9 Environmental Risk Assessment

This chapter reports on the environmental risk assessment conducted for the Project. The principal objective of the assessment is to categorise aspects into key and other issues, and to guide the focus of the assessment. The assessment considers risk separately for construction and operation. This approach has been taken to reflect that while a number of environmental aspects (eg noise, air quality) are relevant to both construction and operation, the associated level of risk may not necessarily be the same for both stages, and indeed may change over time. The risk assessment also forms the basis for the analysis of residual impacts following implementation of mitigation and management measures, and which is reported on in Chapter 18.

9.1 Introduction

Risk is generally defined in terms of the probability or likelihood of something occurring that will have a negative impact on the outcome of a given activity (Wild River and Healy 2006, Standards Australia 2004). As such, the environmental risk assessment is considered an integral process in managing and mitigating potential environmental impacts for this Project.

This chapter describes the environmental risk assessment undertaken during the development and environmental assessment phases, consistent with the requirements of the EAR. This assessment was undertaken to effectively separate key and other environmental issues as well as to analyse the residual risk once management and mitigation measures have been taken into consideration.

This risk assessment only deals with environmental aspects. Risks associated with technical issues such as dam safety and geological issues have been dealt with separately through the engineering design process. Similarly, risks associated with occupational health and safety

would be dealt with through the design process and the implementation of appropriate management controls during the construction and operation phases. Notwithstanding this, there are a number of risks that interrelate such as the storage of fuels, whereby managing the occupational health and safety risks would also assist in managing the environmental risk.

Having a clear understanding of the environmental risks associated with the Project has allowed HWC to progressively make informed decisions regarding the implementation of appropriate management and mitigation measures.

9.2 Risk assessment methodology

The overall structure of the risk assessment methodology is consistent with *AS/NZS 4360:2004 Risk Management*. The Standard provides guidance to enable:

- a more confident and rigorous basis for decision-making and planning
- better identification of opportunities and threats
- gaining value from uncertainty and variability
- proactive rather than reactive management
- more effective allocation and use of resources
- improved incident management and reduction in loss and the cost of risk
- improved stakeholder confidence and trust
- improved compliance with relevant legislation
- better corporate governance.

The main elements of the risk assessment process included:

- consultation with key stakeholders
- establishing the context
- identifying the risks
- analysing the risks
- evaluating the risks
- developing management and mitigation measures to treat the risk.

9.2.1 Consultation with key stakeholders

An environmental risk workshop was held in August 2007 at the commencement of the environmental assessment phase of the Project. This was attended by representatives from HWC and Connell Wagner's project management teams and technical specialists.

The consideration of environmental risk issues for the Project has been comprehensive, spanning diverse biophysical aspects as well as community, social and economic risk matters. The risk assessment completed for the Project was also able to draw on considerable input from a variety of sources including specialist consultants, the community as well as key government stakeholders to identify Project impacts, and to develop appropriate strategies to minimise and manage these for each stage of the development.

9.2.2 Identification of environmental risks

The following technical investigations were carried out to identify environmental risks:

- planning and land use
- water quality and hydrology
- fluvial geomorphology
- aquatic ecology
- terrestrial ecology
- environmental flows and river management
- aboriginal heritage
- contemporary heritage
- socioeconomic analysis
- road and public infrastructure dilapidation
- air quality
- noise and vibration
- sustainable resource use
- landscape and visual amenity
- contamination
- cumulative impacts.

The results of these specialist technical studies as well as consultation undertaken with key stakeholders contributed to the identification of environmental risks and impacts for the Project.

9.2.3 Environmental risk assessment

The environmental risk assessment involved consideration of potential and likely sources of risk associated with an event, the consequences of the event should it occur and the likelihood of occurrence of the event. In undertaking the assessment the consequences related to the outcome of an event, whereas likelihood related to the probability or frequency of the event occurring (Standards Australia 2004). Using the matrix in Figure 9.1 and Tables 9.1 and 9.2, the level of environmental risk was determined for each risk from an analysis of the likelihood and consequence of each risk occurring.

LIKELIHOOD	A	B	C	D	E
CONSEQUENCE					
1	1	2	4	7	11
2	3	5	8	12	16
3	6	9	13	17	20
4	10	14	18	21	23
5	15	19	22	24	25

FIGURE 9.1 MATRIX USED TO DETERMINE THE LEVEL OF ENVIRONMENTAL RISK

The colour coding in the above matrix is arbitrary but is used to amalgamate levels of risk into the following three broad classifications:

Major (red) Moderate (tan) Minor (lime)

TABLE 9.1 LIKELIHOOD OF OCCURRENCE FOR RISK

LIKELIHOOD RANK	DESCRIPTOR	DESCRIPTION
A	Almost certain	Expected to occur in most circumstances
B	Likely	Will probably occur in most circumstances
C	Possible	Could possibly occur at some time
D	Unlikely	Could possibly occur at some time but is unlikely
E	Rare	May occur in exceptional circumstances

TABLE 9.2 CONSEQUENCE OF RISK

CONSEQUENCE	DESCRIPTOR	DESCRIPTION
1	Catastrophic	Major irreversible impact on environment
2	Major	Major impact, long term (>5 years), potentially irreversible
3	Moderate	Moderate impact, medium term (6-24 months) likely reversible
4	Minor	Minor impact, localised, reversible (<6 months)
5	Insignificant	Negligible impact, localised

A summary of the principal environmental risks for the Project is provided in Table 9.3. It should be noted that this is not exhaustive. Other risks are considered in discussion of individual environmental aspects.

TABLE 9.3 PRINCIPAL ENVIRONMENTAL RISKS FROM CONSTRUCTION AND OPERATION OF TILLEGRA DAM

ENVIRONMENTAL ASPECT	ENVIRONMENTAL ISSUE	POTENTIAL IMPACT	LIKLIHOOD	CONSEQUENCE	RISK	COMMENT
Air quality	Dust generation from construction activities	Reduced air quality at nearby residences	Likely	Minor	Moderate	Could be readily managed with dust mitigation measures
Aquatic ecology	Changes in hydrology upstream of dam through inundation	Loss of existing habitat	Almost certain	Moderate	Moderate	Different habitat expected to establish around storage shoreline over time
	Reduction in frequency and volume of flows downstream of dam	Loss of existing habitat	Almost certain	Major	Major	Operation would include environmental flow releases. Bulk water transfers would approximate the existing flow regime as closely as possible to mimic natural flows
	Possible differences in storage water quality and downstream water quality	Detrimental effects on aquatic fauna from differences in water quality	Possible	Major	Moderate	Design includes multi-level offtake tower to maximise operational flexibility with regard to matching receiving water quality
Climate change and GHG emissions	GHG emissions from construction activities	GHG releases to atmosphere	Almost certain	Minor	Moderate	Project includes development of carbon neutral strategy to address construction phase emissions
	Inundation of 2,100 ha of vegetation	GHG emissions from decaying vegetation	Almost certain	Major	Major	Would be offset principally by establishment of habitat corridor and undertaking other plantings
Environmental flows and river management	Reduction in flows through creation of barrier	Changes in downstream water quality, flow regime, aquatic habitat, and channel morphology	Almost certain	Major	Major	Development of bulk water transfer strategy to approximate existing flow regime
Fluvial geomorphology	Disruption of sediment supply to Williams River downstream of dam	Erosion of channel and banks, particularly immediately downstream of dam	Almost certain	Major	Major	Further analysis of the matter required during development of the EIA process
Contemporary heritage	Presence of items of local and State heritage significance	Damage to items from construction activities or from inundation	Likely	Major	Major	Further analysis of the matter required during development of the EIA process

ENVIRONMENTAL ASPECT	ENVIRONMENTAL ISSUE	POTENTIAL IMPACT	LIKLIHOOD	CONSEQUENCE	RISK	COMMENT
Aboriginal heritage	Presence of Aboriginal heritage items	Damage to items from construction activities or from inundation	Possible	Major	Major	Further analysis of the matter required during development of the EIA process
Landscape and visual amenity	Introduction of new built elements into the landscape	Reduced visual amenity at residences near dam and spillway	Possible	Major	Major	Further analysis of the matter required during development of the EIA process
	Introduction of major water body into the landscape	Change to rural character but not necessarily a negative impact	Almost certain	Moderate	Moderate	Presence of lake would present opportunities for recreation and tourism
Noise and vibration	Noise and vibration generation from construction activities	Increased noise and vibration at nearby residences	Likely	Moderate	Medium	Develop a construction noise and vibration management plan
Roads and infrastructure	Use of public roads by construction vehicles	Damage to road pavements private access	Possible	Moderate	Medium	Develop a better understanding of construction traffic volumes and consider the implementation of appropriate traffic management measures
	Property access	Loss of existing access to properties	Possible	Minor	Minor	Would be managed through provision of alternate temporary or permanent access
		Severance of existing routes	Almost certain	Minor	Minor	Principally related to severance of Salisbury Road. Alternative access would be provided as noted above
	RFS station lies within inundation area	Loss of rural firefighting capability	Almost certain	Minor	Minor	Alternative location identified for RFS station
	Telecommunication and electricity services traverse inundation area	Disruption of services to local residents	Almost certain	Minor	Minor	Services would be relocated in consultation with relevant service provider
Socioeconomic	Change in land use (agricultural to water supply)	Loss of agricultural land and associated economic activities	Almost certain	Major	Major	Work to promote maximum benefits of land use change opportunities through promotion of integrated

ENVIRONMENTAL ASPECT	ENVIRONMENTAL ISSUE	POTENTIAL IMPACT	LIKLIHOOD	CONSEQUENCE	RISK	COMMENT
						land use plan. Work with Council to encourage review of planning strategies to take advantage of new socioeconomic opportunities
	Inundation of Munni/Quart Pot Cemetery	Area occupied by cemetery would be underwater for majority of time	Almost certain	Major	Major	Alternative location identified for new cemetery which could also accommodate existing burials
	Presence of construction work force	Potential demand on local services	Almost certain	Moderate	Moderate	Positive impacts also likely through use of local businesses, etc.
Terrestrial ecology	Inundation of terrestrial ecosystems	Loss of habitat	Almost certain	Major	Major	Project includes establishment of habitat corridors to provide connectivity from Williams River to Barrington Tops and Mount Butterwicki areas
		Impact on threatened species and endangered ecological communities	Possible	Major	Moderate	As above
Water quality and hydrology	Pollutants entering water during construction	Change in water quality during construction	Possible	Moderate	Moderate	Would be managed through installation of appropriate erosion and sediment controls
	Permanent change in downstream hydrological regime	Changes in downstream water quality, flow regime, aquatic habitat, and channel morphology	Almost certain	Major	Major	Effect will lessen as distance downstream increases. Risk mitigated through release of dedicated environmental flows from the dam
	Stratification of storage	Alteration of downstream water quality and consequent impacts on aquatic fauna	Possible	Major	Moderate	Design includes multi-level offtake tower to maximise operational flexibility with regard to matching receiving water quality

9.3 Summary of key and other issues

9.3.1 Key issues

On the basis of the risk assessment undertaken, the following were identified as key issues for the environmental assessment for the Tillegra Dam project:

Water quality and hydrology

- change in existing hydrological regime through creation of a barrier across the Williams River
- stratification of storage and potential downstream impacts from differences in storage and receiving water quality
- potential for construction activities to affect downstream water quality through erosion and sedimentation, fuel and chemical spills, etc.

Fluvial geomorphology

- potential changes in channel morphology due to reduction in volume of sediment delivered to Williams River from catchment upstream of dam
- similar changes due to alteration of existing hydrological regime.

Aquatic ecology

- Altered aquatic habitat in inundation area
- change in existing flow regime and consequent downstream impacts on aquatic habitat, particularly between the dam and the Chichester River confluence
- changes in hydrology during and following inundation has the potential to affect the existing aquatic ecology and alter ecosystem processes downstream of the dam.

Environmental flows and river management

- need for development of holistic management strategy that equitably balances sustainable outcomes for water quality and hydrology, fluvial geomorphology, and aquatic ecology.

Terrestrial ecology

- construction would require removal of vegetation from the Tillegra Travelling Stock Route (impacted directly by spillway)
- loss of terrestrial ecosystems currently located within the inundation area.
- potential impacts on threatened species and endangered ecological communities.

Socioeconomic issues

- conversion of more than 2,100 hectares of land from agricultural/rural land use to water supply (and, to a lesser degree, transport)
- presence of construction workforce could temporarily place demands on local services but could also support local economy
- opportunities for recreation and tourism through presence of new waterbody.

Contemporary heritage

- damage or loss of items and/or places of contemporary heritage significance through inundation or from construction activities.

Aboriginal heritage

- damage or loss of items and/or places of Aboriginal heritage significance through inundation or from construction activities.

Landscape and visual amenity

- significant changes to the landscape through the introduction of significant new elements (dam wall and spillway, waterbody) with potential for reduced visual amenity at residences near the dam wall.

Key issues are assessed in detail in Part D (Chapters 10 to 15 inclusive). A review of the environmental risks was undertaken following assessment of the impacts for these issues and the outcomes of this are detailed in Chapter 18 *Analysis of Residual Environmental Risks*. This re-evaluates the anticipated level of risk expected to remain following the implementation of the identified mitigation measures and management strategies.

9.3.2 Other issues

The following issues while still of direct relevance to the assessment, were identified as being relatively less significant in terms of the anticipated level of impact.

Air quality

- dust generated from construction activities has potential to reduce air quality at nearby residences.

Climate change and GHG emissions

- GHG emissions would be associated with both construction and operation of the dam.

Noise and vibration

- both construction and operation activities have the potential to affect amenity at nearby residences, mainly in relation to the dam.

Roads and infrastructure

- construction activities have potential to further impact on existing road pavement conditions
- construction traffic has potential to worsen existing road safety issues
- construction activities have potential to affect access, both along existing transport routes (notably Salisbury Road) and to individual properties.

While these are not considered likely to represent significant impacts, it would still be necessary to implement appropriate management controls and impact mitigation measures to reduce them to the lowest practicable level.

These have also been considered in the analysis of residual environmental risk (refer Chapter 18).