# Eildon Dam to Killingworth

## At a glance

The flow footprints constraints work is investigating are 12,000–20,000 megalitres/day (ML/d) between Eildon Dam and the Killingworth gauge on the Goulburn River, including the flow contributions of tributaries. Extended duration releases from Lake Eildon and releases on top of high tributary flows are not being investigated. Flow footprints higher than 20,000 ML/d are not being investigated, which are large events like 2010 which reached over 40,000 ML/d at Trawool. The overbank flows that constraints work is looking at occurred more frequently in the past.

Feedback from local councils and landholders was that the 12,000 ML/d flow footprint map looked about right and would not be expected to cause too many issues. However, the 15,000 ML/d and 20,000 ML/d flow maps underestimate the flow footprint.

Initial feedback from landholders suggests that up to a maximum 12,000 ML/d flow footprint around Molesworth and a 15,000 ML/d flow footprint elsewhere in the subreach may be a tolerable level of inconvenience flooding if suitable mitigation measures are put in place. Flows of up to 12–15,000 ML/d could be created by releases from Eildon with no tributary inflows, tributary flows on their own, or a mix of tributary flows and Eildon releases.

### **Reach characteristics**

This subreach flows from Eildon Dam to the Killingworth gauge (405329) on the Goulburn River (Figure 15). Water in this stretch of river comes from releases from Eildon Dam and inflows from several unregulated tributaries. The quick rising and falling, or 'flashy', Rubicon River, Acheron River, Spring Creek, and Home Creek all enter this stretch of Goulburn River.





Figure 15 Eildon Dam to Killingworth subreach



One flood gauge used for Bureau of Meteorology flood forecasting purposes is located in this subreach: station number 405203 at the Goulburn River downstream of Eildon Dam. The river flows for the Goulburn River gauge at Eildon between 1979 and 2013 can be seen in Figure 16. Because this flood gauge is close to Eildon Dam, it provides a history of the releases from the dam but doesn't provide a clear picture of the range of flows that have been experienced over the entire Eildon to Killingworth subreach due to flows from unregulated tributaries. Although outside the subreach, the Trawool flood gauge, station number 405201 has been included at Figure 17 to show the range of flows that passed through the subreach incorporating a variable combination of Lake Eildon releases and tributary inputs.



MDBA = Murray-Darling Basin Authority; ML = megalitre

Note: The shaded box outlines the range of flows that constraints work is investigating (12–20,000 ML/day). The flood categories (minor, moderate and major floods) are as defined by the Bureau of Meteorology, noting that flood categories are linked to specific gauges. As you move away from the gauge, the river situation can be quite different from what is being recorded at the gauge.

#### Figure 16 Flows in the Goulburn River at the Eildon gauge, 1979–2013

![](_page_3_Figure_2.jpeg)

#### Figure 17 Flows in the Goulburn River at the Trawool gauge, 1979–2013

Eildon Dam was constructed in the 1950s to replace the original Sugarloaf Dam and increase water storage, and is very effective at providing flood protection for those living downstream of the dam. Only one major flood at the Eildon gauge has occurred since 1980, peaking at more than 5.0 metres and flowing at more than 40,000 ML/day. However, there have been several major floods further downstream in the subreach due to unregulated tributary flows (e.g. January 2011, September 2010). The overbank flows below and in the minor flood range that constraints work is looking at have occurred occasionally in the past. These historical data are presented in Table 6.

A range of flows has been provided as background context for the river levels that people have experienced first-hand. Some are far larger and more damaging than the flow footprints constraints work is investigating; they are not the aim of this Strategy. Smaller historical events are also included in Table 6 that are in the range of the managed overbank flow footprints being investigated. This is so people can think about the types of effects that have occurred at flows of these sizes.

![](_page_4_Picture_1.jpeg)

 Table 6
 Examples of recorded flows for the Eildon to Killingworth subreach

| Date          | Season      | Lake<br>Eildon,<br># 405203,<br>(ML/d) | Assume<br>1–2 day<br>travel<br>time | Trawool,<br># 405201,<br>(ML/d) | Difference<br>between<br>Trawool<br>and Lake<br>Eildon<br>flows<br>(ML/day) | Amount of<br>tributary<br>contribution | Is constraints<br>work<br>investigating<br>these kinds of<br>flow<br>footprints? |
|---------------|-------------|--|-------------------------------------|---------------------------------|---|--|--|
| Historical su |             |  |                                     |                                 |   |  |  |
| 25/02/2006    | Summer      | 12,793                                 | $\rightarrow$                       | 10,812                          | -1,981  | Very little/none                       | yes  |
| 12/01/2006    | Summer      | 10,970                                 | $\rightarrow$                       | 11,363                          | +393  | Small                                  | yes  |
| 17/02/2004    | Summer      | 11,519                                 | $\rightarrow$                       | 8,755                           | -2,765  | Very little/none                       | yes  |
| 18/03/2002    | Autumn      | 11,067                                 | $\rightarrow$                       | 7,735                           | -3,332  | Very little/none                       | yes  |
| 19/12/2001    | Summer      | 12,122                                 | $\rightarrow$                       | 10,223                          | -1,899  | Very little/none                       | yes  |
| 8/02/2001     | Summer      | 11,165                                 | $\rightarrow$                       | 9,913                           | -1,252  | Very little/none                       | yes  |
| 3/02/2000     | Summer      | 12,100                                 | $\rightarrow$                       | 9,706                           | -2,394  | Very little/none                       | yes  |
| 4/04/1999     | Autumn      | 12,801                                 | $\rightarrow$                       | 9,361                           | -3,440  | Very little/none                       | yes  |
| 12/12/1998    | Summer      | 11,934                                 | $\rightarrow$                       | 10,449                          | -1,485  | Very little/none                       | yes  |
| 9/01/1998     | Summer      | 11,183                                 | $\rightarrow$                       | 10,506                          | -677  | Very little/none                       | yes  |
| 10/03/1995    | Autumn      | 11,385                                 | $\rightarrow$                       | 10,222                          | -1,162  | Very little/none                       | yes  |
| 10/12/1992    | Summer      | 12,747                                 | $\rightarrow$                       | 14,693                          | +1,946  | Small                                  | yes  |
| 2/02/1992     | Summer      | 11,492                                 | $\rightarrow$                       | 10,062                          | -1,430  | Very little/none                       | yes  |
| 5/03/1991     | Summer      | 11,573                                 | $\rightarrow$                       | 10,898                          | -675  | Very little/none                       | yes  |
| 21/02/1975    | Summer      | 11,918                                 | $\rightarrow$                       | 9,034                           | -2,884  | Very little/none                       | yes  |
| Historical su | breach flow | s around 15,                           | 000 ML/day                          | 1                               |   |  |  |
| 27/09/1991    | Spring      | 15,210                                 | $\rightarrow$                       | 21,115                          | +5,905  | Moderate                               | yes  |
| 4/11/1989     | Spring      | 15,076                                 | $\rightarrow$                       | 19,364                          | +4,288  | Moderate                               | yes  |
| Historical su | breach flow | s around 20,                           | 000 ML/day                          | /                               |   |  |  |
| 7/01/1997     | Summer      | 17,819                                 | $\rightarrow$                       | 10,673                          | -7,147  | Very little/none                       | yes  |
| 10/10/1996    | Spring      | 17,304                                 | $\rightarrow$                       | 23,902                          | +6,598  | Moderate                               | yes  |
| 1/09/2005     | Spring      | 227                                    | $\rightarrow$                       | 20,010                          | +19,783   | Large                                  | yes  |
| 25/07/2003    | Winter      | 210                                    | $\rightarrow$                       | 19,047                          | +18,837   | Large                                  | yes  |
| 25/09/1998    | Spring      | 337                                    | $\rightarrow$                       | 18,471                          | +18,134   | Large                                  | yes  |
| 8/08/1995     | Winter      | 619                                    | $\rightarrow$                       | 18,467                          | +17,848   | Large                                  | yes  |
| 12/09/1988    | Spring      | 191                                    | $\rightarrow$                       | 21,281                          | +21,090   | Large                                  | yes  |
| 24/10/1986    | Spring      | 194                                    | $\rightarrow$                       | 20,851                          | +20,657   | Large                                  | yes  |
| Historical su |             |  |                                     |                                 |   |  |  |
| 15/01/2011    | Summer      | 128                                    | $\rightarrow$                       | 28,432                          | +28,304   | Very large                             | no   |
| 7/09/2010     | Spring      | 434                                    | $\rightarrow$                       | 40,411                          | +39,977   | Very large                             | no   |
| 3/10/1996     | Spring      | 1,189                                  | $\rightarrow$                       | 35,445                          | +34,256   | Very large                             | no   |
| 7/10/1993     | Spring      | 46,626                                 | $\rightarrow$                       | 51,709                          | +5,083  | Moderate                               | no   |
| 20/09/1975    | Spring      | 44.767                                 | $\rightarrow$                       | 56.131                          | +11.364   | Large                                  | no   |

9/1975Spring44,767 $\rightarrow$ 56,131+11,364Largeno\* Note that flood categories are linked to specific gauges. As you move away from the gauge, the river situation can be quite different from what is being recorded at the gauge.

![](_page_5_Picture_1.jpeg)

Goulburn–Murray Water manages the day-to-day river operations of Eildon Dam to limit flows to 2.5 metres at the river gauge, equivalent to flows of 9,500 megalitres/day (ML/d) (outside of flood operations). This is to prevent water moving onto private land in the Molesworth region where the channel capacity of the Goulburn River is low (natural restriction or choke point). This kind of release is only performed when there is very little flow coming down the tributaries (Acheron, Yea, etc.).

Due to the steepness of the local topography, rainfall can rapidly increase flows in several tributaries downstream of the Eildon gauge, and these flows can affect riverbank farmers and communities between Eildon and near Yea. Water releases from Eildon Dam are therefore not made when there are high flows coming down the tributaries.

# What flows are being considered

Constraints work is investigating flow rates of between 12,000 and 20,000 ML/d (Table 7, and as indicated by the shaded box on Figure 16).

This would be overbank flows up to around the minor flood level range. At below minor flood level, river levels are not high enough to trigger emergency management or flood warnings from the Bureau of Meteorology. At minor flood level, there is some inconvenience. Low-lying areas next to rivers and creeks start to get inundated, requiring the removal of stock and equipment. Minor roads may be closed and low-level bridges submerged (see also 'What is the Constraints Management Strategy?').

Constraints work is **not** considering flows at moderate or major flood levels. Flows significantly higher than the minor flood level range are damaging and disruptive, and outside the bounds of active river management. Constraints work is collecting information about what effects river flows have at different places along the Goulburn River, but only up to the minor flood level range.

| Measure                            | Flow foot<br>for the E<br>subreach<br>contrib | prints bein<br>ildon to Ki<br>(that inclu<br>ution of tril | g looked at<br>llingworth<br>de the flow<br>butaries) | Eildon<br>gauge,<br>Minor flood<br>level <sup>1</sup> | Eildon<br>gauge,<br>Moderate<br>flood<br>level <sup>1</sup> | Eildon<br>gauge,<br>Major<br>flood<br>level <sup>1</sup> |
|------------------------------------|---|--|---|---|---|--|
| Flow rate<br>(megalitres/day)      | 12,000  | 15,000   | 20,000  | 14,500  | 25,980  | 39,380   |
| e.g. Eildon<br>Gauge height<br>(m) | 2.8   | 3.1  | 3.5   | 3.0   | 4.0   | 5.0  |

# Table 7Comparison of flow footprints being investigated for the Eildon to Killingworthsubreach and flood categories at the Eildon gauge

<sup>1</sup> As defined by the Bureau of Meteorology, noting that flood classes are linked to specific gauges. As you move away from the gauge, the river situation can be quite different from what is being recorded at the gauge.

# $\sum$

# What these flows look like

Linking a gauge reading at Eildon with the actual flow downstream is not always accurate, because of the effect of tributaries inflows and localised rainfall run-off. To assist MDBA to understand how landholders and community assets could be affected by different flows, flow footprint maps were developed to help visualise the flows.

Flow footprint maps were created using hydraulic models to show how flows of different sizes move down the river and spread across the landscape. Flow footprint maps let you look at what is likely to get wet for different-sized river flows, not tied to particular river gauges.

When interpreting the maps, it is important to bear in mind that they are from a model of a generalised event, not a real event. Therefore, some caution should be used when interpreting the 'typical flow' footprints presented in this report. They are not intended to mimic real flow events, but to be an initial representation of what could get wet for a flow of a particular size.

Figures 18a and b show flow footprint maps for 12,000, 15,000 and 20,000 ML/d flows downstream of Eildon Dam. The maps clearly show the old Goulburn River course near Alexandra becoming active at all flow rates (the breakaway), and areas of localised overbank flooding between Alexandra and Molesworth.

Feedback from local councils and landholders was that the 12,000 ML/d flow footprint map looked about right and would not be expected to cause too many issues.

However, the 15,000 ML/d and 20,000 ML/d flow maps underestimate the flow footprint. For example, Breakaway Caravan Park noted that the 20,000 ML/d map shows most of the caravan park dry, when in reality a large area would be underwater. In particular, it was suggested that there would be a lot more water on the flats around Molesworth, Killingworth, and upstream of Ghin Ghin Bridge.

Further, due to modelling assumptions, the maps did not capture the possible effect of the tributaries backing up (not being able to drain freely due to high Goulburn River levels). If work in the Goulburn proceeds, then additional modelling of potential inundation for landholders in tributaries should be included.

The accuracy of the maps is currently limited by the amount of data available to calibrate the hydraulic model. Mapping accuracy is a particular issue for the mid-Goulburn, as calibration data to reflect the complexity of the river channel were limited. The maps should therefore be viewed as a first estimate, with more accurate mapping required.

![](_page_7_Picture_1.jpeg)

![](_page_7_Figure_3.jpeg)

![](_page_7_Figure_4.jpeg)

# Figure 18 a and b

Flow footprints for flows of 12,000, 15,000 and 20,000 megalitres (ML)/day between Eildon Dam and Killingworth

# **Tributaries**

The tributaries in the Goulburn have different characteristics and therefore different effects on the flow of the main Goulburn stem. Water Technology analysed historical flow data in the Goulburn River and its tributaries to provide a general, though incomplete, understanding of the tributaries in the Goulburn catchment. This information is summarised for each tributary below.

# **Snobs Creek**

Snobs Creek has a catchment area of 51 km<sup>2</sup>. The creek has one gauge at Snobs Creek Hatchery. This gauge has 41 years of instantaneous data (Figure 19), classified as 'poor' because there are a lot of missing data (from a 41 year record, 1987 to 2007 is missing and the rest is patchy).

![](_page_8_Figure_6.jpeg)

Figure 19 Average daily water flow in Snobs Creek at Snobs Creek hatchery (gauging station 405257), December 1980 – December 2013

# **Rubicon River**

The Rubicon River has a catchment area of 129 km<sup>2</sup>. The catchment is steep and rocky, and includes the Royston River, which joins the Rubicon River at Rubicon. The Rubicon River has one gauge at Rubicon. This gauge has 31 years of instantaneous data, classified as 'good'. The mean daily flow for July–November is 492 ML/d (Figure 20). The Mean of the Seasonal max flow is 2,578 ML/day. The Rubicon River contributes 6.5% of the Goulburn flow at Trawool. The 'peakiness' ratio value of the catchment is 5.34.

![](_page_9_Figure_4.jpeg)

Figure 20 Average daily water flow in Rubicon River (gauging station 405241), December 1980 – December 2013

# **Acheron River**

The Acheron River has a catchment area of 619 km<sup>2</sup>. The Acheron River has one gauge at Taggerty. This gauge has 32 years of instantaneous data, classified as 'good'. The mean daily flow for July–November is 1,367 ML/d (Figure 21). The Acheron River contributes 18% of the Goulburn flow at Trawool. The 'peakiness' ratio value of the catchment is 3.94. It has a relatively high 'base flow index' value (0.71) which means there is large base flow (groundwater) contribution to flows at this site (Taggerty) consistent with the strongly perennial nature of the flow regime of streams in this area.

![](_page_10_Figure_4.jpeg)

Figure 21 Average daily water flow in Acheron River at Taggerty (gauging station 405209), December 1980 – December 2013

# **Home Creek**

Home Creek has a catchment area of 187 km<sup>2</sup>. The creek has one gauge with 28 years of instantaneous data, classified as 'fair to good'. The mean daily flow for July–November is 138 ML/d (Figure 22). The creek contributes 1.8% of the Goulburn flow at Trawool. The 'peakiness' ratio value of the catchment is 43.40, however a number of major floods affect this data.

![](_page_11_Figure_4.jpeg)

Figure 22 Average daily water flow in Home Creek at Yarck (gauging station 405274), December 1980 – December 2013

![](_page_12_Picture_1.jpeg)

# What could be affected by these flows

The following information about what might happen at different river levels is a guide only. Information has been sourced from community feedback, local flood guides and council reports, where available.

**Below minor flood level** — examples of areas affected by overbank flows below minor flood level include:

- Breakaway Caravan Park's river flats start to get wet
- localised flooding in low-lying rural paddocks, especially around Molesworth
- Goulburn River is brimming at Molesworth at around 12,000 ML/d.1

**Minor flood level** — examples of areas affected by overbank flows around minor flood level include:

- old Goulburn River at Thornton floods
- localised flooding in rural paddocks throughout the subreach impeding access for stock and causing pasture management and drainage issues
- Breakaway Caravan Park's river flats and mini golf area start to flood
- drainage issues start at trout farm
- lagoons at Molesworth flooded
- Molesworth Caravan Park's low areas start to get wet
- stormwater drainage in Molesworth starts flooding.

Low-lying river flats, caravan parks and recreation reserves near the townships of Thornton and Molesworth and the old Goulburn River course near Alexandra are particularly vulnerable to overbank river flows because the channel capacity is limited at these locations.

# What the community thinks about the suggested flows

Initial feedback from landholders suggests that less than a 12,000 ML/d flow footprint around Molesworth and less than a 15,000 ML/d flow footprint elsewhere in the subreach may be a tolerable level of inconvenience flooding if suitable mitigation measures are put in place. The flow footprints of up to 12,000 ML/d to 15,000 ML/d may occur through a combination of releases from Eildon with no tributary inflows, tributary flows on their own, or a mix of tributary flows and Eildon releases. More detail on risks and successful combinations of tributary inflows and Eildon Dam releases is required.

Impacts include:

- 12,000 ML/day footprint will cause private property impacts, especially around Molesworth (water through anabranches isolating paddocks); these are potentially tolerable if suitable mitigation measures in place first
- **15,000 ML/day footprint** will cause significant private property impacts and disruption around Molesworth (paddocks under water, impeded access) and some private property

<sup>&</sup>lt;sup>1</sup> This is often when water level is 5.2 m at the Goulburn River gauge at Ghin Ghin. The flow history for the Goulburn River at Ghin Ghin has not been included in this report, as the Ghin Ghin gauge has only been operational since September 2001 and is not part of the Bureau of Meteorology's flood warning system.

impacts that will be widespread elsewhere along the subreach (water through anabranches isolating paddocks)

 20,000 ML/day footprint — is considered an untenable level of impact along the subreach, including widespread and significant inundation between Thornton and Killingworth (paddocks under water, impeded access, loss of productive use of the river flats).

Given that Molesworth would be one of the first affected areas, several farm and business visits were made in April–May 2015 to better understand potential farm level impacts. An initial landholder case study describing potential impacts at different flow footprints is included at the end of this subreach report.

Local councils and landholders in this region provided a number of other key points in relation to considering any change to regulated river flows.

#### Effects

In the mid-Goulburn, the main issue is about the risk of the flow getting higher than you intended, because of all the 'flashy' unregulated tributaries involved. Flows quickly rise and fall in a matter of hours in these creeks and rivers after rain events. There is not a lot of warning and people have been caught out by rapidly rising water when trying to move stock to higher ground.

There can be backing-up effects in tributaries, depending on how high the Goulburn River is running. This affects the river flats of properties along the tributaries, not just properties along the Goulburn River.

I welcome floods, but they come up and down quickly, and there can be 4 or 5 tributary floods in a year. However, environmental flows in the Goulburn must be careful not to cause extended backing up in the tributaries. This happened in 2012 because of the long duration of Eildon pre-releases (8–9,000 ML/d for several weeks) — the Yea couldn't get away and ran a banker for weeks and flooded out for more than 10 days. Duration is a key issue. The concern for tributary landholders is that extended environmental releases from Eildon Dam could behave like pre-releases during flood operations and cause backing-up flooding in tributaries. In the future, perhaps GMW [Goulburn–Murray Water] could vary the pre-release to avoid prolonged inundation; for example, high-low-high releases. The low release period would allow the tributaries to drain away.

Bank erosion and slumping are issues, especially in winter when the riverbank is wet. Higher flows more often could increase riverbank erosion and decrease water quality.

There have been significant investment in riverbank tree plantings and these can be at risk (depending on species, and life stage or size) of being killed if they are wet for too long or if the flows are too fast.

![](_page_14_Picture_1.jpeg)

At about 8,000 ML/d, flow starts going down the old course of the river, effectively turning the Goulburn into two rivers.

We entered our business on the knowledge of the risk profile based on Eildon Dam being in existence. If humans are now trying to change how the dam is managed, then that will change the risk profile and it will affect businesses and their practices. This is especially the case directly below Eildon Dam before any of the tributaries come in.

Thornton is still on septic, so it is critical that flows do not hit this level. However, noting that the flows that get Thornton wet would be much larger than 20,000 ML/d.

It is not necessarily inundation that is the problem. Drainage can be an issue at high river flows, and at certain river levels some businesses have to switch to using pumps to get rid of excess water rather than allowing gravity to do its work (e.g. the Eildon trout farm uses pumps to get rid of extra water flowing through the fish farm when flows get above 15–20,000 ML/d).

Groundwater is connected to the river in some places by a gravel layer about 10 feet below ground. Some wetland water levels go up and down with the river level, whereas others don't.

Having a flood on the river flats can have some benefits for productivity and ecologically, SO LONG as it doesn't stay too long.

#### Access

At Molesworth Caravan Park, water comes up around the oval at around a 10,000 ML/d release from Eildon Dam (plus a little bit coming down from the tributaries — about 2,000 ML/d maybe). There is a high piece of ground and a low piece of ground. Anyone that wants to put the van on the low piece of ground does so at their own risk. They set up on these 'annual holiday sites' and they are not permanently occupied. They are weekenders, although many now have awnings and semi-permanent fixtures. When a flood comes through often people just wait for it to pass and clean out afterwards.

#### Management

Back a few years ago, Goulburn–Murray Water used to allow 12,000 or 13,000 ML/d releases from Eildon when the tributaries were dry. That type of flow would look absolutely different to an event when they release 7,000 or 8,000 ML/d and the tributaries are also contributing. It is vital that the tributaries are properly understood.

We need to have better forecasting for how the unregulated tributaries behave. A good understanding of the flow characteristics for each of the different rivers and

![](_page_15_Picture_1.jpeg)

creeks that join the Goulburn River will be essential. This is so that river operators have enough confidence and forecasting power to safely add Eildon Dam releases to tributary flows.

A number of properties and infrastructure assets in the mid-Goulburn are already protected from nuisance flooding by levees and/or raised floors.

There are remnants of levees in the mid-Goulburn. Indeed levees on the riverbanks may have been the reason that the Goulburn has a breakaway near Alexandra. Two stories for the origin of the breakaway were heard — it was a neighbourly dispute with landholders on opposite sides of the riverbank building up the levees in competition until eventually one side blew and the breakaway formed with a new river course. Another version is that the breakaway started in 1912 following a big flood (the watercourse went through three properties, splitting them up). The breakaway was then further entrenched by feuding farmers raising levees on their own property to prevent flooding.

# Landholder case study — Molesworth

The flow footprints being investigated in the Strategy affect landholders along the Goulburn differently. Molesworth is of significance as a natural 'pinchpoint'. Molesworth is the location along the Goulburn where riverbank landholders would first start to be affected by higher managed flows. Given this, and recognising the significance of landholder knowledge, a number of farm and business visits were made in April–May 2015 to better understand potential impacts of higher managed flows at a farm level.

Families living along the Molesworth river flats have been observing and caring for the river, lagoons and flats for much of their lives. A good number of Molesworth families have lived in the area for many generations; our family alone has been farming here from 1901.

The farmers here have walked every inch of the river lands in all weather conditions. They've learnt how the tributaries work alongside the river and the billabongs, ponds and lagoons. They've seen the damage potential and the health of the river and its systems. They've watched the river flats through droughts and also floods, how it behaves and how it recovers.

These families and farmers in Molesworth are also the reason why so many of the lagoons, billabongs and pond systems are healthy in this area as they care for and about the land and waterways. They take on advice from authorities and experts and work hard to try to implement strategies to maintain and improve the river's health. As one of the many land owners of this unique fragile and sensitive environment our family has had intimate knowledge of the Molesworth river flats and so we feel qualified to present an environmental impact statement from our perspective.

#### Molesworth landholders, Andy and Karen Williamson, Bonnie Brae Farmstay.

Inundation of some areas of private land around Molesworth will happen at all of the flows being looked at (12,000, 15,000 and 20,000 ML/d). This is because the channel capacity is very limited at Molesworth (9,500 ML/d). Currently, Goulburn–Murray Water specifically limits releases from Eildon Dam because of the risks of inundating private land around Molesworth.

Landholders in Molesworth are concerned that the flow footprints under investigation will have a negative impact on the use of their farms and livelihoods. In this case study, we report the scale of likely impacts across the range of flow footprints being looked at.

#### Landscape and socio-economic context

At Molesworth, in the mid-Goulburn reach, the floodplain is narrow, bordered by steep hills (Figure 23). Several unregulated tributaries join the Goulburn River near here and the channel capacity of the main stem of the Goulburn is lower than in areas upstream and downstream.

![](_page_17_Picture_1.jpeg)

![](_page_17_Figure_3.jpeg)

Figure 23 Topography of the Molesworth region

![](_page_17_Picture_5.jpeg)

Example of a river flat property with a range of terraces and billabongs near Native Dog Creek, just downstream of Molesworth. Flows fill the old channel networks and billabongs first, then spread overland onto pastures.

![](_page_18_Picture_1.jpeg)

![](_page_18_Picture_2.jpeg)

Overlooking riverflats running below the Whanregarwen Road. This is an example of a Molesworth property with flatter topography without a network of depressions and billabongs. Flows spread overland onto pastures straight away. *Photo: Emma Hampton, MDBA.* 

The river is confined by hills either side, leaving a relatively narrow section of fertile river flats to farm. Landholders in this section of the catchment farm right up to the riverbank, and in-between the network of billabongs and depressions that can meander through the river flats.

Landholders depend on the river flats because they are often the most productive parts of their farm. River flats provide good quality spring pasture that stays greener for much longer than the surrounding hill country. This land is therefore used for grazing and hay and silage production, which provides reliable income and feed through summer and dry times, and fodder for over winter. For many landholders, river flats are used for sheltered locations for calving between July and September, and for growing pastures between September and November.

The dependence on river flat productivity means riverbank farmers in Molesworth are particularly susceptible to how often water flows over their land, for how long and at particular times of year. Some farms have access to higher ground to move their cattle, others don't.

The hills either side of the river are steep, unsuitable for cropping, and have limited grazing potential. Without the value and feed that the pasture on the river flats produces, and without access to sufficient higher country, the concern is that some of the smaller Molesworth farms may not be viable.

![](_page_19_Picture_1.jpeg)

![](_page_19_Picture_3.jpeg)

#### Molesworth in the 1800s. Photo provided by A&K Williamson

The majority of landowners in and around Molesworth are farmers, most with some connection and reliance on the river flats, lagoons, billabongs, ponds, river and tributaries for their business and farm welfare. They have survived droughts, fires, wars, floods and depressions and still looked after each other and their land. They may not be young, educated, pretty, huge earners or international businesses but they are the mainstay for the local economies.

It is their expenditure that provides the local towns with income in the off tourist seasons. Indirectly and directly these farmers are the major employers in the district, they influence sale yards, stock agents, the sale of stock products, equipment, machinery, seed, stock and vehicles. They have a huge economic impact on the district and their livelihoods and financial viability is directly linked to the health of the river and its associated wetlands.

Molesworth is the town that doesn't seem to rate much of a mention in this proposal other than with released flows of larger than 12,000ML/day it becomes a wildcard. You can drive through Molesworth in a blink, there's a pub, an old general store, a proud old community hall and a beautiful church that stops travellers in their tracks. You'd think Molesworth was empty but it's probably the fullest town you'd find in the district. It's full of people that know each other, work together and can identify as Molesworth residents.

Molesworth has been on the maps since around 1824 and generation's later still has many families living here that are descendants of the original families settled in the area. These families have handed down their farms and their knowledge and spent their lives working with and living for this land. Many still hope to be able to hand their

![](_page_20_Picture_1.jpeg)

homes and their histories onto the next generation. Molesworth also has a huge extended family. People from all around Australia have strong links with Molesworth through family, holidays and work and it is considered one of the most beautiful places. On more than one occasion Molesworth has been described as 'Gods own office'. We are close to Melbourne but we reflect so much of the older values where time slows and people take that time to talk and care. Molesworth is where you can come across wildlife, peace and quiet, welcoming faces, healthy land and waters, all these things become so rare.

Molesworth farmers are also on the endangered list with land values pushing rates up and the cost of living and working pushing their livelihoods into survival of a lifestyle. Yet top of the list of these farmers is always working on helping the land, clearing pests and weeds, preventing erosion, planting and fencing to protect the environment is part of their daily lives. Anyone with knowledge of agriculture would know that diversity is important for resilience and these farmers represent diversity. Having different kinds of farms, the older and newer farming styles, understanding systems and also natural processes is vital to agricultural resilience and progress. They provide pockets of knowledge, skills, techniques as well as the genetics in their pastures and livestock that are a buffer in an agricultural society that is becoming more centralised and uniform.

Molesworth landholders, Andy and Karen Williamson, Bonnie Brae Farmstay.

![](_page_21_Picture_1.jpeg)

# Impacts of overbank flows

Landholders in Molesworth have shared with us some of the impacts they face when water flows onto their land.

However, before describing the scale of impacts that are likely to be experienced under a range of flow footprints, it is important to assess how easy it is for people to be able to accurately connect impacts to specific flows. There are two particular challenges for the Lake Eildon to Killingworth subreach (including Molesworth): the long distance between main-stem gauge locations and issues with flow footprint mapping accuracy.

There are several significant tributaries that join the Goulburn River, but only two gauges on the main stem of the Goulburn a long way apart, Eildon and Trawool (Killingworth gauge is a relatively recent addition, and has a limited range of measurement). The Goulburn River between Eildon and Trawool has 57% of the total catchment ungauged and within this some tributaries are well gauged, some are partially gauged (e.g. Yea River) and some are ungauged. The main-stem gauges let people know what the flow levels are in terms of releases from Eildon and what could have passed their property before ending up at Trawool, but it is difficult to be exact. This means that there is some uncertainty for mid-Goulburn mainstem landholders in describing the scale of impact around each of the flows.

The flow footprint maps have been prepared from a hydrodynamic model of how the river works. Sufficient calibration data is important, to make sure that the model's representation of how water moves across the landscape matches what people experience in real life. We know that we do not have enough calibration data for the mid-Goulburn. Landholders have told us that our flow footprint maps underestimate where water spreads and that the 20,000 ML/d footprint perhaps looks more like a 15,000 ML/d footprint. Further calibration data and work is needed to improve map accuracy.

Our current understanding of the increasing scale of impacts of a range of flow footprints is therefore based on several detailed landholder interviews around Molesworth which are described below. This understanding may change in the future as new information emerges.

Summer irrigation:

- Landholders value the wetlands, trees and wildlife on their properties and actively look after them.
- Current regulated irrigation flows in summer have an impact on some landholders (around 9,000 ML/day released from Eildon). For example, water from the main Goulburn channel begins to flow into lagoons on private property, cutting off access tracks to some farm areas (see photo). One Molesworth landholder has told us that when summer irrigation flows increase to around 9,500 ML/day, some crossings between paddocks become impassable above car bonnet depth.
- Typically these are minor impacts that landholders already have ways to work around.

![](_page_22_Picture_2.jpeg)

Stock crossing between billabongs that is impassable to cars even at summer irrigation levels (too deep, overbonnet depth). *Photos: Beatrix Spencer, MDBA.* 

12,000 ML/d flow footprint — in addition to the above

- For a 12,000 ML/d footprint the Goulburn River flows into billabongs and lagoons close to the river. Landholders have a network of pastures in and around these billabongs and watercourse on the river flats. There are a number of 'flood runners' that weave across pastures and some start to fill at this flow footprint. This can affect landholders by impeding access to areas of their farm, which can affect overall farm planning (e.g. where stock are grazed or hay is stored).
- The filling up of billabongs and lagoons is valuable to some landholders. Flow footprints of this size may 'top up' water in lagoons that stock use.
- For other properties, there is no longer a network of old channels and billabongs to fill, so water starts spreading over the grazing land rather than staying within channels. There are some depressions and terraces, but the land is largely flat and productively grazed and thus immediately affected.
- Flows of this size start to enter the Molesworth Recreation Reserve and caravan park, filling up the billabongs in the Parks Victoria reserve next door, then starting to flow through the drains under the loop road near the boat ramp. There is already a partial levee bank surrounding the caravan park alongside the river. The caravan park could be protected by extending the levee around two sides of the park to protect assets, upgrading two butterfly drainage valves under the park's ring road to better control water

![](_page_23_Picture_1.jpeg)

coming into and out of the park; and upgrading the main access road to the caravan park (which gets cut) through raising and larger capacity drainage pipes under the road.

A flow footprint of this size could be largely described as 'inconvenient'. Subject to timing and duration and investment in on-farm mitigation measures to improve access and drainage, the impacts created by this size flow could be acceptable.

15,000 ML/d flow footprint — in addition to the above

- At 15,000 ML/d, most of the 'flood runners' and depressions would be filled. There would be more water flowing into billabongs and lagoons would become connected to the main Goulburn River channel.
- Some farm areas may be completely isolated and access tracks inundated. This has impacts for accessing stock and pastures and moving machinery.
- There is a channel that runs below the Whanregarwen Road (the old river course). When this fills, it cuts access to the river flats for several properties. The water in this channel can run in both directions from the river or rainfall from the surrounding steep hills to the river. This channel means that you can't necessarily move stock out to higher ground and it also makes it difficult to get feed in.
- At this flow, flooding is relatively confined to wetlands (land not grazed) but also some low-lying depressions and terraces (land grazed). There is concern that water will remain in depressions for extended durations, leading to water logging of soils and damage to pastures.
- Inundation of low-lying areas of farms could reduce the area of land available to grazing and hay or silage production, with impacts on farm productivity. If areas are inundated for a long time, there will be issues if the production of feed for the next year is compromised.
- Landholders are concerned that more regularly connecting lagoons to the main channel may result in the spread of weeds or invasive species such as carp. Landholders in this area are conscious of the environmental value of their billabongs and lagoons.
- There is also concern that more regularly connecting the main Goulburn River to these lagoons could damage the uniqueness of these environments: their ecology could become more similar to the riverine habitat rather than isolated wetlands and lagoons with divergent habitat characteristics and ecology.
- Time of year and duration are key to impacts short, sharp flows at the right time of the year would be good for the soil and productivity so long as they don't occur every year. But flows that are too long and/or at the wrong time of year and without warning would have a very big impact on landholders.
- Most farm infrastructure (sheds and pumps) appear to be already protected up to large flood levels (e.g. 1993, 1975, 2010).

Overall, a flow footprint of this size is likely to create a larger number of impacts for landholders that would require more effort and resources to manage through. Flow footprints of this size could be quite disruptive to farmers around Molesworth and would require significant on-farm mitigation efforts to reduce impacts.

20,000 ML/d flow footprint — in addition to the above

• For 20,000 ML/day, water is likely to be flowing overland onto productive pastures. Once all the channels and flood runners in the landscape have filled, the water spills out onto higher pasture areas which may or may not drain effectively when river levels recede.

![](_page_24_Picture_1.jpeg)

- Flows of this size for an extended duration (more than several days), would have detrimental effects on farm productivity in Molesworth.
- Flows of this size would cut the main access road to the Molesworth Recreation Reserve and caravan park.
- Landholders in this reach have invested in improving higher pastures on the river flats (e.g. \$30,000–\$40,000 for seeds, soil preparation for even relatively small paddock sizes etc.). Investments have also been made in weed management such as blackberries. If a flow footprint of 20,000 ML/d resulted in more regular inundation of higher pasture areas, it could negatively affect existing and future investments in pasture improvements.
- Inundation of low depressions and higher pastures leads to growth of both native saplings and weeds. Landholders have to invest time in clearing up these weeds and saplings as they reduce areas of grazing and pasture growth. More regular inundation would increase the time spent on managing undesirable species.
- Flow footprints of this size will cut access tracks and potentially impede access to significant areas of river flats in the Molesworth region.
- Further upstream along the Whanregarwen Road the floodplain widens, which means cattle can still be moved to higher ground, however in the constricted floodplain area around Molesworth, cattle are difficult to move because of access issues and become stranded. Even if you can round them up, they have to be trucked off-farm. Some farms have higher ground to move their cattle, others don't.
- Removal of debris and damage to fencing is often a major cost to landholders.
- People and livestock could be at risk if flooding was extended and frequent, where increased erosion could change the river's course.

Overall, a flow footprint of this size is likely to create a significant number of impacts for landholders that would require significant long-term efforts and resources to manage through. Flow footprints of this size could be disruptive to a large number of farmers around Molesworth, and are likely to be unacceptable to many in the community.

Greater than 20,000 ML/d flow footprint — in addition to the above:

- Higher flow footprints, such as the floods of 2010, cause significant damage to private property (e.g. 2010 was 40,600 ML/d at the Trawool gauge).
- Flows of this size threaten the safety of humans and stock. During 2010, a number of animals were stranded and a number of landholders were put in dangerous situations when rapidly rising floodwaters cut off sections of farm with little notice.
- Flows of this size also damage roads and properties (e.g. in the 2010 and 1993 floods the access road to the Molesworth Recreation Reserve was cut and many caravans flooded).
- There is potential for the river to change course, cutting through farmland. There are places where billabongs on the river flats are separated from the main river channel by only a few metres. Any increase in riverbank erosion from larger or sustained high river flows could increase the chance of the river 'breaking away' and forming a new course.

These large damaging flow footprints are well above what is being investigated as part of the constraints work. A flow footprint such as what occurred during the 2010 floods is recognised as very damaging to landholders in the Molesworth region. Flows footprints of this size will still happen naturally in the future as a result of large rainfall events. As is currently the case, this is

![](_page_25_Picture_1.jpeg)

part of living alongside a river, and landholders will continue to manage the short- and long-term after effects of damaging flows of this size.

Property photographs highlighting a range of management issues of concern to Molesworth landholders

![](_page_25_Picture_4.jpeg)

Raised entrance road to property, built up to enable access to stock after difficulties during 2010 flood.

![](_page_25_Picture_6.jpeg)

Area of active tunnel erosion, with landholder concern that overbank flows could increase property erosion issues.

![](_page_26_Picture_1.jpeg)

![](_page_26_Picture_3.jpeg)

Paddock trees that died after prolonged waterlogging in depressions in 2010.

![](_page_26_Picture_5.jpeg)

Property has a number of terraces at different levels which get wet at different flow rates.

![](_page_26_Picture_7.jpeg)

Depressions that fill with overland flows that don't always drain well, and can have pasture re-establishment and long-term weed issues.

![](_page_27_Picture_1.jpeg)

![](_page_27_Picture_2.jpeg)

Billabongs on-farm with varying levels of grazing access and water permanence. *Photos: Beatrix Spencer, MDBA.* 

# Flow footprint mapping at an individual landholder scale

Current mapping shows the 12,000 and 15,000 ML/day flow footprints as staying largely in channel (Figure 24). Further model calibration is required to improve mapping accuracy given that these are understood to be overbank flows in the Molesworth region.

![](_page_28_Picture_4.jpeg)

![](_page_28_Picture_5.jpeg)

![](_page_28_Picture_6.jpeg)

![](_page_28_Figure_7.jpeg)