Jersey Water

Water Resources and Drought Management Plan

Appendix H. Drought Management

CONTENTS

JERSEY WATER RESOURCES AND DROUGHT MANAGEMENT PLAN

APPENDIX H. DROUGHT MANAGEMENT

1. PURPOSE

This appendix sets out the development of the drought management components of the Water Resources and Drought Management Plan, including the formulation of potential drought management measures to be implemented to safeguard essential water supplies.

2. DROUGHT MANAGEMENT

Development of the drought management component of the Water Resources and Drought Management Plan has taken account of UK water industry best practice guidance on drought planning, including the Environment Agency Drought Plan Guideline, UKWIR reports on the effectiveness of drought-related customer water use restrictions and the Water UK Code of Practice on temporary water use restrictions.

Drought management planning focuses on:

- Ensuring drought risks are identified at the earliest stage though routine hydrometeorological and water resource monitoring
- Assessing the scale, magnitude and duration of likely future drought events
- Identifying viable drought management response measures that can be reliably implemented in a timely manner according to the rate at which drought effects are likely to intensify
- Establishing defined drought management decision points for identification that a drought is developing and intensifying and when to instigate specific drought management measures, such as increasing supply or reducing demand as a drought intensifies
- Determining any regulatory or statutory requirements that Jersey Water might need to comply with or which support implementation of specific drought management measures
- Determining those non-essential water uses that can be restricted in a drought to help conserve water resources for essential water uses (to protect public health and well-being of the population), including considering other water abstractors on the island
- Identifying the monitoring and assessments Jersey Water will use to assess drought management measures and their effects before and after a drought
- Setting out the likely frequency and duration of implementing drought water use restrictions in order to inform customers of the level of service they can expect – both now and in the future
- Setting out the required communications with government, customers and other stakeholders during a drought
- Post-drought recovery measures.

The following sections address these key components which, in turn, have informed the overall drought management approach set out in the Water Resources and Drought Management Plan.

3. DROUGHT MONITORING

Taking account of the nature of the Jersey Water supply system, the primary leading indicator of drought conditions is the amount of rainfall received on the island and, subsequently, the total storage remaining in the Val de la Mare, Queen's Valley, Grands Vaux and Waterworks Valley raw water storage systems (see Appendix C for more details about these raw water sources).

Total rainfall is measured daily at rain gauges at seven separate locations across Jersey (Handois, Millbrook, Augrès, Val de la Mare, Queen's Valley, Greve de Lecq and St. Catherine) and total raw water storage is monitored at least weekly against the long-term average and historic drought event data to provide an early indication of drought conditions. As well as daily rainfall and weekly raw water storage conditions, the following drought indicators will also be used to provide early warning of the risk of worsening drought conditions:

- Soil Moisture Deficit in key surface water catchments, if feasible. The UK Met Office does not calculate Soil Moisture Deficit for the Channel Islands and therefore this would likely require a number of lysimeters to be installed in the key reservoir catchments or development of a derived calculation based on rainfall, temperature and soil conditions. This could be developed in conjunction with the agriculture sector who may also benefit from the data.
- Maximum and average air temperature (as an indicator of hot weather peak demand risks as well as subsequent impact on Actual Evaporation/Soil Moisture Deficit) – this data is already available daily from the Jersey Met Office.
- Total water production volume (as an indicator of hot and/or dry weather peak and average demand) – this data is already available within Jersey Water.
- Water demand, split between household and non-household demand (to disaggregate the demand that could be managed through water use restrictions) – this data is already available on at least a monthly basis within Jersey Water.
- District Meter Area metered peak flow data (to further understand any more local details of peaks in demand that may be taking place in response to dry and/or hot weather conditions and to further help disaggregate the demand that could be managed through water use restrictions). This data is already available at least weekly within Jersey Water.

These indicators will form part of a weekly resource situation report that would be established at the onset of a drought and will include a simple drought risk "dashboard" summary – ranking the risk to water supplies from negligible to high – to inform senior management of the prevailing drought risk. Monitoring frequency will be increased in accordance with the severity of a drought situation up to 3 times a week during a very severe drought.

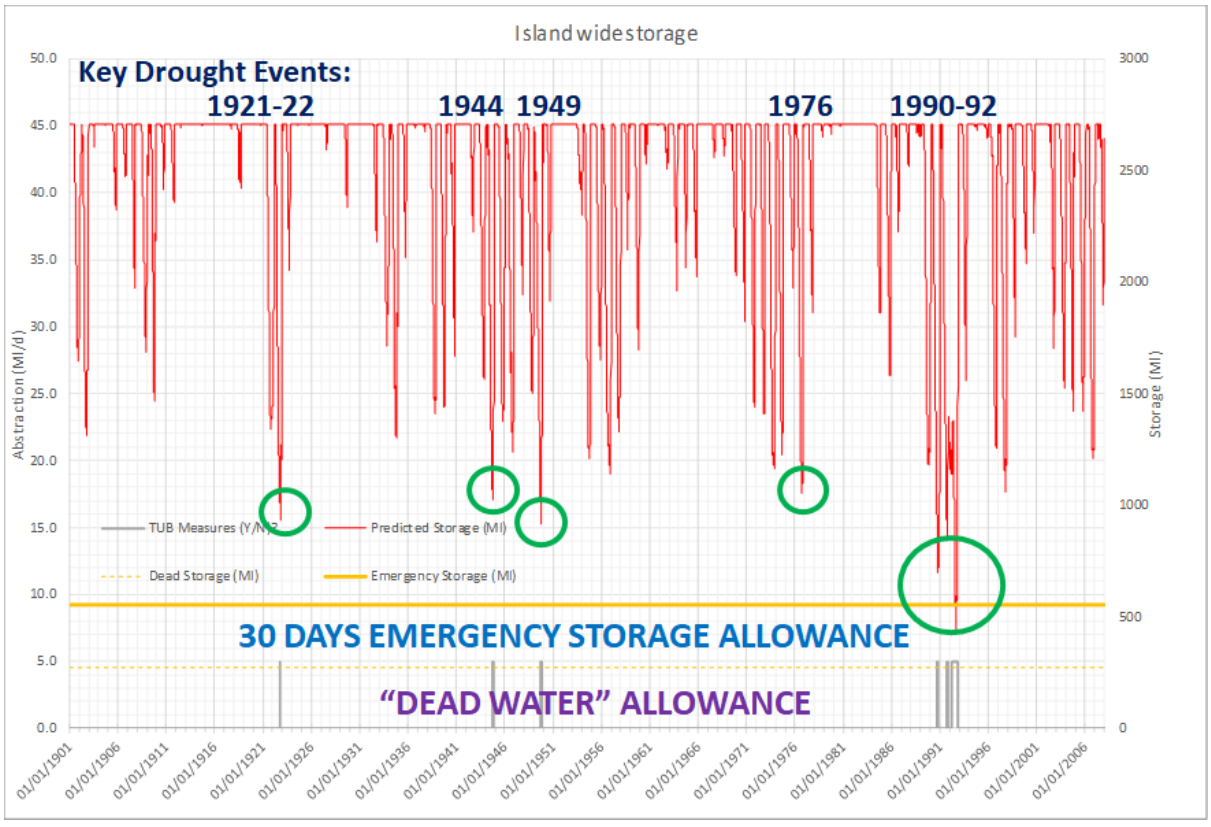
4. ASSESMENT OF HISTORICAL DROUGHT AND POTENTIAL FUTURE DROUGHT RISKS

As part of the work to assess the reliable water source yield of the Jersey Water supply system and potential future climate change risks (see Appendices C and D), the level of drought risk for the island has been assessed.

Over the historic simulated inflow record (see Appendix C), a number of severe drought events have been identified which, if they were to occur again, would require specific management measures to be implemented by Jersey Water in order to safeguard essential water supplies to customers, taking account of the current and future level of water demand on the island. Severe drought events have occurred relatively frequently over this historic record. The five most severe events to occur over the last 100 years of rainfall and inflow records are listed below and illustrated in Figure H.1:

- 1921-22
- 1944
- 1949
- 1976
- 1990-92

Figure H.1 Historic modelled drought storage showing key historic drought events: 1900 to 2008



As illustrated in Figure H.1, the two most severe drought events (1921-22, 1990-92) have lasted over at least a two-year period, with a very dry summer followed by a very dry winter which would hinder the refill of storage over the winter months, thereby placing supplies at risk during the subsequent

summer. The most intense drought over the last 100 years was the 1990-92 event. This event dictates Jersey Water's drought planning as the cost of securing supply reliability against the risk of a similar severity drought event occurring in the future is significantly greater than the cost of securing supplies under a repeat of the other major historic drought events (notably 1921-1922 and 1976). It is important for water supply reliability to customers that adequate measures are put in place to mitigate against a future drought with an equivalent, or an increased, severity level as the 1990-92 event (which is considered to have an approximate return period of 1 in 200 years based on evidence of the same drought event available for Southern England).

The assessment of climate change (**Appendix D**) has indicated that there could be a risk of an increase in magnitude/duration of future drought events, but it is important to stress that the available evidence is highly uncertain. Consequently, Jersey Water plans to adopt a prudent approach that "future-proofs" the drought management approach to the risk that a future drought may be more severe in either duration and/or magnitude than those identified from the historic record.

Jersey Water's supply system is reliant on key operational assets being fully available for use in a drought. Asset outages could result in an additional risk to the severity of a future drought, hence our drought management approach also considers the resilience of the supply assets and the overall water supply network to potential outages (see also **Appendix F**).

5. DROUGHT MANAGEMENT OPTIONS

A range of options have been considered for implementation during a drought. Options may be split into two main categories:

- Options to temporarily manage the demand for water.
- Options to temporarily augment water supply availability.

Temporary Drought Demand Management Options: Initial Considerations

Table H.1 sets out the initial wide range of options that were considered as potential measures to manage the demand for water in drought conditions. Options may be considered both individually and cumulatively.

Table H.1 Temporary Drought Demand Management Options: Initial Considerations

Option	Details	Issues	Potential Benefit
Temporary Use Ban (TUB)	Temporarily restrict the use of hosepipes and sprinklers, and other similar water uses. Permitted under powers outlined by the Water Law.	Need to set out a detailed list of uses that would be prohibited and any exemptions, for example for disabled customers.	3-5% reduction to average dry year demand. Up to 10% reduction to peak week demand.

Temporary Non-Essential Water Use Ban	Wider temporary restrictions on non-essential uses of water, including some commercial uses such as hand car washes (if water not recycled), filling private and commercial (but not public) swimming pools, washing of stonework and windows, water use by municipal parks, turning off beach showers and taps.	Some businesses may be adversely affected with a loss of income. Need to set out a detailed list of uses that would be prohibited and any exemptions, for example for car wash companies that have 100% water recycling systems.	1-2% reduction to average dry year demand. 2-3% reduction to peak week demand.
	Temporarily restrict Fire Service hydrant testing and Jersey Water hydrant flushing activities.	Some risks related to drinking water quality (flushing) and fire safety (hydrant testing).	0.1% reduction to average dry year demand
Enhancing Leakage Control and Water Efficiency Measures	Reduce leak repair response times by providing additional resources through use of overtime or weekend working.	Leak repair times are already very low, so limited benefits.	Less than 0.1 Ml/d benefit.
	Free customer pipe repair during a drought.	Expensive option in terms of cost/benefit. Legally, property owners are already required to repair leaks on their customer supply pipe in a timely manner.	Less than 0.1 Ml/d benefit.
	Provide additional water audits for commercial and residential customers.	Cost and resource implications. There will already be savings from existing Jersey Water audit activity included in the base demand management activities.	Less than 0.2 Ml/d benefit.
Operational Water Use	Restrict operational flushing (continuous	Some risks related to drinking water quality and	0.01 Ml/d

	flushing at Greve de Leq sampling points; mains flushing only occurs when testing new mains).	very small water saving benefit.	
	Replace potable water used in construction (e.g. spraying) with recycled grey water.	Recycled water comes with some potential effects on public health. Logistically challenging option.	0.01 Ml/d
	Cease Jersey Water's Water Tankering Service, including private swimming pool refill service.	An alternative company (AA Langlois) also offers this service.	0.02 Ml/d
	Distribution Pressure Control: temporarily lower the pressure in the water network to reduce usage and the volume lost from any leaks.	Need to be on call to change pressures in response to a call from the fire services in case of emergency. Some flats/apartment blocks may suffer temporary loss of supply.	0.04 Ml/d
Incentive Tariffs	Offer of incentive tariffs, e.g. provide a voucher if customers use less water than usual.	Not currently easy to monitor with current billing system set up and difficult to implement quickly in a drought.	0.02 Ml/d
Communication	Enhance water conservation communications, and promote the importance of reporting leaks and fixing dripping taps, provide advice on how to use water wisely, etc. Could include Water Efficiency Roadshows, mainstream media, social media, television, radio and newspaper adverts,	Additional activity to normal year communications on using water wisely.	2-3% reduction to average dry year demand. 3-4% reduction to peak week demand.

	bus and street adverts, sponsorship of weather bulletins.		
	Request to customers to voluntarily refrain from using hosepipes and sprinklers (rather than impose restrictions)		1-2% reduction to average dry year demand. 2-3% reduction to peak week demand.
	Request to non-household customers to minimise non-essential water use.		0.5-1% reduction to average dry year demand.
Restrict supply of water to customers using standpipes and/or rota cuts	All water supplies to customers cut off on a rota basis for a defined period of the day (e.g. 6 hours), or supplies cut off all the time with use of standpipes implemented as the only means of supply.	Very unlikely to be acceptable except in a drought worse than historic drought conditions. Risk of significant public health impacts. Technically very challenging to implement. Hospitals, care homes, prison, schools (unless school holidays) and other essential public service properties would need to be exempted. Fire service considerations would need very careful planning and liaison arrangements.	15% reduction to average dry year demand. 20% reduction to peak week demand.

Jersey Water recognises the absolute importance of maintaining essential water supplies to all of its customers. It is therefore **considered <u>unacceptable</u> to plan to restrict <u>essential</u> water use or ration essential water supplies to customers through the use of standpipes or rota cuts if there was a repeat of the worst historic drought conditions – other measures need to be implemented instead to maintain essential water supplies. These extreme demand management measures may only be required if a future drought is more severe than the worst historic drought on record.**

The potential benefit figures from implementing demand management options shown in Table H.1 are somewhat uncertain (and are not necessarily cumulative, depending on which combination of measures are implemented). Communications, incentives and temporary use measures restrictions (both encouraged and enforced) rely heavily on the participation and goodwill of customers. Some measures have a seasonal variability, with the full benefit only being realised in spring and summer

months (e.g. beach tap/shower use and garden watering with hosepipes is minimal during winter months).

Temporary Drought Supply Augmentation Options: Initial Considerations

Table H.2 indicates the potential temporary measures that were initially considered by Jersey Water to augment water supply availability in drought conditions.

Table H.2 Potential Temporary Drought Supply Augmentation Options: Initial Considerations

Option	Details	Issues	Potential Benefit
Reduce impact of other abstractors on public water supply sources.	Use existing regulatory powers (or seek voluntary arrangements) to restrict or prohibit abstractions by other abstractors upstream of Jersey Water abstraction sources.	Food security is important for Jersey and any reduction to agricultural abstraction may have adverse effects on crop yields.	Benefit is very low in drought conditions due to low flows but higher benefits in drought recovery periods when flows are higher.
Alternative Supply Options	Measures to increase the transfer of water eastwards to augment Queen's Valley during refill period. Queen's Valley is the largest reservoir but has a relatively small catchment area.	Option would require laying of temporary pipework and/or installation of temporary pumping stations with potential for disruption to local residents/landowners. A permanent solution to install permanent pipework and pumping stations is preferable if it can be delivered in the time available.	Will help to refill Queen's Valley reservoir, enhancing the reliable yield by up to 0.8 Ml/d depending on the additional volume that can be transferred from sources in the west of the island.
	Harness small surface water catchments (e.g. Rozel, Beaumont, Fernlands and St Catherine) and pipe water to operational catchments.	Small catchments are likely to dry up before the principal Jersey Water catchments so yields may be very limited. Would require temporary pipework and pumps to be installed with potential for disruption to local residents/landowners.	Very small yield benefit in drought and small benefit during reservoir refill period.

	Harness North St. Ouen's Bay catchment.	Nitrate levels in this catchment are in excess of 100 mg/l and water is already abstracted by farmers for irrigation.	Small benefit and drinking water quality standards for nitrate may constrain use.
	Use the Fort Regent Cavern as an alternative reservoir	Water quality is generally very poor as it is used to hold contaminated flood water and only refills in heavy rainfall events.	Approximately 60 Ml storage might be available and would be unlikely to recharge during a drought once utilised.
	Develop new groundwater sources at Grands Vaux, Ponterrin and Chaise au Diable	Small benefits during drought and timescales to drill new boreholes will limit the duration of benefit once commissioned.	Small benefit of approximately 0.1 to 0.3 Ml/d
	New temporary desalination plant on East Coast	Technically challenging and expensive. Delivery timescales will likely be too long to provide a benefit in drought. Lack of availability of temporary desalination treatment modules due to drought in other countries. Would require new sea water intake and delivery pipelines which would take time to construct in challenging tidal and marine conditions. Likely adverse effects on marine and coastal environmental habitat in designated conservation area.	Up to 5 Ml/d
Third Party Sources	Make use of 3rd party water sources on the island	It is likely that most third-party water sources would dry up or be severely depleted during drought with little benefit.	Very low benefit, probably no greater than 0.15 Ml/d

Recommission or Expand Existing Water Sources	Abstract more water from the St Ouen's boreholes in a drought with temporary GAC treatment to address the PFAS pollution.	PFAS groundwater contamination plume may be pulled closer to the boreholes exacerbating water quality issues. Water quality may not be satisfactory for potable supply.	0.5 Ml/d assuming can install temporary GAC treatment modules.
	Commissioning a new temporary desalination treatment stream at La Rosière.	Expensive and delivery timescales may not provide the benefit in time. Lack of availability of temporary desalination treatment modules due to drought in other countries. Blending ratios with freshwater could be challenging in drought if Val de la Mare reservoir storage is depleted.	Up to 5 Ml/d
Other options	Undersea transfer pipe to/from France (~40 km) in the St Malo peninsular area.	Dependent on availability of local French water sources – likely that drought will also be affecting water sources in this part of France. Water resources in this part of France are already limited and at the extremity of the regional treated public water supply network. Challenging construction requirements and very expensive.	Unlikely to be feasible. Could potentially provide up to 5.0 Ml/d.
	Import water from abroad by shipping tankers.	Expensive and availability likely to be limited due to demand from other countries. Challenges with availability of harbour space to moor the tankers and discharge to road tankers to distribute to raw water storage reservoirs.	Unlikely to be feasible but could provide 1-2 Ml/d.

6. OPTIONS ASSESSMENT

There are a limited number of options to reduce demand and augment supply in a drought and most provide only a very small benefit if implemented in isolation. Options that provide greater benefits are very challenging for a variety of reasons with implementation lead times that may well exceed the duration of need during a time-limited drought event.

As part of the option appraisal process (see Appendix I) for the Water Resources and Drought Management Plan, the options set out in Section 5 above were considered for inclusion in the final recommended programme for the 25-year planning period, taking into account a range of factors such as:

- Legal, regulatory, commercial and political issues
- Financial costs
- Feasibility
- Availability of options
- Implications for drinking water quality
- The benefits of the option in severe drought.

Following an internal workshop to review the initial list of options shown in Tables H.1 and H.2, several of the options were removed from consideration in the options appraisal coarse screening process due to technical and/or very high cost reasons, as summarised in Table H.3.

Table H.3 Drought management options discarded prior to option coarse screening process

Option	Reason(s) for discarding
Reduce leak repair response times by providing additional resources through use of overtime or weekend working.	Leak repair times are already very low, so limited benefits. Additional leakage control actions on a permanent basis are a better solution than a temporary measure. Permanent measures to further reduce leakage are included in the option appraisal process.
Free customer pipe repair during a drought.	Expensive option in terms of cost/benefit. Legally, property owners are already required to repair leaks on their customer supply pipe in a timely manner and this is the best option to pursue in a drought.
Provide additional water audits for commercial and residential customers.	Audit activity already included in the base demand management activities. Additional water audit actions on a permanent basis are a better solution than a temporary measure. Permanent measures for increased water audit activities are included in the option appraisal process.
Restrict operational flushing (continuous flushing at Greve de Leq sampling points; mains	Some risks related to drinking water quality and very small water saving benefit. In a drought, these activities would be carefully managed to minimise the volumes of water lost

flushing only occurs when testing new mains).	from the water network but volumes involved are very small.
Replace potable water used in construction (e.g. spraying) with recycled grey water.	Recycled water comes with some potential effects on public health. Logistically challenging option to collect grey water in any appreciable volume to be viable.
Cease Jersey Water's Water Tankering Service, including private swimming pool refill service.	Restricting swimming pool filling and other non-essential water uses included as water use restriction options so this option does not provide any additional water saving benefit in a drought.
Distribution Pressure Control: temporarily lower the pressure in the water network to reduce usage and the volume lost from any leaks.	Not a feasible option at a scale necessary to achieve water saving benefit. Technically challenging as need to be able to increase pressure rapidly in response to a call from the fire services for fire fighting water supplies. Some flats/apartment blocks may suffer temporary loss of supply requiring provision of alternative water supplies.
Offer of incentive tariffs, e.g. provide a voucher if customers use less water than usual.	Not currently easy to monitor with current billing system set up and difficult to implement quickly in a drought. Incentive tariffs are not included as a permanent option for consideration at this time, but will be reviewed again in the future as part of a wider review of the tariff structure and taking account of experience in England and elsewhere of such tariffs (e.g. the Thames Water trial).
Use existing regulatory powers (or seek voluntary arrangements) to restrict or prohibit abstractions by other abstractors upstream of Jersey Water abstraction sources.	Food security is important for Jersey and any reduction to agricultural abstraction may have adverse effects on crop yields. Water supply benefit is small versus the impact on wider economy, making this option unfavourable.
Measures to increase the transfer of water eastwards to augment Queen's Valley during refill period. Queen's Valley is the largest reservoir but has a relatively small catchment area.	A permanent solution to install permanent pipework and pumping stations is preferable and is included in the option appraisal process. A partial temporary solution may be feasible but cannot be relied on to maintain supplies due to the uncertainty around delivery and the benefit of a temporary solution during a drought.
Harness small surface water catchments (e.g. Rozel, Beaumont, Fernlands and St Catherine) and pipe water to operational catchments.	Small catchments are likely to dry up before the principal Jersey Water catchments so yields may be very limited. Would require temporary pipework and pumps to be installed with potential for disruption to local residents/landowners. A permanent solution for the Rozel catchment is included in the option appraisal process.
Harness North St. Ouen's Bay catchment.	Nitrate levels in this catchment are in excess of 100 mg/l and water is already abstracted by farmers for irrigation.

	Not a viable option due to drinking water quality risks and the low level of benefit to water supplies.
Use the Fort Regent Cavern as an alternative reservoir	Water quality is generally very poor as it is used to hold contaminated flood water and only refills in heavy rainfall events. Logistically very challenging to abstract the water to existing raw water storage facilities. Not a viable option due to these issues and the low level of benefit to water supplies.
Develop new groundwater sources at Grands Vaux, Ponterrin and Chaise au Diable	Small benefits during drought and timescales to drill new boreholes will limit the duration of benefit once commissioned. Permanent option to develop new groundwater source is included in the option appraisal process which would be a better solution than drilling a new borehole during a drought with a limited duration of benefit.
New temporary desalination plant on East Coast	Technically challenging and expensive. Delivery timescales will likely be too long to provide a benefit in drought. Lack of availability of temporary desalination treatment modules due to drought in other countries. Would require new sea water intake and delivery pipelines which would take time to construct in challenging tidal and marine conditions. Likely adverse effects on marine and coastal environmental habitat in designated conservation area. Permanent solution is included in the option appraisal process.
Make use of 3rd party water sources on the island	It is likely that most third-party water sources would dry up or be severely depleted during drought with little benefit, so this is not a viable option.
Undersea transfer pipe to/from France (~40 km) in the St Malo peninsular area.	Dependent on availability of local French water sources – likely that drought will also be affecting water sources in this part of France. Water resources in this part of France are already limited and at the extremity of the regional treated public water supply network. Challenging construction requirements and very expensive. Not a viable option to be implemented in the timescales of a drought. A permanent option has been included for consideration in the option appraisal process.

The remaining options were taken forward to the option coarse screening process and, subsequently, a smaller number of options were carried forward to the fine screening process (see **Appendix I**). Tables H.4a and H.4b summarise the drought management options discarded during the option coarse screening and fine screening processes, respectively.

Table H.4a Drought management options discarded during the option coarse screening process

Option	Reason(s) for discarding
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.
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 H.4b Drought management options discarded during development of the final Feasible Options list

Option	Reason(s) for discarding
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.
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.
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 H.5** were included in the final Feasible Options list for consideration during the programme appraisal process.

Table H.5 Drought management options included in the final feasible options list

Option	Reason for inclusion

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).
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.
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.

Following the programme appraisal process (**Appendix J**), all three of the drought management options shown in Table H.5 were included in the final preferred programme of measures to balance supply and demand in drought conditions. In combination, these drought management measures would provide estimated temporary demand savings of around 5% of dry year average demand (around 1 Ml/d) during the duration of a severe drought, but actual savings in a specific drought will depend on the prevailing demand and weather conditions. These measures are available to be implemented already in a drought under existing legislation.

7. DECISION-MAKING FOR IMPLEMENTING DROUGHT MANAGEMENT MEASURES

UK best practice for drought management recommends that water companies develop a series of sequential drought decision points or "control lines" to respond to the evolution of a drought event, with a gradation of response of drought management measures linked to different decision control lines based on the key indicator of drought severity (i.e. total raw water storage volume in the case of Jersey Water).

The drought decision control lines need to be set at a level of water storage that provides sufficient time between initiating a set of drought management responses and actually realising the benefit of

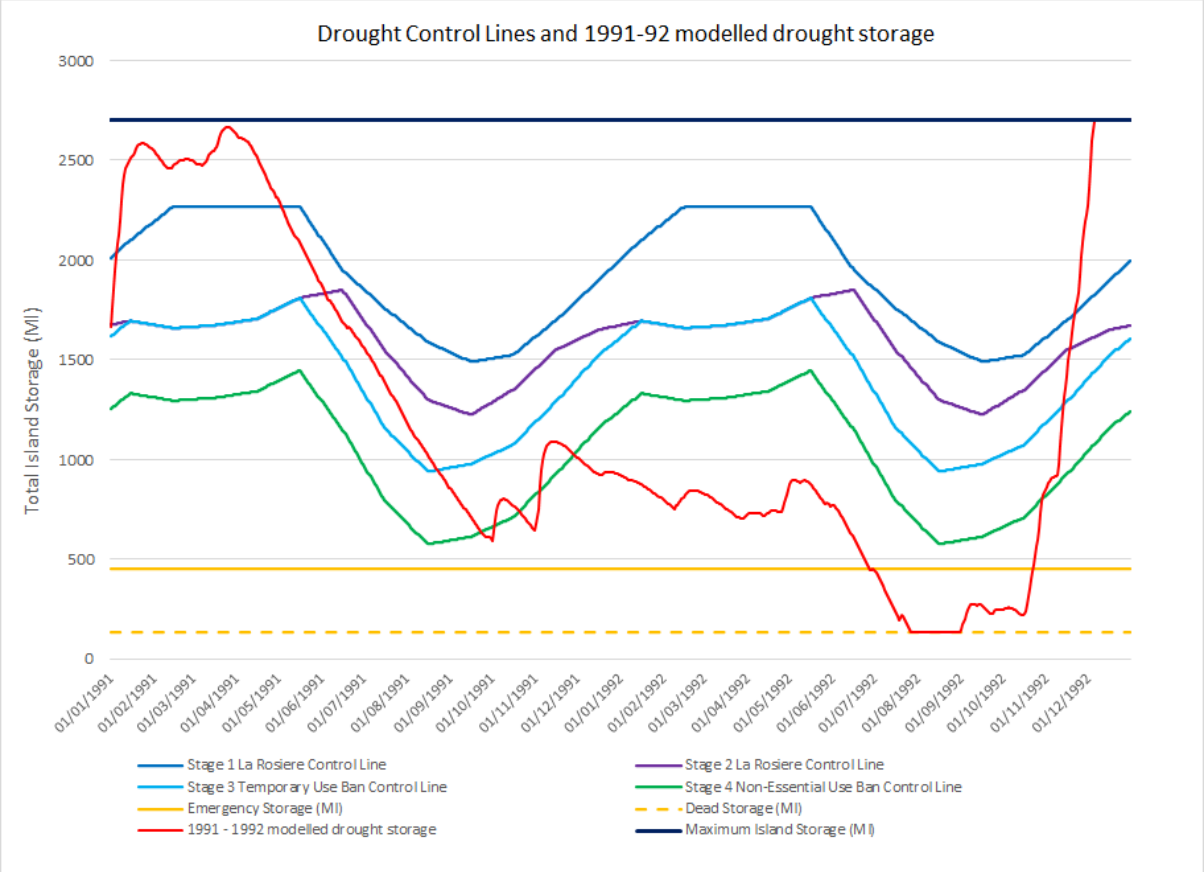
the management response. Inevitably, this is likely to mean that, in some cases, particular management measures are implemented but are subsequently found not to have been necessary at a later stage as the weather and/or demand conditions improved. Equally, the drought decision points need to reflect different patterns of drought events such that they can cater for a variety of possible future droughts.

A series of key drought decision control lines linked to total island raw water reservoir storage have been developed based on modelling of historic drought conditions (Figure H.2):

- **Stage 1:** Consider need to commence operation of Stage 1 of the La Rosière desalination plant
- **Stage 2:** Consider need to instigate a Drought Customer Awareness Campaign seeking voluntary actions to reduce non-essential water use. Consider the need to commence operation of the second treatment stage at La Rosière desalination plant.
- **Stage 3:** Consider and consult with key stakeholders and government about the need to implement a Temporary Use Ban prohibiting a range of specified water uses with a focus on domestic customers.
- **Stage 4:** Consider and consult with key stakeholders and government about the need to implement a Non-Essential Use Ban prohibiting a further range of specified water uses with a greater focus on commercial customers.

The indicative control lines shown in Figure H.2 are based on analysis of the modelled historic drought events to identify the maximum rate of water storage decline in different drought conditions in order to assess how many days would be available to implement drought management measures before further, more intensive, actions would need to be initiated. Modelling has been used to help optimise the drought control lines, seeking to minimise the frequency with which the lines are crossed whilst ensuring there is sufficient time to implement the more intensive drought management measures in a severe drought to safeguard essential water supplies.

Figure H.2 Indicative Drought Management Control Lines



Benefits from the implementation of measures at different control lines may not be realised immediately. Bringing La Rosière desalination plant into supply has a lead time of several weeks due to the start-up processes that have to be completed before being able to treat water to meet the required water quality standards for blending with surface water sources prior to full potable treatment at Handois and/or Augrès water treatment works. Although evidence suggests a good reception to media campaigns (e.g. Summer 2018), customer communication messages require time to circle around the community and for customers to respond and change their water use activities.

Due to the lead times required for many of the drought management measures and the steep rate of storage decline in a severe drought, the final control line (Severe Drought Stage 4) cannot be set at too low a storage level, otherwise there may be insufficient time for the management measures to be implemented to reduce the rate of storage decline and/or support recovery of storage volumes.

The Stage 4 control line (Non-Essential Use Ban) has been set to prevent storage falling into the emergency storage zone; this is to ensure that the emergency storage volume is protected. The Emergency storage allocation is equivalent to 30 days of supply at unrestricted dry year average demand levels and is intended for providing a small drought contingency storage should a future drought be more severe than historic drought events.

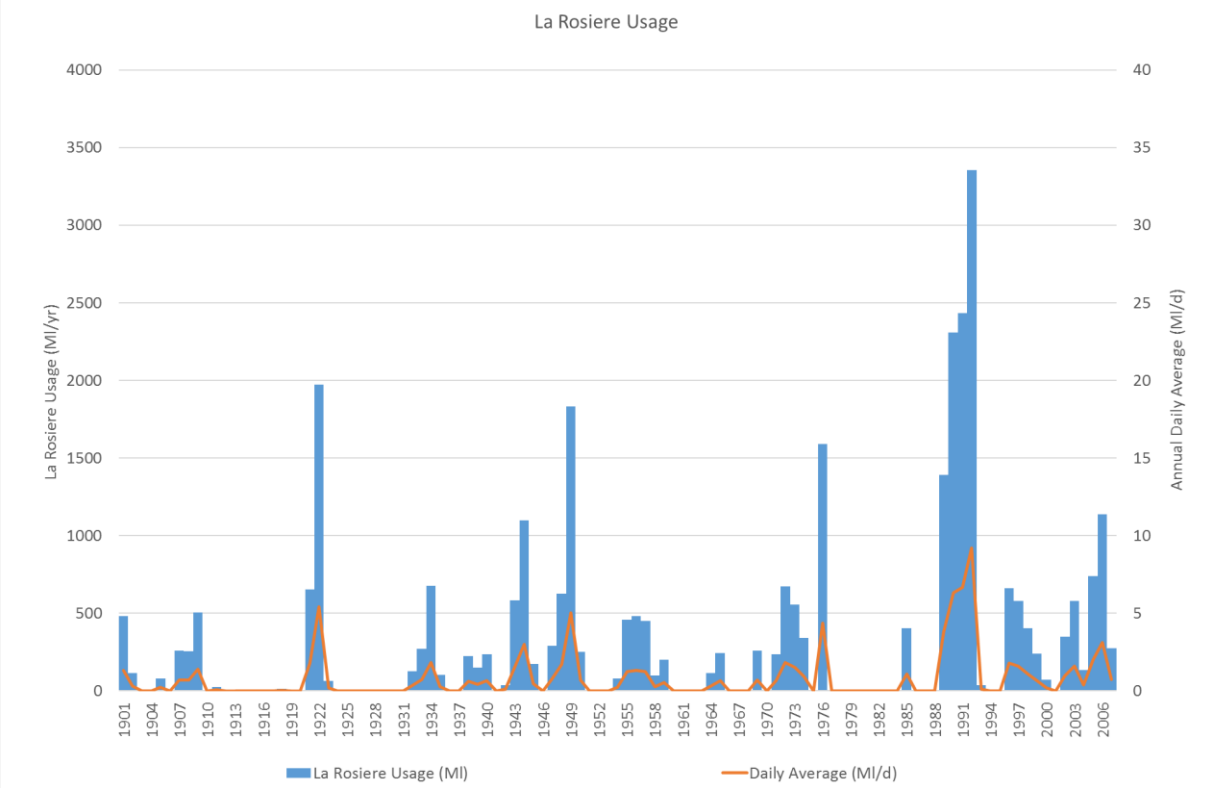
The decision control lines were tested in the water resource model to assess how they performed against the worst historic drought conditions (1991-92 drought) with the current water resources system. Figure H.2 illustrates how the indicative control lines would have been progressively crossed in the severe two-year drought of 1991-92 based on the results from the water storage model testing (not the actual storage from 1991-92 as the supply system was less resilient in that drought event than currently due to the commissioning of Queen's Valley Reservoir and the development of the second stage of treatment at La Rosière desalination plant). During this severe drought event, the modelling indicates that water storage would remain below the Stage 4 Control Line for a maximum period of ~13 months duration (September 1991 to October 1992). Emergency storage was breeched for a maximum period of ~4 months (July to October 1992). Storage would be effectively empty for 1 month in August 1992 as indicated by the current supply-demand balance which shows a supply deficit in severe drought with current levels of dry year demand. However, these simulated storage levels do not take account of the benefit of the Temporary Use Ban water use restrictions and customer communications that would be implemented before the Stage 4 control line is crossed. In practice therefore, the duration of time that storage would stay below the Stage 4 control line would be reduced; the water use restrictions (including Non-Essential Use Ban once Stage 4 has been reached) would just be sufficient to prevent storage emptying completely with a repeat of the 1991-92 drought conditions.

The control lines in Figure H.2 are indicative and further work will be carried out to review and refine them taking account of the operational experience of their use, particularly in relation to the new additional stage of treatment at La Rosière desalination plant which has recently (2020) completed its final commissioning trials. The control lines will be reviewed a least every three years as they may need further optimisation in light of actual operational experience. They will also need amendment once any new water sources are developed in due course as part of the Water Resources and Drought Management Plan delivery programme.

8. SIMULATED LA ROSIÈRE DESALINATION PLANT USAGE

The drought control lines include the use of the La Rosière desalination plant. The control lines for considering the use of the two stages of treatment at the desalination plant have been simulated against the historic reservoir inflows used in the water resource model with the current water resources system. Figure H.3 shows when the La Rosière desalination plant is online during the simulated historic drought conditions.

Figure H.3 Modelled Desalination Plant Usage vs. Historic Drought Record and Indicative Stage 1 and Stage 2 Control Lines



The modelling indicates that the desalination plant would be used in 58 years out of the 107-year historic record period if the decision was made at Stage 1 and Stage 2 control lines to bring the plant into supply. The usage would typically be limited to below 500Ml/year; however this value would be exceeded for 10 separate drought events. On average the desalination plant would have been used for 5 consecutive months. Years of modelled peak usage are shown in Table H.6.

Table H.6 Simulated Desalination Plant Production Output (Maximum Capacity of 10.8 Ml/d)

Drought Year	**1992**	**1991**	**1990**	**1922**	**1949**	**1976**
Total Usage per year (Ml)	3354	2433.5	2306.5	1973	1831.5	1590.5
Consecutive Periods within year.	April 91 - Nov 92		Jul 89- Jan 90 April 90 - Jan 91	Sep 21 - Mar 22 Jun 21- Jan 23	Oct 48 - Jan 49 Mar 49 - Nov 49	May 76 - Nov 76
Daily Average Usage (Ml/d)	9.19	6.67	6.32	5.41	5.01	4.35

9. DROUGHT MANAGEMENT MEASURES AND CUSTOMER LEVEL OF SERVICE

As set out earlier, a range of temporary drought management measures have been considered relative to permanent supply-demand measures. A trade-off needs to be determined between investing in permanent supply-demand measures (which increase the resilience of the supply system to drought and reduce the risk of requiring drought management measures), but which may not be used very often (and for which there would be an ongoing maintenance cost burden), with reliance on temporary drought management measures (notably temporary water use restrictions) which would be required occasionally to maintain essential water supplies to customers. This trade-off is reflected in the level of service that can be offered to customers in respect of implementing temporary water use restrictions, including comparing the existing level of service that can be provided with the costs involved in improving the level of service.

Level of Service Implications of Drought Control Lines

Assessment has been made of the level of service implications of the drought control lines against the historic drought events. A temporary use ban would be considered if storage falls below the Stage 3 control line. For the purposes of the simulation, a temporary use ban has only been initiated in the model if the Stage 3 control line is crossed between April and October inclusive. In winter months, temporary use bans are unlikely to be initiated even if the Stage 3 Control Line is reached as external water use is usually very low in winter and the restrictions would have little benefit.

Based on the simulated historic drought events in the water storage model and using forecast future demand plus target headroom (to cater for uncertainties), the temporary use ban Stage 3 Control Line would be crossed, on average, once in every 20 years on average. This is consistent with most water companies in Southern England (see Table H.7). The non-essential water use ban Stage 4 Control Line would be crossed, on average, only once in every 50 years, again consistent with most water companies in Southern England (see Table H.7).

Jersey Water believes it is unacceptable to plan for the use of rota cuts or standpipes even under worst historic drought conditions, i.e. the 1990-1992 drought which has a return period of approximately 1 in 200 years based on evidence from the same drought event in Southern England. This level of service is consistent with water companies in England where Defra has required water companies to ensure they can meet essential water supplies in a 1 in 200-year drought event without recourse to rota cuts or standpipes.

Measures to augment supply or reduce demand may help to improve this level of service or help maintain the level of service against the backdrop of a forecast increase in demand and small reduction in reliable supply. This is considered further as part of the development of the preferred programme for the 25-year planning period in the Water Resources and Drought Management Plan (see also **Appendix J**).

Table H.7 Level Of Service For Temporary Water Use Restrictions for Water Companies in England And Wales[1]

Water Company	Temporary Use Bans	Drought Orders to Ban Non-Essential Water Use	Rota Cuts and Standpipes
Affinity Water	1 in 10 years	1 in 40 years	Considered Unacceptable, though may be considered in 1 in 200-year drought or worse
Anglian Water	1 in 10 years	1 in 40 years	1 in 200 years
Bristol Water	1 in 15 years	1 in 33 years	1 in 100 years
Bournemouth Water	1 in 20 years	Not specified	Not Specified
Cambridge Water	1 in 20 years	1 in 50 years	1 in 100 years
Essex and Suffolk Water (Northumbrian Water)	1 in 20 years	1 in 50 years	Never
Hafren Dyfrdwy / Severn Dee	1 in 40 years	Not specified	Not specified
Hartlepool Water	1 in 10 years	1 in 40 years	Not Specified
Leep Utilities	In line with United Utilities (see below)	In line with United Utilities (see below)	In line with United Utilities (see below)
Portsmouth Water	1 in 20 years	1 in 80 years	1 in 200 years
South Staffordshire Water	1 in 40 years	1 in 80 years	Not anticipated up to a 1 in 200-year drought
Sutton and East Surrey Water	1 in 10 years	1 in 20 years	Only required in the most extreme droughts or emergency situations (1 in 200)
Veolia Water	1 in 25 years	1 in 100 years	1 in 100 years
Northumbrian Water	1 in 150 years	1 in 200 years	1 in 250 years
Severn Trent Water	3 in 100 years	3 in 100 years	Regarded as unacceptable. in up to a 1 in 200-

[1]Information taken from published water company WRMPs in 2019

			year drought)
South East Water	1 in 10 years	1 in 40 years	Not Specified
South West Water	1 in 20 years	1 in 40 years	1 in 200 years
Southern Water	1 in 10 years	1 in 20 years	1 in 500 years
Thames Water	1 in 10 years on average for sprinklers/unattended hosepipe bans. 1 in 20 years for other TUB elements	1 in 20 years	Never.
United Utilities	1 in 20 years	1 in 35 years (to 2025) 1 in 80 (from 2025)	None (resilient to 1 in 200 years as per Defra's reference level of service)
Welsh Water	1 in 20 years	1 in 40 years	Never
Wessex Water	1 in 100 years	1 in 150 years	Never
Yorkshire Water	1 in 25 years	1 in 80 years	1 in 500 years

10. DROUGHT MANAGEMENT COMMUNICATIONS

Once the drought management Control Line Stage 1 has been crossed, Jersey Water will decide on the establishment of a Drought Management Team to implement the Drought Management Plan, monitor the key drought indicators and ensure effective communications with the government, key stakeholders and customers. A stakeholder communications plan will be produced to keep government and key stakeholders informed of the drought situation and the measures being considered and/or implemented.

A customer communications plan will also be prepared to ensure Jersey Water keeps all its customers informed of the actions being taking to maintain essential water supplies and targeted advice to domestic customers and key commercial customer groups (agricultural, tourism, etc.) on how customers can help use water wisely. Media campaigns should be ongoing to maintain engagement.

Generally, media campaigns should use all avenues available, including TV and radio broadcasts, social media campaigns, newsletters, newspaper advertisements, billboard style advertising (e.g. on buses or street billboards) and Water Efficiency Roadshows (e.g. at DIY stores and retail hubs, plus appropriate public events).

Anecdotally, uptake of media campaigns in Jersey have been well received by customers but it should be noted there is a lead time for media campaigns to take full effect on customer water use behaviour.