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Flood and Water Management Bill

Impact Assessment - Reservoir Safety

Last updated: 14 October 2009

Summary: Intervention & Options

Department /Agency: Defra	Title: Impact Assessment of Reservoir Safety	
Stage: Bill	Version: 2.03	Date: 14 October 2009
Related Publications: Government Response to the Pitt Review (recommendation 57)		

Available to view or download at:

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What is the problem under consideration? Why is government intervention necessary?

Reservoirs store water for drinking supply, agriculture and recreation etc. They pose a risk to communities downstream in the event of a breach. Both operational requirements and the need to compensate for any damage encourage maintenance, but the low probability and large consequences of a breach can mean they are insufficient to protect public safety. Insurance is not an alternative to regulation in safeguarding the public as it is a thin market which cannot be relied on adequately to address all risks. This market failure has led to government regulation, however this is based on volume of water, not risk. Welfare can be improved by de-regulating some low risk large reservoirs and identifying and regulating smaller high risk ones.

What are the policy objectives and the intended effects?

The on going policy objective is to provide a high level of protection to the public from the continued operation of reservoirs. Related objectives are to ensure that reservoirs are managed in a way that reflects the risk, to build on the reservoir owners' own incentives to manage this risk and to minimise the subsequent cost to government and the tax-payer in the event of a breach. At this stage in the policy cycle the objective is to move to a more risk based approach by de-regulating large low risk reservoirs and registering and risk assessing small reservoirs. Later stages (and subject to separate consultation and impact assessment) will focus on ensuring an appropriate level of protection is provided.

What policy options have been considered? Please justify any preferred option.

The proposal is to require registration of all reservoirs above the de minimis size; and to provide for the proportionate risk-based controls to be set out in detailed rules once registration is completed and risks assessed. Market-based and "do-nothing" options have been considered; and more ambitious approaches have been discarded at the primary legislation stage as a means of risk assessment is not available against which their effectiveness can be properly addressed. Consideration of their applicability will be reviewed post-registration in the light of knowledge gained as detailed rules are developed.

When will the policy be reviewed to establish the actual costs and benefits and the achievement of the desired effects?

Implementation will be subject to stakeholder engagement to ensure it is bedding in properly. Monitoring indicator will be numbers of reservoirs being registered. Government intends to review any new provisions within two years of Enactment or the entry into force (as appropriate).

Ministerial Sign-off For final proposal/implementation stage Impact Assessments:

I have read the Impact Assessment and I am satisfied that (a) it represents a fair and reasonable view of the expected costs, benefits and impact of the policy, and (b) the benefits justify the costs.

Signed by the responsible Minister:

.....Date:

Summary: Analysis & Evidence

Policy Option: Preferred Option

Description: Deregulation/registration

COSTS	ANNUAL COSTS		Description and scale of key monetised costs by 'main affected groups' Costs of registration of all reservoirs over 10,000 cu metres above ground capacity falling almost exclusively on owners of SRRs.
	One-off (Transition)	Yrs	
	£ 7million	50	
	Average Annual Cost (excluding one-off)		
	£ -		Total Cost (PV) £ 7 million
Other key non-monetised costs by 'main affected groups'			

BENEFITS	ANNUAL BENEFITS		Description and scale of key monetised benefits by 'main affected groups' Cost savings from deregulation of low risk reservoirs over 25,000 cu metres above ground capacity. Savings will fall to the owners of such LRRs, some of whom will also be owners of SRRs.
	One-off	Yrs	
	£ -	50	
	Average Annual Benefit (excluding one-off)		
	£ 5million		Total Benefit (PV) £ 121 million
Other key non-monetised benefits by 'main affected groups'			

Key Assumptions/Sensitivities/Risks See Annex 3. It is assumed that the costs of on and off site flood plans associated with S12 of the Reservoirs Act are part of the reference case. Sensitivity analysis has focussed on two key variables: the extent to which voluntary action is undertaken in the absence of regulation and the proportion of reservoirs requiring further action beyond simple registration.

Price Base Year	Time Period Years	Net Benefit Range (NPV) £	NET BENEFIT (NPV Best estimate) £
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What is the geographic coverage of the policy/option?	England and Wales			
On what date will the policy be implemented?	2010			
Which organisation(s) will enforce the policy?	Defra and EA			
What is the total annual cost of enforcement for these organisations?	£ -0.9 million			
Does enforcement comply with Hampton principles?	Yes			
Will implementation go beyond minimum EU requirements?	Yes			
What is the value of the proposed offsetting measure per year?	£			
What is the value of changes in greenhouse gas emissions?	£			
Will the proposal have a significant impact on competition?	No			
Annual cost (£-£) per organisation (excluding one-off)	Micro	Small 1230	Medium	Large -6410
Are any of these organisations exempt?	Yes/No	Yes/No	N/A	N/A

Impact on Admin Burdens Baseline (2005 Prices) £million					(Increase - Decrease)
Increase of	£	0.79	Decrease of	£	0.82
Net Impact					£ -0.03

Key: Annual costs and benefits: Constant Prices

Evidence Base (for summary sheets)

Scope of this Impact Assessment

This impact assessment considers the costs and benefits of changing the reservoir regulatory regime such that reservoirs that do not pose a risk to the public are de-regulated and other reservoirs which may pose a risk are registered. In so doing it will be possible to deregulate some low risk reservoir undertakers that are currently subject to regulation, but undertakers of high risk reservoirs will be subject to new regulations to register and have inundation maps produced. Following this step, further regulations will be brought forward which will lead to any necessary public safety measures. These further regulations are not considered in this IA as they will not follow automatically from the Bill. However a longer term expected outcome is presented for information only. This longer term outlook presents the costs only as it is not possible at this stage to estimate the benefits.

1.1 Status of Evidence

This assessment addresses the clauses in the Bill that deal specifically with reservoir safety which remain substantially unchanged from the proposals in the draft Floods and Water Management Bill. It is based on existing information from numerous sources and our interpretation of factors that potentially affect the safety of reservoirs. Since the preparation of the draft Impact Assessment for the Floods and Water Management Bill we have commissioned further work to improve our assessment of the costs and benefits of these proposals.

In the context of the Defra Policy Cycle, the driver for developing and appraising options is a Government commitment to modernising reservoir safety legislation. The independently-led review into the summer 2007 floods (the Pitt Review <http://archive.cabinetoffice.gov.uk/pittreview/thepittreview.html>) concluded that the current statutory regime did not adequately cater for risks to public safety from an uncontrolled release of water from reservoirs and concluded in particular that a more risk-based approach should be adopted. The review noted that risks exist for reservoirs whose capacity is less than that which qualified them to be included in the controls in Reservoirs Act 1975, as amended. Within the Defra Policy Cycle this Impact Assessment is at the "Prepare for Delivery" stage.

If enacted, the effects of the Bill would be both regulatory and deregulatory as the clauses would:

- (a) remove some of the existing regulatory requirements with which undertakers of Large Raised Reservoirs (those of a capacity of over 25,000 cubic metres) currently have to comply, by virtue of the Reservoirs Act 1975 (as amended); and
- (b) place proportionate regulatory requirements on undertakers of Small Raised Reservoirs (those of a capacity between 10,000 and 25,000 cubic metres) that pose risks to public safety but which are not currently covered by the provisions of the 1975 Act.

Knowledge gaps

This Impact Assessment is based on a number of assumptions, which we have had to make since we do not yet know with any degree of certainty:

- how many Small Raised Reservoirs (SRRs) exist; so
- how many of those SRRs might present a risk to the public; and
- the likelihood of a reservoir breach occurring that might affect people (partly because of a lack of any recently recorded events; partly because we have limited information on the types and condition of SRRs; and partly because the likelihood is inherently difficult to assess).

For LRRs we know enough about the risks to be clear that a proportion of them do not pose a risk to public safety because of their location. So an element of deregulation can be introduced once the Bill has been enacted and registration completed.

For SRRs although overall information is lacking, enough is known from incidents for it to be clear that in at least some cases, risks do exist (see Annex 2). In addition a comparison of risks from SRRs compared to those from LRRs is also possible through information from one portfolio risk assessment for reservoirs in one area. The advantage of this comparison is that a number of factors go into the rankings within a portfolio which give a good indication of the relative condition of LRRs and SRRs. This indicates that a disproportionately large number of SRRs appear high up the list, ie represent a greater risk than LRRs and thus present greater chance of uncontrolled releases of water. It should be borne in mind that the reservoirs studied are all in the ownership of one institutional owner. However, there is no reason to suppose that their condition is any worse than those SRRs in other ownership.

2.1 Policy rationale

Reservoirs store water for drinking supply, agriculture and recreation etc. They pose a risk to communities downstream in the event of a breach. Both operational requirements and the need to compensate for any damage encourage maintenance, but the low probability and large consequences of a breach can mean they are insufficient to protect public safety. Insurance is not an alternative to regulation in safeguarding the public as it is a thin market which cannot be relied on adequately to address all risks. This market failure has led to government regulation, however this is based on volume of water, not risk. Welfare can be improved by de-regulating some low risk large reservoirs and identifying and regulating smaller high risk ones.

Recognising this, in its December 2008 response to Sir Michael Pitt's report on the summer 2007 floods, the Government said it accepted the need to improve the efficacy of the Reservoirs Act 1975, as amended, and was developing proposals for revised legislation, to be included in the draft Floods and Water Management Bill.

Based on the evidence gathered and presented by Sir Michael Pitt, there are a number of weaknesses in the current controls relating to risk:

- they assume that controls should apply to all LRRs, regardless of whether or not there are risks to downstream populations from uncontrolled releases of water;
- they exclude any reservoir below the 25,000 cubic metre criterion; and
- levels of enforcement are unsatisfactory or lead to a high level of risk (see Annex 1)

The results of the consultation on the Floods and Water Management Bill indicate a high level of agreement that the legislation needs to be updated to better reflect a risk-based approach. The degree of concern expressed in responses about the uncertainty over the precise impacts of the changes is well understood, since the proposals provide essentially only for a more risk-based system to be put in place; detailed rules, to be determined later and subject to their own IA, would contain specific requirements, which would drive safety measures and hence costs and benefits.

Therefore the rationale for the policy is largely to correct a regulatory failure such that current regulations do not properly account for the risk associated with different reservoirs and as a result misdirect resources devoted to reservoir safety. The development of a more risk-based approach would enable those resources to be better directed.

Elaboration of risk-based approach as it applies to reservoirs

A risk-based approach starts with the notion that the costs of measures to address risks to the public should at least be matched by the benefits derived from those measures. Risk is the

likelihood of an event occurring and its impact. In this context, the risk is that posed to the public from uncontrolled releases of water from reservoirs.

This sector does of course have its own peculiarities in the application of a risk-based approach. The main one is that it is not possible to lay down in legislation broad criteria that, with any degree of objective certainty, will identify one reservoir within a particular description (e.g. for illustration such a description might be earth embankment construction) as being more or less likely to fail than another (see Annex 2 for a description of the types of failure). A wide range of factors affect likelihood which can be assessed only by engineering experts on a case by case basis.

Nevertheless, there are certain broad descriptions that might be applied. For example, certain service reservoirs (which supply potable water direct to consumers) which inherently pose a negligible risk, might be exempted from regulation (see below); some structures might be subject to lower levels of regulation, depending on embankment height. The proposals will enable exemptions to be set out and for proportionate levels of regulation to be specified. At the moment, however, it is not possible definitively to say what descriptions might be adopted in secondary legislation, although they will, of course, be subject to consultation at the time. In order to develop Regulations, registration of SRRs is needed to enable risk assessment to be done and we would also look to the engineering profession to advise on technical matters and may need to commission specific studies where, for example, existing information needs to be refined.

However, objective certainty can be achieved in relation to impacts. Reservoir inundation mapping enables identification of whether an uncontrolled release of water from a particular reservoir could result in loss of life. For this purpose the area of high impact must cover not only residential areas but also those where people might be expected to gather, e.g. at school or at work, i.e. day time and night time populations, because “sunny day” failures are a constant risk (see Annex 2). However, for impounding reservoirs there is expected to be a number of cases where the additional risk of flooding from attenuated flows adds negligibly to that from fluvial events. These procedures allow classification of reservoirs into high risk and low risk.

Translation into primary legislation

The main requirement is for the primary legislation to provide procedures for risk based controls to be applied. This recognises that no such controls can be developed until registration has been completed and a professional view can be taken of the nature of the risks. To help to develop a more risk based approach, we will also be carrying out:

- An analysis of the effects of breach on a number of smaller reservoirs to show the level of impacts and to inform risk assessment;
- A study into appropriate safety standards. The move towards a more risk-based approach requires consideration of what level of safety is appropriate. This is not, of course, for theoretical purposes: the question is whether different levels of risk which are within an acceptable range, have a significant effect on costs. Current engineering guidance gives acceptable levels of inflow to an impounding reservoir under specified conditions. Application of different levels to the costs of the same remedial works for one situation is underway to indicate whether cost differences are significant. If so, we will commission further work to ensure that appropriate levels are set. It is also intended to commission further studies into where alternative engineering solutions might give an acceptable level at lower cost. Consideration must then be given as to how to propagate these standards – through guidance or through regulation.

2.2 Proposed changes to primary legislation

2.2.1 Overview

The key changes to the existing primary legislation are summarised as follows:

- We should redefine “reservoir” to include structures with a capacity of less than the current criterion - over 25,000 cubic metres. There would be provisions to allow the definition to be amended by secondary legislation, should this be necessary either to include or exclude further reservoirs.
- We should **introduce a requirement for registration of all structures within the new definition**, together with sufficient information to enable the risk classification to be determined.
- We should develop procedures to **impose differential requirements according to:**
 - a) **whether or not a structure poses risks to public safety from uncontrolled releases of water;**
 - b) **whether by its nature it can be wholly or partly exempted from regulation.**

Those differential requirements are therefore assumed to mean that for:

- Large Raised Reservoirs (LRRs) – i.e. those which come within the current legislation - the effect of the approach will mean a progressive reduction in the levels of controls. First, those which can be quickly classified as low risk will effectively be deregulated; second, Regulations defining structures that can be exempted will also deregulate some other LRRs; and, third, Regulations specifying lower levels of controls will partially deregulate. It is not possible to say with any degree of certainty what Regulations under the second and third items will be, let alone their effects, but we can be confident enough of the position on the first to draw some conclusions for economic analysis;
- Small Raised Reservoirs (SRRs), application of controls to SRRs may have to proceed at a slower pace than deregulation of LRRs, mainly because little is known about them. It is in any case desirable to introduce controls in phases. Economic analysis in this Impact Assessment therefore proceeds on the same basis as for LRRs and no account is taken of the effects of exemption or lower controls. Instead the analysis assumes that all small reservoirs that are assessed as high risk are required to meet the same standard.

2.2.2 Key elements of the proposals in more detail

Definition of a reservoir

The current Act applies only to large raised reservoirs capable of holding more than 25,000 cubic metres of water (roughly equivalent to 10 Olympic-sized swimming pools) above natural ground level. Removing the capacity criterion entirely would not be consistent with a risk based approach. The Bill provides for a new minimum **criterion so that bodies of water below 10,000 cubic metres would not be subject to controls**. A general consensus has emerged within the dam engineering profession that this capacity represents the lowest one that could pose risks to the public. However, the profession’s knowledge of smaller reservoirs is necessarily incomplete and once the process of registration has been finished it will be possible to refine this figure. The proposals would provide a procedure for the figure to be extended for example downwards if particular circumstances are identified in the future where risks arise from reservoirs below 10,000 cubic metres capacity. The proposals would also provide a procedure for defining circumstances in which reservoirs can be considered a negligible risk (see below) even if they are close to areas of population. Otherwise the proposals would cover any structure (whether wholly or partially artificial) which is designed to collect and store a large volume of water for any purpose.

Registration

There would be a proposed legal obligation on all undertaker(s) to register with the Environment Agency any reservoir which is subject to the proposed requirements. We are proposing to set out the detailed registration requirements in secondary legislation. A number of suggestions were made in responses to consultation on the draft Floods and Water Management Bill about what should be required in registering and we shall reflect on these when drawing up proposals with the aim of keeping the initial requirements for information as simple as possible and include only readily available information. Also, an undertaker who had been an undertaker of a LRR prior to the commencement of this requirement would not need to supply any information held on the register under the previous regime.

An important component of registration is an inundation map, as that is the main basis on which risk classifications would be made. In response to a recommendation from Sir Michael Pitt, the Government is currently producing inundation maps for LRRs which will show the potential area that would be affected by a reservoir breach.

Classification of reservoirs

Reservoirs are currently categorised on a non-statutory basis as to whether an uncontrolled release of water would cause risks to people in a community (broadly, 10 people or more, category A); not in a community (under 10 people category B); property damage (C); and little or no damage (D). Our proposals would provide for delegated powers to establish a more risk-based classification.

The proposed approach is for all reservoirs to be classified by reference to two broad classes:

- “High risk reservoirs” – any reservoir subject to the revised Act, which if it failed, could result in the loss of life in downstream populations (daytime and night time); or
- Other (“Low risk”) reservoirs” – any reservoir subject to the revised Act, which if it failed, should not result in the loss of life in downstream populations.

Whether or not a reservoir failure could result in the loss of life will be determined by reference to the inundation map for each reservoir. Inundation maps will show in each case the inundation zone and the daytime and night time populations in that zone and need to be prepared to a prescribed methodology.

Exemptions and lower levels of control

In addition, Regulations will specify exemptions, dependent on any characteristics which mean that in practice certain classes of reservoir pose negligible risks to the public. For example, it has been proposed that certain concrete service reservoirs fall into this category. This is, of course, only one description of type: other descriptions might involve embankment height, for example, and might involve partial exemption (i.e. a lower level of regulation).

The system set out above will be used to drive safety measures. Reservoir owners maintain their reservoirs to keep them operational. They are also motivated to avoid compensation claims which might be made in the event of a breach. Such claims may or may not be fully offset by insurance. However where reservoirs are likely to pose a risk to human life public liability insurance cannot adequately cover the loss of life and this is one of the main reasons why there is a need for government regulation in cases where there is a risk to life.

In such circumstances the public safety standard to which the reservoir *should* operate may be above the standard the owner would privately decide to operate at. The benefits of the higher standard are public benefits and we cannot rely on the market to deliver these on its own. The risk classification etc will be used to determine the appropriate safety measures by balancing

the cost of the additional public safety controls with the benefits. In addition consideration will also be given at the time of developing the classification system to the affordability of the public safety measures, since these will have a consequence for tax-payers in the event that the reservoir owners cannot afford them. It is not possible at this stage to determine what the results of this will be. This will only be possible following the registration and inundation mapping which are a direct consequence of the Bill. Secondary legislation, with its own consultation and impact assessment will be required before appropriate public safety measures can be determined on the basis of the new risk classification system.

Charging

There is currently no provision under the Act to charge undertakers for the costs and expenses the enforcement authority incurs from carrying out its enforcement functions. The proposals include a power for a charging scheme to be introduced but excluding costs of registration.

Flood plans

Section 12 of the Reservoirs Act was introduced by the Water Act 2003 and enables Ministers to make a direction on undertakers to prepare on-site flood plans. The proposals in the Floods and Water Management Bill carried forward those provisions, but amended them to include amongst other things a requirement on undertakers to obtain a certificate in a prescribed form from the Supervising Engineer that the on-site emergency plan meets the required technical standards.

The power in Section 12 has not been used to date and the consultation on the Floods and Water Management Bill included a question as to whether we should do so. Nevertheless, in this IA we have assumed such a direction will be made. No costs are included for this since they are considered to be part of the do-nothing/reference case.

Flood plans would comprise the following elements:

- On-site plan - guidance on the content of on-site plans is being prepared, which will set out the requirements for an operational plan which will enable the reservoir undertaker to deal with potential incidents on the site of the reservoir, including contact details of Panel Engineers and emergency services;
- Inundation map – as noted above, in response to a recommendation from Sir Michael Pitt, the Government is currently producing inundation maps for LRRs which will show the potential area that would be affected by a reservoir breach; and
- Off-site plan - this would detail the actions needed by the Category 1 responders - emergency services and local authority - in the event of a likely or actual reservoir breach. Guidance is being prepared on the content of these plans, which would be drawn up by the Category 1 responders.

3.1 Post-implementation review

The proposals would provide for their own review process in the sense that detailed rules will require further consultation and Impact Assessment. In particular, Regulations setting out a system of civil sanctions will need to be introduced to enable more flexible and proportionate enforcement. As part of this process, Government intends to review any new provisions in primary legislation within two years of Enactment or the entry into force of the relevant secondary legislation (as appropriate). Key to such reviews will be the numbers of:

- SRRs that have registered;
- LRRs and SRRs which have been designated as high risk and low risk

4.1 Alternative policy options

In addition to the Government's proposals as set out in the Flood and Water Management Bill, we have explored a number of policy options for primary legislation. We treat these below only in relation to primary legislation: their application at the level of detailed rules and Regulations may well be a different matter.

The “do nothing” more option/reference case

This option would mean that only LRRs would be continue to be subject to controls; and would apply those controls largely regardless of risks to people. This is inconsistent with a risk-based approach to the point that people are exposed to a higher level of an identical type of risk because of the operation of an arbitrary criterion in the RA 1975 and runs counter to Sir Michael Pitt's recommendation, which the Government accepted. The incident referred to in Annex 2 is one example of the types of risks that can occur for reservoirs which are not subject to the RA 1975 and where people are at risk from uncontrolled releases of water. This option is also inconsistent with one result of a risk-based approach, that of deregulation. However, it provides the base option against which other options are judged.

The 'do nothing' more option does not preclude other measures to improve reservoir safety that could be taken on the basis of existing legislation. But there are drawbacks to many, if not all, of these measures.

Insurance / market based option

Another approach might be to manage the risks through compulsory public liability insurance, in the same way that cover is required for car drivers. The rationale for this is that insurance would provide greater confidence that any compensation due in the event of major damage could be provided. Insurance should also 'internalise' the risks, providing a mechanism that reflects the probability and consequences of reservoir failure, thus incentivising effective risk management i.e. encouraging reservoir owners to maintain their reservoirs in a safe condition by proving immediate benefits through reduced insurance premiums.

In setting premiums (and other policy terms) insurers would need to take all relevant factors into account and so it is assumed that they would seek engineering assessment of the reservoir. This is likely to include condition, management, impacts and other factors and combine this with appropriate actuarial / underwriting analysis to price cover appropriately, but there is considerable variation in practice between different insurers.

There are however several complications that make this approach less attractive than it may at first appear. The main problem is that the market for insurance cover is likely to be very thin. Reservoir failures are extremely rare events and very difficult to predict. As such there is unlikely to ever be the type of historical risk/outcome information that would be needed for a competitive market to develop. Whilst public liability cover is widely taken up by businesses it often includes a large range of risks and the incentive to manage a particular risk may not be readily apparent. Conversely if a specific product was developed for reservoir liability, the market would be relatively small and the profile of losses extremely uncertain (since very few reservoirs would be expected to fail, but the costs of such a failure could be very large). As well as resulting in a less competitive market, this is likely to mean that insurers rely on reinsurance which could be subject to rapid variations in cost or availability, thus making the operation of reservoirs sensitive to wider events (such as increases in the cost of capital).

Similarly, if the cover is provided through an annual contract (as is currently the norm for commercial insurance) the transaction costs associated with inspections and assessments could be very high in relation to the risks posed by some reservoirs. Insurance policies seldom cover the full range of impacts – they typically include tangible property damage and injury to people (including loss of life), but some risks (such as incident response cost and some

consequential losses) may be excluded. In some cases the total impacts significantly exceed the cover and thus the appropriate level of safety may not be achieved.

Based on these considerations and consultation with insurers to date, we have concluded that an insurance based approach will not provide an adequate substitute for the primary legislation and without effective regulation the availability of insurance is likely to be severely constrained. The new legislation will facilitate a continuing role for insurance in enabling organisations to manage their potential liabilities. Further discussions with the insurance industry, focussed on ensuring that there is an appropriate market to maintain widespread availability of cover, will continue to take place as policy develops in detail and information from inundation mapping and registration becomes available.

Other options

The **Water Act 2003** introduced the power to direct reservoir owners to produce flood plans, and amended the Reservoirs Act. This could be implemented in its own right and would provide added controls in the event of emergency. However, it would apply only to LRRs and has some inadequacies for example in enforcement.

The **Building Act 1984** provides a mechanism for local authorities to take emergency action in the event that any building – which includes any structure – poses a risk to the public. It is understood that local authorities have in some cases acted under the Building Act. However, it is very much a reactive measure and is unlikely therefore to manage the risk adequately.

Another approach would be to include requirements on safety within **sector-specific legislation** (as with, for example, the **Mines and Quarries Directive**). However, this option may only be for sectors where oversight by a statutory regulator would provide an adequate system of controls. Currently, the water sector owns and operates only 35% of the LRRs in England and Wales, the remainder being in diverse ownership. Only horizontal legislation will address the risks from the whole reservoir stock. This option is therefore rejected.

The “deregulation” only option

The second main alternative to the Government’s proposals would involve removal of controls on low risk LRRs only. Whilst this would clearly benefit owners and undertakers of low risk LRRs, it would not address the risks from some SRRs.

5.1. Costs and Benefits

The costs and benefits discussion below take no account of the benefits to reservoir owners and taxpayers of a level of regulation that goes beyond what the insurance option above describes. Ultimately, the common law liability for any damage caused by an uncontrolled release of water from a reservoir lies with the owner. Regulation to protect the public lessens the likelihood of such a breach. The benefit to the owner from an increased level of avoidance of the common law liability therefore exists but it is unquantifiable. Nevertheless, depending on circumstances it might be large and could have the effect of leading to bankruptcy of the owner, as it is unlikely that insurance will cover the full costs, particularly in extreme cases. For assets owned by the state, the common law liability falls at the Government’s door. Some reservoirs are in Departments’ ownership, including Defra(1) and MoD (several). Local authorities also own reservoirs. For private owners there is in theory no need for the Government to step in to cover any unmet liabilities of an owner who is driven into bankruptcy by the common law liabilities. There might also be costs to the taxpayer (for example through loans, grants or indemnities to provide for services to be maintained) where a water company was forced into special administration because of the size of the liability.

It should also be noted that whilst the proposals are a public safety measure, in those cases where reservoirs are classified as high risk people become a proxy for property, which is thus protected to the same level. In cases where for example people are not at risk – a low risk reservoir – but property such as infrastructure may be, it will be for the owner of the infrastructure asset to determine with the reservoir owner whether the level of risk is acceptable and who should pay for any additional protection; and it will be for Local Resilience Fora (LRFs) to identify these instances.

We have commented above on the reasons for not including any effects arising from exemptions or levels of controls in the following analysis. We have however included the deregulation effects of high and low risk classification of LRRs. That is for two reasons. One, the existence of the Environment Agency's reservoir database and the inundation mapping project currently underway already provides the essential information needed to arrive at this classification. Two, the relatively advanced state of knowledge of LRRs means that it will be possible to set earlier and shorter timetables for classification decisions to be made for LRRs. However, whilst the proposals will also provide for further deregulation by way of exemption and lower levels of controls, we do not consider that any analysis including them would be safe. We can note one potential example: we mention above that newer service reservoirs might be considered for exemption. These make up around half the total number of over 150 such reservoirs in England and Wales that are currently regulated.

Bearing the above in mind, the spreadsheet at Annex 3 sets out the costs by different type of reservoirs under three options.

- Do nothing more (existing situation continues). This represents a base or reference case.
- Deregulation/registration only (Bill preferred Option). Under this option a phased/proportional and evidence based approach is taken in which the first step of moving to a more risk based approach is to deregulate large low risk reservoirs where we are confident that risk is low. This will save time, effort and money and is not expected to affect the overall risk to the public. The next step is to register all small reservoirs and produce inundation maps for these. This will provide information on which to base future regulation which will produce guidance on the standards to which small reservoirs will need to be maintained in order to provide a proportionate level of protection.
- Longer term expected outlook, involving further regulation based on post registration risk assessment and classification etc. In principle it is an option to go beyond the deregulation/registration only option at this stage. This would go beyond the Bill Preferred Option and involve producing on and off-site flood plans, monitoring, supervision and inspection and maintenance to the desired standard. Going forward with this option at this stage is not considered to be feasible given available evidence. Only when registration and inundation mapping are completed will it be possible to identify the current standard of protection and a cost-beneficial desired standard of protection. If this option were pursued at this stage it would likely mean that the existing standards of protection would be under or over-estimated and the desired standard of protection may not be cost-beneficial. However for the purposes of this Impact Assessment an expectation of these future costs is included, making assumptions only about the numbers which might be high risk (i.e. taking no account of exemptions or lower levels of controls). The costs, however, would be offset by the benefits of protection – in terms of avoided damages.

The spreadsheet shows one off and annual costs for regulation and maintenance (detail on each item is provided in the note on assumptions accompanying the spreadsheet):

General comments on Spreadsheet

One off costs. Costs that are not expected to continue have been classified as one off costs. These include registration of the reservoirs, the preparation of inundation maps and the creation of on-site and off-site flood plans. One-off costs would recur only if a reservoir's characteristics change as a result of alterations to the structure or as a result of development, which would be considered as part of the planning process.

Annual costs. All other costs are assumed to recur annually (or because it is unknown when they would occur, they are allocated to the number of years of the assets life). These include the maintenance of the on and off site flood plans, the monitoring of the reservoir condition and necessary work undertaken by the supervising and inspecting engineers. Costs of works to maintain the reservoirs to the required standard are annualised based on a 50 year asset life.

There are four types of reservoirs based on size and risk. There are large low risk reservoirs and large high risk reservoirs (LRRs); and high and low risk small reservoirs (SRRs).

Commentary

To assist in consideration of the proposals we have attached at Annex 4 a provisional timeline for the introduction of controls. This is provisional as it assumes first of all that the proposals are enacted; that unforeseen problems do not arise; and that R&D and its subsequent policy development proceed at a certain pace. Subject to those caveats, the main points to note are that:

- Deregulation of LRRs can be assumed to take place progressively but to begin earlier than regulation of SRRs. For example, whilst classification into high risk and low risk can be done relatively speedily, further deregulation to exempt defined types of structure, say, may not happen at the same time; and
- Regulation of SRRs on a more risk-based approach should take place at the time of risk classification so that classification, exemptions and lower levels of controls can all be introduced together. We believe this is necessary to avoid a situation where a SRR might, say, be classified as high risk and subject to controls for the first time but later be included in exempting Regulations.

The effects of future proposals for detailed rules to be contained in Regulations will set out the effects on LRRs and SRRs separately.

Do nothing more option/reference case

To aid comparison of the options in the evidence spreadsheet the cells show which costs change under each option by different types of shading. Each number in the spreadsheet is also cross referenced to a footnote and to a more detailed list of assumptions.

Under the do nothing more/reference case it is considered that it costs almost the same amount to regulate a low risk as a high risk large reservoir (around £256 (low risk)K versus £299 (high risk)K in present value terms per reservoir, 2008 prices over a 50 year asset life. This includes the cost of producing flood plans under the Reservoirs Act 1975, as amended by the Water Act 2003, as this is assumed to be part of the reference case). The difference being that onsite and offsite flood plans are not produced for low risk LRRs. Some of these costs are considered to be voluntarily incurred; others are the result of the regulations themselves. Thus monitoring of reservoir condition is not a requirement of law, but it is expected that some owners (e.g. water companies) would do it anyway.

Small reservoirs are not currently regulated and it is assumed in the absence of a risk based approach that owners spend about the same amount on both [both what? Low and high risk SRR?] (around £96K). This is largely made up of the cost of maintenance works and fits with the principle that owners would by and large “do as they have always done” irrespective of the actual condition and standard of protection offered by the asset. Many of the same type of costs are incurred, however, generally at a lower cost than for large reservoirs (or equally fewer on average would incur these costs). So as with large reservoirs monitoring of reservoir condition is not required, but it is assumed that some still do this – but generally a lower frequency (25% of them rather than 50%). Similarly there is no legal requirement for supervising or inspection engineers, but it is assumed that some still do this. The main difference in cost, however, is the extent of maintenance expenditure. It is assumed that large reservoirs spend around twice as much as small reservoirs on maintenance per year (£5,000 as opposed to £2,500).

This characterisation of the do nothing is therefore based on the absence of a risk based approach. Costs vary by reservoir type but in relation to size and not in relation to risk. Regulation misdirects costs of around £160K (£256K-£96K) to large low risk reservoirs and leads to under-investment in protection in high risk small reservoirs.

Bill preferred option

Under the Bill preferred option there would be a deregulation of large low risk reservoirs and a registration (including inundation mapping) of small reservoirs (all small reservoirs, since until registration and inundation mapping are completed its impossible to determine the risk posed).

Costs for large low risk reservoirs fall substantially from £256K to £97K (a deregulation saving of around £160K per reservoir). Essentially the large low risk reservoirs are assumed to move to a regime more similar to small reservoirs at present. Hence less would be spent on monitoring, inspection and supervision (or fewer would continue to do this when not legally required) and the reservoirs would be maintained to a lower standard, more proportionate to the risk they pose. There is a small increase in costs to large high risk reservoirs to cover the one-off re-registration under the new system (£60 per reservoir).

For small reservoirs costs increase very marginally (£1,230) to cover new registration and inundation mapping – the pre-requisites to future risk based regulation for smaller reservoirs. Using the numbers of reservoirs presented in Annex 3 gives the following costs for the preferred option:

	FLOW Bill Preferred Option						
	LRR		SRR		Subtotals		
	low risk	high risk	low risk	high risk	LRR	SRR	All
Incremental costs per reservoir £ (2008 prices)							
Incremental one-off costs	60	60	1,230	1,230	120	2,460	2,580
Incremental annual costs (excluding one-off)	- 6,470	-	-	-	- 6,470	-	- 6,470
PV of incremental costs	- 158,590	60	1,230	1,230	- 158,530	2,460	- 156,070
Number of reservoirs	811	1,287	4,682	1,170	2,098	5,852	7,950
Total costs for England and Wales (£M 2008 prices)							
Total incremental one-off costs	0.05	0.08	5.76	1.44	0.13	7.20	7.32
Total incremental annual costs (excluding one-off)	- 5.25	-	-	-	- 5.25	-	- 5.25
Total PV of incremental costs	- 128.62	0.08	5.76	1.44	- 128.54	7.20	- 121.34

These one off additional registration costs (£1230 per reservoir) would mean costs in the region of £7 million for the small reservoirs. This small increase in costs is hugely offset by the deregulation savings of around £128 million for LRRs. As such this option has a net benefit of around £121 million.

Long term expected outlook

The deregulation/registration option would pave the way for a risk based approach to be extended to smaller reservoirs. Under this option the costs for low risk large reservoirs stay the same as for the previous option, as would the costs for low risk small reservoirs (around £97K each). There would be an increase in costs for high risk reservoirs. The increase in cost for large high risk reservoirs reflects the fact that all high risk reservoirs would be expected to undertake the additional monitoring (additional £2,500). As such costs rise from £299K to £361K

For small high risk reservoirs it is expected that significant additional expenditure would be required for monitoring, inspecting, supervising and maintaining small high risk reservoirs. In effect it is assumed that these reservoirs take on costs similar to large high risk reservoirs today – more proportionally reflecting their risk (as opposed to their size). This increases the costs from £97K to £361K for large high risk reservoirs.

In fact the only difference between the cost for a small as opposed to a large high risk reservoir is assumed to be the one off cost of registration. In all other ways costs do not vary with the size of the reservoir, they only vary in terms of risk. This result is based purely on assumption at this stage, since it will only be after registration/inundation mapping that the risk assessment can take place.

	Long term expected outlook (post flow Bill and further regulation)						
	LRR		SRR		Subtotals		
Incremental costs per reservoir £ (2008 prices)	low risk	high risk	low risk	high risk	LRR	SRR	All
Incremental one-off costs	60	60	1,230	9,150	120	10,380	10,500
Incremental annual costs (excluding one-off)	- 6,470	2,500	-	10,420	- 3,970	10,420	6,450
PV of incremental costs	- 158,590	61,360	1,230	264,660	- 97,230	265,890	168,660
Number of reservoirs	811	1,287	4,682	1,170	2,098	5,852	7,950
Total costs for England and Wales (£M 2008 prices)							
Total incremental one-off costs	0.05	0.08	5.76	10.71	0.13	16.46	16.59
Total incremental annual costs (excluding one-off)	- 5.25	3.22	-	12.19	- 2.03	12.19	10.16
Total PV of incremental costs	- 128.62	78.97	5.76	309.65	- 49.65	315.41	265.76

In PV terms the additional costs of monitoring increase costs for large high risk reservoirs by around £79 million. This offsets some of the savings of around 128 million from deregulation. Costs of regulation of small reservoirs would be around £315 million. Hence in the overall expected outlook costs of regulation could rise by £265 million. This cost would either need to be offset by the benefits of the additional risk reduction (public safety benefits that would follow from the regulation of the small high risk reservoirs) or the standards would need to be lowered in order to reduce the costs of maintenance etc until these were proportional to benefits. This proportionality will be the subject of a later impact assessment once the current Bill provisions have been established.

Enforcement costs for the regulations

Under the preferred option the costs of enforcement would be reduced as a result of the de-regulation. This is estimated to save around £1,100 for the 811 large reservoirs that are assumed to be low risk and are therefore de-regulated. This represents an enforcement saving of around £890,000, or £0.9 million.

Annual cost per organisation

This is difficult to estimate since it is not known how many reservoirs each organisation owns. However the information can be estimated on a per reservoir basis. Each organisation would be expected to experience these costs for each reservoir it owns.

Under the preferred option there would be a saving to large low risk reservoirs of around £6470. This would be an annual saving. For large high risk reservoirs there would be no ongoing

increase in costs, but there would be a one off increase in costs for registration and inundation mapping of around £1,230. The outcome for each organisation would depend on how many small and large reservoirs they owned and their risk profile. Those with a large number of low risk large reservoirs and a small number of small reservoirs would stand to gain considerably. Conversely, those with a small number of low risk reservoirs and a large number of small reservoirs may see costs rise.

Admin burdens

As with annual costs it is only possible to undertake the calculations of admin burdens on a per reservoir basis.

Registration costs are expected to be low and are considered to place a small admin burden on the owners. The costs are based on experience in the EA with similar schemes. They are based on requiring owners to supply readily available information and to follow this up by an Agency visit where this information is insufficient to fulfil the requirements of inundation mapping. The owners will not be charged for the follow up visits but would be assumed to incur similar time costs to the Agency.

The readily available information is assumed to be:

- Owner name and details
- Location
- Capacity of reservoir (actual or estimated)
- Embankment height

This information would be supplied in response to a publicity campaign run by the EA to notify potential owners of the requirement to submit the details. It is assumed that on average this would impose a time burden on the owner of around 1 hour, to collate the details and submit them via a letter. It is assumed that this hour has an opportunity cost similar to that of a supervising engineer (see below). Therefore based on an 8 hour day and a per day cost of £480, this would mean a cost of £60 to submit these details. Total costs therefore would be £350,000 ($£60 * 5852$ reservoirs).

The Agency would then collate the information and arrange site visits to those reservoirs where the information isn't considered sufficient or robust enough to input into inundation mapping. It is assumed that visits are required in 45% of cases. This is based on experience with LRRs. Hence it is assumed that 2,633 visits would be made (45% of the total number of SRR, $45% * 5852 = 2633$). The Agency would be expected to combine these visits in as organised way as possible and it is assumed that this would require 3.2 hours per visit (hence 2.5 visits per day). This is based on a scoping project by the EA which established that it was feasible for engineers to conduct around 2-3 visits per day. The cost of an engineering supervisor's time is assumed to be £480 or £60 per hour. Hence the total cost of the visits would be in the region of £506,000 ($3.2 * 2633 * 60 = 506,000$) or £86 per reservoir. These costs would be incurred by the Agency and would not be recovered from the owner.

As the owner or a representative of the owner would be expected to accompany the engineer during the visit this cost is doubled to allow for his time. Hence there would be a further £506,000 administrative cost associated with the owners time to facilitate visits.

The total burden for small reservoirs therefore would be £60 to supply the information plus a further £86 to facilitate a visits (only required in 45% of cases). Hence a total cost of £146. The Agency would incur a further £86 per SRR for the engineers time (making the total £232) but the cost of the engineers is assumed not to be passed on to the reservoir owner. Hence the cost would be £146.

In addition there are the costs of the inundation mapping. These, however, are not passed on to the owners. Hence the total admin burden increase would be £146 for the 5852 small reservoirs, or £860,000. This would be offset by a saving in the admin costs to the deregulated large reservoirs. This would amount to £1,100 for each of the 811 large, low risk reservoirs and hence a total of £890,000. The net change in admin burdens under the preferred option would therefore be a saving of £30,000. These figures are in 2008 prices. For the purposes of the IA these are converted to 2005 prices using the GDP deflator of 1.085. Hence the increase is £790,000, the decrease is £820,000 and the net effect is a saving of £30,000.

Sensitivity analysis for Preferred Option

A sensitivity analysis has been conducted to examine the implications of changes in assumptions for the overall economic case for the preferred Option.

Areas of the economic analysis which were particularly uncertain were targeted for sensitivity analysis. These were:

- The extent to which undertakers are carrying out (or would carry out under relaxed regulation) voluntary monitoring, supervision, inspection and record keeping;
- The proportion of SRRs which would be likely to incur extra costs from registration (over and above the basic £60 charge)

A summary of the results is presented below, with more detail available in Appendix 5

Sensitivity analysis – summary

Test	Variation	Total E&W saving over doing nothing (2008 prices)		% change in saving
		TOTAL	Change on base case	
	BASE CASE	£121m	-	-
1	Proportion of reservoirs benefitting from voluntary monitoring increased from 50% to 65% (high-risk LRRs), and 25% to 33% (low risk LRRs and SRRs)	£129m	Extra saving of £7m to low-risk LRRs on deregulation	+6%
2	As 1, but reduction of proportions to 25% (high risk LRR) and 12.5% (low risk LRR and SRR)	£109m	Reduced saving of £12m to low-risk LRRs on deregulation	-10%
3	No reservoirs have voluntary monitoring	£96m	Reduced saving of £25m to low risk LRRs on deregulation	-20%
4	Proportion of reservoirs benefitting from voluntary supervision and record keeping increased from 10% to 65%	£105m	Reduced saving of £16m for low-risk LRRs on deregulation	-14%
5	No reservoirs have voluntary supervision or record keeping	£124m	Extra saving of £3m for low-risk LRRs on deregulation	+2%
6	Proportion of reservoirs benefitting from voluntary inspections	£118m	Reduced saving of £3m	-3%

	increased from 10% to 65%		for low-risk LRRs on deregulation	
7	No reservoirs have voluntary inspections in absence of regulation	£122m	Extra saving of £0.6m for low risk LRRs on deregulation	+0.5%
8	Proportion of SRRs facing extra costs from registration (beyond £60 fee) increased from 45% to 75%	£121m	Extra cost of £0.6m to SRRs	-0.5%
9	As 8, but proportion reduced from 45% to 10%	£122m	Reduced cost of £0.6m to SRRs	+0.5%

Overall it can be seen that reasonable (and in some cases extreme) changes in assumptions do not change the fundamental economic case for the preferred Option, which ultimately arises because of significant savings to LRRs from deregulation. These are unlikely to be offset to a large degree by increased costs to SRRs from registration.

Specific Impact Tests

Competition Assessment

There will be no impact on competition because the requirements relate to physical characteristics of individual structures and not to the nature of the business operating that structure.

Small Firms Impact Test

There will be no impact on small firms because the requirements relate to physical characteristics of individual structures and not to the nature of the business operating that structure. Depending on who owns the small firms, the size of enterprise owning or managing a reservoir is not related to the capacity of the reservoir. So while the proposals will have impacts on small firms, they will also have impacts on big firms.

Legal Aid

There will be no impact on legal aid as a result of implementing the preferred option.

Sustainable Development

Protecting the surrounding environment, society and local economy by reducing the risk of a reservoir breach will support sustainable development.

Carbon Assessment

There will be no impact on carbon assessments as a result of implementing the preferred option.

Other Environment

By reducing the likelihood of a reservoir breach, the risk of environmental damage is also reduced.

Health

There will be no impact on health as a result of implementing the preferred option, other than protecting human welfare including health.

Race, Disability or Gender Equality

There will be no impact on race, disability or disability equality as a result of implementing the preferred option.

Human Rights

There will be no impact on human rights as a result of implementing the preferred option.

Rural Proofing

See Annex 5.

Specific Impact Tests: Checklist

Use the table below to demonstrate how broadly you have considered the potential impacts of your policy options.

Ensure that the results of any tests that impact on the cost-benefit analysis are contained within the main evidence base; other results may be annexed.

Type of testing undertaken	<i>Results in Evidence Base?</i>	<i>Results annexed?</i>
Competition Assessment	No	No
Small Firms Impact Test	No	No
Legal Aid	No	No
Sustainable Development	No	No
Carbon Assessment	No	No
Other Environment	No	No
Health Impact Assessment	No	No
Race Equality	No	No
Disability Equality	No	No
Gender Equality	No	No
Human Rights	No	No
Rural Proofing (see Annex 5)	No	Yes

Annexes

Annex 1

Deficiencies with current policy: enforcement

The provisions of the RA 1975 have led to inconsistencies in enforcement, e.g:

1. Inspecting Engineers' reports are not required to be sent to the enforcement authority if they contain no recommendations in the interests of safety.
2. The enforcement authority is therefore unable to build a picture of the condition of all reservoirs within the controls.
3. The enforcement provisions are also inflexible: they provide for serving of notices when compliance with the requirements has not been achieved and prosecution.
4. Modern regulation as set out in the Regulatory Enforcement and Sanctions Act 2008 takes a much more flexible and proportionate approach with penalties being able to be set in relation to the risks posed by individual instances of non-compliance.

A voluntary system of incident reporting was introduced by the Environment Agency in 2007. The aim is to provide reservoir undertakers and the civil engineering profession with a source of information on problems identified so that these can be shared and others learn from individual experiences. This system has met with a variable response from undertakers, not all of whom provide information to make the system a comprehensive picture of problems to be shared.

Annex 2

Background on reservoirs

Reservoirs are civil engineered structures that together with the surrounding land hold water above normal ground levels. In England and Wales the water stored is used for a number of purposes, the most obvious being water supply for drinking water, farm irrigation or industrial processes but also includes recreational uses, flood water storage (to attenuate flood flows on a watercourse), hydro-power and landscape features etc.

Ownership is similarly diverse: water companies, local authorities, industrial concerns, private individuals, the National Trust and fishing clubs are included in this, as well as the Environment Agency which manages a number of flood storage reservoirs (as well as being the enforcement authority in England and Wales for the 1975 Act and under these proposals). Although official controls do exist on reservoir safety (see below), the liability under common law for any effects the reservoir has on third parties – e.g. through flooding caused by overtopping or breach of the retaining structures – lies with the reservoir owner. For this reason, we understand that many reservoir owners maintain public liability insurance against such risks.

Since 1930, reservoirs with capacity in excess of 25,000 cu metres have been classified as Large Raised Reservoirs (LRRs). The origins of this figure lie in the size of those reservoirs which breached in the 1920s causing loss of life. Policy since that time has been to apply a system of safety controls for LRRs which has sought to minimise the risks to public safety from uncontrolled releases of water. There are no such provisions for reservoirs below this capacity (i.e. SRRs).

The Reservoirs Act 1975 (RA 1975) provides for undertakers of LRRs to appoint supervising and inspecting engineers to oversee the safety of the reservoir and recommend works in the interests of safety. Recommended works are mandatory and inspections must take place at least once every 10 years. The RA 1975 provides for the Secretary of State to appoint panels of civil engineers who are qualified and can be called on by undertakers to provide the supervising and inspecting services required. It also provides for enforcement including powers and penalties, currently through the Environment Agency in England and Wales; for the keeping of records of such matters as water levels in the reservoir and leakages from it as well as specific provisions on “new Build” reservoirs, on abandonment and on discontinuance.

Reservoir incidents and their consequences

Failure of reservoir embankments can be described under two heads, “rainy day” and “sunny day”. “Rainy day” refers to a rainfall event in the reservoir’s catchment which may lead to flows in the feeder watercourse(s) that exceed the spillway design standard for handling such flows. The overtopping that might occur may cause water to flow over the crest of the dam and can

cause flooding downstream. The amounts will be limited to the “excess”. More seriously, however, such overtopping might erode the downstream face of the retaining embankment to the point where it can no longer support the pressure of water behind it.

“Sunny day” is called such as it is not weather related but refers to internal erosion over time within the structure, the signs of which will be evident only externally, in for example subsidence in the embankment, growing leakages and/or leakages which contain debris. It is because of the constant possibility of these internal causes that vigilance by owners and others is essential: if they go unnoticed for too long it may be impossible to take remedial action.

Whatever the reason, the effects of embankment collapse would be sudden and lead to catastrophic flooding in a zone demarcated by a number of factors such as volume of water and embankment height, but including downstream topography. This last introduces wide variation in the areas that might be affected. For example, on a narrow watercourse with a steep gradient, topography could funnel the flow and the biggest impacts might be felt at several points some way downstream of the reservoir. Impacts in such areas would be destructive of any life and property in the path until flows reach the point where they attenuate to become the same type of flooding of an area as would be seen from rivers or the sea. By way of description, a breach would create a significant movement of water, which would lead to the accumulation of debris (including trees, vehicles and sediment), the complete destruction of some residential and commercial properties and serious damage to others. It may also cause loss of life.

In addition to catastrophic flooding, flows would reach a point where they would attenuate. This attenuated effect might add to the already existing flood risks on that watercourse from fluvial flows (indeed, in some cases a reservoir might be operated so as at least partially to contain those flows). For non-impounding reservoirs such as those in the Thames and Lea valleys which store water from rain falling directly on them or which is pumped into them, the inundation area would be a relatively wide and short area and may not be associated with any watercourse.

Generally, the capacity of the reservoir is a determining factor only in the volumes of water released: other things being equal, impacts would be less from smaller reservoirs but may be as great or greater if smaller volume is offset by the other factors. However, below a certain capacity, breaches and so impacts are unlikely: engineering assessment is that up to around 10,000 cubic metres capacity excessive leakage, for example, would so effectively drain the reservoir that breach would be extremely unlikely. However, in the current state of knowledge of the reservoir stock, it is not possible to say that in all cases risks from such reservoirs would not be sufficient to cause harm to people and property.

Flooding from the sea or rivers is rarely of the type that could result from reservoir failure: only in exceptional cases such as Boscastle in North Cornwall in 2004 can the type of effects be seen. In an area beyond that - when flows have attenuated - flooding of the type typically seen from rivers or the sea would occur, with waters rising to flood levels. For impounding reservoirs

– where a dam is constructed across a river valley – the valley would funnel the flows and the impacts would be in a relatively long, narrow area of inundation. Particularly in cases where no monitoring has taken place and so early warning signs are not spotted, risks of embankment collapse without warning exist. Early warning will prompt the undertaker to seek professional advice and in serious cases to his calling in of an Inspecting Engineer to advise on immediate measures and to his alerting the emergency services in case precautionary evacuation of local people needs to be arranged and to his notifying other authorities if, for example, roads or other infrastructure might be at risk. For the most part there is no specific contingency planning in place for particular reservoirs.

Since the current controls serve to lessen the likelihood of uncontrolled releases of water, they also serve to reduce the likelihood of emergency response having to be activated. However, likelihood can never be reduced to zero and it is usual in any case where an emergency might occur to reduce the impacts from an event by having contingency planning in place. Currently, there are no requirements for monitoring or contacts with emergency services. Provision exists in S12 of the Reservoirs Act 1975 (an amendment introduced by the Water Act 2003) for undertakers to be given a Direction to prepare flood plans. This has not yet been implemented.

Example of the potential consequences of current policy

Incidents have occurred at reservoirs that do not fall within the RA 1975. It is not possible to ensure that all such incidents are recorded and for the purpose of this Impact Assessment detail must rely on a limited number of cases.

One such involved a reservoir of around 12,000 cubic meters capacity with residential properties and an infant school downstream.

- In September 2008 it was found by the local authority to be in distress and emergency action was taken to remove stop logs and other obstructions across the right and left hand overflows to lower the water level and drain the reservoir.
- There was significant erosion of the downstream shoulder as a result of overtopping of the dam crest and the water level remained perilously close to the top of the embankment.
- Water was also seen to be leaking through the embankment adjacent the left hand overflow, and this was successfully plugged with cement/sand bags. The bottom outlet valve was found to be inoperable due to it being silted up.
- Later, the outlet was water jet cleared and the valve was found to be fully operable.
- The police had been alerted to the risk of the dam breaching and the sensible precaution of closing the school was taken.
- Any further overtopping would have resulted in rapid erosion of the crest with the possibility that the dam could then be breached within a matter of minutes resulting in an unstoppable release of water.

This incident would have been avoided had proper monitoring, supervision and safety works been carried out. Indeed, if the distress of the reservoir had not been noticed, emergency action might not have been taken. It does serve to illustrate that risks to people exist from small raised reservoirs (SRRs) just as they do from LRRs. Nevertheless, there is no requirement on the undertakers of such reservoirs to take even basic precautions or to reinstate the reservoir in a safe condition.

Annex 3 – Summary of costs and benefits

	Do nothing more/reference case						FLOW Bill Preferred Option						Long term expected outlook (post flow Bill and further regulation)									
	LRR			SRR			LRR			SRR			LRR			SRR						
	low risk	high risk		low risk	high risk		low risk	high risk		low risk	high risk		low risk	high risk		low risk	high risk					
Per reservoir costs																						
One off costs per reservoir																						
Registration	1,000	a	1,000	a	NA	NA	60	o	60	o	230	p	230	p	60	o	60	o	230	p		
Inundation maps	1,000	a	1,000	a	NA	NA	1,000	a	1,000	a	1,000	a	1,000	a	1,000	a	1,000	a	1,000	a		
Creation of on-site flood plans		NA	2,640	b	NA	NA		NA	2,640	b		NA	NA		NA	2,640	b		NA	2,640	b	
Creation of off-site flood plans		NA	5,280	c	NA	NA		NA	5,280	c		NA	NA		NA	5,280	c		NA	5,280	c	
Annual costs per reservoir (including capital costs with unknown timing)																						
Maintenance of on-site flood plans		NA	1,000	d	NA	NA		NA	1,000	d		NA	NA		NA	1,000	d		NA	1,000	d	
Maintenance of off-site flood plans		NA	450	e	NA	NA		NA	450	e		NA	NA		NA	450	e		NA	450	e	
Monitoring reservoir condition	2,500	f	2,500	f	1,250	g	1,250	g	1,250	g	2,500	f	1,250	g	1,250	g	5,000	f1	1,250	g	5,000	f1
Supervising engineer and record keeping	1,500	h	1,500	h	150	i	150	i	150	i	1,500	h	150	i	150	i	1,500	h	150	i	1,500	h
Inspection by an inspecting engineer	300	j	300	j	30	k	30	k	30	k	300	j	30	k	30	k	300	j	30	k	300	j
Cost of capital / maintenance works	5,000	l	5,000	l	2,500	m	2,500	m	2,500	m	5,000	l	2,500	m	2,500	m	5,000	l	2,500	m	5,000	l
Charging by the enforcement authority	1,100	n	1,100	n		NA		NA	1,100	n		NA		NA		NA	1,100	n		NA	1,100	n
Total costs per reservoir																						
Total one-off costs	1,000		8,920		-	-	1,060		8,980		1,230		1,230		1,060		8,980		1,230		9,150	
Total annual costs (excluding one off)	10,400		11,850		3,930	3,930	3,930		11,850		3,930		3,930		3,930		14,350		3,930		14,350	
PV of costs	256,020		299,500		96,370	96,370	97,430		299,560		97,600		97,600		97,430		360,860		97,600		361,030	
Incremental costs per reservoir																						
Incremental one-off costs							60		60		1,230		1,230		60		60		1,230		9,150	
Incremental annual costs (excluding one-off)							- 6,470		-		-		-		- 6,470		2,500		-		10,420	
PV of incremental costs							- 158,590		60		1,230		1,230		- 158,590		61,360		1,230		264,660	
Number of reservoirs							811	r	1287	q-r	4682	s-t	1,170	t	811	r	1287	q-r	4682	s-t	1,170	t
Total costs for England and Wales																						
Total incremental one-off costs							0.05		0.08		5.76		1.44		0.05		0.08		5.76		10.71	
Total incremental annual costs (excluding one-off)							- 5.25		-		-		-		- 5.25		3.22		-		12.19	
Total PV of incremental costs							- 128.62		0.08		5.76		1.44		- 128.62		78.97		5.76		309.65	

		na	not applicable																			
1000	1	1000	a	Inundation maps, £1,000 per reservoir, one off cost																		
2640	1	2640	b	Creation of on-site flood plans, £2,640 preparation, one off cost																		
5280	1	5280	c	Creation of off-site flood plans, £5,280 preparation, one off cost																		
		1000	d	Maintenance of on site flood plans, £1,000 a year																		
		450	e	Maintenance of off-site flood plans, £450 a year																		
50%	5000	2500	f	Monitoring reservoir condition, not required by existing legislation but water co's will (and others may) do anyway: say 50% at £5,000 a year																		
25%	5000	1250	g	as f but likely lower proportion, say 25% at £5,000 a year																		
100%	5000	5000	f1	but assumed all high risk reservoirs would carry out monitoring																		
		1500	h	Supervising engineer and record keeping, approx £1,500 a year																		
10%	1500	150	i	as h but no formal requirement, say 10% at £1,500 a year																		
		300	j	Inspection by an inspecting engineer, approx £300 a year																		
10%	300	30	k	as j but no formal requirement, say 10% at £300 a year																		
250000	50	5000	l	Cost of capital/maintenance works, highly variable but assume on average £5000 a year per reservoir, based on £250,000 decommissioning cost over asset life (50 years)																		
125000	50	2500	m	as l but no regulatory requirement but maintenance undertaken anyway (to lower standard) say half of l cost applies.																		
		1100	n	Charging by by Agency for regulation, EA costs incurred for all LRRs at £1,100 a year per reservoir																		
		60	o	Registration costs, nominal update/extension cost of £60 per reservoir as already registered, one off cost.																		
		0	p	As o but new registration, estimated £60 per reservoir + in 45% of cases a further cost for Engineer and owner participation in vists. One off cost.																		
		2098	q	LRR (total)																		
		811	r	LRR Low risk (de-regulated)																		
		5852	s	SRR Total (registerd/regulating)																		
		1170	t	High risk SRR. Assumed half of all small reservoirs are low risk farm reservoirs. The remaining 50% have same risk profile as large reservoirs in England (i.e. 60% are high risk)																		

ANNEX 3 contd.– SUMMARY OF COSTS AND BENEFITS. NOTES**COSTS****Flood plans**

A £1,000 per reservoir. Current estimate from Government reservoir inundation mapping project for producing outline map showing consequences of breach. This would apply to all reservoirs over 10,000 cu metres above ground capacity

B £2,640 preparation. Current estimate from Government reservoir inundation mapping project for preparation of on-site plan for reservoir owner's response to an actual or potential reservoir breach, including liaison with local emergency services. This would apply only to high risk reservoirs

C £5,280 preparation. Current estimate from Government reservoir inundation mapping project for preparation of off-site emergency plan for response by local emergency services and others to an actual or potential reservoir breach. This would apply only to high risk reservoirs

D £1,000 a year. Current estimate from Government reservoir inundation mapping project for maintenance of on-site plan for reservoir owner's response to an actual or potential reservoir breach, including liaison with local emergency services. This would apply only to high risk reservoirs

E £450 a year. Current estimate from Government reservoir inundation mapping project for maintenance of off-site emergency plan for response by local emergency services and others to an actual or potential reservoir breach. This would apply only to high risk reservoirs

Monitoring reservoir condition

F Does not apply under Reservoirs Act 1975; would apply only to high risk reservoirs. Although not required by existing legislation water co's will (and others may) do anyway: assumption that 50% will do so at £5,000 a year. Cost estimate from an institutional owner for staff resources for monitoring a reservoir.

F1 As F but assumed to apply to all high risk reservoirs at £5,000 a year.

G As F but likely lower proportion, say 25% at £5,000 a year. Assumption that around 25% of owners will continue to carry out monitoring for asset management purposes in the absence of regulatory requirement to do so (ie this assumption includes that this proportion of SRR owners already carry out monitoring).

Record keeping and supervision

H Approx £1,500 a year. Cost estimate from an institutional owner for staff resources for record keeping and the costs of employing a Supervising Engineer as required by Reservoirs Act 1975. Applies to all currently regulated reservoirs; would apply to all high risk reservoirs.

I As H but requirement would apply only to high risk reservoirs. Where no formal requirement, assumption that 10% of owners of LRRs and SRRs would continue to keep records and employ a supervising engineer at £1,500 a year.

Inspection

J Approx £300 a year. Cost estimate from an institutional owner for staff resources for the costs of employing an Inspecting Engineer as required by Reservoirs Act 1975. Assumption is that costs of £3,000 would be met once every 10 years (the current minimum period between inspections) and figure therefore annualised on that basis. Applies to all currently regulated reservoirs; would apply to all high risk reservoirs.

K Costs as J but assumed to apply only to all high risk reservoirs. Where no formal requirement, assumption that 10% of owners of LRRs and SRRs would continue to keep records and employ an inspecting engineer at £300 a year.

L Cost estimate of works to decommission a reservoir from Environment Agency costs in engineering works of decommissioning (£250,000 cost once in 50 years, therefore an annual cost of £5,000 a year). Assumed to arise from directions of Inspecting Engineers as to works needed in the interests of safety. Given the high level of variability, the cost is assumed to be that of decommissioning as this is assumed to be the minimum an owner would incur if he/she were unwilling or unable to meet higher costs of remedial works. Applies to all currently regulated reservoirs; would apply to all high risk reservoirs.

M As L but assumption that such costs would be incurred in only 50% of cases as part of owners' asset management decisions. NOTE this figure is assumed to apply in a higher number of cases than K above to reflect owners' normal asset management and replacement decisions.

Charging

N EA costs incurred for all LRRs at £1,100 a year per reservoir. Cost estimate from Environment Agency for its current costs of enforcing provisions of Reservoirs Act 1975.

Registration

O Nominal update/extension cost of £60 per reservoir as LRRs already registered. Assumed nominal cost of registration based on this requirement involving only available or readily derivable information.

P New registration, as O but estimated at £230 to include extra costs (see main section)..

RESERVOIR NUMBERS

LRRs. Figures derived from Environment Agency Register, which EA required to maintain under Reservoirs Act 1975. High risk and low risk estimates derived from register's additional information about unofficial categorisation of reservoirs into A (risks to lives in a community); B (lives not in a community); C (property damage); D (little or no damage). High risk is taken to include reservoirs in Bands A and B, low risk those in Bands C and D. Where no categorisation is available, an estimate has been made based on the proportions of known categorisations.

LRRs England	LRRs Wales	High risk England	High risk Wales	Low risk England	Low risk Wales
1,896	202	1,151	136	745	66

SRRs. Figures derived from Halcrow data adjusted by +25%. Preliminary results from Atkins study suggest that problems with underlying data could result in under-counting by a 25-50% in

areas of hilly terrain. As the Halcrow data show a high proportion (around 50%) of SRRs in East Anglia and Midlands regions of flatter terrain, confidence can be placed in those figures; and so an assumed figure of +20% is used across the country.

Assumptions are made about the numbers of high risk and low risk SRRs as follows.

SRRs England	SRRs Wales	Assumption HR=High Risk	High risk England	High risk Wales	Low risk England	Low risk Wales
		<i>10% HR</i>	<i>546</i>	<i>39</i>	<i>4,917</i>	<i>350</i>
5,463	389	20% HR	1,092	78	4,371	311
		<i>50% HR</i>	<i>2,732</i>	<i>195</i>	<i>2,731</i>	<i>194</i>
		<i>As for LRRs E 60% HR W 67% HR</i>	<i>3,278</i>	<i>261</i>	<i>2,185</i>	<i>128</i>

Thus the summary table at the start of this annex assumes 811 (745 +66) low risk LRRs, 1,287 (1,151+136) high risk LRRs, 4,682 (4,371+311) low risk SRRs and 1,170 (1,092+78) high risk SRRs.

Annex 4 – Bill proposals on reservoir safety. Provisional timeline for deregulation and regulation

	2009	2010	2011	2012	2013	2014
Government	Introduce Bill	Enact and commence primary legislation	Reg's for EA to classify; and notify owners (LRRs)	Reg's specifying exemptions		
		Registration Reg's LRRs	Registration Reg's SRRs	Reg's for EA to classify; and notify SRR owners		
				Reg's specifying lower controls (partial exemption)		
		R&D on standards		Consult on and promulgate revised standards		
Environment Agency (and LRFs for mapping)	Inundation mapping LRRs		Update register of LRRs and notify owners of classification.	Review LRR classifications in light of exempting Reg's and notify owners		
		Inundation mapping SRRs		Update register of SRRs		
LRR owners		Confirm registration details	Notified of risk classification		Notified of whether exempted	Adopt new requirements
SRR owners			Supply registration details		Notified of class and whether exempted	Adopt new requirements

ANNEX 5: RURAL PROOFING

The impact of the policy on rural communities is expected to be on businesses and is most likely to affect farmers. The current policy requires regulation of reservoirs above 25,000 cu metres regardless of risks to people. As part of deregulation, we expect a large proportion of these reservoirs to be classed as low risk in the first place and a further number to benefit from progressive deregulation as exemptions are developed and exempting regulations are made.

A large number of the reservoirs in the 10-25,000 cu metres range that would be brought into regulation for the first time are likely to be farm reservoirs and, again, a large proportion of these are expected to be classified as low risk and to be exempted. These would not be brought into regulation until classification into high risk and low risk is determined and exempting regulations made.

The eventual net effect is impossible to gauge at this stage. However, we do not expect that the smaller reservoirs will in general be subject to regulation beyond the point of registration and that it will be only in exceptional cases where there are risks to public safety. We also intend to produce guidance for farmers and landowners as to how new farm reservoirs can be constructed so as to avoid the need for any regulation in the future.