

Repairing Toddbrook Reservoir.

To Rebecca Pow, Secretary of State MP, Robert Lagan, MP, David Rutley MP, Richard Parry CEO (CRT),

Summary.

This paper seeks support from the Government for active commitment to an integrated whole system approach to any modifications and repairs proposed for the Toddbrook Reservoir.

In Part B of his study Prof. Balmforth has carefully analysed the Safety and Operational Management of the Reservoir Sector from a starting point at Toddbrook and found many serious deficiencies in the laws and their loose interpretation especially in inspection procedures. The sector is not 'world beating', it is not 'second to none' as some might wish to claim. Prof. Balmforth made 22 recommendations for more immediate improvement in Part A of his Report which the Govt. has accepted. In Part B there are 15 much more fundamental and long term Proposals for the Sector for new major Legislation, Risk Ratings, Recruitment, Training, Standards and Safety, Inspection and Maintenance Procedures etc.

Although these recommendations are firmly endorsed by Ms. Pow nothing is likely to happen for many years, because the Govt. & Civil Service are overloaded with many other immense priorities, both self inflicted and natural, and Prof Balmforth's papers will therefore join the other valuable but sadly dusty recommendations for 'Modern Reservoir Practice' that have been largely ignored *in implementation* since they were written. The new Reservoir Management Act that both Prof. Balmforth and I have called for incorporating all these recommendations will not be drafted and rushed through Parliament for many years.

However it is encouraging that many of these radical recommendations fully agree with the my own independent conclusions from observations at Toddbrook (and other local reservoirs) over many years and from comparisons with the safety operations of other industries with dangerous infrastructure located in the public domain.

I argue here that we must apply the relevant recommendations to the repairs, modifications and operation of the Toddbrook System. Although it is very unfortunate that none of Prof. Balmforth's recommendations specifically recognise the most rare and most safety critical of all the possible scenarios...and the most relevant in this case..... that of the necessary procedures for rigorous safety assessment and potential repair of a previously neglected Reservoir with a failed 180 year old damaged High Risk Earth Clay Dam.

This assessment must include all the associated reservoir sub systems because their reliability and probability of failure combine mathematically to define the actual operational safety of the Reservoir System. It is astonishing that there is no evidence that the Sector views a reservoir as a large machine, a System of co-operating parts rather than just a Dam. This appears to be a fundamental weakness in the sector.

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Nevertheless the new recommendations do indicate the spirit of what must be done at Toddbrook in terms of evaluation of future RISK and therefore achievement of highest safety even, for example, at the minimal but justifiable cost of lowering the reservoir by 1.5m.

Ms. Pow asserts in previous replies to me that “the CRT owns the reservoir and is therefore responsible for it, including decisions about future works.” I absolutely disagree. That can only be true for certain ‘routine’ operational works on a reservoir system. The Toddbrook failure is far too rare and too dangerous, the necessary modifications and repairs are extraordinary and exceptional. It requires a fundamental re-assessment of the safety of the whole system which has been semi derelict for many years under two owners both financially supported by the Govt. (see photos GA2,3,4)

This is a Government rated High Risk Reservoir which has recently failed very seriously. The Government has already become inextricably involved by defining this risk category and supporting the subsequent crisis with troops and Chinooks. The Govt. also intervened in Sept 2019 by blocking FOI requests, on the dubious grounds of National Security, for the names of the other 7 earth/clay dams that had been damaged (probably by the same rogue Engineer) by installing over crest auxiliary spillways. We cannot have a repeat of 1970; the Govt. must take full responsibility for oversight and approval in this almost unique case.

The reservoir system has been damaged, by uncertain repairs (1980) to a long term leak (discovered in 1930,), by a dangerous and inept modification (Aux. Spillway) badly installed without independent oversight, by inadequate maintenance and lack of timely repair, by a near breach leading to emergency stabilisation with a dramatic bag drop. The village school, with its 244 little children and 25 staff is located 275m. from the toe of the 77ft. high dam, one of the oldest and highest of its kind. Fortunately this is a rare failure but we must actively ensure that the greatest expertise is available to support the safest repair and modifications at Toddbrook if it is ever to be reused.

The Government cannot stand aside. It must appoint its own critical Independent Engineers to approve or otherwise ANY proposals for an integrated modification plan to the entire Reservoir system. And this plan must start with the forensic removal of every piece of 1970s concrete from the Dam. It is fatuous to speculate, as the Expert Investigators have, about what might be under the concrete when it is so easy to remove it, given that, in any case, this must be the first crucial step to assess the damage caused by the Spillway Failure to the Dam.

However a huge design effort and cost has simply been devoted to a new overflow system that **will not be required** if the dam is proven unsafe. Only with prior forensic removal will the current structural safety and the necessary safety work on the Dam become obvious. Only then will the works deserve wide support from the Reservoir Sector, from Parliament and especially from the Community of Whaley Bridge, who, with their children and grandchildren and even great grand children are at mortal risk from a botched repair.

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Table 1: Safety Assessment & Technical Approval is required for the following integrated Plans and Procedures before any physical work commences.

TITLE OR PURPOSE	PLAN STATUS
DAM: Removal of all 1970's concrete and temporary bags. Assessment and repair of damaged structure. Installation of modern monitors. Decision on reservoir level. Public Access across the Dam Estimation of the safe future life of this Dam. Fundamental Safety Issue	No formal plan. Some structural studies done. Dam will have to accept Max TWL from new overflow
NEW DESIGN RESERVOIR OVERFLOW SYSTEM. Option chosen and description produced, design details not yet available. Decision on reservoir level required (TWL). Fundamental Safety Issue	Planning application into HPBC. Invalid max TWL defined prior to all Dam repair
DISCHARGE VALVES & CANAL FEED CULVERTS. Valves to be modernised, safer, moved ex dam, upstream hydraulic operation. Plus emergency discharge large dia.pipes into spillway. No 1 canal discharge culvert to be repaired. Deliberately blocked in 1990 reason then not given. Critical Safety Issue	These engineering upgrade intentions seem to be committed.
THE ABSTRACTION or PRIMARY FILL WEIR. Proposal to repair and operate this weir as the primary Fill Weir. The Operation and Emergency procedures must be described in the Toddbrook Safety Plan.	Intentions Unknown, not discussed.
HEAD WEIR, GATE CONTROLS. BYPASS & FEED CHANNEL. Sluice gate proposal Dec 2019, apparently abandoned. Critical Safety Issue	Intentions Unknown, not discussed
VEHICULAR ACCESS TO THE HEAD WEIR. Critical Safety Issue. Ref Aug 2019 emergency. Incredibly not on current plan with HPBC.	Critical Importance not recognised. Not planned
REDESIGNED OVERFLOW CONVERGENCE WITH THE RIVER GOYT. Critical Safety Issue. Ref. Aug 2019 emergency video evidence	No plan for redesign despite evidence !
PROTECTION FOR THE FERNILEE/ERRWOOD RESERVOIR DELIVERY PIPE. Very Critical Safety Issue.	No Plan. Not recognised as a very serious safety issue
INSTALLATION OF RAIN GAUGES IN TODDBROOK WATERSHED. Essential for flood management. Critical Safety Issue	Not even considered so no plans or intentions
1) OPERATIONAL MAINTENANCE AND INSPECTION PROCEDURES. 2) OPERATIONAL PROCEDURES PRIOR TO AND DURING FLOODS. These procedures must be written to utilise all the new and repaired system facilities in the list above. They should be submitted as part of the Safety Plan for Toddbrook.	No recognition of this requirement despite Prof Balmforth's two reports on deficiencies in Resr. Management.

It is essential that all the proposed designs are targeted at sustaining exceptional extreme floods at Toddbrook greater than July 2019 as videos show. Engineers must not be deceived by the normal modest flow of the Todd Brook. This table was updated after phone meeting (7 Dec 2021) with Mr Martin Hewitt, the appointed Qualified Civil Engineer (QCE) under the Reservoirs Act for Toddbrook.

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It is hoped that this document will be seen as a careful and positive contribution to the future safety of the Community of Whaley Bridge and its little School. Those in control must acknowledge that there is no way that a new reservoir would ever be approved in 2021 for this location if the old reservoir had not previously existed. Yet here we are trying to do just that but without any rigorous time tried official safety procedures and committed Govt. oversight. It is not just a case of major modifications to an old reservoir, it is a case of major modifications to an old reservoir now in the wrong place.

Toddbrook needs more than just a few repairs, it must have a whole system assessment, each subsystem must be updated and then managed and operated differently than in the last 50 years. It is an important recreational and healthy asset but it is potentially very dangerous as all reservoirs are. This document is my attempt to emphasise this paradox and to urge the WB Community, WB Town Council, the HP Borough Council, Local MPs, Ministers and Owners to take an urgent proactive interest in all the operations required to modify, repair and make safe the Toddbrook System. To ignore my recommendations could lead to a future catastrophe as Prof Balmforth bluntly emphasises on page 86 of his critical review (Part B):-

“The Environment Agency estimates that over 2.4m people in England are at risk from 2095 large raised reservoirs, most of which are currently designated as high risk. They present one of the largest threats to human life and property of any infrastructure sector in the UK.

The failure of a dam can lead to a sudden and large release of water which would be difficult for the population affected to envisage. The Toddbrook Reservoir incident in 2019 could have ended in disaster. Had the dam breached, and had this occurred at night and without warning, there would likely have been a significant loss of life.”

One could add if the dam had breached during school hours then there could have been a disaster far more catastrophic than the tragedy at the Aberfan school when, in 1966, 144 people died, 116 of whom were little children. The Safety of Toddbrook will be the legacy of all those in local and elected office who have the responsibility to ensure that the dam and every subsystem at least meets the critical safety standards outlined here.

Graham Aldred,
graham@sheardhall.co.uk

15 Sept 2021.

Cc. Prof Balmforth, Dr Hughes, Dr Mason, Dr. Tedd, British Dam Soc.
Local Community Groups, Local Individuals,

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1.0 Introduction.

The Overflow System proposed by the CRT addresses many of the issues I have identified in the original Overflow System, GA2,3,4 www.lymewood.co.uk

These will occur if Overflow is expected to function without the careful management of the warden which the reservoir had for the first 130 years.

Destruction of the 5 ft. safety margin of the dam in 1970 in order to add an appallingly dangerous concrete auxiliary spillway was not a solution for an unmanaged overflow system. Fifty years ago this destruction deliberately took the dam crest *below* top water level. Without any cut off, water progressively established erosion channels under the concrete with obvious cross dam leaks apparently not visible to the Inspectors during 50 years. This led directly to serious damage to the Dam in 2019.

However my major concern is the unknown integrity of the old damaged dam because a new overflow system (£14M- £20M?) is irrelevant and will not be required unless the dam can be independently proved to be safe beyond any reasonable doubt.

To date the focus has been on the revised overflow system and all its *thirteen* options. However there are several other major safety critical systems which are inter-dependent and which impose mutual constraints. Therefore an integrated Safety and Modification Plan must be produced for the whole Reservoir System, (see *Table 1*) most especially for the Dam itself, but also the Head Weir Control System, the Canal Supply System and River Goyt Discharge System, Automated Monitoring including the extensive Watershed. The safety analysis of all these facilities acting together will define the operational safety of the High Risk Toddbrook Reservoir System if and when these revisions are approved. The following paragraphs provide more details on the logic of this necessary approach to Safety at Toddbrook.

2.0 Planning Permission and Independent Safety Assessment.

It is encouraging that the CRT has at least acknowledged the requirement for planning permission for the revised Overflow System. I have called for the full Planning & Safety process in the four papers I have written since Sept.2019. Ref. www.lymewood.co.uk It is vital that in 2021, unlike 1970, the safety of this High Risk Reservoir is widely underwritten both by named Independent Engineering Experts and Secretaries of State. By comparison in 1970 the destructive and dangerous auxiliary spillway was only approved by the Owner, British Waterways, and their favourite subcontractor. The incorrect claims for compliance and safety made by the unnamed Inspecting Engineer in 1970 have been exposed by Prof Balmforth, by Dr Hughes and by me in our several recent reports. (Ref. www.lymewood.co.uk)

Given that this is a very rare civil engineering re-construction project with the highest Public Safety implications for the school and town, we expect that rigorous planning and safety assessment procedures will be followed. (*Even although they are not defined anywhere yet !*) This means public notification of the planning submission and availability for public inspection of copies of all the documents submitted with time and opportunity for issues to be raised by the Public at the Planning & Safety Enquiry. The documents should be available for inspection in a suitable public building in Whaley Bridge because that is where those most at risk live and work.

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Although there are commendable proposals to reinstate the park and playground after the major overflow work is completed, approval for that is of minor importance and well within the scope of any local planning office. However approval of the engineering functionality and safety of the renewed Toddbrook Reservoir System will require rare and robust reservoir engineering safety qualifications unlikely to be found in any County Planning Department. This very necessary support for the planning authority should be funded by the Govt. It must be independent of the Owner (CRT) and his contractors (ARUP) and or KEIR if the near catastrophic events initiated in 1970 are not to be repeated. The proposals for the whole system must be independently peer reviewed and must fully include all the relevant recommendations given in both parts of the review of reservoir safety by Prof. Balmforth.

All of the engineering details, design calculations and risk assessments of the proposed modifications to the Toddbrook Reservoir System should be submitted at the same time for Planning Permission and Safety Authorisation. The overflow redesign proposal can only be assessed with all the other remedial work that is required on all the other sub-systems. This safety approval process cannot possibly be piecemeal.

The focus should be on the Engineering Integrity of the whole system as indicated above, including the extent of major modern monitoring in the dam structure and the proposed emergency operational procedures when an extreme flood is anticipated and/or is in progress. These did not exist in August 2019; there was no precautionary discharge management in the days prior to the event. The Assessment must be driven by RISK, it must be aimed at the overall safety for the School and Town. This is what I would expect for safety approval for major repairs to and reconstruction of one of the oldest most dangerous High Risk reservoirs in the country.

3.0 Temporary Works and the Future Reservoir Level.

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 had decided 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, which, due to obvious cost and duration of the work, is evidently anything but 'temporary'.

This Cut off wall would not be required at all if the future reservoir level was to be lowered by as little as 1.5m, which is sufficient to 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. The pressure on the (*damaged*) upstream face increases by the *square* of the depth of the water.

So hidden in the 'temporary works' designed in Oct. 2019 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 a given 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.

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This cut off wall was specified before any engineering assessment could have been made of the structural safety of the dam, before any load modelling had been carried out, before both Expert groups had even started in their investigations, before the essential and forensic removal of the whole spillway structure, including the crest panels. Such is the lack of engineering curiosity about the state of the most vulnerable section of the damaged dam that the concrete is still in place 2 years after the event.

2.0 The Safety of Toddbrook Dam.

There are major concerns for the current safety of the dam structure, particularly the most damaged, the most vulnerable and heavily loaded part which has not been seen investigated or maintained for the last 51 years. The history of leaks outlined below shows that there is no conclusive evidence that the leaks, first identified in 1930, were actually ever successfully repaired. The following two sections should convince readers why they should be concerned about safety of the dam.

2.1 History of Dam Leaks

Quotations in italics from "Lessons from Historical Dam Incidents. 2011" Defra. Charles, Tedd, Warren, regarding the Toddbrook Dam. Dr.Tedd was also a member of Prof. Balmforth's Team.

1930 Leak was observed in the Dam toe downstream. Reservoir drained, matching depression in the upstream shoulder of the dam was found. Repair attempted 1931.

1969-70. As confirmed by both Expert Reports (2020), the badly designed Auxiliary Spillway, which destroyed the clay core safety margin and did not provide any form of cut off, was also badly constructed. The work removed thousands of tonnes of structure and created two unblocked dangerous cross dam paths (for the abutment walls), well below Top Water Level.

(Note that the following investigations were then compromised by the concrete spillway and the much modified LH side wall which prevented investigative access to leaks in the downstream shoulder.)

November 1975. When the reservoir was low, a depression was noted in the same position on the upstream face as the 1931 depression.

In Autumn 1977, 120 mm of subsidence was measured since 1975. The reservoir was emptied to inspect the full extent of the depression and revealed:- a crater approximately four metres across at the upstream toe partly in filled with silt and into which a tree appeared to have been sucked.

Investigations 1978-80. Extensive investigation included boreholes, sampling and piezometers. Exploratory shafts were sunk on the upstream and downstream faces between 1978 and 1980. In 1981, a 1.2-m diameter masonry culvert was found beneath the dam, possibly for stream diversion during construction. Tracer tests showed this to have formed a leakage path through the dam.

Remedial works In 1981, A compacted clay blanket was placed over the suspect area of the upstream toe and the bed of the reservoir. To solve the leakage problem, a single row grout curtain 60 m long within the clay core was formed using the tube-à-manchette system. The reservoir was refilled in December 1983.

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Note that it took 53 years to *possibly* resolve the problem in the dam first noticed in 1930.

From 1981 to 2007. The recent expert reports record the attempts made to provide drainage and pressure release for water that was flowing under the concrete spillway, the source could never be investigated and the drainage and relief 'fixes' were not documented for future maintenance so they soon became ineffective. With the concrete spillway in place and without monitors it could not be known if the dam itself was leaking, especially at the cross dam abutment wall footings, or if the flawed spillway design and construction failures were the cause...or both !

March 2019. As a result of the very critical findings of a "10 year" Inspection (Nov 2018), the CRT chose to downgrade the 'condition' of the Dam from "Fair" to "Poor". This meant that the probability of a serious dam event was increased but was still conveniently 'in' the next 5 years rather than 'in' the next 10 years. Unfortunately it was a paper exercise and it did not result in any immediate precautionary safety measures.....for example ...drawing down the level 2m below TWL which would have avoided the August collapse.

This is a serious flaw in reservoir safety not identified by Prof Balmforth. The Inspecting Engineer should have the authority to grade the condition and order a cautious action, it should not be the Owner's choice. For comparison: The Truck Owner does not grade the 'condition' of the brakes at the MOT, the Govt. approved Inspector does that. !

This vulnerability was confirmed dramatically in July-Aug. 2019 by the massive failure of the auxiliary spillway which considerably damaged the dam and depleted the clay core at the LH end beneath the abutment wall where the dam has always leaked under the crest. I have actually seen water driven under the crest panels, pulsed in time with the waves, and out onto the downstream chute a number of times in recent years. Dr Hughes physically measured a 100mm slot under the LH crest panels, photos show wet chute panels. So it is astonishing that the alleged level of twice weekly inspection by 'trained staff' for 50 years has never recognised this evidence of potential failure.

2.2 The Event

The structural state of the 180 year old Dam for future loading was unfortunately outside of the scope of recent Expert Investigations. However in Jan 2019 significant subsidence on the crest was detected by satellite at the weak LH end where the near breach occurred. There is no explanation for such a specific and expensive survey. Our MPs ought to be very curious. Who ordered it ? And Why ? Seven months before the near breach ? Who knew about the result ?

In Jul-Aug 2019, 800-1000 tonnes of clay core and embankment earth were dramatically flushed away by erosion channels under the concrete spillway and under the LH side wall. In response, 800-1000 tonnes of stone and other material had to be dropped by helicopter in great haste into the exposed cavity in the dam. This was crucial to very urgently stabilise the dam physically to prevent a breach of the then unsupported clay core until the reservoir could be lowered. This was not a carefully designed long term repair to a High Risk dam, it was an urgent emergency 'fix' which cannot be allowed to remain as a long term engineering solution to the dam structure.

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Subsequently Dr. Hughes attempted to make a 'hands on' practical investigation of conditions at the crest where there never had been a 'cut off' since 1970. However his report shows that he was prevented in this by other simultaneous conflicting activities by the CRT which should have been deferred in his favour. Nevertheless he found a considerable gap under the Crest panels and reported many cracks in the crest apron.

He confirmed the 190 ft. longitudinal crack that I reported in (GA2)). This crack crosses 75% of Crest panels, very significantly crossing their boundaries in exact alignment. This evidence suggests serious subsidence and erosion damage of the whole downstream crest edge of the dam under the Apron. It is very probable that the under-crest panel gaps are enhanced by the physical support provided by the leg flanges of the footbridge which all span two adjacent crest panels and thus hang the panels from the footbridge whilst the gap underneath is enhanced by natural subsidence and the depletion of the crest material by water erosion. This will be confirmed when the concrete is removed and is a major reason why that should happen.

It is astonishing that the cause of this sinister crack across 75% of the Apron has not been carefully investigated by removal of all the 1970s concrete and the cross dam footbridge. After nearly 2 years none of these concrete structures have been removed to expose the damaged state of the Dam crest caused by 50 years of leakage (Ref Dr Hughes AH1) and exacerbated by the massive near breach in August 2019. Instead an alleged "temporary" cut off wall has been constructed in a slot cut across the entire Crest which now impedes (*but must not prevent*) any assessment of the state of the upstream crest edge of the dam which has been progressively and invisibly eroded over the last 50 years.

2.3 The Dam Repair Plan

This High Risk dam must be repaired using a properly engineered risk assessed solution because the actual state is currently unknown. The safety calculations, load modelling and specification for all work on the dam itself must be included in the Reservoir Repair Plan to be submitted for Planning, Construction and Safety Approval.

The plan should specify the forensic and analytic removal of all the Auxiliary Spillway structure, footbridge and crest panels which are currently hiding the degraded state of the dam especially at the crest. This must be under the operational control of an Independent Govt. Engineer. The operations on the dam itself should be carefully defined in the plan without ambiguity. In particular it must describe the removal of the bags which were just a 'sticking plaster' fix not designed to ensure the future long term safety of the dam at any loading especially maximum.

In order to meet the recommendations of both Prof. Balmforth's reports for Public Safety and its collective responsibility by the Owner and the Govt., we will expect that the specific Dam Assessment and Repair Plan will define the forensic removal of everything constructed on the Dam from 1970 onwards including the removal of all the emergency bags and other stuff dropped in haste in 2019.

These are:- Cross dam abutment walls, side walls, all crest panels, all chute panels, cross spillway footbridge.

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The careful and forensic removal of all the 1970s structure and all the emergency bags is necessary because this will then allow the crest and downstream shoulder of the dam to be properly inspected for the first time in 52 years and the full extent of the erosion channel damage plus other dam defects to be visible. It will also reveal why and how the spillway failed. It must be remembered that there are 7 other 'Govt. Secret' Dams that may share the same defects, obvious when Toddbrook is exposed and analysed. The structural safety of the dam for future use cannot be verified until this is done. This was a 'near miss' (*Ref. Dr. Tedd*), many people and children could have been killed. The evidence is still there and it must be treated as an accident site and investigated with archaeological patience.

3.0 The Abstraction Weir.

The Toddbrook filling operation has been misunderstood at least for the last 30 years. The so called Bypass channel is in fact the Primary Fill channel and it should be run at high volume. The Abstraction and Fill should take place as designed by John Wood on the side of this channel at the currently neglected Abstraction Weir, close to the Dam, midway between the Warden and Managers houses and therefore originally much more convenient and precise for regulatory adjustment.

This Abstraction Weir is an impressive heavy masonry step structure fitted with four pairs of slots to accommodate planks and a fixed stone blocking weir in the main channel to provide a weir head (this was smashed out in the emergency to increase the Bypass flow). Its pre event state was that of long neglect, three of the 4 weirs inoperable, blocked by accumulated mud banks and debris. The low volume Bypass struggles past on its way to the Convergence Basin just downstream and then into the River Goyt.

I suggest that in the original design the large weir at the head of the reservoir (very often dry) is in fact an emergency discharge weir to pass any water, which would otherwise overload the Bypass, directly into the upper reaches of the Reservoir. It is not a primary feed weir. Its wide throat is deliberately raised by at least 0.4m to ensure that all the normal modest flow of the Todd is totally available for diversion into the Bypass (& Primary Fill) Channel. So the Bypass gate should be wide open, hitherto in the last 30 years it has been virtually shut with large mud banks blocking the direct flow of the Todd into the Bypass culvert which sent water over the large weir.

It is recommended that the Fill Operations should return to the method designed by John Wood and make full and proper use of the Abstraction weir which should be kept in a careful state with 100% availability of the four slotted weir edges. It is possible that the CRT could have been entitled to abstract much more water if this weir had been maintained and operated properly.

4.0 The proposed Head Weir Sluices and Bypass Channel

A scheme to install blocking at the neglected head weir with automated sluice gates was described in a CRT leaflet in Dec.2019. Work was supposed to start Q1 2020. The sluice gates would have had to provide a 'dam' about 1m high with sufficient strength to retain a new wide "flood pond" extending 400m. upstream to Kishfield Bridge. This proposal appears to have been abandoned.

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Therefore a new modification plan describing the water management at Head Weir and the Bypass flow capacity is required as part of the System Repair Plan. The Bypass channel capacity was shown to be inadequate in Aug 2019, thousands of sandbags were required to prevent overflow from its sides into the reservoir (and are still in place but this cannot be the final solution). The Bypass & Feed Channel is another component of the Safety System and actions to remove its limitations must be addressed in the Toddbrook System Safety Plan.

5.0 The Discharge Valves and the Culverts.

Some revisions are planned because the valves are to be replaced and modernised. The valves will be moved upstream and be hydraulically operated from the dam not from the valve houses. The cast iron pipes that pass under the dam clay core received an internal anti corrosion and smoothing coating in 2009. The pipes feed into a pair of open culverts which were designed to discharge to either the Canal Basin or the River Goyt, switched by selection of blocking planks in side slots. Over time these facilities have been crudely modified, been broken or fallen into disuse. The intake pipes is arranged at two heights, No.1 is main supply of cleanest water, No. 2 the is much lower scour pipe. No. 1 feed to the canal was deliberately blocked in 1990 so the canal can only be fed by the lower more muddy scour No. 2 inlet. It is now planned to repair this problem.

The repairs and modifications to the canal feed valves & culverts should be described in the Reservoir System Safety Plan. The current Reservoir Act requires the valves of High Risk Reservoirs to be fully opened and the discharge options, both to Goyt and Canal, to be tested every six months. In an emergency, (as on 31 July 2019) if water is just below TWL, the culverts are the only way to lower the pressure on the dam.

6.0 The Head Weir Vehicle Access.

For the last 6 years I have documented (to the CRT) my serious safety concerns about the impossibility for vehicular access to the Feed Weir in an emergency. These concerns were ignored by the CRT. However the validity of my foresight was confirmed on Aug.1 2019 when 100-200 (?) troops had to come from miles away to hand carry sand bags, materials, equipment and tools to the Feed Weir, a mile upstream using the only narrow footbridge accessible from the road.

After some days additional haulage was provided by an expensive Chinook helicopter to bring gabions of aggregate to block the main weir (which has no operational means of flow control). This dangerous deficiency of vehicle access was criticised and described in the 2020 July Web Seminars by the Engineer in Charge. His task was to divert the critical flow at the weir, a mile upstream, at night, no lights, in order to save the dam and therefore the town. In 8 years of tenure by the CRT this safety deficiency was not even recognised in the 16 Supervising Engineer inspections, by the single '10 Year' inspection and 400 'site visits' by 'Trained Personnel' which should have taken place under the Reservoir Act. During that period the neglect and derelict state of the feed weir, the ineffective control gate and blocked channels were never recorded let alone maintained.

The CRT cannot rely on the Army and the Royal Air Force to be available on call. Consequently, in the new Reservoir Plan, the existing vehicle track to the feed weir must be provided with service access for emergency and maintenance vehicles to drive

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from the road. With the proposed demise of the current overflow arrangement a vehicle route can now easily be devised especially if the TWL is lowered by 1.5m.

We will expect that this safety requirement for vehicular access to the Feed Weir will be recognised in the Plan and that a solution will be described in the construction documentation submitted for Planning and Safety Approval.

7.0 Convergence with the River Goyt.

The overflow discharge is still shown joining the river Goyt at right angles in the new Overflow Proposal. This will cause astonishing hydraulic chaos as the videos of 2019 showed. It is very unfortunate that nobody has bothered to study how Todd Brook and the overflow channel behaved then. This inept convergence takes place 200m. from the School. The Toddbrook overflow discharge has to be engineered and aligned to converge with the river flow not to oppose it. In any future extreme event the volume and rate of discharge attempting to converge with the Goyt will be the same as 31 July 2019 or greater, volume and rate will not be changed by the design of proposed new overflow system. In fact it will be greater because the new overflow design because Bypass flow does not block reservoir overflow.

7.1 Blocking the Randal Car Brook.

This opposing discharge actually caused the river Goyt to back up (!) which in turn blocked the Randal Carr brook discharge, (bringing the overflow from the CRT's Coombs reservoir) which in turn led to damage to the embankment supporting houses at Horwich End just off the A5004. The CRT may remember spending several months repairing this damage.

Therefore a proper directional hydraulic convergence of the overflow for the maximum discharge with the Goyt which does not oppose the river flow should be engineered as I have described in much more detail in GA3.

8.0 The Errwood Fernilee Drinking Water Supply Pipe.

A large (20 in?) exposed unprotected unsupported steel pipe crosses the Toddbrook overflow stream (only 2ft. headroom) just before the stream discharges into the Goyt, at the memorial footbridge in the Park. This pipe is the main output from the Fernilee & Errwood Reservoirs about 4 miles up the valley. Therefore it carries enormous energy at very high pressure and with an immense rate of flow if it were smashed or disconnected. Emptying Errwood & Fernilee reservoirs into the Park below the Dam at Whaley Bridge, next to the school, with the Toddbrook Dam within critical breach would have been a catastrophe beyond reasonable imagination.

Sometime during 31 July 2019 a huge tree trunk 25 ft. x 24 in. dia. perhaps 2-3 tons was carried at speed in the wall of water from the aux. spillway towards the pipe and bridge. Fortunately it turned longitudinally across the overflow stream and rammed into some side steel railings, it bent them into hoops and got stuck but was thus prevented from ramming the supply pipe end on with the same energy as a huge battering ram. The tree remained in place for many months, the bent railings still provide the evidence of the energy of impact. Engineers designing the very necessary intelligent flow convergence at the Toddbrook discharge to Goyt must address the proper safety protection of this pipe and share this frightening safety problem with United Utilities or whoever is responsible for Errwood & Fernilee Reservoirs.

Repairing Toddbrook Reservoir.

9.0 Watershed Rain Gauges.

The Toddbrook watershed is about 16.8 sq.km in area. It lies roughly parallel (NS) with the Goyt Valley watershed. Its section, south of Kettlethulme, has a wide marshy bottom which does retain rainwater initially. However the section north of Kettlethulme has steep sided hills with not much floor for retention so water is quickly discharged into the Todd and its tributaries to arrive at speed at the Head Weir. It is in this section that three roads and bridges were seriously damaged In July –Aug 2019. Also at Reeds Bridge a local man was drowned when his car was washed over the parapet in 2009. Engineers must design not for the modest trickle but for the rare but extreme flood.

The time between high water at the head weir and previous rainfall can vary between a few hours to more than 24 hours, which appears to confirm the varied flow response of this watershed. Toddbrook Reservoir safety management must not rely on the solitary Cat & Fiddle Rain Gauge which serves the Goyt Valley which is definitely a different watershed. Its readings did vary considerably (less) from the northern Toddbrook catchment as the records of local climatologists show for Aug. 2019.

In order to manage the safety of the reservoir system it is necessary to have the earliest warning of the potential high flow at the Head Weir. Therefore I strongly recommend that several automatic wireless rain gauges are installed in the Toddbrook Watershed so their data can be used at the Toddbrook Flood Management Centre.

Graham Aldred,

15 Sept 2021.
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