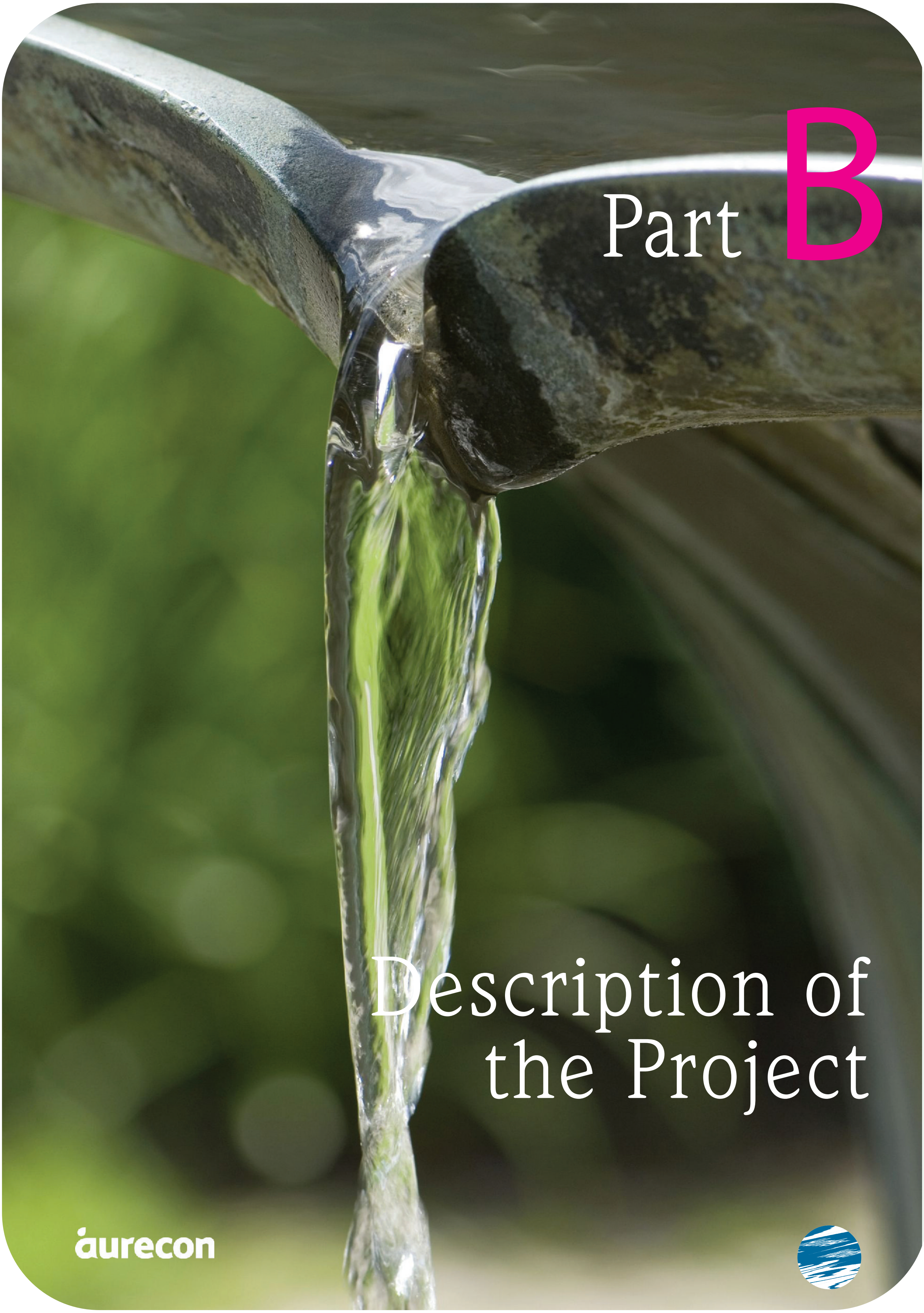
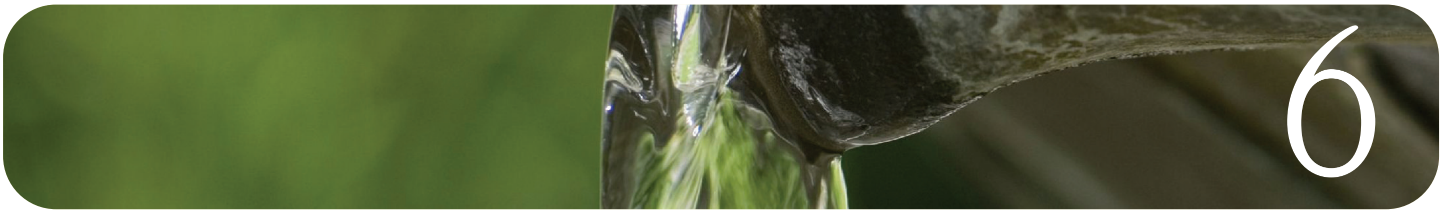
Part B

Description of the Project





Description of the Project

This chapter describes the key elements of the Project, these principally comprising the dam wall and related infrastructure, and the relocated section of Salisbury Road. Other important matters such as the management of Quart Pot/Munni Cemetery, the provision of alternate access to the Quart Pot Creek area and the relocation of public infrastructure and telecommunications services are also described. The chapter concludes with a discussion of issues relating to operation of the dam and management of the storage and its surrounds.

6.1 General description of the Project

The information provided in this chapter draws upon work undertaken in developing the concept design for the proposed dam. This has been documented in the report titled *Tillegra Dam Design Options Study* (Department of Commerce 2008a) and *Tillegra Dam Concept Report* (Department of Commerce 2008b). Discussion also draws on work undertaken by Opus International Consultants (Opus) to develop a concept design for the relocation of both Salisbury Road and Quart Pot Creek Road. There has been substantial overlap between the engineering and environmental investigations with each informing the other – effectively a process of continual improvement – which has supported refinement of the overall Project.

The design development work has been supported by a number of other studies including:

- analysis of hydrological and flooding issues
- detailed geotechnical investigations for both the dam site and Salisbury Road realignment
- assessment of dam safety issues including consideration of flood and earthquake risk
- geochemical analysis of the existing and proposed cemetery sites.

A number of these studies, such as the suitability of the site for a dam, have been independently peer reviewed by recognised authorities.

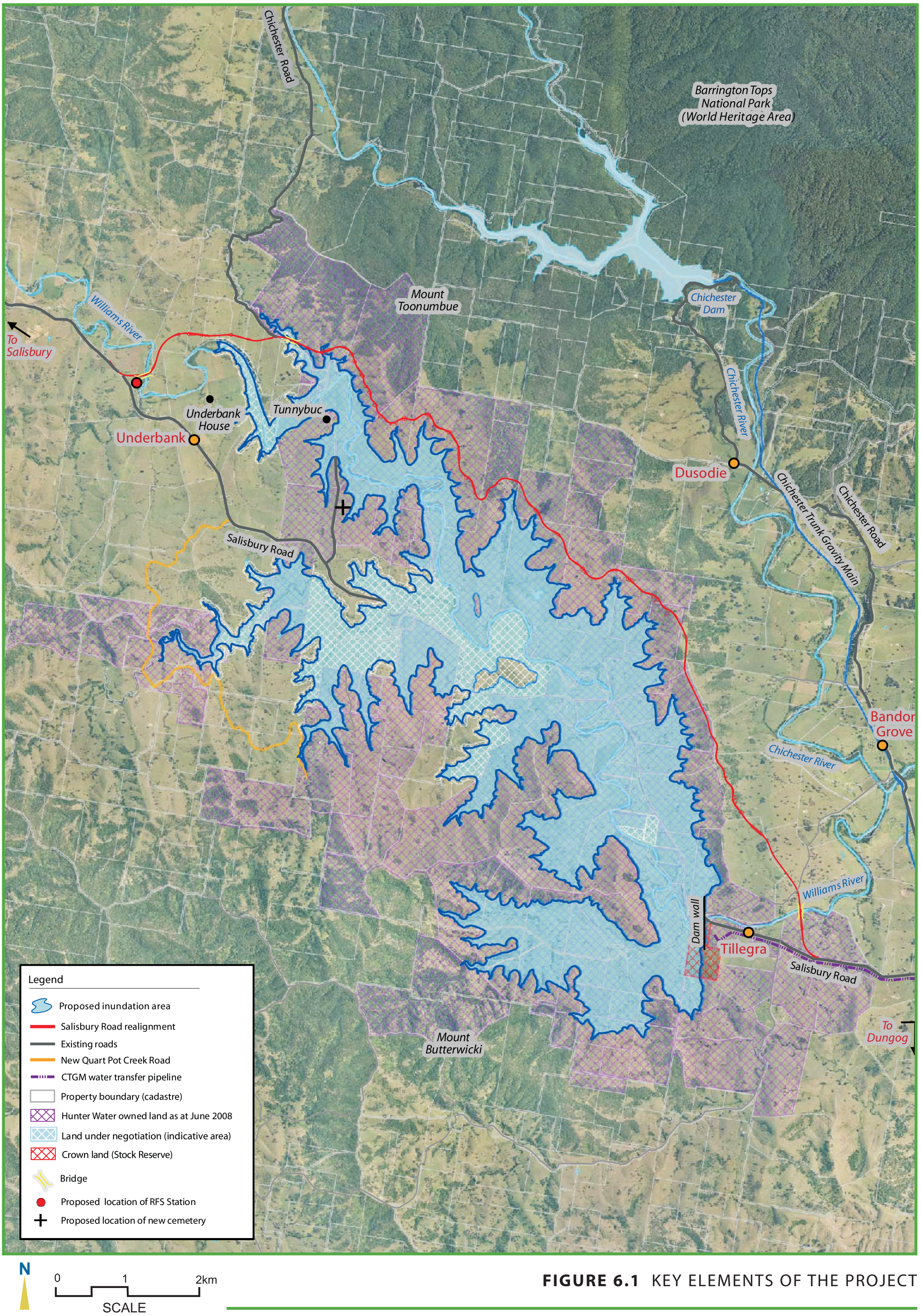


FIGURE 6.1 KEY ELEMENTS OF THE PROJECT

Specific details on the Project are illustrated in the concept designs for the construction of the dam wall and the relocation of Salisbury Road, and are provided as Annexures A and B to the EA Report. The concept designs show the overall schematics necessary for construction. Subsequent detailed designs will build on the concepts detailed, as well as incorporate refinements to manage any environmental risks detailed in this report. Refinements will also be made to accommodate applicable approval conditions that may affect the future detailed design and construction process.

The key elements of the Project are summarised in Table 6.1 and illustrated in Figure 6.1.

TABLE 6.1 KEY ELEMENTS OF THE PROJECT

COMPONENT	KEY ASPECTS
Dam wall	Concrete face rock fill dam (CRFD), approximately 76 m high and 800 m long located at Tillegra
Spillway	Simple chute spillway controlled by an ogee crest located on the right abutment (looking downstream). The spillway would be 40 m wide at the crest and approximately 600 m long. The spillway is designed to handle the probable maximum flood (PMF) with a full storage prior to flood inflow and a dry freeboard of 1.3 m above the design flood level.
Multi-level offtake tower	The dam design provides for an offtake tower with full height selective withdrawal facilities. This would allow selection of water at optimum quality for releases.
Mini hydroelectric power plant	The dam outlet works include provision for installation of a mini HEP plant to take advantage of environmental flow releases and bulk water transfers from the dam. The plant could generate up to 3,000 MWh of electricity annually which is roughly equal to the energy demands of 500 households. HWC would invite expressions of interest for installation and operation of the plant. Operation required to conform to the environmental flow release and bulk water transfer strategies.
Transfer pipeline and pump station	The design provides for a pipeline to transfer water from the dam to the Chichester Trunk Gravity Main (CTGM) which conveys water from Chichester Dam to Dungog water treatment plant, and then delivery to various towns and settlements in the Lower Hunter. The pipeline would be used as a backup to the existing water supply from Chichester Dam in the event of a water quality problem in the Chichester catchment. The pipeline could ultimately permit the transfer of water between storages, however planning approval for such water transfers is not being sought at this stage. The pipeline would run generally within the road reserve on the northern side of Salisbury Road.
Chlorination plant	In conjunction with the transfer pipeline and pump station noted above, a chlorination plant would be installed at Tillegra Dam to disinfect water prior to treatment at the Dungog Water Treatment Plant. Disinfection is required as there are non-standard connections to the CTGM that allow residential supply, prior to full treatment of the water at Dungog.
Dam access roads	Access to the dam wall would be provided from below the dam. A temporary bypass road would be established around the dam construction site. Part of this road would be retained for future access to the dam wall. A bridge across the Williams River is required to replace the existing Tillegra bridge, for the temporary bypass road. For additional access over the longer term, a footbridge across the crest of the spillway would also be constructed.

COMPONENT	KEY ASPECTS
Salisbury Road realignment	The impoundment of water behind the dam wall would flood or isolate approximately 17 km of the existing Salisbury Road. The dam wall itself would be situated across the road at Tillegra bridge (which is also within the dam footprint). The relocated section of the road would be 16.8 km in length and located on the eastern side of the storage. This would require a new bridge over the Williams River approximately 500 m downstream of Tillegra bridge. There would also be a second bridge crossing over the Williams River above the storage area in the vicinity of Underbank. An additional bridge is required to span Moolee Creek. The road would be one lane in each direction, 3.5 m lane widths and 0.5 m shoulders/verges. It would comply with appropriate road design standards and the requirements of the local road authority.
Provision of other access roads	Access to the Quart Pot Creek locality is currently via Quart Pot Creek Road which runs off the section of Salisbury Road in the inundation area. Alternative access would be provided to the locality off Salisbury Road above the inundation area, with the construction of a new 7.5 km road of which approximately half the length would be sealed.
Relocation of Quart Pot / Munni Cemetery	Quart Pot/Munni Cemetery is located within the inundation area of the dam. The cemetery covers an area of 0.85 ha and contains about 80 known burials within 55 graves. Options available to affected families include leaving graves as they are, or partial or complete relocation to a new cemetery.
Relocation of utilities and public infrastructure	The Project would impact a number of utilities which currently cross the inundation area. These include approximately 20 km of telecommunications and electrical supply. The Rural Fire Service (RFS) currently has a station located within the inundation area. An alternative location has been identified above the storage near where the new section of Salisbury Road would join the existing Salisbury Road.
Ancillary works	A number of ancillary works are being considered as part of the Project. These include look outs and viewing areas, walking tracks, a boat ramp, information centre, caretaker's residences, HWC office building and storage sheds, as well as a river flow gauging station.
Property boundary adjustments	Not all land acquired by HWC would be required for the Project. This activity would involve the subdivision or consolidation, as appropriate, of surplus land for subsequent divestment.

As a result of previous feasibility studies into the general geological and geotechnical properties of the site and investigations into the yield (storage capacity), the location of the dam and the preferred FSL are considered fixed.

6.2 Dam and spillway design development

The proposed site for Tillegra Dam provides a sound rock foundation available on both abutments and in the river bed with minimal stripping although some 10 metres of alluvial material would need to be removed in limited areas across the river flats. The site foundation is suited to most standard dam constructions with no special features that require use of complex construction techniques. Suitable chute spillway and diversion tunnel sites were also available on both abutments.

6.2.1 Options considered

Three standard dam types were examined:

- concrete face rockfill (CFRD)
- roller compacted concrete dam (RCCD)
- earth core rockfill (ECRD).

The CFRD and RCCD options were considered the most likely options and received the more detailed assessment. Experience on similar sites has indicated that the ECRD option is generally more expensive than the CFRD option and more likely to be used in situations where the topography does not suit a CFRD. A zoned earthfill dam was also briefly considered. This design has been used by the Department of Commerce on a number of smaller off-river storages where sound rock was not available. However, this design requires large volumes of materials compared with other dams and was discounted early in the option evaluation process.

6.2.2 Design criteria

All options developed were based on the NSW Dams Safety Committee (DSC) requirements and are also consistent with Australian National Committee on Large Dams (ANCOLD) guidelines. The consequence category has been assumed to be 'extreme' and spillways have been designed to pass the probable maximum flood (PMF) with a nominal freeboard of 1.3 metres between the PMF flood level and the parapet wall.

The PMF is the flood hydrograph resulting from the probable maximum precipitation (PMP) (and snowmelt if relevant) coupled with the worst flood-producing catchment conditions that could be realistically expected in the prevailing meteorological conditions. The PMP is the theoretical greatest depth of precipitation for a given duration that is physically possible over a particular drainage basin (or catchment).

ANCOLD guidelines cover concrete face rockfill dams and gravity dams. RCC has limited coverage in the gravity dams guideline, which in any case is being rewritten (there will be greater coverage in the revision). The United States Army Corps of Engineers (USACE) provides a wide range of engineering manuals that cover RCC dams, spillways, outlets and a variety of other areas. The USACE manuals would be used during the design process and specific decisions taken outside the manuals would be reported.

The annual exceedance probability (AEP) assigned to the PMF is 1×10^{7}. This can also be expressed as there being, on average, a 1 in 10 million chance of the PMF occurring in a particular year. Dams designed in accordance with current industry practice would satisfy the DSC and ANCOLD risk management guidelines for the dam during operation.

Design development to date has included expert peer reviews of specific technical aspects of the Project including the geotechnical investigations into storage rim stability and earthquake stability. Further review of dam foundation and material types will occur during the detailed design stage for the dam.

6.2.3 Option assessment

The three options were evaluated on cost and non-cost criteria to provide an overall rating score for comparative purposes. The latter comprised technical performance, construction risk and environmental considerations. These contributed 45 per cent, 25 per cent and 15 per cent respectively to the overall score.

For each of the non-cost categories a list of factors was developed and assigned a weighting. For example, construction risk considered flood risk, complexity of construction techniques, weather, expertise required, constructability, geotechnical difficulties, duration of construction and potential for delays. Scores (expressed as percentages) were subsequently derived and these are listed in Table 6.2 for each option together with construction cost estimates. These estimates were made in 2006–07 (real) meaning that they were not adjusted to take into account inflation to 2010, the time when it is proposed to start construction on the dam wall.

The CFRD option scored highest overall on the non-cost criteria and was also the lowest cost of the three options. The option evaluation process undertaken was sufficiently robust to select the CFRD option as the preferred option and to support commencement of the overall concept design.

TABLE 6.2 DAM OPTION EVALUATION RESULTS

OPTION	COST[1]	SCORE			
		TECHNICAL PERFORMANCE	CONSTRUCTION RISK	ENVIRONMENTAL	OVERALL
CFRD	$180 million	44%	21%	6%	71%
ECRD	$192 million	33%	13%	5%	51%
RCCD	$233 million	36%	21%	5%	62%

[1] Excludes contingency

6.2.4 Concept and detailed design

Concept design for Tillegra Dam commenced in 2008. Design of the dam and the river diversion works is being undertaken by the Department of Commerce. Design aspects considered in the concept have included a consideration of how to construct the main embankment and concrete face, a chute spillway with ogee crest, terminating flip bucket and plunge pool, a diversion tunnel with inlet and outlet channels on the right abutment, outlet tower and works, electrical works, telemetry, dam access roads and pedestrian access.

The concept design (refer Annexure A) has been supported by geological investigations, risk and safety analysis, investigations to optimise placement of the spillway and hydrological analysis.

The detailed design phase of the Project would involve further detailed survey, geotechnical, hydraulic and hydrological investigations leading to refinement of the design prior to construction. Some aspects of detailed design have commenced where it has been necessary to further inform the assessment process or otherwise allow project development. Additional geotechnical investigations and analysis, and hydraulic modelling are examples of such work undertaken to date.

The detailed design would take into account matters raised in submissions, adjustments to the design as required by conditions of approval and the results of any further investigations. In addition, alternative approaches derived from the greater knowledge of detailed design, safety refinements, innovation, new standards and technologies or the passage of time may be incorporated in relation to elements of the concept design.

In order to adequately incorporate the key principles established during the dam options study and inherent in the concept design, the development of the detailed design would:

- be consistent with the design criteria and design principles on which the concept design is based, as described in this environmental assessment and any subsequent submissions report
- consider opportunities for refinement of the Project footprint for safety, engineering and functional reasons, taking into account the presence of environmentally sensitive areas

- address unresolved issues associated with the development of the concept design as described in this environmental assessment and any subsequent submissions report
- address relevant conditions of approval arising from the environmental assessment approval process unless changes to the conditions of approval are subsequently agreed
- incorporate opportunities for innovation
- develop and refine impact management measures
- appropriately develop and incorporate the urban design strategy and landscape concept developed in the environmental assessment
- establish detailed proposals for the construction delivery method and construction staging addressing geotechnical issues, all relevant specifications and design requirements, current guidelines and policies and practicality/cost effectiveness
- incorporate the construction concepts and environmental management measures presented in this environmental assessment and any subsequent submissions report
- address risk management during construction and operation
- allow for safe and cost effective maintenance of the Project during operation in accordance with occupational health and safety requirements and relevant specifications.

The concept design and construction methods discussed in this chapter and Chapter 7 are proposed as a functional solution to the Project's objectives and constraints. They may be refined by HWC and its construction contractor(s) within the limits of any conditions imposed and the design constraints, principles and standards presented in this chapter.

6.3 Description of dam and related infrastructure

6.3.1 Embankment

As noted previously, the preferred dam option is a concrete face rockfill dam (CFRD). The dam wall (embankment) would be approximately 76 metres high and 800 metres wide. The full supply level (FSL) of the dam would be at RL 152.3 metres. Design has adopted a PMF level of 158.9 metres which provides 6.6 metres head on the spillway crest and a parapet level set at RL 160.2 metres in turn providing a dry freeboard of 1.3 metres.

The embankment design comprises a number of zones, with each zone requiring differing rockfill sizes and compaction layering. Table 6.3 provides an overview of material quantities and details for each of the five dam wall zones. The detail relating to dam wall zones is subject to refinement during the detailed design process and as such may alter to that identified in Table 6.3.

TABLE 6.3 DAM WALL DETAILS BY ZONE

ZONE[1]	QUANTITY (M^3)	DESCRIPTION	MATERIAL	PLACEMENT
2A	5,300	Reverse filter material	Processed fine filter providing filter protection d/s of the toe slab where foundation conditions warrant	Compacted to minimum RD of 70%

ZONE[1]	QUANTITY (M^3)	DESCRIPTION	MATERIAL	PLACEMENT
2B	99,800	Semipervious U/S 'cushion' zone under concrete face slab	Crushed rockfill, max. size 100 mm, with sufficient sand sizes and fines to provide workability and low permeability	Placed in 500 mm layer with four passes of a 10 tonne roller. U/S batter slope compacted with vibrating plate or 10 tonne roller if kerbs not used
3A	101,300	Transition rockfill	Free draining sound rockfill with max size of 0.5 m	Water and compacted in 0.5 m layers with four passes of a vibratory roller
3B	871,965	U/S rockfill zone	Free draining sound rockfill with max size of 1 m	Water and compacted in 1 m layers with four passes of a vibratory roller
3C	635,193	D/S rockfill zone	Moderately weathered rock	Water and compacted in layers as determined by trial embankment
3D	267,437	Rockfill in D/S stage	Free draining sound rockfill with max size of 1.6 m	Water and compacted in 1.6 m layers with four passes of a vibratory roller
3E		Facing rock on D/S batter	Select fresh large rock dozed to the D/S batter face and placed by excavator	Nominal compaction by the excavator
4	123,194	Meshed rockfill in main cofferdam	Selected durable free draining rockfill	Placed to suit detailed requirements of steel mesh protection
5	50,000	U/S impervious zone	Fine silty material covering lower toe slab and extending to upstream cofferdam	Placed in 0.5 m layers and compacted with construction equipment

Source: Department of Commerce (2008b)
1 As per usage in Dept of Commerce report

The footprint of the dam is illustrated in Figure 6.2 while the cross section is shown in the upper diagram in Figure 6.3. The dam wall would include an upstream facing concrete face slab at a batter slope of 1:1.3. The downstream rockfill face would also be at a batter slope of 1:1.3. The concrete face slab would extend for essentially the full height of the upstream facing wall (to the base of the parapet wall). The total volume of material required for the dam wall would be approximately 2.15 million cubic metres.

Rock fill for the dam embankment would be sourced from three potential quarry sites within or close to the reservoir area. Rock fill would also be obtained from the spillway excavation with the possible extension of this source along the back of the ridge on the right (facing downstream) abutment.

Rock material excavated from the spillway would be augmented with rock obtained from a quarry on a ridge to the west of the dam. This area is commonly referred to as Mount Elwari or Rockfield. Geological investigations indicate that two faces should be able to be worked within sandstone and meta-shales to obtain the volume of material required after spillway excavation.

A third source of sandstone is available from the storage in the vicinity of the left abutment. While the majority of material is likely to be sourced from Mount Elwari, this source of quarried material may be

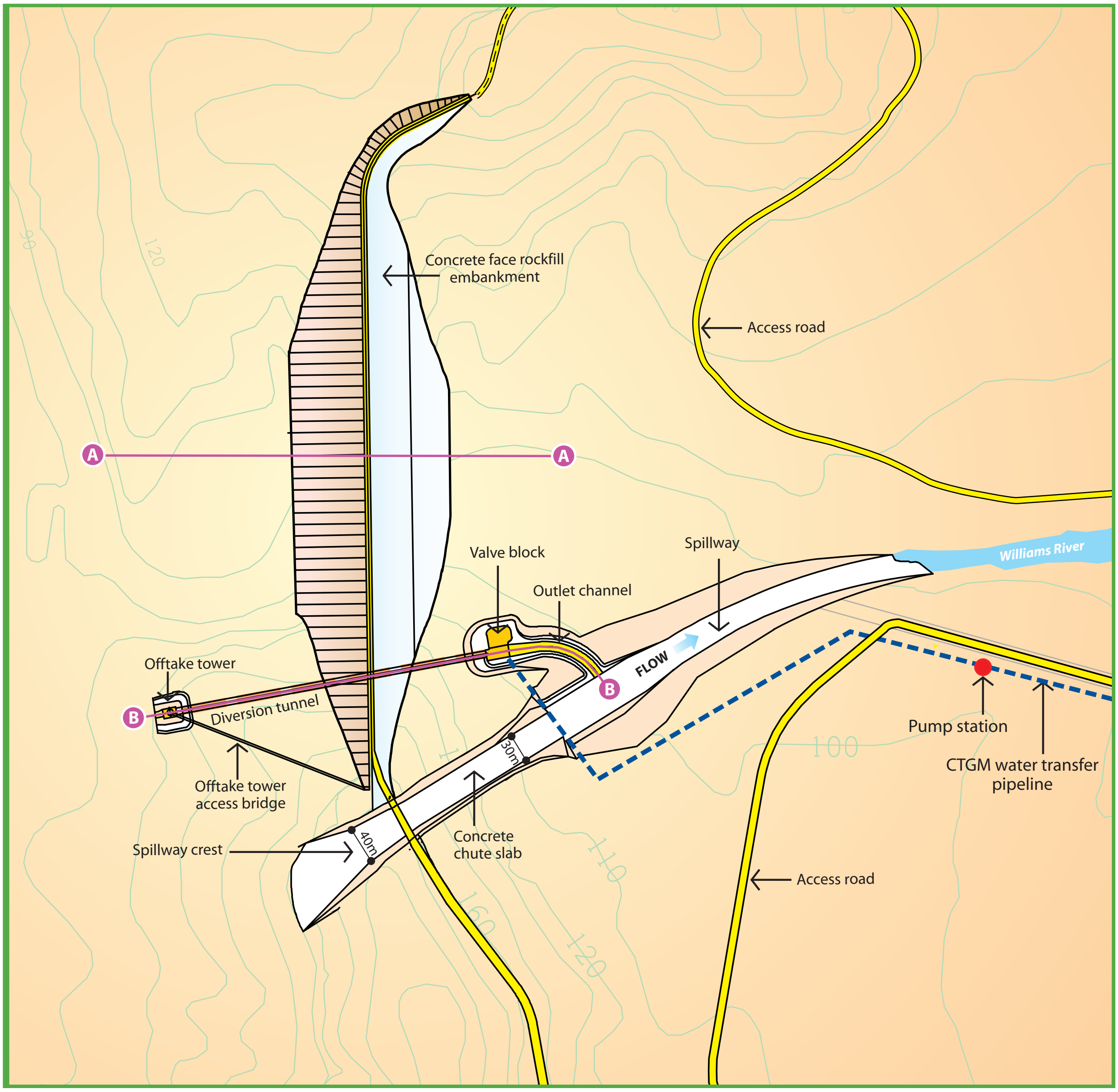


FIGURE 6.2 DAM DESIGN LAYOUT

used due to its close proximity to the left abutment, its elevation and ability to deliver material directly to the dam embankment.

Construction of the dam embankment requires stripping of alluvial gravel and overburden to reach sound rock, at a depth of about 10 metres at the dam site. A stepped foundation surface would be prepared. Both blanket and curtain grouting would be undertaken to provide a water tight seal to the required design standard. A toe slab is incorporated into the foundation design.

Layers of rockfill of various pre-determined sizes would be placed and compacted in correct sequence. A concrete slab on the upstream face would be slipformed in a continuous pour from the toe slab to the parapet wall. Protective mesh anchorage would be attached to the downstream face to allow safe overtopping during the construction period.

Construction phases for the dam are described in more detail in Chapter 7.

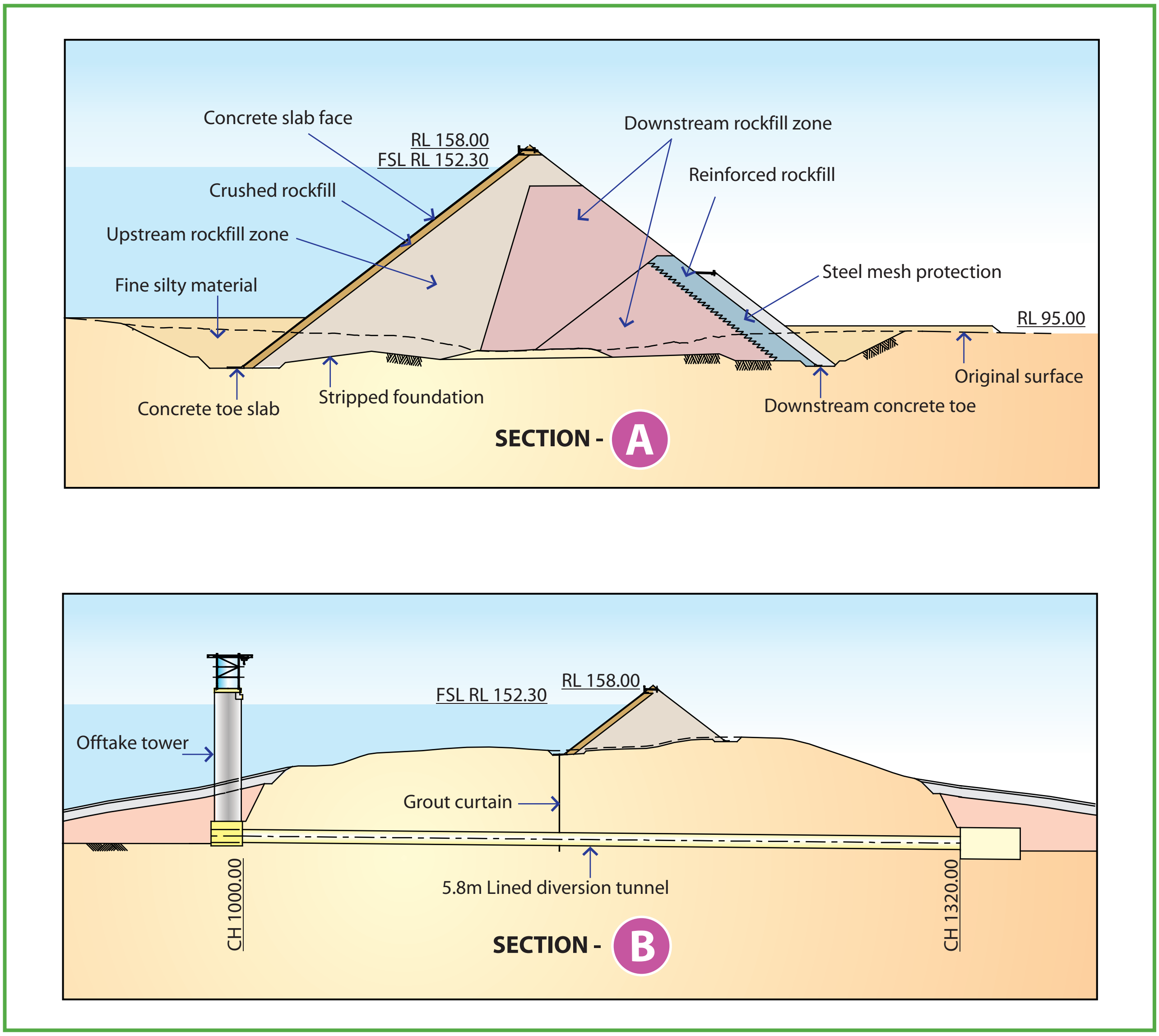


FIGURE 6.3 DAM DESIGN CROSS SECTIONS

6.3.2 Spillway

The site suits a simple chute spillway controlled by an ogee crest. A crest width of 40 metres is set at a design flood level of RL 158 metres with 1.3 metres freeboard to parapet level (refer Figures 6.2 and 6.3). The crest would contract sharply into a 20 metre wide chute. Experience with ogee controlled chute spillways on this size of dam has shown that maximum heads of less than five metres are generally not economically viable. The Project cost is not sensitive to small changes in spillway crest length.

The chute spillway has a design length of approximately 600 metres and would be located on the right abutment. The chute would terminate into a flip bucket located above tailwater level and discharge into an excavated plunge pool. The need for lining of the spillway and plunge pool with concrete would be decided during detailed design, subject to final geotechnical analysis.

Issues relevant to the placement of the chute spillway are dominated by prevailing geological conditions, including depth of weathering and depth of river gravels and slope wash materials. Cost differences between a 20 metre wide chute and a 40 metre wide chute are considered to be marginal and the exact chute width including its fan shaped contraction would be determined in detailed design.

Chute slabs would be slipformed over long lengths to provide a small number of transverse joints. Chute walls would be provided to the 'hard' water depth for the PMF with no allowance for aeration. The walls would be 300 millimetres thick shotcrete lining anchored to the excavated rock surface.

Storage operation data for the minimum likely environmental release shows the spillway operating for 47 per cent of the time with an average discharge of 169 ML/d. The corresponding figures for the maximum likely environmental release are for operation at 29 per cent of the time and an average discharge of 118 ML/d.

The spillway would include terminal structures to dissipate energy from spillway flows. Consideration was given to both an unlined hydraulic jump dissipater and a flip bucket structure both of which would require an excavated scour hole. The flip bucket is currently preferred. The basin would be excavated to a level and length to ensure stable discharge of all flows up to the PMF.

6.3.3 Offtake tower

A multi–level offtake tower allows selection of water at optimum quality for releases. The dam design provides for an offtake tower with full height selective withdrawal facilities. Foot access to the tower would be provided by a bridge connected to the embankment. Public access to the offtake tower would not be permitted.

6.3.4 Outlet works

The proposed outlet works would incorporate the temporary river diversion tunnel and channel construction works which include a 5.8 metre diameter concrete–lined tunnel through the right dam wall abutment.

The outlet works would comprise:

- a 2.5 metre diameter steel liner within the diversion tunnel connecting the offtake tower to the outlet works on the downstream side of the dam
- an 850 millimetre bypass pipe located within the diversion tunnel lining to provide environmental flows during outlet construction
- a 2,500mm main penstock leading to a 1800 fixed cone dispersion valve (FDCV) a 1,400 mm branch line, a 1,800 mm bypass line and subordinate lines and valves leading to the CTGM and mini-hydro plant.

6.3.5 CTGM water transfer pipeline

The distribution works would include a pipeline connection from Tillegra Dam to the CTGM (refer Figures 6.1 and 6.2). This pipeline would be used as a back-up to the supply from Chichester Dam in the event of a water quality problem in the Chichester catchment. It could also be used for the future transfer of water from Chichester Dam to Tillegra Dam, however, the transfer of water between the two dams does not form part of the current Project.

The CTGM transfer pipeline would run generally within the road reserve on the northern side of Salisbury Road. The CTGM itself is in a slight cutting on both sides of Salisbury Road before passing under the road. The northern side is considered the best point to connect the new pipe from Tillegra Dam as it would be possible to keep the transfer pipeline buried until very close to the CTGM.

The connection would involve removing a 10–15 metre section of the existing CTGM and replacement with a new section with the necessary valves, fittings and tee piece to allow connection of the pipe from Tillegra Dam. A steelwork platform would be needed over the connection to allow operation of the valves. Thrust blocks would also be required. It is anticipated that no additional land would be needed. However, it would be necessary to establish an easement over the buried section of pipe which diagonally crosses the corner of the adjacent property and a construction lease to lay pipe work out before installation.

It is anticipated that for construction purposes, the CTGM would need to be shutdown for 12 24 hours. During this time water could be supplied to downstream customers from reservoirs at Dungog water treatment plant (WTP) and if necessary, by supplementing supplies to customers below Seaham with water from Grahamstown Dam.

A small chlorination plant would be provided at the dam to dose water to manage water quality during transfer of water to the Dungog WTP.

6.3.6 Mini hydro-electric power station

The dam design provides for the installation of a mini hydroelectric power (HEP) plant to take advantage of releases via the outlet works for generation of electricity. This forms part of the Project offsets for carbon emissions. It is expected that the mini HEP plant could generate up to 3,000 MW hours of electricity which is roughly equivalent to the annual energy demands of 550 households.

Specific details of the mini HEP plant components would be confirmed during detailed design. It is anticipated these would include an intake screen, bypass pipe, a penstock pipe of between 200 millimetre and 300 millimetre internal diameter, powerhouse to site the turbine and generator, mini hydro machine and tailrace.

The mini HEP plant may be procured by way of a separate contract which would cover design, construction and operation of the plant. HWC would retain ownership of the carbon credits associated with the plant's operation.

6.3.7 Other works

Transmission network requirements

The existing 11 kV rural distribution feeder which services the general area in the vicinity of the dam site is known as the Chichester/Salisbury feeder (DGG6607). It carries a distributed rural load which peaks at around 1 MVA and has a minimum loading of about 250 kVA.

The physical connection point for the mini HEP plant generator is likely to be a new 315 kVA or 500 kVA substation sited as close as practicable to the generator. A relatively short section of 11 kV overhead line or underground cable would need to be extended from the substation to one of the existing adjacent 11 kV poles.

There are standard protection requirements for plant connected to a distribution network. The mini HEP plant is defined as a 'permanent parallel operation low voltage generating plant' for protection requirement purposes. Consultation with Country Energy indicated that it is unlikely that a special 11 kV isolation point would be required for the mini HEP plant at its connection to the distribution network. For Country Energy isolation purposes at this site, only a low voltage circuit breaker (connection point circuit breaker) would be required. The connection point circuit breaker would need to be a current sensing circuit breaker (ie not just an isolator). It would need to be easily accessible to Country Energy at all times and secure against unwanted access or interference by non-authorised persons.

Upgrade of the existing transmission network to accommodate the mini HEP plant generator may be undertaken early during the dam construction phase to ensure that there is enough capacity in the lines to provide electrical power for the construction phase.

Fish passage

Construction of the dam would present a significant barrier to the movement of aquatic fauna along the Williams River which is already affected by the presence of Seaham Weir. The dam would restrict the upstream movement of fauna below the dam and would isolate fauna located above the dam site when construction commences.

In view of the likely cumulative impact on connectivity, consideration has been given to the provision of fish passage. This work has examined options for both Tillegra Dam and Seaham Weir. Further detailed discussion is provided in Chapter 10 and Working Papers C and D (*Aquatic Ecology and Environmental Flows and River Management* respectively).

Considering impacts on aquatic ecology in isolation, the specialist aquatic ecology investigation recommended provision of some form of fish passage at Tillegra Dam. However, the anticipated cost (a minimum of $28.3 million) was considered to provide limited benefit with much greater benefits likely to be accrued through taking a more catchment-wide perspective. In view of this, HWC is proposing to fund a package of works targeted at improving fish passage at other locations across the Lower Hunter and Williams catchments. This would include upgrading the fish passage at Seaham Weir and undertaking work on several other existing priority barriers.

6.4 Dam access roads

Temporary diversion–left abutment

A temporary access road would be constructed to allow public traffic to bypass the dam construction site. The detour would commence from Salisbury Road approximately 100 200 metres below the placement of the spillway. It would then cross the river to the left abutment of the dam, reconnecting with the road approximately two kilometres north of the construction site. This would maintain the connectivity of Salisbury Road above and below the dam during the construction phase. The road would be bitumen sealed and have a design speed of 40 km/hr.

The bridge for the temporary diversion route would comprise a multiple span structure about 45 metres in length. The structure would include two reinforced concrete blade piers requiring a spread footing below current surface level supporting a reinforced concrete headstock. The bridge deck would consist of pre-cast, prestressed concrete planks with a reinforced concrete topping slab. The bridge would be similar to that proposed for the new Salisbury Road. While this bridge would provide only a single lane width of 3.5 metres to convey vehicles; it would incorporate a dedicated pedestrian crossing.

After construction has been completed, this road would be retained to provide public access to a recreation area below the dam and to a lookout on the left abutment. This road would also provide access for HWC employees to the main embankment for maintenance purposes and to the valve block and the mini HEP plant.

Construction access road–right abutment

During construction it would be necessary to provide access from the contractors work compound to the dam wall construction site as well as to the various quarry locations and batching plants located within the proposed reservoir area. For public safety, it would be desirable to separate construction traffic from normal vehicle movements on Salisbury Road. A separate road would be constructed for this purpose.

The road would be specifically designed and constructed by the dam contractor to ensure that it suits construction vehicle traffic. At the end of the construction period, the majority of the road would be bitumen sealed and retained for general public access to the right abutment, visitor area, spillway footbridge and the crest of the dam embankment. A private driveway would also be constructed perpendicular to the spillway crest, leading to the weather station and caretakers cottages.

6.5 Relocation of Salisbury Road

6.5.1 Initial route development

Options for the route of the new section of Salisbury Road around the storage were initially developed by GHD for HWC and are shown in Figure 6.4. The options comprised a common southern section (denoted by the solid red and green lines) which subsequently split into a 'high road' option (the solid magenta line) and a 'low road' option (the solid yellow line). Three possible northern connections back to Salisbury Road were also identified for the high road and low road options.

A subsequent review of the southern section of the new alignment (the solid red line) identified that this would necessitate construction of a major embankment to get up on to the ridge which forms the eastern side of the storage. This would have had significant cost implications for the Project as well as significant visual impacts with the scale of the embankment being comparable to the dam wall.

Two alternative routes up on to the ridge were subsequently identified to the east of the initial route. These are shown as dotted and dashed red lines in Figure 6.4. Refinement of these routes involved consultation with the affected landowners.

In addition to the route options shown in Figure 6.4, a connection from Chichester Dam Road in the general vicinity of Dusodie was also considered during the early stages of route option development. This was discounted on the grounds of the following considerations:

- steep grades of 10 per cent for two kilometres on the ascent to the ridge would be unsuitable for heavy vehicles
- does not allow for temporary connection back to Salisbury Road during construction
- about nine kilometres of the existing road from the Salisbury Road turnoff would need to be upgraded (the existing road beyond Bandon Grove is to a much lesser design speed than that before to Bandon Grove therefore requiring an even higher cost rate for the upgrade to a 70 km/hr standard)
- it was among the higher cost routes
- it would not provide for access to the storage
- it would run through vegetated areas more extensively with associated environmental impacts and increased bushfire risk
- with the inclusion of upgrades to the existing road, it had the longest route length.

6.5.2 Selection and development of preferred option

The initial set of route options was placed on public exhibition and comment invited. In total, 110 submissions were received. From this, the following conclusions were made:

- the Low Road options were preferred by 73 per cent of respondents
- Low Road Option B was preferred by the most number of respondents (32 per cent) followed closely by Low Road Option C (26 per cent)