River Murray Efficiency Measures

Adelaide Desalination Plant Feasibility Study

SA Water

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This report was initially developed from January 2019 to April 2019 and based on data access at that point in time. More recent versions of this report have taken into account comments of stakeholders however the core data has not been updated.

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Executive Summary

This study presents the analysis undertaken to consider the feasibility of SA Water using the Adelaide Desalination Plant (ADP) to reduce the volume of water taken from the River Murray to supply metropolitan Adelaide, in exchange for investment in water efficiency and security measures provided:

- The ADP can be operated at a higher rate with no increased cost to the customers of SA Water and with customers being appropriately reimbursed;
- The ADP can be efficiently operated without generating avoidable spill of inflows to local reservoirs;
- SA Water can retain an acceptable water security risk profile.

The metropolitan Adelaide water supply network draws water from a range of sources including natural catchments, in particular the Western Mount Lofty Ranges and the River Murray as well as the ADP. Production of potable water from the Mount Lofty Ranges Reservoirs and the River Murray is used in preference to the ADP as it is significantly less expensive than the cost of producing desalinated water. A review of the best operational mode for the ADP recommended to operate the ADP at minimum production, currently 5.3 GL per annum, to reduce asset maintenance costs and retain operation of the plant for water security.

The Murray Darling Basin Plan was implemented in 2012 to manage the basin as a whole connected system. An aim of the plan is to provide 450GL of additional water by 2024 for the environment through projects to improve water efficiency on the condition that they have neutral or positive social and economic outcomes. The Commonwealth Government and Murray Darling Basin States have committed to achieving the 450GL water efficiency program, where the Commonwealth Government provides investment in water efficiency infrastructure, at a multiple of the market entitlement price, in exchange for release of water entitlements to provide environmental flows and the associated benefits to the River Murray.

Figure 1: SA Water Metropolitan Network – Major Pipelines

Executive Summary

This study finds that there is the opportunity to **maintain SA Water's water security while reducing the volume of the water taken from the River Murray up to a maximum of 30GL per annum on average** based on modelling as outlined in Figure 2. A product of this nature would:

- Reduce the volume on an average basis to allow SA Water the flexibility to manage variability in the climate, water demand and water storage each year. The year to year variability impacts the ability of the ADP to produce water without causing spills to reservoirs in the catchment and the ability to reduce the offtake from the River Murray.
- Align the reduction in offtake from the River Murray with environmental requirements (i.e. minimum reduction in wet years or extreme drought years, significant reduction in average and dry years).

The Commonwealth investment criteria for the River Murray Efficiency Program, requires release of permanent water entitlements. Any return of permanent water entitlements must be done in a way to allow SA Water to:

- Maintain the water security needs of its customers.
- Maintain flexibility for SA Water to manage its operations and maintain network resilience.
- Meet other constraints detailed in this report.

However, there is opportunity to utilise the spare capacity of the plant over the next 30 years to provide additional water for farmers in a similar manner as has recently been implemented in the 'Water for fodder' program, and this is considered in Option 2.

The product options identified in this study to reduce offtake from the River Murray include:

1. Reduce the volume of water taken from the River Murray **up to 30GL on average per annum in perpetuity** allowing for augmented capacity in approximately 30 years time and when there is the ability to increase production at the ADP.
2. Reduce the volume of water taken from the River Murray **up to 30GL on average per annum for 30 years** when there is the ability to increase production at the ADP.

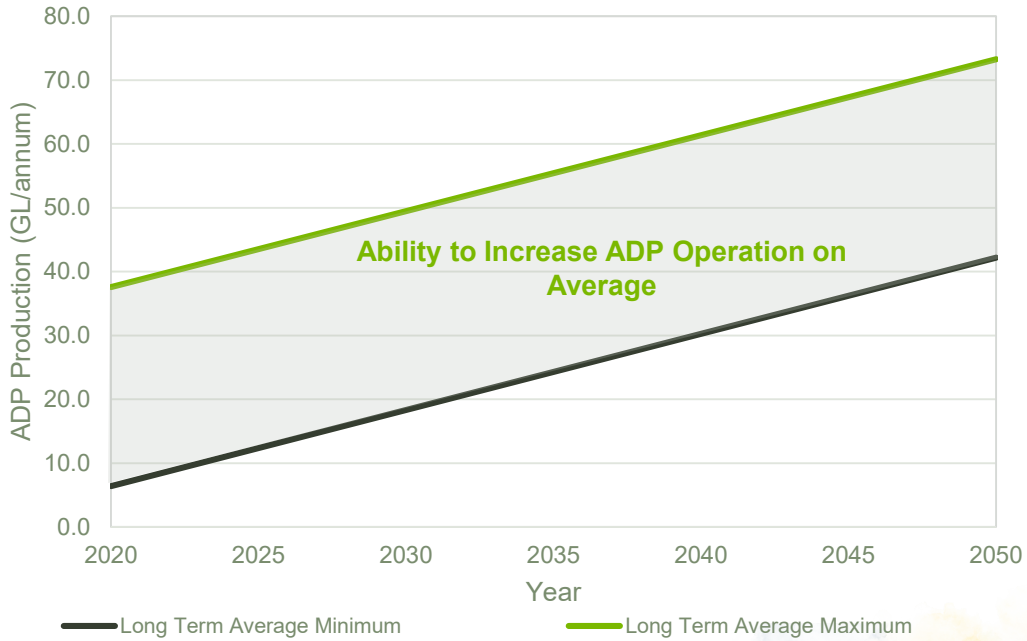

Figure 2: Average ADP production return over time

Executive Summary

The feasibility of this project is dependent on the following:

- An agreement allowing flexibility for SA Water to manage its constraints and risks as detailed in this report.
- Appropriate sharing of costs between SA Water customers and the Commonwealth Government including the base cost recovery (marginal additional costs of operation), an allowance for risk (managing risks in agreement) and contribution for use of regulated assets.

The Commonwealth Government and Murray Darling Basin States have committed to achieving the 450GL of environmental flows by 2024 that have neutral or positive socioeconomic impacts. Urban projects have been identified to have the ability to address socioeconomic impacts and have a significant early impact to achieving a pathway to 450GL. As a result, urban projects should have additional value to the Commonwealth and Basin States in the current context. The following scenarios have been assessed as part of this study.

Scenario 1

The first scenario examined assessed the return for SA Water if the Commonwealth Government invested in product Option 1, **providing up to 30GL per annum in perpetuity**. This scenario assumes :

a) The existing plant is utilised with the Commonwealth Government contributing to cover the additional cost of operating the ADP, including base recovery costs and a risk allowance and;

b) The Commonwealth Government investment covers the cost of augmenting desalination capacity of 30GL in the future.

This would require a Commonwealth Government investment of $21.48 million per GL, equating to a water entitlement multiplier of 3.58 multiplied by a water market price of $6 million per GL. SA Water would receive:

- An investment of **$645 million** to cover the additional cost of operating the ADP including base recovery costs, a risk allowance and the cost of augmenting desalination capacity of 30GL in the future.

Executive Summary

Scenario 2

The second scenario assesses the return for SA Water if the Commonwealth Government invested in product Option 2, **providing up to 30GL on average per annum for 30 years,** at the higher end of the range of historical water entitlement multipliers and a market price for water entitlements within the range of the South Australian Department of Environment and Water forecasts. This scenario builds on approach identified in the EY report, Analysis of efficiency measures in the Murray Darling Basin , which assumed that the proposal would "operate on a temporary basis, accessing spare ADP capacity when not otherwise required to meet the water requirements of metropolitan Adelaide water users". This would allow Basin jurisdictions to address a portion of the environmental objectives of the efficiency measures for a significant length of time (i.e. 30 GL for 30 years), before a future decision point at which either the desalination capacity would be replaced (as per option 1) or alternative investments would be considered and implemented to additional recover water via efficiency measures (taking account of improvements in technology, market conditions and the impact of climate on water availability).

If the Commonwealth Government were to invest $16.2 million per GL (water entitlement multiplier at 2.7* multiplied by a market price for water entitlements at $6 million per GL), SA Water would receive the following:

- A total investment to SA Water of **$486 million** to cover the additional cost of operating the ADP including base recovery costs, a risk allowance and a portion contributed for the use of a regulated asset.

The costs in question have not factored in any return to customers for use of spare desalination capacity paid for by customers or forgone opportunities for alternatives uses of spare capacity, such as potential trading of unused River Murray allocations for Metropolitan Adelaide in dry years, when the price of River Murray allocations exceeds the marginal cost of running the plant.

*Water market entitlement multiplier of 2.7 has been taken from Page 32 of the Independent Report to the Murray-Darling Basin Ministerial Council "Analysis of Efficiency Measures in the Murray-Darling Basin" (EY, 19 January 2018). An indicative range of multipliers was provided and this multiplier represents the top of the range based on the historical maximum average from a selection of reference programs for off-farm projects.

Executive Summary

Recommendations

This report finds that there is the opportunity to reduce offtake from the River Murray by **up to 30GL on average per annum over 30 years,** although as noted previously this volume is not guaranteed. Any proposal will need to consider the uncertainty around climate, customer expectations and costs.

If this work is to proceed further, due to the high level nature of this work, investment in a detailed business case in order to resolve the costs of investment in a water efficiency measure is required. This would include the following:

- Assessment of a renewable energy generation and storage option together with either further capital investment or a fund to cover operational costs to improve efficiency.
- SA Water operational flexibility requirements.
- Further risk and opportunity analysis to better quantify the impacts to SA Water customers.
- Further investment in future climate change and population change scenarios.
- Analysis of SA Water investing in projects to achieve a recovery of the current Weighted Average Cost of Capital (WACC) or the fund being indexed to achieve SA Water's regulatory WACC.

At a broader program level, and as part of any future business case, it is also recommended that further consideration be given to:

- The variable nature of the ability of the ADP to offset River Murray water use, whether a desalination project should be more appropriately considered as a "gap bridging" project to help meet the Basin Plan sustainable diversion limit in effect from 1 July 2019, which in turn would allow water previously recovered as efficiency measures to be repurposed as a contribution to the extra 450 GL required by 2024.
- Whether operation of the desalination plant better supports the socio-economic neutrality requirements of the 450 GL recovery program as an efficiency measure or whether its available capacity is better used to support the water market in dry years through water trading.

Bringing ideas to life

Introduction

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Purpose of Report

This study presents the analysis undertaken to consider the feasibility of SA Water using the ADP to reduce the volume of water taken from the River Murray and release some of its permanent River Murray entitlements to the Commonwealth Government in exchange for investment in water efficiency and security measures, provided:

- The ADP can be operated at a higher rate with no increased cost to the customers of SA Water;
- The ADP can be efficiently operated without generating spill of inflows in upstream systems;
- The requirements for River Murray water to supply metropolitan Adelaide are reduced on average; and
- SA Water can retain an acceptable water security risk profile.

This report has considered the following items in assessing the feasibility of the project:

- Options for investment in SA Water's business that would result in increased usage or more efficient operation of the ADP, in a manner that is cost neutral to SA Water customers over an appropriate timeframe and maintains a level of water security acceptable to SA Water;
- Considers the total lifecycle costs that would be incurred through preferential use of the ADP, if relevant;
- Considers the current and projected future demands for water for metropolitan Adelaide;
- Identifies the volume of water that could potentially be returned to the environment for each option;
- Robustly tests the sensitivity of decision relevant assumptions;
- Identifies and assesses relevant risks, constraints and opportunities.

Background & Context

The metropolitan Adelaide water supply network draws water from a range of sources including natural catchments, in particular the Western Mount Lofty Ranges, and the River Murray. The network consists of two major systems from the River Murray; Murray Bridge – Onkaparinga – Happy Valley in the southern suburbs, and Mannum – Adelaide – Anstey Hill in the northern suburbs. To increase water security in times of drought in which local catchments and the River Murray use may be limited, the Adelaide Desalination Plant (ADP) was built at Lonsdale to provide a climate-independent source of water.

Production of potable water from the Mount Lofty Ranges Reservoirs and the River Murray is used in preference to the ADP as it is significantly less expensive than the cost of producing desalinated water. As such, following the completion of the ADP, a review was undertaken to determine the best operational mode for the ADP with respect to asset condition and maintenance. From the review it was recommended to operate the ADP at minimum production, currently 5.3 GL per annum, to reduce asset maintenance costs and retain operation of the plant for water security.

In years of low rainfall in the Mount Lofty Ranges catchment area, a significant volume of water is provided from the River Murray to meet the needs of metropolitan Adelaide. SA Water's River Murray entitlement has recently been changed to a permitted take agreement in which the yearly entitlement will vary based on the volume of rainfall in the Mount Lofty Ranges catchment.

Figure 3: SA Water Metropolitan Network – Major Pipelines

Background & Context

The Murray Darling Basin Plan was implemented in 2012 to manage the basin as a whole connected system. The aim of the plan is to bring the Basin back to a healthier and sustainable level, while continuing to support farming and other industries for the benefit of the Australian community. The plan sets limits on the volume of water that can be taken for irrigation, drinking water, and industry while leaving enough for our environment and the plants and animals that depend on it.

An aim of the plan is to provide 450GL of additional water by 2024 for the environment through projects to improve water efficiency on the condition that they have neutral or positive social and economic outcomes. The Commonwealth of Australia and Murray Darling Basin States have committed to achieving the 450GL water efficiency program, where the Commonwealth Government provides investment in water efficiency infrastructure, at a multiple of the market entitlement price, in exchange for release of water entitlements to provide environmental flows and the associated benefits to the River Murray.

As part of this program, increasing operation of the ADP to offset water typically taken from the River Murray for metropolitan Adelaide was identified as an opportunity to return environmental flows to the Murray Darling Basin.

Separate from the Murray Darling Basin Plan, in 2019 and 2020, through agreement between the Federal and South Australian governments, SA Water was funded to operate the Adelaide Desalination Plant and provide up to 100GL of River Murray Water for farmers as part of the ‘Water for Fodder‘ program.

Figure 4: River Murray

Bringing ideas to life

Analysis and Financial Modelling

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Adelaide Desalination Plant Production

The ADP at Lonsdale pumps treated water directly into the Adelaide metropolitan network at Happy Valley Water Treatment Plant (WTP) and is operated in accordance with demand in the water network with some buffer storage present to prevent excessive ramping of the treatment process. As such, ADP can only be operated to maximum efficiency when demand for water is high during dry periods where operation does not cause spills at reservoirs upstream of Happy Valley WTP, e.g. Mount Bold Reservoir. The ADP has a maximum production capacity of 100GL per annum however its ability to provide water into the network is dependent on the demand for water from metropolitan Adelaide and the volume of inflows from the Mount Lofty Ranges catchment.

To understand the short term operational requirements of the ADP to provide water security for metropolitan Adelaide, SA Water undertook modelling to assess operational extremes with respect to climate and demand. The model assessed dry, average, and wet scenarios for current climate and demand conditions utilising 5%, 50% and 95% probabilities of exceedance for both demand and climate. The modelling identified the volume of water able to be produced by ADP without causing spills of water collected from rainfall within the Mount Lofty catchment reservoirs, although the ADP could be operated at a higher capacity, it is not efficient to do so as water would be wasted.

This modelling has shown significant difference in the ability to operate ADP between wet and dry years in current climate and demand expectations. These numbers reflect the total production of the ADP and do not necessary reflect the reduction in offtake from the River Murray.

- During wet years ADP can be efficiently operated up to approximately **15GL** without generating avoidable additional spill at reservoirs.
- During average years ADP can be efficiently operated up to approximately **49GL** without generating avoidable additional spill at reservoirs.
- During dry years ADP can be efficiently operated up to approximately **80GL** to meet the demand for water.

The above operations have been determined without consideration to worst case risk events, for example, the failure of any critical part of the distribution network.

Metropolitan Adelaide Water Supply Modelling

To understand the long term requirements of the ADP to provide water security for metropolitan Adelaide, SA Water undertook modelling for current water demand and climate data. The model assessed 127 scenarios based on historical climate and catchment information. The maximum reduction in the volume of water, indicated by the red line, that is taken from the River Murray was also identified under each scenario.

Significant variability in the requirement to pump from the River Murray is reflected across the inflows from the Mount Lofty Ranges catchment. This is the result of:

- Variability of annual rainfalls in the catchment impacting inflows and demand.
- Volume of water storage in the reservoirs from the previous year.
- The variability of timing of rainfall within the year, for example summer storms that fill reservoirs and this water is utilised over River Murray and ADP water.
- Circumstances where high inflow is experienced within short periods of time resulting in large volumes of spill.

Due to the variability of pumping from the River Murray, it is very difficult to establish a permanent return from operation of the ADP each year, however an average return scenario would increase the volume able to be returned over a period of time. Under an average return, SA Water is provided flexibility to manage the variability of climate each year in line with the permitted take agreement.

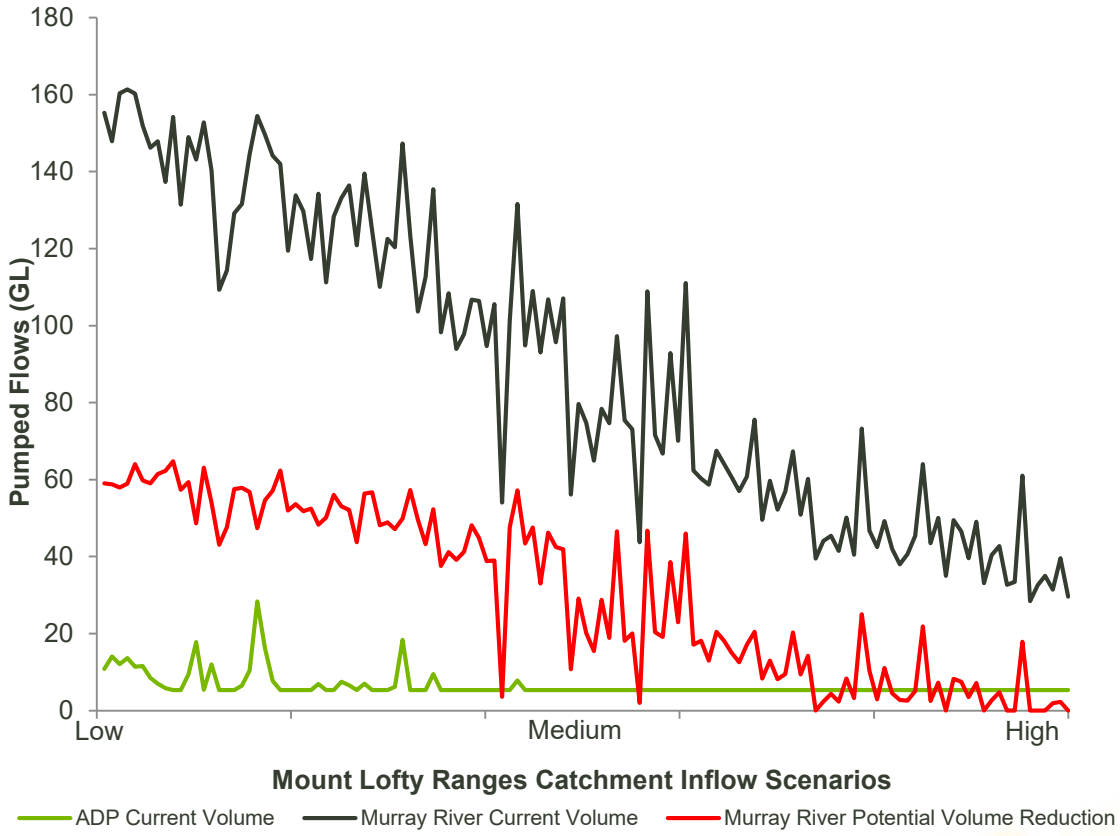
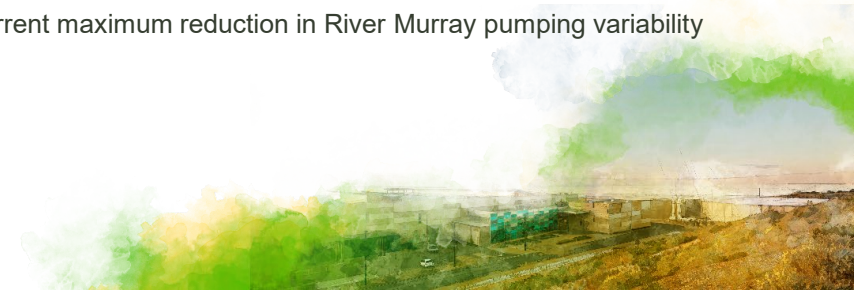


Figure 5: Current maximum reduction in River Murray pumping variability



Adelaide Desalination Plant Current Water Production

To assess the ability for the ADP to reduce the volume taken from the Murray River, the ADP was modelled to run in preference to the River Murray, but not in preference to Mount Lofty Ranges catchment inflows. The average volumes available are represented in terms of the probability of it occurring in any given year. The ADP capacity is 100GL/annum, based around short term modelling in 2009 at the time of design indicating severe water restrictions would be required as early as 2013 should the drought have continued.

- Modelling indicates that under current climate and demand scenarios, ADP has approximately a 20% probability of being required to be operated above its minimum production.
- The ADP is expected to produce nearly 30GL in a year under current very dry climate and demand conditions.
- If the ADP is utilised in preference to pumping from the River Murray, operation of the ADP can be increased on average a maximum of 31GL per year under current demand and climate data.
- In wet years with high Mount Lofty catchment inflows, approximately a 10% of occurring, the ADP will continue to be operated at minimum capacity.
- In dry years, with low Mount Lofty catchment inflows, the ADP could be efficiently operated above 70GL per annum.

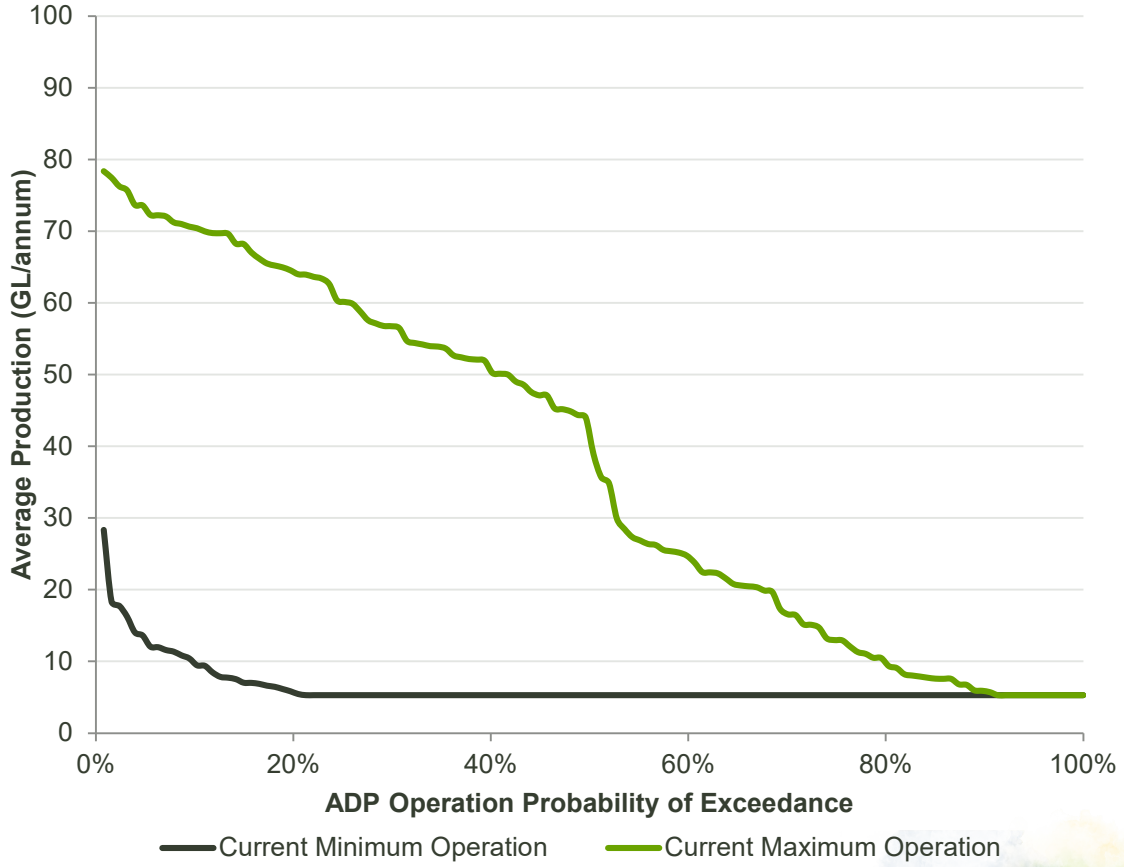


Figure 6: Current probability of operating ADP

Adelaide Desalination Plant 2050 Water Production

To assess the ability for the ADP to reduce the volume taken from the River Murray into the future, modelling was completed for the year 2050 based on current forecasts for population growth and climate change. The average volumes available in 2050 are represented in terms of the probability of it occurring in any given year.

- Modelling indicates that under future climate and demand scenarios, the ADP will almost certainly be operated above current minimum capacity every year.
- The ADP is expected to produce over 60GL in a year under future very dry climate and demand scenarios.
- If the ADP is utilised in preference to pumping from the River Murray, operation of the ADP can be increased on average by a maximum of 29GL per year.
- In dry years, with low Mount Lofty catchment inflows, the ADP could be efficiently operated close to 100GL per annum, it's maximum capacity.

It is noted that the expected use of the ADP has decreased since completion of the project, resulting from decreases to average household water consumption.

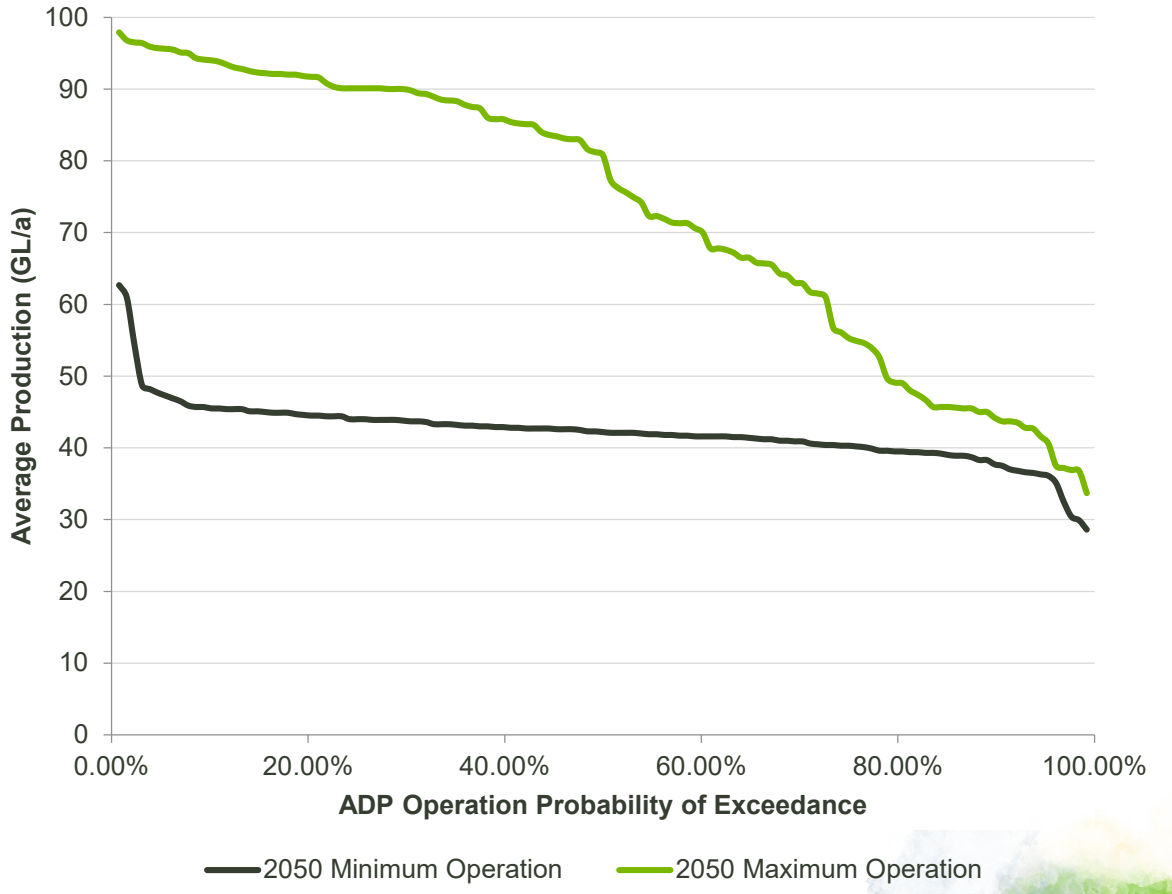


Figure 7: 2050 probability of operating ADP

Adelaide Desalination Plant River Murray Offset

The year to year variability in the volume of inflows from the Mount Lofty Ranges catchment significantly impacts the ability for the ADP to be utilised to reduce the volume of water required from the River Murray each year. As such, the volume on average that the ADP would be able to provide over time has been evaluated. An average over time allows the flexibility to operate the ADP as required to suit the climate and demand scenario in any given year.

Future modelling assessed the impact of increasing demand for water with growing population and less inflows from the Mount Lofty Ranges due to a changing climate. On average an increased volume of water is required from the River Murray to supply metropolitan Adelaide in the future.

This provides a greater opportunity to use the ADP on average to reduce water pumped from the River Murray. The long term average minimum is the average requirements for SA Water to meet forecasted water security needs. The volume of water between the long term average maximum and minimum is the potential to increase production of ADP to offset the take from the River Murray.

Modelling has been completed for current and 2050 scenarios and data has been linearly interpolated between these two points. Modelling considers the system operating in-line with historical experiences.

In assessing average return options, a number of scenarios have been modelled below the long term average maximum of 30GL per annum over the 30 years.

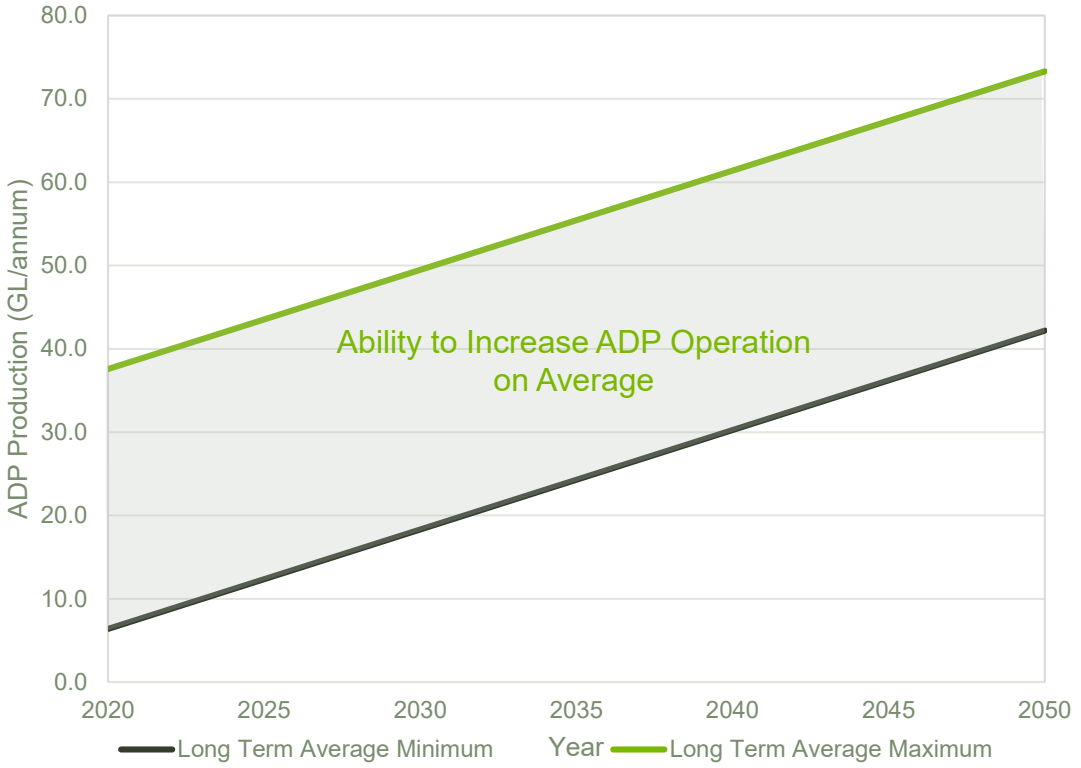


Figure 8: Average ADP production return over time

Year	Average ADP Production for Water Security (GL)	Average Maximum ADP Operation (GL)	Average River Murray Return (GL)
2020	6	38	31
2050	42	73	29

Decision Making Criteria

SA Water has the following constraints in considering the opportunity to utilise the ADP to reduce the volume of water taken from the River Murray for metropolitan Adelaide's water supply. These constraints are required to provide the best outcomes for their customers to ensure they are no worse off in terms of pricing and appropriate sharing of costs between customers and the Commonwealth government are agreed upon. The following constraints were applicable at the time modelling was undertaken.

Constraints
SA Water's customers can be no worse off in terms of pricing for providing capacity at the ADP.
SA Water to recover all costs for any increase in desalination operation through an arrangement with the Commonwealth.
Any changes to the water security risk profile must be acceptable to SA Water.
SA Water to have flexibility to allow for climate change and demand exceeding current forecasts.
ADP operation each year must be flexible to reflect variability in demand and climate conditions.
SA Water to be able to utilise the ADP under its requirement of Water Allocation Framework under existing rules of the Water Allocation Plan.
SA Water to have the flexibility to allow for changes in water or energy regulations that impact the operations or costs of the ADP.
SA Water currently do not have the ability to trade the metropolitan licence on the water market.
SA Water to be able to utilise any investment in return for water received for the best interest of its customers.
SA Water's metropolitan Adelaide permitted take license from the River Murray must not exceed a long term average of 100 GL per annum.
SA Water to achieve a WACC recovery on funds held, this may include identifying other SA Water capital projects for investment or receiving an annuity indexed to the WACC.

Options Identification

The following options were identified in consultation with SA Water in consideration of their constraints. To manage the constraints of maintaining water security for its customers and allow flexibility to manage variability in the climate each year, permanent water entitlements were assessed as being required to be maintained by SA Water. An agreement to increase the production of the ADP to offset pumping from the River Murray must allow flexibility for SA Water to manage its water security and variability of available ADP production each year.

Product Options
Base Case – Do Nothing - Continue to operate the desalination plant at the minimum as per current operating practices and do not change water taken from the River Murray.
Option 1 – Reduce the volume of water taken from the River Murray **up to 30GL on average per annum in perpetuity** when there is the ability to use the ADP.
Option 2 – Reduce the volume of water taken from the River Murray **up to 30GL on average per annum for 30 years** when there is the ability to use the ADP.

The following options were identified for investment for money received from reducing the offtake from the River Murray in consultation with SA Water.

Water Efficiency Investment Options
Option A – Increase use of ADP to offset River Murray pumping in return for capital for investment in renewable energy to lower cost of energy for ADP. An investment in increased energy generation and storage to achieve zero net energy costs to offset the increased energy intensity of a water resource mix that increases reliance on desalination. Provision of a fund to cover other associated costs of increased operations.
Option B – Increase use of ADP to offset River Murray pumping in return for capital to cover costs of increased operations.

Investment in Alternative Energy Generation

SA Water are currently delivering the Zero Cost Energy Future project by investing in renewable energy technology with the aim to achieve zero net energy costs from 2020 - 2021. Energy is one of SA Water's biggest costs, with more than 220 gigawatt hours consumed in Financial Year 2016 - 2017 at a cost of $55 million. The project looks to install approximately 154 megawatts of solar panels, and 17 megawatt hours of energy storage by 2020 across many of their sites.

Increasing the operations of the ADP in preference to pumping from the River Murray significantly impacts the ability for SA Water to meet its zero net energy cost target. The ADP operation is an energy intensive process and the current project will not cater for the increased consumption at the ADP.

To meet SA Water's zero net energy cost, an investment in energy generation and storage is required to cover the additional energy costs of operating the ADP. The Office of the Technical Regulator in South Australia requires a solar generator of this size to provide real inertia or fast frequency response*, as such a battery storage solution has been proposed in line with industry trends adding a significant cost to the energy generation. Existing solar installations are currently exempt from the requirements, providing opportunity for a greater return on investment when compared to a new solar installation. The investment required is dependent on the additional average operations of the ADP, and for a maximum scenario of 30GL reduction in volume taken from the River Murray over 30 years, an investment in the order of $140 million to $160 million is required. The scale of this level of project investment is in the order of 65 megawatts of solar panels, and a 25 MW/1 hr battery energy storage system based on the expected capacity factor and achieving no net additional costs of electricity including consumption, transmission and other costs from increased use of the ADP.

Key risks to SA Water associated with investing in this option that were addressed by increasing the discount rate to 7.63% for this component, include:

- Consumption of energy at ADP does not match solar energy production
- Unpredictability of forecasting energy and REC spot prices
- Uncertainty around changes in future energy market regulations

*"Generator Development Approval Procedure" (South Australian Office of the Technical Regulator, 1 July 2017, Version 1.1).

Key Risks – Non Financial

An interactive risk identification workshop was held with key stakeholders to identify and quantify key risks associated with the project and, importantly, consider risk mitigation strategies. The following is a summary of key risks to SA Water and it's customers that were identified. Lower impact risks have not been included below.

Risk Description	Pre Mitigation Impact	Mitigations Required
Reputation Increased energy costs for SA Water through increased operation of ADP.		Invest in power generation and/or storage to achieve the target of Zero Cost Energy Future. Conduct a study demonstrating environmental benefits for the community.
Customer Changes to SA Water's Metropolitan water licence to a permitted take agreement.		Agreement with the Commonwealth to provide operational flexibility.
Customer SA Water is unable to operate ADP when required for major unplanned incidents or capital upgrades.		Agreement with Commonwealth around return of River Murray flows, rather than operation of ADP.
Customer There is uncertainty in forecasting the impacts of climate change and population growth over a 30 year period.		2050 forecast modelling undertaken using latest climate and population projections. Engagement with stakeholders/community regarding risks.
Customer Variations in aesthetic water quality when changing between ADP and Happy Valley water.		Conduct a study to investigate aesthetic quality of water, and regularly monitor quality. Engagement with community regarding water aesthetic quality.

Extreme High Moderate Low

Key Risks – Financial

Risk Description	Pre Mitigation Impact	Mitigations Required
Depth of analysis undertaken at feasibility stage fails to identify all risks.	High	Key stakeholders to be consulted to ensure all foreseeable risks are identified and managed as part of the project. Next stage of works to undertake further detailed risk analysis and assessment before identifying preferred option.
Consumption of energy costs does not match with spot pricing on the market from generation. Power costs calculated using averages do not reflect variability and SA water's ability to manage daily costs/operations.	Moderate	During average and wet years, optimise use of desal during daylight hours. Investigate application of storage to align energy generated with consumption.
Volatility of Revenue and Costs for SA Water due to uncertainty of future markets.	Moderate	Investigate application of storage to provide flexibility to discharge energy in higher price times.
Unpredictability of energy spot price and REC price.	Moderate	Financial model to assess sensitivities to fluctuations in price. Investigate application of energy storage to provide flexibility to discharge energy in higher price times.
Use of funding to invest in an efficiency project delayed into the future to take advantage of expected reduction in technology prices (e.g. battery storage).	Moderate	Assess forecasts of future technology prices compared to the benefits and risks of delaying investment.

Extreme High Moderate Low

Key Risks – Financial

Risk Description	Pre Mitigation Impact	Mitigations Required
Reduced use of Happy Valley Water Treatment Plant resulting from increased use of ADP that doesn't realise the investment of capital works.		Assess opportunity to delay capital works that have not yet been undertaken. Maintain use of Happy Valley to the extent possible for natural inflows.
ADP Chemical prices are indexed every year which creates uncertainty around future cost, especially where price increase exceeds inflation.		Where possible, investigate the use of different chemicals or different suppliers.
Changes to membrane technology and/or price over time.		When membranes are required to be replaced, investigate advancements in membrane technology that offer improved operational efficiency.
ADP O&M costs have to be forecast past the end of the current contract in 2032.		Sensitivity analysis on future forecasting post O&M contract to assess the potential financial impacts and assess need for contingency.
Increased operation of ADP increases asset degradation, with increased risk to SA Water if operators fail to carry out maintenance.		Enforce periodic inspection to ensure maintenance is being undertaken as per the current contract. Exercise due diligence before end of the contract.

Extreme High Moderate Low

Key Risks – **Financial**

To assess the impact of financial risks to SA Water, a Monte Carlo simulation was run on a normal probability distribution that provides a way to capture the range of outcomes in risk and opportunity analysis. Each financial risk and opportunity was assessed and given a low, medium and high financial impact with a probability of this occurring to develop the probability distributions for each option. This develops a probability of exceedance for the overall financial risk and allows a P90 risk allowance in line with SA Water's approach to be factored into the financial model to account for this risk. The risks of investment in renewable energy were considered separately and was accounted for using a risk adjusted weighted average cost of capital (WACC) and is equivalent to approximately $1.8 million per GL.

Option	P10 ($/GL Produced)	P50 ($/GL Produced)	P90 ($/GL Produced)
A – Invest in Renewable Energy	$2.5 million*	$2.9 million*	$3.3 million*
B – Investment in Fund	$0.8 million	$1.2 million	$1.6 million

*Includes risk adjusted energy WACC adjustment

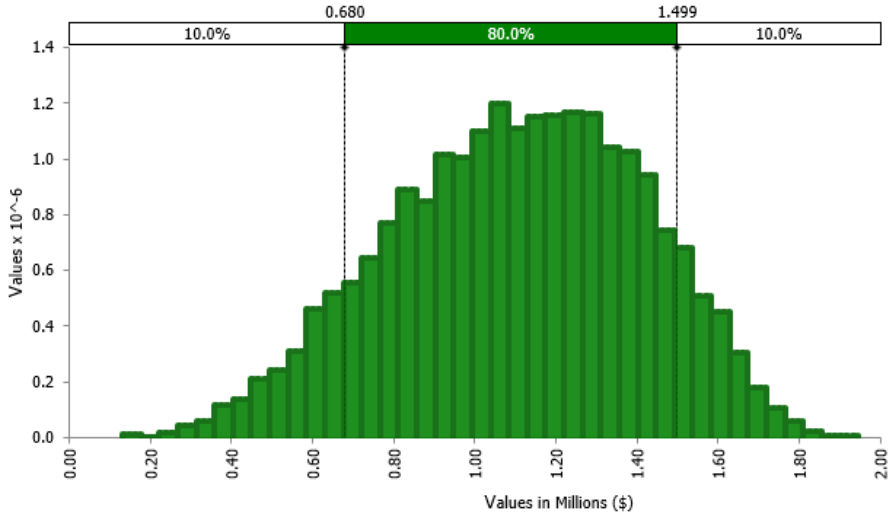


Figure 9: Option 1 - Renewable energy investment risk distribution

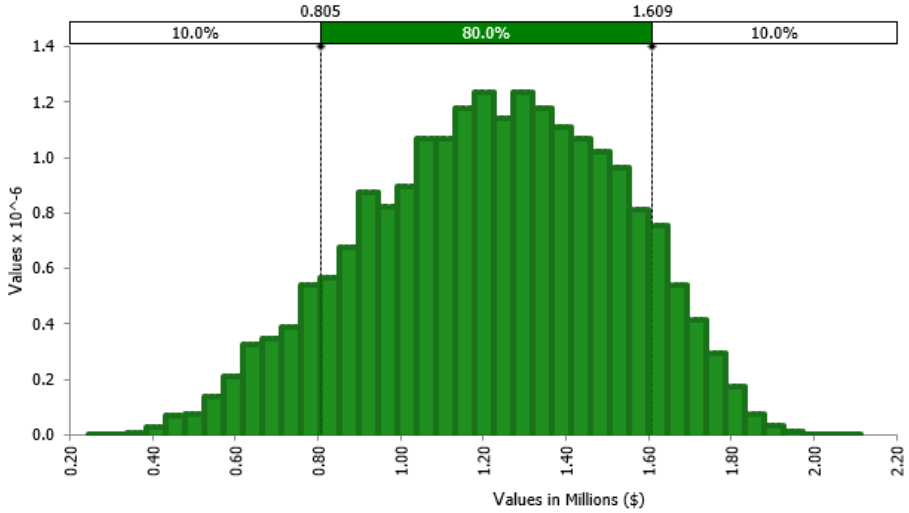


Figure 10: Option 2 - Fund investment risk distribution

Financial Evaluation

To assess financial outcomes for SA Water, a Net Present Value (NPV) analysis was completed using real discount rates based on SA Water's financial guidelines.

Financial analysis assessed the capital expenditure of investments, the operating expenditure of increasing ADP operations and decreasing River Murray pumping operations, the revenues from energy and water as well as a risk allowance to address financial risks of the project.

Key Assumptions

- Evaluation period of 30 years to reflect water modelling up to this timeline.
- Discount rate of 4.63% (excluding energy investment using a risk adjusted WACC of 7.63%)
- Renewable energy investment constructed within the first year of the financial model with a return on investment following construction.
- Water fund investment received in first year of the financial model.
- Option 1, the permanent allocation includes a Terminal Value that assesses the value of the water in perpetuity from the ADP, in effect permanent purchase of the GL on an average basis.
- SA Water is able to invest in projects to achieve the WACC or the fund must be indexed to achieve SA Water's regulatory WACC.
- That there will not be any significant change to the regulatory model that will impact this analysis over the next 30 years.
- SA Water avoids the cost of pumping and treating water from the River Murray when utilising the ADP.

Financial Evaluation

The feasibility of this project is dependent on an agreement to increase production of the ADP allowing flexibility for SA Water to manage its constraints and risks.

The **Base Cost Recovery** is the marginal additional costs of operating the ADP and aligns with SA Water having flexibility and control to use the ADP as required over a 30 year period. The marginal additional cost of operating the ADP would be covered by the Commonwealth of Australia at this recovery of costs with no financial benefit to SA Water's existing customers over the current state.

The **P90 Risk Allowance** is the allowance for managing the risk accepted by SA Water in proceeding with the agreement.

The **Terminal Value for Perpetuity** reflects the additional cost if the product impacted SA Water's access to the ADP in perpetuity (only required to be considered as part of Option 1 when reducing the volume of water taken from the River Murray in perpetuity). A terminal value has been applied in Year 30 to reflect the additional investments of ADP capacity in the future to meet SA Waters' customer's water needs. The terminal value cost of the ADP is estimated at $8.3 million per GL based on the assumption that growth in demand for the ADP continues at the rate it does between 2020 & 2050. We recommend that further analysis is completed on the demand profile post 2050 to inform more accurate timing on when new ADP capacity is required.

ADP Operation Cost Breakdown - The breakdown of the recovery of costs required for a 30GL reduced offtake scenario.

Option A - Capital for investment in renewable energy to lower cost of energy for ADP.

Option B - Capital to cover costs of increased operations.

Figure 11: ADP Operation Cost Breakdown

Financial Evaluation

Multiple scenarios were assessed between operating the ADP at a minimum level to provide water security and the maximum the ADP is able to be operated. The scenarios assessed to reduce the volume taken from the River Murray on average included 5GL per annum, 15GL per annum, 20GL per annum, 25GL per annum and 30GL per annum (the maximum). The volume of water reduced from the offtake of the River Murray on average impacts the range of the minimum and maximum return for water as per the graph below. It can be shown that there is a small variation in the return required for water per GL between the different volumes however it is slightly more cost efficient at 20GL average return per annum. Option A & B have very similar financial outcomes with Option A having a greater risk allowance due to the risk of investment in an energy generation and storage option.

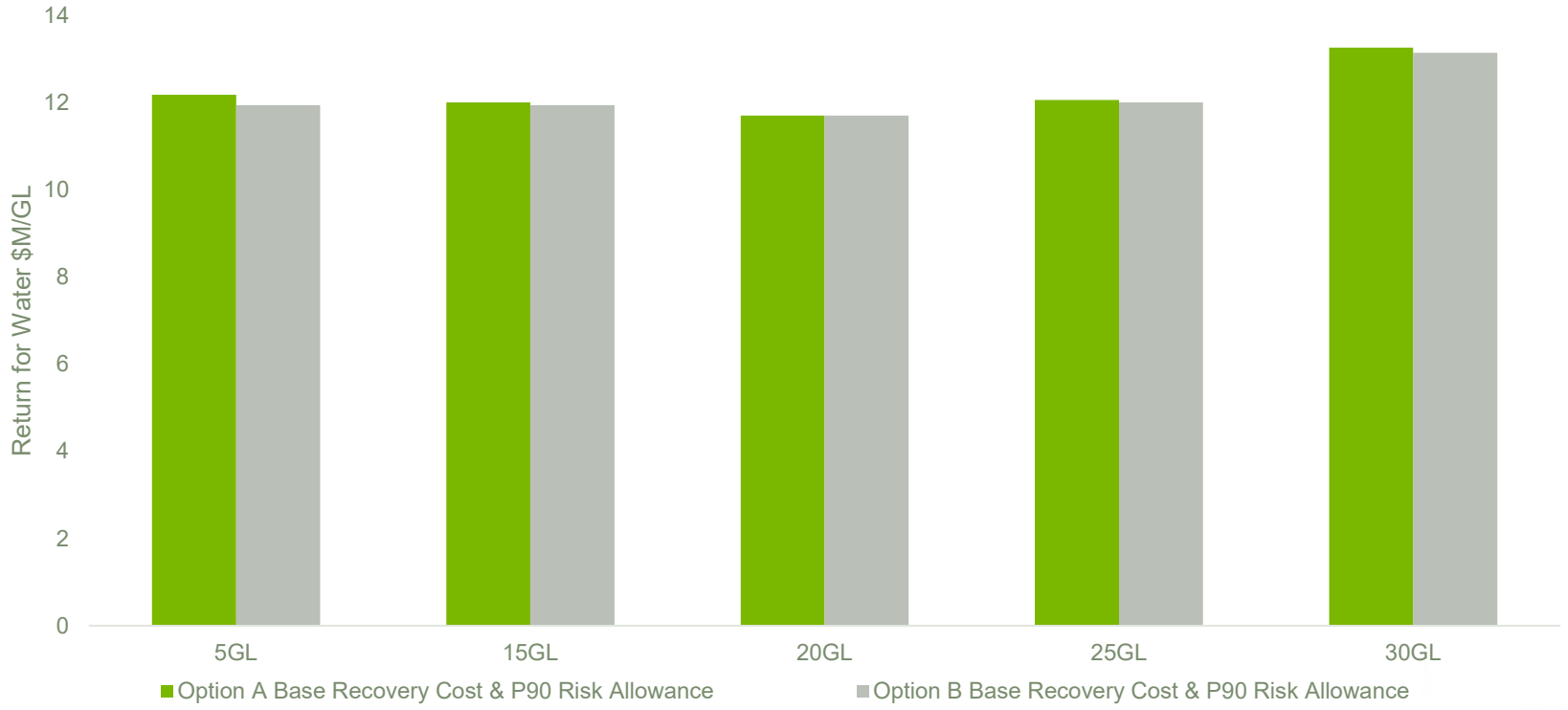


Figure 12: Variability of Return for Water through volume scenarios

Bringing ideas to life

Conclusion and Recommendations

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Conclusion & Recommendations

This study finds that there is the opportunity to **maintain SA Water's water security while reducing the volume of the water taken from the River Murray up to a maximum of 30GL per annum on average** based on modelling as outlined in Figure 2. A product of this nature would:

- Reduce the volume on an average basis to allow SA Water the flexibility to manage variability in the climate, water demand and water storage each year. The year to year variability impacts the ability of the ADP to produce water without causing spills to reservoirs in the catchment and the ability to reduce the offtake from the River Murray.
- Align the reduction in offtake from the River Murray with environmental requirements (i.e. minimum reduction in wet years or extreme drought years, significant reduction in average and dry years).

The Commonwealth investment criteria for the River Murray Efficiency Program, requires release of permanent water entitlements. Any return of permanent water entitlements must be done in a way to allow SA Water to:

- Maintain the water security needs of its customers.
- Maintain flexibility for SA Water to manage its operations and maintain network resilience.
- Meet other constraints detailed in this report.

However, there is opportunity to utilise the spare capacity of the plant over the next 30 years to provide additional water for farmers in a similar manner as has recently been implemented in the 'Water for fodder' program, and this is considered in Option 2.

The product options identified in this study to reduce offtake from the River Murray include:

1. Reduce the volume of water taken from the River Murray **up to 30GL on average per annum in perpetuity** allowing for augmented capacity in approximately 30 years time and when there is the ability to increase production at the ADP.
2. Reduce the volume of water taken from the River Murray **up to 30GL on average per annum for 30 years** when there is the ability to increase production at the ADP.

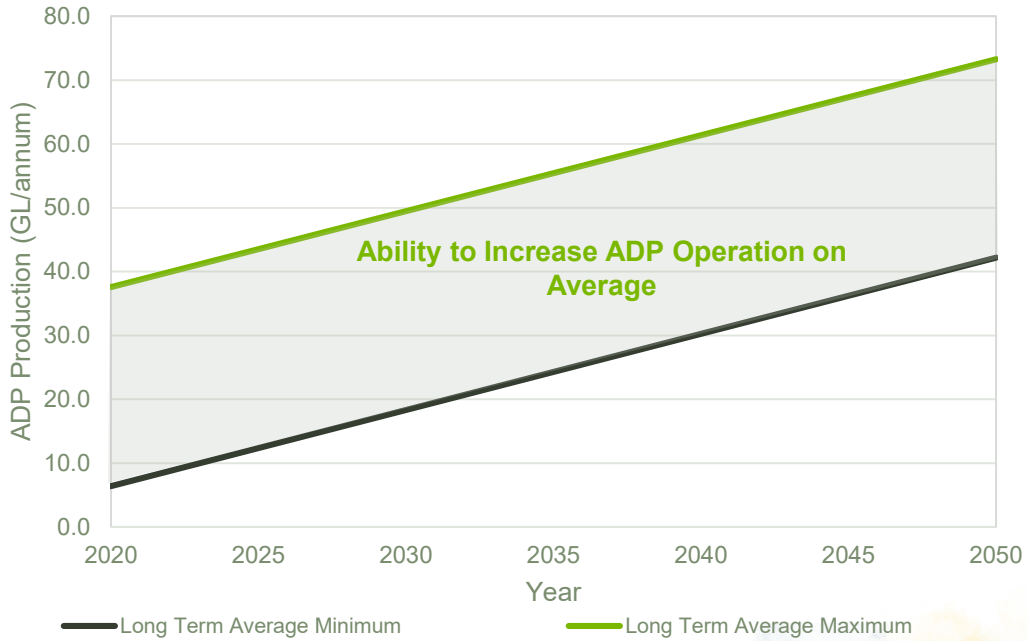

Figure 13: Average ADP production return over time

Conclusion & Recommendations

The feasibility of this project is dependent on the following:

- An agreement allowing flexibility for SA Water to manage its constraints and risks as detailed in this report.
- Appropriate sharing of costs between SA Water customers and the Commonwealth Government including the base cost recovery (marginal additional costs of operation), an allowance for risk (managing risks in agreement) and contribution for use of regulated assets.

The Commonwealth Government and Murray Darling Basin States have committed to achieving the 450GL of environmental flows by 2024 that have neutral or positive socioeconomic impacts. Urban projects have been identified to have the ability to address socioeconomic impacts and have a significant early impact to achieving a pathway to 450GL. As a result, urban projects should have additional value to the Commonwealth and Basin States in the current context. The following scenarios have been assessed as part of this study.

Scenario 1

The first scenario examined assessed the return for SA Water if the Commonwealth Government invested in product Option 1, **providing up to 30GL per annum in perpetuity**. This scenario assumes :

a) The existing plant is utilised with the Commonwealth Government contributing to cover the additional cost of operating the ADP, including base recovery costs and a risk allowance and;

b) The Commonwealth Government investment covers the cost of augmenting desalination capacity of 30GL in the future.

This would require a Commonwealth Government investment of $21.48 million per GL, equating to a water entitlement multiplier of 3.58 multiplied by a water market price of $6 million per GL. SA Water would receive:

- An investment of **$645 million** to cover the additional cost of operating the ADP including base recovery costs, a risk allowance and the cost of augmenting desalination capacity of 30GL in the future.

Conclusion & Recommendations

Scenario 2

The second scenario assesses the return for SA Water if the Commonwealth Government invested in product Option 2, **providing up to 30GL on average per annum for 30 years,** at the higher end of the range of historical water entitlement multipliers and a market price for water entitlements within the range of the South Australian Department of Environment and Water forecasts. This scenario builds on approach identified in the EY report, Analysis of efficiency measures in the Murray Darling Basin , which assumed that the proposal would “operate on a temporary basis, accessing spare ADP capacity when not otherwise required to meet the water requirements of metropolitan Adelaide water users”. This would allow Basin jurisdictions to address a portion of the environmental objectives of the efficiency measures for a significant length of time (i.e. 30 GL for 30 years), before a future decision point at which either the desalination capacity would be replaced (as per option 1) or alternative investments would be considered and implemented to additional recover water via efficiency measures (taking account of improvements in technology, market conditions and the impact of climate on water availability).

If the Commonwealth Government were to invest $16.2 million per GL (water entitlement multiplier at 2.7* multiplied by a market price for water entitlements at $6 million per GL), SA Water would receive the following:

- A total investment to SA Water of **$486 million** to cover the additional cost of operating the ADP including base recovery costs, a risk allowance and a portion contributed for the use of a regulated asset.

The costs in question have not factored in any return to customers for use of spare desalination capacity paid for by customers or forgone opportunities for alternatives uses of spare capacity, such as potential trading of unused River Murray allocations for Metropolitan Adelaide in dry years, when the price of River Murray allocations exceeds the marginal cost of running the plant.

*Water market entitlement multiplier of 2.7 has been taken from Page 32 of the Independent Report to the Murray-Darling Basin Ministerial Council “Analysis of Efficiency Measures in the Murray-Darling Basin” (EY, 19 January 2018). An indicative range of multipliers was provided and this multiplier represents the top of the range based on the historical maximum average from a selection of reference programs for off-farm projects.

Conclusion & Recommendations

Recommendations

This report finds that there is the opportunity to reduce offtake from the River Murray by **up to 30GL on average per annum over 30 years,** although as noted previously this volume is not guaranteed. Any proposal will need to consider the uncertainty around climate, customer expectations and costs.

If this work is to proceed further, due to the high level nature of this work, investment in a detailed business case in order to resolve the costs of investment in a water efficiency measure is required. This would include the following:

- Assessment of a renewable energy generation and storage option together with either further capital investment or a fund to cover operational costs to improve efficiency.
- SA Water operational flexibility requirements.
- Further risk and opportunity analysis to better quantify the impacts to SA Water customers.
- Further investment in future climate change and population change scenarios.
- Analysis of SA Water investing in projects to achieve a recovery of the current Weighted Average Cost of Capital (WACC) or the fund being indexed to achieve SA Water's regulatory WACC.

At a broader program level, and as part of any future business case, it is also recommended that further consideration be given to:

- The variable nature of the ability of the ADP to offset River Murray water use, whether a desalination project should be more appropriately considered as a "gap bridging" project to help meet the Basin Plan sustainable diversion limit in effect from 1 July 2019, which in turn would allow water previously recovered as efficiency measures to be repurposed as a contribution to the extra 450 GL required by 2024.
- Whether operation of the desalination plant better supports the socio-economic neutrality requirements of the 450 GL recovery program as an efficiency measure or whether its available capacity is better used to support the water market in dry years through water trading.

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