SUPPLEMENTARY HABITAT FACTSHEET

Designing wildlife ponds in wetlands and reedbeds

MILLION PONDS PROJECT
Pond Conservation

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

1. The value of wetland and reedbed ponds

Wetlands such as fen, carr, marsh, swamp and reedbeds (Box 1) develop anywhere where water remains at or near the surface year-round. They can be found on river floodplains, around springs and seepages, over impermeable bedrock or where salt water flows inland over coastal marshes.

Ponds are an integral feature of wetlands and many species are found within or adjacent to standing open water, from charismatic bird species to the smallest invertebrates. Some of the most species rich areas for aquatic species in wetlands are the pond edge habitats, rather than the uniform stands of reed or deep open water.

Ponds in wetlands form part of a continuum of waterbodies from the river to the smallest flooded hollows. In Europe only a handful of wetlands are still allowed to function naturally in this way (Figure 1), which along with declines in water quality has led to the loss of many wetland plants and animals. This factsheet explains how to create clean water ponds as part of a wetland mosaic.

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Figure 1. A floodplain wetland in Belarus showing the wide range of pond types, from large to small, connected and isolated.

What's in this factsheet?

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'.

2. Design principles for wetland and reedbed ponds

- **Don't connect ponds directly to ditches or rivers.** Inflows carry high levels of nutrients and silts which reduce the quality and lifespan of ponds. Separate waterbodies such as ponds can provide a key resource for many species away from the main ditch system.
- **Design ponds which replicate waterbodies found in wetlands.** New ponds can restore features which have been lost or which have become degraded, such as cut-off meanders, waterbodies with 'ditch-like' profiles and turf ponds.
- **Create a complex of ponds of different sizes, depths and shapes.** Wetlands can be relatively uniform in structure, with extensive stands of single species. Small waterbodies can be created within these habitats to greatly increase the diversity of the site.

Box 1: Characteristic pond types in wetland and reedbeds

The development of any wetland pond is dependent to a large extent on the surrounding habitat. Wetlands can be very different in character depending on the type of flooding, source of water and management - each with ponds supporting their own unique plant and animal communities. Below is an overview of wetland types, but all can co-occur as part of a wetland continuum within the same site.

FENS

HABITAT TYPE

- **Key sites –** Redgrave and Lopham Fen, Suffolk; The Norfolk Broads; Wicken Fen, Cambridgeshire and Cors Bodeilio, Anglesey.
- **Hydrology –** Fens are found in valley basins and are predominantly groundwater fed. Water levels are close to the surface throughout the year. Permanently waterlogged conditions lead to the formation of peaty soils.
- **pH –** Water percolating through mineral rich rocks gives rise to alkaline waters. But fens can also support acid loving species depending on the underlying geology.
- **Nutrient status –** Oligotrophic to mesotrophic.
- **Management –** Grazing and/or cutting.
- **Vegetation type –** Species rich – often dominated by sedges and rushes. Mosses and liverworts form an important component of the community.

POND TYPE

- **BAP pond species –**Important for many rare and declining species, e.g. Norfolk Bladder-moss *Physcomitrium eurystomum*, Fen Orchid *Liparis loeselii*, Fen Violet *Viola persicifolia*, Fen Raft Spider *Dolomedes plantarius* and many others.
- **Pond features –** Small waterbodies created as a result of small scale peat digging (Figure 2). A practice which has largely ceased but which is easily replicated to create new pond habitat.
- **Pond creation –** A sensitive and vulnerable habitat but opportunities for small-scale pond creation especially following scrub removal and stump pulling. Create ponds on rotation to produce early and late successional habitats.


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Figure 2. A small turf pond on Redgrave and Lopham Fen home to Great Fen Raft Spider.

SWAMP AND REEDBED

HABITAT TYPE

- **Key sites –** The Cheshire Meres, Cambridgeshire's Fenland, Dungeness in Kent, The Norfolk Broads, Minsmere, Suffolk and Slapton Ley, Devon.
- **Hydrology –** Water table at or above surface for most of the year.
- **Nutrient status –** Oligotrophic to naturally eutrophic.
- **Management –** Grazing at very low density or cut. Where there is no management swamp may form as a transitional habitat on a gradient from open water to carr woodland.
- **Vegetation type –** Dominated by single species e.g. Great Fen Sedge *Cladium mariscus*, Reed Sweet-grass *Glyceria maxima*, Branched Bur-reed, Reed Canary-grass *Phalaris arundinacea*, Common Reed *Phragmites australis*, tall sedges *Carex* spp., club-rushes *Schoenoplectus* spp. (Figure 3).

POND TYPE

- **BAP pond species –** Tall herbs including, Tubular Water-dropwort *Oenanthe fistulosa* and Greater Water Parsnip *Sium latifolium*, Zircon Reed Beetle *Donacia aquatica*, Reed Bunting *Emberiza schoeniclus*, Bittern *Botaurus stellaris* and Otter *Lutra lutra*.
- **Pond features –** Shallow water bodies will quickly be covered by stands of dominant grass, sedge and rushes. Deeper water >1m in small or large waterbodies can be very species rich, with a narrow emergent zone but many floating-leaved and submerged species.
- **Pond creation –** In areas with uniform stands of tall emergent plants and on the margins of reedbeds. It is important that not all ponds are connected to ditches.


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Figure 3. Bladderwort carpeting a reedbed pond at Woodwalton Fen. Also important habitat for Reed Bunting.

MARSH

HABITAT TYPE

- **Key sites –** Pevensey Levels, Somerset Levels, Avon Valley, Norfolk Broads and the Essex Marshes.
- **Hydrology –** Marshes are inundated areas fed by groundwater, surface water or both. Water levels usually fluctuate seasonally and flooding may occur. The ground is not permanently waterlogged and therefore it's not as peaty as fens.
- **Nutrient status –** Mesotrophic.
- **Management –** Grazing at low stocking densities will create a varied but tall grass community. Moderate stocking densities produces a more open, short, wet grassland habitat.
- **Vegetation type –** Emergent herbaceous vegetation, commonly dominated by grasses, sedges and reeds, but with an important herb rich community (Figure 4).

POND TYPE

- **BAP pond species –** e.g. Marsh Stitchwort *Stellaria palustris*, Lesser Water Measurer *Hydrometra gracilenta*, Desmoulin's Whorl Snail *Vertigo moulinsiana* and water vole *Arvicola terrestris*.
- **Pond features –** Shallow ponds with gently shelving margins which allow grazing animals access to the entire pond basin.
- **Pond creation –** A feasible option in many unimproved and semi-improved grasslands.


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Figure 4. Marsh Stitchwort in a pond in species rich grazing marsh - Foxlease, Hampshire.

CARR AND WET WOODLAND

HABITAT TYPE

- **Key sites –** The Meres in Shropshire, Wybunbury Moss in Cheshire and the Norfolk Broads.
- **Hydrology –** Water levels above the surface for most of the year. In late succession habitats, ponds may become temporary as the site dries out.
- **Management –** Occasional grazing at low stocking densities can slow down the rate of succession.
- **Vegetation type –** Succession of wetland types leads to areas dominated but water tolerant trees such as willows *Salix* spp. and Alder *Alnus glutinosa*. The understory may be formed of tall-herb fen or large tussock forming grasses (Figure 5).

POND TYPE

- **Important species –** This is a rare and often overlooked habitat which is important for many shade tolerant plants such as Least Bur-reed *Sparganium natans* and Marsh Fern *Thelypteris palustris*. It is also important for many invertebrates including the ground beetle *Agonum scitulum* and species such as Otter and bats.
- **Pond features –** Late succession temporary ponds are very valuable, especially where there is a transition from open water to woodland, or some wooded and some open ponds. If all ponds are in a state of late succession new ponds should be created in open areas to provide continuity of pond habitat in the future.
- **Pond creation –** Mimic ponds which have been created as a result of tree fall in wet woodlands. This is often possible in floodplain restoration schemes.


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Figure 5. Carr in the Meres, Shropshire.

3. Case studies: Opportunities for pond creation in wetlands and reedbeds

Wetlands such as fens and marshes can have very high biodiversity value. Opportunities for pond creation on these sites may be limited, especially where sites are small. Pond creation should enhance and not replace existing wildlife value. However, there are many places where it is possible to create ponds in wetlands.

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Figure 6. Restoration of fen habitat, Anglesey - uniform areas of species poor habitat provide opportunities for pond creation.

Dominant stands of a single species

On large wetland sites, with dominant stands of single species, pond creation will add to the diversity of the site.

- At Ham Wall, RSPB reserve, Somerset the diversity of a 100ha reedbed has been increased by the creation of small ponds to provide important habitats for aquatic plants, amphibians and birds.
- In Anglesey, the Countryside Council for Wales is restoring parts of the Cors Bodeilio fen through a programme of ditch blocking and reinstatement of grazing management. This provides opportunities to create ponds in areas of currently uniform habitat (Figure 6) to support important populations of Fen Pondweed *Potamogeton coloratus* and Dwarf Stonewort *Nitella tenuissima*.

Wetland creation schemes

On new sites where wetland creation is the main conservation objective, e.g. following mineral extraction, a clean slate is available to include smaller water bodies in the design plans.

- The Eye Landfill site, Peterborough (Biffa Waste Services Ltd), is located on old mineral workings. As part of a mitigation plan to increase the area of landfill, 20 waterbodies were created for Great Crested Newt *Triturus cristatus*, Water Vole *Arvicola terrestris* and Grass Snake *Natrix natrix* (see the *Aggregates Toolkit Case Study* for more information).

Wetland restoration schemes

Restoration of degraded wetland habitats. Many sites have suffered from drainage, agricultural enrichment and a lack of management, but plans are in place in many areas to restore them to their former glory. Restoration plans can include pond creation even in habitats with high wildlife value.

- The Great Fen Project, Cambridgeshire, is a partnership project to create 3,700ha of wetland to link two important fens, Woodwalton Fen and Holme Fen. Creation of a network of waterbodies between these sites will remove the barrier that arable land currently presents, allowing species such as Fen Violet *Viola persicifolia* and Shining Ram's-horn Snail *Segmentina nitida* to disperse to new habitats.

Species conservation work

In sites where traditional management practices have ceased, the age and structure of ponds may become unsuitable for the needs of rare pond species. In these sites it may be worth considering pond creation even in areas with high biodiversity value. Fortunately many rare pond species thrive in very small ponds, some less than $1m^2$, making it possible to create new ponds without damaging the overall value of the site.

- Creation of ponds by Suffolk Wildlife Trust at Lopham and Redgrave Fen for the Fen Raft Spider *Dolomedes plantarius* is helping to secure the survival of this species, which is known from only three sites in the UK. New ponds mimic the small deep ponds created as a result of digging turf and enhance the existing value of the site.
- Sutton Fen, Norfolk is an extensive area of species rich fen, managed by the RSPB. Alder trees were encroaching onto part of the site and a plan to remove them provided opportunities for pond creation. Stump pulling has created many small ponds ($<5m^2$), which replicate the ponds created in the 18th and 19th Century by small scale peat digging.

4. Wetland pond designs

Pond location

The key to creating wildlife rich ponds is to ensure that they have clean water, shallow edge habitat and are part of a dynamic wetland mosaic. Land-use and management in the pond catchment (the area that the pond drains) will have a huge influence on water quality.

- Locate ponds in semi-natural catchments: e.g. in areas surrounded by low intensity grasslands and woodlands.
- Ponds created close to (but not replacing) areas with high conservation value will have more species and more scarce species than ponds surrounded by species poor habitats.
- Create some ponds on the edge of reedbeds to provide open conditions and others in the centre of the reedbed to provide shelter and seclusion for shy wetland birds.
- Wetland ponds are often connected to the river or ditch network. However, today when most ditch systems are highly polluted the best option is to avoid direct links (Figure 7).

Figure 7. To connect or not to connect? The advantages and disadvantages of connecting ponds to ditches, streams and rivers.

	Unconnected ponds	Pond connected to the river
Water quality	Isolated ponds fed by surface water or groundwater, draining from unimproved habitats, e.g. heathlands, woodlands and low-intensity grasslands will have clean water and can support rich plant and animal communities, including both common and rare species.	Ponds connected to the river or ditch network tend to have poor water quality because of pollution and high levels of nutrients in UK rivers. This will reduce their biodiversity value and many rare species will not be able to survive.
Refuges	Unconnected ponds provide a refuge for species such as Water Vole when rivers and ditches flood. Many wetland species (e.g. Eels and some aquatic snails) are capable of crossing some distance on land and can thrive in isolated permanent ponds.	Ponds connected to the river provide important nursery sites for fish. In wetlands it is important to provide both connected and isolated ponds as part of the mosaic of waterbodies to benefit the greatest range of species.
Dispersal	In the winter, groundwater levels rise and may create a sheet of water between adjacent ponds and wetlands, allowing species to disperse whilst maintaining good water quality. Grazing stock and birds can also provide connectivity, moving seeds and spores between ponds.	Direct connection to the river can help in the dispersal of many wetland species, but it is not generally necessary and the benefits of direct connectivity for dispersal are outweighed by the need for clean water.
Water levels	Shallow, isolated ponds may dry out. These ponds are important habitat for many rare species. Target species which need permanent water can be provided for by creating pond complexes with a range of sizes and depths.	Linking ponds and wader scrapes to rivers, streams or ditches can help maintain water levels for longer into the summer. In addition to habitat created for wetland birds provide isolated ponds for a greater range of pond plants and animals.

Pond size

It is not possible to be prescriptive about pond sizes in wetlands and reedbeds, as ponds of all sizes and shapes will work. But there are a number of issues which are worth considering.

- **Create a complex of ponds of different shapes and sizes.** This will maximise the wildlife potential of the site and allow species to move between waterbodies as conditions change.
- **Create ponds which are suitable for the target species.** This will probably be based on the historical use of the site and the management practices or hydro-geological features which originally lead to the formation of ponds, even if these processes are no longer underway.
- **If sites are not grazed,** small shallow ponds will become completely dominated by tall emergent plants in as little as 5 years. These small features can have fantastic wildlife value so if this is the case, plan a rolling programme of new ponds to provide a range of pond ages.
- **In unmanaged sites** the habitat will eventually develop into carr woodland. Create some **large shallow ponds** to ensure that some open water remains beyond the tree canopy (see *Supplementary Habitat Factsheet: Woodland ponds* for information).

Pond profiles

As noted above, it is difficult to be too prescriptive about the design of wetland ponds. But, there are a number of design features which can help to enhance the pond for wetland wildlife.

- **Gentle undulating margins.** The first 10cm of water depth is the most important habitat for pond plants and invertebrates. Aim to maximise this habitat with a bank angle less than 1:20 (3°).

  Shallow margins will encourage grazing animals to browse emergent vegetation which will increase the diversity and structure of pond plants. They also create patches of bare muddy ground in the drawdown zone (the area wet in winter and dry in summer) which is an important habitat for many invertebrates and provides the necessary space for many wetland plants to germinate and grow (Figure 8).

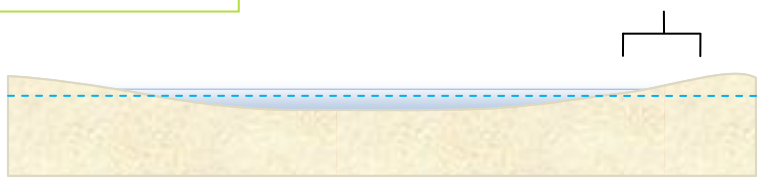
Figure 8. Designing the drawdown zone in wetland ponds

To maximise the width of the drawdown zone and to ensure that summer water levels remain close to the soil surface, the pond margin must be as shallow as possible.

Narrow drawdown zone

Good for many pond species but could be better

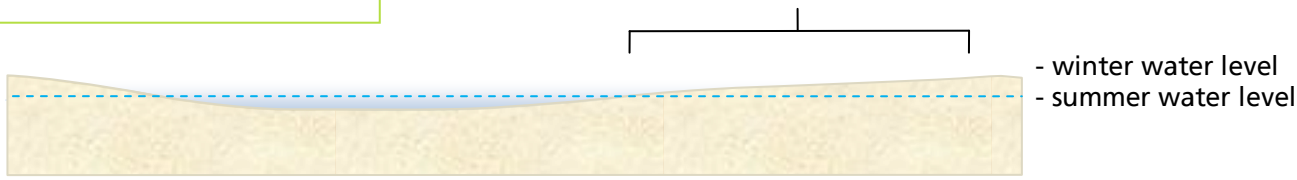
1 in 10 (5°) – a drop in height of 10cm between summer and winter water levels gives a drawdown zone of just 1m



Broad drawdown zone

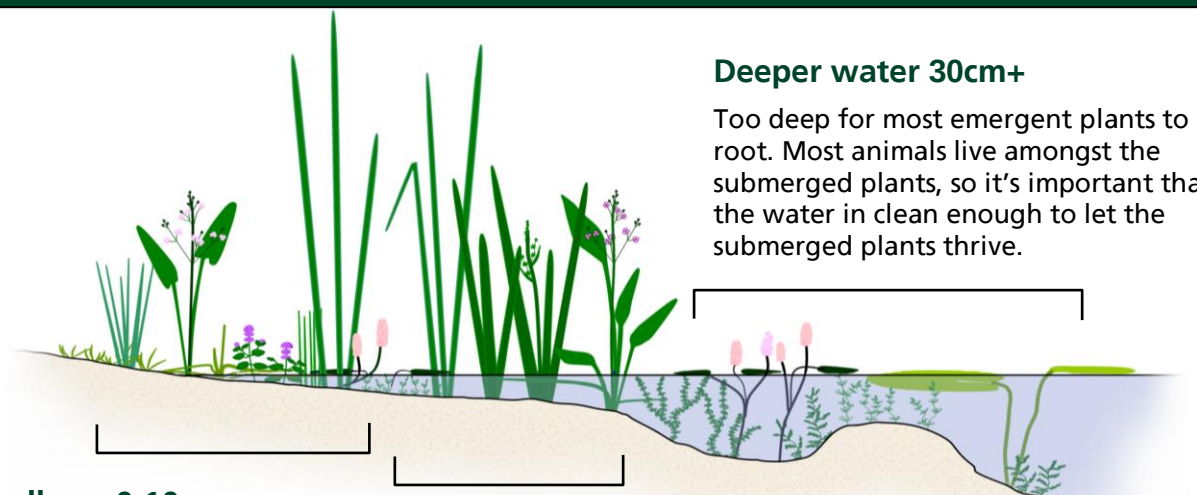
Optimum habitat for emergent plants and pond edge invertebrates

1 in 20 (3°) - a drop in height of 10cm between summer and winter water levels gives a drawdown zone of 2m



- **Shallow ponds.** Ponds don't need to be deep. After you've maximised the shallows (<10cm deep) keep the rest of the pond relatively shallow. Submerged and floating plants are happy in water depths up to 30cm. Beyond this, few emergent plants will grow and unless water quality is very good the water will be too cloudy for any submerged plants to take hold (Figure 9).

Figure 9. Pond margins should be shallow and undulating to maximise the habitat for freshwater plants and invertebrates.



Deeper water 30cm+

Too deep for most emergent plants to root. Most animals live amongst the submerged plants, so it's important that the water in clean enough to let the submerged plants thrive.

The shallows 0-10cm

This is the richest part of the pond. Many animal species are only found here, living amongst the low submerged grasses and wetland herbs at the water's edge.

Mid-depth 10-30cm

Tall marginal plants often dominate here, though submerged and floating plants are happy too.

- **Deeper ponds.** In reedbeds and ungrazed marshes create some deeper water to help limit colonisation by tall dominant grasses and sedges across the entire pond surface. Emergent plants such as Common Reed *Phragmites australis* will generally not grow in water >1m deep, though in some cases Common Reed can grow in floating rafts across the surface.

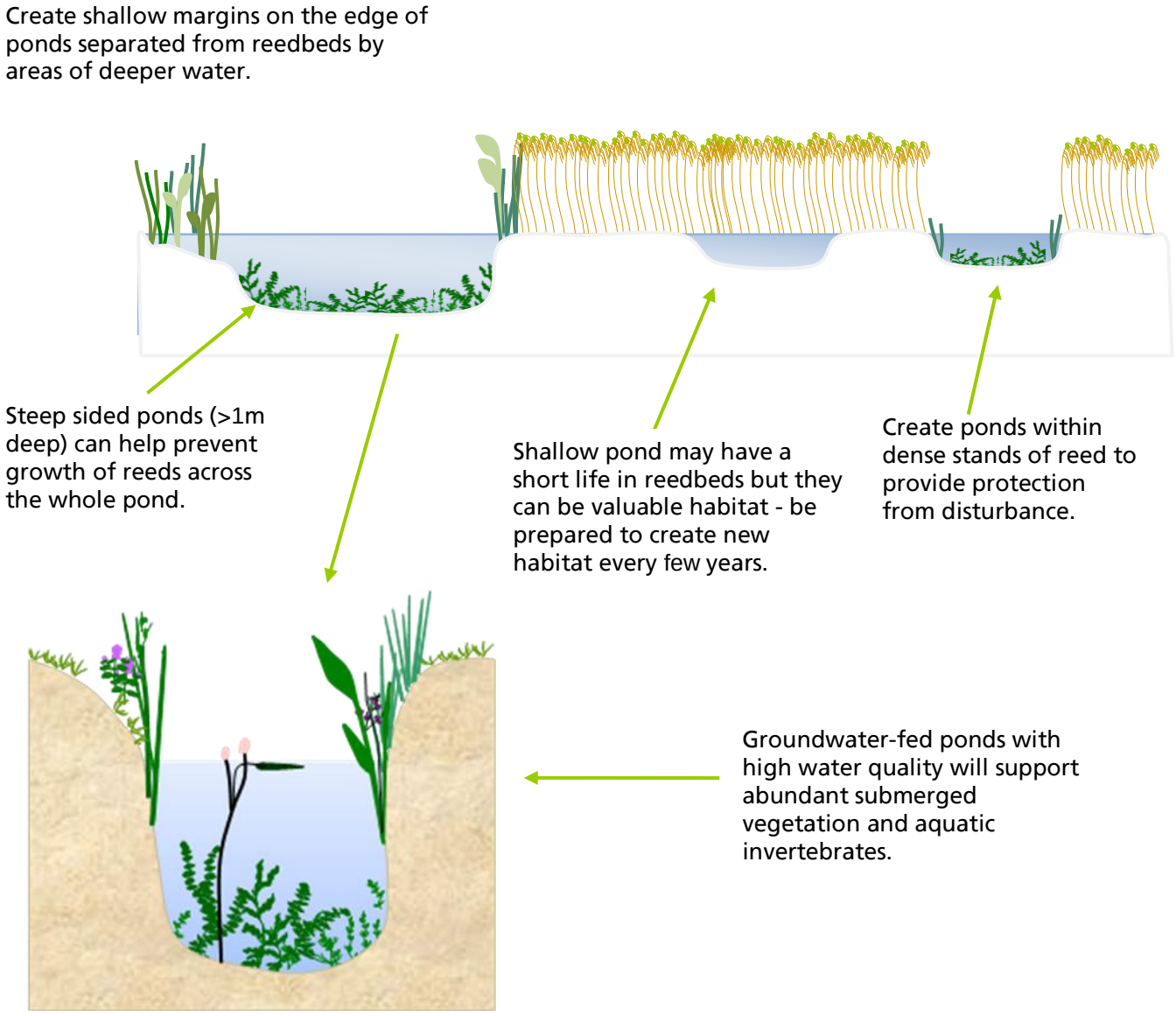
  Creating deeper ponds in low intensity catchments will ensure that they have high water quality. Clean deeper water may support submerged plants and floating wetland plants such as Water Soldier *Stratiotes aloides* (Figure 10).

  Ponds with a 'ditch-like' profile (Figure 11) will support species which are not found in more conventional pond designs. Steep muddy banks will be used by Water Vole *Arvicola terrestris*, White-clawed Crayfish *Austropotamobius pallipes* and European Eel *Anguilla anguilla*, all of which like to burrow into soft sediments below the water line to avoid predators.

  However, in wetlands and reedbeds it is the edge habitat between terrestrial and deeper water which will have the greatest value for wetland pond plants and animals. So concentrate on maximising the amount of edge habitat.

Figure 10. Water Soldier *Stratiotes aloides* at Potter Heigham Marshes, Norfolk.

Figure 11. Pond profiles for ponds in reedbeds



Wetland pond complexes

Waterbodies in naturally functioning wetlands are highly variable and dynamic. So to replicate this create a complex of ponds of different profiles, sizes and degrees of connectedness to the ditch network.

There is no one rule which will fit all sites - the best option is to remain flexible and create as many different pond types on the site as possible, to maximise its value for wetland pond species.

Think about the bigger picture – ponds can provide useful stepping stones between wetlands to increase connectivity across the landscape.

7. Management for wetland and reedbed ponds

Well designed ponds need little additional management. The greater the number of waterbodies the less need there is to micro-manage individual ponds. But there are a few things to think about once the pond creation scheme has been completed.

- **Don't plant up wetland ponds.** They develop very quickly without help and many species e.g. stoneworts (see the *Stoneworts Species Dossier* for more information), need the bare ground habitat available at the beginning of a ponds life to germinate and grow.
- **Manage people on wetland sites.** Wetlands are very sensitive habitats and many wetland species cannot tolerate disturbance from dogs or people. Use strategic pathways and boardwalks to channel people away from sensitive areas.
- **Look out for invasive non-native plants** as they will quickly spread in wetlands, especially if waterbodies are connected during winter flooding. Remove them as soon as they appear because once established they are very hard to eradicate, especially in sites with stands of dense emergent plants.
- **Grazing using low stocking densities** will be the most effective management technique for ponds in fen and marsh habitats. Harder grazing for short periods may be required for some species to reduce the dominance of reed monocultures. Additional scrub clearance may be required in some years to reduce the spread of woody vegetation.
- **In reedbeds, cutting may be a more practical and traditional technique** than grazing to manage large stands of reed. Late summer management will suppress reed growth, whilst winter management will encourage growth the following year.

7. Further reading

This factsheet covers a broad range of wetland pond types, but it is worth noting that ponds within the river floodplain have specific issues due to the proximity of the river. To address these issues we have created a separate *Supplementary Habitat Factsheet: Creating wildlife ponds in the river floodplain*. We recommend that you refer to this factsheet and the other advice sheets in the *Pond Creation Toolkit* for more information.

Specialist species often have specific habitat requirements. The *BAP Species Map* gives a summary of the requirements and distribution of BAP pond species. *Species Dossiers* are also available in the *Pond Creation Toolkit*, giving detailed pond habitat designs for key Priority Species.

Other useful sources of information:

- Hawke, CJ. and José, PV. (1996) Reedbed Management for Commercial and Wildlife Interests. RSPB.
- Nottage, AS. and Robertson, PA. (2005) The Saltmarsh Creation Handbook: A Project Manager's Guide to the Creation of Saltmarsh and Intertidal Mudflat. RSPB.
- RSPB (1997) The Wet Grassland Guide: Managing Floodplain and Coastal Wet Grasslands for Wildlife. Eds. Treweek, J., Drake, M., Mountford, O., Newbold, C., Hawke, C., Jose, P., Self, M. and Benstead, P. RSPB.
- RSPB: Bringing reedbeds to life www.rspb.org.uk/ourwork/projects/details.aspx?id=tcm:9-210865
- The Wetland Vision www.wetlandvision.org.uk/dyndisplay.aspx?d=home

For further information about the Million Ponds Project and to consult other factsheets in the Pond Creation Toolkit, please visit *www.pondconservation.org.uk/millionponds* or email enquiries to *info@pondconservation.org.uk*

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