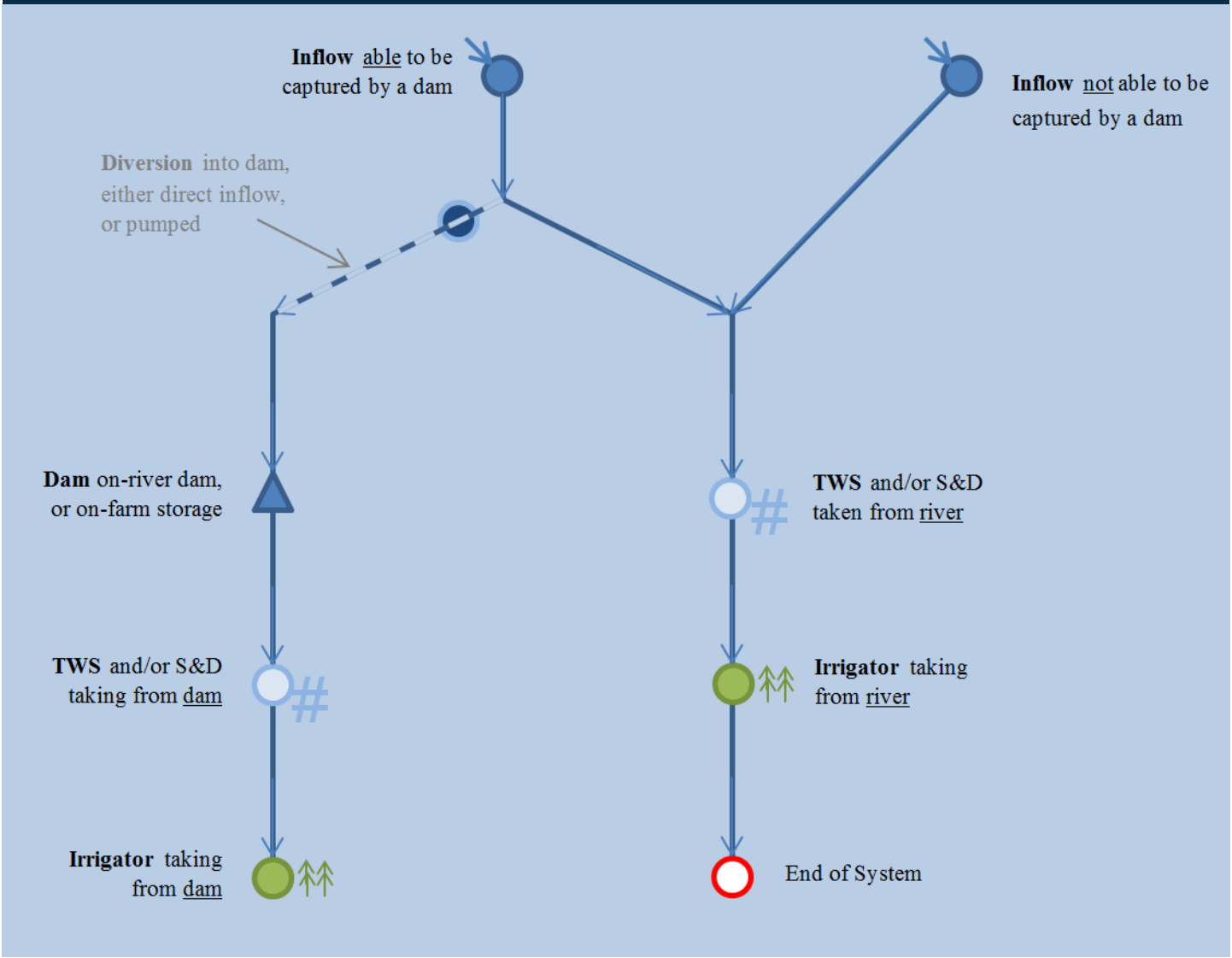

WATER MANAGEMENT

Estimating the likelihood of impacting on the key riverine ecosystem functions using river modelling

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Estimating the likelihood of impacting on the key riverine ecosystem functions using river modelling

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More information

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Executive summary

The *Basin Plan 2012* (the Basin Plan) is an adaptive management framework that has been developed by the Murray–Darling Basin Authority (MDBA) to coordinate the management of water resources in the Murray–Darling Basin (MDB). Essential to the Basin Plan is the development of a water resource plan (WRP) for each river valley and groundwater area. A risk assessment is a key step in the development of a WRP for each of these areas in the MDB. One of the risks that must be assessed is the risk of insufficient water for the environment.

Risk assessments require a rating of a *consequence* and the *likelihood* of that consequence occurring, to identify the risk. While all rivers have ecologic value, some have more value than others. The high ecological value aquatic ecosystems (HEVAE) rating of ecological value of rivers was used in rating the consequence of impacting on the ecological function of the rivers. The likelihood of the consequence of impacting on the key ecosystem functions was estimated using hydrologic modelling, and is the subject of this report.

This report documents the assessment method that was used to determine the likelihood of impacting on the key ecosystem functions. The degree of hydrologic alteration of a river's flow will impact of the ecological functioning of the river. The higher the level of hydrologic alteration, the higher the likelihood it is impacting the functioning of the dependant biota. Existing hydrologic models were used, where they were available, to quantify the hydrologic alteration. Where existing models were not available, single-reach models were developed to estimate the degree of hydrologic alteration and subsequently rate the likelihood of impacting on the key ecosystem functions. This report describes the approach used to assess hydrologic alteration, and is a supporting document to the risk assessments completed in each valley.

Contents

Equations

Tables

Figures

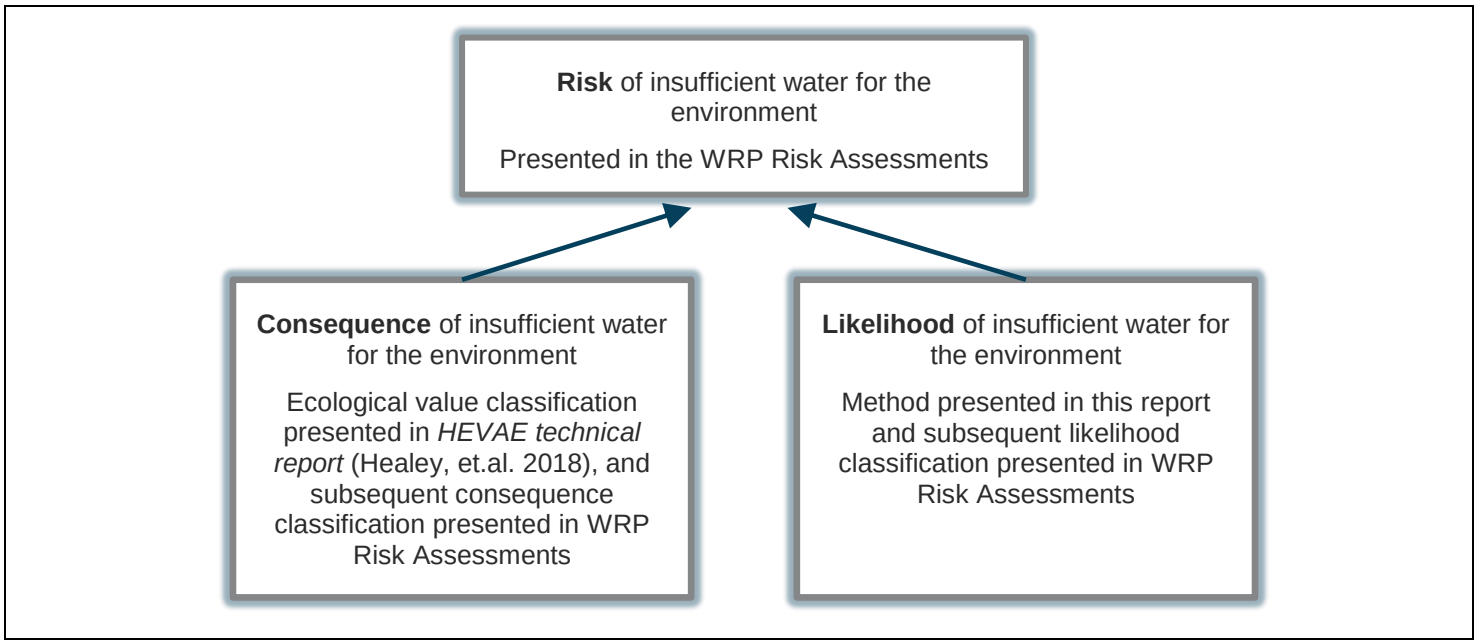
1 Background

The *Basin Plan 2012* (the Basin Plan) is an adaptive management framework that has been developed by the Murray–Darling Basin Authority (MDBA) to provide a coordinated approach to managing water resources across the four member states and territory in the Murray–Darling Basin (MDB).

A risk assessment is a key step in the development of a water resource plan (WRP) for each valley and groundwater area in the MDB. Chapter 4, Part 2 of the Basin Plan (*Risks and strategies to address risks*) sets out matters that must be considered in terms of risk and management strategies in WRPs. Chapter 10, Part 9 (*Approaches to addressing risk to water resources*) outlines how Basin states must undertake risk assessments as well as the MDBA's associated accreditation requirements. The Basin Plan requires that a WRP must be prepared having regard to current or future risks to the condition and continued availability of water resources of a water resource plan area.

This report documents the assessment method that was used to determine the degree of hydrologic alteration for each water source, in each of the WRP areas. In many cases, hydrologic alteration was used as the basis for the 'likelihood' component of the risk assessment (see Figure 1).

Figure 1. Context of this report with the WRP Risk Assessment



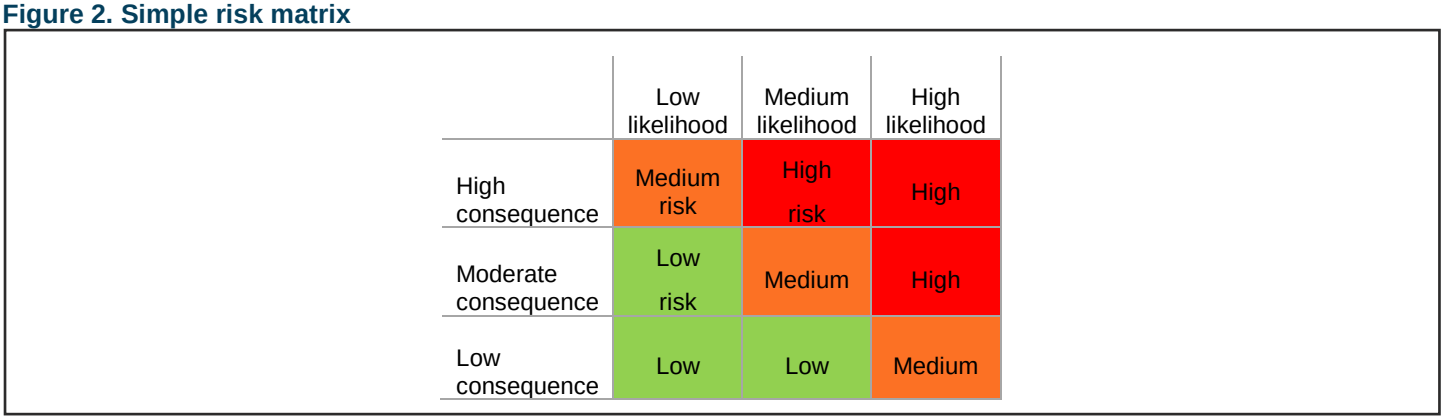
The Basin Plan, and the work around its implementation, identifies impacts on key ecosystem functions (KEF) of the rivers as an undesirable consequence. One of the objectives of the Basin Pan is to 'protect and restore the ecosystem functions of water-dependent ecosystems'. The Basin Plan expands on this in its definition of sustainable diversion limits (SDLs). Where part of the definition of the limit is that if exceeded it would compromise 'key ecosystem functions of the water resource'.

There has been more focus on key environmental assets in implementing the Basin Plan. The risks to the key environmental assets are addressed in the risk assessment by assessing the ecosystem functions that maintain them, as well as the rivers associated with them.

1.1 Assessing risk

A risk assessment identifies undesirable consequences and quantifies the likelihood of these consequences occurring. It is the combination of consequence and its likelihood of occurring that quantifies risk (as a risk is the likelihood of a particular consequence). The most common way of presenting the relationship between consequence and its likelihood is in the form of a risk matrix (see Figure 2).

Figure 2. Simple risk matrix



1.2 Assessing risk in rivers

The majority of unregulated rivers (rivers not declared regulated, as they are not managed with a large dam or water storage suppling water along their length) have their streamflow reduced, most notably through irrigation extractions. A small number of unregulated rivers have dams on them that have the ability to discharge, but these dams generally only capture water, usually resulting in reduced flows downstream. The exceptions, of which there are very few, are dams and schemes that are used for hydroelectricity generation and some town water supply (TWS) schemes that transfer water from one stream to another.

The alteration of streamflow in regulated rivers is quite different to that in the unregulated rivers, as significant volumes are captured or diverted into regulating dams in wet periods, which is later released in dryer periods. While flows can be reduced at the downstream end of regulated rivers, similar to unregulated rivers, this is not always the case. Hydrological alteration in regulated rivers is very variable with the highest degree of alteration often directly downstream of the regulating dam. Alteration such as elevated flows during the irrigation season, reversing the seasonality of flow, the loss of low flow period, as well as the capturing of some high flow events.

The alteration of streamflow in regulated and unregulated rivers can have undesirable consequences, and it is these consequences that the WRP risk assessment is aimed at identifying. The consequence of impacting on a KEF is identified within the WRP risk assessments, and termed ‘consequence’ for the risk evaluation process. Key ecosystem functions are a grouping of ‘physical, chemical and biological exchanges and processes that contribute to the self-maintenance and self-renewal of an ecosystem’ (Alluvium, 2010). The KEFs identified by Alluvium are presented in Table 1.

The degree of consequence was quantified by considering the ecological value of the rivers where key ecosystem functions are being impacted. The approach used for rating the value of rivers is consistent with a nationally recognised framework (*Guidelines for identifying high ecological value aquatic ecosystems—HEVAE*, 2012). The detailed method for applying HEVAE and deriving consequence ratings in NSW is documented in *Applying the high ecological value aquatic ecosystem (HEVAE) framework to water management needs in NSW* (Healey et al, 2018).

To assess the risk to rivers, the likelihood of these consequences occurring is required. It is the purpose of this report to document the modelling used to quantify the likelihood of impact occurring on the key ecosystems functions within unregulated rivers. It is the likelihood information generated from this modelling which is used in the WRP risk assessment.

Table 1. Identified key ecosystem functions (KEF) (Source: Alluvium, 2010)

Ecosystem function	Physical process
Disturbance through cease-to-flow periods	Creation and maintenance of bed, bank and riparian habitat
Disturbance and wetting through bankfull and overbank flows	
Provide wetted habitat diversity in pool environments	
Provide wetted habitat diversity in riffle and run environments	
Provide appropriate wetted habitat heterogeneity within a reach (creation of diverse hydraulic features)	
Provide in-channel habitat features within a reach (point bars and benches)	
Organic and inorganic sediment delivery to downstream reaches (debris flows, scouring, flushing of fine sediments)	Mobilisation, of biotic and abiotic material (e.g. sediment, nutrients and organic matter)
Sediment delivery to and from floodplains (floodplains, benches)	
Dilute carbon and nutrients from litter and soil on the floodplain that has been returned to the river systems	
Dispersal of aquatic communities (including drift)	Lateral and longitudinal connectivity to maintain populations
Recolonisation of aquatic fauna and flora communities	
Migration to fulfil requirements of life-history stages (e.g. diadromous fish species)	
Foraging of aquatic species	
Instream primary production by periphyton, phytoplankton and biofilms	

1.3 Estimating the likelihood of impacting on key ecosystem functions

The MDBA engaged Alluvium to define key ecosystem functions (KEF) and recommend how to appraise the flow required to maintain them (Alluvium, 2010). This work resulted in the development of a set of flow metrics, which measure flow alteration of particular components of the hydrograph, as well as targets to the amount of alteration that would impact upon the KEF. The KEF hydrologic alteration metrics and limits of alteration are further discussed in Section 5.

The approach taken by Alluvium was consistent with many of the approaches used both in Australia and internationally for evaluating environmental flow requirements of rivers (Alluvium, 2010). While there have been numerous differences in evaluation methods, the approach taken here is consistent with a paper synthesising environmental flow evaluation approaches, titled *Ecological Limits of Hydrologic Alteration (ELOHA)* (Poff, 2010).

The calculation of KEF flow metrics requires two flow sequences: a natural flow sequence used as the reference and an altered flow sequence based on a particular management scenario. To generate these sequences, two types of model were used:

- multi-reach models for major rivers with significant river infrastructure
- single reach river models (or lump models) for smaller river systems.

2 Multi-reach modelling

Where possible, existing multi-reach models were used to generate the flow sequences required for calculating the KEF metrics. Multi-reach models have been developed for all regulated river systems. Sequences from these models were used by the MDBA to evaluate the KEF of the regulated rivers. The models that were used for each regulated river are listed in Appendix A.

Multi-reach models were only available for a small number of unregulated rivers. Typically, these models are for streams where there has been substantial investment in water infrastructure such as dams and pipelines (e.g. Fish River and Barwon Darling Rivers). The models that were used for unregulated rivers are presented in Appendix B.

In other locations on unregulated rivers, where the unregulated flows are associated with a regulated river, the sequences from the regulated river multi-reach models could be used. Such locations include:

- unregulated reaches of rivers that are downstream of a regulated system
- terminating effluent streams downstream of a regulated reach
- anabranching effluents on a floodplain associated with the regulated river.

3 Single-reach modelling

The simplest configuration of a single-reach model was initially used, which only had an inflow, an irrigator, and an end of system gauge. This was found to be too simplistic for many of the unregulated rivers; therefore a standard, but more complex, model configuration was adopted. This standard configuration was used for virtually all unregulated rivers to:

- automate model development
- improve the ability for others to understand the numerous models
- increase repeatability of the modelling
- maintain the quality of the results.

While the configuration is standardised, the parameterisation of each model is specific to each unregulated river. The node parameters and model assumptions used in the single reach models for each water source are tabulated in Appendix C.

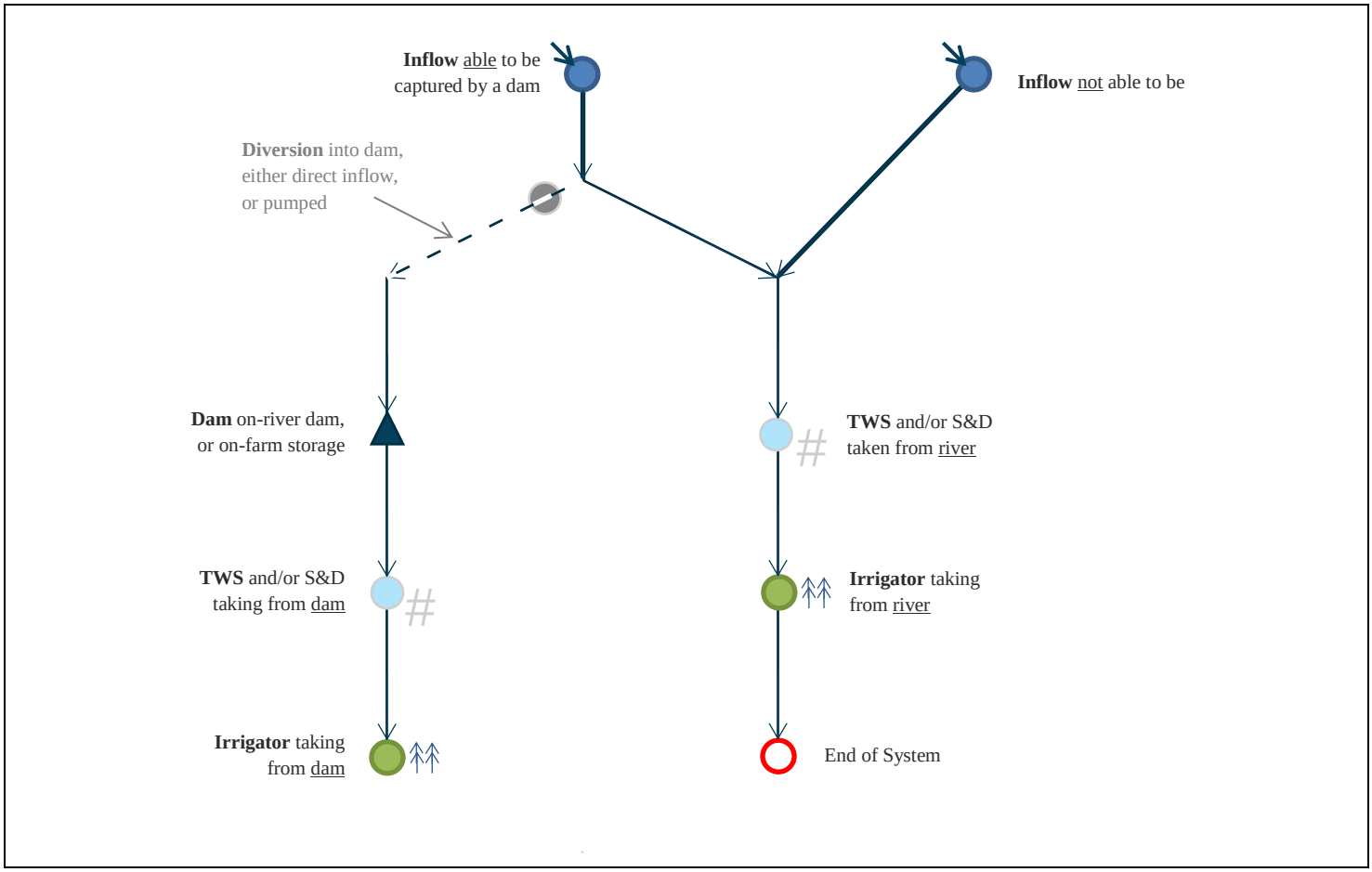
The IQQM modelling package (Version 7.79.10 NSW Office of Water) was used to simulate the unregulated rivers. An MS Excel file was used to generate the system files for each river. The Excel file automated the parameterisation of the standard configuration (from larger datasets), helping maintain the quality of the input data for the numerous models that were developed.

3.1 Standard model configuration

The standard model configuration used has two sets of inflows: (1) inflow that can flow into a dam, and (2) inflow that is unimpeded. The model also has two sets of extractors (1) those that can assess water from a dam, and, (2) those that access water directly from the river. These function, inflows and extractions, are performed by nodes in the model. Figure 3 illustrates the major nodes of the standard model used for simulation flow and extraction.

The unimpeded flow side of the model (right-hand side of Figure 3) flows to the end of the river system and is the core of the model (further discussion in section 3.1.1). While the flows that can be captured by dams (left-hand side of Figure 3 and highlighted in Figure 5) flow into the uncontrolled flow side if the flow is not captured by the dam (further discussion in section 3.1.2). The full schematic diagram as shown in IQQM is presented in Appendix A.

Figure 3. Standard model configuration used for single reach models

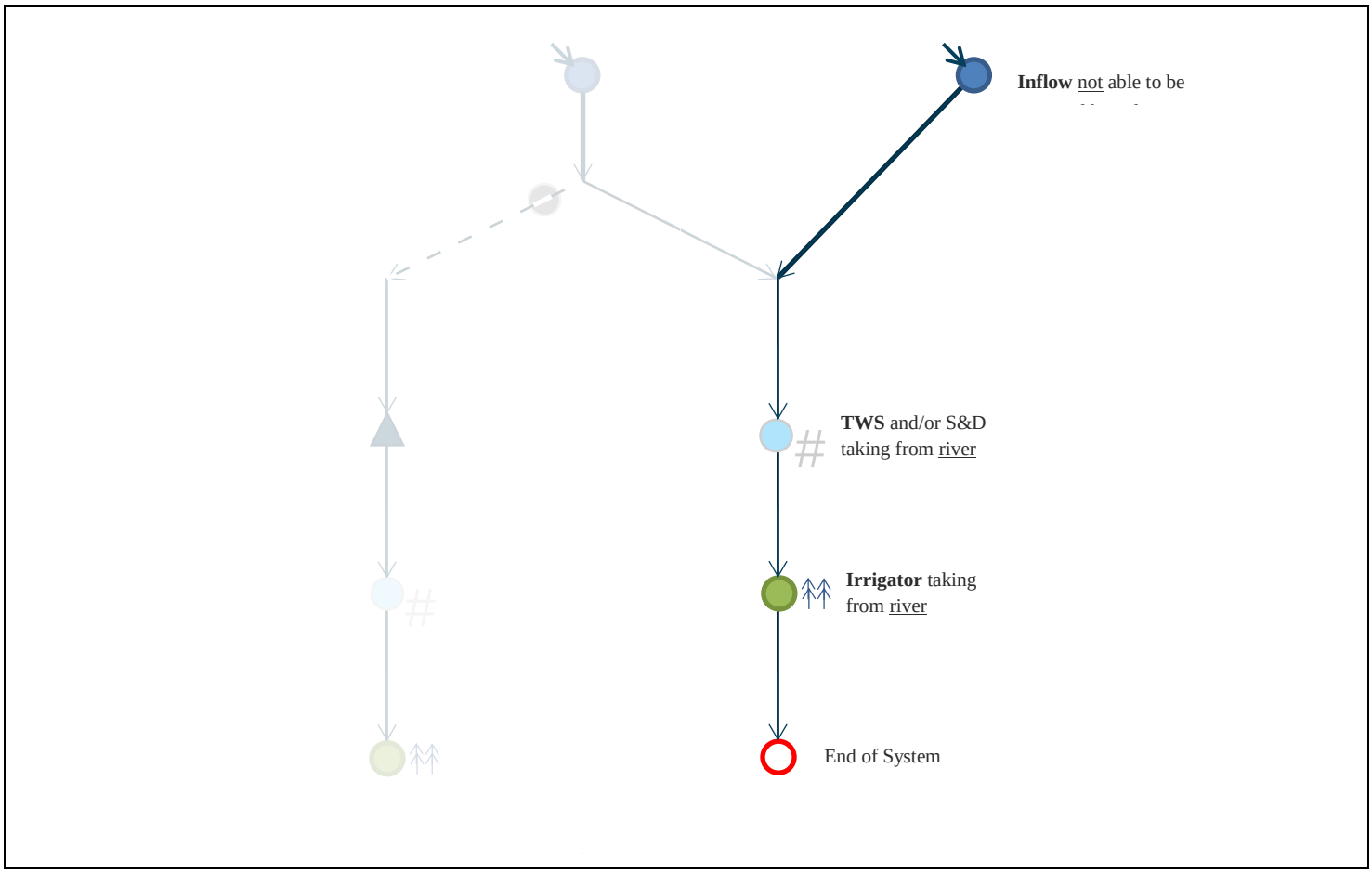


Key: S&D refers to stock and domestic demand and TWS refers to town water demand

3.1.1 Run-of-river simulation

If there are no substantial dams in the water source (either on-river dams or on-farm storages), the simplest configuration of a single reach model is used, consisting of an inflow, a TWS extraction, an irrigator, and an end-of-system gauge. These functions are performed by the nodes in the model that are highlighted in Figure 4. The remaining nodes in Figure 4 that would not operate, as there is no dam being simulated, are greyed out. This pattern of extraction is termed 'run-of-river' extraction, as water is used directly from the river and is not stored in a dam.

Figure 4. Standard model configured for unimpeded flow simulation



3.1.2 Stored flow simulation

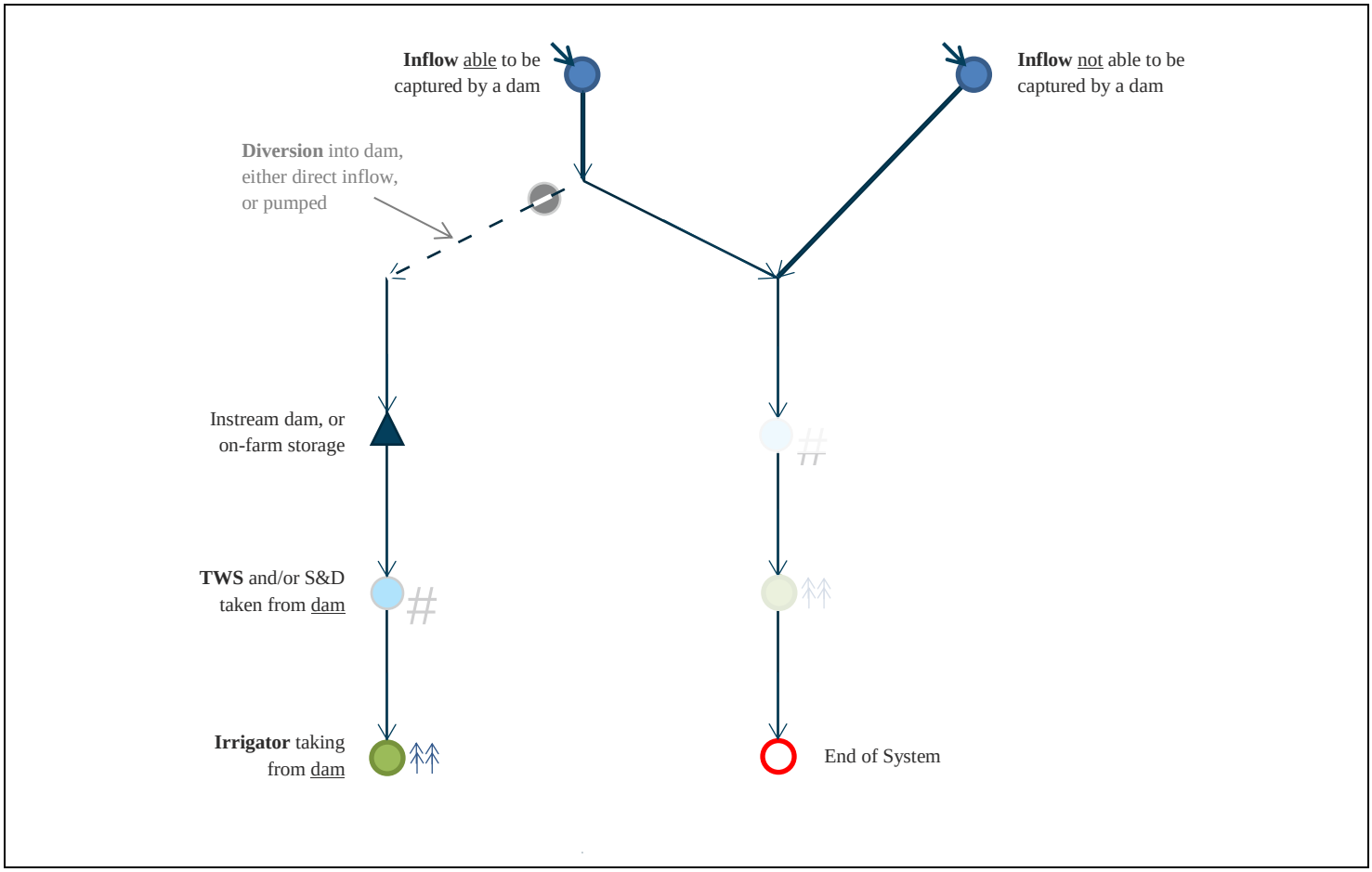
The alternative scenario to run-of-river extraction occurs in streams that do not have consistent flow, hence either utilise on-river dams or on-farm storages. To simulate either of these, the left side of the model can be used. In the extreme case where all water is accessed through a dam or storage, the 'run-of-river' extraction nodes are inactive (this is shown by the greyed out nodes in Figure 5).

While on-river dams have to be simulated using the diversion of water into a dam node, there are two possible configurations for simulating the on-farm storage of irrigators (not available for the TWS). The simplest configuration is to add on-farm storage volume into the run of river irrigator node, enabling on-farm storage to be simulated with fewer nodes, as illustrated in Figure 4.

To simulate (1) on-river dams, (2a) the second method of simulating on-farm storage, or (2b) off-river storage for TWS (the equivalent of on-farm storage), the configuration highlighted in Figure 5 would be utilised. For each of these configurations, the nodes that extract water from the dam (the demand nodes below the dam) are set up to order water from the dam. The difference between simulating on-river dams and on-farm storage scenarios using the dam node is how the diversion (dashed line in Figure 5) that runs water into the dam is set

up. If simulating an on-river dam scenario (1), all flow available will be diverted into the dam if it is not full. Alternatively, if simulating an on-farm storage/TWS off-river storage scenario (2a and 2b), the diversion is setup as a pump, with limited pump capacity and a cease-to-pump rule (CtP) if there is one in place.

Figure 5. Standard model configured for stored flow simulation



3.1.3 Combination simulation

A proportion of the unregulated rivers simulated were essentially run-of-river scenarios where only the run of river extraction nodes were active (see Figure 4). There were also a number that only had extraction from on-farm storage (two methods to simulate available, as in Figure 5; or the alternative using on-farm storage volume in the run of river irrigator node). Some were a combination of different extraction practices; run of river, on-river dams, and/or on-farm storage:

a. run of river extraction and on-river dams (in the head water streams)
b. run of river extraction and on-farm storage (on the main trunk of the river)
c. on-river dams (head water) and on-farm storage (trunk)
d. run of river extraction, on-river dams (head water) and on-farm storage (trunk).

The most common combination was combination (a), but the other three combinations were simulated where required.

4 Information and data used in the models

While the configuration of the models is consistent, it is the climatic and flow sequences, and parameters quantifying the node operations, which enable the models to represent the different river systems.

4.1 Information used for parameters

The adopted standard single-reach IQQM model (see Figure 3) has five types of operational nodes:

1. Inflow node (two used; one for flow available to a dam and one for flow that is not)
2. Diversion node (one used to fill the dam, either as an inflow or pumped)
3. Dam node (one used to simulate either an on-river dam or on-farm storage)
4. TWS and S&D node (two used; one run of river and one that orders from a dam)
5. Irrigator node (two used; one run of river and one that orders from a dam)

The information used to set these nodes up to simulate the movement of water in the unregulated rivers is presented in the following four sections. The information requirements for the dam node and diversion node are presented together in Section 4.1.2.

4.1.1 Inflow

While there are two inflow nodes in the models, only one streamflow sequence is used. A proportion of the flow can be entered into the model through each of the two inflow nodes (that is, 50% of the inflow can enter the model through one node and similarly for the other inflow node). The proportion of the inflow that enters the model at each node was determined based on the area that is being simulated by the node (proportional area factoring).

The available flow sequences (See section 4.2.2 for detail on the sequences used) varied in their ability to represent the water available to extractors. In some cases, the flow sequences were derived from a gauging point in the mid-reaches of the river and area factors were used to represent the flow available in the whole river system (that is, a factor greater than one, e.g. 1.45). In other cases, there was no gauging point in the river with adequate data. In this case, a streamflow sequence from an adjacent river (of a similar size, shape and aspect) was used and factored for area.

4.1.2 Dam and diversion

The capacity of the dam node was either determined from licensing information (generally only available for TWS dams) or by assumption (assuming that dam capacity is associated with the entitlements, hence it can be estimated as a proportion of the irrigator's entitlement, for example50%).

Direct rainfall into the dam(s) and evaporation from the dam(s) are estimated by multiplying the water surface area of the dam with either the rainfall or evaporation depth (See Section 4.2.1 for detail on the sourcing of the data). To estimate the dam(s) water surface area, a volume/area relationship is used. This relationship is based on the dam capacity identified and the following assumptions about the shape of the dam(s):

- the dam(s) shape is square
- the depth of the dam(s) (often used an arbitrary depth of 3 m, as this is typical of many dams)
- the number of dams (identified through licensing data).

For some models, the daily evaporation depth from the surface of the dam(s) was estimated by the evapotranspiration sequence to reduce the time to develop the models. Where the dams were significantly large, a more accurate open water evaporation sequence, derived from the class A pan evaporation sequence, was used.

If the dam node was set up to simulate on-river dams, the diversion node was set up to divert all available flow up to the available capacity within the dams. If the dam node was used to simulate on-farm storage, the diversion node was set up as a pump with limited pump capacity and a CtP rule if required.

4.1.3 Town water supply and stock and domestic supply

The full development of current licences is used in quantifying risk, as it is anticipated that all entitlements will be active at some time in the future. For the simulation of domestic demands, which includes both town water

supply (TWS) and rural stock and domestic demands (S&D), a constant daily demand is assumed, calculated by dividing the entitlement by 365.

4.1.4 Irrigator

The irrigator nodes include a crop model. This is populated with cropping information collected as part of the conversion of unregulated licences from an area to a volumetric basis, known as the VolCon database (This is a MS Access database of survey results for most *Water Act 1912* licences). The surface authority licences were not entered into this database because their data was too complex, as these were licences with multiple users accessing the water through common infrastructure. Both crop survey data collected and crop water requirement information derived for the conversion of licences was used.

It was assumed that an appropriate crop mix for the future would be similar to the crop mix surveyed between 1993 and 2000. This survey data was retrieved from the VolCon database (MS Access database of survey results). As the survey information was collected for reasonably small sub-catchments (similar to the water sources used in each of the NSW water sharing plans), it was possible to identify the crop mixes for each river.

Full development of current licences is used in quantifying the risk. This was done because there is currently no data available on water usage. Using the full entitlement therefore represents a worst-case scenario. The conversion rates used to convert area licences to volumetric were used in reverse to determine the area of crop that could be irrigated if current entitlement was active.

The crop model in the irrigator node utilises the rainfall and reference crop evapotranspiration sequences 'ETo' (See Section 4.2.1 for detail on the sourcing of the data). To estimate crop demand, another input, the monthly crop factor 'kc' files (values that were generated as part of the licence conversion process) is used (See equation below).

$$\text{Crop demand} = \text{Crop area} \times kc \times ETo$$

When the run of river irrigator node was set up to have on-farm storage, the dam capacity, volume/area relationship and the daily evaporation depths were estimated in the same way to that used for the dam node

4.2 Time sequence data

Two types of sequences are required for these relatively simple models: climate sequences (which include rainfall, standard evapotranspiration, and open water evaporation) and streamflow sequences that represent the water available to be extracted.

4.2.1 Climate data

Climatic data was sourced from the patch point dataset through the SILO website (www.longpaddock.qld.gov.au/silo/). The data is a combination of historic measured, interpolated, and estimated data. The sequences provided for each site start as early as January 1889 and continue up until the day the data is accessed. The text file requested from the site is the *Standard including FAO56 Reference Evapotranspiration (ETo)* format file and has nine sequences.

Generally, only two sequences are obtained: (1) rainfall and (2) reference crop evapotranspiration. An optional sequence of open water evaporation was used in some models, which is derived from the class A pan evaporation sequence.

4.2.2 Flow data

Historic streamflow sequences (in ML/day) were used as the inflows to the single-reach models. The duration of the streamflow sequences determined the period of the simulation, as these data sets were shorter than the climate sequence. In most cases, measured streamflow sequences were used, but for some streams a rainfall-runoff modelled sequence was available.

The measured sequences were accessed from the HYDSTRA[1] database and imported into IQQM. Gaps in the sequences, either due to poor quality of the data, or lack of any measurement, were filled. Correlated flow sequences from adjacent unregulated rivers were used to estimate the flow during the missing periods.

The available rainfall-runoff modelled flows were similar in length to the climatic sequences and considerably longer than the measured sequence. The rainfall runoff modelled sequences that were available were used in existing multi-reach models, often as an inflow sequence in a regulated river model.

5 Calculating likelihood metrics

The approach of using KEF metrics is consistent with an article that investigated the synthesising environmental flow evaluation approaches used around the world, titled *Ecological Limits of Hydrologic Alteration (ELOHA)* (Poff, 2010). Consequently, using limits to hydrologic alteration (measured by the metrics) to quantify likelihood and evaluate risk is also consistent. Improvement of the application of ELOHA is possible, but at this point in time, the KEF metrics provided a sound basis for assessing the likelihood of flow alteration impacting on riverine ecology.

There were 17 key ecosystem function metrics (KEF metrics) developed by Alluvium (2010) for the MDBA. These metrics cover four critical components of the hydrograph:

1) zero flow events
2) low flows
3) freshes
4) bankfull to just overbank flow events.

These metrics are designed to measure the hydrologic alteration of ecologically significant elements of the hydrograph. The zero flow events and the low flow metrics focus on flows below the 80th percentile flow (flow exceeded 80% of days). The freshes and bankfull to just overbank flow events metrics focus on flow alteration above the 20th percentile flow (flow only exceeded 20% of days). This illustrates that the more extreme components of the hydrograph are particularly significant to ecological processes.

This does not mean that the other parts of the hydrograph are not important. It is important that the moderate flows (60% of days between the 20th and the 80th percentiles) are maintained at reasonable levels. It can be reasonably argued that the 80th percentile would likely be highly altered if moderate flows were, therefore it would most likely only be necessary to consider alteration of moderate flow if the low flow metric was highly altered.

Very infrequent high flows (floods) are also not covered by the KEF metrics. Again, it can be reasonably argued that the just overbank flow events metrics would be highly altered if floods were altered. The size of floods mean that it is hard to alter these events enough to impact of KEF, conversely, it is more likely that low flow and zero flow periods are altered significantly because it is much easier to alter them.

5.1 Relating metrics to different stream types

Because the ecology of rivers is not homogeneous, ecosystem functions will have different requirements in different river types. For example, the significance of the frequency and duration of zero flow events in perennial streams is likely to be more significant than in intermittent flowing streams, as the ecology of a perennial flowing stream is not adapted for frequent or long periods of no flow periods.

The KEF metrics are designed to deal with this by being comparative with the base-case hydrology for each stream individually. This is also reflected in preferred KEF targets (or limits to hydrologic alteration) for these metrics, as they are expressed as a percentage change from the base-case hydrology (e.g. 20% increase or

[1] HYDSTRA is the database developed by Kisters to store and manage streamflow time series data, as well as other time series data. WaterNSW owns and maintains the main NSW Government HYDSTRA database.

decrease of the size of a flow) and not expressed in absolute terms (e.g. 15ML/day increase or decrease of the size of a flow).

Alluvium investigated separating rivers into different river types to allow the metrics and targets to vary between stream types. For this, they adopted Geomorphic Functional Process Zones. They found that KEFs (presented in Table 1) fell into each of the four hydrograph components in each of the geomorphic zones, with one exception. This is shown in a table, presented in Appendix E where the KEF associated with geomorphic zones is listed. The exception is that a KEF associated with the zero flow component of the hydrograph was not identified for some western streams. The western streams concerned, are more intermittent flowing streams with long duration, zero flow periods.

Other than this exception, all metrics were relevant to all the other river types, although not always for the same functions. There are two reasons that KEF metrics relate so widely: (1) the KEFs are defined as generic ecological process; and (2) the KEF metrics are designed to measure alteration in important components of the hydrology that shape riverine ecology.

5.2 Low and high flow seasons

As the climate varies across the basin, much of the water sources have distinct streamflow seasons where flow is lower and higher. To take this into account, a low flow season and high flow season were defined for all of the KEF metrics, with the exception of the bankfull and overbank flow component metrics. The low flow season and high flow season are defined as the five consecutive months with lowest and highest median monthly flow respectively.

In employing this definition, an additional criterion was added: that there is a transition month gap between the low and high flow seasons. This was introduced to be consistent with the metrics published in the MDBA modelling report (MDBA, 2012). It was later found that the transition month gap was not consistently applied in the MDBA modelling report.

5.3 Standard metrics

The proposed metrics in the Alluvium report (2010) are in the form of percentage of change, with a reduction seen as a negative percentage and an increase as a positive percentage. This presentation of the metric was adopted. The MDBA modelling report (MDBA 2012) however, presented flow metrics as a ratio, where a decrease was a percentage less than 100% and an increase a percentage greater than 100%.

Separate metrics were calculated for both low flow and high flow seasons for all metrics except the Average Recurrence Interval (ARI) high flow metrics. These are calculated on the full annual sequence.

Equation 1. Zero flow event component metrics (both low and high flow season)

Percentage change in the Number of years with zero flow events (Zero years)

$$= \frac{\text{(current No. of Zero years) - (natural No. of Zero years)}}{\text{(natural No. of Zero years)}} \times 100$$

Percentage change in the Number of zero flow events per year (Zero events/year)

$$= \frac{\text{(current No. of Zero events/year) - (natural No. of Zero events/year)}}{\text{(natural No. of Zero events/year)}} \times 100$$

Percentage change in the Average duration of zero flow events (Ave dur of zero events)

$$= \frac{\text{(current Ave dur of zero events) - (natural Ave dur of zero events)}}{} \times 100$$

(natural Ave dur of zero events)

Equation 2. Low flow (baseflow) component metrics (both low and high flow season)

Percentage change in the size of the 80th percentile flow (80th percentile flow)

= (current 80th %ile flow) - (natural 80th %ile flow) x 100

(natural 80th %ile flow)

Equation 3. Fresh event (spate) component metrics (both low and high flow season)

Percentage change in the Number of years with freshes (Fresh years)

= (current No. of Fresh years) - (natural No. of Fresh years) x 100

(natural No. of Fresh years)

Percentage change in the Number of freshes per year (Fresh events/year)

= (current No. of Fresh events/year) - (natural No. of Fresh events/year) x 100

(natural No. of Fresh events/year)

Percentage change in the Average duration of freshes (Ave dur of fresh events)

= (current Ave dur of fresh events) - (natural Ave dur of fresh events) x 100

(natural Ave dur of fresh events)

Equation 4. Bankfull to overbank flow events component metrics (all year)

Percentage change in the 1.5 year ARI flow, 2.5 year ARI flow, 5 year ARI flow (X year ARI flow)

= (current X year ARI flow) - (natural X year ARI flow) x 100

(natural X year ARI flow)

5.4 Corrected metrics for event loss and join

The metrics for flow event (zero flow events and freshes) can be confusing in some cases, as they can show a change in the metric which conflicts with what is happening to flow. In virtually all unregulated rivers, this can be rectified because flow can only be reduced, not increased, as can occur in regulated rivers. Three corrections were made to the metrics for unregulated rivers to avoid counter intuitive values.

Zero flow event component metrics

Correction 1: In calculating the number of zero flow events, the number of events can reduce, even though the number of days with zero flow has increased. This is because extraction can reduce flow between zero flow events joining them together, hence reducing the number of events.

To avoid the change in zero flow events per year metric showing a decrease when zero flows are increasing, events that were joined together were still considered as separate events. For example, if three events that had flows between them were joined into one through extraction, the event would be counted as three events when calculating this frequency metric.

Correction 2: In calculating the average duration of zero flow events, the duration of events can reduce, even though the number of days with zero flow has increased. This is because extraction can create a number of short zero flow events, hence reducing the average duration of events.

To avoid the change in average duration of zero flow events metric showing a decrease when zero flows are increasing, the number of events was held static. This ignores both joined events (which increase the duration metric) as well as the created low flow periods (often reducing the duration metric). For example, if a short event was created through extraction, it was assumed to be joined to the existing events when calculating this average duration metric.

Fresh event (spate) component metrics

Correction 3: In calculating the average duration of fresh events, the average duration of events can increase, even though the number of days with higher flow has decreased. This is because extraction can remove smaller, shorter fresh events, hence increasing the average duration of events.

To avoid the change in average duration of fresh events metric showing an increase when freshes are decreasing, only the duration of events that remain after extraction was considered. This ignores the duration of events that were lost all together. For example, if a fresh event was lost through extraction, it was not included in calculating this average duration metric.

6 Applying the likelihood metrics

The metrics presented in the previous section are measures of hydrologic alteration and indicators of the likelihood of impacting on ecosystem functions, as the higher the alteration of flows, the high the likelihood that the ecosystem functions are being impacted. These metrics indicated the alteration in the four different parts of the hydrograph (zero flow, low flow, freshes, and bankfull to overbank flows). In the three lower flow metrics, both low and high flow seasons metrics are calculated. The exception is the higher flows, where the bankfull and overbank flow component are calculated as annual metrics.

The metrics for the zero flow and low flow components in the unregulated rivers generally show the greatest alteration during the dryer, low flow season. For the fresh component, the season most altered varied, depending on the hydrology of the stream and the predominant extraction practice used in the area; run of river, or pumping to storage. Overbank flow metrics often showed no impact in run of river unregulated systems. In unregulated rivers where there was high flow extraction, the lower flow 1.5-year ARI metric generally showed the greatest alteration and the 5-year ARI metric the least.

The metrics in the regulated rivers are much more varied and are dependant of the location within the regulated river system. In the upper reaches directly below a dam, the low flow metrics often showed increase in the flow due to irrigation deliveries, sometimes making the dryer season wetter, and the wetter season dryer. In these upper reaches, the higher flows were generally reduced due to the flows impounded by the dam, while lower in the system the higher flows could have less impact, as tributaries entering the system can provide some high flow variability. The pattern of hydrologic alteration is much more complicated in the regulated rivers in comparison to the unregulated rivers due to the size and configuration of the infrastructure that regulates the flows.

An example of the 17 KEF metrics is presented in Table 2. In the first column of the table you can see the 'number of years with cease to flow in the low flow season' has been reduced by 100%, and in the far right column the 'change in the 5-year Average Reoccurrence Interval (ARI) flow' has reduced by 21%.

Table 2. KEF metrics for an example stream

Zero Flow Periods						Baseflow or Low Flows		Fresh Flows						Bankfull and Overbank Flows		
Low flow season			High flow season			Low	High	Low flow season			High flow season			All year		
Nº yrs with CtF	Ave CtF per year	Ave Dur CtF	Nº yrs with CtF	Ave CtF per year	Ave Dur CtF	Chge in 80th %ile	Chge in 80th %ile	Nº yrs with Fresh	Ave Fresh per year	Ave Dur Fresh	Nº yrs with Fresh	Ave Fresh per year	Ave Dur Fresh	Chge in 1.5yr ARI	Chge in 2.5yr ARI	Chge in 5yr ARI
-100%	-100%	-100%	-100%	-100%	-100%	15%	-1%	-35%	-45%	-2%	-21%	-36%	-17%	-36%	-30%	-21%

Abbreviations:

- Nº = number
- yrs = years
- CtF = cease to flow events
- Ave = average
- Dur = duration,
- Chge = change
- %ile = percentile
- ARI = average reoccurrence interval.

Intrinsic to evaluating risk is estimating the likelihood of a defined consequence. In this assessment, it was the consequence of impacting on the KEFs being assessed. The consequence of impairing riverine KEFs was rated as either high, medium, or low, based on the HEVAE assessment of river value. Further detail is available in the HEVAE method documentation (Healey et al, 2018). This was a value decision indicating that altered hydrology, impacting on the functioning of the ecology, in some rivers is more significant than in other rivers. It was assumed in defining consequence that it is the same for each of the four hydrologic components, as KEF were identified in most stream types (see Section 5.1).

The consequence of impairing ecosystem function in different seasons, low or high, was not captured in the defining consequence as the consequences were not seasonal. Seasonal likelihood measures, while providing more information, were not necessary for evaluating risk, hence only a single indicator of likelihood of impacts on each of the three components (zero flow, low flow, and fresh hydrograph components) were needed. The metrics for these were rolled up into one metric by selecting the highest impacted (furthest from 0%) for each flow component. An example of the rolled up metrics is shown in Table 3.

Table 3. Rolled up metrics for an example stream

Zero Flow Periods	Baseflow or Low Flows	Fresh Flows	Bankfull and Overbank Flows		
			1.5 ARI	2.5 ARI	5.0 ARI
-100%	15%	-45%	-36%	-30%	-21%

Likelihood category definitions are defined based on the extent of deviation from the near-natural condition (Table 4). Flow deviation can be positive (for example, 25%), which means more water is available for that particular flow component than the near-natural condition; conversely a negative deviation (for example –25%) means less water for that particular flow component. Note this is a different style of presenting the same metrics that the MDBA have published, as they presented them as a ratio, where an increase is represented as above 100% (e.g. 125%), and reduction is below 100% (e.g. 75%).

Table 4. Likelihood metrics for risk of insufficient water available for the environment

Likelihood metric	Metric category	Metric category definition
Flow Deviation of scenario compared to near-natural condition	Low	< 20% departure from near-natural condition (+/-)
	Medium	20-50% departure from near-natural condition (+/-)
	High	> 50% departure from near-natural condition (+/-)
Reference: Alluvium 2010; VanLaarhoven & van der Wielen 2009		

Based on the ranges of hydrologic alteration indicated in Table 4, the metrics are converted to likelihood ratings of high, medium, and low. An example of the rating of likelihood is in Table 5.

Table 5. Likelihood rating for an example stream

Zero Flow Periods	Baseflow or Low Flows	Fresh Flows	Bankfull and Overbank Flows		
			1.5 ARI	2.5 ARI	5.0 ARI
H-	L+*	M-	M-	M-	M-

As indicated in the Background section of the report, the likelihood ratings are used in conjunction with the consequence rating to determine a risk rating. The details on how these likelihood ratings are used to determine risk rating is presented in the Risk Assessments for the surface water in the Water Resource Planning Areas (presented in the 'Risks to water available for the environment and capacity to meet environmental water requirements' sections of the risk assessments reports).

7 Improvements

The length of flow records used in some models was short and could be extended using rainfall runoff modelling. Ideally, all models would use the same period of record, possibly extending out to nearly 100 years in duration.

If possible, the flow sequences would represent naturalised flow sequences, where the extractions that have reduced the measured flow sequences are added back into the flow sequence. Consideration of whether this is repetitive of the flow that is available to extract could also see some other adjustment either up or down.

While the crop mix information is reasonable, there are other types of farm information which would improve modelling, such as the typical amount of on-farm storage in the different river systems and the typical pump capacities, both into storage and onto crops. In many cases, the unregulated water that is extracted is only to supplement other sources of water; groundwater, floodplain harvested water, supplementary water, and regulated water from the regulated river system. Understanding more about how these other sources are used would also improve the simulation of unregulated water extraction.

Should more specific ecological functions be identified in the future, the need to identify and separate river types would likely be required. Using river types would be consistent with the ELOHA process and could be

generated using the ANAE guidelines (AETG, 2012a). Currently 10 geomorphic types have been proposed for NSW rivers. These are based on grouping River Styles® (Brierley & Fryirs, 2005) that have been mapped across all of NSW. To better employ the approach suggested within ELOHA and meet the ANAE guidelines, hydrologic types would need to be overlayed with the geomorphic types to generate adequate river typing, and allow more specific ecosystem functions to be considered.

More sophisticated KEF metrics for use in regulated rivers could be investigated. The metrics for analysing events (both zero flow events and fresh event metrics) often appear contrary to reality and are misleading if considered separately from the other metrics. Such metrics would need to consider whether events are being joined, being removed, or being created. This is because the average event frequency metrics and the average event duration metrics can suggest more flow when there is less and vice-versa. This is because averaging the duration misses information about change in frequency. Similarly, averaging frequency misses information about changes in duration. Ideally, more sophisticated KEF metrics would be able to be applied constantly no matter how the hydrology is altered, and the metric could be intuitive, even when evaluated without the context of the other metrics (also see discussion in Section 5.4).

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Appendix A Multi-reach models used for regulated rivers

Border Rivers Regulated River IQQM Model

Gwydir Regulated River IQQM Model

Namoi Regulated River IQQM Model

Macquarie Regulated River IQQM Model

Lachlan Regulated River IQQM Model

Murrumbidgee Regulated River IQQM Model

Murray Regulated River (BigMod) Model

Appendix B Multi-reach models used for unregulated rivers

Barwon Darling IQQM River model

Castlereagh River IQQM modelling (flow sequences sources for use in single reach models)

Fish River IQQM model (End of System node)

Upper Murrumbidgee River IQQM model (not able to be sourced)

Appendix C Sequences, parameters, and assumptions used in single-reach models

Border Rivers unregulated river models

Table 6. Beardy River

Water source and model	**Beardy River: model Beardy River**	
Water source boundaries	The main stream is the Beardy River with headwater streams flowing into it.	
Assumptions		**Confidence**
Flow sequence		High
flows used	A measured flow sequence was used to represent the streamflow available to be extracted. This flow was measured at the gauging station "Beardy River at Haystack" (416008). The flow sequence extends from 01/11/1960 to 16/11/2009, 49.0 years in total. 4.2% of the measured sequenced need to be filled using a correlation with a nearby gauging station.	
total area factor	The flow sequence was factored for area by 1.00.	
on-river dams area factor	No on-river dam simulated.	
on-farm dams area factor	No on-farm dams simulated.	
Water access		High
level of entitlement	The total entitlement simulated was 470ML made up of: • 464 ML Unregulated category entitlement • 6 ML Domestic and Stock category.	
access rules (CtP)	A CtP was not simulated.	
higher access rule (CtP on Approval)	No higher of access rules (CtP) were simulated.	
pump capacity	A pump capacity of 7.73 ML/day was available for irrigation and 0.02 ML/day was available for Stock and Domestic and LWU water extraction.	
on-river dam access	No on-river dams simulated.	

Water source and model	Beardy River: model Beardy River	
on-farm storage available	No on-farm storage simulated.	
Irrigation pattern		High
crop	The crop mix assumed is from the survey for a conversion of unregulated licences carried out in 2000. The crop survey result for Stressed Rivers Assessment unit “Beardy Creek” (416_16) was used. This crop mix is represented by simulating the water demands of the following crops: • Annual pasture 2% • Lucerne 80% • Vegetables 18%. The total area irrigated (based on the full development of the entitlement) in the Beardy River system was estimated to be 77ha. The weather station used was Bonshaw (Monkstadt) (station number 56041). The crop factor file used was “nthtab6ed.crp”, which was developed for the licence conversion process.	
Groundwater extraction	No substaintial alluvial extractions indentified as impacting on streamflow.	
Licence locations		

Table 7. Bonshaw

Water source and model	**Bonshaw: model Spring Creek and Crooked Creek (along with other small streams)**	
Water source boundaries	The main streams are Spring Creek and Crooked Creek (along with other small streams), which flow into the regulated river.	
Assumptions		**Confidence**
Flow sequence		Low
flows used	A rainfall runoff modeled flow sequence was used to represent the streamflow available to be extracted. This flow was based on a gauging station from an adjacent catchement “Reedy Creek at Dumaresq” (416026). The flow sequence extends from 01/01/1890 to 30/09/1996, 106.7 years in total.	
total area factor	The flow sequence was factored for area by 1.09. Of this factor 93 was not avaliable to be accessed by licence holders.	
on-river dams area factor	No on-river dam simulated.	
on-farm dams area factor	No on-farm dams simulated.	
Water access		High
level of entitlement	The total entitlement simulated was 56 ML made up of: • 51 ML Unregulated category entitlement • 5 ML Domestic and Stock category	
access rules (CtP)	A CtP was not simulated.	
higher access rule (CtP on Approval)	No higher of access rules (CtP) were simulated.	
pump capacity	A pump capacity of 0.85 ML/day was available for irrigation and 0.01 ML/day was available for Stock and Domestic and LWU water extraction.	
on-river dam access	No on-river dams simulated.	
on-farm storage available	No on-farm storage simulated.	
Irrigation pattern		High

Water source and model	Bonshaw: model Spring Creek and Crooked Creek (along with other small streams)
crop	The crop mix assumed is from the survey for a conversion of unregulated licences carried out in 2000. The crop survey result for Stressed Rivers Assessment unit “Bonshaw (small part)” (416_12) was used. This crop mix is represented by simulating the water demands of the following crops: • Lucerne 56% • Vegetables 33% • Grapes 11%. The total area irrigated (based on the full development of the entitlement) in the Spring Creek and Crooked Creek (along with other small streams) system was estimated to be 8ha. The weather station used was Bonshaw (Campbell St) (station number 54007). The crop factor file used was “nthwst6ed.crp”, which was developed for the licence conversion process.
Groundwater extraction	No substaintial alluvial extractions indentified as impacting on streamflow.
Licence locations	

Table 8. Campbells Creek

Water source and model	**Campbells Creek: model Campbells Creek (along with other small streams)**	
Water source boundaries	The main stream is Campbells Creek (along with other small streams), which flow into the regulated river.	
Assumptions		**Confidence**
Flow sequence		High
flows used	A measured flow sequence was used to represent the streamflow available to be extracted. This flow was measured at the gauging station "Campbells Creek at Near Beebo" (416036). The flow sequence extends from 01/04/1973 to 05/05/1996, 23.1 years in total. 3.9% of the measured sequenced need to be filled using a correlation with a nearby gauging station.	
total area factor	The flow sequence was factored for area by 1.00.	
on-river dams area factor	No on-river dam simulated.	
on-farm dams area factor	No on-farm dams simulated.	
Water access		High
level of entitlement	The total entitlement simulated was 125ML made up of: • 120 ML Unregulated category entitlement • 5 ML Domestic and Stock category.	
access rules (CtP)	A CtP was not simulated.	
higher access rule (CtP on Approval)	No higher of access rules (CtP) were simulated.	
pump capacity	A pump capacity of 2.00 ML/day was available for irrigation and 0.01 ML/day was available for Stock and Domestic and LWU water extraction.	
on-river dam access	No on-river dams simulated.	
on-farm storage available	No on-farm storage simulated.	
Irrigation pattern		High

Water source and model	Campbells Creek: model Campbells Creek (along with other small streams)
crop	The crop mix assumed is from the survey for a conversion of unregulated licences carried out in 2000. The crop survey result for Stressed Rivers Assessment unit “Stony Creek” (416_06) was used. This crop mix is represented by simulating the water demands of the following crops: • Lucerne 100%. The total area irrigated (based on the full development of the entitlement) in the Campbells Creek (along with other small streams) system was estimated to be 18ha. The weather station used was Yetman (Warialda Street) (station number 54035). The crop factor file used was “nthwst6ed.crp”, which was developed for the licence conversion process.
Groundwater extraction	No substaintial alluvial extractions indentified as impacting on streamflow.
Licence locations	

Table 9. Camp Creek

Water source and model	**Camp Creek: model Camp Creek (along with other small streams)**	
Water source boundaries	The main stream is Camp Creek (along with other small streams), which flow into the regulated river.	
Assumptions		**Confidence**
Flow sequence		Moderate
flows used	A measured flow sequence was used to represent the streamflow available to be extracted. This flow was measured at a gauging station from an adjacent catchement “Campbells Creek at Near Beebo” (416036). The flow sequence extends from 01/04/1973 to 05/05/1996, 23.1 years in total. 3.9% of the measured sequenced need to be filled using a correlation with a nearby gauging station.	
total area factor	The flow sequence was factored for area by 1.05. Of this factor 63 was not avaliable to be accessed by licence holders.	
on-river dams area factor	No on-river dam simulated.	
on-farm dams area factor	No on-farm dams simulated.	
Water access		High
level of entitlement	The total entitlement simulated was 82 ML made up of: 82 ML Unregulated category entitlement	
access rules (CtP)	A CtP was not simulated.	
higher access rule (CtP on Approval)	No higher of access rules (CtP) were simulated.	
pump capacity	A pump capacity of 1.37 ML/day was available for irrigation and 0.00 ML/day was available for Stock and Domestic and LWU water extraction.	
on-river dam access	No on-river dams simulated.	
on-farm storage available	No on-farm storage simulated.	
Irrigation pattern		High

Water source and model	Camp Creek: model Camp Creek (along with other small streams)
crop	The crop mix assumed is from the survey for a conversion of unregulated licences carried out in 2000. The crop survey result for Stressed Rivers Assessment unit “Camp Creek” (416_10) was used. This crop mix is represented by simulating the water demands of the following crops: • Annual pasture 53% • Lucerne 47%. The total area irrigated (based on the full development of the entitlement) in the Camp Creek (along with other small streams) system was estimated to be 15 ha. The weather station used was Texas Post Office (station number 41100). The crop factor file used was “nthwst6ed.crp”, which was developed for the licence conversion process.
Groundwater extraction	No substaintial alluvial extractions indentified as impacting on streamflow.
Licence locations	

Table 10. Glen Innes

Water source and model	**Glen Innes: model Severn River**	
Water source boundaries	The main stream is the Severn River with headwater streams flowing into it. Part of the lower end of the water source has some small residual streams flowing into the regulated river dam. The Severn River flows into Pindari Dam, which falls in the lower end of the water source.	
Assumptions		**Confidence**
Flow sequence		High
flows used	A measured flow sequence was used to represent the streamflow available to be extracted. This flow was measured at the gauging station "Severn River at Strathbogie" (416039). The flow sequence extends from 10/05/1974 to 05/11/2009, 35.5 years in total. 1.7% of the measured sequenced need to be filled using a correlation with a nearby gauging station.	
total area factor	The flow sequence was factored for area by 1.10.	
on-river dams area factor	A proportion of the streamflow sequence (14% of the unfactored flow sequence) is able to be captured by on-river dams.	
on-farm dams area factor	No on-farm dams simulated.	
Water access		Moderate
level of entitlement	The total entitlement simulated was 5764 ML made up of: • 4599 ML Unregulated category entitlement • 1165 ML Domestic and Stock category	
access rules (CtP)	A CtP was not simulated.	
higher access rule (CtP on Approval)	No higher of access rules (CtP) were simulated.	
pump capacity	A pump capacity of 76.65 ML/day was available for irrigation and 3.19 ML/day was available for Stock and Domestic and LWU water extraction.	
on-river dam access	1000 ML of on-river dam capacity was simulated. 0% of the unregulated entitlement had access to on-river dams. 97% of the Stock and Domestic and LWU entitlement had access to the on-river dams.	
on-farm storage available	No on-farm storage simulated.	
Irrigation pattern		High

Water source and model	Glen Innes: model Severn River
crop	The crop mix assumed is from the survey for a conversion of unregulated licences carried out in 2000. The crop survey result for Stressed Rivers Assessment unit “Glen Innes” (416_15) was used. This crop mix is represented by simulating the water demands of the following crops: • Lucerne 10% • Perennial pasture 7% • Summer Maize 67% • Vegetables 2% • Wheat 14%. The total area irrigated (based on the full development of the entitlement) in the Severn River system was estimated to be 1,387 ha. The weather station used was Deepwater Post Office (station number 56008). The crop factor file used was “nthtab6ed.crp”, which was developed for the licence conversion process.
Groundwater extraction	No substaintial alluvial extractions indentified as impacting on streamflow.
Licence locations	Some of the licences have access to on-river dams (see sections 'on-river dam area factor' and 'on-river dam access').

Table 11. Inverell

Water source and model	**Inverell: model Macintyre River**	
Water source boundaries	The main stream is the Macintyre River with headwater streams flowing into it. Part of the lower end of the water source has some small residual streams flowing into the trunk stream.	
Assumptions		**Confidence**
Flow sequence		High
flows used	A measured flow sequence was used to represent the streamflow available to be extracted. This flow was measured at the gauging station "Macintyre River at Wallangra" (416010). The flow sequence extends from 01/01/1937 to 19/11/2009, 72.9 years in total. 1.5% of the measured sequenced need to be filled using a correlation with a nearby gauging station.	
total area factor	The flow sequence was factored for area by 1.07.	
on-river dams area factor	A proportion of the streamflow sequence (29% of the unfactored flow sequence) is able to be captured by on-river dams.	
on-farm dams area factor	No on-farm dams simulated.	
Water access		Moderate
level of entitlement	The total entitlement simulated was 7,377.5 ML made up of: • 7,206 ML Unregulated category entitlement • 71.5 ML Domestic and Stock category • 100 ML LWU category entitlement	
access rules (CtP)	A CtP was not simulated.	
higher access rule (CtP on Approval)	No higher of access rules (CtP) were simulated.	
pump capacity	A pump capacity of 120.10 ML/day was available for irrigation and 0.47 ML/day was available for Stock and Domestic and LWU water extraction.	
on-river dam access	100 ML of on-river dam capacity was simulated. 0% of the unregulated entitlement had access to on-river dams. 58% of the Stock and Domestic and LWU entitlement had access to the on-river dams.	
on-farm storage available	No on-farm storage simulated.	
Irrigation pattern		High

Water source and model	Inverell: model Macintyre River
crop	The crop mix assumed is from the survey for a conversion of unregulated licences carried out in 2000. The crop survey result for Stressed Rivers Assessment unit “Inverell” (416_14) was used. This crop mix is represented by simulating the water demands of the following crops: • Annual pasture 4% • Lucerne 67% • Perennial pasture 10% • Intensive perennial pasture 4% • Soybeans 2% • Summer Maize 6% • Vegetables 1% • Wheat 6% The total area irrigated (based on the full development of the entitlement) in the Macintyre River system was estimated to be 1,190 ha. The weather station used was Inverell Comparison (station number 56017). The crop factor file used was “nthtab6ed.crp”, which was developed for the licence conversion process.
Groundwater extraction	No substaintial alluvial extractions indentified as impacting on streamflow.
Licence locations	Some of the licences have access to on-river dams (see sections 'on-river dam area factor' and 'on-river dam access').

Table 12. Kings Plains

Water source and model	**Kings Plains: model Frazers Creek**	
Water source boundaries	The main stream is Frazers Creek with headwater streams flowing into it. Part of the lower end of the water source has some small residual streams flowing into the trunk stream.	
Assumptions		**Confidence**
Flow sequence		High
flows used	A measured flow sequence was used to represent the streamflow available to be extracted. This flow was measured at the gauging station "Frazers Creek at Westholme (Ashford)" (416021). The flow sequence extends from 07/03/1967 to 15/04/2015, 48.1 years in total. 28.3% of the measured sequenced need to be filled using a correlation with a nearby gauging station.	
total area factor	The flow sequence was factored for area by 1.04.	
on-river dams area factor	No on-river dam simulated.	
on-farm dams area factor	No on-farm dams simulated.	
Water access		High
level of entitlement	The total entitlement simulated was 564 ML made up of: • 559.5 ML Unregulated category entitlement • 4.5 ML Domestic and Stock category.	
access rules (CtP)	A CtP was not simulated.	
higher access rule (CtP on Approval)	No higher of access rules (CtP) were simulated.	
pump capacity	A pump capacity of 9.33 ML/day was available for irrigation and 0.01 ML/day was available for Stock and Domestic and LWU water extraction.	
on-river dam access	No on-river dams simulated.	
on-farm storage available	No on-farm storage simulated.	
Irrigation pattern		High

Water source and model	Kings Plains: model Frazers Creek
crop	The crop mix assumed is from the survey for a conversion of unregulated licences carried out in 2000. The crop survey result for Stressed Rivers Assessment unit “Kings Plain” (416_13) was used. This crop mix is represented by simulating the water demands of the following crops: • Annual pasture 4% • Lucerne 52% • Perennial pasture 44%. The total area irrigated (based on the full development of the entitlement) in the Frazers Creek system was estimated to be 90 ha. The weather station used was Ashford (Sunhaven Hostel) (station number 54002). The crop factor file used was “nthtab6ed.crp”, which was developed for the licence conversion process.
Groundwater extraction	No substaintial alluvial extractions indentified as impacting on streamflow.
Licence locations	

Table 13. Mole River

Water source and model	**Mole River: model Mole River**	
Water source boundaries	The main stream is the Mole River with headwater streams flowing into it.	
Assumptions		**Confidence**
Flow sequence		High
flows used	A measured flow sequence was used to represent the streamflow available to be extracted. This flow was measured at the gauging station "Mole River at Donaldson" (416032). The flow sequence extends from 01/02/1924 to 16/11/2009, 85.8 years in total. 0.1% of the measured sequenced need to be filled using a correlation with a nearby gauging station.	
total area factor	The flow sequence was factored for area by 1.03.	
on-river dams area factor	A proportion of the streamflow sequence (14% of the unfactored flow sequence) is able to be captured by on-river dams.	
on-farm dams area factor	No on-farm dams simulated.	
Water access		Moderate
level of entitlement	The total entitlement simulated was 4,867 ML made up of: • 4,766.5 ML Unregulated category entitlement • 36.5 ML Domestic and Stock category • 64 ML LWU category entitlement	
access rules (CtP)	A CtP was not simulated.	
higher access rule (CtP on Approval)	No higher of access rules (CtP) were simulated.	
pump capacity	A pump capacity of 79.44 ML/day was available for irrigation and 0.28 ML/day was available for Stock and Domestic and LWU water extraction.	
on-river dam access	130 ML of on-river dam capacity was simulated. 4% of the unregulated entitlement had access to on-river dams. 64% of the Stock and Domestic and LWU entitlement had access to the on-river dams.	
on-farm storage available	No on-farm storage simulated.	
Irrigation pattern		High

Water source and model	Mole River: model Mole River
crop	The crop mix assumed is from the survey for a conversion of unregulated licences carried out in 2000. The crop survey result for Stressed Rivers Assessment unit “Tenterfield Creek2 (half)” (416_21) was used. This crop mix is represented by simulating the water demands of the following crops: • Annual pasture 2% • Lucerne 43% • Orchard 6% • Perennial pasture 13% • Summer Maize 12% • Vegetables 18% • Wheat 6%. The total area irrigated (based on the full development of the entitlement) in the Mole River system was estimated to be 867 ha. The weather station used was Mole River (Trenayr) (station number 56055). The crop factor file used was “nthtab6ed.crp”, which was developed for the licence conversion process.
Groundwater extraction	No substaintial alluvial extractions indentified as impacting on streamflow.
Licence locations	Some of the licences have access to on-river dams (see sections 'on-river dam area factor' and 'on-river dam access').

Table 14. Ottleys Creek

Water source and model	**Ottleys Creek: model Ottleys Creek**	
Water source boundaries	The main stream is Ottleys Creek with headwater streams flowing into it. Part of the lower end of the water source has some small residual streams flowing into the trunk stream.	
Assumptions		**Confidence**
Flow sequence		Low
flows used	A measured flow sequence was used to represent the streamflow available to be extracted. This flow was measured at the gauging station "Ottleys Creek at Coolatai" (416020). The flow sequence extends from 03/03/1967 to 14/12/2009, 42.8 years in total. 0.9% of the measured sequenced need to be filled using a correlation with a nearby gauging station.	
total area factor	The flow sequence was factored for area by 3.66. Of this factor 266 was not avaliable to be accessed by licence holders.	
on-river dams area factor	No on-river dam simulated.	
on-farm dams area factor	No on-farm dams simulated.	
Water access		High
level of entitlement	The total entitlement simulated was 101 ML made up of: • 101 ML Unregulated category entitlement • 0 ML Domestic and Stock category.	
access rules (CtP)	A CtP was not simulated.	
higher access rule (CtP on Approval)	No higher of access rules (CtP) were simulated.	
pump capacity	A pump capacity of 1.68 ML/day was available for irrigation and 0.00 ML/day was available for Stock and Domestic and LWU water extraction.	
on-river dam access	No on-river dams simulated.	
on-farm storage available	No on-farm storage simulated.	
Irrigation pattern		Moderate

Water source and model	Ottleys Creek: model Ottleys Creek
crop	The crop mix assumed is from the survey for a conversion of unregulated licences carried out in 2000. The crop survey result for Stressed Rivers Assessment unit “Dumaresq” (416_07) was used. This crop mix is represented by simulating the water demands of the following crops: • Fababean 32% • Lucerne 37% • Wheat 32%. The total area irrigated (based on the full development of the entitlement) in the Ottleys Creek system was estimated to be 20 ha. The weather station used was Coolatai (Orana) (station number 54012). The crop factor file used was “nthwst6ed.crp”, which was developed for the licence conversion process.
Groundwater extraction	Alluvial groundwater is accessed in the vicinity of these unregulated streams which may also impact on streamflow but these were not simulated.
Licence locations	

Table 15. Reedy Creek

Water source and model	**Reedy Creek: model Reedy Creek (along with other small streams)**	
Water source boundaries	The main stream is Reedy Creek (along with other small streams), which flow into the regulated river.	
Assumptions		**Confidence**
Flow sequence		High
flows used	A measured flow sequence was used to represent the streamflow available to be extracted. This flow was measured at the gauging station "Reedy Creek at Dumaresq" (416026). The flow sequence extends from 24/04/1969 to 31/12/1988, 19.7 years in total. 28.6% of the measured sequenced need to be filled using a correlation with a nearby gauging station.	
total area factor	The flow sequence was factored for area by 1.00.	
on-river dams area factor	No on-river dam simulated.	
on-farm dams area factor	No on-farm dams simulated.	
Water access		NA
level of entitlement	The total entitlement simulated was 0ML made up of:	
access rules (CtP)	A CtP was not simulated.	
higher access rule (CtP on Approval)	No higher of access rules (CtP) were simulated.	
pump capacity	A pump capacity of 0.00 ML/day was available for irrigation and 0.00 ML/day was available for Stock and Domestic and LWU water extraction.	
on-river dam access	No on-river dams simulated.	
on-farm storage available	No on-farm storage simulated.	
Irrigation pattern		Moderate

Water source and model	Reedy Creek: model Reedy Creek (along with other small streams)
crop	The crop mix assumed is from the survey for a conversion of unregulated licences carried out in 2000. The crop survey result for Stressed Rivers Assessment unit “Bonshaw (small part)” (416_12) was used. This crop mix is represented by simulating the water demands of the following crops: • Lucerne 56% • Vegetables 33% • Grapes 11%. The total area irrigated (based on the full development of the entitlement) in the Reedy Creek (along with other small streams) system was estimated to be 0ha. The weather station used was Bonshaw (Monkstadt) (station number 56041). The crop factor file used was “nthtab6ed.crp”, which was developed for the licence conversion process.
Groundwater extraction	No substaintial alluvial extractions indentified as impacting on streamflow.
Licence locations	

Table 16. Tenterfield Creek

Water source and model	Tenterfield Creek: model Tenterfield Creek	
Water source boundaries	The main stream is Tenterfield Creek with headwater streams flowing into it.	
Assumptions		**Confidence**
Flow sequence		Moderate
flows used	A measured flow sequence was used to represent the streamflow available to be extracted. This flow was measured at the gauging station "Tenterfield Creek at Clifton" (416003). The flow sequence extends from 06/09/1934 to 15/11/2009, 75.2 years in total. 0.6% of the measured sequenced need to be filled using a correlation with a nearby gauging station.	
total area factor	The flow sequence was factored for area by 1.38.	
on-river dams area factor	A proportion of the streamflow sequence (11% of the unfactored flow sequence) is able to be captured by on-river dams.	
on-farm dams area factor	No on-farm dams simulated.	
Water access		Low
level of entitlement	The total entitlement simulated was 3,788 ML made up of: • 2,780 ML Unregulated category entitlement • 184 ML Domestic and Stock category • 824 ML LWU category entitlement.	
access rules (CtP)	A CtP was not simulated.	
higher access rule (CtP on Approval)	No higher of access rules (CtP) were simulated.	
pump capacity	A pump capacity of 46.33 ML/day was available for irrigation and 2.76 ML/day was available for Stock and Domestic and LWU water extraction.	
on-river dam access	924 ML of on-river dam capacity was simulated. 0% of the unregulated entitlement had access to on-river dams. 92% of the Stock and Domestic and LWU entitlement had access to the on-river dams.	
on-farm storage available	No on-farm storage simulated.	
Irrigation pattern		High

Water source and model	Tenterfield Creek: model Tenterfield Creek
crop	The crop mix assumed is from the survey for a conversion of unregulated licences carried out in 2000. The crop survey result for Stressed Rivers Assessment unit “Tenterfield Creek1 (most)” (416_20) was used. This crop mix is represented by simulating the water demands of the following crops: • Annual pasture 3% • Lucerne 35% • Orchard 2% • Perennial pasture 5% • Summer Maize 4% • Turf 3% • Vegetables 28% • Grapes 2% • Wheat 18%. The total area irrigated (based on the full development of the entitlement) in the Tenterfield Creek system was estimated to be 674 ha. The weather station used was Tenterfield (Federation Park) (station number 56032). The crop factor file used was “nthtab6ed.crp”, which was developed for the licence conversion process.
Groundwater extraction	No substaintial alluvial extractions indentified as impacting on streamflow.
Licence locations	Some of the licences have access to on-river dams (see sections 'on-river dam area factor' and 'on-river dam access').

Table 17. Yetman

Water source and model	Yetman: model Mandoe Creek (along with other small streams)	
Water source boundaries	The main stream is Mandoe Creek (along with other small streams), which flow into the regulated river.	
Assumptions		**Confidence**
Flow sequence		Low
flows used	A measured flow sequence was used to represent the streamflow available to be extracted. This flow was measured at a gauging station from an adjacent catchement “Campbells Creek at Near Beebo” (416036). The flow sequence extends from 01/04/1973 to 05/05/1996, 23.1 years in total. 3.9% of the measured sequenced need to be filled using a correlation with a nearby gauging station.	
total area factor	The flow sequence was factored for area by 1.64. Of this factor 71 was not avaliable to be accessed by licence holders.	
on-river dams area factor	No on-river dam simulated.	
on-farm dams area factor	No on-farm dams simulated.	
Water access		NA
level of entitlement	The total entitlement simulated was 0ML made up of:	
access rules (CtP)	A CtP was not simulated.	
higher access rule (CtP on Approval)	No higher of access rules (CtP) were simulated.	
pump capacity	A pump capacity of 0.00 ML/day was available for irrigation and 0.00 ML/day was available for Stock and Domestic and LWU water extraction.	
on-river dam access	No on-river dams simulated.	
on-farm storage available	No on-farm storage simulated.	
Irrigation pattern		High

Water source and model	Yetman: model Mandoe Creek (along with other small streams)
crop	The crop mix assumed is from the survey for a conversion of unregulated licences carried out in 2000. The crop survey result for Stressed Rivers Assessment unit “Camp Creek” (416_10) was used. This crop mix is represented by simulating the water demands of the following crops: • Annual pasture 53% • Lucerne 47% The total area irrigated (based on the full development of the entitlement) in the Mandoe Creek (along with other small streams) system was estimated to be 0ha. The weather station used was Yetman (Warialda Street) (station number 54035). The crop factor file used was “nthwst6ed.crp”, which was developed for the licence conversion process.
Groundwater extraction	Alluvial groundwater is accessed in the vicinity of these unregulated streams which may also impact on streamflow but these were not simulated.
Licence locations	

Gwydir unregulated river models

Table 18. Boorolong Creek

Water source and model	Boorolong Creek: model Boorolong Creek	
Water source boundaries	The main stream is Boorolong Creek with headwater streams flowing into it.	
Assumptions		**Confidence**
Flow sequence		High
flows used	A measured flow sequence was used to represent the streamflow available to be extracted. This flow was measured at the gauging station "Boorolong Creek at Yarrowyck" (418020). The flow sequence extends from 01/06/1965 to 14/09/1987, 22.3 years in total. 0.6% of the measured sequenced need to be filled using a correlation with a nearby gauging station.	
total area factor	The flow sequence was factored for area by 1.00.	
on-river dams area factor	A proportion of the streamflow sequence (90% of the unfactored flow sequence) is able to be captured by on-river dams.	
on-farm dams area factor	No on-farm dams simulated.	
Water access		Moderate
level of entitlement	The total entitlement simulated was 231 ML made up of: • 225 ML Unregulated category entitlement • 6 ML Domestic and Stock category	
access rules (CtP)	A CtP was not simulated.	
higher access rule (CtP on Approval)	No higher of access rules (CtP) were simulated.	
pump capacity	A pump capacity of 3.75 ML/day was available for irrigation and 0.02 ML/day was available for Stock and Domestic and LWU water extraction.	
on-river dam access	115 ML of on-river dam capacity was simulated. 100% of the unregulated entitlement had access to on-river dams. 50% of the Stock and Domestic and LWU entitlement had access to the on-river dams.	
on-farm storage available	No on-farm storage simulated.	
Irrigation pattern		High

Water source and model	Boorolong Creek: model Boorolong Creek
crop	The crop mix assumed is from the survey for a conversion of unregulated licences carried out in 2000. The crop survey result for Stressed Rivers Assessment unit “Boorolong Creek” (418_30) was used. This crop mix is represented by simulating the water demands of the following crops: • Lucerne 34% • Perennial pasture 66%. The total area irrigated (based on the full development of the entitlement) in the Boorolong Creek system was estimated to be 42 ha. The weather station used was Guyra Post Office (station number 56016). The crop factor file used was “nthtab6ed.crp”, which was developed for the licence conversion process.
Groundwater extraction	No substaintial alluvial extractions indentified as impacting on streamflow.
Licence locations	Some of the licences have access to on-river dams (see sections 'on-river dam area factor' and 'on-river dam access').

Table 19. Rocky River

Water source and model	**Rocky River: model Rocky River**	
Water source boundaries	The main stream is the Rocky River downstream of other water sources that flow into it.	
Assumptions		**Confidence**
Flow sequence		High
flows used	A measured flow sequence was used to represent the streamflow available to be extracted. This flow was measured at the gauging station "Gwydir River at Yarrowyck" (418014). The flow sequence extends from 01/01/1955 to 10/05/2009, 54.4 years in total. 0.6% of the measured sequenced need to be filled using a correlation with a nearby gauging station.	
total area factor	The flow sequence was factored for area by 1.00.	
on-river dams area factor	A proportion of the streamflow sequence (35% of the unfactored flow sequence) is able to be captured by on-river dams.	
on-farm dams area factor	No on-farm dams simulated.	
Water access		Low
level of entitlement	The total entitlement simulated was 893.5ML made up of: • 253 ML Unregulated category entitlement • 640.5 ML Domestic and Stock category	
access rules (CtP)	A CtP was not simulated.	
higher access rule (CtP on Approval)	No higher of access rules (CtP) were simulated.	
pump capacity	A pump capacity of 4.22 ML/day was available for irrigation and 1.75 ML/day was available for Stock and Domestic and LWU water extraction.	
on-river dam access	400 ML of on-river dam capacity was simulated. 100% of the unregulated entitlement had access to on-river dams. 97% of the Stock and Domestic and LWU entitlement had access to the on-river dams.	
on-farm storage available	No on-farm storage simulated.	
Irrigation pattern		High

Water source and model	Rocky River: model Rocky River
crop	The crop mix assumed is from the survey for a conversion of unregulated licences carried out in 2000. The crop survey result for Stressed Rivers Assessment unit “Rocky River” (418_28) was used. This crop mix is represented by simulating the water demands of the following crops: • Lucerne 100%. The total area irrigated (based on the full development of the entitlement) in the Rocky River system was estimated to be 51ha. The weather station used was Uralla (Dumaresq St) (station number 56034). The crop factor file used was “nthtab6ed.crp”, which was developed for the licence conversion process.
Groundwater extraction	No substaintial alluvial extractions indentified as impacting on streamflow.
Licence locations	Some of the licences have access to on-river dams (see sections 'on-river dam area factor' and 'on-river dam access').

Table 20. Roumalla Creek

Water source and model	Roumalla Creek: model Roumalla Creek	
Water source boundaries	The main stream is Roumalla Creek with headwater streams flowing into it.	
Assumptions		**Confidence**
Flow sequence		High
flows used	A measured flow sequence was used to represent the streamflow available to be extracted. This flow was measured at the gauging station "Roumalla Creek at Kingstown" (418024). The flow sequence extends from 10/06/1965 to 15/01/1989, 23.6 years in total. 3.4% of the measured sequenced need to be filled using a correlation with a nearby gauging station.	
total area factor	The flow sequence was factored for area by 1.10.	
on-river **dams area factor**	A proportion of the streamflow sequence (1% of the unfactored flow sequence) is able to be captured by on-river dams.	
on-farm **dams area factor**	No on-farm dams simulated.	
Water access		High
level of entitlement	The total entitlement simulated was 254 ML made up of: • 242 ML Unregulated category entitlement • 12 ML Domestic and Stock category.	
access rules (CtP)	A CtP was not simulated.	
higher access rule (CtP on Approval)	No higher of access rules (CtP) were simulated.	
pump capacity	A pump capacity of 4.03 ML/day was available for irrigation and 0.03 ML/day was available for Stock and Domestic and LWU water extraction.	
on-river dam access	30 ML of on-river dam capacity was simulated. 25% of the unregulated entitlement had access to on-river dams. 42% of the Stock and Domestic and LWU entitlement had access to the on-river dams.	
on-farm storage available	No on-farm storage simulated.	
Irrigation pattern		High

Water source and model	Roumalla Creek: model Roumalla Creek
crop	The crop mix assumed is from the survey for a conversion of unregulated licences carried out in 2000. The crop survey result for Stressed Rivers Assessment unit “Roumalla Creek” (418_01) was used. This crop mix is represented by simulating the water demands of the following crops: • Lucerne 88% • Perennial pasture 12% The total area irrigated (based on the full development of the entitlement) in the Roumalla Creek system was estimated to be 48ha. The weather station used was Uralla (Dumaresq St) (station number 56034). The crop factor file used was “nthtab6ed.crp”, which was developed for the licence conversion process.
Groundwater extraction	No substaintial alluvial extractions indentified as impacting on streamflow.
Licence locations	Some of the licences have access to on-river dams (see sections 'on-river dam area factor' and 'on-river dam access').

Table 21. Upper Gwydir River

Water source and model	**Upper Gwydir River: model Gwydir River**	
Water source boundaries	The main stream is the Gwydir River downstream of other water sources that flow into it. The reach of Gwydir River in this water sources may be better managed as a separate water sources (linear) along with other reaches of the Gwydir River. Simlarly for associated residual tributaries in a separate (polygon) water source.	
Assumptions		**Confidence**
Flow sequence		High
flows used	A rainfall runoff modeled flow sequence was used to represent the streamflow available to be extracted. This flow was based on the gauging station "Gwydir River at Stonybatter" (418029). The flow sequence extends from 01/01/1889 to 06/07/2009, 120.5 years in total.	
total area factor	The flow sequence was factored for area by 1.00.	
on-river **dams area factor**	A proportion of the streamflow sequence (7% of the unfactored flow sequence) is able to be captured by on-river dams.	
on-farm **dams area factor**	No on-farm dams simulated.	
Water access		Low
level of entitlement	The total entitlement simulated was 2,486 ML made up of: • 1,806 ML Unregulated category entitlement • 680 ML Domestic and Stock category	
access rules (CtP)	A CtP was not simulated.	
higher access rule (CtP on Approval)	No higher of access rules (CtP) were simulated.	
pump capacity	A pump capacity of 30.10 ML/day was available for irrigation and 1.86 ML/day was available for Stock and Domestic and LWU water extraction.	
on-river dam access	875 ML of on-river dam capacity was simulated. 55% of the unregulated entitlement had access to on-river dams. 91% of the Stock and Domestic and LWU entitlement had access to the on-river dams.	
on-farm storage available	No on-farm storage simulated.	
Irrigation pattern		Moderate

Water source and model	Upper Gwydir River: model Gwydir River
crop	The crop mix assumed is from the survey for a conversion of unregulated licences carried out in 2000. The crop survey result for Stressed Rivers Assessment unit “Roumalla Creek” (418_01) was used. This crop mix is represented by simulating the water demands of the following crops: • Lucerne 88% • Perennial pasture 12% The total area irrigated (based on the full development of the entitlement) in the Gwydir River system was estimated to be 357ha. The weather station used was Bundarra Post Office (station number 56006). The crop factor file used was “nthtab6ed.crp”, which was developed for the licence conversion process.
Groundwater extraction	No substaintial alluvial extractions indentified as impacting on streamflow.
Licence locations	Some of the licences have access to on-river dams (see sections 'on-river dam area factor' and 'on-river dam access').

Table 22. Laura Creek

Water source and model	**Laura Creek: model Laura Creek**	
Water source boundaries	The main stream is Laura Creek with headwater streams flowing into it. Part of the lower end of the water source has a reach of trunk stream and small residual creeks flowing into it. The reach of Gwydir River in this water sources may be better managed as a separate water sources (linear) along with other reaches of the Gwydir River. Simlarly for associated residual tributaries in a separate (polygon) water source.	
Assumptions		**Confidence**
Flow sequence		High
flows used	A measured flow sequence was used to represent the streamflow available to be extracted. This flow was measured at the gauging station “Laura Creek at Laura” (418021). The flow sequence extends from 01/06/1967 to 21/06/2009, 42.1 years in total. 2.2% of the measured sequenced need to be filled using a correlation with a nearby gauging station.	
total area factor	The flow sequence was factored for area by 1.10.	
on-river dams area factor	A proportion of the streamflow sequence (6% of the unfactored flow sequence) is able to be captured by on-river dams.	
on-farm dams area factor	No on-farm dams simulated.	
Water access		Moderate
level of entitlement	The total entitlement simulated was 145 ML made up of: • 140 ML Unregulated category entitlement • 5 ML Domestic and Stock category	
access rules (CtP)	A CtP was not simulated.	
higher access rule (CtP on Approval)	No higher of access rules (CtP) were simulated.	
pump capacity	A pump capacity of 2.33 ML/day was available for irrigation and 0.01 ML/day was available for Stock and Domestic and LWU water extraction.	
on-river dam access	140 ML of on-river dam capacity was simulated. 100% of the unregulated entitlement had access to on-river dams. 100% of the Stock and Domestic and LWU entitlement had access to the on-river dams.	
on-farm storage available	No on-farm storage simulated.	
Irrigation pattern		High

Water source and model	Laura Creek: model Laura Creek
crop	The crop mix assumed is from the survey for a conversion of unregulated licences carried out in 2000. The crop survey result for Stressed Rivers Assessment unit “Laura Creek” (418_03) was used. This crop mix is represented by simulating the water demands of the following crops: • Perennial pasture 100%. The total area irrigated (based on the full development of the entitlement) in the Laura Creek system was estimated to be 25ha. The weather station used was Wandsworth (Strabanne) (station number 56036). The crop factor file used was “nthtab6ed.crp”, which was developed for the licence conversion process.
Groundwater extraction	No substaintial alluvial extractions indentified as impacting on streamflow.
Licence locations	Some of the licences have access to on-river dams (see sections 'on-river dam area factor' and 'on-river dam access').

Table 23. Georges Creek

Water source and model	Georges Creek: model Georges Creek	
Water source boundaries	The main stream is Georges Creek with headwater streams flowing into it.	
Assumptions		**Confidence**
Flow sequence		High
flows used	A rainfall runoff modeled flow sequence was used to represent the streamflow available to be extracted. This flow was based on the gauging station “Georges Creek at Clerkness” (418022). The flow sequence extends from 01/01/1889 to 06/07/2009, 120.5 years in total.	
total area factor	The flow sequence was factored for area by 1.04.	
on-river dams area factor	No on-river dam simulated.	
on-farm dams area factor	No on-farm dams simulated.	
Water access		High
level of entitlement	The total entitlement simulated was 24ML made up of: • 24ML Unregulated category entitlement	
access rules (CtP)	A CtP was not simulated.	
higher access rule (CtP on Approval)	No higher of access rules (CtP) were simulated.	
pump capacity	A pump capacity of 0.40 ML/day was available for irrigation and 0.00 ML/day was available for Stock and Domestic and LWU water extraction.	
on-river dam access	No on-river dams simulated.	
on-farm storage available	No on-farm storage simulated.	
Irrigation pattern		High

Water source and model	Georges Creek: model Georges Creek
crop	The crop mix assumed is from the survey for a conversion of unregulated licences carried out in 2000. The crop survey result for Stressed Rivers Assessment unit “Moredun Creek” (418_08) was used. This crop mix is represented by simulating the water demands of the following crops: • Annual pasture 8% • Lucerne 1% • Perennial pasture 91%. The total area irrigated (based on the full development of the entitlement) in the Georges Creek system was estimated to be 5 ha. The weather station used was Bundarra Post Office (station number 56006). The crop factor file used was “nthtab6ed.crp”, which was developed for the licence conversion process.
Groundwater extraction	No substantial alluvial extractions indentified as impacting on streamflow.
Licence locations	

Table 24. Moredun Creek

Water source and model	Moredun Creek: model Moredun Creek	
Water source boundaries	The main stream is Moredun Creek with headwater streams flowing into it. Part of the lower end of the water source has a reach of trunk stream and small residual creeks flowing into it. The reach of Gwydir River in this water sources may be better managed as a separate water sources (linear) along with other reaches of the Gwydir River. Simlarly for associated residual tributaries in a separate (polygon) water source.	
Assumptions		**Confidence**
Flow sequence		High
flows used	A rainfall runoff modeled flow sequence was used to represent the streamflow available to be extracted. This flow was based on the gauging station “Moredun Creek at Bundarra” (418023). The flow sequence extends from 01/01/1889 to 06/07/2009, 120.5 years in total.	
total area factor	The flow sequence was factored for area by 1.04.	
on-river dams area factor	No on-river dam simulated.	
on-farm dams area factor	No on-farm dams simulated.	
Water access		Moderate
level of entitlement	The total entitlement simulated was 753 ML made up of: • 743 ML Unregulated category entitlement • 10 ML Domestic and Stock category.	
access rules (CtP)	A CtP was not simulated.	
higher access rule (CtP on Approval)	No higher of access rules (CtP) were simulated.	
pump capacity	A pump capacity of 12.38 ML/day was available for irrigation and 0.03 ML/day was available for Stock and Domestic and LWU water extraction.	
on-river dam access	No on-river dams simulated.	
on-farm storage available	No on-farm storage simulated.	
Irrigation pattern		Moderate

Water source and model	Moredun Creek: model Moredun Creek
crop	The crop mix assumed is from the survey for a conversion of unregulated licences carried out in 2000. The crop survey result for Stressed Rivers Assessment unit “Moredun Creek” (418_08) was used. This crop mix is represented by simulating the water demands of the following crops: • Annual pasture 8% • Lucerne 1% • Perennial pasture 91%. The total area irrigated (based on the full development of the entitlement) in the Moredun Creek system was estimated to be 140 ha. The weather station used was Bundarra Post Office (station number 56006). The crop factor file used was “nthtab6ed.crp”, which was developed for the licence conversion process.
Groundwater extraction	No substaintial alluvial extractions indentified as impacting on streamflow.
Licence locations	

Table 25. Bakers Creek

Water source and model	**Bakers Creek: model Bakers Creek**	
Water source boundaries	The main stream is Bakers Creek with headwater streams flowing into it.	
Assumptions		**Confidence**
Flow sequence		High
flows used	A rainfall runoff modeled flow sequence was used to represent the streamflow available to be extracted. This flow was based on the gauging station “Bakers Creek at Bundarra” (418033). The flow sequence extends from 01/01/1889 to 06/07/2009, 120.5 years in total.	
total area factor	The flow sequence was factored for area by 1.25.	
on-river dams area factor	No on-river dam simulated.	
on-farm dams area factor	No on-farm dams simulated.	
Water access		High
level of entitlement	The total entitlement simulated was 35 ML made up of: 35 ML Unregulated category entitlement	
access rules (CtP)	A CtP was not simulated.	
higher access rule (CtP on Approval)	No higher of access rules (CtP) were simulated.	
pump capacity	A pump capacity of 0.58 ML/day was available for irrigation and 0.00 ML/day was available for Stock and Domestic and LWU water extraction.	
on-river dam access	No on-river dams simulated.	
on-farm storage available	No on-farm storage simulated.	
Irrigation pattern		High

Water source and model	Bakers Creek: model Bakers Creek
crop	The crop mix assumed is from the survey for a conversion of unregulated licences carried out in 2000. The crop survey result for Stressed Rivers Assessment unit “Keera Creek” (418_06) was used. This crop mix is represented by simulating the water demands of the following crops: • Lucerne 100% The total area irrigated (based on the full development of the entitlement) in the Bakers Creek system was estimated to be 7ha. The weather station used was Bundarra Post Office (station number 56006). The crop factor file used was “nthtab6ed.crp”, which was developed for the licence conversion process.
Groundwater extraction	No substaintial alluvial extractions indentified as impacting on streamflow.
Licence locations	

Table 26. Copeton Dam: model Sandy Creek

Water source and model	**Copeton Dam: model Sandy Creek**	
Water source boundaries	The main waterbody is Copeton Dam downstream of other water sources that flow into it. The reach of Gwydir River in this water sources may be better managed as a separate water sources (linear) along with other reaches of the Gwydir River. Small tributary streams such as Sandy Creek and Copes Creek may be better in a separate (polygon) water source.	
Assumptions		**Confidence**
Flow sequence		Low
flows used	A measured flow sequence was used to represent the streamflow available to be extracted. This flow was measured at a gauging station from an adjacent catchement “Copes Creek at Kimberley” (418005). The flow sequence extends from 14/10/1970 to 11/11/2009, 39.1 years in total. 0.1% of the measured sequenced need to be filled using a correlation with a nearby gauging station.	
total area factor	The flow sequence was factored for area by 0.40.	
on-river dams area factor	A proportion of the streamflow sequence (17% of the unfactored flow sequence) is able to be captured by on-river dams.	
on-farm dams area factor	No on-farm dams simulated.	
Water access		Moderate
level of entitlement	The total entitlement simulated was 288.5 ML made up of: • 278 ML Unregulated category entitlement • 10.5 ML Domestic and Stock category	
access rules (CtP)	A CtP was not simulated.	
higher access rule (CtP on Approval)	No higher of access rules (CtP) were simulated.	
pump capacity	A pump capacity of 4.63 ML/day was available for irrigation and 0.03 ML/day was available for Stock and Domestic and LWU water extraction.	
on-river dam access	90 ML of on-river dam capacity was simulated. 32% of the unregulated entitlement had access to on-river dams. 100% of the Stock and Domestic and LWU entitlement had access to the on-river dams.	
on-farm storage available	No on-farm storage simulated.	
Irrigation pattern		Moderate

Water source and model	Copeton Dam: model Sandy Creek
crop	The crop mix assumed is from the survey for a conversion of unregulated licences carried out in 2000. The crop survey result for Stressed Rivers Assessment unit “Copeton Dam” (418_09) was used. This crop mix is represented by simulating the water demands of the following crops: • Lucerne 17% • Perennial pasture 83% The total area irrigated (based on the full development of the entitlement) in the Sandy Creek system was estimated to be 51ha. The weather station used was Bundarra Post Office (station number 56006). The crop factor file used was “nthtab6ed.crp”, which was developed for the licence conversion process.
Groundwater extraction	No substaintial alluvial extractions indentified as impacting on streamflow.
Licence locations	Some of the licences have access to on-river dams (see sections 'on-river dam area factor' and 'on-river dam access').

Table 27. Copeton Dam: model Copes Creek

Water source and model	Copeton Dam: model Copes Creek	
Water source boundaries	The main waterbody is Copeton Dam downstream of other water sources that flow into it. The reach of Gwydir River in this water sources may be better managed as a separate water sources (linear) along with other reaches of the Gwydir River. Small tributary streams such as Sandy Creek and Copes Creek may be better in a separate (polygon) water source.	
Assumptions		**Confidence**
Flow sequence		High
flows used	A measured flow sequence was used to represent the streamflow available to be extracted. This flow was measured at the gauging station "Copes Creek at Kimberley" (418005). The flow sequence extends from 14/10/1970 to 11/11/2009, 39.1 years in total. 0.1% of the measured sequenced need to be filled using a correlation with a nearby gauging station.	
total area factor	The flow sequence was factored for area by 1.35.	
on-river dams area factor	No on-river dam simulated.	
on-farm dams area factor	No on-farm dams simulated.	
Water access		High
level of entitlement	The total entitlement simulated was 11 ML made up of: • 11 ML Unregulated category entitlement • 0 ML Domestic and Stock category.	
access rules (CtP)	A CtP was not simulated.	
higher access rule (CtP on Approval)	No higher of access rules (CtP) were simulated.	
pump capacity	A pump capacity of 0.18 ML/day was available for irrigation and 0.00 ML/day was available for Stock and Domestic and LWU water extraction.	
on-river dam access	No on-river dams simulated.	
on-farm storage available	No on-farm storage simulated.	
Irrigation pattern		Moderate

Water source and model	Copeton Dam: model Copes Creek
crop	The crop mix assumed is from the survey for a conversion of unregulated licences carried out in 2000. The crop survey result for Stressed Rivers Assessment unit “Copeton Dam” (418_09) was used. This crop mix is represented by simulating the water demands of the following crops: • Lucerne 17% • Perennial pasture 83%. The total area irrigated (based on the full development of the entitlement) in the Copes Creek system was estimated to be 2ha. The weather station used was Mount Topper State Forest (station number 56021). The crop factor file used was “nthtab6ed.crp”, which was developed for the licence conversion process.
Groundwater extraction	No substaintial alluvial extractions indentified as impacting on streamflow.
Licence locations	

Table 28. Mackenzies Flat

Water source and model	Mackenzies Flat: model Gouron Creek	
Water source boundaries	The main stream is Gouron Creek, which flow into the regulated river.	
Assumptions		**Confidence**
Flow sequence		Low
flows used	A measured flow sequence was used to represent the streamflow available to be extracted. This flow was measured at a gauging station from an adjacent catchement “Halls Creek at Bingara” (418025). The flow sequence extends from 01/03/1966 to 10/11/2009, 43.7 years in total. 2.0% of the measured sequenced need to be filled using a correlation with a nearby gauging station.	
total area factor	The flow sequence was factored for area by 0.59.	
on-river dams area factor	No on-river dam simulated.	
on-farm dams area factor	No on-farm dams simulated.	
Water access		High
level of entitlement	The total entitlement simulated was 27 ML made up of: • 27 ML Unregulated category entitlement.	
access rules (CtP)	A CtP was not simulated.	
higher access rule (CtP on Approval)	No higher of access rules (CtP) were simulated.	
pump capacity	A pump capacity of 0.45 ML/day was available for irrigation and 0.00 ML/day was available for Stock and Domestic and LWU water extraction.	
on-river dam access	No on-river dams simulated.	
on-farm storage available	No on-farm storage simulated.	
Irrigation pattern		High

Water source and model	Mackenzies Flat: model Gouron Creek
crop	The crop mix assumed is from the survey for a conversion of unregulated licences carried out in 2000. The crop survey result for Stressed Rivers Assessment unit “Mackenzies Flat” (418_13) was used. This crop mix is represented by simulating the water demands of the following crops: • Lucerne 100%. The total area irrigated (based on the full development of the entitlement) in the Gouron Creek system was estimated to be 4ha. The weather station used was Bingara Post Office (station number 54004). The crop factor file used was “nthwst6ed.crp”, which was developed for the licence conversion process.
Groundwater extraction	No substaintial alluvial extractions indentified as impacting on streamflow.
Licence locations	

Table 29. Keera Creek

Water source and model	**Keera Creek: model Keera Creek**	
Water source boundaries	The main stream is Keera Creek with headwater streams flowing into it.	
Assumptions		**Confidence**
Flow sequence		High
flows used	A rainfall runoff modeled flow sequence was used to represent the streamflow available to be extracted. This flow was based on the gauging station “Keera Creek at Keera” (418018). The flow sequence extends from 01/01/1890 to 06/07/2009, 119.5 years in total.	
total area factor	The flow sequence was factored for area by 1.11.	
on-river dams area factor	No on-river dam simulated.	
on-farm dams area factor	No on-farm dams simulated.	
Water access		High
level of entitlement	The total entitlement simulated was 102 ML made up of: • 102 ML Unregulated category entitlement.	
access rules (CtP)	A CtP was not simulated.	
higher access rule (CtP on Approval)	No higher of access rules (CtP) were simulated.	
pump capacity	A pump capacity of 1.70 ML/day was available for irrigation and 0.00 ML/day was available for Stock and Domestic and LWU water extraction.	
on-river dam access	No on-river dams simulated.	
on-farm storage available	No on-farm storage simulated.	
Irrigation pattern		High

Water source and model	Keera Creek: model Keera Creek
crop	The crop mix assumed is from the survey for a conversion of unregulated licences carried out in 2000. The crop survey result for Stressed Rivers Assessment unit “Keera Creek” (418_06) was used. This crop mix is represented by simulating the water demands of the following crops: • Lucerne 100% The total area irrigated (based on the full development of the entitlement) in the Keera Creek system was estimated to be 16ha. The weather station used was Upper Bingara (Emohta) (station number 54005). The crop factor file used was “nthtab6ed.crp”, which was developed for the licence conversion process.
Groundwater extraction	No substaintial alluvial extractions indentified as impacting on streamflow.
Licence locations	

Table 30. Halls Creek

Water source and model	**Halls Creek: model Halls Creek**	
Water source boundaries	The main stream is Halls Creek with headwater streams flowing into it.	
Assumptions		**Confidence**
Flow sequence		Moderate
flows used	A measured flow sequence was used to represent the streamflow available to be extracted. This flow was measured at the gauging station "Halls Creek at Bingara" (418025). The flow sequence extends from 01/03/1966 to 10/11/2009, 43.7 years in total. 2.0% of the measured sequenced need to be filled using a correlation with a nearby gauging station.	
total area factor	The flow sequence was factored for area by 1.52.	
on-river dams area factor	No on-river dam simulated.	
on-farm dams area factor	No on-farm dams simulated.	
Water access		High
level of entitlement	The total entitlement simulated was 441 ML made up of: • 441 ML Unregulated category entitlement	
access rules (CtP)	The visible flow CtP was simulated by allowing access down to zero flow, which is the same as simulating no CtP.	
higher access rule (CtP on Approval)	No higher of access rules (CtP) were simulated.	
pump capacity	A pump capacity of 7.35 ML/day was available for irrigation and 0.00 ML/day was available for Stock and Domestic and LWU water extraction.	
on-river dam access	No on-river dams simulated.	
on-farm storage available	No on-farm storage simulated.	
Irrigation pattern		High

Water source and model	Halls Creek: model Halls Creek
crop	The crop mix assumed is from the survey for a conversion of unregulated licences carried out in 2000. The crop survey result for Stressed Rivers Assessment unit “Halls Creek” (418_11) was used. This crop mix is represented by simulating the water demands of the following crops: • Annual pasture 4% • Lucerne 61% • Perennial pasture 16% • Summer Maize 11% • Wheat 8%. The total area irrigated (based on the full development of the entitlement) in the Halls Creek system was estimated to be 73 ha. The weather station used was Bingara Post Office (station number 54004). The crop factor file used was “nthwst6ed.crp”, which was developed for the licence conversion process.
Groundwater extraction	No substaintial alluvial extractions indentified as impacting on streamflow.
Licence locations	

Table 31. Myall Creek

Water source and model	**Myall Creek: model Myall Creek**	
Water source boundaries	The main stream is Myall Creek with headwater streams flowing into it.	
Assumptions		**Confidence**
Flow sequence		Moderate
flows used	A measured flow sequence was used to represent the streamflow available to be extracted. This flow was measured at the gauging station "Myall Creek at Molroy" (418017). The flow sequence extends from 19/05/1964 to 12/08/2009, 45.2 years in total. 2.9% of the measured sequenced need to be filled using a correlation with a nearby gauging station.	
total area factor	The flow sequence was factored for area by 1.11.	
on-river dams area factor	A proportion of the streamflow sequence (4% of the unfactored flow sequence) is able to be captured by on-river dams.	
on-farm dams area factor	No on-farm dams simulated.	
Water access		Moderate
level of entitlement	The total entitlement simulated was 1,419.5 ML made up of: • 1,388 ML Unregulated category entitlement • 31.5 ML Domestic and Stock category.	
access rules (CtP)	A CtP was not simulated.	
higher access rule (CtP on Approval)	No higher of access rules (CtP) were simulated.	
pump capacity	A pump capacity of 23.13 ML/day was available for irrigation and 0.09 ML/day was available for Stock and Domestic and LWU water extraction.	
on-river dam access	600 ML of on-river dam capacity was simulated. 46% of the unregulated entitlement had access to on-river dams. 52% of the Stock and Domestic and LWU entitlement had access to the on-river dams.	
on-farm storage available	No on-farm storage simulated.	
Irrigation pattern		High

Water source and model	Myall Creek: model Myall Creek
crop	The crop mix assumed is from the survey for a conversion of unregulated licences carried out in 2000. The crop survey result for Stressed Rivers Assessment unit “Myall Creek” (418_18) was used. This crop mix is represented by simulating the water demands of the following crops: • Annual pasture 4% • Fababean 5% • Lucerne 30% • Perennial pasture 56% • Summer Maize 5%. The total area irrigated (based on the full development of the entitlement) in the Myall Creek system was estimated to be 229 ha. The weather station used was Bingara Post Office (station number 54004). The crop factor file used was “nthwst6ed.crp”, which was developed for the licence conversion process.
Groundwater extraction	No substaintial alluvial extractions indentified as impacting on streamflow.
Licence locations	Some of the licences have access to on-river dams (see sections 'on-river dam area factor' and 'on-river dam access').

Table 32. Warialda Creek

Water source and model	Warialda Creek: model Warialda Creek	
Water source boundaries	The main stream is Warialda Creek with headwater streams flowing into it. Part of the lower end of the water source has some small residual streams flowing into the trunk stream.	
Assumptions		**Confidence**
Flow sequence		Moderate
flows used	A rainfall runoff modeled flow sequence was used to represent the streamflow available to be extracted. This flow was based on the gauging station "Warialda Creek at Warialda No.3" (418016). The flow sequence extends from 01/01/1889 to 06/07/2009, 120.5 years in total.	
total area factor	The flow sequence was factored for area by 1.46.	
on-river dams area factor	A proportion of the streamflow sequence (1% of the unfactored flow sequence) is able to be captured by on-river dams.	
on-farm dams area factor	No on-farm dams simulated.	
Water access		Moderate
level of entitlement	The total entitlement simulated was 479 ML made up of: 479 ML Unregulated category entitlement	
access rules (CtP)	A CtP was not simulated.	
higher access rule (CtP on Approval)	No higher of access rules (CtP) were simulated.	
pump capacity	A pump capacity of 7.98 ML/day was available for irrigation and 0.00 ML/day was available for Stock and Domestic and LWU water extraction.	
on-river dam access	200 ML of on-river dam capacity was simulated. 91% of the unregulated entitlement had access to on-river dams. 0% of the Stock and Domestic and LWU entitlement had access to the on-river dams.	
on-farm storage available	No on-farm storage simulated.	
Irrigation pattern		High

Water source and model	Warialda Creek: model Warialda Creek
crop	The crop mix assumed is from the survey for a conversion of unregulated licences carried out in 2000. The crop survey result for Stressed Rivers Assessment unit “Warialda Creek” (418_20) was used. This crop mix is represented by simulating the water demands of the following crops: • Lucerne 100%. The total area irrigated (based on the full development of the entitlement) in the Warialda Creek system was estimated to be 74 ha. The weather station used was Warialda Post Office (station number 54029). The crop factor file used was “nthwst6ed.crp”, which was developed for the licence conversion process.
Groundwater extraction	No substaintial alluvial extractions indentified as impacting on streamflow.
Licence locations	Some of the licences have access to on-river dams (see sections 'on-river dam area factor' and 'on-river dam access').

Table 33. Cobbadah

Water source and model	**Cobbadah: model Cobbadah Creek**	
Water source boundaries	The main stream is Cobbadah Creek with headwater streams flowing into it.	
Assumptions		**Confidence**
Flow sequence		Low
flows used	A measured flow sequence was used to represent the streamflow available to be extracted. This flow was measured at a gauging station from an adjacent catchement “Horton River at Horton Dam Site” (418027). The flow sequence extends from 01/05/1967 to 10/11/2009, 42.5 years in total. 1.5% of the measured sequenced need to be filled using a correlation with a nearby gauging station.	
total area factor	The flow sequence was factored for area by 2.13.	
on-river dams area factor	No on-river dam simulated.	
on-farm dams area factor	No on-farm dams simulated.	
Water access		Moderate
level of entitlement	The total entitlement simulated was 332 ML made up of: • 332 ML Unregulated category entitlement.	
access rules (CtP)	The CtP of 2 ML/day was not simulated as the CtP is expected not to be implemented.	
higher access rule (CtP on Approval)	No higher of access rules (CtP) were simulated.	
pump capacity	A pump capacity of 5.53 ML/day was available for irrigation and 0.00 ML/day was available for Stock and Domestic and LWU water extraction.	
on-river dam access	No on-river dams simulated.	
on-farm storage available	No on-farm storage simulated.	
Irrigation pattern		High

Water source and model	Cobbadah: model Cobbadah Creek
crop	The crop mix assumed is from the survey for a conversion of unregulated licences carried out in 2000. The crop survey result for Stressed Rivers Assessment unit “Cobbadah” (418_05) was used. This crop mix is represented by simulating the water demands of the following crops: • Citrus 9% • Lucerne 91%. The total area irrigated (based on the full development of the entitlement) in the Cobbadah Creek system was estimated to be 50 ha. The weather station used was Upper Bingara (Emohta) (station number 54005). The crop factor file used was “nthwst6ed.crp”, which was developed for the licence conversion process.
Groundwater extraction	No substaintial alluvial extractions indentified as impacting on streamflow.
Licence locations	

Table 34. Upper Horton

Water source and model	**Upper Horton: model Horton River**	
Water source boundaries	The main stream is the Horton River with headwater streams flowing into it.	
Assumptions		**Confidence**
Flow sequence		Low
flows used	A measured flow sequence was used to represent the streamflow available to be extracted. This flow was measured at the gauging station "Horton River at Horton Dam Site" (418027). The flow sequence extends from 01/05/1967 to 10/11/2009, 42.5 years in total. 1.5% of the measured sequenced need to be filled using a correlation with a nearby gauging station.	
total area factor	The flow sequence was factored for area by 5.55.	
on-river dams area factor	A proportion of the streamflow sequence (7% of the unfactored flow sequence) is able to be captured by on-river dams.	
on-farm dams area factor	No on-farm dams simulated.	
Water access		Moderate
level of entitlement	The total entitlement simulated was 1,710 ML made up of: • 1,692 ML Unregulated category entitlement • 18 ML Domestic and Stock category.	
access rules (CtP)	The CtP of 2 ML/day was not simulated as the CtP is expected not to be implemented.	
higher access rule (CtP on Approval)	No higher of access rules (CtP) were simulated.	
pump capacity	A pump capacity of 28.20 ML/day was available for irrigation and 0.05 ML/day was available for Stock and Domestic and LWU water extraction.	
on-river dam access	75 ML of on-river dam capacity was simulated. 9% of the unregulated entitlement had access to on-river dams. 39% of the Stock and Domestic and LWU entitlement had access to the on-river dams.	
on-farm storage available	No on-farm storage simulated.	
Irrigation pattern		High

Water source and model	Upper Horton: model Horton River
crop	The crop mix assumed is from the survey for a conversion of unregulated licences carried out in 2000. The crop survey result for Stressed Rivers Assessment unit “Upper Horton” (418_04) was used. This crop mix is represented by simulating the water demands of the following crops: • Lucerne 100%. The total area irrigated (based on the full development of the entitlement) in the Horton River system was estimated to be 260ha. The weather station used was Bingara (Derra Derra) (station number 54014). The crop factor file used was “nthwst6ed.crp”, which was developed for the licence conversion process.
Groundwater extraction	No substaintial alluvial extractions indentified as impacting on streamflow.
Licence locations	Some of the licences have access to on-river dams (see sections 'on-river dam area factor' and 'on-river dam access').

Table 35. Rocky Creek

Water source and model	**Rocky Creek: model Rocky Creek**	
Water source boundaries	The main stream is Rocky Creek with headwater streams flowing into it.	
Assumptions		**Confidence**
Flow sequence		Low
flows used	A measured flow sequence was used to represent the streamflow available to be extracted. This flow was measured at a gauging station from an adjacent catchement “Horton River at Horton Dam Site” (418027). The flow sequence extends from 01/05/1967 to 10/11/2009, 42.5 years in total. 1.5% of the measured sequenced need to be filled using a correlation with a nearby gauging station.	
total area factor	The flow sequence was factored for area by 1.96.	
on-river dams area factor	No on-river dam simulated.	
on-farm dams area factor	No on-farm dams simulated.	
Water access		High
level of entitlement	The total entitlement simulated was 291 ML made up of: • 284 ML Unregulated category entitlement • 7 ML Domestic and Stock category.	
access rules (CtP)	The CtP of 2ML/day was not simulated as the CtP is expected not to be implemented.	
higher access rule (CtP on Approval)	No higher of access rules (CtP) were simulated.	
pump capacity	A pump capacity of 4.73 ML/day was available for irrigation and 0.02 ML/day was available for Stock and Domestic and LWU water extraction.	
on-river dam access	No on-river dams simulated.	
on-farm storage available	No on-farm storage simulated.	
Irrigation pattern		High

Water source and model	Rocky Creek: model Rocky Creek
crop	The crop mix assumed is from the survey for a conversion of unregulated licences carried out in 2000. The crop survey result for Stressed Rivers Assessment unit “Rocky Creek” (418_07) was used. This crop mix is represented by simulating the water demands of the following crops: • Lucerne 85% • Vegetables 2% • Wheat 13%. The total area irrigated (based on the full development of the entitlement) in the Rocky Creek system was estimated to be 47ha. The weather station used was Bingara (Derra Derra) (station number 54014). The crop factor file used was “nthwst6ed.crp”, which was developed for the licence conversion process.
Groundwater extraction	No substaintial alluvial extractions indentified as impacting on streamflow.
Licence locations	

Table 36. Lower Horton

Water source and model	**Lower Horton: model Horton River**	
Water source boundaries	The main stream is the Horton River downstream of other water sources that flow into it.	
Assumptions		**Confidence**
Flow sequence		Low
flows used	A measured flow sequence was used to represent the streamflow available to be extracted. This flow was measured at the gauging station "Horton River at Rider (Killara)" (418015). The flow sequence extends from 10/01/1957 to 10/11/2009, 52.8 years in total. 2.6% of the measured sequenced need to be filled using a correlation with a nearby gauging station.	
total area factor	The flow sequence was factored for area by 1.08.	
on-river dams area factor	A proportion of the streamflow sequence (1% of the unfactored flow sequence) is able to be captured by on-river dams.	
on-farm dams area factor	No on-farm dams simulated.	
Water access		Moderate
level of entitlement	The total entitlement simulated was 6,084 ML made up of: • 6,057 ML Unregulated category entitlement • 27 ML Domestic and Stock category • 0 ML LWU category entitlement.	
access rules (CtP)	The CtP was simulated by placing a threshold on the irriration pumps of 4 ML/day, which simulated a CtP at the end of the system.	
higher access rule (CtP on Approval)	No higher of access rules (CtP) were simulated.	
pump capacity	A pump capacity of 100.95 ML/day was available for irrigation and 0.07 ML/day was available for Stock and Domestic and LWU water extraction.	
on-river dam access	75 ML of on-river dam capacity was simulated. 2% of the unregulated entitlement had access to on-river dams. 26% of the Stock and Domestic and LWU entitlement had access to the on-river dams.	
on-farm storage available	No on-farm storage simulated.	
Irrigation pattern		High

Water source and model	Lower Horton: model Horton River
crop	The crop mix assumed is from the survey for a conversion of unregulated licences carried out in 2000. The crop survey result for Stressed Rivers Assessment unit “Lower Horton” (418_15) was used. This crop mix is represented by simulating the water demands of the following crops: • Annual pasture 13% • Lucerne 74% • Wheat 13%. The total area irrigated (based on the full development of the entitlement) in the Horton River system was estimated to be 1047ha. The weather station used was Bingara (Derra Derra) (station number 54014). The crop factor file used was “nthwst6ed.crp”, which was developed for the licence conversion process.
Groundwater extraction	No substaintial alluvial extractions indentified as impacting on streamflow.
Licence locations	The CtP is triggered at a location below the majority of the irrigation pumps, hence it is simulated as if all pumps are above the trigger point. Some of the licences have access to on-river dams (see sections 'on-river dam area factor' and 'on-river dam access').

Table 37. Slaughterhouse Creek

Water source and model	Slaughterhouse Creek: model Slaughterhouse Creek	
Water source boundaries	The main stream is Slaughterhouse Creek, which flow into the regulated river.	
Assumptions		**Confidence**
Flow sequence		Low
flows used	A measured flow sequence was used to represent the streamflow available to be extracted. This flow was measured at a gauging station from an adjacent catchement “Tycannah Creek at Horseshoe Lagoon” (418032). The flow sequence extends from 01/06/1971 to 08/10/2009, 38.4 years in total. 9.0% of the measured sequenced need to be filled using a correlation with a nearby gauging station.	
total area factor	The flow sequence was factored for area by 0.15.	
on-river dams area factor	No on-river dam simulated.	
on-farm dams area factor	No on-farm dams simulated.	
Water access		High
level of entitlement	The total entitlement simulated was 0 ML made up of: • 0 ML Unregulated category entitlement • 0 ML Domestic and Stock category • 0 ML LWU category entitlement.	
access rules (CtP)	A CtP was not simulated.	
higher access rule (CtP on Approval)	No higher of access rules (CtP) were simulated.	
pump capacity	A pump capacity of 0.00 ML/day was available for irrigation and 0.00 ML/day was available for Stock and Domestic and LWU water extraction.	
on-river dam access	No on-river dams simulated.	
on-farm storage available	No on-farm storage simulated.	
Irrigation pattern		High

Water source and model	Slaughterhouse Creek: model Slaughterhouse Creek
crop	The crop mix assumed is from the survey for a conversion of unregulated licences carried out in 2000. The crop survey result for Stressed Rivers Assessment unit “Lower Horton” (418_15) was used. This crop mix is represented by simulating the water demands of the following crops: • Annual pasture 13% • Lucerne 74% • Wheat 13%. The total area irrigated (based on the full development of the entitlement) in the Slaughterhouse Creek system was estimated to be 0 ha. The weather station used was Gravesend Post Office (station number 54017). The crop factor file used was “nthwst6ed.crp”, which was developed for the licence conversion process.
Groundwater extraction	No substaintial alluvial extractions indentified as impacting on streamflow.
Licence locations	

Table 38. Mosquito Creek

Water source and model	Mosquito Creek: model Mosquito Creek	
Water source boundaries	The main stream is Mosquito Creek with headwater streams flowing into it.	
Assumptions		**Confidence**
Flow sequence		Low
flows used	A rainfall runoff modeled flow sequence was used to represent the streamflow available to be extracted. This flow was based on a gauging station from an adjacent catchement "Warialda Creek at Warialda No.3" (418016). The flow sequence extends from 01/01/1889 to 06/07/2009, 120.5 years in total.	
total area factor	The flow sequence was factored for area by 1.17.	
on-river dams area factor	A proportion of the streamflow sequence (77% of the unfactored flow sequence) is able to be captured by on-river dams.	
on-farm dams area factor	No on-farm dams simulated.	
Water access		Moderate
level of entitlement	The total entitlement simulated was 38 ML made up of: 38 ML Unregulated category entitlement	
access rules (CtP)	A CtP was not simulated.	
higher access rule (CtP on Approval)	No higher of access rules (CtP) were simulated.	
pump capacity	A pump capacity of 0.63 ML/day was available for irrigation and 0.00 ML/day was available for Stock and Domestic and LWU water extraction.	
on-river dam access	20 ML of on-river dam capacity was simulated. 100% of the unregulated entitlement had access to on-river dams. 0% of the Stock and Domestic and LWU entitlement had access to the on-river dams.	
on-farm storage available	No on-farm storage simulated.	
Irrigation pattern		Moderate

Water source and model	Mosquito Creek: model Mosquito Creek
crop	The crop mix assumed is from the survey for a conversion of unregulated licences carried out in 2000. The crop survey result for Stressed Rivers Assessment unit “Warialda Creek” (418_20) was used. This crop mix is represented by simulating the water demands of the following crops: • Lucerne 100%. The total area irrigated (based on the full development of the entitlement) in the Mosquito Creek system was estimated to be 6 ha. The weather station used was Warialda Post Office (station number 54029). The crop factor file used was “nthwst6ed.crp”, which was developed for the licence conversion process.
Groundwater extraction	No substaintial alluvial extractions indentified as impacting on streamflow.
Licence locations	Some of the licences have access to on-river dams (see sections 'on-river dam area factor' and 'on-river dam access').

Table 39. Moree

Water source and model	Moree: model Marshalls Ponds Creek	
Water source boundaries	The main stream is Marshalls Ponds Creek, which flow into the regulated river. Part of the lower end of the water source has some anabranching channels associated with the regulated river.	
Assumptions		**Confidence**
Flow sequence		Low
flows used	A measured flow sequence was used to represent the streamflow available to be extracted. This flow was measured at a gauging station from an adjacent catchement “Tycannah Creek at Horseshoe Lagoon” (418032). The flow sequence extends from 01/06/1971 to 08/10/2009, 38.4 years in total. 9.0% of the measured sequenced need to be filled using a correlation with a nearby gauging station.	
total area factor	The flow sequence was factored for area by 0.37.	
on-river dams area factor	No on-river dam simulated.	
on-farm dams area factor	No on-farm dams simulated.	
Water access		Low
level of entitlement	The total entitlement simulated was 1,700 ML made up of: 1,700 ML Unregulated category entitlement	
access rules (CtP)	A CtP was not simulated.	
higher access rule (CtP on Approval)	No higher of access rules (CtP) were simulated.	
pump capacity	A pump capacity of 28.33 ML/day was available for irrigation and 0.00 ML/day was available for Stock and Domestic and LWU water extraction.	
on-river dam access	No on-river dams simulated.	
on-farm storage available	No on-farm storage simulated.	
Irrigation pattern		Low

Water source and model	Moree: model Marshalls Ponds Creek
crop	The crop mix assumed is from the survey for a conversion of unregulated licences carried out in 2000. The crop survey result for Stressed Rivers Assessment unit “Lower Horton” (418_15) was used. This crop mix is represented by simulating the water demands of the following crops: • Annual pasture 13% • Lucerne 74% • Wheat 13%, The total area irrigated (based on the full development of the entitlement) in the Marshalls Ponds Creek system was estimated to be 298 ha. The weather station used was Moree Aero (station number 53115). The crop factor file used was “nthwst6ed.crp”, which was developed for the licence conversion process.
Groundwater extraction	No substaintial alluvial extractions indentified as impacting on streamflow.
Licence locations	

Table 40. Tycannah Creek

Water source and model	Tycannah Creek: model Tycannah Creek	
Water source boundaries	The main stream is Tycannah Creek with headwater streams flowing into it.	
Assumptions		**Confidence**
Flow sequence		Moderate
flows used	A measured flow sequence was used to represent the streamflow available to be extracted. This flow was measured at the gauging station "Tycannah Creek at Horseshoe Lagoon" (418032). The flow sequence extends from 01/06/1971 to 08/10/2009, 38.4 years in total. 9.0% of the measured sequenced need to be filled using a correlation with a nearby gauging station.	
total area factor	The flow sequence was factored for area by 1.30.	
on-river dams area factor	No on-river dam simulated.	
on-farm dams area factor	No on-farm dams simulated.	
Water access		Low
level of entitlement	The total entitlement simulated was 2,780 ML made up of: • 2,768 ML Unregulated category entitlement • 12 ML Domestic and Stock category.	
access rules (CtP)	A CtP was not simulated.	
higher access rule (CtP on Approval)	No higher of access rules (CtP) were simulated.	
pump capacity	A pump capacity of 46.13 ML/day was available for irrigation and 0.03 ML/day was available for Stock and Domestic and LWU water extraction.	
on-river dam access	No on-river dams simulated.	
on-farm storage available	No on-farm storage simulated.	
Irrigation pattern		High

Water source and model	Tycannah Creek: model Tycannah Creek
crop	The crop mix assumed is from the survey for a conversion of unregulated licences carried out in 2000. The crop survey result for Stressed Rivers Assessment unit “Millie Creek” (418_17) was used. This crop mix is represented by simulating the water demands of the following crops: • Cotton 72% • Fababean 4% • Wheat 24% The total area irrigated (based on the full development of the entitlement) in the Tycannah Creek system was estimated to be 437ha. The weather station used was Gurley (Glenroy) (station number 53014). The crop factor file used was “nthwst6ed.crp”, which was developed for the licence conversion process.
Groundwater extraction	No substaintial alluvial extractions indentified as impacting on streamflow.
Licence locations	

Table 41. Gurley Creek

Water source and model	**Gurley Creek: model Gurley Creek**	
Water source boundaries	The main stream is Gurley Creek with headwater streams flowing into it.	
Assumptions		**Confidence**
Flow sequence		Low
flows used	A measured flow sequence was used to represent the streamflow available to be extracted. This flow was measured at a gauging station from an adjacent catchement “Tycannah Creek at Horseshoe Lagoon” (418032). The flow sequence extends from 01/06/1971 to 08/10/2009, 38.4 years in total. 9.0% of the measured sequenced need to be filled using a correlation with a nearby gauging station.	
total area factor	The flow sequence was factored for area by 0.37.	
on-river dams area factor	No on-river dam simulated.	
on-farm dams area factor	No on-farm dams simulated.	
Water access		Moderate
level of entitlement	The total entitlement simulated was 542 ML made up of: • 542 ML Unregulated category entitlement	
access rules (CtP)	A CtP was not simulated.	
higher access rule (CtP on Approval)	No higher of access rules (CtP) were simulated.	
pump capacity	A pump capacity of 9.03 ML/day was available for irrigation and 0.00 ML/day was available for Stock and Domestic and LWU water extraction.	
on-river dam access	No on-river dams simulated.	
on-farm storage available	No on-farm storage simulated.	
Irrigation pattern		Moderate

Water source and model	Gurley Creek: model Gurley Creek
crop	The crop mix assumed is from the survey for a conversion of unregulated licences carried out in 2000. The crop survey result for Stressed Rivers Assessment unit “Millie Creek” (418_17) was used. This crop mix is represented by simulating the water demands of the following crops: • Cotton 72% • Fababean 4% • Wheat 24%. The total area irrigated (based on the full development of the entitlement) in the Gurley Creek system was estimated to be 83 ha. The weather station used was Warialda Post Office (station number 54029). The crop factor file used was “nthwst6ed.crp”, which was developed for the licence conversion process.
Groundwater extraction	No substaintial alluvial extractions indentified as impacting on streamflow.
Licence locations	

Table 42. Millie Creek

Water source and model	**Millie Creek: model Millie Creek**	
Water source boundaries	The main stream is Millie Creek with headwater streams flowing into it.	
Assumptions		**Confidence**
Flow sequence		Low
flows used	A measured flow sequence was used to represent the streamflow available to be extracted. This flow was measured at a gauging station from an adjacent catchement “Tycannah Creek at Horseshoe Lagoon” (418032). The flow sequence extends from 01/06/1971 to 08/10/2009, 38.4 years in total. 9.0% of the measured sequenced need to be filled using a correlation with a nearby gauging station.	
total area factor	The flow sequence was factored for area by 0.90.	
on-river dams area factor	No on-river dam simulated.	
on-farm dams area factor	No on-farm dams simulated.	
Water access		Low
level of entitlement	The total entitlement simulated was 5,633 ML made up of: • 5,599 ML Unregulated category entitlement • 34 ML Domestic and Stock category.	
access rules (CtP)	A CtP was not simulated.	
higher access rule (CtP on Approval)	No higher of access rules (CtP) were simulated.	
pump capacity	A pump capacity of 93.32 ML/day was available for irrigation and 0.09 ML/day was available for Stock and Domestic and LWU water extraction.	
on-river dam access	No on-river dams simulated.	
on-farm storage available	2,800 ML of on-farm storage capacity was simulated in the irrigation node.	
Irrigation pattern		High

Water source and model	Millie Creek: model Millie Creek
crop	The crop mix assumed is from the survey for a conversion of unregulated licences carried out in 2000. The crop survey result for Stressed Rivers Assessment unit “Millie Creek” (418_17) was used. This crop mix is represented by simulating the water demands of the following crops: • Cotton 72% • Fababean 4% • Wheat 24%. The total area irrigated (based on the full development of the entitlement) in the Millie Creek system was estimated to be 722 ha. The weather station used was Gurley (Glenroy) (station number 53014). The crop factor file used was “nthwst6ed.crp”, which was developed for the licence conversion process.
Groundwater extraction	No substaintial alluvial extractions indentified as impacting on streamflow.
Licence locations	

Table 43. Millie Creek

Water source and model	**Millie Creek: model Boggy Creek**	
Water source boundaries	The main stream is Boggy Creek with headwater streams flowing into it.	
Assumptions		**Confidence**
Flow sequence		Low
flows used	A measured flow sequence was used to represent the streamflow available to be extracted. This flow was measured at a gauging station from an adjacent catchement “Tycannah Creek at Horseshoe Lagoon” (418032). The flow sequence extends from 01/06/1971 to 08/10/2009, 38.4 years in total. 9.0% of the measured sequenced need to be filled using a correlation with a nearby gauging station.	
total area factor	The flow sequence was factored for area by 0.47.	
on-river dams area factor	No on-river dam simulated.	
on-farm dams area factor	No on-farm dams simulated.	
Water access		Moderate
level of entitlement	The total entitlement simulated was 682 ML made up of: • 648 ML Unregulated category entitlement • 34 ML Domestic and Stock category	
access rules (CtP)	A CtP was not simulated.	
higher access rule (CtP on Approval)	No higher of access rules (CtP) were simulated.	
pump capacity	A pump capacity of 10.80 ML/day was available for irrigation and 0.09 ML/day was available for Stock and Domestic and LWU water extraction.	
on-river dam access	No on-river dams simulated.	
on-farm storage available	324 ML of on-farm storage capacity was simulated in the irrigation node.	
Irrigation pattern		Moderate

Water source and model	Millie Creek: model Boggy Creek
crop	The crop mix assumed is from the survey for a conversion of unregulated licences carried out in 2000. The crop survey result for Stressed Rivers Assessment unit “Boggy Creek” (418_10) was used. This crop mix is represented by simulating the water demands of the following crops: • Cotton 52% • Fababean 11% • Wheat 37%. The total area irrigated (based on the full development of the entitlement) in the Boggy Creek system was estimated to be 92 ha. The weather station used was Gurley (Glenroy) (station number 53014). The crop factor file used was “nthwst6ed.crp”, which was developed for the licence conversion process.
Groundwater extraction	No substaintial alluvial extractions indentified as impacting on streamflow.
Licence locations	

Table 44. Gil Gil Creek

Water source and model	**Gil Gil Creek: model Gil Gil Creek**	
Water source boundaries	The main stream is Gil Gil Creek with headwater streams flowing into it. Part of the lower end of the water source has some small residual streams flowing into the trunk stream.	
Assumptions		**Confidence**
Flow sequence		Low
flows used	A measured flow sequence was used to represent the streamflow available to be extracted. This flow was measured at the gauging station "Gil Gil Creek at Boolataroo" (416054). The flow sequence extends from 06/12/1996 to 17/03/2015, 18.3 years in total. 57.6% of the measured sequenced need to be filled using a correlation with a nearby gauging station.	
total area factor	The flow sequence was factored for area by 1.01.	
on-river dams area factor	No on-river dam simulated.	
on-farm dams area factor	No on-farm dams simulated.	
Water access		Low
level of entitlement	The total entitlement simulated was 1,502.5 ML made up of: • 1,421 ML Unregulated category entitlement • 81.5 ML Domestic and Stock category.	
access rules (CtP)	A CtP was not simulated.	
higher access rule (CtP on Approval)	No higher of access rules (CtP) were simulated.	
pump capacity	A pump capacity of 23.68 ML/day was available for irrigation and 0.22 ML/day was available for Stock and Domestic and LWU water extraction.	
on-river dam access	No on-river dams simulated.	
on-farm storage available	No on-farm storage simulated.	
Irrigation pattern		Low

Water source and model	Gil Gil Creek: model Gil Gil Creek
crop	The crop mix assumed is from the survey for a conversion of unregulated licences carried out in 2000. The crop survey result for Stressed Rivers Assessment unit “Gil Gil Creek” (416_02) was used. This crop mix is represented by simulating the water demands of the following crops: • Cotton 99% • Turf 1%. The total area irrigated (based on the full development of the entitlement) in the Gil Gil Creek system was estimated to be 159 ha. The weather station used was Garah Post Office (station number 53011). The crop factor file used was “nthwst6ed.crp”, which was developed for the licence conversion process.
Groundwater extraction	No substaintial alluvial extractions indentified as impacting on streamflow.
Licence locations	

Namoi unregulated river models

Table 45. Upper Macdonald River

Water source and model	Upper Macdonald River: model Macdonald River	
Water source boundaries	The main stream is the Macdonald River with headwater streams flowing into it.	
Assumptions		**Confidence**
Flow sequence		High
flows used	A measured flow sequence was used to represent the streamflow available to be extracted. This flow was measured at the gauging station "Macdonald River at Cobrabald" (419038). The flow sequence extends from 22/06/1965 to 12/04/1987, 21.8 years in total. There was no need to fill any gaps in the measured flow sequence.	
total area factor	The flow sequence was factored for area by 1.97.	
on-river dams area factor	A proportion of the streamflow sequence (9% of the unfactored flow sequence) is able to be captured by on-river dams.	
on-farm dams area factor	No on-farm dams simulated.	
Water access		High
level of entitlement	The total entitlement simulated was 30 ML made up of: • 30 ML Unregulated category entitlement.	
access rules (CtP)	A CtP was not simulated.	
higher access rule (CtP on Approval)	No higher of access rules (CtP) were simulated.	
pump capacity	A pump capacity of 0.50 ML/day was available for irrigation and 0.00 ML/day was available for Stock and Domestic and LWU water extraction.	
on-river dam access	3 ML of on-river dam capacity was simulated. 100% of the unregulated entitlement had access to on-river dams. 0% of the Stock and Domestic and LWU entitlement had access to the on-river dams.	
on-farm storage available	No on-farm storage simulated.	
Irrigation pattern		High

Water source and model	Upper Macdonald River: model Macdonald River
crop	The crop mix assumed is from the survey for a conversion of unregulated licences carried out in 2000. The crop survey result for Stressed Rivers Assessment unit “Upper Macdonald River” (419_41) was used. This crop mix is represented by simulating the water demands of the following crops: • Lucerne 100%. The total area irrigated (based on the full development of the entitlement) in the Macdonald River system was estimated to be 6 ha. The weather station used was Walcha Post Office (station number 56035). The crop factor file used was “nthtab6ed.crp”, which was developed for the licence conversion process.
Groundwater extraction	No substaintial alluvial extractions indentified as impacting on streamflow.
Licence locations	Some of the licences have access to on-river dams (see sections 'on-river dam area factor' and 'on-river dam access').

Table 46. Mid-Macdonald River

Water source and model	Mid-Macdonald River: model Macdonald River	
Water source boundaries	The main stream is the Macdonald River downstream of other water sources that flow into it.	
Assumptions		**Confidence**
Flow sequence		Moderate
flows used	A measured flow sequence was used to represent the streamflow available to be extracted. This flow was measured at the gauging station "Macdonald River at Retreat" (419028). The flow sequence extends from 07/09/1965 to 24/02/1987, 21.5 years in total. 1.4% of the measured sequenced need to be filled using a correlation with a nearby gauging station.	
total area factor	The flow sequence was factored for area by 1.00.	
on-river dams area factor	A proportion of the streamflow sequence (1% of the unfactored flow sequence) is able to be captured by on-river dams.	
on-farm dams area factor	No on-farm dams simulated.	
Water access		Moderate
level of entitlement	The total entitlement simulated was 4,485.5 ML made up of: • 4,350 ML Unregulated category entitlement • 135.5 ML Domestic and Stock category.	
access rules (CtP)	The CtP was simulated by placing a threshold on the irriration pumps of 10 ML/day, which simulated a CtP at the end of the system.	
higher access rule (CtP on Approval)	No higher of access rules (CtP) were simulated.	
pump capacity	A pump capacity of 73.00 ML/day was available for irrigation and 0.37 ML/day was available for Stock and Domestic and LWU water extraction.	
on-river dam access	400 ML of on-river dam capacity was simulated. 13% of the unregulated entitlement had access to on-river dams. 9% of the Stock and Domestic and LWU entitlement had access to the on-river dams.	
on-farm storage available	No on-farm storage simulated.	
Irrigation pattern		High

Water source and model	Mid-Macdonald River: model Macdonald River
crop	The crop mix assumed is from the survey for a conversion of unregulated licences carried out in 2000. The crop survey result for Stressed Rivers Assessment unit “Mid Macdonald River” (419_19) was used. This crop mix is represented by simulating the water demands of the following crops: • Annual pasture 3% • Perennial pasture 97%. The total area irrigated (based on the full development of the entitlement) in the Macdonald River system was estimated to be 736 ha. The weather station used was Bendemeer (Caroline St) (station number 55004). The crop factor file used was “nthtab6ed.crp”, which was developed for the licence conversion process.
Groundwater extraction	No substaintial alluvial extractions indentified as impacting on streamflow.
Licence locations	The CtP is triggered at a location below the majority of the irrigation pumps, hence it is simulated as if all pumps are above the trigger point. Some of the licences have access to on-river dams (see sections 'on-river dam area factor' and 'on-river dam access').

Table 47. Upper Namoi: model Namoi River

Water source and model	Upper Namoi: model Namoi River	
Water source boundaries	The main stream is the Namoi River downstream of other water sources that flow into it.	
Assumptions		**Confidence**
Flow sequence		Moderate
flows used	A measured flow sequence was used to represent the streamflow available to be extracted. This flow was measured at the gauging station "Halls Creek at Ukolan and Namoi River at North Cuerindi" (419029 and 419005). The flow sequence extends from 22/05/1965 to 27/07/2008, 43.2 years in total. 4.8% of the measured sequenced need to be filled using a correlation with a nearby gauging station.	
total area factor	The flow sequence was factored for area by 1.05.	
on-river dams area factor	A proportion of the streamflow sequence (105% of the unfactored flow sequence) is able to be captured by on-river dams.	
on-farm dams area factor	No on-farm dams simulated.	
Water access		Moderate
level of entitlement	The total entitlement simulated was 15,814 ML made up of: • 14,911 ML Unregulated category entitlement • 183 ML Domestic and Stock category • 720 ML LWU category entitlement.	
access rules (CtP)	The CtP was simulated by placing a threshold on the irriration pumps of 0.1 ML/day, which simulated a CtP at the end of the system.	
higher access rule (CtP on Approval)	No higher of access rules (CtP) were simulated.	
pump capacity	A pump capacity of 248.52 ML/day was available for irrigation and 2.47 ML/day was available for Stock and Domestic and LWU water extraction.	
on-river dam access	2 ML of on-river dam capacity was simulated. 0% of the unregulated entitlement had access to on-river dams. 80% of the Stock and Domestic and LWU entitlement had access to the on-river dams.	
on-farm storage available	No on-farm storage simulated.	

Water source and model	**Upper Namoi: model Namoi River**	
Irrigation pattern		High
crop	The crop mix assumed is from the survey for a conversion of unregulated licences carried out in 2000. The crop survey result for Stressed Rivers Assessment unit “Upper Namoi” (419_20) was used. This crop mix is represented by simulating the water demands of the following crops: • Annual pasture 2% • Fababean 2% • Lucerne 70% • Perennial pasture 11% • Summer Maize 2% • Wheat 13%. The total area irrigated (based on the full development of the entitlement) in the Namoi River system was estimated to be 2,519 ha. The weather station used was Manilla Post Office (station number 55031). The crop factor file used was “nthwst6ed.crp”, which was developed for the licence conversion process.	
Groundwater extraction	No substaintial alluvial extractions indentified as impacting on streamflow.	
Licence locations	The CtP is triggered at a location below the majority of the irrigation pumps, hence it is simulated as if all pumps are above the trigger point. Some of the licences have access to on-river dams (see sections 'on-river dam area factor' and 'on-river dam access').	

Table 48. Upper Namoi: model Halls Creek

Water source and model	Upper Namoi: model Halls Creek	
Water source boundaries	The main stream is Halls Creek with headwater streams flowing into it.	
Assumptions		**Confidence**
Flow sequence		High
flows used	A measured flow sequence was used to represent the streamflow available to be extracted. This flow was measured at the gauging station "Halls Creek at Ukolan" (419029). The flow sequence extends from 22/05/1965 to 27/07/2008, 43.2 years in total. 4.8% of the measured sequenced need to be filled using a correlation with a nearby gauging station.	
total area factor	The flow sequence was factored for area by 1.00.	
on-river dams area factor	No on-river dam simulated.	
on-farm dams area factor	No on-farm dams simulated.	
Water access		High
level of entitlement	The total entitlement simulated was 949 ML made up of: • 949 ML Unregulated category entitlement • 0 ML Domestic and Stock category • 0 ML LWU category entitlement.	
access rules (CtP)	The CtP was simulated by placing a threshold on the irriration pumps of 1 ML/day, which simulated a CtP at the end of the system.	
higher access rule (CtP on Approval)	No higher of access rules (CtP) were simulated.	
pump capacity	A pump capacity of 15.82 ML/day was available for irrigation and 0.00 ML/day was available for Stock and Domestic and LWU water extraction.	
on-river dam access	No on-river dams simulated.	
on-farm storage available	No on-farm storage simulated.	
Irrigation pattern		High

Water source and model	Upper Namoi: model Halls Creek
crop	The crop mix assumed is from the survey for a conversion of unregulated licences carried out in 2000. The crop survey result for Stressed Rivers Assessment unit “Upper Namoi” (419_20) was used. This crop mix is represented by simulating the water demands of the following crops: • Annual pasture 2% • Fababean 2% • Lucerne 70% • Perennial pasture 11% • Summer Maize 2% • Wheat 13%. The total area irrigated (based on the full development of the entitlement) in the Halls Creek system was estimated to be 160ha. The weather station used was Manilla Post Office (station number 55031). The crop factor file used was “nthwst6ed.crp”, which was developed for the licence conversion process.
Groundwater extraction	No substaintial alluvial extractions indentified as impacting on streamflow.
Licence locations	The CtP is triggered at a location below the majority of the irrigation pumps, hence it is simulated as if all pumps are above the trigger point.

Table 49. Upper Manilla

Water source and model	Upper Manilla: model Manilla River (not Ironbark Creek)	
Water source boundaries	The main streams are Manilla River and Ironbark Creek with headwater streams flowing into it.	
Assumptions		**Confidence**
Flow sequence		High
flows used	A rainfall runoff modeled flow sequence was used to represent the streamflow available to be extracted. This flow was based on the gauging station “Manilla River at Black Springs” (419053). The flow sequence extends from 01/01/1890 to 31/12/1996, 107.0 years in total.	
total area factor	The flow sequence was factored for area by 1.00.	
on-river dams area factor	No on-river dam simulated.	
on-farm dams area factor	No on-farm dams simulated.	
Water access		Moderate
level of entitlement	The total entitlement simulated was 1,690 ML made up of: • 1,668 ML Unregulated category entitlement • 22 ML Domestic and Stock category.	
access rules (CtP)	The CtP was simulated by placing a threshold on the irriration pumps of 3 ML/day, which simulated a CtP at the end of the system.	
higher access rule (CtP on Approval)	No higher of access rules (CtP) were simulated.	
pump capacity	A pump capacity of 27.80 ML/day was available for irrigation and 0.06 ML/day was available for Stock and Domestic and LWU water extraction.	
on-river dam access	No on-river dams simulated.	
on-farm storage available	No on-farm storage simulated.	
Irrigation pattern		High

Water source and model	Upper Manilla: model Manilla River (not Ironbark Creek)
crop	The crop mix assumed is from the survey for a conversion of unregulated licences carried out in 2000. The crop survey result for Stressed Rivers Assessment unit “Upper Manilla” (419_32) was used. This crop mix is represented by simulating the water demands of the following crops: • Annual pasture 3% • Lucerne 83% • Perennial pasture 4% • Summer Maize 1% • Vegetables 1% • Wheat 8%. The total area irrigated (based on the full development of the entitlement) in the Manilla River (not Ironbark Creek) system was estimated to be 271 ha. The weather station used was Barraba Post Office (station number 54003). The crop factor file used was “nthwst6ed.crp”, which was developed for the licence conversion process.
Groundwater extraction	No substaintial alluvial extractions indentified as impacting on streamflow.
Licence locations	The CtP is triggered at a location below the majority of the irrigation pumps, hence it is simulated as if all pumps are above the trigger point.

Table 50. Keepit

Water source and model	Keepit: model Lake Keepit	
Water source boundaries	The main waterbody is Lake Keepit, which is part of the Regualted System, and it is the small stream that flow into it that make up the unregulated water source.	
Assumptions		**Confidence**
Flow sequence		Low
flows used	A measured flow sequence was used to represent the streamflow available to be extracted. This flow was measured at the gauging station “Halls Creek at Ukolan” (419029). The flow sequence extends from 22/05/1965 to 27/07/2008, 43.2 years in total. 4.8% of the measured sequenced need to be filled using a correlation with a nearby gauging station.	
total area factor	The flow sequence was factored for area by 1.24.	
on-river dams area factor	A proportion of the streamflow sequence (22% of the unfactored flow sequence) is able to be captured by on-river dams.	
on-farm dams area factor	No on-farm dams simulated.	
Water access		Moderate
level of entitlement	The total entitlement simulated was 774 ML made up of: • 769 ML Unregulated category entitlement • 5 ML Domestic and Stock category.	
access rules (CtP)	A CtP was not simulated.	
higher access rule (CtP on Approval)	No higher of access rules (CtP) were simulated.	
pump capacity	A pump capacity of 12.82 ML/day was available for irrigation and 0.01 ML/day was available for Stock and Domestic and LWU water extraction.	
on-river dam access	300 ML of on-river dam capacity was simulated. 42% of the unregulated entitlement had access to on-river dams. 0% of the Stock and Domestic and LWU entitlement had access to the on-river dams.	
on-farm storage available	No on-farm storage simulated.	
Irrigation pattern		High

Water source and model	Keepit: model Lake Keepit
crop	The crop mix assumed is from the survey for a conversion of unregulated licences carried out in 2000. The crop survey result for Stressed Rivers Assessment unit “Keepit” (419_21) was used. This crop mix is represented by simulating the water demands of the following crops: • Annual pasture 3% • Lucerne 67% • Perennial pasture 14% • Wheat 16%. The total area irrigated (based on the full development of the entitlement) in the Lake Keepit system was estimated to be 132ha. The weather station used was Manilla Post Office (station number 55031). The crop factor file used was “nthwst6ed.crp”, which was developed for the licence conversion process.
Groundwater extraction	No substaintial alluvial extractions indentified as impacting on streamflow.
Licence locations	Some of the licences have access to on-river dams (see sections 'on-river dam area factor' and 'on-river dam access').

Table 51. Warrah Creek

Water source and model	**Warrah Creek: model Warrah Creek**	
Water source boundaries	The main stream is the Mooki River with headwater streams flowing into it.	
Assumptions		**Confidence**
Flow sequence		Moderate
flows used	A measured flow sequence was used to represent the streamflow available to be extracted. This flow was measured at a gauging station from an adjacent catchement “Mooki River at Caroona” (419034). The flow sequence extends from 01/08/1965 to 27/10/2009, 44.2 years in total. 0.5% of the measured sequenced need to be filled using a correlation with a nearby gauging station.	
total area factor	The flow sequence was factored for area by 0.96.	
on-river dams area factor	No on-river dam simulated.	
on-farm dams area factor	No on-farm dams simulated.	
Water access		High
level of entitlement	The total entitlement simulated was 426 ML made up of: • 420 ML Unregulated category entitlement • 6 ML Domestic and Stock category	
access rules (CtP)	The CtP was simulated by placing a threshold on the irriration pumps of 4 ML/day, which simulated a CtP at the end of the system.	
higher access rule (CtP on Approval)	No higher of access rules (CtP) were simulated.	
pump capacity	A pump capacity of 7.00 ML/day was available for irrigation and 0.02 ML/day was available for Stock and Domestic and LWU water extraction.	
on-river dam access	No on-river dams simulated.	
on-farm storage available	No on-farm storage simulated.	
Irrigation pattern		High

Water source and model	Warrah Creek: model Warrah Creek
crop	The crop mix assumed is from the survey for a conversion of unregulated licences carried out in 2000. The crop survey result for Stressed Rivers Assessment unit “Warrah Creek” (419_02) was used. This crop mix is represented by simulating the water demands of the following crops: • Annual pasture 22% • Lucerne 44% • Wheat 34%. The total area irrigated (based on the full development of the entitlement) in the Warrah Creek system was estimated to be 86 ha. The weather station used was Quirindi Post Office (station number 55049). The crop factor file used was “nthwst6ed.crp”, which was developed for the licence conversion process.
Groundwater extraction	No substaintial alluvial extractions indentified as impacting on streamflow.
Licence locations	The CtP is triggered at a location below the majority of the irrigation pumps, hence it is simulated as if all pumps are above the trigger point.

Table 52. Phillips Creek

Water source and model	Phillips Creek: model Phillips Creek	
Water source boundaries	The main stream is the Mooki River with headwater streams flowing into it.	
Assumptions		**Confidence**
Flow sequence		Moderate
flows used	A measured flow sequence was used to represent the streamflow available to be extracted. This flow was measured at a gauging station from an adjacent catchement “Mooki River at Caroona” (419034). The flow sequence extends from 01/08/1965 to 27/10/2009, 44.2 years in total. 0.5% of the measured sequenced need to be filled using a correlation with a nearby gauging station.	
total area factor	The flow sequence was factored for area by 0.96.	
on-river dams area factor	No on-river dam simulated.	
on-farm dams area factor	No on-farm dams simulated.	
Water access		High
level of entitlement	The total entitlement simulated was 426 ML made up of: • 420 ML Unregulated category entitlement • 6 ML Domestic and Stock category.	
access rules (CtP)	The CtP was simulated by placing a threshold on the irriration pumps of 4ML/day, which simulated a CtP at the end of the system.	
higher access rule (CtP on Approval)	No higher of access rules (CtP) were simulated.	
pump capacity	A pump capacity of 7.00 ML/day was available for irrigation and 0.02 ML/day was available for Stock and Domestic and LWU water extraction.	
on-river dam access	No on-river dams simulated.	
on-farm storage available	No on-farm storage simulated.	
Irrigation pattern		High

Water source and model	Phillips Creek: model Phillips Creek
crop	The crop mix assumed is from the survey for a conversion of unregulated licences carried out in 2000. The crop survey result for Stressed Rivers Assessment unit “Warrah Creek” (419_02) was used. This crop mix is represented by simulating the water demands of the following crops: • Annual pasture 22% • Lucerne 44% • Wheat 34%. The total area irrigated (based on the full development of the entitlement) in the Phillips Creek system was estimated to be 86ha. The weather station used was Quirindi Post Office (station number 55049). The crop factor file used was “nthwst6ed.crp”, which was developed for the licence conversion process.
Groundwater extraction	No substaintial alluvial extractions indentified as impacting on streamflow.
Licence locations	The CtP is triggered at a location below the majority of the irrigation pumps, hence it is simulated as if all pumps are above the trigger point.

Table 53. Quirindi Creek

Water source and model	Quirindi Creek: model Quirindi Creek	
Water source boundaries	The main stream is Quirindi Creek with headwater streams flowing into it. In the lower reaches of this stream flow is lost into the alluvium and the river channel peters out. Part of the lower end of the water source has some small residual streams flow	
Assumptions		**Confidence**
Flow sequence		Low
flows used	A measured flow sequence was used to represent the streamflow available to be extracted. This flow was measured at the gauging station "Quirindi Creek at Greenacres" (419098). The flow sequence extends from 22/05/2003 to 18/08/2008, 5.2 years in total. There was no need to fill any gaps in the measured flow sequence.	
total area factor	The flow sequence was factored for area by 1.04.	
on-river dams area factor	A proportion of the streamflow sequence (13% of the unfactored flow sequence) is able to be captured by on-river dams.	
on-farm dams area factor	No on-farm dams simulated.	
Water access		Low
level of entitlement	The total entitlement simulated was 2,785.5 ML made up of: • 1,740 ML Unregulated category entitlement • 45.5 ML Domestic and Stock category • 1,000 ML LWU category entitlement.	
access rules (CtP)	The CtP was simulated by placing a threshold on the irriration pumps of 2 ML/day, which simulated a CtP at the end of the system.	
higher access rule (CtP on Approval)	No higher of access rules (CtP) were simulated.	
pump capacity	A pump capacity of 29.00 ML/day was available for irrigation and 2.86 ML/day was available for Stock and Domestic and LWU water extraction.	
on-river dam access	1,000 ML of on-river dam capacity was simulated. 0% of the unregulated entitlement had access to on-river dams. 96% of the Stock and Domestic and LWU entitlement had access to the on-river dams.	

Water source and model	Quirindi Creek: model Quirindi Creek	
on-farm storage available	No on-farm storage simulated.	
Irrigation pattern		High
crop	The crop mix assumed is from the survey for a conversion of unregulated licences carried out in 2000. The crop survey result for Stressed Rivers Assessment unit “Quirindi Creek” (419_05) was used. This crop mix is represented by simulating the water demands of the following crops: • Annual pasture 15% • Lucerne 65% • Perennial pasture 11% • Wheat 9%. The total area irrigated (based on the full development of the entitlement) in the Quirindi Creek system was estimated to be 298ha. The weather station used was Quirindi Post Office (station number 55049). The crop factor file used was “nthwst6ed.crp”, which was developed for the licence conversion process.	
Groundwater extraction	Alluvial groundwater is accessed in the vicinity of these unregulated streams which may also impact on streamflow but these were not simulated.	
Licence locations	The CtP is triggered at a location below the majority of the irrigation pumps, hence it is simulated as if all pumps are above the trigger point. Some of the licences have access to on-river dams (see sections 'on-river dam area factor' and 'on-river dam access').	

Table 54. Werris Creek

Water source and model	Werris Creek: model Werris Creek	
Water source boundaries	The main stream is Werris Creek with headwater streams flowing into it. In the lower reaches of this stream flow is lost into the alluvium and the river channel peters out. Part of the lower end of the water source has some small residual streams flowin	
Assumptions		**Confidence**
Flow sequence		Low
flows used	A measured flow sequence was used to represent the streamflow available to be extracted. This flow was measured at a gauging station from an adjacent catchement “Quirindi Creek at Greenacres” (419098). The flow sequence extends from 22/05/2003 to 18/08/2008, 5.2 years in total. There was no need to fill any gaps in the measured flow sequence.	
total area factor	The flow sequence was factored for area by 0.55.	
on-river dams area factor	A proportion of the streamflow sequence (3% of the unfactored flow sequence) is able to be captured by on-river dams.	
on-farm dams area factor	No on-farm dams simulated.	
Water access		Moderate
level of entitlement	The total entitlement simulated was 1,281 ML made up of: • 1,281 ML Unregulated category entitlement	
access rules (CtP)	A CtP was not simulated.	
higher access rule (CtP on Approval)	No higher of access rules (CtP) were simulated.	
pump capacity	A pump capacity of 21.35 ML/day was available for irrigation and 0.00 ML/day was available for Stock and Domestic and LWU water extraction.	
on-river dam access	700 ML of on-river dam capacity was simulated. 58% of the unregulated entitlement had access to on-river dams. 0% of the Stock and Domestic and LWU entitlement had access to the on-river dams.	
on-farm storage available	No on-farm storage simulated.	
Irrigation pattern		High

Water source and model	Werris Creek: model Werris Creek
crop	The crop mix assumed is from the survey for a conversion of unregulated licences carried out in 2000. The crop survey result for Stressed Rivers Assessment unit “Werris Creek” (419_10) was used. This crop mix is represented by simulating the water demands of the following crops: • Annual pasture 4% • Citrus 2% • Lucerne 49% • Summer Maize 1% • Vegetables 39% • Wheat 5%. The total area irrigated (based on the full development of the entitlement) in the Werris Creek system was estimated to be 187ha. The weather station used was Breeza (The Park) (station number 55065). The crop factor file used was “nthwst6ed.crp”, which was developed for the licence conversion process.
Groundwater extraction	Alluvial groundwater is accessed in the vicinity of these unregulated streams which may also impact on streamflow but these were not simulated.
Licence locations	Some of the licences have access to on-river dams (see sections 'on-river dam area factor' and 'on-river dam access').

Table 55. Mooki River

Water source and model	Mooki River: model Mooki River	
Water source boundaries	The main stream is the Mooki River downstream of other water sources that flow into it.	
Assumptions		**Confidence**
Flow sequence		Low
flows used	A measured flow sequence was used to represent the streamflow available to be extracted. This flow was measured at the gauging station "Mooki River at Breeza" (419027). The flow sequence extends from 01/09/1957 to 27/10/2009, 52.2 years in total. 0.5% of the measured sequenced need to be filled using a correlation with a nearby gauging station.	
total area factor	The flow sequence was factored for area by 1.38.	
on-river dams area factor	No on-river dam simulated.	
on-farm dams area factor	A proportion of the streamflow sequence (138% of the unfactored flow) is able to be accessed by pumps that can fill the on-farm dams.	
Water access		Low
level of entitlement	The total entitlement simulated was 33,857 ML made up of: • 33,751.5 ML Unregulated category entitlement • 105.5 ML Domestic and Stock category.	
access rules (CtP)	The CtP was simulated by placing a threshold on the irriration pumps of 50 ML/day, which simulated a CtP at the end of the system.	
higher access rule (CtP on Approval)	No higher of access rules (CtP) were simulated.	
pump capacity	A pump capacity of 562.53 ML/day was available for irrigation and 0.29 ML/day was available for Stock and Domestic and LWU water extraction.	
on-river dam access	No on-river dams simulated.	
on-farm storage available	25,300 ML of on-farm storage capacity was simulated. 100% of the unregulated entitlement had access to on-farm dams. 0% of the Stock and Domestic and LWU entitlement had access to the on-farm dams.	

Water source and model	**Mooki River: model Mooki River**	
Irrigation pattern		High
crop	The crop mix assumed is from the survey for a conversion of unregulated licences carried out in 2000. The crop survey result for Stressed Rivers Assessment unit “Mooki River” (419_09) was used. This crop mix is represented by simulating the water demands of the following crops: • Cotton 61% • Fababean 1% • Pecans 1% • Soybeans 10% • Summer Maize 4% • Vegetables 1% • Wheat 22%. The total area irrigated (based on the full development of the entitlement) in the Mooki River system was estimated to be 5921ha. The weather station used was Gunnedah Pool (station number 55023). The crop factor file used was “nthwst6ed.crp”, which was developed for the licence conversion process.	
Groundwater extraction	Alluvial groundwater is accessed in the vicinity of these unregulated streams which may also impact on streamflow but these were not simulated.	
Licence locations	The CtP is triggered at a location below the majority of the irrigation pumps, hence it is simulated as if all pumps are above the trigger point. Some of the licences have access to on-farm dams (see sections 'on-farm dam area factor' and 'on-farm dam available').	

Table 56. Chaffey

Water source and model	**Chaffey: model Chaffey Dam**	
Water source boundaries	The main waterbody is Chaffey Dam, which is part of the Regualted System, and it is the small stream that flow into it that make up the unregulated water source.	
Assumptions		**Confidence**
Flow sequence		High
flows used	A rainfall runoff modeled flow sequence was used to represent the streamflow available to be extracted. This flow was based on the gauging station “find a name” (regional parameters). The flow sequence extends from 01/01/1892 to 30/06/2008, 116.5 years in total.	
total area factor	The flow sequence was factored for area by 0.80.	
on-river dams area factor	No on-river dam simulated.	
on-farm dams area factor	No on-farm dams simulated.	
Water access		High
level of entitlement	The total entitlement simulated was 388.5 ML made up of: • 384.5 ML Unregulated category entitlement • 4 ML Domestic and Stock category.	
access rules (CtP)	The CtP was simulated by placing a threshold on the irriration pumps of 2 ML/day, which simulated a CtP at the end of the system.	
higher access rule (CtP on Approval)	No higher of access rules (CtP) were simulated.	
pump capacity	A pump capacity of 6.41 ML/day was available for irrigation and 0.01 ML/day was available for Stock and Domestic and LWU water extraction.	
on-river dam access	No on-river dams simulated.	
on-farm storage available	No on-farm storage simulated.	
Irrigation pattern		High

Water source and model	Chaffey: model Chaffey Dam
crop	The crop mix assumed is from the survey for a conversion of unregulated licences carried out in 2000. The crop survey result for Stressed Rivers Assessment unit “Chaffey” (419_06) was used. This crop mix is represented by simulating the water demands of the following crops: • Annual pasture 15% • Lucerne 53% • Intensive Perennial Pasture 32%. The total area irrigated (based on the full development of the entitlement) in the Chaffey Dam system was estimated to be 59ha. The weather station used was Nundle Post Office (station number 55041). The crop factor file used was “nthwst6ed.crp”, which was developed for the licence conversion process.
Groundwater extraction	No substaintial alluvial extractions indentified as impacting on streamflow.
Licence locations	The CtP is triggered at a location below the majority of the irrigation pumps, hence it is simulated as if all pumps are above the trigger point.

Table 57. Cockburn River

Water source and model	Cockburn River: model Cockburn River	
Water source boundaries	The main stream is the Cockburn River with headwater streams flowing into it.	
Assumptions		**Confidence**
Flow sequence		Moderate
flows used	A rainfall runoff modeled flow sequence was used to represent the streamflow available to be extracted. This flow was based on the gauging station "Cockburn River at Mulla Crossing" (419016). The flow sequence extends from 01/01/1892 to 30/06/2008, 116.5 years in total.	
total area factor	The flow sequence was factored for area by 1.25.	
on-river dams area factor	No on-river dam simulated.	
on-farm dams area factor	No on-farm dams simulated.	
Water access		High
level of entitlement	The total entitlement simulated was 4,459 ML made up of: • 4,385 ML Unregulated category entitlement • 74 ML Domestic and Stock category.	
access rules (CtP)	The visible flow CtP was simulated by allowing access down to zero flow, which is the same as simulating no CtP.	
higher access rule (CtP on Approval)	No higher of access rules (CtP) were simulated.	
pump capacity	A pump capacity of 73.08 ML/day was available for irrigation and 0.20 ML/day was available for Stock and Domestic and LWU water extraction.	
on-river dam access	No on-river dams simulated.	
on-farm storage available	No on-farm storage simulated.	
Irrigation pattern		High

Water source and model	Cockburn River: model Cockburn River
crop	The crop mix assumed is from the survey for a conversion of unregulated licences carried out in 2000. The crop survey result for Stressed Rivers Assessment unit “Cockburn River” (419_15) was used. This crop mix is represented by simulating the water demands of the following crops: • Annual pasture 2% • Citrus 3% • Lucerne 68% • Olives 1% • Pecans 3% • Perennial pasture 3% • Summer Maize 5% • Turf 1% • Wheat 14%. The total area irrigated (based on the full development of the entitlement) in the Cockburn River system was estimated to be 719 ha. The weather station used was Tamworth Airport (station number 55054). The crop factor file used was “nthwst6ed.crp”, which was developed for the licence conversion process.
Groundwater extraction	Alluvial groundwater is accessed in the vicinity of these unregulated streams which may also impact on streamflow but these were not simulated.
Licence locations	

Table 58. Goonoo Goonoo Creek

Water source and model	Goonoo Goonoo Creek: model Goonoo Goonoo Creek	
Water source boundaries	The main stream is Goonoo Goonoo Creek with headwater streams flowing into it.	
Assumptions		**Confidence**
Flow sequence		High
flows used	A rainfall runoff modeled flow sequence was used to represent the streamflow available to be extracted. This flow was based on the gauging station "Goonoo Goonoo Creek at Timbumburi" (419035). The flow sequence extends from 01/01/1892 to 30/06/2008, 116.5 years in total.	
total area factor	The flow sequence was factored for area by 1.10.	
on-river dams area factor	A proportion of the streamflow sequence (8% of the unfactored flow sequence) is able to be captured by on-river dams.	
on-farm dams area factor	No on-farm dams simulated.	
Water access		High
level of entitlement	The total entitlement simulated was 1,055 ML made up of: • 1,033.5 ML Unregulated category entitlement • 21.5 ML Domestic and Stock category.	
access rules (CtP)	The visible flow CtP was simulated by allowing access down to zero flow, which is the same as simulating no CtP.	
higher access rule (CtP on Approval)	No higher of access rules (CtP) were simulated.	
pump capacity	A pump capacity of 17.23 ML/day was available for irrigation and 0.06 ML/day was available for Stock and Domestic and LWU water extraction.	
on-river dam access	190 ML of on-river dam capacity was simulated. 37% of the unregulated entitlement had access to on-river dams. 47% of the Stock and Domestic and LWU entitlement had access to the on-river dams.	
on-farm storage available	No on-farm storage simulated.	
Irrigation pattern		High

Water source and model	Goonoo Goonoo Creek: model Goonoo Goonoo Creek
crop	The crop mix assumed is from the survey for a conversion of unregulated licences carried out in 2000. The crop survey result for Stressed Rivers Assessment unit “Goonoo Goonoo Creek” (419_07) was used. This crop mix is represented by simulating the water demands of the following crops: • Citrus 1% • Lucerne 90% • Perennial pasture 7% • Wheat 2%. The total area irrigated (based on the full development of the entitlement) in the Goonoo Goonoo Creek system was estimated to be 161 ha. The weather station used was Goonoo Goonoo Station (station number 55067). The crop factor file used was “nthwst6ed.crp”, which was developed for the licence conversion process.
Groundwater extraction	No substaintial alluvial extractions indentified as impacting on streamflow.
Licence locations	Some of the licences have access to on-river dams (see sections 'on-river dam area factor' and 'on-river dam access').

Table 59. Upper Peel River

Water source and model	**Upper Peel River Tributaries: model Dungowan Creek, and Duncan Creek**	
Water source boundaries	The main streams are Dungowan Creek, and Duncan Creek, which flow into the regulated river.	
Assumptions		**Confidence**
Flow sequence		Moderate
flows used	A rainfall runoff modeled flow sequence was used to represent the streamflow available to be extracted. This flow was based on a nearby gauging station. The flow sequence extends from 01/01/1892 to 30/06/2008, 116.5 years in total.	
total area factor	The flow sequence was factored for area by 2.00.	
on-river dams area factor	A proportion of the streamflow sequence (100% of the unfactored flow sequence) is able to be captured by on-river dams.	
on-farm dams area factor	No on-farm dams simulated.	
Water access		Low
level of entitlement	The total entitlement simulated was 9,643 ML made up of: • 4,018 ML Unregulated category entitlement • 5,625 ML Domestic and Stock category.	
access rules (CtP)	The visible flow CtP was simulated by allowing access down to zero flow, which is the same as simulating no CtP.	
higher access rule (CtP on Approval)	No higher of access rules (CtP) were simulated.	
pump capacity	A pump capacity of 66.97 ML/day was available for irrigation and 15.41 ML/day was available for Stock and Domestic and LWU water extraction.	
on-river dam access	6,300 ML of on-river dam capacity was simulated. 0% of the unregulated entitlement had access to on-river dams. 100% of the Stock and Domestic and LWU entitlement had access to the on-river dams.	
on-farm storage available	No on-farm storage simulated.	
Irrigation pattern		High

Water source and model	Upper Peel River Tributaries: model Dungowan Creek, and Duncan Creek
crop	The crop mix assumed is from the survey for a conversion of unregulated licences carried out in 2000. The crop survey result for Stressed Rivers Assessment unit “Upper Peel River Tributaries” (419_08) was used. This crop mix is represented by simulating the water demands of the following crops: • Annual pasture 6% • Lucerne 77% • Perennial pasture 6% • Intensive Perennial Pasture 4% • Summer Maize 1% • Turf 3% • Wheat 3%. The total area irrigated (based on the full development of the entitlement) in the Dungowan Creek, and Duncan Creek system was estimated to be 625ha. The weather station used was Dungowan Station (station number 55171). The crop factor file used was “nthwst6ed.crp”, which was developed for the licence conversion process.
Groundwater extraction	Alluvial groundwater is accessed in the vicinity of these unregulated streams which may also impact on streamflow but these were not simulated.
Licence locations	Some of the licences have access to on-river dams (see sections 'on-river dam area factor' and 'on-river dam access').

Table 60. Lower Peel River Tributaries

Water source and model	**Lower Peel River Tributaries: model Sandy Creek, Tumbumburi Creek, Moore Creek, Attunga Creek, and Tangaratta Creek**	
Water source boundaries	The main streams are Sandy Creek, Tumbumburi Creek, Moore Creek, Attunga Creek, and Tangaratta Creek, which flow into the regulated river.	
Assumptions		**Confidence**
Flow sequence		Low
flows used	A rainfall runoff modeled flow sequence was used to represent the streamflow available to be extracted. This flow was based on the gauging station “Goonoo Goonoo Creek at Timbumburi” (419035). The flow sequence extends from 01/01/1892 to 30/06/2008, 116.5 years in total.	
total area factor	The flow sequence was factored for area by 1.88.	
on-river dams area factor	No on-river dam simulated.	
on-farm dams area factor	No on-farm dams simulated.	
Water access		High
level of entitlement	The total entitlement simulated was 2,530.5 ML made up of: • 2,472 ML Unregulated category entitlement • 58.5 ML Domestic and Stock category.	
access rules (CtP)	The visible flow CtP was simulated by allowing access down to zero flow, which is the same as simulating no CtP.	
higher access rule (CtP on Approval)	No higher of access rules (CtP) were simulated.	
pump capacity	A pump capacity of 41.20 ML/day was available for irrigation and 0.16 ML/day was available for Stock and Domestic and LWU water extraction.	
on-river dam access	No on-river dams simulated.	
on-farm storage available	No on-farm storage simulated.	
Irrigation pattern		High

Water source and model	Lower Peel River Tributaries: model Sandy Creek, Tumbumburi Creek, Moore Creek, Attunga Creek, and Tangaratta Creek
crop	The crop mix assumed is from the survey for a conversion of unregulated licences carried out in 2000. The crop survey result for Stressed Rivers Assessment unit “Lower Peel River Tributaries” (419_11) was used. This crop mix is represented by simulating the water demands of the following crops: • Annual pasture 4% • Lucerne 57% • Perennial pasture 14% • Intensive Perennial Pasture 9% • Summer Maize 7% • Turf 1% • Wheat 8%. The total area irrigated (based on the full development of the entitlement) in the Sandy Creek, Tumbumburi Creek, Moore Creek, Attunga Creek, and Tangaratta Creek system was estimated to be 400ha. The weather station used was Tamworth Airport (station number 55054). The crop factor file used was “nthwst6ed.crp”, which was developed for the licence conversion process.
Groundwater extraction	Alluvial groundwater is accessed in the vicinity of these unregulated streams which may also impact on streamflow but these were not simulated.
Licence locations	

Table 61. Rangira Creek

Water source and model	Rangira Creek: model Rangira Creek	
Water source boundaries	The main stream is Rangira Creek with headwater streams flowing into it. In the lower reaches of this stream flow is lost into the alluvium and the river channel peters out.	
Assumptions		**Confidence**
Flow sequence		Low
flows used	A rainfall runoff modeled flow sequence was used to represent the streamflow available to be extracted. This flow was based on a gauging station from an adjacent catchement “Maules Creek at Avoca East” (419051). The flow sequence extends from 01/01/1890 to 31/12/1997, 108.0 years in total.	
total area factor	The flow sequence was factored for area by 0.33.	
on-river dams area factor	A proportion of the streamflow sequence (10% of the unfactored flow sequence) is able to be captured by on-river dams.	
on-farm dams area factor	No on-farm dams simulated.	
Water access		Moderate
level of entitlement	The total entitlement simulated was 1,479 ML made up of: • 1,458 ML Unregulated category entitlement • 21 ML Domestic and Stock category.	
access rules (CtP)	The visible flow CtP was simulated by allowing access down to zero flow, which is the same as simulating no CtP.	
higher access rule (CtP on Approval)	No higher of access rules (CtP) were simulated.	
pump capacity	A pump capacity of 24.30 ML/day was available for irrigation and 0.06 ML/day was available for Stock and Domestic and LWU water extraction.	
on-river dam access	1000 ML of on-river dam capacity was simulated. 100% of the unregulated entitlement had access to on-river dams. 100% of the Stock and Domestic and LWU entitlement had access to the on-river dams.	
on-farm storage available	No on-farm storage simulated.	
Irrigation pattern		High

Water source and model	Rangira Creek: model Rangira Creek
crop	The crop mix assumed is from the survey for a conversion of unregulated licences carried out in 2000. The crop survey result for Stressed Rivers Assessment unit “Rangira Creek” (419_22) was used. This crop mix is represented by simulating the water demands of the following crops: • Perennial pasture 100%. The total area irrigated (based on the full development of the entitlement) in the Rangira Creek system was estimated to be 243ha. The weather station used was Barraba (Mount Lindsay) (station number 54021). The crop factor file used was “nthwst6ed.crp”, which was developed for the licence conversion process.
Groundwater extraction	No substaintial alluvial extractions indentified as impacting on streamflow.
Licence locations	Some of the licences have access to on-river dams (see sections 'on-river dam area factor' and 'on-river dam access').

Table 62. Bluevale

Water source and model	Bluevale: model Deadmans Gully, Driggle Draggle Creek, Bollol Creek, and Collygra Creek	
Water source boundaries	The main streams are Deadmans Gully, Driggle Draggle Creek, Bollol Creek, and Collygra Creek, which flow into the regulated river.	
Assumptions		**Confidence**
Flow sequence		Low
flows used	A rainfall runoff modeled flow sequence was used to represent the streamflow available to be extracted. This flow was based on a gauging station from an adjacent catchement “Maules Creek at Avoca East” (419051). The flow sequence extends from 01/01/1890 to 31/12/1997, 108.0 years in total.	
total area factor	The flow sequence was factored for area by 1.12.	
on-river dams area factor	A proportion of the streamflow sequence (56% of the unfactored flow sequence) is able to be captured by on-river dams.	
on-farm dams area factor	No on-farm dams simulated.	
Water access		Low
level of entitlement	The total entitlement simulated was 1,647 ML made up of: • 1,635 ML Unregulated category entitlement • 12 ML Domestic and Stock category.	
access rules (CtP)	A CtP was not simulated.	
higher access rule (CtP on Approval)	No higher of access rules (CtP) were simulated.	
pump capacity	A pump capacity of 27.25 ML/day was available for irrigation and 0.03 ML/day was available for Stock and Domestic and LWU water extraction.	
on-river dam access	1,000 ML of on-river dam capacity was simulated. 100% of the unregulated entitlement had access to on-river dams. 100% of the Stock and Domestic and LWU entitlement had access to the on-river dams.	
on-farm storage available	No on-farm storage simulated.	
Irrigation pattern		High

Water source and model	Bluevale: model Deadmans Gully, Driggle Draggle Creek, Bollol Creek, and Collygra Creek
crop	The crop mix assumed is from the survey for a conversion of unregulated licences carried out in 2000. The crop survey result for Stressed Rivers Assessment unit “Bluevale” (419_16) was used. This crop mix is represented by simulating the water demands of the following crops: • Canola 6% • Cotton 53% • Lucerne 3% • Wheat 38%. The total area irrigated (based on the full development of the entitlement) in the Deadmans Gully, Driggle Draggle Creek, Bollol Creek, and Collygra Creek system was estimated to be 295ha. The weather station used was Boggabri (Milchengowrie) (station number 55034). The crop factor file used was “nthwst6ed.crp”, which was developed for the licence conversion process.
Groundwater extraction	No substaintial alluvial extractions indentified as impacting on streamflow.
Licence locations	Some of the licences have access to on-river dams (see sections 'on-river dam area factor' and 'on-river dam access').

Table 63. Bluevale: model Deadmans Gully and Collygra Creek

Water source and model	Bluevale: model Deadmans Gully and Collygra Creek	
Water source boundaries	The main streams are Deadmans Gully and Collygra Creek with headwater streams flowing into it.	
Assumptions		**Confidence**
Flow sequence		Low
flows used	A rainfall runoff modeled flow sequence was used to represent the streamflow available to be extracted. This flow was based on a gauging station from an adjacent catchement “Maules Creek at Avoca East” (419051). The flow sequence extends from 01/01/1890 to 31/12/1997, 108.0 years in total.	
total area factor	The flow sequence was factored for area by 0.56.	
on-river dams area factor	A proportion of the streamflow sequence (56% of the unfactored flow sequence) is able to be captured by on-river dams.	
on-farm dams area factor	No on-farm dams simulated.	
Water access		Low
level of entitlement	The total entitlement simulated was 1,647 ML made up of: • 1,635 ML Unregulated category entitlement • 12 ML Domestic and Stock category.	
access rules (CtP)	A CtP was not simulated.	
higher access rule (CtP on Approval)	No higher of access rules (CtP) were simulated.	
pump capacity	A pump capacity of 27.25ML/day was available for irrigation and 0.03ML/day was available for Stock and Domestic and LWU water extraction.	
on-river dam access	1,000 ML of on-river dam capacity was simulated. 100% of the unregulated entitlement had access to on-river dams. 100% of the Stock and Domestic and LWU entitlement had access to the on-river dams.	
on-farm storage available	No on-farm storage simulated.	
Irrigation pattern		High

Water source and model	Bluevale: model Deadmans Gully and Collygra Creek
crop	The crop mix assumed is from the survey for a conversion of unregulated licences carried out in 2000. The crop survey result for Stressed Rivers Assessment unit “Bluevale” (419_16) was used. This crop mix is represented by simulating the water demands of the following crops: • Canola 6% • Cotton 53% • Lucerne 3% • Wheat 38%. The total area irrigated (based on the full development of the entitlement) in the Deadmans Gully and Collygra Creek system was estimated to be 295ha. The weather station used was Boggabri (Milchengowrie) (station number 55034). The crop factor file used was “nthwst6ed.crp”, which was developed for the licence conversion process.
Groundwater extraction	No substaintial alluvial extractions indentified as impacting on streamflow.
Licence locations	Some of the licences have access to on-river dams (see sections 'on-river dam area factor' and 'on-river dam access').

Table 64. Coxs Creek

Water source and model	Coxs Creek: model Coxs Creek	
Water source boundaries	The main stream is Coxs Creek with headwater streams flowing into it.	
Assumptions		**Confidence**
Flow sequence		High
flows used	A rainfall runoff modeled flow sequence was used to represent the streamflow available to be extracted. This flow was based on the gauging station “Coxs Creek at Boggabri” (419032). The flow sequence extends from 01/01/1890 to 31/12/1996, 107.0 years in total.	
total area factor	The flow sequence was factored for area by 1.00.	
on-river dams area factor	No on-river dam simulated.	
on-farm dams area factor	A proportion of the streamflow sequence (100% of the unfactored flow) is able to be accessed by pumps that can fill the on-farm dams.	
Water access		Low
level of entitlement	The total entitlement simulated was 17,627 ML made up of: 17,519.5 ML Unregulated category entitlement 107.5 ML Domestic and Stock category	
access rules (CtP)	The CtP was simulated by placing a threshold (in a decision table) on the end of system flow below the pumps that fill on-farm storages of 11ML/day.	
higher access rule (CtP on Approval)	No higher of access rules (CtP) were simulated.	
pump capacity	A pump capacity of 291.99ML/day was available for irrigation and 0.29ML/day was available for Stock and Domestic and LWU water extraction.	
on-river dam access	No on-river dams simulated.	
on-farm storage available	17,520 ML of on-farm storage capacity was simulated. 100% of the unregulated entitlement had access to on-farm dams. 0% of the Stock and Domestic and LWU entitlement had access to the on-farm dams.	

Water source and model	Coxs Creek: model Coxs Creek	
Irrigation pattern		High
crop	The crop mix assumed is from the survey for a conversion of unregulated licences carried out in 2000. The crop survey result for Stressed Rivers Assessment unit “Coxs Creek” (419_14) was used. This crop mix is represented by simulating the water demands of the following crops: • Cotton 67% • Summer Maize 2% • Wheat 31%. The total area irrigated (based on the full development of the entitlement) in the Coxs Creek system was estimated to be 2884ha. The weather station used was Boggabri (Milchengowrie) (station number 55034). The crop factor file used was “nthwst6ed.crp”, which was developed for the licence conversion process.	
Groundwater extraction	No substaintial alluvial extractions indentified as impacting on streamflow.	
Licence locations	The CtP is triggered at a location below the majority of the pumps filling on-farm storages, hence it is simulated as if all pumps are above the trigger point. Some of the licences have access to on-farm dams (see sections 'on-farm dam area factor' and 'on-farm dam available').	

Table 65. Coxs Creek

Water source and model	Coxs Creek: model mid reach of Coxs Creek	
Water source boundaries	The main stream is Coxs Creek with headwater streams flowing into it.	
Assumptions		**Confidence**
Flow sequence		Moderate
flows used	A measured flow sequence was used to represent the streamflow available to be extracted. This flow was measured at the gauging station "Coxs Creek at Mullaley" (419052). The flow sequence extends from 02/01/1890 to 31/12/1996, 107.0 years in total. 84.8% of the measured sequenced need to be filled using a correlation with a nearby gauging station.	
total area factor	The flow sequence was factored for area by 1.00.	
on-river dams area factor	No on-river dam simulated.	
on-farm dams area factor	A proportion of the streamflow sequence (100% of the unfactored flow) is able to be accessed by pumps that can fill the on-farm dams.	
Water access		Low
level of entitlement	The total entitlement simulated was 3,525 ML made up of: • 3,484 ML Unregulated category entitlement • 41 ML Domestic and Stock category.	
access rules (CtP)	The CtP was simulated by placing a threshold (in a decision table) on the end of system flow below the pumps that fill on-farm storages of 15 ML/day.	
higher access rule (CtP on Approval)	No higher of access rules (CtP) were simulated.	
pump capacity	A pump capacity of 116.13 ML/day was available for irrigation and 0.11 ML/day was available for Stock and Domestic and LWU water extraction.	
on-river dam access	No on-river dams simulated.	
on-farm storage available	3,484 ML of on-farm storage capacity was simulated. 100% of the unregulated entitlement had access to on-farm dams. 0% of the Stock and Domestic and LWU entitlement had access to the on-farm dams.	

Water source and model	Coxs Creek: model mid reach of Coxs Creek	
Irrigation pattern		High
crop	The crop mix assumed is from the survey for a conversion of unregulated licences carried out in 2000. The crop survey result for Stressed Rivers Assessment unit “Bundella Creek” (419_04) was used. This crop mix is represented by simulating the water demands of the following crops: • Cotton 51% • Fababean 2% • Soybeans 5% • Summer Maize 6% • Wheat 36%. The total area irrigated (based on the full development of the entitlement) in the mid reach of Coxs Creek system was estimated to be 648 ha. The weather station used was Mullaley (Bando) (station number 55002). The crop factor file used was “nthwst6ed.crp”, which was developed for the licence conversion process.	
Groundwater extraction	No substaintial alluvial extractions indentified as impacting on streamflow.	
Licence locations	The CtP is triggered at a location below the majority of the pumps filling on-farm storages, hence it is simulated as if all pumps are above the trigger point. Some of the licences have access to on-farm dams (see sections 'on-farm dam area factor' and 'on-farm dam available').	

Table 66. Maules Creek

Water source and model	**Maules Creek: model Maules Creek**	
Water source boundaries	The main stream is Maules Creek with headwater streams flowing into it.	
Assumptions		**Confidence**
Flow sequence		High
flows used	A rainfall runoff modeled flow sequence was used to represent the streamflow available to be extracted. This flow was based on the gauging station “Maules Creek at Avoca East” (419051). The flow sequence extends from 01/01/1890 to 31/12/1997, 108.0 years in total.	
total area factor	The flow sequence was factored for area by 1.20.	
on-river dams area factor	No on-river dam simulated.	
on-farm dams area factor	No on-farm dams simulated.	
Water access		Moderate
level of entitlement	The total entitlement simulated was 1,079 ML made up of: • 1,072 ML Unregulated category entitlement • ML Domestic and Stock category.	
access rules (CtP)	The CtP was simulated by placing a threshold (in a decision table) on the inflow above the irrigation pumps of 4 ML/day.	
higher access rule (CtP on Approval)	No higher of access rules (CtP) were simulated.	
pump capacity	A pump capacity of 17.87 ML/day was available for irrigation and 0.02 ML/day was available for Stock and Domestic and LWU water extraction.	
on-river dam access	No on-river dams simulated.	
on-farm storage available	No on-farm storage simulated.	
Irrigation pattern		High

Water source and model	Maules Creek: model Maules Creek
crop	The crop mix assumed is from the survey for a conversion of unregulated licences carried out in 2000. The crop survey result for Stressed Rivers Assessment unit “Maules Creek” (419_30) was used. This crop mix is represented by simulating the water demands of the following crops: • Cotton 11% • Lucerne 16% • Summer Maize 11% • Wheat 62%. The total area irrigated (based on the full development of the entitlement) in the Maules Creek system was estimated to be 244ha. The weather station used was Boggabri (Kanownda) (station number 55076). The crop factor file used was “nthwst6ed.crp”, which was developed for the licence conversion process.
Groundwater extraction	Alluvial groundwater is accessed in the vicinity of these unregulated streams which may also impact on streamflow but these were not simulated.
Licence locations	The CtP is triggered at a location above the majority of the irrigation pumps, hence it is simulated as if all pumps are below the trigger point.

Table 67. Eulah Creek

Water source and model	Eulah Creek: model Tulla Mullen Creek, and Bullawa Creek	
Water source boundaries	The main streams are Tulla Mullen Creek, and Bullawa Creek, which flow into the regulated river.	
Assumptions		**Confidence**
Flow sequence		Low
flows used	A rainfall runoff modeled flow sequence was used to represent the streamflow available to be extracted. This flow was based on a gauging station from an adjacent catchement “Maules Creek at Avoca East” (419051). The flow sequence extends from 01/01/1890 to 31/12/1997, 108.0 years in total.	
total area factor	The flow sequence was factored for area by 0.93.	
on-river dams area factor	A proportion of the streamflow sequence (44% of the unfactored flow sequence) is able to be captured by on-river dams.	
on-farm dams area factor	No on-farm dams simulated.	
Water access		Low
level of entitlement	The total entitlement simulated was 3,893.75 ML made up of: • 3,858.75 ML Unregulated category entitlement • 35 ML Domestic and Stock category.	
access rules (CtP)	A CtP was not simulated.	
higher access rule (CtP on Approval)	No higher of access rules (CtP) were simulated.	
pump capacity	A pump capacity of 40.67 ML/day was available for irrigation and 0.10 ML/day was available for Stock and Domestic and LWU water extraction.	
on-river dam access	1,220 ML of on-river dam capacity was simulated. 100% of the unregulated entitlement had access to on-river dams. 0% of the Stock and Domestic and LWU entitlement had access to the on-river dams.	
on-farm storage available	No on-farm storage simulated.	
Irrigation pattern		High

Water source and model	Eulah Creek: model Tulla Mullen Creek, and Bullawa Creek
crop	The crop mix assumed is from the survey for a conversion of unregulated licences carried out in 2000. The crop survey result for Stressed Rivers Assessment unit “Eulah Creek” (419_29) was used. This crop mix is represented by simulating the water demands of the following crops: • Cotton 54% • Lucerne 20% • Perennial pasture 4% • Wheat 22%. The total area irrigated (based on the full development of the entitlement) in the Tulla Mullen Creek, and Bullawa Creek system was estimated to be 390ha. The weather station used was Turrawan (Wallah) (station number 55058). The crop factor file used was “nthwst6ed.crp”, which was developed for the licence conversion process.
Groundwater extraction	No substaintial alluvial extractions indentified as impacting on streamflow.
Licence locations	Some of the licences have access to on-river dams (see sections 'on-river dam area factor' and 'on-river dam access').

Table 68. Bohena Creek

Water source and model	Bohena Creek: model Bohena Creek	
Water source boundaries	The main stream is Bohena Creek with headwater streams flowing into it. Part of the lower end of the water source has some anabranching channels associated with the regulated river.	
Assumptions		**Confidence**
Flow sequence		Moderate
flows used	A measured flow sequence was used to represent the streamflow available to be extracted. This flow was measured at the gauging station "Bohena Creek at Newell Highway" (419905). The flow sequence extends from 09/06/1995 to 13/06/2005, 10.0 years in total. There was no need to fill any gaps in the measured flow sequence.	
total area factor	The flow sequence was factored for area by 1.06.	
on-river dams area factor	A proportion of the streamflow sequence (0% of the unfactored flow sequence) is able to be captured by on-river dams.	
on-farm dams area factor	No on-farm dams simulated.	
Water access		Moderate
level of entitlement	The total entitlement simulated was 415 ML made up of: • 410 ML Unregulated category entitlement • 5 ML Domestic and Stock category.	
access rules (CtP)	A CtP was not simulated.	
higher access rule (CtP on Approval)	No higher of access rules (CtP) were simulated.	
pump capacity	A pump capacity of 6.83 ML/day was available for irrigation and 0.01 ML/day was available for Stock and Domestic and LWU water extraction.	
on-river dam access	177 ML of on-river dam capacity was simulated. 43% of the unregulated entitlement had access to on-river dams. 0% of the Stock and Domestic and LWU entitlement had access to the on-river dams.	
on-farm storage available	No on-farm storage simulated.	
Irrigation pattern		High

Water source and model	Bohena Creek: model Bohena Creek
crop	The crop mix assumed is from the survey for a conversion of unregulated licences carried out in 2000. The crop survey result for Stressed Rivers Assessment unit “Bohena Creek” (419_23) was used. This crop mix is represented by simulating the water demands of the following crops: • Annual pasture 24% • Lucerne 47% • Wheat 29%. The total area irrigated (based on the full development of the entitlement) in the Bohena Creek system was estimated to be 82ha. The weather station used was Narrabri Bowling Club (station number 54120). The crop factor file used was “nthwst6ed.crp”, which was developed for the licence conversion process.
Groundwater extraction	No substaintial alluvial extractions indentified as impacting on streamflow.
Licence locations	Some of the licences have access to on-river dams (see sections 'on-river dam area factor' and 'on-river dam access').

Table 69. Spring and Bobbiwaa Creeks

Water source and model	Spring and Bobbiwaa Creeks: model Spring Creek	
Water source boundaries	The main stream is Spring Creek with headwater streams flowing into it. In the lower reaches of this stream, flow is lost into the alluvium and the river channel peters out. Part of the lower end of the water source has some small residual streams flowing.	
Assumptions		**Confidence**
Flow sequence		Low
flows used	A measured flow sequence was used to represent the streamflow available to be extracted. This flow was measured at a gauging station from an adjacent catchement “Brigalow Creek at Tharlane” (419083). The flow sequence extends from 15/10/1993 to 20/01/2010, 16.3 years in total. There was no need to fill any gaps in the measured flow sequence.	
total area factor	The flow sequence was factored for area by 0.78.	
on-river dams area factor	No on-river dam simulated.	
on-farm dams area factor	A proportion of the streamflow sequence (54% of the unfactored flow) is able to be accessed by pumps that can fill the on-farm dams.	
Water access		Low
level of entitlement	The total entitlement simulated was 533 ML made up of: • 528 ML Unregulated category entitlement • 5 ML Domestic and Stock category.	
access rules (CtP)	A CtP was not simulated.	
higher access rule (CtP on Approval)	No higher of access rules (CtP) were simulated.	
pump capacity	A pump capacity of 17.60 ML/day was available for irrigation and 0.01 ML/day was available for Stock and Domestic and LWU water extraction.	
on-river dam access	No on-river dams simulated.	
on-farm storage available	533 ML of on-farm storage capacity was simulated. 100% of the unregulated entitlement had access to on-farm dams. 100% of the Stock and Domestic and LWU entitlement had access to the on-farm dams.	
Irrigation pattern		High

Water source and model	Spring and Bobbiwaa Creeks: model Spring Creek
crop	The crop mix assumed is from the survey for a conversion of unregulated licences carried out in 2000. The crop survey result for Stressed Rivers Assessment unit “Spring Creek” (419_37) was used. This crop mix is represented by simulating the water demands of the following crops: • Lucerne 41% • Vegetables 5% • Wheat 54%. The total area irrigated (based on the full development of the entitlement) in the Spring Creek system was estimated to be 113ha. The weather station used was Narrabri Bowling Club (station number 54120). The crop factor file used was “nthwst6ed.crp”, which was developed for the licence conversion process.
Groundwater extraction	No substaintial alluvial extractions indentified as impacting on streamflow.
Licence locations	Some of the licences have access to on-farm dams (see sections 'on-farm dam area factor' and 'on-farm dam available').

Table 70. Spring and Bobbiwaa Creeks

Water source and model	Spring and Bobbiwaa Creeks: model Bobbiwaa Creek	
Water source boundaries	The main stream is Bobbiwaa Creek with headwater streams flowing into it. In the lower reaches of this stream flow is lost into the alluvium and the river channel peters out. Part of the lower end of the water source has some small residual streams flow	
Assumptions		**Confidence**
Flow sequence		Low
flows used	A measured flow sequence was used to represent the streamflow available to be extracted. This flow was measured at a gauging station from an adjacent catchement “Brigalow Creek at Tharlane” (419083). The flow sequence extends from 15/10/1993 to 20/01/2010, 16.3 years in total. There was no need to fill any gaps in the measured flow sequence.	
total area factor	The flow sequence was factored for area by 0.86.	
on-river dams area factor	No on-river dam simulated.	
on-farm dams area factor	A proportion of the streamflow sequence (43% of the unfactored flow) is able to be accessed by pumps that can fill the on-farm dams.	
Water access		Low
level of entitlement	The total entitlement simulated was 448 ML made up of: • 448 ML Unregulated category entitlement • 0 ML Domestic and Stock category • 0 ML LWU category entitlement.	
access rules (CtP)	A CtP was not simulated.	
higher access rule (CtP on Approval)	No higher of access rules (CtP) were simulated.	
pump capacity	A pump capacity of 14.93 ML/day was available for irrigation and 0.00ML/day was available for Stock and Domestic and LWU water extraction.	
on-river dam access	No on-river dams simulated.	
on-farm storage available	448 ML of on-farm storage capacity was simulated. 100% of the unregulated entitlement had access to on-farm dams. 100% of the Stock and Domestic and LWU entitlement had access to the on-farm dams.	
Irrigation pattern		High

Water source and model	Spring and Bobbiwaa Creeks: model Bobbiwaa Creek
crop	The crop mix assumed is from the survey for a conversion of unregulated licences carried out in 2000. The crop survey result for Stressed Rivers Assessment unit “Bobbiwaa Creek” (419_38) was used. This crop mix is represented by simulating the water demands of the following crops: • Cotton 86% • Lucerne 8% • Wheat 6%. The total area irrigated (based on the full development of the entitlement) in the Bobbiwaa Creek system was estimated to be 63ha. The weather station used was Narrabri Bowling Club (station number 54120). The crop factor file used was “nthwst6ed.crp”, which was developed for the licence conversion process.
Groundwater extraction	No substaintial alluvial extractions indentified as impacting on streamflow.
Licence locations	Some of the licences have access to on-farm dams (see sections 'on-farm dam area factor' and 'on-farm dam available').

Table 71. Bundock Creek

Water source and model	Bundock Creek: model Bundock Creek	
Water source boundaries	The main stream is Bundock Creek with headwater streams flowing into it. Part of the lower end of the water source has some small residual streams flowing into the trunk stream.	
Assumptions		**Confidence**
Flow sequence		Low
flows used	A measured flow sequence was used to represent the streamflow available to be extracted. This flow was measured at a gauging station from an adjacent catchement “Brigalow Creek at Tharlane” (419083). The flow sequence extends from 15/10/1993 to 20/01/2010, 16.3 years in total. There was no need to fill any gaps in the measured flow sequence.	
total area factor	The flow sequence was factored for area by 1.28.	
on-river dams area factor	No on-river dam simulated.	
on-farm dams area factor	A proportion of the streamflow sequence (128% of the unfactored flow) is able to be accessed by pumps that can fill the on-farm dams.	
Water access		Low
level of entitlement	The total entitlement simulated was 3,219.5 ML made up of: • 3,206 ML Unregulated category entitlement • 13.5 ML Domestic and Stock category.	
access rules (CtP)	A CtP was not simulated.	
higher access rule (CtP on Approval)	No higher of access rules (CtP) were simulated.	
pump capacity	A pump capacity of 106.87 ML/day was available for irrigation and 0.04 ML/day was available for Stock and Domestic and LWU water extraction.	
on-river dam access	No on-river dams simulated.	
on-farm storage available	3,220 ML of on-farm storage capacity was simulated. 100% of the unregulated entitlement had access to on-farm dams. 100% of the Stock and Domestic and LWU entitlement had access to the on-farm dams.	
Irrigation pattern		Moderate

Water source and model	Bundock Creek: model Bundock Creek
crop	The crop mix assumed is from the survey for a conversion of unregulated licences carried out in 2000. The crop survey result for Stressed Rivers Assessment unit “Bobbiwaa” (419_38) was used. This crop mix is represented by simulating the water demands of the following crops: • Cotton 86% • Lucerne 8% • Wheat 6%. The total area irrigated (based on the full development of the entitlement) in the Bundock Creek system was estimated to be 448 ha. The weather station used was Wee Waa (George St) (station number 53044). The crop factor file used was “nthwst6ed.crp”, which was developed for the licence conversion process.
Groundwater extraction	No substaintial alluvial extractions indentified as impacting on streamflow.
Licence locations	Some of the licences have access to on-farm dams (see sections 'on-farm dam area factor' and 'on-farm dam available').

Table 72. Bundock Creek

Water source and model	Bundock Creek: model Wee Waa Creek	
Water source boundaries	The main stream is Wee Waa Creek with headwater streams flowing into it.	
Assumptions		**Confidence**
Flow sequence		Low
flows used	A measured flow sequence was used to represent the streamflow available to be extracted. This flow was measured at a gauging station from an adjacent catchement “Brigalow Creek at Tharlane” (419083). The flow sequence extends from 15/10/1993 to 20/01/2010, 16.3 years in total. There was no need to fill any gaps in the measured flow sequence.	
total area factor	The flow sequence was factored for area by 0.30.	
on-river dams area factor	No on-river dam simulated.	
on-farm dams area factor	No on-farm dams simulated.	
Water access		Low
level of entitlement	The total entitlement simulated was 513.5 ML made up of: 500 ML Unregulated category entitlement 13.5 ML Domestic and Stock category.	
access rules (CtP)	A CtP was not simulated.	
higher access rule (CtP on Approval)	No higher of access rules (CtP) were simulated.	
pump capacity	A pump capacity of 8.33 ML/day was available for irrigation and 0.04 ML/day was available for Stock and Domestic and LWU water extraction.	
on-river dam access	No on-river dams simulated.	
on-farm storage available	No on-farm storage simulated.	
Irrigation pattern		Moderate

Water source and model	Bundock Creek: model Wee Waa Creek
crop	The crop mix assumed is from the survey for a conversion of unregulated licences carried out in 2000. The crop survey result for Stressed Rivers Assessment unit “Bobbiwaa” (419_38) was used. This crop mix is represented by simulating the water demands of the following crops: • Cotton 86% • Lucerne 8% • Wheat 6%. The total area irrigated (based on the full development of the entitlement) in the Wee Waa Creek system was estimated to be 70 ha. The weather station used was Wee Waa (George St) (station number 53044). The crop factor file used was “nthwst6ed.crp”, which was developed for the licence conversion process.
Groundwater extraction	No substaintial alluvial extractions indentified as impacting on streamflow.
Licence locations	

Table 73. Brigalow Creek

Water source and model	Brigalow Creek: model Brigalow Creek	
Water source boundaries	The main stream is Brigalow Creek with headwater streams flowing into it.	
Assumptions		**Confidence**
Flow sequence		High
flows used	A measured flow sequence was used to represent the streamflow available to be extracted. This flow was measured at the gauging station "Brigalow Creek at Tharlane" (419083). The flow sequence extends from 15/10/1993 to 20/01/2010, 16.3 years in total. There was no need to fill any gaps in the measured flow sequence.	
total area factor	The flow sequence was factored for area by 1.00.	
on-river dams area factor	No on-river dam simulated.	
on-farm dams area factor	A proportion of the streamflow sequence (100% of the unfactored flow) is able to be accessed by pumps that can fill the on-farm dams.	
Water access		Low
level of entitlement	The total entitlement simulated was 1,257 ML made up of: • 1,243 ML Unregulated category entitlement • 14 ML Domestic and Stock category.	
access rules (CtP)	The CtP was simulated by placing a threshold (in a decision table) on the end of system flow below the pumps that fill on-farm storages of 4 ML/day.	
higher access rule (CtP on Approval)	No higher of access rules (CtP) were simulated.	
pump capacity	A pump capacity of 20.72 ML/day was available for irrigation and 0.04 ML/day was available for Stock and Domestic and LWU water extraction.	
on-river dam access	No on-river dams simulated.	
on-farm storage available	1,257 ML of on-farm storage capacity was simulated. 100% of the unregulated entitlement had access to on-farm dams. 100% of the Stock and Domestic and LWU entitlement had access to the on-farm dams.	
Irrigation pattern		High

Water source and model	Brigalow Creek: model Brigalow Creek
crop	The crop mix assumed is from the survey for a conversion of unregulated licences carried out in 2000. The crop survey result for Stressed Rivers Assessment unit “Brigalow Creek” (419_34) was used. This crop mix is represented by simulating the water demands of the following crops: • Cotton 5% • Lucerne 40% • Wheat 55%. The total area irrigated (based on the full development of the entitlement) in the Brigalow Creek system was estimated to be 269ha. The weather station used was Wee Waa (George St) (station number 53044). The crop factor file used was “nthwst6ed.crp”, which was developed for the licence conversion process.
Groundwater extraction	No substaintial alluvial extractions indentified as impacting on streamflow.
Licence locations	The CtP is triggered at a location below the majority of the pumps filling on-farm storages, hence it is simulated as if all pumps are above the trigger point. Some of the licences have access to on-farm dams (see sections 'on-farm dam area factor' and 'on-farm dam available').

Table 74. Coghill Creek

Water source and model	**Coghill Creek: model Coghill Creek**	
Water source boundaries	The main stream is Coghill Creek with headwater streams flowing into it. Part of the lower end of the water source has some small residual streams flowing into the trunk stream.	
Assumptions		**Confidence**
Flow sequence		Low
flows used	A measured flow sequence was used to represent the streamflow available to be extracted. This flow was measured at a gauging station from an adjacent catchement “Brigalow Creek at Tharlane” (419083). The flow sequence extends from 15/10/1993 to 20/01/2010, 16.3 years in total. There was no need to fill any gaps in the measured flow sequence.	
total area factor	The flow sequence was factored for area by 2.62.	
on-river dams area factor	No on-river dam simulated.	
on-farm dams area factor	A proportion of the streamflow sequence (262% of the unfactored flow) is able to be accessed by pumps that can fill the on-farm dams.	
Water access		Low
level of entitlement	The total entitlement simulated was 600 ML made up of: • 600 ML Unregulated category entitlement.	
access rules (CtP)	A CtP was not simulated.	
higher access rule (CtP on Approval)	No higher of access rules (CtP) were simulated.	
pump capacity	A pump capacity of 20.00 ML/day was available for irrigation and 0.00 ML/day was available for Stock and Domestic and LWU water extraction.	
on-river dam access	No on-river dams simulated.	
on-farm storage available	600 ML of on-farm storage capacity was simulated. 100% of the unregulated entitlement had access to on-farm dams. 100% of the Stock and Domestic and LWU entitlement had access to the on-farm dams.	
Irrigation pattern		Moderate

Water source and model	Coghill Creek: model Coghill Creek
crop	The crop mix assumed is from the survey for a conversion of unregulated licences carried out in 2000. The crop survey result for Stressed Rivers Assessment unit “Bobbiwaa” (419_38) was used. This crop mix is represented by simulating the water demands of the following crops: • Cotton 86% • Lucerne 8% • Wheat 6%. The total area irrigated (based on the full development of the entitlement) in the Coghill Creek system was estimated to be 84ha. The weather station used was Wee Waa (George St) (station number 53044). The crop factor file used was “nthwst6ed.crp”, which was developed for the licence conversion process.
Groundwater extraction	No substaintial alluvial extractions indentified as impacting on streamflow.
Licence locations	Some of the licences have access to on-farm dams (see sections 'on-farm dam area factor' and 'on-farm dam available').

Table 75. Etoo and Talluba Creeks

Water source and model	Etoo and Talluba Creeks: model Talluba Creek	
Water source boundaries	The main stream is Talluba Creek with headwater streams flowing into it. Part of the lower end of the water source has some anabranching channels associated with the regulated river.	
Assumptions		**Confidence**
Flow sequence		Low
flows used	A measured flow sequence was used to represent the streamflow available to be extracted. This flow was measured at a gauging station from an adjacent catchement “Brigalow Creek at Tharlane” (419083). The flow sequence extends from 15/10/1993 to 20/01/2010, 16.3 years in total. There was no need to fill any gaps in the measured flow sequence.	
total area factor	The flow sequence was factored for area by 1.80.	
on-river dams area factor	No on-river dam simulated.	
on-farm dams area factor	A proportion of the streamflow sequence (28% of the unfactored flow) is able to be accessed by pumps that can fill the on-farm dams.	
Water access		Low
level of entitlement	The total entitlement simulated was 120 ML made up of: • 115 ML Unregulated category entitlement • 5 ML Domestic and Stock category.	
access rules (CtP)	A CtP was not simulated.	
higher access rule (CtP on Approval)	No higher of access rules (CtP) were simulated.	
pump capacity	A pump capacity of 3.83 ML/day was available for irrigation and 0.01 ML/day was available for Stock and Domestic and LWU water extraction.	
on-river dam access	No on-river dams simulated.	
on-farm storage available	120 ML of on-farm storage capacity was simulated. 100% of the unregulated entitlement had access to on-farm dams. 100% of the Stock and Domestic and LWU entitlement had access to the on-farm dams.	
Irrigation pattern		Moderate

Water source and model	Etoo and Talluba Creeks: model Talluba Creek
crop	The crop mix assumed is from the survey for a conversion of unregulated licences carried out in 2000. The crop survey result for Stressed Rivers Assessment unit “Bobbiwaa” (419_38) was used. This crop mix is represented by simulating the water demands of the following crops: • Cotton 86% • Lucerne 8% • Wheat 6%. The total area irrigated (based on the full development of the entitlement) in the Talluba Creek system was estimated to be 13 ha. The weather station used was Cuttabri (Athlone) (station number 53094). The crop factor file used was “nthwst6ed.crp”, which was developed for the licence conversion process.
Groundwater extraction	No substaintial alluvial extractions indentified as impacting on streamflow.
Licence locations	Some of the licences have access to on-farm dams (see sections 'on-farm dam area factor' and 'on-farm dam available').

Table 76. Etoo and Talluba Creeks

Water source and model	Etoo and Talluba Creeks: model Etoo Creek	
Water source boundaries	The main stream is Etoo Creek with headwater streams flowing into it. Part of the lower end of the water source has some anabranching channels associated with the regulated river.	
Assumptions		**Confidence**
Flow sequence		Low
flows used	A measured flow sequence was used to represent the streamflow available to be extracted. This flow was measured at a gauging station from an adjacent catchement “Brigalow Creek at Tharlane” (419083). The flow sequence extends from 15/10/1993 to 20/01/2010, 16.3 years in total. There was no need to fill any gaps in the measured flow sequence.	
total area factor	The flow sequence was factored for area by 2.65.	
on-river dams area factor	No on-river dam simulated.	
on-farm dams area factor	No on-farm dams simulated.	
Water access		Low
level of entitlement	The total entitlement simulated was 785 ML made up of: • 778 ML Unregulated category entitlement • 7 ML Domestic and Stock category.	
access rules (CtP)	A CtP was not simulated.	
higher access rule (CtP on Approval)	No higher of access rules (CtP) were simulated.	
pump capacity	A pump capacity of 0.00 ML/day was available for irrigation and 0.02 ML/day was available for Stock and Domestic and LWU water extraction.	
on-river dam access	No on-river dams simulated.	
on-farm storage available	No on-farm storage simulated.	
Irrigation pattern		Moderate

Water source and model	Etoo and Talluba Creeks: model Etoo Creek
crop	The crop mix assumed is from the survey for a conversion of unregulated licences carried out in 2000. The crop survey result for Stressed Rivers Assessment unit “Bobbiwaa” (419_38) was used. This crop mix is represented by simulating the water demands of the following crops: • Cotton 86% • Lucerne 8% • Wheat 6%. The total area irrigated (based on the full development of the entitlement) in the Etoo Creek system was estimated to be 0 ha. The weather station used was Baradine Post Office (station number 53001). The crop factor file used was “nthwst6ed.crp”, which was developed for the licence conversion process.
Groundwater extraction	No substaintial alluvial extractions indentified as impacting on streamflow.
Licence locations	

Table 77. Baradine Creek

Water source and model	Baradine Creek: model Baradine Creek	
Water source boundaries	The main stream is Baradine Creek. The stream channel in this area anabraches and the flow is associated with the higher flow in the main river.	
Assumptions		**Confidence**
Flow sequence		Moderate
flows used	A rainfall runoff modeled flow sequence was used to represent the streamflow available to be extracted. This flow was based on the gauging station “Baradine Creek at Kienbri No.2” (419072). The flow sequence extends from 01/01/1887 to 30/06/1998, 111.5 years in total.	
total area factor	The flow sequence was factored for area by 1.76.	
on-river dams area factor	No on-river dam simulated.	
on-farm dams area factor	A proportion of the streamflow sequence (137% of the unfactored flow) is able to be accessed by pumps that can fill the on-farm dams.	
Water access		Low
level of entitlement	The total entitlement simulated was 288 ML made up of: • 276 ML Unregulated category entitlement • 12 ML Domestic and Stock category.	
access rules (CtP)	A CtP was not simulated.	
higher access rule (CtP on Approval)	No higher of access rules (CtP) were simulated.	
pump capacity	A pump capacity of 4.60 ML/day was available for irrigation and 0.03 ML/day was available for Stock and Domestic and LWU water extraction.	
on-river dam access	No on-river dams simulated.	
on-farm storage available	288 ML of on-farm storage capacity was simulated. 100% of the unregulated entitlement had access to on-farm dams. 100% of the Stock and Domestic and LWU entitlement had access to the on-farm dams.	
Irrigation pattern		High

Water source and model	Baradine Creek: model Baradine Creek
crop	The crop mix assumed is from the survey for a conversion of unregulated licences carried out in 2000. The crop survey result for Stressed Rivers Assessment unit “Baradine Creek” (419_13) was used. This crop mix is represented by simulating the water demands of the following crops: • Lucerne 94% • Wheat 6%. The total area irrigated (based on the full development of the entitlement) in the Baradine Creek system was estimated to be 40ha. The weather station used was Pilliga Post Office (station number 52023). The crop factor file used was “nthwst6ed.crp”, which was developed for the licence conversion process.
Groundwater extraction	No substaintial alluvial extractions indentified as impacting on streamflow.
Licence locations	Some of the licences have access to on-farm dams (see sections 'on-farm dam area factor' and 'on-farm dam available').

Castlereagh unregulated river models

Table 78. Castlereagh River above Binnaway

Water source and model	Castlereagh River above Binnaway: model Castlereagh River	
Water source boundaries	The main stream is the Castlereagh River (above Binnaway) with headwater streams flowing into it.	
Assumptions		**Confidence**
Flow sequence		Moderate
flows used	A measured flow sequence was used to represent the streamflow available to be extracted. This flow was measured at the gauging station "Castlereagh River at Binnaway" (420007). The flow sequence extends from 23/09/1965 to 04/09/1981, 15.9 years in total. 0.1% of the measured sequenced need to be filled using a correlation with a nearby gauging station.	
total area factor	The flow sequence was factored for area by 1.00.	
on-river dams area factor	No on-river dam simulated.	
on-farm dams area factor	No on-farm dams simulated.	
Water access		Low
level of entitlement	The total entitlement simulated was 5,722 ML made up of: • 4,745 ML Unregulated category entitlement • 18 ML Domestic and Stock category • 959 ML LWU category entitlement.	
access rules (CtP)	A CtP was not simulated.	
higher access rule (CtP on Approval)	No higher of access rules (CtP) were simulated.	
pump capacity	A pump capacity of 95.37 ML/day was available for irrigation and 0.00 ML/day was available for Stock and Domestic and LWU water extraction.	
on-river dam access	No on-river dams simulated.	
on-farm storage available	No on-farm storage simulated.	
Irrigation pattern		High

Water source and model	Castlereagh River above Binnaway: model Castlereagh River
crop	The crop mix assumed is from the survey for a conversion of unregulated licences carried out in 2000. The crop survey result for Stressed Rivers Assessment unit “Castlereagh above Binnaway” (420_21) was used. This crop mix is represented by simulating the water demands of the following crops: • Lucerne 64% • Orchard 4% • Perennial pasture 18% • Summer Maize 2% • Grapes 4% • Wheat 7%. The total area irrigated (based on the full development of the entitlement) in the Castlereagh River system was estimated to be 924ha. The weather station used was Coonabarabran (Namoi Street) (station number 64008). The crop factor file used was “cenwst6ed.crp”, which was developed for the licence conversion process.
Groundwater extraction	No substaintial alluvial extractions indentified as impacting on streamflow.
Licence locations	

Table 79. Binnaway to Gilgandra

Water source and model	Binnaway to Gilgandra: model Castlereagh River	
Water source boundaries	The main stream is the Castlereagh River (Binnaway to Gilgandra) downstream of other water sources that flow into it.	
Assumptions		**Confidence**
Flow sequence		Moderate
flows used	A rainfall runoff modeled flow sequence was used to represent the streamflow available to be extracted. This flow was based on the gauging station "Castlereagh River at Mendooran" (420004). The flow sequence extends from 01/01/1883 to 30/12/2002, 120.0 years in total.	
total area factor	The flow sequence was factored for area by 1.00.	
on-river dams area factor	No on-river dam simulated.	
on-farm dams area factor	No on-farm dams simulated.	
Water access		Low
level of entitlement	The total entitlement simulated was 13,701 ML made up of: • 12,493 ML Unregulated category entitlement • 74 ML Domestic and Stock category • 1,134 ML LWU category entitlement.	
access rules (CtP)	A CtP was not simulated.	
higher access rule (CtP on Approval)	No higher of access rules (CtP) were simulated.	
pump capacity	A pump capacity of 228.35 ML/day was available for irrigation and 0.00 ML/day was available for Stock and Domestic and LWU water extraction.	
on-river dam access	No on-river dams simulated.	
on-farm storage available	No on-farm storage simulated.	
Irrigation pattern		High

Water source and model	Binnaway to Gilgandra: model Castlereagh River
crop	The crop mix assumed is from the survey for a conversion of unregulated licences carried out in 2000. The crop survey result for Stressed Rivers Assessment unit “Castlereagh Binnaway Gilgandra” (420_22) was used. This crop mix is represented by simulating the water demands of the following crops: • Annual pasture 2% • Fababean 1% • Lucerne 60% • Orchard 1% • Perennial pasture 3% • Summer Maize 5% • Vegetables 13% • Wheat 15%. The total area irrigated (based on the full development of the entitlement) in the Castlereagh River system was estimated to be 2,239 ha. The weather station used was Neilrex (Caigan) (station number 64007). The crop factor file used was “cenwst6ed.crp”, which was developed for the licence conversion process.
Groundwater extraction	Alluvial groundwater is accessed in the vicinity of these unregulated streams which may also impact on streamflow but these were not simulated.
Licence locations	

Table 80. Castlereagh River Gilgandra to Coonamble

Water source and model	**Castlereagh River Gilgandra to Coonamble: model Castlereagh River**	
Water source boundaries	The main stream is the Castlereagh River (Gilgandra to Coonamble) downstream of other water sources that flow into it.	
Assumptions		**Confidence**
Flow sequence		Moderate
flows used	A rainfall runoff modeled flow sequence was used to represent the streamflow available to be extracted. This flow was based on the gauging station “Castlereagh River at Coonamble” (420005). The flow sequence extends from 01/01/1883 to 30/12/2002, 120.0 years in total.	
total area factor	The flow sequence was factored for area by 1.00.	
on-river dams area factor	No on-river dam simulated.	
on-farm dams area factor	No on-farm dams simulated.	
Water access		Low
level of entitlement	The total entitlement simulated was 18,637 ML made up of: • 15,713 ML Unregulated category entitlement • 194 ML Domestic and Stock category • 2,730 ML LWU category entitlement.	
access rules (CtP)	A CtP was not simulated.	
higher access rule (CtP on Approval)	No higher of access rules (CtP) were simulated.	
pump capacity	A pump capacity of 310.62 ML/day was available for irrigation and 0.00 ML/day was available for Stock and Domestic and LWU water extraction.	
on-river dam access	No on-river dams simulated.	
on-farm storage available	No on-farm storage simulated.	
Irrigation pattern		High

Water source and model	Castlereagh River Gilgandra to Coonamble: model Castlereagh River
crop	The crop mix assumed is from the survey for a conversion of unregulated licences carried out in 2000. The crop survey result for Stressed Rivers Assessment unit “Castlereagh River Gilgandra - Co” (420_25) was used. This crop mix is represented by simulating the water demands of the following crops: • Lucerne 80% • Summer Maize 3% • Vegetables 10% • Wheat 5%. The total area irrigated (based on the full development of the entitlement) in the Castlereagh River system was estimated to be 2,543 ha. The weather station used was Coonamble Comparison (station number 51010). The crop factor file used was “cenwst6ed.crp”, which was developed for the licence conversion process.
Groundwater extraction	Alluvial groundwater is accessed in the vicinity of these unregulated streams which may also impact on streamflow but these were not simulated.
Licence locations	

Table 81. Castlereagh River below Coonamble

Water source and model	**Castlereagh River below Coonamble: model Castlereagh River**	
Water source boundaries	The main stream is the Castlereagh River (below Coonamble) downstream of other water sources that flow into it.	
Assumptions		**Confidence**
Flow sequence		Moderate
flows used	A measured flow sequence was used to represent the streamflow available to be extracted. This flow was measured at the gauging station "Castlereagh River at Gungalman" (420020). The flow sequence extends from 31/05/2001 to 28/03/2011, 9.8 years in total. 9.7% of the measured sequenced need to be filled using a correlation with a nearby gauging station.	
total area factor	The flow sequence was factored for area by 1.00.	
on-river dams area factor	No on-river dam simulated.	
on-farm dams area factor	No on-farm dams simulated.	
Water access		Low
level of entitlement	The total entitlement simulated was 23,618 ML made up of: • 17,312 ML Unregulated category entitlement • 246 ML Domestic and Stock category • 2,730 ML LWU category entitlement.	
access rules (CtP)	A CtP was not simulated.	
higher access rule (CtP on Approval)	No higher of access rules (CtP) were simulated.	
pump capacity	A pump capacity of 81.13 ML/day was available for irrigation and 0.00 ML/day was available for Stock and Domestic and LWU water extraction.	
on-river dam access	No on-river dams simulated.	
on-farm storage available	No on-farm storage simulated.	
Irrigation pattern		High

Water source and model	Castlereagh River below Coonamble: model Castlereagh River
crop	The crop mix assumed is from the survey for a conversion of unregulated licences carried out in 2000. The crop survey result for Stressed Rivers Assessment unit “Castlereagh River Gilgandra - Co” (420_25) was used. This crop mix is represented by simulating the water demands of the following crops: • Lucerne 80% • Summer Maize 3% • Vegetables 10% • Wheat 5%. The total area irrigated (based on the full development of the entitlement) in the Castlereagh River system was estimated to be 664 ha. The weather station used was Walgett Council Depot (station number 52026). The crop factor file used was “nthwst6ed.crp”, which was developed for the licence conversion process.
Groundwater extraction	No substaintial alluvial extractions indentified as impacting on streamflow.
Licence locations	

Macquarie unregulated river models

Table 82. Bell River

Water source and model	Bell River: model Bell River	
Water source boundaries	The main stream is the Bell River downstream of other water sources that flow into it.	
Assumptions		**Confidence**
Flow sequence		High
flows used	A measured flow sequence was used to represent the streamflow available to be extracted. This flow was measured at the gauging station "Bell River at Newrea" (421018). The flow sequence extends from 01/08/1939 to 30/09/2009, 70.2 years in total. 1.4 percent of the measured sequenced need to be filled using a correlation with a nearby gauging station.	
total area factor	The flow sequence was factored for area by 1.16.	
on-river dams area factor	A proportion of the streamflow sequence (20% of the unfactored flow sequence) is able to be captured by on-river dams.	
on-farm dams area factor	No on-farm dams simulated.	
Water access		High
level of entitlement	The total entitlement simulated was 8,157 ML made up of: • 7,138 ML Unregulated category entitlement • 1,019 ML Domestic and Stock category.	
access rules (CtP)	A CtP was not simulated.	
higher access rule (CtP on Approval)	No higher of access rules (CtP) were simulated.	
pump capacity	A pump capacity of 205ML/day was available for irrigation and 4.5ML/day was available for Stock and Domestic and LWU water extraction.	
on-river dam access	100 ML of on-river dam capacity was simulated. 52% of the unregulated entitlement had access to on-river dams. 54% of the Stock and Domestic and LWU entitlement had access to the on-river dams.	
on-farm storage available	No on-farm storage simulated.	
Irrigation pattern		High

Water source and model	Bell River: model Bell River
crop	The crop mix assumed is from the survey for a conversion of unregulated licences carried out in 2000. The crop survey result for Stressed Rivers Assessment unit “Bell River” (421_15) was used. This crop mix is represented by simulating the water demands of the following crops: • Citrus 2% • Lucerne 68% • Orchard 6% • Perennial pasture 7% • Summer Maize 1% • Turf 1% • Mixed vegetable crops 8% • Wine Grapes 4% • Wheat 3%. The total area irrigated (based on the full development of the entitlement) in the Bell River system was estimated to be 2075ha. The weather station used was Cumnock (Willow Park) (station number 65011). The crop factor file used was “cenwst6ed.crp”, which was developed for the licence conversion process.
Groundwater extraction	No substaintial alluvial extractions indentified as impacting on streamflow.
Licence locations	Some of the licences have access to on-river dams (see sections 'on-river dam area factor' and 'on-river dam access').

Table 83. Burrendong Dam Tributaries

Water source and model	Burrendong Dam Tributaries: model Burrendong Dam	
Water source boundaries	The main waterbody is Burrendong Dam, which is part of the Regualted System, and it is the small stream that flow into it that make up the unregulated water source. The largest of the streams in the water source is Meroo Creek.	
Assumptions		**Confidence**
Flow sequence		Moderate
flows used	A rainfall runoff modeled flow sequence was used to represent the streamflow available to be extracted. This flow was based on the gauging station “Meroo Creek at Yarrabin No.2” (421073). The flow sequence extends from 01/01/1890 to 06/07/2009, 119.5 years in total.	
total area factor	The flow sequence was factored for area by 1.12.	
on-river dams area factor	A proportion of the streamflow sequence (1% of the unfactored flow sequence) is able to be captured by on-river dams.	
on-farm dams area factor	No on-farm dams simulated.	
Water access		High
level of entitlement	The total entitlement simulated was 584 ML made up of: • 572 ML Unregulated category entitlement • 12 ML Domestic and Stock category.	
access rules (CtP)	A CtP was not simulated.	
higher access rule (CtP on Approval)	No higher of access rules (CtP) were simulated.	
pump capacity	A pump capacity of 10 ML/day was available for irrigation and 0.03 ML/day was available for Stock and Domestic and LWU water extraction.	
on-river dam access	120 ML of on-river dam capacity was simulated. 43% of the unregulated entitlement had access to on-river dams. 100% of the Stock and Domestic and LWU entitlement had access to the on-river dams.	
on-farm storage available	No on-farm storage simulated.	
Irrigation pattern		High

Water source and model	Burrendong Dam Tributaries: model Burrendong Dam
crop	The crop mix assumed is from the survey for a conversion of unregulated licences carried out in 2000. The crop survey result for Stressed Rivers Assessment unit “Burrendong Dam Storage Tributaries” (421_10) was used. This crop mix is represented by simulating the water demands of the following crops: • Lucerne 92% • Orchard 8%. The total area irrigated (based on the full development of the entitlement) in the Burrendong Dam system was estimated to be 92ha. The weather station used was Hill End Post Office (station number 63035). The crop factor file used was “centab6ed.crp”, which was developed for the licence conversion process.
Groundwater extraction	No substaintial alluvial extractions indentified as impacting on streamflow.
Licence locations	Some of the licences have access to on-river dams (see sections 'on-river dam area factor' and 'on-river dam access').

Table 84. Campbells River

Water source and model	Campbells River: model Campbells River	
Water source boundaries	The main stream is the Campbells River with headwater streams flowing into it.	
Assumptions		**Confidence**
Flow sequence		High
flows used	A rainfall runoff modeled flow sequence was used to represent the streamflow available to be extracted. This flow was based on the gauging station “Campbells River upstream Ben Chifley Dam” (421101). The flow sequence extends from 01/01/1890 to 06/07/2009, 119.5 years in total.	
total area factor	The flow sequence was factored for area by 1.19.	
on-river dams area factor	No on-river dam simulated.	
on-farm dams area factor	No on-farm dams simulated.	
Water access		Moderate
level of entitlement	The total entitlement simulated was 2,106 ML made up of: 2,058 ML Unregulated category entitlement 48 ML Domestic and Stock category	
access rules (CtP)	A CtP was not simulated.	
higher access rule (CtP on Approval)	No higher of access rules (CtP) were simulated.	
pump capacity	A pump capacity of 34 ML/day was available for irrigation and 0.13 ML/day was available for Stock and Domestic and LWU water extraction.	
on-river dam access	No on-river dams simulated.	
on-farm storage available	No on-farm storage simulated.	
Irrigation pattern		High

Water source and model	Campbells River: model Campbells River
crop	The crop mix assumed is from the survey for a conversion of unregulated licences carried out in 2000. The crop survey result for Stressed Rivers Assessment unit “Campbells River” (421_01) was used. This crop mix is represented by simulating the water demands of the following crops: • Lucerne 61% • Perennial pasture 1% • Mixed vegetable crops 37% • Wine Grapes 1%. The total area irrigated (based on the full development of the entitlement) in the Campbells River system was estimated to be 468ha. The weather station used was O'connell (Stratford) (station number 63064). The crop factor file used was “centab6ed.crp”, which was developed for the licence conversion process.
Groundwater extraction	No substaintial alluvial extractions indentified as impacting on streamflow.
Licence locations	

Table 85. Coolbaggie Creek

Water source and model	Coolbaggie Creek: model Coolbaggie Creek	
Water source boundaries	The main stream is Coolbaggie Creek with headwater streams flowing into it. Part of the lower end of the water source has some small residual streams flowing into the trunk stream.	
Assumptions		**Confidence**
Flow sequence		High
flows used	A measured flow sequence was used to represent the streamflow available to be extracted. This flow was measured at the gauging station "Coolbaggie Creek at Rawsonville" (421055). The flow sequence extends from 01/02/1966 to 17/03/2009, 43.1 years in total. 4.8 percent of the measured sequenced need to be filled using a correlation with a nearby gauging station.	
total area factor	The flow sequence was factored for area by 1.00.	
on-river dams area factor	A proportion of the streamflow sequence (1% of the unfactored flow sequence) is able to be captured by on-river dams.	
on-farm dams area factor	No on-farm dams simulated.	
Water access		High
level of entitlement	The total entitlement simulated was 0 ML made up of: • 454 ML Unregulated category entitlement • 12 ML Domestic and Stock category.	
access rules (CtP)	A CtP was not simulated.	
higher access rule (CtP on Approval)	No higher of access rules (CtP) were simulated.	
pump capacity	A pump capacity of 8 ML/day was available for irrigation and 0.03 ML/day was available for Stock and Domestic and LWU water extraction.	
on-river dam access	116 ML of on-river dam capacity was simulated. 93% of the unregulated entitlement had access to on-river dams. 100% of the Stock and Domestic and LWU entitlement had access to the on-river dams.	
on-farm storage available	No on-farm storage simulated.	
Irrigation pattern		Moderate

Water source and model	Coolbaggie Creek: model Coolbaggie Creek
crop	The crop mix assumed is from the survey for a conversion of unregulated licences carried out in 2000. The crop survey result for Stressed Rivers Assessment unit “Maryvale-Geurie” (421_18) was used. This crop mix is represented by simulating the water demands of the following crops: • Canola 2% • Lucerne 33% • Summer Maize 11% • Mixed vegetable crops 2% • Wheat 52%. The total area irrigated (based on the full development of the entitlement) in the Coolbaggie Creek system was estimated to be 93 ha. The weather station used was Dubbo (Darling Street) (station number 65012). The crop factor file used was “cenwst6ed.crp”, which was developed for the licence conversion process.
Groundwater extraction	No substaintial alluvial extractions indentified as impacting on streamflow.
Licence locations	Some of the licences have access to on-river dams (see sections 'on-river dam area factor' and 'on-river dam access').

Table 86. Cooyal Wialdra Creek

Water source and model	Cooyal Wialdra Creek: model Wialdra Creek	
Water source boundaries	The main stream is Wialdra Creek with headwater streams flowing into it. Its main tributaries are Slapdash Creek and Cooyal Creek.	
Assumptions		**Confidence**
Flow sequence		High
flows used	A rainfall runoff modeled flow sequence was used to represent the streamflow available to be extracted. This flow was based on the gauging station “Wyaldra Creek at Gulgong” (421058). The flow sequence extends from 01/01/1882 to 07/07/2009, 127.5 years in total.	
total area factor	The flow sequence was factored for area by 1.00.	
on-river dams area factor	No on-river dam simulated.	
on-farm dams area factor	No on-farm dams simulated.	
Water access		High
level of entitlement	The total entitlement simulated was 18 ML made up of: 594 ML Unregulated category entitlement 147 ML Domestic and Stock category	
access rules (CtP)	A CtP was not simulated.	
higher access rule (CtP on Approval)	No higher of access rules (CtP) were simulated.	
pump capacity	A pump capacity of 12 ML/day was available for irrigation and 0. ML/day was available for Stock and Domestic and LWU water extraction.	
on-river dam access	No on-river dams simulated.	
on-farm storage available	No on-farm storage simulated.	
Irrigation pattern		High

Water source and model	Cooyal Wialdra Creek: model Wialdra Creek
crop	The crop mix assumed is from the survey for a conversion of unregulated licences carried out in 2000. The crop survey result for Stressed Rivers Assessment unit “Cooyal Wialdra Creek System” (421_13) was used. This crop mix is represented by simulating the water demands of the following crops: • Annual pasture 2% • Lucerne 65% • Orchard 1% • Perennial pasture 28% • Mixed vegetable crops 3% • Wheat 1%. The total area irrigated (based on the full development of the entitlement) in the Wialdra Creek system was estimated to be 128ha. The weather station used was Gulgong Post Office (station number 62013). The crop factor file used was “centab6ed.crp”, which was developed for the licence conversion process.
Groundwater extraction	No substaintial alluvial extractions indentified as impacting on streamflow.
Licence locations	

Table 87. Lawsons Creek

Water source and model	Lawsons Creek: model Lawsons Creek	
Water source boundaries	The main stream is Lawsons Creek with headwater streams flowing into it. Part of the lower end of the water source has some small residual streams flowing into the trunk stream.	
Assumptions		**Confidence**
Flow sequence		Moderate
flows used	A measured flow sequence was used to represent the streamflow available to be extracted. This flow was measured at the gauging station "Cudgegong River at Rylstone Bridge" (421038). The flow sequence extends from 01/03/1957 to 30/06/1980, 23.3 years in total. 0.6 percent of the measured sequenced need to be filled using a correlation with a nearby gauging station.	
total area factor	The flow sequence was factored for area by 0.85.	
on-river dams area factor	A proportion of the streamflow sequence (25% of the unfactored flow sequence) is able to be captured by on-river dams.	
on-farm dams area factor	No on-farm dams simulated.	
Water access		High
level of entitlement	The total entitlement simulated was 1,496 ML made up of: • 1,443 ML Unregulated category entitlement • 53 ML Domestic and Stock category.	
access rules (CtP)	A CtP was not simulated.	
higher access rule (CtP on Approval)	No higher of access rules (CtP) were simulated.	
pump capacity	A pump capacity of 24 ML/day was available for irrigation and 0.15 ML/day was available for Stock and Domestic and LWU water extraction.	
on-river dam access	184 ML of on-river dam capacity was simulated. 23% of the unregulated entitlement had access to on-river dams. 70% of the Stock and Domestic and LWU entitlement had access to the on-river dams.	
on-farm storage available	No on-farm storage simulated.	
Irrigation pattern		High

Water source and model	Lawsons Creek: model Lawsons Creek
crop	The crop mix assumed is from the survey for a conversion of unregulated licences carried out in 2000. The crop survey result for Stressed Rivers Assessment unit “Lawsons Creek” (421_09) was used. This crop mix is represented by simulating the water demands of the following crops: • Lucerne 81% • Perennial pasture 1% • Turf 1% • Wine Grapes 10% • Wheat 7%. The total area irrigated (based on the full development of the entitlement) in the Lawsons Creek system was estimated to be 264 ha. The weather station used was Rylstone (Ilford Rd) (station number 62026). The crop factor file used was “centab6ed.crp”, which was developed for the licence conversion process.
Groundwater extraction	No substaintial alluvial extractions indentified as impacting on streamflow.
Licence locations	Some of the licences have access to on-river dams (see sections 'on-river dam area factor' and 'on-river dam access').

Table 88. Little River

Water source and model	Little River: model Little River	
Water source boundaries	The main stream is the Little River with headwater streams flowing into it. Part of the lower end of the water source has some small residual streams flowing into the trunk stream.	
Assumptions		**Confidence**
Flow sequence		High
flows used	A rainfall runoff modeled flow sequence was used to represent the streamflow available to be extracted. This flow was based on the gauging station “Little River at Arthurville No. 2” (421176). The flow sequence extends from 01/01/1889 to 06/07/2009, 120.5 years in total.	
total area factor	The flow sequence was factored for area by 1.14.	
on-river dams area factor	A proportion of the streamflow sequence (6% of the unfactored flow sequence) is able to be captured by on-river dams.	
on-farm dams area factor	No on-farm dams simulated.	
Water access		Low
level of entitlement	The total entitlement simulated was 2,272 ML made up of: • 2,131 ML Unregulated category entitlement • 141 ML Domestic and Stock category.	
access rules (CtP)	A CtP was not simulated.	
higher access rule (CtP on Approval)	No higher of access rules (CtP) were simulated.	
pump capacity	A pump capacity of 36 ML/day was available for irrigation and 0.39 ML/day was available for Stock and Domestic and LWU water extraction.	
on-river dam access	58 ML of on-river dam capacity was simulated. 75% of the unregulated entitlement had access to on-river dams. 75% of the Stock and Domestic and LWU entitlement had access to the on-river dams.	xxx
on-farm storage available	No on-farm storage simulated.	
Irrigation pattern		High

Water source and model	Little River: model Little River
crop	The crop mix assumed is from the survey for a conversion of unregulated licences carried out in 2000. The crop survey result for Stressed Rivers Assessment unit “Little River” (421_17) was used. This crop mix is represented by simulating the water demands of the following crops: • Annual pasture 9% • Lucerne 45% • Perennial pasture 7% • Summer Maize 17% • Turf 4% • Wheat 18%. The total area irrigated (based on the full development of the entitlement) in the Little River system was estimated to be 364ha. The weather station used was Cumnock (Willow Park) (station number 65011). The crop factor file used was “cenwst6ed.crp”, which was developed for the licence conversion process.
Groundwater extraction	No substaintial alluvial extractions indentified as impacting on streamflow.
Licence locations	Some of the licences have access to on-river dams (see sections 'on-river dam area factor' and 'on-river dam access').

Table 89. Lower Talbragar River

Water source and model	Lower Talbragar River: model Lower Talbragar River	
Water source boundaries	The main stream is the Lower Talbragar River downstream of other water sources that flow into it. The inflowing water source is the Upper Talragar River water source.	
Assumptions		**Confidence**
Flow sequence		Low
flows used	A measured flow sequence was used to represent the streamflow available to be extracted. This flow was measured at the gauging station "Talbragar River at Emanon" (421163). The flow sequence extends from 31/12/1980 to 09/12/1997, 16.9 years in total. 10.5 percent of the measured sequenced need to be filled using a correlation with a nearby gauging station.	
total area factor	The flow sequence was factored for area by 1.00.	
on-river dams area factor	A proportion of the streamflow sequence (0% of the unfactored flow sequence) is able to be captured by on-river dams.	
on-farm dams area factor	No on-farm dams simulated.	
Water access		Moderate
level of entitlement	The total entitlement simulated was 2,251 ML made up of: • 2,227 ML Unregulated category entitlement • 24 ML Domestic and Stock category.	
access rules (CtP)	A CtP was not simulated.	
higher access rule (CtP on Approval)	No higher of access rules (CtP) were simulated.	
pump capacity	A pump capacity of 43 ML/day was available for irrigation and 0.08 ML/day was available for Stock and Domestic and LWU water extraction.	
on-river dam access	869 ML of on-river dam capacity was simulated. 71% of the unregulated entitlement had access to on-river dams. 0% of the Stock and Domestic and LWU entitlement had access to the on-river dams.	
on-farm storage available	No on-farm storage simulated.	
Irrigation pattern		High

Water source and model	Lower Talbragar River: model Lower Talbragar River
crop	The crop mix assumed is from the survey for a conversion of unregulated licences carried out in 2000. The crop survey result for Stressed Rivers Assessment unit “Lower Talbragar” (421_20) was used. This crop mix is represented by simulating the water demands of the following crops: • Lucerne 67% • Summer Maize 33%. The total area irrigated (based on the full development of the entitlement) in the Lower Talbragar River system was estimated to be 400 ha. The weather station used was Dunedoo Post Office (station number 64009). The crop factor file used was “cenwst6ed.crp”, which was developed for the licence conversion process.
Groundwater extraction	No substaintial alluvial extractions indentified as impacting on streamflow.
Licence locations	Some of the licences have access to on-river dams (see sections 'on-river dam area factor' and 'on-river dam access').

Table 90. Macquarie River above Burrendong

Water source and model	**Macquarie River above Burrendong: model Macquarie River above Burrendong**	
Water source boundaries	The main stream is the Macquarie River above Burrendong downstream of other water sources that flow into it.	
Assumptions		**Confidence**
Flow sequence		High
flows used	A rainfall runoff modeled flow sequence was used to represent the streamflow available to be extracted. This flow was based on the gauging station "Macquarie River at Dixons Long Point" (421080). The flow sequence extends from 01/01/1890 to 06/07/2009, 119.5 years in total.	
total area factor	The flow sequence was factored for area by 1.02.	
on-river dams area factor	A proportion of the streamflow sequence (8% of the unfactored flow sequence) is able to be captured by on-river dams.	
on-farm dams area factor	No on-farm dams simulated.	
Water access		Moderate
level of entitlement	The total entitlement simulated was 25,586 ML made up of: • 8,032 ML Unregulated category entitlement • 54 ML Domestic and Stock category • 17,500 ML LWU category entitlement.	
access rules (CtP)	A CtP was not simulated.	
higher access rule (CtP on Approval)	No higher of access rules (CtP) were simulated.	
pump capacity	A pump capacity of 314 ML/day was available for irrigation and 116.69 ML/day was available for Stock and Domestic and LWU water extraction.	
on-river dam access	22,628 ML of on-river dam capacity was simulated. 17% of the unregulated entitlement had access to on-river dams. 99% of the Stock and Domestic and LWU entitlement had access to the on-river dams.	
on-farm storage available	No on-farm storage simulated.	
Irrigation pattern		High

Water source and model	Macquarie River above Burrendong: model Macquarie River above Burrendong
crop	The crop mix assumed is from the survey for a conversion of unregulated licences carried out in 2000. The crop survey result for Stressed Rivers Assessment unit “Macquarie Above Burrendong” (421_04) was used. This crop mix is represented by simulating the water demands of the following crops: • Lucerne 35% • Orchard 1% • Perennial pasture 3% • Summer Maize 15% • Turf 2% • Mixed vegetable crops 33% • Wheat 11%. The total area irrigated (based on the full development of the entitlement) in the Macquarie River above Burrendong system was estimated to be 3,895 ha. The weather station used was Hill End Post Office (station number 63035). The crop factor file used was “centab6ed.crp”, which was developed for the licence conversion process.
Groundwater extraction	No substaintial alluvial extractions indentified as impacting on streamflow.
Licence locations	Some of the licences have access to on-river dams (see sections 'on-river dam area factor' and 'on-river dam access').

Table 91. Maryvale Geurie Creek

Water source and model	Maryvale Geurie Creek: model Maryvale and Geurie Creeks	
Water source boundaries	The main streams are Maryvale and Geurie Creeks, which flow into the regulated river.	
Assumptions		**Confidence**
Flow sequence		Low
flows used	A measured flow sequence was used to represent the streamflow available to be extracted. This flow was measured at the gauging station from an adjacent catchement "Coolbaggie Creek at Rawsonville" (421055). The flow sequence extends from 01/02/1966 to 17/03/2009, 43.1 years in total. 4.8 percent of the measured sequenced need to be filled using a correlation with a nearby gauging station.	
total area factor	The flow sequence was factored for area by 0.10.	
on-river dams area factor	No on-river dam simulated.	
on-farm dams area factor	No on-farm dams simulated.	
Water access		High
level of entitlement	The total entitlement simulated was 639 ML made up of: • 637 ML Unregulated category entitlement • 2 ML Domestic and Stock category.	
access rules (CtP)	A CtP was not simulated.	
higher access rule (CtP on Approval)	No higher of access rules (CtP) were simulated.	
pump capacity	A pump capacity of 11 ML/day was available for irrigation and 0.01 ML/day was available for Stock and Domestic and LWU water extraction.	
on-river dam access	No on-river dams simulated.	
on-farm storage available	No on-farm storage simulated.	
Irrigation pattern		High

Water source and model	Maryvale Geurie Creek: model Maryvale and Geurie Creeks
crop	The crop mix assumed is from the survey for a conversion of unregulated licences carried out in 2000. The crop survey result for Stressed Rivers Assessment unit “Maryvale-Geurie” (421_18) was used. This crop mix is represented by simulating the water demands of the following crops: • Canola 2% • Lucerne 33% • Summer Maize 11% • Mixed vegetable crops 2% • Wheat 52%. The total area irrigated (based on the full development of the entitlement) in the Maryvale and Geurie Creeks system was estimated to be 130 ha. The weather station used was Wellington Research Centre (station number 65035). The crop factor file used was “cenwst6ed.crp”, which was developed for the licence conversion process.
Groundwater extraction	No substaintial alluvial extractions indentified as impacting on streamflow.
Licence locations	

Table 92. Molong Creek

Water source and model	Molong Creek: model Molong Creek	
Water source boundaries	The main stream is Molong Creek with headwater streams flowing into it.	
Assumptions		**Confidence**
Flow sequence		Moderate
flows used	A measured flow sequence was used to represent the streamflow available to be extracted. This flow was measured at the gauging station "Molong River at Molong" (421049). The flow sequence extends from 13/07/1965 to 31/12/2005, 40.5 years in total. 54.3 percent of the measured sequenced need to be filled using a correlation with a nearby gauging station.	
total area factor	The flow sequence was factored for area by 1.42.	
on-river dams area factor	A proportion of the streamflow sequence (35% of the unfactored flow sequence) is able to be captured by on-river dams.	
on-farm dams area factor	No on-farm dams simulated.	
Water access		Low
level of entitlement	The total entitlement simulated was 5,802 ML made up of: • 5,178 ML Unregulated category entitlement • 624 ML Domestic and Stock category.	
access rules (CtP)	A CtP was not simulated.	
higher access rule (CtP on Approval)	No higher of access rules (CtP) were simulated.	
pump capacity	A pump capacity of 86 ML/day was available for irrigation and 1.71 ML/day was available for Stock and Domestic and LWU water extraction.	
on-river dam access	2,682 ML of on-river dam capacity was simulated. 92% of the unregulated entitlement had access to on-river dams. 100% of the Stock and Domestic and LWU entitlement had access to the on-river dams.	
on-farm storage available	No on-farm storage simulated.	
Irrigation pattern		High

Water source and model	Molong Creek: model Molong Creek
crop	The crop mix assumed is from the survey for a conversion of unregulated licences carried out in 2000. The crop survey result for Stressed Rivers Assessment unit “Molong Creek and Tributaries” (421_16) was used. This crop mix is represented by simulating the water demands of the following crops: • Citrus 1% • Lucerne 2% • Orchard 88% • Wine Grapes 9%. The total area irrigated (based on the full development of the entitlement) in the Molong Creek system was estimated to be 647ha. The weather station used was Molong (King St) (station number 65023). The crop factor file used was “centab6ed.crp”, which was developed for the licence conversion process.
Groundwater extraction	No substaintial alluvial extractions indentified as impacting on streamflow.
Licence locations	Some of the licences have access to on-river dams (see sections 'on-river dam area factor' and 'on-river dam access').

Table 93. Piambong Creek

Water source and model	Piambong Creek: model Piambong Creek	
Water source boundaries	The main stream is Piambong Creek, which flow into the regulated river.	
Assumptions		**Confidence**
Flow sequence		Low
flows used	A measured flow sequence was used to represent the streamflow available to be extracted. This flow was measured at the gauging station from an adjacent catchement "Meroo Creek at Yarrabin No.2" (421073). The flow sequence extends from 01/03/1968 to 25/01/1983, 14.9 years in total. 4.5 percent of the measured sequenced need to be filled using a correlation with a nearby gauging station.	
total area factor	The flow sequence was factored for area by 0.26.	
on-river dams area factor	A proportion of the streamflow sequence (4% of the unfactored flow sequence) is able to be captured by on-river dams.	
on-farm dams area factor	No on-farm dams simulated.	
Water access		Moderate
level of entitlement	The total entitlement simulated was 925 ML made up of: • 911 ML Unregulated category entitlement • 14 ML Domestic and Stock category.	
access rules (CtP)	A CtP was not simulated.	
higher access rule (CtP on Approval)	No higher of access rules (CtP) were simulated.	
pump capacity	A pump capacity of 15 ML/day was available for irrigation and 0.04 ML/day was available for Stock and Domestic and LWU water extraction.	
on-river dam access	60 ML of on-river dam capacity was simulated. 13% of the unregulated entitlement had access to on-river dams. 64% of the Stock and Domestic and LWU entitlement had access to the on-river dams.	
on-farm storage available	No on-farm storage simulated.	
Irrigation pattern		High

Water source and model	Piambong Creek: model Piambong Creek
crop	The crop mix assumed is from the survey for a conversion of unregulated licences carried out in 2000. The crop survey result for Stressed Rivers Assessment unit “Piambong Creek” (421_11) was used. This crop mix is represented by simulating the water demands of the following crops: • Lucerne 21% • Perennial pasture 40% • Summer Maize 4% • Wine Grapes 35%. The total area irrigated (based on the full development of the entitlement) in the Piambong Creek system was estimated to be 173 ha. The weather station used was Mudgee (George Street) (station number 62021). The crop factor file used was “centab6ed.crp”, which was developed for the licence conversion process.
Groundwater extraction	No substaintial alluvial extractions indentified as impacting on streamflow.
Licence locations	Some of the licences have access to on-river dams (see sections 'on-river dam area factor' and 'on-river dam access').

Table 94. Pipeclay Creek

Water source and model	Pipeclay Creek: model Pipeclay Creek	
Water source boundaries	The main stream is Pipeclay Creek, which flow into the regulated river.	
Assumptions		**Confidence**
Flow sequence		Low
flows used	A measured flow sequence was used to represent the streamflow available to be extracted. This flow was measured at the gauging station from an adjacent catchement "Wyaldra Creek at Gulgong" (421058). The flow sequence extends from 24/08/1966 to 27/01/1983, 16.4 years in total. 0.6 percent of the measured sequenced need to be filled using a correlation with a nearby gauging station.	
total area factor	The flow sequence was factored for area by 0.20.	
on-river dams area factor	A proportion of the streamflow sequence (4% of the unfactored flow sequence) is able to be captured by on-river dams.	
on-farm dams area factor	No on-farm dams simulated.	
Water access		High
level of entitlement	The total entitlement simulated was 446 ML made up of: • 418 ML Unregulated category entitlement • 28 ML Domestic and Stock category.	
access rules (CtP)	A CtP was not simulated.	
higher access rule (CtP on Approval)	No higher of access rules (CtP) were simulated.	
pump capacity	A pump capacity of 7 ML/day was available for irrigation and 0.08 ML/day was available for Stock and Domestic and LWU water extraction.	
on-river dam access	120 ML of on-river dam capacity was simulated. 82% of the unregulated entitlement had access to on-river dams. 82% of the Stock and Domestic and LWU entitlement had access to the on-river dams.	
on-farm storage available	No on-farm storage simulated.	
Irrigation pattern		High

Water source and model	Pipeclay Creek: model Pipeclay Creek
crop	The crop mix assumed is from the survey for a conversion of unregulated licences carried out in 2000. The crop survey result for Stressed Rivers Assessment unit “Pipeclay Creek” (421_12) was used. This crop mix is represented by simulating the water demands of the following crops: • Wine Grapes 100%. The total area irrigated (based on the full development of the entitlement) in the Pipeclay Creek system was estimated to be 139ha. The weather station used was Mudgee (George Street) (station number 62021). The crop factor file used was “centab6ed.crp”, which was developed for the licence conversion process.
Groundwater extraction	No substaintial alluvial extractions indentified as impacting on streamflow.
Licence locations	Some of the licences have access to on-river dams (see sections 'on-river dam area factor' and 'on-river dam access').

Table 95. Queen Charlottes Vale and Evans Plains Creek

Water source and model	**Queen Charlottes Vale and Evans Plains Creek: model Queen Charlottes Creek and Evans Plains Creek**	
Water source boundaries	The main streams are Queen Charlottes Creek and Evans Plains Creek with headwater streams flowing into it.	
Assumptions		**Confidence**
Flow sequence		Low
flows used	A rainfall runoff modeled flow sequence was used to represent the streamflow available to be extracted. This flow was based on the gauging station “Queen Charlottes Creek at Georges Plains” (421053). The flow sequence extends from 01/01/1890 to 06/07/2009, 119.5 years in total.	
total area factor	The flow sequence was factored for area by 3.27.	
on-river dams area factor	A proportion of the streamflow sequence (68% of the unfactored flow sequence) is able to be captured by on-river dams.	
on-farm dams area factor	No on-farm dams simulated.	
Water access		Moderate
level of entitlement	The total entitlement simulated was 1,935 ML made up of: • 1,889 ML Unregulated category entitlement • 46 ML Domestic and Stock category.	
access rules (CtP)	A CtP was not simulated.	
higher access rule (CtP on Approval)	No higher of access rules (CtP) were simulated.	
pump capacity	A pump capacity of 31 ML/day was available for irrigation and 0.13 ML/day was available for Stock and Domestic and LWU water extraction.	
on-river dam access	186 ML of on-river dam capacity was simulated. 18% of the unregulated entitlement had access to on-river dams. 87% of the Stock and Domestic and LWU entitlement had access to the on-river dams.	
on-farm storage available	No on-farm storage simulated.	
Irrigation pattern		High

Water source and model	Queen Charlottes Vale and Evans Plains Creek: model Queen Charlottes Creek and Evans Plains Creek
crop	The crop mix assumed is from the survey for a conversion of unregulated licences carried out in 2000. The crop survey result for Stressed Rivers Assessment unit “Queen Charlottes Vale Creek Evans Plains Creek” (421_03) was used. This crop mix is represented by simulating the water demands of the following crops: • Annual pasture 2% • Lucerne 65% • Perennial pasture 1% • Intensive perennial pasture 8% • Summer Maize 1% • Turf 3% • Mixed vegetable crops 14% • Wine Grapes 4% • Wheat 2%. The total area irrigated (based on the full development of the entitlement) in the Queen Charlottes Creek and Evans Plains Creek system was estimated to be 331 ha. The weather station used was Bathurst Agricultural Station (station number 63005). The crop factor file used was “centab6ed.crp”, which was developed for the licence conversion process.
Groundwater extraction	No substaintial alluvial extractions indentified as impacting on streamflow.
Licence locations	Some of the licences have access to on-river dams (see sections 'on-river dam area factor' and 'on-river dam access').

Table 96. Summerhill Creek

Water source and model	Summerhill Creek: model Lewis Ponds Creek	
Water source boundaries	The main stream is Lewis Ponds Creek with headwater streams flowing into it. The main tributary is Summerhill Creek.	
Assumptions		**Confidence**
Flow sequence		High
flows used	A rainfall runoff modeled flow sequence was used to represent the streamflow available to be extracted. This flow was based on the gauging station “Lewis Ponds Creek at Ophir” (421052). The flow sequence extends from 01/01/1889 to 06/07/2009, 120.5 years in total.	
total area factor	The flow sequence was factored for area by 1.36.	
on-river dams area factor	A proportion of the streamflow sequence (39% of the unfactored flow sequence) is able to be captured by on-river dams.	
on-farm dams area factor	No on-farm dams simulated.	
Water access		Moderate
level of entitlement	The total entitlement simulated was 11,765 ML made up of: • 3,796 ML Unregulated category entitlement • 169 ML Domestic and Stock category • 7,800 ML LWU category entitlement.	
access rules (CtP)	A CtP was not simulated.	
higher access rule (CtP on Approval)	No higher of access rules (CtP) were simulated.	
pump capacity	A pump capacity of 63 ML/day was available for irrigation and 21.83 ML/day was available for Stock and Domestic and LWU water extraction.	
on-river dam access	1,159 ML of on-river dam capacity was simulated. 59% of the unregulated entitlement had access to on-river dams. 99% of the Stock and Domestic and LWU entitlement had access to the on-river dams.	
on-farm storage available	No on-farm storage simulated.	
Irrigation pattern		High

Water source and model	Summerhill Creek: model Lewis Ponds Creek
crop	The crop mix assumed is from the survey for a conversion of unregulated licences carried out in 2000. The crop survey result for Stressed Rivers Assessment unit “Summerhill Creek” (421_07) was used. This crop mix is represented by simulating the water demands of the following crops: • Annual pasture 6% • Lucerne 3% • Orchard 83% • Perennial pasture 4% • Mixed vegetable crops 4%. The total area irrigated (based on the full development of the entitlement) in the Lewis Ponds Creek system was estimated to be 671 ha. The weather station used was Orange (Mclaughlin St) (station number 63066). The crop factor file used was “centab6ed.crp”, which was developed for the licence conversion process.
Groundwater extraction	No substaintial alluvial extractions indentified as impacting on streamflow.
Licence locations	Some of the licences have access to on-river dams (see sections 'on-river dam area factor' and 'on-river dam access').

Table 97. Turon Crudine River

Water source and model	**Turon Crudine River: model Turon River and its tributary the Crudine River**	
Water source boundaries	The main streams are Turon River and its tributary the Crudine River with headwater streams flowing into it.	
Assumptions		**Confidence**
Flow sequence		Moderate
flows used	A measured flow sequence was used to represent the streamflow available to be extracted. This flow was measured at the gauging station "Turon River at Sofala" (421026). The flow sequence extends from 10/09/1947 to 26/05/2009, 61.7 years in total. 3.3 percent of the measured sequenced need to be filled using a correlation with a nearby gauging station.	
total area factor	The flow sequence was factored for area by 1.79.	
on-river dams area factor	No on-river dam simulated.	
on-farm dams area factor	No on-farm dams simulated.	
Water access		High
level of entitlement	The total entitlement simulated was 328 ML made up of: • 316 ML Unregulated category entitlement • 12 ML Domestic and Stock category.	
access rules (CtP)	A CtP was not simulated.	
higher access rule (CtP on Approval)	No higher of access rules (CtP) were simulated.	
pump capacity	A pump capacity of 5ML/day was available for irrigation and 0.03ML/day was available for Stock and Domestic and LWU water extraction.	
on-river dam access	No on-river dams simulated.	
on-farm storage available	No on-farm storage simulated.	
Irrigation pattern		High

Water source and model	Turon Crudine River: model Turon River and its tributary the Crudine River
crop	The crop mix assumed is from the survey for a conversion of unregulated licences carried out in 2000. The crop survey result for Stressed Rivers Assessment unit “Turon Crudine River” (421_06) was used. This crop mix is represented by simulating the water demands of the following crops: • Lucerne 73% • Mixed vegetable crops 2% • Wine Grapes 25%. The total area irrigated (based on the full development of the entitlement) in the Turon River and its tributary the Crudine River system was estimated to be 61ha. The weather station used was Sofala Old Post Office (station number 63076). The crop factor file used was “centab6ed.crp”, which was developed for the licence conversion process.
Groundwater extraction	No substaintial alluvial extractions indentified as impacting on streamflow.
Licence locations	

Table 98. Upper Bogan River

Water source and model	Upper Bogan River: model Bogan River	
Water source boundaries	The main stream is the Bogan River with headwater streams flowing into it. The end of this water sources is only half way along the river.	
Assumptions		**Confidence**
Flow sequence		Moderate
flows used	A measured flow sequence was used to represent the streamflow available to be extracted. This flow was measured at the gauging station "Bogan River at Dandaloo" (421083). The flow sequence extends from 01/12/1971 to 23/10/2008, 36.9 years in total. 30.5 percent of the measured sequenced need to be filled using a correlation with a nearby gauging station.	
total area factor	The flow sequence was factored for area by 1.31.	
on-river dams area factor	A proportion of the streamflow sequence (21% of the unfactored flow sequence) is able to be captured by on-river dams.	
on-farm dams area factor	No on-farm dams simulated.	
Water access		Moderate
level of entitlement	The total entitlement simulated was 1,735 ML made up of: • 1,463 ML Unregulated category entitlement • 90 ML Domestic and Stock category • 182 high flowML LWU category entitlement.	
access rules (CtP)	A CtP was not simulated.	
higher access rule (CtP on Approval)	No higher of access rules (CtP) were simulated.	
pump capacity	A pump capacity of 24 ML/day was available for irrigation and 0.25 ML/day was available for Stock and Domestic and LWU water extraction.	
on-river dam access	264 ML of on-river dam capacity was simulated. 53% of the unregulated entitlement had access to on-river dams. 69% of the Stock and Domestic and LWU entitlement had access to the on-river dams.	
on-farm storage available	No on-farm storage simulated.	
Irrigation pattern		High

Water source and model	Upper Bogan River: model Bogan River
crop	The crop mix assumed is from the survey for a conversion of unregulated licences carried out in 2000. The crop survey result for Stressed Rivers Assessment unit “Upper Bogan River Catchment” (421_25) was used. This crop mix is represented by simulating the water demands of the following crops: • Annual pasture 2% • Fababean 5% • Lucerne 38% • Perennial pasture 2% • Soybeans 14% • Summer Maize 10% • Wheat 29%. The total area irrigated (based on the full development of the entitlement) in the Bogan River system was estimated to be 272ha. The weather station used was Goolma (Brooklyn) (station number 62028). The crop factor file used was “cenwst6ed.crp”, which was developed for the licence conversion process.
Groundwater extraction	No substaintial alluvial extractions indentified as impacting on streamflow.
Licence locations	Some of the licences have access to on-river dams (see sections 'on-river dam area factor' and 'on-river dam access').

Table 99. Upper Cudgegong River

Water source and model	Upper Cudgegong River: model Cudgegong River	
Water source boundaries	The main stream is the Cudgegong River with headwater streams flowing into it. It provides the major inflows to Windanere Dam.	
Assumptions		**Confidence**
Flow sequence		High
flows used	A measured flow sequence was used to represent the streamflow available to be extracted. This flow was measured at the gauging station "Cudgegong River at Rylstone Bridge" (421038). The flow sequence extends from 01/03/1957 to 30/06/1980, 23.3 years in total. 0.6 percent of the measured sequenced need to be filled using a correlation with a nearby gauging station.	
total area factor	The flow sequence was factored for area by 1.34.	
on-river dams area factor	A proportion of the streamflow sequence (73% of the unfactored flow sequence) is able to be captured by on-river dams.	
on-farm dams area factor	No on-farm dams simulated.	
Water access		Moderate
level of entitlement	The total entitlement simulated was 6,451.5 ML made up of: • 3,882 ML Unregulated category entitlement • 69.5 ML Domestic and Stock category • 2,500 ML LWU category entitlement.	
access rules (CtP)	A CtP was not simulated.	
higher access rule (CtP on Approval)	No higher of access rules (CtP) were simulated.	
pump capacity	A pump capacity of 65 ML/day was available for irrigation and 7.04 ML/day was available for Stock and Domestic and LWU water extraction.	
on-river dam access	1,758 ML of on-river dam capacity was simulated. 25% of the unregulated entitlement had access to on-river dams. 99% of the Stock and Domestic and LWU entitlement had access to the on-river dams.	
on-farm storage available	No on-farm storage simulated.	
Irrigation pattern		High

Water source and model	Upper Cudgegong River: model Cudgegong River
crop	The crop mix assumed is from the survey for a conversion of unregulated licences carried out in 2000. The crop survey result for Stressed Rivers Assessment unit “Upper Cudgegong River above Windamere” (421_08) was used. This crop mix is represented by simulating the water demands of the following crops: • Annual pasture 5% • Lucerne 63% • Perennial pasture 30% • Wine Grapes 1% • Wheat 1%. The total area irrigated (based on the full development of the entitlement) in the Cudgegong River system was estimated to be 715 ha. The weather station used was Rylstone (Ilford Rd) (station number 62026). The crop factor file used was “centab6ed.crp”, which was developed for the licence conversion process.
Groundwater extraction	No substaintial alluvial extractions indentified as impacting on streamflow.
Licence locations	Some of the licences have access to on-river dams (see sections 'on-river dam area factor' and 'on-river dam access').

Table 100. Upper Cudgegong River

Water source and model	Upper Cudgegong River: model Cudgegong River	
Water source boundaries	The main stream is the Cudgegong River with headwater streams flowing into it. It provides the major inflows to Windanere Dam.	
Assumptions		**Confidence**
Flow sequence		Moderate
flows used	A back calcuated flow sequence was used to represent the streamflow available to be extracted. This flow was based on a nearby gauging station used to simulate the "Windermere Dam inflow". The flow sequence extends from 01/01/1890 to 08/07/2014, 124.5 years in total.	
total area factor	The flow sequence was factored for area by 1.00.	
on-river dams area factor	A proportion of the streamflow sequence (55% of the unfactored flow sequence) is able to be captured by on-river dams.	
on-farm dams area factor	No on-farm dams simulated.	
Water access		Moderate
level of entitlement	The total entitlement simulated was 6,451.5ML made up of: • 3,882 ML Unregulated category entitlement • 69.5 ML Domestic and Stock category • 2,500 ML LWU category entitlement.	
access rules (CtP)	A CtP was not simulated.	
higher access rule (CtP on Approval)	No higher of access rules (CtP) were simulated.	
pump capacity	A pump capacity of 65 ML/day was available for irrigation and 7.04 ML/day was available for Stock and Domestic and LWU water extraction.	
on-river dam access	1,758 ML of on-river dam capacity was simulated. 25% of the unregulated entitlement had access to on-river dams. 73% of the Stock and Domestic and LWU entitlement had access to the on-river dams.	
on-farm storage available	No on-farm storage simulated.	
Irrigation pattern		High

Water source and model	Upper Cudgegong River: model Cudgegong River
crop	The crop mix assumed is from the survey for a conversion of unregulated licences carried out in 2000. The crop survey result for Stressed Rivers Assessment unit “Upper Cudgegong River above Windamere” (421_08) was used. This crop mix is represented by simulating the water demands of the following crops: • Annual pasture 5% • Lucerne 63% • Perennial pasture 30% • Wine Grapes 1% • Wheat 1%. The total area irrigated (based on the full development of the entitlement) in the Cudgegong River system was estimated to be 715 ha. The weather station used was Rylstone (Ilford Rd) (station number 62026). The crop factor file used was “centab6ed.crp”, which was developed for the licence conversion process.
Groundwater extraction	No substaintial alluvial extractions indentified as impacting on streamflow.
Licence locations	Some of the licences have access to on-river dams (see sections 'on-river dam area factor' and 'on-river dam access').

Table 101. Upper Talbragar River

Water source and model	Upper Talbragar River: model Talbragar River	
Water source boundaries	The main stream is the Talbragar River with headwater streams flowing into it. The end of this water sources is only half way along the river.	
Assumptions		**Confidence**
Flow sequence		Low
flows used	A measured flow sequence was used to represent the streamflow available to be extracted. This flow was measured at the gauging station "Coolaburragundy River at Coolah" (421056). The flow sequence extends from 26/11/1980 to 04/08/1999, 18.7 years in total. 3.8 percent of the measured sequenced need to be filled using a correlation with a nearby gauging station.	
total area factor	The flow sequence was factored for area by 8.09.	
on-river dams area factor	No on-river dam simulated.	
on-farm dams area factor	No on-farm dams simulated.	
Water access		High
level of entitlement	The total entitlement simulated was 376 ML made up of: • 370 ML Unregulated category entitlement • 6 ML Domestic and Stock category	
access rules (CtP)	A CtP was not simulated.	
higher access rule (CtP on Approval)	No higher of access rules (CtP) were simulated.	
pump capacity	A pump capacity of 6 ML/day was available for irrigation and 0.02 ML/day was available for Stock and Domestic and LWU water extraction.	
on-river dam access	No on-river dams simulated.	
on-farm storage available	No on-farm storage simulated.	
Irrigation pattern		High

Water source and model	Upper Talbragar River: model Talbragar River
crop	The crop mix assumed is from the survey for a conversion of unregulated licences carried out in 2000. The crop survey result for Stressed Rivers Assessment unit “Upper Talbragar River Coolaburragundy River” (421_19) was used. This crop mix is represented by simulating the water demands of the following crops: • Lucerne 100% The total area irrigated (based on the full development of the entitlement) in the Talbragar River system was estimated to be 62ha. The weather station used was Coolah (Binnia St) (station number 64025). The crop factor file used was “centab6ed.crp”, which was developed for the licence conversion process.
Groundwater extraction	No substaintial alluvial extractions indentified as impacting on streamflow.
Licence locations	

Table 102. Upper Talbragar River

Water source and model	Upper Talbragar River: model Talbragar River	
Water source boundaries	The main stream is the Talbragar River with headwater streams flowing into it. The end of this water sources is only half way along the river.	
Assumptions		**Confidence**
Flow sequence		Moderate
flows used	A rainfall runoff modeled flow sequence was used to represent the streamflow available to be extracted. This flow was based on the gauging station "Talbragar River at Elong Elong" (421042). The flow sequence extends from 01/01/1886 to 06/07/2009, 123.5 years in total.	
total area factor	The flow sequence was factored for area by 0.55.	
on-river dams area factor	No on-river dam simulated.	
on-farm dams area factor	No on-farm dams simulated.	
Water access		High
level of entitlement	The total entitlement simulated was 376 ML made up of: • 370 ML Unregulated category entitlement • 6 ML Domestic and Stock category.	
access rules (CtP)	A CtP was not simulated.	
higher access rule (CtP on Approval)	No higher of access rules (CtP) were simulated.	
pump capacity	A pump capacity of 6ML/day was available for irrigation and 0.02ML/day was available for Stock and Domestic and LWU water extraction.	
on-river dam access	No on-river dams simulated.	
on-farm storage available	No on-farm storage simulated.	
Irrigation pattern		High

Water source and model	Upper Talbragar River: model Talbragar River
crop	The crop mix assumed is from the survey for a conversion of unregulated licences carried out in 2000. The crop survey result for Stressed Rivers Assessment unit “Upper Talbragar River Coolaburragundy River” (421_19) was used. This crop mix is represented by simulating the water demands of the following crops: • Lucerne 100% The total area irrigated (based on the full development of the entitlement) in the Talbragar River system was estimated to be 62ha. The weather station used was Coolah (Binnia St) (station number 64025). The crop factor file used was “centab6ed.crp”, which was developed for the licence conversion process.
Groundwater extraction	No substaintial alluvial extractions indentified as impacting on streamflow.
Licence locations	

Table 103. Wambangalong and Whylandra Creeks

Water source and model	Wambangalong and Whylandra Creeks: model Wambangalong and Whylandra Creeks	
Water source boundaries	The main streams are Wambangalong and Whylandra Creeks, which flow into the regulated river.	
Assumptions		**Confidence**
Flow sequence		Low
flows used	A measured flow sequence was used to represent the streamflow available to be extracted. This flow was measured at the gauging station from an adjacent catchement "Coolbaggie Creek at Rawsonville" (421055). The flow sequence extends from 01/02/1966 to 17/03/2009, 43.1 years in total. 4.8 percent of the measured sequenced need to be filled using a correlation with a nearby gauging station.	
total area factor	The flow sequence was factored for area by 0.09.	check
on-river dams area factor	No on-river dam simulated.	
on-farm dams area factor	No on-farm dams simulated.	
Water access		High
level of entitlement	The total entitlement simulated was 169 ML made up of: • 141 ML Unregulated category entitlement • 28 ML Domestic and Stock category	
access rules (CtP)	A CtP was not simulated.	
higher access rule (CtP on Approval)	No higher of access rules (CtP) were simulated.	
pump capacity	A pump capacity of 2 ML/day was available for irrigation and 0.08 ML/day was available for Stock and Domestic and LWU water extraction.	
on-river dam access	No on-river dams simulated.	
on-farm storage available	No on-farm storage simulated.	
Irrigation pattern		High

Water source and model	Wambangalong and Whylandra Creeks: model Wambangalong and Whylandra Creeks
crop	The crop mix assumed is from the survey for a conversion of unregulated licences carried out in 2000. The crop survey result for Stressed Rivers Assessment unit “Wambangalong - Whylandra system” (421_23) was used. This crop mix is represented by simulating the water demands of the following crops: • Lucerne 35% • Perennial pasture 38% • Wine Grapes 15% • Wheat 12% The total area irrigated (based on the full development of the entitlement) in the Wambangalong and Whylandra Creeks system was estimated to be 25ha. The weather station used was Dubbo (Mentone) (station number 65030). The crop factor file used was “cenwst6ed.crp”, which was developed for the licence conversion process.
Groundwater extraction	No substaintial alluvial extractions indentified as impacting on streamflow.
Licence locations	

Table 104. Winburndale Rivulet

Water source and model	Winburndale Rivulet: model Winburndale Rivulet	
Water source boundaries	The main waterbody is Winburndale Rivulet with headwater streams flowing into it.	
Assumptions		**Confidence**
Flow sequence		High
flows used	A rainfall runoff modeled flow sequence was used to represent the streamflow available to be extracted. This flow was based on the gauging station "Winburndale Rivulet at Howards Bridge" (421072). The flow sequence extends from 01/01/1890 to 06/07/2009, 119.5 years in total.	
total area factor	The flow sequence was factored for area by 1.01.	
on-river dams area factor	A proportion of the streamflow sequence (14% of the unfactored flow sequence) is able to be captured by on-river dams.	
on-farm dams area factor	No on-farm dams simulated.	
Water access		Moderate
level of entitlement	The total entitlement simulated was 1,635 ML made up of: • 592 ML Unregulated category entitlement • 1,043 ML Domestic and Stock category	
access rules (CtP)	A CtP was not simulated.	
higher access rule (CtP on Approval)	No higher of access rules (CtP) were simulated.	
pump capacity	A pump capacity of 10 ML/day was available for irrigation and 2.86 ML/day was available for Stock and Domestic and LWU water extraction.	
on-river dam access	695 ML of on-river dam capacity was simulated. 61% of the unregulated entitlement had access to on-river dams. 98% of the Stock and Domestic and LWU entitlement had access to the on-river dams.	
on-farm storage available	No on-farm storage simulated.	
Irrigation pattern		High

Water source and model	Winburndale Rivulet: model Winburndale Rivulet
crop	The crop mix assumed is from the survey for a conversion of unregulated licences carried out in 2000. The crop survey result for Stressed Rivers Assessment unit “Winburndale Rivulet” (421_05) was used. This crop mix is represented by simulating the water demands of the following crops: • Citrus 3% • Lucerne 93% • Orchard 2% • Perennial pasture 2% The total area irrigated (based on the full development of the entitlement) in the Winburndale Rivulet system was estimated to be 102ha. The weather station used was Bathurst Agricultural Station (station number 63005). The crop factor file used was “centab6ed.crp”, which was developed for the licence conversion process.
Groundwater extraction	No substaintial alluvial extractions indentified as impacting on streamflow.
Licence locations	Some of the licences have access to on-river dams (see sections 'on-river dam area factor' and 'on-river dam access').

Table 105. Bulbodney Grahway Creek

Water source and model	Bulbodney Grahway Creek: model Bogan River	
Water source boundaries	The main stream is the Bogan River downstream of other water sources that flow into it.	
Assumptions		**Confidence**
Flow sequence		Moderate
flows used	A measured flow sequence was used to represent the streamflow available to be extracted. This flow was measured at the gauging station "Bogan River at Nyngan" (421138). The flow sequence extends from 08/06/1993 to 07/09/2009, 16.2 years in total. 5.2 percent of the measured sequenced need to be filled using a correlation with a nearby gauging station.	
total area factor	The flow sequence was factored for area by 1.00.	
on-river **dams area factor**	A proportion of the streamflow sequence (7% of the unfactored flow sequence) is able to be captured by on-river dams.	
on-farm **dams area factor**	No on-farm dams simulated.	
Water access		Low
level of entitlement	The total entitlement simulated was 10,335 ML made up of: • 6,725 ML Unregulated category entitlement • 1,398 ML Domestic and Stock category • 2,212 high flowML LWU category entitlement	
access rules (CtP)	A CtP was not simulated.	
higher access rule (CtP on Approval)	No higher of access rules (CtP) were simulated.	
pump capacity	A pump capacity of 140 ML/day was available for irrigation and 4.08 ML/day was available for Stock and Domestic and LWU water extraction.	
on-river dam access	264 ML of on-river dam capacity was simulated. 7% of the unregulated entitlement had access to on-river dams. 0% of the Stock and Domestic and LWU entitlement had access to the on-river dams.	
on-farm storage available	No on-farm storage simulated.	

Water source and model	Bulbodney Grahway Creek: model Bogan River	
Irrigation pattern		High
crop	The crop mix assumed is from the survey for a conversion of unregulated licences carried out in 2000. The crop survey result for Stressed Rivers Assessment unit “Bulbodney - Grahway Creek System” (421_26) was used. This crop mix is represented by simulating the water demands of the following crops: • Canola 8% • Fababean 3% • Lucerne 41% • Soybeans 14% • Wheat 34% The total area irrigated (based on the full development of the entitlement) in the Bogan River system was estimated to be 1684ha. The weather station used was Tottenham (Burdenda) (station number 50011). The crop factor file used was “cenwst6ed.crp”, which was developed for the licence conversion process.	
Groundwater extraction	No substaintial alluvial extractions indentified as impacting on streamflow.	
Licence locations	Some of the licences have access to on-river dams (see sections 'on-river dam area factor' and 'on-river dam access').	

Lachlan unregulated river models

Table 106. Lachlan River above Reids Flat

Water source and model	Lachlan River above Reids Flat: model Lachlan River (upstream of Wyangala Dam)	
Water source boundaries	The main stream is the Lachlan River (upstream of Wyangala Dam) downstream of other water sources that flow into it.	
Assumptions		**Confidence**
Flow sequence		High
flows used	A measured flow sequence was used to represent the streamflow available to be extracted. This flow was measured at the gauging station "Lachlan River at Reids Flat" (412027). The flow sequence extends from 01/12/1930 to 30/10/1967, 36.9 years in total. 0.4% of the measured sequenced need to be filled using a correlation with a nearby gauging station.	
total area factor	The flow sequence was factored for area by 1.03.	
on-river dams area factor	A proportion of the streamflow sequence (5% of the unfactored flow sequence) is able to be captured by on-river dams.	
on-farm dams area factor	No on-farm dams simulated.	
Water access		Moderate
level of entitlement	The total entitlement simulated was 2,016.5 ML made up of: • 1,872 ML Unregulated category entitlement • 34.5 ML Domestic and Stock category • 110 ML LWU category entitlement	
access rules (CtP)	The CtP was simulated by placing a threshold on the irriration pumps of 2ML/day, which simulated a CtP at the end of the system.	
higher access rule (CtP on Approval)	No higher of access rules (CtP) were simulated.	
pump capacity	A pump capacity of 52.02 ML/day was available for irrigation and 1.51 ML/day was available for Stock and Domestic and LWU water extraction.	
on-river dam access	1,373 ML of on-river dam capacity was simulated. 22% of the unregulated entitlement had access to on-river dams. 97% of the Stock and Domestic and LWU entitlement had access to the on-river dams.	

Water source and model	Lachlan River above Reids Flat: model Lachlan River (upstream of Wyangala Dam)	
on-farm storage available	No on-farm storage simulated.	
Irrigation pattern		High
crop	The crop mix assumed is from the survey for a conversion of unregulated licences carried out in 2000. The crop survey result for Stressed Rivers Assessment unit “Lachlan River above Reid's Flat” (412_01) was used. This crop mix is represented by simulating the water demands of the following crops: • Annual pasture 5% • Lucerne 14% • Perennial pasture 33% • Summer Maize 12% • Vegetables 12% • Wheat 24% The total area irrigated (based on the full development of the entitlement) in the Lachlan River (upstream of Wyangala Dam) system was estimated to be 715ha. The weather station used was Gunning Rural Supplies (station number 70043). The crop factor file used was “sthtab6ed.crp”, which was developed for the licence conversion process.	
Groundwater extraction	No substaintial alluvial extractions indentified as impacting on streamflow.	
Licence locations	The CtP is triggered at a location below the majority of the irrigation pumps, hence it is simulated as if all pumps are above the trigger point. Some of the licences have access to on-river dams (see sections 'on-river dam area factor' and 'on-river dam access').	

Table 107. Crookwell River

Water source and model	Crookwell River: model Crookwell River	
Water source boundaries	The main stream is the Crookwell River with headwater streams flowing into it.	
Assumptions		**Confidence**
Flow sequence		High
flows used	A measured flow sequence was used to represent the streamflow available to be extracted. This flow was measured at the gauging station "Crookwell River at Narrawa North" (412050). The flow sequence extends from 21/01/1955 to 25/05/2011, 56.3 years in total. 22.9% of the measured sequenced need to be filled using a correlation with a nearby gauging station.	
total area factor	The flow sequence was factored for area by 1.04.	
on-river dams area factor	A proportion of the streamflow sequence (19% of the unfactored flow sequence) is able to be captured by on-river dams.	
on-farm dams area factor	No on-farm dams simulated.	
Water access		Moderate
level of entitlement	The total entitlement simulated was 1,655 ML made up of: • 1,249 ML Unregulated category entitlement • 6 ML Domestic and Stock category • 400 ML LWU category entitlement	
access rules (CtP)	The CtP was simulated by placing a threshold on the irriration pumps of 2ML/day, which simulated a CtP at the end of the system.	
higher access rule (CtP on Approval)	No higher of access rules (CtP) were simulated.	
pump capacity	A pump capacity of 20.82 ML/day was available for irrigation and 1.11 ML/day was available for Stock and Domestic and LWU water extraction.	
on-river dam access	1,072 ML of on-river dam capacity was simulated. 54% of the unregulated entitlement had access to on-river dams. 100% of the Stock and Domestic and LWU entitlement had access to the on-river dams.	
on-farm storage available	No on-farm storage simulated.	

Water source and model	Crookwell River: model Crookwell River	
Irrigation pattern		High
crop	The crop mix assumed is from the survey for a conversion of unregulated licences carried out in 2000. The crop survey result for Stressed Rivers Assessment unit “Crookwell River” (412_02) was used. This crop mix is represented by simulating the water demands of the following crops: • Annual pasture 14% • Lucerne 32% • Perennial pasture 19% • Summer Maize 7% • Vegetables 17% • Wheat 11% The total area irrigated (based on the full development of the entitlement) in the Crookwell River system was estimated to be 332ha. The weather station used was Crookwell Post Office (station number 70025). The crop factor file used was “centab6ed.crp”, which was developed for the licence conversion process.	
Groundwater extraction	No substaintial alluvial extractions indentified as impacting on streamflow.	
Licence locations	The CtP is triggered at a location below the majority of the irrigation pumps, hence it is simulated as if all pumps are above the trigger point. Some of the licences have access to on-river dams (see sections 'on-river dam area factor' and 'on-river dam access').	

Table 108. Abercrombie River above Wyangala

Water source and model	**Abercrombie River above Wyangala: model Abercrombie River (but it also includes Wyangala Dam itself)**	
Water source boundaries	The main stream is the Abercrombie River (but it also includes Wyangala Dam itself) with headwater streams flowing into it.	
Assumptions		**Confidence**
Flow sequence		Moderate
flows used	A measured flow sequence was used to represent the streamflow available to be extracted. This flow was measured at the gauging station "Abercrombie River at Abercrombie" (412028). The flow sequence extends from 09/12/1930 to 13/09/2011, 80.8 years in total. 0.7% of the measured sequenced need to be filled using a correlation with a nearby gauging station.	
total area factor	The flow sequence was factored for area by 1.51.	
on-river dams area factor	A proportion of the streamflow sequence (1% of the unfactored flow sequence) is able to be captured by on-river dams.	
on-farm dams area factor	No on-farm dams simulated.	
Water access		Moderate
level of entitlement	The total entitlement simulated was 1,003 ML made up of: • 969 ML Unregulated category entitlement • 34 ML Domestic and Stock category	
access rules (CtP)	The CtP was simulated by placing a threshold on the irriration pumps of 7ML/day, which simulated a CtP at the end of the system.	
higher access rule (CtP on Approval)	No higher of access rules (CtP) were simulated.	
pump capacity	A pump capacity of 16.15 ML/day was available for irrigation and 0.09 ML/day was available for Stock and Domestic and LWU water extraction.	
on-river dam access	323 ML of on-river dam capacity was simulated. 33% of the unregulated entitlement had access to on-river dams. 29% of the Stock and Domestic and LWU entitlement had access to the on-river dams.	
on-farm storage available	No on-farm storage simulated.	

Water source and model	**Abercrombie River above Wyangala: model Abercrombie River (but it also includes Wyangala Dam itself)**	
Irrigation pattern		High
crop	The crop mix assumed is from the survey for a conversion of unregulated licences carried out in 2000. The crop survey result for Stressed Rivers Assessment unit “Abercrombie River above Wyangala” (412_03) was used. This crop mix is represented by simulating the water demands of the following crops: • Lucerne 67% • Perennial pasture 6% • Summer Maize 4% • Vegetables 22% • Wheat 1% The total area irrigated (based on the full development of the entitlement) in the Abercrombie River (but it also includes Wyangala Dam itself) system was estimated to be 212 ha. The weather station used was Tuena (Wyoming) (station number 63271). The crop factor file used was “centab6ed.crp”, which was developed for the licence conversion process.	
Groundwater extraction	No substaintial alluvial extractions indentified as impacting on streamflow.	
Licence locations	The CtP is triggered at a location below the majority of the irrigation pumps, hence it is simulated as if all pumps are above the trigger point. Some of the licences have access to on-river dams (see sections 'on-river dam area factor' and 'on-river dam access').	

Table 109. Boorowa River and Hovells Creek

Water source and model	Boorowa River and Hovells Creek: model Boorowa River	
Water source boundaries	The main stream is the Boorowa River with headwater streams flowing into it. Note the water source also includes the smaller seperate Hovells Creek system.	
Assumptions		**Confidence**
Flow sequence		Moderate
flows used	A measured flow sequence was used to represent the streamflow available to be extracted. This flow was measured at the gauging station "Boorowa River at Prossers Crossing" (412029). The flow sequence extends from 01/07/1938 to 22/12/2008, 70.5 years in total. 4.7% of the measured sequenced need to be filled using a correlation with a nearby gauging station.	
total area factor	The flow sequence was factored for area by 1.42.	
on-river dams area factor	A proportion of the streamflow sequence (38% of the unfactored flow sequence) is able to be captured by on-river dams.	
on-farm dams area factor	No on-farm dams simulated.	
Water access		High
level of entitlement	The total entitlement simulated was 1,187 ML made up of: • 1,128 ML Unregulated category entitlement • 59 ML Domestic and Stock category • 0ML LWU category entitlement	
access rules (CtP)	A CtP was not simulated.	
higher access rule (CtP on Approval)	No higher of access rules (CtP) were simulated.	
pump capacity	A pump capacity of 18.80 ML/day was available for irrigation and 0.16 ML/day was available for Stock and Domestic and LWU water extraction.	
on-river dam access	131 ML of on-river dam capacity was simulated. 9% of the unregulated entitlement had access to on-river dams. 14% of the Stock and Domestic and LWU entitlement had access to the on-river dams.	
on-farm storage available	No on-farm storage simulated.	
Irrigation pattern		High

Water source and model	Boorowa River and Hovells Creek: model Boorowa River
crop	The crop mix assumed is from the survey for a conversion of unregulated licences carried out in 2000. The crop survey result for Stressed Rivers Assessment unit “Boorowa River and Hovell's Creek” (412_04) was used. This crop mix is represented by simulating the water demands of the following crops: • Annual pasture 1% • Lucerne 65% • Wheat 34% The total area irrigated (based on the full development of the entitlement) in the Boorowa River system was estimated to be 245ha. The weather station used was Boorowa Post Office (station number 70220). The crop factor file used was “sthwst6ed.crp”, which was developed for the licence conversion process.
Groundwater extraction	No substaintial alluvial extractions indentified as impacting on streamflow.
Licence locations	Some of the licences have access to on-river dams (see sections 'on-river dam area factor' and 'on-river dam access').

Table 110. Waugoola Creek

Water source and model	Waugoola Creek: model Waugoola Creek	
Water source boundaries	The main stream is Waugoola Creek, which flow into the regulated river. Part of the lower end of the water source has some small residual streams flowing into the trunk stream.	
Assumptions		**Confidence**
Flow sequence		High
flows used	A measured flow sequence was used to represent the streamflow available to be extracted. This flow was measured at the gauging station "Waugoola Creek upstream Cowra" (412091). The flow sequence extends from 25/08/1971 to 22/12/1994, 23.3 years in total. 0.7% of the measured sequenced need to be filled using a correlation with a nearby gauging station.	
total area factor	The flow sequence was factored for area by 1.00.	
on-river dams area factor	A proportion of the streamflow sequence (8% of the unfactored flow sequence) is able to be captured by on-river dams.	
on-farm dams area factor	No on-farm dams simulated.	
Water access		High
level of entitlement	The total entitlement simulated was 359 ML made up of: • 341 ML Unregulated category entitlement • 18 ML Domestic and Stock category	
access rules (CtP)	A CtP was not simulated.	
higher access rule (CtP on Approval)	No higher of access rules (CtP) were simulated.	
pump capacity	A pump capacity of 5.68 ML/day was available for irrigation and 0.05 ML/day was available for Stock and Domestic and LWU water extraction.	
on-river dam access	100 ML of on-river dam capacity was simulated. 28% of the unregulated entitlement had access to on-river dams. 33% of the Stock and Domestic and LWU entitlement had access to the on-river dams.	
on-farm storage available	No on-farm storage simulated.	
Irrigation pattern		High

Water source and model	Waugoola Creek: model Waugoola Creek
crop	The crop mix assumed is from the survey for a conversion of unregulated licences carried out in 2000. The crop survey result for Stressed Rivers Assessment unit “Waugoola Creek” (412_05) was used. This crop mix is represented by simulating the water demands of the following crops: • Lucerne 100% The total area irrigated (based on the full development of the entitlement) in the Waugoola Creek system was estimated to be 57 ha. The weather station used was Cowra Ag Research Station (station number 63022). The crop factor file used was “centab6ed.crp”, which was developed for the licence conversion process.
Groundwater extraction	No substaintial alluvial extractions indentified as impacting on streamflow.
Licence locations	Some of the licences have access to on-river dams (see sections 'on-river dam area factor' and 'on-river dam access').

Table 111. Belubula River above Carcoar Dam

Water source and model	**Belubula River above Carcoar Dam: model Belubula River above Carcoar Dam**	
Water source boundaries	The main stream is the Belubula River above Carcoar Dam with headwater streams flowing into it.	
Assumptions		**Confidence**
Flow sequence		Moderate
flows used	A measured flow sequence was used to represent the streamflow available to be extracted. This flow was measured at the gauging station "Coombing Creek at Near Neville" (412092). The flow sequence extends from 01/09/1971 to 29/03/1993, 21.6 years in total. 8.6% of the measured sequenced need to be filled using a correlation with a nearby gauging station.	
total area factor	The flow sequence was factored for area by 1.54.	
on-river **dams area factor**	No on-river dam simulated.	
on-farm **dams area factor**	No on-farm dams simulated.	
Water access		High
level of entitlement	The total entitlement simulated was 266 ML made up of: • 262 ML Unregulated category entitlement • 4 ML Domestic and Stock category	
access rules (CtP)	A CtP was not simulated.	
higher access rule (CtP on Approval)	No higher of access rules (CtP) were simulated.	
pump capacity	A pump capacity of 4.37 ML/day was available for irrigation and 0.01 ML/day was available for Stock and Domestic and LWU water extraction.	
on-river **dam access**	No on-river dams simulated.	
on-farm **storage available**	No on-farm storage simulated.	
Irrigation pattern		High

Water source and model	Belubula River above Carcoar Dam: model Belubula River above Carcoar Dam
crop	The crop mix assumed is from the survey for a conversion of unregulated licences carried out in 2000. The crop survey result for Stressed Rivers Assessment unit “Belubula River above Carcoar Dam” (412_06) was used. This crop mix is represented by simulating the water demands of the following crops: • Lucerne 44% • Vegetables 56% The total area irrigated (based on the full development of the entitlement) in the Belubula River above Carcoar Dam system was estimated to be 51ha. The weather station used was Blayney Post Office (station number 63010). The crop factor file used was “centab6ed.crp”, which was developed for the licence conversion process.
Groundwater extraction	No substaintial alluvial extractions indentified as impacting on streamflow.
Licence locations	

Table 112. Belubula Tributaries below Carcoar Dam

Water source and model	**Belubula Tributaries below Carcoar Dam: model Belubula Tributaries below Carcoar Dam**	
Water source boundaries	The main waterbody is Belubula Tributaries below Carcoar Dam, which flow into the regulated river.	
Assumptions		**Confidence**
Flow sequence		Low
flows used	A measured flow sequence was used to represent the streamflow available to be extracted. This flow was measured at the gauging station "Flyers Creek at Beneree" (412080). The flow sequence extends from 17/04/1968 to 17/08/2011, 43.3 years in total. 12.0% of the measured sequenced need to be filled using a correlation with a nearby gauging station.	
total area factor	The flow sequence was factored for area by 3.82.	
on-river dams area factor	A proportion of the streamflow sequence (32% of the unfactored flow sequence) is able to be captured by on-river dams.	
on-farm dams area factor	No on-farm dams simulated.	
Water access		Moderate
level of entitlement	The total entitlement simulated was 9,583 ML made up of: • 6,380 ML Unregulated category entitlement • 53 ML Domestic and Stock category • 3,150 ML LWU category entitlement	
access rules (CtP)	A CtP was not simulated.	
higher access rule (CtP on Approval)	No higher of access rules (CtP) were simulated.	
pump capacity	A pump capacity of 19.83 ML/day was available for irrigation and 8.79 ML/day was available for Stock and Domestic and LWU water extraction.	
on-river dam access	361 ML of on-river dam capacity was simulated. 61% of the unregulated entitlement had access to on-river dams. 100% of the Stock and Domestic and LWU entitlement had access to the on-river dams.	
on-farm storage available	No on-farm storage simulated.	
Irrigation pattern		High

Water source and model	Belubula Tributaries below Carcoar Dam: model Belubula Tributaries below Carcoar Dam
crop	The crop mix assumed is from the survey for a conversion of unregulated licences carried out in 2000. The crop survey result for Stressed Rivers Assessment unit “Belubula Tributaries below Carcoar Dam” (412_07) was used. This crop mix is represented by simulating the water demands of the following crops: • Annual pasture 3% • Cotton 2% • Lucerne 17% • Pecans 6% • Perennial pasture 9% • Vegetables 34% • Grapes 26% • Wheat 3% The total area irrigated (based on the full development of the entitlement) in the Belubula Tributaries below Carcoar Dam system was estimated to be 281ha. The weather station used was Canowindra (Canowindra Street) (station number 65006). The crop factor file used was “centab6ed.crp”, which was developed for the licence conversion process.
Groundwater extraction	No substaintial alluvial extractions indentified as impacting on streamflow.
Licence locations	Some of the licences have access to on-river dams (see sections 'on-river dam area factor' and 'on-river dam access').

Table 113. Mandagery Creek

Water source and model	Mandagery Creek: model Mandagery Creek	
Water source boundaries	The main stream is Mandagery Creek with headwater streams flowing into it.	
Assumptions		**Confidence**
Flow sequence		Moderate
flows used	A measured flow sequence was used to represent the streamflow available to be extracted. This flow was measured at the gauging station "Mandagery Creek upstream Eugowra (Smithfield)" (412030). The flow sequence extends from 27/04/1938 to 03/08/2011, 73.3 years in total. 10.9% of the measured sequenced need to be filled using a correlation with a nearby gauging station.	
total area factor	The flow sequence was factored for area by 1.24.	
on-river dams area factor	No on-river dam simulated.	
on-farm dams area factor	No on-farm dams simulated.	
Water access		Moderate
level of entitlement	The total entitlement simulated was 7,838 ML made up of: • 7,750 ML Unregulated category entitlement • 88 ML Domestic and Stock category	
access rules (CtP)	The CtP was simulated by placing a threshold on the irriration pumps of 10 ML/day, which simulated a CtP at the end of the system.	
higher access rule (CtP on Approval)	No higher of access rules (CtP) were simulated.	
pump capacity	A pump capacity of 129.17 ML/day was available for irrigation and 0.24 ML/day was available for Stock and Domestic and LWU water extraction.	
on-river dam access	No on-river dams simulated.	
on-farm storage available	No on-farm storage simulated.	
Irrigation pattern		High

Water source and model	Mandagery Creek: model Mandagery Creek
crop	The crop mix assumed is from the survey for a conversion of unregulated licences carried out in 2000. The crop survey result for Stressed Rivers Assessment unit “Mandadgery Creek” (412_08) was used. This crop mix is represented by simulating the water demands of the following crops: • Annual pasture 4% • Lucerne 85% • Orchard 3% • Perennial pasture 2% • Summer Maize 1% • Vegetables 3% • Grapes 1% • Wheat 1% The total area irrigated (based on the full development of the entitlement) in the Mandagery Creek system was estimated to be 1,310 ha. The weather station used was Cudal Post Office (station number 65010). The crop factor file used was “cenwst6ed.crp”, which was developed for the licence conversion process.
Groundwater extraction	No substaintial alluvial extractions indentified as impacting on streamflow.
Licence locations	The CtP is triggered at a location below the majority of the irrigation pumps, hence it is simulated as if all pumps are above the trigger point.

Table 114. Goonigal and Kangarooby Creeks

Water source and model	Goonigal and Kangarooby Creeks: model Goonigal and Kangarooby Creeks	
Water source boundaries	The main streams are Goonigal and Kangarooby Creeks, which flow into the regulated river. Part of the lower end of the water source has some small residual streams flowing into the trunk stream.	
Assumptions		**Confidence**
Flow sequence		Poor
flows used	A measured flow sequence was used to represent the streamflow available to be extracted. This flow was measured at the gauging station "Goonigal Creek at Gooloogong" (412068). The flow sequence extends from 25/08/1966 to 06/04/2004, 37.6 years in total. 5.1% of the measured sequenced need to be filled using a correlation with a nearby gauging station.	
total area factor	The flow sequence was factored for area by 2.01.	
on-river dams area factor	A proportion of the streamflow sequence (1% of the unfactored flow sequence) is able to be captured by on-river dams.	
on-farm dams area factor	No on-farm dams simulated.	
Water access		High
level of entitlement	The total entitlement simulated was 1,107 ML made up of: • 1,103 ML Unregulated category entitlement • 4 ML Domestic and Stock category • 0,ML LWU category entitlement	
access rules (CtP)	A CtP was not simulated.	
higher access rule (CtP on Approval)	No higher of access rules (CtP) were simulated.	
pump capacity	A pump capacity of 9.70 ML/day was available for irrigation and 0.01 ML/day was available for Stock and Domestic and LWU water extraction.	
on-river dam access	255 ML of on-river dam capacity was simulated. 46% of the unregulated entitlement had access to on-river dams. 100% of the Stock and Domestic and LWU entitlement had access to the on-river dams.	
on-farm storage available	No on-farm storage simulated.	

Water source and model	Goonigal and Kangarooby Creeks: model Goonigal and Kangarooby Creeks	
Irrigation pattern		Moderate
crop	The crop mix assumed is from the survey for a conversion of unregulated licences carried out in 2000. The crop survey result for Stressed Rivers Assessment unit “Crowther Creek” (412_13) was used. This crop mix is represented by simulating the water demands of the following crops: • Orchard 100% The total area irrigated (based on the full development of the entitlement) in the Goonigal and Kangarooby Creeks system was estimated to be 68 ha. The weather station used was Grenfell (Manganese Rd) (station number 73014). The crop factor file used was “cenwst6ed.crp”, which was developed for the licence conversion process.	
Groundwater extraction	No substaintial alluvial extractions indentified as impacting on streamflow.	
Licence locations	Some of the licences have access to on-river dams (see sections 'on-river dam area factor' and 'on-river dam access').	

Table 115. Tyagong Creek

Water source and model	Tyagong Creek: model Tyagong Creek	
Water source boundaries	The main stream is Tyagong Creek with headwater streams flowing into it.	
Assumptions		**Confidence**
Flow sequence		Low
flows used	A measured flow sequence was used to represent the streamflow available to be extracted. This flow was measured at a gauging station from an adjacent catchement “Back Creek at Koorawatha” (412072). The flow sequence extends from 01/09/1966 to 10/03/1989, 22.5 years in total. 0.1% of the measured sequenced need to be filled using a correlation with a nearby gauging station.	
total area factor	The flow sequence was factored for area by 1.02.	
on-river dams area factor	No on-river dam simulated.	
on-farm dams area factor	No on-farm dams simulated.	
Water access		High
level of entitlement	The total entitlement simulated was 184 ML made up of: • 184 ML Unregulated category entitlement • 0 ML Domestic and Stock category	
access rules (CtP)	A CtP was not simulated.	
higher access rule (CtP on Approval)	No higher of access rules (CtP) were simulated.	
pump capacity	A pump capacity of 3.07 ML/day was available for irrigation and 0.00 ML/day was available for Stock and Domestic and LWU water extraction.	
on-river dam access	No on-river dams simulated.	
on-farm storage available	No on-farm storage simulated.	
Irrigation pattern		High

Water source and model	Tyagong Creek: model Tyagong Creek
crop	The crop mix assumed is from the survey for a conversion of unregulated licences carried out in 2000. The crop survey result for Stressed Rivers Assessment unit “Tyagong Creek” (412_11) was used. This crop mix is represented by simulating the water demands of the following crops: Lucerne 100% The total area irrigated (based on the full development of the entitlement) in the Tyagong Creek system was estimated to be 28ha. The weather station used was Grenfell (Manganese Rd) (station number 73014). The crop factor file used was “cenwst6ed.crp”, which was developed for the licence conversion process.
Groundwater extraction	No substaintial alluvial extractions indentified as impacting on streamflow.
Licence locations	

Table 116. Burrangong Creek

Water source and model	Burrangong Creek: model Burrangong Creek	
Water source boundaries	The main stream is Burrangong Creek with headwater streams flowing into it.	
Assumptions		**Confidence**
Flow sequence		Low
flows used	A measured flow sequence was used to represent the streamflow available to be extracted. This flow was measured at a gauging station from an adjacent catchement “Back Creek at Koorawatha” (412072). The flow sequence extends from 01/09/1966 to 10/03/1989, 22.5 years in total. 0.1% of the measured sequenced need to be filled using a correlation with a nearby gauging station.	
total area factor	The flow sequence was factored for area by 0.78.	
on-river dams area factor	A proportion of the streamflow sequence (8% of the unfactored flow sequence) is able to be captured by on-river dams.	
on-farm dams area factor	No on-farm dams simulated.	
Water access		Moderate
level of entitlement	The total entitlement simulated was 2,554.5 ML made up of: • 2,501.5 ML Unregulated category entitlement • 53 ML Domestic and Stock category	
access rules (CtP)	A CtP was not simulated.	
higher access rule (CtP on Approval)	No higher of access rules (CtP) were simulated.	
pump capacity	A pump capacity of 41.69 ML/day was available for irrigation and 0.15 ML/day was available for Stock and Domestic and LWU water extraction.	
on-river dam access	740 ML of on-river dam capacity was simulated. 59% of the unregulated entitlement had access to on-river dams. 25% of the Stock and Domestic and LWU entitlement had access to the on-river dams.	
on-farm storage available	No on-farm storage simulated.	
Irrigation pattern		High

Water source and model	Burrangong Creek: model Burrangong Creek
crop	The crop mix assumed is from the survey for a conversion of unregulated licences carried out in 2000. The crop survey result for Stressed Rivers Assessment unit “Burrangong Creek” (412_12) was used. This crop mix is represented by simulating the water demands of the following crops: • Lucerne 15% • Orchard 81% • Vegetables 1% • Grapes 2% • Wheat 1% The total area irrigated (based on the full development of the entitlement) in the Burrangong Creek system was estimated to be 297ha. The weather station used was Wombat (Tumbleton) (station number 73041). The crop factor file used was “sthwst6ed.crp”, which was developed for the licence conversion process.
Groundwater extraction	No substaintial alluvial extractions indentified as impacting on streamflow.
Licence locations	Some of the licences have access to on-river dams (see sections 'on-river dam area factor' and 'on-river dam access').

Table 117. Crowther Creek

Water source and model	Crowther Creek: model Crowther Creek	
Water source boundaries	The main stream is Crowther Creek with headwater streams flowing into it. Part of the lower end of the water source has some small residual streams flowing into the trunk stream.	
Assumptions		**Confidence**
Flow sequence		Moderate
flows used	A measured flow sequence was used to represent the streamflow available to be extracted. This flow was measured at the gauging station "Back Creek at Koorawatha" (412072). The flow sequence extends from 01/09/1966 to 10/03/1989, 22.5 years in total. 0.1% of the measured sequenced need to be filled using a correlation with a nearby gauging station.	
total area factor	The flow sequence was factored for area by 2.13.	
on-river dams area factor	A proportion of the streamflow sequence (2% of the unfactored flow sequence) is able to be captured by on-river dams.	
on-farm dams area factor	No on-farm dams simulated.	
Water access		High
level of entitlement	The total entitlement simulated was 1,404 ML made up of: • 1,363 ML Unregulated category entitlement • 41 ML Domestic and Stock category	
access rules (CtP)	A CtP was not simulated.	
higher access rule (CtP on Approval)	No higher of access rules (CtP) were simulated.	
pump capacity	A pump capacity of 22.72 ML/day was available for irrigation and 0.11 ML/day was available for Stock and Domestic and LWU water extraction.	
on-river dam access	498 ML of on-river dam capacity was simulated. 73% of the unregulated entitlement had access to on-river dams. 24% of the Stock and Domestic and LWU entitlement had access to the on-river dams.	
on-farm storage available	No on-farm storage simulated.	
Irrigation pattern		High

Water source and model	Crowther Creek: model Crowther Creek
crop	The crop mix assumed is from the survey for a conversion of unregulated licences carried out in 2000. The crop survey result for Stressed Rivers Assessment unit “Crowther Creek” (412_13) was used. This crop mix is represented by simulating the water demands of the following crops: • Orchard 100% The total area irrigated (based on the full development of the entitlement) in the Crowther Creek system was estimated to be 160ha. The weather station used was Murringo (Windermere) (station number 73051). The crop factor file used was “sthwst6ed.crp”, which was developed for the licence conversion process.
Groundwater extraction	No substaintial alluvial extractions indentified as impacting on streamflow.
Licence locations	Some of the licences have access to on-river dams (see sections 'on-river dam area factor' and 'on-river dam access').

Table 118. Western Bland Creek

Water source and model	Western Bland Creek: model Bland Creek	
Water source boundaries	The main stream is Bland Creek downstream of other water sources that flow into it. The downstream end of the water source is Lake Cowal.	
Assumptions		**Confidence**
Flow sequence		Low
flows used	A measured flow sequence was used to represent the streamflow available to be extracted. This flow was measured at the gauging station "Bland Creek at Morangarell" (412103). The flow sequence extends from 17/11/1976 to 07/04/2004, 27.4 years in total. 0.8% of the measured sequenced need to be filled using a correlation with a nearby gauging station.	
total area factor	The flow sequence was factored for area by 2.86.	
on-river dams area factor	A proportion of the streamflow sequence (31% of the unfactored flow sequence) is able to be captured by on-river dams.	
on-farm dams area factor	No on-farm dams simulated.	
Water access		Moderate
level of entitlement	The total entitlement simulated was 3,641 ML made up of: • 3,562 ML Unregulated category entitlement • 69 ML Domestic and Stock category • 10 ML LWU category entitlement	
access rules (CtP)	A CtP was not simulated.	
higher access rule (CtP on Approval)	No higher of access rules (CtP) were simulated.	
pump capacity	A pump capacity of 59.37 ML/day was available for irrigation and 0.22 ML/day was available for Stock and Domestic and LWU water extraction.	
on-river dam access	12 ML of on-river dam capacity was simulated. 13% of the unregulated entitlement had access to on-river dams. 54% of the Stock and Domestic and LWU entitlement had access to the on-river dams.	
on-farm storage available	No on-farm storage simulated.	
Irrigation pattern		High

Water source and model	Western Bland Creek: model Bland Creek
crop	The crop mix assumed is from the survey for a conversion of unregulated licences carried out in 2000. The crop survey result for Stressed Rivers Assessment unit “Western Bland Creek” (412_14) was used. This crop mix is represented by simulating the water demands of the following crops: • Fababean 4% • Lucerne 39% • Orchard 21% • Summer Maize 6% • Grapes 5% • Wheat 25% The total area irrigated (based on the full development of the entitlement) in the Bland Creek system was estimated to be 635ha. The weather station used was Temora Ambulance Station (station number 73037). The crop factor file used was “sthwst6ed.crp”, which was developed for the licence conversion process.
Groundwater extraction	No substaintial alluvial extractions indentified as impacting on streamflow.
Licence locations	Some of the licences have access to on-river dams (see sections 'on-river dam area factor' and 'on-river dam access').

Table 119. Ooma Creek and Tributaries

Water source and model	Ooma Creek and Tributaries: model Ooma Creek	
Water source boundaries	The main stream is Ooma Creek with headwater streams flowing into it.	
Assumptions		**Confidence**
Flow sequence		Low
flows used	A measured flow sequence was used to represent the streamflow available to be extracted. This flow was measured at a gauging station from an adjacent catchement “Goonigal Creek at Gooloogong” (412068). The flow sequence extends from 25/08/1966 to 06/04/2004, 37.6 years in total. 5.1% of the measured sequenced need to be filled using a correlation with a nearby gauging station.	
total area factor	The flow sequence was factored for area by 0.90.	
on-river dams area factor	A proportion of the streamflow sequence (2% of the unfactored flow sequence) is able to be captured by on-river dams.	
on-farm dams area factor	No on-farm dams simulated.	
Water access		High
level of entitlement	The total entitlement simulated was 216 ML made up of: • 116 ML Unregulated category entitlement • 0 ML Domestic and Stock category • 100 ML LWU category entitlement	
access rules (CtP)	A CtP was not simulated.	
higher access rule (CtP on Approval)	No higher of access rules (CtP) were simulated.	
pump capacity	A pump capacity of 1.93 ML/day was available for irrigation and 0.27 ML/day was available for Stock and Domestic and LWU water extraction.	
on-river dam access	50 ML of on-river dam capacity was simulated. 0% of the unregulated entitlement had access to on-river dams. 100% of the Stock and Domestic and LWU entitlement had access to the on-river dams.	
on-farm storage available	No on-farm storage simulated.	
Irrigation pattern		High

Water source and model	Ooma Creek and Tributaries: model Ooma Creek
crop	The crop mix assumed is from the survey for a conversion of unregulated licences carried out in 2000. The crop survey result for Stressed Rivers Assessment unit “Ooma Creek and tributaries” (412_15) was used. This crop mix is represented by simulating the water demands of the following crops: • Lucerne 100% The total area irrigated (based on the full development of the entitlement) in the Ooma Creek system was estimated to be 18ha. The weather station used was Forbes (Camp Street) (station number 65016). The crop factor file used was “cenwst6ed.crp”, which was developed for the licence conversion process.
Groundwater extraction	No substaintial alluvial extractions indentified as impacting on streamflow.
Licence locations	Some of the licences have access to on-river dams (see sections 'on-river dam area factor' and 'on-river dam access').

Table 120. Goobang and Billabong Creeks

Water source and model	Goobang and Billabong Creeks: model Goobang Creek	
Water source boundaries	The main stream is Goobang Creek with headwater streams flowing into it. A major tributary in the headwaters is Billabong Creek.	
Assumptions		**Confidence**
Flow sequence		High
flows used	A measured flow sequence was used to represent the streamflow available to be extracted. This flow was measured at the gauging station "Goobang Creek at Darby S Dam" (412043). The flow sequence extends from 24/08/1947 to 14/11/1982, 35.2 years in total. 1.4% of the measured sequenced need to be filled using a correlation with a nearby gauging station.	
total area factor	The flow sequence was factored for area by 1.01.	
on-river dams area factor	A proportion of the streamflow sequence (4% of the unfactored flow sequence) is able to be captured by on-river dams.	
on-farm dams area factor	No on-farm dams simulated.	
Water access		Moderate
level of entitlement	The total entitlement simulated was 3,718 ML made up of: 2,200 ML Unregulated category entitlement 18 ML Domestic and Stock category 1,500 ML LWU category entitlement	
access rules (CtP)	A CtP was not simulated.	
higher access rule (CtP on Approval)	No higher of access rules (CtP) were simulated.	
pump capacity	A pump capacity of 36.67 ML/day was available for irrigation and 4.11 ML/day was available for Stock and Domestic and LWU water extraction.	
on-river dam access	750 ML of on-river dam capacity was simulated. 27% of the unregulated entitlement had access to on-river dams. 100% of the Stock and Domestic and LWU entitlement had access to the on-river dams.	
on-farm storage available	No on-farm storage simulated.	
Irrigation pattern		High

Water source and model	Goobang and Billabong Creeks: model Goobang Creek
crop	The crop mix assumed is from the survey for a conversion of unregulated licences carried out in 2000. The crop survey result for Stressed Rivers Assessment unit “Goobang - Billabong Creeks” (412_17) was used. This crop mix is represented by simulating the water demands of the following crops: • Lucerne 38% • Perennial pasture 17% • Summer Maize 14% • Wheat 31% The total area irrigated (based on the full development of the entitlement) in the Goobang Creek system was estimated to be 401ha. The weather station used was Forbes (Camp Street) (station number 65016). The crop factor file used was “cenwst6ed.crp”, which was developed for the licence conversion process.
Groundwater extraction	No substaintial alluvial extractions indentified as impacting on streamflow.
Licence locations	Some of the licences have access to on-river dams (see sections 'on-river dam area factor' and 'on-river dam access').

Murrumbidgee unregulated river models

Table 121. Yass Lower

Water source and model	Yass Lower: model Yass River	
Water source boundaries	The main stream is the Yass River downstream of other water sources that flow into it.	
Assumptions		**Confidence**
Flow sequence		High
flows used	A measured flow sequence was used to represent the streamflow available to be extracted. This flow was measured at the gauging station "Yass River at Yass" (410026). The flow sequence extends from 25/08/1915 to 28/08/2011, 96.0 years in total. 36.9% of the measured sequenced need to be filled using a correlation with a nearby gauging station.	
total area factor	The flow sequence was factored for area by 1.30.	
on-river dams area factor	A proportion of the streamflow sequence (99% of the unfactored flow sequence) is able to be captured by on-river dams.	
on-farm dams area factor	No on-farm dams simulated.	
Water access		Moderate
level of entitlement	The total entitlement simulated was 3838.45ML made up of: • 2,052.2 ML Unregulated category entitlement • 1,786.25 ML Domestic and Stock category	
access rules (CtP)	The visible flow CtP was simulated by allowing access down to zero flow, which is the same as simulating no CtP.	
higher access rule (CtP on Approval)	No higher of access rules (CtP) were simulated.	
pump capacity	A pump capacity of 34.20 ML/day was available for irrigation and 4.89ML/day was available for Stock and Domestic and LWU water extraction.	
on-river dam access	500 ML of on-river dam capacity was simulated. 0% of the unregulated entitlement had access to on-river dams. 95% of the Stock and Domestic and LWU entitlement had access to the on-river dams.	
on-farm storage available	No on-farm storage simulated.	
Irrigation pattern		High

Water source and model	Yass Lower: model Yass River
crop	The crop mix assumed is from the survey for a conversion of unregulated licences carried out in 2000. The crop survey result for Stressed Rivers Assessment unit “Yass Lower” (410_27) was used. This crop mix is represented by simulating the water demands of the following crops: • Lucerne 13% • Perennial pasture 13% • Turf 13% • Vegetables 61% The total area irrigated (based on the full development of the entitlement) in the Yass River system was estimated to be 334ha. The weather station used was Yass (Linton Hostel) (station number 70091). The crop factor file used was “sthtab6ed.crp”, which was developed for the licence conversion process.
Groundwater extraction	No substaintial alluvial extractions indentified as impacting on streamflow.
Licence locations	Some of the licences have access to on-river dams (see sections 'on-river dam area factor' and 'on-river dam access').

Table 122. Yass Upper

Water source and model	**Yass Upper: model Yass River**	
Water source boundaries	The main stream is the Yass River with headwater streams flowing into it.	
Assumptions		**Confidence**
Flow sequence		High
flows used	A measured flow sequence was used to represent the streamflow available to be extracted. This flow was measured at the gauging station "Yass River at Yass" (410026). The flow sequence extends from 25/08/1915 to 28/08/2011, 96.0 years in total. 36.9% of the measured sequenced need to be filled using a correlation with a nearby gauging station.	
total area factor	The flow sequence was factored for area by 0.95.	
on-river dams area factor	A proportion of the streamflow sequence (5% of the unfactored flow sequence) is able to be captured by on-river dams.	
on-farm dams area factor	No on-farm dams simulated.	
Water access		Moderate
level of entitlement	The total entitlement simulated was 1,662.2 ML made up of: • 1,605.2 ML Unregulated category entitlement • 57 ML Domestic and Stock category	
access rules (CtP)	The CtP was simulated by placing a threshold (in a decision table) on the inflow above the irrigation pumps of (equivalent of 45ML at the upstream inflow node) 6 ML/day.	
higher access rule (CtP on Approval)	No higher of access rules (CtP) were simulated.	
pump capacity	A pump capacity of 26.75 ML/day was available for irrigation and 0.16ML/day was available for Stock and Domestic and LWU water extraction.	
on-river dam access	200 ML of on-river dam capacity was simulated. 20% of the unregulated entitlement had access to on-river dams. 49% of the Stock and Domestic and LWU entitlement had access to the on-river dams.	
on-farm storage available	No on-farm storage simulated.	
Irrigation pattern		High

Water source and model	Yass Upper: model Yass River
crop	The crop mix assumed is from the survey for a conversion of unregulated licences carried out in 2000. The crop survey result for Stressed Rivers Assessment unit “Yass Upper” (410_28) was used. This crop mix is represented by simulating the water demands of the following crops: • Annual pasture 8% • Citrus 3% • Lucerne 52% • Perennial pasture 28% • Vegetables 5% • Grapes 4% The total area irrigated (based on the full development of the entitlement) in the Yass River system was estimated to be 319ha. The weather station used was Gundaroo (Bairnsdale) (station number 70042). The crop factor file used was “sthtab6ed.crp”, which was developed for the licence conversion process.
Groundwater extraction	No substaintial alluvial extractions indentified as impacting on streamflow.
Licence locations	The CtP is triggered at a location above the majority of the irrigation pumps, hence it is simulated as if all pumps are below the trigger point. Some of the licences have access to on-river dams (see sections 'on-river dam area factor' and 'on-river dam access').

Table 123. Adjungbilly/Bombowlee/Brungle

Water source and model	Adjungbilly/Bombowlee/Brungle: model Killimicat Creek	
Water source boundaries	The main stream is Killimicat Creek, which flow into the regulated river.	
Assumptions		**Confidence**
Flow sequence		Low
flows used	A measured flow sequence was used to represent the streamflow available to be extracted. This flow was measured at the gauging station "Killimcat Creek at Wyangle" (410114). The flow sequence extends from 29/05/1975 to 09/09/2015, 40.3 years in total. 0.5% of the measured sequenced need to be filled using a correlation with a nearby gauging station.	
total area factor	The flow sequence was factored for area by 3.07.	
on-river **dams area factor**	No on-river dam simulated.	
on-farm **dams area factor**	No on-farm dams simulated.	
Water access		High
level of entitlement	The total entitlement simulated was 124 ML made up of: • 124 ML Unregulated category entitlement • 0 ML Domestic and Stock category	
access rules (CtP)	The visible flow CtP was simulated by allowing access down to zero flow, which is the same as simulating no CtP.	
higher access rule (CtP on Approval)	No higher of access rules (CtP) were simulated.	
pump capacity	A pump capacity of 2.07 ML/day was available for irrigation and 0.00 ML/day was available for Stock and Domestic and LWU water extraction.	
on-river dam access	No on-river dams simulated.	
on-farm storage available	No on-farm storage simulated.	
Irrigation pattern		Moderate

Water source and model	Adjungbilly/Bombowlee/Brungle: model Killimicat Creek
crop	The crop mix assumed is from the survey for a conversion of unregulated licences carried out in 2000. The crop survey result for Stressed Rivers Assessment unit "Adjungbilly/Bombowlee/Brungle" (410_25) was used. This crop mix is represented by simulating the water demands of the following crops: • Annual pasture 3% • Lucerne 31% • Orchard 38% • Perennial pasture 27% • Vegetables 1% The total area irrigated (based on the full development of the entitlement) in the Killimicat Creek system was estimated to be 20ha. The weather station used was Cavan (station number 70019). The crop factor file used was "sthwst6ed.crp", which was developed for the licence conversion process.
Groundwater extraction	No substaintial alluvial extractions indentified as impacting on streamflow.
Licence locations	

Table 124. Adjungbilly/Bombowlee/Brungle

Water source and model	**Adjungbilly/Bombowlee/Brungle: model Brungle Creek**	
Water source boundaries	The main stream is Brungle Creek, which flow into the regulated river.	
Assumptions		**Confidence**
Flow sequence		High
flows used	A measured flow sequence was used to represent the streamflow available to be extracted. This flow was measured at the gauging station "Brungle Creek at Red Hill" (410071). The flow sequence extends from 28/01/1954 to 16/09/1984, 30.6 years in total. 0.7% of the measured sequenced need to be filled using a correlation with a nearby gauging station.	
total area factor	The flow sequence was factored for area by 1.20.	
on-river **dams area factor**	A proportion of the streamflow sequence (64% of the unfactored flow sequence) is able to be captured by on-river dams.	
on-farm **dams area factor**	No on-farm dams simulated.	
Water access		High
level of entitlement	The total entitlement simulated was 134 ML made up of: • 125 ML Unregulated category entitlement • ML Domestic and Stock category	
access rules (CtP)	The visible flow CtP was simulated by allowing access down to zero flow, which is the same as simulating no CtP.	
higher access rule (CtP on Approval)	No higher of access rules (CtP) were simulated.	
pump capacity	A pump capacity of 2.08 ML/day was available for irrigation and 0.02 ML/day was available for Stock and Domestic and LWU water extraction.	
on-river dam access	7 ML of on-river dam capacity was simulated. 10% of the unregulated entitlement had access to on-river dams. 100% of the Stock and Domestic and LWU entitlement had access to the on-river dams.	
on-farm storage available	No on-farm storage simulated.	
Irrigation pattern		Moderate

Water source and model	Adjungbilly/Bombowlee/Brungle: model Brungle Creek
crop	The crop mix assumed is from the survey for a conversion of unregulated licences carried out in 2000. The crop survey result for Stressed Rivers Assessment unit "Adjungbilly/Bombowlee/Brungle" (410_25) was used. This crop mix is represented by simulating the water demands of the following crops: • Annual pasture 3% • Lucerne 31% • Orchard 38% • Perennial pasture 27% • Vegetables 1% The total area irrigated (based on the full development of the entitlement) in the Brungle Creek system was estimated to be 20ha. The weather station used was Cavan (station number 70019). The crop factor file used was "sthwst6ed.crp", which was developed for the licence conversion process.
Groundwater extraction	No substaintial alluvial extractions indentified as impacting on streamflow.
Licence locations	Some of the licences have access to on-river dams (see sections 'on-river dam area factor' and 'on-river dam access').

Table 125. Adjungbilly/Bombowlee/Brungle

Water source and model	Adjungbilly/Bombowlee/Brungle: model Adjungbilly Creek	
Water source boundaries	The main stream is Adjungbilly Creek, which flow into the regulated river.	
Assumptions		**Confidence**
Flow sequence		High
flows used	A measured flow sequence was used to represent the streamflow available to be extracted. This flow was measured at the gauging station "Adjungbilly Creek at Darbalara" (410038). The flow sequence extends from 28/04/1932 to 21/09/2011, 79.4 years in total. 3.0% of the measured sequenced need to be filled using a correlation with a nearby gauging station.	
total area factor	The flow sequence was factored for area by 1.08.	
on-river dams area factor	No on-river dam simulated.	
on-farm dams area factor	No on-farm dams simulated.	
Water access		High
level of entitlement	The total entitlement simulated was 163 ML made up of: • 159 ML Unregulated category entitlement • 4 ML Domestic and Stock category	
access rules (CtP)	The CtP of 14.3ML/day was not simulated as the CtP is expected not to be implemented.	
higher access rule (CtP on Approval)	No higher of access rules (CtP) were simulated.	
pump capacity	A pump capacity of 2.65 ML/day was available for irrigation and 0.01 ML/day was available for Stock and Domestic and LWU water extraction.	
on-river dam access	No on-river dams simulated.	
on-farm storage available	No on-farm storage simulated.	
Irrigation pattern		Moderate

Water source and model	Adjungbilly/Bombowlee/Brungle: model Adjungbilly Creek
crop	The crop mix assumed is from the survey for a conversion of unregulated licences carried out in 2000. The crop survey result for Stressed Rivers Assessment unit "Adjungbilly/Bombowlee/Brungle" (410_25) was used. This crop mix is represented by simulating the water demands of the following crops: • Annual pasture 3% • Lucerne 31% • Orchard 38% • Perennial pasture 27% • Vegetables 1% The total area irrigated (based on the full development of the entitlement) in the Adjungbilly Creek system was estimated to be 25ha. The weather station used was Cavan (station number 70019). The crop factor file used was "sthwst6ed.crp", which was developed for the licence conversion process.
Groundwater extraction	No substaintial alluvial extractions indentified as impacting on streamflow.
Licence locations	

Table 126. Adjungbilly/Bombowlee/Brungle

Water source and model	Adjungbilly/Bombowlee/Brungle: model Bombowlee Creek	
Water source boundaries	The main stream is Bombowlee Creek, which flow into the regulated river.	
Assumptions		**Confidence**
Flow sequence		Moderate
flows used	A measured flow sequence was used to represent the streamflow available to be extracted. This flow was measured at the gauging station "Bombowlee Creek at Bombowlee" (410070). The flow sequence extends from 25/01/1954 to 31/12/1984, 30.9 years in total. 13.6% of the measured sequenced need to be filled using a correlation with a nearby gauging station.	
total area factor	The flow sequence was factored for area by 1.08.	
on-river dams area factor	No on-river dam simulated.	
on-farm dams area factor	No on-farm dams simulated.	
Water access		High
level of entitlement	The total entitlement simulated was 148 ML made up of: 143 ML Unregulated category entitlement 5 ML Domestic and Stock category	
access rules (CtP)	The CtP of 4ML/day was not simulated as the CtP is expected not to be implemented.	
higher access rule (CtP on Approval)	No higher of access rules (CtP) were simulated.	
pump capacity	A pump capacity of 2.38 ML/day was available for irrigation and 0.01 ML/day was available for Stock and Domestic and LWU water extraction.	
on-river dam access	No on-river dams simulated.	
on-farm storage available	No on-farm storage simulated.	
Irrigation pattern		Moderate

Water source and model	Adjungbilly/Bombowlee/Brungle: model Bombowlee Creek
crop	The crop mix assumed is from the survey for a conversion of unregulated licences carried out in 2000. The crop survey result for Stressed Rivers Assessment unit "Adjungbilly/Bombowlee/Brungle" (410_25) was used. This crop mix is represented by simulating the water demands of the following crops: • Annual pasture 3% • Lucerne 31% • Orchard 38% • Perennial pasture 27% • Vegetables 1% The total area irrigated (based on the full development of the entitlement) in the Bombowlee Creek system was estimated to be 23ha. The weather station used was Cavan (station number 70019). The crop factor file used was "sthwst6ed.crp", which was developed for the licence conversion process.
Groundwater extraction	No substaintial alluvial extractions indentified as impacting on streamflow.
Licence locations	

Table 127. Tarcutta Creek

Water source and model	Tarcutta Creek: model Tarcutta Creek	
Water source boundaries	The main stream is Tarcutta Creek with headwater streams flowing into it.	
Assumptions		**Confidence**
Flow sequence		High
flows used	A measured flow sequence was used to represent the streamflow available to be extracted. This flow was measured at the gauging station "Tarcutta Creek at Old Borambola" (410047). The flow sequence extends from 07/06/1938 to 22/09/2011, 73.3 years in total. 10.1% of the measured sequenced need to be filled using a correlation with a nearby gauging station.	
total area factor	The flow sequence was factored for area by 1.03.	
on-river dams area factor	A proportion of the streamflow sequence (1% of the unfactored flow sequence) is able to be captured by on-river dams.	
on-farm dams area factor	No on-farm dams simulated.	
Water access		Moderate
level of entitlement	The total entitlement simulated was 5,220 ML made up of: • 5,107 ML Unregulated category entitlement • 83 ML Domestic and Stock category • 30 ML LWU category entitlement	
access rules (CtP)	The CtP was simulated by placing a threshold on the irriration pumps of 13ML/day, which simulated a CtP at the end of the system.	
higher access rule (CtP on Approval)	No higher of access rules (CtP) were simulated.	
pump capacity	A pump capacity of 85.12ML/day was available for irrigation and 0.31ML/day was available for Stock and Domestic and LWU water extraction.	
on-river dam access	1,000 ML of on-river dam capacity was simulated. 37% of the unregulated entitlement had access to on-river dams. 47% of the Stock and Domestic and LWU entitlement had access to the on-river dams.	
on-farm storage available	No on-farm storage simulated.	
Irrigation pattern		High

Water source and model	Tarcutta Creek: model Tarcutta Creek
crop	The crop mix assumed is from the survey for a conversion of unregulated licences carried out in 2000. The crop survey result for Stressed Rivers Assessment unit “Tarcutta Creek” (410_17) was used. This crop mix is represented by simulating the water demands of the following crops: • Annual pasture 1% • Citrus 2% • Lucerne 27% • Orchard 43% • Perennial pasture 9% • Intensive perenial pasture 13% • Summer Maize 1% • Grapes 3% The total area irrigated (based on the full development of the entitlement) in the Tarcutta Creek system was estimated to be 779ha. The weather station used was Tarcutta Post Office (station number 72042). The crop factor file used was “sthwst6ed.crp”, which was developed for the licence conversion process.
Groundwater extraction	No substaintial alluvial extractions indentified as impacting on streamflow.
Licence locations	The CtP is triggered at a location below the majority of the irrigation pumps, hence it is simulated as if all pumps are above the trigger point. Some of the licences have access to on-river dams (see sections 'on-river dam area factor' and 'on-river dam access').

Table 128. Muttama

Water source and model	**Muttama: model Muttama Creek**	
Water source boundaries	The main stream is Muttama Creek with headwater streams flowing into it.	
Assumptions		**Confidence**
Flow sequence		High
flows used	A measured flow sequence was used to represent the streamflow available to be extracted. This flow was measured at the gauging station "Muttama Creek at Coolac" (410044). The flow sequence extends from 02/06/1938 to 30/08/2011, 73.2 years in total. 8.5% of the measured sequenced need to be filled using a correlation with a nearby gauging station.	
total area factor	The flow sequence was factored for area by 1.06.	
on-river dams area factor	No on-river dam simulated.	
on-farm dams area factor	No on-farm dams simulated.	
Water access		High
level of entitlement	The total entitlement simulated was 900 ML made up of: • 873 ML Unregulated category entitlement • 27 ML Domestic and Stock category	
access rules (CtP)	A CtP was not simulated.	
higher access rule (CtP on Approval)	No higher of access rules (CtP) were simulated.	
pump capacity	A pump capacity of 14.55 ML/day was available for irrigation and 0.07 ML/day was available for Stock and Domestic and LWU water extraction.	
on-river dam access	No on-river dams simulated.	
on-farm storage available	No on-farm storage simulated.	
Irrigation pattern		High

Water source and model	Muttama: model Muttama Creek
crop	The crop mix assumed is from the survey for a conversion of unregulated licences carried out in 2000. The crop survey result for Stressed Rivers Assessment unit “Muttama” (410_22) was used. This crop mix is represented by simulating the water demands of the following crops: • Lucerne 94% • Perennial pasture 6% The total area irrigated (based on the full development of the entitlement) in the Muttama Creek system was estimated to be 146ha. The weather station used was Gundagai (William St) (station number 73141). The crop factor file used was “sthwst6ed.crp”, which was developed for the licence conversion process.
Groundwater extraction	No substaintial alluvial extractions indentified as impacting on streamflow.
Licence locations	

Table 129. Molonglo

Water source and model	Molonglo: model Molonglo River	
Water source boundaries	The main stream is the Molonglo River downstream of other water sources that flow into it. The water source is not the whole catchment only the section upstream of the ACT boundary.	
Assumptions		**Confidence**
Flow sequence		Low
flows used	A measured flow sequence was used to represent the streamflow available to be extracted. This flow was measured at the gauging station "Molonglo River at Burbong" (410705). The flow sequence extends from 13/02/2012 to 13/03/2016, 4.1 years in total. There was no need to fill any gaps in the measured flow sequence.	
total area factor	The flow sequence was factored for area by 1.00.	
on-river dams area factor	A proportion of the streamflow sequence (6% of the unfactored flow sequence) is able to be captured by on-river dams.	
on-farm dams area factor	No on-farm dams simulated.	
Water access		Moderate
level of entitlement	The total entitlement simulated was 480.5 ML made up of: • 222.5 ML Unregulated category entitlement • 258 ML Domestic and Stock category	
access rules (CtP)	The CtP was simulated by placing a threshold (in a decision table) on the inflow above the irrigation pumps of 1.6 ML/day.	
higher access rule (CtP on Approval)	No higher of access rules (CtP) were simulated.	
pump capacity	A pump capacity of 3.71 ML/day was available for irrigation and 0.71 ML/day was available for Stock and Domestic and LWU water extraction.	
on-river dam access	250 ML of on-river dam capacity was simulated. 7% of the unregulated entitlement had access to on-river dams. 98% of the Stock and Domestic and LWU entitlement had access to the on-river dams.	
on-farm storage available	No on-farm storage simulated.	
Irrigation pattern		High

Water source and model	Molonglo: model Molonglo River
crop	The crop mix assumed is from the survey for a conversion of unregulated licences carried out in 2000. The crop survey result for Stressed Rivers Assessment unit “Molonglo” (410_03) was used. This crop mix is represented by simulating the water demands of the following crops: • Lucerne 18% • Perennial pasture 82% The total area irrigated (based on the full development of the entitlement) in the Molonglo River system was estimated to be 43ha. The weather station used was Queanbeyan (Carwoola) (station number 70101). The crop factor file used was “sthtab6ed.crp”, which was developed for the licence conversion process.
Groundwater extraction	No substaintial alluvial extractions indentified as impacting on streamflow.
Licence locations	The CtP is triggered at a location above the majority of the irrigation pumps, hence it is simulated as if all pumps are below the trigger point. Some of the licences have access to on-river dams (see sections 'on-river dam area factor' and 'on-river dam access').

Table 130. Jugiong

Water source and model	Jugiong: model Jugiong Creek (with major tributary Cunningham Creek)	
Water source boundaries	The main stream is Jugiong Creek (with major tributary Cunningham Creek) with headwater streams flowing into it.	
Assumptions		**Confidence**
Flow sequence		Low
flows used	A measured flow sequence was used to represent the streamflow available to be extracted. This flow was measured at the gauging station "Jugiong Creek at Jugiong (Inverlockie)" (410025). The flow sequence extends from 08/08/1915 to 14/08/2011, 96.0 years in total. 15.7% of the measured sequenced need to be filled using a correlation with a nearby gauging station.	
total area factor	The flow sequence was factored for area by 0.38.	
on-river dams area factor	A proportion of the streamflow sequence (4% of the unfactored flow sequence) is able to be captured by on-river dams.	
on-farm dams area factor	No on-farm dams simulated.	
Water access		Moderate
level of entitlement	The total entitlement simulated was 2,293.5 ML made up of: • 2,204.5 ML Unregulated category entitlement • 89 ML Domestic and Stock category	
access rules (CtP)	The visible flow CtP was simulated by allowing access down to zero flow, which is the same as simulating no CtP.	
higher access rule (CtP on Approval)	No higher of access rules (CtP) were simulated.	
pump capacity	A pump capacity of 36.74 ML/day was available for irrigation and 0.24 ML/day was available for Stock and Domestic and LWU water extraction.	
on-river dam access	1,000 ML of on-river dam capacity was simulated. 94% of the unregulated entitlement had access to on-river dams. 100% of the Stock and Domestic and LWU entitlement had access to the on-river dams.	
on-farm storage available	No on-farm storage simulated.	

Water source and model	Jugiong: model Jugiong Creek (with major tributary Cunningham Creek)	
Irrigation pattern		High
crop	The crop mix assumed is from the survey for a conversion of unregulated licences carried out in 2000. The crop survey result for Stressed Rivers Assessment unit “Jugiong” (410_23) was used. This crop mix is represented by simulating the water demands of the following crops: • Lucerne 2% • Orchard 36% • Grapes 62% The total area irrigated (based on the full development of the entitlement) in the Jugiong Creek (with major tributary Cunningham Creek) system was estimated to be 471 ha. The weather station used was Murrumburrah Old Post Office (station number 73029). The crop factor file used was “sthwst6ed.crp”, which was developed for the licence conversion process.	
Groundwater extraction	No substaintial alluvial extractions indentified as impacting on streamflow.	
Licence locations	Some of the licences have access to on-river dams (see sections 'on-river dam area factor' and 'on-river dam access').	

Table 131. Houlaghans

Water source and model	Houlaghans: model Houlaghans Creek	
Water source boundaries	The main stream is Houlaghans Creek with headwater streams flowing into it.	
Assumptions		**Confidence**
Flow sequence		Moderate
flows used	A measured flow sequence was used to represent the streamflow available to be extracted. This flow was measured at the gauging station "Houlaghans Creek at Downside" (410103). The flow sequence extends from 18/07/1980 to 06/09/2011, 31.1 years in total. There was no need to fill any gaps in the measured flow sequence.	
total area factor	The flow sequence was factored for area by 1.00.	
on-river dams area factor	A proportion of the streamflow sequence (100% of the unfactored flow sequence) is able to be captured by on-river dams.	
on-farm dams area factor	No on-farm dams simulated.	
Water access		High
level of entitlement	The total entitlement simulated was 22 ML made up of: • 10 ML Unregulated category entitlement • 12 ML Domestic and Stock category	
access rules (CtP)	A CtP was not simulated.	
higher access rule (CtP on Approval)	No higher of access rules (CtP) were simulated.	
pump capacity	A pump capacity of 0.17 ML/day was available for irrigation and 0.03 ML/day was available for Stock and Domestic and LWU water extraction.	
on-river dam access	15 ML of on-river dam capacity was simulated. 100% of the unregulated entitlement had access to on-river dams. 42% of the Stock and Domestic and LWU entitlement had access to the on-river dams.	
on-farm storage available	No on-farm storage simulated.	
Irrigation pattern		Moderate

Water source and model	Houlaghans: model Houlaghans Creek
crop	The crop mix assumed is from the survey for a conversion of unregulated licences carried out in 2000. The crop survey result for Stressed Rivers Assessment unit “Burkes/Bullenbung” (410_32) was used. This crop mix is represented by simulating the water demands of the following crops: • Lucerne 95% • Perennial pasture 5% The total area irrigated (based on the full development of the entitlement) in the Houlaghans Creek system was estimated to be 2ha. The weather station used was Wagga Wagga Agricultural Institute (station number 73127). The crop factor file used was “sthwst6ed.crp”, which was developed for the licence conversion process.
Groundwater extraction	No substaintial alluvial extractions indentified as impacting on streamflow.
Licence locations	Some of the licences have access to on-river dams (see sections 'on-river dam area factor' and 'on-river dam access').

Table 132. Hillas

Water source and model	Hillas: model Hillas Creek	
Water source boundaries	The main stream is Hillas Creek with headwater streams flowing into it.	
Assumptions		**Confidence**
Flow sequence		High
flows used	A measured flow sequence was used to represent the streamflow available to be extracted. This flow was measured at the gauging station “Hillas Creek at Mount Adrah” (410043). The flow sequence extends from 08/06/1938 to 18/04/2011, 72.9 years in total. 74.3% of the measured sequenced need to be filled using a correlation with a nearby gauging station.	
total area factor	The flow sequence was factored for area by 1.22. Of this factor 0.5965 was not avaliable to be accessed by licence holders.	
on-river dams area factor	No on-river dam simulated.	
on-farm dams area factor	No on-farm dams simulated.	
Water access		Moderate
level of entitlement	The total entitlement simulated was 1,543.1 ML made up of: • 1,513.1 ML Unregulated category entitlement • 30 ML Domestic and Stock category	
access rules (CtP)	The CtP was simulated by placing a threshold (in a decision table) on the inflow above the irrigation pumps of (equivalent of 4.9ML at the upstream inflow node) 8 ML/day.	
higher access rule (CtP on Approval)	No higher of access rules (CtP) were simulated.	
pump capacity	A pump capacity of 25.22 ML/day was available for irrigation and 0.08 ML/day was available for Stock and Domestic and LWU water extraction.	
on-river dam access	No on-river dams simulated.	
on-farm storage available	No on-farm storage simulated.	
Irrigation pattern		High

Water source and model	Hillas: model Hillas Creek
crop	The crop mix assumed is from the survey for a conversion of unregulated licences carried out in 2000. The crop survey result for Stressed Rivers Assessment unit “Hillas” (410_19) was used. This crop mix is represented by simulating the water demands of the following crops: • Annual pasture 3% • Lucerne 9% • Orchard 78% • Perennial pasture 10% The total area irrigated (based on the full development of the entitlement) in the Hillas Creek system was estimated to be 217ha. The weather station used was Mundarlo (Yabtree) (station number 73055). The crop factor file used was “sthwst6ed.crp”, which was developed for the licence conversion process.
Groundwater extraction	No substaintial alluvial extractions indentified as impacting on streamflow.
Licence locations	The CtP is triggered at a location above the majority of the irrigation pumps, hence it is simulated as if all pumps are below the trigger point.

Table 133. Goodradigbee

Water source and model	Goodradigbee: model Goodradigbee River	
Water source boundaries	The main stream is the Goodradigbee River with headwater streams flowing into it. It flows directly in to Burrinjuck Dam.	
Assumptions		**Confidence**
Flow sequence		High
flows used	A measured flow sequence was used to represent the streamflow available to be extracted. This flow was measured at the gauging station "Goodradigbee River at Wee Jasper (Kashmir)" (410024). The flow sequence extends from 19/09/1914 to 27/07/2011, 96.9 years in total. 0.1% of the measured sequenced need to be filled using a correlation with a nearby gauging station.	
total area factor	The flow sequence was factored for area by 1.07.	
on-river dams area factor	No on-river dam simulated.	
on-farm dams area factor	No on-farm dams simulated.	
Water access		Moderate
level of entitlement	The total entitlement simulated was 875 ML made up of: • 874 ML Unregulated category entitlement • 1 ML Domestic and Stock category	
access rules (CtP)	The CtP was simulated by placing a threshold (in a decision table) on the inflow above the irrigation pumps of (equivalent of 48.3 ML at the upstream inflow node) 45 ML/day.	
higher access rule (CtP on Approval)	No higher of access rules (CtP) were simulated.	
pump capacity	A pump capacity of 14.57 ML/day was available for irrigation and 0.00 ML/day was available for Stock and Domestic and LWU water extraction.	
on-river dam access	No on-river dams simulated.	
on-farm storage available	No on-farm storage simulated.	
Irrigation pattern		High

Water source and model	Goodradigbee: model Goodradigbee River
crop	The crop mix assumed is from the survey for a conversion of unregulated licences carried out in 2000. The crop survey result for Stressed Rivers Assessment unit “Goobarragandra” (410_15) was used. This crop mix is represented by simulating the water demands of the following crops: • Annual pasture 7% • Fababean 2% • Lucerne 18% • Pecans 1% • Perennial pasture 67% • Summer Maize 2% • Vegetables 3% The total area irrigated (based on the full development of the entitlement) in the Goodradigbee River system was estimated to be 168ha. The weather station used was Cavan (station number 70019). The crop factor file used was “sthtab6ed.crp”, which was developed for the licence conversion process.
Groundwater extraction	No substaintial alluvial extractions indentified as impacting on streamflow.
Licence locations	The CtP is triggered at a location above the majority of the irrigation pumps, hence it is simulated as if all pumps are below the trigger point.

Table 134. Goobarragandra

Water source and model	Goobarragandra: model Goobarragandra River	
Water source boundaries	The main stream is the Goobarragandra River with headwater streams flowing into it.	
Assumptions		**Confidence**
Flow sequence		High
flows used	A measured flow sequence was used to represent the streamflow available to be extracted. This flow was measured at the gauging station "Goobarragandra River at Lacmalac" (410057). The flow sequence extends from 18/12/1944 to 11/09/2011, 66.7 years in total. 0.9% of the measured sequenced need to be filled using a correlation with a nearby gauging station.	
total area factor	The flow sequence was factored for area by 1.12.	
on-river dams area factor	No on-river dam simulated.	
on-farm dams area factor	No on-farm dams simulated.	
Water access		Moderate
level of entitlement	The total entitlement simulated was 1,686 ML made up of: 1,672 ML Unregulated category entitlement 14 ML Domestic and Stock category	
access rules (CtP)	The CtP was simulated by placing a threshold (in a decision table) on the inflow above the irrigation pumps of (equivalent of 70.6ML at the upstream inflow node) 63ML/day.	
higher access rule (CtP on Approval)	No higher of access rules (CtP) were simulated.	
pump capacity	A pump capacity of 27.87 ML/day was available for irrigation and 0.04 ML/day was available for Stock and Domestic and LWU water extraction.	
on-river dam access	No on-river dams simulated.	
on-farm storage available	No on-farm storage simulated.	
Irrigation pattern		High

Water source and model	Goobarragandra: model Goobarragandra River
crop	The crop mix assumed is from the survey for a conversion of unregulated licences carried out in 2000. The crop survey result for Stressed Rivers Assessment unit “Goobarragandra” (410_15) was used. This crop mix is represented by simulating the water demands of the following crops: • Annual pasture 7% • Fababean 2% • Lucerne 18% • Pecans 1% • Perennial pasture 67% • Summer Maize 2% • Vegetables 3% The total area irrigated (based on the full development of the entitlement) in the Goobarragandra River system was estimated to be 322ha. The weather station used was Tumut Plains (Homesdale) (station number 72046). The crop factor file used was “sthwst6ed.crp”, which was developed for the licence conversion process.
Groundwater extraction	No substaintial alluvial extractions indentified as impacting on streamflow.
Licence locations	The CtP is triggered at a location above the majority of the irrigation pumps, hence it is simulated as if all pumps are below the trigger point.

Table 135. Gilmore/Sandy

Water source and model	Gilmore/Sandy: model Gilmore Creek	
Water source boundaries	The main stream is Gilmore Creek with headwater streams flowing into it.	
Assumptions		**Confidence**
Flow sequence		High
flows used	A measured flow sequence was used to represent the streamflow available to be extracted. This flow was measured at the gauging station "Gilmore Creek at Gilmore" (410059). The flow sequence extends from 13/06/1946 to 13/03/2011, 64.7 years in total. 33.5% of the measured sequenced need to be filled using a correlation with a nearby gauging station.	
total area factor	The flow sequence was factored for area by 1.09.	
on-river dams area factor	A proportion of the streamflow sequence (10% of the unfactored flow sequence) is able to be captured by on-river dams.	
on-farm dams area factor	No on-farm dams simulated.	
Water access		Moderate
level of entitlement	The total entitlement simulated was 5,046.85 ML made up of: • 4,429.35 ML Unregulated category entitlement • 617.5 ML Domestic and Stock category	
access rules (CtP)	The CtP was simulated by placing a threshold on the irriration pumps of 10 ML/day, which simulated a CtP at the end of the system.	
higher access rule (CtP on Approval)	No higher of access rules (CtP) were simulated.	
pump capacity	A pump capacity of 73.82 ML/day was available for irrigation and 1.69 ML/day was available for Stock and Domestic and LWU water extraction.	
on-river dam access	1,250 ML of on-river dam capacity was simulated. 54% of the unregulated entitlement had access to on-river dams. 97% of the Stock and Domestic and LWU entitlement had access to the on-river dams.	
on-farm storage available	No on-farm storage simulated.	
Irrigation pattern		High

Water source and model	Gilmore/Sandy: model Gilmore Creek
crop	The crop mix assumed is from the survey for a conversion of unregulated licences carried out in 2000. The crop survey result for Stressed Rivers Assessment unit “Gilmore/Sandy” (410_16) was used. This crop mix is represented by simulating the water demands of the following crops: • Annual pasture 2% • Citrus 1% • Lucerne 2% • Orchard 57% • Pecans 2% • Perennial pasture 18% • Intensive perenial pasture 15% • Summer Maize 1% • Wheat 2% The total area irrigated (based on the full development of the entitlement) in the Gilmore Creek system was estimated to be 650 ha. The weather station used was Springvale (station number 72048). The crop factor file used was “sthwst6ed.crp”, which was developed for the licence conversion process.
Groundwater extraction	No substaintial alluvial extractions indentified as impacting on streamflow.
Licence locations	The CtP is triggered at a location below the majority of the irrigation pumps, hence it is simulated as if all pumps are above the trigger point. Some of the licences have access to on-river dams (see sections 'on-river dam area factor' and 'on-river dam access').

Table 136. Burkes and Bullenbung Creeks

Water source and model	**Burkes/Bullenbung: model Bullenbung Creek (with major tributary Burkes Creek)**	
Water source boundaries	The main stream is Bullenbung Creek (with major tributary Burkes Creek) with headwater streams flowing into it.	
Assumptions		**Confidence**
Flow sequence		Low
flows used	A measured flow sequence was used to represent the streamflow available to be extracted. This flow was measured at the gauging station "Bullenbung Creek at Above Old Man Creek" (410087). The flow sequence extends from 16/03/1959 to 31/12/1972, 13.8 years in total. 5.2% of the measured sequenced need to be filled using a correlation with a nearby gauging station.	
total area factor	The flow sequence was factored for area by 1.00.	
on-river dams area factor	A proportion of the streamflow sequence (26% of the unfactored flow sequence) is able to be captured by on-river dams.	
on-farm dams area factor	No on-farm dams simulated.	
Water access		Moderate
level of entitlement	The total entitlement simulated was 513 ML made up of: • 491 ML Unregulated category entitlement • 22 ML Domestic and Stock category	
access rules (CtP)	A CtP was not simulated.	
higher access rule (CtP on Approval)	No higher of access rules (CtP) were simulated.	
pump capacity	A pump capacity of 8.18 ML/day was available for irrigation and 0.06 ML/day was available for Stock and Domestic and LWU water extraction.	
on-river dam access	250 ML of on-river dam capacity was simulated. 100% of the unregulated entitlement had access to on-river dams. 100% of the Stock and Domestic and LWU entitlement had access to the on-river dams.	
on-farm storage available	No on-farm storage simulated.	
Irrigation pattern		High

Water source and model	Burkes/Bullenbung: model Bullenbung Creek (with major tributary Burkes Creek)
crop	The crop mix assumed is from the survey for a conversion of unregulated licences carried out in 2000. The crop survey result for Stressed Rivers Assessment unit “Burkes/Bullenbung” (410_32) was used. This crop mix is represented by simulating the water demands of the following crops: • Lucerne 95% • Perennial pasture 5% The total area irrigated (based on the full development of the entitlement) in the Bullenbung Creek (with major tributary Burkes Creek) system was estimated to be 76ha. The weather station used was The Rock (Bullenbong) (station number 74021). The crop factor file used was “sthwst6ed.crp”, which was developed for the licence conversion process.
Groundwater extraction	No substaintial alluvial extractions indentified as impacting on streamflow.
Licence locations	Some of the licences have access to on-river dams (see sections 'on-river dam area factor' and 'on-river dam access').

Table 137. Adelong Creek

Water source and model	Adelong Creek: model Adelong Creek	
Water source boundaries	The main stream is Adelong Creek with headwater streams flowing into it.	
Assumptions		**Confidence**
Flow sequence		Moderate
flows used	A measured flow sequence was used to represent the streamflow available to be extracted. This flow was measured at the gauging station "Adelong Creek at Batlow Road" (410061). The flow sequence extends from 11/09/1947 to 11/08/2011, 63.9 years in total. There was no need to fill any gaps in the measured flow sequence.	
total area factor	The flow sequence was factored for area by 1.46.	
on-river dams area factor	A proportion of the streamflow sequence (7% of the unfactored flow sequence) is able to be captured by on-river dams.	
on-farm dams area factor	No on-farm dams simulated.	
Water access		Moderate
level of entitlement	The total entitlement simulated was 3,875.8 ML made up of: • 3,778.3 ML Unregulated category entitlement • 97.5 ML Domestic and Stock category	
access rules (CtP)	The CtP was simulated by placing a threshold (in a decision table) on the inflow above the irrigation pumps of (equivalent of 17.5 ML at the upstream inflow node) 15 ML/day.	
higher access rule (CtP on Approval)	No higher of access rules (CtP) were simulated.	
pump capacity	A pump capacity of 62.97 ML/day was available for irrigation and 0.27 ML/day was available for Stock and Domestic and LWU water extraction.	
on-river dam access	1,500 ML of on-river dam capacity was simulated. 78% of the unregulated entitlement had access to on-river dams. 33% of the Stock and Domestic and LWU entitlement had access to the on-river dams.	
on-farm storage available	No on-farm storage simulated.	

Water source and model	Adelong Creek: model Adelong Creek	
Irrigation pattern		High
crop	The crop mix assumed is from the survey for a conversion of unregulated licences carried out in 2000. The crop survey result for Stressed Rivers Assessment unit “Adelong Creek” (410_18) was used. This crop mix is represented by simulating the water demands of the following crops: • Lucerne 1% • Orchard 97% • Perennial pasture 1% • Turf 1% The total area irrigated (based on the full development of the entitlement) in the Adelong Creek system was estimated to be 505ha. The weather station used was Adelong Post Office (station number 72000). The crop factor file used was “sthwst6ed.crp”, which was developed for the licence conversion process.	
Groundwater extraction	No substaintial alluvial extractions indentified as impacting on streamflow.	
Licence locations	The CtP is triggered at a location above the majority of the irrigation pumps, hence it is simulated as if all pumps are below the trigger point. Some of the licences have access to on-river dams (see sections 'on-river dam area factor' and 'on-river dam access').	

Table 138. Billabung

Water source and model	Billabung: model Billabung Creek	
Water source boundaries	The main stream is Billabung Creek with headwater streams flowing into it.	
Assumptions		**Confidence**
Flow sequence		Moderate
flows used	A measured flow sequence was used to represent the streamflow available to be extracted. This flow was measured at the gauging station "Billabung Creek at Glenfield (Sunnyside No.3)" (410080). The flow sequence extends from 24/10/1956 to 28/07/1971, 14.8 years in total. There was no need to fill any gaps in the measured flow sequence.	
total area factor	The flow sequence was factored for area by 1.19.	
on-river dams area factor	No on-river dam simulated.	
on-farm dams area factor	No on-farm dams simulated.	
Water access		High
level of entitlement	The total entitlement simulated was 211 ML made up of: • 191 ML Unregulated category entitlement • 20 ML Domestic and Stock category	
access rules (CtP)	The CtP of 0.6m ML/day was not simulated as the CtP is expected not to be implemented.	
higher access rule (CtP on Approval)	No higher of access rules (CtP) were simulated.	
pump capacity	A pump capacity of 3.18 ML/day was available for irrigation and 0.05 ML/day was available for Stock and Domestic and LWU water extraction.	
on-river dam access	No on-river dams simulated.	
on-farm storage available	No on-farm storage simulated.	
Irrigation pattern		Moderate

Water source and model	Billabung: model Billabung Creek
crop	The crop mix assumed is from the survey for a conversion of unregulated licences carried out in 2000. The crop survey result for Stressed Rivers Assessment unit “Bredbo” (410_07) was used. This crop mix is represented by simulating the water demands of the following crops: • Lucerne 96% • Vegetables 4% The total area irrigated (based on the full development of the entitlement) in the Billabung Creek system was estimated to be 32ha. The weather station used was Eurongilly (Bundaleer) (station number 73124). The crop factor file used was “sthwst6ed.crp”, which was developed for the licence conversion process.
Groundwater extraction	No substaintial alluvial extractions indentified as impacting on streamflow.
Licence locations	

Table 139. Bredbo

Water source and model	**Bredbo: model Bredbo River**	
Water source boundaries	The main stream is the Bredbo River with headwater streams flowing into it.	
Assumptions		**Confidence**
Flow sequence		Low
flows used	A measured flow sequence was used to represent the streamflow available to be extracted. This flow was measured at the gauging station "Strike-A-Light Creek at Jerangle Road" (410076). The flow sequence extends from 27/01/1972 to 13/10/2015, 43.7 years in total. 11.9% of the measured sequenced need to be filled using a correlation with a nearby gauging station.	
total area factor	The flow sequence was factored for area by 3.50.	
on-river dams area factor	No on-river dam simulated.	
on-farm dams area factor	No on-farm dams simulated.	
Water access		High
level of entitlement	The total entitlement simulated was 230.5 ML made up of: • 230.5 ML Unregulated category entitlement	
access rules (CtP)	The visible flow CtP was simulated by allowing access down to zero flow, which is the same as simulating no CtP.	
higher access rule (CtP on Approval)	No higher of access rules (CtP) were simulated.	
pump capacity	A pump capacity of 3.84 ML/day was available for irrigation and 0.00 ML/day was available for Stock and Domestic and LWU water extraction.	
on-river dam access	No on-river dams simulated.	
on-farm storage available	No on-farm storage simulated.	
Irrigation pattern		Moderate

Water source and model	Bredbo: model Bredbo River
crop	The crop mix assumed is from the survey for a conversion of unregulated licences carried out in 2000. The crop survey result for Stressed Rivers Assessment unit “Bredbo” (410_07) was used. This crop mix is represented by simulating the water demands of the following crops: • Lucerne 96% • Vegetables 4% The total area irrigated (based on the full development of the entitlement) in the Bredbo River system was estimated to be 39ha. The weather station used was Bredbo (Bredbo Station) (station number 70098). The crop factor file used was “sthtab6ed.crp”, which was developed for the licence conversion process.
Groundwater extraction	No substaintial alluvial extractions indentified as impacting on streamflow.
Licence locations	

Table 140. Kyeamba Creek

Water source and model	**Kyeamba: model Kyeamba Creek**	
Water source boundaries	The main stream is Kyeamba Creek with headwater streams flowing into it.	
Assumptions		**Confidence**
Flow sequence		Low
flows used	A measured flow sequence was used to represent the streamflow available to be extracted. This flow was measured at the gauging station "Kyeamba Creek at Book Book" (410156). The flow sequence extends from 12/07/1985 to 08/10/2015, 30.2 years in total. There was no need to fill any gaps in the measured flow sequence.	
total area factor	The flow sequence was factored for area by 4.13.	
on-river dams area factor	No on-river dam simulated.	
on-farm dams area factor	No on-farm dams simulated.	
Water access		Moderate
level of entitlement	The total entitlement simulated was 406 ML made up of: • 388 ML Unregulated category entitlement • 18 ML Domestic and Stock category	
access rules (CtP)	The CtP was simulated by placing a threshold on the irriration pumps of 1 ML/day, which simulated a CtP at the end of the system.	
higher access rule (CtP on Approval)	No higher of access rules (CtP) were simulated.	
pump capacity	A pump capacity of 6.47 ML/day was available for irrigation and 0.05 ML/day was available for Stock and Domestic and LWU water extraction.	
on-river dam access	No on-river dams simulated.	
on-farm storage available	No on-farm storage simulated.	
Irrigation pattern		High

Water source and model	Kyeamba: model Kyeamba Creek
crop	The crop mix assumed is from the survey for a conversion of unregulated licences carried out in 2000. The crop survey result for Stressed Rivers Assessment unit “Kyeamba” (410_31) was used. This crop mix is represented by simulating the water demands of the following crops: • Annual pasture 2% • Lucerne 25% • Intensive perenial pasture 41% • Summer Maize 15% • Wheat 17% The total area irrigated (based on the full development of the entitlement) in the Kyeamba Creek system was estimated to be 64ha. The weather station used was Wagga Wagga Amo (station number 72150). The crop factor file used was “sthwst6ed.crp”, which was developed for the licence conversion process.
Groundwater extraction	No substaintial alluvial extractions indentified as impacting on streamflow.
Licence locations	The CtP is triggered at a location below the majority of the irrigation pumps, hence it is simulated as if all pumps are above the trigger point.

Table 141. Lake George

Water source and model	**Lake George: model Lake George**	
Water source boundaries	The main waterbody is Lake George with headwater streams flowing into it. Lake George is a sink and there is no surface fow out of the system.	
Assumptions		**Confidence**
Flow sequence		Low
flows used	A measured flow sequence was used to represent the streamflow available to be extracted. This flow was measured at the gauging station "Turallo Creek at Bungendore" (411002). The flow sequence extends from 24/09/1971 to 18/01/1980, 8.3 years in total. 28.5% of the measured sequenced need to be filled using a correlation with a nearby gauging station.	
total area factor	The flow sequence was factored for area by 2.10.	
on-river **dams area factor**	No on-river dam simulated.	
on-farm **dams area factor**	No on-farm dams simulated.	
Water access		High
level of entitlement	The total entitlement simulated was 332 ML made up of: • 391.5 ML Unregulated category entitlement • 12 ML Domestic and Stock category	
access rules (CtP)	A CtP was not simulated.	
higher access rule (CtP on Approval)	No higher of access rules (CtP) were simulated.	
pump capacity	A pump capacity of 6.53 ML/day was available for irrigation and 0.03 ML/day was available for Stock and Domestic and LWU water extraction.	
on-river dam access	No on-river dams simulated.	
on-farm storage available	No on-farm storage simulated.	
Irrigation pattern		Moderate

Water source and model	Lake George: model Lake George
crop	The crop mix assumed is from the survey for a conversion of unregulated licences carried out in 2000. The crop survey result for Stressed Rivers Assessment unit “Bredbo” (410_07) was used. This crop mix is represented by simulating the water demands of the following crops: • Lucerne 96% • Vegetables 4% The total area irrigated (based on the full development of the entitlement) in the Lake George system was estimated to be 65ha. The weather station used was Bungendore Post Office (station number 70011). The crop factor file used was “sthtab6ed.crp”, which was developed for the licence conversion process.
Groundwater extraction	No substaintial alluvial extractions indentified as impacting on streamflow.
Licence locations	

Table 142. Lower Billabong

Water source and model	Lower Billabong: model Billabong Creek	
Water source boundaries	The main stream is Billabong Creek downstream of other water sources that flow into it.	
Assumptions		**Confidence**
Flow sequence		Moderate
flows used	A measured flow sequence was used to represent the streamflow available to be extracted. This flow was measured at the gauging station "Billabong Creek at Cocketgedong" (410012). The flow sequence extends from 02/01/1916 to 17/11/2015, 99.9 years in total. 15.3% of the measured sequenced need to be filled using a correlation with a nearby gauging station.	
total area factor	The flow sequence was factored for area by 1.00.	
on-river dams area factor	No on-river dam simulated.	
on-farm dams area factor	No on-farm dams simulated.	
Water access		Moderate
level of entitlement	The total entitlement simulated was 1,630 ML made up of: • 1,563 ML Unregulated category entitlement • 67 ML Domestic and Stock category	
access rules (CtP)	The CtP was simulated by placing a threshold on the irriration pumps of 49ML/day, which simulated a CtP at the end of the system.	
higher access rule (CtP on Approval)	No higher of access rules (CtP) were simulated.	
pump capacity	A pump capacity of 26.05 ML/day was available for irrigation and 0.18 ML/day was available for Stock and Domestic and LWU water extraction.	
on-river dam access	No on-river dams simulated.	
on-farm storage available	No on-farm storage simulated.	
Irrigation pattern		High

Water source and model	Lower Billabong: model Billabong Creek
crop	The crop mix assumed is from the survey for a conversion of unregulated licences carried out in 2000. The crop survey result for Stressed Rivers Assessment unit “Lower Billabong” (409_07) was used. This crop mix is represented by simulating the water demands of the following crops: • Annual pasture 37% • Citrus 4% • Lucerne 6% • Perennial pasture 23% • Wheat 21% • Rice 9% The total area irrigated (based on the full development of the entitlement) in the Billabong Creek system was estimated to be 619ha. The weather station used was Walbundrie (Crediton Street) (station number 74115). The crop factor file used was “sthwst6ed.crp”, which was developed for the licence conversion process.
Groundwater extraction	No substaintial alluvial extractions indentified as impacting on streamflow.
Licence locations	The CtP is triggered at a location below the majority of the irrigation pumps, hence it is simulated as if all pumps are above the trigger point.

Table 143. Murrumbidgee River I

Water source and model	Murrumbidgee I: model Murrumbidgee River	
Water source boundaries	The main stream is the Murrumbidgee River downstream of other water sources that flow into it.	
Assumptions		**Confidence**
Flow sequence		Moderate
flows used	A measured flow sequence was used to represent the streamflow available to be extracted. This flow was measured at the gauging station "Murrumbidgee River at Mittagang Crossing" (410033). The flow sequence extends from 28/03/1926 to 20/01/2011, 84.8 years in total. 80.0% of the measured sequenced need to be filled using a correlation with a nearby gauging station.	
total area factor	The flow sequence was factored for area by 1.02.	
on-river dams area factor	No on-river dam simulated.	
on-farm dams area factor	No on-farm dams simulated.	
Water access		High
level of entitlement	The total entitlement simulated was 4,541 ML made up of: • 1,752.5 ML Unregulated category entitlement • 654.5 ML Domestic and Stock category • 2,134 ML LWU category entitlement	
access rules (CtP)	The CtP was simulated by placing a threshold on the irriration pumps of 33ML/day, which simulated a CtP at the end of the system.	
higher access rule (CtP on Approval)	No higher of access rules (CtP) were simulated.	
pump capacity	A pump capacity of 29.21 ML/day was available for irrigation and 7.64 ML/day was available for Stock and Domestic and LWU water extraction.	
on-river dam access	No on-river dams simulated.	
on-farm storage available	No on-farm storage simulated.	
Irrigation pattern		High

Water source and model	Murrumbidgee I: model Murrumbidgee River
crop	The crop mix assumed is from the survey for a conversion of unregulated licences carried out in 2000. The crop survey result for Stressed Rivers Assessment unit “Murrumbidgee I” (410_05) was used. This crop mix is represented by simulating the water demands of the following crops: • Lucerne 18% • Perennial pasture 17% • Wheat 27% • Vegetables 37% • Pecans 1% The total area irrigated (based on the full development of the entitlement) in the Murrumbidgee River system was estimated to be 383ha. The weather station used was Cooma (Kiaora) (station number 70054). The crop factor file used was “sthtab6ed.crp”, which was developed for the licence conversion process.
Groundwater extraction	No substaintial alluvial extractions indentified as impacting on streamflow.
Licence locations	The CtP is triggered at a location below the majority of the irrigation pumps, hence it is simulated as if all pumps are above the trigger point.

Table 144. Murrumbidgee River II

Water source and model	**Murrumbidgee II: model Murrumbidgee River**	
Water source boundaries	The main stream is the Murrumbidgee River downstream of other water sources that flow into it.	
Assumptions		**Confidence**
Flow sequence		Moderate
flows used	A measured flow sequence was used to represent the streamflow available to be extracted. This flow was measured at the gauging station "Murrumbidgee River at Billilingra" (410050). The flow sequence extends from 01/08/1966 to 20/01/2011, 44.5 years in total. 80.0% of the measured sequenced need to be filled using a correlation with a nearby gauging station.	
total area factor	The flow sequence was factored for area by 1.44.	
on-river dams area factor	No on-river dam simulated.	
on-farm dams area factor	No on-farm dams simulated.	
Water access		High
level of entitlement	The total entitlement simulated was 16,042.5 ML made up of: • 13,190.5 ML Unregulated category entitlement • 2,852 ML Domestic and Stock category • 0 ML LWU category entitlement	
access rules (CtP)	The CtP was simulated by placing a threshold on the irriration pumps of 27 ML/day, which simulated a CtP at the end of the system.	
higher access rule (CtP on Approval)	No higher of access rules (CtP) were simulated.	
pump capacity	A pump capacity of 219.84 ML/day was available for irrigation and 7.81 ML/day was available for Stock and Domestic and LWU water extraction.	
on-river dam access	No on-river dams simulated.	
on-farm storage available	No on-farm storage simulated.	
Irrigation pattern		High

Water source and model	Murrumbidgee II: model Murrumbidgee River
crop	The crop mix assumed is from the survey for a conversion of unregulated licences carried out in 2000. The crop survey result for Stressed Rivers Assessment unit “Murrumbidgee II” (410_06) was used. This crop mix is represented by simulating the water demands of the following crops: • Lucerne 33% • Perennial pasture 17% • Summer Maize 2% • Grapes 2% • Wheat 16% • Vegetables 30% The total area irrigated (based on the full development of the entitlement) in the Murrumbidgee River system was estimated to be 2654ha. The weather station used was Bredbo (Bredbo Station) (station number 70098). The crop factor file used was “sthtab6ed.crp”, which was developed for the licence conversion process.
Groundwater extraction	No substaintial alluvial extractions indentified as impacting on streamflow.
Licence locations	The CtP is triggered at a location below the majority of the irrigation pumps, hence it is simulated as if all pumps are above the trigger point.

Table 145. Murrumbidgee North

Water source and model	**Murrumbidgee North: model Mirool Creek, Sandy Creek, Boggy Creek, and Cowabbie/Redbank/Yarran Creek system**	
Water source boundaries	The main streams are Mirool Creek, Sandy Creek, Boggy Creek, and Cowabbie/Redbank/Yarran Creek system, which flow into the regulated river.	
Assumptions		**Confidence**
Flow sequence		Low
flows used	A measured flow sequence was used to represent the streamflow available to be extracted. This flow was measured at a gauging station from an adjacent catchement "Houlaghans Creek at Downside" (410103). The flow sequence extends from 19/07/1980 to 24/11/2015, 35.3 years in total. There was no need to fill any gaps in the measured flow sequence.	
total area factor	The flow sequence was factored for area by 2.17.	
on-river dams area factor	No on-river dam simulated.	
on-farm dams area factor	No on-farm dams simulated.	
Water access		Moderate
level of entitlement	The total entitlement simulated was 689 ML made up of: • 659 ML Unregulated category entitlement • 30 ML Domestic and Stock category	
access rules (CtP)	A CtP was not simulated.	
higher access rule (CtP on Approval)	No higher of access rules (CtP) were simulated.	
pump capacity	A pump capacity of 10.98 ML/day was available for irrigation and 0.08 ML/day was available for Stock and Domestic and LWU water extraction.	
on-river dam access	No on-river dams simulated.	
on-farm storage available	No on-farm storage simulated.	
Irrigation pattern		Low

Water source and model	Murrumbidgee North: model Mirool Creek, Sandy Creek, Boggy Creek, and Cowabbie/Redbank/Yarran Creek system	
crop	The crop mix assumed is from the survey for a conversion of unregulated licences carried out in 2000. The crop survey result for Stressed Rivers Assessment unit “Bredbo” (410_07) was used. This crop mix is represented by simulating the water demands of the following crops: • Lucerne 96% • Vegetables 4% The total area irrigated (based on the full development of the entitlement) in the Mirool Creek, Sandy Creek, Boggy Creek, and Cowabbie/Redbank/Yarran Creek system was estimated to be 110ha. The weather station used was Ardlethan Post Office (station number 74000). The crop factor file used was “sthwst6ed.crp”, which was developed for the licence conversion process.	xxx
Groundwater extraction	No substaintial alluvial extractions indentified as impacting on streamflow.	
Licence locations		

Table 146. Middle Billabong

Water source and model	Middle Billabong: model Billabong Creek	
Water source boundaries	The main stream is Billabong Creek downstream of other water sources that flow into it.	
Assumptions		**Confidence**
Flow sequence		Moderate
flows used	A measured flow sequence was used to represent the streamflow available to be extracted. This flow was measured at the gauging station "Billabong Creek at Walbundrie" (410091). The flow sequence extends from 19/06/1965 to 02/12/2015, 50.5 years in total. 1.3% of the measured sequenced need to be filled using a correlation with a nearby gauging station.	
total area factor	The flow sequence was factored for area by 1.00.	
on-river dams area factor	No on-river dam simulated.	
on-farm dams area factor	No on-farm dams simulated.	
Water access		High
level of entitlement	The total entitlement simulated was 379 ML made up of: • 353 ML Unregulated category entitlement • 26 ML Domestic and Stock category	
access rules (CtP)	The CtP was simulated by placing a threshold on the irriration pumps of 49 ML/day, which simulated a CtP at the end of the system.	
higher access rule (CtP on Approval)	No higher of access rules (CtP) were simulated.	
pump capacity	A pump capacity of 5.88 ML/day was available for irrigation and 0.07 ML/day was available for Stock and Domestic and LWU water extraction.	
on-river dam access	No on-river dams simulated.	
on-farm storage available	No on-farm storage simulated.	
Irrigation pattern		Moderate

Water source and model	Middle Billabong: model Billabong Creek
crop	The crop mix assumed is from the survey for a conversion of unregulated licences carried out in 2000. The crop survey result for Stressed Rivers Assessment unit “Upper Billabong” (409_19) was used. This crop mix is represented by simulating the water demands of the following crops: • Lucerne 65% • Summer Maize 35% The total area irrigated (based on the full development of the entitlement) in the Billabong Creek system was estimated to be 52.9ha. The weather station used was Culcairn Bowling Club (station number 74188). The crop factor file used was “sthwst6ed.crp”, which was developed for the licence conversion process.
Groundwater extraction	No substaintial alluvial extractions indentified as impacting on streamflow.
Licence locations	The CtP is triggered at a location below the majority of the irrigation pumps, hence it is simulated as if all pumps are above the trigger point.

Table 147. Numeralla East

Water source and model	Numeralla East: model Numeralla River	
Water source boundaries	The main stream is the Numeralla River downstream of other water sources that flow into it.	
Assumptions		**Confidence**
Flow sequence		Low
flows used	A measured flow sequence was used to represent the streamflow available to be extracted. This flow was measured at the gauging station "Numeralla River at Numeralla School" (410062). The flow sequence extends from 04/06/1964 to 14/10/2015, 51.4 years in total. 1.0% of the measured sequenced need to be filled using a correlation with a nearby gauging station.	
total area factor	The flow sequence was factored for area by 2.47.	
on-river dams area factor	No on-river dam simulated.	
on-farm dams area factor	No on-farm dams simulated.	
Water access		Moderate
level of entitlement	The total entitlement simulated was 4,310 ML made up of: • 4,284 ML Unregulated category entitlement • 26 ML Domestic and Stock category	
access rules (CtP)	The CtP was simulated by placing a threshold on the irriration pumps of 4.5ML/day, which simulated a CtP at the end of the system.	
higher access rule (CtP on Approval)	No higher of access rules (CtP) were simulated.	
pump capacity	A pump capacity of 71.40 ML/day was available for irrigation and 0.07 ML/day was available for Stock and Domestic and LWU water extraction.	
on-river dam access	No on-river dams simulated.	
on-farm storage available	No on-farm storage simulated.	
Irrigation pattern		High

Water source and model	Numeralla East: model Numeralla River
crop	The crop mix assumed is from the survey for a conversion of unregulated licences carried out in 2000. The crop survey result for Stressed Rivers Assessment unit “Numeralla East” (410_02) was used. This crop mix is represented by simulating the water demands of the following crops: • Annual pasture 3% • Citrus 56% • Lucerne 28% • Perennial pasture 7% • Wheat 1% • Vegetables 5% The total area irrigated (based on the full development of the entitlement) in the Numeralla River system was estimated to be 1808ha. The weather station used was Cooma North Smhec (station number 70094). The crop factor file used was “sthwst6ed.crp”, which was developed for the licence conversion process.
Groundwater extraction	No substaintial alluvial extractions indentified as impacting on streamflow.
Licence locations	The CtP is triggered at a location below the majority of the irrigation pumps, hence it is simulated as if all pumps are above the trigger point.

Table 148. Numeralla West

Water source and model	Numeralla West: model Flat Rock Creek and Cooma Creek	
Water source boundaries	The main streams are Flat Rock Creek and Cooma Creek with headwater streams flowing into it.	
Assumptions		**Confidence**
Flow sequence		Moderate
flows used	A measured flow sequence was used to represent the streamflow available to be extracted. This flow was measured at a gauging station from an adjacent catchement "Numeralla River at Numeralla School" (410062). The flow sequence extends from 04/06/1964 to 14/10/2015, 51.4 years in total. 1.0% of the measured sequenced need to be filled using a correlation with a nearby gauging station.	
total area factor	The flow sequence was factored for area by 0.82.	
on-river dams area factor	No on-river dam simulated.	
on-farm dams area factor	No on-farm dams simulated.	
Water access		High
level of entitlement	The total entitlement simulated was 345.5 ML made up of: • 339 ML Unregulated category entitlement • 6.5 ML Domestic and Stock category	
access rules (CtP)	The CtP was simulated by placing a threshold on the irriration pumps of 0.6 ML/day, which simulated a CtP at the end of the system.	
higher access rule (CtP on Approval)	No higher of access rules (CtP) were simulated.	
pump capacity	A pump capacity of 5.65 ML/day was available for irrigation and 0.02 ML/day was available for Stock and Domestic and LWU water extraction.	
on-river dam access	No on-river dams simulated.	
on-farm storage available	No on-farm storage simulated.	
Irrigation pattern		High

Water source and model	Numeralla West: model Flat Rock Creek and Cooma Creek
crop	The crop mix assumed is from the survey for a conversion of unregulated licences carried out in 2000. The crop survey result for Stressed Rivers Assessment unit “Numeralla West” (410_04) was used. This crop mix is represented by simulating the water demands of the following crops: • Annual pasture 6% • Citrus 1% • Lucerne 88% • Orchard 4% • Perennial pasture 1% The total area irrigated (based on the full development of the entitlement) in the Flat Rock Creek and Cooma Creek system was estimated to be 60ha. The weather station used was Cooma North Smhec (station number 70094). The crop factor file used was “sthtab6ed.crp”, which was developed for the licence conversion process.
Groundwater extraction	No substaintial alluvial extractions indentified as impacting on streamflow.
Licence locations	The CtP is triggered at a location below the majority of the irrigation pumps, hence it is simulated as if all pumps are above the trigger point.

Table 149. Queanbeyan

Water source and model	**Queanbeyan: model Queanbeyan River**	
Water source boundaries	The main stream is the Queanbeyan River with headwater streams flowing into it.	
Assumptions		**Confidence**
Flow sequence		Low
flows used	A measured flow sequence was used to represent the streamflow available to be extracted. This flow was measured at a gauging station from an adjacent catchement "Shoalhaven River at Kadoona" (215008). The flow sequence extends from 22/01/1976 to 29/04/2009, 33.3 years in total. 1.4% of the measured sequenced need to be filled using a correlation with a nearby gauging station.	
total area factor	The flow sequence was factored for area by 2.89.	
on-river **dams area factor**	No on-river dam simulated.	
on-farm **dams area factor**	No on-farm dams simulated.	
Water access		High
level of entitlement	The total entitlement simulated was 32 ML made up of: • 32 ML Unregulated category entitlement	
access rules (CtP)	The CtP of 1 ML/day was not simulated as the CtP is expected not to be implemented.	
higher access rule (CtP on Approval)	No higher of access rules (CtP) were simulated.	
pump capacity	A pump capacity of 0.53 ML/day was available for irrigation and 0.00ML/day was available for Stock and Domestic and LWU water extraction.	
on-river dam access	No on-river dams simulated.	
on-farm storage available	No on-farm storage simulated.	
Irrigation pattern		Moderate

Water source and model	Queanbeyan: model Queanbeyan River
crop	The crop mix assumed is from the survey for a conversion of unregulated licences carried out in 2000. The crop survey result for Stressed Rivers Assessment unit “Queanbeyan” (410_08) was used. This crop mix is represented by simulating the water demands of the following crops: • Citrus 21% • Turf 79% The total area irrigated (based on the full development of the entitlement) in the Queanbeyan River system was estimated to be 4 ha. The weather station used was Queanbeyan Bowling Club (station number 70072). The crop factor file used was “sthtab6ed.crp”, which was developed for the licence conversion process.
Groundwater extraction	No substaintial alluvial extractions indentified as impacting on streamflow.
Licence locations	

Table 150. Burrumbuttock

Water source and model	Burrumbuttock: model Burrumbuttock Creek	
Water source boundaries	The main stream is Burrumbuttock Creek with headwater streams flowing into it.	
Assumptions		**Confidence**
Flow sequence		Low
flows used	A measured flow sequence was used to represent the streamflow available to be extracted. This flow was measured at a gauging station from an adjacent catchement “Bowna Creek at Yambla” (401015). The flow sequence extends from 18/12/1973 to 28/07/2011, 37.6 years in total. 0.5% of the measured sequenced need to be filled using a correlation with a nearby gauging station.	
total area factor	The flow sequence was factored for area by 0.75.	
on-river dams area factor	No on-river dam simulated.	
on-farm dams area factor	No on-farm dams simulated.	
Water access		High
level of entitlement	The total entitlement simulated was 95 ML made up of: • 95 ML Unregulated category entitlement	
access rules (CtP)	A CtP was not simulated.	
higher access rule (CtP on Approval)	No higher of access rules (CtP) were simulated.	
pump capacity	A pump capacity of 1.58ML/day was available for irrigation and 0.00ML/day was available for Stock and Domestic and LWU water extraction.	
on-river dam access	No on-river dams simulated.	
on-farm storage available	No on-farm storage simulated.	
Irrigation pattern		Moderate

Water source and model	Burrumbuttock: model Burrumbuttock Creek
crop	The crop mix assumed is from the survey for a conversion of unregulated licences carried out in 2000. The crop survey result for Stressed Rivers Assessment unit “Upper Billabong” (409_19) was used. This crop mix is represented by simulating the water demands of the following crops: • Lucerne 65% • Summer Maize 35% The total area irrigated (based on the full development of the entitlement) in the Burrumbuttock Creek system was estimated to be 14.2ha. The weather station used was Walbundrie (Crediton Street) (station number 74115). The crop factor file used was “sthwst6ed.crp”, which was developed for the licence conversion process.
Groundwater extraction	No substaintial alluvial extractions indentified as impacting on streamflow.
Licence locations	

Table 151. Mountain Creek

Water source and model	**Mountain: model Mountain Creek**	
Water source boundaries	The main stream is Mountain Creek with headwater streams flowing into it.	
Assumptions		**Confidence**
Flow sequence		Moderate
flows used	A measured flow sequence was used to represent the streamflow available to be extracted. This flow was measured at the gauging station "Mountain Creek at Thomond North" (410096). The flow sequence extends from 21/11/1967 to 04/01/1994, 26.1 years in total. 3.1% of the measured sequenced need to be filled using a correlation with a nearby gauging station.	
total area factor	The flow sequence was factored for area by 1.98.	
on-river dams area factor	No on-river dam simulated.	
on-farm dams area factor	No on-farm dams simulated.	
Water access		High
level of entitlement	The total entitlement simulated was 7 ML made up of: • 7 ML Domestic and Stock category	
access rules (CtP)	The CtP was simulated by placing a threshold on the irriration pumps of 1ML/day, which simulated a CtP at the end of the system.	
higher access rule (CtP on Approval)	No higher of access rules (CtP) were simulated.	
pump capacity	A pump capacity of 0.12ML/day was available for irrigation and 0.02ML/day was available for Stock and Domestic and LWU water extraction.	
on-river dam access	No on-river dams simulated.	
on-farm storage available	No on-farm storage simulated.	
Irrigation pattern		Moderate

Water source and model	Mountain: model Mountain Creek
crop	The crop mix assumed is from the survey for a conversion of unregulated licences carried out in 2000. The crop survey result for Stressed Rivers Assessment unit “Upper Billabong” (409_19) was used. This crop mix is represented by simulating the water demands of the following crops: • Lucerne 65% • Summer Maize 35% The total area irrigated (based on the full development of the entitlement) in the Mountain Creek system was estimated to be 1ha. The weather station used was Holbrook (RSL) (station number 72022). The crop factor file used was “sthwst6ed.crp”, which was developed for the licence conversion process.
Groundwater extraction	No substaintial alluvial extractions indentified as impacting on streamflow.
Licence locations	The CtP is triggered at a location below the majority of the irrigation pumps, hence it is simulated as if all pumps are above the trigger point.

Table 152. Ten Mile Creek

Water source and model	**Ten Mile: model Ten Mile Creek**	
Water source boundaries	The main stream is Ten Mile Creek with headwater streams flowing into it.	
Assumptions		**Confidence**
Flow sequence		Moderate
flows used	A measured flow sequence was used to represent the streamflow available to be extracted. This flow was measured at a gauging station from an adjacent catchement "Mountain Creek at Thomond North" (410096). The flow sequence extends from 21/11/1967 to 04/01/1994, 26.1 years in total. 3.1% of the measured sequenced need to be filled using a correlation with a nearby gauging station.	
total area factor	The flow sequence was factored for area by 1.54.	
on-river dams area factor	No on-river dam simulated.	
on-farm dams area factor	No on-farm dams simulated.	
Water access		High
level of entitlement	The total entitlement simulated was 0 ML made up of: • 7 ML Unregulated category entitlement	
access rules (CtP)	The CtP was simulated by placing a threshold on the irriration pumps of 1ML/day, which simulated a CtP at the end of the system.	
higher access rule (CtP on Approval)	No higher of access rules (CtP) were simulated.	
pump capacity	A pump capacity of 0.12 ML/day was available for irrigation and 0.00 ML/day was available for Stock and Domestic and LWU water extraction.	
on-river dam access	No on-river dams simulated.	
on-farm storage available	No on-farm storage simulated.	
Irrigation pattern		Moderate

Water source and model	Ten Mile: model Ten Mile Creek
crop	The crop mix assumed is from the survey for a conversion of unregulated licences carried out in 2000. The crop survey result for Stressed Rivers Assessment unit “Upper Billabong” (409_19) was used. This crop mix is represented by simulating the water demands of the following crops: • Lucerne 65% • Summer Maize 35% The total area irrigated (based on the full development of the entitlement) in the Ten Mile Creek system was estimated to be 1ha. The weather station used was Holbrook (RSL) (station number 72022). The crop factor file used was “sthwst6ed.crp”, which was developed for the licence conversion process.
Groundwater extraction	No substaintial alluvial extractions indentified as impacting on streamflow.
Licence locations	The CtP is triggered at a location below the majority of the irrigation pumps, hence it is simulated as if all pumps are above the trigger point.

Table 153. Upper Billabong

Water source and model	Upper Billabong: model upper reaches of Billabong Creek	
Water source boundaries	The main stream is upper reaches of Billabong Creek with headwater streams flowing into it.	
Assumptions		**Confidence**
Flow sequence		High
flows used	A measured flow sequence was used to represent the streamflow available to be extracted. This flow was measured at the gauging station "Billabong Creek at Aberfeldy" (410097). The flow sequence extends from 23/11/1967 to 27/11/2011, 44.0 years in total. 8.0% of the measured sequenced need to be filled using a correlation with a nearby gauging station.	
total area factor	The flow sequence was factored for area by 1.02.	
on-river dams area factor	No on-river dam simulated.	
on-farm dams area factor	No on-farm dams simulated.	
Water access		High
level of entitlement	The total entitlement simulated was 337 ML made up of: • 330 ML Unregulated category entitlement • 7 ML Domestic and Stock category	
access rules (CtP)	The CtP of 1.84 ML/day was not simulated as the CtP is expected not to be implemented.	
higher access rule (CtP on Approval)	No higher of access rules (CtP) were simulated.	
pump capacity	A pump capacity of 5.50 ML/day was available for irrigation and 0.02 ML/day was available for Stock and Domestic and LWU water extraction.	
on-river dam access	No on-river dams simulated.	
on-farm storage available	No on-farm storage simulated.	
Irrigation pattern		High

Water source and model	Upper Billabong: model upper reaches of Billabong Creek
crop	The crop mix assumed is from the survey for a conversion of unregulated licences carried out in 2000. The crop survey result for Stressed Rivers Assessment unit “Upper Billabong” (409_19) was used. This crop mix is represented by simulating the water demands of the following crops: • Lucerne 65% • Summer Maize 35% The total area irrigated (based on the full development of the entitlement) in the upper reaches of Billabong Creek system was estimated to be 49.4ha. The weather station used was Holbrook (Glenfalloch) (station number 72019). The crop factor file used was “sthwst6ed.crp”, which was developed for the licence conversion process.
Groundwater extraction	No substaintial alluvial extractions indentified as impacting on streamflow.
Licence locations	

Table 154. Urana

Water source and model	Urana: model Lake Urana	
Water source boundaries	The main waterbody is Lake Urana with headwater streams flowing into it. The lake is fed by the Urangeline Creek system.	
Assumptions		**Confidence**
Flow sequence		Low
flows used	A measured flow sequence was used to represent the streamflow available to be extracted. This flow was measured at a gauging station from an adjacent catchement "Bullenbung Creek at Above Old Man Creek" (410087). The flow sequence extends from 16/03/1959 to 31/12/1972, 13.8 years in total. 5.2% of the measured sequenced need to be filled using a correlation with a nearby gauging station.	
total area factor	The flow sequence was factored for area by 4.40.	
on-river dams area factor	No on-river dam simulated.	
on-farm dams area factor	No on-farm dams simulated.	
Water access		Moderate
level of entitlement	The total entitlement simulated was 403 ML made up of: • 229 ML Unregulated category entitlement • 174 ML Domestic and Stock category	
access rules (CtP)	A CtP was not simulated.	
higher access rule (CtP on Approval)	No higher of access rules (CtP) were simulated.	
pump capacity	A pump capacity of 3.82 ML/day was available for irrigation and 0.48 ML/day was available for Stock and Domestic and LWU water extraction.	
on-river dam access	No on-river dams simulated.	
on-farm storage available	No on-farm storage simulated.	
Irrigation pattern		High

Water source and model	Urana: model Lake Urana
crop	The crop mix assumed is from the survey for a conversion of unregulated licences carried out in 2000. The crop survey result for Stressed Rivers Assessment unit “Urana” (409_21) was used. This crop mix is represented by simulating the water demands of the following crops: • Perennial pasture 50% • Summer Maize 50% The total area irrigated (based on the full development of the entitlement) in the Lake Urana system was estimated to be 36.6 ha. The weather station used was Urana Post Office (station number 74110). The crop factor file used was “sthwst6ed.crp”, which was developed for the licence conversion process.
Groundwater extraction	No substaintial alluvial extractions indentified as impacting on streamflow.
Licence locations	

Table 155. Yarra Yarra

Water source and model	Yarra Yarra: model Yarra Yarra Creek	
Water source boundaries	The main stream is Yarra Yarra Creek with headwater streams flowing into it.	
Assumptions		**Confidence**
Flow sequence		High
flows used	A measured flow sequence was used to represent the streamflow available to be extracted. This flow was measured at the gauging station "Yarra Yarra Creek at Yarra Yarra" (410099). The flow sequence extends from 23/11/1967 to 31/05/1973, 5.5 years in total. 2.4% of the measured sequenced need to be filled using a correlation with a nearby gauging station.	
total area factor	The flow sequence was factored for area by 1.34.	
on-river dams area factor	No on-river dam simulated.	
on-farm dams area factor	No on-farm dams simulated.	
Water access		High
level of entitlement	The total entitlement simulated was 32 ML made up of: • 12 ML Unregulated category entitlement • 20 ML Domestic and Stock category	
access rules (CtP)	The visible flow CtP was simulated by allowing access down to zero flow, which is the same as simulating no CtP.	
higher access rule (CtP on Approval)	No higher of access rules (CtP) were simulated.	
pump capacity	A pump capacity of 0.20 ML/day was available for irrigation and 0.05 ML/day was available for Stock and Domestic and LWU water extraction.	
on-river dam access	No on-river dams simulated.	
on-farm storage available	No on-farm storage simulated.	
Irrigation pattern		Moderate

Water source and model	Yarra Yarra: model Yarra Yarra Creek
crop	The crop mix assumed is from the survey for a conversion of unregulated licences carried out in 2000. The crop survey result for Stressed Rivers Assessment unit “Upper Billabong” (409_19) was used. This crop mix is represented by simulating the water demands of the following crops: • Lucerne 65% • Summer Maize 35% The total area irrigated (based on the full development of the entitlement) in the Yarra Yarra Creek system was estimated to be 1.8ha. The weather station used was Holbrook (RSL) (station number 72022). The crop factor file used was “sthwst6ed.crp”, which was developed for the licence conversion process.
Groundwater extraction	No substaintial alluvial extractions indentified as impacting on streamflow.
Licence locations	

Murray unregulated river models

Table 156. Albury

Water source and model	Albury: model Dead Mans, Splitters, Bungambrawatha, and Eight Mile Creeks	
Water source boundaries	The main streams are Dead Mans, Splitters, Bungambrawatha, and Eight Mile Creeks, which flow into the regulated river.	
Assumptions		**Confidence**
Flow sequence		Low
flows used	A measured flow sequence was used to represent the streamflow available to be extracted. This flow was measured at a gauging station from an adjacent catchement “Bowna Creek at Yambla” (401015). The flow sequence extends from 18/12/1973 to 28/07/2011, 37.6 years in total. 0.5% of the measured sequenced need to be filled using a correlation with a nearby gauging station.	
total area factor	The flow sequence was factored for area by 0.83. Of this factor 25 was not avaliable to be accessed by licence holders.	
on-river dams area factor	No on-river dam simulated.	
on-farm dams area factor	No on-farm dams simulated.	
Water access		High
level of entitlement	The total entitlement simulated was 405 ML made up of: • 352 ML Unregulated category entitlement • 53 ML Domestic and Stock category	
access rules (CtP)	A CtP was not simulated.	
higher access rule (CtP on Approval)	No higher of access rules (CtP) were simulated.	
pump capacity	A pump capacity of 5.87 ML/day was available for irrigation and 0.15 ML/day was available for Stock and Domestic and LWU water extraction.	
on-river dam access	No on-river dams simulated.	
on-farm storage available	No on-farm storage simulated.	
Irrigation pattern		Low

Water source and model	Albury: model Dead Mans, Splitters, Bungambrawatha, and Eight Mile Creeks
crop	The crop mix assumed is from the survey for a conversion of unregulated licences carried out in 2000. The crop survey result for Stressed Rivers Assessment unit “Jingellic” (409_12) was used. This crop mix is represented by simulating the water demands of the following crops: • Annual pasture 34% • Fababean 33% • Soybeans 33% The total area irrigated (based on the full development of the entitlement) in the Dead Mans, Splitters, Bungambrawatha, and Eight Mile Creeks system was estimated to be 301ha. The weather station used was Albury Pumping Station (station number 72097). The crop factor file used was “sthwst6ed.crp”, which was developed for the licence conversion process.
Groundwater extraction	No substaintial alluvial extractions indentified as impacting on streamflow.
Licence locations	

Table 157. Hume

Water source and model	Hume: model Bowna Creek and a number of smaller creeks flowing in the Hume Weir	
Water source boundaries	The main streams are Bowna Creek and a number of smaller creeks flowing in the Hume Weir. It only includes the NSW stream north of the storage.	
Assumptions		**Confidence**
Flow sequence		Low
flows used	A measured flow sequence was used to represent the streamflow available to be extracted. This flow was measured at the gauging station "Bowna Creek at Yambla" (401015). The flow sequence extends from 18/12/1973 to 28/07/2011, 37.6 years in total. 0.5% of the measured sequenced need to be filled using a correlation with a nearby gauging station.	
total area factor	The flow sequence was factored for area by 2.54. Of this factor 116 was not avaliable to be accessed by licence holders.	
on-river dams area factor	No on-river dam simulated.	
on-farm dams area factor	No on-farm dams simulated.	
Water access		High
level of entitlement	The total entitlement simulated was 715 ML made up of: • 676 ML Unregulated category entitlement • 39 ML Domestic and Stock category	
access rules (CtP)	A CtP was not simulated.	
higher access rule (CtP on Approval)	No higher of access rules (CtP) were simulated.	
pump capacity	A pump capacity of 11.27 ML/day was available for irrigation and 0.11 ML/day was available for Stock and Domestic and LWU water extraction.	
on-river dam access	No on-river dams simulated.	
on-farm storage available	No on-farm storage simulated.	
Irrigation pattern		Low

Water source and model	Hume: model Bowna Creek and a number of smaller creeks flowing in the Hume Weir
crop	The crop mix assumed is from the survey for a conversion of unregulated licences carried out in 2000. The crop survey result for Stressed Rivers Assessment unit “Jingellic” (409_12) was used. This crop mix is represented by simulating the water demands of the following crops: • Annual pasture 34% • Fababean 33% • Soybeans 33% The total area irrigated (based on the full development of the entitlement) in the Bowna Creek and a number of smaller creeks flowing in the Hume Weir system was estimated to be 578ha. The weather station used was Jindera Post Office (station number 74056). The crop factor file used was “sthwst6ed.crp”, which was developed for the licence conversion process.
Groundwater extraction	No substaintial alluvial extractions indentified as impacting on streamflow.
Licence locations	

Table 158. Indi

Water source and model	Indi: model Murray River upstream of the confluence with Swampy Plain River	
Water source boundaries	The main stream is the Murray River upstream of the confluence with Swampy Plain River with headwater streams flowing into it. It only includes the NSW headwater stream north of the Murray River.	
Assumptions		**Confidence**
Flow sequence		High
flows used	A measured flow sequence was used to represent the streamflow available to be extracted. This flow was measured at the gauging station "Murray River at Biggara" (401012). The flow sequence extends from 22/07/1948 to 22/10/2011, 63.2 years in total. 0.2% of the measured sequenced need to be filled using a correlation with a nearby gauging station.	
total area factor	The flow sequence was factored for area by 1.08.	
on-river dams area factor	No on-river dam simulated.	
on-farm dams area factor	No on-farm dams simulated.	
Water access		Moderate
level of entitlement	The total entitlement simulated was 2,222 ML made up of: • 2,215 ML Unregulated category entitlement • 7 ML Domestic and Stock category	
access rules (CtP)	The CtP was simulated by placing a threshold (in a decision table) on the inflow above the irrigation pumps of 87 ML/day.	
higher access rule (CtP on Approval)	No higher of access rules (CtP) were simulated.	
pump capacity	A pump capacity of 36.92 ML/day was available for irrigation and 0.02 ML/day was available for Stock and Domestic and LWU water extraction.	
on-river dam access	No on-river dams simulated.	
on-farm storage available	No on-farm storage simulated.	
Irrigation pattern		High

Water source and model	Indi: model Murray River upstream of the confluence with Swampy Plain River
crop	The crop mix assumed is from the survey for a conversion of unregulated licences carried out in 2000. The crop survey result for Stressed Rivers Assessment unit “Indi” (409_01) was used. This crop mix is represented by simulating the water demands of the following crops: • Annual pasture 18% • Lucerne 1% • Perennial pasture 18% • Intensive Perennial Pasture 63% The total area irrigated (based on the full development of the entitlement) in the Murray River upstream of the confluence with Swampy Plain River system was estimated to be 366ha. The weather station used was Khancoban Smhea (station number 72060). The crop factor file used was “sthwst6ed.crp”, which was developed for the licence conversion process.
Groundwater extraction	No substaintial alluvial extractions indentified as impacting on streamflow.
Licence locations	The CtP is triggered at a location above the majority of the irrigation pumps, hence it is simulated as if all pumps are below the trigger point.

Table 159. Jingellic

Water source and model	Jingellic: model Jingellic Creek	
Water source boundaries	The main stream is Jingellic Creek with headwater streams flowing into it. There also a smaller tributary Horse Creek in the water source.	
Assumptions		**Confidence**
Flow sequence		High
flows used	A measured flow sequence was used to represent the streamflow available to be extracted. This flow was measured at the gauging station "Jingellic Creek at Jingellic" (401013). The flow sequence extends from 13/07/1965 to 23/11/2011, 46.4 years in total. 1.9% of the measured sequenced need to be filled using a correlation with a nearby gauging station.	
total area factor	The flow sequence was factored for area by 1.23. Of this factor 20 was not avaliable to be accessed by licence holders.	
on-river dams area factor	No on-river dam simulated.	
on-farm dams area factor	No on-farm dams simulated.	
Water access		High
level of entitlement	The total entitlement simulated was 249 ML made up of: • 240 ML Unregulated category entitlement • ML Domestic and Stock category	
access rules (CtP)	The CtP was simulated by placing a threshold (in a decision table) on the inflow above the irrigation pumps of 10 ML/day.	
higher access rule (CtP on Approval)	No higher of access rules (CtP) were simulated.	
pump capacity	A pump capacity of 4.00ML/day was available for irrigation and 0.02ML/day was available for Stock and Domestic and LWU water extraction.	
on-river dam access	No on-river dams simulated.	
on-farm storage available	No on-farm storage simulated.	
Irrigation pattern		High

Water source and model	Jingellic: model Jingellic Creek
crop	The crop mix assumed is from the survey for a conversion of unregulated licences carried out in 2000. The crop survey result for Stressed Rivers Assessment unit “Jingellic” (409_12) was used. This crop mix is represented by simulating the water demands of the following crops: • Annual pasture 34% • Fababean 33% • Soybeans 33% The total area irrigated (based on the full development of the entitlement) in the Jingellic Creek system was estimated to be 205ha. The weather station used was Walwa (station number 82052). The crop factor file used was “sthwst6ed.crp”, which was developed for the licence conversion process.
Groundwater extraction	No substaintial alluvial extractions indentified as impacting on streamflow.
Licence locations	The CtP is triggered at a location above the majority of the irrigation pumps, hence it is simulated as if all pumps are below the trigger point.

Table 160. Majors Creek

Water source and model	Majors: model Majors Creek	
Water source boundaries	The main stream is Majors Creek with headwater streams flowing into it. Part of the lower end of the water source has some small residual streams flowing into the trunk stream.	
Assumptions		**Confidence**
Flow sequence		Low
flows used	A measured flow sequence was used to represent the streamflow available to be extracted. This flow was measured at a gauging station from an adjacent catchement "Bowna Creek at Yambla" (401015). The flow sequence extends from 18/12/1973 to 28/07/2011, 37.6 years in total. 0.5% of the measured sequenced need to be filled using a correlation with a nearby gauging station.	
total area factor	The flow sequence was factored for area by 0.55.	
on-river dams area factor	A proportion of the streamflow sequence (2% of the unfactored flow sequence) is able to be captured by on-river dams.	
on-farm dams area factor	No on-farm dams simulated.	
Water access		High
level of entitlement	The total entitlement simulated was 81 ML made up of: • 76 ML Unregulated category entitlement • 5 ML Domestic and Stock category	
access rules (CtP)	A CtP was not simulated.	
higher access rule (CtP on Approval)	No higher of access rules (CtP) were simulated.	
pump capacity	A pump capacity of 1.27 ML/day was available for irrigation and 0.01 ML/day was available for Stock and Domestic and LWU water extraction.	
on-river dam access	50 ML of on-river dam capacity was simulated. 100% of the unregulated entitlement had access to on-river dams. 100% of the Stock and Domestic and LWU entitlement had access to the on-river dams.	
on-farm storage available	No on-farm storage simulated.	
Irrigation pattern		Low

Water source and model	Majors: model Majors Creek
crop	The crop mix assumed is from the survey for a conversion of unregulated licences carried out in 2000. The crop survey result for Stressed Rivers Assessment unit “Jingellic” (409_12) was used. This crop mix is represented by simulating the water demands of the following crops: • Annual pasture 34% • Fababean 33% • Soybeans 33% The total area irrigated (based on the full development of the entitlement) in the Majors Creek system was estimated to be 65ha. The weather station used was Howlong Post Office (station number 74054). The crop factor file used was “sthwst6ed.crp”, which was developed for the licence conversion process.
Groundwater extraction	No substantial alluvial extractions indentified as impacting on streamflow.
Licence locations	Some of the licences have access to on-river dams (see sections 'on-river dam area factor' and 'on-river dam access').

Table 161. Mannus

Water source and model	Mannus: model Mannus Creek	
Water source boundaries	The main stream is Mannus Creek with headwater streams flowing into it.	
Assumptions		**Confidence**
Flow sequence		High
flows used	A measured flow sequence was used to represent the streamflow available to be extracted. This flow was measured at the gauging station "Mannus Creek at Tooma" (401008). The flow sequence extends from 01/12/1947 to 24/10/2011, 63.9 years in total. 27.9% of the measured sequenced need to be filled using a correlation with a nearby gauging station.	
total area factor	The flow sequence was factored for area by 1.03.	
on-river dams area factor	A proportion of the streamflow sequence (1% of the unfactored flow sequence) is able to be captured by on-river dams.	
on-farm dams area factor	No on-farm dams simulated.	
Water access		Moderate
level of entitlement	The total entitlement simulated was 1671 ML made up of: • 1,655 ML Unregulated category entitlement • 16 ML Domestic and Stock category	
access rules (CtP)	The CtP was simulated by placing a threshold (in a decision table) on the inflow above the irrigation pumps of (used a equivalent trigger of 17.9 ML/day due to flow factoring) 9.4 ML/day.	
higher access rule (CtP on Approval)	No higher of access rules (CtP) were simulated.	
pump capacity	A pump capacity of 27.58 ML/day was available for irrigation and 0.04 ML/day was available for Stock and Domestic and LWU water extraction.	
on-river dam access	50 ML of on-river dam capacity was simulated. 3% of the unregulated entitlement had access to on-river dams. 0% of the Stock and Domestic and LWU entitlement had access to the on-river dams.	
on-farm storage available	No on-farm storage simulated.	
Irrigation pattern		High

Water source and model	Mannus: model Mannus Creek
crop	The crop mix assumed is from the survey for a conversion of unregulated licences carried out in 2000. The crop survey result for Stressed Rivers Assessment unit “Mannus” (409_15) was used. This crop mix is represented by simulating the water demands of the following crops: • Lucerne 2% • Orchard 9% • Perennial pasture 1% • Intensive Perennial Pasture 36% • Grapes 52% The total area irrigated (based on the full development of the entitlement) in the Mannus Creek system was estimated to be 324ha. The weather station used was Brookfield Forest Station (station number 72009). The crop factor file used was “sthwst6ed.crp”, which was developed for the licence conversion process.
Groundwater extraction	No substaintial alluvial extractions indentified as impacting on streamflow.
Licence locations	The CtP is triggered at a location above the majority of the irrigation pumps, hence it is simulated as if all pumps are below the trigger point. Some of the licences have access to on-river dams (see sections 'on-river dam area factor' and 'on-river dam access').

Table 162. Maragle

Water source and model	Maragle: model Maragle Creek	
Water source boundaries	The main stream is Maragle Creek with headwater streams flowing into it.	
Assumptions		**Confidence**
Flow sequence		High
flows used	A measured flow sequence was used to represent the streamflow available to be extracted. This flow was measured at the gauging station "Maragle Creek at Maragle" (401009). The flow sequence extends from 02/12/1947 to 23/11/2011, 64.0 years in total. 1.7% of the measured sequenced need to be filled using a correlation with a nearby gauging station.	
total area factor	The flow sequence was factored for area by 1.15.	
on-river dams area factor	A proportion of the streamflow sequence (3% of the unfactored flow sequence) is able to be captured by on-river dams.	
on-farm dams area factor	No on-farm dams simulated.	
Water access		Moderate
level of entitlement	The total entitlement simulated was 411 ML made up of: • 402 ML Unregulated category entitlement • 9 ML Domestic and Stock category	
access rules (CtP)	The CtP was simulated by placing a threshold (in a decision table) on the end of system flow below the irrigation pumps of (used a equivalent trigger of 11.2ML/day due to flow factoring) 10 ML/day.	
higher access rule (CtP on Approval)	No higher of access rules (CtP) were simulated.	
pump capacity	A pump capacity of 6.70 ML/day was available for irrigation and 0.02 ML/day was available for Stock and Domestic and LWU water extraction.	
on-river dam access	69 ML of on-river dam capacity was simulated. 15% of the unregulated entitlement had access to on-river dams. 78% of the Stock and Domestic and LWU entitlement had access to the on-river dams.	
on-farm storage available	No on-farm storage simulated.	
Irrigation pattern		High

Water source and model	Maragle: model Maragle Creek
crop	The crop mix assumed is from the survey for a conversion of unregulated licences carried out in 2000. The crop survey result for Stressed Rivers Assessment unit “Maragle” (409_16) was used. This crop mix is represented by simulating the water demands of the following crops: • Lucerne 6% • Pecans 2% • Perennial pasture 6% • Turf 4% • Grapes 82% The total area irrigated (based on the full development of the entitlement) in the Maragle Creek system was estimated to be 109ha. The weather station used was Maragle Station (station number 72033). The crop factor file used was “sthwst6ed.crp”, which was developed for the licence conversion process.
Groundwater extraction	No substaintial alluvial extractions indentified as impacting on streamflow.
Licence locations	The CtP is triggered at a location below the majority of the irrigation pumps, hence it is simulated as if all pumps are above the trigger point. Some of the licences have access to on-river dams (see sections 'on-river dam area factor' and 'on-river dam access').

Table 163. Ournie Welaregang

Water source and model	Ournie Welaregang: model Ournie Creek, and Spring Creek	
Water source boundaries	The main streams are Ournie Creek, and Spring Creek.	
Assumptions		**Confidence**
Flow sequence		Moderate
flows used	A measured flow sequence was used to represent the streamflow available to be extracted. This flow was measured at a gauging station from an adjacent catchement “Welumba Creek at The Square” (401016). The flow sequence extends from 16/06/1983 to 24/10/2011, 28.4 years in total. 5.6% of the measured sequenced need to be filled using a correlation with a nearby gauging station.	
total area factor	The flow sequence was factored for area by 2.68. Of this factor 1.99 was not avaliable to be accessed by licence holders.	
on-river dams area factor	No on-river dam simulated.	
on-farm dams area factor	No on-farm dams simulated.	
Water access		High
level of entitlement	The total entitlement simulated was 13 ML made up of: • 1 ML Unregulated category entitlement • 12 ML Domestic and Stock category	
access rules (CtP)	A CtP was not simulated.	
higher access rule (CtP on Approval)	No higher of access rules (CtP) were simulated.	
pump capacity	A pump capacity of 0.02ML/day was available for irrigation and 0.03ML/day was available for Stock and Domestic and LWU water extraction.	
on-river dam access	No on-river dams simulated.	
on-farm storage available	No on-farm storage simulated.	
Irrigation pattern		Low

Water source and model	Ournie Welaregang: model Ournie Creek, and Spring Creek
crop	The crop mix assumed is from the survey for a conversion of unregulated licences carried out in 2000. The crop survey result for Stressed Rivers Assessment unit “Jingellic” (409_12) was used. This crop mix is represented by simulating the water demands of the following crops: • Annual pasture 34% • Fababean 33% • Soybeans 33% The total area irrigated (based on the full development of the entitlement) in the Ournie Creek, and Spring Creek system was estimated to be 1ha. The weather station used was Walwa (station number 82052). The crop factor file used was “sthwst6ed.crp”, which was developed for the licence conversion process.
Groundwater extraction	No substaintial alluvial extractions indentified as impacting on streamflow.
Licence locations	

Table 164. Swampy Plain

Water source and model	**Swampy Plain: model Swampy Plain River upstream of Khancoban Pondage**	
Water source boundaries	The main stream is the Swampy Plain River upstream of Khancoban Pondage with headwater streams flowing into it. Part of the lower end of the water source has some small residual streams flowing into the trunk stream.	
Assumptions		**Confidence**
Flow sequence		Moderate
flows used	A measured flow sequence was used to represent the streamflow available to be extracted. This flow was measured at the gauging station "Swampy Plain River at Khancoban" (401501). The flow sequence extends from 07/12/1926 to 31/12/1965, 39.1 years in total. 1.5% of the measured sequenced need to be filled using a correlation with a nearby gauging station.	
total area factor	The flow sequence was factored for area by 1.44. Of this factor 1.13 was not avaliable to be accessed by licence holders.	
on-river dams area factor	No on-river dam simulated.	
on-farm dams area factor	No on-farm dams simulated.	
Water access		High
level of entitlement	The total entitlement simulated was 290 ML made up of: • 129 ML Unregulated category entitlement • 21 ML Domestic and Stock category • 140 ML LWU category entitlement	
access rules (CtP)	A CtP was not simulated.	
higher access rule (CtP on Approval)	No higher of access rules (CtP) were simulated.	
pump capacity	A pump capacity of 2.15 ML/day was available for irrigation and 0.44ML/day was available for Stock and Domestic and LWU water extraction.	
on-river dam access	No on-river dams simulated.	
on-farm storage available	No on-farm storage simulated.	
Irrigation pattern		Low

Water source and model	Swampy Plain: model Swampy Plain River upstream of Khancoban Pondage
crop	The crop mix assumed is from the survey for a conversion of unregulated licences carried out in 2000. The crop survey result for Stressed Rivers Assessment unit “Mannus” (409_15) was used. This crop mix is represented by simulating the water demands of the following crops: • Lucerne 2% • Orchard 9% • Perennial pasture 1% • Intensive Perennial Pasture 36% • Grapes 52% The total area irrigated (based on the full development of the entitlement) in the Swampy Plain River upstream of Khancoban Pondage system was estimated to be 25ha. The weather station used was Khancoban Smhea (station number 72060). The crop factor file used was “sthwst6ed.crp”, which was developed for the licence conversion process.
Groundwater extraction	No substaintial alluvial extractions indentified as impacting on streamflow.
Licence locations	

Table 165. Tooma

Water source and model	Tooma: model Tooma River	
Water source boundaries	The main stream is the Tooma River downstream of other water sources that flow into it.	
Assumptions		**Confidence**
Flow sequence		High
flows used	A measured flow sequence was used to represent the streamflow available to be extracted. This flow was measured at the gauging station "Tooma River at Pinegrove" (401014). The flow sequence extends from 08/08/1955 to 25/10/2011, 56.2 years in total. 24.4% of the measured sequenced need to be filled using a correlation with a nearby gauging station.	
total area factor	The flow sequence was factored for area by 1.00.	
on-river dams area factor	No on-river dam simulated.	
on-farm dams area factor	No on-farm dams simulated.	
Water access		Moderate
level of entitlement	The total entitlement simulated was 1,397 ML made up of: • 1,390 ML Unregulated category entitlement • 7 ML Domestic and Stock category	
access rules (CtP)	The CtP was simulated by placing a threshold (in a decision table) on the inflow above the irrigation pumps of 79 ML/day.	
higher access rule (CtP on Approval)	No higher of access rules (CtP) were simulated.	
pump capacity	A pump capacity of 74.00 ML/day was available for irrigation and 1.60 ML/day was available for Stock and Domestic and LWU water extraction.	
on-river dam access	No on-river dams simulated.	
on-farm storage available	No on-farm storage simulated.	
Irrigation pattern		Moderate

Water source and model	Tooma: model Tooma River
crop	The crop mix assumed is from the survey for a conversion of unregulated licences carried out in 2000. The crop survey result for Stressed Rivers Assessment unit “Tumbarumba” (409_03) was used. This crop mix is represented by simulating the water demands of the following crops: • Lucerne 20% • Orchard 32% • Perennial pasture 13% • Intensive Perennial Pasture 21% • Summer Maize 12% • Turf 2% The total area irrigated (based on the full development of the entitlement) in the Tooma River system was estimated to be 665ha. The weather station used was Maragle Station (station number 72033). The crop factor file used was “sthwst6ed.crp”, which was developed for the licence conversion process.
Groundwater extraction	No substaintial alluvial extractions indentified as impacting on streamflow.
Licence locations	The CtP is triggered at a location above the majority of the irrigation pumps, hence it is simulated as if all pumps are below the trigger point.

Table 166. Tumbarumba

Water source and model	Tumbarumba: model Tumbarumba Creek	
Water source boundaries	The main stream is Tumbarumba Creek with headwater streams flowing into it.	
Assumptions		**Confidence**
Flow sequence		High
flows used	A measured flow sequence was used to represent the streamflow available to be extracted. This flow was measured at a gauging station from an adjacent catchement "Tooma River at Pinegrove" (401014). The flow sequence extends from 08/08/1955 to 25/10/2011, 56.2 years in total. 24.4% of the measured sequenced need to be filled using a correlation with a nearby gauging station.	
total area factor	The flow sequence was factored for area by 1.00.	
on-river dams area factor	No on-river dam simulated.	
on-farm dams area factor	No on-farm dams simulated.	
Water access		Moderate
level of entitlement	The total entitlement simulated was 1,546 ML made up of: • 993 ML Unregulated category entitlement • 54 ML Domestic and Stock category • 499 ML LWU category entitlement	
access rules (CtP)	The CtP was simulated by placing a threshold (in a decision table) on the end of system flow below the irrigation pumps of 32 ML/day.	
higher access rule (CtP on Approval)	No higher of access rules (CtP) were simulated.	
pump capacity	A pump capacity of 50.83 ML/day was available for irrigation and 1.58 ML/day was available for Stock and Domestic and LWU water extraction.	
on-river dam access	No on-river dams simulated.	
on-farm storage available	No on-farm storage simulated.	
Irrigation pattern		High

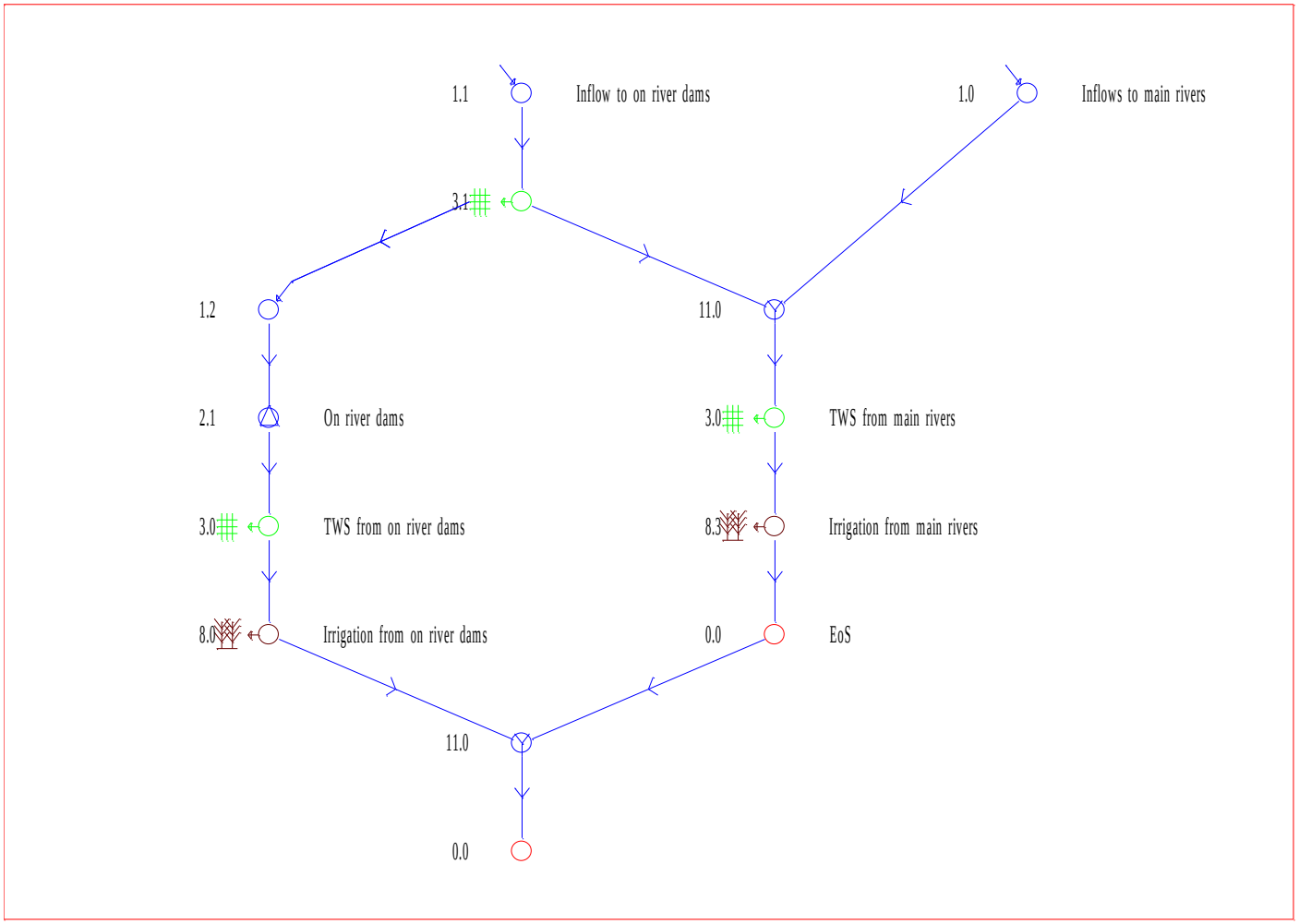
Water source and model	Tumbarumba: model Tumbarumba Creek
crop	The crop mix assumed is from the survey for a conversion of unregulated licences carried out in 2000. The crop survey result for Stressed Rivers Assessment unit “Tumbarumba” (409_03) was used. This crop mix is represented by simulating the water demands of the following crops: • Lucerne 20% • Orchard 32% • Perennial pasture 13% • Intensive Perennial Pasture 21% • Summer Maize 12% • Turf 2% The total area irrigated (based on the full development of the entitlement) in the Tumbarumba Creek system was estimated to be 457ha. The weather station used was Maragle Station (station number 72033). The crop factor file used was “sthwst6ed.crp”, which was developed for the licence conversion process.
Groundwater extraction	No substaintial alluvial extractions indentified as impacting on streamflow.
Licence locations	The CtP is triggered at a location below the majority of the irrigation pumps, hence it is simulated as if all pumps are above the trigger point.

Table 167. Upper Murray River

Water source and model	**Upper Murray River: model Murray River (upstream of Hume Wier) but also includes Swampy Plain River (downstream of Khancoban Pondage)**	
Water source boundaries	The main stream is the Murray River (upstream of Hume Wier) but also includes Swampy Plain River (downstream of Khancoban Pondage).	
Assumptions		**Confidence**
Flow sequence		High
flows used	A measured flow sequence was used to represent the streamflow available to be extracted. This flow was measured at the gauging station "Murray River at Walwa" (401011). The flow sequence extends from 30/05/1948 to 08/11/1961, 13.4 years in total. 21.5% of the measured sequenced need to be filled using a correlation with a nearby gauging station.	
total area factor	The flow sequence was factored for area by 1.18.	
on-river dams area factor	No on-river dam simulated.	
on-farm dams area factor	No on-farm dams simulated.	
Water access		Moderate
level of entitlement	The total entitlement simulated was 5,982 ML made up of: • 5,896 ML Unregulated category entitlement • 86 ML Domestic and Stock category	
access rules (CtP)	The CtP was simulated by placing a threshold (in a decision table) on the end of system flow below the irrigation pumps of 600 ML/day.	
higher access rule (CtP on Approval)	No higher of access rules (CtP) were simulated.	
pump capacity	A pump capacity of 98.27 ML/day was available for irrigation and 0.24 ML/day was available for Stock and Domestic and LWU water extraction.	
on-river dam access	No on-river dams simulated.	
on-farm storage available	No on-farm storage simulated.	
Irrigation pattern		Moderate

Water source and model	Upper Murray River: model Murray River (upstream of Hume Wier) but also includes Swampy Plain River (downstream of Khancoban Pondage)
crop	The crop mix assumed is from the survey for a conversion of unregulated licences carried out in 2000. The crop survey result for Stressed Rivers Assessment unit “Indi” (409_01) was used. This crop mix is represented by simulating the water demands of the following crops: • Annual pasture 18% • Lucerne 1% • Perennial pasture 18% • Intensive Perennial Pasture 63% The total area irrigated (based on the full development of the entitlement) in the Murray River (upstream of Hume Wier) but also includes Swampy Plain River (downstream of Khancoban Pondage) system was estimated to be 975ha. The weather station used was Walwa (station number 82052). The crop factor file used was “sthwst6ed.crp”, which was developed for the licence conversion process.
Groundwater extraction	No substaintial alluvial extractions indentified as impacting on streamflow.
Licence locations	The CtP is triggered at a location below the majority of the irrigation pumps, hence it is simulated as if all pumps are above the trigger point.

Appendix D Schematic diagram of standard single-reach model



Appendix E KEF linked to different stream types

Table 168. Key ecosystem functions (KEF) linked to different stream types

Type	Cease-to-flow	Low flow season base flow	Low flow season fresh	High flow season base flow	High flow season fresh	Bankfull flow	Overbank flow
Source, pool	1	3, 10, 11, 14	7, 10, 11	3, 10, 14	7, 10	2, 7	2, 7
Source, confined	1	3, 4, 10, 11, 14	7, 10, 11	3, 4, 10, 14	7, 10	2, 7	2, 7
Source, armoured	1	3, 4, 10, 11, 13, 14	7, 10, 11	3, 4, 10, 13, 14	5, 7, 10	2, 5, 7	2, 5, 7
Transport, mobile	1	3, 4, 10, 11, 13, 14	6, 7, 10, 11, 12	3, 4, 10, 12, 13, 14	5, 6, 7, 10	2, 5, 6, 7, 12	2, 5, 6, 7, 12
Transport, meandering	1	3, 4, 10, 11, 13, 14	6, 7, 10, 11, 12	3, 4, 10, 12, 13, 14	5, 6, 7, 10	2, 5, 6, 7, 12	2, 5, 6, 7, 12
Transport, anabranch	1	3, 4, 10, 11, 13, 14	6, 7, 10, 11, 12	3, 4, 10, 12, 13, 14	5, 6, 7, 10	2, 5, 6, 7, 12	2, 5, 6, 7, 12
Deposition, meandering	0	3, 9, 10, 11, 13, 14	6, 10, 11, 12	3, 9, 10, 12, 13, 14	5, 6, 10	2, 5, 6, 12	2, 5, 6, 8, 12
Deposition, anabranch	0	3, 9, 10, 11, 13, 14	6, 10, 11, 12	3, 9, 10, 12, 13, 14	5, 6, 10	2, 5, 6, 12	2, 5, 6, 8, 12
Deposition, distributary	1	3, 9, 10, 11, 13, 14	6, 10, 11, 12	3, 9, 10, 12, 13, 14	6, 10	2, 6, 12	2, 6, 8, 12
Deposition, lowland confined	0	3, 10, 11, 13, 14	11, 12	3, 10, 12, 13, 14	10	2, 12	2

Table 169. Legend for functions

Number	Key ecosystem functions (KEF)
0	none
1	Disturbance through cease-to-flow periods
2	Disturbance and wetting through bankfull and overbank flows
3	Provide wetted habitat diversity in pool environments
4	Provide wetted habitat diversity in riffle and run environments
5	Provide appropriate wetted habitat heterogeneity within a reach (creation of diverse hydraulic features)
6	Provide in-channel habitat features within a reach (point bars and benches)
7	Organic and inorganic sediment delivery to downstream reaches (debris flows, scouring, flushing of fine sediments)
8	Sediment delivery to and from floodplains (floodplains, benches)
9	Dilute carbon and nutrients from litter and soil on the floodplain that has been returned to the river systems
10	Dispersal of aquatic communities (including drift)
11	Recolonisation of aquatic fauna and flora communities
12	Migration to fulfil requirements of life-history stages (e.g. diadromous fish species)
13	Foraging of aquatic species
14	Instream primary production by periphyton, phytoplankton and biofilms