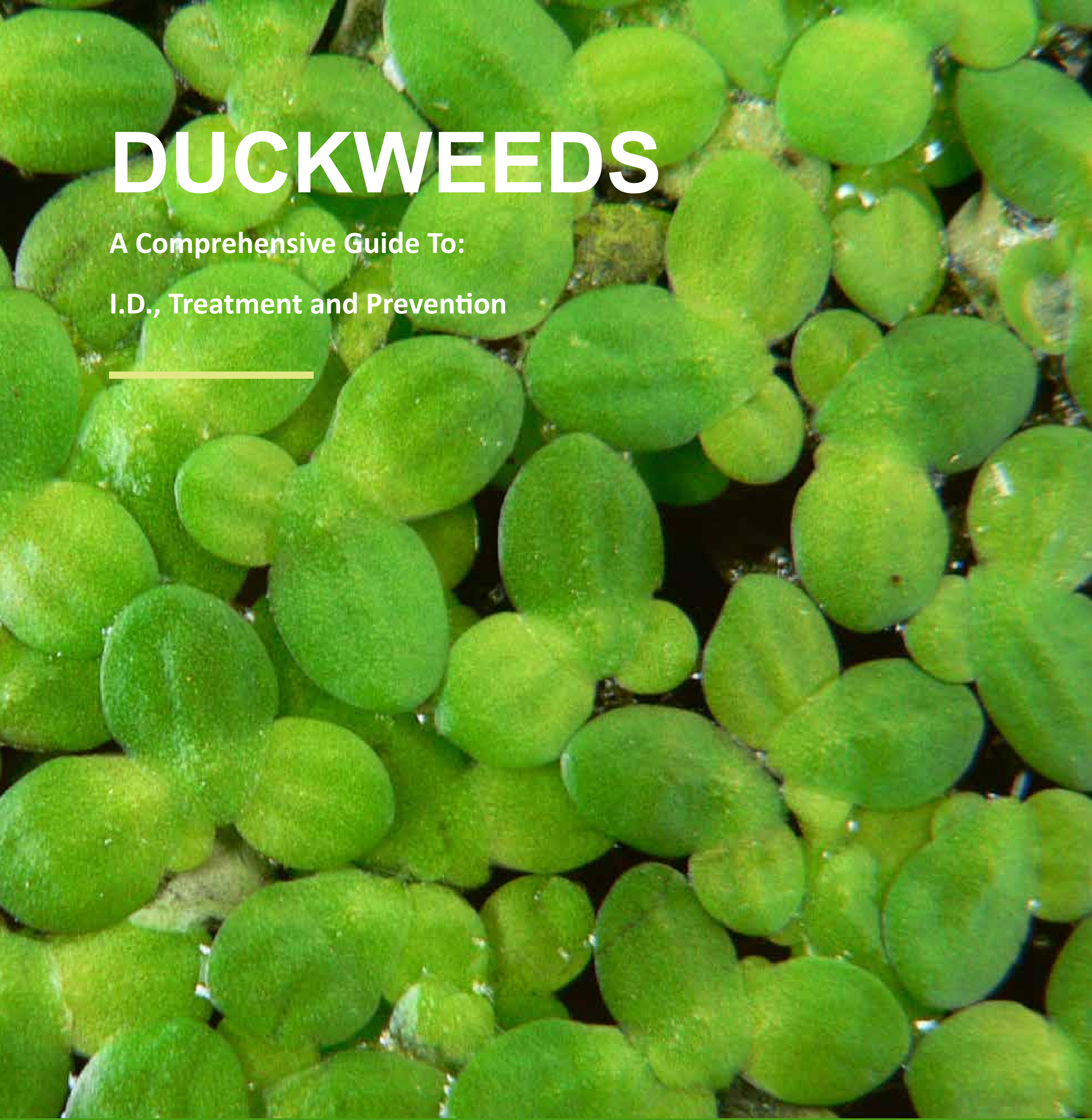

DUCKWEEDS

A Comprehensive Guide To:

I.D., Treatment and Prevention

Authored by Brittany Pondeljak

Aquatic Technologies, 2021

AQUATIC TECHNOLOGIES

The Water Treatment Experts!

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INTRODUCTION

Duckweed is a free floating aquatic plant.

There are three species of duckweed found in Australia; Lemna minor, Spirodela polyrhiza and Wolffia arrhiza.

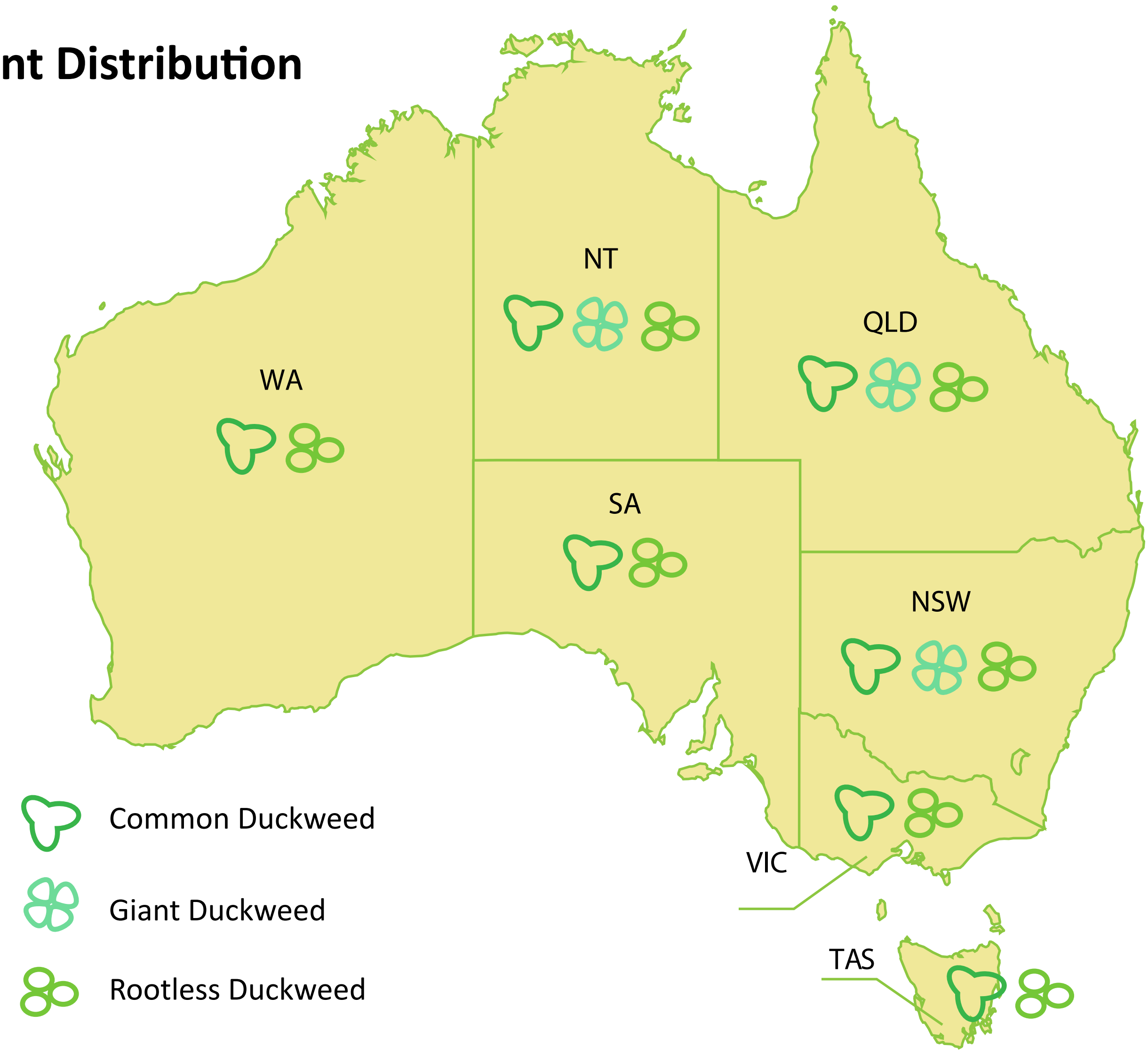
Duckweed is a native, fast-growing weed which can form dense mats that can cover the entire surface of a water body.

ABOUT THIS GUIDE

The information presented here provides a detailed guide on how to identify, manage and treat Ducweed in varying freshwater situations.

It is designed to enable the user to make an informed decision on what management approach is best suited to their unique situation.

Current Distribution



HOW TO IDENTIFY DUCKWEED

Scientific name:	*Lemna Minor*
Common name:	Common Duckweed
Description:	A common tiny native plant which floats freely on the water's surface. The leaves of the plant are green above and red below. They have three (rarely five) veins and small air spaces to assist flotation. It can have several oval leaves that are from 1 to 8mm in length with each having a single root hanging in the water.
Habitat:	Stationary and slow-moving fresh water bodies, especially where nutrient levels are high such as dams, ponds and lakes.
Distribution:	NSW, NT, QLD, SA, TAS, VIC, WA
Reproduction:	Whilst it can flower, it mainly reproduces vegetatively by division. As more leaves grow, the plants divide and become separate individuals.
Dispersal:	Birds are important in dispersing L. minor to new sites. The sticky root enables the plant to adhere to the plumage or feet of birds and can thereby colonise new ponds.


Lemna Minor


Lemna Minor

Scientific name:	*Spirodela polyrhiza*
Common name:	Giant Duckweed
Description:	A free floating aquatic plant that is typically larger than other species of duckweed. It usually has two to three oval leaves which are 5 to 10 mm long with several veins, 7 to 16 on each leaf. Each leaf has within 5 to 18 short roots hanging below in the water. The upper surface of the leaf is yellow to green in colour whilst beneath they are usually a purplish colour. The upper side also commonly has red spots on it.
Habitat:	Stationary and slow-moving fresh water bodies, especially where nutrient levels are high such as dams, ponds and lakes.
Distribution:	NSW, NT, QLD
Reproduction:	Whilst it can flower, it mainly reproduces vegetatively by division. As more leaves grow, the plants divide and become separate individuals.
Dispersal:	Attaching to animals such as waterfowl, human activity or floods.

Spirodela polyrhiza

Spirodela polyrhiza

Scientific name:	*Wolffia arrhiza*
Common name:	Spotless Watermeal, Rootless Duckweed
Description:	A native plant that floats on the water's surface, it is typically smaller than the other species of duckweed. The green part of the plant, the frond, is a sphere measuring about 1 mm wide, but with a flat top that floats at the water's surface. Unlike the other species of duckweed, it has no roots.
Habitat:	Stationary and slow-moving fresh water bodies, especially where nutrient levels are high such as dams, ponds and lakes.
Distribution:	NSW, NT, QLD, SA, TAS, VIC, WA
Reproduction:	It reproduces mainly vegetatively by division, with the rounded part budding off into a new individual. When the weather becomes cooler, a turion* is produced and sinks to the bottom of the water body, where it lies dormant throughout winter. During warmer weather, it rises to the surface of the water to begin the growth process again. *Turion (a type of bud that is capable of growing into a complete plant).
Dispersal:	Attaching to animals such as waterfowl, human activity or floods.

Wolffia arrhiza

Wolffia arrhiza

WHY TOO MUCH DUCKWEED IS BAD

Duckweeds are free floating plants that are native to Australia [9] [14]. It can be a welcome aquatic plant in a water body or it can become extremely invasive [29]. They are considered problem weeds due to their prolific growth rate, duckweed is one of the fastest growing plants [2][3][7]. Under optimal conditions, duckweed has the ability to double its mass in less than four days [4][5][17].

Duckweed grows especially in warm, nutrient rich conditions when it receives long periods of light [11][12][17]. As a result, water bodies experience rapid growth of duckweed during the warmer summer months which have longer periods of daylight.

The presence of duckweed in an aquatic environment can adversely impact it due to its ability to form dense and multilayered mats in its later growth stages [4][13]. Once the infestation is completely blanketing the surface of the water, it can give rise to physical and chemical changes in the water beneath [12].

The dense growths of duckweed act as a physical barrier on the water's surface. It can interfere with light penetration into the water column.

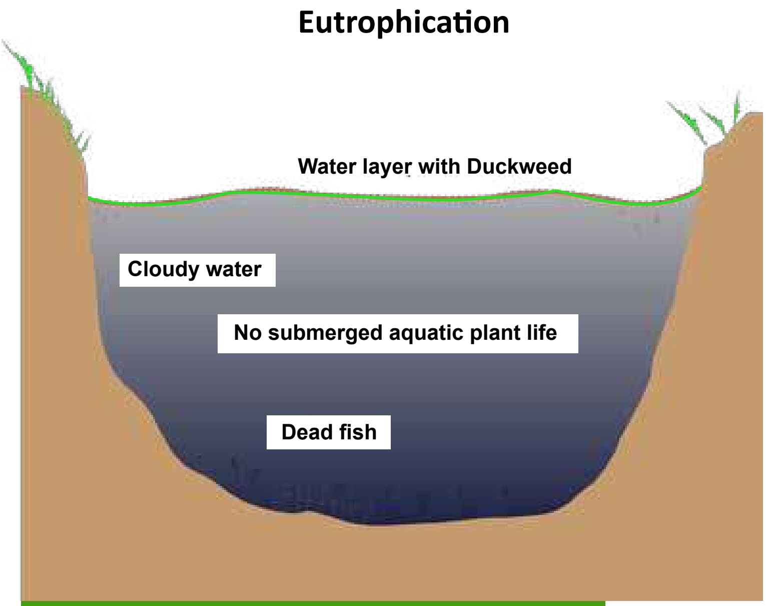
With less light, its shades out plants and reduces the ability of vegetation in the lower levels of the water body to photosynthesise [12][15][16][19]. If respiration begins to overtake photosynthesis, it will lead to an increase in dissolved carbon dioxide and a reduction of the pH of the water [12][15].

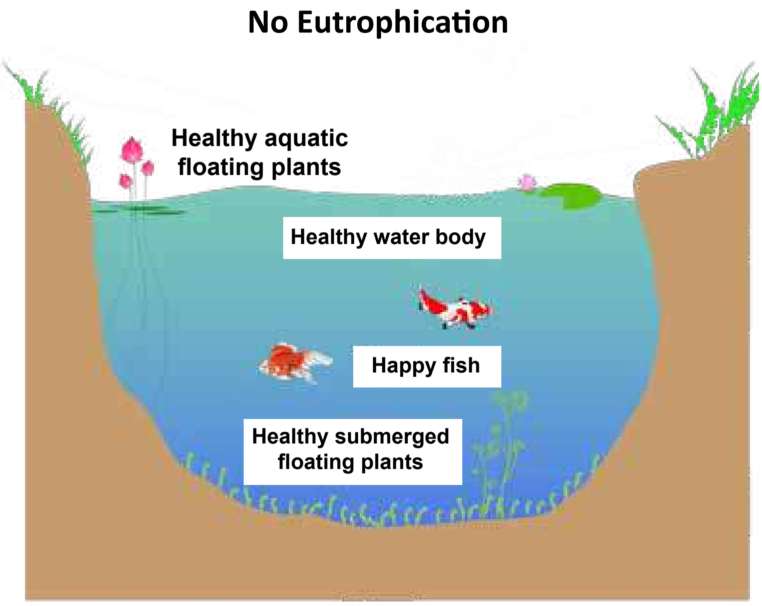
The presence of duckweed also impacts gas exchange between the water and the air. The mats formed prevent oxygen diffusion into the water, thereby dramatically decreasing the level of dissolved oxygen in the water [12][15][29].

Light reduction and low oxygen in the water impact the communities of plants and animals living in the water below the mats, deteriorating the food web of the aquatic ecosystem [12][16].

The process of duckweed decomposing also reduces the amount of dissolved oxygen in the water. This creates a hostile environment that does not have enough oxygen to support most life, especially fish [23][30].

HOW DUCKWEED CAN GROW OUT OF CONTROL





FUN FACT: DUCKWEED GROWS FAST!

Duckweed species are ranked as some of the fastest growing plants [2][3][7]! They are able to double their mass in under 4 days [4][17][29]. Sometimes as quickly as 16 hours [5].

Although duckweed can flower, it mostly reproduces asexually [3][6][8]. As each leaf matures, it produces buds which form new leaves whilst still attached to the parent leaf [18].

Duckweed grows best under optimal conditions including warm temperatures (20-31°C), high nutrient levels and in strong sunlight [11-13][17][21].

Fact: Duckweed Has Many Uses!

Duckweed is known as a great accumulators of trace elements and heavy metals. They are able to thrive on wastewater so Duckweed has been traditionally used to treat wastewater streams rich with industrial waste and landfill pollution [2][7][19]. Duckweed has also been successfully used as animal feed and for bio-ethanol production [9].

Duckweed has incredibly fast accumulation rates as such it can be used to help remediate polluted water and prevent eutrophication (water enriched with minerals and nutrients) [7]. Controlling eutrophication can improve a water body by preventing harmful algal blooms [20].

Duckweed absorbs large amounts of nutrients such as nitrogen and phosphorous [11]. Specifically, they thrive in high nitrogen environments. Duckweed can take up or exhaust almost all the nitrogen in the water [1][5].

What is Nitrogen?

Duckweed is able to thrive in aquatic environments enriched with nitrogen [29].

Duckweed is described as a nitrogen 'specialist' due to its ability to grow well in high nitrogen environments [2]. For optimal plant growth, duckweed requires relatively small amounts of the nutrient phosphorous in comparison to nitrogen [25].

Nitrogen is an essential nutrient that plays an important role in plant growth [23][24]. It is a key element in DNA, RNA and protein formation [23].

Excess nitrogen that is found in water bodies is mainly the result of agricultural processes [26][27]. Common sources of nitrogen are:

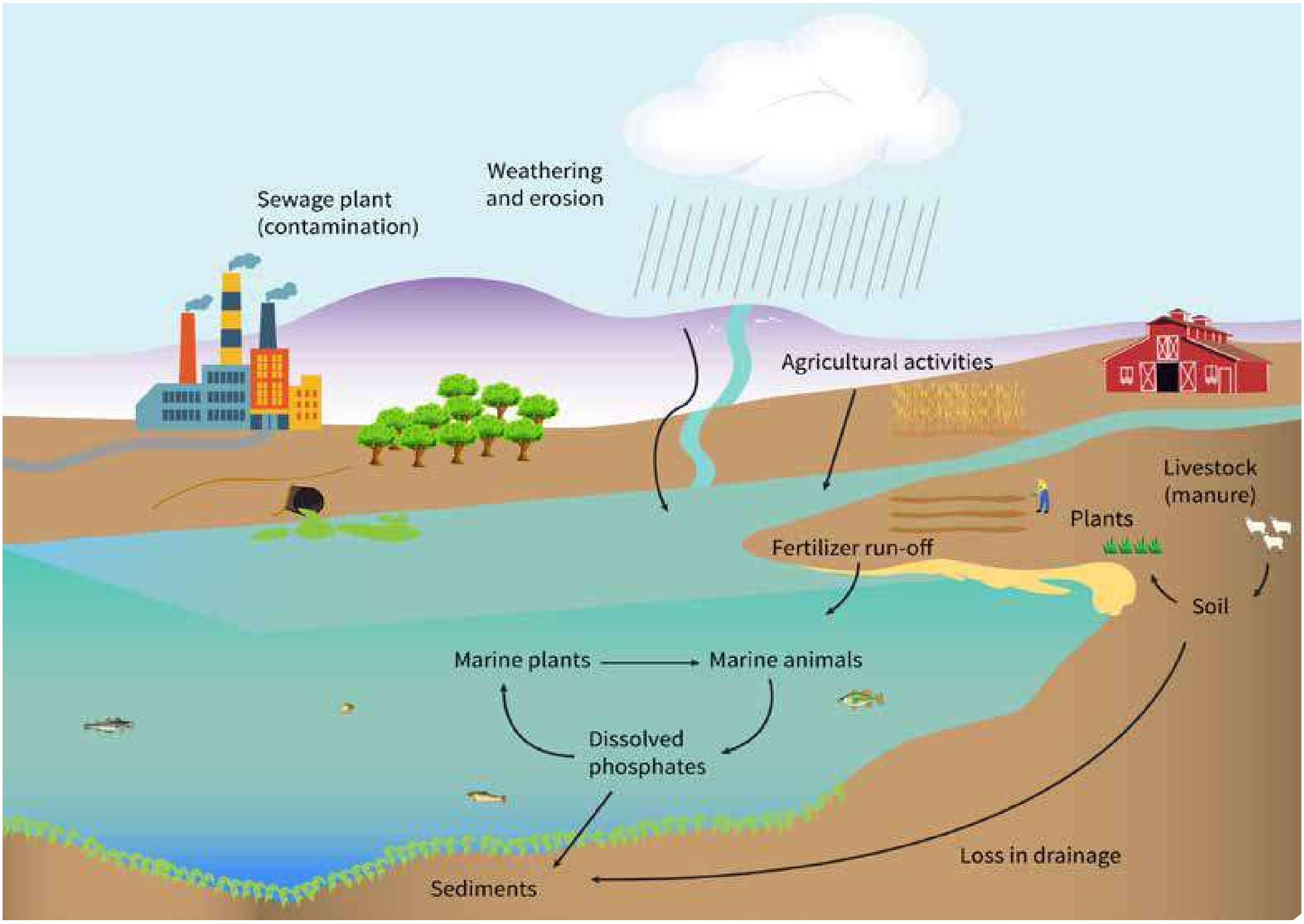
- Fertilisers
- Manure
- Septic systems
- Animal feed lots
- Industrial waste
- Sanitary land fills
- Garbage tips

How does nitrogen get into the water?

These sources of nitrogen then find their way into waterways through waste water, storm water, runoff and sewage [27][29].

Australian soils and surface waters are typically low in nitrogen and phosphorous, so native plants such as Duckweed have adapted to these low levels [30].

This means that Duckweed has adapted to grow in environments with relatively low amounts of nutrients. When there is an excess amount of nitrogen input into a water body, it can result in the extensive growth of duckweed to the point where they completely dominate a water body.



HOW TO IDENTIFY THE RIGHT DUCKWEED TREATMENT FOR YOUR SITUATION

Treatments currently avaliable

Currently there are 2 main types of treatment available. These are:
• Aquatic herbicides (chemical & natural based)
• Physical removal (manual & machine)

To determine which treatment will suit your situation best, you must first categorise the severity of your Duckweed bloom.

How Severe is your Duckweed Bloom?

Primary Growth Stage

0-30% of the water body is covered in Duckweed
Primary growth occurs in the early stages of an infestation, when plants are not crowded. The water surface is clearly visible between plants and the plant is lying flat on the surface of the water [31].

Secondary Growth Stage

30-60% of the water body is covered in Duckweed
Secondary growth occurs when the water surface is barely visible but the Duckweed is still only a single layer [31].

Tertiary Growth Stage

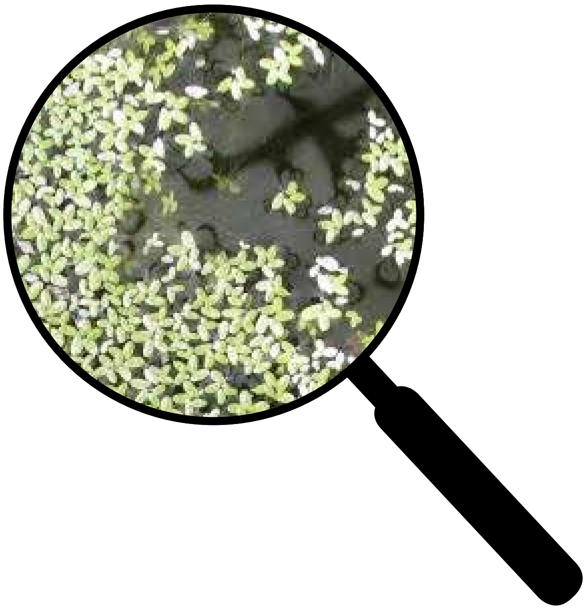
60-100% of the water body is covered in Duckweed
Tertiary growth occurs when the plants become crowded and mature in infestation. The water surface is no longer visible preventing light from entering the water [31].

Multilayered Growth Stage

100%+ of the water body is covered in Duckweed
Tertiary weed mats can become multilayered, displaying ridge-like thickenings as layers build up affecting the water beneath by eliminating submerged plants and algae, preventing photosynthesis and blocking oxygen diffusion from the air resulting in an anaerobic environment [12] [15] [29] .

Primary Growth Stage

Example of Duckweed in its primary growth stage. Notice how much free water is present and how spread out the individual plants are!



Secondary Growth Stage

Example of what Duckweed can look like in its secondary growth stage. Notice how the water is barely visible.

Tertiary Growth Stage

Example of what Duckweed can look like in its tertiary growth stage. Notice how the water is no longer visible.

Multilayered Growth Stage

Examples of what Duckweed can look like in its multilayered growth stage.

Notice how dense the Duckweed has become and there is no visible water at all.

Once you have categorised your Duckweed bloom, you can then choose your treatment. Use the table below to help you:

	Treatment Options			
Growth Stage	Herbicide: chemical-based	Herbicide: natural-based	Physical removal: manual	Physical removal: machine
Primary	✓	✓	✓	
Secondary	✓	✓	✓	✓
Tertiary	✓		✓	✓
Multilayered	✓			✓

What you use your water body for will also play a role in the type of treatment most suitable for you. For example if you are unable to withhold using the water for 10-days, then a traditional herbicide may not be suitable.

There are different treatment methods available to suit most types of water bodies. Continue reading to find out which treatment is most suitable for your waterbody.

Types of Aquatic Herbicides

All approved aquatic herbicides can be used on all species of Duckweed but not all aquatic herbicides are effective against all growth stages.

The following Aquatic Herbicides are successful on primary and secondary growth stages:

- AQ200
- Calcium dodecyl benzene sulfonate
- *Glyphosate
- Orange Oil

The following Aquatic Herbicides are successful on tertiary stages of growth:

- AQ200
- *Glyphosate

The following Aquatic Herbicides are successful on multilayered stages of growth:
- AQ200

Benefits of chemical control:

Typically only one full application with follow up spot treatments advised.
Kills Duckweed fast (within 7-14 days) [28].

Disadvantages of chemical control:

Treated plants remaining in the water can cause oxygen to deplete within the system, affecting water quality [30]. However, if left untreated water quality will continue to decline. Treating with aquatic herbicides may see a short term decline in water quality, however once cleared a rapid recovery takes place.

There is a possibility of spray drift onto non-target vegetation.

There is a withholding period is once the herbicide has been applied meaning the water cannot be used for either irrigation or watering stock until the breakdown of the herbicide (excludes orange oil) [30].

Table 1. Summarises the effectiveness of various herbicides on the growth stages of free-floating aquatic weeds.

Herbicide	Primary Stage 0-30%	Secondary Stage 30-60%	Tertiary Stage 60-100%	Multilayered 100%+
Orange oil (Natural-based)	✓	✓	×	×
AQ200	✓	✓	✓	✓
*Glyphosate	✓	✓	✓	×
Calcium dodecyl benzene sulfonate	✓	✓	×	×

Primary: Early stages of infestation, crowded plants, water surface visible.
Secondary: Moderate infestation, water surface barely visible.
Tertiary: Mature infestation, water surface is not visible.
Multilayered: Display ridge-like thickening as layers build up.

*** In 1997, the APVMA implemented new regulations regarding the usage of Glyphosate in aquatic environments within Australia. These regulations stipulated that Glyphosate is no longer permitted for use in treating weeds that grow in or over bodies of water in Australia. Furthermore, the application of Glyphosate via spraying across open water surfaces or allowing Glyphosate to enter bodies of water is strictly prohibited. Instead, may only be used for the treatment of dry drains and channels, as well as the dry margins of dams, lakes, and streams. Additionally, users must ensure that water does not return to these treated areas within a 4-day period after application. Therefore, using Glyphosate herbicides in water is not permitted. Only use an approved aquatic herbicide like AQ200 in such cases [46].**

	AQ200	*Glyphosate	Calcium dodecyl benzene sulfonate	Orange Oil
Mode of action	• Contact herbicide that causes rapid plant injury in exposed tissue through disruption of photosynthesis [10] [32].	• Disrupts the shikimic acid pathway through inhibition of the enzyme 5-enolpyruvyl-3-shikimate phosphate (EPSP) synthase. The resulting deficiency in EPSP production leads to reductions in aromatic amino acids that are vital for protein synthesis and plant growth [33] [34].	• Reduces buoyancy causing plant to sink [35].	• Disrupts cuticle, breaking down or dissolving the waxy coating on plant cell walls. Contributes to the desiccation or burndown of young tissues [36] resulting in the plant losing its ability to retain water [37]. The damaged leaf cells leak water and the plants die of dehydration [38].
Timing of application	• Throughout the entire growing season; Control of early growth is recommended [345.	• When plant is actively growing [41].	• During primary and secondary growth stages only to floating plants only [35].	• Throughout the entire growing season [39] [40].
Waiting period	• Plants absorb AQ200 rapidly; plant decline is usually within less than 7 days post treatment [35].	• Following treatment, plants will gradually wilt, appear yellow/brown, and will die in approximately 2 to 7 days [41].	• Needs at least three applications and anything from a week to three weeks between applications [35].	• Plants will begin to sink within the hour after application. Full results may take up to 7 days [35].
Use restrictions/ Precautions	• Do not use herbicide in muddy water or on vegetation coated with mud or algae [35].	• Does not work on solid plant mats or where no water surface is visible [35]. • Do not treat weeds under poor growing or dormant conditions [35]. • Is not effective on submerged aquatic plants [41]. • Do not treat in water with high turbidity [35].	• Free water must be visible for application [35]. • Only works on floating ferns [35].	• Avoid a single heavy application; instead apply several light applications over a 1-3 week period [35]. • Apply when weed infestation is small, rather than advanced. Do not spray dense solid mats with no visible water surface. Water bodies with an average depth of less than 1 metre should not be treated [35].
Breakdown in water	• AQ200 is rarely found longer than 10 days after application and is often at levels below detection 3 days after application [32] [42]. • Binds tightly to clay particles in the water and the bottom sediments, where it becomes biologically unavailable [32] [42].	• The concentration of glyphosate is reduced through dispersal by water movement, binding to the sediments, and break-down by microorganisms [41]. • Glyphosate's half-life is between 3 days and 19 weeks depending on water conditions [41].	• Calcium dodecyl benzene sulfonate takes between 24 hours and 7 days to vaporise, depending on weather conditions (it takes longer on overcast days) [35].	• Non-persistent which means it decomposes rapidly, preventing the accumulation of compounds in soil and its subsequent influence on non-target organisms [43].

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TREATMENTS AQUATIC TECHNOLOGIES OFFER

AQ200 Aquatic Herbicide + Wetting Agent Treatment

Preparing AQ200 + Wetting Agent Solution:	**Applying AQ200 + Wetting Agent Solution:**	**Spot Treatment:**
Step 1) Combine 400mL of AQ200 with the 150mL of Wetting Agent and dilute in 100L town/tank water (please note it is important to use town/tank water for this application). *Always put 80 per cent of the required water into your clean sprayer before adding the chemicals, then slowly add the other 20 per cent of the water. This avoids frothing of the spray mix.*	Step 2) Spray diluted mixture directly onto Duckweed using a shower spray (not a mist spray). Ensure all Duckweed is covered. *If Duckweed is at 100% coverage, it is advised to physically remove some prior to spraying OR ensure a heavy wetting application is applied.*	Step 3) Spot treat any remaining plants 1-2 weeks after a full application. Continue to spot treat until Duckweed is no longer visible. *Check beneath rocks, lily pads and reeds etc. for any hidden Duckweed plants.*

1L of AQ200 + 500mL Wetting Agent will treat between 250m² – 500m² of surface area depending on how dense the Duckweed coverage is.

Tips for eradicating:

- If Duckweed is layered or at 100% coverage, physically remove some Duckweed to thin it out before commencing herbicide treatment OR ensure a heavy drenching is applied.
- It is best to treat on a day with no rain and minimal wind
- Spot treat any remaining plants
- Check beneath rocks, lily pads and reeds etc. for any hidden Duckweed plants.

Notes:

- Use PPE when handling AQ200 including; gloves, goggles, mask, overalls/protective clothing
- DO NOT use treated water for human consumption, livestock watering or irrigation purposes for 10 days after application
- AQ200 is best applied with a spray unit
- Use a shower spray (do not mist)
- Limit overspray as this can affect non-target terrestrial and aquatic plants.

Orange Oils: Natural Treatments

Preparing Orange Oil Solution:	Applying Orange Oil Solution:	Spot Treatment:
Step 1) Dilute 1L of Orange Oil per 100L of water. *Always put 80 per cent of the required water into your clean sprayer before adding orange oil, then slowly add the other 20 per cent of the water. This avoids frothing of the spray mix.*	Step 2) Spray diluted Orange Oil directly onto Duckweed using a light shower spray (not a mist spray). Ensure that the full surface area of the water is treated (even where no Duckweed is present). Spray onto Duckweed enough to change their normal colour (plants darken and show an oily sheen). Spray a light coverage over any free water present. *If Duckweed is at 100% coverage, you must physically remove some until the Duckweed is single layered and there is free water present prior to spraying.*	Step 3) Spot treat any remaining plants 1-2 weeks after a full application. Continue to spot treat until Duckweed is no longer visible. *Check beneath rocks, lily pads and reeds etc. for any hidden Duckweed plants.*

1L of Orange Oil will treat between 250^2 - 500m^2 of surface area depending on the Duckweed coverage.

Tips for eradicating:

• For large infestations covering up to 90% of the water's surface – partially remove sections of the infestation to create space for the treated matter to sink. In such instances, we recommend applying an extra 20% of the product to ensure saturation.

• This product works best when surface matter is small and manageable. It's advised to do several light applications, instead of a single heavy dose.

Aquatic Technologies have found best results when Orange Oil is applied on day 1, day 2 and day 4.

• It is best to treat on a day with no rain and minimal wind.

• Spot treat any remaining plants until no longer visible.

Notes:

• Use PPE when handling Orange Oil including; gloves, goggles, overalls/protective clothing.

• Orange Oil is best applied with a spray unit.

• Use a shower spray (do not mist).

• Ensure your shower spray is not too powerful, you want to lightly coat the Duckweed not blast at it as this may cause the product to wash off.

Physical Removal: Duckweed Skimmers

Physical removal can be a labour-intensive method, but has the advantage of being ecologically benign [30]. Small infestations of Duckweed in accessible areas can be removed with rakes and fine-mesh nets, and used as either fodder or compost [9]. The disadvantage of this method is that under optimal conditions, Duckweed can double its population in 2 to 10 days [4] [5] [7] [17].

Advantages of physical removal:

• Removes extra nutrients caused by the breakdown of Duckweed thereby reducing the likelihood of future blooms.

• A dense coverage consumes a lot of oxygen leaving little left for fish and other aquatic organisms. Avoids fish kills by ensuring adequate oxygen levels remain.

• Removes habitat for breeding mosquitoes.

Aquatic Surface Skimmers

Can be used on all species of Duckweed and primary, secondary and tertiary growth stages. This method is best used in conjunction with spray treatments or when partial removal is desired.

Physically removing Duckweed from the water's surface will reduce the likelihood of future blooms by decreasing the amount of nutrients in your water. Nutrient-rich water lets aquatic vegetation thrive, meaning you might experience more infestations of unwanted Duckweed.

Easily remove Duckweed from your water body in 4 steps:

1. Toss the skimmer in the water
2. Slowly pull it back in using the string attached
3. Dump the Duckweed out onto the bank or into a container for easy transport
4. Repeat

Tips:

• Keep collected Duckweed away from water's edge to avoid recontamination.

• Use the collected Duckweed on your garden! Duckweed is a great fertilizer.

Aquatic Harvesting

Amphibious Aquatic Harvesting machines can be used on all species of Duckweed and is better suited to larger infestations where chemical treatment is not desirable or practical.

Aquatic harvesters can remove the bulk of an infestation in accessible areas, and other control methods are then required for the remnant Duckweed left close to edges, or in shallow or inaccessible areas.

Brittany Pondeljak ©

Maintaining a healthy water body

A healthy water body consists of native plant and animal populations interacting in balance with one another as well as nonliving things.
In a healthy ecosystem there will be:

- An energy source (primarily the sun)
- Living organisms (primary producers, consumers, decomposers)
- Non-living things (water, soil, rocks etc.)
- Dead/decaying matter

Freshwater ecosystems differ greatly from one another depending on type, location, and climate, but they nevertheless share important features [42]. By knowing what's normal for your water body will help you maintain a healthy ecosystem.

Water Features:
1. Flow pattern – defines where the water comes from. Knowing the source of your water can be indicative of factors that may influence water body health.

2. Sediment and organic matter – raw materials that create physical habitat structure as well as supply energy sources to sustain aquatic plants and animals. Knowing what inputs are going into your water body will help you manage its overall health.

3. Temperature and light – regulate metabolic processes, activity levels, and productivity of aquatic organisms. These factors change seasonally and aquatic plants and animals have adapted to these changes. Knowing what is regular for your water body will help you monitor any unusual changes.

4. Nutrient and other chemical conditions – regulate pH, water quality and plant and animal productivity. An imbalance will likely be displayed by algal blooms, excessive aquatic plant growth, foul odours or changes in animal behaviour.

5. Plants and animals – influences ecosystem function and community structure. A diverse range of aquatic plants and animals indicate a healthy ecosystem. When one species becomes dominant, it is indicative of an imbalance within the water body.

By monitoring the status of these five features, you can more easily distinguish where an imbalance might be and rectify the issue.

Signs that your water body is unhealthy:

- Odours (foul, sulphur, rotten-egg)
- Water clarity (turbid water can be indicative of health concerns)
- Algal blooms
- Excessive aquatic plant growth
- Dead animals
- Fish consistently swimming near the water's surface

An essential feature for water body health not listed above is oxygen, known as dissolved oxygen in the context of water. Dissolved oxygen is an essential requirement for living aquatic organisms.

Most of the organisms that inhabit fresh water constantly consume dissolved oxygen (DO).
In order for life to be sustained this oxygen must be replenished, and in many waters this can be accomplished by a process called re-aeration (surface water taking up oxygen from the overlying air) [45].

However, re-aeration is only effective if the water is moving and mixing rapidly enough for the DO to reach deeper water before oxygen reserves become depleted [45].

In rivers and streams, the constant flow of water is the likely source of re-aeration and mixing in freshwater systems [45], however the same cannot be said for slow moving water bodies such as dams and lakes.

In northern parts of Australia, a substantial amount of habitats are highly productive and very warm, therefore oxygen consumption rates are very high [45].

As a consequence the re-aeration rates required in order to maintain oxygenation are often highest at the sites that are most poorly re-aerated [45].

Some large exposed waterbodies such as lakes can be partially re-aerated by winds, but some freshwater habitats are too small and/or sheltered to allow wind mixing to fully replenish oxygen reserves [45].

Waterbodies that cannot rely on re-aeration will primarily rely on submerged photosynthetic organisms (plants and algae) to produce enough DO during daylight hours to meet the needs of the entire ecosystem during the night [43].

Biological oxygenation of this kind can be surprisingly effective; nevertheless it is still very common to find that DO concentrations have fallen to potentially life-threatening levels by the time the sun rises each day [45].

Changes to this type of ecosystem can greatly influence DO levels and collapse it entirely e.g.

- water clarity
- depth
- amount and type of submerged plants
- nutrient availability

Nowadays, DO can be maintained artificially via aquatic aerators. This is a reliable way to ensure the basic health needs are met of all aquatic life in managed waterbodies.

AERATION

Water aeration is the process of increasing or maintaining sufficient oxygen levels of water in both natural and artificial environments.

Aeration is a common tool used in pond, dam, lake, and reservoir management to maintain healthy waterbodies by addressing low oxygen levels or controlling algal blooms.

Artificial aeration can help reduce algal and noxious aquatic plant blooms by encouraging the growth of beneficial aerobic bacteria.

These bacteria consume excess nutrients that is otherwise available to aquatic plants and algae.

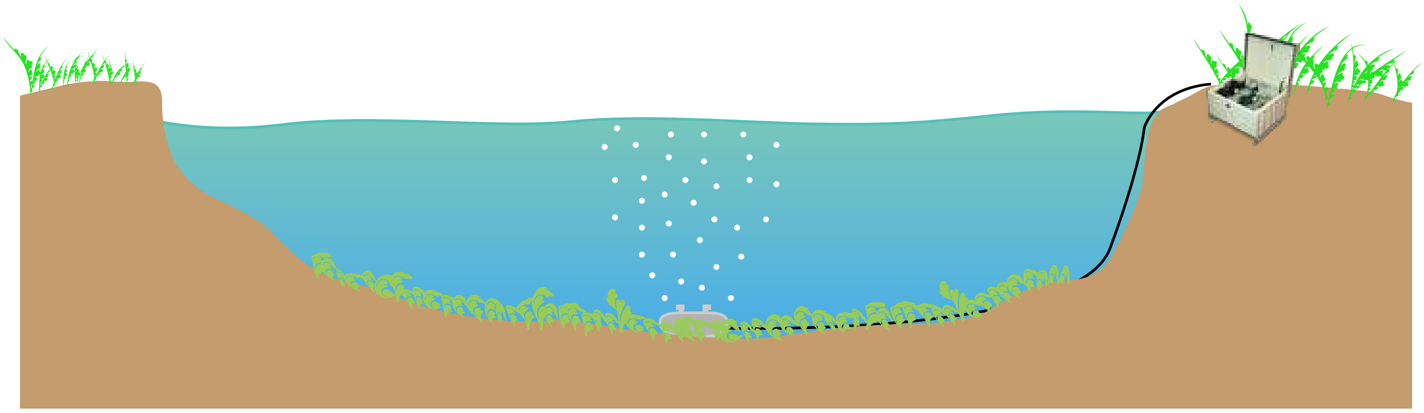
Not only do these bacteria reduce the amount of nutrient availability, they help prevent a build-up of “muck” at the bottom of the water body. This muck can house noxious gases that can lead to foul odours and muddy water.

An aerated water body will have reduced algal blooms, normalised aquatic plant growth, adequate oxygen availability, no foul odours, improved water clarity and a reduction in muck accumulation.

Subsurface aeration:

Subsurface aeration is designed to release bubbles from the bottom of the water body and allow them to rise by the force of buoyancy. Diffused aeration systems utilize bubbles to aerate as well as mix the water to prevent stratification (water stratification is when water masses with different properties - salinity, oxygenation, density, temperature - form layers that act as barriers to one another preventing mixing). Water displacement from the expulsion of bubbles will cause a mixing action to occur, and the contact between the water and the bubble will result in an oxygen transfer.

Subsurface aeration is better suited to deeper waterbodies where stratification is more likely to occur.

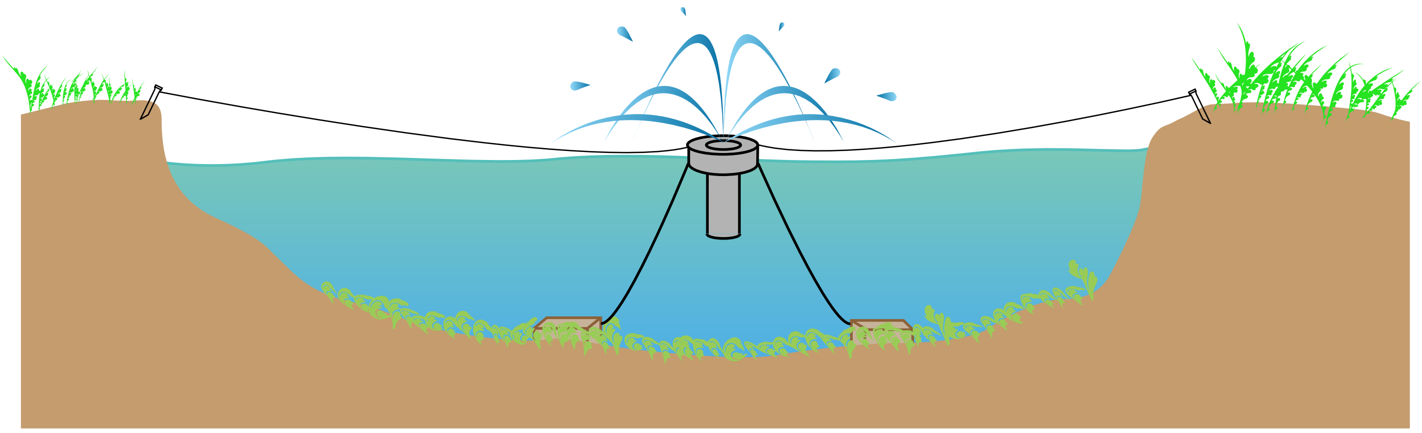


Surface aeration:

Surface aeration is designed to mimic re-aeration (surface water taking up oxygen from the overlying air). The surface aerator disrupts the surface of the water body allowing adequate air-water contact for successful oxygen diffusion.

In a fountain surface aerator, the water droplets created have a large surface area through which oxygen can be transferred and as they fall back into the water body, the droplets mix with the rest of the water and transfer the oxygen.

Surface aeration is better suited to smaller, shallower waterbodies.



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