

Toddbrook reservoir planning application HPK/2021/0607.

Introduction.

This application is unique for HPBC in that it seeks approval for a major civil engineering modification to be carried out on an existing High Risk Reservoir critically located inside Whaley Bridge town. I believe that it is the responsibility of Planning Authority to ensure that any Construction to which it gives Approval meets the highest safety criteria if it is to be installed in the Public Domain and can potentially harm or kill people or damage property. What makes this application complicated for HPBC is that the construction to be approved does not stand alone when completed but it will become the controlling part of an existing old reservoir system. Consequently HPBC will need to assess how the safety of the whole system will be affected by the integration of the new part (the overflow) even if the design of the new part itself is perfectly well specified and designed.

This is precisely what did not happen in 1970. The Toddbrook dam was recklessly modified by the previous owner, British Waterways without any concern for the effect on the overflow system. Fifty years later this led directly to a dramatic near breach of the dam in August 2019 and the urgent evacuation of 1500 people for 10 days.

In any reservoir the load on the dam by the impounded water and the height of the overflow weir are fundamentally linked. In this case of an old recently damaged dam the formal documentation submitted for approval of a new overflow weir should include a full safety assessment of the dam, the removal of all the concrete, any inspections and technical results, any repairs, and enhancements, load profiles for different heights and risk assessments.

Critical safety issues for the planning application.

1)Damage History

The Toddbrook earth/clay dam is more than 182 years old, under construction before Queen Victoria's reign started, one of the oldest and highest (77ft) of this primitive type in the country. It is rated ' High Risk' by the Environment Agency which means that it could kill people if the dam breaches (which it very nearly did in Aug 2019).

The construction of the Aux. Spillway over the crest in 1970 removed many tonnes of material from the downstream shoulder of the dam. It removed 6ft or more from the crest and clay core. No cut off was installed to protect the clay core at Top Water Level (TWL). Then very dangerous **cross dam** abutment walls were built and these required footings at least 2-3 ft below TWL. Thus the overall integrity of the dam was destroyed and this caused the development of erosion channels for 50 years under the concrete of the Aux. Spillway. These channels allowed water to pass under the crest panels under the Aux .Spillway and under the cross dam footings to run under the LH side wall.

A leak in the dam, first detected in 1930, led to extensive investigations and speculative remedies over the next 50 years. The investigation continued even after the Aux. Spillway was constructed. It is therefore not certain that the leak was ever cured because the installation of the Aux. spillway prevented further access to the shoulder to confirm success. The evidence of water under the spillway concrete became obvious but those responsible unfortunately attempted to treat the symptoms rather than find the cause. The water could have been from the 1930s leak or the erosion channels or both.

On July 31 2019 there was a massive overflow on the Aux spillway, only the fourth in its history. Erosion channels were finally widened and major flow under the concrete shifted some spillway panels. The much increased flow under the concrete crest then attacked the unprotected clay core. Many tonnes of shoulder and core from the dam were washed into the Goyt creating a huge hole which left the remains of the clay core in a dangerous unstable state. The school and town were at critical risk but saved from the breach because it stopped raining *just in time*. Chinook helicopters managed to create a temporary repair with 800 tonnes of a special grit and grout mixture in bags which supported the clay core whilst the reservoir level was lowered.

Obviously this old Dam has had a hard life. So it can be strongly argued that it must be rigorously assessed and its safety confirmed beyond doubt before it is operated at any Top Water Level (TWL) but especially at the maximum level as proposed in this application.

2)Choice of the new Top Water Level.

If a new reservoir with an earth clay dam were to be proposed in the same location in Whaley Bridge it would never be approved because of the obvious serious risks to the school and town. However the current intention is just to repair the existing reservoir by building a new overflow/ spillway system to replace the original overflow arrangements which were designed in 1830 to be managed by a resident warden. This was successful for the first 130 years until British Waterways recklessly removed the essential 5-6 ft. clay core safety margin from the dam and thereby destroyed its integrity.

But the major safety issue which must be paramount in the consideration by HPBC is not any (unlikely) flaws in the design of the new overflow system itself. It is the intention to construct the new overflow weir at the original height chosen in 1830. The main overflow weir determines the maximum height of the water behind the dam which is called Top Water Level (TWL). As a consequence, the load profile on the old damaged dam from the impounded water in the reservoir will be exactly the same in future as it ever was. Keeping the events of Aug 2019 fully in mind, the justification and risks of this decision must be critically examined by HPBC when considering the approval of a modern modification to be applied to an old existing system to make it function again at the full specification. In any other Engineering sector this is a practice that would generally be treated with considerable caution. HPBC may need to seek independent technical advice to assess the state of the dam.

What has been done to prepare the dam for re-use?

This question should have been answered in a comprehensive document submitted by the CRT with the application.

From the outset in Oct 2019, less than 3 months after the auxiliary spillway failure which caused massive damage to the dam itself, it was evident that the CRT intended to refill the reservoir to its original level without any evidence that the dam was undamaged and that it was safe to be loaded to the same height. A leaflet describing 'temporary work' was issued in Dec. 2019 at the Public Meeting in Buxton. In fact only one part of this work has been implemented, the Cut Off wall across the crest, which, due to obvious cost and duration of the work, is evidently anything but 'temporary'

So hidden in the 'temporary works' was the construction of a very permanent cut off wall which could not have been justified until the dam had been assessed and approved for maximum load. An expensive cut off wall at that height could only mean that the CRT has always intended to return the reservoir to the original level, only 2 months after the town and school were nearly inundated and 1500 residents had to be evacuated at 30 minutes notice for 10 days. If the TWL was to be lowered by around 1.5m then the cut off wall would not have even been required.

It is understood that subsequently various bores and ground penetrating radar (GPR) surveys have also been used to look through the concrete to assess the internal structure of the dam and detect any leakage. But the reservoir has been empty for over 2 years so the dam is neither wet (to be able to leak) nor loaded (to allow pressure measurements) so such investigations have considerable limitations. Also the GPR survey could not have been complete across the Aux. spillway particularly in the crucial area of damage where the bags were dropped. GPR imaging is also disturbed by steelwork in the concrete. All these technical investigations and limitations should be documented formally and presented with the application.

What has not been done to prepare the dam for re-use?

The downstream shoulder of the dam has not been exposed by removal of ALL the 1970s concrete nor have the emergency repair bags which are hiding the state of the near breach and are preventing inspection and repair.

The Application indicates the order of work. It is planned to construct the new overflow system first before all the redundant concrete of the Aux. Spillway system has been removed from the dam, before the 'sticking plaster' bags, the temporary repair of Aug. 2019, are removed, before the dangerous near breach hole is exposed, before the depleted clay core is actually inspected, before the cause of the 175 ft longitudinal crack across the crest panels is investigated, before the urgency to evacuate 1500 people from their homes at 25 minutes notice is confirmed by inspection of the state of the old dam.

Why is it important that the dam is modified and repaired first?

Obviously the state of the dam is fundamental to the safety for Whaley Bridge. Although some confidence has been built in the structure of the dam this cannot be complete until the whole downstream shoulder and damaged core is exposed by careful removal of all the concrete. Then all the repairs and reconstruction of the dam can be carried out. Simply put the state of the dam determines the safe height to construct the new overflow weir and that will not be known until the dam is exposed.

HPBC may know that there are 7 other earth clay dams that were recklessly modified in the 1970s with the same dangerous over crest auxiliary overflow. Toddbrook was the first, a very poor design not even constructed to the flawed specification. The identity of these dams has been kept secret by the Govt. since Oct 2019 despite FOI requests.

The expert Investigators have only speculated about how bad the Aux Spillway is, speculated about the extent of water erosion channels, the cause of failure and its sequence. There has been the opportunity to carefully remove all the concrete to confirm their theories (or not) but in 2.5 years this has not been done. The point is that there is unexamined evidence in the Toddbrook Aux Spillway System that is not only relevant to the safety of Toddbrook but also to the safety of the other 7 Dams. This means that careful, even forensic, dismantling of the whole concrete system is a very important priority task in its own right.

What are the weaknesses in this planning application ?

1) Overflow constructed at max TWL prior to Dam repair.

There is no clear statement in the submission that the original 1840 TWL is to be retained. Given that this has serious implications for the dam a document describing all the operations to assess and repair the dam should have been submitted. It was not. The design drawings submitted for approval simply describe an excellent new overflow construction to be set at a certain absolute height but with no obvious consequence or connection with the loading on the old dam.

The major weakness is that the HPBC planning team should have been guided to recognise that the Overflow Construction, however perfect it may be in itself, cannot be approved in isolation. It can only be approved in conjunction with an understanding of the state of the Dam itself and the profound safety influence of the height of the new overflow weir, which defines TWL and therefore the load on the dam.

2) Construction sequence.

The application says that the first phase will be to build the Overflow system and this will be constructed to provide the historic maximum TWL which cannot then be reduced. This means that it will be built first before all the redundant concrete of the Aux. Spillway system has been removed from the dam. Given the history of the dam summarised above, the construction of the Overflow system before all operations to

inspect and repair the dam are completed is the fundamental engineering error in this Project as submitted. It means that any defects, damage, leaks and structural faults in the old dam, which have not been detected or have been misunderstood, hidden or ignored for the last 52 years under the concrete (especially the crest), will be prevented from having any influence on the future operational TWL. Because, in the current plan, the TWL will already be defined by the overflow weir which will have been set permanently in concrete and steel....literally..... before the dam is fully exposed and inspected.

Exposing the state of dam shoulder, the clay core and its crest to daylight prior to any Overflow construction begins will certainly provide the opportunity for forensic inspection of the most damaged part of the dam and a complete Risk assessment. But in addition it will provide the opportunity to exercise sound engineering caution by lowering the TWL even if unexpected safety issues are not exposed on the dam. There cannot be any justification for the sequence 1)“Construct Overflow” followed by 2)“Repair Dam” as proposed, it is not logical and has profound safety implications.

Requirement for maximum TWL questioned.

This demand is made by the CRT who opposes any lowering of the Reservoir TWL. That is why the new cut off wall was installed (Jan-June 2020) so prematurely. This was constructed at maximum TWL having been designed just 2 months after the near breach in Aug. 2019. The Canal system is well served by supply reservoirs and conduits. Coombs was first to supply Marple locks in 1810 and that was when commercial canal use was approaching its zenith, creating a huge demand from Coombs to support the Marple Lock traffic plus general leakage and usage in the Macclesfield canal. Toddbrook was only completed by 1840 when canal use was rapidly falling into decline caused by railway expansion. So it can be argued that the modern recreational traffic (much less than the commercial traffic of the 1810-35 can be adequately supported by Coombs plus a somewhat lower but much safer Toddbrook.

Advantages of a lower TWL:- Safety for Whaley Bridge.

If the future reservoir level was to be lowered by as little as 1.5m, it would re-establish the original 1830 Dam safety margin of 5 ft. recklessly destroyed by British Waterways in 1970. This would bring the additional safety benefit of considerably reducing the pressure on the 180 year old recently damaged dam. There are obvious consequences which would increase the margin of safety for the school and the town.

- 1) It would reduce the risk /probability of breach because as the height of water is reduced the pressure on the old damaged dam is reduced considerably in proportion to the height squared.
- 2) But if a breach were to occur then the lower the reservoir the less energy and volume of water would be available to injure, kill and destroy as it rushed over the school and down the main street of Whaley Bridge.

- 3) The Primary school with up to 244 little children and perhaps 26 staff is about 350m directly from the toe of the dam and therefore directly in line of flow from a breach in the dam.
- 4) The children's playground in the Park is only about 50m from the toe.

Summary.

I have argued the case against the current application fully in the interests of increased safety for the children, the school, the residents and businesses of Whaley Bridge. The Safety of the community is paramount and if it cannot be achieved than the reservoir should decommissioned. I am sure HPBC can only agree.

The state of the dam cannot be excluded from the Approval sought for the new overflow.

The plan should be resubmitted to HPBC with the following modifications:-

All work on the dam, as summarised above :- careful and forensic removal of all concrete and bags, investigations of leaks, rebuilding the dam and repairs, load modelling to explore various TWLs must be completed, described in detail and submitted in a report with the revised application. This means that the dam must be completely repaired BEFORE Approval is sought, before any work starts on the new overflow system.

The overflow system specification and drawings should be revised to allow TWL to be set potentially lower than the current maximum. The desired TWL should be proposed with justification for the very safe Dam loading in the Dam Report given that the commercial/recreational requirement for max TWL cannot possibly outweigh the human right for community safety in Whaley Bridge.

A lowered TWL does not mean that the proposed design will not function it just means that the basic construction datum is lower by perhaps 1.5m. This ought not to change any details within the design itself.

The excellent new design is the result of efforts by a team of engineers supported by digital design drawing facilities so changes to the base datum of the proposed overflow should be extremely routine to process. It should not be argued that any resulting changes are too expensive or will cause delays. The max TWL design is premature, it is based on what the CRT wants rather than based on a confirmation of safety of the dam. Max TWL has pre-empted essential safety work on the dam which alone should define the safe TWL which may or may not be the max TWL.

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