt and the cost of debt actually implied by the index. Ofwat has further stated that:

- Adjustments for out / underperformance against the index will be made at the 'end of period', rather than in period.
- Ofwat's initial assumptions at the start of PR19 will reflect the iBoxx A/BB 10 yrs -non-financials index – and will build in both expectations of interest rate movements in 10 and 20-year gilt yields – as well as Ofwat's views on outperformance scope.
- Relating to the last point above, Ofwat has said: *"For new debt, we consider that the persistent evidence of the ability of the sector to outperform the benchmark iBoxx index justifies an ex-ante assumption that the sector's allowed cost of debt should outperform the iBoxx. For our early view, we have assumed an outperformance adjustment of 15 basis points."*
- Finally, Ofwat's approach includes an allowance for issuance and liquidity costs – where the regulator is allowing for a 10 basis-point uplift to cover both.

In its methodology, Ofwat set out its provisional view on the cost of new debt at PR19, as follows: (i) guideline nominal cost of new debt of 3.40%; and (ii) an allowance of 0.1% for issuance and liquidity.

Overall, Ofwat's revised approach at PR19 means that financing out and underperformance risk is likely to be significantly reduced, relative to previous price controls. Nonetheless, we will continue to face some risks in this area. Relevant risk factors we have considered include the following:

- Issuance requirements. Clearly, variation regarding the cost of new debt only arises to the extent that we expect there to be a need to issue new debt over PR19. Ofwat's estimated overall cost of debt at PR19 assumes a 70%/30% split between 'embedded' and 'new' debt. In practice, however, individual requirements could vary by company and may depend on factors which are themselves uncertain. For example, we have had to consider: (i) the

[5] *'Delivering Water 2020: Our methodology for the 2019 price review Appendix 12: Aligning risk and return.' Ofwat (December 2017); page 11.*

[6] *'Delivering Water 2020: Our methodology for the 2019 price review Appendix 12: Aligning risk and return.' Ofwat (December 2017); page 72.*

extent to which existing debt needs to be refinanced over PR19; and (ii) the extent to which new capital enhancement spend over PR19 might require additional debt finance.

- Financing cost risk. Whilst our allowed debt costs will reflect movements associated with Ofwat's index (variation adjusted for end-of-period) we will continue to face financing cost risk (i.e. the extent to which the cost of any new finance raised is above or below the index). There are two elements to this: (i) inflation related risk – where we note that in making reconciliation payments, Ofwat is intending to apply a rate based on long-term CPIH (2.0%). Consequently, if we raise debt over PR19, we are exposed to variations between assumed and actual inflation; and (ii) financing cost performance risk – i.e. putting inflation to one side, whether we are able to raise debt above / below the assumed level.
- Actual issuance cost risk. Whilst Ofwat's approach includes an allowance of 10 basis points for issuance, we bear actual cost risk in this regard. Consequently, we need to consider likely variations in issuance costs.

Our approach to assessing risk impacts

We undertook the following analysis to quantify financing cost risk:

- Firstly, we quantified the difference between our expected weighted average cost of debt relative to the trailing average used in the PR19 indexation mechanism.
- Secondly, we examined the difference between the historic range of the chosen indices, versus the average rate used in indexation method (where we found the max / min variance compared to the average to be c0.2%).
- Thirdly, we examined CPIH related variance (to reflect the above referenced inflation risk).

Results

The following tables summarise the results of our analysis.

Table 30: Financing (new debt) High RoRE case

	2020 / 21	2021 / 22	2022 / 23	2023 / 24	2024 / 25	Total over AMP	Average over AMP
Water network plus	£0.41	£1.12	£1.90	£2.74	£3.63	£9.80	£1.96
Water resources	£0.10	£0.27	£0.45	£0.64	£0.84	£2.31	£0.46
Wastewater network plus	£0.66	£1.88	£3.28	£4.76	£6.29	£16.88	£3.38
Bioresources	£0.06	£0.17	£0.29	£0.41	£0.53	£1.47	£0.29

Table 31: Financing (new debt) Low RoRE case

	2020 / 21	2021 / 22	2022 / 23	2023 / 24	2024 / 25	Total over AMP	Average over AMP
Water network plus	-£0.43	-£1.51	-£2.69	-£3.97	-£5.30	-£13.89	-£2.78
Water resources	-£0.11	-£0.36	-£0.63	-£0.91	-£1.16	-£3.17	-£0.63
Wastewater network plus	-£0.68	-£2.57	-£4.75	-£7.06	-£9.25	-£24.31	-£4.86
Bioresources	-£0.06	-£0.23	-£0.41	-£0.59	-£0.73	-£2.03	-£0.41

Risk mitigations and efficient management responses

We understand the importance of having appropriate risk mitigation plans in place – and ensuring that our responses to risk are as efficient as possible. This is so as to ensure that any adverse impacts on customers are minimised. As such, and in line with Ofwat's methodology and guidance for completing table App26, **we have ensured that all of the RoRE risk analysis here explicitly takes into account the most efficient management responses we can implement.**

In practice, to ensure that mitigating actions were reflected in our various risk analyses, we undertook the following steps:

- Firstly, for every scenario modelled, we identified the full set of mitigating actions we could take. This was based on expert judgement and the internal personnel with responsibility for developing the scenario were tasked with this exercise.
- Secondly, we then considered what the 'impact' of the mitigating action would be. Here, we considered this in two distinct ways:
    - In some cases, the 'impact' was to reduce the potential size of financial impact, should the risk crystallise. In these cases, we ensured that the risk mitigation was incorporated within our assessment of potential cost impacts.
    - In other cases, the 'likelihood' of the impact was reduced. In these cases, we ensured that this was reflected in our selection of P10 and P90 values. In practice, this primarily occurred when identifying relevant probability distributions - where we would select a 'lower risk' option post-mitigation.

To illustrate the above, the following table outlines the mitigating steps we would take in relation to risks relating to business retail. A similar set of steps was identified for each scenario.

Table 32: illustration of mitigating actions – business retail

Risk category for business retail	Mitigating actions factored into our analysis
Loss of people	• Small reduction in headcount could be covered by absorbing the workload across the remainder of workforce for a short period of time. • Longer periods of absence, may require the recruitment of temporary resources to sit alongside the permanent workforce. • In extreme circumstances e.g. due to a pandemic, a significant temporary workforce may have to be recruited in an unaffected area.
Loss of buildings	• Employees can work from home and/or from the business continuity service centre provision offered by contracted third party.
Loss of IT	• Full IT disaster recovery plans to provide recovery of backed up data within an acceptable time period. • Plans include replacement of destroyed hardware.
Loss of key supplier meter reading	• For a short time period, bills could stop being sent out or bills could be sent on the basis of estimates. • For longer periods, there are alternative suppliers who could be contracted with.
Increase in bad debt (e.g. through adverse economic performance)	• Monitoring of customer debt positions, and short lead time debt management processes including interactions with disconnection teams.

Summary of overall RoRE risk range

Finally, the table below summarises the RoRE risk ranges implied by our analysis used to populate table App26. To help inform the reasonableness of our results, these are compared against: (i) Ofwat's published guidelines for PR19; and (ii) the initial indicative evidence we received from Economic Insight as part of their assurance support. Note, totex related impacts are reported after the application of the 50% sharing rate for consistency with Ofwat's guidelines.

Overall, our finalised risk impact values for the high and low case scenarios imply RoRE ranges that are in line with both Ofwat's published guidelines and the initial assurance evidence we received. This provides further validation that our approach and results are reasonable.

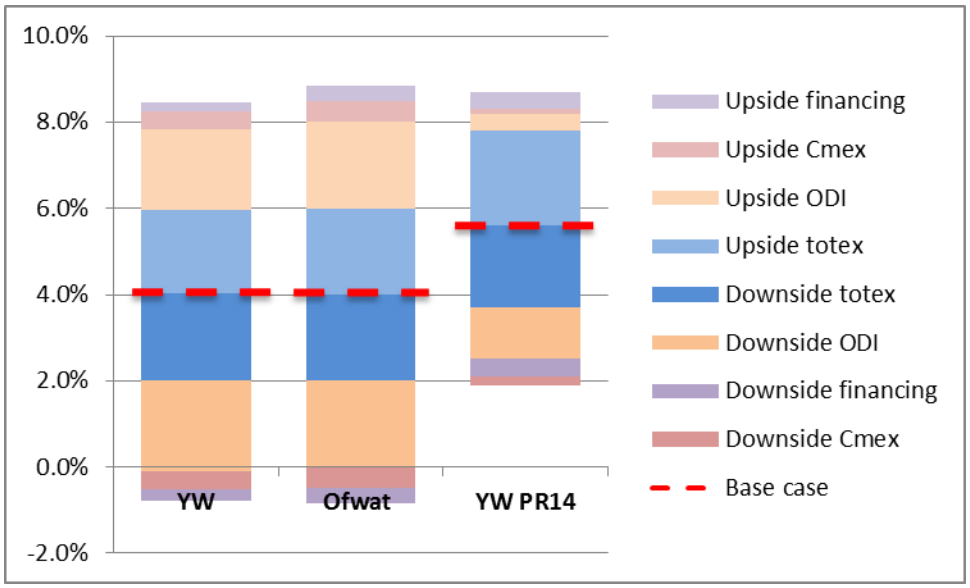
Table 33: Summary of overall RoRE risk ranges implied by our analysis

	Our assessment (reflects our App26 values)		Ofwat's PR19 guidelines		Economic Insight (initial assurance evidence)	
	High case	Low case	High case	Low case	High case	Low case
Revenues (wholesale)	+0.7%	-0.7%			+0.5%	-0.5%
Revenues (retail)	+0.0%	-0.0%			+0.1%	-0.1%
Totex	+1.9%	-2.0%	+2.0%	-2.0%	+2.2%	-2.2%
Retail cost	+0.00%	-0.00%			+0.2%	-0.2%
ODIs	+1.9%	-2.1%	+2.0%	-2.0%	+0.9%	-1.7%
WaterworCX	+0.4%	-0.4%	+0.5%	-0.5%	+0.4%	-0.00%
Financing (new debt)	+0.2%	-0.3%	< +0.5%	>-0.5%	-0.00%	-0.0%
Total risk exposure	+5.2%	-5.6%	+5.0%	-5.0%	+4.3%	-4.8%
Total risk exposure (comparable metrics only – i.e. excluding revenue scenarios to enable comparison with Ofwat range)	+4.4%	-4.8%	+5.0%	-5.0%	+3.7%	-4.2%

Notes: (i) Ofwat's totex guideline range is reported <u>after</u> the application of the sharing rate; (ii) for ODIs, Ofwat's guidelines indicate the range should be > +/- 1% and < +/- 3%. Ofwat's stack chart indicates a central expectation of +/- 2% for ODIs; (iii) for WaterworCX, both E&Y and Economic Insight demonstrate that impacts must be smaller than Ofwat's guideline range – see page 42 of Economic Insight's report: 'RoRE risk analysis: framework, preliminary evidence and advice for Yorkshire Water'; (iv) for financing costs, Ofwat is not explicit, but the regulator's stack chart indicates a minimal impact of < +/- 0.5%; (v) Economic Insight's early indicative RoRE range for ODIs was not Yorkshire specific and is superseded by their Monte Carlo modelling analysis.

The table below summarises the above results as a RoRE chart, as presented in our Business Plan.

Figure 7: RoRE chart



The results above have been calculated by ourselves and Economic Insight. We note that there are a couple of small differences between the figures quoted above and those calculated within Ofwat's financial model, which do not impact upon our overall assessment.

- **Base return difference**
  We have used a base return of 4.0% in comparison to the 4.7% calculated within Ofwat's model.
  We have used 4.0% (which is the appointee RPI stripped base return) to enable comparison with the charts within Ofwat's PR19 methodology which also used 4.0% and also provide comparability with the PR14 figures.
  4.7% is the equivalent "blended" rate stripping the same nominal return on a combined CPIH and RPI basis.

- **Scenario range differences**
  These are primarily caused by Ofwat's financial model including total retail earnings after tax (EAT) within the base RoRE figure, but only including residential retail EAT within the scenario RoRE figures, leading to an additional RoRE variance due to the difference in retail EAT.
  We note that as a result of query 653 the base return was adjusted to include total retail EAT, but as the scenarios were not also adjusted this has led to an apparent inconsistency between the base and scenarios.

The table below, summarises our results in comparison to those calculated within Ofwat's financial model, plus an amended version of Ofwat's model with consistent retail EAT figures.

The adjustments made within the amended version of Ofwat's model were as follows:

- Rows 1462, 1479, 1498, 1514, 1532, 1548, 1569, 1585, 1603, 1618 amended to ensure consistency in the Retail EAT included.
- Rows 352 and 364 amended as linked to incorrect row on InpActive tab.
- Row 1512 amended as linked to incorrect row.

Table 34: Summary of overall RoRE risk ranges in comparison to Ofwat financial model

	Our assessment		Ofwat's financial model		Ofwat's financial model (amended)	
	High case	Low case	High case	Low case	High case	Low case
Revenues (wholesale)	+0.7%	-0.7%	+0.6%	-0.7%	+0.7%	-0.7%
Revenues (retail)	+0.0%	-0.0%	+0.0%	-0.0%	+0.0%	-0.0%
Totex	+1.9%	-2.0%	+1.7%	-1.9%	+1.9%	-2.0%
Retail cost	+0.0%	-0.0%	+0.0%	+0.0%	+0.0%	-0.0%
ODIs	+1.9%	-2.1%	+1.9%	-2.2%	+1.9%	-2.1%
WaterworCX	+0.4%	-0.4%	+0.4%	-0.5%	+0.4%	-0.4%
Financing (new debt)	+0.2%	-0.3%	+0.1%	-0.4%	+0.2%	-0.3%
Total risk exposure	**+5.2%**	**-5.6%**	**+4.7%**	**-5.8%**	**+5.2%**	**-5.6%**

Note: Table columns may not cast due to rounding

Figure 8: Revised RoRE chart