SUMA PARK DAM – SAFETY UPGRADE AND 1M WALL RAISING

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ABSTRACT

Suma Park Dam was constructed in 1962 on Summer Hill Creek and is the main water supply reservoir for Orange. Suma Park Dam is owned and operated by Orange City Council.

The dam was designed and constructed to the respective safety standards of the time. In 1985, a safety assessment by the New South Wales Dam Safety Committee and the Australian National Committee on Large Dams (ANCOLD) was conducted. Following the assessment, Suma Park was categorized as a category 1 dam under Schedule 1 of the Dams Safety Act, 1978, in need of urgent upgrades to meet a 1: 1 000 000 year Probable Maximum Flood (PMF). The predicted stresses placed on the dam wall as a result of water overtopping in a flood event is the primary concern.

Council has taken advantage of the required safety upgrade and undertaken investigation and concurrently raising the spillway 1m.

Suma Park Dam an most important element in Oranges Integrated Water Management Strategy (IWMS). Council has considered the upgrade works for a number of years with design plans dating back to 1985. Over time, the safety upgrades have become more urgent, due to increasingly stringent safety standards. This, combined with an increased focus on the need to achieve water security in a growing city. A combination of political will, necessity and clever engineering have combined to make the project a reality.

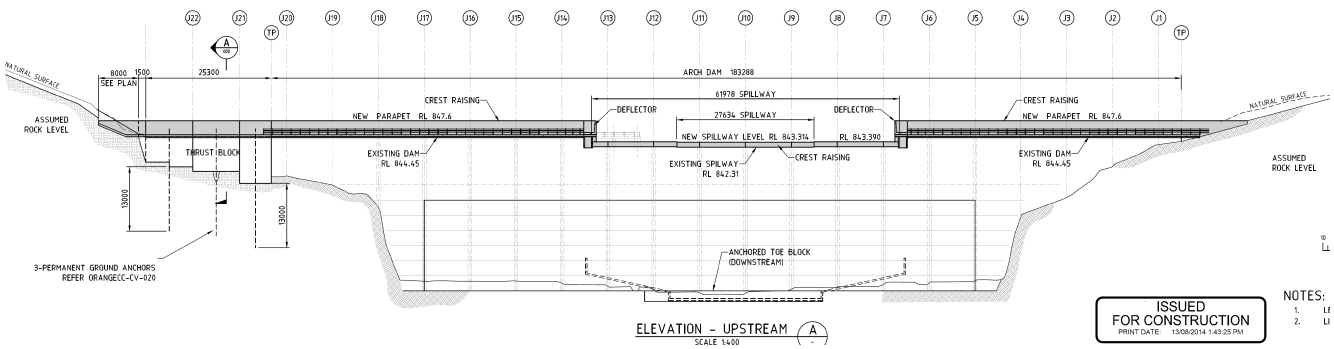

Figure 1: ***Section through the Dam Wall***

1.0 INTRODUCTION

Suma Park Dam is a concrete arch dam with an auxiliary earth saddle dam, originally designed to have a capacity at Full Supply Level (FSL) of 18,100 ML. more recent bathymetric and spillway survey undertaken in 2010 revealed the volume at FSL is 17,290 ML.

In 2010 Consultants "Entura" were engaged by Council to undertake the detailed design for the Suma Park Dam upgrade.

The Entura design introduced a new philosophy of splitting the large peak flows between the augmented concrete arch and through an auxiliary spillway compared with a proposal to take all the flow through the main spillway. This innovative solution significantly reduced construction costs.

Following review of the concept design prepared for the safety upgrade works, Council commissioned an assessment of the technical, cost and program implications of raising the FSL of Suma Park Dam by a 1 m or 2 m increase in FSL which would provide the following volumes:

- 1 m raise 18,970 ML (an increase of 1,680 ML)
- 2 m raise 20,760 ML (an increase of 3,500 ML)

The assessment found that raising Suma Park Dam FSL by 1 m is the most technically and economically feasible solution given significant additional strengthening required for the 2m raise.

The detailed design upgrade works consist of:

- 1m raising of the existing spillway.
- 2.65m high precast concrete parapet walls, anchored to the existing abutments.
- Strengthening the existing stilling basin with concrete overlay and toe block anchor.
- Outlet tower refurbishment and access bridge.
- Auxiliary Spillway Fusegate.
- Automated downstream valve pit
- Ancillary works

Figure 2: ***Historical Photo During Construction of Suma Park Dam***

2.0 CULTURAL AND ENVIRONMENTAL CONSIDERATIONS

A significant review of environmental factors was undertaken in consultation with downstream water users and key stakeholders. Four environmental release rules were developed to maintain and/or improve water quality, maintain biodiversity, river and riparian health and ecological condition.

1. Maintenance of a base flow
2. Maintenance of a base flow during extreme dry conditions
3. Provision of fresh magnitude flows
4. Preservation of storage level in Suma Park Dam During a prolonged dry period

The upgraded automated valve pit will work in conjunction with a stream gauge installed approximately 14km downstream which is used to measure the flow and ensure correct environmental releases are being made.

As a consequence of constant water flow within Summer Hill Creek, it is expected to result in a healthier ecosystem and better availability of water for downstream users and stakeholders.

The area of inundation around the dam will increase as a result of the 1m raise of the spillway. There have been a number of Aboriginal archaeological sites identified around Suma park Dam that will be affected and potentially damaged with the higher water levels. Following consultation with local Orange Local Aboriginal Land Council (OLALC) it is their wish that the eight sites identified be salvaged, and placed into their care for reburial.

A Aboriginal Heritage Impact Permit (AHIP) was required as a part of this process under the National Parks and Wildlife Act 1974. Once received the salvage was undertaken with two (2) Aboriginal representatives present approximately 300 artefacts were recovered and will be smoked and reburied at the conclusion of construction works as traditional methods require.

3.0 DISCUSSION

3.1 Auxiliary Spillway

Suma Park Dam was constructed with an earthen saddle dam to the west of the main arch. Entura's tender design called for the replacement of the saddle dam with a concrete and earthen Fuseplug arrangement. To replace the two (2) temporary Fuseplugs that were installed in 2004 and are designed to operate in a 1:200 flood event.

The proposed fuse plug system combines concrete and an earthen bank system which will trigger in a 1:500 year flood event, will trigger causing water to over top the embankment which causes scouring and eventual controlled failure.

Geotechnical Engineering (GE) were engaged as the successful construction contractor, their tender proposal included an alternative Fusegate system for the auxiliary spillway as provided by Hydroplus. Investigation of the Fusegate system determined it feasible and a more predictable engineering solution. The Fusegate system offers reduced maintenance requirements with less inspections required and ongoing landscaping requirements.
The fusegate system is essentially a series of concrete sections placed concurrently to form a wall. Each individual section is called a "Fusegate" the principal behind the system is broadly utilising hydrostatic pressure of the water to keep the gates in place.

The Fusegates operate by water entering the inlet pipe at the top of the fuse gates. Once water proceeds to enter the chamber, it causes pressurisation underneath the base of the gate. This cancels the hydrostatic pressure of the water and causes the gate to tip.

The Fusegates are set at a design tipping elevation of 1:2000 year flood event opposed to a 1:500 of the Fuseplug system.. The Fusegate system will maintain a higher FSL upon triggering.

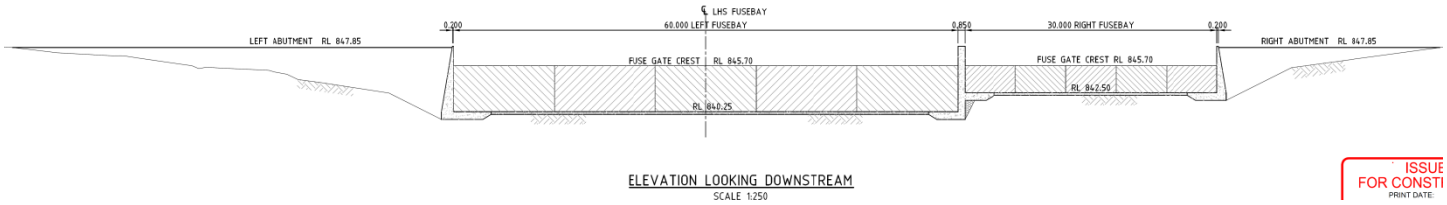

Figure 3: ***Fusegate Foundation Technical Drawings***

3.2 Main concrete arch safety upgrade and spillway raising

The spillway crest raising will maintain its ogee shape for hydraulic efficiency. The crest will be cast in situ concrete cut into the original crest and anchored with regularly spaced dowels and reinforced for crack control.

Precast parapet components are manufactured offsite at a local site in north Orange. Currently, panels are being produced at the rate of two (2) panels per day, with a total of 87 to be constructed. Current methodology involves;

Mould being stripped and parapets lifted out, after achieving the required concrete strengths overnight.
Pre-fabricated steel cages are then lifted into the moulds.
The steel moulds are then closed and end shutters installed.
Concrete is delivered via a kibble, lifted by a manatu.

All precast panels are required to be stored on their side on top of hardwood dunnage to circumvent any damage. The panels are loaded onto floats using a 25T franner crane when transported to Suma Park Dam.

Installation of “L” shaped parapet walls onto the dam abutments, facilitating light vehicle access to the outlet tower. The parapets are fastened to the dam wall using anchors that are drilled and grouted in place.

3.3 Stilling Basin

Proposed modifications to the stilling basin include the following:

- Construction of a new reinforced concrete slab that overlays the existing stilling basin and covers the existing joints and drain outlets to prevent pressurisation of the drainage system.
- Grouted dowels through the new and existing slab.
- The existing invert drains to be interconnected to embedded pipes within the overlay slab.

In order to provide additional sliding resistance for the dam wall, an anchored toe block is proposed to be placed and extend 30 m along the base of the dam (i.e.15 m on each side of the dam centre line) compromising of post tensioned rock anchors.

3.4 Valve Pit

Currently there is only one operational scour on Suma Park Dam, this scour has been in place since the construction back in 1960. Operators are required to manually actuate the scour, which is approximately 3m deep in the ground. Due to the scour's age and frequency of use, there can be no guarantee for the valves performance in the event of an emergency. For these reasons the valve pit is being upgraded and automated to eliminate the safety risk for both operators and in the event of emergency.

The valve pit, once upgraded will run remotely via telemetry which is also used to control the environmental flows out of Suma Park Dam. This will create a fully automated system which will be easier to operate and maintain.

3.5 Outlet Tower

The upgrade of the Outlet Tower requires the full replacement of the pipework and existing intake valves they have reached the end of their 50 year design life with considerable corrosion as a consequence of a damp acidic environment.

The existing scour valve is considered too risky to operate; due to the infrequent use and potential seizing of the unit. The existing scour will be totally encased in concrete in a fully closed position, the dewatering of the storage being provided only through the new intake valves. Existing tower is a non-conforming confined space making retrieval of personnel in an emergency extremely difficult.

The existing internal concrete floors as well as the roof of the Outlet Tower will be cut out and replaced with steel access platforms and stairs that meets current WHS standards. With operator consultation, a system was engineered to fully automate the operation of the outlet tower through telemetry. This minimised the WHS risk of having an operator enter a high risk confined space.. A new access bridge will be constructed to the tower.

During major maintenance work the hoisting of the valves and ancillary equipment will be done by a davit arm complete with chain and block.

<u>Figure 4:</u> ***Precast Parapet Cage & Finished Product***

4.0 CONCLUSION

Suma Park Dam safety upgrade and 1 m wall raising is being designed and constructed in consultation with key stakeholders, the community and operators.
This has resulted in a practical and cost effective engineering solution. The upgrade utilises the latest in engineering innovation and design in order to produce a safe and user friendly dam. With the increased automation, Suma Park Dam has aligned with operational requirements and achieves an increased safety for the community.

5.0 ACKNOWLEDGEMENTS

Robin Edwards – Suma Park Dam Contract Officer.

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