GOVERNMENT OF WESTERN AUSTRALIA

MID WEST DEVELOPMENT COMMISSION

Drought Impacts on Water Resources of the Mid West: Opportunities to Build Resilience

A Focus on the Northern Agricultural Region

Regional Drought Resilience Planning Program

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Mid West Development Commission, June 2022

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1. Overview

The Mid West region predominantly relies on groundwater for its water needs. Groundwater is considered more reliable than surface water as a water source in times of drought. However, it is not immune to impacts from low rainfall. Therefore, it is important that existing and proposed water supplies are thoroughly assessed for drought resilience.

Declining rainfall from drying climate trends are causing aquifer water levels to fall and water quality to decline in some areas. Periods of drought will further increase aquifer stress and pressure on water sources to meet demand during these times. Groundwater sources are highly variable in quality, quantity and accessibility across the region. Therefore, tailored solutions are needed at a local scale.

This assessment, prepared for the Regional Drought Resilience Planning Program, focuses on the three pilot study areas in the northern agricultural region: the City of Greater Geraldton, the Shire of Northampton and the Shire of Chapman Valley. This paper provides an overview of the climate influences affecting water availability and outlines the available water resources over the region. Issues for current water use and future availability for both potable and non-potable supplies are examined and opportunities are identified to build greater water resilience now and into the future.

2. Climate Influences

The climate in the Mid West Region is drying and reduced rainfall will have a significant impact on groundwater availability. Declining rainfall trends have been observed in climatic patterns since the 1970's and more recent trends between 2010-2018 indicate that the Mid West region is tracking on the projected drying climate trend[1]. Refer to Figure 1.

As groundwater aquifers are recharged by rainfall, a drying climate will mean there will be less water getting to groundwater aquifers. It is predicted that from now until 2050, recharge is expected to significantly decrease. Modelling indicates that when the average annual rainfall declines to less than 300mm per year, there will be little to no recharge to groundwater[2]. The average yearly rainfall for the Mid West consortia region from 1980 to 2020 was 254mm. Over this period, there were only nine of the 41 years where rainfall was above 300mm[3]. When specifically examining rainfall in the Chapman River catchment, this picture improves with an average rainfall over the same period of 372mm per year with 33 out of the 41 years having rainfall above 300mm.

The volume of water recharged to aquifers is also dependent on when the rain falls. Most recharge occurs in the cooler months of June to September when rainfall exceeds evaporation

[1] Department of Water and Environmental Regulation 2021, *Allocation limit review for the Yarragadee aquifer in the Allanooka and Casuarinas subareas – Improving the Arrowsmith groundwater allocation plan, 2010*, Water Allocation Planning Internal Report series no. 10, January 2021.

[2] Department of Water and Environmental Regulation 2019 *Allocation limit review for the Parmelia aquifer in the Mingenew subarea – Improving the Arrowsmith groundwater allocation plan, 2010,* Water Allocation Planning Internal Report series no.9, Internal Report- available on request, August 2019.

[3] Stanley Mastrantonis, University of Western Australia & Curtin University, Personal communication, 2 June 2022.

and when rain falls over consecutive days. Therefore, recharge to groundwater will also decline as winter rainfall reduces and summer rainfall increases under predicted drying climate scenarios.

Given these compounding influences, it is critical to build water security and ensure that existing and new sources can provide water in times of drought and over the longer term.

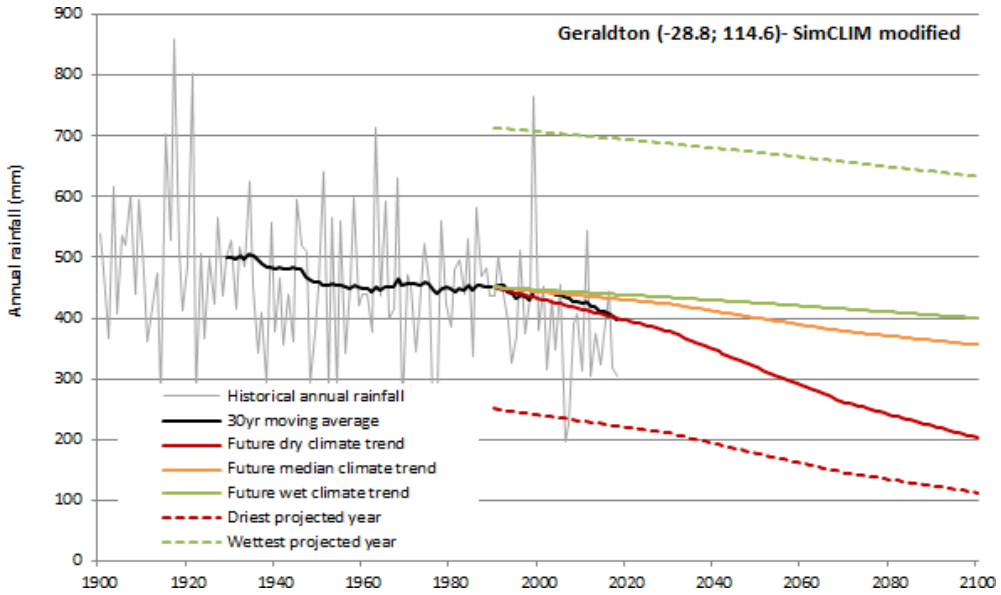

Figure 1: Geraldton SILO[4] rainfall long-term projections to 2100

3. Water Resources

3.1. Groundwater

The RDRP pilot study areas are located within geological provinces of the Northern Perth Basin, the Northampton Inlier and the Carnarvon Basin (Figure 2).

The Northern Perth Basin consists of primarily sedimentary aquifers that offer generally reliable groundwater supplies, and is the primary source of water for Geraldton and surrounding towns. Aquifers within the Basin provide water of relatively good quality and volume. The Department of Water and Environmental Regulation (DWER) has set limits on the total volume of water that can be taken from the main aquifers in the Northern Perth Basin. The Arrowsmith Groundwater Area Allocation Plan[5] outlines key objectives and strategies to manage groundwater resources from basin aquifers located within the Mid West region.

The Northampton Inlier (often referred to as the Northampton Block) is particularly prevalent through the Shires of Northampton, parts of the Chapman Valley and the eastern parts of the City of Greater Geraldton and water is found in fractures within this granite or in the overlying

[4] Queensland Government 2018, *SILO (Scientific Information for Land Owners) interpolated climate data, Queensland climate change centre of excellence*, accessed from https://legacy.longpaddock.qld.gov.au/silo/

[5] Department of Water 2010 *Arrowsmith Groundwater Allocation Plan,* Water resource allocation planning series, Report no. 28, August 2010.

weathered profile. Water in fractured rock aquifers is generally found in smaller quantities and is of poorer quality. The Northampton aquifer is directly recharged by rainfall and surface water leakage from creeks[6] making it particularly vulnerable to periods of low rainfall. Water in this aquifer has also been known to have high concentrations of copper and lead, and may not be suitable for some purposes[6].

The Tumblagooda Sandstone in the Carnarvon and Northern Perth Basins outcrops on either side of the Northampton Inlier, and can offer more favourable water source options[6]. Water supply for Kalbarri and Horrocks is sourced from this aquifer. Water quantity and quality will be variable where this aquifer is present. Site-specific investigation is required to determine its potential for further supply opportunities.

3.2. Surface water

Due to variable rainfall, sandy soils and high evaporation rates the use of surface water from the regions network of rivers and streams is limited to opportunistic small- scale use. Most of the waterways are seasonal and tend to be brackish in quality (1500 – 5000mg/L TDS) and also importantly support a range of ecological, cultural and social values[9]. Therefore, surface water sources are not considered to be a secure supply of water, paticularly during times of drought.

Figure 2: Primary Geological Provinces of the study area (Source: DWER[7])

[6] Department of Water 2017, *Northern Perth Basic: Geology, hydrogeology and groundwater resources,* Hydrogeological bulletin series, Report no HB1.

[7] Department of Water and Environmental Regulation, website, https://www.water.wa.gov.au/water-topics/groundwater/northern-perth-basin, accessed 6/6/2022.

4. Water Use and Availability

4.1. Potable water

Potable water for public use is provided by the Water Corporation from local groundwater sources and distributed through the scheme networks to regional and local towns. The Greater Geraldton supply is the largest scheme in the region sourced from the Allanooka borefield approximately 40km south-east of Geraldton. This scheme supplies the towns of Geraldton, Dongara, Port Denison, Nabawa, Yuna, Northampton, Walkaway and Mullewa. This scheme also provides water to horticulture, local industry in Narngulu, and for emergency and farm supplies. The Water Corporation currently abstracts approximately 10.5 gigalitres of water per year to provide for these purposes.

Water Corporation has a Groundwater Licence issued by DWER to take up to 12 gigalitres per year from the Allanooka Borefield for the Greater Geraldton water supply scheme under specific operating conditions. DWER has reserved an additional 2 gigalitres of water per year from this aquifer for future public water supply providing this can be taken without significant impact to the aquifer. This licensed and reserved volume of water was reduced in 2020 by approximately 6 gigalitres per year as a result of a water allocation limit review for the aquifer[1]. This has significantly limited the ability for the scheme to provide water for growth and development now and into the future.

A rising salinity trend has been observed in groundwater abstracted from the Scheme since 2000 from approximately 700mg/L to 800mg/L which indicates changes in aquifer conditions that require careful monitoring and management[1]. Water quality from the scheme is considered too poor for optimum growth of horticultural produce. Growers manage this by blending scheme water with rainwater captured onsite and in some cases using on-farm desalination units.

The long-term drying climate trend is impacting current and future water supply availability from groundwater resources. This was first identified from an allocation limit review conducted for the Mingenew-Parmelia resource in 2018[2] that lead to the initiation of the review for the Greater Geraldton Scheme[1].

The review of the Greater Geraldton Scheme found that:

- under all population growth scenarios supply (under existing water allocations) can meet potable demand until 2030.
- access to the reserved water allocation (additional 2GL/yr) will enable supply to meet potable demand until late 2030s or early 2040s.
- The implementation of improved water efficiency and distribution will also be necessary to achieve this.

Additional water demand from existing or new industry and horticultural users was not included in this modelling. New requests to Water Corporation for water from the Scheme is currently being met with caution and requests for large volumes cannot be accommodated. Therefore, a new water source is needed to allow immediate growth and development in other sectors. Further planning and feasibility studies for a desalination plant are needed to progress towards a solution to this issue.

In summary, these water reviews have significantly changed the picture of future water availability in the region and have prompted the cascade of future work to respond to these challenges.

Opportunities

It is the Water Corporation's responsibility to operate and manage the long-term security of public water supply. Water Corporation has advised that in times of drought, there is not a significant increase in the demand of water from customers. However, should smaller on-farm or community supplies become dry, users seek water from local Water Corporation town supplies and therefore demand can significantly increase. Should supply pressures be identified, demand management strategies such as water restrictions would be implemented or alternative sources would be provided[8].

Water Corporation has commenced conceptual planning for new water source options for Geraldton however has not identified further planning or feasibility analysis within their current 5 year plan. A new desalination plant takes 5 to 8 years from planning to operation, therefore, to support growth and development in the region, feasibility planning needs to commence immediately. Funding to support Water Corporation to commence this work sooner would be a positive investment, as supporting new growth and development in the region will build drought resilience.

In response to new climate data, DWER has initiated a review of all groundwater allocation limits for water resources across the Mid West to ensure limits are sustainable now and into the future. The outcomes of this review are yet to be released but it is expected that water allocation limits will decrease, meaning water availability will be further constrained.

The Department of Water and Environmental Regulation is also currently updating the *2015 Mid West Regional Water Supply Strategy*[9]*.* This document provides a long-term outlook of water demand and supply across all water use sectors and provides valuable analysis of current water use and water availability information. This will provide high level strategic information to inform planning and future water development. Opportunities to increase water availability to manage the demand-supply shortfall are expected to be provided.

It is crucial that new knowledge on the changing state of water resources, is communicated to the community in a timely manner. It is also necessary to build community understanding of climate science in relation to water availability and management particularly in these drying climatic times. Funding to support the development of modern and effective communication tools such as short videos, animated infographics and podcasts would significantly improve water literacy and empower the community to adapt.

4.2. Non potable

The Water Corporation operates the Yuna Farm scheme which provides non-potable water to select farming properties in the Shire of Chapman Valley. Scheme connections are allocated to those that contributed to the original establishment of the scheme infrastructure. There are no plans for the expansion of this farm scheme.

[8] Stephen Greeve, Water Corporation Mid West Region, Personal Communication, 14 May 2022.

[9] Department of Water 2015, *Mid West regional water supply strategy – a long term outlook of water demand and supply,* Regional water supply strategy series, Report no.3, April 2015.

The City of Greater Geraldton operates ten metered fixed water standpipes for public use that take water from the Greater Geraldton scheme supply[10]. Fixed standpipes provide an essential source of water for people in communities who are remote from reticulated water schemes and may otherwise have limited or no water for household purposes, firefighting or to supplement water for stock. Businesses are also able to utilise these sources and all users are charged accordingly for water used. There are no fixed standpipes for public use in the Shire of Northampton or the Shire of Chapman Valley.

Two Shires within the pilot study area received funding through the *Community Water Supplies Partnership Program* for non-potable water supply options. This Program is a State government initiative administered by DWER with the objective to assist broadacre farming communities in establishing or improving non- potable water supplies. Funding of up to $100,000 has been available for projects from local governments community groups since the program commenced 2020. The Program has provided support to the following Shires in the region to a combined total of almost $200,000:

- Shire of Chapman Valley – upgrade old and install new infrastructure to provide non-portable water to the Yuna townsite from the Rockwell bore to irrigate sporting facilities and public open space.
- City of Greater Geraldton – for new infrastructure for 3 strategic non-potable bores in the Mullewa area to provide water for unsealed road maintenance, emergency water for firefighting and farms.

The National Water Grid Connections Fund is a combined State and Federal funding pathway for water infrastructure projects for Australia's regional communities. The fund supports projects that either improve water access and security, promote regional economic growth and sustainability, or build resilience to drought and a changing climate. The DWER is administering funding and the Mid West has received support for the following:

- Shire of Chapman Valley - Install new rainwater storage tanks on the Yuna CBH shed to capture rainfall roof runoff to provide a source for emergency use.
- City of Greater Geraldton – for Water Corporation to re-equip a bore in the Wicherina borefield, install new storage infrastructure and pump to City owned land to provide a water source for emergency access.

Opportunities

There are opportunities for funding under the Community Water Supply Scheme and National Water Grid Connections Fund until 2023 for additional water supply projects from local governments or community groups to receive support to improve local water supplies. It is recommended that the Shire of Northampton, consider water supply projects that could be put forward individually or collaboratively with other Shires in the Mid West. The Tumblagooda aquifer in the Shire of Northampton and Chapman Valley is expected to be the most prospective source for additional water supplies.

Where non-potable and farm supplies are not provided by Water Corporation, it is responsibility of the individual, organisation or local government to ensure that this water supply is managed to ensure long term water supply security.

[10] City of Greater Geraldton, website https://www.cgg.wa.gov.au/build/infrastructure/water-standpipes.aspx, accessed 7 June 2022.

Water supply security is key to ensuring water resilience is maintained over the drying climate and in drought periods. To build and maintain water supply security the following aspects are necessary:

1. A clear understanding of peak water demand during drought periods on individual, emergency and community water supplies.
2. A sound level of hydrogeological understanding of the water source, its capability to meet demand and its vulnerability to reduced rainfall and recharge.
3. Regular monitoring programs in place to detect changes to water supply capability (water level and water quality).
4. Clear contingency plans in place to manage identified risks.

In areas where emergency water supplies across a community have not been assessed at this level of detail, it would be beneficial to undertake detailed risk assessments for these supplies. This should be conducted with reference to the local government water management strategy or relevant strategic planning document. This work may highlight the need for new or upgraded infrastructure, the expansion of existing supplies, improving monitoring or contingency planning or the development of new sources.

5. Water Quality

The deterioration of water quality, observed by increasing salinity, is an indicator of changing aquifer conditions and careful monitoring and management is needed to ensure abstraction remains sustainable. Contingency plans also need to be in place should water quality changes become unacceptable under public health guidelines or from a resource management perspective. Over abstraction from shallow bores along coastal areas are particularly vulnerable from saltwater intrusion, and require ongoing monitoring of quality and water levels to detect adverse changes.

Opportunities

Getting access to a good quality water source in the right location will become increasing difficult as freshwater recharge is reduced to local aquifers through the drying climate and drought. In some cases, the water supply may be plentiful however the water unsuitable for use due to poor quality.

Technological solutions to improve the quality of water, for example the removal of salt through desalination, that can be adopted cost effectively on a small scale will increase water resilience and provide opportunities that didn't previously exist. Considerations for the disposal of brine water from the treatment need to be managed to ensure this can be undertaken sustainability in regard to the local environment.

6. Water Reuse

Wastewater reuse schemes are in operation in Kalbarri and Geraldton that provide a source of water to irrigate public open space, golf courses or sporting grounds. In Kalbarri 100% of

the wastewater from the treatment plant is used on the local golf course. In Geraldton, 1100m^3 of wastewater per day is provided to five facilities across the local government area[11].

Wastewater is utilised either by direct use from wastewater ponds or indirectly by abstraction of infiltrated wastewater using groundwater bores. There is greater demand for reuse water from the No. 2 Plant in Geraldton than can currently be met and Water Corporation has plans to examine the potential for 50% more water to be abstracted from this site for existing users[11].

The use of treated wastewater reduces demand on the scheme supply and is more cost effective for customers. In addition, the nutrient rich water reduces fertiliser application on irrigated areas. In Geraldton, the quality of treated wastewater is fresher than the local groundwater therefore, it enables users to blend wastewater with local groundwater bores to improve the overall water quality they use.

Wastewater reuse is particularly attractive in larger towns where wastewater volumes are sufficient to warrant investment in reuse options that provide mutual benefit to the Water Corporation and the community.

Harvesting large quantities of stormwater can be also used as a water source (e.g. to irrigate public open space through storage or managed aquifer recharge).[12] Stormwater harvesting projects have been implemented in the City of Greater Geraldton to provide a source of water for the irrigation of recreation areas and additional projects may be identified for grant funding support.

Opportunities

Actions to support increased use of wastewater from Geraldton treatment plants to meet current demand is recommended and further investigation. The infrastructure costs to deliver the water to the point of use is the most significant cost. Therefore, ways to leverage funding to increase water use schemes would be favourable. This initiative would meet the criteria for the National Water Grid Connections Funding Pathway. Collective proposals with other regional areas would enable this project to be scaled-up significantly to obtain greater efficiencies and value.

Opportunities also exist to examine the feasibility of stormwater harvesting in major towns. There is a need for further investigation to determine the feasibility of stormwater harvesting projects in all local governments. Water re-use using wastewater or stormwater presents a drought resilient water supply option and reduces water supply costs from scheme water demand.

7. Water Efficiency

Using water more wisely is key to reducing demand and increasing the longevity of water resources. From a scheme water use perspective, whilst there is effort in promoting and assisting greater water efficiency, the provisions that allow decision making authorities the ability to require smart water design and high standards of water efficiency are limited. In towns or regions that have limited or vulnerable water supplies, water efficiency is critical.

[11] John Darcy, Water Corporation - Mid West Region, Personal Communication, 2-3 June 2022.
[12] Department of Water and Environmental Regulation, https://www.water.wa.gov.au/urban-water/water-recycling-efficiencies/waterwise-community-toolkit/stormwater-harvesting, accessed 6 June 2022.

The Water Corporation requires business customers who use more than 20,000 kilolitres of per year to submit an annual Water Efficiency Management Plan to demonstrate water saving improvements in their operations. DWER works with developers, local governments and industry to improve water use efficiency. Large self-supply users of groundwater are required to submit a Water Conservation and Efficiency Plan as part of their application for a groundwater licence.

Opportunities

Mechanisms that stipulate increase the ability to improve water efficiency standards and expectations for new or retrofit buildings in relation to water reuse and efficiency are necessary as the current mechanisms are not strong enough[11]. This would provide clear guidance to proponents and provide decision making authorities a greater ability to examine and influence new proposals. The recent review of *State Planning Policy 2.9 Water Resources* may provide the required strategic support to allow for improvements in this area. This could be achieved through the planning and development avenues at the local government level and be supported by key water efficiency targets and incentives from the State government.

In addition, water lost from the scheme supply network is currently well above the Water Corporations target of 10%. This unaccounted water is the difference between water supplied but not billed for and can be attributed to water theft, water use for firefighting, inaccurate meters, and pipe leaks and bursts. A review of Water Corporations management of water pipes by the Office of the Auditor General in 2021[13] identified that whilst improvements have been made since 2014, there has been no progress overall in reducing water losses. Reducing water losses can increase water availability for users or reduce abstraction pressure on the aquifer system.

In relation to water storage, high evaporation rates in the northern agriculture region mean closed water storage is key to reducing water loss. Water tank storage solutions are more appropriate than storage in dams in this region and should be key to any water supply storage solutions.

8. Opportunities to Build Water Resilience - Summary

Table 1 summaries eight concept opportunities to improve water resilience across the pilot areas and some can be extended to the broader Mid West region. These ideas require further discussion with key stakeholders to determine feasibility and effectiveness.

Table 1: Building Water Resilience – Summary of Opportunities

Ensuring water supply security
Opportunity 1: Water supply assessments Aim: Ensure water supply security of community and emergency water supply points Term: Immediate Location: All pilot areas.

[13] Office of the Auditor General, 2021 *Water Corporation: Management of Water Pipes – follow-up,* Report 7: 2021-22, 17 November 2021.

Details: Undertake an assessment of community water supply schemes and emergency water sources to determine the level of water supply security in times of drought and in relation to long-term drying climate trends.
Stage 1: Review of hydrogeological assessments, water monitoring programs and contingency plans
Identify level of demand in peak times determine level of vulnerability
Stage 2: Identify and build water resilience options to address risks identified.
Key delivery partners: DWER, consultants with hydrogeological specialists, LGA's.
Potential Funding source: Future Drought Fund

Opportunity 2: Communicating changing water science to empower the community
Aim: Increase awareness of changing climate and water science to improve community drought resilience planning and adaptation.
Term: Immediate
Location: All pilot areas
Details: Using effective and modern communication tools such as short videos, animated infographics and podcasts, build community understanding of new climate and water science information that is easily accessible and engaging.
Key delivery partners: DWER, Bureau of Meteorology, DPIRD.
Potential Funding source: Future Drought Fund

Securing new sources

Opportunity 3: Accelerate planning for a new desalinated water supply
Aim: Progress planning and feasibility studies for a new desalination water supply to support growth and drought resilience.
Term: Immediate
Location: Geraldton – with distribution to all pilot study areas.
Details: Provide financial support to accelerate feasibility planning for a new desalination water source to support growth and drought resilience in all pilot study areas. This will inform decision making and provide greater clarity for the future of the region.
Key delivery partners: Water Corporation
Potential Funding source: Future Drought Fund

Opportunity 4: Water Source Investigations
Aim: To identify potential new water sources to support growth and drought resilience
Term: Immediate
Location: Shire of Northampton and Shire of Chapman Valley
Details: Undertake hydrogeological investigations in the Tumblagooda aquifer to support growth and drought resilience.
Key delivery partners: DWER, DPIRD, Shire of Northampton, Water Corporation, Shire of Chapman Valley
Potential Funding source: Future Drought Fund

Opportunity 5: Improve local non-potable water supplies
Aim: Improve water sources at the farm and community scale to build drought resilience.
Term: Immediate
Location: All pilot areas
Details: Identification of options to upgrade or establish new on-farm or community water supplies and seek funding at individual or collective scale.
Key delivery partners: DWER, LGA's.
Potential Funding source: Community Water Supply Scheme or National Water Grid

Opportunity 6: Increase wastewater reuse
Aim: Increase wastewater reuse to improve access to drought resilient water sources
Term: Immediate – short term
Location: All pilot areas
Details: Examine opportunities and current barriers to increasing reuse in Geraldton and examine opportunities in smaller towns with reticulated sewerage e.g Horrocks. Conduct cost/ benefit analysis of stormwater harvesting opportunities throughout major towns.
Key delivery partners: Water Corporation and Local Government.
Potential Funding source: Future Drought Fund

Technological advances

Opportunities 7: Improving water efficiency
Aim: Improve implementation of water efficiency measures in new and retrofit builds
Term: Medium
Location: All areas and opportunities to scale-up.
Details: Understand barriers to increasing water efficiency, implement better urban water management principals and advocate for stronger mechanisms for decision making authorities to require greater water efficiency.
Key delivery partners: DWER, WALGA, Water Corporation
Potential Funding source: Future Drought Fund

Opportunity 8: Improving water quality
Aim: To improve water quality to meet desired use for small supplies at farm or community scale using new technology.
Term: Short - Medium
Location: All three pilot areas
Details: Examine and trial technological solutions to provide a cost effective and sustainable options for desalination of water including waste disposal.
Key delivery partners: Private industry, DPIRD
Potential Funding source: Future Drought Fund