Table of Contents

Figures

Tables

3. Project Description

3.1 Location and General Description of the Project

3.1.1 Project Area

Hinze Dam is located within hinterland of the Gold Coast in South East Queensland approximately 18 km from Nerang and downstream of the confluence of the Nerang River and Little Nerang Creek.

The major streams of the Nerang River catchment are the Nerang River, Little Nerang Creek and Mudgeeraba Creek. The total area of the catchment is 495 km^2. The headwaters for the Nerang River catchment streams are in the McPherson ranges, which is a forested area, generally in an undisturbed condition. The Nerang River and Little Nerang Creek flow north easterly, through predominantly agricultural land, before converging at Hinze Dam. Downstream of the dam the Nerang River continues north east through foothills and the township of Nerang before heading east across floodplains towards the coast. Mudgeeraba Creek joins the Nerang River a few kilometres upstream of the Southport broad water, where the river enters the ocean.

Approximately two thirds of the Nerang River catchment is rural and forest, comprising National Parks, conservation areas and rural residential allotments. The remainder of the catchment is more densely developed with greater diversity of activities including industrial, commercial and medium to high density residential areas.

3.1.2 Hinze Dam Stage 3 Project

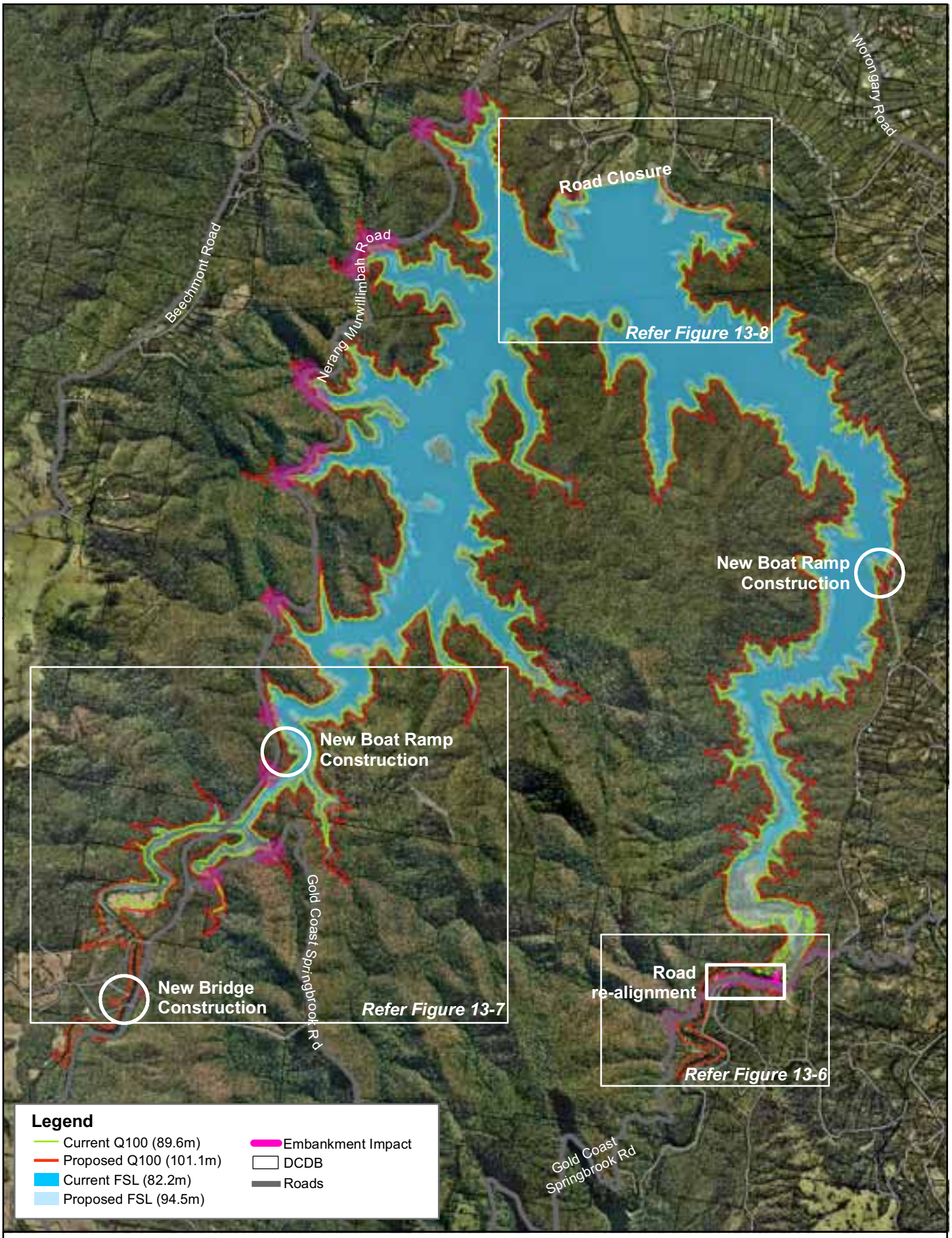
The purpose for raising of the wall for the Hinze Dam Stage 3 project is to provide improved flood mitigation, increase the overall capacity of the dam and to make the dam compliant with current dam safety guidelines and standards.

Hinze Dam Stage 3 works will be undertaken over a period of approximately 36 months with the majority of the works occurring in the immediate vicinity of the existing dam wall at the northern end of the CID area. In addition to the areas surrounding the dam wall and saddle dam, construction works will also occur at the upper intake tower where upgrading works are required, within the road network surrounding the site, surrounding the new full supply level of the dam where vegetation clearing is required, and at the site of both the upstream eastern and western boat ramps. The extent of construction works and infrastructure works to be undertaken as part of the project is shown on **Figure 3-1**.

3.1.3 Current Structure and Facilities

Hinze Dam currently comprises a number of structures and facilities that provide for the functioning of the dam and support for associated activities such as recreation. The current structure and facilities at the Hinze Dam include:

- central core earth and rockfill main embankment and saddle dam;
- concrete spillway;
- two intake towers, the lower tower located adjacent to the embankment, and the upper tower located on the Little Nerang Creek arm of the dam;
- pump stations associated with each of the intake towers;
- break of head tank;
- hydro-electricity generating device;
- outlet for the release of environmental flows;
- rangers facilities, including offices and sheds;
- three dwelling houses owned by Gold Coast City Council;
- koala food tree plantations;
- road infrastructure;



N

0 0.5 1 2

Kilometres

Scale - 1:50,000

Projection: MGA Zone 56

Figure 3-1

Site Construction Works

Hinze Dam Stage 3 EIS

- cafe;
- lookout;
- passive recreation facilities, including picnic areas, BBQs, picnic shelters, playground equipment;
- active recreation facilities including multi-purpose recreation trails;
- toilet facilities;
- two formal boat ramps located to the east and west of the dam wall;
- two informal boat ramps located on the upper reaches of the eastern and western arms of the dam;
- water based rowing infrastructure; and
- land based rowing infrastructure incorporating a site hut and shelter.

3.1.4 Construction Footprint

The bulk of the construction works associated with Hinze Dam Stage 3 will occur in the vicinity of the dam wall, whilst other works will also occur throughout the Community Infrastructure Designation boundary and within the surrounding road network.

Details of the construction activities to be undertaken as part of this project and their location on the site are detailed in the following parts of this section.

3.2 Proposed Works

3.2.1 Overview

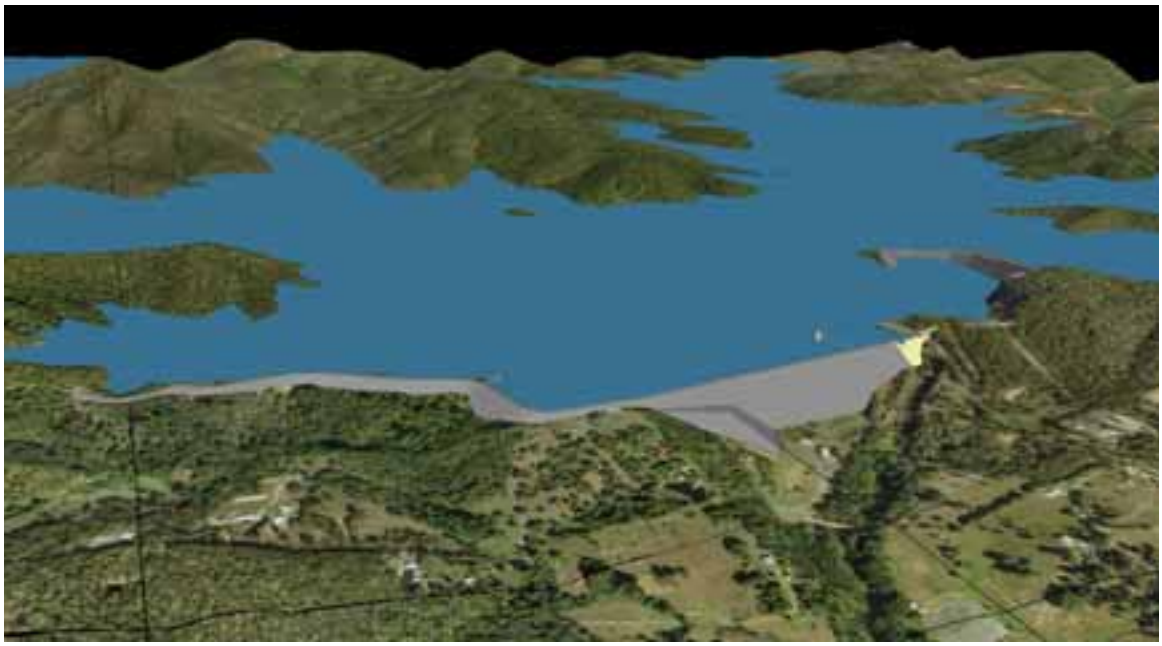
The works comprising the Hinze Dam Stage 3 are detailed in the following sections with a summary of the proposed change in the characteristics of the dam provided in **Table 3-1**.

Table 3-1 Hinze Dam Storage Characteristics

	Current Stage 2	Stage 3	Change
Full Supply Level (FSL)	82.2m AHD	94.5m AHD	12.3 m
Storage Capacity	161 070 ML	309 700 ML	148 630 ML
Surface Area	972ha	1505ha	533 ha
Catchment Area	209.1km^2	209.1km^2	nil
Dam Crest Level (DCL)	93.5m AHD	108.5m AHD	15 m
Dam Yield	209 ML/day	225 ML/day	
Maximum Depth	57.2m	69.5m	12.3m
Average Depth	-	20m	-
Spillway Capacity	2330 m^3/s at PMF level 92.7m AHD	3900 m^3/s at PMF level 108.35m AHD	1570 m^3/s
Design Flood	PMF	PMF	-
Maximum Flood level	92.7m AHD	108.35m AHD	15.65m
Peak Outflow	2330 m^3/s	3900 m^3/s	1510 m^3/s
AEP of Flood	Not defined	>1 : 5 000 000 yr	Defined
Freeboard	0.8m	0.15m	-0.65m
Peak Outflow Q100 Flood	1100m^3/sec	550 m^3/sec	50% attenuation
Mean period between spills	1 year	1.7 years	0.7 years
Dead Storage Level	45.6m AHD	45.6m AHD	-

A perspective view of the completed Stage 3 dam is shown in **Figure 3-2**.

■ **Figure 3-2 Hinze Dam Stage 3 - Conceptual Image**



3.2.2 Barrier/Embankment Structures

Embankment

The embankment works for project involve raising the dam crest level by 15m from its present elevation of 93.5m AHD to EL 108.5m AHD. The works comprise a 1690m long embankment up to 80m in height on the eastern side of the spillway. This structure incorporates a main embankment and saddle dam, and a low height embankment in the saddle area to the west of the spillway. **Table 3-2** provides a summary of the embankment works to be undertaken in comparison with the current dam structure.

■ **Table 3-2 Hinze Dam Embankment**

Embankment Details - Main Embankment			
	Current Stage 2	**Proposed Stage 3**	**Change**
Embankment Type:	Central core earth and rockfill		nil
Crest Length:	600m	750m	150m
Maximum Height:	63.5m	78.50m	15m
Crest Width	10.8m	10m	- 0.8m
Embankment Slopes:	Upstream 1.5H:1V Downstream 1.4H:1V (2H:1V above RL 85.28)	Upstream 1.5H:1V Downstream 1.4H:1V	
Embankment Details - Saddle Dam			
	Current Stage 2	**Proposed Stage 3**	**Change**
Embankment Type:	Central core earth and rockfill		nil
Crest Length:	140m	940m	800m
Maximum Height:	8.5m	23.50m	15m
Crest Width	8m	7m	- 1m
Embankment Slopes:	Upstream 1.5H:1V, Downstream 1.5H:1V		nil

The construction of the embankment incorporates a range of excavation and foundation preparation works. The key works to be undertaken during construction are:

- foundation stripping of areas at the downstream toe of the main embankment (up to 10 to 12m depth), on the right abutment of the main embankment (typically 3 to 8m deep), and at the saddle dam extension. These works are undertaken to remove existing fill;
- construction of a single line grout curtain on the saddle dam extension with an estimated length of 300m;
- construction of a series of drainage trenches at the downstream toe of the main embankment right abutment, saddle dam and saddle extension; and
- undertake general fill of the area downstream of the main embankment on the right abutment to address instability of the natural slope.

Spillway

The modifications to the main spillway are a key element of the project and consist of raising the existing mass concrete spillway to accommodate the raised FSL, flood mitigation and dam safety requirements. The spillway works to be undertaken as part of this project in comparison with the current dam structure are detailed in **Table 3-3**.

Table 3-3 Hinze Dam Spillway

	Current Stage 2	Proposed Stage 3	Change
Spillway Type:	Ungated overflow gravity structure with slot and ogee crest shape		nil
Spillway Crest:	82.2m AHD (lower crest) 89.2m AHD (upper crest)	94.5 m AHD (lower crest) 100 m AHD (upper crest)	12.3 m AHD (lower crest) 10.8 m AHD (upper crest)
Stilling Basin Floor Level:	60.0 m	60.6 m	0.6 m
Spillway Width:	60.0 m total 24.5 m slot	75 m total 12.25 m slot	15 m total -12.25 m slot
Energy Dissipation:	Dissipater channel		nil
	Concrete weir (existing crest to be raised)		1m
	Chute (some existing walls to be raised)		1m
	Flip bucket (to be raised)		1.5m

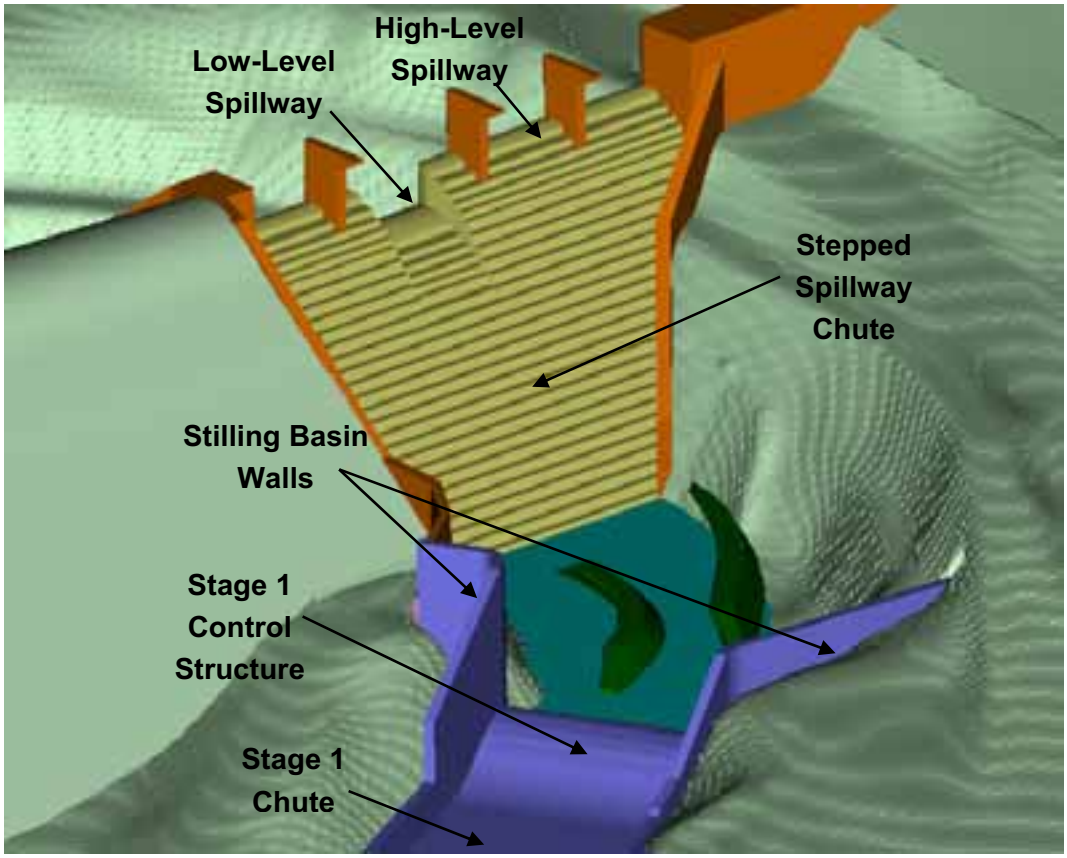
The Stage 3 works are similar to the current spillway arrangement with a low-level crest for the passing of more frequent flows and a high-level crest to pass the less frequent flows up to the Probable Maximum Flood (PMF). A 3-D visualisation of the stage 3 spillway is shown in **Figure 3-3**.

Works to be undertaken for the construction of the spillway include:

- concrete raise of the existing overflow sections. The Stage 3 spillway will have a two level crest similar to the existing spillway. The arrangement will comprise a 12.25 m long lower crest at EL 94.5 m with two adjacent overflow crests at EL 100.0 m giving a total crest length of 75 m;
- construction of a concrete non-overflow section on the left abutment of the spillway. This will be approximately 60 m in length and a minimum of 10.5m in width to accommodate the spillway access road;
- raising of the existing dam abutment wall to following the line of the raised embankment. Both the upstream and downstream sections of this wall will be buttressed with mass concrete to the main spillway;

- construction of a new road bridge across the entire width of the spillway. Four bridge spans are required with a maximum span of approximately 25m;
- the energy dissipation for the Stage 3 spillway will be achieved by using a stepped spillway chute and by an hydraulic jump in the stilling basin;
- the base of the stilling basin will be concrete lined and anchored into the rock foundation and drained;
- raising the crest for the Stage 1 spillway chute by approximately 1 m and subsequent raising of the left training wall by 1 m to maintain the existing capacity of the chute;
- raising of the right training walls to protect the toe of the embankment during the PMF; and
- construction of a flip bucket structure consisting of 10 dentates, 1.5 metres high and 1.5metres wide to disperse the flow jet, increase the impact surface area in the plunge pool, and reduce the potential for erosion at the base of the plunge pool.

- **Figure 3-3 Stage 3 Spillway – Proposed Design**



Intake Towers

For the raised FSL and raised embankment, modifications are required to the intake towers and outlet works. A description of the lower intake tower and outlet in comparison with the existing dam is provided in **Table 3-4**.

Table 3-4 Hinze Dam Lower Intake Tower and Outlet

	Current Stage 2	Proposed Stage 3	Change
Outlet Type and Description:	Multi level intake tower (existing structure to be raised)		15m
Off-take Description:	Eight off-takes (1500mm dia.)	Eleven off-takes (1500mm dia.)	Additional three off-takes
	One scour outlet 600mm dia.		nil
	One off-take 225mm with needle valve for riparian releases		nil
Outlet Pipe:	1440mm dia. Main pipe 806mm dia. Scour pipe		nil

Key features of the works to be undertaken on the intake towers and outlet works include:

- raising the lower and upper intake towers by 15 metres. This will include modifications to the intake arrangements for the raised FSL to provide additional variable draw off points with electrically operated butterfly valves;
- raising the existing lower and upper intake access bridges to the new embankment crest level. This includes construction of piers at the existing abutments and installation of new bridge spans;
- extension of the outlet conduit by approximately 25m to the toe of the raised embankment, some modifications to the outlet works and instrumentation gauge house arrangement will be required and undertaken as part of the project; and
- modifications will be undertaken to the lower pump station and break of head tank components, including the installation of variable speed drives on the existing pumps, replacement of the backup diesel generator and upgrade of the main electrical infrastructure within the pump station.

3.2.3 Inundation Areas and flooding

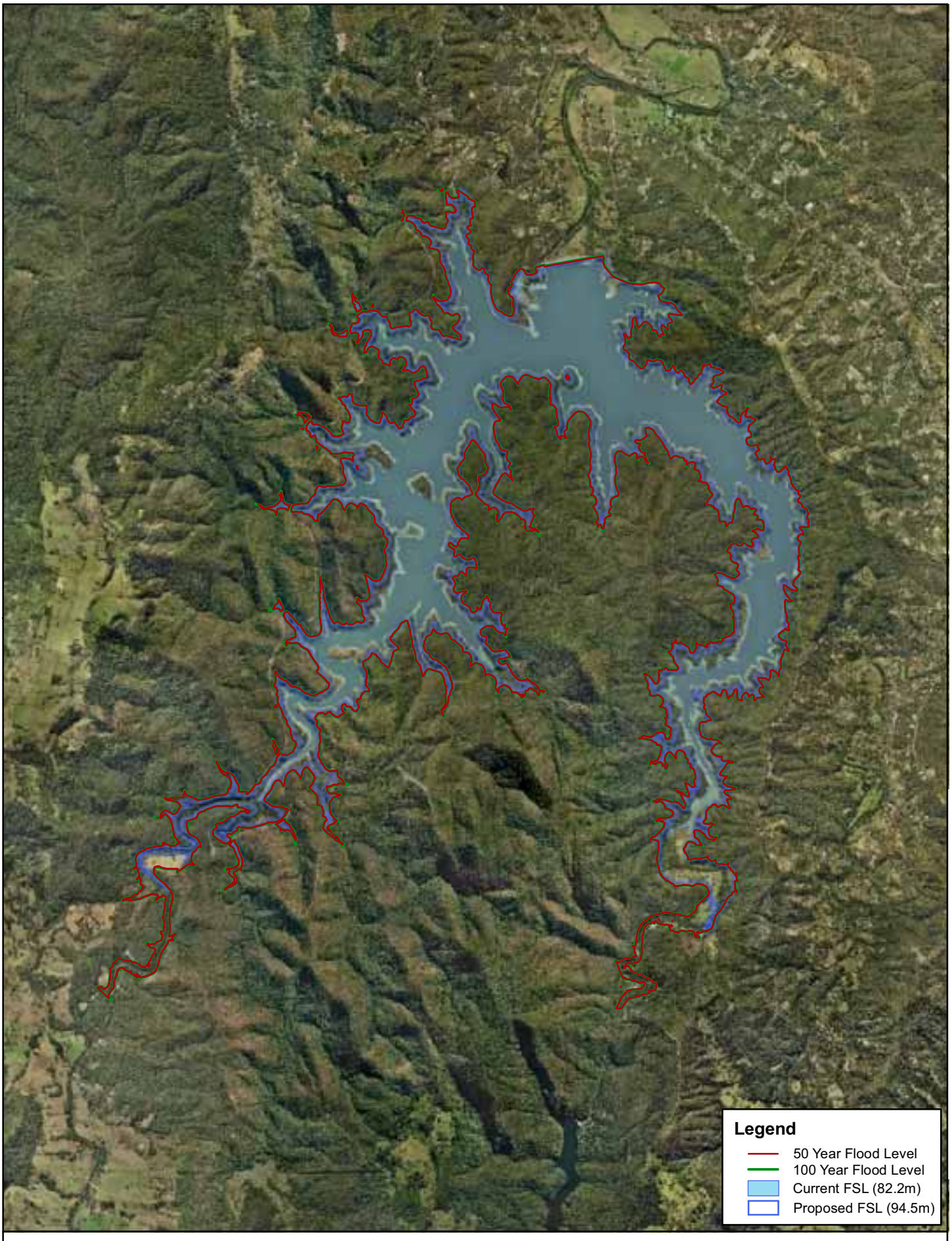
Full Supply Level

The FSL of HDS3 will be raised to 94.5m. This represents a surface area of 1505ha, which is an increase of 533ha from the current full supply level of 82.2m. **Table 3-5** shows the inundation area at a range of water levels.

Table 3-5 Hinze Dam Stage 3 Inundated Areas

Water Level (m AHD)	Inundated Area (ha)
80.0	887
82.2	972
85.0	1083
90.0	1297
94.5	1505
100.0	1779

The impact of the full supply level and the 1 in 50 year and 1 in 100 year flood events on the CID area, and adjacent land is detailed in **Section 6** of this EIS. The full supply level for the project, along with the 1 in 50 year and 1 in 100 year flood levels are shown on **Figure 3-4**.



N

0 0.5 1 2

Kilometres

Scale - 1:60,000

Projection: MGA Zone 56

Figure 3-4

Full Supply Level and Flood Levels

Hinze Dam Stage 3 EIS

Flood Levels

Upstream Flooding

Upstream flood modelling has been conducted with 10 modelling scenarios completed as part of this project to assess the change in the inundated area. These modelling scenarios were conducted for Stage 3 for the 100, 50, 20, 10 and 5 year AEP storms.

The peak flood heights for Hinze Dam Stage 2 and Stage 3, and the change in area of inundation are detailed in **Table 3-6**. The modelling indicates that the level of impact that the project will have on the upstream inundated area is very consistent across the range of flood events tested.

The flood modelling is addressed in detail in **Section 7** of this EIS while the impacts on upstream properties are detailed in **Section 6**.

Table 3-6 Flood Levels and Area of Inundation

Flood Frequency (AEP)	Peak Flood Level at Hinze Dam (m AHD)		Change in Inundated Area (ha)
	Stage 2	Stage 3	
100	89.61	101.03	+ 415
50	88.87	100.30	+ 416
20	88.11	99.51	+ 415
10	87.07	98.55	+ 419
5	86.23	97.76	+ 423

Nerang River Flood Impacts (Western Arm)

The peak flood levels for the current dam and the proposed Stage 3 coincide between Nerang-Murwillumbah Road Bridge and Pocket Road Bridge, approximately 1 km downstream of Pocket Road Bridge on the Nerang River. Upstream of this point there is no further impact on flood levels from the proposed Stage 3 upgrade. Properties on the Nerang River will not be affected by changes to flood levels caused by the proposed Stage 3 upgrade.

The Numinbah Forest Reserve covers an area of approximately 2184 ha and is located immediately adjacent to the CID area. The FSL and the 1 in 100 year ARI flood event will extend over part of the Numinbah Forest Reserve. The Numinbah Valley Environmental Education Centre is located within Numinbah Forest Reserve with some impact on the area currently used by this centre. The extent of the impact on the forest reserve is addressed in further detail in **Section 6** and shown on **Figure 6-12.**

There are two bridges on the Nerang River, upstream of Hinze Dam, which are potentially affected by flooding. These are the Nerang-Murwillumbah Road Bridge and the Pocket Road Bridge. The Nerang-Murwillumbah Road Bridge does not overtop in the 1 in 100 year ARI flood for the current or proposed dam configurations.

The Pocket Road Bridge has a current flood immunity of less than the 1 in 5 year ARI event based on the current deck level of RL 98.0 m AHD. The peak flood levels at the bridge site predicted for the 5 year through to the 1 in 100 year ARI floods are not affected by the proposed works, however, the time of submergence will increase for all events. As part of the project works the Pocket Road Bridge will be raised to approximately 104.0 m AHD ensuring a flood immunity of 1 in 10 year ARI. This will result in a significant improvement to the level of service provided to the residents of the Pocket Road district with the total time of submergence for the 1 in 100 year ARI flood reduced from 76 hours to approximately 7 hours. The location of the Pocket Road bridge upgrading and other infrastructure works to be undertaken on the western arm of Hinze Dam is shown on **Figure 13-7** in **Section 13**.

The proposed Stage 3 FSL and associated flood levels will impact on some of the road embankments along the Nerang-Murwillumbah Road and the western end of Gold Coast-Springbrook Road (near Pine Creek). Works are proposed to further investigate these embankments to ensure their safety and stability is not compromised. These works are described in **Sections 6 and 13** of this EIS.

Little Nerang Creek Flood Impacts (Eastern Arm)

The modelled peak flood levels for the current dam configuration and proposed Stage 3 coincide approximately 400 m downstream of Springbrook Road Bridge on Little Nerang Creek. Upstream of this point there is no further impact on flood levels from the proposed Stage 3 upgrade.

Five freehold land parcels on Gold Coast-Springbrook Road adjacent to Little Nerang Creek will be affected by the changed 1 in 100 year flood level (refer to **Figure 6-11**). Two of these properties are currently owned by GCCC. These properties will be partially inundated for a short period of time during the 1 in 100 year ARI flood, but there are no houses affected. Easements are proposed for the areas inundated during flood events and communications with the owners of these properties has commenced and every effort will be made to obtain these through voluntary agreements with land holders. The process for obtaining easements over these areas will be finalised during the detailed design phase of the project.

The Springbrook Road Bridge over Little Nerang Creek is potentially affected by flooding and was investigated for flood impacts. This bridge does not overtop in the 1 in 100 year ARI flood for either the current or proposed dam configurations.

A section of the Gold Coast Springbrook Road downstream of the Springbrook Road Bridge has an existing flood immunity of approximately 1 in 50 year ARI. The proposed Stage 3 dam will increase flood levels and will reduce the current level of flood immunity. To mitigate these impacts the road will be raised to an elevation of approximately 100.3 m AHD to provide an immunity of 1 in 50 year ARI. The final level will be determined in the detailed design phase in consultation with the Department of Main Roads. These works are addressed further in **Section 13** and shown on **Figure 13-6**.

Downstream Flooding

One of the main drivers for the project is the need for increased flood mitigation on the Nerang floodplains. The intent being to achieve a 50% reduction in peak flows from the dam up to a 1 in 100 year ARI. Currently 4441 properties, including 4212 residential and 229 commercial/industrial properties, downstream of Hinze Dam could be affected in a 1 in 100 year ARI flood event. If this project does not proceed it is unlikely a significant reduction in flood risk could be achieved via any other means.

The economic and social impacts of a major flood on the Nerang River floodplain would be significant at a local, regional and national level. Flooding would affect properties, tourists and the tourism industry, community facilities, potentially causing loss of life and significant psychological stress to residents. The flood impact has been assessed for the current dam and the proposed Stage 3 works for flood peak levels, flood peak discharge, affected area, cost of damage and number of affected properties.

Table 3-7 summarises the peak instantaneous flood discharge directly downstream of Hinze Dam for the current dam configuration and for Stage 3. As shown in the table the proposed Stage 3 design meets the flood mitigation criteria.

- **Table 3-7 Hinze Dam Outflow Peak Discharges**

Flood Frequency	Peak Outflow (m^3/s)		
(ARI)	Current Stage 2	Proposed Stage 3	Reduction (%)
10	594	208	65 %
20	759	268	65 %
50	919	396	57 %
100	1113	558	50 %

Table 3-8 summarises the reduction in the flood affected areas downstream of Hinze Dam due to the reduction in peak flood discharges.

- **Table 3-8 Flood Affected Areas**

	Area (km^2)		
Flood Frequency	Current Stage 2	Proposed Stage 3	Reduction
Q10	36.6	34.4	6%
Q20	39.3	37.2	5%
Q50	43.6	39.7	9%
Q100	49.7	43.5	13%
Q200	53.9	46.5	14%
Q500	59.4	50.2	15%
Q1000 - 48 hr	65.7	60.5	8%
Q10K – 48 hr	73.0	70.6	3%
PMF – 36hr	81.4	80.5	1%

Source: GCCC 2007

3.2.4 Stream Bed Impacts

Downstream Impacts

The Hinze Dam Stage 3 construction works downstream of the dam wall are limited to the upgrade of the spillway and the construction of the fish transfer device. No additional permanent works will be undertaken to the downstream bed of the Nerang River. Details of the spillway works are contained in **Section 3.2.2**, and the proposed fish transfer device is outlined in **Section 3.5.2**.

Some construction works will be undertaken within the Nerang River immediately downstream of the spillway. These works will be undertaken to enable construction of the haul roads and the spillway and fish transfer. These are described in **Sections 3.3 and 3.4**.

Upstream Impacts

The increase in the full supply level and the area of inundation, and changes to the upstream flood levels will have some impact on the watercourses above the dam. The flood impacts on these are addressed more fully in **Sections 6 and 7**, while the Terrestrial and Aquatic Ecology sections (**Sections 9 and 10**) also address these potential impacts.

3.3 Pre-Construction Activities

3.3.1 Overview

The main focus of the initial site development will be the construction of infrastructure in the vicinity of the dam wall to enable the establishment of site security and office facilities for the construction team.

These works will include:

- security of the site and closure to public access;
- site Office (including communications, power, water reticulation and ablutions);
- induction and training facility;
- soils laboratory;
- workshop and maintenance facility;
- fuel and oil storage facilities;
- crib and satellite office facilities;
- crushing and screening plants;
- installation and commissioning of the concrete batch plant;
- vehicle parking areas;
- construction of haul routes; and
- establishment of replacement boat ramps.

This network of site facilities will allow for the establishment of a permanent site workforce. During this period there will need to be the connection of power, communications, water and IT to the site to deliver an integrated site facility.

3.3.2 Site Activities

The activities to establish the site for construction works are detailed in **Table 3-9**.

Table 3-9 Pre-Construction Activities

Activity	Details
Maintain recreational infrastructure	■ construction of east and west upstream boat ramps
Site Office and Supporting Facilities	■ site office buildings - 700m^2 floor area ■ induction and training facility – 100m^2 floor area ■ soils laboratory – 120m^2 floor area ■ workshop and maintenance facility – 3000m^2 floor area ■ 5 crib and satellite office facilities – 100m^2 floor area each ■ associated car parking – 150 spaces
Services	■ establishment of power, water and compressed air facilities at various locations across the site
Haul Routes	■ quarry haul road ■ saddle dam haul road ■ main dam haul road ■ clay borrow haul road
Other Site Works	These works and facilities are required for the processing and controlled transportation of raw material around the site. ■ temporary river crossings ■ material processing pads – 1ha area ■ material stockpile pads – 3 ha area ■ clay conditioning pads – 1ha area ■ environmental control structures

3.3.3 Location of Pre-Construction Activities

The pre-construction activities associated with the establishment of the site for construction works are largely located in the vicinity of the dam wall and current recreation areas, and incorporate areas both to the west and east of the dam wall. The location of each of the activities is shown on **Figure 6-9** in **Section 6** of the EIS.

The site offices are located near the northern CID boundary within an area currently used for recreation purposes. This area will be accessed from the existing road that services the park and pump station. Crib huts are located

throughout this part of the construction site but will also be sited at the upper intake tower. The heavy equipment workshops are located on a current cleared area off Advancetown Road near the entrance to the CID area. The batching plant is also located in this general area of the site.

The network of haul roads links the various components of this area and will be construction during this site establishment phase of the project. The location of the haul roads are shown on **Figure 6-9**.

These activities are largely temporary in nature and will be removed from the site following completion of the construction works. The only exception being part of the haul road used the quarry which will provide permanent road access to the recreation facilities to be constructed to the west of the dam wall.

3.3.4 Haul Roads

The construction of Hinze Dam Stage 3 will necessitate the need to move large quantities of rock from the quarry on the left abutment to the existing dam wall and to the saddle dam. In addition, there is also a need to extract and cart clay from the downstream right abutment to the existing dam wall and to the saddle dam. In conjunction with the establishment of the site offices the construction of the site haul roads will be undertaken.

The haul road network includes:

- quarry haul road;
- saddle dam haul road;
- main dam haul road; and
- clay borrow haul road.

The haul roads have the following design requirements:

- the haul road must rise out of the quarry and pass through the saddle at approx RL100 and then descend to the river crossing below the flip bucket at RL35. The haul road will run upstream beside the chute and progressively ramps up to approx RL65 to place rock up to this level (refer to **Figure 6-9**);
- the haul road runs downstream and rises to RL 80 to pass around the north side of the break of head tank and run to the dam wall to place rock from RL 65 to RL 108;
- road width is recommended to be 3 to 3.5 times the width of the trucks, resulting in a 20m wide haul road;
- the grades required are < 10%; and
- the haul road alignment is constrained by services around the north side of the break of head tank by power lines, the rising main pipe, the outlet pipe and the property boundary.

3.4 Construction Activities

3.4.1 General Construction Activities

The major activities required for the construction of the dam and associated facilities are detailed in **Table 3-10**.

Table 3-10 General Construction Activities

Activity	Details
Quarrying	■ removal of overburden ■ extraction of rock for dam wall using excavators and drill and blast operations ■ stabilisation of the quarry face and rehabilitation of the quarry surrounds at the completion of quarry activities
Clay Extraction and Conditioning	■ excavation of clay using scrapers ■ conditioning of clay to increase the moisture content for use in embankment and saddle dam construction ■ rehabilitation of the clay borrow area following the completion of extraction activities

Activity	Details
Dam Embankment and Saddle Dam Construction	■ construction of the main embankment ■ construction of saddle dam ■ use of dozers, excavators and vibrating rollers used to compact and shape the wall
Concrete manufacturing	■ operation of an on-site concrete batching plant ■ crusher will operate near the quarry to produce aggregate for use in concrete mix
Material Haulage	■ most of the materials required for construction will be sourced from the site with the use of trucks to transport materials around the site ■ truck haulage of additional construction materials not sourced from the site. this includes materials such as sand, cement and reinforced steel to the site
Construction of Intake Towers	■ raising of the structures by 15 m ■ increase in the number of off-takes from 8 to 11 ■ upgrading of the access road to the upper intake tower
External Infrastructure	■ road and culvert upgrading ■ bridge upgrading works
Internal Infrastructure	■ internal permanent road network ■ reinstatement of services, such as water supply and power where required
Clearing of Vegetation	■ vegetation clearing for the establishment of site infrastructure and for the commencement of site operations such as the quarry and clay borrow area ■ clearing for the construction of boat ramps and road upgrading ■ vegetation removal below the full supply level. this clearing will occur in selected areas around the perimeter of the dam
Recreation Area Construction	■ haul trucks used for the transfer of material for the creation of the lakeside park ■ use of dozers and scrapers to shape the area ■ reinstatement and upgrading of park areas below dam wall ■ re-establishment of multi-purpose recreation trails
Site Rehabilitation	■ rehabilitation of area disturbed for the clay borrow activities ■ rehabilitation and reinstatement of the parkland area and other disturbed areas around the construction site

3.4.2 Construction Phases

Phase 1

Phase 1 will involve preparation for the start of construction of permanent works at the main dam site and includes:

- preliminary quarry development including the first portion of the haul road network out of the quarry;
- removal of redundant existing site facilities to allow for construction;
- development of the quarry including removal of vegetation and overburden;
- demolition of structures and buildings that are located within the construction footprint;
- development of the haul road network from the quarry to the toe of the main dam including a causeway/ culvert crossing of the downstream channel;
- development of the haul road along the new saddle dam;
- excavation of the foundation of the new saddle dam and establishment of the clay conditioning pad; and
- establish access into the base of the spillway.

Phase 2

Phase 2 will involve construction of the major elements of the project including:

- construction of the main embankment;
- construction of the saddle dams;
- construction of the spillway;
- raising of the lower intake tower; and
- construction of recreation facilities.

Raising of the Upper Intake and Access Road Construction

The raising of the upper intake tower and the associated road construction works will commence at the completion of the works on the lower intake tower. The road construction works will be undertaken in parallel with the raising of the tower and the extension of the bridge.

Site office, crib and ablutions facilities will be established at this new site to service these employees. It is expected that this workforce involved in these activities will be less than 30 persons including supervision.

3.4.3 Construction Works

Construction Materials

The geotechnical investigations undertaken on the site have confirmed that the rock, clay and overburden required for the construction of the dam wall and saddle dam, haul roads, and the recreation areas can be sourced from within the CID boundary (**Figure 6-9**). These areas are located in close proximity to the main embankment and saddle dam where the materials will be used for construction.

The quantities of these materials required for each of the construction elements are detailed in **Table 3-11**.

Table 3-11 Construction Materials

Material	Location and Quantity
Rock	Toe Wall: 1.5 million m^3 Saddle Dam: 0.6 million m^3
Clay	250 000m^3
Overburden	Toe Wall: 240 000m^3 Saddle Dam: 240 000m^3 Recreation Area: 300 000m^3

Quarry

Initial works include the clearing of vegetation and overburden for the commencement of the quarry operations. This process will use dozers, scrapers and later in the process, excavators and haul trucks. There is expected to be 3 operations occurring in the quarry during the construction period, the first is the removal of the overburden, with the second and third involving the removal of rock to the main embankment and the saddle dam.

The construction program incorporates 1 blast per day, with approximately 5000m^3 of material per blast.

Clay Extraction

The clay borrow area is located to the east of the dam wall in an area that includes both open parkland and areas of non-remnant vegetation in the vicinity of Gilston Road (refer to **Figure 6-9**). The extraction process includes the clearing of vegetation and removal of the topsoil. The clay will then be excavated and transported to the clay conditioning area for treatment. The material will then be stockpiled for use in constructing of the core of the main embankment and saddle dam.

Embankment Construction

General Description

Stage 1 and Stage 2 of the construction works for Hinze Dam were undertaken in the mid 1970s and mid to late 1980s respectively. The embankment works for Stage 1 involved construction of a 47m high central core earth and rockfill embankment across the Nerang River valley. The works for Stage 2 involved raising the existing embankment 17.9m to its present crest level of EL 93.5m AHD and construction of saddle dam (23m height in

height) to the east of the main embankment. Both embankments are of central core earth and rockfill design, and both were designed with the intent of Stage 3 raising works being undertaken.

The project involves raising the dam crest level 15m from its present elevation of EL 93.5m AHD to EL 108.5m AHD. The embankment works comprise a 1700m long embankment up to 80m in height on the eastern side of the spillway incorporating the existing main embankment and saddle dam, and a low height embankment in the saddle area to the west of the spillway.

Table 3-12 summarises the elements of the embankment for Stage 3. The main embankment will be raised from the downstream side and the existing saddle dam. Extension of the main embankment around to the saddle dam is required and this section will be constructed across the upstream sloping hillslope. The extension of the saddle dam (to the south-east) is along the narrow ridge line.

Table 3-12 Summary of Embankment Elements

Embankment	Length	Embankment Type	Maximum Height	Comment
Saddle Dam Extension	745 m	Central core earth and rockfill	25m	Located along the ridge line south-east of the existing saddle dam
Existing Saddle Dam	175 m	Central core earth and rockfill	38m	Central raise of existing embankment
Main Embankment Extension	180 m	Central core earth and rockfill	25 to 30m	Between the main embankment and saddle dam. Constructed across the hillslope sloping to upstream.
Main Embankment	590 m	Central core earth and rockfill	80m	Downstream raise of existing embankment
Saddle B	115 m	Zoned Earthfill / Earth - Rockfill	6m	Low height embankment in saddle area west of the spillway.

Foundation Preparation

The general requirements for foundation preparation prior to placement of embankment materials are:

- excavation to a surface free from overhangs and sharp changes in slope;
- removal of all loose material from the excavated surface and all water from depressions;
- cleaning of the surface by air/water blasting (excluding the surface of the Stage 2 earthfill);
- shotcreting of areas comprising fractured and broken chert with soil throughout;
- dental concrete will be required for the local treatment of shear zones, open joints, possibly the boundaries between the geological units and where local overhangs or steepened sections cannot be practicably removed; and
- the foundation surface shall be wetted prior to placement of earthfill.

To address the current and future seepage and piping risks as identified, a preliminary design has been prepared for construction of a positive seepage barrier in the form of a cut-off wall to control seepage flows and associated risk of erosion and piping through the foundation on the right abutment. The extent of works required is currently being investigated through geotechnical works and will be incorporated into the detailed design of the project.

Embankment Construction Materials

The materials required for the construction of the various zones within the embankment are summarised **Table 3-13**. The filter and rockfill materials will be sourced from the quarry located to the west of the main embankment. The fine filter may require an imported sand filler to achieve the finer portion of the specified grading envelope.

Table 3-13 Embankment Construction Materials

Zone	Description
Earthfill Core	The water barrier element within the embankment constructed using select fine grained earthfill material.
Contact Core	Contact Core zone to be placed at the foundation contact and at the interface with structures (e.g. dam abutment wall and cut-off wall).
Fine Filter	Located immediately downstream of the earthfill core (and upstream up to FSL), on the foundation below the downstream shoulder where specified and within selected filter drains.
Coarse Filter	Located downstream of the fine filter material (and upstream of it up to FSL). Also placed on top of the fine filter below the downstream shoulder where specified and in selected filter drains.
Upstream Filter	Located immediately upstream of the Zone 1 earthfill core above FSL and below the upstream shoulder where specified.
Rockfill Transition	Located upstream and downstream of the filter zones.
Main Rockfill	Main Rockfill Zone within the upstream and downstream shoulders of the embankments. It forms the bulk of the embankment and provides overall embankment stability.
Rip-Rap	Rip-Rap. Coarse rockfill placed on the upstream face of the embankments.
Course Rockfill	Coarse rockfill placed at the downstream toe in the culvert area.

Embankment Design

The main embankment will be raised from the downstream side. It will be a central core earth and rockfill embankment with the narrow central core, filter zones either side of the core and rockfill shoulders.

The key features of the embankment are:

- 10m wide crest;
- upstream slope of 1.5H to 1V (horizontal to vertical) and downstream slope of 1.4H to 1V;
- central earthfill core matching the width of the existing core and have a minimum top width of 3m at EL 108.5m AHD;
- filter zones upstream and downstream of the core. Dual filters are provided for the full height downstream and up to FSL while a single filter is provided above FSL;
- rockfill transition zones upstream and downstream of the filter zones having a minimum horizontal width of 5m;
- riprap protection on the upstream face;
- coarse rockfill zone around the outlet conduit to provide drainage capacity as protection against a dam breach;
- downstream stability berm on the right abutment; and
- filter blankets are to be placed below the rockfill shoulder where erodible materials are exposed in the foundation to provide protection against piping through the foundation.

The elevation of the existing core varies along the embankment, and for most of the length of the embankment has a top elevation of 88.0m AHD (5.5m below Dam Crest Level). This rises to approximately 92.8m AHD toward both abutments. The top of the earthfill core will be covered with a 0.3m thick layer of fine filter in turn covered by a pavement roadbase layer and bitumen seal. The sealed road surface is designed to minimise drying and cracking of the upper section of core.

Once construction of the embankment is above the natural surface at the downstream toe (excavations up to 4 to 12m are expected in this area), the gap between the battered excavation and rockfill will be backfilled with random fill. A 1.5m wide zone of rockfill transition and filter will be placed between the rockfill and random fill to reduce the potential for migration of fines into the rockfill.

Main Embankment to Saddle Dam

The embankment extends around the hillslope between the main embankment and saddle dam. It is of central core earth and rockfill design and is constructed on the upstream facing hill slope. The design is very similar to the main embankment at the right abutment with filter zones upstream and downstream of the core, rockfill shoulders, and filter blanket below the shoulders.

Features that are different to the main embankment are:

- upstream and downstream slopes of 1.5H to 1V;
- central core with upstream and downstream slopes of 0.43H to 1V. The core width will narrow at the junction with the existing saddle dam to match the existing earthfill core;
- a layer of contact earthfill is to be placed on the foundation;
- a filter blanket below the upstream shoulder comprising a single 0.75m thick layer; and
- upstream rockfill stability berm.

Saddle Dam

The existing saddle dam is to be raised centrally. The extended downstream shoulder will be founded on MW greenstone for the most part with possible areas of chert toward the left abutment.

Features that are different from the main embankment are:

- crest width of 7m;
- upstream and downstream slopes of 1.5H to 1V;
- the central core is relatively narrow with core slopes of 0.13H to 1V upstream and downstream;
- the filter widths narrow as the crest is approached to achieve the 7m wide crest; and
- a downstream filter blanket below the downstream shoulder is included in the preliminary design.

Saddle Dam Extension

The existing saddle is to be extended along the ridgeline to the east for a distance of approximately 750m. A central core earth and rockfill embankment is proposed for the saddle extension to maintain the embankment as far as practicable to the narrow crest of the ridgeline.

The saddle dam and extension are essentially an extension of the natural hill slope. The natural elevation of the ridge for a large portion of the saddle extension is at 95m AHD (close to design FSL) with small saddles to as low as 90m AHD.

The features of the saddle dam extension include:

- the alignment along the ridgeline;
- founding the embankment on a solid foundation of greenstone; and
- construction of a drainage trench along the downstream toe of the embankment and a second drainage trench below across the natural slopes below the embankment.

Saddle Dam B

Saddle B is located west of the main embankment and spillway within a low saddle. The embankment is approximately 115m long and 5m high at the maximum section. The embankment design is for a zoned earthfill embankment. Saddle B will be capped with gravel.

Works within Impoundment Area

Quarrying

The quarry is located upstream of the dam wall and within the catchment of Hinze Dam. This area was used for materials in the construction of Stage 2 with further excavation of the quarry to provide the hard rock for the Stage 3 construction works.

The final configuration of the quarry will be:

- for hard rock slopes, the minimum bench width shall be 5 metres, and the maximum vertical spacing allowed between benches shall be 10 metres;
- for slopes in weathered rock, slopes shall not be steeper than 0.6H:1V; and
- for the soil overburden, slopes shall not be steeper than 2H:1V.

Intake Tower Construction

Upgrading of the both the upper and lower intake towers will involve the use of a barge/ platform. The barge, which is 24.4mx18.3mx2.13m, forms a platform for a 100 ton crawler crane. The barge will be shunted around by the work boats which are propelled by 4 stroke outboards. Once in position the barge will then be fixed by 4 anchors operated through hydraulic winches.

Onboard power for the hydraulics is provided by a diesel generator with on-barge diesel storage of 1200 litres. The barge will also have a portaloo and crib hut on board.

The barge will be cleaned to the standards required by Gold Coast Water before use on the Hinze Dam. A spill pan will be used to capture any hydrocarbons from the crane operation. In the unlikely event of the barge sinking, the Emergency Response plan would be implemented. This is addressed further in **Section 14**.

Vegetation Clearing

The clearing of vegetation will be undertaken in the area between the Stage 3 full supply level and the current full supply level. Approximately 360ha of vegetation is to be removed within this zone. The extent of vegetation clearing is shown on **Figure 11-7** contained within **Section 11** of this EIS.

Approximately 318 ha, of the total vegetation to be removed, is remnant vegetation located below the Stage 3 FSL. 20.67 ha is 'Of Concern' while the remaining 297.67 ha are 'Not of Concern' regional ecosystems. No endangered regional ecosystems will be affected. The regional ecosystems represented in the inundation area and areas to be impacted by the proposed FSL are provided in **Table 3-4**.

Due to the volume of material and the difficulty in gaining access to much of this area it is not feasible to mulch this cleared material and therefore the majority of vegetation cleared will be moved above the FSL. Some logs will be stacked in windrows, while others will be scattered depending on erosion potential of area and density of trees. Some of the vegetation cleared in the vicinity of the dam wall will be chipped on site for use in rehabilitation works, site landscaping and for erosion control measures. Vegetation to be removed within the quarry area, approximately 5-10ha, will be stacked and burned in designated areas.

Table 3-14 Areas of Regional Ecosystems to be Cleared

Regional Ecosystem	VMA Status	Area (ha)
12.11.1 - Simple notophyll vine forest often with abundant Archontophoenix unninghamiana (gully vine forest) on metamorphics ± interbedded volcanics	NOC	1.51
12.11.3 - Open forest generally with Eucalyptus siderophloia, E. propinqua on metamorphics ± interbedded volcanics	NOC	92.48
12.11.3/12.11.1	NOC	10.73
12.11.5 - Open forest complex with Corymbia citriodora, Eucalyptus siderophloia, E. major on metamorphics ± interbedded volcanics	NOC	170.36
12.3.7 - Eucalyptus tereticornis, Callistemon viminalis, Casuarina cunninghamiana fringing forest	NOC	22.59
12.3.11 - Eucalyptus siderophloia, E. tereticornis, Corymbia intermedia open forest on alluvial plains usually near coast	OC	13.15
12.3.2 - Eucalyptus grandis tall open forest on alluvial plains	OC	7.52
Total		**318.34**

The opportunity to source valuable timber that will be felled during this process for use in site works such as the construction of the interpretative centre is currently being investigated. Where possible this vegetation would be relocated to a stacking area within the CID for drying and future use.

The following measures will be undertaken during the construction phase of the project to minimise potential impacts on vegetation from construction activities:

- identification of vegetation within the inundation area that are to be cleared and/or retained on construction drawings;
- avoidance of impact on remnant vegetation outside the inundation area by clearly identifying the FSL boundary, and directing contractors to avoid these areas;
- boundaries of areas to be retained to be clearly marked by tape and/or pegs and conform to the drawings;
- contractors are to monitor vegetation clearing to ensure only approved areas are cleared; and
- preparation of a weed management plan prior to any construction or clearing activities occurring to prevent the spread of declared weeds.

Recreation Facilities

The stage 3 works incorporate the provision of new and upgraded recreation facilities, several of which are located within the catchment of the dam. The locations of the proposed recreation facilities to be constructed on site are shown on **Figure 3-5** .

These recreation facilities are:

- Lakeside Parkland - The lakeside parkland, incorporates passive parkland and recreation areas and an interpretative centre and associated facilities. The area on which these facilities will be construction will be constructed through the use of approximately 300 000m^3 of overburden and other spoil from the construction works and will comprise approximately 3 ha of land. This parkland area replaces the recreation land that is currently located to the east of the dam wall that will be inundated following the completion of the works.
- Upstream Boat Ramps – the upgrading of the eastern and western upstream boat ramps involves the construction of new concrete ramps, new sealed access roads, sealed parking for cars and boat trailers, provision of toilet facilities and associated landscaping.
  - Eastern Boat Ramp - Currently, patronage at the eastern boat ramp is significantly higher than that seen at the western boat ramp. The design of this facility therefore includes the provision of thirty car and trailer

parking spaces. A 4.4m wide concrete ramp will be provided enabling this ramp to be operational from the Stage 3 full supply level of RL94.5m down to approximately RL78.0m.

The road leading down to the eastern boat ramp will be bitumen sealed with table drains and planted embankments. In order to increase the useability of the facility prior to the raising of the wall, a gravel manoeuvring area will be constructed near the current water level to reduce the need for excessive trailer reversing. Composting toilet facilities will also be provided.

- Western Boat Ramp - The western boat ramp will provide the same level of accessibility as the upgraded eastern ramp with a concrete ramp 4.4m wide and the capacity to be operational from RL94.5m to RL78.0m. This ramp will be provided with a sealed car park for 10 cars and trailers and will also be provided with composting toilet facilities. As with the western ramp the access road will be bitumen sealed with table drains and planted embankments. In order to increase the useability of the facility prior to the raising of the wall, a gravel manoeuvring area will be constructed near the current water level to reduce the need for excessive trailer reversing.
- Relocation of a grave site that is located within the Stage 3 inundation area will be undertaken as part of the project works and a park area located adjacent to this ramp will be provided as the relocated site.

Downstream Works

Waterway Works

Works downstream of the dam will are limited to the construction of the spillway, raising of the chute walls, construction of the fish transfer device, and the establishment of a temporary river crossing for the movement of construction vehicles. No other works will be undertaken within the waterway.

During the construction of the dam there will be no disruption to the current environmental flows, and no diversion works will be undertaken as part of the project. Works associated with the construction of the spillway and the fish transfer will be undertaken with the required environmental controls. The environmental management plans associated with the construction and operation of the project are contained within **Section 19**.

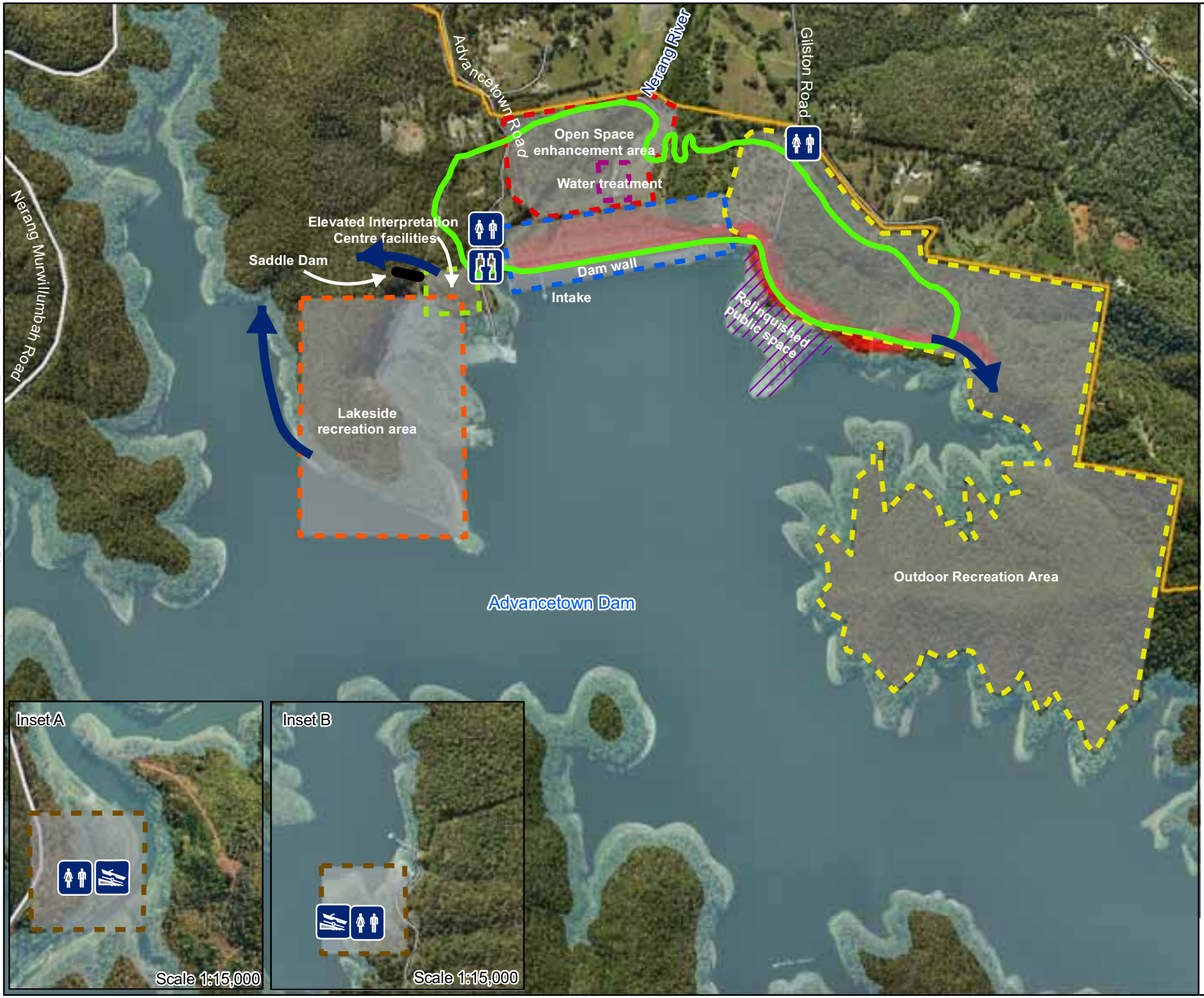
Fish Transfer

Upstream fish passage for the project will be provided via a trap and haul system that will be located in the vicinity of the existing environmental flow outlet adjacent to the pump station. Details of the fish passage and transfer system and associated works are detailed in **Section 3.5.2**.

Hillslope Protection Downstream of Main Embankment

The hillslope forming the right abutment of the main embankment comprises a deeply weathered profile on the mid to lower slopes with chert cap on the hill crest. The natural slopes are relatively steep at 20 to 22 degrees (average slope) and landsliding is likely to have been significant in slope forming processes. Evidence of sinkholes and landslide features indicate they are still prevalent today.

The embankment itself forms a buttress for the hill slope; however, downstream of the embankment the hillslope is exposed to natural slope forming processes. Stabilising works will be undertaken to the hillslope region for a distance of approximately 150m downstream from the embankment.



N

0 75 150 300 450

Metres

Scale - 1:15,000

Projection: MGA Zone 56

Legend

- Spillway Lookout
- Car Park and Public Amenities
- Boat Ramps
- Mountain Bike and Walking Circuit
- Roads
- Link to possible walking tracks
- Proposed FSL(94.5m)
- CID

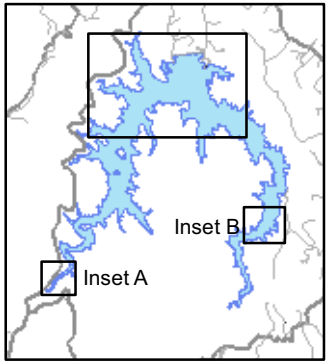


Figure 3-5

Proposed Recreation Facilities

Hinze Dam Stage 3 EIS

The proposed works will include:

- a series of drainage trenches across and down the slope. The drains are designed to collect seepage from the chert body and discharge into the Nerang River at the toe of the slope; and
- placement of a stability berm over the mid to lower section of the slope. The berm is proposed to be constructed from materials excavated from the foundation of the embankment.

Recreation Facilities

The reestablishment and enhancement of the downstream recreation areas are key elements of the Recreation Concept Master Plan for the project. The locations of the proposed recreation facilities to be constructed on site are shown on **Figure 3-5** .

The recreation facilities include:

- Koala Park – The dam wall and the stability berm encroach into the area that is currently known as Koala Park. The recreation area remaining in this area will be rehabilitated and the recreation facilities reinstated;
- West of Nerang River – the area to the west of the Nerang River currently has limited recreation facilities and is not used to the same extent as other parkland surrounding the dam. Due to the location of the site works, haul roads and stockpiles this area will be impacted on and rehabilitation works will be undertaken as part of the dam construction works. The provision of additional passive recreation areas, new and upgraded facilities will be undertaken in this area;
- Trails Area – The construction of the saddle dam and the operation of the clay borrow area will impact on the current recreation facilities located to the east of the dam wall. Works to be undertaken in this area include the rehabilitation of the site and the re-establishment of the trails including those used by walkers and mountain bikers. This track will be constructed using the current best practice standards and will incorporate tracks linking with the fire trails located in this area of the site. Car parking and amenities will be provided in association with these facilities. This area will also be linked with the other parkland areas through the provision of pedestrian and cycling pathways; and
- Pedestrian and Cyclist Facilities – upgraded pedestrian and cyclist facilities will be provided across the dam wall and throughout the downstream recreation areas.

3.4.4 Construction Traffic Requirements

General Construction Traffic Access

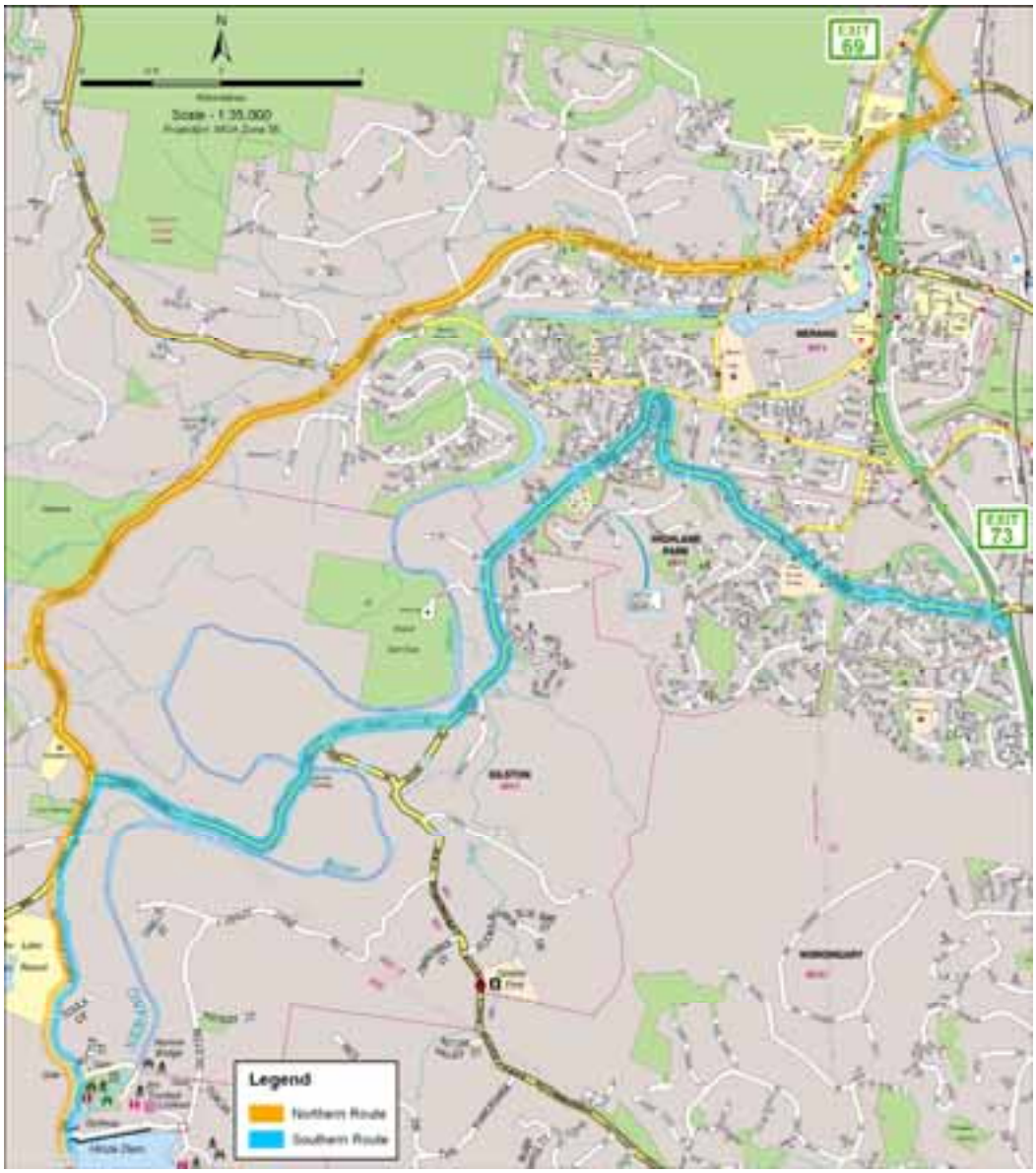
General construction traffic includes all traffic other than construction workforce traffic which arrives and departs the Hinze Dam site using the surrounding road network external to the Hinze Dam site.

Construction equipment will be transported by road to the site on standard or over-sized loads. Large items of construction equipment that cannot be divided into smaller components will be transported on State Controlled roads under permit and, where necessary, accompanied by safety escorts. Deliveries to the construction site will be limited to items such as concrete, steel, fuel and construction equipment and supplies that are not able to be sourced from the site. The haul routes for the movement of construction equipment are shown on **Figure 3-6**.

Concrete

Deliveries of materials for the manufacture of concrete will include sand, fly-ash and cement. Cement and fly-ash have been assumed to travel on the same type of vehicle. The sand will be transported by semi-trailers with approximately 20t capacity. The fly-ash and cement will be transported using B-Doubles. A maximum of five trucks/day will occur in May 2009 (four B-double and one semi-trailer).

- **Figure 3-6 Construction Haul Routes**



Equipment

The delivery and removal of equipment will occur over the entire length of the project. The total traffic flows are estimated in **Table 3-15**.

- **Table 3-15 Traffic Flow due to Delivery and Removal of Equipment**

Item	Quantity	Trips/Item	Trips	Oversized
80t trucks	5	2	10	Yes
50t trucks	5	1	5	No
35t articulated trucks	5	1	5	No
300t excavator	1	8	8	Yes
150t excavator	1	5	5	No
80t excavator	1	1	1	No
30t excavator	1	1	1	No
Scraper	4	1	4	Yes
12t crane	1	1	1	No

Item	Quantity	Trips/Item	Trips	Oversized
50t rough terrain crane	1	1	1	No
150 crawler crane	1	8	8	No
Barge crane (crane)	1	1	1	Yes
Barge crane (barge)	1	8	8	Yes
Scaffold			10	No
Formwork			10	No
Site offices	50	1	50	No
Total Trips Oversized				**31**
Total Trips Normal Size				**97**
Total Trips due to Delivery and Removal of Equipment (whole project period)				**128**

Heavy Vehicles and Oversized Vehicles Access

An estimated 31 oversize loads will be required to deliver indivisible construction equipment to the construction site. The origin of these loads is likely to be Brisbane. Standard permit approval processes and arrangements for these deliveries, such as escorting vehicles will apply on a case-by-case basis.

Service Vehicles

Service vehicle movements to and from the site during the construction phase are most likely to include postal deliveries, canteen and office supplies and Gold Coast City Council waste removal trucks. Approximately four service vehicle movements per day (2 in and 2 out) are expected during this period.

Materials

A maximum of eight heavy vehicles per day is likely to occur during the construction period (October 2007 to July 2008).

Construction Workforce Access

Two methods of transport are being considered to bring the construction workforce to the site, these are:

- Option 1 - Two buses carrying up to 40 workers each will run between the Nerang train station and the Hinze Dam site along the Nerang - Murwillumbah Road and Advancetown Road. The remaining workers will travel by their own means; and
- Option 2 - All workers will travel by their own means.

The selected routes for the dam access during the construction are:

- Route 1 - 70% of the workforce is expected to be coming from Brisbane and therefore will most likely travel off the Pacific Highway at Nerang to the Hinze Dam site via Nerang Murwillumbah and Advancetown roads.
- Route 2 - the remaining 30% will travel off the Pacific Highway at Mudgeeraba to the Hinze Dam site via Alexander Drive and Gilston Road.

Day time employment on the site will vary depending on the stage of construction. The initially ramp up to approximately 150 persons during October, November and December of 2007 and then increase constantly to a maximum of approximately 240 persons by April 2008. Employment will then remain at approximately 240 until August 2009 when it will progressively decline to zero by the end of construction in November 2010.

Parking will be provided at the construction site to accommodate the workforce vehicles.

Summary of Estimated Vehicle Trips for the Construction Phase

The total estimated number of vehicle trips to and from the site during the construction phase is summarised in **Table 3-16**. Daily traffic during the construction peak is estimated as vehicle trips per day.

Table 3-16 Estimated Vehicle Movements Generated during Construction

Generation Type	Daily Traffic Generation - Peak Construction Period (Vehicles Per Day)			Total Heavy Vehicles During Construction
	Light Vehicles (Option 2)	Buses (Option 1)	Heavy Vehicles	
Workforce	520	4	-	-
Visitors	6	-	-	-
Concrete (including ash, cement and sand)	-	-	10	-
Equipment	-	-	-	128
Service Vehicles	-	-	4	-
Materials	-	-	8	-
Total	**526**	**4**	**22**	**128**

3.4.5 Construction Equipment

The construction operations require the use of a range of machinery throughout the construction area. The extent of construction equipment and their location within the site are detailed in **Table 3-17**.

Table 3-17 Construction Equipment and Location

Equipment	Quarry	Clay Borrow	Dam Wall	Total
Dozers	1		2	3
Scrapers		3	3	6
Excavators	3		3	6
Haul Trucks	15	5		20
Drills	2			
Graders	1	1	1	3
Vibrating roller			2	2

In addition to the machinery detailed above there is other equipment and machinery required for the construction of the dam. Additional equipment to be used on site during the construction works include:

- Crusher – A crusher will operate on site to produce concrete aggregate and filter material. The crushing will occur at a rate of approximately 1000t per day and will operate 5 days a week for 30 months of the construction period; and
- Concrete Batching Plant – The concrete batching located on-site will be capable of producing 80m^3 per hour.

3.4.6 Construction Management

Dam Safety during Construction

Two significant dam safety risk issues have been identified for the construction phase of the project:

- the staging of the construction works in general. Staging of the spillway works relative to embankment works to maintain an acceptable level of risk against dam breach due to flood over-topping; and
- the construction risk associated with excavation to expose the earthfill core of the main embankment. The top of the earthfill core is as low as EL 88m AHD over a significant length of the main embankment.

The dam safety risk criteria that will be adopted during the construction works are:

- the probability of a dam crest flood shall not exceed an AEP of 1 in 50 000; and
- for flood events up to an AEP of 1 in 50 000, the embankment stability shall not be less than a factor of safety of 1.3 for failure surfaces that result in loss of freeboard (i.e. extend back to the upstream shoulder of the embankment). This includes retrogressive type failures and sloughing type failures.

Spillway Works

It is proposed to monitor the flood related dam safety risk during the construction works inline with ANCOLD recommendations and guidelines. Flood modelling will be undertaken in advance of each stage of the spillway works to define the required construction crest level to achieve the dam safety flood risk criteria. Assessment of the crest detailing will also be undertaken to confirm that the stability criteria under a flood condition is also achieved.

At times during the works it is likely that the minimum construction crest level or flood stability criterion will not be achieved. These works will be managed under a dam safety flood emergency plan.

The issue of dam safety during construction is addressed further in **Sections 14 and 19**.

Crest Excavation

The more significant construction risk issue is associated with the excavation works to expose the earthfill core and filters of the existing main embankment. The risk issue is that to excavate down to the core potentially increases the probability of a flood related dam breach scenario to a level above the dam safety risk criteria.

A methodology has been developed to manage the construction risk whilst raising the earthfill core of the existing main embankment to achieve the dam safety risk criteria. There is a period during the construction works when the stability under flood loading does not meet the criteria. It is proposed to manage this stage of the works by undertaking it progressively (i.e. only expose a section of the works to the flood instability risk at any time) and implement a dam safety flood emergency plan during construction to close up the exposed works area prior to the flood levels reaching EL 88m AHD. This is addressed further in **Sections 14 and 19**.

Construction Program

The program for construction comprises two main elements, mobilisation for construction and the construction phase. A project program is attached as **Figure 3-7**.

The commencement of the pre-construction phase will occur mid-2007 with the procurement of plant and equipment, engaging sub-consultants and obtaining offices and other site establishment equipment.

The construction component of the program commences in October 2007 and continues through to November 2010. The program is dependant upon gaining the required approvals prior to the construction of works. The main elements of construction are the main embankment, the saddle dam, the spillway, the upper and lower intake towers, and the construction of the supporting infrastructure. The construction program for each of these components is detailed in **Figure 3-7**.

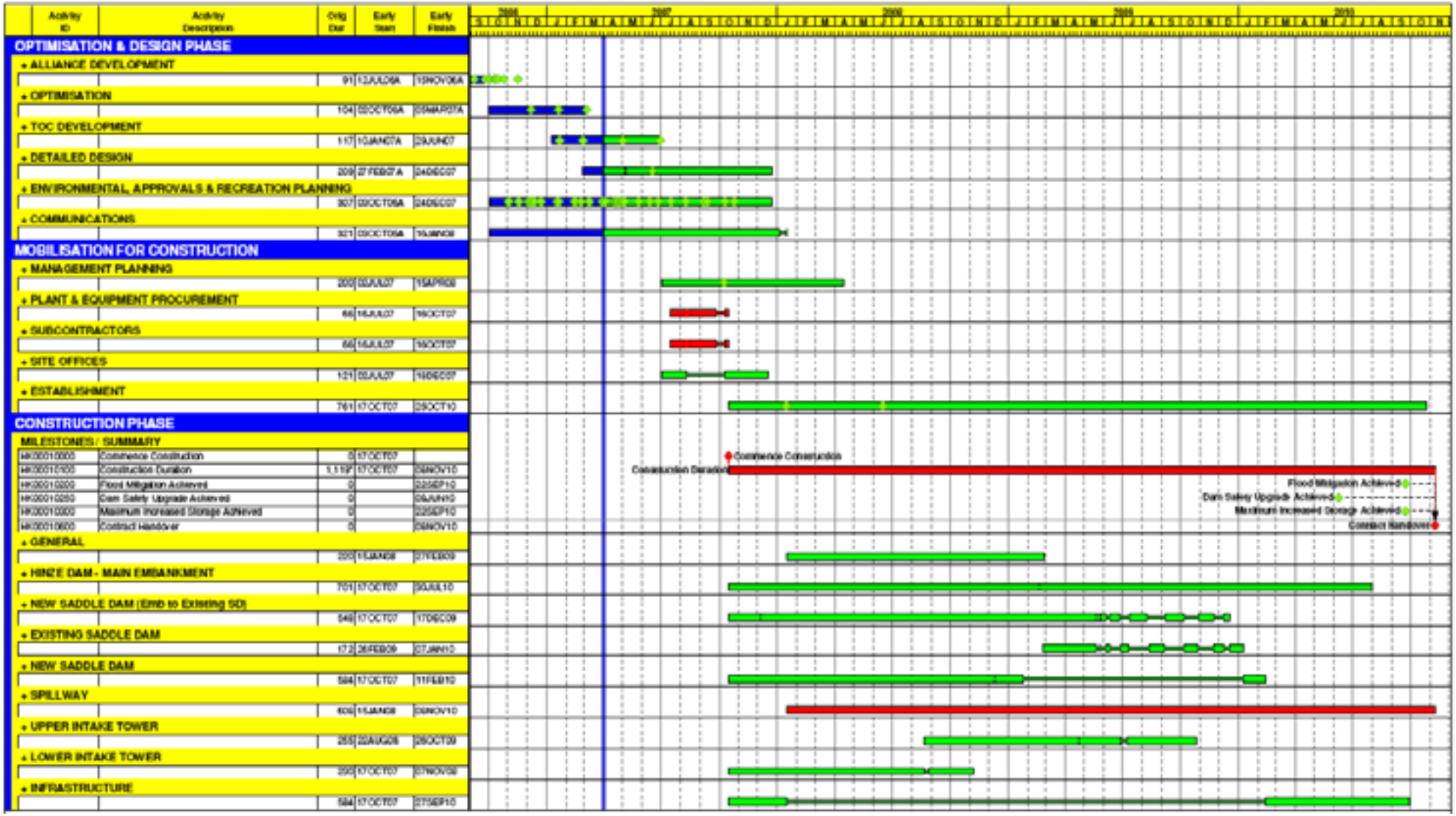
Operating Hours

Construction working hours will be in accordance with the requirements of the *Environmental Protection Regulation 1998*. These hours of operation are as follows:

- Monday to Friday 6.00 am – 6.00 pm
- Saturdays (each 4th week) 8:00 am – 6.00 pm

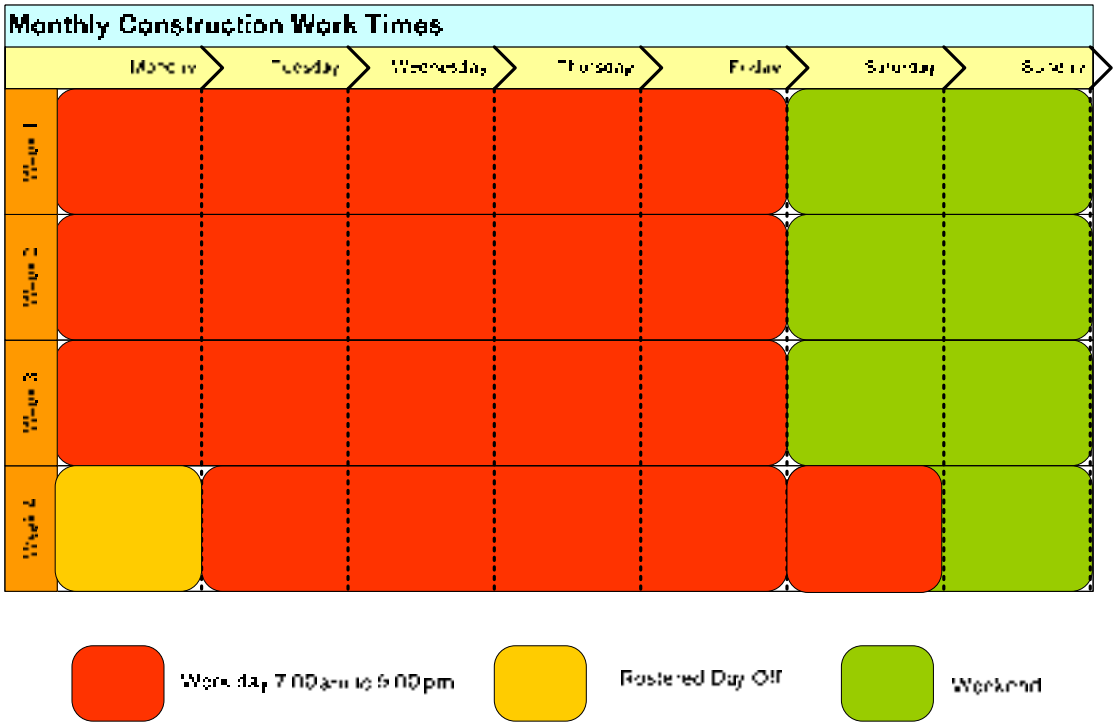
A maintenance shift will operate on-site outside these hours.

Figure 3-7 Project Construction Program



During the construction period between October 2007 to November 2010 work will be undertaken on site over a 5 day working week. The proposed operating days for each four week period are detailed in **Figure 3-8**.

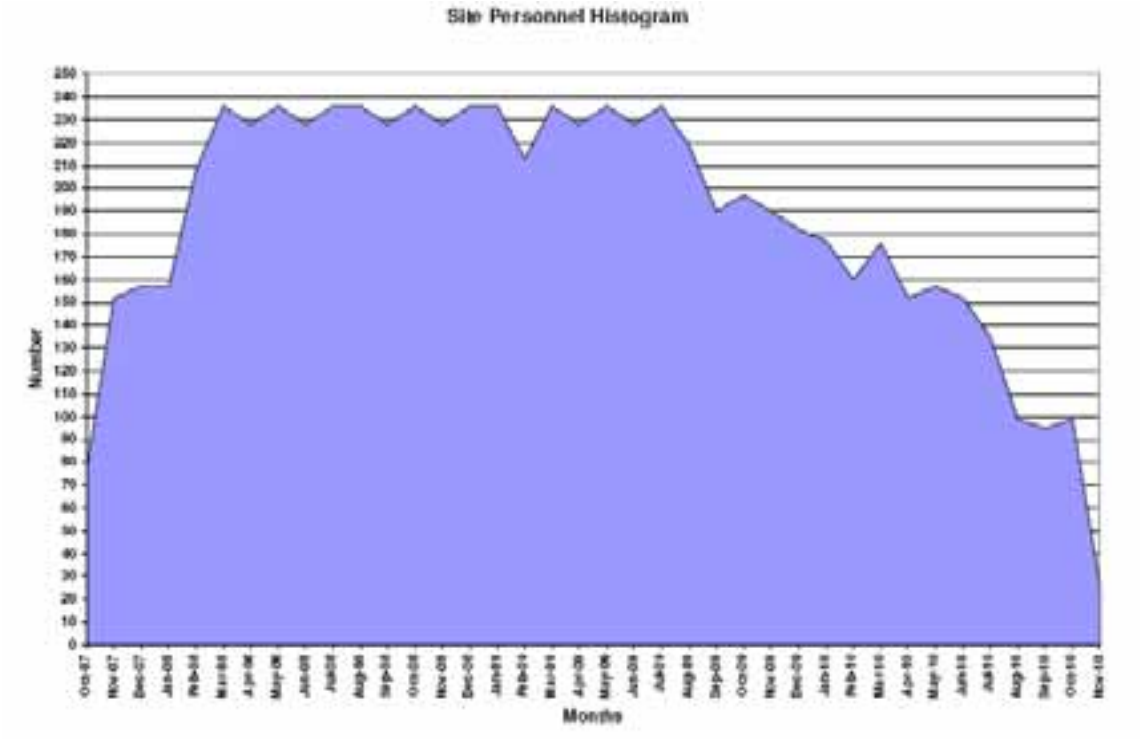
- **Figure 3-8 Construction Working Week**



Workforce Requirements

The workforce for the period of site construction operations are detailed in **Figure 3-9**.

- **Figure 3-9 Construction Workforce**



3.4.7 Legislative Requirements

The project is subject to an extensive range of legislative requirements that cover the approval processes, the site construction works and site management, and the operation of the dam facility.

The legislative requirements are addressed in the following sections of the EIS:

- development and other approvals – **Appendix B**;
- construction and site management – **Sections 14, 15 and 19**; and
- operation of the dam – **Sections 14, 15 and 19**.

3.4.8 Quality Control

General

In general terms, quality assurance may be defined as the system of documentation established to demonstrate that the works have been carried out in accordance with the technical specifications. Quality control (QC) is the implementation of the quality assurance system during construction, as applied to each specific area of work.

A Quality Management Plan (QMP) will be produced as part of the final design that sets out the general QA/QC requirements in overall terms, while individual specifications will detail specific requirements in terms of quality procedures.

For overall project management, the Hinze Dam Alliance will operate under the management plans developed for the project. The preliminary management plans for the construction and operation phases of the project are contained within **Section 19** of the EIS. The QMP will comprise method statements to show how it is intended to construct the works and to demonstrate compliance with any specific design requirements. It will also include check sheets, provisions for inspections, approvals and sign-offs throughout the work.

The Hinze Dam Alliance will be able to demonstrate, with appropriate documentation, that the work has been constructed in accordance with the QMP and hence in accordance with the drawings and specifications.

Quality Management Plan

The QMP will describe the overall project QA/QC structure and philosophy, including personnel responsibilities, and will have separate sections on the key elements of the project. Each section will define responsibilities for QC, testing requirements, approvals and documentation. In particular "hold point" inspection points will be clearly defined. These will be required where a section of work must be approved and signed off before the next section of work or action may proceed, e.g. approval to place levelling concrete after final foundation preparation.

The QMP will set out the project QC documentation, comprising test results, check sheets etc., required to be provided by material suppliers and the construction personnel throughout the work period. The intent is to be able to demonstrate by way of QC reports and backup documentation, that the project has been constructed in accordance with the drawings, specifications and the design intent.

3.4.9 Hazard and Risk

Construction Hazard Identification

Section 14 of the EIS addresses the Hazard, Safety and Risk elements of the project. The main hazards identified for the construction phase of the project are detailed in **Table 3-18**.

Table 3-18 Construction Hazard Identification

Hazard or Event	Possible Causes	Possible Consequences	Detection/Protection Measures
Crane is submerged during dam raising.	■ High water flow ■ High winds	■ Loss of life; ■ Short term, minor degradation of river water quality	■ Construction phase during dry season ■ Flood and wind monitoring/warning system
Failure of dam embankment	■ Structural Failure ■ Unpredicted heavy rainfall event ■ Poor maintenance ■ Inadequate design/ construction	■ Delayed release of water followed by a surge downstream ■ loss of life	■ Design according to category of installation determined by Failure Impact assessment according to ANCOLD standards. ■ Use of fail safe devices ■ Develop Emergency Action Plan ■ Remote monitoring by maintenance crew
Major flood during construction causing 'wash out'	■ Unpredicted heavy rainfall event	■ Loss of works, increase in litter in river	■ Construction timed to occur during dry season. ■ Undertake weather monitoring. ■ Construction activities phased to minimise potential 'wash out impacts'
Flood during construction impacts embankment	■ Unpredicted heavy rainfall event	■ Consequence related to magnitude of flood	■ Construction flood risk assessment to be carried out
Spill of hydrocarbons or chemicals, concrete spills, or sedimentation	■ Spill or leakage of fuel or lubricating oil	■ Short term, minor degradation of river water quality ■ Short term, minor land contamination	■ Construction activities to operate to approved EMP ■ Provide spill clean up kits ■ Provide means and guidelines for containment and responsible disposal

The major hazard resulting in the possible loss of life which ranks as a high impact / consequence has been identified to be due to high water flow or high winds causing the crane to become submerged during dam construction. All other hazards associated with the construction of the project raising are minor.

Operation Hazard Identification

As with the construction phase of the project **Section 14** of the EIS addresses the Hazard, Safety and Risk elements associated with the operation of the dam. The hazards involve:

- dam failure;
- electrical systems;
- flooding;
- public safety; and
- river water quality.

The hazards due to operating the dam are detailed in **Table 3-19**.

Table 3-19 Operation Hazard Identification

Hazard or Event	Possible Causes	Possible Consequences	Detection/Protection Measures
Sudden failure of dam	■ Vandalism ■ Structural Failure ■ Poor maintenance ■ Inadequate design/ construction	■ Delayed release of water followed by a surge downstream ■ loss of life	■ Design according to category of installation determined by Failure Impact assessment according to ANCOLD standards. ■ Use of fail safe devices ■ Regular maintenance ■ Develop Emergency Action Plan ■ Remote monitoring by maintenance crew

Hazard or Event	Possible Causes	Possible Consequences	Detection/Protection Measures
Flooding	■ Presence of dam	■ Different lands/habitats being inundated	■ Ensure potential flooding zone does not affect significant habitats or residents where possible.
Drowning in Dam	■ Public access	■ Injury/Loss of life	■ Provide adequate signage to warn public of any dangers ■ Restrict primary contact recreation if possible
Water quality of dam reduced	■ Inundation of vegetation ■ Recreational activities	■ Gold Coast potable water supply reduced	■
Changes to current downstream river ecology	■ Water release flows and schedules do not mimic current environmental conditions ■ Barrier to passage of aquatic life	■ Reduction of current populations due to: ■ reproductive and life cycle ecology altering from changes in spawning and migration queues; ■ barrier impacts on migratory species so do not complete life cycle.	■ Ensure fish lock is adequate ■ Mimic environmental flows with release patterns ■ Maintain downstream riffle areas ■ Survey for relevant indicator species' population ■ Log water release flows and schedules ■ Review schedules after survey
Increase in Inundation area	■ Reservoir changes water depth, flows, temperatures, plant and bed habitat	■ Displacement of species, change to/reduction of shallow habitat including riffles resulting in reduction in numbers	■ Maintain upstream and downstream riffle areas ■ Determine status of vulnerable species ■ Determine if possible to relocate vulnerable species ■ Continue to monitor numbers of these species

Dam Safety Flood Emergency Plan (DSFEP)

The catchment area of Hinze Dam is relatively small and the storm events of relatively short duration up to the 1 in 50 000 AEP. Hence, a proactive response for implementation of the DSFEP is required. It is proposed to use the following information sources to assist with the triggering the response levels of the DSFEP:

- Storm information and warnings issued by Bureau of Meteorology;
- Rainfall gauges within the catchment area;
- Stream flow gauges in the feeder creeks and rivers within the Hinze Dam catchment;
- Automated reservoir level monitoring;
- The reservoir level; its level at the time of the works and the rate of rise during a flood event.

A three stage series of response levels is proposed leading up to the implementation of the DSFEP. These response levels are summarised in **Table 3-20** along with a summary of the proposed actions.

A risk assessment has been undertaken to assist in the assessment of response trigger levels and actions. The preliminary findings indicate that appropriate trigger levels for each response level can be developed and that personnel can get to site and complete the works within the timeframe required.

Table 3-20 DSFEP Response Levels

Response Level	Trigger	Actions
Response Level 1 (base level warning)	Forecasting from Bureau of Meteorology and/or rainfall within catchment (i.e. 75mm rainfall in 3 hours)	■ DSFEP management staff on site (24 hour site presence) and with work crew alerted and on standby. ■ Close up work areas ■ Check and confirm materials and equipment on site (night lights, geofabric) ■ Automated live monitoring of reservoir level, rainfall gauges and stream flow gauges
Response Level 2	A combination of the following: 1. 100mm of rainfall in 6 hours within the catchment 2. streamflow gauge 3. reservoir level, measured rise and predicted rise	■ DSFEP management team and work crews to come to site (once on site, they are briefed and on standby waiting instruction). ■ All works to cease on Steps 2 to 5 of construction works ■ Plant and equipment to work area including laying out rolls of geofabric
Response Level 3	A combination of the following: 1. 250mm rainfall in 12 hours OR 360mm rainfall in 6 hours within the catchment 2. streamflow gauge 3. reservoir level, measured rise and predicted rise	Implementation of DSFEP

3.4.10 Waste Management

Waste monitoring and auditing will be undertaken as part of the project. The purpose of monitoring waste management activities and outcomes on-site include:

- assessing actual waste results and comparing with predicted impacts and mitigation measures;
- monitoring for potential environmental impacts; and
- providing baseline data to enable continuous improvement of waste avoidance, reduction and management measures throughout the project.

Waste Sources

The key sources of waste from the project are:

- demolition waste (concrete, rock, gravel, steel and timber);
- construction material wastes (timber framing, concrete, rock, gravel, scrap metals, cable, wire, insulation, plastics and packaging);
- vegetation and soils as a result of clearing;
- regulated waste (hydrocarbon waste, chemical resides, detergents, solvents, batteries, tyres);
- drums and containers from supply of chemicals and oils;
- domestic and other general waste (food scraps, packaging, rags);
- recyclable waste (aluminium cans, glass, cardboard and paper)
- scrap metal; and
- sewage effluent and sludge.

The wastes generated by infrastructure construction activities, and the proposed method of mitigation are detailed in **Table 3-21**.

Table 3-21 Waste Management - Construction Phase

Waste Type	Source	Estimated Quantity	Management Method
Vegetation	Tree clearing in construction and inundation areas	360 ha	Cleared timber moved above future storage line in-inundation areas. It is not feasible to mulch material in inundation areas. Some logs stacked in windrows others scattered depending on erosion potential of area and density of trees. Some vegetation chipped on site for landscaping and erosion control. Vegetation within quarry area stacked and burned in designated areas (5-10 ha).
Soil, silt and fines	Excavation of quarry material; upgrade of dam wall; fines from concrete batching plant	>10 000 tonnes	All used as fill within dam wall or in recreation areas. Soil not used immediately for fill stockpiled in designated area. Silt and fines captured in slimes dam and used as fill in the quarry.
Waste rock	Excavation of quarry material; upgrade of dam wall	>50 000 tonnes	Use of excavated and demolition rock in embankment. Waste rock not used immediately for fill stockpiled in designated area.
Concrete	Construction of dam wall	~1% of total concrete produced (approx 60 000 m^3 produced during construction)	Minimise waste by producing / procuring only the amount necessary. Use of hardened waste concrete as crushed material for the batching plant and as fill material on site.
General building materials	Construction	Unknown	Reused and recycled where possible as construction material, fill etc. Disposed of in general or recycle bins as appropriate.
Timber – pallets and off-cuts	Construction, packaging of structures; maintenance	Minor	Minimise waste by producing / procuring only the amount necessary. Pallets reused by suppliers etc. Reuse on-site as construction material wherever possible. Convert to woodchips and mulch for landscaping and erosion control. Excess disposed of in general waste to go to landfill.
Steel/ metal off cuts	Weldmesh, pipework, structural material	Minor	Minimise waste by producing / procuring only the amount necessary. Segregation in designated recycle bins and collection on-site. Transportation off-site by a waste contractor for recycling.
Plastics and electrical cable	Conduit, pipework and packaging	Minor	Minimise waste by producing / procuring only the amount necessary. Reuse on-site as construction material wherever possible. Excess disposed of in general waste to go to landfill.
Liquid Nitrogen	Lowering the placement temperature of concrete	85 500 m^3	Stored in vacuum insulated vertical vessels and applied as necessary to avoid wastage. Unused quantities transported to other sites for further use.
Detergents and cleaning agents	Waste from cleaning activities	Minor	Use of non-toxic and biodegradable products where possible. Unused quantities transported to other sites for further use. Non-toxic and biodegradable agents can be drained into the sediment ponds with wastewater. Toxic agents treated as hazardous spills and cleaned up as per spill procedures and MSDS.
Cutback bitumen or bitumen emulsion	Excess from road upgrade and haul road sealing	Unknown	Minimise waste by producing / procuring only the amount necessary. Unused quantities return to supplier in delivery truck. Larger quantities of hardened excess able to be used as fill.

Waste Type	Source	Estimated Quantity	Management Method
Herbicide	Residue from containers	Minor	Drums returned to supplier for reuse or refill. Small plastic containers disposed of in general waste. Spills and leaks contained and treated as per the EMP.
Oils, fuels, lubricants, spill kit clean up materials, and water, rags and soils containing these substances	Vehicle maintenance, spilt oils collected in separators and grease trap, spill clean up	<500L / month hydrocarbons 1 skip bin / week solid waste	Storage of oils, fuels and chemicals in bunded pallets or within a bunded container. Refuelling at workshop in bunded area. Some machinery (eg excavators, cranes) refuelled in situ as per site Refuelling Procedure. Workshop sealed and bunded appropriately. Liquids in the workshop collected in oil/water separator. Solid waste contaminated by regulated waste substances deposited in regulated waste bins. Regulated wastes transported off site by licensed regulated waste contractor. Emergency Management Plan to be generated for the site. Contaminated soil from spills – soil from small spills treated on site outside impoundment area in a location adjacent to stockpile area. Spills treated as per Emergency Management Plan.
Oily air filters	Air filters from vehicle maintenance in workshop	Minimal – likely to be generated every three months from each unit	Oil filters will either be: drained (hot draining, puncturing, crushed) and sent to landfill; or taken off site and disposed of by an approved regulated waste contractor. Otherwise, oily air filters disposed of in regulated waste bin. Regulated wastes transported off-site by licensed regulated waste contractor.
Paints, resins and solvents	Residue from drums	Minor	Storage of paints, resins and solvents in bunded area. Collection on-site in regulated waste bins. Regulated wastes transported off-site by licensed regulated waste contractor.
Acid Hydrochloric acid, dry acid, alum in liquid and powder forms	Reside from washing concrete equipment	Minor	Waste water containing acid washed into settlement ponds where pH is balanced by waste materials from concrete agitators and further treatment if required. Excess acids transported to other sites for further use. Spills and leaks treated as per the EMP.
Empty drums and containers – suitable for return to supplier	Supply of chemicals, paints, oils, acids, cleaning agents etc	Minor	Drums and containers that held regulated waste stored in bunded area during use and prior to disposal. Drums and containers that held regulated wastes transported off-site by licensed regulated waste contractor or collected by supplier. Non-regulated waste drums and containers returned to supplier.
Empty drums and containers – suitable for recycling	Supply of chemicals, paints, oils, acids, cleaning agents etc	Minor	Drums and containers that held regulated waste stored in bunded area during use and prior to disposal Drums and containers that held regulated wastes transported off-site by licensed regulated waste contractor Non-regulated waste drums and containers transported to licensed facility for recycling
Empty containers (not drums) – not suitable for recycling	Supply of chemicals, paints, oils, acids cleaning agents etc	Minor	Drums and containers that held regulated waste stored in bunded area during use and prior to disposal Drums and containers that held regulated wastes transported off-site by licensed regulated waste contractor Non-regulated waste drums and containers triple rinsed on site, crushed, punctured and sent to landfill.
Tyres	Vehicle maintenance	4 / month	Stored in designated tyre disposal area. Regulated wastes transported off-site by licensed regulated waste contractor to licensed facility for recycling or disposal.
Batteries	Vehicle maintenance	1 / month	Stored at workshop on pallet off the ground. Regulated wastes transported off-site by licensed regulated waste contractor.

Waste Type	Source	Estimated Quantity	Management Method
Sewage	Visitors and employees	1.4 ML / 3 years of construction	Sewage directed to on-site septic system maintained regularly by licensed contractor. Additional portaloos provided on site to accommodate construction workforce pumped out by licensed contractor and transported off-site to licensed treatment facility.
Concrete Batching Plant wastewater	Concrete batching plant operations	0.4 ML / 3 years of construction	Treated on site to appropriate pH, transferred to settling tanks and reused in the Plant or for dust suppression on site.
Aggregate crushing and screening plant wastewater	Aggregate processing operations	400 ML / 3 years of construction	Pumped to sediment pond and treated on-site as part of water quality regime.
Workshop washdown wastewater	Vehicle washdown	32 ML / 3 years of construction	Washdown area to be designated with separator in place.
Domestic wastewater	Domestic use in offices	6 ML / 3 years of construction	Pumped to sediment pond and treated on-site a part of water quality regime.
Domestic waste – putrescible and organic (food waste), wrapping, paper and packaging with food / non-regulated waste contamination	Employees lunches	Minor	Collected in covered bins marked and colour coded as “general waste”. Removed from site by licensed contractor at least weekly and disposed to landfill.
Cans, bottles, jars	Employees lunches, general works	200 L container / month	Collected in covered bins marked and colour coded for recyclable items Removed from site by licensed contractor and transported to recycling facility.
Paper, cardboard	Office paper, packaging of goods	Minor	Collected in covered bins marked and colour coded for recyclable paper and cardboard. Removed from site by licensed contractor and transported to recycling facility.

During operation of the Hinze dam facility, waste will be generated predominantly from maintenance activities and personnel. All wastes from these activities will be removed from site and disposed of in appropriate waste disposal facilities. The waste type likely to be generated during dam operation activities and the proposed mitigation are shown in **Table 3-22**.

Table 3-22 Waste Management - Operation Phase

Waste Type	Source	Estimated Quantity	Management Method
Vegetation	Trimming, lopping and clearing for maintenance, access and safety	Minor	Used as firewood in recreational area on-site. Chipped and used in landscaping and erosion control, or removed from site. Off-cuts placed in appropriate areas to decompose.
Scrap steel	Weldmesh, pipework, maintenance	Minor	Minimise waste by producing / procuring only the amount necessary. Segregation and collection on-site. Transportation off-site by contractor for off-site recycling.
Plastics and electrical cable	Conduit, pipework, electrical maintenance	Minor	Minimise waste by producing / procuring only the amount necessary. Reused on site where possible. Transported off site by contractor. Excess disposed of in general waste to go to landfill.

Waste Type	Source	Estimated Quantity	Management Method
Timber – crates, pallets and off-cuts	Packaging of structures; maintenance	Minimal during operation	Minimise waste by producing / procuring only the amount necessary. Used as firewood in recreational area on-site. Pallets returned to supplier.
Oils and fuels, and spill kit clean up materials and rags and water containing these substances	Maintenance, spill clean up	Very minor	Storage of oils, fuels and chemicals in bunded area in shed. Solid waste contaminated by regulated waste substances deposited in regulated waste bins. Regulated wastes transported off site by licensed regulated waste contractor as required. Emergency Management Plan to be generated for the site to include operational phase.
Paints, resins and solvents	Residue from drums	Minor	Storage of paints, resins and solvents in bunded area. Collection on-site in regulated waste bins. Regulated wastes transported off-site by licensed regulated waste contractor.
Sewage	Visitors and workers	12 400 litres/month	Sewage directed to on-site septic system. Pumped out by licensed contractor and transported off-site to licensed treatment facility.
Domestic Wastewater	Domestic use in offices	31 000 litres/month	Pumped to sediment pond and treated on-site a part of water quality regime.
Domestic waste – putrescible and organic (food waste), wrapping, paper and packaging with food / non-regulated waste contamination	Employees lunches	Minor	Collected in covered bins marked and colour coded as “general waste”. Removed from site by contractor at least weekly and disposed to landfill.
Cans, bottles, jars	Employees lunches, maintenance activities	Minor	Collected in covered bins marked and colour coded for recyclable items. Removed from site by licensed contractor and transported to recycling facility.
Paper/cardboard	Office paper, packaging of goods	Minor	Collected in covered bins marked and colour coded for recyclable paper and cardboard. Removed from site by contractor and transported to recycling facility.

3.4.11 Environmental Safety and Management

The management of the water storage both during and construction and operation will be undertaken through the implementation of a series of environmental management plans and emergency management plans.

These plans form part of this Environmental Impact Statement and are detailed in **Section 19**.

3.4.12 Security

Construction Phase

There will be no public access to the dam site during construction. A security checkpoint will be set up at the Advancetown Rd entrance, while the Gilston Rd entrance will be closed. On-site security staff will provide 24 hour monitoring of the site.

Operation Phase

A vehicular gate installed on the western side of the spillway bridge will prevent public vehicle access to the dam crest. This will likely be operated with a swipe card system to allow access for maintenance and Emergency Services vehicles. The adopted security system will be replicated throughout the site and with appropriate data

logging will enable the dam operator to identify who accessed what facility and when. It will also provide alarms for unauthorised access, doors remaining open longer than a pre-set time, etc.

Vandalism of facilities at Hinze Dam is presently an issue. During construction this ought to be reduced due to the site closure and presence of security personnel. Prevention measures to be installed for the Stage 3 operations phase may include fixed and motion-activated security lights, CCTV, audible alarms, security signage etc. This will be developed during detailed design.

3.5 Infrastructure Requirements and Upgrading

In addition to the construction of the dam and associated works there is also a range of infrastructure that requires upgrading as part of the project. The infrastructure requirements for the project include road upgrading, bridge and culvert upgrading, the construction of the fish transfer device, the construction of recreation facilities, and infrastructure pipelines.

3.5.1 Road Upgrading and Construction

In general, the project has the following impacts on road infrastructure:

- partial inundation of some road embankments during FSL or flood events compromising the stability and integrity of embankment materials;
- inundation of cross-road culvert outlets affecting performance and capacity during flood events;
- full inundation of roads during flood events reducing current flood immunity; and
- increased time of submergence of the bridge over the Nerang River along Pocket Road.

Details of the road upgrading and construction works that will be undertaken as part of this project are contained in **Figures 13-5, 13-6, and 13-7** in **Section 13** of this EIS.

Partial Embankment Inundation

The stability and integrity of road embankment along Nerang-Murwillumbah Road and Gold Coast-Springbrook Road is affected to some extent in 15 locations. During significant storm events, flood waters in particular, inundate the embankment introducing the risk of slope failure due to saturation.

To clarify the impact on the stability of the embankments partially inundated by the Stage 3 flood events, the characteristics and interface of the embankment layers will have to be confirmed through detailed invasive investigations.

The possible scenarios include:

- if the interface between the rock-fill and granular layers falls above the future Q100 water level and the rock fill is free draining then no slope stabilisation measures will be required for the embankments; or
- if the soil/rock interface however falls below the future Q100 water level or the rock-fill is deemed not to be adequately free draining, then slope stabilisation measures as well as appropriate measures to prevent the excessive loss of fines from the upper soil layer passing through the voids in the rock fill layer will be required for the embankments. It is proposed to protect the embankments in these situations with rock-fill berms or gabion structures with a geotechnical interface.

Culvert Inundation

Cross road drainage culvert performances are affected due to the tail-water of the dam extending up the catchments inundating the culvert outlets during storm events. However, analysis has shown that the level of headwater from the culverts does not overtop the road during a 1 in 50 year Average Recurrence Interval (ARI) critical storm except in one location on Gold Coast-Springbrook Rd.

This culvert currently has 1 in 20 year ARI flood immunity, and in the event of a 1 in 50 year ARI flood the headwater from the culvert would currently overtop the road by approximately 500mm. This is under free outflow conditions with no tailwater effects from the dam.

The analysis undertaken to assess this culvert has been discussed in detail with the Department of Main Roads and it has been agreed in principle that there is no requirement to undertake remedial treatment of this culvert. However, further detailed analysis will be carried out to confirm there is no safety risk imposed by any scenario Hinze Dam Stage 3 would produce.

Road Re-alignment

One section of Gold Coast-Springbrook Road has been identified as being susceptible to flooding. This section is located approximately 250 m east of Little Nerang Creek across the upper eastern arm of the impoundment. This section of road drops to an approximate height of 98 m Australian Height Datum (AHD) over an approximate length of 250 m, which is 2.3 m below the 1 in 50 year ARI flood level.

It is proposed to realign Gold Coast-Springbrook Road vertically under the requirement of the Department of Main Roads. This is proposed over a length of approximately 700 m starting approximately 250 m east of the Little Nerang Creek Bridge to a maximum height of 100.7, 2.7 m above current road levels. Access to adjacent properties will have to be upgraded to suit the proposed new road level. Further, Telstra and Energex services will need to be relocated to accommodate the new road formation.

The embankment for the proposed road realignment will extend within Lot 2 on RP166736 and RP49670 Gold Coast City Council owned land. Detailed survey and design is to be carried out to determine the real property boundary and extent of land requirements.

Pocket Road Bridge

A low level timber structure bridge across the Nerang River on Pocket Road is affected by dam flood waters. While it has been calculated that the depth of water over the bridge is not increased by the Stage 3 works to provide for 1 in 10 year ARI flood immunity for the Pocket Road Bridge, a new bridge will need to be constructed off-line at a higher level to the existing bridge. This will allow flood waters during a 1 in 10 year ARI critical storm to be conveyed without submergence of the bridge. The new bridge deck height will have to be at approximately 104.5 m AHD which is approximately 6.7 m higher then the existing bridge.

The construction of the Pocket Road Bridge, land will be required from Lot 702 on AP6298 State Forest Land. Detailed survey and design is to be carried out to determine the real property boundary and extent of land requirements.

Internal Access Roads

Due to the augmentation of the dam wall under this project local roads within the CID area will be impacted. Access to the community recreation areas including the facilities themselves will either be inundated or within the proposed construction footprint.

Access across the dam wall and spillway will be impacted by the project due to the raising of the wall. It is proposed to remove public access across the wall and spillway for the following reasons:

- Latimers Crossing Rd downstream of the dam provides a link between Gilston Rd and Advancetown Rd;
- reinstating Gilston Rd will be difficult and costly. With the Hinze Dam Stage 3 embankment 15m higher than existing a new road alignment is required in order to maintain trafficability;
- with limited recreation facilities proposed on the eastern side, and recreation activities focused on the western side of the dam, there is little reason to maintain public vehicle access across the dam crest;

- there is no identified agency (Emergency Services, police, GCCC, Gold Coast Water) requirement to maintain a link between Gilston Rd and Advancetown Rd. In the proposed road network, provision has however been made for Emergency Services access to the Saddle Dam; and
- provision of public vehicle access across the dam would require dual lanes. As the dam crest is only 10m wide this would severely limit pedestrian and bicycle access.

The permanent roads, and their configuration, to be undertaken within the CID area are shown on **Figure 3-10**.

3.5.2 Fish Transfer

The design of the fish transfer system for Hinze Dam was based on a number of key factors, including legislative requirements, practicality of design, construction and operational costs, and the most beneficial system for fish species that will be transferred. The Queensland Department of Primary Industries – Fisheries (DPIF) confirmed the need for a fish transfer device and consultation has been undertaken with the department throughout the preliminary design phase of the fish transfer device.

Upstream fish passage for Stage 3 upgrade of Hinze Dam will be provided via a trap and haul system that will be located in the vicinity of the existing environmental flow outlet adjacent to the pump station. No downstream passage is to be provided other than fish passing over the spillway during spill events.

The key criteria for the fish transfer system are:

- the entire environmental flow of 7ML/day, after passing through the on-site hydro-electric plant, is available to facilitate fish transfer;
- the fish transfer system is to be designed to accommodate fish sizes ranging from elvers each weighing a few grams up to occasionally large eels up to 1 m or more in length;
- the fish transfer system design and operation is to be flexible to accommodate potential variation in the number of fish to be transferred; and
- fish trapping and transfer facilities to be operable for floods up to the 1 in 20 AEP flood. However no transfer of fish would be undertaken when the causeway downstream of the fishway is inundated.

The system will consist of an approach channel leading fish upstream through a trap into a holding chamber. The chamber can be isolated from the rest of the system and the fish guided into a screened hopper. The hopper will be lifted periodically, with fish and water placed into a tank mounted onto a suitably equipped truck then transported upstream for release into the reservoir. A weir has been provided across the entire river channel to assist in guiding fish to the approach channel.

Trap Location

The following two locations were considered for the trap:

- near the right bank at the upstream terminus of the river, ie. directly downstream of the spillway chute; and
- downstream on the right bank adjacent to the existing environmental flow release at the micro-hydro power station.

G:\SpatialArc_MXD\EIS\Project_Description\Fig_3_10_070522.mxd Produced: 22/5/2007

N

0 75 150 300

Metres

Scale - 1:10,000

Projection: MGA Zone 56

Legend

- CID
- Dam Footprint
- Public Road (includes bicycle lane and footpath)
- Pedestrian / Bicycle Access plus maintenance vehicles
- Maintenance Vehicle Road (No public access)

Figure 3-10

Road Network within CID

Hinze Dam Stage 3 EIS

The upstream location would require the environmental flow release to be moved 200 m upstream and additional channel works to be undertaken downstream of the trap entrance. This location would provide good attraction during non-spillway flow releases but likely poor attraction during spillway flow as the trap entrance would be located upstream of the spillway flow impingement zone. Fish would have to pass through highly turbulent and chaotic flow surrounding the jet impingement to find the trap channel entrance.

The existing outlet for environmental releases is located on the right bank approximately 200 m downstream of the spillway with this being considered the most appropriate location. It provides good attraction during both spillway flow and non-spillway flow releases. This location requires an upstream barrier weir be constructed across the river channel to prevent fish moving upstream of the fish pass entrance during spillway releases.

Upstream Barrier Weir

The barrier weir is likely to be a concrete weir that extends up to 3m above the existing channel bed. Investigations will be conducted during the detailed design phase to determine whether a grouted rock weir may be more suitable. The barrier will have a pipe that will drain the upstream pool following cessation of spillway flow. This will allow downstream passage of fish in the pool upstream of the barrier and provide additional attraction flow along the right bank near the approach channel entrance. The weir will act as a barrier for the fish travelling upstream and will assist in guiding the fish towards the approach channel. The weir also has the added benefit of creating a pool downstream of the flip bucket to reduce the impacts on fish moving downstream during spill events.

Attraction Flows and Approach Channel

The fish collection pool consists of an attraction flow provided at the upstream end, a large collection pool with a fish transfer hopper recessed in the invert and a screen with a 'V' trap and a slide gate at the downstream end. An approach channel is then provided downstream to guide the fish towards the trap.

The environmental flow will be passed through the collection pool and attraction channel. The collection pool will be approximately 6m long by 2.0 m wide with variable depth. The maximum depth would be approximately 1.7 m.

Fish Hopper

A fish transfer hopper with a water volume of approximately 750 L will be provided. The hopper will be approximately 1.2 m in diameter and 1 m in height with a 250 mm diameter drain port in the base. The collection pool is to be drained through a dewatering screen located below the hopper's upper rim. Water will be held in the hopper during fish transfer by a plug which would either be opened by manually pulling a cable or by air or electric actuator.

Protection of Fish

Screening, submerged cover and grid-decking will be used to separate small fish from larger fish predators and stop fish from jumping out of the system. Screens and grid-decking are also required to prevent bird predation and avoid human interference.

Trap and Haul Operation

The following process will be required for the operation of the trap and haul system:

- the fish attraction phase will consist of the environmental flow discharged through a diffuser at the head of the collection chamber. The duration of the attraction phase will be dependent on the number of fish moving into the collection chamber;
- prior to a fish transfer, the fish transfer truck will be filled with approximately 1250 L of water and positioned to receive fish and water from the transfer hopper;
- the transfer process starts by closing the environmental flow supply valve, opening the sump drain valve and closing the slide gate at the downstream end of the collection chamber, thus isolating the collection chamber.

The electrical and mechanical system will be arranged such that these three actions are initiated by a single switch;

- during the fish transfer process the environmental flow bypasses the collection chamber and is released directly downstream of the slide gate, thus maintaining the attraction flow downstream of the collection chamber;
- water in the collection chamber drains out through the hopper screen, leaving fish and approximately 750 L of water in the hopper;
- the operator will use the overhead hoist to lift the hopper and position it over the fish transport truck. The operator then releases the plug in the fish hopper draining the contents into the truck;
- the hopper is then moved back into position in the collection chamber and the gates are switched to their prior position, allowing fish collection; and
- the truck will be driven to the desired release location and fish are released with 2000 L of water through a valve and chute on the rear of the truck transfer tank.

Occasional, part-time operation will be required to run the system and a remotely operated monitoring capacity may be included to determine the necessary timing. As an initial estimate, this frequency could range from daily to intervals of several days. Timing could be based on video or other monitoring of fish accumulation in the trap. Imaging could also be used to generate a fish-passage data record, especially describing the numbers, approximate biomass, species composition and timing of fish movements.

Release of Fish into the Reservoir

Upstream-moving fish will need to be released close to the reservoir shoreline in order to continue their upstream movement and to be able to locate sheltering cover and other habitat features within their preferred ranges. Prior to release fish will be screened for pest species. The screening procedure will be developed during the detailed design phase of the project.

Release points will be suitably distant (>100 m) from both the spillway and the intake towers to avoid fish becoming entrained and being returned downstream. Furthermore, to avoid learned predatory behaviour by resident fish in the reservoir, which can have a major impact on survival of transported fish, releases should occur at multiple locations along the shoreline, preferably separated by approximately 100 m or more.

Monitoring

Environmental flow discharge and the water surface elevation in the trap will be monitored electronically to ensure flow conditions in the trap and attraction channel are in compliance with desired operating conditions. A deviation of these measured parameters outside established operating ranges will trigger an alarm notifying operators. System parameters can be monitored remotely.

Fish Transfer Infrastructure

- a range of pipework is required for the operation of the system. All pipework will be cement lined mild steel, however this will be evaluated during detailed design;
- a variety of small gates and valves will be required for the trap and haul system. These will typically be electrically actuated and operated in fully-open or fully-closed positions and will not be required to regulate the flow. All flow will be regulated from the existing pump station. All of the valves, gates and actuation systems are relatively small and are standard items of equipment;
- a hoist is required to lift the hopper from the normal operating position across to where the truck will be situated. The winch will be a variable speed drive to allow speed reduction and to increase hopper positioning accuracy; and

- all components of the trap and haul system will be operated from the site. It is intended that the entire fish transfer process can be conducted by a single operator and the electrical and mechanical components of the system will be arranged to simplify the transfer process.

Long-term Provision of Fish Passage

An assessment was undertaken as to whether the long-term provision of fish passage negatively impacts upon the viability of the project. The direct capital cost of the 'trap and truck' option proposed for Hinze Dam is estimated at $1 602 100 (representing just 0.4% of the total capital cost of the project), while the ongoing operational costs are likely to be in the order of $150 000 per annum.

In annual full cost recovery terms (taking into account total project operating costs, depreciation and a return on capital), the additional cost per megalitre from the fishway option proposed is estimated at around $20/ML in terms of an annual yield cost. This equates to less than 1% of the total cost per ML yielded for the overall project.

3.5.3 Infrastructure Pipelines

There are no additional water supply infrastructure pipelines to be provided as part of the project. Repair works will be undertaken where required in association with other works such as the repair of the existing tunnel for the Little Nerang pipeline beneath the Gold Coast Springbrook Rd.

3.5.4 Aquatic Flora and Fauna Transfer

The project does not involve the construction of any infrastructure or include any works associated with the transfer of water between catchments. The impacts or transfer of aquatic flora and fauna in such a system is therefore not part of this project and outside the scope of this environmental impact statement.

3.6 Proposed Water Storage Operation

3.6.1 Water Resources (Gold Coast) Plan 2006

Reservoir Yield

The water supply objective for the project is governed by State Government legislation and a Gold Coast City Council resolution.

- **Water Amendment Regulation (No. 6) 2006** – In accordance with the regulation, the Alliance has adopted a target yield for the Stage 3 raise based on increasing the existing supply entitlement of 209 ML/day (as defined in the Interim Resource Operations Licence – IROL) by the required 16 ML/day. Therefore the target yield for Hinze Dam Stage 3 is 225 ML/day.
- **Gold Coast City Council's resolution of the 22 November 2004 (G04.1122.032)**
  - in accordance with item a in the resolution, the Hinze Dam Stage 3 is to be designed with operation of a buffer storage (i.e. the storage volume below the lowest intake gate; otherwise known as dead storage) of 19 192 ML which is 12% of the Stage 2 volume; and
  - the Alliance has included allowance for an environmental flow release of 7.25 ML/day in the assessment of the yield from Stage 3 to comply with the Gold Coast WRP.

Full Supply Level

The *Water Resource (Gold Coast) Plan* was gazetted in December 2006. The plan preserves existing water entitlements within the plan area as well as makes provision for a strategic reserve of up to 30 000 ML/annum of additional water supply to the region. The strategic reserve is made up of additional yield from the Hinze Dam catchment as well as water harvesting into the dam from adjacent catchments.

The Hinze Dam Alliance investigated a range of full supply levels between 90 m AHD and 100 m AHD to produce a target yield of 225 ML/day, with an adopted buffer storage of 19 192 ML, and environmental flow releases of 7.25 ML/day for Hinze Dam.

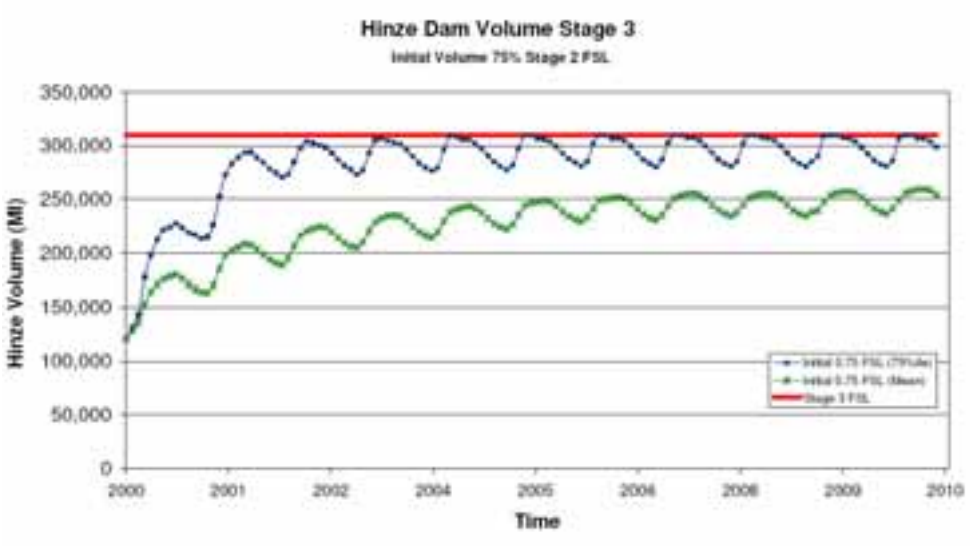
The hydrologic modelling undertaken by the Hinze Dam Alliance demonstrates that an adopted FSL of RL 94.5 m AHD will meet these requirements. Additionally, the assessment confirmed that the provision of an FSL of 94.5 m AHD will result in compliance with the *Water Resource (Gold Coast) Plan a*nd the requirements of Schedule 10B Measure 11 of the *Water Amendment Regulation (No. 6) 2006* in terms of additional yield and preparedness for future water harvesting.

3.6.2 Water Storage Operation and Flow Releases

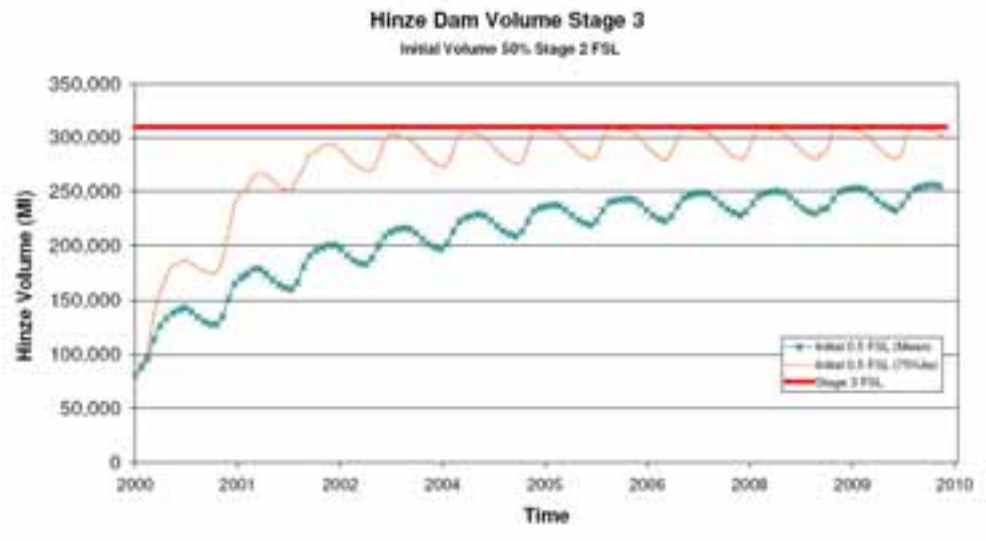
Reservoir Fill Plan

The modeling of the filling of Hinze Dam has been undertaken for several scenarios (**Figure 3-11** and **Figure 3-12**). This modeling was based on 10 years of stochastic data, generated by the SCL from the historic sequence and it includes rainfall, evaporation and inflows data.

- **Figure 3-11 Predicted Fill Rate – 75% full at Commencement**



- **Figure 3-12 Predicted Fill Rate – 50% full at Commencement**



There is no maximum rate of filling nor are any hold points necessary during filling process. The initial fill plan will consist of surveillance programme comprising frequent evaluation of the dam safety instrumentation data supplemented by visual observations of the dam and surrounding areas.

The dam safety instrumentation will be collected and evaluated on a frequent and regular basis during the initial period of filling and for the subsequent two years. The data will be compared criteria established during final design and construction phase. The objective will be to identify potential conditions within the dam and foundation that could impact the safety and operation of the dam. Low level outlets have been provided through the spillway should emergency evacuation of the reservoir be required.

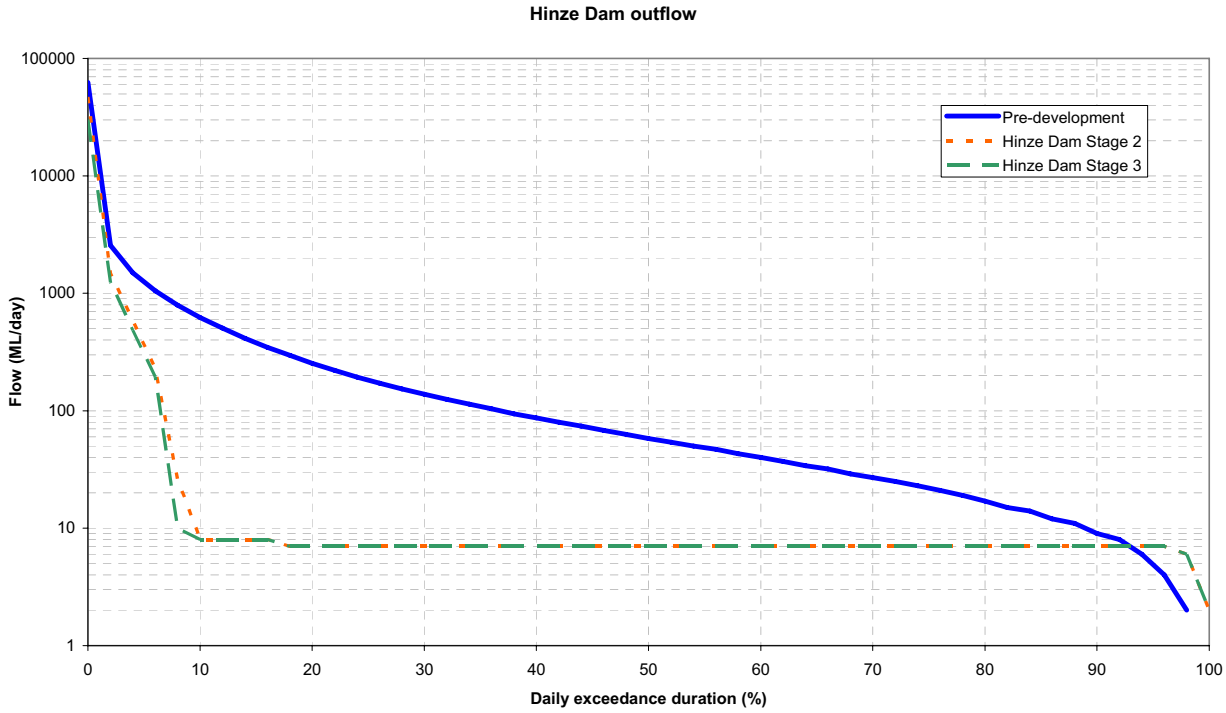
Visual observations of the dam and surrounding foundations and abutment areas will be made to identify signs of potential distress and to supplement the data obtained from the dam instrumentation.

Environmental Flows

Hinze Dam has a catchment area of 210 km^2, almost half of the Nerang River catchment, and has impacted the flow regime of the Nerang River. Flow duration curves show that the project works will have very little further impact on the downstream river flow.

The flow duration curve shown in **Figure 3-13** indicates that the flow is greater than 10 ML/d for less than 10% of the time. For approximately 90% of the time the flow consists of a constant release of about 7.25 ML/d, which is made from the dam as an environmental release and compensation flow. This release will not be changed by the project.

- **Figure 3-13 Daily Flow Duration Downstream of Hinze Dam**



Inundation Pattern

The areas of inundation, including the full supply level and the peak flood levels, are described in **Section 3.2** of the EIS.

Seasonal Flows

The river flow downstream of Little Nerang Dam and Hinze Dam is supplemented by low flow releases from both dams. These releases are intended as compensation flows for downstream landowners as well as an environmental benefit. Medium to high flows are not released from Hinze Dam as the downstream area is highly developed and vulnerable to flooding.

The Nerang Water Supply Scheme iROL (DNRMW 2006) specifies the following passflow rules from Hinze Dam:

- when the FSL of Hinze dam is less than EL 66.69 m AHD 50% of the sum of the inflows into Hinze dam and Little Nerang Dam must be released, up to a maximum of 6 ML/d; or
- if the FSL of Hinze dam is greater than EL 66.69 m AHD the sum of the inflows into Hinze dam and Little Nerang Dam must be released, up to a maximum of 6 ML/d.

The Nerang iROL was released in July 2006. Prior to this, modelling of the Nerang system assumed a constant environmental release of 7.25 ML/d from Hinze Dam and 0.86 ML/d from Little Nerang Dam in order to meet anticipated environmental flow objectives. This flow remains constant throughout the year.

3.6.3 Water Treatment and Supply

Urban Water Supply Requirements

The Gold Coast City water supply is sourced from both Hinze Dam and Little Nerang Dam with an urban allocation of 76 300 ML/a from the two storages. However, for planning purposes GCCC assumes that the current available yield is 69 900 ML/a (DNRMW 2006) with the current consumption being in the order of 69 000 ML/a. The demand pattern varies throughout the year as demonstrated in **Table 3-23** The average demand is 189 ML/d with a peak occurring in December and January at 220 ML/d (GCCC 2005). This is due to hot weather and the peak of the tourist season increasing the water demand.

- **Table 3-23 Gold Coast City Water Supply - Demand Pattern**

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
% of Annual demand	9.62	8.22	8.05	7.97	7.16	7.36	7.59	8.11	8.62	9.03	8.67	9.60
Monthly demand (ML)*	6724	5746	5627	5571	5005	5145	5305	5669	6025	6312	6060	6710

Based on an annual demand of 69 900 ML
Source: Gold Coast Water 2004

Sourcing of Water

Currently water is transferred from Hinze Dam to Molendinar and Mudgeeraba water treatment plants (WTP) via pump stations. As shown in **Table 3-24** Molendinar WTP receives a maximum of 120 ML/d and Mudgeeraba WTP receives a maximum of 74 ML/d from Hinze Dam. The maximum combined treatment capacity of the plants is 296 ML/d (GCCC 2005).

- **Table 3-24 Water Treatment Plant Intake**

Intake	Description	Intake level	Maximum outlet capacity
Lower Intake	Hinze Dam to Molendinar WTP	EL 45.6 m AHD	240 ML/d (pumped flow) 120 ML/d (gravity flow)
Upper Intake	Hinze Dam to Mudgeeraba WTP	EL 58.0 m AHD	87.4 ML/d (pumped flow to Head Tank) 74 ML/d (gravity flow from Head Tank to WTP)

Source: DNRMW 2006

Drawdown Levels

The drawdown levels of Hinze Dam are detailed in **Table 3-25**. The dead storage capacity of the dam is 2180 ML at 45.6 metres AHD.

Table 3-25 Dam Drawdown Levels

Location	Minimum Drawdown Level
Lower Intake Tower - Molendinar Water Treatment Plant	45.6m AHD
Upper Intake Tower - Mudgeeraba Water Treatment Plant	58.0m AHD.
Nerang River Outlet	45.6m AHD.
Emergency Outlet	43.0m AHD.

Source: DNRMW 2006

Water Extraction

Lower Intake Tower

The lower intake tower is currently a 61m high dry well reinforced concrete tower housing. The height of this tower will be increased by 15m to provide for the new full supply level of the dam. This tower currently has eight off-takes at EL 43.316m, 48.316m, 53.316m, 58.316m, 63.316m, 68.316m, 73.316m and 78.316m AHD. The off-takes will be increased to eleven as part of the project works. There are no changes proposed to the scour outlet and the outlet pipes.

Upper Intake Tower

The upper intake tower located 4.5 km upstream of the main embankment on the Little Nerang Creek arm of Hinze Dam. The intake structure consists of a 43m high dry well reinforced concrete tower the height of which will be increased by 15 metres as part of the Stage 3 works. This intake tower currently houses six inlet pipes located at EL 76.934m, 71.713m, 66.536m, 61.337m, 58.842m and 56.340m AHD.

The upper intake supplies water to the Mudgeeraba WTP. It is also possible to supply the Mudgeeraba WTP with water from the Little Nerang Dam via an existing 860 mm diameter raw water pipeline. This pipeline will be utilised during the Stage 3 works so that the upper intake tower can be taken offline. It is expected that the tower will need to be taken offline twice during Stage 3. The first of these will be when the electrical controls are moved to the abutment such that they don't interfere with the works required to raise the tower. The tower will be put back online as the tower is being raised. The second time will occur when the bridge is raised, the electrical controls are re-established within the tower and the existing pipework is connected to the new pipework.

Treatment Facilities

The connection from the lower and upper intake towers to the Molendinar and Mudgeeraba WTPs will not be altered with the construction of Stage 3.

Connection to Molendinar Water Treatment Plant

A 1440mm diameter outlet pipe from the lower intake tower transports raw water to the pump station. The pump station associated with the intake tower houses 3 pumps. Flow is regulated at the intake tower inlets by electrically actuated butterfly valves. The rate of pumped flow is controlled by the pump/s in operation. The maximum outlet capacity is 240 ML/day or 2778 L/s.

Modifications may be undertaken to the lower pump station and break of head tank components of the intake tower. The extent of these modifications will be determined during the detailed design phase of the project.

Connection to Mudgeeraba Water Treatment Plant

A 750mm diameter outlet pipe from the lower intake tower transports raw water to the pump station. Three electric pumps are located in the dry well of the upper intake tower, and flow is regulated on the intake tower inlets by electrically actuated butterfly valves. The rate of pumped flow is controlled by the pump/s in operation.

The rate of pumped flow from the Upper Intake Tower to the Break of Head Tank is 87.4 ML/day or 1012 L/s. Gravity flow from the break of head tank to Mudgeeraba WTP is 74.0 ML/day or 856 L/s.

3.6.4 Access Points

There will be four key access points to the dam following the completion of the Stage 3 works:

- the main dam infrastructure will be access from Advancetown Road where public vehicle access will be provided to recreation areas and infrastructure downstream of the dam wall, recreation and information areas to the west of the dam wall, and car parking located adjacent to the interpretative centre;
- from Advancetown Road maintenance and emergency vehicles will be able to access the dam wall and infrastructure located to the east of the main embankment;
- Gilston Road will be closed in the vicinity of the intersection with Duncan Road. This will provide pedestrian and cyclist access to the recreation areas;
- access to the upper intake tower and the eastern boat ramp will remain unchanged; and
- the construction of an upgraded public boat ramp on the western arm of the dam will incorporate the provision of a new access road. This road will provide access to the boat ramp and the adjacent parkland.

Additional vehicle access points are available from Nerang Murwillumbah Road for maintenance and emergency vehicles.

3.6.5 Recreation Infrastructure

The scope of recreation infrastructure provided as part of the project works include:

- Lakeside parkland providing passive recreation opportunities;
- interpretive/Information Centre;
- cafe or food outlet;
- car parking facilities;
- public amenities;
- downstream parkland providing for both passive and active recreation opportunities
- a walking tracks in the immediate vicinity of the café facility /interpretive centre and the dam wall;
- reinstatement of the mountain bike track;
- extensive network of walking and cycling opportunities;
- two boat ramps with associated parking and facilities; and
- opportunities for the continuation of some event based recreation activities.

3.6.6 Operational Management of Water Storage

The management of the water storage both during and construction and operation will be undertaken through the implementation of a series of environmental management plans and emergency management plans. These plans form part of this EIS and are detailed in **Section 19**.

3.7 Rehabilitation

3.7.1 Vegetation Management

Vegetation management during the construction phase of the project will be undertaken to minimise potential impacts on vegetation within and adjacent to construction zones.

The following strategies will be employed prior to the commencement of site works and during construction stage:

- identification of areas within the inundation area that are to be cleared and/or retained on construction drawings;
- boundaries of areas to be retained to be clearly marked by tape and/or pegs and conform to limits on drawings;
- contractor and Site Environmental Adviser (or equivalent) to monitor vegetation clearing to ensure only approved areas are cleared;
- avoidance of damage to root zones of adjacent trees during construction – locate vehicle access, material storage and the cleaning of plant and equipment away from adjacent trees, where possible;
- salvage of topsoil from the quarry and clay borrow areas for future rehabilitation and landscaping works;
- commencement of revegetation/assisted natural regeneration within the construction site in areas that will not be inundated with local native species as soon as possible after disturbance;
- revegetatation of embankment treatments along the Nerang-Murwillumbah Road with local native species, including *Allocasuarina* as soon as possible after disturbance;
- use of existing roads and disturbed areas with non-remnant vegetation for haul routes, storage/stockpile areas, workshops, crib huts and site office wherever practicable;
- trees of merchantable size and value are to be salvaged. Arrangements with the Department of Primary Industries (DPI) will be made in relation to the logging of salvageable timber; and
- preparation of a weed management plan prior to any construction or clearing activities occurring to prevent the spread of declared weeds.

A compensatory habitat strategy will be developed for the project. The strategy will provide, as a minimum, one for one "replacement" of the remnant vegetation and essential habitat lost. Details of the compensatory habitat strategy are provided in **Section 9** of this EIS.

3.7.2 Significant Flora

The construction phase of the project is considered likely to have minimal impact on populations of significant flora. These flora species are predominantly located away from proposed infrastructure and in areas which will be subject to inundation. There are several actions which will be completed concurrently with or prior to construction works, including:

- identification of potential translocation sites for significant flora;
- development of Translocation Plans for Spiny Gardenia, Onion Cedar, *Plectranthus nitidus* and Rough-shelled Bush Nut. It is intended that suitable translocation sites be identified within the study area (above the proposed FSL), and that propagated individuals of the target species be planted at several sites;
- propagation trials for significant flora known from the study area and establishment of ex-situ populations of those species. Pilot propagation and planting trials should be initiated as soon as practicable to determine the translocation potential of the target species; and
- environmental awareness training of employees to include targeted training in relation to identification of certain threatened flora and fauna species.

3.7.3 Fauna Management

The *Queensland Nature Conservation Act 1992* and *Nature Conservation (Wildlife) Regulation 1994* require that protected animals whose habitat has been or is about to be destroyed by human activities or natural disasters are cared for and rehabilitated. Compliance with these Acts will be required and undertaken as part of the site works.

Few ongoing impacts on terrestrial fauna have been identified as a result of this project, and it is expected that there will be minimal fauna management required during the operation phase. Vertebrate pest management (which is currently carried out by GCCC Rangers) will continue on-site.

3.7.4 Weed Management

A Weed Management Plan will be prepared for the project in accordance with the EMPs detailed in **Section 19**. Management measures to prevent the movement of declared weeds to and from the construction site include:

- use of wash-down facilities for vehicles and equipment entering and leaving the dam construction site and those areas proposed for vegetation clearance. All machinery, equipment and vehicles shall be certified as "clean" prior to entering the site by trained personnel in accordance with DNRW practices;
- weeds are not to be used as mulch for landscaping, disposed of to Council's landfill and burnt to prevent reseeding;
- soil, earth and landscaping material brought onto the site must be from a source that is clean and weed free;
- the monitoring of re-vegetated areas to identify new infestations and eradicate any declared weeds found; and
- weed monitoring to ensure that new weed species are not introduced into the immediate area of the dam catchment.

3.8 Decommissioning

The nominal engineering life of the upgraded Hinze Dam is expected to be 100 years, though it is likely to be maintained after that period provided that it continues to meet dam safety requirements and remains an integral part of the South East Queensland regional water supply strategy. The dam may be decommissioned during or after the initial engineering design life if:

- it suffers significant damage that cannot be repaired to meet safety standards; or
- it is no longer required to provide flood mitigation or water supply to the Gold Coast region.

If decommissioning of the dam is required, the procedures will follow the requirements on the Australian National Commission on Large Dams (ANCOLD).

3.8.1 Decommissioning of Construction Works

Following the completion of the site construction works the site will be rehabilitated, materials cleared, and all site construction infrastructure removed. All park areas that are damaged during the construction works will be turfed, rehabilitated and returned to a suitable standard. These works will include the rehabilitation works detailed above. Following the completion of the decommissioning works the site will be inspected by the client and signoff achieved.

In relation to the clay borrow area the following demobilisation works will be undertaken:

- at the end of borrow area operations, the Constructor shall remove all equipment, including rock processing plant(s) and equipment, lighting, temporary fencing, and water removal and drainage systems;
- the Constructor shall not leave any low areas, holes or pits that will not drain naturally;
- on completion of all processing, the Constructor shall spread waste material and overburden within the limits of work to support tree growth, and shall scarify the surface to promote infiltration; and

- all excavated batters or slopes in the borrow areas shall be left in a stable, safe condition on completion of the works. Stormwater swales or bunds shall be constructed to ensure that stromwater runoff from either inside or outside the borrow areas does not cause instability or erosion of ground.

3.8.2 Commissioning

A number of components of the Stage 3 upgrade works will require commissioning prior to handover. By commissioning the components during the construction works this has the advantage that it can be ensured that the items are working as designed and any required modifications can be made prior to the construction works being completed.

3.8.3 Handover Documentation

The following plans and manuals will be produced during Stage 3 in accordance with the requirements of the Queensland Dam Safety Management Guidelines – February 2002.

The following documentation will be handed over to Gold Coast City Council for the upgraded dam:

- Data Book
- "As Built" drawings;
- Construction Report;
- Commissioning Report;
- Reservoir Fill Plan;
- Operation and Maintenance Manual;
- Standard Operating Procedures; and
- Emergency Action Plan.