

Session 1

KEYNOTE SPEECH & ENVIRONMENTAL CHALLENGES

Sustainable or senseless? Global lessons from dam building - D Fleming (WWF-UK)

Haweswater Reservoir: an environmental asset or an environmental liability? - P Rigby and A Thompson

Operation Triton - D Hall

Discussion



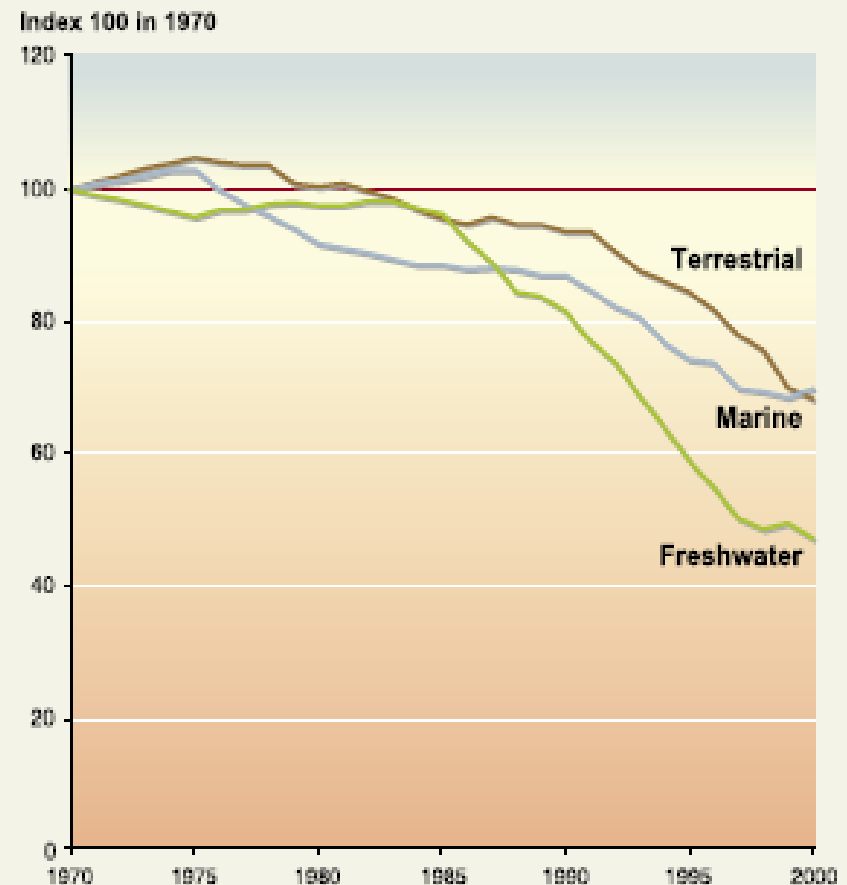
19TH BIENNIAL CONFERENCE OF THE
BRITISH DAM SOCIETY

Sustainable or senseless? Global lessons from dam building

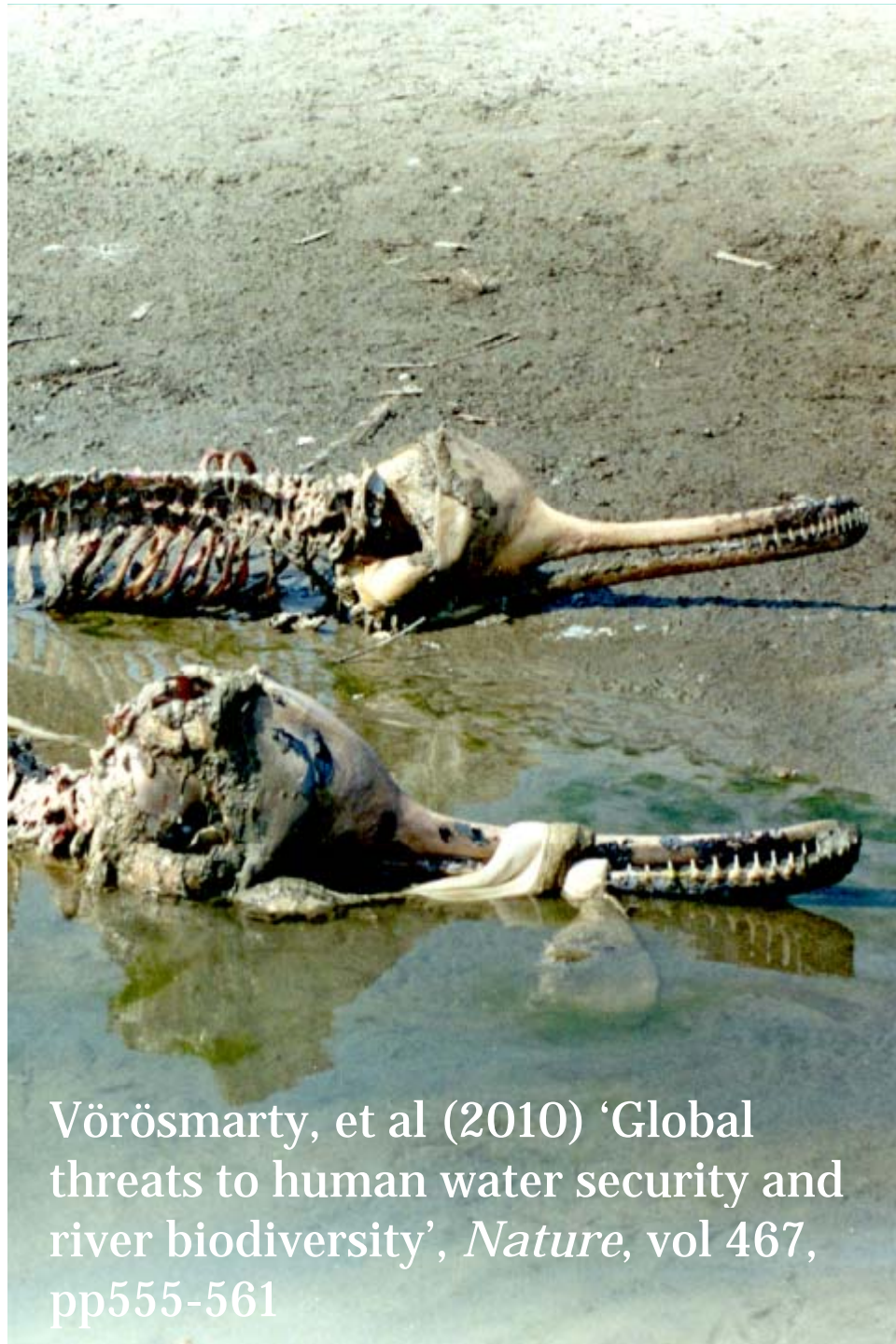
SEPTEMBER 2016



Figure. TRENDS IN FRESHWATER, MARINE, AND TERRESTRIAL LIVING PLANET INDICES, 1970–2000



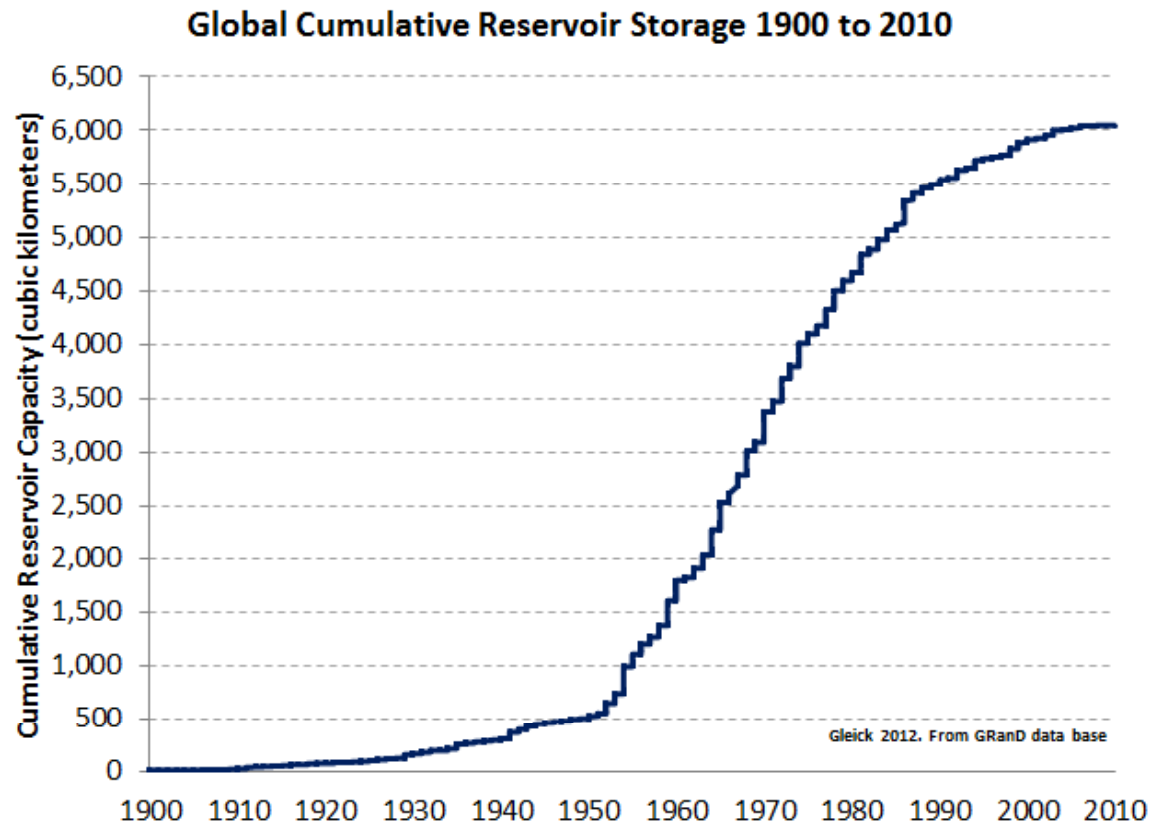
Sources: World Wide Fund for Nature and UNEP World Conservation Monitoring Centre

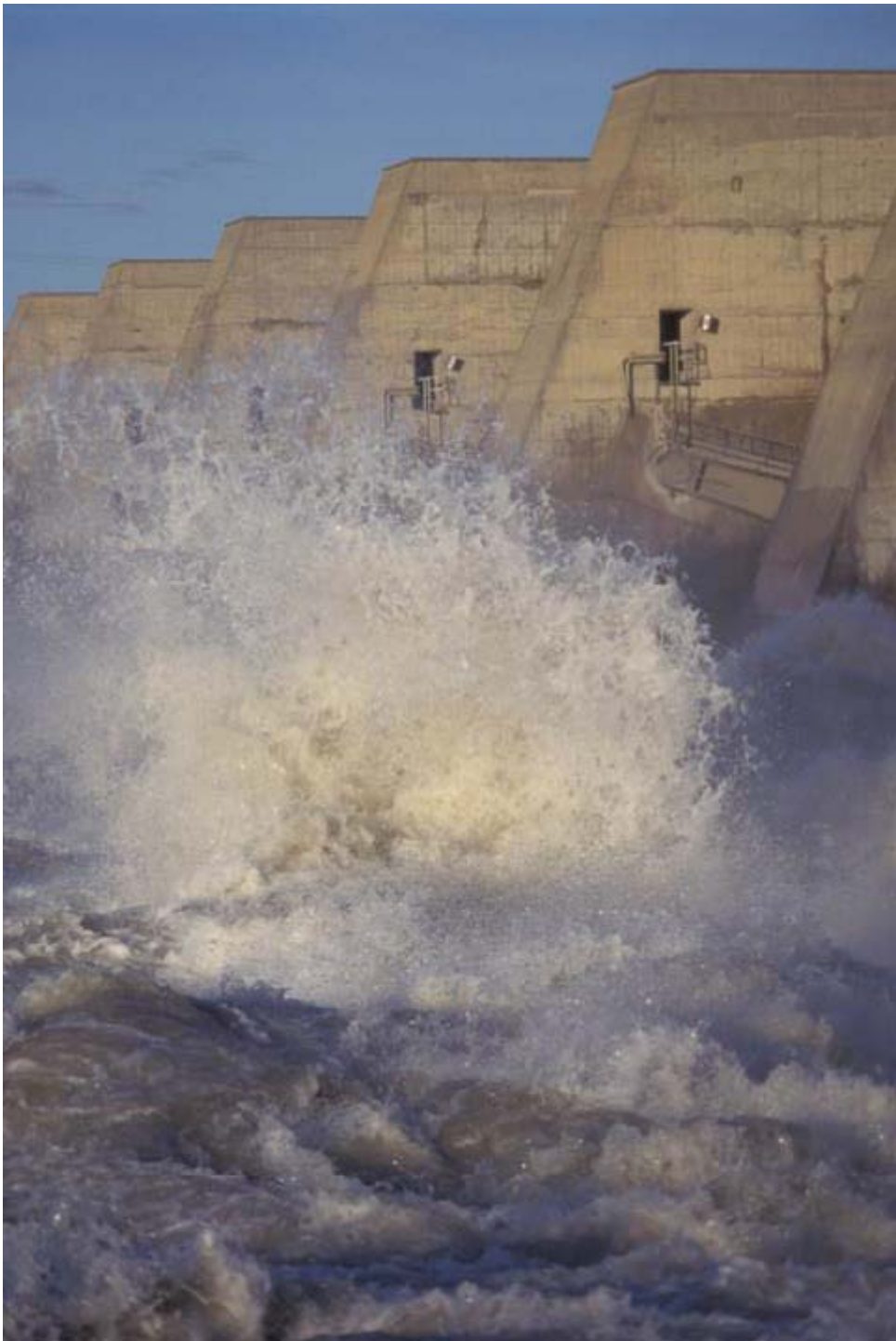


Vörösmarty, et al (2010) 'Global threats to human water security and river biodiversity', *Nature*, vol 467, pp555-561



A SECOND WAVE OF DAM BUILDING?





- Increase in irrigated food production
- Increase urban water supply
- Provide 'clean' energy



- Human displacement
- Loss of ecosystems
- River fragmentation
- Flow regulation
- Sediment transport
- Indirect impacts –
transmission lines, social



- Building on the wrong river
- Neglecting downstream flows
- Neglecting biodiversity
- Falling for bad economics
- Failing to acquire a social license to operate
- Mishandling risks and impacts
- Bias to build



Solutions

BASIN SCALE STRATEGIC PLANNING

<https://www.youtube.com/watch?v=xGN42lj5ctk>



BEST IN CLASS PROJECT PLANNING





The saddest aspect of life right now
is that science gathers knowledge
faster than society gathers wisdom

Isaac Asimov
Russian-American writer



**DO IT
FOR YOUR
PLANET**



Haweswater Reservoir: an environmental asset or an environmental liability

Pamela Rigby and Andrew Thompson

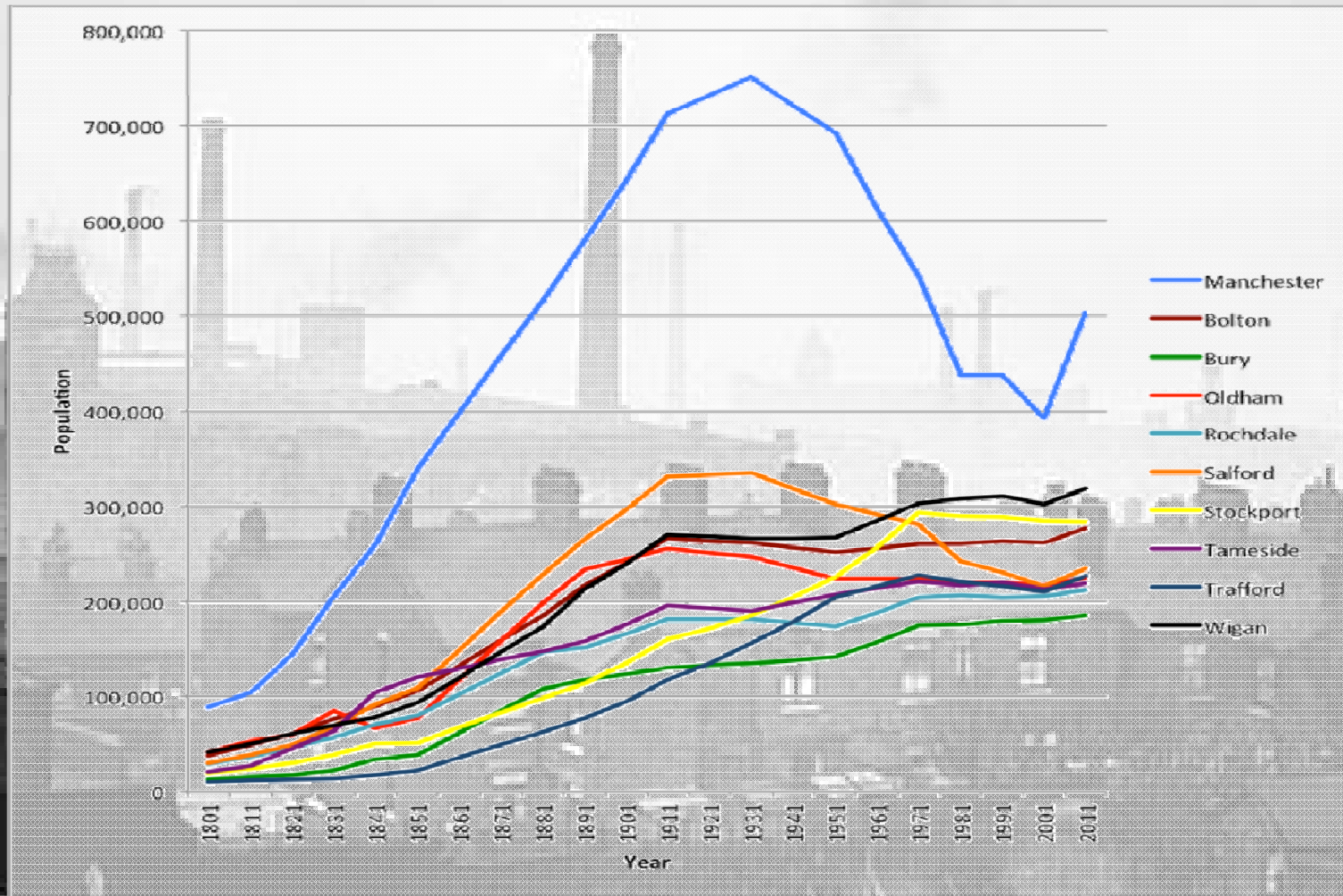
Agenda

- Demand for water
- The Haweswater Act of 1919
- Benefits and Disbenefits
 - Dam construction
- An Asset or Liability?
 - Present Considerations
 - Future Considerations

Population Growth in the Manchester and surrounds



Population Growth in the Manchester and surrounds



Demand for Water

- Industrial Revolution
- Urban explosion migration from country to town
- Exponential increase in water demand driven by:

Increasing populations

Industrial growth

- Water borne sanitation
- Prolific dam building 1850 to 1890s (Bateman and Hawksley dams) but could not match the growing demand.
- In 1878 Manchester Corporation turned its attention to the Lake District.....

CHOLERA DISTRICTS.

LOOSENESS of the BOWELS is the Beginning of CHOLERA.

Thousands of Lives may be saved by attending in Time to this Complaint, which should on no account be neglected by either Young or Old, in Places where the Disease prevails.

When CRAMPS IN THE LEGS, ARMS, or BELLY are felt, with LOOSENESS or SICKNESS AT STOMACH, when Medical Assistance is not at hand, *Three Teaspoonfull of MUSTARD POWDER in Half a Pint of warm Water*, or the same Quantity of warm Water with as much COMMON SALT as it will melt, should be taken as a Vomit; and after the Stomach has been cleared out with more warm Water, TWENTY-FIVE DROPS OF LAUDANUM should be taken in a small Glass of any agreeable Drink.

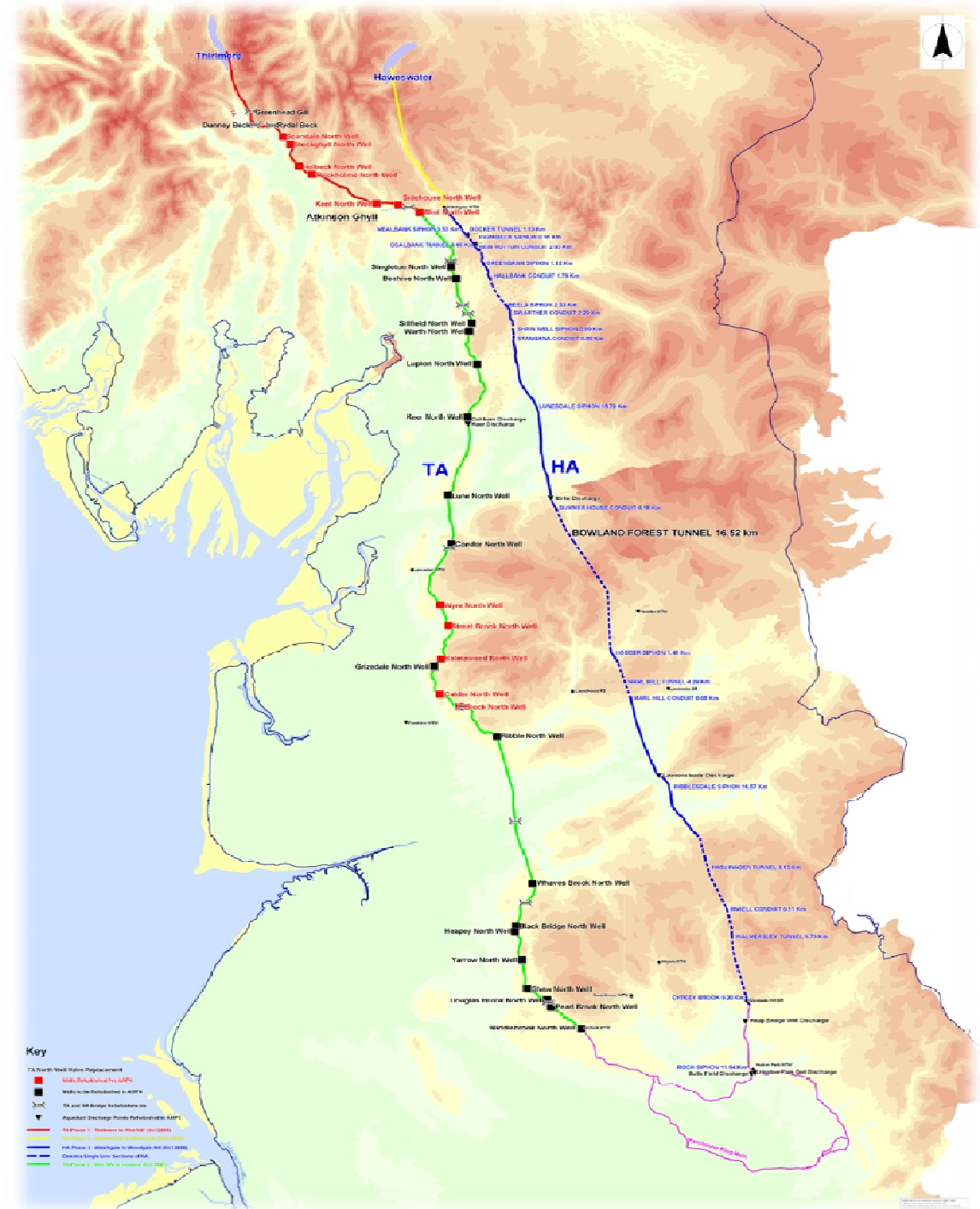
HEATED PLATES or PLATTERS to be applied to the BELLY and PIT of the STOMACH.

As Persons run considerable Risk of being infected by visiting those suffering from this Disease in crowded Rooms, it is most earnestly recommended that only such a Number of Persons as are sufficient to take care of the Sick be admitted into the Room.

Central Board of Health,
Council Office, Whitehall, 15th Feb. 1832.

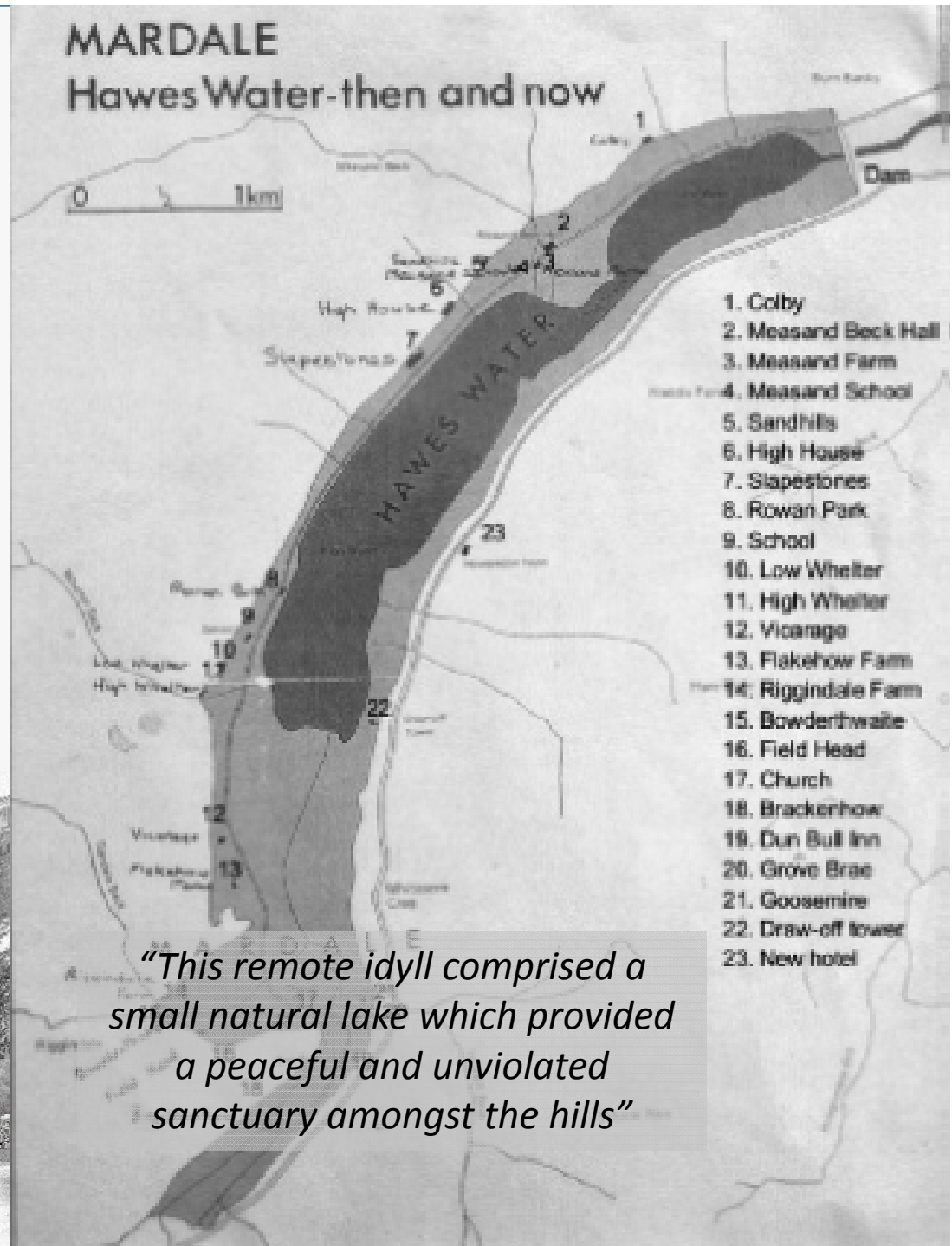
W. MACLEAN, Sec^r.

The Haweswater Act of 1919 Manchester Corporation had permission to acquire the Mardale valley and adjacent catchment to construct a new dam and impounding reservoir



The controversial proposal was challenged by Lancashire County that the an upland catchment be treated as a national trust.
(status gained in 9th May 1951)

Originally a natural lake 4km long within the farming villages of Measand and Mardale Green



Impact of the Haweswater Act 1919

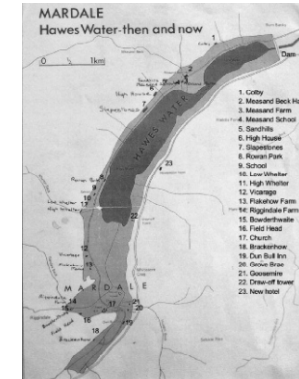
Benefits

- Secure supply of water to Manchester area
- Scheme provided local jobs



Disbenefits

- 100's of Inhabitants moved
- Water not for local consumption
- Flooding of the valley
- Loss of farming land and environment
- Mardale village was “blown up” by Royal Engineers





Dam Construction



Dam Construction

- First buttress dam of its time built in UK
- 470m long, 33m high comprising 44 concrete buttresses
- Engineer for the scheme Mr Holme Lewis
- Commenced in 1929 – ongoing public outcry
- Excavations to rock 16 to 35ft bgl
- Grouting required at base of cut off trench
- A Sustainable Approach
- Dam constructed using direct local labour
- Innovative design – buttress approach
 - Reduced uplift pressure ensured efficient use of materials
 - 27% saving in materials compared to gravity dam
- Materials locally sourced
 - 140,000 cu yards of concrete
 - 30,000 tons of cement
 - 190,000 tons of stone
- Visual aesthetics considered – simplicity of form and line



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Present Considerations



Present Considerations

Environmental asset or an environmental liability?

- Lake District attracts over 16 million visitor/year
£1,140 million into local economy
Considered one of Cumbria's iconic lakes
An area with diverse flora and fauna
- UU managing impact of tourism
£40,000/year working with RSBP on Sustainable Catchment Management Programme
Aims – improve water quality
Sustainable future tenant farmers
Manage long term climate change
- Climate Change
Droughts and Floods

Future Considerations

Has the view on Haweswater changed since 1919?

- Considered one of Cumbria's iconic lakes
- An area with diverse flora and fauna

Would we ever even consider a discontinuance and return to a 1919 landscape

Resource Needs v Ongoing Maintenance and Operation

Requirements to ensure resilience

Recent correspondence.....

“Fiercely opposed by the local community and beyond ..wish to maintain the reservoir and its surrounding area as a place of outstanding natural beauty. Without the reservoir the area would lose its magic”

Are customers prepared to pay?

Opportunities around management of water stocks

Photo – Hurst IR Discontinuance

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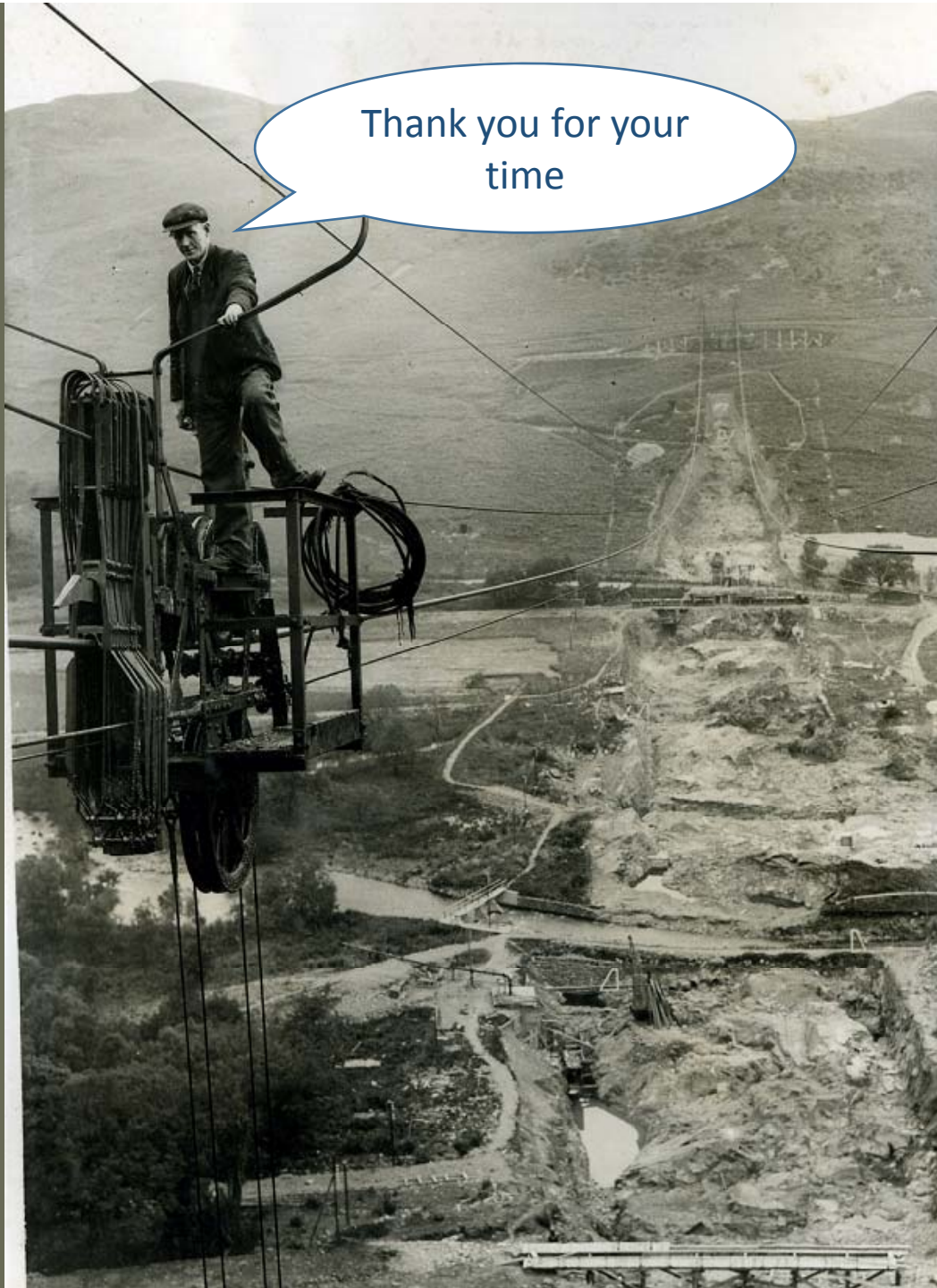


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Thank you for your
time



Exercise Triton



Duncan Hall

The image shows a scenic view of a large reservoir surrounded by lush green hills. In the foreground, there are tall, dry grasses and some green foliage. In the middle ground, a small, circular stone structure, identified as Duncan Hall, is visible on a grassy slope overlooking the water. The background features rolling hills covered in dense forests under a cloudy sky.

Triton: Greek Mythology

- Triton was the son of Poseidon and Amphitrite, god and goddess of the sea.
- He was the messenger of the sea and is usually represented as a merman.
- Famed for his twisted conch shell which he blew like a trumpet to calm or raise the waves.

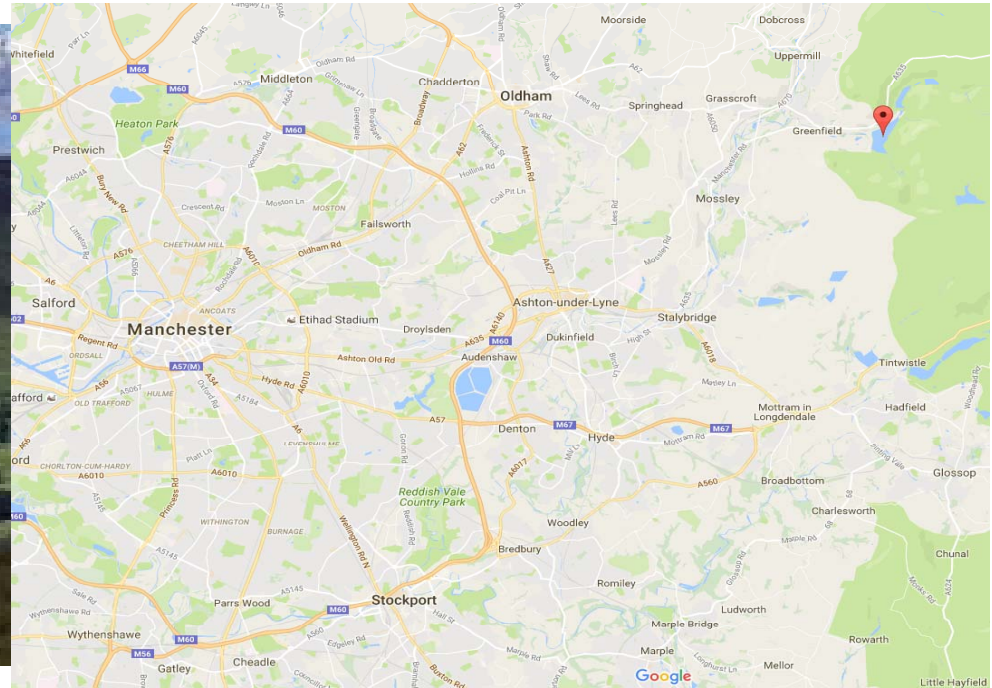


Context

- Under the Civil Contingencies Act 2004, it is a requirement for local authorities and emergency services to plan for major incidents.
- This year's exercise involved around 36 organisations making it one of the biggest of its kind ever held in the region.
- It gave personnel from the organisations involved the vital opportunity to put their emergency plans into practice on the ground.
- The complex scenario, including the scale of destruction and chaos, was designed to stretch all participants.
- United Utilities contributed around 75 people, including support staff, for the exercise and over 25 major assets, including pumps, vehicles, power packs etc.

Location

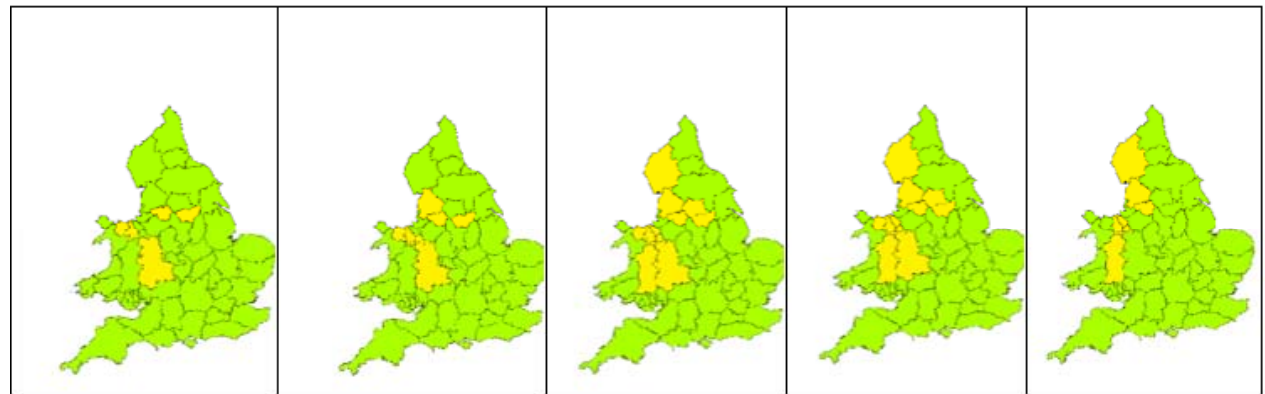
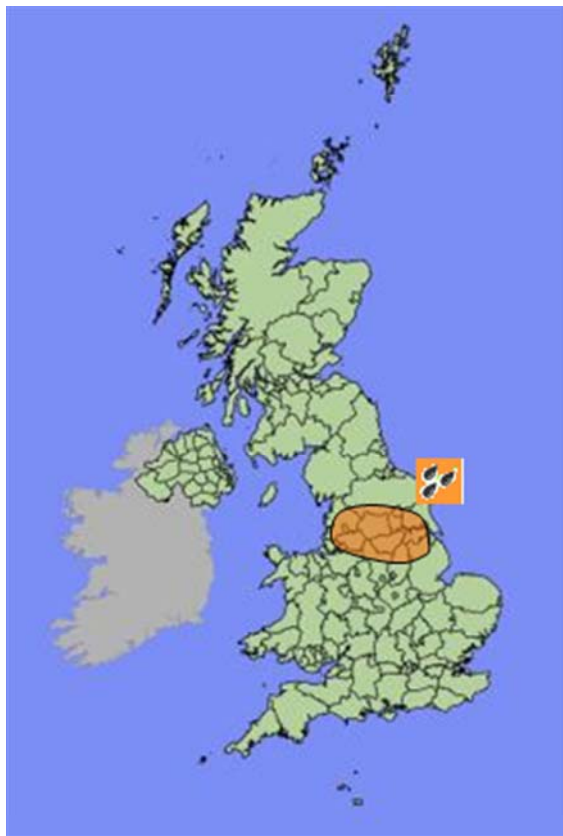
Dovestone reservoir was our chosen location for the Exercise as it provided all the necessary requirements to impact Local Authorities within Manchester.



Monday 11th July

Flood Guidance statements were issued by the EA with an Amber Rain Alert

Flood Warnings and Alerts began to spread around the Greater Manchester Area



The warning depicted a medium likelihood of medium impacts and suggested event rainfall totals of the order of 60 to 70mm with perhaps as much as 90 to 100mm!

Tuesday 12th July

- Primarily a Desktop based exercise.
- Catchment Controller noticed a depression in the reservoir.
- Supervising Engineer is called out to inspect and begins controlled drawdown.
- We inform the Force Duty Officer what is happening.
- Flood Advisory call occurs: A multi-agency call aimed with the intent of discussing the flooding situation.



Wednesday 13th July

- Live play begins on site for UU personnel and in the Incident Room
- Joined by the Panel Engineer on site
- Met with Fire Service on site to work out placement of High Volume Pumps
- UU launched our pontoon to pump over the spillway to reduce reservoir level
- Multi Agency conference calls going on throughout the day



Thursday 14th July

- Joined by the Fire Service and Military on site
- Strategic and Tactical Coordinating groups sat down at GMP HQ
- Supported by the Social Simulator (Pseudo Media) throughout the day
- Situation deteriorates throughout the day until collapse



Lessons Learnt: What went well

- New roles worked well in an incident: The Area Engineering Manager and Extendibility Manager.
- Successful work between Forward Incident Controller (FIC) and Engineering teams on site.
- Successful work between all multi-agency partners both on and off site, despite communication issues between site and our incident room.
- All staff responded professionally and treated it like a real life incident.
- Identified gaps within the Incident Management Procedure.
- Exercise moved at the correct pace to fit with the wider planned scenario.

Lessons Learnt: What didn't go so well

- Scenario could have been developed further rather than just sinkhole measurements, reliant on improvisation of the field team.
- Communications between Site and the Incident Room were poor.
- Unfortunately we didn't have our Incident Bus and instead had to use our Customer Bus.
- Conference Calls took a lot of time for our FIC and immediate team.
- Lack of facilities for Wi-Fi meant getting information to the incident room e.g. drawings were difficult.

Lessons Learnt: Improvement Actions

- Emergency kit bags to be produced with charged phones, noise cancelling earphones, dongles etc. which can be distributed quickly across the North West
- Credit card aide memoirs to be developed for key roles with the 'top 5' requirements for when an incident begins to ensure crucial things are done straight away
- Update the on-site plan
- Update the Incident Management Procedure

Thank you



Session Chair: Dr Andy Hughes

Technical Reporter: Ben Jones

Sustainable or senseless? Global lessons from dam building (Keynote Speech by Damian Fleming (WWF-UK))

Question: Jonathan Hinks (HR Wallingford)

I would like to thank Damian Fleming on his very balanced and thought provoking paper. I would offer only five comments:

1. Firstly I agree that resettlement is a major issue, although the total of 40 to 80 million oustees quoted by the World Commission on Dams (WCD) has never been justified and seems to be something of a guess. It is true that around 1.3 million were resettled for the Three Gorges scheme in China but this seems to have been reasonably well done and needs to be seen against the backdrop of historical flooding of the Yangtze. 30,000 people died in the 1954 floods when 1 million were made homeless. Millions are said to have died in five major floods in the last century. The Three Gorges reservoir is now held 50m below Top Water Level in the summer months to provide 22km³ flood storage. This was an important motive behind the decision to build the dam.
2. My second point is that around 1 billion people are fed due to irrigation schemes that are supplied from dams. With a rapidly increasing world population more irrigation dams are going to be needed.
3. Thirdly, as cities grow the demand for clean water increases. I am presently involved with dams to supply three African cities with increased water supply. Worldwide there are around 2,500 dams solely for water supply and yet we still have some 5,000 children under five dying each day because of water borne diseases.
4. The question of migratory fish is a very important one and the World Wildlife Fund (WWF) is absolutely right to highlight their concerns. However, it is worth noting that many reservoirs yield large catches of non-migratory fish – catches of 35,000 tonnes/year were being landed from the Aswan Reservoir in the 1990s.
5. Finally I would like to ask two questions relating to Damian Fleming's assertion that "one study showed that average costs for dams were 96 % higher than planned". What study was this and why did its findings differ so much from the WCD figure of an average 21 % overrun based on the study of 81 dam projects?

Response: Damian Fleming (WWF)

There are some very relevant points there. In terms of the number of people displaced by dams, to a certain degree different organisations will use different studies, and all of these studies are scientifically reviewed. WWF is very conscious, as a science-led organisation, not to pick reports that are not peer reviewed and don't appear in scientific journals. So that's one report I used in terms of displacement.

An example of some of the positives is the Three Gorges dam as you went on to mention. We have a memorandum of understanding with [the operators of] the Three Gorges dam, as they are a partner of ours in China. We recognise many of the benefits that the dam has provided. The advantage of having this open relationship that WWF likes to have is that we can work with them on environmental flows, so we've had a number of controlled releases from the Three Gorges dam, which we believe are very important for spawning of many of the fish that are downstream, and this has been shown to be successful.

By WWF having an open mind and the Three Gorges dam having an open mind, this kind of relationship with developers and operators can lead to very positive results. So you rightly point that out as an example, and working with organisations like ourselves can actually minimise even further some of the risks.

I would agree with talking about the billion people that are fed by irrigation from dams. The paper talks about the absolute advantages of over 50% of food coming from irrigated resources, and dams are clearly very important in that.

Just to remind ourselves that when done very well, dams can be very important in terms of providing irrigation for agriculture, but [consider] the example I gave there of the Belo Monte dam in Brazil where what you also need to be very conscious of is the change in climate. So we need to make sure we are fully factoring in many of these factors and that we are not building dams based on where we are today, but also thinking forward in terms of providing water. So we recognise the benefits of dams, but we need to incorporate some more of this thinking as well.

In terms of migratory fish, again I agree there are some benefits and areas where things are done well and not done so well. The Mekong delta is another example, where some of these dams could have dramatic effects on the delta and 60% of protein for people living on the Mekong delta comes from fish.

We need to be very sure that we are looking not just at the immediate impacts of dams but also looking at the impacts on the whole system itself.

Question: Christine McCulloch (University of Oxford)

Damian has listed Seven Sins of Dam Building but has omitted two additional serious problems:

- a) Sedimentation within reservoirs, and
- b) Corruption associated with the building of dams.

At the recent ICOLD conference in Johannesburg a World Bank official stated a very disturbing statistic: the global amount of reservoir storage per capita is today the same as it was in 1965, despite a huge increase in dam building during the period! The amount of reservoir storage lost to sediment accumulating in reservoirs is so great that more and more dams will have to be built just to keep pace with the continuing loss and the world's growing population.

Corruption leading to diversion of large amounts of funding intended for dam schemes has risen to disturbing levels and the contribution of dam construction to debt in some developing countries is significant.

Response: Damian Fleming (WWF)

Well I only had half an hour and also I did come here to make friends, because I think it is really important that we understand where each of us are coming from.

WWF is very much about development; our strap line is 'where nature and people thrive' and people are an important part of that as well. If we don't bring on board the full range of stakeholders we're not going to get win-win solutions so we have to recognise that dams are very important part of development and if we can have open and friendly dialogue then we may not get everything we want, but we can help to influence things for the better - so it is the case of trying to make friends and trying to understand each other's perspectives and trying to work together for more sustainable solutions.

Comment: Dr Andy Hughes (BDS Chairman)

That is why we invited you here because I like to think we are friends and that the BDS and WWF can work together more closely in the future.

Comment: Tony Morison (CH2M Hill)

I was involved some 20 years ago on the Se Kong, Se San, Nam Theun Hydropower Project in developing strategic plans for further hydropower developments on these sub-catchments of the Mekong in Laos and parts of Cambodia and Viet Nam for the Asian Development Bank.

More than 50% of the project team and budget were involved in looking at the social and environmental aspects of the individual and combined impacts of present, planned and possible future hydropower development on the Mekong basin. A particular focus was on the fisheries aspects, with the delta area and Tonle Sap in mind.

A major problem we found in undertaking that project was the lack of research, information and data on fish issues, and fish migration in particular, in order to carry out the study. This limited the project's ability to try to assess impacts or develop fisheries mitigation strategies, even though the importance of this issue was fully accepted. The environmental conclusion, paraphrased as "*since we do not know the impacts, we should do nothing*" did not fit well with the scientific approach to other aspects of the study. "*Do nothing*", on this basis, was never going to happen, although funding of further research on this key aspect was a strong recommendation from the project.

I am therefore very pleased to see from the presentation that this is no longer the situation, at least in WWF's approach in the Amazon basin. I commend the WWF policy of engagement and working together to produce a practicable sustainable development strategy, even if this is a "least worst" solution from an environmental point of view.

Engineers are used to accommodating different views and priorities into development projects, and I feel that in the past it has often been the lack of a scientific and data-led basis for environmental objections, with blanket objections to every option, which has limited engineering acceptance of the validity of environmental argument. It is therefore good to see that this has changed, at least in this area, to a policy of taking a lead in an attempt to steer development strategically towards what is a more environmentally acceptable solution. This is ultimately to everyone's benefit.

Question: Ian Hope (Severn Trent Water)

I'm very keen to learn a bit more of the politics of interaction, because arguably we're coming from the perspective of a wealthy nation and you're confronted with impoverished communities.

Then I'd like to ask a controversial question. I read your paper, and as an engineer we look at the cause of the problem and the world is basically confronted with an exponential increase of its most destructive species, so what are you doing to influence that.

Response: Damian Fleming (WWF)

In terms of the politics of that, it's two-fold. The tool that we developed in the Amazon is an open source tool; we invested quite a lot of time in training government officials involved in that and all the technical people, so ultimately what we're trying to do is give people better data to make more informed choices. If we really think red lines are crossed, as in the case of the Selous, then we will campaign but campaigning also has its own risks for us as an organisation.

We want to have a seat at the table, so it is about trying to provide those tools and trying to help make better informed decisions and it's also about trying to build capacity of local people to fully understand things, so we see places like the Amazon, where some don't even speak Portuguese, and even though the developers may organise one or two workshops to explain to local people the impacts of the dam, for people to get there is often very difficult; they don't have negotiating skills and they often don't speak the language. So it's about trying in a balanced way to build the capacity of those people to respond and to be able to fully negotiate with those processes. We are seeing lots of positive signs, at the same time but the results are pretty damning.

We are working on a number of different angles. What we're trying to move away from, is not just supporting the recovery of individual species such as pandas, although there's been some real success there, but what we're trying to do more of as an organisation, which chimes with what we're discussing today, is to look at the landscapes and the ecosystems that these species depend on. Because I think if we, in isolation, look at species, we're going to get overridden by some of the big changes and some of the big decisions that are being made so we have to keep working with the environmental ministries but more and more we have to be more engaged with treasuries where the real decisions are made.

So as an example, in the UK we are engaging with the Treasury on the 25 year plan for nature. Those are the things that override these decisions. We know in Africa (Tanzania) there is an agriculture growth corridor. In China there is the One Belt One Road initiative, which is basically how China is going to connect with Africa and Europe through a series of railways and roads, and we have to spend our energy working to protect pandas but we also have to engage with these things because they are going to override any sort of small projects that we have.

So in the UK office we have a sustainable finance team that are out there talking to the insurers, which is increasingly where these decisions are made. So what we are doing at the moment is continuing to work on the smaller projects but increasingly building up the capacity and expertise to engage with big decision making, and again people might not think we are engaging in sustainable hydroelectric power, but rather than working on lots of fisheries projects we have to be in these kinds of audiences talking to different sets of people and trying to change those mindsets.

Question: Alan Brown (Stillwater Associates)

You mentioned a 30% conservation target for the Amazon, as being the minimum to maintain a viable ecosystem.

1. What were the criteria used to establish that target, and evidence for that value?
2. Are there targets in other river basins and if so what are the values?

Response: Damian Fleming (WWF)

I have to confess I wasn't actually involved in that as I'm not a scientist - there were a number of our conservation scientists that were involved but the research they understood was that in order for a particular habitat type to be fully functioning it needed 30% of that habitat type as a minimum to function.

I could find out the particular scientific paper where that 30% came from, but it wasn't a definitive solution as every river basin and every habitat is different so it's about using the available research and trying to use that data in the type of solutions that we showed here.

This is our perspective using the research that we have drawn on, but we have to listen to other people's points of view as well and we won't get everything we want, but hopefully by putting across some of our arguments we can have more balanced decision-making, so we're open to having our science and research questioned and hopefully we can respond to that. But it is about trying to get an understanding that we need to get a space for nature and for people in those arguments, and in many cases this has been happening.

Question: Peter Down (Mott Macdonald)

It was noted that a "bias to build" was referred to in the presentation. As reservoir engineers, we are often responsible for the design and construction of dams whose locations have already been decided. As we are often paid by clients who are promoting these schemes, it could be argued that the engineer has limited influence, indeed, many of the decisions need to be made in the feasibility stage to ensure a dam is suitably located and sustainable. The World Bank and other bodies can have a key role in influencing the decision making at this stage. What is the WWF's role in influencing this decision-making process?

Response: Damian Fleming (WWF)

Very good question and I agree with your conclusions there. In many parts of the world the decision-making process is very open - there are review bodies, multi-party groups that look at these and review and have their proper checks and balances in decision-making. Whereas, in other parts of the world, these big infrastructure projects, not just dams but rail and road projects, are pet projects of prime ministers and heads of state. Often the frustration is we spend time training the technocrats in government who are very supportive of what we are saying, and those decisions are completely overridden by a particular key politician. In that particular case, we will campaign where we think certain red lines are crossed, but it is also about working with other necessary stakeholders in that process.

We are working with the Inter American Development Bank in Latin America, and we have a partnership in them in the Marañon river basin in Peru, as they are obviously a very key funder of these projects. So we are working with them; they are much more powerful in many cases than the WWF in lobbying governments. Interestingly, the IDB have a project with the Peruvian government to try and make more transparent their decision making processes. At the moment there is not a process for projecting energy demand into the future, it's very arbitrary, there is not a proper scientific process for that, and the IDB is demanding that process in return for further support for infrastructure projects.

So having that kind of dialogue with some of the world banks, IDBs, Asian development banks, and we are having a lot of work very closely with Chinese banks at the moment - they have some green infrastructure guidelines that the Chinese banks recently worked on, and we're working with those to ensure the right checks and balances are in place.

But in terms of people like yourselves, I think you perhaps have less chance to influence the actual planning and siting of dams, but certainly in embracing things like the Hydropower Assessment Protocol we are ensuring that we do that where possible.

We do understand that guidelines and things like the protocol involve a little bit more time and consideration; they involve a little bit more resource, but we think there can be economic and reputational benefits to doing that as well as some of the social and environmental ones.

Comment: Dr Andy Hughes (BDS Chairman)

Thank you for coming. I would like to think that we are friends and we will continue this dialogue with WWF and please encourage your UK based people in Guildford to talk to us as well. We welcome papers from you about the seven deadly sins of dam building and we'd welcome you as a corporate member. Asking you to sponsor one of our conferences might be pushing it a bit too far but thank you so much for coming and exposing us to a wider initiative.

Haweswater Reservoir: an environmental asset or an environmental liability? (Rigby *et al*, p175 of Proceedings)

Question: Paul Monaghan (City of London)

At which point did the reservoir go from being seen as an environmental disaster to being one of the best loved places in the eastern part of the Lakes?

Response: Pam Rigby (United Utilities)

I think it was just over time really, it was filled about 1953, and they've lived with it since then, and they knew it was happening since about 1919 so it was a long time coming.

People now don't realise that the reservoir is actually not a natural lake, unless you're a dam engineer and you can see that it isn't, so people just expect it to be there.

So I think it was more a slow kind of building into people's perceptions and the people of Mardale are still remembered. People still go to this reservoir when the water level comes down and go to look at the village remains. I went about 10 years ago.

Comment: Dr Andy Hughes (Atkins)

Years ago when I first joined North West Water there was an undertone that the water was stolen from the Lakes to bring it down to Manchester, but that's eased over the years.

And now, because of people's mobility the ability to drive out into the Lake District to see the sights and the fact that water enhances a valley is a very important part and certainly the attitudes have softened.

When there were floods recently, United Utilities had a role in using the reservoir storage capacity to minimise the flooding. They were often blamed for causing the flooding, but actually United Utilities dams prevented, minimised or even reduced the flooding, so it's always a win-win or no-win, you're damned if you do and damned if you don't type situation.

Operation Triton (Presentation by Duncan Hall, United Utilities)

Question: Robert Mann (AECOM)

I congratulate the authors on a very informative presentation. As panel engineers and others may have to be prepared for real instances of such an emergency, will there be a paper written on this for us to refer to?

Response: Duncan Hall (United Utilities)

I am halfway through the paper and hopefully I will get this published for the next edition of Dams and Reservoirs.

Question: Keith Gardiner (Stillwater Associates)

Did you look at consequences at all? Did you get flood maps out and figure out how you were going to evacuate everybody or did you not go that far?

Response: Duncan Hall (United Utilities)

In our HQ office we had the on-site plan and off-site plan, we've got six big screens in our incident room. We had all of those up, [showing] what would be affected and what would flood. Now, we on our own would not actually do that - this is where we go to the Strategic Coordinating Group (SCG), and the Tactical Coordinating Group (TCG), which are run primarily by the police, but they have the military, they have the utilities companies, they have a number of other organisations there, that undertake the evacuation procedure, at which point we're giving updates on site about what we think might impact, it's up to them (the SCG and TCG) to decide when to call an evacuation and how to proceed with that.

Question: Keith Gardiner (Stillwater Associates)

At what point was that going to be triggered, when did you know the dam was definitely going to fail?

Response: Duncan Hall (United Utilities)

We were trying to tailor it to the Thursday which was when everyone joined in the exercise, so it was Thursday morning, and so we essentially slow played it from Tuesday. On Tuesday we noticed the depression coming in, Wednesday things were a bit out of hand, Thursday we needed to get everyone out as soon as possible, telling them "this reservoir's about to fail".

Question: Keith Gardiner (Stillwater Associates)

So you had plans for an evacuation, even though you wouldn't have implemented it?

Response: Duncan Hall (United Utilities)

Yes.

Comment: Dr Andy Hughes (Atkins):

At one stage we were informed exactly how many people had to be evacuated, how many water treatment works and sewage treatment works would be lost, it was the end of the world. But there will be a new training course run by Develop on emergency planning soon, which I think will be a useful asset to us all.

As a Panel Engineer you often get asked if the dam is going to fail, when is it going to fail, who we should evacuate, when should we evacuate, and those are difficult questions. And one of the things that as Panel Engineers we've got to get from owners is indemnity against those situations in an emergency, because we often don't have a contract. I remember a lawyer in KBR when I worked there saying "you didn't answer those questions, did you?" I said "Well, yes of course I did". "Do you have a contract?" "No".

You do put yourself in the firing line if you call those questions incorrectly. You have to use your best endeavours. So I have campaigned for some time for water companies to get together and indemnify Panel Engineers in that emergency situation to use our best endeavours. But it's quite a stressful time, even though it was an exercise, and a very interesting time, so a lot to be learnt.

Comment: Pam Rigby (United Utilities)

Tim Dyke had the experience of being on site - he was told nothing, and he was the Supervising Engineer, and I'd be interested to see what Tim's thoughts on that were. (Tim Dyke was not available for comment).

Comment: Dr Andy Hughes (Atkins):

From my point of view working with the Supervising Engineer, I was supposed to be driving up, actually I was already there, but I was asking the Supervising Engineer questions as to what he was seeing, and what was happening. And Tim had just the brief that there was a hole, and he didn't realise at first that he had to ad-lib about how quickly the hole propagated and where it was and how serious it was, which would have made the scenario slightly different, so that's why Duncan made the comment he did.

But you've also got to appreciate that it did take 18 months to plan something of this size and it's important to keep the secrecy surrounding the incident so people don't know what's going to happen. So that's the real life situation, things will develop quickly, slowly, sidewinder missiles come in or Chinook helicopters or whatever it is, so it's all there to test you under a very high pressure situation.

So I think with these incidents you need to plan the scenario a little bit better, even if it's not disclosed to somebody, perhaps use a Panel Engineer who's not going to be used in the incident, to plan something out that's a little more realistic.

But we got there in the end. Needless to say, whatever I did, that last piece of paper was going to say 'the dam failed'.

Question: Alasdair Couttie (SSE plc)

Did you have a framework civils contractor at the Triton exercise?

Response: Duncan Hall (United Utilities)

No we didn't, what we had was a couple of our civil engineers on site, they were just booked up for a couple of days. We didn't know whether we needed them or not, so it was more kind of creating them a job at times, depending on how well they improvised, and whether they could do something. So when it came to contractors, there were more discussions around, like we need to get X or Y contractor in, how long will that take, and it was again more ad-libbing it, making sure we had a rough time where people might arrive with certain kit. So updates were whenever someone fancied, they could make the situation worse, a lot of them did, or they could just say "well it's due in 6 hours", and it hasn't arrived, so that was our set-up.

Response: Dr Andy Hughes (Atkins):

So I did ask for 100 tonnes of stone and an excavator, but the contractors said "No, we can't do that". And this thing is going to happen between Friday night and Monday morning, on a Bank Holiday, when the Supervising Engineer or the reservoir keeper is not around, so just be aware that the time of day and the day of the week is going to make a difference too.

Question: Constantinos Constantinou (Ministry of Defence, Cyprus)

How often should undertakers do exercises? Would they consider a computer simulation that would run the whole exercise plainly on a computer, just to avoid the logistics?

Response: Duncan Hall (United Utilities)

I'd certainly agree with a computer simulation, I think that's a fantastic idea. The first exercise (there's only been one previously of this kind of scale) was two years ago in Staffordshire. Whether or not they will get another pot of money for another exercise is down to costs, so this is one of the big issues with these exercises. On the back of the success of this exercise, UU is planning to do one major incident exercise a year, not always relating to dams, other incidents that may occur, and we do smaller ones as well, but I think the big issue is cost so who's going to pay for it.

Greater Manchester Resilience Forum had a large sum of money and they could call in the helicopter for a couple of hours. The military provided some funding, we put some money in as well, and it's just a question of how willing people are to pay, more than anything, and whether they have the available funds.

Response: Dr Andy Hughes (Atkins):

There is a requirement to exercise plans, not well defined, of at least every five years, but this can vary from a desktop exercise right through to the scale of Operation Triton. One of the interesting factors which an on-site plan should include is a loaf of bread to entice the ducks away from the Chinook.

Question: Craig Woolhouse (Environment Agency)

The National Flood Resilience Review is published today by government, and one of the outcomes of that is increased investment in flood fighting capability, and the Agency has been given money to buy some very large pumps to support flood response. There is an issue there for us in terms of reservoir safety in floods over whether we've got the right assets to respond to incidents. Have we got the kit we need, across England, Scotland and Wales, to make the right response and I think that's an area where we could contribute as a group to prompting a discussion around what we need to purchase.

Response: Dr Andy Hughes (Atkins):

A lot of water companies invest in varying degrees of equipment. People think of pumps straight away, and what are deemed high capacity pumps, that the Fire Brigade have, are not really high capacity pumps and they will admit that themselves. They're tiddly little things, particularly with a reservoir that size when there's a storm, you won't control it with pumps. And so drawdown, (and there's going to be a new guide soon on low level drawdown requirements), is important, you must have that facility, and a number of companies in this room have invested heavily in these large capacity drawdown facilities for large reservoirs. But I don't think you can rely on pumps always.

Access is a problem. Access to Dovestone was relatively easy, with a main road, tarmac roads, plenty of hard-standing. Some of UU's dams are on the tops of mountains with very poor access, so when you're looking at these emergencies you have to think about the whole scenario, and it won't be possible to get some of the equipment there quickly, so yes we do have to look at both the facilities there that you have on site, make sure they work and can discharge water, and then see what else you can bring in. But the pumps are not very big.

Question: Alan Brown (Stillwater Associates)

Just as a broad brush estimate, how much did the LRF think they needed to get to run the exercise?

Response: Duncan Hall (United Utilities)

I don't know how much the LRF got, they must have had quite a significant pot. There were a couple of people working full time on the project. The Chinook and Merlin helicopters cost £15k an hour, but this cost was absorbed by the military in this case. There was a lot of best practice so everyone opted in and said they would pay for this and that. The social simulator, the fake newsreel that added realism to the event, was another £15k. We're looking at well over £100k, but I couldn't give an exact figure.

Comment: Dr Andy Hughes (Atkins):

It would be interesting if you could put that into your paper.