

# Paradise Dam Essential Works

## Fact Sheet: Anchor Trials

**Updated January 2021**

### **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, an 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 post-tensioned anchoring can be an effective long term 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) is 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 to improve the dam's resistance to sliding and overturning from the force that floodwater 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 (steel cables) 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, including those at Catagunya, Wellington and Keepit Dams.

These anchors are very large, and each applies 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

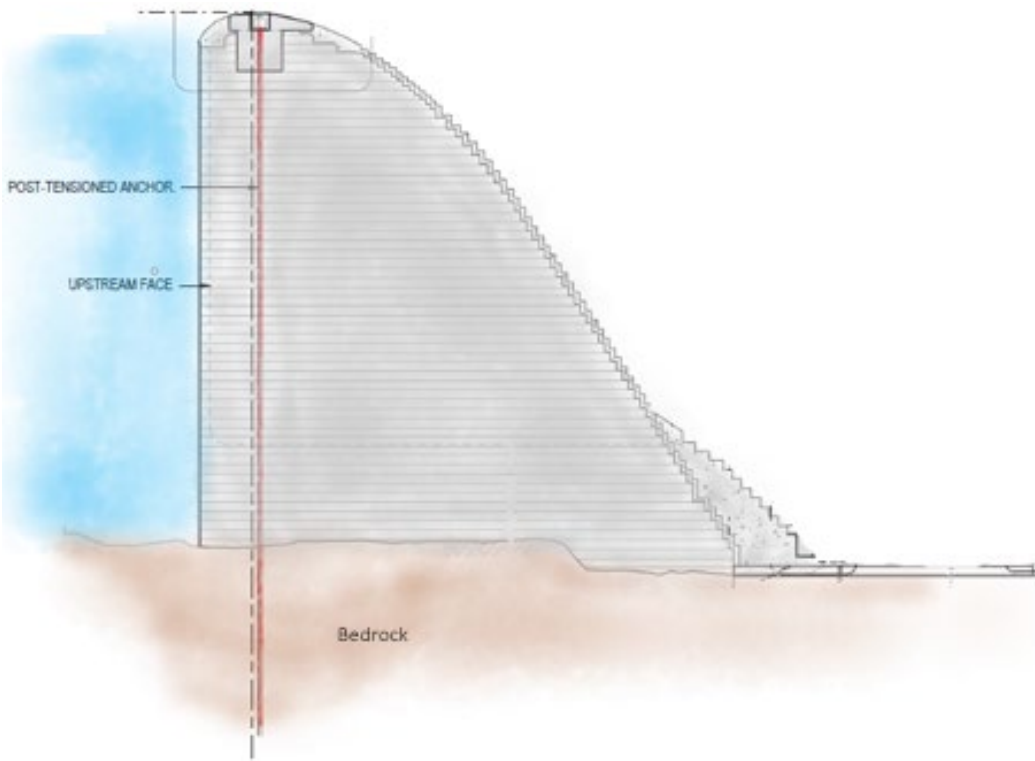


Figure 2 - Stylised Paradise Dam Spillway section with post-tensioned anchor

## **What does the anchor trial involve?**

The anchoring trial will test:

- the capacity of the existing dam foundation/ground conditions to hold post-tensioned anchors; 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, reviews are being undertaken to assess various drilling techniques for the 360 mm 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, and the assessment will determine 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 assess 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?**

The option for a full post-tensioned anchor solution would 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. It would also require 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.

Alternatively, Sunwater is also considering a design based on mass concrete “buttressing”, to limit or mitigate the need for post-tensioned anchors, by relying on the mass weight of the concrete to resist flood loads.

It is important to note that anchoring the primary spillway, and/or buttressing, 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 2020 to confirm geology at the test hole locations. Drilling and installation of 91 strand post-tensioned anchors were then progressed at the six locations in December 2020 and January 2021.

Initial results will be obtained directly after the initial stressing of the anchors and follow up checks 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) have been used to secure the upper half of the dam wall and to strengthen the RCC lift joints against flood loading. These anchors will also secure the crest in place. The trial does not relate to this work.

## **Stakeholder engagement**

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

## **Questions?**

Please contact us on 3120 0270 or [paradise.dam@sunwater.com.au](mailto:paradise.dam@sunwater.com.au) with any questions.