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Implementing climate change adaptation pathways in DWMPs

INTRODUCTION

Climate change represents a series of potential risks to water and sewerage undertakers in the United Kingdom, such as changes in rainfall intensity and sea level rise as a consequence of global temperature raise and greenhouse emissions.

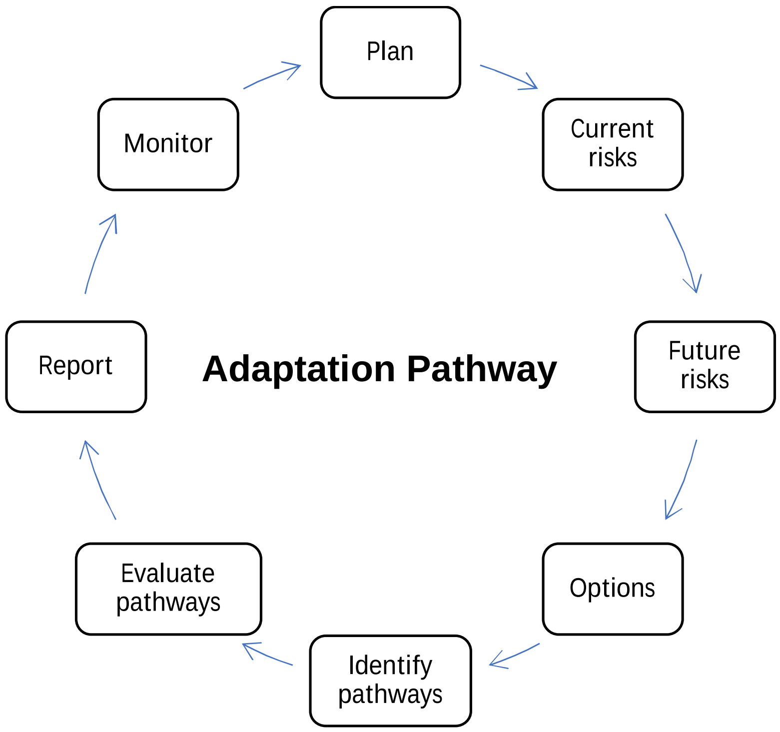
There are deep uncertainties about the future arising from climate, population growth and economic development, which can make it difficult to consider these potential risks for water company planning. Although the UK has strong planning for climate risks set out in the Climate Change Act 2008, flooding remains a key risk to infrastructure with the latest climate projections indicating an increased likelihood of heavy precipitation.

In the past, water and sewerage undertakers have generally developed static plans using a single 'most likely' value for climate change. However, if the future turns out to be different from the previous hypothesis, the plans will be at risk of failure. Water companies therefore need an improved method to create a strategic vision of the future. Thus, anticipating the change or considering transitions will be crucial to deliver a good level of service, and this requires new approaches and methodologies to adapt.

Adaptation pathways (APs) form an effective planning approach to respond to those associated uncertainties. APs are sequences of potential actions that can be implemented as conditions evolve in response to climate change risks, helping to develop flexible long-term responses that can be incorporated into short-term decisions, facilitate planning for multiple features, identify which short-term decisions could limit future adaptation and help to identify interested parties to achieve effective outcomes.

British Standard 8631:2021 sets out a framework for the use of adaptation pathways. This recommends first assessing risks from climate change and then considering the implications of interdependencies with other drivers. However, for urban drainage, future population growth can also be a significant change, so we modified the approach to consider all impacts on risk together. The modified approach has 8 steps:

Figure 1. Steps to develop climate change adaptation pathways in DWMPs. Adapted from BS 8631:2021



CASE STUDY

For Wessex Water (WxW) WSP has developed an AP approach to the Option Development and Assessment (ODA) stage of Drainage and Wastewater Management Plans (DWMPs) for the Avonmouth catchment covering the greater Bristol area. This was assessed as a Complex catchment as defined in the DWMP guidance. The application of the 8 steps process is described in the case study below.

Step 1 – Planning

WxW set up the context of the ODA stage of the DWMP, to be applied at the scale of the Avonmouth catchment, and at two different planning horizons: 2035 and 2050. The aim of this study was to identify long term investment needs to meet the expectations of the performance of a modern sewerage system, by the introduction of uncertainties to provide a more robust plan.

Step 2 – Understanding current risks

WxW carried out a baseline assessment of the current level of flooding risks and pollution risks to watercourses, using a hydraulic modelling assessment as the prediction tool following the DWMP Baseline Risk and Vulnerability Assessment (BRAVA).

Step 3 – Understanding risks from a range of future scenarios

The drivers for future changes in risk include: population growth, urban creep (modified from the WxW standard to give a more gradual change in values), peak rainfall intensity (based on the worst case of the WxW standard and the UKWIR 2017 report), future TSR rainfall patterns using the Red UP perturbation tool, sea level rise from the UKCP18 Marine Report and per capita consumption (PCC) and trade discharges.

Each of these drivers has significant uncertainty in the rate of change.

Each planning horizon had low, medium and high estimates of the uncertain changes above mentioned, generating 6 scenarios. Given the time restraints of Cycle 1 of the DWMP two extreme scenarios were selected, (2035 Medium as “Scenario A”, and 2050 High as “Scenario C) and an intermediate “Scenario B” by looking at the input data for rainfall uplift, increase in impermeable area or creep, sea level rise and % in total population.

These three scenarios define expected levels of future change, but the uncertainty remains as to when each of them will occur. The three scenarios selected for Avonmouth applied the following parameters to represent the level of uncertainty expected:

Table 1. Scenarios with uncertainties

	Scenario	Rainfall (%)	Imp area (yrs)	Sea level (m)	PE	PCC & trade (%)
	2035 low	0	0	0.12	809 451	-10
A	2035 Med	10	5	0.20	835 750	-10
	2035 High	20	10	0.28	862 050	0
	2050 Low	14	5	0.15	816 330	-30
B	**2050 Med**	20	10	0.27	845 578	-10
C	2050 High	35	15	0.39	874 826	0

Step 4 – Consider adaptation options for different levels of risks and their thresholds

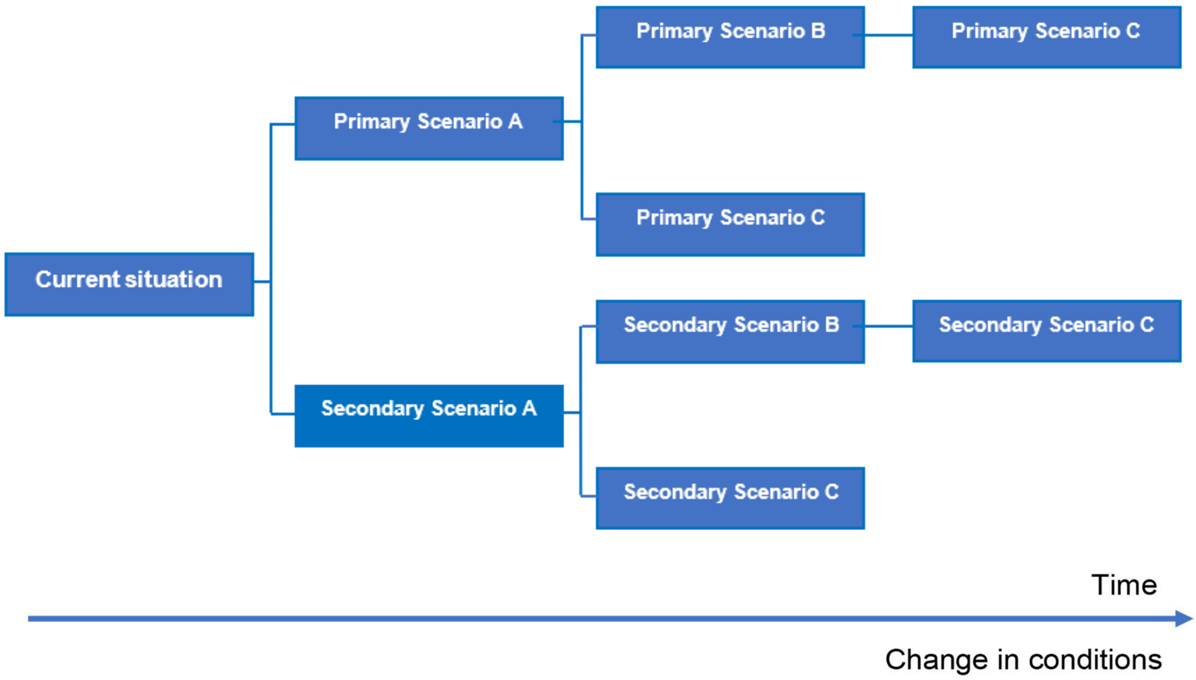
Once the scenarios were identified, the procedure defined to develop options for the catchments using the Extended approach was followed. This used an option scoring spreadsheet to rank the potential options for the economic, social and environmental costs, benefits and attributes of each combination, giving primary and secondary options.

For the lowest (A) scenario, individual solutions were identified for each trigger location. For the other two scenarios (B and C), integrated solutions across all trigger locations were developed, starting from the baseline of the implementation of the previous scenario and again developing primary and secondary options.

Step 5 – Assemble a route map of adaptation pathways

As most of the option development had been done as integrated solutions for all of the risks in the catchment, we used a fairly simply adaptation pathways looking at catchment wide options. The main choice was whether to build improvements required for the later scenarios early, at the same time as building for the earlier scenarios. The decision tree in Figure 2 indicates the different combinations according to what has been tested.

Figure 2 Decision tree



Step 6 – Evaluate and chose adaptation pathways

We assessed the range of dates when each scenario might be required depending on the rate of change of climate and other drivers. This gave the ranges shown in Table 2.

Table 2 Time range of scenarios

	Scenario		
Rate of change	**A**	**B**	**C**
Low	2045	2055	2060
Med	2035	2050	2055
High	2026	2040	2050

The whole-life costs of the interventions were calculated for each option using for the range of potential timings using a simple discounted cashflow model (rate of 2.9%). This was used to choose the lowest whole life cost between the primary and secondary options. It was then used to assess the potential change in cost of moving later schemes earlier to coincide with earlier work. If the marginal cost of earlier investment was small, then this was selected. Although the absolute timescale of required investment is not yet known, if implementing an option is the best decision for every potential timeframe, it is accepted. If not, then it is delayed until it is the best decision.

Step 7 – Report preferred adaptation pathways

We reported the preferred pathways as a simple spreadsheet that automatically indicated the preferred option and those components of the investment that should be brought forward to deliver best value. The tool also identified those areas where more detailed re-assessment was required due to inconsistencies between the scenario plans that indicated a risk of over-investing in short term assets that would not be needed in the long term.

Step 8 – Set out implementation, monitoring and evaluation plans

The success of the APs in the context of a DWMP will depend on monitoring the uncertainties and anticipating the change. This step is undertaken to determine the occurrence and timing of adaptation using different signals which indicate that further implementation measures need to come into place.

The signals must be measurable, reliable, credible (scientifically convincing), legitimate (acceptable to stakeholders) and need to be identified in a timescale that leaves enough time to prepare follow-up measures.

Although the identification of these signals was not in the scope of this project, academic research suggests signals such as frequency and intensity of extreme rainfall, measured global mean sea-level rise, alarms of high water level and high groundwater levels could all be used.

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Conclusions

1. In order to adapt to climate change, different scenarios with degrees of uncertainty should be investigated.

2. Wessex Water and WSP have worked in collaboration to provide a plan using adaptation pathways in the context of DWMP.

3. This is an iterative process that may require adjustments in future DWMP cycles in line with scientific findings about climate ensuring no regret scenarios.

4. Due to the increase of pressure added by the uncertainties, very few schemes were identified to generate betterment beyond resolving detriment.

5. The use of transient scenarios identified lock-in situations that would have increased vulnerability.

6. Acknowledgement that uncertainty will always exist but with the aim to make it manageable and enable Wessex Water to plan.