AN FÓRAM UISCE

REVIEW OF THE EASTERN & MIDLANDS WATER SUPPLY PROJECT

Report

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1 CONTEXT AND OBJECTIVE OF THE ASSIGNMENT

There is agreement, in general, that Dublin and its region are becoming increasingly water stressed, that the risk of water shortages will become ever more important and that failure to address this risk would have a catastrophic impact in terms of economic development in that region, which will impact the country as a whole. It is understood that water demand may exceed production capacity by the mid-2020s, so that it has now become urgent to develop new water supplies.

Irish Water (IW), the national water utility in Ireland, is therefore progressing with their most significant water supply project, the Eastern and Midlands Water Supply Project (WSP), to address and resolve this situation.

The project has been on-going for many years, long before the establishment of Irish Water and has followed a pathway involving several key stages: an assessment of the project need (i.e. an estimate of the future water demand to be met), the identification of alternative supply solutions which underwent a robust assessment process and the selection of a preferred option.

This “preferred option” is a scheme designed to abstract water from the River Shannon and pipe it across the country to supply water to communities along its pathway and ultimately to Dublin City and region. In addition to providing a long term and reliable solution for water supply in the greater Dublin area, it would also enable to improve water supply in a large “benefitting corridor”. As a result, the Eastern and Midlands WSP has become a nationally strategic water supply project, which will concern up to 45% of Irish population and require an investment of above 1 billion €.

However there is not an agreed acceptance in the population of IW’s proposed solution and a heated debate has ensued. A multiplicity of concerns have been voiced, with regard to the assessment of current and future demand assessment (is it accurate?), the leakage of leakage and IW’s strategy to address it (shouldn’t it be reduced more and faster?), the potential impact on the Shannon or the choice of the most suitable route.

In response to the various controversies, the Commission for Regulation of Utilities (CRU), i.e. the Irish regulator for water, will undertake a complete review of the Eastern and Midlands WSP, which will involve consultation with key stakeholders of the sector, including the Water Forum.

The Water Forum has sought outside expertise to look into the various issues raised in the debate around the Eastern and Midlands Water project, in order to be able to contribute meaningfully to the CRU review. The assignment’s objective was to provide insight about the project need assessment based on an independent review of existing data, and benchmarking information about the potential to use groundwater, desalination, recycled water or rainwater collection as alternative water supplies.

A presentation addressing these issues was made during a dedicated Forum meeting on the 9 April 2019. The present note provides a summary of the elements that were discussed on that day; the full presentation is included in Appendix.

2 REVIEW OF THE PROJECT NEED

The need for the project arises in relation to two separate objectives:

- Meeting drinking water needs in the long run
- Increasing the resilience of the water supply.

2.1 MEETING DRINKING WATER NEEDS IN THE LONG RUN

The challenge of meeting drinking water needs in the long run lies in properly assessing the evolution of demand in order to estimate future production requirements and then plan in a timely manner the delivery of any additional production capacity that may be required.

Irish Water's assessment of future water demand in the Dublin water supply area is provided in the Project Need Report (PNR) published in 2015, with an updated version published in the First Options Appraisal Report (FOAR) in 2016. In its response to the public consultation on the FOAR, IW mentioned that it should release a "revised Project Need Report" towards the end of 2017; this document could not be retrieved.

2.1.1 Preliminary observations about Irish Water's published analysis

Supply-demand balance is a standard tool with abundant literature and models available to support its implementation (in particular from the International Water Association, which has codified its various components). However Irish Water's analysis of this balance, as presented in the project document, shows a number of weaknesses:

- **Poor quality of baseline data**[1]: the data used to establish the starting point for the analysis are now significantly outdated (2011); yet, their reliability can be questioned as "adjustments" had to be made between the PNR and FOAR; finally, these data are not always consistent with other available sources.
- **Lack of "depth":** the hypothesis is underpinning the projections are not presented in a clear and structured manner and no supporting evidence(such as historical analysis, modelling, benchmark, etc.) or detailed arguments is provided to demonstrate their pertinence; in particular, very few explanations are provided as to why some of these hypothesis have evolved between the PNR and the FOAR.
- **Absence of "sensitivity"** analysis: IW used several scenarios of population growth (and retained the "most likely" one) for its projections; however, only a single hypothesis was made for other parameters (such as per capita consumption or leakage), without characterizing the "level of confidence" attached to it. Considering a "range" of values for the various parameters used in the projections would have allowed to model several trajectories of evolution for the demand; and to show the influence on these trajectories (and therefore on production requirements) of each parameter (which are to some extent "within the control" of the water utility). Sensitivity analyses are standard components of forward looking studies.

[1] "The background data sets used to underpin the assessments were from recognised and authoritative sources such as the Census and non-domestic metering data": Irish Water's response to challenges of its assessment provides no specifics about data sources used for domestic consumption and leakage.

Table 1 Variation of baseline data on demand

	PNR data - 2015	FOAR data -2016	Difference
Domestic demand (ML/d)	231	216	-7%
Non domestic demand (ML/d)	126.5	110	-13%
Leakage(ML/d)	178.1	204.7	15%

2.1.2 Review of demand projections[2]

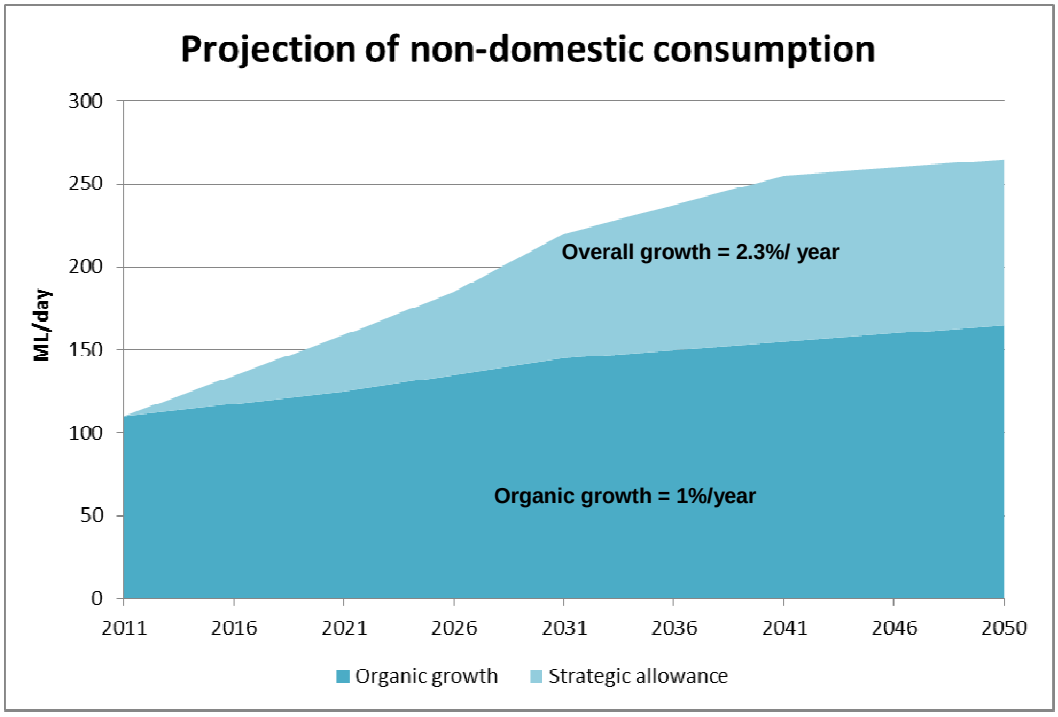
a) Non domestic consumption

Non-domestic consumers have been metered since 2008; thus, in theory, there should be a 10 year series of data documenting their consumption, enabling to set the baseline level with a good degree of precision and providing context about past evolution. In particular, it would be insightful to compare the actual evolution of non-domestic consumption between 2011 and today with the 1.25 % /year growth over the period assumed in the FOAR projection. While this data has informed Irish Water's analysis, it is not provided in the project documents

The projection of non-domestic demand includes two separate components:

- "organic growth", which results from the development of the economy according to a "natural" trend;
- a "strategic allowance" meant as a "response to additional demand", which represents almost twice as much as the organic growth between 2011 and 2050.

Figure1 Evolution of non-domestic consumption

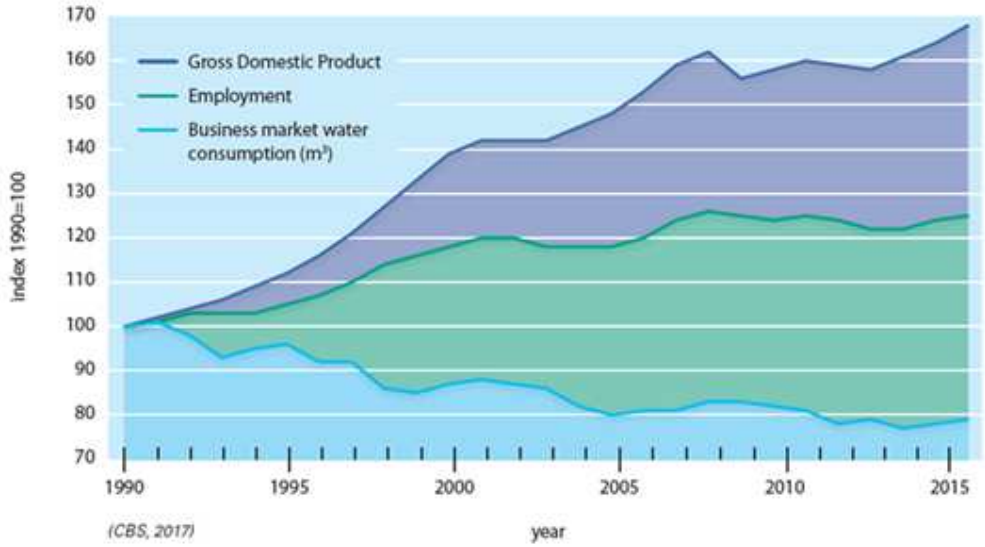


The notion of a "strategic allowance" in itself is confusing: either there is a reasonable expectation that this water might be needed and then it should be included in the demand projection; or it is a "security buffer" which should rather be included in the "headroom".

[2] In the following, we refer to the water actually needed and used by consumers as "consumption", while demand refers to the overall volumes that need to be put in the system, i.e. including leakage.

The addition of these two components results in an overall increase of non-domestic consumption by 2.3% / year over the period to 2050. This is in the high range of what would be considered as reasonable in such analysis. International benchmark shows that PIB growth and water consumption have been largely decorrelated in past decades, a result of increased water efficiency.

Figure2Business market drinking water consumption vs. development of the economy in the Netherlands, 1990-2015



Source: Dutch Drinking Water Statistics 2017 "From source to tap"

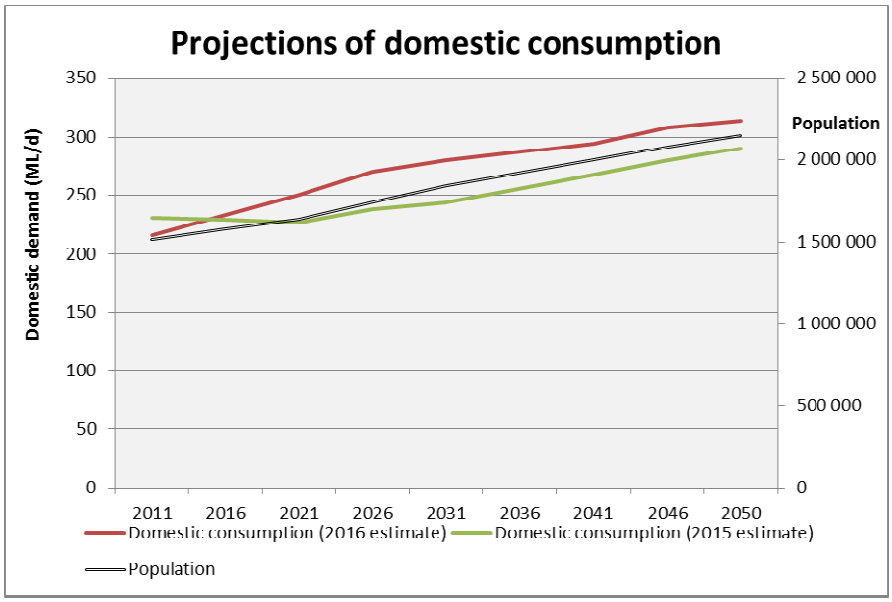
b) Domestic consumption

Domestic demand can be calculated as follows:

- number of connections x consumption per connection;
- population x consumption per capita;

The first approach was used in the PNR and the second in the FOAR, which makes it quite difficult to reconcile the projections made in each case; as a matter of fact, these projections lead to markedly different estimates of future demand (+26% vs +45% increase from 2011 baseline), even though they use the same scenario of population growth.

Figure3Projections of domestic consumption



The assumptions made in the FOAR, summarized below, result in a PCC of circa 140 L/day.

Table 2 Estimates of per capita consumption

	2011	**2021**	**2050**
Population	1 516 133	1 642 391	2 154 252
Occupancy rate	2.69	2.48	2.2
Number of households	591 798	695 366	1 028 165
Consumption per connection (l/property/day)	365	360	305
Domestic consumption	216	250.3	313.6
Consumption per capita (l/day) calculated as total / population	*142*	*152*	*146*
*Consumption per capita (l/day) calculated as per connection consumption / occupancy rate**	*136*	*145*	*139*

* The difference between the two estimates results from Irish Water's calculation including an extra 5% of unoccupied properties to the total number of households, with the same consumptions as occupied dwellings.

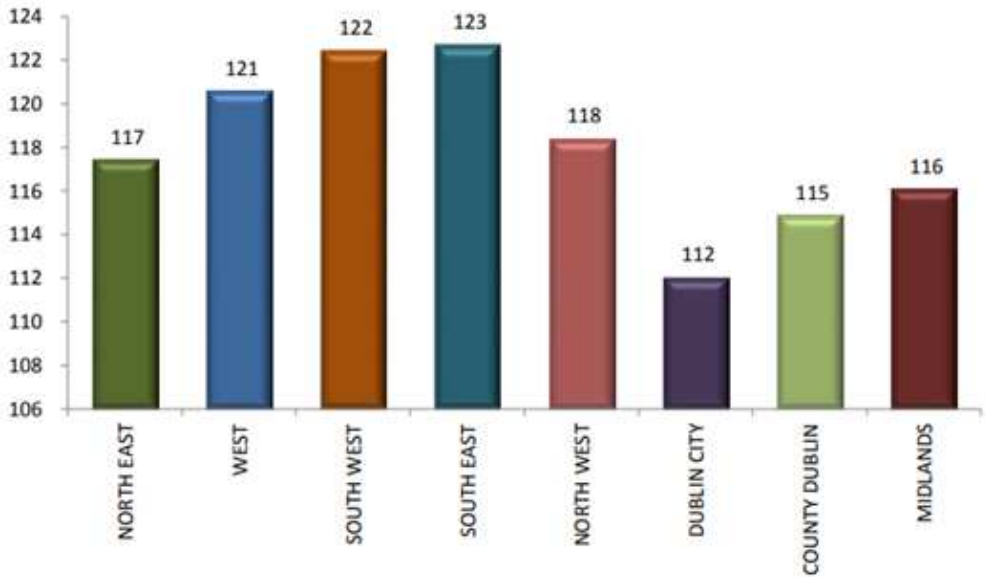
This number is not consistent with PCC calculated on the basis of meter data:

- In 2015, a water consumption project undertaken by Irish Water showed that the average PCC was rather around 123 L/day/capita[3], a number that was reliable enough to be submitted to the Expert Commission that was in place at the time[4]. Furthermore, it identified that a significant share of consumption could be attributed to a small numbers of "outliers" with disproportionately high consumption. PCC excluding these outliers (referred to as "regulated PCC") was around 110 L/day/capita.
- Consumption reports produced quarterly by Irish Water since this initial study have confirmed the above figures; they also show that regulated PCC is the lowest in Dublin city, Dublin County and the Midlands.
- In August 2018, the Central Statistics Office released a report compiling Irish Water's meter data from 2014 to 2016: it shows that average PCC is below 130 L/day per capita and regulated PCC under 100L/capita/day in 2016 (considering an occupancy rate of 2.75, as per the latest census data), thus outline the disproportionate influence of "outliers" on average consumption:

[3] https://www.cru.ie/wp-content/uploads/2014/07/CER14570g-Irish-Water-Consumption-Research-Project-IWCRP-Phase-3.pdf
https://www.cru.ie/wp-content/uploads/2014/07/CER14420-A11-Irish-Water-Water-Consumption-Research-Project-Memo-to-CER-1.pdf

[4] *Irish Water presented consumption data to the Expert Commission based on metered consumption to date, which indicated that domestic consumption is relatively low in Ireland with average consumption of 123 litres per capita (…) While comparison of domestic consumption with other European countries is difficult due to differing methods of measurement and because the data can be out of date, this most recent consumption data suggests that Ireland is at the lower end of the spectrum of EU countries with regard to domestic consumption.*

Figure4Regulated PCC per region (litres per day)

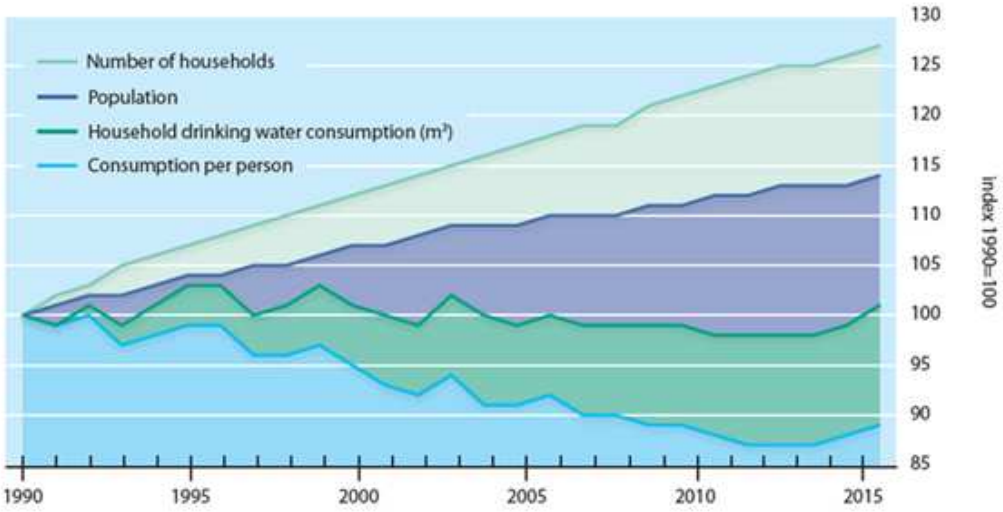


Source: Q3 2016 CRU Consumption Report

In addition to using baseline data that seem to overestimate "current" PCC, Irish water's projection include no reduction of this PCC by 2050 (even though it considers a -16% reduction in "per connection" consumption). This hypothesis can be challenged in two respects.

First, PCC has decreased across developed countries over the past decades[5] and, while retrospective trend cannot always be extrapolated, most utilities expect to maintain this trend thanks to ambitious demand management strategies[6].

Figure5Household drinking water consumption vs. population growth in the Netherlands, 1990-2015

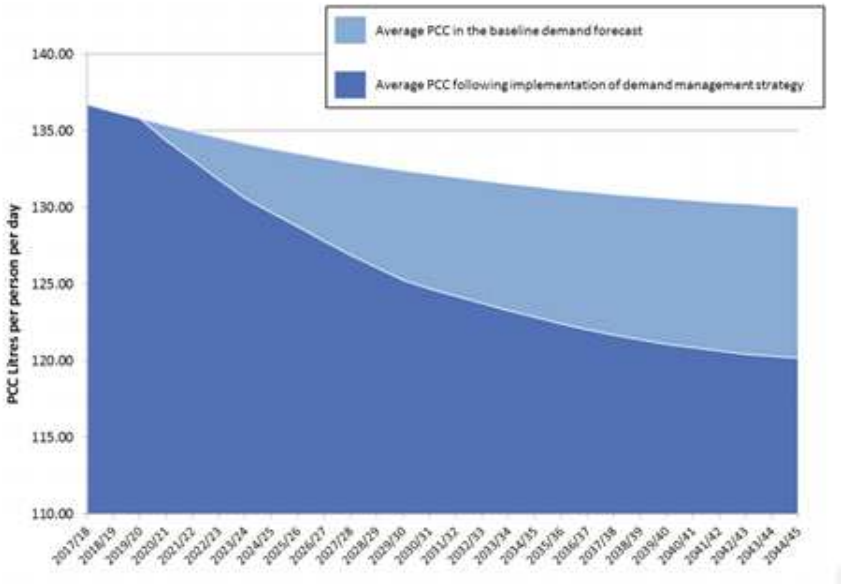


Source: Dutch Drinking Water Statistics 2017 "From source to tap"

[5]This trend has even jeopardized the economic model of water utilities, the revenues of which have dropped while their costs are essentially fixed costs.

[6] Even though further reduction will likely be ever more difficult to obtain as PCC becomes lower.

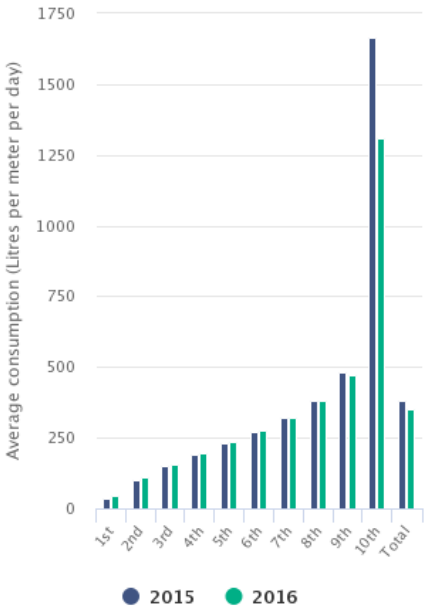
Figure6Evolution of PCC in the Anglian Water area



Source: Anglian Water – Water resources management plan

In addition, reduction of average PCC could be achieved "just" by eliminating excess consumption by outliers (whose excess consumption most likely results from undetected customer side leakage rather than deliberate wastage). Significant progress was made in this regard thanks to the First Fix Free Scheme: it led to an 8.4 % reduction in average PCC between 2015 and 2016, as shown in the table below.

Figure 7Domestic Public metered water consumption by decile , 2015 and 2016



Source: CSO Ireland[7]

In 2016,"outliers" (with consumption above 1000 L/capita/day) accounted for less than 1% of households but 25 % of metered volumes Bringing down their consumption to the average level would save circa 20% of total consumption, close to 25 ML/day.

Even though these numbers might not be extrapolated to non-metered households and that reducing internal leaks will become ever more challenging (e.g. leaks located in underground supply pipes), this shows that there is still considerable room to maneuver in terms of "demand management".

[7] https://www.cso.ie/en/releasesandpublications/er/dmwc/domesticmeteredpublicwaterconsumption2016/

2.1.3 Review of leakage projections

Leakage is a significant issue for water utilities in many regards: environmental, (over abstraction), economic (capital and operational costs of producing water in excess of actual consumption), operational (time dedicated to finding and fixing leaks).

The level of leakage depends on various parameters:

- « External » conditions (soil, weather, traffic)
- Network characteristics (age, material)
- Leakage management
    - Speed of detection
    - Speed of detection and repair
    - Infrastructure renewal (mains, supply pipes)
    - Pressure management

While the current level of leakage is known to be high in the Greater Dublin water supply area and in Ireland in general, it couldn't be precisely determined at the time when demand projections were established. Estimates for 2011 leakage volumes varied between 178 ML/day in the PNR report and 204.7 ML/day in the FOAR report (a 15% difference).

The reason for such uncertainty was explained by Irish Water in its Strategic Plan published in October 2015: *"We are currently carrying out detailed audits across the country and validation of the local area metering and valve controls forming District Meter Areas (DMAs) which have been installed since 2000 in most local authorities at a cost of over €100M. In many cases, the integrity of DMA boundaries has been compromised for local operational reasons so that accurate leakage calculations and leak targeting are not currently possible. We are working to re-establish the DMA infrastructure as a pre-requisite to a large scale programme of water conservation measures, which we plan to deliver on a regional basis."*

The implementation and operation of a new system providing Irish Water with greater capability to accurately report on leakage performance and monitor progress over time was due to be completed by Q4 2018 according to IW's 2018 Performance Assessment Report

It is hardly meaningful to comment on the ambition of the proposed leakage reduction targets (shown in the table below) given this uncertainty about the "starting point", but also because the "ambition" varies depending on which indicators is considered (most "standard" indicators on leakage are biased by the evolution of some other parameters of the service: consumption, number of connections, length of mains, etc…). Such indicators should therefore be used with caution, especially to benchmark leakage level across water utilities.

Alternative indicators such as the "sustainable level of leakage" or Infrastructure Leakage index, while requiring more data to calculate, are now widely recommended are more appropriate tools to asses leakage performance and track progress.

Table 3 Variation of baseline data on leakage

	2011 level	**2050 target**	**"Ambition"**
Unaccounted for water	204.7	140.8	-31%
as % of average demand	38%	19%	-49%
Linear Leakage Index (m3/km/day)	22.32	15.35	-31%
*Network length**	*9171*	*9173*	-
Leakage per property per day	*346*	*137*	-60%

* A simple calculation shows that leakage projection expressed as LLI does not take account of network extensions.

Despite the aforementioned caveats about benchmarking, it is insightful to analyze some case studies demonstrating that significant reduction in leakage can be achieved in fairly short period of times. Progress can be achieved through a combination of means, including improved data management to speed up leak detection (e.g. Scottish Water achieved 96% DMA coverage), pressure management, new operational organization, regulatory pressure, etc…thus showing

that infrastructure renewal is not the only solution to leakage. A strong focus from the leadership/management and dedicated resources appear to be key factors of success.[8]

Table 4Leakage reduction performance in three countries

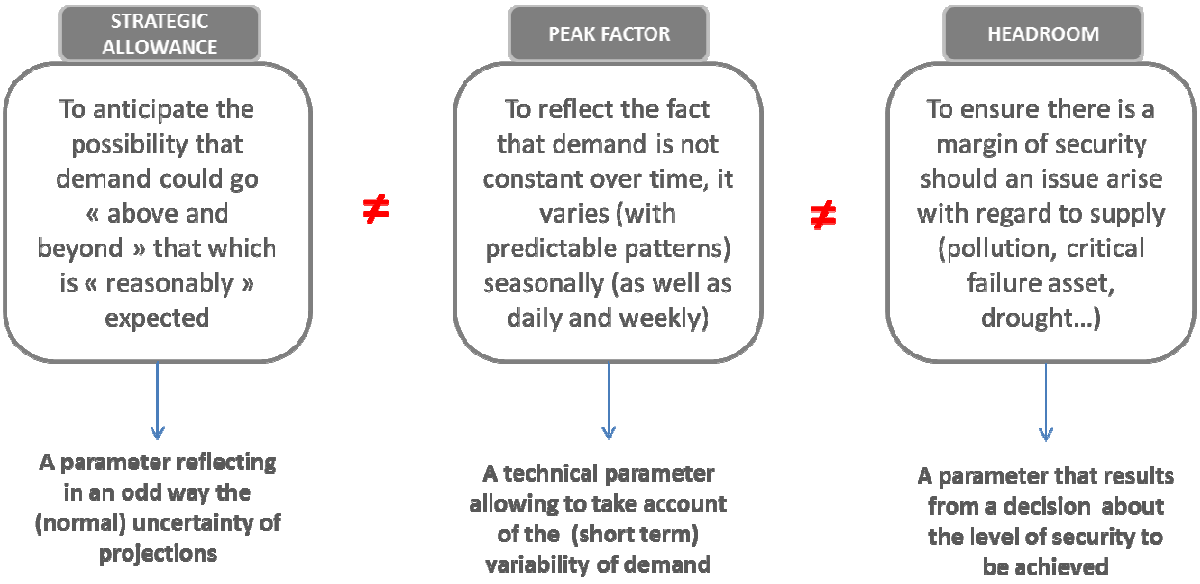
Malta	Losses per connection per day reduced by 70% in 12 years, production reduced from 50 to 30 Mm3 per year
Portugal/Lisbon	Losses reduced from 27 to 8.1 Mm3/yr(-70%) between 2005 and 2013
Scotland	Losses reduced from 1104 to 575ML/d (-48%) between 2006 and 2013

2.1.4 Conclusions about the supply demand balance

Uncertainty is inherent to the exercise of developing projections but it should be reduced to a minimum by using accurate data, robust hypothesis and sensitivity analysis. Unfortunately, the elements presented in the project documents that were released IW do not meet these requirements; they appear too superficial to give confidence in the soundness and reliability of the estimates of future demand (although this does not prejudge the quality of the work carried out internally by Irish Water).

In particular the lack of rigor, details and pedagogy regarding how the projections were built (absence of data sources, inconsistencies, adjustments) has created confusion, which in turn has fed distrust towards the justification for the project.

Figure 8an example of confusion about three parameters of the supply and demand balance



Furthermore, the analysis can be challenged in substance as much as in form: the significant growth in demand that is anticipated is in contradiction with the trend that has been observed in other countries over the past decades; and it could likely be curbed by using various levers of demand management that have been successfully implemented by other utilities. Therefore, future demand seems overestimated, possibly with a view to building a stronger case to justify the project?

[8]These and other case studies are presented in "EU Reference document - Good Practices on Leakage Management WFD CIS WG PoM - Case Study document", available at https://bit.ly/1K6K8BK.

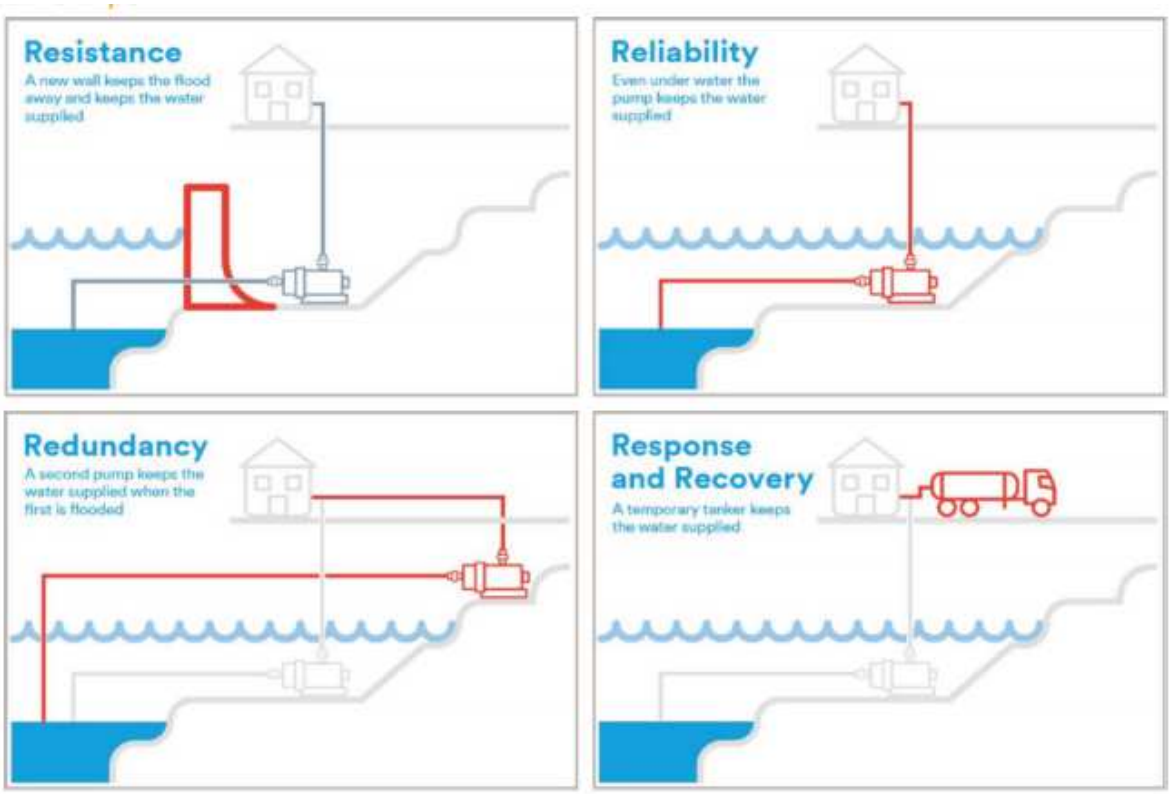
2.2 INCREASING THE RESILIENCE OF WATER SUPPLY

The resilience of a water supply system (including infrastructure as well as organizational components) can be defined as the ability of such system to maintain the continuity, safety, security, and sustainability of water supply services, even in case of unplanned natural events such as storms, drought, pollutions or any other reasons that could cause critical assets failure.

As was highlighted in Irish Water's 25 years strategy, "*Planning for resilient water supplies must take place independently of any progress in demand management (reducing unnecessary use of water) or success in reducing leakage, because loss of a key water source, treatment plant, or pipeline remains a separate risk to be managed*".

Resilience can be strengthened by improving performance on four key parameters: resistance, reliability, redundancy and response & recovery, as illustrated by the example below.

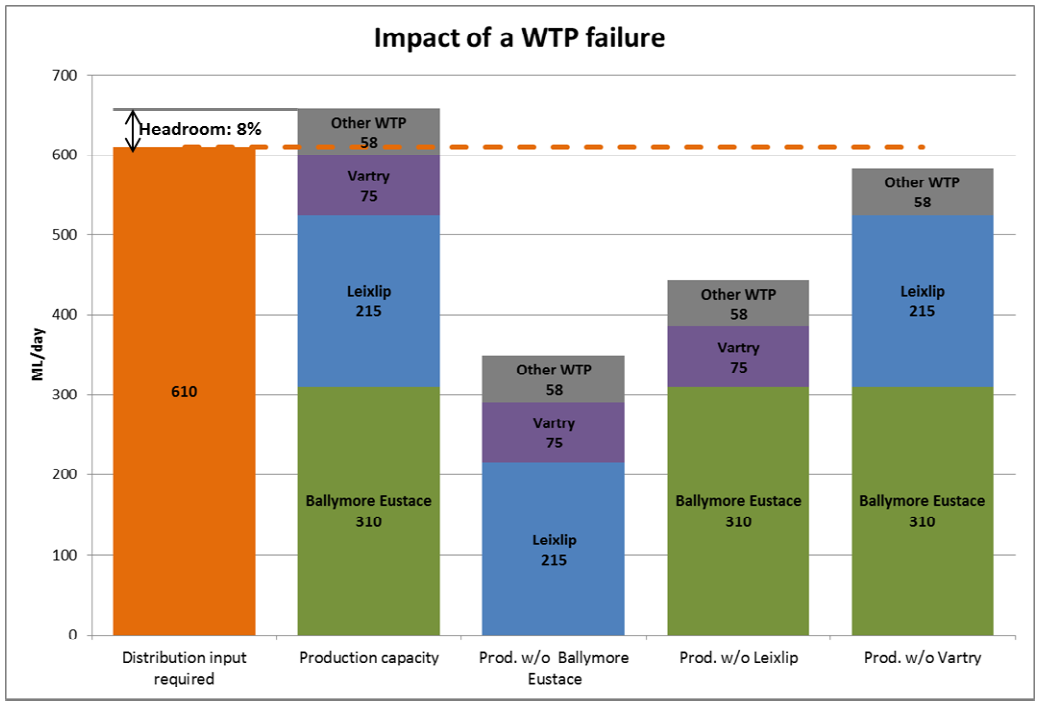
Figure 9Explanation of the 4 Rs of resilience using different ways to provide resilience of water supplies to flooding as an example



Source: United Utilities

Currently, approximately 84% of Dublin's water comes from the River Liffey, which means that the service could not be maintained if this source was to become "unavailable" (e.g. due to acute pollution) or insufficient (e.g. in case of drought reducing the flow available for abstraction). Furthermore, as the main treatment plants (Ballymore Eustace, Leixlip, and Vartry) are currently at their maximum production capacity, any failure of these assets would also result in significant disruption to the service. Similar "risky" situations seem to be pervasive in the midlands, in particular where water supply relies on a single groundwater source with a yield that may reduce at times of drought.

Figure 10Impact of a water treatment plan failure on water supply capacity



Two approaches can be used (and combined) to improve the resilience of the water supply and therefore the security of supply:

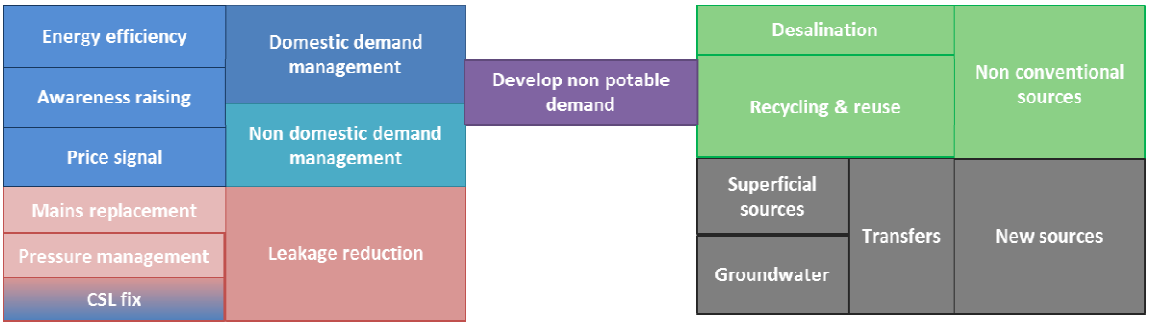
- increasing the headroom between production capacity and demand;
- diversifying supply sources.

The Eastern and Midlands WSP meets both these objectives; and would benefit both Dublin and a “corridor” made up of all the water supply areas that could connect to the main supplying water from the Shannon River.

3 POTENTIAL SOLUTIONS FOR BALANCING WATER DEMAND AND SUPPLY

A broad panel of solutions can be envisioned to ensure that an adequate balance between water supply and demand is maintained over the long term.

Figure 11 Illustration of the various solutions enabling to manage the supply demand balance



All these options can (and, in many cases, should) be implemented simultaneously, with cost-benefits analysis, and impact assessment enable to choose the most effective and efficient combination.

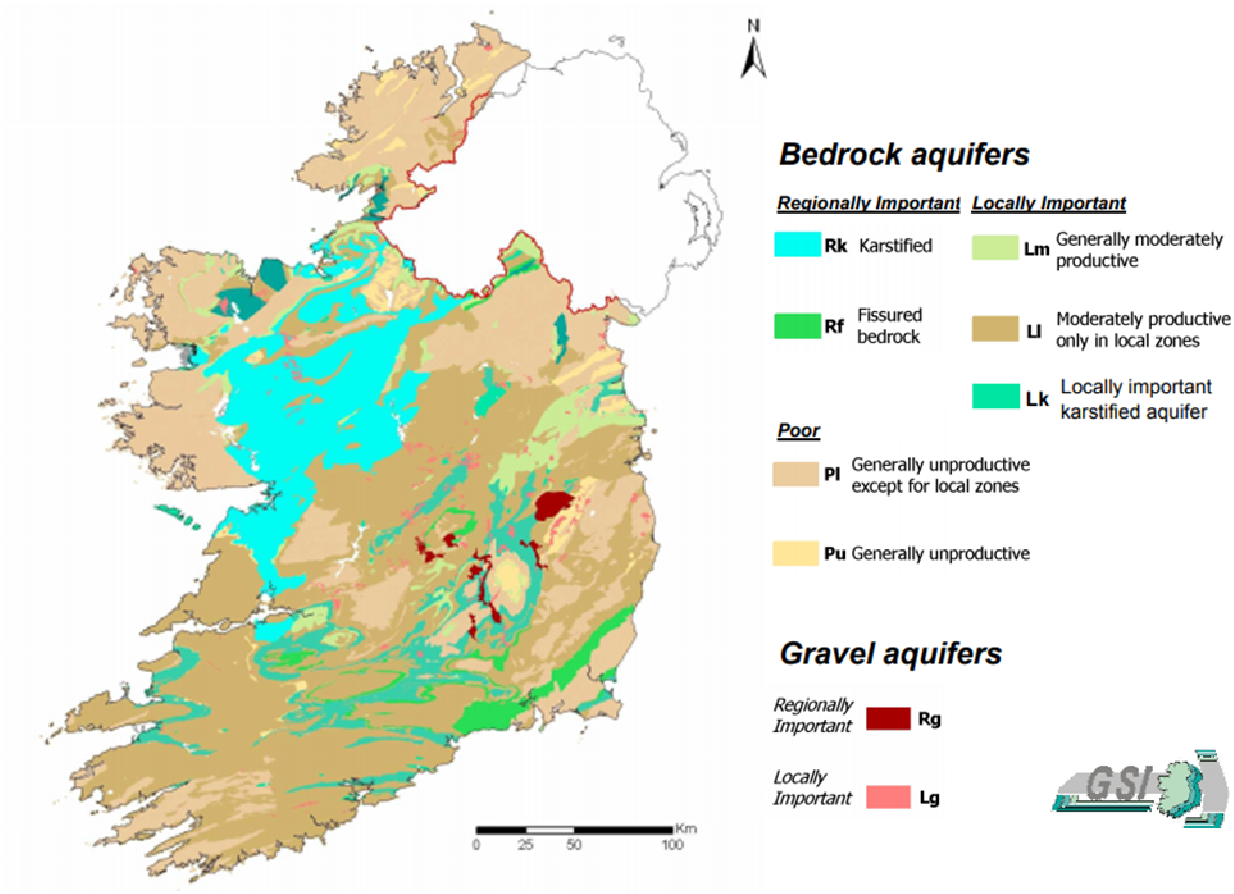
While Irish Water indicates that it will implement demand management and leakage reduction strategies in addition to developing new supplies, it is not clear how much effort (financially and operationally) will be dedicated to each of these components, making it impossible to appreciate the pertinence of the overall approach to meeting future water needs in the Dublin and midlands area.

As to the development of new water supplies, benchmark illustrates that groundwater abstraction, desalination or the use of non-conventional resources are being used by water utilities across the world. However, the potential (and limits) of such options depend on the local context in which they are implemented; "site specific" analysis is therefore required to gain insight into whether and by how much they could contribute to reducing the water supply "gap" in the Eastern and Midlands region.

A few comments can still be made:

- Key drivers for the installation of rainwater collection systems include expected savings on water bills and/or regulatory requirements; none of these drivers is currently present in Ireland. However, should they be put in place, the resulting impact on drinking water demand would likely be limited and slow to materialize;
- A study conducted during the project development process concluded that "*groundwater on its own would not be able to supply the projected demand, and that the best use of this limited groundwater resource would be in a 'supplementary' capacity*." In fact, there are only a few "regionally important" aquifers with significant productivity in Ireland (as illustrated on the map thereafter); only 100 wells in the country (out of 2000, i.e. 5%) supply more than 1ML/day.
- A significant barrier to the use of desalination is the high cost associated with this technology, hence why it has been used almost exclusively in highly water-stressed countries to date. Cost was in fact a criterion for ruling out desalination as an alternative for the Eastern and Midlands WSP; however the main weakness of this option was that it could only address the water needs of the Dublin area while the Shannon scheme will benefit a significant corridor in the Midlands as well.

Figure 12Hydrogeological map of Ireland



Source: http://www.wfdireland.ie/

Finally, Irish water assessed several scenarios of water transfer from the Shannon River, with different abstraction points and pipeline routes. A detailed review of the available (and additional?) studies would be required to confirm whether the best scenario has been retained; without taking a position in this regard, it can be noted that Irish Water's arguments haven't completely settled the case, as some stakeholders still raise the existence of other alternatives (e.g. use of the Royal canal?).

4 CONCLUSION

The “helicopter” review of the Eastern and Midlands WSP that was conducted provided the Forum with some necessary insight to prepare its contribution to the CRU review, and in particular toidentify the points that deserve further clarification or consideration by Irish Water.

The key take away points from the review include the following:

- The information presented to justify the need for the WSP project suffers from many unknowns and uncertainties :
    - Either supporting data are available but not shared by Irish Water, which reflects a lack of pedagogy and transparency
    - Or these data don’t exist, which means that there is no solid foundation for the projections justifying the need for the project (at least at this scale): it might then be better to wait for progressing any further that basic buildings blocks are in place.
- However, without considering future demand, the situation in Dublin is already very challenging, due to the lack of headroom and more importantly, the almost exclusive reliance on a single source. Increasing the resilience of the water supply not just in Dublin but for all the Midlands region is therefore a critical argument to justify the Eastern and Midlands WSP; and may justify that it should start sooner rather than later.
- By all means, “fixing” water supply challenges are a complex matter, for which there are usually no “silver bullet” and the Eastern and Midlands WSP makes no exception. In particular, different ways of reducing demand as well as increasing supplies could be considered and implemented simultaneously, with impact assessment and cost benefits analysis allowing to define the most adequate combination.
- Water demand is not an external parameter, such as rainfall, but instead a component of the system that a water utility can, and should, manage; to that end, it is necessary to adopt a holistic view of all the drivers, as well as levers, that can influence water demand in the future. While Irish water indicates that it intends to implement a demand management strategy, the impact of such strategy is not evidenced in the proposed demand projections.
- The same applies for the leakage issue: Irish Water does not explain how future leakage targets have been set and how they are aligned with best practices, available resources and customer preferences. International experience, including that of Scottish Water, show that significant progress can be achieved in this area in relatively short period of time and without relying exclusively on infrastructure renewal. Raising ambition on leakage could help increase the acceptability of the Eastern and Midlands project, which otherwise could be seen as a “necessary evil” to compensate the current wastage of resources.
- At the same time, it is important to stress that improving performance (whether on leakage, demand management or operations in general) takes time and depends on many conditions (human resources capabilities, leadership, financial resources and above all regulatory pressure/support). Irish Water is still a fairly new organization inheriting a challenging situation: should the role of the CRU in helping it deliver better performance be strengthened?
- In addition to the CRU, the Forum could also play a significant role in helping Irish Water better understand the views of its customers as well as their preferences and priorities: through an ongoing engagement process, the utility could better anticipate, understand and potentially resolve future issues before they become national controversies; and develop better ways to engage and communicate with customers, above and beyond institutional “consultation”.

5 APPENDIX