



**GOULBURN  
BROKEN**

CATCHMENT  
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# REGIONAL IRRIGATED LAND AND WATER USE MAPPING IN THE GOULBURN MURRAY IRRIGATION DISTRICT 2018/2019

## TECHNICAL REPORT



Environment,  
Land, Water  
and Planning



This Technical Report can be found at  
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- Department of Environment, Land, Water and Planning (DELWP)
- Agriculture Victoria
- Goulburn-Murray Water (GMW)
- North Central Catchment Management Authority (NCCMA)
- Murray Dairy
- HMC Property Group

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- Claire Miller Consulting - Claire Miller



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Goulburn Broken Catchment Management Authority  
168 Welsford St, PO Box 1752  
Shepparton VIC 3630  
Email: [reception@gbcma.vic.gov.au](mailto:reception@gbcma.vic.gov.au)  
Website: [www.gbcma.vic.gov.au](http://www.gbcma.vic.gov.au)

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## 4. Executive Summary

The Goulburn Murray Irrigation District (GMID) (Figure 1) is the largest irrigation system in Australia, supporting diverse agricultural commodities including dairy, cropping, horticulture, beef and sheep. Irrigation activities in the GMID are in transition. Land use has shifted away from dairying into cropping, mixed farming and non-dairy livestock grazing since 2015/16. Water use in 2018/19 was similar to 2015/16, also a warm, dry season. It was evident that while the land use mix had changed, properties<sup>1</sup> (defined by Water Use Licence, WUL) were still being irrigated rather than converting to dryland.

Land and water use change over the last 15 years has been driven by seasonal extremes, climate change and commodity prices, along with water, agricultural and planning policy reforms.

### Land Use

- Cropping is the most extensive land use, covering 259,566 ha, or 31 per cent of the irrigable land area of 840,010 ha. The area increased marginally by 12,101 ha since 2015/16.
- Combined Dairy<sup>2</sup> is the second largest land use, covering 213,140 ha, or 25 per cent of irrigable land. In 2015/16 the Combined Dairy land use covered 286,280 ha, or 35 per cent of then irrigable land. The number of properties (defined by Water Use Licences - WULs) linked to an active dairy shed fell from 1,138 to 781.
- Perennial Horticulture land use remains relatively stable in area with 31,569 ha, covering 3.7 per cent of the GMID's irrigable land.
- Annual Horticulture covered 11,603 ha, eight per cent smaller than 2015/16 (12,590 ha). But the number of properties (based on WULs) increased from 121 to 145.
- Mixed Farming and Grazing jumped 46 per cent, from 103,674 ha in 2015/16 to 151,129 ha. The number of WULs increased 15 per cent to 1601.
- Grazing – Non-Dairy land use expanded 22 per cent to 126,260 ha. The number of properties (WULs) increased 23 per cent to 1242.
- The number of Rural Lifestyle WULs increased 30 per cent, from 4880 properties in 2015/16 to 6327 in 2018/19. The Rural Lifestyle land footprint expanded 36 per cent from 26,777 ha up to 36,370 ha.
- Rural Lifestyle properties were interspersed fairly evenly among other GMID land uses, with concentrations on the outskirts of Echuca, Swan Hill, Shepparton and near Lake Boga.

### Water Use

- Water use across the GMID land use categories in 2018/19 (1,059,265 megalitres - ML) was marginally less (four per cent) than in 2015/16 (1,103,094 ML).
- Combined Dairy remains the single largest water user, accounting for 46 per cent of water delivered, down from 55 per cent in 2016.
- The shift in water use from Dairy to other land uses was fairly evenly distributed among Cropping, Grazing Non-Dairy, Mixed Farming and Grazing, and Perennial Horticulture.
- The higher number of Water Use Licences among Cropping, Mixed Farming and Grazing, and Grazing Non-Dairy mainly reflects land transitioning from Dairy to other uses.
- The increase in Perennial Horticulture's share of water use (10 per cent, up from eight per cent in 2015/16) likely reflects an intensification in production and new orchards maturing.

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<sup>1</sup> Note: One 'property' equates to one Water Use Licence (WUL). One WUL can cover several land titles.

<sup>2</sup> Combined Dairy Land Use: Combined area of 'Dairy' (active dairy shed), 'Dairy Associated' (linked to 'Dairy' WUL) and 'Dairy Agistment/Fodder' land uses.

## 5. Introduction

The Goulburn Murray Irrigation District (GMID) (Figure 1) is the largest irrigation system in Australia, supporting diverse agricultural commodities including dairy, cropping, horticulture, beef and sheep. It is located in northern Victoria and is part of the southern Murray-Darling Basin. The GMID covers 9,950 square kilometres or 995,000 hectares (ha), approximately 840,011 ha of which are linked to over 14,000 Water Use Licences (WUL), thus considered irrigated land. Properties classified as non-irrigated include urban centres and conservation areas.

This report updates the 2015/16 Regional Irrigated Land and Water Use Mapping (RILWUM) in the GMID project (GB CMA, 2017<sup>2</sup>). It also builds upon land use mapping undertaken in 2009/10 (HMC Property Group, 2010<sup>3</sup>) and irrigator farm surveys, the last of which was undertaken in 2004/05 (GMW, 2006<sup>4</sup>).

The 2018/19 RILWUM in the GMID project involved comprehensively mapping land and water use against WULs, across the GMID's six water service areas (Murray Valley, Central Goulburn, Shepparton, Pyramid-Boort, Rochester and Torrumbarry). This work will enable continued assessment and reporting on change in the GMID, to inform regional, State and national water, agriculture and planning policy.

The 2019 project has an interactive capability that enables changes to be assessed by property and by irrigation channel system. This insight can inform strategic and targeted land use planning. It can also inform regional economic development planning and structural adjustment, as well as strategic planning by Goulburn-Murray Water (GMW) for infrastructure rationalisation and renewal, fit-for-purpose water services and financial sustainability.

The project was undertaken in the 2018/19 irrigation season, in collaboration with stakeholder organisations. The objectives were to:

- Renew through on-farm surveying and spatial analysis, the land and water use data for all irrigated properties in the GMID in 2019.
- Develop an on-line interactive Geocortex tool and train staff to enable more regular, efficient and effective collection of land and water use spatial data across the GMID.
- Conduct a comparative analysis between the 2018/19 irrigation season and the 2015/16 season, and where appropriate compare with data collected in other similar mapping exercises since the turn of the century.
- Provide land and water use data to inform Regional, National and State water policy.

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<sup>2</sup> Goulburn Broken Catchment Management Authority (2017). 'Regional Irrigated Land and Water Use Mapping in the Goulburn Murray Irrigation District – Technical Report'. State of Victoria.

<sup>3</sup> HMC Property Group (2010). 'Changing land use in the GMID 2006-2010. Where have all the dairies gone?' Report for Northern Victoria Irrigation Renewal Project and the Department of Primary Industries, by HMC Property Group. July 2010.

<sup>4</sup> GMW (2006). 'Irrigation Farm Survey 2004/2005. Final Date: 5/12/06.' Report by Goulburn-Murray Water (GMW), Goulburn Broken Catchment Management Authority, North Central Catchment Management Authority, with contribution from Department of Primary Industries and Australian Bureau of Statistics.

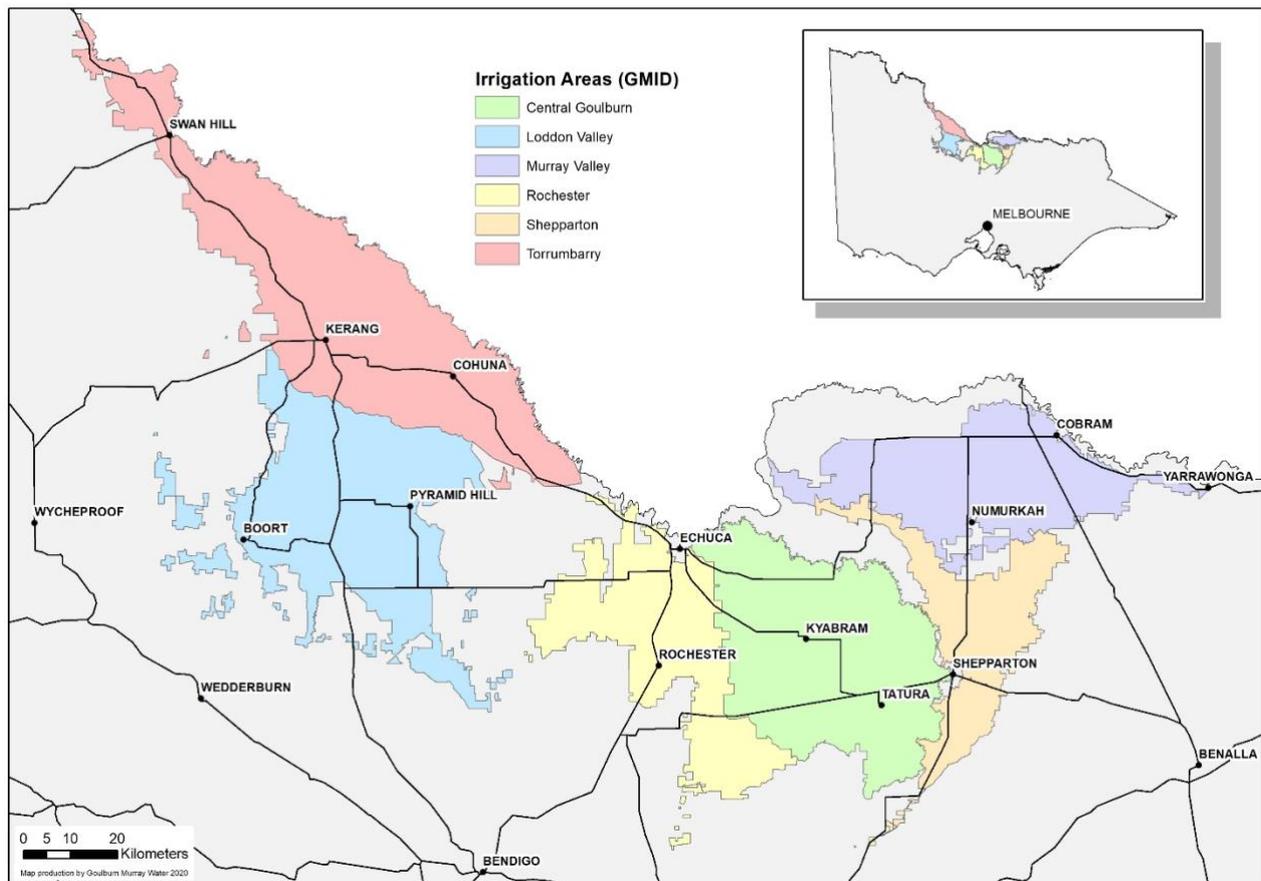


Figure 1. The project area, the Goulburn Murray Irrigation District (GMID)

## 6. Methodology

The method of data collection in 2018/19 consisted of the following steps:

### 1. TOOL DEVELOPMENT

An on-line interactive Geocortex tool was developed by Goulburn-Murray Water (GMW) Geographical Information System (GIS) staff to enable ready capture of land use change data. The Geocortex tool incorporated the 2015/16 land use layer as the reference point. The classification occurred at the Water Use Licence (WUL) level (parcels linked to enable viewable mapping).

### 2. END USER TRAINING

GMW Customer Service Officers (Field Officers), allocated to their respective water service areas (Shepparton, Murray Valley, Central Goulburn, Pyramid-Boort, Rochester and Torrumbarry) were trained to build consistent interpretation in the land use classifications. Staff from each water service area then completed the mapping individually for their respective areas.

### 3. DATA CAPTURE

The Geocortex tool was developed using standardised lists (drop downs) to enable the end user to capture the following data using desktop assessment:

- a. Primary Land Use (by Industry e.g. cropping) (refer to Table 1)
- b. Secondary Land Use (by Industry e.g. mixed farming)
- c. Other Land Use (aim to capture new land use not already listed)
- d. On-Farm Irrigation Modernisation Assessment
  - i. Yes or No
- e. Irrigation Methods
  - i. Pivot/Linear move
  - ii. Gravity channel
  - iii. Pipes and Risers
- f. Comments (to assist with analysis)
- g. Ground Truthing Required?
  - i. Yes or No
- h. Date of Assessment
- i. Assessors Names

Not all the data captured is covered in this report. This report focuses on comparing the 2015/16 and 2018/19 land and water use data, noting that the water use information has been collected from Goulburn Murray Water WUL data and from information sourced from the Victorian Water Register. A single enterprise can have one WUL covering several land properties titles.

### 4. ANALYSIS OF DATA

The data was then analysed by GMW and the GIS Team at Agriculture Victoria (Department of Jobs, Precincts and Regions - DJPR). This included the following:

- a. To enable comparison with the previous dataset (2015/16) and therefore assess land use change, data collected in the 2015/16 mapping, was re-categorised by WUL. It is important to note the property numbers in the 2015/16 project<sup>5</sup> and the 2009/10 study<sup>6</sup> reflected Local Government

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<sup>5</sup> Goulburn Broken Catchment Management Authority (2017). 'Regional Irrigated Land and Water Use Mapping in the Goulburn Murray Irrigation District – Technical Report'. State of Victoria.

<sup>6</sup> HMC Property Group (2010). 'Changing land use in the GMID 2006-2010. Where have all the dairies gone?' Report for Northern Victoria Irrigation Renewal Project and the Department of Primary Industries, by HMC Property Group. July 2010.

land property titles. This is distinct from the number of farms, where a single enterprise could be operating across several property titles. One WUL can cover several property titles. A selection of Australian Valuation Property Classification Codes (AVPCC) was applied to each WUL and then further grouped to refine the classification (Table 1). This was consistent with the land use categories used with the 2015/16 mapping.

- b. A business enterprise view was also developed where a GMW single customer view was linked to WULs.
- c. Calculation of change statistics.
- d. Water Use v Land Use Analysis – WUL data collected as part of WUL information from GMW.
- e. Land Use mapping analysis.

*Table 1. Australian Valuation Property Classification Code (AVPCC) and Land Use categorisations*

AVPCC <sup>6</sup>	Summary categories for this project	Description
Domestic livestock grazing	Grazing – Non-Dairy	Land used for grazing domestic and commercial livestock.
Livestock production - beef cattle		
Livestock production - sheep		
Crop production - fodder crops	Cropping	Land used for broad-acre crops, e.g. grains, oilseeds.
Crop production - mixed/other		
General cropping		
Cattle feed lot	Intensive animal	Land developed with specialist infrastructure for intensive feeding of cattle, pigs, or poultry.
Piggery		
Poultry (broiler or egg production)		
Horse stud/training facilities/stables	Horses	Land developed with specialist infrastructure for a horse stud farm or training facility. May include recreational equestrian.
Livestock production - dairy cattle	Dairy	WUL with active dairy (milking) shed.
	Dairy Associated	Land linked to the active dairy shed WUL; may include some cropping and other dairy uses.
	Dairy Agistment and Fodder	No clear link to a Dairy WUL, but dairy cattle were present during survey or a former dairy farm may be in transition.
	Combined Dairy	Defined as the combined area of the above three dairy land uses (Dairy, Dairy Associated and Dairy Agistment and Fodder)
Market garden - vegetables	Annual Horticulture	Land used for growing vegetable crops e.g. tomatoes.
Mixed farming and grazing	Mixed	Land used for mixed use farming purpose, e.g. cropping and grazing/livestock production.
Orchards, groves and plantations	Perennial Horticulture	Land planted to grow fruit and nuts, e.g. olives, stone fruits, tropical fruits, citrus, grapes.
Vineyards		
Rural residential <sup>7</sup>	Rural residential/lifestyle	A residential/lifestyle use dwelling on land in a rural, semi-rural or bushland setting.

<sup>7</sup> Combined Rural residential and lifestyle and included to ensure capture of this land use.

		Primary production uses and associated improvements are secondary to the residential/lifestyle use. Rural residential <0.5ha; Rural Lifestyle <0.5 delivery share and <20ha property size.
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## 5. DATA COLLECTION PERIOD

The assessment period incorporated the irrigation season of 2018/19. Data was collected during May-July 2019. The data was then validated against other available sources, to ensure consistency of interpretation during July 2019.

## 6. PRIVACY STATEMENT

Irrigated enterprises will only be identified by a generic identification. No identifying data was collected.

## 7. QUALIFICATIONS/LIMITATIONS OF DATA

Data collection was completed using the knowledge of GMW Customer Service Officers, to integrate field knowledge into a spatial mapping tool. The process has some inherent challenges in interpretation; however, all measures were undertaken to minimise objectivity. Table 2 highlights some of the data limitations and how the limitations were managed.

*Table 2. Management of Data Limitations*

Issue	Risk	Management of Limitations
Incorrect assessment of land use or modernisation status	Potential for minimal land use categorisation inaccuracy	Acknowledged high level of local knowledge among GMW Customer Service Officers. Consistent staff training about categorisation. Application of uniform Yes/No answer to Modernisation. Inclusion of secondary land use (not shown in this report).
Seasonality issues and context	Land use requires a continued iteration depending on timing of inspection and interpretation. For example, the land use may be cropping; followed by sheep grazing the stubble (e.g. Grazing Non-Dairy) before another crop is sown. This exemplifies the changes that can occur when trying to identify single land uses.	Acknowledgement that results are a snapshot in time. Aim for annual update of data. The benefit of the new Geocortex tool and data collection methodology is that it allows for consistent assessment of the same units in the future.
Data mismatches	Integrating datasets such as the council property view of land use with information from GMW, DJPR and the Victorian Water Register, to the Land Victoria Vic Map parcel dataset, can result in minimal data mismatches.	All attempts to correct data inconsistencies have occurred during the linking of datasets, including rechecking data. GMW and Agriculture Victoria staff continually work to improve datasets, which is why data is expected to continually improve.
Limitations exist in the accuracy of determining AVPCC codes	Potential for minimal Dairy land use categorisation inaccuracy	Consistent methodology in categorisation of properties linked to dairy. E.g. Properties were categorised as linked to dairy in one of four ways:

<p>and sub-categorisation to the 'Dairy cattle agistment/ fodder'</p>		<ul style="list-style-type: none"> <li>• <b>'Dairy'</b> – defined as WULs linked with a functioning milking shed;</li> <li>• <b>'Dairy Associated'</b> – linked to 'Dairy' through customer data (WUL) and therefore forming part of a dairy enterprise; or,</li> <li>• <b>'Dairy Agistment and Fodder'</b> – Land use defined as still servicing the dairy industry or are in transition (but have not been linked to a 'Dairy' WUL). The land use may be used by another AVPCC land use code such as cropping or mixed farming; or a link may exist with a dairy enterprise but was not found through integration with existing datasets. The decision was made to group these together as 'Dairy Agistment and Fodder' and document the methodology, to enable future investigation.</li> <li>• <b>Combined Dairy</b> – Combined Dairy, Dairy Associated and Dairy Agistment and Fodder land uses.</li> </ul>
<p>Using WUL as the comparative attributed in place of 2015/16 Council property level attribute analysis</p>	<p>Change in methodologies may lead to some confusion</p>	<p>The shift from mapping by property titles to WUL has shifted numbers up and down in some areas since 2015/16, because property land titles that weren't connected before, are now combined directly under one WUL. However, the same methodology was retrospectively applied to the 2015/16 dataset to enable comparison against 2018/19 data. Going forward, the use of WUL will provide the most effective methodology for analysis of both land use and water use.</p>
<p>Combination of Rural Residential and Lifestyle land uses to form the one land use Rural Lifestyle land use</p>	<p>Combining Rural Residential and Lifestyle may lead to some confusion</p>	<p>Differences in both Rural Lifestyle land area and number of Rural Lifestyle WULs may be a result of a change in classification methods and assessment methodology from Council property to WUL (e.g. access to WUL data), where smaller properties (e.g. &lt;0.5 ha or &lt;20 ha) on the fringes of urban areas, may not have been visually identified in 2015/16 as being connected to channel systems and therefore were not included.</p>

## 7. Data Summary - Results

### 7.1. Land Use across the Goulburn Murray Irrigation District (GMID)

Primary land use as defined by industry type (Table 3) was mapped and analysed in 2015/16 and 2018/19. The total land use (ha) for each land use category is presented in Table 3 and graphically in Figure 2. Land use mapping illustrates GMID land use for 2018/19 (Map 1) in comparison to 2015/16 (Map 2).

Table 3. Land Use in the GMID (hectare – ha)

Land Use in GMID	2015/16 (ha)	2018/19 (ha)
Dairy	160,984	120,178
Dairy Associated	73,829	61,750
Dairy Agistment and Fodder	51,467	31,212
<b>COMBINED DAIRY</b>	<b>286,280</b>	<b>213,140</b>
Horticulture - Perennial	32,050	31,569
Horticulture - Annual	12,590	11,603
Cropping	247,465	259,566
Grazing - Non-Dairy	110,329	126,260
Mixed Farming and Grazing	103,674	151,129
Intensive - Animals	6,092	4,852
Horses	4,736	5,521
Rural Lifestyle	26,777	36,370
<b>Total*</b>	<b>829,993*</b>	<b>840,010</b>

\*There is a 10,017ha increase in land capture from 2015/16 to 2018/19. This is not an overall increase in the irrigation footprint. It is a result of including existing rural residential/lifestyle properties which can be irrigated and a change in methodology from council properties to WUL.

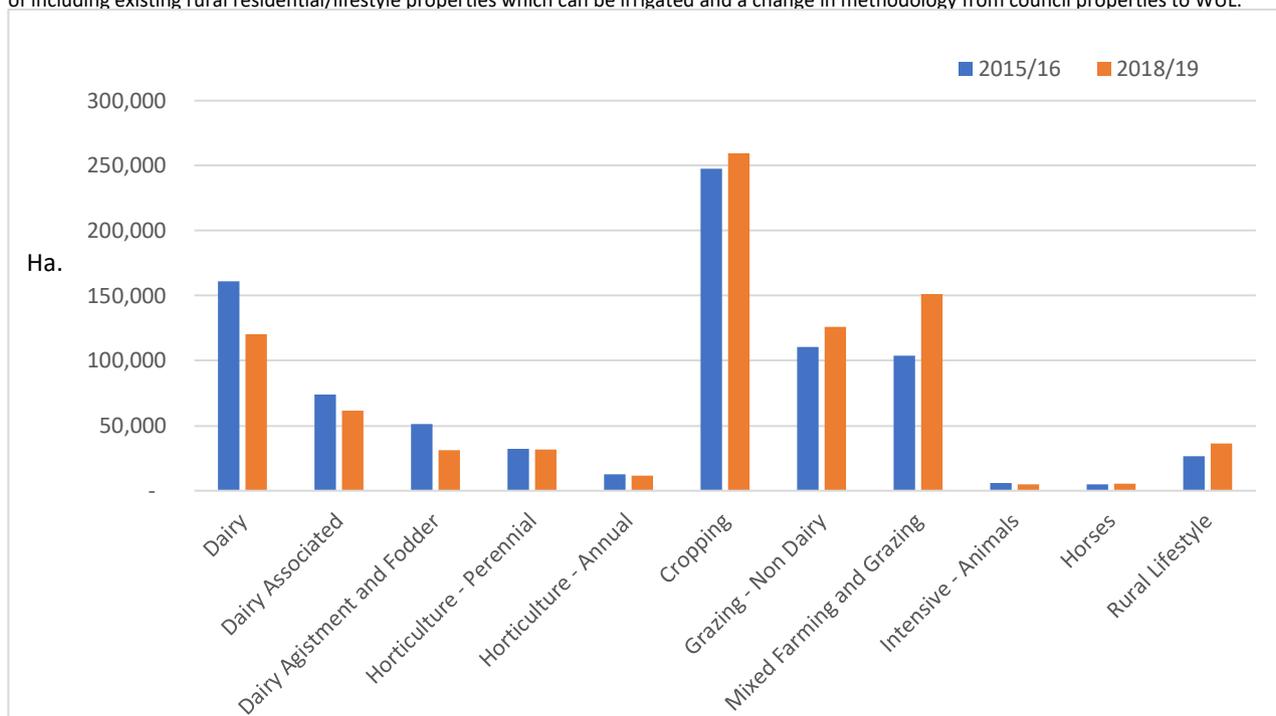
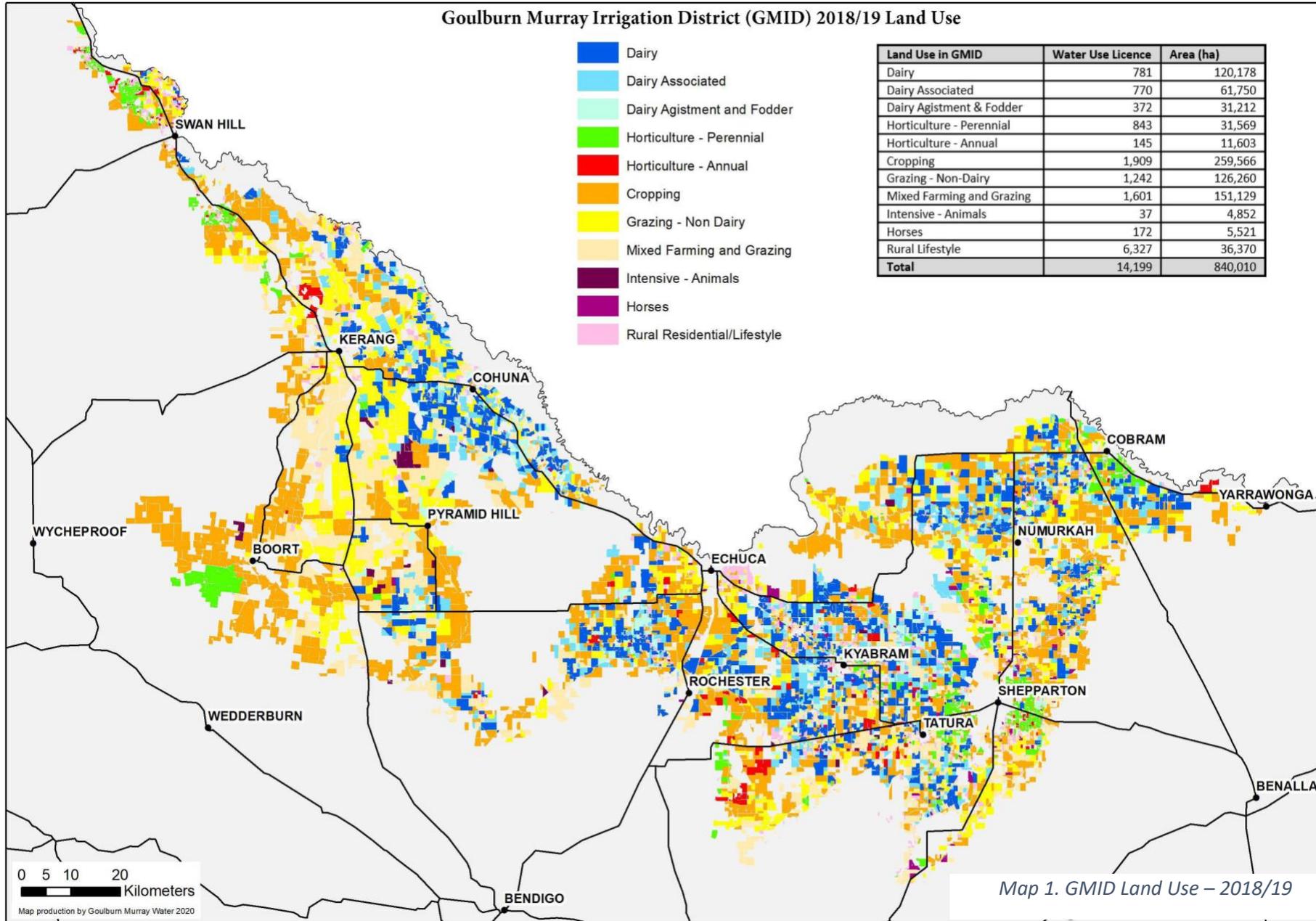


Figure 2. Land Use in the GMID (hectare – ha)

### Goulburn Murray Irrigation District (GMID) 2018/19 Land Use

- Dairy
- Dairy Associated
- Dairy Agistment and Fodder
- Horticulture - Perennial
- Horticulture - Annual
- Cropping
- Grazing - Non Dairy
- Mixed Farming and Grazing
- Intensive - Animals
- Horses
- Rural Residential/Lifestyle

Land Use in GMID	Water Use Licence	Area (ha)
Dairy	781	120,178
Dairy Associated	770	61,750
Dairy Agistment & Fodder	372	31,212
Horticulture - Perennial	843	31,569
Horticulture - Annual	145	11,603
Cropping	1,909	259,566
Grazing - Non-Dairy	1,242	126,260
Mixed Farming and Grazing	1,601	151,129
Intensive - Animals	37	4,852
Horses	172	5,521
Rural Lifestyle	6,327	36,370
<b>Total</b>	<b>14,199</b>	<b>840,010</b>

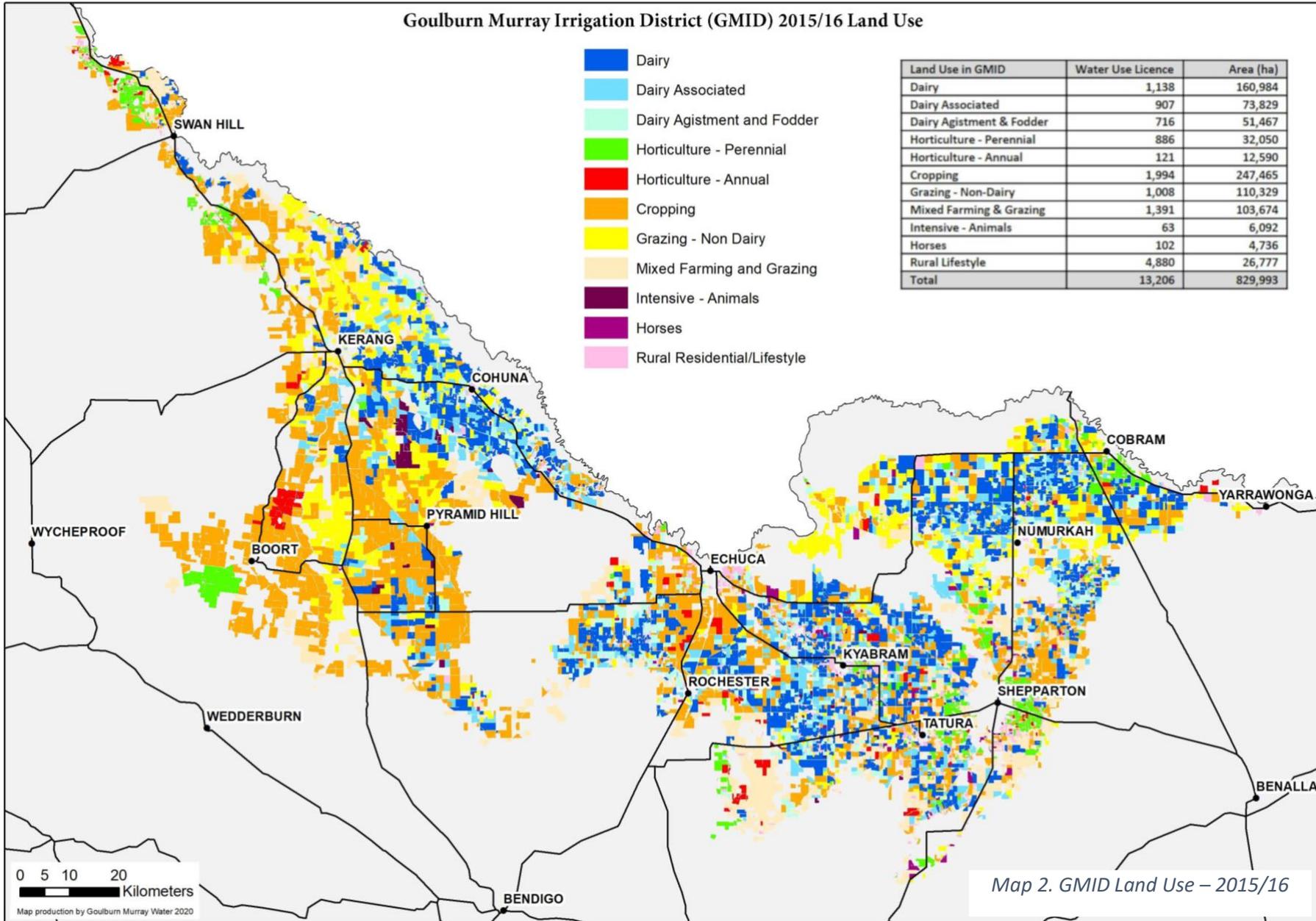


Map 1. GMID Land Use – 2018/19

### Goulburn Murray Irrigation District (GMID) 2015/16 Land Use

- Dairy
- Dairy Associated
- Dairy Agistment and Fodder
- Horticulture - Perennial
- Horticulture - Annual
- Cropping
- Grazing - Non Dairy
- Mixed Farming and Grazing
- Intensive - Animals
- Horses
- Rural Residential/Lifestyle

Land Use in GMID	Water Use Licence	Area (ha)
Dairy	1,138	160,984
Dairy Associated	907	73,829
Dairy Agistment & Fodder	716	51,467
Horticulture - Perennial	886	32,050
Horticulture - Annual	121	12,590
Cropping	1,994	247,465
Grazing - Non-Dairy	1,008	110,329
Mixed Farming & Grazing	1,391	103,674
Intensive - Animals	63	6,092
Horses	102	4,736
Rural Lifestyle	4,880	26,777
<b>Total</b>	<b>13,206</b>	<b>829,993</b>



Map 2. GMID Land Use – 2015/16

Comparison of Maps 1 and 2 suggests that the land use mix across the GMID has changed in area (hectares – ha) and distribution between 2015/16 and 2018/19. This change is more obvious in some land use categories (e.g. Dairy and Mixed Farming and Grazing) compared with other land uses (e.g. Perennial Horticulture). Notable land use changes across each land use category (industry) are outlined in the following sections.

*Dairy*

Figure 2 illustrates the contraction in the Combined Dairy land use by approximately 73,000 ha between 2015/16 and 2018/19.

The Combined Dairy land use categories made up the largest portion of land use in the GMID in 2015/16 (286,280 ha), accounting for approximately 35 per cent of the GMID’s then total irrigable land area (829,993 ha) (Table 3). However, in 2018/19, the Combined Dairy land use by area represented the second largest land use (213,140 ha, or 25 per cent of irrigable area), behind Cropping (259,566 ha) (Table 3).

Figure 3 shows the spread of Dairy, Dairy Associated and Dairy Agistment and Fodder for each water service area. Further discussion on each water service area is provided in Section 7.2.

Land use with an active dairy shed (Dairy land use) contracted more than 40,000 ha between 2015/16 and 2018/19, representing the largest land use contraction in the GMID (Table 3). The decline in Combined Dairy land use is also reflected in the 31 per cent reduction in the number of Water Use Licences associated with an active dairy (milking) shed, from 1,138 in 2015/16 to 781 in 2018/19 (See Table 5 in Section 7.3.1). It is noted that Dairy and Dairy Associated are supported by other land uses such as mixed farming and cropping.

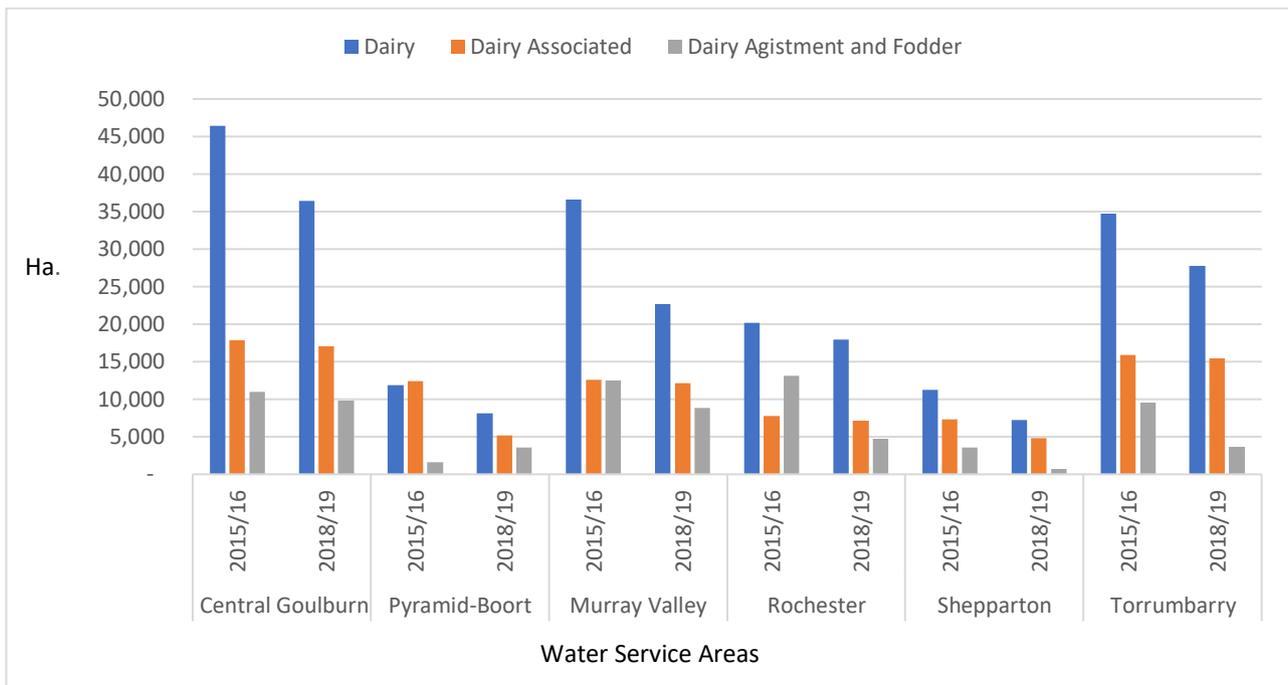


Figure 3. Dairy, Dairy Associated, Dairy Agistment and Fodder Land Use (ha) - GMID Water Service Areas

*Perennial and Annual Horticulture*

The area of Perennial Horticulture (e.g. permanent plantings such as stone fruits, apples and pears) accounted for 3.7 per cent of the GMID’s irrigable land (Table 3) and in 2018/19 remained concentrated in traditional locations such as the Shepparton, Central Goulburn and Torrumbarry water service areas (Figure 4). Perennial Horticulture land use remained relatively stable (less than one per cent change) between 2015/16 and 2018/19 (Table 3), with the most change in Murray Valley (13 per cent contraction) from 4,644 ha to 4,039 ha (refer to Section 7.2 for further information).

The area of Annual Horticulture (e.g. tomatoes and mixed market gardens) decreased slightly (approximately eight per cent) between 2015/16 and 2018/19. In 2018/19, Annual Horticulture accounted for 1.3 per cent the total irrigable land area (Table 3) and was randomly spread across the GMID, indicating that it is an opportunistic, transient land use. Figure 4 shows that the Rochester water service area had the largest extent of Annual Horticulture in both 2015/16 and 2018/19. Annual Horticulture land use decreased 96 per cent in Pyramid-Boort (down from 3,285 ha to 121 ha) in 2018/19; this water service area now accounts for the least area (ha) of Annual Horticulture land use in the GMID.

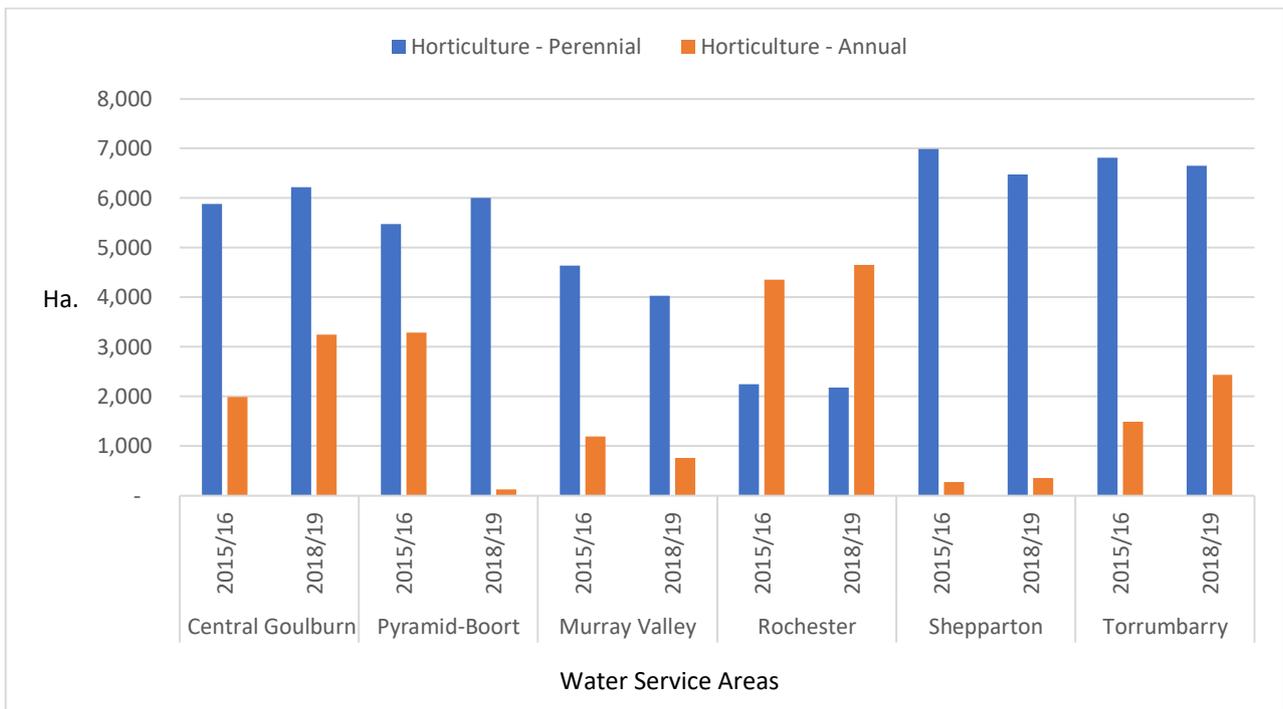


Figure 4. Perennial and Annual Horticulture Land Use (ha) - GMID Water Service Areas

*Cropping*

Cropping was the most extensive land use category across the GMID in 2018/2019, covering 259,566 ha, or more than 30 per cent of the irrigable land area (Table 3). Cropping increased by more than 12,000 ha between 2015/16 and 2018/19.

Cropping is now (2018/19) the most extensive land use, compared to 2015/16 when the Combined Dairy land use had the largest footprint (area). Figure 5 shows that despite being one of the only two water service areas where the Cropping extent reduced, Pyramid-Boort still has the largest number of Cropping hectares in the GMID.

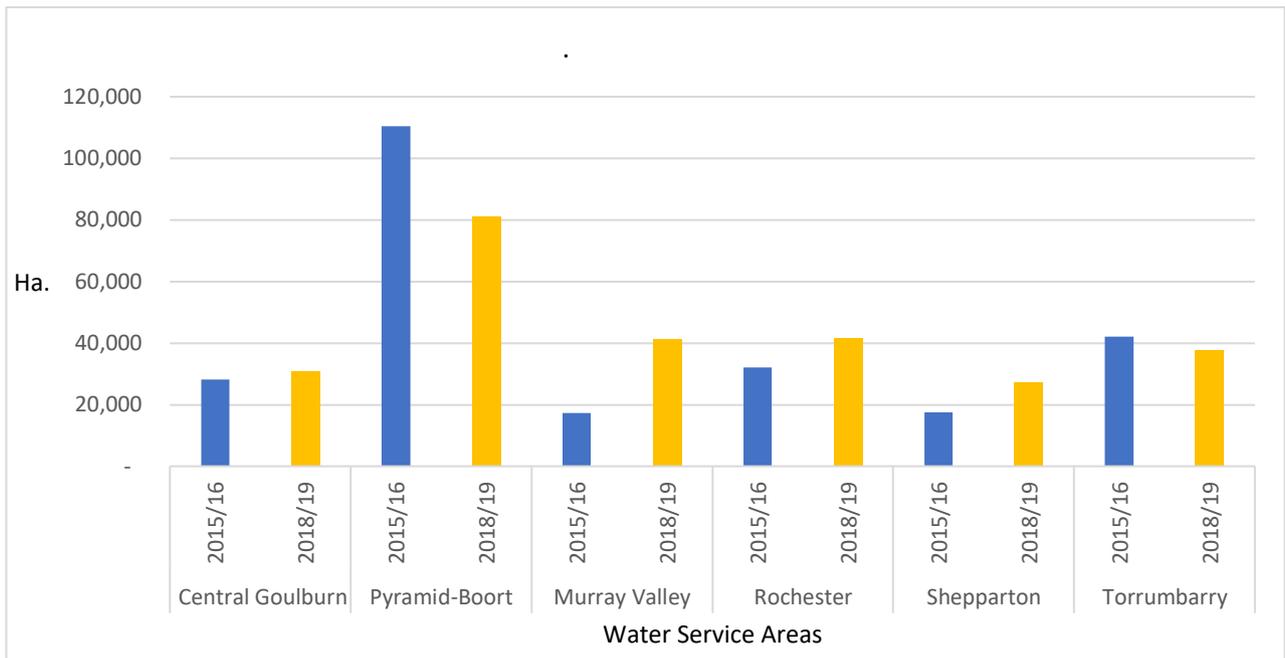


Figure 5. Cropping Land Use (ha) - GMID Water Service Areas

#### Grazing Non-Dairy

The 'Grazing Non-Dairy' land use category (often associated with Cropping land use) increased in area between 2015/16 and 2018/19 by 15,931 ha, up from 110,329 ha to 126,260 ha, representing a 22 per cent increase (Table 3). It is the fourth largest land use across the GMID, following Cropping, Combined Dairy and Mixed Farming and Grazing.

Figure 6 shows an increase in area of the Grazing Non-Dairy land use category throughout the west of the GMID (e.g. Torrumbarry, Pyramid-Boort and Rochester water service areas), and in the Shepparton water service area.

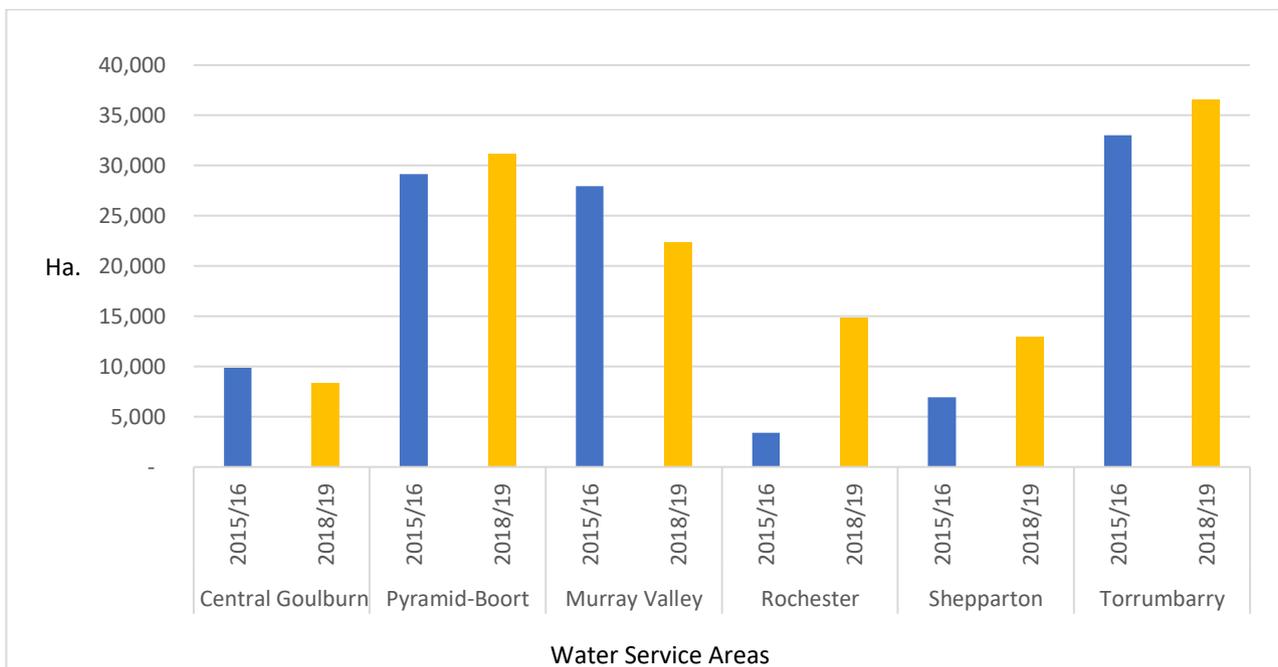


Figure 6. Grazing Non-Dairy Land Use (ha) - GMID Water Service Areas

*Mixed Farming and Grazing*

The Mixed Farming and Grazing land use category covered 151,129 ha of irrigable land in the GMID in 2018/19, representing a 46 per cent increase in area since 2015/16 (Table 3). The Mixed Farming and Grazing land use category was the third largest land use in the GMID in 2018/19 (after Cropping and the Combined Dairy land uses), and larger than the area of dairy properties with an active dairy shed ('Dairy'). Figure 7 shows the prevalence of Mixed Farming and Grazing in the Pyramid-Boort water service area, compared to other water service areas.

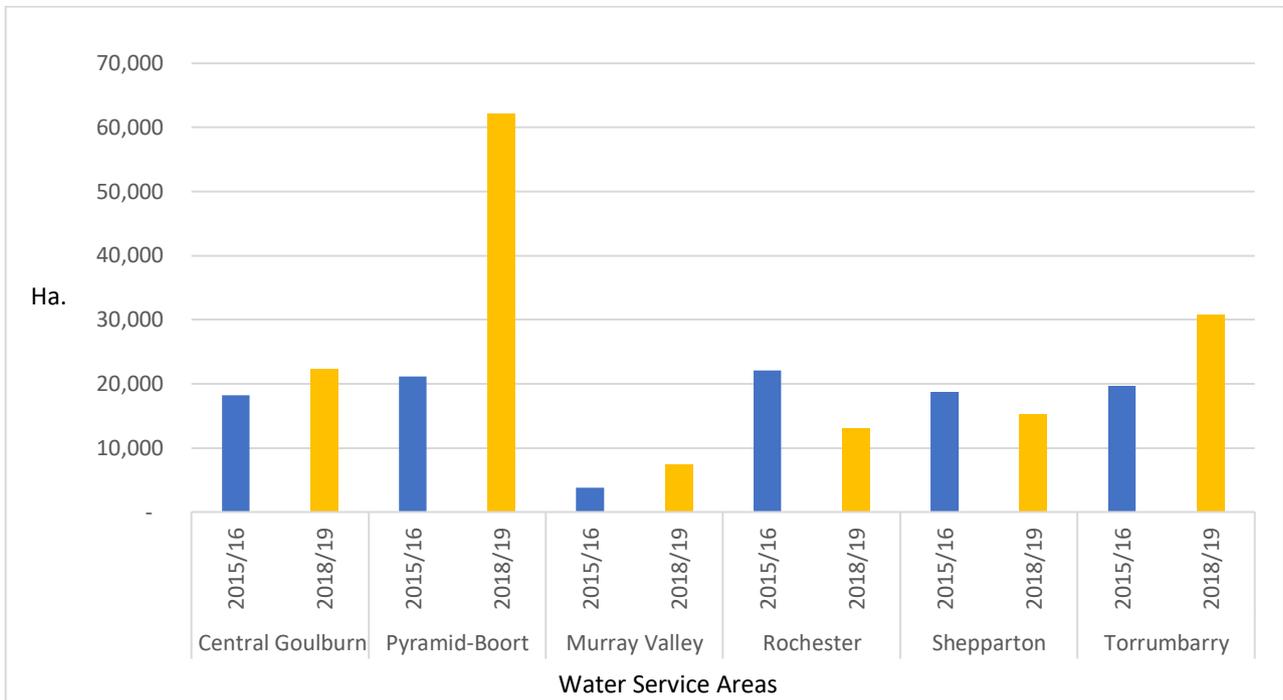


Figure 7. Mixed Farming and Grazing Land Use (ha) - GMID Water Service Areas

*Intensive – Animals*

The Intensive - Animals (e.g. piggeries, feedlots and poultry) land use category declined 20 per cent across the GMID between 2015/16 and 2018/19 (Table 3). This category is the smallest mapped land use at 4,825 ha, closely followed by Horses at 5,521 ha.

Figure 8 shows that in 2018/19, the largest Intensive – Animals land use was in the Pyramid-Boort water service area, expanding since 2015/16. Torrumbarry has seen a decrease (77 per cent) in Intensive – Animals, while Murray Valley has seen a considerable increase (411 per cent) (Refer to Section 7.2 for further information).

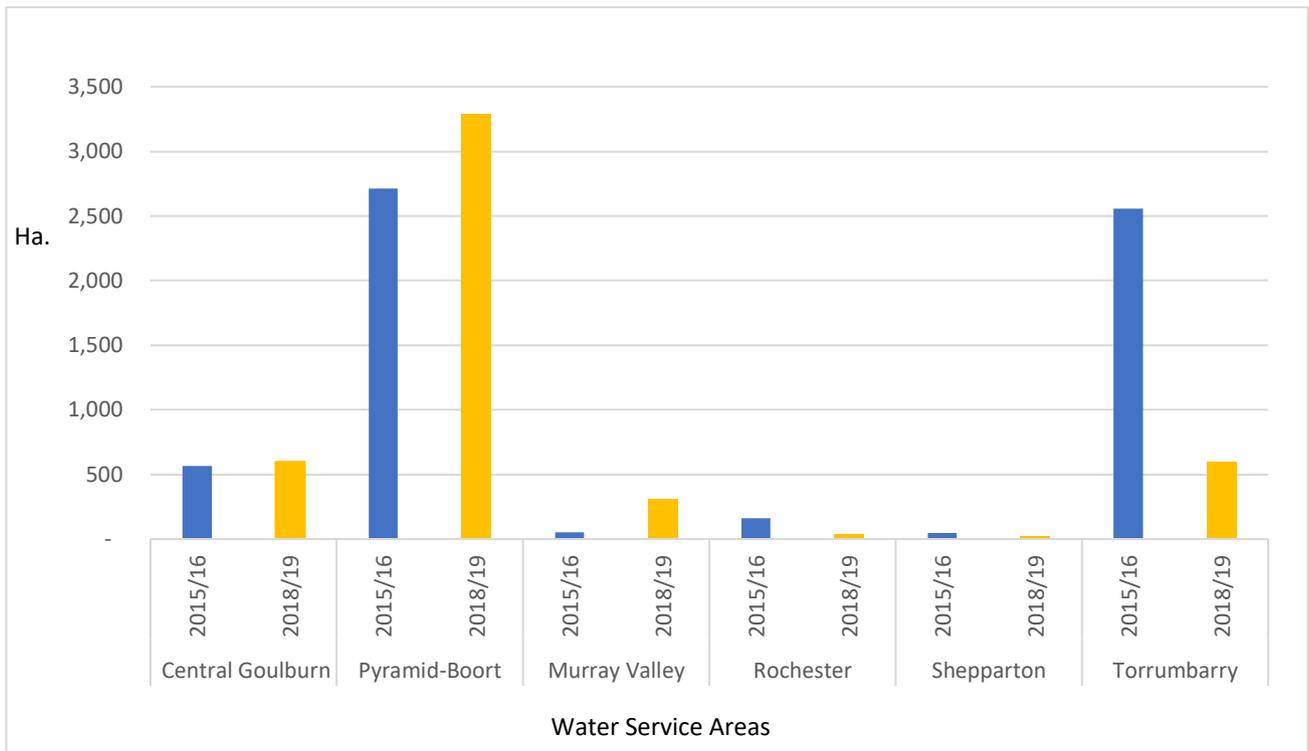


Figure 8. Intensive – Animals (ha) - GMID Water Service Areas

#### Horses

The Horses land use category covered 5,521 ha across the GMID, up 17 per cent from 4,736 ha in 2015/16 (Table 3). Figure 9 shows that in 2018/19, most of this footprint was located in the east of the GMID (e.g. Central Goulburn and Shepparton water service areas), within close travelling distance to regional centres such as Shepparton/Mooroopna, Echuca, Kyabram and Tatura (Map 1).

Figure 9 shows that Central Goulburn has the largest extent of the Horse land use category, increasing since 2015/16. Pyramid-Boort and Torrumbarry also had increases by area, while Murray Valley, Shepparton and Rochester remained relatively stable for the Horse land use category.

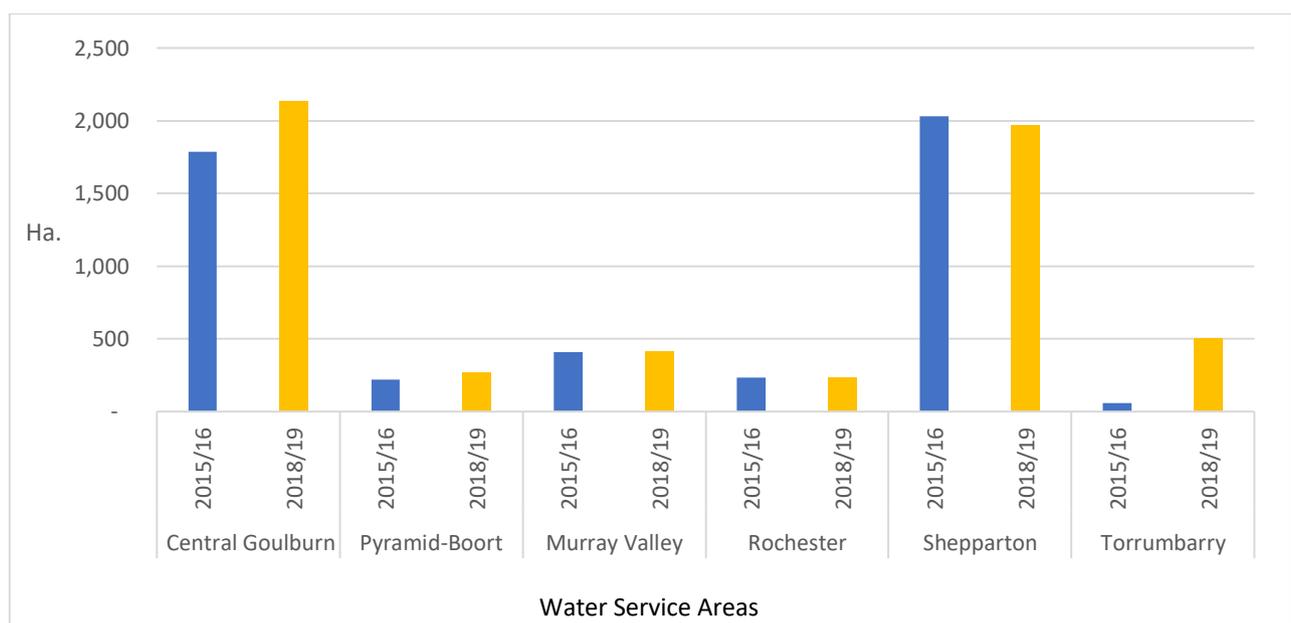


Figure 9. Horses (ha) - GMID Water Service Areas

### Rural Lifestyle

Rural Lifestyle land use includes both rural residential properties that are smaller than 0.5 ha, and Rural Lifestyle properties with less than 0.5 delivery share that are smaller than 20 ha (Table 1).

The Rural Lifestyle land use category (only including Rural Lifestyle land area with a WUL) has increased by 36 per cent, from 26,777 ha in 2015/16 to 36,370 ha in 2018/19 (Table 3). Rural Lifestyle was the fifth largest land use across the GMID in 2018/19, and now covers more land than Perennial Horticulture. There is a large concentration of Rural Lifestyle between Echuca and Kyabram visible in 2018/19 (Map 1) and 2015/16 (Map 2).

Figure 10 shows that Rural Lifestyle continues to expand in the Central Goulburn water service area, which still has the most hectares in this category despite some increases elsewhere since 2015/16 (e.g. Pyramid-Boort and Torrumbarry). This land use remained relatively stable in Murray Valley, Rochester and Shepparton water service areas.

It is recognised that the difference in Rural Lifestyle land area and number of WULs between 2015/16 and 2018/19 may be a result of a change in classification methods and assessment methodology from Council property to WUL (refer to Table 2 for further explanation). Ongoing land use mapping using the 2018/19 WUL methodology, will assist in further understanding the Rural Lifestyle land use in the GMID.

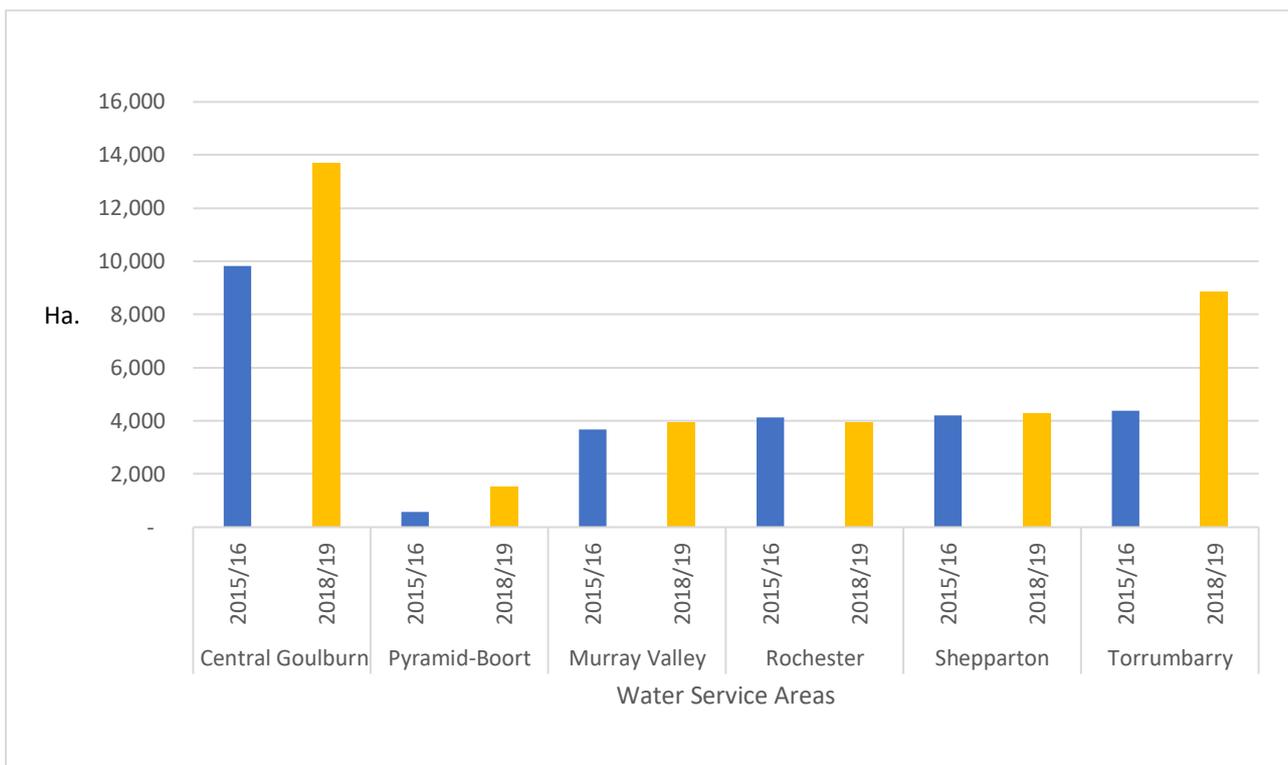


Figure 10. Rural Lifestyle (ha) - GMID Water Service Areas

## 7.2. Land Use Change by Water Service Area

Table 4 presents a comparison of land use (hectares and percentage change) between 2015/16 and 2018/19 across each of the GMID water service areas (Murray Valley, Shepparton, Central Goulburn, Rochester, Pyramid-Boort and Torrumbarry). Land use change from 2015/16 to 2018/19 is also illustrated in Maps 3-8 and Figures 11-16. Notable trends in land use change observed in each category and in each water service area are outlined in the following section.

### Murray Valley Water Service Area

Land use in Murray Valley has undergone considerable change since 2015/16 (Table 4). Table 4 shows a 38 per cent decline in Dairy (with an active dairy shed) land use area, which reduced by 13,903 ha. The Combined Dairy land use reduced by 18,052 ha. Perennial Horticulture, Annual Horticulture and Grazing Non-Dairy land use in Murray Valley also contracted over this period (13 per cent, 36 per cent and 20 per cent respectively).

In 2015/16, Murray Valley had the least cropping land use (17,293 ha). Since then cropping has increased 139 per cent, totalling 41,305 ha in 2018/19 (increase of 24,012 ha). This makes Murray Valley the third-largest cropping area in the GMID after Pyramid-Boort (81,107 ha) and Rochester (41,521 ha) (Table 4). This suggests land use change in the Murray Valley area since 2015/16, given the infrastructure requirements of Dairy (including active dairy sheds) compared to cropping.

Murray Valley also experienced substantial increases in the Intensive – Animals (255 ha or 490 per cent) and Mixed Farming and Grazing (3,748 ha or 100 per cent) land use categories (Figure 11). These changes, however, are not as evident as the Dairy and Cropping land use change (Map 3).

### Shepparton Water Service Area

Land use changed in the Shepparton water services area between 2015/16 and 2018/19 (Figure 12). The Combined Dairy land use footprint contracted by 9,444 ha, due largely to an 81 per cent reduction in Dairy Agistment and Fodder land use, but also including a 36 per cent decline for Dairy (WULs with an active dairy shed) or 3,999 ha (Table 4). Intensive – Animals land use in Shepparton also contracted (almost halved) from 47 ha in 2015/16 to 24 ha in 2018/19.

Cropping and Grazing – Non-Dairy land use in Shepparton expanded by 9,647 ha (55 per cent) and 6,048 ha (87 per cent) respectively between 2015/16 and 2018/19. Mixed Farming and Grazing also increased marginally (18 per cent). These increases coincided with the contraction in the Combined Dairy land use outlined above. The reduction in Dairy and increase in Cropping land use is evident in Map 4, particularly in the north-east corner near townships such as Katandra.

### Central Goulburn Water Service Area

Central Goulburn water service area remains a diverse mix of land use (Figure 13) but has undergone some changes since 2015/16. The Combined Dairy land use decreased by 12,098 ha (Table 4). The main decrease was in Dairy (defined by WULs with an active dairy shed), which reduced by 22 per cent or 10,045 ha. This suggests a shift away from dairying, which is also evident through mapping comparison of the 2015/16 and 2018/19 land use maps (Maps 4 and 5).

Grazing Non-Dairy was the only other land use category to decrease in extent in Central Goulburn with a 15 per cent (1496 ha) reduction from 9,853 ha to 8,357 ha. All other land uses in Central Goulburn increased by between 5.8 per cent and 64 per cent (Table 4). Annual Horticulture changed the most (largest increase) with a 64 per cent increase from 1,988 ha in 2015/16 to 3,251 ha in 2018/19.

Rural Lifestyle had the second largest increase in Central Goulburn, increasing by 40 per cent from 9,820 ha to 13,722 ha (Table 4). Central Goulburn maintains the largest Rural Lifestyle land use area in the GMID, 4,845 ha larger than the second largest area being the Torrumbarry water service area. Central Goulburn continues to have the largest area for Horses land use in the GMID (2,136 ha, up from 1,784 ha in 2015/16), closely followed by Shepparton with 1,969 ha (down from 2,033 ha in 2015/16).

#### Rochester Water Service Area

Rochester water services area has recorded considerable land use change between 2015/16 and 2018/19 (Map 6), particularly in the Combined Dairy land use around the towns of Rochester and Lockington. The Combined Dairy land use reduced by 11,202 ha (down from 41,402 ha to 29,840 ha), largely due to a 64 per cent decline in the Dairy Agistment and Fodder category (Table 4).

Mixed Farming and Grazing contracted in Rochester by 41 per cent (down from 22,111 ha to 13,030 ha). Intensive – Animals reduced by 71 per cent, down from 159 ha in 2015/16 to 37 ha in 2018/19 (Table 4).

Cropping is the largest land use category by area in the Rochester water service area (Figure 14). Cropping and Grazing Non-Dairy land use increased by 9,494 ha (30 per cent) and 11,409 ha (334 per cent) respectively. Comparing the 2015/16 and 2018/19 land use maps suggests that these land uses often replaced Dairy land use (Map 6).

Rochester had the least area of the Horse land use category with 233 ha, closely followed by Pyramid-Boort with 268 ha. Rochester was the only water service area to have less area categorised as Rural Lifestyle, although the change was relatively small (4.2 per cent, down from 4,137 ha to 3,965 ha) (Table 4).

#### Pyramid-Boort Water Service Area

Table 4 shows changes in land use composition in the Pyramid-Boort water service area. The Combined Dairy land use contracted by 9,069 ha; this was particularly evident in the south-east (Map 7). This includes a 32 per cent reduction in land area with an active dairy shed, down from 11,909 ha to 8,111 ha (Table 4).

Pyramid-Boort maintained the highest extent of cropping land use in the GMID, despite declining 27 per cent (29,276 ha) between 2015/16 and 2018/19 (down from 110,383 ha to 81,107 ha) (Figure 15). This coincided with a 40,951 ha increase (193 per cent) in Mixed Farming and Grazing land use and an increase in Rural Lifestyle land use (up 166 per cent from 577 ha in 2015/16 to 1,533 ha in 2018/19) (Table 4).

Annual Horticulture land use in Pyramid-Boort was 3,285 ha in 2015/16 compared with 121 ha in 2018/19, highlighting the transient nature of annual horticulture (e.g. tomatoes) and a shift away from Annual Horticulture at the time of mapping (Figure 15).

#### Torrumbarry Water Service Area

Table 4 shows land use changes in the Torrumbarry water service area since 2015/16. The Combined Dairy land use has contracted by 13,277 ha; this change was particularly evident in the central and south-eastern half of Torrumbarry (Map 8). This includes a 20 per cent reduction in Dairy, down from 34,691 ha to 27,805 ha and a 62 per cent reduction in Dairy Agistment and Fodder (down from 9,587 ha to 3,668 ha) (Table 4). Intensive – Animals land use also dropped substantially (2,558 ha to 598 ha) (Figure 16).

Rural Lifestyle land use in Torrumbarry has increased by 103 per cent (4,499 ha) since 2015/16. Over the same period, Mixed Farming and Grazing land use expanded 57 per cent (from 19,695 ha in 2015/16 to 30,822 ha in 2018/19) (Table 4), while Grazing Non-Dairy increased slightly by 11 per cent (3,565 ha). Horse land use increased sharply in Torrumbarry, up from 57 ha in 2015/16 to 504 ha in 2018/19.

Torrumbarry has the largest area of the Perennial Horticulture and Grazing Non-Dairy land use in the GMID, with 6,648 ha and 36,572 ha respectively (Table 4).

Table 4. Land Use Change (ha and %) between 2015/16 and 2018/19 in each GMID Water Service Area

Land use (ha.) and % change by Water Service Area	Murray Valley			Shepparton			Central Goulburn			Rochester			Pyramid Boort			Torrumbarry		
	2015/16	2018/19	%	2015/16	2018/19	%	2015/16	2018/19	%	2015/16	2018/19	%	2015/16	2018/19	%	2015/16	2018/19	%
Dairy	36,565	22,662	-38	11,227	7,228	-36	46,435	36,390	-22	20,158	17,982	-11	11,909	8,111	-32	34,691	27,805	-20
Dairy Associated	12,616	12,150	-3.7	7,358	4,821	-35	17,825	17,011	-5	7,728	7,131	-7.7	12,369	5,166	-58	15,932	15,470	-2.9
Dairy Agistment and Fodder	12,487	8,804	-30	3,608	700	-81	11,022	9,783	-11	13,156	4,727	-64	1,597	3,529	121	9,597	3,668	-62
COMBINED DAIRY	61,668	43,616	-29	22,193	12,749	-43	75,282	63,184	-16	41,039	29,840	-27	25,875	16,806	-35	60,220	46,943	-22
Horticulture - Perennial	4,644	4,039	-13	6,991	6,481	-7.3	5,879	6,218	5.8	2,244	2,184	-2.7	5,476	6,000	9.6	6,816	6,648	-2.5
Horticulture - Annual	1,192	768	-36	274	358	31	1,988	3,251	64	4,362	4,660	6.8	3,285	121	-96	1,488	2,444	64
Cropping	17,293	41,305	139	17,593	27,240	55	28,163	30,771	9	32,027	41,521	30	110,383	81,107	-27	42,006	37,622	-10
Grazing - Non-Dairy	27,945	22,399	-20	6,939	12,987	87	9,853	8,357	-15	3,416	14,825	334	29,170	31,122	6.7	33,007	36,572	11
Mixed Farming and Grazing	3,747	7,495	100	18,771	15,339	-18	18,167	22,309	23	22,111	13,030	-41	21,183	62,134	193	19,695	30,822	57
Intensive - Animals	52	307	490	47	24	-49	565	598	5.8	159	37	-77	2,711	3,289	21	2,558	598	-77
Horses	408	411	0.7	2,033	1,969	-3.1	1,784	2,136	20	233	233	0.0	220	268	22	57	504	784
Rural Lifestyle	3,668	3,965	8.1	4,197	4,309	2.7	9,820	13,722	40	4,137	3,965	-4.2	577	1,533	166	4,378	8,877	103
<b>TOTAL</b>	<b>120,616</b>	<b>124,306</b>	<b>3.1</b>	<b>79,039</b>	<b>81,455</b>	<b>3.1</b>	<b>151,501</b>	<b>150,546</b>	<b>-0.6</b>	<b>109,731</b>	<b>110,294</b>	<b>0.5</b>	<b>198,880</b>	<b>202,378</b>	<b>1.8</b>	<b>170,226</b>	<b>171,031</b>	<b>0.5</b>

Murray Valley Water Service Area – Maps

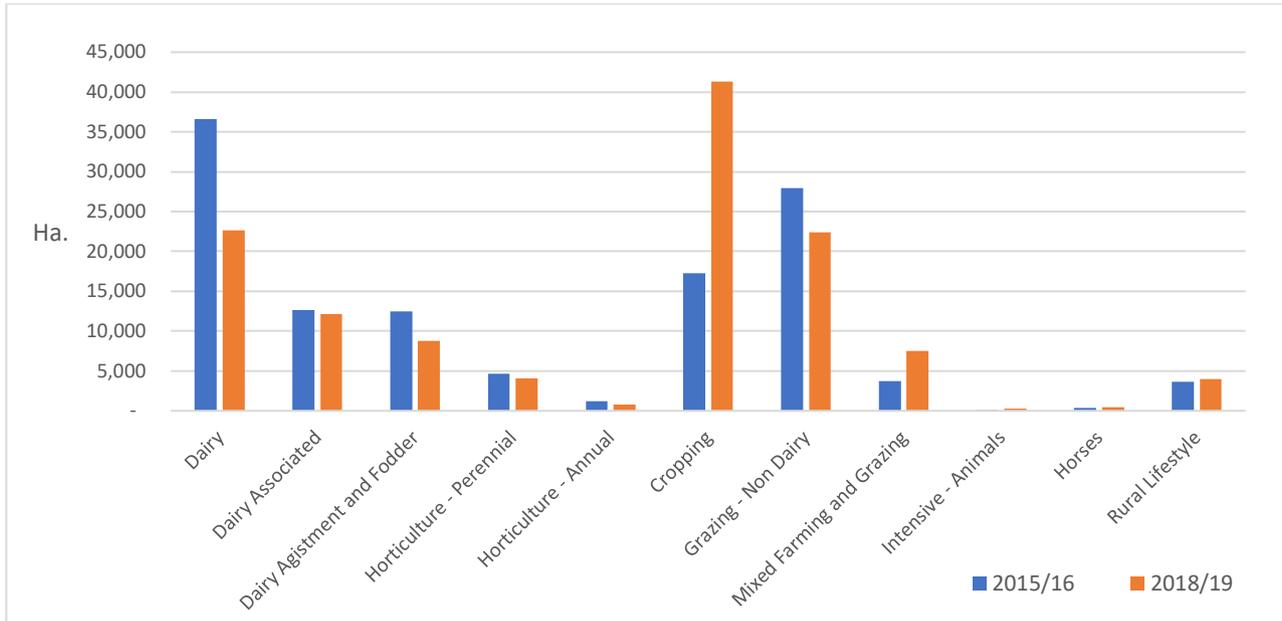
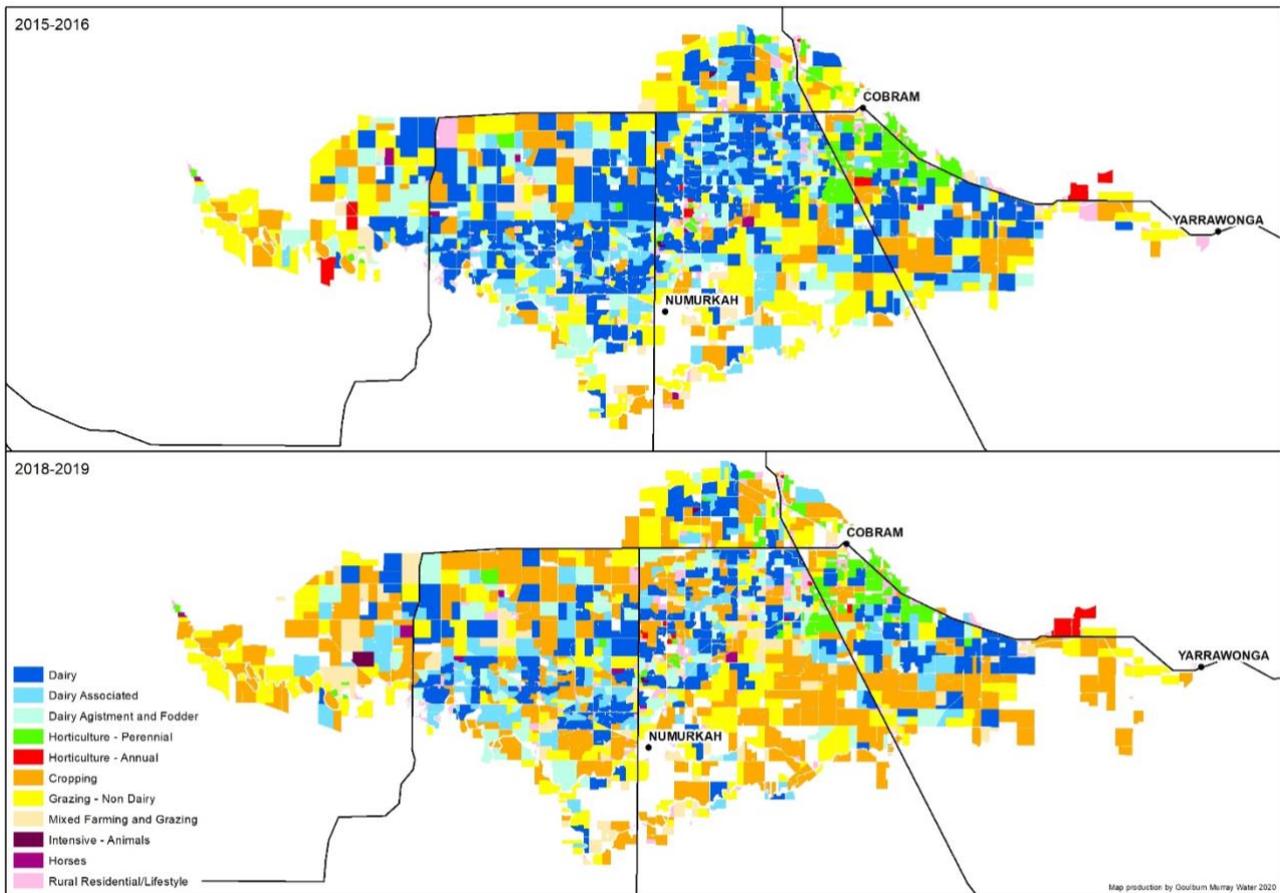


Figure 11. Land Use - Murray Valley Water Service Area 2015/16 and 2018/19



Map 3. Land Use - Murray Valley Water Service Area 2015/16 (top) and 2018/19 (bottom)

Shepparton Water Service Area – Maps

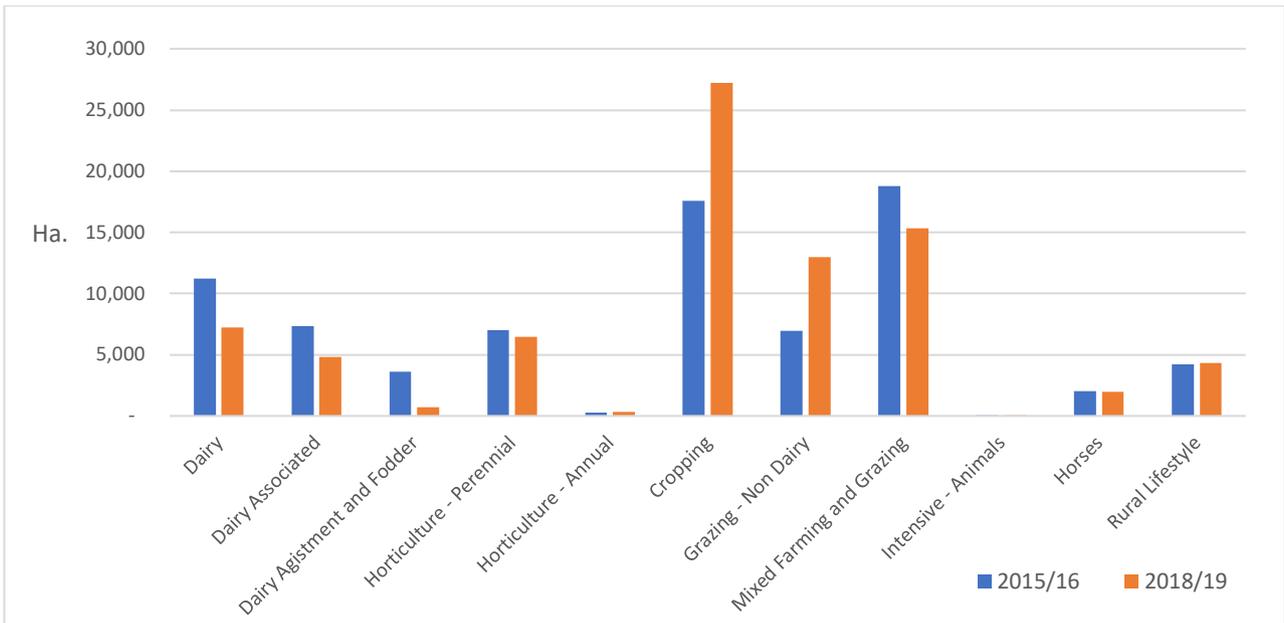
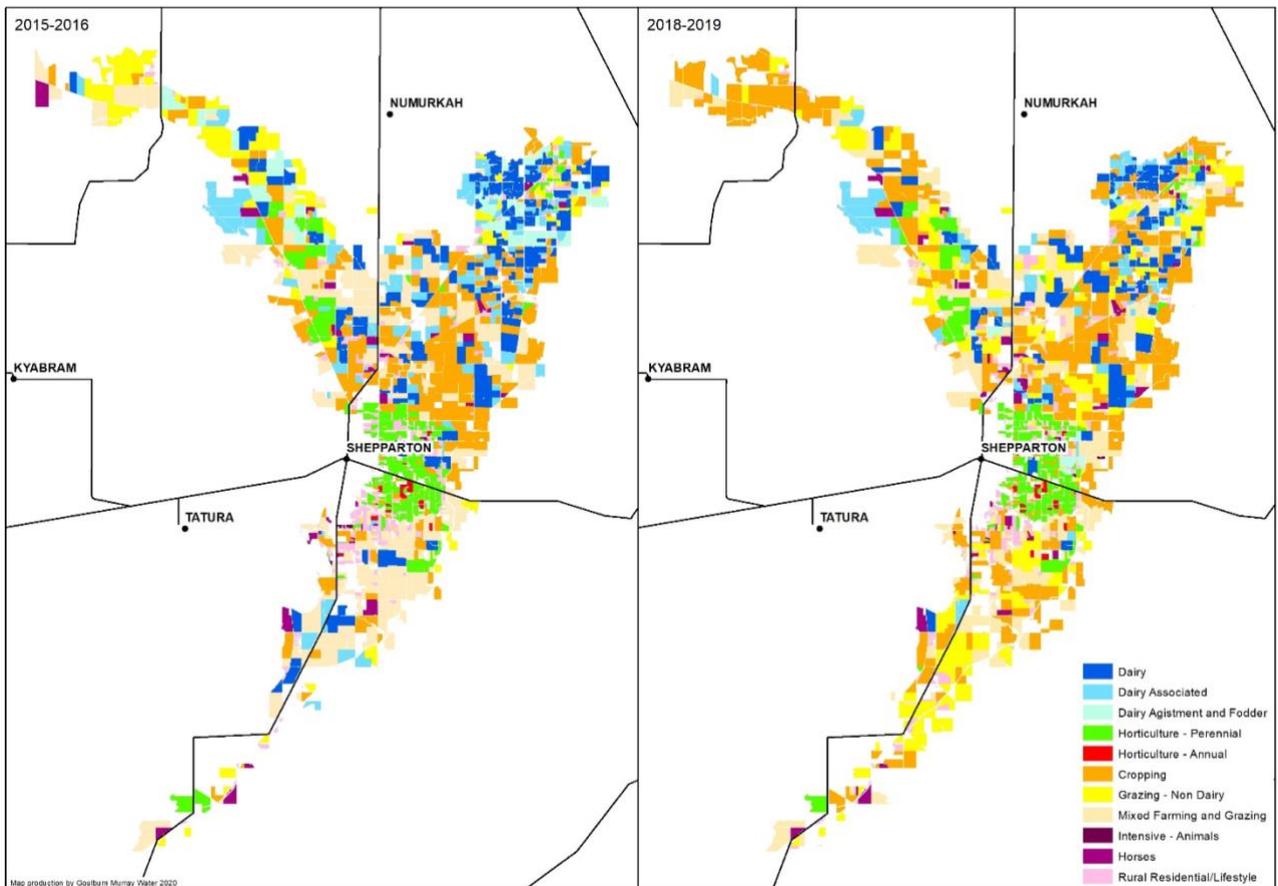


Figure 12. Land Use - Shepparton Water Service Area 2015/16 and 2018/19



Map 4. Land Use - Shepparton Water Service Area 2015/16 (left) and 2018/19 (right)

Central Goulburn Water Service Area – Maps

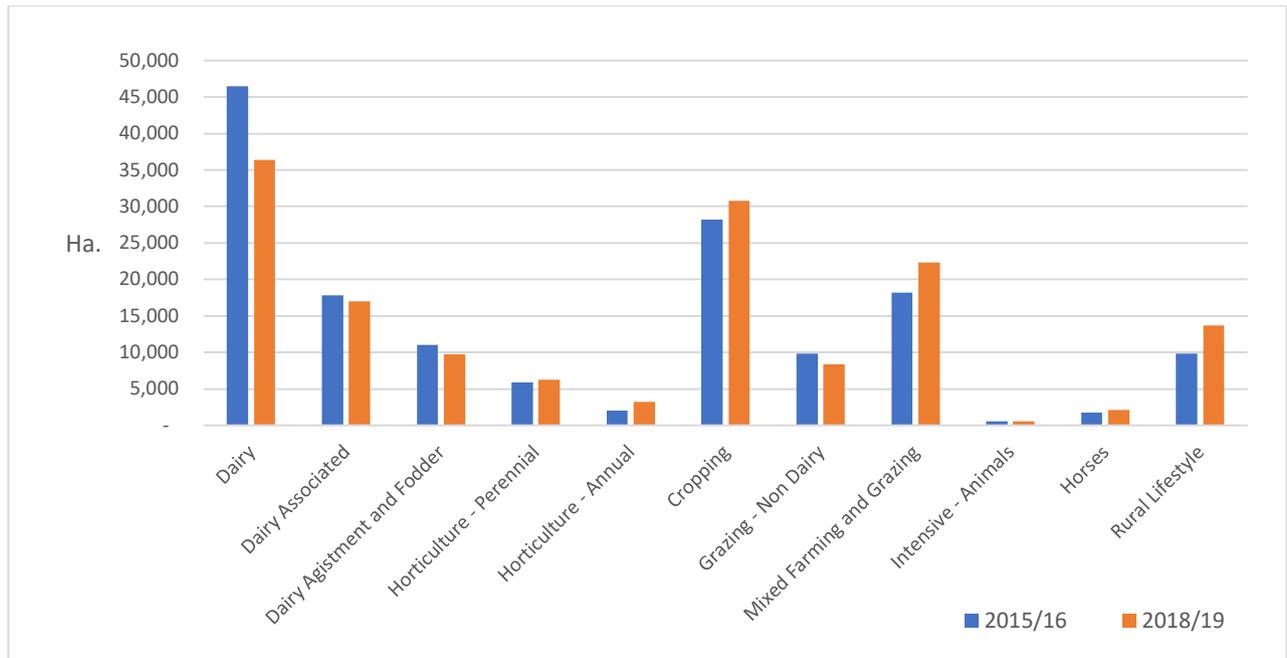
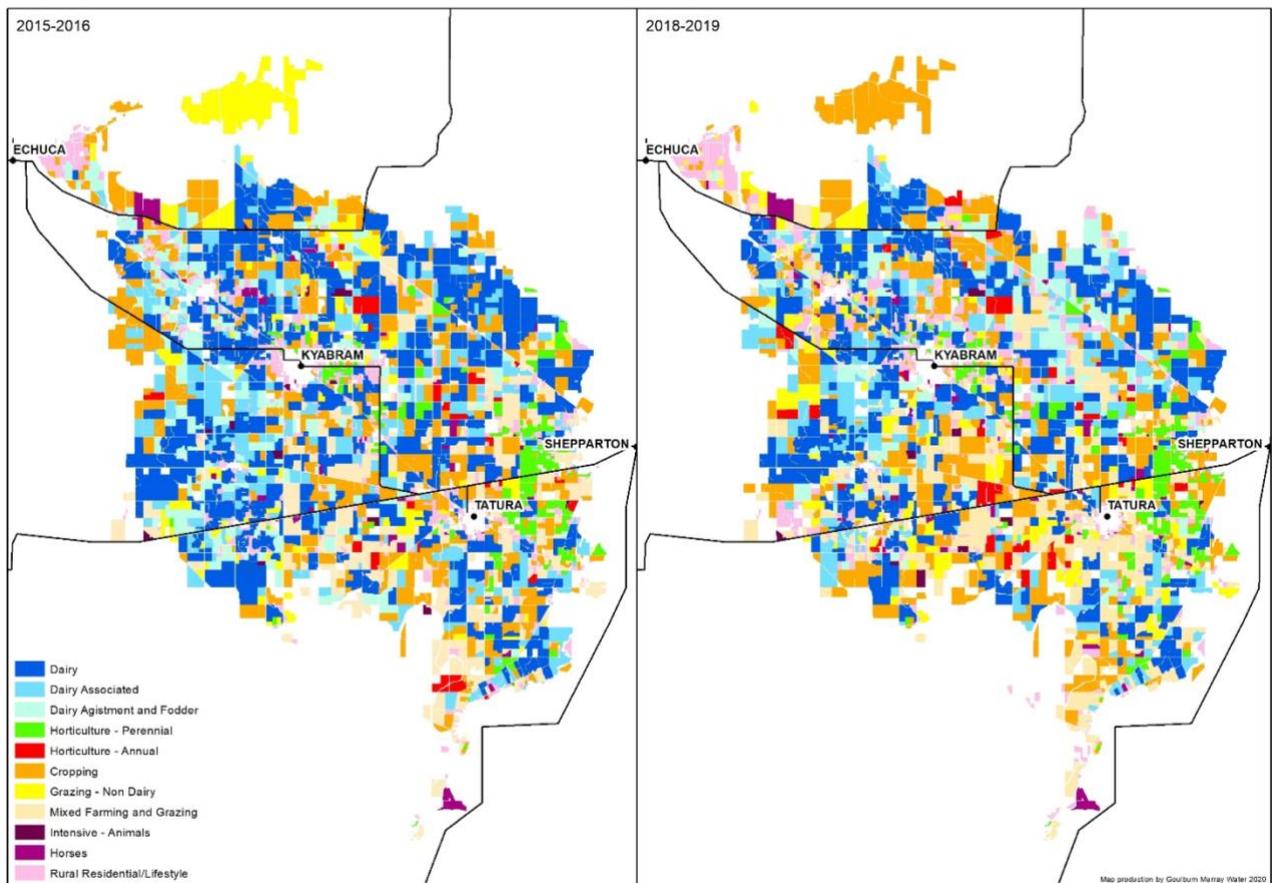


Figure 13. Land Use - Central Goulburn Water Service Area 2015/16 and 2018/19



Map 5. Land use - Central Goulburn Water Service Area 2015/16 (left) and 2018/19 (right)

Rochester Water Service Area – Maps

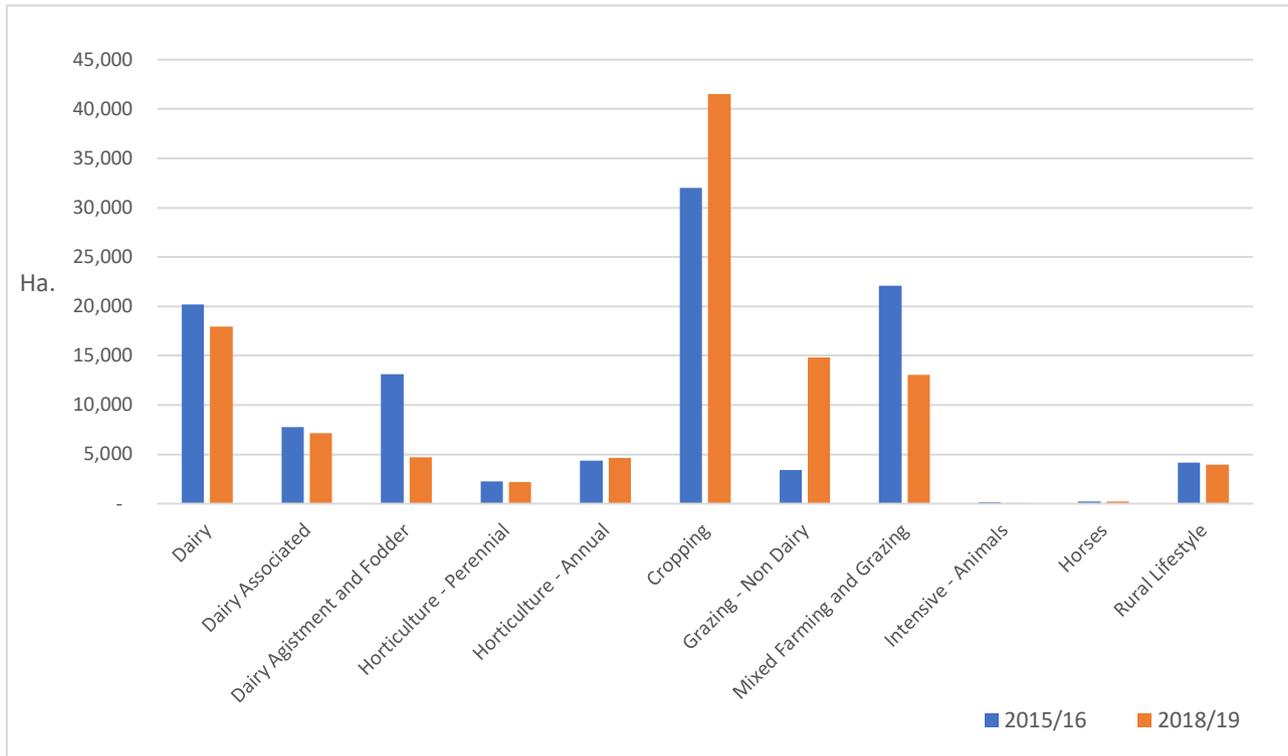
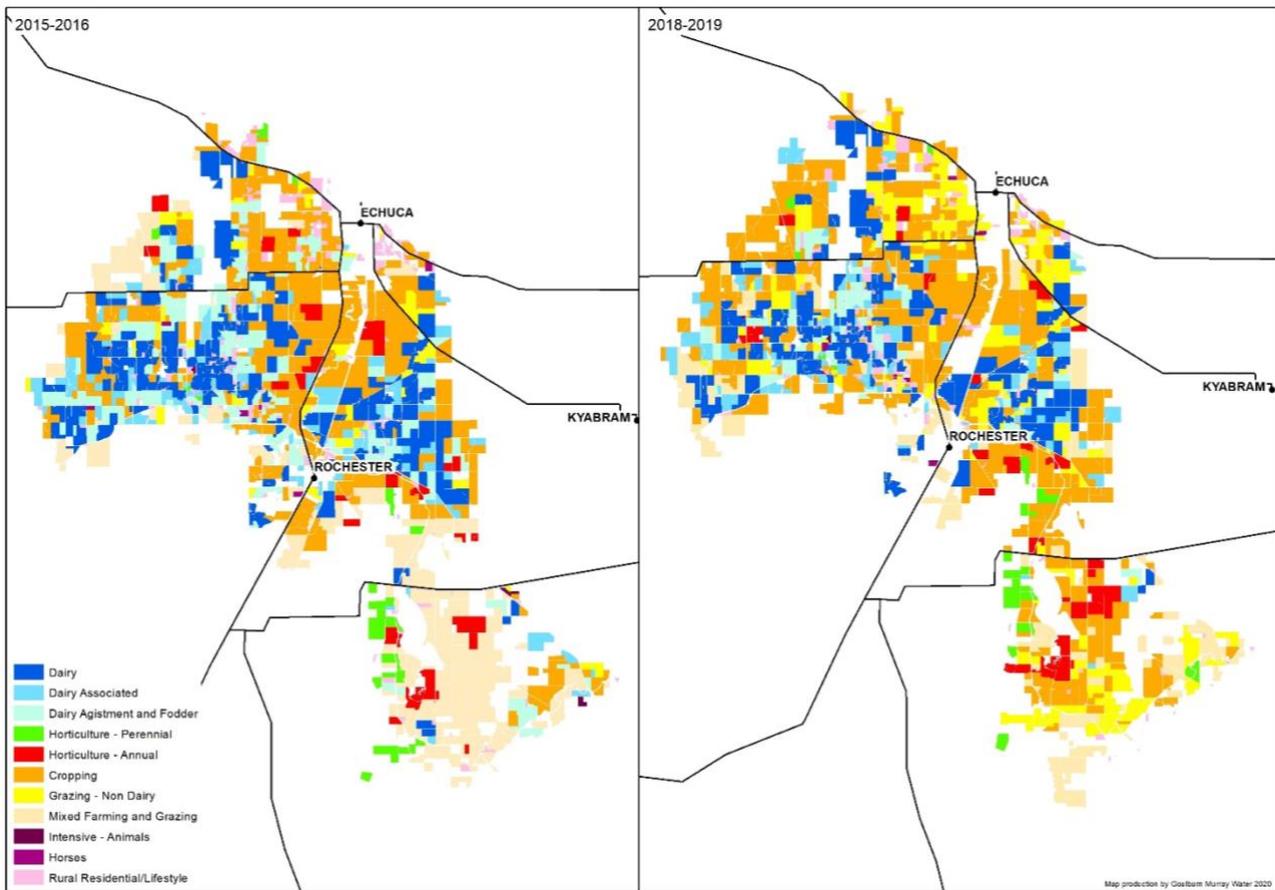


Figure 14. Land Use - Rochester Water Service Area 2015/16 and 2018/19



Map 6. Land Use - Rochester Water Service Area 2015/16 (left) and 2018/19 (right)

Pyramid-Boort Water Service Area – Maps

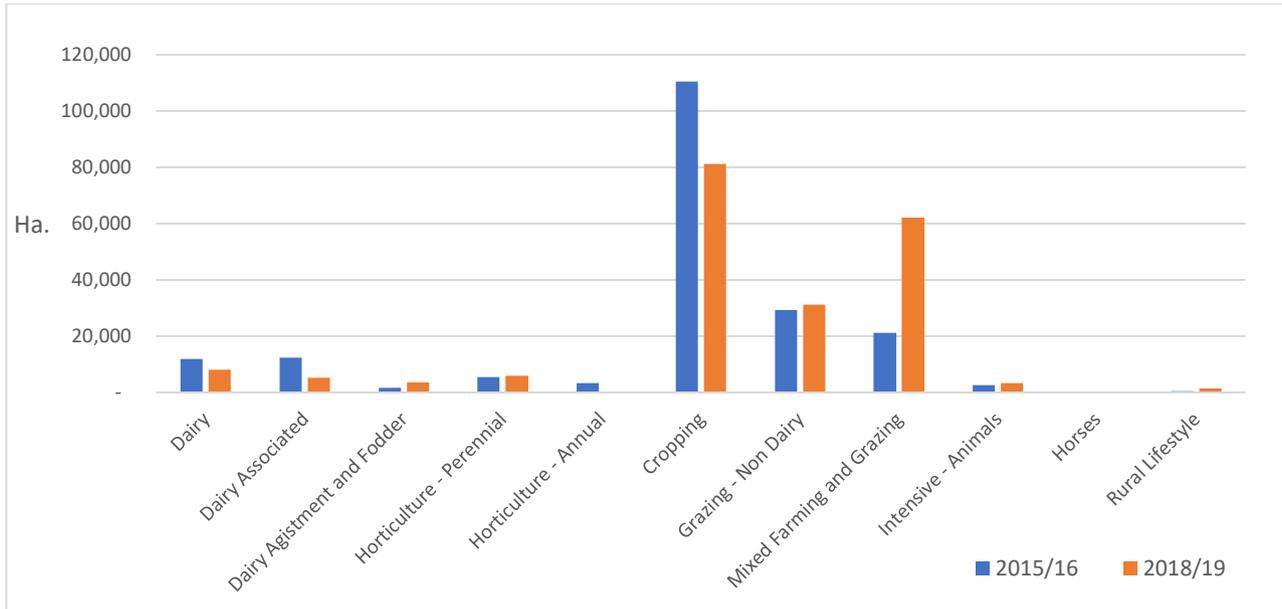
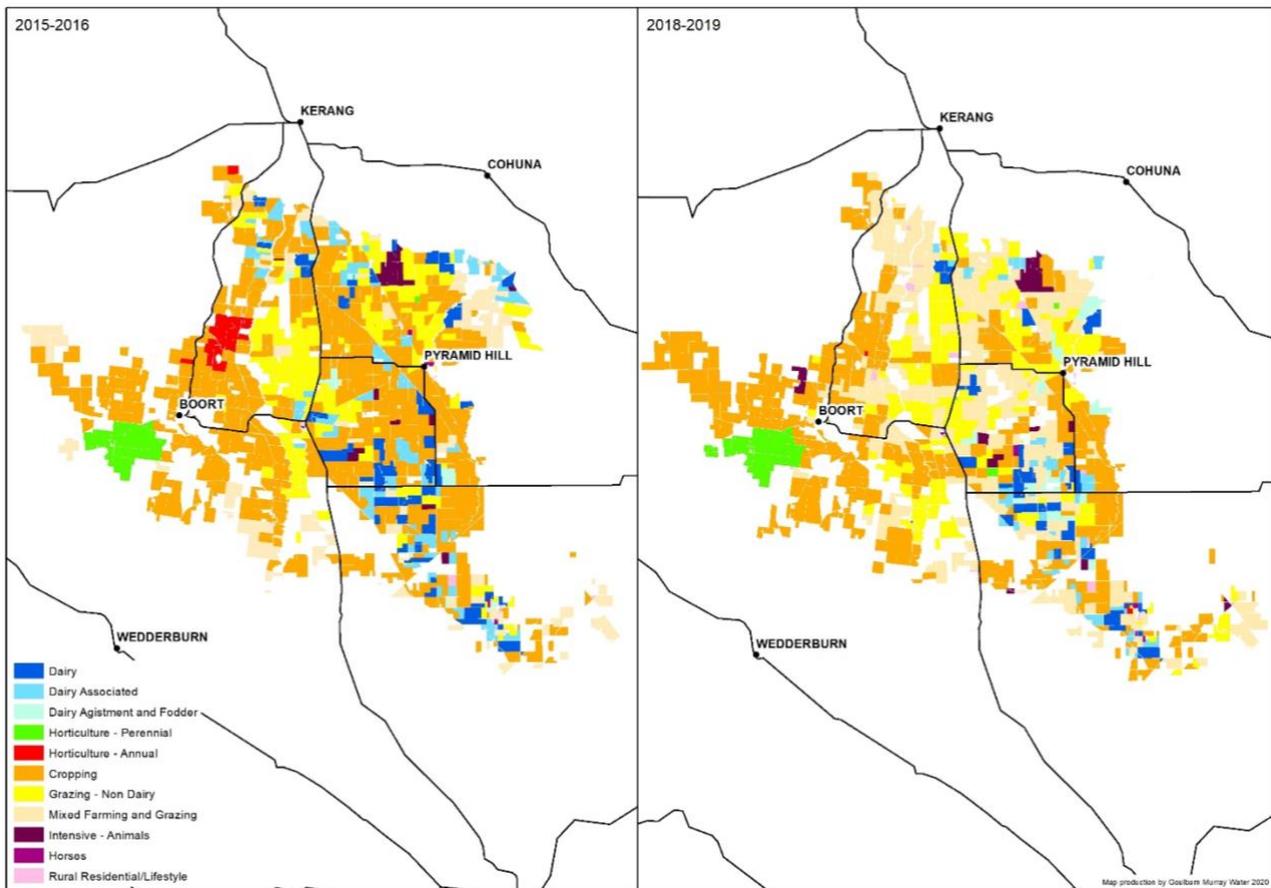


Figure 15. Land Use - Pyramid-Boort Water Service Area 2015-16 and 2018-19



Torrumbarry Water Service Area – Maps

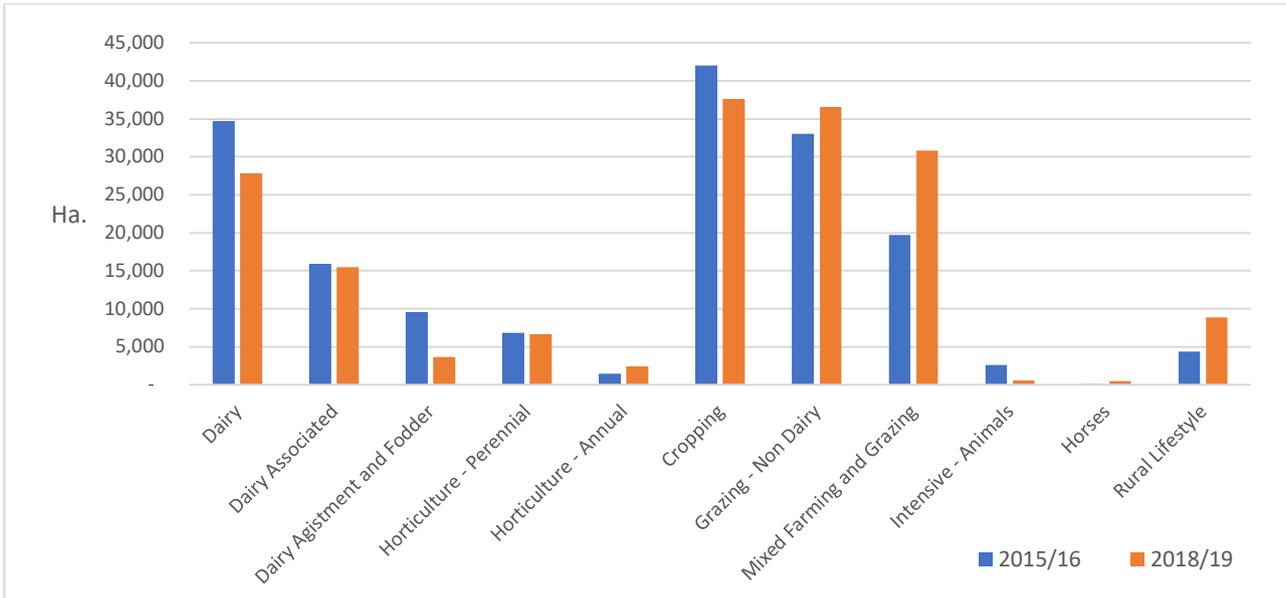
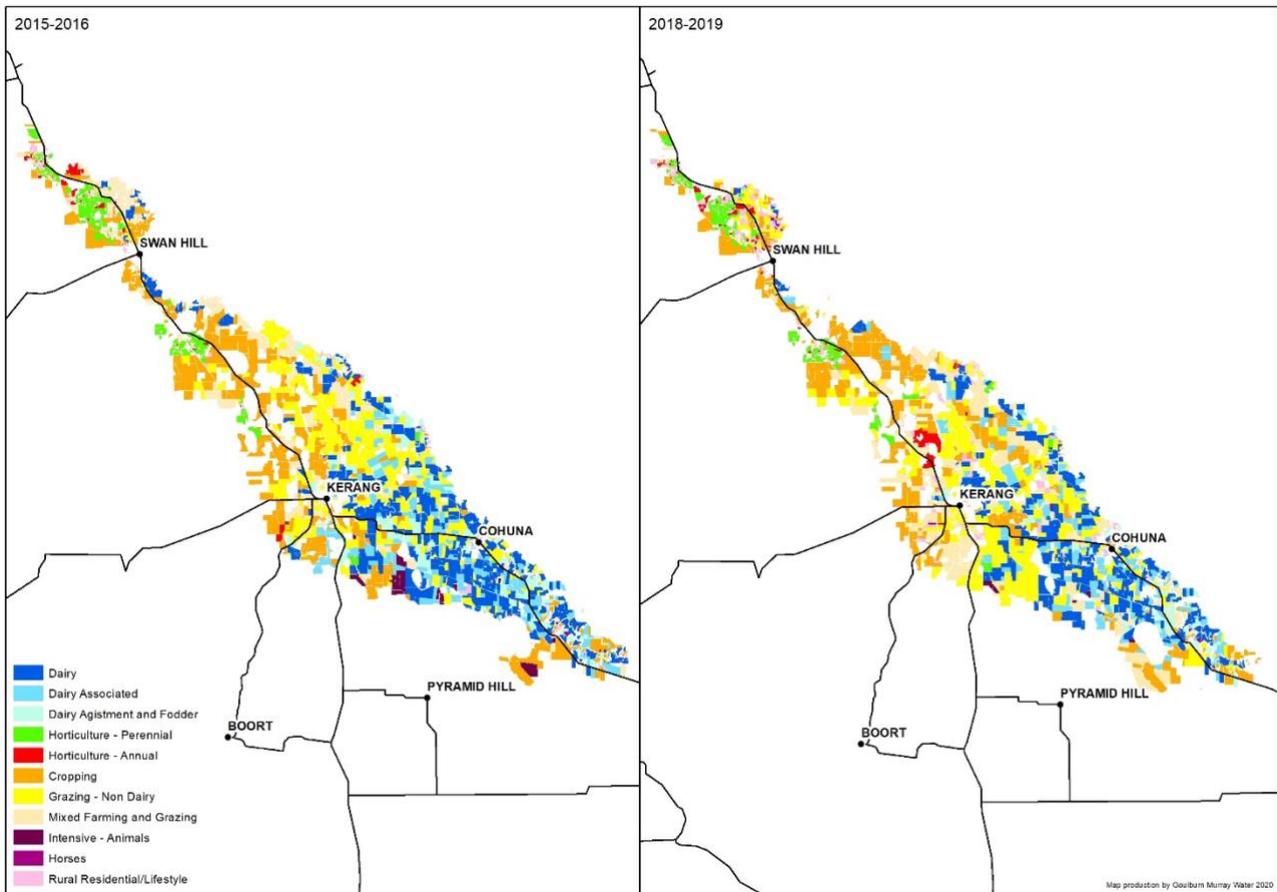


Figure 16. Land Use - Torrumbarry Water Service Area 2015-16 and 2018-19



Map 8. Land use - Torrumbarry Water Service Area 2015/16 (left) and 2018/19 (right)

## 7.3 Water Use

### 7.3.1 Water Use Licences by Land Use category

In 2018/19, land use was classified at the Water Use Licence (WUL) level. This methodology was also applied to 2015/16 data to enable consistent comparison and provide an overarching enterprise structure. A single WUL can cover several land properties titles and is therefore more aligned with business enterprises.

Table 5 shows the number of WULs in each land use category. Figure 17 illustrates the data for ease of comparison. This is only a comparison of WUL numbers, not total volume held or used against each licence.

Table 5. GMID Water Use Licence (WUL) numbers by Land Use category, 2015/16 and 2018/19

	2015/16 (WUL no.)	2018/19 (WUL no.)	Change (WUL no.)	% Change (+/-)
Dairy	1,138	781	-357	-31
Dairy Associated	907	770	-137	-15
Dairy Agistment and Fodder	716	372	-344	-48
<b>COMBINED DAIRY</b>	<b>2,761</b>	<b>1,923</b>	<b>-838</b>	<b>-30</b>
Horticulture - Perennial	886	843	-43	-5
Horticulture - Annual	121	145	24	20
Cropping	1,994	1,909	-85	-4
Grazing - Non-Dairy	1,008	1,242	234	23
Mixed Farming and Grazing	1,391	1,601	210	15
Intensive - Animals	63	37	-26	-41
Horses	102	172	70	69
Rural Lifestyle	4,880	6,327	1,447	30
<b>Total</b>	<b>13,206</b>	<b>14,199</b>	<b>993</b>	<b>7.5</b>

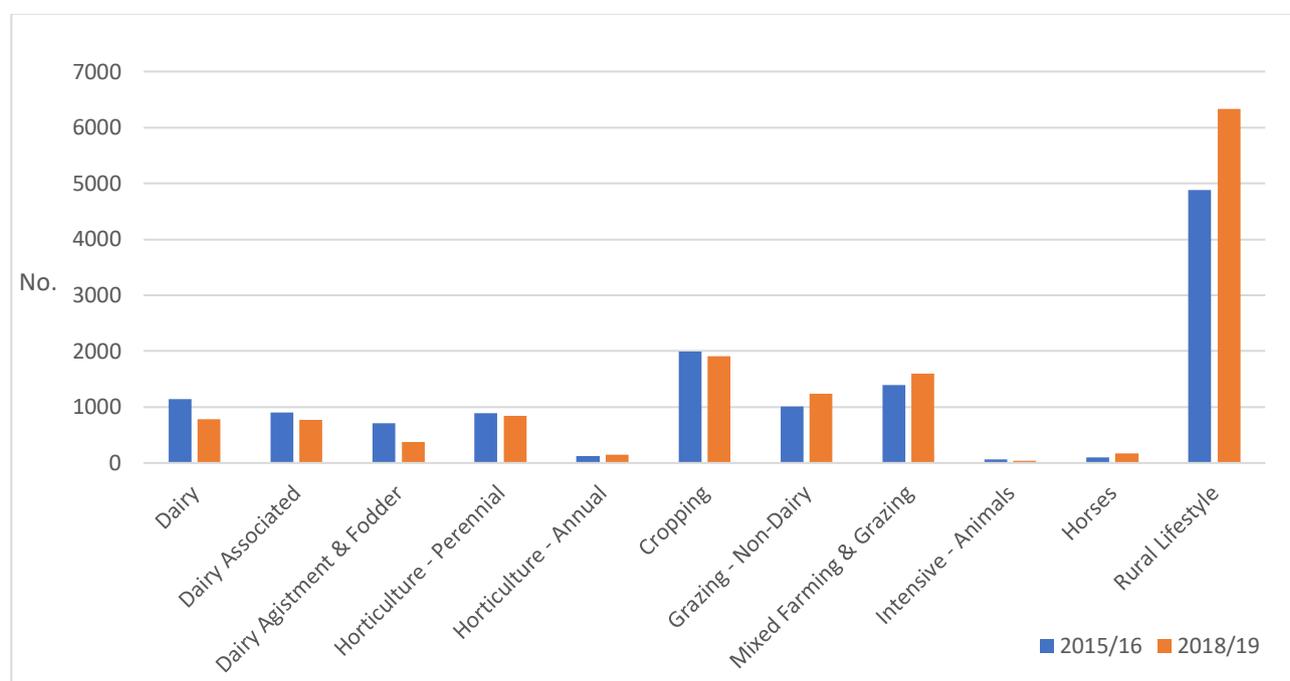


Figure 17. Number of Water Use Licences (WUL) by Land Use category in the GMID

Table 5 shows the total number of WULs across the GMID increased between 2015/16 and 2018/19. This was particularly in the Horses land use category which increased by 70 WULs (69 per cent), Mixed Farming and Grazing by 210 WULs (15 per cent), Grazing Non-Dairy by 234 WULs (23 per cent), Rural Lifestyle by 1,447 (30 per cent) and Annual Horticulture (up 20 per cent from 121 to 145 WUL).

Rural Lifestyle continues to have the highest number of WULs (Figure 17), despite only covering 36,370 ha or 4 per cent of the GMID's total 840,010 ha of irrigable area (Table 3).

Combined Dairy land use recorded the largest fall in the number of WULs since 2015/16, reducing by 838, or 30 per cent. The decrease was particularly evident in the Dairy category (WULs with an active dairy shed), falling by 357 or 31 per cent, and the Dairy Agistment and Fodder category, which fell by 344 WULs or 48 per cent.

The number of active dairy sheds (Dairy land use) fell from 2721<sup>8</sup> to 1143<sup>9</sup> during the Millennium drought (2004-2010). After a short period of stability, dairy numbers began to decline again, with a reduction from 1,138 to 781 observed between 2015/16 and 2018/19. The concurrent 73,000 ha contraction in the Combined Dairy land use between 2015/16 and 2018/19 (Table 3) suggests consolidation into larger dairy enterprises, and business exits.

### 7.3.2 Water Use Licences in Water Service Areas, 2015/16 and 2018/19

Table 6 compares the Water Use Licence (WUL) numbers in each water service area by land use category between 2015/16 and 2018/19. The data for each water service area is discussed in more detail below.

#### *Central Goulburn*

The number of WULs attributed to the Combined Dairy Land Use reduced by 218, or 25 per cent. This is slightly lower than the average 30 per cent reduction across the GMID.

The number of Annual Horticulture WULs in Central Goulburn increased from 28 to 40, the second largest increase in any water service area behind Torrumbarry. The number of WULs attributed to Horses increased the most in the Central Goulburn water service area compared to all other water service areas, increasing from 39 to 70.

In 2018/19 Central Goulburn had the highest number of WULs attributed to Rural Lifestyle land use, with a total of 1,953 WULs, compared to the next highest area of Torrumbarry, with 1,454. This coincides with Central Goulburn having the largest Rural Lifestyle land footprint covering 13,722 ha (Table 4).

#### *Pyramid-Boort*

The number of WULs attributed to the Combined Dairy land use in the Pyramid-Boort water service area reduced by 49 WUL (40 per cent). This is higher than the average 30 per cent reduction across the GMID.

The number of Cropping WULs in Pyramid-Boort decreased from 412 to 246, this coincided with a 29,276 ha contraction in the Cropping area over the same period (Table 4). The number of WULs attributed to Mixed Farming and Grazing increased by 166 (up from 88 to 254), corresponding with a 193 per cent expansion in this category's land use footprint from 21,183 ha to 62,134 ha (Table 4).

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<sup>8</sup> GMW (2006). 'Irrigation Farm Survey 2004/2005. Final Date: 5/12/06.' Report by Goulburn-Murray Water (GMW), Goulburn Broken Catchment Management Authority, North Central Catchment Management Authority, with contribution from Department of Primary Industries and Australian Bureau of Statistics.

<sup>9</sup> HMC Property Group (2010). 'Changing land use in the GMID 2006-2010. Where have all the dairies gone? Report for Northern Victoria Irrigation Renewal Project and the Department of Primary Industries, by HMC Property Group. July 2010.

### *Murray Valley*

The number of WULs attributed to Combined Dairy land use in Murray Valley water service area reduced by 179 WUL (32 per cent). This is consistent with the average 30 per cent reduction across the GMID.

The number of Cropping WULs in Murray Valley increased by 194 (140 per cent) from 139 to 333. This was supported by an expansion in Cropping area (139 per cent or 24,012ha) over the same period (Table 4). The number of WULs in Mixed Farming and Grazing in Murray Valley also increased, from 55 to 95, which coincided with a larger land use footprint of 3748 ha (100 per cent increase). The number of Rural Lifestyle WULs also increased by 66 per cent, from 504 to 835. However, the Rural Lifestyle land footprint increased by only 8.1 per cent.

### *Rochester*

The number of WULs attributed to Combined Dairy land use in the Rochester water service area reduced by 164 WUL (36 per cent). This is higher than the average 30 per cent reduction across the GMID.

The number of WULs in Rochester for Grazing Non-Dairy land use increased by 170 (up from 49 to 219, or 346 per cent). This was supported by Grazing Non-Dairy land use expanding 334 per cent or 11,409 ha. Conversely, the number of WULs for Mixed Farming and Grazing in Rochester reduced from 170 to 120 (29 per cent), coinciding with the area contracting 41 per cent to 9,081 ha (Table 4). The number of WULs across all other land uses remained unchanged in Rochester during this period.

### *Shepparton*

The number of WULs attributed to Combined Dairy land use in the Shepparton water service area reduced by 103 WUL (42 per cent). This is higher than the average 30 per cent reduction across the GMID.

The number of WULs in Shepparton for Grazing Non-Dairy land use increased by 69 WULs (up from 93 to 162, or 74 per cent). This reflected Grazing Non-Dairy land use expanding by 87 per cent or 6,048 ha (Table 4). Rural Lifestyle WULs also increased from 785 to 1132 (44 per cent), but the land footprint barely changed (up 2.7 per cent).

### *Torrumbarry*

The number of WULs attributed to Combined Dairy land use in the Torrumbarry water service area reduced by 125 WUL (25 per cent). This is lower than the average 30 per cent reduction across the GMID.

The number of WULs also decreased for Mixed Farming and Grazing (down from 447 to 343), despite this land use category expanding from 19,695 ha to 30,822 ha (Table 4).

Compared to all other water service areas, the number of Annual Horticulture WULs increased the most, up 14 from 33 to 47, while the number of WULs attributed to Intensive – Animals reduced the most, down 10 from 19 to 9. The number of WULs attributed to Horses also increased substantially, from two to 28.

Table 6. Water Use Licences (WUL) by Land Use category and Water Service Area, 2015/16 and 2018/19

	Central Goulburn			Pyramid-Boort			Murray Valley			Rochester			Shepparton			Torrumbarry		
	2015/16	2018/19	%*	2015/16	2018/19	%	2015/16	2018/19	%	2015/16	2018/19	%	2015/16	2018/19	%	2015/16	2018/19	%
Dairy	374	272	-27	43	26	-40	249	139	-44	145	117	-19	104	73	-29	223	154	-31
Dairy Associated	282	259	-8	71	37	-48	169	141	-17	122	94	-23	106	66	-37	157	173	10
Dairy Agistment and Fodder	220	127	-42	10	12	20	139	98	-29	188	80	-57	45	13	-71	114	42	-63
<b>COMBINED DAIRY</b>	<b>876</b>	<b>658</b>	<b>-25</b>	<b>124</b>	<b>75</b>	<b>-40</b>	<b>557</b>	<b>378</b>	<b>-32</b>	<b>455</b>	<b>291</b>	<b>-36</b>	<b>255</b>	<b>152</b>	<b>-40</b>	<b>494</b>	<b>369</b>	<b>-25</b>
Horticulture – Perennial	172	172	0	4	8	100	123	109	-11	17	20	17	293	263	-10	277	271	-2
Horticulture – Annual	28	40	43	5	3	-40	9	9	0	26	22	-15	20	24	20	33	47	42
Cropping	437	376	-14	412	246	-40	139	333	140	335	322	-4	284	351	24	387	281	-37
Grazing - Non-Dairy	101	154	52	106	99	-7	324	252	-22	49	219	346	93	162	74	335	356	6
Mixed Farming and Grazing	344	500	45	88	254	189	55	95	72	170	120	-29	287	289	0.1	447	343	-23
Intensive – Animals	19	10	-47	11	10	-9	2	3	50	5	3	-40	7	2	-71	19	9	-53
Horses	39	70	80	5	6	20	8	8	0	7	8	14	41	52	27	2	28	1300
Rural Lifestyle	1,614	1,953	21	74	174	135	504	835	66	774	779	0.6	785	1,132	44	1,129	1,454	28
<b>TOTAL</b>	<b>3,630</b>	<b>3,933</b>	<b>8.5</b>	<b>829</b>	<b>875</b>	<b>6</b>	<b>1,721</b>	<b>2,022</b>	<b>18</b>	<b>1,838</b>	<b>1,784</b>	<b>-3</b>	<b>2,065</b>	<b>2,427</b>	<b>17</b>	<b>3,123</b>	<b>3,158</b>	<b>1</b>

\*Denotes percentage (%) change

### 7.3.3 GMID Water Use by Land Use category, 2015/16 and 2018/19

In 2018/19, land use was classified at the Water Use Licence (WUL) level. This WUL data provided additional data such as annual water use volume (ML). Water use information was also sourced from the Victorian Water Register to assist with analysis of change. This methodology was also applied to 2015/16 data to enable consistent comparison and provide an overarching enterprise structure. A single WUL can cover several land properties titles and is therefore more aligned with business enterprises.

The WUL water use data shows that total GMID water use was similar in both years, albeit slight lower (four per cent) in 2018/19 (Table 7). Declines in water use were most evident for Dairy; Dairy Agistment and Fodder; Annual Horticulture; and, Intensive – Animals land use categories. Water use increased notably for Mixed Farming and Grazing (53 per cent), Grazing – Non-Dairy (27 per cent) and Perennial Horticulture (20 per cent). In terms of climate, both 2015/16 and 2018/19 were warm, dry years, with low inflows into storages.

Table 7: GMID Water Use (ML) by Land Use category, 2015/16 and 2018/19

	2015/16	2018/19	ML change	% change
Dairy	434,266	335,565	-98,701	-23
Dairy Associated	97,604	95,406	-2198	-2
Dairy Agistment and Fodder	76,139	49,714	-26,425	-35
<b>COMBINED DAIRY</b>	<b>608,009</b>	<b>480,684</b>	<b>-127,325</b>	<b>-21</b>
Horticulture – Perennial	88,650	106,446	17,796	20
Horticulture – Annual	26,083	20,127	-5956	-23
Cropping	180,761	203,897	23,136	13
Grazing – Non-Dairy	90,095	114,706	24,611	27
Mixed Farming and Grazing	61,700	94,394	32,694	53
Intensive - Animals	7,407	4,841	-2566	-35
Horses	4,968	6,801	1833	37
Rural Lifestyle	35,422	27,369	-8053	-23
<b>TOTAL</b>	<b>1,103,094</b>	<b>1,059,265</b>	<b>-43,829</b>	<b>-4</b>

Water use varies from one season to the next depending on allocations, rainfall, temperatures, commodity markets and the water market. Overall, GMID water use<sup>10</sup> has been trending down since 2000 (Figure 18). Water use in the GMID declined during the Millennium Drought when allocations got as low as 35 per cent (Victorian Murray High Reliability Water Share, HRWS) and 33 per cent (Goulburn HRWS) in 2008/09. Water use increased following the drought, but to volumes generally lower than before the drought, except in 2012/13 when landholders ramped up production to take advantage of favourable seasonal conditions and markets.

<sup>10</sup> Data sourced from GMW records of water deliveries.

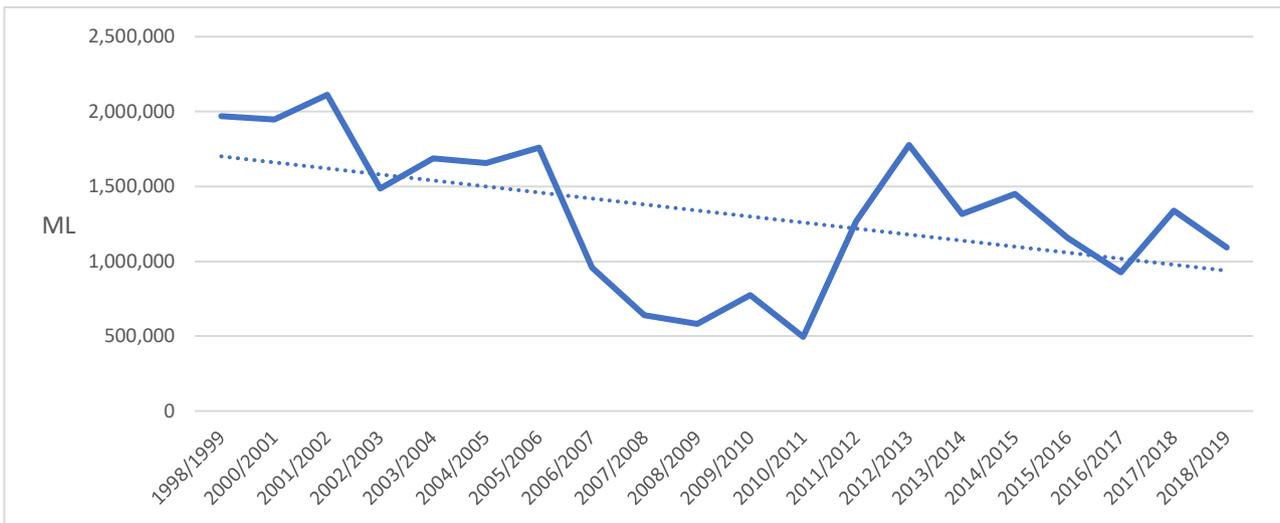


Figure 18. GMID Water Use (ML) between 1998/99 and 2018/19

Figure 19 illustrates that GMID irrigators are now using more water each year than they hold in HRWS<sup>11</sup>. Total water use by GMID irrigators fluctuated slightly from year to year until 2006/07 but was generally close to the volume of HRWS owned.

The volume of HRWS held in the GMID declines from 2008 onwards, reflecting environmental water recovery and entitlement trading (being sold) out of the district. Since the Millennium Drought broke and water use began to increase again, a gap has become evident between the volume of HRWS held and water use by GMID irrigators. The difference is bridged by buying allocation on the temporary market.

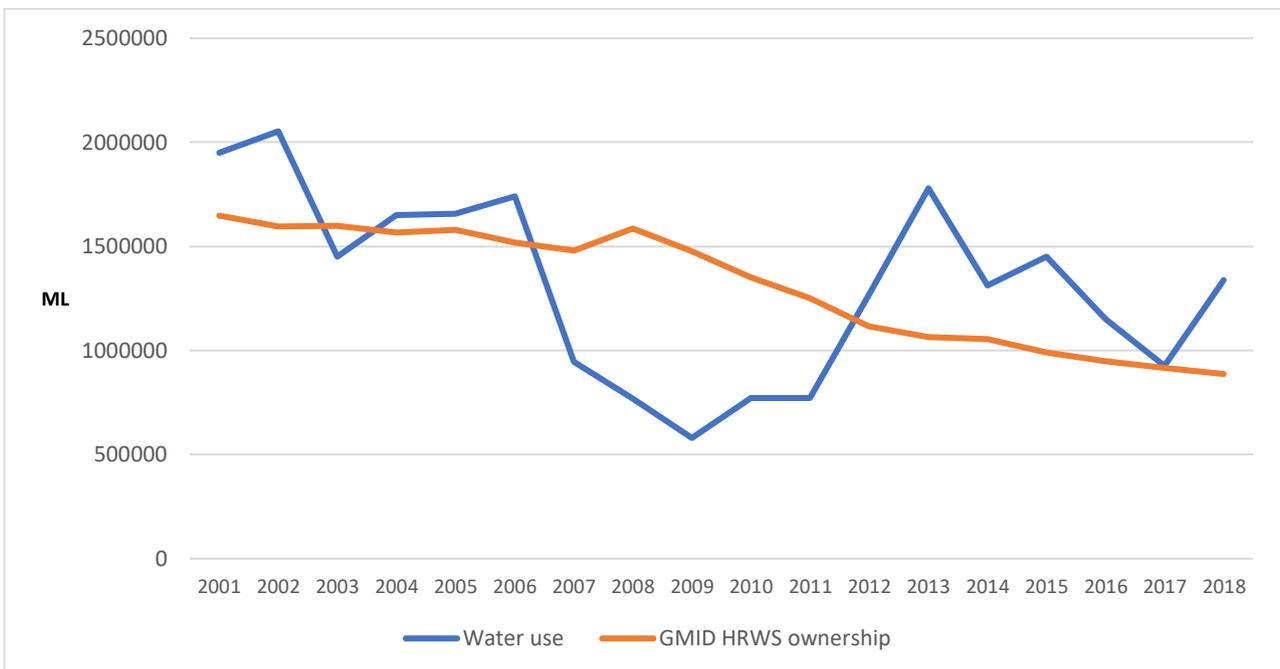
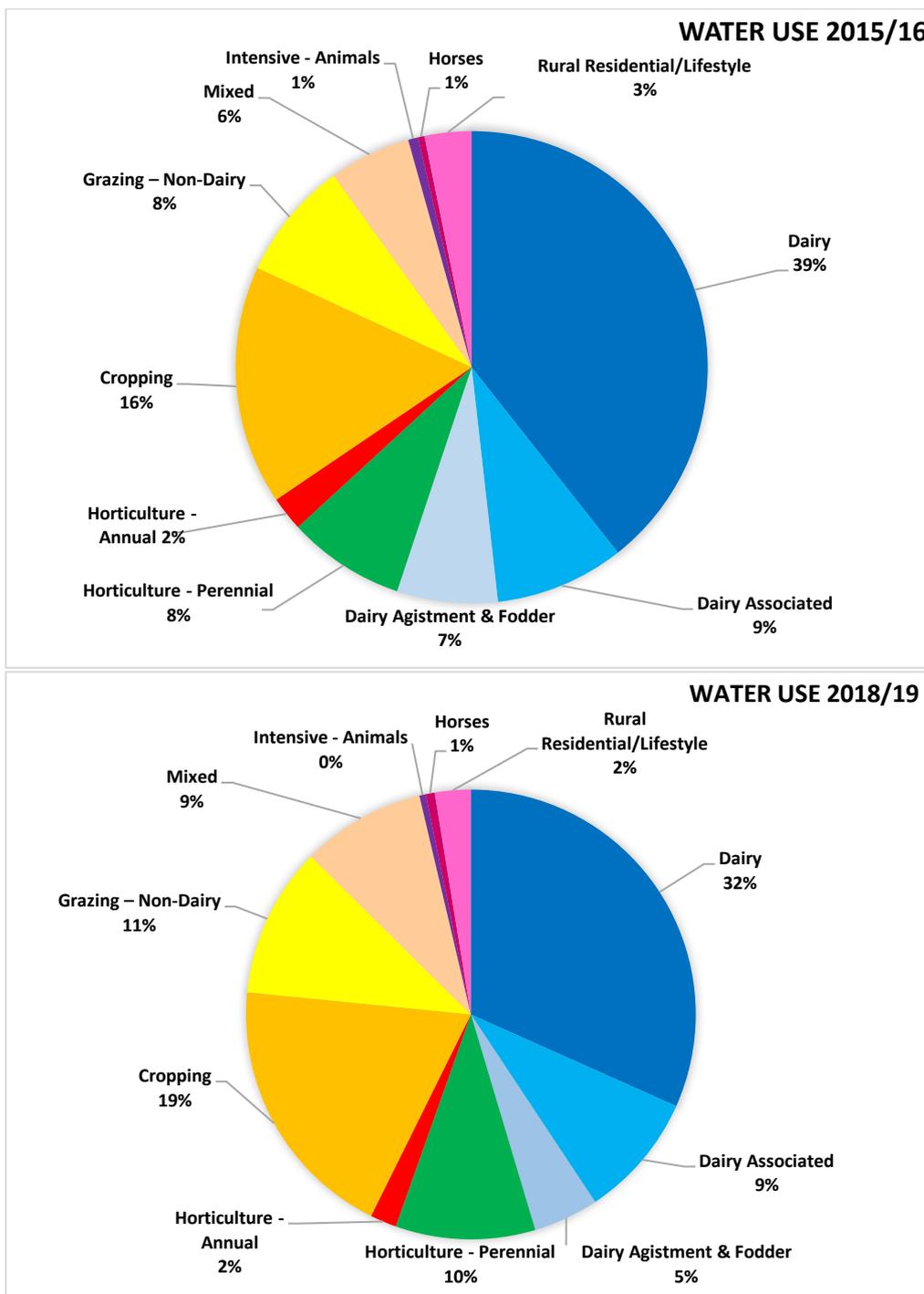


Figure 19. GMID HRWS ownership and water deliveries

<sup>11</sup> Data sourced from Goulburn Broken Catchment Management Authority (2017). 'Regional Irrigated Land and Water Use Mapping in the Goulburn Murray Irrigation District – Executive Summary', p11, State of Victoria. Updated with GMW water delivery record and HRWS in 'Water Market Trends – Updated Trends in northern Victorian Water Trade 2001-2018'. Department of Environment, Water Land and Planning, March 2019

Figure 20 compares water use by land use category. The Combined Dairy land use remains the single largest water user in the GMID in 2018/19, accounting for a total 46 per cent of water delivered, down from 55 per cent in 2015/16. The shift in water use from Dairy to other land uses was fairly evenly distributed among Cropping, Grazing Non-Dairy, Mixed Farming and Grazing, and Perennial Horticulture.

Cropping, the largest land use category (ha) across the GMID, accounted for 19 per cent of the water use in 2018/19, making it the second largest irrigation water user. Despite an increase in the Rural Lifestyle land use category, its irrigation water use declined moderately (from 3 to 2 per cent water use in the GMID), reflecting decision making during dry seasonal conditions. Perennial horticulture water use increased (from 8 to 10 per cent), while Annual horticulture remained stable at 2 per cent.



Note: Land use categories with water use less than 1 per cent of GMID water use is shown as 0%

Figure 20. Share of GMID Water Use by Land Use category, 2015/16 and 2018/19

## 8. Conclusion

The 2019 Regional Irrigated Land and Water Use Mapping in the GMID project demonstrates the value of mapping land and water use change trends to inform strategic planning by government and industry.

Multiple factors have been driving rapid and changes across the GMID since the turn of the century. Change drivers include seasonal conditions (including the Millennium Drought, and floods in 2011, 2012 and 2016), climate change, fluctuating commodity prices and transformative changes in water, agriculture and planning policy.

GMID land use has strongly shifted away from dairying into cropping, mixed farming and non-dairy livestock grazing. Water use remained similar to 2015/16, also a warm, dry season. It was evident that while land use had changed, properties are still being irrigated rather than converting to dryland.

The pattern of land use change is uneven across the GMID's six water service areas. Dairy remains dominant west of the Goulburn River in Central Goulburn, Rochester and Torrumbarry; the exception is Pyramid-Boort, where the Combined Dairy land use contracted. East of the Goulburn River, Dairy land use has almost halved, changing primarily to Cropping, Grazing Non-Dairy or Mixed Farming and Grazing. It is possible that some of the Cropping that has replaced Dairy is still providing feed to the dairy industry.

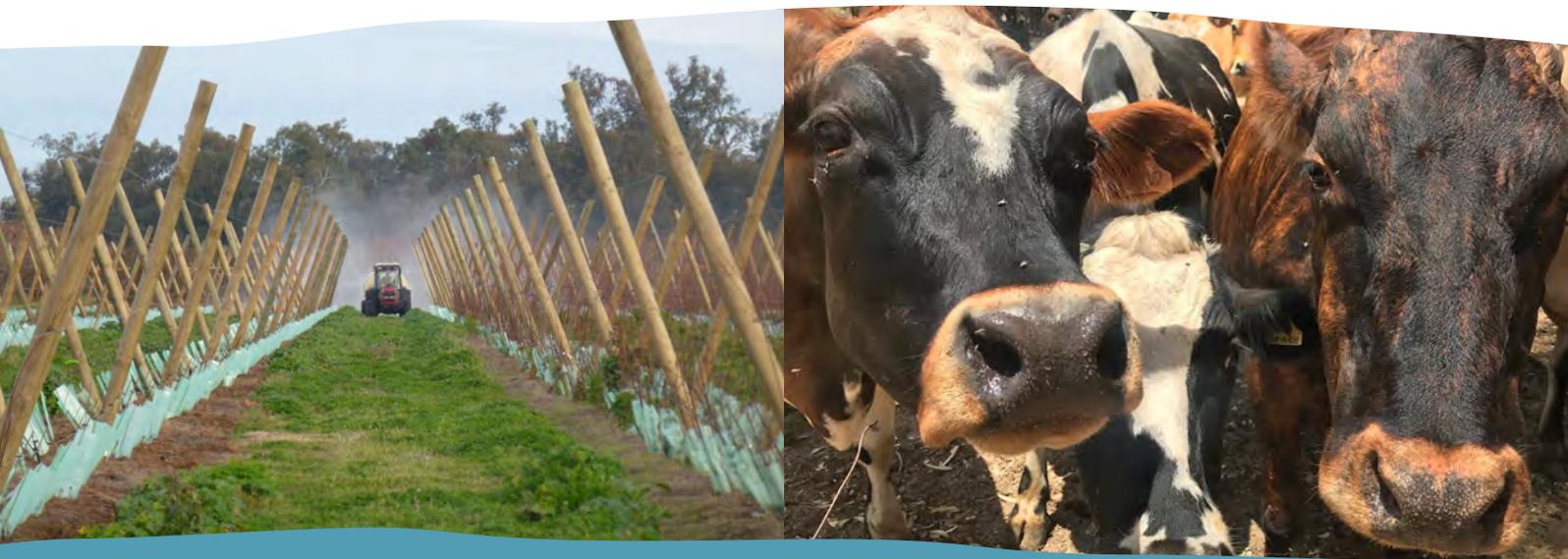
The changes observed since 2015/16 indicate that irrigation activities in the GMID are in transition. Water availability and affordability will remain key drivers of land and water use trends, and broader socio-economic change. Whether the transition from Dairy to land uses such as Cropping, Mixed Farming and Grazing Non-Dairy land use is permanent is too early to tell. Dairy, Cropping and Mixed Farming and Grazing land uses are particularly vulnerable to rising water prices and water market conditions.

It is possible some land will revert to dairy if commodity markets and seasonal conditions improve. Indeed, 2019/20 pricing patterns suggest that GMID areas above the Barmah Choke or sourcing water from the Goulburn River may have a competitive water price advantage in drier years<sup>12</sup>. This may drive further land use changes if the GMID becomes attractive for new ventures looking for cheaper temporary water and fewer constraints on delivery.

Land and water use in the GMID will continue to be monitored to build further understanding of how irrigated agriculture is changing across the region.

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<sup>12</sup> Water Flow. <https://www.waterflow.io/overview>. Website accessed 13 December 2019. Prices recorded on Victorian and other State Water Registers.



## GOULBURN BROKEN CATCHMENT MANAGEMENT AUTHORITY

PO Box 1752  
Shepparton VIC 3632

Tel. (03) 5822 7700

Fax. (03) 5831 6254

Email. [reception@gbcma.vic.gov.au](mailto:reception@gbcma.vic.gov.au)

[www.gbcma.vic.gov.au](http://www.gbcma.vic.gov.au)

find us on [facebook](#)

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