About The Million Ponds Project

MILLION PONDS PROJECT
Pond Conservation

A 50-YEAR PROJECT TO CREATE A NETWORK OF CLEAN WATER PONDS FOR FRESHWATER WILDLIFE

What is the Million Ponds Project?

The Million Ponds Project will create an extensive network of new ponds across the UK.

Ultimately the aim is to reverse a century of pond loss, ensuring that once again the UK has over one million countryside ponds.

A critical element of the project is that these new ponds will have clean water. This is important because most countryside ponds are now badly damaged by pollution, and evidence shows that pond wildlife is declining across the UK.

Making clean new ponds is one of the simplest and most effective ways to protect freshwater wildlife. New clean water ponds can quickly become exceptionally rich habitats, supporting sensitive plants and animals. Ponds are easy and cheap to make, and in the face of widespread pollution and climate change, pond creation is one of the quickest, simplest and most affordable things we can do to benefit freshwater wildlife.

What's in this factsheet?

- Project aims
- Phase I (2008-2012)
- Who's involved?
- Who can join in?
- Resources available
- How to get involved

The first phase of the Million Ponds Project

Phase 1 of the Million Ponds Project runs from 2008 to 2012 and aims to create the first 5,000 clean water ponds in England and Wales. Around a quarter of the ponds will be targeted to support some of the 100 or so pond species that are a national priority for conservation action under the UK Biodiversity Action Plan (BAP).

Who's involved?

The Million Ponds Project is a collaboration of major landowners and land managers, co-ordinated by Pond Conservation. Partner organisations including the Defence Infrastructure Organisation, the Environment Agency, the RSPB, Natural England and the Forestry Commission are creating hundreds of ponds on their land and elsewhere. The project team is currently supported by The Tubney Charitable Trust and the Countryside Council for Wales.

Wildlife organisations like Buglife, Plantlife, the RSPB and the Aquatic Coleoptera Conservation Trust are providing information about pond creation for rare species. Amphibian and Reptile Conservation is co-ordinating part of the project, in association with the Amphibian and Reptile Groups (ARGs), to encourage the creation and management of ponds for amphibians and the pond-loving grass snake.

We are also working with the mineral industry to create clean water ponds on aggregate extraction sites.

New organisations are continuing to join the project – for an up-to-date list visit the Million Ponds Project website.

Can anyone join in?

Anyone who can create a new clean water pond can contribute to the Million Ponds Project. We want to encourage everyone who can to join in. To contribute to the pond creation target, a new pond needs to fulfil three criteria. It needs:

1. a clean water source.
2. to be left to colonise naturally.
3. to be left to thrive without undue disturbance.

An explanation of why these factors are so important and how to achieve them is given in Factsheet 2 of the *Pond Creation Toolkit*.

Following these guidelines brings many benefits: not only will the ponds be very rich in wildlife throughout their lifetime, but most ponds will also be longer-lived and need less management than typical countryside ponds.

We hope many thousands of people will join in to bring wonderful and diverse small waterbodies back to the countryside. You can tell us about the ponds you've created that contribute to the Million Ponds Project targets on the *website*.

What help and resources are available?

The Pond Creation Toolkit

The Pond Creation Toolkit includes a range of factsheets available to download for free (see Figure 1). These include:

- ***Core factsheets 1 to 8*** with background information on the project and the best practice principles of clean water pond creation, such as pond location, design, project planning and implementation.
- ***Habitat factsheets***, which present detailed information on designing ponds in different landuses, e.g. woodland, grassland etc.
- ***Advice factsheets***, which deal with issues such as birdstrike, planning permission, and ponds in public access areas.
- ***Species dossiers*** with technical information on creating ponds specifically for over 40 pond-associated BAP species, based on their ecological requirements.

- ***Aggregates factsheets*** specifically targeted at pond creation on mineral sites.
- ***Case studies***.

The Pond Creation Toolkit also includes the **BAP species map**, which helps you find out which pond-associated BAP species occurs in a particular area (English BAP species only).

CORE FACTSHEETS

FACTSHEET 1
About the Million Ponds Project
An overview of aims, partners and resources.

FACTSHEET 2
Clean water ponds for wildlife
An overview of why creating clean water ponds is important, what clean water ponds are, and how to create one.

FACTSHEET 3
Outline steps for pond creation for wildlife
Summary of the pond creation process from beginning to end.

FACTSHEET 4
Pond design

FACTSHEET 5
Locating ponds and finding a clean water source

FACTSHEET 6
Planning pond creation

FACTSHEET 7
Constructing ponds

FACTSHEET 8
Managing ponds after creation

BAP SPECIES MAP
Online tool to help you find out more about pond-associated BAP species
- Site view
- Minerals view
- Species view

SUPPLEMENTARY FACTSHEETS

HABITAT FACTSHEETS
Designing ponds in:
- Woodlands
- Grasslands
- Heathland
- Wetlands and reedbeds
- River floodplains

ADVICE FACTSHEETS
- Designing wildlife ponds in areas with public access
- Designing wildlife ponds to avoid the risk of birdstrike
- Planning permission advice
- Project costing advice

SPECIES DOSSIERS
Creating ponds for:

Plants
- Bryophytes
- Stoneworts
- Pillwort
- Yellow Centaury
- Coral Necklace
- Pigmy Rush
- Marsh Clubmoss
- Three-lobed Water-crowfoot
- Brown Galingale
- Small Fleabane

Invertebrates
- One-grooved Diving Beetle
- Zircon Reed Beetle
- Spangled Water Beetle
- Oxbow Diving Beetle
- Ground beetles
- Lagoon Sand Shrimp
- Crystal Moss Animal
- Starlet Sea Anemone
- Pondweed Leafhopper
- Fen Raft Spider

Vertebrates
- Bats
- Water Vole
- Common Toad, Great Crested Newt and Grass Snake

AGGREGATES TOOLKIT

FACTSHEET A1
Why make ponds on aggregate sites?

FACTSHEET A2
Pond design principles for biodiversity

FACTSHEET A3
Pond construction on aggregate sites: good practice guidelines

FACTSHEET A4
Ponds, a priority habitat: best practice guidelines for planners and developers

FACTSHEET A5
Integrating ponds with aggregate afteruses

FACTSHEET A6
Great Crested Newts and the aggregate extraction industry

CASE STUDIES
- **Eye Landfill** – best practice pond design principles applied to compensation schemes for protected species.
- **King's Dyke** – ongoing habitat creation and management at a restored mineral extraction site.
- **Nosterfield** – retro-fitting ponds and scrapes for wading birds can have benefits for a variety of wetland wildlife.
- **Darcy Lever Gravel Pits** – how a partnership led by volunteers benefits freshwater wildlife.

Figure 1. Content of the Pond Creation Toolkit

Pond creation advice

In England and Wales, Project Officers can provide advice on pond creation projects until Spring 2012 – including site visits for larger schemes. If you would like to get in touch with a Project Officer, then please contact 01865 483249. Please note that there is currently no funding to support this work in Scotland or Northern Ireland.

Training courses

Training courses are available to major project partners until January 2012. 'Open-entry' courses are also available. Please see the project website for further information.

Advice on amphibian and reptile BAP species

Pond creation for amphibians and grass snakes is an important component of the Million Ponds Project and this is being coordinated by Amphibian and Reptile Conservation (ARC). ARC can also assist with advice and assistance on pond management for amphibians and grass snakes.

Get involved

Keep yourself informed: get updates on the Million Ponds Project, the Pond Habitat Action Plan and other freshwater conservation issues by visiting the *Pond Conservation website*.

Contribute to the Million Ponds Project targets: tell us about the clean water ponds you've created on the *project website*.

Help create ponds for threatened pond wildlife by contributing to the Pond Digging Fund: every £1 donated will generate £10 of funding through the Landfill Communities Fund for the *Pond Digging Fund*.

If you have any enquiries about the Million Ponds Project or any other aspect of the conservation of ponds, email *info@pondconservation.org.uk*

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Photographs: Keith Walkling, John Baker, Fred Holmes, Andy Harmer, Peter Wakely

Clean water ponds for wildlife

MILLION PONDS PROJECT
Pond Conservation

A 50-YEAR PROJECT TO CREATE A NETWORK OF CLEAN WATER PONDS FOR FRESHWATER WILDLIFE

1. Why create clean water ponds?

The aim of the Million Ponds Project is simple: to create new wildlife-friendly ponds, the type of ponds once common in natural landscapes.

Animals and plants have evolved to live in ponds over many millions of years. The best way to protect pond wildlife today is to create waterbodies that mimic the clean wild ponds common in the past. This isn't hard because natural ponds come in all shapes, sizes and depths, and many are tiny and seasonal! The main requirement is clean, unpolluted water.

2. Why not just manage existing ponds?

It's a very common question: 'why bother to dig new ponds – why not just manage existing ones?' There are some unique advantages which make pond creation an especially effective way to help freshwater wildlife:

- New ponds let you start with a clean slate. Critically, you can dig them in places where it's easy and convenient to keep the pond's water clean throughout its lifetime. Evidence shows that 80% of countryside ponds are now degraded, and it's often hard to clean these ponds and keep them unpolluted.
- Pond creation is usually 'safer' than pond management. With management there is always a risk that the work will do harm. Finding out if this is likely can require expensive professional surveys of the existing wildlife. Creation is cheaper and simpler.

3. How do you make a new clean water pond?

To create a pond for the Million Ponds Project there is a simple recipe (see 'Recipe for a clean water pond' in box). It's surprising

What is a pond?

Ponds are permanent or seasonal waterbodies between 1 m^2 and 2 hectares in surface area (about 2.5 football pitches).

This definition includes temporary ponds that dry up during the year, as well as tiny pools and very shallow ponds like 'wader scrapes'.

Clean ponds have many advantages

- **High biodiversity value:** these ponds are exceptionally rich in wildlife and often have uncommon species.
- **A long lifespan:** most clean water ponds will survive for hundreds and sometimes thousands of years.
- **Minimal management:** there will be little requirement for sediment dredging or other management.
- **Few long-term problems:** e.g. cloudy water, excessive algae or duckweed growth.

how few countryside ponds today meet these criteria – only a few percent in lowland England and Wales. The damage caused by pollution, in particular, is getting worse. Clean new ponds are now vital to help maintain freshwater biodiversity in the countryside.

4. What if I can't meet all the criteria?

Not all new pond creation projects will be able to meet the Million Ponds Project criteria. Ponds that don't, unfortunately, can't contribute to the clean water pond 2012 target (see *Factsheet 1*). Ponds with poor water quality, in particular, won't enjoy the benefits of a clean water pond (see box) or usually support their exceptional wildlife communities in the long term.

However almost all new ponds can still be valuable for wildlife, and they add to the freshwater network as a whole, which is welcomed.

If it is not possible to follow the Million Ponds Project recipe, still read the advice in the *Pond Creation Toolkit*. Do the best you can to keep the water as clean as possible. Where water quality is very poor, focus on creating very shallow water and good edge habitats to maximise the pond's wildlife value.

Recipe for a clean water pond

1. Find a place with a clean water source (Figure 1). To do this:
   - make sure the pond has natural surrounds.
   - avoid linking the pond to stream or ditch inflows.
   - don't add topsoil in or around the pond.
2. Leave the pond to colonise naturally – don't stock it with plants, fish or other animals.
3. Make sure the pond will have few impacts during its lifetime: no frequent disturbance from dogs or duck feeding.

5. More about making good ponds

a) Find a good place

(i) Make sure the landuse around the pond is non-intensive. The critical area is the pond's 'catchment' – i.e. any area 'up hill' of the pond, from which water and silt will drain off towards the pond. So within this catchment area:

- Look for a site which will provide the pond with an unpolluted water source. Choose areas like rough grassland, wood or heath.
- Ensure that there is no arable or other land where the ground is regularly disturbed or is likely to be high in nutrients. Avoid intensive grassland where fertilisers or pesticides are applied and could run off.
- Avoid places likely to receive run off from roads, tracks, houses, yards or spoil heaps. Roof run-off is often pretty clean, but other urban surfaces are usually not.

(ii) Generally avoid stream, ditch or drain inflows into ponds. Across most of Britain inflows bring polluted water and silt into ponds. The silt they carry also rapidly fills ponds up reducing their lifespan by decades and sometimes centuries. The best sources of water for ponds are usually (a) groundwater or (b) rain and surface water draining from non-intensive areas.

(iii) Don't add topsoil or leave it near the pond. Topsoil is very high in nutrients. So, having made sure the pond water source is clean, don't then add pollutants from topsoil. The ideal substrates for the base and banks of a clean water pond are those that are naturally nutrient-poor, like bare clay or sand.

What is clean water?

For ponds (and other waterbodies), 'clean' means that the water it receives hasn't been degraded by pollution. This generally means water with low levels of nutrients (like nitrates and phosphates) and heavy metals, and no pesticides or other manmade chemicals.

Factsheet 10 of the *Pond Creation Toolkit* lists the levels of these elements expected in clean water and shows how pollutants get into ponds.

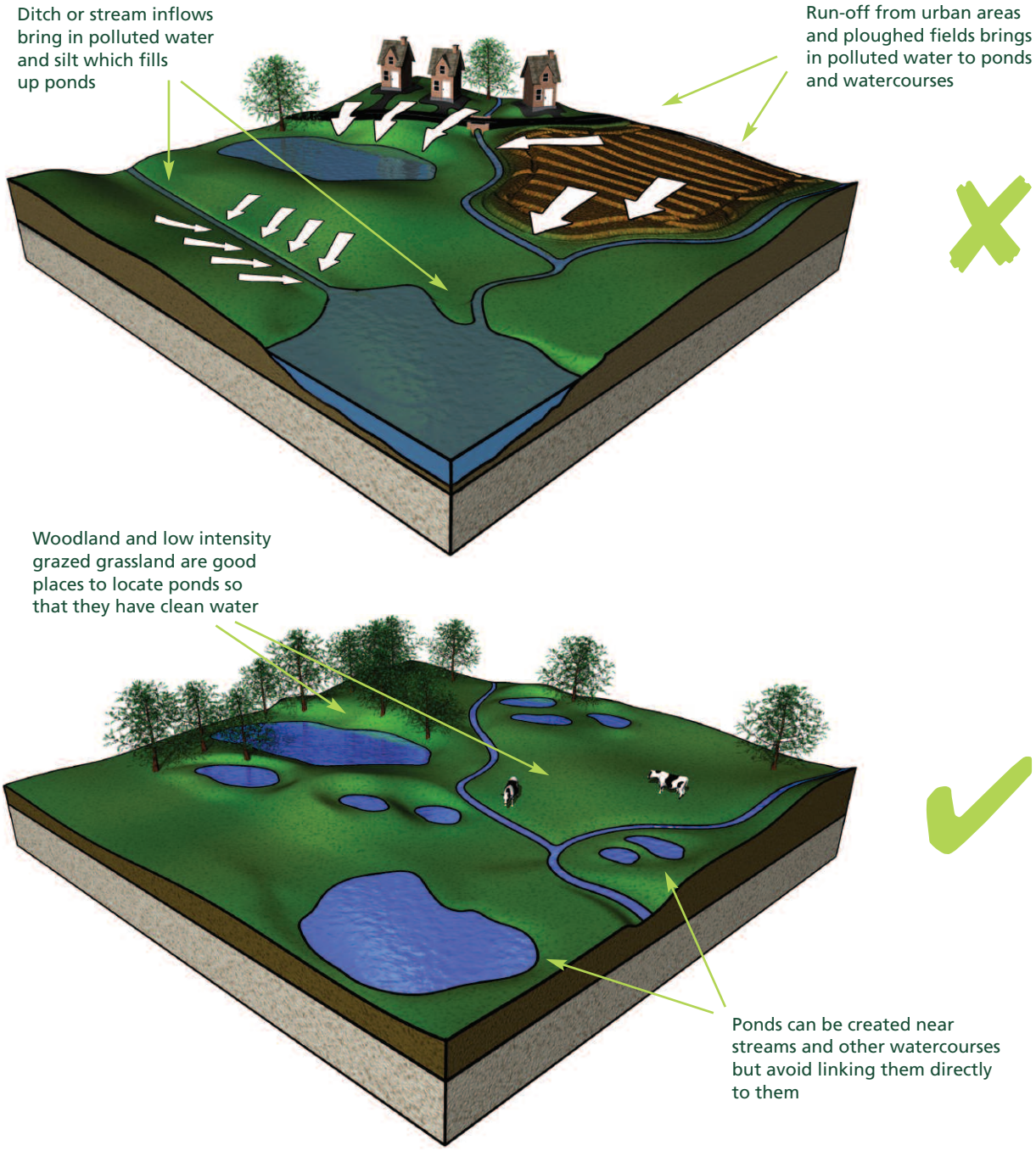


Figure 1. Locate ponds where they will have a clean water source.

b) Let the pond colonise naturally

A guiding principle for new ponds is don't add anything – not plants, fish, amphibians, or a bucket of sludge from another pond to act as a 'starter' (see *Factsheet 8*).

It can be enormously tempting to add plants to a new pond – it certainly makes the pond look better to our eyes. But there are good ecological reasons for not stocking ponds. The most important is that new ponds are not empty habitats. The bare sand or clay and plant-free conditions that new ponds provide create a very special wildlife habitat.

A clean water pond can have a lifetime of 100 years or more and the early bare stage is fleeting enough. Don't shorten it – enjoy what makes a new pond so special.

c) Avoid disturbance from people and pets

People in themselves are fine, and they should be encouraged to enjoy wildlife ponds. However people and their pets can also severely impact clean water ponds. The main problems are addition of fish (particularly carp) and regular swimming by dogs, both of which can stir up the water and make it permanently cloudy. Alien plants and duck feeding will also cause problems.

Any pond located near to a path or in clear view and with easy public access is likely to be impacted by people in one or more of these ways. There are many possible solutions: don't locate the pond near a public path, dig pond complexes with 'sacrificial' ponds, restrict access, make natural barriers etc. See other factsheets in the *Pond Creation Toolkit* for more detailed information on pond creation, planning and aftercare.

6. Tips for making great ponds

What kind of ponds?

As long as ponds have clean water they can be any size, shape or depth and still be great for wildlife. Single ponds are valuable in their own right, especially if they are part of an already pond-rich landscape. Pond complexes are even more valuable: particularly if they have pools of different depths and permanence, including temporary ponds which dry up every year. This variety increases the range of wildlife that can colonise a site, and will ensure useful habitats remain whatever the future climate has in store.

▲ **Even very small pools are good for wildlife**

Good design

Good design can be used to make great ponds even better, and the *Pond Creation Toolkit* has extensive guidance and a Design Bank to provide ideas.

Important principles are:

- Think about the site's afteruse – there is a divide between designs for ponds that will be grazed, and those that will not.
- Keep most bank angles very shallow with a broad, almost flat zone near the pond edge (less than 5°). The most diverse area of a pond is its shallows.

- Don't forget that pond water levels rise and fall during the year – the average is a 30 – 80 cm drop between spring and autumn. Consider this in design, so that there are always areas of shallow water.

The richest parts of a pond for wildlife are the water areas only a couple of centimetres deep! Really!

A good pond design has lots of areas with water that is this shallow. Water levels will go up and down during the year – so creating long low-angled banks makes sure there are always shallows available.

- Design the underwater topography too. Many of our native submerged plants, including stoneworts and pondweeds, grow best in areas free of the organic sediments that build up in ponds though time. These plants prefer bare clay or sand. So create underwater bars and shoals. The fine organic silts slip off the top of the bars and accumulate in the troughs below, leaving the top bare for plant growth.

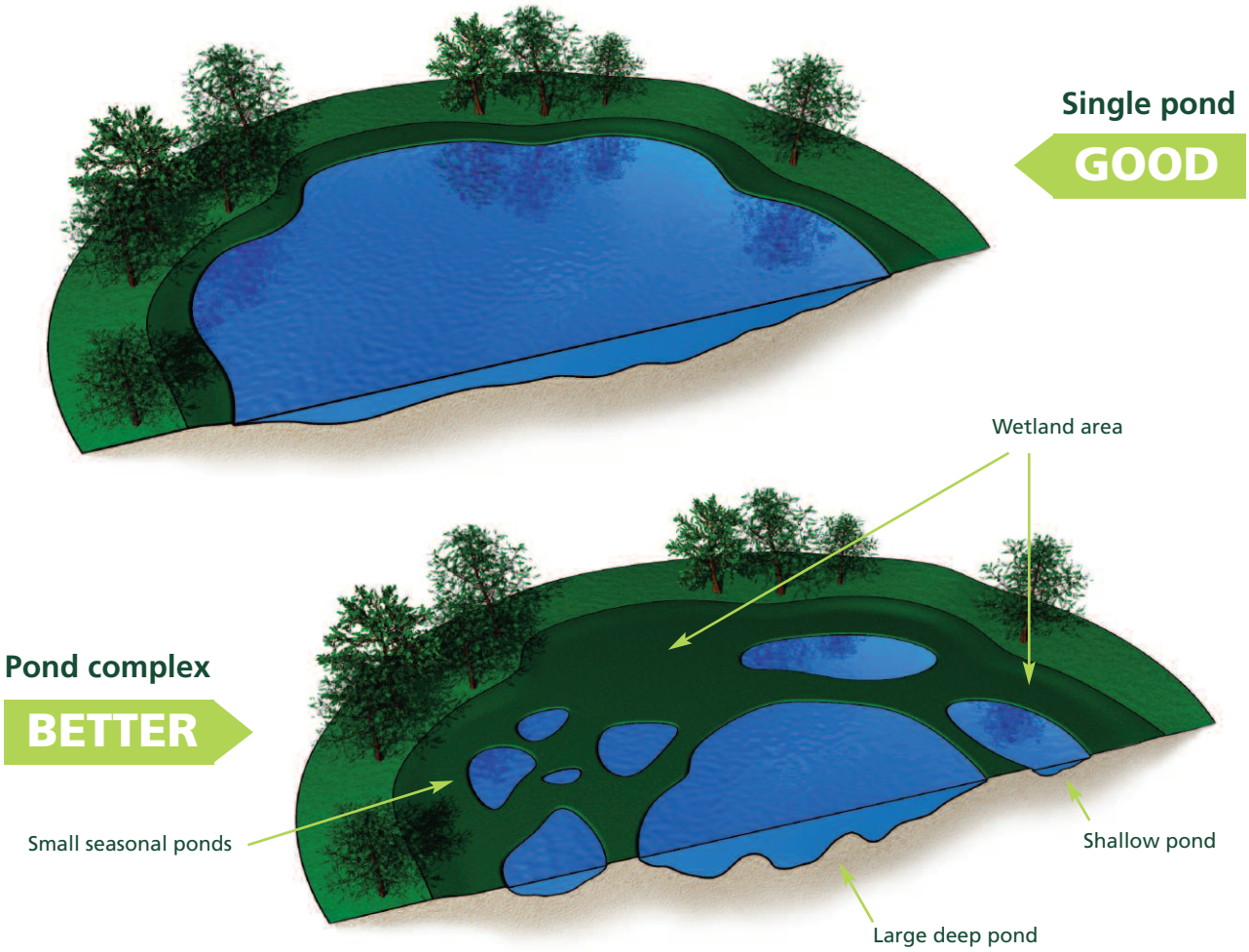


Figure 2. **Create complexes of ponds with different depths and surface area – this will increase the range of wildlife attracted to the site, and provide habitats in all climate conditions.**

7. Great places to make ponds

As long as the principles of 'clean water' and 'low disturbance' are followed, ponds can be dug more or less anywhere. The countryside is full of places to put them. Low intensity grassland, woodland, scrub, heath, moorland, coastal marshes and dune slacks are all ideal habitats. With a bit of care it's also possible to make clean water ponds on farmland, commons, golf courses and even in urban gardens.

Andy Harmer

Grassland: Animal-grazed grassland pools are often rich and can be very varied. Livestock often keeps the vegetation short so that even tiny shallow pools last for many years. The poaching and churning up of the wet ground by animal hooves usefully creates an extra level of habitat complexity at the pond edge.

Rod d'Ayala

Froglife

Woodland and scrub: Ponds in woodland are often especially good for amphibians and dragonflies. Shelter from trees protects many delicate-winged wetland insects that would otherwise get buffeted about by strong winds. Ponds with a large area are often useful to ensure that all ponds are not totally overhung by trees.

Wetlands: Digging ponds in bogs, fens, and marshes can help to add to habitat diversity in these wetland areas. However care needs to be taken, both so that existing wetlands are not damaged and because, in these climate-aware times, digging out peat needs to be considered carefully.

Coastal areas: The UK's coastal zone is narrow and under many pressures. If planned with care, pools in these areas can help to support many vulnerable species found in seasonal dune-slack pools and brackish and saline lagoons.

Andy Harmer

Heathland and moorland: Heathland pools are biodiversity hotspots, and a lot of rare species are associated with these wet areas. A special suite of plants and animals are found in heathland temporary pools in the wheel-ruts on trackways and around trampled gateways.

Andy Harmer

Farmland: Many farms have places where clean water ponds can flourish – woods and copses, areas of poorly drained land, corners which are awkward or unprofitable to cultivate. Evidence shows that new pond creation is already common on farmland but is not usually providing high quality habitats. Ensuring these new ponds have clean catchments will do much to benefit freshwater biodiversity in the countryside.

Garden Ponds: It is possible, but not always easy, to create clean water garden ponds. The main problem is temptation – it's very hard to resist adding tap water or plants to a garden pond, especially in the first few years when the pool looks bare and the water is often cloudy. If the clean water pond principles are followed however, you can create these very special habitats in your garden. For information on creating clean water garden ponds, visit *www.pondconservation.org.uk/gardens*

8. Places to take care!

One of the very important things about digging new ponds is that this should not destroy something that is already valuable.

Existing habitat: checks need to be made to ensure that the habitat being dug up is not valuable in its own right. If in doubt, err on the side of caution. Given a uniform field with a single wet area, dig the pond next to the wet area rather than replacing it.

Species at risk: on rare occasions digging a new pond may encourage a flood of unwanted colonising species to an area. The ancient temporary pingo ponds of Norfolk, for example, are over 10,000 years old, and have a very special wildlife which could be damaged by an influx of new pond species and/or invasive species to the area.

Archaeology: archaeology is part of our national heritage, and digging ponds can easily destroy it. Always check with the county archaeologist.

See *Factsheet 5* about locating ponds and *Factsheet 6* for a review of issues to be considered when planning a pond creation scheme.

9. Rare species ponds

HCT

HCT

Ponds are home to hundreds of rare species. Around 80 of these *species* are under such threat that they have Priority Status under the UK's Biodiversity Action Plan – animals like the pondweed leafhopper, which survives in just a few ponds, and is incredibly vulnerable to extinction in Britain.

One of the aims of the Million Ponds Project is to create at least 1,000 ponds that will help to support many of these species. To do this the project will produce *Species Dossiers* in 2009-2010, which will provide information about the design and location of ponds specifically for these BAP species. Project Officer support and funding will be available to help ensure these ponds can be created where they can do the most good.

Grass snake (above) and pool frog (below). The grass snake is a good swimmer often associated with ponds where it feeds on amphibians and fish. The pool frog is the rarest native amphibian species in the UK.

For further information about the Million Ponds Project please visit *www.pondconservation.org.uk/millionponds* or email enquiries to *info@pondconservation.org.uk*

Outline steps for pond creation for wildlife

MILLION PONDS PROJECT
Pond Conservation

A 50-YEAR PROJECT TO CREATE A NETWORK OF CLEAN WATER PONDS FOR FRESHWATER WILDLIFE

About this summary sheet

This factsheet summarises the main steps to create clean water ponds for wildlife, including:

- Pond design
- Choosing a site and finding a clean water source
- Planning pond creation
- Constructing ponds
- Managing ponds after creation

Detailed information on all topics can be found in *Factsheets 4* to *8*.

1. Pond Design

Designing new ponds is fun – there are many different types of ponds, and many features which can be included. To maximise the wildlife value of a pond site:

- Create pond complexes or multiple pools including both permanent and seasonal ponds of varying areas and depths, rather than a single waterbody.
- Make broad, undulating drawdown zones.
- Make sure that most pond slopes are shallow (less than 1:5).
- Create underwater bars and shoals to benefit aquatic plants.
- Design according to your landuse and site management (e.g. grazed or ungrazed meadow) and think about how the site will develop in the longer term.
- Use design to minimise future problems – think about how the pond will be used by people and animals.

If there are uncommon or protected species you want to attract to the site, also refer to the appropriate *Species Dossiers*. In particular, consider how natural factors, such as grazing pressure or shade, can be used to create the conditions the species needs, so that the ponds are self-sustaining, without requirement for regular management.

For more design information and ideas, see *Factsheet 4* and the *Pond Design Bank*.

What is a pond?

Ponds are permanent or seasonal waterbodies between 1m^2 and 2 hectares in surface area (about 2.5 football pitches).

This definition includes temporary ponds that dry up during the year, as well as tiny pools and very shallow ponds like 'wader scrapes'.

How to create a clean water pond

To create clean water ponds for wildlife, follow three basic principles:

1. Find a place with a clean water source.
2. Leave the pond to colonise naturally.
3. Make sure the pond is protected from damaging impacts during its lifetime.

2. Choosing a site and finding a clean water source

Choosing the site for a pond is the most important decision you take in pond making and will make a big impact on how good it will be for wildlife. The main issues are summarised below.

Clean Water

As stressed often in the Pond Creation Toolkit, it is important that ponds have clean water. To ensure this:

(i) Make sure the landuse in the pond catchment is non-intensive. Within this catchment area:

1. Look for a site which will provide the pond with an unpolluted water source. Choose areas like rough grassland, wood or heath.
2. Ensure that there is no arable or other land where the ground is regularly disturbed or is likely to be high in nutrients. Avoid intensive grassland where fertilisers or pesticides are applied and could run off.
3. Avoid places likely to receive run-off from roads, tracks, houses, yards or spoil heaps. Roof run-off is usually pretty clean, but other urban surfaces are usually not.

(ii) Generally avoid stream, ditch or drain inflows into ponds. Across most of Britain inflows bring polluted water and silt into ponds. The silt they carry also rapidly fills ponds up reducing their lifespan by decades and sometimes centuries. The best sources of water for ponds are usually (a) groundwater or (b) rain and surface water draining into the pond from non-intensive areas.

(iii) Think carefully before locating ponds near to public paths or open access areas with high levels of public pressure (e.g. commons, amenity grasslands) or design to avoid impacts on wildlife.

If there are concerns about water quality, move the pond to another location or check whether water quality can be improved by, for example, de-intensifying the area of land from which water drains.

If these remedies are not possible, do the best you can with the site and water sources you have. The pond may not contribute to achieving the targets of the Million Ponds Project, but ponds that are not 'pristine' can still be valuable for many freshwater species, and will support the freshwater network as a whole.

Making sure the pond will hold water

In most cases, 'natural' ponds without artificial liners are the best type of pond to create. If you are not sure whether a pond on your site will hold water naturally, or are concerned about water levels, then investigate the local hydrology and geology and other waterbodies in the area (see *Factsheet 10* for further details). Ponds don't have to hold water all year round: seasonal ponds are an important pond type in their own right. And water quality is more important than quantity.

Strategic locations for ponds

Across the UK as a whole, it is important that clean water ponds are spread around and dug in a wide range of landscape types. It is this mix of locations that will protect the widest range of freshwater biodiversity.

This said, it can be useful to locate some new ponds more strategically:

- Dig ponds near other wetlands to improve connectivity – stepping-stones between waterbodies.
- Dig ponds where uncommon species occur to help strengthen their populations.

Or it may be important not to dig at all:

- Don't dig ponds where there are existing valuable habitats.
- Don't dig ponds where this might damage uncommon species.
- Don't dig up peat, except where there are very good reasons.
- Don't dig up our archaeological heritage.

Avoiding later problems

If a pond is going to be located close to a public path or in an area of open public access, think carefully about the impact this may have on its wildlife. The main issues, in rough order of importance are:

- **Ducks:** too many using a pond pollutes the water and makes it cloudy and generally reduces its wildlife value.
- **Dogs:** too many jumping in a pond makes the water cloudy.
- **Fish:** not all ponds should have fish. Too many fish or introduced species like goldfish cause many problems.
- **Invasive plant and animal species:** people often add these to countryside ponds causing problems for our native wildlife.
- **People:** people themselves are fine! Unless there are so many that they wear down large areas of bank or rubbish dumping becomes a significant problem.

See *Factsheet 5* for further information about locating ponds and clean water sources.

3. Planning pond creation

At an early stage, it is worth outlining how you will undertake all elements of the pond creation project.

Pre-site checks

Take care to ensure that pond creation does not cause damage or contravene legislation. In general, the safest approach to pond construction is to talk to all relevant public bodies and other interested parties to ensure that they are happy with what you are doing. Issues to consider are listed below (see Table 1 for a list of contacts):

- **Damage to existing habitats and species:** Ensure that the pond excavation area and routes onto the site don't damage valuable, threatened or protected habitats or species. Ponds are often dug in naturally damp places, so take particular care not to destroy existing wetlands (damp hollows, seepages, temporary ponds and springs) (see *Factsheet 5).* If in doubt, be cautious: dig ponds in vegetation types that are extensive and uniform.
- **Protected sites:** If there are protected sites close by (e.g. SSSIs, nature reserves etc.) ensure that pond creation won't have a damaging effect on factors such as drainage or water levels.
- **Archaeology:** Check with the Country Archaeologist to find out if there is likely to be any interest.
- **Pond creation on floodplains:** If the site is on a floodplain, there is a legal requirement to ensure that excavated spoil: (a) does not reduce the area's capacity to store floodwater (b) is not piled up causing an obstruction to floodwater movement.

- **Underground pipes and services:** Check if the site is crossed by underground cables and pipes, carrying electricity, gas, oil, water, telephone lines and sewage.
- **Above ground services:** Check if the maximum height of machinery that can be used on site is constrained by overhead power lines. Direct contact with the lines is not necessary – electricity can flashover when equipment gets close.
- **Neighbours:** If ponds lie close to a neighbouring property, and particularly if the land on which the pond lies connects to a neighbour's drainage system, talk to your neighbour to ensure there won't be any conflict.
- **Planning permission:** Consult the local planning authority at an early stage to determine whether the pond needs planning permission, or if there are likely to be other concerns. If you need planning permission, a fee will be charged with the amount dependent on the complexity of the project.

Table 1. Pre-site checks and people to talk to

Topic	Who	Contact details
Impact on protected species or designated sites	Natural England or Countryside Council for Wales	*www.naturalengland.org.uk* *www.ccw.gov.uk*
Tree felling, coppicing etc	Forestry Commission	*www.forestry.gov.uk*
Impact on historic sites or archaeological remains	County Archaeologist	At local planning authority
Work on a floodplain, impacts on watercourses, concerns over contaminated land, complying with environmental law	Environment Agency	*www.environment-agency.gov.uk* *www.netregs.gov.uk*
Impact on other properties e.g. by altering drainage	Neighbouring landowners	
Locating and working near buried services and overhead powerlines	Service providers	Contact service providers direct or use a search facility such as *www.linesearch.org* or *www.linewatch.co.uk*
Health and safety, risk assessments, CDM Regulations	Health and Safety Executive	*www.hse.gov.uk*
Planning permission requirements or other land use concerns	Local Planning Authority e.g. district council or National Park Authority	Contact the authority direct or find contact details of the relevant authority on *www.planningportal.gov.uk*

Approaches to pond creation

Depending on the circumstances of your pond creation project, you have three main approaches to choose from – each has merit according to site location and source of funding:

1. **Quick approach:** ponds can be made quickly over hours or days and simply left to colonise.
2. **Phased approach:** if you are unsure about the ponds' final water levels, consider a phased approach digging out deeper ponds in the first year and disposing of all the spoil. Then fine-tune the drawdown zone and margins in years 2 or 3.
3. **Long-term approach:** plan pond digging over a longer time scale, bringing in a digger every few years to create new pools and maybe modify existing ones.

Planning the construction phase

The important issues to consider are:

- **Timing works:** There is no best time for pond creation. Avoiding the winter period can be preferable if soils are likely to become waterlogged, particularly if dumper trucks are needed to move spoil. There may also be restrictions linked to breeding or protected species.
- **Access for machinery:** Excavators and dump trucks are tall, broad, and often heavy machines, so ensure that all route ways, bridges, and gates onto the site can accommodate them – it may be necessary to reinforce access routes and prune or remove bordering scrub, trees or hedgerows. Temporary structures may be needed to access some areas of the site (e.g. temporary bridges over ditches). If there are sensitive areas on site, these should be marked on plans and ideally taped-off on the ground.
- **Dealing with spoil:** Disposing of the excavated spoil is often the most time consuming and expensive part of a pond construction project! To minimise costs consider how you may be able to use spoil on-site, either by spreading it thinly or creating useful features for wildlife or to prevent polluted water entering the pond. If the spoil is to be spread, make sure it won't form a rim around the pond which interferes with a clean surface water source. If spoil is to be taken off-site for disposal, the pond creation project may require planning permission.
- **Dealing with topsoil:** Topsoil has very high levels of nutrients and can pollute pond water. Topsoil should not be used either in the pond, on its edges, on the upper banks or anywhere where surface water could wash nutrients into the pond. If it can't be used on-site, consider selling it.

Designs and drawings

The main reasons for producing sites drawings are (i) to get your ideas straight and (ii) to present them to others: potentially including planning officers, contractors, digger drivers or funders.

Site drawings often begin as a back-of-the-envelope sketch, and sometimes you may not need much more. However, if you are communicating your ideas to others, then include what they will need to know. See *Factsheet 6* and examples in the *Design Bank*.

Project costs and funding sources

The project cost will vary widely depending on the nature of your project. Small ponds can be dug by hand by volunteers or by using a self-drive mini-digger for a day. Larger, more complex projects may

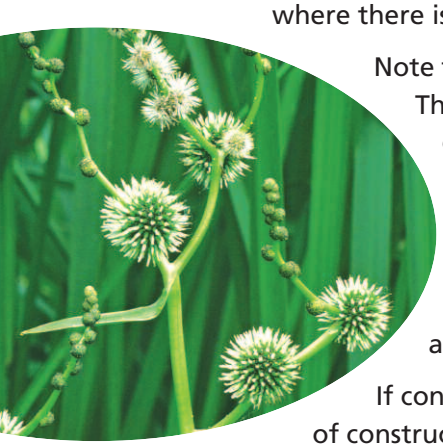
cost many thousands of pounds. Lining a pond can easily double its cost because of the extra digging, materials, equipment and handling time necessary.

It's useful to include a contingency fund, usually around 10% of project costs, or 5% on large schemes, to cover unexpected costs and price rises.

A list of possible funding sources for creating ponds as part of the Million Ponds Project will be regularly updated on the *project website*.

Health and Safety

In carrying out practical work on ponds, the first concern should be that the work is carried out safely. Risk assessments are a legal requirement for all companies, and may be a condition on insurance policies. Health and safety should also be assessed once pond creation is completed, particularly where there is public access.



Note that health and safety issues and assessments are always site and project specific. There is simple guidance on a sensible approach to risk management and carrying out risk assessments on the Health and Safety Executive (HSE) website at *www.hse.gov.uk/risk/index.htm*

If a pond creation project falls into the category of 'construction project', the Construction (Design and Management) Regulations apply (CDM Regulations, see *www.hse.gov.uk*) – it is good practice to follow the CDM Regulations for all projects.

If construction work lasts longer than 30 days or involves more than 500 person days of construction, there are additional legal requirements. A notification form should be completed and sent to the Health and Safety Executive (see Table 1), a CDM co-ordinator and a principal contractor must be appointed, a health and safety plan must be in place, and a heath and safety file must be kept as a record of relevant health and safety information and as a reference for future works or maintenance on the pond site.

Project Risk Management

There are potential risks to the success of any project, and they will differ for each site and each project (e.g. funding falls through, bad weather makes route-ways impassable, unknown drains are encountered). Draw up a list of the issues that could pose a risk to your project, and take action to minimise the level of risk. There is more information about possible risks on the *project website*.

Finding contractors

If you are using contractors for the excavation phase, try to approach firms who are experienced and skilled in digging ponds. A typical first stage is to prepare a written brief and plan for the work required and get quotes from around three contractors. It can be useful for both you and the contractor to visit the site together. Ensure that contractors are notified of any potential hazards to staff or machinery e.g. steep slopes, soft or unstable areas, deep water, and power lines.

Confirm responsibilities with the contractor before agreeing a contract. Take particular care to ensure that you are not liable for loss or damage if machines get stuck or damaged.

See *Factsheet 6* for further information about planning pond creation projects.

4. Constructing Ponds

- **Managing the phases of construction:**
  - Before work starts on site, mark out important areas such as the pond outlines, where heavy machinery can move about, where spoil should be placed, or out-of-bounds areas.
  - Provide detailed site plans, perhaps laminated so that they can be kept in the cab of the digger for easy referral.
  - Spend time with the excavator driver before the start of the excavation to explain the scheme and stay at least for the first few hours to make sure all is going well. Bear in mind that many contractors are not experienced in creating wildlife ponds. Visit regularly to check progress and adjust the plan or deal with problems as necessary.
  - On completion of the project, check that everything has been done to your satisfaction and the site has been left in good order before signing off – check the contract and any conditions of licenses or consents.
- **Excavation machinery:** A wide range of machines are available. Small self-drive diggers can be hired per day or week from many suppliers. Larger tracked excavators are usually hired with a licenced driver. It is possible to dig very shallow scrape-type pools with a bulldozer if this is available on site. Where spoil needs to be moved around site one or more dumper trucks will be needed.
- **Excavation method:** Depending on the size and location of the pond, soil types, ground water levels, and the machinery used, there are a variety of approaches to excavation and you should discuss the best strategy with the contractor. Bringing back a digger to the site for half a day or so a year after creation can fix most problems and brings additional benefits.
- **Dealing with excavated spoil:**
  - If spoil needs to be moved, have a sufficient number of suitable vehicles to transport it so the digger driver doesn't lose time.
  - Dumper trucks heavily laden with spoil sink deep into damp soils, so ensure there is room for them to vary their route, whilst avoiding sensitive areas identified during the planning stage.
- **Topsoil:** Don't add topsoil to the pond margins or on slopes above the pond. Nutrients draining from the topsoil into the pond will pollute the water. Topsoil is, in any case, unnecessary because native plants grow perfectly well in subsoil, clay or sand, and in a couple of years the end result will be better.
- **Finishing sites off:** Ensure the contractor leaves the site and any access routes in good order, but don't tidy up the excavation area too much. The rough surfaces left by toothed excavation buckets, low heaps of dumped or spilled soil, scuffed turfs and wheel ruts all add to the micro-scale structural diversity of a site for plants and invertebrate animals.
- **Documenting pond construction:** Keep a record of how the pond was constructed – this can be useful for the future management of the site and help others learn from your experience.

See *Factsheet 7* for further information about pond construction.

5. Managing ponds after creation

One of the benefits of a clean water pond is that, once made, it should need little management. The less done in terms of adding things to a pond, the better, although a few tweaks in the first few years can sometimes be helpful. The main issues are:

Don't plant up: the new-pond stage is very short compared to the whole life of a pond. Many pond species use this early stage of succession – and it is usually very short. It is important not to shorten it further by adding plants or a bucket of sludge from another site to help the pond 'mature' faster.

Keep an eye on the pond in the early stages: a little effort may be needed 2-5 years after creation, whilst plants are colonising a pond, so that invasive species such as Bulrush and alien plants do not dominate the new site.

Temporary fencing: if wildfowl, stock or people are likely to use the site in considerable numbers, it can sometimes be useful to protect vegetation with temporary fencing. Usually however this won't be necessary unless considerable amounts of silt are eroding into the pond from the bare ground.

Management in later years: well designed clean-water ponds should need little management in later years. Pond management may be required in the following circumstances:

1) The landuse or management of the site has changed (e.g. loss of grazing so that woody vegetation develops). In such cases there are two main options: (a) periodically manage the site to artificially maintain it close to the original state (e.g. control trees, remove vegetation or create new pools), or (b) leave the site to develop in its own way. As long as the site has a variety of pools of different depths and areas, it is likely that the site, as a whole, will remain diverse and valuable.

2) The site is being managed for uncommon species with particular habitat requirements (such as great crested newts, or one of the many rare bare ground plants).

When managing for particular species, think about pond density: as the number of ponds increases, the need for micro-management of individual ponds can often be reduced as the inherent variety of the ponds provides landscape-scale protection.

See *Factsheet 8* for further information about managing ponds after creation.

For further information about the Million Ponds Project please visit *www.pondconservation.org.uk/millionponds* or email enquiries to *info@pondconservation.org.uk*

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Pond design

MILLION PONDS PROJECT
Pond Conservation

A 50-YEAR PROJECT TO CREATE A NETWORK OF CLEAN WATER PONDS FOR FRESHWATER WILDLIFE

1. Introduction and principles

Any pond design works if you have clean water. Even vertically-sided tanks will develop rich wildlife communities. But with good design it's easy to create better opportunities for wildlife, making ponds richer and longer-lived.

To maximise the wildlife value of a pond site:

- Create pond complexes or multiple pools rather than a single waterbody.
- Within complexes, include both permanent and seasonal ponds. Ponds don't need to hold water all year round: temporary ponds are important wildlife habitats.
- Make sure that almost all pond slopes are shallow, less than 1:5 (12°) and preferably less than 1:20 (3°).
- Make broad, almost flat, undulating wetland areas around and between ponds.
- Create underwater bars and shoals to benefit aquatic plants.
- Design according to your landscape. If ponds are grazed, even tiny micro-pools can persist in the long term. If the pond surrounds are not grazed, dig at least some larger ponds (at least 20 m diameter) to avoid complete over-shading by trees.
- Use design to minimise future problems for your ponds: think about how the pond will be used by people and animals.

2. Create pond complexes

Creating a single clean water pond is good. Creating a pond complex with many different ponds is even better (Figure 1).

The simplest way to increase site richness is to dig a series of ponds with different maximum depths. Ideally some pools should dry up every year, others dry occasionally in drought years, and some should be permanent.

It is possible to make pond complexes at all but the smallest sites. Individual pools can be tiny, just a few meters across. But it's best to keep shallow and deep water pools separate (except, perhaps in winter high water conditions) to maintain different communities in different ponds.

What's in this factsheet?

- Principles of pond design
- Pond complexes
- Designs for different landscapes
- Designing different areas:
  - drawdown zone
  - shallow water
  - deeper water
- Varying pond area
- Wind, fetch and bank erosion
- Islands
- Adding more variety:
  - water source and substrate
  - location
- Design for change
- Design for BAP species
- Practicalities
- The Design Bank

What is a pond?

Ponds are permanent or seasonal waterbodies between 1 m^2 and 2 hectares in surface area (about 2.5 football pitches).

This definition includes temporary ponds that dry up during the year, as well as tiny pools and very shallow ponds like 'wader scrapes'.

Creating varied sites has long term benefits for wildlife:

- The mosaic of permanent, semi-permanent and seasonal ponds will encourage a far greater variety of plants, invertebrates, amphibians and mammals to use the site.
- It creates a protective network whatever the climate that year or however the ponds mature. If one pool becomes unsuitable, plants and animals can move to another.
- It provides a safety net so that if unwanted species (like invasive plants or ornamental fish) or pollutants get into one pond, others remain problem free.

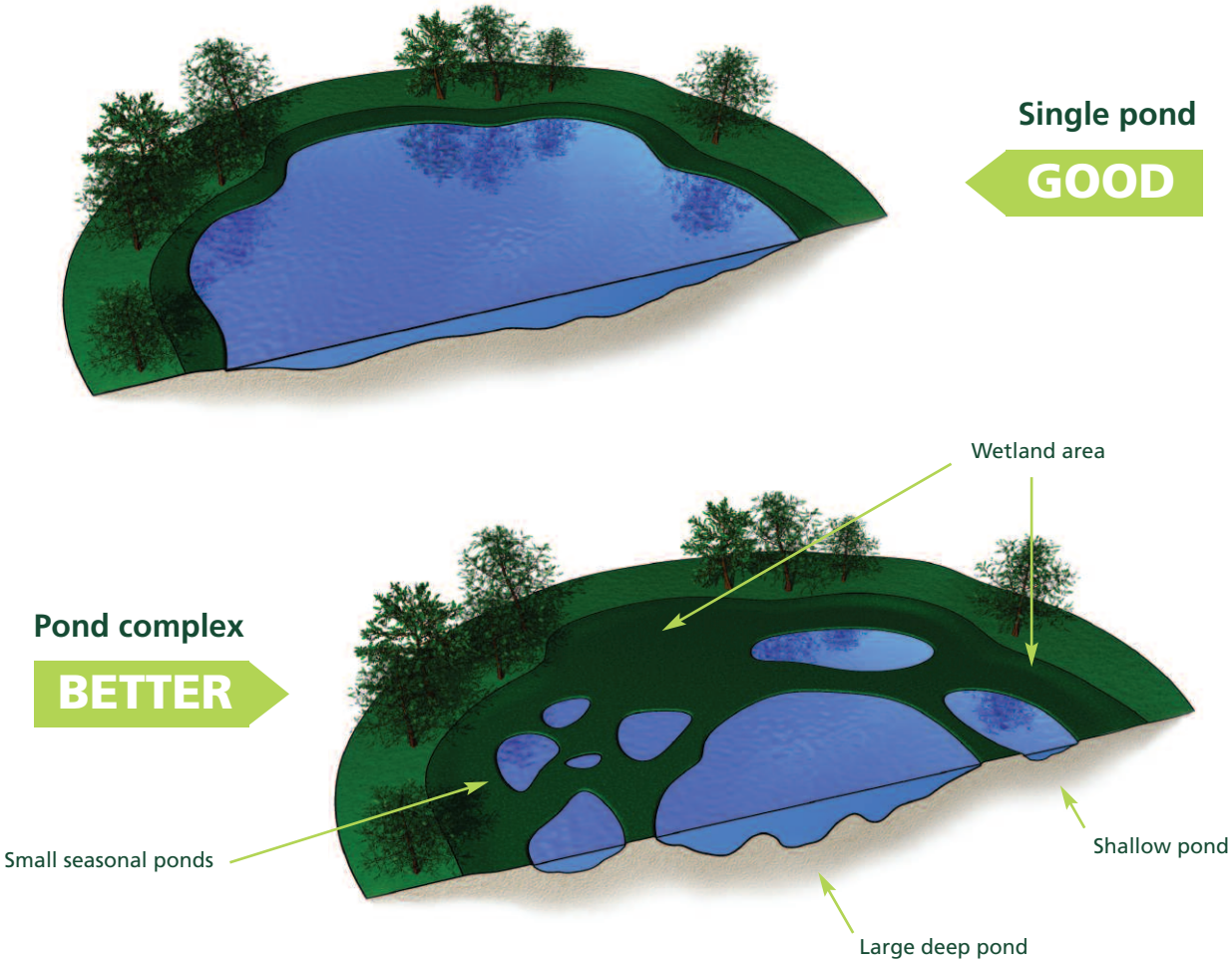


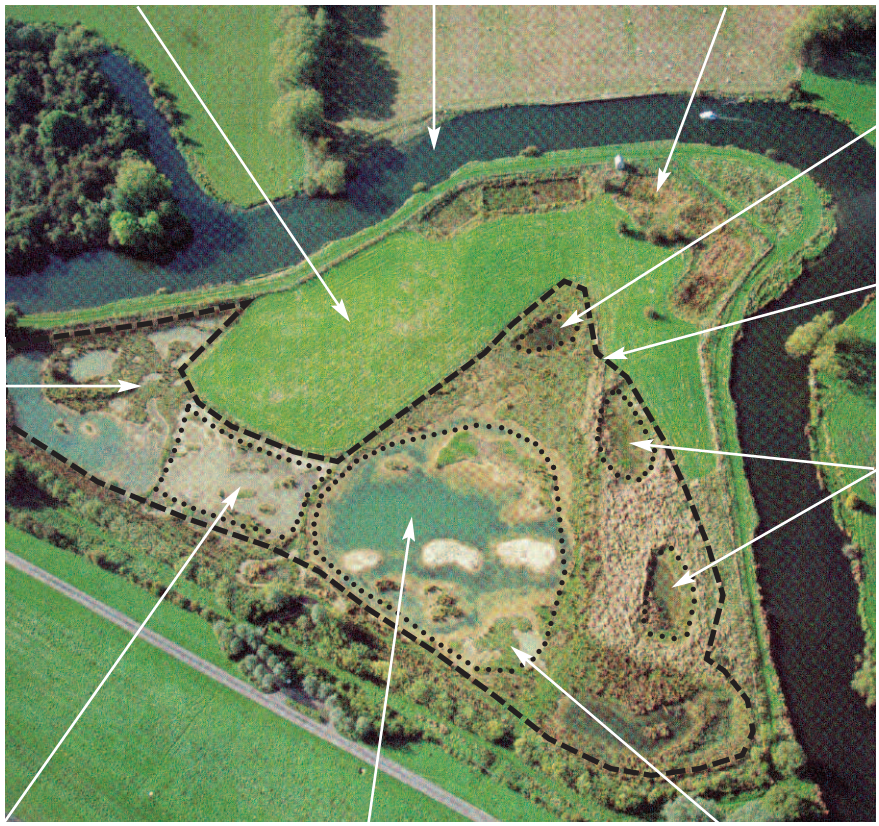
Figure 1. Create complexes of ponds with different depths and surface area. This will increase the range of wildlife attracted to the site, and provide habitats in all climate conditions.

Pinkhill Meadow pond complex

The Pinkhill Meadow pond complex was created in 1990 and has some 40 ponds of varying sizes and depths on a five hectare site. It quickly became one of the richest pond sites in the UK.

Detailed monitoring of the site shows that individual ponds have changed in wildlife value, but 20 years on the site as a whole is still as rich as ever. The ponds monitored reached 'Priority Pond' status (see the *Pond HAP*) very quickly – after just three years, and this is still the case today, some 15 years later.

This creation scheme was a partnership between the Environment Agency, Thames Water and Pond Conservation.



3. Pond design and landscape type

The landscape type in which you put a pond will fundamentally affect how the pond develops. You can use design to make sure that ponds in any landscape are long-lived and maintain a varied range of habitats through their lifetime.

The most important landscape distinction is between ponds that are grazed by stock (cattle, sheep or horses), and those that are not (Figure 2).

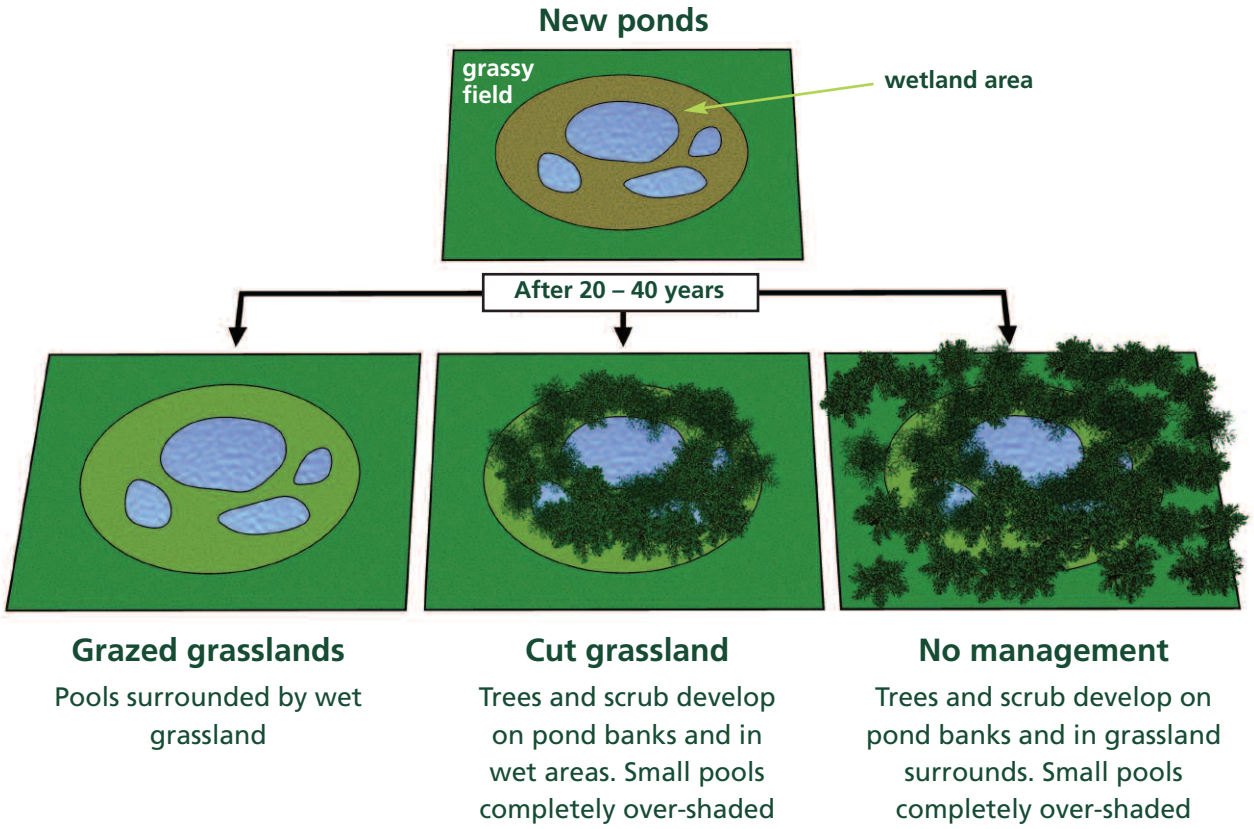


Figure 2. Ponds on grazed and un-grazed sites develop very differently over time.

If ponds are grazed, even small-scale features such as tiny 20 cm deep grassy pools are worth creating and these features will usually be maintained in the long term. This gives enormous flexibility in pond design: all sizes, shapes and depths of pond and pool will work (Figure 3).

If ponds are not grazed, tiny pools are quickly filled by the roots and leaves of taller sedges and reeds. As ungrazed sites mature they will usually become wooded and small pools can quickly become heavily shaded and full of leaves. Even if sites are cut or mowed, a tree-lined fringe will usually grow up on the un-cut pond edges, overshading the pond.

There is nothing wrong with tree-shaded leaf-filled pools: they can support distinctive pond animal communities, and wet woodland is a priority habitat type. However, small leaf-filled ponds tend to be rather uniform. Where sites are not grazed, it is worthwhile including large (sometimes shallow) waterbodies and carefully planning pond edge and slopes to ensure wetland plants can grow at the margins (see website for lots of design examples).

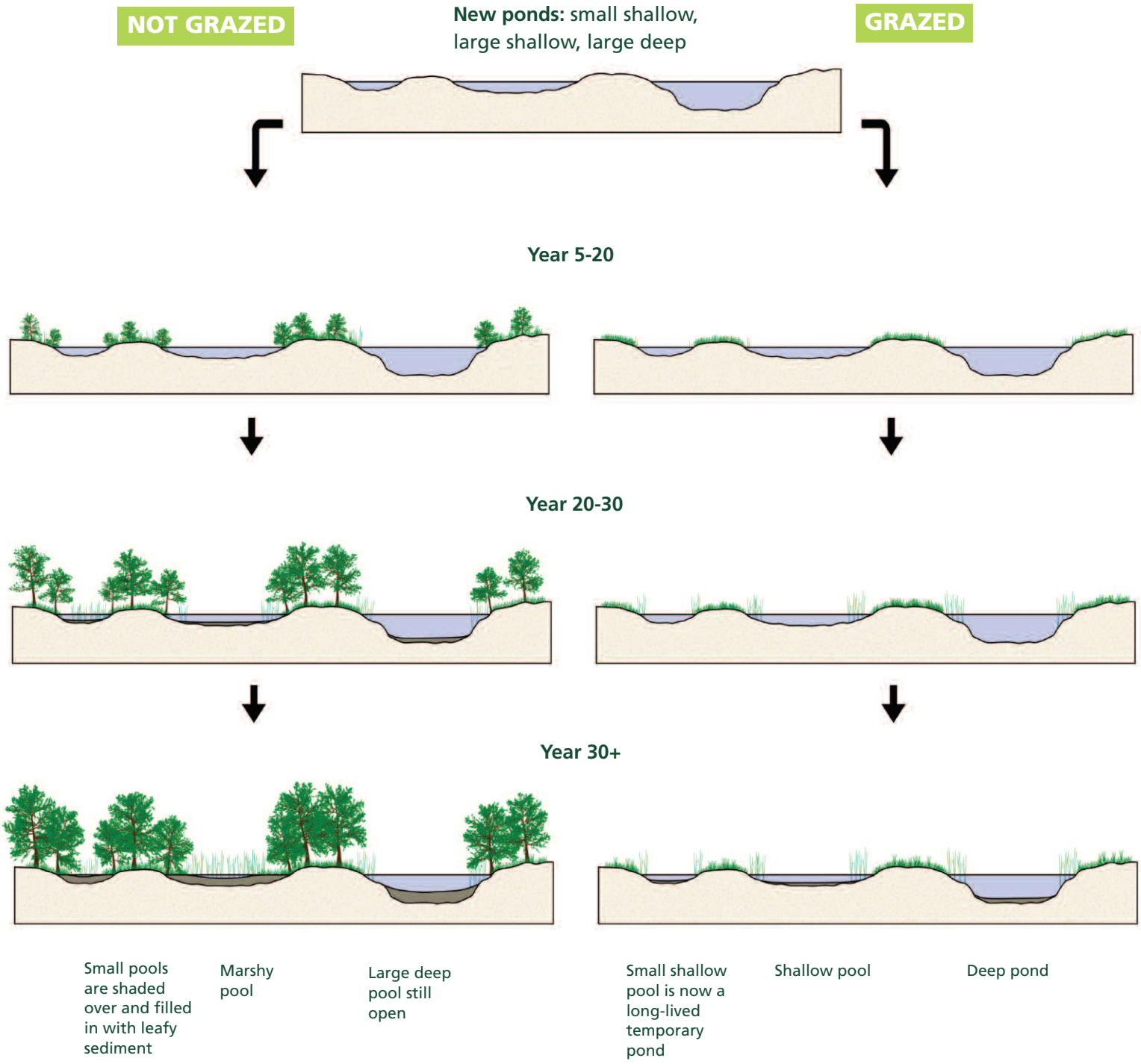


Figure 3. The fate of small, deep and shallow ponds under grazed and ungrazed management.

4. Designing different areas of the pond for wildlife

To design good wildlife ponds it helps to understand the different areas of a waterbody and how they are used by plants and animals (Figure 4).

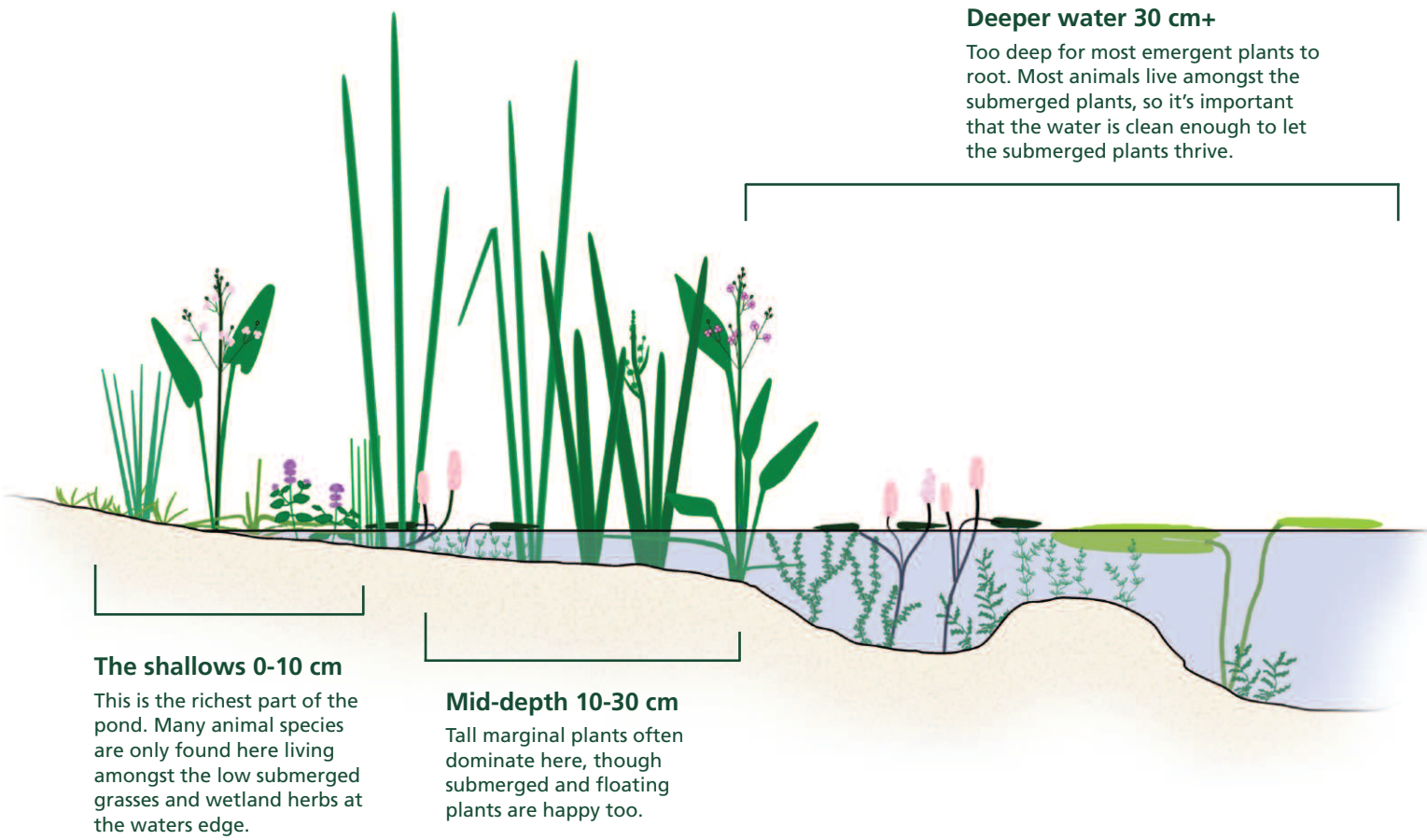


Figure 4. Where's the wildlife?

4.1 The drawdown zone

One of the many myths about ponds is that pond water levels need to be stable throughout the year. In most ponds, nothing could be further from the truth.

Typically, pond water levels drop by around half a meter or more during the summer months. This exposes a seasonal 'drawdown zone' – an area of mud and vegetation which is flooded in winter and spring, and progressively dries as water levels fall in summer. The ever-changing drawdown zone is one of the most important areas of a pond. It is an exceptionally rich habitat for plants and invertebrates, and often used by birds and small mammals as a feeding area.

Designing the drawdown zone

In traditional pond designs the drawdown area is rarely considered and, by default, is usually restricted to a narrow strip at the water's edge. Broadening the drawdown to create extensive summer marsh and mud habitats can considerably improve a pond's wildlife value (Figure 5).

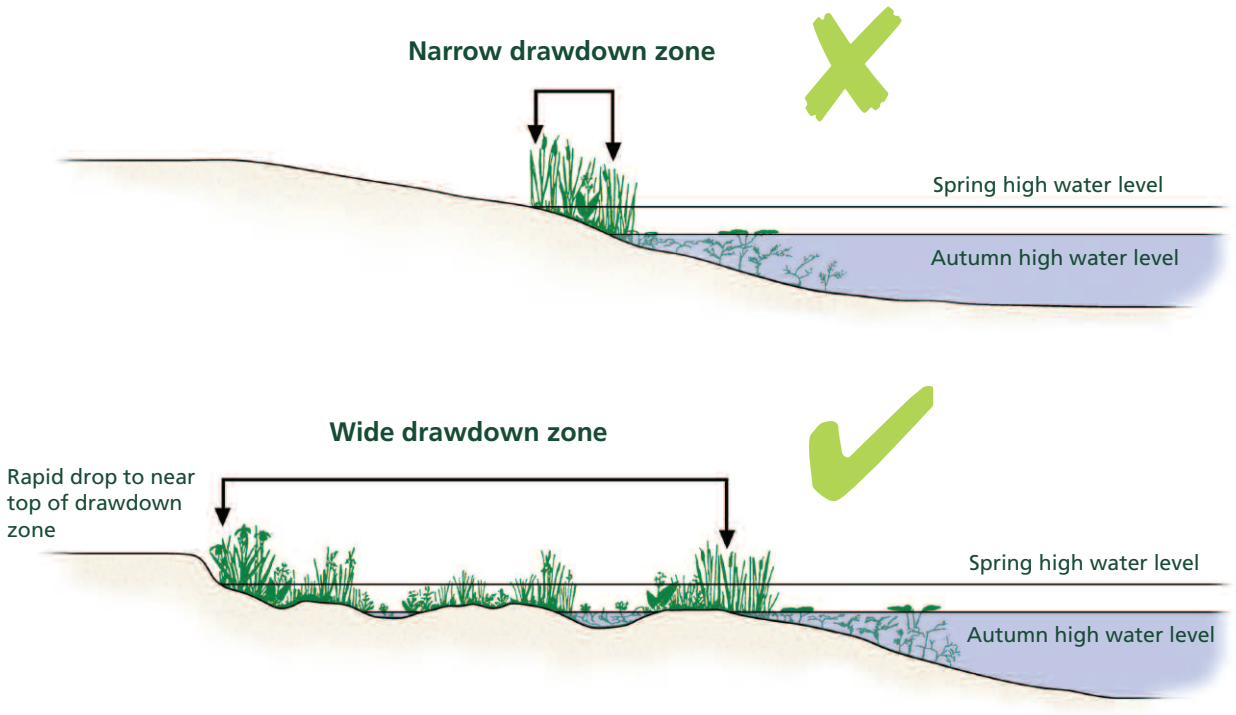


Figure 5. **Create broad undulating drawdown zones – they are one of the most valuable areas for wildlife.**

To design a good drawdown zone you need to roughly know the height of the winter and summer water levels (something that is not always easy before you dig a pond: see *Factsheet 10*). At sites where space is limited it can be useful to cut down steeply through the overburden (which will eventually form the pond's upper banks), then the slope below the top of the winter water level can be flattened off to create the drawdown zone (Figure 5).

Where a number of pools are being created close together, a good option is to remove overburden across the whole area to near the upper drawdown level (Figure 6). This increases the amount of spoil that needs to be excavated (with cost implications), but creates rich and natural wetland areas between the ponds and makes it easy to create new pools or change the site later without generating much additional spoil.

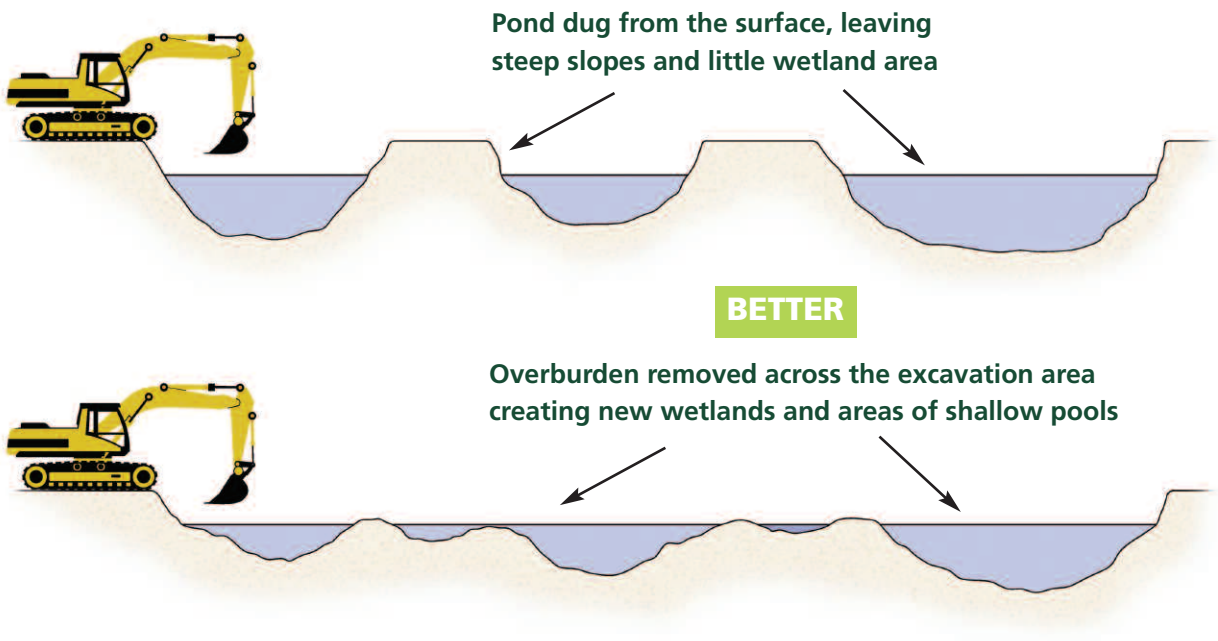


Figure 6. Rather than excavating all the ponds from the surface, strip off overburden across the whole area and create new pools and wetland areas between.

Undulating drawdown zones

Drawdown zones don't need to slope evenly down to deeper water: they can undulate, creating pools, spits and marshy areas around the pond edge. Designed well, these wet areas create a patchwork mosaic of small-scale habitats which can be exceptionally rich in plants and invertebrates (see Pinkhill Meadow box).

4.2 Shallow water

Many people know that the shallow areas of a pond are the best for wildlife, but think that 'shallow' means water 20 – 30 cm deep. Most pond animal species live in very shallow areas, right against the bank, often in water that's often only 1 – 10 cm deep. To improve ponds for wildlife, focus on these marginal areas.

Designing shallow water

To create such shallow areas, ponds need to slope very gently at the edge, at less than 1:5 (12°) and preferably less than 1:20 (3°) (Figure 7). Typical pond margins of 20-30° are usually too steep. With a 20° slope the critical wildlife-rich area (water less than 10 cm deep) is only a band around 35 cm wide – slightly more than the length of your shoe (Figure 8).

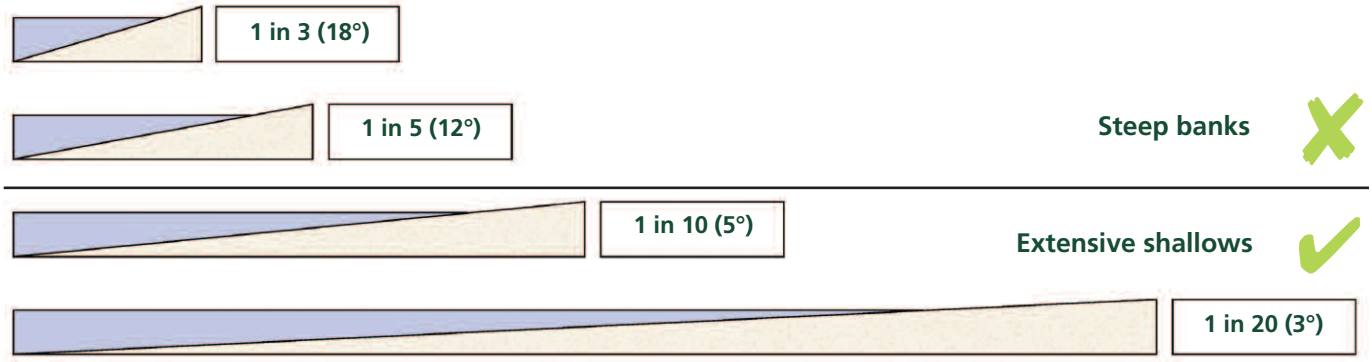


Figure 7. Bank angles. Slopes less than 1:10 are preferable for water's edge areas (though the terrestrial bank above can be much steeper). The aim is to create broad areas of very shallow water. Even with a 1:10 slope the shallow water zone (<10 cm deep) is only 1 m wide. Three strides from the bank, and the water is over the top of Wellington boots – too deep for many pond animals to be comfortable.

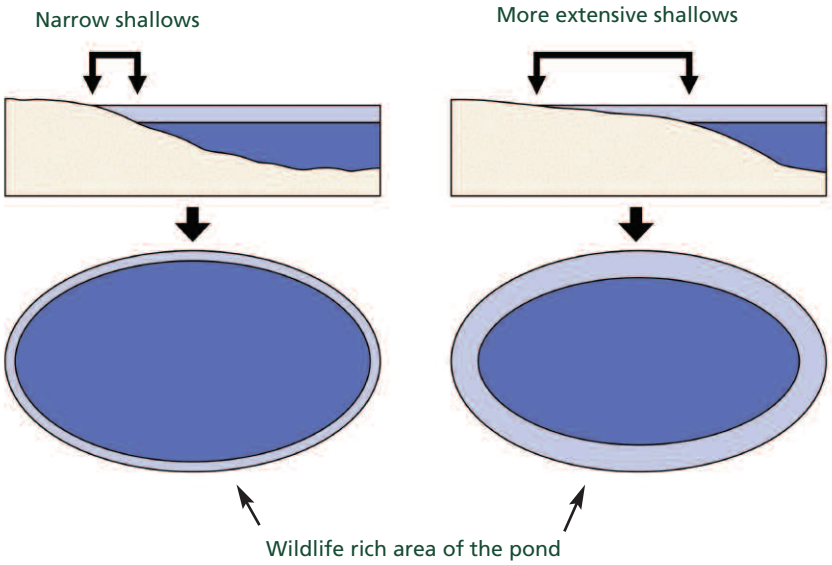


Figure 8. Design extensive shallows to improve the pond for wildlife.

To create deeper ponds (with depth over 0.5 m) and broad areas of shallow water – you need larger ponds. For a small pond (less than 10 m x 10 m) with an average summer drawdown of 0.5 m in height, even with quite a steep 10° (roughly 1:6) slope, the maximum summer water depth in the middle would be 50 cm, and the average depth 25 cm.

If necessary go for an asymmetric shape with some very shallow water, and a steeper far bank to gain water depth (Figure 9).

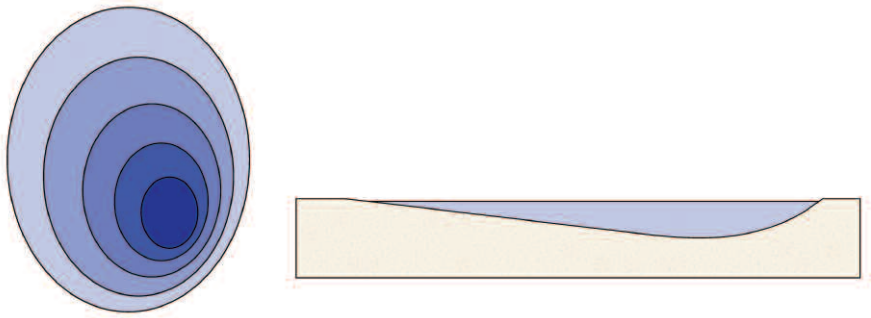


Figure 9. Asymmetric profile – useful to combine shallow water areas with greater depth.

Scalloped edges

Another classic way to increase the area of shallows and the length of pond margins is by creating embayments around the pond edge. This works well on ponds of all but the smallest size.

4.3 Deeper water

Traditionally it has been thought that deeper open water areas are an essential component of a successful wildlife pond, and older guides used to suggest that new ponds should be dug to at least 1.5-2 m deep. In fact, deep water is quite a specialised habitat, vital for few species.

This said, although deeper water (more than 30 cm deep) is not necessary in a pond, it can be useful within a pond complex. From a wildlife perspective deep water can also be valuable habitats – but the water needs to be clean. From a practical point of view:

- Where vegetation is not grazed down by stock, deep water can be used to stop marginal emergent plants dominating all ponds.
- Deeper ponds will take longer to fill in with sediment, so the permanent-water phase of the pond is more prolonged.

Designing deep water areas

A general rule in pond design is: the poorer the water quality, the shallower you make the pond. This is because submerged deep water plants, which provide homes for many animals, don't grow well in polluted water. So if the water is polluted, its best to go for shallow ponds where unfussy marginal plants (like yellow flag, water mint, and wetland grasses) can grow – at least then you don't end up with a rather scummy, cloudy pond with an impoverished deep water zone.

BUT – one of the many benefits of ponds created as part of the Million Ponds Project is that, because they have clean water, deep-water ponds can be created without worry. Most clean water ponds will support rich submerged plant communities and since many native submerged plant species are now uncommon and declining, this is a major opportunity to benefit wildlife.

Amongst the particular target plants for deep clean water ponds are the many submerged stonewort and pondweed species which are now becoming rare in the UK. We can design the deep water areas of our ponds to help these species thrive (Figure 10).

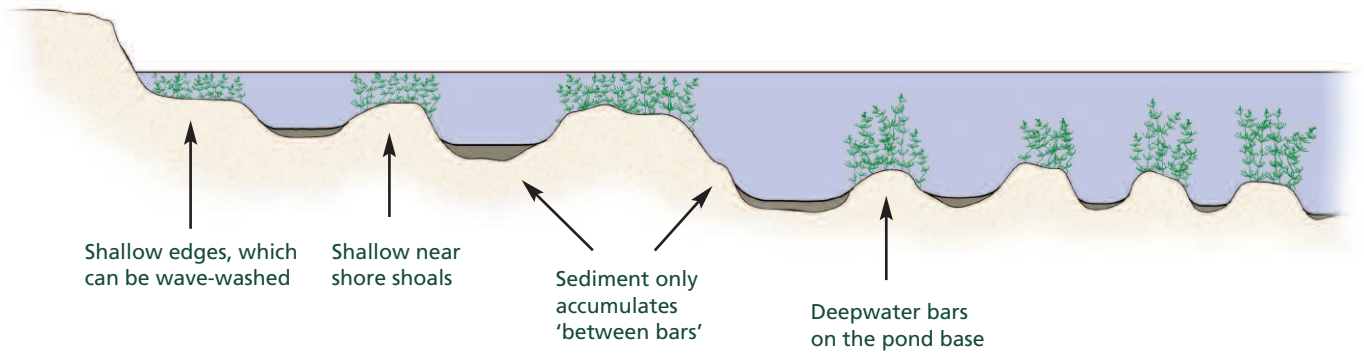


Figure 10. Organic sediments don't accumulate on top of submerged shoals and bars – so uncommon submerged stonewort and pondweed species can thrive.

Many of our rarest submerged plants need mineral soils to root into – they are happy in the bare clay or sand at the bottom of new ponds, but not in the dark organic-rich silts that build up as ponds age. You can keep mineral substrates exposed on the pond bottom for longer by creating underwater hummocks and bars. Organic sediments slip off the top of the bars, filling up the low troughs between the bars, and leaving the bar-top sediment-free for plants to root into (Figure 10).

The main draw back with this design is safety – rapid changes in underwater slopes can be treacherous for people wading in the pond – so this is not an ideal design for sites with public access.

5. Varying pond area

There is no right size for a pond but the landuse in which a new pond is created can influence the size of ponds that work best.

Tiny pools

Even tiny micro pools just a meter or so in diameter can be rich in wildlife – and will support different species to those in nearby deeper pools (Figure 11). Small pools are quick to make, and can be useful for adding variety to larger sites, since you can create many ponds in little space. The smallest pool that can easily be dug with a digger bucket is about 0.5 m diameter.

The main consideration which will determine whether it is worth creating very small pools on a site is the site's subsequent management. If ponds are not grazed by stock, tiny shallow pools usually fill in quickly. If they are grazed, even the smallest shallow pools can be very long-lived (Figures 3 and 11).

Figure 11. Even tiny pools can be good for wildlife – particularly where they are kept open by grazing.

Large ponds

The number of wetland bird species you can attract to a pond increases with pond area. For most other plant and animals however, the relationship is less clear cut – very roughly to double the number of species you need to increase the area by tenfold. So doubling the size of a pond can double the cost of excavation, but makes little difference to the number of species that will occur there.

Evidence shows that you will get more species if you create many smaller ponds rather than one single large waterbody in a given area. This said, there are situations where larger ponds are at a distinct advantage:

- In wooded landscapes larger ponds don't get completely over-shaded.
- Large ponds give you scope to create complex waterbodies: it's possible to combine extensive undulating shallows, deep water and islands in a single pond.
- Large ponds often have wind-blown waves, which can be used to advantage (see next section).

6. Wind, fetch and bank erosion

On larger ponds strong winds will often whip up waves. The longer the fetch (length of water across which the wind blows), the bigger the waves (Figure 12). As waves hit the far bank, they can erode small sharp-edged cliffs. The prevailing wind direction in Britain is broadly from the south-west. So, in a large pond, the opposite (north-east) banks will be the most eroded. Even moderate-sized 20-30 m diameter ponds can be affected by wave-wash, especially if the pond is located in an exposed landscape with few trees or hedges.

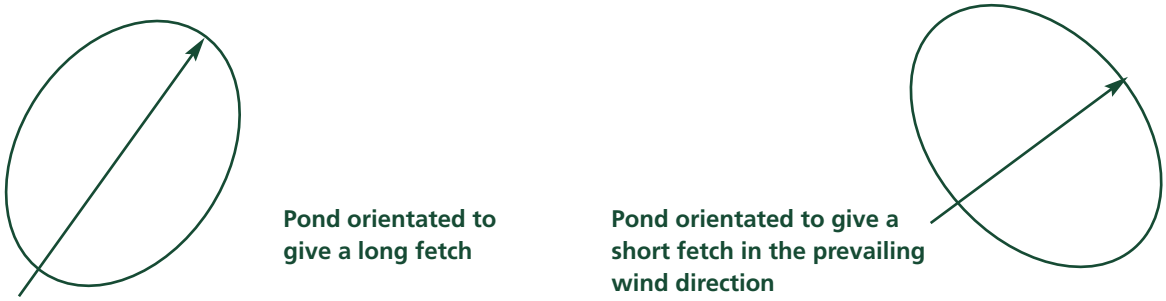


Figure 12. Wave wash.

Wave wash is often seen as a bad thing, and certainly steep eroded banks can be can inhospitable to wildlife. But, like many natural processes, waves can be a creative force. They are particularly useful for pond making in two ways (Figure 13):

- **Keeping bare sediments for submerged plants:** as noted above, clean-water ponds are good habitats for submerged plants like stoneworts which grow on bare sands or clays. Wave wash can help keep areas free of organic sediment and suitable for these plants by: (i) continually eroding sand and clay bank materials, and depositing them in the water (ii) keeping the pond base free of organic silt by washing organic silts into deeper water areas (Figure 10).
- **Creating wildlife rich backwaters:** a useful effect of the wind is that it blows seeds, spores, animal eggs and plant fragments across a pond and concentrates them along the wind-blown margin. If the right conditions are created, and these seeds germinate, the wave-washed margin can develop into a particularly rich habitat. The key is to slacken the wind and wave energy before it reaches the bank and erodes it. This can be done by creating islands or deep embayments along eastern margins. Very narrow-necked pools work particularly well, especially if their entrance is off-set so that they don't face the prevailing wind. Islands can be similarly protected from waves by creating submerged bars along their front edge.

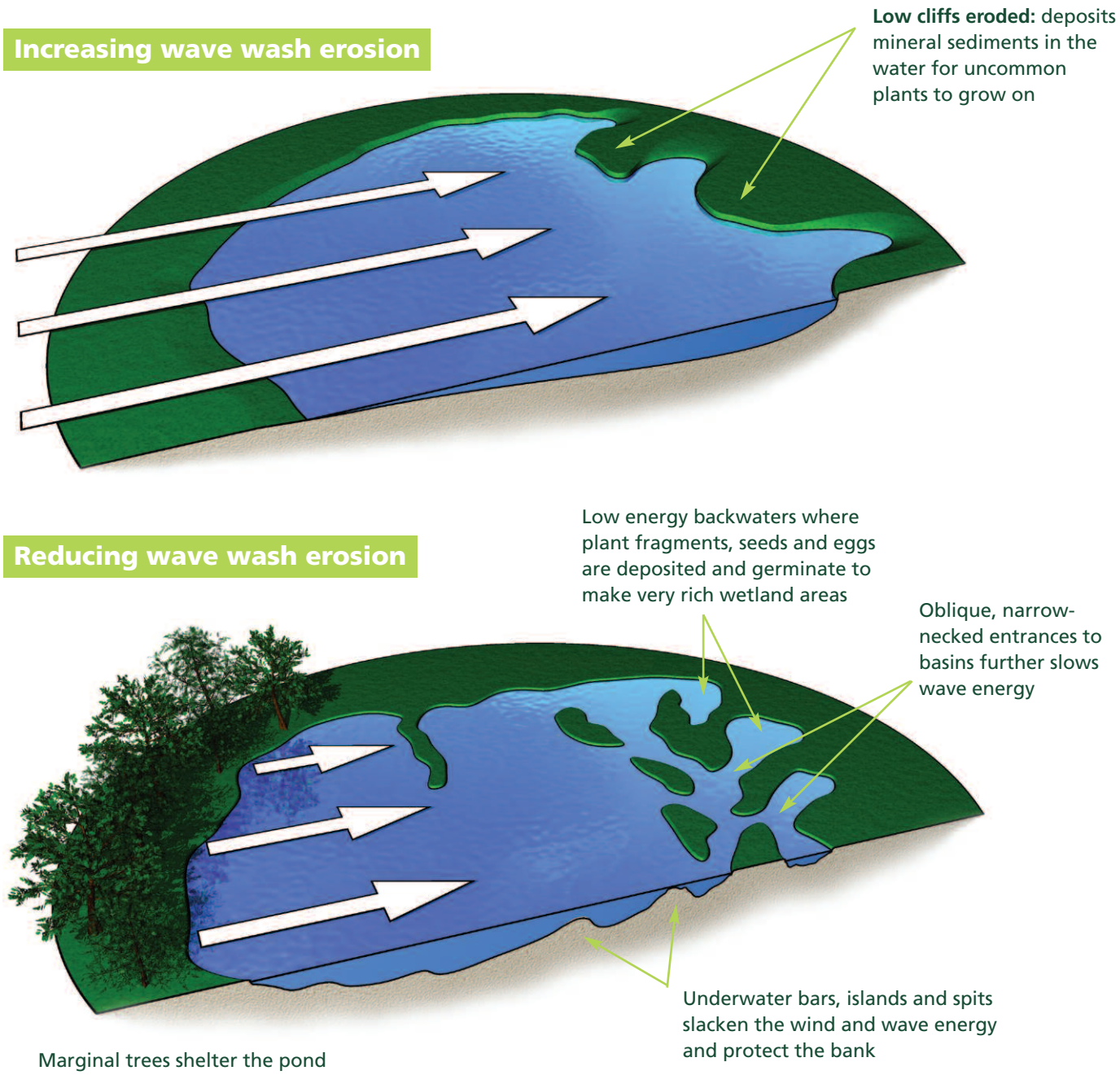


Figure 13. Using design to increase or reduce wave wash effects.

7. Islands

There are pros and cons to including islands in a new pond (Figure 14). For waterfowl and wading birds, islands can provide safe areas for feeding, roosting and nesting. However, if large numbers of feral geese or gulls regularly congregate, this may damage pond vegetation and degrade water quality.

Islands can add new habitats to ponds, especially if the pond margins are closely grazed, and the ungrazed island edges have tall wetland vegetation. However, in small ponds, their edges can be colonised by emergent plants like bulrush that quickly spread across the rest of the pond.

The main problem with islands is that it can be difficult to get their height just right. Often they are created too high, and quickly become wooded, blocking views and, in some cases, providing perching places for crows on the look out for wading bird chicks.

If islands are too low this is much less of a problem: they just become submerged bars – useful for aquatic plants to root in.

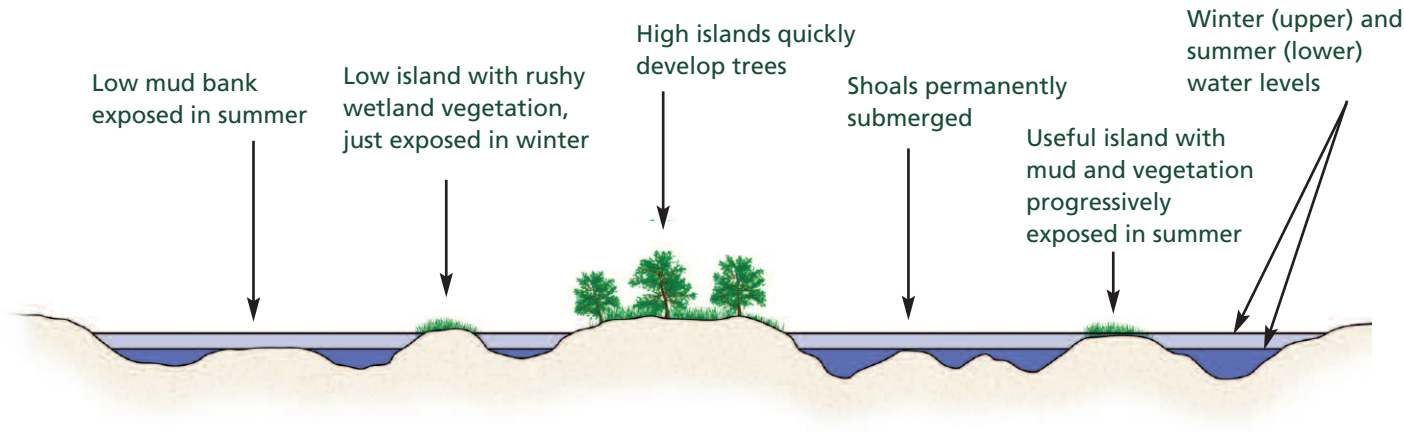


Figure 14. Design islands to minimise the need for management – ideally keep them low.

To minimise the need for management, create islands so that they are submerged in winter and early spring, which will kill off tree and shrub species, but become progressively exposed in summer to provide feeding and roosting areas. Higher islands, 20 – 50 cm above average spring water level, can be useful for water fowl and waders but plan in time to allow for periodic management. If management (or monitoring) is likely, consider creating a submerged causeway which will allow you access by wading rather than requiring a boat.

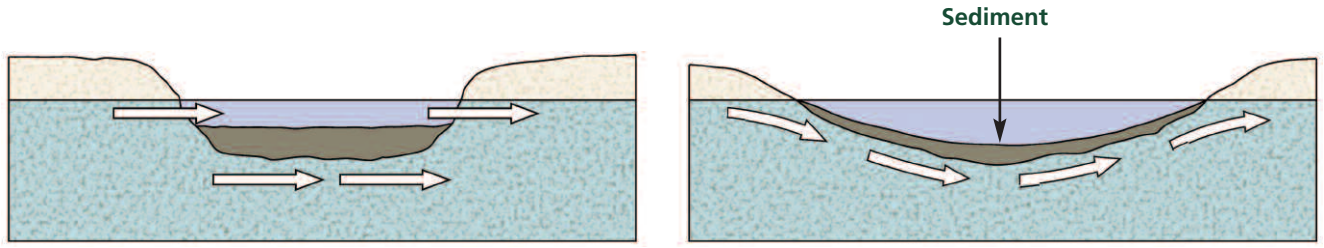
Islands, just like pond margins, can be varied habitats: depending on their height and exposure they can create either a marshy wetlands or, if lower, off-shore mud-banks for feeding waders. They can also be used in many ways to create shelter and seclusion to adjacent bank areas.

Where possible, locate islands at least 4-5 m away from the bank and maintain at least 0.5 m depth of water in summer, to provide birds with some protection from predators.

8. Adding even more variety to sites

Anything that adds to the natural variability of a site will usually add to its richness. Here are some examples:

- **Different water sources and substrates:** Groundwater fed ponds have a different chemistry and water regime (e.g. drawdown height) to surface water ponds, and in many places it is possible to create both pond types. Similarly, if geology varies, it is sometimes possible to create gravel, clay and peat-based ponds on a single site.
- **Different locations:** Even within one field, ponds created on a hedge line with its shade, shelter and leaf-litter will support a different fauna and flora to a mid-field pond.
- **Different bank angles:** Shallow edged ponds are especially useful for wildlife, but steep edged ponds can work too. This is especially true in gravel and sand based groundwater ponds where steep banks can keep the pond connected to groundwater after it has begun to silt-up (Figure 15).



This waterbody has steep banks. This stops sediment accumulating at the edges, so the pond continues to be groundwater fed – an advantage if the groundwater is clean.

This waterbody has shallow slopes and has now become sealed-off from groundwater by its own accumulating sediments.

Figure 15. Steep banks can sometimes be useful in groundwater fed ponds.

9. Design for change

Pond creation is not an exact science: often you won't know exactly where the water will sit before the pond is made, and may want to modify the pond a little when you do. Some features will also work better than others and you may want to dig new pools or alter banks.

When designing a pond, its worth planning for change from the outset. In particular: try to maintain access to all edges of the pond, leave borders along fence lines, ensure spits are wide enough to take a digger, and think about shallow-water pathways to islands.

10. Pond designs for Biodiversity Action Plan species

There are over 80 Priority Species that use ponds in the UK. They include animals like Lesser Horseshoe bats and Tree sparrow which feed over and around ponds, together with 70 or more specialised plants and animals that live in the water and around the pond edge.

Clean water is critical for many of these species. A recent review showed that 85% of the rarest Priority Species need good water quality to survive.

A major aim of the Million Ponds Project is to create clean water ponds that will support the populations of many of these species. To do this 1,000 ponds will be specifically created for them over the next four years.

During 2009-2010, *Species Dossiers* will be available for key Priority Species, to provide guidance about the places, habitats and designs which will best support these species.

11. Design practicalities

This factsheet focuses on pond designs that will create good wildlife habitats. But on any site, wildlife will be only one of the factors that influence design.

As the planning phase continues and you understand more about the site (e.g. its hydrology archaeology, location of service pipes), the original design may need to be modified a number of times. The implication is that it can be useful to keep designs rough, and flexible in the early stages, so that changes can be more easily accommodated.

Other issues, such as location, project planning, access, safety and particularly budget will constrain what is possible (see *Factsheets 5* and *6*).

12. The Design Bank

More detailed design ideas for new ponds can be found on the *website*.
They currently include:

- Woodland ponds
- Grazed ponds

Future factsheets will include:

- Heathland ponds
- Ponds in wetlands
- Moorland ponds and bog pools
- River floodplain ponds – how ponds fit in with river restoration
- Dune slack pools
- Ponds near paths – designs to minimise problems from dogs, fish and alien species
- Ponds and safety
- Designs to minimise risk of bird strike
- Ponds on farmland
- Agri-environment grants – designs to maximise funding benefits
- SUDS ponds

For further information about the Million Ponds Project please visit *www.pondconservation.org.uk/millionponds* or email enquiries to *info@pondconservation.org.uk*

Locating ponds and finding a water source

MILLION PONDS PROJECT
Pond Conservation

A 50-YEAR PROJECT TO CREATE A NETWORK OF CLEAN WATER PONDS FOR FRESHWATER WILDLIFE

1. Clean water

The Million Ponds Project aims to create clean water ponds that will provide exceptional wildlife habitats, now and long into the future.

The critical step that will achieve this is making sure that ponds have clean water. If ponds have *poor* water quality this:

- Significantly reduces the pond's wildlife value
- Often creates long-term management problems
- Means that ponds silt up faster

What's in this factsheet?

- Clean water
- Water sources for ponds
- Making sure the pond holds water
- Strategic locations for new ponds
- Avoiding later problems

What is clean water?

'Clean' water is water that is as near to 'natural' as possible. It has *low* levels of pollutants, particularly:

- nutrients like nitrate and phosphate
- heavy metals like copper and zinc
- residues of man-made compounds like pesticides

Pollutants can get into a pond from many places, including stream and ditch inflows, runoff from agricultural land, and roads and tracks. Once in a pond, these pollutants accumulate in water and sediments, and can move between the two. This degrades the pond and its wildlife potential for the long term. Polluted ponds have fewer plant and animal species and rarely have uncommon species. For around 85% of our rarest freshwater species, clean water is vital (see *Factsheet 10*).

How to find clean water?

To ensure ponds stay clean throughout their lifetime, locate ponds in catchments that are 'natural' – areas like woodland, scrub, rough grassland or unimproved permanent pasture. This type of habitat can be found in many corners of the countryside: on farmland, golf courses and commons as well as in more extensive natural areas, including nature reserves.

If there are concerns about water quality, try to move your pond to another location or check whether water quality can be improved by, for example, de-intensifying the pond catchment.

If these remedies are not viable, do the best you can with the site and water sources you have. Unfortunately, if a new pond does not have a sufficiently clean catchment and water source, it cannot be counted towards the Million Ponds Project target. This is because clean water ponds are now exceptionally rare, and creating them will do most to protect freshwater wildlife.

This said, even ponds that are not 'pristine' can still be valuable for many freshwater species, and will support the freshwater network as a whole. You can use design techniques (e.g. keeping ponds shallow), to maximise the wildlife potential of a pond even if water quality is compromised.

2. Water sources for ponds

Apart from rainwater, there are three main sources of water for ponds (Figure 1):

(i) surface water

(ii) groundwater

(iii) inflow streams, ditches or springs

Ponds may be fed by a combination of these water types and their relative importance can vary during the year.

In general, the cleanest water sources are (i) groundwater, and (ii) surface water that drains from un-polluted areas.

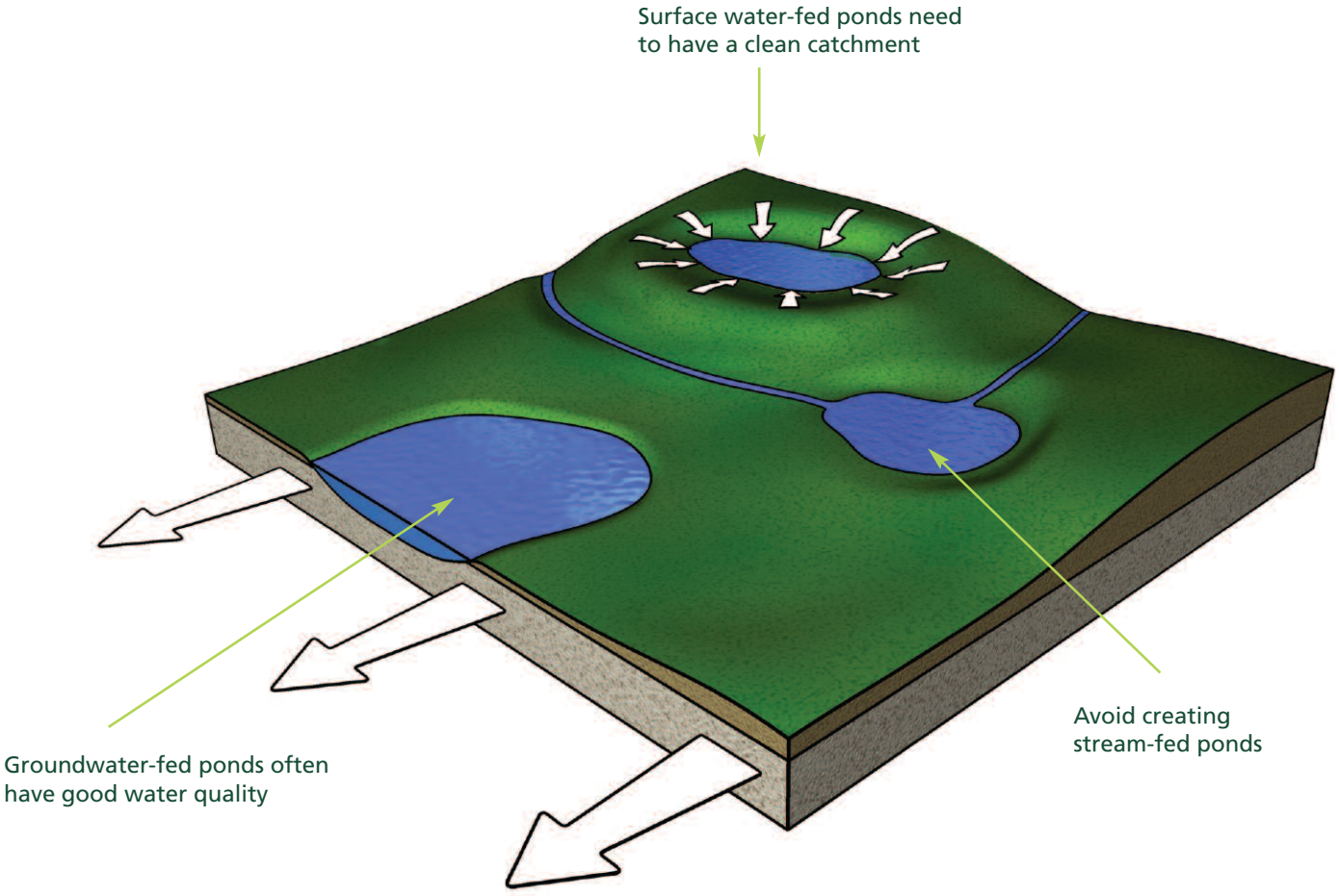


Figure 1. Water sources for ponds.

Surface water

Surface water is rain water that runs into the pond from higher ground. The water flows either across the land surface through the vegetation or, more often, through the soil and subsurface. Surface water is a surprisingly important water source for many ponds and will often be the main source of water where ponds are created in clay soils.

Surface run-off can provide some of the best and some of the worst quality water for ponds depending on the pond's catchment (see box). In intensive agricultural land and urban areas, surface waters are often of poor quality with high levels of water pollutants.

Surface water ponds are at their best where the whole catchment (big or small), is as natural as possible. This means ensuring that the pond's catchment has no intensive agricultural or urban land and that water does not run into the pond from tracks, roads, yards, spoil heaps, or other polluting surfaces.

What is a pond's surface water catchment?

A pond's catchment is the land area that lies above the pond, and from which water will drain into the pond. A pond on top of a hill will have a small catchment – maybe just the pond banks. Ponds at the base of a slope may have a large catchment, of thousands of square metres or more – sometimes a whole hillside.

For a new pond it is important to identify the pond's catchment area, because this is the area that will supply the pond with surface water, and will profoundly affect the pond's quality – for good or bad.

Groundwater

Groundwater is water that is present as a saturated layer in the ground (Figure 2). Groundwater levels rise and fall during the year, sometimes by a few centimetres, sometimes by a metre or more.

If groundwater lies near to the surface, and you dig a hole, it rapidly fills with water to the level of the groundwater table. In sands and gravels, a new hole will begin to fill immediately. In clays, it may take a day or so for the water to begin to seep out from the small pores in the clay.

Because groundwater has been partly filtered by passing through the ground, it is often one of the cleanest water sources for ponds. It is particularly low in pollutants like phosphates and metals which generally get into ponds attached to silt.

However, in intensive agricultural areas groundwater may still contain high levels of soluble nutrients like nitrate. Particular care needs to be taken with springs issuing from the base of chalk or limestone, where there is arable cultivation of the hillsides above.

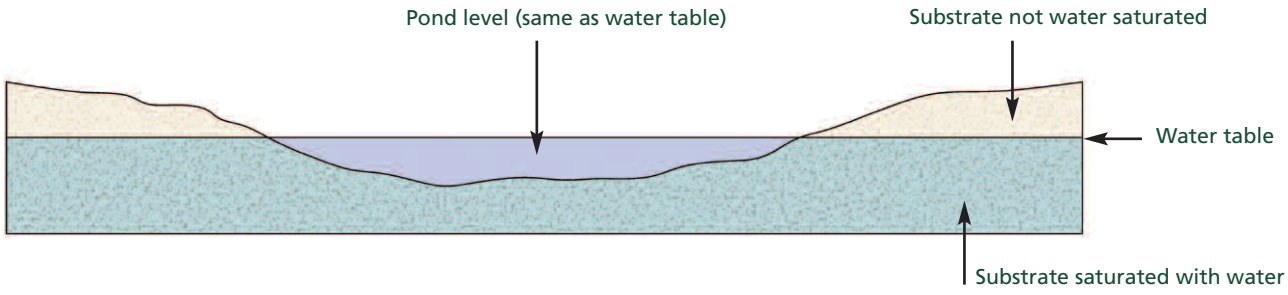


Figure 2. What is groundwater?

Inflows and drains

Modern ponds are often fed by inflows: streams, agricultural ditches or urban drains. This may seem an easy and simple water supply for a pond, but it causes many problems for ponds and their wildlife.

Ponds with ditch or stream inflows have higher pollutant levels, significantly fewer plant and animal species, and many more management problems than other pond types. Stream-fed ponds also fill up much more quickly: often they fill completely within a decade or two (see Figure 3).

For all of these reasons, one of the main stipulations of the Million Ponds Project is that contributing ponds should not have inflows. This rule may seem severe, but such problems have long been recognised in countries like Denmark, where planning permission is not given to ponds with inflows.

3. How do you make sure your pond will hold water?

One of the main concerns when digging any pond is 'will it hold water?' Ponds don't have to hold water all year round: seasonal ponds are an important pond type in their own right. And in general quality is more important than quantity. However, for a hollow to deserve the name pond, it needs to hold water long enough for wetland plants and animals to live in it. This means that water should persist into spring.

Ponds can be dug into just about any substrate: clay, sand, gravel, peat or rock. The trick is to choose locations where water is naturally retained in these substrates. If the location is not naturally suitable, then the pond basin can be lined (see *Factsheet 7*).

For the Million Ponds Project the ideal is to dig unlined ponds. There is nothing intrinsically wrong with lined ponds – they can make great wildlife habitats. Their main disadvantage is a lack of flexibility: you can't easily modify or extend lined ponds, they are more expensive to make, and there is always a worry that you may puncture the lining if management is undertaken. Because lined ponds need to have the liner covered with spoil, there is also the potential for unwanted nutrients to be introduced at this stage.

So how do you dig an unlined pond without an inflow? Sometimes it's easy. If you know that groundwater lies near to the soil surface, you just dig a hole.

If not, there are a series of steps that will tell you what kind of pond is right for your area. In summary:

1. Identify the local geology: are you in a clay area where ponds are likely to fill with surface water? Or in sand/gravels which may have an aquifer?
2. Look at the water levels in nearby ponds, springs, ditches or streams. How do water levels vary between these waterbodies and during the year?
3. Dig test holes across your site. Check first to ensure that service pipes, cables etc do not run across the site (see below). Ensure test hole locations reflect any differences in the landscape where you might dig the pond (e.g. valleys, hill tops, base of slopes, areas where water accumulates, edge of any wet bits).
4. Ideally, dig test holes to at least 0.5 m deeper than the maximum depth you expect for the final pond. When digging the test holes, note the depths at which the geology changes, or at which you meet water.
    - If you dig into sand, gravel or peat (sometimes clay) which is waterlogged, a groundwater pond will usually be possible.
    - If you dig into sediments with a very high proportion of clay (and little sand, rock or gravel), surface water ponds will often be possible.
    - If there are major changes in geology in the test holes i.e. different layers of clay and sand or peat, dig additional holes of shallower depth to see if the capacity for water-holding varies in the different layers.

5. Leave the test holes open and monitor water level fluctuations for as long as possible, ideally through both wet and dry seasons. This will help provide an idea of water level variation in the final pond.
6. If the test holes do not hold water for more than a few days after wet weather, then either find another location, or consider using a pond liner.

More detail is given in *Factsheet 10*.

Can a pond last for 10,000 years?

Ponds with an inflow stream usually fill up quickly (Figure 3). Even a crystal clear stream or a drain that only runs in wet weather will dump large amounts of sediment in a pond. A 60 m^2 pond can fill-up completely within 5 years – just by the sediment brought in by a spring 50 m upstream of the pond.

In contrast ponds without inflows fill very slowly. The permanent water phase of a 1 m deep pond can last well over 100 years. Once the pond begins to dry up in summer, the rate of infill slows even further (because the organic sediments are oxidised during the summer dry phase). As a result temporary ponds are very stable habitats, and they can be exceptionally long-lived. Many can far outlive lakes. There are many post-glacial temporary ponds in Britain which are over 10,000 years old, and will probably survive 10,000 years more.

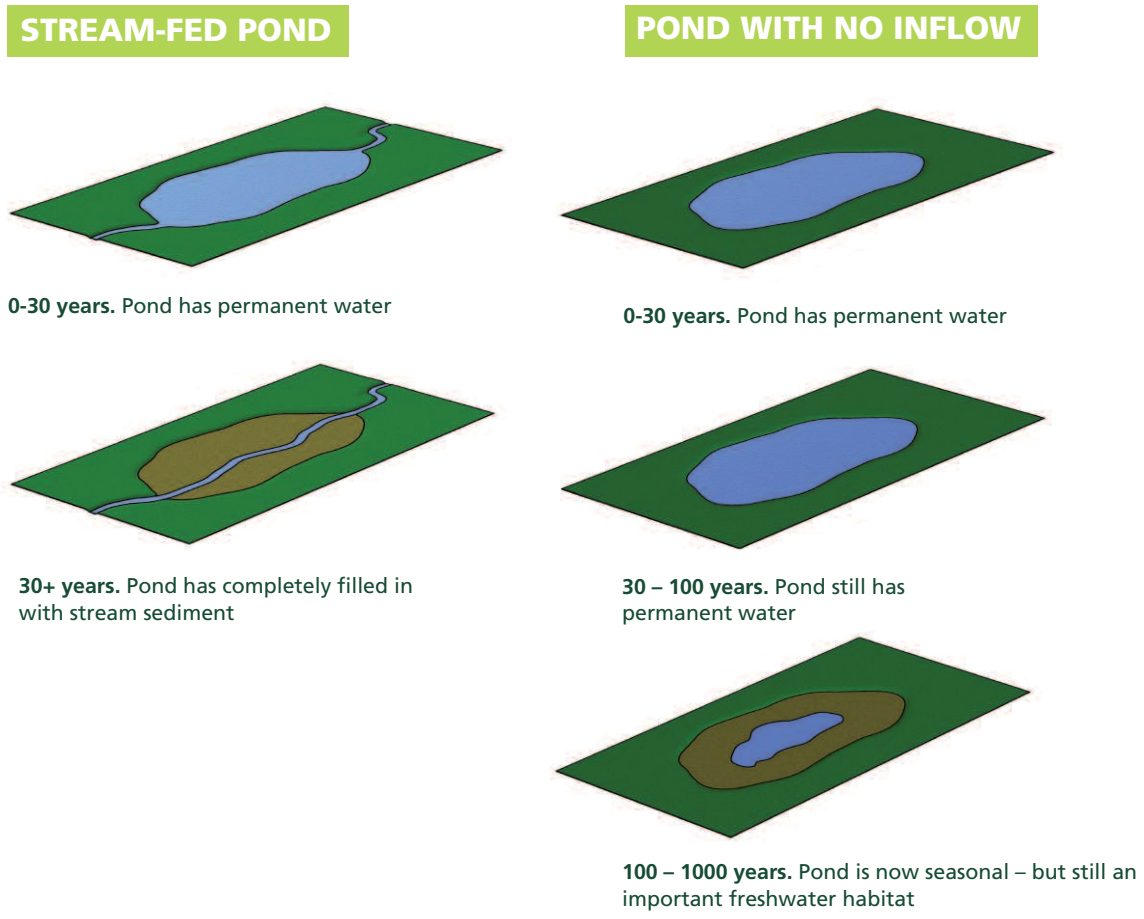


Figure 3. Stream-fed ponds are short-lived compared to ponds with no inflow.

4. Strategic locations for new ponds

Across the UK as a whole, it is important that clean water ponds are spread around and dug in a wide range of landscape types, such as woodlands and meadows, in valleys and on hilltops. It is this mix of locations that will protect the widest range of freshwater biodiversity.

This said, it can be useful to locate some new ponds more strategically:

- Dig ponds near other wetlands to improve connectivity.
- Dig ponds where uncommon species occur to help strengthen their populations.

Or it can also be important not to dig at all:

- Don't dig ponds where there are existing wetland habitats.
- Don't dig ponds where this might damage existing species.
- Don't dig up peat.
- Don't dig up our archaeological heritage.

Connectivity – linking ponds and other wetlands

In natural landscapes ponds rarely occur in isolation: usually they form part of a complex together with other wet habitats like rivers, wet woodlands, springs, mires and other ponds and pools.

Mimicking this natural connectedness can have benefits. We now know that pond plant and animal populations often fluctuate widely at a site, and that local extinctions are relatively common as part of natural processes. If there are many waterbodies in an area, there is a much greater chance that, after a natural extinction, the species can recolonise from another nearby waterbody. If not it will be lost forever, and gradually pond richness will decline.

Creating protective pond networks is very valuable: we know that it helps to maintains wildlife-rich ponds and is particularly important for uncommon pond species like great crested newt. As our climate changes, in ways that are not always predictable, such networks are likely to be even more important.

Ponds for rare species

We are currently developing support tools to identify species and areas which will benefit most from strategic pond creation. This includes:

- **Identifying Important Areas for Ponds (IAPs):** these are geographic areas with large numbers of high quality ponds, many supporting rare species. Creating new ponds within IAPs can help protect networks of the most important ponds for biodiversity. An IAP assessment is currently available for Wales, and will soon also be for other parts of the UK. Check *www.pondconservation.org.uk* for details.
- **Species dossiers:** these provide accounts of where and how to dig new ponds for some of the UK's most uncommon pond animals and plants. The aim is to develop dossiers for around 40 of the 80+ priority species associated with ponds.

5. Places not to dig new ponds

Creating new ponds has many benefits, but it shouldn't be at the expense of valuable existing wetland habitats (Figure 4). A particular trap to avoid is digging up existing wet bits. Make sure you carry out a risk assessment before digging (see *Factsheet 6*). Although it might seem logical to put new ponds in a place that is already damp, like seepages, springs or damp hollows, these areas may already have considerable value in their own right, particularly if there are few other wet places in the area.

Take particular care with dried up ponds. If the pond still holds water in winter and spring – it is a seasonal pond. Many seasonal ponds have uncommon plants and animals, so it is best to leave them alone. Even if the pond is now completely dry all year through, it may still contain seeds or spores from uncommon plants that grew there in the past. This is one of the rare occasions where it may be valuable to spread a little of the excavated spoil (the old pond's sediment) into the new pond to see what comes up.

This field looks like a good place to dig ponds: there is water around near to the surface and ponds have been dug in the past. **But** don't dig up the existing wet bits – places like springs, flushes and temporary ponds are important and of value in their own right.

Figure 4. Take care not to damage existing wetlands.

Avoid damage to existing pond species

There are a very few occasions where digging a new pond may actively damage existing pond wildlife. The risk is greatest where very old ponds of considerable value are present, and a new pond might encourage colonisation from unwanted species, threatening existing communities. The ancient pingo ponds of Norfolk are a case in point. These 10,000 years old ponds have very special wildlife communities with rare species found at few other sites in Britain. We don't know if new ponds would cause damage, but it is not a risk worth taking.

Don't dig up peat

In these climate-aware days, it's generally considered bad practice to dig up peat, because its subsequent decay produces the greenhouse gas carbon dioxide (CO_2). Overall, high quality pond creation may benefit the global carbon budget, because the carbon rich sediments that accumulate in the ponds will lock up CO_2. Nevertheless, when creating ponds for the Million Ponds Project, peat areas should generally be avoided. The main exceptions are small ponds created specifically for some of the very rare plants and animals that live in fen and peatland pools. Because the pools are tiny, the scale of CO_2 release is very small and is warranted by the considerable benefits of rare species protection.

6. Avoiding later problems

If the pond is going to be located close to a public path or in an area of open public access, think carefully about the impact this may have on the pond. The main issues are: dogs, ducks, fish, invasive species and people.

If necessary, consider relocating the pond, or use a design that will minimise the impact of these factor (see the *Design Bank* for example of designs). Or make a pond for people, not wildlife. (Though note that this may not count for the Million Ponds Project).

Dogs and ducks

The impact of dogs may seem a trivial concern, but their effect on ponds can be very significant (Figure 5). Many dogs love water, and most of us enjoy watching them plunge in to splash or swim for sticks. There are many places where dogs can swim with few problems – many of the UK's rivers, streams and ponds are already very damaged, and a bit more disturbance is unlikely to have much impact.

Figure 5. dogs enjoying themselves in a New Forest pond.

This is not true of clean water ponds, however. The occasional dog swimming will not damage a pristine pond, but regular disturbance churns up the bottom sediment. This makes the water cloudy; aquatic plants cannot grow, and pond animal diversity declines. A pond on a regular dog-walking path where dogs may swim every day will be permanently damaged. You can see this effect widely in the countryside, from the New Forest to small Lake District Tarns.

A small number of ducks on a pond is natural, but as soon as ducks are fed, their numbers rise. And anyone who has pond-dipped in a duck pond will know how impoverished they are in anything except ducks. Duck ponds are an important amenity for people, and especially children, but the presence of ducks in unnatural numbers is not compatible with the creation of clean water ponds.

There are pond designs you can use to minimize dog and duck impacts such as having sacrificial ponds (where dogs or duck feeding are allowed), leaving shallow seasonal ponds near the path and deeper pools further away, or reducing access. However the easiest treatment may be prevention: move the pond, or perhaps, the path.

Alien and invasive species

Countryside ponds located in public areas, beside paths, and especially near to roads or car parks are much more likely to contain invasive non-native species than other ponds. Invasive plants like new zealand pigmyweed (*Crassula helmsii*) are widespread in these easy to access ponds, and there is evidence that their presence continues to damage the populations of some of our rarest plants. Other invasive plants like water ferns (*Azolla filiculoides* and *A. caroliniana*), parrot's feather (*Myriophyllum aquaticum*), floating pennywort (*Hydrocotlyle ranunculoides*) and least duckweed (*Lemna minuta*) are spreading too (Figure 6).

Figure 6. A pond completely covered with water fern.

Many exotic amphibians, like green frogs and midwife toads, have been released into British ponds. Goldfish are common in many roadside ponds, and in some places this threatens one of our few native pond fish – the crucian carp, which interbreeds with the non-native goldfish.

The implication is clear – many people introduce garden plants and animals into the wild. This may be because their ponds are being cleared out and pond owners don't want wildlife to die, or just because it seems like 'a good thing to do'.

There have been many campaigns by wildlife organisations to stop such introductions happening. But a significant risk still exists. New ponds are often particularly vulnerable, because their bare soils are a perfect place for invasive plant species.

To avoid problems:

1. Check other waterbodies in the area before making new ponds. If invasive plants are present and it is not possible to get rid of them, locate ponds as far as possible away from any existing sources. When the new pond is made, check regularly for signs of unwanted species, until other vegetation has developed and covered the bare ground.
2. As noted above, prepare in advance - avoid locating new ponds near to areas of regular public access, particularly close to car parks or roads, from which it is easy to unload unwanted pond plants and animals.

People

Having people (without uncontrolled dogs) around ponds is not a problem. People really like ponds, and ponds play an important role as a link between people and wildlife, so this should be encouraged. People around ponds can also be useful for keeping down vegetation and making patches of bare ground – adding to the natural variations in bank type.

Occasionally, in very public places, rubbish dumping may be an issue, or paths develop all around a pond, completely eroding all natural vegetation. In most cases, there are usually simple things that can be done to reduce damage, such as use of trenches, banking or provision of alternative routes.

For further information about the Million Ponds Project please visit *www.pondconservation.org.uk/millionponds* or email enquiries to *info@pondconservation.org.uk*

Planning pond creation

MILLION PONDS PROJECT
Pond Conservation

A 50-YEAR PROJECT TO CREATE A NETWORK OF CLEAN WATER PONDS FOR FRESHWATER WILDLIFE

1. Pond creation objectives

Why do you want to create ponds? It is important to decide on the project objectives at a very early stage – this will help you select suitable sites, prioritise expenditure and avoid unnecessary work.

Examples of wildlife objectives:

- To create stepping-stone habitats to link water vole populations.
- To create high quality freshwater habitats in the landscape.
- To strengthen a local population of the mud snail.
- To increase the diversity of pond habitats in the area.

Some objectives may be incompatible. For example, the same pond site cannot help to increase the population size of both natterjack toads and common toads because competition from common toads is a known factor in limiting natterjack toad populations. Likewise, some agricultural practices and public amenity aims for sites can be incompatible with some species or habitats.

What's in this factsheet?

- Pond creation objectives
- Pre-site checks (e.g. existing value, archaeology, utilities/services, etc.)
- Phased approach to pond creation
- Planning the construction phase
- Designs and drawings
- Project costs
- Funding sources
- Health and safety
- Project risk assessments
- Finding contractors
- Working with volunteers

2. Pre-site checks

Pre-site checks should be undertaken as early as possible in the planning process because this can affect the design, operation and even viability of projects.

The safest approach to pond construction is to talk to all relevant public bodies and other interested parties to ensure that they are happy with what you are doing (see Table 1 for contact details).

Damage to existing habitats and species

If the site is already known to be of particular ecological value, don't dig it up, dump spoil on it, or disturb vulnerable areas during excavation works. If in doubt, err on the side of caution and dig ponds in vegetation types that are extensive and uniform. In particular, put new ponds near to existing wetlands (damp hollows, seepages, temporary ponds, springs) but don't destroy the original wet bits (see *Factsheet 5*).

In semi-natural landscapes, an ecological survey is advisable before deciding on the suitability of a site. Pond creation on, or adjacent to, land designated as a SSSI or other protected area may require consent from Natural England or the Countryside Council for Wales.

The value of trees as landscape features, habitats or as important organisms in their own right (e.g. black poplars) should be considered. Any tree work could require a felling licence from the Forestry Commission unless it qualifies for an exemption, e.g. felling of less than 5 cubic metres of timber in a calendar quarter. More information on felling licences and exemptions is available from the Forestry Commission at *www.forestry.gov.uk*.

Some trees may also be protected by Tree Preservation Orders or Conservation Area designations – the Local Planning Authority should be consulted.

On rare occasions digging new ponds may put existing pond species at risk. This is most likely in areas with existing very stable, long lived pond types (e.g. bog pools, ancient temporary ponds like the Norfolk pingos). It is possible that populations of some of the very rare animal species in these ponds might be damaged by an influx of 'new pond species' to nearby sites. If there are concerns, seek advice from a relevant species expert or contact Pond Conservation on *info@pondconservation.org.uk* for guidance on finding the right support.

The presence of protected species (e.g. great crested newts, bats, water voles, badgers) is of particular importance, because of the legal implications. The relevant legislation is the Wildlife and Countryside Act and the Conservation (Habitats, &c.) Regulations. Depending on the species and the legislation, protected species are protected against killing, injury, disturbance, and damage to their habitat. Penalties include a criminal record, fines and custodial sentences. Pond creation projects can therefore pose a significant threat e.g. by moving large volumes of soil, felling trees, or driving machinery over areas of habitat.

Table 1. **Pre-site checks – people to talk to**

Topic	Who	Contact details
Impact on protected species or designated sites	Natural England or Countryside Council for Wales	*www.naturalengland.org.uk* *www.ccw.gov.uk*
Tree felling, coppicing etc	Forestry Commission	*www.forestry.gov.uk*
Impact on historic sites or archaeological remains	County Archaeologist	At local planning authority
Work on a floodplain, impacts on watercourses, concerns over contaminated land, complying with environmental law	Environment Agency	*www.environment-agency.gov.uk* *www.netregs.gov.uk*
Impact on other properties e.g. by altering drainage	Neighbouring landowners	
Locating and working near buried services and overhead powerlines	Service providers	Contact service providers direct or use a search facility such as *www.linesearch.org* or *www.linewatch.co.uk*
Health and safety, risk assessments, CDM Regulations	Health and Safety Executive	*www.hse.gov.uk*
Planning permission requirements or other land use concerns	Local Planning Authority e.g. district council or National Park Authority	Contact the authority direct or find contact details of the relevant authority on *www.planningportal.gov.uk*

Depending on the nature of the work, (e.g. whether or not it will cause significant disturbance to a population of a protected species), a licence from Natural England or the Countryside Council for Wales may be required. Licensed activities should aim to improve the habitat for protected species, so specialist advice may be required to ensure this happens. Unless you have experience of working with the target species, it is advisable to seek professional advice during the planning stage of your project to ensure that the relevant regulations and best practice are complied with.

Archaeology

Pond creation can be both a threat and opportunity for archaeology. Digging holes in areas that are scheduled ancient monuments would obviously raise concerns and trigger a requirement for planning permission (see below). However, beyond the scheduled list, there are very many areas that are of interest and importance for archaeology. The critical step is to check if there is likely to be any interest by contacting the county archaeologist.

Archaeological importance will not necessarily prevent pond creation. But there might be a need to investigate the site (e.g. field walking or digging test pits) before any pond excavation is undertaken. The extent of checking will be dependent on the perceived risk. In some cases an archaeologist may want to visit the site during pond excavation.

If it is a condition imposed that an archaeologist is present during excavation, you may have to pay a consultant archaeologist to attend, which will have a significant impact on the project budget (see box).

Pond creation on floodplains

Where ponds are created on floodplains the Environment Agency will be concerned to ensure that excavated spoil (a) does not reduce the area's capacity to store floodwater and (b) is not piled up causing an obstruction to floodwater movement. You can reduce these risks by removing pond spoil from the floodplain completely, or in some cases with smaller/shallower ponds, by spreading the spoil thinly on the surrounds. If the location of a pond could breach the bank of the watercourse this would also cause concern – though for clean water ponds created for the Million Ponds Project, riverbanks are not a likely pond location (see *Factsheet 5*).

To identify if your site is on the floodplain check the 'extreme flooding' zone on Environment Agency flood maps (*www.environment-agency.gov.uk*). If it is on the floodplain, contact the Environment Agency directly for further advice.

Neighbouring land

If ponds lie close to a neighbouring property, and particularly if the land on which the pond lies could influence a neighbour's drainage system or site hydrology, then the neighbour should be contacted to ensure there is no conflict. If the pond is near a neighbour's boundary, it is obviously polite to tell them about your plans to allay any fears about the presence of excavation machinery and changes of landuse.

If the site lies close to a SSSI or other protected area, pond creation could require consultation of Natural England or the Countryside Council for Wales, or the Local Planning Authority. There are likely to be particular concerns if the pond could permanently influence the surface water catchment or groundwater supply to the protected area. If the pond is groundwater fed, and a deep excavation is planned, there may be concerns about impacts if pumping is necessary to temporarily de-water the excavation. If the project requires planning permission, these issues will be picked up by all interested parties. If planning permission is not required, the regional office of Natural England or the Countryside Council for Wales should be consulted directly.

Checks for underground pipes and services

The UK is criss-crossed by a buried network of cables and pipes, carrying private or public services like electricity, gas, oil, water, telephone lines and sewage. It is obviously vital that you identify if and where these occur at an early stage of project planning because (i) they can pose a significant threat to health and safety, (ii) damage to service infrastructure can be costly and cause considerable inconvenience, and (iii) early information means that pond designs can be adapted to any constraints they impose.

The service operators should be able to provide you with details of services on the land you are working on. There may be a charge for providing this information. There are some on-line tools for checking your site: contact Linesearch at *www.linesearch.org* or 0870 403 6484, and Linewatch at *www.linewatch.co.uk* or 02380 883150. For high risk services (e.g. gas pipes operating at a pressure of 2 bar or above), there may be constraints on the working practices adopted when digging ponds and you may need to contact the pipeline operator before beginning work.

The exact line of service cables and pipes may not be marked accurately on site maps. Always leave a margin of error if service lines are known. If there are particular risks, it is advisable to identify the exact line using a locating device.

Above ground services

If the site, or its access route, has overhead power lines this can constrain the maximum height of machinery that can be used on site. Direct contact with the lines is not the only danger, as electricity can flashover when equipment gets close. The risks of contact or flashover can be greatly reduced by using machinery that will not reach more than 4m from the ground.

Precautions you can take:

- Consult the local electricity company and/or the National Grid Company for lines on steel towers operating at 275 and 400 kV (operating voltage will be displayed on the tower). They will provide free advice and information about precautions and safe working procedures.
- Find out the maximum height and maximum vertical reach of all machines that will be on site.
- Mark the location of all power lines on the site plan, together with information on the maximum working heights permitted under each span of overhead line.

An information sheet on working safely near overhead power lines is available from the Health and Safety Executive (HSE) website at *www.hse.gov.uk/electricity/information/overhead.htm*.

Land drains

If field drains run through or immediately next to the pond excavation they may (a) pollute the water and bring in sediment, or (b) drain water out of the pond. To avoid this you may often need to either break and block drains or, if it is important to maintain drainage function, divert them around the pond.

It is sometimes possible to find land drains from two or three historical periods crossing a site. Old field drains may be French drains (stone filled trenches), constructed in a box form using stone, or moulded clay pipes; modern field drains are often plastic pipes. In modern drainage schemes, the drains are usually laid at regular intervals, and once you have found two parallel drains, you can predict where the remaining drains are.

Site plans may show the location of field drains, or these may only be located when work begins on site. In either case it is wise to be prepared and have a plan ready for how to deal with them (see Figure 1).

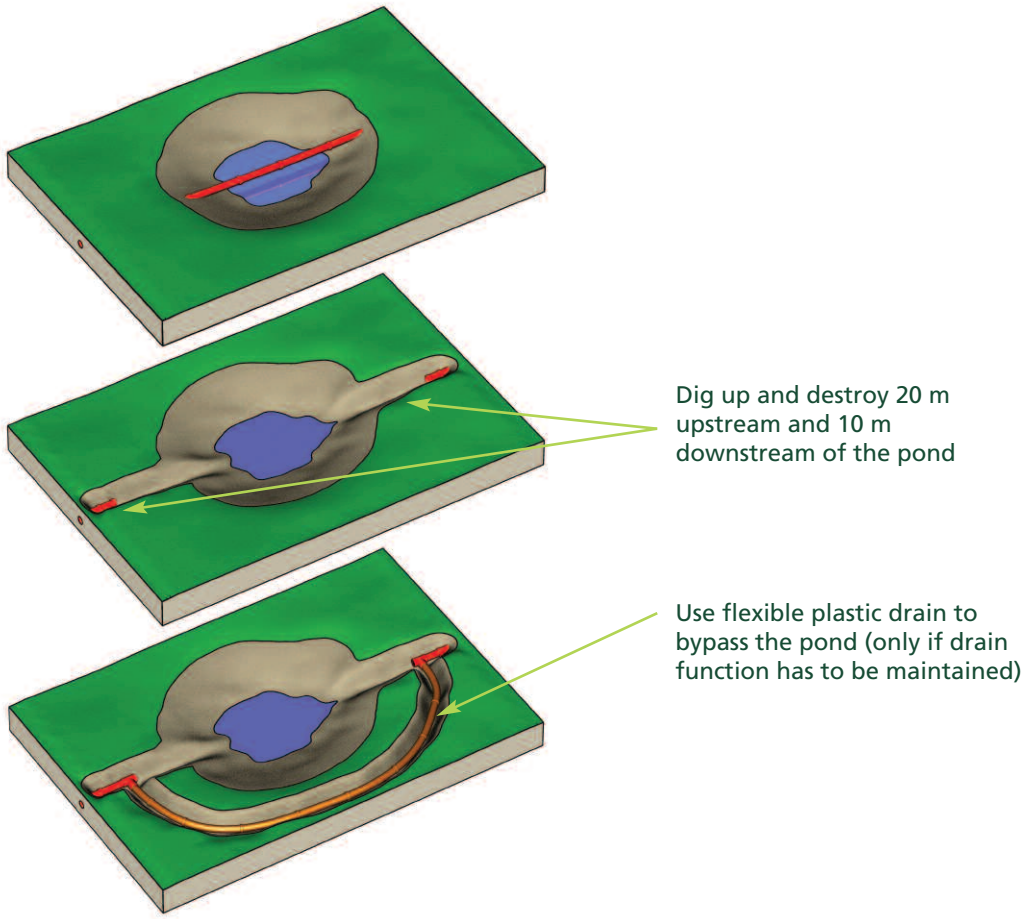


Figure 1. Dealing with land drains. Typically, dig out and destroy 20 m of drain upstream and 10 m downstream of the pond (middle). If the drain function has to be maintained, use impermeable flexible plastic drain pipe to bypass the pond (bottom).

Planning permission

The planning process is an important system for ensuring that changes in landuse and developments are appropriate for that location. Consult the local planning authority at an early stage to determine if the pond needs planning permission, or if there are likely to be other concerns. A planning officer will advise you on the need for planning permission. Provide simple information on location, approximate size, purpose, any materials etc, and ask for a written response.

Note that there is considerable regional variation in planning officers' approach as to which pond creation projects need to go through the planning process. However, in general, planning permission may be needed for pond creation if it:

- involves engineering operations e.g. requires large excavation machinery
- is a change of use of the land e.g. from agriculture to nature conservation or recreation
- may affect highways or properties
- may affect important wildlife/archaeological sites
- may affect floodplains or other sites, or
- is in the flight path of an airport and could increase the risk of aircraft bird strike

If you need planning permission, a fee will be charged (the amount varies depending on type and scale of the project) and there might be additional costs where there is a need for surveys/assessments or plans to be drawn up by a landscape architect or similar professional. For more information on the planning process go to *www.planningportal.gov.uk* and your local planning authority website.

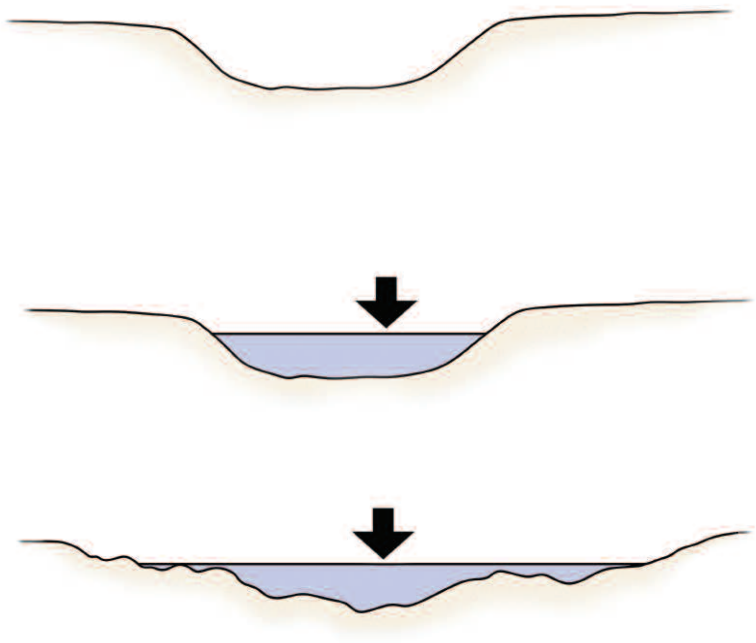
If you don't need planning permission, you should still carry out other checks. If you change your plans significantly, check that the new plans don't then require planning permission.

3. Phased approach to pond creation

Pond creation can be perfectly satisfactory as a one-off affair. You dig the ponds and it's finished. This works particularly well where soils and water levels are understood and predictable.

However, if funding allows, don't discount a more phased approach, particularly if you don't know exactly where the water will settle and how it will fluctuate (Figure 2). For larger sites, one option is to dig out deeper parts of ponds in the first year, disposing of the bulk of the spoil. Then bring back the digger for a day or so to finish off the shallow marginal areas in years 2 or 3. This approach is not suitable for lined ponds.

Another option is to plan pond digging over a much longer time frame, bringing in a digger every few years to create new pools and improve the shape of existing ones. The advantages are that the site can benefit from lessons learnt, incorporate new ideas, and crucially, the ponds will be of different ages and at different stages of succession, leading to a more varied site.



Phase 1 (Year 1)

Dig out the deepest area of the pond and roughly shape some areas of shallow pools, mud flats, islands etc.

Phase 2 (Year 1 to 2)

Observation phase – monitor seasonal water levels over a calendar year and make plans for modifications to the pond.

Phase 3 (Year 2 to 3)

Make changes to the shape of the pond according to observed water levels; undertake delicate shaping of margins and shallows.

Figure 2. Phased excavation and pond profiles. This is one option for pond creation where the water levels are not known in advance.

4. Planning the construction phase

Timing works

There is no best time for pond creation. Winter can sometimes be problematic, but is usually fine for smaller projects, especially where the ground is not waterlogged. Wet weather or waterlogged ground can be more difficult for larger schemes because heavy vehicles often get bogged down, particularly in areas where they are regularly travelling to and from the site (e.g. dumpers removing spoil). At other times of the year, breeding birds, or sensitive periods for protected or vulnerable species and habitats may impose restrictions.

Access for machinery

Excavators and dump trucks are broad, tall machines, so ensure that route ways, bridges, and gates onto the site are big enough to accommodate them. If spoil needs to be moved around or off site this can be very time consuming, so it is particularly worthwhile identifying the most efficient routes for dumper trucks. It may be appropriate to temporarily remove fencing, or create temporary bridges or bunds across streams and ditches to make journey times as short as possible (see box).

It may be necessary to create safe access for heavy machinery, e.g. creating hardcore track, especially in gateways, so vehicles and machinery don't get bogged down. Decide if you want to create permanent or temporary access – this may be important for post-creation monitoring and management and visitor access.

Creating access for machinery

At a pond complex creation scheme in Cutteslowe (Oxon), the contractors made a temporary crossing over a ditch using excavated spoil and a pipe to maintain the flow of water. This cut about 5 minutes off each round trip for the two dumpers, a lot of time when you consider they did >100 trips (=1.5 days in a 10 day scheme). At the end of the project, the ditch was restored to its original condition.

Choose the materials carefully as there is a potential for causing pollution or altering water chemistry, e.g. avoid bringing crushed limestone onto an acidic site. If you use recycled material (demolition rubble etc) check that it complies with waste regulations and has been certified as clean. For more information visit the NetRegs website *www.netregs.gov.uk* and Environment Agency website *www.environment-agency.gov.uk*.

If there are areas of sensitive vegetation near to the pond site these should be marked on plans and perhaps taped-off on the ground. All excavations will need some 'working area' beyond the pond itself. This is the area from which the digger will excavate, where spoil may be temporarily piled or spread, or a dump truck has room to load up and turn. It is possible to minimise the working area through careful planning and skilled digging, but the pond may take longer to make.

What you consider to be an acceptable level of damage to the ground (compaction, damaged turf, ruts, damaged sward, bare ground etc) may also influence your choice of machine size, and what kinds of ground protection you use, at additional cost. Soft ground can get very churned up by pond excavation. In general, larger tracked excavators are better on soft ground than smaller vehicles, because their weight is spread over a larger area of track. Note that dumpers are particularly likely to churn up soil because they are usually wheeled (not tracked) and are likely to make repeat journeys transporting spoil.

Where will the spoil go?

Before beginning a project consider carefully how spoil will be disposed of (see box: 'A few tips about spoil disposal'). The volume of spoil that comes out of a pond always looks enormous and it is easy to underestimate the volume and time it takes to handle it. Disposing of spoil is usually the most time consuming and expensive part of a pond construction project. Factor this into the brief for the contractors.

Estimate the volume of spoil expected and consider where to put it, how to transport it, how the heap of spoil will be shaped, and the cost. When calculating the amount of spoil generated by the excavations, remember that in many ponds the water surface will not be at ground level, so digging a 1 m deep hole will not usually create a 1 m deep pond. Particularly in groundwater-fed ponds, you may need to remove a considerable amount of overburden just to reach water (see *Factsheet 10* for more information on geology and hydrology).

Be aware that there may be legal or regulatory restrictions and limitations on how spoil can be used or disposed of:

- On floodplains, spoil must either be a) spread flat and made stable so that it doesn't erode and lead to pollution or silting up of water courses, or b) removed from the site (see also earlier section on pond creation on floodplains).
- Where sensitive habitats or species are present, spoil disposal could result in damage to or loss of habitats, or injury to or obstruction of species (see pre-site checks above).
- If spoil is to be taken off site, the pond creation project may require planning permission (see section on planning permission). There may also be other regulations you need to comply with, such as obtaining a waste transfer note – discuss the project with the Environment Agency.
- Spoil contaminated with pollutants or invasive plants such as Japanese knotweed must be carefully handled – contact the Environment Agency for advice (*www.environment-agency.gov.uk*). If your land is contaminated, it may not be a suitable place for pond creation.

More information on dealing with spoil and obtaining consents is available from NetRegs *www.netregs.gov.uk*.

Dealing with topsoil

Topsoil is usually an unwanted and polluting material in pond creation projects. It has very high nutrient levels, and if these nutrients drain or leach into the water they will reduce water quality. Topsoil should not be used either in the pond, on its edges, or on the upper banks i.e. anywhere where surface water could wash nutrients into the pond.

When planning the construction phase of pond creation ensure that:

(i) if spoil is to be spread around the pond, the topsoil is spread furthest way and down hill of the pond

(ii) topsoil temporarily stored on site is kept away from the pond so that soil and nutrients are not washed in by rainfall.

Topsoil is often highly valued in landscaping, so in larger pond creation projects, if there are no other uses on site, consider if you can sell the topsoil to local landscaping firms, developers or soil merchants. Talk to the potential users, the local planning authority, and the Environment Agency about ensuring all relevant regulations are met when removing material from the site.

5. Designs and drawings

The main reasons for producing site drawings are (i) to get your ideas straight and (ii) to present them to others: potentially including planning officers, contractors, digger drivers or funders.

Site drawings often begin as a back-of-the-envelope sketch, and sometimes you may not need much more. However, if you are communicating your ideas to others, then include what they will need to know.

Typical steps in the design process are:

1. Create a large-scale map outline of the site (e.g. by photocopying). Ensure you have a scale bar.
2. Make sketches that outline the waterbodies you want to create until you are happy they meet your requirements and constraints.
3. Draw depth contours within the waterbodies at suitable intervals (i.e. 20 – 50 cm) to indicate excavated depth. The eventual pond water level won't usually be at the ground surface, so don't forget that the first (outermost) contour will define the slope of the upper banks, and below this will be the drawdown zone. Indicate the maximum depth.
4. Check that the contours you have drawn will create your desired bank angles. Consider this particularly carefully if the current ground surface is sloping.
5. Add other important features to the sketch, for example: service pipes, access paths, no-go areas, areas where spoil can be dumped and how it should be spread or piled, location of fencing.
6. If you are aiming to create complex areas e.g. hummocky drawdown zones or areas of tiny pools, these can be hard to illustrate. Since the exact shape, size and location will not usually be critical, shade over or box the area as a whole and draw an example area or label with your specification e.g. 'create approximately 10 small irregular pools, 1 – 3 m diameter, 15 – 35 cm maximum depth'.
7. Consider including one or two cross-sectional drawings.
8. Using colour can help define areas more clearly – e.g. shallow and deep water.

It can be helpful to provide additional notes of things that can't be summarised graphically e.g. project aims, construction stages, access arrangements and after-use. See *Factsheet 4* for principles and ideas for designing ponds for wildlife and for further information.

6. Funding sources

There are a wide range of funding sources for pond creation using public and private money, including agri-environment schemes, the National Lottery, national government biodiversity grant schemes, and charitable trusts. A list of possible funding sources will be regularly updated on *www.pondconservation.org.uk*.

A few tips about spoil disposal

- Moderate amounts of spoil can be disposed of around a site, leaving little long-term trace. Spread thinly, at least 3 m to 4 m away from the top of the pond bank. Don't:
  - pile up spoil more than 30 cm deep.
  - fill in hollows which may have an existing wildlife or archaeological interest.
- If spreading spoil then place it down hill of the pond (exception below) so that you don't form a rim preventing clean water draining into the pond (Figure 3). This is because run off from spoil placed up hill of the pond will bring in considerable amount of silt during heavy rain, at least until the area becomes vegetated.

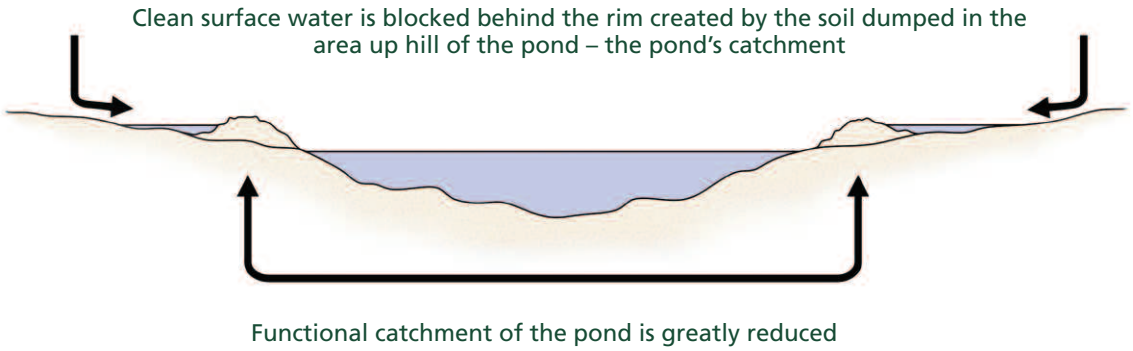


Figure 3. Example of routes used by heavy machinery (e.g. excavators and dumper trucks) on a pond creation site to minimise impacts.

- Where groundwater-fed ponds are created in agricultural landscapes, low banks made from excavated spoil can be used to create a barrier to redirect polluted surface water coming from arable fields away from the pond. (Figure 4).

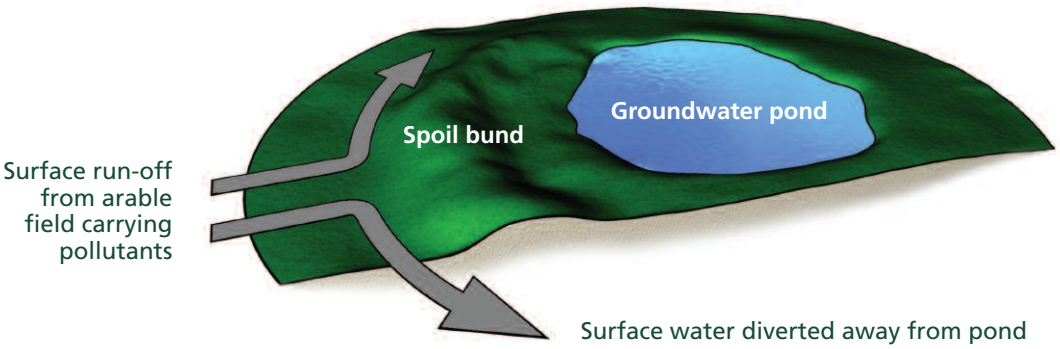


Figure 4. To prevent polluted surface water entering a groundwater-fed pond, create bunds to divert the water away from the pond.

- Spoil can be used to dam up ponds by forming the lower bank of a pond on a slope (Figure 5). This is best for small ponds because there may be issues regarding the strength and safety of dams retaining larger ponds. Such ponds are more likely to be considered engineering operations and require planning permission. For very large ponds, with over 25,000 cubic metres (i.e. 2 ha pond, 1.5 m deep) of water held above the natural ground level, the pond will fall under the Reservoir Act and require professional engineering input and regular monitoring.

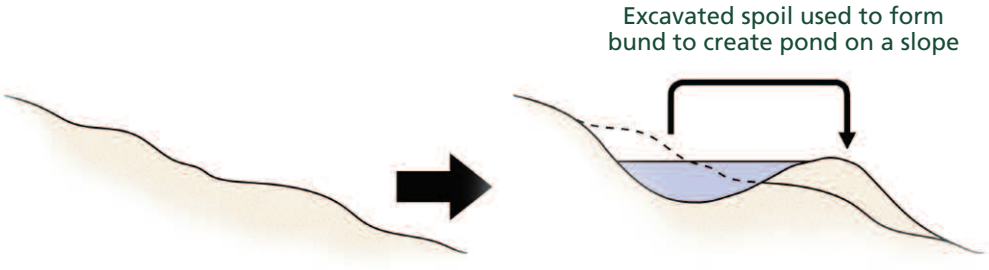


Figure 5. Spoil can be used to form lower bank of pond on slope.

- In many cases spoil can be put to good use for example by creating beneficial features such as new habitats, or access infrastructure such as a raised walkway or viewing area (Figure 6), or landscaped mound for planting with trees and shrubs. Note that effective landscaping requires that mounds are in keeping with the scale of the landscape. Mounds can also be used to screen unsightly buildings or busy roads, and will provide a buffer against spray pesticides drifting from adjacent fields.

Figure 6. Spoil used to create raised walkway and viewing platform at Lawson's Wetland, Blackpool.

7. Project costs

Some pond creation projects come virtually cost free: when, for example, a group of staff or volunteers create small ponds by hand, or where machinery and labour is freely available on site. Smaller unlined ponds (e.g. 5 m+ diameter) may be excavated for around £350 if they are finished in a day using a hired digger and driver, especially if the contractor is experienced and the spoil spread nearby. Larger and more complex projects may cost tens of thousands of pounds (see box).

List of potential costs for pond creation projects

Costs differ depending on the scale and type of project but may include the following. Please note this is not an exhaustive list.

- purchase or leasing of land (purchase price and legal expenses)
- modification of lease agreements (compensation and legal expenses)
- planning application fees
- professional design costs (may be required to satisfy planning application requirements, or useful to communicate ideas to stakeholders or attract funding)
- tests, surveys, and checks, e.g. soil or water sampling, or checks or surveys for utilities (gas, electric, water, drains), archaeology, species and habitats, hydrology, etc
- project management and administration costs
- machinery and equipment purchase or hire (excavator, dumper, fuel, pump etc)
- health and safety requirements
- spoil transfer and disposal costs
- hire-in insurance
- materials (liner, fencing, etc)

A contingency fund, usually around 10% of project costs, or 5% on large schemes, needs to be included in the project budget to cover unexpected costs and price rises.

8. Health and Safety

In carrying out practical work on ponds, the first concern should be that the work is carried out safely. Every company or organisation has a legal duty to consider the health and safety of their employees and others that could be affected by their work. This includes identifying hazards, assessing the level of risk posed to health and safety, and taking appropriate steps to avoid or minimise the risk, in other words carrying out risk assessments. You need to think through the whole process of pond creation and prepare a risk assessment adapted to each project.

Definition of a construction project

A simple definition of a construction project, when considering if the CDM Regulations apply to your pond project, is ‘any project that involves moving quantities of soil’. This immediately includes all pond creation projects, but shouldn’t be seen as an extra burden as it is considered good practice to follow the CDM Regulations anyway.

Of particular relevance to pond creation projects are the Construction (Design and Management) Regulations (CDM Regulations, see *www.hse.gov.uk*), which aim to help ensure that construction projects are safe to build, safe to use, and safe to maintain.

If a pond creation project falls into the category of 'construction project' (see box), there are a range of steps that should be taken by everyone involved, whether they are the client, contractor or worker. The CDM Regulations do not apply to a domestic client, such as a householder having a pond created on domestic premises, but the Regulations do apply to contractors who work for them on the project. It is good practice to follow the CDM Regulations for all projects.

If construction work lasts longer than 30 days or involves more than 500 person days of construction, there are additional legal requirements. A notification form should be completed and sent to the Health and Safety Executive (HSE), a CDM co-ordinator and a principal contractor must be appointed, a health and safety plan must be in place, and a heath and safety file must be kept as a record of relevant health and safety information and a reference for future works or maintenance on the pond site. More information on the CDM Regulations is available online at *www.hse.gov.uk/construction/cdm.htm.*

There is simple guidance on having a sensible approach to risk management and carrying out risk assessments on the Health and Safety Executive (HSE) website at *www.hse.gov.uk/risk/index.htm*. Regardless of the legal obligations, it is obviously good practice to consider the health and safety of yourself, people working with or for you, and others. Following guidelines and assessing the risks is therefore a useful tool.

Example of good health and safety practice – Lawson's Wetland in Blackpool, Lancashire

Alison Whalley/EA

Crew wearing appropriate Personal Protective Equipment.

This pond site, consisting of six large ponds each measuring over 750 m^2, was created in 2007. Work was predicted to take six to eight weeks, during which time it would be necessary to store machinery and materials on site, for the workforce to be comfortable, and for the general public to be kept safe. Harras fencing was hired to form a secure compound, a portacabin and toilet were hired, the public footpath was temporarily closed and diverted, and information was displayed. All visitors to the site were required to wear high-visibility vests and hardhats whilst large machinery was in operation.

To compile a complete list of potential hazards, walk around the site, think through every stage of the project, and talk to contractors, suppliers and people who have done similar work before. The list below highlights some of the issues that may be relevant when writing a risk assessment for pond creation work. **But please note that health and safety issues and assessments are always site and project specific so this list is for illustrative purposes only; you must carry out your own risk assessment.**

Potential hazards:

- Slips, trips and falls on uneven, sloping or slippery ground, or over equipment and materials.
- Limb or back injury from use of equipment or heavy lifting.
- Injury to staff and public from large machinery.
- Loss of or damage to large machinery on steep or soft ground.
- Exposure of staff to high or low temperatures, strong sunlight or wet weather.
- Diseases associated with the water environment.
- Drowning.

There may be particular concerns where work is being undertaken by community and voluntary groups who may not be familiar with the range of risks associated with the water environment, machinery and tools.

The risk posed to people can often be eliminated or minimised by taking a few simple steps, such as clearly marking and warning people about hazardous areas such as boggy/slippery ground or areas where large machinery is operating, keeping equipment and materials neatly stored, or ensuring everyone is trained and confident in the use of tools and has appropriate protective equipment, e.g. high visibility clothing, footwear, hardhats, gloves, sunblock etc.

Even if you are a private individual carrying out a small project on your own land, going through the risk assessment process is worthwhile and may help you identify issues where perhaps you need to get some help in, or can find an alternative, safer approach.

For more information on health and safety legislation and risk assessments, got to the HSE website at *www.hse.gov.uk*. Find out more about the CDM Regulations at *www.hse.gov.uk/construction/cdm.htm.*

Post-construction safety

Health and safety considerations are a concern not just during the construction phase, but for the ponds' after-use. Give thought to who may access the site when it is complete (e.g. owner, site management staff or volunteers, general public, invited visitors, or trespassers) and what activities may be carried out (e.g. mowing, tending grazing animals, educational visits, recreation), and locate and design the ponds accordingly. Risks may be reduced or avoided through design, providing information, choice of materials, controlling access, provision of equipment, or training and education. It is easier and cheaper to get these aspects right during the planning phase than to address them at a later date.

9. Project Risk Management

There are potential risks to the success of any project, and they will differ for each site and each project (e.g. funding falling through, damage to unknown pipes). Before embarking on pond creation it is advisable to draw up a list of the issues that could pose a risk to your project, and to take action to minimise the level of risk. Because risks are project specific, it is not possible to draw up a definitive list. However by reading through the toolkit you should be able to identify many of the risks involved. Think carefully how they relate to your own project.

10. Finding contractors

Finding the right contractor is critical to the success of a project. Getting recommendations from people and visiting sites that contractors have worked on will help you choose. Similar tactics can help you find other key suppliers.

Be aware that a contractor highly skilled in handling a digger, or experienced in one type of work, is not necessarily experienced in the type of work you want doing. Discussing the details of your project with several contractors, and giving them examples of sites similar to what you want to achieve will help both you and the contractors understand the constraints and key issues involved in your project. If appropriate, accompany contractors on a site visit to discuss your plans. This information could help you plan the project, and draw up a realistic budget.

A typical first stage towards finding a contractor is to prepare a brief for the work required and get tenders/quotes from three or four contractors. Let them know it's a competitive process as this could encourage better prices. Ask for a quote for the whole job rather than a day rate. Confirm that it is the contractor and not you that is responsible if a machine should get stuck or damaged on site, and what insurance requirements there are.

In the brief, include a site plan showing the required work, out-of-bounds areas, where spoil can and cannot go, access points, how the site should be left when the contractors have finished, and any other information or restrictions that could affect how a contractor will be able to work on site. This is so the contractors know exactly what is required, but also importantly so that you can ask for reimbursement if the work is not satisfactory e.g. an ecologically important flush has been buried. Ensure that contractors are notified of any potential hazards to staff or machinery e.g. steep slopes, soft or unstable areas, deep water, power lines.

Confirm responsibilities with the contractor before agreeing a contract, and if there are concerns include them in the contract.

11. Working with volunteers

Involving volunteers in a project has many benefits, but working with volunteers, as opposed to staff or consultants, requires understanding of the pace of work and expectation of what is achievable, what volunteers need to feel motivated and stay involved, selection of suitable tasks, making the most of the contribution volunteers can make (including accessing a wider range of funding sources), and the responsibilities that fall on anyone managing volunteers.

For further information about the Million Ponds Project please visit *www.pondconservation.org.uk/millionponds* or email enquiries to *info@pondconservation.org.uk*

Constructing ponds

MILLION PONDS PROJECT
Pond Conservation

A 50-YEAR PROJECT TO CREATE A NETWORK OF CLEAN WATER PONDS FOR FRESHWATER WILDLIFE

Pond construction can be as simple as digging a hole in the ground, but in most cases there are practical issues that require consideration, and often regulations to follow. Understanding these issues can make a pond creation project easier, safer, and more successful.

What's in this factsheet?

- Managing the phases of construction
- Choice of excavation techniques
- Pond liners
- Dealing with spoil and topsoil
- Responsibilities and constraints
- Documenting pond creation

1. Managing the phases of construction

Starting work on site

Before excavation work starts on site, mark out important areas such as the pond outlines, where heavy machinery can move about, where spoil should be placed, or out-of-bounds areas. Use coloured sprays, stakes, fence posts with rope or hazard tape, or orange safety net fencing to outline areas. Ensure the digger driver has appropriate site plans to work to, perhaps laminated so that they can be kept in the cab of the digger for easy referral.

Hold a site meeting for those involved to talk over the purpose of the project, health and safety issues, everyone's role, the decision making process, and any other key information about the site and project.

On the first day, spend time with the digger driver explaining what you want to achieve and why. Make sure they look out for (and alert you to) likely problems such as field drains which could pollute or drain the pond.

Stay on site with the driver for at least the first few hours of digging to ensure your ideas are understood and being implemented. In many cases contractors will be used to working on ditches or road-building schemes where straight lines and evenly sloping banks are required, and may not easily adapt to the irregular slopes and rough finish of a pond creation scheme (Figure 1).

Continuing work

If you're not always on site yourself, visit regularly during working hours to talk to the on-site staff, check everything is OK, and solve any problems right away. Time visits to coincide with critical points in the excavation. Swap mobile phone numbers with the digger driver so that you can be contacted if issues arise at other times. If it becomes evident that additional works are needed, discuss the time and budget implications and get the work priced first before agreeing to it.

Good communication with contractors is essential

A pond was dug by a digger driver with high level of expertise in using machinery to maintain water courses primarily for flood alleviation. The resulting pond was very neat and tidy, with a perfectly flat bottom and accurately angled batters (sides).

However the purpose of the pond creation project was to encourage a wide range of different pond plants and animals, which required a large drawdown zone and a lot of variation in pond depth. The whole project had been well-planned, but there was not enough communication with the digger driver about the pond design.

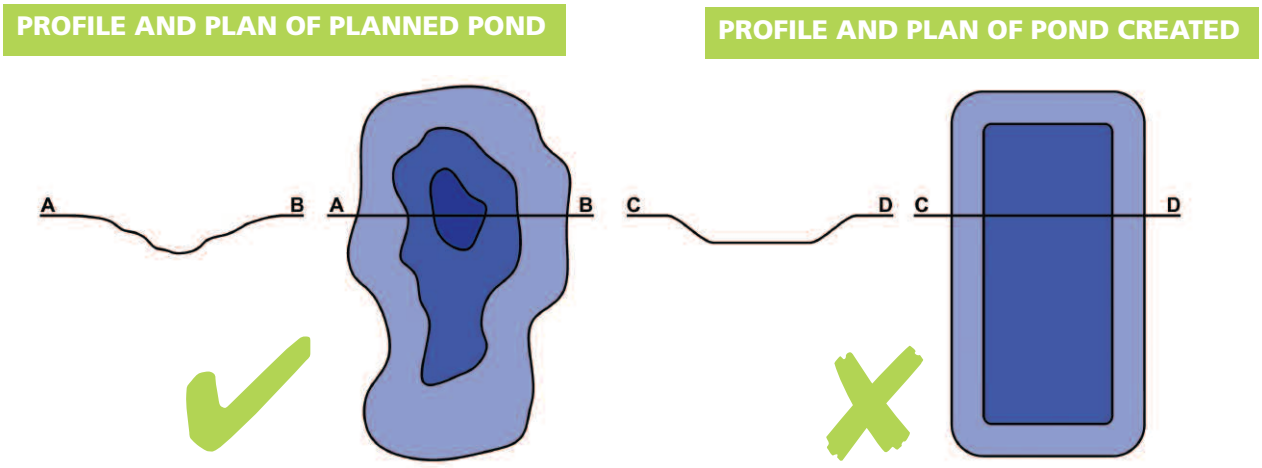


Figure 1. **A pond as designed (left) and as implemented by a contractor with little expertise in digging wildlife ponds (right).**

Completion of on-site works

Check that everything has been done to your satisfaction before signing off. This is easier if you are on site on a regular basis, able to address issues as they arise, and not just to see the end result.

The construction staff should leave the site in good order, but that doesn't necessarily mean perfectly neat. The rough surfaces left by toothed excavation buckets, mounds of dumped or spilled soil, scuffed turfs and wheel ruts can all add to the structural diversity of a site. Even at the micro-scale, such variations can improve the wildlife potential of wetlands.

It is important that key features such as paths and tracks, fences, gates and hedgerows are re-instated or returned to a satisfactory condition, and that all the conditions laid out in any licences or consents are met before signing off the work. If such works were specified in a contract, ensure the contractor has fulfilled all their obligations before they leave the site and payment is made.

2. Choice of excavation techniques

Small ponds with a volume of 1 – 2 cubic metres can be dug by hand by one or two people fairly easily especially where the spoil can be disposed of next to the pond. This can be a good task for a volunteer work party, and can be useful at sites with vulnerable habitats or species, or access issues. Larger ponds will normally require an excavator.

Large projects may also fall into the category of 'civil engineering project' or 'construction project', with implications for planning permission and health and safety requirements. Consultation with the local planning authority and examination of the Construction (Design and Management) (CDM) regulations will help you decide whether your project falls into these categories. For more information, see *Factsheet 6*.

Excavation machinery

Machinery can be hired on a daily or weekly rate, with or without a driver. If you are hiring a driver, bear in mind that, as experienced as the driver may be, they may not be experienced in creating ponds, and will require a detailed briefing on your project.

If you hire self-drive machinery, many companies ask for insurance to cover the value of the machinery whilst out on hire. The machinery needs to be insured by the person in control/custody of the machinery. You can buy a hire-in plant policy for the machine and time period you need. If you hire a driver with the machine, it remains under the control of the hire company and should therefore be covered by the hire company's insurance policy, leaving the responsibility for what happens to the machine in the hands of the hire company. Check this is the case before hiring any machinery.

Types of machinery

Mini-digger – these diggers range in size from 0.25 to 8 or 9 tons. They are useful for digging smaller ponds, trial pits and working under overhead obstacles, but they have a very limited reach and lifting capability. Although mini-diggers can be a cheap and attractive option, it is worth noting that larger machines are generally safer as they are more stable, harder to roll, and have fewer problems on soft ground because their weight is spread over a larger area.

Tracked excavator – these diggers can be anything from a few tons upwards, with a variety of different length arms. The cab and arm turn through 360 degrees, making them versatile and very efficient in excavating ponds and moving the spoil out of the way. They can also lift and move materials, such as rolls of pond liner. The tracks make them more stable on slopes or slippery ground than wheeled machines; rubber tracks cause less damage to hard surfaces than metal tracks.

Wheeled excavator – these machines, also known as 'rubber ducks', are less flexible for pond excavation than the tracked excavators. The wheels mean they can be unsteady, and get bogged down in soft ground.

Bulldozer – if they are already available on site, these can be used for creating very shallow scrapes, but are limited to a forward/backward movement to move spoil around. If spoil needs to be carried away from the pond, additional machinery will be needed.

Wheeled digger – this digger, also known as a 'JCB' or backhoe loader, is good for moving spoil around, but the limited forward/backward motion (the cab and arm don't turn like the tracked excavator) makes them less efficient for pond excavation and detailed landscaping. The wheels mean they can be unsteady on soft ground.

Dumper – these mobile machines, available in a range of sizes, are useful for moving spoil around site. An excavator's progress can be slowed down if it is waiting for a dumper to return, so larger dumpers are generally more efficient. Think about how long it will take for the dumper to make a round journey. Two dumpers that work in relay is often a good solution for longer journey times.

Telehandler – these fast, mobile machines are good for handling rolls of liner and other materials and running them around a site. Using a telehandler leaves the excavator free to dig whilst the telehandler runs materials across the site.

The size of excavating machinery and dumper trucks used can be important issues. Site access restrictions, such as narrow gateways, soft ground, valuable habitats, the space between or under trees, or overhead power lines, will influence the size of machine you choose. Delivery of the machine to site on a low loader could also be an issue – liaise closely with the hire company to identify suitable access points for delivery and collection of the machinery.

The types of bucket used on an excavator will have an impact on the rate of work, and the quality of the results.

Digging bucket – available with or without teeth, this is the best bucket for excavating ponds. The teeth are good for digging and breaking up the ground, and forming a rough surface in ponds that provides a varied micro-topography. Toothless buckets may be more suited to some soil types, especially when it is desirable to form a more compact surface on soils vulnerable to erosion or washing into the pond.

Dyking/dredging bucket – generally a very wide, shallow bucket. It is ideal for moving loose soil around, and dropping spoil back into ponds (necessary for some types of liner), or creating other landscape features.

Trenching bucket – available with or without teeth, this narrow bucket is good for digging narrow trenches for drains etc, but it less useful for excavating ponds.

Excavation methods

Depending on the size and location of the pond, soil types, ground water levels, and the machinery used, there are a variety of approaches to excavation and you should discuss the best strategy with the contractor.

Some ponds, particularly large ponds or sites with high groundwater levels, may start to fill with water during excavation. You will need to have a plan to deal with this, and discussions with the digger driver will be valuable.

If you know in advance that the site will fill rapidly (observed in test pits or other ponds), an appropriate pattern of excavation can be used from the start. For example start excavating the centre of the pond and gradually remove spoil as you work out towards the edge to avoid having to re-work deep areas that have filled with water (Figure 2). This is only suitable for sites where there is good access round the pond perimeter.

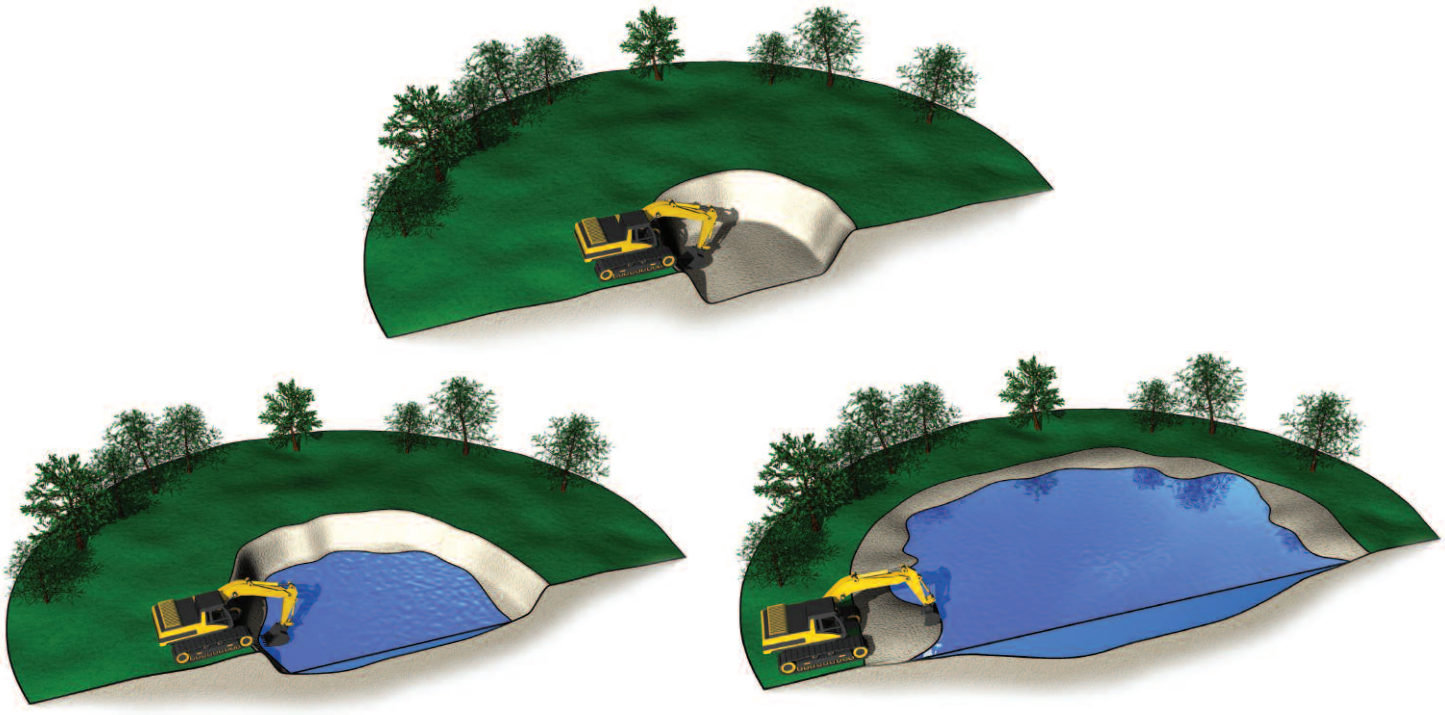


Figure 2. Working a pond from the centre outwards – good for ponds which fill quickly with water.

Water-pumps are sometimes necessary to help excavate ponds. They are usually required for deeper groundwater ponds or in cases where excavations have been left unfinished for some time. Pumps can take up to a few days to drain flooded sites, which can cause additional delay. Care needs to be taken so that terrestrial or aquatic habitats or other properties are not affected by the discharge water, particularly if this water is silty. The last dregs of water from a pond often contain particularly high levels of silt so switch off the pump before it sucks them up. Silty water may have to be pumped into a temporary lagoon, bunded area, settling tank or filter system before it is disposed of. Discharging water into streams, ditches or drains may require a discharge licence from the local authority or the Environment Agency.

Finishing-off the pond margins

Pond creation is not an exact science, and sometimes ponds don't turn out exactly as planned. Usually this is because water levels aren't exactly where predicted.

Bringing back a digger to the site for half a day a year after creation can fix most problems and brings additional benefits:

- Firstly, banks can be modified with the pond now full of water. Using water level as a guide, it's very quick and easy to create pools and hummocks in shallow water areas using a digger (Figure 3).
- Secondly, it's cost effective. The small amounts of excavated spoil (though not topsoil), can be re-used around the site to make hummocks, spits, islands, underwater bars or shallower slopes in the pond itself. See the Factsheet 4 for ideas.

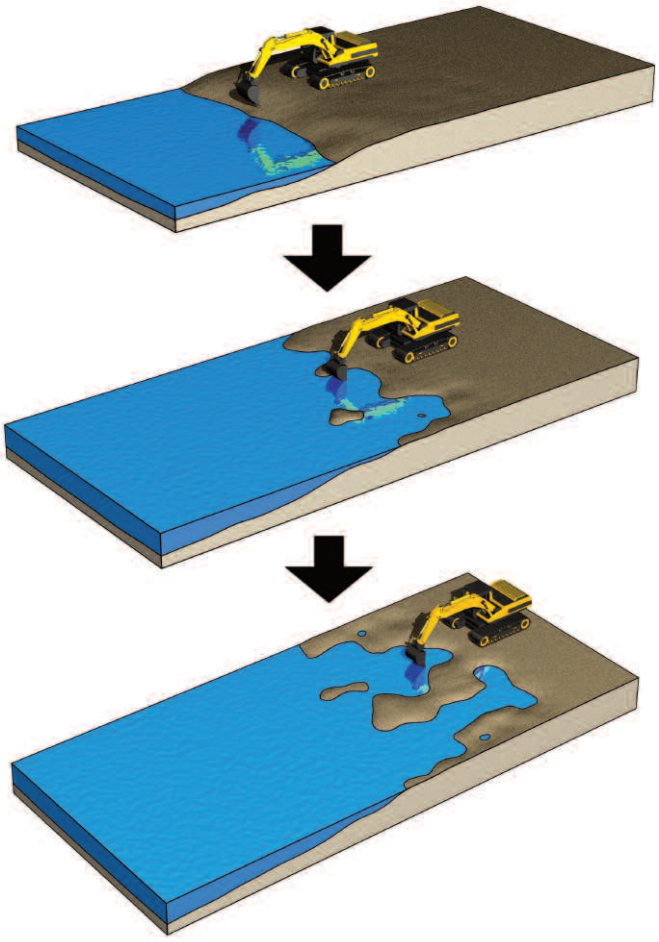


Figure 3. How to improve pond margins after creation. Digger driver works backwards from the waters edge, creating undulating edges and using the water as a natural 'level' to see the shapes made.

3. Pond liners

Pond liners are often not needed to create ponds. The rationale behind the Million Ponds Project is to put clean waterbodies back in the landscape, and the most sustainable and cost effective way of doing this is to make use of natural, clean water sources without the need for pond liners. Reliance on natural hydrology will mean that ponds will have natural fluctuations in water levels. Some may dry up in drier months but this is not a problem for wildlife. Temporary (seasonal) ponds, or ponds with large water level fluctuations, are important for a wide range of wildlife, and a much neglected habitat type.

Practically, though, pond liners do allow ponds to be created on sites where the natural hydrology or geology is unsuitable, or where there is good reason to keep the pond separate from the groundwater, e.g. where groundwater may be polluted such as on reclaimed landfill sites. There are, however, significant drawbacks to using liners: the ponds are more expensive to create, more prone to damage and sudden water loss and have little flexibility if you want to modify the pond at a later date.

Highly permeable and freely-draining soils are not ideal for pond creation, and can require lots of effort or resources to ensure water is retained, even with a liner. For example, the catchment of a lined pond in very permeable substrates like gravels or sands may be restricted to the area that is lined – other water drains straight into the ground. This could result in a pond that holds water only in periods of high rainfall, which can be an excellent wildlife habitat, but will disappoint anyone hoping to create a permanent water body. The catchment could be increased by extending the liner well beyond the pond margin, but it may be more appropriate to look for an alternative site to create a pond (Figure 4).

Information about the range of pond liners available and their merits is given on the *project website*.

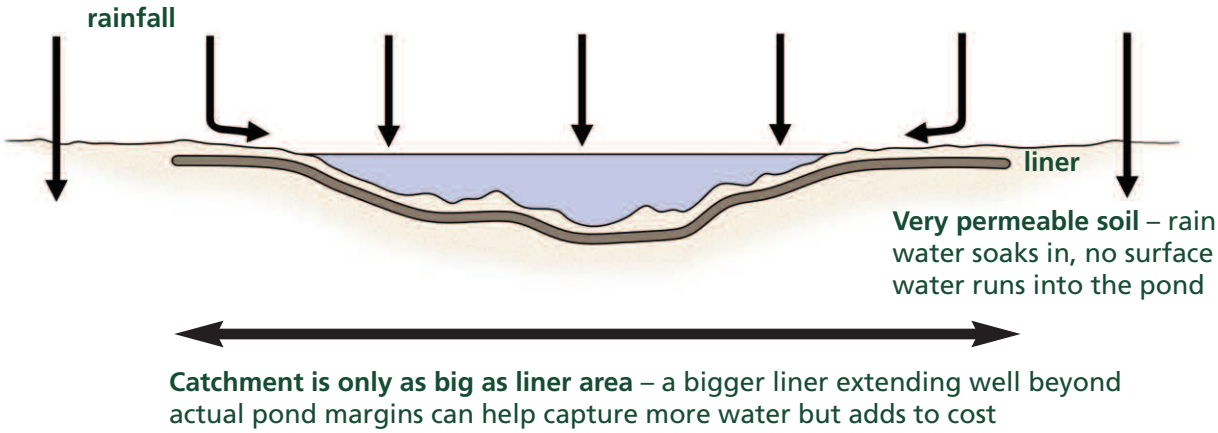


Figure 4. Use of a pond liner on a highly permeable soil.

4. Dealing with spoil and topsoil

It is easy to underestimate the volume and weight of spoil that pond excavation generates, and the amount of time it takes to handle it. So:

- Minimise time and costs by not moving spoil far from the pond wherever possible and using it to create beneficial features.
- Have a sufficient number of suitable vehicles to transport the spoil.
- Ensure the machines use the designated routes identified during the planning stage to transport spoil to minimise any impact to sensitive areas.

Always bear in mind the impact dumped spoil could have on terrestrial and aquatic habitats, and on the success of the ponds being created. For example, do not build a rim or bank around the pond which could interfere with the passage of good quality surface water into the pond, don't use spoil to fill in hollows or depressions which could be of ecological value, and don't spread spoil in areas where is can be washed into ponds or other water bodies.

Topsoil is the dark organic rich soil at the surface, usually it forms a layer somewhere between 5 and 20 cm deep. Topsoil is often added around pond margins to add fertility, but this pollutes pond water, and should be avoided in all areas either in or around the pond, or on its upper banks.

To avoid any enrichment problems, scrape off topsoil from around the pond, and don't store or dispose of topsoil in any areas where it can be washed into the pond or other waterbody. Temporary bunds can be used to contain any run-off from temporary storage piles of spoil or topsoil.

There are more details of dealing with spoil in *Factsheet 6*.

5. Working within responsibilities and constraints

The main issues associated with pond creation should have been foreseen and allowed for during the planning phase of a pond project. The main tasks during construction are to ensure that any necessary licences or consents have been obtained before work starts on site, and that the agreed work plans are followed. If legal requirements are not met, anyone involved in the work may be liable to prosecution.

Some potential constraints

Please read *Factsheet 6* for additional information about taking into consideration these constraints at the planning stage.

- **Designated sites** – some sites (e.g. Sites of Special Scientific Interest and Special Areas of Conservation) are legally protected against a range of harmful operations either on site or on nearby land. Natural England *www.naturalengland.org.uk* or the Countryside Council for Wales *www.ccw.gov.uk* should be consulted well in advance, and any consents obtained before work commences. The agreed work plan should be adhered to; if plans are changed, new consents may be required.
- **Tree felling or pruning** – if the project involves tree work, a felling licence may be required from the Forestry Commission. There are several exemptions from licensing. Check with the Forestry Commission if you think the work is exempt from licensing. Find out more on the Forestry Commission website at *www.forestry.gov.uk*. The local authority should be consulted over trees covered by Tree Preservation Orders or by conservation area designations.
- **Planning permission** – if planning permission has been granted, ensure that the conditions are met, including timing of works and size of excavations. There are implications if the plans are not stuck to, including orders to re-do or un-do any inappropriate or poor quality works at your own expense. If you want to modify plans, consult a planning officer and, if necessary, apply for a modification to planning consent.
- **Health and safety** – the potential risks to health and safety should be identified and assessed in advance, and the necessary precautions, such as fencing off hazardous areas or provision of personal protective equipment, put in place. During construction, look out for new hazards and update the risk assessment as necessary and record and communicate any changes to all who need to know. If the project falls under the CDM Regulations, ensure all the responsibilities are met.
- **Protected species** – licences should be obtained in advance for any work that affects protected species from Natural England or the Countryside Council for Wales. Work carried out without a licence, including site preparation work such as cutting long grass, may be unlawful and result in prosecution. If you want to modify plans, get expert advice and apply for new licences if necessary. If protected species are discovered during construction, work should be suspended immediately and advice sought. It may be necessary to change your plans and obtain a licence.
- **Work in a floodplain** – work within floodplains is likely to require written consent from the Environment Agency. This should be in place before work begins on site. Again, if you want to modify plans, discuss it with an Environment Agency officer and get written consent if required.
- **Services** – ensure plans are in places to avoid or deal with the power lines, drains, gas pipes etc that have been identified on site, but be prepared for the discovery of other pipes or cables, or accidental damage to services. Have all the relevant phone numbers and emergency contact details to hand on site, and if unsure about anything, halt work and get expert advice.

6. Documenting pond construction

It is good practice to keep a record of how ponds were constructed (see box) – this can be very beneficial for the future management of the site, dealing with problems or failures, and helping others undertaking similar projects. Such documentation will also be useful in the unlikely event that regulatory authorities (e.g. local planning authority) question an aspect of the project.

Photographs and annotated plans are an excellent way of documenting the site before, during and after the pond construction work.

Documenting pond construction

Keep a record of the your pond creation project, including:

- the type of materials used
- where materials were sourced
- costs and sources of funding
- timing and time taken for pond creation
- manpower required
- site information
- licences and consents
- surveys and assessments
- plans of drains and utilities
- soil types and hydrology
- Photographs (before construction, during construction and after construction)

When you've created your ponds, contribute to the Million Ponds Project targets: tell us about the clean water ponds you've created on the *project website*.

For further information about the Million Ponds Project please visit *www.pondconservation.org.uk/millionponds* or email enquiries to *info@pondconservation.org.uk*

Managing ponds after creation

MILLION PONDS PROJECT
Pond Conservation

A 50-YEAR PROJECT TO CREATE A NETWORK OF CLEAN WATER PONDS FOR FRESHWATER WILDLIFE

1. Managing clean water ponds

One of the benefits of a clean water pond is that, once made, it should need little management, as long as the site as a whole is adequately managed (see Section 4 and Factsheet 4). In general, the less done to a pond, the better. Although 'leave it to nature' is the main aftercare needed there are a few management tweaks in the first few years that can sometimes be helpful.

2. Things to avoid: planting up

Pond management guides often suggest that new ponds need to be planted up because they are thought to be 'empty habitats' that need a helping hand.

In fact most people who make a new pond are struck by the remarkable speed with which plants and animals arrive. Water bugs and beetles will often fly in within hours, especially in the summer months. Most other insect families (e.g. mayflies, caddis flies, dragonflies) and some annual water plants can become established within the first summer. Flatworms, snails, and submerged plants will usually arrive within a few years.

Within two or three years after a clean water pond is made, it can be as rich as a 50 year old pond – entirely by natural colonisation. More importantly, though, new ponds provide a distinctive habitat type which has its own value and is very different to older ponds.

New ponds are used by a specific range of plant and animal species which either: (a) prefer open bare conditions to live in (b) need inorganic mud and sands to root into, or (c) do not compete well with other species. These 'new pond' plants and animals often disappear after a few years as ponds become more mature.

The new-pond stage is very short compared to the whole life of a pond. It is important not to shorten it further by adding plants or a bucket of sludge from another site to help the pond 'mature' faster. The pond should have centuries in which to mature.

What's in this factsheet?

- Things to avoid: planting up
- Early management
- Temporary fencing
- Managing ponds in later years

Why do ponds attract wildlife so quickly?

The naturalist Charles Darwin originally pointed out the probable reason that ponds colonise so quickly. In 'The Origin of Species' he noted that many freshwater plants and animals were particularly well adapted for dispersal – much better, in fact, than most woodland plants and insects.

Many water beetles and bugs are active fliers, and, as Darwin himself proved, both plant seeds and small aquatic animals are easily moved about on the feet of ducks and other water birds (he bought severed ducks feet from butchers and put them in water to see what hatched out of the mud!).

Darwin and others suggested that the reason many freshwater animals are so mobile is because they often need to move between waterbodies, for example, when one pond fills in and another is created.

2. Early management

Keep an eye on new ponds in the first few years after creation, while their vegetation is still establishing. Bare pond edges are particularly susceptible to colonisation by invasive alien plant species. Plant species to particularly look out for are (Figure 1):

- New zealand swamp-stonecrop (*Crassula helmsii*)
- Parrot's-feather (*Myriophyllum aquaticum*)
- Floating pennywort (*Hydrocotyle ranunculoides*)
- Water primrose (*Ludwigia grandiflora*)

Figure 1. **Parrot's-feather is hard to control once it's established**

If caught early enough, alien plants can be easily removed whilst they are still controllable. Once these plants are established, some can out-compete most of our native plants – including even bulrush. They spread rapidly, leading to loss of plant biodiversity. The cost of getting rid of large areas of invasive plants once they have developed can run to many thousands of pounds – and may not even be possible.

There is much less need to control native plant species that arrive at the pond. However, you might choose to remove bulrush (*Typha latifolia*) if it colonises in the first few years. Bulrush is probably the only wetland plant currently increasing in the UK. The seeds of young plants are very fertile (and there can be over 200,000 seeds in a single bulrush head), so this species can rapidly fill new ponds before other plants have a chance to establish and create a more mixed plant community.

3. Temporary fencing

If wildfowl, stock or people are likely to use the site in considerable numbers, it may be worth protecting colonising vegetation by erecting temporary fencing around part, or all, of the pond. However, in principle, there is nothing wrong with grazing or trampling pressure at a new site. It may take longer for the site to become vegetated, and this may mean the pond edges look bare for longer, but it is not something that is likely to be ecologically damaging – as long large amounts of silt don't erode into the pond.

4. Managing ponds in later years

Well designed clean-water ponds should need little management in later years (see *Factsheet 4*).

Over the decades the ponds will gradually fill with sediment and their plant and animal communities will change. This is a natural process and requires no intervention. Early, mid and late succession ponds are all valuable for wildlife. Ultimately succession produces, usually after hundreds of years, not dry land but temporary ponds or other wetland habitat like bog, fen or wet woodland: all are important, highly threatened and often very long-lived habitat types.

Ponds made by the Million Ponds Project should typically persist in good condition for hundreds to thousands of years – effectively making them permanent landscape features. As older ponds become very shallow and seasonal, rather than dredging to make them deeper again, consider creating a new pond nearby.

Unexpected landuse changes may mean that clean water ponds may require more management than anticipated. If, for example, a planned grazing regime has not been possible, shallow pools and edge areas may develop into marshy wet woodland over the course of a few decades (see *Factsheet 4*). In such cases there are two main options: (a) periodically manage the site to artificially maintain it close to the original state (e.g. control trees, remove vegetation or create new pools), or (b) leave the site to develop in its own way. As long as the site has a variety of pools of different depths and areas, it is likely that even unmanaged the site as a whole will still remain diverse and valuable.

Another reason that pond management may be required is when ponds are being managed for uncommon species with particular habitat requirements (such as great crested newts, or one of the rare bare ground plants). In some cases, periodic management may be required to maintain optimal conditions for these species.

However, considering good pond design and location at the planning stage can make many sites self-sustaining even for rare target species with particular habitat requirements. Consider how natural factors such as grazing pressure, or shade can be used to create the conditions you need.

Think also about pond density: as the number of ponds increases in the landscape, the need for micro-management of individual ponds for a species can often be reduced as the inherent variety of the ponds provides landscape-scale protection.

For further information about the Million Ponds Project please visit *www.pondconservation.org.uk/millionponds* or email enquiries to *info@pondconservation.org.uk*