Macorna Wind Farm – Implications for the irrigation district

Atmos Renewables

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1 Introduction

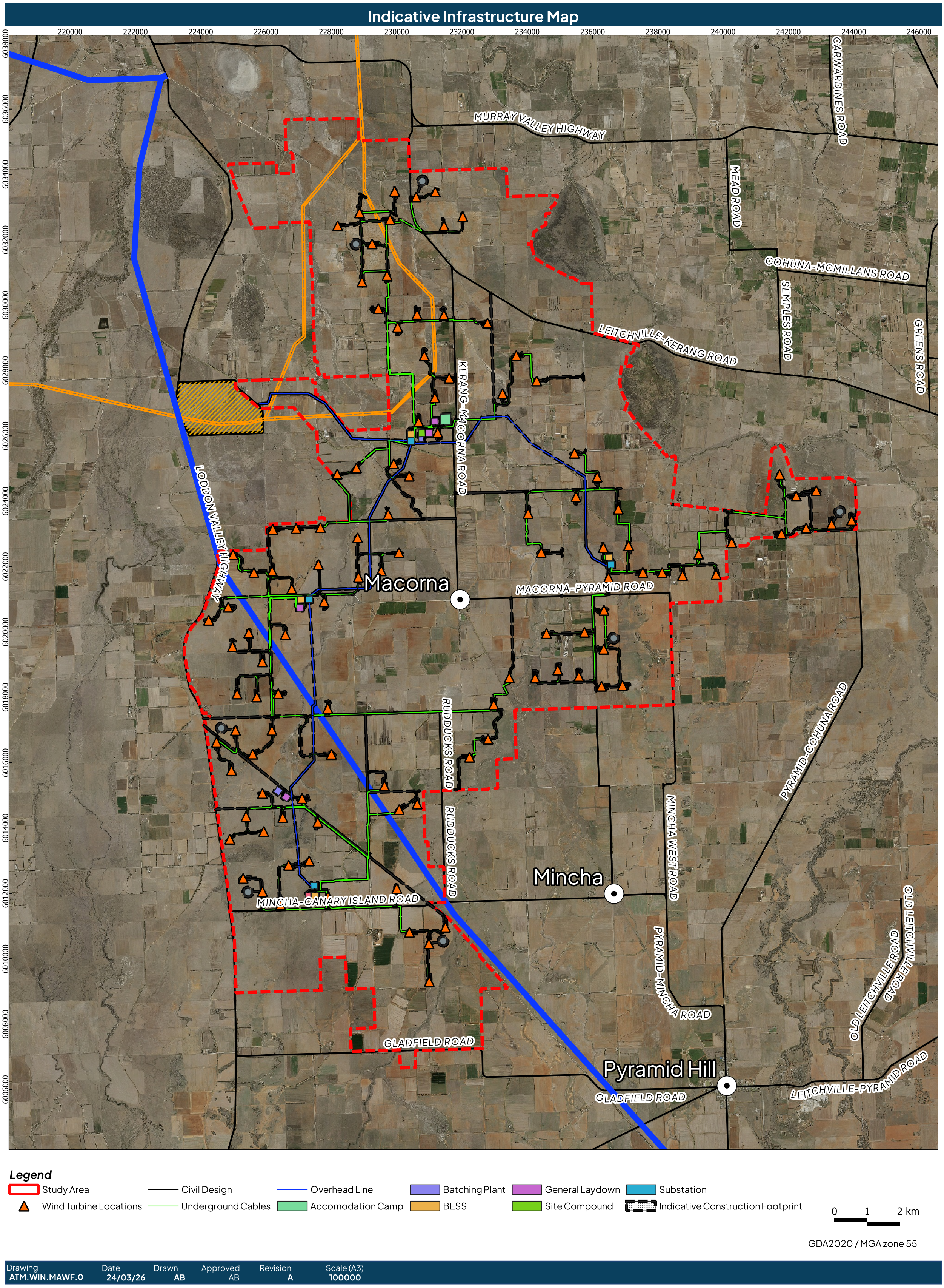
Atmos Renewables is planning a potential wind farm development in the Macorna district near Kerang in north central Victoria. They have engaged RM Consulting group to provide:

- A description and history of the structure and operation of the irrigation district
- The potential impacts of a wind farm in this area (both positive and negative) on irrigation infrastructure, water delivery, drainage/flood management and agricultural productivity
- Identifies any risks with the irrigation district's ability to function as an integrated system as a result of the wind farm.

This report will provide an overview of the changes that occurred in the district from an irrigation perspective over time to provide some context for the potential implications of a wind farm development to the irrigation network within the region.

2 The Project

Atmos Renewables is planning the development of an 820 MW Wind Farm Project at Macorna in northern Victoria. A concept map is provided in Figure 2-1.



NOTE: Commercial in Confidence. Infrastructure Layout locations shown are preliminary, and may be subject to change based on further studies.

Atmos RENEWABLES

Figure 2-1: Concept Map – Macorna Wind Farm

The project area covers an area of approximately 23,000 ha, and the plan is to install 114 wind turbines, of which 25 are currently proposed to be located on actively irrigated land.

The land use within project area consists of livestock grazing (beef, prime lamb and wool), broadacre cropping, dairy and pig production with the relative areas of each activity provided in Table 2-1.

Table 2-1: Land use within the project area[1]

ENTERPRISE	TOTAL IN PROJECT AREA (HA)
Livestock Grazing - Average Beef, Prime Lamb & Wool	~10,370 (45%)
Broadacre Cropping	~8,716 (38%)
Dairy	~2,199 (10%)
Piggery	~1,385 (6%)
Total	**~22,670 ha**

Table 2-2: Proposed Infrastructure and Footprint (ha) during the construction and operational phase[1]

INFRASTRUCTURE PROPOSED	CONSTRUCTION FOOTPRINT	OPERATIONAL FOOTPRINT
Turbines & Hardstands	273.4 ha	114 ha
Access Tracks	219.4 ha	150.3 ha
Underground cabling	69.7 ha	0 ha
Transmission Line	30.6 ha	30.6 ha
Benched Areas; BESS, Site Compound, Substation, Batching Plant	78.1 ha	43.4 ha
Wind Monitoring Masts	49.4 ha	0 ha
Offsite impacts	24.3 ha	0 ha
Total	**745.1 ha**	**338.3**

During the operational phase of the project, the average project footprint per wind turbine will be in the order of 3 ha which includes access tracks.

3 Irrigation History

3.1 IRRIGATION DEVELOPMENT

The region has a long irrigation history spanning more than 130 years, during which it has continually evolved and adapted. Conditions have not remained static, with ongoing change occurring in response to shifting opportunities and pressures over time.

[1] Information provided by Atmos

Irrigation was first developed in the region in 1893 with the development of irrigation trusts covering an area of 12,596 ha at Macorna north with 38% of the area irrigated[2]. Following the construction of Lake Eildon in 1955 the region along with the entire Goulburn Murray Irrigation District (GMID) saw significant growth. Water entitlements were effectively given out to land holders calculated on a formulae based on land ownership – 1st 100 acres owned – 100 acre feet in water entitlement, then 1 acre feet per 12 acres owned up to 300 acres then 1 acre feet for every 3 acres owned beyond 300 acres. There were also different allocations if the land was considered suitable for horticulture (2 acre feet per acre of land). This was quite a socialist approach that provided sufficient access to water to promote the development of irrigation farms to support farming families.

With the increased water availability through the expansion of water storages (including Lake Dartmouth completed in 1979) and relatively underdeveloped irrigation land, there seemed to be an unlimited amount of water available as allocations against water rights were consistently 200%. This period saw significant on farm development peaking in the 1970's.

3.2 SALINITY IMPLICATIONS

During the extreme wet years from 1972 through to 1974 and combined with extensive growth of irrigation (often very inefficiently applied prior to the introduction of laser grading) saw a rise in water tables and associated salinity issues that was first experienced in the Tragowell plains (and later spread to other regions). The community in response established its own salinity research farm (Kerang Agricultural Research Farm) to undertake research to assist the community manage salinity. The Kerang Irrigation Region Salinity Action Committee (KIRSAC) was one of the forerunners for salinity management planning in Australia and leading to the development of the Tragowell Salinity Management Plan. Many of the farming families within the Macorna wind farm development played active roles in these responses.

These plans resulted in proactive on farm action to help alleviate the implications of salinity including:

- Extensive soil salinity surveys to assist farm management decisions focusing production on the better soils and rehabilitation on the poorer soils
- Community drainage schemes (sponsored by the local Council) were initiated in the Tragowel Plains to reduce incursions to the water table. Unlike other irrigation regions state government funding was not available because of the perception that drainage on relatively less intensive low productive land affected by rising water tables was not economic. So the community found cost effective ways of improving the drainage
- Introduction and pioneering of laser grading to improve irrigation efficiency
- Community ground water pumps to help lower water tables.

This focus on managing salinity and adopting the latest technology enabled the area to expand and grow.

Water use peaked in 1989/90 pre permanent water trade and implementation of the Murray Darling Basin Plan and in the Pyramid Hill/Boort area (Loddon Valley) the irrigation area comprised of:

- 166,000 ha of holdings
- 91,533 ha irrigated,
- 330,647 ML used (3.6 ML/ha) and
- 226,314 ML of water right[3].

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[2] Royal Commission on Water Supply 1896

[3] Rural Water Commission Annual Report.

3.3 PRESSURE ON WATER RESOURCES RESULTING IN WATER LEAVING THE DISTRICT – WATER TRADE AND WATER CAP IN THE MURRAY DARLING BASIN

Up until 1987, the only way an irrigator could increase water entitlement was through the purchase of extra land with an existing water entitlement. However, many irrigators continued to develop their properties and relied on water allocations of 150% or greater which was what had been delivered in the majority of years previously.

In 1987 a major change took place which allowed for temporary trade of water followed by the allowance of permanent trade in 1991. This enabled individual irrigators to meet their water needs during years of lower allocation by buying from individuals who had not developed their properties to the same degree. It also allowed for individuals to increase their water right as a risk management strategy.

Maximum allocation remained at 200% but the average allocation started to fall to around 180% with a minimum of 130%. Water trade increased water use as previously unused or sleeper entitlements were traded and used.

The continued rise in water use started to have some broader impacts and more and more pressure was starting to be applied to maintain and improve river health.

In response, the Murray Darling Basin Commission introduced the Murray Darling Basin cap based on the volume of water that would have been diverted under 1993/94 levels of development. This was seen as an "essential first step in establishing management systems to achieve healthy rivers and sustainable consumptive use including agriculture".

This signalled the start of water trade with a "finite resource" and the first area to sell water was the Tragowel plains. This was due to a combination of:

- Relatively poor soils that only enabled low intensive irrigation for pastures for grazing animals
- A significant area of saline land that was low productivity
- The enterprises practised were relatively low return (i.e. grazing animals) compared to horticulture.

The buyers of water initially were mainly wine grape farmers in the Sunraysia region which was experiencing enormous growth during the 1990's.

3.4 MILLENNIUM DROUGHT AND IMPLEMENTATION OF THE MURRAY DARLING BASIN PLAN – MORE WATER LEAVING THE DISTRICT.

The millennium drought of 2006-9 was really the first time that water had been scarce and water trade meant that the limited water available was sold from the Tragowel Plains to the horticulture farmers of Sunraysia and Riverland.

For 3 years there was almost no irrigation in the Plains.

The basin plan required the amount of water available to be reduced by "buyback". Much of the Victorian contribution to this came from the Tragowel Plains area either through direct buyback or buy further trade to areas that had sold through buyback (premium price) and then repurchased water from the Tragowel Plains.

A report by Tim Cummings and associates in 2016[4] highlighted the change in water ownership which reflects the changes that have been experienced in the region. This report highlighted the change in water ownership by irrigators within the GMID had fallen by 40% since June 2001. Although water entitlement ownership does not reflect water usage (as irrigators can purchase and trade-in allocation water), the statistic certainly confirms that the amount of water allocated to irrigation property-owners within the GMID has fallen dramatically.

Water owner	Location		High-reliability water share volume (GL)		% change
			30 June 2001	30 June 2015	
Irrigator	LMW diverters		203	216	6%
	LMW districts		189	125	-34%
	GMW diverters		243	164	-32%
	GMW districts	Torrumbarry	378	234	-38%
		Loddon Valley	230	124	-46%
		Rochester/Campaspe	208	113	-46%
		Central Goulburn	391	237	-39%
		Shepparton	181	117	-35%
		Murray Valley	259	167	-35%
		GMID Subtotal	**1,648**	**992**	**-40%**
	Not tied to land		0	175	N/A
Water corporation	Not tied to land		0	62	N/A
Environment	Not tied to land		0	605	N/A
TOTAL			**2,283**	**2,338**	**2%**

Figure 3-1: Change in water ownership (Tim Cummings and associates 2016)

It is noted that the water ownership loss in the Loddon Valley (including the Tragowell Plains) was the highest of all the GMID irrigation districts at 46%.

This is further reflected when looking directly at water deliveries with the GMID over time. The amount of irrigation water used by irrigation in the GMID has effectively halved from around 2,000 GL in the 1990s to around 1,200 GL in recent years. This means there is a significant amount of land previously irrigated that is now dryland.

[4] Tim Cummins & Associates. 2016. Trends in Northern Victorian Water Trade 2001-2015. DELWP

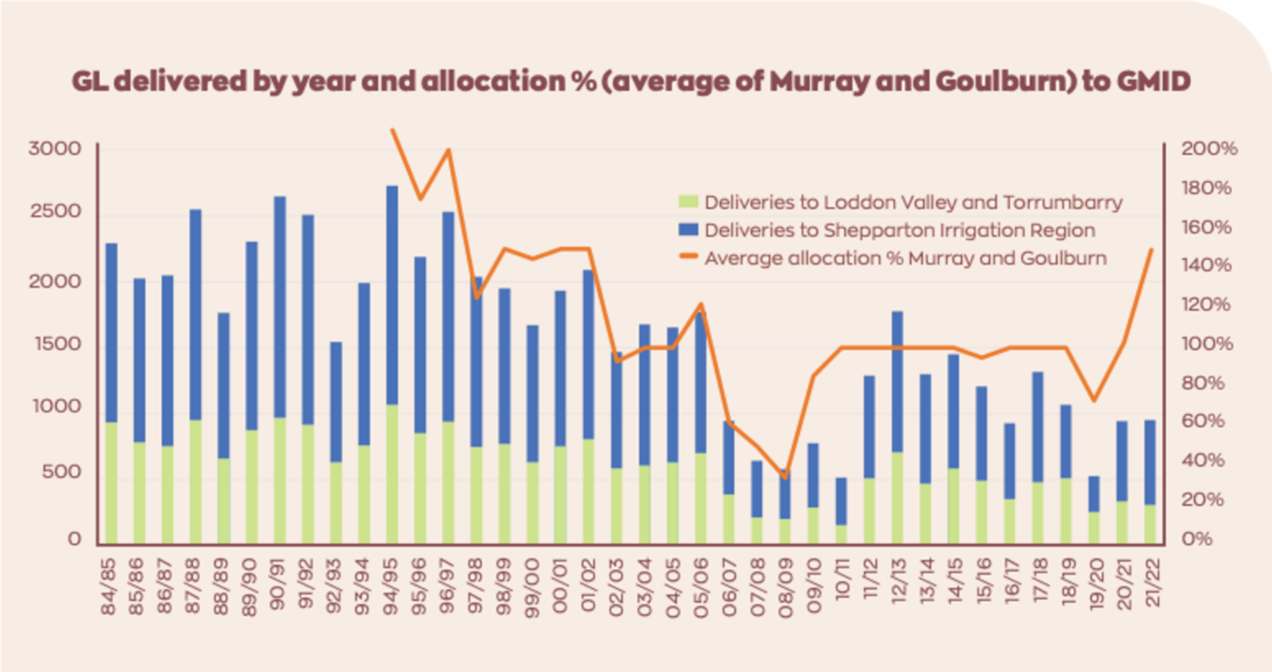

Figure 3-2: GMID Irrigation water deliveries – the Loddon-Murray Irrigation Region shown in light green[5].

3.5 MODERNISATION OF GMW IRRIGATION INFRASTRUCTUER

The Northern Victoria Irrigation Renewal Project (NVIRP) was established in 2007 and later become known as the Connections Project. The was in response to a combination of:

- Aging irrigation infrastructure
- A basin wide environment that needed water
- Inefficient infrastructure that could generate “water savings” which could be used for the environment
- Melbourne was running out of water and some of the savings could be piped
- Excessive infrastructure that needed to be rationalised (both because of changing farming practices but most importantly in some regions the loss of water as per Tragowel Plains).

The $2.2 billion project had two key elements:

- Automation of control structures to modernise operations and provide efficiencies
- Rationalisation of channels and structures to reflect the changed farming practices and in some areas such as Tragowel Plains the greatly reduced water use.

In 2017 the Victorian Government published a report: Regional Irrigated Land and Water Use Mapping in the Goulburn Murray Irrigation District, Technical Report which provides a table of land-use within the total GMID including the Loddon valley region (described as Pyramid Hill/Boort in Figure 3-3).

[5] https://www.nccma.vic.gov.au/media/documents/North_Central_CMA_Loddon-Murray_Irrigation_Region_Irrigation_Drainage_Strategy_Final.pdf

Categories	Murray Valley		Shepparton		Central Goulburn		Rochester		Torrumbarry		Pyramid-Boort		Totals	
	Properties (Number)	Area (ha)	Properties (Number)	Area (ha)	Properties (Number)	Area (ha)	Properties (Number)	Area (ha)	Properties (Number)	Area (ha)	Properties (Number)	Area (ha)	**Properties (Number)**	**Area (ha)**
Properties with dairy	264	26,169	103	8,049	363	37,493	155	19,758	204	26,690	53	8,561	**1,142**	**126,720**
Associated with dairy	152	12,365	81	3,678	220	11,454	97	7,774	152	11,473	63	7,201	**765**	**53,945**
Dairy cattle agistment/fodder	153	11,137	44	3,250	238	14,243	199	13,637	115	11,448	10	1,138	**759**	**54,853**
Perennial horticulture	136	4,672	227	6,482	179	5,460	9	981	389	7,086	8	4,448	**948**	**29,129**
Annual horticulture	8	794	12	283	28	2,203	25	3,501	37	1,139	5	2,120	**115**	**10,040**
Cropping	198	21,607	271	19,792	508	45,845	397	38,118	412	39,154	540	97,258	**2,326**	**261,774**
Mixed	76	4,856	292	21,561	471	35,451	201	20,000	505	23,638	95	12,610	**1,640**	**118,116**
Grazing non-dairy	456	40,540	99	6,901	113	7,578	47	3,955	418	48,197	132	26,719	**1,265**	**133,890**
Intensive animal	2	52	1	74	21	978	6	160	17	2,110	9	1,936	**56**	**5,310**
Horses	14	761	31	1,855	42	1,821	8	245	1	8	6	647	**102**	**5,337**
Lifestyle	379	5,690	645	5,755	1,454	11,014	734	4,198	760	2,835	140	776	**4,112**	**30,268**
Totals	1,838	128,643	1,806	77,680	3,637	173,540	1,878	112,327	3,010	173,778	1,061	163,414	**13,230**	**829,382**

Figure 3-3: Land use across the water service areas in the GMID[6]

The table above shows the total area within the irrigation area but it does not show the actual area irrigated. Of the total area of 829,382 ha there will be tracks of land not suitable for irrigation or permanent dryland but the report also provides the area of actual irrigation in the 2015/16 year.

Irrigated land cover/usage	Total (ha)	Percent%
Winter grain or fodder crop (e.g. wheat, barley, canola, faba beans, oats)	131,029	50.8
Annual pasture (pasture irrigated in spring and/or autumn)	62,497	24.2
Perennial pasture (pasture irrigated through to summer)	20,267	7.9
Summer grain or fodder crop (e.g. maize, millet, sorghum, soybean)	18,717	7.3
Irrigated lucerne	6,108	2.4
Stone fruit (e.g. apricot, peach, nectarine)	4,309	1.7
Pome fruit (e.g. apples, pears)	3,843	1.5
Other permanent orchard species (e.g. kiwi fruit, berries, avocados, nuts)	3,447	1.3
Grapevines	2,380	0.9
Tomatoes	2,239	0.9
Poor block (weeds only)	825	0.3
Other vegetables and annual fruit crops (e.g. melon, lettuce)	742	0.3
Turned and rested paddock or orchard	630	0.2
Other irrigated plantings (please specify)	442	0.2
Any other irrigated crops or irrigated fallow	346	0.1
Citrus fruits of all types	226	0.1
Irrigated wood lots (not shelter belts)	71	0.0
Total	**258,117**	**100.0**

Figure 3-4: Irrigated land cover/usage in the GMID[6]

As shown in Figure 3-4 the area of irrigated land in the GMID is 258,117 ha which is around 1/3 of the land area of the GMID. This means there is around 550,000 (66% of the land area in the GMID) of dryland or an increase of approximately 300,000 ha since the 1990's. This represents the area that typically would be able to irrigate but is without irrigation water, leading to a large increase in the area of dry-land (rainfall-only) or non-irrigated agriculture throughout the region.

[6] Regional Irrigated Land and Water Use Mapping in the Goulburn Murray Irrigation District, Technical Report, GB CMA 2017.

This has created a “swiss cheese” effect with pockets of irrigation spread across the region with significant areas of dryland in between. **It also demonstrates that it is the lack of water that impacts on productivity of the region and not a lack of land.**

3.6 STILL MORE POTENTIAL FOR LOSS OF WATER

While wine grapes created a strong demand for water in the 1990’s, the demand has switched to almonds which has had a significant growth in the past decade. Despite the millennium drought and the 2019 drought the expansion of the almond industry has continued. This has created further pressure for water to leave the district.

The Australian Government is committed to securing the 450 GL of additional environmental water of which voluntary water purchase (Buyback) is one of the mechanisms to achieve this. The outcome will reduce the water available to consumptive users further reducing available water and the area required for irrigation.

4 Future implications for the region

The Loddon Valley irrigation district has a greatly reduced agricultural output and in the numbers of farms. There is ongoing pressure on farm viability and for those remaining it is critical that the irrigation infrastructure is able to be maintained without excessive charges that could cripple remaining farms.

As described the district has undergone constant change as has the irrigation businesses.

1900’s

In the 1900’s farms were relatively small self-sufficient operations where the irrigation enabled sufficient pasture to have a mix of cattle dairy cows (there was a milk factory at almost every little town on the railway line including Mincha, Macorna , and Tragowel).

Post War

Following the war the farms with increased irrigation got more intensive with more dairy cows, sheep and lambs and cattle and some limited cropping.

Salinity era

During the salinity era, lots of farms struggled financially and there was considerable rationalisation of farms in the Tragowel plains

A number of farms were able to expand and increase their dairy herds and grazing.

Post laser grading saw some cropping and considerable attempts at summer cropping including sunflowers, sorghum but mainly the area was most successful at annual pastures - less intensive irrigation on poorer soils.

Post buyback

The region has seen farms become much more extensive in the Macorna area with annual pastures for adjuncts to dairy farms (out blocks to raise heifers on low cost pastures) or extensive grazing with limited winter cropping.

The farms with large areas of land available for irrigation are very flexible. When water is plentiful and cheap they will irrigate more of their irrigation area (even purchase cheap water) and they grow lots of pasture but in drier years and shortage of water they will irrigate less area. They may even choose not to irrigate at all and sell what water they may have available at a high price (noting that they may not have many ML to sell).

They have become the “buffer” area which are a boom or bust depending upon water prices.

The future - more rationalisation larger less intensive farms

The boom or bust mentality will continue even more as the demand for high security water increases even more with downstream development. Farms will need to have the flexibility and resilience within their business to be able to opt in or opt out of irrigation depending on the prevailing conditions.

Thus this area will require the minimum of irrigation infrastructure possible ensure water delivery costs are affordable and farms can remain viable.

5 Implications of the Macorna Wind Farm

5.1 LOSS OF AGRICULTURAL LAND

The Macorna Wind Farm is located in the irrigation district and of the 114 planned wind turbines, 25 are located on actively irrigated properties.

During the operational phase of the project, the average project footprint per wind turbine will be in the order of 3 ha so the 114 turbines would cover an area 342 ha representing 0.16% of the agricultural land in the Gannawarra LGA. Note some of the Macorna Wind Farm is within the Loddon LGA and therefore the actual land area % lost will be lower.

There are 25 wind turbines on actively irrigated land covering an area of approximately 75 ha and represents 0.05% of the area in the Pyramid Hill/ Boort (Loddon Valley) irrigation district.

Most farming activities will be able to continue outside of the tower footprints so the loss of land and subsequent loss of agricultural production will be negligible.

5.2 ON FARM MITIGATION

Where possible existing farm tracks will be utilised for access tracks to minimise the impact at a farm level.

Siting of the wind turbines has been done in consultation with the landowner. Every farm will have areas of lower agricultural value that will be the target for where the wind turbines are located reducing the impact.

Irrigation delivery infrastructure both to the farm and within the farm will be avoided so there will be no impact on the capacity of the farm to irrigate the non-affected areas of the farm. This also means there is no impact to other irrigators within the district or on irrigation delivery efficiency.

As described, it is a lack of water rather than a lack of land that will be limiting irrigated agricultural output from the region. This translates to the farm level as if an irrigation bay is now no longer able to be irrigated due to the presence of the wind turbine, then the farmer will be able to utilise that water on other areas of the farm as there will be surplus irrigatable land available. There will also be no impact to the district’s irrigation delivery infrastructure and will not result in any further fragmentation or “swiss cheese” effect in the region.

5.3 SIGNIFICANT STRENGHENING OF FARM RESILIENCE

The financial contribution to farmers who are hosting wind turbines is significant. Depending on the size of the wind turbine, income for hosting the infrastructure is in the order of $40,000 to $50,000 per annum. As described in this report, there has been significant change in the irrigation enterprises within the region and there remain ongoing challenges to be able to provide an irrigation supply at a cost that can cope with the boom and bust cycle of irrigation in the region.

Farms have to continually adapt to the changing operating environment, and having an injection of funds that can provide some economic stability that is consistent and reliable is invaluable.

To put this into perspective, based on ABS data, the average farm size in the Gannawarra LGA is 614 ha. The average Gross Value of agricultural production (GVAP) is $1,181/ha meaning the GVAP per farm is in the order of $725,000. Based on RM Consulting group's experience working with farming businesses for over 30 years, typically farms are able to achieve a profit margin in the order of 10%. That is what is left over after paying for all variable and overhead costs, owners' labour, depreciation and financing debt. The average profit therefor would be in the order of $72,500. Hosting one wind turbine at say an annual rate of $45,000 per annum represents 62 % of the average profit. This represents a significant contribution to a farm business and can underpin the longer-term survival of the farm operation.

It is also noted that higher profitable businesses are more likely to reinvest in their operations as they can be more confident of positive outcomes. This can further strengthen the viability of the operations with increased productivity and contribution to the regional economy.

5.4 OTHER CONSIDERATIONS

It is considered that the installation and operation of the wind turbines on irrigation land will not adversely impact on the drainage or have flooding implications at a farm or regional level.

There can be limitations on manned aerial spraying in the direct vicinity of wind turbines, which is sometimes employed on farm when conditions are too wet to carryout farm activities such as spraying with land-based machinery. This impact can be mitigated through the coordination with the wind farm to shut off turbines for periods to allow spraying to occur or the use of helicopters and drones that can operate in closer proximity to obstacles than would be possible with fixed wing aircraft due to their greater manoeuvrability.

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