



So you're thinking about a pond...

A guide to the design, management and consent requirements for landowners

Quality for Life



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Ponds can be an interesting and attractive feature on a property – but it's easy to overlook the important features that are essential for their long-term success.

Common problems with ponds include bad smells, insect plagues, algal blooms, aquatic weed infestations and pest fish. In addition, poorly sited and designed ponds can destroy habitat, degrade water quality and damage streams and wetlands.

This guide provides an overview of the issues and problems faced by people constructing artificial ponds. It gives some direction on how to plan and design a healthy pond and how to maintain these naturally dynamic systems. It also provides advice on getting a resource consent. Depending on what you're planning, you may need specialist ecological and engineering advice.

If you already have a pond you'll find advice here on how to improve water quality, appearance and safety. This guide does not cover stormwater or effluent treatment.



This person is planting a submerged species (common water millifol) next to a rush (wivi).

Photo: Copyright Christchurch City Council

How your pond works



Lots of nutrients in a pond encourage algae to grow in the water. Too much algae can turn the water green, brown, yellow or even red. When this happens, the pond is said to have an algal 'bloom'. This is not good because the algae will eventually die and rot using up all of the oxygen in the pond. This can suffocate fish and other pond life.

Ponds are very sensitive to outside influences, especially the quality of water flowing through them and the nutrients and organic material being washed or blown into them.

The ideal pond has clear cool water, low nutrient levels and lots of large leaved aquatic plants.

However, over time the gradual build up of nutrients and organic matter washed into the pond can lead to too much plant or algae growth. When this dies and rots it kills animal life by depriving it of oxygen. This process is called eutrophication and is bad for the health of the pond. Eutrophic ponds have cloudy and dark coloured water with low oxygen levels, thick stagnant sediments and lots of algae.

Healthy pond with good water quality	Unhealthy pond with poor water quality (eutrophic)
low nutrient levels in water	high nutrient levels in water
clear water	cloudy, dirty looking water
cool water	warm water
lots of native aquatic and wetland plant species	infested with pest aquatic plants or algae
no build up of sludge	build up of nutrient-rich, smelly, oxygen depleted sludge at the bottom of the pond

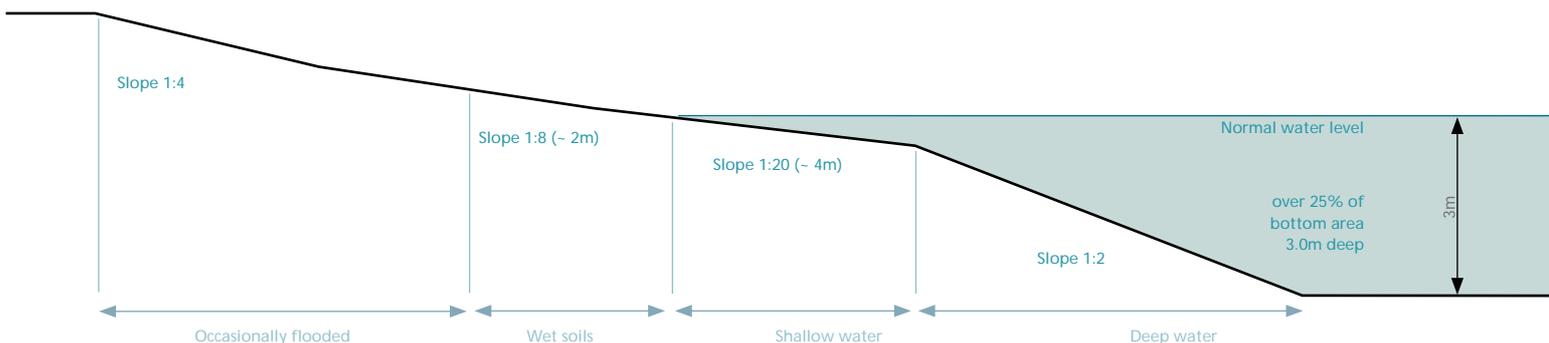
Once a pond becomes unhealthy (eutrophic) it is very difficult to get it back to a healthy non-eutrophic state. The only remedy for persistent algal blooms or aquatic weeds may be dredging, flushing, replacing the sediments and replanting. That's why well designed ponds are isolated from sources of nutrients and pollution. It's vital that stormwater or waste is not discharged into your pond – stormwater and waste should be treated by specially designed treatment wetlands.

How to design a good pond

Step 1: What is your pond for?

The first step in designing a healthy pond is to decide why you want a pond.

Some ponds are strictly ornamental water features, while others are put to work, providing storage for flood management, water for livestock, hazards for golf courses, habitat for native fish and wildlife, places for ducks and other waterfowl, storage for fire control or for crop and orchard spraying.



Your pond should be designed primarily to meet its intended use and then other functions can be considered if they do not conflict with the pond's primary purpose. For example, if you're designing a pond for ducks, you'll need plenty of shallow water areas where the birds can feed. But bear in mind that raupo can colonise these areas so you will also want some deep areas. If you're designing the pond for native fish, you'll need rocks and dense overhanging vegetation to provide shade and let the fish hide under.

Regardless of your pond's main function you need to consider how to prevent the pond becoming eutrophic or infested with exotic weeds.

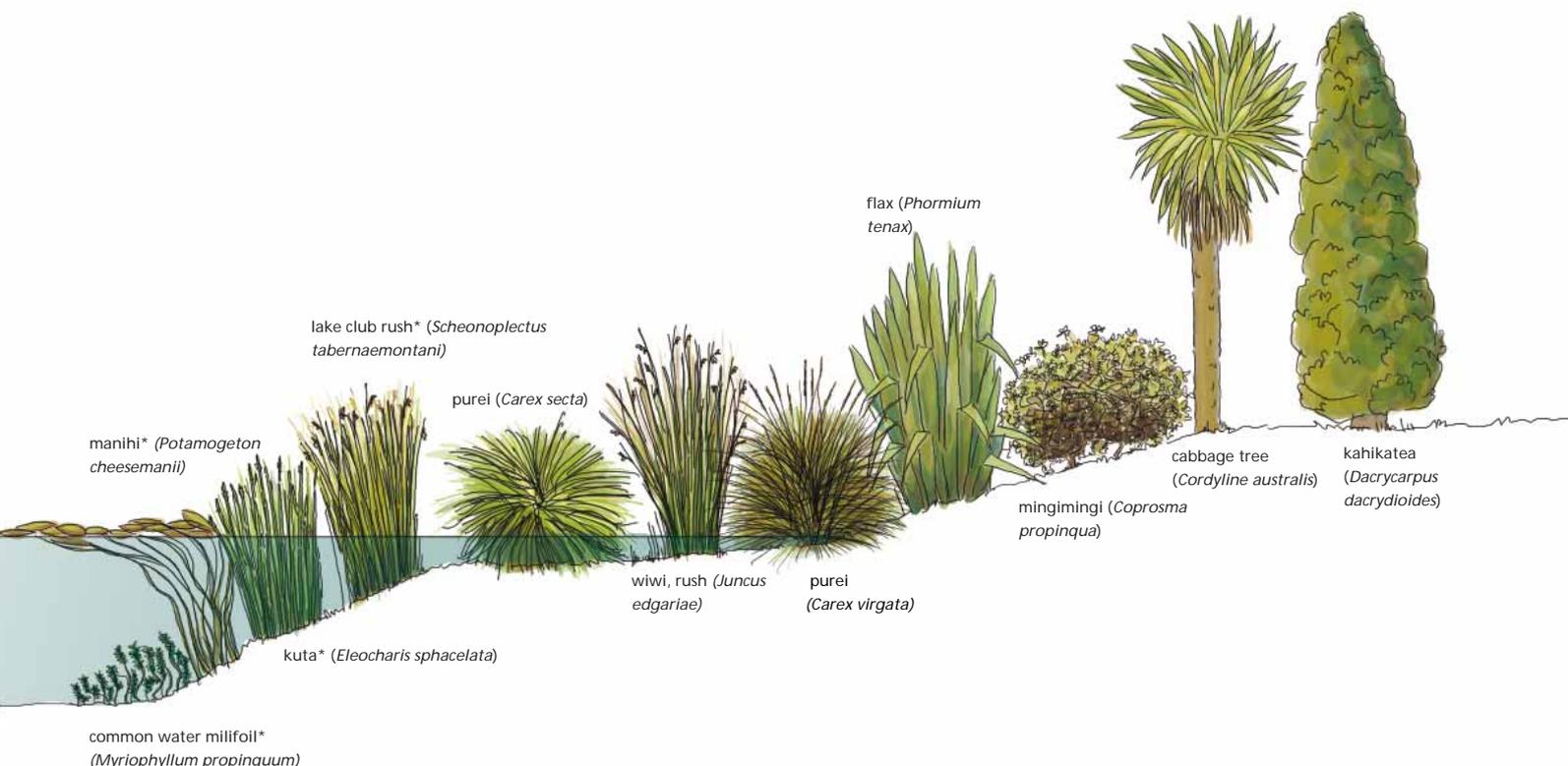
Step 2: Evaluate your site

The second step in designing your pond requires an understanding of the water catchment – stream flows and ground water table, seasonal variation of water supply and the underlying geology. This will tell you if the pond will hold water, maintain a desired depth and if there is any risk of future water quality problems.

You'll probably need specialist advice at this stage. This advice will tell you if your pond needs a special fabric or clay lining. You will also need to investigate the influence of the surrounding land and how this affects nutrient and sediment run-off. Look under 'environmental consultants' in the Yellow Pages or on the internet.

Streams are good sources of water for ponds, but avoid creating ponds by damming streams because this can harm stream life - including fish. It is better to divert some water from a stream to feed the pond – but keep the pond some distance away from the stream.

Don't create a pond by excavating material from existing natural wetlands unless you are restoring a degraded wetland area. There are very few wetlands left that support native plants and animals and these should not be disturbed unnecessarily. We can give you advice and assistance for managing wetlands – check out www.gw.govt.nz/wetlands or ring 04 384 5708 or 0800 496 734.



* available from specialist nurseries, or they can be collected, with landowner permission, from established ponds.

Step 3: Follow the key design rules

Every pond is unique, varying in size, depth, vegetation, substrate, nutrient status and water flows. However, there are some key rules to design a sustainable pond.



The plant pest in this pond (hornwort) was spread by machinery. Before pond construction, make sure all machinery is clean.

Pond shape and depth

- Create gently sloping irregular shorelines. This will extend the belt of reeds and rushes growing around the water's edge.
- Design margins and shallows so that they include a diversity of habitats. Options include logs, boulder outcrops, dense vegetation, gravel beaches and hard edges that alternate with wide wetland margins. A combination of different edge types is visually more attractive and offers more diverse habitat for plants, fish and birds.
- Try and have some areas in your pond that are at least three metres deep. This will provide sufficient volume to stop the pond heating up in summer, and also prevent colonisation by raupo.
- Expose your pond to wind. Consider the prevailing wind direction and where tall trees and shrubs are planted. Wind will help oxygenate the pond and promote mixing of surface and subsurface waters.
- Design your pond so that it can be drained. This will help establish plants (it's easier to establish plants when water levels are low and then raise the water level later) and also if you need to deal with any weeds or pest fish in the future.
- To help reduce inputs of nutrients and debris, contour the pond margins to direct surface run-off away from the pond, especially if fertiliser is used on surrounding land. If this cannot be done, a wide vegetated buffer will filter some overland flow.
- Please consider appropriate disposal of overburden if you are excavating a pond. Dumped overburden next to a pond will cause weed and sedimentation problems.

Water source

- Consider engaging an expert to develop a 'water budget' which measures all water inflows and outflows. This will help show if there is sufficient water to sustain your pond. This may involve up and down gradient wells outside the wetland and water level gauges in the wetland.
- Water entering the pond needs to be clean and unpolluted. You may need to get specialist advice on how to treat polluted water before it enters the pond. Your consultant may suggest wetland or infiltration systems, swales¹ or vegetated buffers.
- Flood flows should bypass the pond system as they can fill the pond with rubbish as well as sediment, organic matter and nutrients.



Water edge plants are generally planted in spring or summer when water levels are lower and water is warmer. The kukuraho in the photograph are growing beside a river mouth on the Kapiti Coast.

Structures and safety

- Minimise the risk to people, especially to children. Dense planting around the pond will discourage children from entering the water. A shallow slope into the water along some of the margin will make it easier to get out, should anyone fall in.
- If your pond is formed by a dam or embankment, it will need to be designed by an engineer to make sure it is safe.
- Convenient access for inspection and maintenance of inlet and outlet structures is essential.

¹A swale is a shallow, seasonally wet drain that is usually heavily vegetated. Swales improve the quality of water flowing through them.

Plants

- Use locally sourced native species if you can. Avoid non-native plants unless you are sure they are not weeds which can spread and cause water quality problems. Never dump aquarium plants into your pond – many are invasive and will quickly take over. The National Centre for Aquatic Biodiversity and Biosecurity has information about what plants to use and what plants to avoid. Visit their website at www.niwascience.co.nz/ncabb. Also check out what to plant at www.gw.govt.nz/wetlands.
- Plant a buffer of native vegetation of at least 3 metres around all or most of the pond margin. This is especially important if the pond is on a farm or horticultural area – because the plants use nutrients to grow so they don't end up in the pond.

Plant type		Description
Submerged		Submerged plants are rooted or free-floating plants that grow completely underwater, such as the native water milfoil (<i>Myriophyllum</i>). These plants are just as important for pond health as are more visible plants. Submerged plants assist greatly in maintaining water clarity, stabilise pond sediments, provide habitat for aquatic fauna and help oxygenate the water. These “hidden” plants are usually forgotten. They are normally found in water deeper than 90cm
Floating		Floating leaf plants float on the pond surface. They include duck weed and the reddish water fern, <i>Azolla</i> . Too many floating leaf plants on a pond are a sign of poor pond health.
Water edge		Water edge plants are the most important plants for pond health. They buffer wave action, help break down excess nutrients before they reach the pond, reduce habitat for mosquitoes and midges, and will disguise pond margins when water levels fluctuate.
	Shallow	Shallow water edge plants (0-30cm deep) such as purei (<i>Carex secta</i>) and wiwi (<i>Juncus pallidus</i>) survive in water levels up to 30cm deep, as well as dry conditions.
	Deep	Deep water edge plants such as lake club rush (<i>Scheonoplectus tabernaemontani</i>) and kuta (<i>Eleocharis sphacelata</i>) generally grow in water from 30cm to 90cm deep.
Shoreline		Shoreline plants include trees and shrubs that grow on the pond's banks. These plants may be flooded occasionally and have adapted to growing in damp soils. They are important because they help to filter sediments and nutrients from surface run-off and improve the quality of water that enters the pond. Avoid large tall overhanging trees such as pine and willow which can drop large amounts of leaves and twigs into the pond. Native trees are fine.



This is a well-designed waterfowl pond. There is a mix of densely vegetated shallows and deeper areas that ensure abundant plant life to maintain water quality.

Fish, birds and other animals

- Native freshwater fish contribute towards a healthy pond and create interest. If you'd like to find out about introducing native fish, contact your local Department of Conservation office for advice and permit requirements.
- It is illegal to introduce exotic fish such as koi carp and rudd into ponds unless you have a permit from the Minister of Conservation. Exotic fish often ruin water quality by stirring up sediments and destroying native plants. They can also escape from ponds into natural waterways, often during floods. They damage other habitats.
- It's okay to attract waterfowl to your pond but you don't want too many. Geese and swans in particular, introduce significant amounts of nutrients into a pond. They also muddy pond edges. You can discourage large flocks of birds from using the pond by limiting grassy bank areas and densely planting the margins of the pond.
- Keep stock out of ponds – it's better for the health of your pond and stock if you pipe clean pond water to drinking troughs.

Step 4: Check out the regulations and consent requirements

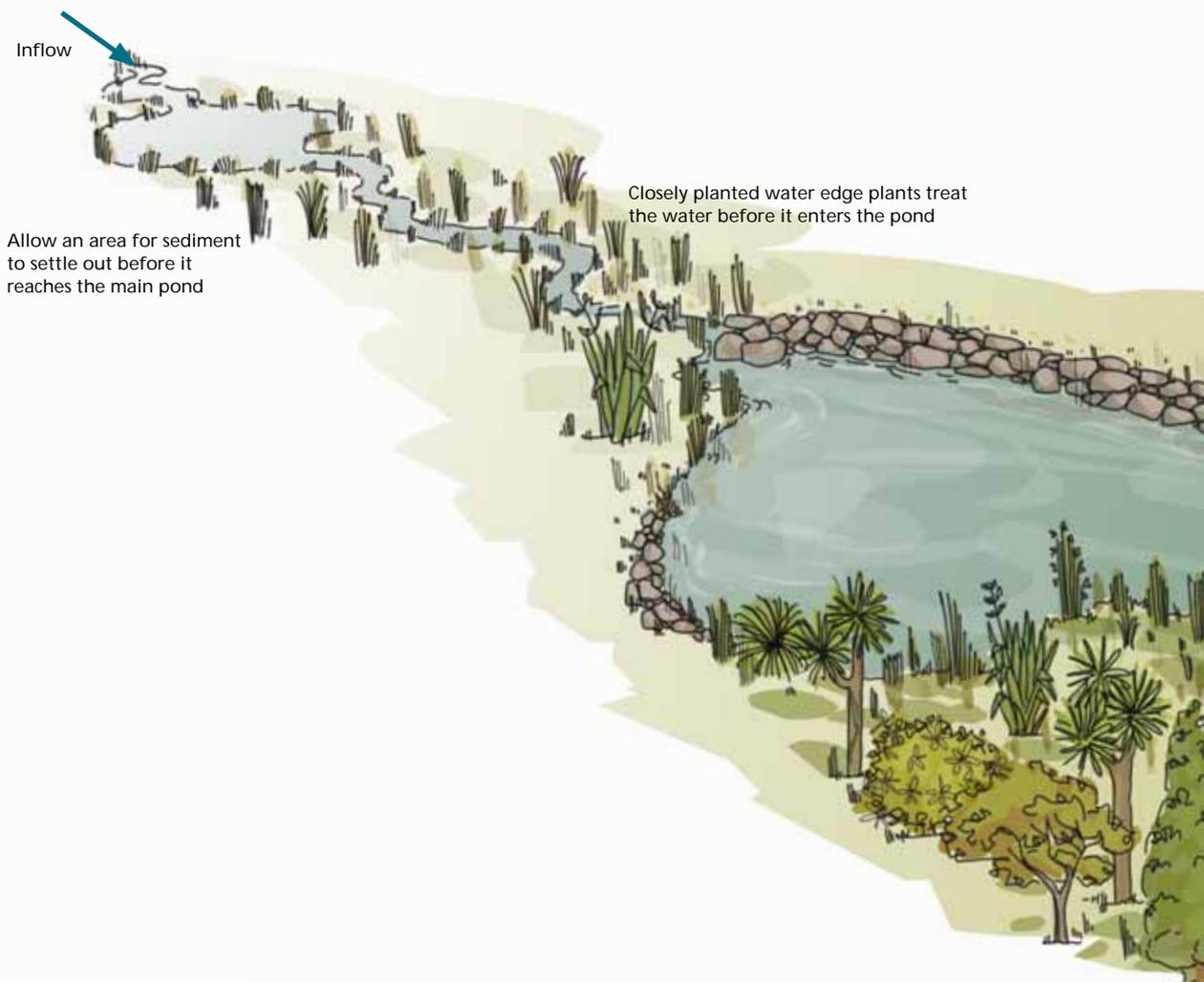
Before constructing any pond (big or small) find out if you need a resource consent. Most ponds will require a resource consent from Greater Wellington, especially if they involve damming or diverting a stream or river, works in an existing wetland or discharging water into a river or wetland. Damming and diverting water requires a resource consent unless it is specifically allowed by a rule in a regional plan. Greater Wellington's Regional Freshwater Plan has rules that allow diversion of water from water races, farm drains or groundwater (provided it does not cause flooding or lower water levels in rivers, lakes and wetlands). You can read the rules on www.gw.govt.nz/regionalrules or contact the Consents Help Desk in Wellington on 04 384 5708 or in Masterton on 06 378 2484.

Your local district or city council may also require a consent. This will depend on the zoning of the land and whether or not construction involves significant earthworks, vegetation clearance, or if it is located in a significant natural area or outstanding landscape.

Ponds greater than three metres deep and holding 20,000m³ or more of water (roughly 0.6 ha or 1.5 acres) that are formed by a dam or embankment must also comply with the Building Act 2004. Contact Greater Wellington for more information about complying with the requirements of the Building Act 2004 – you will probably need to seek the advice of an engineer. Structures, such as boardwalks and jetties, may require building consent as well as a resource consent.

As part of your resource consent application you will need to provide information on the effects of your pond on water flows and levels, wildlife, habitats, vegetation and neighbours.

You may also need to show that you have identified people interested or affected by the proposal, such as neighbours and interest groups, and discussed your proposal with them.

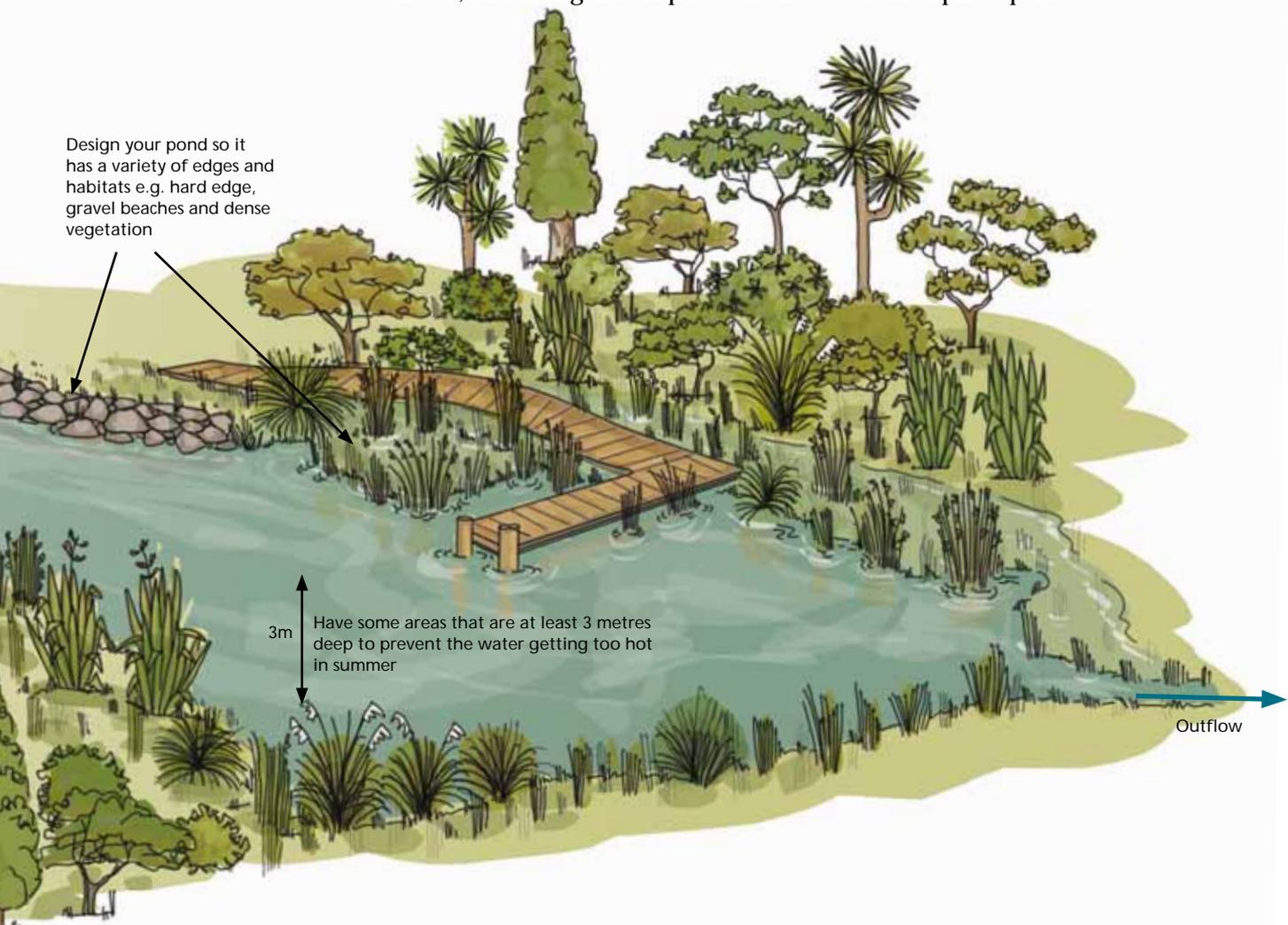


Step 5: Plan for ongoing pond management and monitoring

Proper maintenance, such as the regular inspection and repair of banks and spillways, will prolong the life of your constructed pond. You may need to prepare a plan of how you will maintain the pond as part of your resource consent application.

The ongoing management of your pond is likely to include:

- Managing activities around your pond, such as the use of fertilisers, herbicides, pesticides and irrigation, so that they don't have a detrimental impact on your pond's water quality. A nutrient budget would be a good first step.
- Inspecting structures to see if they need repairing or cleaning.
- Monitoring sediment accumulation annually. From time to time you may need to dredge excess sediment.
- Regular checking for problem weeds so you can control them before they take over. Our pest plant Biosecurity staff can help with identification of these.
- Replacing any plants that have not survived and pruning overhanging trees.
- Checking for insect pests, particularly midges and mosquitoes. If these are found, check the health of plants around the edge. You may need to seek advice on using insecticides. Native frogs eat mosquito larvae and prefer native wetland plant habitat.
- Developing and implementing a water monitoring programme to sample nutrient levels, temperature, water clarity, type and colour of algae and water levels. This will help you decide what management actions you need to take.
- Making notes about the general condition of pond: colour, algae, clarity, smells, and insects, and taking annual photos from several fixed photo points.



Some good and bad examples.....



This well-designed urban pond has a mix of shallows and deep areas as well as densely-vegetated margins and boulder beaches that provide good habitat and help maintain water quality. A paved or vegetated buffer is provided between the pond and adjacent lawns to reduce nutrient-rich run-off from entering. There is a wide separation between the pond and residential properties. Slopes leading to the water are gentle and safe.



Water quality monitoring of a large healthy artificial pond. Note the lush band of wetland plants. The pond has a mix of shallow and deep areas with submerged aquatics forming dense beds. Monitoring will help you determine if you need to take action to improve water quality.



Stock access is causing water quality problems for this pond. Stock eat water edge plants and their dung and urine increases nutrient levels in the water. Algae is colouring the shallow water red and green.

Photo: copyright NIWA (Rohan Wells)



The slopes above and below the water are too steep which make it unsafe and limit the chance that water edge plants will establish. The edge is eroding because there are no plants to protect it. Grass is mown and fertilised to the water's edge, so nutrients will run into the water.

Good luck

We hope that this brochure has provided some useful guidance for your project. Our key message is that building a healthy sustainable pond needs considerable planning and ongoing care. We strongly recommend that you seek professional advice when evaluating your site, designing your pond and planning for its ongoing management.

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For more wetland information check out: www.gw.govt.nz/wetlands

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