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NSW Office of Water and Forests NSW

Koondrook-Perricoota Forest Flood Enhancement Project

Submissions Report and Preferred Project Report

June 2010

INFRASTRUCTURE | MINING & INDUSTRY | DEFENCE | PROPERTY & BUILDINGS | ENVIRONMENT

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1. Introduction

1.1 Purpose of this report

An Environmental Assessment was prepared for the Koondrook-Perricoota Forest Flood Enhancement project (the project) by GHD Pty Limited on behalf of the NSW Office of Water and NSW Industry and Investment (Forests NSW). The Environmental Assessment supported project Application No. MP 09_0098 and was submitted to the Department of Planning for public exhibition between 17 March 2010 and 7 June 2010. It was prepared in accordance with Part 3A of the *Environmental Planning and Assessment Act* 1979 (the EP&A Act) and addressed requirements issued by the Director-General of the Department of Planning on 22 May 2009.

During the exhibition period the community and other stakeholders were invited to make submissions to the Department of Planning and a total of eight submissions were received.

The purpose of this report is to address the requirements of Section 75H(6) of the EP&A Act as requested by the Director-General by:

- Responding to the issues raised in submissions received following exhibition of the Environmental Assessment;
- Providing a Preferred Project Report that outlines any proposed changes to the project and mitigation measures to minimise environmental impacts; and
- Finalising the draft Statement of Commitments that was provided in the Environmental Assessment.

This Preferred Project Report should be read in conjunction with the Environmental Assessment.

1.2 Overview of the project

The project has been designed to enable controlled diversion of water from the Torrumbarry Weir pool on the Murray River to enhance the flood regime within the Forest. It involves construction and operation of infrastructure with the capacity to transfer up to 6,000 ML/day from Torrumbarry Weir pool into the Forest. The scheme would be operated to enhance the existing flood regime to provide a flood regime that is more representative of natural conditions, where practicable. The following sections outline the main construction and operational features of the project. A detailed description is provided in Chapter 6 of the Environmental Assessment.

1.2.1 Infrastructure

Structures that would form part of the project, inclusive or refinements that are discussed in Section 3, are detailed in Table 1 and Figure 1 and can be classified into the following broad categories:

- **Upstream structures** to divert water into the Forest from the Torrumbarry Weir pool. These structures include an inlet channel, inlet regulator and associated infrastructure, as well as regulators at Swan Lagoon to control flows re-entering the Murray River; and
- **Downstream structures** to control the release of water from the Forest and to maximise return flows back to the Murray River. These structures include a levee to retain water within the Forest, as well as regulators controlling discharge water to downstream waterways.

Table 1 Key features of the project

Infrastructure	Description
Upstream structures	
Inlet channel	Construction of a 3.8 km long earth channel extending north from the Torrumbarry Weir pool on the Murray River to Bullock Head Creek.
Inlet regulator, dual fishway and turtle ramp	Construction of a gated regulator structure and a fishway within the inlet channel, approximately 200 m from the Murray River.
River Road crossing	Construction of a bridge or causeway at the intersection of Freemans Road and River Road.
Swan Lagoon structures	Two regulators and associated works at Swan Lagoon to control water flow between the Forest and the river.
Downstream structures	
Stop log regulators	Stop log regulators at Runner A, Barbers Creek, Cow Creek, Calf Creek and Thule Creek to control downstream flows and protect surrounding property and infrastructure from flood waters during operation of the scheme.
Downstream levee	Construction of a levee connecting the regulators at Runner A, Barbers Creek, Cow Creek, Calf Creek, Thule Creek, and the return channel. It would also upgrade and extend the existing Barham flood protection levee. The levee would retain flood waters within the Forest and protect surrounding infrastructure and property from floods during managed events.
Return channel	The return channel would deliver water from Crooked Creek to a regulator within the return channel.
Return channel regulator and junction structure	A gated regulator and drop down structure at the intersection of the return channel with the Murray River.

1.2.2 Operational features

Operational flexibility

The project has been specifically designed to provide the flexibility to operate within a range of flows to ensure that effective and measurable environmental outcomes are delivered using a broad range of available water. The structures have been designed to create a large flood event, however they can also control small or medium flows of variable volume and duration.

It is intended that large flood events would occur every three to four years and that smaller events would occur more frequently. For the purposes of this assessment, a ‘large’ flood event is defined as one that would be capable of inundating up to 52% of the Forest. The maximum maintainable inundation area would be approximately 41% of the Forest (approximately 16,000 ha) for a period of about 100 days. The operating regime would allow it to contribute to the Gunbower-Koondrook-Perricoota Icon Site Environmental Management Plan's (MDBC, 2006) interim objective to maintain 30% of River Red Gum

forest in healthy condition. The flooding would result in numerous ecological benefits such as improved ecosystem health and encouraging bird and fish breeding within the Forest's wetlands.

As the project would be operated in a regulated river system that is operated for multiple outcomes, there are a range of risks and trade-offs that need to be managed. The design has been developed to manage these risks by enabling highly varied and flexible operations which provide the opportunity to implement adaptive management principles in response to factors such as:

- Differing water availability and river conditions;
- Risk management requirements; and
- The targeting of specific environmental outcomes (e.g. vegetation response, bird or fish breeding events) that may be required from time-to-time to achieve long term objectives.

The natural flow regime at the site provides a guide to the water requirements of the existing ecological processes and communities. This regime is highly variable, and comprises floods of various magnitudes and durations, occurring at a range of frequencies. In general, small floods occur more frequently, and larger floods less frequently. It is highly desirable that the project provide a very flexible mechanism that is capable of delivering a range of flood events that are able to sustain a range of ecological processes and elements, for example:

- Frequent, low flows (but exceeding the commence to flow levels) to maintain the wetland habitats occurring in lagoons, depressions and flood runners;
- Less frequent floods of medium magnitude to maintain the extent of the River Red Gum communities, with larger floods maintaining the extremities, and smaller floods supporting the core areas with flood dependent understorey communities;
- Flood events of long duration to cue and facilitate bird breeding; and
- Very large, infrequent flood events to occasionally inundate fringing Black Box communities.

Flexible operation and the ability to capitalise on a variety of flow events is an important element of the project as there is uncertainty regarding the exact nature of unregulated and regulated river flows, and the quantum of environmental water available.

While predictive models provide some guidance as to the environmental outcomes of an event, there remains some uncertainty regarding the ecological impacts (positive and negative) arising from operation of the project. The project would implement adaptive management principles to maximise benefits and minimise adverse impacts. To achieve this, it is important to be able to alter the operation of the structures, both during operations and from one operation to the next, to react to the ecological response observed.

Role of the Operating Plan

The project would be operated in accordance with an Operating Plan developed specifically for the project. The purpose of the Operating Plan is to provide a framework for the operation of the structures to meet key ecological objectives within the broader context of The Living Murray initiative and project governance. The preliminary draft of the Operational Plan included in Appendix B of the Environmental Assessment will be finalised in consultation with relevant government agencies prior to commencement of operations.

The Operating Plan would not prescribe particular watering events, however it would provide an effective platform for operational decision making based on knowledge development and a strong understanding of what the project should aim to achieve.

With reference to hydrologic conditions in the Murray River downstream of Torrumbarry Weir, operation of the project would operate in one of three general ways:

- For flow events <18,000 ML/day, water can be delivered to the Forest through the inlet channel. This is referred to as an 'entirely managed' event, as flows in the Murray River would not be of sufficient magnitude to naturally enter the Forest;
- For flow events >18,000 ML/day, water can enter the Forest through natural watercourses/effluents and potentially be supplemented with water delivered through the inlet channel. This is referred to as a 'hybrid' event, as water would be sourced from stored water as well as unregulated flows. Under these conditions, water would enter the Forest via natural low points in the landscape, as well as via the inlet channel; and
- For larger flood events >35,000 ML/day water enters the Forest via overbank flow and the project infrastructure would not be operated. As the infrastructure would not be operated during these events, they are referred to as 'uncontrolled' events.

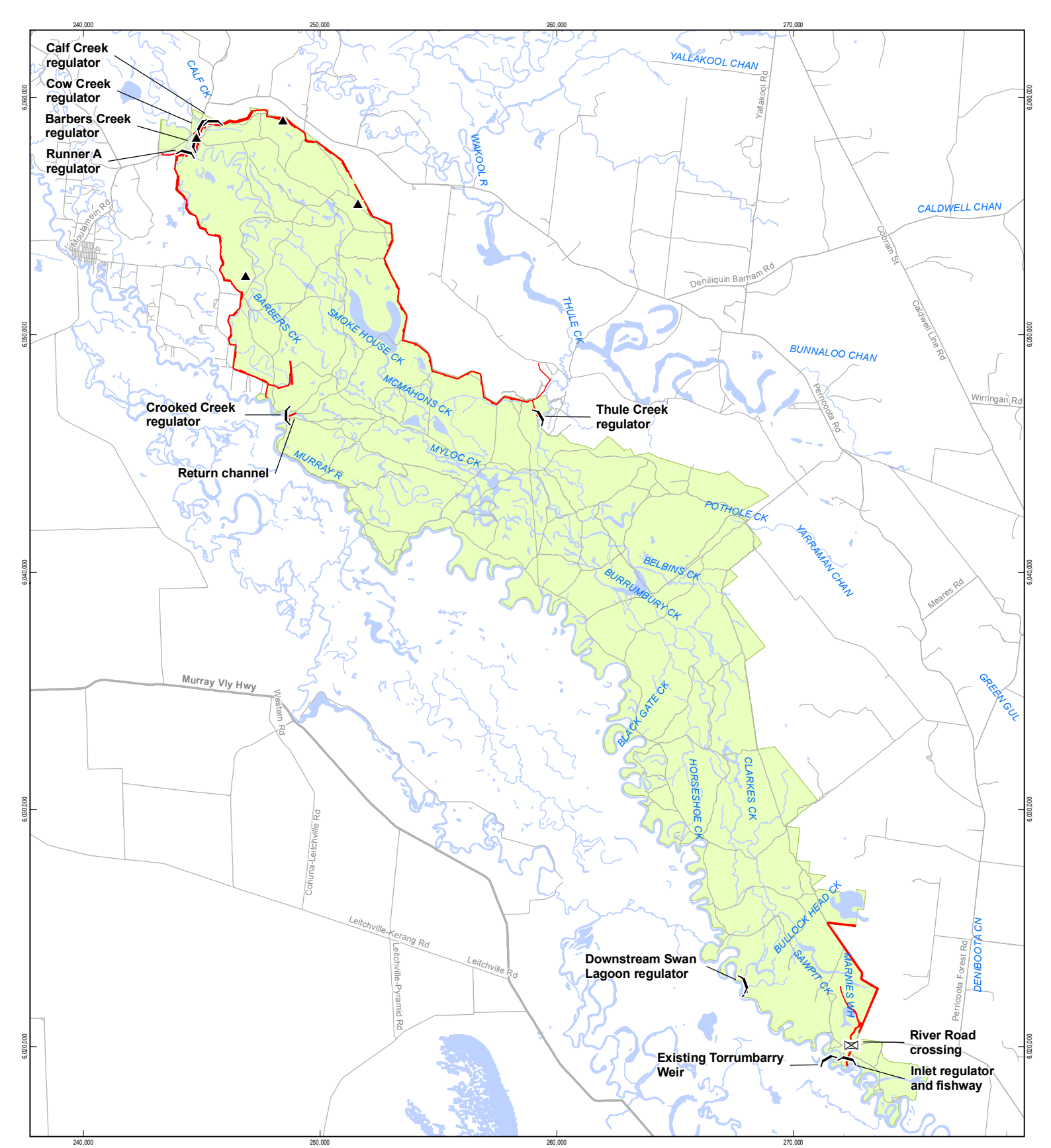
The management sequence needs to be flexible to allow for uncontrolled flood events, entirely managed events, or a combination of uncontrolled and managed events (referred to as 'hybrid events'), dependant on climatic conditions. The ability to plan for, and respond to, specific ecological objectives would be a key function of the Operating Plan.

1.2.3 Availability of water

The availability of water for the project would be dependent on the overall volume of water in the Murray River system. Water would be obtained from a number of sources, including:

- Regulated water that is sourced from different types of entitlements;
- Unregulated flows;
- Commonwealth water entitlements;
- NSW environmental water; and
- Water made available via water recovery measures achieved through measures implemented as part of The Living Murray initiative.

As the water would be sourced from entitlements within a regulated system, the project would not change water allocations to other licensees.



Legend

- Turkey's nest dam
- River Road bridge
- Regulator
- Construction features
- Roads
- Waterway
- Koondrook Perricoota Forest Site

0 1 2 4
Kilometres
Map Projection: Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 55

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NSW Office of Water
Koondrook-Perricoota Flood Enhancement Works

Job Number 21-18573
Revision C
Date 10 JUN 2010

Figure 1 - Location of the main structures

G:\21\18573\GIS\Arcview\Map_Documents\21.18573.Z014_Site_Layout_.mxd
Level 15, 133 Castlereagh Street Sydney NSW 2000 T 61 2 9239 7100 F 61 2 9239 7199 E sydmail@ghd.com.au W www.ghd.com.au

Data source: Dept of Commerce, Street Map- Navtec, Drawn: Cwilson, cwilson

1.3 Refinements to the project since exhibition of the Environmental Assessment

Some refinements have been made to the project described in the Environmental Assessment. These refinements address issues raised in submissions and reflect refinements during the detailed design process based on inputs from prospective tenderers during the early tenderer involvement process.

The refinements to the project are described in Section 3 and include:

- Postponement of construction of the internal floodway;
- Borrow pits – refinements in the size, location and method of rehabilitation;
- Spoil disposal site(s) outside the Forest boundary;
- Refinements to the construction footprint to ensure that sufficient allowance is made to enable the project to be constructed within the required timeframe;
- Revising the estimate of waste likely to be generated during the construction phase;
- Extending the working hours to allow activities to occur in evenings and on Sundays in locations where construction noise and light would not adversely impact on the nearest sensitive receivers.

1.4 The approval process

The project is subject to approval under Part 3A of the EP&A Act by virtue of application of the Order issued by the Minister for Planning under Section 75B(1) in NSW Government Gazette (No. 96) on 29 July 2005 (refer to Section 3.1.1 of the Environmental Assessment). The Minister for Planning is the approval authority.

Pursuant to Section 75F of the EP&A Act, the Director-General of the Department of Planning issued requirements for the Environmental Assessment on 22 May 2009. A copy of these can be found in Appendix A of the Environmental Assessment.

The Environmental Assessment was exhibited by the Department of Planning between 17 March 2010 and 7 June 2010. A total of eight submissions were received and this document responds to issues raised in submissions.

The Department of Planning will evaluate the Environmental Assessment and the Preferred Project Report giving consideration to submissions received during the exhibition period and determine whether to grant approval to the project.

NSW Office of Water and Forests NSW may proceed with the project if it is approved by the Minister for Planning.

1.5 Structure of this report

This Preferred Project Report is structured as follows:

- Chapter 1 – Introduction:
  - Introduces the Preferred Project Report;
  - Summarises the project described in the Environmental Assessment;

  - Outlines refinements that have been made to the project described in the Environmental Assessment;
- Chapter 2 – Response to submissions. This chapter responds to the issues raised in submissions received during exhibition of the Environmental Assessment;
- Chapter 3 – Preferred project. This describes the refinements made to the project described in the Environmental Assessment
- Chapter 4 - Assesses the environmental impacts of the refinements that have been made to the project described in the Environmental Assessment;
- Chapter 5 – Final Statement of Commitments. This presents the final Statement of Commitments which includes amendments that have been made to the draft Statement of Commitments that was included in the Environmental Assessment. The final Statement of Commitments addresses issues raised in submissions and refinements to the project; and
- Chapter 6 – Conclusion.

2. Consideration of submissions

2.1 Overview

The Environmental Assessment was exhibited by the Department of Planning from 17 March 2010 to 7 June 2010. The community and other stakeholders were invited to make submissions to the Department of Planning during this time. A total of eight submissions were received during the exhibition period and issues raised are addressed in the following section of this Preferred Project Report. The submissions are generally supportive and none objected to the project.

2.2 Murray Darling Basin Authority

Issue - It is important that the project approval does not constrain operational flexibility

The Murray Darling Basin Authority (MDBA) is funding the project in accordance with the Intergovernmental Agreement on Addressing Water Over-allocation and Achieving Environmental Objectives in the Murray-Darling Basin. This agreement was signed on 25 June 2004 by Ministers of the Murray-Darling Basin Ministerial Council from NSW, Victoria, South Australia, the ACT, and the Australian Government.

The MDBA strongly supports the project. It is the largest project being undertaken under The Living Murray Environmental Works and Measures Program and would provide environmental benefits to approximately 32,000 ha of the Forest.

The submission highlighted that, due to the size and complexity of the project, it will require significant real-time management and site specific experience to inform the adaptive management approach. As there will be significant learnings in the future, MDBA advises that it would be prudent to ensure there is a high degree of flexibility during operation of the project.

The key issue raised by MDBA is that, as the project will be operated to maximise environmental benefits, it is important that the project approval does not impose constraints that will limit operational flexibility, environmental outcomes or the capacity to manage risks.

The importance of operational flexibility and the role of the Operating Plan is discussed in Section 6.4 of the Environmental Assessment.

2.3 Department of Environment, Climate Change and Water

2.3.1 Flora, fauna and threatened species

The Department of Environment, Climate Change and Water (DECCW) advised that adequate consideration has been given towards flora and fauna, including survey and assessment of impacts. DECCW requested that further consideration be given to:

- Clearly defining what is meant by permanent and temporary clearing. This is addressed in Section 4.1;
- Providing a clearly defined development footprint, indicating the area of temporary and permanent clearing to be undertaken in the vegetation communities. This is addressed in Section 4.1;

- Reflecting that the rehabilitation program would be 'active', including the development of a Rehabilitation Plan, rather than the 'passive' program that is included in the Environmental Assessment. As indicated in Section 5, the Statement of Commitments has been revised to respond to this issue and specifically requires development and implementation of a Rehabilitation Plan;
- Confirming that the FMZ3A of the offset area covers the entire offset, rather than only the boundary of the endangered ecological community. The proponents confirm that the entire 149 ha offset area would be managed in accordance with FMZ3A. This includes approximately 94 ha of Inland Grey Box Woodland endangered ecological community and approximately 55 ha of other communities, including River Red Gum, derived tussock grasslands and shallow depressional marsh vegetation communities;
- Including a statement recognising that although the project will have substantial benefit to a large area of the Forest, some areas will only gain similar benefits through large unregulated flood events. These areas may gain indirect benefits from the project, such as groundwater recharge and providing habitat for fauna using the flooded areas, however the current observed decline in condition may continue to occur in these areas. This issue is addressed in the Environmental Assessment which reflects that the project has been designed to address the interim objectives for the Koondrook-Perricoota Forest under the Icon Site EMP and would not inundate the entire area of the Forest; and
- Include *Wilsonia rotundifolia* and Grey-crowned Babbler in the Assessment of Significance. This is addressed in Section 4.1.

2.3.2 Flooding

DECCW noted that the Environmental Assessment is generally in line with specific recommendations regarding alignments and capacities for regulating structures. It was noted that the location of the upstream spoil disposal area has not been finalised and DECCW's preference is for this to be located on private property outside the Forest.

As indicated in Section 3.4, the project has been refined to reflect that the process for selecting the upstream spoil disposal site would involve evaluation of options both within and outside the Forest boundary. An additional commitment has been included in Section 5 to ensure that the spoil disposal location is selected with appropriate consideration of environmental impacts. This would involve further assessment of potential impacts on aspects such as hydrology, ecology, heritage, time and cost, as well as negotiation with private landholders.

2.3.3 Noise and vibration

DECCW confirmed that it is likely that residences within 500 m of the constructed may be impacted by noise and the mitigation measures included in the Environmental Assessment would need to be implemented in these situations. This issue would be addressed by implementing the Statement of Commitments.

2.3.4 Greenhouse gas emissions

DECCW noted that:

- There is a significant level of uncertainty associated with the clearing emissions developed using the National Carbon Accounting Toolbox, however the actual emissions from clearing are likely to be within the uncertainty of the modelled emissions;
- It is likely the assessment has over estimated the emissions from diesel use;
- Emissions from inundation of land are estimated and it is likely that there will be minimal carbon sequestration.

2.3.5 Refinements to the Statement of Commitments

DECCW requested amendments to the Statement of Commitments relating to flora and fauna, noise and vibration, and Aboriginal cultural heritage. The final Statement of Commitments presented in Section 5 addresses the intent of the requested amendments.

2.4 NSW Industry and Investment

NSW Industry and Investment listed four specific issues relating to potential adverse impacts on aquatic ecology. These issues relate to operational impacts and were discussed with NSW Industry and Investment during preparation of the Environmental Assessment. While the project has the potential to result in adverse operational impacts, on balance, it would lead to long-term environmental benefits that substantially contribute to the objectives and targets for the Living Murray Icon Site for communities of River Red Gum.

The benefits of the project are considered to outweigh potential adverse impacts, particularly given that the Operating Plan would implement adaptive management principles that would seek to reduce environmental impacts and enhance benefits over time. Specific actions would be implemented as part of the Operating Plan to address the issues raised by NSW Industry and Investment.

Potential impacts on water quality

NSW Industry and Investment considered that there is the potential for blackwater to be generated and have significant adverse impacts on aquatic biota and the Lower Murray River endangered aquatic ecological community that is listed as threatened under the *Fisheries Management Act 1994*. The water quality outcomes resulting from controlled flooding need to be regularly monitored to qualify and quantify the significance of any potential impacts. This monitoring would also inform the management and operational changes required to mitigate impacts during both the first and subsequent watering events.

NSW Industry and Investment recommended that the following condition of approval be applied to the project:

The Final Operating Plan for the project is to contain detailed proposals for water quality monitoring of dissolved oxygen and dissolved organic carbon levels both within the Forest during watering events and in the Murray River and other downstream waterways when water is being discharged from the Forest, to the satisfaction of I&I NSW (Fisheries).

As indicated in Section 6.4 of the Environmental Assessment, a comprehensive water quality monitoring program would be implemented as part of the Operating Plan. This would ensure that potential water quality impacts are considered as part of planning for individual events. The intent of this recommendation has been addressed by Statement of Commitment 7 which relates to water quality

monitoring, and Statement of Commitment 8 which relates to development of specific measures to manage blackwater impacts.

Potential adverse impacts on threatened fish species

The Lower Murray River endangered aquatic ecological community listed under the *Fisheries Management Act 1994* includes a number of species of fish and aquatic invertebrates. Many of these have larval lifecycle phases and will passively drift into the Forest with diverted water. Monitoring of the movement of fish communities into and out of the Forest is required to inform the management and operational changes required to mitigate impacts on aquatic biota during watering events.

NSW Industry and Investment recommended that the following condition of approval be applied to the project:

The Final Operating Plan for the project is to contain detailed proposals for the monitoring of fish movement into and out of the Forest and fish community changes within the Forest during watering events, to the satisfaction of I&I NSW (Fisheries).

The Statement of Commitment has been modified to incorporate the intent of this recommendation.

Potential impacts associated with fish stranding

It is likely that native fish will persist or reside in residual aquatic habitats and channels within the Forest during and post flood recession. There is the potential for fish to be stranded and for this to generate community concern.

To manage this potential impact, NSW Industry and Investment recommended that the following condition of approval be applied to the project:

The Final Operating Plan for the project is to contain detailed proposals for the surveillance of the Forest during and following watering events to detect incidences of fish strandings or fish kills, to the satisfaction of I&I NSW (Fisheries).

The Environmental Assessment recognised the importance of implementing a program to monitor the impact of watering events, including incidences such as strandings. This is reflected in Statement of Commitment 5 which addresses the intent of the above recommendation.

Impact upon pest fish species

There is the potential that the project may create or augment opportunities for spawning and dispersal of pest fish species such as carp and weatherloach. NSW Industry and Investment advised that the response of pest species to watering events should be monitored to inform the management and operational changes required to mitigate impacts during subsequent events.

To manage this potential impact, NSW Industry and Investment recommended that the following condition of approval be applied to the project:

The Final Operating Plan for the project is to contain detailed proposals for the monitoring of pest fish response to watering events, to the satisfaction of I&I NSW (Fisheries).

The Environmental Assessment recognised the importance of monitoring the spawning and dispersal of pest fish species. This is reflected in Statement of Commitment 5 which addresses the intent of the above recommendation.

2.5 Wakool Landholder Association

2.5.1 What effect will the 0.16m rise in flood levels have on other levees in the vicinity of the downstream levee during a natural flood? Will this affect the structural integrity of the existing levees?

Section 3.11 reflects that the design of the structures on Cow and Calf Creeks has been revised to reduce the number of stop log bays at Cow and Calf Creeks to reduce capital cost. Investigations by NSW Department of Technology, Services and Administration (DTSA) indicate that there would be an increase in afflux of approximately 20 mm above the levels outlined in the Environmental Assessment. DTSA discussed this increase with the DECCW Floodplain Manager and it was agreed to be acceptable.

Potential impacts on floodplain hydrology associated with this change are discussed in Section 4.2.

2.5.2 There is concern regarding blackwater events. A dilution flow for blackwater should be considered in the overall watering volumes.

As discussed in Section 10.2.4 of the Environmental Assessment, the project has been designed to return the majority of water directly to the Murray River via the return channel. This is considered to be the most effective means of diluting blackwater.

When the return channel is operating at maximum flow rates of 1,850 ML/day, flows in the Murray River downstream of the Torrumbarry Weir are likely to be at least 5,000 - 6,000 ML/day. As a result, blackwater would be diluted by flows in the Murray River.

If blackwater is produced and released down Barbers Creek at the maximum rate of 250 ML/day, it would flow approximately 58 km downstream before being diluted by the Wakool River which is likely to have flows in the order of 500 – 600 ML/day at the time of year the project is likely to operate. If flows from the Merran Creek system are entering Barbers Creek upstream of the confluence with the Wakool River, this would assist in diluting blackwater.

Blackwater could be diluted either by providing additional diversions into the Forest via the inlet channel, or providing additional flows in the Wakool River to dilute water that enters the Wakool via Barbers Creek.

Water sourced for the project under The Living Murray would not be able to be used to provide additional flows to the Wakool River via the Edward River as the Wakool is not part of an Icon site. As such, this is not part of the project. It is unlikely that additional flows could be provided in the Wakool unless environmental water is available from water sources other than The Living Murray and these flows are available to the Wakool River at the same time as operation of the project.

A significant volume of water would need to be diverted into the Forest to dilute blackwater within the flood pool prior to this water being released downstream to either the Murray River or Barbers Creek.

The water quality assessment in Section 10 of the Environmental Assessment indicates that the seasonality of a flood event is main variable that influences the likelihood of blackwater conditions developing. Flood events that extend over summer are most likely to generate blackwater conditions due to the rise in water temperatures. If a blackwater event does occur, diverting additional flows from the Murray River into the Forest would be likely to extend the flood event further into summer which would both prolong the blackwater event and increase the risk of more severe blackwater conditions developing.

This option is not currently being considered due to the large volume of water that would be required and the likelihood that dilution flows would exacerbate the blackwater conditions. The preferred option to dilute blackwater is described in the Environmental Assessment and involves release of water via the return channel.

2.5.3 The project is an opportunity to address block banks in Barbers Creek which have the potential to create problems when watering the Forest. The block banks may limit the volumes of water that are required to dilute blackwater discharged from the Forest.

As indicated in Section 2.5.3, the most effective method for diluting blackwater is considered to be discharging the water directly to the Murray River via the return channel. Dilution flows down Barbers Creek are not considered effective given that it would require a significant volume of water to be diverted into the Forest and then released down Barbers Creek.

As indicated in Section 3.12, the project has been refined to increase the design capacity of the bywashes from 250 ML/day to 500 ML/day. Further investigations would be undertaken prior to implementation of an operating scheme that involves flows in excess of 250 ML/day being released down Barbers Creek. This would ensure that potential impacts associated with aspects such as net water use, hydrology, geomorphology, terrestrial and aquatic ecology (including any fish passage requirements), and water quality are considered prior to increases in discharge rates to this waterway.

The block banks are not proposed to be removed from Barbers Creek as part of this project.

2.5.4 Will the internal floodway affect the volume of water discharged to the Wakool River system under a large natural flood event? At present, the Wakool system gets its fair share of flood flows and anymore would be onerous on landholders.

Sections 6.4 and 9.2.2 of the Environmental Assessment indicate that during large natural flood events, all Forest watering structures would be de-activated to enable floodwaters to enter and exit the Forest area in an uncontrolled manner, similar to the existing situation. Thus, it is intended that the project would not impact on large flood flows in the Murray River or discharges to the Wakool River system, relative to existing conditions.

As indicated in Section 3.2, the internal floodway would not be constructed as part of the initial works for the project. A monitoring program would be implemented as part of the Operating Plan to evaluate the effectiveness of the flood events and determine whether the floodway is required to enhance the flow of water from the flood pool to the return channel.

If operational monitoring determines that a floodway is required, further investigations would be undertaken to confirm the preferred alignment and dimensions. This would involve consideration of the impacts of operation of the overall project during large natural flood events. Preliminary indication are that, if required, the internal floodway would be approximately 1 km by 50 m which is significantly smaller than that 1 km by 250 m structure assessed in the Environmental Assessment.

2.5.5 There has been a lack of input from the local community. A similar group to the Land and Water Management Plan Working Group should be created that is representative of existing established groups.

The NSW Murray Catchment Management Authority (CMA) and the Victorian North Central CMA advertised for expressions of interest for membership of the Gunbower-Koondrook-Perricoota Icon Site Community Reference Group (CRG) on behalf of the Integrated Coordinating Committee (ICC) for the

Icon Site. The advertisement indicated that the CRG would be formed under the Living Murray Initiative to provide advice to the ICC on community issues, interests and knowledge as it relates to water management within the Icon Site.

Expressions of interest closed on 25th October 2006 and community representatives were subsequently appointed to the CRG following evaluation of the applications. While the CRG was established for the overall Gunbower-Koondrook-Perricoota Icon Site, it has been consulted specifically regarding the project.

In addition to representation on the CRG, the community has been provided with a number of formal and informal opportunities to have input to the project as detailed in Section 4.1.1 of the Environmental Assessment. The community consultation program has focused on targeted meetings with individuals that may potentially be affected. Since January 2009, there have been a total of 35 community consultation events that have been attended by approximately people from the farming community and around an additional 300 general community members, including representatives from a diverse range of organisations with an interest in the project. It is therefore considered that an appropriate process was implemented to obtain input from the local community.

2.5.6 The project is costly and it is important that construction is carried out efficiently. Bores have been proposed as a source of construction water. How does the salt from the groundwater affect the clay material used in levee construction? This is an example of an issue that could be clarified with input from a group representing the local community.

The source of construction water will be confirmed by the contractor during construction planning. The contractor will consider a range of factors when selecting the construction water source, including the characteristics of the water and potential impacts on the construction process. As indicated in Section 3.8, the project has been refined to also enable construction water to be sourced from canals and piped to the worksite. This refinement provides the contractor with the flexibility to select the most appropriate source of construction water.

Geotechnical and water technical analysis has been undertaken which determined that the groundwater is suitable for the intended construction purpose.

2.6 Wakool River Association

2.6.1 One of the principles of floodplain management is to minimise development or obstructions within the designated floodway. Has the effect of growth and associated congestion within the floodway and flood runners been assessed?

The potential for regrowth to congest the floodway was considered during development of the concept design. As the project has been refined to reduce flow rates, regrowth is expected to have negligible impact on operation of the floodway.

2.6.2 The flood modelling is based on the original alignment for the downstream levee. Will this be reviewed based on the final alignment?

The downstream levee alignment presented in the Environmental Assessment included an area of private property that has been purchased as it would be inundated by the project. The flood modelling

discussed in the Environmental Assessment was completed during the concept design phase and did not include this area of private property.

Preliminary modelling undertaken since completion of the Environmental Assessment includes the area of private property purchased for the project that would be inundated. The results indicate that the maximum area of inundation would increase from about 17,000 to about 18,000 ha.

2.6.3 Have the negative impacts associated with small, frequent events (every 1 to 2 years) been identified and assessed?

The project has been specifically designed to have a high degree of operational flexibility. As discussed in Sections 1.6 and 6.4.1 of the Environmental Assessment, there are numerous possible operating scenarios and it is not feasible to assess them all within the Environmental Assessment. As a result, the adopted approach focused on one possible operating scenario which is described in the Preliminary Environmental Assessment (DWE, 2009) and summarised in Section 6.9 of the Environmental Assessment. This operating scenario is an entirely managed flood event involving the maximum possible in-flows of 6,000 ML/day via the inlet channel and would inundate the maximum possible area. In terms of flood extent and duration, this event would be generally equivalent to a natural event involving flows of 35,000 ML/day at Torrumbarry Weir. This operating scenario was selected as the basis for the Environmental Assessment as it would result in the maximum area and duration of inundation able to be maintained by the project.

Section 6.4.1 of the Environmental Assessment indicates all events would be managed in accordance with the Operating Plan and associated adaptive management principles. While the Environmental Assessment does not specifically assess adverse impacts associated with small, frequent events, the monitoring programs implemented as part of the Operating Plan would ensure that impacts are identified and mitigation strategies are implemented during subsequent events. This would ensure that lessons are applied so that, over time, there are improvements in the efficiency and environmental outcomes of individual events. This process of continuous improvement would be one of the core functions of the monitoring programs to be implemented as part of the Operating Plan.

2.6.4 The internal floodway would be approximately 1 km long and 500 m wide. Would this affect the pattern of a large natural flood event?

This issue is addressed in Section 2.5.4.

2.6.5 The project should use the natural drainage path down Barbers Creek and to a lesser degree Thule Creek to reuse the water in the Wakool River system. Barbers Creek has an in-bank capacity in excess of 1200 ML/day.

A range of options were evaluated during development of the concept design, including an option that involved releasing larger volumes of water down Barbers Creek to the Wakool system. This option was not progressed because, compared to the preferred option, it would have substantially higher water use requirements and higher net water use. This was primarily due to additional losses along Barbers Creek and the Wakool River that would occur before the water is returned to the Murray River. The preferred option has substantially lower water use requirements because a high proportion of the water is released directly to the Murray River via the return channel and so involves much lower losses.

Releasing higher volumes of water to Barbers Creek was also considered likely to compromise the integrity of the block banks in Barbers Creek and potentially result in significant third party downstream flooding and landholder compensation risks.

The preliminary draft Operating Plan reflects that the project has been specifically designed to allow large floods to pass unhindered. As indicated in Section 2.5.4, the project would not be operated during large natural flood events. During these events, flows would continue to pass down Barbers Creek and Thule Creek.

2.6.6 During a watering event, what percentage of time would the turtle ramp and fishway be used? Do the costs warrant this level of use?

Section 6.4.5 of the Environmental Assessment discusses the design considerations for the fishway on the inlet channel. The structure has been designed to have a high level of operational flexibility to enable diversion discharges to be ramped up and ramped down. It also has acceptable flow characteristics, structure profile and control for upstream fish passage (Department of Commerce 2008).

To enable fish movement, the inlet regulator comprises a dual-fishway to cater for the variable headwater and tailwater levels and the corresponding flow rates. The design and operational specifications of the fishway are driven by the existing knowledge of native fish biology and physiology, with an acute focus on migratory lifecycle aspects of the Murray River fish community. The native fish biomass migrating on large flows at the site will comprise of larger bodied fish such as golden perch, silver perch and Murray cod. A denil-slot fishway will operate during the corresponding headwater and tailwater at these high flows of 900 to 6000 ML/d. As flow recede below 1,000 ML/d and the differential head is between 1.3 to 2.3 m, the biomass of native fish migrating will be smaller species such as Australian smelt, gudgeons and hardyhead. A vertical-slot fishway will operate at this lower flow range to accommodate these smaller species which are unable to utilise the denil-slot fishway at higher flows.

The operational overlap between 900 to 1100 ML/d is an optimised operating phase where both fishways may have some functionality on either receding or increasing flow regimes at the regulator. This strategic biological optimisation allows for construction savings as a single fishway that caters for all flows and all fish size classes and species was considered cost prohibitive.

The provision of fishways on barriers to fish passage such as dams, weirs and regulators is consistent with NSW government policy and other projects undertaken as part of The Living Murray Environmental Works and Measures Program. Furthermore, Section 218 of the New South Wales *Fisheries Management Act 1994* (Fishways to be provided in construction of dams and weirs) states that “a public authority that proposes to construct, alter or modify a dam, weir or reservoir on a waterway must, if the Minister so requests, include as a part of the works for the dam, weir or reservoir, or for its alteration or modification, a suitable fishway or fish by-pass”. The intent of Section 218 of the *FMA 1994* is to allow for the installation of a fishway to mitigate the impact of weir or dam on fish migration where possible. There are several aspects which are considered when applying this provision. The relevant aspects include:

- Presence of native fish that require to migrate as part of their lifecycle
- Potential extent and value of habitat to be reinstated to fish migration
- Presence of other barriers to fish migration and future actions and developments
- Cost benefit of a fishway

The cost of the fishway is considered to be warranted given the known biological requirements for native fish in the area and the importance of enabling fish passage across the floodplain during inundation events.

The turtle ramp is designed to provide a migratory route for turtles during both filling and drawn down phases. The intent of the turtle passage facilitation is similar to that for fish as it caters for the migratory function of refuge. In the event that migration, with respect to seeking refuge, is terminated, the likely outcome for aquatic fauna (including fish and turtles) is mortality. In this context, the facilitation of these functions at the inlet regulator as a part of the project is prudent and warranted.

2.6.7 The claim that ponding water would have no effect on groundwater is questionable. Previous studies have concluded that large flooding events can have more of a short term influence on groundwater than anything else.

Site specific data to the Koondrook-Perricoota Forest is restricted to two groundwater monitoring events, lithological and EC soils depth profiling. To understand the driving hydrogeological processes on the floodplain and the anticipated response to flooding, a groundwater and surface water monitoring plan would be initiated as part of the Operating Plan. The information collected as part of this program would provide site specific information and enhance knowledge of floodplain processes across the Murray River.

Infiltration to the groundwater due to flooding is likely to increase groundwater levels (particularly in areas of preferential recharge – such as sandy layers or Gilgai clays), however the current data it is unlikely that this would increase groundwater levels sufficiently to impact on surface waters via direct groundwater discharge to the Murray river or associated water courses.

The major groundwater – surface water impacts associated with operation of the project are related to potential lateral flow from waterways to adjacent sandy layers, increased recharge to groundwater systems, and / or development of localised perched groundwater systems. The impacts on groundwater and salinity due to these mechanisms are not quantifiable with the data available to date. Lateral flow mechanisms have previously been observed as a natural process which serves as a water resource to forest vegetation. Depending on the salinity of the sandy layers and lateral flow mechanisms, the response is likely to be variable across the floodplain. Localised perching of groundwater and / or increased infiltration is unlikely to increase groundwater levels to cause groundwater discharge to surface water systems.

Flooding is a natural process and the project aims to enhance the flood regime within the Forest such that it is more reflective of natural conditions. As indicated in Statement of Commitment 8, a surface and groundwater monitoring program will be implemented as part of the Operating Plan. In general, the Forest naturally lends itself to a number of mitigation features from groundwater impacts to waterways of the Forest:

- Depth to groundwater – the groundwater depth below the natural surface varies between 6 to 12 m compared to the surrounding landscape and river system. While groundwater levels may rise slightly, the limited duration of flooding and depth to the water table means that it is unlikely that regional groundwater levels would rise sufficiently to reverse the current gradients and cause salinity impacts to surrounding properties or the river system. Recharge would need to increase the groundwater levels 2 to 3 m to intersect with local creek systems and up to at least 7 m to cause groundwater flow to the river.

- Surficial clays to sandy clay layers limit recharge potential. Preferential recharge may occur for a limited period via deep cracks in the surficial clays. Low permeability material at the surface is likely to limit infiltration and increase evaporation.
- Groundwater – surface relationship – The creeks and River Murray are losing surface water to the groundwater and there is no evidence to suggest groundwater is discharging or is likely to impact waterways of the Forest;

An important consideration in the monitoring plan is the cumulative effects of the flooding events over the long term. It is therefore important to continue the monitoring program through out the life of the project to ensure that the required information is available to enable the adaptive management approach outlined in the Operating Plan to be effectively implemented.

2.6.8 Data indicates that there have been many prolonged dry periods where the Murray River would have ceased to flow on many occasions, without the influence of river regulation. Under natural conditions the Forest would have prolonged dry periods. What are the consequences of removing this natural drying phase?

As indicated in the Environmental Assessment, analysis of hydrological data for the period 1891 – 2008 shows that river regulation has reduced the average magnitude of flows in late winter and early spring. Average flows for September have dropped from approximately 37,000 ML/day to approximately 28,000 ML/day downstream of Torrumbarry Weir. Without the effects of climate change, flows are predicted to fall to approximately 21,000 ML/day as the impact of river regulation takes affect on the long-term average.

Changed flow regimes in the Murray River due to the long term effects of a century of river regulation and more recent effects of prolonged drought have significantly reduced the ecological health and productivity of the Forest. This is primarily due to a reduction in the frequency, duration and magnitude of flooding, such that the current flooding regime is inadequate to support flood dependent vegetation communities (DWE 2009).

The project has been designed to enable flexible operations and enhance the flood regime by facilitating a range of different magnitude, frequency and duration of flood events. As indicated in Section 6.4 of the Environmental Assessment, it is not intended that the Forest would be subject to large flood events on an annual basis. It would be operated in accordance with an Operating Plan that would involve monitoring the ecological condition of the Forest and the response to inundation events. If evaluation of monitoring results indicates that the Forest would benefit from a drying phase, the project has the required flexibility to accommodate this scenario.

2.6.9 What is the alignment of the eastern levee in relation to the existing levee? Will this have any detrimental effect on the floodway?

As indicated in Figure 9.3 and Section 9.2.4 of the Environmental Assessment, a network of levees is located along the western, eastern and northern perimeter of the Forest. Adjoining land is private property which comprises mixed land use including dryland and irrigated agriculture. These levees are generally located within the private property in the immediate vicinity of the Forest boundary and have been constructed by private landowners to provide flood protection to the adjacent private property.

The eastern section of the downstream levee will be located in the immediate vicinity of the Forest boundary. Figure 9.3 of the Environmental Assessment shows the main hydrology features of the Forest

and indicates that private landholders have constructed levees within their properties in close proximity to the Forest boundary.

Flood inundation extents from the 1993 flood event show that the existing levees contained that flood within the Forest boundary and prevented uncontrolled flooding of private property. As the eastern section of the downstream levee will be in close proximity to existing private levees, detrimental impacts on operation of the floodplain are considered to be unlikely.

Under a managed flow event, modelling has shown that in the upstream part of the Forest, the depth and overall extent of flooding would be less than the 1993 flood event. It is therefore not expected that the project would have a detrimental impact on the floodway or increase the risk of flooding of private property adjacent to the eastern boundary of the Forest.

The project does not involve upgrading any existing levees other than the section of downstream levee that provides Barham with flood protection.

2.7 Community submission

Restoration of roads damaged by construction vehicles

A member of the community agreed with Section 14.2.2 of the Environmental Assessment which states that it is likely some sections of Nineteen Mile Road and Perricoota Forest Road would need to be upgraded to ensure it is suitable for construction traffic. The submission indicated concern that damage to these roads during construction would not be repaired.

As indicated in Section 14.2.2 of the Environmental Assessment, dilapidation surveys would be undertaken of access roads in the vicinity of the Forest. The surveys would be undertaken prior to commencement of construction to identify sections of the road that need to be upgraded to ensure it is suitable for use by construction vehicles. A survey would also be undertaken following completion of construction to identify sections of the road network that have been degraded during the construction period. If road damage is attributable to construction, repairs would be performed in consultation with the relevant road authority. The Statement of Commitment has been revised to specifically address this issue.

Access to private properties during construction

The submission indicated that reasonable access is required to the landholder's property via public roads during and after completion of construction.

As indicated in the Statement of Commitments, work practices will be developed as part of the CEMP to minimise construction traffic impacts on the surrounding road network. This will involve consultation with road authorities and informing and consulting with the local community and road users on changed traffic conditions prior to construction commencing. This will ensure that access to properties is maintained via the public road network.

2.8 Department of Water, Land and Biodiversity Conservation

The South Australia Department of Water, Land and Biodiversity Conservation (DWLBC) raised issues relating to operation of the project to manage ecological risks. These issues are outlined below.

2.8.1 Water delivery and timing

Capacity to deliver water at the required time of year

DWLBC indicated that it is proposed that autumn is the preferred timing for watering to minimise the risk of blackwater events, however no information is provided to demonstrate that there is capacity to deliver the required volumes at this time of year.

As indicated in Section 6.4 of the Environmental Assessment, it is preferred that large inundation events commence in winter. Section D10 of the Preliminary Operating Plan indicates that modelling was undertaken to determine how the project could have been operated between 1990 and 2005 based on watering principles and water available through the Living Murray account and natural inflows. The period 1990 – 2005 was selected as it includes both relatively wet and relatively dry periods.

Table 6.11 of the Environmental Assessment provides a summary of whether the project would achieve the intended ecological objectives in each of the years between 1990 and 2005. This indicates that the scheme would have achieved the intended ecological objectives for inundation of River Red Gum communities in 44% of years.

An Annual Environmental Watering Plan would be prepared at the beginning of each 'water' year (July to June, aligning with the seasons and water allocation policy in the River Murray system). The plan would be prepared in May/June for the forthcoming year as outlined in Section 5.2 of the Environmental Assessment. It would set the environmental watering priorities under The Living Murray for the next 12 month period by:

- Considering current and likely water availability for the forthcoming year;
- Considering the need and priority of watering activities at the Icon Sites; and
- Establishing a decision making framework for watering actions for the forthcoming year, based on water availability and environmental conditions at the Icon sites (MDBA 2009).

The Annual Environmental Water Plan would be built up from inputs from the Icon Site managers. The need for and priority of watering activities considers the condition of the sites, recent watering history, ecological outcomes to be targeted in that year, and other conditions, particularly related to environmental and third-party risks (MDBA 2009).

The relative priority of the proposed watering activities across the Icon Sites would be compared and a hierarchy of watering actions be developed aligning with water availability thresholds and other implementation criteria. A decision making structure would be established so that rapid decisions can be made during the water year as it unfolds and water becomes available (MDBA 2009).

As the Annual Environmental Watering Plan is adaptive in response to water availability and other environmental conditions, implementation of the associated watering activities is also adaptive. During preparation of the Annual Environmental Water Plan, consideration would be given to the capacity to deliver the required volume of water at the desired time of year.

Clarification of the preferred timing of watering would improve understanding of potential benefits and risks

DWLBC indicated that there is a preference for spring/summer flooding that would provide optimum timing for water bird breeding and that this seems to be at odds with the preferred autumn watering outlined in other sections of the Environmental Assessment.

Section 6.4.2 outlines the desired watering regime and states that the primary objective of the project is to deliver a flood regime that restores and maintains an adequate, representative area of River Red Gum forest, particularly that part that supports flood dependent understorey communities. An effective flood is considered to endure for at least 100 days, and an acceptable regime is considered one that delivers flood water at greater than half the natural frequency, during the late winter/spring period (Leslie and Jacobs, 2003).

A water regime that would achieve the project's management goal would ensure that a significant proportion of the Forest and a variety of ecosystems would be retained within the forest. This watering regime is summarised in Table 2.

Table 2 Desired water regime for vegetation classes

Vegetation class	Frequency	Duration	Timing
Wetland vegetation	6-9 years in 10	2-8 months	August – December
Waterbird breeding	6-9 years in 10	5-8 months	September – February
Fish	6-9 years in 10	2-4 months	August – November
River Red Gum forest	3-9 years in 10	4 months	August – November
Waterbird breeding	3 years in 10	5 to 8 months	September – February
River Red Gum Woodland	1-4 years in 10	1-4 months	August – November
Black Box	6-9 years in 10	1-4 months	September, October
Grey box, sandhills	Nil		

Source: MDBC, 2006

Section 6.4 of the Environmental Assessment confirmed that the Operating Plan would include a monitoring program to ensure that the ecological response to watering events is assessed and the results are considered during planning for subsequent watering events. This will ensure that there is an improved understanding of potential benefits and risks over time.

2.8.2 Ecology and risk mitigation

Additional detail on possible mitigation approaches for pest fish species should be provided

As indicated in the response to issues raised by NSW Industry and Investment (Section 2.4), a program will be developed to monitor impacts on fish and aquatic invertebrates, including aspects such as stranding of native fish, and spawning and dispersal of aquatic pests. This program will be developed in consultation with NSW Industry and Investment and will include mitigation measures to be implemented if large scale breeding events of pest species are observed.

A geomorphological investigation was undertaken to assess the impacts of the flows released down Barbers Creek and the main recommendation of the report is that variable flows should be released to minimise impacts. The project has been designed to have the flexibility to release water at variable flow rates down this waterway. The need to vary the flow rates down Barbers Creek would be considered during planning for individual flood events.

There is limited information on measures to be implemented to mitigate operational impacts, including what is to be monitored and what actions would be implemented to mitigate unintended environmental consequences.

Section 6.4.1 of the Environmental Assessment states that the Preliminary Operating Plan – Draft (NSW Office of Public Works, 2009) included in Appendix B will be finalised in consultation with relevant agencies prior to commencement of operations. This plan will include aspects that will be monitored and the specific actions to be implemented to minimise impacts.

The following Statements of Commitments include environmental aspects that would be monitored as part of the Operating Plan:

- Statement of Commitment 5 – monitoring the response of the ecosystem to flood events;
- Statement of Commitment 8 – surface and groundwater monitoring program;
- Statement of Commitment 9 – blackwater monitoring program;
- Statement of Commitment 13 – monitoring impacts associated with erosion and sedimentation;

The monitoring program that would form part of the Operating Plan would be developed in consultation with lead government agencies, including NSW Industry and Investment, MDBA, NOW, State Water, Forests NSW and DECCW. This would involve developing specific actions to be implemented to minimise impacts and would ensure that the management measures are consistent with relevant government policies.

Management of risks and efficacy of the risk management strategy

DWLBC suggested that a table should be provided that clearly identifies potential risks, monitoring required to evaluate the risks and the range of potential mitigation measures. This would enable a clearer assessment of how well each potential risk is being addressed and would aid in identifying gaps in the risk management strategies.

DWLBC advised that for the efficacy of the risk mitigation strategy to be evaluated, there should be a clear statement of what the risks are, how they will be monitored and what mitigation strategies are available, particularly for the potentially big risk area of water quality.

This issue is addressed by Chapter 7 of the Environmental Assessment which summarises the outcome of the risk assessment process that was undertaken by the project team. This includes a summary table that reflects that risks were identified, along with the indicative management measures and the residual risk following implementation of the management measures.

A number of the risk management measures rely on monitoring programs that will be implemented as part of the Operating Plan. This strategy is appropriate because the potential environmental risks will vary according to the timing, duration and ecological objectives of individual inundation events. As such, planning for inundation events will consider the risks and associated management measures on a case by case basis to ensure that the management approach is tailored towards the characteristics of the individual event.

Potential risks such as erosion or bank slumping have been mentioned in passing and there is no obvious indication of how they would be managed.

Section 11 of the Environmental Assessment assesses potential impacts associated with erosion and sedimentation. Statement of Commitment 13 relates specifically to management of these risks and

requires development and implementation of a monitoring program as part of the Operating Plan to monitor impacts associated with erosion and sedimentation. The program will:

- Include areas in the immediate vicinity of all regulators and channels constructed as part of the project;
- Include areas downstream of the project along Barbers Creek, in particular the block banks; and
- Identify procedures to be implemented to minimise potential impacts.

2.9 Joint submission from environmental groups

A joint submission was received from the National Parks Association of NSW, The Wilderness Society Sydney, Inland Rivers Network and the Nature Conservation Council of NSW. The submission supports the project because of the urgent need for improved flooding in the Forest, subject to the issues raised being adequately addressed. The response to issues raised in the submission is provided below.

2.9.1 The project should include an informed consent process with Traditional Owners and all interested Aboriginal parties

The submission stated that the project should include an informed consent process with Traditional Owners and all interested Aboriginal parties that is as inclusive as possible, whilst recognising the special rights and interests of Traditional Owners. Specific issues raised in the submission are discussed below.

Socio-economic outcomes for Traditional Owners are maximised, including the provision of timber from felled trees where sought by Traditional Owners, and contracting appropriate Traditional Owner groups to provide cultural awareness training.

As indicated in Section 4.5.1, a Joint Indigenous Group (JIG) has been formed that contains representatives from Yorta Yorta Nation, Barapa Barapa Nation, Deniliquin Local Aboriginal Land Council, and Moama Local Aboriginal Land Council. The purpose of the JIG is to work in partnership with the project Team to provide advice on how the Aboriginal custodians may protect the integrity of their cultural heritage during the construction of the project and how to achieve both cultural and socio-economic outcomes through the project to benefit Indigenous peoples. This would involve participating in cultural awareness training.

Timber from felled trees is a commercial state-owned commodity. Merchantable timber will sold to the market and this will include local businesses that are part of the timber industry.

Cultural heritage surveys are conducted by Traditional Owners to the intensity they deem necessary in all areas earmarked for disturbance of any kind.

As indicated in Section 4.5.1, the Cultural Heritage Management Plan would be developed in consultation with the JIG and this would involve confirming the scope of cultural heritage surveys required prior to commencement of construction at a particular location. As such, the monitoring approach would be endorsed by the JIG which includes representatives of the Traditional Owners.

Cultural awareness training is provided for all contractors.

As required by Statement of Commitment 23, cultural awareness training for contractors will be included in the Cultural Heritage Management Plan.

Traditional Owners are the key decision-makers as to any process for dealing with any cultural heritage items affected by the project.

Section 4.5.1 reflects that the JIG will be the decision making body for issues relating to cultural heritage items affected by the project. During development of the Cultural Heritage Management Plan, the JIG will develop a process to be implemented to manage any items of cultural heritage significance that may be encountered during construction.

Any other aspirations for the flooding from the Traditional Owners are met, including any potential proposals in relation to cultural watering outcomes.

The JIG will be consulted during planning for individual inundation events. While this will involve discussing aspirations for inundation events, all decisions regarding watering events would be made within the context of The Living Murray initiative. The Living Murray Business Plan and overarching Environmental Watering Plan set the policy context for the Living Murray Initiative (Section 5.2 of the Environmental Assessment). Amongst other things, these documents set out how environmental watering decisions are made, how water use is accounted, and how the outcomes are to be reported.

The Living Murray Annual Environmental Watering Plan is prepared at the beginning of each 'water' year (July to June, aligning with the seasons and water allocation policy in the River Murray system). The plan is prepared in May/June for the forthcoming year and sets the environmental watering priorities under The Living Murray for the next 12 month period by:

- Considering current and likely water availability for the forthcoming year;
- Considering the need and priority of watering activities at the Icon Sites; and
- Establishing a decision making framework for watering actions for the forthcoming year, based on water availability and environmental conditions at the Icon sites (MDBA 2009).

2.9.2 Impact of inundation of Inland Grey Box Woodland

The submission notes that approximately 100 ha of Inland Grey Box Woodland will be flooded by the project and considers that this may potentially destroy this forest community or have a severe impact on its health. It is notable that whilst the assessment looks at the impact of the duration of the flood event on the Grey Box woodland, and concludes (albeit with little evidence to support it) that there is likely to be minimal impact, it does not even consider negative impacts from flood frequency. The submission states that whilst Inland Grey Box Woodland might survive one flood inundation, it may not survive repeated, regular flood inundation. It is crucial that there is an intensive monitoring effort in the areas of Inland Grey Box Woodland that are inundated, and that if there is any evidence of decline, that changes are made to minimise future inundation and restore the health of the woodland.

Section 6.4 of the Environmental Assessment reflects that the project would be operated in accordance with an Operating Plan that will provide a framework for operation of the structures to meet key ecological objectives within the broader context of The Living Murray Initiative and Scheme's governance. The Operating Plan would provide an effective platform for operational decision making based on knowledge development and a strong understanding of what the project aims to achieve.

In line with adaptive management principles, it is important to be able to alter the operation of the structures, both during events and from one operation to the next, in order to react to the ecological response observed. The ability to plan for, and respond to, varying ecological objectives would be a key function of the Operating Plan.

The project would be operated using adaptive management techniques, where knowledge from previous events would be incorporated into the decision making process, both during individual events, and from event to event. Operation would be fine-tuned as improvements to the practical operation of the structures are made, and as ecological responses are monitored and evaluated. Appropriately designed and implemented monitoring programs would be detailed in the Operating Plan and would be required to ensure this adaptive management approach is effective.

The need to monitor the impact of inundation of Inland Grey Box Woodland was identified and discussed with DECCW. This is reflected in Statement of Commitment 5 which requires monitoring in a range of vegetation communities including the Inland Grey Box Woodland endangered ecological community, and sites outside areas of the Forest that would be inundated by the project.

If adverse impacts on the Inland Grey Box Woodland are identified and attributed to the project, the principles of adaptive management would be applied during planning for subsequent inundation events. Part of this process would involve consideration of the net environmental impacts such that beneficial impacts outweigh adverse impacts.

2.9.3 The offset for the loss of Inland Grey Box Woodland is inadequate

The submission considered that the offset for clearing 8 hectares of Inland Grey Box Woodland for the inlet channel is inadequate because it is neither permanent nor additional. Forest Management Zone 3a is a very weak zoning that can be changed unilaterally by a Forests NSW Regional Manager. Grazing is set to continue in the offset areas, despite a body of scientific evidence that grazing has a negative impact on riverine and floodplain environments and very lax implementation by Forests NSW of their Grazing Management Plan. The submission indicated that there are no additional requirements for weed or feral animal control in the offset areas and considered that Forests NSW current practices for weed and feral animal control are inadequate. The submission recommended the offset area include:

- Permanent protection of both land purchase areas through gazettal under the *Forestry Act 1916* as Flora Reserves.
- Requirements for additional active weed and feral animal control in these areas, with systematic monitoring to test effectiveness over time.
- Exclusion of grazing from these areas.

The approach to development of the offset strategy was discussed with, and agreed to, by DECCW. The offset area will be located on the former Toorangabby property that was purchased for the project. This property was extensively cleared and degraded by historical timber harvesting and sheep grazing.

It was agreed that the offset is additional as Toorangabby was purchased specifically for the project and application of the land management practices detailed in Section 8.7.4 of the Environmental Assessment would lead to a long term improvement in ecological condition and biodiversity values relative to continued management as a pastoral property if it was not purchased for the project. As the change in management procedures would improve ecological condition, the offset strategy is consistent with DECC (2008) offsetting principles.

Management in accordance with Forest Management Zoning 3A is considered appropriate as it would exclude harvesting but would allow other silvicultural practices undertaken by Forests NSW as part of ongoing operation of the Forest, including grazing to manage fine fuel loads.

DECCW advised that the ratio of the size of the offset area relative to the area of Inland Grey Box Woodland that would be removed would depend on the management practices that would be implemented. The size of the offset area was agreed on the basis that Forests NSW existing management measures, including grazing, are implemented to manage the offset area. This would mean that a smaller offset area would be required if management practices such as grazing were not permitted. Therefore the proposed 149 ha offset site, including 94 ha of Inland Grey Box Woodland, is adequate to offset impacts on 8 ha of Inland Grey Box Woodland.

2.9.4 Impacts associated with disposal of spoil from the inlet channel

The submission considers that there will be significant impacts from the spreading of the spoil from inlet channel along the north-eastern edge of the Forest. This will undoubtedly lead to impacts both on mature trees and on important understorey. An alternative site that is already cleared should be located for depositing spoil.

As indicated in Section 3.4, of the Environmental Assessment, since completion of the Environmental Assessment, further consideration has been given to the upstream spoil disposal site. Discussions with DECCW indicate that it is preferable that the spoil be placed outside the Forest boundary in a location that has already been disturbed as this would minimise impacts associated with vegetation clearance (refer to Section 2.3).

Preliminary investigations have identified a number of sites outside the Forest boundary that may be suitable for spoil emplacement subject to agreement being reached with the landholders. If spoil is placed on private property, it would be contoured to look as natural as possible and batters would be suitable to enable agricultural machinery traverse the area. It would be capped with topsoil and revegetated to assist stabilise the area in the long term. Further description of the offsite spoil disposal option is provided in Section 4.1.2.

The project has been refined to enable spoil to be placed either on private property or within the Forest. Regardless of the disposal location, selection of the disposal site would involve consideration of the associated environmental impacts and this would involve minimising the area of vegetation affected. The spoil disposal site would not impact on the Inland Grey Box Woodland endangered ecological communities.

2.9.5 The island effect could increase feral animal predation of native fauna

The submission noted that the island effect described in the Environmental Assessment could result in a major impact on native fauna through feral animal predation during inundation. Actions should be required to address this issue – including monitoring of the areas during inundation, and then application of feral control actions if required.

Forests NSW existing forest management procedures would be implemented during operation of the project and this includes measures to manage predation of native fauna by feral animals. These measures are outlined in the Riverina Ecological Sustainable Forest Management Plan (Forests NSW 2008) and include management of feral animals as part of the measures to preserve forest health and maintain biodiversity and productivity. Feral animal control programs, as detailed in Riverina Ecological Sustainable Forest Management Plan, would conducted by Forests NSW consistent with management plans and programs in place on adjoining lands.

2.9.6 Due to the topography, inundation at the western end of the Forest would be deep for an extended period of time

The submission states that, due to the natural slope of the land, during large flood events there will be a significant depth of water at the western end of the Koondrook-Perricoota. This will result in understorey vegetation and young saplings being under deep water for significant periods of time - an unnatural event. This may lead to a lack of development of a healthy understorey in the longer term. Consideration should be given to alternatives to give more flexibility with the flooding depth at the western end, and intensive monitoring will also be required. Slow low release flows through regulators at the western end may be one option to mitigate pooling depth.

The project has been specifically designed to enable flexible operations such that a range of different depths of inundation are possible. Section 6.4 of the Environmental Assessment reflects that flows would be released to the Barbers Creek system during the flood recession phase. Monitoring would also be conducted as part of the Operating Plan to monitor the ecological response to the flood events and progress towards achieving the ecological objectives. This would involve monitoring the condition of the understory vegetation.

Figures 18 and 19 of the Ecology Assessment (Appendix C to the Environmental Assessment) reflect that vegetation at the western end of the Forest is predominantly comprised of River Red Gum communities that are tolerant of flooding. Figure 15 also reflects that a very small proportion of the Forest would be subject to inundation in excess of 3 m and these areas are in the immediate vicinity of waterways. These figures are based on a large inundation event that would occur about every 3 – 4 years.

As stated in Section 9.4 of the Ecology Assessment, impacts to understorey communities have also been studied in similar systems to that occurring in the Forest. In Chowilla, environmental watering resulted in a change in community composition in floodplain understorey from terrestrial species to flood tolerant or wetland species (Nicol *et al*., 2009). While this may be seen as an impact to the terrestrial phase of these communities, under natural flooding conditions, it would be expected that during inundation wetland species would emerge; with species composition cycling with wet and dry water regimes. Any shift towards a more natural regime may be considered as generally positive. It is predicted that the impacts will be beneficial with little or no negative impacts compared with current conditions.

2.9.7 The levee alignment should be amended to avoid impacts on mature trees at the edge of the Forest

The submission notes that many large trees are found on the outside edges of the Forest because they appear to have been deliberately excluded from logging. It would be worthwhile if efforts could be made, wherever possible, to extend the levee beyond the line of mature trees on the perimeter of the Forest to limit the loss of mature trees.

A range of alternative levee alignments were considered during development of the concept design including:

- Eastern levee alignment – this was located along the historical boundary of the Forest; and
- Western levee alignment – this was located in the immediate vicinity of the existing levee that provides flood protection to Barham which is close to the edge of the forested area. The existing levee is located to the west of the Koondrook Forest boundary.

The western levee alignment was selected as it reduces the area of vegetation that would be impacted by construction of the project. As indicated in Section 2.3.2 of the Environmental Assessment, about 800 ha of private property is located at the downstream end of the Forest between the existing levee and the forest boundary. The western levee alignment would result in the project inundating this 800 ha, the private property has been purchased and added to the Koondrook State Forest.

It is considered that due consideration has been given to minimising impacts associated with clearing vegetation, including mature trees, as a section of the alignment would be located in the immediate vicinity of an existing levee. The alignment has also been designed to maximise the area of forest that would be inundated by the project and this has resulted in a about 800 ha of private property being purchased specifically for the project. The positive long term impacts associated with the purchase and inundation of this 800 ha, inclusive of the mature trees contained in this area, is considered to outweigh any adverse impacts associated with clearing about 195 ha along the levee alignment.

2.9.8 All clearing of native vegetation needs to be offset

The submission indicated that there is no offset proposed for the clearing of the levees and the channel apart from the Inland Grey Box vegetation, and that all clearing of native vegetation needs to be offset, as it would occur in an internationally significant Ramsar site. It noted that the project will have a permanent impact on an internationally significant wetland and suggested that there should be additional permanent protection of hollow-bearing trees in other areas of the Forest to offset the impacts of clearing of hollow-bearing trees associated with the levee and channel construction. This would best be achieved by a substantial system of secure Flora Reserves under the *Forestry Act 1916* over Red Gum/Box areas in the eastern part of the forest which have a higher density of hollow-bearing trees. Such areas should be managed with active invasive species measures and the exclusion of grazing.

As stated in Section 4.2.4 of the Environmental Assessment, representatives from DECCW, Forests NSW, NOW, NSW Office of Public Works and GHD discussed the scope of the offset strategy on 17 November 2009. The outcome was an agreement that the strategy should focus on offsetting the area of Inland Grey Box Woodland which is an endangered ecological community listed under the TSC Act that would be permanently removed to allow construction of the inlet channel. This vegetation community is not dependent on flooding and so would not benefit from the project.

Adverse construction impacts on River Red Gum communities were considered to be negligible in comparison to the long term direct benefit the project would deliver to over 16,000 ha of these communities. DECCW agreed that the offset strategy did not need to offset the effects of clearing other vegetation communities such as River Red Gum because they would benefit substantially from operation of the project. Similarly, construction impacts on the Ramsar site as a whole would be offset by positive impacts from environmental watering of the Forest through the project.

Impacts on hollow bearing trees would continue to be protected in line with Forests NSW management prescriptions which rely on two complementary approaches:

- Exclusion of harvesting from areas that are resource-rich and/or connect significant areas of habitat across the landscape. A protected area network has been developed for the forest estate within the Riverina Region and incorporated into the Forest Management Zoning mapping system. Areas that are predicted to support high densities of hollow-using fauna have been included in the network, such as riparian zones, stands of high site quality River Red Gum forest and box woodlands. Connectivity

is provided by a 20m exclusion zone along the banks of all rivers and major internal creeks as well as nominated wetlands; and

- Prescriptions within the area available for harvesting. Prescriptions provide for the retention of habitat trees within the harvest area as well as recruitment trees, which would develop into habitat trees over time. The general prescription provides for retention of two habitat trees and a further two recruitment trees per hectare across the net harvest area (Leslie, *unpub*.).

The creation of flora reserves under the *Forestry Act 1916* is not considered to be necessary because the Inland Grey Box Woodlands are already excluded from harvesting due to their ecological values and listing as an endangered ecological community.

2.9.9 Loss of hollow bearing trees

The submission considered that any loss of hollow-bearing trees in the Forest is a major cause of concern, given the cumulative impact that is occurring from forestry operations and given the cumulative impact of forestry operations over time. Many of the trees that will be destroyed in the project (for either levee or channel construction) may potentially be occupied by either threatened or common hollow-using species. The following measures proposed relating to any hollow-bearing trees that are removed:

- Considerable survey effort should be put in to surveying hollow-bearing trees prior to felling, through a range of methods, to see if they are occupied.
- Where trees are occupied, efforts should be made to relocate species in such cases or to leave the felling until the tree has been vacated.
- After each hollow-bearing tree is felled, it should be checked for evidence of occupancy.
- If a threatened species is found dead in a hollow, then work should be stopped immediately and increased efforts made to determine whether threatened species are using adjacent hollow-bearing trees earmarked for felling.
- There should be a full inventory conducted, and made public, of the number of hollows and the number and type of occupants within felled trees, to improve the knowledge base about hollow occupancy in these forests.
- All hollow-bearing trees that are felled should be moved into the adjacent forest and retained as coarse woody debris, which is vital habitat during inundation and also during dry periods (for aquatic and terrestrial species respectively). No hollow-bearing trees should be removed from the forest for timber purposes.

As indicated in Chapter 8 of the Environmental Assessment, while construction would involve removal of hollow bearing trees, the loss of this habitat resource is considered to be minor in comparison to the overall positive impacts that would result from operation of the project. Monitoring by FNSW and the results of the present ecological surveys suggest that large, over-mature trees are exhibiting the most pronounced signs of drought stress. The proposed environmental watering of the Forest would increase the chances of survival of these trees and is likely to improve the security of the hollow bearing tree resource in the Forest in the longer term.

The need to minimise impacts associated with removal of hollow bearing trees is reflected in Statement of Commitment 2 which requires management practices be developed for implementation during construction to reduce impacts on biodiversity. Where practicable, removal of habitat trees and/or hollow

bearing trees will be avoided, and a pre-clearance inspection protocol will be undertaken prior to removal of habitat trees and/or hollow bearing trees. The pre-clearance inspection protocol would be included in the CEMP and would include procedures such as:

- Inspecting the hollow to determine whether it occupied;
- Relocation or any fauna found in occupied hollows; and
- Managing any fauna, including threatened species, that is found within a hollow.

Rehabilitation would involve placing some forest debris over the construction footprint to provide a habitat resource that is representative of the adjacent sections of the Forest. It will not be possible to retain all hollow bearing trees as coarse woody debris as this would present an unacceptable bushfire risk. Any hollow bearing trees that are required to removed and are merchantable will be sold to the market.

2.9.10 Removal of the floodway

The submission suggests that the floodway for returning water to the Murray River will have a major environmental impact and it is preferable if this element could be dispensed with.

As indicated in Section 3.2, the project has been refined and the internal floodway would not be constructed as part of the initial works for the project. Flood patterns within the Forest would be monitored as part of the Operating Plan and this would involve monitoring a range of flood magnitudes. If monitoring indicates that an internal floodway is required to maintain effective operation, a separate detailed design process would be implemented to ensure the design responds to the issues identified during monitoring. Preliminary investigations by DTSA indicate that if a floodway is required, it is likely to be approximately 1 km by 50 m, which is substantially smaller than the 1 km by 250 m floodway that was assessed in the Environmental Assessment.

If required, construction of the floodway would require about 5 ha of vegetation that is predominantly River Red Gum communities to be cleared. Impacts associated with removal of this vegetation are considered to be negligible in comparison to the over 16,000 ha of Forest that would directly benefit from the project.

2.9.11 Clearing for earthworks is suggested as having a temporary impact. This really has a permanent impact.

The definition of the temporary and permanent footprints are provided in Section 3.9 and reflect that areas cleared for temporary construction works will have the opportunity to be rehabilitated. Section 4.1 indicates that a Rehabilitation Plan will be developed in consultation with DECCW to ensure that temporary disturbance areas are rehabilitated (refer to Statement of Commitment 6).

2.9.12 There is reference to saline subterranean soils in relation to the proposed work on bores. All bores will need to be properly capped to prevent the escape of saline water.

All bores required for construction of the project would be licensed by the NSW Office of Water in accordance with the *Water Management Act 2000*. If required as part of the licence, these bores would be capped to prevent the discharge of saline water.

2.9.13 Other points that are not related to the Environmental Assessment

The submission raised other points that are not related to the Environmental Assessment. These issues are discussed below.

Operational water management regime

The submission stated that there is insufficient detail on the water management regime that will be put in place when the scheme is operational. It is important that there is independent expert oversight of the water management regime during the operation of the flood scheme to ensure that ecological objectives are being met.

As indicated in Section 5 of the Environmental Assessment, the project is one of a number of works that are part of The Living Murray initiative. Progress on implementation of the Living Murray Initiative and compliance with the Murray-Darling Basin Cap are independently audited on an annual basis. This auditing is undertaken in accordance with the Intergovernmental Agreement on Addressing Water Over-allocation and Achieving Environmental Objectives in the Murray-Darling Basin that was signed on 25 June 2004 by Ministers of the Murray- Darling Basin Ministerial Council from NSW, Victoria, South Australia, the ACT, and the Australian Government. Clause 78 of this agreement requires that:

The following would be subject to annual external auditing to the satisfaction of the MDB Ministerial Council:

- *Financial records of expenditure accredited against funding commitments under the Intergovernmental Agreement;*
- *Financial records of any temporary or permanent trade of recovered water;*
- *Registries of recovered water;*
- *The environmental management of recovered water; and*
- *Management of the impacts on the Long Term Diversion Cap which result from the recovery and delivery of water under the Intergovernmental Agreement.*

The outcome of the audit is recorded in The Living Murray Implementation Report.

The project will be operated in accordance with an Operating Plan that will summarise the overall operating context of the project within the framework of The Living Murray. This will include the Business Plan, Environmental Watering Plan, Icons Site Environmental Management Plans, Annual Environmental Watering Plan, and Outcomes Evaluation Framework which are summarised in Section 5.2 of the Environmental Assessment.

The Outcomes Evaluation Framework is the framework for monitoring and evaluating the outcomes of environmental watering and the achievement of the Icon Site objectives under The Living Murray Initiative. The current framework was finalised in 2007. This led to the development of condition monitoring plans for the Icon Sites (which feed into the annual Icon Site Condition reports) and investment in many intervention monitoring projects that have improved the general understanding of ecosystem processes and the specific outcomes of watering actions (MDBA 2009). The Outcomes Evaluation Framework will involve reviewing the success of individual inundation events achieving the objectives for that event.

The long term aim of the project should be to ensure that all River Red Gum forests are in a healthy condition.

The submission states that the aims of the project are to meet the Icon sites' management plan and its 'interim objective' of ensuring that 30% of red gum forest are in a healthy condition and 80% of permanent and semi-permanent wetlands are in a health condition. While these may be worthy goals, the longer term aim would be to ensure that all the red gum forests are moved to a healthy condition. It is not clear whether this project can meet this longer term goal. The longer-term objectives of the site should be considered in the project objectives and these are absent.

The project has been designed to address the interim objectives set by the Murray Darling Basin Ministerial Council and have been developed within the context of the overarching objective for the Gunbower-Koondrook-Perricoota Forest which is to maintain and restore a mosaic of healthy floodplain communities. The project has not been designed to inundate the entire Forest such that all River Red Gum communities are healthy as this would require significantly larger and more intrusive engineering works, as well as a significant additional volume of water

2.9.14 Use of environmental water to produce timber products

The submission suggests that if environmental water is going to be used to flood the Forest to produce timber products, then major improvements are needed in the environmental management of the Forests. If environmental water is committed to this forest then major changes are need to ensure that the greater emphasis in the future is on environmental management, instead of an exclusive emphasis on heavy unsustainable logging and grazing as there has been in the past, which has led to major environmental damage.

As indicated in the Environmental Assessment, the scope of the project is limited to construction and operation of the engineering works. Issues associated with the ongoing operation of the Forest are beyond the scope of the Environmental Assessment.

Forests NSW's sustainable forest management is recognised through its external certification to the Australian Forestry Standard AS-4708 and recognition under the international Program for Endorsement of Forest Certification Schemes. The Forests NSW Environmental Management System is also certified to ISO 14001. These management practices aim to preserve the conservation, cultural and heritage values of the forests as well as providing timber and other services, such as grazing and recreation, which support local communities and industries. The effectiveness of multi-purpose management is also recognised in the Ramsar listing of the Central Murray State Forests, which include the Koondrook-Perricoota Forest.

3. Preferred project

3.1 Refinements to the project

The following section describes refinements to the project that have been incorporated to address issues raised in submissions or reflect additional information that has become available since completion of the Environmental Assessment. The environmental impacts of the refinements are assessed in Section 4.

3.2 Postponement of the internal floodway

The internal floodway would not be constructed as part of the initial works for the project. Further investigations have been undertaken by DTSA since completion of the Environmental Assessment and this has included sourcing additional detailed topographical survey data. A review of this information indicates that the area in the vicinity of the internal floodway has a lower elevation than was suggested by the preliminary survey.

DTSA has considered the effect of this more detailed topographical data on the hydrological modelling previously undertaken of the Forest. This analysis concluded that, due to the lower elevation of this part of the Forest, an internal floodway is unlikely to be required to enhance the movement of water towards the return channel.

Based on this analysis, the project team has decided that approval for the internal floodway should be obtained, however it would not be constructed as part of the initial works for the project. Flood patterns within the Forest would be monitored as part of the Operating Plan and this would involve monitoring a range of flood magnitudes. If monitoring indicates that flow paths within the Forest should be enhanced to maintain effective operation, a separate investigation would be undertaken to identify the preferred response and this would involve evaluation of the need for a floodway. Preliminary investigations by DTSA indicate that if a floodway is required, it is likely to be approximately 1 km by 50 m, which is substantially smaller than the 1 km by 250 m floodway that was assessed in the Environmental Assessment.

3.3 Size, location and treatment of borrow pits

The Environmental Assessment was based on the assumption that approximately 800,000 m^3 of material would be required to construct the downstream levee and that about 123,000 m^3 of this material would be sourced from earthworks associated with the internal floodway. As the internal floodway would not be constructed as part initial works for the project, additional borrow pits would be required to source material to construct the downstream levee.

The Environmental Assessment indicated that about 41 borrow pits would be required and each would be about 250 m long, 25 m wide and 2.5 m deep. For the purposes of assessing impacts, it was assumed that the borrow pits would be spaced approximately 1 km apart.

Further investigations during detailed design have refined the estimate of material required from borrow pits to construct the downstream levee, as well as the size and location of the borrow pits. It is estimated that approximately 760,000 m^3 of material is required and that this would be sourced from borrow pits of various dimensions in the vicinity of the levee.

The location of the borrow pits would be determined by the contractor during construction planning and would be based on detailed consideration of the volume of material required at individual locations. Figure 2 shows indicative locations for the borrow pits and reflects that they are likely to be larger and more closely spaced in the vicinity of those sections of the levee that are higher and wider and so require greater volumes of material. These sections are generally located in the vicinity of the regulators along the downstream levee.

The dimensions of the borrow pits would vary according to the volume of material required at each location and the type of material present in the borrow pits. One possible configuration would be for borrow pits approximately 25 m wide at the base, up to 3 m finished depth, with 1 in 3 battered side slopes. In locations where the levee would be relatively high and wide, borrow pits may be contiguous which would reduce the overall number of borrow pits. Conversely, in locations where the levee would be relatively low, the borrow pits would be more widely spaced. As indicated in the Environmental Assessment, the borrow pits would be sited to:

- Preferentially utilise existing cleared areas;
- Minimise impacts associated with clearing;
- Avoid impacts on items of Aboriginal heritage significance where practicable; and
- Minimise the haulage distance between the borrow pit and levee alignment.

It is estimated that the borrow pits would disturb approximately 59 ha. The total disturbance footprint for the borrow pits is estimated to be 65 ha which includes the 59 ha plus a contingency allowance of 6 ha that has been included to account for unforseen circumstances, such as the need to revise the location to avoid impacts on an item of significant cultural heritage significance. This is an upper limit and the contractor would be required to implement all reasonable and feasible measures to minimise the disturbance footprint. The contractor would be required to obtain written approval from the proponent prior to utilising the contingency.

Geotechnical investigations would be undertaken to confirm that each proposed borrow pit is able to provide the required volume and quality of material. These investigations would be undertaken prior to the surface area of the borrow pit being cleared in its entirety. Topsoil from the borrow pits will be stockpiled and may potentially be mixed with mulch and placed on the surface of the borrow pits to assist with rehabilitation.

In summary, the key refinements relating to the borrow pits are that:

- The overall volume of material required to construct the levee has decreased from 800,000 m^3 to 760,000 m^3;
- The volume of material to be obtained from borrow pits has increased by about 83,000 m^3 because the internal floodway would not initially be constructed. The additional volume required is 83,000 m^3 rather than 123,000 m^3 as the overall volume required has reduced by approximately 40,000 m^3; and
- The number and dimensions of borrow pits has increased due to the need for additional material to be sourced from borrow pits.

Location of borrow pits relative to the downstream levee alignment

The Environmental Assessment stated that borrow pits would be in the vicinity of the downstream levee alignment, but did not specify whether they would be located on the inside of the levee (in which case

they would be inundated by the project) or on the outside of the levee (in which case they would not be inundated by the project). Although it is anticipated that the majority of borrow pits would be located within the levee, the project has been refined to enable borrow pits to be located outside the levee, including on adjacent private property, if it can be demonstrated to be acceptable to the affected landholder and beneficial following consideration of aspects such as construction time, cost, and environmental impacts.

The minimum separation distance of borrow pits from the toe of the levee depends on whether they would retain water following an inundation event. A larger separation distance is required from borrow pits that retain water compared to those that would not because there is the potential for retained water to develop preferential infiltration paths that may impact on the structural integrity of the levee. As borrow pits within the levee would retain water, a minimum separation distance of 10 m has been nominated. Borrow pits located outside the levee would not retain water during inundation events and the minimum separation distance is 5 m.

Since completion of the Environmental Assessment, it has been identified that construction time, cost and environmental impacts could be reduced if borrow pits are located outside the levee in selected areas. Locating borrow pits outside the levee would reduce construction time and cost because, as they would not be inundated, the minimum separation distance from the levee would be 5 m rather than the 10 m minimum separation distance for borrow pits on the inside of the levee. As the borrow pits could be located closer to the levee alignment, there is the potential to reduce the construction disturbance footprint.

The majority of the downstream levee alignment would be located in the immediate vicinity of the boundary of the Koondrook-Perricoota Forest. If borrow pits are outside the levee, in some locations the only possible site would be outside the Forest boundary on adjacent private property. Borrow pits would only be located on private property if agreement can be reached with the affected landholder.

The project has therefore been refined to specifically reflect that borrow pits may be located:

- Within the levee, on land that is part of the Forest;
- Outside the levee, on land that is part of the Forest; and
- Outside the levee, on adjacent private property.

The final location would be determined by the contractor during construction planning and would involve consideration of the following items:

- Negotiations with landholders. This would involve discussions to identify suitable locations, access arrangements, the final landform, rehabilitation requirements, ongoing management obligations, and commercial arrangements;
- Impacts on ecology. Further investigations would be undertaken on the potential site(s) to identify whether there are any ecological constraints;
- Impacts on items of Aboriginal significance. The potential site(s) would be inspected by representatives of Traditional Owners to identify whether there are any items of Aboriginal significance that would constrain its use for spoil placement;
- Impacts on the floodway. DECCW's Floodplain Manager would be consulted to ensure that the borrow pits would not adversely affect floodplain hydrology; and
- Cost and time required for each option.

The results of these investigations would be documented in a report prepared by the contractor to justify selection of the preferred borrow pit locations. The report would be submitted to the NOW and Forests NSW who would endorse the option if it is considered to be consistent with the Minister's Conditions of Approval.

3.4 Upstream spoil disposal site

Excavation of the inlet channel would generate approximately 250,000 m^3 of material that would need to be managed. The Environmental Assessment included an indicative spoil disposal location that was situated adjacent to an existing levee near the upstream boundary of the Forest. The Environmental Assessment stated that the final location for spoil storage would be determined during detailed design and would be placed so that it is equal to or below the top of the levee to minimise potential impacts on the hydrology of the floodplain in this area.

The spoil disposal location in the Environmental Assessment included an area of vegetation that is mapped as Inland Grey Box Woodland which is an endangered ecological community. The Environmental Assessment indicated that an area of about 8 ha of Inland Grey Box Woodland community would be removed during construction and this did not include any areas within the spoil disposal footprint because the spoil disposal location would be selected such that there are not impacts on this community. To remove any ambiguity, the indicative location has been revised such that it would not impact on Inland Grey Box Woodland (refer to Figure 3).

Since completion of the Environmental Assessment, further consideration has been given to the upstream spoil disposal site. Discussions with DECCW confirm that it is preferable that the spoil be placed outside the Forest boundary in a location that has already been disturbed as this would minimise impacts associated with vegetation clearance (refer to Section 2.3).

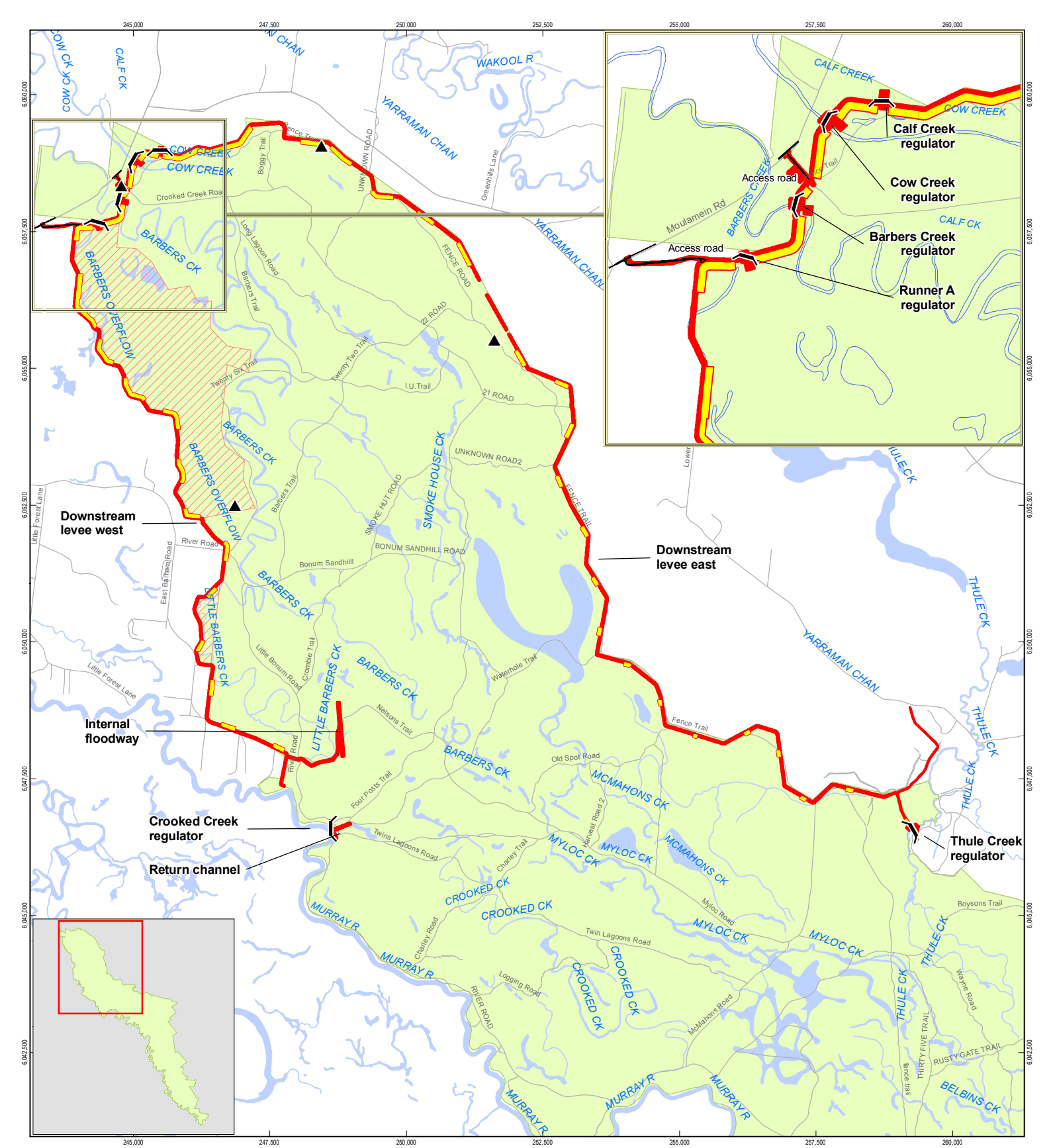
Preliminary investigations have identified a number of sites outside the Forest boundary that may be suitable for spoil emplacement subject to agreement being reached with the landholders. If spoil is placed on private property, it would be contoured to look as natural as possible and batters would be suitable to enable agricultural machinery traverse the area. It would be capped with topsoil and revegetated to assist to stabilise the area in the long term.

The project has therefore been refined to include the following options to manage spoil from the inlet channel:

- Placement within the Forest; and
- Placement on private property.

The final spoil placement location would be determined by the proponent during construction planning and would involve consideration of the following items:

- Negotiations with landholders. This would involve discussions to identify suitable locations, access arrangements, the final landform, rehabilitation requirements, ongoing management obligations, and commercial arrangements;
- Impacts on ecology. Further investigations would be undertaken on the potential site(s) to identify whether there are any ecological constraints. Specifically, the site would be selected to avoid impacts on the Inland Grey Box Woodland which is listed as an endangered ecological community;



Legend

- Turkey's nest dam
- Regulator
- Access Road Design
- Construction features
- Construction features
- Western levee alignment area
- Roads
- Waterway
- Koondrook Perricoota Forest Site

0 0.5 1 2
Kilometres

Map Projection: Transverse Mercator
Horizontal Datum: World Geodetic System 1984
Grid: Universal Transverse Mercator, Zone 55S

N

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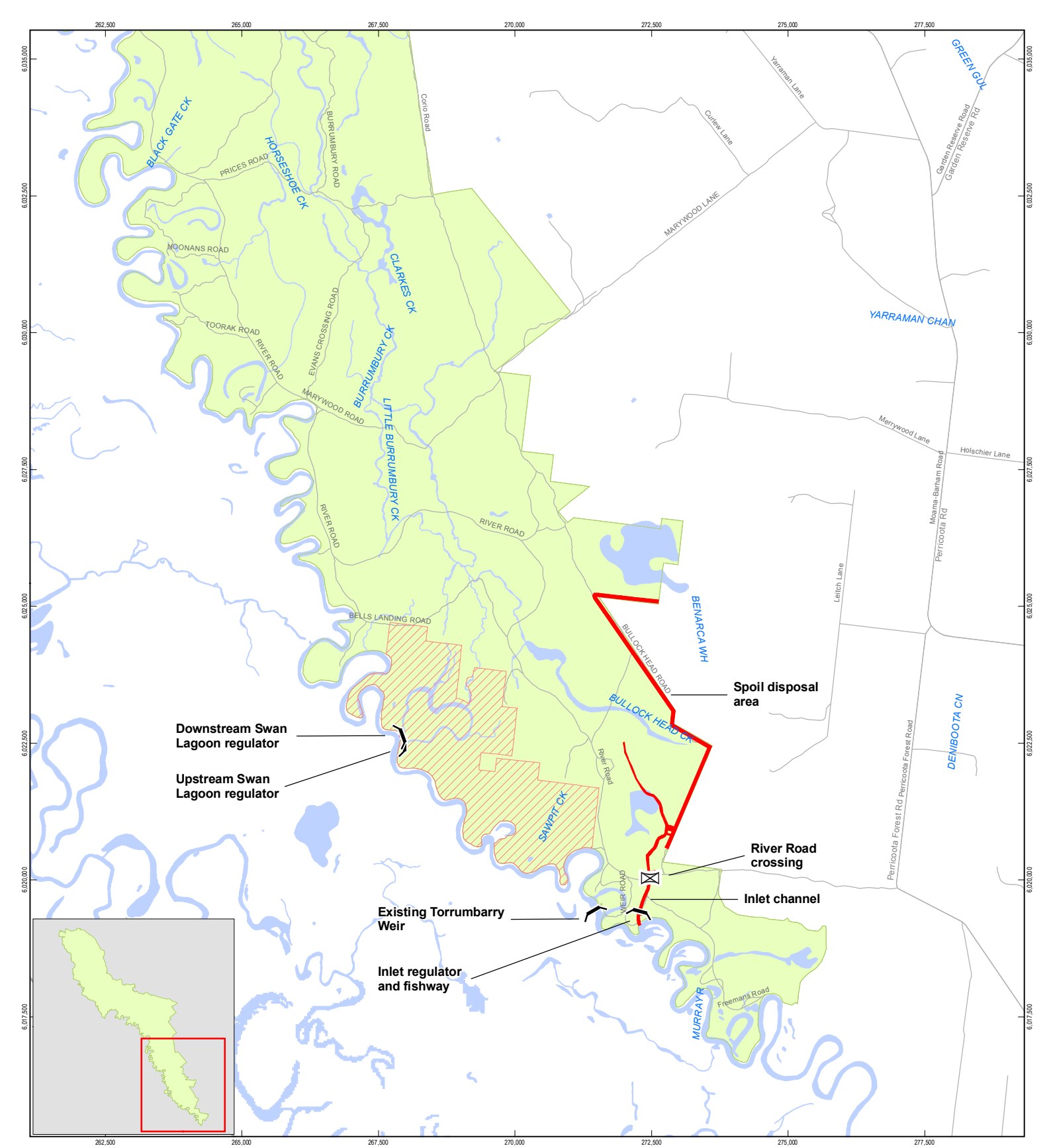
NSW Office of Water
Koondrook-Perricoota Flood Enhancement Works

Job Number	21-18573
Revision	B
Date	10 JUN 2010

Figure 2 - Indicative location of downstream structures

G:\21\18573\GIS\Arcview\Map_Documents\21.18573.Z014_Site_Layout_downstream_.mxd
Level 15, 133 Castlereagh Street Sydney NSW 2000 **T** 61 2 9239 7100 **F** 61 2 9239 7199 **E** sydmail@ghd.com.au **W** www.ghd.com.au

Data source: StreetMap - Navegate, Drawn: Cwilson, cwilson



Legend

- River Road bridge
- Regulator
- Construction features
- Toorangabby Boundary
- Roads
- Waterway
- Koondrook Perricoota Forest Site

0 0.5 1 2
Kilometres

Map Projection: Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 55

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NSW Office of Water
Koondrook-Perricoota Flood Enhancement Works

Job Number 21-18573
Revision B
Date 10 JUN 2010

Figure 3 - Indicative location of upstream structures

G:\21\18573\GIS\Arcview\Map_Documents\21.18573.Z014_Site_Layout_Upstream_PPR.mxd
Level 15, 133 Castlereagh Street Sydney NSW 2000 **T** 61 2 9239 7100 **F** 61 2 9239 7199 **E** sydmail@ghd.com.au **W** www.ghd.com.au

Data source: StreetMap - Navegate, Drawn: Cwilson, cwilson

- Impacts on items of Aboriginal significance. The potential site(s) would be inspected by representatives of Traditional Owners to identify whether there are any items of Aboriginal significance that would constrain its use for spoil placement;
- Impacts on the floodway. DECCW's Floodplain Manager would be consulted to ensure that the spoil placement would not adversely affect floodplain hydrology; and
- Cost and time required for each option.

The results of these investigations would be documented to justify selection of the preferred option. This would involve a comparative evaluation of the in-Forest and private property management options.

3.5 Management of vegetation waste

The Environmental Assessment states that:

All vegetation that is cleared would be removed from the site, apart from:

- *Possible stockpiling of logs for a maximum of 3 months of timber beside construction areas;*
- *Stockpiling stumps on the former Toorangabby property for up to 12 months for reuse. Opportunities would be investigated to reuse stumps in restoration projects, such as resnagging in the Murray River; and*
- *Relocating felled fauna-bearing trees in nearby forest.*

Cleared vegetation would not be burnt within the forest as this would present a substantial bushfire risk. Long term stockpiles or windrows of vegetation would not be placed within the Forest as Forests NSW advises that this would also present a bushfire risk. Some vegetation would be mulched and reused on site to stabilise selected areas disturbed by construction.

Refinements to the management of vegetation waste described in the Environmental Assessment include:

- Clarifying that logs stockpiled beside the construction areas would be removed within three months of the completion of construction; and
- Stumps removed from the inlet channel and stored on the former Toorangabby property for use in restoration projects, such as resnagging in the Murray River and river erosion works, may be stockpiled for up to three years, not 12 months as indicated in the Environmental Assessment. The increase in the duration of the stockpiling is required to maximise the potential for stumps to be reused in resnagging programs. Forest NSW will ensure that impacts associated with bushfire risks due to the stockpile are minimised (refer to Statement of Commitment 17).

The project has been refined to reflect that, in addition to the above, cleared timber that is unable to be sold commercially, such as root balls and stumps, may be ground into a mulch. The contractor will determine whether the mulch will be sold to the market or used for purposes such as site rehabilitation If the mulch is used for site rehabilitation, it could be incorporated into topsoil that will be placed in the borrow pits to a maximum thickness of 150 mm, or spread on the outside of the downstream levee to a maximum thickness of 150 mm. Mulch may also be placed over other areas that are disturbed as part of the construction process.

As indicated in Section 2.3, DECCW requested that a Rehabilitation Plan be prepared and discussions with DECCW indicate that mulching may be an acceptable component of this plan (refer to Section 5). It

is estimated that approximately 87,000m^3 of mulch may be reused as part of the Rehabilitation Plan if it is unable to be sold to the market.

The Rehabilitation Plan will reflect that existing surface timber/debris currently lying on the surface of the borrow pit areas will be placed back within the temporary footprint areas (such as the borrow pits) following completion of construction, provided that this does not create access or safety issues. Some forest debris will also be placed within the inlet channel to provide habitat for aquatic species.

As detailed in the Environmental Assessment, cleared vegetation would not be burnt within the Forest as this would present an unacceptable bushfire risk. In addition, the stumps and root balls would not be buried.

3.6 Estimate of the volume of construction waste

The Environmental Assessment estimated that there would be approximately 5 -10 tonnes of construction waste from the project. Based on more detailed estimates developed during the detailed design phase and feedback from prospective tenderers during the early tenderer involvement process, it is considered likely that approximately 50 - 70 tonnes of construction waste would be generated.

Although the estimated volume of waste has increased, it would continue to be managed in accordance with the measures outlined in the Environmental Assessment and this would involve implementation of Statements of Commitment 14 – 19.

3.7 Working hours

The working hours in the Environmental Assessment were based on construction occurring over a period of about 9 months, commencing in October 2010 and finishing in June 2011, and crews working six days per week during the following general construction hours:

- *Monday – Saturday – 7 am – 6.30 pm; and*
- *No work on Sunday or public holidays.*

There may be occasions where work occurs outside these hours. For example, it is likely that soil conditioning in the borrow pits may be undertaken during evening and night time periods to reduce the amount of construction activity in the borrow pits and reduce evaporation of water used in the conditioning process. It is anticipated that there would be a weekend shutdown once a month.

Discussions with prospective tenderers during the early tender involvement process indicate that it may be necessary to undertake additional works outside the general construction hours identified in the Environmental Assessment to ensure the project is constructed within the required timeframe. The construction hours have therefore been refined to include:

- Monday to Saturday, 7 am to 7 pm; and
- No work on public holidays,

In addition to the works outside the general hours that are specified in the Environmental Assessment, work may also be undertaken during the evenings and on Sundays at locations where neighbouring residences would not be disturbed. This would generally be at locations that are in excess of 500 m from a neighbouring noise receptor.

3.8 Source of construction water

The Environmental Assessment indicates that construction water could be sourced either from surface or ground water supplies. This has been refined to include alternative surface water sources, such as piping water from irrigation channels in the vicinity of the work sites. The contractor will consider a range of factors when selecting the construction water source, including the characteristics of the water and potential impacts on the construction process.

This refinement is required to provide greater flexibility for the contractor to obtain water from the most appropriate source and minimise the extent of clearing required for infrastructure such as turkey nest dams and installation of bores.

3.9 Construction footprint

Discussions with prospective tenderers during the early tenderer involvement process indicated that the construction footprint presented in Section 6.3.1 of the Environmental Assessment needs to be revised to ensure the project can be constructed within the required timeframe. As the project is required to be operational by July 2011, the construction footprint has been revised to ensure that a construction method is able to be implemented that will achieve this completion date.

Table 3 summarises the refined construction footprint and indicates that the main changes relate to:

- An increase in the area of borrow pits. This is, in part, related to the decision not to construct the internal floodway initially and the resultant increase in the volume of material required to be sourced from borrow pits;
- An increase in the area required to construct the downstream levee. This is due to an increase in the allowance that has been made for haul roads and temporary topsoil stockpiles along the alignment; and
- A contingency allowance of 18 ha to account for situations such as the potential need to realign sections of the downstream levee if significant cultural sites are identified. The contractor would require prior written approval from the proponent prior to utilising this contingency.

These areas are indicative and the contractor will be required to implement all reasonable, feasible and practical measures to minimise the construction footprint. As detailed in the Environmental Assessment, where possible temporary features such as the spoil disposal area, borrow pits, haul roads, turkey nest dams, and site compounds would be located to minimise environmental impacts. This would involve:

- Avoiding locations that contain the Inland Grey Box Woodland which is an endangered ecological community;
- Minimise the disturbance footprint by confining activities to existing cleared or disturbed areas where practicable; and
- Where practicable, avoid items/ areas of Aboriginal heritage significance.

The permanent disturbance footprint referred to in Table 3 is defined as the area occupied by all permanent infrastructure, inclusive of batter slopes that form part of any earthworks and any associated adjacent maintenance zones. Disturbance within this area is considered to be permanent because operational and maintenance requirements mean that there would not be an opportunity for these areas to be rehabilitated to contain vegetation communities such as River Red Gum or Inland Grey Box Woodland.

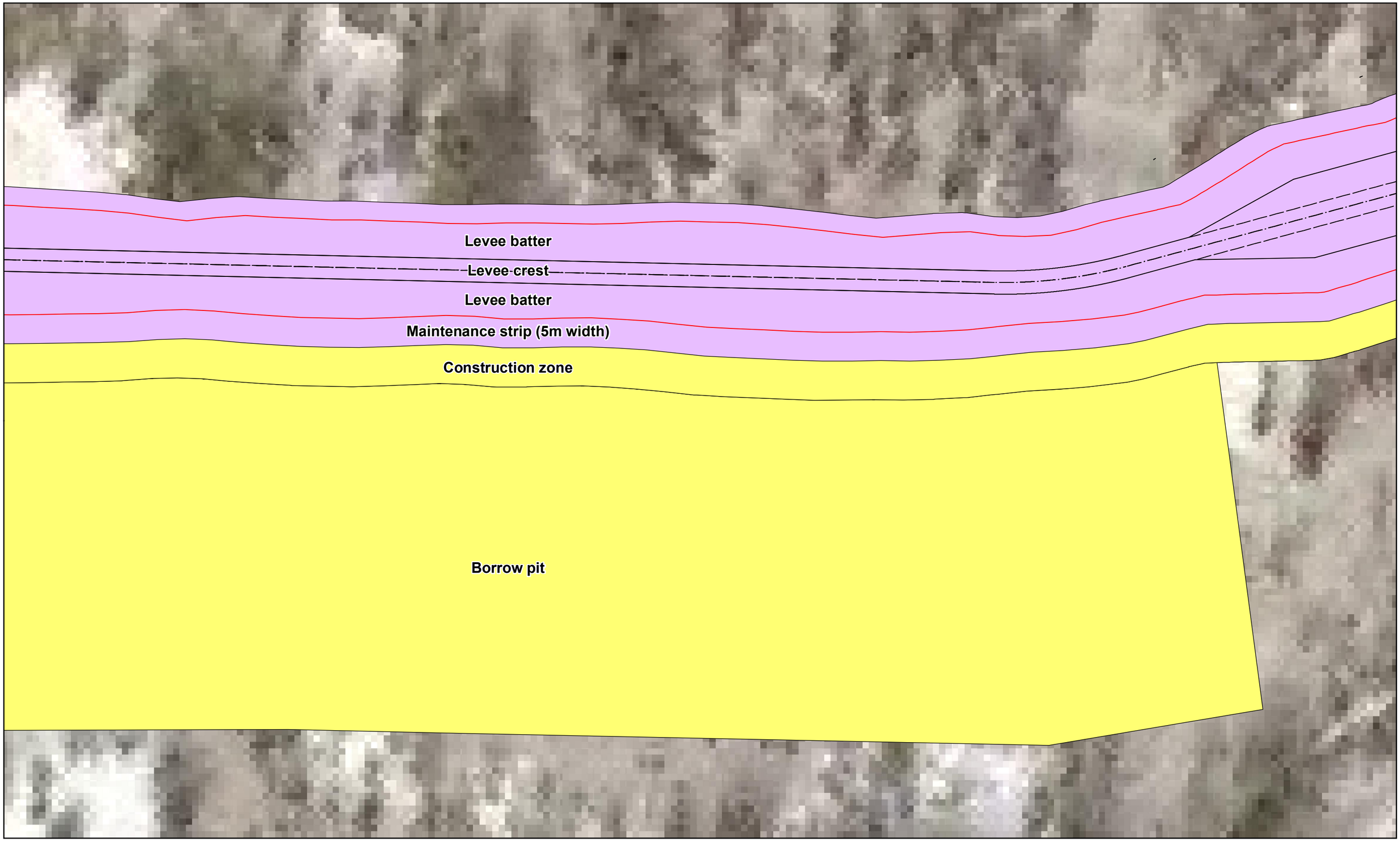
The construction footprint referred to in Table 3 is defined as the footprint of disturbance of any kind required to enable the construction of the works. This includes a combination of the permanent footprint in addition to areas that are required for ancillary construction activities, such as borrow pits, haul roads, site facilities, and topsoil storage areas. The contractor is required to minimise the size of the construction footprint.

The difference between the construction footprint (272 ha) and the permanent infrastructure footprint (89.6 ha) represents an area that would be temporarily disturbed (182.4 ha). Disturbance within this area is considered to be temporary because there would be an opportunity for rehabilitation and/or recolonisation in the long term to restore vegetation communities that exist in the Forest, such as River Red Gum or Inland Grey Box Woodland. The area that would be temporarily disturbed is primarily located within areas that would be inundated by the project and will be rehabilitated via recolonisation of River Red Gum communities following inundation events. Rehabilitation will be monitored in accordance with the Rehabilitation Plan developed in consultation with DECCW and detailed in Statement of Commitment 6.

Figure 4 provides an indicative diagram of the temporary and disturbance footprints along a section of the downstream levee.

Table 3 Summary of construction corridor and permanent disturbance footprints

project Infrastructure	Construction footprint (ha)			Permanent disturbance footprint (ha)		
	Table 6.3 in the Environmental Assessment	Revised footprint	Change in area	Table 6.3 in the Environmental Assessment	Revised footprint	Change in area
Haul roads (indicative)	2.7	7.3	4.6	0.0	0.0	0
Site facilities (indicative)	0.77	2.9	2.13	0.0	0.0	0
Upstream Structures						
Inlet channel and inlet regulator and fishways	14.39	16.5	2.11	14.39	14.4	0.01
Swan Lagoon regulators	0.15	0.2	0.05	0.15	0.15	0
Spoil disposal area	38.97	42.3	3.33	0.0	0.0	0
Downstream Structures						
Downstream levee alignment	69.55	120	50.45	69.55	69.55	0
Downstream stop log regulators	2.6	5.1	2.5	2.6	2.6	0
Internal floodway	29.94	5	-24.94	0.00	0.00	0
Borrow pits	44.31	65	20.69	0.00	0.00	0
Return channel, return channel regulator and exit structure	1.06	1.3	0.24	1.06	1.3	0.24
Turkey nest dams (four)	1.47	1.5	0.03	0.00	0.00	0
By washes		1.6	1.6		1.6	1.6
Temporary topsoil stockpiling at downstream regulators		2.5	2.5			
Total	205.91	272	66.09	87.75	89.6	1.85



1:600 (at A3)

0 5 10 20

Metres

Map Projection: Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 55

N

Legend

- Temporary disturbance footprints
- Permanent disturbance footprint

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NSW Office of Water
Koondrook-Perricooda Flood Enhancement Works

Job Number	21-18573
Revision	A
Date	10 JUN 2010

Figure 4 - Indicative diagram of temporary and permanent disturbance footprints.

G:\21\18573\GIS\Arcview\Map_Documents\21.18573.Z052_NewFeatures24052010.mxd

Level 15, 133 Castlereagh Street Sydney NSW 2000 **T** 61 2 9239 7100 **F** 61 2 9239 7199 **E** sydmail@ghd.com.au **W** www.ghd.com.au

Data Source: Benson: Vegetation Types - 2006; NSW Office of Water: Cad Data - 17/03/2010; Navigate StreetMap: Street Map - 17/03/2010. Created by: qjchung

3.10 River Road Bridge

The project described in the Environmental Assessment included a bridge over the inlet channel at the point the channel crosses River Road. During the course of detailed design it has been determined that an appropriate level of access could be provided by constructing a two lane causeway instead of the bridge. The causeway would have approach gradients designed to safely pass normal passenger vehicles and logging trucks.

Discussions between DTSA and Forests NSW indicate that this refinement would not substantially alter access to the Forest because the majority of the areas downstream of the inlet channel would be inundated when the inlet channel is being operated. This will inundate a number of creek crossings, such as the Burrumbury Creeks, that will be impassable until they are upgraded by Forests NSW. As access would already be restricted due to the extent of inundation, the absence of vehicular access across the inlet channel would not substantially reduce access levels.

Access to the Forest will be available via the bridge across the return channel regulator, and emergency access will continue to be provided across the Torrumbarry Weir.

Although approval is sought for both the bridge and causeway, only one would be constructed. Further investigations would be undertaken during detailed design to select the preferred option and this would involve consideration of the relative duration and cost of construction for this element of the project.

3.11 Reduction in the number of bays in the Cow Creek and Calf Creek regulators

Appendix H of the Environmental Assessment contained concept designs for selected structures that form part of the project. These indicate that the Cow Creek regulator had a total of 10 bays and the Calf Creek regulator had a total of five bays. During development of the detailed design, the Cow Creek regulator has been reduced to an eight bay structure and the Calf Creek regulator reduced to a four bay structure. This refinement has been made to reduce construction and operational costs.

Reducing the number of bays in the regulators reduces the cross sectional area of the floodway at these points. DTSA calculated that this refinement would have a minor increase in afflux of approximately 20 mm. DTSA and NOW has discussed this with the DECCW Floodplain Manager and it was agreed that this increase in afflux would be acceptable.

3.12 Design of the bywashes along Barbers Creek

The project described in the Environmental Assessment involved construction of bywashes on three block banks in Barbers Creek downstream of the regulators that were designed to accommodate flows of up to 250 ML/day. Based on the findings of a geomorphological assessment undertaken following completion of the Environmental Assessment, the design of the bywashes has been refined to allow passage of flows of up to 500 ML/day. This would provide greater flexibility during the operational phase by allowing flows of up to 500 ML/day to be passed down Barbers Creek without compromising the integrity of the block banks.

Flows greater than 250 ML/day are not currently proposed and the intention of the refinement is to provide flexibility for this to occur in the future if it is demonstrated to be required to facilitate effective operation of the project. The results of monitoring undertaken in accordance with the Operating Plan will determine whether there is a need to release flows in excess of 250 ML/day down Barbers Creek. This

would involve assessment of the impacts of the increased rate on hydrology, geomorphology, water quality, and aquatic ecology, including the potential need to provide fish passage. These assessments would be undertaken in consultation with relevant government agencies.

4. Environmental assessment of the proposed refinements

The following section assesses the potential environmental impacts of the refinements to the project that are described in Section 3.

4.1 Ecology

4.1.1 Assessment of impacts

Revised construction impacts

Modifications to the layout of the construction footprint for the project will increase the area of temporary construction disturbance by approximately 66 ha and the area of permanent disturbance by approximately 2 ha. A breakdown of the revised construction footprints is provided in Table 3. The revised extent of clearing of vegetation communities for construction of project infrastructure is provided in Table 4.

Direct surface disturbance from the project would impact a maximum of 272 ha. The revised area of negative impacts is still minor in the context of the area of undisturbed vegetation that would be retained within the Forest (approximately 0.85 % of 32,000 ha) and the area that is likely to experience positive effects of managed floods (17,000 ha). The total estimated area of vegetation clearing presented in Table 4 (266 ha) is less than the total surface disturbance footprint for the project. This discrepancy is due to the following factors:

- A portion of the haul road to the Thule regulator follows the alignment of an existing road outside the Forest (0.6 ha);
- Some project infrastructure footprints and site facilities overlap (3.8 ha); and
- The by-washes are outside the Forest and were not mapped as part of this assessment (1.6 ha).

The estimates of vegetation clearing are conservative as they do not account for existing disturbance within the forest. Many of the haul roads and other temporary construction sites would be situated on existing access roads or other disturbed areas and would not require vegetation clearing.

Construction of the by-washes will require the clearing of approximately 1.6 ha of River Red Gum Forest along Barbers Creek to the west of the Forest. As with the remainder of the project, options to minimise the extent of clearing, including removal of hollow bearing trees, would be investigated during detailed design and construction planning.

Most fauna will readily escape harm from vegetation clearing and construction. Flora and fauna populations would persist in retained vegetation outside the disturbance area. Reproduction at population scale is unlikely to be disadvantaged by injury or displacement of individuals. Any disruption to reproduction would only be for the one season.

Impacts on individual species would occur through removal of specific habitat resources. Impacts within temporary construction footprints are readily reversible through flood-induced regeneration of native vegetation. The project would remove habitat resources that take a long time to develop, such as hollow-bearing trees. There is the potential for negative impacts on fauna which rely on these resources. The

project would remove a small proportion of the overall amounts of these resources available in the Forest.

Construction of the inlet channel and regulator will require the clearing of approximately 8 ha of Inland Grey Box Woodland, which is equivalent to the impacts presented in the Environmental Assessment. The modifications presented in this Preferred Project Report have been designed to ensure that there are no additional impacts on this community.

The modified construction footprint for the within-Forest spoil disposal area would affect approximately 3 ha of additional native vegetation, however has been reconfigured to ensure that there are no impacts on Inland Grey Box Woodland. Options for spoil disposal outside the Forest are being investigated and would further reduce ecological impacts as described in Section 4.1.2 below.

The remainder of the additional clearing is unlikely to have impacts on any vegetation communities or habitats with very high conservation significance. The majority of the additional clearing is associated with borrow pits for the downstream levee, which would be sited in disturbed or cleared land as far as is practicable. Based on the results of the ecological surveys conducted for the Environmental Assessment, there is likely to be scope for placing borrow pits in land with lower conservation value. The indicative construction corridor for the levee and borrow pits is close to the margins of the Forest. These portions of the Forest have been relatively intensely modified by historical activities such as clearing, grazing and road, levee and fence construction. These areas have reduced habitat value due to edge effects and feature lower habitat tree densities and greater percentage cover of exotic plants. Pre-clearing ecological surveys throughout the construction phase would further assist in concentrating disturbance in areas with lesser value and further reduce impacts.

The majority of the additional disturbance footprint presented in this Preferred Project Report falls within River Red Gum dominated vegetation and would be allowed to regenerate post-construction. These vegetation types and habitats are flood-dependant and would experience positive impacts due to the proposed environmental watering. Further, River Red Gum forests are relatively resilient to disturbance and would regenerate readily once the disturbance area is flooded. An active regeneration program is proposed which would include monitoring of disturbance footprints to ensure that the anticipated regeneration occurs. Adaptive management principals would be adopted, including management of weeds and facilitated regeneration of native vegetation if required.

Table 4 Clearing of native vegetation for project infrastructure and evaluation of impacts

Project Infrastructure	Vegetation type (Benson, 2006)	Area within disturbance footprint (ha)	Evaluation of Impacts
Haul roads (indicative)	Comm ID 10: River Red Gum - Black Box woodland	0.51	Modification of native vegetation and habitat within footprint, situated in disturbed areas as far as is practicable. Vegetation would be allowed to regenerate. Compared to the Environmental Assessment, an additional 4.6 ha of vegetation would be removed due to refinements to the project described in this Preferred Project Report.
	Comm ID 13: Blackbox - Lignum woodland	0.30	
	Comm ID 250: Derived tussock grasslands	0.50	
	Comm ID 7: River Red Gum - herbaceous tall open forest	2.13	
	Comm ID 9: River Red Gum - wallaby grass tall woodland	2.92	
Site facilities (indicative)	Comm ID 10: River Red Gum - Black Box woodland	0.97	Modification of native vegetation and habitat within footprint, situated completely outside of EEC areas and in disturbed areas as far as is practicable. Vegetation would be allowed to regenerate. Compared to the Environmental Assessment, an additional 2.9 ha of vegetation would be removed due to refinements to the project described in this Preferred Project Report.
	Comm ID 13: Blackbox - Lignum woodland	0.98	
	Comm ID 9: River Red Gum - wallaby grass tall woodland	0.77	
Upstream Structures			
Inlet channel and inlet regulator and fishways	Comm ID 10: River Red Gum - Black Box woodland	3.11	Permanent removal or modification of native vegetation, including Inland Grey Box Woodland EEC. Understorey vegetation would be allowed to regenerate within the channel. Compared to the Environmental Assessment, an additional 2.13 ha of vegetation would be removed due to refinements to the project described in this Preferred Project Report
	Comm ID 13: Blackbox - Lignum woodland	2.28	
	Comm ID 237: Riverine Inland Grey Box grassy woodland	8.00	
	Comm ID 250: Derived tussock grasslands	0.41	
	Comm ID 7: River Red Gum - herbaceous tall open forest	2.21	
	Comm ID 9: River Red Gum - wallaby grass tall woodland	0.23	
Swan Lagoon regulators	Comm ID 2: River Red Gum-sedge tall open forest	0.05	Permanent removal of tall, highly significant riparian River Red Gum Forest. Compared to the Environmental

Project Infrastructure	Vegetation type (Benson, 2006)	Area within disturbance footprint (ha)	Evaluation of Impacts
	Comm ID 7: River Red Gum - herbaceous tall open forest	0.15	Assessment, an additional 0.05 ha of vegetation would be removed due to refinements to the project described in this Preferred Project Report.
Spoil disposal area	Comm ID 10: River Red Gum - Black Box woodland	4.97	Modification of native vegetation and habitat through spreading of approximately 500mm of spoil material. Disturbance would be concentrated on the existing levee and would not be placed in Inland Grey Box Woodland. Compared to the Environmental Assessment, an additional 3.33 ha of vegetation would be removed due to refinements to the project described in this Preferred Project Report. An option for offsite spoil disposal is being investigated.
	Comm ID 13: Blackbox - Lignum woodland	38.12	
	Comm ID 9: River Red Gum - wallaby grass tall woodland	0.04	
Downstream Structures			
Downstream levee alignment	Comm ID 10: River Red Gum - Black Box woodland	30.25	Permanent removal of vegetation and habitat along maintenance tracks. Modification of forest and woodland vegetation through conversion to grass and herbland along remainder of levee. Compared to the Environmental Assessment, an additional 50.45 ha of vegetation would be removed due to refinements to the project described in this Preferred Project Report.
	Comm ID 13: Blackbox - Lignum woodland	2.81	
	Comm ID 250: Derived tussock grasslands	5.92	
	Comm ID 7: River Red Gum - herbaceous tall open forest	12.13	
	Comm ID 9: River Red Gum - wallaby grass tall woodland	68.46	
Downstream stop log regulators	Comm ID 10: River Red Gum - Black Box woodland	0.62	Permanent removal of vegetation and habitat within infrastructure footprint. Compared to the Environmental Assessment, an additional 2.5 ha of vegetation would be removed due to refinements to the project described in this Preferred Project Report.
	Comm ID 13: Blackbox - Lignum woodland	0.29	
	Comm ID 250: Derived tussock grasslands	0.04	
	Comm ID 7: River Red Gum - herbaceous tall open forest	1.81	
	Comm ID 9: River Red Gum - wallaby grass tall woodland	2.31	

Project Infrastructure	Vegetation type (Benson, 2006)	Area within disturbance footprint (ha)	Evaluation of Impacts
Internal floodway	Comm ID 2: River Red Gum-sedge tall open forest	0.52	Modification of native vegetation and habitat within footprint. Vegetation would be allowed to regenerate. Compared to the Environmental Assessment, clearing of native vegetation will be reduced by 24.94 ha due to refinements to the project described in this Preferred Project Report.
	Comm ID 7: River Red Gum - herbaceous tall open forest	3.91	
	Comm ID 9: River Red Gum - wallaby grass tall woodland	0.57	
Borrow pits	Comm ID 10: River Red Gum - Black Box woodland	22.74	Modification of native vegetation and habitat within footprint situated in disturbed areas as far as is practicable. Vegetation would be allowed to regenerate. Compared to the Environmental Assessment, an additional 20.69 ha of vegetation would be removed due to refinements to the project described in this Preferred Project Report.
	Comm ID 13: Blackbox - Lignum woodland	1.54	
	Comm ID 250: Derived tussock grasslands	0.47	
	Comm ID 7: River Red Gum - herbaceous tall open forest	4.92	
	Comm ID 9: River Red Gum - wallaby grass tall woodland	35.14	
Return channel, return channel regulator and exit structure	Comm ID 250: Derived tussock grasslands	0.82	Permanent removal of vegetation within footprint, the majority of which is exotic grassland. Compared to the Environmental Assessment, an additional 0.24 ha of vegetation would be removed due to refinements to the project described in this Preferred Project Report.
	Comm ID 7: River Red Gum - herbaceous tall open forest	0.07	
	Comm ID 9: River Red Gum - wallaby grass tall woodland	0.34	
Turkey nest dams (four)	Comm ID 250: Derived tussock grasslands	0.18	Removal of native vegetation and habitat within footprint, situated in disturbed areas as far as is practicable. Vegetation would be allowed to regenerate.
	Comm ID 7: River Red Gum - herbaceous tall open forest	0.03	
	Comm ID 9: River Red Gum - wallaby grass tall woodland	1.02	
	Comm ID 13: Blackbox - Lignum woodland	0.17	
Temporary topsoil stockpiling at downstream regulators	Comm ID 10: River Red Gum - Black Box woodland	0.14	An additional 2.5 ha of vegetation would be removed through inclusion of this new disturbance footprint. Removal of native vegetation and habitat within footprint, Situated in disturbed areas as far as is
	Comm ID 13: Blackbox - Lignum woodland	0.49	

Project Infrastructure	Vegetation type (Benson, 2006)	Area within disturbance footprint (ha)	Evaluation of Impacts
	Comm ID 7: River Red Gum - herbaceous tall open forest	0.49	practicable. Vegetation would be allowed to regenerate.
	Comm ID 9: River Red Gum - wallaby grass tall woodland	1.33	

Consideration of additional threatened biota

Based on consultation with DECCW, two additional species of threatened biota are considered likely to occur in the Forest:

- Round-leafed Wilsonia (*Wilsonia rotundifolia*), which is listed as Endangered under the TSC Act; and
- Grey-crowned Babbler (*Pomastomus temporalis temporalis)*.

The project will not directly impact any known populations of these threatened species. Therefore additional, specific Assessments of Significance for these threatened species have not been prepared. An evaluation of the magnitude, extent and significance of impacts of the project on these threatened species and their habitats based on a general consideration of the assessment criteria identified in the Guidelines for Threatened Species Assessment under Part 3A of the EP & A Act (DEC and DPI 2005) has been undertaken.

The outcome of this assessment is that the project is unlikely to have a significant negative effect on local populations of the threatened plant *Wilsonia rotundifolia* based on the following considerations:

- No adult individuals or important marshland habitat for the species was observed within the construction footprints for the project and so construction is unlikely to disturb any adult individuals;
- Negative impacts arising from the project would be limited to indirect effects and would affect a very minor proportion of individuals and habitats; and
- Inundation of a portion of the Forest would increase the area of potentially suitable habitat for the species and would be expected to have positive effects through a general increase in floodplain health and productivity due to flooding.

The project is unlikely to have a significant negative effect on local populations of the Grey-crowned Babbler based on the following considerations:

- Construction may displace or disturb some individuals if they are within or near the disturbance area. This disturbance would be short-term and is likely to affect a small proportion of any fauna populations, given the maximum construction corridor of 272 ha within the 32, 000 ha of similar habitat in the Forest that could potentially be occupied by the species;
- Inundation of a portion of the Forest may limit some individual's access to preferred habitat and displace them for the duration of the inundation period. There are extensive areas of alternative habitat that would not be inundated both within and outside the Forest. Grey-crowned Babblers are a mobile species and so local populations are likely to utilise alternative habitat and reoccupy the inundation area after flood recession;
- Construction would remove some valuable habitat resources, including established trees and understorey vegetation but would affect a minor proportion of resources available in the locality and would help to secure habitat resources in the longer term as environmental watering would facilitate regrowth of vegetation;
- There is no evidence that any specific habitat resources that would be removed by the project or significantly adversely affected by flooding are critical to the maintenance of local populations of the species. Grey-crowned Babblers are likely to benefit from a general increase in floodplain health and productivity as a result of flooding; and

- Direct negative impacts arising from the project would affect a very minor proportion of individuals and habitats (within a maximum of 272 ha) compared to the overall area of similar habitats in the Forest (approximately 32,000 ha) and the area likely to experience beneficial effects of flooding (17,700 ha). This magnitude of impacts is not likely to comprise a significant negative effect on local populations of the Grey-crowned Babbler.

Revised conclusion of Ecological Impact Assessment

Project applications under Part 3A must contain a justification of the project based on key thresholds presented in the DEC/DPI (2005) assessment guidelines. These key thresholds comprise the conclusion to ecological impact assessments to support Part 3A Environmental Assessments. These conclusions have been re-assessed based on the revisions to the project and are presented below.

Whether or not the proposal, including actions to avoid or mitigate impacts or compensate to prevent unavoidable impacts will maintain or improve biodiversity values.

The application of the "improve or maintain" test to the project requires the consideration of positive and negative ecological impacts, proposed mitigation of negative impacts, and biodiversity offsets to compensate for residual negative impacts.

Construction will have negative impacts on native biota and habitats within a maximum construction corridor of 272 ha. Operation of the project will inundate over 17,000 ha of the Forest and is likely to result in positive impacts on floodplain and aquatic organisms within this area. Specific impact mitigation and environmental management measures will be adopted to increase the certainty of the long term maintenance of the biodiversity values of the Forest during construction and operation of the project. This would maintain some values of habitat within disturbance footprints and substantially avert indirect impacts on surface waters, native vegetation and fauna habitats. The majority of the additional disturbance footprint presented in this Preferred Project Report falls within River Red Gum dominated vegetation and would be allowed to regenerate post-construction. These vegetation types and habitats are flood-dependant and would experience positive impacts due to the environmental watering and are likely to regenerate readily once the disturbance area is flooded.

The project will not mitigate all impacts on native flora and fauna within the surface disturbance area. Further, not all species and communities within the Forest will experience positive impacts from the inundation. Therefore there are residual impacts on some native biota, including the EEC Inland Grey Box Woodland. These impacts will require commensurate biodiversity offsets to ensure the project will "improve or maintain biodiversity values". The comparison of ecological impacts, mitigation and offsets associated with the application of the "improve or maintain" test to the project are summarised in Table 5 for terrestrial ecosystems. There has been a relatively minor change to the application of the improve or maintain test to the project as a result of the refinements to the project presented in this Preferred Project Report. Compared to the Environmental Assessment, there has been a minor increase in adverse impacts through an increase in the construction footprint from 206 ha to 272 ha. Negative impacts are significantly outweighed by positive effects associated with flooding over 17,000 ha of the Forest. The additional disturbance footprint is located entirely within River Red Gum vegetation types and habitats that are likely to experience positive impacts. Therefore there is no increase in residual impacts and so no additional offset contributions are required.

No additional impacts on aquatic ecosystems are anticipated as a result of the revisions presented in this Preferred Project Report.

Table 5 Comparison of ecological impacts, mitigation and offsets on terrestrial ecosystems

Positive Impacts	Negative Impact	Mitigation	Offset
Environmental watering of approximately 17,000 ha of the Forest and associated ecological benefits for floodplain biota, including: ◗ improved health of River Red Gums, Black Box and associated understorey species; ◗ improved health of floodplain marshes and growth and reproduction opportunities for associated wetland biota; ◗ migration and breeding opportunities for waterbirds, frogs and other floodplain biota; and ◗ improved habitat resources for floodplain biota, including many terrestrial fauna, due to a general increase in floodplain health and productivity.	◗ Potential displacement or mortality of native biota within a construction corridor of 272 ha. ◗ Removal of native vegetation including: – Permanent removal of 8 ha of Inland Grey Box Woodland; – Temporary disturbance of approximately 272 ha of native vegetation. This includes 182 ha of project construction footprints that would be allowed to regenerate to their pre-disturbance state; – Permanent removal or modification of approximately 90 ha of native vegetation within project infrastructure footprints; and ◗ Removal of an estimated 532 habitat trees for permanent project infrastructure and potential removal of additional habitat trees within the remaining 182 ha construction corridor. ◗ Isolation, displacement or degradation of flooding-intolerant flora, fauna and vegetation communities.	◗ Remediation and revegetation of temporary construction footprints ◗ Habitat enhancement in remediated areas through placement of hollow trees and fallen timber. ◗ Pre-clearing surveys for (and salvage of) resident native fauna. ◗ Soil and surface water management. ◗ Improved long-term security of the habitat tree resource through watering of drought-stressed River Red Gums. ◗ Potential further reduction of construction impacts through off-site spoil disposal. ◗ Purposeful operation of infrastructure and adaptive management to avoid negative impacts during the proposed inundation.	Residual negative impacts arising from the project on terrestrial vegetation that would not benefit from the environmental watering of the Forest, including permanent removal of 8 ha of Inland Grey Box Woodland. Therefore an offsets strategy has been developed in consultation with DECCW that would include: ◗ A 149 ha offset site containing appropriate 'like for like' vegetation communities including 94 ha of Inland Grey Box Woodland plus additional habitat for terrestrial fauna in cleared and River Red Gum communities; ◗ Management for conservation, in perpetuity, under secure tenure as FMZ 3a within the FNSW Estate; and ◗ Improvement of condition through: – conversion from Sheep grazing to tactical Cattle grazing and management of weeds and pest fauna; and – Regeneration of cleared and River Red Gum vegetation through exclusion of timber harvesting.

Whether or not the proposal is likely to reduce the long-term viability of a local population of any threatened species, population or ecological community.

The project is unlikely to reduce the viability of any local populations of threatened biota based on the following considerations:

- Direct negative impacts arising from construction would affect a very minor proportion of individuals and habitats within a maximum of 272 ha or approximately 0.85 % of the 32,000 ha of similar habitats within the Forest. The refinements to the project presented in this Preferred Project Report would increase the extent of clearing by 66 ha. This would be a minor increase in the impacts presented in the Environmental Assessment and would not comprise a significant negative effect on any populations of threatened biota;
- Construction would disrupt habitat connectivity within a maximum temporary construction corridor of 272 ha, including a permanent infrastructure footprint of 90 ha. The refinements to the project presented in this Preferred Project Report would not significantly increase the degree of fragmentation of habitat. The modified gaps in habitat created would still be less than 100 metres across and would be adjacent to extensive areas of intact native vegetation. Ecosystem functions necessary for the maintenance of local populations such as migration, dispersal and pollination are likely to continue across these modified areas of habitat;
- Construction would remove some valuable habitat resources, including habitat trees but would affect a minor proportion of resources available in the locality. The additional disturbance areas presented in this Preferred Project Report are associated with temporary construction footprints that would be placed to minimise, where practicable, the number of hollow-bearing trees and other habitat resources to be removed. The project may help to secure the habitat tree resource in the longer term through environmental watering of mature River Red Gums;
- Inundation of a portion of the Forest is equivalent to that presented in the Environmental Assessment. This may displace some individuals for the duration of the inundation period. Local populations are likely to persist in extensive areas of native vegetation and alternative habitat that would not be flooded and reoccupy the inundation area after flood recession; and
- There is no evidence that any specific habitat resources that are critical to the maintenance of any local populations would be significantly adversely affected by flooding. The project aims to restore a more natural flood regime and so the majority of species and populations within the Forest are likely to benefit from a general increase in floodplain health and productivity as a result of the inundation.

Whether or not the proposal is likely to accelerate the extinction of any species, population or ecological community or place it at risk of extinction.

The project is not likely to accelerate the extinction of any threatened biota based on the following considerations:

- Direct negative impacts arising from the project would affect a relatively minor proportion of individuals and habitats compared to the overall area of similar habitats within the Forest (272 ha or approximately 0.85 % of 32,000 ha). There is no evidence that an ecologically significant proportion of any populations are concentrated within the disturbance footprint and so this would comprise a minor contribution to the rate of decline of any populations of threatened biota;
- The project is unlikely to comprise a significant negative contribution to the operation of any key threatening processes. The project will modify natural hydrology and interrupt natural drainage

systems but with the overall purpose of restoring a more natural flood regime. Potential negative effects of the proposed hydrological changes would be mitigated by the proposed purposeful operation of the project, adaptive management and provision of appropriate fauna passages at project infrastructure. The refinements to the project presented in this Preferred Project Report would not significantly increase he operation of any key threatening processes beyond the effects outlined in the Environmental Assessment;

- Inundation of a portion of the Forest may limit some species access to preferred habitat and may displace some individuals for the duration of the inundation period. There are extensive areas of alternative habitat that would not be inundated both within and outside the Forest. Mobile fauna populations are likely to utilise alternative habitat and reoccupy the inundation area after flood recession;
- There is no evidence that any specific habitat resources that would be removed by the project or adversely affected by flooding are critical to the maintenance of any populations of threatened biota;
- The environmental watering of over 17,000 ha of the Forest and likely ecological benefits would exceed the likely negative impacts arising from the project for the majority of aquatic, wetland and floodplain species occurring within the Forest. The 66 ha of additional disturbance footprints that would be affected by the refinements to the project are located entirely within native vegetation and habitats that would experience beneficial effects of flooding; and
- Offsetting residual negative impacts arising from the project on terrestrial vegetation that would not directly benefit from the environmental watering of the Forest. Residual impacts include the permanent removal of 8 ha of Inland Grey Box Woodland. These impacts would be offset through conservation, in perpetuity and under secure tenure, of a 149 ha offset site containing 94 ha of Inland Grey Box Woodland and management to improve its biodiversity value. The refinments to the project would not result in any additional impacts to Inland Grey Box Woodland nor any other additional residual impacts.

Whether or not the proposal will adversely affect critical habitat.

No listed critical habitat will be removed or adversely affected as a result of this project. The 66 ha of additional disturbance footprints that would be affected by the revisions to the project would not affect any critical habitat.

4.1.2 Mitigation measures

Offsite spoil disposal

Options are being investigated to dispose of spoil from the inlet channel outside of the Forest. The spoil disposal scenario presented in the Environmental Assessment involves spreading spoil to approximately 50 cm depth over approximately 40 ha within the forest. This option would have disturbed understorey vegetation and reduced tree health within native woodland and forest with high conservation significance, including Inland Grey Box Woodland EEC. Offsite spoil disposal would involve spreading spoil to approximately 150 cm depth over approximately 15 ha outside the forest in partially cleared and modified agricultural land. This will reduce ecological impacts associated with the project by affecting a receiving environment with lower conservation significance and by affecting a smaller area. GHD ecologists have assessed two potential offsite spoil disposal sites and confirmed that have lesser ecological value than the Forest and therefore that this option would reduce impacts associated with the project. The final

location and layout of offsite spoil disposal is still subject to consultation with affected landowners. Ecological impacts associated with the final offsite spoil disposal option will be documented as part of a report justifying selection of the preferred disposal site.

Rehabilitation Plan

DECCW was consulted regarding the need to develop a Rehabilitation Plan that details for areas disturbed during construction of the project. The aim of the plan will be to ensure the disturbed areas provide an ecological function and that vegetation recovers to pre-existing conditions where possible. It was agreed that the Rehabilitation Plan is to be developed in consultation with DECCW and include the following components:

- As part of final site works, the contractor would place forest debris over the construction footprint outside the footprint of the permanent infrastructure. The forest debris may include fallen timber removed to permit construction activities that would provide a habitat resource for fauna;
- Monitoring the condition of areas disturbed during construction. This would be done as part of the annual condition assessments that form part of the Icon site reporting; and
- Noxious weeds would be managed in accordance with existing Forests NSW management procedures.

Measures such as tree planting schemes were not considered to warranted because there is likely to be a suitable seed bed within the Forest and it is likely that River Red Gum seedlings will colonise the disturbed areas following inundation events.

If borrow pits are located on private property outside the downstream levee alignment, they would not be inundated by the project and so would be less likely to regenerate via seeds carried by flood waters. As a result, rehabilitation of borrow pits outside the levee is likely to require more active techniques compared to those to be implemented for disturbed areas that would be inundated. Discussions with the Murray Catchment Management Authority indicate that direct seeding using seeds of local provenance is one rehabilitation technique that has been successfully implemented on other borrow pits on the floodplain. The use of tube stock had been trialled but it has been found direct seeding gave superior results in both cost and establishment.

A new Statement of Commitment 6 has been developed to include the requirement for a Rehabilitation Plan to be prepared.

4.2 Hydrology

4.2.1 Assessment of impacts

Postponing construction of the internal floodway

As indicated in Section 3.2, further investigations undertaken by DTSA since completion of the Environmental Assessment indicate that the area in the vicinity of the internal floodway has a lower elevation than was suggested by the preliminary survey. The effect of this more detailed topographical data on the hydrology of the Forest was analysed and this concluded that, due to the lower elevation of this part of the Forest, an internal floodway is unlikely to be required to enhance the movement of water towards the return channel.

Flood patterns within the Forest would be monitored as part of the Operating Plan and this would involve monitoring over a range of flood magnitudes. If monitoring indicates that an internal floodway is required to maintain effective operation, a separate detailed design process would be implemented to ensure the design responds to the issues identified during monitoring. Preliminary investigations by DTSA indicates that if a floodway is required, it is likely to be approximately 1 km by 50 m, which is substantially smaller than the 1 km by 250 m that has been assessed in the Environmental Assessment.

This refinement would not increase the hydrological impacts of the project described in the Environmental Assessment because it would defer a component that is now considered unlikely to be required.

Reduction in the number of stop log bays in the Cow and Calf Creek regulators

DSTA investigated the hydraulic implications associated with reducing the number stop log bays on the Cow Creek regulator from 10 to 8 bays, and from 5 to 4 bays on the Calf Creek regulator. Consideration was given to reducing the number of bays at these two regulators because these sites were identified as being those most likely to result in significant cost savings while minimising impacts on afflux.

Modelling was undertaken using the MIKE-11 model that was validated using available historical information and run to investigate different options for the regulator widths. The model was used with previous peak inflows for the 1993 flood event as boundary inflows. The 1993 event was modelled as it is considered to be generally equivalent to the maximum design event. Regulator cross section areas were altered to reflect the reduced waterway area associated with the reduction in the number of bays, with each bay having a standard 5.1m of free waterway area.

The model was run with the revised regulator width and peak water levels and velocities were calculated. The results are summarised in Table 6 and

Table 7 and are compared with the project described in the Environmental Assessment.

Table 6 Summary of change in afflux

Structures	Existing case – water level (m AHD)	project described in the Environmental Assessment		Reduced number of bays		Change in afflux (m)
		Water level (m)	Afflux (m)	Water level (m)	Afflux (m)	
Calf Regulator	76.95	77.03	0.08	77.06	0.11	0.03
Cow Regulator	76.88	76.93	0.05	76.97	0.09	0.04
Barbers Regulator	76.96	77.07	0.11	77.09	0.13	0.02
Runner A Regulator	76.96	77.12	0.16	77.14	0.18	0.02

Table 7 Summary of changes in velocities

Structures	project described in the Environmental Assessment-velocity (m/s)	Reduced number of bays - velocity (m/s)	Change in velocity (m/s)
Calf Regulator	1.15	1.31	0.16
Cow Regulator	0.88	1.09	0.21
Barbers Regulator	0.74	0.77	0.03
Runner A Regulator	0.98	1.00	0.02
Calf Creek Bridge	0.57	0.55	-0.02
Cow Creek Bridge	0.71	0.70	-0.01
Barber Creek Bridge	0.74	0.77	0.03
Barbers Overflow Bridge	0.56	0.58	0.02

Based on the modelling results, DSTA consider that there is very little change in afflux or velocity due to the reduction in the number of stop log bays at Cow and Calf Creeks. The greatest afflux occurs at Runner A of 0.18 m, which is an increase of 0.02 m from that outlined in the Environmental Assessment. The greatest increase in velocity occurs on the Cow Creek Regulator of 0.21 m/s, with a velocity of 1.09 m/s. Generally the design has targeted regulator velocities of 1 m/s to allow for upstream fish migration, however provisions have been made on all structures to aid this process and consultation with the Fish Passage Task Force indicates that these velocities are most probably acceptable.

DTSA conclude that the reduction in structure size is likely to have very minor implications on flood event hydraulics. Based on this, it is considered likely that the refinements would have a minor increase in impacts assessed in the Environmental Assessment related to afflux and velocity of discharges at the downstream regulators.

4.2.2 Mitigation measures

Flood patterns within the Forest would be monitored as part of the Operating Plan and this would involve monitoring over a range of flood magnitudes. If monitoring indicates that an internal floodway is required to maintain effective operation, a separate detailed design process would be implemented to ensure the design responds to the issues identified during monitoring. This is reflected in Statement of Commitment 7.

4.3 Water quality

4.3.1 Impact assessment

The refinements detailed in Section 3 would not involve any additional impacts on water quality to those detailed in the Environmental Assessment. The main changes in impacts would be related to the increase in the temporary disturbance area which would increase the area that has the potential to result in erosion and sedimentation that may increase turbidity in receiving waterways. This impact is discussed in Section 4.4.

4.3.2 Mitigation measures

Potential impacts would be managed in accordance with the Statement of Commitments and additional mitigation measures are not required to address impacts associated with the refinements.

4.4 Soils and erosion

4.4.1 Impact assessment

Potential impacts on soils and erosion due to the refinements would be related to:

- Increases in the depth of excavation for the borrow pits; and
- Increases in the area of the construction footprint.

These refinements would increase the area of soil that would be impacted and so increase the potential for erosion. While there would be an increase in the area impacted, there would not be any new impacts and the management measures outlined in the Environmental Assessment would be applied to the additional areas to minimise impacts. The additional 66 ha impacted and the associated increase in the potential for erosion is considered to be minor in the context of the overall area of the Forest that would benefit from the project.

4.4.2 Mitigation measures

As the refinements would not involve any new impacts, no additional mitigation measures are proposed. Potential impacts would be managed by implementing the Statement of Commitments.

4.5 Indigenous heritage

4.5.1 Impact assessment

Potential indigenous heritage impacts due to the refinements would be related to the increase in the construction footprint, particularly for the downstream levee and associated borrow pits. The potential for the construction footprint to be amended was identified during preparation of the Environmental Assessment and this resulted in the field surveys being undertaken approximately 40 m on either side of the alignment of the levee. The project has been designed to avoid the items of significance to indigenous communities, such as scarred trees, that were identified during the field surveys.

The refinements would not alter the type of impacts on items of significance to indigenous communities that are described in the Environmental Assessment, however there would be an increase in the area of land that is disturbed that may contain items significance to the indigenous communities. A small proportion of the refined construction footprint, principally the extremities of the borrow pits, is beyond the corridor that was surveyed as part of the Environmental Assessment. The additional areas have not been surveyed during preparation of the Preferred Project Report because they are indicative only and the final construction footprint will be determined by the contractor during construction planning. Statement of Commitments 22 - 25 will be implemented which includes a Cultural Heritage Management Plan developed in consultation with the Joint Indigenous Group and DECCW and will include a procedure to be implemented if unexpected items of significance to the indigenous community are encountered. This approach will ensure that appropriate measures are implemented to manage potential cultural heritage impacts associated with the final construction footprint.

The project involves ground excavation and there is the potential for buried items of significance to the indigenous community to be impacted. As this has been identified as one of the key risks to the project, the Environmental Assessment indicated that a Cultural Heritage Management Plan would be developed in consultation with representatives of the Traditional Owners and DECCW. This would include measures such as monitoring surface excavations by representatives of the Traditional Owners, and procedures to be implemented if items of potential significance to the indigenous community are encountered. The intent of these measures would be to ensure that the approach for management of unexpected finds is discussed with and agreed to by representatives of the Traditional Owners and DECCW prior to construction commencing.

The refinements involve investigating the potential for spoil from the inlet channel to be deposited at a location that is outside the Forest boundary. Potential impacts on items of significance to indigenous communities have not been assessed at this stage because the location is yet to be determined. As indicated in Sections 3.4 and 5, the Statement of Commitments has been revised to reflect that the spoil disposal location would be selected following an assessment of the potential environmental impacts. This would involve undertaking field surveys with representatives of the Joint Indigenous Group (JIG) and refining the location to avoid impacts on items of significance to the indigenous community where possible.

Joint Indigenous Group

Since completion of the Environmental Assessment, a JIG has been formed that contains representatives from Yorta Yorta Nation, Barapa Barapa Nation, Deniliquin Local Aboriginal Land Council, and Moama Local Aboriginal Land Council.

The purpose of the JIG is to work in partnership with the project Integration Team to provide advice on how the Aboriginal custodians may protect the integrity of their cultural heritage during the construction of the project and how to achieve both cultural and socio-economic outcomes through the project to benefit Indigenous peoples.

The Cultural Heritage Management Plan would be reviewed and endorsed by the JIG to ensure that the management measures for both known and unknown items are supported by the Traditional Owners. DECCW has also been invited to comment on the draft plan. This approach would ensure that appropriate measures are implemented to manage issues that arise during construction, such as encountering items of significance to the indigenous community that are currently unknown.

The JIG would specifically provide the project team with recommendations on:

- Recruitment of a two Indigenous Coordinators;
- Recruitment and employment of Indigenous cultural heritage monitors;
- Training of potential Indigenous cultural heritage monitors and other Indigenous workers;
- Identifying processes for managing the discovery of Indigenous cultural items;
- Promotion of long term economic, cultural, employment opportunities;
- Cultural activities relating to the project; and
- Opportunities to undertake sharing of information.

The JIG would work within the guidelines of a Partnership Agreement to be established with the proponent. Advice provided by the JIG would represent the views of the local Indigenous community and be developed in a culturally appropriate context.

4.5.2 Mitigation measures

As the refinements would involve the same types of impacts as those discussed in the Environmental Assessment, potential impacts would be managed by implementing the Statement of Commitments 22 - 25. The Statement of Commitments has been expanded to reflect that further assessment of potential impacts on items of Aboriginal significance would be undertaken during selection of the upstream spoil disposal location. The commitment has also been revised to reflect the formation and role of the JIG.

4.6 Spoil and waste

4.6.1 Impact assessment

There are a number of aspects of the refinements that relate to management of spoil and waste. While the estimated volumes would increase, the type of waste generated is not expected to change and the over-riding management principles would be the same as those discussed in the Environmental Assessment, that is:

- All waste would be managed in accordance with DECC's Waste Classification Guideline; and
- Spoil disposal sites would be selected during the construction planning phase. This would involve a range of investigations to identify, assess and minimise potential environmental impacts.

These impacts are discussed below.

Upstream spoil disposal site

The upstream spoil disposal site would be confirmed during the construction planning phase. As indicated in Section 3.4, this would involve the proponent undertaking a range of investigations to consider the following items:

- Negotiations with landholders. This would involve discussions to identify suitable locations, access arrangements, the final landform, rehabilitation requirements, ongoing management obligations, and commercial arrangements;
- Impacts on ecology. Further investigations would be undertaken to determine whether there are any ecological constraints on the potential site(s). Specifically, the site(s) would be selected to avoid impacts on the Inland Grey Box Woodland which is listed as an endangered ecological community;
- Impacts on items of Aboriginal significance. The potential site(s) would be inspected by representatives of Traditional Owners to identify whether there are any items of Aboriginal significance that would constrain its use for spoil placement;
- Impacts on the floodway. DECCW's Floodplain Manager would be consulted to ensure that the spoil placement would not adversely affect operation of the floodway; and
- Cost and time required for each option.

The intent of these investigations would be to identify a suitable spoil disposal site that minimises the potential environmental impacts. These assessments are unable to be detailed within this Preferred

Project Report because consideration is being given to a range of possible sites at this point in time. The results of these investigations would be documented to justify selection of the preferred option and would involve a comparative evaluation of the in-Forest and private property management options.

Relative to the Environmental Assessment, this refinement would provide flexibility to utilise disposal options outside the Forest boundary that would reduce the environmental impacts compared to those outlined in the Environmental Assessment.

Postponing construction of the internal floodway

Section 3.2 indicates that the internal floodway would not be initially constructed. Flood patterns within the Forest would be monitored as part of the Operating Plan and this would involve monitoring over a range of flood magnitudes. If monitoring indicates that an internal floodway is required to maintain effective operation, a separate detailed design process would be implemented to ensure the design responds to the issues identified during monitoring.

Preliminary investigations by DTSA indicates that if a floodway is required, it is likely to be approximately 1 km by 50 m, which is substantially smaller than the 1 km by 250 m that has been assessed in the Environmental Assessment. This would also be likely to require much shallower excavations such that the volume of spoil would be significantly reduced from the 123,000 m^3 estimated in the Environmental Assessment. Should the internal floodway be required, the proponent would undertake a study to identify the preferred spoil disposal site and this would involve consideration of locations both within the Forest (including borrow pits) and outside the Forest. The preferred option would be selected based on the outcome of environmental investigations relating to Aboriginal heritage, ecology, hydrology, water quality and landholder negotiations.

Waste management

The refinement detailed in Section 3.6 indicates that there would be a 65 tonne increase in the volume of construction waste generated. While the volume of waste would increase, it is not expected that there would be any changes to the type of waste. As a result, waste would continue to be managed in accordance with the Statement of Commitments which focuses on ensuring compliance with DECC's Waste Classification Guideline.

4.6.2 Mitigation measures

Potential environmental impacts associated with the refinements would be minimised by implementing the Statement of Commitments which has been revised to specifically refer to the additional investigations that would be undertaken to select the disposal for spoil from the inlet channel and the internal floodway (if required).

As general construction waste would continue to be managed in accordance with the measures detailed in the Environmental Assessment, additional mitigation measures are not required.

4.7 Traffic and access

4.7.1 Impact assessment

Impacts on traffic and access due to the refinements would be associated with:

- Alterations to access arrangements to part of the Forest due to possible construction of a causeway rather than a bridge at the intersection of River Road and the inlet channel; and
- Access to upstream spoil disposal locations that are outside the Forest boundary.

Construction of a causeway across the inlet channel

Construction of a causeway instead of a bridge across the inlet channel at River Road would mean that vehicle access would not be available at this location during operation of the project due to the depth of the water in the inlet channel. DTSA has discussed this with Forest NSW and it was agreed that the impact on access is likely to be minor because, during operation of the project, large areas of the Forest to the west of the inlet channel would be inundated and these areas would therefore be inaccessible by road. The inundated area would include a number of creek crossings that will be impassable until they can be upgraded by Forests NSW. As a result, this refinement would be likely to lead to a minor increase in the area of the Forest that would be inaccessible during a flood event.

Access to the Forest will still be available via the road that extends over the return channel regulator, and emergency access will continue to be available cross Torrumbarry Weir.

Access to upstream spoil disposal locations

The refinements involve utilising sites beyond the Forest boundary to dispose of approximately 250,000 m^3 spoil from construction of the inlet channel. This would require heavy vehicles to utilise Forest roads and access points may be created from the Forest roads to the spoil disposal sites with the private properties.

The main potential impacts on the forest road network would be temporary changes to road conditions due to vehicle movement and the operation of plant and machinery. These impacts would be consistent with those described in the Environmental Assessment for other activities associated with the project in that they would be short term and are considered to be minor as the Construction Environmental Management Plan would detail measures to be implemented to minimise road safety risks, for both the contractor, Forest NSW, and the general public. Section 6.3.13 of the Environmental Assessment indicates that the contractor would be required to implement a safety plan that would include providing signage to ensure that those using the forest are aware of the presence of construction vehicles on the forest roads.

It would be necessary to construct tracks to access the spoil disposal sites from the existing forest road network. Construction and maintenance of these tracks would be undertaken in accordance with Forests NSW guidelines, in particular Forest Practices Code Part 4: Forest Roads and Trails. The alignment of these tracks would be selected to minimise environmental impacts by traversing existing cleared or disturbed areas where practicable.

Heavy vehicles may be required to use non-Forest roads to access spoil disposal sites located on private property. These vehicles are likely to travel relatively short distances on non-Forest roads because the spoil disposal sites would be selected to minimise haul distances. Potential impacts on the non-Forest

road network would be associated with road safety issues and dilapidation due to the increase in heavy vehicle traffic. These impacts are similar to those assessed in the Environmental Assessment that would occur during construction of the downstream levee and associated infrastructure, and impacts would be mitigated by implementing the same management measures.

4.7.2 Mitigation measures

The refinements would result in similar impacts to those assessed in the Environmental Assessment, and potential impacts would be managed by implementing the mitigation measures detailed in the Environmental Assessment and the Statement of Commitments in Section 5. These management measures focus on development of a Construction Traffic Management Plan in consultation with RTA, Wakool and Murray Shire Councils that will form part of the Construction Environmental Management Plan. This will include specific measures to mitigate impacts on road safety and dilapidation due to heavy vehicle traffic on the road network in the immediate vicinity of work sites.

4.8 Noise and vibration

4.8.1 Impact assessment

Noise and vibration impacts associated with the refinements would be limited to the extension to the working hours as detailed in Section 3.7. In addition to the works outside the general hours that are specified in the Environmental Assessment, work may also be undertaken during the evenings until 7 pm Monday – Saturday and on Sundays at locations where works would not disturb neighbouring residences. This would generally be at locations that are in excess of 500 m from an occupied residence.

The Environmental Assessment predicts that construction activities during DECCW's recommended construction hours are likely to achieve the noise goals if they are undertaken greater than 1000 m of the nearest sensitive receiver. Works outside the DECCW's recommended construction hours are likely to achieve the noise goals if they are undertaken greater than 1500 m of the nearest sensitive receiver.

Relative to the impacts described in the Environmental Assessment, potential noise and vibration impacts associated with this refinement would increase the duration of works that would exceed the noise goals each day. However, the extended working hours would reduce the duration of the works that would exceed the noise goals at individual locations as the work front would progress more rapidly. These impacts are expected to be minor given the low population density and low number of potentially affected receivers that would be affected.

As with the project assessed in the Environmental Assessment, it is likely that the refinements would result in noise goals being exceeded at some locations. Work on Sundays would only be undertaken at locations in excess of 500m from residences and only when it is unlikely that the works would not disturb the residents.

4.8.2 Mitigation measures

The Statement of Commitments has been revised to require the following consultation to be undertaken prior to undertaking works outside DECCW's recommended construction hours:

- Potentially affected residents will be consulted prior to undertaking works outside DECCW's standard construction hours to provide information on the need for and duration of works to be undertaken

outside standard hours, management measures to be implemented, and methods to contact the project team in the event of a complaint.

4.9 Land use

4.9.1 Impact assessment

The Environmental Assessment indicated that, with the exception of the bywashes on Barbers Creek and upgrades to road access to Moulamein Road, construction activities would be limited to the Koondrook-Perricoota Forest. To minimise environmental impacts and reduce the duration and cost of construction, the project has been refined to provide the flexibility to include the following discrete activities on private property outside the Forest boundary:

- Location of borrow pits outside the downstream levee, including possibly on adjacent private property – refer to Section 3.3; and
- Disposal of spoil from the inlet channel – refer to Section 3.4

The need for and justification of both these activities is subject to further detailed investigations that will be undertaken during construction planning. The scopes of investigations to be undertaken are detailed in Statement of Commitments 15 (spoil disposal) and 38 (borrow pits) and would be documented to justify selection of the preferred option. Private property would only be used for borrow pits or spoil disposal sites is agreement can be reached with the relevant landholders. Investigations would include consideration of the following aspects:

- Negotiations with landholders, including discussions to identify suitable locations, access arrangements, the final landform, rehabilitation requirements, ongoing management obligations, and commercial arrangements;
- Impacts on ecology. Further investigations would be undertaken on the potential site(s) to identify whether there are any ecological constraints. Specifically, the site would be selected to avoid impacts on the Inland Grey Box Woodland which is listed as an endangered ecological community;
- Impacts on items of Aboriginal significance. The potential site(s) would be inspected by representatives of Traditional Owners to identify whether there are any items of Aboriginal significance that would constrain use of the site;
- Impacts on the floodway. DECCW's Floodplain Manager would be consulted to ensure that the proposal would not adversely affect operation of the floodplain; and
- Cost and time required for each option.

The use of private property for borrow pits and spoil disposal sites is considered unlikely to adversely impact land use as it would only be undertaken in accordance with written agreements with relevant landholders.

4.9.2 Mitigation measures

Potential impacts on land use on private property that may be used for the project subject to landholder agreement would be mitigated by implementing Statements of Commitment 15 and 38.

5. Final Statement of Commitments

The draft Statement of Commitments provided in Section 15.3 of the Environmental Assessment has been revised to address issues raised in the submissions and also refinements to the project that are described in Section 3 and assessed in Section 4 of this report. The final Statement of Commitments for the project is provided in Table 8.

Changes from the draft Statement of Commitments that was included in the Environmental Assessment are shown in blue text.

Table 8 Final Statement of Commitments

Number	Desired outcome	Commitment	Timing
Key Impacts			
Ecology impacts			
1	To protect threatened species and endangered ecological communities from construction activities.	The design and layout of the project will minimise the area required to construct the infrastructure to reduce impacts on significant vegetation communities on site and protect habitat and movement corridors for threatened fauna.	During design and before construction commences
2	To minimise impacts on biodiversity during construction.	Management practices will be developed for implementation during construction to reduce impacts on biodiversity, including: ◗ Develop work practices such as fencing and worker education to reduce damage to vegetation communities and fauna during construction. This will include an awareness program to advise workers of the process to follow if injured wildlife is found during construction. ◗ Where practicable, avoiding removal of habitat trees and/or hollow bearing trees. ◗ Develop a pre-clearance inspection protocol to be implemented prior to removal of habitat trees and/or hollow bearing trees. ◗ Develop weed management measures to prevent invasive weed species colonising the Forest.	Prior to and during construction
3	No significant impact on threatened species and endangered ecological communities during construction.	Where practicable, disturbance footprints, including spoil disposal areas and temporary construction sites will avoid sensitive flora and fauna communities. For infrastructure where the location is not fixed, such as site facilities, borrow pits, and haul roads, ensure that sites chosen minimise the extent of clearing of endangered ecological communities or significant threatened species habitat (including hollow bearing trees).	During design, before and during construction
4	Offset adverse impacts on endangered ecological communities during operation of the project	Implement an offset strategy developed in consultation with DECCW to offset the loss of Inland Grey Box Woodland endangered ecological community removed during construction of the project. This will involve verification of the area of this community permanently removed and ensuring that this area is offset at a ratio developed in consultation with DECCW.	Before construction

Number	Desired outcome	Commitment	Timing
5	To maintain and improve the health of ecological communities and their habitats during operation of the project.	The Operating Plan will include a long term program to monitor the response of the ecosystem to flood events. The monitoring program will be integrated with that undertaken as part of the ongoing Icon site condition reporting, and will be developed in consultation with DECCW and include: ◗ Monitoring in a range of vegetation communities including the Inland Grey Box Woodland endangered ecological community, and sites both within and outside the area to be inundated by the project; ◗ Evaluation of the ecological response against the objectives for the event; ◗ Evaluation of the progress towards achieving the interim objectives for the site defined under The Living Murray Initiative; ◗ Procedures to be implemented to mitigate adverse impacts identified during the course of the monitoring; ◗ Monitoring impacts on aquatic ecology to determine whether a fishway is required at the Barbers Creek regulator; ◗ Development of a monitoring program in consultation with NSW Industry and Investment (Fisheries) to monitor impacts on fish and aquatic invertebrates, including aspects such as stranding of native fish, fish kills, and spawning and dispersal of aquatic pests; ◗ Procedures to be implemented if native fish are unable to exit the floodplain during the recession cycle of the flood.	Prior to and during operation.
6	Ensure that areas disturbed by construction are rehabilitated.	A Rehabilitation Plan will be developed in consultation with DECCW and Murray CMA that will ensure that temporary disturbance areas are rehabilitated. This will include monitoring the recovery of vegetation as part of Icon site condition monitoring to determine whether rehabilitation occurs. It would include measures such as noxious weed management, replacement of Forest debris on disturbed areas, but would not involve tree planting schemes. In addition, if borrow pits are located outside the downstream levee alignment, the Murray Catchment Management Authority would be consulted regarding rehabilitation techniques that have been implemented for other borrow pits, such as direct seeding using seeds of local provenance.	Prior to and during operation
Hydrology impacts			
7	project is implemented within the framework of The Living Murray Initiative	The Operating Plan will define measures to be implemented to ensure the project is operated in accordance with the Living Murray Initiative. This will include reporting on the volume of water diverted into and out of the Forest during each event, and the hydrological response. Flood patterns within the Forest would be monitored as part of the Operating Plan and this would involve monitoring over a range of flood magnitudes. If monitoring indicates that flow paths within the Forest should be enhanced to maintain effective operation, a separate investigation would be undertaken to identify the preferred response and this would involve evaluation of the need for a floodway.	Prior to and during operation
Water Quality impacts			

Number	Desired outcome	Commitment	Timing
8	Implement a site specific groundwater and surface water monitoring program.	Develop and implement a groundwater and surface water monitoring program as part of the Operating Plan. This will include monitoring water quality prior to, during, and post flood events, including events that involve operation of the project as well as events that do not involve operation of the project. Procedures will be outlined to respond to adverse impacts on water quality attributed to the project. The monitoring program would be developed in consultation with NSW Industry and Investment (Fisheries), NOW, and DECCW and would specifically include parameters such as temperature, dissolved organic carbon and dissolved oxygen that are indicators of potential blackwater events. It would also include general water quality parameters such as salinity, turbidity, flow and pH.	Throughout all phases of the project.
9	Reduce the likelihood of adverse environmental impacts associated with blackwater events, and reduce the severity of blackwater events if they do occur.	Develop a management plan as part of the Operating Plan that outlines procedures to be implemented to optimise the overall environmental outcomes of the project, including consideration of blackwater issues. This will be based on a blackwater model developed for the local conditions in the Forest that will be used to predict the likely timing, duration and severity of blackwater events.	Prior to and during operation
10	Chemicals used and stored during construction within guidelines.	Work practices to reduce hazards from chemical use will be developed for implementation during construction including: ◗ Measures for the handling, storage and disposal of hazardous substances in accordance with the relevant legislation, standards and guidelines. ◗ Development of procedures for incident management including spill control, clean-up measures, emergency and incident response measures.	During design and during construction.
11	Chemical spills do not impact on water quality during operation of the project	Any contamination of soil that may occur due to incidents such as spills during construction will be cleaned up in accordance with the DECC Waste Classification Guidelines (2008) and disposed of prior to the area being flooded.	Prior to operation
Soils			
12	Ecosystem protected from stormwater impacts during construction	Work practices, such as sediment control devices, will be developed for implementation during construction to manage surface water from disturbed areas generally in accordance with Managing Urban Stormwater: Soils and Construction (Landcom 2004).	Prior to and during construction
13	No significant erosion and sedimentation impacts	Develop and implement a monitoring program as part of the Operating Plan to monitor impacts associated with erosion and sedimentation. The program will: ◗ Include areas in the immediate vicinity of all regulators and channels constructed as part of the project; ◗ Include areas downstream of the project along Barbers Creek, in particular the block banks; and ◗ Identify procedures to be implemented to minimise potential impacts.	Prior to and during operation
Spoil and Waste Management			

Number	Desired outcome	Commitment	Timing
14	Beneficial re-use of spoil from construction maximised.	A strategy to beneficially re-use all suitable spoil will be developed for implementation during construction to effectively reduce the volumes of spoil. This will include: ◗ To the greatest extent practicable and feasible, maximising the reuse of suitable material generated from construction in preference to importing fill; ◗ Adopting appropriate health, safety and environmental protocols during any disturbance of potentially contaminated soils.	Throughout all phases of the project.
15	Environmental impacts associated with the upstream spoil disposal site are minimised	Identifying possible sites for beneficial spoil reuse or disposal either within or outside the Forest and securing arrangements. This will involve consideration of the following aspects: ◗ Negotiations with landholders, including discussions to identify suitable locations, access arrangements, the final landform, rehabilitation requirements, ongoing management obligations, and commercial arrangements; ◗ Impacts on ecology. Further investigations would be undertaken on the potential site(s) to identify whether there are any ecological constraints. Specifically, the site would be selected to avoid impacts on the Inland Grey Box Woodland which is listed as an endangered ecological community; ◗ Impacts on items of Aboriginal significance. The potential site(s) would be inspected by representatives of Traditional Owners to identify whether there are any items of Aboriginal significance that would constrain its use for spoil placement; ◗ Impacts on the floodway. DECCW's Floodplain Manager would be consulted to ensure that the spoil placement would not adversely affect operation of the floodplain; and ◗ Cost and time required for each option. The results of these investigations would be documented to justify selection of the preferred option. This would involve a comparative evaluation of the in-Forest and private property management options.	Prior to start of construction of the inlet channel
16	Environmental impacts associated with disposal of spoil from the internal floodway are minimised.	If an internal floodway is required, a study would be undertaken to select the preferred spoil disposal site and this would involve consideration of locations both within the Forest (including borrow pits) and outside the Forest. The preferred option would be refined based on the outcome of environmental investigations relating to Aboriginal heritage, ecology, hydrology, water quality, and landholder negotiations.	Prior to start of construction on the internal floodway
17	Construction wastes minimised, reuse and recycling maximised.	Measures to reduce, reuse and recycle construction wastes will be developed with consideration of the Resource NSW (2003) Waste Avoidance and Resource Recovery Strategy, for implementation during construction. This will include developing strategies to manage timber, including commercial sale of harvested timber, and the management of residues such as stumps in resnagging projects. Forest NSW will ensure that bushfire risks associated with stumps being stockpiled on the former Toorangabby property for use in resnagging and river restoration projects are minimised.	During design, prior to and during construction
18	Waste disposal during construction and operation managed in accordance with guidelines.	Waste management procedures will be developed to dispose of any construction or operational waste material unable to be reused or recycled in accordance with the relevant legislation and guidelines.	During design and construction.
19	Ensure offsite spoil reuse is in accordance with legislative requirements.	Auditing to ensure any offsite spoil re-use location has all the required environmental and planning approvals.	During construction.

Number	Desired outcome	Commitment	Timing
20	Contaminated soils are managed in accordance with relevant guidelines.	Management measures will be developed to identify and manage contaminated soils during construction, including: ◗ Field investigations to identify soil contamination in accordance with DECC Waste Classification Guidelines (2008); and ◗ Confirming the presence of acid sulphate soils and developing management procedures consistent with Acid Sulphate Soil Manual (Acid Sulphate Soil Management Advisory Committee (1998)).	During construction
21	Chemicals used and stored during construction within guidelines	All chemicals will be stored in accordance with relevant Australian Standards, relevant legislation and guidelines.	During construction.
Indigenous Heritage Impacts			
22	Preserve Indigenous cultural heritage values	Where practicable, the layout of the project works will avoid potential impacts on items of Aboriginal heritage significance.	During design and before construction commences
23		An indigenous heritage management plan will be developed as part of the CEMP to define procedures to be implemented during construction to avoid or otherwise minimise impacts on items of Aboriginal heritage significance. This will include: ◗ An education program for all construction personnel on their obligations relating to Aboriginal cultural materials; ◗ A program for surveys by representatives of the Traditional Owners along the construction corridor during construction to identify potential issues of concern. This will involve at least one Aboriginal representative being present on site during construction; ◗ Developing work practices to reduce the risk of damage to heritage items, such as limiting disturbance, fencing, and worker education; and ◗ A flowchart to clearly define the process to be followed, and associated reporting procedures, should an item of potential significance to the Aboriginal community be encountered.	Prior to and during construction
24	If encountered, previously unidentified Aboriginal objects are managed appropriately	If previously unidentified Aboriginal objects are discovered during construction, all work likely to affect the object(s) will cease and DECCW and representatives of the Traditional Owners will be notified. An investigation will be undertaken by a suitably qualified archaeologist to identify measures to be implemented to reduce impact on the objects discovered, prior to recommencing works.	During construction.
25	A Joint Indigenous Group will be formed to advise on management of indigenous heritage impacts	A Joint Indigenous Group will be established comprising representatives from Yorta Yorta Nation, Barapa Barapa Nation, Deniliquin Local Aboriginal Land Council, and Moama Local Aboriginal Land Council. The purpose of the JIG will be to work in partnership with the project Integration Team to provide advice on how the Aboriginal custodians may protect the integrity of their cultural heritage during the construction of the project and how to achieve both cultural and socio-economic outcomes through the project to benefit Indigenous peoples. This will involve input to development of the Cultural Heritage Management Plan.	Prior to and during construction
Noise and vibration			

Number	Desired outcome	Commitment	Timing
26	Construction noise disturbance of the nearest residents minimised.	Construction work sites will be located and work practices will be developed for implementation during construction, including implementation of the noise and vibration mitigation measures detailed in the Environmental Assessment, to limit noise disturbance as far as practicable. Potentially affected residents will be consulted prior to undertaking works outside DECC's standard construction hours to provide information on the need for the works to be undertaken outside standard hours, management measures to be implemented, and methods to contact the project team in the event of a complaint.	During design and construction
27	Vibration impacts during construction on property and amenity of the nearest residents minimised.	Work practices will be developed to minimise vibration impacts as far as practicable for implementation during construction.	During design and construction.
28	Impacts on residences are minimised	The noise and vibration mitigation measures detailed in the Environmental Assessment will be implemented.	During construction
Air Quality			
29	Avoid dust generation along haul routes	Where practicable, select haul routes away from sensitive receptors. Reduce the length of haul roads to minimise surface area from which dust may be produced. Limit vehicle speeds to minimise dust.	Prior to construction
30	Dust generation during construction minimised.	Construction activities will be undertaken in a manner that limits dust emissions from the site including: ◗ Managing stockpiles to suppress dust emissions; ◗ Collecting dust from enclosed spaces; and ◗ Measures to wash vehicles and cover loads where there is the potential to generate dust, as practicable. ◗ Damp down earthworks during dry weather.	Prior to construction
Property and Land Use			
31	Minimise potential construction related damage to structures, properties and infrastructure.	Design measures and management procedures will be developed to prevent or suitably mitigate, damage to existing properties, structures and infrastructure for implementation during construction.	During design and construction.
32	Impact of construction activities on surrounding road network minimised.	Work practices will be developed to minimise construction traffic impacts on the surrounding road network and disruptions from works such as informing the local community and road users on changed conditions prior to commencement and scheduling disruptive works outside peak commuting times.	During design and construction.
33	Damage to the public road network during construction would be rectified.	Dilapidation surveys would be undertaken on sections of the public road network in the immediate vicinity of the work sites, in particular along Moulamein Road. Damage attributed to construction of the project would be rectified by the proponent.	Prior to, during, and post construction
Visual Impacts			
34	Construction work sites rehabilitated.	A program will be developed to minimise construction time and to progressively rehabilitate areas disturbed temporarily by construction as far as practicable to pre-work construction to mitigate visual impact.	During design and construction.
Traffic			

Number	Desired outcome	Commitment	Timing
35	Impact of construction activities on surrounding network minimised	Work practices will be developed as part of the CEMP to minimise construction traffic impacts on the surrounding road network and disruptions from works near road reserves, such as levees, be undertaken in consultation with road authorities for implementation during construction. The following will be carried out: ◗ Informing and consulting with the local community and road users on changed traffic conditions prior to construction commencing. ◗ Where practicable, scheduling any disruptive works to outside peak hours. ◗ Arrangements for parking and safe access to work areas. ◗ Methods to reduce temporary lane closures reduce delays and provide alternative access. ◗ Controlling traffic in accordance with RTA Traffic Control at Work Site and AS 1742.3 1996, Traffic Control Devices for Works on Roads.	Prior to construction and during construction
36	New intersections comply with RTA design requirements	Intersections of access roads with Moulamein Road will comply with RTA's design requirements.	Prior to construction
Communications			
37	The community has a high level of awareness of all processes and activities associated with the project, accurate and accessible information is provided, and there is a high level of responsiveness to community concerns	The community will be kept informed about the project in a timely manner. Key activities and tools will include: ◗ Development and implementation of a detailed Community and Stakeholder Involvement Plan for the construction phase of the project; ◗ Notification of any works that may alter or reduce access to the Forest or disturb nearby landowners and Forest users (such as noisy activities, works outside standard construction hours, and changed traffic conditions); ◗ 24-hour toll-free community information phone line; ◗ Complaints management process; ◗ Operation of the project Information Centre; ◗ Regular updates to the project website (www.kpforest.com.au); ◗ Regular community newsletters, information brochures and fact sheets; ◗ Signage at construction sites; ◗ Media releases and regular newspaper advertisements in local papers; ◗ Regular government agency meetings; and ◗ Regular briefings for key stakeholders (including councils and landowners).	Prior to and during construction

Number	Desired outcome	Commitment	Timing
38	Environmental impacts associated with borrow pits are minimised	Where practicable, borrow pits would be sited to: ◗ Preferentially utilise existing cleared areas; ◗ Minimise impacts associated with clearing; ◗ Avoid impacts on items of Aboriginal heritage significance where practicable; and ◗ Minimise the haulage distance between the borrow pit and levee alignment. Borrow pits would only be located on private property following consideration of the following aspects: ◗ Negotiations with landholders, including discussions to identify suitable locations, access arrangements, the final landform, rehabilitation requirements, ongoing management obligations, and commercial arrangements; ◗ Impacts on ecology. Further investigations would be undertaken on the potential site(s) to identify whether there are any ecological constraints. Specifically, the site would be selected to avoid impacts on the Inland Grey Box Woodland which is listed as an endangered ecological community; ◗ Impacts on items of Aboriginal significance. The potential site(s) would be inspected by representatives of Traditional Owners to identify whether there are any items of Aboriginal significance that would constrain its use for a borrow pit; ◗ Impacts on the floodway. DECCW's Floodplain Manager would be consulted to ensure that the borrow pit would not adversely affect operation of the floodplain; ◗ Visual impacts. Adverse visual and amenity impacts would be minimised, particularly for sites in close to proximity to main roads and residences; and ◗ Cost and time required for each option. The results of these investigations would be documented in a report prepared by the contractor to justify selection of the preferred borrow pit locations. This would involve a comparative evaluation of the in-Forest and private property borrow pit options. The report would be submitted to the NOW and Forests NSW who would endorse the option if it is considered to be consistent with the Minister's Conditions of Approval.	Prior to start of construction of individual borrow pits

6. Conclusion

NOW and Forests NSW has reviewed the submissions received on the Environmental Assessment that formed part of the application for project Approval for the Koondrook-Perricoota Forest Flood Enhancement project. The submissions sought clarifications of the project and the proponents commitment to the management of environmental issues throughout the delivery of the project. None of the submissions objected to the project proceeding.

This Submissions Report and Preferred Project Report addresses the issues raised in submissions and describes refinements that have been made to the project that is assessed in the Environmental Assessment. These refinements have been made based on additional information that has become available due to further investigations undertaken since completion of the Environmental Assessment. The refinements would not substantially alter the impacts detailed in the Environmental Assessment and potential impacts would be managed by implementation of the Statement of Commitments.

The Statement of Commitments has been reviewed and amended to address issues raised in submissions (where required) and ensure that potential environmental impacts are appropriately managed.

The project would be operated in accordance with an Operating Plan that would involve monitoring the ecological response so adaptive management principles. This operational flexibility is a critical requirement to enable the system to be refined to address ecological responses observed prior to, during, and following flood events. This would be based on the results of an extensive long-term monitoring program that would report on the effectiveness of the project in addressing the interim ecological objectives for the Icon Site. Operational flexibility is a critical requirement to allow the project to achieve the overall objective of the Gunbower – Koondrook – Perricoota Forest Icon Site Environmental Management Plan (MDBC, 2006) which is to 'maintain and restore a mosaic of healthy floodplain communities'. It would also achieve the interim ecological objectives for the Forest which are:

- 30% of River Red Gum forest in healthy condition;
- 80% of permanent and semi-permanent wetlands in healthy condition; and
- Successful breeding of thousands of colonial waterbirds in at least three years out of ten.

While the project is likely to result in adverse construction and operational impacts, on balance, it would lead to long-term environmental benefits that substantially contribute to the objectives and targets for the Living Murray Icon Site for communities of River Red Gum. The benefits of the project are considered to outweigh potential adverse impacts, particularly given that the Operating Plan would implement adaptive management principles that would seek to reduce environmental impacts and enhance benefits over time.

As a component of the Living Murray Initiative, the project has been developed as a mitigative strategy to respond to the long term effects of river regulation and improve the ecological health of the Forest. Based on this, the environmental impacts are considered to be justified.

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