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Gold Coast City Council

Hinze Dam Stage 3

Initial Advice Statement

August 2006



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

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1. Introduction

1.1 Scope of Report

This Initial Advice Statement (IAS) was prepared for the Gold Coast City Council (GCCC) (referred to as Council) for the purposes of identifying the environmental issues and approvals to be addressed for the proposed Stage 3 augmentation of Hinze Dam (HDS3). This IAS is intended to scope the potential impacts that will be investigated in detail prior to the project being granted appropriate approvals. It is proposed that an Environmental Impact Statement (EIS) and Environmental Management Plan (EMP) be prepared as part of the approvals process. Terms of Reference (ToR) for the EIS will be developed based on the outcomes of this report and the requirements of relevant government agencies.

Gold Coast City Council is the proponent for the HDS3 project.

1.2 Project Scope

The HDS3 project will provide greater flood mitigation capacity to properties downstream on the Nerang River, improve the yield and reliability of the dam for water supply and make the dam compliant with current dam safety design guidelines and standards. Based on the above requirements and preliminary investigations undertaken to date, the height of the main dam embankment crest is planned to increase from 93.5 m AHD to 106 m AHD[1]. The rise consists of:

- dam safety requirements based on Bureau of Meteorology methodology for estimating Peak Mean Flow (PMF) events;
- flood mitigation purposes (Q100 flood events); and
- additional water storage capacity[2].

1.3 Location

Hinze Dam is located approximately 15 km southwest of Nerang on the Nerang River. The impoundment area behind Hinze Dam is known as Advancetown Lake and forms two distinct arms extending upstream along the main contributing waterways of Nerang River and Little Nerang Creek. Advancetown Lake is bordered by the Tallai Range to the east, Nerang-Murwillumbah Road to the west and Gold Coast-Springbrook Road to the south (refer to Figure 1-1 and Figure 1-2). Hinze Dam has a catchment area of 207 km^2 and includes the Numinbah Valley along the Nerang River and the Springbrook Plateau at the top of Little Nerang Creek. The catchment of Hinze Dam catchment includes a number of State Forests and National Parks.

[1] AHD – Australian Height Datum

[2] The capacity for additional water supply to be accommodated in the detailed design will be determined subject to a dam optimisation study.

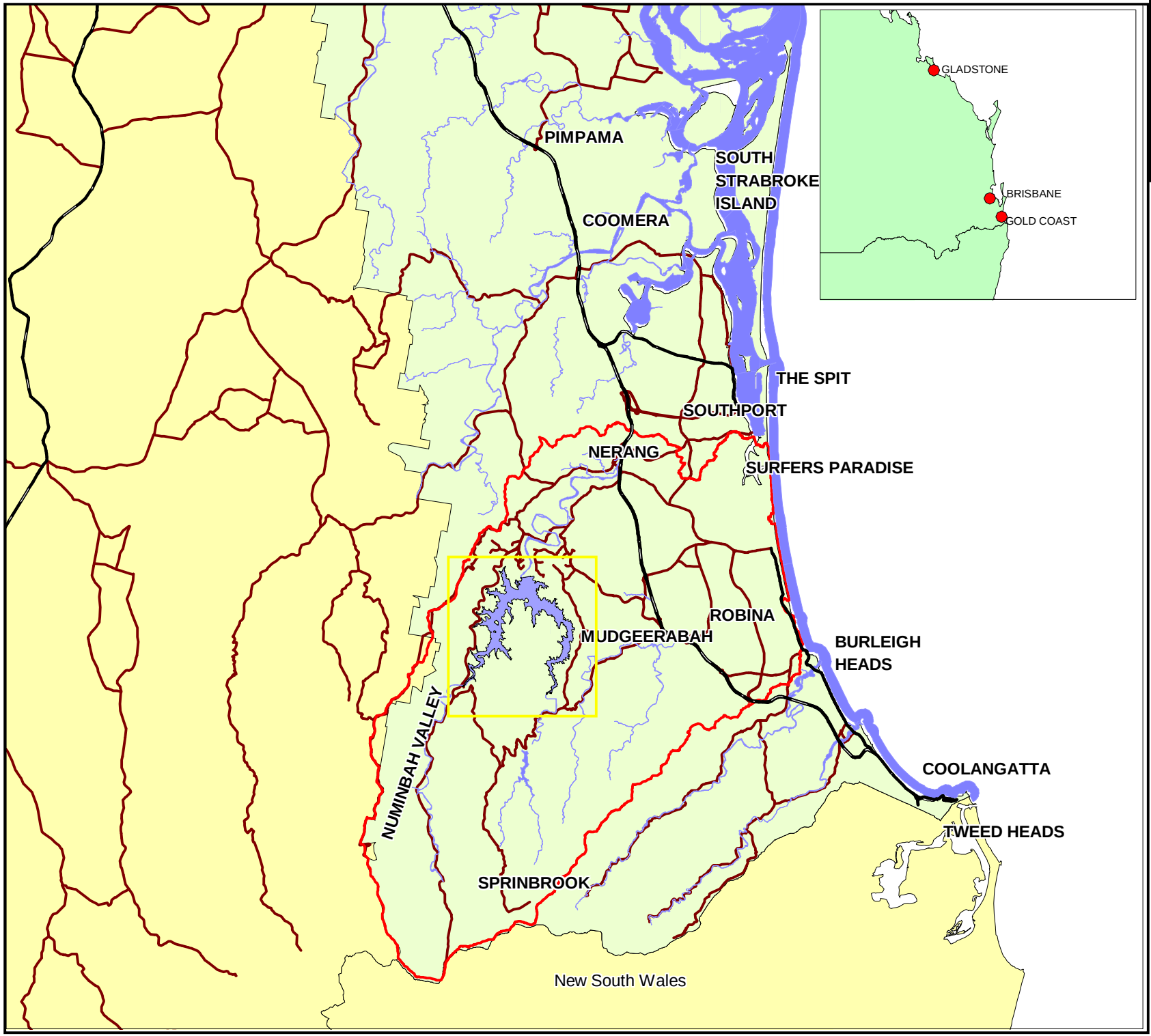
Council owns the majority of the land immediately around Hinze Dam, which has a Community Infrastructure Designation (CID) (Lot 4SP164198).

1.4 Approvals Process

The HDS3 Project is expected to require a number of approvals at the Commonwealth and State levels in order to proceed. Much of the project area is already subject to a Community Infrastructure Designation and this will be extended to cover the additional impoundment area. As such, no Gold Coast City Council Planning Scheme approvals are required. The ToR will be drafted to meet the legislative requirements of all Government agencies.

For this project, the project approvals process is expected to proceed under a 'Significant Project Status' through the carriage of State Government Coordinator General. The relevant legislation and policy identified includes:

- *Environment Protection and Biodiversity Conservation Act 1999;*
- *State Development and Public Works Organisation Act 1971;*
- *Integrated Planning Act 1997*;
- *Vegetation Management Act 1999;*
- *Environmental Protection Act 1994*;
- *Water Act 2000;*
- *Fisheries Act 1995;*
- *Nature Conservation Act 1992;*
- *Aboriginal Cultural Heritage Act 2003;*
- *Transport Infrastructure Act 1994;* and
- *Land Act 1994.*



GOLD COAST CITY COUNCIL
HINZE DAM STAGE 3

STUDY AREA

FIGURE 1-1

- Hinze Dam
- Study Area
- Nerang River Catchment
- Gold Coast LGA
- Waterway
- Highway
- Major Roads

North

0 10 20
kilometers

Source Information: GCCC, EPA (2005)

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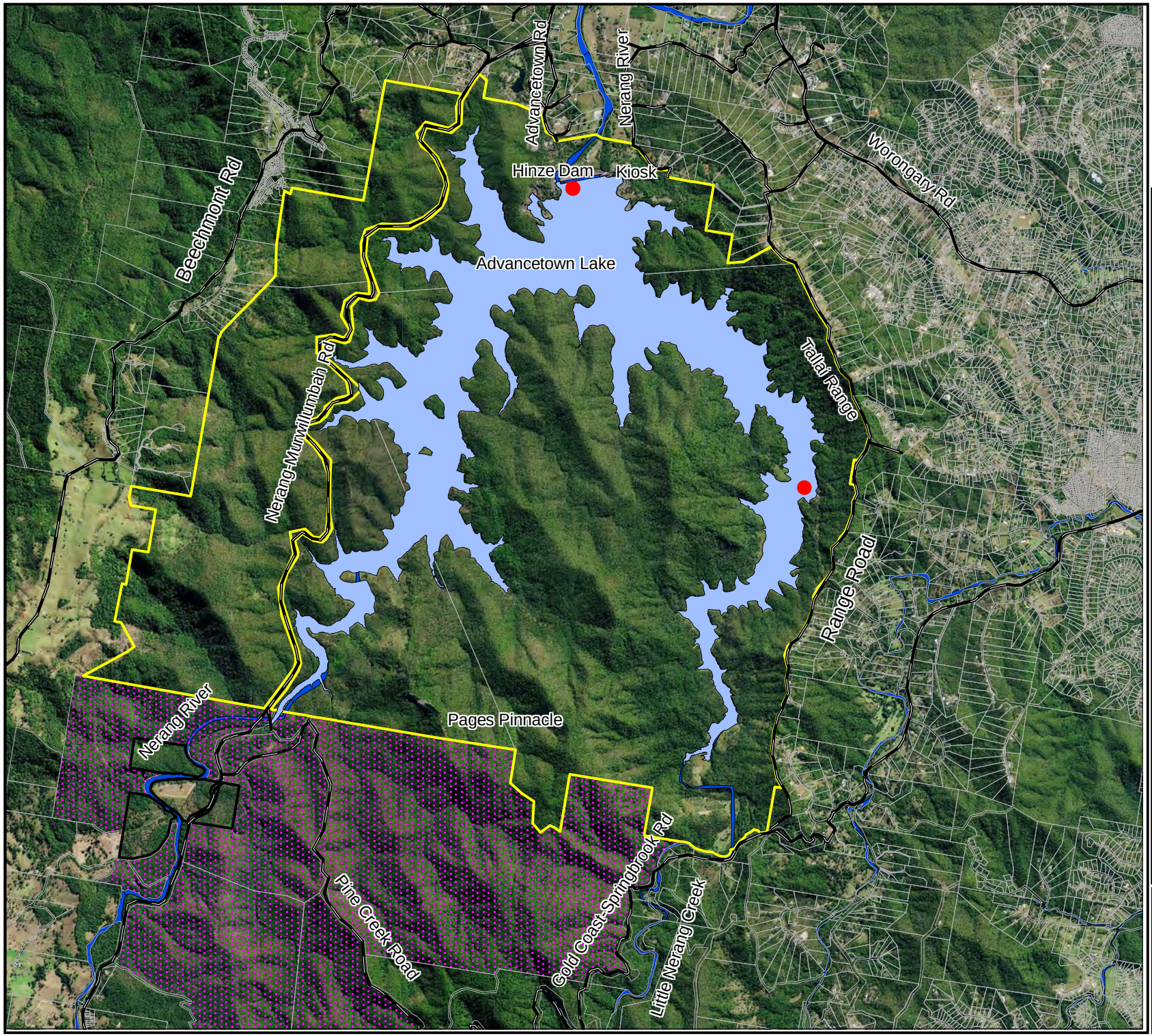

GOLD COAST CITY COUNCIL
HINZE DAM STAGE 3

STUDY AREA

FIGURE 1-2

- Current FSL (82.2 m AHD)
- DCDB
- Intake Towers
- Major Roads
- Community Infrastructure Designation
- Numinbah State Forest Reserve
- GCCC Freehold Open Space

North

0 1.5 3
kilometers

Source Information: GCCC, EPA (2005)

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2. Project Description

2.1 Current Structure and Facilities

2.1.1 Existing structure and operation

The Hinze Dam is the main bulk water supply source for Gold Coast region, supporting a rapidly growing urban centre and buoyant economy. The region's other bulk supply sources are the Little Nerang Dam and water from Wivenhoe Dam via a pipeline from Logan and Brisbane. The Hinze Dam currently supplies on average 191 ML per day[3]. Hinze Dam has two intake towers, the lower tower is located adjacent to the dam wall and the upper tower is located in the Little Nerang Creek branch of the lake. The lower tower feeds Molendinar Water Treatment Plant and the upper tower feeds the Mudgeeraba Water Treatment Plant.

The Hinze Dam wall comprises a zoned earth and rockfill main dam and a saddle dam with a concrete gravity spillway. The characteristics of the dam are summarised in Table 1. These characteristics relate to Stage 2 of Hinze Dam (the existing structure).

Table 1 Hinze Dam Characteristics (Stage 2)

Parameter	Value*
Full Supply Level (m)	82.20
Full Supply Volume (ML)	161, 070
Catchment Area (km^2)	207
Dam Crest Level (m)	93.50
Dam Crest Length (m)	600 m for main dam and 120 m for saddle dam
Lowest withdrawal level from upper tower	58.00
Lowest withdrawal level from lower tower	42.00

* All meter values are in AHD

2.1.2 Existing Facilities

Recreational facilities are present around the dam wall including kiosk, barbeques, parking and toilet facilities. Boat ramps and a championship-rowing course are also located around and upon the impoundment.

A number of private facilities are located upstream of the impoundment, including koala feed tree plantations, Scouts Association camping ground, Model Aeroplane Flying club ground and Numinbah Environmental Education Centre.

[3] www.goldcoast.qld.gov.au, 24/03/2006

2.2 Proposed Works

The HDS3 Project will be delivered by an Alliance consortium involving both Council and specialists from the private sector. The Alliance will be formed as a one-project company, drawing on a cooperative incentive driven approach with the Council as the sole funding entity.

Performance of Alliance-based project teams to date has proven this method to be an effective and flexible means of delivering high quality infrastructure projects, and it is considered that this approach will provide Council with the best opportunity to achieve the desired outcomes for the project.

The proposed works for the HDS3 project include the following:

- Raising of existing dam wall by up to 12.5m to accommodate dam safety, flood mitigation, and additional water supply storage;
- Modification of existing spillway and possible installation of flood gates;
- Raising of the lower and upper water intake towers to accommodate the additional water storage capacity;
- Construction of a new saddle dam;
- Raising of the existing saddle dam; and
- Upgrade/replacement of other ancillary services and structures including:
  - Parks and recreation facilities around dam wall;
  - Road and bridge upgrades; and
  - Re-alignment of water pipeline.

The following related works may also be required as a result of the HDS3 project:

- Upgrade of the Gold Coast Springbrook Road to ensure that it is not flood prone where it passes close to Little Nerang Creek and at its intersection with Nerang-Murwillumbah Road;
- Upgrade of the Nerang-Murwillumbah Road west of the impoundment and in the vicinity of Nerang River upstream of the existing impoundment; and
- Commissioning of the existing quarry on Lot 4 SP164198 or development of new quarries on Council owned land along the Nerang River above the current impoundment (Lot 11 WD2914, Lot 274 W312359 and Lot 275 W312359).

Downstream works, including possible future upgrade to Water Treatment Plants, are to be undertaken as required as separate projects.

Figure 2-1 shows the preliminary concept design for the HDS3 Project and Figure 2-2 shows the proposed maximum cross section of Hinze Dam Stage 3. Note that optimisation studies undertaken during detailed design may produce a different infrastructure configuration.

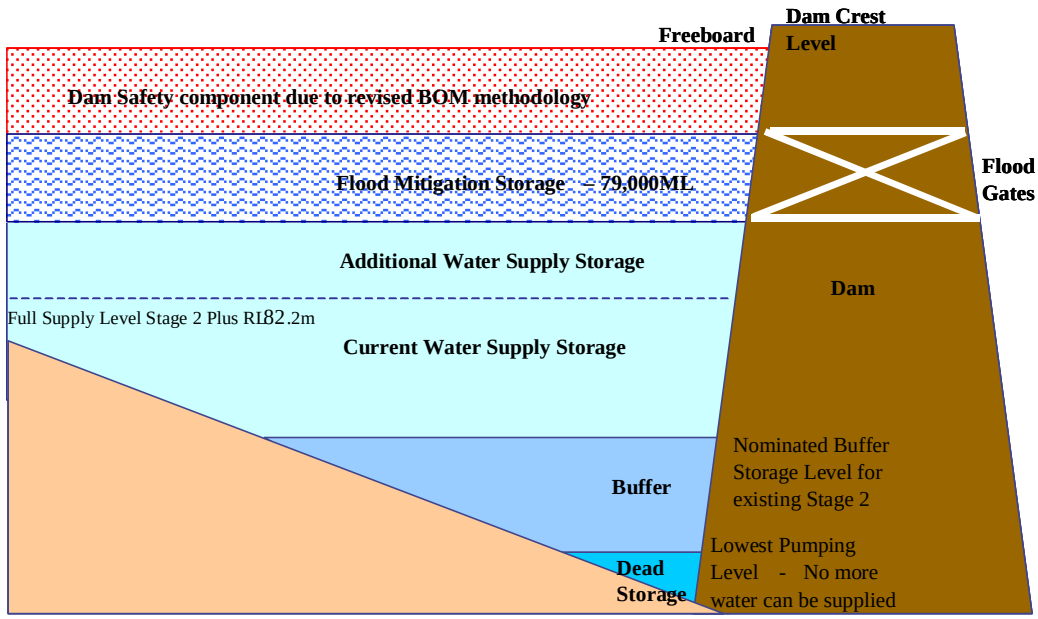


Figure 2-1 Preliminary Concept Design (source GCCC)

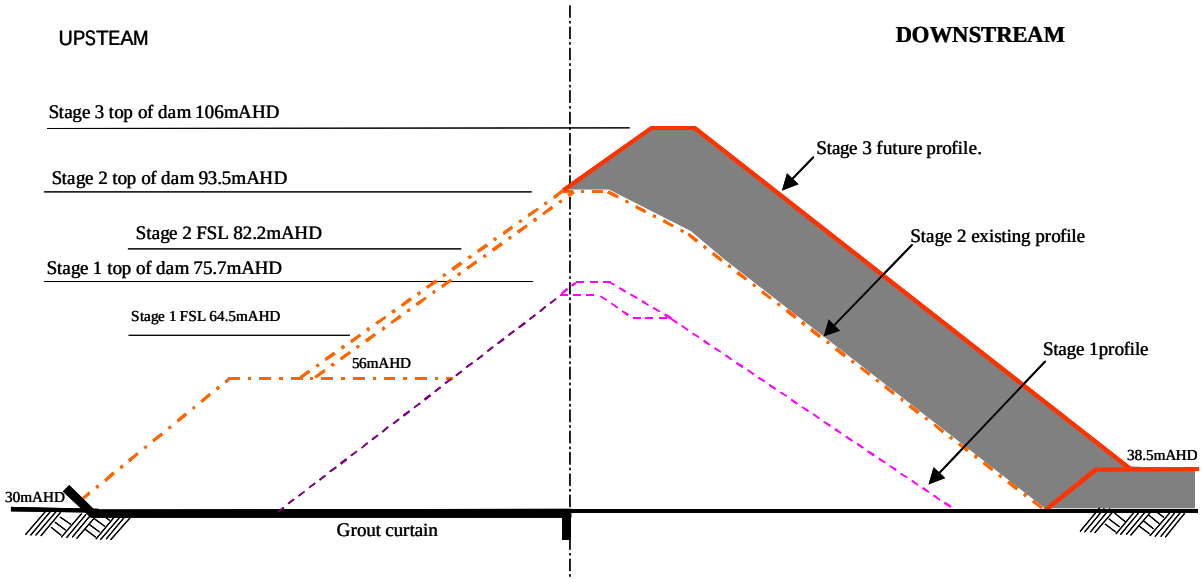


Figure 2-2 Maximum section of Hinze Dam wall (source GCCC, based on DAMCORP Embankment Design Report Nov 1989)

2.3 Construction Methodology

The overall construction period for the proposed HDS3 Project is likely to extend for 24 to 30 months. Prior to this, approximately 14 months will be required for detailed engineering studies, environmental impact assessment, approvals and preparation for construction.

The anticipated construction methodology and location of the construction footprint is as follows:

» Establishment of site offices, storage/stockpile areas, lay down areas – where possible these will be located in similar locations as for Stage 2 (such as cleared and car park areas around current kiosk and recreational facilities);

» Establishment and operation of quarries (refer to Section 2.3.1);

» Establishment of temporary haul roads as required (refer to Section 2.3.2);

» Construction/upgrade of main dam wall, saddle dam walls, spillway and intake towers;

» Clearing of vegetation around impoundment up to the proposed FSL;

» Relocate/upgrade Nerang-Murwillumbah Road and Gold Coast-Springbrook Road; and

» Reinstate car park and other public facilities, depending on final arrangements for access to dam and dam wall.

2.3.1 Construction Materials and Quarry Operation

Materials required for the Stage 3 raising were estimated by Damcorp at the time of the Stage 2 construction as follows:

» Rockfill, various classes 194,000 m^3

» Clay core 142,000 m^3

» Filters, various classes 168,000 m^3.

There are several known or assumed quarry resources available close by and the location of these potential quarry sites are shown on Figure 2-3. At this stage it is expected that all quarry material required for the project will be sourced from these sites. Detailed assessment of these resources has yet to be undertaken, along with detailed design of the wall raising. As such it has not been confirmed if these resources will be adequate in quality or quantity for the proposed dam raising and saddle dam construction. However, it is likely that a significant proportion of the total requirements for the dam wall raising will be available from these sources and that little or no material will need to be imported from any distance.

Quarrying activities will involve excavation and rockbreaking techniques. Rock quarry resources are identified as being “weathered” and thus use of explosives is likely to be minimal. Rock material will need to be screened, crushed or otherwise processed to create suitable sizes for the range of material requirements.

2.3.2 Traffic and Access

Construction activities will generate external traffic as follows:

» Transportation of construction equipment to the dam wall and quarry locations. This will necessitate heavy vehicle movement on the Advancetown Road/Hinze Dam Road and Nerang-Murwillumbah Road, particularly at the commencement of the project.

» Transportation of construction materials to the dam wall and saddle dam. Temporary haul roads will be established within Lot 4 wherever possible, however for some quarry locations, material may need to be hauled from the quarry to the dam wall via Nerang-Murwillumbah Road.

» Travel to site by construction workers.

Construction related traffic may created hazards on roads, as well as potentially causing delays. This will be managed through a Construction Traffic Management Plan which will specify haul routes, speed limits, warning signs and any other special precautions.

Construction traffic will also be generated by the relocation of the Nerang-Murwillumbah Road and Gold Coast-Springbrook Road. These activities may also cause some traffic delays and safety concerns and these will be addressed in a separate Construction Traffic Management Plan.

2.3.3 Waste Generation and Management

Management of wastes generated during construction will be at the discretion of the construction contractor/alliance partner, and will also be subject to legislative requirements. Table 2 provides an overview of the main waste streams likely to be generated during construction and suggested management measures that would be acceptable.

Table 2 Construction Waste Generation and Management

Potential Waste Stream	Potential Management Measures
Vegetation from clearing of approximately 400 ha of bush.	Mulching and placement in areas requiring stabilisation and revegetation, including haul roads and quarry sites.
Reject rock and clay material	Placement at quarry sites. Clay piles would need to be stabilised to prevent future erosion.
Reject concrete and road surfacing materials	Crush and reuse in municipal applications Dispose at hard waste landfill
Oil and grease from construction equipment maintenance	Dispose of via registered waste oil contractor.

2.4 Inundation Areas

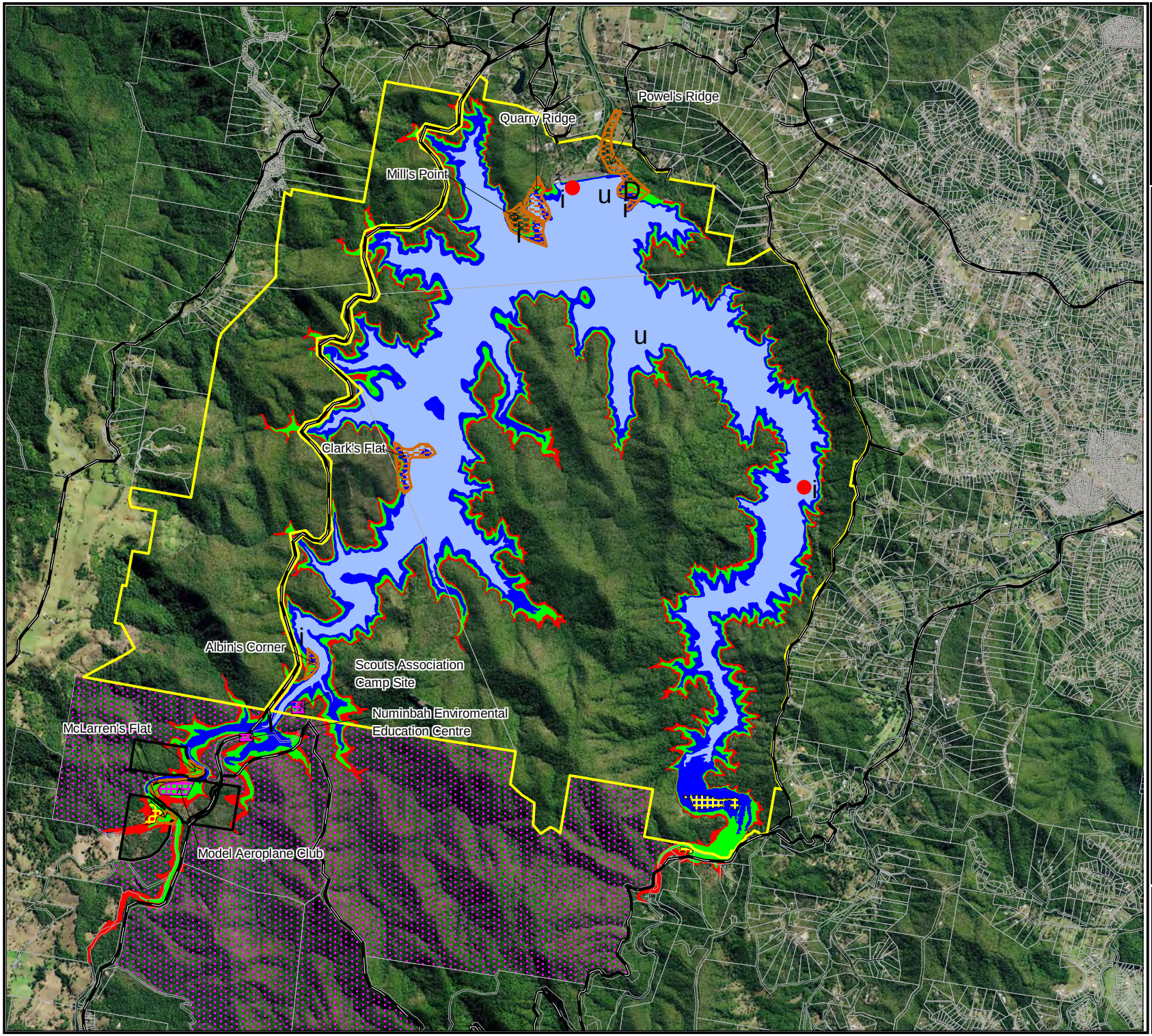
Figure 2-3 shows the proposed inundation areas for additional water supply, flood mitigation and dam safety. Table 3 describes the additional areas to be inundated and proposed frequency of inundation.

Table 3 Dam levels, inundation areas and frequency

Dam Level (mAHD)	Purpose	Innundation Area* (ha)	Frequency	Comments
92.5	Additional water supply	411	Permanently inundated at Full Supply Level (FSL)	Increase of 411 ha over the current Stage 2 impoundment area of 977 ha. Therefore, FSL Inundation for HDS3 is 1388 ha. Will impact on approximately 18.99 ha of Numinbah State Forest Reserve. No private properties affected.
99.7	Q100 Flood Event	325 (above FSL)	Flood frequency of 100 years.	Extreme flooding events will inundate sections of two privately owned, two Council owned and one State owned properties. One Council owned house will be inundated. No existing private houses will be affected.
105.5	Dam safety	598 (above FSL	Theoretical Probable Maximum Flood (PMF) event, i.e. the maximum predicted inundation that might ever occur.	A total of nine privately owned lots are expected to be affected by the PMF, including those affected by Q100. No existing privately owned houses will be affected.

* [1] Note that these estimates are based on aerial photography, and as such are subject to a margin of error. Further assessments will be undertaken to identify the exact area of impact.

Council is considering acquiring easements over privately owned land that is affected up to the Q100 flood level. At this stage it is not proposed to acquire easements over private land for flooding associated with PMF events.



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HINZE DAM STAGE 3

INUNDATION AREAS AND EXISTING FACILITIES/ INFRASTRUCTURE

FIGURE 2-3

- Current FSL (82.2 m AHD)
- Proposed FSL (92.5 m AHD)
- Q100 Peak Level (99.7 m AHD)
- PMF Peak Level (105.5 m AHD)
- DCDB
- Intake Towers
- Potential Quarry Sites
- Community Infrastructure Designation
- Numinbah State Forest Reserve
- GCCC Freehold Open Space
- Koala Feed Tree Plantation
- i Boat Ramp
- D Picnic Facilities
- u Rowing Course

North

0 1.5 3
kilometers

Source Information: GCCC, EPA (2005)

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2.5 Need and Justification

The need for the HDS3 project is threefold:

1. To achieve flood mitigation objectives that are in line with Council's commitment. Currently over 4,000 existing properties downstream of Hinze Dam could potentially be affected in a 1:100 year flood event and result in $147 M in damages. Flood mitigation works would provide a reduction of approximately 3,400 affected properties and 80% ($114 million) reduction in community wide damage[4].
2. To increase capacity and reliability of water supply inline with the Gold Coast Water Futures & the Queensland Government's South East Queensland Regional Water Supply Strategy (SEQRWSS) findings.
3. To satisfy new dam safety requirements. Based on recent new methodology developed by the Bureau of Meteorology, Hinze Dam no longer conforms with safety requirements under State legislation for PMF. Council has accordingly resolved to augment the dam to satisfy these requirements, and in doing so reduce the significant risk to downstream property and life.

2.6 Significance of Investment

The HDS3 Project requires a significant investment in infrastructure on the part of the proponent. Initial estimates indicate a total project cost of approximately $140 million, including design, approvals and construction costs.

Investment of this magnitude is expected to provide significant short-term economic benefits during the construction period and longer term social and economic benefits.

The project constitutes a significant strategic augmentation to the bulk water supply within the South East Queensland Region, as demonstrated by the Gold Coast Water Futures Study and the Queensland Government's South East Queensland Regional Water Supply Strategy findings.

2.7 Project Alternatives

Council has assessed a number of alternatives for providing flood mitigation in the lower Nerang River and additional water supplies across the City. These are described below.

2.7.1 Flood Mitigation Options

Four alternatives for providing flood mitigation in the lower Nerang catchment have been considered (SKM 2002):

» Raising of Hinze Dam – Three different dam wall height and spillway scenarios have been considered:

[4] Council's Flood Strategies Section 2003

- Option HD2B1 – Raising Hinze Dam crest to 106 m AHD, provision of uncontrolled spillway length at two crest levels (45m length at 99m AHD crest and 40m length at 102m AHD crest). Storage volume allocated for flood mitigation of 60,600 ML
- Option HD2B2 – Raising Hinze Dam crest to 106m AHD, provision of uncontrolled spillway length at two crest levels (45 m length at 99 m AHD crest and 40m length at 102 m AHD crest). Storage volume allocated for flood mitigation of 92,800 ML
- Option HD4 – Raising Hinze Dam crest to 110 m AHD, provision of uncontrolled 60 m long spillway at 104 m AHD crest. Storage volume allocated for flood mitigation of 98,000 ML.

» Dredging of the Lower Nerang River – Dredging to improve water flow through the mid and the lower sections of the Nerang River, by accelerating flows of floodwaters and allowing greater discharge through the system;

» Bridges Improvements – Increasing cross sectional area of the waterway at bridges could potentially reduce peak flood levels; and

» Benowa Flood Channel Modifications – Bypass the current Benowa Flood Channel configuration to reduce congestion of floodwaters.

Cost benefit analysis of each of these options was undertaken to identify the benefit : cost ratio, (i.e. the option that had the maximum benefit for the lowest cost). The option with the highest benefit : cost ratio was the Benowa channel modification option, however this option was not able to provide a sufficient scale of flood mitigation benefits. Raising of Hinze Dam is the preferred option as it had the highest benefit cost ratio and resulted in the most significant flood mitigation benefits of all of the options.

Subsequent studies on different dam levels have been investigated for Hinze Dam (SKM May 2005, GHD December 2005) and the final review was based on:

» Allowing 79,000 ML of flood storage;

» Ensuring that the dam wall did not overtop in the PMF; and

» Providing for varying levels of water supply augmentation.

In addition, Council considered whether Hinze Dam should be raised for flood mitigation alone or for water supply and flood mitigation.

2.7.2 Water Supply Options

Council has prepared a Water Futures report (GCCC 2005) which outlines strategies and options for increasing water supply to the City over the next 50 years. The strategy identified the raising of Hinze Dam for water supply as a key element in overall security of supply for a growing Gold Coast population. However, the raising of Hinze Dam was set amongst a range of other strategies including:

» Construction of the Southern Regional Pipeline from Wivenhoe Dam (expected to be operational 2007);

» Use of recycled water for toilet flushing and gardens;

» Use of rainwater tanks;

- Seawater desalination;
- Repairing leakages and pipe breaks; and
- Water conservation through community education programs.

The Water Futures reports concluded that the above measures were intended to compliment bulk water supplies from the dam, and that the requirement for further augmentation of the Hinze Dam remained.

Regional Water Supply Options

In response to the current drought conditions in Southeast Queensland, the South East Queensland Regional Water Supply Strategy (SEQRWSS) has been developed as a partnership between the Queensland Government and the Council of Mayors SEQ to formulate regional strategies for managing the future water supply needs of South East Queensland. This strategy will investigate alternative options in developing water infrastructure to address water supply within SEQ. Options include re-commissioning of existing dams, use of recycled water, investigations into additional dams, rasing of existing dams (including Hinze Dam) and developing a water grid across SEQ.

3. Description of Existing Environment

3.1 Rainfall

Hinze Dam and its catchment experience a sub tropical climate and are situated in a high rainfall zone, with highest rainfalls historically recorded in January and minimum rainfall in August and September. Annual average rainfall at the nearby Mt Tambourine and Murwillumbah meteorological stations is approximately 1.5 m (Bureau of Meteorology data).

3.2 Topography and Landscape

The Hinze Dam is located downstream of the confluence of the Nerang River and Little Nerang Creek. The Hinze Dam wall and surrounding parklands are visually pleasing. The landscape is one of open parkland surrounded by vegetation, with views across the water body of the impoundment from some locations (Plate 1). The dam wall dominates most views in this area. Immediately surrounding the current dam impoundment, the topography varies from moderate to very steep slopes. The most dominant topographical feature within the vicinity of the dam and impoundment area is Pages Pinnacle, an exposed igneous rock, with an elevation of 398 m AHD (Plate 2). Tallai Range to the east of the lake drains to Little Nerang Creek via typically short and steep gullies. Most of the slopes are well vegetated.

The dominant land use immediately around the impoundment is natural forest within the CID. Recreational facilities are located adjacent to the dam wall. Residential and rural residential landuses are located immediately downstream of the dam wall. The catchment has about 77% native vegetation cover, most of which is contained within State Forests and National Parks. Approximately 15% of the catchment area is developed for dairy and beef cattle pasturelands. The locality of Springbrook is also located within the catchment area.

Plate 1 Landscape characteristics of Hinze Dam and impoundment (public parkland to left)

Plate 2 View of Pages Pinnacle from Nerang River branch of Lake Advancetown

3.3 Soils and Geology

Rocks of the Neranleigh Fernvale Beds prevail in much of the proposed FSL area. The soils associated within this geology include kursols and ferrosols. Alluvial terrace deposits comprising clay, silt, sand, gravels and cobbles are present along both Little Nerang Creek and Nerang River.

Given the steep slopes around the impoundment, there is a high potential for soil erosion, however there was minor erosion observed around the current impoundment area or within gullies draining into the dam as these slopes are currently heavily vegetated.

The soils of the catchment above Hinze Dam appear to be well stabilised with siltation in the dam reported to be minor (SKM 2005). This is probably attributable to the high proportion of forest cover in the catchment above Hinze Dam.

3.4 Water Resources

The water quality of Hinze Dam appears to be of good quality, it is understood that in the past, the dam has been subject to the occasional algal bloom (GCCC, 1996) and seasonal turnovers in the water column.

There will be a requirement for the Hinze Dam to continue to be used as the bulk potable water supply for the City throughout construction period.

The metamorphic rocks of the area supports ground water resources. During the construction of Stages 1 and 2 of the existing dam wall, no significant groundwater issues were encountered during construction.

3.5 Terrestrial Flora

3.5.1 Conservation Areas

Numinbah State Forest Reserve borders the southern boundary of the CID along the Nerang River branch of the dam. Numinbah State Forest Reserve is currently in the process of being designated as a National Park under the Regional Forest Agreement for the area and is likely to be declared in the second half of 2006. Springbrook and Lamington National Parks are located in the upper sections of the Hinze Dam catchment which also forms part of the World Heritage listed 'Central Eastern Rainforest Reserves (Shield Volcano Group) NSW'.

The Nerang River flows into the southern Broadwater. The northern Broadwater (north of the Gold Coast seaway) is within the Moreton Bay Marine Park and is also a Ramsar Wetland.

3.5.2 Vegetation Communities and Regional Ecosystems

Intact remnant vegetation communities predominantly surround the study area. The dominant vegetation community is eucalypt forests, with small areas of rainforest and wet sclerophyll forest located within sheltered gullies (Plate 3 to 5). Several small cleared and weed invested areas that are a legacy from old rural land holdings are present around the impoundment (Plate 6).

The proposed works will impact upon eleven Regional Ecosystems (RE)[5]. A description of these regional ecosystems, their current conservation status under the VMA 1999 and approximant areas to be impacted for each water level is provide in Table 4. The regional ecosystem mapping for the study site is provided in Figure 3-1.

No threatened ecological communities as listed under the EPBC Act 1999 are present within the proposed inundation area.

Plate 3 Dry eucalypt forest found around majority of current FSL (RE 12.5.11k)

Plate 4 Wet sclerophyll forest and Araucarian rainforest found along gullies on eastern and sheltered western facing gullies (RE 12.11.1)

Plate 5 Rainforest found along sheltered steep gullies around the dam

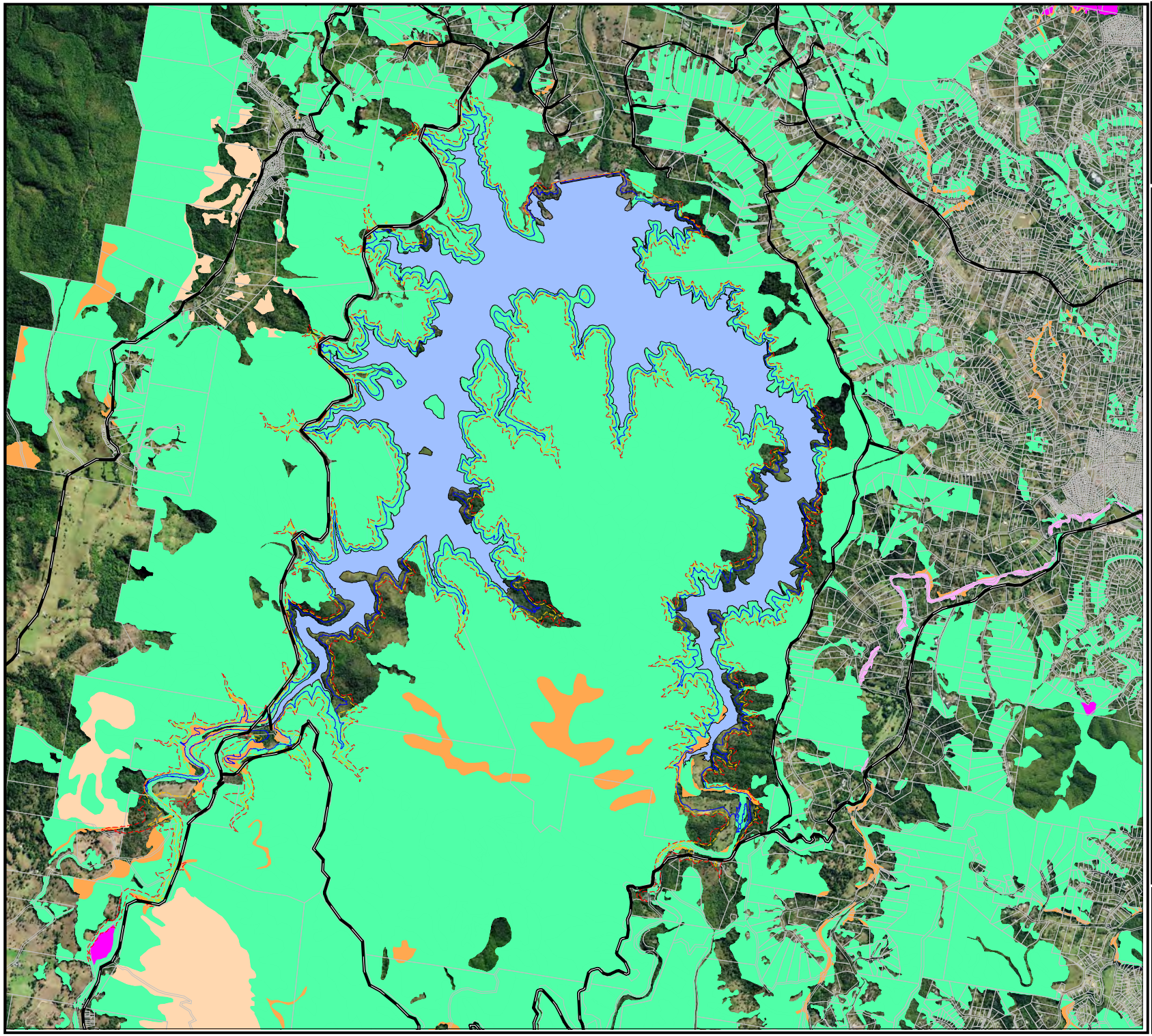
Plate 6 Cleared and weed invested areas around sections of the lake.

[5] Based on Version 5.0 of the EPA certified RE mapping.

Table 4 Regional Ecosystems (REDD Version 5.0)

RE	Description	Status		Area affected (ha)		
		VMA	BAM	FSL	Q100	PMF
12.3.1	Complex to simple notophyll vine forest. Waterhousea floribunda is predominant. Other species include *Cryptocarya hypospodia, C. triplinervis, Argyrodendron trifoliolatum, Ficus coronata, F. macrophylla, Aphananthe philippinensis, Elaeocarpus grandis, Castanospermum australe* and *Syzygium francisii*.	E	E	-	-	0.39
12.3.2	*Eucalyptus grandis* tall open forest on alluvial plains	OC	OC	7.03	1.23	2.66
12.3.7	*Eucalyptus tereticornis, Callistemon viminalis, Casuarina cunninghamiana* fringing forest	NOC	NCP	17.26	18.87	10.7
12.3.11	*Eucalyptus siderophloia, E. tereticornis, Corymbia intermedia* open forest on alluvial plains usually near coast	OC	NCP	9.36	9.55	0.78
12.11.1	Simple notophyll vine forest often with *Archontophoenix cunninghamiana* on metamorphics ± interbedded volcanics	NOC	NCP	1.12	2.02	2.4
12.11.3	Open forest generally with *Eucalyptus siderophloia, E. propinqua* on metamorphics ± interbedded volcanics	NOC	NCP	67.48	62.51	74.49
12.11.3a	Open-forest of *Lophostemon confertus* with *Eucalyptus microcorys* and *E. propinqua*. Occurs in gullies and exposed ridges of Paleozoic and older moderately to strongly deformed and metamorphosed sediments and interbedded volcanics.	NOC	NCP	15.32	13.36	9.83
12.11.5a	Open forest of *Eucalyptus tindaliae, Eucalyptus carnea ± E. siderophloia, E. microcorys, E. racemosa, E. propinqua.* Occurs on Paleozoic and older moderately to strongly deformed and metamorphosed sediments and interbedded volcanics.	NOC	NCP	131.96	112.92	98.35
12.11.5k	Open forest of *Corymbia henryi, Eucalyptus fibrosa subsp. fibrosa ± C. citriodora, Angophora leiocarpa, E. carnea, E. tindaliae, E. propinqua, C. intermedia*. Occurs on drier ridges and slopes on Paleozoic and older moderately to strongly deformed and metamorphosed sediments and interbedded volcanics.	NOC	NOC	7.53	6.07	4.79
12.12.14	Shrubby woodland usually of rocky near coastal areas on Mesozoic to Proterozoic igneous rocks	OC	OC	-	-	0.075
12.12.15	*Eucalyptus siderophloia, E. propinqua, E. acmenoides* open forest on near coastal hills on Mesozoic to Proterozoic igneous rocks	NOC	NCP	-	-	1.26
TOTAL CLEARED				***257***	***227***	***206***

VMA – *Vegetation Management Act* 1999; BAM – Biodiversity Mapping Assessment; E- Endangered; OC – Of Concern; NOC – Not of Concern; NCP – No Concern at Present



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HINZE DAM STAGE 3

REGIONAL ECOSYSTEMS
VERSION 5.0

FIGURE 3-1

Current FSL (82.2 m AHD)

Proposed FSL (92.5 m AHD)

Q100 Peak Level (99.7 m AHD)

PMF Peak Level (105.5 m AHD)

DCDB

Regional Ecosystem VMA Status

Endangered (dominant)

Endangered (sub dominant)

Of Concern (dominant)

Of Concern (sub dominant)

Not of Concern

North

Source Information: GCCC, EPA (2005)

G:\41\15842\GIS\WORKSPACES/RE_MAP.WOR

GHD

CLIENTS|PEOPLE|PERFORMANCE

3.5.3 Threatened Flora Species

A search of the Queensland Herbarium HERBRECS database, EPA's Wildlife Online database and EPBC On Line Search Tool were undertaken to provide a list of flora previously recorded or potentially occur or suitable habitat potentially occurs within the study site and immediate surrounds[6].

More than 680 species have been previously recorded within the search area, of these 23 are listed as rare, vulnerable or endangered under the NCA 1992 and/or EPBC Act 1999. In addition, a further 35 threatened flora species were identified by the EPBC On Line Search Tool to potentially occur within the area. It should be noted that the EPBC online search gives details of species that are likely to occur on site based on bioclimatic modelling. As such, these species have not necessarily been observed or are present within the search area.

A list of these species, their conservation status, description of preferred habitat and any previous recordings in the area is provided in Table 5.

[6] Search Area: Latitude between 28.0401 to 28.1356 and Longitude between 153.2481 to 153.308

Table 5 Threatened flora species previously recorded or potentially occur within the study area

Scientific name	Common Name	Preferred Habitat and Previous Records in Hinze Dam region	Status		Source			
			NCA	EPBC	EPBC On Line Database	Wildlife	HERBRECS	Literature
Austromyrtus fragrantissima	Scale Myrtle	Grows in subtropical rainforest; coastal districts. No records in area small areas of habitat present, possible to be present.	E	E	X			
Baloghia marmorata	Marbled Balogia	Found in subtropical rainforest on basaltic soil; rare, confined to Lismore area and Tamborine Mtn, Qld. No records in area suitable habitat present, and may be present within the study area.	V	V	X			
Bosistoa transversa	Three-leaved Bosistoa	Found in rainforest to an altitudes of 150 m, north of Mullumbimby, NSW. No records in area, suitable habitat present within study area, however unlikely to be impacted by the project.	-	V	X			
Bulbophyllum globuliforme	Miniature Moss orchid	Grows on rainforest trees, particularly Araucaria cunninghamii; restricted to the McPherson Range, usually from 300 to 600 m alt. No records in area and no suitable habitat present.	R	V	X			
Clematis fawcettii	Stream Clematis	Usually found near streams, in drier rainforest north of the Richmond River. No records in area and no suitable habitat present.	V	V	X			
Cryptocarya foetida	Stinking Cryptocarya	Scattered in littoral rainforest north from Iluka Natural Reserve in NSW. No records in area, however suitable	V	V	X			

Scientific name	Common Name	Preferred Habitat and Previous Records in Hinze Dam region	Status		Source			
			NCA	EPBC	EPBC On Line Database	Wildlife	HERBRECS	Literature
foetida	Cryptocarya	habitat present within study area and potentially may occur within study area.						
Cryptostylis hunteriana	Leafless Tongue orchid	Grows in swamp-heath on sandy soils, chiefly in coastal districts. No records in area and no suitable habitat present.	-	V	X			
Cyperus semifertilis	-	Found in open forest and rainforest openings. No records in area, potential to occur within study area.	-	V	X			
Davidsonia jerseyana	Davidson's plum	Confined to subtropical rainforest in coastal areas from the Brunswick River to the Tweed Valley, NSW. No records in area and unlikely to occur.	-	E	X			
Diospyros mabacea	Red fruited Ebony	Found in lowland subtropical rainforest; rare, confined to the Tweed Valley, NSW. No records in area and unlikely to occur.	-	E	X			
Elaeocarpus williamsianus	Hairy Quandong	In disturbed rainforest in the Burringbar Range, NSW. No records in area and unlikely to occur.	-	E	X			
Endiandra floydii	Floyd's Walnut	Found in warm-temperate and subtropical rainforest, from sea level to 430 m altitude; rare, confined to Tweed district, NSW. No records in area and unlikely to occur.	E	E	X			
Endiandra hayesii	Rusty Rose Walnut	Found in lowland subtropical rainforest on sedimentary soils and alluvium in cool, moist, sheltered valleys; locally abundant, north from the Clarence River. No records in	V	V	X			

Scientific name	Common Name	Preferred Habitat and Previous Records in Hinze Dam region	Status		Source			
			NCA	EPBC	EPBC On Line Database	Wildlife	HERBRECS	Literature
		area, suitable habitat present and likely to occur within study area.						
Euphrasia bella	Lamington Eyebright	Grows in exposed sites in cool-temperate rainforest in the McPherson Range. Grows on the Qld-NSW border. No records in area and unlikely to occur.	E	V	X			
Floydia praealta	Ball Nut	Grows in subtropical and riverine rainforest north from the Clarence River, NSW. No records in area, suitable habitat present and likely to occur within study area.	-	V	X			
Fontainea australis	Southern Fontainea	Occurs in rainforest. No records in area small areas of suitable habitat present, possible to occur within study area.	V	V	X			
Hicksbeachia pinnatifolia	Monkey Nut	Grows in subtropical rainforest north from the Nambucca Valley, chiefly north of Lismore; often regenerates by suckering in disturbed sites. No records in area, suitable habitat present and likely to occur within study area.	V	V	X			
Ochrosia moorei	Southern ochrosia	Grows in subtropical rainforest. No records in area, suitable habitat present and likely to occur within study area.	E	E	X			
Owenia cepiodora	Onionwood	Found in subtropical and dry rainforest. No records in area, small areas of suitable habitat present, may occur within study area.	V	V	X			
Ozothamnus vagans	-	Grows in and around rainforest. No records in area, small areas of suitable habitat present, may occur within study	V	V	X			

Scientific name	Common Name	Preferred Habitat and Previous Records in Hinze Dam region	Status		Source			
			NCA	EPBC	EPBC On Line Database	Wildlife	HERBRECS	Literature
		area.						
Sarcochilus fitzgeraldii	Ravine Orchid	Usually grows on rocks or rarely on bases of trees, in subtropical rainforest, usually near streams, from 500-700 m. No records in area and no suitable habitat.	E	V	X			
Sarcochilus hartmannii	Waxy Sarcochilus	Usually grows on volcanic rocks, often in shallow soil, in sclerophyll forest or exposed sites, from 500 to 1000 m. No records in area and no suitable habitat.	V	V	X			
Sophora fraseri	-	Grows in moist situations, often near rainforest. No records in area, suitable habitat present and likely to occur.	V	V	X			
Symplocos baeuerlenii	Small-leaved Hazelwood	Grows in subtropical and warm-temperate rainforest. No records in area, small areas of suitable habitat present, possible to occur.	V	V	X			
Syzygium hodgkinsoniae	Smooth-bark Rose Apple	Grows in subtropical rainforest or gallery forest. No records in area, small areas of suitable habitat present, possible to occur.	V	V	X			
Syzygium moorei	Rose Apple	Grows in lowland subtropical rainforest. No records in area, small areas of suitable habitat present, possible to occur.	V	V	X			
Zieria collina	-	Forms thickets in light rainforest, and often a dominant shrub in regrowth, restricted to Tamborine Mountain. No records in area, suitable habitat present, but unlikely to occur within study area	V	V	X			

Scientific name	Common Name	Preferred Habitat and Previous Records in Hinze Dam region	Status			Source		
			NCA	EPBC	EPBC On Line Database	Wildlife	HERBRECS	Literature
Marsdenia hemiptera	-	Grows in littoral rainforest, and rarely in subtropical rainforest. Observed on banks of Hinze Dam.	R			X	X	
Marsdenia longiloba	Clear Milkvine	Grows in rainforest, north from Coffs Harbour. No records in area, small areas of suitable habitat present, may occur within study area.	V	V	X			
Pararistolochia praevenosa	-	Grows in subtropical rainforest in coastal areas. Observed at several locations around the banks of Hinze Dam.	R	-		X	X	X
Pandorea baileyana	Large-leaved Wonga Vine	Grows in subtropical and warm-temperate rainforest. Found near Little Nerang Dam.	R	-			X	
Cassia marksiana	-	Observed on banks of Hinze Dam.	R	-		X	X	
Cyperus rupicola	-	Grows amongst rocks or on exposed cliff faces near forest. Found on lower slopes of Mt Wagan.	R	-			X	
Ricinocarpos speciosus	-	Found in damp situations along streams, observed along Springbrook-Mudgeeraba Rd.	V	-		X		
Callerya australis	Native Wisteria	Grows in warmer rainforest on the coast and adjacent ranges, recorded near Canungra.	R	-			X	
Argophyllum nullumense	Silver Leaf	Grows in subtropical and warm-temperate rainforest. Observed at several locations around the banks of Hinze Dam.	R	-		X	X	X

Scientific name	Common Name	Preferred Habitat and Previous Records in Hinze Dam region	Status		Source			
			NCA	EPBC	EPBC On Line Database	Wildlife	HERBRECS	Literature
Plectranthus nitidus	-	Grows on rocky outcrops underneath rainforest canopy along a creek. Records along Little Nerang Creek.	E	E		X	X	
Westringia rupicola	-	Recorded on Pages Pinnacle.	V	V	X	X	X	
Westringia blakeana	-	Grows in wet sclerophyll forest, often near creeks or waterfalls on edge of rainforest, records around Canungra.	R	-			X	
Lenwebbia prominens	-	Grows in subtropical rainforest, often on stream banks. Records on upper Mudgeeraba Creek	R	-			X	
Rhodamnia maideniana	-	Grows in subtropical rainforest, coastal districts. Observed on banks of Hinze Dam.	R	-		X	X	
Jasminum jenniae	-	Recorded on 'The Panorama' Gilston.	E	-			X	
Helmholtzia glaberrima	Flax Lily	Grows on steep sides of damp rainforest gullies and along rocky streams. Observed in Nerang Creek.	R	-			X	
Arthraxon hispidus	Hairy-joint grass	Grows in rainforest; north from Gibraltar Range. Previously recorded in Canungra, small areas of habitat present in study area.	V	V	X		X	
Helicia ferruginea	Rusty Helicia	Found in riverine and warm-temperate rainforest on the coast and ranges. Observed on banks of Hinze Dam.	R	-			X	
Macadamia	Macadamia	Found in drier types of subtropical rainforest. Observed on	V	V	X	X	X	

Scientific name	Common Name	Preferred Habitat and Previous Records in Hinze Dam region	Status			Source		
			NCA	EPBC	EPBC On Line Database	Wildlife	HERBRECS	Literature
integrifolia		banks of Hinze Dam.						
Macadamia tetraphylla	Rough-shelled Bush Nut	Grows in subtropical rainforest in coastal areas north of the Clarence River, chiefly in the Richmond and Tweed Valleys. No records in area, suitable habitat present and possible to occur within study area.	V	V	X			
Randia moorei	Spiny Gardenia	Found in subtropical rainforest. 'Previously recorded at 'The Panorama' near the study area.	E	E	X		X	
Acronychia baeuerlenii	Byron Bay Acronychia	Grows in subtropical and warm-temperate rainforest. Observed on Springbrook-Nerang Rd.	R	-			X	
Cupaniopsis newmanii	-	Grows on the margins and in warmer rainforest. Observed at several locations around the banks of Hinze Dam.	R	-		X	X	X
Diploglottis campbelli	Small-leaved Tamarind	Grows in riverine rainforest. Previously recorded in Mudgeeraba, suitable habitat is present and likely to be found within the study area.	E	E	X		X	
Rulingia salviifolia	-	Previously found in Numinbah Valley.	R	-		X	X	

EPBC – *Environmental Protection and Biodiversity Conservation* Act 1999; NCA – *Nature Conservation Act* 1992, E – Endangered; V – Vulnerable; R - Rare

3.6 Terrestrial Fauna

3.6.1 Threatened and Migratory Fauna

A search of the EPA's Wildlife Online database, Queensland Museum Database, GCCC GIS records and EPBC On Line Search Tool were undertaken to provide a list of fauna previously recorded or potentially occur or suitable habitat potentially occurs within the study site and immediate surrounds[7].

The Wildnet search revealed the previous recording of 164 fauna species, of these, five species are listed as vulnerable under the NCA 1992 and/or the Commonwealth EPBC Act 1999. The Queensland Museum database search revealed previous recordings of 31 species, of these two are listed as vulnerable or endangered under the NCA 1992 and/or the Commonwealth EPBC Act 1999. In addition a further 14 threatened and 11 migratory fauna species were identified by the EPBC On Line Search Tool to potentially occur on site. It should be noted that the EPBC online search gives details of species that are likely to occur on site based on bioclimatic modelling. As such, these species have not necessarily been observed or are present within the search area

Threatened and migratory fauna species previously recorded or potentially occur within the study area are listed and described in Table 6.

[7] Search Area: Latitude between 28.0401 to 28.1356 and Longitude between 153.2481 to 153.308

Table 6 Threatened fauna species previously recorded or potentially occur within the study area

Class	Scientific name	Common name	Preferred Habitat	Status		Source		
				NCA	EPBC	Wildlife	Museum	EPBC Database
Amphibian	*Adelotus brevis*	Tusked frog	Lives in rainforests, wet sclerophyll forests and open grasslands. Usually found under logs, stones or leaf litter near puddles, creeks and ponds.	V	-	X		
Amphibian	*Mixophyes fleayi*	Fleay's barred frog	Upland rainforest in leaf litter and at watercourses.	E	E		X	X
Amphibian	*Mixophyes iteratus*	Giant Barred Frog	Occurs along shallow rocky streams in rainforest, wet sclerophyll forest and farmland between 100 and 1000m (Covacevich and McDonald 1993). Has been recorded in the upper reaches of the Nerang River near Springbrook. Possible habitat present within wetter gullies draining into impoundment area. Further studies are required.	E	E			X
Bird	*Calyptorhynchus lathami*	Glossy black-cockatoo (GBC)	Preferred food source is cones of *Allocasuarina* spp trees. Numerous sightings within the study area and have previously been observed feeding on *Allocasuarina littoralis* trees around the existing quarry on western side of dam wall.	V	-	X		X
Bird	*Cyclopsitta diophthalma coxeni*	Coxen's Fig-Parrot	Primarily inhabits lowland rainforests but also uses semi-deciduous vine forests and gallery forests. Limited suitable habitat present within the study area. Unlikely to be present within areas to be inundated.	E	E			X
Bird	*Lathamus discolor*	Swift Parrot	Periodic visitor to Queensland from Tasmania and Victoria typically inhabits open and dry eucalypt woodland and forest containing box-ironbark where they feed on nectar and sap	E	E			X

Class	Scientific name	Common name	Preferred Habitat	Status		Source		
				NCA	EPBC	Wildlife	Museum	EPBC Database
			sucking insects. Suitable habitat present. Potential to utilise the site when in Queensland. Project is not considered to have a significant impact.					
Bird	*Poephila cincta cincta*	Blackthroated Finch	The black-throated finch occupies grassy woodland dominated by eucalypts, paperbarks or acacias, where there is access to seeding grasses and water (BTFRT 2004). Limited suitable habitat, unlikely to be present within study area.	V	E			X
Bird	*Rostratula australis*	Australian Painted Snipe	This species inhabits wetland regions. The upper reaches of the lake may provide limited suitable habitat. Possible to utilise the site.	-	V			X
Bird	*Turnix melanogaster*	Black-breasted Button-quail	Most often found in vine thicket rainforest with a closed canopy and deep litter layer. This species has also been recorded from Hoop Pine plantation, vine scrub regrowth and dry sclerophyll adjacent to rainforest. Some suitable habitat present within the study area, potential to be present within areas to be inundated.	V	V			X
Bird	*Xanthomyza phrygia*	Regent Honeyeater	Typically inhabit box ironbark eucalypt associations, and within these, prefer the wettest, most fertile sites, usually along watercourses (Garnett and Crowley, 2000). Suitable habitat present along the gullies within the study area. Likely to use the site.	E	E			X
Mammal	*Chalinolobus dwyeri*	Large-eared Pied Bat	This species is insectivorous and roost in caves and disused mines (Churchill, 1998). Utilises a variety of drier eucalypt forest habitats for feeding. No suitable roosting sites are	R	V			X

Class	Scientific name	Common name	Preferred Habitat	Status		Source		
				NCA	EPBC	Wildlife	Museum	EPBC Database
			present. The species may utilise the eucalypt forests within the study area as a feeding resource. Project not considered to have a significant impact.					
Mammal	*Dasyurus maculatus maculatus*	Spotted-tail quoll	Inhabits a wide range of habitats including rainforests and eucalypt forests. Suitable habitat occurs within the study area and it is likely to be present. Project will result in loss of habitat for this species.	V	E			X
Mammal	*Petrogale penicillata*	Brush-tailed rock-wallaby	Known released population inhabits the rocky areas around Pages Pinnacle.	V	V	X		X
Mammal	*Potorous tridactylus tridactylus*	Long-nosed Potoroo	Inhabits coastal heath and dry and wet sclerophyll forests. Thick groundcover is a major habitat requirement and it displays a preference for areas were soil is light and sandy (Johnstone, 1995). Suitable habitat occurs within the study area is it is likely to be present. Project will result in loss of habitat for this species.	V	V			X
Mammal	*Phascolarctos cinereus*	Koala	Eucalypt forests that contain a varity of preferred feeding trees. Individuals have been observed around the dam.	V#	-	X		
Mammal	*Pteropus poliocephalus*	Grey-headed flying-fox	Flowering eucalypt forests. No known camp sites are present within the study area.	C	V	X		X
Reptile	*Coeranoscincus reticulates*	Three-toed snake-tooth skink	Inhabits rainforest and wet eucalypt forests. Suitable habitat is present and project will result in loss of habitat for this species.	-	V			X

EPBC – *Environmental Protection and Biodiversity Conservation* Act 1999; NCA – *Nature Conservation Act* 1992, E – Endangered; V – Vulnerable; R - Rare # Only listed as vulnerable in South East Queensland

3.6.2 Wildlife Corridor

The remnant vegetation surrounding Hinze Dam forms part of a larger mosaic of highly diverse and interconnected remnant vegetation, including Numinbah State Forest Reserve, Springbrook National Park, Lamington National Park, Border Ranges National Park in Northern NSW and Canungra to the west. As part of this larger remnant vegetation patch it provides important ecological functions, including a refuge to flora and fauna species, linkage corridor, retention of local and regional biodiversity and maintenance of water quality.

The EPA's Biodiversity Planning Assessment (BPA) mapping for the study area (Version 3.4) shows that the vegetation surrounding the majority of dam is classified as having Regional significance. The vegetation in the south-western corner has State Significance and forms part of the declared State Wildlife Corridor. Under the GCCC Conservation Strategy Plan the entire area around Hinze Dam is mapped as Large Habitat System, as is the whole mountain region in the Gold Coast.

3.7 Aquatic Ecology

There is limited information available on the aquatic ecology of the dam and immediate upstream environments. Eight fish species have previously been recorded downstream of the dam. No threatened species have been previously recorded within or upstream of the dam.

The Hinze Dam has been stocked for recreational fishing since 1991, including Silver Perch, Australian Bass, Golden Perch, Saratoga and Mary River Cod[8].

3.8 Noise and Air Quality

Hinze Dam is located in a natural bushland and rural environment and as such there are few existing noise sources. No noise monitoring has occurred around the dam, however current noise levels are considered low with main sources including local traffic, the water treatment facility, natural noises such as bird calls and the wind.

Current air quality in the vicinity of Hinze Dam and its catchment has not been monitored but is expected to be of good quality. The main existing sources of air emissions would be local vehicle exhausts and occasional smoke from bushfires.

3.9 Social Environment

Hinze Dam is situated in a rural residential and natural bushland area and there are few residential properties in close proximity, with 50-60 residential properties within one kilometre of the dam wall/saddle dam location. The nearest residences to the existing main dam and proposed saddle dam locations are approximately 300 m north of the saddle dam and 500 m north of the main dam wall.

There are approximately 11 privately owned rural/rural residential allotments and three Council owned allotments along the Gold Coast - Springbrook Road and the Nerang-Murwillumbah Road that will potentially be affected by the proposed works.

[8] www.goldcoastcity.com.au/t_gcw.asp, 28/04/06

3.9.1 Downstream Community

The lower Nerang River flows through the suburbs of Carrara, Nerang, Burleigh Waters, Benowa, Miami, Surfers Paradise, Mermaid Waters, Main Beach, Robina, Mudgeeraba and Burleigh Heads. Major rainfall events in the Nerang River catchment can cause flooding to rural, residential, commercial, industrial, community use and publicly owned properties and infrastructure within these suburbs.

Table 7 shows the likely number of properties (residential, business and other) and the estimated total damage cost for various statistical flood events in 2001 dollars (SKM, 2002).

Table 7 Flood Related Damages – Current Situation

Flood Event ARI	Properties Inundated	Estimated Total Damage Cost ($M)
1 in 10 year	195	$13.88
1 in 20 year	300	$18.44
1 in 50 year	782	$37.16
1 in 100 year	4,148	$146.65
1 in 200 year	7,692	$292.06
1 in 500 year	11,309	$556.21
Probable Maximum Flood	22,653	$1,416.66

3.10 Cultural Heritage

A search of the Aboriginal Cultural Heritage register has not been undertaken for lands affected by the project, nor has a cultural heritage survey been undertaken. In any case, most of the affected area is covered with remnant vegetation and hence, there is potential for as yet undiscovered sites to be identified during vegetation clearing.

Searches of the Queensland and National Heritage Registers have not identified any listed items of European Cultural Heritage. Some structures such as bridges and buildings that may be affected by HDS3 Project may have cultural heritage significance. An historic gravesite is located near the current FSL on the western side of the Nerang River branch. The site will be inundated with the raising of the dam wall.

3.11 Traffic and Access

Currently, access to the Hinze Dam wall is via Advancetown Road, from the Nerang-Murwillumbah Road. Land use along these roads is predominantly rural residential and low density residential. Access is also possible via Gilston Road. The main roads in the area that are likely to be affected by the project for the movement of equipment, quarry materials and personnel are the Nerang-Murwillumbah Road and Gold Coast – Springbrook Road.

4. Potential Impacts and Management Requirements

The following outlines the key areas of potential impact of the project and investigation areas to be conducted for the EIS. Where possible impacts have been described as insignificant, minor, moderate or major.

4.1 Land Resources and Infrastructure

Raising of the Hinze Dam wall will permanently change the topography in the vicinity of the wall, adding approximately 12.5 to the wall height at the dam wall and saddle dams. Quarrying activities will also permanently remove rock from the identified quarry sites.

The water level in the impoundment will increase by approximately 10 m. Due to the steepness of the Nerang and Little Nerang valleys this increase does not equate to a significant expansion in the surface area of the dam, however the raising will result in effectively permanent inundation of an additional 1388 ha of land. Some additional land areas will also be more likely to flood, including infrastructure such as the Nerang-Murwillumbah Road and Gold Coast-Springbrook Road.

The project will result in the permanent inundation and subsequent loss of land currently located within the Numinbah State Forest Reserve along the Nerang River. It is expected that this State Forest will be designated as National Park and areas to permanently inundated will need to be revoked from the National Park status. In addition to the above, further areas of State Forest will be temporarily affected during Q100 flood events and PMF events.

4.2 Visual Amenity

The HDS3 project may generate some short-term loss of visual amenity as a result of the quarrying, construction and land clearing. Restricted access to recreation areas overlooking the dam, and subsequent relocation of these facilities will impact on visual amenity to a limited extent.

Private properties in the vicinity of the dam are not expected to incur any long-term loss of visual amenity.

4.3 Land Use and Tenure

The HDS3 Project will result in the following impacts on private, Council and State owned land:

- Permanent inundation of State owned State Forest Reserve and Council land within the CID;
- Q100 flooding events will inundate sections of two privately owned, two Council owned and one State owned properties. One Council owned house will potentially be inundated during a Q100 flood event.
- A PMF flood event could potentially impact on sections of seven privately owned lots in addition to those affected by a Q100 flood.
- No existing privately owned houses will be affected by the project.

It is not anticipated that the HDS3 Project will result in any additional restrictions on land use in the catchment.

4.4 Soil and Sediment Erosion

The project will require the clearing of vegetation between the current FSL and the proposed FSL and there is a high potential for soil erosion to occur, especially on steeper slopes. The high rainfall tendency of the region means the potential and severity of erosion to occur is exacerbated. The main consequences of erosion are loss of topsoil/subsoil and degradation in water quality. To minimise the risk of soil erosion, a detailed erosion and sediment control plan will be included in the construction Environmental Management Plan and be implemented during the construction phase.

4.5 Water Quality

Key potential impacts associated with the project on water quality include sedimentation of the water column from increased erosion associated with vegetation clearing and quarry activities and contamination of water with hydrocarbon and other chemicals from construction activities. Given the importance of maintaining water quality in Hinze Dam as Gold Coast's main water source, a detailed erosion and sediment control plan will be included in the construction Environmental Management Plan and be implemented during the construction phase.

A suitable erosion and sediment control plan will, if properly implemented, minimise the risk to water quality from sediment releases. The construction Environmental Management Plan will also contain a hazardous substances management plan relating to all aspects of construction where a leak or spill of hydrocarbons could occur. This plan will include emergency response measures covering incidents involving hydrocarbons.

Water quality monitoring prior, during and post construction at key locations around the impoundment will need to be incorporated into the Construction Environmental Management Plan to monitor and manage risks to water quality.

4.6 Hydrology

4.6.1 Environmental Flows

Environmental Flow Objectives for the Nerang River are being established as part of the Gold Coast Water Resource Plan and will be incorporated into the Resource Operations Plan and any Resource Operations Licences for the Nerang River. The Environmental Flow Objectives will take into account the need to maintain water quality and protect aquatic ecosystems in the Nerang River downstream of Hinze Dam. Given implementation of these Environmental Flow Objectives, it is expected that downstream impacts will be minimal.

The Nerang River flows into the southern Broadwater and Hinze Dam is located approximately upstream from the Broadwater. The northern Broadwater (north of the Gold Coast seaway) is within the Moreton Bay Marine Park and is also a Ramsar Wetland. The influence of changed outflows from the Nerang River on these features as a result of the HDS3 project is not expected to be significant. The State Government's Environmental Flow Objectives will take this potential downstream sensitivity into consideration.

4.6.2 Flooding

The proposed raising of Hinze Dam will not increase the velocity of flows in the catchment. Velocity of flows in major flood events may be reduced in the Nerang River downstream of Hinze Dam due to the flood storage capacity to be provided in the raise dam.

The project will reduce the frequency and height of large-scale flood events, which may in turn affect downstream aquatic organisms that rely on large flood events as triggers for key behavioural responses such as breeding or replenishing food resources. Further studies should be undertaken on the requirement for downstream aquatic species to determine the reliance on flood events.

4.7 Terrestrial Flora and Fauna

The project will result in the permanent loss of 257 ha remnant vegetation due to clearing below the proposed FSL and cause temporary impacts associated within inundation on a further 226 ha and 205 ha of remnant vegetation during Q100 and extreme PMF flood events respectively[9]. Further vegetation will be lost as a result of construction activities such as quarries.

The project will result in a loss of remnant vegetation in the area, including loss of suitable habitat, refuge and feeding resources for potentially 52 threatened flora and 17 threatened fauna species listed under State and Commonwealth legislation. Further detailed flora and fauna studies are required to determine the likelihood of these threatened flora and fauna occurring on site. The project will have minor impacts on habitat fragmentation and the existing functionality of fauna movement corridors in the area.

The impacted land area is expected to be offset by the provision of compensatory habitat. The intent of the compensatory habitat is to mitigate any loss of vegetation or ecosystem function which would otherwise result from the project. Within the region of the impacted area there is the potential to use the compensatory habitat to secure and restore critical missing links in GCCC's nature conservation network, particularly within Numinbah Valley. The location and quantum of the compensatory habitat will be subject to negotiation with the Queensland Government.

Operation of the dam could result in a gradual permanent change in vegetation communities around the impoundment to those commonly found in a riparian environment. This could lead to changes in habitat and potential loss or gain in habitat suitability for specific threatened flora and fauna species. Infrequent and temporary inundation of habitat that supports threatened flora and fauna species during flood events will occur, however is not considered significant.

4.8 Aquatic Ecology

Freshwater aquatic flora and fauna upstream and downstream of the Hinze Dam may be affected by the project through changes in downstream environmental flows and direct loss of in-stream habitat.

Environmental flow objectives currently being prepared for the Nerang River will take into consideration the need to provide sufficient flows to protect freshwater aquatic ecosystems and provided these objectives are meet, impacts from the operation of the dam should be minor.

The loss of in-stream habitat is not considered significant as similar habitat will be available upstream of the proposed inundation areas for aquatic species dependent on shallow and rocky stream environments.

[9] These areas are based on the EPA certified regional ecosystems mapping (Version 5.0).

Another potential impact will be the impediment to fish movement, however the existing dam has been in place for 30 years without any fish movement devices. Further studies will be undertaken as part of the EIS to identify which species may require a fishway. An application to Department of Primary Industries to obtain a Waterway Barrier Works Approval will be required for the project.

4.9 Noise and Vibration

Major noise sources during construction include:

» Blasting and crushing of rock at quarries;

» Heavy earthmoving equipment;

» Haulage vehicles;

» Concrete batching plant; and

» Road works associated with realignment of the Gold Coast-Springbrook Road and Nerang-Murwillumbah Road.

Noise from construction activities is likely to be audible to nearby residences, in particular those proximal to the main and saddle dam walls and be of sufficient levels to cause nuisance. A detailed noise impact assessment incorporating acoustic modelling will be required as part of the EIS to quantify the potential level of disturbance from dam wall/saddle dam construction and outline mitigation measures.

Blasting is likely to be necessary at some of the quarries to extract rock and this can create ground vibration that can damage structures and houses. A detailed assessment of potential vibration impacts will be required for quarries located proximal to houses to ensure that impacts on houses can be controlled.

4.10 Air Quality

Major sources of potential air quality impacts include:

» Dust generation from earthworks, concrete batching, vehicle movement and quarrying activities; and

» Exhaust emissions from haul vehicles and earthmoving equipment.

Dust impacts from construction activities can be readily controlled by measures including wetting of dusty surfaces and are not likely to be significant. Exhaust air emissions tend to be localised and are unlikely to affect sensitive receptors more than a hundred metres away from the source.

4.11 Greenhouse Gas Impacts

Greenhouse gas emissions for the project are anticipated to be minor and related to construction traffic and equipment during the construction phase. Operation of the dam should result in very minor greenhouse gas emissions. There will also be a minor net loss of vegetation around the dam that assists in trapping and converting greenhouse gases.

An assessment of potential sources and volume of greenhouses to be generated during the project is to be undertaken as part of the EIS in accordance with the requirements of the Australian Greenhouse Office (AGO).

4.12 Cultural Heritage

Clearing of vegetation for the project could uncover Aboriginal cultural heritage items or sites. Under the *Aboriginal Cultural Heritage Act 2003* this project is considered a Category 5 and as such the following process to manage risk to cultural heritage materials needs to be followed:

» Aboriginal parties with an interest in cultural heritage at the project site will be identified;

» Typically, these parties will undertake an archaeological survey of the project area to identify sites or potential sites; and

» A Cultural Heritage Management Plan (CHMP) will be prepared for the project. The CHMP sets out how known and unknown Aboriginal cultural heritage material will be dealt with during and after construction.

There is limited European heritage in the area, however a known gravesite of early settlers will be investigated for relocation.

A cultural heritage study of the area will be undertaken as part of the EIS.

4.13 Social and Economic Impacts

The HDS3 project will have considerable social benefits through downstream flood mitigation and additional water storage capacity. There will be some detrimental impacts on local residents associated with the construction phase, however these will be temporary and able to be managed through an EMP.

The lower Nerang River flows through dense residential and commercial areas and the project will substantially reduce the impacts and costs of significant flood events on these downstream properties. The amount of damage and cost reduction depends on the final flood storage volume and Table 8 provides a range of flood storages verus cost reductions[10].

Table 8 Estimated Reduction in Flood Affected Properties

Flood Event	Flood affected properties (Base Case)	Flood affected properties (60,600 ML storage)	Flood affected properties (92,800 ML storage)
1 in 10	195	99	100
1 in 20	300	177	198
1 in 50	782	291	297
1 in 100	4,148	735	736
1 in 200	7,692	1,966	1,664
1 in 500	11,309	4,321	3,426
PMF	22,653	8,647	6,854

[10] Based on studies undertaken by SKM (2002)

The dam safety component of the project likewise provides potential for significant potential social and economic benefits in the event that the upgrade serves to avoid a dam failure event.

The project includes a proposed increase in water storage capacity of Hinze Dam. This will increase both the quantity and reliability of water supply to the Gold Coast. This is particularly significant in the light of drought conditions suffered in the past 2-3 years, during which Hinze Dam levels fell below 30% capacity and residents and business operators in the Gold Coast were subject to severe water restrictions.

There will be a temporary loss or impact to recreational and other facilities around the dam and these will need to be relocated.

4.14 Employment

The project will result in increased employment during the design and construction phase. It is anticipated that during the peak construction period approximately 450 on-site jobs will be created. A significant proportion of the employment and small business opportunities provided by the project are expected to benefit the local area. The scale of investment in the project implies significant short term income, skills development and business growth opportunities which can be expected to provide multipliers and ongoing benefits for the local economy.

Given the level of available housing and services within the area, imported labour required for the project is not considered to negatively impact on the local community.

4.15 Traffic Management

Existing traffic levels and patterns in the area are not known and a traffic impact assessment study will be required as part of the EIS.

Sections of the Gold Coast-Springbrook and Nerang-Murwillumbah Road will be inundated by the project during Q100 and PMF events and access to Springbrook village would be cut at these times. The project will include road and bridge upgrades and realignment to provide flood immunity. Sections of private property will be affected with these upgrades.

4.16 Hazard and Risk

The potential hazard and risks of the project will be controlled in accordance with relevant legislation and codes of practise.

The transport of fuels, chemicals and quarry material to and from the site will conform to relevant guidelines. Emergency procedures will be implemented including fire fighting and medical systems. Fuel and chemicals are to be stored outside of the catchment are for the impoundment and are to be bunded in accordance with Australian Standards. Sediment and erosion control devices are to be installed downslope of all stockpiles, clearing areas and quarrying sites and are to be as per the *Soil Erosion and Sediment Control-Engineering Guidelines for Queensland Construction Sites (1996)*. Regular safety and emergency training will be undertaken.

A preliminary assessment of the likely hazards and risk for the HDS3 Project will be undertaken as part of the EIS.

5. Monitoring and Reporting

It is important that a detailed and practical Environmental Management Plan is prepared for the specific purpose of ensuring minimal environmental impact as a result of quarrying, construction and clearing activities. Strict monitoring of the contractors' operations will be required in order to ensure compliance with the Environmental Management Plan.

6. Conclusions

The key potential impacts and issues of the HDS3 Project are summarised below:

» Temporary increase in sedimentation and degradation of dam water quality as a result of clearing activities around the impoundment area;

» Permanent loss of remnant vegetation and habitat for threatened flora and fauna species;

» Temporary impacts to local residents during construction activities; and

» Substantial benefits to residents of the Gold Coast through increased water supply and reduction in downstream flood potential and damages.

Further studies are to be undertaken as part of the EIS to determine the extent and severity of potential impacts of the project on both the dam and downstream environment, however provided appropriate mitigation measures are implemented the project is not considered to cause substantial loss of biodiversity or social disruption. It has significant social benefits, particularly in flood mitigation and also security of future water supply. Some of the potential impacts will be irreversible, however in general it is considered the potential impacts especially those construction related are short term and largely manageable.

Consultation with the relevant State and Commonwealth Government Agencies should be undertaken to identify the need for and scope of any environmental impact assessment. Draft Terms of Reference for an Environmental Impact Study will be prepared and advertised for public comment. Agency and community comments will be incorporated into a Final Terms of Reference for the Environmental Impact Study, which will be prepared in 2006/7.

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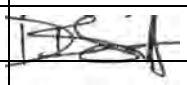
0	L. Eykamp	B. Skarratt		B. Skarratt		01/08/06