THERESA CREEK DAM; "DAM SAFETY AND MANAGEMENT PLAN"

Tahir Khan, Technical Officer Dams*, Isaac Regional Council, Qld*
Stephen Wagener, Manager Operation & Maintenance, Water and Wastewater, *Isaac Regional Council, Qld*

ABSTRACT

Theresa Creek Dam, constructed in 1982 and located about 18 km south of Clermont town is the only drinking water source for the town of Clermont. The 2021 comprehensive inspection report by consulting engineers on Theresa Creek Dam infrastructure has identified several critical issues that demand immediate attention for ensuring the dam's structural integrity and operational safety. A concerning finding is the variable gap between the left retaining wall and the staircase, which is assumed to be widening over time. Seepage was notably observed through the dam's horizontal and vertical drains, particularly around the left concrete terraced section (55 m) and the right concrete terrace section (150 m). This phenomenon, coupled with the detection of cracks in the concern apron slabs, highlights areas of concerns.

In accordance with the Queensland Dam Safety Guidelines (2003), a comprehensive dam safety plan for Theresa Creek Dam was developed which includes regular monitoring and data collection, to maintain safety standard. This includes twice a week dam inspection, seepage data collection and monthly measurement of cracks identified in the dam apron and variable gap between the retaining wall and staircase. Similarly downstream erosion data is also collected after major flood incident in the area. In this paper data collected in past one year is presented which showcase the inspection, monitoring, and investigation aspects of the Thresa Creek Dam "Dam Management System" to meet regulatory compliance requirement and to ensure dam safety.

1.0 INTRODUCTION

All dams in Queensland, irrespective of their size, volume and classification are required to operate in accordance with the Queensland Dam Safety Guidelines (2003), which were updated in 2020. Specifically, referable dams must adhere to the dam safety conditions (DSC) outlined in the Water Supply (Safety and Reliability). Dam safety responsibility is on dam owners only as described in Clause s364 of the Water Supply Act,

> *'Nothing in this chapter affects the liability of a dam owner or operator for any loss or damage caused by the failure of a dam or the escape of water from the dam'*.

Theresa Creek Dam, constructed in 1982 was primarily constructed as water storage reservoir for the town of Clermont which has a population of 3000 approximately (Census 2016) However, with time TCD has also evolved as a recreation location, playing significant role in town's economy. This dam features a concrete ogee-crested primary overflow, alongside flanking reinforced concrete terraces, and earth-filled overflow and non-overflow embankments leading to abutments. It has a storage capacity of 9,200 megalitres at the spillway crest level and a catchment area of 836 sq kilometre. Some of the salient dam features are given in Table 1.

Figure A: Theresa Creek Dam's Layout

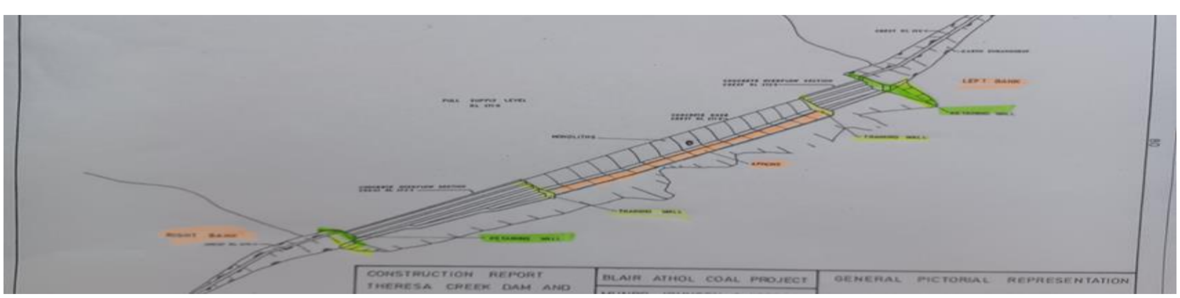


Table 1: Basic data of Theresa Creek Dam

Description	Value	Description	Value
Dam number	0366	Spillway length	225 m
Dam owner	Isaac Regional Council	Right Concrete Terrace	150 m
Dam catchment area	838 km^2	Left Concrete Terrace	55 m
Full supply level (FSL)l	RL 271.0 m AHD	Spillway height	16.8 m
Storage at spillway crest level	9,200 ML		
Dead storage level	EL 259.7 m AHD		
Inundation area at FSL	250 ha		
Total dam length including spillway	849 m (approx.)		

Theresa Creek Dam does not serve as a flood mitigation structure due to its limited storage volume and uncontrolled ogee spillway design, offering minimal peak discharge reduction. Consequently, it relies on a comprehensive dam safety plan, which includes regular monitoring and data collection, to maintain safety standard. This became a high priority for the Isaac Regional Council in 2022 when comprehensive inspection report identified several critical issues that demanded immediate attention for ensuring the dam's structural integrity and operational safety. This paper discusses some of the inspection, monitoring, and investigation aspects of the Thresa Creek Dam "Dam Safety and Management Plan" to meet regulatory compliance requirement and ensure dam safety.

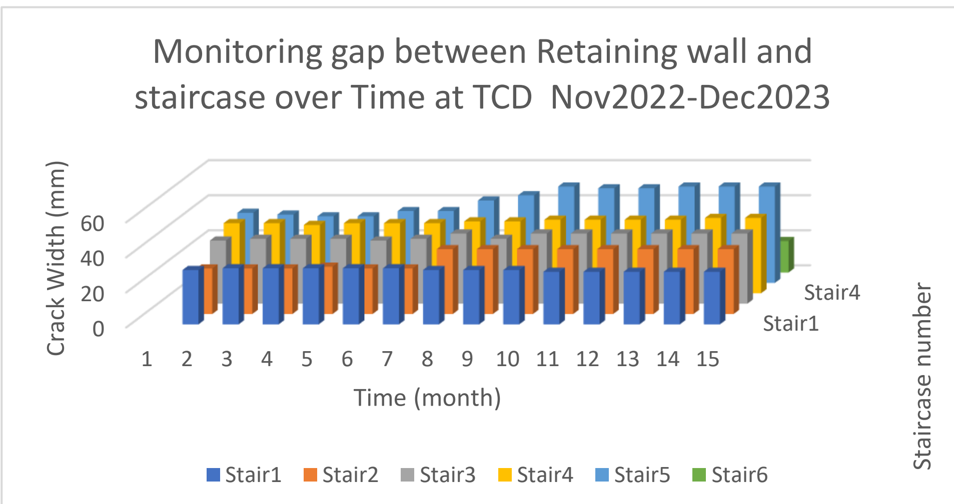
2.0 RESULTS AND DISCUSSION

In the last Comprehensive Inspection report (2022), the consulting engineers showed their concerns about the variable gap between the left retaining wall and the staircase on the left embankment of the Theresa Creek dam. The consulting engineer was concerned about possible movement of the structure over time, which could lead to dam failure. Similarly, significant cracks in the dam apron on both sides of the spillway were identified which could also trigger structural instability and subsequent dam failure. In response to these findings, a comprehensive dam safety plan for Theresa Creek Dam was developed which include twice a week dam inspection, seepage data collection, monthly measurement of cracks identified in the dam apron and measuring variable gap between the retaining wall and staircase. Similarly downstream erosion data is also collected after major flood incident in the area. Besides this Theresa Creek Dam has an active 'Emergency Action Plan" (EAP) and "Standard Operating Procedures".

Figure 1 shows gap between dam retaining wall and staircase. The data presented in Graph 1 does not show any significant movement of the structure over the period that data has been collected. However, such data is more conclusive when collected for a longer duration. This graph 1 shows data collected for little over one year. Potential ground movement is most likely to occur in the wet season, when the water level in the dam changes significantly on a regular basis due to rain and floods, resulting in an increased and variable hydraulic pressure. This creates enormous stress on the dam structure; therefore, it is necessary to collect data over a longer period before making any conclusive predictions about any possible movement of the retaining wall. The data collection is ongoing. However, last summer was comparatively dry with only one incidents of spillway overflow in December 2023 without raising any alert as per EAP.

Figure 1: Gap between the Dam Left Retaining Wall and Staircase of Left Embankment

Graph 1: Monitoring gap between Dam Retaining Wall and Staircase of Left Embankment.

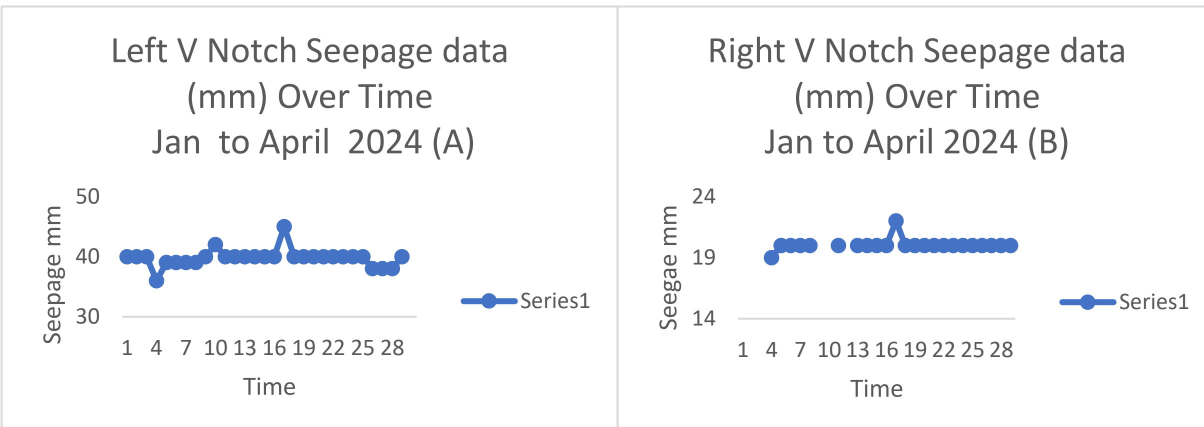


In the Concrete Terraces sections, on both the left and right sides of the dam spillway (Figure 2), pressure relief drains are built into the structure through which water is constantly seeping out in various locations. To measure the seepage volume, V-Notch Weirs have been installed below the Concrete Terrace Sections on both the left and right sides of the dam spillway. Graph 2 A & B shows the pattern of water seepage from these concrete terrace sections recorded that is being measured at both V Notch Weirs.

The data (Graph 2 A&B) for both V-Notch Weirs show a constant pattern with a few spikes and missing data points in the right V-Notch Weir. The constant pattern of seepage volume indicates that there is no potential variation of hydraulic pressure in these sections and a constant flow rate of seepage through these pressure relief drains is maintained. This is very reassuring in terms of dam safety. A change in seepage volume will indicate variable hydraulic pressure and changing stress on the Concrete Terrace sections of the dam. The spikes in the graph show an extra volume of water passing through V-notch weirs after rain or flood events, which is added surface inflow from adjacent areas. The missing data on the right V-Notch Weir shows the inaccessibility of staff to the right side of the spillway after flooding, particularly when the area downstream of the dam is inundated with water.

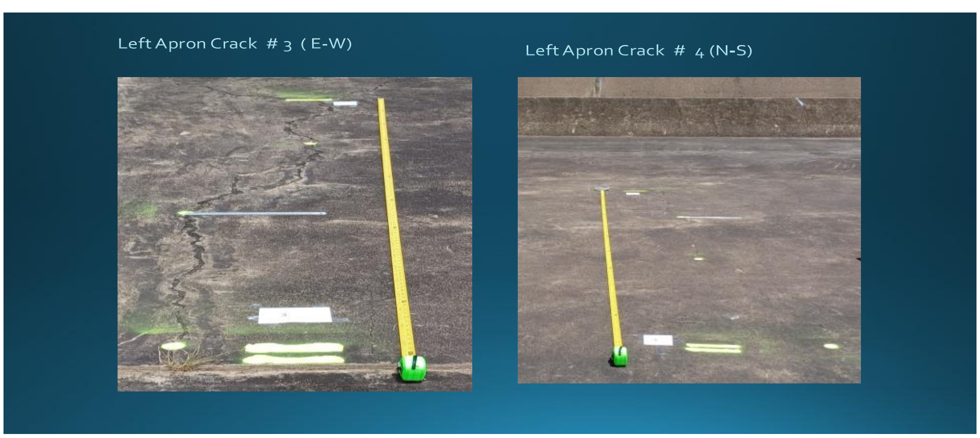
Figure 2 Concrete Overflow Sections of Theresa Creek Dam (TCD)

Graph 2: V-Notch Seepage data over time (mm) Left side (A) and Right Side (B) of the dam spillway of Theresa Creek Dam.

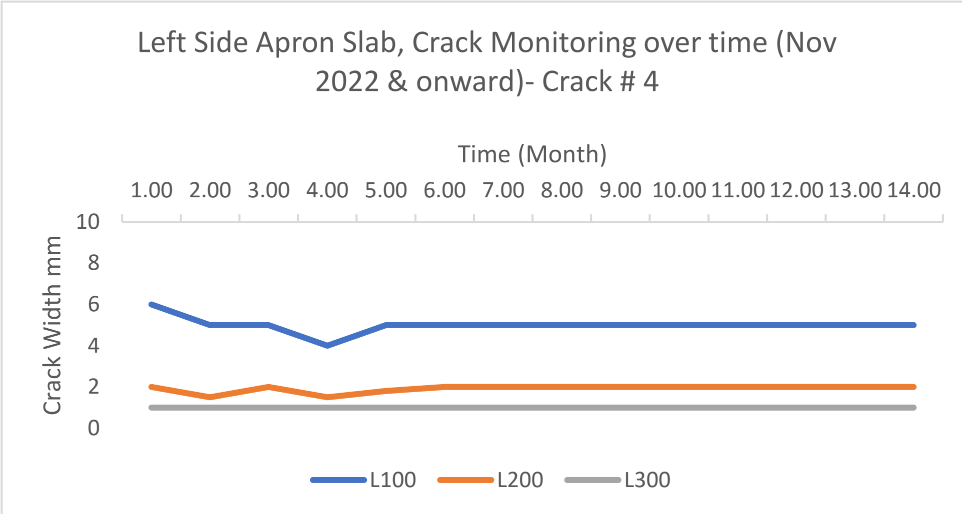


Downstreet Monolith 13 to 15 seven (7) visible cracks in the apron slabs were selected. For uniformity of results 300 centimeters length of the crack was selected and crack width was measured at 100 centimeters, 200 centimeters and 300 centimeters. The width of these cracks at same locations are measured monthly to note any differences. Results of one of such cracks #4 is presented below in Graph 3.

Figure 3: Monthly Cracks width measurement of Apron Slab Cracks at TCD



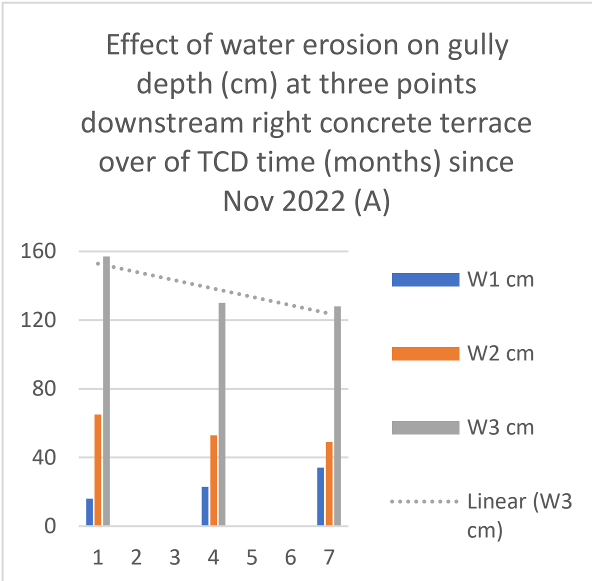
Graph 3: Apron Slab Crack monitoring over time at TCD

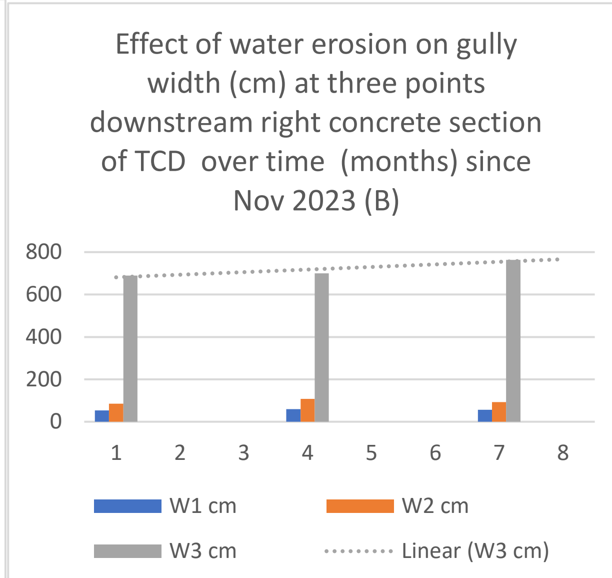


Downstream of the right Concrete Terrace section of the dam, there is significant water erosion which occurred in a flood event during February 2021 (Figure 4). The water inflows from adjacent hills and paddocks during heavy rains and it is believed to have exacerbated this erosion. A rehabilitation project is being scoped and is waiting for budget allocation. There is no immediate risk to the dam structure, currently, but a monitoring program has been placed to study the gully development after storms or flood events in the area. The data (Graph 4 A&B) shows that at the top the gully (W1), the depth of the gully increases with successive storms, whereas towards the end of the gully (W3) the depth is decreasing. The increase in depth at the top of the gully signifies the soil erosion due to water dissipating energy at location W1, whereas the reduction in depth at location 3 suggests the transportation and deposition of debris. However, the width of the gully keeps increasing under the hydraulic forces, especially at W3 (Figure 4 B).

Figure 4 Gully area below the right concrete terrace of the dam being monitored.

Graph 4: Data showing effect of water erosion on Gully width (A) and gully depth (B) the Right Concrete Terrace of TCD





3.0 CONCLUSION

Although it is still early to reach final conclusions, preliminary findings suggest no significant changes in seepage or structural movement, including cracks in the dam apron or gaps between the retaining wall and staircase at Theresa Creek Dam. Therefore, it is reasonable to expect that the dam is safe for operation, and the current dam safety management plan is performing effectively. Nonetheless, ongoing monitoring is recommended to ensure continued safe and confident operation of the dam in the coming years.

4.0 REFERENCES

- Theresa Creek Dam: Data Book 2020
- Theresa Creek Dam; Dam Logbook 2023
- Queensland Safety Dam Guidelines – February 2002:
- Theresa Creek Dam Comprehensive Inspection Report (GHD) 2022