9 Environmental risk analysis

This chapter explains how environmental issues for the project were identified and evaluated through an environmental risk analysis process. It also provides a summary of the environmental risk analysis results. The environmental risk analysis covered bio-physical, social and economic risks.

Director General's requirements	Where addressed
Environmental Risk Analysis – notwithstanding the above key assessment requirements, the Environmental Assessment must include an environmental risk analysis to identify potential environmental impacts associated with the project (construction and operation), proposed mitigation measures and potentially significant residual environmental impacts after the application of proposed mitigation measures.	Section 9.1 and Section 9.2
Where additional key environmental impacts are identified through this environmental risk analysis, an appropriately detailed impact assessment of this additional key environmental impact must be included in the Environmental Assessment.	Section 9.2

9.1 Environmental risk analysis methodology

Before lodging the major project application for the proposed Glenugie upgrade, the RTA reviewed the outcomes of preliminary investigations undertaken during concept design development and identified those environmental issues anticipated to be of most importance. The outcomes of this process were documented in a preliminary environmental assessment report, which was submitted to the Director-General, NSW Department of Planning, with the major project application. The preliminary environmental assessment report helped the Director-General identify the key issues for the project and the associated requirements for this environmental assessment. The Director-General's requirements (DGRs) for this environmental assessment are presented in Appendix A. The key environmental issues identified in the DGRs are:

- Impacts on ecology.
- Impacts on channel structure – receiving environments.
- Operational traffic and transport implications.
- Operational noise impacts.
- Aboriginal cultural heritage.
- General construction impacts, including
  - Construction noise and vibration.
  - Construction traffic.
  - Erosion, sedimentation, water quality and riparian management issues.

As required by the DGRs, the process of environmental risk analysis continued

throughout the preparation of this environmental assessment, using the information obtained from detailed specialist studies and concept design refinement. This risk analysis:

- Examined the environmental issues associated with the project, including but not limited to the key issues identified in the DGRs.
- Examined the potential environmental impacts and proposed impact mitigation measures for each of the identified issues.
- Identified the nature and extent of environmental impacts that are likely to remain after the proposed impact mitigation measures are applied.

Based on the results of this analysis, an environmental risk category was assigned to each of the identified issues using a qualitative approach. The risk categories and corresponding criteria are presented in **Table 9-1**. The purpose of this qualitative risk analysis was to identify any additional key issues that might be associated with the project (in addition to those identified in the DGRs) and the corresponding requirements for environmental assessment. Any impacts designated to be risk category 'A' were deemed to be key issues. Key issues identified in the DGRs were automatically allocated risk category 'A'.

Table 9-1 Risk analysis categories and criteria

Risk category	Description
A	May have high or moderate impacts. Detailed assessment necessary to determine the level of potential impact and to develop appropriate measures to mitigate and manage the impacts.
B	May have high or moderate impacts. These can be mitigated by the application of standard environmental management measures.
C	Has low impacts. These can be managed by standard environmental management measures.

9.2 Environmental risk analysis results

A summary of the environmental risk analysis results is provided in **Table 9-2**. The results of the environmental risk analysis confirm that the DGRs included all key issues. No additional key issues were identified.

- **Table 9-2 Environmental risk analysis**

Issue	DGRs key issue?	Potential impacts	Analysis - Proposed impact mitigation measures and impacts remaining after their application	Risk category following analysis[2]	EA reference
Ecology	Yes	Impacts on State (TSC Act) and Nationally (EPBC Act) listed threatened species.	A Flora and Fauna Management Plan (FFMP) would be prepared for the project and would incorporate strategies to avoid, mitigate, offset and manage impacts. The FFMP would incorporate specific measures for threatened species, including the measures identified below for native vegetation and habitat impact.	A	Section 7.1
		Clearing of native vegetation communities.	The clearing area would be kept to the minimum area necessary for project construction. 'No-go areas' would be delineated with protective fencing. Pre-clearance surveys would be carried out to identify the presence of native fauna within the clearance zone and relocate fauna as required.	A	Section 7.1

[2] Issues falling within risk category 'A' are considered to be key issues. All DGRs key issues are designated category 'A'.

Issue	DGRs key issue?	Potential impacts	Analysis - Proposed impact mitigation measures and impacts remaining after their application	Risk category following analysis[2]	EA reference
		Impacts on terrestrial fauna habitat, including loss of habitat area and habitat connectivity.	A range of management measures would be implemented to prevent degradation and maximise habitat value of areas where vegetation is to be retained. Measures would include: • Restoration and revegetation strategies. • Weed management. • Ecological monitoring. A habitat compensation package would be negotiated with DECC for unavoidable impacts. Project design includes fauna crossing structures to facilitate movement of fauna across the road corridor.	A	
		Impacts on aquatic ecology, including aquatic and riparian habitat.	Measures to control the rate and direction of surface runoff from the new road would be incorporated into design. Temporary and permanent erosion and sediment control measures, including measures for stormwater management, would be implemented, as required. Measures to minimise the risks accidental spills of fuels and other chemicals entering waterways would be implemented during construction.	A	Section 7.1, Section 7.2 & Section 7.6.3
		Fauna road kills.	Project design includes fauna crossing structures to facilitate safe movement of fauna across the road corridor.	A	Section 7.1

Issue	DGRs key issue?	Potential impacts	Analysis - Proposed impact mitigation measures and impacts remaining after their application	Risk category following analysis[2]	EA reference
Channel structure – receiving environments	Yes	Soil and stream bank erosion caused by construction activities.	Erosion and sediment controls would be implemented during construction in accordance with 'Blue Book' guidelines. Effectiveness of erosion and sediment controls would be monitored during construction and improved as required. Erosion and sediment control requirements would be specified in an erosion and sediment control plan.	A	Section 7.2 & Section 7.6.3
		Scour of flow paths due to uncontrolled runoff from construction areas.	Measures to control rate and direction of runoff from construction areas would be implemented in accordance with 'Blue Book' guidelines. Temporary and/or permanent measures would be implemented, as required, to prevent scouring at culverts. Detailed design would include appropriate design of drainage entry points to prevent flow concentration and souring.	A	Section 7.2 & Section 7.6.3
		Intersection of dispersible soils causing accelerated erosion. Inappropriate management of dispersible soils causing piping and failure of drainage structures.	Dispersible soils would be identified and appropriate management methods implemented in the relevant areas.	A	Section 7.2 & Section 7.6.3

Issue	DGRs key issue?	Potential impacts	Analysis - Proposed impact mitigation measures and impacts remaining after their application	Risk category following analysis[2]	EA reference
		Potential to initiate head cutting upstream of highway in the event of poor or inappropriate construction methods. Potential to exacerbate existing head cuts in the event of poor or inappropriate construction methods.	The erosion and sediment control plan would include specific measures for management of works within and adjacent to waterways. Culverts would be protected as required with engineering measures such as rock armouring.	A	Section 7.2 & Section 7.6.3
		Creek scour downstream of culverts as a result of increased runoff from paved surfaces and increased storm intensity. Turbulence and scour on upstream sides of culverts as a result of increased runoff from paved surfaces and increased intensity of storms.	Detailed design would include appropriate surface drainage treatments and appropriate culvert design to prevent flow concentration and souring.	A	Section 7.2
		Upstream progressing head cuts upstream and downstream of highway in channel and on floodplain.	'Hard points' (barriers) to limit head cut movement would be installed if necessary. Performance monitoring of impact mitigation measures would be undertaken and appropriate improvements made as required.	A	Section 7.2
		Ongoing deposition of sediment in Glenugie Creek.	Measures for stormwater management, including flow energy dissipation between the highway and Glenugie Creek, would be incorporated into the detailed design.	A	Section 7.2
		Increased upstream flood afflux from increased head loss through extended culverts.	Hydraulic design is to be reviewed with appropriate changes made where necessary.	A	Section 7.2

Issue	DGRs key issue?	Potential impacts	Analysis - Proposed impact mitigation measures and impacts remaining after their application	Risk category following analysis[2]	EA reference
		Accelerated erosion due to climate change and subsequent failure of drainage structure/scour protection due to under-design.	Hydraulic design is to be reviewed with appropriate changes made where necessary using a precautionary approach to manage uncertainty.	A	Section 7.2
Operational traffic and transport implications	Yes	Impacts on access to local road networks, including impacts from traffic rerouting and modified access to the upgraded highway.	Access to properties and local road networks to the west of the proposed upgrade will be maintained by retaining the existing Pacific Highway as a local access and service road. For the full class M upgrade proposal, grade-separated access will be provided to the upgraded highway section just south of Eight Mile Lane. For the initial staging option, access to/from Franklins Road will be maintained by constructing a new at-grade intersection at its junction with the new south bound carriageways.	A	Section 7.3
		Impacts on access to State Forest service roads, including impacts from traffic rerouting and modified access to the upgraded highway.	Access to Lookout Road within Glenugie State Forest will be provided for by construction of a new service road from Eight Mile Lane.	A	Section 7.3

Issue	DGRs key issue?	Potential impacts	Analysis - Proposed impact mitigation measures and impacts remaining after their application	Risk category following analysis[2]	EA reference
		Impacts on operational road safety	The project would improve road safety for users of the Pacific Highway. No impact mitigation measures required. For the full class M upgrade proposal, local traffic movement would be safer as it would be separated from highway traffic. There would be a reduction in traffic volumes and heavy vehicles on the local road network. The concept design was refined to incorporate an emergency vehicle access facility.	A	Section 7.3
					Section 7.3
Operational noise	Yes	Operational noise may be greater than that predicted with the result that additional noise treatments may need to be applied.	Predicted operational noise levels and associated impacts would be confirmed 12 months after completion of construction.	A	Section 7.4
Aboriginal cultural heritage	Yes	Any undetected Aboriginal objects and sites that may be present within the project footprint have the potential to be directly impacted by construction.	Protocols defining actions to be taken if Aboriginal objects or suspected remains are encountered during construction would be implemented. In the event that previously unrecorded Aboriginal objects are encountered during construction, protocol defined actions are likely to involve recovery of any significant archaeological material prior to recommencement of construction and consequential destruction of the site.	A	Section 7.5
		Proposed upgrade corridor may be subject to a Native Title claim.	Due process to be applied.	A	Section 7.5

Issue	DGRs key issue?	Potential impacts	Analysis - Proposed impact mitigation measures and impacts remaining after their application	Risk category following analysis[2]	EA reference
Construction impacts: Construction noise	Yes	Sensitive receivers in the vicinity of the upgrade may be impacted by construction noise.	Potentially affected sensitive receivers are to be given adequate prior notice of the construction program, kept informed throughout the construction period, and provided with a name and contact number for construction noise information and complaints. A specific notification procedure would be developed for any blasting activities. Any noise complaints will be dealt with through a standard complaints management procedure identified in the community consultation plan. Construction would be confined to approved construction hours. Construction noise and vibration would be minimised as far as practical through the implementation of all feasible and reasonable measures. Construction staff training would cover noise mitigation techniques. Monitoring would be carried out at sensitive receiver locations to assess the need for additional impact mitigation measures. Where potential or actual exceedences of noise goals are identified, additional feasible and reasonable best practice noise management measures will be considered and investigated.	A	Section 7.6.1

Issue	DGRs key issue?	Potential impacts	Analysis - Proposed impact mitigation measures and impacts remaining after their application	Risk category following analysis[2]	EA reference
Construction impacts: Construction traffic	Yes	Temporary impacts on local traffic movement as a result of construction traffic (including spoil haulage).	Movement of construction vehicles and plant would be managed with a construction traffic management plan to minimise impacts on local traffic.	A	Section 7.6.2
		Temporary disruptions to traffic movements along the existing Pacific Highway due to construction activities.	The impacts of construction activities on road users would be managed through a construction traffic management plan.	A	Section 7.6.2
		Impacts on local roads caused by movement of heavy construction vehicles, plant and machinery.	Heavy vehicle access to local roads would be controlled through the construction traffic management plan. Impacts on local roads would be assessed after completion of construction.	A	Section 7.6.2
		Disruption to cyclist/ pedestrian movements through the study area.	Pedestrian and cycle facilities would be incorporated into the detailed design where required. The conversion of the existing highway to a local access road would provide an improved north-south route for cyclists and pedestrians.	A	Section 7.6.2
		Impacts on road safety due to construction activities.	Road safety issues during construction would be managed through the construction traffic management plan. The plan would incorporate measures such as signage, barriers and reduced speed limits.	A	Section 7.6.2

Issue	DGRs key issue?	Potential impacts	Analysis - Proposed impact mitigation measures and impacts remaining after their application	Risk category following analysis[2]	EA reference
Construction impacts: Soil, water and riparian management issues	Yes	Constructability issues associated with existing subsurface material.	Geotechnical investigations have been undertaken to inform the concept design. The project is likely to result in surplus material that requires stockpiling.	A	Section 7.6.3
		Erosion of soil from construction areas and potential for subsequent sedimentation of waterways.	Standard erosion and sedimentation controls as per the 'Blue Book' guidelines would be incorporated into detailed design. Culverts would be designed to reduce potential for downstream scour. Scour protection would be provided as required at culvert outlets and at the intersection of swales and creeks. Scour protection measures would be designed to prevent upstream migration of head cuts and undercutting. Effectiveness of erosion and sediment controls and drainage design would be monitored and improved as required.	A	Section 7.6.3
		Erodibility and instability of cutting slopes.	Cutting slopes have generally been conservatively designed at 2:1 slope to minimise erosion risks. If necessary, additional measures such as flattening of batters or slope treatments would be applied.	A	Section 7.6.3

Issue	DGRs key issue?	Potential impacts	Analysis - Proposed impact mitigation measures and impacts remaining after their application	Risk category following analysis[2]	EA reference
Non-Aboriginal heritage	No	Direct construction impacts on a remnant 250 m section of a 1915 branch rail line easement that has moderate heritage significance within a local context.	Archival recording of the branch line remnant would be conducted before ground disturbance. This recording will reduce the loss of heritage values that would otherwise result from the destruction of the 250 m section.	B	Section 8.1
		Direct construction impacts on any undetected non-Aboriginal sites and/or relics that may present within the construction footprint.	Protocols defining actions to be taken if non-Aboriginal relics or suspected remains are encountered are encountered during construction would be implemented. In the event that relics are encountered within the upgrade, protocol defined actions are likely to involve recovery of any significant archaeological material prior to recommencement of construction activity and consequential destruction of the site.	C	Section 8.1
Land use and socio-economic impacts	No	Loss of 85 ha of State/ National Forest land).	Land swap to be negotiated with Forests NSW.	C	Section 8.2
Green house gases and climate change	No	Green house gas emissions during construction.	Standard procedures would be applied to minimise construction emissions.	C	Section 8.3
		Reduction in green house gas emissions during operation.	No impact mitigation measures required.	C	Section 8.3
Landscape and visual impacts	No	Potential visual impacts on areas adjacent to road corridor.	Disturbed areas will be revegetated following construction.	C	Section 8.4

Issue	DGRs key issue?	Potential impacts	Analysis - Proposed impact mitigation measures and impacts remaining after their application	Risk category following analysis[2]	EA reference
Air quality	No	Potential air quality impacts on areas adjacent to road corridor	Dust management measures will be used during construction.	C	Section 8.5
Hazards and risks	No	Potential spills during construction	Bunds will be used to contain hazardous liquids and materials. Construction sedimentation basins will contain spills.	C	Section 8.6
		Safety issues during construction	OH&S to be managed in accordance with legislative requirements.	C	Section 8.6
		Potential spills during operation	Permanent water quality basins will contain spills.	C	Section 8.6
Waste management	No	Production of waste not avoided where possible. Suitable waste not reused or recycled.	Waste management would be in accordance with the waste hierarchy, avoid, reuse, recycle.	C	Section 8.7