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Maintaining the Safety of our Dams and Reservoirs

Edited by Andrew Pepper

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Proceedings of the 18th Biennial Conference of the British Dam Society at Queen's University, Belfast, from 3–6 September 2014

Edited by Andrew Pepper

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Preface

This book contains the proceedings of the 18th Biennial Conference of the British Dam Society, *Maintaining the Safety of our Dams and Reservoirs*, held at Queen's University, Belfast, in September 2014.

The 44 papers of these proceedings are grouped into seven chapters, although many papers cover more than one chapter topic area. The papers have been written by professionals who have investigated, designed, and overseen a wide variety of work on dams and reservoirs in the UK and around the world.

Recently introduced updates to legislation mean different regulations for each of the four countries that comprise the UK. Papers covering these changes and the variations across the UK form essential reading for dam engineers practising in these countries.

Throughout the papers there are references to the environmental framework within which dam engineers work, whether it be discontinuing reservoirs, raising retained water levels, installing additional spillway capacity, or carrying out repairs in the interest of safety.

Earth embankment dams, many over 100 years old, are common throughout the UK, and a number of papers address the geotechnical issues of maintaining and repairing such dams, including various means of locating and dealing with leakage. But leakage is just one of a number of potential causes of dam failure, and a chapter covers the analysis of risk and actions that can be taken to reduce such risks – risks not only of the escape of water but risks to the public from the water retained in the reservoir.

Many reservoirs rely on gates and other mechanical devices to function safely, and papers covering the repair and replacement of gates and valves show how such works can be installed in existing civil engineering structures.

Several papers refer to the use of modelling – both physical and mathematical – that has assisted in optimising designs for new works such as spillways, where increased capacity has been required on an existing dam while complying with all the associated site constraints.

Overseas dam construction is also covered, with papers on the construction of new hydropower dams in Vietnam and Georgia, and a comprehensive monitoring system for two Portuguese dams being described.

The conference included the presentation of the biennial Geoffrey Binnie Lecture by Alan Cooper OBE, entitled '*The Heritage of Dams in Northern Ireland*'. This 2014 lecture is published in the Society's technical journal *Dams and Reservoirs*.

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SECTION 1:
LEGISLATION AND ENVIRONMENTAL CHALLENGES

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Changes to the Reservoirs Act 1975 – the enforcement authority's perspective in England

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SYNOPSIS The Environment Agency has been the enforcement authority for the Reservoirs Act 1975 ('the Act') in England since 2004, when it took over the role from 140 local authorities. The Act places a duty on the enforcement authorities to ensure that reservoir undertakers observe and comply with its requirements. In July 2013 the Act was amended by the commencement of the amendments in Schedule 4 of the Flood and Water Management Act 2010. This paper discusses the changing legal requirements and how they are being enforced in England.

INTRODUCTION

The purpose of the Reservoirs Act 1975 ('the Act') is to 'make provision against escapes of water from large raised reservoirs or from lakes or lochs artificially created or enlarged'. It built upon the Reservoir (Safety Provisions) Act 1930, which was enacted following a number of dam and reservoir failures in Britain in the 19th and early 20th centuries that resulted in loss of human life. The Act was amended by the Water Act 2003 and the Flood and Water Management Act 2010. The latter amendments were brought into effect in July 2013.

The Environment Agency took over the enforcement authority role from 140 local authorities in 2004, when the amendments brought in by the Water Act 2003 were given effect. The Act was amended again in April 2013, when Natural Resources Wales took over from the Environment Agency as the enforcement authority for Wales. The Act places a duty on the enforcement authorities to ensure that reservoir undertakers observe and comply with its requirements.

This paper discusses the amendments and some of the implications in England for reservoir undertakers, panel engineers and the enforcement authority. It assumes some prior knowledge of the Act and does not purport to explain the provisions that remain unaltered. Neither does it discuss

details of the effects of any changes in Wales and Scotland, where the Act also applies, albeit with some differences.

REASONS FOR CHANGE

In summer 2007 there was widespread flooding in England. During the floods, Ulley dam near Rotherham came close to failure, leading to the closure of the M1 motorway and the evacuation of 1,000 people from downstream properties (Environment Agency, 2007). Subsequently, Sir Michael Pitt carried out a comprehensive review of the floods. The subsequent Pitt Report (2008) recommended a number of improvements to the Act, following discussions with the reservoir industry and based on operational experience over the 25 years since it was commenced, in order to make the provisions of the Act more risk-based and effective.

THE AMENDMENTS

Following consultation the subsequent amendments, some of which had been suggested by the Environment Agency (2009) in one of its biennial reports to Defra, were included in schedule 4 of the Flood and Water Management Act 2010. Much of schedule 4 was commenced between 28 and 30 July 2013, through four statutory instruments (2013). The main changes to the Act that were commenced in July 2013 are listed in Table 1 and briefly discussed in the following paragraphs.

Table 1. Main changes to the Reservoirs Act 1975 in force in England from July 2013

Section	Statutory Instrument 2013 No.	Description
A1	1590 regulation 4(1), 1677 regulation 3 and 1896 regulation 3	Definition of a large raised reservoir. Note that the change in qualifying capacity for a reservoir to come within the ambit of the Act remains at 25,000m³ and has not yet been changed to 10,000m³.
2(2B)	1677 regulation 7	Undertaker must register a large raised reservoir, unless it was already registered before 30 July 2013
2(2C-2E)	1677 regulations 4 and 5	Regulations about registration and requirements for undertaker to provide up to date information to the enforcement authority

Section	Statutory Instrument 2013 No.	Description
2A-2D		The Environment Agency shall make risk designations for registered large raised reservoirs
2E	1896 regulation 4	Undertakers may appeal to the First-tier Tribunal against confirmed high-risk designation notices
10	1896 regulation 7	Until its risk designation is confirmed, undertakers shall have any existing large raised reservoir inspected and carry recommended measures to be taken in the interests of safety as soon as practicable. Thereafter, amended section 10 only applies to designated high-risk reservoirs
10(1)		Undertakers shall have designated high-risk reservoirs inspected
10(2)	1896 regulation 6	Additional inspection requirements
10(3)(b)		Inspecting engineers of designated high-risk reservoirs shall include maintenance recommendations in their reports
10(3)(c)		Inspecting engineers of designated high-risk reservoirs shall include in their reports the period within which measures required in the interests of safety must be taken
10(3A)		If the inspecting engineer has not provided his report on a designated high-risk reservoir within 6 months of the inspection, the engineer must notify the enforcement authority and explain why
10(5A)		Undertakers must comply with maintenance recommendations for designated high-risk reservoirs

Section	Statutory Instrument 2013 No.	Description
10(6)		Undertakers must carry recommendations as to measures to be taken in the interests of safety into effect for designated high-risk reservoirs within the period specified in the inspection report
10(6A)		Inspecting engineers of designated high-risk reservoirs must include in inspection reports statements and explanations about safety measures recommended in previous reports and not yet taken
11	1590 regulation 4(2), 1677 regulation 9	Until its risk designation is confirmed, undertakers of every existing large raised reservoir shall keep records in the prescribed form. Thereafter, this requirement only applies to designated high-risk reservoirs.
12	1590 regulation 4(2)	Until its risk designation is confirmed and at all times when not under construction, undertakers of every existing large raised reservoir shall employ a supervising engineer to supervise the reservoir. Thereafter, this requirement only applies to designated high-risk reservoirs.
12(2A), 12(2B)		At least once every 12 months, supervising engineers of designated high-risk reservoirs must provide a written statement of steps taken to maintain the reservoir
12(6)		Supervising engineers of designated high-risk reservoirs may direct undertakers to carry out visual inspections
12(7)		Undertakers of designated high-risk reservoirs must notify supervising engineers of each visual inspection carried out and anything noticed in the course of it
12A(1A)		Definition of a flood plan
12AA		Flood plan requirements (when directed by the Secretary of State)

Section	Statutory Instrument 2013 No.	Description
13(1A)		Interim certificates for large raised reservoirs being discontinued
13(5)		The Environment Agency may serve notice on undertaker to appoint a discontinuance engineer
19A	1896 regulation 5	Undertakers may appeal to the First-tier Tribunal against enforcement notices
20(1)	1677 regulations 10, 11 and 12	New prescribed forms for certificates, reports and directions
20(4)(b)		Inspecting engineers to copy to the enforcement authority any inspection report or abandonment report, whether or not it includes measures to be taken in the interests of safety
20(4)(f)		Supervising engineers to copy to the enforcement authority any written statement on matters to be watched or steps taken to maintain the reservoir
20(4)(g)		Supervising engineers to copy to the enforcement authority any undertaker direction to carry out visual inspections
20A		The Minister may by regulations make provision for the assessment of the quality of reports and written statements
21A		The Environment Agency may serve notice on an undertaker to provide information
21B	1677 regulation 14	Undertakers must report incidents to the Environment Agency
22(A1)		Offence to fail to register a large raised reservoir or to comply with regulatory requirements
22(1)		Strict liability offences for failure to comply with the requirements of the Act or to comply with an enforcement notice or direction

Section	Statutory Instrument 2013 No.	Description
22C		Undertakers to pay the Environment Agency expenses reasonably incurred in consulting qualified civil engineers for times to be specified in enforcement notices

DEFINITION OF A LARGE RAISED RESERVOIR

A large raised reservoir is a large raised structure, raised lake or other area capable of storing water and artificially created or enlarged. The arguably superfluous words 'as such' in the original Act no longer apply to 'water'.

Mine and quarry tips, canals, inland navigations, road and railway embankments (unless artificially designed to store water) are expressly excluded from the ambit of the Act.

The issue of how siltation affects the escapable volume of water can only be considered at the time when a panel engineer issues a final certificate or a discontinuance certificate. Reservoir undertakers must calculate the capacity of their reservoir whenever a panel engineer issues a final certificate or discontinuance certificate. The method for calculating the capacity is defined in the new regulations as the maximum volume of water capable of being stored above reservoir bed level and between its toe (defined as the point where the downstream side of any structure or dam meets lowest natural ground level) and top water level. It excludes any allowance for silt that is judged by the panel engineer to be incapable of flowing out of the reservoir in the event of an uncontrolled release of water.

For the time being, the qualifying capacity for a reservoir to come within the ambit of the Act remains unchanged at 25,000m^3 above lowest surrounding ground level, as before.

REGISTRATION REQUIREMENTS

It is now the reservoir undertakers' responsibility to register their large raised reservoirs with the Environment Agency. Failure to do so is a criminal offence under the Act. There are three new pieces of information not previously required to be on the public register of large raised reservoirs: dam or reservoir top level; top water level and whether the reservoir is designated as high-risk.

Reservoir information already on the Environment Agency's English register before 30 July 2013 is deemed to have been provided as required. For new or altered reservoirs, the information must be registered within 28 days of the issue of the final certificate.

This is after and in addition to the issue of a section 21 notice of intention to construct, alter or bring back into use a large raised reservoir. Much of the prescribed information in a section 21 notice is the same as that in the list of registration requirements. By implication, the information in the original section 21 notice must be reviewed and supplemented as necessary when the final certificate is issued.

Undertakers must provide any changed or additional information to the Environment Agency within 28 days of the change or addition occurring. This includes:

- The appointment of a construction, supervising or inspecting engineer
- The cessation of an appointment of a construction or supervising engineer
- Any change of undertaker and the date it will take effect

RISK DESIGNATIONS

For all registered large raised reservoirs, as soon as reasonably practicable after registration, the Environment Agency must consider whether to designate them as 'high-risk' or 'not high-risk'. The term 'high-risk' is defined in the new section 2C of the Act. A large raised reservoir may be designated high-risk if the Environment Agency thinks that, in the event of an uncontrolled release of water from the reservoir, human life could be endangered.

The Environment Agency has the discretion to consider the probability of reservoir failure in its decision to designate. However, there are many varying factors which can influence the probability of failure, which will inevitably change over time. Therefore for designation purposes, until and unless a different approach is agreed, the Environment Agency assumes a conditional probability of failure of unity for each reservoir.

If the probability of failure at a certain time was considered to be low and a reservoir were to be designated as not high-risk, then the supervision and inspection requirements of the Act would no longer apply, and the condition of the reservoir could deteriorate in the absence of expert engineering surveillance. Therefore it is undesirable from a public safety point of view for the risk designation process to take into account the probability of failure, which would vary over time. The consequence of failure is the over-riding consideration.

The Environment Agency has published the methodology (2013) it uses to carry out the risk designation process. It expects to complete the initial risk designation process for the 1982 existing reservoirs on the English register by April 2015. The following considerations are taken into account:

- The proximity of infrastructure and residential, business and recreational areas downstream of the reservoir
- Advice contained in section 10 inspection reports
- Reservoir flood maps showing the potential impact of a dam or reservoir failure
- Local site knowledge, maps and photographs
- The recommendations of an All Reservoirs Panel Engineer

Undertakers have an opportunity to make representations to the Environment Agency against provisional high-risk designations and appeals to the First-tier Tribunal against confirmed high-risk designations for their reservoirs. Both the provisional high-risk designation and confirmed high-risk designations are made by sending a notice to the relevant undertaker. Where the Environment Agency has assessed a reservoir as not high-risk, the undertaker is informed of this decision by letter. Only the undertaker can make representations after receiving a notice of provisional high-risk designation.

Risk designations must be reviewed if the Environment Agency thinks it appropriate. Any party, including members of the general public, can ask for a review at any time.

Under the transitional provisions in the new regulations, until the Environment Agency has notified the undertakers of the confirmed risk designation for their reservoir, undertakers of existing large raised reservoirs that were in operation on 30 July 2013 must continue to keep the prescribed records, have the reservoir supervised and inspected and carry into effect safety measures as soon as practicable, as before.

Once the Environment Agency has designated a reservoir as not high-risk, the supervision and inspection requirements of the Act will no longer apply to that reservoir. However, not high-risk large raised reservoirs will remain on the public register and the construction, discontinuance and incident reporting provisions of the Act will continue to apply to them. It is important to remember that the common law liabilities of the undertaker will continue, even if a reservoir is assessed as not high-risk. It therefore may be prudent to continue to manage the reservoir as if it were still under the Act.

INSPECTIONS

Inspecting engineers must provide their inspection reports for designated high-risk reservoirs within six months of the date of completion of the inspection, or else provide a written statement to the Environment Agency of the reasons why the report has not been provided.