Department of Regional Development, Manufacturing and Water

Water supply planning

Guideline for water service providers

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Summary

Proactive and well-considered planning to reduce water supply security risks is essential to the delivery of safe, reliable and cost-effective water supplies which underpin the livelihoods and lifestyles of all Queenslanders.

Integrated plans for water supply system assets and upgrades, and managing supplies during ‘normal times’ and drought, are fundamental to the prudent and efficient delivery of water supply services to any community. This guideline has been developed to assist service providers to undertake water supply planning in normal times, as part of their responsibility for managing risks to water supply security and continuity of supply.

The main water supply planning considerations are:

- water supply source access and reliability
- projections for water demand
- key infrastructure constraints
- the frequency, severity and duration of potential future water supply shortfalls
- solutions to any potential water supply shortfall including, if appropriate, demand management, augmented water supply and asset management options
- the monitoring and review of the assumptions underpinning the water supply planning and the effectiveness of implemented actions .

This information provides a basis for establishing plans to meet the future water supply needs of serviced communities, aligned with any level of service objectives for water supply security, continuity of supply, and health and safety. Water supply planning should consider different circumstances such as normal times, drought and flood, bushfires and other severe weather events.

This guide aims to provide assistance to service providers to undertake the planning described above (to meet their responsibilities for urban water supply provision), and provides what the department considers is a minimum standard for each.

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1.0 Introduction

Safe, reliable and cost-effective water supplies underpin the livelihoods and lifestyles of all Queenslanders. Queensland is a vast state with great variations in climate, from the hot and humid tropical north to the arid west and sub-tropical south east. Informed and effective planning for water supplies is essential to support our communities, industry and agriculture in this variable and changing climate.

In Queensland, the provision of reticulated water supplies to urban communities is the responsibility of water service providers, which is often the local council. This responsibility includes planning for new water supply sources, demand management and infrastructure works, to meet demand over the short and long term, in normal times and in drought.

The state government aims to support water service providers to deliver safe and reliable water services by establishing appropriate policy and regulatory frameworks, developing guidance material, and working with providers to understand the ability of their systems to meet current and future demands.

2.0 Purpose

Integrated water supply planning, asset management planning and drought management planning are fundamental to the prudent and efficient delivery of water supply services to any community. Water supply planning is a key consideration by the Department of Regional Development, Manufacturing and Water for regulatory activities conducted under Part 5A, Division 3 of the *Water Supply (Safety and Reliability) Act 2008* in relation to water security and continuity of supply.

If there is reduced water supply to a community there is potential for public health risks, economic stress, social hardship and loss of amenity–regardless of the cause (for example a shortage of source water, a failure in the water treatment process or a reduced ability to distribute water through the service network). One of the best ways to minimise risk to water security and continuity of supply, and the potential associated hardships, is through proactive and well-considered planning.

Water supply planning should consider different circumstances such as normal times, drought and flood, bushfires and other severe weather events. This guideline has been developed to assist service providers to undertake water supply planning in normal times, as part of their responsibility for managing risks to water supply security and continuity of supply. This guideline provides various levels of detail, to support service providers at different stages of planning maturity.

This guide provides what the department considers is a minimum standard for:

- assessing water supply source access and reliability (see Table 1 and Section 5.2)
- forecasting demand for water (see Table 2 and Section 5.3)
- identifying key infrastructure constraints (see Table 3 and Section 5.4)
- identifying potential future water supply shortfalls in terms of timing and magnitude (see Table 4 and Section 5.5)
- identifying actions to manage any potential water supply shortfall predicted to occur in the next 10 years (see Table 5 and Section 5.6).
- the monitoring and review of the assumptions underpinning the water supply planning and the effectiveness of implemented actions (Section 6.0).

Adoption of these guidelines will support water supply planning, including the development of plans for new water sources, new or upgraded supply infrastructure, and/or new demand management programs. Implementation of such plans will assist service providers to meet their responsibilities for urban water supply provision and contribute to the effective management of risks to water security and continuity of supply.

This guideline does not deal with the management of risks related to drinking water quality or dam safety risks. These risks are dealt with elsewhere in Queensland's regulatory framework for water (refer to *Water industry regulation and dam safety guidelines and requirements* at www.business.qld.gov.au).

This guideline also does not deal with the detailed modelling and planning associated with water supply distribution networks (refer to *Planning guidelines for water supply and sewerage*, April 2010, prepared by the (Qld) Department of Energy and Water Supply).

3.0 Using this guideline

3.1 Background

In Queensland, the *Water Supply (Safety and Reliability) Act 2008* (the Act) establishes a regulatory framework to provide for the safety and reliability of water supplies. The framework allows the Regulator (Department of Regional Development, Manufacturing and Water) to take certain actions if it reasonably believes that there is a risk to water security or continuity of supply of a water service (sections 445 and 448 of the Act).

In 2014, there were some significant changes to the regulatory framework for water service provision. Mandatory requirements for a range of management plans were replaced with a system of annual reporting against key performance indicators (KPIs). Since 2020, providers have been required to report if:

- water demand forecasts for the scheme have been developed or reviewed in the last five years (KPI QG 2.11c)
- an assessment of key capacity constraints of the water infrastructure has been undertaken in last 10 years (KPI QG 2.11d)
- the timing for potential future supply augmentation has been assessed in the last 10 years (KPI QG 2.11e)
- confidence that water demands will be met over the next 18 months and five years (KPI QG 2.13 and 2.14).

The *Local Government Act 2009* (section104) and its subordinate regulations (sections 167and 168), require a local government to prepare and adopt a long-term asset management plan that provides strategies to ensure the sustainable management of assets and infrastructure to deliver effective services, for at least the next 10 years. The asset management plan must state the estimated capital expenditure for renewing, upgrading and extending assets, and the plan must be part of and consistent with long-term financial forecasts. The systematic approach to water supply planning described in this guide provides a solid basis for developing key elements of a long-term asset management plan for water service assets.

3.2 How this guideline applies

This guideline has been prepared to assist water service providers to undertake water supply planning as part of their responsibility for managing risks to urban water security and continuity of supply of their water supply services.

When assessing risk to water security and continuity of supply for a scheme, the Regulator will take into consideration if a water supply plan, asset management plan and drought management plan exist, if these documents meet the minimum standards recommended in the guidelines provided by the department and if there is evidence that the plans are being implemented (or that the water service provider has capacity to implement the plans when required).

The intent of the minimum standards specified in this guideline (see Tables 1, 2, 3, 4 and 5) is to position water service providers to understand what actions could be required to help manage risk to water security and continuity of supply. The 'documentation supporting implementation' section (Section 6.0) outlines what documentation is considered appropriate to support the delivery of the planned actions.

The use of the word 'should' in this guideline indicates a recommended course of action, and establishes what the department considers is a minimum standard for water supply planning.

This guideline provides recommendations and suggestions; it does not contain any mandatory requirements and it does not override any legislation or regulatory requirements. While it is recommended that water service providers follow this guideline, a water service provider can choose their own methods or information as the basis for undertaking water supply planning.

The *Water Act 2000*[1] requires the Queensland Government Bulk Water Supply Authority for South East Queensland (Seqwater) to develop a water security program for South East Queensland's bulk water supply system. As such, it is not expected that SEQ service providers[2] in the region will need to assess the timing for potential future supply augmentation related to bulk water supplies. However, it is expected that SEQ service providers[2] will continue to assess the need for potential future infrastructure augmentation consistent with the water security program for the South East Queensland region. Where appropriate, the SEQ water service providers are encouraged to use the existing Netserv planning process, required by the *South-East Queensland Water (Distribution and Retail Restructuring) Act 2009*, as the basis for water supply planning.

3.3 Relationship to regulations and other guidelines

Water supply planning should be integrated almost seamlessly with drought management planning and asset management planning, to provide a sound basis for decision making and support the prudent and efficient delivery of water supply services to a community. To develop appropriate plans for the security and continuity of supply, it is necessary to understand a range of matters including:

- sources of supply, their reliability, and possible future options
- demands needed for lifestyle and prosperity
- the condition and capacity of assets and how water is being used including water losses
- the tolerance for restrictions and the potential effectiveness of restrictions / reduced water use, and
- where appropriate, the modelled performance of the supply system (especially for larger communities reliant of surface water).

The legislative framework that provides for safe and reliable water supplies can be found in the *Water Supply (Safety and Reliability) Act 2008* available at www.legislation.qld.gov.au. The Act also describes the requirements for drinking water quality management plans, customer service standards and the rules governing how a water service provider establishes, implements and enforces water restrictions.

Guidance on planning to manage risk associated with drought conditions is presented in the *Drought management plans and water restrictions: guideline for development*.

Guidance on asset management planning to support maintenance of asset capability, is dealt with in the *Asset management planning: guideline for development*.

Guidance on developing level of service objectives for water security is presented in the *Water security level of service objectives: guidelines for development*.

Guidance on developing a water supply security statement is presented in the *Water supply security statement: template and guidance*, which assists water service providers to develop their own water supply security assessments and understand the water supply security needs of their communities.

These documents can be found in the 'Water supply security' section of the Business Queensland website at www.business.qld.gov.au

[1] *Water Act 2000* (Chapter 2A) and Water Regulation 2016 (Part 6)

[2] SEQ service provider has the meaning referred to in the *South-East Queensland Water (Distribution and Retail Restructuring) Act 2009* (i.e. a distributor-retailer, a withdrawn council, or corporate entity established by a withdrawn council.

3.4 Key terminology

To assist in interpretation of the minimum standards and guidance provided in this guideline, the following descriptions of key terms are provided.

Asset management: Asset management is the coordinated activity of an organisation to realise value from assets. The aim of asset management planning is to determine how best to acquire, operate, maintain, renew, replace and decommission assets, to deliver the agreed standard of service.

Accessible water supplies: A water supply is considered accessible if there is water available at the source and the permissions have been secured and the infrastructure is in place so water can be extracted; or if there is water available at the source and there is a high degree of confidence that the permissions can be secured and infrastructure installed when required.

Demand management: Demand management refers to any strategy that reduces the demand for drinking water or supports efficient water consumption. This can include:

- mandatory water restrictions on the volume, time of day or way that water can be used
- behavioural change education, for example time of day to water gardens, sweep hard surfaces to remove leaves rather than hose, turn off the tap when you brush your teeth
- rebate programs that support residential efficiency improvements such as installing water efficient appliances (toilets, washing machines, flow reducers in taps), adding timer switches or drip irrigation systems for outdoor watering, pool covers
- drinking water offsets such as using recycled water on active playing surfaces, installing rainwater tanks, diverting rainwater to swimming pools for topping up
- leakage reduction in the distribution network by enhancing inspection and monitoring programs, installing pressure reducing devices in the network (this also reduces household water use) or fast-tracking refurbishment programs.

Drinking water: A drinking water scheme is infrastructure owned by a provider for single or multiple combinations of the individual components of treatment, transmission, or reticulation of drinking water supply, or the storage of recycled water to augment a drinking water supply.

Urban water security: Urban water security means having a high degree of confidence that the water needs of a community can be sustainably met now and in the future (with the community's water needs clearly described, and ideally agreed between the water service provider and the community).[3] Water security is underpinned by the availability, accessibility and dependability/reliability of the sources of supply to meet the community's water needs. Water security (particularly short-term) is influenced by the continuity of supply, i.e. the condition, capacity, capability and resilience of the water supply infrastructure to maintain a consistent and adequate volume of water to meet the community's water needs.

Water service: A water service refers to water harvesting or collection (including water storages, groundwater extraction and river extraction), water transmission, water reticulation, drainage (other than stormwater drainage) and water treatment or recycling. A water service can comprise of one or more drinking water schemes and/or non-drinking water schemes (for example recycled water).

Water supply shortfall: A water supply shortfall occurs when water supplies (including any contingency measures that may have been undertaken to avoid and/or delay such shortfall) and associated infrastructure cannot meet the demands of a community and local storages reach minimum operating level. Adopting a restricted demand can avoid or delay a supply shortfall.

[3] Modified from: Allan, JV, Kenway, SJ and Head, BW, (2019) *Urban water security – what does it mean?* Urban Water Journal, 15(9).

4.0 Minimum standards for water supply planning

The department expects water service providers to undertake and document water supply planning for all of their urban water schemes. This includes undertaking and documenting: an assessment of water supply sources and their reliability, demand forecasting, an assessment of key capacity constraints of infrastructure, an assessment of timing for potential future water supply shortfall/augmentation, and identifying actions to manage such a water supply shortfall. If the water service provider considers that no actions are required to manage risk to water security in normal times, the assessment underpinning this decision should still be documented, including all key assumptions related to the supply-demand balance.

Table 1 outlines the department's minimum standard expectations for assessing water supply source access and reliability. Further details and guidance is provided in section 5.2.

Table 2 outlines the department's minimum standard expectations for forecasting demand for water. Further details and guidance is provided in 5.3.

Table 3 outlines the department's minimum standard expectations for identifying key capacity constraints of infrastructure. For details and guidance on this, refer to section 5.4.

Table 4 outlines the department's minimum standard expectations for identifying timing for potential future supply shortfall/augmentation. Further details and guidance is provided in section 5.5.

Table 5 outlines the department's minimum standard expectations for identifying actions to manage any potential water supply shortfall predicted to occur in the next 10 years. Further details and guidance is provided in section 5.6.

If a water service provider does not meet the minimum standards in this guideline, they should carry out at least one of the following actions:

- explain how and when the standards will be met in the near future in the KPI annual report, as comments against the relevant KPI (QG 2.11c, QG 2.11d, or QG 2.11e).
- if the water service provider considers itself to be still meeting the overall objective for water supply planning (e.g. a demand forecast is based on five years of historical data, rather than ten years, due to availability of reliable data), provide information in relation to this in the KPI annual report as comments against the relevant KPI (QG 2.11c, QG 2.11d, or QG 2.11e).

Table 1: Minimum standards for assessing water supply sources

Element	Minimum standard	Desirable inclusions
Scope	The WSP should specify the water service to which the assessment relates. The scope of assessment should be 'normal' (non-drought) conditions.	The WSP can include maps showing the location of water supply sources.
Usual supply sources	The WSP should list each water supply source, its location, associated entitlements, infrastructure and treatment requirements (including details of recycled water sources, bulk water supplied by third parties and any other usual sources). The WSP should describe the historical performance of the water supply source in terms of indicators such as water levels in dams, streams or aquifers; announced entitlements, harvesting days; and results of yield assessments. Historical performance should be based on analysis of data for at least the past 10 years. Determine the likely reliability of the water supply source/s, separately and combined, for the next 10 years in ML/a.	Consider including details of how the supplies are typically operated, linkages to other water schemes, significant other users of the water supply source and known water quality issues. Where available, provide details of aquifer pump tests in the WSP. If available, provide the estimated water source/s yield based on hydrologic or stochastic modelling in the WSP. Where hydrologic modelling has been undertaken, state the probabilities of reaching critical thresholds (such as restriction triggers and reaching minimum storage operating levels). Also state the frequency, severity and duration of restrictions. Such assessments should include the effect of contingency and emergency supplies.
Contingency and emergency supplies	The WSP should provide details of any contingency or emergency supplies that are currently available including, location, associated entitlements, infrastructure, treatment requirements, and historical performance.	The probable yield based on historical data or modelling could be included in the WSP, as could the details of past, and proposed, contingency and emergency supplies.

Note: WSP = water supply plan

Table 2: Minimum standards for forecasting demand for water

Element	Minimum standard	Desirable inclusions
Scope	The demand forecast should be for a planning horizon of 20 years or more.	Maps showing the extent of the distribution network could be included.
Context	The WSP should list the customer segments serviced. If a hierarchy of customer criticality has been identified, this should be described.	Note times in the last 10 years when water restrictions have been in place and their effect on demand, in the WSP.
Residential demand	The WSP should detail historical population serviced for a minimum of the past 10 years, and provide projections for the serviced population for the planning horizon based on QGSO forecasts. The WSP should detail historical residential demand for water from the past 10 years including demand for source water and delivered water, in absolute terms (ML/a) and on a per person basis (L/p/d).	Consider at least two projection scenarios, i.e. most likely and high or low, when developing a population projection, based on consideration of the upper and lower bands of the range of historic demand. Consider other potential users of the network (e.g. off-network customers that rely on standpipes to supplement rainwater supplies). In the WSP, present data graphically and tabulated.
Non-residential demand	The WSP should detail historical demand for water by non-residential customers for a minimum of the past 10 years. The WSP should identify non-residential demand relative to residential population (L/p/d) and in absolute terms (ML/a).	Consider itinerant population associated with tourism or seasonal events in determining non-residential demand. Identify current high demand businesses, and note any likely plans for expansion or contraction of demands. In the WSP, present data graphically and tabulated.
Scenarios and projections	Develop two demand scenarios as the basis for the demand forecast (i) a most likely case and (ii) a high or low case depending on the trend of the projected population. Prepare forecasts for annual source water demand for each of the next 20 years, for both scenarios. In the WSP, present the forecast in absolute terms of ML/annum.	Develop additional residential demand scenarios based on combinations of population growth and usage. Develop additional non-residential demand scenarios. Integrate these and prepare additional forecasts to be incorporated into the WSP. An assessment of the current level of non-revenue water could be included in the WSP.

Note: WSP = water supply plan; QGSO = Queensland Government Statistician's Office

Table 3: Minimum standards for identifying key capacity constraints of infrastructure

Element	Minimum standard	Desirable inclusions
Infrastructure description	The WSP should include a water supply chain diagram for the scheme, starting with extraction of water sources, water treatment facilities, product water storages, major pumps and key interconnections. It should also include a process diagram for the water treatment facilities where appropriate. The WSP should describe the process including the purpose of each of the above units and its design capacity.	Include maps showing the location of the raw water supply, water treatment facilities and extent of distribution network. Include details of major equipment such as the unit operations within the water treatment plant in the WSP. Include details of the age of key infrastructure items in the WSP.
Operating modes*	The key characteristics for each operating mode should be described in the WSP, including changes compared to the normal operating mode for access to feed water volumes, feed water quality and demand for product water. Operating modes that should be included are those associated with extreme weather events that have occurred in the past such as flood, storm and/or bushfires, and regular events that significantly impact on demand such as festivals. (Drought scenarios should be considered in relation to drought management planning.)	Consider additional operating modes associated with events that have not occurred, but could occur in the future, that would have a significant impact on water supplies. Present a master process flow diagram showing all key equipment and indicate the operational changes that occur in each mode in the WSP.
Assessment of system capacity	The WSP should provide the reliable capacity of each unit in the water supply chain, for each operating mode. It should describe the factor that limits the capacity of each unit, in each operating mode. Assess the overall capacity of the water supply chain for each operating mode. The WSP should document the system limitation (capacity constraint) for each operating mode.	Provide the design capacity of all key equipment and the conditions for which this applies in the WSP. Provide the peak capacity of key equipment and the maximum duration this applies in the WSP.

* For this assessment, an operating mode is taken to be a pre-determined way of operating infrastructure in response to known or expected conditions.
Note: WSP = water supply plan

Table 4: Minimum standards for identifying potential future supply shortfalls

Element	Minimum standard	Desirable inclusions
Scope	The scope of assessment should be for a planning horizon of at least 20 years.	Extend time-step to 30 years or more where the economic opportunities are strong and liveability conditions highly desirable.
Context	The WSP should reference relevant customer service standards, level of service objectives, relevant legislative and regulatory requirements and business (Council) objectives.	List all current service drivers in the WSP. Identify trends that might impact on future service requirements. Consider legislative and regulatory requirements, water entitlements, drinking water quality requirements, planning schemes.
Supply-demand balance	The WSP should include a supply-demand balance (graphically) showing the two demand scenarios, the estimated combined reliable water supply source volume and key infrastructure constraints. (The two scenarios being most likely case and a high or low case depending on the population projection.) The WSP should identify: • timing (year) of any potential supply shortfall • nature of any potential shortfall i.e. related to capacity of infrastructure or access to source water to meet demand • scale (ML/a) of potential shortfall, within the planning horizon. Where no potential water supply shortfalls are identified, this should be clearly noted in the WSP.	Develop additional scenarios to further assess the sensitivity of results to key assumptions. Consider population growth, residential water demand (normal and during drought), and reliability of water supplies (usual and contingency supply). Assess the adequacy of current WSPs to meet potential water supply shortfalls. Make recommendations on further work required to address identified potential water supply shortfalls in the WSP.

Note: WSP = water supply plan

Table 5: Minimum standards for managing potential water supply shortfalls

Element	Minimum standard	Desirable inclusions
Demand management	The WSP should state the preferred demand management measures to be implemented to mitigate the risk of a future water supply shortfall (for example permanent water conservation measures), the associated triggers for implementation and the demand targets. Include the assessment criteria.	Consider including a summary of all the demand management options considered including the advantages and disadvantages of each option; and a communications plan to support implementation of the preferred demand management options.
Water supply	The WSP should state the preferred options for accessing additional water supply sources, the volume of water expected to be accessed, and the triggers for action. Include the assessment criteria.	The WSP might include a summary of all the water supply options considered including the advantages and disadvantages of each option.
Resources	The WSP should include an estimate of the financial and physical resource requirements to implement the planned demand management and water supply options.	Consider including a risk management plan that identifies the key risks to maintaining water security and continuity of supply; and mitigating measures to manage the risks.
Monitoring, reporting and review	The WSP should be reviewed at least once every ten years, or if there is a significant change to any of the underlying assumptions.	

Note: WSP = water supply plan

5.0 Water supply planning details

Water supply planning considers water supply source access and reliability, water demand forecasts, and infrastructure capacity, to ensure that a water service provider can meet the future water supply needs of its serviced community at an appropriate level of water supply security. By using a water-supply demand balance, the timing, magnitude and nature of potential water supply shortfalls can be identified. This information provides a basis for establishing plans to mitigate unacceptable risks to water security and continuity of supply.

While the scope of any water supply planning activity is a matter for the water service provider, it should be clearly articulated.

When interpreting the water supply-demand balance, a water service provider should consider if a potential water supply shortfall can be mitigated through the use of demand management, changes to operations, new water supply sources, augmented infrastructure capability or a combination of these. Consideration should also be given to the relationship between the water balance for ‘normal’ times and those for drought (see also Appendix D). Figure 1 shows key elements of planning to manage risk to water security and continuity of supply and their relationships.

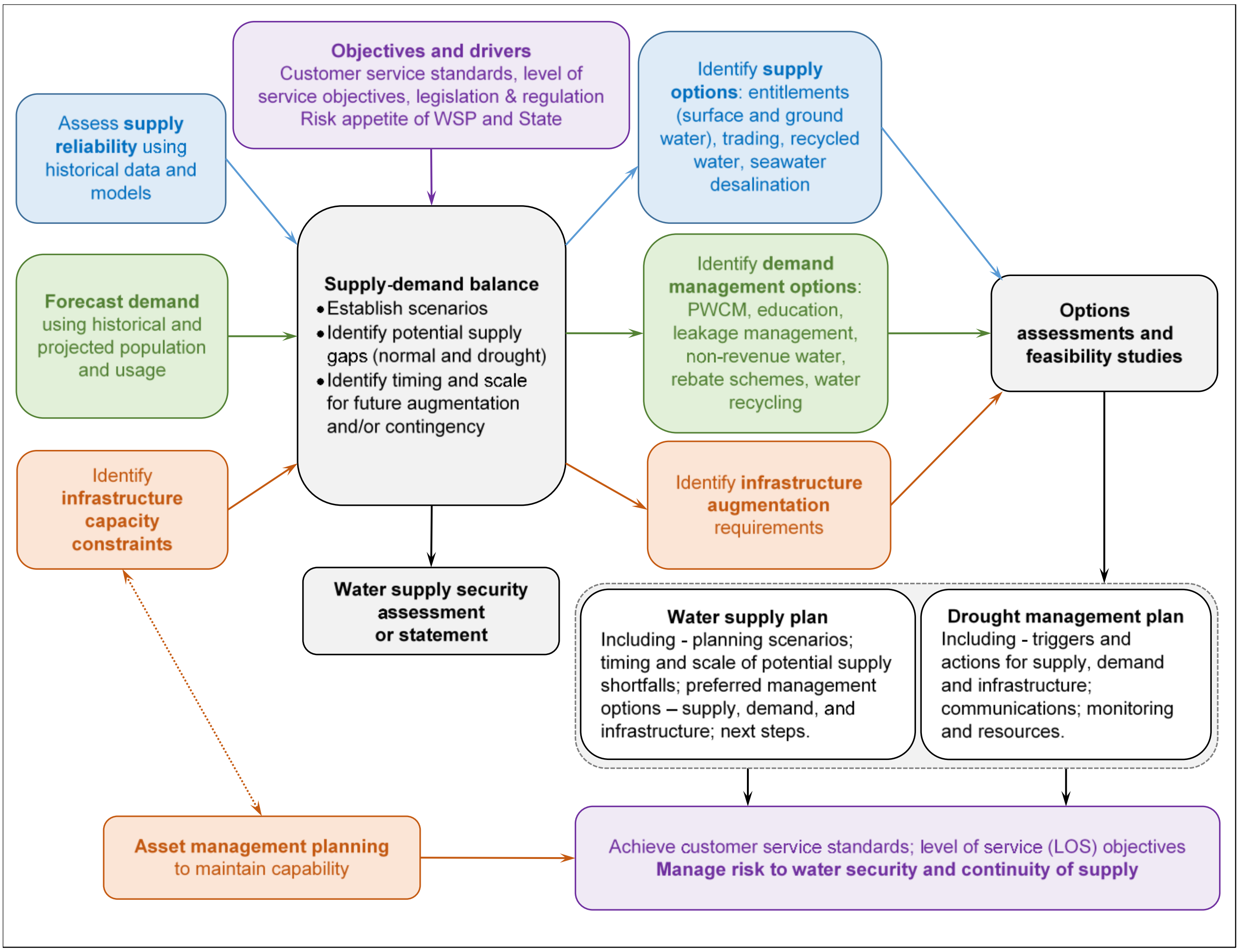

Figure 1: Key elements of planning to manage risk to water security and continuity of supply

5.1 Planning principles

The following water supply planning principles may be useful when undertaking water supply planning:

- Decisions by a water service provider should be transparent and equitable.
- A water service provider should, as far as practical, provide adequate water supply volumes to support the well-being, health and safety of the community (including being able to maintain supplies for essential needs and services).
- All water security planning should have clearly articulated service objectives, noting that these could evolve over time with consideration of trade-offs for water availability, costs, community water needs and tolerance for water restrictions.
- Selection of preferred service delivery options should be balanced against technical, financial, social, and environmental constraints.
- Consideration should be given to both infrastructure and non-infrastructure options for maintaining service delivery.

- All reasonable options for improving supply resilience should be considered[4].
- Community engagement should occur throughout the planning process, during implementation and as part of the review of effectiveness after implementation.
- Where possible, regional collaboration and consistency should be sought.
- Risk management activities related to continuity of water supplies in 'normal times' should be fully integrated with other business risk systems, including for water supply provision during drought.

Council-owned water service providers should also consider the local government principles described in the *Local Government Act 2009* (Section 4) that require:

- transparent and effective processes, and decision-making in the public interest
- sustainable development and management of assets and infrastructure, and delivery of effective services
- democratic representation, social inclusion and meaningful community engagement
- good governance of, and by, local government
- ethical and legal behaviour of councillors and local government employees.

Data quality

The ability to understand and manage risks to water security and continuity of supply is highly dependent on the quality, nature and granularity of the supply and demand data available. Importantly, understanding data quality can provide additional insights into the assessment of water-related risks. So even if data quality is not ideal, simply understanding this can be very useful. An analysis of current metered water use to understand patterns of use, system losses, and opportunities for reducing demand during a drought is suggested.

It is good practice for all water service providers to have established data management protocols, including a clear understanding of what data they collect, how and when; and how that data is stored and shared, both internally and externally.

In the same way that a water supply-demand balance can identify potential water supply shortfalls, it is recommended that water service providers consider a regular review of what data they require and compare this to what is available, to identify improvement needs and opportunities. Such a data review could occur when there are significant changes to regulatory or reporting requirements, or on a 10 year cycle that precedes a review or update of key water supply planning activities.

5.2 Assessing water supply source access and reliability

A water service provider must hold water entitlements or have contractual arrangements in place with the owner of water entitlements to access water for urban supply purposes. A water entitlement is the right to a share of the available water identified under the *Water Act 2000* up to a specified volume. There is no certainty that the volume of water available (i.e. the physical water that is able to be accessed) will be equivalent to your entitlement (i.e. there is a difference between "paper water" specified on your entitlement and "wet water" that you are able to reliably access)[5]. Water infrastructure used to store the water accessible under your entitlement can enhance your water security. Also there could be circumstances where a water entitlement holder can achieve higher levels of water supply security by using less than their entitlement.

Factors that can constrain access to "'wet water" from a surface or groundwater system on a year-to-year basis, include:

[4] More information on alternative water supply options can be found in *All options on the table: urban water supply options for Australia*, a report by the Water Services Association of Australia 2020 (accessed through www.wsaa.asn.au)

[5] Water allocation security objectives under the relevant water plan provide the reliability of a water allocations.

- the conditions of entitlements such as: the volumes allowed to be taken, the priority of water compared to other entitlement holders[6], water accounting rules, announcements on the proportion of entitlements (made under the water sharing rules) that can be taken and periods when water can be harvested; and limitations on the purposes for taking water.
- how much water is physically available that can be delivered to customers, which is affected by the weather (rainfall patterns, evaporation, temperatures) and the rules for sharing water with the environment.

The information used to assess the historical reliability of a water supply source will vary depending on the type of supply and the nature of the entitlement or contractual arrangement, but might include:

- historical water levels (in dam/weir, bore, river gauging stations, etc.)
- historical stream flow rates (cumecs, m^3/sec)
- announced entitlements (water sharing) history, harvesting days allowed
- yield assessment results, pumping tests
- local knowledge of the system.

For alternative water sources, such as seawater desalination, coal seam gas associated water or recycled water, there are different factors affecting reliability and these need to be well understood by any service provider who relies of such sources to maintain supply resilience (refer to Appendix A for background on alternative water sources).

5.3 Forecasting demand for water

Demand forecasts are an essential component of a water supply-demand balance, which is required to estimate when future water supply shortfalls might occur. The use of multiple demand scenarios allows a water service provider to assess the sensitivity of water demand to key drivers such as population growth, behavioural patterns or weather conditions. This provides insights into possible futures and potential risks that might require management.

A breakdown analysis of metered water use and comparisons with similar communities can be helpful in understanding patterns of residential and non-residential water use. Such analysis can also be beneficial to identify whether system losses need to be addressed and if water use efficiency improvements are appropriate.

Urban water demand is commonly expressed in terms of megalitres per annum (ML/a) and litres per person per day (L/p/d) of water sourced. Since residential water demand is one of the most significant drivers of urban water demand, understanding water demand in terms of ‘per person’ usage is useful, while averages for ‘per person per day’ can support communication with the community. It is important to discern between average demand projections and longer duration drought demands, particularly where the source of supply is reliant on regular rainfall and runoff for recharging. Demands can be significantly higher during extended dry periods.

Conducting analyses that are more granular than an annual basis, such as seasonal or maximum daily and hourly consumption, is useful and necessary for pipe network planning purposes. However, these are generally not required to support long term water supply security assessment and planning. A key exception is water supply systems that hold less than 12 months of water supply; for these annual demand averages or medians might be unsuitable, and more detailed data, such as monthly demands, might be required.

The main steps in developing a water demand forecast are generally:

1. Assess historical water demands from at least the last 10 years; consider relative proportion of water use between different customer sectors such as residential and non-residential including servicing of the transient population).
2. Identify the key factors that affected historical demand and examine how these might impact future demand; consider factors such as population growth, business activity, weather, the effectiveness of demand management measures and system losses (such as leakage).

[6] Different water allocation priorities are associated with different levels of reliability, indicated through the water allocation security objectives. High priority and medium priority water allocations are allocated to different purposes such as urban, industrial, mining and agriculture with the highest priority water reserved for more critical purposes.

3. Consider expected future conditions including population growth rate projections, town planning arrangements and expected future business activity.
4. Use insights from the previous steps to develop at least two scenarios as the basis for demand projections. Develop a baseline case that represents the most likely scenario, and a high or low demand case, as appropriate. Further scenarios might be developed to understand the sensitivity of water demand to key assumptions.
5. Make demand forecasts for source water required each year, for the next 20 years, for each of the identified scenarios.

When developing scenarios to underpin demand forecasts, data sources and key assumptions should be clearly specified. The likely future demand should be the baseline for a demand forecast scenario. The likely future demand scenario should be developed based on consideration of the historical average total urban water demand (L/p/d), QGSO projections (www.statistics.qgso.qld.gov.au), and checked against local knowledge of any proposed development or expected change in local industries that could affect future water demands.

Refer to Appendix B for more information to support a demand assessment.

5.4 Identifying key infrastructure constraints

There are many factors that can contribute to a water supply's capacity to deliver, including physical limitations of plant and equipment. The aim of assessing the key capacity constraints in a water infrastructure system is to identify limitations or 'bottlenecks' in the source, treatment, storage, transport and distribution infrastructure.

The main steps in assessing the key capacity constraints of an infrastructure system are generally:

1. Describe the contextual setting for the assessment, including: the scope of assets included, regulatory requirements and service objectives (for water security and customer service standards).
2. Identify the circumstances that influence the way infrastructure is operated (the key operating modes) since these impact on the capacity of the system to deliver water to meet demand. Examples include: changes in feed water quality due to extreme weather events (such as increased turbidity) or switching between feed water sources to allow bores to rest, step changes in demand due to seasonal or tourism effects that impact on peak daily demands or instantaneous demands.
3. Identify and describe the process units within the water supply system (including their reliable capacity), including all key steps in the supply chain. Examples include: intake works for source water, water treatment units (such as flocculation, sedimentation, filtration and disinfection), product water storage, pumps and distribution networks.
4. Assess the capacity of the water supply system in each key operating mode and identify the capacity constraint/s; make use of appropriate software and models.

There is a need to understand each process unit qualitatively and quantitatively. Its role should be described in terms of the following, with consideration of the key operating modes:

- the physical (e.g. quantity, temperature, turbidity), chemical (e.g. composition, pH) and/or biological (e.g. algae, biological oxygen demand) functions or treatment it delivers
- how it fits with the units around it, including how material enters it and passes to the next unit
- its reliable capacity, and what limits its reliable capacity
- where relevant, its peak capacity.

To understand what influences and constrains how infrastructure is operated, and its capacity to deliver water to a desired standard, consideration should be given to:

- regulatory requirements including for drinking water quality, dam safety, health and safety (workplace and community)
- physical boundaries of the system—what is included and excluded in terms of infrastructure
- limits and conditions on water access entitlements
- customer service standards and level of service objectives for water security

- aesthetic water quality targets (taste and odour compounds, colour, hardness)
- local government objectives, policy and risk appetite
- Australian Standards and industry benchmarks.

Refer to Appendix C for more detail on identifying key capacity constraints.

5.5 Identifying timing for potential future supply shortfall

A critical element of water supply planning is understanding when the water supply system might not be able to meet the community's demands for water. This is ideally done well in advance of such an occurrence so appropriate planning and action can be taken to manage and mitigate the risks to water security and continuity of supply. Planning and actions to mitigate risk might include augmentation of water supply infrastructure, access to new water supply sources, or management of water demands.

An assessment of timing for potential shortfalls should include, but not be limited to, consideration of the water supply and demand balance. A water supply and demand balance compares the reliable water supply source availability and critical infrastructure capacity with projected water demands. The intersection point between the demand forecast trajectory/s and either of the supply or infrastructure capacity indicates when there might be a potential water supply shortfall, and if it is related to water supply sources or infrastructure (demonstrated in Figure 2). The distance between the lines, at a point in time, provides an indication of the potential magnitude of the supply shortfall. The scope of assessment should be for a planning horizon of at least 20 years. While this guideline is focussed on water supply planning during normal times, consideration should also be given to planning in response to drought and other extreme weather events, at an appropriate time.

The main steps in assessing the timing for potential water supply shortfalls are generally:

1. Describe the contextual setting for the assessment. To assess the timing for potential future supply shortfalls in a water supply scheme, it is necessary to understand the physical nature of the system, and the operating context (e.g. level of service objectives, regulatory requirements, and/or business objectives).
2. Assess the projected reliability of the sources of water for the scheme. Refer to Section 5.2.
3. Forecast the demand for source water. Refer to Section 5.3.
4. Describe the capability of infrastructure. Refer to Section 5.4.
5. Identify scenarios to be assessed for combinations of supply, demand and capacity. These can be developed on the basis of planned improvements if there is a reasonable degree of confidence that these will proceed, but this must be clearly articulated and justified.
6. Prepare and assess a supply-demand balance for each selected scenario.

An example water balance is provided in Figure 2. In this example, the reliable water supplies are about 100 ML/a less than entitlements, and depending on demands:

- current water supply sources should be adequate to meet demands until at least 2030, but new water supplies might be required after this
- by 2040, an additional 180 ML per annum of water supplies might be required
- augmentation of water supply infrastructure might be required after 2026.

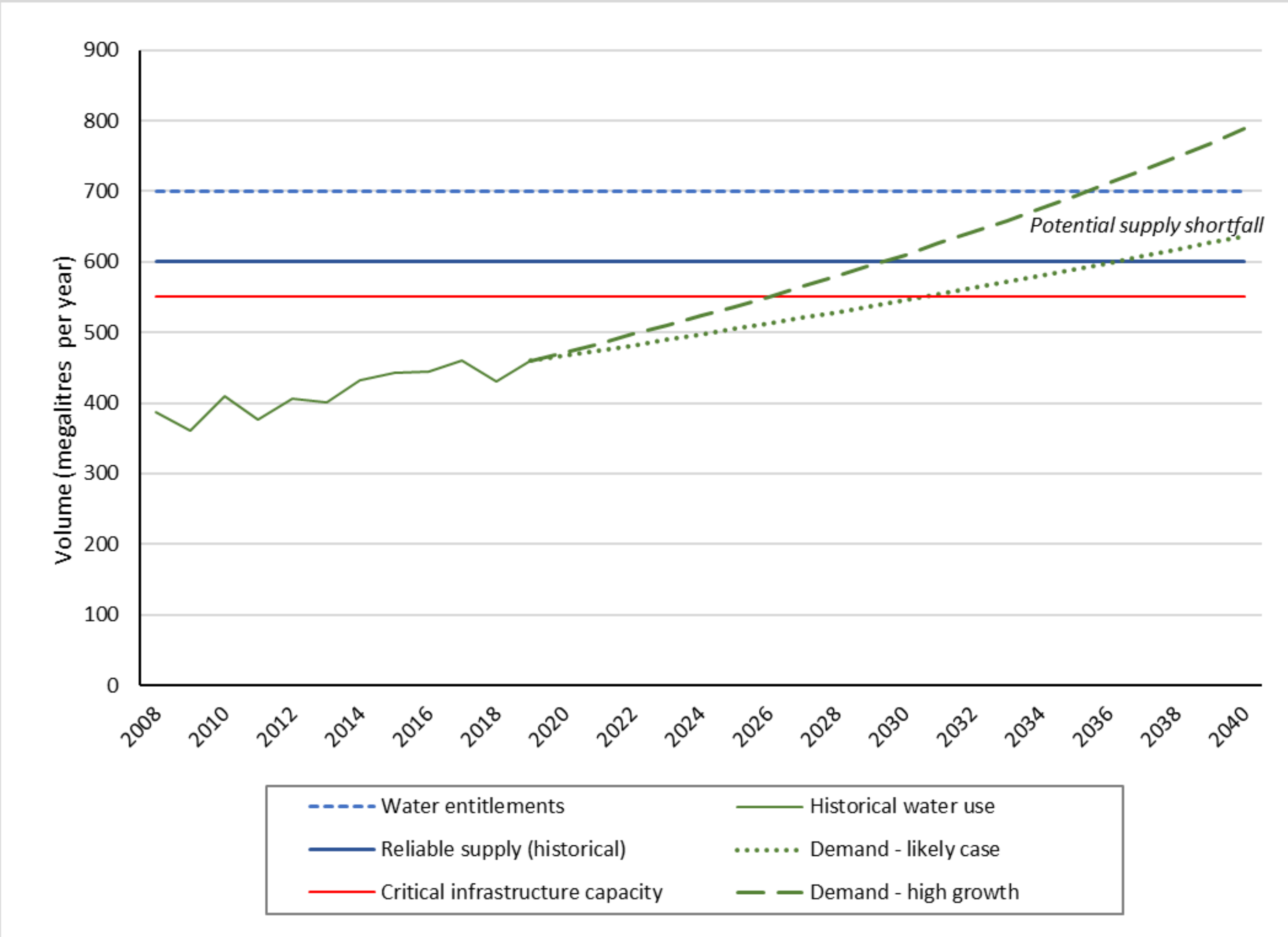

Figure 2: Example water supply-demand balance showing timing of potential shortfalls

An example of a water balance assessment that considers expected changes in supply and demand during a drought period is provided in Appendix D, Figure D1.

There are many reasons why a water supply system might require augmentation including:

- increasing demand due to population growth, growth in local industrial activity, increasing rates of water consumption due to changes in lifestyle, or changing weather patterns
- declining source water availability due to changing climate
- down-rating of infrastructure capacity due to changes in feed water quality.

Understanding the need for system augmentation supports effective solution identification. Likewise, there might be circumstances where demand in a community is declining and efficiencies in the water supply scheme can be implemented. The next section discusses how to respond if it is identified that the water supply system might require augmentation (i.e. where there is a potential water supply shortfall).

Refer to Appendix D for more detail on assessing the timing for potential future supply shortfall or augmentation.

5.6 Responding to a potential water supply shortfall

If it is predicted that there is potential for a water supply shortfall to occur in the next 10 years, the water service provider should identify actions to mitigate the risk to water security and continuity of supply. The water service provider should consider options to manage demand, increase the capacity of infrastructure and secure access to additional water sources, at a scale aligned with any potential water supply shortfall.

The water service provider should develop its water supply plan to manage the supply of water during normal times. The plan should include the actions to be undertaken to maintain water supply to meet the demands of the community (including to upgrade supply capacity), what will trigger the actions, an estimate of the resources required to support the action, and a clear outline of roles and responsibilities for developing and implementing a water supply plan. The water supply plan should integrate with the drought response plan to provide a seamless transition to protecting water security and continuity of supply during drought (refer to Drought response planning: guidelines for water service providers)[7].

Options for reducing water demand in a community include:

- a leakage management program, including active leak detection, proactive maintenance, improved water metering, and targeted pressure management
- modifying maintenance activities that require substantial water use, while still maintaining public health and safety (such as reduced frequency of reservoir cleaning, mains flushing, and pressure and flow testing of hydrants)
- having systems in place to minimise water theft (such as improved metering)
- having systems in place to reduce authorised non-revenue water use (such as reducing the number of accessible taps in parks as restrictions advance)
- using rebate programs or 'device swap' initiatives to assist and support the uptake of water efficient appliances (such as pool covers, rainwater tanks, low flow taps and dual flush toilets)
- providing waterwise information to the community; initiating partnerships with schools, commercial operators and community organisations to generate awareness and promote waterwise behaviours (including the installation of smart meters or leak detection programs)
- offsetting demand for drinking water with fit-for-purpose use of reclaimed or recycled water (or other alternative water sources) for uses such as construction, road maintenance and irrigation of active playing surfaces, fields and ovals
- requiring particular users to develop water efficiency management plans (more details on these plans are available on the Business Queensland website).

Resources to support efficient use of water are available at the 'Using water wisely' section of the Queensland Government website (www.qld.gov.au); and the 'Managing water demand' section of the Business Queensland website (www.business.qld.gov.au).

Information on recycled water is available at the 'Recycled water' section of the Business Queensland website (www.business.qld.gov.au).

For support in accessing additional water resources, the Queensland Government has established the Water investor hotline which can be access from 'Optimised water markets' page of Department of Regional Development, Manufacturing and Water at www.drdmw.qld.gov.au.

[7] The water supply plan and the drought response plan can be one document, or two separate documents, as preferred by the water service provider.

5.7 Monitoring and review

To understand and improve the effectiveness of water supply planning in achieving the business objectives, the planning activities discussed in this guideline should be monitored and reviewed.

The review of supply source reliability, demand forecasts, key infrastructure capacity constraints and timing for potential water supply shortfalls should be done at least every 10 years, or more frequently if triggered by a significant change to any key assumptions.

Monitoring of the water supply plan implementation should be carried out in alignment with standard practices of the business. This might occur at an annual frequency, and consider matters such as:

- if actions are being implemented as planned
- if implemented actions are delivering the intended results, for example:
  - if outcomes are aligned with customer service standards and level of service objectives for water security
  - if there is an appropriate level of confidence that water demands can be met for the next 12 months and five years
  - if financial investments in water supply security and continuity of supply are prudent and efficient.
- if there are opportunities for clarifying or improving the planning process.

6.0 Documentation supporting implementation

When assessing risk to water security and continuity of supply for a scheme, the Regulator will take into consideration if a water supply plan exists, if it meets the minimum standards recommended in this guideline and if there is evidence that the plan is being implemented, or that the water service provider has capacity to implement the plan when required.

Examples of evidence of water supply plan implementation and capacity to implement include:

- Options assessments:
  - feasibility and options assessments that support the actions described in the water supply plan
  - a program of planned feasibility and options assessments to be undertaken to respond to potential water supply shortfalls.
- A plan showing how water supplies will be met including:
  - any triggers for actions to be taken
  - information related to a documented capital works program for system upgrades that includes:
    - a program of major capital works (upgrades, augmentations and decommissioning) that:
      - covers each year for the next five years
      - is linked to the water supply plan and, where appropriate, an asset portfolio master plan
      - includes a summary of the project name, description, estimated capital cost, commencement and completion dates
    - a copy of any approved and forecast budgets for capital expenditure
    - a summary of capital expenditure for each year in the previous five years

- referring to operating cost estimates that is supported by:
  - an estimate of the planned operating costs for the next financial year linked to the water supply plan
  - a copy of any approved and forecast budgets for operating expenditure
  - a summary of operating expenditure for each year in the previous five years
- regular monitoring and review (see also Section 5.7):
  - a history of document review and revision evolved over time
  - key performance indicators are established against objectives and regularly reported on.

7.0 Supplementary resources

The following resources might further assist water service providers to undertake water supply planning:

- the *Water Supply (Safety and Reliability) Act 2008* is accessible at www.legislation.qld.gov.au
- water supply planning and management resources in the 'Water supply security' section of the Business Queensland website at www.business.qld.gov.au
- waterwise support material from the 'Using water wisely' section of the Queensland Government website at www.qld.gov.au
- population data and projections from www.qgso.qld.gov.au and www.abs.gov.au; tourism data at Tourism & Events Queensland website (www.teq.queensland.com)
- information on climate change projections on the Climate future dashboard on Queensland Government's The Long Paddock website at www.longpaddock.qld.gov.au and the Australian Government's Climate change in Australia website at www.climatechangeinaustralia.gov.au.
- information on water entitlements across Queensland from the Water entitlement viewer, accessed via the 'Water entitlement viewer' section of www.business.qld.gov.au
- weather and climate data (historical and projected) at the Bureau of Meteorology website (www.bom.gov.au/climate).

Additional material on water supply planning for urban communities might be available from industry and professional organisations such as:

- Water Services Association of Australia at www.wsaa.asn.au
- Queensland Water Directorate at www.qldwater.com.au
- The Australian Water Association at www.awa.asn.au

8.0 Guideline review

The Department of Regional Development, Manufacturing and Water invites water service providers to email any feedback on this document to UrbanWaterSupply@rdmw.qld.gov.au. It is planned that this guideline will be reviewed within 18 months of its release and then every five years or earlier, if required.

Appendices

Appendix A. Water supply assessment—details

Surface and underground water entitlements

In Queensland, access to surface and underground water entitlements is determined through the water planning process described in the *Water Act 2000* and managed by the Department of Regional Development, Manufacturing and Water. The water planning process is designed to sustainably manage and allocate water resources in Queensland to meet current and future water needs. Water entitlements sometimes might only be accessible through the provision of infrastructure (such as from a dam or weir). Water delivered from dams or weirs is supplemented water, and can be used to supplement run-of-river or ground water. The owner of such infrastructure will usually be granted a resource operations licence to manage such a scheme. Unsupplemented water could include water such as run-of-river, overland flow or groundwater and is water not managed under a resource operations licence).

A water entitlement is the right to a share of the available water up to a specified volume, however it is not a guarantee of water availability every year as the amount available will depend on many factors including rainfall, runoff and infiltration and the amount of water used by others. A water service provider must hold water entitlements or have contractual arrangements in place with the owner of water entitlements to access water for urban and other supply purposes[8].

Entitlements to water might be in the form of tradable allocations, or as licences or permits. The volume of water entitlements available across Queensland is relatively stable. Occasionally new entitlements become available through the release of a reserve. Sometimes this may be associated with the construction of new infrastructure. Trading is an option to supplement existing supplies and make better use of available water.

There is no requirement to secure permission to access seawater as a water supply source for a desalination treatment process, or recycled wastewater that is already collected and treated by a service provider. However, there are other approval requirements for the construction, operation and use of water and disposal of brine produced from marine desalination plants or advanced water treatment plants producing recycled wastewater. For more on the water planning framework and water resource management arrangements, visit the Business Queensland website.

Alternative water supply sources

Using alternative water supplies in tandem with traditional supplies, increases diversity and can result in reduced demand for the primary water supplies, which typically increases resilience and overall security of supply for urban communities. Such alternative supplies can include municipal and industrial recycled wastewater, marine or brackish (estuarine or groundwater) water desalination, coal seam gas water, rain water and storm water. In many cases these alternative supplies are used for non-drinking water purposes, which reduces demand on drinking water supplies and provides an overall improvement in water supply security for a community.

It is essential that any water supply source is treated to a quality standard that is matched appropriately to the end-users requirements. Indirect reuse of recycled water (produced from treated sewage or wastewater) to augment raw water supplies upstream of a water treatment plant is allowable in Queensland. However, direct reuse by injection of recycled water into the drinking water system is not permitted.

Recycling and fit-for-purpose use of treated sewage effluent generated by an urban community is considered climate resilient rather than climate independent. When extreme water restrictions are in place, there is likely to be a reduction in indoor water use and a concurrent reduction in the volume of wastewater sewage produced. These

[8] Water can be taken for stock and domestic purposes, without an entitlement, in accordance with the conditions set out in water plans and their supporting instruments (water management protocols, resource operations licences, water entitlement notices and operations manuals).

are key considerations when assessing the potential of recycle water for 'fit-for-purpose' uses to supplement drinking water supplies, particularly as a response to drought.

Both local rainwater (collected through household and commercial rainwater tanks) and local stormwater (run-off from roofs, roads and other hard surfaces centrally collected in managed holding basins) will have variable reliability depending on the climate and rainfall variability of a region. They are generally considered less suited in areas where there is a long, annual dry season – but have been used in inland communities to supplement supply. Long term storage and treatment of stormwater also requires careful planning to manage variable and potential poor water quality.

To produce coal seam gas (CSG), wells are drilled into underground coal seams releasing the gas brings water (CSG water) from the seams to the surface. The management of CSG water is heavily regulated through a range of regulations including the *Petroleum and Gas (Production and Safety) Act 2004*, the *Water Act 2000* and the *Environmental Protection Act 1994*. The quality of CSG water varies greatly, and it can be rich in salts and other minerals which requires some degree of desalination or other treatment to make the water usable. Beneficial reuse of CSG water in a way that protects the environment and maximises its productive use is encouraged. However, consideration needs to be given to a potential future time when CSG water might not be available.

Appendix B. Forecasting demand for water—details

Urban water demand includes water supplied to residential and non-residential customers in an urban setting. Assessment of urban water demand requires consideration of source water inputs, water delivered to customers (including from standpipes and for community use such as fire-fighting), system losses and unauthorised water take (theft).

Many factors affect water demand, as shown in Figure B1, but the key factors are generally population and residential consumption patterns. A detailed assessment of historical demands can assist in understanding the past impact of various factors and assist in developing scenarios to underpin forecasts of future demand.

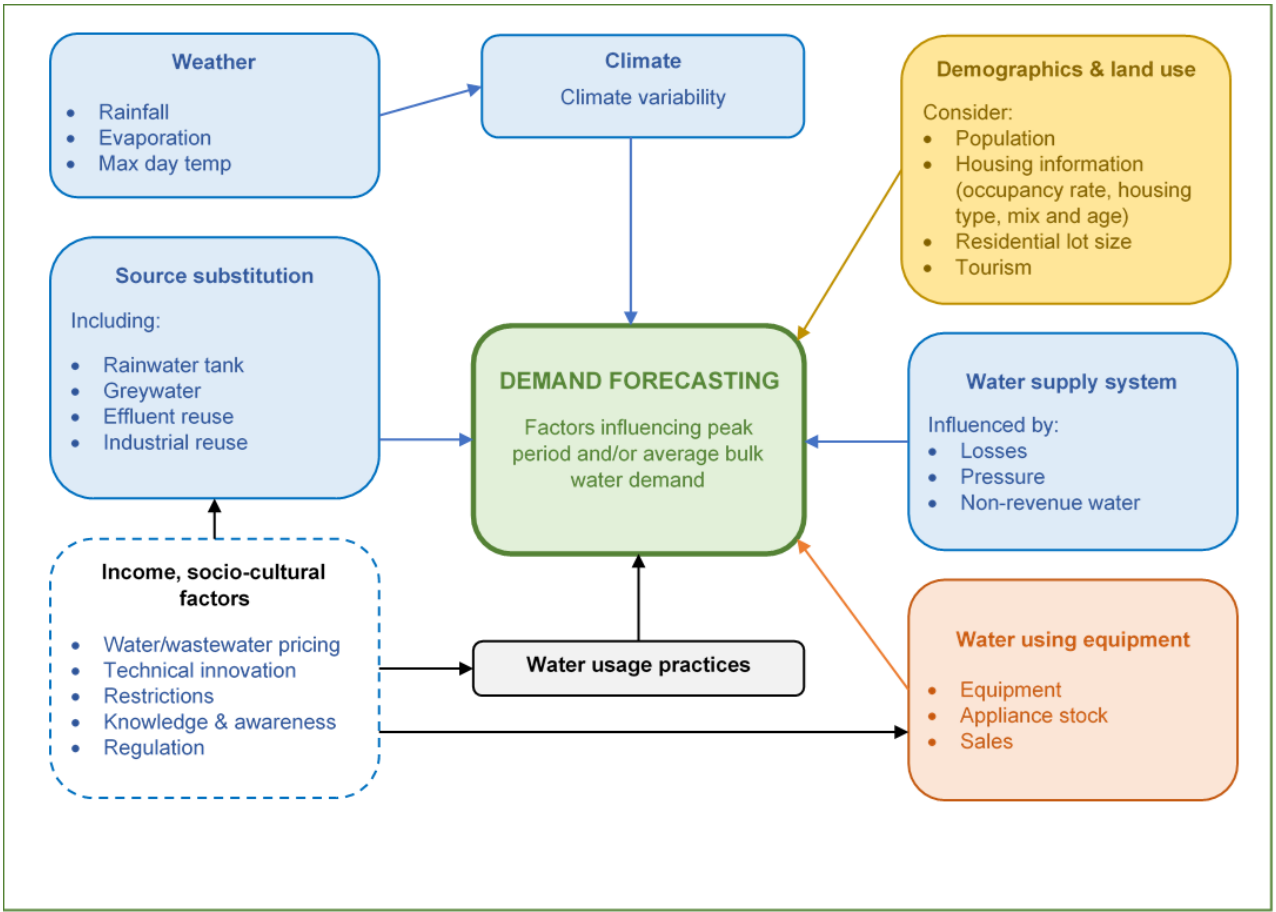

Figure B1: Factors affecting water demand

Adapted from: Water Services Association of Australia 2003

A simple approach to forecasting demand

The simplest way to calculate the average urban water demand is by averaging the total volume of water sourced for all of the community's water requirements for each year, dividing by the serviced population and dividing by 365 days per year. This is expressed as litres per person per day (L/p/d).

Some water service providers use EP as the basis of water supply system planning. Using equivalent persons (EP) as the basis for demand analyses, assigns an 'equivalent population' to non-residential water users, such as commercial premises, industrial water users and public connections for parks, libraries and residential dwellings. The method has the challenges of calculating and communicating equivalent populations that are different to surveyed or projected populations available through the Australian Bureau of Statistics (ABS) national Census and projections available through the Queensland Government Statistician's Office (QGSO).

Population

Well-founded population estimates are integral to understanding historical water demand and to support forecasts. Population assessments can be informed by the QGSO estimates of residential population, the ABS census data, and service provider connection data. When accessing population information from QGSO or ABS it is critical to identify and use the statistical area that is best aligned with the network service area.

To project the population for a community, inputs might include historical population growth, QGSO and ABS projections, town planning information including planning schemes and proposed developments.

The transient population includes itinerant workers, tourists and visitors and can be significant for some localities. Water demand by this sector is commonly included with non-residential demand since it is serviced through commercial accommodation service providers. It is important to understand how surveys and projections account for the transient population and make appropriate allowances for potential seasonal increases in demand.

Urban water demand

An assessment of historical demand can reveal trends in water use that can be used to develop water demand scenarios. Where possible, records of over 10 years should be assessed.

In assessing the historical data, the key factors influencing demand should be noted (e.g. weather patterns and demographics). An assessment of historical demand alongside these key factors will show relationships and trends that inform the development of a demand scenario. If any of the identified key factors affecting water demand are considered to have a high degree of variability or uncertainty, this should be noted. Assessment of historical water demand might involve consideration of different customer segments (particularly for non-residential customers), different types of water use (indoor and outdoor), climate and weather impacts, and effects of past demand management programs.

The simplest approach to assessing historical residential demand is to plot the annual average water use in L/p/d for each of the past 10 years, note periods when mandatory restrictions have been in place and identify any trends, including the frequency of restrictions and their impact on demand. A better approach is to also consider the upper and lower bands on the range of demands experienced so that the effects of long duration droughts on supply sources can be considered more rigorously.

Where smart meter data is available, a water service provider might investigate demand patterns for indoor and outdoor components. This would assist with the development of future demand management initiatives.

For projecting non-residential water demand, consideration might be given to such bases as: (i) demand remains constant, (ii) demand follows historical trends, (iii) demand is proportional to residential population, (iv) demand varies aligned with town planning and known plans for local business activity. If trends in non-residential water demand are proportional to residential water demand, and this is expected to continue, the average daily per person urban demand rate can be used to make demand projections based on population forecasts.

Demand projections have been historically difficult to predict accurately, especially the benefits likely to be obtained from the application of restrictions and other demand reduction strategies. Hence it is important to plan ahead of time for system upgrades and responses to drought.

Scenarios

A water service provider might choose to develop one or more additional demand scenarios. A sensitivity case might be applied to reflect uncertainty (e.g. considering the bounds on population and demand projections as described earlier or applying a +/- 10% sensitivity case to the base demand forecast to accommodate uncertainty in population forecasts and water demand behaviours of the community).

Alternative approaches

Table B1 shows some possible alternative approaches to developing varying elements of a water demand forecast, based on the characteristics of the local water service.

Table B1: Demand forecasting alternative approaches

Local characteristic	Possible alternative approach
Demand is influenced by an itinerant population or highly seasonal variation in population.	Collect demand data on itinerant population trends (e.g. peak seasons) where possible from ABS, owners of accommodation, employers of itinerant workforce, and tourism data sources to integrate into demand scenarios.
Non-residential water use trends are not proportionate to residential water use.	Produce separate forecasts for residential and non-residential water demand, and then add them together.
Historical demand is highly variable (demand varies more than 45% from the annual average of the dataset).	Assess the data and ensure that there are no obvious errors, removing data that appears erroneous or an outlier. Produce multiple scenarios that collectively will represent the expected variability of future demand. This could include the application of a sensitivity case to reflect uncertainty (e.g. applying a +/- 10% sensitivity case to the base demand forecast to accommodate uncertainty. Clearly communicate the high level of uncertainty inherent in the demand forecast(s).
Available datasets used to produce demand forecasts are constrained by data age, incomplete and/or inconsistent data.	Acknowledge data limitations in any demand forecast statements, and schedule the review of demand forecasts when improved data becomes available.
Growth scenarios from QGSO and ABS differ to historical population trends.	Do a scenario based on historical growth rates, and one based on QGSO or ABS projected population growth.
There is planned future development of a significant scale, or expected change in local industry.	Estimate the water use of local industry and produce a separate forecast for it based on expected future growth.
There are differing demand profiles across different parts of the serviced area.	Separate demand profiles can be developed for different areas, and then totalled to provide a consolidated demand profile.
Demand is heavily influenced by weather and climate.	Develop demand scenarios based on different climate conditions (e.g. a scenario that is based on an extended dry period). Consider climate projections and the impact this would likely have on demand. The potential net effect of climate change could be considered by adjusting average demand over time to reflect the potential climate change impacts. Consider links to Queensland Water Regional Alliance Program (QWRAP) research on the relationship between evapotranspiration and demand (available through www.qldwater.com.au).
Available historical data does not represent expected future conditions.	If possible, consider using historical data from a time period that is more representative of future conditions. The assessment of historical data and local knowledge can investigate to ascertain the effect of historical conditions and (relevant factors) on demand in historical data. The average demand of historical data can then be adjusted to reflect what they would be expected to be under normal/future conditions.

Appendix C. Asset capacity constraint assessment—details

Capacity is the quantity of material that can be handled (transported, treated etc.) by a system, in a specified time, to a defined quality. A system can be at any scale - component, equipment, unit, facility, or entire supply chain. There are many factors that can contribute to a water supply's capacity to deliver and ensure continuity of supply, including physical limitations (including the condition) of plant and equipment; access to water entitlements; product quality specifications; regulatory requirements; access to resources (human and financial); and business objectives.

The aim of assessing the key capacity constraints in a water infrastructure system is to identify limitations or 'bottlenecks' in the source, treatment and transport (or distribution) infrastructure. This guide focusses on understanding capacity constraints associated with the physical limitations of built assets in urban water supply systems; however, it is essential that any assessment and planning for water security also ensures that there are sufficient water entitlements to be able to provide the desired service.

Operating modes

It is possible and often necessary to change the way that infrastructure is operated in response to changing circumstances to ensure continuity of supply. For example:

- during a drought, access to regular water supplies might be reduced and there might be a need to access alternate raw water supplies with different chemical and physical characteristics
- during an extreme event such as a storm, flood or bushfire, there might be a constraint in the treatment plant associated with handling an extraordinary load of particulates (dirt) in the source water
- in hot weather there might not be enough storage capacity in the distribution network to meet peak demands of customers during the day.

In all the above examples, there is potential for temporary or prolonged loss of supply, but in each case the capacity limitation (bottleneck) is in a different part of the supply chain infrastructure. Understanding the constraints and preparing responses, is a useful way of managing risk to the continuity of water supply service.

An operating mode is a pre-determined way of operating infrastructure in response to known or expected conditions to achieve security and continuity of supply. Some examples of operating modes with example features, include:

- Normal #1: base case, applies most of the time.
- Normal #2: regular (e.g. annual) event with a temporary population influx into community, requires additional production of treated water, no change to feed water quality or access to reliable feed water volumes.
- Drought #1: low feed water flows in weir/river, leads to increased solids loadings, iron and manganese (taste and odour compounds), requires increased pre-treatment and disinfection, and solids waste management, no change to demand or supply access.
- Drought #2: contingent supplies of saline groundwater triggered, requires activation of additional treatment units, demand is lower due to introduction of medium level restrictions.
- Extreme wet weather: significant increase in solids loading in feed water, impacts on capacity of water treatment plant, expected to be temporary for up to five days, possible (temporary) increase in demand for clean-up after storm.
- Bushfire: ash, heavy metal contamination, requires additional treatment with powdered activated carbon, possible increase in demand due to hose-down of houses to manage ember risk.

Process units

Capacity constraints can be identified at any scale in a system, such as the system as a whole, facilities, units, equipment or components. Process units are considered a useful scale for assessment of capacity constraints.

A process unit represents each process step in the water supply chain where a physical, chemical or biological change occurs. The delineation between units is not critical. However, it is important that all major equipment in the supply chain is associated with a process unit and considered when assessing the capacity of a water supply system. The linkages and connections between process units should also be considered. Examples of process units are:

- Source water: bores, dam, weir, off-stream storage, in-stream pumping pools, intake works, pumps, pipes, meters.
- Conventional water treatment: flocculation, sedimentation, filtration, disinfection.
- Special water treatment: microfiltration and reverse osmosis (to desalinate saline groundwater or marine seawater), activated carbon (to remove taste and odour compounds), dissolved air filtration (to remove colour), fluoridation dosing.
- Storage and distribution: product water reservoirs located throughout the network, pipes, pumps and valves; re-chlorination facilities.

System assessment

An assessment of capacity for a water supply system can be done in many ways including the use of proprietary software, using an in-house model (e.g. built in Excel) or simply by completing a material balance, within the known capacity constraints of each process unit.

A material balance keeps track of the amounts of material that enter and leave each unit in a system. At its most simple, a material balance tracks the total mass of streams. It can be developed on a volumetric basis if minimal heating and pressurisation occurs. A material balance is also an ideal way to track the movement of one or more contaminants through a system, or track changes in physical characteristics such as temperature or pH. A material balance can be readily integrated with an energy balance to assist in understanding where energy is consumed (or produced) in a process and how this can be optimised. Pinch point analysis was a method traditionally used to minimise energy consumption from a process by optimising heat recovery systems. The term has now expanded in use to include identification of broader efficiency improvements including waste minimisation and reduction of capacity limitations or ‘bottlenecks’.

Appendix D. Timing of potential water supply augmentation

To augment means to increase in capacity, improve or make more effective. Understanding when potential future water supply infrastructure augmentations will be required is an essential component of water supply planning.

Scenarios

To assess the potential future timing for augmenting a water supply scheme, consideration should be given to the likelihood of particular scenarios eventuating and whether such scenarios should be more fully assessed. Examples of scenarios are provided in Table D1 and include examples related to drought.

Table D1: Example scenarios for assessment

Case	Supply	Demand	Infrastructure
Most likely case			
1a	Surface water reliability remains constant.	Low series population growth and residential demand reduced to 220 L/p/d due to effective education.	System leakage reduced from 18% to 12%.
1b	Access to additional 10 ML/yr of groundwater due to planned new bores becoming operational next year.	Medium series population growth, reduced non-residential demand due to increased production of recycled water for industry and fields.	Increased water treatment plant capacity by 12 ML/yr due on-line next year, to service new bore water source.
Reduced supply and high demand case			
2a	Groundwater reliability continues to decline every year, as per historical decline.	High series population growth and continued high residential demand (350 L/p/d).	Capacity of water treatment plant reduced by 10% due to improved aesthetic water quality requirements (taste), as agreed through the customer service standards.
2b	Other entitlement holders in the water management area increase their utilisation.	High series population growth and an increase in residential demand in summer (up to 420 L/p/d) due to increasing temperatures.	Capacity constraints as per assessment.
Typical drought			
3a	Surface water becomes unreliable, but contingent groundwater from GAB maintained.	Effective restrictions program reduces demand to 180 L/p/d.	Soil shrinkage causes increased failures in the network, increasing leakage from 12% to 15%.
3b	Declining access to water in weir requires access to 5 ML/yr of alternate run-of-river supply.	Effective restrictions program reduces demand to 150 L/p/d.	Poor source water quality (blended) reduces effective treatment capacity by 20%.

Interpreting the supply-demand balance

In the context of water supply provision, a supply-demand balance is a schematic representation of the relationship between the project supply, projected demand and key infrastructure constraints. Where these lines intersect, provides an indication of when a water supply shortfall might occur. The gaps between the lines, at a point in time, provide an indication of the potential magnitude of the supply shortfall.

An example of a supply-demand balance is provided in Figure D1, showing three key demand scenarios, followed by notes on interpretation.

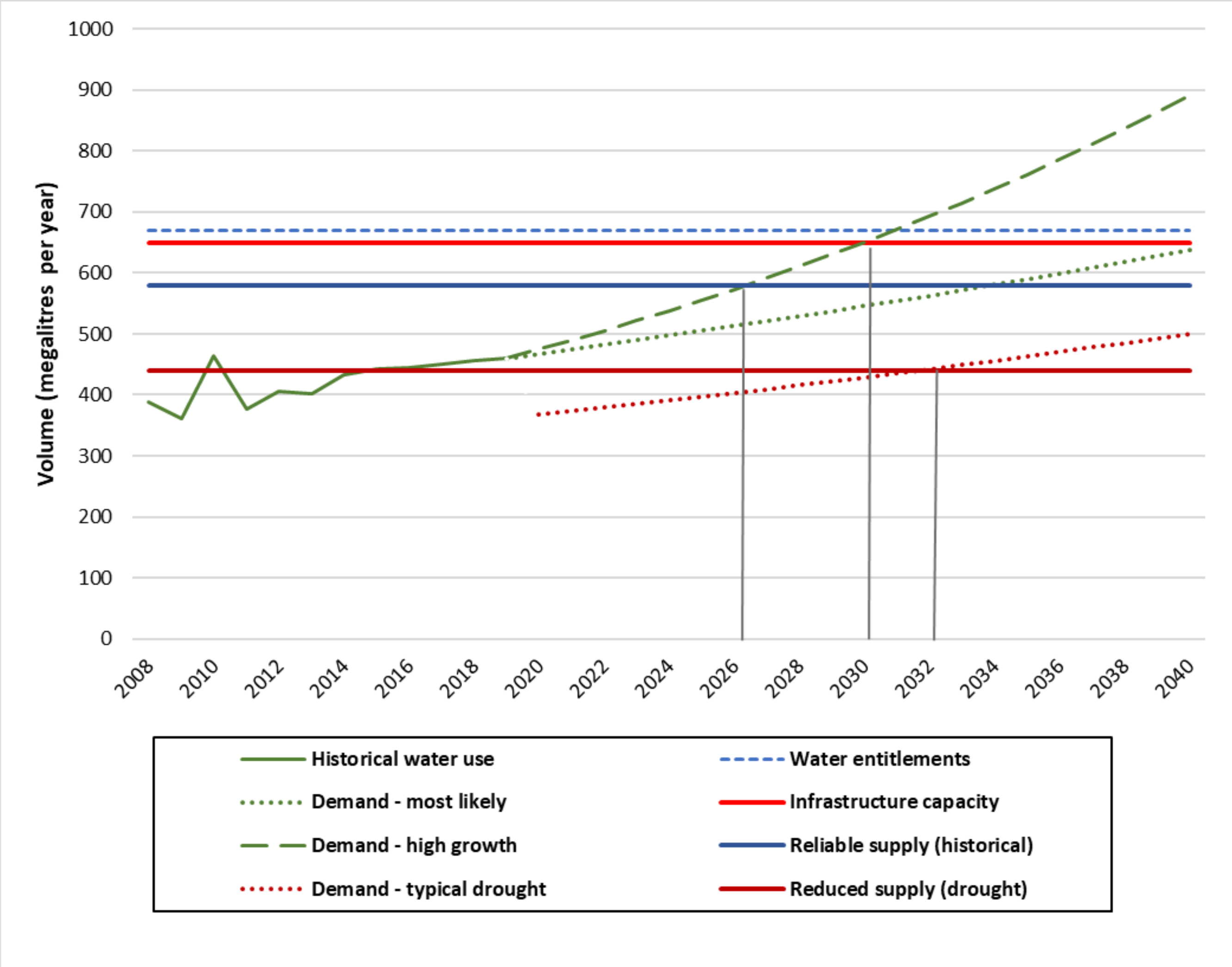

Figure D1: Example water supply-demand balance

(Note: For simplicity, the potential bounds of water demand have not been shown.)

Figure D1 shows that:

- Under normal conditions, for the high demand case:
  - there should be adequate water supply sources to meet demands until after 2026
  - augmentation of source water supplies might be required after 2026
  - by 2040, an additional 300 ML/year of source water supplies might be required
  - augmentation of water supply infrastructure might be required after 2030.
- Under normal conditions, for the most likely case:
  - there should be adequate water supply sources to meet demands until after 2034

- augmentation of source water supplies might be required after 2034
- by 2040, an additional 60 ML/year of source water supplies might be required
- augmentation of water supply infrastructure is not required before 2040.

- Under typical drought conditions:
  - additional drought management measures might be required after 2032
  - by 2040, an additional 60 ML/year of drought management measures (supply and/or demand) might be required.

Figure D2 shows an example supply-demand balance where a planned augmentation to access a new water supply source is presented in 2024, for example where additional bores will provide access to an existing groundwater entitlement. It shows that:

- under normal conditions:
  - there should be adequate water supply sources to meet predicted high demands until about 2035, after which time there might be a need to access additional water supply entitlements
  - if demand can be managed to achieve the likely case, there will be adequate water supplies until after 2040
- under drought conditions, there should be adequate contingency measures in place until about 2032.

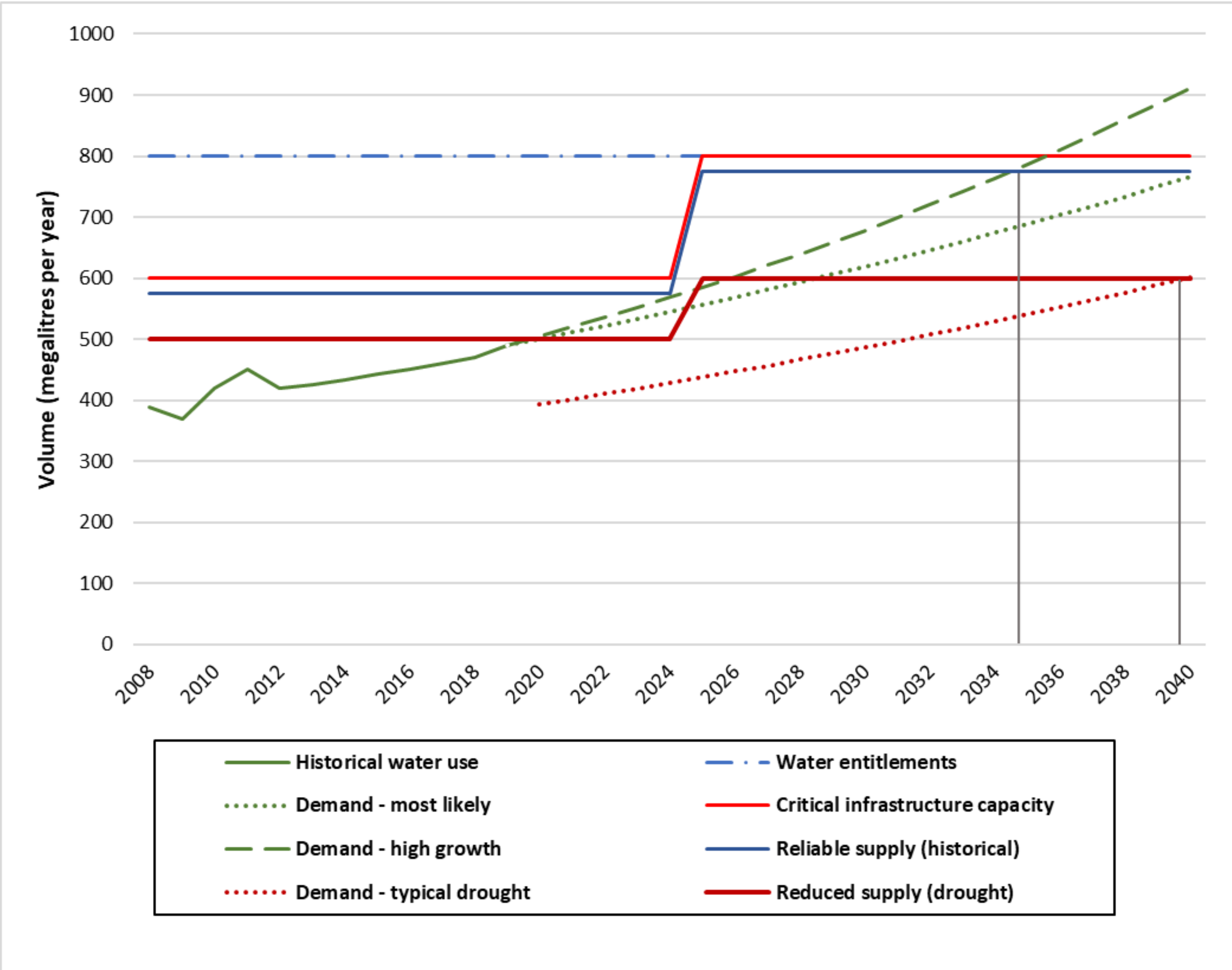

Figure D2: Example water supply-demand balance, with planned augmentation

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