



Broken Groundwater Management Area Local Management Plan

October 2016

Cover image: Monitoring station and Casey's Weir located on Broken River

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Quick reference guide to the Plan rules

Rule 1 Cap on groundwater entitlement (Page 18)

Goulburn-Murray Water may issue a groundwater licence provided that in doing so it does not exceed the Permissible Consumptive Volume established for Broken Groundwater Management Area.

Rule 2 Transfer of groundwater entitlement (Page 19)

Goulburn-Murray Water may approve a transfer of groundwater entitlement under section 62 of the Act provided that relevant matters under the Act have been considered and that it accords with the following:

- (a) Entitlement may be transferred on a permanent or temporary basis within or between management zones and Basin Plan SDL units as specified below:

Zone	Can trade to	Can trade from
Broken Sedimentary Plains	<ul style="list-style-type: none"> Broken Sedimentary Plains Goulburn-Murray Sedimentary Plains SDL Unit Broken Highlands Goulburn-Murray Highlands SDL Unit 	<ul style="list-style-type: none"> Broken Sedimentary Plains Goulburn-Murray Sedimentary Plains SDL Unit
Broken Highlands	<ul style="list-style-type: none"> Broken Highlands Goulburn-Murray Highlands SDL Unit 	<ul style="list-style-type: none"> Broken Highlands Broken Sedimentary Plains Goulburn-Murray Highlands SDL Unit Goulburn-Murray Sedimentary Plains SDL Unit

- (b) The approval of a permanent or temporary transfer must not cause the sum of total entitlement to exceed the Permissible Consumptive Volume

- (c) The buyer has a bore with a metered diversion point

- (d) The seller's licensed bore/s is/are either metered or not equipped for use.

Rule 3 Record meter readings (Page 22)

Goulburn-Murray Water will read flow meters on licensed bores at least once annually and record usage in the Victorian Water Register and consider data collected as part of a review of the Plan.

Rule 4 Annual newsletter (Page 23)

By 1 October each year GMW will post on its website a newsletter reporting on groundwater resource status, licensed groundwater use and trade activity for the previous season. The newsletter will also identify the need for any changes to the Plan.

Rule 5 Review of the Plan (Page 23)

Goulburn-Murray Water will consider the need for any amendments to the Plan on a yearly basis in conjunction with the release of the annual newsletter.

If amendments are proposed that directly impact rights of access to water, Goulburn-Murray Water will consult groundwater users in the Broken GMA.

Endorsement

This local management plan (the Plan) has been developed to provide a clear operational framework for managing groundwater resources in the Broken Groundwater Management Area (GMA), and provides specific information to Goulburn-Murray Water's customers about taking and using of groundwater in this area.

The Plan fulfils Sustainable Water Strategy obligations and relevant Ministerial guidelines by explaining to Goulburn-Murray Water's customers and the broader community the specific management arrangements governing the licensed extraction of groundwater in the Broken GMA.

The development of the Plan has relied on valuable guidance and feedback from Goulburn-Murray Water's customers and key stakeholders.

This Plan aims is to provide simple and flexible rules to support groundwater use while recognising the need to protect high value environmental values such as stream baseflow and groundwater dependent ecosystems during critical dry periods. The Plan also seeks to give proactive guidance about where future groundwater development may occur.

This Plan will require periodic review particularly as the Murray-Darling Basin Plan is implemented, as changes to Victoria's groundwater management framework take effect and as information about groundwater resources in the Broken GMA improves.

Goulburn-Murray Water will continue to work with customers, local communities and other stakeholders to ensure that the Plan is reviewed and updated as necessary.



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Date: 25 October 2016



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Date: 25 October 2016

Acknowledgements

Goulburn-Murray Water (GMW) would like to express its appreciation to the Goulburn-Broken Regional Water Service Committee, the Goulburn-Broken Catchment Management Authority and the Yorta Yorta Nation for their input to the Plan, and is grateful to groundwater customers who took the time to provide feedback on groundwater resource management values and issues. This feedback has been invaluable in helping to test and refine the information contained in the Plan.

This Plan acknowledges and pays its respect to the Yorta Yorta people as the Traditional Owners of the Broken catchment. The Plan recognises and acknowledges that the Traditional Owners and their Nations have a deep cultural, social, environmental, spiritual and economic connection to their lands and waters. The Plan understands the need for recognition of Traditional Owners' knowledge and cultural values during the implementation of actions set out in this Plan.

Glossary

Term/Acronym	Description
Act	Water Act 1989 (Victoria)
AHD	The reference level for groundwater levels is the Australian Height Datum (AHD), the geodetic datum for altitude measurement in Australia. It is the mean sea level for 1966-1968 and is assigned the value of zero.
Aquifer	A geological structure or formation or an artificial land fill permeated or capable of being permeated permanently or intermittently with water;
D&S	Domestic and Stock
GMA	Groundwater Management Area
GMW	Goulburn-Murray Water Rural Water Corporation acting as a delegate of the Minister
Groundwater entitlement	Licensed volume of groundwater specified as megalitres per year
Groundwater licence	Licence issued to take and use groundwater under section 51 of the Act
L/sec	Litres per second
m	metre
ML	Megalitre or one million litres
PCV	Permissible Consumptive Volume is the volume of groundwater that the Minister has declared may be extracted from a defined area in a season
The Plan	The Broken Groundwater Management Area Local Management Plan
Season	Period of 12 months commencing 1 July
SOBN	State Observation Bore Network
Trade	Transfer of groundwater entitlement
Zone	A part of a Groundwater Management Area defined for management purposes

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1 Introduction

1.1 Background

The aim of the Broken Groundwater Management Area (GMA) Local Management Plan (the Plan) is to provide groundwater users with a system-specific management framework. The Plan has been developed by Goulburn-Murray Rural Water Corporation (GMW) using the best available technical information. Importantly the Plan has relied on information gathered from a customer survey, from discussions with the Goulburn-Broken Regional Water Service Committee representatives and via consultation with relevant stakeholder and agency groups.

Local management plans describe how GMW will manage the take and use of groundwater licensed under section 51 of the *Water Act 1989* (the Act), using powers delegated under the Act and in accordance with Victoria's *Policies for Managing Take and Use Licences*.

The development of the Plan is a requirement of Action 4.6 in the Northern Region Sustainable Water Strategy (2009) and it has been developed by GMW as part of a wider programme to ensure that formal, adaptable, risk-based groundwater management rules are in place across its entire region. The Plan will also be an important building block to enable GMW to meet its obligations under the Murray-Darling Basin Plan.

The development of this Plan also seeks to address broad community concerns, particularly prominent during the 1997-2009 drought, about the security of water supplies (both groundwater and surface water); as well as concerns about the impact of groundwater diversions on stream flows in upper catchment areas. Several groundwater resource appraisal projects have been carried out for the Goulburn-Broken catchment in the past 5 years (GHD 2010; GHD 2011). This resource appraisal work has been important in underpinning the development of this Plan.

1.2 Guiding principles

The following guiding principles have been adopted in the development of this Plan:

- The rights of existing groundwater licence holders will not be changed.
- All licenced groundwater use has equal value (whether use is for irrigation, commercial, industrial or urban supply purposes).
- While the development of this Plan considered potential impacts on surface water values from groundwater use, it does not seek to manage groundwater and surface water together.
- Where there is uncertainty over the level of risk posed by groundwater use, a conservative approach has been taken to rules about limits to new groundwater licence entitlement.
- Groundwater management should be commensurate with the level of risk to social, environmental and economic values posed by groundwater use.

1.3 Groundwater management objectives

Management objectives have been developed by considering the groundwater values in the catchment and the potential risk to these values from groundwater use.

The management objectives for Broken GMA are to:

- Provide a simple, proactive and adaptive management framework which supports the benefits of groundwater use in an equitable and sustainable manner;
- Ensure that future groundwater development does not unacceptably impact environmental assets; (such as river flow, springs and groundwater dependent ecosystems);
- Improve community understanding of groundwater management through effective communication, consultation and engagement.

1.4 Broken Groundwater Management Area

The Broken GMA comprises the Broken River catchment from south of Lake Nillahcootie to just south of the Murray River. The Broken GMA incorporates the towns of Benalla, Dookie, Katandra and Tungamah (shown in Figure 1).

Groundwater resources in the Broken GMA occur within sedimentary aquifers which form part of the Goulburn-Murray Sedimentary Plain Sustainable Diversion Limit (SDL) and fractured rock aquifers that are part of the Goulburn-Murray Highlands SDL units. Both SDL units are set by the Murray Darling Basin Plan (the Basin Plan).

The northwest of the Broken GMA is overlain by the Shepparton Irrigation Region (SIR) GMA. The SIR GMA includes groundwater resources to a maximum depth of 25 metres below the surface. Where it overlaps with the SIR GMA the Broken GMA covers groundwater resources at depths greater than 25 m from ground surface.

The Plan applies to groundwater resources to a depth of 200 m below ground surface in the Broken GMA in line with the Victorian Groundwater Management Framework (DSE, 2012), as shown in Figure 2.

Bores screened at depths greater than 200 m below ground surface are not subject to the rules outlined in the Plan. Currently there are no licensed bores greater than 200 m in depth in the Broken GMA. Future developments greater than 200 m will be managed and licensed in accordance with the Act on a case by case basis.

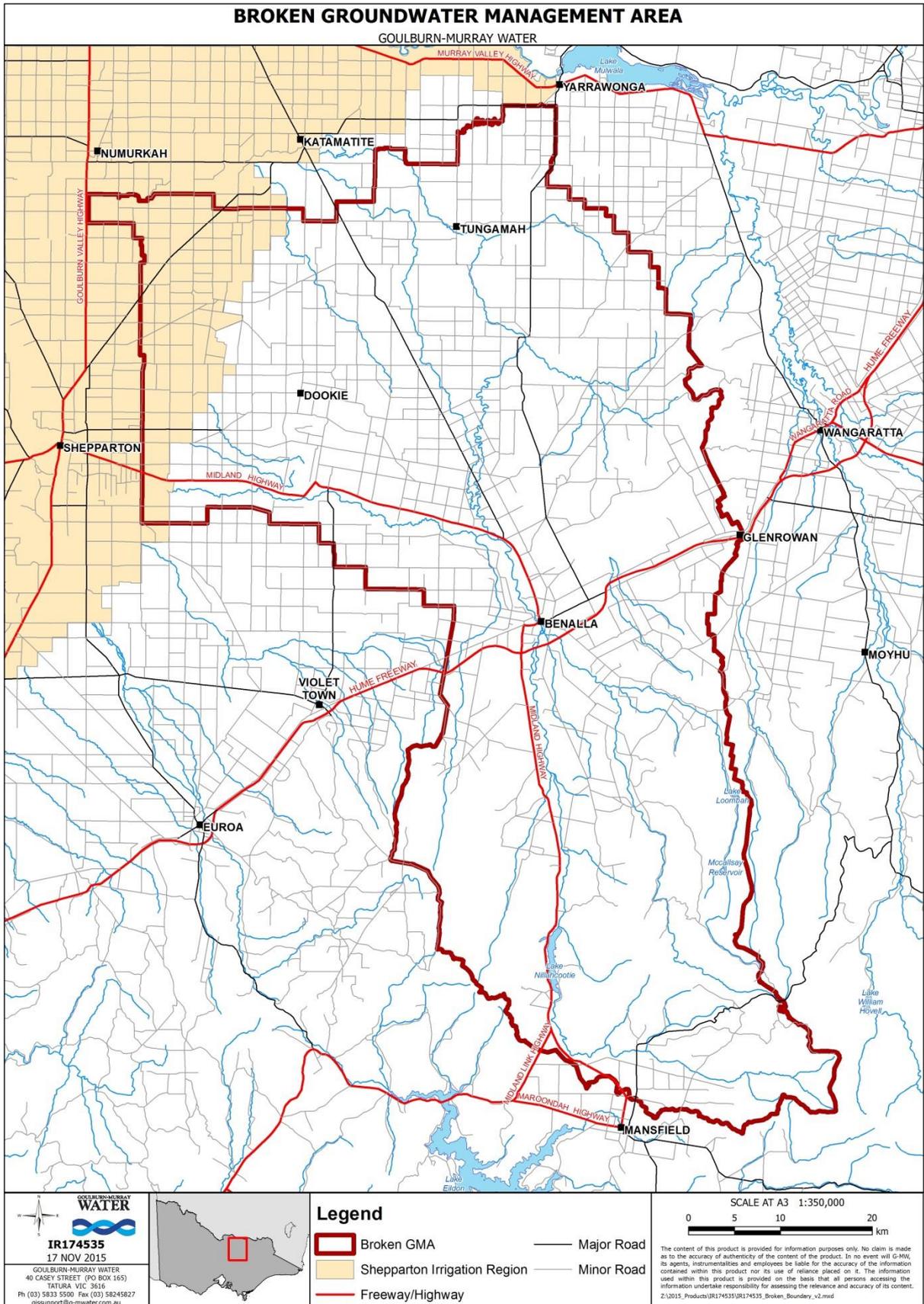


Figure 1 Broken Groundwater Management Area

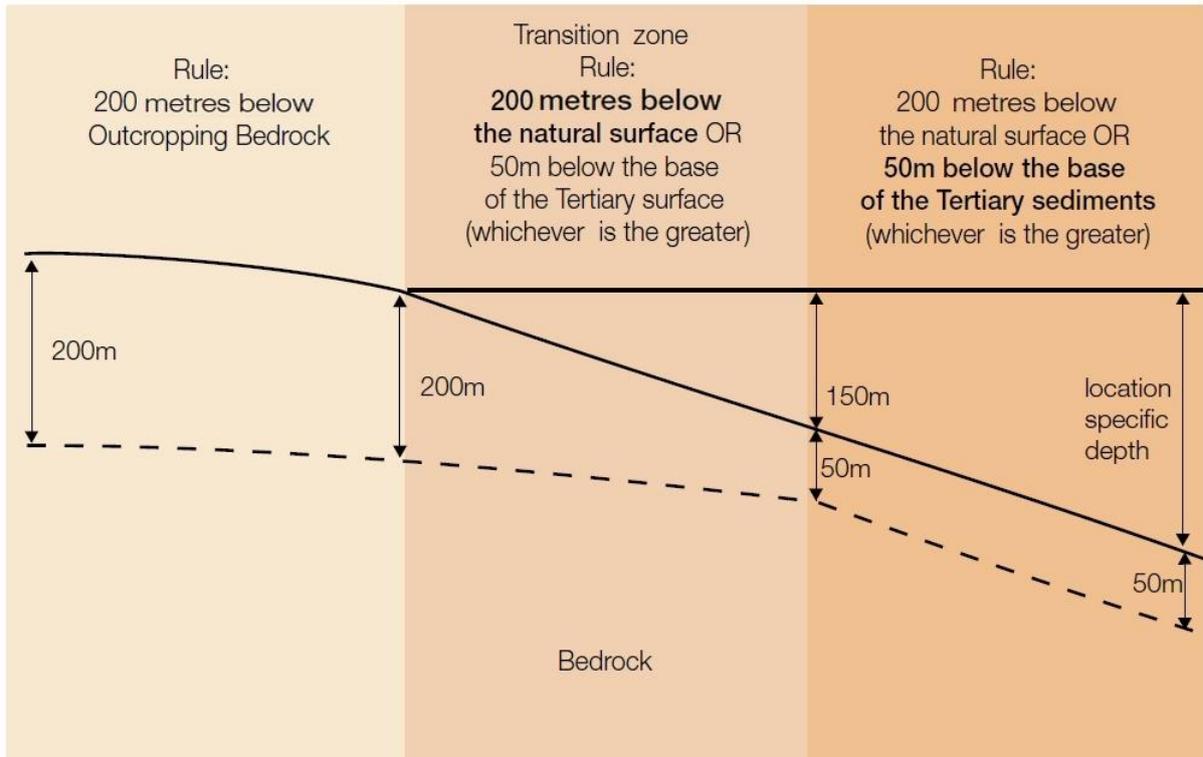


Figure 2 Groundwater management framework depth boundaries (DSE, 2012)

2 Groundwater System

2.1 Aquifers

Groundwater resources within the Broken GMA occur within two aquifer types:

- Fractured rock aquifers; and
- Alluvial aquifers.

The Basin Plan imposes limits on groundwater use in Northern Victoria through SDLs. GMW's region contains the following three SDL units defined by the Basin Plan:

- Shepparton Irrigation Region (SIR) SDL unit (all groundwater located in sedimentary formations to a depth of 25 m below groundwater surface within the SIR GMA boundary)
- Goulburn-Murray Highlands SDL unit (all groundwater found in basement bedrock/fractured rock formations)
- Goulburn-Murray Sedimentary Plain SDL unit (all groundwater found in sedimentary/alluvial formations to a depth of 200 m below ground surface, and excluding the SIR)

Of these SDL units parts of the Goulburn-Murray Sedimentary Plain (alluvial aquifers) and the Goulburn-Murray Highlands (basement bedrock aquifers) resources are managed within the Broken GMA Local Management Plan, while use in the SIR SDL Unit is addressed by the SIR GMA Local Management Plan. Further information on the SIR GMA Local Management Plan can be found on the Goulburn-Murray Water website.

2.1.1 Fractured rock aquifers (Goulburn- Murray Highlands SDL unit)

Fractured rock aquifers are present throughout much of the Broken GMA. These include Palaeozoic aged sedimentary (mudstone, siltstone and sandstone), metamorphic (schist and phyllite) and intrusive (granite) rocks.

Groundwater is stored and moves through fractures and faults in the bedrock. The highest yields occur in fracture zones and along faults; particularly where these are enhanced by weathering.

Bore yields from the bedrock aquifer are generally low (typically less than 0.5 L/sec) but can vary significantly over short distances.

The bedrock aquifer is an important source of domestic water supply for residents without access to reticulated water, and it is also used to support industrial, commercial and agricultural industries.

2.1.2 Alluvial aquifers (Goulburn- Murray Sedimentary Plain SDL)

The alluvial aquifers comprise the Upper and Lower Shepparton Formations which cover the floodplains along the Broken River and the Broken Creek downstream of Benalla.

The alluvial deposits are variable in composition, generally consisting of clays and silts with isolated lenses of sands and gravels. Permeability of the fine sediments is poor, while the more permeable gravel lenses are deposited along the ancestral Broken River valley.

2.2 Groundwater levels

Groundwater levels are monitored by the State Observation Bore Network (SOBN). In the Broken GMA, there are 37 State observation bores in the bedrock and alluvial aquifers (Figure 5).

Groundwater levels in the alluvial aquifers are typically within 0.5 m to 6 m of the ground surface. On Sharp Road at Goorambat, two SOBN bores measure the water levels within the upper and lower sections of the alluvial aquifers (Figure 3).

Figure 3 shows groundwater levels declined in the shallow and deeper alluvial aquifer in this area during the millennium drought and recovered following high rainfall in 2010 and 2011.

Groundwater levels in bedrock aquifer bores, such as those situated near Baddaginnie shown in Figure 4, indicate a steady groundwater level increase with no clear impact to groundwater levels during the millennium drought.

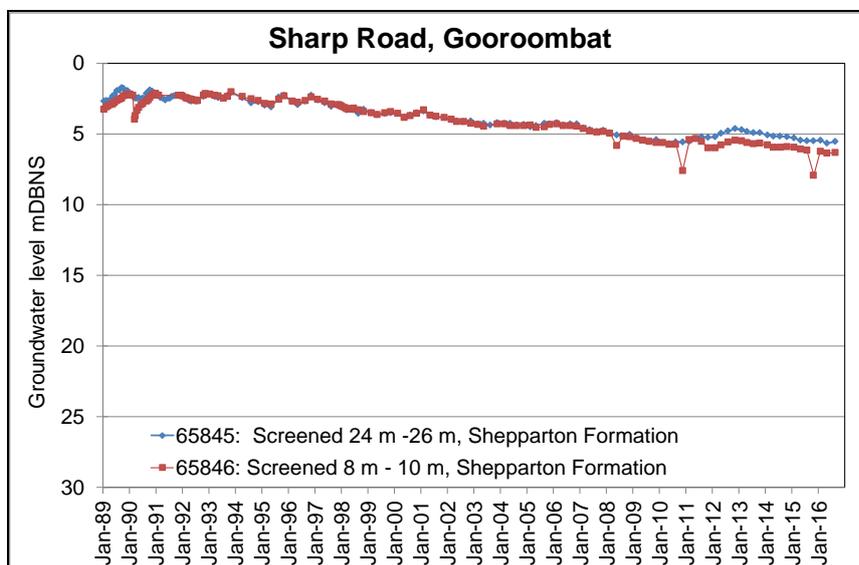


Figure 3 SOBN monitoring of the shallow and deep alluvial aquifers at Goorambat

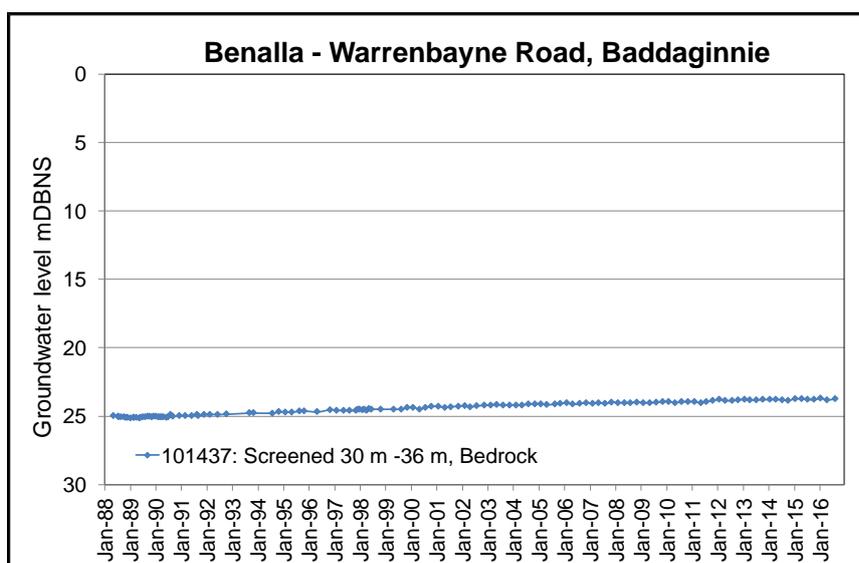


Figure 4 SOBN monitoring of the bedrock aquifer at Baddaginnie

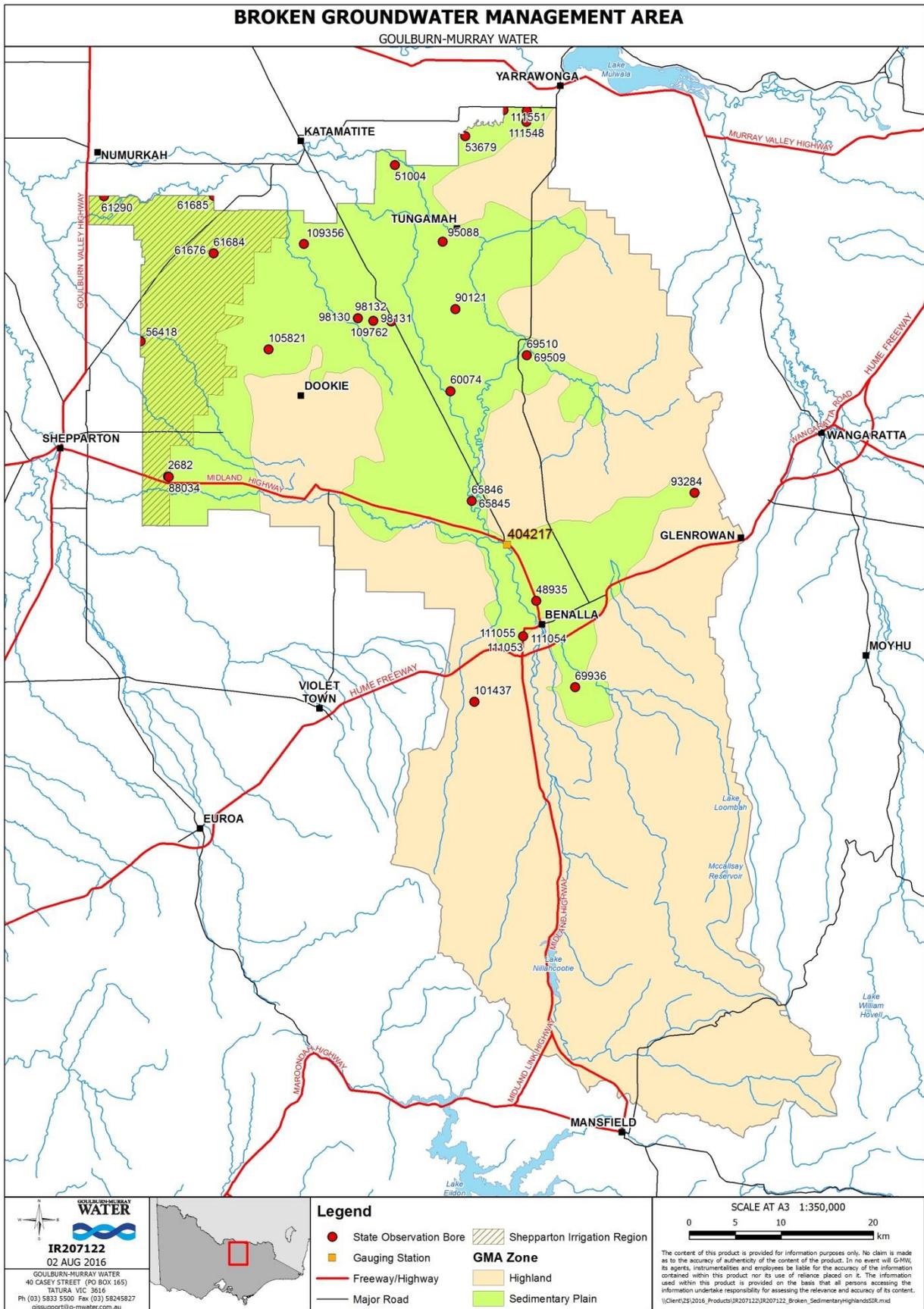


Figure 5 Management Zones and groundwater monitoring sites

2.3 Groundwater flow

Locally groundwater in the fractured rock aquifer flows from topographic high points and areas of highest rainfall to the valley floors, where it discharges into streams as baseflow.

In the bedrock aquifer groundwater flow occurs in the weathered zones and fracture zones, in the uppermost 100 m of bedrock as illustrated in Figure 6.

Regionally groundwater flows through the fractured rock aquifer from elevated areas upstream of the Lake Nillahcootie towards lower lying areas around Benalla.

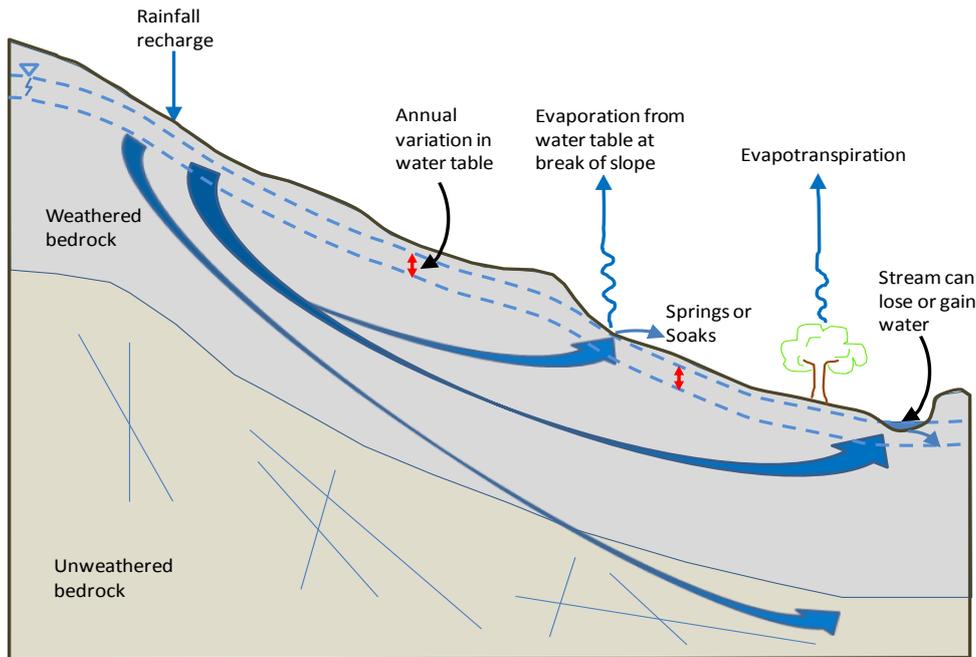


Figure 6 Groundwater flow through a bedrock aquifer

Groundwater flow in the alluvial aquifer is local and follows the gradient of the river valleys and discharges into waterways as illustrated in Figure 7.

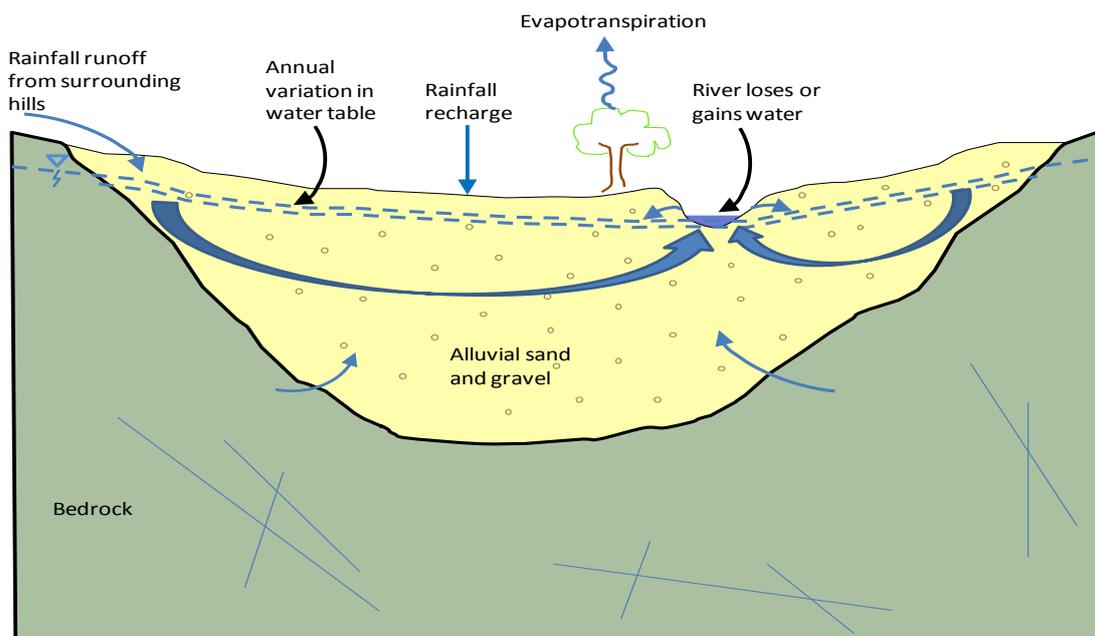


Figure 7 Groundwater flow through an alluvial aquifer

2.4 Groundwater recharge

The majority of recharge to the bedrock aquifer in the Broken GMA is from rainfall.

A significant proportion of rainfall runs over ground directly into streams, or is lost through evaporation and evapotranspiration. The remaining water moves through the ground surface and reaches the local watertable.

Where the level of water in a stream is higher than the surrounding groundwater level, some recharge is likely to occur as the stream loses water to the groundwater system. In the bedrock aquifer in the Broken GMA, groundwater levels indicate that this generally only occurs during extended dry periods.

Recharge to the alluvial aquifer occurs through rainfall and runoff from the surrounding upland bedrock, infiltration of rainfall over the sedimentary plain and leakage from the Broken River and Broken Creek. The alluvial aquifer also receives a small volume of water from the bedrock aquifer as throughflow.

2.5 Groundwater discharge

Where the water level in a stream is below the surrounding groundwater level the groundwater discharges to the stream as baseflow. In the Broken GMA groundwater in the fractured rock aquifer discharges to streams and springs in valley floors or breaks of slope where the water table is close to the surface.

Groundwater discharge to waterways is greater in the highlands where short flow paths cause recharged water to discharge quickly at local topographic lows.

Discharge into the Broken River and Broken Creek across the sedimentary plain downstream of Benalla occurs when the water table rises above the level of the river bed following prolonged rainfall.

A small volume of groundwater is extracted by bores (both licensed and domestic and stock), estimated to be less than 1% of annual average recharge over the whole GMA.

2.6 Groundwater quality

Groundwater quality is relatively fresh in the highlands of the Broken GMA with groundwater salinity less than 1,000 mg/L. However, groundwater salinity notably increases north of Benalla.

Groundwater salinity on the sedimentary plains north of Benalla tends to be between borderline potable and brackish with salinity levels ranging from 1,000 mg/L up to 35,000 mg/L (Figure 8). Potable water in the sedimentary aquifer north and west of Benalla is associated with the Broken River, which indicates groundwater is being recharged from the river.

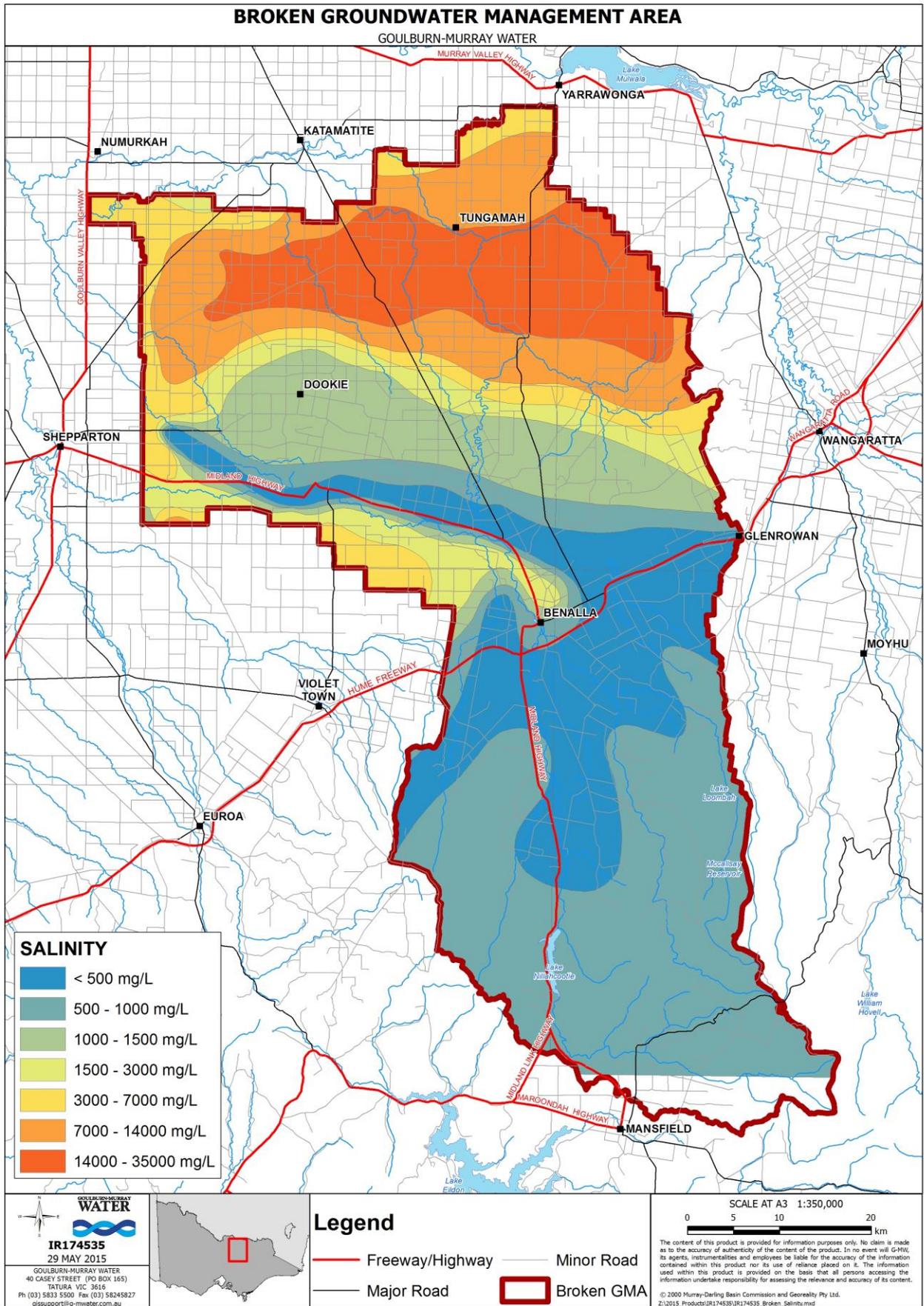


Figure 8 Groundwater salinity across Broken GMA (GHD, 2011)

3 Groundwater dependent values and licensed use

3.1 Groundwater dependent values

After consulting with key stakeholders a number of environmental, economic and social values; that are dependent on groundwater, have been identified in the Broken GMA (Table 1).

Table 1 Groundwater dependent values in the Broken GMA

Environmental	Social	Economic
<ul style="list-style-type: none"> Groundwater dependent ecosystems (riparian and terrestrial vegetation; aquatic pools; springs) Waterways Wetlands 	<ul style="list-style-type: none"> Stock and domestic groundwater use Licensed groundwater use Cultural and recreational values 	<ul style="list-style-type: none"> Economic development through use of water

Groundwater dependent values are discussed in greater detail below.

3.1.1 Groundwater dependent ecosystems

Groundwater dependent ecosystems are features that rely on groundwater to some degree for their survival.

In the Broken GMA groundwater dependent ecosystems include:

- Ecosystems dependent on surface expression of groundwater (springs, wetlands, aquatic pools, baseflow); and
- Ecosystems dependent on subsurface expression of groundwater where roots tap into the groundwater system (e.g. riparian and terrestrial vegetation).

These features are often considered to be important environmental and cultural features.

Information on the location and sensitivity to groundwater dependent ecosystems is currently limited in the Broken GMA. Where present, these features may be susceptible to changes in climate and groundwater extraction, particularly where bores are located in close proximity to such features. Impacts on groundwater dependent ecosystems are considered by GMW when assessing groundwater licence applications.

General information on groundwater dependent ecosystems (GDEs) is available from the National GDE Atlas at <http://www.bom.gov.au/water/groundwater/gde/> and GIS layers of Potential Groundwater Dependent Ecosystem Mapping for the Goulburn-Broken CMA are available through the Department of Environment, Land, Water and Planning.

3.1.2 Groundwater interaction with surface water

Groundwater discharge to surface water is variable in the Broken GMA. Groundwater can make an important contribution to baseflow, particularly in the upper reaches of the Broken River.

Baseflow to rivers supports a wide range of fauna, including native fish, invertebrates and in-stream and riparian vegetation.

The value of the Broken River catchment is highlighted in the Goulburn-Broken Regional River Health Strategy (GBCMA, 2014) with the lower, mid and upper reaches of the Broken River identified as high priority targets.

The environmental values of waterways in the Broken GMA are considered high due to the presence of a number of *Environment Protection and Biodiversity Conservation Act 1999* listed fauna such as endangered Silver Perch, Macquarie Perch, Murray Cod and Trout Cod (Figure 9), and flora found along the waterways of the Broken GMA (GBCMA, 2014).

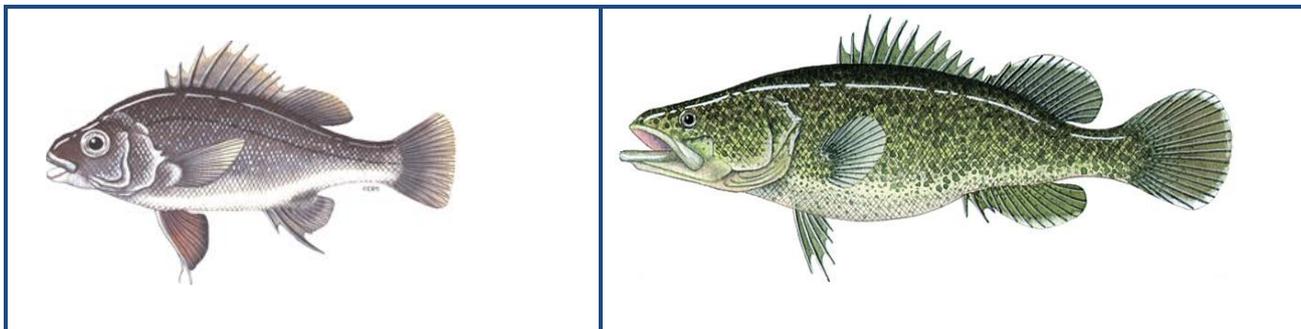


Figure 9 Macquarie Perch and Murray Cod¹

The Broken River and Broken Creek also support a wide range of other fauna, including other native fish, platypus, invertebrates and in-stream and riparian vegetation.

Waterways in the GMA are also valued for recreational and cultural purposes. These include values of the local indigenous community the Yorta Yorta Nation and Taungurung Clans, aesthetic values and activities such as fishing, swimming and camping.

The waterways are used to provide vital water supplies to urban authorities, domestic and stock users and licensed diverters, in turn supporting the local economy. Lake Nillahcootie on the Broken River also provides water security for users (Figure 10).



Figure 10 Lake Nillahcootie.

¹ These images are © State of Victoria, Department of Primary Industries. Reproduced with permission. Creator of the Macquarie Perch image is Krystii Melaine

3.2 Licensed groundwater use

Groundwater has locally significant social and economic value in the Broken GMA, particularly where groundwater resources have been developed for irrigation and commercial use.

There are currently 89 bores with an entitlement of 2,934 ML per year in the Broken GMA.

The distribution of licensed bores in the Broken Highlands zone and the Broken Sedimentary Plain zone are shown in Figure 11. Approximately 66% of groundwater entitlement volume in the Broken GMA is located in the Broken Highlands zone and 34% in the Broken Sedimentary Plain zone (Table 3). Licensed groundwater use is a small percentage of available entitlement.

Groundwater is licensed for irrigation, industrial, commercial and communal domestic purposes. Most licensed groundwater taken from within the Broken River catchment is for irrigation use.

Meters were installed between 2007 and 2009 on all licensed operational groundwater bores with an annual groundwater licence entitlement of 20 ML or more. Metered groundwater use data will continue to provide valuable information to support management decisions.

Groundwater use varies from season to season and is generally dependent on rainfall and availability of surface water. Annual metered usage is generally less than 30% of the Broken GMA's entitlement volume.

3.3 Domestic and stock use

Groundwater also holds significant social value as a resource for domestic and stock purposes, particularly in areas where there is no reticulated water supply available.

Domestic and stock use of groundwater is a statutory right under the Act and is not required to be licensed or metered. Landholders must apply to GMW for a works licence to construct a bore for domestic and stock purposes.

In the Broken GMA there are approximately 443 domestic and stock bores with an estimated use of around 886 ML/yr. This is based on the number of bores recorded in the State groundwater database as constructed for solely domestic and stock purpose and assuming each one is used to extract 2 ML/yr which is considered a conservative estimate.

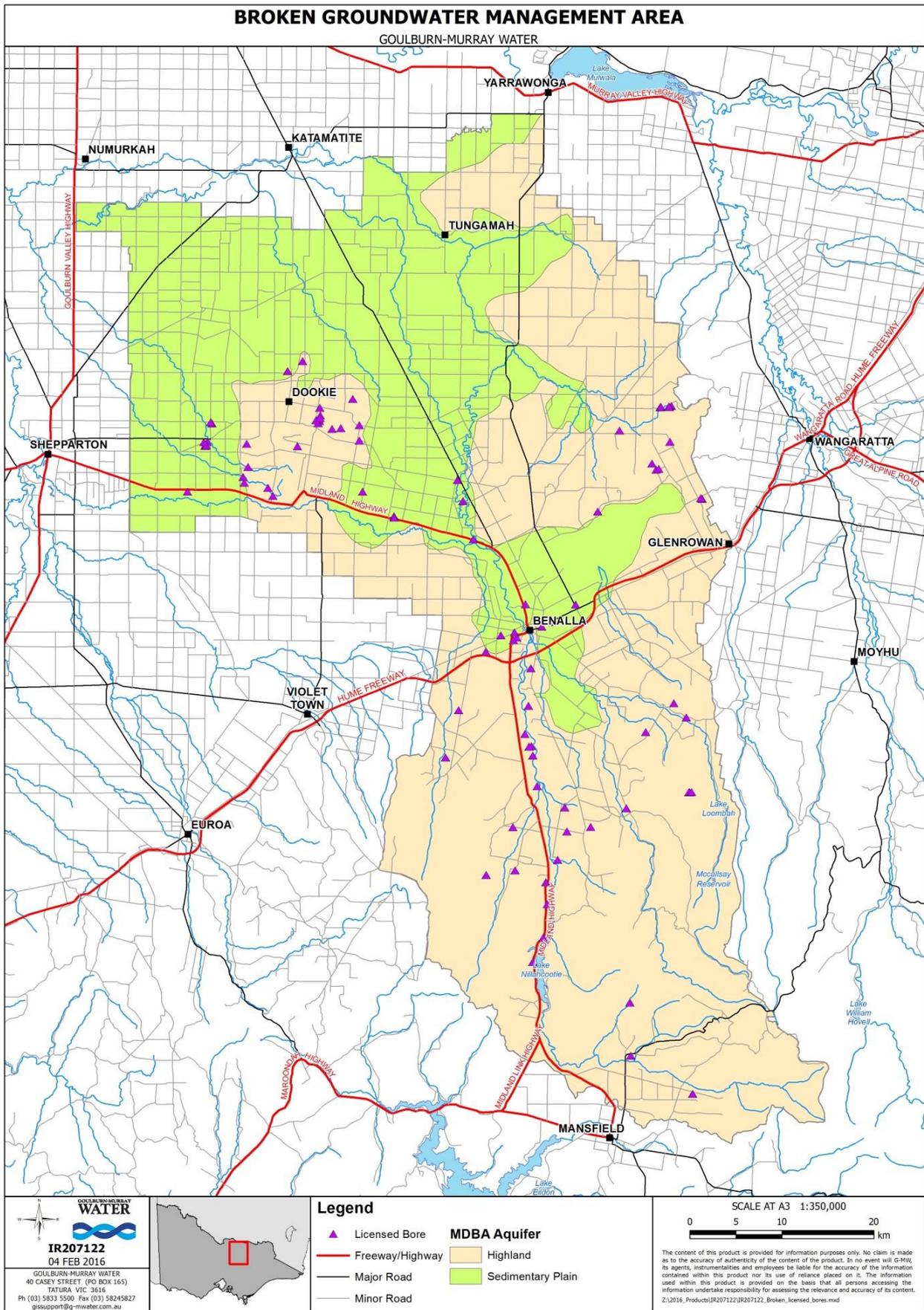


Figure 11 Licensed bores in the Broken GMA

3.4 Groundwater pumping impacts

Groundwater pumping lowers the groundwater level around the bore being pumped. This decline in groundwater level is referred to as a drawdown cone (Figure 12). The size and shape of the drawdown cone depends primarily on the nature of the aquifer as well as the pumping rate and duration. Drawdown decreases with distance from the bore, and the cone expands in size whilst pumping continues until steady-state conditions are reached (no further expansion of the drawdown).

Groundwater level interference can occur when the drawdown cone intersects a neighbouring bore or environmental feature such as a stream or a spring. The impacts from groundwater pumping are site specific as the pumping requirements are likely to be different and aquifer hydraulic characteristics can vary. The potential for interference is considered by GMW when assessing licence applications.

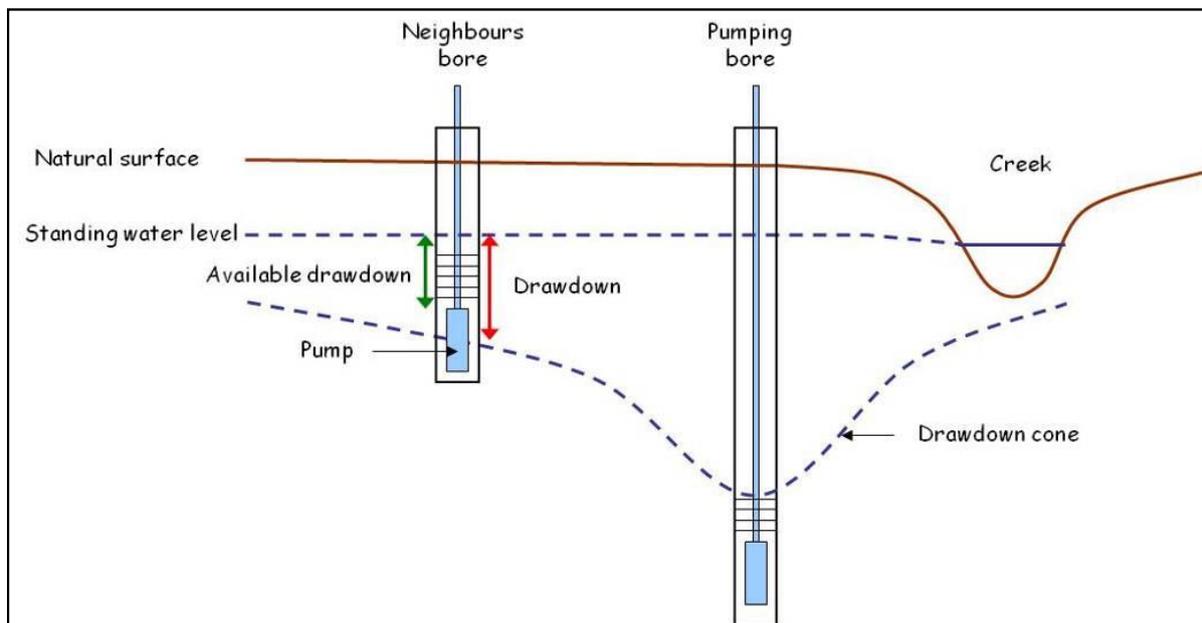


Figure 12 Drawdown cone caused by groundwater pumping

When bores located in close proximity are extracting from the same aquifer it can result in intersecting drawdown cones. Unacceptable drawdown levels can be a consequence of the cumulative impacts of a number of pumps operating in a local area (intensive groundwater pumping) (Figure 13).

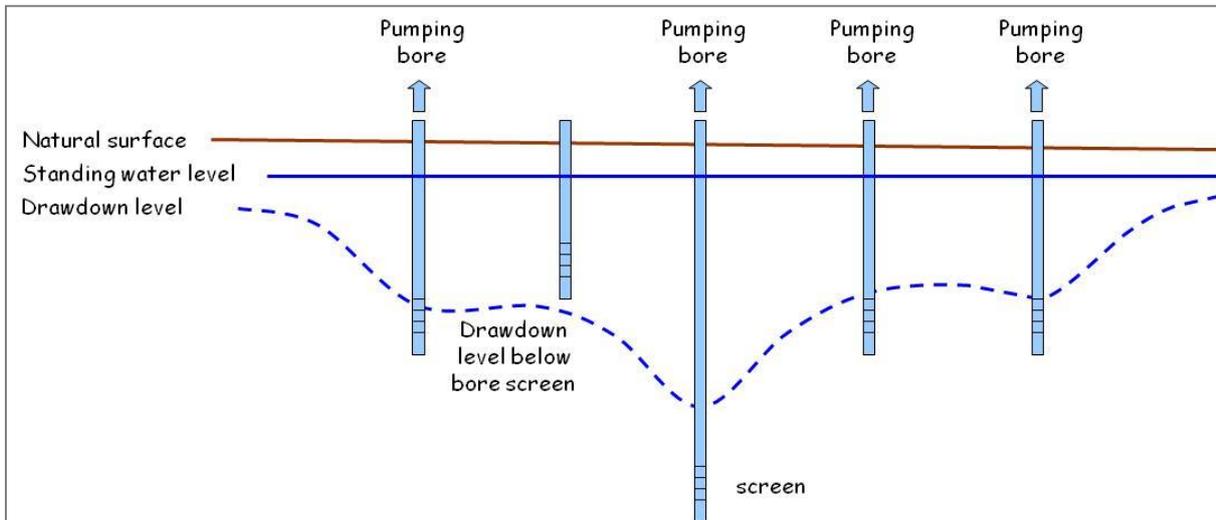


Figure 13 Interference caused by cumulative impacts of groundwater pumping

Where groundwater is extracted beyond sustainable limits at local or regional scales groundwater dependent values can be impacted. For example groundwater pumping may reduce the amount of groundwater that discharges into streams (baseflow), which can impact dry weather stream flow. It should be noted that there is generally a time lag between when groundwater is pumped and when the impacts on stream flow may occur.

4 Groundwater Management

4.1 Groundwater licensing

Bore construction and groundwater extraction are managed by GMW in accordance with the licensing provisions defined in the Act and associated Ministerial policies.

A works licence must be obtained from GMW to drill and construct a bore. Groundwater bores must be drilled by a licensed driller. The Australian Drilling Industry Association (www.adia.com.au) provides contact details of its members.

A take and use licence must be obtained from GMW to extract groundwater for irrigation, commercial, dewatering and urban use.

A range of matters will be considered by GMW when assessing both works and take and use licences, including the potential for unacceptable impacts to existing authorised users, stream flow and the environment.

If groundwater is used exclusively for domestic and stock purposes, a take and use licence is not required.

More information on groundwater licensing, including fees and charges, is available on GMW's website <http://www.g-mwater.com.au/>.

4.2 Groundwater Management Zones

The Broken GMA includes two management zones, based principally on the aquifer types described by the Basin Plan. These zones are described in Table 2 and illustrated in Figure 5.

Table 2 Groundwater Management Zones

Zone	Description
Broken Sedimentary Plains	Includes the sedimentary aquifers (alluvial aquifer) identified in the Basin Plan as occurring with the Goulburn-Murray Sedimentary Plains SDL unit.
Broken Highlands	Includes the bedrock/ fractured rock aquifers identified in the Basin Plan as occurring with the Goulburn-Murray Highlands SDL unit.

The groundwater management zones are based on Goulburn-Murray Sedimentary Plains and Highlands SDL units which enables consistency with the Murray Darling Basin Plan.

Table 3 details the number of licensed bores and entitlement volume in the Broken GMA by management zone at the time of Plan development.

Table 3 Bore and licence entitlement by zone

Management Zone	Number of Licensed Bores*	Current Licence Volume (ML/yr)*
Broken Sedimentary Plains	23	987
Broken Highlands	66	1,947
Total	89	2,934

Based on a consideration of catchment values and the Basin Plan, entitlement caps are not set for either management zone.

4.3 Groundwater entitlement availability

An assessment of the potential impacts of groundwater development on social, environmental and economic groundwater dependent values in the Broken GMA has been undertaken to inform limits on groundwater use.

A new approach was utilised to define acceptable limits on groundwater entitlement set by the Plan (GMW, 2013). The approach focusses on assessing the impact of a range of groundwater and surface water diversion scenarios on stream flows during periods of low flow.

A range of diversions can reduce stream flow, including extraction from licensed bores, domestic and stock bores, direct extraction from streams, and water harvested from farm dams. In developing this Plan consideration has been given to the potential impact of existing levels of diversions on stream flow, particularly during periods of low flow when catchment values are most at risk. Existing groundwater impacts and future groundwater extraction scenarios have been assessed against these baseline low flow conditions (GMW, 2015b).

The assessment indicated that the potential impacts from groundwater extraction are low as streams in the Broken GMA continue to flow during periods of average rainfall. Nevertheless a conservative approach has been taken in this Plan which recognises the potential for impact. Groundwater pumping impacts on stream flow are assumed to occur on a 1:1 ratio, and impacts are assumed to be spread evenly across the year. As more information becomes available and our knowledge of the groundwater systems improves this approach can be updated if necessary.

In order to protect existing authorised groundwater users and allow development of groundwater to sustainable levels, while at the same time considering uncertainties associated with the understanding of the groundwater resource, groundwater licence entitlement for the GMA will be capped through the declaration of a Permissible Consumptive Volume (PCV) (Rule 1). GMW will make an application to the Minister for Water to declare a PCV at 3,732 ML/year. Total entitlement in the Broken GMA must not exceed the PCV.

The PCV does not include domestic and stock use and GMW may seek to amend the PCV to overcome any administrative oversight, error or other anomaly which occurred prior to the approval of this Plan.

Rule 1 Cap on groundwater entitlement

Goulburn-Murray Water may issue a groundwater licence provided that in doing so it does not exceed the Permissible Consumptive Volume established for Broken Groundwater Management Area

New entitlement may be issued in the Broken Highlands management zone provided that the PCV is not exceeded. No new entitlement may be issued in the Broken Sedimentary Plains management zone, however further development may occur through transfer of groundwater licence entitlement.

4.4 Transfer of groundwater licence entitlement

Transferring groundwater licence entitlement supports new business opportunities, or enables existing businesses to grow. Licence transfer rules:

- Enable access to groundwater entitlement in zones where new groundwater licence entitlement is capped,
- Increase flexibility for licensed groundwater users to manage production in response to changes in seasonal or climatic conditions,

- Allow licensed groundwater holders to better realise the value of their licence.

Rule 2 relates to groundwater licence transfers in the Broken GMA. This rule recognises that groundwater use in the Broken GMA is presently low and provides greater opportunity for groundwater trade. Additionally the rule recognises the limits of the Basin Plan units.

Entitlement may be temporarily or permanently transferred within each zone. Entitlement may be transferred on a temporary or permanent basis from the Broken Sedimentary Plains Zone to the Broken Highlands Zone (Figure 5).

Entitlement may be temporarily or permanently transferred into or out of the Broken Highlands Zone (Figure 5) provided the PCV is not exceeded and the limits that apply to the SDL units in the Basin Plan are not exceeded. This means that entitlement may be transferred temporarily or permanently:

- between the Broken Highlands Zone and the Goulburn-Murray Highlands SDL Unit
- from the Goulburn-Murray Sedimentary Plains SDL Unit to the Broken Highlands Zone
- between the Broken Sedimentary Plains Zone and the Goulburn-Murray Sedimentary Plains SDL Unit in surrounding areas (e.g. Lower Ovens GMA, Katunga WSPA, Mid Goulburn GMA)

Temporary transfer of entitlement can occur for a period of up to five years.

When assessing temporary and permanent transfer of groundwater entitlement GMW must consider a range of relevant matters identified in the Act. These matters include the need to consider potential impacts on local environmental values and nearby groundwater users.

Licence holders should apply well in advance of requiring the water as it can take a number of weeks to process an application. The trade must be approved in writing by GMW before the water may be taken. Penalties apply for unauthorised take and use.

Rule 2 Transfer of groundwater entitlement

Goulburn-Murray Water may approve a transfer of groundwater entitlement under section 62 of the Act provided that relevant matters under the Act have been considered and that it accords with the following:

- (a) Entitlement may be transferred on a permanent or temporary basis within or between management zones and Basin Plan SDL units as specified below:

Zone	Can trade to	Can trade from
Broken Sedimentary Plains	<ul style="list-style-type: none"> • Broken Sedimentary Plains • Goulburn-Murray Sedimentary Plains SDL Unit • Broken Highlands • Goulburn-Murray Highlands SDL Unit 	<ul style="list-style-type: none"> • Broken Sedimentary Plains • Goulburn-Murray Sedimentary Plains SDL Unit
Broken Highlands	<ul style="list-style-type: none"> • Broken Highlands • Goulburn-Murray Highlands SDL Unit 	<ul style="list-style-type: none"> • Broken Highlands • Broken Sedimentary Plains • Goulburn-Murray Highlands SDL Unit • Goulburn-Murray Sedimentary Plains SDL Unit

- (b) The approval of a permanent or temporary transfer must not cause the sum of total entitlement to exceed the Permissible Consumptive Volume

- (c) The buyer has a bore with a metered diversion point

- (d) The seller's licensed bore/s is/are either metered or not equipped for use.

4.5 Carryover

Carryover is the ability for licence holders to bank some of their unused allocation from one year and use it in the following year.

Carryover can be introduced to areas where there is a good understanding of the hydrogeology, there is a desire for it amongst groundwater users and all licensed bores are metered.

In the Broken GMA not all licensed bores are currently metered, groundwater use is low and the response of aquifers to pumping is not well enough understood. It is therefore not proposed to introduce carryover at this stage.

5 Monitoring program

Monitoring, evaluation and reporting are vital to enabling adaptive and improved resource management to occur. The results of groundwater and surface water monitoring and evaluation activities directly shape future management actions and planning.

5.1 Groundwater levels

The Department of Environment, Land, Water and Planning (DELWP) manages SOBNS which monitor groundwater levels and quality throughout the State.

State observation bores in the Broken GMA (Figure 5) are monitored at either monthly or quarterly intervals. Groundwater data is publicly available online from DELWP (currently via the Water Measurement Information System).

These bores enable the groundwater resource condition to be understood, in particular:

- Groundwater interactions with surface water,
- Groundwater dependent ecosystems,
- Groundwater quality,
- Groundwater system response to recharge,
- Impacts from pumping.

Continued monitoring of groundwater levels is required to ensure our understanding of how the groundwater system responds to different stresses, such as climate change and shifts in the distribution of groundwater extractions resulting from the uptake or transfer of groundwater licences, is maintained. This in turn supports responsible resource management decision making.

Throughout the GMA there is no evidence that groundwater extraction is causing any significant reduction in groundwater levels, or is impacting upon resource availability. This is most likely due to the low intensity of use. There are relatively small seasonal changes in groundwater levels but it is considered very unlikely that this will impact upon the ability of users to access groundwater.

GMW will continue to support a baseline level of groundwater level monitoring in the Broken GMA.

5.2 Surface Water Flows

Data from a number of surface water flow gauges were used in determining acceptable groundwater entitlement limits in the Plan. These gauges are used by different stakeholders including the Bureau of Meteorology, Goulburn-Valley Water and GMW to support a range of surface water management objectives.

From a groundwater resource management perspective this data also enables estimates of groundwater discharge to be made and it provides information on the risk posed to a range of environmental, social and economic values from new groundwater licences and from groundwater licence transfers.

Surface water gauging data is publicly available online from DELWP (currently via the Water Measurement Information System). GMW will continue to use this data to estimate groundwater discharge and to assess the status of groundwater and surface water resources across the area. This data will be used to assist in any future reviews of the Plan.

5.3 Groundwater use

Recording groundwater use is an important part of resource management. Under average and wet conditions groundwater use is a small component of the total water balance of the Broken GMA and it is only slightly more significant during extended dry periods.

Currently there is only a limited amount of metered data for this area as meters have only been in place since 2009. Recording groundwater use will help to better understand the relationship between groundwater use and climate and gain a clearer indication of the volumes of groundwater

pumped in dry periods. This will help GMW assess the potential risk of pumping on surface water resources in future plan reviews.

All existing licensed and operational bores, with a licence volume equal to or greater than 20 ML are fitted with a flow meter. For any operational bore with licence volume less than 20 ML, use is estimated and recorded within the Victorian Water Register.

Meters will be read at least once annually and non-metered operational licences will be deemed. The information will be stored in the Victorian Water Register database to assist with reporting on usage and compliance as well as assisting in improving groundwater knowledge and management over time.

Rule 3 Record meter readings

Goulburn-Murray Water will read flow meters on licensed bores at least once annually and record usage in the Victorian Water Register and consider data collected as part of a review of the Plan

6 Implementation

6.1 Annual newsletter

GMW will prepare an annual newsletter for the Plan. This newsletter will summarise groundwater entitlement, use and transfers in each management zone, and the overall resource position based on available monitoring data. The newsletter will help GMW to keep customers and stakeholders informed and engaged. The newsletter will be made available on the GMW web site at: www.g-mwater.com.au.

Rule 4 Annual newsletter

By 1 October each year GMW will post on its website a newsletter reporting on groundwater resource status, licensed groundwater use and trade activity for the previous season. The newsletter will also identify the need for any changes to the Plan.

6.2 Review of the Plan

Over time this Plan will need to be adapted in response to policy changes in groundwater resource management, as our understanding of the aquifer system increases and as management improvements are identified.

At the time of the development of this Plan, implementation of the Basin Plan had commenced. This Plan may need to be reviewed to ensure it is kept up to date and reflects the requirements of the Basin Plan.

Each year during the preparation of the annual newsletter GMW will consider the need to make amendments to the Plan.

Any significant changes to the Plan must be based on sound technical understanding of the issues and will require consultation.

Rule 5 Review of the Plan

Goulburn-Murray Water will consider the need for any amendments to the Plan on a yearly basis in conjunction with the release of the annual newsletter.

If amendments are proposed that directly impact rights of access to water, Goulburn-Murray Water will consult groundwater users in the Broken GMA.

7 References

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