Autumn 2022

Draft Regional Water ResourcesPlan - North West

Appendix 5 Study Area E Technical Report

Tionscadal Éireann
Project Ireland
2040

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 applicable policy documentation.

Baseline data included in the draft RWRP-NW has been incorporated from numerous sources including but not limited to National Planning Framework, Central Statistics Office, Regional Spatial and Economic Strategies, Local Authority data sets, Regional Assembly data sets and Irish Water data sets. Data sources will be detailed in the relevant sections of the draft RWRP-NW. 2019 was selected as the base year to align with the planning period (2019-2025) of the NWRP.

Table of Contents

1 Introduction and Background

1 Introduction – Study Area E – Louth

This is the Technical Report for Study Area E which applies the Options Assessment Methodology, as set out in the National Water Resources Plan - Framework Plan (NWRP-FP), the final version of which was reviewed by the authors of this Technical Report Prior to finalisation of this Technical Report. This document should be reviewed in conjunction with Framework Plan and the draft Regional Water Resources Plan – North West (RWRP-NW), which explain key concepts and terminology used throughout the report.

This Study Area includes 9 water resource zones located in County Louth, County Meath, County Monaghan and County Cavan. This Technical Report includes:

- The summary of Identified Need in this Study Area including Quality, Quantity, Reliability and Sustainability;
- Options considered within the Study Area;
- The range of approaches to resolve Identified Need;
- Development of an Outline Preferred Approach for the Study Area; and
- The adaptability of our Preferred Approach.

The Preferred Approach for this Study Area feeds into the regional Preferred Approach detailed in the draft RWRP-NW.

1.1 Summary of Our Options Assessment Methodology

In Chapter 8 of the Framework Plan, we described the Option Assessment Methodology that will be used to develop a national programme of proposed solutions for all of our water supplies. The objective of these solutions is to resolve the needs identified through the Supply Demand Balance (SDB), Water Quality, Reliability and Sustainability assessments. These needs will be discussed in further detail in this report. In the draft RWRP-NW, we apply this methodology to the North West Region shown in Figure 1.1.

As outlined in Section 1.9.4 of the Framework Plan, the regional boundaries have been delignated for the purpose of delivering the National Water Resources Plan. As a National Plan, sources outside the delivery region may be considered to meet need within a particular region.

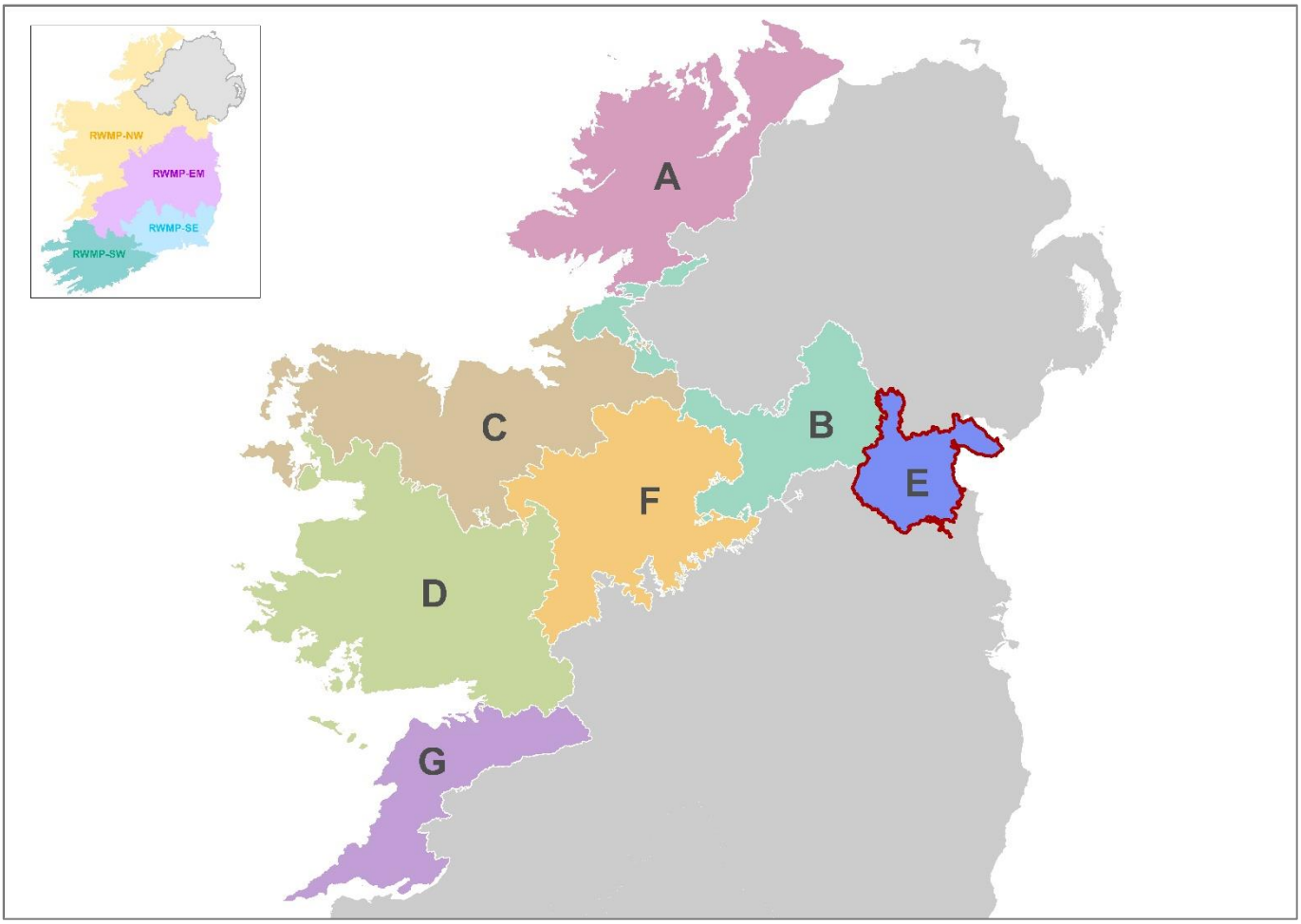


Figure 1.1 Overview of Study Areas within the North West Region.

This Technical Report is for Study Area E (SAE), which consists of 9 individual water resource zones (WRZs). Within this Study Area, the Preferred Approach has been developed following the process shown in in Figure 1.2 and as outlined in Section 8.3 of the Framework Plan.

In this document, Option codes are labelled using the following naming convention: SAX-00X

- SAX refers to the Study Area within which the option is located.
- 00X refers to the individual option number.
- Any references to TG1 refers the North West Region (Regional Group 1).

It should be noted that assessments and preferred approaches and solutions at this stage are at a plan level. Environmental impacts and costing of projects are further reviewed at project level. No statutory consent or funding consent is conferred by inclusion in the national plan. Any projects that are progressed following this plan will require individual environmental assessments, including Environmental Impact Assessment and Appropriate Assessment (as required), in support of planning applications (where a project requires planning permission) or in support of licencing applications (for example, for new abstractions). Any such applications will also be subject to public consultation.

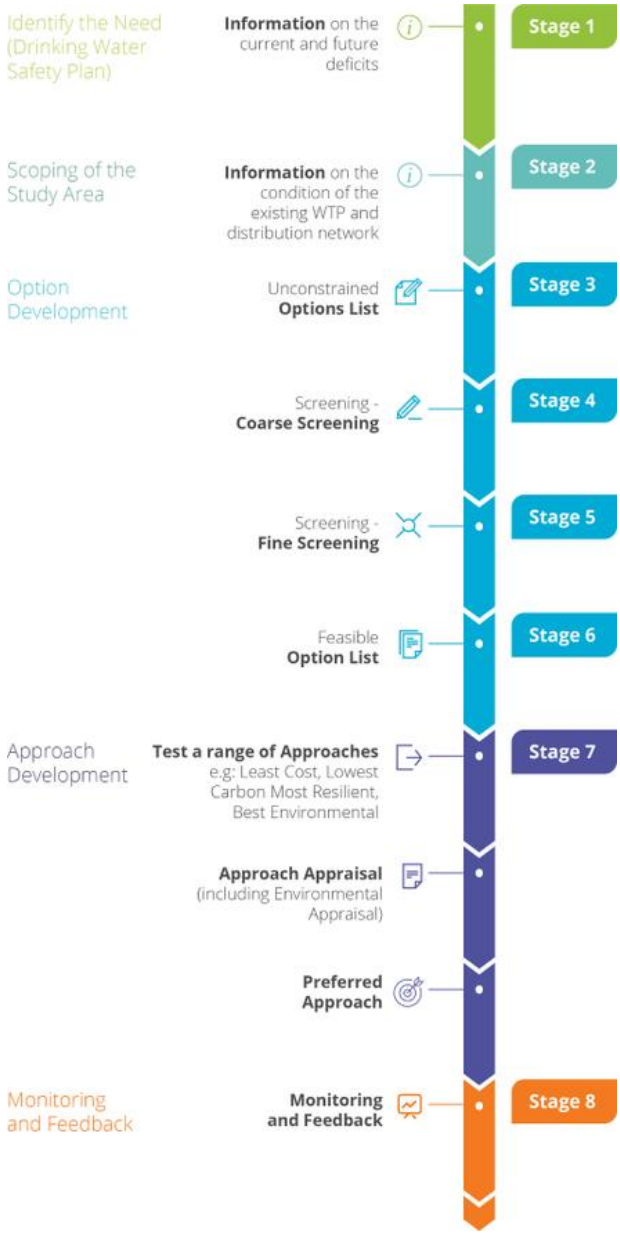


Figure 1.2 Option Assessment Methodology Process

1.2 Introduction to the Study Area

SAE consists of 9 WRZs supplying a population of approximately 84,053 people via approximately 1,036 kilometres of distribution network. The majority of the Study Area is in County Louth, with the southwestern boundary in County Meath, the western boundary in County Cavan and the northwest boundary in County Monaghan. The largest town is Dundalk, whilst Ardee and Carrickmacross are other areas of high demand within the Study Area. The Study Area's water treatment plants (WTPs) and their associated source type are summarised in Figure 1.3 and Table 1.1.

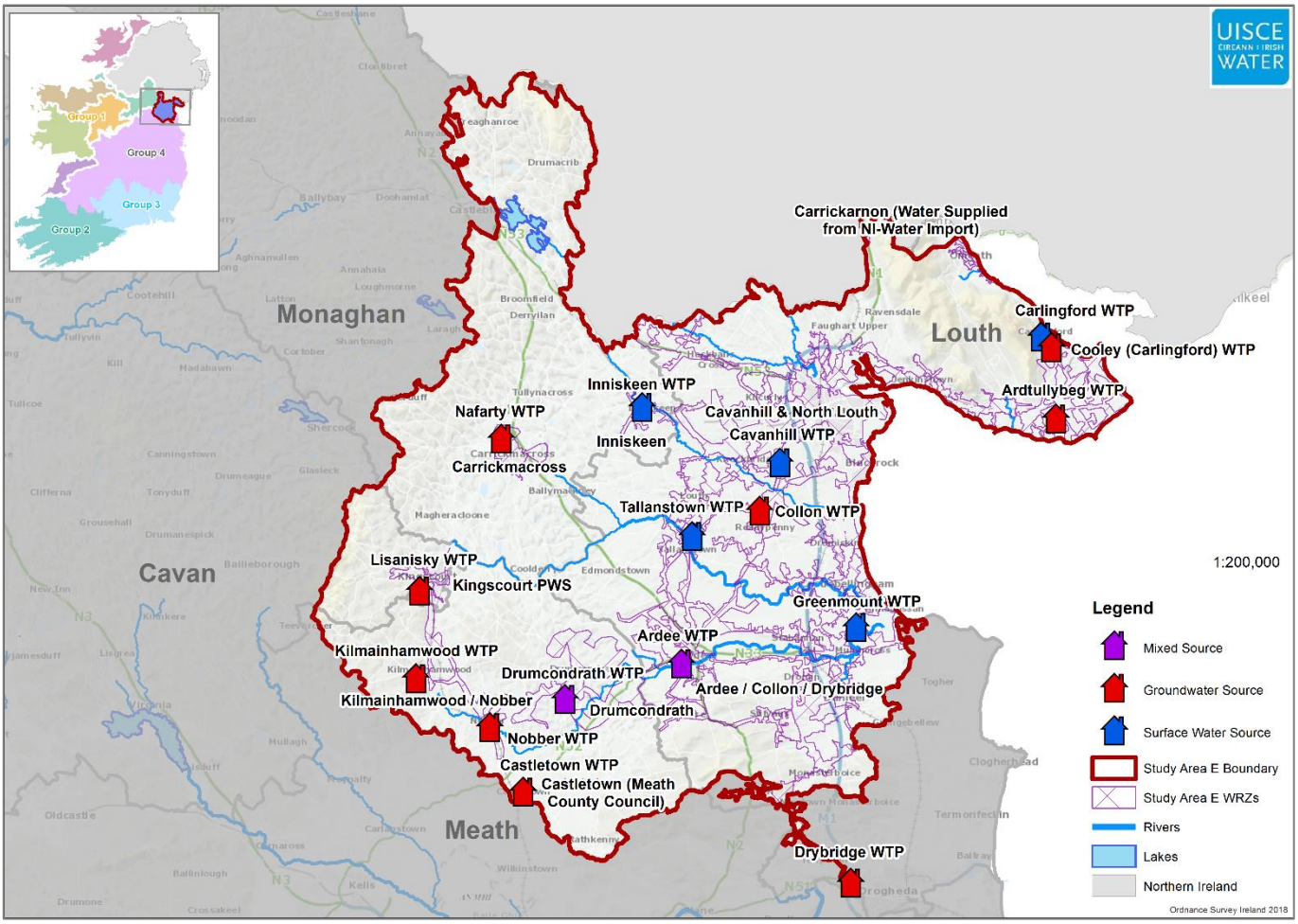


Figure 1.3 SAE Louth Meath Water Supply Study Area

The sources of water supply consist of 8 surface water abstraction and 11 groundwater abstractions in SAE.

Regarding surface water availability in the Study Area, SAE is entirely within the boundaries of the Newry, Fane, Glyde and Dee catchment (HA 06). This catchment includes the area drained by the Newry, Fane, Glyde and Dee rivers, and by all streams entering tidal water between Murlough Upper and The Haven, Co. Louth. Regarding surface waters within designated areas, there is only the Carlingford Mountain SAC in the North East of the Study Area. There are no High Ecological Status (HES) waterbodies within SAE.

Over two thirds of the total water supply for the Study Area comes from surface water sources, with a third supplied up from groundwater sources. Around 60% of the SAE supply comes from a large river abstraction at River Fane to supply Cavanhill & North Louth WRZ. The River Fane source was designed as part of a low flow augmentation scheme for the Dundalk Water Supply Scheme some thirty years ago. The River Fane source has two centres of activity as it comprises a headworks at Lough Muckno in County Monaghan to regulate lake levels and outflows, and the abstraction intake from River Fane over 20km downstream in County Louth. Dundalk U.D.C have an historical water order to abstract up to 36,400 m^3/day from River Fane.

Elsewhere in the Study Area, the other surface water abstractions consist of another smaller intake from the River Fane at Inniskeen WTP, an abstraction from the River Glyde at Tallanstown WTP, two intakes from the River Dee at Ardee and Greenmount WTPs, two mountain stream sources feed Carlingford WTP, and the small lake source Lough Brackan partly supplying Drumcondrath WTP.

Overall, 22 groundwater sources are managed by Irish Water in the region. The predominant aquifer type of the area is made up of poorly productive bedrock (70%), with a relatively minor contribution from karstic (5%), productive fissured (5%) and sand and gravel aquifers (3%). Although groundwater abstractions are more numerous than surface water they serve a smaller fraction of the region's total supply. This highlights the difficulty in procuring large volumes of water from groundwater abstractions.

Much of the Study Area forms part of the low-lying Longford-Down massif and is underlain by sandy and shaley rocks deposited in the Silurian period. These areas, as seen in North Louth and eastern Monaghan, are classified as poorly productive aquifers and will not offer the same kind of groundwater potential as the karstic and productive fissured rocks seen elsewhere. Although fractured, these rocks generally have a low permeability and are regarded as poor aquifers. Such rocks will often yield enough water to supply a house or small farm (0.2-0.5 l/s) and occasionally in major fracture zones may yield a good deal more. However, since the yield often depends on the permeability developed in the uppermost few metres of broken and weathered rock, yields will often decrease markedly in dry spells as the water table falls, and these supplies may therefore be unreliable.

The karst forms a key regionally important aquifer in some areas, most notably in the west of the Study Area around Carrickmacross, which consists of clean limestone that has been extensively karstified. The flow regime in the area is strongly affected by the aquifer, with recharge occurring rapidly. Streams and lakes in the area are also predominantly supplied by baseflow. The well data indicate that high permeability zones exist within the aquifer. Due to the karstic nature of the aquifer, the permeabilities are likely to be variable. Thus, this aquifer is classified as a regionally important karstic aquifer (Rk). Given the number of productive wells and the apparent lack of 'failed' or 'poor' wells, this aquifer is considered to be dominated by diffuse flow within the karstic system (Rk^d). Notable high yielding wells in this area include the Nafarty well field, with potential yields of up to 1,600 m^3/day reported.

The sandstone aquifers which outcrop nearby the aforementioned Carrickmacross area, are classified by the GSI as Locally Important Aquifers - generally moderately productive (Lm) and would generally offer less groundwater potential than the karst. The main units of interest here are the Kingscourt/Permian-Triassic Sandstones and the Carrickleck Sandstones. The Permian and Triassic are a very significant aquifer in Northern Ireland due to the high yields, however, make up a much smaller areal extent in the Republic. They generally consist of red shales, siltstones and sandstones. Drilling at Mullantra showed the sandstones were very friable and liable to collapse, with yields in the range of 500 m^3/day. The Carrickleck Sandstones are composed of thick alternating sequences of sandstones with shales, with the Carrickleck Sandstone Member being cleaner and less shaley, and therefore considered to be the more productive portions of the aquifer. Groundwater flow in these sandstones is expected to be largely along faults and fractures, however those within the shaley or mudstone beds are likely to be closed due to the high clay content. The wells at Descart have a proven combined yield of 2,160 m^3/day, although they are believed to receive much of their supply from the deeper, confined, dolomitised limestone strata (Rk).

There are a number of locally important sand and gravel aquifers (Lg) in the region, namely in the east at Williamstown, Dromiskin and Dundalk. In some cases, these can offer 'Moderate' to 'Excellent' with drilling records showing yields can reach 545 m^3/day. There is potential for saline intrusion, namely along the eastern side of Dromiskin, and some interaction between the River Fane and groundwater. It is thought the variability in the recorded yields is a reflection in the variability in composition of the deposits.

An overview of the Study Area is outlined in **Error! Reference source not found.**.

Table 1.1 SAE Study Area Summary

Louth	Total Population	84,053	Total Network Length (km)	1,036	Number of Water Resource Zones	9
Counties in Study Area	Cavan, Louth, Meath, Monaghan					
Principle Settlements	Dundalk, Ardee, Dunleer, Carrickmacross, Castlebellingham-Kilsaran, Knockbridge, Annagassan, Kingscourt, Carlingford, Louth, Tallanstown, Tinure, Lordship, Dromiskin, Collon, Jenkinstown					
Number of Water Sources	19	Surface Water Sources	8		Groundwater Sources	11
Water Treatment Plant	**Source**	**Population**	**WTP Capacity (m^3/day)**	**Quality**	**Quantity**	**Reliability**	**Potential Sustainability**
Inniskeen WTP	Fane River	509	460	●	●	●	●
Nafarty WTP	Groundwater	5,229	3,520	●	●	●	●
Nobber WTP	Groundwater	466	250	●	●	●	●
Kilmainhamwood WTP	Groundwater	566	340	●	●	●	●
Castletown WTP	Groundwater	108	40	●	●	●	●
Drumcondrath WTP	Lough Brackan, Groundwater	1,204	1,250	●	●	●	●
Drybridge WTP	Groundwater	1,110	430	●	●	●	●
Collon WTP	Groundwater	3,477	1,680	●	●	●	●
Ardee WTP	River Dee, Groundwater	8,381	3,100	●	●	●	●

[Type here]

Water Treatment Plant	Source	Population	WTP Capacity (m^3/day)	Quality	Quantity	Reliability	Potential Sustainability
Cavanhill WTP	River Fane (Stephenstown)	47,927	27,300	●	●	●	●
Carlingford WTP	Barnavave Stream, Carlingford Mountain (Unnamed Stream)	789	500	●	●	●	●
Tallanstown WTP	Kilbride / River Glyde	1,970	1,200	●	●	●	●
Cooley (Carlingford) WTP	Groundwater	4,203	1,200	●	●	●	●
Ardtullybeg WTP	Groundwater	4,203	2,600	●	●	●	●
Greenmount WTP	River Dee / Greenmount	5,139	1,920	●	●	●	●
Lisanisky WTP	Groundwater	2,969	1,402	●	●	●	●

Score	Irish Water Asset Standard Assessment	Priority
●	Low Risk	Low Priority Asset
●	Medium Risk	Priority 2 Asset
●		
●	High Risk	Priority 1 Asset

2 Scoping the Study Area

2 Scoping the Study Area

In this chapter we summarise the current and future issues with water supplies in Study Area E, in terms of water quality, quantity, reliability and sustainability.

To identify the issues and corresponding need with the water supplies in this Study Area, and to inform the nature, scale and scope of the solutions that we need to consider to meet them, we have assessed:

- The **water quality** that we can supply;
- The **water quantity** that we can supply;
- The **reliability** of our existing supplies; and
- Additional information that impacts the long-term **sustainability** of our sources or infrastructure.

2.1 Water Quality

We assess the water quality investment needs of our water supplies by assessing the performance of our assets against the barriers set out in Chapter 5 of the Framework Plan. As set out in Chapter 5 of the Framework Plan, Irish Water is developing scientifically robust datasets to assign risk. Irish Water are utilising the well-established 'Failure Mode Effect Analysis' which provides a step-by-step approach for identifying all possible failure modes that can result in a hazardous event. Once identified, we assess risk against the existing controls (Barriers), which we have in place for source protection within our water treatment plants and networks. This Barrier Assessment process highlights where there is a deficit or potential for future deficit in these controls or treatment process elements.

The barriers are an internal gauge and the initial desktop assessments of barrier performance for SAE are summarised in Table 2.1

Table 2.1 Quality: Barrier Scores

Quality: Barrier Scores				
Water Treatment Plants	**Barrier 1: Bacteria & Virus**	**Barrier 2.1: Maintain chlorine Residual in the Network**	**Barrier 3 Protozoa (Crypto) Asset Potential**	**Barrier 6b THM's Leading Indicator**
Inniskeen WTP	●	●	●	●
Nafarty WTP	●	●	●	●
Nobber WTP	●	●	●	●
Kilmainhamwood WTP	●	●	●	●
Castletown WTP	●	●	●	●
Drumcondrath WTP	●	●	●	●
Drybridge WTP	●	●	●	●
Collon WTP	●	●	●	●

Quality: Barrier Scores				
Water Treatment Plants	**Barrier 1: Bacteria & Virus**	**Barrier 2.1: Maintain chlorine Residual in the Network**	**Barrier 3 Protozoa (Crypto) Asset Potential**	**Barrier 6b THM's Leading Indicator**
Ardee WTP	●	●	●	●
Cavanhill WTP	●	●	●	●
Carlingford WTP	●	●	●	●
Tallanstown WTP	●	●	●	●
Carlingford BH	●	●	●	●
Ardtullybeg WTP	●	●	●	●
Greenmount WTP	●	●	●	●
Lisanisky WTP	●	●	●	●

Score	Irish Water Asset Standard Assessment	Priority
●	Low Risk	Low Priority Asset
●	Medium Risk	Priority 2 Asset
●		
●	High Risk	Priority 1 Asset

The colour coding within the outline assessment indicates the severity of the potential risk of barrier failure. It should be noted that the table is not an indicator of non-compliance with the European Union (Drinking Water) Regulations 2014 as amended (Drinking Water Regulations), but an internal Irish Water assessment of the asset capability standard compared with the asset standard set out in Section 5.7 of the Framework Plan. The assessment provides an indication of the need to invest in areas of our asset base (human and structural) through resource planning, to ensure that we can address potential risks or emerging risks to our supplies.

Based on the barrier assessment, 14 of the 16 WTPs in the Study Area are considered to be at high risk of failing to achieve the required standards in relation to maintaining chlorine residual in the network (Barrier 2.1) and the effectiveness of Irish Water's protozoa removal processes (Barrier 3). However, in some cases our desktop assessments can over-estimate risk, particularly when there is little available data on the catchment characteristics of our raw water sources. As our "Source to Tap" Drinking Water Safety Plan (DWSP) assessments, which are a requirement under the Recast Drinking Water Directive

(2020), are developed for each water supply, the barrier scores for all of our supplies will be updated and become more reliable.

It should be noted that the “quality need” identified through the Barrier Assessment is not an indicator of compliance with the Drinking Water Regulations. It is an assessment of the need to invest in areas of our asset base (human and structural) through resource planning, to ensure that we can address potential risks or emerging risks to our supplies.

At present, there are 3 WTPs within SAE on the Environmental Protection Agency (EPA) Remedial Action List (RAL), Tallanstown, Greenmount and Drumcondrath.

Irish Water is currently progressing immediate corrective action in advance of the NWRP for a number of supplies within SAE. A national programme to improve disinfection standards (Barrier 1) at water treatment facilities across Ireland was initiated by Irish Water in 2016. Details of the ‘in progress’ projects to address critical water quality requirements are included in Table 2.2.

Table 2.2 Critical Water Quality Requirements SAE – Louth

Critical Water Quality Requirements	Progress
1. **Dundalk Water Supply Scheme- Cavanhill WTP Upgrade** Cavanhill WTP is the primary drinking water production facility for Dundalk and serves over 35,000 people. The project has provided a significant upgrade of treatment facilities at the plant, including the installation of a UV disinfection system, to address and remedy the deficiencies in the treatment plant. The scheme abstracts raw water from River Fane and, until the completion of this project, did not have an effective treatment system. This meant that the areas supplied by the Dundalk Water Supply Scheme were at risk due to the lack of sufficient water treatment.	**Complete**
2. **Kingscourt Water Supply Scheme** This project involved the construction of a new water treatment plant and storage reservoir capable of serving the existing and future residential and commercial needs of Kingscourt and the surrounding rural area. This has led to the Kingscourt Water Supply being removed from the EPA RAL.	**Complete**
3. **Tallanstown RAL** Rationalisation project progressing to resolve ongoing THM issues	**Ongoing**
4. **Drumcondrath RAL** Integration of new groundwater supply to resolve ongoing THM issues	**Ongoing**
5. **Greenmount RAL** WTP upgrade progressing to resolve ongoing THM issues	**Ongoing**
6. **Reservoir Cleaning Programme:** A major reservoir cleaning programme has been undertaken at 15 sites, which has reduced network water quality issues.	**Complete**

7. Disinfection Programme In 2016, Irish Water completed a nationwide review of all water treatment plants where disinfection upgrades were required, followed by a programme of works to deliver the required upgrades. To date, the disinfection programme has completed upgrade works at 4 of the 16 WRZs in SAE, based on assessed priority basis. • Greenmount WTP • Castletown WTP • Nobber WTP • Inniskeen WTP It is proposed to complete Ardee WTP, Collon WTP, Ardtullybeg WTP, Carlingford WTP, Cooley (Carlingford) WTP, Kilmainhamwood WTP in 2022. Any requirements within the remaining 6 supplies will be identified via Drinking Water Safety Plans with solutions developed as part of the NWRP.	**Complete**

In summary, in relation to water quality Irish Water will:

- Continually update Barrier Performance issues in the WRZ which have the potential to impact on drinking water quality in the region;
- Improve these assessments through the development of DWSPs for all of our supplies;
- Address the priority risks identified on the EPA Remedial Action List (noting that steps have already been taken, and are ongoing, to address these risks); and
- All residual need (grey dots) in relation to water quality will be brought through our options assessment process

2.2 Water Quantity – Supply Demand Balance

Irish Water assess the water quantity investment needs of our supplies by developing SDB calculations for each of our water supplies as summarised in Chapter 3, 4 and 6 of the Framework Plan. The calculations are used to assess the amount of water available in our supplies and compare that to the current and forecast demand for water in accordance with Figure 2.1.

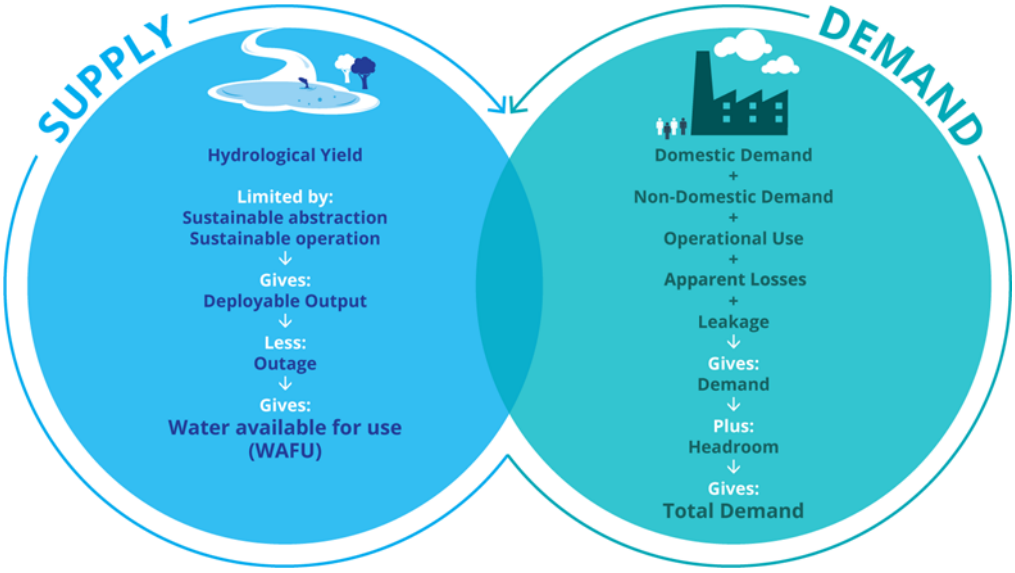


Figure 2.1 Supply Demand Balance

For each of the 9 WRZs in this Study Area, we assessed the baseline SDB and developed 25-year forecasts of supply and demand, in accordance with Figure 2.1.

The SDB assessments were carried out for each of the weather event planning scenarios (Normal Year Annual Average, Dry Year Annual Average, Dry Year Critical Period, Winter Critical Period) which described in Chapter 2 of the Framework Plan. The SDB deficits in SA E manifest in the following ways:

1. **Inappropriate standards and levels of risk for a strategic water supply:** As water supply is essential for public health, Irish Water must ensure appropriate standards of supply and be able to cope with drought conditions, peak events, and maintenance of assets. This requires adequate reserve capacity in our supplies to provide a 1 in 50 Level of service. At present, not all supplies within this Study Area meet the required levels of reserve capacity. However, due to the lack of historical monitoring, particularly in relation to groundwater supplies, some of the deficits may be data driven

2. **Day to day operations:** At present, 3 out of 9 of the WRZs in SAE have a current deficit and 4 out of 9 have a projected SDB deficit (based on a “do minimum” approach). However, under normal weather and demand conditions, this does not manifest as an interruption to supply for all WRZs. During recent dry periods, particularly the summer of 2018 and 2020 when water conservation orders were implemented, a number of the supplies in SAE were impacted. Night-time restrictions have also been implemented in recent years for the Ardee / Collon / Drybridge supply.

A summary of the SDB deficit across all 9 Water Resource Zones is summarised in Table 2.3. The water resources zones are detailed in Appendix L of the Framework Plan - Supply Demand Balance Summaries.

Table 2.3 WRZ SDB Dry Year Critical Period Deficits

Water Resource Zone Name	Water Resource Zone code	Population	Maximum Deficit m^3/day					
			2019	2025	2030	2035	2040	2044
Inniskeen	2400SC0009	509	No Deficit	No Deficit	No Deficit	No Deficit	No Deficit	No Deficit
Carrickmacross	2400SC0006	5,229	No Deficit	No Deficit	No Deficit	No Deficit	No Deficit	No Deficit
Kilmainhamwood / Nobber	2300SC0025	1,031	-51	-82	-106	-117	-125	-131
Castletown (Meath County Council)	2300SC0024	108	-1	-2	-3	-3	-4	-5
Drumcondrath	2300SC0004	1,204	No Deficit	No Deficit	No Deficit	No Deficit	No Deficit	No Deficit
Carrickarnon (Water Supplied from NI-Water Import)	2100SC0013	5	0	0	0	0	0	0
Ardee / Collon / Drybridge	2100SC0007	12,969	-1,181	-1,327	-1,470	-1,561	-1,641	-1,705
Cavanhill & North Louth	2100SC0002	60,028	No Deficit	No Deficit	No Deficit	No Deficit	-748	-1,387
Kingscourt PWS	0200SC0018	2,969	No Deficit	No Deficit	No Deficit	No Deficit	No Deficit	No Deficit

As outlined in Chapter 4 of the framework plan, the estimated population currently living in each WRZ has been based on the 2016 Census data. Forecasts for future populations have been based on draft growth projections from the National Planning Framework (NPF), and updated information from the Regional Spatial and Economic Strategies (RSES) and Local Authority Planning sections (where available).

The target 1 in 50 level of service in the region were applied in each case, along with the corresponding requirements for reserves, indicating that our supplies are operating with a cumulative SDB deficit of approximately 1,233 m^3/day for the Study Area. As a result, while we can continue to supply water, the water supplies in this area may come under pressure, particularly in drought conditions. In addition, there may be ongoing reliability issues.

This situation will further deteriorate over time due to climate change driven reductions in water resources, together with increased demand due to population growth. If we do nothing, the SDB deficit is projected to increase to approximately 3,228m^3/day by 2044.

Our ongoing activities to improve the Supply Demand Balance in SAE are prioritised as:

- Ongoing leakage management including active leakage control, pressure management and find and fix activities to meet target levels of Leakage
- Water Conservation measures, including information campaigns and initiatives, and Water Conservation Orders during drought periods

2.3 Water Supply Reliability

The benefits of having sufficient water supplies in terms of quality and quantity are negated if we cannot distribute the water we produce effectively around our networks. We also need sufficient treated water storage to enable us to respond to planned or unplanned outages on our trunk main and distribution networks.

There are a number of problematic distribution and trunk mains throughout SAE. Irish Water & the Local Authority Water Services sections will continue to monitor the performance of all water mains in the network to ensure that the most problematic mains are replaced as required.

A significant amount of watermain rehabilitation has been carried out, to date, across Study Area E. This provides for a more reliable water supply, reducing instances of bursts and water outages. The works also improve water quality by replacing old cast iron and lead watermains, whilst reducing leakage and improving overall operation and maintenance of our supply system.

During the drought in summer 2018, several raw water sources experienced issues; raw water levels dropped significantly at Lough Muckno reducing to level where proposed over pumping required at headworks feeding River Fane for Cavanhill WTP and nigh time restrictions for Collon WTP.

During our needs assessment, Irish Water has identified a number of critical requirements for upgrades to the existing asset base, including storage and trunk main requirements. Progress to date on these projects is summarised in Table 2.4.

Table 2.4 SAE Critical Infrastructure Projects and Need Identification

Critical Requirement	Progress
1. **Tallanstown WTP:** Rationalisation of Tallanstown to Cavanhill WTP, due to THMs	**Ongoing**
2. **Distribution Network Repairs and Upgrades:** Rolling programme of active leakage control, pressure management, find and fix and network upgrades	**In Progress**

In summary, there are some asset reliability issues across the distribution network within the WRZ. Some critical infrastructural projects, outlined in Table 2.4, to address these issues have been identified and are in progress. In addition to this, a continuous programme of repairs, upgrades and leakage reduction is being progressed as part of Irish Waters National Leakage Reduction Programme across all Study Areas.

2.4 Water Supply Sustainability

The water supplies within the region were developed over time to address the needs of the local populations and to support growth and development. Most of these supplies predate most modern environmental legislation and none of our current abstractions in this area were developed through any formalised abstraction process.

As outlined at Section 3.7.2 of the Framework Plan, the Government is currently developing new legislation dealing with water abstractions. As this legislation is still being developed, we do not have full visibility of the future regulatory regime. We have therefore not progressed through a theoretical licencing process on a site by site basis and cannot reliably include an estimation of sustainable abstraction within the SDB calculations. Instead, we use the hydrological yield, water treatment capacity and bulk transfer limitations in our calculation of DO. This assessment procedure is set out at Appendix C of the Framework Plan, and in line with a precautionary approach.

To understand the potential impact of the Abstraction Legislation on the SAE supplies, we have assessed the potential impacts on our 8 no. surface water abstractions: River Dee (Ardee/ Collon/ Drybridge), River Dee (Cavanhill & North Louth), River Glyde (Cavanhill & North Louth), Barnavave (Cavanhill & North Louth), Carlingford Mountain (Cavanhill & North Louth), River Fane (Cavanhill & North Louth), River Fane (Inniskeen), and Lough Brackan (Drumcondrath).

Table 2.5 presents the findings of this assessment in order to indicate the potential reductions to abstraction that may be required at our existing surface water supplies. The table presents our current abstraction levels[1], our source hydrological yield[2], and our estimated potential sustainable abstraction[3] amount which the source may be limited to in the future.

Based on this initial assessment, the volumes of water abstracted at Barnavave (Cavanhill & North Louth), Carlingford Mountain (Cavanhill & North Louth), River Fane (Cavanhill & North Louth), and Lough Brackan (Drumcondrath) may not meet sustainability guidelines during dry weather flows. However, under the proposed regulatory regime, this will be adjudicated by the EPA. We have assumed,

[1] Based on WTP 22hr (DYCP) capacity
[2] Our hydrological yield estimate is the 'safe' yield calculated to be available during a 1 in 50 year drought event. We use this figure in the SDB calculations to determine whether a WRZ is projected to be in deficit or surplus
[3] Our sustainable or 'allowable' abstraction estimate is based on limiting abstraction to 5-15% of the Q95 low flow for river sources or 10% of Q50 inflow for lakes. This is based on our best understanding of how the EPA may enforce future abstraction licencing applying UKTAG guidance.

given the need to maintain supplies, that a transition to new abstraction quantities would likely take place in the medium term.

Error! Reference source not found. shows the Cavanhill & North Louth WRZ could have the most significant impact to SDB based on the potential sustainability reductions for the River Fane abstraction source but it has been assumed that the existing Water Order abstraction limits of up to 36,400 m^3/day can be maintained, therefore allowing the current abstraction rates from the river to be maintained and potentially developed further to meet future projected deficits in the region. However, this is dependent on the operational regime required for the River Fane low flow augmentation scheme being correctly implemented to ensure the protection of the Lough Muckno and River Fane system.

Table 2.5 Comparison of Current Abstraction, Hydrological Yield and Theoretical Future Abstraction

Source (WRZ)	Current abstraction (m^3/day)	Hydrological yield (m^3/day)	Theoretical future abstraction limit (m^3/day)
River Dee (Ardee/ Collon/ Drybridge)	2,842	13,534	3,560
River Dee (Cavanhill & North Louth)	1,760	17,263	6,716
Kilbride / River Glyde (Cavanhill & North Louth)	1,100	15,231	6,139
Barnavave (Cavanhill & North Louth)	458	125	125
Carlingford Mountain (Cavanhill & North Louth)		125	125
River Fane (Cavanhill & North Louth)	25,025	43,200	5,107
River Fane (Inniskeen)	422	14,687	4,142
Lough Brackan (Drumcondrath)	1,146	391	69

The potential change to the SDB for each WRZ, as a result of these potential reductions in abstraction during dry weather flows are summarised in Table 2.6.

Table 2.6 Potential Change to the SDB Based on Potential Abstraction Reductions

Source (WRZ)	Potential change SDB[4] (m^3/day)
River Dee (Ardee/ Collon/ Drybridge)	None
River Dee (Cavanhill & North Louth)	-19,476
Kilbride / River Glyde (Cavanhill & North Louth)	
Barnavave (Cavanhill & North Louth)	
Carlingford Mountain (Cavanhill & North Louth)	
River Fane (Cavanhill & North Louth)	
River Fane (Inniskeen)	None
Lough Brackan (Drumcondrath)	-308

The net impact of these potential minimum environmental flow requirements has been assessed using the outline assessment methodology described in Appendix C of the Framework Plan.

Groundwater abstractions will need to conform to the proposed new abstraction licencing regime. These abstractions will be assessed in two ways:

- Impacts on the groundwater bodies from which they abstract; and
- Impact of the groundwater abstraction on the base flow in surface waterbodies.

As noted in Section 3.2.2 of the framework plan producing robust desktop assessments of water availability from our existing groundwater abstractions is very difficult. Ideally, yield estimates would be based on a three-dimensional assessment of the geology within the vicinity of the supply, supplemented with long term records on pumping and drawdown of water levels over many years. Irish Water does not have this type of information available for most of our groundwater supplies and while we will aim to complete site-specific studies of groundwater availability, this may take many years.

On an interim basis Irish Water has developed an initial assessment for existing abstractions based on best available information. For more information, please see Appendix C Supply Assessment and Appendix G Regulatory and Licensing Constraints of the NWRP - Framework Plan. Over the coming years, Irish Water will work with the environmental regulator EPA and the Geological Survey of Ireland, to develop desktop and site investigation systems to better understand the sustainability of our groundwater sources. We are not in a position to estimate changes to the groundwater availability until better data is available.

In summary, when considering the requirements of the Water Framework Directive (WFD), some of our schemes may be subject to reductions in abstraction, especially during drought periods. While we have

[4] Based on potential changes to the projected 2044 Dry Year Critical Period (DYCP) scenario

developed a potential understanding of the impact of the legislation we cannot reliably include an estimation of sustainable abstraction within the SDB calculations.

However, we do use our sustainable abstraction estimations to assess the sensitivity of the Preferred Approach as set out in Chapter 7 of this Technical Report. This assessment determines whether the Preferred Approach is adaptable to change across a range of potential future scenarios and verifies our ability to adapt and increases our resilience to future changes.

When the new Legislation on abstraction of water has been enacted and regulatory assessments completed if an abstraction is confirmed to be affecting a waterbody status the Supply Demand Balance will be updated as outlined in the monitoring and feedback section of the draft RWRP, Section 9.2.2. All future abstractions considered through the Framework Plan options assessment are validated for sustainability, including options to increase abstraction at existing sites.

2.5 Water Resource Zone Needs Summary

Study Area E has issues in relation to quality, quantity, reliability and sustainability which must be addressed as part of the preferred approach to future water resources planning, summarised in Table 2.7.

Table 2.7 Summary of Need Quality, Quantity, Reliability, Sustainability

Quality	Upgrades required at all WTPs
Quantity	Nett leakage reduction 40 m^3/d in the region Additional Leakage Targets of 4,945 m^3/day to achieve SELL and reduce leakage levels to 21% of demand in WRZs with demand in excess of 1,500 m^3/day. Interim additional supplies of 1,233 m^3/day within 10 years. Total of 3,228 m^3/day additional supplies beyond the 10 year horizon.
Reliability (In addition to projects in	Continued network upgrades and improvements in the bulk and distribution networks and storage.
Sustainability	It is not envisaged that there are sustainability issues with the volumes abstracted at River Dee (Ardee/ Collon/ Drybridge), River Dee (Cavanhill & North Louth), River Glyde (Cavanhill & North Louth), and River Fane (Inniskeen). Based on this initial assessment, the volumes of water abstracted at Barnavave (Cavanhill & North Louth), Carlingford Mountain (Cavanhill & North Louth), River Fane (Cavanhill & North Louth), and Lough Brackan (Drumcondrath) may not meet sustainability guidelines during dry weather flows. However, under the proposed regulatory regime, this will be adjudicated by the EPA. Over the coming years, Irish Water will work with the environmental regulator EPA and the Geological Survey of Ireland, to develop desktop and site investigation systems to better understand the sustainability of our groundwater sources.

All of these needs will be considered within our options assessment process and in the development of the Preferred Approach.

Further details of planned, live and recently completed projects are available on our website see: https://www.water.ie/projects-plans/our-projects/

3 Solution Types Considered in Study Area E

3 Solution Types Considered in Study Area E

In this chapter, we summarise the type of solutions we have considered to address identified need for treated drinking water supply in Study Area E.

As outlined in Chapter 7 of the Framework Plan, we consider measures across the following three pillars: **Lose Less**, **Use Less** and **Supply Smarter** in forming our list of unconstrained options, which are assessed for short, medium and long-term solutions. For SAE as part of our unconstrained options, the following options have been reviewed.

3.1 Leakage Reduction

The Leakage reduction measures across the public water supply considered for SAE are based on what we assess to be both achievable and sustainable and include:

- Ongoing leakage management, including active leakage control, pressure management and Find and Fix activities, to offset Natural Rate of Leakage Rise (NRR); and
- Net leakage reductions targets listed in Table 3.1 have been applied to SDB deficit to move towards achieving the national Sustainable Economic Level of Leakage (SELL) target prioritised based on
    - Supply demand deficit;
    - Existing abstractions with sustainability issues; and
    - Drought impacts.
- Additional leakage Targets to achieve SELL and reduce leakage levels to 21% of demand in WRZs with demand in excess of 1,500m^3/day, see Table 3.1.

Table 3.1 SELL Targets for WRZ in SAE

WRZ	Net Leakage Reduction applied to SDB (m^3/day)	Additional leakage Targets to achieve SELL and reduce leakage levels to 21% of demand in WRZs with demand in excess of 1,500 m^3/day (m^3/day)	Total Leakage Targets (m^3/day)
Cavanhill & North Louth		3,651	3,651
Ardee / Collon / Drybridge		1,267	1,267
Carrickarnon (Water Supplied from NI-Water Import)		27	27
Carrickmacross	40		40

3.2 Water Conservation

At present, Irish Water is conducting pilot studies in relation to water conservation stewardship in businesses and is actively pursuing Conservation Education Awareness Campaigns and partnerships. During drought conditions in 2018 and 2020, a Water Conservation Order was implemented in order to protect our water supplies and reduce pressure on the natural environment during this period. We will continue to promote 'Water Conservation Activities', collecting and monitoring data over a number of years to assess the benefits. As part of the NWRP – Framework Plan, we have not applied reductions to the SDB deficit for unquantifiable water conservation gains, however as stipulated within the Consultation Report prepared in relation to the NWRP- Framework Plan, IW will progress pilot studies on water conservation measures. Based on the outcomes of these studies, we may include such factors in future iterations of our NWRP. However, we do assume that any gain will offset consumer usage growth factors.

3.3 Supply Smarter

The supply options considered as part of the options development are unconstrained by distance from SAE and include:

- Standalone groundwater options across the Study Area;
- Standalone surface water options across the Study Area;
- Transfers
- Cross Study Area Supply
- Rationalisations
- Water Treatment Plant Upgrades for water quality purposes
- Network improvements

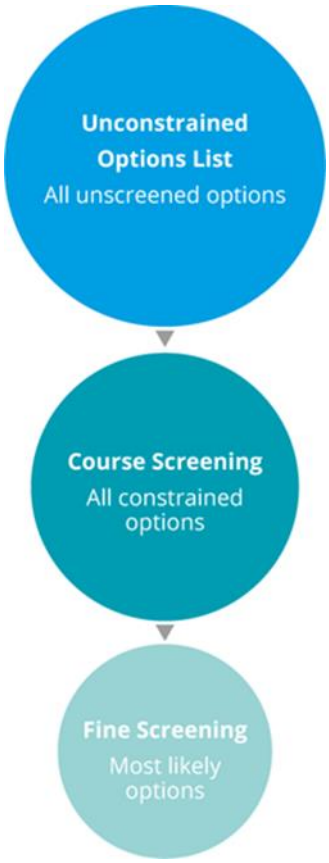
4 Option Development SAE

4 Option Development for Study Area E

This chapter describes how our options assessment methodology was applied to produce a Feasible Options list to meet the identified needs.

The purpose of our options assessment process, as outlined in Chapter 8 of the Framework Plan, is to consider the widest practicable range of solutions to resolve identified need within a given area. A suitable screening criterion is then applied to filter out any options that are not feasible, based on sustainability (environmental and social impacts), resilience or deliverability. As sustainability is at the heart of our plan, environmental and social assessment criteria are included at the earliest stages of the screening process. At the outset of the process, some fundamental rules are applied even before screening begins to ensure the protection of the environment. For example, having regard to WFD objectives, Irish Water does not allow for any inter-catchment raw water transfers due to the high risk of transferring invasive non-native species (INNS) between catchments and non-compliance with WFD objectives.

The options assessment screening process involves the following:



- Developing a long list of unconstrained options – Unconstrained Options constitute all of the possible solutions, which either fully or partly resolve a water supply deficit, regardless of any cost, environmental or social constraints. In developing the Unconstrained List, we identify options that are applicable to meet the needs of the study area;
- Coarse Screening – We filter the unconstrained options using a coarse screening assessment where we remove any options that fail to meet desktop assessment criteria under: Resilience, Deliverability and Flexibility or Sustainability (Environmental and Social Impacts); and
- Fine Screening – We filter the remaining options from the coarse screening exercise through a fine screening assessment, which includes detailed questions, related to environmental objectives identified for the SEA (including biodiversity, the water environment and requirements under climate change adaptation) as well as Resilience, Deliverability and Progressibility.

The coarse screening and fine screening questions, and the associated scoring criteria, are included in Chapter 3 and Appendix A of the Study Area Environmental Report.

4.1 Developing a List of Unconstrained Options

At the start of our screening process, we conduct a specialist desktop review of groundwater bodies and surface water catchments. This allows us to understand potential additional availability at existing water abstractions or to identify any potential new water sources within the Study Area; as summarised in Table 4.1

Table 4.1 Desktop Assessments for Unconstrained Options

Existing and New Ground Water sources	A Hydrogeologist conducts a desktop groundwater availability assessment of all potential aquifers and aquitards within, and within a reasonable distance of, the study area.
Existing and New Surface Water sources and Conjunctive Use Options	A Hydrologist carries out a desktop surface water availability assessment of all potential catchments and waterbodies within, and within a reasonable distance of, the study area.
Water Treatment upgrades, Desalination, Rationalisation and Effluent Reuse Options	An Engineer reviews any potential increases in capacity at existing water treatment sites and any potential conjunctive use or effluent reuse options.

Based on these desktop assessments, Irish Water developed an initial list of unconstrained options for new supplies and increases and upgrades to existing supplies and assets. An unconstrained options review workshop was then held with our Local Authority Partners to identify any additional unconstrained options that may be available based on local knowledge. A total list of unconstrained options was then compiled.

For SAE, 63 Unconstrained Options were identified to address need. These unconstrained options were not limited by cost, distance from the area or feasibility. These options are summarised in Table 4.2 and shown spatially in Figure 4.1.

Table 4.2 SAE Unconstrained Options

No. of Options	Option Type
24	Groundwater
10	Surface Water
8	Transfers
10	Rationalisation
3	Network improvements
4	Cross Study Area Supply
4	Upgrade WTP (WQ upgrade)

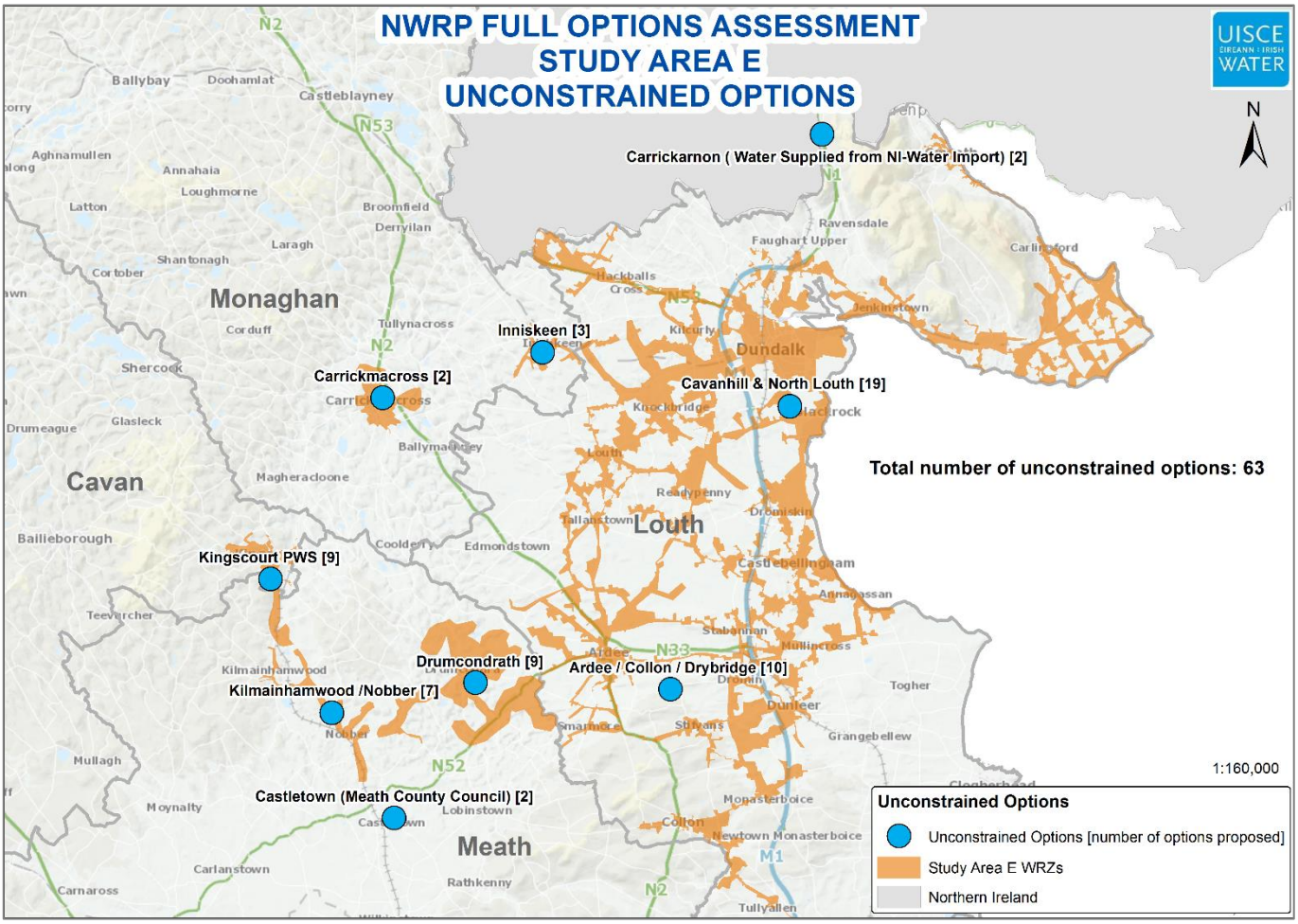


Figure 4.1 SAE Unconstrained Options

The 63 options were filtered through our screening process to eliminate those with potentially unviable environmental impacts or feasibility issues. This process is summarised below.

4.2 Coarse Screening

The 63 identified Unconstrained Options were assessed through Coarse Screening against the criteria of:

- Resilience;
- Deliverability and Flexibility; and
- Sustainability (Environmental and Social Impacts).

The Course Screening process is summarised in Chapter 8 of the Framework Plan. The coarse screening assessments were conducted by a specialist team, including Engineers, Hydrologists and, Hydrogeologists, Ecologists, and Environmental Scientists.

25 Unconstrained Options were rejected at this stage as they were found to be unviable in relation to one or more assessment criteria. Details of these options and the justification for their rejection are outlined in the rejection summary, Annex B of this report. The rejection summary records the criteria against which the rejected options were assessed as having a ‘red’ score for the purposes of the coarse screening exercise (as explained in more detail in Chapter 8 of the framework plan), and accordingly were not brought forward at the coarse screening phase. The box below provides an example of a

rejection justification for an option considered for a Carrickarnon (Water Supplied from NI-Water Import) WRZ in Study Area E.

Example Rejected Option

Option SAE-032

New GW abstraction from Louth GWB to supply the scheme (Carrickarnon (Water Supplied from NI-Water Import) WRZ)

Rejection Reason

The option requires a significant length of pipeline for a relatively very small supply. Transferring small quantities of water over long distances can affect the quality of water. As there are other viable alternative option for this WRZ this option was considered not feasible at coarse screening stage.

The remaining 38 options were progressed to further assessment through the Fine Screening process. The rejected options are summarised in Annex A of this technical report. Annex A records the criteria against which the rejected options were assessed as having a “red” score for the purposes of the coarse screening exercise (as explained in more detail in Chapter 8 of the Framework Plan), and accordingly were not brought forward at the coarse screening stage. The options remaining after Coarse Screening are summarised by type in Table 4.3.

Table 4.3 SAE Remaining Options after Course Screening

No. of Options	Option Type
13	Groundwater
6	Surface Water
5	Transfers
6	Rationalisation
1	Network improvements
4	Cross Study Area Supply
3	WTP Upgrade (WQ only)

4.3 Fine Screening

The 38 remaining options were subject to a more detailed multi-criteria assessment (MCA) at the Fine Screening Stage using desktop assessments of performance against 33 specified questions relating to Sustainability (Environmental and Social Impacts), Resilience, Deliverability and Progressibility. These questions are set out in Appendix N of the Framework Plan. The assessment for each option was based on an objective assessment with uniform scoring criteria, based on best publicly available datasets.

At Fine Screening stage, no further options were rejected, with the remaining 38 options considered to be feasible and brought forward to desktop outline design and costing. These are summarised in Table 4.4 and shown spatially in Figure 4.2.

Table 4.4 SAE Remaining Options after Fine Screening (Feasible Options)

No. of Options	Option Type
13	Groundwater
6	Surface Water
5	Transfers
6	Rationalisation
1	Network improvements
4	Cross Study Area Supply
3	WTP Upgrade (WQ only)

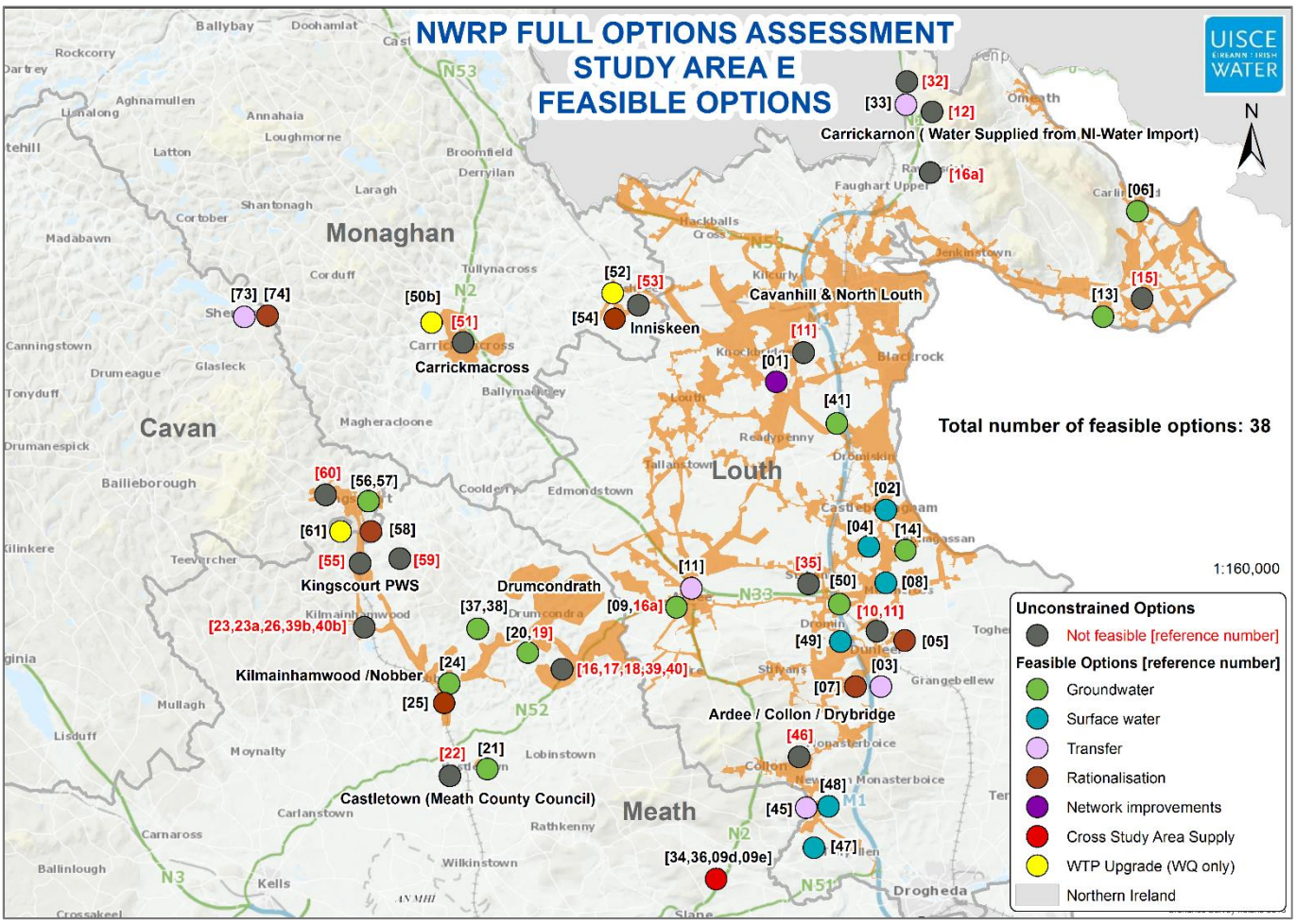


Figure 4.2 SAE Spatial Overview of the Feasible Options

For the purposes of the NWRP, outline designs have been prepared at a desktop level for each feasible option (for use as part of comparative assessments between options). The outline designs include a high-level inventory of option requirements, including capacities of plants, pipelines, pumps and treatment requirements. They include comparative budget costs estimates for required site level studies (including site level environmental assessments), Capital (CAPEX), Operational (OPEX), Environmental and Social (E&S) costs and Carbon Costs for use in the next stage of the assessment process.

4.4 Options Assessment Summary

The SDB deficit in the region ranges between 1,233 m^3/day in 2019 during normal conditions, to a maximum of 3,228 m^3/day in 2044 during dry conditions. During the options assessment stage, a total of 63 unconstrained options were assessed. Of these, 25 options were screened out for the reasons summarised in Table 4.5 and recorded in Annex B.

Table 4.5 Rejected Options Summary

No. of Options	Reason for Rejection
14	Resilience, Deliverability & Flexibility, Sustainability
4	Deliverability & Flexibility
7	Other

The remaining 38 feasible options are categorised into options that resolve the need for one WRZ only "WRZ options" and options that resolved the need for more than one WRZ "Study Area options". Table 4.6 provides an overview of the number of WRZ options and Study Area options for the WRZs in Study Area E. From this table it can be noted that there are 18 WRZ Options and 20 options which can be merged to form 10 Study Area Options.

A summary of the number of options and whether they are WRZ or SA options is contained in Table 4.6.

Table 4.6 SAE Feasible Options Summary

Water Resource Zone Name	Option Type	
	WRZ Option	SA Grouped Option
Ardee / Collon / Drybridge	2	6
Carrickarnon (Water Supplied from NI-Water Import)	1	0
Carrickmacross	1	0
Castletown (Meath County Council)	1	0
Cavanhill & North Louth	8	6
Drumcondrath	1	2
Inniskeen	1	1
Kilmainhamwood /Nobber	2	0
Kingscourt PWS	1	5

5

Approach Development

5 Approach Development

This chapter describes how we tested different combinations of the Feasible Options to develop a Preferred Approach to meet the needs we identified for the WRZ in Study Area E.

5.1 Approach Development

5.1.1 Introduction to Approach Development

The purpose of the NWRP is to examine all potential options that could be used to resolve issues within the water resource zone (unconstrained options) and then to eliminate those that are not feasible or that have identifiable environmental issues at a desktop level (options assessment screening). Of the remaining feasible options Irish Water's next step is to assess a specified number of approaches to resolve need across the Study Area. An approach is a way of configuring an option or options to meet the deficit focused on a particular outcome. For example, a "Least Carbon" approach would be the option or combination of options that would involve the least embodied and operational carbon load over the lifetime of the option. As part of the NWRP, Irish Water considers six approaches, as summarised in Table 5.1.

These six approaches have been outlined at Section 8.3.7 of the Framework Plan and were consulted on as part of the SEA Scoping consultation conducted between 9th November 2017 and 22nd December 2017. These approaches have been specifically chosen to ensure that the NWRP aligns with all the relevant Government Policies outlined in Table 5.1.

Table 5.1 The Six Approaches

Approaches Tested	Description	Policy Driver
Least Cost	Lowest NPV cost in terms of Capital, Operational, Environmental, Social and Carbon Costs.	Public Spending Code
Best Appropriate Assessment (AA)	Lowest score against the European Sites (Biodiversity) sub-criteria question: Score = 0 equates to no likely significant effects (LSEs). If, in our opinion, these 0 scoring options meet the deficit/ plan objectives, they are automatically picked as the Preferred Approach. Score = -1 or -2 equates to LSEs that can be addressed with general/standard mitigation measures. Score = -3 equates to LSEs that may be harder to mitigate or require significant project level assessment.	Habitats Directive
Quickest Delivery	Based on an estimate of the time taken to bring an option into operation (including typical feasibility, consent, construction and commissioning	Statutory Obligations under the Water Supply Act and Drinking Water Regulations

Approaches Tested	Description	Policy Driver
	durations) as identified at Fine Screening This is particularly relevant where an option might be required to address an urgent Public Health issue.	
Best Environmental	This is the option or combination of options with the highest total score across the 19 No. SEA MCA sub-criteria questions	SEA Directive and Water Framework Directive
Most Resilient	This is the option or combination of options with the highest total score against the resilience criteria.	National Adaptation Framework and Climate Action Plan
Lowest Carbon	This is the option or combination of options with the lowest embodied and operational carbon cost.	Climate Action Plan

We then compare the options identified as the best performing within each of the six approach criteria (Least Cost, Best AA, Lowest Carbon etc.) against each other as outlined in Figure 5.1 to come up with a Preferred Approach that meets the objectives of the Framework Plan and aligns with all relevant Government Policy.

STEP 0 Best AA	If there is an option that meets the Objectives of the Plan, and is assessed as having no potential impact on a European Site (based on desktop assessment), it is automatically adopted as the Preferred Approach
STEP 1 Least Cost	Compare Least Cost against **best AA** Approach, and consider again at Step 6
STEP 2 Quickest Delivery	Compare Least Cost against Quickest Delivery Approach and develop Modified Approach if appropriate
STEP 3 Best Environmental	Compare Least Cost or Modified Approach against Best Environmental, and modify approach **if appropriate**
STEP 4 Most Resilient	Compare Least Cost or Modified Approach against Most Resilient
STEP 5 Least Carbon	Compare Least Cost or Modified Approach against **Lowest** Carbon
STEP 6 Approach Comparison	Compare output from Steps 1 to 5 against: • SEA required outcomes • Sectoral Adaptation Outcomes • **Best AA outcomes** • Public Expenditure Code Outcomes
STEP 7 Preferred Approach	Select Preferred Approach based on steps 0 to 6

Figure 5.1 Figure of the 7 step assessment process

This methodology which is further detailed in Chapter 7 of the draft RWRP -NW follows a process to develop the Preferred Approach for a Study Area across three stages;

- **Stage 1** – We assess the water resource zones individually to develop an initial Preferred Approach, the WRZ Preferred Approach for all of the supplies in the Study Area
- **Stage 2** – We assess whether there are any larger options that might resolve deficits across multiple WRZs within a Study Area. We then develop combinations of these options (SA Combinations).
- **Stage 3** – We assess the SA Combinations and the WRZ Level approach in order to determine the best performing combination. This is known as the Preferred Approach at SA Level.

At each stage of assessment as detailed above, we carry out an assessment of the cumulative and in-combination effects of the Preferred Approach as detailed in the SEA Environmental Report for the RWRP-NW and the Environmental Review for this Study Area.

Within the Regional Plan, we will examine the Preferred Approach at a third spatial level across all of the Study Areas in the North West Region and will make any required changes in order to develop a Preferred Approach across the entire Region.

Further details on these three stages is provided in Chapter 7 of the draft RWRP-NW. Section 5.2 provides an overview of the application of this process to SAE.

5.2 Preferred Approach Development Process for Study Area E

5.2.1 Stage 1 – WRZ Level Approach

As outlined in Section 4.4 of this technical report there are 38 feasible options. 18 of these options are WRZ Options while 20 options are merged to form 11 Study Area Options. Table 5.2 outlines the 18 WRZ options for SAE, providing option reference numbers and detailing the WRZs they provide a solution to. These solutions are presented as "Options" for the purposes of this plan; however, will be subject to their own regulatory, timing and budgetary constraints.

Tale 5.2 SAE Feasible Options

Water Resource Zone Name	Feasible Option SAE Louth	
	Option Code	Option Description
Ardee, Collon and Drybridge	SAE-009	GW potential from limestone aquifer at Ardee, east of plant.
Ardee, Collon and Drybridge	SAE-045	Supply from Ballymakelly GWS.
Carrickarnon (Water Supplied from NI-Water Import)	SAE-033	Maintain import from Northern Ireland Water - isolated scheme.
Carrickmacross	SAE-050	Upgrade WTP for water quality improvements. Carrickmacross WRZ is not in deficit.
Castletown (Meath County Council)	SAE-021	GW enhancement at Castletown.
Cavanhill & North Louth	SAE-001	Dependant on operational regime implementation, increase abstraction from the river Fane and upgrade existing WTP to meet critical peak demand. SCADA and weir control system upgrade required.
Cavanhill & North Louth	SAE-003	Extension from Staleen (South Louth & East Meath) to Cavanhill, offsetting supply when new source is available from GDA.
Cavanhill & North Louth	SAE-004	Increase SW abstraction from River Dee at Greenmount and upgrade WTP.
Cavanhill & North Louth	SAE-006	Potential for new GW source in the Williamstown Gravels.
Cavanhill & North Louth	SAE-008	New SW abstraction from River Glyde at Castlebellingham.

Water Resource Zone Name	Feasible Option SAE Louth	
	Option Code	Option Description
Cavanhill & North Louth	SAE-013	New wellfield at Carlingford BH site.
Cavanhill & North Louth	SAE-014	Potential to develop wellfield in Cooley Gravel Aquifer.
Cavanhill & North Louth	SAE-041	Potential for new GW source from Dromiskin Gravels.
Drumcondrath	SAE-020	New GW abstraction in vicinity of Drumcondrath WTP on Coillte land.
Inniskeen	SAE-052	Upgrade WTP for water quality improvements. Inniskeen WRZ is not in deficit.
Kilmainhamwood /Nobber	SAE-024	Maintain both plants and new GW abstractions in Kingscourt GWB.
Kilmainhamwood /Nobber	SAE-025	Rationalise Kilmainhamwood WTP and Nobber WTP to Kingscourt WRZ (Cavan).
Kingscourt PWS	SAE-061	Upgrade Lisanisky WTP for water quality improvements. Kingscourt WRZ is not in deficit.

The WRZ options are then assessed against the six approach types, outlined in Table 5.1 and the result of this process is provided in Table 5.3.

Table 5.3 SAE Alignment of WRZ Option/s with Approach Categories

Water Resource Zone Name	No. WRZ Options	Feasible Options SAE Louth	Approach					
		Option Description	Least Cost	Quickest Delivery	Best AA	Best SEA	Lowest Carbon	Most Resilient
Ardee, Collon and Drybridge	2	GW potential from limestone aquifer at Ardee, east of plant.	-	-	✓	-	-	-
		Supply from Ballymakelly GWS.	✓	✓	-	✓	✓	✓
Carrickarnon (Water Supplied from NI-Water Import)	1	Maintain import from Northern Ireland Water - isolated scheme.	✓	✓	✓	✓	✓	✓

Water Resource Zone Name	No. WRZ Options	Feasible Options SAE Louth	Approach					
		Option Description	Least Cost	Quickest Delivery	Best AA	Best SEA	Lowest Carbon	Most Resilient
Carrickmacross	1	Upgrade WTP for water quality improvements. Carrickmacross WRZ is not in deficit.	✓	✓	✓	✓	✓	✓
Castletown (Meath County Council)	1	GW enhancement at Castletown.	✓	✓	✓	✓	✓	✓
Cavanhill & North Louth	8	Dependant on operational regime implementation, increase abstraction from the river Fane and upgrade existing WTP to meet critical peak demand. SCADA and weir control system upgrade required.	✓	✓	✓	✓	-	✓
		Extension from Staleen (South Louth & East Meath) to Cavanhill, offsetting supply when new source is available from GDA.	-	-	-	-	-	✓
		Increase SW abstraction from River Dee at Greenmount and upgrade WTP.	-	-	✓	-	✓	-
		Potential for new GW source in the Williamstown Gravels	-	-	✓	-	-	-
		New SW abstraction from River Glyde at Castlebellingham.	-	-	✓	-	-	-
		New wellfield at Carlingford BH site.	-	-	-	-	-	-
		Potential to develop wellfield in Cooley Gravel Aquifer.	-	-	✓	-	-	-
		Potential for new GW source from Dromiskin Gravels.	-	-	✓	-	-	-
Drumcondrath	1	New GW abstraction in vicinity of Drumcondrath WTP on Coillte land.	✓	✓	✓	✓	✓	✓

Water Resource Zone Name	No. WRZ Options	Feasible Options SAE Louth	Approach					
		Option Description	Least Cost	Quickest Delivery	Best AA	Best SEA	Lowest Carbon	Most Resilient
Inniskeen	1	Upgrade WTP for water quality improvements. Inniskeen WRZ is not in deficit.	✓	✓	✓	✓	✓	✓
Kilmainhamwood /Nobber	2	Maintain both plants and new GW abstractions in Kingscourt GWB.	✓	-	✓	-	-	✓
		Rationalise Kilmainhamwood WTP and Nobber WTP to Kingscourt WRZ (Cavan).	-	✓	✓	✓	✓	-
Kingscourt PWS	1	Upgrade Lisanisky WTP for water quality improvements. Kingscourt WRZ is not in deficit.	✓	✓	✓	✓	✓	✓

The 7 Step Process outlined in Figure 5.3 was then applied to each WRZ in SAE, in order to develop a WRZ level approach. A summary of the outcome of this assessment at WRZ level (i.e. WRZ options only) is shown in Table 5.4.

The findings of the Preferred Approach Development for SA at WRZ level, include the following:

- In terms of Best AA, 3 WRZ options scores a 0 in relation to potential impact on a designated European Site;
- The Best AA and the Best Environmental (overall SEA score) approach is identified as the Preferred Approach for 6 of the 9 WRZs;
- Of the 18 WRZ level feasible options, 1 option has a -3 score against biodiversity, but this feasible option has not been identified as the preferred approach for the relevant WRZ (Cavanhill & North Louth).

The preferred WRZ level approaches for each WRZ in SAE are outlined in Table 5.4.

Table 5.4 SAE WRZ Approach Options

Water Resource Zone Name	Feasible Options SAE Louth		Zero AA	Approach						Preferred Approach
	Option Code	Option Description		Least Cost	Quickest Delivery	Best AA	Best SEA	Lowest Carbon	Most Resilient	
Ardee, Collon and Drybridge	SAE-045	Supply from Ballymakelly GWS.	-	✓	✓	-	✓	✓	✓	✓
Carrickarnon (Water Supplied from NI-Water Import)	SAE-033	Maintain import from Northern Ireland Water - isolated scheme.	-	✓	✓	✓	✓	✓	✓	✓
Carrickmacross	SAE-050	Upgrade WTP for water quality improvements. Carrickmacross WRZ is not in deficit.	-	✓	✓	✓	✓	✓	✓	✓
Castletown (Meath County Council)	SAE-021	GW enhancement at Castletown.	✓	✓	✓	✓	✓	✓	✓	✓
Cavanhill & North Louth	SAE-001	Dependant on operational regime implementation, increase abstraction from the river Fane and upgrade existing WTP to meet critical peak demand. SCADA and weir control system upgrade required.	-	✓	✓	✓	✓	-	✓	✓
Drumcondrath	**No local solution**									
Inniskeen	SAE-052	Upgrade WTP for water quality improvements. Inniskeen WRZ is not in deficit.	-	✓	✓	✓	✓	✓	✓	✓
Kilmainhamwood /Nobber	SAE-024	Maintain both plants and new GW abstractions in Kingscourt GWB.	✓	✓	-	✓	-	-	✓	✓

Water Resource Zone Name	Feasible Options SAE Louth		Zero AA	Approach						Preferred Approach
	Option Code	Option Description		Least Cost	Quickest Delivery	Best AA	Best SEA	Lowest Carbon	Most Resilient	
Kingscourt PWS	SAE-061	Upgrade Lisanisky WTP for water quality improvements. Kingscourt WRZ is not in deficit.	✓	✓	✓	✓	✓	✓	✓	✓

5.2.2 Stage 2 - Preferred Approach Development at the Study Area Level

The Second Stage of our Approach Development Process involves identifying the Study Area options that can address Need in more than one WRZ within the Study Area, and then develop various combinations which contain elements of the different options. These are called SA Combinations SA Combinations will consist of a number of different projects or options; however, looking at a wider, more holistic, spatial scale benefits the plan level assessment in considering what options might work across multiple WRZ's.

For each Study Area, one of the SA Combinations will always be the WRZ Level Approach. The WRZ Level Approach is the combination of all of the individual the Preferred Approaches at WRZ level for the entire Study Area. Table 5.5 below provides a summary of the 10 Study Area options.

Table 5.5 SAE Grouped options

Water Resource Zone Name	Feasible Options SAE Louth		
	Option Code	Option Description	SA Grouped Option
Cavanhill & North Louth	SAE-501	Dependant on operational regime implementation, increase abstraction from the river Fane and upgrade existing WTP to meet critical peak demand. Rationalisation of Greenmount to Cavanhill WTP - will require WTP upgrade at Cavanhill to meet critical peak demand, and upgrade of 8km of watermain. Rationalisation of Tallanstown and connection with Cavanhill due to WQ issues. Long term will require increased abstraction and upgrade at Cavanhill WTP to meet critical peak demand.	Group 1
Ardee, Collon and Drybridge South Louth & East Meath	SAE-505	Transfer from GDA (new source required). Rationalisation of Ardee, Collon and Drybridge to South Louth East Meath - New source required from GDA to offset demand.	Group 5
Cavanhill & North Louth Ardee, Collon and Drybridge South Louth & East Meath	SAE-506	Import from Cavanhill to South Louth East Meath in the short term. New main could be dual purpose allowing reverse flow to Cavanhill when new source from the GDA is supplying into South Louth East Meath. Interconnection of Ardee, Collon and Drybridge with South Louth & East Meath WRZ (approx. 0.5km distance).	Group 6
Ardee, Collon and Drybridge South Louth & East Meath	SAE-507	Connect Ardee to Greenmount (R Dee). Rationalise Collon Drybridge to South Louth East Meath.	Group 7
Ardee, Collon and Drybridge South Louth & East Meath	SAE-508	Rationalise Collon Drybridge to South Louth East Meath. New GW (partial supply) for Ardee within WTP vicinity.	Group 8

Water Resource Zone Name	Feasible Options SAE Louth		
	Option Code	Option Description	SA Grouped Option
Shercock PWS (GWS Import) Kingscourt PWS	SAE-511	Increase existing GW abstraction and supply deficit Lisanisky WTP. Interconnect Shercock and Kingscourt WRZs and supply deficit from Kingscourt.	Group 11
Shercock PWS (GWS Import) Kingscourt PWS	SAE-512	Increase existing GW abstraction and supply deficit Lisanisky WTP. Rationalise Shercock to Kingscourt WRZ.	Group 12
Drumcondrath	SAE-513	Groundwater from Pure Bedded Lst aquifer at Possextown (2 TW's ongoing). This is to serve as the primary option to supply full demand (subject to final BH pumping configuration). Refurb of existing borehole from Rolagh townland. Option to serve as backup if additional supply needed to meet changes in future demand.	Group 13
Inniskeen Cavanhill & North Louth	SAE-551	Rationalise Inniskeen to Cavanhill WRZ.	Group 51
Kingscourt PWS Bailieboro RWSS	SAE-552	Rationalise Kingscourt to Bailieboro for increased resilience. New SW abstraction from Lough Ramor.	Group 52

The 10 Study Area options result in 12 SA Combinations that could meet the need across all WRZs. The WRZ Level Approach is excluded at this stage of comparison as Drumcondrath does not have a WRZ Level Approach (and accordingly the WRZ Level Approach does not meet the need across all WRZs). The 12 SA Combinations in terms of the types of options within each combination are summarised in Table 5.6 below.

Table 5.6 SAE Combinations Options Summary

Key	WRZ Approach Option	○	SA Grouped Option	□

WRZ	WRZ Approach Options	SA Combination 1 (SA Grouped Option 1 and 13)	SA Combination 2 (SA Grouped Option 5 and 13)	SA Combination 3 (SA Grouped Option 6 and 13)	SA Combination 4 (SA Grouped Option 1, 5 and 13)	SA Combination 5 (SA Grouped Option 1, 6 and 13)	SA Combination 6 (SA Grouped Option 7 and 13)	SA Combination 7 (SA Grouped Option 8 and 13)	SA Combination 8 (SA Grouped Option 11 and 13)	SA Combination 9 (SA Grouped Option 12 and 13)	SA Combination 10 (SA Grouped Option 13)	SA Combination 11 (SA Grouped Option 13 and 51)	SA Combination 12 (SA Grouped Option 13 and 52)
Ardee, Collon and Drybridge	○	○	□	□	□	□	□	□	○	○	○	○	○
Carrickarnon (Water Supplied from NI-Water Import)	○	○	○	○	○	○	○	○	○	○	○	○	○
Carrickmacross	○	○	○	○	○	○	○	○	○	○	○	○	○
Castletown (Meath County Council)	○	○	○	○	○	○	○	○	○	○	○	○	○
Cavanhill & North Louth	○	□	○	○	□	□	○	○	○	○	○	○	○
Drumcondrath	No local solution	□	□	□	□	□	□	□	□	□	□	□	□
Inniskeen	○	○	○	○	○	○	○	○	○	○	○	□	○
Kilmainhamwood /Nobber	○	○	○	○	○	○	○	○	○	○	○	○	○
Kingscourt PWS	○	○	○	○	○	○	○	○	□	□	○	○	□

5.2.3 Stage 3 – Preferred Approach at Study Area Level

As part of stage three, we compare the WRZ Level Approach and the SA Combinations to determine the Preferred Approach that provides the best outcome for the Study Area. As the WRZ Level Preferred Approach did not meet the deficit for the Study Area as a whole, it has not been assessed and assigned a score for the purposes of determining the best performing alternative within each approach category.

We use the EBSD tool to rank the combinations against the assessment criteria and we then compare the best performing SA Combinations under each of the six approach types, using the 7 step process set out in Fig 5.1, to establish the Preferred Approach at Study Area level. The results of this process are provided in Table 5.7.

In accordance with Section 7.2.2 of the draft RWRP NW, where options or combinations of options achieve similar, although not exactly identical scores under the six approach types, IW takes a wider look at the comparable combinations /options to consider which to categorise as the “Best” approach within each category. In particular, IW takes into account whether the option or combination of options meets the SEA and Habitats objectives outlined in the Framework Plan. This is an example of the professional judgement from the multi-disciplinary teams, identified in section 8.3.7.4 of the Framework Plan.

For SAE, seven SA combinations had a very similar ranking under the Least Cost category, within 5% of each other.

- Combination 1
- Combination 6
- Combination 7
- Combination 8
- Combination 9
- Combination 10
- Combination 11

The Least Cost Approach is determined using an Irish Water Net Present Value assessment tool. The NPV tool uses a strict set of requirements and is limited in what flexibility it offers. Therefore, as set out in further detail in Section 7.2.1 of the draft RWRP NW, where an Option or Combination of Options provide similar NPV costs, and in some circumstances so as to ensure that no option is discounted at this early stage by reference only to “Least Cost” only, Irish Water has considered that all options within a 5% NPV cost margin are in principle eligible to be identified as the “Least Cost” option. This approach recognises the desktop nature of the NPV assessment and the fact that the figures will almost certainly change at project stage.

When we compare these seven combinations against each other to identify which should go forward as the Least Cost approach. Combination 6 and 7 score best in terms of delivery, carbon, resilience and overall environmental score. Combination 7 considers local ground water as a solution for the Ardee supply while Combination 6 considers connecting Ardee to the Greenmount supply which requires the provision of a significant length of mains. The Ardee supply is currently operating at a deficit and a new supply is urgently required. While Combination 7 scores worst against the resilience criteria the absolute difference in the resilience score between the highest and lowest resilience scores is minimal and associated with the fact that further project level assessments are required to confirm the supply available from the groundwater source. As Combination 7 is the Quickest Delivery Approach, and there is no significant difference in costs between Combination 6 and Combination 7, with Combination 7 being the absolute Least Cost Approach (noting again that it is within 5% of the NPV for Combination 7), Combination 7 is therefore, progressed as the Least Cost Approach.

Table 5.7 SAE Summary of SA Combination of Performance against Approach Type

Ranked order (best to worst)	Best													Worst

WRZ	WRZ Approach Options	SA Combination 1 (SA Grouped Option 1 and 13)	SA Combination 2 (SA Grouped Option 5 and 13)	SA Combination 3 (SA Grouped Option 6 and 13)	SA Combination 4 (SA Grouped Option 1, 5 and 13)	SA Combination 5 (SA Grouped Option 1, 6 and 13)	SA Combination 6 (SA Grouped Option 7 and 13)	SA Combination 7 (SA Grouped Option 8 and 13)	SA Combination 8 (SA Grouped Option 11 and 13)	SA Combination 9 (SA Grouped Option 12 and 13)	SA Combination 10 (SA Grouped Option 13)	SA Combination 11 (SA Grouped Option 13 and 51)	SA Combination 12 (SA Grouped Option 13 and 52)
Least Cost						Worst		Best					
Quickest Delivery						Worst		Best					
Best AA *no. of -3 scores against biodiversity	0 No. -3 Scores	0 No. -3 Scores	0 No. -3 Scores	0 No. -3 Scores	0 No. -3 Scores	0 No. -3 Scores	0 No. -3 Scores	0 No. -3 Scores	0 No. -3 Scores	0 No. -3 Scores	0 No. -3 Scores	0 No. -3 Scores	0 No. -3 Scores
Lowest Carbon						Worst	Best						
Most Resilient							Best	Worst					
Best Environmental						Worst	Best						

The SA combinations including the WRZ approach outlined in Table 5.6 are assessed to determine the approach categories as summarised in Table 5.8.

Table 5.8 Best Combinations

Approach Categories	Best Performing Combination
Least Cost (LCo)	SA Combination 7
Best Environmental (BE)	SA Combination 6
Quickest Delivery (QD)	SA Combination 7
Most Resilient (MR)	SA Combination 6*
Lowest Carbon (LC)	SA Combination 6
Best AA (BA)	SA Combination 6 & 7**

**6 combinations have the same resilience score, however, SA Combination 6 is brought forward as the best as overall it scores best under the other approaches*

***All Combinations have no -3 AA impacts. SA Combination 6 & 7 have the best overall AA score, with four -1 AA impacts and five 0 AA impacts.*

The MCA assessment included the following assessment criteria:

- Resilience;
- Deliverability and Flexibility;
- Progressibility; and
- Sustainability (Environmental and Social Impacts).

The NPV Costs are based on four criteria:

- Capital Costs – the cost to construct the option, including all overheads, consent and land acquisition costs;
- Operational Costs – the whole life cost to operate the option, including operators, chemical requirements and energy requirements including pumping;
- Carbon Costs – the whole life embodied and operational Carbon costs of the option; and
- Environmental and Social – the whole life Environmental and Social cost of the option covering climate regulation, traffic disruption and food production (carbon emissions are covered separately in the bullet point above).

The wider range of costs used in the estimation of the NPV aligns our Plan with any future Project Level Cost Benefit Analysis, in accordance with the Public Spending Code.

In terms of NPV Cost, the SA Combination 7 has the lowest NPV Cost, as shown in Figure 5.2, with the lowest total costs (CAPEX and OPEX) over the solutions lifetime.

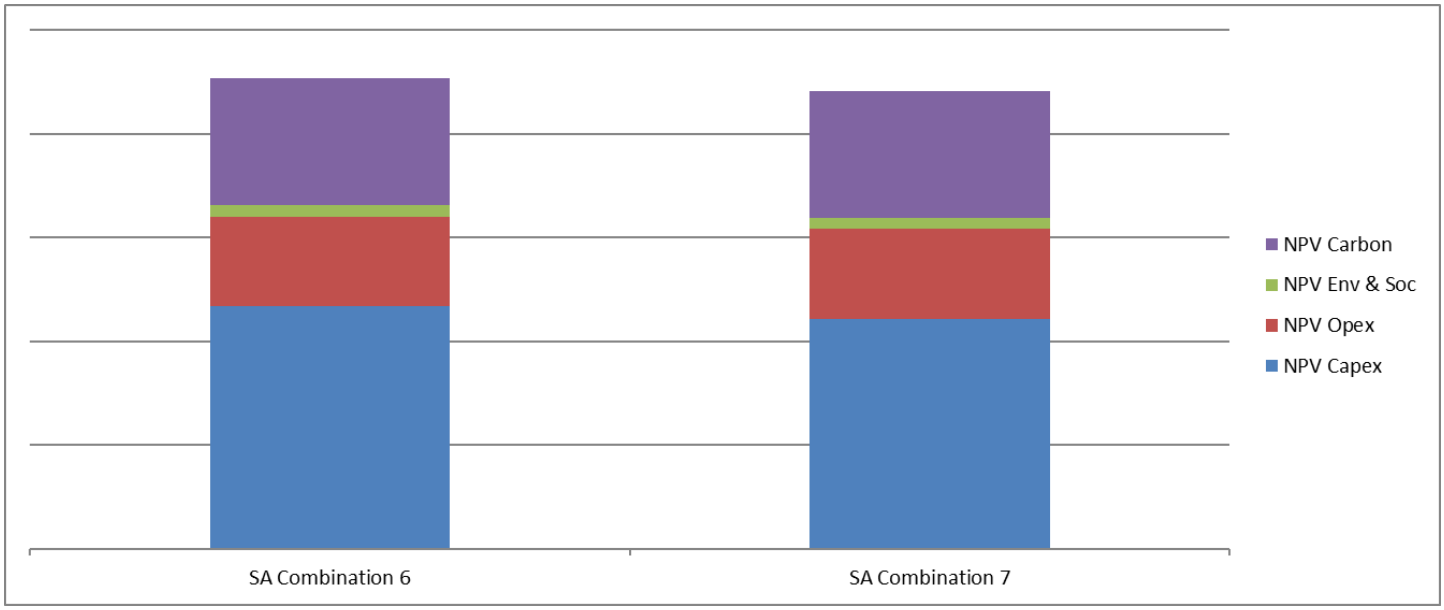


Figure 5.2 SAE NPV Costs for WRZ and SA Approaches

In accordance with the Options Methodology, these approaches are then compared against each other using the 7-Step process in Figure 5.1 to generate the best value combination of options at the Study Area level. The best value combination of options at the Study Area level results in the SA Preferred Approach. The outputs from the assessment were as follows:

- Step 1 – We compared the Least Cost Approach against the Best AA approach. The Least Cost Approach scored the same as the Best AA approach against the Best AA criteria. The Least Cost approach was therefore retained at this stage.
- Step 2 – We compared the Quickest Delivery Approach against the Least Cost Approach. The Quickest Delivery is the Least Cost Approach therefore the Least Cost Approach was retained at this stage.
- Step 3 - We compared the Least Cost against the Best Environmental Approach. The Best Environmental Approach and the Least Cost Approach are similar options, and both score similarly across all criteria. The Least Cost Approach considers local ground water as a solution for the Ardee supply while the Best Environmental Approach considered connecting Ardee to the Greenmount supply which requires the provision of a significant length of mains. The Ardee supply is currently operating at a deficit and a new supply is urgently required. As the Least Cost Approach is the Quickest Delivery Approach and there is no significant difference between Least Cost and the Best Environmental Approach against all other criteria, the Least Cost Approach was retained at this stage.
- Step 4 – We compared the Least Cost against the Most Resilient Approach. The Most Resilient Approach and the Least Cost Approach are similar options, and both score similarly across all criteria. The Least Cost Approach considers local ground water as a solution for the Ardee supply, while the Best Environmental Approach involves connecting Ardee to the Greenmount supply, which would require the provision of a significant length of mains. While Least Cost Approach scores worst against the resilience criterion, the absolute difference between the highest and lowest resilience scores is minimal, and is associated with the fact that further project level assessments are required to confirm the supply available from the groundwater source. The Ardee supply is currently operating at a deficit and a new supply is urgently required. As the Least Cost Approach is the Quickest Delivery Approach and there is no significant difference between Least Cost and the Most Resilient Approach against all other criteria, the Least Cost Approach was retained at this stage.

- Step 5 - We compared the Least Cost Approach against the Lowest Carbon Approach. There is a less a very small difference in carbon cost between the Least Cost approach and the Lowest Carbon Approach. The Least Cost approach was therefore retained at this stage.
- Step 6 – A final assessment of the Least Cost and Quickest Delivery Approach was completed against the Lowest Carbon, Best Environmental, Best AA and Most Resilient Approach. The Least Cost and Quickest Delivery Approach is very similar to the Lowest Carbon, Best Environmental, Best AA and Most Resilient Approach and both Approaches score similarly across all criteria. The Least Cost Approach and Quickest Delivery Approach considers local ground water as a solution for the Ardee supply, while the Lowest Carbon, Best Environmental, Best AA and Most Resilient involve connecting Ardee to the Greenmount supply, which requires the provision of a significant length of mains. While the Least Cost and Quickest Delivery Approach score worst against the resilience criteria the absolute difference in the resilience score between the highest and lowest resilience scores is minimal, and is associated with the fact that further project level assessments are required to confirm the supply available from the groundwater source. The Ardee supply is currently operating at a deficit and a new supply is urgently required. As the Least Cost Approach is the Quickest Delivery Approach and there is no significant difference between the Least Cost and the Lowest Carbon, Best Environmental, Best AA and Most Resilient Approach against all other criteria the Least Cost Approach was retained at this stage.
- Step 7 – The Least Cost Approach was therefore selected as the Preferred Approach.

5.3 Study Area Preferred Approach Summary

On the basis of this initial assessment at Plan level, SA Combination 7 represents the Preferred Approach for Study Area E, which consists of the options listed in Table 5.9.

Table 5.9 Preferred Approach for SAE

WRZ Name	Preferred Approach Option Description SA Combination 7
Ardee, Collon and Drybridge South Louth & East Meath	TG1-SAE-508: Rationalise Collon Drybridge to South Louth East Meath. New GW (partial supply) for Ardee within WTP vicinity.
Carrickarnon (Water Supplied from NI-Water Import)	TG1-SAE-033: Maintain import from Northern Ireland Water - isolated scheme.
Carrickmacross	TG1-SAE-050: Upgrade WTP for water quality improvements. Carrickmacross WRZ is not in deficit.
Castletown (Meath County Council)	TG1-SAE-021: GW enhancement at Castletown.
Cavanhill & North Louth	TG1-SAE-001: Dependant on operational regime implementation, increase abstraction from the river Fane and upgrade existing WTP to meet critical peak demand. SCADA and weir control system upgrade required.
Drumcondrath	TG1-SAE-513: Groundwater from Pure Bedded Lst aquifer at Possextown (2 TW's ongoing). This is to serve as the primary option to supply full demand (subject to final BH pumping configuration). Refurb of existing borehole from Rolagh townland. Option to serve as backup if additional supply needed to meet changes in future demand.
Inniskeen	TG1-SAE-052: Upgrade WTP for water quality improvements. Inniskeen WRZ is not in deficit.
Kilmainhamwood /Nobber	TG1-SAE-024: Maintain both plants and new GW abstractions in Kingscourt GWB.
Kingscourt PWS	TG1-SAE-061: Upgrade Lisanisky WTP for water quality improvements. Kingscourt WRZ is not in deficit.

The Preferred Approach (SA approach Combination 7) is shown schematically in Figure 5.3.

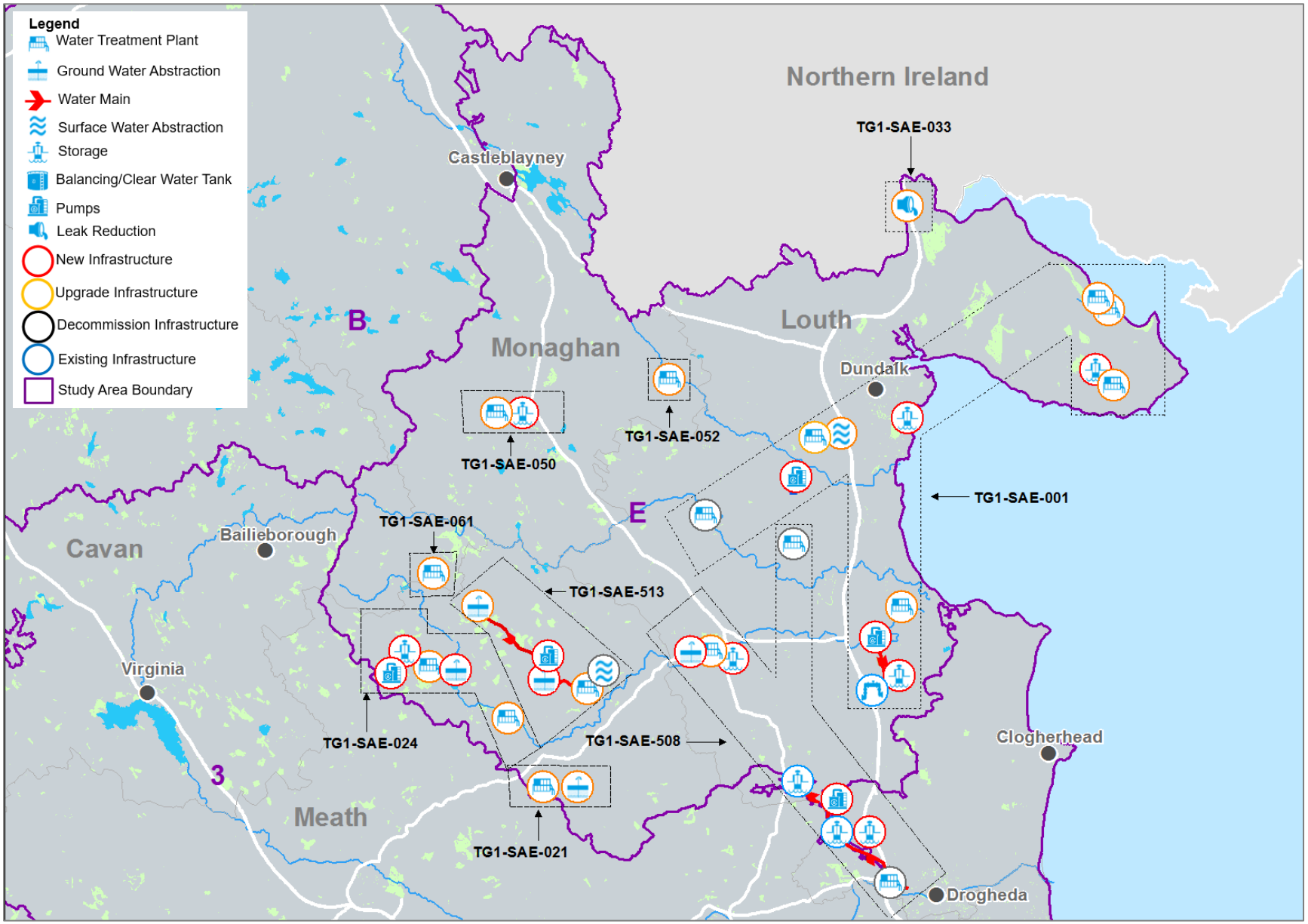


Figure 5.3 SAE Preferred Approach

The Preferred Approach for SAE Louth also includes for demand side (**Lose Less** and **Use Less**) measures, including.

- Ongoing leakage management including active leakage control, pressure management and find and fix activities to offset Natural Rate of Leakage Rise (NRR)
- Continuation of IW household and business water conservation campaigns, initiatives and education programmes
- The option to implement legally enforceable Water Conservation Orders in drought periods in order to protect the environment and our public water supplies

Before we adopt this approach at Plan level for SAE, we must give consideration to the following:

- **Interim Solutions**: Based on the scale of need identified across all 539 WRZs, it is likely that it may take 5-10 investment cycles before we address all issues with the existing water supplies. Therefore, small localised options may be required on an interim basis to secure priority need in existing supplies until the SA Preferred Approach can be delivered; and
- **Sensitivity Analysis**: When planning for water supplies over a medium to long term horizon, we must give consideration to adaptability of our plan to change across a range of future scenarios (for example, what if changes to technology allow us to reduce leakage beyond SELL, even in small WRZs or what if we are unable to secure a licence in the medium term to abstract the quantity water currently allowed for at a given location).

6 Preferred Plan Constraints – Interim Solutions

6 Preferred Plan Constraints – Interim Solutions

As outlined in more detail in Section 8.3.7.6 of the Framework Plan, the NWRP provides for an "interim solution" approach, which allows shorter term interventions to be identified and prioritised, when needed. The Preferred Approach for each WRZ, Study Area and Region will be delivered on a phased basis subject to budget and regulatory constraints. It will take many investment cycles to deliver the Preferred Approach across all WRZs, therefore, Irish Water must have a means to continue delivering safe, secure and reliable water supplies (on a short to medium term basis) while we deliver our Preferred Approach.

On this basis, interim, short term capital maintenance solutions have been identified for all WTPs and will be utilised when needed. These solutions will allow IW time to deliver the Preferred Approach, while at the same time, maintaining a sustainable water supply. These interim solutions are generally smaller in scale and rely on making best use of already existing infrastructure.

Examples of general interim measures for different water sources include the following:

- For groundwater sites, where the Preferred Approach requires that the existing WTP is to be maintained, the interim solution would typically provide for refurbishment of the existing or development of new boreholes and borehole pumps, and an upgrade of the treatment process in line with proposed growth predictions. This may require a staged upgrade of the WTP. For example, the interim solution would typically include an upgrade of the WTP to provide supply to existing customers with consideration given to a further required expansion of the WTP at a later date.
- For surface water sites, where the Preferred Approach requires that the existing WTP is to be maintained, the interim option would typically involve the upgrade of the existing WTP in line with proposed growth predictions. As for groundwater sites this may require a staged upgrade of the WTP where the interim solution would typically include an upgrade of the WTP to provide supply to existing customers with consideration given to a further required expansion of the WTP at a later date.
- For groundwater and surface water sites where the Preferred Approach involves the decommissioning of the WTP by providing supply to the customers from another WTP within the WRZ or from another WRZ/Study Area/Region, the interim solution would involve the advancement of the rationalisation of the WTP, by provision of part supply or full supply if possible. If rationalisation is not feasible at that point in time due to dependencies on Study Area or Regional options, containerised WTP upgrade solutions would be considered for the WTP. This involves the provision of a package WTP within a containerised unit. These package plants can be modified for use on other sites in the future therefore are considered "no regrets" infrastructure investment.

A decision to progress any interim solution will be based on urgent or priority need to address water quality risk or supply reliability e.g. RAL or drought issues or critical need for example. The Regional Plan does not confer funding availability for any project and any interim measures will be subject to budget availability, relevant environmental assessment and other required consents in the normal way.

These solutions, in most cases, will only be used to allow time to deliver the longer-term solution. The interim solutions are determined in line with the Preferred Approach and as such, they are considered "no regrets" infrastructure investment.

Table 6.1 SAE Interim Options

WTP Name	Interim Option
Lisanisky WTP	Refurb existing Boreholes, and upgrade WTP to IW Standards

WTP Name	Interim Option
Ardee WTP	Refurb existing Borehole, and upgrade WTP to IW Standards
Greenmount WTP	Upgrade WTP to IW Standards
Ardtullybeg WTP	Refurb existing Boreholes, and upgrade WTP to IW Standards
Cooley (Carlingford) WTP	Refurb existing Boreholes, and upgrade WTP to IW Standards
Tallanstown WTP	Upgrade WTP to IW Standards – Potential site for a containerised solution
Collon WTP	Refurb existing Boreholes, and upgrade WTP to IW Standards – Potential site for a containerised solution
Carlingford WTP	Upgrade WTP to IW Standards
Cavanhill WTP	Upgrade WTP to IW Standards
Drybridge WTP	Refurb existing Borehole, and upgrade WTP to IW Standards – Potential site for a containerised solution
Castletown WTP	Refurb existing Borehole, and upgrade WTP to IW Standards
Drumcondrath WTP	Refurb existing Boreholes, and upgrade WTP to IW Standards
Kilmainhamwood WTP	Refurb existing Boreholes, and upgrade WTP to IW Standards
Nobber WTP	Refurb existing Borehole, and upgrade WTP to IW Standards
Nafarty WTP	Refurb existing Boreholes, and upgrade WTP to IW Standards
Inniskeen WTP	Upgrade WTP to IW Standards

7

Preferred Approach – Sensitivity Analysis

7 Preferred Approach – Sensitivity Analysis

Our supply demand forecast, and water quality barrier deficit assessments have been developed using the application of best practice methods within the data available. We have identified areas where we will focus improvements in data to improve the certainty of our forecasts. However, all long-term forecasts are subject to uncertainty. We have explored the sensitivity of our supply and demand forecasts to some of the key factors which influence them through a range of scenarios. This enables us to test the sensitivity of the Preferred Approach to changes in need, in order to ensure that our decision making is robust and that the approach is adaptable. We describe the factors which have been considered in Chapter 8 of the Framework Plan. In summary we test our Preferred Approach against the following questions:

1) What if the deployable output across our supplies is reduced based on sustainability limits within the new legislation on abstraction resulting in a larger supply demand balance deficit?
2) What if climate change impacts on our existing supplies are greater than anticipated?
3) What if our forecasts are too great and expected demand growth does not materialise resulting in a smaller supply demand balance deficit?
4) What if we are able to reduce leakage below SELL within the timeframe of the plan resulting in lower Needs?

A summary of the adaptability criteria and analysis we have undertaken for SAE is shown in Table 7.1.

Table 7.1 Sensitivity Analysis for SAE

Uncertainty	Likelihood	Increase/Decrease in Deficit	Impact on Preferred Approach
Sustainability	Moderate/High (as our current abstractions are large compared to the water bodies from which they abstract)	+20,000 m^3/day	**The impact of sustainability reductions would reduce the volumes that can be abstracted from our existing sources therefore increasing the supply demand balance deficit**. There are two surface water sources in SAE that would be potentially impacted from sustainability reductions – River Fane and Lough Bracken. Regarding River Fane, it has been assumed that the historical Water Order abstraction limits can be maintained therefore allowing an abstraction increase as part of the preferred approach, however this is dependent on implementing the operational regime required for the River Fane low flow augmentation scheme to ensure the protection of the Lough Muckno and River Fane system. Regarding Lough Brackan, our preferred approach is designed to relieve pressure on this source by supplying from a new more resilient groundwater source.
			Based on this scenario, the Preferred Approach remains the optimal solution.

Uncertainty	Likelihood	Increase/Decrease in Deficit	Impact on Preferred Approach
Climate Change	High (international climate change targets have not been met)	+300 m3/day	**Higher climate change scenarios would impact our existing supplies and result in decreased water availability at certain times of year.** Although the likelihood of this scenario is high based on climate change adaptation to date, potential impacts may be mitigated against by optimizing our operations on a more environmentally sustainable basis across the range of supplies. Based on this scenario, the Preferred Approach remains the optimal solution.
Demand Growth	Low/Moderate (growth has been based on policy)	-1,233 m^3/day	**The impact of lower than expected growth would reduce the supply demand balance deficit and the overall need requirement.** The supply demand balance deficit is spread across 9 individual water resource zones and is driven by quality as well as quantity issues. In this rural area, growth is relatively low. Based on this scenario, the Preferred Approach remains the optimal solution.
Leakage Targets	Low (Irish Water is focused on sustainability and aggressive leakage reduction)	40 m^3/day	**The impact of lower than expected leakage savings would increase the supply demand balance deficit and the overall need requirement.** As Irish Water is committed to achieving leakage reductions, the likely scenario would be an extension in the period of time taken to achieve leakage targets as opposed to accepting lower targets. Based on this scenario, the Preferred Approach remains the optimal solution.

Uncertainty	Likelihood	Increase/Decrease in Deficit	Impact on Preferred Approach
	Moderate/High (Irish Water is focused on sustainability and aggressive leakage reduction)	4,945 m^3/day	**Increased leakage savings beyond SELL would reduce the supply demand balance deficit and the overall need requirement.** The need drivers in SAE are across all 9 water resource zones and are driven by quality as well as availability issues. Therefore, the Preferred Approach is required, even accounting for increased leakage savings. Based on this scenario, the Preferred Approach remains as the optimal solution.

In reality, a combination of these scenarios may occur together. For example, growth in demand might be lower if we achieve greater leakage reductions. However, if this coincided with a reduction in permitted abstraction volume under the abstraction licensing regime, the reduction in demand may offset some or all of the loss in supply availability due to abstraction sustainability reductions.

Based on the adaptability assessment, the Interim and Preferred Approaches perform as follows:

- Interim Approach – As the purpose of the Interim Approach is to allow for emergency works for priority Quality and Quantity issues, the solutions will have a limited design life (usually less than 10 years). They allow time to assess the Preferred Approach and improve adaptability within our Plan
- Preferred Approach – As the Supplies in SAE Louth are relatively small, and as conservative limits have been applied to the supply availability assessments, the Preferred Approach is adaptable to a range of future outlooks in relation to sustainability and climate change. The demand growth in the area is small, and the Supply Demand Deficits are primarily driven by reliability. As Water Treatment Plants are modular, capacity will be delivered on a phased basis, allowing for adaptation across a range of futures. Our Preferred Approach is therefore Adaptable.

In summary, our sensitivity assessment of the Interim and Preferred Approaches demonstrates that they are both highly adaptable to a broad range of futures, and therefore represent ‘no regrets’ infrastructure.

8

Summary of Study Area E

8 Summary of Study Area E

The Preferred Approach for SAE (summarised in Table 5.8 and Figure 5.3) consists of local WRZ solutions for Cavanhill & North Louth, Castletown (Meath County Council), Kilmainhamwood/Nobber, Carrickarnon (Water Supplied from NI-Water Import), Kingscourt PWS, Carrickmacross and Inniskeen WRZs, primarily driven by the small scale of the supplies and difficulties in transporting small volumes of water over long distances.

The preferred approach for Collon Drybridge and Ardee involves developing a new GW source at Ardee WTP and rationalising Collon and Drybridge to South Louth East Meath. The preferred approach for Drumcondrath involves developing two new GW water sources at Possextown and Rolagh townland to address the deficit within the WRZ.

Delivery of the Preferred Approach will secure all of the supplies in the area in terms of Quality, Quantity, Sustainability and Resilience. The Preferred Approach for SAE Louth also includes for demand side (**Lose Less** and **Use Less**) measures, including.

- Ongoing leakage management including active leakage control, pressure management and find and fix activities to offset Natural Rate of Leakage Rise (NRR)
- Nett leakage reduction in Carrickmacross Water Resource Zone, amounting to 40 m^3 per day (applied to SDB Deficit) to move towards achieving the National SELL Target by 2034
- Continuation of IW household and business water conservation campaigns, initiatives and education programmes
- The option to implement legally enforceable Water Conservation Orders in drought periods in order to protect the environment and our public water supplies

As part of our Preferred Approach we have also identified a range of interim emergency solutions for SAE, as summarised in **Error! Reference source not found.**. The measures will only be progressed in the event of critical need and/or public health impact and to allow time for delivery of the required Preferred Approach solutions in the Study Area.

Annex A – Study Area E Water Treatment Plants

WTP Asset Name	Local Plant Names
Inniskeen WTP	Inniskeen WTP
Nafarty WTP	Nafarty WTP
Nobber WTP	Nobber WTP
Kilmainhamwood WTP	Kilmainhamwood WTP
Drumcondrath WTP	Drumcondrath WTP
Castletown WTP	Castletown WTP
Drybridge WTP	Drybridge WTP
Cavanhill WTP	Cavanhill WTP
Carlingford WTP	Carlingford WTP
Collon WTP	Collon WTP
Tallanstown WTP	Tallanstown WTP
Ardtullybeg WTP	Ardtullybeg WTP
Cooley (Carlingford) WTP	Cooley (Carlingford) WTP
Greenmount WTP	Greenmount WTP
Ardee WTP	Ardee WTP
Lisanisky WTP	Lisanisky WTP

Annex B – Study Area E Rejection Register Summary

Annex B Study Area E Rejection Register Summary

Study Area E - CS Rejection

Option Reference	Option Description	Rejection Reasoning	Resilience	Deliverability & Flexibility	Sustainability
TG1-SAE-010	Tactical/ Operational Option - Interconnection exists for Ardee with Greenmount, Tallanstown, Collon and Dunleer. Ardee can supplement portions of these schemes to be supplemented by these schemes if required.	This option is a 'Tactical Option' and does not offer a new supply to meet deficit. This will be considered as part of operating regime and outline design. As this option will progress in conjunction with other supply options, this option was screened out of the Preferred Approach development phase at coarse screening.	This option is a tactical option and is unlikely to meet the full deficit. This will likely be implemented along with a new supply option		
TG1-SAE-011	Dunleer currently supplied from Greenmount - pressurised system and limited volume from hydrant . New reservoir and gravity pipeline to supply must be considerd as part of the FOA as this is the limiting factor here.	This option is a 'Tactical Option' and does not offer a new supply to meet deficit. This will be considered as part of operating regime and outline design. As this option will progress in conjunction with other supply options, this option was screened out of the Preferred Approach development phase at coarse screening	This option is a tactical option and is unlikely to meet the full deficit. This will likely be implemented along with a new supply option		
TG1-SAE-012	New wellfield at Ardtullybeg site - pumps and rising main is the limiting factor here and to be upgraded as part of options assessment	Abstracting the volume of water required is considered unfeasible. Therefore, this option did not meet the requirements of the Environmental, Resilience or Deliverability criteria.	●	●	●
TG1-SAE-015	Potential to look at bringing WTP at Castletown back into operation - Annaskeagh, supply off Cooley Mountains.	Abstracting the volume of water required is considered unfeasible. Therefore, this option did not meet the requirements of the Environmental, Resilience or Deliverability criteria.	●	●	●

Option Reference	Option Description	Rejection Reasoning	Resilience	Deliverability & Flexibility	Sustainability
TG1-SAE-016	Rationalisation Drumcondrath to new GW supply at Ardee	Abstracting the volume of water required is considered unfeasible. Therefore, this option did not meet the requirements of the Environmental, Resilience or Deliverability criteria.	●	●	●
TG1-SAE-016a	GW potential from limestone aquifer at Ardee, east of plant	Abstracting the volume of water required is considered unfeasible. Therefore, this option did not meet the requirements of the Environmental, Resilience or Deliverability criteria.	●	●	●
TG1-SAE-017	Upgrade of Drumcondrath WTP to solve WQ issues (CFC package plant), WRZ not in deficit	Abstracting the volume of water required to make this a feasible option is considered likely to result in the waterbody not achieving WFD objectives. Therefore, this option did not meet the requirements of the Environmental, Resilience or Deliverability criteria.	●	●	●
TG1-SAE-018	New SW source abstraction on the River Dee, new WTP or upgrade of existing WTP, abandon existing Lough Bracken source. Full demand required.	Abstracting the volume of water required to make this a feasible option is considered likely to result in the waterbody not achieving WFD objectives. Therefore, this option did not meet the requirements of the Environmental, Resilience or Deliverability criteria.	●	●	●
TG1-SAE-019	New GW abstraction (Ardee GWB) in vicinity of Drumcondrath WTP, WRZ not in deficit	The trial wells developed here identified unacceptable quality issues. This option was not progressed to the fine screening stage as there are better viable options. This option did not meet the requirements of the Deliverability and Flexibility criteria, due to quality issues.		●	

Option Reference	Option Description	Rejection Reasoning	Resilience	Deliverability & Flexibility	Sustainability
TG1-SAE-022	Rationalise Castletown to Navan-Mid Meath WRZ (requires increases supply from Navan)	The option requires a significant length of pipeline for a relatively very small supply. Transferring small quantities of water over long distances can affect the quality of water. Therefore, this option did not meet the requirements of the Deliverability and Flexibility criteria.		●	
TG1-SAE-023	New GW abstraction in Kingscourt GWB. Rationalise Nobber WTP to Kilmainhamwood WTP.	Abstracting the volume of water required is considered unfeasible. Therefore, this option did not meet the requirements of the Environmental, Resilience or Deliverability criteria.	●	●	●
TG1-SAE-023a	New GW abstraction in Carrickmacross GWB. Rationalise Kilmainhamwood WTP to Nobber WTP.	Abstracting the volume of water required is considered unfeasible. Therefore, this option did not meet the requirements of the Environmental, Resilience or Deliverability criteria.	●	●	●
TG1-SAE-026	Rationalise Kilmainhamwood to Meath Hill GWS	The option requires a significant length of pipeline for a relatively very small supply. Transferring small quantities of water over long distances can affect the quality of water. Therefore, this option did not meet the requirements of the Deliverability and Flexibility criteria.		●	
TG1-SAE-032	New GW abstraction from Louth GWB to supply the scheme (Carrickarnon WRZ)	The option requires a significant length of pipeline for a relatively very small supply. Transferring small quantities of water over long distances can affect the quality of water. As there are other viable alternative option for this WRZ this option was considered not feasible at coarse screening stage.		●	
TG1-SAE-035	Possible option of supplying/interconnecting with Tullyallen Group Water Scheme	Abstracting the volume of water required is considered unfeasible. Therefore, this option did not meet the requirements of the Environmental, Resilience or Deliverability criteria.	●	●	●

Option Reference	Option Description	Rejection Reasoning	Resilience	Deliverability & Flexibility	Sustainability
TG1-SAE-039	Supply Drumcondrath from new GW at Kingscourt and rationalise to Kilmainhamwood	Abstracting the volume of water required is considered unfeasible. Therefore, this option did not meet the requirements of the Environmental, Resilience or Deliverability criteria.	●	●	●
TG1-SAE-039b	New GW from Kingscourt GWB. Includes gravity main from Kilmainhamwood, rationalising Nobber and Drumcondrath	Abstracting the volume of water required is considered unfeasible. Therefore, this option did not meet the requirements of the Environmental, Resilience or Deliverability criteria.	●	●	●
TG1-SAE-040	Connect Drumcondrath to Kilmainhamwooid (New GW from Nobber (Karstic GWB).)	Abstracting the volume of water required is considered unfeasible. Therefore, this option did not meet the requirements of the Environmental, Resilience or Deliverability criteria.	●	●	●
TG1-SAE-040b	New GW from Nobber (Karstic GWB) and connect to and rationalise Drumcondrath	Abstracting the volume of water required is considered unfeasible. Therefore, this option did not meet the requirements of the Environmental, Resilience or Deliverability criteria.	●	●	●
TG1-SAE-046	New SW abstraction at the confluence of the River Dee and River Glyde to supply deficit at Ardee, Collon and Drybridge WRZ	Water quality issues associated with this option. Therefore, this option did not meet the requirements of the Environmental, Resilience or Deliverability criteria.	●	●	●
TG1-SAE-051	Increase existing GW (Carrickmacross GWB (karstic)) abstraction and supply spare capacity to neighbouring schemes. WRZ is not in deficit.	When unconstrained options list was originally drawn up this WRZ was identified as having a deficit; however, due to an updated SDB, a surplus was identified in the WRZ. Therefore, no new supply option is required.	**WRZ is no longer in deficit**		
TG1-SAE-053	Increase existing SW abstraction from River Fane and supply spare capacity to neighbouring schemes. Inniskeen WRZ is not in deficit.	When unconstrained options list was originally drawn up this WRZ was identified as having a deficit; however, due to an updated SDB, there is no longer an identified deficit in this WRZ. Therefore, no new supply option is required.	**WRZ is no longer in deficit**		

Option Reference	Option Description	Rejection Reasoning	Resilience	Deliverability & Flexibility	Sustainability
TG1-SAE-055	Increase existing GW abstraction and supply deficit at Kingscourt WRZ, upgrade Lisanisky WTP	When unconstrained options list was originally drawn up this WRZ was identified as having a deficit; however, due to an updated SDB, a surplus was identified in the WRZ. Therefore, no new supply option is required.	**WRZ is no longer in deficit**		
TG1-SAE-059	Interconnect Kingscourt WRZ and Meath Hill GWS and supply deficit from GWS.	When unconstrained options list was originally drawn up this WRZ was identified as having a deficit; however, due to an updated SDB, a surplus was identified in the WRZ. Therefore, no new supply option is required.	**WRZ is no longer in deficit**		
TG1-SAE-060	Interconnect Kingscourt WRZ and Magheracloone GWS and supply deficit from GWS.	When unconstrained options list was originally drawn up this WRZ was identified as having a deficit; however, due to an updated SDB, a surplus was identified in the WRZ. Therefore, no new supply option is required.	**WRZ is no longer in deficit**		