3. Project Description

3.1 Project Overview

The Emu Swamp dam site is located on the Severn River between Fletcher Road and Emu Swamp Road in Stanthorpe Shire. The dam site is 5 km north of Ballandean and 15 km southwest of Stanthorpe. The location of the dam is presented in **Figure 1-1**.

There are two dam options being considered for the Project.

- Urban Water Supply Dam; and
- Combined Urban and Irrigation Dam.

The Emu Swamp Dam Project has four major components. These are:

- Emu Swamp Dam;
- Stalling Lane Access;
- Urban Pipeline; and
- Irrigation Pipeline.

These components are described below.

3.1.1 Emu Swamp Dam

The Urban Water Supply Dam has a storage capacity of 5,000 ML. The Full Supply Level is 734.5 m AHD with an associated inundation area of 110 ha. The proposed water entitlement licence is 1,500 ML/year as provided in the *Water Resource (Border Rivers) Plan* (WRP) (DNRW 2003). The proposed dam and pipeline is sized to deliver 750 ML/year and the average annual yield will be 696 ML.

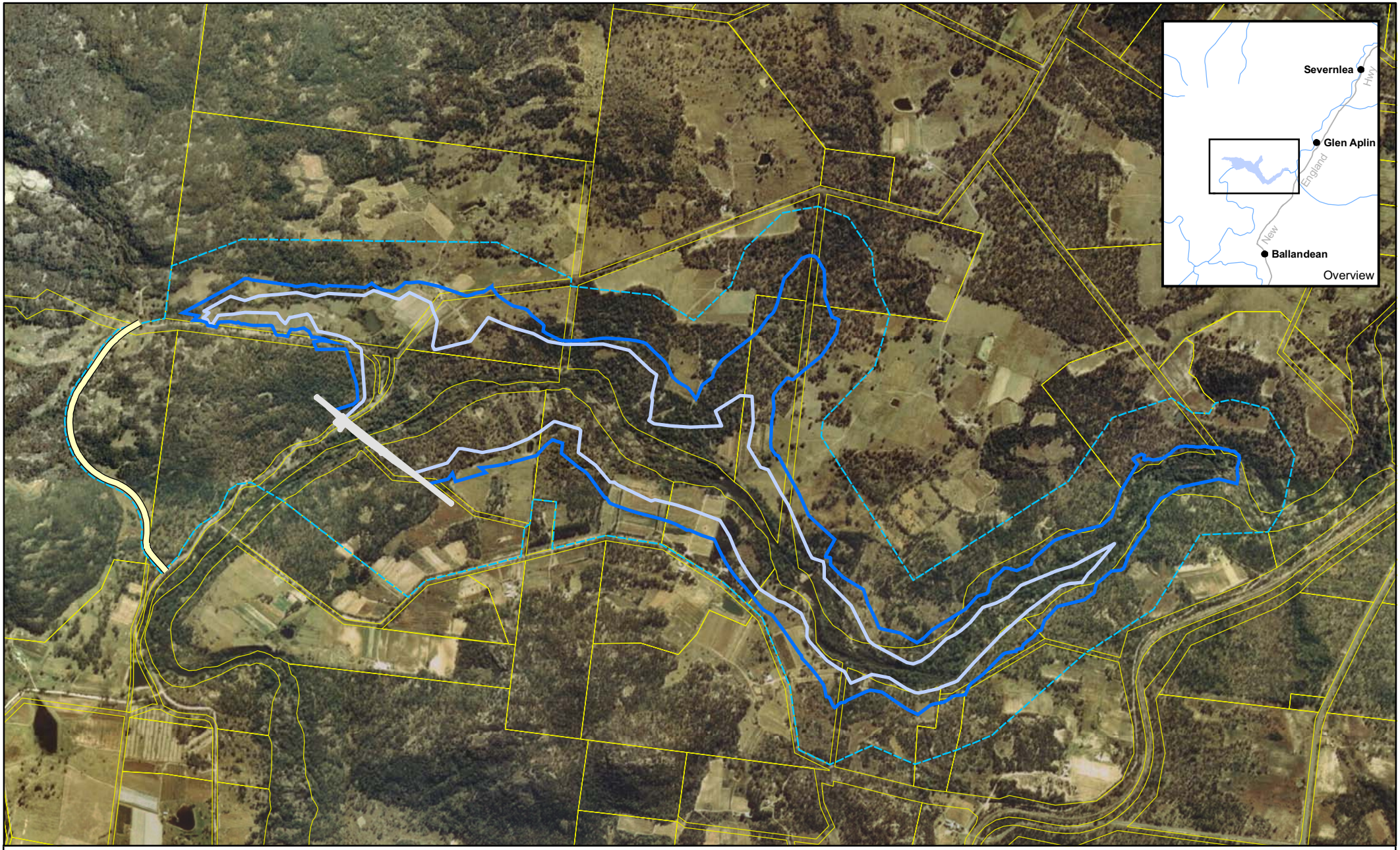
The Combined Urban and Irrigation Dam has a storage capacity of 10,500 ML. The Full Supply Level is 738 m AHD with an associated inundation area of 196 ha. The proposed water entitlement licence for the Urban component is 1,500 ML/year. The proposed water entitlement licence for the Irrigation component is 1,740 ML/year as provided in the WRP and the draft *Border Rivers Resource Operations Plan* (ROP). This dam option can deliver an average 696 ML/year of urban water plus 1,384 ML/year of irrigation water.

The proposed inundation areas for both dam options are presented in **Figure 3-1**. A buffer area of approximately 200 m is proposed surrounding the dam to protect the water quality within the dam and also to maintain ecological connectivity within the region.

Emu Swamp Dam is relatively small in comparison with other dams being proposed in southeast Queensland. Both dam options are compared with Wyaralong Dam, Traveston Crossing Dam (Stage 1) and Hinze Dam (Stage 3) in **Table 3-1**Error! Reference source not found..

- **Table 3-1 Comparison of Emu Swamp Dam with other proposed dams**

Dam Name	Volume (ML)	Surface Area (ha)	Percentage of Volume		Percentage of Area	
			Urban	Urban	Urban	Combined
Emu Swamp Dam			5,000 ML	10,500 ML	110 ha	196 ha
Wyaralong Dam	103,000	1,230	5%	10%	9%	9%
Traveston Crossing Dam Stage 1	153,000	3,000	3%	7%	4%	4%
Hinze Dam (Stage 3)	309,700	1,505	2%	3%	7%	7%



SHIRE OF STANTHORPE

Legend

- Full Supply Level 734.5m AHD
- Full Supply Level 738m AHD
- Buffer Area
- Dam Wall
- Stalling Lane Access
- Cadastre

N
W E
S

0 100 200 400 600 800

Metres

Scale - 1:20,000 (at A4)

Projection: Map Grid of Australia Zone 56

EMU SWAMP DAM EIS

Emu Swamp Dam Site

Figure 3-1
Inundation Areas and Buffer Area

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3.1.1.1 Dam Design

Preliminary designs for the Urban Water Supply Dam and Combined Urban and Irrigation Dam have been prepared (URS, 2007). Summaries of the dam characteristics for both project options are provided in **Table 3-2**.

Table 3-2 Emu Swamp Dam Characteristics

Feature	Characteristic	Urban Water Supply Dam	Combined Urban & Irrigation Dam
Dam	Full Supply Level (FSL)	734.5 m AHD	738.0 m AHD
	Average annual yield	696 ML/year	696 + 1,383 ML/year
	Storage Capacity	5,000 ML	10,500 ML
	Surface Area	110 ha	196 ha
	Maximum Depth	13.5 m	17.0 m
	Average Depth	4.5 m	5.4 m
	Dead Storage Level	726 m AHD	726 m AHD
	Dead Storage Volume	330 ML	330 ML
	Dead Storage % Storage Capacity	6.6 %	3.1 %
Embankment	Embankment Type	Roller Compacted Concrete	Roller Compacted Concrete
	Total Crest Length	445 m	576 m
	Maximum Height (top of parapet)	15.1 m	19.6 m
	Parapet Height	1.1 m	1.1 m
	Crest Width	5 m	5 m
	Upstream slope	Vertical	Vertical
	Downstream slope	Stepped, 0.8H : 1V	Stepped, 0.8H : 1V
Spillway	Service Spillway length	200 m	200 m
	Auxiliary Spillway length	160 m	264 m

The main dam barrier will be a roller compacted concrete (RCC) structure. The dam and spillway features are shown on **Figure 3-2**.

The intake tower will be integrated into the dam structure adjacent to the right abutment. A number of gates will be included in the intake tower to allow water to be withdrawn from an appropriate level, for water quality purposes. The number and elevations of the gates will be established during detailed design to optimise water quality and water management flexibility. The top 3 to 6 m of the water column will contain the best quality water and intake gates will be provided at 1 metre vertical spacing to allow water to be extracted from a selected depth. A low level gate on the intake tower will be provided at the 726.0m AHD dead storage level.

The stage storage curve for the proposed Emu Swamp Dam is presented in Error! Reference source not found..

SHIRE OF STANTHORPE

Legend

- Full Supply Level 734.5m AHD
- Full Supply Level 738m AHD

N
W E
S

0 25 50 100 150 200

Metres

Scale - 1:5,000 (at A4)

Projection: Map Grid of Australia Zone 56

EMU SWAMP DAM EIS

Emu Swamp Dam Area

Figure 3-2
Emu Swamp
Dam Site Layout

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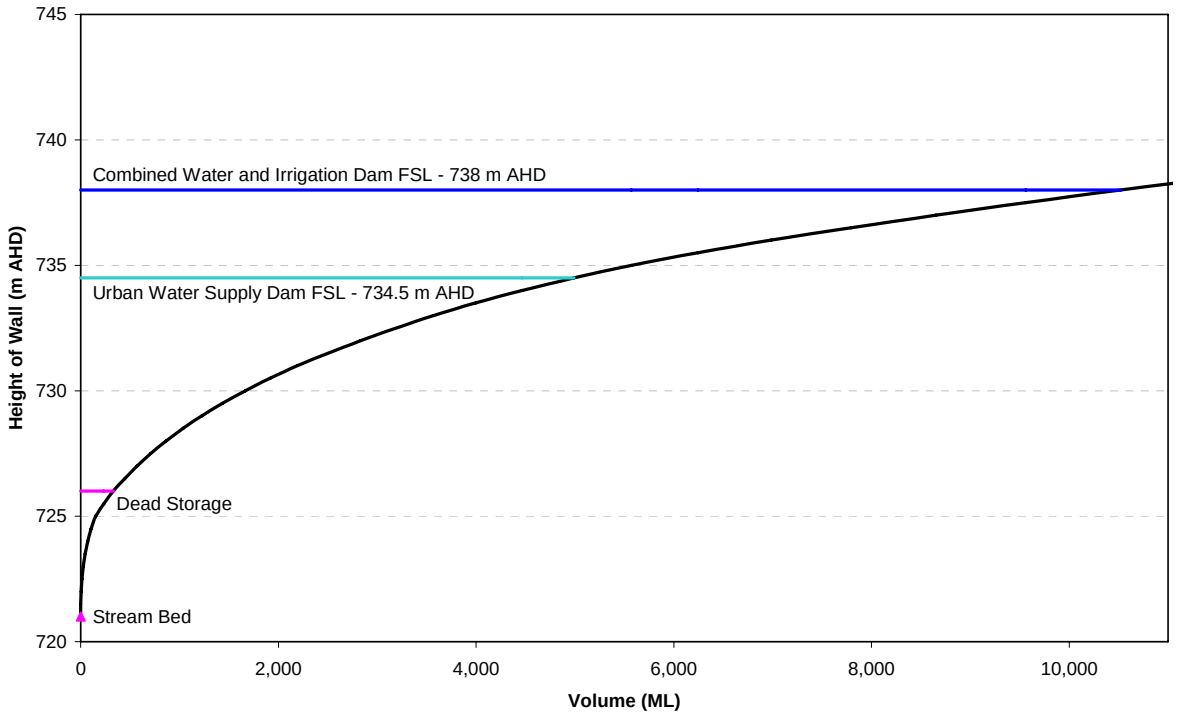
- **Figure 3-3 Emu Swamp Dam Stage Storage Curve**



3.1.1.2 Fish Movement

The Severn River contains a large numbers weirs upstream and downstream of the proposed Emu Swamp Dam. They provide a physical barrier to upstream fish movement. There is considerable doubt about the migratory needs of the local native fish as discussed in **Section 10** of the EIS.

Undertake further monitoring of the present distribution and abundance of those endemic species that are currently impacted and develop a management plan to repopulate areas of remaining suitable habitat. Detailed design of the dam will allow for retrofitting of a fish transfer device if monitoring indicates that a fish transfer device would be beneficial for the endemic dish species.

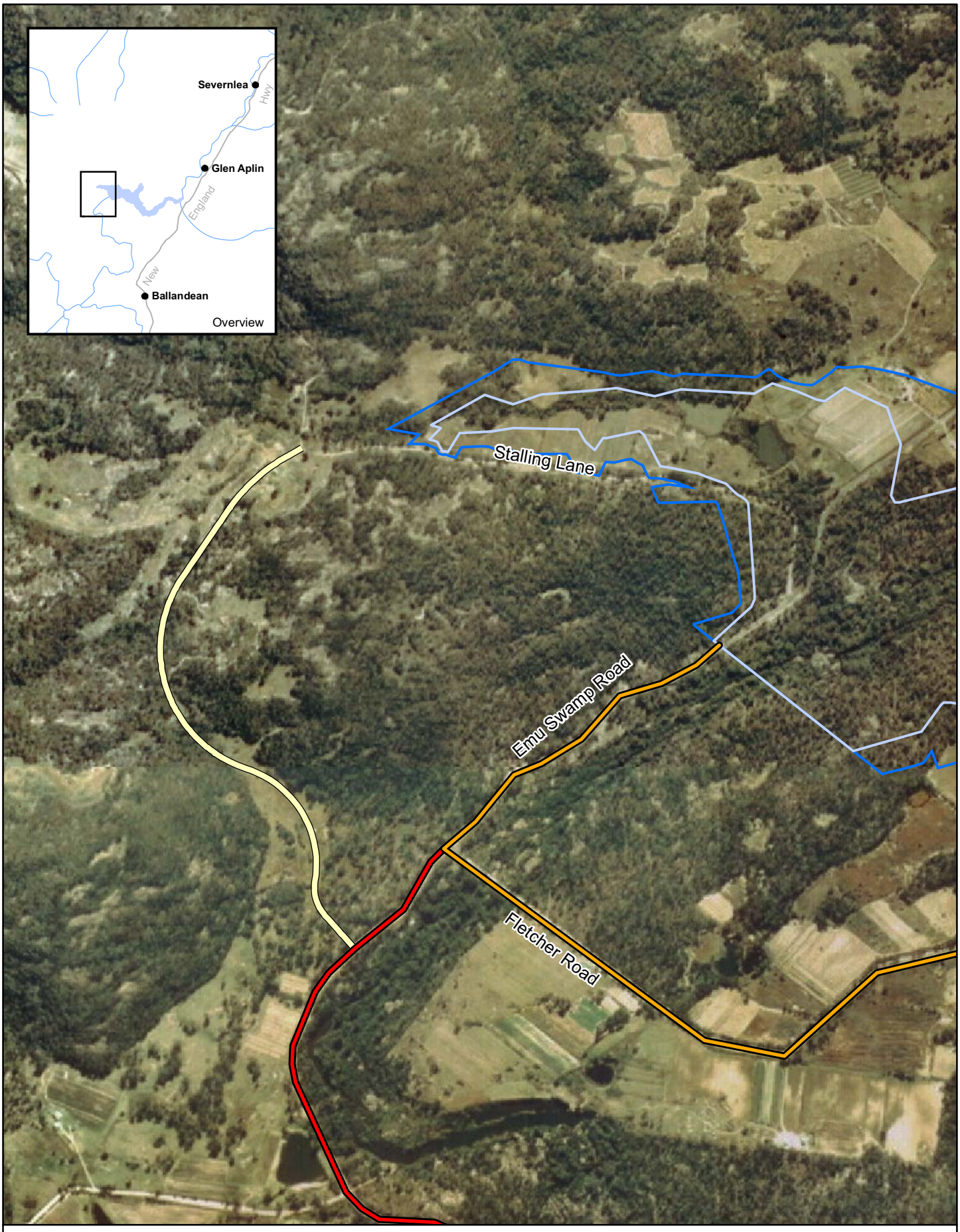
3.1.1.3 Stalling Lane Access

The inundation area for the proposed dam will result in the closure of Emu Swamp Road. As a result of this closure Stalling Lane will no longer be accessible from Emu Swamp Road. Stalling Lane currently provides access to two properties. To maintain this access, the Stalling Lane Access is proposed to be constructed from Fletcher Road to the western end of Stalling Lane. The location of the Stalling Lane Access is presented in **Figure 3-4**.

3.1.1.4 Recreation Facilities

Public recreation facilities will be provided on the left abutment of the dam after construction is completed. The facilities will be similar to those at Storm King Dam and will typically comprise:

- picnic area shelters with rainwater tanks (4), uncovered picnic tables (4), wood fired BBQs (4);
- playground equipment;
- toilet facilities with water tank, on-site septic tank treatment and pump out capability;
- boat ramp (5 m wide concrete extending to 3 m below FSL);
- gravel access from Fletcher Road; and
- gravel surfaced car park (10 cars) and boat trailer park (4 trailers).



SHIRE OF STANTHORPE

Legend

- Urban Pipeline
- Irrigation Pipeline
- Full Supply Level 734.5m AHD
- Full Supply Level 738m AHD
- Stalling Lane Access

N
W E
S

0 50 100 200 300 400

Metres

Scale -1:10,000 (at A4)

Projection: Map Grid of Australia Zone 56

EMU SWAMP DAM EIS

Dam Area

Figure 3-4
Stalling Lane Access

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Stanthorpe Shire Council (SSC) permits the following recreational activities at Storm King Dam (when sufficient water is available) - jet skis, water skiing, power boats, sail boats, house boats, canoes, rowing, fishing and swimming. Camping is prohibited.

Fish stocking occurs at Storm King Dam and it is expected that it will occur at Emu Swamp Dam either intentionally or by fish being washed in from upstream.

3.1.2 Urban Pipeline

The Urban Pipeline is 23.2 km long and is largely (approximately 95%) located in road reserves. The route follows Fletcher Road, the New England Highway, Wiskey Gully Road, Brunckhorst Avenue, Hale Haven Drive, Rifle Range Road, Eukey Road/Sugar Loaf Road, Kingston Road, across private property, Greenup Street/Diamondvale Road and across SSC land to the Mt Marlay water treatment plant. The Urban Pipeline route is presented in **Figure 3-5**.

For the Urban Water Supply Project the pipeline is 250 mm diameter in Fletcher Road and along the New England Highway reducing to 225 mm diameter at the Mt Marlay water treatment plant. For the Combined Urban and Irrigation Water Supply Project the Urban Pipeline along Fletcher Road and the New England Highway will be 375 mm diameter reducing to 250 mm diameter at the Wiskey Gully Road intersection.

The pipeline grade will follow the natural land form, with no tunnels or major pipe bridges required.

The pipeline will be constructed from Ductile Iron Concrete Lined (DICL) pipes, with an internal cement lining and external cold applied bituminous paint. No cathodic protection will be required for the pipeline, which will have a design life of 50 years.

The maximum pipeline capacity will be 40 L/s for the Urban Water Supply Project and 100 L/s for the Combined Urban and Irrigation Water Supply Project. The maximum operating pressure within the pipeline will vary from a maximum head of 180m at the dam site reducing to a head of 10m at the delivery locations. Test pressures will generally be 1MPa, with 4MPa for the section from approximately Glen Aplin to the dam.

A concrete blockwork pump station for the Urban Pipeline will be located at Emu Swamp Dam. The location of the pump station is shown in **Figure 3-5**. The dimensions of the pump station are approximately 25 x 25 m.

3.1.3 Irrigation Pipeline

The Irrigation Pipeline route largely (more than 98%) follows road reserves although there are some short sections crossing private lands. The Irrigation Pipelines are supplied from the Urban Pipeline. The total length of Irrigation Pipeline (excluding the Urban Pipeline section) is 102 km.

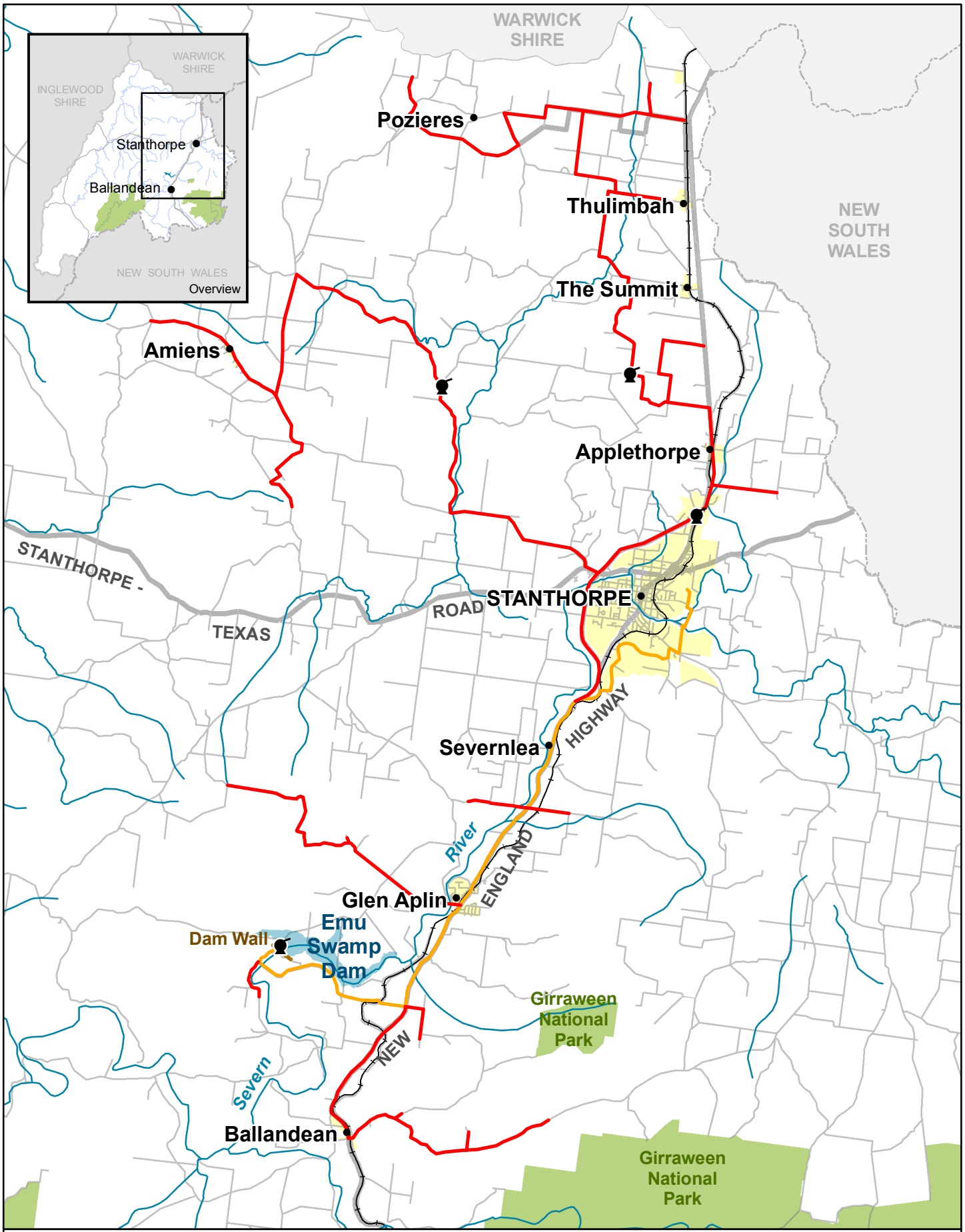
The Irrigation Pipeline route follows Eukey Road, the New England Highway, Horans Gorge Road, Mt Stirling Road, Winkler Road, Back Creek Road, Stabiles Road, Amiens Road, Cannon Creek Road, Bapaume Road, Swans Lane, Spring Creek Road, Barracks Road, Aerodrome Road, Applethorpe Road, Ellwood Road, Rogers Road, Church Road, Teale Road, Goodwin Road, Gangemi Road, Poziers Road, Newlands Road, Pfrunder Road, Pradella Road and Scotts Camp Road. The Irrigation Pipeline route is presented in **Figure 3-5**.

The pipeline grade will follow the natural land form, with no tunnels or major pipe bridges required.

The Irrigation Pipeline will be constructed from flexible pipe materials like high-density polyethylene (HDPE) and polyvinyl chloride (PVC) and will range in size from 40 mm to 300 mm diameter. No cathodic protection will be required for the pipeline, which will have a design life of 50 years.

The maximum operating pressure within the pipeline will vary from a maximum head of 180m at the dam site reducing to a head of 10m at the delivery locations. Test pressures will generally be 1MPa, with 4MPa for the section from approximately Glen Aplin to the dam.

Small concrete blockwork pump stations will be constructed on Old Caves Road (near the New England Hwy intersection), on Church Road (near the Ellwood Road intersection) and on Cannon Creek Road (near the Barkers Lane intersection). The dimensions for the pump stations on the Irrigation Pipeline are with 10 x 10 m and indicative locations are presented in **Figure 3-5**



SHIRE OF STANTHORPE

Legend

- Indicative Pump Station Location
- Urban Pipeline
- Irrigation Pipeline
- Emu Swamp Dam
- Towns & Villages
- National Parks

N W E S

0 0.5 1 2 3 4 5 6

Kilometres

Scale -1:150,000 (at A4)

Projection: Map Grid of Australia Zone 56

EMU SWAMP DAM EIS

Project Area

Figure 3-5 Urban and Irrigation Pipeline Routes

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3.2 Construction

This section describes the construction activities, equipment, resources and management of the construction of the Project.

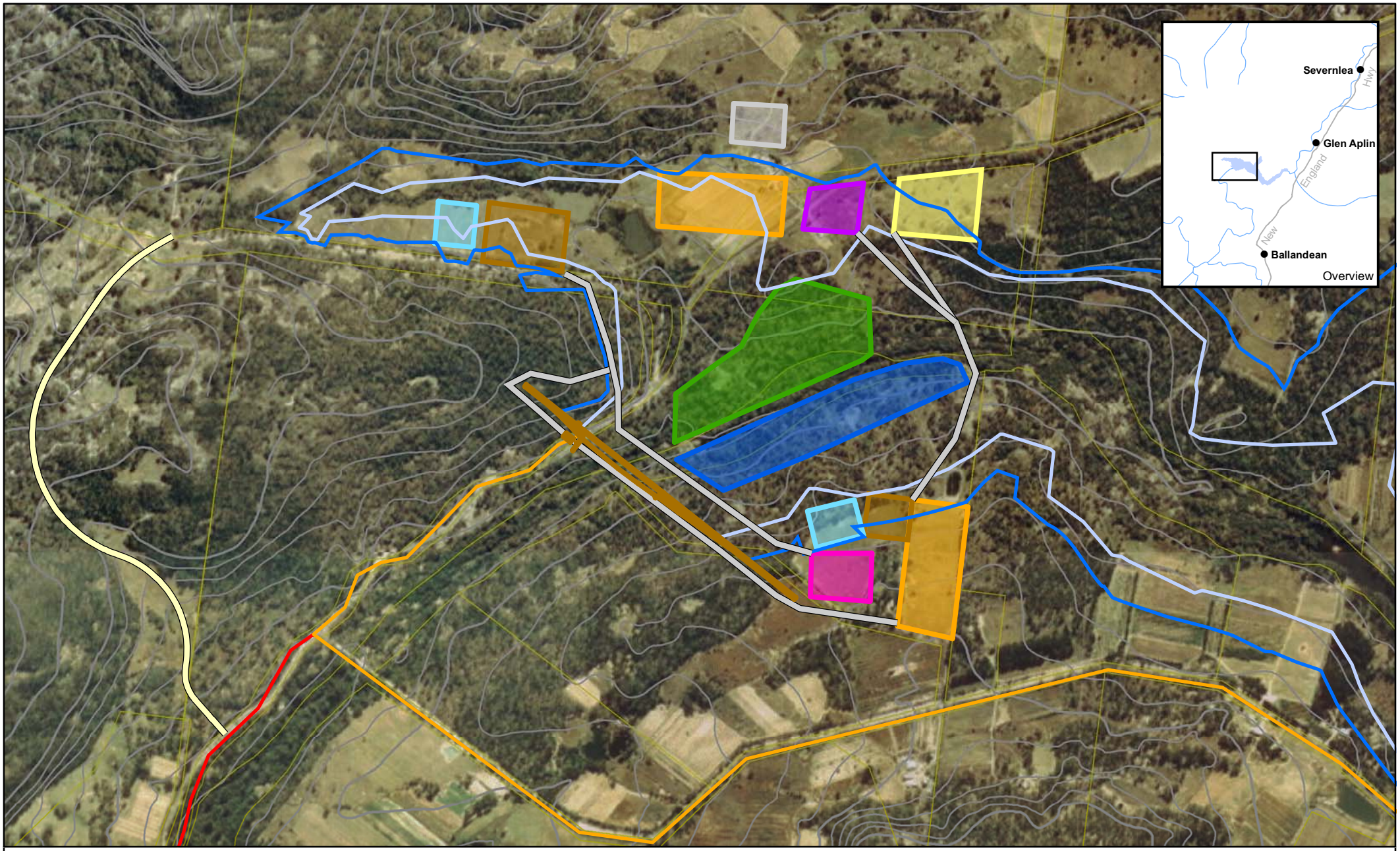
3.2.1 Construction Activities

3.2.1.1 Emu Swamp Dam

The major activities for the construction of the dam and associated facilities are detailed in **Table 3-3**. The construction activities and level of intensity will be the same for the Urban Water Supply Dam and the Combined Urban and Irrigation Dam. The Combined Urban and Irrigation Dam will have a longer construction period. A figure showing the location and layout of construction areas is presented in **Figure 3-6**.

Table 3-3 Emu Swamp Dam Construction Activities

Activity	Details
Stalling Lane Access Road	■ Clearing ■ Blasting and earthworks
Clearing	■ Clearing for site establishment ■ Clearing for quarry and sand pit development ■ Clearing of dam construction site ■ Clearing of inundation area (in stages following dam completion)
Quarrying and Sand Extraction	■ Removal of overburden ■ Drilling, blasting and rock removal by excavators ■ Sand removal by excavators
Concrete Manufacture	■ Operation of crushing and screening plants ■ Stockpiling of aggregate and sand for concrete batching ■ Operation of concrete batch plant
Dam Foundation Preparation	■ Excavation and removal of upper jointed and weathered rock ■ Dental grouting to fill holes and non-uniform surfaces ■ Flush grouting of open joints and surface fractures ■ Drilling and injection of grout curtain
RCC Wall Construction	■ Construction of the RCC Wall ■ Involves articulated trucks, dozer, rollers, drills and water cart
Materials Haulage	■ Most construction materials will be sourced onsite and transported as required ■ Truck haulage of materials not sourced on-site. This includes cement, fly ash, reinforcing steel, pipe, fittings etc
Intake Tower & Outlet	■ Reinforced concrete construction, pipe, gates, electrics ■ Involves formwork, cranes, vibrators, stripping, building trades
Recreation Facilities	■ Removal of construction site facilities ■ Picnic shelters, BBQs, toilet facilities ■ Involves cranes, graders, trucks, concrete, building trades
Site Rehabilitation	■ Rehabilitation & reinstatement of disturbed construction site
Fish Transfer (if required)	■ Construction of Fish Transfer device as part of the dam



SHIRE OF STANTHORPE

Legend

- Urban Pipeline
- Irrigation Pipeline
- Full Supply Level 734.5m AHD
- Full Supply Level 738m AHD
- Stalling Lane Access
- Dam Wall
- 5m Contours

Construction Site Facilities

- Roads for Construction
- Batch Plant
- Crusher
- Filter/Sand
- Laydown Area
- Quarry
- Sand Screen
- Site Office
- Stockpile
- Workshop

N W E S

0 50 100 200 300 400 500

Metres

Scale - 1:10,000 (at A4)

Projection: Map Grid of Australia Zone 56

EMU SWAMP DAM EIS

Emu Swamp Dam Site

Figure 3-6

Emu Swamp Dam - Construction Layout

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Pre-Construction

The main emphasis of the initial site development at the dam site will be establishment of the construction site. These works will include:

- construction of Stalling Lane Access Road;
- closure of public access on Emu Swamp Road between the Fletcher Road intersection and (approximately) the eastern extent of the of the inundation area;
- erection of security fencing around the construction site;
- construction of a hardstand area for offices and car parking (50 sites) – 2,500 m^2 site area;
- construction of site offices, laboratory, storage, crib, ablutions (18 units, 12 x 3 m – 2,000 m^2 site area);
- establish communications, power, water reticulation and ablution services;
- construction of workshop, maintenance facility and hardstand (2 units, 14 x 3 m – 2,000 m^2 site area);
- construction of a self-contained, bunded fuel tank (60,000 L), dangerous goods container for oil & grease;
- construction access roads within the construction site;
- construction of a temporary water storage in inundation area for harvesting construction water after rain;
- construction of a hardstand for materials handling at right and left abutments – 1,500 m^2 each side;
- establishment of quarry, crushing & screening plants and concrete batch plant on site;
- construct upstream gauging weir.

Clearing

Clearing for the Emu Swamp Dam Project will be undertaken in phases:

- initial site establishment at the dam construction site; and
- the remainder of the inundation area later when the dam construction is well advanced.

Vegetation screening the construction site will be retained as long as possible reducing the visual, noise and dust impact on neighbours. It will also provide more time for clearing activities to be planned and implemented in the areas of ecologically important habitat.

The clearing approach adopted for the project includes:

- clearing in selected phases to encourage fauna movement to areas that are not to be cleared;
- minimising the area of the dam construction footprint;
- identifying and protecting all vegetation areas that are to be retained;
- planning for fauna and flora requirements;
- facilitating selected fire wood collection (because of its cool climate Stanthorpe has a substantial demand for fire wood);
- clearing the inundation area up to two metres (vertical) below the FSL (to improve erosion control, restrict human access and to encourage establishment of fringing riparian vegetation);
- mulching cleared timber for landscaping of the recreation area and in rehabilitation works;
- positioning cleared timber in the secondary (off the main Severn River) reaches of the inundation area to provide habitat for aquatic fauna; and
- windrowing excess cleared timber in the inundation area for drying and burning under the supervision of fire authorities

Quarrying and Sand Extraction

The quarry and sand extraction areas are located in the inundation area of the Emu Swamp Dam and are shown in **Figure 3-6**.

The quarrying operation will commence with clearing and site levelling. The maximum quarry depth will be five metres and the approximate dimension of the excavation for the Combined Urban and Irrigation Dam will be 100 m by 200 m.

The programmed blast frequency is one blast per day. Blasting will be scheduled to occur in the afternoon on weekdays to minimise the disturbance on neighbours.

The sand required for the Combined Urban and Irrigation Dam is only 5,000 m^3 – the excavation will be a maximum of 3 m deep and 50 m by 50 m in area. The sand excavation may be extended for pipeline bedding material.

Concrete Manufacture

Most materials for construction will be sourced from onsite including rock aggregate, sand and water . Rock material from the quarry will be crushed to form aggregate for concrete manufacture. Sand will be screened for coarse (1 to 5 mm) and fine (less than 1 mm) particle sizes. Rock aggregate and sand will both be stockpiled onsite prior to concrete batching. Cement and flyash will be transported to site and stored in silos.

The concrete batching plant will be relocated during construction to minimise haul distances for the left and right RCC wall constructions. The location of concrete batching plant, crusher, sand screen and stockpiles for aggregate and sand are shown in **Figure 3-6**.

Dam Foundation Preparation

The RCC Wall will be constructed in two halves to as part of the water management during construction.

The foundations for each half will be prepared by removing jointed and weathered rock to about 1 m depth. Dental concrete and flush grouting will be undertaken to provide a level working face. A grout curtain of 75 mm diameter holes drilled to about 12 m depth and pressure grouted will be established to prevent leakage under the wall.

RCC Wall Construction

Each half of the RCC Wall will be constructed continuously for a period up to 3 months. Concrete will be batched on-site, trucked to the dam wall site, spread in a 300 mm layer and compacted. The width of the layers reduces as the wall height rises. The work is undertaken with road construction equipment.

Materials Haulage

The location of haul roads for transport of construction materials within the construction site are shown in **Figure 3-6**. The haul roads will be 20 m wide to allow for the safe passage of trucks.

Site Rehabilitation

Following completion of the site construction works, areas outside of inundation area will be rehabilitated, materials cleared and all site construction infrastructure removed.

Downstream Works

Works downstream of the dam wall will be limited to the temporary construction access (20 m width for haul road), the spillway chute walls, the downstream release pipe and control house, pipe connections for a future “trap and transfer” fish transfer device, the pump station and the permanent access road.

An existing section of Emu Swamp Road will be retained as the permanent access road to the dam wall, outlet pipe, pumping station and fish transfer station.

3.2.1.2 Urban Pipeline

The pipeline from Emu Swamp Dam to Mt Marlay water treatment plant for the Urban Water Supply Dam and the Combined Urban and Irrigation Dam have essentially the same construction inputs and are termed the Urban Pipeline in this section.

The Urban Pipeline will be constructed largely in road reserves and by a combination of methods that will be determined by various constraints including other services, road requirements, accesses, topography, geology, safety and environment. The construction will involve a combination of buried and above ground pipe. The preference will be for buried pipelines but until detailed surveys and design is undertaken it will not be possible to define which sections are buried and which are above ground.

The major construction activities for the Urban Pipeline are as follows:

- clearing;
- trench excavation including drilling and blasting in rock (where required) for buried pipes;
- concrete pedestal construction for above ground pipe sections (where required);
- directional drilling for road, rail and creek crossings;
- pipe delivery and stringing;
- pipe laying and jointing;
- trench backfilling / surface reinstatement;
- building construction of pump stations and valve chambers; and
- pump, electrics and telemetry installation.

The construction will involve a combination of buried and above ground pipe. The preference will be for buried pipelines but until detailed surveys and design is undertaken it will not be possible to define which sections will be buried and which will be above ground.

The Urban Pipeline will be buried to a depth of approximately 1 m (with at least 600 mm depth of cover) with the potential disturbance expected to be up 5 m in width. The disturbance area for above ground pipes would be less than for buried pipes.

The Urban Pipeline will be initially constructed from the Emu Swamp Dam site. A satellite construction office will established at Back Creek Road as the pipeline progresses.

3.2.1.3 Irrigation Pipeline

The irrigation pipelines will be constructed after the urban pipeline and the satellite construction office would be relocated progressively to suitable locations on Aerodrome Road, Goodwin Road and Cannon Creek Road.

The Urban Pipelines will also be constructed largely in road reserves but will also be located on a number of private properties. The Irrigation Pipeline will be buried at most locations but detail surveys will determine if there will be some above ground sections.

The Irrigation Pipeline will be buried to a depth of approximately 1 m (with at least 600 mm depth of cover) with the potential disturbance expected to be up 5 m in width.

The construction activities for the Irrigation Pipeline are similar to the Urban Pipeline although they are unlikely to involve blasting.

3.2.2 Construction Program

For both the Urban Water Supply Project and the Combined Urban & Irrigation Project the construction program will consist of the following work packages;

- early works;
- dam construction; and
- pipeline construction.

Early Works include all work to be undertaken before the construction site establishment including power supply to the dam and construction of the Stalling Lane Access.

The construction of Emu Swamp Dam allows for flood diversion during the construction period and for efficient concrete transport for the RCC dam. The construction program will occur in four phases:

- pre-construction – clearing, site establishment, quarrying and sand extraction;
- right half RCC wall construction – the right half of the dam (when looking downstream) will be constructed first. This includes dam foundation preparation, construction of the RCC Wall and construction of the inlet tower and outlet works;
- left half RCC wall construction – construction of the left half of the dam including dam foundation preparation and construction of the RCC Wall; and
- rehabilitation and Commissioning

A construction program for the Urban Water Supply Project is provided in **Figure 3-7**. The construction program is expected to last 14 months.

A construction program for the Combined Urban & Irrigation Dam is provided in **Figure 3-8**. The Combined Urban and Irrigation Dam construction program occupies 16 months.

The objective is to commence construction by mid 2008 so that the critical works can be completed during the dry season. This start date implies completion of construction by the end of 2009.

■ **Figure 3-7 Construction Timeline for the Urban Water Supply Dam**

Stage	Activity	Duration	Month 1	2	3	4	5	6	7	8	9	10	11	12	13	14
Early Works																
	Stalling Lane Access Road	3.0														
	Power supply to dam	1.0														
Dam Construction																
	Site establishment	2.0														
	Clearing	1.5 / 1.5														
	Quarrying and Sand Extraction	3.0														
Right Half RCC Wall Construction																
	Dam Foundation Preparation	2.5														
	Intake tower and Outlet	1.5														
	Plinth and starter wall	1.5														
	RCC Wall Construction	2.0														
Left Half RCC Wall Construction																
	Relocation of batch plant	0.5														
	Dam Foundation Preparation	2.5														
	Plinth and starter wall	1.0														
	RCC Wall Construction	1.5														
	Commissioning	1.0														
Pipeline Construction																
	Pump station	3.0														
	Supply & Install Pumps	6.0														
	Pipe supply	6.0														
	Pipeline Construction	6.0														
	Telemetry	1.0														
	Commissioning	1.5														

■ **Figure 3-8 Construction Timeline for Combined Urban and Irrigation Dam**

Stage	Activity	Duration	Month 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Early Works																		
	Stalling Lane Access Road	3.0																
	Power supply to dam	1.0																
Dam Construction																		
	Site establishment	2.0																
	Clearing	1.5 / 1.5																
	Quarrying and Sand Extraction	4.0																
Right Half RCC Wall Construction																		
	Dam Foundation Preparation	2.5																
	Intake tower and Outlet	1.5																
	Plinth and starter wall	1.5																
	RCC Wall Construction	2.5																
Left Half RCC Wall Construction																		
	Relocation of batch plant	0.5																
	Dam Foundation Preparation	2.5																
	Plinth and starter wall	1.0																
	RCC Wall Construction	3.0																
	Commissioning	1.0																
Pipeline Construction																		
	Pump station	3.0 / 3.0																
	Supply & Install Pumps	8.0																
	Pipe supply	7.0																
	Pipeline Construction	8.0																
	Telemetry	1.5																
	Commissioning	1.5																

3.2.3 Construction Equipment

3.2.3.1 Emu Swamp Dam

On site construction equipment will be the same for both the Urban Water Supply Dam and the Combined Urban and Irrigation Dam. Construction equipment for each major construction activity is presented in **Table 3-4**.

Table 3-4 On-Site Construction Equipment, Emu Swamp Dam

Material	Construction Equipment		
Stalling Lane Access	■ D9 Dozer ■ 30 t Excavator ■ Hydraulic Drill	■ 12 t Trucks (2) ■ Backhoe ■ Grader	■ Water Truck ■ 10t Roller
Quarry	■ D9 Dozer ■ Hydraulic Drill	■ 65 t Excavator ■ 35-50t Dump Trucks	■ Water Truck ■ Explosives Truck
Crushing Plant	■ Mobile Jaw Crusher ■ Cone Crusher ■ Screening Deck	■ Stacker ■ 30 t Excavator ■ Cat 980 Loader	■ 25 t Artic. Trucks (2) ■ Water Truck ■ 500 kVA Generator
Screening Plant	■ Screening Plant ■ Stacker	■ Cat 966 Loader ■ 25t Artic. Trucks (2)	■ Water Truck ■ 100 kVA Generator
Concrete Batch Plant	■ Batch Plant ■ 250 kVA Generator	■ Cat 980 Loader	
Dam Foundation Preparation	■ 30 t Excavator ■ 12 t Truck ■ 600 m^3 Compressor	■ Water Blaster ■ Hydraulic Drill ■ Grout Mixer	■ Grout Pump ■ Agitator Truck ■ Water Truck
RCC Wall Construction	■ 35 t Artic. Trucks (3) ■ D5 Dozer	■ Rollers (2) ■ Backhoe	■ Compressor ■ Water Truck
Intake Tower & Outlet Works	■ 50 t Crane ■ Concrete Pump	■ Agitator Trucks (2) ■ Flat Top Truck	
Pump Station	■ 50 t Crane ■ Concrete Pump	■ Agitator Trucks (2) ■ Flat Top Truck	

3.2.3.2 Urban and Irrigation Pipelines

The equipment requirements for the Urban Pipeline and the Irrigation Pipeline are presented in **Table 3-5**.

Table 3-5 Construction Equipment for the Urban and Irrigation Pipelines

Urban Pipeline	Irrigation Pipeline
■ D8 Dozer ■ 30t Excavators (2) ■ Hydraulic Rock Drill, Explosives Truck ■ Loader ■ 25t Trucks (3), Water Truck ■ Grader ■ Roller	■ 10t Excavator ■ Hydraulic Rock Drill (occasional) ■ Backhoe ■ 12t Trucks (2), Water Truck ■ Hand Compactor

3.2.4 Construction Resources

3.2.4.1 Emu Swamp Dam

The geotechnical investigations undertaken on the site (URS 2006) indicate that the rock and sand (for concrete aggregates) can be sourced from within the inundation area. The required quantities of material to be sourced from onsite are summarised in **Table 3-6**.

- **Table 3-6 Major Construction Materials Sourced Onsite**

Material	Urban Water Supply Dam	Combined Urban and Irrigation Dam
Roller compacted concrete	38,500 m^3	48,000 m^3
Conventional facing concrete	3,900 m^3	6,500 m^3
Other conventional concrete	4,300 m^3	4,600 m^3
Road embankment	6,200 m^3	6,200 m^3
Road base & sub-base gravel	1,500 m^3	1,500 m^3
Chip seal aggregates	200 m^3	200 m^3

The required quantities of construction materials and consumables for the Urban Water Supply Dam and Combined Urban and Irrigation Dam to be sourced from offsite are presented in **Table 3-7**

- **Table 3-7 Major Construction Materials Sourced Offsite**

Material	Urban Water Supply Dam	Combined Urban and Irrigation Dam
Cement	5,300 t	7,600 t
Fly ash	4,000 t	5,800 t
Reinforcing steel	560 t	800 t
Diesel fuel	650,000 L	850,000 L
Electricity	73 MWh	95 MWh
Explosives	48 t	60 t
Construction water (half on-site)	19,000 kL	28,000 kL
Potable water	1,600 kL	2,250 kL

There will also be significant, but smaller, quantities of pipes, valves, fittings, building materials, pumps and electrical equipment for the intake tower and pump station.

3.2.4.2 Urban Pipeline

The required lengths for different diameters of DICL piping for the Urban Pipeline are presented in **Table 3-8**. There will also be but smaller, quantities of valves, and fittings.

- **Table 3-8 Length (km) of DICL Piping for the Urban Pipeline**

Pipe Diameter	Urban Water Supply Dam	Combined Urban and Irrigation Dam
225 mm	7 km	-
250 mm	16 km	7 km
375 mm	-	16 km

The required quantities of construction materials and consumables for the Urban Pipeline are presented in **Table 3-9**. Bedding sand will be sourced from the sand extraction operation as part of the dam construction. Half of the construction water will be sourced from onsite.

- **Table 3-9 Major Construction Materials for the Urban Pipeline**

Material	Urban Pipeline
Bedding Sand	13,000 m^3
Diesel fuel	675,000 L
Electricity	-
Explosives	20 t
Construction water (half on-site)	9,000 kL
Potable water	900 kL

3.2.4.3 Irrigation Pipeline

The required lengths for different diameters of HDPE and PVC piping for the Irrigation Pipeline diameters are presented in **Table 3-10**.

- **Table 3-10 Required Lengths of HDPE and PVC Piping for the Irrigation Pipelines**

Pipe Diameter	Length of HDPE Piping (km)	Length of PVC Piping (km)
40 mm	1.3	
63 mm	21.6	
75 mm	7.7	
90 mm	15.0	
110 mm	7.3	
160 mm	2.8	
180 mm	4.7	
200 mm	25.0	
225 mm		4.7
250 mm		7.6
300 mm		4.3
TOTAL	85.4	16.6

3.2.5 Construction Management

Water Management

The construction water requirements for the Project components are listed in **Table 3-11**.

- **Table 3-11 Water Requirements for Construction**

Construction Stage	Water Requirement
Urban Water Supply Dam	38 ML
Combined Urban and Irrigation Dam	56 ML
Urban Pipeline	18 ML
Irrigation Pipeline	54 ML

These volumes are not large but water availability may be a significant challenge if the drought continues. It is proposed to obtain half of the construction water from the Severn River (by permit) at the Emu Swamp dam site. The other half will be carted from other water sources depending on availability at the time.

A temporary water storage will also be constructed in the inundation area.

The temporary storage will be operated similarly to the completed Emu Swamp Dam with environmental pass flows maintained and determined from the upstream flow gauging weir.

Flooding During Construction

The main risk during dam construction is flooding. The Severn River is a relatively steep stream and the delay time between rainfall and runoff can be quite short.

The phased approach of constructing the Right Half RCC Wall first provides protection for this part of the works against most flood events.

For the Left Half RCC Wall half there is less protection because the outlet pipe has limited capacity.

However, one of the advantages of RCC construction is that over-topping rarely leads to failure of the structure. There may be damage to unset concrete but the bulk of the completed works can generally be salvaged.

The construction management team will be cognisant of these risks and will monitor upstream rainfall and take appropriate decisions to protect the works.

Working Hours

The majority of construction works associated with Emu Swamp Dam are expected to occur for 10 hours per day, 6 days per week from Monday to Saturday.

Concrete batching operations will occur for 7 days per week. Construction hours for most operations will be 10 hours per day, apart from crushing operations (20 hours per day) and concrete batching (24 hours per day).

Normal working hours for construction of Emu Swamp Dam will be 10 hours per day between 6AM to 6PM from Monday to Saturday

Construction activities which will operate outside the normal working hours are:

- Crushing & Screening – 2 x 10 hour shifts per day for 6 days per week are proposed for up to four months to complete the concrete aggregate preparation;
- RCC embankment – 2 x 10 or 12 hour shifts per day for 7 days per week are proposed for two periods of up to three months to complete the RCC wall; and
- Workshop - a maintenance crew will operate in the workshop during the night.

Normal working hours for the construction of the Urban Pipeline and Irrigation Pipeline will be 10 hours per day between 6am to 6pm from Monday to Saturday.

Traffic

Construction traffic will be generated from construction staff and transport of construction materials to site. Controlling working hours and limiting transport routes to established truck routes and major arterial roads will assist in reducing impacts on the local road network.

The impacts on traffic from the Project are discussed further in **Section 13** of the EIS.

3.3 Operation

3.3.1 Urban Water Supply Project

SSC will manage the Urban Water Supply Project. SSC officers already manage the operation of Storm King Dam and will be able to manage the Emu Swamp Dam. SSC will establish appropriate operations, maintenance and safety management systems for the Emu Swamp Dam and the associated urban supply pipelines. This will include weekly visits by SSC staff to undertake inspections maintenance work, as required, for the dam, pump stations and the Urban Pipeline.

Emu Swamp Dam will operate in accordance with the final ROP. The ROP will define how to manage water infrastructure is to comply with the Water Allocation Security Objectives (WASOs) and Environmental Flow Objectives (EFOs).

Inflows to the dam will be measured at the upstream gauging weir. Daily flow volumes will be calculated and recorded in the Project's SCADA system database. Decisions will then be made about size and timing of releases from the dam.

The operation of the pump station will be automatically controlled by a radio telemetry linked SCADA system.

The fish transfer device, if fitted, will be a "trap and transfer" device. Fish will be transported from downstream in a daily operation during periods of flow. A non-selective fish transfer may foster the movement of translocated predators such as Murray cod, Silver perch and Yellowbelly. These species will be removed from the fish transfer device to protect naturally occurring species in the system.

3.3.2 Combined Urban and Irrigation Project

SSC will be the operator of the shared urban and irrigation components and operations will be similar to the Urban Water Supply Project. The Irrigators Group will be a customer of the SSC.

The Combined Urban and Irrigation Project will operate in accordance with the finalised ROP to meet WASOs and EFOs

SSC will establish a committee comprising on-dam licence holders and downstream water licence holders to ensure stakeholders are kept informed about the dam operating objectives and the decisions that SSC needs to take to comply with ROP requirements.

The Urban Storage Reserve for the Combined Urban and Irrigation Dam is 2,000 ML. When the dam volume is less than the Urban Storage Reserve no water from Emu Swamp Dam may be used for irrigation.

The Irrigators Group will own, operate and maintain the Irrigation Pipeline network. The Irrigators Group may engage a competent organisation to provide this service. The Irrigation Pipeline will be automatically controlled by a radio telemetry linked SCADA system.

Farm delivery points will include magnetic flow meters, actuated valves, a radio receiver / transmitter with power provided by solar panels.

3.3.3 Buffer Area

A buffer area of approximately 200 m is proposed surrounding Emu Swamp Dam to protect the water quality within the dam and also for maintaining ecological connectivity within the region.

It is expected that the buffer area surrounding the dam lake will become Nature Refuge/s with the landholders retaining the ownership of the land. The Nature Refuges will be managed by the landholders to comply with conservation agreements negotiated with EPA.

It is anticipated these conservation agreements will include requirements for weed control, re-vegetation of cleared areas, feral animal control etc. SSC will provide assistance to local landholders and work with EPA in the negotiation and implementation of the conservation agreements.

Where landholders do not enter into conservation agreement SSC will acquire the buffer area. SSC will also enter into a conservation agreement with EPA for any part of the buffer area it owns.

3.3.4 Recreational Infrastructure

Recreational infrastructure to be provided at Emu Swamp Dam has been described in **Section 3.1.1.4**. It will be operated and maintained by SSC.

SSC already operates similar facilities at Storm King Dam and has the appropriate resources and experience for this activity.

3.4 Infrastructure Requirements

The key infrastructure requirements are discussed briefly below. **Section 13** of the EIS contains a more detailed assessment of the infrastructure requirements for Emu Swamp Dam.

3.4.1 Roads

The inundation area for the proposed dam will result in the closure of Emu Swamp Road. As a result of this closure Stalling Lane will no longer be accessible from Emu Swamp Road. Stalling Lane currently provides access to residents located on two properties. To maintain this access, the Stalling Lane Access is proposed to be constructed from Fletcher Road to the western end of Stalling Lane. The location of the Stalling Lane Access is presented in **Figure 3-4**.

3.4.2 Water Supply and Storage

Urban water from Emu Swamp Dam will be pumped to the existing water treatment plant at Mt Marlay in Stanthorpe.

The Mt Marlay water treatment plant treats water from Storm King Dam. Storm King Dam is in the upper parts of the Severn River catchment and has the same raw water quality characteristics. The existing treatment processes are flocculation, coagulation, clarification, filtration and disinfection and these will be suitable for the Emu Swamp Dam water.

The Mt Marlay water treatment plant has spare capacity for a number of years.

Treated water is stored in reservoirs at Mt Marlay and distributed to the Stanthorpe water service area. The storage capacity is presently adequate but additional reservoir capacity will be required as new development occurs in Stanthorpe.

SSC has already received development applications that require expansion of its potable water supply systems and planning (SKM 2007d) has been undertaken for upgrades to the water treatment plant, trunk delivery systems, reservoirs and reticulation systems.

3.4.3 Sewerage

During construction portable toilet facilities will be on-site. Waste will be regularly collected and removed offsite by a licensed operator.

Toilet facilities with water tank, on-site septic tank treatment and pump out capability for the recreation area.

3.4.4 Workforce and Accommodation

During construction of Emu Swamp Dam there will be approximately 30 management staff. There will be a further 50 construction staff, with a peak of 75 during the RCC wall construction. The workforce numbers are the same for both the Urban Water Supply Dam and the Combined Urban and Irrigation Dam options. The duration of construction for the Urban Water Supply Dam will be shorter than the Combined Urban and Irrigation Dam (refer to **Section 3.2.2**).

During construction of the Urban Pipeline there will be approximately 10 management staff. There will be a further 30 construction staff.

The management staff will either be accommodated in Stanthorpe or they will obtain their own accommodation in the area. Construction staff can be accommodated at a number of caravan parks, motels and guest houses located in the region. This is further discussed in **Section 14** of the EIS.

The workforce numbers will be the same for both the Urban and Irrigation Pipelines.

3.4.5 Decommissioning

The nominal engineering life of Emu Swamp 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 provide for the water supply needs of Stanthorpe. The dam may be decommissioned during or after the initial engineering design life if it suffers damage that cannot be repaired to meet safety standards.

Following completion of the site construction works the site will be rehabilitated, materials cleared and all site construction infrastructure removed. All public areas that are damaged during construction works will be rehabilitated and returned to a suitable standard. All disturbed outside of the inundation area will be rehabilitated to a self-sustaining, native vegetation community. Management and monitoring of the rehabilitation will be undertaken by SSC as par management of the buffer area.

The quarry excavation will be partially filled with excess rock from the dam and pipelines construction. The final quarry excavation walls will be shaped at a maximum slope of 0.6H:1V to eliminate steep unsafe faces. The quarry will be covered by the water in the storage.

3.5 Ecologically Sustainable Development

The National Strategy for Ecologically Sustainable Development (NSESD) (DEH 1992) provides a number of specific objectives for a range of sectoral issues (such as Fisheries Ecosystem Management) followed by a series of action that Governments will achieve. As the NSESD (1992) is aimed at the Government policy level, application of specific objectives stated within the NSESD at the project level is not considered appropriate. However, ESD principles provided by DEW in the Australian Local Sustainability Initiative (EA 2002) are considered more applicable at the project level whilst being cognisant of the overall ESD objectives outlined the NSESD (1992).

In addition to the NSESD, the SSC Planning Scheme identifies three Desired Environmental Outcomes (DEO). The DEOs seek to achieve ecologically sustainability by ensuring:

- the existing natural capital of the Shire, the life supporting capacity of air, water, soil and ecosystems will be maintained in some cases restored;
- the economy of the Shire will be increasingly diverse and efficient and economic development will compliment the environmental and social values of the Shire residents; and
- the cultural, economic, physical and social wellbeing of the residents of Stanthorpe Shire will be maintained.

Table 3-12 outlines how the proposed Emu Swamp Dam will achieve the key objectives of sustainability as outlined in the NSESD. The DEOs from the SSC Planning Scheme are consistent with the objectives and guiding principles of the NSESD. In satisfying the objectives of the NSESD the Project is also satisfying the the SSC Planning Scheme's DEOs.

Table 3-12 Project Responses to the Objectives and Principles of the NSESD

Objectives and Principles	Project Response
To enhance individual and community well-being and welfare by following a path of economic development that safeguards the welfare of future generations	The availability of a reliable water supply is a major constraint to the future growth and development of the Stanthorpe Shire. Additional urban and irrigation water is required to allow any urban growth and expansion of agricultural industries in the Shire. The total water demand for Stanthorpe (740 ML/year) currently exceeds the average annual yield for Storm King Dam (654 ML/year). SSC anticipates the need to increase water supply capacity for the Shire by a further 1,500 ML/year to meet demand in 2065. SSC propose to staged this increase by delivering an additional 750 ML/year to cater for demand for the next 30 years. The new urban water allocation will primarily be required for Stanthorpe town but it will also service future demands in other urban centres in the Shire. The provision of a reliable urban water supply would allow future residential development within the Shire's urban areas. The irrigation allocation will provide agricultural users with improved water security throughout the Shire. The impact of additional irrigation supplies in the region has been assumed to result in 5% growth per annum on top of current production values. The operation of the dam would also provide opportunities for the establishment of new outdoor recreation facilities and activities. The economic benefits for recreation and tourism provided by these new facilities are likely to be significant.
Decision making processes should effectively integrate both long and short-term economic, environmental, social and equity considerations	The project will have both short and long term benefits and impacts for the Shire. Overall, local residents are generally supportive of the project and believe that the provision of a reliable urban and irrigation water supply is necessary for the future growth and sustainability of the Shire. During the construction period, the project will: ■ employ approximately 120-145 people, of which approximately 30% would be sourced locally. ■ ensure local employment and training opportunities during construction, particularly for young people; and ■ ensuring business opportunities during construction are maximised, through the use of local goods and services. During operation, the project will: ■ ensure access to the recreational and amenity values of the dam, including fishing, boating, canoeing, and casual recreation; ■ provide a reliable water supply allowing opportunities for the development of additional housing and tourist accommodation in the Shire; ■ maintain existing water rights downstream; and ■ maintain vegetated a buffer zone around the impoundment for protection of water quality values. A cost benefit analysis for both dam options over 30 years was undertaken indicating that they would both have a positive economic benefit on the Darling Downs. The irrigation component of the Combined Urban and Irrigation Dam will have significant economic benefits for Darling Downs.
The global dimension of environmental impacts of actions and policies should be recognised and considered	The environmental impacts associated with the project are considered to be localised to the direct impact areas with the exception of greenhouse gas (GHG) emissions. A preliminary greenhouse gas inventory has been prepared for the construction and operation of the project. GHG emissions from the clearing of vegetation are not expected to be significant as any vegetation offsets and the creation of the buffer area will compensate for most of these emissions. Therefore the net change in greenhouse emissions is not expected to be significant. GHG emissions from the construction of the Urban Water Supply Dam is estimated to result in approximately 3,666 t CO_2-e, and the Combined Urban and Irrigation Dam in 4,231 t CO_2-e of greenhouse gases. These emissions represent a small fraction of Queensland's annual GHG. For the operation of the Urban Water Supply Dam and Combined Urban and Irrigation Dam, GHG emissions represent approximately 0.0004% and 0.002% respectively of Queensland's annual greenhouse gas emissions.

Objectives and Principles	Project Response
The need to develop a strong, growing and diversified economy which can enhance the capacity for environmental protection should be recognised	Stanthorpe's economy has strong agricultural focus, particularly in vegetable and fruit growing, wool and beef cattle farming, timber growing and sawmilling are also important agricultural industries. Almost all agricultural production is exported from the Shire. As such, the Shire has a very high proportion of people employed in primary industries (28%). Water security was identified as a barrier to the expansion of agricultural operations into export markets. Therefore, this project is important to the maintenance and growth of the agricultural industry in Stanthorpe Shire as it will provide greater water security to irrigators as well as urban users.
The need to maintain and enhance international competitiveness in an environmentally sound manner should be recognised	The enhanced reliability afforded by the water storage infrastructure at Emu Swamp Dam would facilitate agricultural stakeholders to expand their operations to export markets as water reliability was identified as the a barrier to growers pursuing export markets in the past. Fruit and vegetable growers would be the main beneficiaries of the Combined Urban and Irrigation Project. The environmental impacts associated with the Emu Swamp Dam have been assessed in this EIS and mitigation measures have been proposed to minimise any impacts identified in order to deliver the Dam with as little impact as possible.
Cost effective and flexible policy instruments should be adopted, such as improved valuation, pricing and incentive mechanisms	SSC has developed a comprehensive water management strategy that incorporates demand management and water recycling initiatives to meet the water needs of the Shire. The development of Emu Swamp Dam is only part of the solution to meeting the demand for water in Stanthorpe Shire. Over the past 32 years, SSC has implemented a range of initiatives to reduce water demands including community education, installation of water efficiency devices and appliances, water pricing, water restrictions and penalties. SSC supports the mandatory provision of AAA-rated shower roses, dual flush toilets and rain water tanks for all new dwellings. In addition, SSC also provides financial assistance for water auditing and efficiency projects for businesses in the Shire. Stanthorpe Shire also uses 100% of its treated sewage effluent for the irrigation of recreational open spaces and for sale to ten irrigators.
Decisions and actions should provide for broad community involvement on issues which affect them	Community and stakeholder consultation, including with affected property owners, was undertaken for this EIS by SSC. In addition, specific consultation has been undertaken with key stakeholders for this social impact assessment. This involved consultation with community service providers, environmental groups, business and industry representatives, SSC officers and elected representatives, and State agencies. The purpose of this consultation was to identify potential impacts and benefits of the Project specific to these stakeholders. The outputs of the consultation program informed the socio-economic assessment described in **Section 14** of the EIS.