Scibus
ABN: 111 264 051 05
2 Broughton Street
PO Box 660 Camden 2570
Phone: 02 46 558532
Fax: 02 46 558501
Website: www.scibus.com

Email: **nmoss@scibus.com.au**

Review of current usage and value to the regional dairy industry and community of the Northern Shoalhaven Reclaimed Water Management Scheme (REMS).

Compiled by Dr Neil Moss BVSc DipVCS PhD and Dr Natasha Booth BVSc DipVCS MACVSc

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Executive summary.

The Northern Shoalhaven Reclaimed Water Management Scheme (REMS) is one of the largest regional water recycling networks constructed in Australia. It was developed to maximise the beneficial reuse of reclaimed water whilst increasing protection of local waterways. The REMS has been operational for 19 years and currently supplies reclaimed water for use on dairy farms (and other users) on the Shoalhaven River floodplain for irrigation purposes as well as for use for stock water and operational functions including dairy shed, yard and machinery washing. During that period nearly 27 gigalitres (27,000ML) of reclaimed water have been beneficially recycled by participating dairy farms.

This review was commissioned by Shoalhaven Water to better understand the long-term economic benefits of the REMS to the region's dairy farmers and the broader community as a whole. A review of the impact and benefit of the existing scheme was conducted utilising financial and production information obtained from a sample of the dairy businesses currently involved in the scheme. Results from these dairy business case studies were then interpreted to provide an indication of the regional benefits of the water recycling scheme, and its possible expansion. Interviews of several supplier and service provider businesses were also conducted to assess the impact of REMS on the scale and viability of those businesses. Table A on Page 2 provides a high-level summary of the estimated financial and employment benefits to the participating farms and, via multipliers, to the Shoalhaven Region's economy.

Initially the 14 participating REMS farms installed around 400Ha of equipment infrastructure. This irrigation area has increased in time to well over 500Ha. While industry consolidation has resulted in the number of farm businesses being supplied reducing from 14 to 9, the scale, output and viability of the businesses that remain has increased markedly. These businesses have continued to grow in terms of their levels of productivity and employment as well as providing continual flow on economic stimulus to local equipment and farm supply, and service provider businesses. In the experience of these authors, when compared to enterprises

without access to the REMS water, these enterprises have anecdotally expanded production at a greater rate and have demonstrated greater resilience under recent pressures of drought and other industry challenges.

Table A – Estimated Annual Income and Employment Benefits – Attributed to Reclaimed Water Irrigation on Shoalhaven Dairy Farms *

	Aggregate Farm Level Benefit	Shoalhaven Regional Benefit
Recycled Water Used / yr	1,750-1,950 ML	-
Increased farm income / yr	$5.2m	$11.3m
Increased employment (full-time)	45 persons	82 persons

** Based on farm case studies for the 2017-18 and 2018-19 years*

Table 1 (page 9) summarises the two-year production data from the herds in the original case study (Nov 2001-October 2003) and compares these to the two-year production data from the herds that participated in this current study (July 2017-June 2019). From this table a marked increase in total herd size, enterprise output of milk and productivity per hectare can be seen in the herds in this current study, when compared to both dryland (non-irrigated) and REMS irrigated farms in the 2004 study. While some of this can be accounted for by an increase in average farm area (approx. 50%), there has been a marked increase in stocking rates, production per hectare and total litres per cow per day in that time. While this study's authors have observed some expansion and improvement in production in the remaining non-irrigated enterprises in the Shoalhaven region, it is their observation that this expansion has been at a substantially lesser rate than the properties with irrigation. In addition, the expansion reported in this study reflects similar expansion in most other dairy businesses participating in the REMS.

Financial benefit

While the increase in productivity to these enterprises shown in Table 1 cannot be solely attributed to the availability of REMS water, as there have also been significant managerial changes and genetic advances (in both cattle and crop and pastures) in the last 20 years that have improved productivity in dairy enterprises more broadly. All participants in the study expressed that the availability of REMS water, particularly for irrigation purposes has given them confidence to expand their business and has also contributed substantially to the viability of this expansion by improving pasture and crop yields and allowing increased use on some enterprises of high yield crops such as maize (for silage). In the author's experience, the rate of business growth has been substantially higher than in the residual dryland enterprises in the region, many of which have either ceased operation in that time or who have expanded production by less than 50%. Importantly, it can be seen that the productivity per ha or milking area across businesses with REMS irrigation is now more than double that in the dryland farms in the 2004 study. If a standardised value of 50c/litre of milk is used to compare 2 year production figures from dryland farms in 2004 and REMS farms in the current study, there is an annualised difference in gross revenue of approximately of $9100 per ha of dairy milking

cow area under management. Using a conservative estimate of half of this value arising directly or indirectly from access to REMS water, a figure of $4550 per ha or $578,000 in gross revenue per enterprise per annum can be deduced. Across the 9 dairy businesses accessing REMS water, this could be extrapolated to total approximately $5.2 million per annum of gross revenue. Using the DPI multiplier of 2.178 (from: http://archive.dpi.nsw.gov.au/__data/assets/pdf_file/0011/619814/primary-industries-eceonomic-key-data-2016.pdf), the impact on the broader economy of this increased productivity is approximately $11.3 million per annum. This increase in activity only reflects milk sales and would be added to substantially and on a pro-rata basis by increased sales of calves, heifers and cull mature cows.

One direct financial benefit of REMS irrigation can be expressed in terms of the potential savings in costs of producing home grown fodder when compared to purchased fodder. Scibus has observed and measured a marked increase in fodder productivity when dryland land is converted to irrigation through either more reliable and more consistent growth and utilisation of pasture, or the reliable production of crops such as maize that otherwise would not have been grown. In the 2004 study, annualised pasture yields from dryland and irrigation farms were 7.2 and 9.6 tonnes, respectively. We have observed substantial improvements in agronomic practices of the last 16 years in forage production that have increased yields since that time and have measured dryland pasture harvest yields of closer to 10 tonnes of dry matter in this district. Similar improvements in practice have increased irrigated pasture yields to 15 tonnes of dry matter and combined yields of annual winter (rye and cereal) and summer forages (maize) of up to 30 tonnes of dry matter per ha can be exceeded. Conversion of dryland to irrigation will conservatively increase the productive capacity of pasture and cropping land from 10 to 20 tonnes of dry matter per hectare. There is a wide variation of cost of pastures and crops from $80 to over $200 per tonne of dry matter depending on crop type, yield, and whether it is direct grazed or conserved. If we assume that the average costs of producing irrigated forage (grazed and conserved) is $150 per tonne of dry matter and the average cost of purchased fodder is $300 per tonne of dry matter (reflecting the lower end of costs we have observed in the last 5 years), then we can extrapolate that the gross savings per irrigated hectare of this additional fodder, compared to purchase is $1500/ha. When compared to sourcing fodder from external sources, home grown fodder represents an average annualised cost saving of $69,450 per enterprise in this study per year. This equates $625,050 if extrapolated across the 9 herds in the REMS. Note, that this is estimated at the lower end of the range of purchased fodder costs.

Forage cost savings can also be expressed in terms of $/ML of irrigation water applied. Estimated and observed irrigated forage production costs are approximately $150 per tonne DM of home-grown fodder (range $120-$220/tonne DM). Nutritionally comparable purchased fodder prices would range of $300-$500 per tonne DM. This is within the range of 90% of purchased fodder prices we have observed across the last 10 years. Water use efficiency of 2.5 tonnes of (forage) dry matter(DM) /ML applied is achievable and can be exceeded with appropriate crop choice and management.. Therefore, for each ML of water applied, a gross margin saving of between $375 and $875 could be achieved when home grown feed is compared to purchased alternatives. This would represent a per hectare range of between $1500 and $3500 based on an application rate of 4 ML/ha. Our data shows average water use of 4.4 ML/ha was applied.

A further saving for all enterprises has been in the use of REMS water for other purposes such as drinking water for livestock as well as washing of plant, yards and machinery. Prior to REMS all farms were using town water for these applications. All farms reported that REMS water

was now the primary source of livestock drinking water. If this is estimated at 150 litres per head per day, each cow would consume approximately 53.4kL/year. Across the 9 herds on REMS, with an estimated herd average size of 481 head, this translates to a total water saving of 231,168 KL per year. One study participant reported that the annual savings in water costs due to having access to REMS water, when compared to town water, was $9000 per quarter. This figure represents a dollar figure only and is unadjusted for expansion in herd size and CPI over that time.

Employment benefit

Expansion in the dairy enterprises receiving REMS water has greatly increased their requirement for staff. This increases their importance as substantial direct and indirect sources of employment in the region. The average number of full-time labour equivalents working on each property was nine. When compared to smaller, non-irrigated enterprises milking < 200 cows it is estimated that this represents an additional five labour units per farm or 45 labour units across all the nine farms participating in the REMS scheme. While some of these additional labour units may represent those displaced from smaller farms that have exited the industry, this still represents a substantial retention of labour within these participating enterprises. Using the DPI multiplier of 1.83, a total net benefit to the economy of 82.4 jobs is likely to be being created as a result of the REMS, many of which are likely to be within the Shoalhaven region. (from: http://archive.dpi.nsw.gov.au/__data/assets/pdf_file/0011/619814/primary-industries-eceonomic-key-data-2016.pdf),

Sustainability benefit

Access to REMS water has increased the business and environmental sustainability of the involved enterprises through multiple mechanisms.

- By allowing dairy businesses to continue in an era where the terms of trade in dairying have declined over time. This has been possible through REMS allowing business expansion via increased fodder production, stocking rate and subsequent increases in output.as
- By providing better forage production risk management and insulation against both regional drought and drought in the cropping regions as per the period 2002-2006 and from 2017 to the current period
- By facilitating farm expansion that in turn has allowed for capital to be sourced to better develop facilities on farms that improve both business and environmental outcomes. For example, feed storage facilities and feed-pads allow cattle to be safely fed in both dry and wet weather while minimising the risk of environmental damage and adverse animal well-being outcomes
- By allowing family properties to grow to a scale that can facilitate successful intergenerational transfer of farm business via farm expansion or acquisition of other dairy enterprises to facilitate sustainable succession planning
- By facilitating retention of a large and viable local dairy production base which in turn supports the sustainability of many service and product supplier businesses- the

retention of quality dairy product and service provision businesses is critical to the sustainability and competitiveness of all individual dairy farms in the region
- By providing a vehicle for distribution of dairy effluent and its re-use as fertiliser improving both farm economic and environmental management outcomes
- By reducing the demand for town water supply for both drinking water provision for dairy cattle as well as for washing purposes (up to 232,000KL/year). This has been critical during times of drought and is important as the population of the Shoalhaven region increases and so too does the demand for town water.

Environmental benefit

Environmental benefits from the REMS arise at both the farm and regional level and include:

- Recycling of some 27,000ML of treated effluent (reclaimed water) onto farms reuses valuable nutrients for growing pastures and crops as opposed to discharge or loss to the environment
- Substantial reduction of effluent discharged to waterways such as the ocean, Jervis Bay and Shoalhaven River thereby protecting these ecosystems and the industries that rely on the quality of the water such as the Shoalhaven shellfish industry as well as tourism
- Preservation of pasture and ground cover is more likely on farms that can irrigate during drought or dry weather so reducing erosion, environmental dust and down stream silt accumulation.
- Greater control of pasture and crop growth on irrigated properties allows for more efficient use of nutrients and less environmental losses of those nutrients that are applied as either farm generated effluent or chemical fertilisers (for example, a reduction in nitrous oxide emissions occurs when nitrogenous fertilisers are applied and lost due to volatilization in dry weather)
- Improved on farm distribution of effluent via mixing with effluent water and distribution through pivot irrigation systems
- Facilitating improved production per hectare and per cow which in-turn reduces net emission intensity for milk production
- By reducing requirements for emissions associated with transport of fodder from out of the region
- Maintaining high levels of milk production close to the Sydney market which reduces emissions due to “food-mile” accrual of milk produced out of the region.

Impact on local businesses and community

Interviews conducted with a number of retail and service businesses including farming contractors, irrigation supply business, tractor supply and service businesses and rural produce stores highlighted the critical importance of the REMS in both driving demand directly for their businesses as well as for maintaining a viable and scaled dairy industry and supporting infrastructure. This translates into both scaled sales and employment as well as maintaining viable regional capacity in farm contracting, veterinary and advisory services, farm-machinery and irrigation supply and services as well as contributing to a buoyant rural-retail sector.

Use of additional water if available

Interviews with farms participating in REMS indicates that there is strong demand for additional water if it became available via increased storage capacity. Farmers interviewed appreciated

both the environmental benefit of this facilitating further reduction in environmental excess water discharge when storage capacity was exceeded during periods of wet weather as well as substantial benefit to their own businesses by being able to either better utilise existing irrigation infrastructure and land or allowing for additional irrigation infrastructure to be installed facilitating irrigation of additional areas of held land. This would benefit these businesses by either allowing increased stocking rates and productivity or providing additional resilience in times of regional or broader drought (or extreme wet weather by having conserved crop available). It is estimated that each additional 2 ML of water per year that can be saved and used on farm could facilitate the support of a minimum of one additional milking cow, that in turn could produce milk valued at $3750 per head per year (based on 7500L of milk valued conservatively at 50c/L- note current milk price is actually approximately 62c/L). Alternatively, if used at peak water use efficiency of 3 tonnes DM/ML applied, this would translate to a feed cost saving of $450 per ML applied based on an average differential price between home grown and purchased feed of $150 per tonne of dry matter.

Through its multiplier impact, increased farm turnover would have a stimulatory flow on effect on the regional economy as previously discussed. Increased installation of irrigation infrastructure and increased farming activity on irrigated land would have substantial benefit for supply and service business in the local economy. Connection of additional dairy enterprises to the scheme if additional water was available would further sustain their viability into the future and have similar additive supportive and stimulatory impact on regional employment and business activity.

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Southern Water Company

Nowra Truck and Tractor

Henry Contracting Services

1) Introduction/Purpose of Review

This review of the Northern Shoalhaven Reclaimed Water Management Scheme (REMS) has been commissioned by Shoalhaven City Council to assess the current usage, value and importance of the scheme to both the regional dairy economy and the wider community.

The scheme commenced operation in 2001 and originally supplied 14 dairy farms irrigating a total of 400 hectares of dairy pastures. This area has now been expanded to cover 500 hectares, however, the number of enterprises supplied has been reduced to nine dairy farms, due to acquisitions of exiting dairy farms by others already in the scheme. Water is still supplied to those acquired properties.

Water derived from the REMS scheme is predominantly used for irrigation but is also used to provide drinking water for stock, for sprinkler systems that cool milking cows and improve animal welfare in summer and for general washing purposes for dairy facilities and equipment.

Irrigation water from REMS has been used on Shoalhaven flood-plain dairy farms to increase pasture and crop growth and security. It has become an integral component of these enterprises' fodder-production and risk-management programs and has allowed them to become more self-sufficient, resilient and to potentially increase stocking rate and productivity with reduced risk. Improvements in productivity and viability have direct flow on benefits for the local economy and employment. There is currently a proposal to extend the scheme with additional water and storage to be made available to these dairy businesses. The scheme supplied approximately 1946 ML and 1767 ML to farms in 2017-18 and 2018-19 respectively. Storage at any one time is currently restricted to 600 ML which constrains the amount that can be withheld during wetter periods, subsequently restricting what can be redistributed during drier periods or periods of reduced water processing through the plant. For example, the normal daily discharge to REMS users of 13 ML was reduced during the summer of 2017/18 to 9-10 ML per day to conserve water. At present just under 70% of reclaimed water produced through the REMS is utilised by farms while the remainder is discharged to the ocean or Shoalhaven River. A key constraint to the current scheme is the limited ability to capture and store excess flows during wet weather events.

A detailed farm business monitor program was conducted between 2001 and 2003 that evaluated, using paired comparison techniques, three irrigated and three non-irrigated dairy enterprises. While not statistically significant (due to small sample size), this review provided valuable insight at that time to some of the benefits of irrigation to those enterprises with irrigation with respect to farm stocking rates and productivity when compared to dry land enterprises used as comparison. As the study was set up prospectively, useful information regarding feeding inputs, pasture inputs and animal health were also able to be collected as well as some estimates of financial benefit.

This current review has been commissioned to better understand the long-term benefits of this scheme to the region's dairy farmers and the broader community. To do this, an assessment of the impact and benefit of the existing scheme utilising financial and production information obtained from a sample of the dairy businesses currently in the program has been conducted. This took the form of a series of farm-enterprise case studies including development of an understanding of the current nature and productivity of these businesses, a review of the benefits and limitations of the current REMS system to them and an assessment of how additional water, if it became available, could be best applied.
The results from these case studies were then extrapolated to provide an indication of the regional benefits of the water recycling scheme currently and subsequently with its possible expansion.

A detailed report profiling each enterprise and its use of the REMS water has been produced and includes a mix of subjective and objective data however the retrospective nature of data collection for this study may limit the accuracy of some of the objective data.

The impact on local businesses and the broader community has also been assessed including impacts on business activity, employment as well as regional character and identity.

2) Farmer Case Studies

For the purpose of assessing the value of REMS irrigation to the local dairy industry all nine farm businesses utilising REMS water were invited to participate in the study. Of these four agreed to be involved in the development of an individual case study profiling that business's utilisation of REMS water through providing a mix of subjective and objective information regarding how access to the REMS water has supported their business's resilience and growth.

The survey was conducted in two parts:

- A table collecting objective production related data filled out by the farmers
- A face to face interview with pre-determined questions conducted on farm. The duration of each interview was approximately 3 hours including a brief property inspection.

The surveys were conducted in September and October 2019 after recent rain had generally resulted in improved pasture conditions.

The farmers involved were enthusiastic participants and in general were extremely positive regarding the impact of the REMS on their enterprise. The review provided useful quantitative and qualitative information regarding the importance and value of REMS on their business's viability and sustainability. The enterprises interviewed appear to be of a very different scale to those interviewed in the initial 2004 survey with their appearing to be substantial increase in output, stocking rate and production intensity during the last 15 years. There are no statistical comparisons that can be drawn from the data as the enterprises involved in each study are different. However, Table 1 provides some comparison between the average values recorded from the original study (2003 data) and the values from each of the 4 study herds participating in this study.

Table 1. Summary of the comparative 2-year productivity data of herds participating in the 2004 and 2020 REMS review.

	2004 Dryland	2004 Irrigated	2020 Irrigated
milking cow (numbers)	162	197	481
total milking cow area (ha)	81	80	127
irrigated milking area (ha)	0	35	46.3
dryland milking area (ha)	81	45	71.7
stocking rate (milking cows/ha)	2.1	2.5	4.3
total litres per enterprise	2540300	2981100	8654945
total litres/ha	30950	36530	67365
litres/cow/day	20.8	21.2	25.4