Water resources and management overview
Gwydir catchment
The NSW Office of Water manages the policy and regulatory frameworks for the state's surface water and groundwater resources to provide a secure and sustainable water supply for all users. The Office of Water also supports water utilities in the provision of water and sewerage services throughout New South Wales.

Water resources and management overview – Gwydir catchment
May 2011
ISBN 978 0 7313 3983 9

This report may be cited as:

Cover photo: upper Gwydir River at Yarrowyck

© State of New South Wales through the Department of Primary Industries, 2011
This material may be reproduced in whole or in part for educational and non-commercial use, providing the meaning is unchanged and its source, publisher and authorship are clearly and correctly acknowledged.
Disclaimer: While every reasonable effort has been made to ensure that this document is correct at the time of publication, the State of New South Wales, its agents and employees, disclaim any and all liability to any person in respect of anything or the consequences of anything done or omitted to be done in reliance upon the whole or any part of this document.
Maps: The maps are to be used as a general guide for regional and local scale natural resource planning and management only, not for the assessment of specific sites which can only be assessed by investigation specific to those sites.
The maps are published by the NSW Office of Water. While every reasonable effort has been made to ensure the accuracy of the information contained in the maps, you should only satisfy yourself as to the accuracy of the information before relying on it.
# Water resources and management overview – Gwydir catchment

## Contents

1. Introduction .................................................................................................................................... 1
2. Climate .......................................................................................................................................... 3
   2.1 Rainfall ................................................................................................................................ 3
   2.2 Evaporation ......................................................................................................................... 4
3. Land use ........................................................................................................................................ 5
4. Environment .................................................................................................................................. 7
   4.1 Native vegetation ................................................................................................................ 7
   4.2 Parks and reserves ............................................................................................................. 7
   4.3 Wetlands ............................................................................................................................. 7
   4.4 Significant biodiversity ........................................................................................................ 9
5. Surface water .............................................................................................................................. 10
   5.1 Gwydir River upstream of Copeton Dam .......................................................................... 10
   5.2 Copeton Dam to Moree ..................................................................................................... 10
   5.3 Carole and Gil Gil Creeks ................................................................................................. 11
   5.4 Mehi River ......................................................................................................................... 11
   5.5 Lower Gwydir and Gingham Watercourses ...................................................................... 12
   5.6 Streamflow characteristics ................................................................................................ 13
6. Groundwater ................................................................................................................................ 16
7. River operations and management ............................................................................................. 18
   7.1 Major storages and regulating structures ......................................................................... 18
   7.2 Licensed water use ........................................................................................................... 19
       Surface water ....................................................................................................................... 19
       Groundwater ....................................................................................................................... 21
   7.3 Water sharing plans .......................................................................................................... 21
       Surface water sharing plans ............................................................................................. 22
       Groundwater sharing plans ............................................................................................... 23
       Plans under development ................................................................................................. 24
8. References .................................................................................................................................. 26
Tables
Table 1: Land use types in the Gwydir catchment ................................................................. 5
Table 2: Threatened aquatic species of the Gwydir catchment ............................................. 9
Table 3: Mean daily flow for selected Gwydir gauge sites ..................................................... 13
Table 4: Major weirs in the Gwydir catchment .................................................................... 18
Table 5: Surface water share components for the regulated Gwydir catchment 2009-10 ....... 20
Table 6: Unregulated licence entitlement for Gwydir catchment 2010 .................................. 20
Table 7: Groundwater licence share components for the Gwydir catchment 2009 ............... 21

Figures
Figure 1: The Gwydir catchment ............................................................................................. 2
Figure 2: Topography and elevation of the Gwydir catchment............................................... 2
Figure 3: Average annual rainfall in the Gwydir catchment..................................................... 3
Figure 4: Average monthly rainfall in Moree 1879–1965 ......................................................... 3
Figure 5: Average annual pan evaporation in the Gwydir catchment ..................................... 4
Figure 6: Average daily evaporation at Moree 1995–2009 ......................................................... 4
Figure 7: Land use in the Gwydir catchment .......................................................................... 6
Figure 8: Annual flows in the Gwydir River at Bundarra 1937–2010 ....................................... 14
Figure 9: Daily flows and cumulative deviation from the mean for Gwydir River at Bundarra .... 15
Figure 10: Groundwater aquifer types in the Gwydir catchment ............................................ 16
Figure 11: Groundwater quality and suitability in the Gwydir catchment ............................... 17
Figure 12: Groundwater Management Areas in the Gwydir catchment ............................... 17
Figure 13: Copeton Dam daily volumes since construction (1972-2010) ............................... 18
1 Introduction

The Gwydir River forms part of the Murray-Darling drainage basin in northern NSW. Covering an area of 26,600 km², the catchment extends 670 km from the Great Dividing Range to the Barwon River near Collarenebri (Figure 1). It is separated from the Border Rivers catchment to the north by the Mastermans Range and from the Namoi catchment to the south by the Nandewar Range.

From its headwaters near Guyra and Uralla, around 1,200 m above sea level, the Gwydir River flows north-west through steep-sided valleys. It is joined by the Horton River, the largest tributary flowing north from the Nandewar Range, before it enters the plains near Gravesend. West of Pallamallawa the valley widens into an almost completely flat floodplain where the elevation is generally less than 200 m (Figure 2). Through this flat landscape the Gwydir flows slowly westward between low natural levee banks towards the Barwon River.

Downstream of Moree is an alluvial fan where extensive floodplain wetlands known as the Lower Gwydir wetlands have developed. These wetlands provide valuable habitat for waterbirds, and are listed as a site of international significance under the Ramsar Convention. The lower half of the basin is characterised by numerous anabranches and effluents, the most significant being the Mehi River and Moomin Creek to the south, and the Carole-Gil Gil Creek system to the north. The latter creek system joins with the southern effluents of the Border Rivers before entering the Barwon River.

The dominant land uses in the valley are livestock grazing and dryland agriculture which together cover 90 per cent of the catchment. The self-mulching black soils of the lower valley are well suited to irrigated agriculture. Irrigation development has occurred rapidly since the early 1960s, and up to 1,000 km² is now used to grow crops such as cotton, cereals and oilseeds. Most of the summer crops such as cotton are irrigated, while much of the winter demand is met by rainfall.

Irrigation water, town water supplies for Bingara and Gravesend and environmental releases for the Lower Gwydir wetlands are supplied from Copeton Dam, the major storage in the valley. Most irrigation diversions occur below Pallamallawa, facilitated by a network of weirs and regulators on the Gwydir River and its effluents.

The Gwydir catchment is part of the lands originally occupied by the Kamilaroi people. The extensive wetlands, riverine forests and grasslands of the Gwydir floodplain formed a rich resource which complemented the adjoining country of plains and ranges. There are now over 26,000 people living within the catchment. The largest town is Moree (8,000 people) which is the main commercial centre for the surrounding agricultural areas. It is also a major transport and tourism hub, being located at the junction of the Gwydir and Newell Highways. There are a number of smaller towns supporting 1,000-2,000 people. These are Uralla and Guyra in the New England tablelands, and Bingara and Warialda in the middle of the catchment. Other small villages within the mid-upper catchment include Bundarra, Delungra, Pallamallawa and Tingha which have populations of 300-700 people.
Water resources and management overview – Gwydir catchment

Figure 1: The Gwydir catchment

Figure 2: Topography and elevation of the Gwydir catchment
2 Climate

2.1 Rainfall

Annual rainfall varies from over 900 mm in the Nandewar Ranges at the top of the catchment to around 450 mm in the west (Figure 3). The average annual rainfall in Moree is around 550 mm. Rain is generally summer dominant with the heaviest rainfall occurring from October to March (Figure 4). January and February receive the most rain with both months averaging 68 mm. Summer storms may cause severe flooding and erosion, and winter flooding may also occur if soils remain saturated after summer rains. Autumn and winter rainfall generally varies between 30-45 mm per month.

Figure 3: Average annual rainfall in the Gwydir catchment

Source: Hutchinson and Kesteven 1998

Figure 4: Average monthly rainfall in Moree 1879-1965

Source: Bureau of Meteorology Climate Data Online
2.2 Evaporation

Pan evaporation in the Gwydir catchment has a strong east-west gradient. Average Class A pan evaporation exceeds average rainfall throughout the whole valley, varying from around 1,200 mm per year in the south-east to over 2,000 mm per year in the north-west (Figure 5). Pan evaporation is also strongly seasonal, varying from 2-3 mm per day during June and July at Moree, to 10 mm per day during December and January (Figure 6).

Figure 5: Average annual pan evaporation in the Gwydir catchment

Source: Hutchinson and Kesteven 1998

Figure 6: Average daily evaporation at Moree 1995-2009

Source: Bureau of Meteorology Climate Data Online
3 Land use

Land use in the Gwydir catchment is dominated by extensive agriculture with 70 per cent of the catchment being used for grazing (Figure 7, Table 1). The next largest land use is dryland cropping which covers 20 per cent of the catchment, and is concentrated in the upper Mehi and Lower Gwydir areas. Irrigated cropping covers 900 km² or 3.4 per cent of the catchment and occurs mostly on the heavy clay soils of the western half of the catchment. Approximately 94 per cent of the irrigated area in the Gwydir valley is used to grow cotton (MDBC 2007). Other irrigated crops are cereals, oilseed, pasture fodder and lucerne (Varley 2001). Forestry, conservation and other remnant native landscapes together account for around 5 per cent of land use, and are concentrated in the mid to upper catchment.

Table 1: Land use types in the Gwydir catchment

<table>
<thead>
<tr>
<th>Land use category</th>
<th>Area (km²)</th>
<th>Proportion of catchment (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grazing</td>
<td>18,875</td>
<td>70.8</td>
</tr>
<tr>
<td>Dryland cropping and horticulture</td>
<td>5,330</td>
<td>20.0</td>
</tr>
<tr>
<td>Irrigation</td>
<td>904</td>
<td>3.4</td>
</tr>
<tr>
<td>Native landscapes</td>
<td>873</td>
<td>3.3</td>
</tr>
<tr>
<td>Forestry</td>
<td>392</td>
<td>1.5</td>
</tr>
<tr>
<td>Conservation</td>
<td>178</td>
<td>0.7</td>
</tr>
<tr>
<td>Residential</td>
<td>52</td>
<td>0.2</td>
</tr>
<tr>
<td>Lakes, rivers, dams</td>
<td>47</td>
<td>0.2</td>
</tr>
<tr>
<td>Wetland</td>
<td>12</td>
<td>&lt;0.1</td>
</tr>
<tr>
<td>Mining</td>
<td>1</td>
<td>&lt;0.1</td>
</tr>
</tbody>
</table>

Source: 2001/02 Land use mapping of Australia, Bureau of Rural Sciences

Gwydir River at Yarraman Bridge near Moree
Figure 7: Land use in the Gwydir catchment

Gwydir Catchment
Land Use

Source: 2001/02 Land use mapping of Australia, Bureau of Rural Sciences
4 Environment

4.1 Native vegetation

The Gwydir catchment supports a diverse range of vegetation types that vary according to altitude, climate, and soil types. Extensive areas of forest occur in the high altitude areas of the eastern catchment, with a gradual westward change to more open forest, shrublands and grassy plains.

The tablelands support a mix of forest and woodlands dominated by various species of stringybark eucalypts including silvertop stringybark, snowgum, whitegum, peppermint and black sally. The vegetation communities of the slopes are mostly fragmented remnants of forest grading into woodland further west. Species include white box, rough barked apple, mugga ironbark, grey box, forest red gum and kurrajong (BRGCMA 2007).

Vegetation in the western part of the region is influenced by the floodplains and alluvial fans. The dominant vegetation consists of floodplain woodlands of coolibah with occasional myall, whitewood and belah. The plains previously supported extensive areas of native grasslands of Mitchell grass and plains grass. These communities are now much reduced in area, however can still be found on the plains south-west of Moree. Other communities occurring on the higher parts of the floodplain include poplar box woodlands, wilga, brigalow, white cypress and silver leaf ironbark (BRGCMA 2007). Seasonal and semi-permanent wetlands occur along the Gingham and Gwydir watercourses.

4.2 Parks and reserves

There is approximately 533 km² of land conserved within national parks and nature reserves within the Gwydir catchment. The majority of this area lies within the middle and upper parts of the catchment. There are no conservation areas on the lower Gwydir floodplain.

The largest conservation area in the catchment is Terry Hie Hie Aboriginal Area, a series of land parcels totalling 153 km² to the south-east of Moree. The land was previously managed for forestry until it was gazetted as an Aboriginal Area in December 2005. A number of other forestry parcels in the catchment were also converted to national parks or conservation areas at this time, including Warialda National Park, Gwydir River National Park, Bingara State Conservation Area, Bullala National Park, Couradda National Park, and Bobbiwaa State Conservation Area.

The second largest conservation area is Mount Kaputar National Park, part of the Nandewar Ranges which divide the Gwydir from the Namoi catchment to the south. The park protects a wide variety of plant communities, including semi-arid woodlands, wet eucalypt forests and sub-alpine heaths. It provides habitat for many threatened species including bats, birds, wallabies, quolls and a large pink slug which is unique to the sub-alpine areas of the park.

4.3 Wetlands

The Gwydir wetlands cover an area of over 1,000 km² on the lower Gwydir floodplain west of Moree. The most extensive wetland areas are located along the Gingham and Lower Gwydir watercourses, where flat overland grades result in extensive shallow flooding over large areas. Water flows through a series of natural and constructed channels and swamps. The core of the wetland supports some of the most extensive areas of water couch pasture remaining in NSW, as well as significant stands of marsh club rush (*Bolboschoenus fluviatilis*) which occurs in three frequently flooded areas of the Gingham and Gwydir watercourses. The areas of marsh club rush have declined from over 2,000 ha in the 1970s to less than 300 ha in 2005 (DECCW 2011). This community has been recently listed as critically endangered under the *Threatened Species Conservation Act 1995*. 

---

7 | NSW Office of Water, May 2011
The floodplain wetlands provide habitat for migratory birds listed under international agreements with Japan, China and the Republic of Korea (JAMBA, CAMBA and ROKAMBA). The wetlands are also recognised internationally through the inclusion of four parcels of privately owned land (covering 8 km²) as a wetland site under the Ramsar Convention. They are recognised at the national level through their inclusion in the Directory of Important Wetlands in Australia.

The wetlands provide breeding and feeding grounds for colonial waterbirds and habitat for many threatened species. Over 235 species of birds have been observed in the wetlands, of which 165 species have been recorded as breeding (DEWHA 2009a). The wetlands also provide habitat for 13 migratory species listed under international agreements. During flooding in 1998 over 500,000 waterbirds were observed using the wetlands (DEWHA 2009a). Apart from their value as waterbird habitat, the Gwydir wetlands are considered to provide a good example of an inland terminal delta which plays an important role in the ecological functioning of the Murray-Darling Basin.

As part of the NSW Wetland Recovery Program the NSW government released an environmental management plan in February 2011 to guide the future of the Gwydir wetlands and ensure their sustainable management (DECCW 2011). Management actions will include water recovery, building on sustainable land management practices and improving water management infrastructure. The Gwydir environmental management plan can be viewed on the NSW Wetland Recovery Program website (www.wetlandrecovery.nsw.gov.au).

Some of the New England tableland lagoons are located within the very upper reaches of the Gwydir catchment. These include Mother of Ducks Lagoon at Guyra, and Racecourse Lagoon and Dangars Lagoon at Uralla. Along with the Gwydir Wetlands, these lagoons are recognised as nationally important wetlands through their inclusion in the Directory of Important Wetlands in Australia (DEWHA 2009b).
4.4 Significant biodiversity

The aquatic and terrestrial environments of the Gwydir catchment provide habitat for a large number of threatened species and ecological communities that are protected under the Threatened Species Conservation Act 1995. There are 44 threatened plant species with 26 of these considered to be endangered. In addition there are 58 threatened animal species within the catchment of which 33 are birds, 21 are mammals and four are reptiles. Many of the threatened bird species are waterbirds, parrots and owls which would rely on the floodplain wetland and woodland habitats within the catchment.

The Gwydir catchment supports 14 endangered ecological communities which occupy the full range of habitats from the tablelands in the east to the floodplains of the west. Up in the tablelands threatened communities include the Upland Wetlands of the New England Tableland Bioregion, New England Peppermint Woodland, and Ribbon Gum, Mountain Gum, Snow Gum Grassy Forest/Woodland. On the slopes of the upper and middle catchment are the threatened White Box Yellow Box Blakely’s Red Gum Woodland, and Inland Grey Box Woodland communities. In the west of the catchment there are extensive areas of endangered Coolibah-Black Box Woodlands (dominated by coolibah in the Gwydir) which are found on the grey, self-mulching clays of the lower Gwydir floodplain. The core of the lower Gwydir wetlands consists of Marsh Club-rush Sedgeland which was listed as an endangered community in 2010 and is known only from the Gwydir valley. The riverine plains of the Gwydir and Mehi Rivers also support remnant areas of Carbeen Open Forest which is characterised by carbeen and white cypress-pine.

Eleven species of native fish and three species of introduced fish were recorded in the lower Gwydir catchment during surveys in 2007 and 2008. The most common native species were Australian smelt, bony bream and Murray Darling rainbow fish. Four aquatic species that potentially occur within the Gwydir catchment are listed as threatened under the NSW Fisheries Management Act 1994. These are the river snail, silver perch, purple spotted gudgeon, and the olive perchlet which is listed as an endangered population (Table 2).

The aquatic community of the Gwydir River forms part of the endangered ecological community known as the aquatic ecological community in the natural drainage system of the lowland catchment of the Darling River. This includes 21 native fish species and hundreds of native invertebrate species that are found within the Darling River and its associated streams, wetlands and anabranches within NSW, including the Gwydir River.

<table>
<thead>
<tr>
<th>Common name</th>
<th>Scientific name</th>
<th>NSW status</th>
</tr>
</thead>
<tbody>
<tr>
<td>River snail</td>
<td>Notopala sublineata</td>
<td>Endangered</td>
</tr>
<tr>
<td>Silver perch</td>
<td>Bidyanus bidyanus</td>
<td>Vulnerable</td>
</tr>
<tr>
<td>Purple spotted gudgeon</td>
<td>Mogurnda adspersa</td>
<td>Endangered</td>
</tr>
<tr>
<td>Olive perchlet</td>
<td>Ambassis agassizii</td>
<td>Endangered population</td>
</tr>
<tr>
<td>Aquatic ecological community in the natural drainage system of the lowland catchment of the Darling River</td>
<td></td>
<td>Endangered ecological community</td>
</tr>
</tbody>
</table>
5 Surface water

5.1 Gwydir River upstream of Copeton Dam

The headwaters of the Gwydir catchment begin between Uralla and Guyra in the New England tablelands. The main tributaries contributing to the river above Copeton Dam are Copes Creek, Moredun Creek, Georges Creek, Laura Creek, and Bakers Creek. A number of large upland wetlands occur in the top of the catchment near Guyra and Uralla. Copeton Dam is located approximately 90 km downstream of the headwaters of the Gwydir River.

5.2 Copeton Dam to Moree

Between Copeton Dam and Gravesend (west of Warialda), the Gwydir River flows westward linking a number of catchments including Keera Creek, Halls Creek, Myall Creek, and Warialda Creek. The Horton River, the major tributary of the Gwydir, rises in the south from the Nandewar Ranges and enters the river between Bingara and Gravesend.

Beyond Gravesend the floodplain begins to widen and the Gwydir River becomes a slow moving river with a complex pattern of effluents, anabranches, and tributaries. Almost the entire runoff for the Gwydir catchment is generated above Pallamallawa, with the western floodplains contributing almost no runoff due to low slopes, absorbent soils and high evaporation. At Pallamallawa a flood channel known as the Biniguy Break conveys floodwaters from the Gwydir River through to the Mehi River. The riverine vegetation in this reach consists of a narrow band of river red gums, and there is a number of lagoons adjacent to the river, associated with small creeks and flood channels (Green and Bennett 1991).

A unique feature of the Gwydir River is the Gwydir Raft, a large log-jam which extends for over 15 km along the river downstream of Moree (Pietsch 2006). The raft is an accumulation of timber, debris and sediment which has been deposited in the former channel of the Gwydir River over many decades. The formation of the raft is thought to be a combination of human activities, such as clearing in the upper catchment and natural depositional processes, which resulted in the build up of logs and silt within the river during floods (CMA 2008). Water pooled behind this blockage breaks out of the Gwydir channel northwards into the Gingham Watercourse and south into the Tyreel Anabranch.

The upper Gwydir River at Yarrowyck
5.3 Carole and Gil Gil Creeks

Carole Creek is an effluent channel that breaks away from the Gwydir River upstream of Moree. At its upstream end the channel is well-defined with steep banks but further downstream the creek becomes shallower. Coolibah and river coobas form a narrow band of riverine woodland along each bank.

Gil Gil Creek has its own catchment area which begins on the plains north of Warialda. Carole Creek merges with Gil Gil Creek about 60 km downstream of its offtake from the Gwydir. After joining with Carole Creek, Gil Gil Creek becomes a wide shallow channel which supports extensive areas of lignum and river cooba (Green and Bennett 1991). Carole Creek and the lower section of Gil Gil Creek are regulated via Boolooroo Weir which diverts water into the creek system from the Gwydir.

5.4 Mehi River

The Mehi River takes the majority of the flow from the Gwydir River 30 km upstream of Moree. Diversions to the Mehi River are regulated by Tareelaroi Weir. For most of its length the Mehi River supports a narrow band of riverine woodland dominated by river red gum, coolibah, river cooba and lignum. Small lagoons and depressions occur adjacent to the channel, some natural and others the result of river straightening. A small number are used as off-river storages, however, most are only filled during large floods (Green and Bennett 1991).

One large semi-permanent wetland is Whittakers Lagoon which receives water from the Mehi River during large floods, as well as some local runoff. This lagoon received targeted environmental flows under the NSW Government’s RiverBank program in December 2008 and January 2010 to help restore the lagoon after years of reduced inflows, weed invasion and grazing impacts.

Moomin Creek is an anabranch which leaves the Mehi River about 20 km downstream of Moree and rejoins it just before the Mehi enters the Barwon River. Like the Mehi there are many small lagoons and depressions adjacent to the channel that are filled during high flows. Mongyer Lagoon is a permanent wetland with a regulated connection to Moomin Creek that forms a valuable drought refuge for waterbirds (Green and Bennett 1991).
5.5 Lower Gwydir and Gingham Watercourses

The lower Gwydir catchment below Moree forms an inland terminal delta resulting in an alluvial fan of 20,000 hectares. This region is referred to as the Lower Gwydir Wetlands and comprises two main channels – the Gingham Watercourse and the Lower Gwydir Watercourse (also known as the Big Leather Watercourse). The wetlands absorb much of the river’s flow during normal conditions, resulting in little water reaching the Barwon River. During flood events, however, the floodplain becomes inundated and water flows into the Barwon River at a number of locations from the wetlands.

Inflows to the Lower Gwydir Wetlands are measured at the Gwydir River gauge at Yarraman Bridge. Flooding in these wetlands starts to occur at flows between 5,000 and 10,000 ML/d at Yarraman Bridge, depending on the amount of extraction occurring and the antecedent conditions in the channels and wetlands (Powell et al 2008).

The Gingham Watercourse supports a small core of semi-permanent wetland vegetation (3,700 ha in 2008) as well as extensive areas of floodplain vegetation (Bowen and Simpson 2010). Gingham Waterhole is a permanent lagoon within the main channel that provides significant waterbird breeding habitat. Towards the lower end of the Gingham channel water spreads out over the floodplain forming extensive areas of water couch pasture with rushes and some lignum. During shallow flooding these pastures form valuable wetland habitat, particularly as feeding grounds for spoonbills and ibis.

The Lower Gwydir Watercourse supports similar wetland habitats to those in the Gingham Watercourse to the north. The Lower Gwydir is characterised by poorly defined channels and extremely flat country with a gradient of less than 1 per cent which leads to widespread flooding. In 2008 the core of the Lower Gwydir Watercourse supported 3,076 ha of semi-permanent wetlands including water couch, marsh club rush, cumbungi and common reed (Bowen and Simpson 2010).

The lower end of the Gwydir Watercourse, also known as ‘The Big Leather’
5.6 Streamflow characteristics

There are currently 60 active river gauges within the Gwydir catchment recording flows on a continuous basis. Table 3 shows mean daily flows for some key locations throughout the catchment.

The Gwydir River reaches its maximum capacity at Pallamallawa upstream of Moree where the mean daily flow is 2,053 ML/d. After this the main channel of the Gwydir begins to lose its flow to the many anabranches and effluent channels that characterise the lower part of the catchment. The channel capacity at Pallamallawa is greater than the combined capacity of the four major distributary streams (the Gwydir, Mehi, Moomin Creek and Carole Creek) and so even small rises at Pallamallawa can cause overbank flow downstream (Pietsch 2006). All of the effluents leaving the river are regulated and have an average flow of 200-300 ML/d (Table 3).

The flow regime of Gwydir River has been substantially altered by the construction of Copeton Dam and the various weirs and regulators that divert water to irrigators along distributary channels such as the Mehi River, Moomin Creek and Carole Creek. Regulation of the river system has caused significant reduction in moderate to high flows in the lower Gwydir. It has also contributed to an increase in the average period between large flows, and a reduction in the average volume of large flows (CSIRO 2007).

Flows have been recorded in the upper Gwydir River at Bundarra since 1937 and provide a good long-term record of natural streamflow patterns in the Gwydir catchment. Bundarra is in the upper catchment where the flows are not regulated by Copeton Dam. The long-term average annual flow at Bundarra is 336,300 ML.

The record of annual flows (Figure 8) shows that years of extreme low flows have occurred on average once every decade, the most recent being in 2002 and 2009. The driest year on record was 1994 when just 3,400 ML of water was recorded at Bundarra. Extended drought periods have occurred in 1937-1949 and 1999-2009 when all annual flows were below the long-term average. The annual flow for 2010 was 381,880 ML, making 2010 the first year since 1998 when higher than average flows were recorded. The highest flow occurred in 1950 when 2,046,000 ML was recorded.

Table 3: Mean daily flow for selected Gwydir gauge sites

<table>
<thead>
<tr>
<th>Gauge site</th>
<th>Catchment area (km²)</th>
<th>Mean daily flow (ML)</th>
<th>Period of record</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gwydir River at Bundarra</td>
<td>3,990</td>
<td>926</td>
<td>1936-2010</td>
</tr>
<tr>
<td>Gwydir River downstream Copeton Dam</td>
<td>5,240</td>
<td>937</td>
<td>1966-2010</td>
</tr>
<tr>
<td>Gwydir River at Gravesend</td>
<td>11,020</td>
<td>2,110</td>
<td>1950-2010</td>
</tr>
<tr>
<td>Gwydir River at Pallamallawa</td>
<td>12,300</td>
<td>2,053</td>
<td>1892-2010</td>
</tr>
<tr>
<td>Gwydir River at Yarraman Bridge</td>
<td>12,960</td>
<td>1,127</td>
<td>1929-2010</td>
</tr>
<tr>
<td>Gwydir River at Brageen Bridge</td>
<td>n/a</td>
<td>183</td>
<td>1982-2010</td>
</tr>
<tr>
<td>Gwydir River at Milliewa</td>
<td>n/a</td>
<td>71</td>
<td>1988-2010</td>
</tr>
<tr>
<td>Horton River at Rider</td>
<td>1,970</td>
<td>461</td>
<td>1957-2010</td>
</tr>
<tr>
<td>Gingham Watercourse at Teralba</td>
<td>n/a</td>
<td>221</td>
<td>1997-2010</td>
</tr>
<tr>
<td>Carole Creek downstream regulator</td>
<td>n/a</td>
<td>306</td>
<td>1939-2010</td>
</tr>
<tr>
<td>Mehi River at Moree</td>
<td>n/a</td>
<td>370</td>
<td>1915-2010</td>
</tr>
<tr>
<td>Mehi River near Collarenebri</td>
<td>n/a</td>
<td>216</td>
<td>1980-2010</td>
</tr>
<tr>
<td>Moomin Creek at Glendello</td>
<td>n/a</td>
<td>287</td>
<td>1984-2010</td>
</tr>
</tbody>
</table>

Source: NSW Office of Water Real Time Data – Rivers and Streams
Figure 8: Annual flows in the Gwydir River at Bundarra 1937-2010

Daily streamflows provide an indication of the variability of flow patterns and the peak height of flood events. The largest flood in the Gwydir River was recorded in August 1949 reaching a peak height of 276,329 ML (Figure 9). Medium to large floods of up to 100,000 ML/d have occurred regularly in the upper Gwydir three to four times per decade. The last significant flood event at Bundarra was in January 2004.

The cumulative mass curve in Figure 9 provides further insight into long-term streamflow trends. The plot is produced by calculating variations from the long-term mean. It can be interpreted according to the following rules (Burrell and Ribbons 2006):

- where the slope of the curve is rising the flow exceeds the long-term average, indicating wetter periods
- where the slope of the curve is falling the flow is less than the long-term average, indicating generally drier periods
- relative magnitude can be determined by the steepness of the slope and the y-axis of the plot.

The cumulative mass curve shows that there was a prolonged dry period in the Gwydir catchment prior to 1950 with long periods of below average flow. A significant shift towards wet conditions occurred with the large flood events during the 1950s. From the mid-1950s to around 1990 the Gwydir River experienced a long period of average conditions with alternating wet and dry periods lasting no more than five years at a time. Since 2000 the Gwydir valley has experienced a prolonged period of drought which has lasted 10 years. The wet conditions experienced in 2010 are noticeable by the distinct change in the direction of the graph, possibly signalling the start of a wetter period.
Figure 9: Daily flows and cumulative deviation from the mean for Gwydir River at Bundarra

Gwydir River at Bundarra (418008)
1937 to 2010

Daily Flow

Cumulative deviation from mean

Mean daily flow = 926 ML/d
6 Groundwater

The major groundwater aquifers in the Gwydir are associated with the extensive alluvial sediments that occur in the western half of the catchment (Figure 10). These unconsolidated sediments were laid down in the floodplains of the ancestral and present Gwydir River systems and include variable amounts of water bearing sand and gravels particularly in the centre of the valley (Bilge 2002).

The water bearing sands and gravels are divided into two main aquifer systems, a shallow aquifer 10-30 m deep and a deep aquifer at 35-80 m deep. The shallow aquifer is locally known as the Narrabri Formation and consists of coarse gravels. The deeper more confined aquifer is known as the Gunnedah Formation which consists of fine to medium sand and gravel (Barrett 2009).

Maximum thickness of the alluvial sediments increases from 20 m in the upstream area to about 60 m near Moree and 75-80 m in the west (Bilge 2002). Bores in the deeper aquifers are capable of yielding up to 100 litres per second, however the majority of bores produce supplies in the range of 10-40 litres per second (Barrett 2009).

Some of the groundwater resources in the middle of the catchment are accessed from the porous rocks of the Great Artesian Basin. This is a layered sequence of sedimentary rocks, predominantly shales, siltstones and sandstones up to 1.5 km thick. In the east of the catchment groundwater is accessed through the fractured rocks of the New England Fold Belt. The highest yielding rocks are the tertiary basalts in the Guyra and Inverell areas where bore depths range between 15 m and 90 m with yields of up to 1.5 litres per second (WRC 1984).

Groundwater quality is generally high being classified as either ‘fresh’ or ‘moderate’ across large areas of the catchment (Figure 11). The highest quality aquifers occur in the alluvial sediments of the Moree area and in the fractured rocks of the upper catchment. Water is generally suitable for irrigation, stock and domestic use throughout the valley, with the exception of small areas in the lower Gwydir catchment where the water is brackish or saline.

Figure 10: Groundwater aquifer types in the Gwydir catchment
Groundwater within the Gwydir valley is managed according to eight Groundwater Management Areas (Figure 12). A water sharing plan has been prepared for Management Area 5 which covers the Lower Gwydir Alluvium. Further details are provided in Section 7.3.

Figure 11: Groundwater quality and suitability in the Gwydir catchment

Figure 12: Groundwater Management Areas in the Gwydir catchment
7 River operations and management

7.1 Major storages and regulating structures

Located on the Gwydir River 35 km south west of Inverell, Copeton Dam is the major irrigation storage within the Gwydir catchment. It was completed in 1972 and provides water for town water supplies, irrigation, stock and domestic requirements, industry and environmental flows along the Gwydir River and its effluent channels. The storage has a total capacity of 1,364,000 ML which it draws from a catchment area of over 5,300 km². A plot of storage volumes since the completion of the dam can be found at Figure 13. While good inflows in 2010 have allowed some recovery of dam levels after a decade of drought, Copeton Dam has not been full since 2000.

AGL Southern Hydro operates a 21 MW hydro power station at Copeton Dam which generates enough power to supply an average of 10,000 people each year. Water is available for power generation only when releases are made for water users, the environment and during flood operations.

A series of weirs and regulators assist in the diversion of water to the various watercourses of the lower Gwydir catchment. The first of these is Tareelaroi Weir about 30 km upstream of Moree, which controls diversions to the Mehi River. Other major structures include Boolooroo Weir, Tyreel Weir, Combadello Weir, Gundare Regulator and Mallowa Regulator. The location and functions of these are shown in Table 4.

Table 4: Major weirs in the Gwydir catchment

<table>
<thead>
<tr>
<th>Weir</th>
<th>Approximate location</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tareelaroi Weir</td>
<td>Gwydir River 30 km upstream</td>
<td>Diversions to the Mehi River</td>
</tr>
<tr>
<td></td>
<td>of Moree</td>
<td></td>
</tr>
<tr>
<td>Boolooroo Weir</td>
<td>Gwydir River downstream of</td>
<td>Diversions to Carole Creek</td>
</tr>
<tr>
<td></td>
<td>Moree</td>
<td></td>
</tr>
<tr>
<td>Tyreel Regulator</td>
<td>Gwydir River downstream of</td>
<td>Diversions to Tyreel Anabranch and then to the Lower</td>
</tr>
<tr>
<td></td>
<td>Moree</td>
<td>Gwydir Watercourse</td>
</tr>
<tr>
<td>Combadello Weir</td>
<td>Mehi River 20 km southwest</td>
<td>Diversions to Moomin Creek</td>
</tr>
<tr>
<td></td>
<td>of Moree</td>
<td></td>
</tr>
<tr>
<td>Gundare Regulator</td>
<td>Mehi River 50 km southwest</td>
<td>Diversions to Mallowa Creek</td>
</tr>
<tr>
<td></td>
<td>of Moree</td>
<td></td>
</tr>
<tr>
<td>Mallowa Creek Regulator</td>
<td>Mallowa Creek 50 km southwest of Moree</td>
<td>Control of stock and domestic flows along Mallowa Creek</td>
</tr>
</tbody>
</table>
7.2 Licensed water use

Surface water

The Gwydir catchment uses around 3.5 per cent of all surface water diverted in the Murray-Darling basin (CSIRO 2007). The Gwydir River system is operated (or regulated) to meet the needs of water users and the environment from Copeton Dam to its junction with the Barwon-Darling River near Collarenebri. Copeton Dam and the various weirs and regulators downstream are operated to meet water user needs. Where possible the tributary inflows from the Keera Creek, Halls Creek, Myall Creek, Horton River, and Warialda Creek are utilised before dam releases are made.

The major water users in the Gwydir River are general security irrigators with an annual entitlement of 509,665 ML (Table 5). The needs of general security irrigators are met through a continuous accounting system where each irrigator operates their own individual account with the dam and can use the water resources as they wish. Irrigators are allowed to maintain up to 150 per cent of their entitlement within their account at any one time and may use up to 100 per cent of their entitlement within a water year.

Under the continuous accounting system the NSW Office of Water maintains a reserve plus a working account (to cover transmission and operation losses) within Copeton Dam to ensure the security of water users. The reserve is used to meet the essential commitments of the system, including town water supply, high security irrigation, stock and domestic needs, and environmental flows. An environmental contingency allowance of 25,000 ML is also available in Copeton Dam.

About 18,700 ML of high security entitlement exists within the valley including town water supply needs and high security irrigation. Minimum flow requirements are in place downstream of Copeton
Dam. Stock and domestic flow replenishment flow rules are also in operation for the Gingham, Lower Gwydir, Mallowa, Thalaba and Ballinboora Creek systems.

When flows in the river are greater than orders, access to this surplus water is declared. During these times, irrigators can divert water without debit to their account. Due to the large volume of on-farm storage capacity within the Gwydir valley rules for the sharing of surplus water were introduced in 1998. Flow thresholds protect low flows and determine the access available to surplus water. For each flow event, irrigators may access 50 per cent of the surplus flow volume with the other 50 per cent remaining in the river for environmental use.

Water users located on the various unregulated tributaries of the Gwydir catchment are entitled to extract water with an unregulated water licence. These licences are subject to a range of access conditions, including cease to pump triggers that protect the health of the watercourses. There is currently around 38,345 ML of unregulated entitlement (see Table 6) within the Gwydir catchment, of which around 5,618 ML is covered by water sharing plans (see Section 7.3). The main licensed use of water is for irrigation accounting for 36,505 ML of entitlement.

Table 5: Surface water share components for the regulated Gwydir catchment 2009-10

<table>
<thead>
<tr>
<th>Access licence category</th>
<th>Total share component (ML)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Domestic and stock</td>
<td>2,506</td>
</tr>
<tr>
<td>Domestic only</td>
<td>8</td>
</tr>
<tr>
<td>Stock only</td>
<td>230</td>
</tr>
<tr>
<td>Local water utility</td>
<td>3,836</td>
</tr>
<tr>
<td>Regulated river (general security)</td>
<td>509,665</td>
</tr>
<tr>
<td>Regulated river (high security)</td>
<td>14,817.9</td>
</tr>
<tr>
<td>Regulated river (high security – research)</td>
<td>60</td>
</tr>
<tr>
<td>Supplementary water</td>
<td>177,346.5</td>
</tr>
</tbody>
</table>

Source: NSW Office of Water

Table 6: Unregulated licence entitlement for Gwydir catchment 2010

<table>
<thead>
<tr>
<th>Access licence category</th>
<th>Total share component (ML)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Water sharing plan areas</strong></td>
<td></td>
</tr>
<tr>
<td>Irrigation</td>
<td>5,591</td>
</tr>
<tr>
<td>Domestic and stock</td>
<td>27</td>
</tr>
<tr>
<td><strong>TOTAL in water sharing plan area</strong></td>
<td>5,618</td>
</tr>
<tr>
<td><strong>Outside water sharing plan areas</strong></td>
<td>Entitlement (ML)</td>
</tr>
<tr>
<td>Domestic</td>
<td>45</td>
</tr>
<tr>
<td>Farming</td>
<td>15</td>
</tr>
<tr>
<td>Industrial</td>
<td>691</td>
</tr>
<tr>
<td>Irrigation</td>
<td>30,914</td>
</tr>
<tr>
<td>Pisciculture</td>
<td>75</td>
</tr>
<tr>
<td>Recreation</td>
<td>20</td>
</tr>
<tr>
<td>Stock</td>
<td>253</td>
</tr>
<tr>
<td>Town water supply</td>
<td>714</td>
</tr>
<tr>
<td><strong>TOTAL outside water sharing plan area</strong></td>
<td>32,727</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td>38,345</td>
</tr>
</tbody>
</table>

Source: NSW Office of Water
Groundwater

The Gwydir region uses approximately three per cent of the groundwater extracted from the Murray-Darling Basin (CSIRO 2007). In 2009 there were 4,740 bores that were licensed to provide over 75,000 ML of water per year (Table 7). Ninety per cent of this entitlement is managed according to water sharing plans (see Section 7.3). Aquifer licences within the water sharing plan area cover a variety of purposes including irrigation, industrial, stock and domestic water. Outside the water sharing plans, the main licensed use of groundwater is for irrigation and stock and domestic requirements. There is a large reliance on groundwater for town water supplies with 16,673 ML of entitlement being held by local water utilities within the catchment.

Table 7: Groundwater licence share components for the Gwydir catchment 2009

<table>
<thead>
<tr>
<th>Access licence category</th>
<th>Total share component (ML)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Water sharing plan areas</strong></td>
<td></td>
</tr>
<tr>
<td>Aquifer</td>
<td>46,802</td>
</tr>
<tr>
<td>Domestic and stock</td>
<td>4,057</td>
</tr>
<tr>
<td>Local water utility</td>
<td>16,581</td>
</tr>
<tr>
<td>TOTAL in water sharing plan area</td>
<td>67,440</td>
</tr>
<tr>
<td><strong>Outside water sharing plan areas</strong></td>
<td></td>
</tr>
<tr>
<td>Aquaculture / Pisciculture</td>
<td>315</td>
</tr>
<tr>
<td>Mining</td>
<td>330</td>
</tr>
<tr>
<td>Domestic and stock</td>
<td>1,094</td>
</tr>
<tr>
<td>Farming</td>
<td>120</td>
</tr>
<tr>
<td>Drainage</td>
<td>1</td>
</tr>
<tr>
<td>Industrial</td>
<td>57</td>
</tr>
<tr>
<td>Irrigation</td>
<td>5,615</td>
</tr>
<tr>
<td>Town water supply</td>
<td>92</td>
</tr>
<tr>
<td>TOTAL outside water sharing plan area</td>
<td>7,624</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>75,064</strong></td>
</tr>
</tbody>
</table>

Source: NSW Office of Water

7.3 Water sharing plans

A water sharing plan is a legal document prepared under the Water Management Act 2000. It establishes rules for sharing water between the environmental needs of the river or aquifer and water users, as well as between different types of users. Water sharing plans are designed to provide security for the environment and water users by setting the rules for how water is allocated over a 10 year period. In addition the plans set rules for water trading and water allocations.

There are currently two surface water sharing plans and two groundwater sharing plans that guide water management within the Gwydir catchment. A further three water sharing plans are currently in preparation for groundwater sources that underlay the catchment. A copy of all water sharing plans referred to below are available from www.water.nsw.gov.au
Surface water sharing plans

Gwydir Regulated Water Source

The Water Sharing Plan for the Gwydir Regulated River Water Source commenced on 1 July 2004 and remains in effect until 30 June 2014. The plan applies to the regulated rivers in the Gwydir catchment including the Gwydir River from Copeton Dam to the Gwydir Raft, the Mehi River, Moomin Creek, Carole Creek, and the regulated sections of Gil Gil Creek.

Environmental flow rules were first applied to the Gwydir River in 1995. Revisions to these rules to improve river health benefits were made in 1998 and then again during preparation of the current water sharing plan. These rules aim to ensure that there is no reduction in the long-term average volume of water available to the environment during the life of the plan, ensure that a proportion of the natural tributary inflows reach the Gwydir wetlands, and provide a volume of water in Copeton Dam that can be released for environmental purposes.

The main environmental provisions of the water sharing plan are as follows (DIPNR 2004):

1. All water above the plan extraction limit is reserved for the environment.
   This means that on a long-term average basis, approximately 56 per cent of yearly flows in the river are protected for the maintenance of environmental health.

2. Pass tributary inflows through to the Gwydir wetlands.
   This is achieved by ensuring that flows into the Gwydir wetlands are at least equal to the sum of inflows from the Horton River, Myall Creek and Halls Creek, (to a maximum of 500 ML/d), and ensuring that 50 per cent of the flows above 500 ML/d are protected for the environment.

3. Provide a reserve of water in Copeton Dam and make releases to achieve downstream environmental benefits.
   This is achieved by setting water aside in an environmental contingency allowance account to a maximum limit of 90,000 ML. Releases may be made for a wide range of purposes related to wetland or river health or for the direct benefit of birds, fish or other fauna.

In addition to the above rules there are also restrictions on extractions under supplementary access licences. These aim to preserve a significant proportion of natural tributary flows for river health, protect important rises in water levels, provide for wetland and floodplain inundation, and maintain natural flow variability.

Rocky Creek, Cobbadah, Upper Horton and Lower Horton Water Source

The Water Sharing Plan for the Rocky Creek, Cobbadah, Upper Horton and Lower Horton Water Source covers the unregulated catchment of the Horton River and its tributaries. The catchment covers an area of approximately 2,250 km², draining from the Kaputar and Nandewar Ranges on the southern side of the Gwydir catchment. The plan commenced on 1 July 2004 and applies until 30 June 2014.

River flows within the Horton catchment are variable throughout the year, with the lowest flows in summer corresponding with the highest water demands for irrigation. At the start of the plan the estimated water requirements in the water source totalled 5,509 ML for 61 water access licences (DIPNR 2005). The majority of these licences are for irrigation, domestic and stock purposes. To protect environmental health the plan defines cease-to-pump conditions and access rules for each of four water management zones within the water source.
Groundwater sharing plans

Lower Gwydir Groundwater Source
The Water Sharing Plan for the Lower Gwydir Groundwater Source commenced on 1 October 2006 and sets the framework for managing groundwater in the Lower Gwydir until June 2017.

Water within the plan area is managed according to three categories of groundwater access licenses - local water utility access licences, aquifer access licences and supplementary water access licences. Local water utility access licences are held by local government for town water supply purposes. There are two of these licences within the Lower Gwydir totalling 3,572 ML.

The plan defines an initial extraction limit for the Lower Gwydir Water Source of 32,300 ML per year, plus water for supplementary water access licences, and basic landholder rights. Water available for supplementary licences will decrease each year from 2009-10 until 2014-15, after which there will be no groundwater available under supplementary water access licences.

NSW Great Artesian Basin Water Sources
The Water Sharing Plan for the NSW Great Artesian Basin Groundwater Source commenced on 1 July 2008 and will apply for a period of 10 years. The Great Artesian Basin (GAB) underlies the western half of the Gwydir valley. The plan covers all water contained in the sandstone aquifers of the NSW portion of the GAB.

The basin has been divided into five groundwater sources – the Eastern and Southern Recharge Groundwater Sources in the non-artesian part of the basin, and the Surat, Warrego and Central Groundwater Sources in the artesian part of the basin, where water flows naturally to the surface.

The Surat Groundwater Source underlies the catchment west of Moree. The Surat Groundwater Source covers an area of 73,418 km² and the water is primarily used for stock, domestic, commercial purposes such as spa bath industries and mining. The area is characterised by a high density of bores, particularly in the south, and high flowing bores with numerous bore drains in the north (DWE 2009a).

The Eastern Recharge Water Source occurs along the eastern fringe of the GAB and underlies the Gwydir catchment south-east of Moree. Here groundwater enters the main Pilliga Sandstone aquifer through exposed outcrops, or via overlying strata. The average annual net recharge is estimated at 19,000 ML per year (DWE 2009b). Irrigation entitlements are in excess of the estimated sustainable yield, and in some areas water use is causing falling water levels. The plan provides for the entitlements of aquifer access licences to be reduced in the Eastern Recharge Groundwater Source to the sustainable yield of the water source.

The basis for water sharing in the Surat Groundwater Source is the **sustainable pressure estimate equivalent**. This is the volume of water required to maintain pressure levels experienced under the water management regime and infrastructure that was in place in 1990. For the Surat Groundwater Source the sustainable pressure estimate equivalent is 75,000 ML per year (DWE 2009b).

The plan makes the following provisions for protection of the environment (DWE 2009b):

- In the Eastern Recharge Groundwater Source 30 per cent of the average annual net recharge is set aside for the environment to provide for the needs of groundwater dependent ecosystems.
- In the Surat Groundwater Source the volume of water required to maintain 1990 pressure levels, plus water savings made under the Cap and Pipe the Bores Program between 1190 and 1999, plus 70 per cent of water savings made under that program since 1999, are set aside from the environment.
Plans under development

A number of draft groundwater sharing plans were placed on public exhibition in December 2010 and are expected to be finalised in 2011. Those that are relevant to the Gwydir catchment are:

Groundwater Sources Overlying the NSW Great Artesian Basin
Within this plan the Gwydir Groundwater Source includes the aquifers of the unconsolidated mostly alluvial sediments that overly the GAB Surat Groundwater Source and covers the surface water catchment of the Gwydir. It excludes however the Lower Gwydir Alluvium Source which is already covered by a water sharing plan.

NSW Murray-Darling Basin Fractured Rock Groundwater Sources
Two water sources covered by this plan occur within the Gwydir catchment. These are related to the fractured rocks of the New England Fold Belt and the Inverell Basalt which are found in the eastern half of the Gwydir catchment.

NSW Murray-Darling Basin Porous Rock Groundwater Sources
Only a small area of the Gwydir catchment is underlain by porous rocks. The Gunnedah-Oxley Basin Groundwater Source lies within Permian and Triassic rocks associated with the Gunnedah Basin and the overlying younger Jurassic and Cretaceous rocks associated with the Oxley Basin.

Gwydir Unregulated and Alluvial Water Sources
A draft Water Sharing Plan for the Gwydir Unregulated and Alluvial Water Sources is being prepared. This is expected to be placed on public exhibition in the near future and consists of plans for the following water sources:

- Roumalla Creek Water Source
- Rocky River Water Source
- Booroolong Creek Water Source
- Upper Gwydir River Water Source
- Laura Creek Water Source
- Bakers Creek Water Source
- Georges Creek Water Source
- Moredun Creek Water Source
- Keera Creek Water Source
- Copeton Dam Water Source
- Halls Creek Water Source
- Mackenzies Flat Water Source
- Myall Creek Water Source
- Gurley Creek Water Source
- Tycannah Creek Water Source
- Warialda Creek Water Source
- Millie Creek Water Source
- Slaughterhouse Creek Water Source
- Mosquito Creek Water Source
- Moree Water Source
- Gil Gil Creek Water Source
- Thalabah Creek Water Source
- Mehi River Water Source
- Gwydir Water Source
- Carole Creek Water Source
- Gingham Watercourse Water Source
- Barwon Water Source
- Upper Gwydir Alluvial Water Source.
8 References


Bilge H. 2002, Lower Gwydir Valley Groundwater Model. NSW Department of Land and Water Conservation, Parramatta, NSW.


