Winter 2020

National Water Resources Plan - Draft Framework Plan
Technical Appendices

Appendix I
Headroom

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Data Disclaimer:
This document uses best available data at time of writing. Some sources may have been updated in the interim period. As data relating to population forecasts and trends are based on information gathered before the Covid 19 Pandemic, monitoring and feedback will be used to capture any updates. The National Water Resources Plan will also align to relevant updates in the National Planning Framework.

1.1 Introduction

Target headroom is the buffer that water companies provide between their supply and demand balances to allow for potential uncertainties in the estimated supply and demand for the current and future scenarios. There are numerous sources of these uncertainties, such as assumptions made about future growth, variations in available data and the impact of climate change and its effect on supply sources. Making an allowance for target headroom ensures that the Level of Service (LoS) is maintained.

Target headroom is added to give demand plus headroom, as illustrated in Figure 1-1.

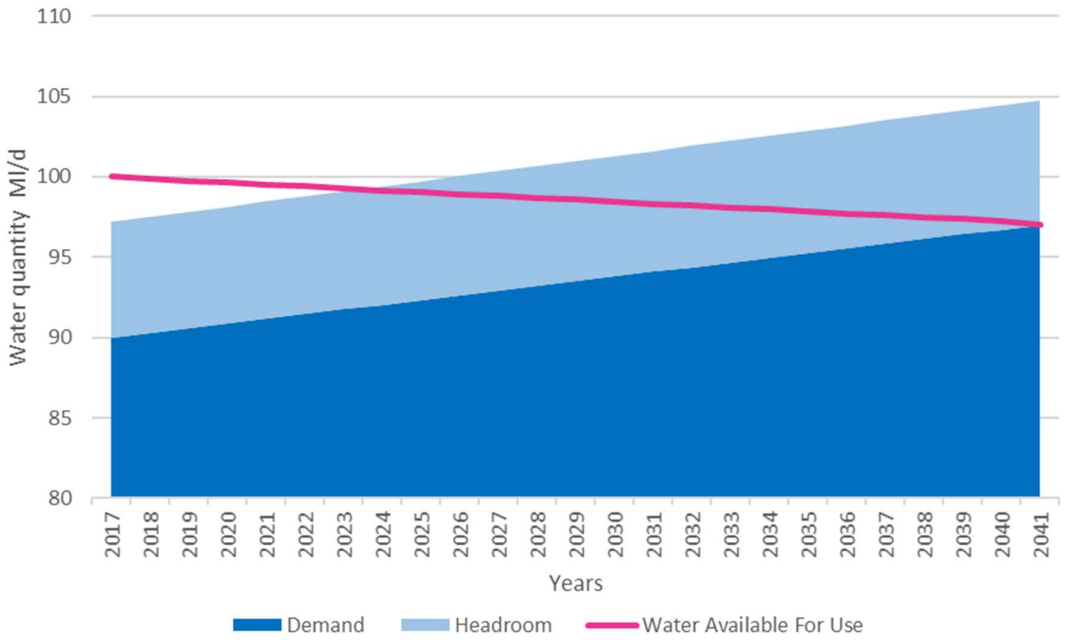

Figure 1-1 A typical Supply Demand Balance

It should be noted that target headroom is not designed to allow for major uncertainties like changes in legislation, as these cannot be predicted or quantified.

1.2 Methodology

1.2.1 UKWIR Methodology for Headroom Assessment

Target headroom is determined at the Water Resource Zone (WRZ) level by obtaining details of the supply-side and demand-side uncertainties. The UK Water Industry Research Ltd's (UKWIR's) Improved Methodology for Assessing Headroom (2002) is the method, used by the UK water utilities, for calculating target headroom and was applied to the Greater Dublin Area (GDA) WRZ.

The UKWIR's methodology details the process to assess the level of uncertainty in the Supply Demand Balance (SDB). It helps to quantify the uncertainties through a risk analysis, which can then be summed and added to the demand balances as an allowance.

Assessment of target headroom enables water companies to see which components of their SDB are the major sources of uncertainties. By understanding the uncertainties in its supply demand projections, water utilities can make appropriate investment decisions to maintain the LoS to its customers.

The 2002 UKWIR methodology suggests that there are eight sources of uncertainty in the supply-side data and four in the demand-side.

1.2.1.1 Supply uncertainties

The UKWIR Supply-side uncertainties, listed from S1 to S9, are as follows:

- S1 Vulnerable surface water licences;
- S2 Vulnerable groundwater licences;
- S3 Time-limited licences;
- S4 Bulk imports;
- S5 Gradual pollution of sources causing a reduction in abstraction;
- S6 Accuracy of supply-side data:
  - S6–1 Infrastructure uncertainty;
  - S6–2 Meter uncertainty;
  - S6–3 Uncertainty for aquifer-constrained sources;
  - S6–4 Uncertainty for hydrology-constrained sources;
- S8 Uncertainty of impact of climate change on source yields; and
- S9 Uncertain output from new resource developments.

(Note that S7 of the original UKWIR methodology is no longer use as a supply side uncertainty)

1.2.1.2 Demand uncertainties

The UKWIR Demand-side uncertainties, listed from D1 to D4, are as follows:

- D1 Accuracy of sub-component data;
- D2 Demand forecast variation;
- D3 Uncertainty of impact of climate change on demand; and
- D4 Uncertain outcome from demand management measures.

The UKWIR methodology is very data-intensive and requires a significant quantity of high-quality data to make reasonable assessments, as well as an understanding of the constraints and limitations of the available data. The current limited understanding of uncertainties alongside current data quality and quantity limitations make the UKWIR methodology unsuitable to calculating target headroom for WRZs in Ireland. The exception is the GDA where there is sufficient data available to apply the UKWIR method to calculate a target headroom.

1.2.1.3 Uncertainty in demand forecasts

Uncertainty in demand forecasts is inevitable for a variety of reasons, including:

- Uncertainty in population projections, which is demonstrated, for example, by the range of projections produced by the Central Statistical Office;
- Uncertainty in Per Capita Consumption (PCC) forecasts because the types of appliances that domestic consumers buy and the way they use water in the future may be different from what has been anticipated in the demand forecast;
- Uncertainty in non-domestic consumption forecasts because, for example, the extent of future new consumer demands, water-saving activities and site closures are unknown;
- Uncertainty in UFW forecasts, for example, due to limited accurate data on current levels of leakage and the inevitable uncertainties about the effectiveness of future leakage reduction actions; and
- Uncertainties in the current data for metered volumes and estimates for unmetered volumes. The uncertainties are particularly large for WRZs where there is limited and/or poor-quality data.

One way of quantifying the impacts of uncertainty is by deriving alternative demand forecasts that apply differing assumptions about the base year data and how population and demand will change in the future.

Therefore, upper and lower bound demand forecasts have been estimated, using generalised alternative assumptions. The upper and lower forecasts provide an indication of the range within which future demand is likely to lie. However, it is still possible that for some WRZs, the future demands will be outside these ranges, especially if the current base year information is inaccurate.

Figure 1-2 and Figure 1-3 illustrate the differing uncertainty ranges for the following example areas:

- the whole area served by Irish Water; and
- an example small WRZ.

Uncertainty ranges can be expected to be greater for smaller WRZs, as any changes in underlying demand may have a relatively much larger impact than for larger WRZs.

The uncertainty ranges, shown in Figure 1-2 and Figure 1-3 below have been used in the calculation of target headroom, which provides an allowance uncertainty in the water Supply Demand Balance.

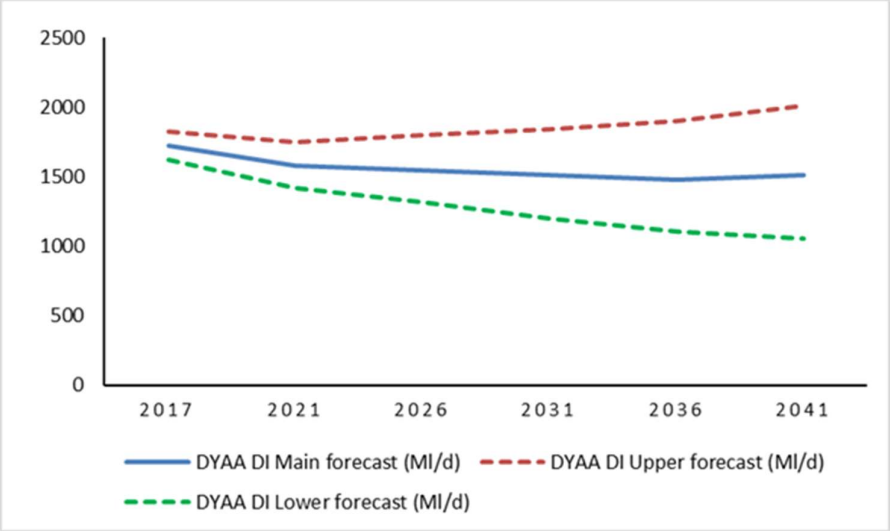

Figure 1-2 Main, upper and lower dry weather demand forecasts for whole area served by Irish Water (Ml/d)

Note – DYAA = Dry Year Annual Average; DI = Distribution Input

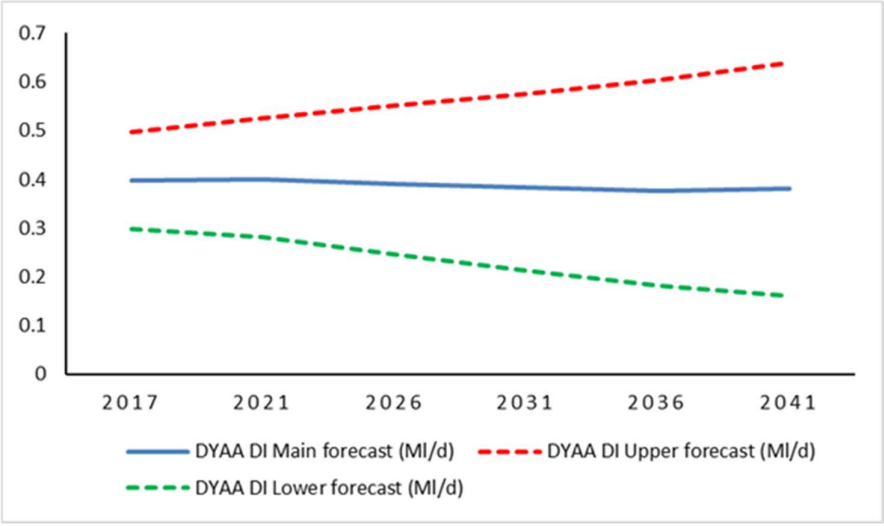

Figure 1-3 Main, upper and lower dry weather demand forecasts for an example small Water Resource Zone (Ml/d)

Note – DYAA = Dry Year Annual Average; DI = Distribution Input

1.2.2 Application of the UKWIR Methodology to the GDA

1.2.2.1 Methodology

As detailed in Sections 1.2.1.1 and 1.2.1.2, the UKWIR guidelines state that the uncertainties can be either supply-related or demand-related and categorise eight components of supply-side uncertainty and four components of demand-side uncertainty that need to be assessed.

The uncertainties are quantified as a volume in the headroom model. Probability distributions are then assigned to the uncertainties based on the guidelines provided in the UKWIR report and a Monte Carlo risk analysis is undertaken, which carries out multiple simulations of potential uncertainty combinations.

A 90% probability level (glide path) is selected from the output of the analysis, and this is taken as the chosen probability distribution for headroom uncertainty for the WRZ.

The model is a statistical tool, with relationships between the uncertainty components that may be independent, overlapping or co-related. Where distributions cannot be modelled independently, correlation coefficients are used.

The base year for demand assessment is 2019. A planning period up to 2044 has been used for determining the probability distributions in the model. A range of assumptions have been made for modelling each of the supply-side and demand-side uncertainties, which are explained in more detail below.

1.2.2.2 Supply-side uncertainties

Table 1-1 - Supply-side headroom assumptions below outlines the assumptions made in the supply-side assessments of headroom for the GDA WRZ.

Table 1-1 Supply-side headroom assumptions

Component	Assumption
S1 Vulnerable surface water licences	There are very few surface water licences in the GDA. While new legislation is being drafted, which will provide a new licensing regime, there is currently insufficient information to make a headroom assessment meaningful. Therefore, there is no headroom allowance under this component.
S2 Vulnerable groundwater licences	There are no groundwater licences in the GDA. The comment under S1 also applies here. Therefore, there is no headroom allowance under this component.
S3 Time-limited licences	There are no time-limited licences in the GDA. Therefore, there is no headroom allowance under this component.
S4 Bulk imports	There are no bulk imports within the GDA. Therefore, there is no headroom allowance under this component.
S5 Gradual pollution of sources causing a reduction in abstraction	There is no evidence that the raw water quality of any source in the GDA is deteriorating to the extent that it would affect the quantity of water that any of the Water Treatment Plants could deploy. Therefore, there is no headroom allowance under this component.
S6 Accuracy of supply-side data	There is uncertainty around the accuracy of meters and capacity of infrastructure, which we have allowed for. We have also allowed for uncertainty in the hydrological analysis.
S8 Uncertainty of impact of climate change on source yields	As set out in Appendix H, we have analysed the GDA for a number of climate change scenarios. The headroom assessment accounts for the impact of

Component	Assumption
	these.
S9 Uncertain output from new resource developments	This is not considered at this stage of the assessment and is undertaken once recommendations are made.

1.2.2.3 Demand-side uncertainties

Table 1-2 below outlines the assumptions made in the demand-side assessments of headroom for the GDA WRZ.

Table 1-2 Demand-side headroom assumptions

Component	Assumption
D1 Accuracy of sub-component data	This component is used to address the uncertainties that arise because the base year data on which the demand forecasts are based are uncertain, leading to errors in demand prediction. Although there are likely to be errors in the estimation of each demand component, it is the uncertainty in estimation of total demand that is of primary concern in the target headroom assessment. Therefore, potential errors in the measurement of Distribution Input at water treatment works are of key importance. Meter accuracy may range from +/- 2% for well-installed magflow meters to +/- 5% for older Venturi or Dall tube meters (UKWIR, 2003). For the GDA, it is assumed that the estimation of total flow from water treatment works will be relatively good, and so a meter accuracy of +/- 2.0% has been used. A triangular probability distribution with variation between +2% and -2% has been used.
D2 Demand forecast variation	This component of target headroom is used to assess the uncertainty in the demand forecast, as actual future demand in the GDA is likely to vary from the forecast. In order to estimate the extent of uncertainty, three demand forecasts using different assumptions have been calculated: • Maximum decrease in demand (in Ml/d) = difference between the base case (principal demand forecast) and the lower demand forecast; • Best estimate change in demand = 0Ml/d (that is, best estimate is the principal demand forecast); and • Maximum increase in demand (in Ml/d) = difference between the upper demand forecast and the base case (principal demand forecast). The key uncertainties and the assumptions used for each of these demand scenarios are described in Chapter 4 of the draft Framework Plan. The key demand components that have been assessed for uncertainty are: • Population uncertainty – to account for uncertainty associated with the base year and forecast population values; • Per Capita Consumption (PCC) uncertainty – to account for uncertainty in how customer behaviour and changes in technology or regulations may affect domestic consumption; • Non-domestic demand uncertainty – to account for uncertainty in the non-domestic demand forecasts; and • Dry weather demand uncertainty – to account for uncertainty in the impact of dry weather on water demand. The headroom assessment applied a triangular distribution for each uncertainty component to account for the impact of the demand scenarios.

Component	Assumption
D3 Uncertainty of impact of climate change on demand	The demand forecast considers the impact of climate change on demand, based on UK studies, and these figures are used for the headroom assessment. Uncertainty of climate change impacts on water demand can be expected to be correlated with uncertainty in climate change on source yields (component S8), because climate change is likely to affect supply and demand at the same time. The correlation can be categorised as “high tendency towards positive correlation”, and so a correlation coefficient of +0.6 has been applied.
D4 Uncertain outcome from demand management measures	There are limited demand management measures recommended. Furthermore, demand management measures contribute very little to the SDB. Subsequently, with the UKWIR methodology, this means any headroom contribution is negligible.

1.2.2.4 Modelling results

All uncertainties are quantified in the headroom model, and the results from the model for the 90th percentile are presented in Table 1-3.

Table 1-3 Greater Dublin Area (GDA) headroom results based on UK Water Industry Research Ltd assessment (UKWIR)

	Headroom provision					
Year	2019	2025	2030	2035	2040	2044
GDA (Ml/d)	45.79	48.17	48.37	48.02	49.43	50.58

The 2041 figure equates to approximately 8% of current and future demand.

1.2.3 Headroom Assessment for all WRZs

As discussed above, the results of the assessment indicate that target headroom percentage for the GDA should be set at 8%.

Headroom needs to be considered for all WRZs. While we have assessed the GDA based on the UKWIR headroom methodology, there is insufficient data to apply this methodology elsewhere. Therefore, we must take an assumption-based approach.

A review of the UK has identified that water companies’ average target headroom percentages vary between 3% and 8%. However, in some of the smaller, rural areas, target headroom can be over 15% where there is greater uncertainty due to limited data and systems being more sensitive to uncertainty. Generally, headroom would be lower in the large urban centres and would increase in the more rural and isolated WRZs.

Our WRZs generally experience a greater level of uncertainty in comparison to typical UK water utilities. This is mainly because we have fewer years of asset data available to us. We are continuously working on building a better understanding of our asset base to reduce our level of uncertainty and achieve a better understanding of our target headroom.

While it is important to consider the headroom, if it is set too high, headroom may become the sole driver for a deficit in the SDB, and therefore potential investment in some WRZs may be solely provided to cover the headroom. There are many WRZs that are already in deficit before headroom is applied. Therefore, we need to be careful that priority is not taken away from these.

Taking into account all of the above, the following headroom figures in Table 1-5 are recommended for the various WRZs.

Table 1-4 National Water Resources Plan headroom allowance

Water Resource Zone	Headroom allowance	Comment
GDA	8%	Based on UKWIR methodology
Large zones (10–100Ml/d)	10%	Large urban centres not significantly different to GDA
Medium zones (1–10Ml/d)	15%	Mostly WRZs with small number of sources or lots of small sources leading to significant uncertainty
Small zones (<1Ml/d)	20%	Mostly small, isolated rural WRZs, where uncertainty is a large percentage but a small quantity

1.3 Next steps

The figures in Table 1-5 have been applied to our demand forecasts up to 2041.

Between now and the second iteration of the National Water Resources Plan, we will look to improve our understanding of headroom. In order to do this, we will undertake the following two key actions:

- Develop our own headroom methodology, which is likely to be based on the UKWIR methodology; and
- Improve our data collection to facilitate a more robust headroom analysis.

These actions should enable us to get to a position on headroom that is consistent with leading water utilities in the UK and further afield.