THE APPLICATION OF A DUCKWEED WASTEWATER TREATMENT SYSTEM AT THE HARRINGTON SEWERAGE TREATMENT WORKS

Overview

The town of Harrington is situated on the mid-north coast of NSW, 320 kilometres north of Sydney. Bio-Tech Waste Management Pty Ltd was commissioned to install its duckweed wastewater treatment solution at the Harrington Sewerage Treatment Works (STW) which uses a Pasveer Channel Treatment Process. Harrington has average temperatures of 26 degrees C. in the summer months and 16 degrees C. in the winter months. The temperature of the wastewater in the ponds varies between 27 degrees C. in the summer months and 11 degrees C. in the winter months.

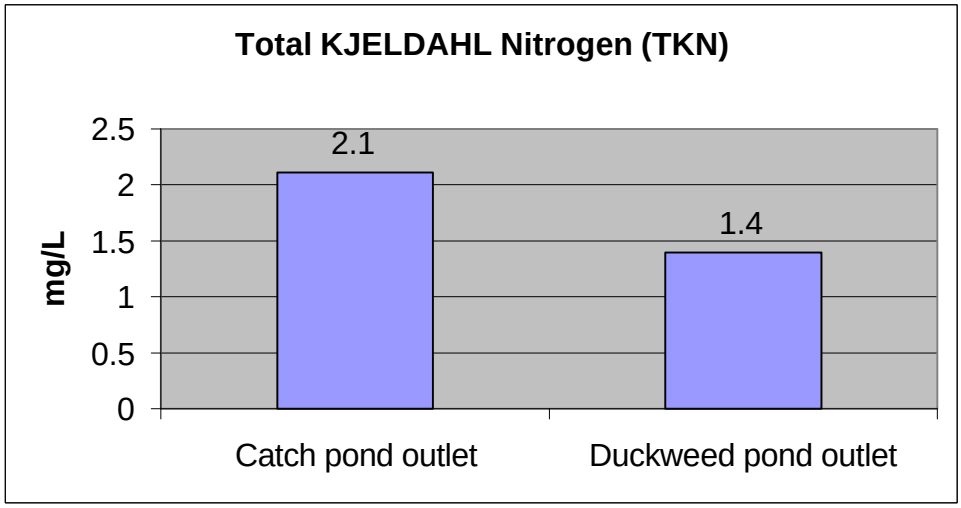
The influent enters the Pasveer Channel for primary treatment, which is a continuous process, after which it flows on to two clarifiers. From the clarifiers the treated effluent flows into a catch pond, which has a retention time of two days. The effluent flows from the catch pond in equal volumes into two maturation ponds, which have identical retention times. The first maturation pond was converted into a duckweed pond while the second maturation pond was used as the control pond.

For the Total Kjeldahl Nitrogen, Total Phosphorus, Nitrate, Nitrite and Ammonia Nitrogen analyses, water samples were taken from the outlets of the catch pond and duckweed pond. For the Suspended Solids and Faecal Coliforms analyses, water samples were taken from the outlets of the control and duckweed pond. The pH readings were taken from the control and duckweed pond.

Nitrogen results

Nitrogen exists in several forms in sewerage effluent, ammonia, organic nitrogen, nitrites and nitrates. Duckweed does not fix nitrogen itself but reportedly has a preference for ammonia and nitrates but can also utilise organic nitrogen. Total Kjeldahl nitrogen (TKN) includes ammonia and organic nitrogen but does not include nitrate or nitrite nitrogen.

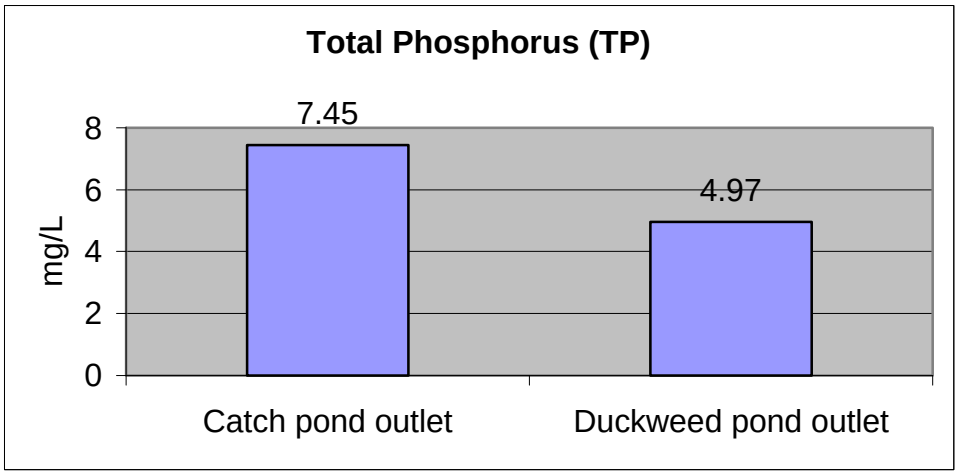
Denitrification occurs in the Pasveer Channel, limiting the levels of TKN and discouraging duckweed growth. The levels of TKN entering both the Catch and Duckweed Pond over a 18 month period were very low, averaging 2.1 mg/l, well below a level necessary to sustain a modest growth of Duckweed.



Phosphorus results

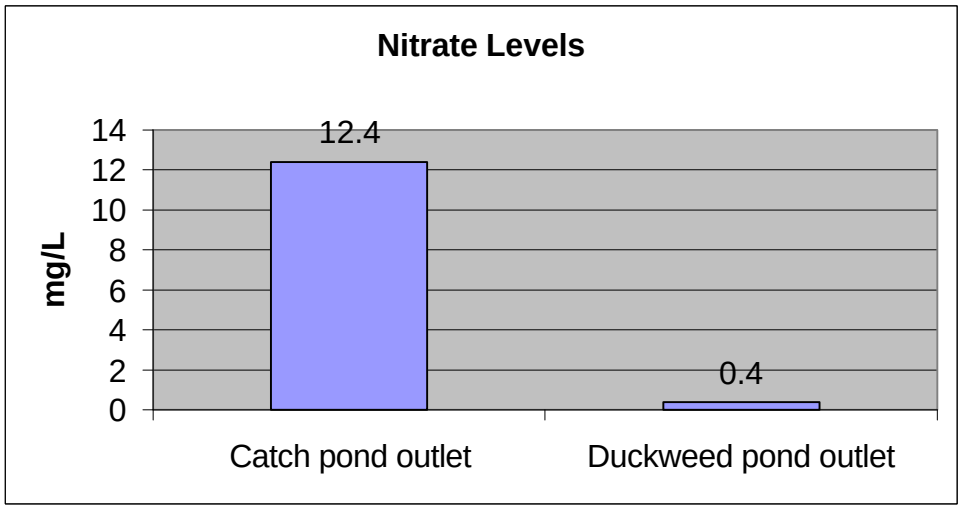
Total Phosphorus (TP) is a nutrient required for biological growth. Normal biological growth in a sewerage treatment process will remove from 10 to 30 percent of the Phosphorus in the sewerage, the balance being discharged with the effluent.

Duckweed absorbs different forms of phosphorus at different rates dependent upon their concentrations, but mostly takes up orthophosphate. Duckweed has a lower growth limit than other pleustophytes and is able to compete effectively for phosphorus in nitrogen poor waters, especially against algae.



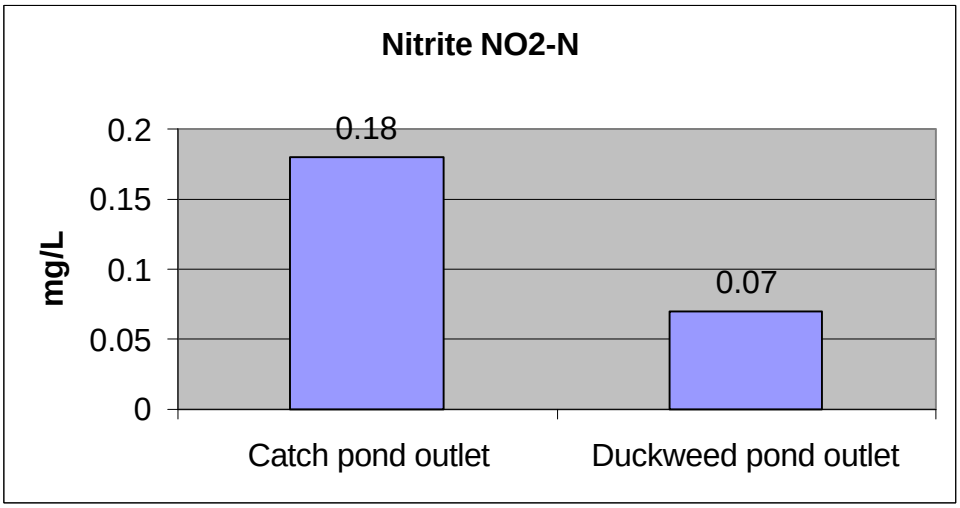
Nitrate results

Nitrate is found only in small amounts in fresh domestic wastewater but in the effluent of nitrifying biological treatment plants, nitrate may be found in concentrations of up to 30 mg (as N)/L. It is an essential nutrient for many photosynthetic autotrophs and in some cases has been identified as the growth-limiting nutrient. Duckweed uses the Nitrate as its growth nutrient at the Harrington STW because of the low levels of TKN and NH3-N.



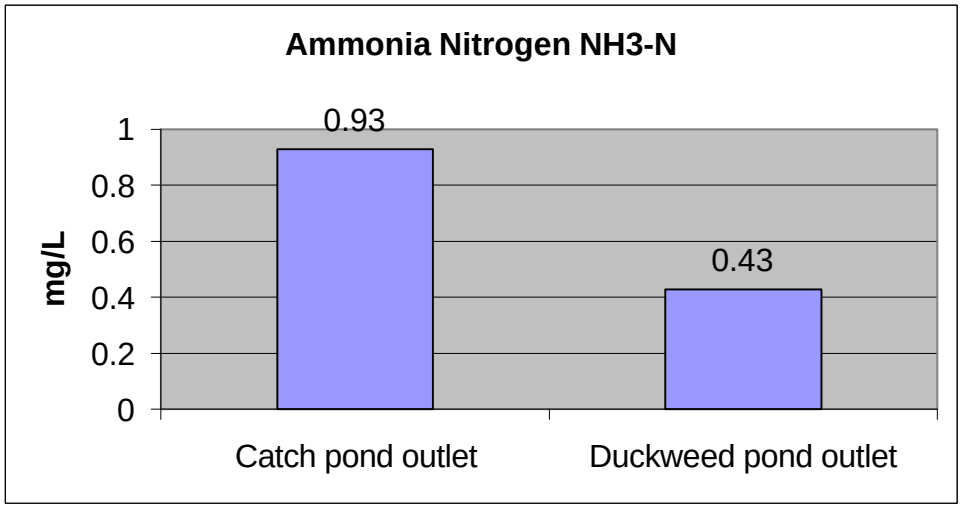
Nitrite results

Nitrite is an intermediate oxidation state of nitrogen, both in the oxidation of ammonia to nitrate and in the reduction nitrate. Such oxidation and reduction may occur in wastewater treatment plants.



Ammonia nitrogen results

The level of NH3-N is determined by the extent of aeration during the treatment process.

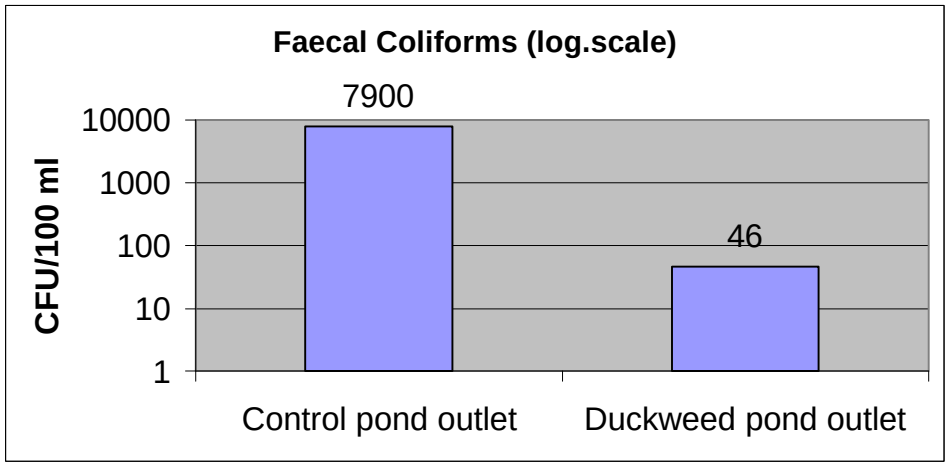


Faecal coliforms.

This coliform group of bacteria is part of the Total Coliform group, and is principal indicator of contamination and the suitability of water for a variety of uses. Maturation

ponds are provided to disinfect the treated effluent from STWs. It was initially thought that the main instrument of disinfection in these ponds is UV light.

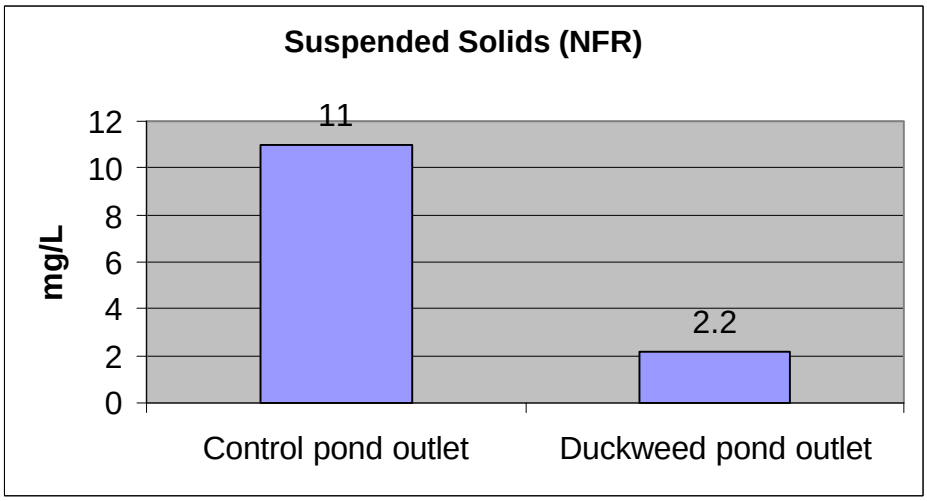
The duckweed restricts light penetration and may inhibit disinfection in the maturation ponds. However, recent studies (DLWC, 1988) have shown that a high level of disinfection is still achieved with 100% shading over maturation ponds. The graphs show the faecal coliform level exiting the duckweed pond was substantially lower than the level exiting the control pond.



Suspended solids

Suspended solids (NFR) analyses are important in the control of biological and physical wastewater treatment processes and for assessing compliance with regulatory agency wastewater effluent limitations.

The duckweed forms a mat over the surface of the pond displacing algae and blocking sunlight. The duckweed also competes with the algae for the nutrients in the wastewater.



Conclusion

From the results of the Harrington STW installation, the efficacy of the Duckweed solution can be clearly demonstrated. While it shows that the standards applied by most state EPAs are not only met but exceeded, the results also have other implications. In particular, the control of algae growth (as shown by Suspended Solids levels) and the potential implications this has for wastewater re-use applications.