Department of Primary Industries
Water

LOWER HUNTER water PLAN

MERI Evaluation 2017

Version 3.0

Version history

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More information

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Contents

Executive summary

The Lower Hunter Water Plan (LHWP) sets out a mix of supply and demand measures to meet its objectives to:

- provide water security during drought
- ensure reliable water supplies to meet growing demand due to a growing population and increased business and industry activity
- help protect aquatic ecosystems
- maximise net benefits to the community.

A Monitoring, Evaluation, Reporting and Improvement (MERI) Plan guides implementation of the LHWP and sets out a framework to assess performance against its objectives, using an adaptive management approach to incorporate the latest knowledge, experience and technology.

The 2017 annual evaluation report is structured around responding to the four key evaluation questions (KEQ) in the MERI Plan. The findings for each of the KEQ are summarised below.

KEQ 1 How effective has the plan been in achieving its objectives?

Most of the questions under KEQ 1 are only addressed as part of the major MERI evaluation, which was conducted in 2016. For an annual evaluation, only evaluation question (EQ) 1.3 is required: EQ 1.3 asks: Is the forecast supply-demand balance still consistent with the LHWP forecast?

The updated forecast supply and demand balance remains close to the 2014 LHWP forecast, with the intersection of the water supply and demand forecast now expected to occur in 2037/38, two years later than projected in the LHWP. The demand forecast is slightly lower, due to greater efficiency of washing machines and higher projected savings from loss minimisation programs. The system yield has increased compared with the LHWP forecasts, because water storage levels in the Central Coast are higher, which impacts inter-regional transfers. This provides sufficient lead time to plan for a new supply augmentation without locking out any available options (13 years).

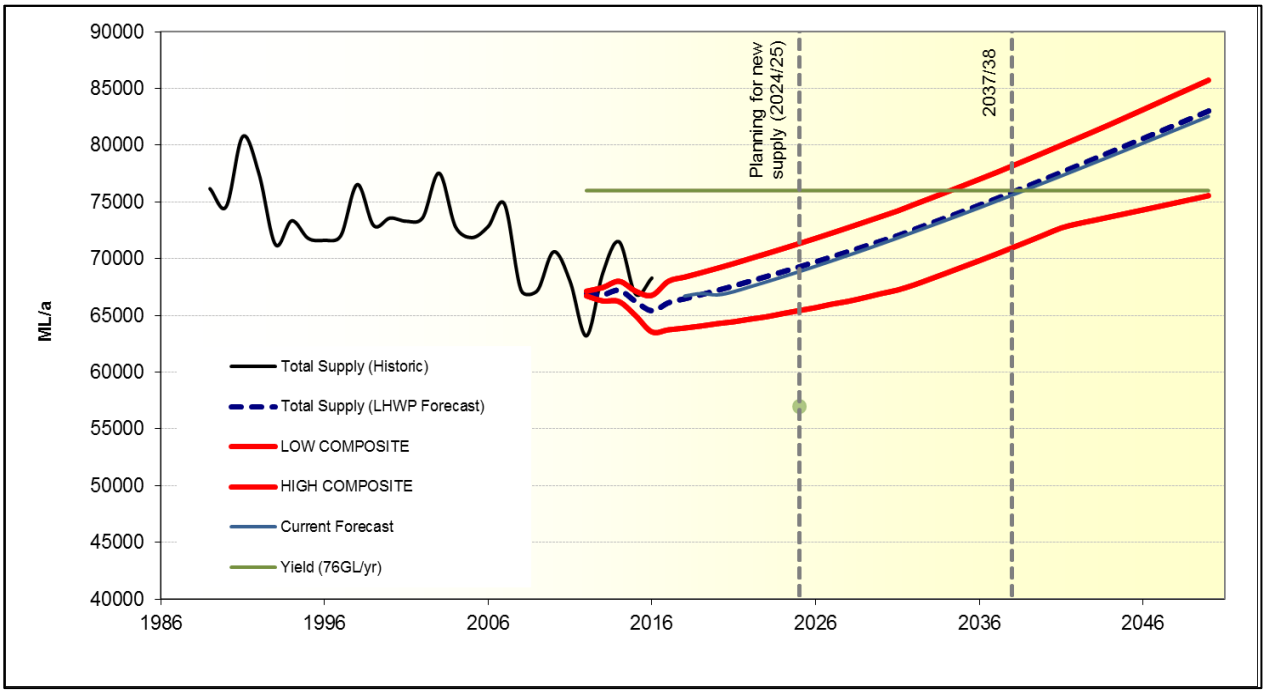

Figure ES.1 Updated supply-demand balance, showing 13-year lead time to provide for future supply augmentation

KEQ 2 How effective are the measures within the plan?

The performance of the drought measures cannot be evaluated because there has not been a drought event since the 2014 LHWP started. The non-drought measures have generally been effective and met expectations for the supply, saving and substitution of water.

The estimated savings from customer water efficiency measures and loss minimisation were higher than forecast. Hunter Water has set an internal target to reduce non-revenue water to below 10 gigalitres per year by mid-2019 and greater savings have been realised in 2016/17 from loss minimisation programs as a result.

The volume of water recycled as a substitute for potable water was lower than forecast, due to lower customer demand for recycled water from the Kooragang Recycled Water Scheme. This was partly due to a shutdown of the KRWS for planned maintenance during the year. Daily recycled water demand at the plant increased during the year, which will bring expected use closer to the forecast in 201/18.

KEQ 3 How efficiently has the plan been delivered?

Most of the implementation actions were delivered on time or are on track, including HWC's work on environmental flow releases from Chichester Dam and Seaham Weir and infrastructure for inter-regional transfers with the Central Coast (based on timing of mid-2018 agreed during the 2016 evaluation).

Central Coast Council's construction of the Mardi to Warnervale pipeline to increase inter-regional transfers has been further delayed due to external factors, and will now be completed by the end of 2019. Given the current storage levels in both regions, this is not expected to have any material impact on achieving the objectives of the LHWP.

The implementation of readiness activities for the contingency measure of temporary desalination is ongoing, with the Belmont selected as the preferred site for the plant. The environmental impact assessment process is underway. The project has been further delayed by around nine months based on the timeline agreed during the 2016 major evaluation. Hunter Water advises that based on current storage levels, the project can still be delivered in the event of an immediate drought.

The costs for implementation actions are generally close to expected, although some cost data was not available. The most significant change was a higher cost to implement the temporary desalination contingency measure. A re-run of the cost-risk modelling using the new information demonstrated that the portfolio in the 2014 LHWP is still the preferred portfolio.

KEQ 4 Do the measures within the plan remain appropriate?

Most of the assumptions underpinning the LHWP remain appropriate. Those which may no longer be valid or where the findings have a potential impact on the LHWP measures are:

- the volume of groundwater that can be accessed from Tomago and Tomaree sandbeds may reduce in the next five years as a result of potential regulatory changes or water quality issues
- the Kooragang Recycled Water Scheme has offset around 1.8 GL/year of potable water use, less than the assumption of 3 GL/year, due to lower customer demand, however this is expected to increase to around 2.75 GL/year in 2017/18.
- the timing for completing infrastructure to increase water transfers from the Central Coast to the lower Hunter has been delayed, but is not expected to have a material impact on achieving the LHWP objectives
- there is insufficient evidence to determine whether or not Water Wise Rules have achieved the assumed 2.5% reduction in residential demand.

The regulatory and operating environment is generally consistent with the 2014 LHWP, although three issues have the potential to impact the supply-demand balance by reducing the yield of the water supply system. These comprise:

- changes to groundwater access conditions for Tomago and Tomaree sandbeds
- operational changes to the Tomago source in response to groundwater contamination from the Williamtown RAAF Base.

New technology and information that may influence the LHWP measures and their implementation, not significantly affecting the 2014 LHWP but relevant to developing the next LHWP, include:

- changes to population projections from the Department of Planning and Environment
- research into climate change and climate variability
- developments in desalination technology.

Recommendations arising from the 2017 evaluation are summarised in Table ES.1.

Table ES.1 Summary of recommendations from the major evaluation

No.	Recommendation	Lead
1	Implement recommendations from the 2016 MERI evaluation not yet completed including: a frame the LHWP objectives to articulate the high level goals reflecting strategic priorities, with more specific measurable objectives under the goals (DoI) b Incorporate updated population projection into the demand model, along with further analysis of the underlying trends as part of the more comprehensive review of the demand model (HWC) c Follow up outstanding actions from the 2013 peer review of the demand forecast as part of developing the next LHWP (HWC) d Follow up outstanding actions arising from the 2013 peer review of the source model as part of developing the next LHWP (HWC)	DoI, HWC
2	Implement recommendations from 2016 MERI evaluation for developing the next LHWP	All
3	Review the levels of service criteria as part of developing the next LHWP	All
4	Examine drivers of increasing residential demand and identify options for cost-effective demand management when developing the next LHWP	HWC
5	Continue to explore opportunities for further water efficiency and recycled water schemes through strategies being developed by HWC and as options for the next LHWP	HWC
6	Ensure the economic level of water conservation (ELWC) methodology takes into account societal costs and benefits to ensure efficient investment in loss minimisation, water efficiency and recycled water and is consistent with the approach used for the LHWP analysis	HWC
7	HWC to re-run the hydro-economic model with current costs for temporary desalination to ensure it is still part of the preferred portfolio	HWC
8	DoI to convene the E-flows working group for an update on infrastructure at Seaham Weir and to agree a timeline for amending the Hunter Unregulated River Water Sharing Plan in early 2018	DoI
9	DoI to convene the Groundwater working group for an update on research into groundwater dependent ecosystems at Tomago and Tomaree, an update on the implications of groundwater contamination at Williamtown for water security and to agree a way forward for including impacts of groundwater extraction into the analysis for the next LHWP	DoI
10	CCC to investigate and report on options for increasing the volume that can be transferred north if a drought occurs before the Mardi to Warnervale pipeline is completed	CCC
11	Where appropriate, take findings from paleoclimate research into account in the hydrologic modelling and economic analysis for the next LHWP	HWC
12	HWC to investigate including a climate correction model in the demand forecast model to better understand the impact of weather on demand and the water savings from WWR, demand management and water efficiency measures	HWC

1 Introduction

The Lower Hunter Water Plan (LHWP) sets out the NSW Government's water strategy for the region, to deliver a mix of supply and demand measures to meet its objectives to:

- provide water security during drought
- ensure reliable water supplies to meet growing demand due to a growing population and increased business and industry activity
- help protect aquatic ecosystems
- maximise net benefits to the community.

The first LHWP, released in 2014, focussed on responding to drought because supply-demand modelling indicated that Hunter Water's supply system could meet new growth for around 20 years. The LHWP comprises a portfolio of supply and demand measures in the categories of surface water, groundwater, water efficiency, demand management, recycling, stormwater and temporary desalination.

A key feature of the plan is that it is flexible to adapt to challenges, such as our highly variable climate patterns and new information and experience gained over time, as well as to changes in behaviour, technology or the regulatory environment that impact the portfolio. The plan will be reviewed every four to five years, so that the portfolio of measures can be adjusted over time to ensure that it continues to achieve its objectives. Planning for the next iteration of the LHWP is underway, with the plan anticipated to be released in 2020.

The Crown Lands and Water Division within the Department of Industry (DoI (Water)) is the lead agency in implementing the MERI plan and developing future iterations of the LHWP, working in partnership with Hunter Water Corporation (HWC) and Central Coast Council (CCC).

As part of the implementation of the LHWP, a Monitoring, Evaluation, Reporting and Improvement (MERI) Plan sets out a framework to assess performance against the LHWP's objectives and to ensure that it can adapt to incorporate the latest knowledge, experience and technology. Key elements to be monitored include:

- achievement of LHWP objectives
- the validity of the assumptions that underpin the LHWP
- the timely implementation of actions identified in the plan
- relevant developments in research and technology.

Annual evaluations were undertaken under the MERI framework in 2014 and 2015. A major evaluation was undertaken in 2016. This report outlines the findings from the 2017 annual evaluation of the performance and implementation of the Lower Hunter Water Plan.

2 The annual evaluation process

The MERI plan includes four key evaluation questions (KEQ) derived from the objectives of the LHWP. The KEQ establish the direction and focus of the evaluation. These are:

KEQ 1	How effective has the plan been in achieving its objectives?
KEQ 2	How effective are the measures within the plan?
KEQ 3	How efficiently has the plan been delivered?
KEQ 4	Do the measures within the plan remain appropriate?

Under these KEQ are two levels of evaluation questions and specific evaluation questions that provide more detailed information needed to answer the four KEQ. This allows us to address the MERI objectives and adapt the LHWP if needed.

Table 2.1 summarises the first two levels of MERI evaluation questions. The lower level 'specific evaluation questions' are covered in the tables in each chapter.

As shown in Table 2.1, only some of the evaluation questions are addressed in the annual evaluation. This is because:

- some actions in the LHWP only occur in the event of a drought
- questions relating to the extent that the LHWP objectives are being met and the contribution of the LHWP to this can only be answered once the plan has been in place for a period of time.

The annual evaluation questions are designed to monitor aspects of the LHWP that can meaningfully be measured each year and provide time series data to evaluate the effectiveness and efficiency of the plan when there is a major evaluation. This evaluation report is structured around responding to the KEQ, with detail on the lower level evaluation questions relevant to the annual reporting.

The steps in the annual evaluation process are illustrated in Figure 2.1. The 2017 annual evaluation began in May 2017. DoI (Water), HWC, and CCC submitted their responses in September 2017. As the lower Hunter did not experience a drought during 2016/17, agencies reported on the annual evaluation questions and the implementation actions under the broad categories of measures in the LHWP. DoI (Water) has collated the information from agencies and assessed the results.

The MERI evaluation report will be submitted to the governance groups that oversee metropolitan water planning for the lower Hunter and greater Sydney, for their review and endorsement. These governance groups include the Lower Hunter Water Senior Officers' Group (LHWSOG), the Independent Water Advisory Panel (IWAP), and the Metropolitan Water Chief Executive Officers' (MWCEO) Committee. The final report and a brief on key findings and issues will be submitted to the Minister for Regional Water in early 2018.

Table 2.1 Summary of MERI evaluation questions and timeframes

Key Evaluation Question	Evaluation Question	Timeframe for monitoring, evaluation and reporting		
		Annual	Intermittent	
			Drought event	Major review
KEQ 1. How effective has the plan been in achieving its objectives?	EQ 1.1 To what extent are the LHWP's objectives being met?			
	EQ 1.2 Have the objectives been achieved as a result of the LHWP implementation?			
	EQ 1.3 The underlying premise of the plan is the supply and demand balance - is the forecast supply and demand balance still consistent with the LHWP's forecast?			
	EQ 1.4 Have there been any unintended outcomes (positive or negative) and how have these impacted on the LHWP's objectives?			
KEQ 2. How effective are the measures within the plan?	EQ 2.1 Do the measures perform as expected under drought conditions? Can any reasons for significant variation be explained?			
	EQ 2.2 Have the non-drought measures (ie, continuing measures) been effective in the supply, saving and substitution of water? Can any reasons for significant variation be explained?			
KEQ 3. How efficiently has the plan been delivered?	EQ 3.1 Have the identified implementation actions been delivered within agreed timeframes or consistent with identified triggers? What are the reasons for any significant variation and how can this understanding improve delivery of the LHWP?			
	EQ 3.2 Are the implementation actions consistent with the LHWP's expectation for deliverables and costs? What are the reasons for any significant variation and how can this understanding improve delivery of the LHWP?			
KEQ 4. Do the measures within the plan remain appropriate?	EQ 4.1 Are the assumptions underpinning the LHWP still appropriate? Do any changes influence the measures and implementation actions in the LHWP?			
	EQ 4.2 Is the regulatory and operating environment still consistent with the LHWP? Do any changes influence the measures and implementation actions in the LHWP?			
	EQ 4.3 Has new technology, information or methods emerged that will influence the measures and their implementation? Do any changes influence the measures and implementation actions in the LHWP?			

Note: Some elements of the MERI plan are specific to drought events and will only be evaluated, when a drought event has occurred. There has not been a drought event in the lower Hunter since the LHWP was released.

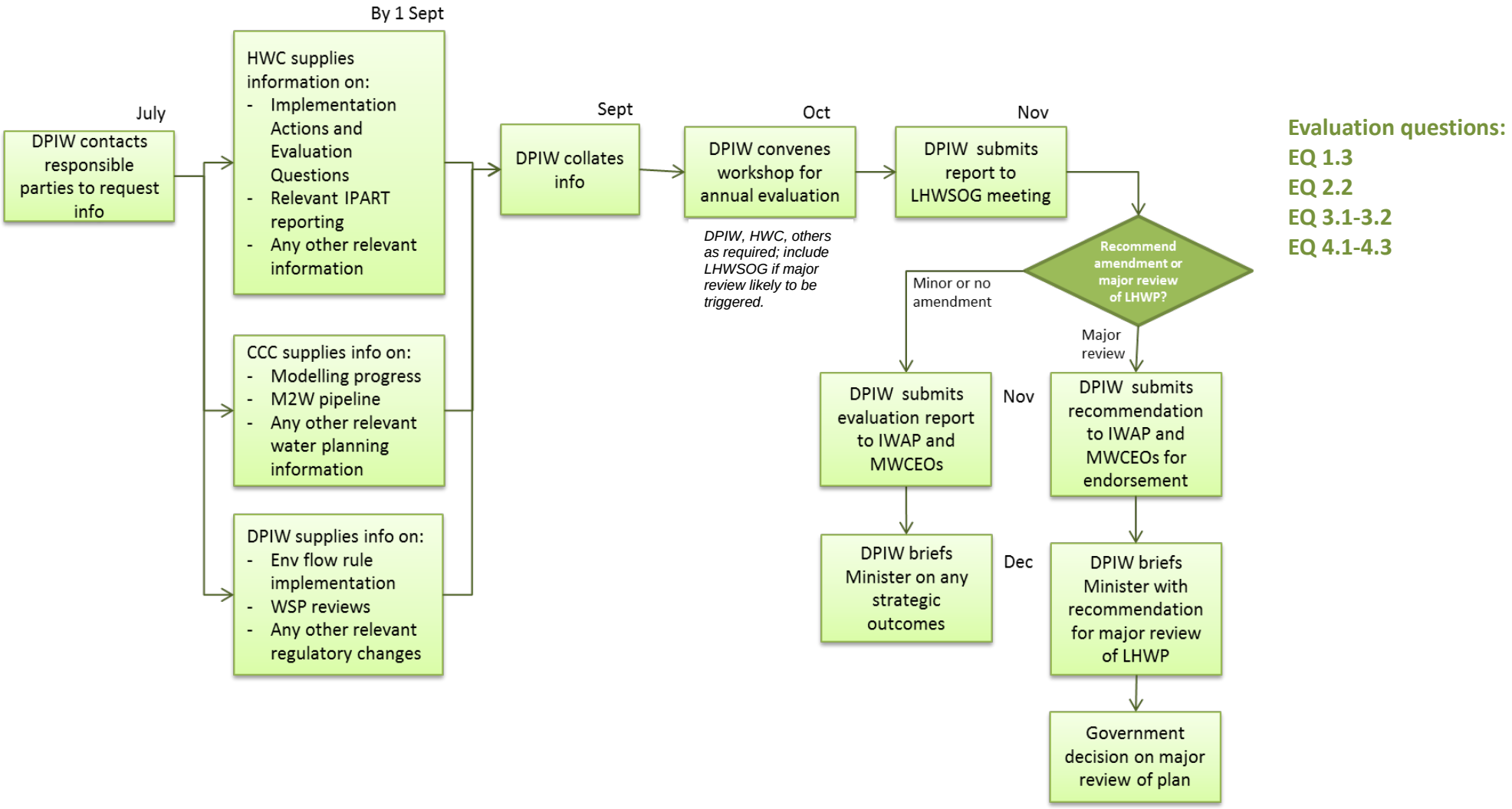

Figure 2.1 Key steps in the annual evaluation process

3 Implementing recommendations from the 2016 major evaluation

In 2016 DoI (Water) undertook a major evaluation of the LHWP, as required in the MERI plan. This involved evaluating progress against all KEQ and conducting more detailed analysis to scrutinise the outcomes of implementing the LHWP and examine how the measures are performing and contributing to outcomes. This allows evaluation of the LHWP against its objectives and will help inform future iterations of the plan.

The major evaluation found that:

- The supply-demand balance remained close to 2014 forecast
- Non-drought measures have generally been effective and met expectations
- Performance of drought measures could not be evaluated because there had not been a drought during the evaluation period
- Most implementation actions were delivered on time or were on track, including
    - Water Wise Rules
    - Kooragang Recycled Water Scheme
    - Improved modelling of transfers between the lower Hunter and the Central Coast.
- Infrastructure to increase flows north from the Central Coast as part of the existing transfer agreement was delayed
- Temporary desalination readiness activities were delayed and scope/timeframes adjusted
- Most assumptions underpinning the LHWP remain appropriate.

A number of the recommendations from the 2016 MERI evaluation will be incorporated into the development of the next LHWP, while others are relevant to the 2017 MERI evaluation. Table 3.1 summarises progress against the recommendations. Where progress has been made in 2016/17, further information is included in the relevant sections of this report.

Legend for tables showing MERI findings

Performance (Evaluation Finding Performance)	
	Satisfactory
	Some risks to delivery of LHWP objectives
	Performance is below expectation
	Events have not occurred or actions are not yet due or not assessable due to inadequate information

Table 3.1 Status of recommendations from the major evaluation

	Action	Lead		Status / Progress
1	Frame the objectives of the next LHWP to articulate the high-level goals that reflect strategic priorities to be achieved by the plan, together with more specific, measurable objectives under these goals. These objectives will also provide a basis for analysing options and portfolios, and will be linked to performance indicators for future evaluations of the performance of the LHWP.	DoI (Water)		Next LHWP – work underway to develop draft objectives and consultancy to review them in context of LHWP decision framework
2	Incorporate the 2016 population projections into the demand model, along with further analysis of underlying trends, as part of the more comprehensive review of the demand forecast in developing the next LHWP.	HWC		To be included in the major review of the demand forecast model due for completion in January 2018
3	Follow up any outstanding actions arising from the 2013 peer review of the demand forecast, such as those relating to outdoor water use, correction for weather conditions, demand characteristics of non-residential customer categories, and price elasticity. Incorporate findings into the process to develop the next LHWP.	HWC	 	Any outstanding actions to be included in the major review of the demand forecast model due for completion in January 2018
4	Follow up any outstanding actions arising from the 2013 peer review of the source model, such as those relating to periodic bathymetric surveys of Grahamstown and Chichester dams, optimisation processes, a proofing model, improved modelling of the Tomaree source, synthetic data generation, validation of the Grahamstown Dam model, updating SoMo to reflect any changes in operating strategies/contingency plans, and climate change assessment. Incorporate findings into the process to develop the next LHWP.	HWC	 	Any outstanding actions to be considered for inclusion in the next LHWP
5	Continue to monitor and evaluate the ongoing performance of HWC's loss minimisation programs (including whether the 'delayed savings' are realised in 2016/17).	DoI (Water)		Delayed savings were realised in 2016/17 and HWC has a program to significantly increase active leak detection to reduce unaccounted for water by 2GL by mid-2019 (see Chapter 5 of this report).
6	Further investigate the reasons for and response to the increasing trend in 'other' (non-revenue) water supply and the Infrastructure Leakage Index as part of developing the next LHWP.	HWC		As above - see Chapter 5, p22-23

	Action	Lead		Status / Progress
7	Investigate the potential to increase utilisation of recycled water (as a substitute for potable water) when developing the next LHWP.	HWC		HWC is developing a recycled water strategy that will identify recycled water opportunities to be considered as part of the next LHWP
8	Complete construction of infrastructure to increase inter-regional transfers between the Central Coast and HWC by the revised timing of July 2018.	HWC and CCC		Ongoing / delayed - completion date for CCC infrastructure revised to late-2019
9	Complete the amended scope of desalination readiness activities (including site selection, concept design, EIS and planning approval) by the revised timing of December 2018 to mitigate the risk to water security in an extreme drought.	HWC		Delayed – see Chapter 5, p27
10	Review the approach to monitoring the implementation of the LHWP (including, for example, the costs and volumes for water efficiency and demand management programs) to efficiently collect relevant data for future evaluations to inform planning for the next LHWP.	HWC		HWC is in the process of streamlining systems for collecting and reporting data on costs and volumes of water conservation and other programs as part of the ELWC methodology development.
11	Address the environmental, economic, social and risk implications of changes to groundwater access (cease-to-pump) conditions for the Tomago and Tomaree groundwater sources in developing the next iteration of the LHWP.	DoI (Water)		Next LHWP – studies underway to better understand ecological impacts of groundwater extraction below the 100th percentile.
12	Develop a new module in HWC's source model (SoMo) to better represent the storage behaviour of the Tomaree aquifer, and hence improve on the current assumption that it can deliver a constant sustainable supply of 7 ML/day.	HWC		Module development complete – HWC is in the process of modelling the impact on system yield
13	Incorporate the outcomes of the latest research into climate change and climate variability into the planning process to develop the next LHWP. The approach will be developed in response to the outcomes of ongoing research and industry best practice, and may include sensitivity analysis, scenario planning to test extremes, and/or recommendations for further work.	DoI (Water)		Next LHWP - HWC has engaged a consultant to incorporate paleoclimate data into hydrologic modelling
14	Consider the capacity to adapt to the potential for significant climate variability in developing the objectives and evaluating measures for the next LHWP.	DoI (Water)		Next LHWP – to be included in development of the decision framework
15	Extend the historic climate and streamflow data used in SoMo to generate stochastic data to include the years since 2011.8	HWC		Complete
16	Amend the storage level triggers in the 2014 LHWP for temporary desalination to: - 'now': investigations, site selection, concept design and EIS/planning approval - 65%: procurement for design and construct package, with optional exit points - 30%: start operation, if construction completed (must produce water no later than 15%)	DoI (Water)		Complete – included in brief to Minister on the 2016 LHWP evaluation

	Action	Lead		Status / Progress
17	Further investigate the impact of Water Wise Rules on demand hardening and any implications for the expected water savings from restrictions.	HWC		HWC consulted with Sydney Water – very difficult to analyse based on existing data. HWC to consider incorporating a climate correction model as part of review of its demand forecast model
18	Consider the impacts on water supply system yield from any risk mitigation measures for managing impact on Grahamstown Dam from the Campvale catchment in developing the next LHWP.	HWC		To be considered in the analysis for the next LHWP
19	Compare the mine water source with other short-listed sources/sites as part of the temporary desalination readiness investigations, and continue liaising with CSIRO and Centennial Coal on the proposed FO/RO technology trial to understand the feasibility of this source and/or technology.	DoI (Water)		Complete for 2014 LHWP Minewater on options list for further investigation for next LHWP
20	Resolve whether or not the lower Hunter alluvial is likely to be a feasible source of supply in drought, so that it can be either included or excluded as an option for developing the next LHWP.	DoI (Water)		Ongoing – see Chapter 5, p26
21	Implement a simplified format for evaluation reporting for annual evaluations, and ensure clear communication of needs to all staff contributing to the reporting.	DoI (Water)		Ongoing – some simplifications made to reporting. Further improvements to be incorporated in next MERI plan
22	When developing the MERI Plan for the next LHWP, aim to avoid overlap between the evaluation questions and hence reduce duplication in reporting.	DoI (Water)		Next LHWP
23	Ensure all assumptions for the plan portfolio and business-as-usual are documented and information is transferred as staff change.	DoI (Water) and HWC		Ongoing

4 KEQ 1: How effective has the LHWP been in achieving its objectives

Key findings for KEQ 1

- Supply and demand modelling indicates that the region's water supply is secure until 2037-38, two years later than the LHWP forecast
- Total demand is trending within forecast sensitivity limits and the 2017 forecast for 2035-36 is slightly lower than the LHWP forecast
- The 2017 residential demand forecast is above the 2013 LHWP forecast, while the forecasts for non-residential and non-revenue water are below the LHWP forecast
- HWC is planning to develop a water conservation strategy in 2018 to identify options that can be implemented in the next 18 months, prior to the next LHWP
- HWC has engaged a consultant to generate paleoclimate informed stochastic rainfall and streamflow data as an input to the hydrologic models to better account for climate variability over thousands of years (before instrumental climate records).

Overview

Most of the questions under KEQ 1 are only addressed as part of the major MERI evaluation because they are concerned with whether the LHWP is achieving its objectives and the contribution of the plan to these outcomes.

Evaluation question 1.3 asks whether the supply-demand balance is still consistent with the LHWP forecast. This is evaluated every year to ensure that:

- the demand forecast is tracking within the sensitivity bounds defined for the LHWP
- there have been no major changes to the levels of service or the system yield that would threaten water security
- there is enough time to plan for and implement new options before demand outstrips supply in the future.

The MERI plan establishes that if the supply-demand balance indicates that demand is likely to exceed supply within 13 years, a major review of the LHWP is triggered. This is based on the lead time for a major supply augmentation.

EQ 1.3 Is the forecast supply-demand balance still consistent with the LHWP forecast?

Review of demand forecast

HWC updated its demand forecast in September 2017 to incorporate changes over the last 12 months. Table 4.1 illustrates changes in the elements of the 2017 demand forecast compared to the 2013 LHWP base case forecast for the LHWP planning period to 2035/36.

The forecast demand in 2035/36 is 74.5 GL, a decrease of 0.2 GL compared to the LHWP forecast of 74.7 GL. The forecast remains within the bounds of the sensitivity envelope.

The updated forecast includes the following changes over the last 12 months:

- Average number of new residential connections per year was extended to include the last eleven years of data, increasing average connections per year from 2,913 to 2,930.

- The number of new residential connections in 2015/16 was 3,548, which is significantly higher than forecast. HWC advised that the majority of extra connections are flats and units, which typically use less water than houses and therefore demand forecasts will not change significantly despite the increase in connections.
- Non-Revenue Water has been updated based on planned initiatives for water loss programs, unmetered authorised consumption and metering inaccuracies. These programs are expected to reduce non-revenue water (excluding metering inaccuracies) by approximately 0.5 GL/year in 2035/36. This is a significant change compared to last year, when non-revenue water was forecast to increase by 0.9 GL/year in 2035/36.

Table 4.1 Changes in elements of the demand forecast for 2035/36 compared to the LHWP base forecast

Change	Description	Demand impact 2035/36 (GL/year)	
Dwelling and population forecast	Forecast of dwelling connections increased, from 2913 per year to 2930 per year		0.0
	Higher population forecast due to higher occupancy rate forecast by the Department of Planning and Environment	Res Non-res	+ 0.3 + 0.2
Residential outdoor water use	LHWP Water Wise rules implemented on 1 July 2014. Note that the first 3 years (in 7-year rolling average) are incorporated in customer base demand		- 0.6
	Garden water use historic trend extended to include the period 2010 to 2017		+ 1.1
Water efficiency	New clothes washing machines more efficient than forecast (new data)		- 1.2
Major customer demand	Recycled water supply from Kooragang scheme forecast to be less than capacity of the treatment plant		+ 1.0
	Reduced demand forecast for large users resulting from water efficiency programs and updated historic consumption analysis		- 0.6
Inter-regional transfers	Potential supply to Singleton as a bulk water transfer no longer included in the forecast		- 0.2
Dual reticulation recycled water	Reduced extent of recycled water customers compared to LHWP forecast will reduce savings from BASIX		+ 0.3
Non-revenue water	Updated NRW program for water losses, unmetered authorised consumption and metering inaccuracies.		- 0.5
Total	**Combined impact compared to LHWP forecast**		**- 0.2**

Non-Residential demand in 2016/17 was 18.8GL. This was slightly lower than the LHWP Demand Forecast of 18.9GL. The non-residential demand is within the sensitivity bounds for large water users as shown in Figure 4.1.

The latest forecast for non-residential demand is less than the forecast for the LHWP. HWC reported that this is largely due to updated forecasts for the largest water using businesses to reflect lower water use by some of these users in recent years.

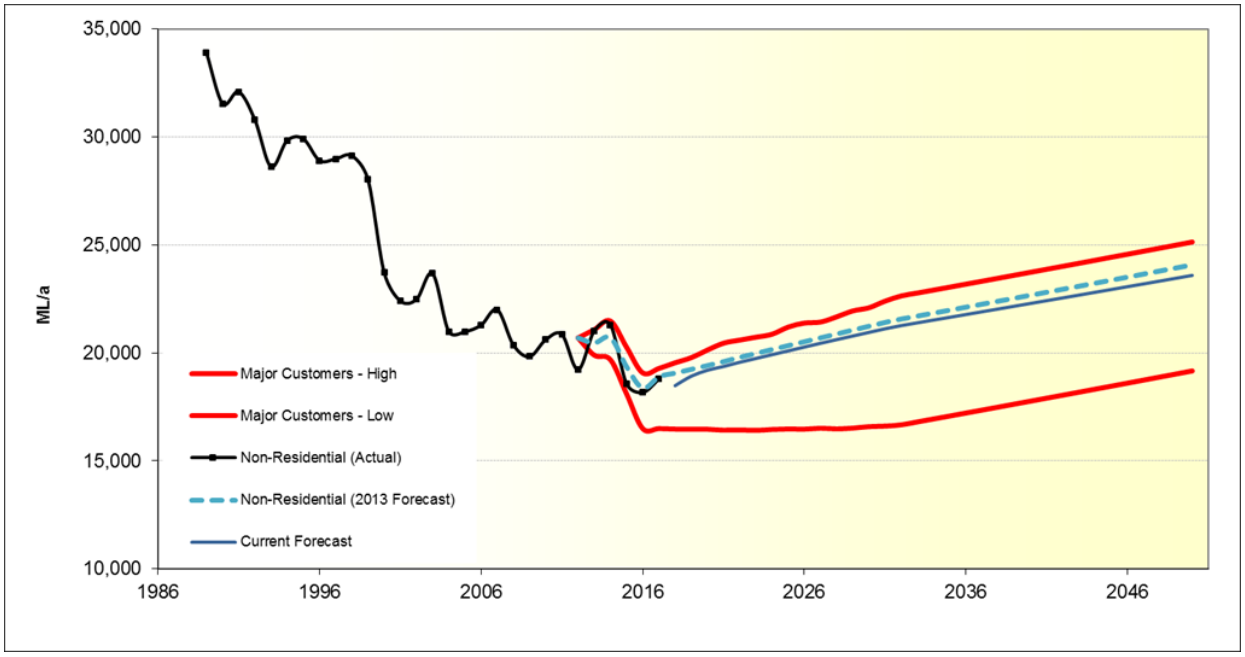

Figure 4.1 Non-residential water demand forecast (updated Sept 2017)

Residential water demand in 2016/17 was 39.9GL, which was higher than the LHWP Demand Forecast of 37.7GL, despite better than expected performance on water efficiency and loss minimisation programs this year (see pp17-20). The difference between the forecast and actual residential demand appears to be a result of higher outdoor (garden) water use. This could be the result of hotter than average climate conditions in recent years, or because of a 'bounce back' in demand after reduced water use in response to the millennium drought.[1] The residential demand forecasts are shown in Figure 4.2.

Higher population forecasts released by the Department of Planning and Environment (DPE) in 2016 have not yet been included in the demand forecast. DPE has advised that modelling for the greater Newcastle Metropolitan Plan, due for release in early 2018, indicates that population is now expected to be higher than the 2016 forecast. Hunter Water is in the process of conducting a major review of its demand forecast and will take account of projected increases in population and changes in occupancy rates in the new demand forecast.

HWC has started work on a water conservation strategy as a key input to its IPART pricing submission in mid-2019. This work will build on HWC's existing non-revenue water program (discussed below) and aim to identify water conservation opportunities to reduce residential and non-residential water demand.

[1] Although there were no drought restrictions in the lower Hunter during the Millennium drought, people may have changed their water using behaviours in response to media reports, or restrictions in neighbouring regions.

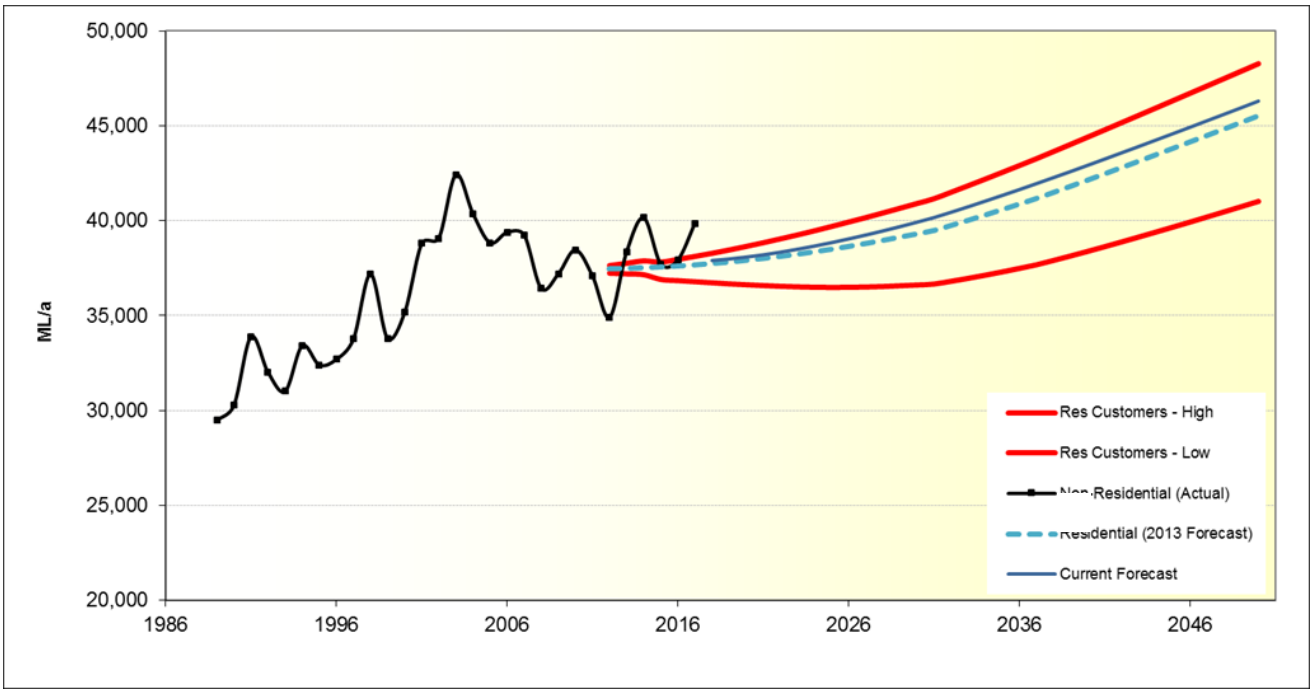

Figure 4.2 Residential water demand forecast (updated Sept 2017)

Non-revenue water (including leakage from the system, firefighting, metering errors and onsite use by HWC) was 11.1 GL in 2016/17, down from 12.2GL the previous year. This reflects HWC's increased effort to reduce leakage from the system through active leak detection and onsite potable water use at a number of its wastewater treatment plants. HWC has set itself a target to reduce non-revenue water to 10GL/year by mid-2019, which is reflected in the 2016/17 forecast for this component of demand (see Figure 4.3).

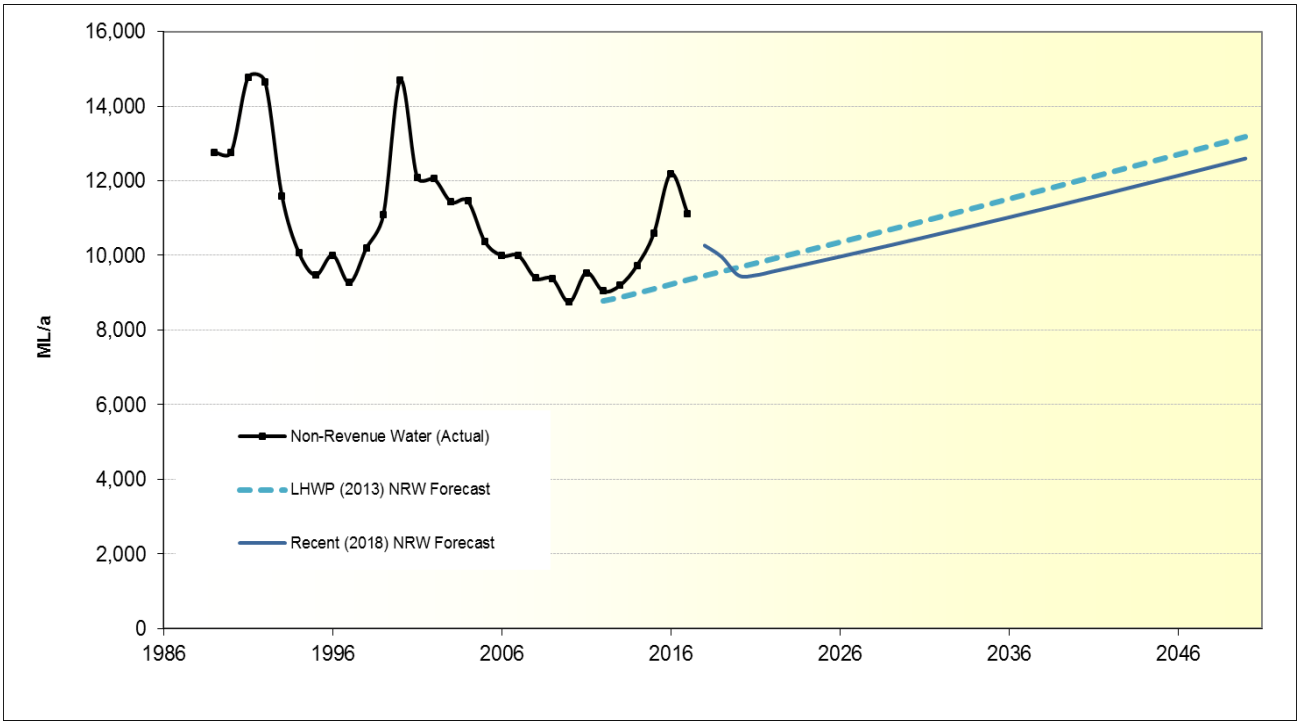

Figure 4.3: Non-revenue water forecast (updated Sept 2017)

Calculation of system yield

There were no changes to the calculation of HWC's system yield (the volume of water that can be reliably supplied each year over the long term) in 2017. The system yield of 76GL/year is based on the current Central Coast transfer link capacity, prior to its planned increase to 30ML/day to meet the terms of the existing transfer agreement between HWC and Central Coast Council.

Modelling a range of alternative transfer regimes between the lower Hunter and the Central Coast identified further potential water security benefits to both regions from changing transfer rules.

HWC noted that a number of supply side risks to water security still exist, including future potential for:

- change due to incorporating pre-instrumental evidence of climate variability from paleo climate records into stochastic modelling
- loss of catchment area within the Tomago Sandbends due to PFAS contamination
- changes to groundwater access following review of the interaction between bore operations and groundwater dependent ecosystems.

Upward and downward pressures on water security, along with alternative measures of security, will be considered as part of the analysis for the next LHWP.

Supply-demand balance

The demand forecast exceeds the yield threshold in 2037-38. This is a two year deferral compared to the original LHWP supply-demand forecast. The supply-demand balance forecast is illustrated in figure 4.4.

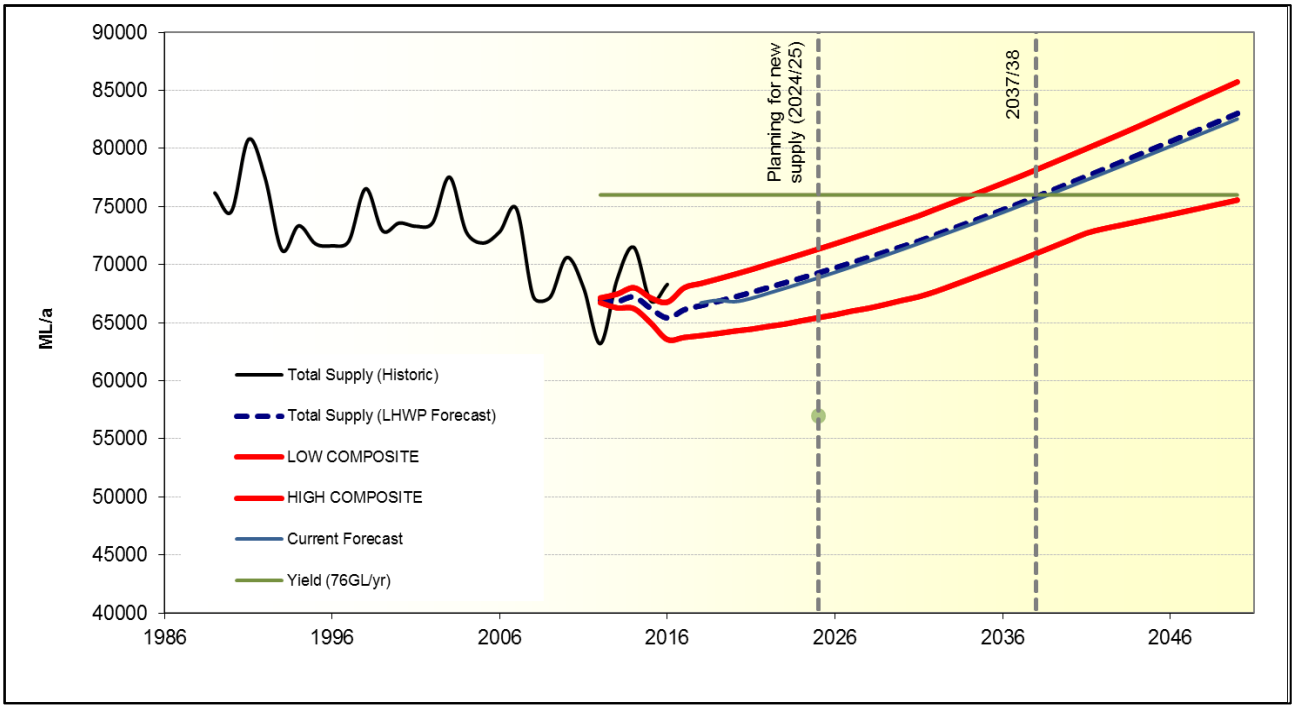

Figure 4.4: Supply-demand balance (updated Sept 2017)

Legend for tables showing MERI findings

Performance (Evaluation Finding Performance)	
	Satisfactory
	Some risks to delivery of LHWP objectives
	Performance is below expectation
	Events have not occurred or actions are not yet due or not assessable due to inadequate information

Table 4.2. Findings for evaluation question EQ 1.3

	Evaluation question	2013/14	2014/15	2015/16	2016/17	Finding	Comment
EQ 1.3	**The underlying premise of the plan is the supply and demand balance. Is the forecast supply and demand balance still consistent with the LHWP's forecast?**						
1.3.1	Is demand trending within the LHWP forecast sensitivity limits? What is the cause of movement outside of the sensitivity range?	Yes	Yes	Yes	Yes		
1.3.2	Have the Level of Service criteria changed and what has been the impact (if any) on the supply-demand balance?	No	No	No	No		To be reviewed as part of developing next LHWP
1.3.3	Is the yield still as expected (75 GL pa)?	Yes	Yes	Yes	No 76GL		Orange traffic light reflects the downward pressures on supply listed on p13.
1.3.4	Is there new information from EQ 4.3 findings that would affect the supply-demand balance?	No	Yes	Yes	Yes		HWC is funding research at the University of Newcastle to investigate methods to combine statistical information from paleo climate reconstruction with instrumental climate records so that better informed synthetic climate data can be generated for use in water resources risk modelling.
1.3.5	Is there new information from the implementation of the actions arising from the peer review of the demand forecast model that would affect the supply-demand balance?	New question added from the mid-term review of the MERI Plan in 2016		No			Some ongoing actions to be followed up as part of process to develop next LHWP.
1.3.6	Is there new information from the implementation of the actions arising from the peer review of the source model that would affect the supply-demand balance?	New question added from the mid-term review of the MERI Plan in 2016		No	Yes		HWC has developed a module to more accurately model water from Tomaree – this may put downward pressure on yield. Some ongoing actions to be followed up as part of process to develop next LHWP.

Action summary

Recommended actions from the evaluation findings for KEQ 1 are summarised below

1. Implement recommendations from the 2016 MERI evaluation not yet completed including:
    - frame the LHWP objectives to articulate the high level goals reflecting strategic priorities, with more specific measurable objectives under the goals (DoI)
    - Incorporate the 2016 population projection into the demand model, along with further analysis of the underlying trends as part of the more comprehensive review of the demand model (HWC)
    - Follow up outstanding actions from the 2013 peer review of the demand forecast as part of developing the next LHWP
    - Follow up outstanding actions arising from the 2013 peer review of the source model as part of developing the next lHWP
2. Review the levels of service criteria as part of developing the next LHWP
3. Examine drivers of increasing residential demand and identify options for cost-effective demand management when developing the next LHWP

5 KEQ 2 How effective are the measures in the plan?

Key findings for KEQ 2

- The non-drought measures have generally been effective and met expectations for the supply, saving and substitution of water, although some 'unders and overs' were observed.
- There was no investment in residential water efficiency programs in 2016/17 because data indicates that adoption of water efficient appliances is close to saturation point.
- The savings from water efficiency measures were higher than the LHWP forecast for 2016/17.
- HWC increased its active leak detection program significantly in 2016/17, with 35% of the supply system surveyed, compared to a forecast of 20%. This resulted in higher than predicted water savings and improved performance against the benchmark 'Infrastructure Leakage Index'
- The volume of recycled water supplied as a substitute for potable water was lower than forecast, due to lower than forecast annual demand for recycled water from the Kooragang Recycled Water Scheme and delays in residential recycling schemes
- Average daily supply of recycled water from the KRWS increased to 7.5 ML/day at the end of 2016/17, bringing expected annual substitution of potable water for 2017/18 to around 2.8 GL/year.

Overview

KEQ 2 aims to evaluate whether the measures in the LHWP, under drought and non-drought conditions, are delivering the desired outcomes. As the lower Hunter has not experienced a drought since the LHWP commenced, this evaluation will focus on answering only EQ 2.2.

Evidence to answer the evaluation questions was sourced from annual reporting spreadsheets documenting the supply, saving and substitution of water, together with HWC's annual Compliance and Performance Reports required under its operating licence.

EQ 2.2 Have the non-drought measures (ie continuing measures) been effective in the supply, saving and substitution of water?

This section discusses how effective the non-drought (i.e. continuing) measures in the LHWP have been in the supply, saving, and substitution of water.

Water supply

HWC supplied sufficient water to meet customer demands from its three main water sources in 2016/17. The lower Hunter's main sources of water supply continue to be surface water from Chichester Dam and Grahamstown Dam (around 90% of supply, although this can vary from year to year), and groundwater from the Tomago and Tomaree sandbeds (around 10% of supply).

In 2016-17 only 6% of water supplied in the lower Hunter was sourced from the sandbeds, because under HWC's optimised operating rules, the surface water sources are used first if water is available. Figure 5.1 shows the supply from surface water and groundwater sources since 2006-07.

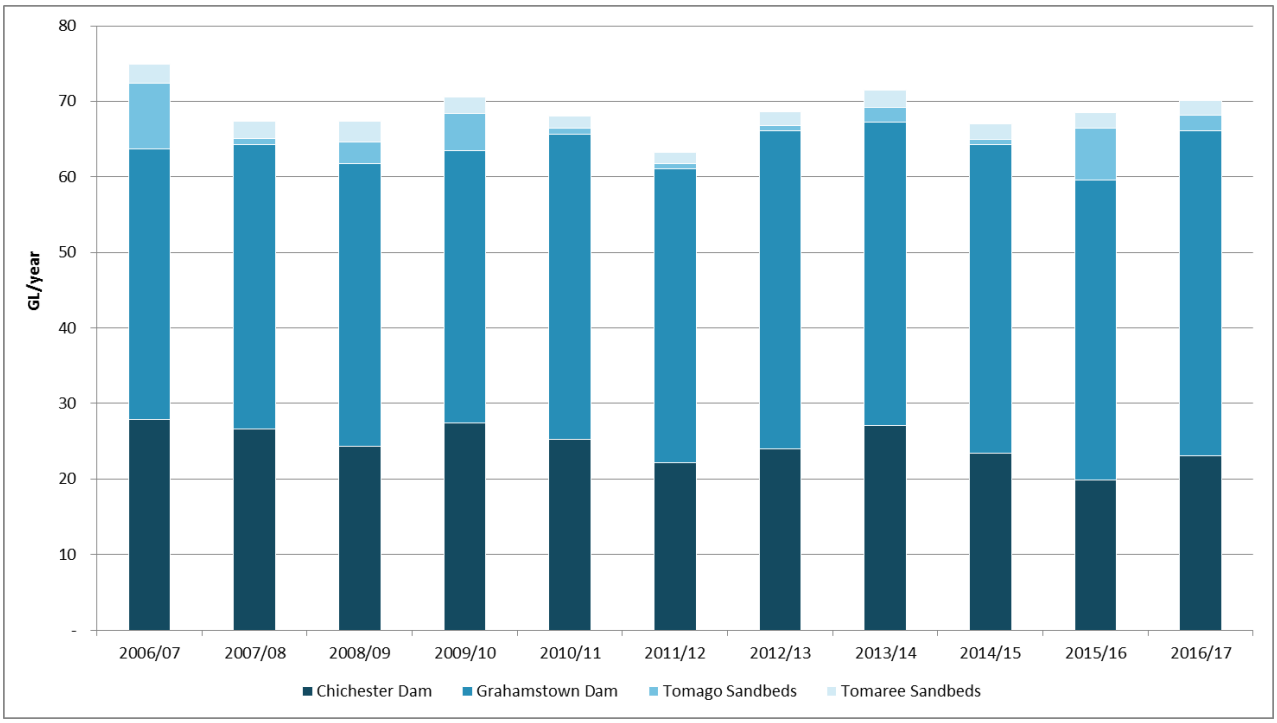

Figure 5.1 Supply from surface water and groundwater sources[2]

Water savings

Water use by sector

The LHWP forecast reductions in water demand from HWC's existing water efficiency and loss minimisation programs. This section compares forecast and actual savings from water efficiency programs. Water conservation from Water Wise Rules is discussed under EQ 4.1.

Figure 5.2 shows the volume of water supplied for each sector (residential, non-residential and non-revenue water) since 2008-09. This shows that:

- Residential water use varies with wet and dry years, but has remained between around 35 and 40 GL per year. Residential use has increased in 2016/17, which could be the result of warmer, drier weather, or could be a 'bounce back' from reductions in household water use in response to restrictions in neighbouring regions during the Millennium drought.
- Non-residential use dropped in 2014-15, as the Kooragang Recycled Water Scheme (KRWS) started to supply water. Non-residential demand has increased slightly in 2016/17.
- 'Other' (non-revenue water) has had an increasing trend over the period, following lags in loss minimisation investment (as reported in the 2016 MERI evaluation). However increased efforts by HWC in 2016/17 have reduced losses from the system. This new trend is expected to continue, as HWC implements programs to meet its target of 10GL/year by mid-2019.

[2] Data source for Figure 4.1: Hunter Water *Compliance and Performance Reports* for 2013-14, 2014-15 and 2015/16, section 6

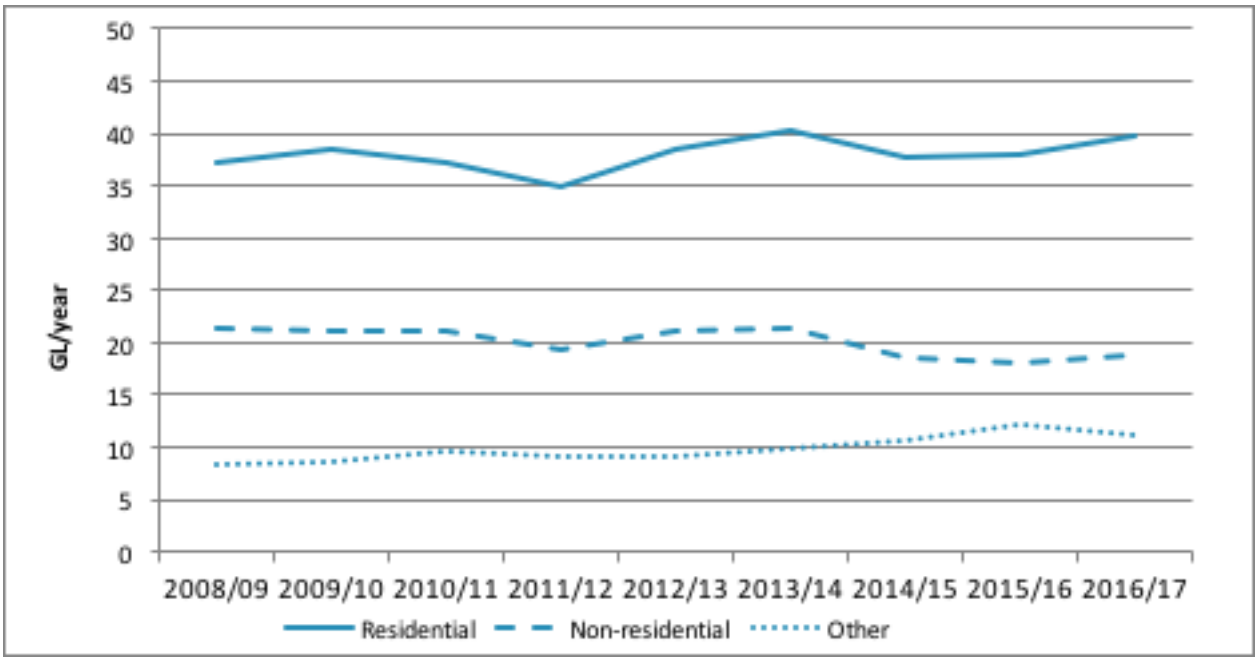

Figure 5.2 Volume of water use by sector[3]

Water efficiency programs

The estimated water savings from water efficiency activities exceeded the savings forecast in the LHWP. This is partly due to appliances being more water efficient than forecast, but in 2016/17, water efficiency savings can also be attributed to HWC's water efficiency programs, including:

- the business water efficiency program, under which four large customer audits were undertaken, identifying around 63 ML of water savings
- a focus on non-revenue water, involving audits of HWC's wastewater treatment plants. The top ten potable water using sites were audited, achieving 49 ML of savings and identifying 40 ML more for investigation in 2017/18
- in addition, around 65 ML of savings identified at Burwood and Dora Creek wastewater treatment plants.

HWC's compliance and performance report sets a target of 250 ML per year reduction in potable water use through water efficiency programs. Water efficiency savings in 2016/17 were slightly less than this, at 235 ML however, average annual savings over the LWHP period have been 266 ML, exceeding the target.

Cumulative water savings from HWC's water efficiency programs since 2007-108 compared with the LHWP forecast are shown in Figure 5.3.

[3] Data source for Figure 4.3: *Compliance and Performance Report*, Hunter Water 2012-2017

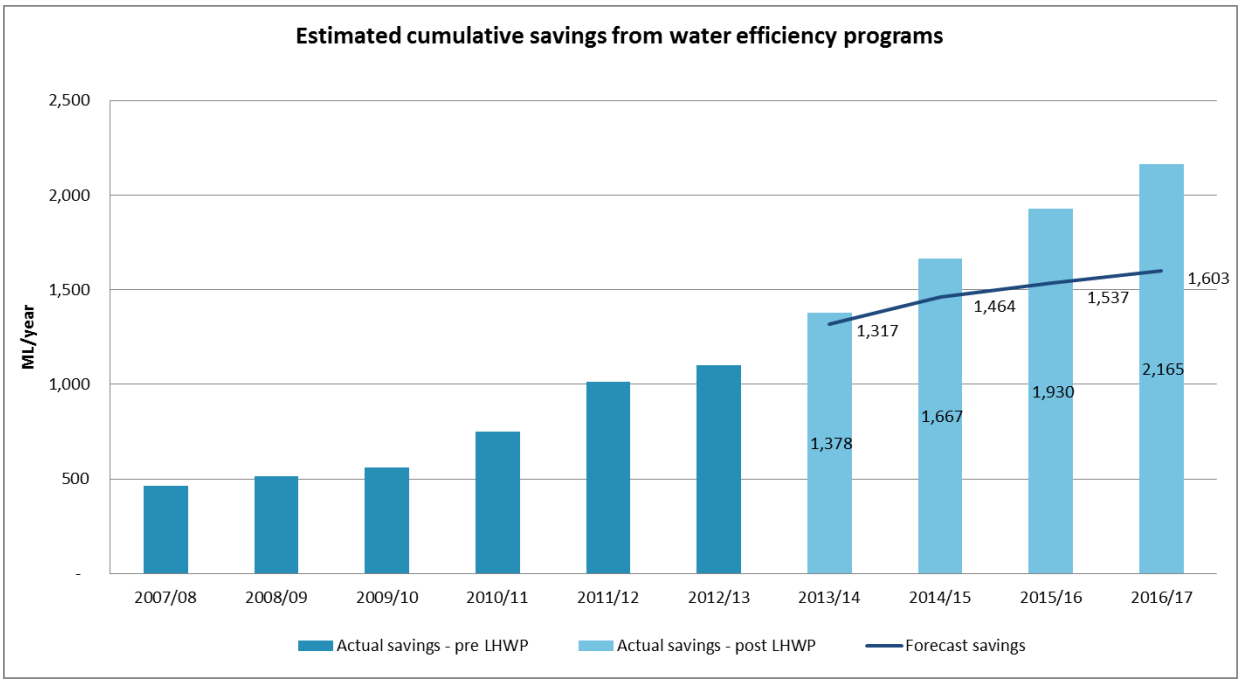

Figure 5.3 Estimated cumulative water savings from water efficiency programs[4]

Water efficiency savings – loss minimisation programs

The main focus of activities to minimise losses from the water supply system involve:

- active leak detection (ALD) and repair (where water loss minimisation is the primary benefit)
- reducing pressure in selected zones with higher pressure (where loss minimisation is a secondary benefit, with the main drivers being related to asset maintenance, asset life, and customer impacts)

The LHWP MERI plan establishes a target of surveying 20% of HWC's water mains for leaks each year under its active leak detection program and completing one pressure management zone each year.

The estimated and actual savings for each year since 2007/08 are shown in Figure 5.4. The estimated water savings from leak reduction was below forecast for each year from 2012-13 to 2015/16, primarily due to delays in implementation of the active leak detection program. The forecast assumed that the delays would be caught up in 2013-14, but this did not start until 2015/16. In 2016/17, the active leak detection program surveyed 35% of HWC's water supply system (compared to the 20% LHWP target) and achieved an estimated saving of 776ML, significantly higher than the 522ML forecast.

The 2016 MERI evaluation reported that there were delays in implementing the pressure management zone scheduled for 2015/16 but that two pressure reduction zones (Charlestown and Edgeworth) would be completed in 2016/17 to achieve the LHWP target of one zone per year. In 2016/17 HWC reported that these zones were not completed in 2016/17, two pressure management zones will be targeted for permanent reductions in pressure from very high to average levels in 2017/18.

[4] Data source for Figure 4.4: 2014 LHWP (graph page 33) and this report, Table 5.1

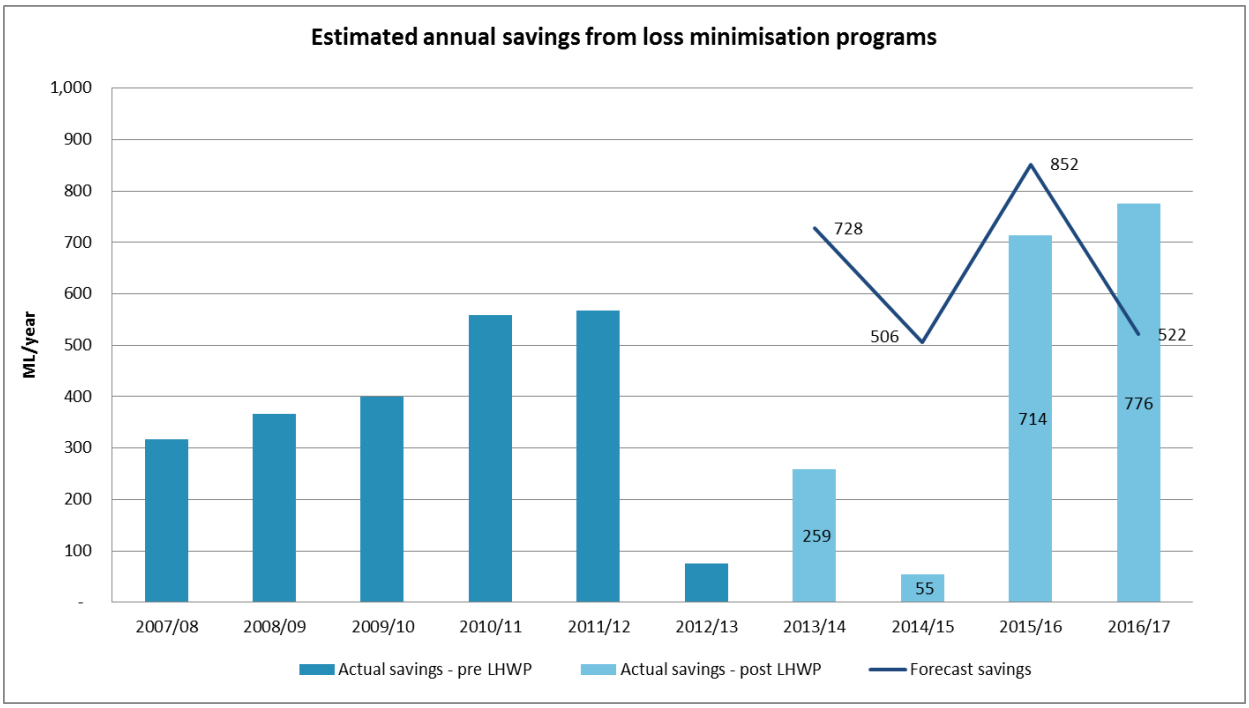

Figure 5.4 Estimated annual water savings from loss minimisation programs[5]

Recommendation 6 of the 2016 MERI major evaluation was to further investigate the reasons for and response to the increasing trend in 'other' (non-revenue) water supply and the Infrastructure Leakage Index as part of developing the next LHWP.

The Infrastructure Leakage Index (ILI) is an internationally-used performance indicator of real (physical) water loss from a water supply network, and is defined as the ratio of current annual real losses to unavoidable annual real losses[6]. The ILI for HWC's network is shown in Figure 5.5.

At the time of the 2016 MERI major evaluation, HWC's drivers for investment in leakage reduction were unclear. The Independent Pricing and Regulatory Tribunal (IPART) had required HWC (via its operating licence 2012-17) to calculate its economic level of leakage (ELL) for investment in leak reduction, however, the linkage between the ELL and HWC's loss minimisation program were not articulated.

Subsequent to release of the 2016 MERI evaluation report, HWC advised that, in the absence of long run marginal cost (due to the fact that the next supply augmentation option is not yet known), the ELL had been calculated based on the short run marginal cost (SRMC) of 12c/kL. This very low cost benchmark meant that most leak reduction projects were not financially viable and that some economically efficient investment in loss minimisation was not made.

During 2016/17, HWC has taken a broader economic perspective and has established an internal target to reduce non-revenue water by 2GL/year by mid-2019. Action towards this target is illustrated in a reduction in the ILI to1.4 in 2016/17 and is expected to result in significantly higher than expected water savings from leakage reduction programs in future years.

In addition, the current operating licence (2017-22) requires HWC to develop a methodology for calculating the economic level of water conservation (ELWC) with respect to leakage reduction,

[5] Data source for Figure 5.4: 2014 LHWP (graph page 33)

[6] 'Real losses' include leakage from water mains, leakage and overflows from reservoirs, and leakage from customer connections up to the property boundary

water efficiency and recycled water. HWC is implementing work programs in these areas, which will contribute to the next LHWP.

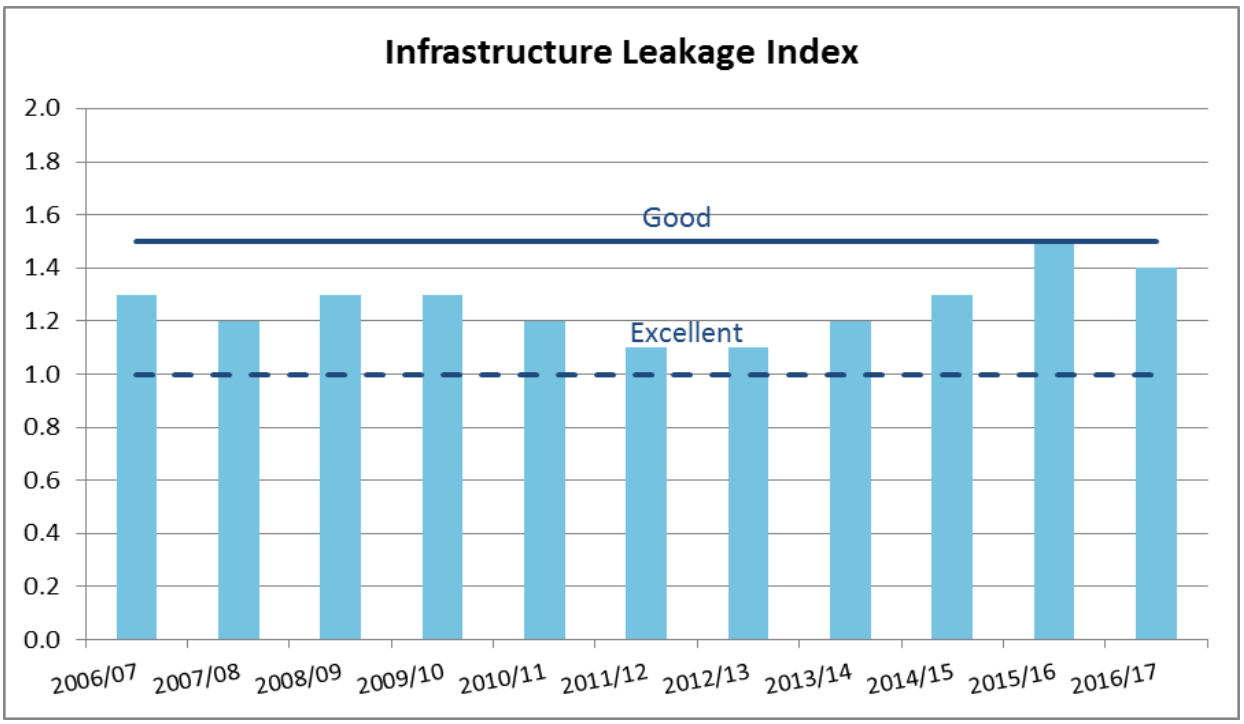

Figure 5.5 Infrastructure leakage index (ILI)[7]

Water substitution – recycled water

The Kooragang Recycled Water Scheme (KRWS) can supply up to 9 ML/day of recycled water to Orica for use in its production processes. Since it was commissioned in 2014, the KRWS has supplied an average of 5.2 ML/day to Orica. This was due to a lower demand from Orica than initially planned, driven by reduced production at the site.

Scheduled maintenance of the plant from February to May 2017 meant that the annual volume of potable demand offset by KRWS was around 1.7 GL/year rather than the LHWP's anticipated 3 GL/year[8]. However, daily recycled use increased to an average of 7.5ML/day during 2016/17, reflecting expanded recycled water use by Orica compared to previous years. This increase is expected to continue, which will result in around 2.75 GL/year of recycled water use at Orica in future, close to the estimated 3 GL/year.

The KRWS has the capacity to increase production of recycled water to 12ML/day. The potential to further increase recycled water from KRWS will be investigated in developing the next LHWP. This was a recommended action of the 2016 MERI Major Evaluation.

Along with recycled water from the KRWS, HWC supplies recycled water for:

- other commercial, industrial and municipal use
- agricultural use
- onsite use at its wastewater treatment plants.

[7] Data source for Figure 5.5: Hunter Water Compliance and Performance Reports

[8] refer SEQ 4.1.11

Total recycled water use in 2016/17 was 5,384 ML, compared with a LHWP forecast of 6,300 ML. Recycled water was lower than forecast mainly because of the lower than expected supply from the KRWS. Recycled water supplied in HWC's area of operations since 2006/07 is shown in Figure 5.6.

The figure also shows increased recycled water for onsite use at a number of HWC's sewerage treatment plants in 2016/17. This reflects HWC's increased efforts to reduce non-revenue water.

Residential recycled water schemes at Chisholm and Gillieston Heights are progressing with detailed design and construction commencing in July 2017. Commissioning of the Gillieston Heights scheme has been delayed until March 2019 to allow additional time for environmental approvals.

HWC has reported that it will develop an internal recycled water strategy in 2018 to explore best practice and identify potentially viable recycled water opportunities. This will help inform options development for the next LHWP.

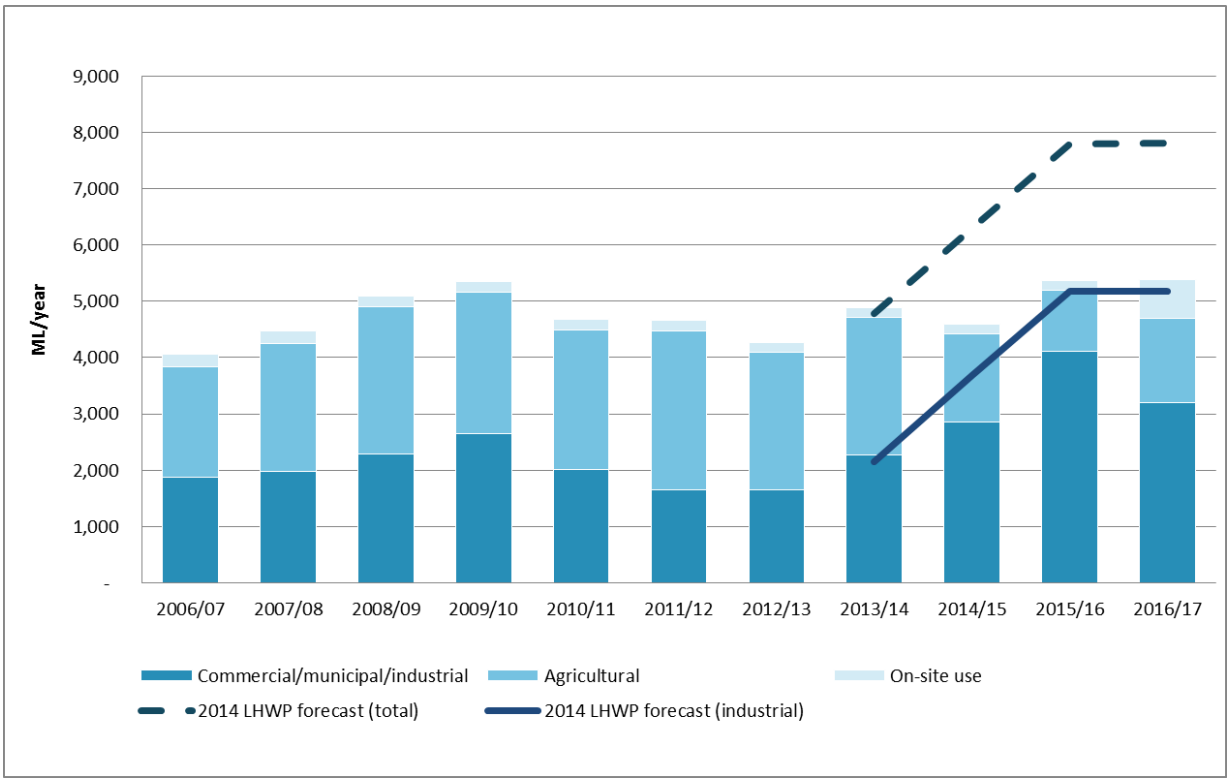

Figure 5.6 Recycled water supplied in HWC's area of operations [9]

[9] Data source for Figure 4.9: 2014 LHWP (graph page 45) and *Compliance and Performance Report 2015/16* (Hunter Water, Sept 2016), Table 8.2, NPR indicators W20-W24

Table 5.2 Findings for evaluation question EQ 2.2

	Evaluation question	2013/14	2014/15	2015/16	2016/17	Finding	Comment
EQ 2.2	**Have the non-drought measures (ie, continuing measures) been effective in the supply, saving and substitution of water?**	Yes	Yes	Yes	Yes		Savings from water efficiency and loss minimisation exceeded forecast.
							Substitution less than forecast due to delays in residential schemes and lower than expected supply from the KRWS (although this has increased in 2017).

KEQ 2 Action summary

Recommended actions from the evaluation findings for KEQ 2 are summarised below

4. Continue to explore opportunities for further water efficiency and recycled water schemes through strategies being developed by HWC and as options for the next LHWP

5. Ensure the economic level of water conservation (ELWC) methodology takes into account societal costs and benefits to ensure efficient investment in loss minimisation, water efficiency and recycled water and is consistent with the approach used for the LHWP analysis

6 KEQ 3: How efficiently has the plan been delivered – timing, delivery and cost?

Key findings for KEQ 3

- Most LHWP actions have been delivered on time, or are on track for delivery in time to achieve LHWP objectives
- HWC and CCC have engaged a consultant to develop a joint WATHNET model to further explore the potential water security benefits to both regions of water transfers and other supply and demand options
- CCC has experienced unavoidable delays in constructing transfer infrastructure and costs have increased. There is a risk that northerly transfers may not be able to be delivered if a drought occurs in the immediate term
- HWC is progressing infrastructure to release improved environmental flows at Seaham Weir and is on track to deliver the project by 2020
- Readiness activities for temporary desalination are underway, but have been delayed by around 12 months. Based on current water storage levels, the measure can still be delivered on time if a severe drought occurs
- The costs for implementation actions are generally close to expected, although some cost data was not available. The most significant change was a higher cost to implement the temporary desalination contingency measure.

Overview

KEQ 3 evaluates the implementation actions established in the LHWP[10] and whether they have been delivered within agreed timeframes or triggers and consistent with expected costs. The two evaluation questions under KEQ 3 are:

- EQ 3.1 – Have the identified implementation actions been delivered within agreed timeframes or consistent with identified triggers?
- EQ 3.2 – Are the implementation actions consistent with the LHWP's expectations for deliverables and cost?

As identified in the 2016 Major Evaluation, the majority of implementation actions are progressing on track and close to expected costs. Where there have been delays, the impact on delivery of the LHWP is not likely to be material because there has been no drought since the plan was released and storage levels are currently high. Similarly, higher than expected costs for some projects do not change the ranking of portfolios considered for the LHWP. More detailed information on factors that have influenced the timing, delivery and costs of the LHWP activities since 2014 is available in the 2016 Major Evaluation report.[11]

In 2016/17, agencies continued work on implementing the LHWP actions, these included:

- inter-regional transfers between the lower Hunter and Central Coast
- implementation of new environmental flow rules for Chichester Dam and Seaham Weir
- investigation of the feasibility of the lower Hunter alluvial aquifer as a potential water supply during drought
- keeping a watching brief on water from underground coal mines on the western side of Lake Macquarie

[10] *MERI Plan for the Lower Hunter Water Plan* (v2.0, Sept 2016), Tables 32 and 33, p117-119

[11] *Lower Hunter Water Plan MERI major evaluation 2016*, Dec 2016, Chapter 5

- ongoing non-residential water efficiency programs
- keeping a watching brief on pricing activities
- investigating stormwater harvesting opportunities as part of water efficiency initiatives for some large customers
- readiness activities for temporary desalination.

Progress against implementation actions in 2016/17 is discussed below. For ease of reading, responses to both EQ 3.1 and EQ 3.2 are reported under each of the actions. A full update on delivery and timing of the implementation actions is provided in Tables 6.2. Costs have not been evaluated in detail, partly because this was done as part of the major evaluation in 2016, but also because there were a number of issues with collecting consistent cost data. This was identified in 2016 and highlights the need for clear articulation of cost data to be collected and reported. This will be addressed as part of the next MERI plan. For the purposes of this report, costs are reported under each of the key LHWP projects where available.

Modelling of inter-regional transfers between the lower Hunter and the Central Coast

Improved modelling of the impact on yield of inter-regional transfers for both regions using existing source models was completed in October 2016. The joint modelling indicated that there is potential for both regions to benefit from changing the transfer regime and a number of options for optimising transfers were modelled.

HWC and Central Coast Council have now engaged an external hydrologic modeller to develop a WATHNET model to improve modelling of transfers between the regions. This project is due for completion by December 2017.

Central Coast Council is developing its long term water supply plan in parallel with the next LHWP. A joint hydro-economic model will allow more accurate modelling of the yield impacts of inter-regional transfers as well as other supply and demand options that could provide mutual benefit to both regions.

There is also potential to include economic capability in the model which would allow the model to be used for hydro-economic modelling for the next LHWP. This will be considered as part of a consultancy to develop a decision framework for the next LHWP.

Infrastructure to increase inter-regional transfers with the Central Coast

HWC and Central Coast Council are responsible for constructing infrastructure to enable more water to be transferred from the Central Coast to the lower Hunter as per the 2006 agreement for inter-regional transfers. Once completed, the infrastructure will increase northbound transfer capacity from around 13 ML/day to 30 ML/day. Transferring water from the Central Coast is a key drought response measure in the LHWP to be triggered when HWC's storage levels reach 60 per cent.

The LHWP indicated that timing for completion of this action was 2017. Agencies have been reporting on progress through the Central Coast Working Group and the LHWSOG.

Both agencies have experienced delays in delivering this project. HWC has now completed most of the project to construct its preferred pipeline, with the detail design and construction contract awarded in April 2017. HWC estimates that the infrastructure is on track for completion by the delivery date of mid-2018 established during the 2016 MERI evaluation.

Central Coast Council's pipeline from Mardi to Warnervale has been further delayed. CCC had planned for the pipeline to be attached to a bridge to cross a wetland. Delays to construction of the bridge mean that the pipeline will not meet the updated completion date of mid-2018. The pipeline will now have to be drilled under the wetland, significantly increasing the cost of the project and delaying delivery until the end of 2019. CCC has reported that detailed design is

currently in final review and specification is being prepared. The draft Review of Environmental Factors is also the subject of internal review. The expenditure in 2016/17 and total project estimates are shown in Table 6.1.

HWC and Central Coast Council have considered the implications of this delay on the LHWP drought response in the event of a drought before the infrastructure is completed. HWC has reported that its infrastructure works will increase the northerly transfers from 13 ML/day to 15 ML/day when they are completed in mid-2018. Flows of up to 20 ML/d may be possible, but there is a risk of excessive pressure (with water hammer as the pumps cut in) at these higher rates.

HWC's water storages are currently at around 85 per cent full. In a severe drought, water storages could fall to 60 per cent within 12 months. If the lower Hunter enters a drought in the immediate future, an inability to deliver sufficient water from the Central Coast could compromise the drought response set out in the LHWP. CCC is considering options to increase northerly transfers if needed in the interim period before the pipeline is complete.

Hunter Water advised DoI (Water) that although it has been delayed, the lead time for delivery of the Central Coast transfers infrastructure from now until its expected delivery in late-2019 is less than the original timeframe for delivery assumed in the LHWP modelling. Given this, the risk to LHWP delivery is not considered to be material and remodelling the portfolio is not necessary at this stage.

The costs of re-routing the Mardi to Warnervale pipeline will significantly increase CCC's project cost. This does not present a risk to delivery of the LHWP, as the infrastructure was part of the pre-existing transfer agreement between HWC and CCC and therefore not a cost attributable to the LHWP. This is also the case for Hunter Water's infrastructure related costs for this measure.

Table 6.1 Costs of infrastructure to increase transfers from the Central Coast

	Expenditure in 2016/17	Total expenditure to 30 June 2017	LHWP estimated cost	Estimated total project cost (2017)	Comment
HWC	$690,000	$282,670 $880,000	$242,680 $2,017,080	$7,600,000	Design costs Revised project total cost estimate increased from $3.4M in 2016
CCC	$1,282,000	$1,499,000	n/a	~$24,000,000	Design costs to date Future construction costs estimate to be updated early 2017

Environmental flows

Chichester Dam

HWC completed minor works at Chichester Dam to enable release of environmental flows agreed during development of the LHWP. DoI (Water) has drafted changes to rules in the Hunter Unregulated Water Sharing Plan (in consultation with HWC) to deliver the agreed environmental flow releases.

To ensure the releases increase flows to the estuary (without affecting volumes that users can take), changes to cease-to-pump rules for Williams River water users are needed. DoI (Water) is preparing communication materials to undertake targeted consultation with these users. Once started, consultation will take six weeks. DoI (Water) is aiming to implement amendments to the WSP to allow the releases from Chichester Dam by mid-2018.

Seaham Weir

HWC is progressing delivery of infrastructure to release environmental flows from Seaham Weir, as agreed during development of the LHWP. HWC will construct a new integrated low to

medium flow gate and fishway structure to allow much better control of the way water is released into the estuary for releases up to around 500ML/day and provide improved fish passage across the weir.

In June 2017, HWC engaged SMEC to undertake concept design for the infrastructure, including scale modelling and environmental assessment. This is on track for completion in mid-2018. Construction is expected in 2020. This is consistent with the timing agreed as part of the 2015 MERI evaluation.

DoI (Water) is working with HWC to establish rules for the Hunter Unregulated Water Sharing Plan that reflect the environmental flow releases at Seaham Weir agreed during development of the 2014 LHWP. DoI (Water) is aiming to include the new rules in the remake of the WSP, due on 1 July 2019.

As an interim measure, HWC has implemented new control systems at Balickera pumping station and Seaham Weir gates in September 2016 to ensure that a specified proportion of river flow is released at Seaham Weir. These 'interim flow rules' use the existing gates at Seaham Weir to better mimic natural flows. This will be significantly improved once the new gates and fishway begin operation.

Table 6.2 Costs of environmental flows

	Expenditure in 2016/17	Total expenditure to 30 June 2017	LHWP estimated cost	Estimated total project cost (2017)	Comment
Chichester Dam	$0	$50,000	n/a	n/a	Completed in 2016
Seaham Weir	$23,000		$5,700,000		

Lower Hunter Alluvial groundwater source

The LHWP initiated studies into a potential groundwater source near the junction of the Hunter and Paterson Rivers – the Lower Hunter Alluvial Aquifer. HWC undertook a range of investigations to attempt to locate the paleochannel and aquifer, including:

- reviewed historical Roads and Maritime Services bore logs
- test drilling in locations based on a conceptual study and from existing Roads and Maritime Services bores
- geophysical investigation using electrical resistivity imaging
- review of ERI data by Professor Ron Boyd
- worked with the University of Newcastle to test the salinity of archived bore logs collected in the 1990s (any water likely to be brackish)
- pilot tests of deep ground penetrating radar in the Morpeth area.

None of the above investigations provided conclusive evidence of the existence of a paleochannel. In 2016/17, further research by HWC suggested that a gravity survey (which measures differences in the underlying rock density) would be more cost effective and accurate in identifying the location of any paleo-channels than deep ground penetrating radar.

HWC engaged a specialist geophysical company, Atlas Geophysics, to carry out the gravity survey. Preliminary results were not conclusive regarding the existence of a paleochannel. Further work is now underway to compare the results of the gravity survey with previous work.

Depending on the outcomes, a decision about whether to pursue further investigations will be made. If there is sufficient evidence to warrant further work, the investigation will follow the steps in the flowchart developed during the 2015 MERI evaluation (see Appendix A).

Rain water and stormwater use

In June 2017, HWC hosted a Water Sensitive Region event to promote a shared understanding of Integrated Water Management and explore opportunities to improve the liveability of the Lower Hunter. During the seminar guests presented on:

- the benefits of integrated planning
- co-operation between government authorities
- definition of a Water Sensitive Region
- current advances in Integrated Water Management and examples of projects where these practices have been successfully implemented.

Further work will be undertaken to progress this initiative in 2017/18 and any opportunities identified will be included in the options for consideration as part of the next LHWP development.

Merewether Golf Club has engaged a consultant to undertake a feasibility study into stormwater harvesting and is also interested in investigating opportunities for recycled water use on the site.

Temporary desalination

The 2016 MERI major evaluation discussed in detail how changes in the scope of temporary desalination readiness had impacted upon the expected costs and timing of deliverables.[12]

At that time, HWC proposed a revised program for delivering temporary desalination, which was approved by the LHWP governance groups and signed off by the Minister as part of the 2016 MERI evaluation report. The revised program:

- included a full Environmental Impact Statement (EIS) and planning approval in 'readiness activities', along with site selection and concept design, which increased the timeframe for this phase from 18 to 24 months, commencing immediately
- set a hold point following planning approval, provided the water storage level was above 65%
- established that procurement for design and construction will be triggered at 65% storage level, with a total timeframe of 24 months, comprising six months for procurement and 18 months for contract delivery (previously 12 months for design and approvals and 12 months for construction)
- confirmed the trigger for operation of the desalination plant at 30% (if construction is complete), with desalinated water to be produced no later than 15% storage level.

HWC also developed a compressed delivery program for temporary desalination in case of a severe drought in the first 12 months of the proposed timeline, whereby some elements of the design and construction procurement could be done in parallel with planning approval processes. Construction could not start until planning approval is granted.

[12] *Lower Hunter Water Plan MERI Major Evaluation 2016*, December 2016, p30-33

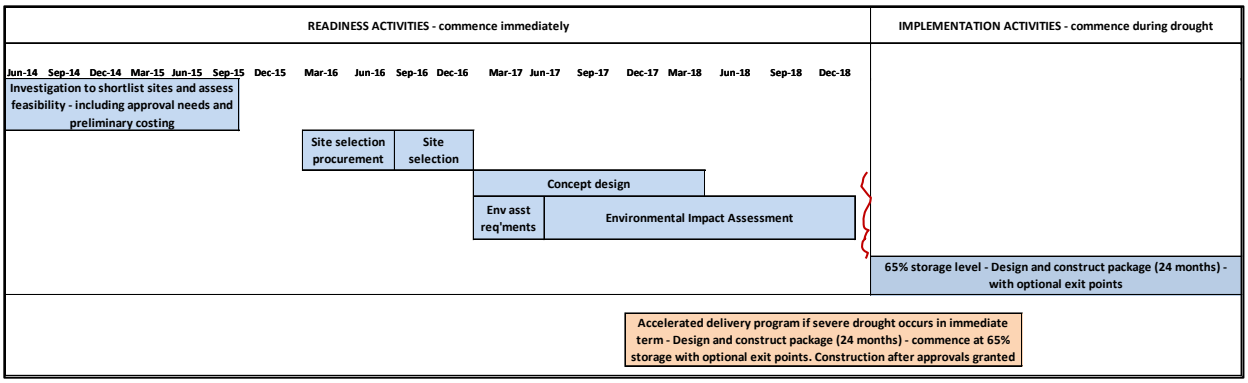

Figure 6.1 Revised timeline for temporary desalination as agreed in 2016

Because of the significant increase in costs and approvals required for temporary desalination identified in 2015/16, it was agreed that HWC would investigate a range of volumes above the 9ML/day modelled for the LHWP, to determine whether greater water security could be cost-effectively achieved with a larger plant. HWC found that increasing the plant size to 15ML/d resulted in only a moderate cost increase and therefore it was agreed to proceed with readiness activities based on this volume.

In 2016/17, HWC has progressed readiness activities for temporary desalination. HWC's consultant, AECOM, completed work on site selection, including a workshop attended by HWC and DoI (Water) in February 2017. Belmont was selected as the preferred site.

A Preliminary Environmental Assessment (PEA) has also been completed for the Belmont site. The PEA will be included in the initial planning approval application that will be submitted to the Department of Planning and Environment in September 2017. Following receipt of the Secretary's Environmental Assessment Requirements (SEARs) from the Department of Planning and Environment, an environmental impact assessment (EIS) will commence and a concept design will be developed for the site.

HWC advised that there has been a delay in the project because while the desalination plant is State Significant Infrastructure (SSI), some associated infrastructure (eg raw water intake) is in a non-prescribed zone and therefore a declaration from the Minister was needed to prescribe it as SSI. HWC received this declaration in mid-November and has now lodged the application for planning approval with the Department of Planning and Environment.

The updated timeline for the temporary desalination project is shown in Figure 6.2. Hunter Water has advised that the project can still be delivered in time if the region experiences a severe drought in the immediate future. This would require some planning activities being done in parallel according to the compressed timeline agreed during the 2016 MERI evaluation. Based on the new timeline, readiness activities for the temporary desalination plan are expected to be finalised in around September 2019.

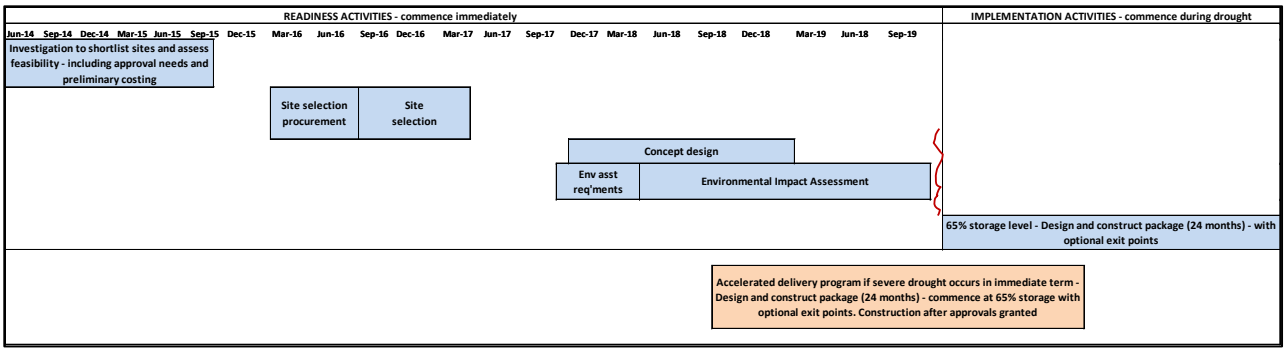

Figure 6.2 Updated timeline for delivery of temporary desalination (2017)

The project will go to HWC's Board of Directors for approval in December 2017 and HWC aims to award a tender for concept design and EIS in March 2018 (following receipt of SEARS). Based on this, the delivery of temporary desalination will be delayed by around nine more months, compared to the 2016 timeline. HWC advises that based on current storage levels of about 85%, the accelerated program would allow the project to be delivered in time in the event of a severe drought.

The expected costs for implementing the temporary desalination measure have increased significantly since the analysis was undertaken for the LHWP. As reported in the 2016 major evaluation and noted above, this cost increase has been driven by the change in scale of the plant from 9 ML/day to 15 ML/day, as well as the requirement to undertake a full environmental impact assessment. Expected costs of construction estimated by AECOM as part of the Preliminary Environmental Assessment are higher than the estimate in 2016.

Hunter Water has modelled the LHWP portfolio with the higher costs included for temporary desalination and has found that it is still the preferred portfolio for the LHWP. This is likely to be because the probability of triggering construction (the highest cost component) is so low that the average expected present value cost remains low when it is calculated over a large number of replicates (possible climate scenarios) in the hydro-economic model.

Table 6.3 summarises the costs for each stage of temporary desalination based on the original LHWP estimate, the updated estimate in 2016 and the current estimate.

Table 6.3 Comparison of cost estimates for temporary desalination

Stage	LHWP assumed cost for 9ML/d plant	Estimated cost for 15ML/d plant (2016)	Revised cost for 15ML/d plant (2017)
Readiness	n/a	$2,000,000	$1,700,000
Trigger 1	$23,000	$3,000,000	$4,900,000
Trigger 2	$23,000,000	$59,400,000	$84,100,000
Total	**$25,500,000**	**$64,400,000**	**$90,700,000**

Table 6.2 Summary of findings for EQ 3.1

EQ 3.1	Have the identified implementation actions been delivered within agreed timeframes or consistent with identified triggers? What are the reasons for any significant variation and how can this understanding improve delivery of the plan?						
Category	**Implementation action / deliverable**	**Who**	**LHWP timing**	**Actual/ Expected**	**Status**	**Finding**	**Comments**
Surface water	Construct infrastructure to transfer more water from the Central Coast to the lower Hunter as per existing agreement	HWC	2017	mid 2018	Delayed		Detail Design and Construction contract awarded in April 2017 – project on track for new delivery date of mid-2018. Mardi to Mangrove pipeline delayed due to factors beyond CCC's control
		CCC	2017	End 2019	Delayed		
	Develop an improved model for inter-regional transfers with the Central Coast	HWC, CCC	Oct 2015	May 2016	Complete		
	Investigate options to optimise water transfers with a view to enhancing existing transfer agreement if required/ appropriate	HWC, CCC, DoI (Water)	Oct 2016	Oct 2016	Complete		Potential transfer arrangements will be available for consideration during development of the next iteration of the LHWP. WATHNET model now in development for joint modelling of options for both regions
	Implement new environmental flow rules for Chichester Dam	DoI (Water), HWC	Not specified	Estimated mid-2018	Delayed		Amendments to Hunter Unregulated River Water Sharing Plan delayed – awaiting approval for targeted consultation with Williams River users
	Implement new environmental flow rules for Seaham Weir	DoI (Water), HWC	Not specified	July 2019	On track		
Groundwater	Consider any implications for the LHWP arising from review of the Water Sharing Plan for the Tomago Tomaree Stockton groundwater sources	DoI (Water)	July 2014	Apr 2015	Completed		NCCS WSP commenced on 1 July 2016, with provision for amendments based on recommendations from inter-agency review

EQ 3.1	Have the identified implementation actions been delivered within agreed timeframes or consistent with identified triggers? What are the reasons for any significant variation and how can this understanding improve delivery of the plan?						
Category	**Implementation action / deliverable**	**Who**	**LHWP timing**	**Actual/ Expected**	**Status**	**Finding**	**Comments**
	Investigate feasibility of Lower Hunter Alluvial for drought supply	HWC	Not specified	June 2016	Delayed		HWC engaged a consultant to undertake a gravity survey to try and locate the potential aquifer. Review of all investigations suggests that there may be an aquifer but that it is likely to be saline and highly connected to the Hunter River. Investigation is ongoing.
	Watching brief on use of water from underground mines	DoI (Water)	Not specified	Ongoing	Ongoing		CSIRO is seeking funding for a pilot FO/RO plant at the Newstan mine
Water efficiency	Continue existing water efficiency programs	HWC	Ongoing	Ongoing	Ongoing		See EQ 2.2
Demand management	Introduce Water Wise Rules	HWC	July 2014	July 2014	Delivered		
	Watching brief on pricing issues	DoI (Water)	Ongoing	Ongoing	Ongoing		In 2016/17, IPART reviewed the prices Sydney Water and HWC can charge for wholesale water and sewerage services. IPART established wholesale pricing arrangements for existing schemes, new schemes with a recycled water plant and new schemes without a recycled water plant.[13]
Recycled water	Dual reticulation schemes at Chisholm and Gillieston Heights as development proceeds	HWC	Not specified	2018 / 2019	Delayed		Concept Design for the Chisholm and Gillieston Heights RW schemes complete. Detailed Design and

[13] *Prices for wholesale water and sewerage services – Sydney Water Corporation and Hunter Water Corporation*, IPART 2017

EQ 3.1	Have the identified implementation actions been delivered within agreed timeframes or consistent with identified triggers? What are the reasons for any significant variation and how can this understanding improve delivery of the plan?						
Category	**Implementation action / deliverable**	**Who**	**LHWP timing**	**Actual/ Expected**	**Status**	**Finding**	**Comments**
							Construction commenced in July 2017. Commissioning of the Gillieston Heights recycled water scheme delayed from Dec 2018 to Mar 2019, to allow additional time for environmental approvals.
	Complete the Kooragang Recycled Water Scheme	HWC	Dec 2014	Nov 2014	Complete		
	Assess future expansion opportunities	HWC	Ongoing	Ongoing	Ongoing		Consider as part of developing next LHWP
Rainwater and stormwater use	Trial with Lake Macquarie Council to better understand rainwater tank failures and educate participants	HWC	June 2014	July 2015	Complete		
	Liaise with Councils to encourage potential stormwater harvesting schemes	HWC, DoI (Water)	Ongoing	Ongoing	Ongoing		HWC investigating ways to improve liveability through integrated water management. Further work will be undertaken to progress this initiative in 2017.
	Consider stormwater harvesting as part of large customer water efficiency initiatives	HWC	Ongoing	Ongoing	Ongoing		Merewether Golf Club is investigating opportunities for stormwater harvesting and recycled water. No progress with Hunter Stadium due to its funding constraints and no stormwater harvesting opportunities identified through large customer audits in 2016/17.
Temporary desalination	Readiness activities - site selection, technical and environmental	HWC	Dec 2015	Sep 2019	Delayed		A preferred site has been selected. HWC is progressing with concept

EQ 3.1	Have the identified implementation actions been delivered within agreed timeframes or consistent with identified triggers? What are the reasons for any significant variation and how can this understanding improve delivery of the plan?						
Category	**Implementation action / deliverable**	**Who**	**LHWP timing**	**Actual/ Expected**	**Status**	**Finding**	**Comments**
	investigations and review of procurement options						design and EIS. Project is around 9 months behind Dec 2018 delivery date
	Water quality monitoring program for preferred sites	HWC	tbc	Dec 2018	Ongoing		Water quality monitoring was removed from the scope of the Site Selection investigations. Water quality monitoring will now be carried out during 2018 as part of the EIS and concept design process for the Belmont site.
	Watching brief on improvements in desalination technology	HWC	Ongoing	Ongoing	Ongoing		Various intake options were considered during the Site Selection process. The Concept Design for the Belmont site will take into consideration current technologies and site requirements. CSIRO is pursuing funding for a pilot Forward Osmosis/Reverse Osmosis plant at Newstan Colliery.
	Liaison with Central Coast regarding desalination as a contingency drought measure	DoI (Water)	Ongoing	Ongoing	Ongoing		The potential for shared water security measures between the lower Hunter and Central Coast will be considered as part of developing the next LHWP and the Central Coast Water Plan.

KEQ 3 Action Summary

Recommended actions from the evaluation findings for KEQ 3 are summarised below:

6. HWC to re-run the hydro-economic model with current costs for temporary desalination to ensure it is still part of the preferred portfolio

7. DoI to convene the E-flows working group for an update on infrastructure at Seaham Weir and to agree a timeline for amending the Hunter Unregulated River Water Sharing Plan in early 2018

8. DoI to convene the Groundwater working group for an update on research into groundwater dependent ecosystems at Tomago and Tomaree, an update on the implications of groundwater contamination at Williamtown for water security and to agree a way forward for including impacts of groundwater extraction into the analysis for the next LHWP

7 KEQ 4: Do the measures in the plan remain appropriate? Assumptions and new information

Key findings for KEQ 4

- Most assumptions underpinning the LWHP are appropriate
- Accessible storage at Tomago and Tomaree Sandbeds will be reviewed as part of developing the next LHWP, to consider supply side risks and incorporate new information
- Hunter Water is funding research by the University of Newcastle to combine paleoclimate data with the instrumental climate record to understand impacts on water security modelling
- Delays in constructing infrastructure to increase water transfers north from the Central Coast during drought poses a risk to the LHWP drought portfolio
- It was not possible to determine whether Water Wise Rules resulted in a 2.5% reduction in residential water demand

Overview

This section considers whether the measures in the plan are affected by new information, changes in the regulatory and operating regime, or other developments such as new technology or information. If new information about water volumes, lead times or costs would substantially change the assumptions used in the portfolio analysis, it may be necessary to re-model the portfolios to test whether the measures remain optimal. The MERI plan establishes that if modelling indicates that the portfolio is no longer preferred, a major LHWP review will be triggered.

EQ 4.1 Are the assumptions underpinning the LHWP still appropriate?

Most of the assumptions underpinning the LHWP remain appropriate. Only the assumptions indicate a risk to delivery of LHWP objectives, or have consistently performed below expectations are discussed below.

Assumptions about groundwater sources

SEQ 4.1.3 Does the accessible storage level of Tomago Sandbeds remain at least 60,000 ML?

SEQ 4.1.8 Is the assumption that Tomaree aquifer can deliver a constant sustainable supply of 7 ML/day still valid?

As noted in the 2016 MERI evaluation, the accessible storage from these sources may be significantly affected by changes to the North Coast Coastal Sands Water Sharing Plan. Potential changes to the regulatory environment are discussed further under EQ 4.2. Changes to assumptions relating to the sandbeds that could impact the LHWP are discussed below.

Depending on outcomes of the analysis for developing the next LHWP and of the research into the impacts of extraction on groundwater dependent ecosystems the accessible storage volume from Tomago and Tomaree Sandbeds could be reduced in the water sharing plan. Modelling indicates that this could reduce the system yield by up to 4.5 GL (current yield is 76 GL).

Modelling for the LHWP assumed that Tomaree aquifer can deliver a constant supply of 7 ML/day. This was a simplified rule in the absence of a specific module in HWC's source model.

HWC has now developed a module for Tomaree in the model. Modelling results are not yet available, but preliminary indications are that the yield will be lower than assumed.

These changes to assumptions could bring forward the intersection of the supply-demand balance by around eight years.

In addition, HWC has reported that if bores need to be abandoned because of PFAS contamination originating from the Williamtown RAAF Base, the impact on yield could be in the order of 1.5 GL/year.

Until more information is available about these potential impacts on yield from groundwater sources, the assumed accessible volume will remain at 60 GL/year.

Assumptions about future climate

SEQ 4.1.7 Is future climate represented by historical climate records as of 2012? How do changes impact on supply (yield) modelling?

It is widely recognised that there are very significant uncertainties about future climate and assumptions that the instrumental climate record of the last 100 years can generate stochastic climate scenarios to accurately represent future climate.

The 2016 MERI evaluation recommended incorporating the outcomes of the latest research into climate change and climate variability into the planning process to develop the next LHWP.

HWC is funding research at the University of Newcastle to investigate methods to combine statistical information from paleoclimate reconstruction with instrumental climate records so that better informed synthetic climate data can be generated for use in water resources risk modelling.

Assumptions about recycled water

SEQ 4.1.11 Has Kooragang Recycled Water Scheme offset 3 GL per annum of potable water use from December 2014

A large component of potable water substitution in the LHWP was recycled water from the KRWS. Modelling for the LHWP assumed that the plant would supply 9 ML/day of recycled water to Orica, equating to an average annual substitution of around 3 GL. Since the plant was commissioned in 2014, it has supplied an average of 5.2 ML/day.

Recycled water production was low in 2016/17 due to a shutdown for maintenance February to May 2016 and the plant offset only 1.6GL of potable water use. However, recycled water usage has increased to an average of about 7.5ML/d since June 2016. The increase is a result of expanded utilisation by Orica and is expected to continue.

Based on the recent increased daily supply of recycled water in 2016/17, the KRWS would be expected to offset 2.8GL of potable water use in 2017/18, close to the assumption in the LHWP.

Assumptions about Central Coast Transfers

SEQ 4.1.23 Can Central Coast transfers supply an average of 30ML/day northbound by 2017?

As discussed in Chapter 6, there have been delays in delivering infrastructure to increase transfers north from the Central Coast to the lower Hunter as per the transfer agreement between HWC and CCC.

The 2105 MERI evaluation established a new delivery date of mid-2018 and HWC is on track for this timeframe. CCC has experienced a further unavoidable delay in delivering the Mardi to Warnervale pipeline, which is now expected to be completed in late-2019.

Transferring water from the Central Coast is a key drought response in the LHWP and modelling assumed that 30ML/day would be transferred once HWC's storage levels reached 60%. Under both moderate and extreme drought scenarios modelled for the LHWP, storages could reach 60% within 12 months.

Hunter Water has advised that once it completes its part of the project, there will be capacity to transfer 15ML/day. Up to 20ML/day will be possible at times, but this is likely to cause pressure problems.

Central Coast Council has advised that it is investigating the potential to transfer more water north before the pipeline is complete. If it is not possible to increase the transfer capacity, this may jeopardise the LHWP portfolio's ability to withstand drought.

Assumptions about Water Wise Rules

SEQ 4.1.24 Does the application of Water Wise Rules result in a demand reduction of 2.5% of residential water demand?

Water Wise Rules were implemented in July 2014 as an immediate priority of the LHWP. The rules require households to use trigger nozzles on hoses, limit hours of water use to before 10am and after 4pm to avoid the heat of the day, prohibit hosing of hard surfaces.

The 2016 MERI evaluation identified that while there had been a downward trend in residential water use since WWR were implemented, it was not possible to distinguish how much of this reduction in use could be attributed to WWR, compared with savings from improvements in household water efficiency and variability due to weather conditions.

HWC does not currently use analysis tools that allow corrections for variations in weather from year to year, so cannot adequately isolate the water savings resulting from the implementation of Water Wise Rules.

In 2016/17, residential water use increased (see Chapter 4) and the residential demand forecast also rose. This could be due to hotter weather over the seven-year average, or due to 'bounce back' of demand if households had previously reduced water use behaviour in response to the Millennium drought, even though restrictions were not in place in the lower Hunter.

The assumptions relating to WWR impact on the assumptions for water restrictions in the event of a drought.

HWC advised that as part of the major review of its demand forecast, it will consider including a climate correction module in the demand model. This will support assessment of the effectiveness of demand management measures such as WWR and drought restrictions in future.

EQ 4.2 Is the regulatory and operating environment still consistent with the LWHP?

The 2016 MERI evaluation noted that while the regulatory and operating environment is generally consistent with the 2014 LHWP, there were a number of supply side risks that had the potential to impact the supply-demand balance, including:

- Changes to groundwater access conditions for the Tomago and Tomaree sources, arising from review of the North Coast Coastal Sands Water Sharing Plan
- Operational changes for the Tomago source, in response to groundwater contamination from the Williamtown RAAF Base
- Potential diversion of flows from Campvale Canal to mitigate risks to water quality in Grahamstown Dam.

Investigations into these risks are ongoing and any impacts on the supply-demand balance will be considered as part of developing the next LHWP.

HWC's operating environment will be different for the next LHWP because of stronger linkages with CCC's water system and long term planning program. Exploring how operation of the two systems can be optimised, as well as opportunities for synergies in investment may result in benefits for both regions.

The Upper Hunter Regional Strategy being developed by DoI (Water) may identify further opportunities for more optimal investment through operation of a broader water network. In addition, DoI (Water) has collaborated with the University of Technology Sydney, to develop a catchment needs assessment framework tool, which could also identify opportunities in the lower Hunter.

EQ 4.3 Has new technology, information or methods emerged that will influence the measures and their implementation?

As noted elsewhere in this report, climate variability is a key driver of water planning and there is a high level of uncertainty associated with it.

Population information

The NSW Department of Planning and Environment released updated population projections and occupancy rates in 2016 indicating that population is now expected to be higher than previously forecast. This has not yet been incorporated into Hunter Water's demand forecasts.

Subsequent to this, the Greater Newcastle Metropolitan Strategy, to be released in 2018, indicates that population is likely to be even higher than indicated by the 2016 projections.

Hunter Water will incorporate the latest population estimates in its review of the demand forecast modelling and potential implications will be considered in the next MERI evaluation and incorporated into development of the next LHWP.

Climatic modelling

Research into pre-instrumental hydroclimatic variability has been undertaken, using paleoclimate proxies, to better understand low-probability, high-consequence events more extreme than those in the instrumental record.

HWC is funding research at the University of Newcastle to investigate methods to combine statistical information from paleoclimate reconstruction with instrumental climate records so that better informed synthetic climate data can be generated for use in water resources risk modelling. This may help inform water security modelling for the next LHWP.

Desalination technology

As noted in the 2016 MERI evaluation report, the CSIRO is seeking funding to undertake research into forward osmosis/reverse osmosis (FO/RO) desalination to treat mine water at Centennial Coal's Newstan colliery. FO/RO has the potential to significantly reduce the costs and emissions of desalination and result in higher potable water recovery rates.

If feasible, this technology could make desalination options more feasible for consideration as options for future iterations of the LHWP.

Table 7.1 Summary of findings for KEQ 4

EQ 4.1 Are the assumptions underpinning the LHWP still appropriate							
	Question	**2013/14**	**2014/15**	**2015/16**	**2016/17**	**Finding**	**Comment**
	Are the assumptions underpinning the LHWP still appropriate? **Do any changes influence the measures and implementation actions in the LHWP?**						
4.1.1	Does the accessible storage at Chichester Dam remain at least 18,357 ML?	Yes	Yes	Yes	Yes		No comment
4.1.2	Does the accessible storage at Grahamstown Dam remain at least 182,400 ML?	Yes	Yes	Yes	Yes		No comment
4.1.3	Does the accessible storage level of Tomago Sandbeds remain at least 60,000ML?	?	?	?	Yes		Orange traffic light recognises supply side risks to the groundwater source from PFAS contamination and potential reduction in assumed access under the WSP to be assessed as part of development of next LHWP
4.1.4	Is the surrogate method of modelling transfers representative of Central Coast transfers under the existing agreement? OR If new inter-regional modelling capacity is developed, do the inter-regional models accurately represent transfers under the existing agreement?	Yes	Yes	Yes	Yes		No comment
4.1.5	Can 90% of pumpable water from Williams River be transferred?	Yes	Yes	Yes	Yes		No comment
4.1.6	Does the current source strategy for Tomago continue to apply / operate? *When the storage in Tomago Sandbeds (in % terms) exceeds the storage in Grahamstown Dam by more than 5%, Tomago is operated at 45ML/day.* *When overall system storage is between 40% and 70%, Tomago Sandbeds is operated at 75ML/day unless it runs out of water.* *When overall system storage is below 40%, Tomago Sandbeds is operated at 45ML/day whenever water is available in Tomago Sandbeds.*	Yes	Yes	Yes	Yes		As noted elsewhere, Tomago operation is currently impacted by PFAS concerns, with Stations 5, 7 and 9 currently isolated. The ongoing impact of PFAS on Tomago operation is unclear, with treatment and blending strategies yet to be investigated.
4.1.7	Is future climate represented by historical climate records as of	Yes	Yes	Yes	Yes		Orange traffic light recognises high uncertainty around

EQ 4.1 Are the assumptions underpinning the LHWP still appropriate							
	Question	**2013/14**	**2014/15**	**2015/16**	**2016/17**	**Finding**	**Comment**
	2012? How do any changes impact on supply (yield) modelling?				 N/A		climate modelling and the potential for greater variability based on inferred paleoclimate records. HWC has engaged a consultant to investigate including paleo climate data in to stochastic climate modelling for water planning and yield modelling. Impact on yield not yet quantifiable
4.1.8	Is the assumption that Tomaree aquifer can deliver a constant sustainable supply of 7ML/d still valid?	Yes	Yes	Yes	No		A model of the Tomaree Sandbeds has been developed so that this assumption can be replaced by a rule based approach in the next iteration of the LHWP
4.1.9	Is 10% total storage representative of nearly empty?	Yes	Yes	Yes	Yes		No change
4.1.10	Is the actual non-residential use trending close to the base case forecast?	Yes	Yes	Yes	Yes		Non-residential use in 2016/17 was 18.6 GL. This is lower than the LHWP demand forecast of 18.9 GL, but higher than the most recent forecast of 18.1 GL. The non-residential actual demand is within the sensitivity bounds for large water users.
4.1.11	Has Kooragang Recycled Water Scheme offset 3 GL/year of potable water use from Dec 2014?	n/a	No	No	No		KRWS offset 1.6GL of potable water use in 2016/17. Recycled water production was low in Feb to May 2016 due to a shutdown for maintenance. Recycled water usage has increased to an average of about 7.5ML/d since June 2016. The increase is a result of expanded utilisation by Orica and is expected to continue.
4.1.12	Have the revised environmental flow rules for Chichester Dam and Seaham Weir been implemented? Do the revised environmental flow rules better reflect natural flow variability?	n/a	n/a	n/a	No	  	DoI (Water) delayed in amending the Hunter Unregulated River WSP for implementing Chichester flows. HWC and DoI (Water) are on track for implementation at Seaham when new gates and fishway are constructed in 2020. Interim rules have been implemented at Seaham Yes

EQ 4.1 Are the assumptions underpinning the LHWP still appropriate							
	Question	**2013/14**	**2014/15**	**2015/16**	**2016/17**	**Finding**	**Comment**
4.1.21	Are the triggers for commencing temporary desalination still appropriate for minimum lead time? *(ie, it is assumed that commencing design and approval no later than 65% total storage level and construction no later than 35% will enable operation to commence no later than 15%)*	Yes	No	No	No		New triggers and activities at each trigger level were agreed as part of the 2016 MERI evaluation. See Implementation Actions table for detail.
4.1.22	Can temporary desalination units supply a minimum of 9ML/d? (ie, capability)	n/a	n/a	n/a	Yes		The site selected is capable of accommodating a temporary desalination plant producing up to 15 ML/d of potable water into the adjacent water supply network.
4.1.23	Can Central Coast transfers supply an average of 30ML/d northbound by 2017?	No	No	No	No		HWC infrastructure will be ready to receive 30 ML/day by mid- 2018, but works by CCC have been delayed beyond this until late-2019
4.1.24	Does the application of Water Wise Rules result in a demand reduction of 2.5% of residential demand?	n/a	?	?	?		Water Wise Rules were introduced on 1 July 2014.
4.1.25	Are the Water Wise Rules cost assumptions still valid?	n/a	Yes	Yes	Yes		Water wise rules cost $85,000 in 2016/17. This is slightly lower than the assumption in the LHWP of $120,000 per year.

EQ 4.2 Is the regulatory and operating environment still consistent with the LHWP?							
	Do any changes influence the measures and implementation actions? *Issues include but are not limited to:* • *Institutional arrangements* • *HWC regulatory environment* • *BASIX* • *Environmental regulation changes which may impact on the viability of measures in the plan (eg, EEC, threatened species)*	No	No	No	Yes		Potential changes to groundwater access will be incorporated into the major review of the LHWP.

EQ 4.3 Has new technology, information or methods emerged that will influence the measures and their implementation?							
	Do any changes influence the measures and implementation actions in the LHWP? *Key issues include but are not limited to:* • *Population forecasts or forecasting methods* • *Climate modelling* • *Results of testing demand forecast assumptions* • *Technology or measures that didn't make the plan* • *Desalination technology* • *Relevant changes in other water authority practices to improve best practice* • *Relevant media for emerging issues* • *Potential to use contingency measures not included in the LHWP*	No	Yes	Yes	Yes		Research to investigate combining paleoclimate reconstruction with instrumental climate records so that better informed synthetic climate data can be generated for use in water resources risk modelling. Greater integration of planning with CCC will potentially provide benefits to both regions Upper Hunter Regional Strategy being developed by DoI (Water) may identify opportunities for water sharing

KEQ 4 Action Summary

Recommended actions from the evaluation findings for KEQ 4 are summarised below

9. CCC to investigate and report on options for increasing the volume that can be transferred north if a drought occurs before the Mardi to Warnervale pipeline is completed

10. HWC to remodel the LHWP drought portfolio assuming that Central Coast transfers can deliver 15ML/d and any increased options provided by CCC to better understand the impact of the delay in transfer infrastructure

11. Where appropriate, take findings from paleoclimate research into account in the hydrologic modelling and economic analysis for the next LHWP

12. HWC to investigate including a climate correction model in the demand forecast model to better understand the impact of weather on demand and the water savings from WWR, demand management and water efficiency measures

8 Conclusions and recommendations

The key findings from the 2017 evaluation of the LHWP are summarised below:

- Supply and demand modelling indicates that the region's water supply is secure until 2037-38, two years later than the LHWP forecast
- Total demand is trending within forecast sensitivity limits and the 2017 forecast for 2035-36 is slightly lower than the LHWP forecast
- The 2017 residential demand forecast is above the 2013 LHWP forecast, while the forecasts for non-residential and non-revenue water are below the LHWP forecast
- HWC is planning to develop a water conservation strategy in 2018 to identify options that can be implemented in the next 18 months, prior to the next LHWP
- HWC has engaged a consultant to generate paleoclimate informed stochastic rainfall and streamflow data as an input to the hydrologic models to better account for climate variability over thousands of years (before instrumental climate records)
- The non-drought measures have generally been effective and met expectations for the supply, saving and substitution of water, although some 'unders and overs' were observed.
- There was no investment in residential water efficiency programs in 2016/17 because data indicates that adoption of water efficient appliances is close to saturation point.
- The savings from water efficiency measures were higher than the LHWP forecast for 2016/17.
- HWC increased its active leak detection program significantly in 2016/17, with 35% of the supply system surveyed, compared to a forecast of 20%. This resulted in higher than predicted water savings and improved performance against the benchmark 'Infrastructure Leakage Index'
- The volume of recycled water supplied as a substitute for potable water was lower than forecast, due to lower than forecast annual demand for recycled water from the Kooragang Recycled Water Scheme and delays in residential recycling schemes
- Average daily supply of recycled water from the KRWS increased to 7.5 ML/day at the end of 2016/17, bringing expected annual substitution of potable water for 2017/18 to around 2.8 GL/year
- Most LHWP actions have been delivered on time, or are on track for delivery in time to achieve LHWP objectives
- HWC and CCC have engaged a consultant to develop a joint WATHNET model to further explore the potential water security benefits to both regions of water transfers and other supply and demand options
- CCC has experienced unavoidable delays in constructing transfer infrastructure and costs have increased. There is a risk that northerly transfers may not be able to be delivered if a drought occurs in the immediate term
- HWC is progressing infrastructure to release improved environmental flows at Seaham Weir and is on track to deliver the project by 2020
- Readiness activities for temporary desalination are underway, but have been delayed by around 12 months. Based on current water storage levels, the measure can still be delivered on time if a severe drought occurs

- The costs for implementation actions are generally close to expected, although some cost data was not available. The most significant change was a higher cost to implement the temporary desalination contingency measure
- Most assumptions underpinning the LWHP are appropriate
- Accessible storage at Tomago and Tomaree Sandbeds will be reviewed as part of developing the next LHWP, to consider supply side risks and incorporate new information
- Hunter Water is funding research by the University of Newcastle to combine paleoclimate data with the instrumental climate record to understand impacts on water security modelling
- Delays in constructing infrastructure to increase water transfers north from the Central Coast during drought poses a risk to the LHWP drought portfolio
- It was not possible to determine whether Water Wise Rules resulted in a 2.5% reduction in residential water demand.

Recommendations

No.	Recommendation	Lead
1	Implement recommendations from the 2016 MERI evaluation not yet completed including: e frame the LHWP objectives to articulate the high level goals reflecting strategic priorities, with more specific measurable objectives under the goals (DoI) f Incorporate updated population projection into the demand model, along with further analysis of the underlying trends as part of the more comprehensive review of the demand model (HWC) g Follow up outstanding actions from the 2013 peer review of the demand forecast as part of developing the next LHWP (HWC) h Follow up outstanding actions arising from the 2013 peer review of the source model as part of developing the next LHWP (HWC)	DoI, HWC
2	Implement recommendations from 2016 MERI evaluation for developing the next LHWP	All
3	Review the levels of service criteria as part of developing the next LHWP	All
4	Examine drivers of increasing residential demand and identify options for cost-effective demand management when developing the next LHWP	HWC
5	Continue to explore opportunities for further water efficiency and recycled water schemes through strategies being developed by HWC and as options for the next LHWP	HWC
6	Ensure the economic level of water conservation (ELWC) methodology takes into account societal costs and benefits to ensure efficient investment in loss minimisation, water efficiency and recycled water and is consistent with the approach used for the LHWP analysis	HWC
7	HWC to re-run the hydro-economic model with current costs for temporary desalination to ensure it is still part of the preferred portfolio	HWC
8	DoI to convene the E-flows working group for an update on infrastructure at Seaham Weir and to agree a timeline for amending the Hunter Unregulated River Water Sharing Plan in early 2018	DoI
9	DoI to convene the Groundwater working group for an update on research into groundwater dependent ecosystems at Tomago and Tomaree, an update on the implications of groundwater contamination at Williamtown for water security and to agree a way forward for including impacts of groundwater extraction into the analysis for the next LHWP	DoI
10	CCC to investigate and report on options for increasing the volume that can be transferred north if a drought occurs before the Mardi to Warnervale pipeline is completed	CCC
11	Where appropriate, take findings from paleoclimate research into account in the hydrologic modelling and economic analysis for the next LHWP	HWC
12	HWC to investigate including a climate correction model in the demand forecast model to better understand the impact of weather on demand and the water savings from WWR, demand management and water efficiency measures	

APPENDIX A: Process for investigating the feasibility of the lower Hunter alluvial aquifer if a paleochannel is found