WHEATBELT NRM

System Analysis of the Avon River Basin - Summary

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1 Introduction

Future strategic investment into natural resource management (NRM) within the Avon River basin is essential to assist the community to maintaining the health and prosperity of the natural environment. The Wheatbelt Regional NRM Strategy enables and guides NRM investment within the region, and therefore reflects community values and objectives in identifying areas where investment is likely to have the most significant and long-lasting influence in achieving NRM outcomes. In achieving this objective, the strategy:

- *Reflects community views*
- *Integrates current scientific knowledge*
- *Describes system elements (stressors, land management and resource impacts)*
- *Defines resource condition where possible*
- *Identifies pressure points and gaps*
- *Defines an appropriate response.*

The last Wheatbelt Regional NRM strategy was developed in 2005 (WNRM 2005), largely guided by the investment principles of the National Action Plan for Salinity and Water Quality (NAP) and the National Heritage Trust (NHT). Since 2005, there have been significant changes in the political and investment landscape relating to NRM, prompting a revision of the Regional NRM Strategy.

The review of the Regional NRM Strategy incorporates principles of resilience and adaptive management in considering the environmental, socio-economic and political landscape influencing NRM within the Wheatbelt region. Adaptive management approaches have been successfully applied to NRM in Australia and overseas across a wide range of environments (Hauser & Possingham 2008, Brodie et al. 2007, Australian Forestry 2011, LWA 2009, ICEWRM 2011, Gilmour et al. 1999).

The adoption of a systems-based approach for reviewing the Wheatbelt Regional NRM Strategy was intended to provide a fresh perspective and avoid the constraints associated with the development of previous strategies.

2 Challenges

The Avon River basin lies at the heart of an International Biodiversity Hotspot and contains a rich diversity of natural ecosystems and landscapes. The region is also home to 44,000 residents and supports a vibrant economy underpinned by extensive agricultural and mining interests.

The western areas of the Avon region were amongst the first settled in Western Australia. Early settled areas were extensively cleared for agriculture, with less than 5% of native vegetation remaining in some shires (Landgate 2012). Although clearing of native vegetation led to extensive erosion of soils, particularly during the 1960s and 1970s, this was later reduced by the maturing of agricultural soils and broad-scale adoption of conservation farming practices.

Clearing of native vegetation changed the hydrologic cycle within the Wheatbelt, resulting in development of secondary dryland salinity, impacting agricultural land, lakes and river systems and low-lying native vegetation (George et al. 2008). It is estimated that the Avon River basin (ARB) contains approximately 400,000–500,000 ha of severely salt-affected land (Landmonitor, George 2008). The rate of spread of salinity in the region is unknown, but groundwater continues to rise within catchments yet to reach post-clearing hydrologic equilibrium (George 2008). Improved surface water management and strategic revegetation have been undertaken in recent decades in response to the widespread salinity threat, however much work is yet to be done.

Decades of agricultural production have resulted in soil degradation (a combination of soil acidity, salinity, subsoil compaction, soil water repellence, soil erosion and soil structure decline) that costs the Western Australian agricultural sector an estimated average of $1.55 billion/year in lost production (Herbert 2009). Soil acidity impacts approximately 80% of topsoils and 50% of subsurface soils within the ARB (Andrew & Gazey 2010). Improvements in soil health through improved farm management practices and increased rates of liming have resulted from previous investment. However, further improvements in soil health and more targeted management of soil acidity remain as key challenges for the vibrant and innovative agricultural industry of the region.

Increasing climate variability has reduced farm profitability, with average wheat yields falling from 1.74 t/ha in 1998–2002 to 1.4 t/ha in 2007–2011 (ABARE 2012). Reduced yields associated with increasing cost of energy and inputs, continuing declining terms of trade, spiralling debt, difficulties accessing human capital, and declining investment – including into research and development (R&D) –interact to present very difficult challenges for agriculture within the region and throughout the South West of Western Australia (Connell & Hooper 2002, Davies & Tonts 2009, Gunasekera et al. 2007, Planfarm 2011). Predictions for future increases in climate variability, and a less conducive world economic climate, suggest more challenging times ahead for the region's agriculture, demanding an increased emphasis on risk management and adaptability (Stephan et al. 2006, IOCO 2012, CoA 2007, van Gool & Vernon 2005).

The region's agricultural industry, which is considered amongst the most efficient in the world, has responded to previous economic challenges by increasing productivity through substitution of capital for labour, adoption of new technologies, and improving economies of scale through farm amalgamation and improved management practice (Alston et al. 2009, Cooks & Levantis 2010). Whilst increases in production have ensured that agriculture has remained profitable, the result has been a loss of resilience through reduced diversity, increased debt, and loss of redundancy within the industry, most dramatically expressed through a declining population throughout the agricultural areas of the region (Longstaff et al. 2010, ABS 2011). The region's declining population has further precipitated a loss of a range of services in many areas, further impacting community resilience (ABS 2006, Tonts 2004, Tonts 2005).

The agricultural industry is responding to these challenges through the development of effective research partnerships, the emergence of coordinated and connected grower groups and adoption of new and innovative management practice. However, the industry needs additional support to overcome future challenges.

Increasing population in the west of the Avon Arc, principally as a result of urban and peri-urban land development, is placing increasing pressure on water resources and the natural environment, and in

particular the Avon River (WAPC 2001). The associated changes in land use and increased demand for services are placing further pressure on local government planning and infrastructure capacity. Nutrient and sediment load from Avon Arc towns in particular are influencing river pool health and contributing phosphorous to the downstream Swan Canning Estuary (WNRM 2009a, WNRM 2011a, WNRM 2011b, Giraudo 2013). Local government within the region are focussed on meeting the challenges of the future but require access to additional resources to help them achieve better environmental outcomes for the region.

Increasing mining activity in the east of the region presents new challenges and opportunities, through increasing revenue and a more diverse regional economy, but is also placing additional pressure on an already tight labour market and presents new challenges to managing impacts on ecosystems associated with targeted landscapes. Government, NGO's and mining companies within the region are working together to achieve positive social and ecological outcomes. A continued whole of community response is essential to the future prosperity of the region.

Fragmentation of native vegetation, changed fire regimes, introduced pests (including predators, rabbits and domestic stock), introduced weeds and declining investment all interact to present serious challenges for biodiversity management (Beecham 2002, DEC 2010). In addition, species modelling undertaken to date indicates that predicted climate change may have dramatic impacts on plant communities within the region, further stressing already stretched ecosystems (Fitzpatrick et al. 2008, Yates et al. 2010). Wheatbelt NRM, the Department of Environment and Conservation (DEC) in association with a range of research institutions are all working to better understand the underlying stressors and develop more effective management responses, however much more work is required in this area.

Aquatic environments are under increasing pressure from a range of stressors, including reduced flows, increased salinity, sedimentation and eutrophication, contaminated stormwater, and loss of riparian vegetation and floodplain connection. In addition, climate change may result in increased severity of flooding. Increases in discharge of acid groundwater from natural creeks and constructed agricultural drains present additional hazards to regional aquatic environments (Jones et al. 2009, WNRM 2011 a, DoW unpublished, Giraudo 2013).

Past investment into protecting and revegetating many reaches of the Avon River and its tributaries has led to dramatic improvements in aquatic health. Additional investment to further restore the regions natural water resources will result in further improvements in water quality with significant downstream benefits.

Senescence of susceptible native vegetation communities through changed fire regimes, loss of native browsers because of exotic predators, and reduced landscape permeability in many areas of the region, is placing extensive pressure on fragile ecosystems (Maher 2007, Short & Smith 1994, Short 2004). Ecosystem resilience has been eroded by a history of passive management of our natural environment and climate change within the region is likely to further reduce ecosystem resilience. Past investment in establishing corridors and controlling feral animals has aimed to reduce impacts of fragmentation and exotic predators. Future targeted investment will be essential to build on the success of previous programs in this area.

Water resources are currently being stretched due to changing rainfall-runoff patterns within the region and predicted future climate variability is likely to result in dramatic water resource management constraints throughout the region (IOCI 2012, ACC 2008). Previous surface water management programs have focussed on whole of sub catchment water management. Future investment is required to build on previous planning and implementation, and to ensure water resources within the region are protected in the face of mounting challenges and stressors.

Mounting community concern over population decline and reduction in the standard of living within the region results from a loss of services and spiralling agricultural debt (Tonts 2004). The community is also concerned about the increasing reliance on agricultural chemicals that may be damaging soil biota, native ecosystems and community health alike.

The Avon Regions community is an incredibly valuable asset, and with an appropriate level of support and with targeted investment will rise up to meet its many challenges.

3 Resilience and Adaptive Management

Natural resource management within the Avon River basin and throughout the Western Australian Wheatbelt presents many challenges. Resilience theory describes how social, economic and ecological systems like those of the Avon region are intertwined within a complex self-organising web, which is governed by a series of positive and negative feedback loops (Walker et al. 2004, Stone 1996). Our communities, industries and natural environment are influenced by a range of overlapping stressors, including changing weather patterns, national and global economic trends, political cycles, physical shocks such as wild fires, droughts, and extremes in temperature and rainfall, in addition to historic impacts including extensive clearing of native vegetation, changes to fire regimes and introduced pests.

Resilience theory confirms that the biophysical components of our region are self-organising, in that they continually adjust and readjust to account for changes in the underlying environment, and in response to external pressures and shocks, often in unpredictable ways (Walker et al. 2004). Systems can also be pushed to tipping or breaking points, at which dramatic and fundamental changes to underlying resources occur, and there are often generational delays in the expression of the impacts of stressors on ecosystems and communities (Fischer et al. 2010, Holling 1973).

For example, ecosystems within the Avon River basin appear to have demonstrated high resilience to a range of stressors including landscape fragmentation, changes to grazing patterns and introduced predators, albeit at the cost of some individual species, particularly at a local scale. However, changes to rabbit control methods during the 1970s led to an increase in fox numbers, which in turn caused a crash in populations of some native mammal species. Although not immediately catastrophic, when combined with an extended period without fire (> 30 years), these changes in land management practice appear to interact in such a way to cause the senescence of the extensive and incredibly diverse scrubland heath, potentially resulting in a fundamental change to the structure and function of the ecosystem (Maher 2007, Shackelford et al. 2011).

Similarly, the impacts of declining public investment in R&D within the agricultural sector over the last three decades will be expressed in the coming decades. Public investment in agricultural R&D dropped from a peak of more than 5% of agricultural GDP during the late 1970s to approximately 3%

in the 2000s (Keating et. al. 2010). A similar slowdown in investment in R&D has occurred in other countries, including the United States, and the outcome is that Australian agriculture is facing a decline in new agricultural technologies that is likely to restrict growth in productivity for several decades (Alston et al. 2009, Sheng et al. 2010, Keating et al. 2010).

A series of bad rainfall years and consequent low productivity has caused an increase in debt within the agricultural industry, potentially influencing landholder willingness and ability to trial and adopt new and innovative farming techniques, invest in water resources, and better manage soil health. Landholders also face a high degree of uncertainty around rainfall variability and world demand for grains. Both variables are difficult to predict as they are influenced by a range of additional,external factors.

The key to effective NRM within an environment of such complex interactions and uncertainty is flexibility and adaptability. Adaptive management approaches have been successfully applied to NRM within Australia and overseas across a wide range of environments (Hauser & Possingham 2008, Brodie et al. 2007, Australian Forestry 2011, ICEWRM 2011, Gilmour et al. 1999).

Understanding system interactions and learning from previous and current investment is crucial, demanding a science-based approach to project development, implementation and assessment. Decades of investment in NRM has achieved many tangible outcomes within the region, including a revolution in agricultural management practice, protection and enhancement of thousands of ha of native vegetation and rehabilitation of much of the Avon River. However, challenges in applying adaptive management systems has meant that we have not always been flexible enough, or adaptive enough to respond to all the challenges placed before us.

The adoption of a truly adaptive management system to account for underlying uncertainty, including the integration of effective monitoring and investigation programs that better define and incorporate uncertainty and risk, and the capacity to adjust programs in response to new information learned from active observation are essential to effective NRM.

Outside of an adaptive management approach, there is limited capacity to deal with the multiple levels of uncertainty and unpredictability associated with biophysical and socioeconomic systems, nor the behavioural traits of the range of underlying stressors and shocks influencing the natural resources of the region.

4 A Way Forward

Achieving future significant and lasting outcomes in NRM and building on the successes of the past decades of investment and planning will require the following fundamentals to be in place:

- *A Shared Vision* – allowing everybody to work together to achieve common goals and aspirations.
- *Technical Capacity* - a solid scientific understanding of what needs to be done to achieve goals and objectives.
- *Human Capacity* - the skills and people-power required to achieve the shared vision(s) through applying scientific knowledge and appropriate land management practice.
- *Capital Investment* - the financial capacity to implement changes essential to achieving the stated goals and objectives.

Whilst we have been working toward achieving these elements, there remains much to be done in achieving a whole-of-community response to the challenges of NRM within the Avon region.

4.1 Shared Vision

A whole-of-community response to managing natural resources is essential because of the nature of stressors influencing our region. Many of the stressors influencing our socio-economic and environmental systems are region-wide and therefore demand a whole-of-landscape response. A shared vision is important in achieving a whole-of-community response (Wallace 2011, Duane 1997).

Community values are typically a reflection of the ecosystem services derived from our environment (including food, fibre, lifestyle, genetic resources, and sense of place) which in turn are typically a reflection of land use (Cork et al. 1997, Gainer & Thackway 2007). Agriculture is the predominant land use within the ARB, but conservation, mining, urban, peri-urban and traditional land uses are also well represented.

Initially the raising of awareness during *the decade of Landcare* and the subsequent building of networks and partnerships by Wheatbelt NRM within the region has provided the foundation for developing a shared vision for the region. Community consultation undertaken in the development of this strategy revealed that landholders within the region greatly value their local environment, but do not necessarily understand the nature of stressors impacting on it, nor necessarily its intrinsic environmental values. Further developing a shared vision within the region will be enhanced by a broader understanding of the underlying values of natural resources within the region, the nature of stressors impacting them and the sense of urgency that surrounds their future management.

Wheatbelt NRM has and continues to play a central role in drawing together the relevant agencies, NGOs and other organisations within the region. Further investment in building and managing these networks and relationships will be essential in achieving future NRM outcomes within the region.

4.2 Technical Capacity (knowledge and understanding)

Development and implementation of effective NRM plans and strategies requires an intimate understanding of the underlying social, economic and environmental systems. For instance, developing and implementing effective fire management strategies for the range of vegetation communities requires a detailed understanding of natural fire regimes, the nature of change already expressed within ecosystems resulting from current and previous stressors, and the likely future interaction of alternated fire regimes with other stress factors including changing climatic conditions and changes in land use (DEC 2010).

Even though previous investment has significantly improved our understanding of many natural systems within our region, there remains gaps in our knowledge, particularly regarding ecosystem function throughout the region, including fire management within altered ecosystems (DEC 2010, Shedley 2007), effectiveness of corridors, thresholds for conservation of biodiversity at a local and regional scale, extent of future salinity threat, rate of decline of key indicator species and risks associated with loss of paddock trees through the adoption of controlled traffic farming techniques.

Other major gaps in knowledge include the likely impacts of projected climate change on soil health, biodiversity, aquatic ecosystems and water resources in the region. The rate of spread of salinity is also currently not well understood and poorly monitored, as are nutrient pathways and trends within our precious aquatic environments.

Effective future NRM outcomes will be enhanced by building on existing linkages between community, industry and research institutions, to ensure that new research is more relevant and more applied. This will ultimately lead to improved effectiveness of adoption pathways and better feedback mechanisms between the community, industry and researches.

4.3 Human Capacity (people power)

Achieving NRM outcomes is a lot about people power. Access to human capital is recognised as a constraint to future development of the regional economy and in particular the agricultural sector (Tonts 2007, Cooks & Levantis 2010). The Wheatbelt is characterised by an ageing population, particularly in qualified and technical professions and the agricultural sector, decreased levels of youth participation across all employment sectors, and limited replacement of those retiring or leaving the labour force (Tonts 2004). The region is also characterised by high levels of employment, except within the aboriginal community.

These issues have previously been identified, and significant investment in Aboriginal NRM programs and a focus on engaging youth in NRM have attempted to address these fundamental issues. Further investment in these areas will be essential to build on these very successful programs.

Trends in human capacity within the ARB reflect underlying socio-economic trends. These trends are driven primarily by declining productivity within the agricultural sector in response to decades of declining terms of trade, and more recently declining seasonal rainfall and increasing farm debt (Planfarm 2011, ABARE 2011) (Cooks & Levantis 2010).

The region has also lost professional and technical people from support industries, a loss exacerbated by rationalisation within the public sector, with state government agencies in particular withdrawing

services from the region across the agricultural, water and environmental sectors (Tonts 2008). Community consultation conducted during this strategy review revealed a palpable sense of frustration and abandonment within some communities in response to declining human resources and associated services.

Wheatbelt NRM have filled some on the gaps left by rationalisation within the public sector, but limited resources means that many challenges remain.

There is an opportunity to improve natural resource management professional networks within the region and better identify effective career paths. Better formal support networks and access to professional support are likely to lead to improved NRM outcomes (ACC 2006).

Wheatbelt NRM have worked with many local governments within the region to raise the awareness of NRM issues and have achieved many tangible results, particularly within the area of water management. However, planners within the region have limited access to the range of professional skills being demanded by increasing statuary requirements and complexity of issues facing planning and development within the region. Identifying and overcoming challenges and constraints associated with human capacity will be essential in achieving NRM objectives for the region.

4.4 Capital Investment

Capital investment is essential to achieving natural resource management objectives for the ARB. The 15 million ha of the Wheatbelt supports a population of 72,000 people (approximately 44,000 within the ARB), and produces 50% of the state's agricultural production, including an average of 8 million tonnes of wheat per annum (ABS 2011). The GDP of the Wheatbelt region is approximately $6.7 billion/annum, with approximately 47% from agriculture and 30% from mining (WDC 2006, WDC 2011). The region's agricultural industry has recently experienced a difficult economic period with a run of poor seasons since 2000, including late season breaks, unreliable growing season rainfall and severe frosts.

Effective NRM within the region requires capital investment. Current investment in managing the nature conservation estate is largely inadequate and private landholders have limited financial capacity and insufficient technical support to manage natural ecosystems on their land. Natural ecosystems require active management, including control of exotic predators and weeds, introduced browsers, weed control and appropriate fire regimes. There is a real cost to managing biodiversity within the region, and there is an enormous benefit to the broader community in the conservation of our natural heritage.

Significant region-wide investment in water resources management is essential. Changes in the reliability of water supplies associated with changing climatic conditions are predicted to be dramatic, yet limited strategic assessment of future risks has been undertaken to date (IOCI 2012, ACC 2008). Local government has limited resources to develop and implement effective water management strategies; this could have adverse environmental consequences, particularly within the Avon Arc where population growth is projected to double within the next two decades (WAPC 2002). Local Government is expected to develop district and local water management strategies to facilitate better urban water management, yet have virtually no access to resources to undertake the task, outside of a moderate investment through Wheatbelt NRM in previous years.

The Avon River is a major contributor of nutrients to the Swan Canning Estuary (SCWQIP 2011). The health of the Avon River is threatened by a range of stressors and potential changes in land management practice, yet nutrient concentrations within the river are no longer monitored due to funding cuts. Capital investment in better managing tributaries is essential, as is active management of sediments within river pools (WNRM 2009a).

On a positive note NRM investment through a range of Wheatbelt NRM programs over the last decade has achieved many tangible outcomes and more recently investment, primarily in infrastructure, through the Royalties for Regions program has also made a significant difference. However, limited investment streams within the NRM field remain an impediment to achieving future social, economic and environmental outcomes for the region. There is a strong need to broaden the base of investment within NRM, to help secure a more positive future for the region.

5 Summary

The challenges facing NRM in the ARB are extensive and multidimensional, demanding a coordinated, landscape-scale, whole-of-community response.

The local community has an overwhelming connection with this diverse and beautiful region. The sense of place and belonging of the local community underlies the strength of character and resolve required to overcome the range of challenges it currently faces. Nevertheless, the local community requires assistance in maintaining its own health and that of the landscape on which they rely.

The underlying resource condition is the principal measure of the health of our natural environment and the communities that inhabit them. Land management practice is a key driver of resource condition and associated community health.

Formulating an effective strategy for improved NRM in the region requires a detailed understanding of the underlying resource condition, trends, drivers and limitations. In addition, changes to land management practice at the target scale will require a shared vision, appropriate technical and human capacity and capital investment. Tables 1-5 below present a summary of these key factors intended to inform responses to natural resource management challenges within the Avon River basin.

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