

# 3. Description of the Project

## **Burnett Catchment Water Infrastructure - Burnett River Dam**

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### **3.1 Project Specifications**

#### **3.1.1 Location and Land Use**

The site for the proposed Burnett River Dam lies 131.2 km (AMTD) upstream of the mouth of the Burnett River. The reservoir will be integrated into the water supply system for the Lower Burnett Region in general and into the Bundaberg Water Supply Scheme in particular. The BWSS is one of the largest irrigation areas in Queensland with a total area exceeding 40,000 ha. The proposed dam is intended to provide water to supplement existing supplies which cannot meet current and future demand.

The dam site is located about 80km south west of Bundaberg and about 20km north west of Biggenden. The catchment area of the Burnett River upstream of the site is 30,785 square kilometres. The township of Gayndah lies upstream of the tailwater of the proposed reservoir. Dallarnil, on the Isis Highway, 14 km to the east of the site, is the closest settlement to the site.

The location of the project is shown on **Figure 3-1** and the proposed inundation area is shown in **Figure 3-2**.

#### **3.1.2 Existing Land Use**

Land use in the area to be inundated by the reservoir and surrounding the dam and reservoir is predominantly agricultural. Most land is used for grazing of cattle with some orchards and horticulture located on alluvial flats close to the river. The orchards and horticultural areas currently draw irrigation water directly from the Burnett River or its tributaries.

To the north of the dam site lies the Goodnight Scrub National Park. As a newly declared park area, the boundaries of the park have been determined by taking the proposed inundation area into consideration. The southern boundary of the park abuts the Q100 (1 in 100 year) flood level for the inundation area and will not be inundated at FSL.

Complete details of land use in the project area are given in Section 6 of this report.

#### **3.1.3 Proposed Water Use**

The reservoir will supply water for irrigation, urban and industrial use in the Lower Burnett region and Bundaberg Water Supply Scheme. Water will be released from the dam into the Burnett River. The water will be extracted along the river by licensed users and at Walla Weir and Ben Anderson Baggage for use in the BWSS, Bundaberg City and Burnett Shire.

The need for the water supply and justification for the project are described in Section 2

#### **3.1.4 Irrigation Infrastructure**

The Engineering Services division of the Department of Natural Resources (now Department of Natural Resources and Mines) carried out a strategic review of the expansion options for the Bundaberg Water Supply Scheme (Burnett Catchment Appraisal Study, June 2001). The study identified the potential to utilise increase water allocations across the Lower Burnett Area. And concluded that that up to 133,800 ML/a of allocation could be economically delivered to the Lower Burnett Area as follows:

- up to 83,000 ML/a of new allocation could be delivered to existing irrigated land within the BWSS before major upgrading of existing distribution infrastructure would be required, provided that irrigation practices were improved and the water applied to the cane throughout the growing season.
- a further 50,800ML/a could be supplied to riparian irrigators along the Burnett and Kolan Rivers with only minor investment in irrigation infrastructure required.

The areas to be supplied with the additional application (Bundaberg Water Supply Scheme) are shown on **Figure 3-3** and detailed in **Table 3.1**.

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**Table 3.1: Bundaberg Water Supply Scheme**

BWSS Section	Release Area type*	Area(Ha)	Additional Supply
Burnett River	A1	5,120	10,906
Kolan River	A1	2,558	5,449
Gin Gin	A1	3,893	8,292
Bingera	A1	5,060	10,778
Gooburum	A1	5,250	9,608
Isis	A1	10,590	22,557
Woongara	A1	7,000	12,810
Abbotsford	A1	252	537
Avondale W/B	A1	1,000	2,130
<b>Sub-total A1</b>		<b>40,723</b>	<b>83,065</b>
Burnett River	B	4,204	27,875
Kolan River	B	3,456	22,914
<b>Sub-total B</b>		<b>7,660</b>	<b>50,789</b>
<b>TOTAL</b>		<b>48,383</b>	<b>133,854</b>

\* Area A1: land with existing allocation

Area B: Undeveloped land with suitable soils

### 3.1.5 The Proposed Dam

The Engineering Services Division of DNR carried out engineering appraisal studies, for alternative dam sites on the lower Burnett River for reservoirs of capacities varying from 300,000 to 750,000 ML (DNR 1999). The dam site at Paradise with a reservoir capacity of 300,000 ML has been selected as the preferred option, as described in Section 2.

The main properties of the proposed dam and reservoir are:

- Full supply level (FSL) 67.6 m EL
- Maximum height of dam wall 37.1 m
- Capacity 300,000 ML
- Yield – 20,000ML/a for urban/industrial use at a WSI of 99.7%
- Yield – 124,000ML/a for irrigation use at a WSI of 95%

The above yields do not include the water requirements to meet the environmental flow objectives of the Burnett Basin WRP.

### 3.1.6 Reservoir Area

Hydrologic and hydraulic modelling of the lower Burnett River with and without the proposed dam has been undertaken by the Engineering Services Division of DNR as part of the engineering appraisal (DNR, 1998). A range of design floods with Annual Exceedence Probabilities (AEP) ranging from 1% up to the Probable Maximum Flood have been derived. The estimated peak inflows for the range of design average recurrence interval (ARI) storm events are as shown in Table 3.2.

**Table 3.2: Estimated Peak Inflows**

ARI(years)	Peak Inflow (cu m/sec)	Volume (ML)
50	17,850	4,570,000
100	21,130	5,300,000
1,000	31,830	7,320,000
10,000	44,350	9,840,000
PMF	58,870	17,100,000

Source: DNR 1998

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A backwater model was run to select the size of the dam spillway and to determine the corresponding flood inundation levels for each ARI flood event. The backwater curves were then used with topographical maps of the area to determine storage volumes and reservoir areas for different Full Supply Levels as shown in **Table 3.3**.

**Table 3.3: Reservoir Volumes**

FSL(m AHD)	Area (Ha)	Capacity(ML)
56.24	986	100,000
63.44	1,962	200,000
67.58	2,950	300,000
70.50	3,956	400,000
72.80	4,900	500,000
74.65	5,750	600,000
77.05	6,950	750,000

Source: DNR 1998

Flood inundation maps were then produced for the alternative reservoir capacities. The inundation map for the 300,000ML capacity reservoir is shown on **Figure 3-2**.

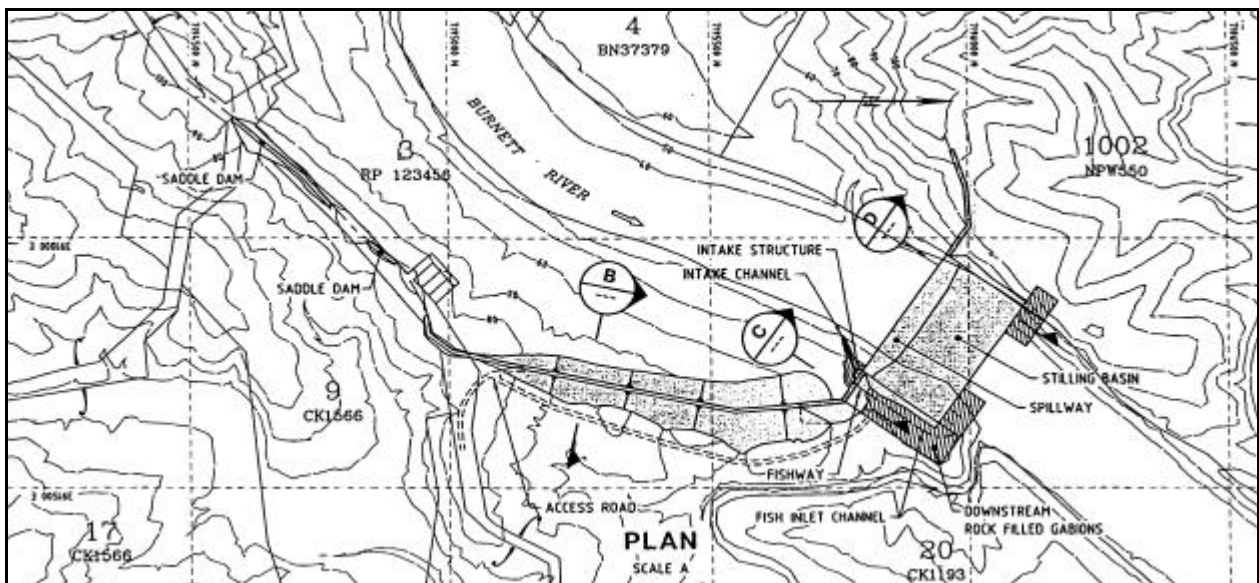
The length of the river inundated at FSL is 45km.

### 3.1.7 Engineering Details of the Dam

The Burnett River at the dam site has a channel width of 60m. A flood terrace about 120m wide lies along the right bank (looking downstream), about 6m above the bed level. On the left bank are basalt outcrops. Within the bed, shallow alluvial deposits overlies the same basalt formation. A geological section of the site is shown in **Section 5, Figure 5.8**.

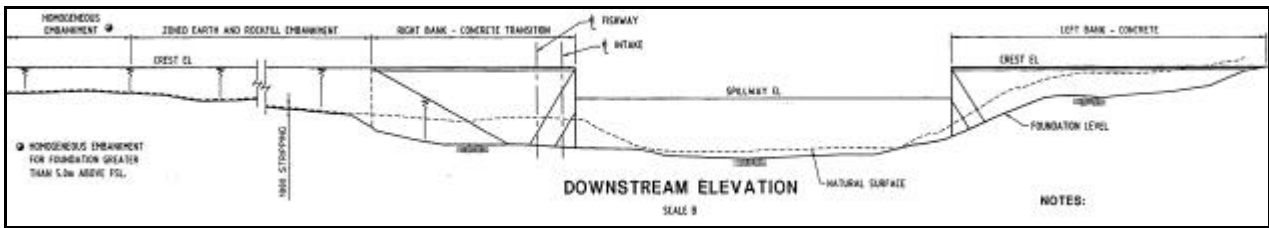
The Initial Engineering Appraisal Study of the Lower Burnett Dam Sites proposed a dam with non overflow clay/earth and rock embankments, with a 285m wide, roller compacted concrete spillway across the river channel.

A plan and sections of the dam are given in **Figure 3-4, Figure 3-5** and **Figure 3-6**.

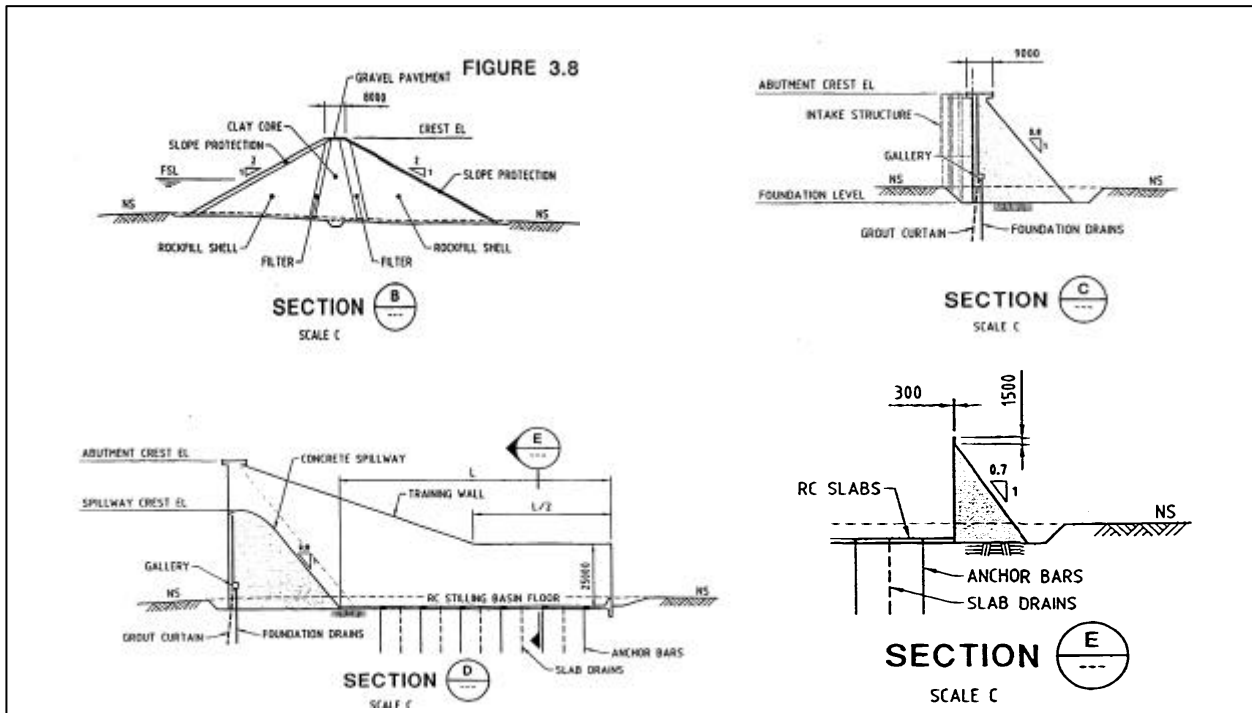


**Figure 3-4 Plan View of Dam**

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**Figure 3-5 Downstream Elevation of Dam**



**Figure 3-6 Sections of the Dam**

The dam wall location and orientation may be subject to small changes in alignment when further detailed site and geological investigations have been carried out. This fine-tuning will not significantly affect information provided in this EIS.

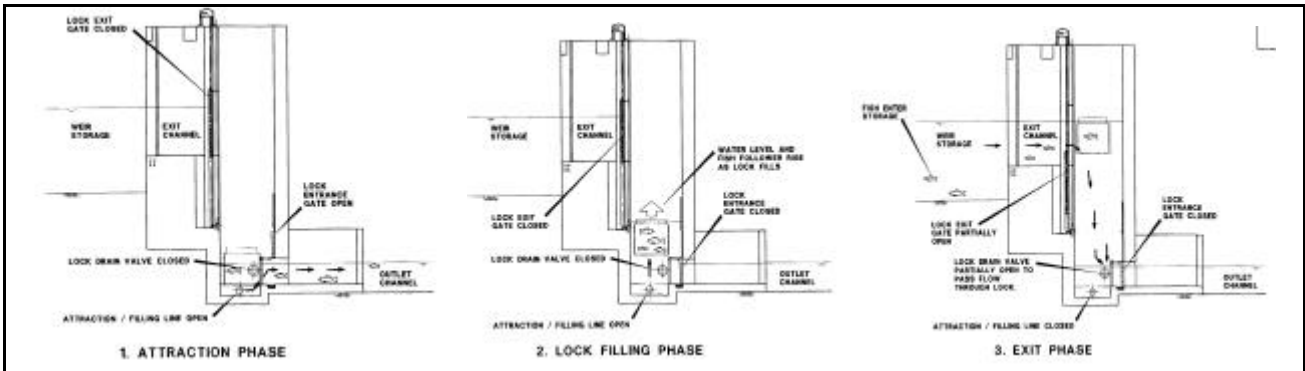
The dam would have a 150m long reinforced concrete stilling basin downstream of the spillway for energy dissipation and protection of the river banks and bed immediately downstream of the dam.

An intake/outlet structure will be located on the right hand side of the main spillway. This structure will allow selective withdrawal from the storage at a range of depths, allowing control over discharged water quality. The intake/outlet will be designed to pass the peak flow rate required by downstream demands throughout the range of reservoir levels, from FSL to minimum active storage level.

A low outlet culvert will be constructed through the left abutment of the dam to act as a diversion channel for the river during construction of the spillway and stilling basin. The culvert may be incorporated into the permanent outlet structure arrangement on completion of the dam

The dam wall will have a fishlock of a similar design to the one installed on Walla Weir. A schematic of a typical fishlock operation is shown in **Figure 3.7**. The design of the fish lock will be finalised following consultation with DPI Fisheries and DNR.

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**Figure 3.7: Fish Lock – Stages of Operation (Fish Moving Upstream)**

It would be possible to attach a small hydroelectric generator with capacity of 3-4 megawatts to the outlet structure. The operation of the hydropower scheme will not affect releases from the storage or downstream water quality or availability. The feasibility of this option has not been considered at this stage.

**3.1.8 Project Costs**

The total development costs of the project is estimated at \$180 million as shown in **Table 3.4**.

**Table 3.4: Estimated Project Costs**

Item	Amount
Infrastructure Relocation, Ancillary Works and Reservoir Clearing	\$ 13,843,000
Dam Embankment	\$ 33,296,000
Dam Spillway	\$ 46,004,000
Outlet Works	\$ 3,592,000
Fishway	\$ 1,492,000
<b>Total Direct Cost</b>	<b>\$ 100,227,000</b>
Contractor's Overhead (12% of Direct Cost)	\$ 12,027,000
Contingency (15% of Direct Cost)	\$ 16,638,000
<b>Total Contract Cost</b>	<b>\$ 129,092,000</b>
Indirect Costs	
Investigation, Design and Project Management (5% of Total Contract Cost)	\$ 6,455,000
Site Supervision and Administration (5% of Total Contract Cost)	\$ 6,455,000
Land Resumption	\$ 36,800,000
Infrastructure relocation	\$ 9,400,000
Capitalised operations and Maintenance Costs	\$ 4,262,000
<b>Total Cost</b>	<b>\$ 180,864,000</b>

Source: DNR 1999

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### **3.2 Construction Issues**

#### **3.2.1 Overview**

The construction contractor will be required to prepare a detailed Environmental Management Plan (EMP) and Emergency Response Plan. The Construction Supervisor will review these plans. Construction contractors will be responsible for ensuring compliance with environmental legislation and may face prosecution for non-compliance. A draft EMP is included in **Section 18** of this EIS.

#### **3.2.2 Construction Methods**

A rock foundation exists under the dam wall site. Chert outcrops in the river bed and basalt outcrops on the right bank of the river. On the left bank up to 10m of sandy alluvium overlies interbedded chert and slate. Weathering below the alluvium is shallow and an estimated 3m to 8m of weathered rock needs to be excavated to provide a sound foundation for the dam.

On the right bank, a 3m thick layer of gravel and fine sand sitting on top of interbedded chert and slate underlies an 18m thick layer of basalt. This layer will require grouting. Further up the right bank the alluvial terrace (up to 20m thick) is underlain by the interbedded chert and slate. This layer will have to be excavated down to sound rock under the transition wall between the concrete spillway and the embankment dam.

Excavation of soft material for foundations will be carried out by scrapers and dozers. Careful consideration must be given in the design and in the construction methods for excavation of up to 20 m of soft material in the foundations of the right bank of the dam.

Quarries will be established for the supply of rockfill and coarse aggregate and borrow pits will be opened up in the riverbed and banks within the inundation area for the supply of clay, sand and concrete aggregates. Blasting in the quarries for rock fill will be carried out by qualified shotfirers in accordance with procedures set out in AS2187-Part 2.

The clay core of the embankments will be placed by scrapers and compacted with vibrating sheepfoot rollers. The rockfill shell and slope protection will be transported by trucks from the quarry and placed with front end loaders or clamshells

Roller compacted concrete will be mixed on-site using a pug mill, transported by truck, spread by dozers and graders and compacted by smooth drum rollers.

Concrete for structural works will be mixed in an on-site batching plant, transported in purpose made agitators, placed by cranes and vibrated into place within formwork.

#### **3.2.3 Construction Timetable**

Construction will extend over 30 months. Construction of the dam will be undertaken during the dry season (nominally April to November). The site access roads and haul roads will be constructed and quarries established during detailed design of the dam and before the start of the dry season. Construction of the dam will commence in April of the first year of construction, the abutments and earth/rock fill embankments will be constructed. A diversion culvert will be constructed in the left abutment of the dam to convey dry weather flows around the foundation works for the spillway and stilling basin (the culvert will later become part of the permanent intake/outlet structure for the dam). Cofferdams will be installed to provide dry working conditions and the foundations for the spillway and stilling basin will be excavated and grouted. An initial layer of concrete will be placed to protect the foundations during the first wet season.

At the completion of the first dry season, cofferdams will be removed to allow unconfined flows through the dam during the wet season. The cofferdams will be reinstated at the end of the wet season, in time for the second years construction. In the second dry season, the main dam wall and spillway will be completed.

Diversion and relocation of infrastructure (roads, telecom, power) will commence at the end of the first year of construction and be completed before closure of the dam at the end of the second dry season.

The construction timetable will minimise the risk of flooding and damage to the works under construction.

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### 3.2.4 Construction Materials

The main materials for construction of the project will be:

- earth/clay and rockfill for the abutments and embankments
- Sand and aggregates for roller compacted and reinforced concrete for the spillway, stilling basin, inlet/outlet structure and bridges and culverts in the inundation area
- Cement for concrete construction and foundation grouting
- Steel reinforcement for structural concrete in the dam and bridges
- Valves, gates and control equipment for the intake and outlets structures and fish ladder
- Metalwork for safety barriers, handrails, ladders etc
- Gravel, aggregates and bitumen for road construction

As part of the appraisal study deposits of sand and gravel were located within the flood channel and inundation area, within easy haul distance of the dam. A quarry with a reserve of 1.5 million m<sup>3</sup> of basalt for coarse aggregate and rock fill was located within 1km of the dam site upstream of the dam wall.

Cement will be transported to site from Gladstone or Brisbane in bulk containers and stored in silos at the pug mill and batching plants.

Bitumen for road construction will be preheated and transported to site in purpose built containers for spraying directly onto the road surface. Bitumen will not be stored on site.

### 3.2.5 Material Quantities

The quantities of the main construction materials are shown in **Table 3.5**.

**Table 3.5: Construction Materials**

Material	Estimated Quantity
Grouting	23570 m <sup>3</sup>
Dental Concrete	11000 m <sup>3</sup>
Structural Concrete	22650 m <sup>3</sup>
Roller compacted concrete	573800 m <sup>3</sup>
Rock and gravel	386700 m <sup>3</sup>
Earth fill	150900 m <sup>3</sup>
Pavement Rock	11200 m <sup>3</sup>
Steel reinforcement	1680 tonnes
Other metal items	102 tonnes

Source: DNR 1999

### 3.2.6 Workforce and Amenities

The size of the workforce will typically be 40 people, peaking at 80 at the end of the first construction season and the beginning of the second. The ratio of skilled to unskilled workers will be in the order of 3:1. It is anticipated that the workers will live in the local communities, and it is therefore not planned to establish a construction camp. Temporary worker amenities will be provided on the site including:

- Toilets and washrooms
- Lunch room
- Office facilities
- First aid station.

Typical work hours will be 10 hours per day, 6 days per week. A second shift may operate if construction works fall behind schedule. Blasting will take place only during daylight hours.

The Construction Contractor will be required to comply with current Workplace Health and Safety Regulations and provide the required accident and emergency medical facilities. The Contractor will also be required to have in place emergency evacuation procedures for ill or injured staff.

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### **3.2.7 Plant and Equipment**

Equipment used in the construction process is expected to consist of:

- 2 tower cranes
- 3 mobile cranes
- 6 scrapers
- 3-4 bulldozers
- 2-3 loaders
- 2 drill rigs
- 5 dump trucks-40tonne
- 5 dump trucks-15tonne
- 3 vibrating rollers
- 1 rubber tyred roller
- 2 water carts
- waterpumps
- 6 utilities

Additional trucks will be used by suppliers to deliver cement and other materials to the site.

A pug mill with a capacity of 1500 m<sup>3</sup>/day will be required to produce a dry concrete mix for roller compaction. A 5m<sup>3</sup> capacity batching plant will be established on site for the production of structural and dental concrete. A portable grout mixer will be used during grouting of the dam foundations.

A crushing plant may be required at the hard rock quarry to produce coarse aggregates for concrete if sufficient quantities of river gravel cannot be found.

A large proportion of the earthmoving equipment may be sourced from local contractors and equipment suppliers.

Maintenance and refuelling facilities will be established at the dam site for servicing of equipment.

## **3.3 Operation Issues**

### **3.3.1 Release Management and Maintenance of Environmental Flows**

It is anticipated that the dam will reach Full Supply Level (FSL) within one normal wet season following completion of construction. During this time, environmental flow releases will be maintained. This will require the outlet works to be designed in such a way as to allow release of water while storage levels are low. This design will also allow environmental flows to be maintained during dry periods that may occur during normal operation.

Once FSL has been reached, water will be released from the major storage as required and pumped from the river at various locations downstream with the major location being Ben Anderson Barrage. The volumes of water to be released from the storage will depend on

- Environmental flow requirements, including flows required to operate the fish lock
- Allocations made under the WRP.

During detailed design of the Burnett River Dam, a reservoir simulation study will be undertaken to better understand the management of flows and releases. The results of this study will be input into the Resource Operating Plan which will set parameters for environmental flows as well as allocations for agricultural, industrial and urban water supply.

**Table 3-6** shows the typical distribution of demand for consumptive uses over a 12 month period within the Bundaberg Water Supply Scheme. This distribution pattern would be supplemented by environmental flow releases. Walla Weir will continue to operate as a flow regulating structure on the river.

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**Table 3-6 Average Monthly Water Demand and Pattern of Release**

Month	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
Percentage of Annual Demand	14	16	15	12	5	2	1	2	5	6	9	13

Levels within the storage will not change rapidly and therefore erosion around the edge of the inundation area is not considered to be a significant problem.

### 3.3.2 Workforce and Facilities

It is not expected that there will be a permanent workforce located at the dam site during operations. Dam operation will be largely automated with sensing and control systems to allow remote operation. Personnel from the Water Service Provider will visit the site for routine maintenance and inspections as well as in the event of equipment failure or other emergency. Routine maintenance will take place during normal working hours wherever possible.

A small office, toilet and storage shed will be provided for workers visiting the site. Water supply for these will be drawn from rooftop catchments or brought in by tanker.

There will be no permanent lighting on the dam or associated facilities. Lighting will be provided for the office, toilets and storage shed and for access to the dam operation room and the lower gallery in the dam.

### 3.3.3 Operating Costs

Based on costs of similar structures, annual operating costs of the dam are estimated to be \$240,000 pa.

### 3.3.4 Access and Recreational Use

The provision of visitor access or facilities at the dam or within the storage has not been considered as part of the current proposal.

Future recreational use of the impoundment is not ruled out but would be subject to assessment of compatibility with safety and environmental objectives set by the operator. Private individuals or organisations or Shire Councils may choose to provide recreational facilities for commercial gain or as community facilities. The operator may also choose to provide such facilities on a commercial basis and where these are compatible with safety and environmental protection goals.

For safety reasons, access to the dam wall and embankments will be restricted.

## 3.4 Decommissioning

The nominal engineering design life of the proposed Burnett River Dam is expected to be 50 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 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 remedied to meet safety standards
- It is no longer needed to provide water within the Burnett Region.

Current practices for dam decommissioning are established by the Australian National Commission on Large Dams (ANCOLD). ANCOLD (1994(a)) identifies that there are two principal alternatives when decommissioning a dam. The dam can be completely abandoned with removal of the dam to the extent that it no longer retains water. This is best achieved by complete removal of the dam wall and reinstatement of the bed and banks, although in some situation it may be appropriate to only partially remove the structure. If there is no current use for the storage contents of the dam and/or it is not practicable to remove the dam wall, the dam may become disused. A disused dam may have features such as the spillway and outlet structures removed but may continue to impound water. Ongoing surveillance and maintenance is necessary to minimise risk of the dam failure while any water is stored behind the dam.

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Environmental issues associated with dam decommissioning must also be addressed. These include:

- Treatment and/or removal of silt sediments that may be anoxic or otherwise pose a threat to water quality and ecosystem health at the site and downstream of the site
- Treatment of stratified water layers that may be low in oxygen and have other chemical characteristics that may be harmful to downstream ecosystems.
- Stabilisation and reinstatement of the river bed and banks at the dam site
- Stabilisation and reinstatement of lands formerly inundated by the dam.

When decommissioning a dam, owners should prepare a decommissioning plan, which outlines the proposed action to be taken to decommission the dam. The decommissioning plan should :

- Include a time sequence of studies and works associated with the decommissioning
- Address all issues associated with the decommissioning including;
  - show impacts of sudden loss of remaining embankments or other dam sections for a range of flood events in compliance with the Guidelines for Failure Impact Assessments of Water Dams;
  - provision of safe release of stored water;
  - assessment of altered hydraulic character of spillways and streams;
  - provision to minimise impact on the downstream residents; and
  - provision for consultation with downstream residents and landholders.

A decommissioning date for the proposed Burnett River Dam has not been determined at this stage and the likely date is too far in the future to allow effective planning for decommissioning to occur at this stage.