Jersey Water

Water Resources and Drought Management Plan

Appendix I. Options Appraisal

CONTENTS

JERSEY WATER
WATER RESOURCES AND DROUGHT MANAGEMENT PLAN

APPENDIX I. OPTIONS APPRAISAL

1. PURPOSE

This appendix describes the appraisal of a range of alternative options to address the forecast supply deficit and identified resilience risks. The key objectives of this phase of water resource and drought planning work were to:

- Develop a suite of alternative supply and demand management options for detailed evaluation that will enable Jersey Water to address the forecast deficit over the next 25 years, taking account of the population and housing growth projections for the island.
- Assess the alternative options against a range of evaluation criteria to compare the feasibility and risk, cost, customer acceptability, engineering requirements, reliable supply or demand saving benefit, operational constraints and environmental and social impact.

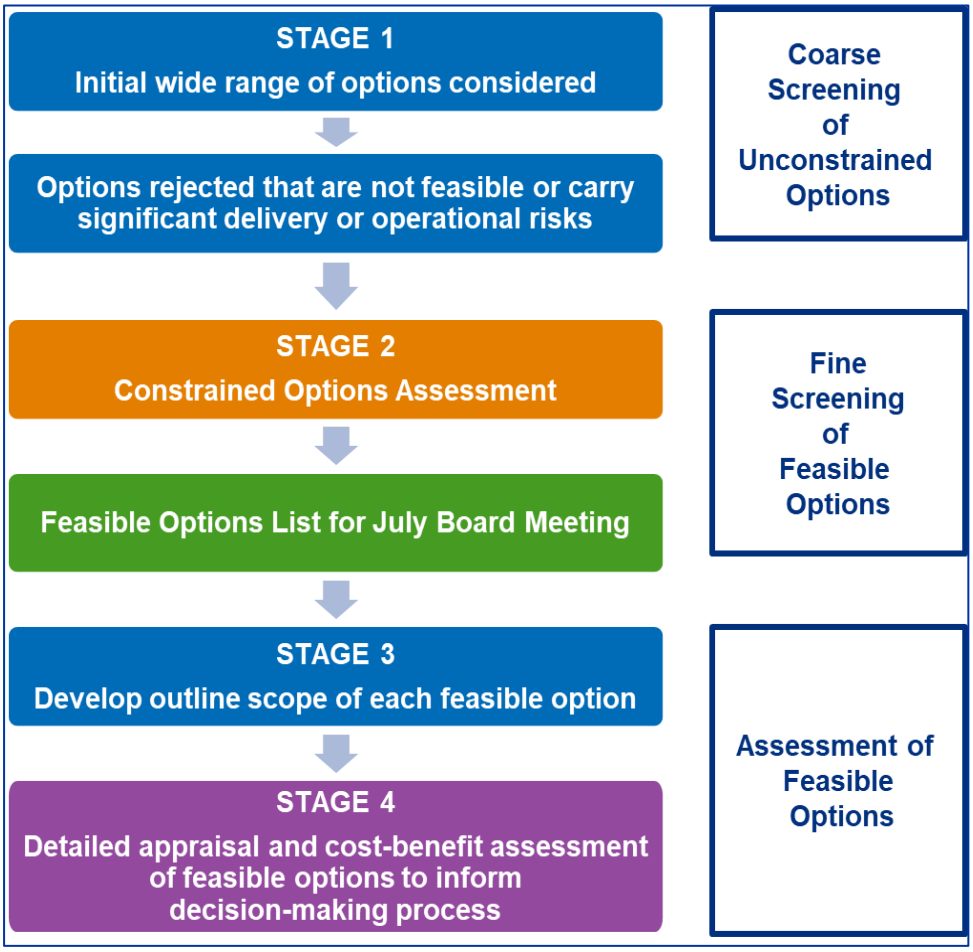
This appendix documents the options appraisal assessment approach, from developing an 'unconstrained' list of options to deriving a final 'constrained' shortlist of options for detailed comparative evaluation.

2. METHODOLOGY

2.1. OVERVIEW

An integrated multi-criteria assessment has been developed and employed for the appraisal of options for the Water Resources and Drought Management Plan. **Figure I.1** summarises the overall appraisal process.

Figure I.1 Summary of overall appraisal process



2.2. STAGE 1: DEVELOPING THE CONSTRAINED OPTION LIST

Development of the constrained option list was undertaken in two key steps:

1. Development of the unconstrained options list
2. Coarse screening of the unconstrained options list.

2.2.1. DEVELOPING UNCONSTRAINED OPTIONS LIST

The unconstrained options list was developed through a review of options, including those identified for the previous WR&DP, the generation of new option ideas from discussions with operational and strategic planning staff at Jersey Water, and a review of options considered

by other water companies in the British Isles, including other small islands. The unconstrained options list includes demand management, leakage control and distribution management, water production and new water source options. This initial stage involved considering a wide range of alternative options with no assessment criteria applied to filter out any options.

An initial unconstrained options list was then reviewed in a structured meeting with operational, engineering, regulatory and strategic planning staff from Jersey Water to ensure that all potential options were identified.

2.2.2. COARSE SCREENING OF UNCONSTRAINED OPTIONS LIST

The coarse screening process involved an assessment of each option on the unconstrained option list against the criteria set out in **Table I-2-1** with the key considerations being any over-riding constraints to option promotion, development and implementation (e.g. legislation or policy, unacceptable risks, customer acceptability or environmental impact). The coarse screening process also helped to rationalise some options from the unconstrained list that were very similar in nature to create single, integrated options.

The unconstrained options were all subject to the coarse screening process. Where unconstrained options were assessed as having an over-riding constraint, or performed very poorly against most criteria, they were rejected and not taken forward to the fine screening stage (Stage 2). Those options rejected at this stage were recorded in the option rejection register (Section 3.5) where the rationale for rejection was clearly set out. Options passing through the coarse screening stage formed the "constrained options" list, which was carried forward into Stage 2.

Table I-2-1 Coarse screening assessment criteria

Jersey Water WRPM19- screening		FEASIBILITY & RISK	ENGINEERING & COST	PERFORMANCE & RESILIENCE	OPERATIONAL	ENVIRONMENTAL
Assessment Grade	Actively contributes to Jersey Water's customer service promises; materially improves drinking water quality					
0	**Positive impact**	Option is straightforward to implement, does not require any further permissions and is beneficial to customers and States of Jersey.	No construction required and option will save JW money.	Option is reliable year round, insensitive to climate change risk and improves resilience of supply zone. Option provides yield >10% of deficit.	Improves drinking water compliance and reduced demand on JW staff.	Option contributes to environmental improvements, reduced flood risk and climate change mitigation.
1	**Zero/negligible risk**	Option can be delivered within 2 years and has no negative impact on customers, States of Jersey or other JW assets.	Very minor construction and associated capex and/or opex costs.	Option is reliable year round, neutral climate change risk and improves resilience of supply zone. Yield benefit <10% of deficit.	No impact on compliance or staff.	No adverse environmental / flood risk / climate impacts.
2	**Low risk**	Some feasibility concerns but option can be delivered within 5 years. Some minor impacts to other JW assets, customers or States of Jersey policy objectives.	Low complexity construction and moderate capex and/or opex cost requirements.	Minor risk of outage, low vulnerability to climate change and limited improvement to resilience of supply zone. Limited uncertainty of supply benefit.	Minor impact on drinking water compliance and some minor training/resource requirements.	Minor risk of adverse environmental / flood risk / climate impacts with mitigation possible.
3	**Medium risk**	Moderate feasibility concerns including some impact to existing JW assests, scheme will take up to 10 years to deliver. Moderate risk of customer or States of Jersey policy impacts.	Low complexity construction with significant site-specific issues. Moderate-high capex and/or opex cost.	Risk of outages, no improvement to resilience, moderate vulnerability to climate change. Moderate uncertainty of yield benefit.	Significant deterioration of drinking water compliance. Option requires some new resources and/or upskilling.	Moderate environmental / flood risk / climate impacts with some mitigation possible.
4	**High risk**	Likely to have siginificant risks or barriers to implementation, including extensive upgrades to JW assets, significant impact on customer service and high risk to Island Plan policy objectives.	Complex engineering solution with high capex and opex costs.	Significant outage risk, option reduced resilience of supply zone, and is highly vulnerable to climate change. High uncertainty of yield benefit.	Drinking water compliance deterioration leading to enforcement action. Option requires significant new skills/resources which may not be readily available.	Major environmental / flood risk / climate impacts with litle possiblility of mitigation.

2.3. STAGE 2: CONSTRAINED OPTIONS ASSESSMENT

2.3.1. INITIAL FINE SCREENING

Options passing through the coarse screening stage formed the "constrained options" list. These options were subject to a greater level of assessment against a wider and more detailed set of assessment criteria ("fine screening"), building on the headline criteria used for coarse screening.

The fine screening assessment was informed by evidence and dialogue with relevant planning, regulatory and operational teams across Jersey Water, including cross-company appraisal workshops and special interest sessions on option types (e.g. leakage control, catchment management, production management).

The assessment approach helped to identify:

- any potential 'over-riding' constraints that would result in an option being discounted, thereby helping to focus effort and resources on options that are promotable.
- early consideration of operational and engineering feasibility and risk.

Table I-2 sets out the multiple criteria adopted for the fine screening assessment of those options taken forward for assessment from the coarse screening stage. For each criterion, options were assessed against a five-point grading scale: from 0 (positive/beneficial effect) through to 4 (major adverse/ high risk) (with an appropriate colour code assigned to each grade to summarise the assessment in tabular form). The graded scales were defined for each criterion to ensure consistent assessment across all the options.

The findings of the constrained options assessment were used to determine those options to be carried forward to a final short-list of feasible options for more detailed appraisal. The draft findings of the fine screening assessment were discussed with the Jersey Water Board in July 2019 and feedback was considered in finalising the feasible options shortlist.

Table I-2: Feasible Options Fine Screening Criteria and Assessment Scale

		FEASIBILITY AND RISK				ENGINEERING AND COST		
Assessment Grade	Actively contributes to Jersey Water's customer service promises; materially improves drinking water quality	**Scheme Dependencies**	**Timeframe to Implement**	**Political acceptability**	**Customer acceptability**	**Delivery / Engineering Complexity**	**Indicative Capital Costs (Capex)**	**Indicative Operational Costs (Opex)**
0	**Positive impact**	Provides a positive benefit to other existing assets	Resource is currently available with no further works or permissions required.	Option positively contributes to the Jersey Island Plan policy objectives. States of Jersey Department of Environment will positively respond to option	Actively contributes to Jersey Water's customer service promises; materially improves drinking water quality	No construction works required, just paperwork	Provides capex benefit by avoiding or delaying significant planned spend on existing assets	Scheme will enable existing higher operational cost assets to be used less frequently.
1	**Zero/negligible risk**	Has no impact on existing assets	Can be designed, delivered and all permissions obtained within a 2 year period	Neutral effect on Jersey Island Plan policy objectives; no concerns likely from States of Jersey	No detriment to Jersey Water's customer service promises; neutral effect on drinking water quality to customers	Minor engineering works only i.e. modifications to existing networks	Capex up to £0.5m per Mr/d of DO benefit	Opex comparable to the mix of resources currently used in Jersey.
2	**Low risk**	Limited / small scale impact on existing asset capacity	Can be designed, delivered and all permissions obtained within a 5-year period	Minor impact on of Jersey Island Plan policy objectives; some low-level concerns likely from States of Jersey	No detriment to Jersey Water's customer service promises; some minor/occasional drinking water quality complaints from small number of customers	Tried and tested water company engineering solutions, no significant site-specific issues to be overcome.	Capex between £0.5m - £1.5M per Ml/d of DO benefit	Opex likely to be slightly higher than those for the mix of resources currently used in Jersey.
3	**Medium risk**	Will impact capacity of existing assets, that will require limited upgrading to accommodate new scheme.	Can be designed, delivered and all permissions obtained within a 10-year period	Option hinders Jersey Island Plan policy objectives; material concerns likely from States of Jersey (onerous planning conditions likely)	Risk of failure to more than one Jersey Water customer service promises; drinking water quality may deteriorate leading to regular customer complaints and/or concerns raised by some customers	Tried and tested water company engineering solutions, significant site-specific issues to be overcome.	Capex between £1.5m - £3M per Ml/d of DO benefit	Opex in line with the higher opex cost resources currently used in Jersey.
4	**High risk**	Likely to have a significant impact on existing assets, requiring extensive upgrades to accommodate the new scheme. Require use and significant reliance on third party assets.	Significant promotional hurdles to be overcome. Delivery programme in excess of 10 years	Option is contrary to Jersey Island Plan policy objectives; substantial concerns likely from States of Jersey (high risk of refusal of planning permission/public inquiry required)	Significant effect on Jersey Water's customer service promises; drinking water quality concerns will be raised by many customers and/or high level of regular customer complaints	Complex engineering solutions required; new treatment processes; multi-site working	Capex will be significant - greater than £3M per Ml/d of DO benefit	Opex likely to be higher than the other resources currently used in Jersey.

Screening Criteria		PERFORMANCE AND RESILIENCE				OPERATIONAL	
Assessment Grade	**Impact Grading**	**Flexibility to Adapt**	**Yield**	**Operational Resilience**	**Climate Resilience**	**Compliance Risk**	**People: Resources & Skills**
0	**Positive impact**	Reliable year-round source of water; scheme output able to be increased or decreased reliably, quickly and remotely, to enable other local sources to be more efficiently managed.	Yield benefit is very certain and provides at least 10% of the required 2045 deficit	Very high resilience factor from resilience assessment. Option makes very positive improvement to the resilience of the supply zone and/or water management area	Option is insensitive to climate change risks	Actively contributes to improving drinking water quality compliance	Option will reduce demand on existing Jersey Water operational staff
1	**Zero/negligible risk**	Reliable year-round source of water; scheme output able to be increased or decreased reliably and quickly.	Yield benefit is very certain but provides less than 10% of the required 2045 deficit	High resilience factor from resilience assessment. Option positively improves the resilience of the supply zone and/or water management area	Option is neutral in relation to climate change risks	Neutral effect on drinking water quality compliance	No new staff or skills required.
2	**Low risk**	Limited risk of source outage; scheme output able to be increased or decreased reliably.	Some limited uncertainty as to yield benefit (within +/- 10%)	Medium resilience factor from resilience assessment. Option makes only a small positive improvement of the resilience of the supply zone and/or water management area	Option has a low degree of vulnerability to climate change risks	Risk of minor deterioration in drinking water quality compliance but within acceptable tolerance limits	Some upskilling of existing operational staff required for operation of the option.
3	**Medium risk**	Risks of source outage for short periods <24 hours; scheme output able to be increased or decreased but not straightforward to implement.	Moderate uncertainty as to yield benefit (+/- 10% to 30%)	Low resilience factor from resilience assessment. Option makes no improvement to resilience of the supply zone/water management area	Option has a medium degree of vulnerability to climate change risks	Drinking water quality compliance will deteriorate sufficient to lead to regulatory attention	Some new resources required and/or considerable training for existing staff required for operation of the option.
4	**High risk**	Risks of source outage for significant periods > 24 hours - weather, pollution etc.; difficult to increase or decrease scheme output reliably.	High uncertainty as to yield benefit (in excess of +/- 30%)	Very low resilience factor from resilience assessment. Option leads to reduction in current level of resilience of supply zone/water management area	Option has a high level of vulnerability to climate change risks	Drinking water quality compliance will deteriorate and lead to enforcement action	Significant number of new operational staff required in addition to further training of existing staff. Specific skills required which may not be readily available.

Screening Criteria		ENVIRONMENTAL CRITERIA				
Assessment Grade	**Impact Grading**	**Aquatic environment**	**Terrestrial environment**	**Planning considerations**	**Flood risk**	**Carbon**
0	**Positive impact**	Potential improvement in water quality or flow (e.g. the water body has flow impedance or over abstraction problems and the proposed scheme may include removal of a structure or reduction in abstraction).	Potential improvement to a protected site/species (e.g. improvement in water quality or creation of new habitat)	The scheme has positive environmental/social/cultural benefits	The scheme could help reduce flood risk (e.g. creation of a new reservoir).	The scheme could help mitigate the impacts of climate change (e.g. the scheme could include the use of trees or wetlands)
1	**Zero/negligible risk**	No deterioration of waterbody condition is likely (e.g. the option will not interact with the water environment or the option will not change the current circumstances)	No adverse impacts on protected site/species is likely (e.g. the option will not interact with the protected site or the option will not alter the management of a protected site/species)	The scheme has neutral environmental/social/cultural benefits	The scheme would have no impact on flood risk.	The scheme will not involve any new structures or increase in energy usage
2	**Low risk**	There is a minor risk of significant short term or long-term impacts on waterbody condition (e.g. a new scheme might involve a new pipe crossing a river or parallel to its course). Mitigation is possible.	Minor risk of adverse impacts on the management of protected sites/species are likely (e.g. the option will marginally interact with the protected site or there is a low-level of risk of alteration to the management of the protected site/species). Mitigation is possible	The scheme would have a minor adverse impact on environmental/social/cultural planning considerations, but mitigation is possible.	Scheme would increase flood risk slightly, but compensation flood storage can be provided	The scheme might involve some minor new structures or increase in energy usage. Mitigation is possible.
3	**Medium risk**	Potential minor deterioration in waterbody condition. Scheme could include short term impacts or information indicates only a potential deterioration with low-moderate certainty, or there is not enough information on the scheme so a precautionary approach has been used for the assessment.	Potential significant adverse impacts on the management of protected sites/species are likely (e.g. the option will interact with the protected site/species and there is a low-moderate degree of certainty that this will alter the management of the protected site/species). Mitigation may be possible	The scheme would have a moderate adverse impact on environmental/social/cultural planning considerations. Mitigation may be possible.	Scheme would increase flood risk significantly, but compensation flood storage can be provided	The scheme might involve new structures or increase in energy usage or there is not enough information about the scheme, so a precautionary approach is being taken. Mitigation is possible depending on the scheme.
4	**High risk**	Significant deterioration in waterbody condition and the option will prevent the waterbody from recovering. For example, the scheme would either increase long term abstraction or involve the construction of a new structure which would cause a deterioration in flow or water quality. Mitigation is unlikely.	Significant adverse impacts on the management of the protected sites/species are likely (e.g. the option will interact with the protected site/species and there is a high degree of certainty that it would alter the management of the protected site/species). Mitigation is unlikely.	The scheme would have a major adverse impact on environmental/social/cultural planning considerations. Mitigation is unlikely.	Scheme would increase flood risk significantly AND compensatory storage is NOT feasible	The scheme will involve significant construction (e.g. new pipeline and use of concrete) and increased energy usage (e.g. pumping water) and mitigation is unlikely.

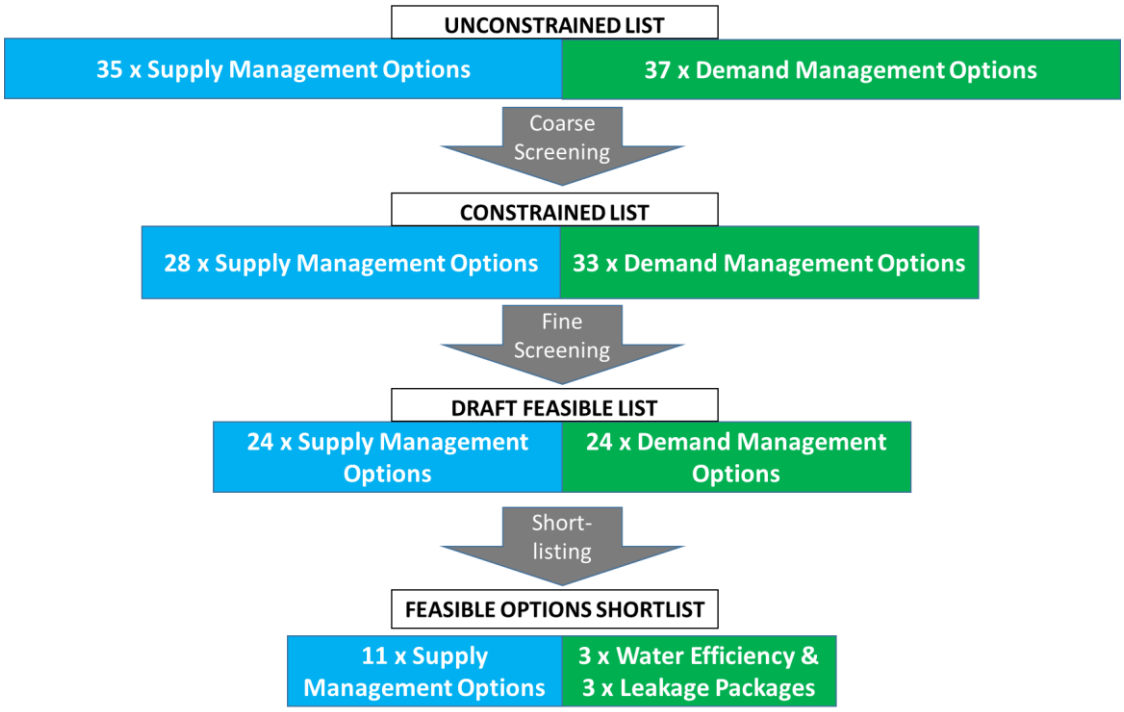
2.3.2. SHORT-LISTING THE FINAL FEASIBLE OPTIONS LIST

The initial Feasible Options List included 24 supply augmentation/resilience options and 24 demand management options. This was considered to be too many options to enable a more detailed and focused assessment of each option at Stage 3 and Stage 4 of the option appraisal process. Consequently, further evaluation work was carried out to refine the Feasible Options List to reduce the number of options to a manageable number. This further work included dialogue with Jersey Water staff and the Jersey Water Board (meeting held on 11 July 2019), as well as a more detailed examination of the performance of each option against the evaluation criteria and consideration of the opportunities to consolidate options.

The shortlisting was carried out with the aim of retaining a broad mix of option types. The scale of the supply benefits of each option was also considered in the context of the supply deficit faced. This was to ensure that sufficient volume of additional supply remained in the options in the feasible list, providing real choice in the programme appraisal process. The operational benefits of each option beyond drought benefits were also considered at this stage, in particular wider supply resilience benefits.

The demand management options were consolidated into three "packages" of water efficiency measures, reflecting the fact that the demand savings invariably depend on the synergies or inter-dependencies between different demand management options. Three leakage measures were also included in the demand management options.

Figure I-2 Summary of the options included at the different appraisal stages



2.4. OPTION DEVELOPMENT

An outline scope for each option taken forward in the Feasible Options shortlist was completed which informed the detailed appraisal stage. An option dossier and assessment proforma was produced for each option outlining the option design, whole life costs, and an assessment of the supply-demand and supply resilience benefits of each option. Environmental and social impacts, planning risks and engineering and operational risks were also considered in detail at this stage.

2.5. STAKEHOLDER ENGAGEMENT

An initial stakeholder engagement workshop was held in Jersey on 29th March 2019, during which the findings of the first phase of the Water Resources and Drought Management Plan development were shared with about 15 representatives from a range of States of Jersey departments. The options appraisal process was also outlined at this meeting.

3. OPTION APPRAISAL FINDINGS AND DISCUSSION

3.1. STAGE 1: DEVELOPING THE CONSTRAINED OPTION LIST

Stage 1 comprised two key steps: the first was developing the unconstrained option list and the second was the coarse screening of the unconstrained option list.

3.1.1. STAGE 1.1 DEVELOPING UNCONSTRAINED LIST OF OPTIONS

The Unconstrained Options list was compiled in discussion with Jersey Water's planning staff, as discussed in Section 2.2.1 The Unconstrained Options were subsequently objectively reviewed in accordance with UK best practice guidance to ensure all appropriate option types (both supply-side and demand-side) had been considered in compiling the list. In total, 73 separate options were included in the unconstrained option list, as follows:

Demand Management Options:

- **Water efficiency options:** 22 options
- **Leakage reduction options:** 11 options
- **Metering & tariff options:** 4 options

Supply Options:

- **New freshwater source options:** 13 options
- **Increasing existing water storage options:** 6 options
- **Improving raw water supply resilience options:** 6 options
- **Bulk water imports to the island:** 4 options
- **Desalination:** 3 options
- **Removal of existing infrastructure constraints options:** 2 options
- **Modification of the levels of service for water use restrictions:** 1 option

A full list of the unconstrained options is provided in Section 3.5, which highlights those options that progressed to the various appraisal stages (the green boxes in **Table I-6** indicate those options that were progressed to the next stage; red boxes indicate those options that were rejected at that stage). The options have been divided into supply options and demand management options.

3.1.2. STAGE 1.2. COARSE SCREENING

The coarse screening process involved assessment of each option on the unconstrained option list against the criteria set out in **Table 1**, with the key considerations being any over-riding constraints to option promotion, development and implementation (e.g. legislation or policy constraints, unacceptable delivery or operational risks, engineering feasibility, cost, customer acceptability or environmental impact). The coarse screening process also helped to rationalise some options from the unconstrained list that were very similar in nature to create a smaller number of single, integrated options.

A total of 72 unconstrained options were subject to the coarse screening process. Where options were assessed as having an over-riding constraint or performed very poorly against most of the appraisal criteria, they were rejected and were not taken forward to the fine screening stage (Stage 2). The initial findings of the coarse screening assessment were discussed with relevant Jersey Water staff and further refinements to the assessment were made considering the feedback and comments made. Those options rejected at this stage were recorded in the option rejection register where the rationale for rejection was clearly set out.

The outcome of the coarse screening process was that the majority of the options were retained and included in the feasible option list for the subsequent constrained options assessment process (Stage 2). The rejected options are set out in **Table I-6**, including the rationale for rejection.

3.2. STAGE 2: CONSTRAINED OPTIONS ASSESSMENT

Stage 2 involved the fine screening assessment of the constrained options list. **Table I-2** (see Section 2 above) sets out the multiple criteria considered in the fine screening assessment. In deciding which options should be to be taken through to the next, more detailed stage of assessment from the fine screening assessment, the following factors were taken into consideration:

- The likely scale of the supply-demand deficit over the planning period
- The level of uncertainty and risk associated with the availble options
- The range of different option types to ensure an appropriate mix of alternative options were retained for more detailed assessment
- Those options identified as mutually exclusive or having a dependency on other options.

Those options that performed least well against the evaluation criteria were rejected from inclusion in the draft Feasible Options list. Options rejected at this stage are detailed in the

option appraisal decision log (**Table I-6**), and included a direct desalination supply option, bulk import options, rainwater harvesting and grey water recycling.

3.3. OPTION APPRAISAL FINDINGS

The outcome of the option fine screening process was a list of 48 feasible options (**Table I-3**) to be taken forward for further more detailed assessment, in particular to refine the costs and benefits to water supply, assessment of resilience benefits and appraisal of environmental performance. The feasible list covered a broad mix of both supply and demand management options: from catchment protection measures to increasing household metering; from "smart" water use audits to the extension of La Rosière desalination plant; and from water efficiency promotion to developing Gigoulande Quarry for water storage. Further details about these options are presented in the options appraisal decision log (**Table I-6)**.

Table I-3: Initial Feasible Options List

Option ID	Option	Reliable supply benefit or demand saving estimate	Option Type
DEMAND MANAGEMENT OPTIONS			
D2	Smart meter installation (and rapid response to leaks at domestic and commercial properties)	0.1-0.3 Ml/d	Metering & tariffs (2 options)
D4	Incentive-based tariffs	0.01-0.03 Ml/d	
D5	Targeted water conservation information	<0.01 Ml/d	Water efficiency (domestic) (8 options)
D6	Education and publicity programmes	<0.01 Ml/d	
D7	Promotion of water saving devices	<0.01 Ml/d	
D8	"Traditional" water use audits	0.1-0.3 Ml/d	
D9	"Smart" water use audits	0.1-0.3 Ml/d	
D10	"Smart customer engagement"	0.1-0.3 Ml/d	
D13	Planning regulations for new homes	0.1-0.3 Ml/d	
D15	Retro-fit programmes or appliance exchange programmes	0.01-0.03 Ml/d	
D16	Targeted water conservation information	<0.01 Ml/d	Water efficiency (commercial) (8 options)
D17	Education and publicity programmes	<0.01 Ml/d	
D18	Promotion of water saving devices	<0.01 Ml/d	
D19	"Traditional" water use audits	0.1-0.3 Ml/d	
D20	"Smart" water use audits	0.1-0.3 Ml/d	
D21	"Smart customer engagement"	0.01-0.03 Ml/d	

Option ID	Option	Reliable supply benefit or demand saving estimate	Option Type
D24	Planning regulations for new commercial buildings	0.01-0.03 Ml/d	
D26	Retro-fit or appliance exchange programmes	<0.01 Ml/d	
D28	Service reservoir and trunk main leakage reduction	0.01-0.03 Ml/d	Leakage reduction (6 options)
D29	Enhanced leak detection and repair	0.1-0.3 Ml/d	
D32	Improved distribution monitoring and modelling	0.1-0.3 Ml/d	
D35	Pressure reduction programme	0.1-0.3 Ml/d	
D36	Poor condition mains replacement	<0.01 Ml/d	
D37	Raw water losses reduction	<0.01 Ml/d	
SUPPLY AUGMENTATION / RESILIENCE OPTIONS			
S9	La Rosière desalination plant extension	5 Ml/d	Desalination (2 options)
S12	New desalination plant on the east coast	5-10 Ml/d	
S23	Increase existing reservoir capacity of Queen's Valley Reservoir	1-2 Ml/d (with existing catchments)	Increase storage (5 options)
S24	Raising of Val de la Mare reservoir	1-2 Ml/d (with existing catchments)	
S25	Gigoulande Quarry partial conversion to raw water storage	1-2 Ml/d (with existing catchments)	
S35	New storage reservoir option	1-3 Ml/d (upper limit dependent on new catchment development)	
S36	Other quarry/new underground artificial storage	1-2 Ml/d (with existing catchments)	
S4	New stream abstraction (St Clement catchment)	0.3-1 Ml/d	New source (10 options)
S5	New stream abstraction (Rozel)	0.3-1 Ml/d	
S8	Extend the St Ouen's groundwater wellfield	1-1.7 Ml/d	
S15	New groundwater abstraction	0.3-1 Ml/d	
S17	New or refurbished groundwater source (e.g. at Rozel)	0.3-1 Ml/d	
S18	Bellozanne indirect treated effluent reuse	3-5 Ml/d	

Option ID	Option	Reliable supply benefit or demand saving estimate	Option Type
S20	Develop / redevelop commercial borehole supplies (non-potable use)	0.1-0.3 Ml/d	
S26	Aquifer Storage and Recovery/Artificial Recharge of groundwater	0.3-1 Ml/d	
S27	Raw water treatment to address adverse surface water quality constraints	0.1-0.3 Ml/d	
S28	Increase catchwater capacities of existing supply catchments	0.1-0.3 Ml/d	
S6	St Ouen's boreholes - groundwater remediation to address PFAS contamination	1-2 Ml/d	Removal of water quality constraints (2 options)
S7	St Ouen's boreholes - treatment to address PFAS contamination	0.7 - 1 Ml/d	
S1	Groundwater catchment management measures	Little additional supply benefit but enhanced resilience	Supply resilience (5 options)
S2	Surface water catchment management measures: education and influencing of land owners and farmers	Little additional supply benefit but enhanced resilience	
S3	Surface water catchment management measures: physical catchment land improvement activities	Little additional supply benefit but enhanced resilience	
S14	Raw water infrastructure system enhancements	0.1-0.3 Ml/d plus enhanced resilience	
S29	Increase raw water transfer capacity, particularly from west to east	Little additional supply benefit but enhanced resilience	

3.4. SHORTLIST OF FEASIBLE OPTIONS

The initial Feasible Options List (**Table I-3**) included 24 supply augmentation/resilience options and 24 demand management options. This was considered to be too many options to enable a more detailed and focused assessment of each option at Stage 3 and Stage 4 of the option appraisal process. Consequently, further evaluation work was carried out to refine the Feasible Options List to reduce the number of options to a manageable number. This further work included dialogue with Jersey Water staff and the Jersey Water Board, as well as

a more detailed examination of the performance of each option against the evaluation criteria and consideration of the opportunities to consolidate options. In addition to removing some options from the options shortlist, some options were adapted or combined during the option design process. Options that have been changed or combined are detailed in the option appraisal decision log (**Table I.6**).

3.4.1. SHORTLISTED DEMAND MANAGEMENT OPTIONS

Demand management options comprise water efficiency measures and leakage reduction measures that aim to reduce the volume of water that needs to be supplied, including:

- Metering of customers and setting of tariffs to encourage customers to save money by reducing their water consumption. Water use at about 98% of properties served by Jersey Water are already metered and the opportunities to manage consumption via additional metering or tariffs are limited. Therefore, no metering or tariff options are included in the feasible list.
- Helping customers to be more water efficient. This may be achieved by customer communication, publicity and education to encourage customers to change their water using behaviour, or by practical measures to help customers install water saving appliances or retro-fit devices.
- Leakage reduction, which can be achieved by a variety of measures in particular by improved methods of finding and fixing leaks, enhancing monitoring of water flow in the distribution system in District Metered Areas (DMAs) and further optimisation of water pressure in the distribution system.

Rather than reducing the total number of demand management options to be considered in the next stages of the options appraisal, the 24 feasible demand management options were consolidated into five demand management "packages" because the demand savings usually depend on the synergies and inter-dependencies between different demand management options. Following option development and a demand management options workshop with Jersey Water staff, these were then consolidated further to three water efficiency "packages" and three leakage reduction options as summarised below.

BASE DEMAND MANAGEMENT PACKAGE

This package comprises possible extensions to the water efficiency promotion activities that Jersey Water is already undertaking. The company is already very active, but it is important to consider whether there are additional activities that the company should be doing.

This package will comprise:

- Development of a water efficiency strategy and communications plan

- Sustained enhancements to publicity, customer communications and water efficiency programme
- Schools engagement programme annually to all Year 4 pupils.
- Targeted water conservation information for domestic and commercial customers
- Education and publicity programmes for domestic and commercial customers
- Promotion of water saving devices for domestic and commercial properties.

It is expected that the combined, direct water savings from enhancements to such measures would be small, with estimated water savings expected to gradually grow to around 0.2Ml/d by 2034/35. However, continuation of existing measures and sustained publicity across the island can help stimulate behavioural change such as adopting water saving tips or choosing low water using appliances when replacing them or installing a new bathroom or kitchen.

PLANNING REGULATIONS AT NEW PROPERTIES PACKAGE

This package involves Jersey Water working in collaboration with the States of Jersey to implement new, or strengthened, regulations to require that all new developments are water efficient.

It is estimated that that a demand reduction of about 0.2 Ml/d could be achieved if 525 new homes are built each year, with an average water saving of 18 litres/person/day, as a result of the new regulations, as well as 50 litres/day saved at new commercial properties.

SCHOOL VISIT-AND-FIT WATER AUDITS PACKAGE

Visit-and-fit water audits have been used by many water companies, including by Jersey Water for some customers, as a direct means of reducing water use by customers. Traditionally the customers involved have volunteered by responding to publicity or invitations to participate from the water company. Often, water audit programmes have not been targeted on just high water users. This package includes visit-and-fit audits at schools with high water use relative to benchmark usage.

A group of 21 schools would be visited in the first year to repair leaks and fit water saving devices, which could achieve savings of 3.7 litres/pupil/day. A maximum saving of 0.02 Ml/d could be achieved in year two after completion of all the water audits.

Visit-and-fit audits at homes or commercial properties have been excluded from this package due to poor cost effectiveness.

LEAKAGE REDUCTION OPTIONS

The volume of total leakage across Jersey Water's water supply system was about 2.5 Ml/d in 2018, which represents about 13% of average distribution input. This is very low compared

with UK and Ireland norms, placing Jersey Water in a frontier position in the British Isles for leakage control performance. Recent work by Artesia Consulting for Jersey Water has provisionally indicated that actual leakage levels may be even lower.

Three leakage reduction option packages were included in the shortlist for consideration during the option appraisal and programme development. Jersey Water commissioned UK leakage experts RPS to further develop, model and cost the three options, working in partnership with Jersey Water staff and its water resource planning consultants, as set out below:

- **Enhanced Leak Detection and Repair.** This option involves implementation of intensive leakage data reviews, including the allowances for legitimate night use of water by customers to deduct from the night-time flow monitoring which is otherwise assumed to be actual water leakage. This improves the quality of the data used by Jersey Water to target leak detection activities and thereby improves the timeliness of leak detection and repair activities, which in turn helps reduce leakage levels.
- **Improved Distribution Monitoring and Modelling.** This option involves improved monitoring of leakage in target areas of the water network using permanently installed noise loggers as well as further division of flow measurement where monitoring currently covers a relatively large area. This helps improves the timeliness of leak detection and helps to pinpoint leak locations better.
- **Pressure Reduction Programme.** This option involves enhanced water pressure management, by further controlling the water pressure at certain points around the island where the pressure remains relatively high (whilst maintaining water pressure at an acceptable level for customers). Lower pressure reduces the volume of water lost from a leaking pipe.

The estimated volume of leakage reduction that may possibly be achievable is around 0.5 Ml/d.

3.4.2. SHORTLISTED SUPPLY OPTIONS

For the supply augmentation and supply resilience options, several considerations influenced the decision on the options to be included in the final Feasible List:

- Need to retain a broad mix of different option types
- Need to reflect the scale of the supply deficit faced – ensure sufficient volume of additional supply remains in the Feasible List to provide real choice in the programme appraisal process
- Consider the operational benefits of each option beyond drought benefits, including for drinking water quality and supply resilience
- Consider the level of uncertainty and risk associated with the options

- Consider options identified as mutually exclusive or having a dependency on other options.

Additionally, key assessment considerations for each main option type were taken into account, as summarised in

Table **I-4**.

Table I-4: Key considerations for each main supply augmentation and resilience option type

Supply Option Type	Key Considerations
Additional Water Storage	• Reliable supply benefit relatively small (around 1-2Ml/d), unless an additional catchment is developed to maximise inflows • Additional water storage combined with desalination or indirect effluent water reuse options could offer greater resilience and increase yield • Enables reduced use of the existing desalination plant in non-drought years (i.e. drier years that usually necessitate use of the existing desalination plant) • Costly to develop but relatively cheap to operate • Some climate change resilience but yield would reduce over time due to likely impacts of climate change on inflows
Additional Desalination	• Jersey Water has the existing expertise to run a desalination plant, but it is expensive to operate • La Rosière desalination plant can be extended to provide an extra 5 Ml/d but blending may require implementation of a re-mineralisation process due to reduced surface water dilution • New desalination plant on the east coast of Jersey could support storage in Queen's Valley reservoir in times of drought (10 Ml/d) • Climate change resilient
Indirect Water Reuse	• Not yet developed in UK where treated effluent is discharged to reservoir storage for blending, and relatively limited use of water reuse globally • Public perception risks – even with blending in reservoirs first • No expertise in Jersey Water for running an indirect water reuse plant. • Expensive to operate due to high level of treatment • Climate change resilient – could provide up to 6 Ml/d
Groundwater sources	• Treatment of St Ouen's aquifer PFAS contamination is expensive, but provides up to 1.7 Ml/d benefit (with some borehole development) or up to 1 Ml/d (if only use the existing boreholes) • Aquifer storage and recovery or artificial recharge options are expensive and high risk of low yields: these options have therefore been excluded from the final feasible options shortlist.

	• Limited scope for additional groundwater source development, but a new borehole could provide up to an estimated maximum of 0.5 Ml/d. • Not climate change resilient
Surface water sources	• Development of Rozel catchment could provide some benefit for new storage and/or to provide benefit to Queen's Valley reservoir (0.3Ml/d) • Addressing water quality constraints by raw water treatment is relatively expensive, but maximises use of existing catchments • Not climate change resilient

Enhance supply resilience	• Catchment management activities are relatively low cost but do not provide additional supply benefit, although they do enhance supply resilience (reduction in outage risk)
	• Improving the raw water supply conveyance system could provide:
	  • a benefit of around 0.8Ml/d by moving more raw water from the west of the island to the east of the island
	  • improved resilience with greater flexibility to move water around the raw water supply system
	  • improved scope for blending of desalination water supplies or indirect water reuse supplies with freshwater

A summary of the rationale for the final eleven supply augmentation and supply resilience options included in the Feasible Options Shortlist is set out below:

a) **Desalination:** two options have been included as both of the options could potentially form the principal supply solution to the forecast supply deficit. Expanding La Rosière desalination plant would not be sufficient on its own to resolve the supply deficit, so it is sensible to also consider a new, modular (assumed two 5Ml/d modules, giving 10 Ml/d in total) desalination plant that can support the Queen's Valley Reservoir system and address the lack of further blending opportunities in the west of the island. The blending of 15Ml/d of desalinated water from an expanded La Rosière desalination plant may be problematic and require a re-mineralisation process which would increase the capital and operating costs of the La Rosière expansion option. This would need to be compared with the whole-life costs for a new desalination plant.

Water storage: raising of Val de la Mare reservoir would yield similar volumes to raising Queen's Valley Reservoir but requires less engineering works and therefore capital costs

would be lower. Development of a new reservoir on the Island is also included in the Feasible Options shortlist so that cost-benefit comparisons can be considered between various reservoir options.

Due to the high cost of raising Val de la Mare reservoir, the Gigoulande Quarry option has also been included in the final option shortlist. Gigoulande Quarry could potentially be partially converted to provide an additional 700Ml of raw water storage and an additional 1 Ml/d of reliable supply in a severe drought, although there is some uncertainty around the availability of the quarry for use as water storage in the future. Discussions were ongoing through the Island Plan development as to the viability of this option at the time of preparing the Feasible Options shortlist.

b) **Indirect Water reuse:** given that the dry weather flow from Bellozanne Wastewater Treatment Works is all discharged to the sea, an indirect treated effluent water reuse scheme is considered an important, climate-change resilient option that should be included in the Feasible Options shortlist so that it can be compared with the desalination and water storage options at the detailed option appraisal stage.

c) **St Ouen's Groundwater sources:** the options for the St Ouen's boreholes and wellfield have been consolidated into one single option for the Feasible Options shortlist, which comprises additional treatment to address PFAS contamination risks to restore the reliable yield of the existing boreholes as well as the potential to increase the reliable supply from the wellfield by further borehole development.

d) **New groundwater source:** this option is potentially a relatively low-cost option that is quick to implement, although there is uncertainty about the optimal location for drilling a new borehole.

e) **Rozel surface water catchment development:** this is considered the best overall new surface water source option, as it has a higher likely yield than other potential surface water catchment options. The scheme would involve Rozel Stream being diverted into Queen's Valley Reservoir.

f) **Enhanced supply resilience options:** while unlikely to provide additional drought supply benefit, these options will enhance the resilience of the supply system both in drought and in normal weather conditions. The catchment protection options have been consolidated into

one option "package" and similarly the raw water system conveyance enhancements have also been consolidated into a single option "package".

3.4.3. FEASIBLE OPTIONS SHORTLIST

Table I-5 lists the Feasible Options that were shortlisted to be taken forward for detailed assessment.

Table I-5: Feasible Options Shortlist

Option ID/ Package no.	Option	Supply benefit or demand saving	Option Type
DEMAND MANAGEMENT OPTIONS			
D6	Water Efficiency: Base Demand Management	0.19 Ml/d	Water efficiency (3 options)
D19	Water Efficiency Visit-and-Fit Water Audits (Schools)	0.02 Ml/d	
D13	Water Efficiency Planning Regulations at New Properties	0.2 Ml/d	
D29	Leakage Reduction: Enhanced Leak Detection and Repair	0.13 Ml/d	Leakage reduction (3 option)
D32	Leakage Reduction: Improved Distribution Monitoring and Modelling	0.26 Ml/d	
D35	Leakage Reduction: Pressure Reduction Programme	0.15 Ml/d	
SUPPLY AUGMENTATION / RESILIENCE OPTIONS			
S9	La Rosière desalination plant extension	5.0 Ml/d	Desalination (2 options)
S12	New desalination plant on the east coast	10.0 Ml/d	
S24	Raising of Val de la Mare reservoir	1.9 Ml/d	Increase storage (3 options)
S25	Gigoulande Quarry partial conversion to raw water storage	1.1 Ml/d	
S35	New storage reservoir option	1-2 Ml/d[1]	
S5	New stream abstraction (Rozel catchment)	0.3 Ml/d	New source (4 options)
S15	New groundwater source	0.5 Ml/d	
S18	Bellozanne indirect treated effluent reuse	6.0 Ml/d	
S6	Increased abstraction from St. Ouen's boreholes (PFAS permitting)	0.7 – 1.0 Ml/d	Removal of water quality constraints (1 option)

[1] Yield dependent on precise storage volume and catchment area – precise design not developed at this stage.

Option ID/ Package no.	Option	Supply benefit or demand saving	Option Type
S1	Targeted catchment protection initiatives (little additional supply benefit but enhanced resilience)	0 Ml/d	Supply resilience (2 options)
S14	Enhance West to East raw water transfer links	0.8 Ml/d	

3.5. OPTION APPRAISAL DECISION LOG

Table I.6 provides the option appraisal decision log, summarising all the unconstrained options that were considered during the options appraisal process at each of the assessment stages: coarse screening; fine screening; final shortlisting. For options that were rejected at any of these stages (red box), the decision log summarises the justification for the option rejection (or in some cases, this was simply due to its consolidation with other options). Where applicable, the green boxes indicate that the option has 'passed' the relevant assessment stage; the red boxes indicate the stage at which an option was ruled out.

Table I-6: Option appraisal decision log

Option ID	Option Type	Option Name	Option Description	Coarse screen	Fine screen	Final shortlisting	Reason for option rejection (where applicable)
DEMAND MANAGEMENT OPTIONS							
D1	Metering & tariffs	Compulsory customer metering	Compulsory installation of water meters for all customers. Probably very limited opportunity as there is already extensive metering of domestic and commercial customers (about 98%).				Jersey Water is already undertaking further metering where possible and meter penetration is already close to 100%. Volumetric benefit is very small.
D2	Metering & tariffs	Smart meter installation	Rolling programme of enhancing current meters with fully "smart" flow monitoring (i.e. frequent logging and more accurate alarming of unusual flow patterns). Prompt advice would be given to customers if supply pipe leakage or plumbing losses identified (e.g. leaking toilet). Smart meters would also provide opportunity for "smart water audits" (D9 or D20) or "smart customer engagement" (D10 or D21) to be considered.				Not cost effective at present, particularly as Jersey Water is already pro-active in identifying cases of high customer flows and requesting the fixing of customer supply pipe leaks. This option will be reviewed further over the coming few years as to the incremental costs of smart meter installation on a cyclical basis as existing customer meters are replaced at the end of their relatively short asset life, taking account of probable further innovation in smart meters and unit costs over the coming years. The position will then be reviewed at the next update to the WRDMP.
D3	Metering & tariffs	Increased volumetric tariffs	New tariffs (e.g. rising block tariffs or seasonal tariffs) to encourage reduced use especially of discretionary water use.				This option would likely be unpopular with customers and result in customer complaints over affordability. Incentive-based tariffs (D4) are a preferable alternative.

Option ID	Option Type	Option Name	Option Description	Coarse screen	Fine screen	Final shortlisting	Reason for option rejection (where applicable)
DEMAND MANAGEMENT OPTIONS							
D4	Metering & tariffs	Incentive-based tariffs	Provision of rewards for reducing consumption. Also incentivise "bulk metered customers" to encourage demand reductions by individual customers within the bulk supply.				Novel approach being tested in UK and so effectiveness is currently unproven. Water saving benefit volume very small.
D5	Domestic water efficiency	Targeted water conservation information	Providing advice to domestic customers on water use and identifying leaks, additional to current baseline activity, e.g. water use calculator, water efficiency check-list, smart visuals to communicate messages. Excludes specific information/media promotions to support water audits, which are included in water audit options.				Elements of this option have been incorporated into Option D6.
D6	Domestic water efficiency	Education and publicity programmes	Water messaging through media, social media, public events, school education, local group meetings etc, additional to current baseline activity.				
D7	Domestic water efficiency	Promotion of water saving devices	Offer free/subsidised devices e.g. cistern displacement devices, shower timers, low-flow showerheads, tap inserts, water butts, or hose trigger devices. Provide retail portal for customers to request/purchase devices.				Elements of this option have been incorporated into Option D6.

Option ID	Option Type	Option Name	Option Description	Coarse screen	Fine screen	Final shortlisting	Reason for option rejection (where applicable)
DEMAND MANAGEMENT OPTIONS							
D8	Domestic water efficiency	"Traditional" water use audits	Programme of visiting individual homes to retro-fit water saving devices, mend leaks and provide water conservation advice. Applicable to properties not covered by "Smart customer engagement" and are not "bulk metered customers". Meter readings and benchmarking would be used to target priority homes. Needs to be supported by media campaign. Implementation to be rolled out one area at a time (as for example Wessex Water's "Home Check" programme).				Not cost effective at present, particularly as Jersey Water is already pro-active in identifying cases of high customer flows and requesting the fixing of customer supply pipe leaks. To be reviewed further over the coming few years as to the incremental costs of smart meter installation on a cyclical basis as existing customer meters are replaced at the end of their relatively short asset life, taking account of probable further innovation in smart meters and unit costs over the coming years. The position will then be reviewed at the next update to the WRDMP.
D9	Domestic water efficiency	"Smart" water use audits	As traditional water use audits, but using information from smart meters (if D2 undertaken) to improve identification of the best homes to include and to target the retro-fit and repair programme, potentially supported by customer engagement (as for example the Thames Water "Smart Home Visit").				As above.
D10	Domestic water efficiency	"Smart customer engagement"	Using smart metering (if D2 undertaken) and in-home water use displays, real-time benchmarking, and behavioural science to "nudge" customers to reduce water use (for example the Anglian Water/Advizzo Newmarket trial).				Novel approaches being tested in UK and so effectiveness is currently unproven. Very small water saving benefit volumes from current UK trials. Jersey Water is already pro-active in identifying cases of high customer flows and requesting repairs of leaks.

Option ID	Option Type	Option Name	Option Description	Coarse screen	Fine screen	Final shortlisting	Reason for option rejection (where applicable)
DEMAND MANAGEMENT OPTIONS							
D11	Domestic water efficiency	Rainwater harvesting	These systems collect and use rainwater for toilet flushing. They could be installed in new homes either by (a) Jersey Water encouraging developers to install in some new developments; or (b) inclusion in new building regulations (D13). Installation in individual homes most likely, but at community level could be considered. Retro-fit to some existing homes may be possible.				Very high costs and energy use. Poor yield resilience in severe, extended drought conditions. Installations can be voluntary as part of Option D13.
D12	Domestic water efficiency	Greywater recycling	These systems recycle shower water and other "greywater" for toilet flushing. There are potential health risks and maintenance concerns, so it is assumed it would be on a voluntary basis only. However, it could be included as a choice for developers in building regulations for new homes (D13).				Very high costs and energy use. Not widely proven. Potential health concerns: would need additional regulations to protect public health from cross-contamination with drinking water supply pipes in the property. Installations can be voluntary as part of Option D13.
D13	Domestic water efficiency	Planning regulations for new homes	Modify Jersey's Building Control regulations to require that installed appliances are water efficient to achieve a required water use standard (e.g. 100 l/person/day). Developers would achieve this by installing, for example, low-water use appliances, water butts, smart in-home displays, rainwater harvesting systems, etc. A Jersey Water online water calculator could be developed to guide developers (as for example provided by Thames Water).				

Option ID	Option Type	Option Name	Option Description	Coarse screen	Fine screen	Final shortlisting	Reason for option rejection (where applicable)
DEMAND MANAGEMENT OPTIONS							
D14	Domestic water efficiency	Night-flow / high use detection using smart meters	To use data from smart meters (if D2 undertaken) to give prompt advice to customers of supply pipe leaks or plumbing losses, including due to "leaking toilets". This would form part of Option D2. Further use of smart meter information could be applied by undertaking option D9 Smart meter audits or option D10 Smart customer engagement.				This option has been incorporated into Option D2.
D15	Domestic water efficiency	Retro-fit programmes or appliance exchange programmes	To undertake subsidised water using appliance exchanges – e.g. toilet scrappage scheme and /or voucher programme for low-flush toilets and high-efficiency white goods based on existing water labels (e.g. Waterwise WaterMark or EU Water Label).				Complex options in practice with low/uncertain water saving benefits.
D16	Commercial water efficiency	Targeted water conservation information	Providing advice to commercial customers on water use and identifying leaks, additional to current baseline activity, for example water use calculator, water efficiency check-list, smart visuals to communicate messages. Excludes specific information/media promotions to support water audits, which are included in the water audit options. Information would be targeted to specific sectors, e.g. schools, offices, hotels, etc.				Elements of this option have been incorporated into Option D6.
D17	Commercial water efficiency	Education and publicity programmes	Water educational messaging through media, social media, and visiting offices/other commercial premises to give talks/advice to staff.				Elements of this option have been incorporated into Option D6.

Option ID	Option Type	Option Name	Option Description	Coarse screen	Fine screen	Final shortlisting	Reason for option rejection (where applicable)
DEMAND MANAGEMENT OPTIONS							
D18	Commercial water efficiency	Promotion of water saving devices	Provide advice on water saving devices and/or offer free/subsidised devices, for example cistern displacement devices, low-flow showerheads, tap inserts, water butts or hose triggers.				Elements of this option have been incorporated into Option D6.
D19	Commercial water efficiency	"Traditional" water use audits	Programme of visiting individual premises to retro-fit water saving devices, repair leaks and provide water conservation advice. These would be prioritised/tailored for specific customer types, e.g. schools, hospital, offices, care homes, hotels, restaurants and pubs, farms, leisure and sports centres, laundrettes, car washers, etc. Meter readings and benchmarking would be used to target priority homes. Would be supported by a media campaign.				

Option ID	Option Type	Option Name	Option Description	Coarse screen	Fine screen	Final shortlisting	Reason for option rejection (where applicable)
DEMAND MANAGEMENT OPTIONS							
D20	Commercial water efficiency	"Smart" water use audits	As traditional retro-fit and repair water use audits, but being more targeted by (a) opportunist visits to streets with commercial properties or (b) using information from smart meters (if D2 undertaken) to improve identification of the best properties to include (see for example the Thames Water "Smart Business Audits"). May be applicable for offices, shops, pubs, etc., but unlikely to provide benefit above traditional audits for schools or for sites with 24-hour use such as hospitals, hotels or industry.				Not cost effective at present, particularly as Jersey Water is already pro-active in identifying cases of high customer flows and requesting the fixing of customer supply pipe leaks. To be reviewed further over the coming few years as to the incremental costs of smart meter installation on a cyclical basis as existing customer meters are replaced at the end of their relatively short asset life, taking account of probable further innovation in smart meters and unit costs over the coming years. The position will then be reviewed at the next update to the WRDMP.
D21	Commercial water efficiency	"Smart customer engagement"	Using smart metering and water use displays and real-time benchmarking, and behavioural science (see for example the Anglian Water/Advizzo Newmarket homes trial). This is undeveloped and untested for commercial premises.				Novel approaches being tested in UK and so effectiveness is currently unproven. Very small water saving benefit volumes from current UK trials. Jersey Water is already pro-active in identifying cases of high customer flows and requesting repairs of leaks.
D22	Commercial water efficiency	Rainwater harvesting	These systems collect and use rainwater for toilet flushing. They could be installed in new commercial properties either by (a) Jersey Water encouraging developers to install in some new developments; or (b) inclusion in new building regulations (D24). Retro-fit to some existing commercial properties may be possible.				Very high costs and energy use. Poor yield resilience in prolonged dry weather/severe drought.

Option ID	Option Type	Option Name	Option Description	Coarse screen	Fine screen	Final shortlisting	Reason for option rejection (where applicable)
DEMAND MANAGEMENT OPTIONS							
D23	Commercial water efficiency	Greywater recycling	These systems use shower or other "greywater" for toilet flushing. There are potential health and maintenance concerns, so it is assumed it would be on a voluntary basis only. However, it could be included as a choice for developers in building regulations for new commercial properties (D24).				Very high costs and energy use. Not widely proven. Potential health concerns due to risk of cross-contamination with the drinking water supply pipework.
D24	Commercial water efficiency	Planning regulations for new commercial buildings	Modify Jersey's Building Control regulations to require water efficient appliances to be used in all new properties and encouraging other measures such as rainwater harvesting.				This option has been incorporated into Option D13.
D25	Commercial water efficiency	Night-flow / high use detection using smart meters	To use data from smart meters (if D2 undertaken) to give prompt advice to customers of supply pipe leaks or plumbing losses or uncontrolled urinals, including due to "leaking toilets". This would form part of Option D2. Further use of smart meter information could be applied by undertaking Option D20 Smart meter audits or Option D21 Smart customer engagement.				This option has been incorporated into Option D2.
D26	Commercial water efficiency	Retro-fit or appliance exchange programmes	To encourage commercial customers to replace or modify appliances to be more water efficient, e.g. low-flush toilets, efficient white goods. A subsidised appliance exchange programme could be considered for all sectors, or limited to certain target sectors, for example schools, hospitals, other institutions and public toilets.				Complex options in practice with low/uncertain water saving benefits.

Option ID	Option Type	Option Name	Option Description	Coarse screen	Fine screen	Final shortlisting	Reason for option rejection (where applicable)
DEMAND MANAGEMENT OPTIONS							
D27	Customer supply pipe leakage reduction	Enhanced leak detection and repair	To use data from smart meters (if D2 undertaken) to enable rapid identification of supply pipe leakage and give prompt advice to customers. This would form part of Option D2. Jersey Water is already proactive with customers in using existing meter readings to identify high/unusual water use.				This option has been incorporated into Option D2.
D28	Leakage reduction	Service reservoir and trunk main leakage reduction	Through more intensive programmes of service reservoir 'drop-tests' to check for leakage and trunk mains detection and repair techniques.				Elements of this option have been incorporated into Option D29.
D29	Leakage reduction	Enhanced leak detection and repair	Better targetting of leak detection by making better use of DMA data. Possible increased resource deployment for leakage detection and repair across the distribution network.				
D30	Leakage reduction	Increased DMA coverage	Enabling installation of DMAs for those parts of St. Helier that are not currently within a DMA and to set up new and/or split existing DMAs elsewhere if appropriate.				High complexity and costs. Benefits achieved more easily by use of acoustic loggers as part of Option D32.
D31	Leakage reduction	Improved DMA monitoring	Using improved and/or smarter monitoring of flow and pressure at DMA sites to provide better DMA data and improve targeting of leakage detection.				Elements of this option have been incorporated into Option D29.

Option ID	Option Type	Option Name	Option Description	Coarse screen	Fine screen	Final shortlisting	Reason for option rejection (where applicable)
DEMAND MANAGEMENT OPTIONS							
D32	Leakage reduction	Improved distribution monitoring and modelling	Installing acoustic loggers and/or more intensive flow and pressure monitoring throughout the distribution system and within DMAs. Supported by better use of the Jersey Water network model and data analysis to improve speed and accuracy of identifying leaks and, in conjunction with the Jersey Water network model, enable intelligent/calm network operation.				
D33	Leakage reduction	Novel leak detection techniques	Implementation of innovative techniques for leak detection, for example drones, novel/smart noise detectors and leak detection sniffer dogs (as currently being investigated by United Utilities).				Methods are unproven and thus costs of development high and benefits uncertain. Developments in the UK and other countries to be monitored over the coming years to inform future feasibility.
D34	Leakage reduction	Novel pipe repair techniques	Use of innovative techniques for pipe repair, for example the emerging use of 'low-dig' and 'no-dig' techniques, to reduce impact on road users and speed-up repairs.				Methods are unproven and thus costs of development high and benefits uncertain. Developments in the UK and other countries to be monitored over the coming years to inform future feasibility.
D35	Leakage reduction	Pressure reduction programme	Improved pressure management and pressure control optimisation, accompanied by a potential reduced property pressure standard for the island.				
D36	Leakage reduction	Poor condition mains replacement	Replacement of poor condition pipes and other distribution system assets prone to bursting, including asbestos pipes.				High costs and small water savings, as Jersey Water is already pro-actively maintaining its water mains system.

Option ID	Option Type	Option Name	Option Description	Coarse screen	Fine screen	Final shortlisting	Reason for option rejection (where applicable)
DEMAND MANAGEMENT OPTIONS							
D37	Leakage reduction	Raw water losses reduction	Identifying and resolving losses from abstraction assets, and raw water pipes, tanks, pumps and overflows in the raw water supply system.				Low cost effectiveness as raw water losses are difficult (and therefore expensive) to find. Visible losses from the raw water system are already addressed proactively by Jersey Water.

Option ID	Option Type	Option Name	Option Description	Coarse screen	Fine screen	Final shortlisting	Reason for option rejection (where applicable)
SUPPLY AUGMENTATION AND SUPPLY RESILIENCE OPTIONS							
S9	Desalination	La Rosière desalination plant extension	La Rosière desalination plant is located on the south-west coastline of the island. This option is to increase capacity of La Rosière desalination plant by a final additional new 5 Ml/d treatment stream. It is assumed that current delivery pipelines are adequately sized to sustain the increase in output. A new pumping station will likely be required, as well as other ancillary assets. Operation of the desalination plant for very prolonged periods is not an environmentally sustainable or financially viable option. This option also has relatively high associated capital costs.				
S12	Desalination	New desalination plant on the east coast	New desalination plant on the east coast of the island near to the Verclut quarry in St. Catherine's Bay. This option involves the construction of sea water intake near to St. Catherine's breakwater and a sea water discharge pipe and outfall to return the treatment process waste stream back to the sea. The plant would be capable of producing 10 Ml/d of new supply (probably with 2 treatment streams, each at 5 Ml/d capacity). It is assumed that the new desalination plant would have similar process design constraints as the existing La Rosière desalination plant. The water would be transferred via a new raw water main to St. Catherine's pumping station for onward transfer to the Queen's Valley Reservoir.				

S13	Desalination	New desalination plant - blending in raw water then direct supply.	This option is to build a new 5-10 Ml/d desalination plant. Desalinated water would be blended with raw water from Queen's Valley Reservoir prior to potable treatment directly into the supply system.				This option is rejected due to major investment in capital and operational costs, and high energy input/carbon cost of the scheme. New infrastructure requirement would also include a transfer pipeline to Queen's Valley Reservoir. Planning conditions likely to minimise environmental/social impacts during construction. East Coast desalination option (S12) is considered a better option to support Queen's Valley reservoir.
S22	Increase storage	Offshore storage	This option is to develop an off-shore storage solution (creating some form of storage facility offshore - could include floating or submerged storage containers for freshwater abstracted from groundwater and/or surface water on the island). Water would need to be piped offshore and then back onshore when needed for supply.				This option was rejected due to major investment in capital, for a limited yield benefit as there is limited new freshwater available and other raw water storage options are cheaper in whole-life cost terms. Additionally, there are climate risks which cannot be completely minimised and risks of damage to the storage vessels due to strong currents around the island and shipping activities.

S23	Increase storage	Increase existing reservoir capacity of Queen's Valley Reservoir	This option involves increasing the capacity of Queen's Valley Reservoir by raising the dam height, most likely in combination with other options to increase raw water supplies to the reservoir due to its slow refill characteristics. Queen's Valley Reservoir is located in the east of Jersey and is the biggest reservoir on the island. The existing top water level of the reservoir is already relatively high in elevation and this option may therefore require a completely reconstructed embankment to support the extra storage. Furthermore, the reservoir has a unique spillway, which may make it difficult to increase the capacity. The estimated yield benefit is 1-2 Ml/d.				This option is rejected in favour of raising Val de la Mare Reservoir (Option S24) as the yield would be similar but Queen's Valley Reservoir raising option requires more capital works as additional catchments and/or increased transfers of raw water from the west of the island would be needed to realise the yield benefit, with additional capital and operational costs. The engineering challenges are also likely to be more challenging at Queen's Valley Reservoir than for the Val de la Mare Reservoir option.
S24	Increase storage	Raising of Val de la Mare reservoir	This option involves raising the existing gravity dam at Val de la Mare Reservoir in order to enlarge the reservoir capacity and thereby increase the reliable yield. This option includes raising of the Val de la Mare dam by 9m with hardfill quarried from the reservoir basin. This option would provide an additional 1,200Ml of storage capacity, equivalent to around an additional 60 days of water supply storage, and an estimated yield benefit of 1.9 Ml/d.				

S25	Increase storage	Gigoulande Quarry partial conversion to raw water storage	This option involves the conversion of part of the existing Gigoulande Quarry into a new raw water storage facility. This option will provide an additional water storage volume of around 700Ml and has a yield benefit of 1.1Ml/d. There would be enough excess winter flows to fill the quarry from the Val de la Mare and Waterworks Valley reservoir system. The option outline design conservatively includes the construction of a new dry well pumping station within the quarry and the installation of a waterproof lining system on the quarry. It is possible that the lining may not be required and abstraction of water could be achieved by use of pumps attached to a floating pontoon (as is the case for quarry storage facilities in Guernsey). Two new delivery mains would be needed to transfer inflows and outflows from the quarry to a new connection point with existing raw water mains feeding to La Hague Reservoir.				
S35	Increase storage	New storage reservoir option	This option would involve construction of a new storage reservoir, pipelines and pumping stations. TThis option has been based on previous studies of a potential new reservoir (Les Mouriers) within Jersey Water's existing Le Mourier stream abstraction catchment.. This option has an estimated yield benefit of 1-2 Ml/d depending on the selected capacity of the reservoir, how much additional new catchment area is developed and if it is developed in combination with other new sources.				

S36	Increase storage	Other quarry/new underground artificial storage	This option is an alternative to the Gigoulande Quarry conversion option (S25) and could be implemented in the event that the Gigoulande Quarry is not available for conversion to a water storage facility. This option has high associated cost in infrastructure, maintenance, monitoring, although might be a faster and cheaper option than creating a new reservoir. There may be a risk of leaching depending on the permeability of the quarry selected. There would be enough excess winter flows to fill a quarry or underground artificial storage facility from the Val de la Mare and Waterworks Valley reservoir system (as is the case for the Gigoulande Quarry option).				This option is rejected in favour of other more feasible and lower cost storage options because of higher capital costs and greater uncertainty as to available storage solutions under this option.
S4	New source	New stream abstraction (St Clement catchment)	This option involves developing a new stream abstraction within the St Clement catchment located as close as possible to the coast (taking account of water quality constraints) to maximise the available catchment area. A pipeline to the existing raw water conveyance system would be required, with the additional raw water supply augmenting storage in Queen's Valley Reservoir. The St Clement region is situated in the south-east of the island. This option has an estimated reliable yield benefit of 0.3 to 1.0 Ml/d. Further investigations would be required to confirm water availability and quality.				This option is rejected in favour of Option S5 as the Rozel catchment is likely to have a higher reliable yield than the St. Clement catchment.

S5	New source	New stream abstraction (Rozel)	This option involves developing two new stream water intakes on the streams draining to Rozel Bay. The abstracted water would be pumped via a new main and discharged via a new outfall into the St. Catherine's catchment. This option has an estimated reliable yield benefit of 0.3 to 1.0 Ml/d. Further investigations would be required to confirm water availability and quality.				
S8	New source	Extend the St Ouen's groundwater wellfield	This option would extend the existing St Ouen's groundwater wellfield northwards and/or make use of the existing groundwater "Control Boreholes". This option would require significant work for minimal gain, although there is potential for up to 1.7 Ml/d of reliable yield at the upper-end of the yield estimates, with a central estimate of around 0.5 Ml/d.				Elements of this option have been incorporated into Option S6 (below).
S15	New source	New groundwater abstraction	This option involves the development of a new borehole source in a suitable aquifer (for example, around Tesson or at Rozel), including borehole pump and around 5km of new rising main. The reliable yield estimate is up to 0.5Ml/d. Investigations will be required to confirm water availability and quality.				
S17	New source	New or refurbished groundwater source (e.g. at Rozel)	This option is to develop a new or refurbished groundwater source in the Rozel area. A borehole at Rozel has historically been used by Jersey Water and could be refurbished or a new borehole drilled. The reliable yield estimate is up to 0.5Ml/d.				This option has been incorporated into Option S15 as one of the possible locations for a new or refurbished borehole source.

S18	New source	Bellozanne indirect treated effluent water reuse scheme	Bellozanne wastewater treatment works (WwTW) serves the whole of the island and discharges treated effluent into St Aubin's Bay in the south of Jersey. This scheme involves the treatment and reuse of the treated final effluent from Bellozanne WwTW to augment water resources in Jersey, primarily during times of drought. The final effluent would be treated to a very high standard by a four-stage treatment process: nitrification / denitrification, phosphate removal, filtration and activated carbon. This treated water would then be pumped via a rising main to Millbrook Reservoir for onward transmission into the reservoir storage system – mostly likely to Queen's Valley Reservoir to achieve the necessary freshwater blending requirements. The blended water would subsequently receive full potable treatment at the Handois and/or Augrès Water Treatment Works. The scheme would provide at least 6Ml/d of additional reliable yield based on the dry weather flow to the WwTW and the need for sufficient freshwater storage in the reservoirs for blending with the highly treated effluent. This option would include: 1) Pumping final effluent flows from downstream of the existing UV disinfection channel to a new effluent reuse treatment plant at the north of the Bellozanne site.				

			2) Pumping flow through the proposed new effluent reuse treatment plant with a four-stage treatment process to remove any residual pesticides, pharmaceuticals, etc. 3) Treated flows to gravitate into a pump sump and be pumped via a new rising main to Millbrook Reservoir for onward transfer, probably to Queen's Valley Reservoir to achieve appropriate blending with freshwater. 4) The flows to be treated would need to be about 25% greater than the required 6 Ml/d output to the reservoir to allow for the backwash from the treatment processes employed.				
S19	New source	Direct effluent reuse for commercial customers (non-potable use)	This option is to develop a direct effluent water reuse scheme based on the final treated effluent from Bellozanne WwTW. The final treated effluent would be further treated to meet industrial but non-potable water supply standards for direct supply to commercial customers, either via tankers (e.g. to golf courses for irrigation, construction and quarry works for dust suppression, or for non-food washing facilities) or via a new dedicated commercial, non-potable water supply distribution system. This scheme would have a limited benefit due to the limited demand for such a non-potable supply on the island.				This option was rejected as there is limited demand for commercial non-potable water use and therefore the yield benefit of the scheme is too small to justify the high costs.
S20	New source	Develop / redevelop commercial borehole supplies (non-potable use)	This option involves the development of some small new boreholes to supply some commercial customers for non-potable needs. Due to limited demand the estimated yield benefit is no greater than 0.5 Ml/d.				This option was ruled out due to limited demand for commercial non-potable supply. Many commercial customers with non-potable water demand already have private borehole supplies and therefore there is limited potential benefit of this option.

S21	New source	Water harnessed from fog	This is option relies on the latest technology to capture water from fog via condensation. The option would need to be implemented close to the shoreline in a location where fog is most likely to form on a regular basis. Any water collected would need to piped and pumped inland to existing reservoir storage.				This option was ruled out due to the low resilience benefit and uncertainty of yield benefit (but likely to be low). These factors stem from the water source being unpredictable and thus likely to be unreliable.
S26	New source	Aquifer Storage and Recovery/Artificial Recharge of groundwater	This option involves aquifer storage and recovery or an artificial groundwater recharge solution in the west of the island. There is a need to consider issues with water quality/contamination of aquifer. Whilst this option is feasible, it is likely to be expensive and the yield benefit may be small, with a relatively high risk that only a small proportion of the volume of water injected into the aquifer can be recovered. A lot of additional handling and treatment/retreatment would be required in relation to this option as identified in previous work on this option by Jersey Water. The estimated yield benefit would be 0.5 Ml/d.				This option is rejected in due to uncertainty around potential water quality/contamination issues and treatment requirements.

S27	New source	Raw water treatment to address adverse surface water quality constraints	This option would provide new raw water treatment facilities to address adverse raw water quality constraints at some surface water sources, reducing risk of outage and possibly increasing reliable yield. This option could include treatment of inflows before reservoir storage, in-reservoir treatment (e.g. algae control measures) and/or between the reservoir source and the inlet to a water treatment works. Other treatment options could include a Nitrate removal plant at Le Mourier in central Jersey using "Phoslock", noting that copper sulphate dosing is currently in operation. This option requires a trade-off between cost and improved supply resilience. The estimated yield benefit is less than 0.5 Ml/d, although option would also increase supply resilience.				This option was rejected on cost and engineering feasibility risks, as well as the inclusion of a catchment management option in the final Feasible List that would provide a much more cost-effective way of addressing raw water quality risks, such as from elevated nitrates and pesticide runoff.
S28	New source	Increase catchwater capacities of existing supply catchments	This option would involve enhancing the existing catchwater systems or developing additional catchwater systems to augment abstraction at existing stream intakes. The solutions would be small scale (in terms of reliable yield), but the infrastructure is already in place, therefore there would be relatively low construction costs and minimal construction impacts. The estimate yield benefit is less than 0.5 Ml/d and there is significant uncertainty in the yield assessment.				This option is rejected due to expected low yield benefit and the availability of more reliable small-scale water supply options (such as the Rozel new stream intake - Option S5, and a new groundwater abstraction - Option S15).
S38	New source	Dedicated seawater supply system	This option involves the supply of partially treated seawater for certain non-potable uses, e.g. toilet flushing. It would require the installation of new abstraction infrastructure on the coast and investment in a whole new water supply network on the island, separate to the existing potable, treated water network.				This option was rejected due to the very substantial major investment in capital and operational costs, and new skills/resources required.

S30	Bulk water import	Raw water transfer – Guernsey	This option would involve purchasing and investing in a transfer of raw water from Guernsey via a new undersea pipeline (which could include developing the Les Vardes quarry storage facility in Guernsey to provide this water reliably in a drought) as well as developing new infrastructure to take the raw water from the coast to the Jersey Water raw water reservoir system.				This option was rejected due to the very substantial major investment in capital and operational costs (including maintenance and monitoring) and the risk that drought conditions in Guernsey may preclude the transfer being feasible in a severe drought in both islands.
S31	Bulk water import	Raw water transfer – France	This option would involve the purchase and transfer of a raw water supply from France via a new undersea pipeline from the St Malo area and developing infrastructure to take the raw water from the coast to the Jersey Water raw water reservoir system.				This option was rejected due to the very substantial major investment in capital and operational costs (including maintenance and monitoring) and the risk that drought conditions in western France may preclude the transfer being feasible in a severe drought. Water resources in the St Malo area are already relatively stressed in drought conditions and there is a limited connectivity to more reliable water supplies further inland and this would be needed to provide a reliable supply in severe drought to Jersey.
S32	Bulk water import	Ship water by tanker to Jersey	This option would involve the purchase and shipping of treated water by tanker from overseas and developing infrastructure at St Helier Port to transfer the water into the Jersey Water treated water supply network.				This option was rejected due to the high purchase costs, capital and operational costs as well as the risk that in drought conditions there will be no guarantee of the water being made available for Jersey due to other islands and nations also seeking such supplies - there are limited tanker facilities worldwide available for the shipping of bulk water supplies. Information from other water companies in the UK indicates that a high “reservation” charge would be payable each year to guarantee priority supply in severe drought.

S34	Bulk water import	Shipping icebergs from Scandinavia	This option would involve shipping of icebergs from norther Scandinavia to supplement raw water supplies during severe drought conditions and developing infrastructure to take the raw water from the coast to the Jersey Water raw water reservoir system.				This option was rejected due to the high purchase costs, capital and operational costs, as well as the longer term climate change risks, e.g. fewer icebergs in the future and warmer seas along the transportation route to Jersey.
S6	Removal of water quality constraints	Increased abstraction from St. Ouen's boreholes (PFAS permitting)	The current maximum output of the St Ouen's boreholes is limited to approximately 0.3 Ml/d due to PFAS contamination of groundwater from historic fire-fighting foam runoff from training activities at Jersey Airport. Due to the persistence of this chemical compound in the water environment, the contamination of the groundwater is likely to continue for a considerable number of years. In the UK, Drinking Water Inspectorate (DWI) guidance restricts the PFAS concentration in drinking water to 1,000ng/l and PFOA to 5,000 ng/l, with a trigger to consult and monitor at 300ng/L. In order to fully use the available output from St. Ouen's boreholes, one option is to remediate the groundwater to prevent contamination of the water abstracted from the boreholes (S6) or to treat the borehole water using Granular Activated Carbon (Option S7). Following a review of the two options available, the option taken forward as Option S6 was the PFAS treatment using Granular Activated Carbon (GAC) or other suitable treatment process. Treatment is more cost-effective and more reliable than groundwater remediation measures. The additional reliable yield of this option is assessed at 0.7 to 1.0 Ml/d.				This option is included in the final shortlist as "S6 Increased abstraction from St. Ouen's boreholes (PFAS permitting)" which incorporates elements of Options S6 and S7.
S7	Removal of water quality constraints						This option has been incorporated into S6.

S1	Supply resilience	Groundwater catchment management measures	This option focusses on implementing catchment management actions (e.g. engagement with farmers and also with Jersey Airport in relation to runoff risks to the St Ouen's boreholes catchment) to protect, and where possible improve, groundwater quality. This option will probably not result in any material additional reliable yield but will help secure existing reliable yield and enhance supply resilience. The Jersey Clean Water Action Group is currently already working with farmers to reduce the use of pesticides and improve farming practices to protect raw water supplies. Work has focussed on potato farming to date and Jersey Water has seen improvements in nitrate levels from the work of the Action Group. Physical measures (with possible Jersey Water funding/financial contributions) could include chemical storage, cattle management fencing, reducing stocking density, removing soil compaction, farm steading design, tillage, woodland planting, wetland buffers and attenuation ponds. It is understood that water quality protection measures are already in place at Jersey Airport, but additional measures could be necessary. This option aims to prevent a reduction of reliable yield due to water quality deterioration and reduce unplanned outage risks due to adverse water quality conditions.				This option is included in the final feasible options list as “Targeted catchment protection initiatives”, incorporating Options S1, S2 and S3.

S2	Supply resilience	Surface water catchment management measures: education and influencing of land owners and farmers	This option focusses on implementing catchment management educational actions (e.g. engagement with farmers) to protect (and where possible improve) surface water quality. This option will probably not result in any material additional reliable yield but will help secure existing reliable yield and enhance supply resilience. The Jersey Clean Water Action Group is currently already working with farmers to reduce the use of pesticides and improve farming practices to protect raw water supplies. Work has focussed on potato farming to date and Jersey Water has seen improvements in nitrate levels from the work of the Action Group. Approaches to further increasing education and engagement with farmers to encourage use of water-friendly farming methods includes provision of information pamphlets/website pages, stakeholder meetings, promoting catchment management techniques through education/farm demonstration days and events, mobile visitor centres, employment of catchment advisors, a dedicated website and helpline, and on-line assistance/dedicated online forums. Work is already ongoing with farming groups, but further actions could be beneficial, principally in relation to nitrates and pesticides. This option aims to prevent a reduction of reliable yield due to water quality deterioration and reduce unplanned outage risks due to adverse water quality conditions.				This option has been incorporated into Option S1.

S3	Supply resilience	Surface water catchment management measures: physical catchment land improvement activities	This option focusses on implementing physical catchment management measures to protect (and where possible improve) surface water quality. This option will probably not result in any material additional reliable yield but will help secure existing reliable yield and enhance supply resilience Physical measures (with possible Jersey Water funding or financial contributions) may include chemical storage, cattle management fencing, reducing stocking density, removing soil compaction, farm steading design, tillage, woodland planting, wetland buffers and attenuation ponds. This option has not previously been attempted and would extend Jersey Water's reach into supporting (either directly or indirectly) the introduction of physical measures on farms to reduce diffuse and point pollution risks. This option aims to prevent a reduction of reliable yield due to water quality deterioration and reduce unplanned outage risks due to adverse water quality conditions.				This option has been incorporated into Option S1.

S14	Supply resilience	Raw water infrastructure system enhancements	This option involves construction of a new raw water pumping station adjacent to Mont Gavey Tank and a new rising main to discharge raw water transferred from the west of the island into Queens Valley Reservoir. The new pumping station will have the capacity to transfer up to 15Ml/d from the existing (and any new) raw water sources in the west of the island to the east (in particular to support storage in Queen's Valley Reservoir). These asset enhancements would increase overall supply resilience and can be operated flexibly. They could be used in conjunction with any new sources of water, including helping to blend any desalination or effluent reuse scheme supplies with freshwater. The estimated reliable yield benefit in severe drought is 0.8 Ml/d (i.e. in a 2-year drought), but this option also provides improved resilience and greater yield benefit in other drier, but not severe drought, conditions.				This option is taken forward in the final Feasible Options list as 'Enhance West to East raw water transfer links'.
S29	Supply resilience	Increase raw water transfer capacity	This option is to enhance the raw water transfer capacity by overcoming some key infrastructure constraints (beyond the West-East transfer constraints noted in Option S14). No additional reliable yield is likely to be provided by this option, but it enhances supply resilience.				This option is incorporated into Option S14.

S33	Supply resilience	Water tankering on island	This option would involve on-island tankering of treated water from service reservoir to areas of the island experiencing supply shortfalls in severe drought conditions.				This option was rejected as there are more appropriate and effective options available in the unconstrained list to address supply deficiencies in drought conditions. Tankering remains an emergency measure as part of the company's contingency plans for water supply outages that lead to a loss of supply to a local community.
S37	Modification of levels of service	Reduce levels of service	This option involves reducing the level of service that Jersey Water provides to its customers in respect of the frequency of implementing temporary drought restrictions on the use of hosepipes and sprinklers and wider restrictions on other non-essential water uses.				This option was rejected because of the likely public and political unacceptability of reducing the existing levels of service (1 in 20 years for temporary water use restrictions), as well as a high risk to wider supply resilience if these standards of service were reduced. The current level of service is consistent with that provided to customers in most of southern England, although the water companies are seeking to improve the levels of services in the longer term.

3.6. DROUGHT MANAGEMENT MEASURES

To help manage the risks to essential water supplies in drought conditions, a series of drought management options have also been considered, as summarised in **Table I.7a and Table I.7b.**

Table I.7a Drought management options discarded during the option coarse screening process

Ref	Option	Reason(s) for discarding
DM1	Ship water to Jersey from abroad	Very high costs (including paying retainers to shipping companies and water suppliers) and difficult operational logistics for a temporary measure.
DM2	Water rationing using standpipes and rota cuts to the supply of water at customer taps.	Substantial public health risks and unacceptable to customers. Should only be considered as part of civil emergency measures and not planned as part of sustaining essential water supplies to customers in severe drought conditions.

Table I.7b Drought management options discarded during development of the final Feasible Options list

Ref	Option	Reason(s) for discarding
DM3	Install additional temporary desalination treatment process at La Rosière (1-2 Ml/d capacity)	High cost (including paying a retainer to a supplier) and takes time to commission to meet water quality needs. Availability in drought in a timely manner is a risk due to competing demand in other locations. Permanent installation to provide additional capacity for drought is a better overall solution.
DM4	Bring abandoned boreholes back into supply	Low supply benefit in a drought and water quality risks. Keep under review if any reliable boreholes are identified that could be used in a drought.
DM5	Install temporary PFAS treatment (GAC unit) at St Ouen's boreholes to increase borehole output.	Viable option but other permanent solutions (e.g. Option S6) were considered more cost-effective and reliable in a severe drought. Keep under review for next plan update.

The remaining temporary drought management options shown in **Table I.8** were included in the final Feasible Options list for consideration during the programme appraisal process.

Table I.8 Drought management options included in the final feasible options list

Ref	Option	Reason for inclusion
DM6	Enhanced customer water efficiency and "use water wisely" education and awareness campaign	Readily implemented with short lead time. Relatively low cost and achieves high level of awareness to customers of the need to conserve water use in a rapid timescale (radio, television, social media, print media, website, leaflets, promotion at events and public spaces).
DM7	Temporary Water Use Ban – covering various non-essential water uses with minimal social or economic impact.	Readily implemented under existing legislation. Uses can be selected depending on time of year and likely volumes to be saved. Could include a ban on watering gardens with a hosepipe or sprinkler, washing private cars with a hosepipe (except any commercial car wash enterprises where water is recycled), filling private swimming pools (aside from commercial hotels/private leisure centres), paddling pools, ornamental ponds or fountains.

DM8	Temporary Non-Essential Water Use Ban – covering a wider range of non-essential water uses with some social or economic impact.	Readily implemented under existing legislation. Uses can be selected depending on time of year and likely volumes to be saved. Could include banning the use of: all car washes (except where water is recycled); washing of windows/buses/ boats/ outdoor surfaces; irrigation of sports grounds/ civic parks / newly laid turf; water for dust suppression (except for health and safety reasons), filling of all swimming pools except public swimming pools.

These drought management options included in the final Feasible List will, in combination, provide estimated temporary demand savings of around 1 Ml/d during a severe drought and are available to be implemented already in a drought under existing legislation.

4. OPTION DEVELOPMENT

4.1. STAGE 3: DEVELOP OUTLINE SCOPE FOR EACH FEASIBLE OPTION

Following the development of the final Feasible Options shortlist, an outline scope was developed for each option to inform detailed option appraisal. This included high level engineering design for the supply options, as well as development of capital and operational cost profiles for each option over an 80-year horizon. Additionally, for water efficiency options the profile of revenue reduction was calculated over the planning period due to reduced demand from customers arising from option implementation.

An option dossier and assessment spreadsheet proforma was developed for each option, comprising the following information:

- **Summary** of the option and main scheme elements, as well as summary costing information, timeframe to implement and reliable yield benefit or demand saving
- **Proposed works** describing the work required to implement the option, any opportunities and benefits beyond reliable yield gain or demand saving, risks and constraints, and any assumptions used in the option development.
- **Resilience** assessment, considering the resilience of the option to a list of key hazards and risks and any resilience benefits provided by the option.
- **Option appraisal** against a range of appraisal criteria (as set out earlier in Section 2): Feasibility and Risk; Engineering and Cost; Performance and Resilience; Operational Risks; Environmental Effects. This assessment built upon the original fine screening multi-criteria appraisal.
- **Cost worksheet** with a detailed breakdown of capital, operational and carbon costs, as well as water available for use (WAFU) benefits over an 80 year horizon. The cost worksheet contains a calculation of net present value (NPV in £) and the discounted average incremental cost (AIC) in £ per Ml. Costs are based on UK rates with an uplift applied to reflect generally higher costs in Jersey. Revenue impacts were included for water efficiency measures only. Carbon costs based on estimated carbon consumption for both construction/implementation and operation of each option are also calculated over the 80-year planning period.

4.2. STAGE 4: DETAILED APPRAISAL AND COST-BENEFIT ASSESSMENT

The outline design and cost information for supply and demand options was used to determine the reliable supply or demand saving benefits, supply resilience benefits, capital and operating costs, impacts on revenue (for water efficiency measures only), delivery risks and any uncertainties, customer and political acceptability, plus any potential environmental and social effects.

The costs and supply or demand saving benefits for each option were used to calculate the discounted Average Incremental Costs (AIC) over the long-term (80-year discount period) using a consistent discount rate (3.5% for the first 30 years, 3.0% until year 75, and 2.5% until year 80). This AIC approach has been adopted for many years in the UK for water resources planning to compare options on a 'like for like' basis (i.e. cost per million litres (Ml) of water provided).

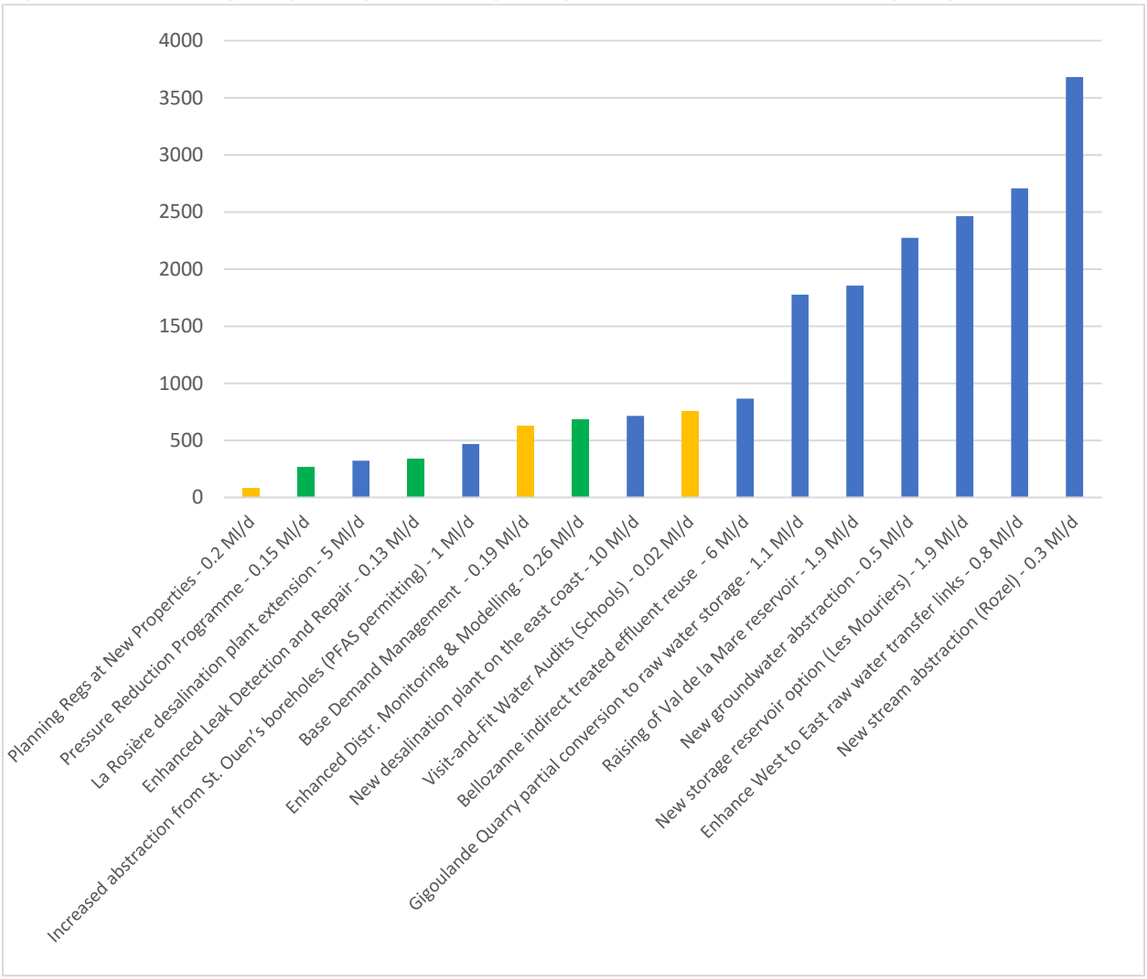
The AICs for each option are shown in **Table I-9** and an AIC ranking of the options is provided in **Figure I-3**. The AIC values exclude any potential land purchase costs (due to current high uncertainty about these values).

Table I-9 and **Figure I-3** show that some of the water efficiency options and the leakage reduction measures compare favourably with supply augmentation options in relation to AIC. The AIC values vary significantly between the different supply augmentation options: La Rosière desalination plant extension has the lowest AIC of the supply augmentation options, followed by the St. Ouen's boreholes PFAS treatment option. The Targeted catchment protection initiatives option does not provide additional water supplies but provides a resilience benefit, principally reducing the risk of a temporary (or potentially permanent) reduction or cessation of water supplies from surface or groundwater sources due to adverse water quality (notably nitrates and pesticides).

Table I-9: Summary of option benefits and AIC values (excluding any land purchase costs and revenue impacts for water efficiency options)

Option ID	Option	Benefit (Ml/d)	AIC (£/Ml)
S1	Targeted catchment protection initiatives	0 (resilience benefit only)	Not applicable
S5	New stream abstraction (Rozel)	0.3	3682
S6	Increased abstraction from St. Ouen's boreholes (PFAS permitting)	1.0	469
S9	La Rosière desalination plant extension	5.0	321
S12	New desalination plant on the east coast	10.0	715
S14	Enhance West to East raw water transfer links	0.8	2707
S15	New groundwater abstraction	0.5	2274
S18	Bellozanne indirect treated effluent reuse	6.0	850
S24	Raising of Val de la Mare reservoir	1.9	1856
S25	Gigoulande Quarry partial conversion to raw water storage.	1.1	1775
S35	New storage reservoir option	1.9	2464
D6	Water Efficiency: Base Demand Management	0.2	630
D13	Water Efficiency Planning Regulations at New Properties	0.2	83
D19	Water Efficiency Visit-and-Fit Water Audits (Schools)	0.02	753
D29	Leakage Reduction: Enhanced Leak Detection and Repair	0.1	338
D32	Leakage Reduction: Improved Distribution Monitoring and Modelling	0.3	681
D35	Leakage Reduction: Pressure Reduction Programme	0.15	266

Figure I-3 AIC Ranking of Options (excludes any land purchase costs and revenue impacts)



The AIC approach excludes the reduced revenue impact of reduced customer demand associated with water efficiency options and does not consider non-monetary effects such as consumer acceptability or environmental effects. Consequently, the AIC ranking provides an initial comparison of options but other considerations also influence decisions on the selection of the options to be included in the preferred plan to secure water supply reliability. A detailed multi-criteria assessment was therefore carried out for each of the options against seven criteria: supply / demand benefit (Ml/d); cost (AIC); acceptability (political, customer and societal); delivery complexity (risk); performance and resilience; operational complexity (risk); environmental effects. The assessment took into consideration the additional design detail carried out for each of the feasible options.

Table I-10 provides a summary of the findings of the multi-criteria options appraisal. The assessment outcomes have been summarised using a Red/Amber/Green assessment approach, where red indicates a high risk or major impact, amber indicates moderate risk or moderate impact, and green indicates low risk or minor impact, or an improvement.

Table I-10 Feasible Options Multi Criteria Appraisal Summary

ID	Option	Benefit (Ml/d)	AIC (£/Ml)	Acceptability	Delivery Complexity	Performance & Resilience	Operational Complexity	Environmental	Summary
S1	Targeted catchment protection initiatives	N/A	N/A						No reliable yield benefit but option provides resilience to water quality outages and has operational benefits through improved water quality. Potential wider environmental benefits, e.g. biodiversity, carbon, flood defence.
S4	New stream abstraction (Rozel)	0.3	3682						Short lead in time and no customer/political acceptability risks. Very high cost for limited and uncertain yield, and option is particularly sensitive to drought risks. Low risk of impacts to aquatic environment given low abstraction rate.
S6	Increased abstraction from St. Ouen's boreholes (PFAS permitting)	1.0	328						Short lead in time but some issues with customer/political acceptability due to drinking water quality challenges. New treatment process which will require some upskilling of staff and/or relatively complex groundwater water quality remediation actions. Some uncertainty around the reliable yield which requires further investigation. Increased abstraction may impact groundwater quality and potential impact on a local nature reserve.
S9	La Rosière desalination plant extension	5.0	321						High capital cost but provides reliable additional yield in a drought. Delivery and operational challenges to integrate additional desalination capacity with existing assets and to ensure robust blending of desalinated water with surface water sources in drought conditions. Negligible

ID	Option	Benefit (Ml/d)	AIC (£/Ml)	Acceptability	Delivery Complexity	Performance & Resilience	Operational Complexity	Environmental	Summary
									environment impacts as energy supplies in Jersey are from certified low-carbon sources.
S12	New desalination plant on the east coast	10.0	715						May require some raw water system upgrades to contain additional water. More expensive than La Rosière option as requires building a new plant rather than upgrading existing plant. Environmental impacts to designated marine/coastal conservation site during construction of sea water intake and potentially from the operational brine discharge to sea. Energy supplies in Jersey are certified low-carbon sources so additional power requirements would not exacerbate greenhouse gas emissions.
S14	Enhance West to East raw water transfer links	0.8	2707						Some complex modifications to the raw water network are required and has the highest AIC of all the supply options, but the option provides additional resilience and flexibility to move water across the island. Minimal operational and environmental risks as energy supplies in Jersey are certified carbon-free.
S15	New groundwater abstraction	0.5	2274						Very high AIC and uncertain yield in drought conditions (pump tests needed), although low operational risk. Moderate environmental risk related to groundwater impacts. Some potential risks to other groundwater abstractors and water quality may present some

ID	Option	Benefit (Ml/d)	AIC (£/Ml)	Acceptability	Delivery Complexity	Performance & Resilience	Operational Complexity	Environmental	Summary
									acceptability challenges due to risk of elevated nitrate and/or pesticide levels.
S18	Bellozanne indirect treated effluent reuse	6.0	1272						May present some political and customer challenges about acceptability of re-using treated effluent. High delivery feasibility risk due to design of new treatment processes and constrained construction site. High capex cost to build although provides reliable yield in drought. Some operational risks as Jersey Water does not control the quality of effluent and possible elevated contaminant concentrations in the treated effluent. Negligible environment impacts as energy supplies in Jersey are certified carbon-free.
S24	Raising of Val de la Mare reservoir	1.9	1856						High capital costs and site-specific engineering challenges in respect of delivery of design and managing outage of the reservoir over many months. Low operational risk. Option provides greater supply resilience and improved resilience for downstream flood risk through increased flood storage provision. No adverse effects on downstream conservation sites anticipated with appropriate mitigation measures in place.
S25	Gigoulande Quarry partial conversion to raw water	1.1	1775						High capital cost and AIC, plus uncertainty around land purchase cost. Option provides supply resilience benefit by

ID	Option	Benefit (Ml/d)	AIC (£/Ml)	Acceptability	Delivery Complexity	Performance & Resilience	Operational Complexity	Environmental	Summary
	storage								providing additional storage and there is potential environmental benefit of a new aquatic habitat. Some delivery construction challenges to partially convert a working quarry into a raw water storage facility.
S35	New storage reservoir option	1.9	2464						High capital cost and AIC with potential risk of site-specific engineering challenges, although option improves resilience and has potential for environmental benefits of a new aquatic habitat but there are also some potential adverse environmental effects for which full mitigation might not be possible (provisional precautionary rating of Amber for environmental effects as further detailed investigations necessary to assess magnitude of effects and potential mitigation measures).
D6	Water Efficiency: Base Demand Management	0.19	630						Low acceptability risk as option is likely to have political and customer support. No engineering required although operational cost is relatively high and some upskilling of staff may be required. Environmental and social benefit related to water savings. Operationally challenging to secure the water saving benefits across many customers and water saving benefits may erode with time, reducing the resilience of the option.

ID	Option	Benefit (Ml/d)	AIC (£/Ml)	Acceptability	Delivery Complexity	Performance & Resilience	Operational Complexity	Environmental	Summary
D13	Water Efficiency Planning Regulations at New Properties	0.2	83						Low acceptability and engineering risk although the time to achieve the full demand savings is 25 years. Option is sensitive to consumer behavioural response. No significant operational risks and option provides environmental and social benefits related to water savings. Water saving benefits may erode with time, reducing the resilience of the option.
D19	Water Efficiency Visit-and-Fit Water Audits (Schools)	0.02	753						Low acceptability risk as likely to have political and customer support. Moderate engineering challenge of installing water-saving equipment in schools and relatively high operational costs compared to small demand saving. No significant operational challenges and option provides environmental and social benefits related to water savings. Water saving benefits may erode with time, reducing the resilience of the option
D29	Leakage Reduction: Enhanced Leak Detection and Repair	0.13	338						Low acceptability risk as likely to have political and customer support, and AIC is low compared to other demand management options. Relatively low water saving benefit and benefit is uncertain. Option provides some operational and climate resilience. Some upskilling of staff will be required. Option provides environmental and social benefits related to water savings. Resilience benefit is subject to sustained resource efforts to find and repair

ID	Option	Benefit (Ml/d)	AIC (£/Ml)	Acceptability	Delivery Complexity	Performance & Resilience	Operational Complexity	Environmental	Summary
									leaks.
D32	Leakage Reduction: Improved Distribution Monitoring and Modelling	0.26	681						Low acceptability risk as likely to have political and customer support, although AIC relatively high compared to other demand management options. Option provides operational and climate resilience. Demand saving is highest of all demand management options although some upskilling of staff will be required. Some delivery complexity risks due to use of new technologies and advanced modelling tools. Option provides environmental and social benefits related to water savings.
D35	Leakage Reduction: Pressure Reduction Programme	0.15	266						Option is likely to have political support although there is a long timeframe required to implement all of the schemes. AIC is relatively low compared to other leakage options and the option provides operational and climate resilience. Some upskilling of staff will be required. Option provides environmental and social benefits related to water savings. Moderate operational challenges to optimise pressure levels to reduce leak volumes but maintain adequate pressure in water network for customers in high rise buildings and for fire fighting.

The options appraisal shows that demand management options generally performed better in terms of engineering and costs than supply options (excluding revenue impacts of water efficiency measures). However, the AIC comparison excludes the revenue impacts of the water efficiency options which would result in significant revenue reductions to Jersey Water due to reductions in customer demand.

Some of the larger supply options provide a more reliable yield benefit compared to the demand management options to meet the forecast supply deficit. The new storage options and the West to East raw water transfer links have significant supply resilience benefits and help provide reliable freshwater blending for any desalination or water reuse options. New surface water and groundwater abstraction options carry some environmental risks, as does the option for increased abstraction at St Ouen's boreholes, the new desalination plant and raising of Val de la Mare reservoir. The leakage reduction options have moderate operational risk and complexity and may require additional staff or upskilling of existing operational staff.

The appraisal shows that only one option (a new desalination plant on the east coast at 10 Ml/d) can resolve the forecast supply deficit in full, but the deficit can also be resolved through delivery of a combination of two or more other options.

These feasible options, along with the demand management options set out earlier, were considered as part of the programme appraisal process to determine the optimal mix of options to resolve the forecast supply deficit, as set out in detail in Appendix J of this Water Resources and Drought Management Plan.