Booklet production

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The authors of this publication – Melvyn Kay (RTCS Ltd) and Jerry Knox (Cranfield University) wish to make it clear that the content and views expressed are those of the authors and do not necessarily represent the views or policies of Water Resources East or other funding partners.

This booklet is provided for information purposes only. Always seek independent professional advice when planning an agricultural reservoir or associated irrigation water resources infrastructure.

Copies of this booklet can also be downloaded from the UK Irrigation Association website www.ukia.org

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Web links to documents referred to in the main text

[1] Thinking about rainwater harvesting?
https://www.ukia.org/3d-flip-book/rwh-book-1/

[2] Environmental Destination
https://wre.org.uk/environmental-destination/ or

https://assets.publishing.service.gov.uk/media/6847ff5189d002b886e787ad/Developing-the-revised-Environmental-Destination-figures-technical-report.pdf

[3] Applying for an abstraction licence
https://www.gov.uk/guidance/water-management-apply-for-a-water-abstraction-or-impoundment-licence

[4] Reservoir Safety Reform Programme updates
https://engageenvironmentagency.uk.engagementhq.com/reservoir-safety-reform

[5] The Farming Equipment and Technology Fund 2026
https://defrafarming.blog.gov.uk/2026/02/24/farming-equipment-and-technology-fund-2026-guidance-now-available

[6] Countryside Stewardship Higher Tier and Sustainable Farming Incentive (SFI)
https://www.gov.uk/find-funding-for-land-or-farms?areas_of_interest%5B%5D=water-availability-and-storage

[7] Water Abstractor Group (WAG) Directory
https://www.ukia.org/wags/

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Planning farm reservoirs

with case studies in Eastern England

A practical guide for farmers and planners on design, permissions and environmental integration

Stage 1: defining need 1 2 3 4

Water under pressure

Aligning agricultural water use with environmental targets

Water resources in Eastern England are under severe pressure. New environmental targets will reduce abstractions to restore river flows and groundwater. This will affect all sectors, including agriculture

Water for agriculture at the heart of the region

Eastern England is one of the driest and most water-stressed regions in the UK, with many catchments already over-abstracted or over-licensed. Average annual rainfall is around 600 mm (less than 70% of the national average), while evapotranspiration approaches 530 mm.

Climate change is increasing aridity, with higher temperatures, rising evapotranspiration, and changing seasonal rainfall patterns, leading to more frequent and intense droughts.

Recent droughts in 2018, 2022 and 2025 highlight the growing risks to both agricultural production and water-dependent ecosystems.

Agriculture dominates the landscape, covering over 80% of the land area. The region's favourable agroclimate, fertile soils and large-scale farming systems support a high concentration of intensive cropping. Much of the UK's fresh produce, particularly potatoes, vegetables, salads and soft fruit, relies on irrigation to maintain quality, consistency and supply to major retailers.

Although agriculture accounts for around 16% of total abstraction, this demand is highly seasonal and largely consumptive. In some catchments, this creates significant pressure on rivers, wetlands and groundwater-dependent habitats during the summer months. Eastern England contains a high concentration of nationally and internationally protected sites, many of which depend on adequate flows and groundwater levels precisely when irrigation demand is highest.

Water is therefore the critical link between agriculture and the environment. Reliable supplies of sufficient quality are essential not only for crop production, but also for livestock, food processing and the wider agri-food economy.

On-farm reservoirs are central to improving water security. By storing water during wetter periods, they reduce reliance on summer abstraction and help protect environmentally sensitive flows. While not new, their role is changing. Increasingly, reservoirs are part of long-term farm business resilience – improving supply reliability and reducing pressures on direct summer abstraction.

However, this shift is not without risk. As more sectors move away from summer abstraction, pressure on winter water resources is likely to increase. In time, this could shift the challenge from summer scarcity to winter competition for available flows.

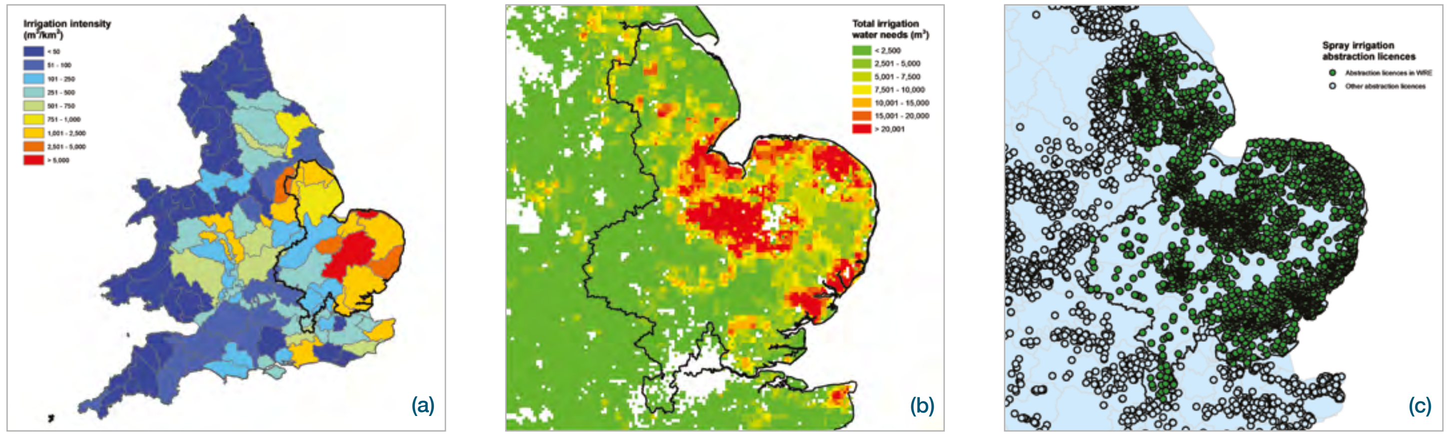


Figure 1: (a) Irrigation intensity (m^3/km^2) highlighting 'hotspots' across Eastern England including the Cam and Ely Ouse catchment; (b) total volumetric irrigation water needs (m^3); (c) spatial distribution of spray irrigation abstraction licences across the WRE region. Source: Knox et al (2018) *.

* Knox, J.W., Haro-Monteagudo, D., Hess, T.M., Morris, J (2018) Identifying trade-offs and reconciling competing demands for water: Integrating agriculture into a robust decision-making framework. Earth's Future, 6(10): 1457-1470. https://doi.org/10.1002/2017EF000741

Building business resilience

Combining rainwater harvesting with reservoir storage[1]

Place UK, a leading soft fruit grower in Norfolk, relies entirely on irrigation for its polytunnel production. In recent years, five abstraction licences were revoked by the Environment Agency (EA) due to concerns over impacts on nearby Sites of Special Scientific Interest (SSSIs), placing the business at significant risk.

To secure an alternative supply, Tim Place turned to rainwater harvesting (RWH). While typically used only to supplement licensed abstraction, he developed an integrated system to capture and store water at scale.

Runoff from the polytunnels is fully intercepted – even when covers are partially open – and directed across the farm using regraded land to maximise gravity flow. Water is stored in a 150,000 m^3 reservoir, providing up to two years' supply and protecting the business against drought.

The system has delivered wider benefits. Improved water quality has reduced fertiliser use and enhanced crop performance, demonstrating how combining RWH with storage can strengthen both resilience and productivity.

The Fens – an engineered landscape for water management

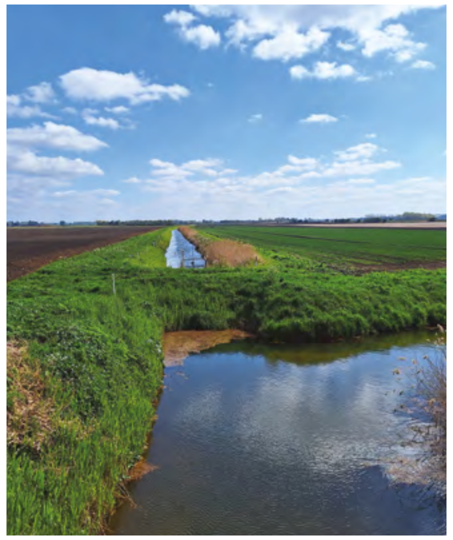
The Fens are a highly modified and intensively managed landscape, shaped over centuries to control water and support agricultural production.

Unlike many other parts of Eastern England, water levels are actively regulated through an extensive network of drains, channels, embankments and pumping stations operated largely by Internal Drainage Boards (IDBs). This infrastructure allows water to be moved, stored and discharged in a controlled way across the region.

This engineered character creates different opportunities for water storage. In contrast to more sensitive landscapes, such as the Suffolk and Essex National Landscapes, where visual and ecological considerations strongly influence reservoir siting and design, the Fens offer greater flexibility to integrate storage within existing systems. Reservoirs can be connected to managed drainage networks, allowing winter flows to be intercepted, transferred and stored at scale.

Importantly, large volumes of water already pass through the Fenland system during winter and are routinely discharged to sea. Capturing a proportion of this managed flow provides a practical way to increase water availability without additional pressure on summer abstraction.

As demands from agriculture, the environment and nearby urban centres such as Cambridge continue to grow, the Fens provide a unique opportunity to develop coordinated storage solutions. By building on existing infrastructure and management systems, reservoirs in the Fens can form part of a wider, connected approach to water resources management. Opportunities to develop this approach are discussed in more detail on p14-15.

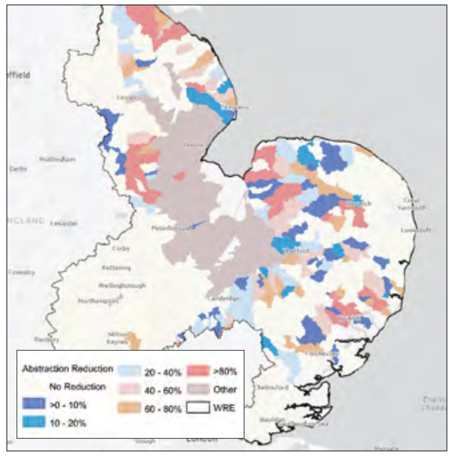


Drivers for change – Environmental Destination

In Eastern England, food production and environmental protection are closely linked through water. Historically, irrigation has relied on direct abstraction from rivers and groundwater under licences granted in very different regulatory and climatic conditions.

While these arrangements supported agricultural growth, potential reductions linked to the Government's Environmental Destination (ED)[2] (EA's environmental targets) are now reshaping water availability. These changes are likely to affect current production and constrain future expansion (Figure 2).

Figure 2: Potential annual licensed reductions (%) to meet Environmental Destination (National Framework, 2025).



Changing role of Internal Drainage Boards?

IDBs already manage water levels across many lowland catchments through extensive networks of channels, structures and pumping stations. With established infrastructure, local knowledge and operational control, they are uniquely placed to support water storage, transfer and redistribution at scale.

Building on this role provides a practical route to integrated water resources management, linking flood protection, agricultural supply and environmental outcomes within a single managed system.

Full four-stage overview

Concept to commissioning

Updating guidance on farm reservoirs

Agricultural water management is now entering a period of rapid change, with reservoir storage becoming central to future water strategies.

With a focus on Eastern England and the Fens, this booklet provides practical, farmer-focused guidance on planning, designing and constructing reservoirs that work with the landscape, particularly in environmentally sensitive areas. Drawing on case studies and updated guidance on permissions, design and construction, the emphasis is on combining robust engineering with environmental enhancement.

Sensitive rural landscapes require careful planning and design. In open areas such as the Fens and the Broads, reservoirs must be well sited, visually contained and integrated into their surroundings. Increasingly, reservoirs are being shaped to follow landform, support biodiversity and enhance landscape character.

The four stages of reservoir planning

Taking the right approach – and doing things in the right order – can save significant time and cost. Successful reservoir projects follow a clear sequence: define the need, test feasibility, secure permissions, then design and build. Skipping steps often leads to long delays and/or planning refusal.

- Stage 1 **DEFINE NEED** Be clear what water is needed and why
- Stage 2 **FEASIBILITY** Check water availability, sources and limits
- Stage 3 **PERMISSIONS** Confirm what licences and permissions are needed
- Stage 4 **DELIVERY AND OPERATION** Build and operate the reservoir as approved

Using the four-stage approach

Getting the sequence right saves time, reduces costs, and avoids frustration

Stage 1: Start by being clear about why you need storage.

What crops are you protecting? What level of resilience do you want in a dry year?

Stage 2: Next, assess whether water is genuinely available and whether your preferred site will work.

There is little value in progressing design or planning if abstraction limits or site constraints make the scheme unviable.

Stage 3: Only once feasibility is clear should you move fully into permissions.

Abstraction licensing, planning approval, safety and environmental assessments can run in parallel, but they must be grounded in sound feasibility.

Stage 4: Finally, proceed to detailed design, construction, and commissioning.

In practice, some stages will overlap. But skipping ahead often leads to redesign, delay or planning refusal.

Early discussion with regulators, planners and advisers usually saves significant time later.

Case Study – Integrating drainage and storage

The East Suffolk IDB Felixstowe Hydrocycle demonstrates how existing drainage infrastructure can be adapted to support agricultural water storage.

Farms on the Felixstowe Peninsula grow high-value irrigated crops but face increasing restrictions on summer abstraction from the River Deben. The scheme captures water during winter and stores it in on-farm reservoirs for use in the growing season.

A key feature is the use of the IDB's drainage network. In winter, large volumes of water are conveyed through managed ditches and pumping stations and normally discharged to sea. Under the Hydrocycle scheme, a proportion of this flow is intercepted and transferred via a 12 km pipeline to farm reservoirs.

This approach effectively recycles water already moving through the system, reducing IDB pumping to the estuary and helping to reduce erosional damage to the receiving salt marsh.

By integrating drainage and storage, the scheme converts surplus winter water into a reliable irrigation supply while maintaining the system's primary flood management function.

How long does it all take?

Most reservoir projects take 18–36 months from first idea to commissioning

Typical timeframes:

- Initial scoping and feasibility: 3–6 months
- Environmental work (if required): 6–12 months
- Planning and abstraction permissions: 4–12 months
- Detailed design and construction: 6–12 months

Times vary depending on catchment constraints, environmental sensitivity and regulator workload

Early engagement and good preparation can significantly shorten the process

Pitfalls to avoid

- Don't start planning before confirming abstraction feasibility
- Don't underestimate environmental constraints
- Don't design storage too small for extended dry periods
- Don't leave discussions with the EA too late
- Don't overlook risk of uncontrolled release from reservoir
- Don't assume permissions will be straightforward
- Don't rush into construction before conditions are discharged

From experience

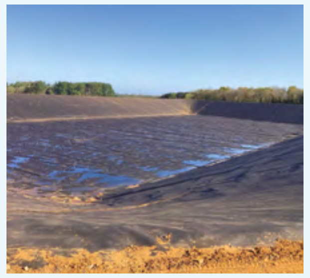
A Suffolk grower began planning a 70,000 m³ reservoir in 2022. Early feasibility work identified abstraction limits that required a change in the intake point. Adjusting the design at that stage avoided a refused application and saved nearly a year.

Feasibility

Will this work for your farm?

Assessing risks and testing your idea before major spend

Case Study – Reservoirs reduce summer abstraction risks



New Shoots is a progressive farming enterprise in East Suffolk growing spinach, babyleaf and wholehead lettuces for retailers and processors where consistency of supply and quality assurance are critical aspects of production.

These shallow rooting crops are heavily dependent on irrigation – with the majority (75%) of water now supplied from four reservoirs. Will Brice, Head of Estates says

"Our philosophy is to reduce dependence on summer abstraction and increase reliance on storage, taking winter high flows which limits our environmental impact and reduces downstream flood risks. We know that summer reductions in licensed allocation pose a major risk to our business sustainability and expansion plans."

Their latest 150,000 m³ HDPE lined reservoir will reduce their vulnerability to both drought and abstraction risks.

"It took us two years to secure planning including some major challenges linked to archaeology, but with perseverance and experienced contractors our latest reservoir is now very close to completion. It will be an invaluable asset to further enhance our water security" says Will Brice.

Before starting detailed design or formal applications, you need to test whether a reservoir is practical, proportionate and deliverable on your farm.

Feasibility goes beyond demand. It means defining your dry-year water requirement, confirming winter water availability, and testing whether the site can support safe, cost-effective storage. Early choices – reservoir size, storage strategy and whether to use clay or lined construction – influence shape, cost, planning complexity and landscape impact.

Water need, availability & storage considerations

How much water is needed?

Water demand

- ☐ Crops grown
- ☐ Irrigated area (ha)
- ☐ Peak daily demand (m³/day)
- ☐ Seasonal total (m³/year)
- ☐ Drought year requirement (1 in 5 or 1 in 10)
- ☐ Water sharing requirements with neighbours

Design for the "dry year" not the average year

Water availability

Source options

- ☐ Winter river abstraction
- ☐ Groundwater (borehole)
- ☐ High-flow capture (flood scalping)
- ☐ Shared supply

Feasibility questions

- ☐ Is water available in winter?
- ☐ Are there low-flow restrictions?
- ☐ Is a new licence likely to be approved?
- ☐ Will monitoring be required?

How much storage?

Reservoir volume must account for:

- ☐ Irrigation demand
- ☐ Evaporation losses
- ☐ Leakage allowance
- ☐ Drought resilience buffer
- ☐ Possible 2+ year storage

2+ year storage: increasingly relevant in water-stressed catchments and droughts

"Snakes and Ladders" of reservoir planning

Ladders

- ☐ Early EA discussion
- ☐ Early landscape, ecological and archaeological assessments
- ☐ Good hydrological, geological and topographic data
- ☐ Clear landscape, ecological and archaeological mitigation plans
- ☐ Neighbour engagement

Snakes

- ☐ Underestimating volume
- ☐ Ignoring evaporation
- ☐ Poor site access
- ☐ Late ecological survey
- ☐ Ignoring visual impact of liner

1. Clay lined reservoir

2. HDPE membrane lined reservoir

3. Construction phase

4. Finished integrated reservoir

Site selection & practical constraints

Choosing the right site is often the difference between a straightforward scheme and a difficult one. Topography, soil type, access and proximity to the abstraction point all affect viability. Just as importantly, the reservoir must sit comfortably within the wider landscape.

In sensitive areas, visual impact and environmental considerations can determine the planning route and the level of supporting information required. In some areas, archaeological sensitivity can also influence site suitability.

Reservoirs that do not store water above ground level pose little risk of uncontrolled release, making them more acceptable to planners and generally exempt from reservoir safety regulations. A Flood Risk Assessment may be required to demonstrate that the scheme does not increase flood risk.

Choosing the right site

- ☐ Near abstraction point
- ☐ Close to irrigation network
- ☐ Natural fall of land
- ☐ Clay availability for lining
- ☐ Avoid high-value habitats
- ☐ Avoid land that floods or disrupts flood flows
- ☐ Ideally near suitable power supply

Landscape considerations

- ☐ Is the site within a designated National Landscape?
- ☐ Will embankments break skyline?
- ☐ Can levels be lowered to reduce visual mass?
- ☐ Will a liner be visible above waterline?
- ☐ Can planting soften edges?

Planning risks

- ☐ Sensitive landscape designation?
- ☐ Archaeology?
- ☐ Ecological sensitivity
- ☐ Flood risk from embankment failure
- ☐ Licence reductions to comply with national environmental targets
- ☐ Refill reliability

Permissions and consents

Before work can begin, permissions and consents are required from the EA and the Local Planning Authority (LPA). Early discussions with these organisations can help avoid delays and streamline the planning process

Farm reservoirs: myths and facts

MYTH: Off-stream reservoirs need no permissions
FACT: Most still require planning permission and an abstraction licence
MYTH: Permitted development rights mean you can build without approval
FACT: Prior approval is usually required and full planning permission is often needed for larger schemes
MYTH: Reservoirs are not allowed in National Landscapes, protected areas or near SSSIs
FACT: They can be approved if well sited, carefully designed and sensitively integrated into the landscape
MYTH: Winter water is always available for storage
FACT: Availability is increasingly constrained, early planning is essential to secure supply
MYTH: Reservoirs cost too much to justify
FACT: Cost must be weighed against the value of crops, supply security, and reduced risk. For high-value production, reservoirs are often a sound investment

Getting necessary permissions is not always easy. This guide is not a straight line – some steps run in parallel or depend on earlier decisions. Not every step will apply for every reservoir. However, good preparation in Stages 1 & 2 is the key to success in Stage 3.

Farm reservoir permissions: decision guide

Type of reservoir

Is the reservoir built across a river, stream or drain?
YES ▶ Impounding reservoir
- Impoundment licence required (EA)
- Planning permission required
- Other environmental consents likely
- Seek expert advice

NO ▶ Off-stream storage
Most farm reservoirs store water off-stream 1

Will the reservoir be filled from a river, drain or borehole?
YES ▶ Abstraction licence required (usually winter-only abstraction)
NO ▶ Rainwater harvesting may not require licensing. Seek advice from EA 2

Is the reservoir in a sensitive location?
(National Landscape, SSSI, SPA, SAC*, floodplain, drained lowland)
YES ▶ Planning permission likely
Ecology/landscape/archaeology checks likely
NO ▶ Planning permission may still be required 3

* Sites of Special Scientific Interest (SSSI); Special Protection Areas (SPA); Special Areas of Conservation (SAC)

** Ramsar Sites are wetlands of international importance designated under the Convention on Wetlands

Planning and environmental checks

Have you submitted a Prior Notification to the LPA?
NO ▶ Prior Notification required in all cases
YES ▶ Proceed to next step 4

Will the reservoir have significant environmental impacts?
(Large size, major earthworks, visual impact)
YES/UNSURE ▶ Request Environmental Impact Assessment (EIA) Screening Opinion from LPA (before Prior Notification is determined)
NO ▶ Continue 5

Does the LPA require Prior Approval?
LPA will decide whether Prior Approval is required, informed by Environmental Screening
YES ▶ Submit further details (design, landscape, ecology, drainage)
NO ▶ Proceed, subject to conditions 6

Will your proposal affect designated habitats?
(SAC, SPA, Ramsar Sites** nearby)
YES/UNSURE ▶ Habitats Regulations Assessment (HRA) may be required
This is separate from an EIA
NO ▶ Continue 7

Technical consents and approvals

Will the works affect ditches, drains or flood risk?
YES ▶ Land Drainage Consent from Lead Local Flood Authority (LLFA)/IDB or Flood Risk Activity Permit required from EA
NO ▶ Continue 8

Will the reservoir hold 25,000 m³ or more above ground level?
YES ▶ Requires reservoir safety registration and appointment of approved reservoir construction engineer (see Reservoir safety reforms p13)
NO ▶ Continue 9

Outcome
Proceed once all required licences, permissions and consents are in place (all reservoirs must still comply with general health & safety and construction regulations) 10

Getting professional support can help anticipate the challenges and frustrations rather than responding reactively to every query

Applying for an abstraction licence[3]

In most cases, the first step is to contact the EA to obtain an abstraction licence to draw water from a river, stream, or groundwater. This should be done as early as possible, ideally alongside reservoir design, so licence conditions can be built into the scheme from the outset.

The EA manages water resources to protect the environment and existing water users. Most abstractions of more than 20 m³ per day require a licence. If you already hold a summer abstraction licence, it may need to be varied or changed to a winter-only licence to support reservoir filling.

An early discussion with the EA will help confirm whether water is available in your catchment, explain local restrictions, and determine whether flow monitoring is required. These early checks often save time and cost later. Catchment information is also available through the EA's Abstraction Licensing Strategies (ALSs) for your area.

Allow several months for the process. The EA must advertise the application, consult statutory bodies, consider objections and assess impacts on the environment and other abstractors. In water-stressed areas, licences may be restricted or refused, so early discussion is important.

Environmental approval

As part of the planning process, the LPA will consult a range of statutory bodies, depending on the proposal's location and nature. This may include organisations such as Natural England (NE), the EA, and others with environmental responsibilities.

Where a reservoir is proposed in sensitive locations, such as National Landscapes or near designated wildlife sites, the EA and NE may request additional environmental information. This could range from targeted ecological surveys to a full statutory EIA.

These organisations will seek to understand how the reservoir will be sited, designed, and landscaped to minimise impacts and, where possible, enhance the local landscape and natural environment. Many environmentally beneficial features can be incorporated at low additional cost, such as sensitive shaping, planting, and habitat creation, as described later in the guide.

Public consultation

In some cases, the LPA may seek views from the local community as part of the planning process. This requirement often depends on the reservoir's size and its proximity to housing or public viewpoints.

In practice, smaller farm reservoirs located away from settlements and well integrated into the landscape tend to attract limited public interest, particularly where they are clearly linked to agricultural use and water security.

Archaeology

Experience suggests that up to one-third of clay-lined reservoirs may require archaeological assessment. Any application should consider the potential impact of the scheme on the historic environment, particularly where the land included in the proposal lies within an area of known or potential archaeological interest. This may include impacts on buried archaeological remains and on the setting of designated or non-designated heritage assets. This process is separate from environmental assessment, but the two can usually run in parallel to minimise delays. The LPA's archaeological advisers will review the proposal (only areas within the red line boundary) and may require further assessment, including intrusive and/or non-intrusive evaluation, that in turn may lead to further archaeological excavation and mitigation. Programmes can prove complex and expensive. Scheme promoters are therefore encouraged to engage with the LPA's archaeological advisers in the very early stages of the proposal to better understand these matters.

Access

Public access to farm reservoirs can be difficult to supervise and may raise safety and security concerns, including vandalism. For this reason, unrestricted public access is generally discouraged.

Controlled access by private groups, such as local birdwatchers or angling clubs, can sometimes be beneficial, as regular visitors may alert the landowner to problems at an early stage. Reservoirs are not suitable for swimming and are generally too small for boating. Appropriate signage and fencing are normally required.

Other permissions and considerations

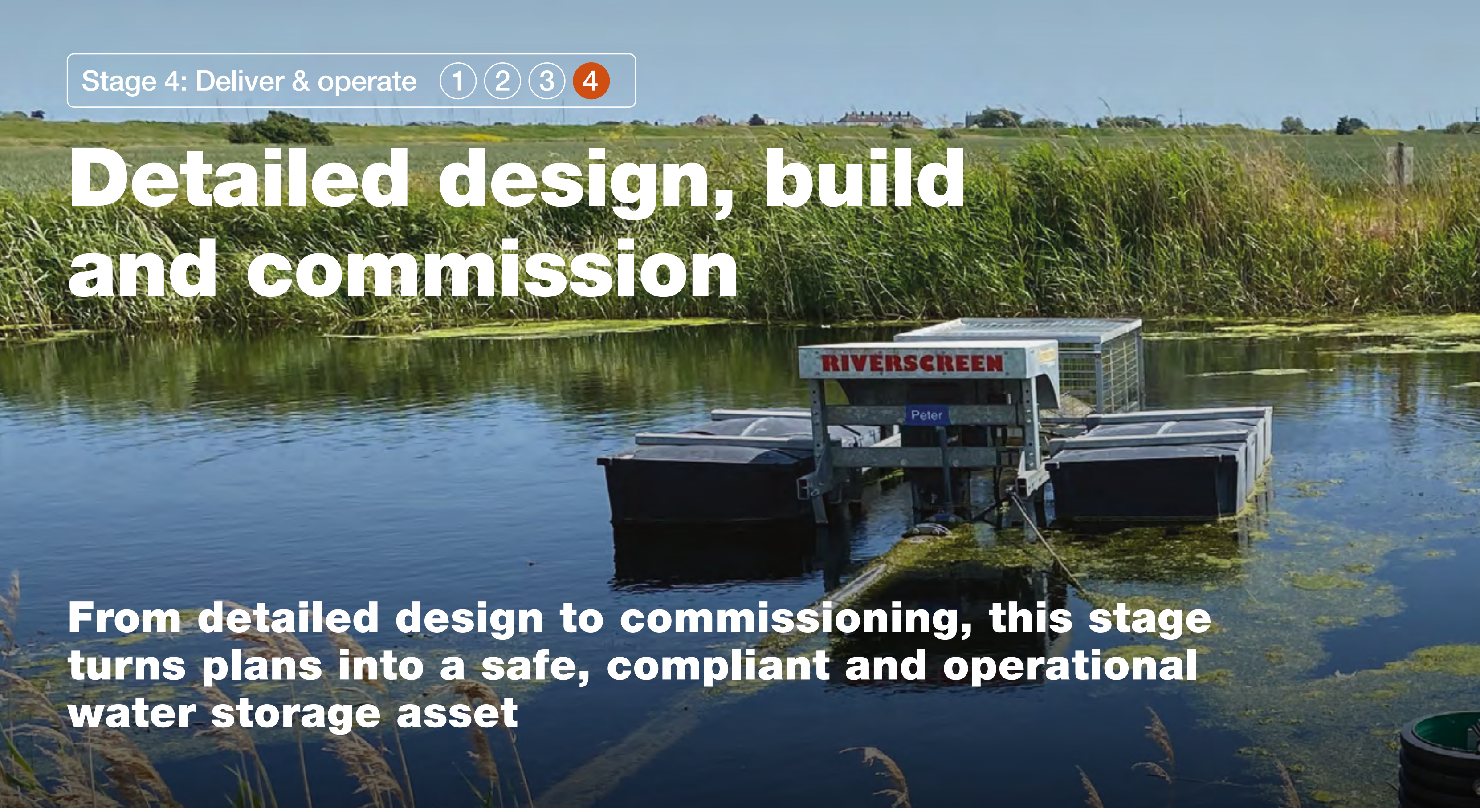
In addition to planning and environmental consents, other permissions or agreements may be needed. These can include:

- Temporary or permanent access across neighbouring land
- Rights for pipelines, electricity supply or telemetry
- Diversion of public rights of way
- Health and safety requirements during construction
- Protection of habitats or species not covered elsewhere
- Mineral or quarrying consent where clay or other materials are excavated.
- Reservoir safety issues (p13)

For larger construction projects, a Site Waste Management Plan may be required. If excavated materials are moved off-site, waste documentation will be needed.

Identifying these issues early helps avoid delays during construction and ensures costs are properly budgeted.

Stage 4: Deliver & operate ① ② ③ ④



Detailed design, build and commission

From detailed design to commissioning, this stage turns plans into a safe, compliant and operational water storage asset

Key pumping considerations

- **Abstraction rate** – Sized to fill within the licensed abstraction period
- **Total head** – Allow for lift to crest plus pipe friction losses
- **Intake protection** – Screens to prevent debris, fish and eel entry
- **Energy supply** – Grid connection preferred; diesel for remote sites
- **Efficiency control** – Variable-frequency drives reduce energy use
- **Pipe sizing** – Avoid excessive velocities and friction losses
- **Compliance** – Flow metering to meet EA licence conditions

Every reservoir is unique. Soils, geology, water source and the farm system all influence the final design.

Design can proceed alongside planning and abstraction licensing applications to save time, but doing so before permissions are secured carries financial risk if applications are delayed or refused. Once permissions are in place, the project moves into detailed design and delivery, where decisions determine structural integrity, regulatory compliance, safety and long-term reliability. Planning drawings set out what is proposed in principle; detailed construction drawings, supported by clear specifications, contractor oversight and systematic commissioning, turn an approved scheme into a safe, durable reservoir that protects your investment for decades.

Understanding the ground

Most long-term problems originate in the foundation or embankment material

The greatest risks are often below ground. Permeable layers, weak soils, buried drains or high groundwater pressures can compromise stability and watertightness. Good delivery begins with understanding the site.

For clay-lined reservoirs, you will need to source sufficient clay suitable for compaction and embankment construction. Be aware of features that can weaken embankments and lead to leakage or failure, such as sand and gravel lenses, existing land drains, high water tables and burrowing animals.

Where uncertainty exists, geotechnical investigation may be justified before finalising design.

A reservoir is an engineered earth structure, not simply an excavated hole

Project delivery

Design & build package

A single contractor undertakes both detailed design and construction.

Advantages include a single point of responsibility, potentially faster programme, and early cost certainty.

Risks include less independent oversight, design optimisation may favour buildability over longevity.

Consultant + contractor

An independent designer prepares a detailed specification; the contractor builds to that specification, usually under the designer's supervision.

Advantages: greater design control, independent quality assurance, clear technical specification, can reduce costs if design is subject to competitive tendering.

Risks include a longer procurement process and potential interface disputes. Choice depends on project scale, complexity and risk appetite.

From construction through commissioning to operation, disciplined delivery ensures the reservoir performs safely and reliably for decades. Ongoing inspection and maintenance are part of responsible water stewardship.

Building properly

When constructing earth embankments, key issues include controlling moisture content to ensure effective compaction, compacting in appropriate layers, protecting liners from puncture, installing pipework to correct levels, and ensuring spillways are robust.

Construction quality determines long-term performance. Poor compaction or unmanaged seepage pathways can lead to leakage, slope instability or long-term maintenance issues.

Earthworks are highly sensitive to weather so summer construction is generally preferred. Winter construction increases the risk of poor compaction and programme slippage. Programming should allow time for settlement before the first filling.

Independent supervision is often prudent on larger schemes.

Building safely

Reservoir construction involves heavy plant, large earthworks and deep excavations, along with installation of major pipework. Robust health and safety planning is essential, and Construction Design Management (CDM) regulations apply. Clear contractor roles, supervision and responsibilities are critical to managing risk.

Reservoirs storing more than 25,000 m³ above ground level must comply with reservoir safety legislation and require appointment of a qualified reservoir construction engineer.

Operating safely

Safety continues beyond construction, with secure fencing, safe access and emergency planning essential for responsible operation.

Commissioning & handover

Commissioning ensures the reservoir operates safely and complies with licence and safety requirements. Before first filling ensure that abstraction meters are installed, pumps tested and calibrated, spillways inspected, flow monitoring operational, as-built drawings retained, and licence conditions understood.

Engagement with the EA may be required where licence conditions apply.

Operating a long-term asset

A reservoir is a 40 to 60-year infrastructure asset if properly managed.

Operation involves:

- Adhering to abstraction timing and limits
- Maintaining embankments and vegetation
- Inspecting for erosion or burrowing
- Managing silt and water quality
- Replacing HDPE membrane liner
- Servicing pumps and control equipment.
- Appointing a reservoir panel engineer if storage is 25,000 m³ above ground level

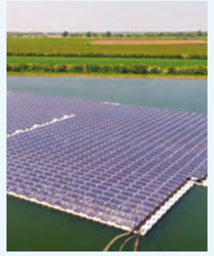
Regular inspection reduces risk and protects investment.

Good reservoirs are not straightforward investments. They are site-specific engineered structures built on variable ground. Sound design, careful construction and disciplined operation ensure reliability for decades.

Reservoir investment and operating costs

Reservoir investment is a major financial commitment. Assess capital and operating costs, integration with existing abstraction, and how to minimise pumping, energy use and drought risk

Floatovoltaics – investing in 'multi' use rather than 'single' use reservoirs



Farmers recognise the need to invest in storage to improve water security and climate resilience. However, the capital cost can be difficult to justify if reservoirs are viewed as serving irrigation alone.

A shift from 'single use' to 'multi-use' storage – combining irrigation, environmental enhancement and renewable energy – can strengthen financial viability. Floating solar panels ('floatovoltaics') offer one such opportunity, generating power while maintaining water storage.

Used year-round, reservoirs can support both irrigation and green energy production, improving business resilience, reducing greenhouse gas emissions and lowering energy costs. This approach can also help avoid conflicts over land use and reduce pressure to develop standalone solar farms on productive farmland.

If floating photovoltaic (FPV) panels are being considered for installation on a reservoir, care should be taken to ensure they do not compromise ecological benefits, for example by restricting access to open water used by wading birds and wildfowl.

Capital costs

The cost of constructing a reservoir depends on site conditions, particularly whether suitable local clay is available or a synthetic HDPE liner is required. Early geotechnical advice is critical to avoid costly problems later.

Figure 3 compares earthworks costs (£) for 30 recently constructed irrigation reservoirs built over the past two years against their storage capacity (m^3). For clay reservoirs, the costs reflect excavation only; for lined reservoirs, they also include the HDPE liner. The scatter in the data reflects the complexity of local site conditions.

The data show a broadly parallel linear trend between both reservoir types. Clay reservoirs (red dotted line) are generally cheaper, although the gap has narrowed considerably following the removal of red diesel entitlement for construction in 2022. The average storage capacity across the sample was 100,000 m^3.

Figure 4 compares unit costs (£/m^3 of usable storage) against reservoir capacity (m^3). It shows that clay reservoirs typically cost £2.00–£3.00/m^3 of gross storage (average £2.75/m^3), while HDPE-lined reservoirs ranged between £2.50–£4.50/m^3 (average £3.25/m^3).

Irrespective of construction type, smaller reservoirs are disproportionately more expensive, so larger schemes do benefit from clear economies of scale.

These costs exclude permissions, site investigations and professional fees. Investigation, design, supervision and statutory certification can add around 15% to construction costs for larger reservoirs. EIAs may also be required on sensitive sites, with upfront costs at risk if the scheme does not proceed.

Additional infrastructure must also be included, such as easements, inlet and outlet structures, pumps, pipework, access roads, landscaping and fencing. Securing a three-phase electricity supply can exceed £100,000 where capacity is limited, so careful site selection can help reduce these costs.

Reservoir sizing should also allow for 'dead storage' to cover evaporation, seepage and liner integrity – typically around 5%.

There is also an opportunity cost from land taken out of production – either as capital tied up or lost cropping – but this can be offset by the higher value and productivity of irrigated land.

Plan for future expansion – limited summer abstraction and potential Environmental Destination reductions may restrict growth in irrigated areas without additional storage

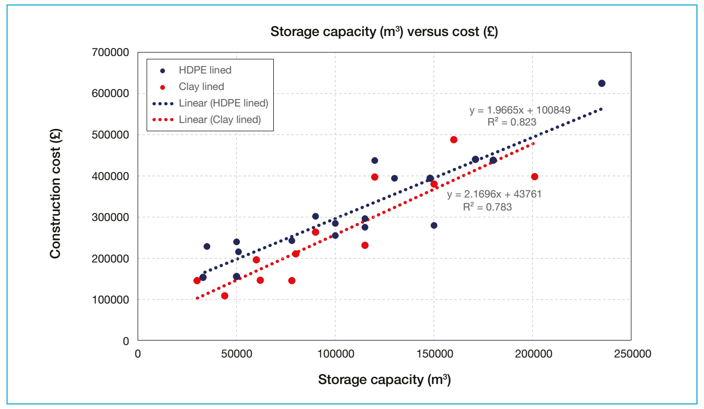


Figure 3: Construction costs (£) vs storage capacity (m^3) for a sample of recently constructed clay-lined and HDPE membrane-lined reservoirs.

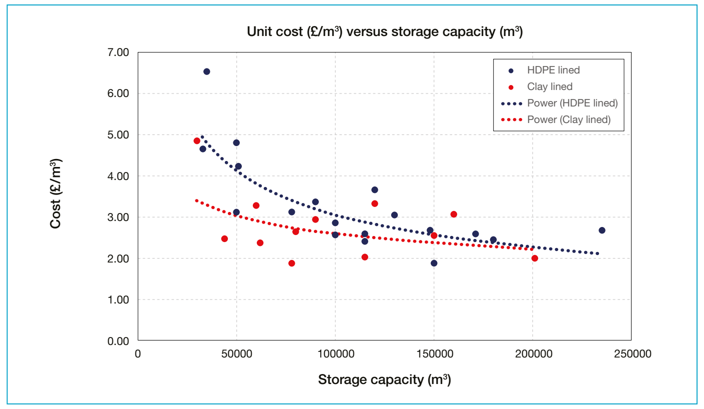


Figure 4: Unit cost (£/m^3) vs storage capacity (m^3) for recently constructed clay and HDPE membrane-lined reservoirs.

Operation and maintenance costs

While capital investment dominates, annual operating and maintenance costs should not be overlooked. For clay-lined reservoirs, these are typically around 1–2% of capital cost.

Clay reservoirs are long-lasting and generally do not require perimeter fencing, although businesses still have a duty of care to prevent accidents. In contrast, HDPE-lined reservoirs require secure boundary fencing due to safety risks (steep, slippery embankments). This adds to the overall costs. Escape measures such as roped tyre ladders at 50 m intervals are now commonly installed. Liners also require periodic repair and typically have a lifespan of around 25 years, so allowance for replacement is advisable.

Energy is another high cost. Most systems involve "double pumping" – into storage and then into distribution – often adding around 1 bar of pumping pressure. Variable speed pumps and off-peak tariffs can help manage energy use and costs.

The Reservoirs Act 1975

In England, reservoirs holding 25,000 m^3 or more above natural ground level must be registered with the EA where they are regulated under the Reservoirs Act 1975. Once registered, the EA will designate each reservoir as either 'high-risk' or 'not high-risk', based on whether an uncontrolled release of water could endanger human life. 'Not high-risk' reservoirs must still be registered with the EA but are not subject to the same level of oversight.

High-risk reservoirs must comply with additional statutory requirements, including ongoing supervision and periodic inspections by qualified panel engineers, usually at least every ten years. These engineering inspection costs are the responsibility of the reservoir owner. Owners must also meet all statutory safety and inspection obligations set out in the Reservoirs Act.

Reservoir safety reforms

Work is underway to modernise reservoir safety regulation. Proposals include a hazard-based classification system to better align safety requirements with risk, and extending regulation to smaller raised reservoirs (10,000–25,000 m^3). Monitor the "Reservoir Safety Reform Programme" for updates[4].

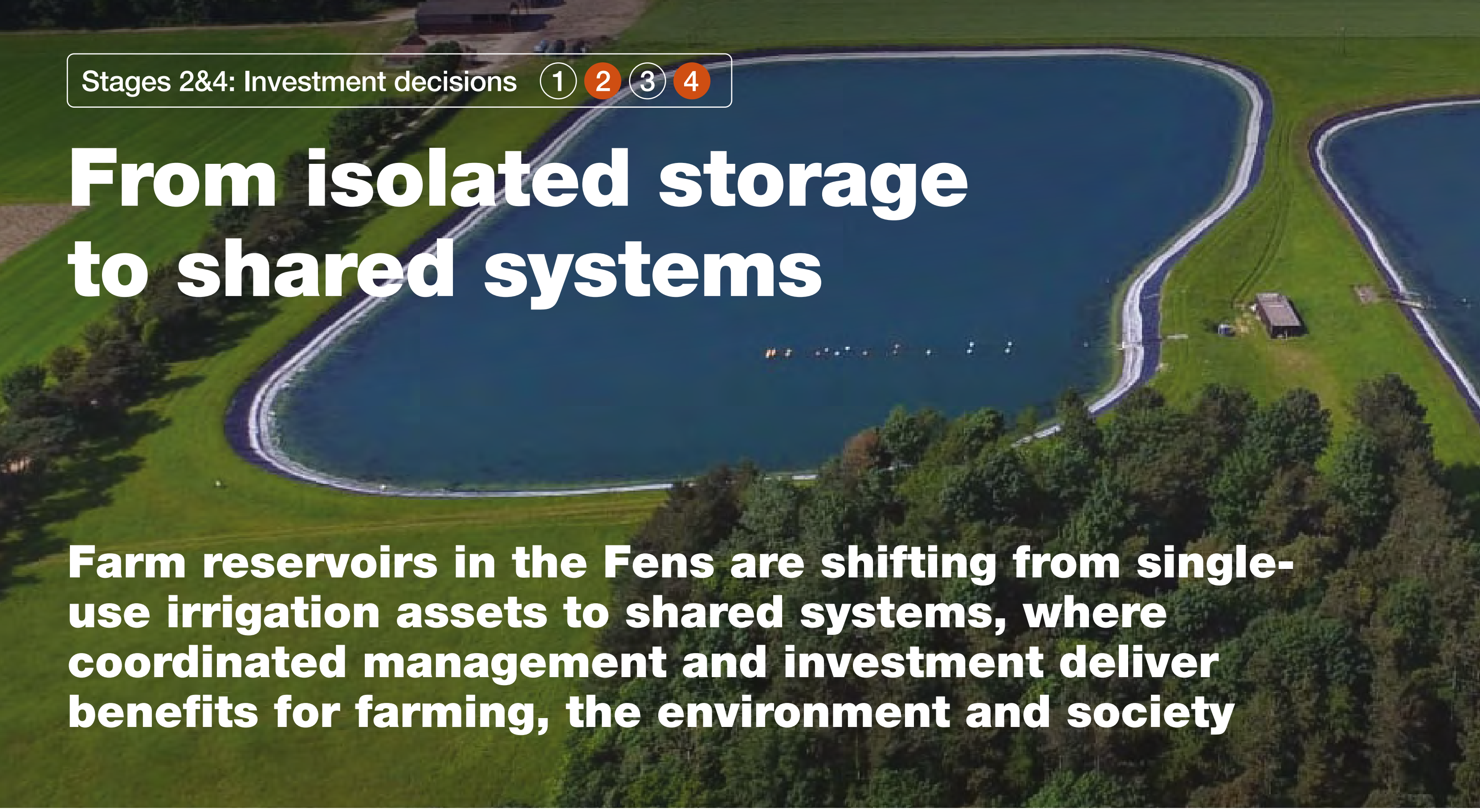
Further information and grant opportunities

The British Dam Society (britishdams.org) provides guidance on engineering and regulatory requirements for reservoir construction, including panel engineers and health and safety compliance.

Recent funding was available through the **Water Management Grant** to support winter storage, reduce reliance on summer abstraction and encourage collaborative reservoirs. Grants have typically ranged from £35,000 to £500,000, covering up to 40% of eligible costs.

The Farming Equipment and Technology Fund 2026, launched in March 2026, includes items related to irrigation management, rainwater harvesting and agricultural demand management[5].

While the grants above may be time-limited, funding is available to farmers for many water-storage actions through **Countryside Stewardship Higher Tier and Sustainable Farming Incentive** (SFI)[6].

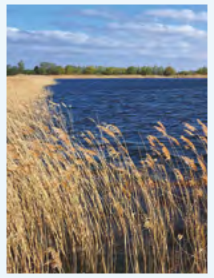


Stages 2&4: Investment decisions ① ② ③ ④

From isolated storage to shared systems

Farm reservoirs in the Fens are shifting from single-use irrigation assets to shared systems, where coordinated management and investment deliver benefits for farming, the environment and society

Case Study – 'De-risking' the business key to future water security



G's is a family-owned farming business focused on high-quality fresh produce including salads and field vegetables. It has significant production within the Cambridgeshire Fens where fertile soils and flat topography provide ideal conditions for irrigated production.

However, acute awareness of increased drought risks coupled with potential changes in water allocations is driving significant investment in reservoirs. They are currently building a new 660,000 m^3 clay lined reservoir which will be winter filled via the adjacent IDB drainage network. Excavation works commenced in March 2026 and will be completed in the autumn, ready for winter filling. Tom Collinson, Farm Manager said,

"The main challenges were the long time to secure the abstraction licence, the very wet winter which delayed our planned start date for excavation and coping with the fast-rising costs of diesel. Overcoming these short-term challenges will reap significant benefits in the long-term by increasing our future water security which fundamentally underpins this business."

Recognising the opportunities

Farm reservoirs should be viewed within their wider catchment, not simply as individual assets. Managed collectively, they can store winter flows, reduce pressure on summer abstraction, and support a more flexible and resilient water system.

In lowland areas such as the Fens, IDBs manage water through drains, channels and pumping stations. In winter, large volumes are discharged to sea. Capturing part of this flow in reservoirs can increase water availability, reduce flood risk and improve drought resilience, using existing infrastructure.

Reservoirs also enable water sharing between farms, help offset abstraction licence reductions, and may support public supply or environmental schemes. They strengthen business resilience, enable higher-value cropping, and offer diversification opportunities. Realising this potential depends on stronger collaboration between farmers, IDBs and environmental bodies.

Connected systems in practice

East Cambridgeshire District Council is promoting a coordinated approach to water management that builds on the existing network of farm reservoirs.

Working with farmers and IDBs, the aim is to connect new and existing reservoirs through the managed drainage system to capture excess winter water currently discharged to sea.

More than 80 reservoirs already exist across the district, many of them licensed and connected to IDB networks. With targeted investment, these assets could be upgraded, better connected and expanded to operate as a distributed storage network across the catchment. Water could be captured during periods of surplus, transferred through existing channels and pipelines, and stored where it is most effectively used.

This approach offers a scalable and cost-effective alternative to major infrastructure projects. By using established infrastructure and operational systems, it can be delivered more quickly and flexibly while also providing environmental benefits, including reduced pressure on summer flows and opportunities for habitat enhancement.

Farmers and landowners would typically fund this, with returns from improved water security and potential income streams.

Councillor Anna Bailey of East Cambridgeshire District Council commented:

"Rather than wait for major national infrastructure, this approach is faster and more flexible to manage, and can better align with environmental objectives than large-scale alternatives."

Collaboration in practice

Collaboration is the key enabler in moving from individual reservoirs to functioning catchment systems. It allows water, infrastructure and abstraction licences to be used more efficiently across multiple farm businesses.

The Lincoln Water Transfer (LWT) scheme shows how abstractors can pool licences while retaining first rights to their original allocations. Unused water can then be shared within the group, improving overall utilisation while maintaining fairness and transparency. The local IDB plays a key role by managing water levels and facilitating transfers through its infrastructure.

IDBs use 'put and take' licences to provide a conduit for water transfers from sources to farms and between farms

Without storage, such collaboration remains constrained by environmental limits and hydrological variability. In practice, it is restricted to short-term operational measures such as alternating abstraction or proportional reductions.

Reservoir storage changes this. By capturing surplus water and holding it within the system, it enables redistribution over longer timescales—days, weeks or seasons—making collaboration more reliable, predictable and economically viable.

Case Study

Building resilience through shared storage

In Norfolk, Heronhill LLP – a partnership between Westacre Estate, CE Cross and Gayton Estate – has developed two shared reservoirs using a cost-sharing model.

This approach distributes both capital investment and long-term benefits across participating businesses, reducing individual financial exposure while increasing the scale and reliability of water storage.

The value of this model was clearly demonstrated during the 2022 drought. While many irrigators faced severe restrictions and crop losses, the partnership was able to maintain supply using stored winter water, protecting both yield and crop quality.

Making collaboration work

While the technical case for shared storage is strong, delivery depends on effective collaboration. Successful schemes require clear agreements from the outset, covering ownership, cost-sharing, operation and maintenance, and the allocation of water – particularly during dry periods.

Trust between participants is critical. Many successful schemes have been triggered by a shared problem or external pressure, creating a clear incentive to work together. Early agreement on rules and expectations, including pre-season contracts for water supply, helps to reduce uncertainty and build confidence.

Facilitation often plays an important role. A lead organisation or coordinator can help bring partners together, develop proposals, secure funding and manage ongoing operation.

Water Abstractor Groups (WAGs) and IDBs are particularly well placed to support this process, given their existing infrastructure, operational role and local knowledge.

Group size and structure also matter. Smaller groups are often easier to manage and can build stronger working relationships, although larger networks may be needed to achieve scale. Flexibility within agreements allows individual farms to retain autonomy while benefiting from collective arrangements.

Ultimately, successful collaboration depends as much on organisation and relationships as on engineering. Reservoirs provide the physical capacity to store water, but it is shared management, clear governance and mutual trust that determine whether that capacity can be used effectively[7].