Dŵr Cymru
Welsh Water

**CONFIDENTIAL**

# Ref 5.1

# PR19 Investment Planning Process

September 2018

## Contents

## 1. Introduction

We want customers to receive a safe, reliable and resilient service which meets all their needs and expectations at a price which is affordable. Our approach to long-term asset planning will ensure the continuation of enhanced service standards for both current and future generations at least whole life cost. Welsh Water's vision is to earn the trust of our customers every day by delivering high quality, essential services that protect our customers' health, our communities and the environment around us.

We achieve this by:

- Complying with current and relevant statutory and regulatory requirements and other requirements deemed necessary by the business
- Consulting our customers and stakeholders on their service requirements now and for the future
- Establishing a common Asset Management system (in accordance with ISO 55000) which is customer service led, forward looking and uses best whole asset life cost supported by a consistent approach to risk identification and management, target setting, asset standards definition, intervention development and delivery
- Embedding a good practice Asset Management system, using our ISO 55000 Strategic Asset Management Plan, by which the business will produce and implement asset management objectives, strategies and plans supporting the optimum achievement of our plan as set out in Welsh Water 2050
- Ensuring that there are adequate resources and appropriately trained teams to develop, implement and continually improve the asset management system
- Aligning our asset management system with other Welsh Water policies including those for Health and Safety, Sustainability, Environmental and Quality Management and Human Resources.

This document describes the approach we have taken to investment planning in order to develop our PR19 investment cases for the targeted PR19 Price Controls. We have developed a holistic methodology that has brought together all existing relevant research and water industry good practice collectively with best practice from other sectors. The approach has not existed in isolation and has been aligned with our accredited approach to Asset Management with reference to external standards such as ISO 55000, which is set out in our Strategic Asset Management Plan, August 2018.

Our approach (Figure 1) has been predicated on the integration of capital and operating expenditure to deliver a total expenditure (TOTEX) approach to investment planning over the whole life of the investment that included company, customer and societal values. Furthermore, we have incorporated non-asset solutions to delivery and included uncertainty and sensitivity analysis to ensure we have fully understood our investment decisions. We have also ensured an alignment of strategic (Welsh Water 2050), tactical and operational planning across the short, medium and long-term.

All this has been undertaken within a robust and specific PR19 governance structure.

| Identify Asset Risks | Assess Risks | Identify Solutions & Costs | Cost Benefit Analyses | Review Business Targets | Apply Constraints | Optimise | Governance |
|---|---|---|---|---|---|---|---|
| **Roles and Responsibilities** | | | | | | | |
| **Identify Asset Risks** | **Assess Risks** | **Identify Solutions & Costs** | **Cost Benefit Analyses** | **Review Business Targets** | **Apply Constraints** | **Optimise** | **Governance** |
| Operations, Science and Regulation Team, Asset Management Teams & Investment Planners | Asset Management & Investment Planners | Asset Management, Investment Planners & Capital Delivery Alliance | Investment Planners | Regulation, Asset Management, Heads of Wholesale Businesses & Investment Planners | Investment Planners and Finance | Investment Planners, Heads of Wholesale Businesses & Asset Management | Investment Planners & Regulation |
| Identification of risks locally on site. Identifying risks and themes from legislation and regulators. Identifying risk themes at a regional level through asset and equipment types. Identification of strategic risks from deterioration and service impact models, resilience, growth and future trends (e.g. climate change). | Asset Management assess the risks for validity, consistency and quality, in particular root-cause understanding and alignment with the Service Measure Framework. | Asset Management, Investment Planners & Capital Delivery Alliance identify potential solutions (multiple options at this stage) which are documented and costed and approved by the Central Costing Team using the Unit Cost Database (UCD). At the higher level, programmes are defined and costed using historical evidence (e.g. unit rates), approved costs and/or modelling. | Investment Planners ensure that all the Whole-life costs and benefits are assigned to the options, including internal and external benefit costs such as private and Willingness to Pay (WtP) values from our Customer Research programmes. | All play a part in understanding how investment links to service, Measures of Success, Outcomes, Future trends, Strategic Responses and residual risk. In particular, how our targets and aspirations align with those of our customers and key stakeholders, our resilience and the needs of the environment. | Investment Planners identify the mandatory and discretionary elements of the plan alongside the costs and performance metrics. Finance and Regulation Teams identifies the overall affordability constraints that reflect the ability to future-finance the business, WtP and our customers' expectations of future bills. | Constraints are added to the individual investment cases and the programmes at service level. Stratified optimisation processes undertaken to determine the right schemes and programmes against our constraints and planning criteria. Results are validated by senior leadership. | Investment Planners & Regulation Team monitor the flow of business plan information internally and externally throughout the planning process. Ultimate material decision making and sign-off is at Board and Executive level (see PR19 Governance Structure). |

## 1.1. Overview of systems

Our investment planning systems have enabled the underpinning asset management processes to identify and assess risk, identify solutions and costs and develop long-term performance targets in order to provide a balanced portfolio for investment at PR19. This is done through the integration of information, people and analytical systems that supports risk-based investment decisions in a transparent framework, our accredited approach under ISO 55000.

Our approach integrates the latest tools, systems and knowledge for assessing business risk and whole life cost benefits to produce robust investment plans. We assess all aspects of investment planning, including (but not limited to), analysis of historical asset performance, projected future performance of assets (e.g. modelling), costs, benefits and understanding the preferences of our customers and key stakeholders. Our risk-based approach to investment planning and the generation of optimal investment programmes through scenario planning is underpinned by the Governance structures we have in place and in particular, the dedicated PR19 governance that surrounds our plan.

Key PR19 features include:

- Consistent risk-based approach to asset management across asset base;
- Forward looking assessments using asset deterioration and service impact modelling;
- Bottom-up approach of identifying asset needs to deliver accurate investment plans;
- Comprehensive Customer Research coverage over prolonged periods;
- Welsh Water 2050 that provides a clear, long-term framework for our future business planning;
- Integration with our AMP6 Capital Investment Process and Capital Delivery Alliance partners;
- Optimal business plans based on whole life cost / whole life benefit analyses and scenario constraints; and
- Applies the principles of the UKWIR Framework for Expenditure Decision Making (2014).

*Systems, Applications and Products* (SAP) is an system for collecting and combining data from modules managing different business functions such as work planning, cost of operation and expenditure, customer feedback and asset performance. SAP facilitates the flow of key information between different modules of the business.

*Geographic Information System* (GIS) is an integrated collection of data used to view and manage information about geographic places, analyse spatial relationships, and model spatial processes. GIS enables users to overlay different maps so that the interrelationships of various spatial features can be displayed and analysed. Information held includes details of assets and performance.

*Asset Investment Manager* (AIM) is a deterioration and service impact modelling tool that is used to determine the unknown and upcoming service risks for our asset types. Future asset performance is linked to service impacts, and interventions are developed and optimised. AIM is also designed to visually represent and analyse all the information needed to make investment decisions across our asset base.

*Unit Cost Database* (UCD) is a repository of the historic total expenditure costs associated with particular elements of our projects. Costs are analysed using data from previous projects for defined measurements (i.e. 'yardsticks' or 'cost drivers'), and are adjusted using statistical formulae to reflect current day prices. An example of a yardstick could be pipe length, and the unit cost 'cost per m', these are the direct costs. Other costs can be analysed, including site supervision, consultant fees and insurance, known as on-costs. By analysing historic project costs, the UCD can be used to produce cost estimates for future projects. A range of capital and operating costs can be estimated, including total project cost, part costs and unit costs, allowing for full resource breakdown. This provides robust investment strategy pricing.

*Investment Manager* (IM) is a decision support tool to cater for investment planning purposes. The system is a single, centralised repository for all risks and interventions across our asset base and has been used to support the PR19 process. Aligned with the Service Measure Framework (SMF), risk is assessed in terms of service impact against a set of output performance measures and investments are based on the optimisation of intervention options, determined using cost-benefit analysis and investment value.

Key elements of IM include:

- Single common system to capture and record asset related risk
- Common assessment of risk and interventions options against the SMF
- Visible workflow from risk identification through to investment decision making
- Cost-benefit analysis derived from business cost, customer benefit and society/environmental damage
- Application of optimisation objectives and scenario planning to derive suitable business plans.

All systems used for the production of the business plan are recognised water and utility industry investment planning tools.

## 2. Identify Risks

We have used several different approaches to the identification of risks, varying by asset type and severity of risk. Where suitable, we use modelling approaches to complement and validate information provided by operational staff. All asset risk information collected is stored in Investment Manager and this is used for both day to day and long-term investment planning. Figure 2 shows (but not limited to) the variety of techniques we use to collect risk information.


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*Figure 1 Sources of risk identification*

### 2.1. Bottom up approach

*Workshops*

We have undertaken a variety of risk and risk related workshops to support the development of the PR19 plan. Our approach included root cause workshops, for example Risk and Value workshops. The processes applied within these workshops ensure that all significant risks were identified, explored and captured. Workshops are formally facilitated and focus on capturing and integrating the knowledge of the local operations teams, tactical teams and regional strategy teams. These workshops covered specific waste water and clean water assets, with particular emphasis on poor performance.

*Drinking Water Safety Plans*

Drinking Water Safety Plans are a regulatory key tool for managing risk within the water business. The risks and the actions required to address them are reviewed in monthly meetings within the operational teams. For water treatment works these now include the full range of risks affecting the site, not only water quality. This provides a comprehensive dataset to understand upcoming investment requirements.

*Day to day risk capture*

The Asset Management teams operate a business-as-usual capture of risks, where their representatives work closely with Operations to identify any new risks and update existing risk information. Significant risks are reviewed at monthly and quarterly meetings. Decisions are made at these meetings on whether funding should be allocated from within AMP budgets or whether the risk should be flagged to the investment planners to be considered for future planning.

*Risks identified by regulators*

Risks relating to upcoming legislation and the impact of our assets have been analysed in conjunction with our regulators; Natural Resources Wales, Environment Agency and Drinking Water Inspectorate.

*Sustainable Drainage Plans*

Sustainable Drainage Plans are a key tool for identifying risk and optioneering solutions within our wastewater business. The process identifies new risks (or investigates significant existing risk) and develops solutions in order to meet service targets over the short, medium and long-term. The process takes into consideration future trends such as growth and climate change to ensure our future solutions are resilient in the face of change. This provides a comprehensive dataset to understand risk and investment requirements.

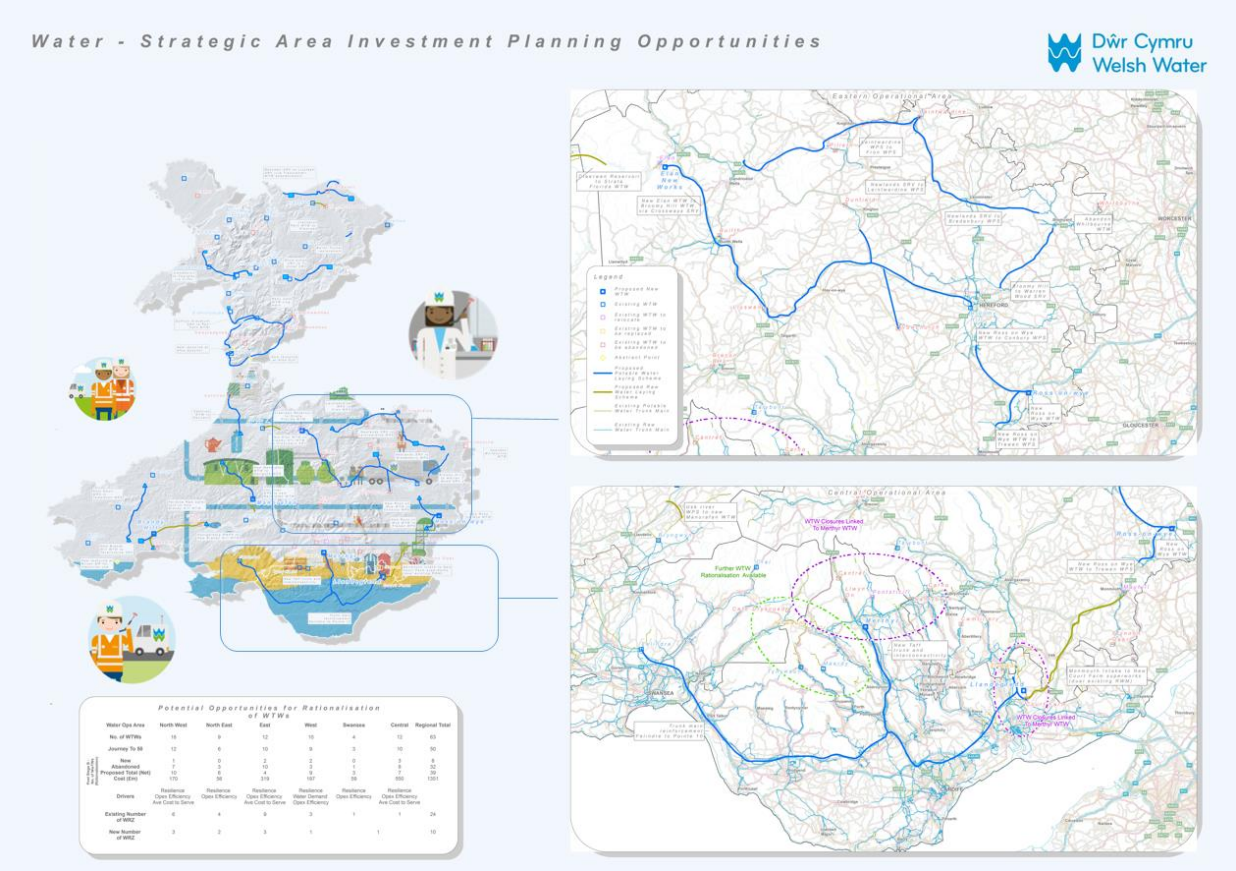
*Zonal studies*

A Zonal Study is a holistic, Source-to-Tap investigation into the factors influencing performance at a Water Quality Zone level. Through the utilisation of mains hydraulic modelling, statistical analysis and by capturing the experience and knowledge of local operations, the Zonal Study is able to identify the root cause of poor performance using an integrated approach within the Water Quality Zone. All the outputs from the Zonal Studies are evidential, auditable and quantitative. It therefore allows for targeted investment within the zone to the most appropriate long and short term solutions for the benefit of our customers and the business. Zonal Studies are a collaborative and integrated “business as usual” tool that acts as a streamlining tool through the capital gateway process and gives a joined up strategic approach to investment.

*Strategic Area Investment Plans*

Strategic Area Investment Plans are a strategic view of assets within a defined sub-regional area (Figure 3). The workshop style sessions involve operational, tactical and strategic colleagues to look towards the medium and long-term to assess the risks and opportunities against known

future trends (e.g. climate change, growth and likely statutory drivers). Outputs from these plans have informed our approach to PR19 and the scope of the programmes within.




- Figure 2 Output from a regional Strategic Area Investment Planning session (water)

*System Resilience Workshops*

During 2017 we ran a series of system resilience workshops all across Wales and parts of England's geographical area, covering water and wastewater assets representing 80% of the population served by Welsh Water. The purpose was to identify specific system resilience issues where asset systems where vulnerable to significant disruption due to the location, configuration or condition of assets with limited options for mitigation. These workshops identified over 200 risks covering 4 Water catchments (Central; Eastern; Swansea & West & North) and 4 Wastewater catchments (Cardiff, Hereford, North-East & North-West and Swansea & West)

The risks were then filtered down to 60 in Water and 86 in Wastewater. Each risk was scored against our existing risk framework and appropriate actions aligned to the resilience '4Rs' – Resistance, Reliability, Redundancy and Recovery. Outputs from the exercise feed into our medium and long term investment plans for Welsh Water.

*Growth*

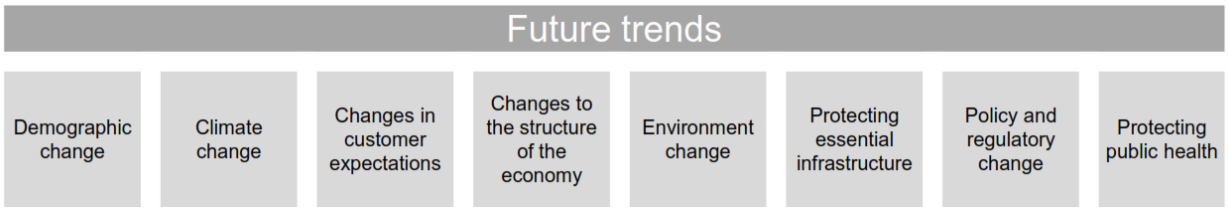
We liaise closely over preparation of Local Development Plans (Wales) and Frameworks (England), and are normally consulted on all individual planning applications. This cooperation increases understanding and improves the planning effectiveness of both parties. We identify risks relating to new development (reacting to requests for requisitions and development sites etc.) and strategic risk around growth in order to identify strategic capacity improvements.

*Water Resources Management Plan*

Our Water Resources Management Plan is our 25-year strategy for managing water resources across our supply area and maintaining the balance between supply and demand. It identifies deficit zones where demand is exceeding (or forecast to exceed) supply and identifies appropriate measures to either increase supply or to manage demand in each water resources zone. We have looked at a range of options to meet the deficit including developing new water resources and the promotion of water efficiency measures.

*Future trends (WW2050)*

Predicting the future is very difficult but there are a number of foreseeable future trends (Figure 4). These will impact on the way we will operate now and in the future. We have considered these in our PR19 plan and strategic aims, so that we can continue to meet the service requirements of our customers long into the future.




- Figure 3 Welsh Water 2050 Future Trends

*Resilience assessment*

The Resilience Wheel (Figure 5) provided an independently facilitated strategic resilience assessment of Welsh Water's current resilience performance, and forms the basis for the Strategic Responses identified in Welsh Water 2050. Being resilient to future challenges, both shocks and stresses, is a key part of Welsh Water 2050. However, we also aim to maximise the benefits that can arise from future opportunities within our approach. Resilience in this context encompasses all aspects of our business, including assets, systems, people, finances, governance and consider economic, social, cultural and environmental perspectives (further information can be found in the supporting document 4.1 PR19 Resilience in the Round: Overview). Specific to assets we have our resilience methodology and scorecard which we use to assess the state (in terms of defined resilience metrics) of our critical assets. From our asset resilience assessment we are able to identify resilience risks and action mitigation and longer-term interventions.

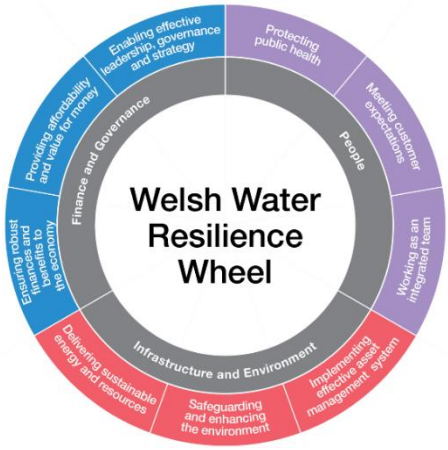



Figure 4 Welsh Water 2050 Resilience Wheel

**Quality assurance**

With information coming from so many different sources there is the risk that requirements could be interpreted differently. In order to mitigate this we have carried out audits of data quality, frequent local reviews and have set up our PR19 TOTEX Groups to regularly review the latest position, clarify 'present-day' objectives and formalise decisions within their Terms of Reference.

## 2.2. Top down approach

We have predominantly utilised predictive modelling to derive source data for investment planning where the scale of full survey of these assets is infeasible (e.g. infrastructure assets) or where we have lower confidence in the wider sources of bottom-up data available. We also use predictive modelling to inform our bottom-up approach in some investment areas and to validate our findings. Our core methodology to predictive modelling is set out in (Figure 6).

The approach involves the statistical analyses failure and asset data from our corporate systems. For deterioration modelling, we use analyses of historical failures to understand key drivers for investment. This allows us to predict the likely frequency of failures in the future. Service impact modelling allows us to predict the impact of future failures at individual locations through analysing characteristics of the immediate assets and location. Where failure and consequence data are brought together, we can understand the risk across differing locations. Standard solutions are costed (utilising UCD models and costs of consequence) and put together with risk information to provide a modelled view of the optimal locations to invest in against various strategic scenarios (Figure 7). Models undergo a process of validation prior to use within the business and outputs are 'ring-fenced' in order to avoid duplication with manually entered risks.

## 2.3. Outputs

The output of this step of the process was a set of localised a regional risk profiles and costed programmes that provided the top-down view of expenditure and informed/validated bottom-up approaches.

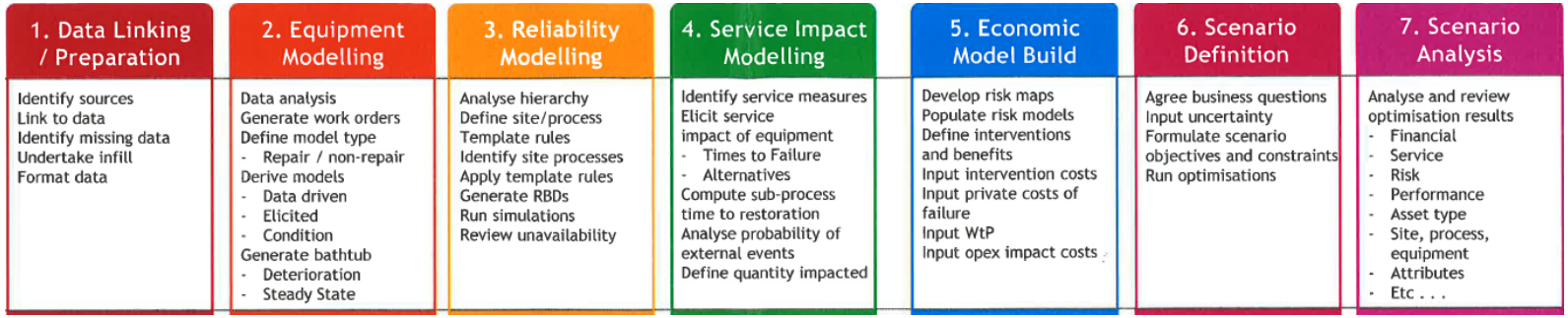



Figure 5 Data Process Flow and methodology for deterioration and service impact modelling (AIM)

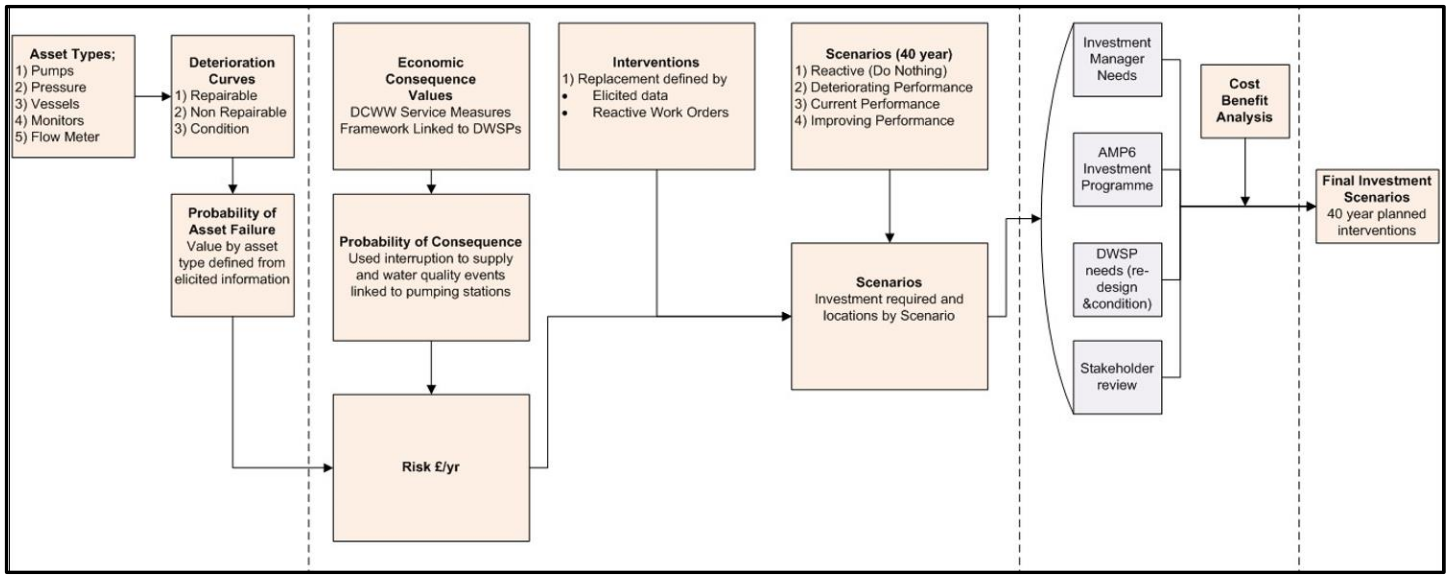



Figure 6 Example Water Pumping Station planning model methodology

## 3. Assess Risks

The process of assessing asset risks involves developing a score from the risk information. All risks are scored consistently through our Service Measure Framework (SMF) and converted into a financial value to support comparability across measures, assets and investment categories. The same framework is used for assessing small value day to day risks and large value strategic risks so that we have 'risk and value' consistency across all elements of the investment process. The evaluation process is predominantly undertaken at the relevant risk identification stage and reviewed as more timely or detailed information becomes available.

### 3.1. The Service Measure Framework

Our SMF is a robust means of ensuring that the measures used to quantify and assess risks are linked to customer/environmental impact. The SMF is embedded within Investment Manager and Risk and Value processes.

*Design*

The SMF provides a driver against which a risk is scored, linked to customer/environmental impact (consequence). When an impact on the customer is not felt, due to reactive mitigation, the Service Measure Framework also captures the financial impact to the company of a reactive approach.

The risk assessment is based on the consequence of an asset failure – not the asset failure itself. This is to ensure that all decisions made on risks are customer/environmentally focused. The Service Measure Framework defines the type of severity per driver, the unit used for that specific driver (e.g. population equivalent or number of properties impacted) and the frequency.

*Root cause*

Our formalised Root Cause process and guidance provides us with confidence that where we encounter risk, we are able to systematically determine the most likely root cause (at the initialisation of the risk), and subsequently with further investigation provide confirmation. This provides us with greater assurance that the development of a solution will address the cause and not the symptoms. Where the risk or multiple risks are complex, we will arrange a root cause analysis workshop. This is a formal event with a trained facilitator where key stakeholders work through the problem statement to determine the root cause/s.

*Resilience*

Our critical asset resilience methodology is now an embedded process within our business and drives an annual review and formal reporting of the resilience (against our set criteria) of each and every critical asset. In these annual assessments, each critical site score is verified against our criteria. Assets not achieving the target performance will have a mitigation plan developed and any significant risks associated with the asset's resilience is captured upon IM. These risks are assessed consistently against other risks in our IM system and depending upon risk, will generate prioritised programmes of work or site specific interventions.

We also undertake wider resilience risk assessments such as our project resilience which reviewed the communication capability and reliability of over 1,800 of our Sewage Pumping

Stations and developed a subsequent prioritised programme of interventions to ensure we are aware of potential critical service issues emanating from our SPS asset base and intervene before customer or environmental impact.

### 3.2. Valuation of risks

In order to compare risks across the wide range of measures we apply financial valuations to the service measure framework. We use two sets of valuations:

1. Cost of consequence. This was built from analysis of historical incidents and standard operational unit cost values and calculates the average cost for a failure of each type. These costs have undergone significant scrutiny in-house by LAM and operational staff.
2. Social valuations. These were built from our Customer Research WtP results. There are a handful of measures where WtP was not appropriate. For these we have used other sources of benefit valuations or left them without a social value. These figures have been peer reviewed by industry experts to ensure that our application is suitable.

Both of the valuations are embedded within our Investment Manager tool to enable further development and prioritisation of risks.

*Training*

We have rolling training programmes for risk assessment, Investment Manager and the Service Measure Framework to ensure that staff remain competent and new staff are developed to meet our required standards. Our frequent and comprehensive training programmes ensure that our processes are understood and applied in a consistent manner by risk identification practitioners.

*Quality assurance*

The Asset Risk Managers challenge the entries through data rich assessments (telemetry readings, number of complaints etc.) and the risks are reviewed at regional quarterly meetings with local Operations, to ensure consistency and priorities remain valid. The validity of risk scoring is also reviewed and challenged (where necessary) within interactive sessions associated with the various risk identification approaches (e.g. Sustainable Drainage Planning). Risk priority is continually evaluated regionally by assessing the respective risk score and the business' concerns both now and in the future. Risk frequencies are scored over a 40 year period. This allows the business to understand the deterioration of assets and the consequential impacts.

### 3.3. Outputs

Once this stage is complete, risks undergo prioritisation in order to identify those to be taken forward for investment and solution development.

## 4. Identify Solutions and Cost

### 4.1. Solution methodology

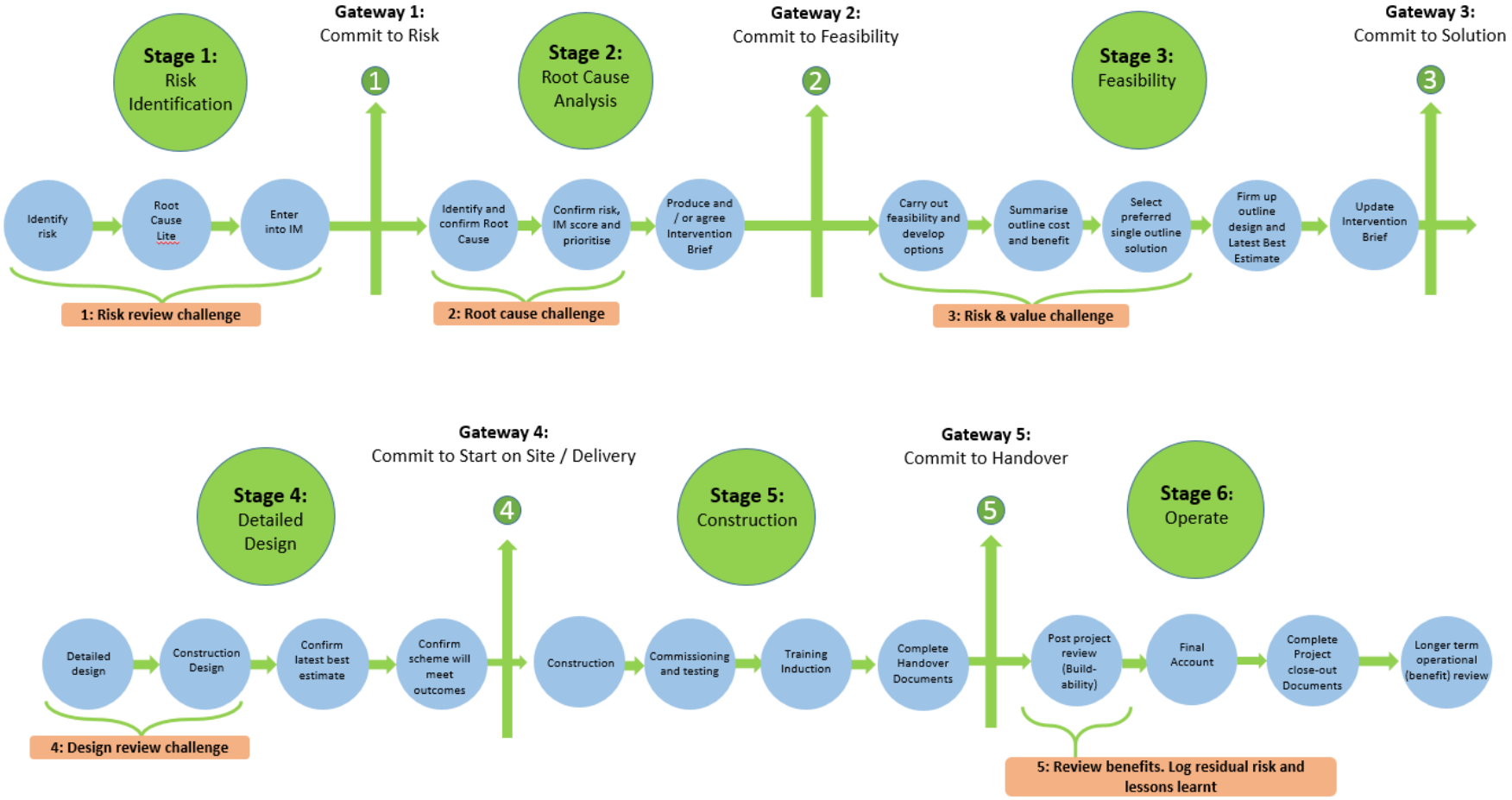
In preparing our PR19 Business Plan we have assessed drivers for potential investment in AMP7 (e.g. asset deterioration, new environmental performance targets and water quality standards, population changes and efficiency opportunities) and developed appropriate TOTEX programmes and asset solutions. We have drawn on technical expertise within our Capital Delivery Alliance and from our expert supply chain to develop interventions that reflect the materiality and complexity of the solution, considering capital, operational and non-asset solutions for delivery. In this section we present details of the methodologies we have used to propose and evaluate options, and select the right solutions to deliver our Measures of Success (MoS).

Underpinning our methodology is the selection of approaches that are appropriate for each sub-programme. To do this we apply an understanding of the complexity of potential options and solutions and their materiality in the context of the overall plan. This informs the extent of investigation, option development and level of outline design for the purposes of business planning. Some projects may reach Stage 4 of our Capital Investment Process as a result of their development or complexity/value (Figure 8). Consequently, the level of detail between the individual sub-programmes and that of the projects we will deliver in AMP7 will vary depending upon the approach we have taken.

Overall the methodology is as follows:

- Establish the likely complexity of the solution, to differentiate between simple solutions (e.g. refurbishment or like-for-like replacement of an existing asset such as a pump or inlet screen) and more complex solutions
- Choose the appropriate pathway to root cause verification and solution development, e.g. a fast-track concept-level study to identify solution; a more detailed option appraisal carried out by our Capital Delivery Alliance, or investigation of the root cause and followed by solution development by a supply-chain specialist
- Develop options and test their feasibility through engagement with Operations and Asset Management teams
- Establish the extent to which each option addresses the investment need (e.g. partial or full mitigation of a risk to service).

More complex/high value projects will be subject to our 'Risk & Value Challenge' appraisal during Stage 3 of our Capital Gateway Process. This process has defined roles and significant levels of subject expertise to ensure the project will deliver the best value for money option in support of the achievement of our performance commitments. In the process, the project risks undergo further validation and review, particularly in light of any temporal changes since initial identification (resilience / customers), root cause is verified in light of further detailed investigation, options are presented and discussed, the cost benefit of each option (including the residual risk) is evaluated and compared. Against each option, the inherent constraints are identified and considered. The responsible member of the Asset Management team will select the best option and the project will progress as per our Capital Investment Process.




- Figure 7 AMP6 Capital Investment Process

To illustrate our approach to developing TOTEX options and selecting a solution, we present an example option from our Water Quality investment case:

**Solution identification - Water Quality**

Maintaining a high quality of water that we supply is the most fundamental part of our water service provision. The deterioration of raw water quality is a current issue that has potential impact for customers in terms of potable water quality, acceptability and the reliability of supply. Although we have carried out significant investment in recent years, many of our current water treatment assets were designed and constructed at a time where regulatory standards were more relaxed due to a lesser understanding of the impact on public health. The replacement of these standards by more stringent requirements coupled with an aging asset base has led to a deterioration in the performance of our assets which has increased the challenge to safeguard water quality and preservation of supply.

In terms of quality and acceptability, the deterioration of raw water has the potential to impact on parameters including bacteriological compliance, cryptosporidium, appearance, taste and odour, disinfection by products and lead at customer taps. Similarly, should we be unable to meet current and future water quality standards then there is a credible risk of being unable to supply potable water to customers. Our assessment has included a review of water quality data, recorded operational constraints, contact tank and service reservoir cleaning programmes along with current and projected changes to water regulations and industry best practice. In developing this investment case we have undertaken a comprehensive review of water quality results, Drinking Water Safety Plans (DWSPs) and lessons learned following unplanned events. This approach has allowed us to identify a small number of priority problems to focus on.
One of the assets that emerged from this analysis is Capel Curig Water Treatment Works, which currently is not only be our last remaining uncoagulated surface water treatment but faces issues related to increasing trends in some parameters, which is recognition that the existing treatment process is not sufficient or robust enough.

**Case Study – Capel Curig**

Capel Curig is an aging asset that was originally constructed in 1960 that supplies approximately 200 people. By 2020, Capel Curig will be our last remaining uncoagulated surface water treatment works. It currently consists of two stage filtration along with ozone as its primary treatment process. Although water quality produced by the works is generally satisfactory and compliant, there is an increasing trend in some parameters which is recognition that the existing treatment process is not sufficient or robust enough for the long term future supply of the area.

The use of ozone treatment at Capel Curig has been deemed not an efficient method of breaking down organic compounds in the raw water and is not in line with current industry best practice for removal of dissolved organics as a primary treatment process. Our own experience has illustrated that due to fluctuations in raw water colour together with inconsistent contact time, ozone has proved ineffective at reducing disinfection by-products at Capel Curig.

Figure 9 below illustrates that THM formation at the treatment works since 2010 has been steadily rising over that period. The graph shows that in recent years during summer months, THMs have reached concentrations of 80 µg/l and have been steadily rising since 2015. Future projections indicate that raw water colour concentrations are set to rise over the next 10 years as indicated in figure 10. Average colour is set to increase from 13 mg/l to over 23 mg/l by 2027 which will further increase the levels of THMs from a current average of 45 mg/l to 60 mg/l.

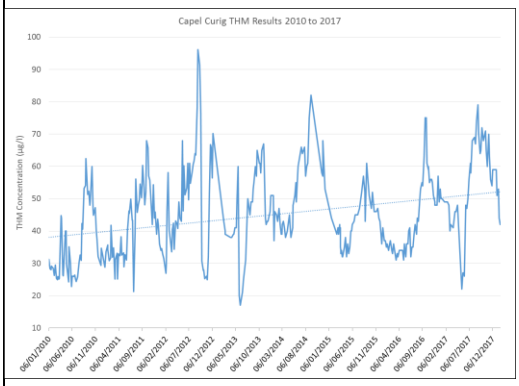



Figure 8 – Capel Curig THM results 2010 - 2017

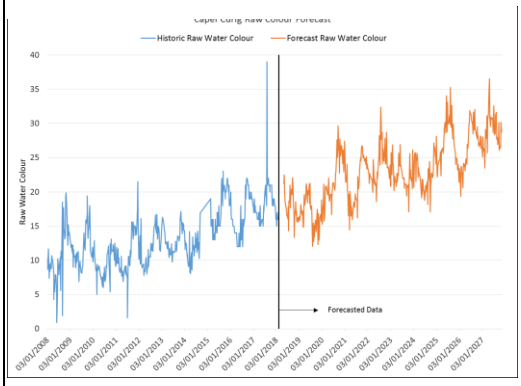



Figure 9 – Historic and forecast raw water colour at Capel Curig

The closure and abandonment of Capel Curig is one of a number of options available including ongoing maintenance of the treatment works, upgrade of existing treatment processes and a complete rebuild with modern processes able to treat current raw water quality. However, both of these options would have been significantly more expensive than the chosen option and would not have necessarily offered an improved level of service to customers. An upgrade or replacement option would have required to consist of at least two stage treatment and disinfection to ensure the sufficient removal of organic material and reduction of disinfection by-products. The raw water resource would be retained as part of all three options where it also supplies Mynydd Llandegai treatment works. The benefits the chosen programme will offer include an improvement to water quality particularly with respect to trihalomethanes for customers currently served from Capel Curig following a change of supply to Llyn Conwy (post abandonment).

We are planning to close and abandon Capel Curig WTW as the chosen option in AMP7. By taking this decision it we believe it will ultimately improve service for our customers in this area and increase resilience without the need for extensive maintenance or installation of new treatment processes at the treatment works.

**Abandonment of Capel Curig WTW**

The proposed closure and abandonment of Capel Curig water treatment works will include laying new trunk and distribution mains to supply customers. The alternative treated water to supply existing customers will come from Llyn Conwy water treatment works where a new main will connect to the existing network at Betws-y-Coed. An assessment of requirements costed using our cost database indicates that the scheme will comprise of the following activities;

- Laying of 6.5km of 150mm (id) pipe using open cut technique (to take into account probable limestone rock geology) from Betws-y-Coed to Capel Curig.
- A 5.5Kw water pumping station (including buildings) to overcome an altitude difference of 190m between the two villages.

The total cost for the installation of these two activities is £2.57m. This includes for uncertainties regarding the ability to lay the water main due to geology, accessibility to the proposed route, power availability and other planning and environmental restrictions.
Costing of the abandonment of Capel Curig WTW has been obtained through an up to date costing exercise of an existing scope of works. Costs have been put together using our Solution Target Pricing Tool which makes use of our Unit Cost Database.

The programmes of work have been developed so that they are delivered in conjunction with other programmes of work. For example, the abandonment of Capel Curig WTW project has been

developed in conjunction with the WTW maintenance programme to ensure the performance of the water treatment works due to replace Capel Curig is satisfactory.

Given the materiality of the business risks and the scope and scale of the solution, we developed options in some detail. The approach was also informed by the presence and availability in our team of experienced technical specialists, and the availability within our Unit Cost Database of up-to-date, relevant CAPEX and OPEX cost models. The comparative appraisal of options included the capital costs, the operational costs and benefits.

Key stakeholders within Welsh Water have been engaged to inform the proposal of options and selection of the right solution at Capel Curig. Production specialists within our Water Treatment Operations team contributed to the consultation process with our Water Asset Management team and the Production Manager. We validated the solutions through engagement with our Water Asset Management team and Operational colleagues.

### **4.2.** Outputs

The output of this stage was a range of solutions for IM.

## 5. Costing Methodology

Costs for our PR19 projects are produced using our Unit Cost Database (UCD) which holds the historical costs associated with delivering projects in the current and previous investment programmes (AMP 4 through to and including AMP6). The UCD generates cost models using the industry standard 'Engineering Estimating System' package, the capture mechanism for historical costs and subsequent statistical cost analysis (utilising 'Engineering Statistical Services Limited' software).

The interface between a projects scope and the UCD that allows us to produce costs is our Solution Target Pricing Tool (STPT). This tool has all the current approved cost models held within UCD embedded within it, along with the cost algorithms to determine the appropriate on-costs (indirect costs) associated with the scope. All cost models are updated annually at the beginning of the new Financial Year and inflated using the Construction output price indices (COPI).

Projects are costed using a comprehensive scope list containing civil, mechanical, electrical and instrumentation and control elements (the direct costs). For those infrequent elements not held within the cost models, a manual user entry (subject to approval) can be entered into the STPT to allow for the direct cost of the activity. The indirect costs are allocated to the project automatically, based on the investment area and the items selected under the direct costs / embedded cost models.

The OPEX models have been produced in line with the CAPEX models and will calculate the change in OPEX costs that the scheme will deliver. To determine the OPEX cost impact from the scope (direct elements), our SAP financial reports on historical OPEX costs are aligned to UCD CAPEX models to generate a TOTEX cost from the processed scope detail.

The CAPEX cost models account for;

- All new, enhanced, replaced, refurbished and decommissioned construction items
- Site specifics
- Construction management
- Risk
- Design
- On-costs.

In addition, we have developed Carbon models that calculate the embodied carbon (in tonnes) that the project will produce. These models have also been produced in line with the CAPEX models.

A two-stage costing process has been used for PR19 projects and programmes. At Stage 1, the 'Concept Costing Stage', initial high level UCD costings/unit rates have been carried out (based upon high-level scope/quantity). The decision to move on to Stage 2, the 'Definition Costing Stage', was based on a risk assessment carried out at Stage 1 which is founded on the materiality and complexity of the project solution (Figure 11).

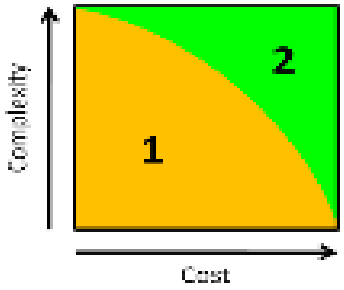
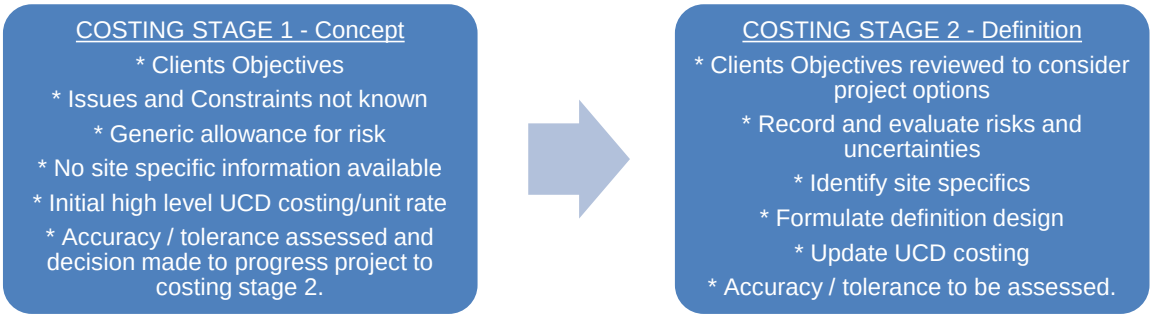



Figure 10 Diagrammatic representation of the selection of costing approach

Select the approach on assessment of combined selection criteria (Figure 12) as the scheme progresses:

- Check materiality
- Check Complexity
    - Assume complex schemes are of greater risk in terms of costing
- Consider
    - Risk
    - Uncertainty
    - Resource levels required
    - Potential numbers of schemes
    - Timescales.




- Figure 11 Costing approach (Concept/Definition)

## 5.1. Benchmarking our costs

Our UCD cost models have been benchmarked during 2018 as part of the overall PR19 quality assurance process (Welsh Water - PR19 Benchmarking Review, Appendix A). During the benchmark exercise, our sample of twenty PR19 scopes were closely aligned to our independent estimating assurance assessor's benchmark costing, with an average work stream difference of -1.0% and an overall programme difference of -3.0% (Figure 13).

| Investment Area | Welsh Water (£) | Mott MacDonald (£) | Difference (£) | % Difference |
|---|---|---|---|---|
| Waste Infra | £5,932,028.14 | £5,743,824.68 | £188,203.45 | 3.28% |
| Waste Non-Infra | £58,683,435.36 | £62,498,163.18 | -£3,814,727.82 | -6.10% |
| Water Infra | £108,813,297.32 | £114,140,308.87 | -£5,327,011.55 | -4.67% |
| Water Non-Infra | £55,665,992.18 | £53,798,348.61 | £1,867,643.57 | 3.47% |

- Figure 12 Alignment between our PR19 scope costs and those of our independent assessors in the benchmarking exercise of 2018

## 5.2. TOTEX efficiency

We have analysed our financial performance in the delivery of our AMP6 plan against the delivery routes and costs of our PR19 proposals. From our analyses we are able to forecast PR19 CAPEX efficiency gains that we will deliver through four overarching themes associated with our investment plan, these are:

- The 3rd phase of our Internal Benchmark Review (e.g. 'spend-to-save' initiatives)
- Improved IT delivery, support, software and systems
- Procurement and delivery of Capital Projects
- 'Cost of service' efficiency.

In each area we have developed a robust view on the level of efficiency that can be delivered by either using a bottom-up or top-down approach.

The majority of the efficiencies delivered from the 3rd phase of our Internal Benchmark Review are through identified and costed projects across the business. Each of these projects will deliver a defined amount of efficiency in our capital expenditure over the investment planning period. Illustrative examples of Internal Benchmark Review projects include:

- Pumping station efficiency
- Lean water production
- Energy strategies (water and wastewater)
- Insourcing
- Reconfiguring parts of our Capital Delivery functions.

Also through bottom-up analyses, we have identified efficiencies through the ways in which we will deliver and support IT along with further efficiencies through the software and systems we operate.

Our analyses has shown that our UCD models are becoming more efficient so we have identified the possibility for significant efficiencies through the procurement and delivery of our capital programme. We have developed two approaches to efficiency in this area that are applied to either developed projects that have been costed by using UCD or, to undefined budgets that require a measure of flexibility.

The purpose of the Cost of Service Efficiency project is to ensure that the central support functions are organised as effectively as possible to deliver what is required by the business in a cost efficient manner. An external consultancy has been appointed to review these areas in order to ensure best service, cost management and value for money. The identified efficiencies that can be achieved through this project have been applied to our plan using a 'top-down' approach.

Our efficiency proposals have been reviewed, challenged and agreed by those that will deliver the efficiencies, and within the PR19 Governance forums.

### 5.3. Investment allocation

For PR19 we have continued to use the latest relevant Regulatory Accounting Guidelines (RAG 4.07 – Guideline for the table definitions in the annual performance report) to allocate our investment and to ensure that our supporting financial information is reported in a clear and transparent way.

### 5.4. Outputs

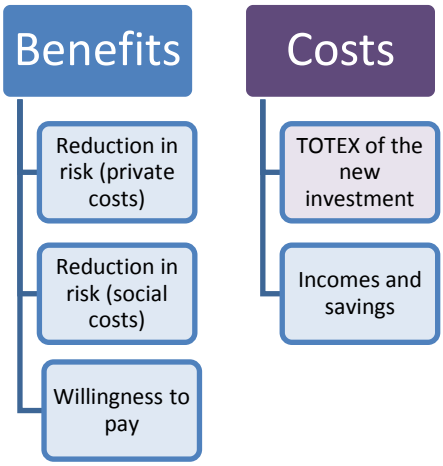
The outputs of this section was numerous solution and benefit costs for IM.

## 6. Cost Benefit Analysis

Cost benefit analysis is a fundamental part of our review of the projects selected for investment. We use a whole life approach, over a 40 year window. This enables all projects to be evaluated on a consistent basis. Cost benefit is not the only criteria for investment decision making, but is an influential guiding principle. As important is understanding the interrelationship between capital and operational costs which have determined our total expenditure approach.

### 6.1. General principles

Our cost benefit methodology is embedded into our Investment Manager system to ensure that it is consistently applied. Our methodology has been developed using the guidance provided in the UKWIR study: "Review of Cost Benefit Analysis and Benefit Valuation". Figure 14 shows the building blocks that make up our cost benefit analysis.




- Figure 13 Parameters assessed in Cost Benefit Analysis

All costs and benefits were considered over a 40 year window and discounted at 2.4% in RPI terms (as set out in Delivering Water 2020: Our final methodology for the 2019 price review December 2017. Internally we use Net Present Value to make comparisons but we have the ability to also use Equivalent Annualised Costs.

*Treatment of benefits*

Benefits were calculated from the reduction in risk, using the monetised values from the Service Measure Framework. Each solution can affect the risk exposure for a number of needs so the benefit was the value of the total reduction in risk across all needs.

*Treatment of costs*

The whole life cost of a solution covers the categories:

- Capital expenditure
- Operational expenditure
- Social and Environmental Costs

Costs are recorded in categories:

- Appraisal, Studies
- Buildings, roads, paths, fences
- Chemicals
- Civils
- Contributions
- Embodied carbon
- Grants
- Infrastructure
- IT and systems
- Labour
- Land
- Land remediation
- Maintenance
- Mechanical and electrical
- New customer tariff income
- On-costs
- Operational carbon
- Other capital income
- Other operational income
- Other OPEX
- Power
- Renovation of obsolete buildings
- Rent and rates
- Sales income
- Sludge
- Social & environmental
- Tax

Operational cost was included as the change in OPEX resulting from the solution, e.g. reduction in power, increase in chemical usage. If a solution was purely operational then this was the cost of the solution. OPEX was captured in categories:

- Chemicals
- Labour
- Maintenance
- Other OPEX
- Power
- Rent & Rates
- Sludge
- Tax

For several of these categories we have costs so that a consistent value was used throughout the system. However, where known site specific values are known, these are used in preference.

UCD automatically provides repeat/replacement CAPEX over the whole life cost horizon based upon set asset design lives. The repeat CAPEX is included in the whole life cost assessment.

We have built models to understand the carbon impact of our investment, which we use as part of our project evaluation within our Risk and Value process.

## 6.2. Outputs

The outputs of this step of the process were cost and benefit values for every solution being considered within the plan.

## 7. Review Business Targets

Producing plans that deliver a resilient, reliable and stable service that meets the needs of our customers and the environment is priority for us. Implementing and measuring the right performance targets to achieve is equally important. We continually seek ways to improve our investment planning processes in order that we can reflect the service we should provide to all of our customers, set out in our customer promises (Figure 15).

| | | | |
|---|---|---|---|
| | **Clean, safe drinking water for all** | | **Personal service that's right for you** |
| | **Safeguard our environment for future generations** | | **Fair bills for everyone** |
| | **Put things right if they go wrong** | | **A better future for all our communities** |

Figure 14 Our six customer promises

Our internal processes for reporting performance are well established. In the majority of areas, performance assessment is an every-day activity which is collated and reported monthly up to Executive and Board level. At any level in this hierarchy concerns relating to performance will be raised immediately and actioned. This information is also provided externally to various key stakeholders at and annually in our published Annual Performance Report.

By collecting and analysing the historical performance data, using predictive methods of analysis and embedding the desires of our customers and stakeholders, we have been able to thoroughly understand the current performance of our asset base to inform day-to-day operational decisions and provide the context for setting future targets. Figure 16 shows the key themes that we have taken into account in the development of our PR19 Investment Plan targets.


| Approach | Description |
|---|---|
| Cost-benefit analysis | Identify marginal costs, customers' marginal willingness (using a wide range of customer information) and other marginal benefits, so that the service level is set at the economic level of service. |
| Comparative information | Use robust comparative information on other companies' performance (and sometimes other sectors) to inform their service levels. |
| Historical information | Previous performance can be used to inform target levels. |
| Minimum improvement | Based on improvements seen in the past or forecast technological improvements. |
| Maximum level attainable | Work out the maximum possible level of performance as the reference point for setting the service level. |
| Expert knowledge | Expert knowledge about possible improvements that are not captured in comparative or historical information from engineering models. |

- Figure 15 Information and influences used in the development of PR19 targets

All of the targets we have set for PR19 have undergone review at varying levels and frequencies within the PR19 Governance structure and with relevant external stakeholders, for example our Customer Challenge Group and through our comprehensive Customer Research Programme. Our final PR19 targets have been signed-off by our Executive and Board.

The next stage of the investment planning process was to review the business targets against potential investments.

## 7.1. Outputs

The output of this stage was a set of business targets.

## 8. Apply Constraints

In a separate strand of work to the collection of risk and solution data we also develop an understanding of the constraints on investment. These took two forms: top down and bottom up.

### 8.1. Scheme specific constraints

Bottom up, scheme specific constraints were identified by analysing the legal and regulatory framework that we operate within.

*Analysing statutory obligations for drinking water quality*

Continued investment in our water treatment asset base is critical to ensure that the drinking water supplied to our customers is of the highest quality and that they have complete confidence that it is safe, reliable and tastes good.

Water treatment investment for PR19 is built in three categories:

- quality
- enhanced maintenance
- base maintenance

Our approach taken for quality and enhancement investment analysed the potential impact on treated water quality in terms of compliance with regulatory requirements, which are enforceable by Drinking Water Inspectorate (DWI).

The drivers for PR19 were outlined in the DWI Guidance Note: Long term planning for the quality of drinking water supplies - September 2017, LTP Version 01.

The Guidance Note provided the necessary information for water companies to submit schemes in relation to PR19 investment. The drivers related to the impacts to quality of treated water and/or the risk to public health.

We undertook a review of those assets that might have fitted the drivers provided by DWI. This review included analysis of all raw and treated water quality data, zonal data, the appropriateness of existing treatment processes, analysis of customer contacts and root cause analysis. We also reviewed our catchments to determine if the cause could be addressed at source rather than through costly treatment processes. Site surveys were also undertaken where high risks were identified. We submitted our response to DWI outlining proposed schemes that met the requirements set out in the Guidance Note (Welsh Water - Long term planning for the quality of drinking water supplies, 2018).

Letters of support for our Quality related programme from DWI were received on 30th May 2018. With this confirmation from DWI these solutions are marked as ‘Must Do’.

*Analysing legal environmental obligations*

We work closely with Natural Resources Wales (NRW) and the Environment Agency (EA) to define the obligations and number of sites for inclusion in the National Environment Programme (NEP) and Water Industry National Environment Programme (WINEP) respectively. This approach enables us to challenge the quality enhancement programme at

each step of its evolution, producing a more robust programme that meets our environmental obligations, whilst ensuring the best outcomes for both our customers and the environment.

Our NEP/WINEP assumptions have been developed from guidance documents that have included, but have not been limited to, the following:

- Welsh Government - Water Strategy for Wales (May 2015);
- OFWAT - Delivering Water 2020: Our final methodology for the 2019 price review (December 2017);
- Environment Agency / Natural Resources Wales – Reasons for Not Achieving Good (RNAG) Database (July 2016);
- Environment Agency - Water Industry Planning: identifying measures for the WINEP including individual driver guidance documents (May 2017);
- Natural Resources Wales - PR19 Expectations and Obligations including individual driver guidance documents (December 2016 to May 2017);
- Environment Agency / Natural England - Water industry strategic environmental requirements (WISER) (October 2017).

Work to provide clarity on environmental obligations is continuously ongoing and there are a number of uncertainties that could have a profound effect on the final programme and hence our ability to deliver.

The Water Quality National Environment Programme drivers that have been considered to require investment in PR19 are as follows:

- Water Framework Directive (WFD) – Improvements, No Deterioration, Drinking Water Protected Areas, Chemicals
- Urban Waste Water Treatment Directive (UWWTD)
- Shellfish Water Directive (SWD)
- Revised Bathing Water Directive (rBWD)
- Conservation Drivers –Wildlife and Countryside Act (W&C Act), Natural Environment and Rural Communities Act 2006 (NERC Act) and biodiversity priorities, Regulation on Invasive Alien Species (IAS).

Where confirmation from our Environmental Regulators is received, these solutions are marked as ‘Must Do’.

## 8.2. Business constraints

For capital maintenance planning we continue to use an approach that is consistent with UKWIR Framework for Expenditure Decision Making (2014) approach. This meant that before setting a maintenance budget for an asset type, we reviewed the current performance metrics and spend to challenge the amount required going forward. This lead to additional top-down constraints in individual areas as we recognise that it would be

inappropriate to increase investment unless drivers have changed or performance was significantly deteriorating.

The overall TOTEX plan was also reviewed to understand the impact on bills of differing levels of investment. The range of possible options, and impact on service levels, was explored with customers to understand constraints of affordability. This created a constraint on the overall size of the plan.

## 8.3. Outputs

As outputs of this stage of the process, constraints were input into our overall business plan programme and IM at scheme level and sub-programme level. These were then passed forward into the optimisation stage.

## 9. Optimise

The optimisation stage is where the underlying Price Control Programmes and the overall Business Plan Programme are defined. Our programme selection has been a combination of system based analysis (typically at asset base level) and scenario planning at the Price Control programme level by the TOTEX groups in their role in the PR19 Governance process.

### 9.1. System optimisation

Our approach to system optimisation has been influenced by a number of factors including (but not limited to) the:

- materiality of the investment
- nature of the investment
- certainty in the programmes and projects put forward
- availability and quality of information.

Where appropriate, we have conducted system optimisation using a suite of tools and approaches on data at the building block level of our programme (i.e. WTW maintenance) in order to develop optimal programmes of projects and sub-programmes of work. This exercise is used to inform the next phase of optimisation that develops scenario planning much further through an iterative process of independent scrutiny (Customer engagement, Customer Challenge Group, Wales Water Forum), internal and external challenge and ultimately PR19 Governance groups' review (e.g. TOTX steering groups up to Board).

Our optimisation algorithms analyse the relationship between costs and benefits from the programme, whilst taking into account any constraints that have been applied at scheme or programme level, including:

- Financial constraints - limit the budget available for an investment case, or impact on OPEX
- Serviceability/MoS constraints - i.e. reduction in number of bursts
- A project's status – i.e. 'Must Do'.

### 9.2. Scenario planning optimisation

Our approach to optimisation through scenario planning provides a greater contextual extent to our programmes and provides a much richer insight. Our approach provides those informed and accountable within the TOTEX Groups (Heads of Service and senior leaders) with both the opportunity to positively influence the scale and content of investment whilst providing them with first-hand assurance of the plans' content and objectives. We consider the combination of the two optimisation approaches provides a more informed and robust approach to investment planning. Like system optimisation, the TOTEX Groups take account of the latest constraints, performance, customer sentiment and wider issues to challenge proposals in order to determine optimal programmes for their respective areas.

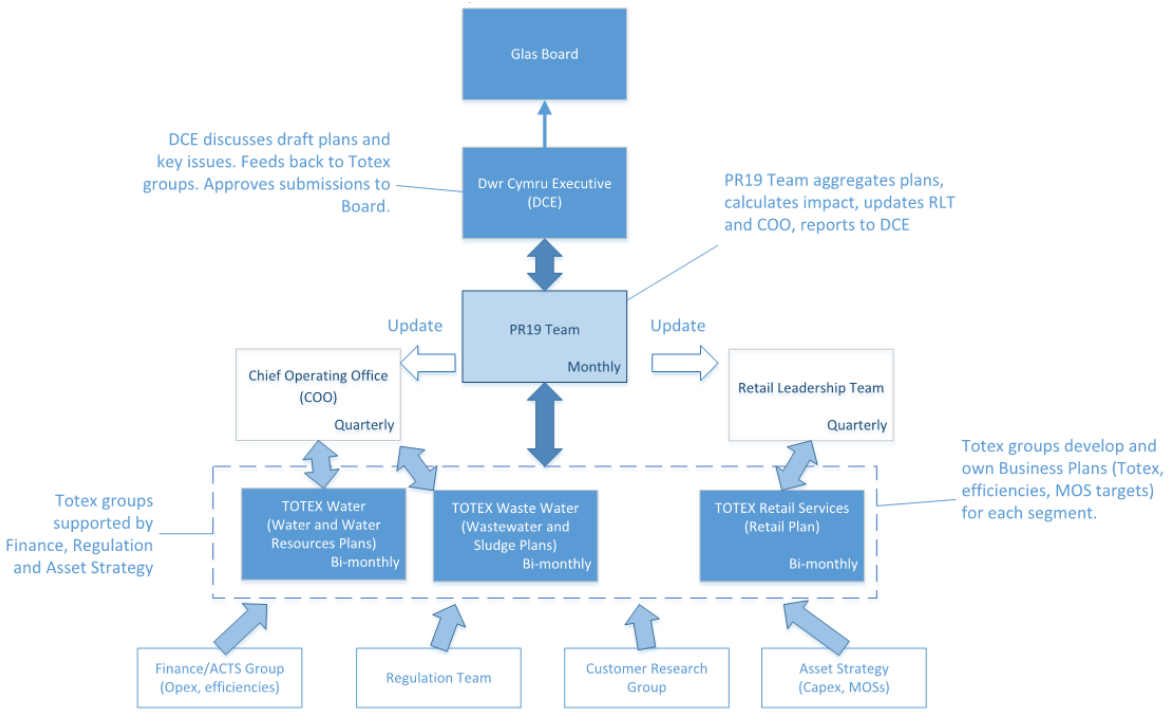
Both optimisation approaches are interlinked and iterative over the PR19 timeline. This ensures that each contributing area, along with the overall plan are optimal at any point of time, reflecting the influence of the constraints at that point in time.

### 9.3. Outputs

The output of this stage of the process was our agreed plan for investment.

## 10. Governance

Best practice governance was at the heart of our PR19 approach. Our internal planning processes and external stakeholder activities have been subject to rigorous challenge, whilst also providing a 'clear line of sight' from our customers, the Board and all the way through to our front-line operational teams (Figure 17). Our hierarchy of PR19 governance (established in 2016) each level with different responsibilities, track the plan as it develops through the PR19 programme at defined and regular milestones. Each iteration and subject area of the programme being subject to review and challenge by the Executive and Board. Once the overall plan is signed-off through the PR19 Governance Structure, it is taken forward to form the basis of our submission and AMP7 plan.




- Figure 16 PR19 governance structure

We developed our Programme for PR19 Governance in 2016.

Stakeholders have been consulted through an extensive programme of stakeholder engagement and customer research that was undertaken on top of the permanent ongoing interaction that we have with Welsh Government, our quality regulators and our customers.

In addition to our customer and stakeholder engagement the plan has been challenged during 2018 by our Board, Customer Challenge Group and our Members following a series of internal discussions, debates, checks and peer reviews of the processes and outputs. We have also subjected our WtP Customer Research to peer review by an independent industry expert and participated in an industry wide WtP benchmarking report.

These internal meetings (Dŵr Cymru Executive / Capital Programme Board / Triage – Strategy & Regulation / Water and Wastewater Asset Management & Operations) have utilised the expert knowledge and experience of the finance & regulation, asset strategy &

planning, local asset management and operational teams to provide a robust challenge on the detail and credibility of the plan and projects therein.

We have commissioned external scrutiny of the processes supporting the plan via our annual ISO 55000 audit and bespoke PR19 audits of methodologies and data; peer reviews of our risk and performance processes, Capital Investment Process and industry benchmarking of our expenditure costs.

### 10.1. Outputs

The output of this stage was our PR19 Governance approach to feed into the Board assurance statement.

Supporting Document

5.1.1 PR19 cost benchmarking review