



Land and Water Use Mapping in Regulated Diversions Catchments of Northern Victoria

Technical Report 2022/23



Energy, Environment and Climate Action



This Technical Report can be found at

www.gbcma.vic.gov.au

This project was supported by the following stakeholders:

- Goulburn Broken Catchment Management Authority (GB CMA)
- Department of Environment, Energy and Climate Action (DEECA)
- Agriculture Victoria
- Goulburn-Murray Water (GMW)
- North Central Catchment Management Authority (NCCMA)
- North East Catchment Management Authority (NECMA)
- Murray Dairy
- Fruit Growers Victoria
- Irrigation Farmers Network

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For further information on the Regional Irrigated Land and Water Use Mapping Program (RILWUM) and to access the latest data via interactive data dashboards, see www.water.vic.gov.au/our-programs/regional-irrigated-land-and-water-use-mapping-program

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1. Executive Summary

The regulated diversions systems (referred to as Regulated Diversions Catchments within this report) of Northern Victoria supply water to landholders supporting diverse agricultural land uses such as dairy, horticulture, beef, sheep, and intensive animals. These systems can secure water supplies by regulating the flow of the river via water storages or weirs. Land and water use is complex within the region and undergoing significant change. Some factors of change include: water supply and demand, water market drivers, and seasonal conditions. Land and water use change in the Goulburn Murray Irrigation District (GMID) has been reported since the 2015/16 irrigation season. This project builds upon the methodology and approaches developed under the Regional Irrigated Land and Water Use Mapping (RILWUM) program and complements the work already undertaken in the GMID and Shepparton Irrigation Region (SIR).

The scope of the Regulated Diversions Catchments Land and Water Use Mapping project includes the large-scale spatial capture of land and water use data of regulated diverters within northern Victoria for the 2022/23 irrigation season. In addition, water use data from 2020/21, and 2021/22 was also available and therefore could be analysed. It is noted that this project focuses solely on surface water diversions from regulated rivers and streams within the Broken, Campaspe, Goulburn, Kiewa, Murray, Loddon, Ovens, and Upper Murray River basins. Mapping of the unregulated rivers and streams, and groundwater systems are not included within the scope of this project but are a logical next step in building the story of land and water use change across Northern Victoria.

Some key findings from this project include:

- Cropping (63,805 ha) and Livestock – Non Dairy (50,776 ha) were the largest primary land uses by area in the Regulated Diversions Catchments. The next largest irrigated agricultural land uses were Horticulture – Perennial (13,969 ha) and Dairy (Combined) (11,751 ha).
- Overall water use has decreased across the region from 2020/21–2022/23 by 10GL (16.7%).
- The biggest water users of this three-year period were consistently Cropping followed by Livestock – Non Dairy, reflecting the largest land use areas.
- Dairy (Combined) was recorded as the second largest water user for the 2022/23 season with 10,496.3 ML, despite this it was the seventh largest land use area.
- Cropping and Horticulture – Perennial experienced the largest variation in water use from 2020/21–2022/23 by 2,931.7 ML (15.2%) and 2,718 ML (33.4%), respectively.
- Rural Lifestyle / Residential had the greatest number of WULs (1,755) however in contrast was ranked fourth in primary land use area with relatively low water use in 2022/23.
- The primary land use area varied significantly across the Regulated Diversions Catchments with the largest by area being Goulburn River Basin (63,588.6 ha) to the smallest being Mitta Mitta (Upper Murray) River Basin (4,220.2 ha).
- The Murray River Basin were consistently the largest water users from 2020/21–2022/23, followed by the Goulburn and Campaspe River Basins.

Ongoing data collection and mapping will contribute to continuing to build an understanding of how the region is changing and adapting to reduced water availability. In determining land and water use changes and trends in the Regulated Diversions Catchments, these findings can inform water, agriculture and planning policy at the local, regional, state and national level.

2. Introduction

The Regional Irrigated Land and Water Use Mapping (RILWUM) program collects information on irrigated land and water use as a tool to support decision makers. The scope of the Regulated Diversion Catchments Land and Water Use Mapping project includes the large-scale spatial capture of land and water use data of regulated diverters within northern Victoria for the 2022/23 irrigation season. It is noted that this project focuses solely on the primary land use associated with the Water Use Licence of surface water diversions from regulated rivers and streams. Mapping of the unregulated rivers and streams, and groundwater systems are not included within the scope of this project.

This project builds upon the methodology and approaches developed under the RILWUM program undertaken in the Shepparton Irrigation Region and more recently the GMID, for over two decades (e.g. 2021/22, 2019/20, 2018/19, 2015/16, 2009/10, 2004/05 and pre-2000). A collaborative approach is being undertaken through existing partnerships between the Goulburn Broken Catchment Management Authority (GB CMA), Goulburn-Murray Water (GMW), Agriculture Victoria (AgVic), Department of Energy, Environment and Climate Action (DEECA), North East CMA (NECMA) and North Central CMA (NCCMA), in collaboration with Murray Dairy, Irrigation Farmers Network, and Fruit Growers Victoria.

The spatial mapping process involves remote and on-ground land use survey in the project study area and the matching of water register data, to determine seasonal water use by Water Use Licence and industry (e.g. Dairy, Cropping, Livestock Non-Dairy and Horticulture). This data is then used to produce land and water use maps as provided in this report. It is noted that this project focuses solely on surface water diversions from regulated rivers and streams. Unregulated rivers and streams, and groundwater systems are not included within the scope of this project.

2.1 Project Outcomes

Mapping of land and water use in the regulated systems provides a basis for continuing assessment of shifting water demands and land use change, and will:

- Build understanding of how the region is changing and adapting to reduced water availability;
- Inform water, agriculture and planning policy at the local, regional, state and national level (e.g. Murray Darling Basin Plan);
- Provide essential input for economic modelling and analysis;
- Guide regional economic development investment;
- Inform and help landowners looking to expand, redevelop or contemplating exit options with data to make informed decisions;
- Educate the broader community on the complexities of water availability;
- Support Goulburn-Murray Water strategic planning and asset management there are; and
- Contribute to Water for Victoria Actions including 4.1 (Support regional development and change), 4.3 (Help irrigation districts adapt), 4.4 (Reduce barriers to change and support communities in irrigation districts) and 4.7 (Manage irrigation development) (DELWP 2016).

2.2 Project Background

Regulated systems refer to the network of "...streams, creeks and rivers that are controlled or 'regulated' by water storages and allow the water to be released to customers when it is required." (Goulburn Murray Water, 2023).

The eight river basins and their associated water supply systems are managed by the rural water corporation Goulburn-Murray Water and fall mostly within the catchment management authority (CMA) boundaries of North East, Goulburn Broken, and North Central. The river basins include the Broken, Campaspe, Goulburn, Kiewa, Murray, Loddon, Ovens, and Upper Murray River basins (see Figures 1 and 2).

For the purposes of this project, the Upper Murray River Basin is referred to as the Mitta Mitta River Basin; the regulated diverters of this basin are solely on the Mitta Mitta River.

The main section of the Kiewa River stream is unregulated but has unique trading rules and so has been included in this study. For this report, the project area covers all regulated systems within the eight river basins and is referred to collectively as the Regulated Diversion Catchments (RDC). It is important to note that there are also existing trading zones and Figure 3 demonstrates the potential for trade and the complexity involved.

FIGURE 1
GOULBURN MURRAY WATER BASINS (GOULBURN-MURRAY WATER, 2024)

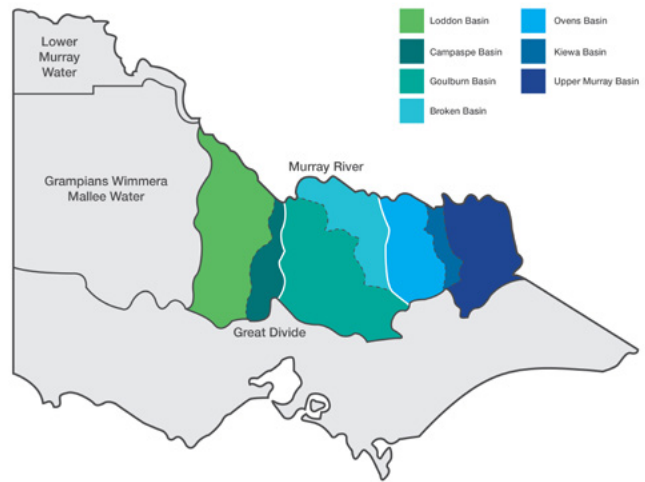


FIGURE 2
VICTORIAN CATCHMENT MANAGEMENT AUTHORITIES (VIC CATCHMENTS, 2024)



FIGURE 3
 VICTORIAN WATER REGISTER, WATER TRADING (VICTORIAN WATER REGISTER 2024)

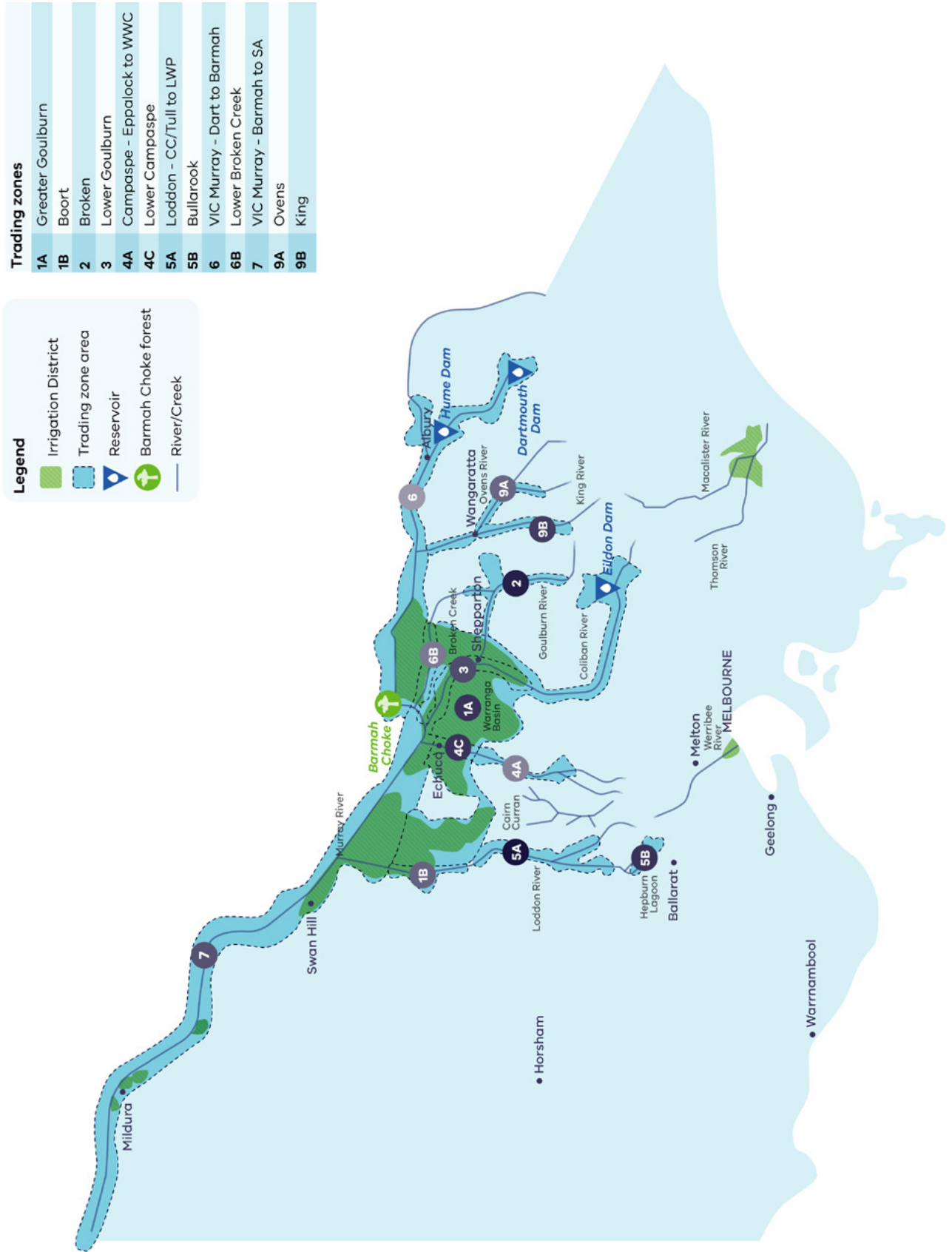
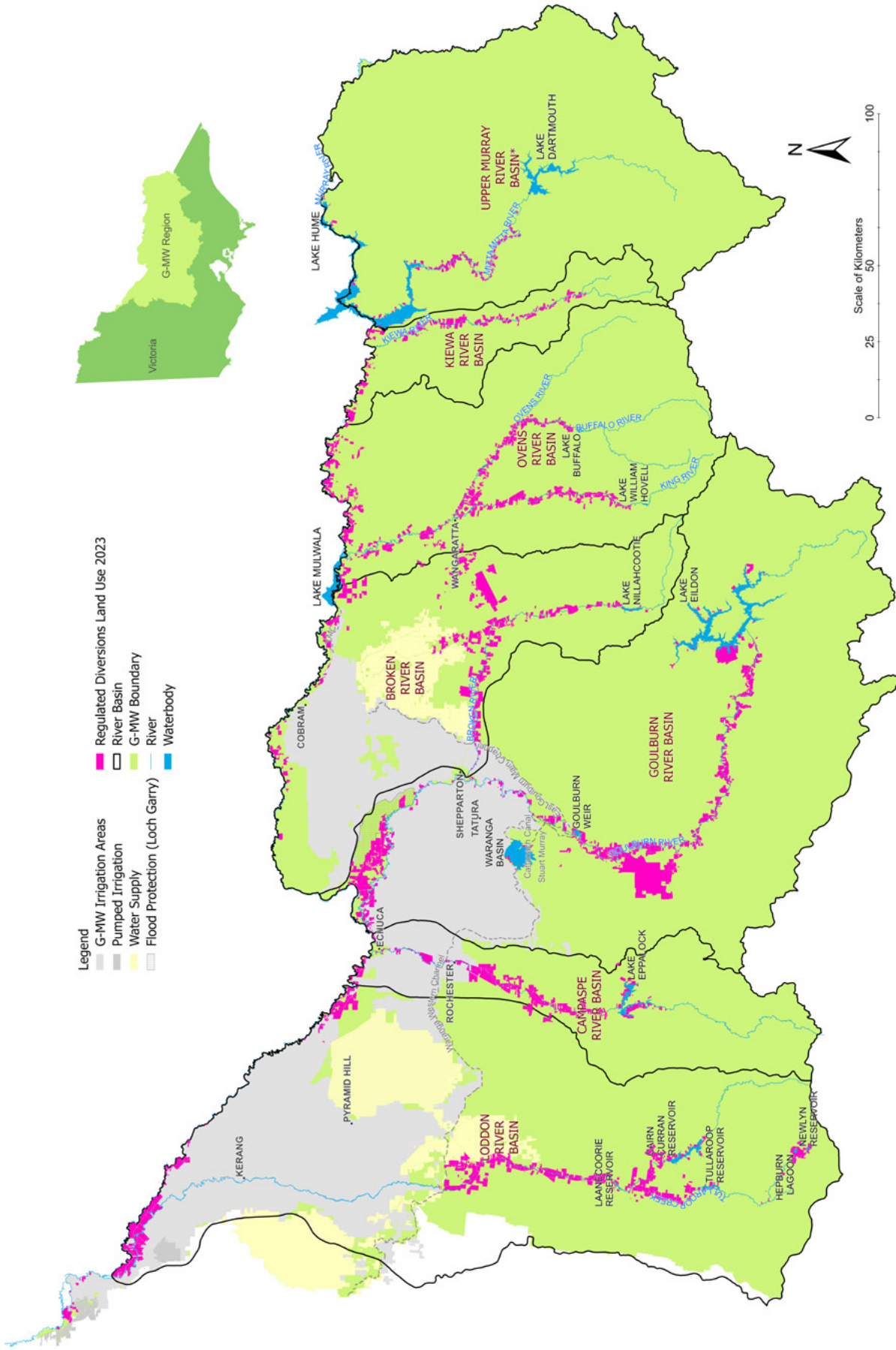


FIGURE 4
GOULBURN MURRAY WATER, RIVER BASINS AND IRRIGATION AREAS (GOULBURN-MURRAY WATER, 2024)



* For the purposes of this project, the Upper Murray River Basin is referred to as the Mitta Mitta River Basin; the regulated diversions of this basin are solely on the Mitta Mitta River

Goulburn-Murray Water is responsible for managing water related services for approximately 6.8 million (M) hectares across Northern Victoria. The catchment management authorities' total area includes:

- North Central CMA (3M hectares)
- Goulburn Broken CMA (2.43M hectares)
- North East CMA (1.95M hectares)

The RDC services major agricultural enterprises such as Cropping, Grazing, Dairy and Horticulture. Economic statistics for the whole Regulated Diversions Catchments are difficult to quantify, however the project area can be summarised by the ABS statistics of the three CMAs (natural resource management regions). It is important to note that the following statistics describe the gross value of irrigated agricultural production (GVIAP) and are not specifically for regulated diversions systems (i.e. also includes unregulated and groundwater systems).

In 2021/22, the total gross value of irrigated agricultural production (GVIAP) in Victoria was \$5.24 billion. By value, the Mallee CMA had the largest GVIAP of the ten natural resource management regions with \$1.29 billion (24.6% of Victoria).

- Goulburn Broken CMA were second largest with \$1.23 billion (23.6%).
- North Central CMA were fourth largest with \$716 M (13.7%) and
- North East CMA were eighth largest with \$165 M (3.1%).

This report provides technical data on spatial mapping and analysis, which involved the collection of data describing the primary land use and water use for every Water Use Licence (3,536) in the Regulated Diversions Catchments, between July 2023 and November 2023. The area of irrigation properties totals 216,172 ha in this assessment.

This project was made possible through the use of a Stakeholder Reference Group and Technical Working Group, representing participating stakeholders who provided collaborative oversight and technical expertise to the project (Appendix 1).

2.3 Project Objectives

The project objectives were to:

- Create (through spatial analysis) the land and water use database for the Regulated Diversions Catchments of the Goulburn-Murray Water region; and,
- Provide enhanced information on land and water use change by industry to support decision makers.

2.4 Project Deliverables

The key project deliverables were to:

- Undertake the 2022/2023 spatial land and water use mapping data classification utilising GMW's Geocortex Tool and staff for each of the 3,536 Water Use Licences in the Regulated Diversions Catchments;
- Expanding the footprint of the Regional Irrigated Land and Water Use Mapping program within Northern Victoria;
- Develop technical reports and associated documents, to communicate findings; and,
- Re-convene stakeholders through involvement in a Technical Working Group and Stakeholder Reference Group.

3. Methodology

The method of data collection in 2022/23 consisted of the following steps:

3.1 Tool Development

An interactive Geocortex tool developed by Goulburn-Murray Water (GMW) Geographical Information System (GIS) staff for the 2018/19 GMID Land and Water Use Mapping project, was used to capture land and water use data for the Regulated Diversions Catchments. A trial was undertaken in July 2023 to ensure the process was effective. The classification occurred at the Water Use Licence (WUL) level, with water use data standardised against 2020/21 WUL data. For this project, we refer to Water Use Licences as the collective, which also includes some Water Use Registrations.

3.2 End User Training

GMW Customer Service Officers (Diversions Inspectors) allocated to their respective basin areas (Broken, Campaspe, Goulburn, Kiewa, Loddon, Murray, Ovens and Upper Murray) were trained, to build consistent interpretation in the land use classifications. Staff from each basin then completed the mapping individually for their respective areas.

3.3 Data Capture

The Geocortex tool uses 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) (if applicable)
- c. Other Land Use (to capture land use categories not already listed)
- d. On-Farm Irrigation Modernisation Assessment (Yes or No)
- e. Irrigation Methods:
 - Drip
 - Low Level Sprinkler
 - Drip tape Subsurface
 - Fast Flow Flood
 - Conventional Flood
 - Pipe and Riser
 - Pivot and Linear Move
 - Fixed Sprinkler
- f. Pump Energy Source:
 - Electric (Grid)
 - Solar Powered
 - Diesel
 - Diesel and Electric
 - Gravity
- g. Comments (to assist with analysis)

Not all the data captured is covered in this report. The water use information has been collected from GMW Water Use Licence (WUL) data and from information sourced from the Victorian Water Register. A single enterprise can have one WUL covering several land properties titles.

3.4

Analysis of Data

The data was analysed by GMW and the Spatial Information Sciences team at Agriculture Victoria. 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 in the GMID Land and Water Use Mapping Project.

TABLE 1
AUSTRALIAN VALUATION PROPERTY CLASSIFICATION CODE (AVPCC) AND LAND USE CATEGORISATION

AVPCC	SUMMARY CATEGORIES FOR THIS PROJECT	DESCRIPTION
Domestic livestock grazing	Livestock - 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 broadacre crops, e.g. grains, oilseeds.
Crop production - Mixed / other		
General cropping		
Cattle feed lot	Intensive - Animals	Land developed with specialist infrastructure for intensive feeding of cattle, pigs, or poultry. It does not include intensive dairy as they are included in the dairy category.
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 (at time of survey in August 2022 - May 2023).
	Dairy Agistment & Fodder	No clear link to a Dairy WUL, but dairy cattle were present during survey or a former dairy farm may be in transition.
	Dairy (Combined)	The combined dairy footprint (Dairy, and Dairy Agistment & Fodder).
Horticulture - Annual	Horticulture - Annual	Land used for growing vegetable crops (e.g. tomatoes) and berry crops (e.g. strawberries).
Horticulture - Berry		
Horticulture - Vegetable		

AVPCC	SUMMARY CATEGORIES FOR THIS PROJECT	DESCRIPTION
Horticulture - Fruit Tree	Horticulture - Perennial	Land planted to grow fruit and nuts, e.g. olives, stone fruits, tropical fruits, citrus, grapes and hops. Also includes land planted to grow turf.
Horticulture - Grapevine		
Horticulture - Nut Tree		
Horticulture - Turf		
*Glasshouse Plant / Vegetable Production	Glasshouse Plant / Vegetable Production	Land developed with specialist infrastructure for the indoor propagation and growing of plants and plant crops.
Rural Residential	Rural Lifestyle / Residential	A Lifestyle / Residential use dwelling on land in a rural, semi-rural or bushland setting. Primary production uses and associated improvements are secondary to the residential/lifestyle use. <ul style="list-style-type: none"> • Rural residential <0.5ha; and • Rural Lifestyle <0.5 delivery share and <20ha property size.
*Solar Electricity Generation / Hydroelectricity Generation / Wind Farm Electricity Generation	Energy	Land developed with specialist infrastructure used in the generation of hydroelectricity, wind powered electricity, or solar electricity (and associated water use).
N/A	Other	A miscellaneous grouping includes areas such as government land, sports ovals, schools, town water, retirement village, cemeteries, showgrounds, factories, caravan parks, and vacant/inactive land.
	Not irrigated	Water Use License associated however not actively irrigating, predominantly dryland farming and utilise their license for Domestic and Stock purposes.

3.5 Data Collection Period

The assessment period was the 2022/23 irrigation season from August 2022 to May 2023. Data was collected primarily during July 2023 to November 2023. The data was validated against other available sources, to ensure consistency of interpretation. The report measures activity at a point in time and should be interpreted with this in mind.

3.6 Privacy Statement

Irrigated enterprises will only be identified by a generic identification and no identifying information will be shared publicly.

3.7

Qualifications / Limitations of Data

Data collection was completed using the field knowledge of GMW Customer Service Officers (Diversion Inspectors), to integrate field knowledge into the 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 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. 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.	Acknowledgement that results are a snapshot in time. The benefit of the Geocortex tool and data collection methodology is that it allows for consistent assessment of the same units in the future.
Limitations exist in the accuracy of determining AVPCC codes and sub-categorisation to the 'Dairy cattle agistment/ fodder' land use.	Potential for minimal Dairy land use categorisation inaccuracy, noting that data is not reflective of formal exits from the industry and is not reflective of dairy licence data, but instead, against WUL data.	<p>Consistent methodology in categorisation of properties linked to Dairy. e.g. properties were categorised as linked to Dairy in one of two ways:</p> <ul style="list-style-type: none"> • 'Dairy' – defined as WULs linked with a functioning milking shed at the time of survey; • 'Dairy Agistment & Fodder' – Land use defined as servicing the dairy industry or in transition (but have not been linked to an active dairy WUL). The land use may be used by another AVPCC land use code such as Cropping; or a link may exist with a dairy enterprise that was not found through integration with existing datasets. The decision was made to group these together as 'Dairy Agistment & Fodder' and document the methodology, to enable future investigation. <p>For the purposes of this project, the Dairy sub categories have been reported together as 'Dairy (Combined)'.</p>

4. Results

4.1

Primary Land Use Across the Regulated Diversions Catchments

Primary land use as defined by industry type was mapped and analysed for the irrigation season of 2022/23 by hectares (Table 3).

In 2022/23, Cropping (63,805 ha) and Livestock - Non Dairy (50,776 ha) were the largest primary land uses by area in the Regulated Diversions Catchments followed by Other (31,622 ha), Rural Lifestyle/Residential (19,654 ha), Not irrigated (15,936 ha) and Horticulture - Perennial (13,969 ha). Land categorised as 'Not irrigated' is associated with a Water Use License but not recorded as being used for irrigation. Table 4 outlines large land uses (>1000 ha) which 63% of the category of 'Other' can be attributed to.

Dairy (Combined) represented 11,751 ha of primary land use in the Regulated Diversion Catchments. Land primarily used for Horses, Horticulture - Annual and Intensive Animals were small in comparison with 3,361 ha, 2,003 ha and 2,203 ha respectively. Energy and Glasshouse Plant / Vegetable Production were minor in area which is reflective of these industries only emerging in recent years.

TABLE 3

PRIMARY LAND USE IN THE REGULATED DIVERSIONS CATCHMENTS (ha), 2022/23

LAND USE	AREA (ha)
Cropping	63,805
Dairy (Combined)	11,751
Energy	633
Glasshouse Plant / Vegetable Production	460
Horses	3,361
Horticulture - Annual	2,003
Horticulture - Perennial	13,969
Intensive Animals	2,203
Livestock - Non Dairy	50,776
Rural Lifestyle / Residential	15,936
Other*	31,622
Not irrigated	19,654
TOTAL	216,172

* Includes Puckapunyal Army Base, Dookie Agricultural College, DEECA land and other miscellaneous land uses.

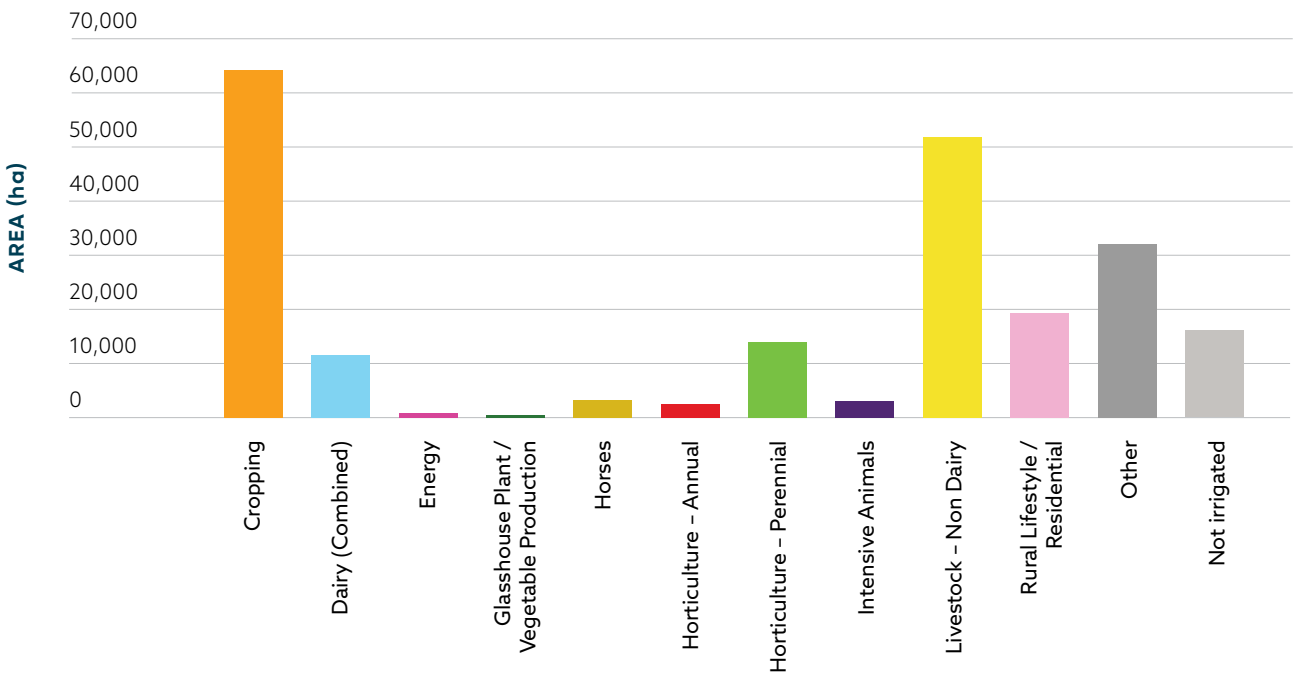
TABLE 4

LIST OF OTHER LAND USES OVER 1000 ha IN AREA, 2022/23

OTHER LAND USES (>1000 HA)	AREA (ha)
Puckapunyal Army Base	15,623
Winton Wetlands (DEECA)	3,145
University of Melbourne Dookie Agricultural College	1,246

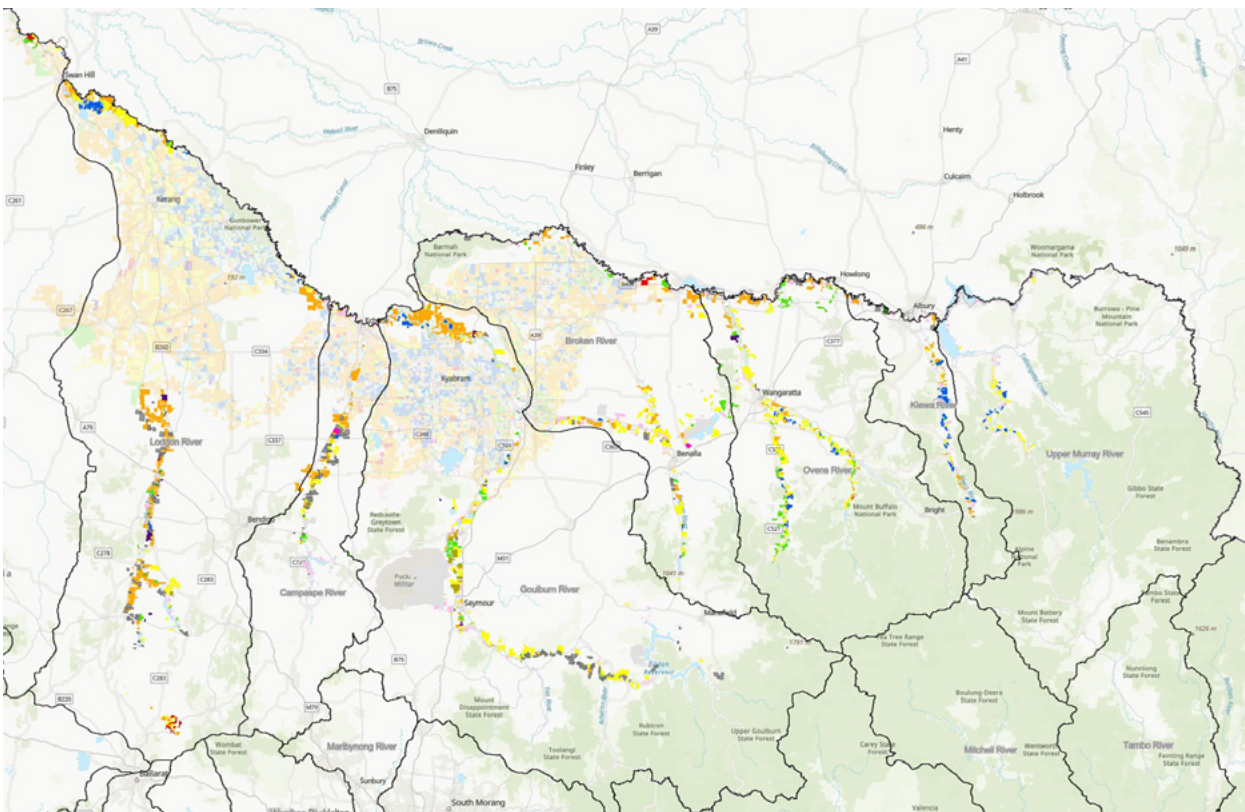
Total land use by area is shown graphically in Figure 5.

FIGURE 5
LAND USE IN THE REGULATED DIVERSIONS CATCHMENTS (ha) 2022/23



The mapping of primary land use across the Regulated Diversions Catchments in 2022/23 is illustrated in Figure 6.

FIGURE 6
REGULATED DIVERSIONS CATCHMENTS 2022/23 PRIMARY LAND USE



4.2

Primary Land Use by Industry

This section examines the primary land use data by industry for the 2022/23 irrigation season. Future data collection will build a picture of any trends in land use change (if any).

4.2.1 CROPPING

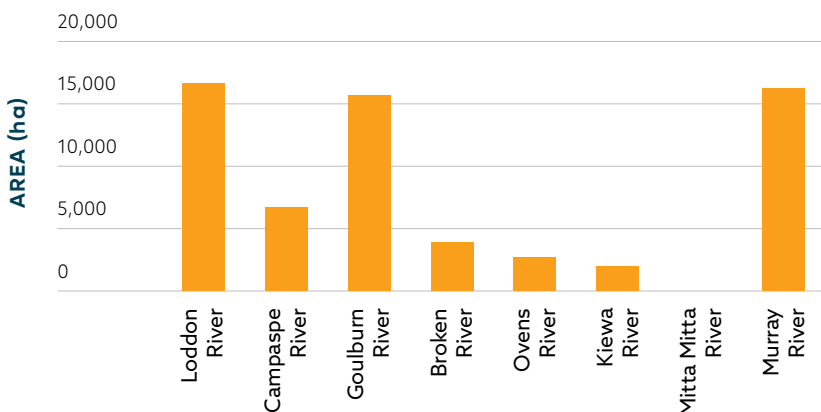


- Overall Cropping is the predominant primary land use in the whole Regulated Diversions Catchments area accounting for 63,805 ha.
- Cropping as a primary land use occurs the most in the Loddon River basin, closely followed by Murray River and Goulburn River basins.
- The Loddon River basin includes larger land holdings and floodplain prone to flooding in wet years leading to annual cropping as the dominant use.
- Cropping was not recorded as a primary land use in the Mitta Mitta River basin (note this is being checked as a classification issue).

TABLE 5
CROPPING – PRIMARY LAND USE 2022/23 (ha)

CATCHMENT	AREA ha
Loddon River	16,640
Campaspe River	6,575
Goulburn River	15,609
Broken River	4,039
Ovens River	2,638
Kiewa River	2,217
Mitta Mitta River	0
Murray River	16,387
TOTAL	63,805

FIGURE 7
PRIMARY LAND USE – CROPPING 2022/23



4.2.2 DAIRY (COMBINED)

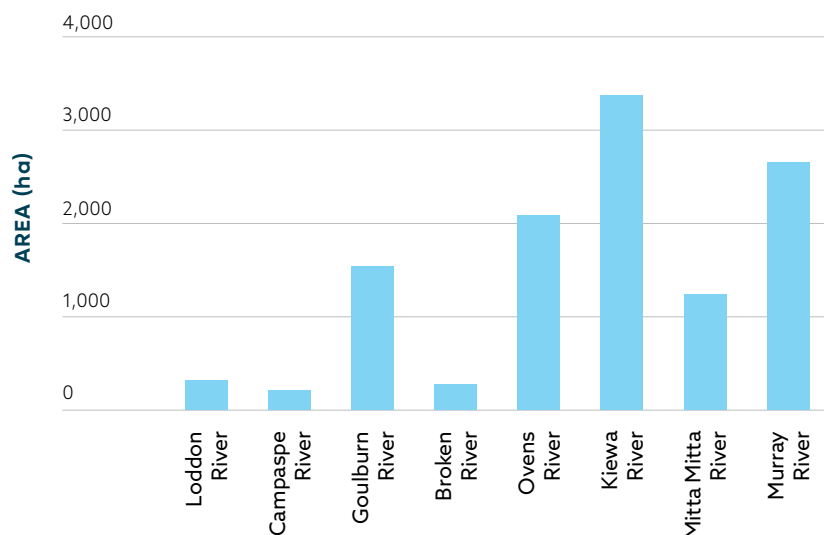


- Dairy (Combined) includes the primary land uses of Dairy and Dairy Agistment & Fodder.
- The largest land use area recorded for Dairy (Combined) was in the Kiewa River and Murray River basins, followed by Ovens River and Goulburn River basins.
- The land recorded in the Kiewa River basin accounted for 29% of the total area of Dairy (Combined) across all basins.

TABLE 6
DAIRY COMBINED – PRIMARY LAND USE 2022/23 (ha)

CATCHMENT	AREA ha
Loddon River	291
Campaspe River	206
Goulburn River	1,594
Broken River	262
Ovens River	2,080
Kiewa River	3,354
Mitta Mitta River	1,208
Murray River	2,756
TOTAL	11,751

FIGURE 8
PRIMARY LAND USE – DAIRY COMBINED 2022/23



4.2.3 EMERGING INDUSTRIES



The land use category of Energy (including land uses such as Solar Electricity Generation / Hydroelectricity Generation / Wind Farm Electricity Generation) is an emerging land use category with a total of 633 ha and often found in combination with other land uses so may not have been recorded as the primary land use (e.g. grazing and solar energy together). The Broken River and Campaspe River basins were the only areas to record Energy as a primary land use.

Similarly, there was a small area of 460 ha recorded as the category of Glasshouse Plant / Vegetable Production found generally west of Albury in the Murray River basin. Future iterations of this mapping will enable monitoring of any growth in these emerging industries within this region.

4.2.4 HORSES

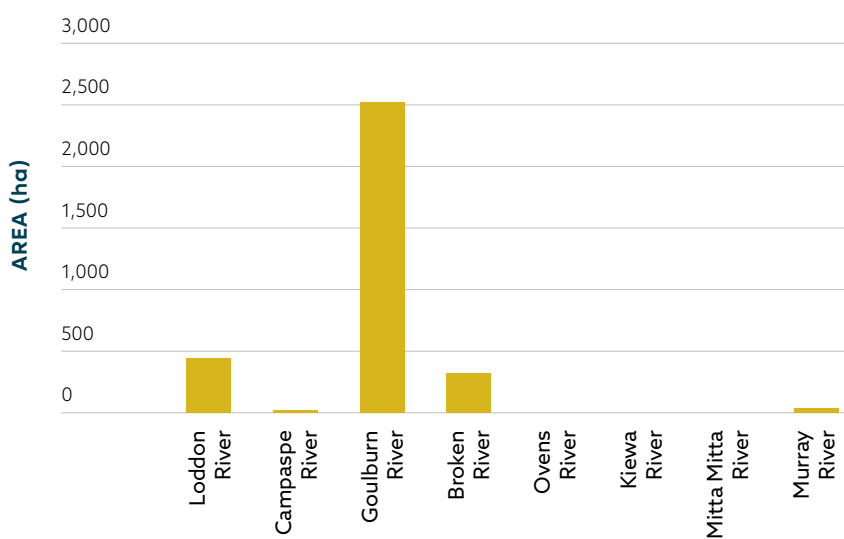


- The largest primary land use area of Horses was recorded within the Goulburn River basin, representing 75% of the total area of Horses across all basins.
- These properties were mainly within the Nagambie region of the Goulburn River basin.
- Loddon River and Broken River basins recorded the second and third largest land use areas within this industry.
- Horses were not recorded as a primary land use in Kiewa River, Ovens River or Mitta Mitta River basins.

TABLE 7
HORSES – PRIMARY LAND USE 2022/23 (ha)

CATCHMENT	AREA ha
Loddon River	464
Campaspe River	10
Goulburn River	2,514
Broken River	355
Ovens River	0
Kiewa River	0
Mitta Mitta River	0
Murray River	18
TOTAL	3,361

FIGURE 9
PRIMARY LAND USE – HORSES 2022/23



4.2.5 HORTICULTURE (ANNUAL AND PERENNIAL)

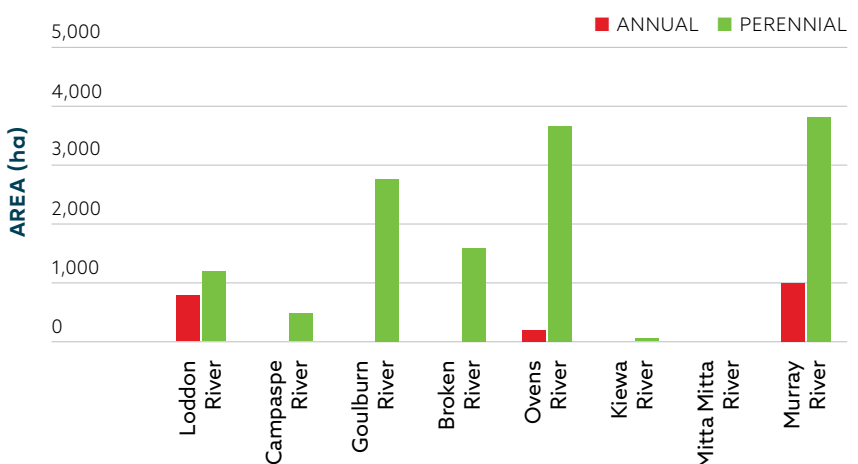


- The largest areas of Annual Horticulture (e.g. vegetables, tomatoes) were recorded in Murray River and Loddon River (concentrated around Newlyn) followed by the Ovens River basins.
- There was no primary land use of Annual Horticulture recorded within the Broken River, Campaspe River, Goulburn River, Kiewa River or Mitta Mitta River basins.
- There is a much larger area of Perennial Horticulture (e.g. fruit, nuts, viticulture, hops) throughout the Regulated Diversion Catchments than Annual Horticulture.
- The Murray River, Ovens River and Goulburn River basins had the largest areas of Perennial Horticulture reflecting the viticulture within these basins (such as Rutherglen, Nagambie, King Valley and Myrtleford). Further to this the hops industry is prominent near Myrtleford (Ovens River) as well as fruit and nut trees in the Woorinen and Nyah irrigation districts (Murray River).

TABLE 8
HORTICULTURAL (ANNUAL AND PERENNIAL) – PRIMARY LAND USE 2022/23 (ha)

CATCHMENT AREA	AREA ha	
	ANNUAL	PERENNIAL
Loddon River	910	1,161
Campaspe River	0	555
Goulburn River	0	2,811
Broken River	0	1,729
Ovens River	94	3,763
Kiewa River	0	86
Mitta Mitta River	0	0
Murray River	999	3,864
TOTAL	2,003	13,969

FIGURE 10
PRIMARY LAND USE – HORTICULTURAL (ANNUAL AND PERENNIAL) 2022/23



4.2.6 INTENSIVE ANIMALS

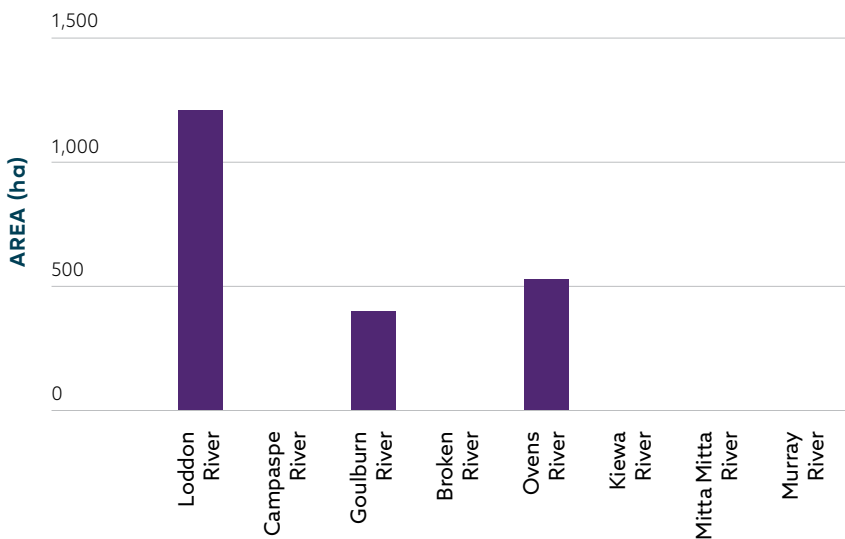


- Loddon had the largest primary land use area of Intensive Animals, mainly large-scale intensive poultry farms, followed by the Goulburn River basin with poultry and piggeries and Ovens River with an intensive beef feed lot.
- No other river basins recorded Intensive Animals as a primary land use.

TABLE 9
INTENSIVE ANIMALS – PRIMARY LAND USE 2022/23 (ha)

CATCHMENT	AREA ha
Loddon River	1,238
Campaspe River	0
Goulburn River	438
Broken River	0
Ovens River	527
Kiewa River	0
Mitta Mitta River	0
Murray River	0
TOTAL	2,203

FIGURE 11
PRIMARY LAND USE – INTENSIVE ANIMALS 2022/23



4.2.7 LIVESTOCK NON-DAIRY

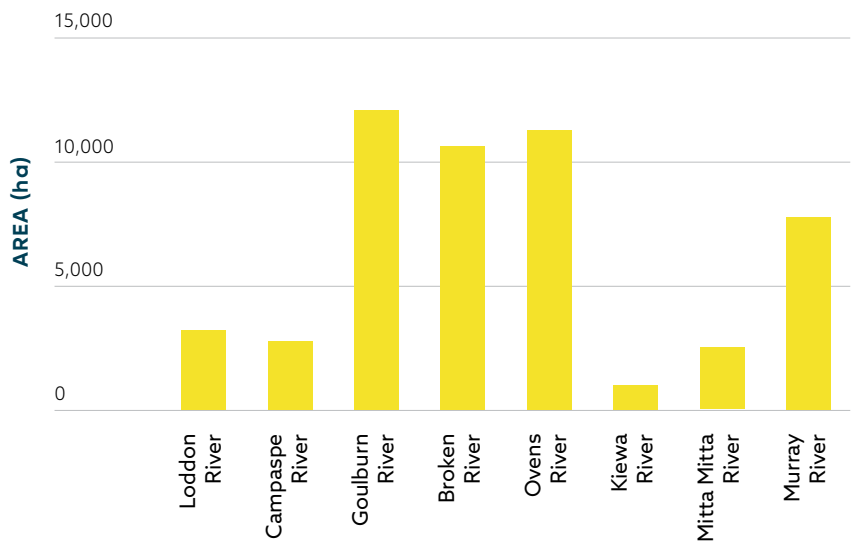


- As the second largest land use across the RDCs, large areas of Livestock Non-Dairy (including grazing and production of beef cattle and sheep) were recorded across the Basins with the highest areas recorded in the Goulburn River basin, closely followed by Ovens River and Broken River.
- The lowest area of this land use recorded was in the Kiewa River basin.

TABLE 10
LIVESTOCK NON-DAIRY – PRIMARY LAND USE 2022/23 (ha)

CATCHMENT	AREA ha
Loddon River	3,133
Campaspe River	2,703
Goulburn River	12,042
Broken River	10,594
Ovens River	10,985
Kiewa River	969
Mitta Mitta River	2,543
Murray River	7,808
TOTAL	50,776

FIGURE 12
PRIMARY LAND USE – LIVESTOCK NON-DAIRY 2022/23



4.2.8 NOT IRRIGATED

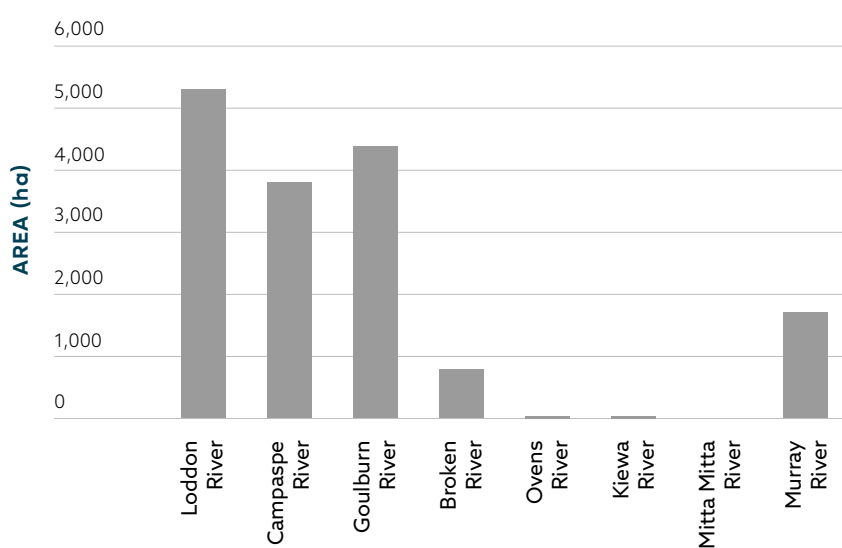


- Land categorised as 'Not irrigated' is associated with a Water Use License but not recorded as being actively used for irrigation. This is predominantly dryland farming or when utilising their license for Domestic & Stock purposes.
- Some examples include: fish farming, the previous SPC Ardmona Factory site, Domestic & Stock only properties, and land that has been subdivided for housing.
- Not Irrigated land typically is associated with smaller landholdings, mainly in the Loddon River, Goulburn River and Campaspe River basins.

TABLE 11
NOT IRRIGATED – PRIMARY LAND USE 2022/23 (ha)

CATCHMENT	AREA ha
Loddon River	5,226
Campaspe River	3,777
Goulburn River	4,387
Broken River	762
Ovens River	74
Kiewa River	58
Mitta Mitta River	0
Murray River	1,652
TOTAL	15,936

FIGURE 13
PRIMARY LAND USE – NOT IRRIGATED 2022/23



4.2.9 OTHER LAND USE

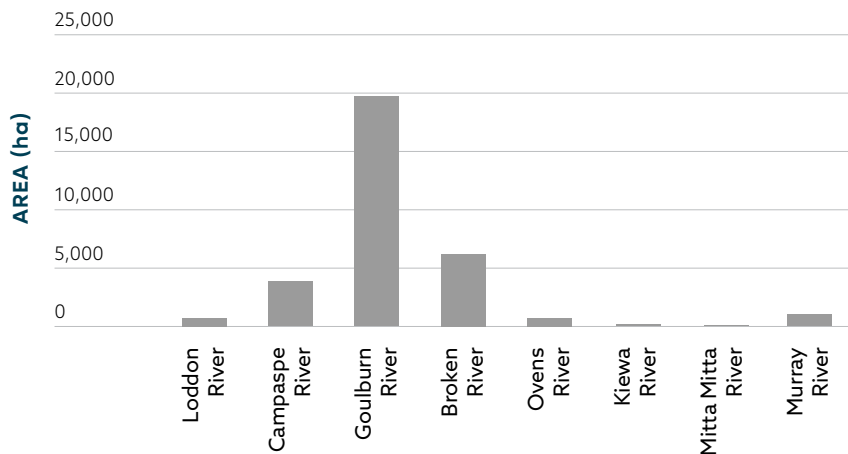


This category is largely miscellaneous including areas such as: government land, sports ovals, reserves, school grounds, town water, retirement village, cemeteries, showgrounds, factories, quarries, bowls clubs, lawn watering for various clubs and associations, recreational water sports clubs, golf clubs, accommodation facilities, camping and caravan parks.

TABLE 12
OTHER LAND USE – PRIMARY LAND USE 2022/23 (ha)

CATCHMENT	AREA ha
Loddon River	535
Campaspe River	3,993
Goulburn River	19,720
Broken River	5,922
Ovens River	476
Kiewa River	14
Mitta Mitta River	0
Murray River	961
TOTAL	31,622

FIGURE 14
PRIMARY LAND USE – OTHER LAND USE 2022/23



This land use was predominant in Goulburn River (19,720 ha) and the least in Mitta Mitta River (0.4 ha), because more than half (63%) of the total 'Other' land use area can be attributed to the following land uses. These are found within the Goulburn River and Broken River basins:

OTHER LAND USES >1000 ha	AREA ha
Puckapunyal Army Base	15,623
Winton Wetlands (DEECA)	3,145
University of Melbourne Dookie Agricultural College	1,246

4.2.10 RURAL LIFESTYLE/ RESIDENTIAL

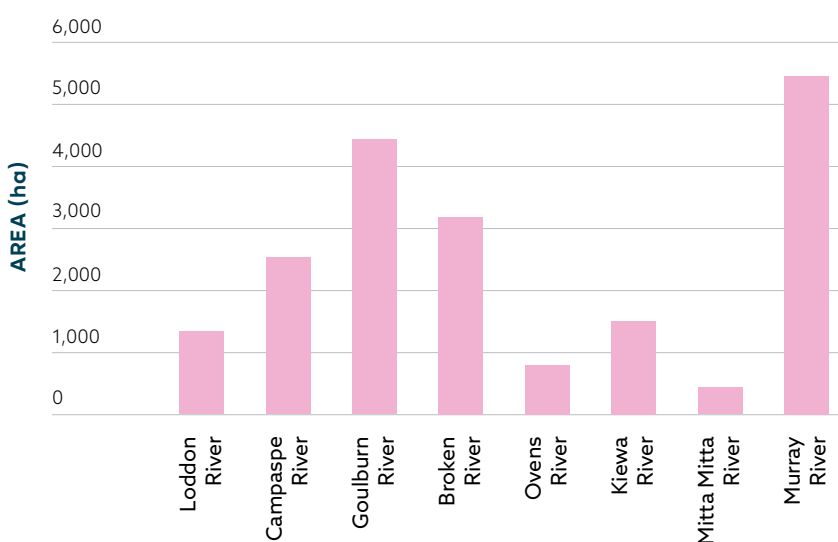


- The largest areas of Rural Lifestyle/Residential were found in the Murray River and Goulburn River basins.
- The Murray River WULs associated with Rural Lifestyle/Residential were generally located in areas around urban centres like Albury/Wodonga, Yarrawonga, Echuca/Torrumbarry, and Swan Hill. There was also a scattering recorded around Lake Hume.
- The Rural Lifestyle/Residential land within the Goulburn River basin were scattered around Eildon, Trawool, Seymour, Nagambie, Goulburn Weir, Waranga Basin, Arcadia, Toolamba, Kialla and the Lower Goulburn. The majority of Old Toolamba was serviced by regulated systems, with a reference to 'Old Toolamba Community Water Syndicate'.
- The Mitta Mitta River basin had the smallest area of Rural Lifestyle/Residential.

TABLE 13
RURAL LIFESTYLE/RESIDENTIAL – PRIMARY LAND USE 2022/23 (ha)

CATCHMENT	AREA ha
Loddon River	1,330
Campaspe River	2,510
Goulburn River	4,474
Broken River	3,088
Ovens River	817
Kiewa River	1,505
Mitta Mitta River	469
Murray River	5,460
TOTAL	19,654

FIGURE 15
PRIMARY LAND USE – RURAL LIFESTYLE/RESIDENTIAL 2022/23



5. Primary Land Use by Basin

This section analyses primary land use of regulated diversions customers within the basin areas. It also notes the water use for 2022/23. This dataset provides a basis for monitoring base land and water use change in each basin.

5.1

Loddon River

This basin has a small area in the south around Newlyn Reservoir which supplies diverters along Birch Creek. The basin largely follows the Loddon River from the Cairn Curran Reservoir, and the Tullaroop Creek from Tullaroop Reservoir meeting at Laanecoore Reservoir, and downstream to approximately Serpentine where the Goulburn Murray Irrigation District (GMID) is situated. In 2022/23, there was a total of 425 WULs in this basin.

- The land use with the largest area was Cropping accounting for over half of the total land use area (54%) and spread throughout the basin.
- Following Cropping, the next largest land uses were Not irrigated and Livestock – Non Dairy.
- Not irrigated land was concentrated around towns such as Carisbrook, Eddington, Baringhup and Bridgewater generally noted as Domestic and Stock only.
- The dominant water users were Cropping followed by Horticulture – Annual (located largely around Newlyn) and Horticulture – Perennial scattered throughout the basin.

FIGURE 16
PRIMARY LAND USE – MAP OF LODDON RIVER
BASIN 2022/23

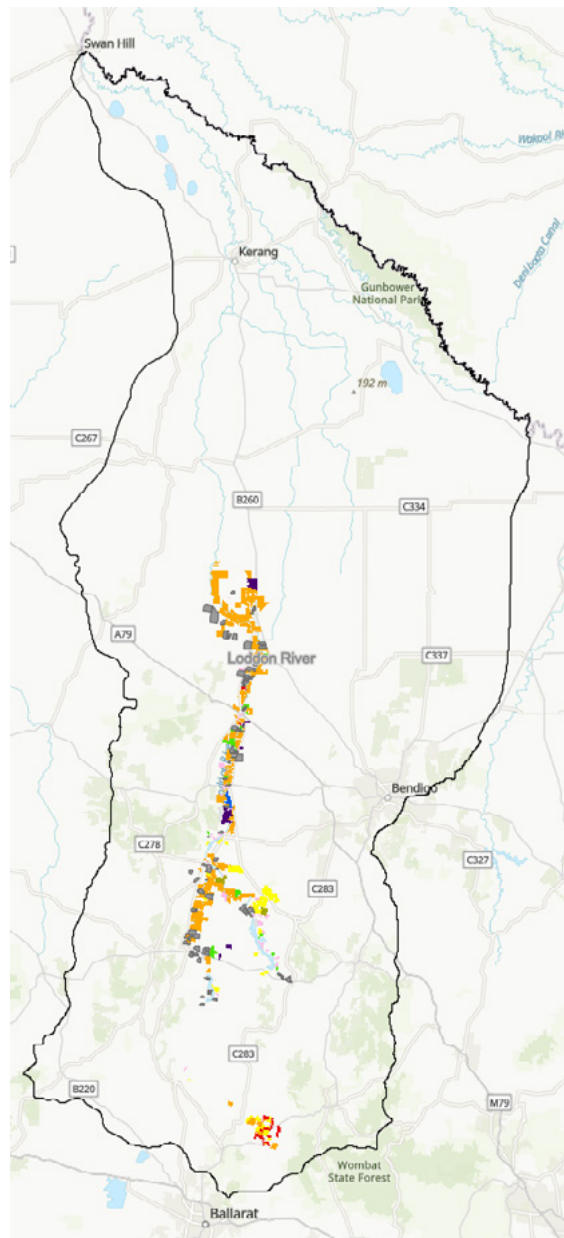
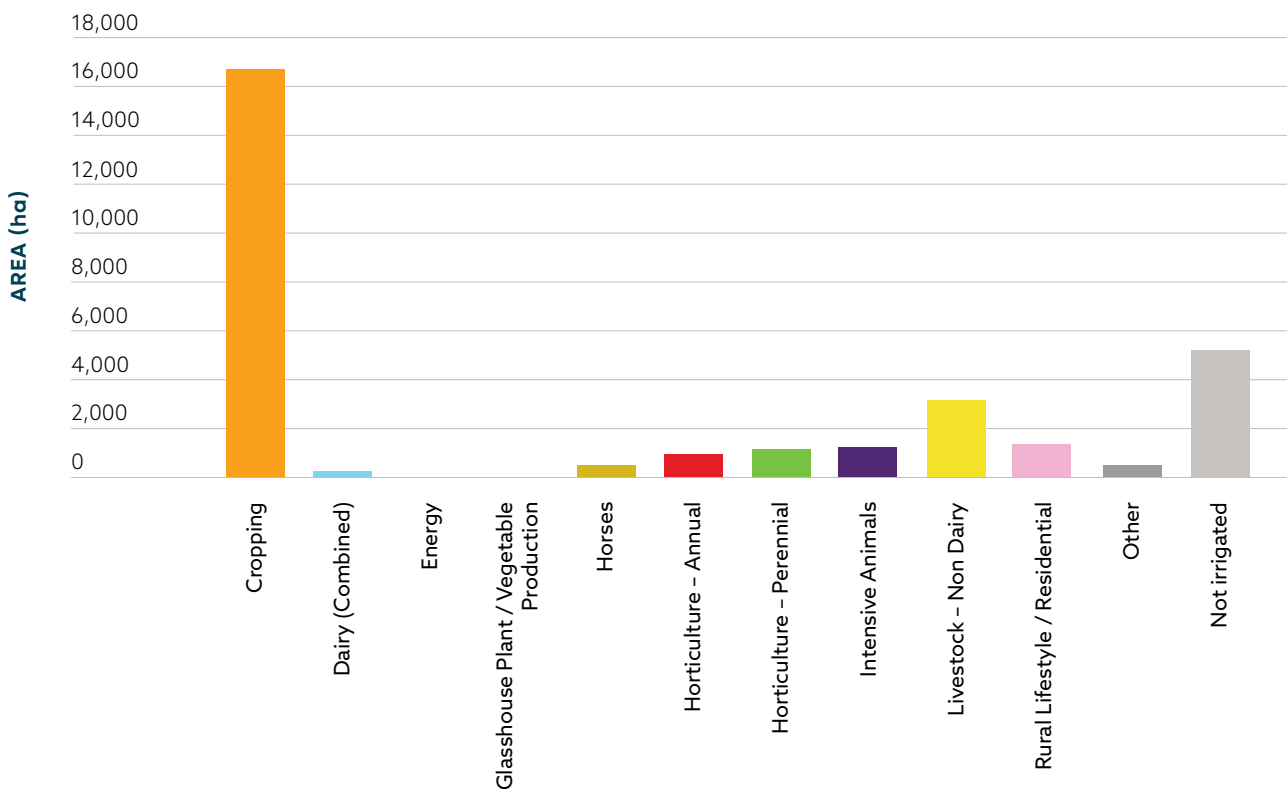


TABLE 14
LODDON RIVER PRIMARY LAND USE 2022/23 (ha)

LAND USE	AREA (ha)	WATER USE (ML)	WATER USE LICENCES
Cropping	16,340	2,599	115
Dairy (Combined)	291	635	2
Energy	0	0	0
Glasshouse Plant / Vegetable Production	0	0	0
Horses	464	4	3
Horticulture - Annual	910	436	14
Horticulture - Perennial	1,161	301	19
Intensive Animals	1,238	247	6
Livestock - Non Dairy	3,133	175	28
Rural Lifestyle / Residential	1,330	237	161
Other	535	60	13
Not irrigated	5,226	48	64
TOTAL	30,628	4,741	425

FIGURE 17
PRIMARY LAND USE – LODDON RIVER BASIN 2022/23



5.2

Campaspe River

This basin follows the Campaspe River downstream of Lake Eppalock through to the Murray River. In 2022/23, there was a total of 294 WULs in this basin.

- The largest primary land use is Cropping, followed by Not Irrigated and Other.
- Cropping and Livestock – Non Dairy are most prevalent around Axedale, Goornong, Elmore, Rochester and Strathallan (see Figure 18).
- Caravan parks, camping grounds and club facilities around Lake Eppalock contribute to the Other category. Rural Lifestyle/Residential also found within this area.
- Large areas of Not Irrigated around Barnadown, Goornong, and Elmore can be attributed to properties not irrigating and with Domestic and Stock supply only.

FIGURE 18
PRIMARY LAND USE – MAP OF CAMPASPE RIVER
BASIN 2022/23

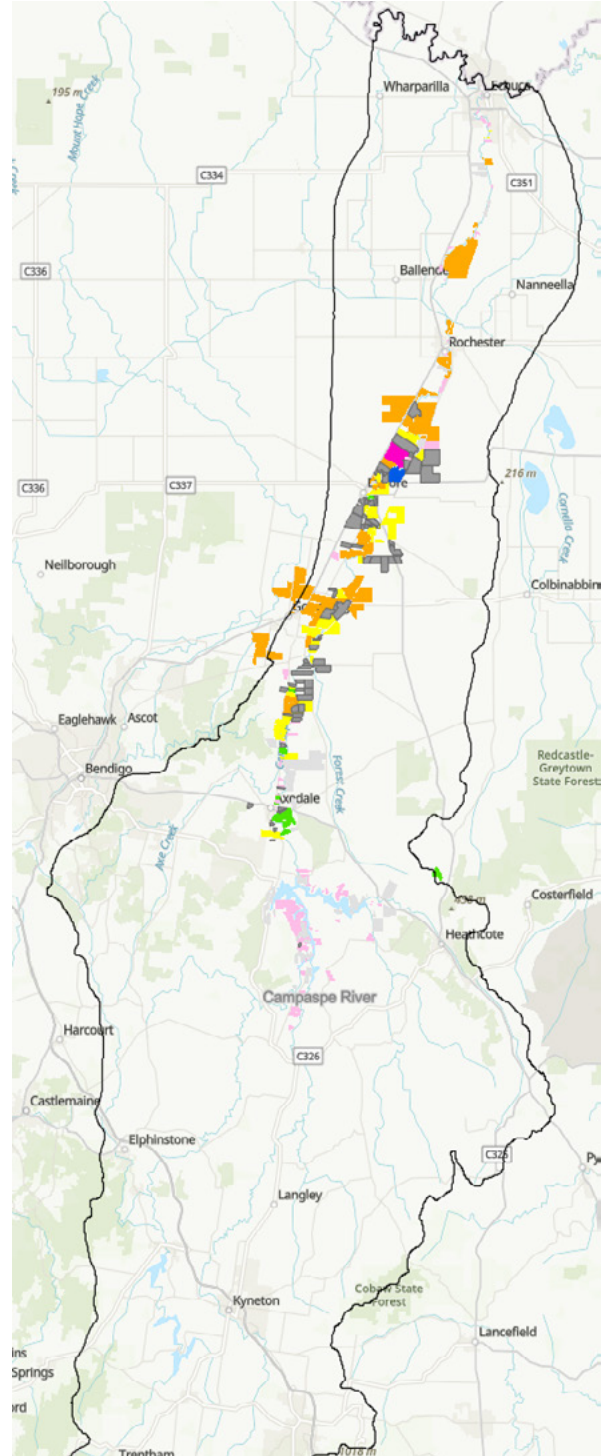
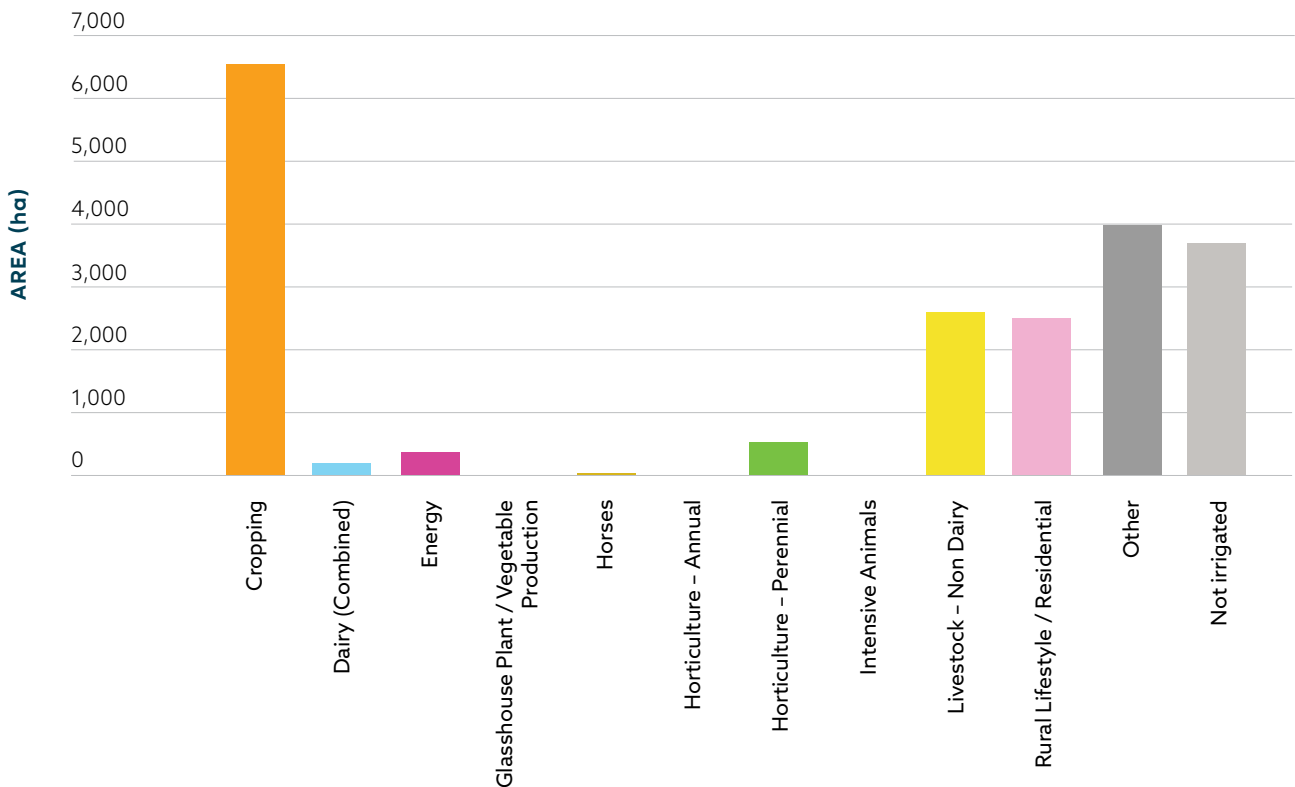


TABLE 15
CAMPASPE RIVER PRIMARY LAND USE 2022/23 (ha)

LAND USE	AREA (ha)	WATER USE (ML)	WATER USE LICENCES
Cropping	6,575	3,994	34
Dairy (Combined)	206	113	1
Energy	387	0	1
Glasshouse Plant / Vegetable Production	0	0	0
Horses	10	0	1
Horticulture - Annual	0	0	0
Horticulture - Perennial	555	166	10
Intensive Animals	0	0	0
Livestock - Non Dairy	2,703	1,139	30
Rural Lifestyle / Residential	2,510	219	125
Other	3,993	270	42
Not irrigated	3,777	34	50
TOTAL	20,716	5,934	294

FIGURE 19
PRIMARY LAND USE – CAMPASPE RIVER BASIN 2022/23



5.3 Goulburn River

This basin follows the Goulburn River from Lake Eildon through to where it meets the Murray River. In 2022/23, there was a total of 884 WULs in this basin.

- The land uses with the largest areas in this basin are Other, Cropping and Livestock – Non Dairy.
- Majority of the land categorised as Other in this basin is the Puckapunyal Army Base (49%).
- Cropping is largely concentrated around the Lower Goulburn area, while Livestock – Non Dairy is spread across the whole basin.
- The largest water users (above 1,000 ML) are Dairy, Cropping, Horses and Livestock – Non Dairy.

FIGURE 20
PRIMARY LAND USE – MAP OF GOULBURN RIVER BASIN 2022/23

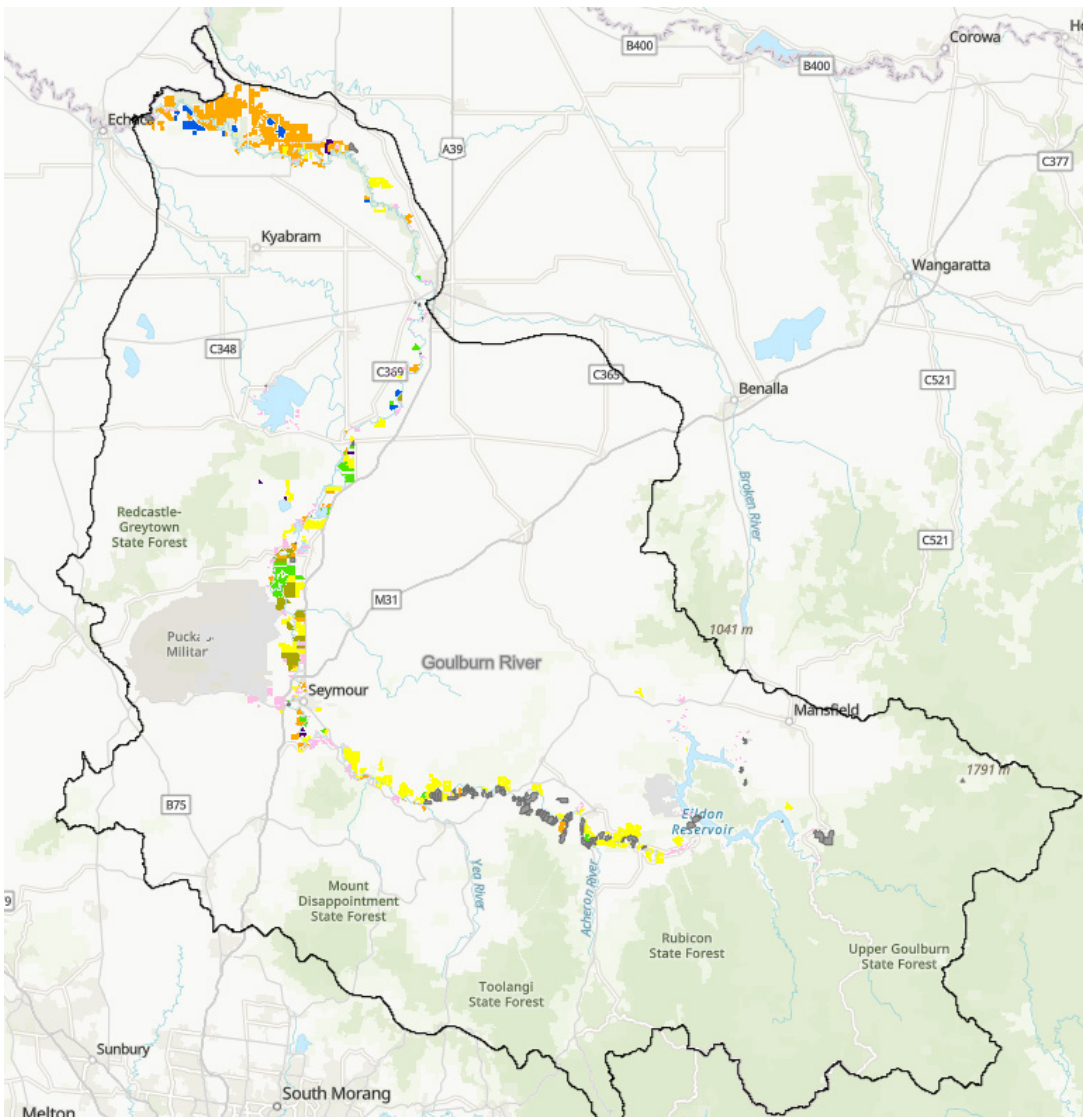
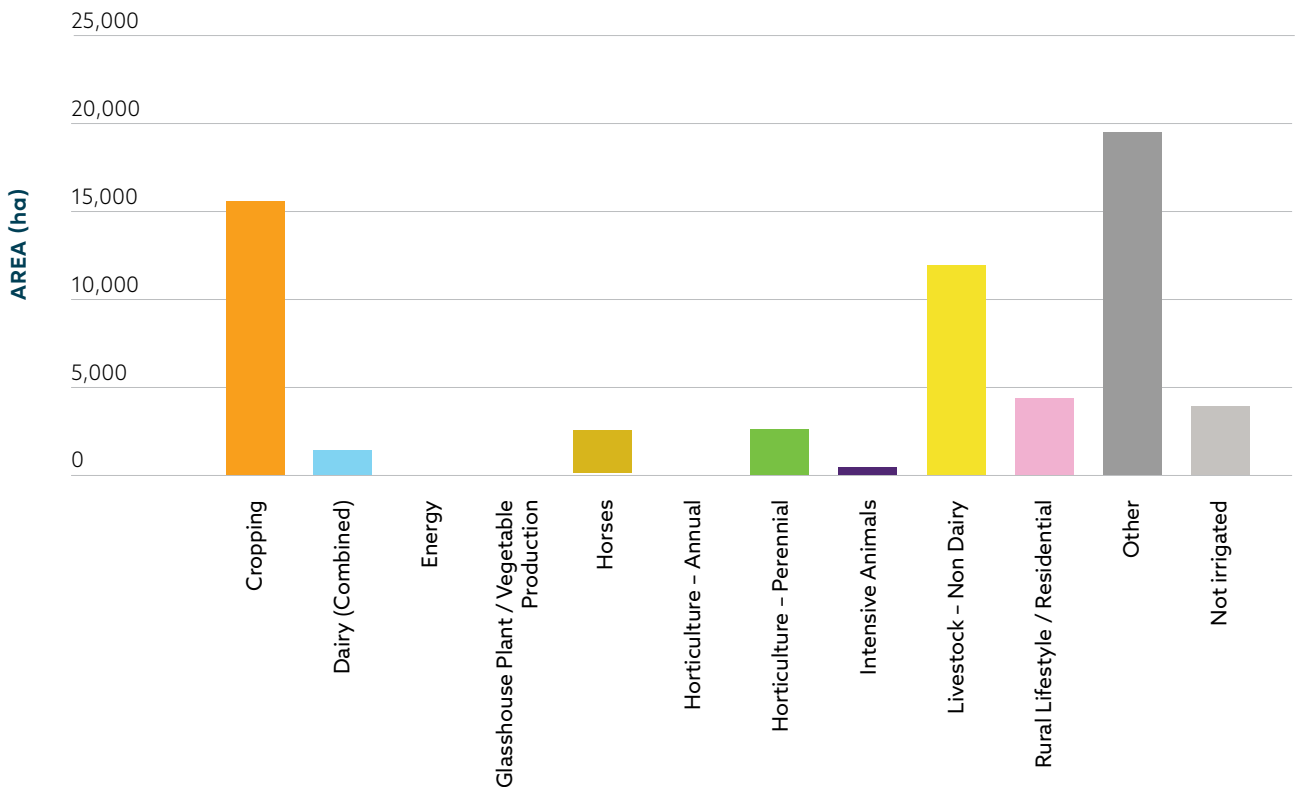


TABLE 16
GOULBURN RIVER PRIMARY LAND USE 2022/23 (ha)

LAND USE	AREA (ha)	WATER USE (ML)	WATER USE LICENCES
Cropping	15,609	1,447	80
Dairy (Combined)	1,594	2,215	11
Energy	0	0	0
Glasshouse Plant / Vegetable Production	0	0	0
Horses	2,514	1,137	15
Horticulture - Annual	0	0	0
Horticulture - Perennial	2,811	1,267	30
Intensive Animals	438	462	5
Livestock - Non Dairy	12,042	1,122	94
Rural Lifestyle / Residential	4,474	894	516
Other	19,720	579	49
Not irrigated	4,387	93	84
TOTAL	63,589	9,217	884

FIGURE 21
PRIMARY LAND USE – GOULBURN RIVER BASIN 2022/23



5.4 Broken River

The Broken River basin includes regulated diversions customers downstream of Lake Nillahcootie through to Kialla near where the Broken River meets the Goulburn River (see Figure 22). It also includes regulated diverters around Winton Wetlands and upper Broken Creek. In 2022/23, there was a total of 269 water use licences (WULs) in this basin.

- Livestock - Non Dairy is the largest land use area with Other and Cropping second and third largest respectively.
- As shown in Figure 22 Livestock - Non Dairy is spread across the Broken River basin.
- Rural Lifestyle/Residential land use is concentrated to the lower Broken River area.
- There are pockets of Perennial Horticulture between Lake Nillahcootie and Benalla, and large parcels of grapevines (with fruit trees as secondary land use) near the Warby Ranges.
- Large areas of the Other category includes Winton Wetlands (DEECA) and Dookie Agricultural College (University of Melbourne).
- In 2022/23, the Broken River made up only 5.1% of the total water use across the RDC (see Section 6).
- The largest water users corresponded with the largest land use areas (Livestock - Non Dairy and Cropping).
- Dairy had a large water use (524.9 ML) associated with a relatively small land use area of 261.9 ha.

FIGURE 22
PRIMARY LAND USE – MAP OF BROKEN RIVER BASIN 2022/23

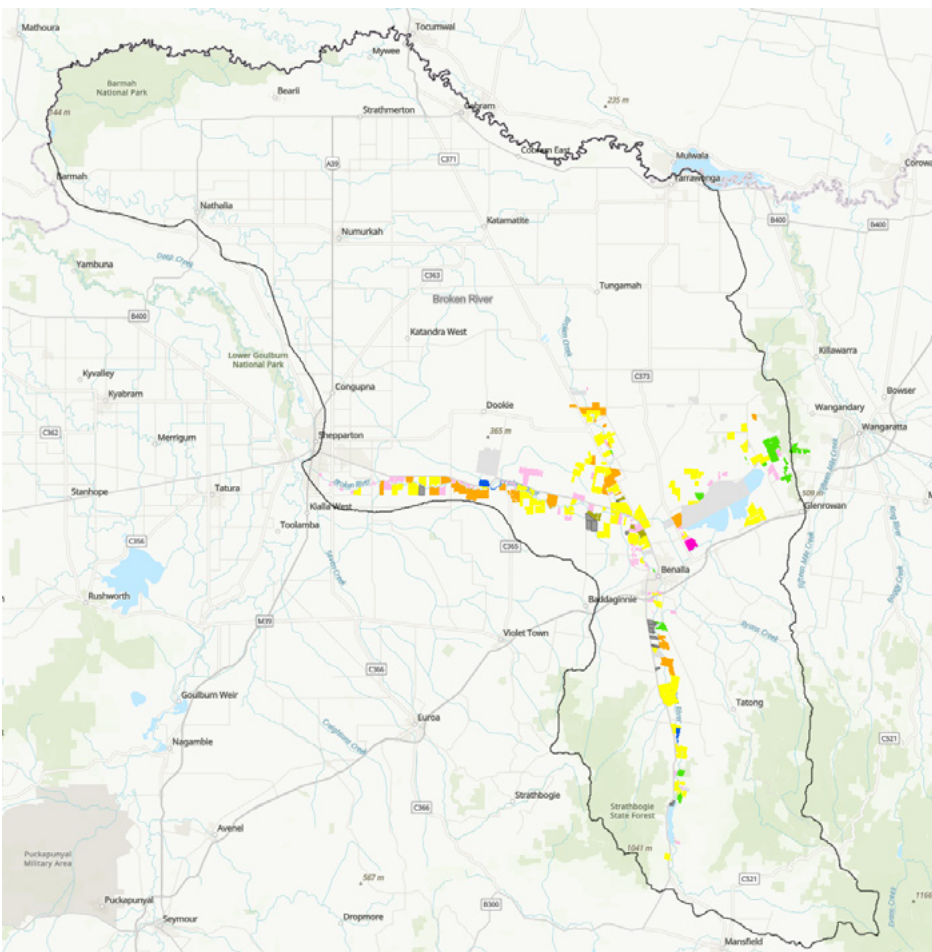
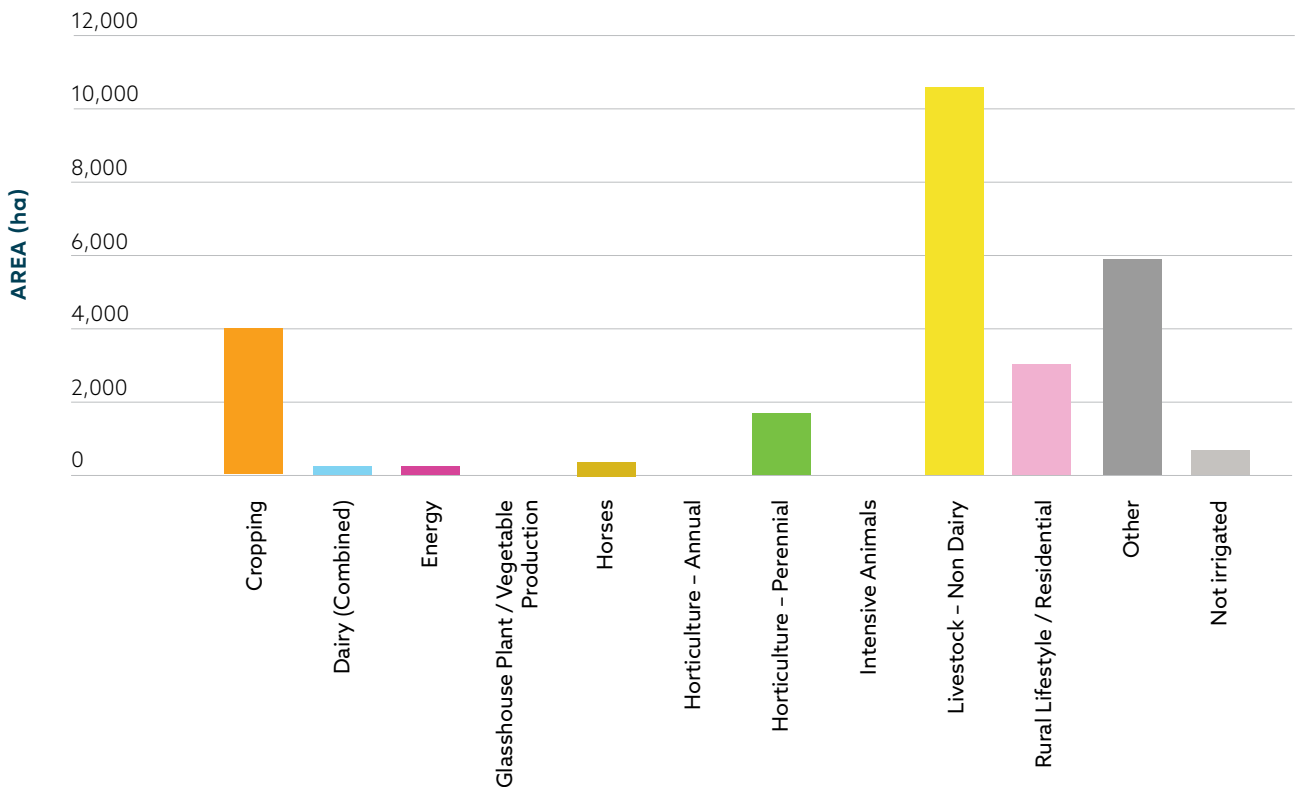


TABLE 17
BROKEN RIVER PRIMARY LAND USE 2022/23 (ha)

LAND USE	AREA (ha)	WATER USE (ML)	WATER USE LICENCES
Cropping	4,039	794	28
Dairy (Combined)	262	525	4
Energy	246	2	4
Glasshouse Plant / Vegetable Production	0	0	0
Horses	355	99	4
Horticulture - Annual	0	0	0
Horticulture - Perennial	1,729	9	10
Intensive Animals	0	0	0
Livestock - Non Dairy	10,594	869	76
Rural Lifestyle / Residential	3,088	125	113
Other	5,922	129	18
Not irrigated	762	0	12
TOTAL	26,997	2,552	269

FIGURE 23
PRIMARY LAND USE – BROKEN RIVER BASIN 2022/23



5.5 Ovens River

This basin follows the Buffalo River downstream of Lake Buffalo where it meets the Ovens River at Myrtleford and follows it through to the Murray River. The basin also includes the diverters from the King River downstream of Lake William Hovell to where it joins the Ovens River at Wangaratta. In 2022/23, there was a total of 468 WULs in this basin.

- The largest land uses were Livestock – Non Dairy, Horticulture – Perennial, Cropping and Dairy (Combined).
- Livestock – Non Dairy was spread across the basin, whereas Dairy (Combined) was concentrated to the Milawa/ Whorouly region and the King Valley.
- The largest water use is attributed to Horticulture – Perennial, then Livestock – Non Dairy, Dairy (Combined) and Horticulture – Annual.

FIGURE 24
PRIMARY LAND USE – MAP OF OVENS RIVER BASIN 2022/23

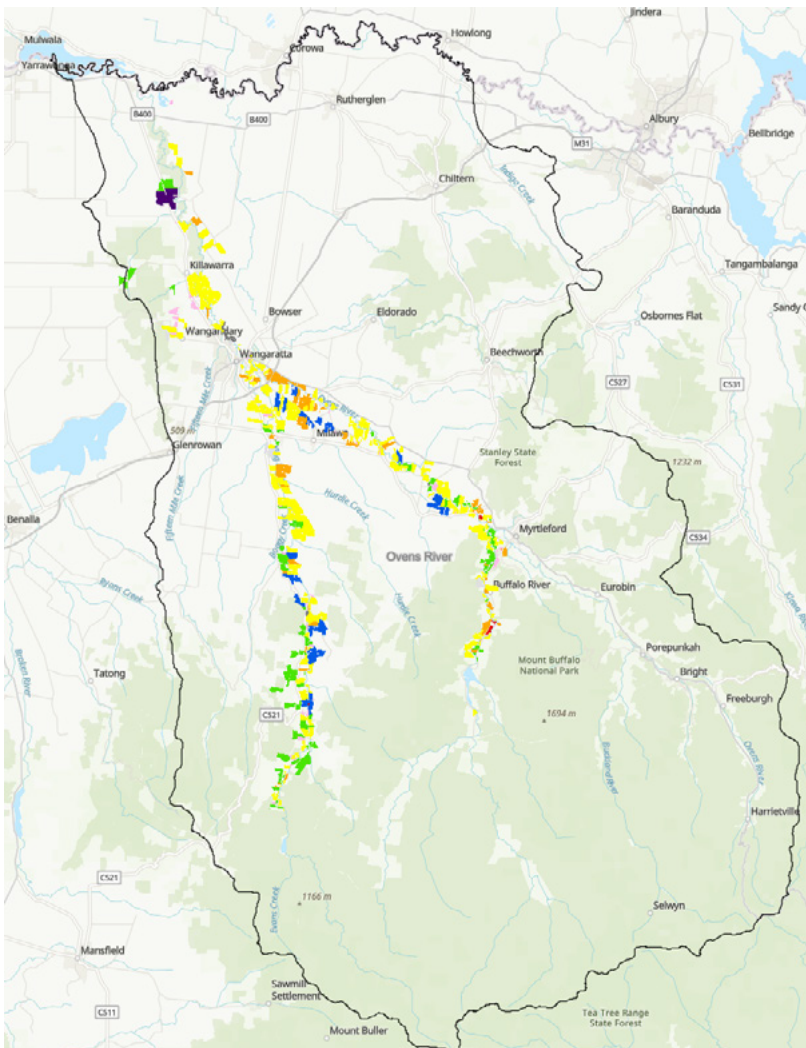
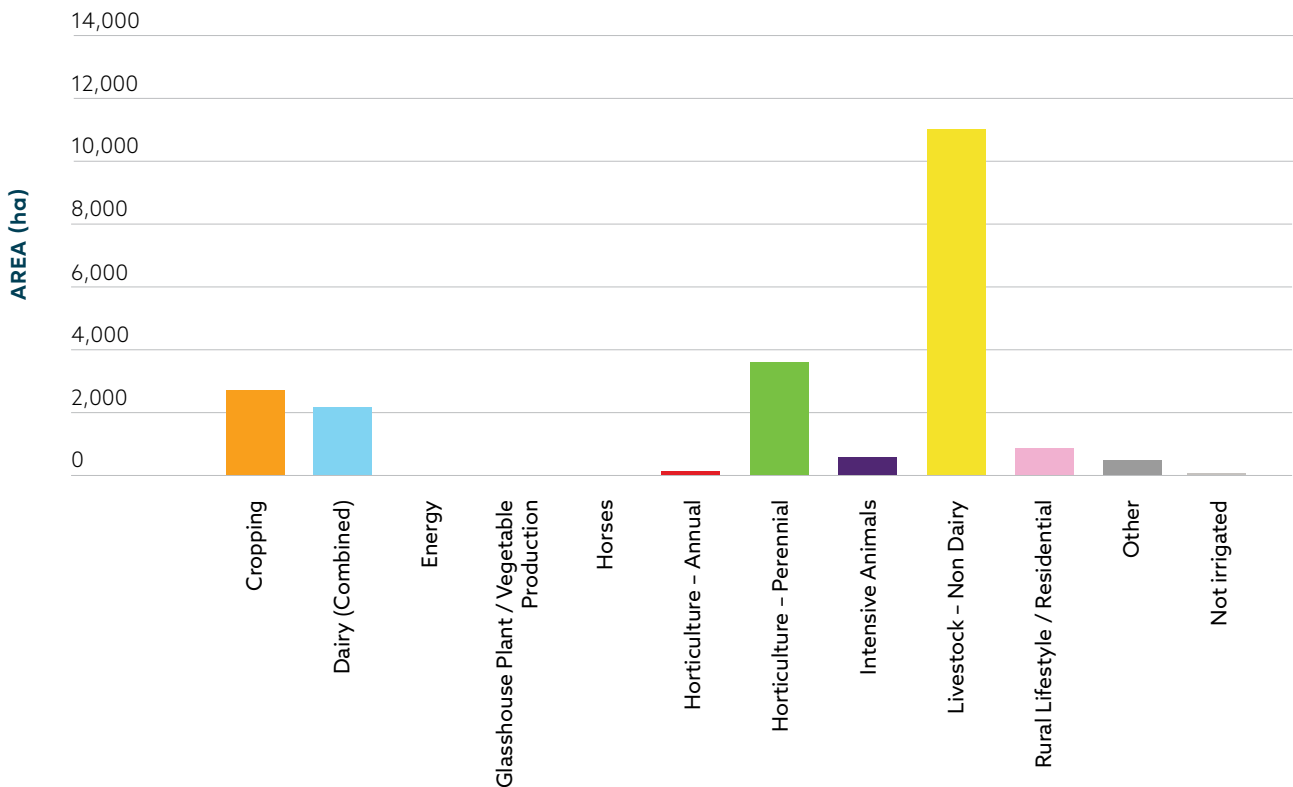


TABLE 18
OVENS RIVER PRIMARY LAND USE 2022/23 (ha)

LAND USE	AREA (ha)	WATER USE (ML)	WATER USE LICENCES
Cropping	2,638	253	59
Dairy (Combined)	2,080	456	16
Energy	0	0	0
Glasshouse Plant / Vegetable Production	0	0	0
Horses	0	0	0
Horticulture - Annual	94	308	4
Horticulture - Perennial	3,763	873	70
Intensive Animals	527	0	1
Livestock - Non Dairy	10,985	530	179
Rural Lifestyle / Residential	817	94	125
Other	476	0	10
Not irrigated	74	0	4
TOTAL	21,455	2,513	468

FIGURE 25
PRIMARY LAND USE – OVENS RIVER BASIN 2022/23

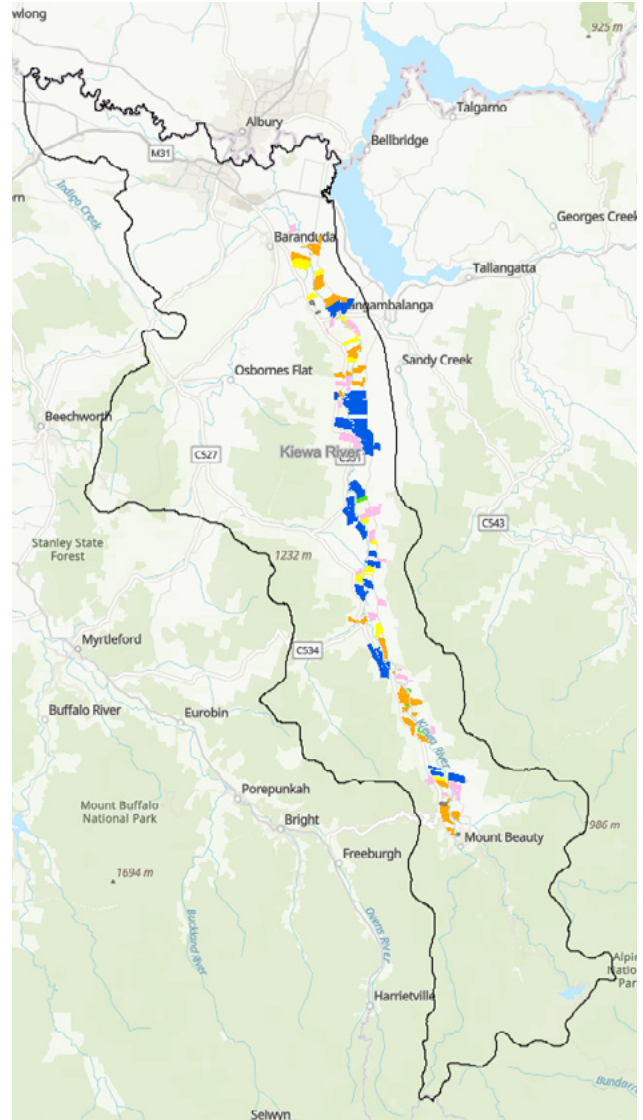


5.6 Kiewa River

This basin follows the Kiewa River from the Mount Beauty regulating pondage through to Baranduda near the Murray River. In 2022/23, there was a total of 123 WULs in this basin. The main section of the Kiewa River stream is unregulated but has unique trading rules¹ to allow trade within the basin and therefore has been included in this study.

- The land uses with the largest areas were Dairy (Combined), Cropping and Rural Lifestyle/Residential.
- Majority of water use in Dairy (Combined) was noted as irrigation of pasture for Dairy farms.
- Horticulture – Perennial, Not irrigated and Other were all minor land uses totalling under 260 ha.
- The largest water users (above 100 ML) were Dairy (Combined), Other and Cropping.
- Majority of the higher water use for Other can be attributed to the Saputo Milk Factory in Tangambalanga together with smaller amounts for caravan parks.
- The following primary land use categories were not recorded in this basin; Energy, Glasshouse Plant / Vegetable Production, Horses, Horticulture – Annual, and Intensive Animals.

FIGURE 26
PRIMARY LAND USE – MAP OF KIEWA RIVER
BASIN 2022/23

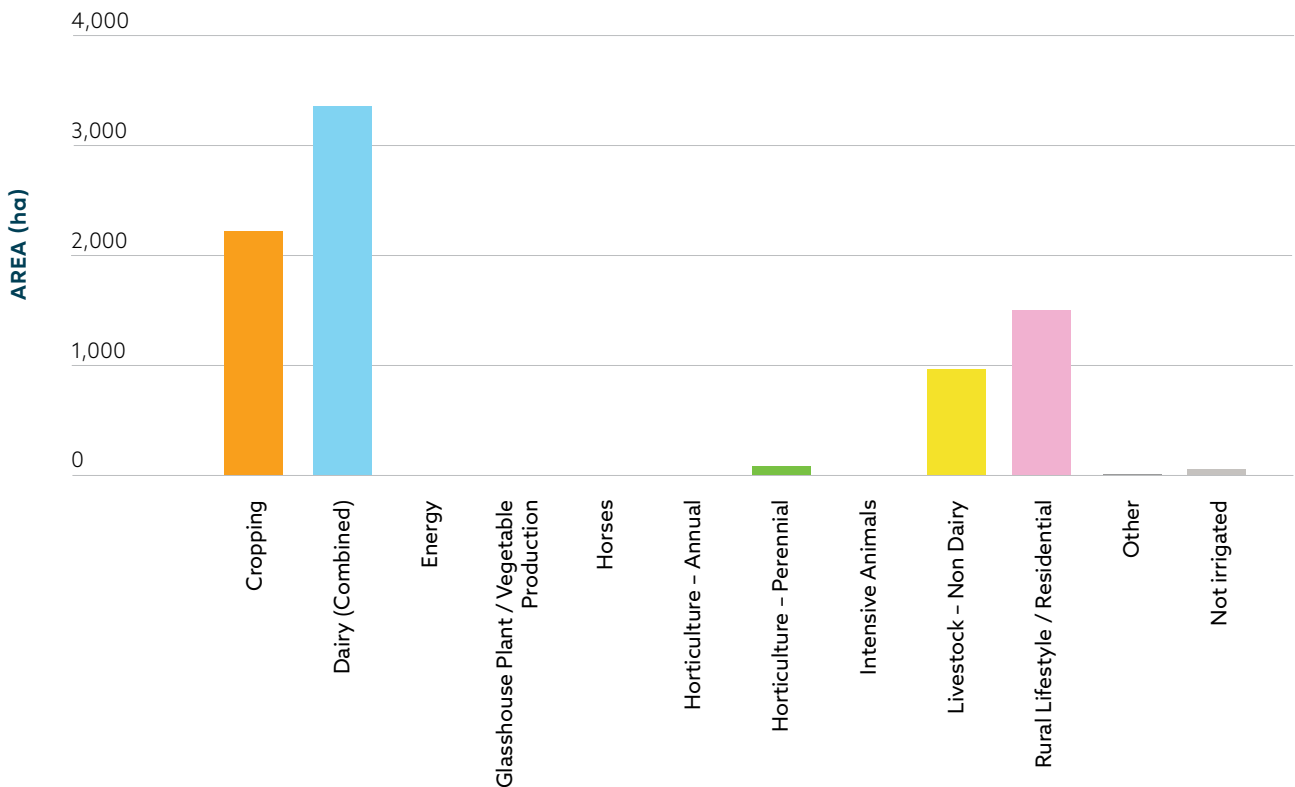


Note: Upstream transfers can only occur in most unregulated water systems when the licence issued to the buyer is a winter-fill licence. All-year licences can be traded both upstream and downstream on the main stem of the Kiewa River in recognition of the reliability of this system.

TABLE 19
KIEWA RIVER PRIMARY LAND USE 2022/23 (ha)

LAND USE	AREA (ha)	WATER USE (ML)	WATER USE LICENCES
Cropping	2,217	295	32
Dairy (Combined)	3,354	1,569	23
Energy	0	0	0
Glasshouse Plant / Vegetable Production	0	0	0
Horses	0	0	0
Horticulture - Annual	0	0	0
Horticulture - Perennial	86	36	5
Intensive Animals	0	0	0
Livestock - Non Dairy	969	46	17
Rural Lifestyle / Residential	1,505	85	37
Other	14	483	5
Not irrigated	58	10	4
TOTAL	8,203	2,524	123

FIGURE 27
PRIMARY LAND USE – KIEWA RIVER BASIN 2022/23



5.7

Mitta Mitta River

This basin follows the Mitta Mitta River downstream of Lake Dartmouth through to Lake Hume at Tallangatta East. In 2022/23, there was a total of 82 WULs in this basin.

- Only four primary land uses were recorded in this basin, the largest being Livestock – Non Dairy and Dairy (Combined).

- Rural Lifestyle/Residential was dispersed across the basin area.
- Dairy (Combined) was the highest water user followed by Livestock – Non Dairy.

FIGURE 28

PRIMARY LAND USE – MAP OF MITTA MITTA RIVER BASIN 2022/23

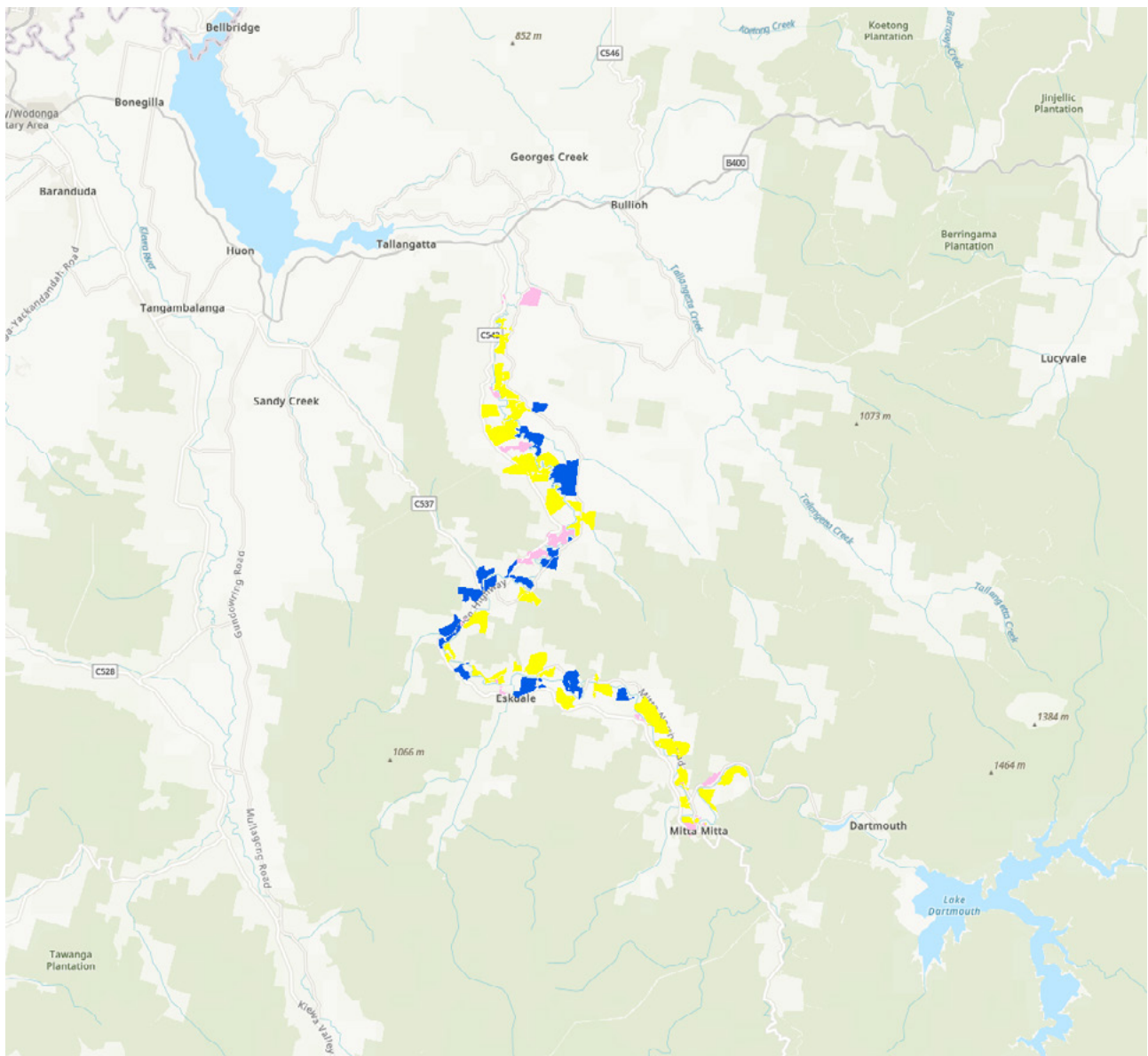
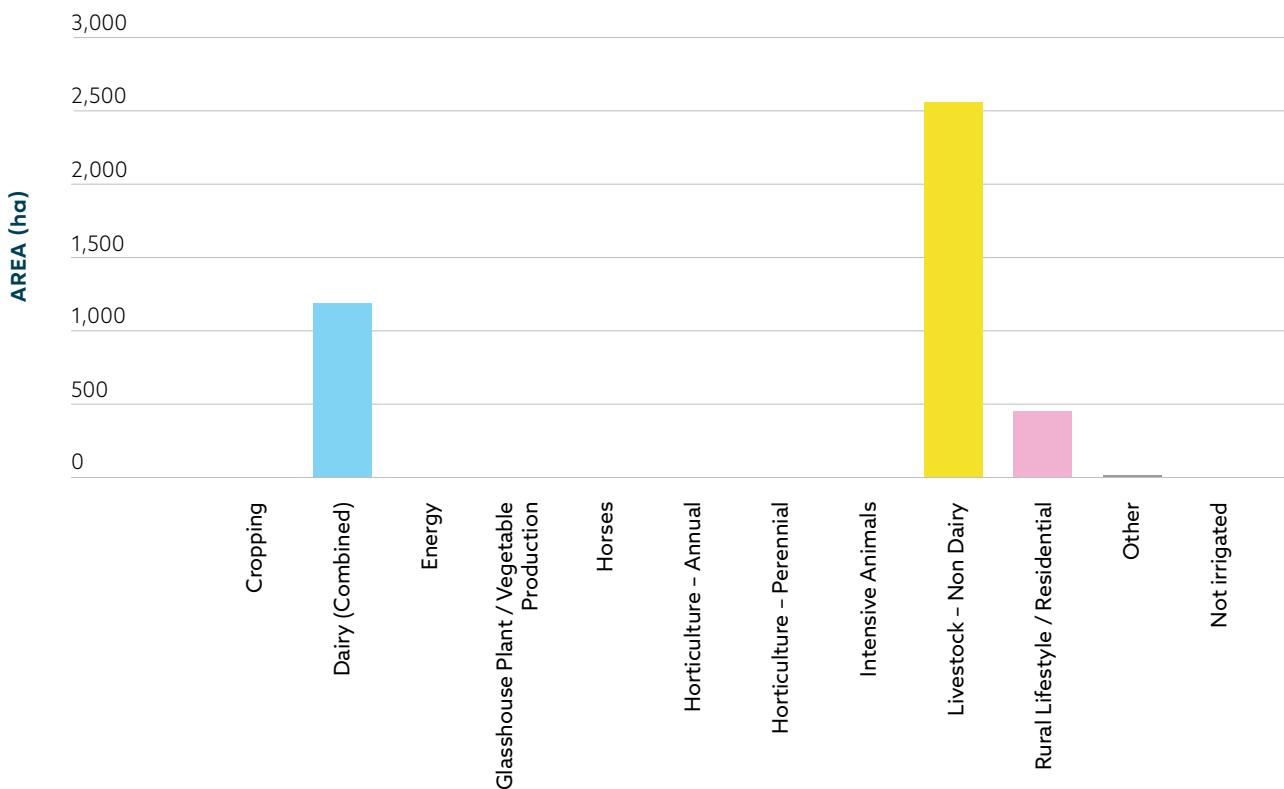


TABLE 20
MITTA MITTA RIVER PRIMARY LAND USE 2022/23 (ha)

LAND USE	AREA (ha)	WATER USE (ML)	WATER USE LICENCES
Cropping	0	0	0
Dairy (Combined)	1,208	776	17
Energy	0	0	0
Glasshouse Plant / Vegetable Production	0	0	0
Horses	0	0	0
Horticulture - Annual	0	0	0
Horticulture - Perennial	0	0	0
Intensive Animals	0	0	0
Livestock - Non Dairy	2,543	480	35
Rural Lifestyle / Residential	469	38	29
Other	0	0	1
Not irrigated	0	0	0
TOTAL	4,220	1,293	82

FIGURE 29
PRIMARY LAND USE – MITTA MITTA RIVER BASIN 2022/23



5.8 Murray River

This basin follows the Murray River from approximately 50 km north east of Lake Hume downstream to Nyah (approximately 30 km northwest of Swan Hill). It is important to note that the data is only for the Victorian side (regulated diversion customers of GMW) and is spread approximately along a 480 km stretch of the Murray River surrounds, interspersed with the GMID, and National Park and State Forest land. In 2022/23, there was a total of 991 WULs in this basin.

- The largest land use was Cropping, then Livestock – Non Dairy and Rural Lifestyle/ Residential.
- Cropping and Livestock – Non Dairy were the largest water users followed by Dairy (Combined) and Horticulture – Perennial.
- Rural Lifestyle/Residential, Cropping and Horticulture – Perennial land uses are spread across the basin while Dairy (Combined) were only recorded in the western part of the basin (Torrumbarry through to Swan Hill area).

FIGURE 30
PRIMARY LAND USE – MAP OF MURRAY RIVER BASIN 2022/23

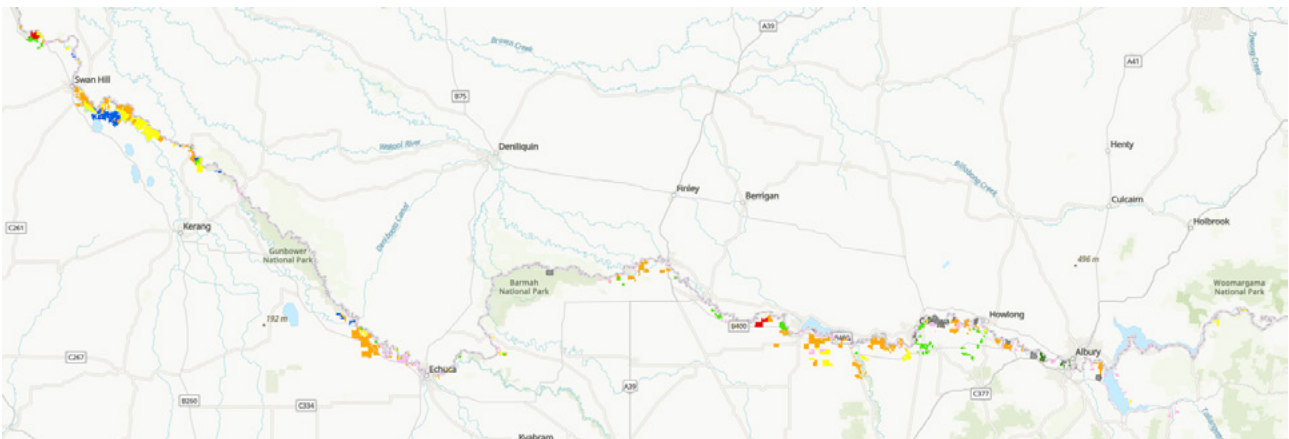
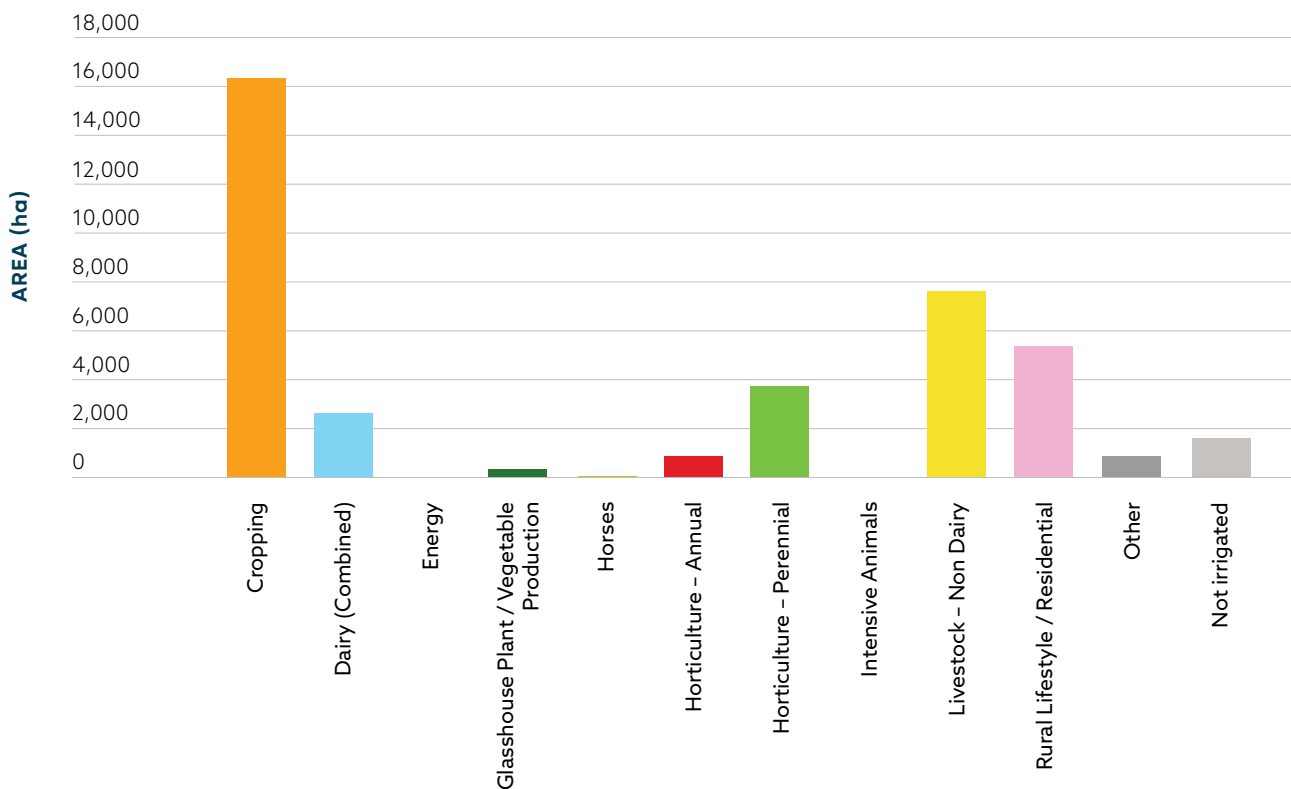


TABLE 21
MURRAY RIVER PRIMARY LAND USE 2022/23 (ha)

LAND USE	AREA (ha)	WATER USE (ML)	WATER USE LICENCES
Cropping	16,387	6,941	136
Dairy (Combined)	2,756	4,209	12
Energy	0	0	0
Glasshouse Plant / Vegetable Production	460	12	4
Horses	18	23	1
Horticulture - Annual	999	774	2
Horticulture - Perennial	3,864	2,759	42
Intensive Animals	0	0	0
Livestock - Non Dairy	7,808	4,761	73
Rural Lifestyle / Residential	5,460	1,459	649
Other	961	714	46
Not irrigated	1,652	1	26
TOTAL	40,364	21,653	991

FIGURE 31
PRIMARY LAND USE – MURRAY RIVER BASIN 2022/23



6. Water Use across the Regulated Diversions Catchments

Water use data from 2020/21, 2021/22 and 2022/23 for the Regulated Diversions Catchments was collated and analysed. The data showed that water use across the RDCs varied by 10 GL (16.7%) between 2020/21 and 2022/23. The region had a wetter season in 2022/23 with more rainfall, which likely would have contributed to the decrease in surface water diversions. It is important to note that 3,613 ML (22/23 figures) of water usage included within the total water use is deemed to have been used by 2,134 unmetered Domestic and Stock connections.

TABLE 22
REGULATED DIVERSIONS CATCHMENTS WATER USE (ML) AND WATER USE CHANGE (ML AND %) BY PRIMARY LAND USE CATEGORY, 2020/21, 2021/22 AND 2022/23

PRIMARY LAND USE	2020/21	2021/22	2022/23	2021-2022		2022-2023		2021-2023	
	Water Use ML			Change ML	Change %	Change ML	Change %	Change ML	Change %
Cropping	19,254.7	21,566.1	16,323.0	2,311.4	12.0	-5,243.1	-24.3	-2,931.7	-15.2
Dairy (Combined)	11,723.0	10,073.8	10,496.3	-1,649.2	-14.1	422.5	4.2	-1,226.7	-10.5
Energy	0.3	3.9	2.0	3.6	1,200.0	-1.9	-48.7	1.7	566.7
Glasshouse Plant / Vegetable Production	21.3	14.5	11.6	-6.8	-31.9	-2.9	-20.0	-9.7	-45.5
Horses	1,402.4	1,178.3	1,263.2	-224.1	-16.0	84.9	7.2	-139.2	-9.9
Horticulture - Annual	1,748.8	1,218.2	1,518.5	-530.6	-30.3	300.3	24.7	-230.3	-13.2
Horticulture - Perennial	8,128.1	6,149.1	5,410.0	-1,979.0	-24.3	-739.1	-12.0	-2718.1	-33.4
Intensive Animals	972.9	502.5	708.9	-470.4	-48.4	206.4	41.1	-264.0	-27.1
Livestock - Non Dairy	11,209.3	10,509.2	9,121.9	-700.1	-6.2	-1,387.3	-13.2	-2,087.4	-18.6
Rural Lifestyle/ Residential	3,513.7	3,399.9	3,151.0	-113.8	-3.2	-248.9	-7.3	-362.7	-10.3
Other	2,397.0	2,134.2	2,235.6	-262.8	-11.0	101.4	4.8	-161.4	-6.7
Not irrigated	193.7	198.2	186.4	4.5	2.3	-11.8	-6.0	-7.3	-3.8
TOTAL (ML)	60,565.2	56,947.9	50,428.4	-3,617.3	-6.0	-6,519.5	-11.4	-10,136.8	-16.7
TOTAL (GL)	60.6	56.9	50.4	-3.6	-6.0	-6.5	-11.4	-10.1	-16.7

Between 2020/21 and 2021/22 water use mainly decreased across the different primary land uses (with the exception of Cropping and Energy). Even though their water use reduced overall from 2020/21 – 2022/23, the biggest water users of the three-year period were consistently Cropping, Livestock – Non Dairy and Dairy (Combined). These land uses reflect the largest land use areas (see Table 22) except for Dairy (Combined), as it was the second largest water user for 2022/23, however is ranked seventh by land use area.

Cropping and Horticulture – Perennial experienced the largest variation in water use from 2020/21 - 2022/23 by 2,931.7 ML (15.2%) and 2,718 ML (33.4%) respectively. This reduction would be primarily due to the available rainfall of the past three seasons resulting in lesser water requirement for irrigation (reflective for all land uses). Further land use studies will confirm if there are trends for farmers exiting the industry, changing primary land uses, or water efficiencies.

FIGURE 32
WATER USE IN THE REGULATED DIVERSIONS CATCHMENTS (ML) FOR EACH PRIMARY LAND USE, 2020/21, 2021/22 AND 2022/23

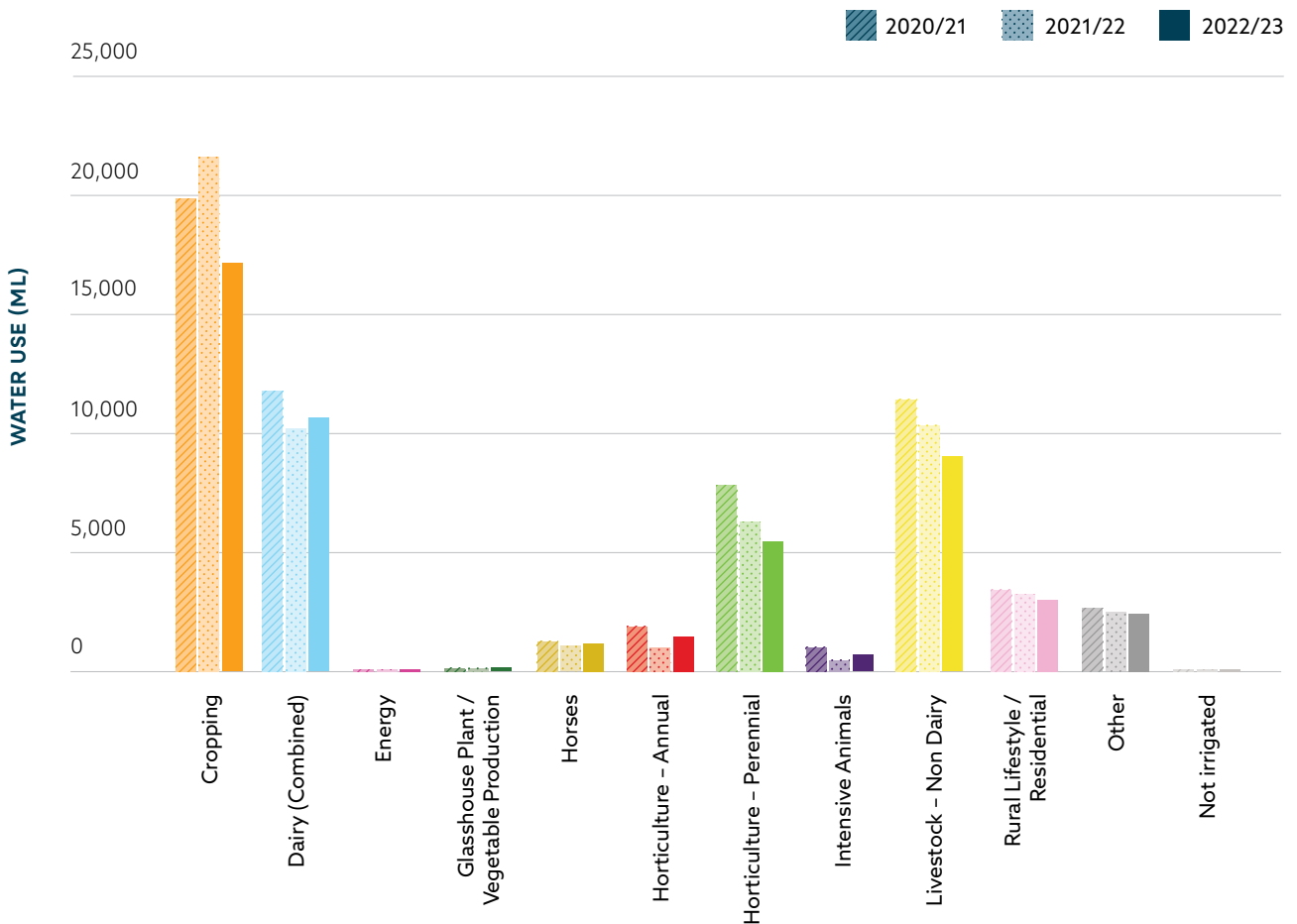
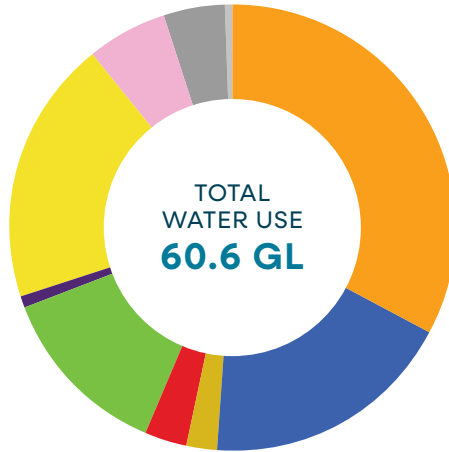


Figure 33 shows the proportion of total water use by primary land use in 2020/21, 2021/22, and 2022/23. Cropping consistently had the largest percentage water use in each of these irrigation seasons, despite the minor drop from 2021/22 to 2022/23 (38.8% to 33.5%).

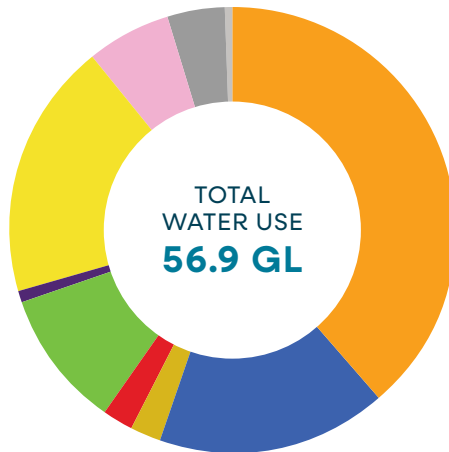
FIGURE 33
PERCENTAGE WATER USE BY PRIMARY LAND USE IN REGULATED DIVERSIONS CATCHMENTS, 2020/21, 2021/22, 2022/23

2020/21



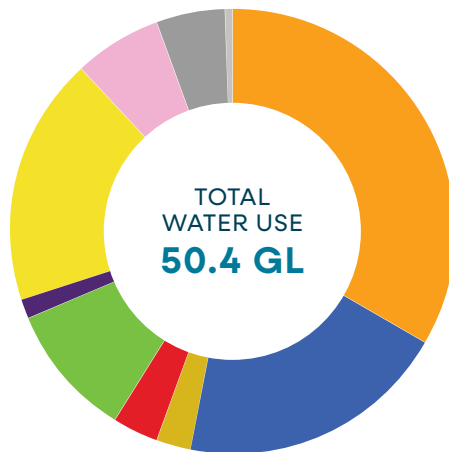
Cropping	31.8%
Dairy	19.4%
Horses	2.3%
Horticulture - Annual	2.9%
Horticulture - Perennial	13.4%
Intensive Animals	1.6%
Livestock - Non Dairy	18.5%
Rural Lifestyle	5.8%
Other	4.0%
Non Irrigated	0.3%

2021/22



Cropping	37.9%
Dairy	17.7%
Horses	2.1%
Horticulture - Annual	2.1%
Horticulture - Perennial	10.8%
Intensive Animals	0.9%
Livestock - Non Dairy	18.5%
Rural Lifestyle	6.0%
Other	3.7%
Non Irrigated	0.3%

2022/23



Cropping	32.4%
Dairy	20.8%
Horses	2.5%
Horticulture - Annual	3.0%
Horticulture - Perennial	10.7%
Intensive Animals	1.4%
Livestock - Non Dairy	18.1%
Rural Lifestyle	6.2%
Other	4.4%
Non Irrigated	0.4%

Note: Data labels are only shown for land uses with more 0.1%

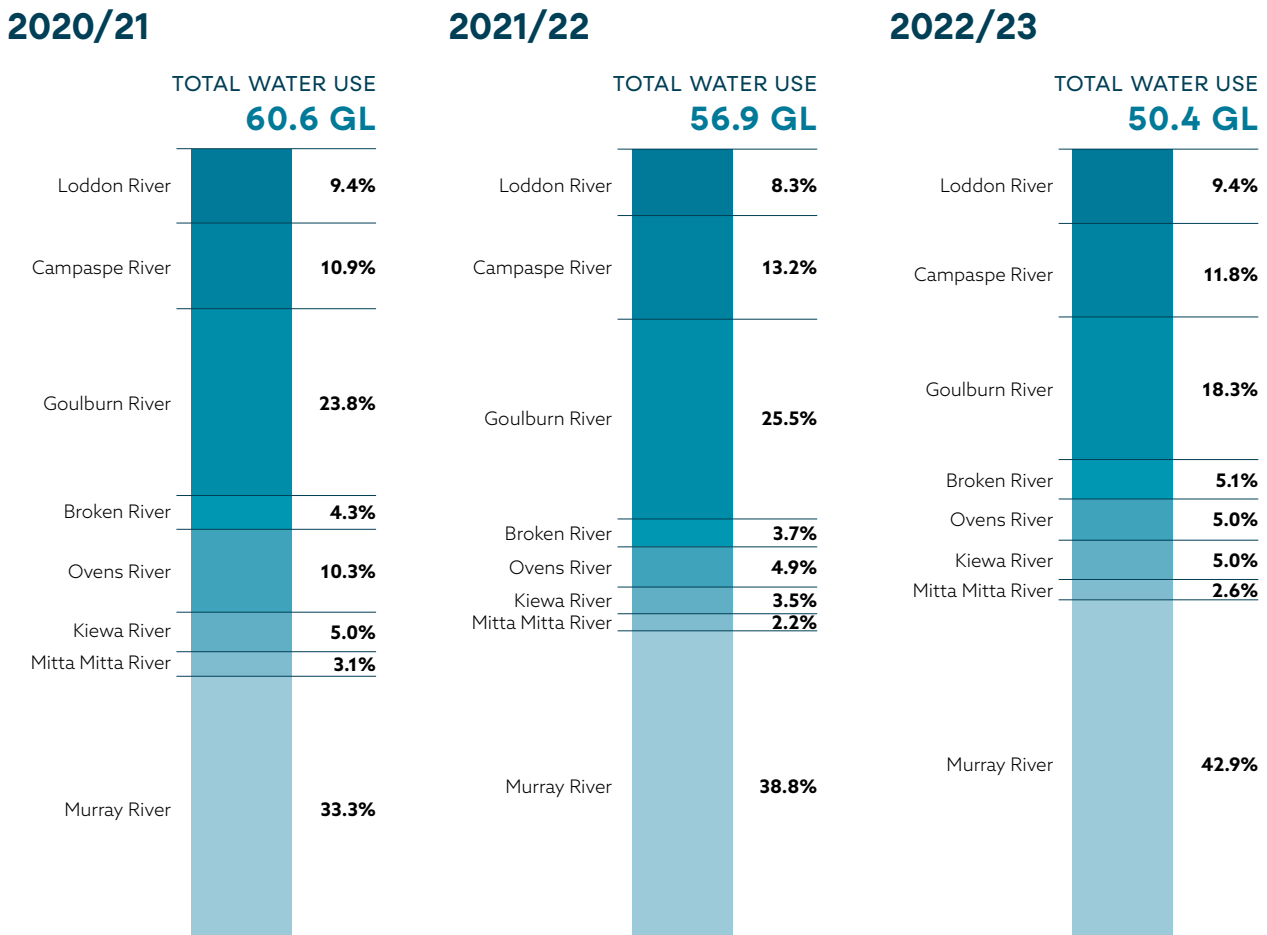
Table 23 and Figure 34 illustrate water usage by Basin, noting the Murray River Basin is consistently the largest water user followed by Goulburn River and Campaspe River.

The percentage of water used by the Murray River Basin continued to increase over the three irrigation seasons from 33.3% to 42.9%. It is observed that Goulburn River Basin has varied between 23.8%, 25.5% and 18.3%. While Ovens River Basin decreased from accounting for 10.3% of the water used in the 2020/21 season to 5.0% in the 2022/23 season. Trends will be able to be reported on when the data base is continued in future land and water mapping projects.

TABLE 23
REGULATED DIVERSIONS CATCHMENTS WATER USE (ML) BY BASIN, 2020/21, 2021/22 AND 2022/23

CATCHMENT AREA	2020/21 ML	2020/21 %	2021/22 ML	2021/22 %	2022/23 ML	2022/23 %
Loddon River	5,674.8	9.4	4,738.2	8.3	4,741.1	9.4
Campaspe River	6,573.0	10.9	7,493.7	13.2	5,934.3	11.8
Goulburn River	14,432.6	23.8	14,495.1	25.5	9,217.4	18.3
Broken River	2,590.9	4.3	2,112.6	3.7	2,551.9	5.1
Ovens River	6,264.2	10.3	2,785.3	4.9	2,513.2	5.0
Kiewa River	3,018.3	5.0	1,999.6	3.5	2,524.3	5.0
Mitta Mitta River	1,851.1	3.1	1,233.9	2.2	1,293.3	2.6
Murray River	20,160.3	33.3	22,089.5	38.8	21,652.9	42.9
TOTAL	60,565.1	100.0	56,947.9	100.0	50,428.4	100.0

FIGURE 34
PERCENTAGE WATER USE BY BASIN, 2020/21, 2021/22, 2022/23



7. Water Use Licences in the Regulated Diversions Catchments

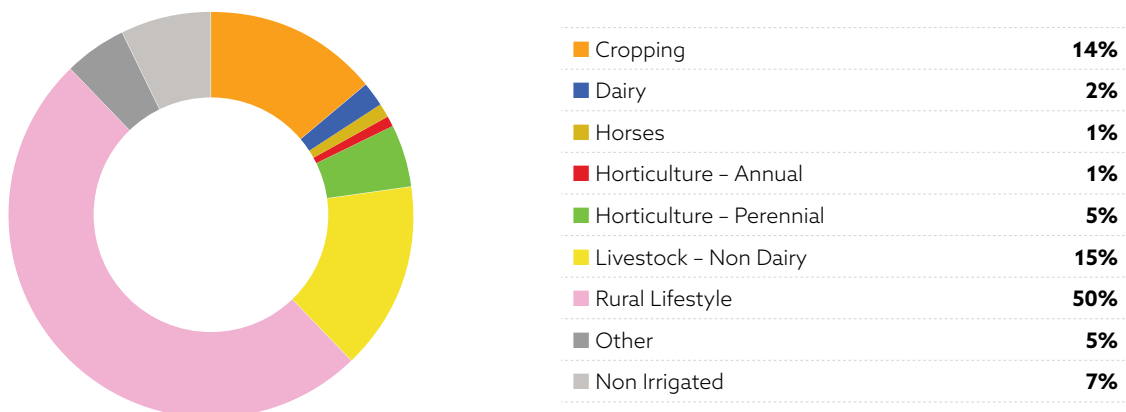
There were 3,536 Water Use Licences (WULs) in the Regulated Diversions Catchments at the time of survey in 2022/23 (this includes some Water Use Registrations as noted in the methodology).

Rural Lifestyle/Residential had the highest number of WULs (1,755 or 50%), followed by Livestock – Non Dairy (532 or 15%) and Cropping (484 or 14%). These primary land uses made up 78% of the WULs in the total region. Even though Rural Lifestyle/Residential had the most WULs the associated land use area recorded was only 19,654 ha, in contrast it ranked fourth in primary land use area behind Cropping, Livestock Non-Dairy and Other Land Use. Similarly, water use for Rural Lifestyle/Residential was relatively low for the number of licences with 3,151 ML recorded for 2022/23.

TABLE 24
WATER USE LICENCE (WUL) (NUMBER) IN THE REGULATED DIVERSIONS CATCHMENTS BY LAND USE CATEGORY, 2022/23

LAND USE	WATER USE LICENCES
Cropping	484
Dairy (Combined)	86
Energy	5
Glasshouse Plant / Vegetable Production	4
Horses	24
Horticulture – Annual	20
Horticulture – Perennial	186
Intensive Animals	12
Livestock – Non Dairy	532
Rural Lifestyle/Residential	1,755
Other	184
Not irrigated	244
TOTAL	3,536

FIGURE 35
WATER USE LICENCE (WUL) (PERCENTAGE) IN THE REGULATED DIVERSIONS CATCHMENTS BY LAND USE CATEGORY, 2022/23



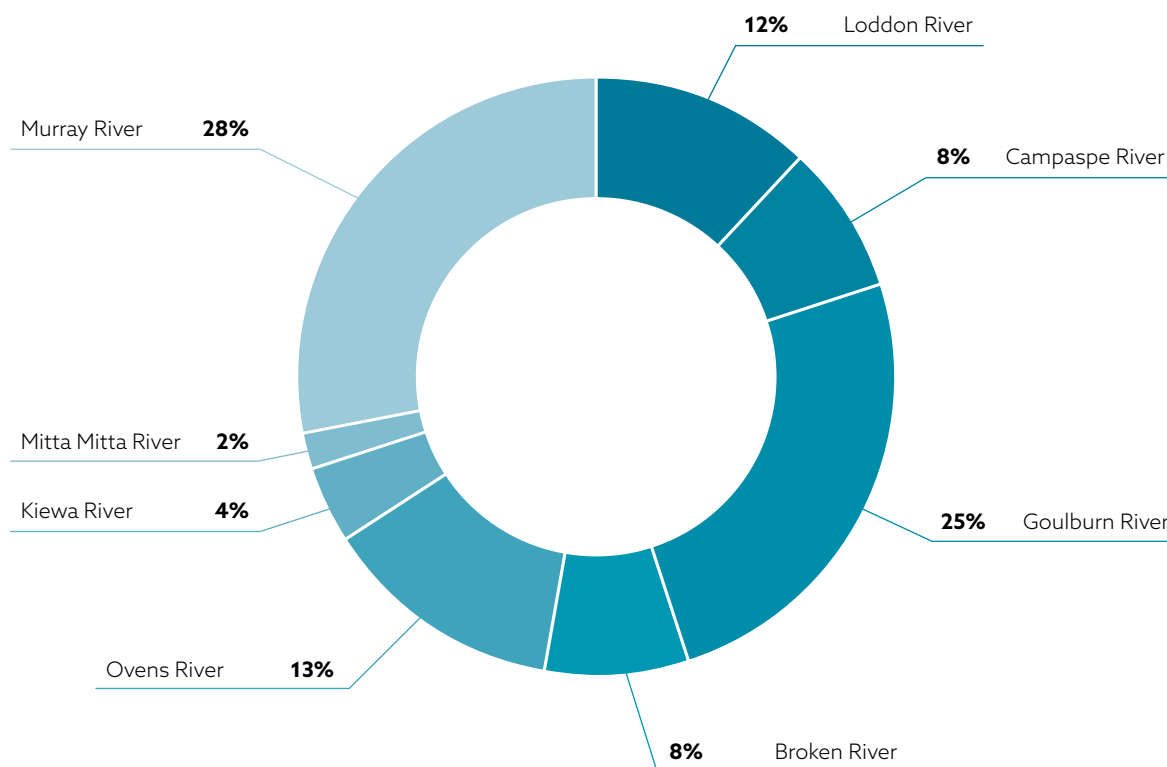
Note: Data labels are only shown for land uses with more 1%

The basin with the most WULs was Murray River with 991 (28%), followed by Goulburn River with 884 (25%), Ovens River with 468 (13%) and Loddon River with 425 (12%). Campaspe River, Kiewa River, Broken River and Mitta Mitta River basins each were recorded as under 10% of the total WULs (see Table 25). Appendix 4 breaks down the number of WULs by primary land use category for each basin.

TABLE 25
WATER USE LICENCE (WUL) (NUMBER) BY BASIN, 2022/23

CATCHMENT AREA	WATER USE LICENCES
Loddon River	425
Campaspe River	294
Goulburn River	884
Broken River	269
Ovens River	468
Kiewa River	123
Mitta Mitta River	82
Murray River	991
TOTAL	3,536

FIGURE 36
WATER USE LICENCE (WUL) (PERCENTAGE) BY BASIN, 2022/23



8. Conclusion

The project has provided a baseline of land use and water use data for the Regulated Diversions Catchments. Future iterations of this data collection can provide insights into trends and in conjunction with the GMID Land and Water Use Mapping Project contributes to building the overall picture of land and water use in Northern Victoria.

Some key findings from this project include;

- Cropping (63,805 ha) and Livestock – Non Dairy (50,776 ha) were the largest primary land uses by area in the Regulated Diversions Catchments. The next largest irrigated agricultural land uses were Horticulture – Perennial (13,969 ha) and Dairy (Combined) (11,751 ha).
- Overall water use has decreased across the region from 2020/21–2022/23 by 10GL (16.7%).
- The biggest water users of this three-year period were consistently Cropping followed by Livestock – Non Dairy, reflecting the largest land use areas.
- Dairy (Combined) was recorded as the second largest water user for the 2022/23 season with 10,496.3 ML, despite this it was the seventh largest land use area.
- Cropping and Horticulture – Perennial experienced the largest variation in water use from 2020/21-2022/23 by 2,931.7 ML (15.2%) and 2,718 ML (33.4%) respectively.
- Rural Lifestyle/Residential had the greatest number of WULs (1,755) however in contrast was ranked fourth in primary land use area with relatively low water use in 2022/23.
- The primary land use area varied significantly across the Regulated Diversions Catchments with the largest by area being Goulburn River Basin (63,588.6 ha) through to the smallest, Mitta Mitta Basin (4,220.2 ha).

- The Murray River Basin were consistently the largest water users from 2020/21-2022/23, followed by the Goulburn and Campaspe River Basins.
- The percentage of water used by the Murray River Basin continued to increase over the three irrigation seasons from 33.3% to 42.9%, while Ovens River Basin decreased from accounting for 10.3% of the water used in the 2020/21 season to 5.0% in the 2022/23 season.

These findings in addition to ongoing data collection and mapping will contribute toward building an understanding of how the region is changing and adapting to reduced water availability. In determining land and water use changes and trends in the Regulated Diversions Catchments, these findings can inform water, agriculture and planning policy at the local, regional, state and national level (e.g. Murray Darling Basin Plan impacts). The project can also support Goulburn-Murray Water strategic planning and asset management processes. Not only does it aid landowners in making informed decisions about their opportunities, but it is also an effective tool in educating the broader community on the complexities of water availability. Further to this, data analysis can provide input into economic modelling, as well as guiding investment in regional economic development.

It is noted that this project focuses solely on surface water diversions from regulated rivers and streams. Unregulated rivers and streams, and groundwater systems are not included within the scope of this project but are a logical next step in building the story of land and water use change across Northern Victoria.

9. References

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10. Appendices

APPENDIX 1

Regional Irrigated Land and Water Use Mapping Governance Structure tailored to the Regulated Diversions Catchments (LUMRDC)

STAKEHOLDER REFERENCE GROUP

STAKEHOLDER	REPRESENTATIVES
Goulburn-Murray Water (GMW)	John Weber, Peter Clydesdale
Agriculture Victoria	Andy McAllister, Rebecca Pike, Matthew Hawken, Rabi Maskey, Dennis Watson
DEECA	Bonnie Glaister
Goulburn Broken CMA (GB CMA)	Carl Walters (Chair), Melanie Squires, Vicki Mackenzie (minute taker)
North Central CMA (NCCMA)	Rachel Murphy, Mandy Coulson
North East CMA (NECMA)	Lachlan Campbell, Helen Wilson
Murray Dairy	Lachlan Barnes, Amy Fay
Fruit Growers (Vic)	Michael Crisera, Nimeshika Aloysius
Irrigated Farmers Network (IFN)	Damian Jones and Charlie Aves

REGULATED DIVERSIONS LUM TECHNICAL WORKING GROUP

STAKEHOLDER	REPRESENTATIVES
Agriculture Victoria	Andy McAllister, Dennis Watson, Matthew Hawken
GMW	John Weber, Stephen Gemmill, Joshua Cimera, Peter Clydesdale, Dale McGraw
DEECA	Bonnie Glaister, Ruth Hicks
GB CMA	Carl Walters (Chair), Melanie Squires (Coordinator), Vicki Mackenzie (minute taker)
NCCMA	Mandy Coulson
NECMA	Lachlan Campbell, Helen Wilson

APPENDIX 2

Land use area (hectares) by Basin, 2022/23

LAND USE AREA (ha) BY INDUSTRY	LODDON RIVER	CAMPASPE RIVER	GOULBURN RIVER	BROKEN RIVER	OVENS RIVER	KIEWA RIVER	MITTA MITTA RIVER	MURRAY RIVER	TOTAL
Cropping	16339.6	6,575.0	15,608.9	4,039.0	2,637.9	2,217.0	0.0	16,387.2	63,804.7
Dairy (Combined)	291.3	205.8	1,594.2	261.9	2,080.0	3,353.9	1,208.0	2,756.0	11,751.1
Energy	0.0	386.7	0.0	246.2	0.0	0.0	0.0	0.0	632.9
Glasshouse Plant / Vegetable Production	0.0	0.0	0.0	0.0	0.0	0.0	0.0	459.5	459.5
Horses	464.4	10.3	2,513.6	354.7	0.0	0.0	0.0	17.6	3,360.6
Horticulture - Annual	910.4	0.0	0.0	0.0	94.3	0.0	0.0	998.6	2,003.3
Horticulture - Perennial	1,160.6	555.0	2,811.1	1,729.3	3,763.3	86.5	0.0	3,863.6	13,969.2
Intensive Animals	1,237.9	0.0	438.3	0.0	526.8	0.0	0.0	0.0	2,203.0
Livestock - Non Dairy	3,132.9	2,702.7	12,041.9	10,594.1	10,984.9	968.6	2,543.1	7,808.0	50,776.1
Rural Lifestyle / Residential	1,330.0	2,510.4	4,473.8	3,088.3	817.2	1,505.2	468.7	5,460.3	19,654.0
Other	534.9	3,993.0	19,719.6	5,922.2	476.4	13.8	0.4	961.3	31,621.6
Not irrigated	5,225.6	3,777.1	4,387.3	761.7	74.4	57.7	0.0	1,652.0	15,935.8
TOTAL	30,627.6	20,716.0	63,588.6	26,997.4	21,455.3	8,202.7	4,220.2	40,364.0	216,171.8

APPENDIX 3

Water Use (ML) Change (%) between 2020/21, 2021/22 and 2022/23 in each Basin

LODDON RIVER

PRIMARY LAND USE	2020/21	2021/22	2022/23 ML	2021-2022 % Change	2022-2023 % Change	2021-2023 % Change
Cropping	3,427.4	2,864.7	2,598.5	-16.4	-9.3	-24.2
Dairy (Combined)	640.5	560.7	634.5	-12.5	13.2	-0.9
Energy	0.0	0.0	0.0	0.0	0.0	0.0
Glasshouse Plant / Vegetable Production	0.0	0.0	0.0	0.0	0.0	0.0
Horses	4.0	4.0	4.0	0.0	0.0	0.0
Horticulture - Annual	428.1	367.9	436.3	-14.1	18.6	1.9
Horticulture - Perennial	478.7	422.1	301.4	-11.8	-28.6	-37.0
Intensive Animals	203.4	64.3	246.7	-68.4	283.7	21.3
Livestock - Non Dairy	143.3	115.9	174.9	-19.1	50.9	22.1
Rural Lifestyle/Residential	236.9	236.8	236.7	0.0	0.0	-0.1
Other	64.8	52.3	59.9	-19.3	14.5	-7.6
Not irrigated	47.7	49.5	48.2	3.8	-2.6	1.0
TOTAL	5,674.78	4,738.18	4,741.1	-16.5	0.1	-16.5

CAMPASPE RIVER

PRIMARY LAND USE	2020/21	2021/22	2022/23 ML	2021-2022 % Change	2022-2023 % Change	2021-2023 % Change
Cropping	4,205.5	5,183.3	3,993.6	23.3	-23.0	-5.0
Dairy (Combined)	175.0	57.6	113.1	-67.1	96.4	-35.4
Energy	0.0	0.0	0.0	0.0	0.0	0.0
Glasshouse Plant / Vegetable Production	0.0	0.0	0.0	0.0	0.0	0.0
Horses	0.0	0.0	0.0	0.0	0.0	0.0
Horticulture - Annual	0.0	0.0	0.0	0.0	0.0	0.0
Horticulture - Perennial	291.9	259.2	165.8	-11.2	-36.0	-43.2
Intensive Animals	0.0	0.0	0.0	0.0	0.0	0.0
Livestock - Non Dairy	1,315.6	1,493.4	1,138.8	13.5	-23.7	-13.4
Rural Lifestyle/Residential	230.9	225.4	219.1	-2.4	-2.8	-5.1
Other	318.25	229.1	269.9	-28.0	17.8	-15.2
Not irrigated	35.8	45.7	34.0	27.7	-25.6	-5.0
TOTAL	6,572.95	7,493.7	5,934.3	14.0	-20.8	-9.7

GOULBURN RIVER

PRIMARY LAND USE	2020/21	2021/22	2022/23 ML	2021-2022	2022-2023 % Change	2021-2023 % Change
Cropping	3,614.3	3,746.1	1,447.1	3.6	-61.4	-60.0
Dairy (Combined)	3,487.6	4,002.9	2,214.9	14.8	-44.7	-36.5
Energy	0.0	0.0	0	0.0	0.0	0.0
Glasshouse Plant / Vegetable Production	0.0	0.0	0	0.0	0.0	0.0
Horses	1,279.4	1,070.6	1,136.9	-16.3	6.2	-11.1
Horticulture - Annual	0.0	0.0	0.0	0.0	0.0	0.0
Horticulture - Perennial	2,192.1	1,880.8	1,267.0	-14.2	-32.6	-42.2
Intensive Animals	429.0	438.2	462.2	2.1	5.5	7.7
Livestock - Non Dairy	1,968.6	1,808.7	1,122.4	-8.1	-37.9	-43.0
Rural Lifestyle/Residential	867.3	883.9	894.3	1.9	1.2	3.1
Other	502.6	571.9	579.4	13.8	1.3	15.3
Not irrigated	91.7	92.0	93.2	0.3	1.3	1.6
TOTAL	14,432.6	14,495.1	9,217.4	0.4	-36.4	-36.1

BROKEN RIVER

PRIMARY LAND USE	2020/21	2021/22	2022/23 ML	2021-2022	2022-2023 % Change	2021-2023 % Change
Cropping	452.5	279.6	794.1	-38.2	184.0	75.5
Dairy (Combined)	550.8	539.1	524.9	-2.1	-2.6	-4.7
Energy	0.3	3.9	2.0	1,200.0	-48.7	566.7
Glasshouse Plant / Vegetable Production	0.0	0.0	0.0	0.0	0.0	0.0
Horses	79.9	72.0	99.0	-9.9	37.5	23.9
Horticulture - Annual	0.0	0.0	0.0	0.0	0.0	0.0
Horticulture - Perennial	30.3	16.8	8.7	-44.6	-48.2	-71.3
Intensive Animals	0.0	0.0	0.0	0.0	0.0	0.0
Livestock - Non Dairy	1,218.6	936.0	868.9	-23.2	-7.2	-28.7
Rural Lifestyle/Residential	150.1	144.5	125.0	-3.7	-13.5	-16.7
Other	108.4	120.7	129.3	11.3	7.1	19.3
Not irrigated	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	2,590.9	2,112.6	2,551.9	-18.5	20.8	-1.5

OVENS RIVER

PRIMARY LAND USE	2020/21	2021/22	2022/23 ML	2021-2022	2022-2023 % Change	2021-2023 % Change
Cropping	762.3	384.6	253.0	-49.5	-34.3	-66.8
Dairy (Combined)	1,923.5	832.7	456.2	-56.7	-45.2	-76.3
Energy	0.0	0.0	0.0	0.0	0.0	0.0
Glasshouse Plant / Vegetable Production	0.0	0.0	0.0	0.0	0.0	0.0
Horses	0.0	0.0	0.0	0.0	0.0	0.0
Horticulture - Annual	8.3	20.5	307.8	147.0	1,401.5	3,608.4
Horticulture - Perennial	1,914.2	881.4	872.7	-54.0	-1.0	-54.4
Intensive Animals	340.5	0.0	0.0	-100.0	0.0	-100.0
Livestock - Non Dairy	1,184.3	534.7	529.5	-54.9	-1.0	-55.3
Rural Lifestyle/Residential	90.4	98.1	94	8.5	-4.2	4.0
Other	32.2	33.0	0.0	2.5	-100.0	-100.0
Not irrigated	8.5	0.0	0.0	-100.0	0.0	-100.0
TOTAL	6,264.2	2,785.3	2,513.2	-55.5	-9.8	-59.9

KIEWA RIVER

PRIMARY LAND USE	2020/21	2021/22	2022/23 ML	2021-2022	2022-2023 % Change	2021-2023 % Change
Cropping	470.2	206.9	295.3	-56.0	42.7	-37.2
Dairy (Combined)	1,930.4	1,140.6	1,568.5	-40.9	37.5	-18.7
Energy	0.0	0.0	0.0	0.0	0.0	0.0
Glasshouse Plant / Vegetable Production	0.0	0.0	0.0	0.0	0.0	0.0
Horses	0.0	0.0	0.0	0.0	0.0	0.0
Horticulture - Annual	0.0	0.0	0.0	0.0	0.0	0.0
Horticulture - Perennial	43.5	29.2	35.8	-32.9	22.6	-17.7
Intensive Animals	0.0	0.0	0.0	0.0	0.0	0.0
Livestock - Non Dairy	39.7	32.2	46.4	-18.9	44.1	16.9
Rural Lifestyle/Residential	93.3	93.4	84.9	0.1	-9.1	-9.0
Other	431.2	487.3	483.4	13.0	-0.8	12.1
Not irrigated	10.0	10.0	10.0	0.0	0.0	0.0
TOTAL	3,018.3	1,999.6	2,524.3	-33.8	26.2	-16.4

MITTA MITTA RIVER

PRIMARY LAND USE	2020/21	2021/22	2022/23 ML	2021-2022	2022-2023 % Change	2021-2023 % Change
Cropping	0.0	0.0	0.0	0.0	0.0	0.0
Dairy (Combined)	1,228.8	746.5	775.6	-39.2	3.9	-36.9
Energy	0.0	0.0	0.0	0.0	0.0	0.0
Glasshouse Plant / Vegetable Production	0.0	0.0	0.0	0.0	0.0	0.0
Horses	0.0	0.0	0.0	0.0	0.0	0.0
Horticulture - Annual	0.0	0.0	0.0	0.0	0.0	0.0
Horticulture - Perennial	0.0	0.0	0.0	0.0	0.0	0.0
Intensive Animals	0.0	0.0	0.0	0.0	0.0	0.0
Livestock - Non Dairy	584.3	449.4	479.7	-23.1	6.7	-17.9
Rural Lifestyle/Residential	38.0	38.0	38.0	0.0	0.0	0.0
Other	0.0	0.0	0.0	0.0	0.0	0.0
Not irrigated	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	1,851.1	1,233.9	1,293.3	-33.3	4.8	-30.1

MURRAY RIVER

PRIMARY LAND USE	2020/21	2021/22	2022/23 ML	2021-2022	2022-2023 % Change	2021-2023 % Change
Cropping	6,322.5	8,900.6	6,941.4	40.8	-22.0	9.8
Dairy (Combined)	1,786.4	2,193.7	4,208.6	22.8	91.8	135.6
Energy	0.0	0.0	0.0	0.0	0.0	0.0
Glasshouse Plant / Vegetable Production	21.3	14.5	11.6	-31.9	-20.0	-45.5
Horses	39.1	31.7	23.3	-18.9	-26.5	-40.4
Horticulture - Annual	1,312.4	829.8	774.4	-36.8	-6.7	-41.0
Horticulture - Perennial	3,177.4	2,659.6	2,758.6	-16.3	3.7	-13.2
Intensive Animals	0.0	0.0	0.0	0.0	0.0	0.0
Livestock - Non Dairy	4,754.9	5,138.9	4,761.3	8.1	-7.3	0.1
Rural Lifestyle/Residential	1,806.8	1,679.8	1459	-7.0	-13.2	-19.3
Other	939.5	639.9	713.7	-31.9	11.5	-24.0
Not irrigated	0.0	1	1	0.0	0.0	0.0
TOTAL	20,160.3	22,089.5	21,652.9	9.6	-2.0	7.4

APPENDIX 4

Water Use Licence (number) 2022/23 by Primary Land Use and Basin

WATER USE LICENCE BY INDUSTRY	LODDON RIVER	CAMPASPE RIVER	GOULBURN RIVER	BROKEN RIVER	OVENS RIVER	KIEWA RIVER	MITTA MITTA RIVER	MURRAY RIVER	TOTAL
Cropping	115	34	80	28	59	32	0	136	484
Dairy (Combined)	2	1	11	4	16	23	17	12	86
Energy	0	1	0	4	0	0	0	0	5
Glasshouse Plant / Vegetable Production	0	0	0	0	0	0	0	4	4
Horses	3	1	15	4	0	0	0	1	24
Horticulture - Annual	14	0	0	0	4	0	0	2	20
Horticulture - Perennial	19	10	30	10	70	5	0	42	186
Intensive Animals	6	0	5	0	1	0	0	0	12
Livestock - Non Dairy	28	30	94	76	179	17	35	73	532
Rural Lifestyle / Residential	161	125	516	113	125	37	29	649	1,755
Other	13	42	49	18	10	5	1	46	184
Not irrigated	64	50	84	12	4	4	0	26	244
TOTAL	425	294	884	269	468	123	82	1,755	3,536

This Technical Report can be found at

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