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Integrated water resource assessment for the Adelaide region, South Australia

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equipment in high priority regions to measure water flow and quality and the subsequent ecological response from fish, vegetation and macro-invertebrates.

2.2.5 SA Climate Ready

SA Climate Ready is the most comprehensive set of downscaled climate projections data ever available in South Australia. The data can be used in future planning decisions. For example, to ensure that planned future infrastructure such as roads, bridges, farm dams and mine tailings dams, are designed to take into account; the impacts of climate change enable water resource and catchment managers to assess the security of future water supplies and protect water supplies for all water users; and anticipate changes in extreme heat and fire risk to inform planning for South Australia's emergency, health and social services sectors.

2.2.6 Stormwater Interventions – linking catchment actions to coastal water quality

The government of South Australia is developing an Integrated Urban Water Management Plan (IUWMP) for Greater Adelaide that will embrace all available water sources including stormwater and wastewater. Currently, investment in stormwater and wastewater infrastructure is made or guided by state and local government agencies of South Australia. This does not currently include an evaluation of the relative effectiveness and efficiency of the investment (separately or in combination) in achieving goals such as water supply security, flood management and improved receiving water quality. In addition, there is a lack of understanding on catchment-scale implications of water sensitive urban design (WSUD) interim targets. While previous work has partially addressed some of the knowledge gaps more information is required to address the most efficient and cost effective way to manage stormwater and wastewater discharges to improve coastal water quality. This research has brought together the available information and tools to enable the assessment of stormwater interventions in the catchment to coastal water quality and other benefits.

These research investments are being drawn together in the peri-urban area north of Adelaide. This is a growing region for urban development, industry and agriculture. All require access to reliable, fit-for-purpose water supplies. The Goyder Institute is leading a program to coordinate the existing knowledge, including the latest science from the Goyder Institute's research portfolio and the specific water infrastructure projects undertaken by local authorities and state government. This coordination will bring together the best available assessment on the available quantity and quality of the northern Adelaide water resources including groundwater, surface water, stormwater and wastewater recycling, desalination, inter-basin transfers and projected demand to deliver an integrated water resource assessment now and into the future to support sustainable development. Outcomes from two of the Goyder Institute projects are presented in relation to the development of the NAP region.

Figure 2. Proposed development region in Northern Adelaide Plains, South Australia.

3 Application of findings to Northern Adelaide Plains

Outcomes from two projects as applied to the NAP region are presented below.

3.1 Adelaide Plains groundwater

The largest reserves of fresh groundwater in the Adelaide Plains are contained in the Tertiary T1 and T2 aquifers which extend from the Eden-Burnside Fault and Para Fault in the east up to an unknown distance offshore in the west (Gerges, 1999). These groundwater resources have been utilised since the start of the 20th century and continue to act as a vital water resource for Adelaide's industry, agriculture and horticulture, and recreational facilities. With growing pressures such as increasing groundwater demand and a changing climate, the longevity of these resources is a critical concern, which calls for effective groundwater management. In this context, a robust understanding of groundwater flow mechanisms is required.

A modelling platform was developed by RPS Aquaterra (Georgiou et al., 2011) for the South Australian Government Department of Environment Water and Natural Resources (DEWNR) and has recently been used to help manage the

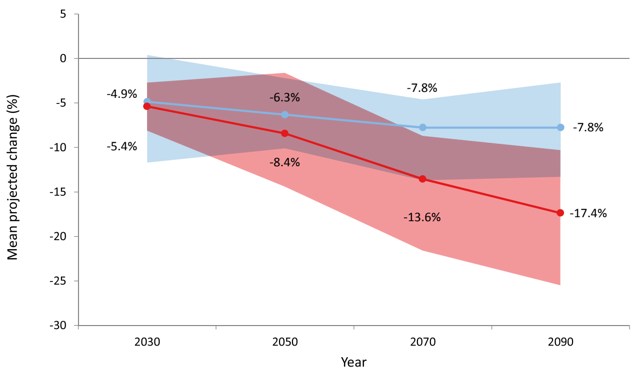

Figure 3. Predicted changes in average annual rainfall in the Adelaide Mt. Lofty Ranges region (from Goyder Institute for Water Research, 2015).

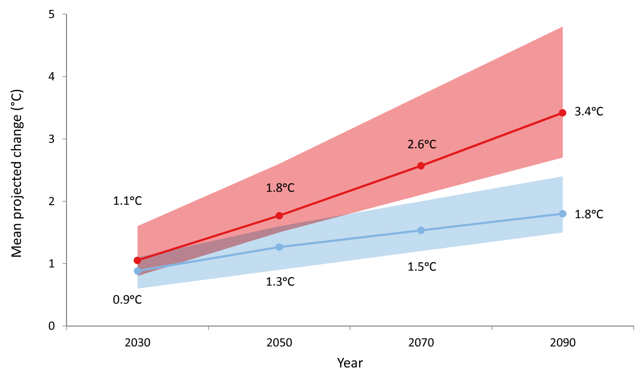

Figure 4. Predicted changes in average annual maximum temperature in the Adelaide Mt. Lofty Ranges region (from Goyder Institute for Water Research, 2015).

groundwater resources of the Adelaide Plains. However, the model showed some significant contradictions with the accepted conceptualization of the groundwater flow mechanisms in the region. Namely, diffuse recharge largely dominated the water budget (Georgiou et al., 2011). In contrast, diffuse recharge across the Adelaide Plains is believed to be insignificant, with recharge being mainly the result of infiltration from surface water features (Miles, 1952; Shepherd, 1975; Gerges, 1999). The model also showed groundwater flowing from the plains towards the hills along a significant portion of the eastern model boundary, especially in the NAP when groundwater should globally flow from the hills towards the plains. Furthermore, the model did not benefit from a number of modern techniques available for calibration.

This research showed that both river leakage flow and lateral flow contribute to groundwater flow mechanisms. Simulations also showed the observed widespread decline of potentiometric levels indicates that total pumping of groundwater is presently occurring at a rate that largely exceeds natural inflows, resulting in a strong decline in storage in the groundwater system and increased cross-formational flow. Furthermore, despite the fact that abstraction is largest from the T1 and T2 aquifers, most of the storage depletion occurs the Quaternary units which have relatively high groundwater salinity. Consequently, there is an increased risk in salinity in the Tertiary aquifers (Bresciani et al., 2015b), which could severely limit the crops able to be grown in the area.

The development of the groundwater flow and transport modelling platform will allow the groundwater supplies to be optimally managed to ensure there is not over-extraction and to minimise the salinisation of the water source.

3.2 SA Climate Ready

One of the key drivers affecting future water availability and hence development in South Australia will be climate change, which will place new pressures on water use and threaten supply. In 2011, the Goyder Institute commenced a project to develop downscaled climate change projections for South Australia, that is, possible future climates generated at a local scale. There are over 40 global climate models (GCMs) used by the Intergovernmental Panel on Climate Change (IPCC) for generating climate projections. The Goyder Institute identified a subset of these GCMs based on their ability to reproduce the State's climate drivers such as the Indian Ocean Dipole and the El Niño-Southern Oscillation (ENSO). This sub-set of GCMs were then used to generate climate projections at a local scale – providing the best available science to ensure that South Australia is Climate Ready. SA Climate Ready is the most comprehensive set of downscaled climate projections data ever available in South Australia. Data is available for six climate variables (rainfall, temperature maximum, temperature minimum, areal potential evapotranspiration, solar radiation, vapour pressure deficit), using two emission scenarios (intermediate and high "representative concentration pathways") through to 2100.

Regional downscaling for the Adelaide and Mt. Lofty Ranges region includes the NAP area that is planned for future expansion. Climate modelling suggests that average annual rainfall in the region could decline by up to 7.8 to 17.4 % by the end of the 21st century (Fig. 3). In addition, average annual maximum temperatures have been modelled to increase by 1.8 to 3.4 °C (Fig. 4). The greatest decline in average annual future rainfall is projected in spring which coincides with warming in spring (Goyder Institute for Water Research, 2015). This projected drier and warmer spring potentially may have implications with regard current agricultural practices in the NAP where horticultural and broadacre crops rely on spring rains to maximise yields. The type of crops grown and the growing season may have to be reassessed based on projected climate changes in the region. In addition alternative sources of water for crop production may need to be identified in the event of reduction in surface water.

4 Conclusions

The findings from projects from the Goyder Institute for Water Research are providing valuable data and models for planning future development in the NAP region. In addition the research will allow better integration of current available water sources and projections of the effect of increasing demands on these sources.

5 Data availability

The Goyder Institute projects have generated substantial data sets. Generally the datasets have been stored with the research partner that was responsible for the project work. However, these data sets are described on the Goyder Institute for Water Research page at the Australian National Data Service (ANDS) http://researchdata.ands.org.au/goyder-institute-water-research/267198/ (Piantadosi et al., 2015; Banks et al., 2015). Further contact details for accessing the data or contacting the key researchers involved are provided at this site. Model Metadata Templates have also been developed for a number of models modified or developed within Goyder Institute projects. These Templates are available at http://goyderinstitute.org/index.php?id=67 (Charles, 2014a, b; Bresciani, 2015).

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