Horsham District Angling Club - Fish survey, Health Check and Water Quality Report

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1.0 Introduction

The Horsham District Angling Club commissioned a fish biomass survey for Roosthole Pond and Birchenbridge Pond, including a water quality test for Birchenbridge Pond and a fish health check for Roosthole Pond. The surveys were conducted to assess fish populations and biomass in these waterbodies, focusing on species composition, growth rates, and overall health. These insights are crucial for understanding the ecological balance and ensuring sustainable fishery management practices.

The surveys employed a combination of electrofishing and netting methods to collect representative data. At Birchenbridge Pond, which covers an area of 20,668 m² (2.07 ha.,5.11 ac.) (*Figure 1*). 4.04% of the waterbody was sampled using electrofishing, and 8.28% was sampled through netting. Similarly, at Roosthole Pond, spanning 8,394 m² (0.84 ha., 2.07 ac.) (*Figure 2*) 1.96% of the total area was surveyed. The results provide an understanding of the fish population structure, including species-specific biomass, abundance, and growth trends.

The water quality assessment conducted at Birchenbridge Pond serves as a critical analytical tool to evaluate whether the aquatic environment is in ecological balance. Specifically, the analysis aims to determine if the prevailing physicochemical conditions within the waterbody meet the necessary criteria to ensure the habitat remains suitable for fish.

Figure 1. Birchenbridge Pond Site Map

Figure 2. Roosthole Pond Site Map.

2.0 Birchenbridge Pond Survey Results

2.1 Electrofishing Survey Birchenbridge Pond

Birchenbridge Pond electrofishing survey data is shown in *Table 1* below.

Fish Number	Species	Weight (g)	Length (cm)
Electrofishing Survey 1			
1	Common Carp (*Cyprinus carpio*)	5000	64
2	Common Carp (*C. carpio*)	4400	58
3	Bream (*Abramis brama*)	650	34
4	Bream (*A. brama*)	2500	48
5	Pike (*Esox Lucius*)	420	40.5
6	Pike (*E. Lucius*)	450	41.5
7	Pike (*E. Lucius*)	270	35
8	Pike (*E. Lucius*)	480	40
9	Pike (*E. Lucius*)	2500	62
10	Pike (*E. Lucius*)	207	32.8
11	Pike (*E. Lucius*)	317	37
12	Pike (*E. Lucius*)	3400	70
13	Perch (*Perca fluviatiils*)	10	<5
14	Bream (*A. brama*)	132	17
15	Perch (*P. fluviatilis*)	16	11
16	Pike (*E. Lucius*)	396	40
17	Common Carp (*C. carpio*)	5300	63
Electrofishing Survey 2			
18	Pike (*E. Lucius*)	234	34
19	Pike (*E. Lucius*)	230	36
20	Tench (*Tinca tinca*)	1130	41.5
21	Bream (*A. brama*)	1900	47.5
22	Tench (*T. tinca*)	1176	42
23	Pike (*E. Lucius*)	1200	46
24	Perch (*P. fluviatilis*)	1800	38
25	Pike (*E. Lucius*)	378	37
26	Bream (*A. brama*)	2100	45.5
Electrofishing Survey 3			
27	Pike (*E. Lucius*)	300	35
28	Tench (*T. tinca*)	769	36
29	Perch (*P. fluviatilis*)	27	12
30	Bream (*A. brama*)	120	18
31	Perch (*P. fluviatilis*)	51	11
32	Pike (*E. Lucius*)	294	35

Table 1. Birchenbridge electrofishing survey results

2.2 Netting Data Birchenbridge

Birchenbridge Pond netting survey data is shown in *Table 2* below.

Fish number	Species	Weight (g)	Length (cm)
1	Pike (*E. Lucius*)	159	29
2	Bream (*A. brama*)	79	17
3	Bream (*A. brama*)	69	16
4	Pike (*E. Lucius*)	201	31
5	Pike (*E. Lucius*)	382	38
6	Bream (*A. brama*)	8	13
7	Bream (*A. brama*)	41	14.5
8	Bream (*A. brama*)	2300	45.5
9	Pike (*E. Lucius*)	3100	70
10	Bream (*A. brama*)	130	20
11	Bream (*A. brama*)	76	17
12	Bream (*A. brama*)	52	17
13	Bream (*A. brama*)	86	19
14	Bream (*A. brama*)	108	19
15	Bream (*A. brama*)	35	19
16	Roach (*Rutilus rutilus*)	80	18
17	Bream (*A. brama*)	80	18
18	Tench (*T. tinca*)	1031	40
19	Bream (*A. brama*)	79	18.5
20	Roach (*R. rutilus)*	43	12.5
21	Bream (*A. brama*)	94	18
22	Roach (*R. rutilus)*	74	16
23	Pike (*E. Lucius*)	415	40
24	Pike (*E. Lucius*)	450	40
25	Pike (*E. Lucius*)	212	31
26	Bream (*A. brama*)	227	24
27	Roach (*R. rutilus)*	102	18
28	Pike (*E. Lucius*)	322	37
29	Perch (*P. fluviatilis*)	39	13
30	Perch (*P. fluviatilis*)	24	11

Table 2. Birchenbridge netting survey results

3.0 Survey Analysis

3.1 Biomass and Abundance

The biomass and abundance of Birchenbridge Pond is displayed in *Table 3* below.

Total Biomass (Electrofishing)	38.16 Kg
Total Biomass (Netting)	10.10 Kg
Extrapolated Biomass (Electrofishing)	945.60 Kg
Extrapolated Biomass (Netting)	202.00 Kg
Total Abundance (Electrofishing)	32 Fish
Total Abundance (Netting)	30 Fish
Extrapolated Abundance (Electrofishing)	793 Fish
Extrapolated Abundance (Netting)	600 Fish

Table 3. Fish Biomass survey of Birchenbridge Fishery

3.2 Length-Weight Relationships:

The k-value, also known as the Condition Factor (CF), is a commonly used metric in fisheries biology to assess the health, well-being, and physical condition of a fish. It provides insight into whether a fish is "plump" and healthy or "thin" and potentially stressed. The condition factor evaluates the relationship between a fish's weight and its length.

A high k-value usually indicates a fish in good condition with adequate fat reserves, suggesting that it is in a healthy environment with sufficient food availability. Alternatively, a low k-value may indicate poor nutrition, stress, or other environmental factors negatively affecting the fish.

3.3 Le Cren's Condition Factor

$$K_{LeCren} = \frac{w}{aL^b}$$

Le Cren's condition factor is used where there is large enough sample size for non-isometric growth pattern species

- K = 1 growth rates are natural
- K = > 1 growth rate is above the natural usual
- K = < 1 growth rate is below the natural usual

Breem (*A. brama*): $K_{lecren} = 1.07$

Pike (*E. Lucius*): $K_{lecren} = 1.01$

These results indicate that the population of pike (*E. Lucius*) are close to their natural growth rates and are growing nominally.

Bream (*A. brama*) has a slightly elevated K value, indicating that they are growing slightly faster than in natural conditions.

3.4 Fulton's K

Fulton's K is a mathematical formula used to assess the condition of a fish. It compares the weight of a fish to its length, providing an indication of its overall health and nutritional status. A higher K value generally suggests a healthier fish with more body reserves.

$$k_c = 100 \times \frac{W}{L^3}$$

Table 4 below displays Fulton’s K value for each species that does not have a large enough sample size for Le Cren’s condition factor.

Species	Average Fulton K value	Nominal value
Roach (*R. rutilus)*	1.78	1
Carp (*C. carpio*)	2.09	1.8-2.2
Perch (*P. fluviatilis*)	2.44	1
Tench (*T. tinca*)	1.61	1

Table 4. Fulton K value for each fish species surveyed at Birchenbridge pond (Eljasik, *et al 2022*)

Carp was found to be within nominal range for growth rates. All other fish species are growing above the expected natural growth rate.

4.0 Roosthole Netting Survey Results

The netting survey results for Roosthole Pond are shown in *Table 5* below.

Fish number	Species	Weight (g)	Length (cm)	Fulton K value
1	Pike (*E. Lucius*)	987	43	1.24
2	Mirror Carp (*C. carpio*)	4900	54	3.11
3	Mirror Carp (*C. carpio*)	3300	48	2.98
4	Pike (*E. Lucius*)	1700	51	1.28
5	Pike (*E. Lucius*)	182	29.5	0.71
6	Common Carp (*C. carpio*)	4700	60.5	2.12
7	Mirror Carp (*C. carpio*)	4800	59	2.34
8	Mirror Carp (*C. carpio*)	3100	47	2.99
9	Pike (*E. Lucius*)	622	43.5	0.76
10	Pike (*E. Lucius*)	240	33	0.67
11	Pike (*E. Lucius*)	1700	54	1.08
12	Common Carp (*C. carpio*)	4100	58	2.10
13	Common Carp (*C. carpio*)	3600	58	1.85
14	Roach (*R. rutilus)*	97	19	1.41
15	Roach (*R. rutilus)*	126	20	1.58
16	Roach (*R. rutilus)*	40	14	1.46
17	Common Carp (*C. carpio*)	4800	58	2.46
18	Mirror Carp (*C. carpio*)	5900	54	3.75
19	Mirror Carp (*C. carpio*)	5200	62	2.18
20	Pike (*E. Lucius*)	636	43	0.80
21	Mirror Carp (*C. carpio*)	4600	55	2.76
22	Mirror Carp (*C. carpio*)	5100	54	3.24
23	Common Carp (*C. carpio*)	3500	51	2.64
24	Roach (*R. rutilus)*	56	9	7.68
25	Roach (*R. rutilus)*	58	9	7.96
26	Roach (*R. rutilus)*	87	13.5	3.54
27	Roach (*R. rutilus)*	142	19	2.07
28	Roach (*R. rutilus)*	132	17	2.69
29	Roach (*R. rutilus)*	98	15.5	2.63
30	Roach (*R. rutilus)*	91	14	3.32

Table 5. Roosthole netting results

An average Fulton K value was calculated, excluding fish that are too young for an accurate assessment. The results are presented in *Table 6*.

Species	Average Fulton K value	Nominal value
Carp (*C. carpio)*	2.66	1.8-2.2
Pike (*E. Lucius*)	0.93	0.63
Roach (*R. rutilus)*	2.3	1

Table 6. Average Fulton K value for Roosthole (Eljasik, *et al 2022; Moslemi-Aqdam et al., 2014)*

Table 6 results indicate that all fish species are growing faster than their natural nominal rate.

5.0 Discussion

The fish biomass survey and health assessment conducted at Birchenbridge Pond and Roosthole Pond provide valuable insights into the fish populations and overall ecological conditions of these waterbodies. The results highlight several important aspects of species composition, growth rates, and health metrics, which are critical for informed fishery management.

5.1 Species Composition and Biomass

The surveys revealed a diverse fish population in both waterbodies; Common Carp (*C. carpio*), Mirror Carp (*C. carpio*), Pike (*E. Lucius*), Bream (*A. brama*) Tench (*T. tinca*), Roach (*R. rutilus)* and Perch (*P. fluviatilis*). Birchenbridge Pond displayed a higher total biomass, particularly when extrapolated from the electrofishing data, which estimated 945.6 kg of fish compared to 202.0 kg from netting. This disparity suggests that electrofishing captured a more representative snapshot of the fish population.

5.2 Growth Rates and Condition Factors

The condition factor analyses, using both Le Cren's and Fulton's K values, indicate healthy fish populations with growth rates that exceed nominal natural levels.

At Birchenbridge Pond:

- Pike (*E. lucius*) showed a condition factor (K) close to 1, indicating natural growth rates.
- Bream (*A. brama*) had a slightly elevated K value (1.07), suggesting faster-than-usual growth.

At Roosthole Pond, growth rates were more pronounced:

- Carp (*C. carpio*) displayed an average Fulton K of 2.66, exceeding the nominal range of 1.8–2.2.
- Roach (*R. rutilus*) exhibited an average K value of 2.3, significantly above the natural level.
- Pike (*E. lucius*) had a relatively low average K value (0.93), though still within a healthy range for the species.

These findings suggest favourable environmental conditions, particularly for Carp (*C. carpio*) and Roach (*R. rutilus*), likely due to ample food availability.

6.0 Water Quality Overview

A brief overview of the significant chemical parameters is given below. Each of the parameters is explained in terms of its effect on fish that sit at the top of the aquatic food chain, rather than as a key indicator. Fish are considered important under the Water Framework Directive (WFD) to assess the ecological standard of a body of water.

It perhaps should be noted that coarse fish such as Carp (*Cyprinus carpio*) along with other cyprinid fish can and will flourish in nutrient enriched conditions (eutrophication) so conditions that support a healthy fish community often also support communities of invasive algae.

6.1 pH

When analysts measure pH, they are determining the relative concentration of hydrogen ions. In a waterbody, the water's pH is affected by its age and the chemicals discharged by local communities, agriculture and industries. Most waterbodies are basic (alkaline) when they are first formed and become more acidic with time due to the build-up of organic materials. As organic substances decay, carbon dioxide (CO_2) forms and combines with water to produce a weak acid.

This weak acid is called "carbonic" acid. The formation of large amounts of carbonic acid will lower the water's pH.

The effect pH has on fish is slightly complicated by the synergistic effect it may have on other chemicals and compounds. For example, when acidic water meets certain chemicals and metals, they often become more toxic than normal.

6.2 Phosphates

Phosphorus is important for plant and animal growth. Phosphates are found in nearly all fertilisers which are washed from farm soils into nearby waterways at times of heavy rain. Whilst phosphate is unlikely to ever be at a level that will be toxic to freshwater fish, it does have a large part to play in eutrophication of our freshwaters along with nitrates. The effects of varying levels are illustrated in *Table 7*

Amount of total phosphate-phosphorus	Effects
0.01-0.03 mg/L	Amount of phosphate-phosphorus in most uncontaminated lakes
0.025 mg/L	Accelerates the eutrophication process in lakes
0.1 mg/L	Recommended maximum for rivers and streams

Table 7. Effects of varying levels of phosphorus/phosphates

6.3 Nitrogen Cycle & the breakdown of Ammonia

Nitrogen makes up about 80% of the air we breathe. As an essential protein component, it is found in the cells of all living things. Inorganic nitrogen may exist in its 'free' state as a gas, or as nitrites, nitrates or ammonia; organic nitrogen is found in proteins and other compounds, it is recycled continually by plants and animals; this natural process is known as the 'Nitrogen Cycle'.

Before specifically considering ammonia, an understanding of this important cycle should be gained. An overview of the nitrogen cycle in soil or aquatic environments is shown in *Figure 3* below. At any one time a substantial proportion of the total fixed nitrogen will be locked up in the biomass or in the dead remains of organisms (shown collectively as "organic matter").

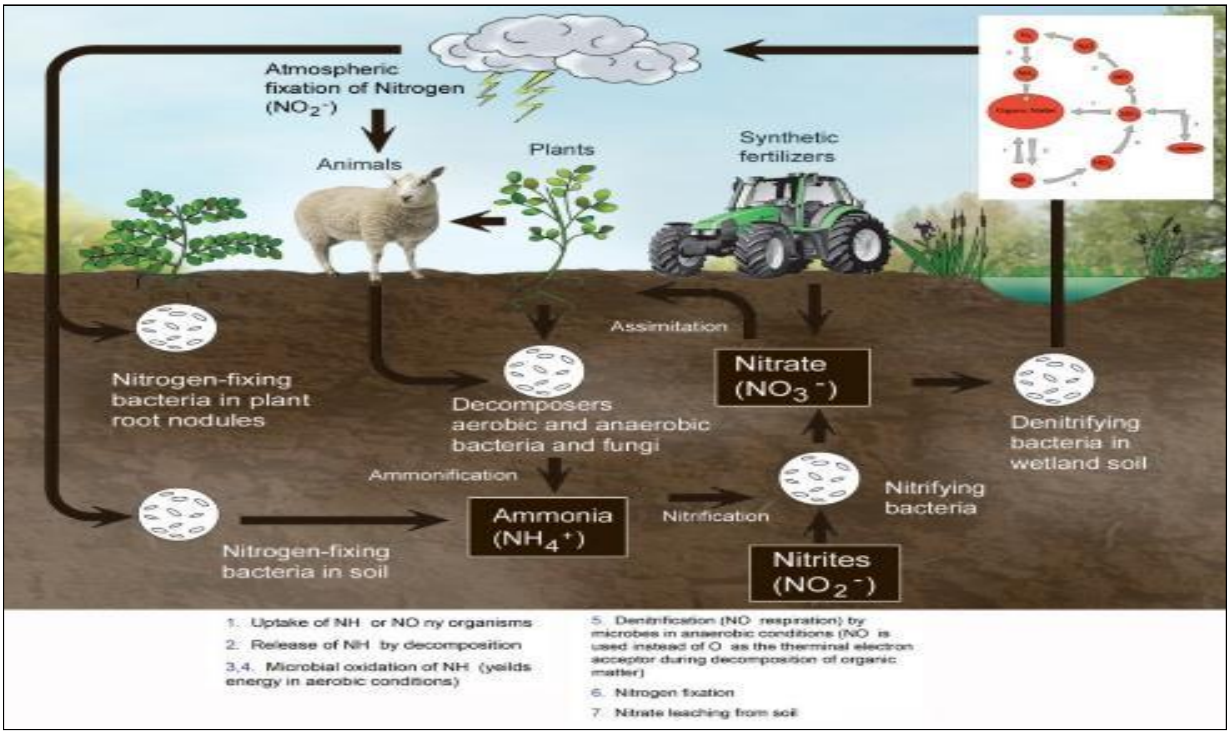

Figure 3. **The Nitrogen Cycle.**

The only nitrogen available to support new growth will be that which is supplied by nitrogen fixation from the atmosphere or by the release of ammonium or simple organic nitrogen compounds through the decomposition of organic matter. Some of other stages in this cycle are mediated by specialised groups of micro-organisms.

6.4 Ammonia

Ammonia is toxic to fish and aquatic organisms, even in very low concentrations. Ammonia levels greater than 0.1mg/L often indicates some degree of organic pollution.

The danger ammonia poses for fish depends on the water's temperature and pH, along with the dissolved oxygen (DO) and carbon dioxide levels (CO_2). The higher the pH and the warmer the temperature, the more toxic the ammonia becomes. It is also much more toxic to fish and aquatic life when water contains very little DO and CO_2. The effects of varying levels of ammonia are described in *Table 8*.

Un-ionised Ammonia – NH3	Effects to Fish
0.06 mg/L	Fish may suffer gill damage
0.2 mg/L	Sensitive fishlike trout and salmon begin to die
2.0 mg/L	Ammonia tolerant fishlike carp begin to die

Table 8. **Effects of ammonia on fish**

6.5 Nitrite

Nitrite is an intermediate product in the breakdown of ammonia to nitrate (nitrification). High nitrite levels in freshwater cause a serious condition known as brown blood disease in fish. Nitrite levels greater than 0.60 mg/L or 10 times higher than the toxic threshold for un-ionised ammonia is toxic to fish. Nitrite can be toxic to fish at levels above 0.03 mg/L.

The action of nitrifying bacteria uses CO_2 as their source of carbon to synthesise organic compounds. Organisms of this sort are termed chemoautotrophs. They gain their energy by chemical oxidations (chemo-) and they are autotrophs (self-feeders) because they do not depend on preformed organic matter.

Nitrifying bacteria are found in most waters of moderate pH but are not active in highly acidic water.

They are almost always found as mixed-species communities (consortia**)** because some of them are specialised to convert ammonium to nitrite (NO_2^-) (*Nitrosomonas*) while others convert nitrite to nitrate (NO_3^-) (*Nitrobacter*). So, in fact, the accumulation of nitrite inhibits *Nitrosomonas*, so it depends on *Nitrobacter* to convert this to nitrate, whereas *Nitrobacter* depends on *Nitrosomonas* to generate nitrite.

The nitrifying bacteria have some important environmental consequences, for example more plants and micro-organisms absorb either nitrate or ammonium. However, the process of nitrification has some undesirable consequences. The ammonium ion (NH_4^+) has a positive charge and so is readily adsorbed onto the negatively charged clay colloids and organic matter. In contrast, the negatively charged nitrate ion is not held on soil particles and so can be washed down the soil profile - the process termed leaching. In this way, valuable nitrogen can be lost from the soil, reducing the soil fertility. The nitrates can then accumulate in groundwater, and other waters adding to their eutrophic nature.

6.6 Nitrate

Nitrate is a major ingredient of farm fertiliser and when it rains, varying amounts of nitrate is washed from the farmland into nearby waterways. However, nitrates may also enter waterways from sources such as leaking septic tanks and cesspools.

Nitrates are also formed naturally by the action of bacteria on ammonia and nitrogen-containing compounds such as nitrite. Nitrate is not likely to be found at levels toxic to fish in natural or semi natural freshwater fishery environments.

6.7 Total Organic Carbon

Total Organic Carbon (TOC) is an important parameter in assessing water quality and its impact on fish health and the aquatic environment generally. TOC measures the amount of carbon found in organic compounds within the water. Elevated TOC levels can significantly impact aquatic ecosystems, as TOC serves as a source of carbon and energy for microorganisms, driving the decomposition of organic matter and influencing nutrient cycling.

Organic carbon decomposition releases nutrients such as nitrogen and phosphorus back into the water, affecting nutrient availability and potentially leading to imbalances. High TOC levels are often associated with eutrophication, a process where nutrient over-enrichment stimulates excessive plant and algal growth, depleting oxygen levels and harming aquatic life.

Although there are no strict safety limits for TOC, a euphotic waterbody, which is characterised by high biological productivity, typically has TOC levels ranging from 3 mg/L to 12 mg/L. In contrast, recommended levels of TOC in a waterbody are around 0.5 mg/L. Elevated TOC levels indicate higher organic matter content, which can lead to increased biological oxygen demand (BOD) and chemical oxygen demand (COD), straining the oxygen available for fish and other aquatic organisms.

TOC also interacts with other water quality parameters, such as pH and alkalinity, influencing their stability and buffering capacity.

These interactions are crucial for understanding the overall health of the aquatic ecosystem. TOC levels can vary seasonally and spatially, influenced by land use, climate, and hydrological conditions. Thus, long-term monitoring is essential to capture these variations and identify trends over time.

7.0 Water Quality Results

Water quality samples were collected from Birchenbridge Pond on 8th January 2025, received on 9th January 2025, and fully analysed on the 12th February 2025. The results of the analysis are presented in *Table 9* below.

Parameter	Unit	Result
pH	pH	6.25
Total Organic Carbon	mg/L	10
Phosphate as P	mg/L	<0.023
Ammoniacal Nitrogen as NH3-N	mg/L	0.048
Ammonia Un-ionised as NH3	mg/L	0
Ammonium as NH4+	mg/L	0.04
Nitrate as (NO3-N)	mg/L	4.845
Nitrite as N (NO2-N)	mg/L	0.327

Table 9. Water quality parameters and results for Birchenbridge Pond, 8th January 2025

7.1 pH

The ideal pH range for is between 6.5 and 8.5. Over time, waterbodies tend to become more acidic due to the accumulation of organic material, which lowers the pH. The recorded pH for the site is 6.25, placing the waterbody in a slightly acidic state, while a value of 6.25 is not greatly concerning in terms of fish health, additional stocking of fish may reduce pH, creating an unsuitable environment and reducing the productivity of the fishery.

7.2 Phosphate

Elevated phosphate concentrations can lead waterbodies into a eutrophic state. Eutrophication can severely threaten aquatic ecosystems. This eutrophication can include oxygen depletion due to the increased decomposition of organic matter, which may result in a loss of fish populations. The total phosphate concentration for the site is <0.023mg/L, indicating low phosphate loading and is not a current cause of concern.

7.3 Nitrogen

Total oxidised nitrogen (NO_x-N) is the sum of the concentrations of nitrate, nitrite, and ammoniacal nitrogen.

7.3.1 Nitrate (NO_3)

For many freshwater systems, nitrate levels should be kept below 1 mg/L to protect sensitive species, such as salmonids. Concentrations above 10 mg/L can cause eutrophication in waterbodies, although nitrate alone is unlikely to harm non-sensitive fish species.

The World Health Organisation (WHO) recommends a maximum nitrate concentration of 50 mg/L in drinking water. The nitrate levels recorded for the waterbody is 4.85 mg/L which is a moderate concentration and is no current cause of concern.

7.3.2 Nitrite (NO_2)

Nitrite is toxic to aquatic organisms, even at low concentrations. Ideally, nitrite levels should be kept below 0.1 mg/L for many freshwater species. Acute toxicity can occur at levels as low as 0.2 mg/L, and concentrations above 1 mg/L can be lethal. The recorded nitrite level in the waterbody is 0.327 mg/L, which is a moderately elevated value that may impact fish health and overall fishery productivity.

7.3.3 Ammoniacal nitrogen as NH3-N

Ammoniacal nitrogen, which represents the combined measure of un-ionised ammonia and ammonium, was recorded at 0.048 mg/L. This value falls within the typical range and is not a cause of concern.

7.3.4 Un-ionised Ammonia (NH_3-N)

Un-ionised ammonia should ideally be kept below 0.02 mg/L to protect sensitive aquatic life. Concentrations above 0.1 mg/L can be harmful or lethal, depending on pH and temperature (see *Table 3*). The NH_3-N levels recorded in the waterbody were recorded at 0 mg/L which is ideal in terms of fish health.

7.3.5 Ammonium (NH_4^+)

While ammonium, is less toxic than un-ionised ammonia, elevated concentrations can still impact aquatic ecosystems by contributing to nutrient loading and promoting eutrophication. Concentrations below 0.5 mg/L are generally considered acceptable. Elevated concentrations, particularly above 1 mg/L, can contribute to nutrient imbalances. The ammonium levels recorded in the waterbody were recorded at 0.04 mg/L, this value falls within the acceptable range and is not a current cause of concern.

7.4 Total Organic Carbon (TOC)

In a euphotic waterbody, characterised by high biological productivity, TOC typically ranges from 3 mg/L to 12 mg/L. Recommended TOC levels for waterbodies are around 0.5 mg/L. The TOC concentration in waterbody were recorded at 10mg/L indicating elevated biological productivity and placing the waterbody in a euphotic state.

8.0 Discussion

The water quality results at Birchenbridge Pond present a mixed outlook for fish health. On the positive side, low phosphate levels (<0.023 mg/L) and acceptable concentrations of ammoniacal nitrogen (0.048 mg/L) and un-ionised ammonia (0 mg/L) indicate a stable environment that can support healthy fish populations.

However, potential concerns arise due to the slightly acidic pH (6.25), which lies below the optimal range of 6.5–8.5 and may impose stress on pH-sensitive fish species. Furthermore, the elevated nitrite concentration (0.327 mg/L), which exceeds the recommended threshold of 0.1 mg/L for freshwater species, poses a risk of toxicity. While the current conditions do not indicate an immediate threat, proactive treatment is recommended to reduce the risk of blue green algal blooms and elevated nitrite toxicity.

9.0 Management

9.1 AquaBio

Elevated nitrate levels often indicate an imbalanced and eutrophic aquatic system, typically caused by poor-quality hydro-soil. To address this issue at its source, Lake Aid AquaBio is recommended for restoring ecological balance by improving hydro-soil conditions. The treatment involves an initial application of two 1000kg doses per hectare over winter, followed by an annual dosage of 1000kg per hectare. The two waterbodies surrounded by woodland, leaf litter contributes to organic decay, increased silt, and nutrient loading. AquaBio helps stabilise these conditions by fostering nitrifying bacteria that convert harmful nitrite into less toxic nitrate. By enhancing natural biological processes, AquaBio mitigates nitrite impact and supports a healthier aquatic ecosystem. Refer to *Appendix 2* for an information poster on AquaBio.

9.2 Baiting Management

A recent study in fisheries management by Imbert *et al* (2025) found that excessive baiting can have significant ecological consequences, by increasing nutrient concentrations in waterbodies. To mitigate these impacts, fisheries should implement measures to control bait input. Clear signage should be installed to inform anglers that over-baiting or disposing of unwanted bait into the waterbody, negatively affects water quality. By raising awareness and promoting responsible baiting practices, the fisheries can help maintain a balanced ecosystem and sustain angling success.

9.3 Bacterius

Treating a waterbody that is out of biological and physiochemical equilibrium with beneficial bacteria can have significant positive impacts on its overall health and water quality. At AGA we trust in a leading product from North America called Bacterius™. The health of a waterbody can be compared to the human gut biome, whereby there is an interdependence of the health of the individual with the quality of good bacteria within the individual's system.

However, treating with beneficial bacteria should be part of a comprehensive waterbody management strategy that considers other factors such as nutrient control, aeration, and habitat restoration to achieve long-term success. The strain of bacteria is dependant of the goals and objectives of the management plan. AGA regularly uses five different types (species) of bacteria in terms of mixes, blends and time of application. An information sheet is attached as *Appendix 3*. Here are the key improvements that such treatment can bring.

1. Improved Water Clarity: Beneficial bacteria can help break down suspended organic matter, such as algae and dead plant material, which contributes to water turbidity. By reducing these particles, water clarity improves, allowing more light to penetrate deeper into the water column. This benefits aquatic plants, which in turn can help stabilise the ecosystem by providing habitat and oxygen production.

2. Reduction in Nutrient Levels: Beneficial bacteria can consume excess nutrients like nitrogen and phosphorus, which often lead to water quality issues. In waterbodies with nutrient imbalances, these nutrients can fuel the growth of harmful algae and aquatic weeds. By reducing nutrient levels, beneficial bacteria can help control algal blooms and maintain a more balanced aquatic ecosystem.

3. Enhanced Oxygen Levels: Aeration and the breakdown of organic matter by beneficial bacteria can increase dissolved oxygen levels in the water. Adequate oxygen is essential for fish and other aquatic organisms to thrive. In a waterbody out of equilibrium, low oxygen levels can lead to fish kills and other ecological problems. Beneficial bacteria play a role in stabilising oxygen concentrations.

4. Reduction in Odours and Muck Accumulation: Beneficial bacteria can break down organic sludge and sediments that accumulate at the waterbody bottom. These sediments often release foul-smelling gases like hydrogen sulphide when they decompose anaerobically. By promoting aerobic decomposition through the activity of beneficial bacteria, these odours can be reduced, and the waterbodies bottom sediments can be less mucky.

5. Restoration of Biological Equilibrium: Beneficial bacteria can help establish a more balanced and diverse microbial community in the waterbody. This, in turn, can support the entire food web. As nutrient levels are reduced and water quality improves, native species may return, and the waterbodies' biological equilibrium can be restored. This is essential for the long-term health of the waterbody ecosystem.

6. Algal Bloom Control: Many harmful algal blooms are fuelled by excess nutrients and low oxygen levels. Beneficial bacteria can help mitigate these blooms by reducing nutrient availability and promoting the competition of beneficial microorganisms with harmful algae for resources. This can lead to a reduction in the frequency and severity of algal blooms.

7. Enhanced Resilience to Environmental Changes: A waterbody brought into biological and physiochemical equilibrium through beneficial bacteria treatment is generally more resilient to environmental changes. It can better withstand natural fluctuations in nutrient inputs, temperature, and other factors without experiencing drastic water quality issues. It is important to note that the effectiveness of beneficial bacteria treatment can vary based on several factors, including the specific bacterial strains used, the waterbodies size and conditions, and the ongoing management practices. Regular monitoring and maintenance are typically necessary to sustain the improvements achieved through bacterial treatment and to adapt to changing environmental conditions.

We recommend applying Bacterius following an initial treatment with AquaBio and a water quality test to assess its suitability as a management strategy for the fisheries. This approach ensures that Bacterius is used effectively.

9.4 Bio X

Overgrowth of filamentous algae (blanket weed) and blue-green algae (BGA) Cyanobacteria has historically been carried out using ‘cereal’ straw, in particular that of barley. The effect is not fully understood, it is believed that the straw omits hydrogen peroxide and lignin which act as an organic algaecide. The application of barley straw can be a laborious and time-consuming process; however, alternatives are available such as Lake Aid Bio X. This product is commercially available and is a barley straw extract. It has the same inhibiting effect on the growth of algae with lignin being the active ingredient, without the labour-intensive process of introducing and removing large quantities of barley straw. Barley straw can be very effective in some waterbodies but conversely have little effect in others.

As a general rule barley straw concentrate such as Lake Aid Bio X does not work where traditional applications of barley straw fail to control algae. The product seems to be affected by a host of environmental factors such as high pH which is considered to affect the way the inhibiting chemicals lignin are broken down from the straw. A product leaflet is shown as *Appendix 4*. We recommend applying Lake Aid Bio X following an initial treatment with AquaBio and a water quality test to assess its suitability as a management strategy for the fishery. This approach ensures that Lake Aid Bio X is used effectively.

9.5 Further testing

AGA Group Consultancy recommends annual testing of waterbodies to assess whether chemical parameters, such as pH and nitrite, exceed safe limits for fish.

If treatments are applied, regular testing also helps evaluate their effectiveness and determine whether adjustments to management strategies are necessary.

9.6 Conclusion

The fish biomass surveys, and water quality test provide valuable data for the sustainable management of Birchenbridge Pond and Roosthole Pond. While both waterbodies support healthy and diverse fish populations, the slightly acidic pH and elevated nitrite levels at Birchenbridge Pond, highlight the need for monitoring and proactive management. By addressing these challenges, the Horsham District Angling Club can ensure the continued ecological health and productivity of these fisheries.

10.0 References

Eljasik, P., Panicz, R., Sobczak, M., & Sadowski, J. (2022). Key Performance Indicators of Common Carp (Cyprinus carpio L.) Wintering in a Pond and RAS under Different Feeding Schemes. Sustainability, 14(7), 3724. https://doi.org/10.3390/su14073724

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Appendix 1: Roosthole Health check

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Page 1 of 2.

FISH HEALTH EXAMINATION			
To:	Mr Lee Waller		
Tel:	07865 439818		
e-mail:	lee.david.w.1979@outlook.com		
Ref:	**CP2425-117**		
Received:	7th January 2025		
Completed:	8th January 2025 / Roach 24th January 2025		
Locality reference:	Roosthole Pond, Hammer Pond Road, Horsham, RHG13 6PG		
Site Ref History:	Site: Permit: EW011-C-052		
Fish species:	Carp (*Cyprinus carpio*) Pike (*Esox Lucius*) Roach (*Rutilus rutilus*)	**Sample Size:**	13 10 10
Weight range (g)	**Length range (cm)**	**Sex**	
Carp: 3100 - 5900 Pike: 182 - 1700 Roach: 40 - 126	Carp: 47.0 – 62.0 Pike: 29.5 – 54.0 Roach: 14.0 – 20.0	Not recorded	

The health examination was commissioned by on behalf of Horsham Angling Club.

Thirty-three (33) fish were examined using accepted methodology and criteria for Section 30 health checks, pursuant to Fish Movements under The Keeping and Introduction of Fish (England and River Esk Catchment Area) Regulations 2015.

General comments:

The thirty-three (33) fish sample that was examined was made up from three (3) species, being Carp (*Cyprinus carpio*), Pike (*Esox lucius*) and Roach (*Rutilus rutilus*) There was found to be know significant disease to report (Category 2 Pathogen - CAT II). However there were diseases worthy of note present, which are outlined below.

Appearance.

The three species examined appeared to be in a condition commensurate with moderate angling pressure seen as some light to moderate hook damage to the mouths of the carp (*C. carpio*). No mouth or fin damage with no obvious scale loss or damage commensurate with capture or predation.

Skin.

Nothing of significance to report however there were low infections of *Trichodina spp.* on all three species of fish examined

Gills.

Nothing of significance to report however there were low infections of *Gyrodactylus spp.* on the Carp (*C. carpio*) examined.

Internal.

Nothing of significance to report. However there were light to medium infections of *Triaenophorus nodulosus* in the pike (*E. Lucius*)

General

The fish did not display any visual signs of bacterial or viral infection.

Recommendation and advice

The sample as described above and the examination meets the criteria of Section 30 health checks, pursuant to Fish Movements under The Keeping and Introduction of Fish (England and River Esk Catchment Area) Regulations 2015.

Note:

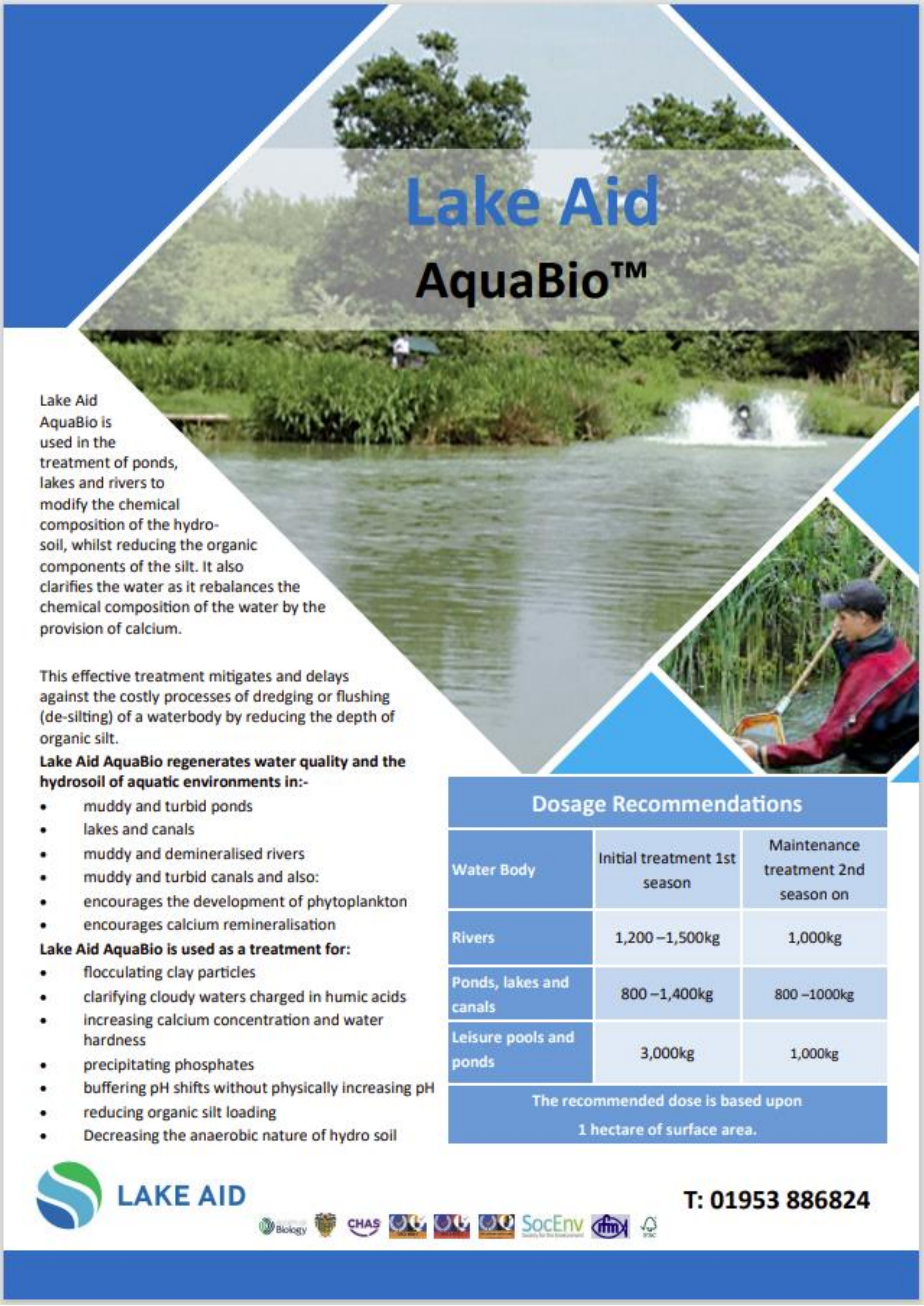
No responsibility is accepted for the source locality reference given above or indeed no assurance can be given that the sample examined is representative of any specific batch or stock of fish.

The examination was performed by:

Ash Girdler **C.Biol, FRSB, CENV, MIFM, FIFM.**
AGA Fish Health

A.R. Girdler - Principal Consultant.
Date: 8th January 2025.

Appendix 2: Lake Aid AquaBio



Lake Aid
AquaBio™

Lake Aid AquaBio is used in the treatment of ponds, lakes and rivers to modify the chemical composition of the hydro-soil, whilst reducing the organic components of the silt. It also clarifies the water as it rebalances the chemical composition of the water by the provision of calcium.

This effective treatment mitigates and delays against the costly processes of dredging or flushing (de-silting) of a waterbody by reducing the depth of organic silt.

Lake Aid AquaBio regenerates water quality and the hydrosoil of aquatic environments in:-

- muddy and turbid ponds
- lakes and canals
- muddy and demineralised rivers
- muddy and turbid canals and also:
- encourages the development of phytoplankton
- encourages calcium remineralisation

Lake Aid AquaBio is used as a treatment for:

- flocculating clay particles
- clarifying cloudy waters charged in humic acids
- increasing calcium concentration and water hardness
- precipitating phosphates
- buffering pH shifts without physically increasing pH
- reducing organic silt loading
- Decreasing the anaerobic nature of hydro soil

Dosage Recommendations

Water Body	Initial treatment 1st season	Maintenance treatment 2nd season on
Rivers	1,200 –1,500kg	1,000kg
Ponds, lakes and canals	800 –1,400kg	800 –1000kg
Leisure pools and ponds	3,000kg	1,000kg

The recommended dose is based upon 1 hectare of surface area.

LAKE AID

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LAKE AID AQUABIO.

To enhance fishery conditions **Lake Aid AquaBio** facilitates the breakdown of previously partially decomposed organic material and boosts aerobic digestion. Untreated the hydro-soil becomes anaerobic producing the undesirable gases methane and hydrogen sulphide. Because of their inbuilt instincts fish will always avoid these poor water areas.

TREATMENT PERIOD.

Any time of the year but most effective between March to November in Temperate regions (water temp 10C).

Two or three treatments spread over a season will be more effective than one application.

This is particularly true for lake bed hydro-soil where there is a significant proportion of partially digested sediment or anaerobic conditions forming the noxious gasses associated with the anaerobic substrate.

PRODUCT DESCRIPTION.

Lake Aid AquaBio is completely harmless to all aquatic organisms including fish and amphibians.

Lake Aid AquaBio is a micronised powder produced from the processing of high purity mineral ($CaSO_4.2H_2O$ - Calcium Sulphate Di-hydrate).

Lake aid AquaBio is completely harmless to all aquatic organisms including fish and amphibians.

TECHNICAL DATA.

For a comprehensive technical data sheet please contact A.G.A. direct.

HEALTH AND SAFETY.

These products are not classified as dangerous/hazardous chemicals. Health and Safety information sheets are always available on request.

SUPPLY DETAILS.

Lake Aid AquaBio is supplied in handy 25Kg plastic sacks.

STORAGE.

When stored under normal dry conditions, this product will not deteriorate chemically, however it is susceptible to compaction lumps. Each bag is stamped with a date of manufacture and a batch reference. Stocks should be rotated so that the oldest material is used first.

This information is subject to change arising from new developments and findings. If you are unable to find the item you are looking for, please do not hesitate to contact us immediately.

The A.G.A. Group installation teams operate solely within the field of aquatic and bioengineering. We operate a policy of 'Best Practice' and are bound by the Code of Conduct of both the Institute of Fisheries Management and the Society of Biology. The A.G.A. Group will quote for the supply of materials, their installation or for 'turnkey' projects.

A.G.A. is Quality assured to: ISO45001 : 2018, ISO9001 : 2015 & ISO 14001 : 2015

A.G.A. Group, MMG and MHP and AGACES are trading styles of A.G.A. Group Enviro-Fix Limited

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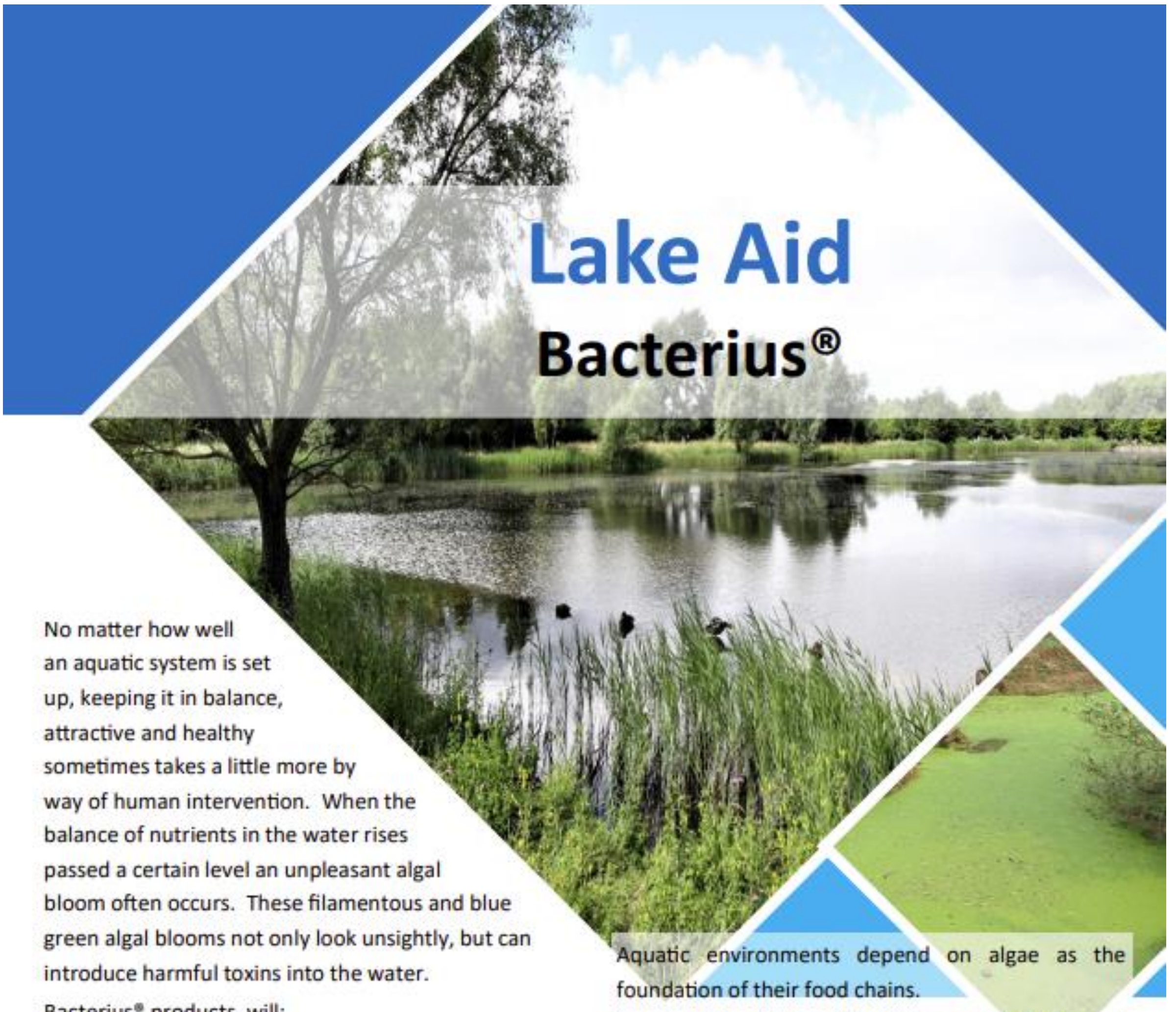
Appendix 3: Bacterius



Lake Aid

Bacterius®

No matter how well an aquatic system is set up, keeping it in balance, attractive and healthy sometimes takes a little more by way of human intervention. When the balance of nutrients in the water rises passed a certain level an unpleasant algal bloom often occurs. These filamentous and blue green algal blooms not only look unsightly, but can introduce harmful toxins into the water.

Bacterius® products will:

- Reduce the levels of nutrients
- Reduce the phosphorus loading
- Reduce the nitrogen loading
- Breakdown dead algae
- Reduce algal blooms
- Reduce toxicity
- Reduce Sludge build up

Bacterius® is safe for fish and plants and will help support fish health and clear water.

Aquatic environments depend on algae as the foundation of their food chains.

In a healthy, stable setting, the amount of algae is regulated by various factors such as light, temperature, available gases, other nutrients, and the organisms that consume it.

Most aquatic systems achieve a balanced state where these factors stabilise. However, this balance may not always be ideal from our perspective. When phosphorus levels increase, it typically encourages the growth of filamentous and blue-green algal blooms.

LAKE AID

Bacterius.

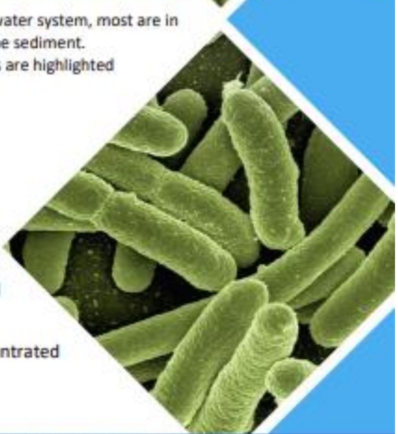
BACTERIUS®

Bacterius®: Natural Water Treatment Solutions
Bacterius® is a brand of water treatment products designed to improve water quality as naturally as possible. Supplied by Canadianpond, a company renowned for its expertise in bioaugmentation and water treatments, Bacterius® products leverage the power of beneficial microorganisms to transform water parameters. In the UK, A.G.A Group is the exclusive supplier of this innovative technology and has successfully used it to treat ponds and lakes across the country.

How Does It Work?
Bioaugmentation involves introducing cultured beneficial microorganisms into an existing microbial community. These microorganisms reduce nutrient levels and break down unwanted compounds, thereby enhancing water quality. Specifically, the microorganisms in Bacterius® products produce enzymes that biodegrade or transform excess ammonia, nitrites, phosphorus, and hydrocarbon-based contaminants. This enzymatic activity is crucial in maintaining a healthy aquatic environment.
The enzymes released by the microbes in Bacterius® products break down various compounds that may contaminate aquatic environments. Bioaugmentation with Bacterius® offers many benefits:

- **Reducing Odours:** The breakdown of organic matter by beneficial microorganisms helps eliminate unpleasant odours commonly associated with stagnant or polluted water bodies.
- **Natural Clarification of Pond Water:** The enzymatic activity helps clear suspended particles and organic matter, increasing water clarity and enhancing the aesthetic appeal of ponds and lakes.
- **Reducing the Risk of Sickness and Death Among Fish:** By maintaining balanced nutrient levels and reducing harmful compounds, bioaugmentation promotes a healthier environment for fish, decreasing disease and mortality rates.
- **Clearing Lake or Pond Bottoms and Reducing Silt:** The microorganisms break down organic matter that accumulates on the bottoms of ponds and lakes, reducing silt and sediment buildup and maintaining the natural depth and health of these water bodies.
- **Controlling Algal Growth, Including Blue-Green Algae:** By breaking down excess nutrients, the beneficial microbes help control and prevent excessive algal growth, maintaining a balanced and healthy aquatic ecosystem.
- **Controlling Ammonia Levels:** Denitrifying bacteria break down harmful ammonia, converting it into nitrogen gas (N_2), which is harmlessly released into the atmosphere.

PRODUCTS WE OFFER



Bacterius® products come in various different product types, each specialised to the needs of the water system, most are in liquid form and are applied to the surface while some are in solid forms designed to dig deep into the sediment.
All Bacterius® products are non-toxic and safe for the environment, the products A.G.A Group offers are highlighted below .

Bacterius® C – Organic matter and waste controller

Bacterius® N – Nitrogen controller to reduce ammonia and nitrites (water nitrification)

Bacterius® EQUINOX – Cold Water Beneficial Bacteria Treatment

Bacterius® MUCK – Concentrated bacterial pellets for treating shoreline muck and sediment rich areas

Bacterius® 5B – High concentration bacteria with barley straw for sediment reduction and water clarity

Bacterius® 1B – Natural bacteria with barley straw, same formulation as 5B but less concentrated

Bacterius® POND – Nitrification and control of organic sediment

This information is subject to change arising from new developments and findings. If you are unable to find the item you are looking for, please do not hesitate to contact us immediately.
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Appendix 4: Bio-X

Easy-to-use, no mess, no unsightly rotting straw, a pure natural straw extract for clearer water.

Using **Lake Aid Bio-X** for conditioning contained water is more effective than straw, it's economical, works faster and totally eliminates the high cost of transporting and handling barley straw.

The benefits of **Lake Aid Bio-X:**

- Harmless to pets
- Harmless to fish and wildlife in ponds
- Controls algae and filamentous algae (blanket weed)
- Accelerates the clearing of the green water
- Contains no synthetic chemicals or artificial pesticides
- Becomes effective weeks earlier than barley straw
- Can safely be used in ponds with filters and water features
- Excellent value
- Environmentally friendly

The A.G.A. Group's Biologists have concentrated the inhibiting chemical compounds produced by barley straw into a practical easy to apply extract.

The application of **Lake Aid Bio-X** barley straw concentrate has the same inhibiting effect on the growth of algae without the often arduous and untidy process of introducing and removing large quantities of barley straw.

LAKE AID

T: 01953 886824

ALGAE CONTROL.

Lake Aid Bio-X is a concentrate of barley straw which conditions the water to inhibit and control algae growth. For years' environmentalist and pond keepers alike have been using barley straw treatment as a control against the nuisance of algae. This laborious and expensive control is no longer the ideal answer.

Lake Aid Bio-X should be applied initially at a dose rate of 5 litres per acre before dilution.

The concentrate should be added to the water body by mixing at least 1 part concentrate to 5 parts water, this is done, not directly to dilute the product, but simply to create volume thus ensuring a good initial spread across the entire area of the waterbody

Further weekly treatment should then be carried out at 1-5 litres per acre dosage, still diluting the product for ease of application across the water surface.

Ideally the dilute concentrate should be applied from a boat preferably by spraying out through a knapsack sprayer which should be kept clean of any other chemicals.

Alternatively it can be drizzled gradually into a running inlet which will then naturally distribute it with the flows and currents.

Lake Aid BioX contains: Aqueous barley straw extract as a natural source of plant lignin. Lake Aid Bio-X is triple distilled to ensure 'full strength' delivery of the active ingredient

DOSAGE.

Lake Aid Bio-X is available in handy 25 litre drums.

Other pack options such as IBC 1000 litre containers available

Initial application rates 5 litre per acre. Subsequent regular applications 1.5 litre per acre should be carried out at weekly intervals.

The treatment should be carried out through the algae season. We therefore recommended that the critical application of **Lake Aid Bio-X** is commenced in early spring and used throughout the spring and summer to prove most effective in the control of algae.

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