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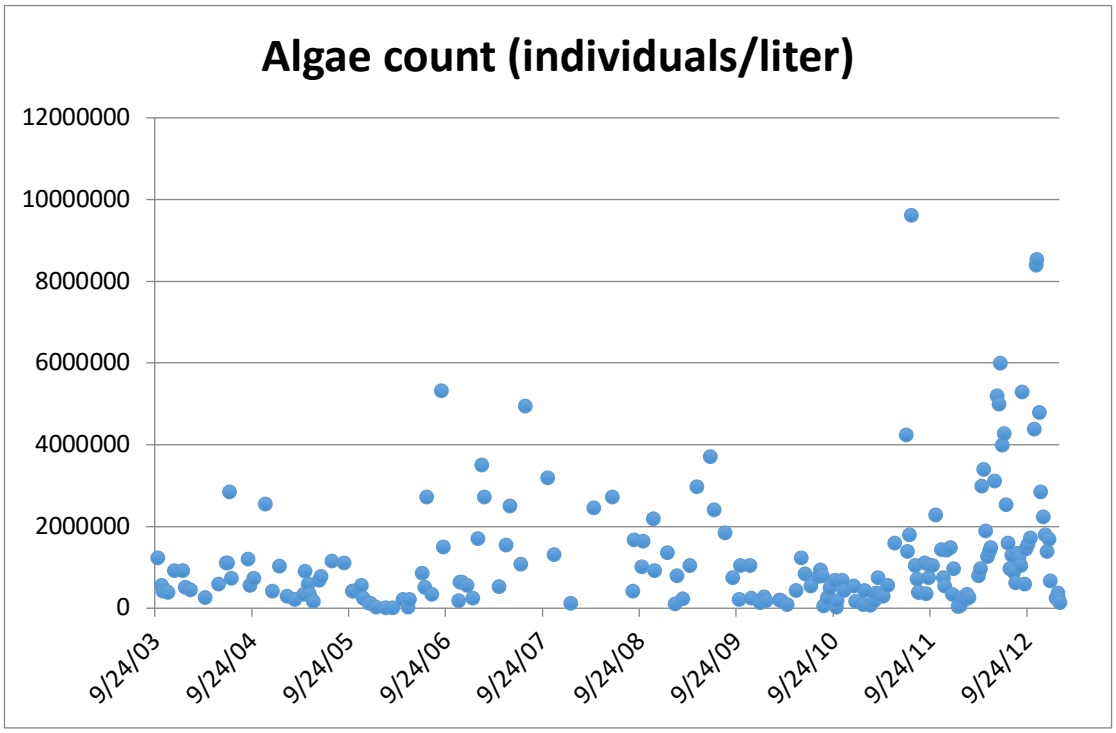
Bioremediation of a Drinking Water Reservoir

Surface area: 13 hectares
Average depth: 7.5 m
Maximum depth: 25 m
Average water volume: 931 000 m3

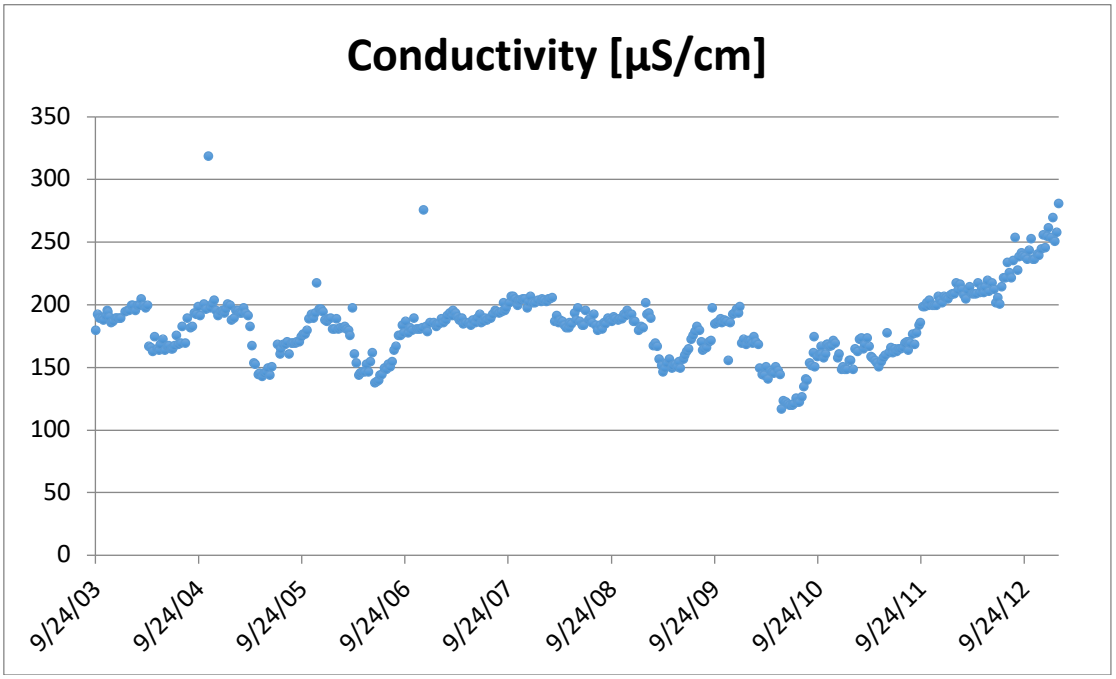
The concerned water body is located in the mountains, and used for potable water abstraction by a local municipal operator company. They supply the nearby settlements, villages, and small cities with the treated water. The reservoir is fed by two clean mountain streams. Its ecological status was mesotrophic in the past, turning to eutrophic in the past years.

The reservoir's problems are the water's unpleasant taste and odor, which occur mostly in the winter period, from October-November until springtime. The phenomenon gets more and more serious each year. The cause is obviously eutrophication, growing algae count, pathogenic count, COD, nutrients, sediment layer depth & organic ratio, and deteriorating Dissolved Oxygen balance. Since the removal of raw water is done from several meters below surface at a horizontal location close to the highest depth, the removed water has low Dissolved Oxygen concentration. Operator aimed to address drinking water quality problems by a targeted bioremediation executed in autumn 2014.

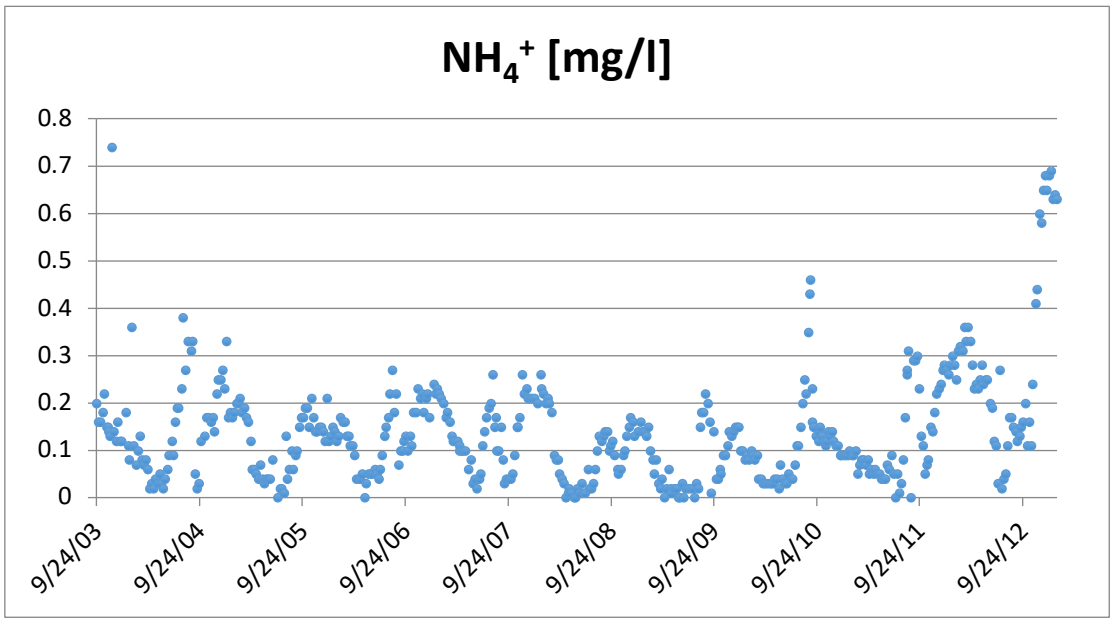
The peak algae count in summer used to be 4-6 million ind./l, but in 2012 algae count above 8 million ind./l were also detected. The situation worsened in 2013, and 2014 with algae count peaks 16 million ind./l in the summer of 2013, and 40 million ind./l in the summer of 2014. Diagrams of historical data below show the typical process of eutrophication of a former mesotrophic lake.



Algae count detected between 2003-2013



Conductivity measured between 2003-2013



Ammonium concentration measured between 2003-2013

Malatech Bioremediation results:

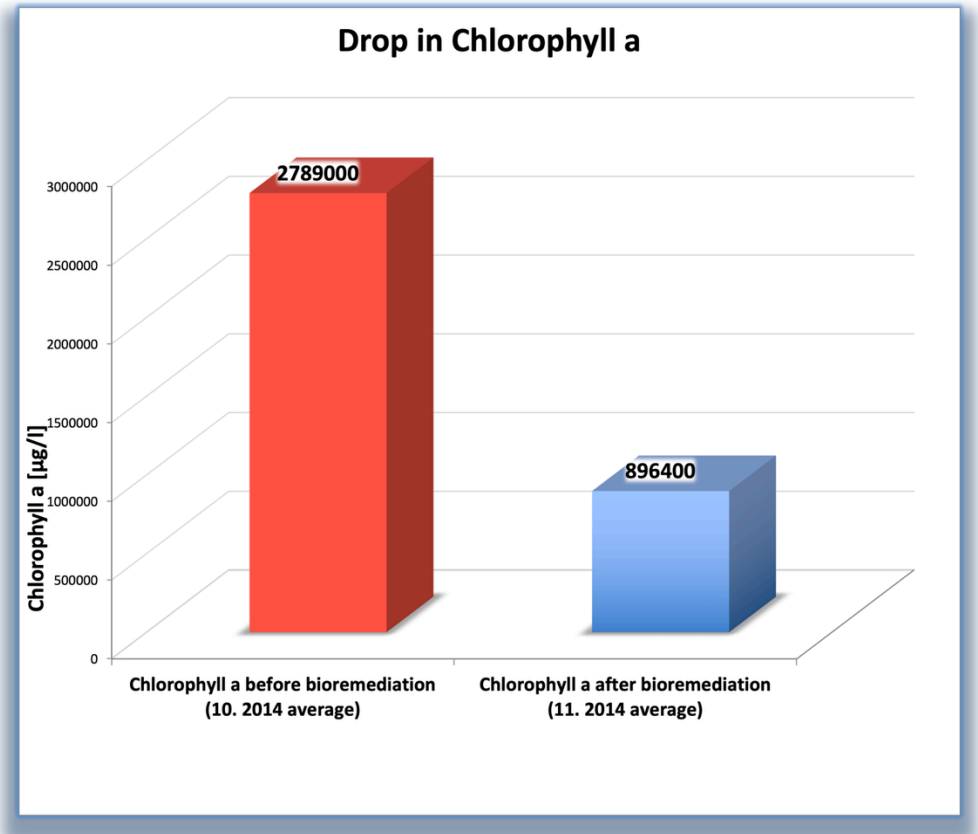
The reservoir has been treated with Bioclean Pond Clarifier in autumn 2014. We did not use the usual treatment schematic by treating the lake in season, dividing the treatment amounts close to the different algal group blooming seasons. We applied a shock treatment instead to be able to address the lake's ecological issues quickly, and provide an immediate solution for the customer for the upcoming cold season, when problems usually occur. We applied 4 treatments with a week's time between each. 200 kgs of Bioclean Pond Clarifier was applied/treatment, 800 kgs overall. **Since the water temperature was low, we have had limited ability to decrease nutrients, and starve algae, despite a decent drop can be seen below in algae count either. The main focus was on restoring DO balance, the biodegradation of potential odor-causing, and taste deteriorating organic matter, and pathogenic bacteria control.**

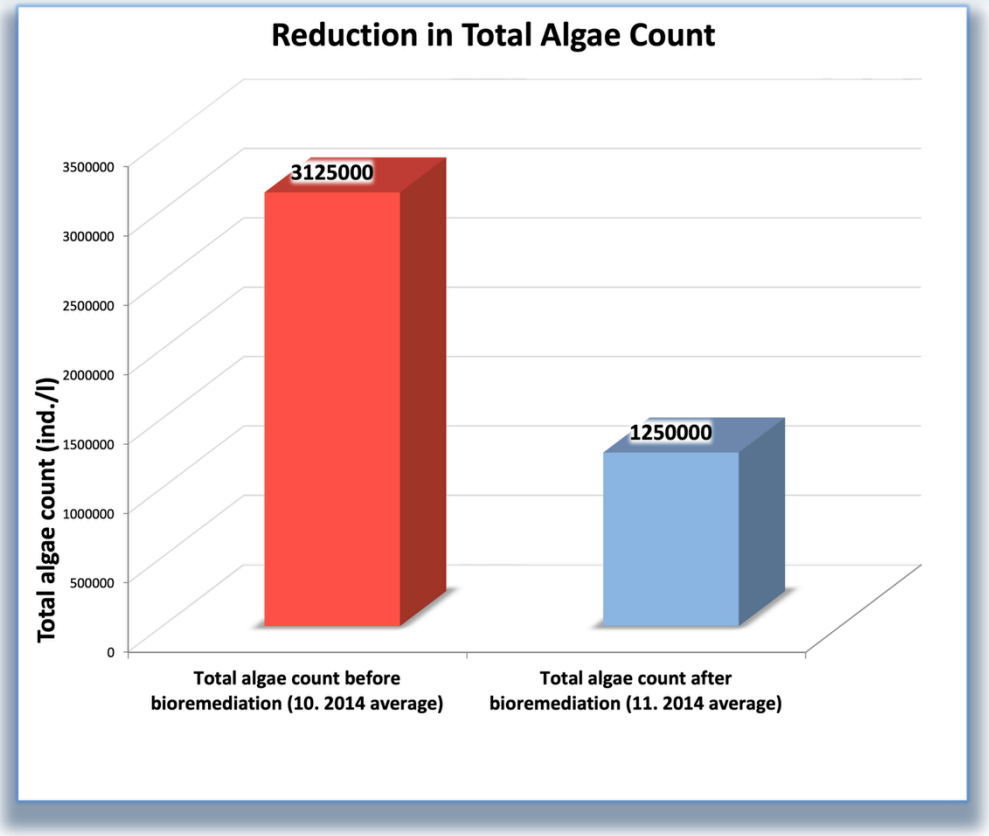
The odor of the supplied drinking water was gradually reduced during the treatment, and the odor has gone completely, and taste of water has been improved from mid-December 2014, and remained perfect throughout 2 years. The summary of the treatment results is shown below.

DO-balance improvement:

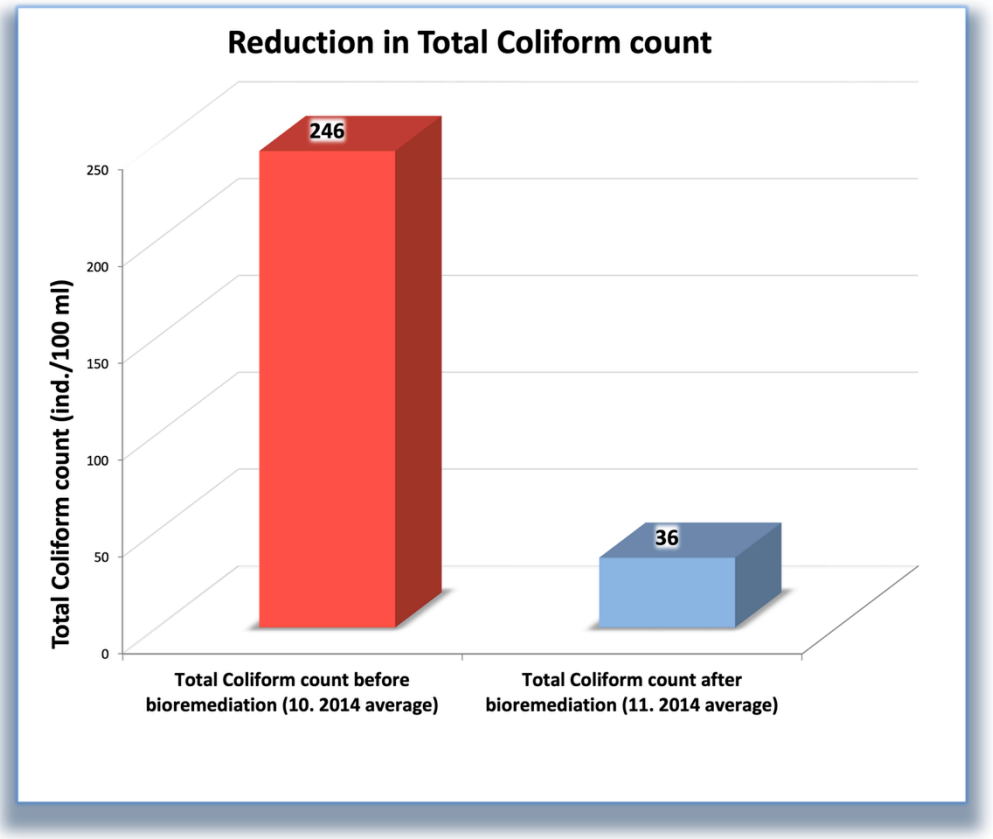
Date:	31.10.2014.		Date:	06.11.2014.		Date:	13.11.2014.		Date:	20.11.2014.	
Measurement location	1. 30 m from water removal	2. 50 m from stream-entry point at the back	Measurement location	1. 30 m from water removal	2. 50 m from stream-entry point at the back	Measurement location	1. 30 m from water removal	2. 50 m from stream-entry point at the back	Measurement location	1. 30 m from water removal	2. 50 m from stream-entry point at the back
	30 cm below surface			30 cm below surface			30 cm below surface			30 cm below surface	
DO conc. (mg/l)	7.13	7.18	DO conc. (mg/l)	7.38	7.21	DO conc. (mg/l)	8.02	7.94	DO conc. (mg/l)	8.55	8.32
DO saturation (%)	68.3	68.8	DO saturation (%)	71.1	68.9	DO saturation (%)	77.9	75.4	DO saturation (%)	84.9	82.2
pH	7.11	6.81	pH	7.12	7.8	pH	7.39	6.64	pH	7.33	6.82
Water temeprature (°C)	11.3	11.2	Water temeprature (°C)	10.7	10.7	Water temeprature (°C)	11	10.9	Water temeprature (°C)	10.9	10.8
	at 3 m depth			at 3 m depth			at 3 m depth			at 3 m depth	
DO conc. (mg/l)	6.94	7.1	DO conc. (mg/l)	7.2	7.16	DO conc. (mg/l)	7.85	7.7	DO conc. (mg/l)	8.34	8.44
DO saturation (%)	66.1	67.9	DO saturation (%)	68.4	68.3	DO saturation (%)	75.2	73.6	DO saturation (%)	82.2	83.8
pH	7.1	7.34	pH	6.73	7.42	pH	7.08	6.67	pH	7.14	7.22
Water temeprature (°C)	11	11.3	Water temeprature (°C)	10.4	10.7	Water temeprature (°C)	10.7	10.6	Water temeprature (°C)	10.7	10.8

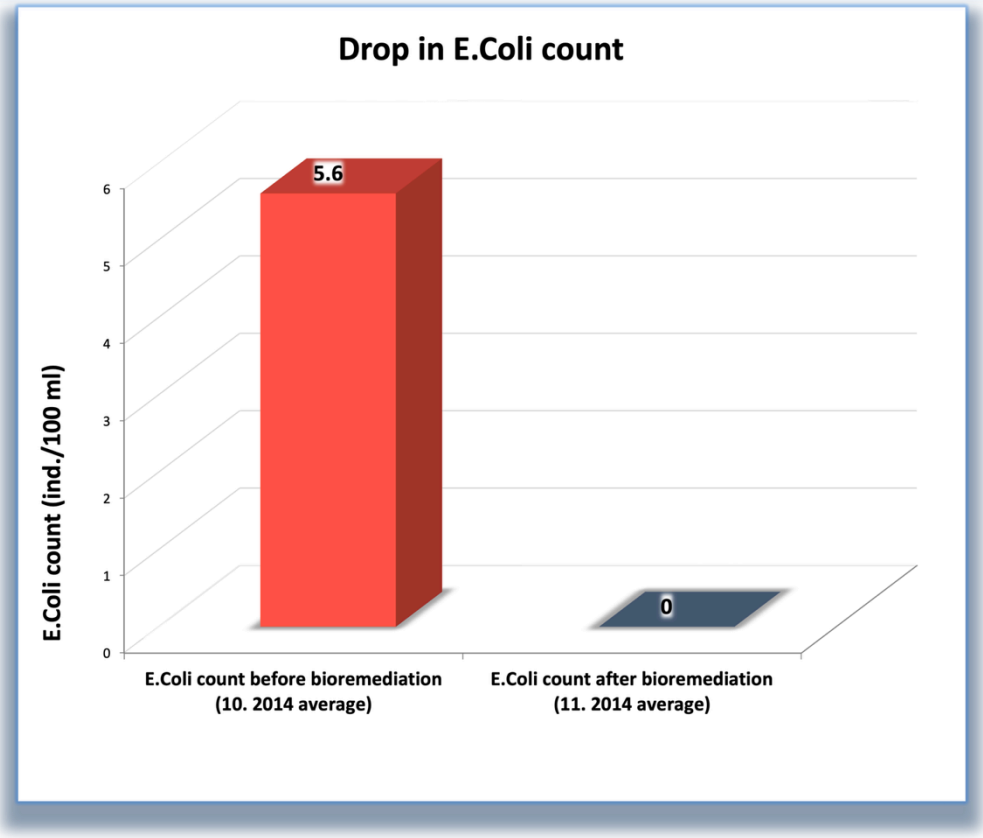
Reduction of algae count:





Reduction of pathogenic count:





Reduction of CODMn concentration, improved biodegradation of organic pollutants: