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STATE WATER CORPORATION

Chaffey Dam Augmentation and Safety Upgrade

Preferred Infrastructure Report

301015-02980 – 301015-02980-REP-0014

15 March 2013

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SYNOPSIS

This Preferred Infrastructure Report has been prepared by WorleyParsons Services Pty Ltd to document the changes to the Chaffey Dam Augmentation and Safety Upgrade Project and respond to submissions received during the public exhibition of the Environmental Impact Statement for the Project.

The Preferred Infrastructure Report has been prepared pursuant to Section 115Z(6) of the *Environmental Planning and Assessment Act 1979*.

PROJECT 301015-02980 - CHAFFEY DAM AUGMENTATION AND SAFETY UPGRADE							
REV	**DESCRIPTION**	**ORIG**	**REVIEW**	**QUALITY MANAGEMENT REVIEW**	**WORLEY-PARSONS APPROVAL**	**DATE**	**CLIENT APPROVAL**
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TERMS AND ACCRONYMS

Acronym / Term	Definition
ABS	Australian Bureau of Statistics
Account water	The balance in an access licence water allocation account at a particular time.
ACT	Australian Capital Territory
AEP	Annual exceedance probability
AHD	Australian Height Datum
Alluvial	Applying to the environments, actions, and products of rivers or streams.
Alluvium	Clay or silt or gravel (sediment) carried by rivers or streams and deposited where the stream slows down.
ANCOLD	Australian National Committee on Large Dams
ANZECC	Australian and New Zealand Environment and Conservation Council
Aquifer	A water-saturated geologic unit that is capable of transmitting significant or usable quantities of groundwater under ordinary hydraulic gradients.
ARI	Average recurrence interval
Catchment	The area of land drained by a creek or river system, or a place set aside for collecting water which runs off the surface of the land. Catchments provide the source of water for the dams and reservoirs in which our drinking water is collected.
CEMP	Construction Environmental Management Plan
Climate Change	Any change in global temperatures and precipitation over time due to natural variability or to human activity.
CMA	Catchment Management Authority
CMSS	Catchment Management Support System
CPP	Certified Practicing Planner
CSIRO	Commonwealth Scientific and Industrial Research Organisation
CTMP	Construction Traffic Management Plan

Acronym / Term	Definition
DEC	Department of Environment and Conservation
DECC	Department of Environment and Climate Change
DECCW	Department of Environment, Climate Change and Water
DGRs	Director-General's Environmental Assessment Requirements
DLWC	Department of Land and Water Conservation
DP	Deposited Plan
DPI	Department of Primary Industries
EIA	Environmental impact assessment
EIS	Environmental Impact Statement
EL	Exploration Licence
ELA	Exploration Licence Application
Endangered ecological community (EEC)	Ecological community listed in Schedule one of the *Threatened Species Conservation Act 1995* or Schedule 4 of the *Fisheries Management Act 1994*.
ENM	Environmental Noise Model
Environmental contingency allowance (ECA)	A volume of water held in storage from which releases are made for particular environmental purposes or in response to particular environmental circumstances.
Environmental releases	Natural flows or releases of water, intend to supply the environment's needs.
EP&A Act	*Environmental Planning and Assessment Act 1979*
EPA	Environment Protection Authority
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
Ephemeral River	Rivers are generally storm-event driven and flow occurs less than 20% of the time; these rivers have limited baseflow component with no groundwater discharge during the no flow period.
Epilimnion	Warm upper layer of water resulting from thermal stratification. Overlies the hypolimnion.
Erosion	The process by which material, such as rock or soil, is worn away or removed by wind or water.

Acronym / Term	Definition
Eutrophication	A process where a water body receive excess nutrients that stimulate excessive plant growth.
Fluvial	Material deposited by moving water.
Fluvial Deposits	All material, past and present, deposited by flowing water.
FRP	Filterable reactive phosphorus
FSL	Full supply level
GL	Gigalitres
Groundwater	All the water contained in the pores/voids within unconsolidated sediments or consolidated rocks (i.e. bedrock).
ha	Hectares
Hypolimnion	Cold lower layer of water resulting from thermal stratification. Underlies the epilimnion.
ICNG	NSW Interim Construction Noise Guideline
INP	NSW Industrial Noise Policy
Integrated Quantity/Quality Model (IQQM)	A numerical hydrologic computer model that simulates a river basin's behaviour on a daily time step, based on inflows to the system, configuration of the major infrastructure, routing and losses of flows through the system and irrigation extractions to meet crop water requirements. It also models the processes of available water determinations, uncontrolled flow, supplementary water announcements and irrigator planting decisions. This model is used to analyse and compare the outcomes of proposed water sharing options or assess potential growth-in-use over long-term climatic sequences (> 100 years).
IPART	Independent Pricing and Regulatory Tribunal
Irrigation	The controlled application of water to cropland, hay fields, and/or pasture to supplement that supplied by nature.
km	Kilometres
LGA	Local Government Area

Acronym / Term	Definition
Long-term average annual extraction limit (LTAAEL)	The target for total extractions (under all water access licences plus an estimate of basic landholder rights within an EMU) which is used to assess whether growth-in-use has occurred. The actual annual extractions (metered plus estimated) are averaged over a fixed period of time defined by the water sharing plan when comparing with the LTAAEL. If the fixed period of time is greater than one water year, then in any one water year, extractions can exceed the LTAAEL without triggering a growth-in-use response.
m	Metre
MDBC	Murray-Darling Basin Commission
MDBMC	Murray-Darling Basin Ministerial Council
MHL	Manly Hydraulics Laboratory
ML	Megalitres
NES	National environmental significance
NSW	New South Wales
Nutrients	Any substance that promotes growth with living organisms. The term is generally applied to nitrogen and phosphorus in wastewater, but is also applied to other essential and trace elements.
NWES	North West Ecological Services
OEH	Office of Environment and Heritage
PADs	Potential Archaeological Deposits
PAG	Peel Advisory Group
Peel Valley Water Sharing Plan	Water Sharing Plan for the Peel Valley Regulated, Unregulated, Alluvium and Fractured Rock Water Sources 2010
PM10	Particulate matter 10 micrometres or less in diameter
PM2.5	Particulate matter 2.5 micrometres or less in diameter
PMF	Probable maximum flood
PO4	Orthophosphate
POEO Act	*Protection of the Environment Operations Act 1997*

Acronym / Term	Definition
Pool and riffle sequence	Occurs where a stream's hydrological flow structure alternates from relatively shallow areas to deeper water. This sequence is present only in streams carrying gravel or coarser sediments. Riffles are formed in shallow areas by coarser materials such as gravel deposits over which water flows. Pools are deeper and calmer areas whose bed load (in general) is made up of finer material such as silt.
RBL	Rating Background Level
Regulated Water Source	The supply of water in regulated rivers is typically controlled by releases of water from dams rather than being dependent solely on rainfall and natural river flows.
Rehabilitation	To restore to former condition or status.
Reservoir	The body of water built up behind the dam wall.
Revegetation	The process of providing denuded land with a new cover of plants.
RMS	Roads and Maritime Services
RTA	Roads and Traffic Authority
SEPP	State Environmental Planning Policy
SES	State Emergency Service
SEWPaC	Department of Sustainability, Environment, Water, Population and Communities
SIS	Species Impact Statement
t	Tonne
TAPM	The Air Pollution Model
The Project	Chaffey Dam Augmentation and Safety Upgrade Project
Thermocline	Transition layer of water resulting from thermal stratification that separates the epilimnion and hypolimnion.
TSC Act	*Threatened Species Conservation Act 1995*
TSP	Total Suspended Particulate
Unregulated Water Source	The supply of water in unregulated rivers is typically not controlled by releases of water from dams but rather is dependent solely on rainfall and natural river flows.

EXECUTIVE SUMMARY

State Water Corporation (State Water) proposes to carry out the Chaffey Dam Augmentation and Safety Upgrade Project (the Project). Chaffey Dam is located on the Peel River approximately 30 kilometres (km) south east of Tamworth, in northern New South Wales (NSW).

The Project will result in a 6.5m increase to the Full Supply Level (FSL) of Chaffey Dam, from 518.6 m Australian Height Datum (AHD) to 525.1 m AHD and an increase in the permanent storage capacity from 62 GL to 100 GL. Safety upgrade construction works to achieve increased flood storage capacity comprise raising the dam wall by 8.4 m to increase the flood storage capacity of the reservoir. Reconfiguration of the auxiliary spillway fuseplug is also proposed to enable staged discharge of flood waters. Raising the morning glory spillway by 6.5 m will enable augmentation to 100 GL. The Project will result in the inundation of an additional 185 ha of land that occurs immediately adjacent to the existing reservoir.

Realignment of roads, limited to parts of Tamworth-Nundle Road, Rivers Road, Western Foreshore Road and bridges, limited to Bowling Alley Point Bridge, Hydes Creek Bridge and a culvert crossing at Silver Gully, are required due to the increased FSL.

Relocation of some facilities at the Bowling Alley Point Recreation Area and the South Bowlo Fishing Club is also required due to the increased FSL. As part of the Project, the South Bowlo Fishing Club facilities will be relocated to higher ground, proximate to their existing locations. State Water is also committed to the relocation of impacted facilities at the Bowling Alley Point Recreation Area and is liaising with the Department of Primary Industries (Crown Lands) to define suitable land for the relocation of these facilities (including a point of access for the relocated boat ramp). This relocation will be the subject of additional approvals (as required) when plans are complete.

The Project will result in an increase in the 100 year average recurrence interval (ARI) flood level and the Probable Maximum Flood (PMF) level around the perimeter of the reservoir.

In April 2012, State Water engaged WorleyParsons Services Pty Ltd (WorleyParsons) to prepare an Environmental Impact Statement (EIS) for the Project on their behalf. The EIS was prepared to accompany a State Significant Infrastructure Application, submitted to the Minister for Planning and Infrastructure pursuant to Part 5.1, Division 2 of *the Environmental Planning and Assessment Act 1979* (EP&A Act).

On 29 August 2012, State Water referred the Project to the Commonwealth Department of Sustainability, Environment, Water, Population and Communities (SEWPaC) under the provisions of the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

On 28 September 2012 the Minister for SEWPaC declared the project a controlled action, therefore the Project also requires assessment and approval under the EPBC Act. SEWPaC advised that the Project would be assessed through an accredited assessment under Part 5.1 of the EP&A Act.

On 12 November 2012 the EIS was submitted to the Department of Planning and Infrastructure for adequacy review.

On 10 December 2012, the Department of Planning and Infrastructure advised that the EIS was adequate for public exhibition. The EIS was placed on public exhibition from 12 December 2012 to 31 January 2013.

Seven submissions on the EIS were received from the Heritage Council of NSW, the NSW Environment Protection Authority (EPA), Namoi Catchment Management Authority (CMA), the NSW Office of Environment and Heritage (OEH), the NSW Roads and Maritime Services (RMS), the NSW Department of Primary Industries (DPI)) and the NSW Department of Planning and Infrastructure.

No submissions were received from members of the public.

Submissions received related to Project justification, options assessment, soil and water, biodiversity, Aboriginal heritage, European heritage, traffic and transport, noise and vibration, air quality, land use, socioeconomics and hazards and risks. All submissions have been addressed in this PIR,

The key matters discussed in detail in this PIR relate to changes to the Project description, Project justification, options assessment, soil and water, biodiversity and European heritage, as set out below.

Following submission of the EIS for public exhibition, further stakeholder consultation has been carried out for the Project, including with various land care groups, the Heritage Council of NSW, Tamworth Regional Council, EPA, OEH (Aboriginal Heritage and Biodiversity), SEWPaC, Namoi CMA and the Department of Planning and Infrastructure.

Changes to the Project Description

Subsequent to submission of the EIS for exhibition, some modifications have been made to the Project to reduce its environmental impact. These changes comprise:

- A reduction in the Works Areas (achieved through refinement of the road design and selection of specific stockpiling and equipment laydown areas)
- A reduction in the excavation rate for road realignment activities
- Consideration of alternative piling methods

Although all works are proposed to be carried out within the standard construction hours specified in the Interim Construction Noise Guideline (ICNG) (DECC 2009), it is noted that should the necessity arise for any construction works to occur outside the standard construction hours, the Contractor will seek prior approval from the Department of Planning and Infrastructure, accompanied by appropriate justification.

A summary of the change in Works Areas is shown below.

Works Area	Original Size (as described in EIS)	Revised Size (as described in PIR)	Reduction in Size
Tamworth-Nundle Road and Rivers Road (including Bowling Alley Point Bridge)	41.1 ha	23.9 ha	**17.2 ha**
Western Foreshore Road (including Hydes Creek and culvert crossing at Silver Gully)	86.7 ha	25.0 ha	**61.7 ha**

The reduction in the Works Areas has reduced the impact from road realignment activities to the White Box-Yellow Box-Blakely's Red Gum Woodland, which is listed as an endangered ecological community (EEC) under the NSW *Threatened Species Conservation Act 1995,* by 50% to 33 ha. Further, the impact to the EPBC Act listed White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland critically endangered ecological community (CEEC) from road realignment activities has been reduced by 25% to 1.4 ha.

The reduction in the Works Areas has also reduced impacts to Aboriginal and European heritage.

The reduction in the Works Areas, combined with the reduction in the excavation rate for road realignment activities and the implementation of further mitigation measures has shown a reduction in air quality impacts. The revised air quality impact assessment shows a 58% decrease in the PM10 emissions estimated for the Western Foreshore Road construction area and a 50% decrease in the PM10 emissions estimated for the Bowling Alley Point construction area. All Project construction activities are anticipated to comply with *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales* (DEC 2005)

In order to reduce noise emissions during construction of the Bowling Alley Point Bridge and Hydes Creek Bridge, alternate piling methods have been considered in lieu of impact piling, where feasible and reasonable. Ground conditions at the Project Site allow for the use of a bore pile rig, which will be the preferred equipment and method for piling works.

Project Justification and Options Assessment

The proposed safety upgrade construction works comprise raising the dam wall by 8.4 m to increase flood storage capacity beyond its existing capacity of a 1 in 470,000 annual exceedence probability (AEP) event. This will enable Chaffey Dam to safely pass a PMF event, whilst also maintaining a 0.6 m freeboard above the PMF. Reconfiguration of the auxiliary spillway fuseplug is also proposed to enable staged discharge of flood waters.

The safety upgrade construction works are proposed to comply with DSC and ANCOLD guidelines and to reduce the risk of dam failure and subsequent downstream damage (estimated to be over $2.1 billion), including the potential loss of life.

Utilising the likely frequency of water restrictions in Tamworth as an indicator of the reliability of Tamworth's water supply, the current supply to Tamworth does not meet Tamworth Regional Council's criteria for adequate town water supply security.

At the current capacity of Chaffey Dam (62 GL), water restrictions occur around every nine years (i.e. 11% of the time) in Tamworth, assuming an allocation of 10 GL per year to Tamworth. As the allocation of Tamworth town water from Chaffey Dam increases to the full entitlement of 16.4 GL per year, the frequency of restrictions increases to around every six years (i.e. 17% of the time) if Chaffey Dam remains at its existing capacity of 62 GL.

At present, irrigators in the Peel Valley have reliability of supply below the minimum criterion which is a 70% probability of announcing 80% allocation on 1 July each year. At the current capacity of Chaffey Dam, the probability of an 80%+ allocation on 1 July drops dramatically from about 60% to 0% when Tamworth demand increases to 12 GL per year (GHD 2007a).

Following detailed options assessments to determine the potential long term options for Chaffey Dam, State Water determined that a combined flood safety and augmentation upgrade provided the highest Net Present Value and Benefit Cost Ratio.

For combined safety and augmentation, the three highest ranking options were those options with a storage capacity of 100 GL. Similarly, for augmentation only options, the three highest ranking options had a storage capacity of 100 GL (Hassall & Associates Pty Ltd 2006).

The supply demand assessment also demonstrated that, giving consideration to both climate change and potential decommissioning of the Dungowan Pipeline, an augmentation of Chaffey Dam to 100 GL is required (GHD 2007a). An augmentation of Chaffey Dam to at least 100 GL is required to meet the needs of Tamworth's water supply as well as maintaining irrigation allocations at or above minimum 70% probability of 80% irrigation allocation on 1 July if Tamworth water demand grows beyond 16.8 GL/a and a 10% reduction in inflows occurs as a result of climate change (GHD 2007a).

Having regard to the outlined socioeconomic, supply demand (high security and general security) and environmental issues, it is considered that a combined safety upgrade and augmentation of Chaffey Dam, incorporating augmentation to 100 GL is the preferred and justified option.

Soil and Water

The augmentation of Chaffey Dam to 100 GL was considered during the planning process for the Water Sharing Plan for the Peel Valley Regulated, Unregulated, Alluvium and Fractured Rock Water Sources 2010 and is specifically referred to in the approved plan.

The Peel Valley Water Sharing Plan demonstrates that an enlarged Chaffey Dam will not result in a growth in extractions. The plan demonstrates 'no growth' beyond that limited by the current Murray-Darling Basin Ministerial Council (MDBMC) Cap Agreement. The plan also provides detailed rules to ensure that extractions remain within the long-term average annual extraction limit (LTAAEL) (NSW Office of Water 2010a).

The use of water from Chaffey Dam will continue to be managed in accordance with the approved Peel Valley Water Sharing Plan following implementation of the Project.

As described in Section 8.1.2 of the EIS, lowering of the reservoir storage level by 2 m may be required during construction works to the morning glory spillway, from 518.6 m AHD to 516.6 m AHD. Such a drawdown will only be required if the storage level is at or within 2 m of the existing FSL during the period of construction works to the morning glory spillway. If the reservoir level is at or below 516.6 m AHD, no drawdown will be required.

On 21 November 2012, State Water sought formal approval from the NSW Commissioner for Water, NSW Office of Water, to maintain a temporary FSL 2 m below the current FSL for a period of six months, from May 2014 onwards (Appendix 3). State Water is continuing to carry out consultation with the NSW Office of Water in regard to the potential requirement for drawdown.

Biodiversity

No significant impacts to the EPBC listed White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland or the TSC listed White Box-Yellow Box-Blakely's Red Gum Woodland are expected to result from the Project. Accordingly, an offset strategy under the EPBC Environmental Offsets Policy is not required for this community.

Residual impacts to vegetation, including the TSC Act listed EEC, will be offset at a ratio of approximately 2:1 and will be representative of all vegetation types to be impacted by the Project. In addition, management measures will target the restoration of foreshore areas, control of weeds and implementation of grazing regimes suitable for regeneration of understorey elements of the communities.

Rigorous surveys for the Queensland Bluegrass indicate that the species is unlikely to occur within the study area and is therefore unlikely to be impacted by the Project. As such, recommendations and mitigation measures specific to Queensland Bluegrass are not required.

A population of the Border Thick-tailed Gecko occurs within the artificial habitat created by the existing dam wall. Construction associated with the raising of the dam wall has been designed to avoid impacts to the Border Thick-tailed Gecko. Construction activities will be staged to ensure sections of the dam wall remain available as habitat for the species throughout construction. The loss of habitat during construction will be temporary and the proposed mitigation measures for the Border Thick-tailed Gecko on the dam wall are considered to be effective in avoiding significant impacts to the species. There are no other habitats suitable for the Border Thick-tailed Gecko that will be

impacted as a result of the Project. The Border Thick-tailed Gecko will not be adversely impacted by the Project.

An offset strategy under the EPBC Environmental Offsets Policy is not required for the Border Thick-tailed Gecko. However, the offsets provided for vegetation loss in accordance with the Principles for the use of biodiversity offsets in NSW incorporate Goat Mountain, an area of known habitat for the species.

Booroolong Frog surveys carried out in January and February 2013 recorded a total of 2,289 individuals over the 25 km of the Peel River and surveyed. Current surveys determined that the large concentration of Booroolong Frogs previously recorded immediately upstream of Chaffey Dam by NWES (2009b) is no longer present. Fifty Booroolong Frogs were recorded between the existing FSL and the new FSL during the current surveys.

Current surveys found the Booroolong Frog to be well distributed along the Peel River, upstream of Chaffey Dam. These surveys showed that of the 25 km of Peel River and Wombramurra Creek surveyed upstream of Chaffey Dam, the entire length was occupied by Booroolong Frogs and is therefore considered to provide suitable habitat for the species. The distribution of metamorph and sub-adult life stages over the entire area surveyed confirms that all 25 km is suitable breeding habitat for the species. Assuming an average habitat width of 14.5 m, this equates to an area of 36.3 ha of known habitat on the Peel River and Wombramurra Creek.

Given the outcomes of the current surveys, the loss of habitat as a result of inundation to the new FSL has been re-assessed to include the entire length of the river between the existing FSL and the new FSL (a distance of 1.6 km). At an average width of 14.5 m, this equates to an area of 2.3 ha, or 6.4% of the known Booroolong Frog habitat on the Peel River immediately upstream of Chaffey Dam.

An Assessment of Significance carried out in accordance with the EPBC Act Significant Impact Guidelines 1.1 Matters of national environmental significance (DEWHA 2009) concluded that, despite the current abundance of the Booroolong Frog along the Peel River, the loss of 6.4% of known Booroolong Frog habitat is considered to have a significant impact at a local and regional level.

As such, an offset is required under both the State and Commonwealth offset policies. The implementation of the proposed offset and management measures will assist in reducing the operation of threatening process on the larger population of Booroolong Frogs on the Peel River resulting in positive long term impacts. The proposed measures have been developed with reference to the National Recovery Plan for the Booroolong Frog (NSW OEH 2012a) in consultation with Namoi CMA, OEH, SEWPaC and species experts, with the overall aim of improving the habitat available for the species outside of the new FSL.

The proposed offset strategy and associated management and monitoring programs provide excellent opportunities for improving knowledge of the operation of threats on the Booroolong Frog population, the distribution of the frog beyond the known occurrence in the Peel River, and the protection of the existing population.

Thus, overall, the Project can be deemed acceptable in that, notwithstanding the residual impacts, the losses can be offset and substantial conservation gains can be achieved for threatened species and vegetation communities impacted by the Project through the ongoing monitoring and management of offset areas.

A summary of the impacts to biodiversity is provided below.

Species	Extent of impact from inundation (inside FSL)	Extent of impact from construction (outside FSL)	Total
Queensland Bluegrass	None	None	N/A
Booroolong Frog	50 individuals	None	50 individuals
Booroolong Frog Habitat	2.3 ha of known Booroolong Frog habitat on the Peel River	None	2.3 ha
Border Thick-tailed Gecko	None	Unknown number of individuals living within the artificial habitat of the dam wall.	Unknown number of individuals living within the artificial habitat of the dam wall.
Border Thick-tailed Gecko Habitat	2,600 m^2 (area of upstream face of dam wall to be inundated).	50,000 m^2 (area of downstream face of dam wall).	52,600 m^2

European Heritage

Correspondence from the Heritage Council during finalisation of the EIS, adequacy review and the EIS exhibition period referenced the Preliminary Archaeological and Heritage Assessment (PAHA) prepared by Navin Officer Heritage Consultants (2008) for the Preliminary Environmental Assessment (PEA) for the Project (Molino Stewart 2011).

The PAHA was considered during preparation of the HIA, however it was considered highly likely that the PAHA would have formed part of the preparation of the Tamworth Regional Local Environmental Plan 2010 (TRLEP) and thus any items of heritage significance documented in the PAHA would have been included on the heritage schedule (Schedule 5) to the TRLEP.

This assumption was based on the recommendation within the PAHA that a copy of that report be provided to Tamworth Regional Council and that the TRLEP 2010 is dated two years after completion of the PAHA.

WorleyParsons liaised with Tamworth Regional Council between December 2012 and January 2013 in relation to this matter and it became apparent that the PAHA was not considered by Tamworth Regional Council in the preparation of the TRLEP.

Of the 26 items, four are listed on the TRLEP and one is proposed for relisting on the State Water s170 Register. These five listed items were assessed in the EIS. The Project impacts to the 21 unlisted items are assessed in the PIR. It is proposed to carry out comprehensive mapping and recording of eight items prior to relevant impacts occurring. Relocation of a further four of these items is proposed. One of the items was reportedly lost during a flood event and not recovered. There will be no direct impact to eight of the unlisted items.

Conclusion

The Project is proposed to increase the flood safety of Chaffey Dam, including compliance with ANCOLD and DSC Guidelines, to meet the needs of Tamworth's water supply, to maintain irrigation allocations at an adequate level and to provide contingency for adverse climate change impacts.

The Project has been confirmed by the Minister for Planning and Infrastructure as a State Significant Infrastructure project.

Giving consideration to socioeconomic, supply demand (high security and general security) and environmental issues, it has been demonstrated that a combined safety upgrade and augmentation of Chaffey Dam, incorporating augmentation to 100 GL is required and justified.

The EIS and PIR have documented all environmental impacts associated with the Project.

The assessment in the EIS and PIR confirm that the environmental and socioeconomic impacts of the Chaffey Dam Augmentation and Safety Upgrade State Significant Infrastructure Project are deemed to be acceptable.

1 INTRODUCTION

State Water Corporation (State Water) proposes to carry out the Chaffey Dam Augmentation and Safety Upgrade Project (the Project). Chaffey Dam is located on the Peel River approximately 30 kilometres (km) south east of Tamworth, in northern New South Wales (NSW).

In April 2012, State Water engaged WorleyParsons Services Pty Ltd (WorleyParsons) to prepare an Environmental Impact Statement (EIS) for the Project on their behalf. The EIS was prepared to accompany a State Significant Infrastructure Application, submitted to the Minister for Planning and Infrastructure pursuant to Part 5.1, Division 2 of the *Environmental Planning and Assessment Act 1979* (EP&A Act).

On 29 August 2012, State Water referred the Project to the Commonwealth Department of Sustainability, Environment, Water, Population and Communities (SEWPaC) under the provisions of the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

On 28 September 2012 the Minister for SEWPaC declared the project a controlled action, therefore the Project requires assessment and approval under the EPBC Act. SEWPaC advised that the Project would be assessed through an accredited assessment under Part 5.1 of the EP&A Act.

On 12 November 2012 the EIS was submitted to the Department of Planning and Infrastructure for adequacy review.

On 10 December 2012, the Department of Planning and Infrastructure advised that the EIS was adequate for public exhibition. The EIS was placed on public exhibition from 12 December 2012 to 31 January 2013.

Submissions on the EIS were received from the Heritage Council of NSW, the NSW Environment Protection Authority (EPA), Namoi Catchment Management Authority (CMA), the NSW Office of Environment and Heritage (OEH), the NSW Roads and Maritime Services (RMS), the NSW Department of Primary Industries (DPI) and the NSW Department of Planning and Infrastructure (Appendix 1). Namoi CMA provided a clarification to its submission, as provided at Appendix 1.

No submissions were received from members of the public.

In accordance with Section 115Z(6) of the EP&A Act, the Director-General of the Department of Planning and Infrastructure may require the proponent to submit:

- A response to any submissions received during the exhibition period
- A preferred infrastructure report that outlines any proposed changes to the State Significant Infrastructure to minimise its environmental impact or to deal with any other issue raised during the assessment of the application concerned

On 20 February 2013, the Director-General requested that State Water respond to the issues raised in submissions and if required, prepare a Preferred Infrastructure Report (PIR).

This PIR is submitted pursuant to Section 115Z(6) of the EP&A Act to respond to submissions received to 15 March 2013. The PIR provides a description of the proposed changes to the Project to minimise its environmental impact. The PIR also documents further biodiversity surveys and impact assessment carried out following lodgement of the EIS.

The PIR has been prepared in accordance with the requirements of Part 5.1 of the EP&A Act and the Environmental Planning and Assessment Regulation 2000 (EP&A Regulation).

2 SUBMISSIONS RECEIVED

The EIS was placed on public exhibition from 12 December 2012 to 31 January 2013. Submissions were received from:

- Heritage Council of NSW (dated 19 December 2012)
- Environment Protection Authority (dated 30 January 2013)
- Namoi Catchment Management Authority (dated 30 January 2013, clarification received 22 February 2013)
- Office of Environment and Heritage (dated 1 February 2013)
- Roads and Maritime Services (dated 13 February 2013)
- Department of Primary Industries (dated 28 February 2013)
- Department of Planning and Infrastructure (dated 20 February 2013).

Table 2-1 summarises the submissions received and the section of the PIR where each issue has been addressed.

Table 2-1: Summary of issues and section of PIR where issue is addressed

Matter	Issues Raised in Submission (summary/extract from submission)	Section of PIR where Issue Addressed
Heritage Council of NSW - 19 December 2012		
European Heritage	A full archaeological study of non-Aboriginal sites and the development of appropriate methodology is recommended.	Section 6.4
Environment Protection Authority - 30 January 2013		
Air Quality	Revise the Air Quality Impact Assessment to include additional air quality particle mitigation strategies to ensure that predicted air impacts at all sensitive receptors meet EPA assessment criteria.	Section 6.7
Air Quality	An Air Quality Management Plan (AQMP) will be required for the Project. The AQMP will require the following information for each air pollutant and emission source: - key performance indicator; monitoring method; location, frequency and duration of monitoring; record keeping; response mechanisms; and compliance reporting.	Section 6.7

Matter	Issues Raised in Submission (summary/extract from submission)	Section of PIR where Issue Addressed
Air Quality	Provide further details of each proposed mitigation strategy to ensure the effective implementation of each strategy can be demonstrated, consistent with the above requirements.	Section 6.7
Noise and Vibration	Alternative piling methods such as bored or vibratory approaches should be considered in lieu of impact piling where feasible and reasonable to reduce noise emissions.	Section 4 Section 6.6
Noise and Vibration	Should the necessity arise for any construction works to occur outside the standard construction hours specified in the Interim Construction Noise Guideline, that this should only occur with prior approval from DP&I and with appropriate justification.	Section 6.6
Noise and Vibration	Monitor the air blast overpressure and ground vibration associated with any blasting activities to ensure compliance with the relevant performance criteria.	Section 6.6
Namoi Catchment Management Authority - 30 January 2013		
Biodiversity – Offset Plan	This Policy highlights some of the inadequate biodiversity outcomes that are contained with the current NSW State and Commonwealth's approaches to biodiversity offsets (Insufficient Gain, Equivalence, Time Lags)	Section 6.2.8
Construction Environmental Management	Namoi CMA be consulted during the preparation of the Construction Environmental Management Plan (CEMP)	Section 6.2
Water	The additional inundation will result in a decrease in aquatic stream environment, however the EIS states on page 106 the decrease is about 1.2km Scaling from Figure 4.4 page 26 appears to indicate that the length of inundation will be 1.7km. The length and impacts on the additional stream environment inundation needs to be clarified, especially with regard to the Booroolong Frog habitat.	Section 6.1
Soil and Water	Namoi recommends that a condition of approval be as follows: that Namoi CMA be consulted during the preparation of the Sediment and Erosion Control Plan.	Section 6.1
Soil and Water	Namoi recommends that a condition of approval be as follows: Namoi CMA is consulted during the revisions of the Foreshore Management Plan.	Section 6.1

Matter	Issues Raised in Submission (summary/extract from submission)	Section of PIR where Issue Addressed
Biodiversity	Additional research and investigation be undertaken prior to project approval into possible mitigation measures for the protection and conservation of the Booroolong Frog and its habitat.	Section 6.2
Biodiversity	Namoi CMA is consulted during the preparation of the Biodiversity Management Plan including the Booroolong Frog Management Plan and the Vegetation Management Plans	Section 6.2
Biodiversity – Offset Plan	Namoi CMA is consulted during the preparation of the Offset Strategy. Recommended inclusions: consideration of the Namoi CMA Biodiversity Offset Policy 2011; offsets achieve multiple identifiable benefits; the whole 203ha of native vegetation be adequately offset; Biobanking Assessment Methodology be used; at least 203ha be planted to native vegetation to offset net loss of native vegetation; that a pro-rata area of native vegetation be planted to offset the loss of equivalence and functional time lags; Offset Monitoring Plan and the completion of a Conservation Property Vegetation Plan.	Section 6.2.8
Aboriginal Heritage	Namoi CMA requests that it be consulted during the development of the 'Back to Country' protocol.	Section 6.2.8
Emergency Planning	Namoi CMA suggests consultation with the yet to be established North West Local Land Services	Section 7
Namoi Catchment Management Authority Clarification to Submission - 22 February 2013		
Biodiversity	It is noted that assessments of condition and RVC benchmarks for the six native vegetation communities are adequately addressed within Appendix 8 to the EIS.	N/A
Biodiversity	Namoi CMA is satisfied with the information provided in sections 4.1.3, 4.1.4 and 4.1.5 of Appendix 8 to the EIS regarding information on critical thresholds.	N/A
Office of Environment and Heritage - 1 February 2013		
Biodiversity	That the proponent provides adequate justification for not targeting *Eucalyptus rubida*, subsp. *Barbigerorum*, *Thesium australe* and *Bothriochloa biloba* as part of this assessment.	Section 6.2.1
Biodiversity	That the proponent undertake additional targeted surveys for *Dichanthium setosum* of an appropriate intensity and during the optimal period for detectability.	Section 6.2.2

Matter	Issues Raised in Submission (summary/extract from submission)	Section of PIR where Issue Addressed
Biodiversity	That the proponent quantify habitat surrounding the site that is suitable for threatened species identified as using, or potentially using, the area. This could be conducted as part of the offset strategy investigations.	Section 6.2.4
Biodiversity	That the proponent: review and amend the assessment of impacts to the Booroolong Frog by adopting a more precautionary approach; and undertake adequate population and habitat surveys throughout the Upper Peel (note: this will inform both the assessment of impacts and the potential for offset).	Section 6.2.6
Biodiversity	That the proponent specifically consider strategies that mitigate impacts to riparian areas for terrestrial biodiversity that are dependent on such habitat	Section 6.2
Biodiversity	That the proponent demonstrate consideration of the high risks and potentially significant impacts of relocation of affected fauna as a mitigation measures; and provide specific alternative strategies for mitigation, or reconsider the level of impact on the Booroolong Frog and Border Thick-tailed Gecko and how this affects biodiversity offset requirements	Section 6.2.5 Section 6.2.6
Biodiversity – Offset Plan	That the proponent considers the following points in their preparation of a detailed biodiversity offset plan, and address all known and potential impacts arising from the Project: • It is OEH's preference by that the proponent submits a final offset plan prior to project determination. • In addition to considering the SEWPAC Environmental Offsets Policy, the proponent should consider the OEH *Interim policy on assessing and offsetting biodiversity impacts of Part 3A, State significant development (SSD) and State significant infrastructure (SSI) projects*. This policy includes reference to both the Biobanking Assessment Methodology (BBAM) and the Principles for the use of Biodiversity Offsets in NSW. • OEH considers that the Proponent's reference to the potential use of the Credit Converter for the conversion of outstanding credit requirements to areas of habitat is inappropriate. Tier 3 Variation Criteria C of the OEH Offset Policy refers to the use of BBAM (and not BCAM) for the conversion of ecosystem credits into hectares.	Section 6.2.8

Matter	Issues Raised in Submission (summary/extract from submission)	Section of PIR where Issue Addressed
	• The OEH Guidance on Appropriate Mechanisms for Securing Biodiversity Offsets asserts that the preferred mechanisms for securing offsets are: the establishment of a biobanking site with a Biobanking agreement under the Threatened Species Conservation Act 1995 (TSC Act); the retirement of biobanking credits; and dedication of land as a public reserve under the NPW Act. • Offset Principle 9 should be addressed for the offset sites • It should be noted that the offset strategy needs to include all native vegetation communities to be affected, not just those listed under the EPBC and TSC Acts.	
Water	OEH recommends that any stimulus flows should, unless advised otherwise by the Environmental Water Manager, be released to reflect the natural rates of the rise and fall for the Peel River system.	Section 6.1
Aboriginal Heritage	Appropriate buffer zones should be applied around Aboriginal heritage sites adjacent to the road works areas to ensure their protection.	Section 6.3
Aboriginal Heritage	Supply OEH with copies of site cards for the sites Chaffey A1, Chaffey A2, Chaffey A3 and Chaffey A4 so they can be registered onto the AHIMS	Section 6.3
Aboriginal Heritage	The proponent should either provide further information or remove/amend the statement about complying with OEH 2010 Aboriginal consultation requirement as the proponent has not complied with these requirements and the statement is therefore misleading.	Section 6.3
Roads and Maritime Services - 13 February 2013		
Construction Traffic	A 'Construction Traffic Management Plan' (CTMP) will need to be prepared and include a Vehicle Movement Plan and Traffic Control Plan. It shall be prepared with the intention of causing minimal impact to the operation of the road network and road infrastructure assets during the construction process. The CTMP shall be submitted to Roads and Maritime Services (RMS) and Council for approval prior to any construction activities occurring onsite.	Section 6.5

Matter	Issues Raised in Submission (summary/extract from submission)	Section of PIR where Issue Addressed
Department of Primary Industries (Fisheries NSW) - 28 February 2013		
Soil and Water	Material taken from borrow areas should be limited to land located above the 1:20 flood level and at a distance greater than 30 m from the waterway. Borrow pits should be backfilled with suitable material to natural bed levels and subsequently revegetated. to limit future erosion and scouring during high flow events and to limit the potential for channel realignment	Section 6.1
Consultation	It should be noted that Fisheries NSW provided advice to the Department of Planning and Infrastructure on the adequacy of the draft EIS, by letter dated 23rd November 2012.	Section 3
Water	Monitoring of water temperatures downstream of Chaffey Dam relative to nearby control tributaries is requested in order to determine the extent of cold water pollution (CWP) with regards to temperature depression and the distance downstream CWP extends. The extent of water quality / temperature monitoring should be detailed in a monitoring plan for review by respective agencies including Fisheries NSW and NSW Office of Water. Selective withdrawal of water from the hypolimnion should be discouraged where possible.	Section 6.1
Biodiversity	The proposed waterway crossing designs at Bowling Alley Point Bridge, Hydes Creek Bridge, and Silver Gully should be provided to Fisheries NSW for assessment.	Section 6.2
Construction Environmental Management	Fisheries NSW should be afforded the opportunity to review the draft CEMP prior to finalisation.	Section 7
Biodiversity	Fisheries NSW should be notified a minimum of three days prior to any removal of large woody debris.	Section 6.2
Biodiversity	It is recommended that where stock are present, riparian plantings be protected by fencing.	Section 6.2
Biodiversity	Fisheries NSW should be consulted during the development of a Water Release Management Plan and operational plan for the use of the Environmental Contingency Allowance.	Section 7
Biodiversity	Fisheries NSW should be consulted during the review of the Chaffey Dam Variable Offtake Management Protocol.	Section 7

Matter	Issues Raised in Submission (summary/extract from submission)	Section of PIR where Issue Addressed
Hazards and Risks	Fuels, lubricants, and chemicals should be stored no closer than 30 m to waterways and be adequately bunded at all times.	Section 6.10
Department of Primary Industries (NSW Office of Water) - 28 February 2013		
Water	The Project could trigger a growth-in-use response strategy within the Peel River system under the rules established by the Water Sharing Plan for the Peel Valley Regulated, Unregulated, Alluvium and Fractured Rock Water Sources 2010 (Peel WSP) and within the Namoi River system under the rules established in the Water Sharing Plan for Upper Namoi and Lower Namoi Regulated River Water Sources 2003 (Namoi WSP).	Section 6.1
Water	It is recommended that further information regarding the risk to users as well as a detailed consultation with water users within the Peel System be undertaken prior to commencement of the part of the project potentially requiring drawdown of the reservoir.	Section 6.1
Water	It is recommended that alternatives to requiring a two metre drawdown, including engineering solutions (such as a coffer dam around the spillway) and reducing the drawdown (and hence time to prepare in the event of a significant rainfall event).	Section 6.1
Water	Consideration should be given to requiring a bond to cover the likelihood of any compensation claims.	Section 6.1
Water	Consideration should be given to a regular sampling program for algal blooms. Algal management downstream should also be addressed through appropriate offtake levels and operational protocols.	Section 6.1
Biodiversity	A plan should be developed to re-establish riparian zone vegetation, to replace that submerged by the augmentation.	Section 6.2
Department of Primary Industries (Crown Lands) - 28 February 2013		
Land Use	Crown Lands is agreeable to the proposal to relocate the facilities contained within the Bowling Alley Point Recreation Area, including boat ramp, picnic tables and chairs, barbeques, toilet facilities and camping areas.	Section 6.8
Land Use	The preparation of the Recreation Continuance Plan for Bowling Alley Point and the future planning of the recreation ground generally should be noted in the assessment of the application and included as a condition should the proposal be approved.	Section 6.8

Matter	Issues Raised in Submission (summary/extract from submission)	Section of PIR where Issue Addressed
Land Use	The proposed Recreation Continuance Plan should ensure that the standard of the current facilities is maintained.	Section 6.8
Department of Planning and Infrastructure - 15 February 2013		
Biodiversity	Adequate information has not been provided to enable the department to assess the impacts of the proposed action on all relevant matters of NES (listed threatened species and communities). Please refer to comments provided 27 November 2012.	Section 6.2
Biodiversity	Insufficient detail has been provided on proposed measures to mitigate impacts on matters of NES to enable an assessment of the merit of these components of the proposal. Please refer to comments provided on 27 November 2012.	Section 6.2 Section 7
Biodiversity	The EIS does not provide a detailed proposal to offset the residual impacts of the proposed action of matters of NES, in accordance with the Commonwealth Offsets Policy (referenced in earlier comments). Please refer to comments provided on 27 November 2012 for further detail.	Section 6.2
Options Assessment Biodiversity	Details of the comparative impacts of the two alternative actions (ie. 80GL and 120GL) on matters of NES must be provided to enable assessment of the merit of the proposed augmentation option in relation to its impacts on matters of NES. Please refer to comments provided on 27 November 2012.	Section 5.3.3
Department of Planning and Infrastructure - 20 February 2013		
Project Justification Options Assessment	The Department is concerned that the justification for the project is not fully addressed in the EIS, particularly with regard to the alternative safety and augmentation options discussed in Section 4.11 (the 80GL and 120GL alternatives), as well as a “do nothing” alternative. Further work is needed to separately clarify the safety upgrade and augmentation components of the proposal, and to provide detailed justification for each component. The Department requires a detailed assessment of the social, economic and environmental costs and benefits of the alternative safety and augmentation options, particularly the 80GL and “do nothing” options.	Section 5

Matter	Issues Raised in Submission (summary/extract from submission)	Section of PIR where Issue Addressed
European Heritage	The Department requires an assessment of the significance of all heritage sites and buildings identified in the Navin Officer Heritage Consultants 2008 report, likely impacts resulting from the proposal, and any mitigation activities that may be required. This assessment should be in accordance with the guidelines and methodologies specified in the Director-General's Requirements and may include archaeological investigation if appropriate.	Section 6.4

3 CONSULTATION

During preparation of the EIS, a range of consultation activities were undertaken by or on behalf of State Water to inform the community and stakeholders of the Project and to seek their comment and input on the Project. The key consultation activities are documented in Section 6 of the EIS.

Prior to commencement of the EIS, the Department of Planning and Infrastructure provided its Draft DGRs to a number of NSW Government Agencies for review and comment. This constituted consultation carried out by the Department of Planning and Infrastructure, rather than State Water, and as such, reference to this consultation was not made in in Section 6 of the EIS.

Following submission of the EIS for public exhibition, further stakeholder consultation has been carried out for the Project. This consultation includes:

- Consultation (email and telephone) with the Heritage Council of NSW in December 2012 regarding European heritage
- Consultation (email and telephone) with Tamworth Regional Council between December 2012 and January 2013 regarding European heritage
- Consultation (email and telephone) with OEH (Aboriginal Heritage) between 13 February 2013 and 27 February 2013 to ensure issues raised by OEH in regard to Aboriginal heritage have been satisfactorily addressed in this PIR
- Consultation (email and telephone) with EPA between February and March 2013 to ensure issues raised by EPA in regard to air quality have been satisfactorily addressed in this PIR
- Consultation (email and telephone) with OEH, SEWPaC, Namoi CMA and Department of Planning and Infrastructure regarding development of the Offset Plan for the Project between January 2013 and March 2013
- Consultation (email, telephone and meetings) with the Department of Planning and Infrastructure regarding the required content and timing of this PIR and the Project overall
- Consultation (letter) with various land care groups regarding seed collection activities at the Dulegal Arboretum scheduled for several days over autumn 2013, spring 2013 and summer 2013/2014

4 CHANGES TO THE PROJECT DESCRIPTION

As described in Section 4 of the EIS, State Water proposes to carry out an augmentation and safety upgrade of Chaffey Dam. The Project will result in an increase to the Full Supply Level (FSL) of 6.5 m, from 518.6 m AHD to 525.1 m AHD and an increase in the permanent storage capacity from 62 GL to 100 GL.

Safety upgrade construction works to achieve increased flood storage capacity comprise raising the dam wall by 8.4 m to increase the flood storage capacity of the reservoir. Reconfiguration of the auxiliary spillway fuseplug is also proposed to enable staged discharge of flood waters.

Raising the morning glory spillway by 6.5 m will enable augmentation to 100 GL. Realignment of roads, limited to parts of Tamworth-Nundle Road, Rivers Road, Western Foreshore Road and bridges, limited to Bowling Alley Point Bridge, Hydes Creek Bridge and a culvert crossing at Silver Gully, are required due to the increased FSL.

Relocation of some facilities at the Bowling Alley Point Recreation Area and the South Bowlo Fishing Club is also required due to the increased FSL. As part of the Project, the South Bowlo Fishing Club facilities will be relocated to higher ground, proximate to their existing locations.

The Project will result in an increase in the 100 year average recurrence interval (ARI) flood level and the Probable Maximum Flood (PMF) level around the perimeter of the reservoir.

Following submission of the EIS for exhibition, some modifications have been made to the Project to reduce its environmental impact.

4.1 Reduction in Works Areas

To decrease the environmental impact of the Project on biodiversity, Aboriginal heritage and European heritage (refer Sections 6.2, 6.2.8 and 6.4 respectively), the Works Areas for the realignment of Tamworth-Nundle Road, Rivers Road and Western Foreshore Road have been reduced in size. This has been achieved through refinement of the road design and selection of specific stockpiling and equipment laydown areas.

The original size of each Works Area, the revised size of each Works Area and the subsequent reduction in the size of the Works Areas is in shown in Table 4-1 and Figure 4-1.

Table 4-1: Change to the size of Project Works Areas

Works Area	Original Size (as described in EIS)	Revised Size (as described in PIR)	Reduction in Size
Tamworth-Nundle Road and Rivers Road (including Bowling Alley Point Bridge)	41.1 ha	23.9 ha	**17.2 ha**
Western Foreshore Road (including Hydes Creek and culvert crossing at Silver Gully)	86.7 ha	25.0 ha	**61.7 ha**

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Figure 4-1: Revised Project Layout

4.2 Reduction in Excavation Rate

As described in the EIS, air quality impacts were assessed based on a worst case scenario. This scenario comprised an excavation rate of 100 tonnes per hour (tph). Air quality modelling for this scenario showed the potential for elevated PM_{10} and $PM_{2.5}$ concentrations at residential receptors located close to the road construction activities along Western Foreshore Road and at Bowling Alley Point (Tamworth-Nundle Road and Rivers Road).

In order to demonstrate that air impacts at all sensitive receptors will meet EPA assessment criteria, the anticipated excavation rate has been reviewed and revised to 50 tph. This has halved the estimated emissions from excavator activity, truck unloading and vehicle movements.

4.3 Alternative Piling Methods

As described in the EIS, impact piling rigs were anticipated to be used during the construction of the Bowling Alley Point Bridge and Hydes Creek Bridge. The Noise Impact Assessment carried out in the EIS showed that peak construction noise levels are expected to be exceeded at rural residential receivers (R4, R5, R6, R7, R8, R9, R10 and R11). However, noise levels at rural residential receivers will be below the “Highly Noise Affected” level of 75 dB(A).

In order to reduce noise emissions during construction of the Bowling Alley Point Bridge and Hydes Creek Bridge, alternative piling methods such as bored or vibratory approaches have been considered in lieu of impact piling, where feasible and reasonable. Ground conditions at the Project Site allow for the use of a bore pile rig, which will be the preferred equipment and method for piling works.

4.4 Construction Hours

As described in the EIS, it is proposed that all construction activities will be carried out within the standard construction hours specified in the Interim Construction Noise Guideline (ICNG) (DECC 2009), as follows:

- Monday to Friday 7:00am to 6:00pm
- Saturday 8:00am to 1:00pm
- No work on Sundays or public holidays

Any blasting required will be further restricted to between the hours of 9:00am to 5:00pm Monday to Friday and 9:00am to 1:00pm on Saturdays.

Should the necessity arise for any construction works to occur outside the standard construction hours, the Contractor will seek prior approval from the Department of Planning and Infrastructure, accompanied by appropriate justification.

5 PROJECT JUSTIFICATION

As documented in the EIS, State Water proposes to carry out a safety upgrade of Chaffey Dam to improve the flood capacity of the dam and consequently reduce the risk of dam failure in an extreme flood event. It is also proposed to concurrently increase the dam's storage capacity to provide greater water security for potable, irrigation and agricultural supplies.

The proposed safety upgrade construction works comprise raising the dam wall by 8.4 m to increase flood storage capacity and reconfiguration of the auxiliary spillway fuseplug to enable staged discharge of flood waters.

The proposed augmentation construction works comprise raising the morning glory spillway by 6.5 m. Modifications to some roads, bridges and existing land uses are also required due to the increased FSL.

Justification for each of the proposed Project components is provided in Sections 5.1 and 5.2. The options considered for each component are also discussed.

5.1 Justification for Safety Upgrade

The Chaffey Dam morning glory spillway was originally designed to handle a PMF determined in accordance with current practice at the time. Advancements in the understanding of meteorology and in hydrologic analysis techniques have shown that the spillway capacities of many existing dams, including the Chaffey Dam morning glory spillway, are inadequate to safely pass a PMF (Public Works Department of NSW 1990).

The PMF is the largest flood that could conceivably occur at a particular location and effectively reflects the extent of the floodplain (NSW Government 2005). At Chaffey Dam, the PMF is approximately equivalent to a 1 in 1,000,000 annual exceedence probability (AEP) event (Molino Stewart 2011).

In 2007, GHD (2007a) provided a review of the Portfolio Risk Assessment carried out by State Water in 2000 (PRA 2002), taking into account new and updated data, as well as the installation of a parapet wall at Chaffey Dam, which increased the height of the dam wall by 1.8 m. The highest probabilities of dam failure (i.e. collapse of the dam wall) were found to be largely driven by the AEP of the flood that will pass over the top of (overtop) the dam wall (Table 5-1).

Table 5-1: Probabilities of dam failure (modified from GHD 2007a)

Scenario	Annual Probabilities of Dam Failure
By Loading	
Flood	1: 99,350
Earthquake	1: 793,650,000
Sunny day operation	1: 98,040,000
Total:	**1: 99,300**
By component	
Dam	1: 110,000
Morning glory spillway	1: 1,521,700
Reservoir rim	1: 15,128,590,000
Total:	**1: 99,300**

The Town of Woolomin is located downstream of Chaffey Dam, approximately 6 km north of the dam wall. Tamworth is located on the Peel River downstream of Chaffey Dam, approximately 30 km north west of the dam wall. If Chaffey Dam were to fail due to an extreme flood event, it has been estimated that the total population at risk (PAR) would be just under 5000, up to 150 lives would be lost and over $2.1 billion damage to property and agriculture would accrue (GHD 2007a). Consequences for townships immediately downstream of the dam, such as Woolomin, would be expected to be catastrophic. SKM (2000) estimated the cost of rebuilding the dam following its failure to be $67.7 million.

Based on the population at risk and the severity of damage and loss that would result from dam failure, Chaffey Dam currently has a Flood Consequence Category of “Extreme”.

Flood Consequence Categories are used to determine whether a dam should be prescribed under the *Dams Safety Act 1978*, to set appropriate level and frequency of surveillance and reporting for prescribed dams and to determine the design standards that a prescribed dam is required to meet. Chaffey Dam is listed under Schedule 1 of the *Dams Safety Act 1978* as a prescribed dam and therefore comes under the regulatory oversight of the Dams Safety Committee (DSC).

Extreme Flood Consequence Category prescribed dams are required by DSC Standards and ANCOLD Guidelines to have capacity to safely pass a PMF with the reservoir full, as well as maintain a minimum 0.6 m freeboard. These requirements are in recognition of the potential catastrophic consequences of dam failure (Dams Safety Committee 2010).

Upgrades to impounding reservoirs, such as Chaffey Dam, for flood mitigation purposes usually involve one or a combination of the following works:

- Increasing the flood discharge capacity of the reservoir
- Increasing the flood storage capacity of the reservoir
- Improving the stability of the dam, including protecting the dam against scouring by flood water which may overtop the dam

State Water carried out a detailed options assessment to determine the potential long term options for Chaffey Dam, including the potential for "flood safety only" upgrades (refer Section 5.3). Improving the stability of the dam, including protecting the dam against scouring was discarded in the early stage of the assessment. Consequently, options to increase the flood discharge capacity of the reservoir and to increase the flood storage capacity of the reservoir were investigated.

All options considered in the detailed options assessment involved the construction of an auxiliary spillway, to increasing flood discharge capacity, in combination with raising of the dam wall, to increase flood storage capacity.

In 2011, State Water completed construction of an auxiliary spillway at Chaffey Dam to provide an interim flood safety measure. Prior to installation of the auxiliary spillway, Chaffey Dam could safely pass a 1 in 100,000 AEP event. The auxiliary spillway provides additional flood discharge capacity, enabling the dam to safely pass a 1 in 470,000 AEP event. Events greater than 1 in 470,000 will result in overtopping of the dam wall and potentially, dam failure.

Damage estimates to infrastructure, buildings and commerce were prepared by GHD (2007a) for six flood frequency events. The size of the damage estimates are linked to the size of the flood event. The larger the flood event, the less frequent (lower probability) it will occur and the higher the damage costs.

The downstream damage estimates show that damage downstream increases as greater volumes of water flows through the existing morning glory and auxiliary spillways, but are much reduced compared to dam failure. Damage estimates are substantially reduced further when combined with the proposed increase in flood storage capacity (through raising of the dam wall) to enable the dam to pass the PMF.

Table 5-2 shows the downstream damage estimates for those options considered by GHD (2007a) that most closely resemble the existing auxiliary spillway and the proposed safety upgrade.

Table 5-2: Downstream damage estimates for existing dam and proposed safety upgrade (modified from GHD 2007a)

Flood Storage Capacity	Annual Exceedence Probability						
	1 in 10,000	1 in 50,000	1 in 100,000	1 in 500,000	1 in 1,000,000	1 in 2,500,000	1 in 6,000,000
Existing (1:470,000)	366	409	417	2,478	2,309	2,607	2,666
Proposed (1:1,000,000)	365	413	424	457	477	508	512

Chaffey Dam has a Flood Consequence Category of Extreme. The existing flood storage capacity of Chaffey Dam is 1 in 470,000 AEP. As such, Chaffey Dam does not currently meet DSC and ANCOLD guidelines, which require extreme consequence dams to be able to safely pass a PMF event.

Flood events greater than 1 in 470,000 AEP are expected to overtop the dam wall, potentially resulting in dam failure. The downstream damage estimates increase substantially for flood events greater than 1 in 500,000 AEP.

In order to comply with DSC and ANCOLD guidelines and to reduce the risk of dam failure and subsequent downstream damage, including the potential loss of life, it proposed to raise the dam wall by 8.4 m to increase the flood storage capacity of Chaffey Dam and enable it to safely pass a PMF event, whilst also maintaining a 0.6 m freeboard above the PMF.

For these reasons and to ensure State Water implements its responsibilities from both due diligence and legal perspectives, the “No Safety Upgrade Option” and associated risk of catastrophic dam failure is considered to be unacceptable.

5.2 Justification for Augmentation

The Estimated Resident Population (ERP) of Tamworth Local Government Area, as at 30 June 2011, is 58,351. Since 2001, the ERP has grown by 8% from 53,973 (Tamworth Regional Council 2013a) (Table 5-3). Based on a linear projection of the annual ERP from 2001 to 2011, the ERP of the Tamworth Local Government Area (LGA) is expected to grow by around 0.9% per year to reach around 75,000 by 2030 (Figure 5-1).

Table 5-3: Tamworth Regional Council Estimated Resident Population (Tamworth Regional Council 2013a)

Year (ending June 30)	Population Number	Change in Number	Change in Percent
2001	53,973	0	0
2002	54,257	+284	+0.53
2003	54,543	+286	+0.53
2004	54,734	+191	+0.35
2005	55,092	+358	+0.65
2006	55,936	+844	+1.53
2007	56,588	+652	+1.17
2008	56,945	+357	+0.63
2009	57,401	+456	+0.80
2010	57,884	+483	+0.84
2011	58,351	+467	+0.81

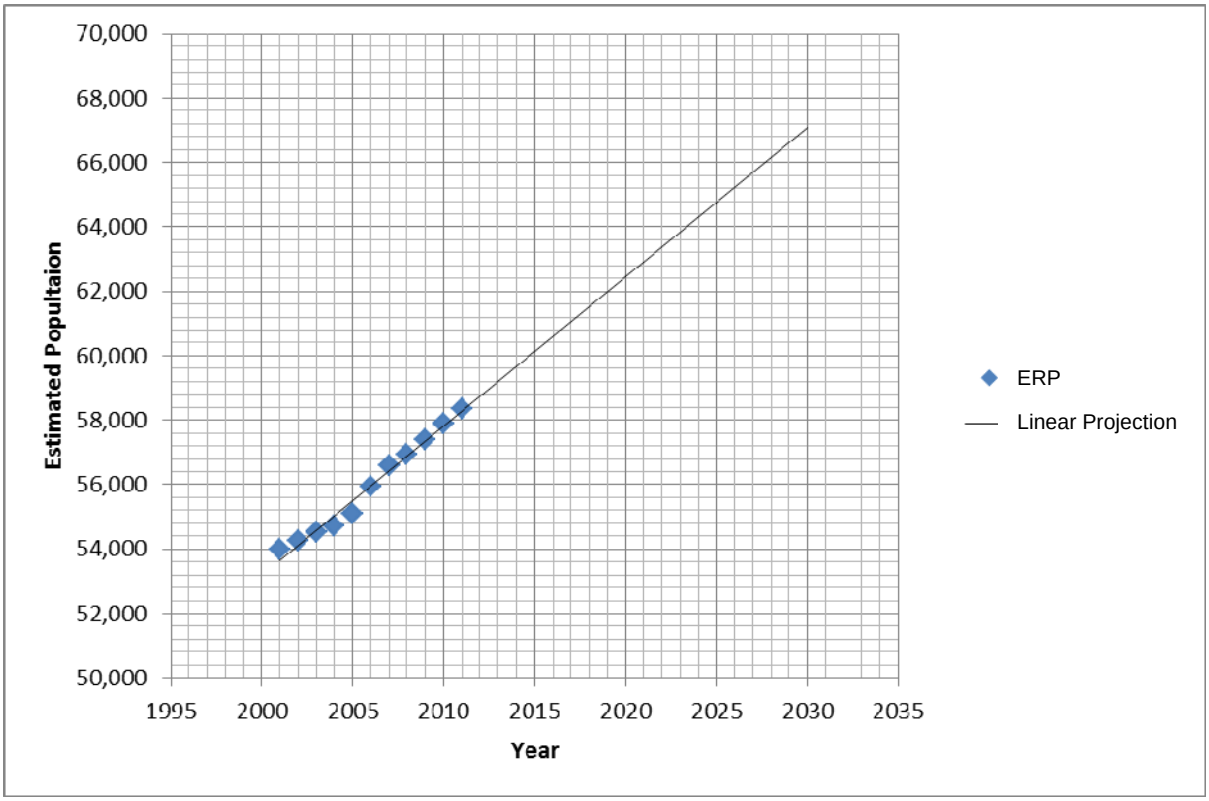

Figure 5-1: Linear projection of Tamworth Local Government Area Estimated Resident Population (ERP) (Tamworth Regional Council 2013a)

The majority of town water supply for Tamworth is sourced from Chaffey Dam, from which Tamworth Regional Council has a high security entitlement of up to 16.4 GL/year. Tamworth Regional Council also has a high security entitlement of up to 5.6 GL/year for supplementary water supply from Dungowan Dam, which has a capacity of 6.2 GL.

Apart from Chaffey and Dungowan Dams, which service Tamworth, the towns and villages of the LGA have their own water supplies:

- Moonbi and Kootingal have groundwater bores and wells adjacent to the Cockburn River
- Manilla has the Namoi River Weir and the Manilla River, which has a licence allowing releases from Split Rock Dam
- Barraba is supplied by the Manilla River, Barraba Creek, Connors Creek Dam and when level four water restrictions are in place, two emergency bores in James Street
- Nundle has the Peel River and the Oakenville bore
- Attunga is supplied by groundwater bores adjacent to the Peel River
- Bendemeer draws on the MacDonald River (Tamworth Regional Council, 2013b)

Chaffey Dam is the primary infrastructure to service the town water supply for Tamworth. Water from the reservoir is also used for irrigation and agricultural purposes. Concern has been expressed from the local community as to the future reliability of supplies to Tamworth and Peel Valley irrigators as Tamworth water supply demands grow (ref).

Tamworth Regional Council note its biggest challenge with the delivery of water services in the Tamworth Region since the Council's inception in 2004[1] has been town water security during the unprecedented drought conditions, experienced from 2003 to 2008 (Tamworth Regional Council 2012). During this time, primary raw water sources failed or approached failure in the majority of water supply systems (including Tamworth) and moderate to severe water restrictions were enforced across all systems during the height of the drought in 2007, due to record low dam levels (Tamworth Regional Council 2012).

5.2.1 High Security Water Demand

GHD (2007b) calculated the projected high security water supply demand for Tamworth to 2033, taking into account historical water usage, usage type (i.e. residential, commercial, industrial, public parks and rural and institutional), projected residential growth (population and dwelling numbers) and climatic conditions.

The assessment included:

- An analysis and interpretation of available historical data on climate, population and water demand in Tamworth, including projected future demand levels and demand management initiatives, current and future irrigation demands and past assessment by Hunter Water Australia on potential supply augmentation options
- The potential impacts of climate change
- The results and analysis of Integrated Quantity/Quality Model (IQQM) modelling for the Peel River, with an emphasis on model accuracy verification. Reliability of water supply for different users within the Peel Valley for a range of Tamworth water demand and sensitivity scenarios was also a key focus
- The Murray-Darling Basin Commission (MDBC) Cap and Water Sharing Plan for the Peel Valley Regulated, Unregulated, Alluvium and Fractured Rock Water Sources 2010 (Peel Valley Water Sharing Plan)
- The results for the inferred reliability of supply

[1] Barraba, Manilla, Nundle, Parry and Tamworth Councils amalgamated in 2004 and formed Tamworth Regional Council.

The adopted average annual growth rate in water supply demand was based on the past and projected residential growth for Tamworth. A varying rate of growth was adopted for each five year period between 2003 and 2033, with an average of rate of 0.97%.

Each dwelling was assumed to use 345 kL/a, based on average metered consumption and dwelling numbers over a three year period between 2000/2001 and 2002/2003.

The average annual growth rate was adapted to also consider low and high growth demand scenarios. Low growth was determined to be half of the average growth while high growth was one and a half times average growth.

Projected water supply demand was calculated both with and without implementation of water efficiency measures[2], as presented in Table 5-4. Numbers in parentheses are the projected demand volumes with the implementation of water efficiency measures. These volumes assume a target reduction in demand, through implementation of efficiency measures, of 0% in 2003, 5% in 2008, 10% in 2013 and 15% from 2018 and beyond.

Demand was found to grow by between 9% and nearly 30% from current (2013) levels, depending on population growth and the implementation of water efficiency measures.

Table 5-4: Projected Tamworth water supply demand, with and without implementation of water efficiency measures

Year	Low Population Growth ML/Y	Average Population Growth ML/Y	High Population Growth ML/Y	Target Reduction
2003	9,658 (*9,658*)	9,658 (*9,658*)	9,658 (*9,658*)	0%
2008	10,375 (*9,856*)	11,350 (*10,782*)	12,324 (*11,708*)	5%
2013	11,228 (*10,105*)	13,056 (*11,750*)	14,881 (*13,393*)	10%
2018	11,696 (*9,942*)	13,992 (*11,893*)	16,284 (*13,841*)	15%
2023	12,165 (*10,340*)	14,927 (*12,688*)	17,686 (*15,033*)	15%
2028	12,633 (*10,738*)	15,863 (*13,484*)	19,088 (*16,225*)	15%
2033	13,102 (*11,137*)	16,799 (*14,279*)	20,491 (*17,417*)	15%

[2] Water efficiency measures considered included BASIX requirements, retrofitting of water efficient fittings and equipment, loss minimisation, wastewater treatment and reuse and education programs, as detailed in GHD (2007b).

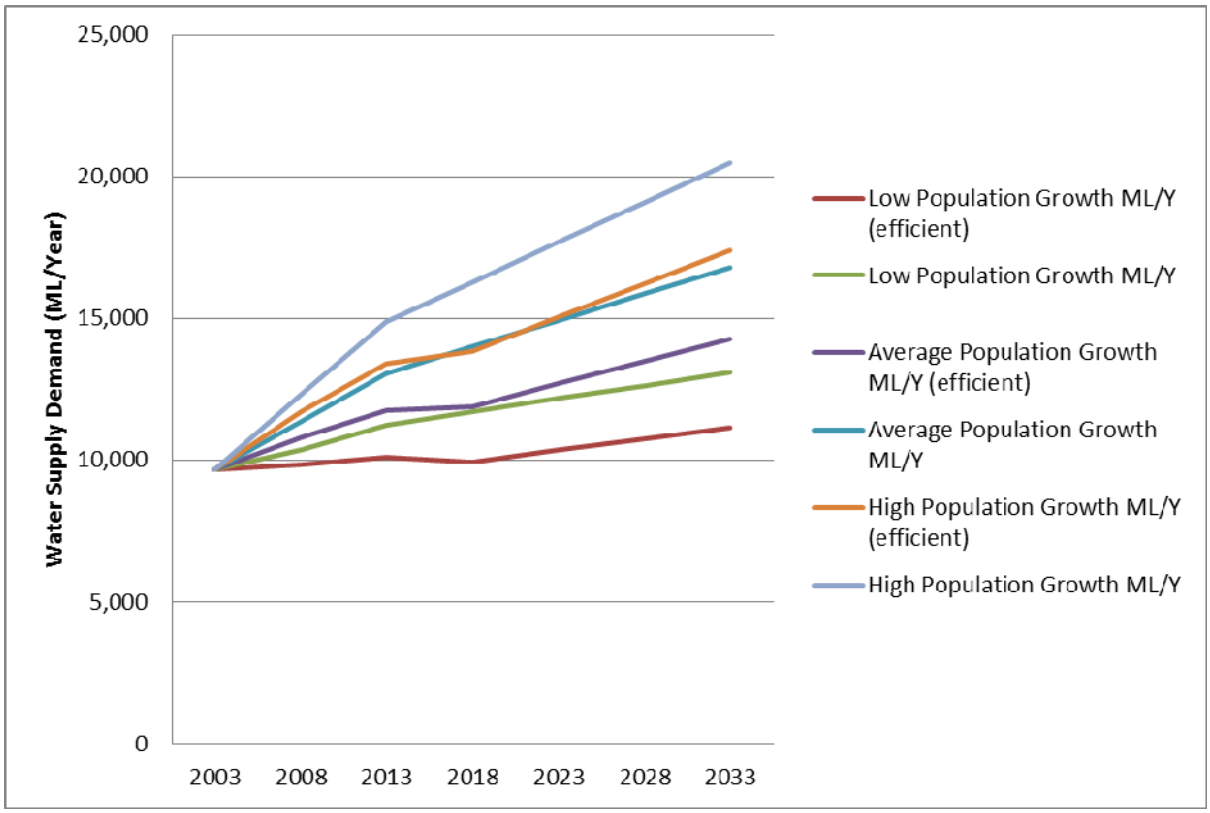

Figure 5-2: Projected Tamworth water supply demand under low, average and high population growth scenarios

Modelling of the IQQM data was carried out to determine the likely frequency of water restrictions in Tamworth as an indicator of the reliability of Tamworth's water supply (refer Section 5.3). At the time of the assessment, the then Department of Energy, Utilities and Sustainability (DEUS) defined standards of service for NSW town water supplies, comprising:

- Restrictions be imposed no more than 5% of the time (5% rule)
- Restrictions should be imposed no more frequently than every 10 years on average (10% rule)

Based on the assumption that restrictions commenced when Chaffey Dam was at 50% capacity, the assessment showed that with the current capacity of Chaffey Dam restrictions occur around every nine years (i.e. 11% of the time) assuming an allocation of 10 GL per year to Tamworth. This does not meet the 5% rule or the 10% rule (Figure 5-5).

As the allocation of Tamworth town water from Chaffey Dam increases to the full entitlement of 16.4 GL per year, the frequency of restrictions increases to around every six years (i.e. 17% of the time) if Chaffey Dam remains at its existing capacity of 62 GL (Figure 5-5). This does not meet the 5% rule or the 10% rule.

Analysis of historical consumption data for Tamworth Water Supply, collected at Calala Water Treatment Plant (WTP), shows that demand increased over the 25 year period from 1983 to 2009 (Figure 5-3). Recent drought and the introduction of a new restrictions regime by Tamworth Regional Council saw a reduction in demand between 2007 and 2009 compared to the long term historical demand. Total consumption in 2007 reached a 25 year minimum of 6.6 GL.

During the drought period between 2002 and 2008, Tamworth's annual demand reached a record high of 10.6 GL in 2002 followed by the second highest recorded annual demand of 10.4 GL in 2006. In 2009, annual demand had increased to 9.1 GL, after falling below 8 GL for two years.

The drought in 2007, when Chaffey Dam fell to 10.5 GL within storage, is reported as the most severe reported water shortage experienced by the Peel Valley, to date (NSW Office of Water 2010a).

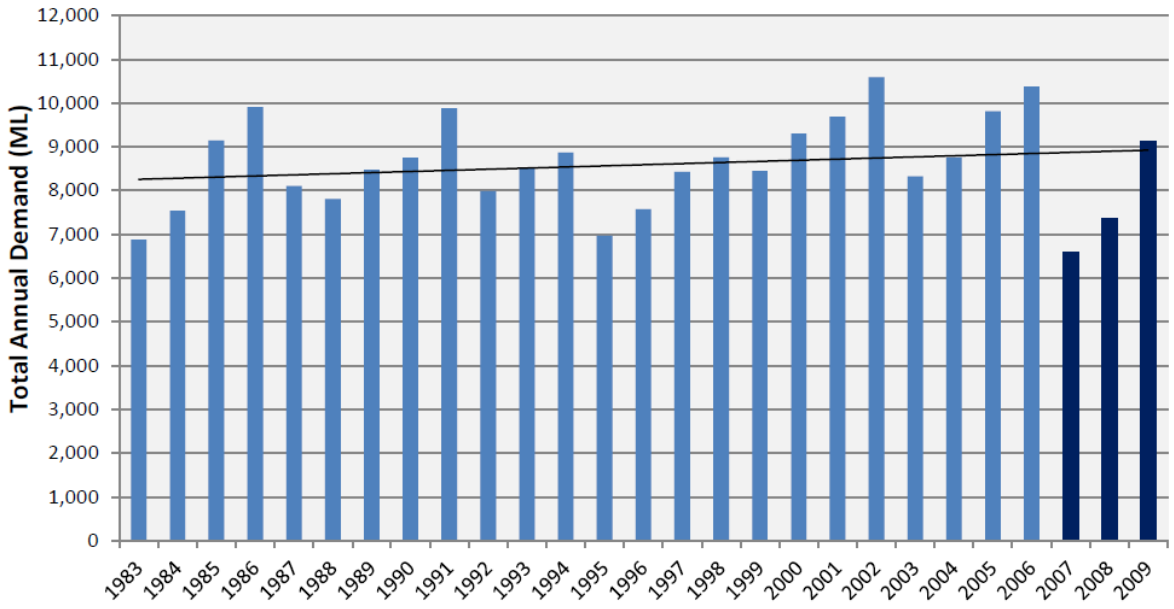

Figure 5-3: Historical town water consumption for Tamworth, as recorded at Calala WTP

In March 2012, Tamworth Regional Council adopted the Tamworth Regional Council Integrated Water Cycle Management (IWCM) Evaluation Study, prepared by Hunter Water Australia (HWA 2011). The IWCM Evaluation Study was prepared in order to plan for and manage the existing and future challenges associated with the future delivery of water and wastewater services in the Tamworth Region.

Tamworth Regional Council's target in the delivery of this supply is to provide "adequate town water supply security". The criteria used to assess this target are:

- Security of Supply: Tamworth Regional Council has a minimum requirement that town water supply should not fail during a repeat of the worst drought on record
- Levels of Service: Tamworth Regional Council has a desirable target of moderate to severe restrictions being imposed no more than 5% of the time and no more frequently than every 10 years on average

The preliminary IWCM issues identified for the Tamworth water supply system included:

- Modelled frequency and duration of restrictions is too high under current demand levels
- Medium to long term water supply security is inadequate

The committed measures for each of these issues included the funding by Tamworth Regional Council, along with the State and Federal Governments for the augmentation of Chaffey Dam from 62 to 100 GL.

Town water supply for Tamworth is currently required for an estimated population of just over 41,000. Tamworth Regional Council is in the process of establishing a permanent connection to the Tamworth water supply system for the towns of Moonbi and Kootingal, which will increase the population served by the Tamworth town water supply to just over 43,000 (HWA 2011). This population is projected to increase at a rate of 0.75% per year to 46,500 in 2020, 50,500 in 2030 and 54,000 in 2030.

In order to determine anticipated growth in water supply demand over time, three demand growth rate scenarios were considered by HWA (2011), as follows:

- Low Growth 0.75% per year
- Average Growth 1.0% per year
- High Growth 1.25% per year

The average (expected) growth scenario of 1% per year is slightly higher than the expected population growth rate of 0.75% pa, which reflects a continuing reduction in dwelling occupancy rates. The low and high growth scenarios are considered likely lower and upper bounds to future growth in residential connections.

Three residential demand levels were also determined by HWA (2011), based on demand observations prior to and during the drought and a predicted demand level post drought, as follows:

- Low Demand (During Drought) 250 kL per year per residential dwelling
- Average Demand (Post-Drought) 300 kL per year per residential dwelling
- High Demand (Pre-Drought) 350 kL per year per residential dwelling

In order to set a lower and upper bound estimate on future demand, the demand observed during drought was combined with low growth to obtain a lower bound projection, the expected post-drought demand was combined with the average growth rate and the pre-drought demand was combined with high growth to obtain the upper bound projection. The projected demand based on the three scenarios is shown in Figure 5-4.

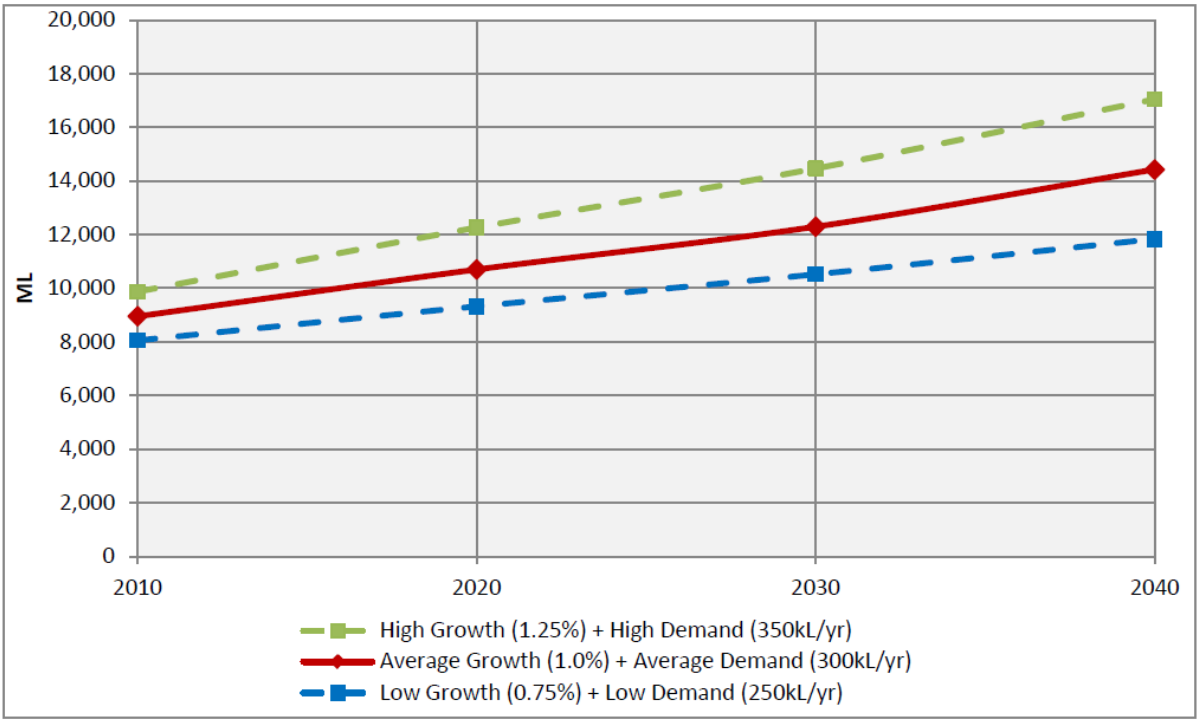

Figure 5-4: Projected future demand on Tamworth town water supply system

Annual demand projections based on average growth and average residential demand levels, along with projected average day and peak day demands are shown below in Table 5-5.

Table 5-5: Projected future annual, average and peak demand on Tamworth town water supply system

Demand	2010	2020	2030	2040
Annual Demand (ML/a)	8,950	10,700	12,300	14,400
Average Day Demand (ML/d)	24.5	29.3	33.7	39.5
Peak Day Demand (ML/d)	49	58.6	67.4	79

Note: Peak Day Demand factor is 2.0 (based on 2009 water production data)

The projected low, average and high water supply demand modeled by HWA (2011) is generally lower than that modeled by GHD (2007b), as follows:

- HWA (2011) high growth high demand scenario roughly aligns with the GHD (2007b) average population growth (efficient) scenario
- HWA (2011) average growth average demand scenario roughly aligns with the GHD (2007b) low population growth scenario
- HWA (2011) low growth low demand scenario roughly aligns with the GHD (2007b) low population growth (efficient) scenario

The frequency of restrictions does not differ between the two models, however the time to reach Tamworth's full high security water supply entitlement is increased under the HWA (2011) model.

As described above and shown in (Figure 5-5), water restrictions occur around every nine years (i.e. 11% of the time) assuming an allocation of 10 GL per year to Tamworth at the current capacity of Chaffey Dam. As the allocation of Tamworth town water from Chaffey Dam increases to the full entitlement of 16.4 GL per year, the frequency of restrictions increases to around every six years (i.e. 17% of the time) if Chaffey Dam remains at its existing capacity of 62 GL.

Neither of these scenarios align with Tamworth Regional Council's Levels of Service target in relation to the delivery of adequate town water supply security.

The IWCM Evaluation Study (HWA 2011) concluded that the duration and frequency of restrictions are expected to improve to acceptable levels once Chaffey Dam is augmented to 100 GL.

5.2.2 General Security Water Demand

Agriculture contributes $72 million to the Gross Regional Product of the Tamworth Region. Employment in the agricultural sector grew by 77% in the 10 years from 1991 to 2001. In 2006/2007 the industry employed 8.3% of the total workforce (Tamworth Regional Council 2013c). Census data for 2011 showed that the agriculture, forestry and fishing industry accounted for 8.6% of employment in the Tamworth State Electoral Division (ABS 2012).

Allocation of water from Chaffey Dam for general security (irrigation) water users is primarily affected by increases in Tamworth town water demand. As Tamworth demand increases to its high security allocation of 16.4 GL, less water is available for provision to general security users.

While high security water has identified supply criteria, no such equivalent criterion exists for general security water supplies. GHD (2007a) presented an adopted minimum reliability level for general security entitlements in the Peel Valley, developed in consultation with various stakeholders, in particular irrigation representatives, along with a review of other valley irrigation reliabilities. The adopted minimum reliability level for general security (irrigation) entitlements is a 70% probability of announcing 80% allocation on 1 July each year.

At present, irrigators in the Peel Valley have reliability of supply below the minimum criterion which is a 70% probability of announcing 80% allocation on 1 July each year. At the current capacity of Chaffey Dam (62 GL) the probability of an 80%+ allocation on 1 July drops dramatically from about 60% to 0% when Tamworth demand increases to 12 GL per year (GHD 2007a) (Figure 5-6).

The IWCM Evaluation Study (HWA 2011) concluded that when town water supply demands reach 14 GL per year, major reductions in general security water allocations to irrigators would result, potentially rendering the local irrigation industry as unviable.

Following augmentation of Chaffey Dam to 100 GL and considering town water supply demands of up to 14 GL per year, acceptable irrigation security will be achieved (HWA 2011).

5.2.3 Climate Change

Over the next 30 to 50 years, NSW is expected to become between 1^{o} and 30^{o} hotter, with the highest temperature increases expected to occur in the north and west of the state. Some parts of NSW are expected to experience a slight increase in summer rainfall, while other parts of the state are expected to experience a significant decline in winter rains. Modelling projections indicate that there will be a shift in runoff patterns resulting in significantly more summer runoff (up to 20% more) and significantly less winter runoff (up to 25% less) (HWA 2011).

Analysis of data from the Bureau of Meteorology shows that climatic conditions since the 1960s and in particular since 1990 have been significantly different from the long term average. GHD (2007a) found that a trend of increasing temperature since the 1950s and reduced rainfall between 1990 and 2004 in Tamworth is likely to result in increased evapotranspiration, subject to soil moisture availability. As a result, soil moisture would be reduced, demand for water for irrigation is likely to be higher and run-off into dams reduced.

Research by the Commonwealth Scientific and Industrial Research Organisation (CSIRO 2004a, 2004b) also indicates that the likely climate change impacts in the Tamworth region are an increase in temperatures and a change in the rainfall pattern throughout the year. The potential for a change in annual rainfall also exists.

GHD (2007b) reported that a potential increase in water demand associated climate change would result in a reduction in productivity within the Peel Valley, or place additional demands on water resources in the Peel Valley to maintain current irrigation levels GHD (2007b).

Studies into climate change in NSW and the ACT (DWE 2008) and water availability in the Namoi catchment (CSIRO 2007) suggest that availability of water from rainfall and runoff in the Tamworth region is likely to decrease as a result of climate change over the next 20 to 30 years.

Although a high level of uncertainty remains in regard to the potential impacts of climate change, HWA (2011) noted the importance of integrating current expected climate change impacts into their long term planning for water infrastructure.

Potential climate change impacts considered by HWA (2011) include:

- Reduced town water supply yields due to reduced runoff, increased evaporation and increased climate variability, resulting in reduced town water supply security and increased periods of restrictions
- Increased town water demands as a result of increased irrigation requirements for residential lawns and gardens due to reduced rainfall and increased evaporation and also as a result of increased evaporative cooler usage due to increased maximum temperatures

Securing of funding for the augmentation of Chaffey Dam is included in Tamworth Regional Council's climate change initiatives currently in progress.

As discussed further in Section 5.3.1, augmentation of Chaffey Dam to 100 GL takes into account the potential impacts of climate change.

5.3 Assessment of Options

As noted above, State Water carried out detailed options assessments to determine the potential long term options for Chaffey Dam. Based on the justification set out in Sections 5.1 and 5.2, the options assessment included the potential for the following upgrade options:

- Flood safety only upgrade
- Augmentation only upgrade
- Combined flood safety and augmentation upgrade

All flood safety upgrade options comprised a combination of increased flood discharge capacity and increased flood storage capacity of the reservoir, which were compared to the base scenario of no safety upgrade works (i.e. the "do nothing" option). The increased flood discharge capacity component of the flood safety upgrade was implemented in 2011 through the installation of the auxiliary spillway.

Primary dam augmentation options ranged from the existing capacity of Chaffey Dam of 62 GL (base scenario or "do nothing" option), to increased capacities of 80, 100 and 120GL. All augmentation options were assessed on the basis of water supply modelling using IQQM (provided by GHD).

5.3.1 Socioeconomic Assessment of Options

Hassall & Associates Pty Ltd (2006) carried out a social and economic (socioeconomic) evaluation (costs and benefits) of shortlisted options for the upgrade of Chaffey Dam. All options were assessed against the "do nothing" option.

The evaluation was used to determine the allocation of resources that maximises community welfare. Therefore the evaluation was principally concerned with the costs and benefits to society as a whole (which includes social and environmental costs and benefits).

The socioeconomic evaluation considered the following key components:

- Social impact, including potential loss and value of life, and tourism and recreation
- Impacts to infrastructure, buildings and commerce
- Agricultural flood losses
- Growth in Tamworth's water use
- Changes in irrigation reliability

The evaluation showed that the major costs associated with the dam safety upgrade are construction of the dam infrastructure and its maintenance. The major benefits are avoided losses from catastrophic dam failure including damage to infrastructure, loss of life and business losses during rebuilding/reconstruction.

Similarly the major costs of augmentation are construction and maintenance while the major benefit is improved reliability of water supply to irrigators to offset the impacts of anticipated growth in Tamworth's use. The augmentation options also improve reliability of supply to households and businesses in Tamworth.

The evaluation found that augmentation options are expected to provide a benefit of between $3.0 million for augmentation to 80 GL and $6.1 million for augmentation to either 100GL or 120GL. This benefit would be derived either through increased confidence in investment or simple willingness to pay to ensure they are not subject to disruption caused by frequent shortages. It was noted that water supply reliability provides a potential marginal incentive to investment in Tamworth and the along the Peel Valley. However is not the only determining factor affecting investment and underlying growth in Tamworth can be expected to occur regardless of the augmentation options.

The results of the evaluation are summarised below and in Table 5-6.

Dam Safety Upgrade Only Options

The results of the evaluation of the dam safety only upgrade options indicated that the staged options perform better (lesser negative NPV) than the full safety upgrade options which can be explained on the basis of deferred expenditure and the discounting effect on the capital expenditure and the benefit stream over time. However for the staged options, capacity of the dam to safely pass a PMF event is not achieved until completion of stage 2.

The best performing staged dam safety upgrade options are DamSafety#6 and DamSafety#8 with NPVs of -$7.7 million (BCR 0.22) and -$8.5 million (BCR 0.22) respectively. Allowing for the uncertainties in the modelling process, these two options could be considered of equal standing.

The best performing full dam safety upgrade options are DamSafety#1 with a NPV of -$11.4 million followed closely by DamSafety#3 with a NPV of -$11.9 million both with a BCR of 0.17.

Combined Dam Safety Upgrade and Augmentation Options

For the combined dam safety upgrade and augmentation options, there are increased costs of construction and maintenance compared to the dam safety upgrade only options. Balancing the additional costs are benefits in the form of improvements to the water supply reliability for both Tamworth (residential and industrial) and irrigation (agricultural) use.

A major potential benefit arising from the augmentation options is the improvement in reliability of supply for irrigators and Tamworth. Due to the significance of this benefit it is important to note that these results assumed that 2006 market prices for irrigation licences were broadly efficient (they take into account the potential fall in their supply reliability associated with Tamworth's growth).

The best performing combined dam safety upgrade and augmentation option was found to be DamAug#3 with a NPV of -$0.7 million (BCR 0.98) followed closely by option DamAug#5 with a NPV of –$1.2 million (BCR 0.96).

Option DamAug#7 is the best performing staged augmentation option with a positive NPV of $0.9 million (BCR 1.05) however it is important to note that the first stage only protects to an AEP of 1:470,000.

DamAug#3 and DamAug#5 both provide full dam safety and 100 GL augmentation in the current program.

Augmentation Only - Incremental Analysis

A separate analysis was carried out to assess the economic value of the augmentation only. The results indicate that DamAug#3 and DamAug#5 are the best performers with NPV results of around $11.1 million and BCRs of 1.7.

The best performing staged augmentation option is DamAug#7 with a significantly lower NPV of $8.8M but with a higher BCR of 2.2. This indicates a higher return on the lower present value cost outlay (linked to a deferred investment expenditure), however this does not represent a better overall economic outcome evaluated over the 25 year analysis period.

Sensitivity to Tamworth Water Use Efficiency

A sensitivity test was carried out to investigate the effect on the results if Tamworth does not achieve its targeted efficiency gains. Alternatively viewed, the scenario can also represent a high level of growth within Tamworth with efficiency gains.

The results indicate that DamAug#3 and DamAug#5 are the preferred options followed by DamAug#4 (and DamAug#6). Full upgrade options in the current program under this scenario are ranked consistently above the staged options due to the increased relative value of benefits derived.

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Table 5-6: Summary of economic evaluation of upgrade options for Chaffey Dam, as ranked by Hassall & Associates (2006)

Upgrade Type	Option Name	Auxiliary Spillway first spill frequency (1 in x)*	Raising Method	Dam Raising (m)	Full Supply Level (m AHD)	Storage Capacity (GL)	BCR	NPV ($)	Rank
Safety Only Options									
Staged - Safety Only	DamSafety#6	N/A ; 10,000/1,000	Vertical	4.3	518.6	62	0.22	-7,699	1
Staged - Safety Only	DamSafety#8	10,000/1,000	Vertical	4.3	518.6	62	0.22	-8,494	2
Staged - Safety Only	DamSafety#7	10,000/1,000	Vertical	4.3	518.6	62	0.2	-9,402	3
Full - Safety Only	DamSafety#1	10,000/1,000	Vertical	4.3	518.6	62	0.17	-11,370	4
Full - Safety Only	DamSafety#3	10,000/1,000	Downstream	4.91	518.6	62	0.17	-11,889	5
Full - Safety Only	DamSafety#5	50,000/1,000	Downstream	4.98	518.6	62	0.17	-12,346	6
Full - Safety Only	DamSafety#2	10,000	Downstream	5.45	518.6	62	0.16	-13,168	7
Full - Safety Only	DamSafety#4	100,000	Downstream	7.15	518.6	62	0.16	-16,822	8
Safety and Augmentation Options									
Staged - Safety and Augmentation	DamAug#7	N/A ; 10,000/1,000	Downstream and Vertical	4.30 / 2.23	518.6 / 525.1	100	1.05	922	1

Upgrade Type	Option Name	Auxiliary Spillway first spill frequency (1 in x)*	Raising Method	Dam Raising (m)	Full Supply Level (m AHD)	Storage Capacity (GL)	BCR	NPV ($)	Rank
Full - Safety and Augmentation	DamAug#3	10,000/1,000	Downstream and Vertical	8.42	525.1	100	0.98	-736	2
Full - Safety and Augmentation	DamAug#5	50,000/1,000	Downstream and Vertical	8.61	525.1	100	0.96	-1,208	3
Full - Safety and Augmentation	DamAug#6	10,000/1,000	Downstream and Vertical	9.02	527.5	120	0.92	-2,859	4
Full - Safety and Augmentation	DamAug#4	50,000/1,000	Downstream	6.56	525.1	100	0.9	-3,066	5
Full - Safety and Augmentation	DamAug#1	10,000/1,000	Downstream	5.29	521.8	80	0.85	-3,779	6
Staged - Safety and Augmentation	DamAug#8	10,000 ; 10,000/1,000	Downstream and Vertical	5.15 / 2.14	518.6 / 525.1	100	0.8	-4,397	7
Full - Safety and Augmentation	DamAug#2	50,000/1,000	Downstream	5.25	521.8	80	0.82	-4,589	8

Upgrade Type	Option Name	Auxiliary Spillway first spill frequency (1 in x)*	Raising Method	Dam Raising (m)	Full Supply Level (m AHD)	Storage Capacity (GL)	BCR	NPV ($)	Rank
Augmentation Only Options									
Full - Augmentation Only	DamAug#3	N/A	Downstream and Vertical	8.42	525.1	100	1.74	11,148	1
Full - Augmentation Only	DamAug#5	N/A	Downstream and Vertical	8.61	525.1	100	1.74	11,134	2
Full - Augmentation Only	DamAug#4	N/A	Downstream	6.56	525.1	100	1.54	9,281	3
Full - Augmentation Only	DamAug#6	N/A	Downstream and Vertical	9.02	527.5	120	1.46	9,025	4
Staged - Augmentation Only	DamAug#7	N/A	Downstream and Vertical	4.30 / 2.23	518.6 / 525.1	100	2.23	8,845	5
Full - Augmentation Only	DamAug#1	N/A	Downstream	5.29	521.8	80	1.79	8,102	6
Full - Augmentation Only	DamAug#2	N/A	Downstream	5.25	521.8	80	1.72	7,755	7

Upgrade Type	Option Name	Auxiliary Spillway first spill frequency (1 in x)*	Raising Method	Dam Raising (m)	Full Supply Level (m AHD)	Storage Capacity (GL)	BCR	NPV ($)	Rank
Staged - Augmentation Only	DamAug#8	N/A	Downstream and Vertical	5.15 / 2.14	518.6 / 525.1	100	1.95	7,738	8

As shown in Table 5-6, the highest ranked safety and augmentation option and all augmentation only options result in positive NPV and BCR greater than 1. The positive NPV and BCR greater than 1 indicate that there is a potential for society to benefit if the augmentation was to proceed (in addition to the dam safety requirement).

For combined safety and augmentation, the three highest ranking options were those options with a storage capacity of 100 GL. Similarly, for augmentation only options, the three highest ranking options had a storage capacity of 100 GL.

5.3.2 Supply Demand Assessment of Options

A study carried out by GHD (2007a) for State Water further examined the need for augmentation of Chaffey Dam and considered a number of augmentation options. The key augmentation options assessed were:

- No augmentation from the current capacity of 62 GL (the “base scenario” or “do nothing” option)
- Augmentation to 80 GL
- Augmentation to 100 GL
- Augmentation to 120 GL

Results from the Peel IQQM analysis were examined to derive an inferred change in reliability of water supplies to both high security and general security water users associated with augmentation of Chaffey Dam.

High Security Water Demand

Modelling of the IQQM data was carried out to determine the likely frequency of water restrictions in Tamworth as an indicator of the reliability of Tamworth’s water supply (Figure 5-5). The modeling shows that the reliability of Tamworth’s water supply, as expressed by the frequency of water restrictions in Tamworth, is expected to decrease as population and demand for water grow.

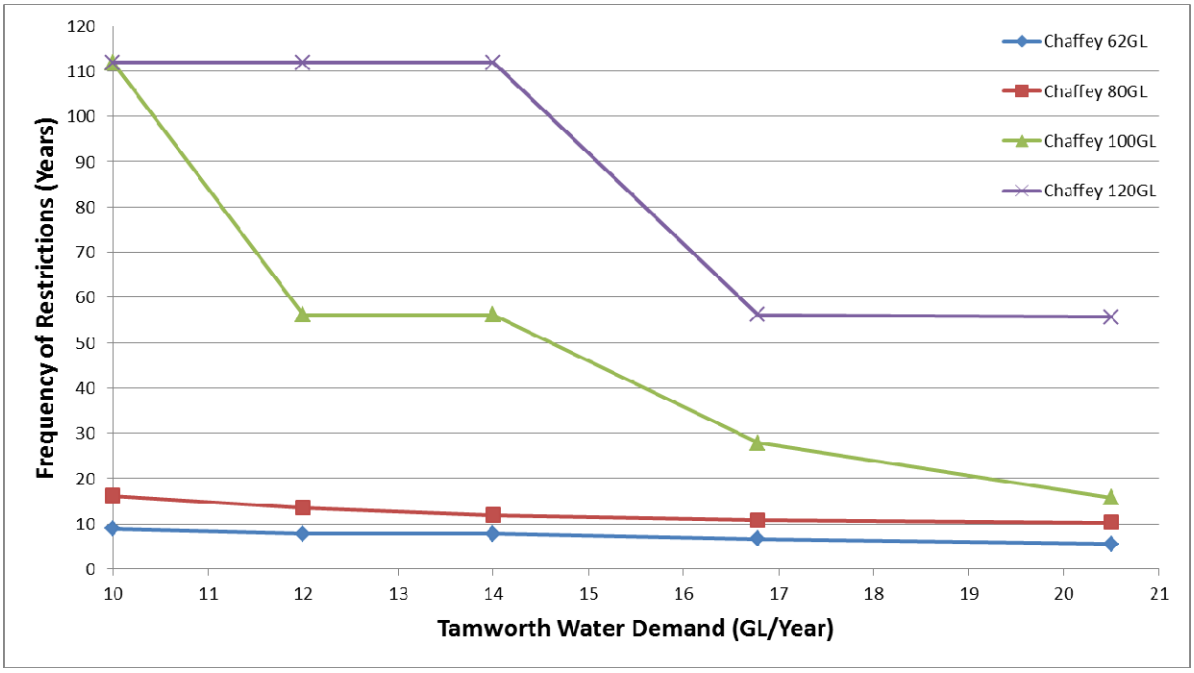

Figure 5-5: Frequency of restrictions (1 in X years) for Tamworth under base scenario (9 GL Tamworth allocation) and future demand scenario (13 GL Tamworth allocation)

Assuming an allocation from Chaffey Dam of 10 GL per year to Tamworth, modeling of the IQQM data shows that restrictions occur around once every nine years at the current capacity of Chaffey Dam. As the allocation of Tamworth town water from Chaffey Dam increases to the full entitlement of 16.4 GL per year, the frequency of restrictions increases to around once every six years if Chaffey Dam remains at its existing capacity of 62 GL.

Augmentation of Chaffey Dam to 80 GL shows a slight improvement in the frequency of water restrictions, with restrictions occurring around once every 15 years when the Tamworth allocation is 10 GL. This would then increase to once every 10 years at the full allocation entitlement.

Augmentation of Chaffey Dam to 100 GL improves reliability with restrictions occurring once every 110 years when allocations are at 10 GL per year. When allocations increase to Tamworth's full entitlement, restrictions occur around once every 35 years.

Where the Tamworth allocation is 10 GL, augmentation of Chaffey Dam to 120 GL improves reliability to the same extent as the 100 GL augmentation. When Tamworth's full entitlement is reached, restrictions occur once every 60 years.

At Tamworth demand levels of 14 GL/year or greater, an augmentation of Chaffey Dam to 100 GL delivers the greatest improvement in reliability of supply, as measured by the reduction in the frequency of restrictions.

GHD (2007a) assessed the augmentation options against the then defined standards of service for NSW town water supplies, as follows:

- Restrictions be imposed no more than 5% of the time (5% rule)
- Restrictions should be imposed no more frequently than every 10 years on average (10% rule)
- The Carryover Reserve should be able to supply restricted demand (equivalent to 20% less than normal demand) during the worst drought on record. This means that for Tamworth, the minimum volume in Chaffey dam should not fall below the Carryover Reserve (20 rule)

These standards are generally consistent with Tamworth Regional Council's current criteria for security of water supply and levels of service (refer Section 5.2.1).

The assessment showed that at the current capacity of Chaffey Dam (62 GL) restrictions occur around every nine years (i.e. 11% of the time) assuming an allocation of 10 GL per year to Tamworth. This does not meet the 5% rule or the 10% rule (Figure 5-5).

As shown in Table 5-7, the 5% rule, 10% rule and 20 rule can be met with an augmentation of Chaffey Dam to 80 GL, however, this does not allow for any contingencies such as climate change or the decommissioning of the Dungowan pipeline, which is subject to frequent failure due to age and poor construction (HWA 2011).

Augmentation of Chaffey Dam to 100 GL enables the 5% rule, 10% rule and 20 rule to be met, whilst also providing contingency for adverse climate change impacts and the decommissioning of the Dungowan pipeline (Table 5-7).

A summary of the required capacity of Chaffey Dam to meet increasing water supply demands is provided in Table 5-7.

Table 5-7: Minimum capacity of Chaffey Dam to meet 5% rule, 10% rule and 20 rule (adapted from GHD 2007a)

Tamworth Water Demand (GL/a)	Carryover Reserve (GL)	Required Capacity to Meet Rule			Notes
		5% Rule	10% Rule	20 Rule	
10	13	80 GL	80 GL	62 GL	Assuming no adverse climate change impacts and continued operation of the Dungowan pipeline
14	16.2	80 GL	80 GL	62 GL	
16.8	18.5	80 GL	80 GL	62 GL	
16.8	18.5	100 GL	100 GL	100 GL	Assuming adverse climate change impacts and no Dungowan pipeline
20.5	21.4	80 GL	80 GL	100 GL	Assuming no adverse climate change impacts and continued operation of the Dungowan pipeline

GHD (2007a) concluded that the augmentation of Chaffey Dam to a minimum of 80 GL is required to meet the supply criteria for Tamworth's water supply, regardless of the level of demand. If Tamworth water demand grows to 16.8 GL/a, and climate change results in a 10% reduction in inflows, then further augmentation is required. Decommissioning the Dungowan pipeline may also require the augmentation to be larger than anticipated without the decommissioning being considered.

Giving consideration to both climate change and decommissioning of the Dungowan Pipeline, an augmentation of Chaffey Dam to 100 GL is required (GHD 2007a).

General Security Water Demand

The demand for general security (irrigation) water in the Peel Valley is restricted by current water allocation rules under the Peel Valley Water Sharing Plan. The availability of allocated water from Chaffey Dam for general security (irrigation) water users is primarily affected by increases in Tamworth town water demand.

At the current capacity of Chaffey Dam (62 GL), GHD (2007a) demonstrated that the probability of an 80%+ allocation on 1 July is around 60%. As Tamworth town water demand increases to 12 GL per year, the probability of an 80%+ allocation on 1 July drops dramatically from about to 0% (Figure 5-6).

As shown in Figure 5-6, augmentation of Chaffey Dam to 80 GL delivers the largest improvement in the probability of an 80%+ allocation for irrigators on 1 July. Further augmentations deliver progressively smaller benefits in terms of increasing the probability of an 80%+ allocation.

When Tamworth water demand exceeds 14 GL/a an augmentation of Chaffey Dam beyond 80 GL in capacity is required to maintain the 70% probability of an 80%+ allocation on 1 July. Should adverse climate change occur, or Tamworth demand grow to above 16.8 GL/a, then augmentation of Chaffey Dam to 100 GL is required to maintain a minimum of a 70% probability of 80%+ allocation on 1 July (Figure 5-6) (GHD 2007a).

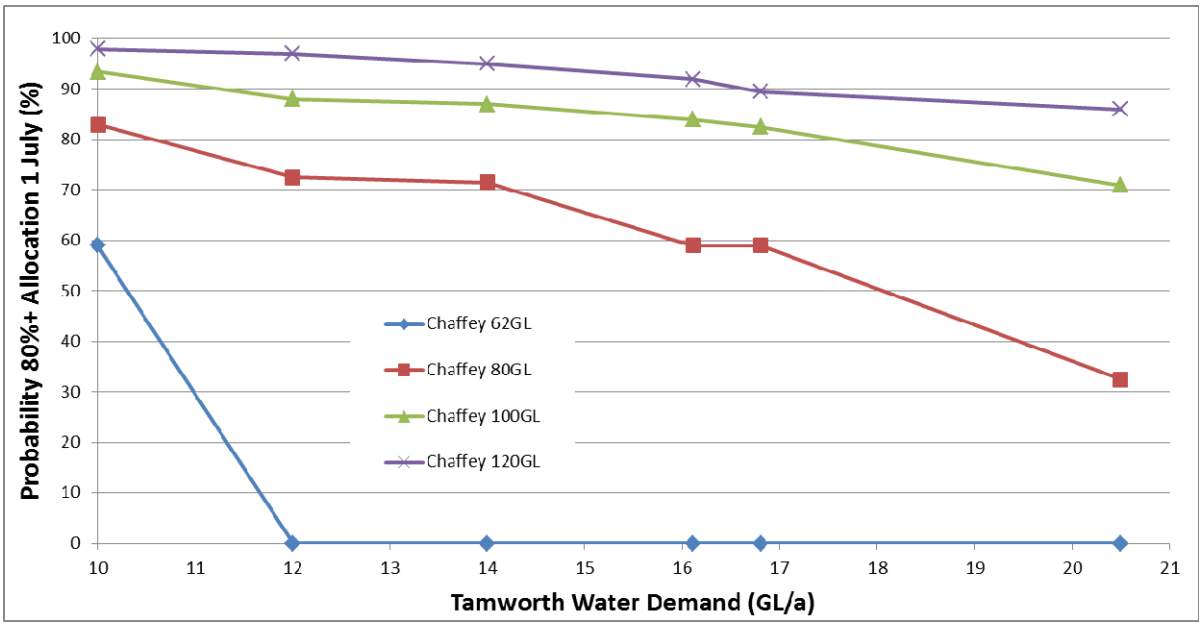

Figure 5-6: General security (irrigation) allocation and Tamworth town water supply demand

GHD (2007a) concluded that an augmentation of Chaffey Dam is required to meet the future needs of the Tamworth region. An augmentation of Chaffey Dam to at least 100 GL will be needed to meet the needs of Tamworth's water supply as well as maintaining irrigation allocations at or above minimum 70% probability of 80% irrigation allocation on 1 July if Tamworth water demand grows beyond 16.8 GL/a and a 10% reduction in inflows occurs as a result of climate change.

5.3.3 Environmental Assessment of Options

The key environmental impacts associated with the various options assessed for the Project relate to biodiversity. The "do nothing" option would not result in any direct impacts to biodiversity. However, if this option is selected, the risk of dam failure will remain at 1 in 470,000 (refer Section 5.1). If the dam were to fail, SKM (2000) found that there would be major impacts to the riverine environment and moderate impacts to heritage sites.

The option to carry out a safety upgrade only (with no augmentation) would require raising of the dam wall and reconfiguration of the existing auxiliary spillway. Conversely, the option to carry out augmentation only (no safety upgrade) would also require raising of the dam wall, reconfiguration of

the existing auxiliary spillway and raising of the existing morning glory spillway. Realignment of roads and bridges is expected to be required regardless of the level of augmentation.

The PMF is consistent between all options except the “do nothing” option. At present, the Chaffey Dam only has flood storage capacity up to the 1 in 470,000 AEP event.

Impacts associated with raising of the dam wall, reconfiguration of the existing auxiliary spillway and realignment of roads and bridges are considered to be consistent across all options. Further, no significant impacts associated with raising of the existing morning glory spillway have been identified. Consequently, impacts associated with raising of the dam wall (including potential impacts to the Border Thick-tailed Gecko), reconfiguration of the existing auxiliary spillway, realignment of roads and bridges and raising of the existing morning glory spillway are not considered further in this environmental assessment of options.

Impacts associated with inundation differ between the various capacity options considered. In addition to the “do nothing” option, as discussed above, augmentation options to 80 GL, 100 GL and 120 GL were considered by State Water. The FSL at each of these augmentation options is shown in Figure 5-7.

Figure 5-7: Comparison of augmentation options

An assessment of the ecological impacts of the various capacity options for the Project was carried out by nghenvironmental (Appendix 2). The proposed augmentation to 100 GL is expected to impact on approximately 1.6 km of Booroolong Frog habitat, with an average width of 14.5 m. This equates to an area of approximately 2.3 ha. In comparison, approximately 0.8 km, or 1.2 ha of Booroolong Frog habitat would be lost under the 80 GL capacity. A total of 2.2 km, or 3.2 ha of Booroolong Frog habitat on the Peel River would be lost under the 120 GL capacity (Table 5-8).

Augmentation to 100 GL, as proposed, is expected to result in the inundation of approximately 180 ha native and non-native vegetation. Comparatively, augmentation to 80 GL would result in the inundation of 67 ha of vegetation, while augmentation to 120 GL would result in the inundation of approximately 250 ha of vegetation, including native and exotic non-native vegetation (Table 5-8).

A summary of the augmentation capacity options and associated impacts is provided in Table 5-8.

Table 5-8: Comparison of biodiversity impacts for each augmentation option

Augmentation Option	Reservoir Surface Area	Height Above AHD (RL)	Booroolong Frog Habitat Inundated	Total Vegetation Inundated	Area of EEC Inundated	Area of CEEC Inundated
62 GL	542 ha	518.6 m AHD	0 ha	0 ha	0 ha	0 ha
80 GL	620 ha	521.9 m AHD	1.2 ha	67 ha	38 ha	1 ha
100 GL	727 ha	525.1 m AHD	2.3 ha	180 ha	117 ha	6 ha
120 GL	807 ha	527.3 m AHD	3.2 ha	249 ha	164 ha	10 ha

Although impacts to biodiversity increase with escalation of the augmentation capacity, the significance of these impacts does not change between the different options.

Consideration was also given to environmental costs and benefits in the socioeconomic assessment of options, as documented in Section 5.3.1.

5.3.4 Conclusion of Options Assessment

As described in Sections 5.3.1 to 5.3.3, numerous studies have been carried out to examine the potential safety upgrade and / or augmentation of Chaffey Dam. The outcomes of the socioeconomic evaluation show safety and augmentation options, along with augmentation only options, result in positive NPV and BCR greater than 1. The positive NPV and BCR greater than 1 indicate that there is

a potential for society to benefit if the augmentation was to proceed in addition to the dam safety requirement (Hassall & Associates Pty Ltd 2006).

For combined safety and augmentation, the three highest ranking options were those options with a storage capacity of 100 GL. Similarly, for augmentation only options, the three highest ranking options had a storage capacity of 100 GL (Hassall & Associates Pty Ltd 2006).

The supply demand assessment also demonstrated that, giving consideration to both climate change and potential decommissioning of the Dungowan Pipeline, an augmentation of Chaffey Dam to 100 GL is required (GHD 2007a). An augmentation of Chaffey Dam to at least 100 GL is required to meet the needs of Tamworth's water supply as well as maintaining irrigation allocations at or above minimum 70% probability of 80% irrigation allocation on 1 July if Tamworth water demand grows beyond 16.8 GL/a and a 10% reduction in inflows occurs as a result of climate change (GHD 2007a).

Although impacts to biodiversity increase with escalation of the augmentation capacity, the significance of these impacts does not change between the different options.

Having regard to the outlined socioeconomic, supply demand (high security and general security) and environmental issues, it is considered that a combined safety upgrade and augmentation of Chaffey Dam, incorporating augmentation to 100 GL is the preferred and justified option.

6 FURTHER ASSESSMENT OF POTENTIAL ENVIRONMENTAL IMPACTS

6.1 Soil and Water

The soil and water assessment remains as documented in the EIS, except for the following clarifications and additional requirements.

As described in Section 8.1 of the EIS, the groundwater sources in the Peel Valley include the Peel fractured rock aquifer and the Peel alluvial aquifer, which is associated with the main Peel River and its tributaries. The fractured rock aquifer is part of the much bigger fractured rock aquifer system of the New England Fold Belt. This system contains water of variable yield and quality, unlike the alluvial areas that have a more reliable yield and generally more consistent quality (NSW Office of Water 2010a).

Alluvial groundwater and surface water are intricately linked in the Peel Regulated River and some of its major unregulated tributaries. The Peel Regulated River loses water to the Peel alluvium along most of its length, although below Attunga at the bottom end of the valley, the river appears to gain water from alluvial aquifers. The general flow direction of groundwater is away from the Peel Regulated River and then down gradients parallel to the river (NSW Office of Water 2010a).

River cross sections showing groundwater levels recorded at NSW Office of Water groundwater monitoring bores in the Peel alluvial aquifer, as provided in NSW Office of Water (2010a) are shown at Appendix 4. There are no monitoring bores maintained by the NSW Office of Water in the Peel fractured rock aquifer.

Surface water flows from the upper south-eastern section of the Namoi River Catchment flow into the Peel River and into Chaffey Dam. The dam has an upstream catchment area of 420 km^2 with the headwaters draining rugged topography of the Great Dividing Range (GHD 2007b). Historical annual inflows to Chaffey Dam have been highly variable, as shown by the two year moving average (red line) in Figure 6-1.

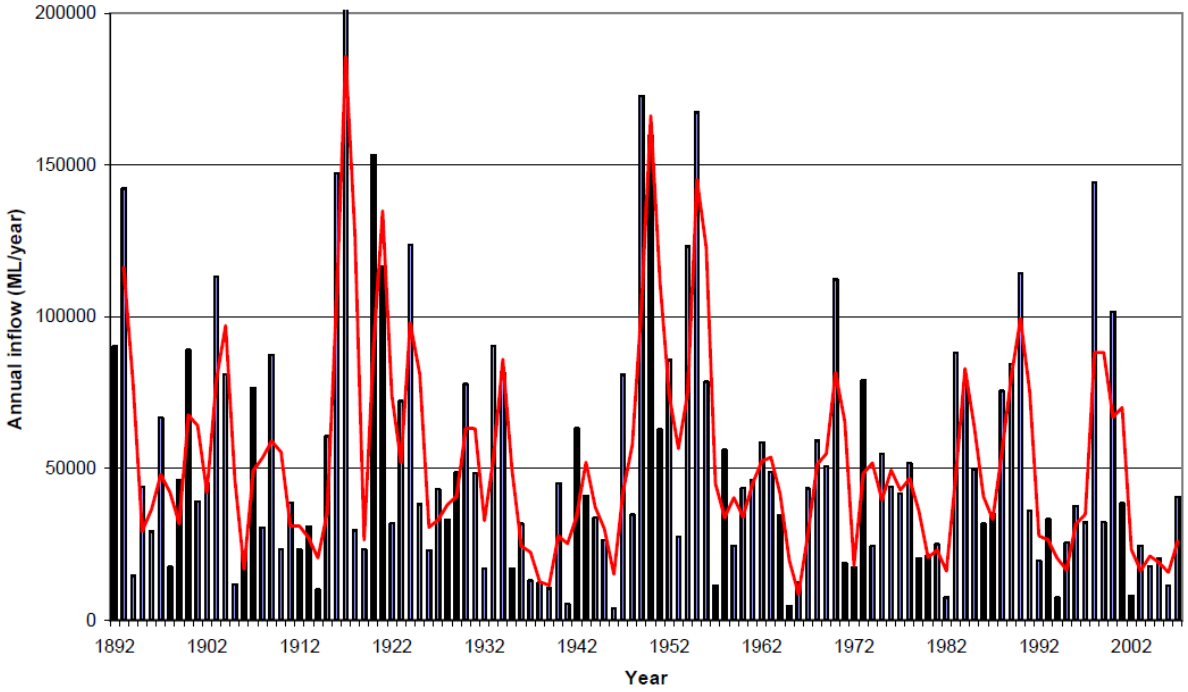

Figure 6-1: Annual inflows for Chaffey over period of record (NSW Office of Water 2010a)

The pattern of historical annual inflow to Chaffey Dam is reflected in the comparison between the recorded storage volume and the maximum capacity of the dam, as shown in Figure 6-2.

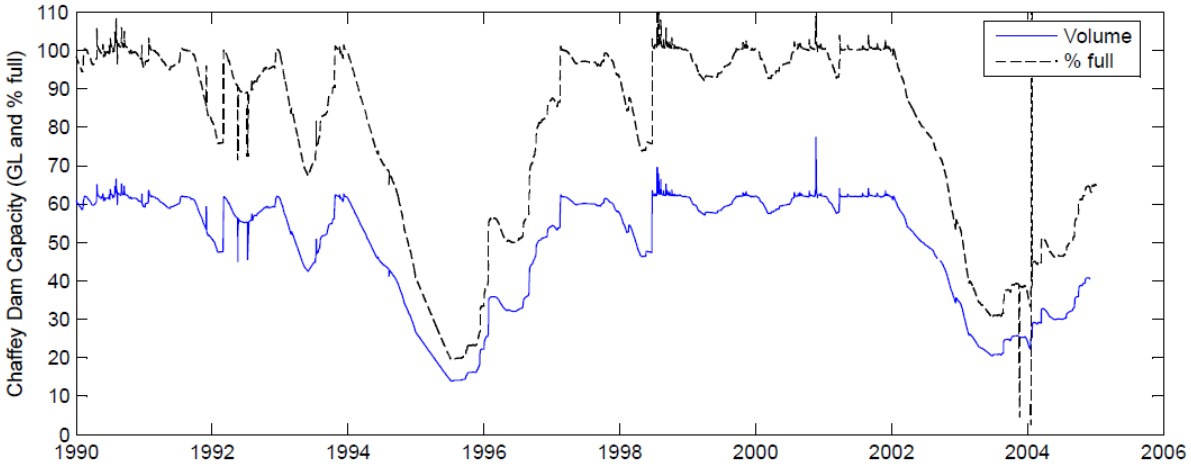

Figure 6-2: Storage volume of Chaffey Dam between 1990 and 2005 (MHL 2005)

This variability in annual inflow and subsequent storage volume is expected to continue following the augmentation of Chaffey Dam to 100 GL capacity, as shown through modelling of 100 year simulated storage volume data assuming an allocation of 11 GL for Tamworth town water supply (Figure 6-3).

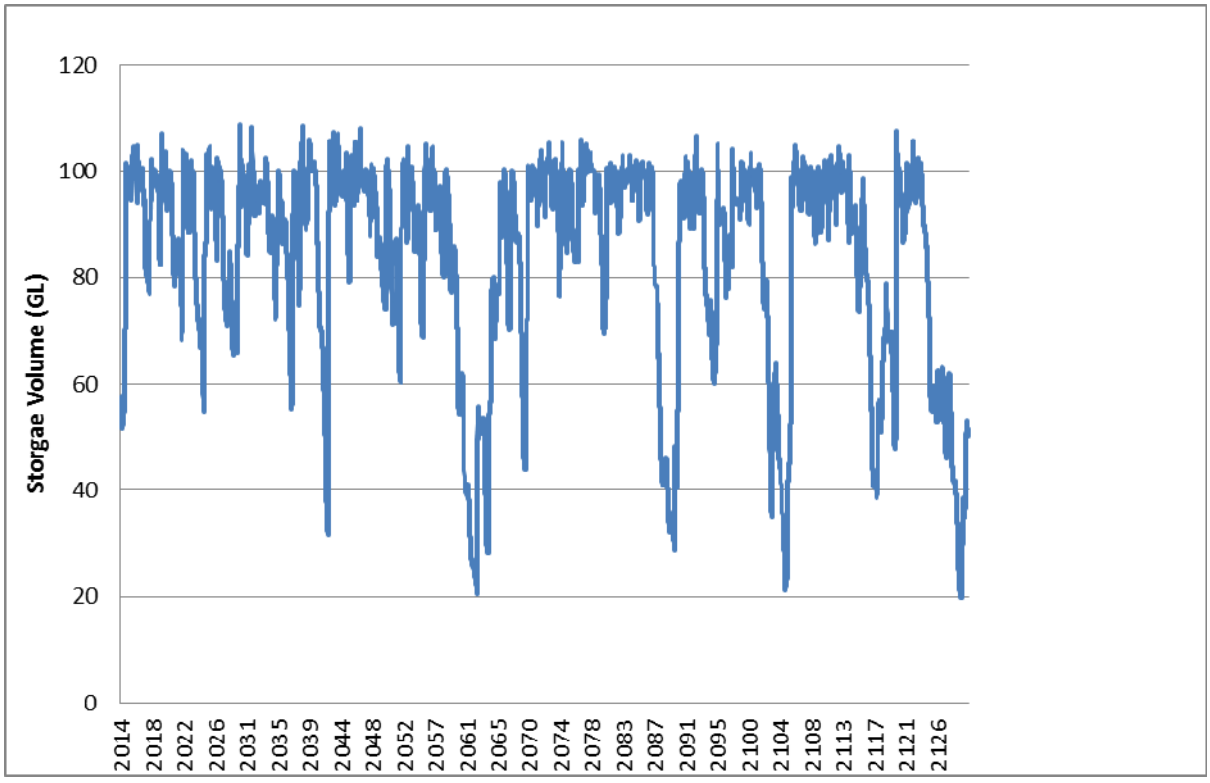

Figure 6-3: 100 year simulated storage volume of Chaffey Dam following augmentation to 100 GL

The average storage volume of Chaffey Dam by month following augmentation was determined, based on 100 year simulated capacity data (assuming an allocation of 11 GL for Tamworth town water supply) (Figure 6-4). Seasonal changes in the storage volume of Chaffey Dam are shown, with lower volumes during autumn and winter and higher volumes during spring and summer.

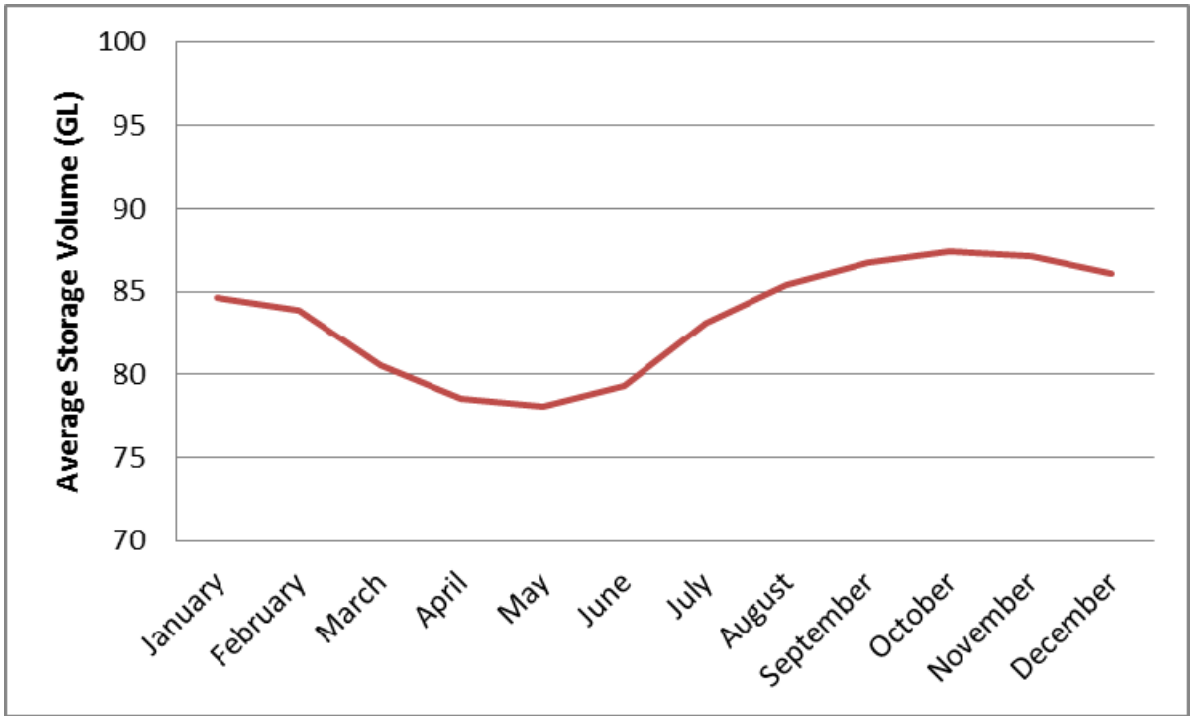

Figure 6-4: Modelled average monthly capacity of Chaffey Dam following augmentation to 100 GL

An analysis of historic physical water quality records at a site upstream and two sites downstream of Chaffey Dam was carried out by GHD (2008) and is summarised below. Water temperature (T), electrical conductivity (EC), turbidity and pH data recorded between 1988 and 2008 is provided in Figure 6-5 and Figure 6-6. The Australian and New Zealand Environment and Conservation Council and Agriculture and Resource Management Council of Australia and New Zealand (ANZECC & ARMCANZ) (2000) guidelines for EC, turbidity and pH are also illustrated in these figures (dashed black line).

This data was recorded at the following stations:

- U/S Dam - Bowling Point Alley station upstream of Chaffey Dam (State Station: 419004)
- D/S Dam - Immediately downstream of Chaffey Dam (State Station: 419045)
- Tamworth - Paradise Weir upstream of Tamworth (State Station: 419081)

Temperature was found to be strongly seasonal, with winter minimums of 8°C to 12°C and summer maximums of 25°C to 30°C. Generally upstream temperatures tend to be substantially greater than those near Tamworth. It is noted that temperature data is predominantly from the Tamworth station.

Upstream EC is generally greater than Tamworth. In contrast, the station immediately downstream of Chaffey Dam generally has lower conductivity than both the upstream and Tamworth stations.

Further, the station immediately downstream of Chaffey Dam has very consistent EC just above the upper ANZECC & ARMCANZ (2000) trigger value for upland river systems of the region (350 µS/cm). The other two stations were generally well above this guideline during the 20 year review period.

Seasonal trends at the upstream and Tamworth stations suggest higher autumn EC and lower levels during spring. An inter-annual trend of decreasing conductivity is suggested by the data at both the upstream and Tamworth stations.

Generally turbidity is greater at the Tamworth station than the other two stations. In particular, sedimentation of particles in Chaffey Dam results in generally relatively low turbidity at the station immediately downstream. Generally, turbidity levels were below the upper ANZECC & ARMCANZ (2000) trigger value for upland river systems of the region of 25 NTU. Seasonality of the turbidity measurements was not strong. An inter-annual trend of decreasing turbidity is suggested by the data.

The upper and lower ANZECC & ARMCANZ (2000) pH trigger values for upland river systems are 8.0 and 6.5, respectively. In general the three stations had pH generally greater than the upper guideline, which indicates the system is relatively alkaline.

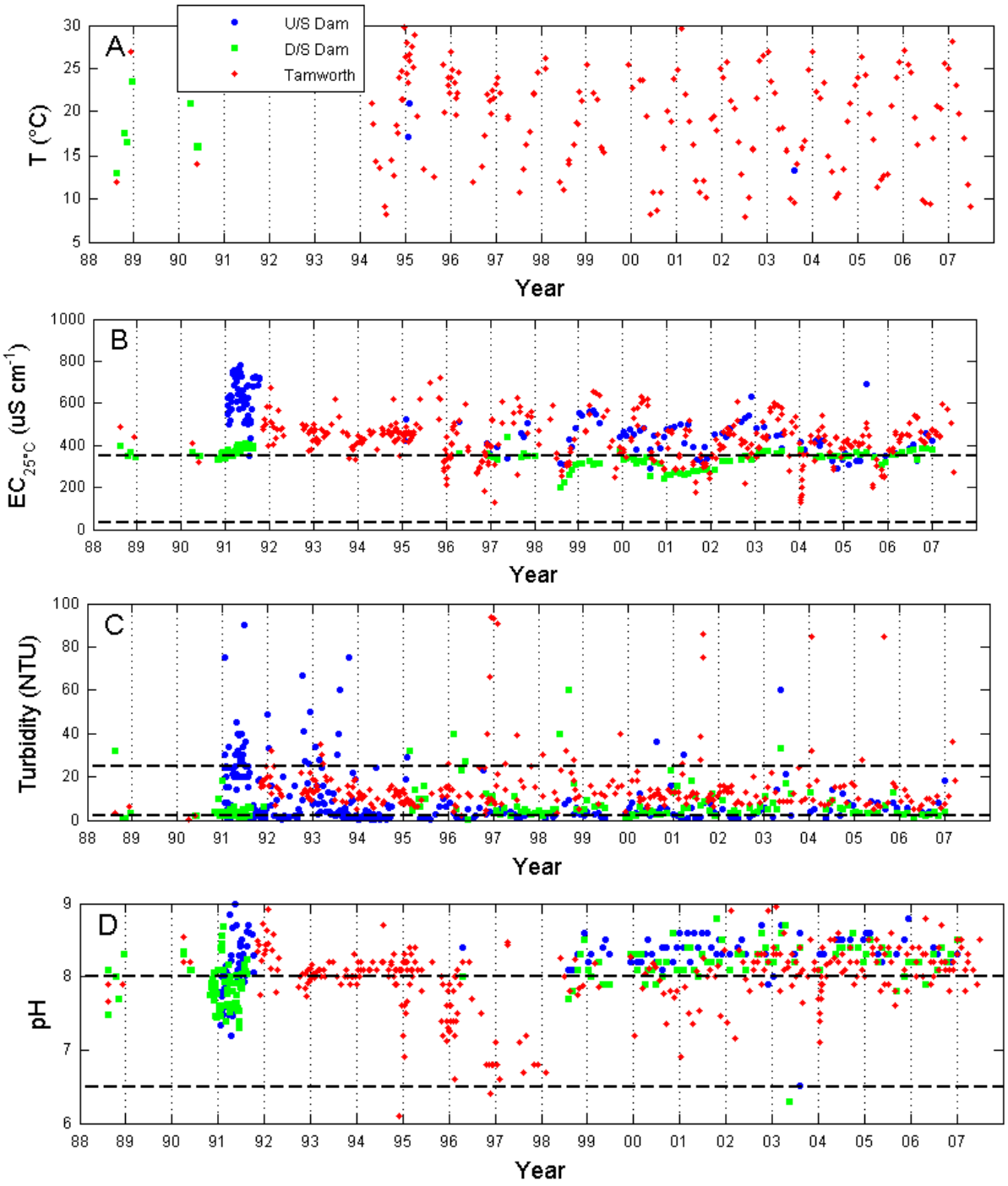

Figure 6-5: Annual time series of physical water quality parameters (T, EC, turbidity and pH) recorded upstream and downstream of Chaffey Dam on the Peel River

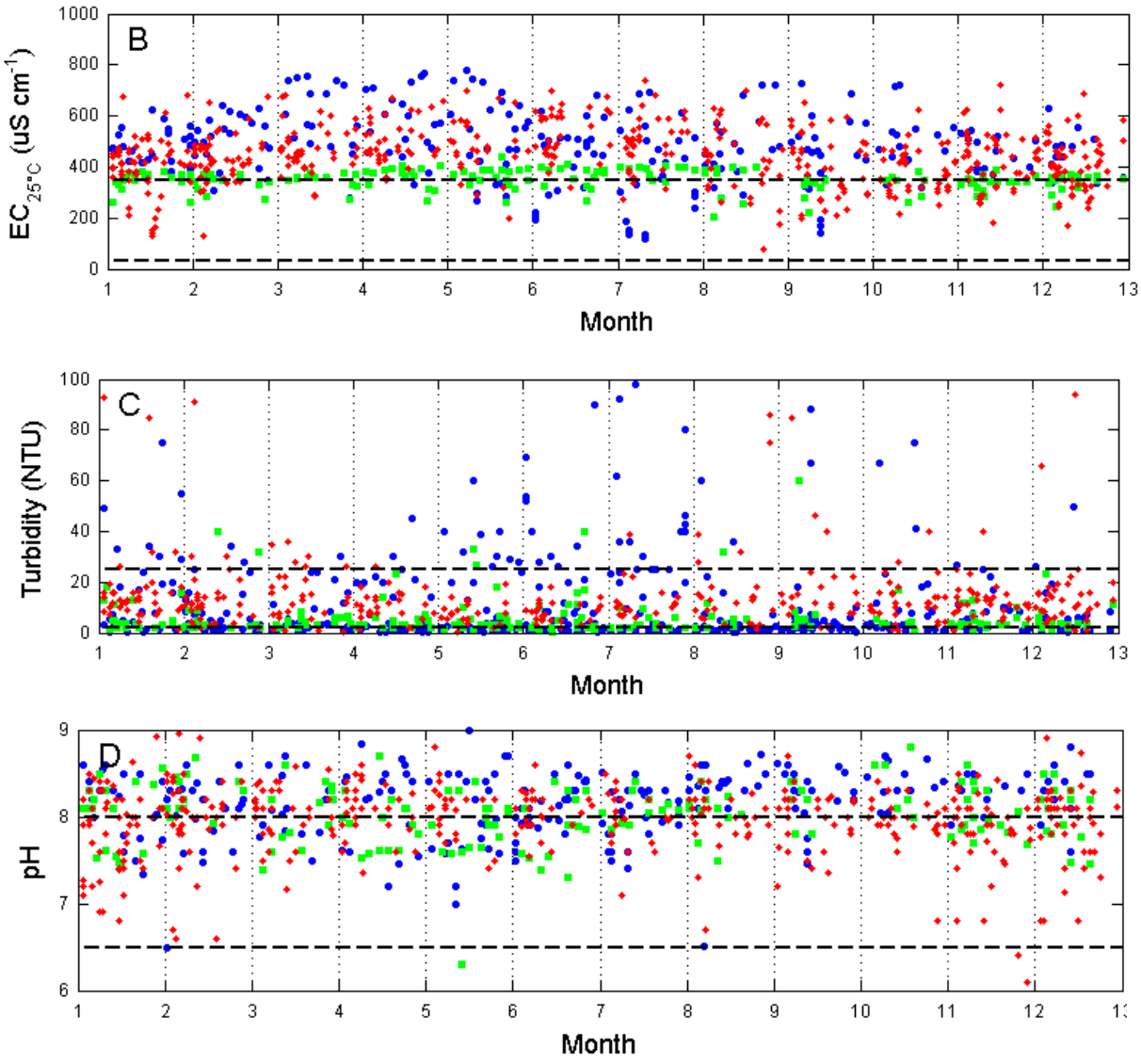

Figure 6-6: Monthly time series of physical water quality parameters (T, EC, turbidity and pH) recorded upstream and downstream of Chaffey Dam on the Peel River

Nutrient and iron data measurements for 1988 to 2007 from the three monitoring stations on the Peel River (refer above) are shown in Figure 6-7 and Figure 6-8. The figures provide temporal and seasonal presentation of total nitrogen (TN), total Kjeldahl nitrogen (TKN), ammoniacal nitrogen (NHX), total phosphorous (TP) and total iron (Fe).

ANZECC & ARMCANZ (2000) trigger values for the protection of river ecosystems for the region are shown to assess the water quality with the exception of TKN, which does not have guidelines and Fe,

which was compared to the ANZECC & ARMCANZ (2000) recreational guideline values. Because of the large range and relatively high number of outliers, GHD (2008) presented each figure with two ranges. The left panels provide the overall range of measurements, whereas the right panels illustrate a decreased range to highlight potential spatial and temporal patterns in the nutrient and iron data.

The ANZECC & ARMCANZ (2000) trigger value for TN in the upland river systems of NSW (0.25 mg/L) is generally met by the station upstream of dam (median = 0.2 mg/L), whereas the median value at Tamworth station (0.35 mg/L) is greater than the guideline value, but not excessively so. The median TN value immediately downstream of Chaffey Dam (0.55 mg/L) also exceeds the guideline. No distinct seasonal trends are clear over the monitoring period, however several periods (1995 to 1996 and 2003 to 2004) show elevated levels downstream of Chaffey Dam.

TKN data were available for the upstream and Tamworth stations, but not the station immediately downstream of Chaffey Dam. In general, the data indicate that TKN is generally low and comprised primarily of ammoniacal nitrogen (NH_X, see below) with relatively low amounts of organic nitrogen.

Relatively few measurements were available for the station upstream of the dam, however the measurements from 1978 to 1981 (shown on seasonal plots only) show that the median NH_X value (0.028 mg/L) was not excessively above the ANZECC & ARMCANZ (2000) guideline of 0.013 mg/L. Similarly NH_X at Tamworth tended to be lower than the upstream station (median = 0.02 mg/L). However, the measurements immediately downstream of Chaffey Dam were generally the greatest (median=0.045 mg/L). No clear seasonal trends were evident and the temporal record was not of sufficient duration (primarily 1991 to 1995) to draw conclusions regarding trends.

In general, TP levels are comparable across the three stations but generally exceed the ANZECC & ARMCANZ (2000) trigger value of 0.02 mg/L. The Tamworth station generally has the lowest median TP levels (0.04 mg/L), although the station upstream of Chaffey Dam has a similar median (0.045 mg/L). The highest levels generally occur immediately downstream of Chaffey Dam (median=0.055 mg/L). A weak seasonal trend is suggested from the data at the station immediately downstream of Chaffey Dam, with higher summer and autumn levels. Long term trends are not obvious from the available data.

Fe levels had considerable scatter and fluctuated above and below the ANZECC & ARMCANZ (2000) recreational guideline of 0.3 mg/L, but medians of all stations are below this trigger level. The highest median level generally occurs at the station upstream of Chaffey Dam (0.155 mg/L), though the station immediately downstream of the reservoir tended to have continuously higher levels (median = 0.24 mg/L). Generally, the Fe levels at the Tamworth station are lower than the other two stations (median=0.13 mg/L) though considerably fewer measurements were available at this site.

The only relatively clear seasonal trend was an increase in Fe levels immediately downstream of the reservoir during the summer and autumn. Long term Fe trends were not readily detectable from the available data.

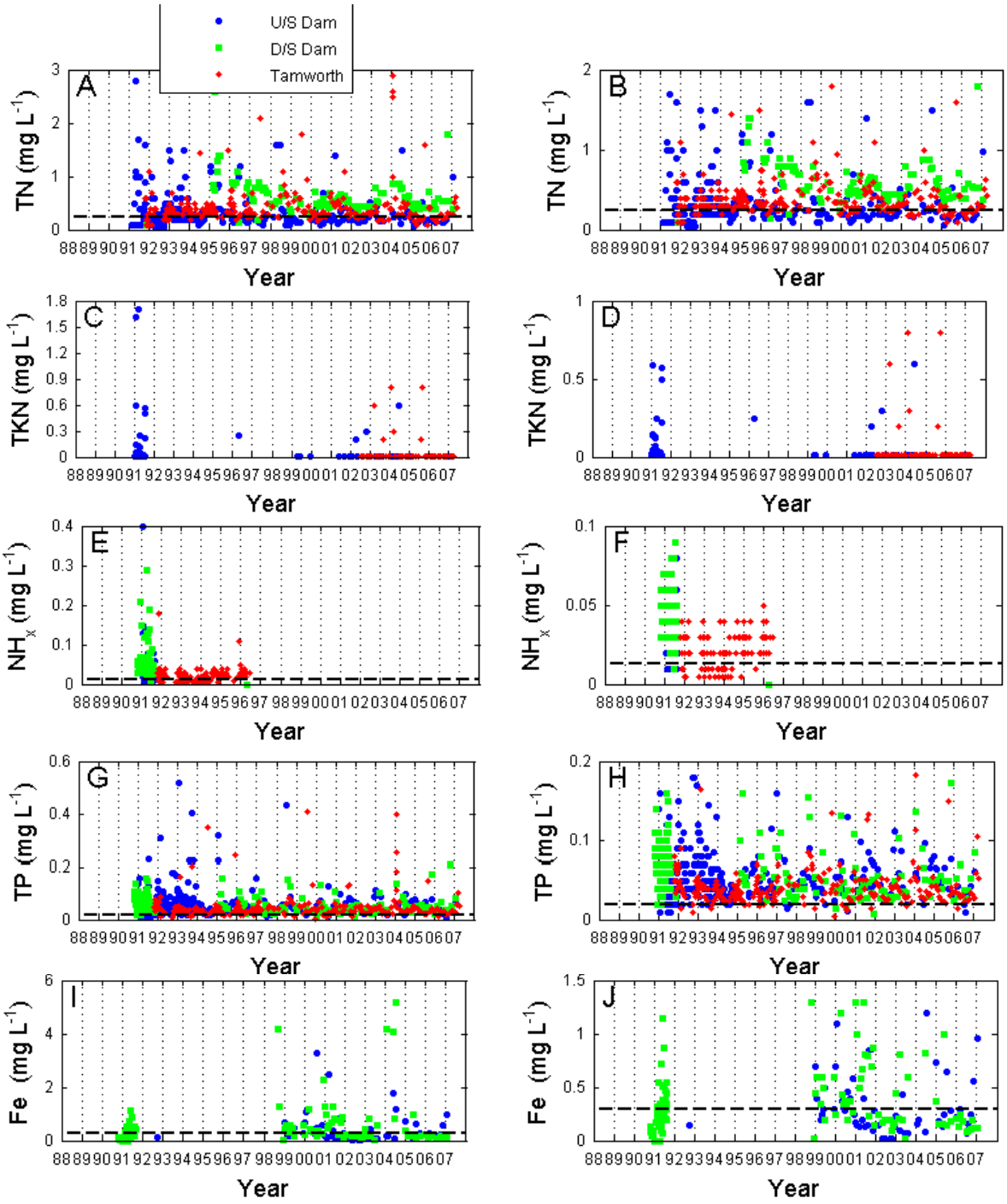

Figure 6-7: Annual nutrient (TN, TKN, NH_X, TP) and total iron (Fe) water quality parameters upstream, immediately downstream of Chaffey Dam and at Tamworth stations on the Peel River

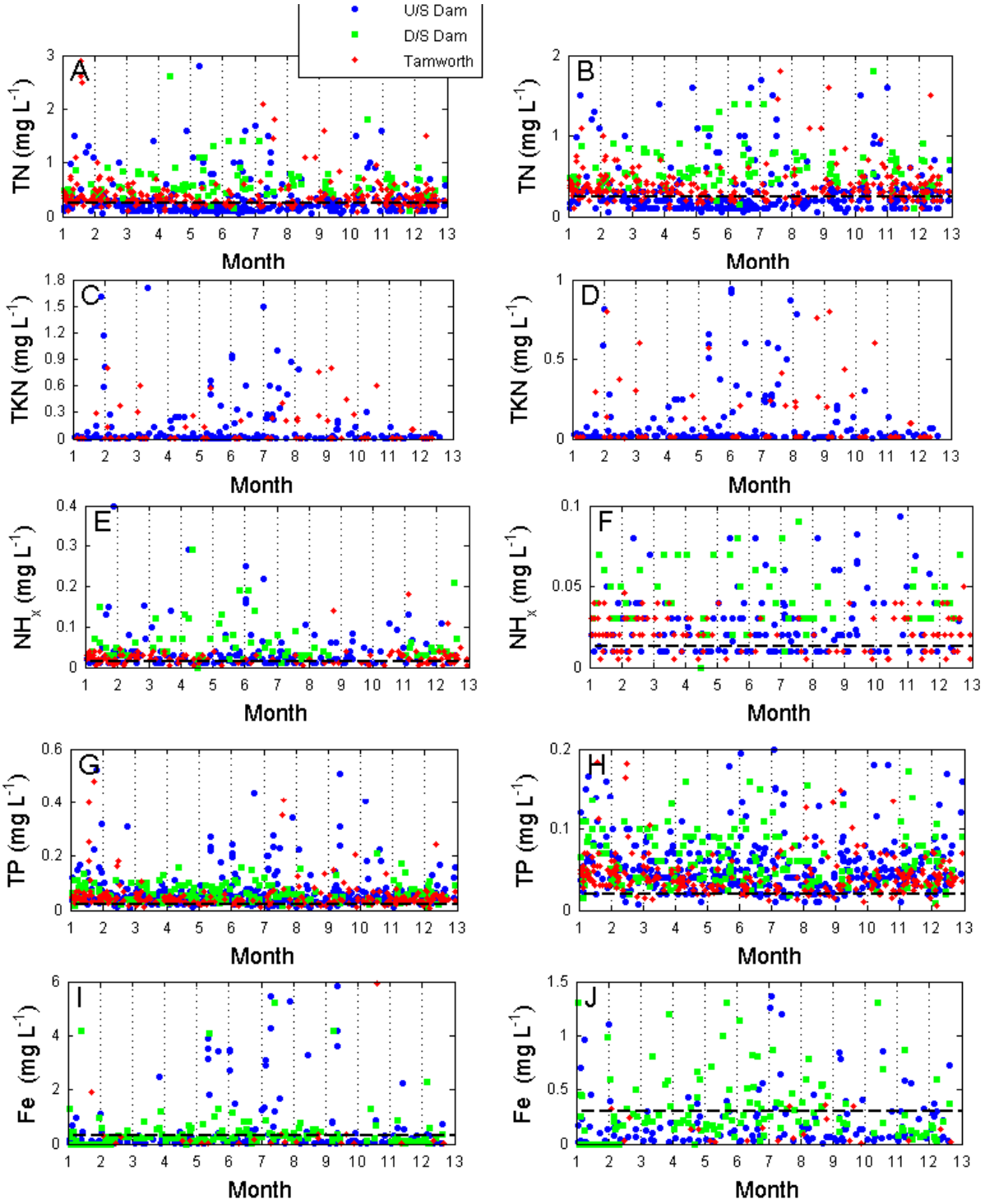

Figure 6-8: Monthly nutrient (TN, TKN, NH_X, TP) and total iron (Fe) water quality parameters upstream, immediately downstream of Chaffey Dam and at Tamworth stations on the Peel River

Water quality impacts associated with construction and operation of the Project are detailed in Section 8.1 of the EIS.

The EIS erroneously stated on page 106 that inundation to the new FSL would result in a decrease in aquatic stream environment of 1.2 km. The remainder of the EIS referred to inundation of 1.7 km of stream environment. This measurement has since been refined to 1.6 km. As such, inundation will result in a decrease in the aquatic stream environment of 1.6 km. It is understood that the pool and riffle sequence continues upstream of the existing FSL at a similar gradient for approximately 12 km. The Project will effectively reduce the length of this stream environment by about 13%, not 10% as described on Page 106 of the EIS.

A detailed description of the water planning and allocation framework, including release strategies, for Chaffey Dam is provided in Section 4.8, 4.9 and 4.10 of the EIS. These sections discuss the key plans relevant to Chaffey Dam: the Peel Valley Water Sharing Plan (including environmental releases, entitlement and use); the Namoi Regulated Water Sharing Plan and the Namoi Catchment Action Plan, as summarised below:

- The Peel Valley Water Sharing Plan (NSW Government 2010) was developed by the NSW Office of Water following extensive environmental, social and economic assessment.
- The Peel Valley Water Sharing Plan commenced in July 2010 following approval by the NSW Minister for Primary Industries in accordance with the Water Management Act 2000.
- The *'Chaffey Water Source'* is listed as being part of the Peel Unregulated Water Sources under the Peel Valley Water Sharing Plan.
- The Peel Valley Water Sharing Plan specifies the water sharing provisions for Chaffey Dam, including environmental water rules, allocation of water to satisfy basic landholder rights, water extraction under access licences and bulk access regimes. The plan is consistent with and contributes to the Namoi Catchment Action Plan.
- The Peel Valley Water Sharing Plan is linked to the Water Sharing Plan for the Upper Namoi and Lower Namoi Regulated River Water Sources 2003 (Namoi Water Sharing Plan) (NSW Government 2003) through rules that are targeted toward managing projected growth in the town water supply demand for Tamworth and rules aimed at managing the trading of water access entitlements and account water. The provisions of the Peel Valley Water Sharing Plan are required to be consistent with those in the Namoi Water Sharing Plan.
- The Peel Valley Water Sharing Plan and the Namoi Water Sharing Plan are subject to and consistent with the MDBMC Cap Agreement. The objective of the MDBMC Cap Agreement, made between NSW, Victoria, South Australia and the ACT, is to manage the extraction from surface waters within the Murray-Darling Basin to '*the volume that would have occurred under 1993/4 levels of development and management*' (NSW Office of Water 2010b).

- The Peel Valley Water Sharing Plan demonstrates 'no growth' beyond that limited by the current MDBMC Cap Agreement, providing detailed rules to ensure that extractions remain within the long-term average annual extraction limit (LTAAEL). The LTAAEL is a fixed value determined from historical levels of water use, implemented to protect water for the environment and the supply to existing users.
- The augmentation of Chaffey Dam to 100 GL was considered during the planning process for the Peel Valley Water Sharing Plan and all management changes under an augmented dam, including planned environmental water, are either explicitly written into the Peel Valley Water Sharing Plan or provided for through amendment clauses.
- The Peel Valley Water Sharing Plan demonstrates that an enlarged Chaffey Dam will not result in a growth in extractions (NSW Office of Water 2010a).
- As the impacts of management changes required by the Peel Valley Water Sharing Plan following augmentation of Chaffey Dam have been assessed (including public consultation) and approved, these impacts were not considered further in the EIS.
- The use of water from Chaffey Dam will continue to be managed in accordance with the approved Peel Valley Water Sharing Plan following implementation of the Project.

As noted in Section 4.8 of the EIS, the Peel Valley Water Sharing Plan commenced in July 2010 following approval by the NSW Minister for Primary Industries in accordance with the *Water Management Act 2000*.

The Peel Valley Water Sharing Plan was developed by the NSW Office of Water following extensive environmental, social and economic assessment. The augmentation of Chaffey Dam to 100 GL was considered during the planning process for the Peel Valley Water Sharing Plan and is specifically referred to in the approved plan.

The background document to the Peel Valley Water Sharing Plan (NSW Office of Water 2010a) states all management changes following augmentation of Chaffey Dam to 100 GL are either explicitly written into the Peel Valley Water Sharing Plan or provided for through amendment clauses.

The Peel Valley Water Sharing Plan demonstrates that an enlarged Chaffey Dam will not result in a growth in extractions. The plan demonstrates 'no growth' beyond that limited by the current Murray-Darling Basin Ministerial Council (MDBMC) Cap Agreement. The plan also provides detailed rules to ensure that extractions remain within the long-term average annual extraction limit (LTAAEL) (NSW Office of Water 2010a).

The comments made on "Growth in Use" in Appendix B to the DPI Submission are noted. However, as documented in Section 4.8.4 of the EIS, the impacts of management changes required by the Peel Valley Water Sharing Plan following augmentation of Chaffey Dam have been assessed (including public consultation) and approved through the Peel Valley Water Sharing Plan. Consequently, these impacts were not considered further in the EIS and are not considered further in the PIR.

The use of water from Chaffey Dam will continue to be managed in accordance with the approved Peel Valley Water Sharing Plan following implementation of the Project.

As noted in the EIS, the provision of environmental water releases from Chaffey Dam will change following augmentation, in accordance with the Peel Valley Water Sharing Plan. Following augmentation of Chaffey Dam to 100 GL, Clause 31(2) of the Peel Valley Water Sharing Plan requires the implementation of an environmental contingency allowance (ECA) of 5,000 ML, which may be released over any period of time at the discretion of the NSW Environmental Water Manager.

The background document to the Peel Valley Water Sharing Plan (NSW Office of Water 2010a) states that although the magnitude, timing and duration of environmental releases after augmentation is not prescribed, the ECA is likely to be used as a stimulus flow over seven days with a peak on day 2 of 1,200 ML/day.

OEH, in its submission, requested that any stimulus flows, unless advised otherwise by the NSW Environmental Water Manager, should be released to reflect the natural rates of the rise and fall for the Peel River system.

State Water has operates Chaffey Dam in accordance with the Peel Valley Water Sharing Plan rules and has so far managed three stimulus flow events. They were in April 2011, May 2012 and March 2013. Stimulus releases have been undertaken in accordance with the release rates agreed with the NSW Office of Water and have been reported in the Annual Compliance Report for Water Supply Works Approval, Peel Regulated River Water Source. State Water will continue to manage future stimulus releases in accordance with the Peel Valley Water Sharing Plan conditions.

As described in Section 8.1.2 of the EIS, lowering of the reservoir storage level by 2 m may be required during construction works associated with raising the morning glory spillway from 518.6 m AHD to 516.6 m AHD. Such a drawdown will only be required if the storage level is at or within 2 m of the existing FSL during the period of construction works to the morning glory spillway. If the reservoir level is at or below 516.6 m AHD, no drawdown will be required.

If drawdown is required, this will reduce the storage volume of Chaffey Dam by 11 GL to a minimum of 51 GL (82% capacity). The drawdown, if required, will be maintained for a maximum period of six months. During this period, inflows and downstream demand will be managed by operating the valves within the morning glory structure to ensure the required flows are maintained.

Water restrictions are implemented in Tamworth when Chaffey Dam reaches 50% capacity. The proposed drawdown will enable a buffer of 32%, or 20 GL in capacity prior to water restrictions being required.

Based on the Project program, raising of the morning glory spillway is not expected to commence before early to mid 2014. Start of this work will also depend on the storage behaviour at the time and the contractor's assessment of the weather forecast for the period of construction.

State Water has investigated alternatives to draw down of the storage including:

- Deferring works until the storage is low enough for works to commence
- Construction of a coffer dam

The morning glory spillway remains the primary spillway for any spills for flood events up to an annual exceedence probability (AEP) of 1 in 10,000. The construction of the raised bell mouth requires work below the current full supply level. In the event the dam is at full capacity this construction cannot commence.

Due to the timeframe in which the funds have been allocated by the Federal and NSW Governments, the construction must be completed by end of June 2015 and does not allow programming the construction work in a dry season when the storage maybe below full supply.

The cost of a coffer dam would increase the construction cost considerably and would require lowering of the storage level for safe installation.

DPI's submission of 28 February 2013 raised concern that the potential 2 m drawdown may trigger compensation under the Peel Water Sharing Plan. The comments made by DPI on "Construction Phase Water Allocation Impacts" in Appendix B to the DPI are summarised below:

- It is recommended that further information regarding the risk to users as well as detailed consultation with water users within the Peel System be undertaken prior to commencement of the part of the project potentially requiring drawdown of the reservoir
- It is recommended that alternatives to requiring a two metre drawdown, including engineering solutions, such as a coffer dam around the spillway, and reducing the drawdown (and hence time to prepare in the event of a significant rainfall event) be considered
- Consideration should be given to requiring a bond to cover the likelihood of any compensation claims

On 21 November 2012, State Water sought formal approval from the NSW Commissioner for Water, NSW Office of Water, to maintain a temporary FSL 2 m below the current FSL for a period of six months, from May 2014 onwards. A copy of this letter is included at Appendix 3.

State Water is awaiting a response from NSW Office of Water and will provide necessary information and undertake consultation with water users to enable lowering of the storage level by 2 m.

Consultation by State Water with Tamworth Regional Council on the feasibility of this proposal has delivered a positive response. At the Tamworth Regional Council Ordinary Meeting on 11 December 2012, in relation to matter 399/12 (iii), Tamworth Regional Council resolved:

> *"Concur with the lowering of the storage level, if and when required, during the construction of the new morning glory spillway".*

As the approval for the potential 2 m drawdown is not sought under this Project but through a separate request to the NSW Commissioner for Water, it is considered that any recommended conditions of approval related to the drawdown of the dam be applied to that application. State Water is continuing to carry out consultation with the NSW Office of Water in regard to the potential requirement for drawdown.

As documented in Section 8.1.1 of the EIS, State Water currently implements the Chaffey Dam – Variable Offtake Management Protocol for dam safety, water delivery, algal management and cold water pollution.

Required offtake levels and operational protocols are prescribed for various temperature and algae levels. Corrective actions, including an increase in monitoring frequency, the implementation of downstream monitoring and changes to offtake levels and operational protocols, are set out in the Protocol and implemented in response to the results of regular temperature and algal monitoring.

As documented in Section 8.3.4 of the EIS, State Water has committed to the review and revision (as relevant) of the existing Chaffey Dam – Variable Offtake Management Protocol, with the aim of avoiding or minimising cold water pollution. The Protocol will also be reviewed and revised (as relevant) to ensure the sampling program for algal blooms is suitable to the augmented storage volume and that any required changes to offtake levels and operational protocols are implemented to ensure appropriate downstream algal management.

The mitigation measures proposed in the EIS to minimise impacts to soil and water from the Project included the development and implementation of a Sediment and Erosion Control Plan and the review and revision (as relevant) of the Foreshore Management Plan for Chaffey Dam (Report for Site Specific Action Plans Chaffey, GHD 2010). In response to the Namoi CMA Submission, Namoi CMA will be consulted during the preparation of the Sediment and Erosion Control Plan and during the revision of the Foreshore Management Plan.

6.2 Biodiversity

The EIS provided an assessment of Project impacts to biodiversity, which was based on existing literature and survey results available at the time. A Terrestrial and Aquatic Flora and Fauna Impact Assessment was provided at Appendix 8 to the EIS. Since completion of the EIS, further biodiversity surveys have been carried out and the impact assessment revised accordingly.

An Addendum Report - Terrestrial and Aquatic Flora and Fauna Impact Assessment has been prepared to address the additional survey requirements and State and Commonwealth assessment provisions identified in the EIS, as well as to respond to the submissions received from Agencies during the public exhibition of the EIS. The Addendum Report is provided at Appendix 2. The key outcomes of the Addendum Report are summarised here.

As documented in the EIS, a number of management plans relevant to biodiversity will be developed and implemented for the Project, as follows:

- Construction Environmental Management Plan (CEMP)
- Booroolong Frog Management Plan[3]
- Border Thick-tailed Gecko Management Plan[3]
- Vegetation Management Plan[3]
- Water Release Management Plan
- Environmental Contingency Allowance (ECA) Operating Protocol
- Chaffey Dam Variable Offtake Management Protocol (review of existing plan and revision as required)

As requested in the Namoi CMA Submission, Namoi CMA will be consulted during the preparation of the CEMP, Biodiversity Management Plan including the Booroolong Frog Management Plan and the Vegetation Management Plan.

As requested in the DPI Submission, Fisheries NSW will be consulted during the development of the CEMP, Water Release Management Plan and the ECA Operating Protocol.

As requested in the DPI Submission, Fisheries NSW will be consulted during the review of the Chaffey Dam Variable Offtake Management Protocol.

The EIS provided a recommendation that the riparian zone of the Peel River should be replanted, using natives species of local provenance, at the new FSL along upstream waterways for a minimum of 10 m from the new FSL and along the shoreline of the reservoir where practicable, particularly in areas identified as having a high risk of erosion. As noted in the DPI Submission, it is also recommended that stock are present, riparian plantings be protected by fencing.

Large woody debris within rivers and riparian zones provides important habitat and shelter for native fish. The removal of large woody debris adversely has the potential affect fauna species. As described in the EIS, the removal of woody debris will be avoided wherever practicable during implementation of the Project. Where woody debris is required to be removed, Fisheries NSW will be notified a minimum of three days prior to removal of any large woody debris.

The proposed waterway crossing designs at Bowling Alley Point Bridge, Hydes Creek Bridge and Silver Gully are consistent with the existing structures at these locations. However as requested in the DPI Submission, these waterway crossing designs will be provided to Fisheries NSW for comment.

[3] Specific management plans may be combined into a single Biodiversity Management Plan for ease of implementation

6.2.1 Threatened Flora Species

As documented in the Terrestrial and Aquatic Flora and Fauna Impact Assessment, a number of threatened flora species have previously been recorded within 10 km of the Project Site (OEH Wildlife Atlas and EPBC Protected Matters Search). The presence of potential habitat and the likelihood of occurrence of each species within the Project Site were assessed in the Terrestrial and Aquatic Flora and Fauna Impact Assessment, provided at Appendix 8 to the EIS. The potential for the Project to impact on each of these species was also assessed.

The location of threatened species registered on the OEH Wildlife Atlas within 10 km of the Project Site is shown in Figure 6-11. The EPBC Protected Matters Search does not provide the location of threatened species previously recorded or likely to occur within 10 km of the Project Site.

The assessment concluded that suitable habitat was potentially present for six of these species, including Queensland Bluegrass (*Dichanthium setosum*), *Eucalyptus rubida* subsp. *barbigerorum*, *Thesium austral*, *Bothriochloa biloba*, Small Snake Orchid (*Diuris pedunculata*) and *Euphrasia arguta*.

Queensland Bluegrass is discussed further in Section 6.2.2.

Eucalyptus rubida subsp. *barbigerorum* is a large tree to 40 m tall and therefore a highly conspicuous species that may be detected at any time of year. Targeted surveys for this species were not carried out, as this species would have been recorded during vegetation and habitat surveys carried out across the Project Site.

There were no records for *Thesium austral* in the vicinity of the areas to be impacted by the Project. The nearest record of the species is approximately 50 km north-east of the site. Potential habitat for this species was present at the site in localised areas and was not of high quality. The timing and location of other targeted flora surveys carried out at the site in October 2012 would have been suitable for detecting this species. This species was not recorded at the Project Site during spring and summer and is considered unlikely to occur at the site.

Heavier soils with which *Bothriochloa biloba* is associated were present at the site however, the preferred habitat of brown or black clays were not present. One previous record from 1997 was located in Nundle, approximately 10 km from the site. As such, targeted surveys were not considered to be warranted for this species.

The Small Snake Orchid is listed as endangered under the TSC Act and the EPBC Act. *Euphrasia arguta* is listed as critically endangered under the EPBC Act. Targeted surveys were carried out in suitable habitat for these species during October 2012, as documented in the Terrestrial and Aquatic Flora and Fauna Impact Assessment. Survey timing was considered suitable for the Small Snake Orchid. Although not optimal, the survey timing was also considered suitable for detecting *Euphrasia arguta* given that flowering has previously been recorded in October. Further, identification of this species would have been possible in its vegetative state if it was not flowering at the time of survey.

As documented on the Terrestrial and Aquatic Flora and Fauna Impact Assessment, targeted surveys did not detect these species and it is considered unlikely that the Small Snake Orchid or *Euphrasia arguta* occur within the study area and that they are unlikely to be impacted by the Project.

6.2.2 Queensland Bluegrass

Queensland Bluegrass (*Dichanthium setosum*) is an upright grass less than 1 m tall. The species occurs on the New England Tablelands, North West Slopes and Plains and the Central Western Slopes of NSW, as well as in Queensland and Western Australia (OEH 2012b). It is listed as vulnerable under both the TSC Act and EPBC Act.

A record exists for Queensland Bluegrass in the Bowling Alley Point cemetery from early February 2003 (OEH Wildlife Atlas). The cemetery is located in close proximity (approximately 500 m east) to the Chaffey Dam reservoir. The habitat that occurs within the cemetery is similar to that which occurs within the area to be inundated by the proposed augmentation.

Targeted surveys carried out by nghenvironmental in October 2012 failed to locate Queensland Bluegrass at the location of the previous recording or elsewhere in the study area. However, it was considered that the species may not have been detectable at the time of these surveys, as the survey was undertaken outside the known flowering period. Utilising the precautionary principle, it was assumed in the EIS that the species may occur on site and that the Project could potentially result in a significant impact to Queensland Bluegrass. A commitment was made in the EIS to carry out further surveys for this species during summer, which is the known flowering period for the species (OEH 2012a).

Targeted surveys for Queensland Bluegrass were undertaken by nghenvironmental from the 31 January to 1 February 2013 by two botanists. Areas of better quality potential habitat within and adjacent to the Project Site were surveyed, as was the location of the previous record (within the Bowling Alley Point cemetery). The surveys comprised a total survey effort of 13 person hours. The timing of these surveys was considered suitable for detecting the species. Further detail on the survey methodology is provided at Appendix 2.

No occurrences of Queensland Bluegrass were identified during the surveys in January and February 2013. Further, it is considered unlikely that any individuals of the species would have been overlooked. Despite extensive searches, the previous record of this species within the Bowling Alley Point cemetery was not detected and thus was not able to be verified.

Given that surveys carried out during the flowering period (when the species is detectable) in areas of better quality potential habitat did not detect Queensland Bluegrass, it is considered that the species does not occur within or adjacent to the Project Site and will not be impacted by the Project.

6.2.3 Vegetation Communities

As documented in the EIS, seven vegetation communities occur within and around the Project Site (Table 6-1). As discussed in Section 4, the Works Areas for the realignment of Tamworth-Nundle Road, Rivers Road and Western Foreshore Road have been reduced since submission of the EIS. As such, the impact of the Project on vegetation communities has also been reduced.

The revised area of impact, as well as the extent of each community within a 1 km radius of the Project Site, is shown in Table 6-1.

Table 6-1: Revised area of impact on vegetation communities

Regional Vegetation Community (RVC)	Inundation Impact Area (ha)	Revised Road Impact Area[4] (ha)	Total Impact Area (ha) (inundation + revised road)	Area within a 1 km Radius (ha) (not impacted)
Box–gum grassy woodlands, Brigalow Belt South and Nandewar (RVC 17)	30	6	36	1,014
Derived grasslands, Brigalow Belt South and Nandewar (RVC 28)	87	27	114	293
Silvertop Stringybark grassy open forests, eastern Nandewar and New England Tablelands (RVC 39)	3	1	4	892
River Oak Riparian Woodland, eastern NSW (RVC 71)	6	0	6	15
Wetlands and marshes, inland NSW (RVC 70)	0.25	0	0.25	0
Sub-total (Native Vegetation)	**126.25**	**34**	**160.25**	**2,214**
Planted non-indigenous native vegetation (no RVC)	9	2	11	21
Exotic non-native vegetation	45	2	47	276
TOTAL	**180.25[5]**	**38**	**218.25**	**2,511**

[4] The road impact area calculations exclude any overlap with those areas to be inundated

The Box-gum grassy woodlands and the Derived grasslands communities present within and around the Project Site constitute the White Box-Yellow Box-Blakely's Red Gum Woodland endangered ecological community (EEC), listed under the TSC Act. Part of the Box-gum grassy woodlands community also constitutes the White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland critically endangered ecological community (CEEC), listed under the EPBC Act.

Approximately 117 ha of the TSC Act listed White Box-Yellow Box-Blakely's Red Gum Woodland EEC occurs within the area to be inundated by the new FSL. An additional 63 ha was expected to be impacted by the required realignment of roads. Following refinement of the road Works Areas, the impact to this community from the realignment of road has been reduced by more than 50% to 33 ha.

Approximately 1300 ha of the TSC Act listed White Box-Yellow Box-Blakely's Red Gum Woodland occurs within a 1 km buffer around the study site.

Of the vegetation comprising the TSC listed EEC within the area to be impacted by the inundation to the new FSL, approximately 6 ha also comprises the EPBC Act listed White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland CEEC. A further 4 ha of this CEEC was expected to be impacted by the required realignment of roads. Following the refinement of the Works Areas though the detailed design phase, the impact to this community from the realignment of roads has been reduced by more than 25% to 1.4 ha.

Approximately 506 ha of the EPBC Act listed White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland CEEC occurs within a 1 km buffer around the study site.

The revised areas of impact for the EEC and the CEEC are provided in Table 6-2. It is noted that these areas are also included as part of the calculations in Table 6-1.

[5] The total area does not include existing cleared and disturbed areas

Table 6-2: Revised area of impact on threatened ecological communities

Threatened Ecological Community	Inundation Impact Area (ha)	Original Road Impact Area (ha)	Revised Road Impact Area[6] (ha)	Total Impact Area (ha) (inundation + revised road)	Area within a 1 km Radius (ha) (not impacted)`
White Box-Yellow Box-Blakely's Red Gum Woodland (TSC Act listed EEC)	117	63	33	**150**	1,307
White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland (EPBC Act listed CEEC)	6	4	1.5	7.5	509

As documented in the Terrestrial and Aquatic Flora and Fauna Impact Assessment, the TSC Act listed White Box-Yellow Box-Blakely's Red Gum Woodland will not be significantly impacted by the Project. However, an offset is required for all vegetation loss under the NSW BioBanking Assessment Methodology. As such, offsets for this community are provided in the Offset Plan (refer Section 6.2.8 and Appendix 3).

Also as documented in the Terrestrial and Aquatic Flora and Fauna Impact Assessment, the EPBC listed White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland will not be significantly impacted by the Project. Accordingly, no offset is required under the EPBC Act Environmental Offsets Policy.

Regardless, a large area of this community is included in the Offset Site proposed to offset vegetation loss under the NSW BioBanking Assessment Methodology. The area of this community constitutes more than 300% of the area that would be required under the EPBC Act Environmental Offsets Policy (refer Section 6.2.8 and Appendix 3).

6.2.4 Threatened Fauna Species

As documented in the EIS, a number of threatened fauna species previously recorded, have the potential to occur or potentially have habitat within 10 km of the Project Site (OEH Wildlife Atlas and EPBC Protected Matters Search). The presence of potential habitat and the likelihood of occurrence of each species within the Project Site were assessed in the Terrestrial and Aquatic Flora and Fauna Impact Assessment, provided at Appendix 8 to the EIS. The potential for the Project to impact on each of these species was also assessed.

[6] The road impact area calculations exclude any overlap with those areas to be inundated

The location of threatened species registered on the OEH Wildlife Atlas within 10 km of the Project Site is shown in Figure 6-11. The EPBC Protected Matters Search does not provide the location of threatened species previously recorded or likely to occur within 10 km of the Project Site.

The Murray Cod was once abundant throughout the Murray-Darling river system, but overfishing and environmental changes have drastically reduced its numbers. The species occurs naturally in the waterways of the Murray-Darling Basin in a wide range of warm water habitats that range from clear, rocky streams to slow flowing turbid rivers and billabongs (DPI accessed 12/03/2013). The species now has a patchy distribution and abundance across its historic range. The Murray Cod is not listed as threatened in NSW, but is identified as a member of the listed endangered ecological community Aquatic Ecological Community in the Natural Drainage System of the Lower Murray River Catchment (*Fisheries Management Act 1994*) (DEH 2003).

As stated in the Terrestrial and Aquatic Flora and Fauna Impact Assessment, the Murray Cod (*Maccullochella peelii*), which is listed as vulnerable under the EPBC Act, occurs within Chaffey Dam as well as downstream and upstream areas. The species is stocked in these areas to enhance recreational fisheries and the Murray Cod is regularly caught in the waterways. As part of the State Government's fish stocking program, 25,000 Murray Cod had been introduced to Chaffey Dam to the summer of 2004/2005. It is therefore not a rare species in the area. The species occurs in a wide range of habitats (flowing and still water). The Project will retain availability of existing habitats, though the occurrence of riverine habitat will slightly decrease and the extent of still waters will increase.

As documented in Section 9 of the EIS, mitigation and management measures will be implemented during construction and operation of the Project to minimise impacts to water quality within the reservoir as well as upstream and downstream. Further, the species is mobile within the reservoir and is expected to be able to avoid any localised impacted areas. The multi-level offtake at Chaffey Dam enables the extraction of water from a range of reservoir depths to control the temperature of downstream releases, as well as avoid the spread of algal blooms downstream.

Impacts on the Murray Cod from the Project will be negligible.

6.2.5 Border Thick-Tailed Gecko

The Border Thick-tailed Gecko (*Uvidicolus sphyrurus*[7]) is listed as vulnerable under the TSC Act and the EPBC Act. The Border Thick-tailed Gecko is a small lizard with an average size of 7 cm long. The species is found on the tablelands and slopes of northern NSW and southern Queensland, reaching south to Tamworth and west to Moree. It is most common in the granite country of the New England Tablelands, occurring at sites ranging from 500 to 1,100 m elevation. Populations are mostly

[7] The scientific name for this species, as listed under the EPBC Act, is *Uvidicolus sphyrurus*. The scientific name for this species, as listed under the TSC Act, is *Underwoodisaurus sphyrurus*.

fragmented, with over 50 discrete sites currently known, each separated by at least 2 km (OEH 2012c).

There are eleven records of the Border Thick-tailed Gecko within 10 km of the dam wall, from between 1993 and 2008 (refer Appendix 2). The species has been recorded on the dam wall and in remnant vegetation on Goat Mountain, adjacent to the dam wall by NWES (2009a) and nghenvironmental (2012).

The Border Thick-tailed Gecko was found to be relatively common within the locality and the region, recorded many times in shrubby rocky remnants around Woolomin, including Goat Mountain, to the immediate northwest of the dam wall. The species was also found to be relatively common within woodland remnants and dry open forests with a patchy and continuous shrub layer in the area (NWES 2009a). NWES (2009a) concluded that the geckos on the dam wall are likely to be part of a much larger population in the remnant habitat of Goat Mountain.

Surveys carried out by nghenvironmental in October 2012, with a total survey effort time of 240 person minutes, recorded three Border Thick-tailed Geckos on the dam wall and one on Goat Mountain to the immediate north of the dam (nghenvironmental 2012). Due to access and safety issues, it was not possible to survey the whole of the upstream and downstream faces of the dam wall. Although the recommended survey period for the species is November to February (SEWPaC 2011), confirmation of the species presence on the dam wall was achieved in October, therefore no further surveys were considered to be required.

The existing constructed rocky surface area of upstream face of the dam wall above the existing FSL provides around 6,000 m^2 of artificial habitat for the Border Thick-tailed Gecko. The downstream face of the dam wall currently provides approximately 50,000 m^2 of artificial Border Thick-tailed Gecko habitat.

As documented in the EIS, a planted wildlife corridor was created in late 2011 and early 2012 with the aim of linking Goat Mountain with the Peel River and habitat areas to the east. The corridor is currently and will continue to be maintained by State Water, including implementation of weed management measures. While it will take some years for the planted vegetation to mature, once established, the wildlife corridor will facilitate movement of the Border Thick-tailed Geckoes between habitats on the dam wall and those on Goat Mountain species.

Inundation to the new FSL of the lower part of the upstream face of the dam wall (approximately 2,600 m^2) has the potential to impact on this species. Given inundation to the new FSL will occur gradually, individuals are expected to relocate up the wall in response to the rising reservoir level.

The placement of additional rock on the downstream face of the dam wall, which is required as part of Project construction activities to raise the dam wall, also has the potential to impact on the Border Thick-tailed Gecko. The rock used for raising of the dam is from the same source and generally of the same type and size as that comprising the existing dam wall.

The Terrestrial and Aquatic Flora and Fauna Impact Assessment recommended that an ecologist be engaged to locate and remove Border Thick-tailed Geckoes to remnant vegetation on Goat Mountain

remnant prior to construction works on the dam wall. Given the unknown size of the population on Goat Mountain and therefore unknown habitat availability relocation of Border Thick-tailed Geckoes is no longer proposed.

Construction activities associated with the raising of the dam wall have been designed to avoid impacts to the Border Thick-tailed Gecko. Consultation was been carried out by nghenvironmental with OEH in order to refine the construction strategy to maintain the population of Border Thick-tailed Geckoes on the dam wall during construction. Construction will be staged and only one section of the dam wall will be impacted at any point in time. Therefore Border Thick-tailed Gecko present on the wall during construction should be able to continue to utilise the areas of the wall that are not under construction at that point in time.

The following strategy will be implemented during construction activities associated with the raising of the dam wall:

- Addition of rock to the downstream face of the dam wall will be carried out gradually.
- An area of artificial habitat will be established adjacent the dam prior to the commencement of construction works to the downstream face of the dam wall. The area of artificial habitat will be created from the same material to be used for raising of the dam wall.
- Each section of the dam wall subject to rock placement will be surveyed for Border Thick-tailed Geckoes immediately prior to commencing work in that section.
- Any Border Thick-tailed Geckoes located during surveys of the first section will be removed to the area of artificial habitat.
- Any Border Thick-tailed Geckoes located during surveys of subsequent sections will be removed to the adjacent completed section of dam wall (i.e. the new dam wall habitat).
- The area of artificial habitat will be gradually dissembled following completion of works to the downstream face of the dam wall and any Border Thick-tailed Geckoes located will be removed to the adjacent completed section of dam wall (i.e. the new dam wall habitat).

The mitigation measures proposed for the Border Thick-tailed Gecko have been developed in consultation with State Water and OEH to provide certainly of practicality and acceptability. Assumptions have been based on available data on the distribution of the species locally, elsewhere in the study area and within the artificial habitat of the dam wall. Adverse impact on the species will be avoided through the implemented of the staged construction strategy described above.

Construction associated with the raising of the dam wall has been designed to avoid impacts to the Border Thick-tailed Gecko. An area of artificial habitat on the dam wall will be removed and replaced. No natural habitat for the species will be removed. Provided that the proposed mitigation measures are carried out, the Project is not considered to have an impact on this species at a local, regional or national scale.

Accordingly, no offset for this species is proposed under the EPBC Act Environmental Offsets Policy. The Offset Site proposed to be secured and managed to compensate for vegetation loss under the NSW BioBanking Assessment Methodology includes the remnant vegetation on Goat Mountain, which provides known habitat for the Border Thick-tailed Gecko (refer Section 6.2.8 and Appendix 3).

6.2.6 Booroolong Frog

The Booroolong Frog (*Litoria booroolongensis*) is a medium sized frog, with adults growing to about 5 cm. The Booroolong Frog is restricted to NSW and north-eastern Victoria, predominantly along the western-flowing streams of the Great Dividing Range (OEH 2012d). The species is estimated to occupy an area of around 1,000 ha over this range (GAA 2006).

Within Victoria there are two known locations for the Booroolong Frog in the north-east of the state: Burrowye and Guys Forest Creeks at Burrowye and Koetong Creek within Mount Lawson State National Park (DSE 2013). Booroolong Frogs have been located along several small creeks north of the Murray River and on the banks of the Murray River, near Jingellic, in southern NSW (The Victorian Frog Group 1999). Surveys have also identified the species in the Yarrangobilly River and in tributaries of the Tumut and upper Murray Rivers (Hunter 2003).

The Booroolong Frog was historically widespread throughout the Central Tablelands, having been recorded from locations within and between tributaries of the Macquarie and Lachlan Rivers. Surveys throughout this region in the late 1990s failed to locate the species along many of these streams, suggesting it is now rare in the Central Tablelands region (Gillespie 1999; Gillespie 2000). The species persists in this region along the Turon River and Winburndale Creek in the Winburndale Nature Reserve (NSW NPWS 2004) and within the Abercrombie River Catchment (Gillespie 2000).

The species was once common in the Northern Tablelands but has was been located during extensive fauna surveys from the mid 1990s to the mid 2000s undertaken by the North-east Forest Biodiversity Study (NSW NPWS 1994), Regional Forests Assessment Program and others (NSW NPWS 2004). Specific surveys in the Northern Tablelands for the Booroolong Frog conducted in 1999 and 2000 also failed to locate the species from a number of historic locations and other potentially suitable habitat (Gillespie 2000).

In northern NSW, the Booroolong Frog is currently known to occur only within the Namoi Catchment, which includes the Peel River and the Cockburn River (Anna Cronin *pers comm.* 2013). Surveys by North West Ecological Services (NWES) (2009b) in 2008/2009 along an estimated 99 km of stream from seven streams found the Booroolong Frog occurring in the headwater streams of the Namoi Catchment between 400 to 700 metres above sea level. The locations of individuals recorded during these surveys were listed or mapped in NWES (2009b). NWES (2009b) located a large population of this species on the Peel River upstream of Chaffey Dam. A large concentration of Booroolong Frogs was recorded immediately upstream of Chaffey Dam, however this concentration was considered to be atypical and excluded from estimates of the overall population. The population of the surveyed streams at that time was conservatively estimated to be between 600 and 800 frogs (NWES 2009a).

The Peel River upstream of Chaffey Dam was again surveyed for the Booroolong Frog in January and February 2013 by experienced herpetologists Phil Spark and Dr Andrew Stauber (see below for further detail). The species was found to be distributed over a total distance of 25 km along the Peel River from upstream of Chaffey Dam (within the current FSL) to Pearly Gates Bridge, Wombramurra Creek and further upstream on the Peel River. Current surveys determined that the large concentration of Booroolong Frogs previously recorded immediately upstream of Chaffey Dam is no longer present. A total of 2,289 Booroolong Frogs were recorded during the current surveys.

The outcome of the current surveys supports the previous assertion of NWES (2009b) that the large concentration of frogs previously recorded immediately upstream of Chaffey Dam was an anomaly and not representative of the distribution along the rest of the Peel River. As discussed in nghenvironmental (2012), the high density of metamorph and juvenile Booroolong Frogs found at the junction of the Peel River with Chaffey Dam in 2008/2009 may have been a result of two floods that occurred in November and December 2008, washing eggs and possibly young tadpoles downstream (NWES 2009).

The current surveys support this hypothesis, as this site does not currently support such a high abundance of individuals and the species is well distributed upstream of this site along the Peel River. It is likely that after the floods individual Booroolong Frogs migrated from Chaffey Dam upstream, and since that time there has been a spread in their distribution along the Peel River (Phil Spark, pers. comm.).

Current Surveys

Targeted surveys for Booroolong Frogs and their habitat were undertaken by Phil Spark and Dr Andrew Stauber, under the direction of Namoi CMA, over 21 nights between 17 January and 21 February 2013. The surveys, including timing and methodology, were undertaken in accordance with the *Survey guidelines for Australia's threatened frogs* (DEWHA 2010), the *Threatened species survey and assessment guidelines: field survey methods for fauna* (DECC 2009) and the *Hygiene Protocol for the Control of Disease in Frogs* (DECC 2008).

Supplementary Director-General's Requirements (DGRs) issued for the Project requested that surveys be undertaken during the Booroolong Frog breeding period from mid-November to mid-December. However the activity period of the species extends until February (DEWHA 2010) and is dependent on local climatic conditions. The timing of the surveys was tailored in response to local conditions and advise from local species expert Phil Spark. The timing of the surveys is considered suitable, as evidenced by the high activity levels observed during surveys.

Spotlighting surveys were undertaken over the full width of the Peel River, commencing at the southern end of Chaffey Dam and working upstream. A total distance of 25 km was surveyed over the 21 nights, comprising 21.3 km of the Peel River, upstream of Chaffey Dam, 3.2 km of Wombramurra

Creek[8] and 0.5 km of the Peel River 11 km upstream of Pearly Gates Bridge. For each Booroolong Frog observed, gender or developmental status was recorded, along with microhabitat details. Further survey details are provided at Appendix 2.

A total of 2,289 Booroolong Frogs were recorded during the current surveys. This comprised four individuals within the existing FSL (over a distance of 200 m), 50 individuals between the existing and new FSLs (over a distance of 1.6 km) and 2,235 individuals outside the new FSL along the Peel River and its tributaries (over a distance of 23.2 km) (Table 6-3). The location and density of Booroolong Frogs recorded during the current survey are shown in Figure 6-3.

Of the Booroolong Frogs recorded, 616 were males, 510 females, 339 metamorphs and 824 sub-adults. There appears to be no pattern in the concentration of sex or age classes along the Peel River.

Table 6-3: Results of current Booroolong Frog surveys (January 2013)

Location	Description	Distance Surveyed	Number of Booroolong Frog Recorded
Inside existing FSL - Peel River	Peel River downstream of existing FSL	0.2 km	4
Inside new FSL - Peel River	Peel River upstream of existing FSL to new FSL	1.6 km	46
Outside new FSL - Peel River	Peel River upstream of new FSL	19.5 km	2,037
Outside new FSL - Wombramurra Creek	Wombramurra Creek, which enters Peel River around 7.5 km upstream of new FSL.	3.2 km	118
Outside new FSL - Peel River	Peel River, 11 km upstream of Pearly Gates Bridge	0.5 km	80
Total		**25.0 km**	**2,289**

[8] Wombramurra Creek is a tributary of the Peel River, located around 7.5 km upstream of the new FSL.

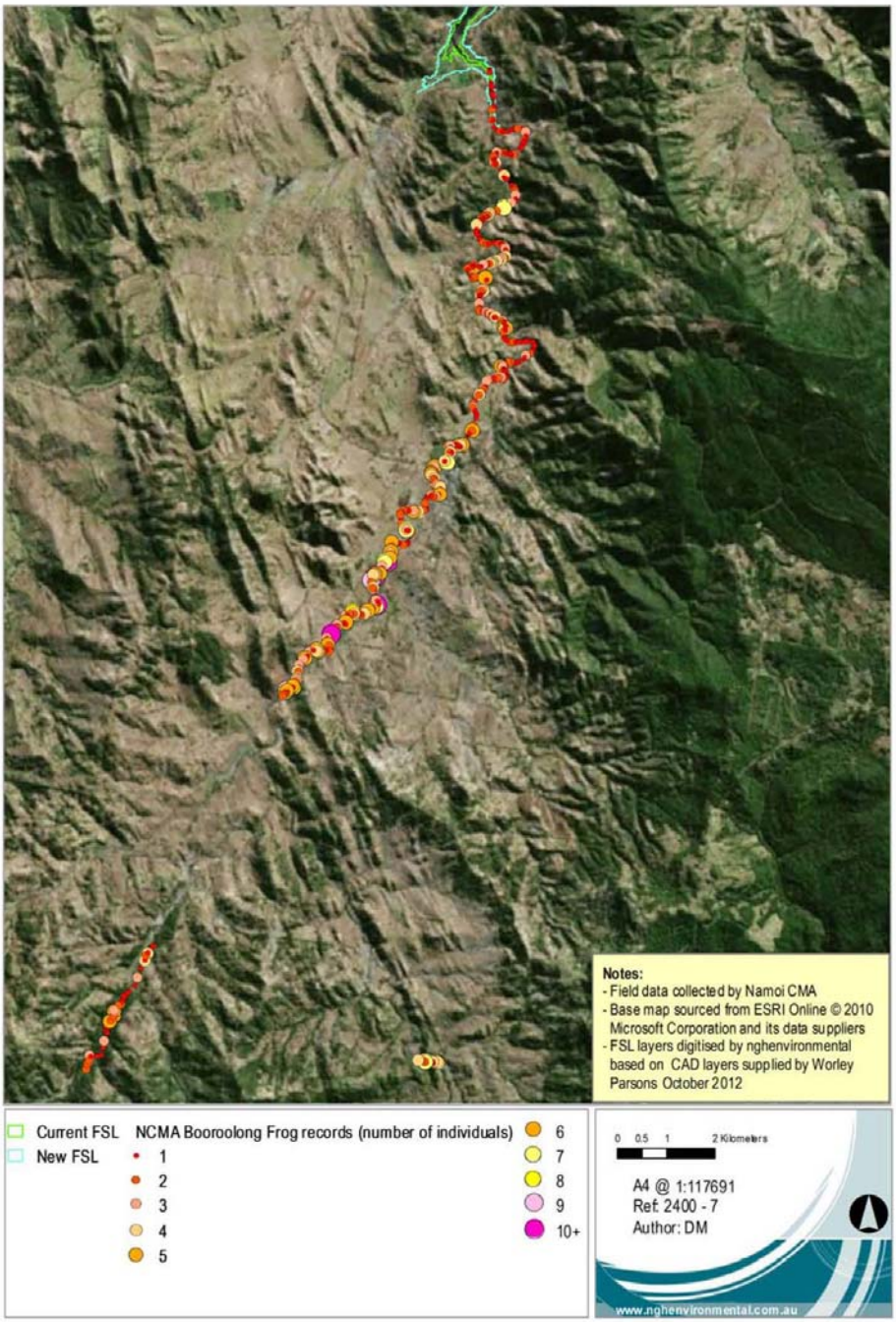

Figure 6-9: Location and density of Booroolong Frogs recorded during current survey (January and February 2013)

Please note that this map is not for public distribution or viewing.

Current Population

The current surveys indicate that the Booroolong Frog population in the Peel River, upstream of Chaffey Dam, currently comprises in the order of 2,000 individuals, with a broad distribution along the length of the river. Fifty individuals were recorded within the new FSL, representing approximately 2.2% of the current known population of the Peel River (and Wombramurra Creek) within the 25 km stretch upstream of Chaffey Dam.

Habitat

Current surveys found the Booroolong Frog to be well distributed along the Peel River, upstream of Chaffey Dam. These surveys showed that the 25 km of Peel River and Wombramurra Creek surveyed upstream of Chaffey Dam, the entire length was occupied by Booroolong Frogs and is therefore considered to provide suitable habitat for the species. The distribution of metamorph and sub-adult life stages over the entire area surveyed confirms that all 25 km is suitable breeding habitat for the species. Assuming an average habitat width of 14.5 m, this equates an area of 36.3 ha of known habitat on the Peel River and Wombramurra Creek.

The current data indicates that the Booroolong Frog is utilising the majority of habitat along the 25 km of Peel River upstream of Chaffey Dam. Furthermore, it is known that the species uses a range of habitats at different life stages, with tadpoles developing in slow-flowing connected or isolated pools (Anstis 2002). It is therefore evident that the Booroolong Frog has a reliance on both riffle and pool habitats, which are the features that comprise the surveyed sections of the Peel River. The current surveys also indicate that the Booroolong Frog has a microhabitat preference for riffles with large rocks (33%) followed by rapids with large rocks (26%) (Figure 2-3).

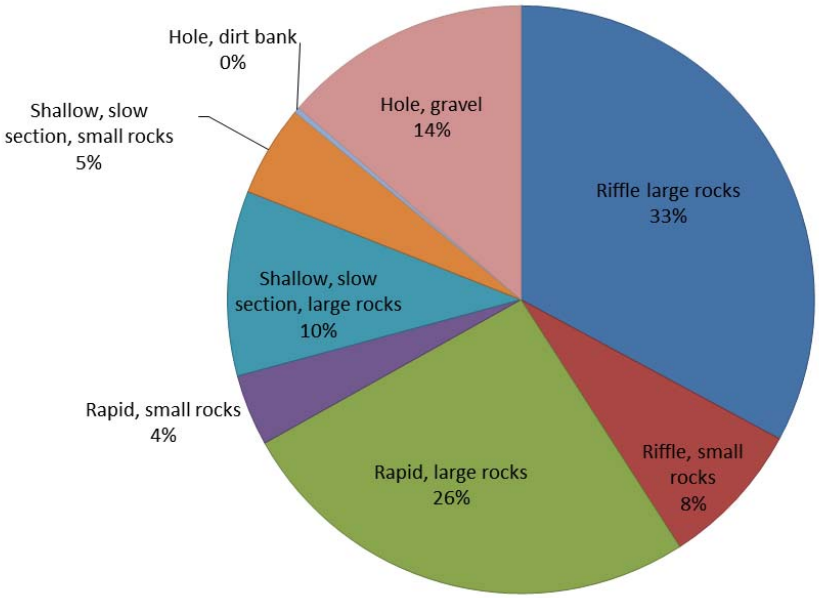

Figure 6-10: Microhabitat preference of Booroolong Frogs recorded during current survey (January and February 2013)

The Terrestrial and Aquatic Flora and Fauna Impact Assessment assessed riffle habitats as being optimal Booroolong Frog habitat both within and outside the new FSL. Given the outcomes of the current surveys, the loss of habitat as a result of inundation to the new FSL has been re-assessed to include the entire length of the river between the existing FSL and the new FSL (a distance of 1.6 km). At an average width of 14.5 m, this equates to an area of 2.3 ha, or 6.4% of the known Booroolong Frog habitat on the Peel River immediately upstream of Chaffey Dam.

Potential Impacts

Due to the nature of the Project, impacts to the Booroolong Frog through inundation to the new FSL are unavoidable and cannot be mitigated. It is estimated that an area of 2.3 ha of Booroolong Frog habitat will be impacted by inundation to the new FSL as a result of the Project, assuming a mean width of 14.5 m over the 1.6 km length of river. This is based on the assumption that the whole area to be inundated provides suitable habitat for the Booroolong Frog, although some areas of this habitat are already negatively impacted by shading, depth and substrate. As previously stated, this constitutes approximately 6.4% of the known Booroolong Frog habitat on the Peel River immediately upstream of Chaffey Dam.

Fifty Booroolong Frogs were recorded between the existing FSL and the new FSL during current surveys. This comprises around 2% of the population recorded within the 25 km stretch of the Peel River and Wombramurra Creek upstream of Chaffey Dam.

The area to be inundated is located at the northern extent of the Booroolong Frog population that occurs along the Peel River upstream of Chaffey Dam. There is no opportunity for the Booroolong Frog to move further north due to the presence of the existing reservoir. Therefore inundation to the new FSL will not result in the fragmentation of the population. There is an abundance of suitable habitat for the Booroolong Frog upstream of Chaffey Dam, for a distance of more than 20 km.

Based on simulated 100 year dam volumes, the minimum duration over which inundation will occur following implementation of the Project is estimated to be between eight and 21 weeks, although inundation to the new FSL could take up to several years. Given the proven ability of the frogs to move according to changed conditions, initial inundation to the new FSL is unlikely to result in the loss of all individuals within the new FSL. This may slow the rate of habitat loss and provide an opportunity for the natural migration of individuals upstream, thereby reducing the impact to the species. Accordingly, it is no longer proposed to carry out relocation of Booroolong Frogs.

Water levels in the reservoir fluctuate with corresponding rainfall, inflow and drought events. Following implementation of the Project, the reservoir water level will not always be at the new FSL. According to simulated 100 year dam volumes, following augmentation to 100 GL the reservoir will only be at FSL around 24% of the time. Further, the reservoir will be at or below the existing FSL around 21% of the time.

The changes in the reservoir storage level mean that impacts to the Booroolong Frog habitat within this area will change over time. The whole of the 2.3 ha will be impacted by inundation only when the reservoir is at 100% capacity (i.e. 24% of the time). When the reservoir is lower, the impact from inundation of the habitat is less, to the point where the storage level is at or below the existing FSL and there is no impact from inundation associated with the Project.

If increased sediment loads occur following initial inundation, this may reduce the availability or quality of oviposition sites through filling of interstitial spaces in the stream bed and blanketing substrates, potentially resulting in increased mortality of eggs from predation, desiccation or flooding (Campbell 1999). Given the steepness of the river bed slope within the area of the new FSL (6.5 metres over 1.6 km) and associated high velocities, significant sedimentation is considered to be unlikely. Further, high inflows primarily occur when the storage is below FSL and any initial silt load is subsequently deposited further downstream within the reservoir.

While the extent of suitability of habitat following inundation and subsequent lowering of the water level is somewhat uncertain, habitat will remain within the new FSL, as evidenced by the Booroolong Frogs recorded from within the existing FSL during the current surveys. Thus, habitat currently occupied by the Booroolong Frog within the new FSL may intermittently provide habitat for the species following implementation of the Project, when reservoir levels are below the new FSL.

Due to uncertainties regarding the timing of initial inundation and the quality of the habitat following initial inundation, the permanent loss of habitat inside the new FSL has been assessed.

An Assessment of Significance carried out in accordance with the *EPBC Act Significant Impact Guidelines 1.1 Matters of national environmental significance* (DEWHA 2009) (refer Appendix 2) concluded that, despite the current abundance of the Booroolong Frog along the Peel River, the loss of 6.4% of known Booroolong Frog habitat is considered to have a significant impact at a local and regional level.

Accordingly, an Offset Plan has been prepared to satisfy State and Commonwealth legislative requirements in regard to the impact of the Project on the Booroolong Frog. The Offset Plan aims to reduce known threatening processes occurring along the Peel River, thereby contributing to the recovery of the Booroolong Frog in the Namoi catchment (refer Appendix 2).

Major threats to the Booroolong Frog within the Namoi catchment include disease (Chytridiomycosis), weed invasion, sedimentation and habitat degradation through vegetation clearing and subsequent erosion, stock grazing and fossicking (OEH 2012e). As such, management measures for the proposed Booroolong Frog offset site have been designed to manage and reduce these major threats.

6.2.7 Threatened Species Habitat

In preparing the Terrestrial and Aquatic Flora and Fauna Impact Assessment, the following databases were searched for records of EPBC Act and TSC Act listed threatened species previously recorded within a 10 km radius of the site:

- Primary Industries Fisheries Records viewer
- OEH Bionet Wildlife Atlas:
- EPBC Protected Matters Search tool

As documented in the Terrestrial and Aquatic Flora and Fauna Impact Assessment, 42 migratory or threatened terrestrial fauna species and/or their potential habitats have been recorded within 10 km of Chaffey Dam (OEH Wildlife Atlas and EPBC Protected Matters Search). Of these species, 16 are listed under the TSC Act, and 25 under the EPBC Act. Of these species, only five of the threatened fauna species and three of the listed migratory species have been recorded within the study area since 1990; the Brown Treecreeper, Speckled Warbler, Little Lorikeet, Border Thick-tailed Gecko, Booroolong Frog, White-bellied Sea-eagle, Rainbow Bee-eater and Great Egret.

The location of threatened species registered on the OEH Wildlife Atlas within 10 km of the Project Site is shown in Figure 6-11. The EPBC Protected Matters Search does not provide the location of threatened species previously recorded or likely to occur within 10 km of the Project Site.

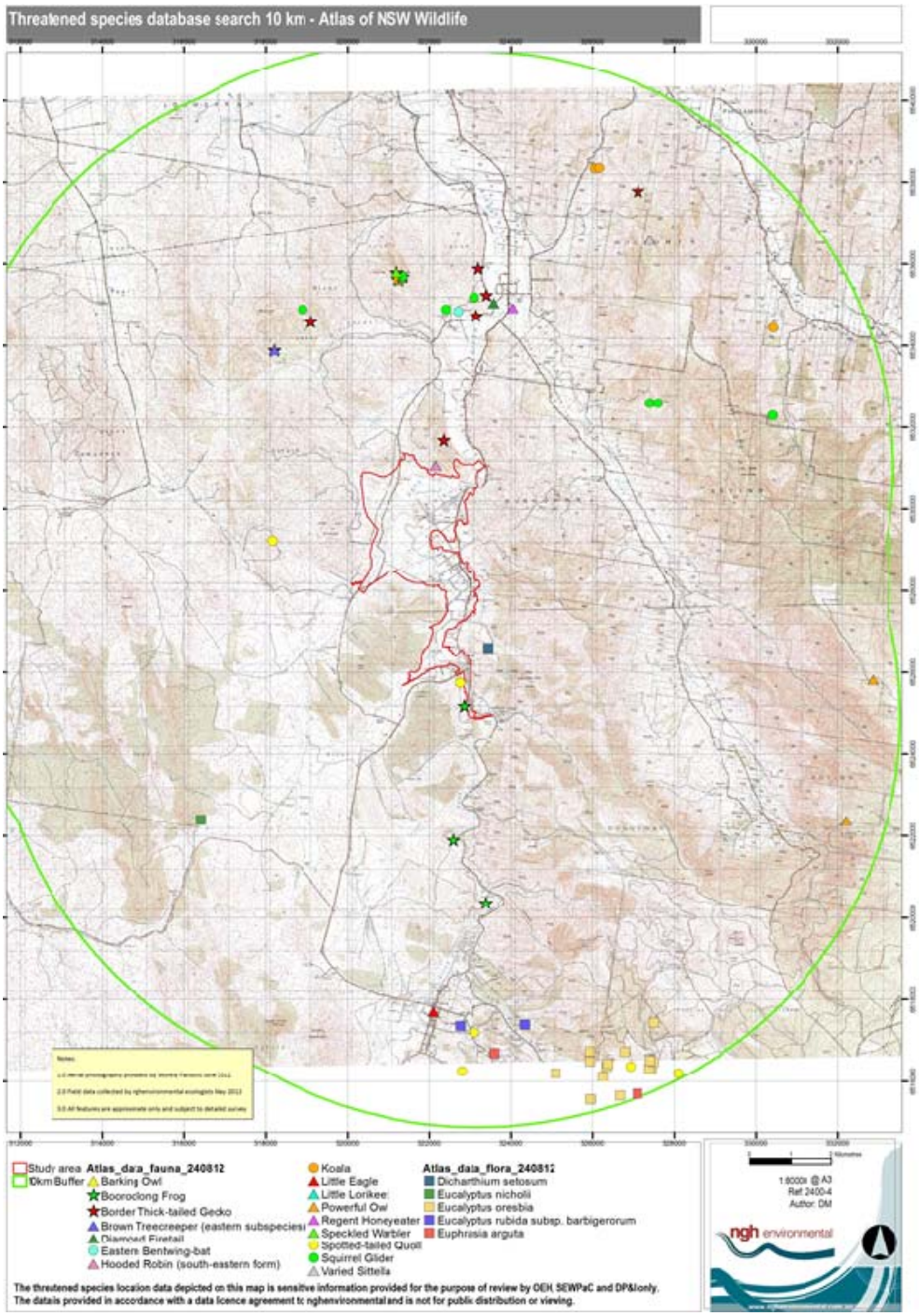

Figure 6-11: Location of threatened species OEH Wildlife Atlas records within 10 km of the Project Site

Please note that this map is not for public distribution or viewing.

An evaluation of the likelihood and extent of impacts on threatened fauna, found 19 other species with the potential to occur at the site, as documented in the Terrestrial and Aquatic Flora and Fauna Impact Assessment. They included the Gang-gang Cockatoo, Varied Sittella, Little Eagle, Swift Parrot, Hooded Robin, Turquoise Parrot, Barking Owl, Powerful Owl, Scarlet Robin, Flame Robin, Australian Painted Snipe, Diamond Firetail, Large-eared Pied Bat, Spotted-tailed Quoll, Eastern Bentwing-bat, South-eastern Long-eared Bat, Squirrel Glider, and Grey-headed Flying-fox.

The presence of potential habitat and the likelihood of occurrence of each species within the Project Site were assessed in the Terrestrial and Aquatic Flora and Fauna Impact Assessment. The potential for the Project to impact on each of these species was also evaluated. The evaluation took into consideration the age and proximity of records within 10 km of the Project Site, the availability of suitable habitat on the site, and the likelihood that the activity would impact on habitat for the species.

For some species, only a small amount of potential and marginal foraging habitat will be impacted by the Project (Swift Parrot, Powerful Owl, Scarlet Robin, Large-eared Pied Bat, Spotted-tailed Quoll). Other resources such as hollow-bearing trees for Squirrel Gliders and nesting or roosting resources for threatened birds and bats are low in abundance and quality at the study site.

The potential impacts to these species were assessed to be nil or low (excluding the Booroolong Frog and Border Thick-tailed Gecko), as the habitat present at the site is not considered to be optimum and none of these species were recorded in surveys of the site.

Further, surveys carried out by nghenvironmental (Appendix 2) showed that large areas outside the area to be impacted provide potential threatened species habitat with a diverse habitat structure of trees, hollows, fallen logs, leaf litter and a complex understorey. The methodology and full outcomes of these surveys are documented in Appendix 2.

As noted in Section 6.2.3, an offset is required for all vegetation loss under the NSW BioBanking Assessment Methodology. The proposed offset site will secure and manage potential large areas of potential threatened species habitat.

6.2.8 Offset Plan

The Flora and Fauna Impact Assessment and the Addendum Report - Flora and Fauna Impact Assessment prepared for the Project concluded that offsets are required for residual impacts to vegetation communities from the Project in accordance with NSW offset requirements. The assessment carried out in the Addendum Report concluded that offsets are also required for the Booroolong Frog in accordance with NSW offset requirements and the EPBC Act Environmental Offsets Policy.

Accordingly, an Offset Plan has been prepared to describe the required offsets and the proposed offset sites, as provided at Appendix 2. The Offset Plan has been developed in consultation with OEH, SEWPaC, Namoi CMA and additional relevant experts.

The Offset Plan has been developed to satisfy NSW and Commonwealth requirements with regard to offsetting, specifically:

- DGRs and Supplementary DGRs issued by DPI
- OEH Interim policy on assessing and offsetting biodiversity impacts of Part 3A, State significant development (SSD) and State significant infrastructure (SSI) projects (OEH SSI Interim Offsets Policy)
- OEH Principles for the use of biodiversity offsets in NSW
- Namoi CMA Biodiversity Offsets Policy
- EPBC Act Environmental Offsets Policy

A hierarchy of principles in regard to Project impacts on biodiversity has been implemented, as follows:

1. Avoid impacts
2. Minimise impacts
3. Mitigate impacts
4. Offset residual impacts

Wherever possible, impacts to biodiversity values have been avoided. In this regard, the impact on native vegetation has been reduced through the refinement of the road design and selection of specific stockpiling and equipment laydown areas. For example, the area of native vegetation to be impacted by road construction activities has been reduced substantially from 161.5 ha to 38 ha as a result of the reduction in size of works areas. Where impacts are unavoidable, mitigation measures have been incorporated into the Project to reduce impacts. In some instances there are residual impacts that cannot be adequately mitigated.

Residual impacts are proposed to be offset in accordance with the NSW OEH SSI Interim Offsets Policy. Where significant residual impacts to matters of national environmental significance remain, these are also proposed to be offset in accordance with the EPBC Act Environmental Offsets Policy.

Residual impacts identified for the Project include:

- A loss of 160 ha of naturally occurring native vegetation including areas comprising 150 ha of the White Box-Yellow Box-Blakely's Red Gum Woodland TSC Act listed EEC
- A loss or modification of habitat for a variety of protected and threatened native fauna species. This includes 2.32 ha of habitat suitable for the endangered Booroolong Frog

Significant residual impacts identified for the Project include:

- A loss of 2.32 ha of habitat suitable for the endangered Booroolong Frog

The methodology used to develop the Offset Plan and an assessment of the proposed offsets against the OEH SSI Interim Offsets Policy, the Namoi CMA Biodiversity Offsets Policy and the EPBC Act Environmental Offsets Policy is provided in Appendix 2.

In NSW, offsets are required to be comparable in terms of vegetation and habitat type and sufficient in area to allow the long-term improvements of the offset site to compensate for the loss of habitat at the impact site. The BioBanking Assessment Methodology (BBAM) (DECC 2009) is used in the Offset Plan to assess the biodiversity values that will be impacted upon as a result of the Project and to determine if the values contained at the proposed offset site are adequate. The results of the BBAM are interpreted with regard to the OEH SSI Interim Offsets Policy.

Under Commonwealth legislation, the EPBC Act Environmental Offsets Policy (SEWPaC 2012) applies to all protected matters under the EPBC Act. Offsets provide environmental benefits to counterbalance the impacts that remain after avoidance and mitigation measures, and can help to achieve long-term environmental outcomes for Matters of National Environmental Significance (MNES) protected under the EPBC Act. The Offsets Assessment Guide used in the Offset Plan is a tool for assessing the suitability of offset proposals, and has been used in conjunction with the EPBC Act Environmental Offsets Policy.

Whilst the NSW and Commonwealth offset policies are focused on different levels of biodiversity protection, the Offset Plan aims to ensure that the processes are consistent and complementary to allow for both objectives to be met within the Offset Plan.

The Offset Plan proposes two offset sites, totaling almost 1,000 ha in size. One offset site is located on the northern and western foreshore of Chaffey Dam and covers an area of approximately 980 ha (the north-western offset site, Figure 6-12), while the other is located one along the Peel River, immediately upstream of the dam and covers an area of 13 ha (the Peel River offset site, Figure 6-13).

North-Western Offset Site

The North-Western Offset Site comprises land owned by the Water Administration and Ministerial Corporation (WAMC). This land is vested in State Water and available for State Water to enter into covenants or agreements. The land is currently leased to local farmers for grazing on a permissive occupancy basis. These leases will be terminated on 31 December 2013 and the lease holders have been informed of this. The land will be available for dedication as offset area from the start of 2014.

The North-Western Offset Site comprises the following allotments. These allotments are contiguous with each other and with the Project Site.

Lot 1 DP 589247	Lot 7012 DP 1026362	Lot 6 DP 1139917
Lot 1 DP 589245	Lot 2 DP 615111	Lot 7 DP 1139917
Lot 5 DP 1139917	Lot 1 DP 1174369	Lot 3 DP 615111
Lot 2 DP 589247	Lot 2 DP 631895	

It is proposed that a Conservation Agreement or Conservation Property Vegetation Plan (CPVP) will be established over the North-Western Offset Site. To ensure that the Conservation Agreement or CPVP is binding on successors in title, an abstract of the Conservation Agreement or CPVP will be registered with the Land and Property Management Authority under the Real Property Act 1900.

The Conservation Agreement or CPVP will be a legally binding agreement under relevant Acts and will include management actions associated with the offset area that will apply in perpetuity. These management actions should be consistent with recommendations specified in this document.

As a Conservation Agreement or CPVP is attached to the land title, the land owner (currently WAMC vested in State Water) is ultimately responsible for funding the management actions required at the offset site and monitoring the effectiveness of their implementation. State Water will be responsible for this funding.

The North-Western Offset Site contains vegetation similar to that within the Project Site. Yellow Box – Blakely's Red Gum grassy woodland occupies the lower slopes, while Rough-barked Apple – Silvertop Stringybark forest occurs on the steeper upper slopes. White Box grassy woodland also occurs within the site as an intermediate between the Yellow Box and Silvertop Stringybark communities. River Oak riparian woodland is present along the Peel River within the north-western offset site.

The Yellow Box – Blakely's Red Gum grassy woodland and White Box grassy woodland (collectively "Box-gum woodland") are considered to comprise the TSC Act listed White Box-Yellow Box-Blakely's Red Gum Woodland EEC. Components of these communities also comprise the EPBC Act listed White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland CEEC.

The offset site supports known habitat for threatened fauna species including the Regent Honeyeater, Border Thick-tailed Gecko and Speckled Warbler (Atlas of NSW Wildlife accessed 24/08/2012; NWES 2009a). The offset site provides suitable habitat for a range of other threatened fauna species including the Spotted-tailed Quoll, Little Lorikeet, and woodland birds including the Brown Treecreeper.

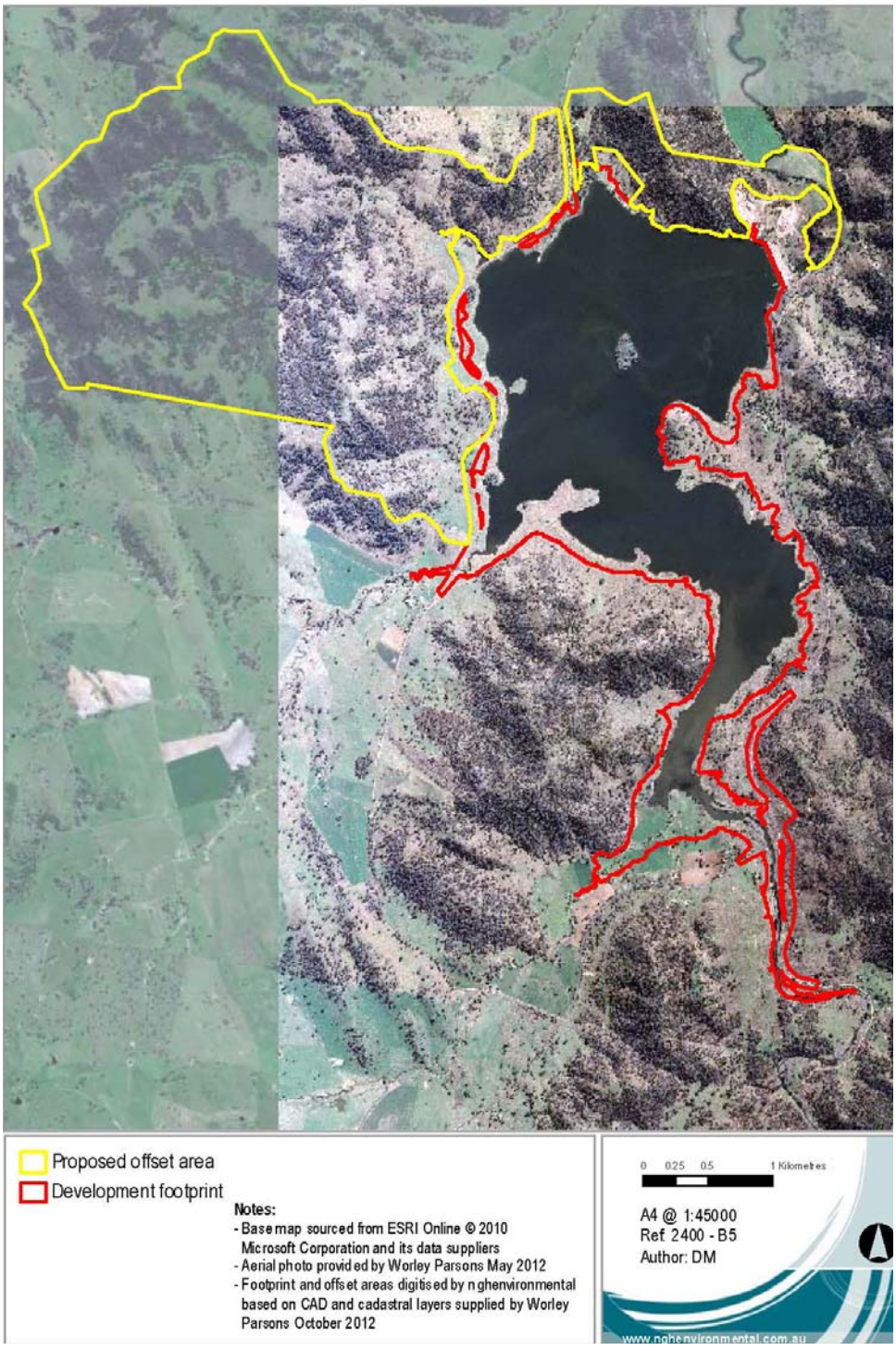

Figure 6-12: Proposed North-Western Offset Site

Management measures will be implemented at the North-Western Offset Site to reduce the level or impact of threats currently occurring and enable a conservation gain at the site. These measures will be incorporated into a detailed North-Western Offset Site Management Plan prepared prior to relevant impacts occurring.

For each of the required management measures, the Offset Site Management Plan will describe the following:

- Describe the existing situation
- Detail the proposed management measure including
    - Specific locations where management is required
    - The objectives of the management
    - The proposed actions to achieve the objectives
    - Identify persons responsible
    - Estimated costs and timeframes
- Proposed monitoring regime
- Reporting requirements

The BioBanking credit calculator BCC recommends specific management measures as they apply to each vegetation zone within an assessment. The requirements for the proposed North-Western Offset Site Management Plan were returned by the offset credit statement (Appendix 2) for all vegetation zones as follows:

- Cat and/or fox control
- Exclusion of miscellaneous feral species
- Feral and /or native herbivore control/exclusion (e.g. rabbits, goats, deer etc)

In addition, the following measures will also be undertaken:

- Restriction of public access including fencing and signage
- Weed control (several noxious weeds are widespread across the offset site)
- Management of stock grazing for conservation purposes (this would be conducted in consultation with a local agronomist)
- Assisted regeneration of cleared areas by either stock exclusion or strategic rehabilitation including plantings
- Implementation of controlled burns

Detailed proposed management measures and associated justification, proposed actions and monitoring are provided in Appendix 2. All management measures are the responsibility of State Water.

Peel River Offset Site

The Peel River Offset Site comprises a 9 km long section of the Peel River upstream of the dam, which supports known habitat for the Booroolong Frog (Figure 6-12). Land within the Peel River Offset Site is currently managed by four landholders, each under a 10 year Management Agreement (MA) with Namoi CMA, as shown in Appendix 2. These MAs are due to expire in five years (2018). The current MAs have a range of conditions, however the implementation and effectiveness of actions carried out under these conditions are not monitored.

Despite the implementation of the MAs over the past five years, residual threats to the Booroolong Frog, such as stock access and weeds, are still ongoing (Phil Spark, pers. comm.). The current MAs focus on restrictions in land use, but do not include actions to actively manage and improve habitat along the Peel River. Under the present management the future quality of the offset site is uncertain.

The following allotments comprising the Peel River Offset Site are contiguous and the offset site is contiguous with the Project Site.

Lot 10 DP 1052016	Lot 1 DP 1029183
Lot 7317 DP 1050859	Lot 297 DP 1028315
Lot 99 DP 1028528	Lot 304 DP 1030470
Lot 7008 DP 1047174	Lot 6 DP 1052467

It is proposed that the existing Mas over the Peel River offset site be terminated and replaced with Conservation Agreements between State Water and each landholder.

Further, additional management actions will be implemented at the Peel River Offset Site to ensure a conservation gain is achieved. Management actions will greatly improve restoration and revegetation of the riparian zone. The effectiveness of management actions will be assessed during annual monitoring and compliance with management actions will also be assessed. Management Plans will be adaptive to allow for amendments in response to monitoring results.

Management measures to be implemented at the proposed offset site will target the restoration of foreshore areas, control of weeds and implementation of grazing regimes suitable for regeneration of understorey elements of the communities. These measures will be incorporated into a detailed Peel River Offset Site Management Plan prepared prior to relevant impacts occurring.

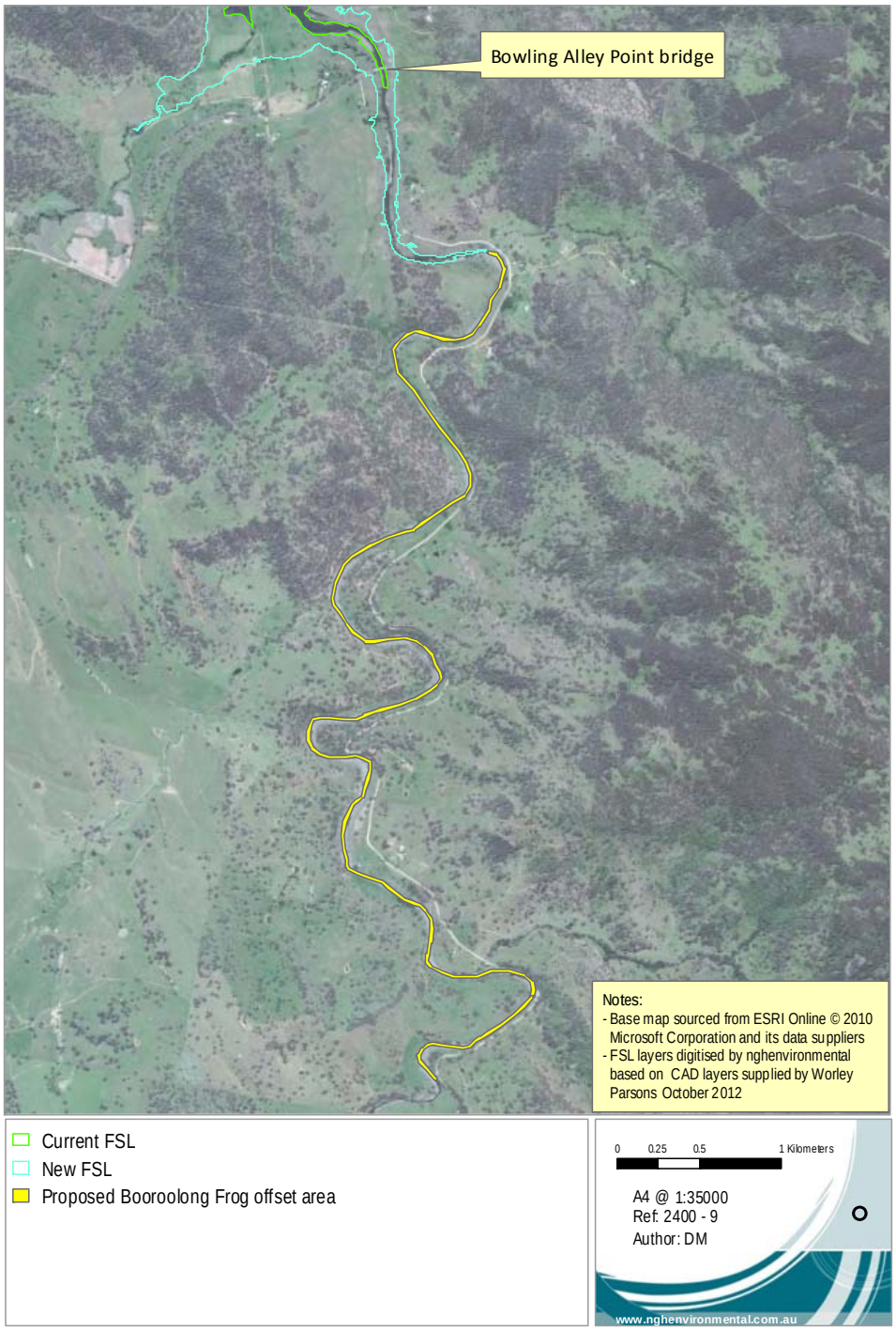

Figure 6-13: Proposed Peel River Offset Site

The general management measures to be implemented at the Peel River Offset Site are as follows:

- Riparian protection and restoration
  - Eradication of weeds
  - Stock exclusion
  - Native revegetation of the riparian zone
  - Prevention of fossicking
  - Limit herbicide and pesticide use
- Predator control
  - Prevent impacts from introduced predatory fish
  - Fox control
- Monitoring
  - Identify population trends in relation to stream drying and riparian restoration
  - Adhere to strict quarantine protocols, such as those outlined in the 'Hygiene protocols for the control of disease in frogs' (NSW NPWS 2001)
  - Identify presence/absence of threats at offset site in order to quantify the success or failure of management measures implemented (e.g. predator and weed abundance, riparian vegetation condition, fossicking activities)

The Peel River Offset Site Management Plan will incorporate additional management measures that ensure a conservation gain above those conditions already in place. Monitoring of the offset site will ensure compliance with those management measures and allow for adaptive management. State Water will be responsible for funding the management actions required at the offset site and monitoring the effectiveness of their implementation.

The management measures and monitoring proposed for the offset site have been recommended in consideration of the National Recovery Plan for the Booroolong Frog and recommendations in NWES (2009).

Detailed proposed management measures and associated justification, proposed actions and monitoring are provided in Appendix 2. All management measures are the responsibility of State Water.

6.3 Aboriginal Heritage

Navin Officer Heritage Consultants Pty Ltd (Navin Officer Heritage Consultants) carried out an Aboriginal Cultural Heritage Assessment for the Project, including consultation with Aboriginal stakeholders and site investigations. This assessment is documented at Section 8.4 of the EIS.

Navin Officer Heritage Consultants documented previously identified sites potentially impacted by the Project in addition to those sites that had not been previously identified.

Given the reduction in size of the Works Areas, as documented in Section 4, impacts to Aboriginal heritage sites are expected to be less than documented in the EIS. Of the nine sites originally assessed as likely to be impacted by road construction activities, only three occur within the revised Works Areas, as shown in Figure 6-14 and described in Table 6-4.

A review of the sites to be impacted by the Project has shown that sites CDAS1 and CDAS9 were located within the original Works Areas and are also located within the revised Works Areas. These sites are also subject to impacts through inundation, as documented in the EIS. The revised Project impact assessment set out in Table 6-4 incorporates this correction.

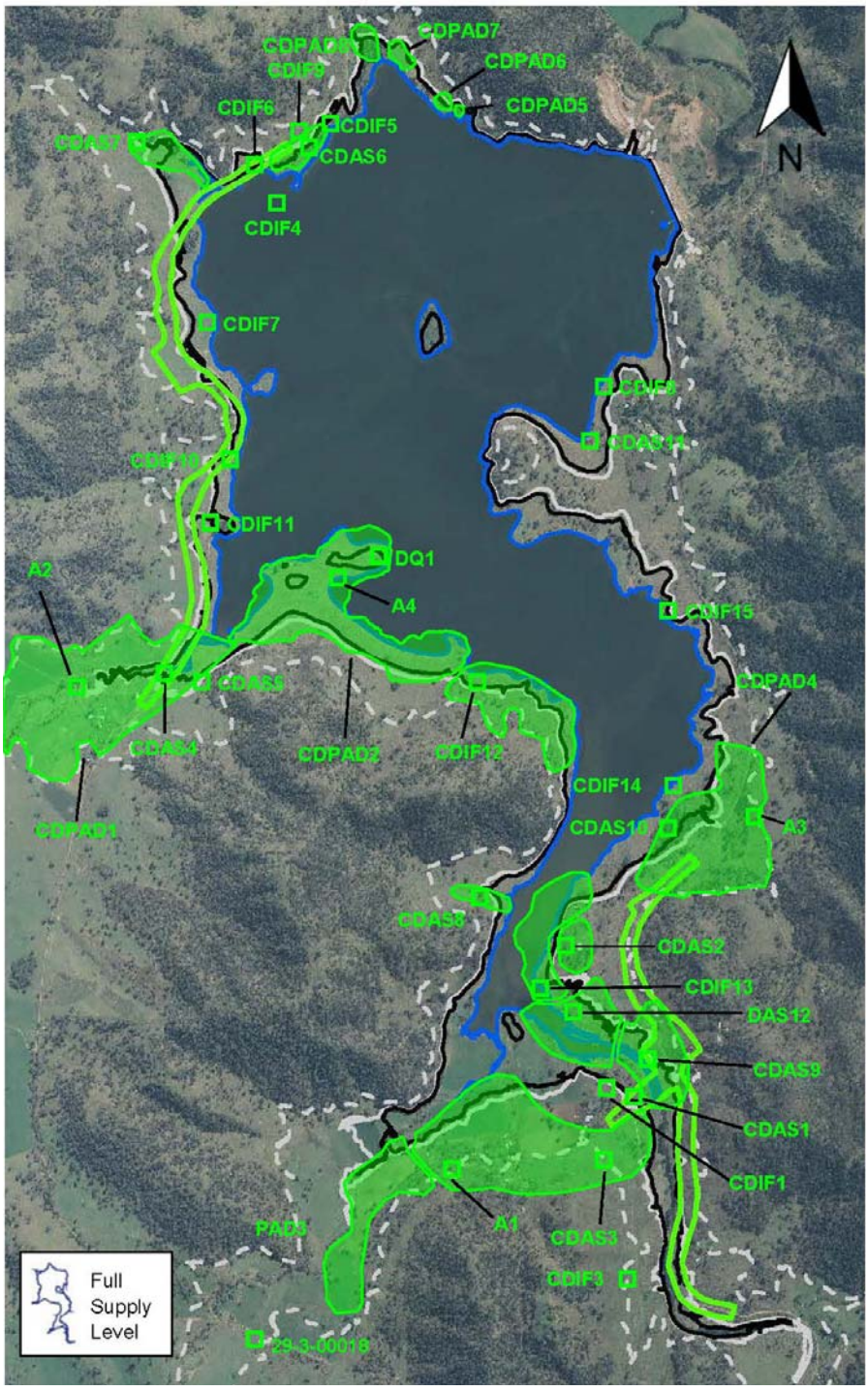

Figure 6-14: Location of Aboriginal heritage items in relation to revised Project layout

Table 6-4: Revised assessment of impact to Aboriginal heritage items within the Chaffey Dam area

Site	Site Type	Landform	Archaeological Significance of Site	Original Project Impact (as documented in EIS)	Revised Project Impact	Revised Consequence of Impact
Nundle / Woolomin 1	Isolated find	Mid slope	Moderate archaeological significance at a local level	Not impacted	Not impacted	N/A
Chaffey A1	Artefact scatter	Basal slope	Moderate archaeological significance at a local level	Not impacted	Not impacted	N/A
Chaffey A2	Isolated find	Creek bank	Moderate archaeological significance at a local level	Not impacted	Not impacted	N/A
Chaffey A3	Artefact scatter	Colluvial flat	Moderate archaeological significance at a local level	Not impacted	Not impacted	N/A
Chaffey A4	Artefact scatter	Spur	Moderate archaeological significance at a local level	Inundation	Inundation	Potential destruction of whole or part of site
CDAS1	Artefact scatter	Mid slope	Moderate archaeological significance at a local level	Inundation	Tamworth- Nundle Rd realignment and/or inundation	Potential destruction of whole or part of site
CDAS2	Artefact scatter	Basal slope	Moderate archaeological significance at a local level	Not impacted	Not impacted	N/A

Site	Site Type	Landform	Archaeological Significance of Site	Original Project Impact (as documented in EIS)	Revised Project Impact	Revised Consequence of Impact
CDAS3	Artefact scatter	Mid slope	Moderate archaeological significance at a local level	Not impacted	Not impacted	N/A
CDAS4	Artefact scatter	Alluvial terrace	Moderate archaeological significance at a local level	Western Foreshore Road realignment and/or inundation	Western Foreshore Road realignment and/or inundation	Potential destruction of whole or part of site
CDAS5	Artefact scatter	Alluvial terrace	Moderate archaeological significance at a local level	Western Foreshore Road realignment	Not impacted	N/A
CDIF1	Isolated find	Gully	Low archaeological significance at a local level	Tamworth- Nundle Rd realignment	Not impacted	N/A
CDIF2	Isolated find	Mid slope	Now part of CDAS12	NA	NA	N/A
CDIF3	Isolated find	Mid slope	Low archaeological significance at a local level	Not impacted	Not impacted	N/A
CDIF4	Isolated find	Mid slope	Low archaeological significance at a local level	Already inundated*	Already inundated*	N/A
CDIF5	Isolated find	Basal slope	Low archaeological significance at a local level	Already inundated*	Already inundated*	N/A

Site	Site Type	Landform	Archaeological Significance of Site	Original Project Impact (as documented in EIS)	Revised Project Impact	Revised Consequence of Impact
CDIF6	Isolated find	Drainage line	Low archaeological significance at a local level	Western Foreshore Road realignment and/or inundation	Western Foreshore Road realignment and/or inundation	Potential destruction of whole or part of site
CDIF7	Isolated find	Mid slope	Low archaeological significance at a local level	Western Foreshore Road realignment and/or inundation	Inundation	Potential destruction of whole or part of site
CDIF8	Isolated Find	Spur crest midslope	Low archaeological significance at a local level	Inundation	Inundation	Potential destruction of whole or part of site
CDIF9	Isolated Find	Basal slope	Low archaeological significance at a local level	Western Foreshore Road realignment	Not impacted	N/A
CDIF10	Isolated Find	Spur crest basal slope	Low archaeological significance at a local level	Western Foreshore Road realignment and/or inundation	Western Foreshore Road realignment and/or inundation	Potential destruction of whole or part of site
CDIF11	Isolated Find	Low gradient knoll	Low archaeological significance at a local level	Western Foreshore Road realignment and/or inundation	Inundation	Potential destruction of whole or part of site

Site	Site Type	Landform	Archaeological Significance of Site	Original Project Impact (as documented in EIS)	Revised Project Impact	Revised Consequence of Impact
CDIF12	Isolated Find and PAD	Basal flats	Moderate to high archaeological significance at a local level	Inundation	Inundation	Potential destruction of whole or part of site
CDIF13	Isolated Find and PAD	Spur crest midslope	Low to moderate archaeological significance at a local level	Inundation	Inundation	Potential destruction of whole or part of site
CDIF14	Isolated Find	Spur crest basal slope	Low archaeological significance at a local level	Inundation	Inundation	Potential destruction of whole or part of site
CDIF15	Isolated Find	Spur crest midslope	Low archaeological significance at a local level	Inundation	Inundation	Potential destruction of whole or part of site
CDAS6	Artefact Scatter and PAD	Basal slope	Moderate to high archaeological significance at a local level	Western Foreshore Road realignment and/or inundation	Inundation	Potential destruction of whole or part of site
CDAS7	Artefact Scatter and PAD	Alluvial terrace	Moderate archaeological significance at a local level	Inundation	Inundation	Potential destruction of whole or part of site
CDAS8	Artefact Scatter and PAD	Spur crest midslope	Moderate archaeological significance at a local level	Inundation	Inundation	Potential destruction of whole or part of site

Site	Site Type	Landform	Archaeological Significance of Site	Original Project Impact (as documented in EIS)	Revised Project Impact	Revised Consequence of Impact
CDAS9	Artefact Scatter	Spur crest midslope	Moderate archaeological significance at a local level	Potential inundation	Tamworth- Nundle Rd realignment and/or potential inundation	Potential destruction of whole or part of site
CDAS10	Artefact Scatter and PAD	Basal slope	Moderate archaeological significance at a local level	Inundation	Inundation	Potential destruction of whole or part of site
CDAS11	Artefact Scatter	Spur crest basal slope	Moderate archaeological significance at a local level	Inundation	Inundation	Potential destruction of whole or part of site
CDAS12	Artefact Scatter and PAD	Alluvial flats	Low to moderate archaeological significance at a local level	Inundation	Inundation	Potential destruction of whole or part of site
CQD1	Potential Quarry	Knoll	Moderate to high archaeological significance at a local level	Potential inundation	Potential inundation	Potential destruction of whole or part of site
CDPAD1	PAD	Alluvial terrace	NA	Inundation	Inundation	Potential destruction of part of site

Site	Site Type	Landform	Archaeological Significance of Site	Original Project Impact (as documented in EIS)	Revised Project Impact	Revised Consequence of Impact
CDPAD2	PAD	Basal slopes	NA	Inundation	Inundation	Potential destruction of part of site
CDPAD3	PAD	Alluvial terrace	NA	Inundation	Inundation	Potential destruction of part of site
CDPAD4	PAD	Alluvial terrace	NA	Inundation	Inundation	Potential destruction of part of site
CDPAD5	PAD	Spur crest	NA	Inundation	Inundation	Potential destruction of part of site
CDPAD6	PAD	Spur crest	NA	Inundation	Inundation	Potential destruction of part of site
CDPAD7	PAD	Spur crest	NA	Inundation	Inundation	Potential destruction of part of site
CDPAD8	PAD	Alluvial terraces	NA	Inundation	Inundation	Potential destruction of part of site

Of the previously identified sites, Navin Officer Heritage Consultants documented sites Chaffey A1, Chaffey A2, Chaffey A3 and Chaffey A4, which were originally identified by Resource Planning (1990). No grid references for these sites were provided in Resource Planning (1990). As documented in Appendix 9 of the EIS (Aboriginal Cultural Heritage Assessment), prior to submission of the EIS, no site cards had been submitted for these sites to OEH.

In response to the OEH Submission, Navin Officer Heritage Consultants has prepared and submitted copies of site cards to OEH for sites Chaffey A1, Chaffey A2, Chaffey A3 and Chaffey A4, so they can be registered onto the AHIMS. As no grid references for these sites were provided in Resource Planning (1990), the locations of the sites were estimated from the figures provided in Resource Planning (1990).

Appendix 9 of the EIS (Aboriginal Cultural Heritage Assessment) documents the Aboriginal consultation carried out for the Project. The consultation was undertaken in accordance with the OEH *Aboriginal cultural heritage consultation requirements for proponents 2010* (NSW OEH 2010) (the 2010 Guidelines). As noted in Section 8.4.1 of the EIS, the 2010 Consultation Guidelines supersede the Draft Guidelines for Aboriginal Cultural Heritage Impact Assessment and Community Consultation (the 2005 Draft Consultation Guidelines; DEC 2005b). Additionally, the 2010 Consultation Guidelines provide a more stringent process, which meets and exceeds the requirements under the 2005 Draft Consultation Guidelines. As such, the requirements under the 2005 Draft Consultation Guidelines have been satisfied.

In response to the OEH Submission, the following additional information was provided by Navin Officer Heritage Consultants to further demonstrate compliance with the 2010 Guidelines. The additional information provided below has been discussed with the Aboriginal Heritage Planning Officer, Regional Operations Group of OEH to confirm that it adequately addresses the relevant components of the OEH Submission.

Aboriginal Consultation

As per the Director-General's Requirements for the Environmental Assessment for the Chaffey Dam Augmentation and Safety Upgrade Project, this cultural heritage assessment complied with the Draft Guidelines for Aboriginal Cultural Heritage Impact Assessment and Community Consultation as set out by the NSW Department of Environment and Conservation (now the NSW Office of Environment and Heritage) in 2005.

The proponent also seeks to comply with the current requirements of the NSW Office of Environment and Heritage (formerly the NSW Department of Environment, Climate Change and Water). The project, therefore, also complies with the NSW OEH Aboriginal cultural heritage consultation requirements for proponents 2010 (NSW OEH 2010). The 2010 guidelines provide a more stringent process which meets and exceeds the requirements under the 2005 draft guidelines.

This document sets out the requirements for 'consulting with those Aboriginal people who can provide information about the significance of Aboriginal cultural heritage as part of the heritage

assessment process that informs any AHIP [Aboriginal Heritage Impact Permit] application' (NSW OEH 2010:1).

The requirements apply to all activities throughout NSW that have the potential to harm Aboriginal objects or places and that also require an AHIP. The requirements specify four stages of consultation:

Stage 1 - notification of project proposal and registration of interest

Stage 2 - presentation of information about the proposed project

Stage 3 – gathering information about cultural significance

Stage 4 – review of draft cultural heritage assessment report

Stage 1

An advertisement was placed in the:

- *Northern Daily Leader on Saturday the 16th of June 2012 (Appendix 1).*

Requests for Potential Aboriginal stakeholders were sent to the:

- *Nungaroo Local Aboriginal Land Council;*
- *Tamworth Local Aboriginal Land Council;*
- *Tamworth Regional Council;*
- *Namoi Catchment Management Authority;*
- *NSW OEH;*
- *Native Title Services Corporation Ltd; and*
- *Office of the Registrar Aboriginal Land Rights Act 1983.*

Following advice received from these requests, letters were sent to the following on 28th June 2012:

- *Mr Tom Taylor;*
- *Mr Greg Clarke and Family;*
- *Mr Joe Brand;*
- *Mr Brent Mathews;*
- *Mr Brian Draper;*
- *Ms Christine Archbold;*
- *Mr Clifford Matthews;*

- *Coonabarabran Local Aboriginal Land Council (LALC);*
- *Mr Derrick Vale, DFTV Enterprises;*
- *Mr Darrell Mathews;*
- *Mr Jeff Mathews;*
- *Mr John Matthews;*
- *Mr Justin Matthews;*
- *Mr Kevin Sampson;*
- *Mr Len Waters;*
- *Mr Lloyd Matthews;*
- *Mooki Plains Management;*
- *Mr Wayne Mathews, Mooki River Consultants;*
- *Mr Brian Horton, Muswellbrook Cultural Consultants;*
- *Ms Rhonda Kitckener,, Nyakka Aboriginal Corporation;*
- *Mr Paul Moodie;*
- *Mr Rodney Mathews;*
- *Mr Scott Smith;*
- *Ms Tania Mathews;*
- *Mr Ron Smith; and*
- *Desley Talbot Consultants.*

The closing date for expressions of interest was 12th July 2012.

Registrations of interest were received from (known as Representative Aboriginal Parties (RAP):

- *Bunda Consultants;*
- *Bawurra Consultants (BC);*
- *DFTV Enterprises;*
- *Tommy Taylor;*
- *Waruu Consultation Group;*
- *Deslee Talbot Consultants (DTC);*

- *Len Waters;*
- *Heilamon Cultural Consultants (HCC);*
- *Breeza Plains (BP); and*
- *Wunda Cultural Consultants (WCC).*

Stage 2

A site visit was conducted on Friday the 28th of September 2012 with invitations to attend provided to all registered Aboriginal stakeholders. This involved a meeting at the State Water office to provide information about and discuss the project, followed by site visit to inspect all recorded sites. The methodology used in the site survey was discussed. No issues or concerns were raised regarding the methodology or the project at this time.

The following attended the site visit:

- *Colin Johnson;*
- *Clifford Johnson (HCC);*
- *Len Waters;*
- *Deslee Matthews (DTC);*
- *Martin Salvador (WCC);*
- *Terry Matthews (BP); and*
- *Kevin Sampson (BC).*

Stage 3

A draft copy of this report, accompanied by an invitation to provide comments, was provided on the 18th September 2012 via post to each of the registered stakeholders.

A site visit conducted on the 28th of September 2012 with an invitation to all registered Aboriginal stakeholders. An invitation to provide culturally appropriate information was provided at this site visit, with requests for any further comment to be provided in writing.(

No formal comments were received however all representatives requested that all impacted Aboriginal objects should be salvaged and collected prior to impact.

Stage 4

A draft copy of this report, accompanied by an invitation to provide comments, was provided on the 18th September 2012 via post to each of the registered stakeholders. As required by the Aboriginal cultural heritage consultation requirements for proponents 2010 (NSW OEH 2010), a period of 28 days, which ended on 15th October 2012, was provided for registered stakeholders to comment on the report. No comments were received.

As noted in the EIS, a 'Back to Country' protocol will be developed in consultation with Aboriginal stakeholders to detail the location and methodology for the placement of salvaged Aboriginal objects. Having regard to the Namoi CMA Submission, Namoi CMA will be consulted during the development of the 'Back to Country' protocol.

The EIS documented the requirement for fencing of known Aboriginal heritage sites adjacent to construction footprints. Further to this requirement, a 10 m buffer zone (as advised by Navin Officer Heritage Consultants) will be established around those known Aboriginal heritage sites that are adjacent to construction footprints. The fencing will be placed on the outer edge of this buffer zone. Unauthorised access to these fenced areas by personnel and equipment will be prohibited.

6.4 European Heritage

A Heritage Impact Assessment (HIA) was carried out as part of the EIS. This assessment is documented at Section 8.5. The HIA assessed the impact of the Project on listed heritage items within the vicinity of the Project Site.

Correspondence from the Heritage Council during finalisation of the EIS, adequacy review and the EIS exhibition period referenced the Preliminary Archaeological and Heritage Assessment (PAHA) (Navin Officer Heritage Consultants 2008) prepared for the project and subsequently discussed in the Preliminary Environmental Assessment (PEA) for the Project (Molino Stewart 2011).

The PAHA documented a total of 26 non-Aboriginal (European) heritage items as occurring within the vicinity of the Project Site. It is noted that the PEA (Molino Stewart 2011) erroneously referred to the PAHA as documenting 24 (rather than 26) European heritage items.

The PAHA was considered during preparation of the HIA, however it was considered highly likely that the PAHA would have formed part of the preparation of the Tamworth Regional Local Environmental Plan 2010 (TRLEP) and thus any items of heritage significance documented in the PAHA would have been included on the heritage schedule (Schedule 5) to the TRLEP.

This assumption was based on the recommendation within the PAHA that a copy of that report be provided to Tamworth Regional Council and that the TRLEP 2010 is dated two years after completion of the PAHA.

WorleyParsons liaised with Tamworth Regional Council between December 2012 and January 2013 in relation to this matter and it became apparent that the PAHA was not considered by Tamworth Regional Council in the preparation of the TRLEP.

Having regard to the above, an assessment is now provided in Table 6-5 of the impact (if any) of the Project on each of the 26 European heritage items identified in the PAHA as occurring within the vicinity of the Project Site. Mitigation measures are documented for each impacted item.

Of the 26 items, four are listed on the TRLEP and one is proposed for relisting on the State Water s170 Register. These five listed items were assessed in the EIS, as noted in Table 6-5.

Figure 6-15 shows the location of the 26 items of European heritage items identified in the PAHA as occurring within the vicinity of the Project Site. The locations of the listed heritage items shown on Figure 6-15 are consistent with those provided in the EIS. The locations of the unlisted heritage items are as per the coordinates provided in the PAHA. It is noted that the location of CDHS14 House is shown as occurring within the Western Foreshore Road Works Area, however examination of aerial photographs and field validation have shown that this item is well outside the Works Area.

Impacts to the Bowling Alley Point Settlement heritage item have been minimised through the reduction in the Rivers Road Works Area, as described in Section 4.

Figure 6-15: Revised European heritage locations within and surrounding the Project Site

Table 6-5: Further assessment of impacts to European heritage

Statutory Listing	Item Significance (Navin Officer 2008)	Assessment of Construction Impact	Assessment of Operational Impact	Navin Officer (2008) Recommendation	Proposed Mitigation Measures
1. Bowling Alley Geological Site					
TRLEP - local significance	Assessment of impact carried out in HIA (Appendix 10 of the EIS)				
2. Bowling Alley Point Historic Settlement					
Not listed	Moderate	Moderate. Direct impacts to part of site during realignment of Rivers Road. Inundation of part of site by new FSL.	Minor. Potential for impacts during extreme flood events, as part of site within new 1 in 100 year flood level and majority of site within new PMF level.	Comprehensive mapping and recording.	Comprehensive mapping and recording of part of site within construction footprint and new FSL prior to these impacts occurring. Fencing (star pickets connected with high visibility flagging, or similar) of Works Area boundary in the vicinity of the site.
3. Bowling Alley Point Post Office Site and Petrol Station					
Not listed	Moderate	None. Outside of construction areas and new FSL.	Minor. Potential for impacts during extreme flood events, as part of	Comprehensive mapping and recording.	Nil.

Statutory Listing	Item Significance (Navin Officer 2008)	Assessment of Construction Impact	Assessment of Operational Impact	Navin Officer (2008) Recommendation	Proposed Mitigation Measures
			site is within new PMF level. Outside new 1 in 100 year flood level.		
4. Bowling Alley Point Hall Site					
Not listed	Moderate	Moderate. Potential for direct impacts to site during realignment of Rivers Road. Potential for inundation of site by new FSL.	Minor. Potential for impacts during extreme flood events, as site is within new 1 in 100 year flood level and new PMF level.	Comprehensive mapping and recording.	Comprehensive mapping and recording of part of site within construction footprint and new FSL prior to these impacts occurring.
5. Bowling Alley Point School Site					
TRLEP - local significance	Assessment of impact carried out in HIA (Appendix 10 of the EIS)				
6. Alluvial and Reef Mining Sites					
Not listed	High	Moderate. Direct impacts to part of northern alluvial mining sites during realignment of Rivers Road. Inundation of part of northern	Moderate. Potential for impacts during extreme flood events, as part of northern alluvial mining sites within new 1 in 100 year flood level and	Comprehensive mapping and recording.	Comprehensive mapping and recording of part of site within construction footprint and new FSL prior to these impacts occurring. Fencing (star pickets connected

Statutory Listing	Item Significance (Navin Officer 2008)	Assessment of Construction Impact	Assessment of Operational Impact	Navin Officer (2008) Recommendation	Proposed Mitigation Measures
		alluvial mining sites and two reef mining sites by new FSL.	part of southern and northern alluvial mining sites and two reef mining sites within new PMF level.		with high visibility flagging, or similar) of Works Area boundary in the vicinity of the site.
7. Bowling Alley Point Footbridge Trestle					
Not listed	The site was not located by Navin Officer (2008). No assessment can be undertaken as the trestle has reportedly been lost during a flood event and not recovered				
8. Footbridge					
TRLEP - local significance	Assessment of impact carried out in HIA (Appendix 10 of the EIS)				
9. World War 1 Monument					
Not listed	Moderate	Significant. Inundation of site by new FSL. Outside of construction areas.	None. Impact associated with FSL, rather than new 1 in 100 year flood level or PMF.	Nil.	Relocate item within the vicinity of its present location, above the new FSL. New location should aid in the interpretation of the monument with regard to its connection to the area.
10. Australian Agricultural Company (AAC) Commemorative Plaque					
Not listed	Moderate	Significant.	None.	Moved.	Relocate item within the vicinity of its present location, above the new

Statutory Listing	Item Significance (Navin Officer 2008)	Assessment of Construction Impact	Assessment of Operational Impact	Navin Officer (2008) Recommendation	Proposed Mitigation Measures
		Inundation of site by new FSL. Outside of construction areas.	Impact associated with FSL, rather than new 1 in 100 year flood level or PMF.		FSL. New location should aid in the interpretation of the plaque with regard to its connection to the development of the area by the AAC.
11. Dulegal Arboretum					
Not listed	High	Moderate. Inundation of part of site (approximately 30%) by new FSL. Outside of construction areas.	Minor. Potential for impacts during extreme flood events, as part of site within new 1 in 100 year flood level and new PMF level.	Further investigation and consultation.	Develop an Interpretation Strategy for the Dulegal Arboretum. Relocate the memorial plaque present the Dulegal Arboretum to above the new FSL, within the Arboretum. State Water will liaise with local environmental groups, including Land Care, Tamworth Urban Group, Tamworth Garden Club and the National Parks Association of NSW Tamworth-Namoi Branch, to organise seed collection activities within the Dulegal Arboretum. All

Statutory Listing	Item Significance (Navin Officer 2008)	Assessment of Construction Impact	Assessment of Operational Impact	Navin Officer (2008) Recommendation	Proposed Mitigation Measures
					groups will be required to be appropriately licensed and insured to take part in the seed collection activities.
12. Chaffey Dam					
State Water s170 Register (proposed for relisting)	Assessment of impact carried out in HIA (Appendix 10 of the EIS)				
13. CDHS1 Windmill and Well					
Not listed	Moderate	Significant. Inundation of site by new FSL. Outside of construction areas.	None. Impact associated with FSL, rather than new 1 in 100 year flood level or PMF.	Nil.	Comprehensive mapping and recording of part of site within new FSL prior to this impacts occurring.
14. CDHS2 Stone Wall associated with a Mining Area					
Not listed	High	None. Outside of construction areas and new FSL.	Minor. Potential for impacts during extreme flood events, as site within	Nil.	Nil.

Statutory Listing	Item Significance (Navin Officer 2008)	Assessment of Construction Impact	Assessment of Operational Impact	Navin Officer (2008) Recommendation	Proposed Mitigation Measures
			new PMF level. Outside new 1 in 100 year flood level.		
15. CDHS3 Remains of 'Rocklight' Homestead					
Not listed	Moderate	None. Outside of construction areas and new FSL. Adjacent to Works Area.	Minor. Potential for impacts during extreme flood events, as site within new PMF level. Outside new 1 in 100 year flood level.	Comprehensive mapping and recording.	Fencing (star pickets connected with high visibility flagging, or similar) of Works Area boundary in the vicinity of the site.
16. CDHS 4 Possibly Remains of a Structure associated with 'Rocklight' Homestead					
Not listed	Moderate	Significant. Inundation of site by new FSL. Outside of construction areas.	None. Impact associated with FSL, rather than new 1 in 100 year flood level or PMF.	Nil.	Comprehensive mapping and recording of part of site within new FSL prior to this impacts occurring.
17. CDHS5 Remains of 'Hillview' Homestead					
Not listed	Moderate	None. Outside of construction areas and new FSL.	Minor. Potential for impacts during extreme flood events, as part of	Comprehensive mapping and recording.	Nil.

Statutory Listing	Item Significance (Navin Officer 2008)	Assessment of Construction Impact	Assessment of Operational Impact	Navin Officer (2008) Recommendation	Proposed Mitigation Measures
			site within new PMF level. Outside new 1 in 100 year flood level.		
18. CDHS6 Possibly the Remains of Structures or Gardens associated with 'Hillview' Homestead					
Not listed	Moderate	None. Outside of construction areas and new FSL.	Minor. Potential for impacts during extreme flood events, as site within new PMF level. Outside new 1 in 100 year flood level.	Nil.	Nil.
19. CDHS 7 Possibly the Remains of Structures or Structures associated with 'Lynhurst' Homestead					
Not listed	Moderate	Significant. Inundation of site by new FSL. Outside of construction areas.	None. Impact associated with FSL, rather than new 1 in 100 year flood level or PMF.	Nil.	Comprehensive mapping and recording of part of site within new FSL prior to this impacts occurring.
20. CDHS 8 Remains of 'Lynhurst' homestead					
Not listed	Moderate	Significant. Inundation of site by new FSL. Outside of construction areas.	None. Impact associated with FSL, rather than new 1 in 100 year flood level	Nil.	Comprehensive mapping and recording of part of site within new FSL prior to this impacts occurring.

Statutory Listing	Item Significance (Navin Officer 2008)	Assessment of Construction Impact	Assessment of Operational Impact	Navin Officer (2008) Recommendation	Proposed Mitigation Measures
			or PMF.		
21. CDHS9 Probable Occupation Site					
Not listed	Moderate	Significant. Inundation of site by new FSL. Outside of construction areas.	None. Impact associated with FSL, rather than new 1 in 100 year flood level or PMF.	Nil.	Comprehensive mapping and recording of part of site within FSL prior to this impact occurring.
22. CDHS10 Mining Race and Tailing Mounds					
Not listed	High	None. Outside of construction areas and new FSL.	Minor. Potential for impacts during extreme flood events, as site is within new PMF level. Outside new 1 in 100 year flood level.	Comprehensive mapping and recording.	Nil.
23. CDHS11 Possibly the Remains of 'Lodhaver' Homestead					
Not listed	Moderate	None. Site is wholly within existing FSL.	None. Site is wholly within existing FSL.	May require further investigation.	Nil.

Statutory Listing	Item Significance (Navin Officer 2008)	Assessment of Construction Impact	Assessment of Operational Impact	Navin Officer (2008) Recommendation	Proposed Mitigation Measures
24. CDHS12 Commemorative Plaques on the Bowling Alley Point Bridge					
Not listed	Moderate	Significant. Direct impact as existing Bowling Alley Point Bridge is to be removed.	None. Impact associated with removal of existing Bowling Alley Point Bridge.	Nil.	Relocate the Commemorative Plaques to the new Bowling Alley Point Bridge.
25. CDHS13 Entranceway to the Bowling Alley Point Cemetery					
TRLEP – local significance (part of Bowling Alley Point Cemetery site)	Assessment of impact carried out in HIA (Appendix 10 of the EIS)				
26. CDHS14 House					
Not listed	Moderate	Moderate. Visual impacts during realignment of Western Foreshore Road. Outside of construction areas and new FSL.	Minor. Potential for impacts during extreme flood events, as site within new PMF level. Outside new 1 in 100 year flood level.	Nil.	The Contractor's CEMP will include measures to minimise visual impacts to the House at Hydes Creek during road and bridge construction activities, such as dust suppression, maintenance of tidy

Statutory Listing	Item Significance (Navin Officer 2008)	Assessment of Construction Impact	Assessment of Operational Impact	Navin Officer (2008) Recommendation	Proposed Mitigation Measures
					construction areas and the use of hoardings.

6.5 Traffic and Transport

As described at Section 8.6 of the EIS, the New England Highway (HW9) and the Tamworth-Nundle Road (MR105) will be utilised to access the Project Site during construction. Both New England Highway and the Tamworth-Nundle Road are classified roads.

Tamworth Regional Council is the Roads Authority for Tamworth-Nundle Road and all other public roads in the area.

RMS is the Roads Authority for the New England Highway.

In accordance with Section 138 of the *Roads Act 1993*, the consent of Tamworth Regional Council is required for the proposed works to Tamworth-Nundle Road, as well as the concurrence of RMS. In accordance with the provisions of Section 115ZH(1)(f) of the EP&A Act, as the Project comprises State Significant Infrastructure, a consent under Section 138 of the *Roads Act 1993* cannot be refused.

The design inputs for road realignment and bridge construction for the Project have been developed in consultation with Tamworth Regional Council. Consultation with Tamworth Regional Council will continue throughout the detailed design phase for road realignment and bridge construction. All road infrastructure works will be carried out in accordance with current Austroads Guidelines and relevant Australian Standards.

As described in Section 5.2.12 of the EIS, there will likely be a requirement for a concrete batching plant on site as part of construction activities for the Project. The concrete batching plant was excluded from the assessment carried out in the EIS, as responsibility for any relevant approvals and licensing of the concrete batching plant will lie with the Construction Contractor. As a worst case scenario, assessment of traffic generation was based on the need to deliver concrete by trucks from the supplier external to the site.

In response to the RMS Submission, the Construction Traffic Management Plan to be prepared and implemented for the Project will include a Vehicle Movement Plan and Traffic Control Plan. The Plan will be prepared with the objective of the Project causing minimal impact on the operation of the existing road network and road infrastructure assets during the construction process. The Construction Traffic Management Plan will be submitted to RMS and Tamworth Regional Council for approval prior to any construction activities occurring onsite.

The operator of any Over-size/Over-mass vehicles will be responsible for obtaining all necessary permits prior to the transport of materials.

6.6 Noise and Vibration

As described in Section 8.7 of the EIS, noise modelling showed that peak construction noise levels are predicted to be exceeded at all rural residential receivers (R4, R5, R6, R7, R8, R9, R10 and R11) (Refer EIS Table 8-16). However, noise levels at rural residential receivers will be below the "Highly Noise Affected" level of 75 dB(A).

In order to reduce noise emissions during construction of the Bowling Alley Point Bridge and Hydes Creek Bridge, alternative piling methods such as bored or vibratory approaches have been considered in lieu of impact piling, where feasible and reasonable. Ground conditions at the Project Site allow for the use of a bore pile rig, which will be the preferred equipment and method for piling works.

As described in the EIS, it is proposed that all construction activities will be carried out within the standard construction hours specified in the Interim Construction Noise Guideline (ICNG) (DECC 2009), as follows:

- Monday to Friday 7:00am to 6:00pm;
- Saturday 8:00am to 1:00pm;
- No work on Sundays or public holidays.

Any blasting required will be further restricted to between the hours of 9:00am to 5:00pm Monday to Friday and 9:00am to 1:00pm on Saturdays.

Should the necessity arise for any construction works to occur outside the standard construction hours, the Contractor will seek prior approval from the Department of Planning and Infrastructure, accompanied by appropriate justification.

As documented in the EIS, monitoring of any blasting required will be carried out to ensure compliance with relevant criteria. This will comprise monitoring of the air blast overpressure and ground vibration associated with blasting activities.

6.7 Air Quality

As documented in Section 8.8 of the EIS, an Air Quality Impact Assessment (AQIA) was prepared by SLR Consulting for the Project. The AQIA comprised atmospheric dispersion modelling of "worst case" fugitive emissions of particulate matter (as TSP, PM10 and PM2.5) from the site using the CALPUFF dispersion model. Local meteorological conditions were predicted using The Air Pollution Model (TAPM) for the year 2011.

The activities assessed included the works associated with raising the dam wall, as well as road works that will be required along Western Foreshore Road and at Bowling Alley Point. Emissions from excavation, vehicle movements, wind erosion, and the handling of soils were addressed in the AQIA.

The results of the dispersion modelling demonstrated compliance with annual average TSP criteria and dust deposition rates at all receptors. Further, no exceedances were predicted for PM_{10} or $PM_{2.5}$ concentrations at sensitive receptors in the vicinity of the dam wall Works Area.

The modelling did however, indicate a potential for elevated PM_{10} and $PM_{2.5}$ concentrations at residential receptors located close to the road construction activities along Western Foreshore Road and at Bowling Alley Point. The greatest impacts were predicted at a residence located immediately east of the southern end of Rivers Road. This receptor was predicted to have the potential to be exposed to a worst case 24-hour average PM_{10} concentration of 150 µg/m^3 (compared to a guideline of 50 µg/m^3) and a worst case 24-hour average $PM_{2.5}$ concentration of 30.5 µg/m^3 (compared to a guideline of 25 µg/m^3).

It was noted in the AQIA that the modelling was based on the peak, worst case construction scenarios occurring at the worst case locations for the full year of meteorological data used in the modelling. Therefore actual concentrations are likely to be lower than the predicted due to the transient and short-term nature of the Project.

Based on the results of the modelling, the AQIA identified that care will need to be taken when the road construction activities are being undertaken in the vicinity of residences along these roads and that a CEMP should be prepared detailing the control measures to be implemented to minimise off-site impacts of fugitive dust emissions. A range of best practice dust control measures were recommended.

The EPA Submission made during exhibition of the EIS requested that the AQIA be revised to demonstrate that air impacts at all sensitive receptors will meet EPA assessment criteria.

In response to the EPA Submission, the excavation rate and proposed mitigation measures for the construction works along Western Foreshore Road and at Bowling Alley Point were reviewed and revised.

The worst case excavation rate of 100 tph utilised in the original AQIA was reviewed and revised to a typical rate of 50 tph. Mitigation measures proposed in the EIS were also incorporated into the revised AQIA, as follows:

- Restrict vehicle speeds to less than 50 km/hr (as described in the EIS, vehicle speeds on unsealed roads within designated works areas will be limited to 40 km/hour or less)
- Minimise disturbed areas (as described in the EIS, the extent of unsealed areas will be minimised by only clearing or unsealing areas required for the works and progressively rehabilitating disturbed areas as soon as possible after works are completed)

Also as documented in the EIS, unsealed roads, other unsealed surfaces, dry, sandy materials and stockpiles (as relevant) within designated works areas will be watered, likely using water carts, when visible dust emissions can be observed travelling offsite.

Further, the following mitigation measures have been incorporated into the revised AQIA and will be implemented during construction of the Project:

- Watering will be carried out at a rate of >2 L/m^2/hour on unsealed travel routes (note it is important to not allow unsealed areas to become saturated as this will increase emissions once they dry out)
- Unsealed travel routes and materials handled by dozers will be kept moist
- Water sprays will be utilised where graders are used
- Wind breaks will be installed to reduce wind speeds across the Works Areas

The revised AQIA showed a 58% decrease in the PM_{10} emissions estimated for the Western Foreshore Road construction area and a 50% decrease in the PM_{10} emissions estimated for the Bowling Alley Point construction area.

While the cumulative 24-hour PM_{10} and $PM_{2.5}$ concentrations do show one predicted exceedance for all receptors, this is due to the background PM_{10} and $PM_{2.5}$ data containing one exceedance. The revised predicted incremental impacts from the road construction activities do not result in any additional exceedances being predicted at any receptors.

The revised AQIA demonstrates the maximum PM_{10} and $PM_{2.5}$ concentrations predicted at residential receptors located close to the road construction activities along Western Foreshore Road and Bowling Alley Point comply with NSW EPA assessment criteria (Table 6-6 and Table 6-7).

Table 6-6: Predicted 24-hour and annual average PM_{10} concentrations

ID	Description	24-Hour Average PM_{10} Concentrations		Annual Average PM_{10} Concentrations	
		Incremental (µg/m³)	Cumulative * (µg/m³)	Incremental (µg/m³)	Cumulative * (µg/m³)
R4	Bowling Alley Point	0.6	51 (1)	<0.1	13
R5	Bowling Alley Point	1.4	51 (1)	0.4	13
R6	Bowling Alley Point	0.9	51 (1)	0.2	13
R7	Bowling Alley Point	29.3	55 (1)	3.1	16
R8	Western Foreshore	7.0	52 (1)	1.1	14
R9	Western Foreshore	4.3	51 (1)	0.7	14
R10	Western Foreshore	1.9	51 (1)	0.3	13
R11	Western Foreshore	1.3	51 (1)	0.2	13
Criteria		**-**	**50**	**-**	**30**

Table 6-7: Predicted 24-hour and annual average $PM_{2.5}$ concentrations

ID	Description	24-Hour Average $PM_{2.5}$ Concentrations		Annual Average $PM_{2.5}$ Concentrations	
		Incremental ($\mu g/m^3$)	Cumulative * ($\mu g/m^3$)	Incremental ($\mu g/m^3$)	Cumulative * ($\mu g/m^3$)
R4	Bowling Alley Point	0.1	25.5 (1)	<0.0	6.6
R5	Bowling Alley Point	0.2	25.5 (1)	0.1	6.6
R6	Bowling Alley Point	0.1	25.5 (1)	<0.0	6.6
R7	Bowling Alley Point	3.0	26.0 (1)	0.3	6.9
R8	Western Foreshore	1.1	25.6 (1)	0.2	6.7
R9	Western Foreshore	0.6	25.5 (1)	0.1	6.7
R10	Western Foreshore	0.3	25.5 (1)	0.1	6.6
R11	Western Foreshore	0.2	25.5 (1)	<0.0	6.6
Criteria		**-**	**25**	**-**	**8**

Given the revised AQIA demonstrates that air quality emissions at residential receptors located close to the road construction activities along Western Foreshore Road and Bowling Alley Point comply with NSW EPA assessment criteria, mitigation measures proposed in the EIS specific to works in the vicinity of Receivers 5, 7 and 8 have been revised, as follows:

- Watering will be carried out at a rate of >2 L/m2/hour on unsealed travel routes (note it is important to not allow unsealed areas to become saturated as this will increase emissions once they dry out)
- Unsealed travel routes and materials handled by dozers will be kept moist
- Water sprays will be utilised where graders are used
- Wind breaks will be installed to reduce wind speeds across the Works Areas

The revised mitigation measures proposed will be implemented when activities are being carried out in close proximity to residential receptors and in response to adverse conditions during construction (i.e. when dust is observed travelling offsite towards residential receptors).

A log sheet will be maintained on site during construction to document meteorological conditions and dust control measures implemented including:

- Wind strength (based on the Beaufort scale, refer Section 8.8.4 of the EIS)
- Wind direction
- Recent rainfall
- Dust controls being implemented
- Visible dust emissions travelling off-site towards residential receptors

Where dust emissions are observed to be travelling off-site towards residential receptors or where complaints are received, corrective actions will be implemented. Where complaints occur while all proposed mitigation and corrective actions are being implemented, dust monitoring will be implemented to assess actual dust levels against relevant guidelines.

As documented in the EIS, residents adjacent to works areas will be informed prior to and during construction, of the nature, duration, expected overall dust levels and relevant contact details for site personnel. Further, an effective Complaints Handling System will be developed and implemented throughout construction.

Further, it is proposed to develop an Air Quality Management Plan (or incorporate relevant measures into the CEMP) for implementation during construction. The Air Quality Management Plan should include the following information for each primary air pollutant and emission source:

- Key performance indicator
- Monitoring method
- Location frequency and duration of monitoring
- Record keeping
- Response mechanisms
- Compliance reporting

6.8 Land Use

As documented in the EIS, a Recreation Continuance Plan will be developed and implemented to address and mitigate impacts on recreational users during construction as well as during the initial inundation period, when the distance between the new facilities and the reservoir will be greater than at present.

Impacted facilities at the Bowling Alley Point Recreation Area will be relocated in consultation with the Bowling Alley Point Recreation Trust. The relocated facilities will be of the same standard or higher than the current facilities.

6.9 Socioeconomic

As documented in the EIS, it is considered that the Project is likely to result in significant socioeconomic benefits. This is further evidenced by the information provided at Section 5.3.1 in regard to assessment of project options, including the “do nothing” option.

Also as documented in the EIS, construction of the Project will create employment opportunities for the area, both locally and regionally. Employment opportunities for between approximately 20 and 50 personnel is expected to be created during the construction period through direct employment on the Project, as follows:

- Weeks 1 to 12 Construction documentation, approvals and establishment (approximately 20 personnel on site).
- Weeks 13 to 60 Raising of dam wall, realignment of roads and bridges and reconfiguration of auxiliary spillway (approximately 50 personnel on site).
- Weeks 61 to 90 Raising of morning glory spillway (approximately 40 personnel on site).
- Weeks 90 to 104 Commissioning and site disestablishment (approximately 20 personnel on site).

Additional employment opportunities will also result from the provision of services for construction.

No change to employment opportunities is expected to result from operation of the Project.

6.10 Hazards and Risks

Section 8.13 of the EIS documents the existing environment, potential impacts and proposed mitigation measures relevant to hazards and risks. Given the nature of the Project and the proximity to drinking water sources, fuels, lubricants, and chemicals should be stored no closer than 30 m to waterways and should be adequately bunded at all times.

7 SUMMARY OF MITIGATION MEASURES

As described in Section 9.1 of the EIS, the Contractor will develop and implement a CEMP that includes mitigation measures described in the EIS, additional measures described in this PIR and any further additional measures considered necessary to manage environmental impacts during construction. The Contractor's CEMP will also need to incorporate all relevant conditions issued for the Project by the Department of Planning and Infrastructure and SEWPaC.

In response to the Namoi CMA Submission, Namoi CMA will be consulted during the preparation of the CEMP. The Draft CEMP will be provided to Fisheries NSW for review prior to finalisation.

As described in Table 8-22 at Section 8.10.4 of the EIS, an Emergency Response Plan will be developed for the Project in collaboration with key stakeholders (e.g. ambulance, SES, police, Tamworth hospital) and implemented as relevant. In response to the Namoi CMA Submission, consultation with the North West Local Land Services will also be carried out during preparation of the Emergency Response Plan, provided the North West Local Land Services is established prior to completion of the Plan. Local Land Services are a State Government initiative, which will merge Catchment Management Authorities, Livestock Health and Pest Authorities and part of the Department of Primary Industries from 2014.

For ease of reference, all mitigation measures listed in the EIS, as well as additional measures described in the PIR, are summarised in (Table 7-1). Additional measures described in the PIR will be marked with an asterisk (*). Those measures no longer proposed are shown in strikethrough (~~strikethrough~~).

Table 7-1: Revised summary of proposed mitigation measures

Ref	Issue	Mitigation Measure	Phase	Relevant Section
1	Soil and Water Terrestrial Biodiversity	Existing cleared, disturbed and sealed areas will be identified and used preferentially for vehicle and machinery access, materials laydown and stockpiling wherever practicable to minimise disturbance to native vegetation, including areas of derived grassland (refer Figure 8−4).	Construction	EIS Section 8.1 EIS Section 8.2
2	Soil and Water	Off road driving will be minimised as far as practicable and will be limited to within designated works areas.	Construction	EIS Section 8.1
3	Soil and Water	Topsoil will be separated from subsoil during excavation and replaced as the top soil layer upon backfilling or reused elsewhere for rehabilitation.	Construction	EIS Section 8.1
4	Soil and Water	Excavations will be backfilled as soon as practicable.	Construction	EIS Section 8.1
5	Soil and Water Visual Amenity	The extent of soil disturbance will be minimised and rehabilitation will be undertaken as soon as practicable following completion of works at each location.	Construction	EIS Section 8.1 EIS Section 8.9
6	Soil and Water Visual Amenity	Rehabilitation will incorporate revegetation with native species of local provenance to stabilise soils and reduce erosion.	Construction	EIS Section 8.1 EIS Section 8.9

Ref	Issue	Mitigation Measure	Phase	Relevant Section
7	Soil and Water	A Sediment and Erosion Control Plan will be developed and implemented, and will include, as a minimum: • Use of silt fences, drains and sediment traps as relevant throughout ground disturbing works; • Use of silt curtains where ground disturbing works are being carried out near or adjacent to waterways; • Use of silt curtains where works are being carried out to the top or upstream embankment of the dam wall; • Regular checking of sediment and erosion control devices, including after heavy rainfall; and • Cleaning or replacement of sediment and erosion control devices as required.	Construction	EIS Section 8.1
8	Soil and Water Visual Amenity	Sediment and erosion control devices will be checked regularly, including after heavy rainfall and cleaned or replaced as required.	Construction	EIS Section 8.1 EIS Section 8.9
9	Soil and Water	All concrete pours and bitumen use will be appropriately supervised.	Construction	EIS Section 8.1
10	Soil and Water	Placement of bitumen products will be restricted to periods where there is expected to be at least two days of dry weather after their application.	Construction	EIS Section 8.1
11	Soil and Water	If the reservoir is at or near FSL at the commencement of construction, the reservoir will be temporarily lowered to 2 m below FSL to provide construction access and flood protection, in accordance with any NSW Office of Water requirements	Construction	EIS Section 8.1

Ref	Issue	Mitigation Measure	Phase	Relevant Section
12	Soil and Water Terrestrial Biodiversity	The use of heavy machinery on areas that are outside of the area of direct impact and excavation works will be avoided during, and immediately following heavy rainfall events to protect soils from erosion and compaction.	Construction	EIS Section 8.1 EIS Section 8.2
13	Soil and Water	The Foreshore Management Plan for Chaffey Dam (Report for Site Specific Action Plans Chaffey, GHD 2010) will be reviewed and revised as relevant. The Plan will be implemented throughout operation of the Project.	Operation	EIS Section 8.1
14	Soil and Water Visual Amenity	The extent of soil disturbance will be minimised and rehabilitation will be undertaken as soon as practicable following completion of works at each location.	Construction	EIS Section 8.1 EIS Section 8.9
15	Soil and Water	Selective withdrawal of water from the hypolimnion will be carried out to maintain or improve the quality of downstream water releases.	Operation	EIS Section 8.1
16	Soil and Water	The vertical distribution of algal biomass and temperature within the reservoir will be monitored to determine the optimum level of draw-off.	Monitoring	EIS Section 8.1
16a	Soil and Water	Namoi CMA will be consulted during the preparation of the Sediment and Erosion Control Plan and during the revision of the Foreshore Management Plan.*	Construction	PIR Section 6.1
17	Terrestrial Biodiversity	Further surveys will be carried out in summer to determine the presence or absence of Queensland Bluegrass (*Dichanthium setosum*) within the Project Site to accurately determine the potential for a significant impact to this species. The results of these surveys will be provided in either a Supplementary Report to be submitted to the Department of Planning in January / February 2013, a submissions report or a Preferred Infrastructure Report (PIR) prepared for the Project.	Pre-construction	EIS Section 8.2

Ref	Issue	Mitigation Measure	Phase	Relevant Section
18	Terrestrial Biodiversity	The design of the raised multi-level off-take tower should enable adequate management of cold water pollution and algal bloom impacts (i.e. allow for releases of water from various depths independently and/or concurrently to allow mixing of water if required to mitigate cold water pollution).	Pre-construction	EIS Section 8.2
19	Terrestrial Biodiversity	A Booroolong Frog Management Plan to be developed and implemented for the Booroolong Frog population on the Peel River that will include provision for: ~~• Information from a pre-construction monitoring program which includes frog surveys in summer 2012 / 2013 to ascertain the current numbers of frogs and to inform the relocation strategy. The results of these surveys will be provided in either a Supplementary Report to be submitted to the Department of Planning in January / February 2013, a submissions report or a Preferred Infrastructure Report (PIR) prepared for the Project;~~ ~~• Depending on the findings of the proposed Summer Survey and if considered appropriate and necessary, relocation of juvenile frogs within the new FSL to suitable habitat upstream on the Peel River, or elsewhere in the catchment to be decided in consultation with Namoi CMA and Philip Spark (or other suitable frog expert);~~ ~~• The relocation strategy will aim to sustain a viable local population. If at any time, this is unlikely to be met, alternative strategies will be developed;~~ • Remediation and threat mitigation as required in receiving sites (e.g. stock exclusion, weed removal, removal of exotic shading vegetation, protection from fossicking, removal of Carp); and • Post-construction monitoring for a minimum of two years to monitor the success of the Management Plan. This will be dependent on the rate of inundation and consultation with the relevant parties (e.g.	Pre-construction Construction	EIS Section 8.2

Ref	Issue	Mitigation Measure	Phase	Relevant Section
		Namoi CMA).		
20	Terrestrial Biodiversity	A Vegetation Management Plan will be developed for the Project including but not limited to the following outcomes: • The control of noxious weeds recorded on the site prior to works commencing; • The management of Coolatai Grass around the dam wall and planted wildlife corridor; • Preventative measures for the spread or introduction of weeds with the aim of ensuring no weeds are spread or introduced as a result of the Project. Any increase in weed infestations should be managed to eliminate or reduce weed infestation; • Provisions requiring weed control measures employing chemicals to be conducted in a manner that does not impact on water quality within the reservoir; • Laydown sites for excavated spoil, equipment and construction materials will be weed-free or treated for weeds; • Sediment control materials should be weed free such as weed free hay bales or geotextiles; • Any imported materials such as sand and gravel will be sourced from sites which do not show evidence of noxious weeds or diseases that may be harmful to native vegetation. If any imported materials result in the occurrence of weeds, measures will be implemented to eliminate weeds before they have the opportunity to spread; and • Monitoring of measures and ongoing adaptive management to control weeds throughout	Construction Operation	EIS Section 8.2

Ref	Issue	Mitigation Measure	Phase	Relevant Section
		construction and operation of the Project.		
20a	Terrestrial Biodiversity	The following strategy will be implemented during construction activities associated with the raising of the dam wall: • Addition of rock to the downstream face of the dam wall will be carried out gradually. • An area of artificial habitat will be established adjacent the dam prior to the commencement of construction works to the downstream face of the dam wall. The area of artificial habitat will be created from the same material to be used for raising of the dam wall. • Each section of the dam wall subject to rock placement will be surveyed for Border Thick-tailed Geckoes immediately prior to commencing work in that section. • Any Border Thick-tailed Geckoes located during surveys of the first section will be removed to the area of artificial habitat. • Any Border Thick-tailed Geckoes located during surveys of subsequent sections will be removed to the adjacent completed section of dam wall (i.e. the new dam wall habitat). • The area of artificial habitat will be gradually dissembled following completion of works to the downstream face of the dam wall and any Border Thick-tailed Geckoes located will be removed to the adjacent completed section of dam wall (i.e. the new dam wall habitat).*	Construction	PIR Section 6.2.5

Ref	Issue	Mitigation Measure	Phase	Relevant Section
21	Aquatic Biodiversity	A Water Release Management Plan will be prepared and implemented if water releases are required to reduce the reservoir level during construction. The Plan will be developed in consultation with relevant stakeholders including State Water, NSW Office of Water and DPI (Fisheries). The Plan will include consideration of the following: • Where possible use water releases will be undertaken as currently required under the Water Sharing Plan for the Peel Valley Regulated, Unregulated, Alluvium and Fractured Rock Water Sources 2010; and • Adequate monitoring of water quality (temperature, algal blooms) should be undertaken to ensure water quality impacts due to release of water are avoided or minimised. The multi-level intake should be used in an effective manner to minimise potential water quality impacts; and	Construction	EIS Section 8.3
22	Aquatic Biodiversity	Laydown areas and stockpile sites should be located at least 40 m from any waterways where possible and should be adequately protected to avoid or minimise any potential pollution of waterways through adequate erosion and sediment controls.	Construction	EIS Section 8.3
23	Aquatic Biodiversity Hazards and Risks	Protocols will be developed to ensure hydrocarbon and chemical spills are contained and treated immediately should they occur. Protocols will aim to ensure no soil or water contamination occurs, with any contaminated material removed and appropriately treated or disposed.	Construction	EIS Section 8.3 EIS Section 8.13

Ref	Issue	Mitigation Measure	Phase	Relevant Section
24	Aquatic Biodiversity	Should large woody debris need to be removed for any construction activities the following will be implemented: • Lopping (trimming) will be considered as a first option; • Instream realignment will be considered as the next option; • If realignment is unfeasible, relocation within the river channel is preferable to removal; and • Removal should be considered as a last resort.	Construction	EIS Section 8.3
24a	Aquatic Biodiversity	Where woody debris is required to be removed, Fisheries NSW will be notified a minimum of three days prior to removal of any large woody debris.*	Construction	PIR Section 6.2
25	Aquatic Biodiversity	The existing Chaffey Dam – Variable Offtake Management Protocol will be reviewed and revised (as relevant) with the aim of avoiding or minimising cold water pollution. The Protocol should be prepared in accordance with the guidelines for managing cold water releases from high priority dams (NOW 2011) and should consider conflicting algal management. The water to be released should match as closely as possible the natural temperature regime, especially during the spring, summer and autumn periods. The natural seasonal temperature regime should be determined through effective monitoring of upstream and downstream reference sites.	Operation	EIS Section 8.3

Ref	Issue	Mitigation Measure	Phase	Relevant Section
26	Aquatic Biodiversity	The release of water during operation will be undertaken in accordance with the Water Sharing Plan for the Peel Valley Regulated, Unregulated, Alluvium and Fractured Rock Water Sources 2010. An adequate operating protocol for the use of the ECA will be developed to provide the best ecological outcome. The operating protocol should consider the Environmental Water Delivery: Namoi River (Barma Water Resources et al. 2012) which provides information on the environmental assets and potential options for environmental water use in the Namoi catchment including at Chaffey Dam. It should also include monitoring requirements, as described in Barma Water Resources et al. (2012), to assess the success of the releases. The operating protocol should be developed in consultation with all relevant stakeholders including but not limited to State Water, NSW Office of Water and DPI (Fisheries).	Operation	EIS Section 8.3
27	Aquatic Biodiversity	The riparian zone of the Peel River should be replanted at the new FSL along upstream waterways for a minimum of 10 m from the new FSL and along the shoreline of the reservoir where practicable, particularly in areas identified as having a high risk of erosion. Revegetation should be undertaken using natives species of local provenance.	Operation	EIS Section 8.3
28	Aquatic Biodiversity	The impact of water releases on temperatures downstream will be monitored through the selection of appropriately located downstream sites and comparisons with reference locations.	Monitoring	EIS Section 8.3
29	Aquatic Biodiversity	Works should be staged so that construction activities that need to be undertaken within waterways (e.g. bridge construction) are undertaken during low reservoir levels.	Construction	EIS Section 8.3
29a	Aquatic Biodiversity	The proposed waterway crossing designs at Bowling Alley Point Bridge, Hydes Creek Bridge and Silver Gully will be provided to Fisheries NSW for comment.*	Construction	PIR Section 6.2

Ref	Issue	Mitigation Measure	Phase	Relevant Section
29b	Biodiversity	The proposed North-Western Offset Site and the proposed Peel River Offset Site will be implemented as described in the Offset Plan*	Construction	PIR Section 6.2.8
30	Aboriginal Heritage	Surface salvage and relocation of all known Aboriginal heritage sites to be directly impacted by the Project will be carried out. Surface salvage will entail the recording of each site by an Archaeologist and the collection of all visible artefacts.	Pre-construction	EIS Section 8.4
31	Aboriginal Heritage	Targeted testing of representative landforms in areas of PAD that will be directly impacted by the Project will be undertaken prior to commencement of construction in that area. The results of these investigations will inform the need for further testing and/or salvage excavations.	Pre-construction	EIS Section 8.4
32	Aboriginal Heritage	A 'Back to Country' protocol will be developed that details the location and methodology to be used for the relocation of Aboriginal objects salvaged as part of the Project. The relocation area should be in close proximity to the Project Site, should be negotiated with Aboriginal stakeholders and can be an area identified by the proponent.	Pre-construction	EIS Section 8.4
33	Aboriginal Heritage	The relocation area for salvaged objects will be recorded by an Archaeologist and placed on the NSW AHIMS as a new Aboriginal site.	Pre-construction	EIS Section 8.4
34	Aboriginal Heritage	Known Aboriginal heritage sites adjacent to construction footprints will be fenced off during all construction works. Unauthorised access to these areas by personnel and equipment will be prohibited.	Construction	EIS Section 8.4
35	Aboriginal Heritage	The Unanticipated Discovery Protocol provided at Appendix 14 will be implemented where any suspected Aboriginal objects or suspected human remains are uncovered during construction.	Construction	EIS Section 8.4

Ref	Issue	Mitigation Measure	Phase	Relevant Section
36	European Heritage	The Iron Footbridge will be carefully dismantled, transported and re-erected in a location within the vicinity of its present location that aids in the interpretation of the footbridge with regard to its connection to the Bowling Alley Point settlement (refer Appendix 10).	Pre-construction	EIS Section 8.5
37	European Heritage	Interpretative signage will be installed at the new location of the Iron Footbridge to document its history, including construction methods, original location and the role and function it had in serving the former Bowling Alley Point gold mining settlement. The importance of its historical, social, cultural and aesthetic significance to the current and future residents and to visitors should also be documented on the signage.	Pre-construction	EIS Section 8.5
38	European Heritage	The Contractor's CEMP will include measures to minimise visual impacts to the Bowling Alley Point School and Uniting Church during road and bridge construction activities, such as dust suppression, maintenance of tidy construction areas and the use of hoardings.	Construction	EIS Section 8.5
39	European Heritage	In the case that a previously unidentified potential heritage object is uncovered during construction, the following measures will be implemented to avoid disturbance to the object, until an appropriate management strategy is implemented. 1. All works must halt in the immediate area of the object(s) and any further disturbance to the area of the object(s) prevented; 2. The discoverer of the object(s) will notify machinery operators in the immediate vicinity of the object(s) so that work can be halted; 3. The object(s) will be reported to the site supervisor and the Principal/Project Manager;	Construction	EIS Section 8.5

Ref	Issue	Mitigation Measure	Phase	Relevant Section
		4. The approximate extent, nature, associated archaeological potential and likely significance of the object(s) will be determined by an appropriately qualified person or persons (such as the project archaeologist); and 5. An appropriate management strategy for recording and preservation of the object (if warranted) will developed, along with a strategy to return to work as far as possible.		
40	European Heritage	Where suspected human remains are uncovered, the protocol provided at Appendix 16 will be implemented.	Construction	EIS Section 8.5
40a	European Heritage	Comprehensive mapping and recording of the parts of European heritage sites within construction footprint and or the new FSL will be carried out prior to these impacts occurring.*	Construction	PIR Section 6.4
40b	European Heritage	Fencing (star pickets connected with high visibility flagging, or similar) of the Works Area boundary will be implemented during works in the vicinity of European heritage sites.*	Construction	PIR Section 6.4
40c	European Heritage	The World War 1 Monument will be relocated within the vicinity of their present locations, above the new FSL.*	Construction	PIR Section 6.4
40d	European Heritage	The Contractor's CEMP will include measures to minimise visual impacts to the House at Hydes Creek during road and bridge construction activities, such as dust suppression, maintenance of tidy construction areas and the use of hoardings.*	Construction	PIR Section 6.4

Ref	Issue	Mitigation Measure	Phase	Relevant Section
41	Traffic and Transport Land Use Socio-economic	A Construction Traffic Management Plan will be developed and implemented for all Project construction activities, including: • Provision for oversized vehicles (where relevant); • Provisions for traffic management during road realignment works, including speed restrictions; • Safety provisions for workers, residents, recreational users and the general public; • Requirement to inform heavy vehicle drivers of the presence of schools and the schedules of school buses in the area, as well as the narrow verges and potentially limited space available for school buses to pull over; and • Requirement to inform local residents, Nundle Fishing Club, South Bowlo Fishing Club and the Bowling Alley Point Trust of upcoming temporary traffic diversions and road closures.	Construction	EIS Section 8.6 EIS Section 8.10 EIS Section 8.11
41a	Traffic and Transport	The Construction Traffic Management Plan to be prepared and implemented for the Project will include a Vehicle Movement Plan and Traffic Control Plan.*	Construction	PIR Section 6.5
41b	Traffic and Transport	The Construction Traffic Management Plan will be prepared with the objective of the Project causing minimal impact on the operation of the existing road network and road infrastructure assets during the construction process.*	Construction	PIR Section 6.5
41c	Traffic and Transport	The Construction Traffic Management Plan will be submitted to RMS and Tamworth Regional Council for approval prior to any construction activities occurring onsite. *	Construction	PIR Section 6.5

Ref	Issue	Mitigation Measure	Phase	Relevant Section
42	Traffic and Transport	Works areas will be designed to allow for all vehicles to enter the works areas, manoeuvre internally and exit the works areas in a forward direction	Construction	EIS Section 8.6
43	Traffic and Transport	All parking will be accommodated on site within the designated works areas	Construction	EIS Section 8.6
44	Traffic and Transport	A new access track will be constructed to the South Bowlo Fishing Club from Western Foreshore Road.	Construction	EIS Section 8.6
44a	Traffic and Transport	The operator of any Over-size/Over-mass vehicles will be responsible for obtaining all necessary permits prior to the transport of materials.*	Construction	PIR Section 6.5
45	Noise and Vibration	All work will be carried out within the following hours: • Monday to Friday 7:00am to 6:00pm; • Saturday 8:00am to 1:00pm; • Blasting Monday to Friday 9:00am to 5:00pm and Saturday 9:00am to 1:00pm only; and • No work on Sundays or public holidays.	Construction	EIS Section 8.7
45a	Noise and Vibration	Should the necessity arise for any construction works to occur outside the standard construction hours, the Contractor will seek prior approval from the Department of Planning and Infrastructure, accompanied by appropriate justification.*	Construction	PIR Section6.6
46	Noise and Vibration Air Quality	Residents adjacent to works areas will be informed prior to and during construction, of the nature, duration and expected overall noise and dust levels of construction activities. Relevant contact details for site personnel will also be provided.	Pre-construction Construction	EIS Section 8.7 EIS Section 8.8

Ref	Issue	Mitigation Measure	Phase	Relevant Section
47	Noise and Vibration	Simultaneous operation of noisy plant will be avoided wherever practicable.	Construction	EIS Section 8.7
48	Noise and Vibration	Maintenance work on construction plant and vehicles will be carried out away from identified sensitive receivers and confined to standard daytime construction hours, wherever practicable.	Construction	EIS Section 8.7
49	Noise and Vibration	Wherever practicable, noisy equipment will be: • Positioned behind structures that act as barriers to identified sensitive receivers; • Positioned at the greatest distance from identified sensitive receivers; and / or • Oriented to directed noise emissions away from identified sensitive receivers.	Construction	EIS Section 8.7
49a	Noise and Vibration	A bore pile rig is the preferred equipment and method for piling works and will be utilised where feasible and reasonable.*	Construction	PIR Section 6.6
50	Noise and Vibration	All vehicles and equipment will be regularly serviced, maintained in proper working order and turned off when not in use.	Construction	EIS Section 8.7
51	Noise and Vibration	“Quiet” practices will be employed wherever practicable when operating equipment.	Construction	EIS Section 8.7
52	Noise and Vibration Air Quality	An effective Complaints Handling System will be developed and implemented throughout construction.	Construction	EIS Section 8.7 EIS Section 8.8

Ref	Issue	Mitigation Measure	Phase	Relevant Section
53	Noise and Vibration	Vibration monitoring will be carried out at the nearest sensitive receiver on commencement of significant construction activities, as follows: • In the event that construction vibration is found to be significantly below construction vibration criteria, no subsequent monitoring of that activity is required; and • If monitored vibration levels are considered to be high-risk or close to the vibration criteria, unattended vibration monitoring will be carried out on a continuous basis at the nearest vibration sensitive receiver.	Construction	EIS Section 8.7
54	Noise and Vibration	Any blasting required will be of similar to blast designs and Maximum Instantaneous Charge (MIC) (i.e. less than 209 kg) carried out during construction of the existing auxiliary spillway.	Construction	EIS Section 8.7
55	Noise and Vibration	Monitoring will be carried out for any blasting required to ensure compliance with relevant criteria.	Construction	EIS Section 8.7
56	Air Quality	Distance travelled on unsealed roads will be minimised by taking the most direct route to the destination.	Construction	EIS Section 8.8
57	Air Quality	Surface drainage will be optimised, particularly at intersections.	Construction	EIS Section 8.8
58	Air Quality	Vehicle speeds on unsealed roads within designated works areas will be limited to 40 km/hour or less.	Construction	EIS Section 8.8
59	Air Quality	Larger trucks will be utilised for material transport to minimise the required number of trips, where possible.	Construction	EIS Section 8.8

Ref	Issue	Mitigation Measure	Phase	Relevant Section
60	Air Quality	Unsealed roads, other unsealed surfaces, dry, sandy materials and stockpiles (as relevant) within designated works areas will be watered, likely using water carts, when visible dust emissions can be observed travelling offsite (note it is important to not allow unsealed roads to become saturated as this will increase emissions once they dry out).	Construction	EIS Section 8.8
61	Air Quality	The extent of unsealed areas will be minimised by only clearing or unsealing areas required for the works and progressively rehabilitating disturbed areas as soon as possible after works are completed.	Construction	EIS Section 8.8
62	Air Quality	Stockpiles will be stabilised (e.g. by watering, covering or revegetating, as practical) and, wherever practicable, shielded from the prevailing wind using wind breaks or by positioning them in sheltered areas, screened from the nearest sensitive receivers by topography or existing trees.	Construction	EIS Section 8.8
63	Air Quality	Dump heights for the unloading and loading of soils will be minimised as far as practicable, particularly when dry, sandy materials are being handled.	Construction	EIS Section 8.8
64	Air Quality	Construction activities will cease or be modified on dry windy days, when significant visible dust emissions can be observed travelling offsite towards nearby sensitive receptors.	Construction	EIS Section 8.8
65	Air Quality	The Contractor will include in its CEMP, a copy of the modified version of the Beaufort Wind Scale, provided in Table 16 of Appendix 13, which is an empirical measure that relates wind speed to observed conditions. This table should be used as a practical guide for the need to implement dust control measures.	Construction	EIS Section 8.8

Ref	Issue	Mitigation Measure	Phase	Relevant Section
65a	Air Quality	The following mitigation measures will be implemented when activities are being carried out in close proximity to residential receptors and in response to adverse conditions during construction (i.e. when dust is observed travelling offsite towards residential receptors). • Watering will be carried out at a rate of >2 L/m^2/hour on unsealed travel routes (note it is important to not allow unsealed areas to become saturated as this will increase emissions once they dry out) • Unsealed travel routes and materials handled by dozers will be kept moist • Water sprays will be utilised where graders are used • Wind breaks will be installed to reduce wind speeds across the Works Areas*	Construction	PIR Section 6.7
65b	Air Quality	A log sheet will be maintained on site during construction to document meteorological conditions and dust control measures implemented including: • Wind strength (based on the Beaufort scale, refer Section 8.8.4 of the EIS) • Wind direction • Recent rainfall • Dust controls being implemented • Visible dust emissions travelling off-site towards residential receptors*	Construction	PIR Section 6.7

Ref	Issue	Mitigation Measure	Phase	Relevant Section
65c	Air Quality	An Air Quality Management Plan will be developed (or relevant measures incorporated into the CEMP) for implementation during construction. The Air Quality Management Plan should include the following information for each primary air pollutant and emission source: • Key performance indicator • Monitoring method • Location frequency and duration of monitoring • Record keeping • Response mechanisms • Compliance reporting*	Construction	PIR Section 6.7
~~66~~	~~Air Quality~~	~~Construction activities with the potential to generate dust emissions in the proximity of Receivers 5, 7 and 8 will be carried out during the summer months where practicable.~~	~~Construction~~	~~EIS Section 8.8~~
~~67~~	~~Air Quality~~	~~Travel speed on unsealed surfaces in the vicinity of Receivers 5, 7 and 8 will be limited to 40 km/h.~~	~~Construction~~	~~EIS Section 8.8~~
~~68~~	~~Air Quality~~	~~Unsealed surfaces in the vicinity of Receivers 5, 7 and 8 will be watered on a consistent routine basis under normal weather conditions, during construction activities with the potential to generate dust emissions. Under adverse conditions, particularly during strong westerly winds, additional watering of unsealed surfaces will be carried out when particulate matter is visible above the roof height of light vehicles.~~	~~Construction~~	~~EIS Section 8.8~~

Ref	Issue	Mitigation Measure	Phase	Relevant Section
69	Visual Amenity	Trimmed and cleared vegetation should be spread over construction areas that are above the new FSL during rehabilitation to assist in stabilisation and revegetation of the area and to minimise visual impacts.	Construction	EIS Section 8.9
70	Visual Amenity Spoil and Waste	The Contractor will maintain the works areas in a clean and tidy fashion.	Construction	EIS Section 8.9 EIS Section 8.12
71	Visual Amenity	Sediment and erosion control devices will be checked regularly, including after heavy rainfall and cleaned or replaced as required.	Construction	EIS Section 8.9
72	Land Use European Heritage	An Interpretation Strategy will be developed for the Dulegal Arboretum.*	Pre-construction	EIS Section 8.10 PIR Section 6.4
73	Land Use European Heritage	The memorial plaque present the Dulegal Arboretum will be relocated to above the new FSL.*	Pre-construction	EIS Section 8.10 PIR Section 6.4
74	Land Use Socio-economic	State Water will further assess impacts to landholders, as follows: • Where land is within the new FSL, State Water proposes to acquire that part of the land impacted by the new FSL; • Where land is within the proposed road realignment boundary, State Water proposes to acquire that part of the land impacted by the road realignment; • Where State Water expects land may be regularly affected in order to manage the storage and associated works, such that the ability of the landowner to engage in ordinary usage of the land is affected, State Water will seek to acquire easements or full title depending on the level of impact; and	Pre-construction	EIS Section 8.10 EIS Section 8.11

Ref	Issue	Mitigation Measure	Phase	Relevant Section
		• State Water will not acquire an interest where land might be affected by an extraordinary natural event.		
75	Land Use	Carry out a features survey to identify features to be avoided during construction within proposed works areas, but outside the road realignment construction area (including road realignment batters).	Pre-construction	EIS Section 8.10
76	Land Use	State Water will liaise with local environmental groups, including Land Care, Tamworth Urban Group, Tamworth Garden Club and the National Parks Association of NSW Tamworth-Namoi Branch, to organise seed collection activities within the Dulegal Arboretum. All groups will be required to be appropriately licensed and insured to take part in the seed collection activities.	Pre-construction	EIS Section 8.10
77	Land Use European Heritage	The Australian Agricultural Company commemorative plaque will be moved from its existing location on the foreshore of Chaffey Dam to higher ground (outside the new FSL), within the proximity of its existing location.*	Pre-construction	EIS Section 8.10 PIR Section 6.4
78	Land Use European Heritage	The two commemorative plaques on the existing Bowling Alley Point Bridge will be relocated to the new Bowling Alley Point Bridge.*	Pre-construction	EIS Section 8.10 PIR Section 6.4
79	Land Use Socio-economic	A Recreation Continuance Plan will be developed and implemented to address and mitigate impacts on recreational users during construction.	Construction	EIS Section 8.10 EIS Section 8.11
80	Land Use Socio-economic	The restricted zone adjacent to the dam wall and morning glory spillway will be extended during construction.	Construction	EIS Section 8.10 EIS Section 8.11
81	Land Use Socio-economic	Impacted facilities at the Bowling Alley Point Recreation Area will be relocated in consultation with the Bowling Alley Point Recreation Trust.	Construction	EIS Section 8.10 EIS Section 8.11

Ref	Issue	Mitigation Measure	Phase	Relevant Section
82	Land Use Socio-economic	Impacted facilities at the South Bowlo Fishing Club will be relocated in consultation with the South Bowlo Fishing Club.	Construction	EIS Section 8.10 EIS Section 8.11
83	Land Use Socio-economic	An Emergency Response Plan will be developed in collaboration with key stakeholders (e.g. ambulance, SES, police, Tamworth hospital) and implemented as relevant.	Construction	EIS Section 8.10 EIS Section 8.11
84	Land Use	A Boating Management Plan should be developed and implemented, which considers no go zones due to inundated perimeter vegetation and potential bank erosion issues.	Operation	EIS Section 8.10
85	Land Use Socioeconomic	State Water will further assess impacts to landholders, as follows: • Where land is within the new FSL, State Water proposes to acquire that part of the land impacted by the new FSL; • Where land is within the proposed road realignment boundary, State Water proposes to acquire that part of the land impacted by the road realignment; • Where State Water expects land may be regularly affected in order to manage the storage and associated works, such that the ability of the landowner to engage in ordinary usage of the land is affected, State Water will seek to acquire easements or full title depending on the level of impact; and • State Water will not acquire an interest where land might be affected by an extraordinary natural event.	Operation	EIS Section 8.10 EIS Section 8.11
86	Socioeconomic	Following completion of the Project, land that is not affected by increased FSL will be leased with longer term lease conditions (5 to 10 years). State Water uses an open tender process to allocate leases and will consider the impact of the Project on affected landholders and lessees.	Operation	EIS Section 8.11

Ref	Issue	Mitigation Measure	Phase	Relevant Section
87	Spoil and Waste	The Contractor will ensure that waste is appropriately contained and disposed and no items fall into the surrounding water.	Construction	EIS Section 8.12
88	Spoil and Waste	A waste collection and storage area will be established and maintained at each work area.	Construction	EIS Section 8.12
89	Spoil and Waste	Water used to clean equipment should not be allowed to flow directly into the reservoir, instead it should be allowed to filter through hessian sacks or similar.	Construction	EIS Section 8.12
90	Spoil and Waste	Recyclable materials and products made from recycled materials will be used where possible.	Construction	EIS Section 8.12
91	Spoil and Waste	Materials with minimal packaging and transport requirements will be used where possible.	Construction	EIS Section 8.12
92	Spoil and Waste	No burning of vegetation or waste is allowed under any circumstances.	Construction	EIS Section 8.12
93	Spoil and Waste	General and putrescible waste and recyclable waste such as metal, plastic, glass, paper and timber will be segregated and collected in suitable waste containers positioned at convenient locations within each work area.	Construction	EIS Section 8.12
94	Spoil and Waste	All waste containers will have secure lids in place to prevent water ingress and access to animals.	Construction	EIS Section 8.12
95	Spoil and Waste	Waste storage areas will be kept away from drainage paths.	Construction	EIS Section 8.12
96	Hazards and Risks	Emergency spill kits will be available on site and construction personnel trained in their use.	Construction	EIS Section 8.13
97	Hazards and Risks	Chemical wastes will be collected in appropriately sized and labelled containers for disposal at an approved chemical waste facility.	Construction	EIS Section 8.13

Ref	Issue	Mitigation Measure	Phase	Relevant Section
98	Hazards and Risks	Waste oil, solvents and hydrocarbons will be collected for reuse, recycling, treatment or disposal at an appropriately licensed facility.	Construction	EIS Section 8.13
99	Hazards and Risks	Floating booms will be utilised during works near water and where the potential for hydrocarbon spills to water exist.	Construction	EIS Section 8.13
100	Hazards and Risks	Material Safety Data Sheets (MSDSs) will be maintained on site for all hazardous substances, including fuels and chemicals, in a readily accessible location.	Construction	EIS Section 8.13
101	Hazards and Risks	Fuels, lubricants and chemicals will be stored and handled within containment facilities, such as bunded areas or leak trays, designed to prevent the release of spilt substances.	Construction	EIS Section 8.13
101a	Hazards and Risks	Fuels, lubricants, and chemicals should be stored no closer than 30 m to waterways and should be adequately bunded at all times.*	Construction	PIR Section 6.10
102	Hazards and Risks	All bunded areas will be designed to contain 110% of the volume stored within them.	Construction Operation	EIS Section 8.13
103	Hazards and Risks	All storage and handling equipment for fuels, lubricants and chemicals will be maintained in good working condition.	Construction Operation	EIS Section 8.13
104	All	The Contractor will develop and implement a CEMP that includes mitigation measures described in the EIS and any additional measures considered necessary to manage environmental impacts during construction. The Contractor's CEMP will also incorporate all relevant conditions issued for the Project by the Department of Planning and Infrastructure and SEWPaC.	Construction	EIS Section 9

Ref	Issue	Mitigation Measure	Phase	Relevant Section
105	All	Existing State Water operational management systems and procedures will be reviewed and revised as required to ensure all operational mitigation measures described in the EIS are implemented. Any additional measures considered necessary to manage environmental impacts during operation of the Project will also be incorporated into State Water's operational management systems and procedures.	Operation	EIS Section 9

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8 CONCLUSION

The Project is proposed to increase the flood safety of Chaffey Dam, including compliance with ANCOLD and DSC Guidelines, to meet the needs of Tamworth's water supply, to maintain irrigation allocations at an adequate level and to provide contingency for adverse climate change impacts.

The Project has been confirmed by the Minister for Planning and Infrastructure as a State Significant Infrastructure project.

Thorough consideration of socioeconomic, supply demand (high security and general security) and environmental issues has been demonstrated that a combined safety upgrade and augmentation of Chaffey Dam, incorporating augmentation to 100 GL is required.

The PIR has documented changes to the Project description, provided a response to submissions received on the Project and documented the outcomes of further surveys and assessments carried out since submission of the EIS.

The Works Areas for realignment of roads and bridges have been refined since submission of the EIS, resulting in a large reduction in the area to be impacted by the construction activities. A subsequent decrease in impacts to biodiversity, Aboriginal heritage and European heritage has resulted from this refinement.

Surveys completed in January and February 2013 concluded that Queensland Bluegrass does not occur on the Project Site and will not be impacted by the Project.

Construction associated with the raising of the dam wall has been designed to avoid impacts to the Border Thick-tailed Gecko. Construction activities will be staged to ensure sections of the dam wall remain available as habitat for the species throughout construction. The loss of habitat during construction will be temporary at worst. There are no other habitats suitable for the Border Thick-tailed Gecko that will be impacted as a result of the Project. The Border Thick-tailed Gecko will not be adversely impacted by the Project.

An offset strategy under the EPBC Environmental Offsets Policy is not required for the Border Thick-tailed Gecko. However, the offsets provided for vegetation loss in accordance with the Principles for the use of biodiversity offsets in NSW incorporate Goat Mountain, an area of known habitat for the species.

The revision to the works areas has reduced the area of the TSC Act listed White Box-Yellow Box-Blakely's Red Gum Woodland EEC or the EPBC listed White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland CEEC to be impacted by road construction activities by 50% and 25% respectively.

As described in the EIS, no significant impacts are expected to result from the Project in relation to the TSC Act listed White Box-Yellow Box-Blakely's Red Gum Woodland EEC or the EPBC listed White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland CEEC. Accordingly, an offset strategy under the EPBC Environmental Offsets Policy is not required.

Residual impacts to vegetation, including the TSC Act listed EEC, will be offset at a ratio of approximately 2:1 and will be representative of all vegetation types to be impacted by the Project. In addition, management measures will target the restoration of foreshore areas, control of weeds and implementation of grazing regimes suitable for regeneration of understorey elements of the communities.

Booroolong Frog surveys carried out in January and February 2013 recorded a total of 2,289 individuals over the 25 km of the Peel River. Current surveys determined that the large concentration of Booroolong Frogs previously recorded immediately upstream of Chaffey Dam by NWES (2009b) is no longer present. Fifty Booroolong Frogs were recorded between the existing FSL and the new FSL during the current surveys.

Current surveys found the Booroolong Frog to be well distributed along the Peel River, upstream of Chaffey Dam. The distribution of metamorph and sub-adult life stages over the entire area surveyed confirms that all 25 km is suitable breeding habitat for the species. Assuming an average habitat width of 14.5 m, this equates an area of 36.3 ha of known habitat on the Peel River and Wombramurra Creek.

Given the outcomes of the current surveys, the loss of habitat as a result of inundation to the new FSL has been re-assessed to include the entire length of the river between the existing FSL and the new FSL (a distance of 1.6 km). At an average width of 14.5 m, this equates to an area of 2.3 ha, or 6.4% of the known Booroolong Frog habitat on the Peel River immediately upstream of Chaffey Dam.

An Assessment of Significance carried out in accordance with the EPBC Act Significant Impact Guidelines 1.1 Matters of national environmental significance (DEWHA 2009) concluded that, despite the current abundance of the Booroolong Frog along the Peel River, the loss of 6.4% of known Booroolong Frog habitat is considered to have a significant impact at a local and regional level.

As such, an offset is required under both the State and Commonwealth offset policies. The implementation of the proposed offset and management measures will assist in reducing the operation of threatening process on the larger population of Booroolong Frogs on the Peel River resulting in positive long term impacts. The proposed measures have been developed with reference to the National Recovery Plan for the Booroolong Frog (NSW OEH 2012a) in consultation with Namoi CMA, OEH, SEWPaC and species experts, with the overall aim of improving the habitat available for the species outside of the new FSL.

The proposed offset strategy and associated management and monitoring programs provide excellent opportunities for improving knowledge of the operation of threats on the Booroolong Frog population, the distribution of the frog beyond the known occurrence in the Peel River, and the protection of the existing population.

From a biodiversity perspective, the Project can be deemed acceptable in that, notwithstanding the residual impacts, the losses can be offset and substantial conservation gains can be achieved for threatened species and vegetation communities impacted by the Project through the ongoing monitoring and management of offset areas.

The assessment in the EIS and PIR confirm that the environmental and socioeconomic impacts of the Chaffey Dam Augmentation and Safety Upgrade State Significant Infrastructure Project are deemed to be acceptable.

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Appendices

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