Paradise Dam Essential Works

Fact Sheet: Anchor Trials

October 2020

Background
Strengthening and stabilising work is required as part of the long-term remediation of Paradise Dam. The options to achieve this include large post tensioned anchors, or alternatively mass concrete buttressing (widening the base of the dam and increasing the wall thickness by mass concrete) or a combination of the two, amongst other improvement works.

These options require further design development, options assessment, and will need several years of construction to implement.

In parallel with the Essential Works to lower the primary spillway to reduce the risk of a dam failure, Sunwater is undertaking anchor trials to determine whether anchoring can be an effective solution to stabilise and strengthen Paradise Dam and to confirm design assumptions.

A geotechnical assessment to review foundation strength parameters, and sampling and testing of the roller compacted concrete (RCC) are also being conducted. The results of these three investigations, together with a detailed water demand assessment, will influence the long-term remediation design for Paradise Dam.

What are post tensioned anchors?
Post tensioned anchors are a bundle of steel cables that are installed vertically through the dam, and into the bedrock improving the dam's resistance to sliding and overturning from the force that flood water places on the dam wall. These steel cables are secured into the bedrock, stretched (tensioned) then locked in place at the top of the dam.

Sunwater has previously installed 75 strand post tensioned anchors at Tinaroo Falls Dam located in Far North Queensland (see Figure 1), and 21 and 23 strand anchors at Fairbairn Dam in 2019-2020.

The anchors that Sunwater is considering using at Paradise Dam have 91 strands and would be installed approximately 60 m into the bedrock. Figure 2 shows how the anchors would be used at Paradise Dam. The 91 strand anchors are the world's largest ground anchors that have been successfully installed as part of Australian dam strengthening projects, such as at Catagunya, Wellington and Keepit Dams.

These anchors are very large and each apply a force of approximately 1,400 tonnes through the dam to hold it in place during large flood events.

Figure 1 - 75 Strand anchor ready for installation at Tinaroo Falls Dam

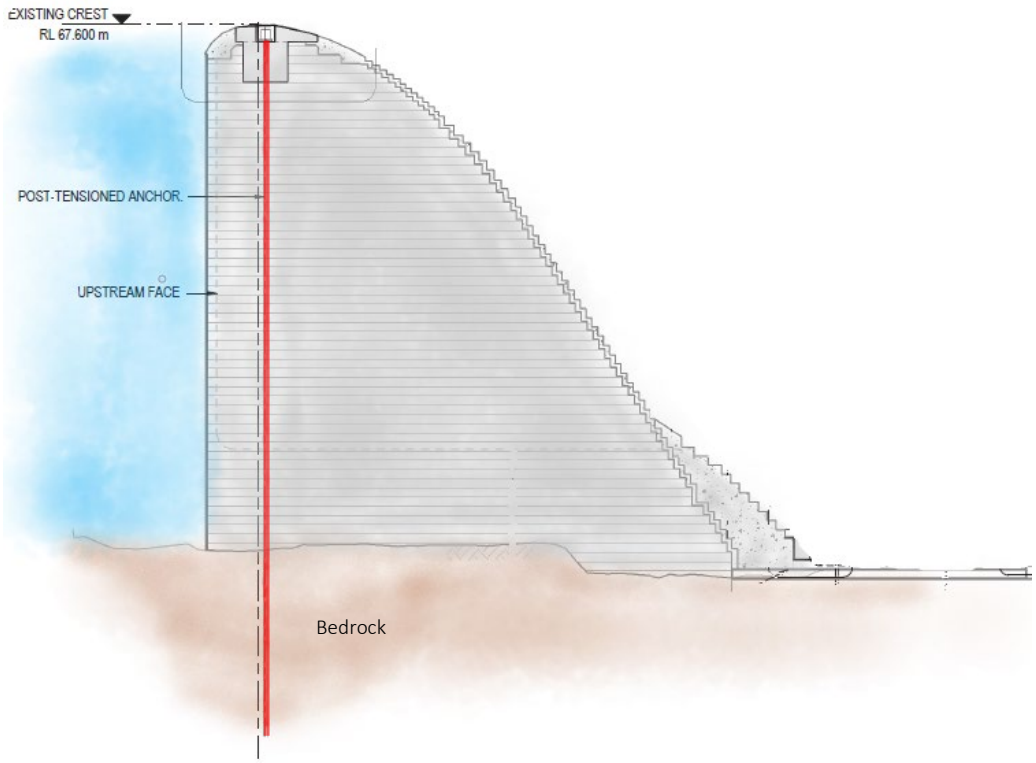

Figure 2 - Stylised Paradise Dam Spillway section with post-tensioned anchor

What does the anchor trial involve?

The anchoring trial will test:

- the existing dam foundation/ground conditions capacity to hold post tensioned anchors;
- drilling techniques to ensure they don't cause damage while drilling though the RCC which makes up the body of the dam; and
- potential settlement that could occur within weak foundation materials.

Full size trial anchors will be installed at six locations downstream of the spillway. The locations have been selected to intercept the varying ground conditions that are expected to be encountered below the dam foundation. The anchors will be stressed beyond the loads that would be applied if installed in the dam and monitored for any loss in tension that occurs over time.

To determine appropriate drilling techniques to be adopted through the dam body itself a drilling contractor will trial various drilling techniques for the 360mm diameter holes required for feeding the anchors through the dam body and into the foundation. The RCC at Paradise Dam presents particular challenges for drilling such large diameter holes, so this trial will confirm the appropriate technique for drilling this material and determine any limitations for installing post tensioned anchoring at Paradise Dam.

Anchoring cannot be reliably planned and implemented without the results of these trials.

Other studies are also underway, including computational finite element analysis to asses the ability of the RCC dam itself to withstand these stresses, and how the forces are distributed through the wall above the foundation.

How many anchors might be required?

Anchoring is expected to be a significant undertaking at Paradise Dam and is estimated to require approximately 100 anchors (each anchor being 90 metres long) across the primary spillway, and to include a strengthening beam constructed into the crest and along the length of the spillway – this would take approximately two to three years to complete.

A combination of anchoring and buttressing may be required, depending on the results of the anchor trials.

Anchoring is not common on RCC dams, and there is no known precedent of this scale.

It is important to note that anchoring the primary spillway would address only one of three possible significant failure risks at Paradise Dam, and was not a feasible risk reduction alternative in the short term to lowering the spillway.

Who is undertaking this work?

CPB Contractors, the lead contractor for the Essential Works, has procured a specialist post-tensioned anchoring and drilling subcontractor to undertake the anchor trial works.

Timing

Initial drilling commenced in early September this year to confirm geology at the test hole locations. Drilling and installation of 91 strand post tensioned anchors will then proceed at the six locations over four months. Initial results will be obtained directly after initial stressing of the anchors and follow up checking will be required one month after anchor installation. This is a major element of an economic remediation solution for Paradise Dam, and these investigations will assist in determining the extent to which anchoring is a viable solution.

Are anchors also being installed in the dam crest?

Yes, small passive anchors (steel bars) will be used to secure the crest in place. The trial does not relate to this work.

Stakeholder engagement

Sunwater is committed to ongoing stakeholder engagement to ensure there is transparency of the testing processes at Paradise Dam. We will share progress updates as the anchor trial progresses and results become available.

Questions?

Please contact us on 3120 0270 or paradise.dam@sunwater.com.au with any questions.