



Improving the future supply of Reservoir Panel Engineers

Call for evidence

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a) Foreword and Invitation to Contribute from Professor Lord Robert Mair CBE FREng FICE FRS

In November 2021 I agreed to Chair a review into the future supply of Reservoir Panel Engineers (Panel Engineers). This review is being carried out by the Institution of Civil Engineers (ICE) at the request of the Department for the Environment Food and Rural Affairs.

The numbers of engineers appointed to the 2 key Panels, the All Reservoirs Panel and the Supervising Engineer Panel have declined significantly over an extended period. This decline coincides with an increase in demand for Panel Engineer services in response to changes introduced in the wake of the major incident at the Toddbrook reservoir in August 2019 when 1500 residents were evacuated from the vicinity after parts of an overflow spillway were partially dislodged following heavy rain, creating a risk that the reservoir dam would collapse.

The UK is now in a situation where there are genuine fears that we will lack sufficient qualified engineers to carry out these vital roles. The goal of this review is to ensure that this risk is averted.

In the first stage of its work, the review team has had the opportunity to meet with a representative cross section of Panel Engineers, their employers, regulators, reservoir owners and officials from the Department for the Environment, Food and Rural Affairs (DEFRA). The team have also reviewed material from previous work by the ICE Reservoirs Committee and have had the opportunity to talk with Professor David Balmforth who led the Independent Review into the Toddbrook incident.

This consultation paper and call for evidence presents the findings from this work and sets out our preliminary understanding the current situation, its causes and potential future trajectory. It also sets out some of the options for action that we believe could help secure a healthy future supply of Panel Engineers.

This is not a new issue and I know that many in the sector have thought deeply about this subject over many years and I am very keen to draw on your thinking. I am also conscious that while the formal output from this review will be a report and set of recommendations for Ministers, many of the potential solutions we have identified require coordinated action by a number of parties, including asset owners, engineering consultancy businesses, regulators, the administrations in the four nations of the UK, ICE, the British Dam Society (BDS) and academia. I hope that this consultation process can itself help to build a sector wide evidence base and consensus for action.

Finally, the review team are very happy, subject to diary availability, to meet with individuals and organisations to discuss their response to this consultation and attend relevant industry forums during the consultation period.

I will be also holding a consultation webinar on Tuesday 7 June at 9.30am, registration details are also below. I look forward to hearing from you.

Professor Lord Robert Mair CBE FREng FICE FRS.

Chair, ICE Review of the Future Supply of Reservoir Panel Engineers



b) Responding to this Call for Evidence

Written submissions can be sent to reservoirs@ice.org.uk up until 5pm on 30 June 2022. Please use the associate response form

An online consultation webinar, open to all interested parties will be held on 7 June, 9.30am-11.00am to register to attend please email reservoirs@ice.org.uk detailing the names, job titles, employers and email addresses of those wishing to attend.

If you would like to contact the review team to arrange a discussion or extend an invitation to attend any organisational or industry fora, please contact the ICE at reservoirs@ice.org.uk , clearly stating the details.

c) Reservoir safety legislation and the roles of Panel Engineers

Reservoir safety in England and Wales is managed under the Reservoirs Act 1975 as subsequently amended by the Water Act 2003 and the Floods and Water Management Act 2010.

In summary, for all raised reservoirs greater than 25000m³ in capacity in England and 10,000m³ in Wales and designated by the Enforcement Authority (the Environment Agency or National Resources Wales as high risk, the legislation requires that:

- A qualified **Construction Engineer** is appointed to certify all work associated with construction of a new reservoir or alterations to the capacity of an existing reservoir (this applies also to reservoirs that are not designated as high risk).
- A qualified **Inspecting Engineer** is appointed to inspect the reservoir at least every 10 years (known as Section 10 inspections as they refer to Section 10 of the Reservoirs Act 1975), and to require the owner to implement measures in the interests of safety (MIOS) and/or specific maintenance (known as statutory maintenance).
- A qualified **Supervising Engineer** is appointed to oversee the reservoir and its surveillance, monitoring, operation and maintenance, and to be available at all times to advise the owner over its safety.

The **reservoir owner**¹ is responsible for appointing reservoir engineers in accordance with the legislation. The owner must provide details of the appointment of qualified engineers to the Regulator (the Environment Agency or devolved nation equivalent) at the times specified in the legislation. Failure to do so is a criminal offence.

¹ Legally, the responsibility for the safety of a reservoir lies with the **undertaker**, the entity who undertakes to operate the reservoir. In most cases the undertaker is the **reservoir owner**. In this report the term reservoir owner is exclusively used to mean the **undertaker**

Construction Engineers must issue certificates to the owner when works at a reservoir are completed to their satisfaction.

Inspecting Engineers must issue their inspection reports to the owner as soon as practicable. When an Inspecting Engineer requires measures in the interests of safety, a mandatory completion date must be specified. These works must be overseen by a **Qualified Civil Engineer** who must certify the work once completed.

Supervising Engineers must visit the reservoir at least once per annum, report to the owner on their visit(s) and issue an annual statement of the reservoir's condition to the owner.

Appointment of Panel Engineers

The English and Welsh Governments formally appoint reservoir engineers to joint Panels for England and Wales. Similar provision is made in Scotland, while Northern Ireland reservoir safety legislation is yet to commence.

There are four Panels, specified by the Ministers, whose members are those engineers qualified to act as reservoir engineers

- **The All-Reservoirs (England and Wales) Panel** (engineers qualified to undertake the duties of Inspecting Engineer and Construction Engineer for all reservoirs, and also act as Supervising Engineers)
- **The Non-impounding Reservoirs (England and Wales) Panel**
- **The Service Reservoirs (England and Wales) Panel**
- **The Supervising Engineers (England and Wales) Panel**

In practice the vast majority of Panel Engineers are appointed to either the All Reservoirs Panel (ARPEs) or the Supervising Engineers Panel (SEs).

Appointments are made by following recommendation by the ICE Reservoirs Committee, which has been established to advise English and Welsh Ministers (and equivalent in Scotland) on the suitability of candidates.

Appointments are for 5 years, and before their term expires engineers may apply for reappointment for a further term.

Applicants are examined on their professional qualifications, experience of work on dams and reservoirs, related knowledge such as hydraulics, hydrology, geotechnics and structures, their knowledge of reservoir legislation and their continuous professional development.

The assessment for suitability is based on the competence of the individual to carry out the tasks required of the respective Panel Engineer, using the applicant's information provided and an in-depth interview. Competence is assessed on the basis of satisfying a set of defined attributes (see Annex B) required for each Panel. The applicant is interviewed and tested against these attributes by a subcommittee comprising three members of the Reservoirs Committee, who are themselves practising Panel Engineers, often accompanied by an independent observer from the Environment Agency. The Reservoirs Committee includes a representative of the Governments of England, Wales, Scotland and Northern Ireland, and their respective Regulators (as observers), as set out in the Reservoirs Act 1975 as amended, and equivalent legislation in Scotland.

d) Summary of call for evidence questions

The review recognises that very few individuals or organisations will be in a position to respond to all of the questions in this call for evidence. Please feel free to leave blank any issues that are outside your areas of interest or to which you do not wish to contribute evidence or views. Similarly, please feel free to use your submission to raise any issues not covered that you believe can make a significant contribution to improving the sustainability of the supply of Panel Engineers.

A short discussion setting out the review's understanding of the context behind each of these questions is set out in section H of this document.

1. The scale of future demand for Panel Engineers services

- Can you provide any evidence that will help the review better understand the scale of future demand for Panel Engineers services, including the pattern of future changes to demand for the Construction Engineer, Inspecting Engineer and Supervising Engineer roles?
- What are the key uncertainties the review should consider?

2. The ability of all reservoir owners to access the services of Panel Engineers

- Can you provide any evidence that will help the review demonstrate the current and potential future availability of the services of Construction, Inspecting or Supervising Engineers to all sizes of reservoir owner?

3. The impact of the commercial environment on investment by consultancy businesses in the development of future Panel Engineers

- Would you be willing to share in confidence any evidence on the risk/reward balance for your business of carrying out ARPE and SE work?
- Do you have any evidence that will help us demonstrate the impact of the current commercial environment on the ability and willingness of your businesses to continue to develop Supervising Engineers and All Reservoir Panel Engineers?
- Do you have any evidence to support the view that clients will be willing to increase fees to reflect:
 - A shortage of supply of Panel Engineers
 - An increased recognition of the value delivered by high quality ARPE and SE work
- Do you have any views or evidence on the benefits and disadvantages of delivering ARPE Section 10 inspections through a possible Independent Inspectorate that set standardised fees?
- Do you have any views on how such an inspectorate could be designed, managed and funded?
- Do you have any views on the desirability and feasibility of reservoir owners and consultancy businesses establishing a sector level agreement or mechanism to establish standard fee rates?

4. The role of collaboration and resource sharing between Water Companies in easing pressure on Panel Engineer resources

- How might it be possible for Water Companies to collaborate to increase the supply of Panel Engineers and make better use of existing resources?
- What impact would an enhanced water company role have on the ability of consultancy businesses to continue developing ARPEs and SEs?

5. The future panel structure

- How could the number and structure of Panels evolve to improve the supply and utilisation of Panel Engineers?

- In the event of a change, what would be your preferred panel structure and why?
- How could any risks be mitigated?

6. A structured development pathway and training for prospective All Reservoir Panel Engineers

- What action can be taken to help prospective All Reservoir Panel Engineers access construction supervision and design experience.
- What role can better communication of the range of works the Reservoir Committee accepts as relevant construction play in solving this problem?
- Do you agree that the Reservoirs Committee should create a structured support and guidance package that sets out a pathway to support SEs develop and demonstrate achievement of the attributes needed for appointment to the All Reservoirs Panel?
- What role could such a codified pathway play in opening the sector to qualified civil engineers from other disciplines
- Does you or your organisation have any materials or processes that could contribute to such a package?
- What role could a formal training course place in this package? How could such a course be funded and delivered?

7. The ARPE Interview

- What has driven the improved pass rate over the last 5 years for candidates presenting for interview for the first time for the All Reservoirs Panel?
- How can the effectiveness and perceived fairness of the interview process be further improved
- How can the pre, during and post interview experience of candidates be improved

8. Diversity

- What can be done to improve the extremely low diversity of the membership of the Reservoir Panels

e) Background – Why has this review been commissioned?

In March 2021, Professor David Balmforth published his [*Independent Reservoir Safety Review*](#). The review was commissioned by DEFRA following Professor Balmforth's earlier review of an incident at Toddbrook reservoir in 2019 in which heavy rainfall led to the partial collapse of the dam, causing significant risk to human life.

The Balmforth review makes a series of recommendations for improving the management of risk in the reservoir sector including that *Defra and the Environment Agency, working with their counterparts in the other administrations of the UK, owners and employers should commission the ICE to undertake a thorough review of the supply and development of supervising and inspecting engineers to ensure future supply.*

ICE and DEFRA are investigating how this recommendation can be addressed. The full terms of reference for the current review are attached as Annex A

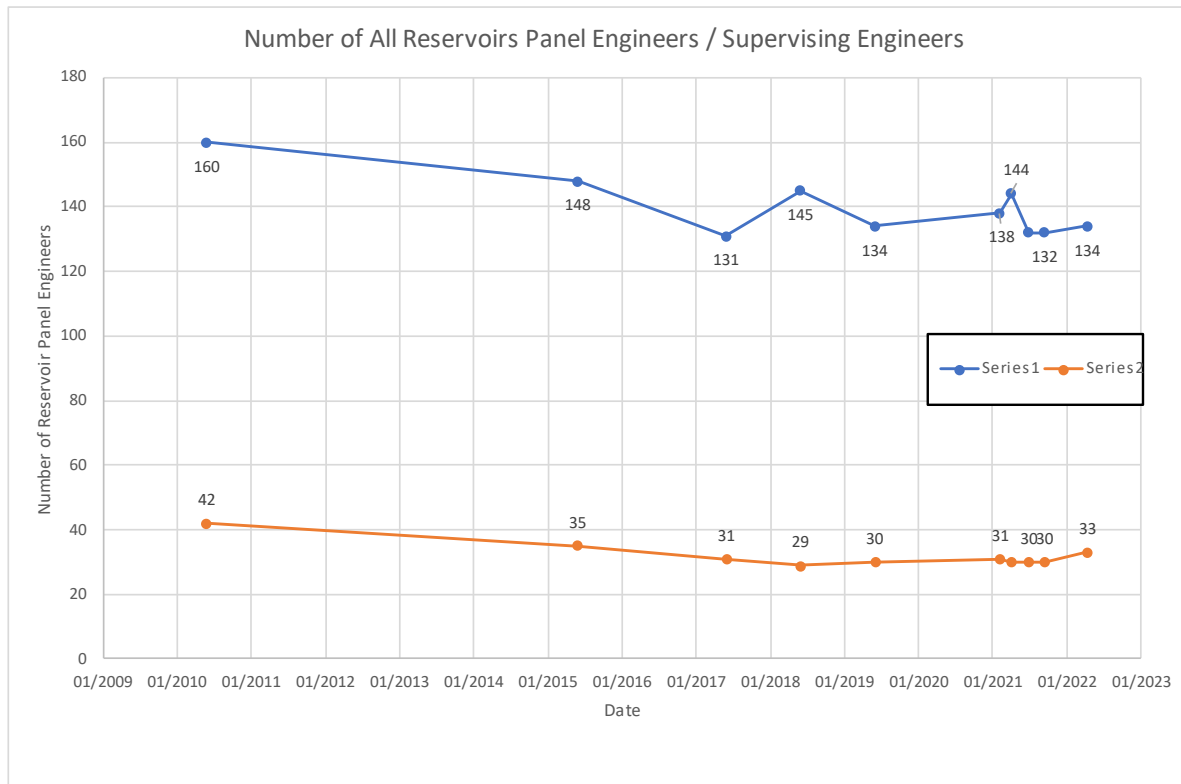
f) Numbers of Reservoir Panel Engineers 2010-2022

The Environment Agency maintains a list of all active Panel Engineers available to carry out work under the Act.

The last update of these lists is dated 6 April 2022 and shows:

- 33 All Reservoirs Panel Engineers
- 134 Supervising Engineers

The Agency does not track these numbers year on year. The Chair of the British Dam Society has however provided the review with his own record of Panel Engineers numbers since 2010 compiled from the Environment Agency data and a range of other sources.



g) Our Approach to the review – A *whole system* approach to securing the future supply of Reservoir Panel Engineers

The early work of the review suggests that the supply of All-Reservoir Panel Engineers (ARPEs) to carry out the Inspecting and Construction Engineer role is the most pressing challenge facing the sector.

The decline in ARPE numbers cannot however be understood in isolation from how the dams and reservoirs sector as a whole currently functions. The review therefore intends to take a whole system view of the supply of Panel Engineers.

To this end, while the review is focused on identifying actions that will create a more sustainable supply of Panel Engineers, the review will take into account any insight that will help us paint a richer picture of the drivers of the current situation. Similarly, we are very keen to understand where action to address the potential shortfall of Panel engineers requires coordinated action to address sector level failings from actors including but not limited to reservoir owners, regulators, consultancy businesses, ICE, BDS, DEFRA and the Devolved Administrations.

h) Issues for the Call for Evidence

1. The scale of future demand for Panel Engineers services

1.1 Questions

- Can you provide any evidence that will help the review better understand the scale of future demand for Panel Engineers services, including the pattern of future changes to demand for the Construction Engineer, Inspecting Engineer and Supervising Engineer roles?
- What are the key uncertainties the review should consider?

1.2 Discussion

Demand for Inspecting Engineers

In 2016 the Reservoirs Committee surveyed all Supervising Engineers about their ambition to progress to the All Reservoirs Panel as part of a review of Inspecting Engineer succession planning². The Committee's analysis suggested that at that time the industry required 20 full-time equivalent (FTE) members of the All Reservoirs Panel to fulfil the demand for Inspecting Engineer services. The Committee added however, that the distribution of work amongst panel members was not equal and that many IEs do not work full time in the role either because of other commitments within their businesses or because they were semi-retired. **As a result the Committee suggested that the industry might require a minimum of 30 engineers at minimum, in order to service the 20 FTE demand.**

The Committee's analysis in 2016 suggested a decline in the membership of the All Reservoirs Panel to between 21 (most realistic case) and 30 (best case) by the present day. As noted above numbers have outperformed the Reservoir Panels best case scenario, with the current membership (as of April 2022) of the All Reservoir Panel standing at 33.

Analysis of data provided to the review by ICE suggests that the number of retirements of ARPEs and applications to the Panel have broadly tracked expectations. The pass rate for prospective new APREs at interview has however outperformed the historic trend. The Committees projects were suggested a 100% pass rate would deliver 36 ARPEs in 2022, while a 50% pass rate would reduce this number to 25. The pass rate in this period has in fact been over 60%.

This positive picture however needs to be set against a potential increase in demand. In his review David Balmforth notes that Wales has recently reduced the threshold at which reservoir safety legislation is applied to embrace high risk small raised reservoirs. On his analysis this increases the total number of reservoirs to be inspected in Great Britain from 2892 to 3547. **He suggested that on a pro-rata basis that this will require a minimum increase to 37 Inspecting Engineers from the current figure of 33.** Professor Balmforth also concluded that if the Environment Agency and SEPA choose to apply the same threshold as their Welsh counterparts the total number of reservoirs requiring inspection will

² Peters A, Goff C, Littlemore D and Williamson T (2018) Inspecting engineer succession planning – plain sailing or choppy waters? Dams and Reservoirs 28(2): 54–61,

increase again to around 4000³ and that **this will increase the total number of Inspecting Engineers required (again on a pro-rata basis) to circa 40. Taking into account the Reservoir Committee's observation about the distribution of workload amongst ARPEs the actual figure required to deliver Inspecting Engineer activity will need to be significantly higher and/or their workload distributed more evenly.** In this context the review also notes that ARPEs are also able to carry out SE duties, a role which we understand many do carry out as part of their work portfolio.

Demand for Construction Engineers

Neither the Reservoir Committee or Professor Balmforth's analysis fully take into account the impact of the wider duties of ARPEs on their availability to deliver Section 10 inspections under the Act. A number of organisations interviewed by the review team suggested that the demand for Construction Engineer services may grow in the coming decade driven by water company plans for new water supply facilities, the Environment Agency's programme of flood storage reservoir construction, both of which reflect broader themes of responding to the impacts of climate change and efforts to improve water resource management. These organisations suggested this could lead to additional pressure on the pool of All Reservoir Panel Engineers not accounted for in the Balmforth review analysis. Our review is not however aware of any publicly available analysis of the scale of this potential demand.

Our Review also notes that any increase in the number of reservoirs falling under the Act and an increase in the design and construction of new reservoirs, or adaptation of existing structures will also have implications on the workload of Supervising Engineers. Contributors have generally been more confident about the sustainability of the future supply of SEs, in part because of an increasing trend for water companies to directly employ their own SEs. Once again however, we have not seen any detailed analysis of future demand for SE services.

The review would therefore welcome any analysis or insight that will help us paint a clearer picture of the scale and nature of the future demand for Panel Engineer services and by extension the size of the recruitment challenge facing the sector.

2. The ability of all reservoir owners to access the services of Panel Engineers

2.1 Questions

- Can you provide any evidence that will help the review demonstrate the current and potential future availability of the services of Construction, Inspecting or Supervising Engineers to all sizes of reservoir owner?

2.2 Discussion

Some contributors to the first stage of the review have raised concerns that the headline number of existing Panel Engineers may mask the fact that some owners may increasingly face difficulties in accessing their services.

In relation to the current availability and willingness of ARPEs and SEs to carry out inspection and supervision activity:

- We were told that some larger consultancy businesses with ARPEs and SEs on staff are increasingly reluctant to carry out work for smaller reservoir owners as they consider the balance of fee, liability and potential future work to be unattractive.
- 51 of the 134 SEs currently on the Supervising Engineer register are employed by water companies or other owners and are not available to the wider market

³ The review also understands that the implementation of the relevant legislation in Northern Ireland could add a further 180 reservoirs requiring inspection and supervision

3. The impact of the commercial environment on investment by consultancy businesses in the development of future Panel Engineers

3.1 Questions

- Would you be willing to share in confidence⁴ any evidence on the risk/reward balance for your business of carrying out ARPE and SE work?
- Do you have any evidence that will help us demonstrate the impact of the current commercial environment on the ability and willingness of your businesses to continue to develop Supervising Engineers and All Reservoir Panel Engineers?
- Do you have any evidence to support the view that clients will be willing to increase fees to reflect:
 - A shortage of supply of Panel Engineers
 - An increased recognition of the value delivered by high quality ARPE and SE work
- Do you have any views or evidence on the benefits and disadvantages of delivering ARPE Section 10 inspections through a possible Independent Inspectorate that set standardised fees?
- Do you have any views on how such an inspectorate could be designed, managed and funded?
- Do you have any views on the desirability and feasibility of reservoir owners and consultancy businesses establishing a sector level agreement or mechanism to establish standard fee rates?

3.2 Discussion

ARPEs are concentrated in consultancy businesses

All Panel Reservoir Engineers currently work exclusively in the consultancy market, the majority as employees of large, multi-disciplinary, multi-national consultancy businesses

ARPEs working in these businesses typically head teams that also include SEs as well as other specialists that offer a *one stop shop* for a client's dams and reservoirs needs. In these businesses supervision and Inspection work would appear to often function primarily as a business development activity. Inspections and supervision are delivered at a relatively low fee in order to open up opportunities for more profitable design and construction work and more broadly to build relationships with major clients.

A low fee-high liability environment

The review is aware that following a number of mergers and acquisitions over the last 20 years, the number of these larger businesses active in the reservoir sector has declined but that the remaining players remain fiercely competitive. We also understand that a smaller number of independent ARPEs, with low overheads continue to operate in the market, potentially placing further downward pressure on fees.

Consultants have thus described to the review a commercially unattractive low fee/high liability environment, with the potential for liabilities to increase further in the wake of the Toddbook incident and the Balmforth review. While we are not aware of any businesses planning to exit the market (and thus further shrink the pool of employers of ARPEs), we would welcome evidence to support anecdotal evidence of a growing trend for internal risk management processes leading to parent businesses rejecting a Dams and Reservoirs team's request to accept commissions from potential clients.

⁴ Any commercially sensitive provided to ICE will be destroyed following the conclusion of the review. Any information reported will be anonymised and presented as a high level summary. Before the review's final report is published we will take advice from DEFRA to ensure that we do not inadvertently place any confidential evidence within the remit of a Freedom of Information request.

High cost of training and development for potential ARPEs and SEs

Consultancy businesses have told the review that this low fee/high risk environment is a barrier to investing in training and mentoring to support staff achieve appointment to first the Supervising Engineer Panel and then the All Reservoirs Panel.

One consultant provided a rough estimate of the cost of supporting an SE achieve ARPE status as around £15-20K, set against a mixture of scope of work and fees that led to ARPEs being deployed at little more than £100 per hour for inspection work. We were also reminded that experience of working alongside an ARPE is an important part of the SE to ARPE development pathway but that it can be hard for a business to meet the costs of junior staff shadowing their senior colleagues within the fees available.

Potential impact on diversity

One result of this situation would appear to be the expectation that potential ARPEs dedicate a significant proportion of their free time and Annual Leave to pursuing their professional development. One Supervising Engineer speculated that this situation contributes to the poor diversity record of the sector.

Fees may be starting to increase

On a more positive note, one large consultant reported that fees are beginning to rise. In their view this was being driven in part by shortage of supply of SEs and ARs but also a growing post Toddbrook recognition of the need to increase fees to Panel Engineers to help owners discharge new responsibilities proposed by the Balmforth Review, for example a new requirement for owners to create and maintain Reservoir Safety Management Plans.

Owner perspective on fees

The review would welcome further input from reservoir owners on their perspective on the challenge of engaging Panel Engineers at fee that they believe is affordable and delivers value for money. In this context the review is aware that the introduction in England of a need for onsite emergency flood plans, signed off by a Panel Engineer means that many smaller organisations with lower risk reservoirs have recently entered the market, creating a short term spike of demand that is still playing out at the time of drafting of this call for evidence.

Will the market adjust to provide a more sustainable commercial environment?

Our review does not believe it is credible to suggest that the dynamics of supply and demand can be left to resolve this situation as the consequence of demand outstripping supply would be to undermine the reservoir safety regime, an outcome which is clearly unacceptable.

The review would however be keen to hear views from the sector on the plausibility of the view that the market is already adjusting to reflect a reassessment of the value owner's receive from Inspection and Supervision activity. The Balmforth review also suggests that a better resourced the Environment Agency with more in-house engineering capability should take a more proactive leadership stance in its role as Regulator. Signals from the regulator to owners about their duties and obligations could raise the bar on quality and discourage a race to the bottom on fees. The ICE may also have a role on the supply side reminding Panel Engineers that under the Institution's code of conduct they must not take on work if the fee or time available will prevent them from discharging their professional duties.

What is the case for an Independent Inspectorate to set fees?

The Balmforth review noted that regulation and enforcement in the UK nuclear and rail sectors differs significantly arrangements in the reservoir sector. Both the Office for Nuclear Regulation and the Office Rail Regulation are underpinned by legislation that gives them duties and powers to thoroughly review the safety processes of their asset owners/operators and where necessary undertake their own inspections, using their own inspectors.

Our review has been told that the idea of delivering Inspection (though not Supervision) activity through a similar Independent Inspectorate sitting within the Environment Agency has previously been discussed within the reservoir sector and was raised again during the Balmforth Review.

While we are not aware of any detailed proposals having been drafted, we understand that the basic idea that has been discussed would be for the Agency to use an enhanced powers contract to create a pool of ARPEs to carry out inspections at a standard fee, recoverable from owners. On this model ARs would continue to be employed by their parent companies. We have been told that this could generate a more attractive fee level that can in turn be reinvested in training. On this model a suitably resourced Environment Agency would also have a much-enhanced role in quality assurance of the work of ARPEs and in driving best practice and learning from incidents. The review notes that while this is the model that has previously discussed within the sector, other approaches are clearly possible and would welcome views of evidence to support different options for how such an inspectorate could be designed, managed and funded.

The review does however want to be clear that at this stage its view is that a fundamental change of this nature is best considered as a last resort given that it would be time consuming, costly and appears to run counter to the principle at the heart of the Balmforth review that reservoir owners should take the lead in the proactive management of risk.

Is an industry level agreement on fees feasible and desirable?

An alternative approach to tackling the *chase to the bottom* suggested by two contributors to the review was for major consultants and major clients, to negotiate some form of industry agreement via a standard contract or other mechanism that would put a floor on fees and codified a fair and equitable approach to risk and liability. In theory both sides can benefit via an increased focus on quality and value for money and by supporting the long-term sustainability of the sector. The review would welcome views on the desirability and feasibility of such an initiative, recognising that it raises significant legal and ethical issues around fair competition and access to the market.

4. The role of collaboration and resource sharing between Water Companies in easing pressure on Panel Engineer resources

4.1 Questions

- How might it be possible for Water Companies to collaborate to increase the supply of Panel Engineers and make better use of existing resources?
- What impact would an enhanced water company role have on the ability of consultancy businesses to continue developing ARPEs and SEs?

4.2 Discussion

51 of the 134 Supervising Engineers on registrar as of April 2022 are employed by Water Companies, the Environment Agency or other reservoir owners. These SEs work exclusively for their employer and are not available to meet the needs of other owners.

The review has been told consistently that an SE working for an owner who has ambition to progress to the All Reservoirs Engineers Panel will have to change employer and find a post with a consultancy businesses. Reservoir safety legislation bars an ARPE from carrying out Inspections on their employers' assets and consequently no owner currently directly employs an ARPE.

While by no means every SE working for an owner will wish to become an ARPE, the current situation clearly presents a barrier for significant barrier to progression for a significant proportion of the SE community.

Some SEs working for owners have suggested to the review that there could be theoretical benefits for water companies having in-house APREs in the form of an increase in the organisations overall competency. It was also suggested to us that the bar on a ARPE carrying out inspections on their employers' own reservoirs does not extend to some of the Construction Engineer and Qualified Civil Engineer functions of an ARPE including the ability to sign off on the completion on Measures in the Interest of Safety. DEFRA has however advised the review that while there may be some ambiguity in

the legislation, its interpretation and strong view is that the independence of the engineers carrying out these duties is an absolute corner stone of the current safety regime.

An alternative, suggested to the review by a senior industry figure would be to investigate if a representative organisation could consider offering ARPE services to the sector. Water UK is the obvious candidate as it funded by a levy on the water companies who are by far the most significant group of owners. Our contributor suggested that this type of sector level collaboration should extend to water companies and other large owners providing greater support, including access to expertise, to smaller owners.

Once again this is a radical and disruptive idea. An obvious risk would be to further reduce the work available to consultancy businesses from large, well-resourced owners with multiple reservoirs, further reducing the attractiveness of the sector.

The review would however welcome views and evidence on the desirability and feasibility of this approach and the practical steps required to put it into practice.

5. The future panel structure

5.1 Questions

- How could the number and structure of Panels evolve to improve the supply and utilisation of Panel Engineers?
- In the event of a change, what would be your preferred panel structure and why?
- How could any risks be mitigated?

5.2 Discussion

In addition to the All Reservoir and Supervising Engineering Panels, legislation also allows Ministers to appoint engineers to the Non-Impounding Reservoir Panel and the Services Reservoirs Panel whose members able to carry out Inspecting and Construction Engineer duties on a limited category of reservoirs. These Panels currently have 1 and 3 members respectively and initial feedback to the review is that they do not offer an attractive career path for Panel Engineers and that clients prefer to gravitate to ARPEs and their teams. The review would however welcome views and evidence as to the future of these Panels and if other specialist panels could be of interest to the market and offer viable career pathways for Supervising Engineers looking to take their career to a higher level.

The review also understands that there has been a long running debate in the sector about the benefits of requesting that the Secretary of State create a new Inspecting Engineer Panel, whose members would be able to carry out the Inspecting Engineer but not the Construction Engineer role of an All-Reservoir Panel Engineer. Variations on this proposal would seek the creation of Panel's based on risk consequence or dam height.

One suggested benefit of this change would be to reduce the size of the jump between what is expected of a Supervising Engineer and an ARPE. In this context, the review notes that the 2016 Reservoir Committee survey of Supervising Engineers discussed earlier in this paper revealed that creating an Inspecting Engineer Panel was the change most likely to induce an existing SE to submit an application for a higher panel.

It is clear from our early work that there is no consensus in the sector on the desirability of this proposal. Opponents suggest that it fails to take into account the fundamental differences between the Inspecting Engineer and Supervising Engineer roles, with the Inspecting Engineer's responsibility for assessing the overall adequacy of a dam requiring the construction experience of an ARPE.

Supporters however suggest that circa 70% of UK reservoirs fall into lower risk categories and that with appropriate mitigations, for example probation periods with supervision from an existing ARPE an experienced Supervising Engineer, with a good level of experience of a range of dams can deliver an acceptable Inspection report for these lower risk assets.

This could in turn have the benefit of freeing up the most experienced ARPEs to focus their activity on the 30% of dams that pose the greatest risk.

The review has an open mind about the future Panel structure and would welcome views and evidence as to the benefits and disbenefits of potential changes.

6. A structured development pathway and training for prospective All Reservoir Panel Engineers

6.1 Questions

- What action can be taken to help prospective All Reservoir Panel Engineers access construction supervision and design experience.
- What role can better communication of the range of works the Reservoir Committee accepts as relevant construction play in solving this problem?
- Do you agree that the Reservoir Committee should create a structured support and guidance package that sets out a pathway to support SEs develop and demonstrate achievement of the attributes needed for appointment to the All Reservoirs Panel?
- What role could such a codified pathway play in opening the sector to qualified civil engineers from other disciplines
- Does you or your organisation have any materials or processes that could contribute to such a package?
- What role could a formal training course place in this package? How could such a course be funded and delivered?

6.2 Discussion

In addition to examining opportunities to reduce the size of the step between the Supervising Engineer and All Reservoirs Panel, contributors to the review have encouraged us to examine the support provided to SEs who wish to progress to the higher panel.

The evidence gathered to date suggest there are some practical barriers that hold back engineers from progressing smoothly through the pipeline from SE to ARPE.

Construction Supervision & Design Experience

The Reservoir Committee's 2016 survey of Supervising Engineers revealed that 48% of the SEs with ambitions to progress to ARPE reported that they believed they needed to acquire further construction supervision experience before applying for appointment as an ARPE. Similar numbers were reported in relation to design experience.

The difficulty in acquiring this experience has been a very common theme of the contributions to the review, with many respondents noting the negative impact of a decline in reservoir construction in the UK and globally over recent decades.

Other contributors however noted that the Reservoir Committee accepts a very broad range of work as relevant experience, including supervision of significant upgrades and maintenance activity. This may not be widely understood by the industry creating an opportunity for a quick-win via targeted communication from the Reservoir Committee to SEs to clarify the situation for potential APREs.

A structured pathway from the Supervising Engineer Panel to All Reservoir Panel

The Reservoir Committee's adoption of sets of attributes for SEs and ARPEs is popular in the sector as it provides a clear and objective standard against which candidates will be assessed at interview.

A number of contributors have however suggested that there would be great value in the Committee publishing further guidance setting out in detail what will be expected or accepted by the Panel to demonstrate that the attributes have been met.

In relation to progression from SE to ARPE, a number of contributors have suggested that the Reservoir Committee should go further and create a structured training and development programme or pathway, allowing candidates to “tick off” progress over a period of years. The programme could incorporate formal training, reading, shadowing of inspections and assessments of a candidates work from an existing ARPE. It was argued that such a pathway should also ensure that candidates only apply for interview when they have clearly passed a threshold of knowledge and experience that will give them a high chance of success at interview. It has also been suggested that such a pathway may improve access to the reservoirs sector for suitably qualified and experienced engineers currently working in other parts of the industry.

An All Reservoir Panel Engineer Training Package

The review understands that formal training can only ever form a part of such an ARPE development programme, as many of the attributes required of an ARPE, particularly for the Inspecting Engineer role must be acquired through experience and mentoring. Our initial soundings have however revealed considerable support for the idea for a short, training course that can ensure that all prospective ARPEs have access to the same baseline of codified knowledge, irrespective of their employer. The review is not aware of a UK university with sufficient expertise to deliver such a course and even if one could be identified, the number of annual participants is unlikely to be sufficient to make it an attractive commercial proposition. The British Dam Society and Institution of Civil Engineers could however play an important role in delivering such a course as part of their roles as Learned Societies. The ultimate beneficiaries would however be the reservoir owners and indirectly the public, so we believe there is a strong case for the water companies and the Environment Agency and devolved nation equivalents, in their role as regulators acting in the public interest making a significant contribution to its costs.

7. The ARPE Interview

7.1 Questions

- What has driven the improved pass rate over the last 5 years for candidates presenting for interview for the first time for the All Reservoirs Panel?
- How can the effectiveness and perceived fairness of the interview process be further improved
- How can the pre, during and post interview experience of candidates be improved

7.2 Discussion

The 2016 Reservoir Committee work on succession planning for Inspecting Engineers (see above) reported a historic success rate for candidates applying for their first appointment to the All Reservoir Panel as circa 33% , a figure which drove the overly pessimistic assessment of likely AR numbers discussed above. Since 2016, the pass rate has risen to 61%. While the small numbers presenting for interview means these headline numbers should be treated with caution, the improved pass rate has been sustained over this period. The review would welcome views on the factors that have driven this change and any lessons this may have for driving future supply of Panel Engineers whilst also maintaining high standards.

We are also concerned that a number of both successful and unsuccessful candidates told us that they found the interview process an unpleasant rather than challenging experience, and that feedback and support to failed candidates could be significantly improved.

A number of the failed candidates have told us that they are unlikely to put themselves forward without changes to the interview process, given that the sector draws on a relatively small pool of potential candidates. The review would therefore be interested in proposals for improving the effectiveness of the All Reservoir Panel interview, in particular ways to improve candidate experience pre and post interview and the overall perception of its fairness and transparency.

8. Diversity

8.1 Questions

- What can be done to improve the extremely low diversity of the membership of the Reservoir Panels

8.2 Discussion

The membership list of the All Reservoir Panel and Supervising Engineers Panel are publicly available on the DEFRA website. They currently show that female engineers account for 2 of 33 ARPEs and 13 of 134 SEs.

The review does not currently have figures for other protected characteristics under the Equalities Act.

The ICE have been able to provide data on the ages of 30 of the 33 ARPEs, which shows the following distribution:

- 43-45 6
- 46-50 4
- 50-55 6
- 56-60 4
- 60-65 1
- 65-70 5
- 70+ 4

The figures on gender balance are extremely stark and are very poor even in the context of the wider engineering sector which has struggled for many years with this issue.

A number of contributors have expressed the view that in the medium term tackling the sectors lack of diversity can make a significant contribution to both the numbers of Panel Engineers available and the overall attractiveness of the sector to potential new entrants.

The review is therefore extremely keen to hear ideas on how the diversity of the dams and reservoir sector can be improved and who must act.

Annex A – Review Terms of Reference

Purpose:

To develop proposals to secure the long-term supply of suitably qualified and experienced engineers to join official Reservoir safety Engineer Panels, enabling them to carry out Construction Engineer, Inspecting Engineer, and Supervising Engineer roles in the UK

To develop proposals for increasing the number of engineers on reservoir engineer panels in the short to medium term over the next five years.

To consider the retention of reservoir engineers within the sector, civil engineering companies, other employers, and as self-employed engineers.

Description:

This project is to help shape and inform the response to recommendations made by the [Independent Reservoir Safety Review](#) concerning the future supply and professional development of engineers. In particular, to ensure the sustainability of sufficient suitably qualified engineers to carry out the Inspecting Engineer and Construction Engineer roles and duties: This project will focus on the following recommendation made from the review (recommendations 7, 8(a), 8(b) – note 8(a) is included in case of links and dependencies but work for 8(a) will be taken forward separately.

Scope:

The aim is to consider the attractiveness of a reservoir engineer specialism, including for individuals and the commercial market and identify measures that could be taken to improve and promote this specialism within civil engineering, and with new entrants into civil engineering. In particular to:

- Define and understand the causes of incentives and disincentives for professional engineers and firms to undertake reservoir inspections as official panel engineers.
- Compare incentives and disincentives in the reservoirs sector to an adjacent sector/s with successful incentivisation
- Identify the solutions to create positive incentives to ensure a healthy future supply of supervising, inspecting and construction engineers
- Identify transferable knowledge, skills, experience and training that would enable engineers to move into reservoir engineer roles from other sectors
- Identify ways in which universities, employers and ICE could help develop the knowledge, skills, experience needed for engineers to enter the reservoir engineer specialism
- Identify training and professional development to enable reservoir Supervising Engineers to become Inspecting and Construction engineers

In considering these matters, the following should be taken into account:

- The consultancy and professional services landscape in the civil engineering sector
- The distribution of work within members of the reservoir engineer panels
- Educational base and professional qualification processes for civil engineers
- Ongoing professional development of civil engineers and the incentives to move between sectors
- Best practice in other countries for managing reservoir engineers professional development.

- The influence of public policy and regulation on the reservoirs sector specifically and professional services in general, and that the regulatory regimes for UK Administrations are different though broadly consistent. Each administration should be consulted as part of the project.

Annex B - Attributes of SE and ARPE Engineers

Supervising Engineers	
Attribute Group	Required skill sets
1. Dam and Reservoirs Engineering knowledge	<p>A. Demonstrate an understanding of issues affecting the safety of dams and reservoirs.</p> <p>B. Demonstrate an understanding of monitoring and surveillance practices that may be adopted to ensure ongoing safety of dams and reservoirs.</p> <p>C. Demonstrate an appreciation of the characteristics of all reservoirs to which current reservoirs legislation applies.</p> <p>D. Be able to provide appropriate technical advice and give directions and written recommendations, where appropriate, to Undertakers and Reservoir Managers.</p> <p>E. Demonstrate practical experience in dam and reservoir engineering in the UK. Recent experience must include one or more of the following activities: dam or reservoir design, supervision of construction or refurbishment or improvement works, and operation of reservoirs.</p>
2. Reservoirs legislation	<p>A. Demonstrate appropriate knowledge of the primary legislation in all territories in which the applicant wishes to practice.</p> <p>B. Demonstrate appropriate knowledge of the subordinate legislation that supports the primary legislation in those territories.</p>
3. Observational skills	<p>A. Be able to recognise symptoms that may give advance warning of a developing structural problem within a dam and its associated works.</p> <p>B. Be able to assemble evidence to form the basis for sound engineering decisions.</p> <p>C. Be able to search out and monitor changes in the condition of a reservoir that might affect its safety.</p>
4. Independent judgment	<p>A. Be able to identify and recognise the limits of personal knowledge and skills.</p> <p>B. Be able to identify and assess critical indicators in connection with the ongoing safe storage of water in a reservoir</p>

	C. Be able to review information critically and to take decisions on actions necessary to ensure ongoing safety.
5. Maturity of judgment	<p>A. Be able to judge the frequency at which visits should be made to reservoirs under their supervision.</p> <p>B. Be able to decide when to escalate a technical issue, such as seeking advice from an Inspecting Engineer or calling for a statutory inspection to be brought forward.</p> <p>C. Demonstrate an understanding as to when to make Directions or written recommendations to Undertakers and Reservoir Managers.</p>
6. Leadership & responsibility	A. Be able to guide the Undertaker or Reservoir Manager on actions to be taken during a reservoir safety incident pending the arrival of an Inspecting Engineer.
7. Health & safety hazards & risk management	<p>A. Demonstrate appropriate knowledge and application of legislation, hazards and safe systems of work relating to the operation and maintenance of reservoirs.</p> <p>B. Be able to produce appropriate risk assessments and method statements for all reservoir activities.</p>
8. Interpersonal skills & communication	<p>A. Be able to communicate well with Undertakers, Managers and non-technical staff involved in the management of reservoir safety.</p> <p>B. Be able to discuss ideas and technical issues affecting reservoir safety with other engineers and specialists.</p> <p>C. Be able to prepare written documents in a concise and succinct manner such that technical issues may be communicated effectively.</p> <p>D. Be able to explain the technical purpose and the reason why Directions or other advice has been recommended.</p>
9. Professional standards	<p>A. Be able to demonstrate that the applicant has kept up to date with advances in dam engineering and surveillance practice.</p> <p>B. Be able to demonstrate that the applicant has kept up to date with latest guidance in each region to which the application refers.</p> <p>C. Be able to demonstrate regular engagement in dams and reservoirs related CPD activities.</p>
10. Generic	A. Incorporated Engineer 1.

All Reservoirs Panel Engineers	
Attribute Group	Required skill sets
<p>1.</p> <p>Dam and Reservoirs Engineering knowledge</p>	<p>A. Demonstrate a detailed knowledge of issues affecting the safety of dams and reservoirs.</p> <p>B. Demonstrate knowledge of geotechnics, hydrology¹, hydraulics¹ & structures in relation to the design and construction of dams and reservoirs.</p> <p>C. Demonstrate a detailed knowledge of the behaviour of dams and reservoirs and of the monitoring and surveillance practices that may be adopted to ensure ongoing safety of existing dams and reservoirs, and first filling of new/raised dams.</p> <p>D. Demonstrate a detailed knowledge of the nature and characteristics of the full range of water retaining structures to which the reservoirs legislation applies.</p> <p>E. Be able to provide appropriate technical guidance and make appropriate recommendations to Undertakers and Reservoir Managers.</p> <p>F. Demonstrate technical expertise and practical experience in design and construction in the UK. Recent experience must include dam or reservoir design and supervision of major reservoir construction works and monitoring / surveillance of dams and reservoirs.</p>
<p>2.</p> <p>Reservoirs legislation</p>	<p>C. Demonstrate appropriate knowledge of the primary legislation in all territories in which the applicant wishes to practice.</p> <p>D. Demonstrate appropriate knowledge of the subordinate legislation that supports the primary legislation in the territories.</p>
<p>3.</p> <p>Observational skills</p>	<p>D. Be able to recognise those features that may give advance warning of a developing structural problem within a dam and its associated works.</p> <p>E. Be able to specify effective monitoring and surveillance regimes.</p>

	F. Be able to diagnose the condition of a dam or reservoir and to direct studies so as to investigate defects that affect reservoir safety and determine whether works are needed to ensure ongoing safety.
4. Independent judgment	<p>D. Be able to identify and recognise the limits of personal knowledge and skills.</p> <p>E. Be able to identify critical indicators and assess risk in connection with the ongoing safe storage of water in a reservoir</p> <p>F. Be able to review information critically and to make independent decisions on those actions necessary to ensure ongoing safety.</p> <p>G. Be able to specify key design/ construction requirements for new dams and/or improvement works at existing dams, including the specification of appropriate supervision, quality management, etc.</p>
5. Maturity of judgment	<p>D. Be able to determine the frequency at which a reservoir should be visited by the Undertaker or Reservoir Manager or other persons, if any, responsible for monitoring and surveillance.</p> <p>E. Be able to decide when to escalate a safety issue, such as seeking advice from other specialists or declaring an incident or emergency.</p> <p>F. Demonstrate the ability to assess reservoir safety issues and to make appropriate recommendations in the interest of safety and/or maintenance.</p>
6. Leadership & responsibility	<p>B. Be able to direct the technical management of a reservoir safety incident until such time as control is passed over to the Emergency Services or other Agency/Department.</p> <p>C. Be able to direct the design and construction of physical works on dams.</p>
7. Health & safety hazards & risk management	<p>C. Demonstrate appropriate knowledge and application of legislation, hazards and safe systems of work relating to the design, alteration, new construction, operation and maintenance of reservoirs.</p> <p>D. Be able to produce appropriate risk assessments and method statements for all reservoir activities.</p>

<p>8. Interpersonal skills & communication</p>	<p>E. Be able to communicate well with Undertakers, Managers and non-technical staff involved in the management of reservoir safety.</p> <p>F. Be able to discuss ideas and technical issues with other engineers and specialists relating to dam design, construction, monitoring and reservoir safety.</p> <p>G. Be able to prepare written documents in a concise and succinct manner such that technical issues may be communicated effectively.</p> <p>H. Be able to explain the technical purpose and reason why safety and/or maintenance measures have been recommended.</p> <p>I. Be able to explain the technical purpose of design features incorporated within new dams)</p>
<p>9. Professional standards</p>	<p>D. Be able to demonstrate that the applicant has kept up to date with advances in dam engineering and surveillance practice.</p> <p>E. Be able to demonstrate that the applicant has kept up to date with latest guidance in each region to which the application refers.</p> <p>F. Be able to demonstrate regular engagement in dams and reservoirs related CPD activities.</p>
<p>10. Generic</p>	<p>A. Chartered Engineer.1. (1. Not required for Service Reservoir or Non Impounding Reservoir Panel applicants)</p>