5. Additional information and investigations

Concurrently with the exhibition of the Environmental Assessment, State Water have continued to progress the concept design of the three dam safety options and environmental improvements.

This has included a number of technical studies which were either ongoing at the time of exhibition or commenced in response to submissions received. Additionally, State Water have undertaken additional consultation with Government agencies and landholders. The results of these recent activities are presented in this section.

The additional information and studies include:

- Results of geotechnical investigations of the proposed spillway and saddle dam areas (Section 5.1.1).
- Revised capital cost estimates (Section 5.1.2).
- Details of the concept design, construction activities and construction program and the requirement for a license under the *Protection of the Environment Operations Act* (Section 5.1.3).
- Air quality assessment (Section 5.1.4).
- Noise and vibration assessment (Section 5.1.5).
- A methodology to guide the development of the proposed biodiversity offset (Section 5.1.6).
- Information on construction traffic movements and routes (Section 5.1.7).

A number of modifications have also been made to the project during this period including:

- Removal of the proposal to construct a fish passage at the dam wall on advice from the Department of Primary Industries (Fisheries) (Section 5.2.1).
- Commitment to construct the multi-level offtake as part of the Keepit Dam Upgrade environmental improvements (Section 5.2.2).
- Proposal to acquire approximately 16 hectares from a private landowner to enable construction of the subsidiary dam wall. (Section 5.2.3).
- Proposed change of approval from Concept Plan to Project Approval (Section 5.2.4).
- Resolution of the footprint of the Caravan Park saddle dam and impacts on existing structures (Section 5.2.5).

The results of these studies, additional information arising and project modifications have been discussed with key project stakeholders during preparation of this report. A summary of the post-exhibition consultation conducted is provided in Table 5-1.

Table 5-1 Summary of post-exhibition stakeholder consultation

Stakeholder	Meeting Date	Key focus of discussions
DoP	Face-to-face, 27 February 2008	Submissions report process, feedback from key stakeholders, approach to submissions report document.
DECC	Face-to-face, 4 March 2008	POEO licensing, details of additional noise and air quality studies required, details of additional information on biodiversity offset required.
DEWHA	Telephone, 3 April 2008	Details of additional information on biodiversity offset required.
DPI	Face-to-face, 18 April 2008	Feasibility of fish passage.
DECC and DEWHA	Letter, 14 May 2008	Draft methodology for preparation of biodiversity offset.
DEWHA	Email, 30 May 2008	Matters to be addressed by biodiversity offset method.
Affected landholders	Telephone, 4 & 5 June 2008 Issue of reports, 16 June 2008	Potential air quality and noise and vibration impacts during construction. Copies of air quality, noise and vibration reports for comment.
DoP	Telephone, 12 June 2008	Status of submissions report, concurrent of NSW and Commonwealth approvals process, program for delivery.
Owner of private land to be acquired	Telephone & email 4th and 13th June 2008	Proposal to acquire land and air, noise and vibration reports discussed and issued.
DECC	Email, 2 July and 29 August 2008	Comments on draft air and noise impact assessment reports.
DECC	Telephone, 17 September 2008	Responses to comments provided and results of revised modelling.
DoP	Telephone, 22 September 2008	Information on saddle dam impacts at the Caravan Park.

5.1 Additional information and studies

5.1.1 Results of geotechnical investigations

State Water commissioned geotechnical investigations at Keepit Dam in September 2007 to confirm foundation conditions at the locations of proposed infrastructure and specifically at, the right hand abutment spillway, boat ramp and sailing club saddle dams. The results of the investigations were not available at the time of exhibition of the Environmental Assessment.

The investigations confirmed the preliminary construction methodology outlined in the Environmental Assessment was appropriate for the right hand abutment. Rock conditions would initially be suitable for ripping by bulldozer but the majority of excavation would require drilling and blasting. Grouting will likely be required under a portion of the new spillway to reduce potential leakage from the dam.

At the boat ramp and sailing club locations, the investigations identified a horizon of shale mudstone underlying the potential new spillways for Options D2 and D3. This horizon is erodible and would be expected to deteriorate on exposure and during spillway flows, thus constraining the design of potential new spillways in these areas. The net effect, as reported in the subsequent section, is that the cost of these options would increase relative to the estimates in the exhibited Environmental Assessment.

In respect of Option B1 where saddle dams are proposed in these locations, the investigations confirmed the suitability of the area for saddle dams with foundations of between approximately 1-2 metres being required. Grouting would also be required to reduce the potential for leakage from the dam.

The report also confirmed that adequate supplies of dam core materials would be available from excavated materials at the site.

5.1.2 Revised capital cost estimates

As a result of the additional project information available, State Water have completed a review of the option capital cost estimates. While both estimates take account of the same elements, which include the cost of acquiring land and establishing the proposed biodiversity offset, the revised capital costs differ markedly primarily as a result of:

- the revised concept design required by specific geotechnical information provided
- the increased cost of materials and labour driven primarily by the current high demand for infrastructure.

The only additional cost item which is not significant relative to the above factors is the cost to acquire approximately 16 hectares of privately owned land for construction of Option B1 (refer Section 5.2.3).

The exhibited (March 2007) and revised (June 2008) capital costs for the dam safety options are provided in Table 5-2.

Table 5-2 Exhibited and revised capital cost estimates for dam safety options

Option	Exhibited Cost (March 2007) ($ million)	Cost relative to Option B1	Revised Cost* (June 2008) ($ million)	Revised Cost relative to Option B1
B1	75.0	-	116.2	-
D2	87.0	+12.0	140.6	+24.4
D3	89.0	+14.0	144.9	+28.7

Notes: 1. Not included are the costs of the environmental improvements. The cost of the multi level offtake is estimated at $5 million. Fish passage will proceed independently of the Keepit Dam Upgrade on advice from the Department of Fisheries (refer Section 5.2.1)

2. The scope of items costed is comparable between the exhibited and revised costs. Both the exhibited cost and revised costs take into account the need to provide a biodiversity offset for the project

*The revised cost estimate equates to an overall scheme budget – it takes into account recent geotechnical results and probability based estimating which considers potential variations to quantities and unit rates as well as providing for contingent items.

5.1.3 Concept design, construction activities and program

Concept design drawings have been developed and are provided in Appendix B. Additional information on the required construction activities and scheduling of works has also been prepared for the purposes of conducting the construction air and noise and vibration impact assessment studies. The preliminary construction program is also provided in Appendix B.

One submission requested State Water provide more information on the need to obtain a license for construction works under the *Protection of the Environment Operations Act*. Schedule 1 of the *Protection of the Environment Operations Act* identifies a range of activities requiring licensing.

The Environmental Assessment stated that a number of activities would be undertaken as part of the project which are considered to be 'scheduled activities' under the Act. The estimated quantities for these activities and threshold quantities under the Act are outlined in Table 5-3. Based on this information, it is likely that a POEO license will be required; however this will be confirmed as part of the detailed design and following engagement of a construction contractor.

Table 5-3 Scheduled activities to be undertaken as part of the Keepit Dam Upgrade

Activity	Scheduled Activity Threshold	Estimated quantity as part of project	Comment
(13) Concrete works including batching plants	30,000 tonnes per year	18,500 cubic metres (approx 45,000 tonnes) over three years	License will be required if more than two-thirds of the total volume of concrete is prepared in any year.
(16) Crushing, grinding or separating	>150 tonnes per day or 30,000 tonnes per year	670,000 cubic metres (approx. 1,400,000 tonnes) over three years	License will be required if more than 2% of the total volume is crushed in any year.
(19) Extractive activities	30,000 tonnes/ cubic metres per year for land or water-based activities respectively	670,000 cubic metres (approx. 1,400,000 tonnes) over three years	License will be required if more than 2% (land-based) or 4% (water-based) of the total volume is excavated in any year.

Note Specific gravity of rock and concrete assumed to be 2.1 and 2.4 tonnes per cubic metre respectively

5.1.4 Air quality assessment

An air quality assessment was conducted for Option B1 and the detailed report is provided in Appendix C. The following sections summarise the results of this study. In summary, compliance with all adopted air quality goals is expected to be achieved except for cumulative PM_{10} 24-hour dust levels at Receptor 1. It is understood that this landowner is not a full-time resident at the property and the conservatism within the model suggests it is possible that no exceedance would actually occur. State Water will however conduct monitoring at the property during construction to confirm the level of any impacts and have already commenced discussions with the landowner on the issue. No changes to operational emissions would occur as a result of the proposed upgrade.

Methodology

The air quality assessment was undertaken in accordance with the *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales* (DECC, 2005).

A computer air dispersion model using the ISCST3 modelling software package was undertaken to predict the impact of dust emissions from the proposed upgrade. Maximum predicted levels were modelled for PM10, TSP and dust deposition. Based on the draft construction program provided by State Water the following stages of construction were considered:

- Stage 1, with the main activities including simultaneous works on the subsidiary wall, right-hand abutment and saddle dams. Blasting at the right-hand abutment would take place during this stage.
- Stage 2, with the main activities comprising raising the main dam wall.

Stage 2 works are anticipated to follow completion of Stage 1.

Only Stage 1 construction works was modelled since this stage comprises the bulk of the construction works and the activities to be undertaken are more likely to result in dust generation and therefore potential impacts. Two scenarios were modelled:

- Scenario 1 - no blasting
- Scenario 2 - with blasting.

Table 5-4 below indicates the adopted sensitive receptors used in the model and distances from the closest work site.

Table 5-4 Adopted sensitive receptor locations

Receptor Number	Property Name	Vector	Approximate distance[1] (m)
1	1521 Bulga Road	west of main dam	1000
2	Illawong	south-west of main dam	1300
3	Mostyn Vale	west of subsidiary dam wall	2100
4	Residential Property A	south-east of subsidiary dam wall	600
5	Sorrento	north-east of main dam	3400

1From centre point of project site

A number of additional receivers are also located within the construction area and were considered in the assessment. These included:

- The Gums caravan park
- Lakeside caravan park
- Lake Keepit Sport and Recreational Centre
- Sailing club
- Golf course.

Predicted impacts

PM_{10} (annual)

Compliance with the adopted annual PM_{10} concentration goal of 30 µg/m^3 was predicted under all scenarios considered at each receptor assessed. The highest concentration was predicted at Receptor 1 (1521 Bulga Road) located approximately 1,000 metres west of the main dam wall during blasting activities, however no adverse PM_{10} impacts are anticipated.

PM_{10} (24-hour)

Compliance with the adopted air quality goal of 50 µg/m^3 is predicted at all modelled receptors with the exception of the cumulative 24-hour PM_{10} levels at Receptor 1 which was predicted at 55.4 µg/m^3. The second highest 24-hour PM_{10} cumulative concentration was predicted at 45.0ug/m3 and below the air quality goal. Therefore, concentrations exceeding the air quality goal were predicted to occur only once over the entire year i.e. less than 1% of the year. It is understood that the landowner is not a full-time resident at the property and that consultation is ongoing between State Water and the landowner over the prediction results as well as other property matters. In relation to the 40 week construction period and the other conservative modelling factors included in the model, it is not anticipated that dust impact predictions will occur. Nonetheless, monitoring and other mitigation and management measures will be implemented to reduce the potential for any impacts.

Within the Gums and Lakeside caravan parks, 24-hour PM_{10} impacts would be expected at an approximate cumulative level of 20 to 50 µg/m^3, and in general, adverse impacts are not expected at these receptors.

TSP (annual)

Compliance with the adopted annual TSP concentration goal of 90 µg/m^3 was predicted under all scenarios considered at each sensitive receptor assessed. No adverse annual incremental or cumulative TSP impacts are predicted.

Dust deposition (monthly)

Compliance with the adopted monthly deposition goals of 2 and 4 g/m^2/month was predicted under all scenarios considered at each sensitive receptor assessed.

$PM_{2.5}$ impacts

A qualitative assessment of anticipated fine ($PM_{2.5}$) particulate matter impact, based on expected constituent size fractions and source apportionment was carried out. Both the 24-hour and annual $PM_{2.5}$ level comply with the adopted air quality goals and therefore no impacts are predicted.

Mitigation measures

The implementation of effective management practices would minimise potential air quality impacts. The Construction Environmental Management Plan (CEMP) would include the following mitigation measures and safeguards:

Blasting impact management

To minimise the level of potential impact during blasting events, the following measures should be incorporated into the CEMP:

- fine material arising from drilling would not be used for blast stemming
- nearest potentially affected receptors would be notified prior to each blast event
- PM10 24-hour concentration would be monitored (TEOM) at Receptor 1 (refer below);, the duration of monitoring would be outlined in the CEMP and should be periodically reviewed
- the horizontal blast area and quantity of charge used would be minimised, where possible
- smaller mass charges i.e. less than 1250 kg may be required to limit the potential for structural damage at the main dam wall. The limiting vibration criteria and relevant mass charges should be determined by an appropriately qualified person
- meteorological monitoring should be conducted at the worksite for association with the monitoring results (refer below)

General dust and emission control measures

The implementation of effective mitigation and management practices would minimise the potential for adverse impact. The following mitigation measures and safeguards, which would be detailed in the project CEMP, would be implemented during the construction phase of the project:

- measures to minimise dust would be developed in consultation with/with agreement of relevant parties prior to commencement of construction
- a consultation plan with all potentially affected receivers would be put in place which would include discussion of the applied mitigation measures, monitoring and a complaints register for the duration of construction
- dampening with water would be applied to internal unsealed access roadways and work areas (application rates would be determined based on atmospheric conditions and the intensity of construction operations). At the joining of unsealed and sealed roads, the area would be swept routinely to remove deposited material that could generate dust. The application of a chemical stabilising agent to unsealed haul roads and stockpile areas may be required where water application rates prove insufficient or there is a limited supply of water. To reduce potable water consumption, recycled water should be used where practicable.

- site rehabilitation would be undertaken as soon as practicable
- disturbed areas would be stabilised immediately to prevent or minimise wind-blown dust
- on-site speed limits would be enforced for all construction vehicles at the site
- vehicle and machinery movements during construction would be restricted to designated areas
- rumble grids and/or wheel wash facilities may be provided at the site exit onto sealed roads to remove mud and dust from vehicles. Alternatively, roads would be swept to remove dirt and mud
- vehicles transporting spoil and materials with the potential to generate dust to and from the site would be covered immediately after loading to prevent wind blown dust emissions and spillages; tailgates of road transport trucks would be securely fixed prior to loading and immediately after unloading
- construction plant and equipment would be well maintained and regularly serviced so that vehicular emissions remain within relevant air quality guidelines and standards
- all site vehicles and machinery would be switched off or throttled down to a minimum when not in use.
- excess or unnecessary revving of engines should not be permitted
- all chemicals and fuels should be stored in sealed containers or sealed buildings
- unloading of diesel should be vented via return hoses that recirculate vapours from delivery to receiver.

Particulate matter monitoring

A monitoring program for dust deposition levels would be undertaken at specific locations (with reference to AS 3580.10.1-1991 Particulates – deposited matter – gravimetric method), and 24-hour concentration levels (with reference to *AS 3580.9.8-2001: Method for sampling and analysis of ambient air – Determination of suspended particulate matter – PM10 continuous direct mass method using a tapered element oscillating microbalance analyser, Homebush, NSW.* Meteorological conditions during dust monitoring should be measured to allow correlation of all reported results.

The requirements for particulate matter monitoring would be outlined within the site specific CEMP prepared for the Project.

Pre-construction baseline levels should be measured to establish the existing ambient air profiles and evaluate the effectiveness of the site-specific ameliorative measures.

Where unacceptable levels of air quality are measured, on-site activities may need to be reviewed, with additional control measures and/or varied site operations being required.

A meteorological station would be installed at a representative location during the construction phase period to monitor parameters such as wind speed, wind direction, and temperature as a minimum.

5.1.5 Noise and vibration assessment

A noise and vibration assessment was conducted for Option B1 and the detailed report is provided in Appendix C. The following sections summarise the results of this study. In summary, compliance with adopted noise goals is expected to be achieved except for subsidiary dam wall works at Residential Property A and main dam wall and cumulative noise impacts at 1521 Bulga Road. It is understood that the landowner at Residential Property A is not a full-time resident at the property. Discussions have also been held with the owner of 1521 Bulga Road who is keen to see the works commence. State Water would conduct monitoring at these and other sensitive receptor locations and intend to obtain agreement with these landholders regarding residual noise and vibration impacts prior to construction commencing. No changes to operational emissions would occur as a result of the proposed upgrade.

Methodology

Construction noise

Ambient noise measurements were undertaken using AS 1259 compliant meters and loggers. Measurements were undertaken at four locations considered representative of the existing noise environment and sensitive receptors (refer Table 5-4).

Noise criteria for construction works were established in accordance with Chapter 171 of the *Environmental Noise Control Manual* (ENCM) (NSW EPA, 1994). The background noise level for the purpose of assessment was adopted as 30 dB(A) L_{A90}, in accordance with Section 3.1.2 of the *NSW Industrial Noise Policy* (NSW EPA (INP) 2000).

A noise propagation model was established for the assessment of potential noise impacts at the nearest potentially affected receptors. Noise modelling was undertaken using the SoundPLAN computer noise propagation model software (Version 6.4).

Road traffic noise impacts were assessed in accordance with the *Environmental Criteria for Road Traffic Noise* (ECTRN) (NSW EPA, 1999). The recommended 'base' goals for land use developments with the potential to create additional traffic local roads are $L_{Aeq,\ 1hr}$ levels of 55 dB(A) during the day time.

Blasting

Guidance on blasting has been established adopting the *Australian and New Zealand Environment and Conservation Council (ANZECC) Guidelines Technical Basis for Guidelines to Minimise Annoyance due to Blasting Overpressure and Ground Vibration*.

The guidelines consider potential human annoyance and discomfort at residential and noise sensitive receptors as a result of blasting activities.

The recommended maximum noise level for airblast overpressure events is 115 dB (Lin peak).

The level of 115 dB may be exceeded on up to 5% of the total number of blasts over a period of 12 months. However, the level should not exceed 120 dB (Lin peak) at any time.

The recommended maximum level for ground vibration is 5 millimetres per second (mm/s), peak particle velocity (ppv). The peak particle velocity level of 5 mm/s may be exceeded on up to 5% of the total number of blasts over a period of 12 months. The level should not exceed 10 mm/s at any time.

A level of 2 mm/s (ppv) is recommended as a long-term regulatory goal.

Vibration

Vibration during construction and concrete batching activities is associated with two main types of impact: disturbance to residents from intermittent vibration, such as from heavy vehicle passage (human comfort); and potential architectural/structural damage to off-site buildings.

Human comfort and structural damage limits vary across the frequency spectrum, although they are generally a constant level across the frequency range generated by most construction activities. Generally, if human disturbance issues are controlled, there is limited potential for structural damage to buildings.

DECC *Environmental Noise Management Assessing Vibration: a technical guideline (2006)* provides recommendations for vibration goals from continuous, impulsive and intermittent sources. Construction works associated with the Project are potential sources of vibration, including the daytime movement of heavy vehicles, and operation of compactors and bulldozers. This type of vibration is assessed on the basis of vibration dose levels.

Structural damage

Although not specified by DECC, *German Standard DIN 4150: Part 3-1986* provides guidance on vibration velocity for evaluating potential structural damage. Limits range from 5 mm/s (less than 10 hertz (Hz)), 5-15 mm/s (10-50 Hz) and 15-20 mm/s (50-100 Hz) at the foundation of a residential dwelling. At the uppermost storey floor plane, a vibration limit of 15 mm/s is applicable for a residential dwelling.

The main dam wall is also a potentially sensitive receptor to vibration from blasting events. While no specific guidance was available, State Water has preliminarily adopted a maximum 50mm/s structural vibration limit for the existing dam wall. Applying the blasting vibration formula, a maximum effective charge mass of 1250kg is recommended to minimise potential for structural damage.

The limiting vibration criteria to be met at the dam wall should be checked by a competent person prior to blasting design and may require the approval of State Water and/or the NSW Dams Safety Committee.

Road traffic noise

The ECTRN (NSW EPA, 1999) recommends 'base' and 'allowance' goals. The recommended 'base' goals for land use developments with the potential to create additional traffic on local roads are daytime $L_{Aeq,\ 1hr}$ levels of 55 dB(A) and night-time $L_{Aeq,\ 1hr}$ levels of 50 dB(A).

The 'allowance' goals are generally established where the 'base' goals are already exceeded. In such circumstances, traffic arising from a development should not lead to an increase in existing noise levels of more than 2 dB. Adopting the allowance criteria is not considered appropriate for this Project based on the short duration of the increased road vehicle movements.

Predicted impacts

General construction works

Based on the draft construction program provided by State Water the following stages of construction were considered:

- Stage 1, with the main activities including simultaneous works on the subsidiary dam wall, right-hand abutment and saddle dams. Blasting at the right-hand abutment would take place during this stage.
- Stage 2, with the main activities comprising raising the main dam wall.

Stage 2 works are anticipated to follow completion of Stage 1.

Table 5-6 details the predicted range of construction noise received at the nearest potentially affected receptors.

Table 5-6 Construction noise impacts at sensitive receptors

	Construction phase (neutral met conditions)		
	Ground preparation noise impact $L_{Aeq, 15min}$	**Excavation noise impact $L_{Aeq, 15min}$**	**Infrastructure works noise impact $L_{Aeq, 15min}$**
Noise design criteria 35 $L_{Aeq, 15min}$			
Right hand abutment spillway	<10 – 32.5	<10 – 25.5	<10 – 31
Saddle dams	<10 – 31.5	<10 – 28	<10 – 26
Subsidiary dam wall	19.5 – 43	14 – 37.5	14 – 37.5
Main Dam Wall	N/A	N/A	15.5 – 35.5

Note: All noise levels in dB(A), to nearest 0.5 dB(A)
The noise level range indicates the predicted range at the sensitive receptors considered

The predictions indicate that the saddle dam and right hand abutment works would be compliant with the adopted noise criteria at the sensitive receptors considered. The subsidiary dam wall works would likely result in a worst case noise exceedance of 8-10 dB(A) at Residential Property A. Works for the main dam wall would result in a predicted exceedance of 0.5 dB(A) at 1521 Bulga Road.

Simultaneous construction work at the right hand abutment, saddle dams and subsidiary dam wall were also considered however, given the geographic separation of the worksites, the topography and the scattered and remote location of the sensitive receptors, received noise levels are likely to be dominated only by the nearest worksite.

Concrete batching plant and aggregate crusher noise

Predicted concrete batching plant and aggregate crusher noise impacts at the nearest identified receptors are detailed in Table 5-7.

Table 5-7 Predicted received noise impacts for concrete batching plant operations and aggregate crushing

Receptor	**Predicted received noise impact $L_{Aeq, 15min}$ neutral conditions**
Noise design goal 35 $L_{Aeq, 15min}$	
1521 Bulga Road	33
Illawong	<20
Mostyn Vale	<20
Residential Property A	<10
Sorrento	<10

Note: All noise levels in dB(A), to nearest 0.5 dB(A)

Predicted received noise impacts for the concrete batching plant and aggregate crusher were determined to be compliant with the adopted 35 dB(A) $L_{Aeq,\ 15min}$ noise design goal.

Clay borrow pit

Predicted received noise levels for the clay borrow pit excavation works are predicted to comply with the adopted 35 dB(A) $L_{Aeq,\ 15min}$ noise criteria at the identified sensitive receptors.

At the State Water offices, potential peak received noise levels up to 45 dB(A) $L_{Aeq,\ 15min}$ have been predicted, representing a potential 10 dB(A) exceedance of the adopted noise goal.

At the Caravan Park, potential peak received noise levels of 39.5 dB(A) $L_{Aeq,\ 15min}$ have been predicted, representing a potential 4.5 dB(A) exceedance of the adopted noise goal. Occupancy at the Caravan Park is seasonal and the works will be scheduled to avoid the peak tourist period.

Cumulative construction works, concrete batching and crushing noise impacts

General construction works are expected to occur simultaneously with concrete batching plant, aggregate crusher and clay borrow pit operations. The potential cumulative noise levels from these works were assessed to determine the total construction noise levels at sensitive receptors.

The following scenarios were investigated relevant to potential cumulative noise impacts, considerate of the geographic separation of the noise sources and sensitive receivers and the intervening topography:

- Scenario 1: Right hand abutment and batching plant and aggregate crushing (at 1521 Bulga Road)
- Scenario 2: Main dam wall and batching plant and aggregate crushing (at 1521 Bulga Road)
- Scenario 3: Saddle dams and clay borrow pit (at State Water offices and caravan park)

Potential noise from the concrete batching plant, crusher operations and clay borrow pit works would not be expected to additionally influence received dominant construction noise levels at all other receptors.

For scenario 1, cumulative received peak noise levels of up to 36 dB(A) are predicted to be 1 dB(A) in exceedance of the adopted 35 dB(A) $L_{Aeq,15min}$ noise goal.

For scenario 2, cumulative received peak noise level during the main dam wall works is 37.5 dB(A) $L_{Aeq,\ 15min}$ or 2.5 dB(A) in exceedance of the adopted noise goal.

For scenario 3, cumulative received peak noise levels at State Water offices of up to 51 dB(A) $L_{Aeq,\ 15min}$ and 41 dB(A) $L_{Aeq,\ 15min}$ at the nearest location at the Caravan Park have been predicted. Potential exceedance of the adopted noise goal by up to 6 dB(A) may occur at the Caravan Park. The works program would be scheduled to avoid the peak tourist season; and therefore undertaken when the Caravan Park is mostly unoccupied.

Reductions in received worst case noise levels predicted would occur where works are not undertaken concurrently, fewer plant are in cumulative operation, where batching and crusher operations are less intense and borrow pit works are undertaken within the pit.

Road Traffic Noise

Proposed construction traffic routes are shown in Figure 5-2. The nearest receptors to the haul routes are 1521 Bulga Road and Residential Property A.

Noise generated by heavy vehicle movements was predicted assuming two trucks passing each other at 50 kilometres per hour (1 truck loaded, 1 unloaded). The results indicate noise level emissions up to 53 dB(A) which are compliant with the adopted noise design criteria. Received noise levels at the caravan park would also be expected to comply.

Blasting

The nearest receptor to blasting at the right hand abutment is approximately 0.75 kilometres distant at 1521 Bulga Road. A mass charge per delay of less than 350 kilograms is recommended in order to achieve compliance with the impact from airblast overpressure (AS2187.2). A maximum mass charge per delay of less than 250 kilograms is recommended to achieve compliance at the State Water offices which are within 0.67 kilometres from the proposed blasting location.

Blasting vibration

The nearest receptor at 1521 Bulga Road is approximately 0.75 kilometres from the proposed blasting sites at the Right Hand Abutment. To achieve compliance with the 5 mm/s adopted vibration criteria, a charge mass of less than 635 kilograms is recommended. For the State Water offices, a maximum mass charge per delay of approximately 500 kilograms is recommended.

The relatively close location of the existing dam wall to the areas where blasting is required will likely govern the maximum acceptable level of ground vibration during blasting events. Water retaining structures such as dams are particularly sensitive to vibration and therefore require strict protection measures to ensure their integrity.

State Water has adopted a preliminary maximum 50mm structural vibration limit for the existing dam wall. Applying the blasting vibration formula, a maximum effective charge mass of 1250 kg is allowable, however the limiting vibration criteria to be met at the dam wall should be checked, with respect to the structural integrity of the dam, prior to blasting events and may require the approval of State Water and/or the NSW Dams Safety Committee.

Construction vibration

The main source of construction vibration would be the excavation works required at key construction locations. Received vibration levels are influenced by the specific construction equipment used, geological conditions and generated vibration frequency spectrum.

The nearest potentially affected receptors to construction locations are approximately 0.75 kilometres from the work sites. It considered that the separation distances between the construction sites and nearest potentially affected receptors are sufficient to limit the potential for any perceived vibration impacts.

Source vibration levels are not expected to result in received vibration levels in exceedance of the defined annoyance and structural limits.

Mitigation measures

General construction works

During the detailed planning and scheduling of construction works, the predicted noise impacts should be considered in establishing work site locations, construction techniques and on-site practices. It is recommended that construction plant and equipment noise source data is confirmed as part of detailed construction noise management planning and as part of the Noise and Vibration Management Sub-Plan and lower noise generating plant selected if possible.

The following principles and proactive noise management measures are recommended for implementation prior to the commencement of construction works:

- Construction noise management measures be formulated as part of the development of the Noise and Vibration Management Sub-Plan. Noise control options, including site mitigation (such as enclosures or screening) and the investigation of low noise plant to be detailed in the plan and direction provided for the delivery of best practice noise management on site.
- Construction works to adopt best management practice and best available technology economically achievable as outlined in current acoustic guidelines. Best management practice includes some of the factors discussed within this report, but also includes encouraging a general staff attitude to reducing noise emissions. Contractors should be made aware of the problems associated with noise. Best available technologies economically achievable involves incorporating the most advanced and affordable technology to minimise noise emissions. All plant should be selected considering noise emissions.
- Due to the elevation of the receptors nearest to the proposed construction sites, screening and fencing is unlikely to have a measureable effect on received construction noise levels.

- Information should be provided to potentially affected local residents prior to commencement of construction works. Construction methods and the duration and timing of events should be outlined. Often with short-term construction works, the provision of information to potentially affected residents reduces the propensity for enquiry and complaint.
- Temporary and permanent construction sites to display appropriate signage, including Project information and relevant contact details for public information and enquiry.
- Standard construction noise mitigation techniques should be applied, as a minimum, to include the following measures:
  - Any excessively loud activities to be scheduled to avoid early morning periods when the daytime noise environment is likely to be most sensitive. This would reduce the potential for cumulative noise levels (relating to worst-case elevated operations).
  - Residential class mufflers, and where applicable, engine shrouds (acoustic lining) to be used. All equipment to be maintained in good order, including mufflers, enclosures and bearings to ensure unnecessary noise emissions are eliminated.
  - Construction works to be restricted to between 7 am and 6 pm Monday to Friday, and between 8 am and 1 pm Saturdays, with no works on Sundays or Public Holidays.
  - Construction activities to be undertaken in accordance with AS 2436 1981 Guide to Noise Control on Construction, Maintenance and Demolition Sites. All equipment used on site would be required to demonstrate compliance with the noise levels recommended within AS 2436 1981.
  - Engines not to be started and on-site activities (including entry or departure from the site) for heavy vehicles not to be undertaken outside of the specified construction hours unless for approved activities or contingency events.
  - Appropriate use of all plant and equipment, with reasonable work practices applied, including no extended periods of ‘revving’, idling or ‘warming up’ in proximity to existing residential receivers.
  - A speed limit of 50 kilometres per hour is proposed for heavy vehicles operating on the haul roads.
  - Intensive works within the caravan park would be undertaken during the tourist ‘low season’ to minimise noise impact on users of the State Park.

- Minimising reversing alarm noise emissions from mobile plant and transport truck operations should be considered, provided occupational health and safety requirements are satisfied. The feasibility of installing reversing alarm systems such as smart alarms (ambient influenced) or broadband frequency alarms (reduced disturbance tone) should be investigated.
- Noise monitoring is recommended at locations within the Keepit Dam Reserve for the measurement of potential noise levels from construction and blasting. The provision of data will assist in the management and mitigation of potential noise levels and the programming of blasting events.
- The measurement of noise and vibration from blasting events should be undertaken adopting monitoring equipment and methodologies recommended in J3.2.1 of AS 2187.2.
- In the event of adverse community comment or complaint, the CEMP should outline procedures to determine the received level of noise level.

Concrete batching plant and aggregate crusher

Measures applicable during the design stage for best practice management of potential noise sources include:

The concrete batching plant design had not been confirmed at the time of this noise assessment. Adopting previous experience in concrete batching plant operations, predicted noise levels at the nearest affected receptors have been determined to comply with the adopted noise design criteria of 35 dB(A) $L_{Aeq, 15min}$ for neutral meteorological conditions.

Measures applicable during the design stage for management of noise sources include:

- undertaking equipment procurement with consideration of potential noise emissions, i.e. lower noise generating plant would be selected where feasible
- using stockpiles of aggregate and materials as screening for ground level noise sources between the concrete batching plant and nearest receptor locations
- enclosing or shrouding conveyor systems, in particular elevated sections
- minimising noise events through reducing drop heights from conveyors and loaders, and lining or enclosing conveyor back plates with absorptive material
- managing site entry and exit to limit the need for reversing
- regular maintenance would be undertaken on all plant and machinery used throughout the operation of the concrete batching plant
- minimising the number of valve release events and sourcing low noise valves.

Blasting noise and vibration

The following measures are recommended to manage noise and vibration received at the nearest potentially affected receptors to blasting locations:

- A maximum charge mass of 350 kilograms is recommended to achieve compliance with the airblast overpressure and vibration criteria at the nearest sensitive receptors.
- A maximum charge mass of 250 kilograms is recommended to achieve compliance with noise and vibration criteria at the State Water offices.
- A maximum charge mass of 1250 kilograms is allowable in relation to the limiting blasting vibration criteria of 50mm/s at the main dam wall. This criterion should be checked by a competent person prior to blasting commencing.
- Unconfined blasting should be avoided, where feasible.
- Blasting design should incorporate appropriate delays and accommodate alternative charge drilling patterns to reduce received impacts.
- Delaying blast events during noise enhancing wind conditions should be considered, wind speed and temperature inversion effects should be accounted for in potential received impacts.
- Blast faces should be orientated to, where feasible, not face directly towards receptor locations.
- Blasting face heights should be kept to a practical minimum.

Consultation with the community during construction

A community consultation plan would be implemented during construction and particularly with affected receptors. This would include a regular status update and forecast of upcoming works as well as more frequent communications, for example regarding upcoming blasting events. Consultation would also include discussion of the effect of potential criteria exceedances, the mitigation measures proposed to be implemented, monitoring results being achieved and any residual effects expected.

Predicted noise and vibration levels from construction activities were communicated to affected landowners by sending them a copy of the draft noise and vibration impact assessment report and telephone discussions on 4 and 5 June 2008. It is understood that the landowner of 1521 Bulga Road is keen to see construction commence. State Water are also in discussion with the owner of Residential Property A, who does not live full-time at the property, about the purchase of a portion of land. State Water intend to reach agreement with these parties regarding the residual noise and vibration levels prior to construction commencing.

5.1.6 Approach to biodiversity offset

Additional information and the principles to be used in the development of an offset for the biodiversity impacts of the project was requested by the relevant State and Commonwealth Government departments. A number of discussions were undertaken during preparation of the Submissions Report and a methodology developed in conjunction with these agencies. The following is a summary of the method proposed in a letter to the agencies dated 14 May 2008.

The NSW DECC BioBanking Assessment Tool will be used as a guide to the appropriate size of offset area required. The actual size and location of the offset site will depend upon a number of factors and will be the outcome of the study. The location of the offset will ideally be identified local to Keepit Dam and contain species characteristic of the communities being affected and in particular the box-gum woodland as defined under the State Threatened Species and Commonwealth Environment Protection and Biodiversity Conservation legislation. Both privately-owned lands and those in Government ownership will be investigated for potential use in the offset.

As well as the size and location of the offset site, the proposed long-term management practices will also be documented. The technical aspects of the study will be conducted by PB but the NSW DECC and Commonwealth Department of Environment, Heritage, Water and the Arts (DEWHA) will be involved at key stages of the study and particularly in the identification, shortlisting and selection of possible offset sites.

A preliminary assessment has been conducted of the area around Keepit Dam to identify potential offset areas containing the White Box Yellow Box Blakely's Red Gum Woodland Endangered Ecological Community. Figure 5-1 summarises the results of the preliminary assessment and indicates a total area of approximately 995 hectares of White Box Woodland has been identified with the majority (approximately 676 hectares) occurring on privately-owned land. Given that the project is required to offset 13.6 ha of woodland, State Water has confidence that given the extent of woodland identified in the vicinity, it is likely that a suitable offset could be found. The potential offset sites would be further investigated for suitability through field surveys and a more detailed process of assessment outlined below.

In order to determine the appropriate size of the offset area, the characteristics of the impact site and the proposed offset sites will be determined and compared. This will involve a combination of review of information collected during the Environmental Assessment, additional desktop assessment of vegetation zones and landscape values, further field evaluation of the site values (jointly with DECC and DEWHA) and the assessment of the threatened species values.

Field surveys of vegetation zones will be conducted to provide a quantitative measure of site attributes in each vegetation zone. Sufficient data will be collated to determine if the vegetation corresponds with the definition of the critically endangered Box Gum Woodland community listed under the *Environment Protection and Biodiversity Conservation Act 1999.* The landscape

values of the impact and proposed offset sites would be determined based on the draft BioBanking assessment methodology.

Threatened species will be assessed using data from the Threatened Species Profile Database and using the five criteria outlined in the draft *BioBanking Assessment Methodology*.

For the proposed impact and offset sites, ecosystem and species credits will be determined following the draft BioBanking Assessment Methodology. Based on the comparison of credits for the impact site versus the proposed offset sites, the ability of the project to improve or maintain ecosystem values will be determined. The shortlisted sites will also be reviewed against the draft offset policy of DEWHA, namely that the:

1. Environmental offsets should be targeted to the matter protected by the EPBC Act that is being impacted.
2. A flexible approach should be taken to the design and use of environmental offsets to achieve long-term and certain conservation outcomes which are cost effective for proponents.
3. Environmental offsets should deliver a real conservation outcome.
4. Environmental offsets should be developed as a package of actions - which may include both direct and indirect offsets.
5. Environmental offsets should, as a minimum, be commensurate with the magnitude of the impacts of the development and ideally deliver outcomes that are ‘like for like’.
6. Environmental offsets should be located within the same general area as the development activity.
7. Environmental offsets should be delivered in a timely manner and be long lasting.
8. Environmental offsets should be enforceable, monitored and audited.

The site specific information will also be reviewed to ensure that like-for-like is included, with particular attention paid to the definition of White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland.

A site meeting and inspection of the possible offset sites will be held with DEWHA, DECC and DoP to present the findings of the assessment and discuss the draft offset package. Management options for the various sites will also be discussed.

A report will be prepared detailing the methods used in determining the offset package and the proposed offset package itself.

A final report will be prepared following incorporation of comments from State Water and the relevant Government agencies.

Appropriate allowance has been made in the project capital cost estimate to implement the biodiversity offset.

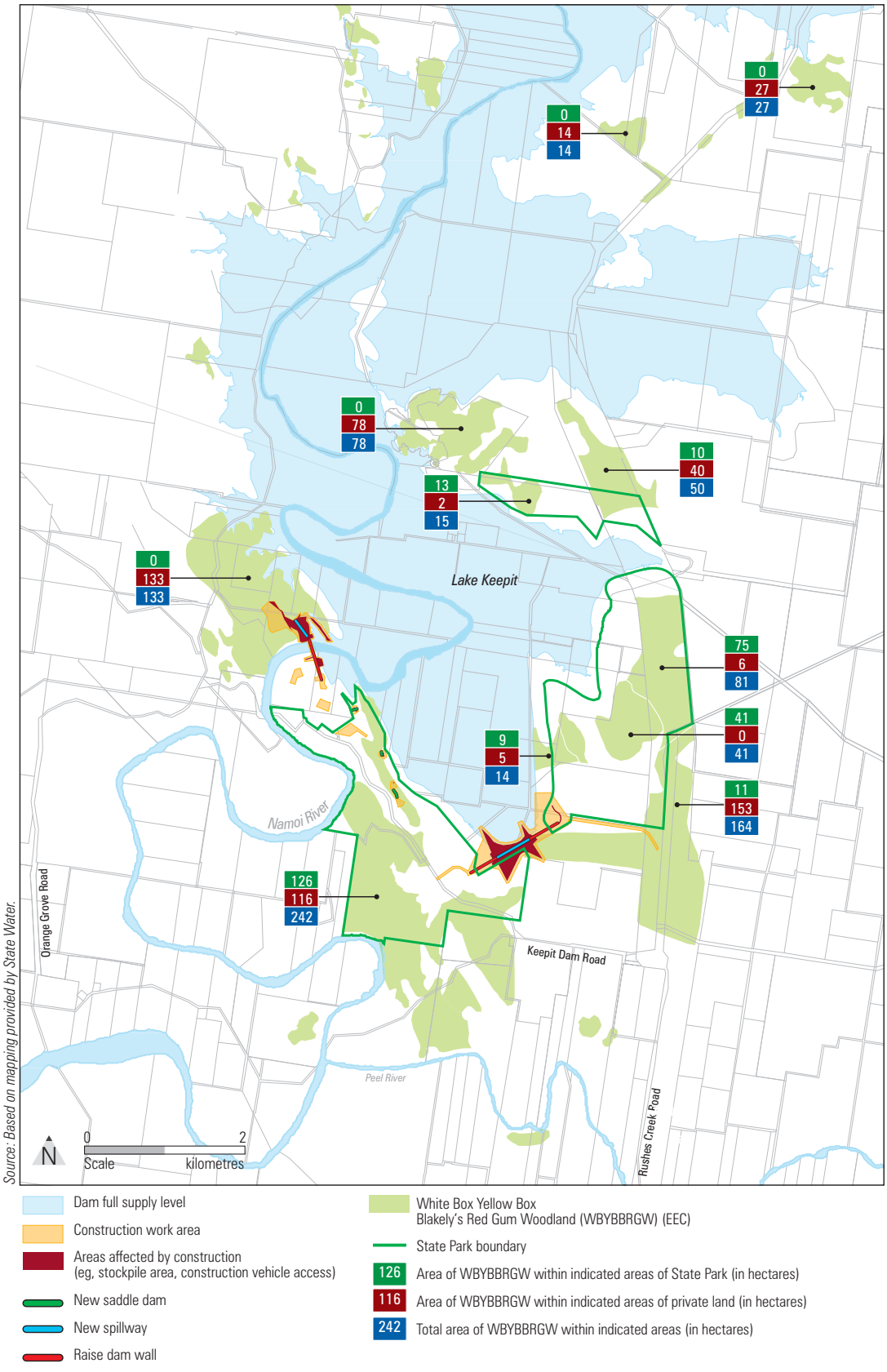

Figure 5-1 **Presence of White-Yellow Box Woodland in the Keepit Dam environs**