Department of Primary Industries
Office of Water

Isis River amendment review

Ecological assessment of the proposed amendment provisions in the Isis River Water Source

Published by the NSW Department of Primary Industries, Water

Isis River amendment review – Ecological assessment of the proposed amendment provisions in the Isis River Water Source

First published August 2015

ISBN number – get this by filling in a request to http://intranet.dpi.nsw.gov.au/library/help/isbn

More information

Skye Taylor & Allan Raine (NSW Office of Water)

www.dpi.nsw.gov.au

Acknowledgments

NSW DPI Fisheries

Jon Sayers, John Paul Williams, Fergus Hangcock, Richard Hillhouse

[Cover image: Morley Downs, Murrurundi - Skye Taylor]

[Insert Reference number]

Contents

Table of Figures

List of Tables

Departmental Approvals

Comments:

Position	Signature	Date
Approving officer: Tara Schalk, A/Manager PEPA	Tara Schalk	24/4/15
Endorsing officer:		

1. Summary

The following report provides an ecological assessment of the Isis River. This report has been prepared in response to the revision of current amendment provisions for the Isis River Water Source outlined in the Water Sharing Plan for the Hunter Unregulated and Alluvial Water Sources (2009). The following table provides an overview of the Isis River Water Source, the findings of this report and subsequent recommendations for the proposed amendments.

Water sharing plan	**Water Sharing Plan for the Hunter Unregulated and Alluvial Water Sources (2009)**
Plan commencement	1 August 2009
Term of the plan	10 years
Current Rules	Cease to pump is when there is no visible flow at Isis River at Stick-Me- Up Bridge gauge.
Amendment Provisions	Cease to pump level may be amended to flow up to the 95th percentile or 1.5 ML/day, whichever is higher, by year six of the Plan based on further studies. Further studies may also recommend the splitting of the water source into management zones and separate cease to pump and flow reference points identified for these zones.

Water Source Context	**River Flows**
Area: 550.1 km^2 **Average Annual Rainfall:** 787 mm **Upstream Water Source:** Nil **Downstream Water Source:** Pages River, Hunter River Regulated System, Hunter River Tidal Pool	**Low Flow Index:** (80th percentile in December of days with flow) = 11.6 ML/day **Flow Records:** 1963 to 1982 (19 yrs) Based on flows measured at Isis River at Lower Timor gauge (210070) adjusted for longer term climate. **Monitoring Sites:** Stick-Me-Up Bridge (210118) and Lower Timor (210070)
Licensed Water Use	1932 ML/year (94 % used for irrigation purposes)
Number of surface water licenses	27 licences - Peak Daily Demand = 27.6 ML/day

Findings	
River Condition Index (RCI)	Overall RCI of **Moderate** for all sub-catchments within the Isis River Water Source. • Poor geomorphic condition • Moderate hydraulic stress in lower Isis River • Good riparian vegetation coverage, biodiversity condition and catchment disturbance
Geomorphology	There is a significant difference in geomorphology between the upper and lower Isis River; • Upper Isis River is characterised by semi-permanent pools with cobble bed matrix separated by bedrock bars. • Lower Isis River is a lower energy, highly mobile bed of mostly gravel with some sand deposits. Shallow pools are susceptible to in-filling from the mobile bedload during high flow events.
Riparian Vegetation	Good native woody riparian vegetation cover mixed with introduced weed species and areas of unvegetated river bank.
Hydrology	There is a vast difference in flow relationship between Lower Timor and Stick-me-Up Bridge gauges • Upper Isis River experiences a constant base flow which is below 2 ML/day during dry conditions. • Below the Lower Timor gauge, the transmission of flow through the alluvium often means there is no surface flow registered at Stick-Me-Up Bridge. • Flow is restored downstream at the Gundy Recorder gauge within the Pages River Water Source. • Long-term flow data estimates the 95 percentile of 2.5 ML/day
Instream Values	• There are no threatened species in the Isis River Water Source. • Fish diversity is low; four native species were identified in the upper Isis River • Macroinvertebrate diversity is estimated to be moderate based on data from the lower Pages River, where conditions are analogous to the lower Isis River.

Recommendations

- Division of the Isis River Water Source into two management zones with separate CtPs.
    - Upper Isis River Management Zone CtP of 2 ML/day measured at the Lower Timor gauge (210070).
    - Lower Isis River Management Zone CtP remains as no visible flow, measured at Stick-Me-Up Bridge gauge (210118).

2. Introduction

2.1. Background

The Isis River is located in the central upper Hunter Valley and is the most northern extending of the catchments within the Hunter River Basin. The Isis River Water Source runs north to south, with the headwaters of the catchment sourced from the Liverpool Ranges. Downstream at the end of system, the River forms a conjunctive water source at Gundy in the lower Pages River before draining into the Hunter Regulated River (Figure 1).

Water access rules for the Isis River are outlined in the Water Sharing Plan for the Hunter Unregulated and Alluvial Water Sources (2009) (the Plan). River flow has been measured at Stick-Me-Up Bridge in Gundy since 2004 and is the nominated reference point outlined in the Plan for setting low flow cease to pump (CtP) access rules. The gauge is located in the lower Isis River and ceases to flow during dry periods. Consequently, upstream users are unable to pump from the river when flow ceases at the downstream gauge, despite the presence of a constant and reliable upstream flow.

The delineation of a subcatchment into management zones can be considered if the overall characteristics of the water source, such as the hydrological nature, are not uniform throughout the system. Consequently, a number of submissions have sought to enact separate management zones under the Plan in recognition of the different flow characteristics within this water source. The Plan outlines an amendment provision which allows for the establishment of two management zones with separate flow reference points and cease to pump (CtP) thresholds. In 2011, a surface flow gauge was established in the upper Isis River at Lower Timor. This gauge would become the new flow reference point should an Upper Isis River Management Zone be created.

Running west, and adjacent to the Isis River is the Pages River Water Source (Figure 1). The Pages River has very similar flow conditions but in contrast, is divided into five Management Zones with different water access rules. Segenhoe is the furthermost downstream Management Zone and comprises an alluvial aquifer covering an area of approximately 10 km^2. The role of stream flow from the Isis River as a recharge source to the Pages River alluvial aquifer is yet to be established.

This review addresses the proposed amendment of water access rules in the Isis River Water Source by creating two management zones with different CtP thresholds. Ecological values and available hydrological data were assessed along with the connectivity between the Isis River and adjacent Pages River alluvial aquifer in the Segenhoe Management Zone.

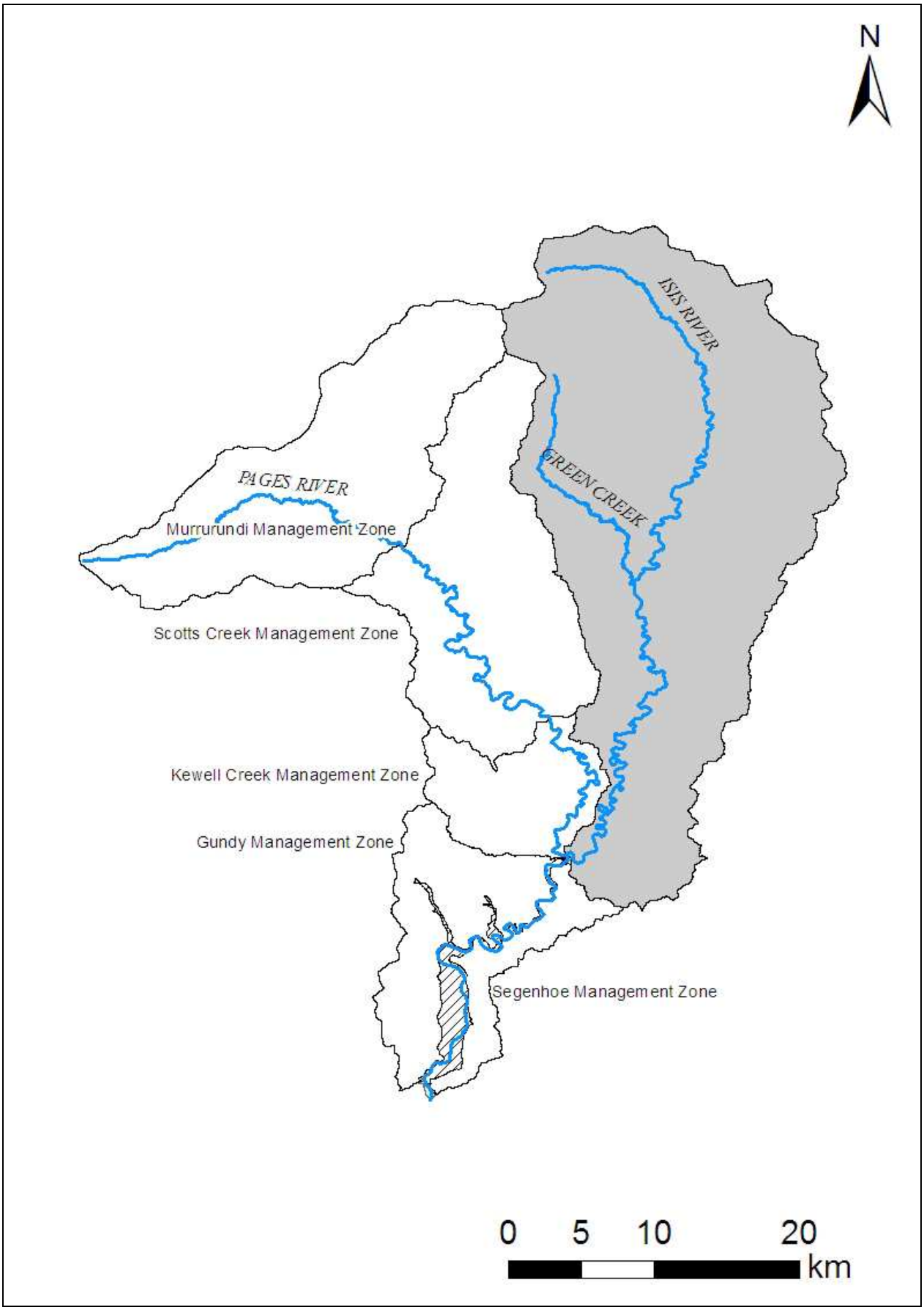

Figure 1 Isis River (shaded) and Pages River catchments. The Isis River joins the Pages River in the Gundy Management Zone and flows through the Segenhoe Management Zone (hatched) before reaching the Hunter Regulated River.

2.2. Isis River water access rules

2.2.1. Current rules

Under the Plan;

(i) the Very Low Flow Class is no visible flow measured at the Isis River at Stick-Me-Up Bridge gauge (210118),

(ii) A Class is a visible flow measured at Stick-Me-Up Bridge gauge (210118) and flows are less than 31 ML/day measured at the Pages River at Gundy Recorder gauge (210052), and

Note. 31 ML/day corresponds to the estimated 50th percentile. The percentile refers to the lowest flow month at the gauge and includes all days of record.

(iii) B Class is a visible flow measured at Stick-Me-Up gauge (210118) and flows equal to or greater than 31 ML/day measured at the Pages River at Gundy Recorder gauge (210052),

2.2.2. Amendment provisions

Under clause 17 (2) (n) of the Plan;

(i) separate management zones are not established under clause 6, such that the top of the Very Low Flow Class on a falling river is equal to the 95th percentile flow level or 1.5 ML/day, whichever is the higher, subject to consideration of the socio-economic impacts and environmental requirements, and

(ii) separate management zones are established:

(1) for an upper management zone, a cease to pump based on studies to determine an appropriate surface water cease to pump level, including consideration of longitudinal connectivity and links between flows in the upper management zone and water levels in remnant pools in the lower management zone, and flow reference points, and

(2) for a lower management zone, such that the top of the Very Low Flow Class on a falling river is equal to the 95th percentile flow level or 1.5 ML/day, whichever is the higher, subject to consideration of the socio-economic impacts and environmental requirements.

2.3. Entitlement

There are currently 25 irrigation licences authorised to extract water from the Isis River Water Source with a total share component of 1862 units. Under the proposed management zone changes, the Upper Isis Management Zone would contain 6 irrigation licences constituting a share component of 507 units (see Table 1).

Table 1 Irrigating properties located upstream of Isis River at Lower Timor gauge 210070.

Property Name	Share Component	Water use	Approval No.
Whissonsett	160	Irrigation	20CA208286
Timor Station	128	Irrigation	20CA208266
Morley Downs	125	Irrigation	20CA208241
Balarang	40	Irrigation	20CA211064
Glenbrae	28	Irrigation, Stock	20CA208256
Nambadilling	26	Irrigation	20CA208236

2.4. Monitoring sites

Two surface flow gauges are established in the Isis River (Table 2, Figure 2).

Gauge **210070**, (Lower Timor gauge), is located above the Green Creek confluence and would become the end of system gauge for the new proposed upper management zone. Here, a consistently low surface flow of often less than 2 ML/day is recorded during dry periods. The bedrock control at this gauging site provides good sensitivity, ensuring reliability of gauged data during low flow periods. On occasion, filamentous weed can dislodge upstream and accumulate at the gauge, resulting in deviations from the rating during low flow periods. Under these conditions, large amounts of weed raise the level of the gauge pool, where an low flow event may potentially be recorded and subsequently published as a higher flow (R. Hillhouse pers. comm.). These events may result in users accessing water when the surface flow is in fact below the set CtP limit.

Gauge **210118** (Stick-Me-Up Bridge gauge) is located at the end of system, above the confluence of the Isis and Pages Rivers. It is the current reference point for all water access licences in the Isis River Water Source. A concrete causeway that forms the control for this gauge has undergone extensive degradation where low flow stage/discharge relationships can change dramatically depending on whether holes within the causeway are clear and flowing or obstructed from accumulating debris (R. Hillhouse pers. comm.). As a result, there is a significant level of scatter in the low flow gaugings and flow data may be misleading at times, however the cease to flow does remain reasonably stable and is considered to be reliable for the current no visible flow CtP rules.

On the Pages River, gauge **210061** (Blandford gauge) has a similar longitudinal position and catchment area to the Lower Timor gauge. Blandford has a much longer period of record compared to Lower Timor (see Table 2) and can be used to inform on flow durations likely to have occurred in the upper Isis River in the absence of long-term data.

Much like Blandford, gauge **210142** (Upstream Kewell gauge) on the Pages River has longitudinally similar location to Stick-Me-Up Bridge gauge in the Isis River catchment. Both gauges are approximately the same distance upstream from the confluence of the Pages and Isis Rivers. They are also a similar distance upstream to the groundwater bores selected to measure aquifer levels for this study.

Gauge **210052** (Gundy Recorder gauge) is the first gauge after the confluence of Pages and Isis Rivers and is used to determine the A Class and B Class water access rules in the Plan.

Two groundwater bores were also used in this study for assessing the connectivity between the Isis River and the alluvial aquifer in the Segenhoe Management Zone of the Pages River Water Source. A desktop study on this hydrological relationship used bores **GW080439** and **GW271022** located at the northern end of the alluvial aquifer (Figure 2).

Table 2 Monitoring sites in the Isis and lower Pages River Water Sources (* = decommissioned)

River/aquifer	Site type	Site name	Site number	Date operational
Isis River	Surface water	Isis River at Lower Timor	210070	1963-1982* Sep 2011
Isis River	Surface water	Isis River at Stick-Me-Up Bridge	210118	Mar 2004
Pages River	Surface water	Pages River at Blandford	210061	May 1960
Pages River	Surface water	Pages River at U/S Kewell	210142	Mar 2004
Pages River	Surface water	Pages River at Gundy Recorder	210052	Sep 1958
Segenhoe aquifer	GW bore	Bellrive Stud Scone	GW080439	Jun 2003
Segenhoe aquifer	GW bore	Arrowfield Stud Scone	GW271022	Feb 2008

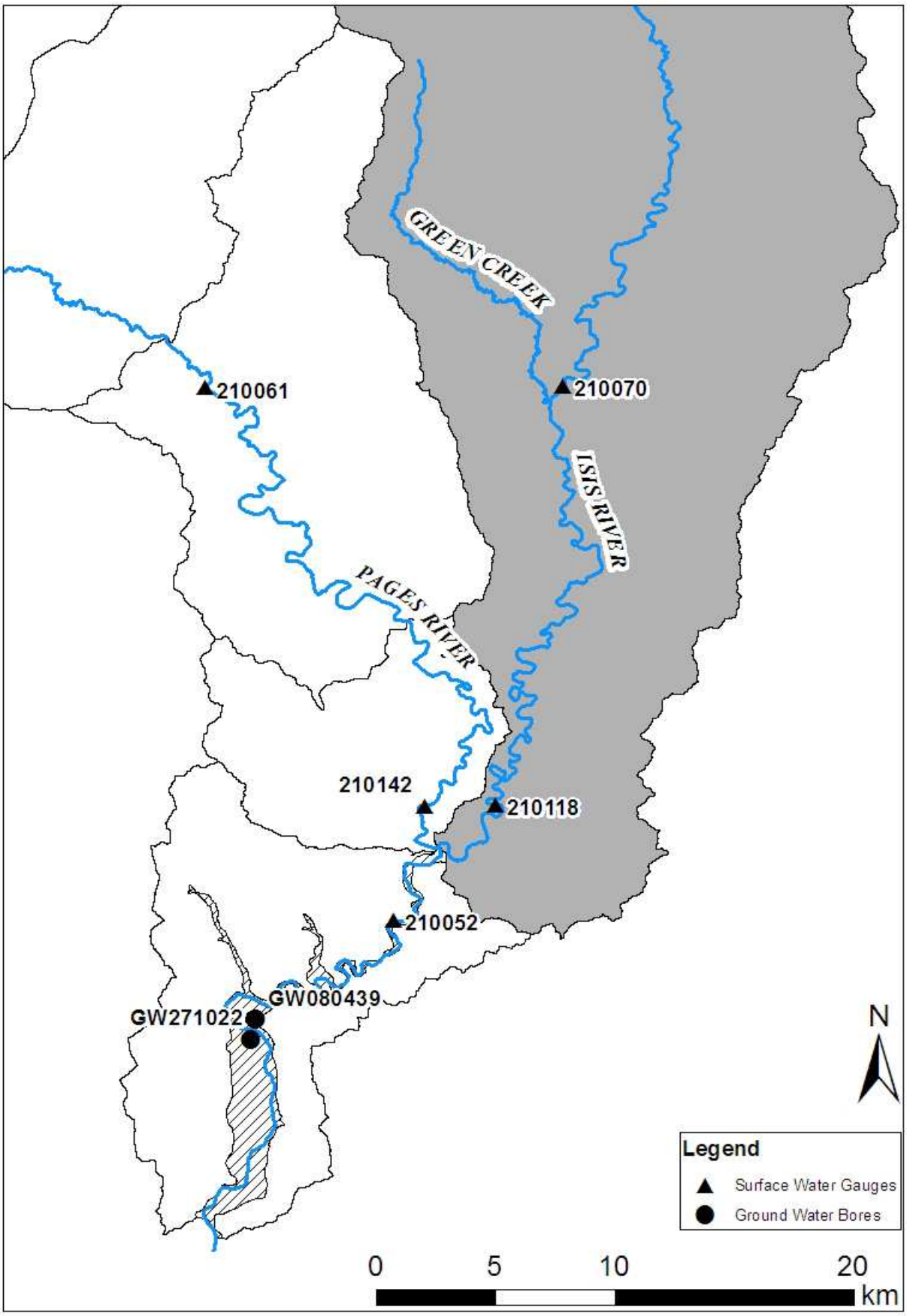

Figure 2 Surface water gauges and groundwater bores in the Isis and Pages River Water Sources

3. Methodology

The Isis River Water Source was reviewed through desktop studies, consultation with landholders and inspections of the river by Departmental staff.

Geospatial applications developed by NSW Office of Water were used to assess the Isis and adjacent Pages River as an indication of overall health and instream value. The two applications used were the River Condition Index (RCI) and High Ecological Value Aquatic Ecosystems (HEVAE) models.

To complement the RCI and HEVAE outputs, macroinverebrate and fish data were investigated to identify species assemblages within these water sources. Macroinvertebrate data from the adjacent Pages River was obtained through the Department of Environment and Heritage *Monitoring River Health Initiative*. NSW DPI Fisheries provided data on fish sampled in the Isis River at Whissonette and the Pages River at Bickham and Glengary.

Hydrological data from the NSW Office of Water was compiled to examine relationships between surface flows in the Isis and Pages Rivers as well as the alluvial aquifer recharge in the Segenhoe Management Zone of the Pages River. The Isis River at Lower Timor gauge has a short, incomplete period of record. A reliable flow duration curve was compiled using the similarly positioned Blandford gauge as a more accurate means of determining the newly recommended CtP for the Upper Isis River Management Zone.

On 13 October 2014 an onsite assessment of the Isis River was conducted when river flow conditions were deemed to be poor, with the Lower Timor flow gauge reading 0.8 ML/day. Departmental staff visited the Morley Downs property, Green Creek Road, Murrurundi; one of six irrigating properties located in the proposed upper management zone. Morley Downs borders the Isis River and provides a typical representation of the upstream environment. Additionally, staff inspected the flow gauge sites of the Isis River at Stick-Me-Up Bridge and the Isis River at Upper Timor, including the low level causeway crossing below the Lower Timor gauge site. Additional sites were two bridge crossings on the Isis River at Waverly Road, Timor and Waverly Road, Gundy and the Pages River crossing at Allan Bridge Road, Gundy.

On 18 December 2014, further assessment of flow gauge sites took place at Lower Timor, Stick-Me-Up Bridge, Gundy Recorder and U/S Kewell.

4. Findings

4.1. River Condition Index (RCI)

The River Condition Index (RCI) is a geospatial tool which assesses a number of indices to produce an overall category of river health or condition based on subcatchments rather than entire catchments or river reaches. The RCI takes into account riparian vegetation, geomorphic condition, hydraulic stress, aquatic biodiversity and catchment disturbance to establish 5 classes ranging from Very Poor to Very Good.

The RCI for the Isis and Pages Rivers is represented in Figure 3. All subcatchments that comprise the Isis River Water Source have an overall moderate condition, with the key driver being very poor geomorphic condition. In the lower Pages River, Gundy and Segenhoe Management Zones are in poor condition which is also attributed to very poor geomorphic condition as well as high hydraulic stress.

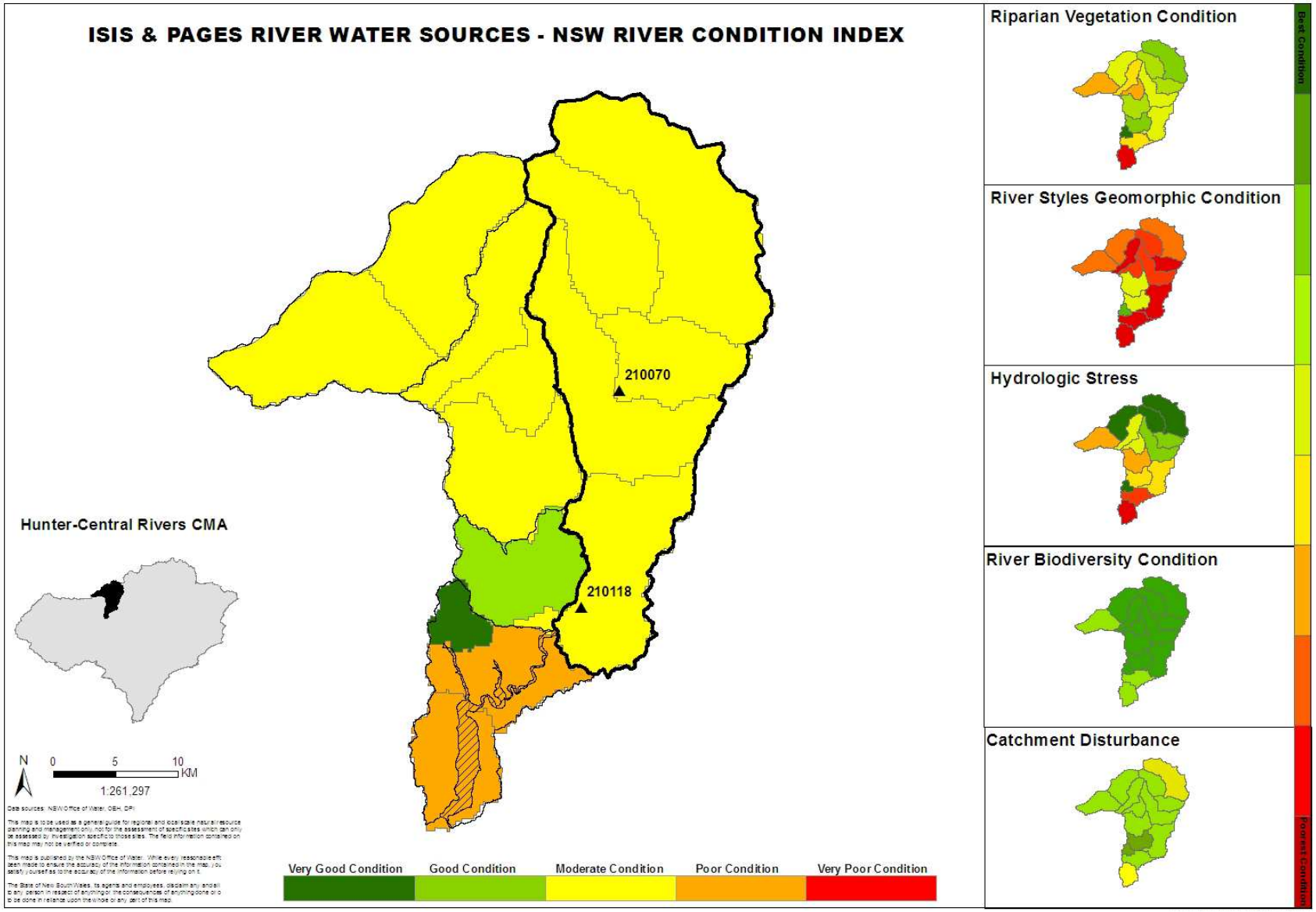

Figure 3 Overall River Condition Index (RCI) for the Isis River (◘) and Pages River (□) Water Sources. Individual indicies contributing to the overall RCI are represented in the right-hand panel. Surface water gauges (▲) at Lower Timor (210070) and Stick-Me-Up Bridge (210118) are depicted.

4.2. Geomorphology

The Isis River is a high gradient, high energy river in the upper catchment largely driven by orographic rainfall, resulting from moist air rising in elevated areas. The headwaters are formed within a geologically complex boundary to the Hunter-Mooki Thrust Fault Zone (Hunter Orogeny), with additional fractured geology in the Mt Royal – Liverpool Range basalts. The strongly fractured geology within the upper reaches of the River favours infiltration and release of base flow contributions, which may extend flows for significant periods following rainfall events.

The Isis River has experienced significant alteration of geomorphic form since European occupation, which is reflected in a very poor RCI rating for geomorphic condition. The river channel has expanded by scour and failure of both banks. This has not only widened but also created a shallow waterway, dominated by migrating gravel slugs which may be observed as a large extended bank and point bars along the entire length of the river. The level of control imposed by exposed (and often elevated) rock bars limits the movement of gravel slugs through the lower river reaches to the Hunter River.

The change in physical form of the Isis River has expanded channel capacity and reduced floodplain connectivity. Low flows are somewhat reduced by underflow through extensive gravel bars (slugs) deposited in the expanded channel, whereas high to flood flow events are contained within the channel and are scouring banks of the river. This adjustment changes the expression of visible flows except where elevated rock bars confine flows across them.

Observations in the upper Isis River showed rock bars provide semi-permanent pools with cobbles locked into the bed matrix which experience movement only under large flow events. Downstream is a lower velocity and lower energy bed comprised of mixed sand to gravel-dominated bed load. Erosion and channel expansion upstream has resulted in the transport of mobile gravel deposits, infilling downstream remnant pools making them shallow and exposed.

Large woody debris is mostly missing from the Isis River. Past channel de-snagging has created conditions favouring further channel widening and simplification of pools to riffle sequences, which has impeded channel scour of deposited gravels and prevented the deepening of pools. This should be considered as a factor limiting the effectiveness of flow access to water users, as pool continuity and maintenance of pool depths are affected if additional gravel material is released into the river channel, and rock bar controls are widely separated. If elevated rock bars are located downstream of concentrations of extraction, they should be preferred to rock shelves, runs and shallow glides, which may be buried below gravel slugs.

4.3. Riparian vegetation

The RCI identifies the upper reaches of the Isis River above the Lower Timor gauge as having good native woody riparian vegetation cover. In the lower Isis River, native riparian vegetation is of moderate condition, extending to very poor in the lower Pages River within the Segenhoe Management Zone.

Widespread land clearing practices were not uncommon in the Hunter River Basin which has been extensively modified since European settlement. These past land management practices have translated to largely degraded catchments and has resulted in the collapse of banks and widening of almost the entirety of the Isis River. The middle to lower reaches of the Isis River have large, expansive areas of unvegetated river bank, alternating with runs of mature native River She-oak and some weed species; notably castor oil plant, tobacco bush, blackberry and a small number of willows. Very little recruitment of River She-oak, a primary coloniser, is evident in the bed. The absence of She-oak can be attributed to several factors including unrestricted cattle access, lack of disturbance either from high flows or mobile gravel deposits after floods

and/or the prevention of recruitment from shading following the colonisation of secondary and tertiary species.

4.4. Hydrology

4.4.1. Short-term flow duration

Both surface flow gauges on the Isis River have short periods of record. The Lower Timor gauge has measured flows since September 2011, whilst the Stick-Me-Up Bridge gauge has been operational since March 2004. Consequently, comparative flow duration curves were plotted for both gauges over the same 3 year time period (Figure 4).

The Lower Timor gauge on the Isis River has a short current period of record beginning from 2011 whilst Stick-Me-Up Bridge has a period of record from 2004 (Table 2). Figure 4 depicts a comparative flow duration curve for the 2011-2014 period for both gauges. Although this period of record is not reliable for determining a long term projection of flow, the vast difference between the two gauges demonstrates different hydrological flow regimes.

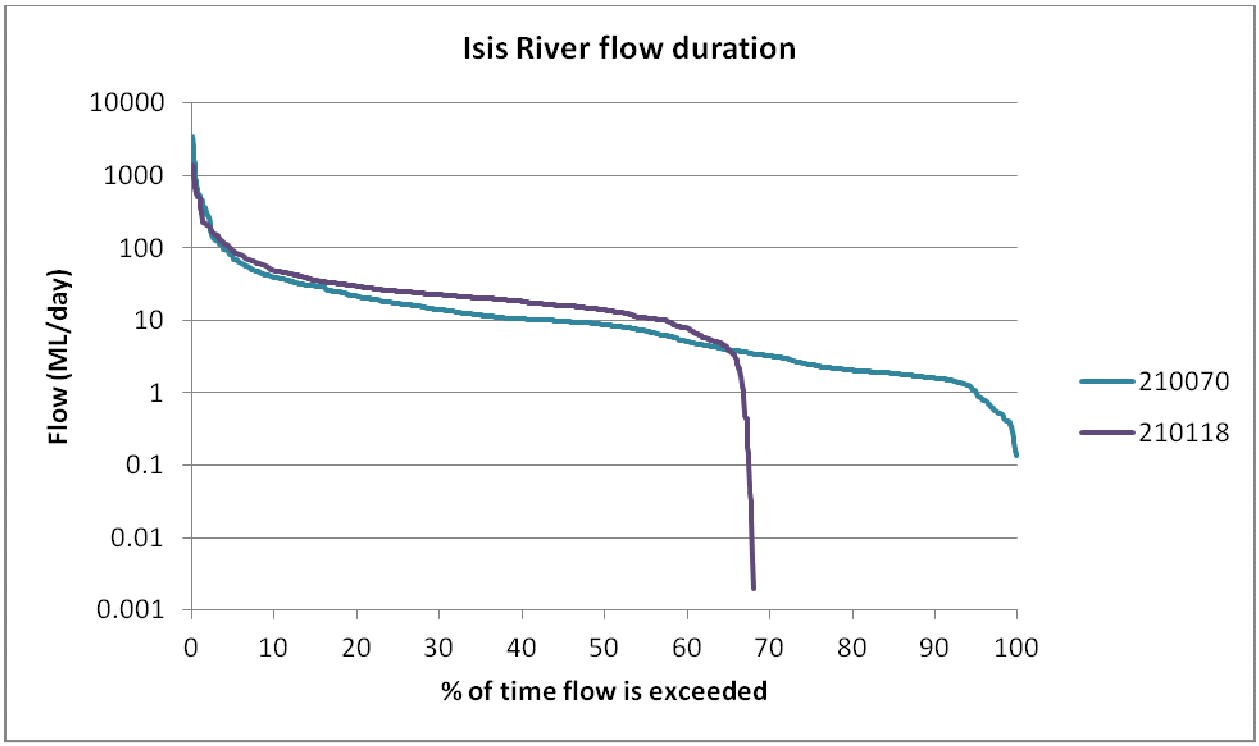

Figure 4 Comparative flow duration curves for Lower Timor (210070) and Stick-Me-Up Bridge (210118) from September 2011 to November 2014.

Based on the recent flow data, the lower Isis River at Stick-Me-Up Bridge has ceased to flow at the 68th percentile. For the same period of record, the 68th percentile at Lower Timor equates to a surface flow of 3.5 ML/day (Figure 4). The 95th percentile at Lower Timor is 1.7 ML/day, however, it must be stressed that this is only over a short three year period and is not indicative of long-term flows or climatic conditions.

4.4.2. Long-term flow duration estimate

A 70 year period of data is typically used to make a accurate estimate of percentile flows. The Lower Timor gauge has an historical 19 year period of record between 1963 and 1982 as well as the current, short period of record from 2011 onwards. Combined, there is approximately 22 years of data from the gauge, albeit with a 29 year data gap. To make a long-term flow duration estimate, the 22 years of data were verified by investigating the implications of longer term climatic conditions to ensure data was not influenced by wet or dry periods.

Lower Timor was compared and correlated with the neighbouring Blandford gauge (210061) on the Pages River, which has similar longitudinal positioning (see Figure 2) and over 70 years of data. The percentiles for the two Lower Timor periods of record were then adjusted to reflect the climatic conditions of the 70 year period at the Blandford gauge. Subsequently, the 95th percentile was estimated as 2.8 ML/day for the period between 1963 and 1982. Similarly the 3 year period between 2011 and 2014 was used to calculate an estimate of 2.2 ML/day (Figure 5).

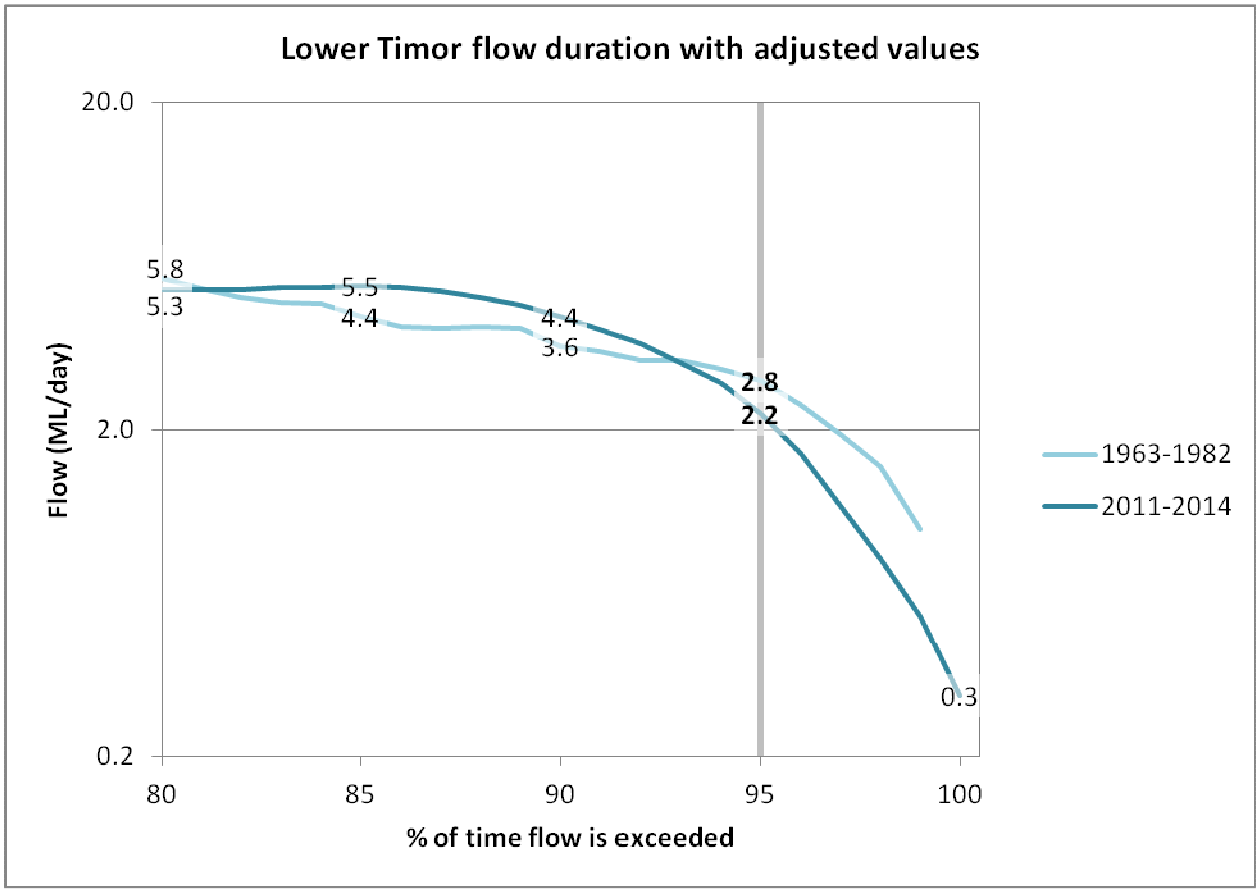

Figure 5 Lower Timor (210070) flow duration curves between the 80th and 100th percentiles for two periods of data (1963-1982 and 2011-2014). Values have been adjusted to reflect long-term climatic conditions at the nearby Blandford gauge (210061) in the Pages River Water Source.

Data from the older, 19 year period is not as reliable but provides a much longer record. The recent 3 year period is reliable but only a small block of data. Subsequently, an average of both periods using Blandford-adjusted values gives a reasonable estimate for the long term 95th percentile flow of 2.5 ML/day.

4.4.3. Cease to pump scenarios

During 2014, the daily flow at Lower Timor ranged from a maximum of 9.7 ML/day in March to a minimum of 0.4 ML/day in November. Stick-Me-Up Bridge ceased to flow for the duration of the year. As one of the lowest flow years in recent times, cease to pump scenarios can be applied to the existing flow data in order to provide an projection of potential rule changes.

Figure 6 depicts the flow recorded at Lower Timor from January to November in 2014, in which there were 58 days where flow exceeded the long-term 95th percentile of 2.5 ML/day, this would allow users to access flows 19% of the year. Figure 7 shows a cease to pump scenario where access doubles to 40% of the year with 120 days where flow exceeded 2 ML/day.

Crop losses are expected to occur following a period of 21 days without irrigation. During 2014, there were three periods where flow was less the 2.5 ML/day for greater than 21 days to trigger potential crop loss. In one instance, flows did not exceed 2.5 ML/day for 50 consecutive days between April and June, whilst another low flow period occurred from late September onwards (Figure 6). Alternatively, there were two periods in 2014 where flows were less than 2 ML/day for greater than 21 days, which also includes the late September period (Figure 7).

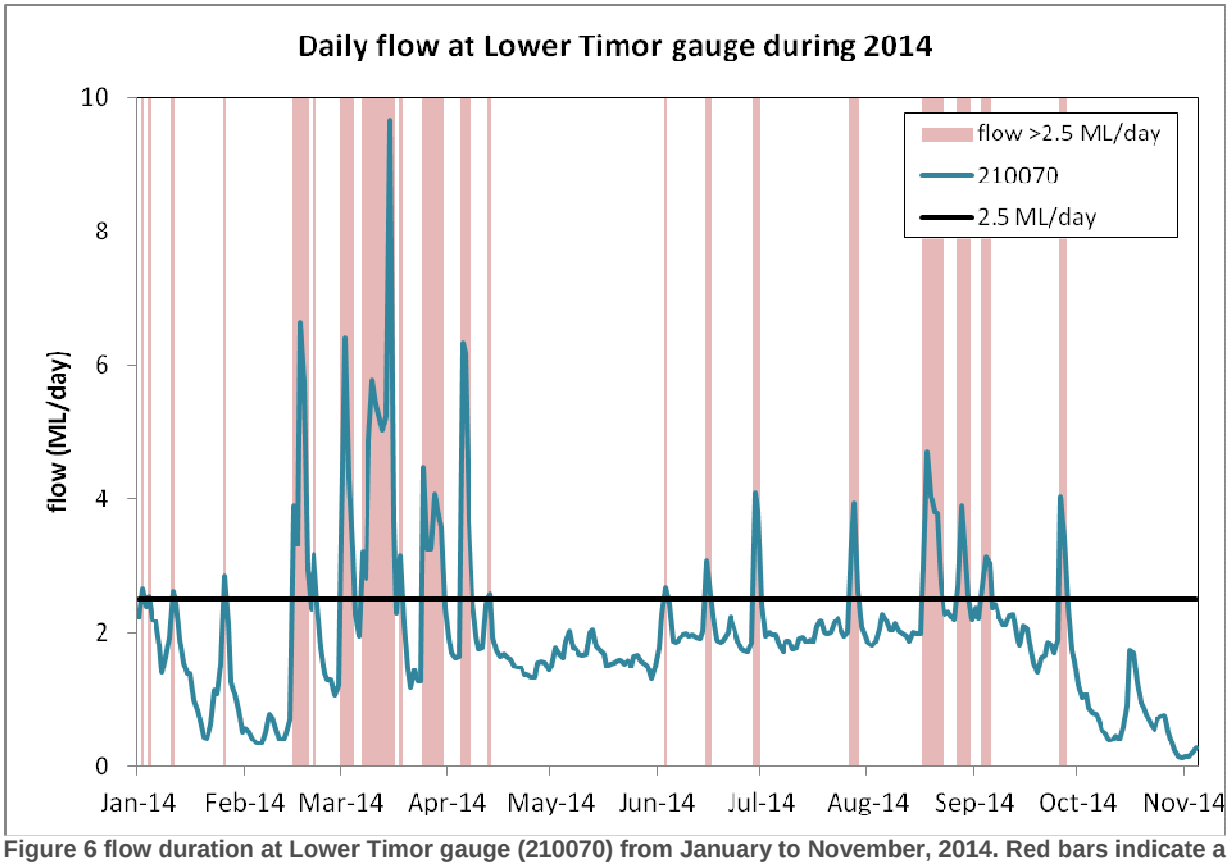

Figure 6 flow duration at Lower Timor gauge (210070) from January to November, 2014. Red bars indicate a mean daily flow exceeding 2.5 ML/day.

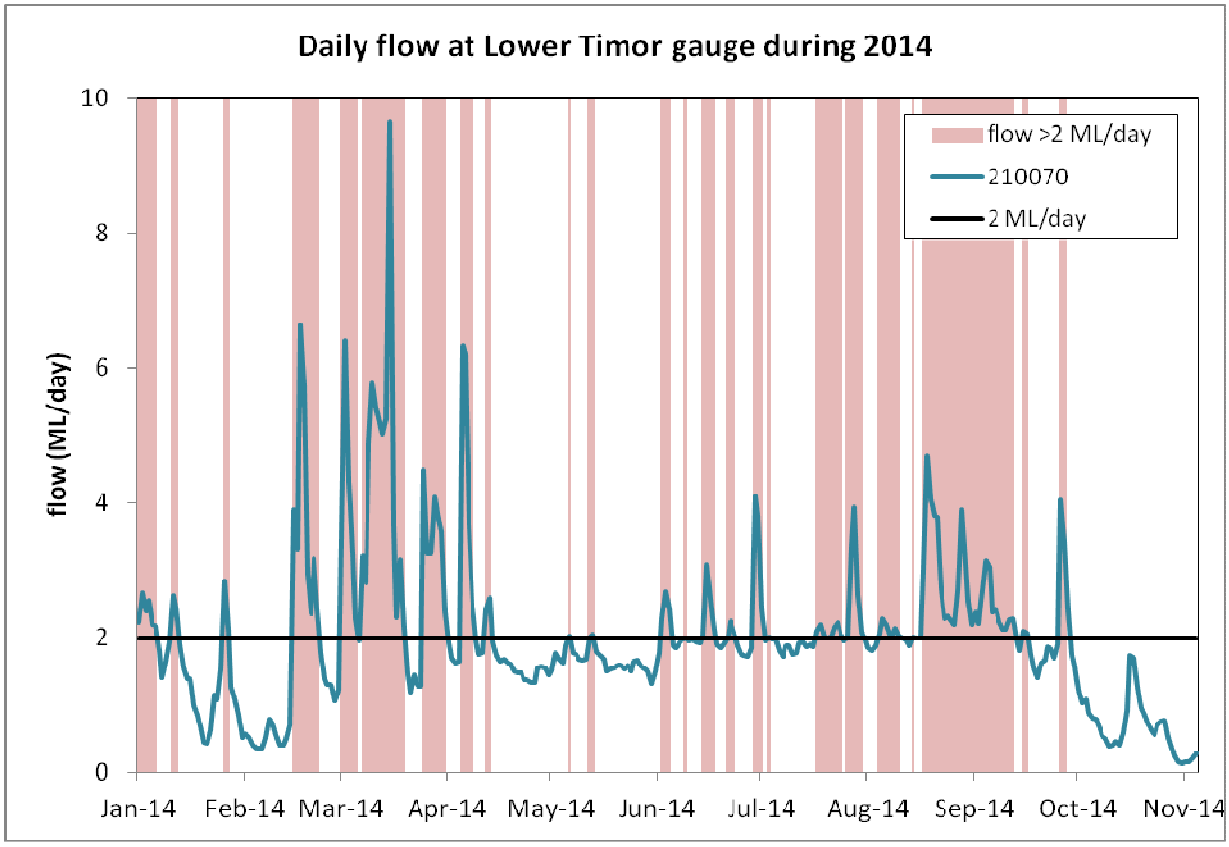

Figure 7 flow duration at Lower Timor gauge (210070) from January to November, 2014. Red bars indicate a mean daily flow exceeding 2 ML/day.

4.4.4. Alluvial connectivity

The cause for stream losses between the upper and lower Isis River during the current CtP is unknown as there are no significant alluvial systems identified to account for these losses. The lower Isis River currently does not experience surface flow when there are low flows upstream, however, regardless of cease to flow conditions, surface flow is restored downstream in the Pages River at Gundy Recorder (210052).

Figure 8 demonstrates peak discharge events in the Pages River (blue line) are typically higher than the discharge in the Isis River (purple line). Furthermore, groundwater levels and surface water flow show similar fluctuation patterns indicating a significant hydrological connection exists between the two streams and their transmission downstream into the aquifer, where there is a slight but normal lag between peak discharge events and groundwater response.

The Segenhoe aquifer is completely dependent on high stream discharge events from the Upper Pages and Isis River for storage recovery. Drawdown in the alluvium occurs from user extraction at the same time as zero to low flows are experienced. Flow events in mid 2010 and early 2013 show high groundwater fluctuation in response to low aquifer storage. Conversely, in early 2012, high stream discharge resulted in only a minor rise in aquifer levels, reflecting a period of high groundwater levels where the aquifer storage was already near full (Figure 8).

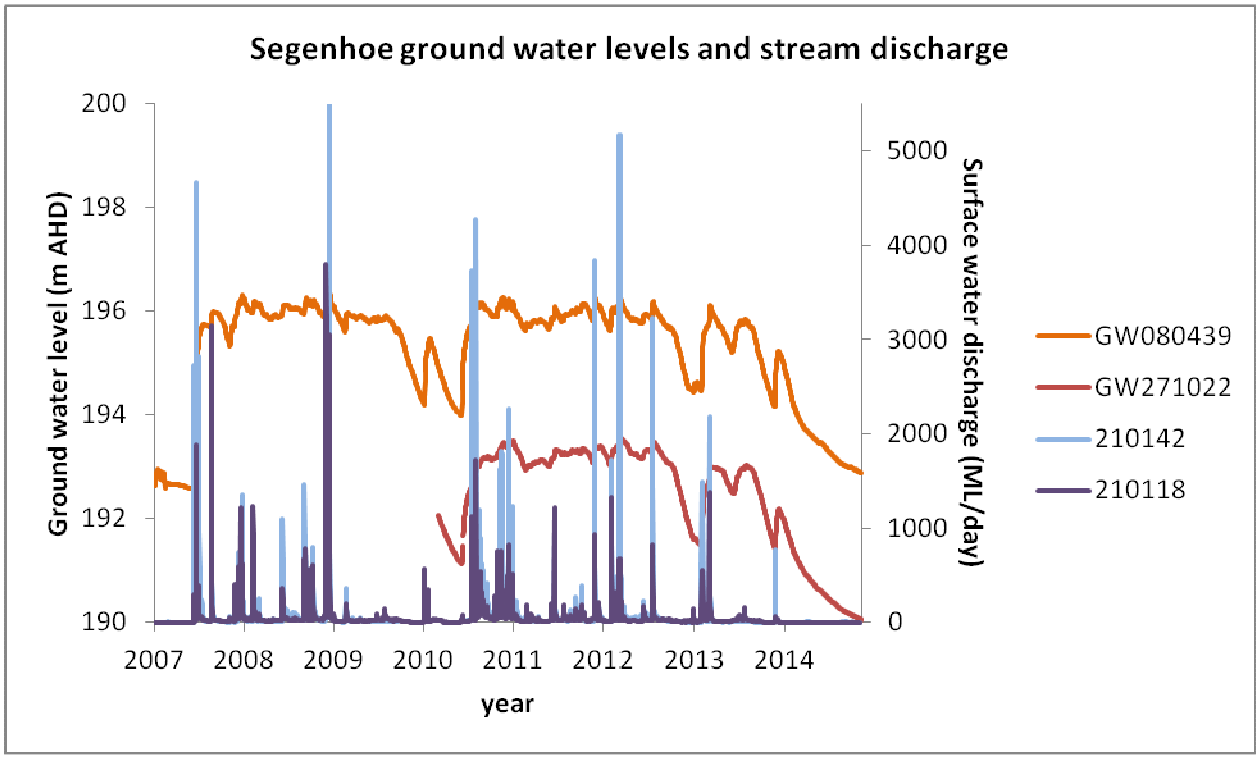

Figure 8 Groundwater levels in the Segenhoe alluvial aquifer measured at Bellrive stud (GW080439) and Arrowfield stud (GW271022), compared with surface water discharge from longitudinally adjacent Upstream Kewell (210142) on the Pages River and Stick-Me-Up Bridge (210118) on the Isis River.

The hydrological desktop study identified that in 2014, groundwater levels declined rapidly as the lower Isis River went dry, this is in contrast to several small discharge events in the Pages River. Furthermore, stream flow in the Isis River at Stick-me-Up Bridge (210118) had the most significant statistical relationship with groundwater levels at Bellrive Stud (GW080439), more so than the Pages River at Upstream Kewell (210142). It is suspected that this is because the alluvial deposits within the Segenhoe aquifer extend across the Upstream Kewell gauge where

there is high connectivity with groundwater and surface water losses may occur during low flow events.

Although flow transmission is interrupted between the Upper to Lower Isis River, the gap in surface flow appears to be partly restored at the Gundy Recorder gauge where the return to greater continuity of flows includes the combined flow contributions of both the Isis and Pages Rivers.

4.5. Instream values

4.5.1. High Ecological Value Aquatic Ecosystems (HEVAE)

HEVAE is a geospatial model which is complementary to the RCI, assigning five categories from Very Low to Very High as an indication of ecological value within a water source. The HEVAE model shown in Figure 9 represents the instream values of the Isis and Pages Rivers, where the instream values ranged between low and high. Only small upstream reaches of the upper Isis River tributaries were identified as having high instream value. The sections of medium instream value in the Upper Isis River are above the extractive pressure of users. There are no threatened species identified in the Isis River Water Source.

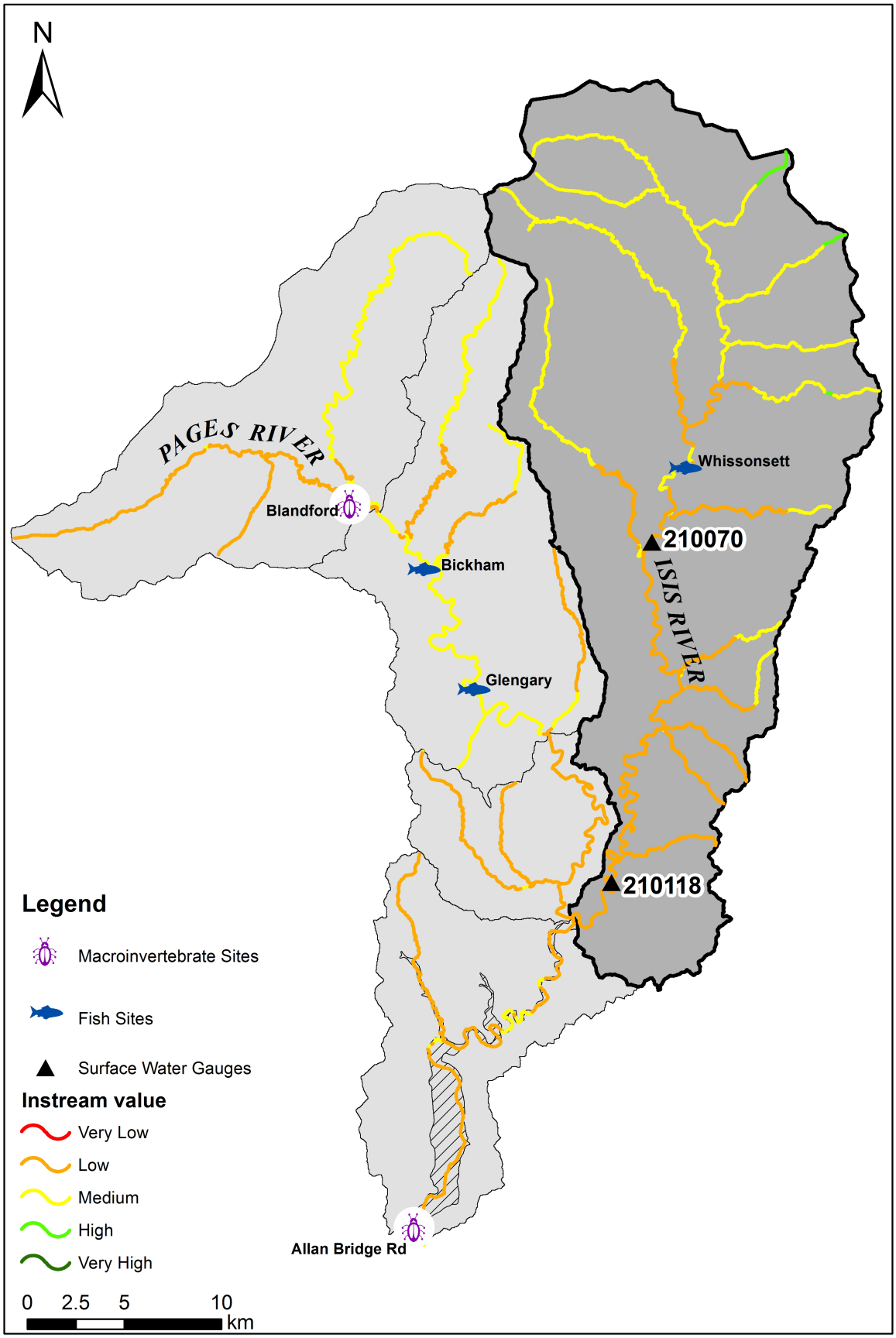

Figure 9 High Ecological Value Aquatic Ecosystems (HEVAE) geospatial output for Isis and Pages River Water Sources. Macroinvertebrate and fish data obtained from the sample locations identified.

4.5.2. Fish assemblages

The most current data available from NSW DPI Fisheries show a low diversity of native fish species. Australian smelt, cox's gudgeon, long-finned eel and freshwater catfish have been sampled using electrofishing in the upper Isis River, at Whissonsett both in 2004 and 2007. These species were also present in the Pages River both at Bickam and Glengary. Common carp was also sampled by NSW DPI Fisheries and have also been caught in abundance by water users. Carp are listed as a Class 3 noxious pest species in the *NSW Fisheries Management Act 1994* and are known to exist in most rivers within the state of NSW.

Australian smelt are considered to be a common and abundant species in NSW. Cox's gudgeon and the long-finned eel have a migratory life history, however in-stream obstructions in the Isis and lower Pages Rivers are not considered to be a significant migratory impediment for these species as both are able to ascend most barriers in wet conditions.

Freshwater catfish have been sighted at the Morley Downs property in the past and are known to exist in the upper Isis as per NSW DPI Fisheries data. Although endangered in the inland Murray/Darling Basin, freshwater catfish are not considered to be threatened in the eastern drainages of NSW. They live and build nests in pools with slow flow and are a relatively sedentary, non-migratory species. Given their limited home range, it is important to protect pools to ensure visible flow and prevent pool draw down. The pools in the upper Isis River are frequently separated by elevated rock bars making them largely permanent but maintaining connectivity through chutes in the bedrock. Pools where freshwater catfish have been found at the Morley Downs property are said to be up to waist-deep.

There is no data available for fish species in the lower Isis River. It can be inferred from the existence of semi-permanent shallow, remnant pools that only common, hardy species would persist in these environments. Such species would have a high tolerance to temperature and low dissolved oxygen and a preference for still or slow flowing water.

4.5.3. Macroinvertebrate diversity

Macroinvertebrates or 'water bugs' are a essential component of all river ecosystems. They are critical for the breakdown of organic matter in the carbon cycle as well as being the main food source for other organisms such as fish, frogs, birds, turtles and platypus. Generally, high abundance in macroinvertebrate diversity is synonymous with good river health.

The scoring system for Australian macroinvertebrate samples, called SIGNAL 2, was used to quantify macroinvertebrate diversity as an indication of water quality. SIGNAL (Stream Invertebrate Grade Number – Average Level) grades ranging between 1 and 10 are assigned to each macroinvertebrate taxonomic family, where a low grade indicates tolerance to a range of environmental conditions including poor water quality, whilst a high score denotes a greater sensitivity to disturbance (Chessman, 2003).

There is no macroinvertebrate assemblage data available for the Isis River Water Source, however historical data from 1999 was sourced from the Pages River crossing at Allan Bridge Road, Segenhoe; above the confluence of the Pages River and Hunter Regulated River (Figure 9). This site is analogous with the lower Isis River and provides an indication of the macroinvertebrate community likely to occur. Data was also obtained from Blandford on the Pages River (Figure 9) from 1997 and is representative of the Lower Timor in the upper Isis River.

Data for Allan Bridge Crossing showed a high abundance of resilient, hardy taxa both in edge and riffle habitats with a low diversity ranging from 9 to 12 families. The low number of taxonomic families represented along with a moderate average SIGNAL 2 score of 4.5, indicates a stressed environment with poor conditions unable to support diverse macroinvertebrate

assemblages (Chessman, 2003). Blandford had a higher diversity ranging from 13 to 20 families, but a moderate average SIGNAL 2 score of 4.2. This site is also indicative of a relatively stressed environment but able support some species from macroinvertebrate families which are more sensitive to disturbance. These conditions are a general but accurate reflection of what can be expected in the Isis River with no data to indicate any rare or vulnerable macroinvertebrate species of significance.

4.5.4. Macrophytes

Currently, *Azolla* spp. occurs throughout the entire Isis River system. It is a native aquatic plant, and is indicative of still or slow moving water bodies, usually synonymous with high nutrient levels. Excessive amounts of *Azolla* spp. are found in the lower Isis River (Figure 10a) in the existing remnant pools where there is no flow transmission. Upstream, there is far less *Azolla* spp. due to increased surface flow (Figure 10b).

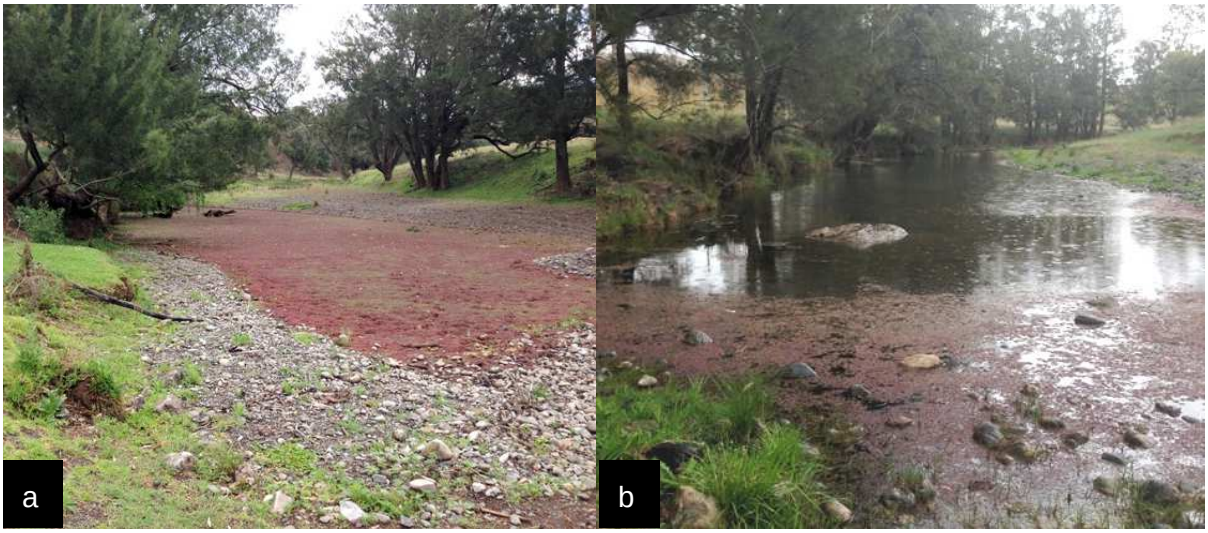

Figure 10 Azolla spp on the surface of the (a) lower Isis River downstream of Stick-Me-Up Bridge gauge and (b) upper Isis River at Morley Downs, Murrurundi in October 2014.

Also in the upstream pools is the submerged macrophyte leafy *Elodea*. The presence of elodea demonstrates the upstream environment has a reliable flow which prevents desiccation of the weed.

5. Conclusions

Stream flow is not uniform throughout the Isis River subcatchment. The river upstream of the Lower Timor gauge experiences a reliable base flow which is crucial for maintaining connectivity between permanent pools with a bedrock foundation. Surface flow ceases in the lower Isis River during dry periods and the river is characterised by a lower energy, mixed sized gravel bed with shallow remnant pools. These pools will determine the demarcation of the Isis River into upper and lower Management Zones.

When the Plan commenced in 2004, the Lower Timor gauge was not operational and an adequate end of system flow reference site was not available to delineate an Upper Isis River Management Zone from the Lower Isis River. Since 2011 the Lower Timor gauge has provided reliable flow data making it an appropriate end of system gauge should an Upper Isis River Management Zone be created.

Flow data from Stick-Me-Up Bridge must be treated with caution. The reliability of the gauge is often compromised by the damaged concrete causeway that forms the control, however there are no alternative gauges that can provide data for the lower Isis River. Importantly, the gauge is still a reliable indicator of no flow.

Long-term adjusted data estimated the 95th percentile at Lower Timor to be 2.5 ML/day. Based on scenarios for 2014, a year of very low flows, a CtP using this estimate would allow irrigators access during high flows. Alternatively, a less conservative CtP of 2 ML/day would allow a two-fold increase in access and potentially reduce the number of instances where CtP durations exceed 21 days.

It is unknown how low flow extraction in the Upper Isis River will impact on the stream flow volumes in the lower Isis River as stream losses cannot be accounted for. There is however, connectivity between the downstream Isis River and the Segenhoe alluvial aquifer through the transmission of flows in the in-filled channel. Due to data from Stick-Me-Up Bridge having a level of inaccuracy during periods of surface flow, it is difficult to ascertain the contribution the Isis River makes to the recharge of the aquifer and how significant it is. Additionally, the Isis River is not the only recharge source, where the Pages River also contributes a significant portion of inflows. Restoration of flow at the Gundy Recorder downstream of Stick-Me-Up Bridge indicates there is a transmission of flow downstream.

Very little data on aquatic species in the Isis River is available, given its overall poor condition and tendency to cease to flow in downstream areas. The upper Isis River has moderate ecological value driven by the existence of some native fish species including the sedentary freshwater catfish, whereas the lower Isis River has low ecological value with no knowledge of the existence of significant species. Macroinvertebrate data from the longitudinally similar locations in the adjacent Pages River suggests the upper reaches support a higher diversity of families with some less tolerant to environmental disturbances. Regardless, the maintenance of water in the river during very low flows is imperative for providing refuge areas for any aquatic species that remain and to uphold the fundamental principles of environmental water provisions which are central to all water sharing plans.

6. Recommendation

If a separate Upper Isis River Management Zone is created, it is recommended that a CtP of 2 ML/day be implemented. Although lower than the long term 95th percentile calculated for the Lower Timor gauge, a CtP of 2 ML/day will provide irrigators with greater access and protect very low flows in the Isis River Water Source during dry periods. Surface flows of 2 ML/day will ensure connectivity between pools and provide refuge for instream biota, of which there are no species of ecological significance known to occur. Furthermore, the Lower Timor gauge has enough sensitivity to measure flows above 1.5 ML/day accurately.

The Lower Isis River Management Zone should continue to operate the current CtP of no visible flow at Stick-Me-Up Bridge. The control for this gauge although damaged, is still a reliable indicator of cease to flow. The control needs to be repaired for ongoing monitoring to determine if the alteration of flow transmission between the two gauge sites is consistent with the increase uptake from the upper Isis River.

7. References

Chessman, B.C. (2003) *SIGNAL 2 – A Scoring System for Macroinvertebrate ('Water Bugs') in Australian Rivers.* Monitoring River Health Initiative Technical Report no. 31. Commonwealth of Australia, Canberra.

www.water.nsw.gov.au/Water-management/Water-sharing-plans/Plans-commenced/Water-source/Hunter-Unregulated-and-Alluvial