

## BiOWiSH™ Aqua: Surface Water Remediation

### Surface Water Remediation Summer Palace, Beijing, China

#### Background

Upon its designation by UNESCO as a World Heritage Site in 1988, the Summer Palace (颐和园 Yíhéyuán) was declared “a masterpiece of Chinese landscape garden design. The natural landscape of hills and open water is combined with artificial features such as pavilions, halls, palaces, temples and bridges to form a harmonious ensemble of outstanding aesthetic value.” The Summer Palace covers an area of 2.9 km<sup>2</sup> (three quarters of which are water) in NW Beijing and is visited by over 15 million tourists a year.

In hopes of replacing the use of chemicals and reducing the many hours of labor needed to maintain adequate water quality in the Palace’s numerous ornamental water bodies, maintenance officials reached out to Beijing Guodian Futong Technology Co. (GDFT), a subsidiary company of NARI Group, to provide an all-natural maintenance solution.

A body of water in front of the Buddha incense court was selected as a test case for the technology. The small pond, with an estimated surface area of 100 m<sup>2</sup>, had to be cleared of floating plants on a weekly basis. Although it is connected to the neighboring Kunming Lake, it has poor exchange with outside water. Through examination of water quality indicators, Total Nitrogen (TN) and Total Phosphorus (TP) were found to be above the compliance levels for Standard IV, as established in the Surface Water Environmental Quality Standard Basic Project Standard Limit, published by the Chinese government. As the temperature increases, floating plants and algae blooms start to appear and manual cleaning frequency needs to be increased, adding to the overall maintenance costs of the Palace.

#### Objectives

By implementing a bioremediation program with BiOWiSH™ Aqua, the Palace’s maintenance officials hope to reduce labor costs while replacing the use of dangerous bio-accumulative chemicals to maintain the water quality compliant with Standard IV.

Surface Water Environmental Quality Standard Limited Value						
Series #	Standard Values Categories Index	I	II	III	IV	V
1	Water Temperature (°C)	Man-made environmental temperature changes should be limited: Average Weekly Maximum Temperature Rise ≤ 1 Average Weekly Maximum Temperature Drop ≤ 2				
2	pH value (Dimensionless)	6~9				
3	Dissolved Oxygen (DO) ≥	Saturation factor 90% (or 7.5)	6	5	3	2
4	Potassium Permanganate Index ≤	2	4	6	10	15
5	Chemical Oxygen Demand (COD KMnO <sub>4</sub> ) ≤	15	15	20	30	40
6	Biochemical Oxygen Demand (BOD <sub>5</sub> ) ≤	3	3	4	6	10
7	Ammonia-Nitrogen (NH <sub>3</sub> -N) ≤	0.15	0.5	1.0	1.5	2.0
8	Total Phosphorous (Measured as P) ≤	0.02 (Lake or reservoir, 0.01)	0.1 (Lake or reservoir, 0.025)	0.2 (Lake or reservoir, 0.05)	0.3 (Lake or reservoir, 0.1)	0.4 (Lake or reservoir, 0.2)
9	Total Nitrogen (Lake, Reservoir, Measured as N) ≤	0.2	0.5	1.0	1.5	2.0

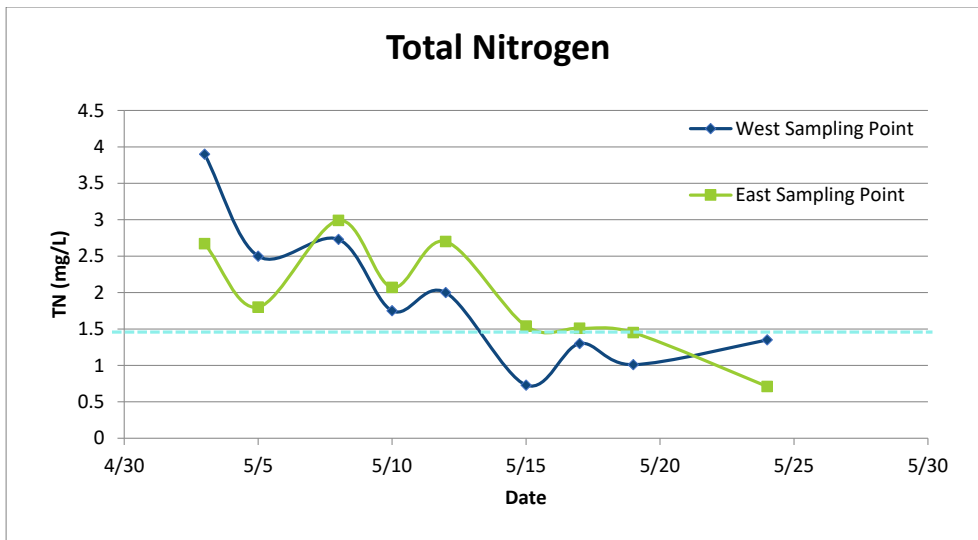
## Solution

A three-phase dosing program of BiOWiSH™ Aqua was implemented.

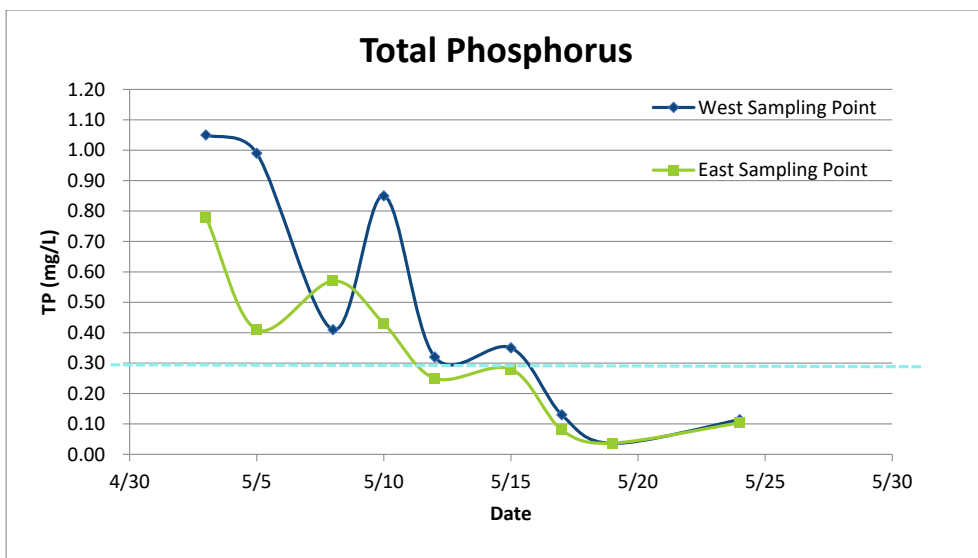
Dosing Scheme				
Dosing Phase	BiOWiSH™ Aqua	Dosing Frequency	Objective	Notes
<b>Phase 1</b> Day 0 - 21	3 kg	Three times per week	Target dose of 3 ppm to favor the growth of BiOWiSH™ organisms. Suggest keeping manual plant removal for this phase.	Solid product is to be dissolved into 30 L of fresh water and sprayed over the surface of the lake uniformly (we recommend the use of a backpack spraying unit)
<b>Phase 2</b> Day 21- j*	1 kg	Weekly	Maintain 1.0 ppm dose until the TN and TP levels are compliant with Standard IV.	
<b>Phase 3</b> Day j* onwards	0.5 kg	Weekly	Reduce the cost down to an optimization phase @ 0.5 ppm while maintaining compliance with Standard IV.	

\*Day j is the day at which the water reaches ideal quality and it is time to start ongoing maintenance.

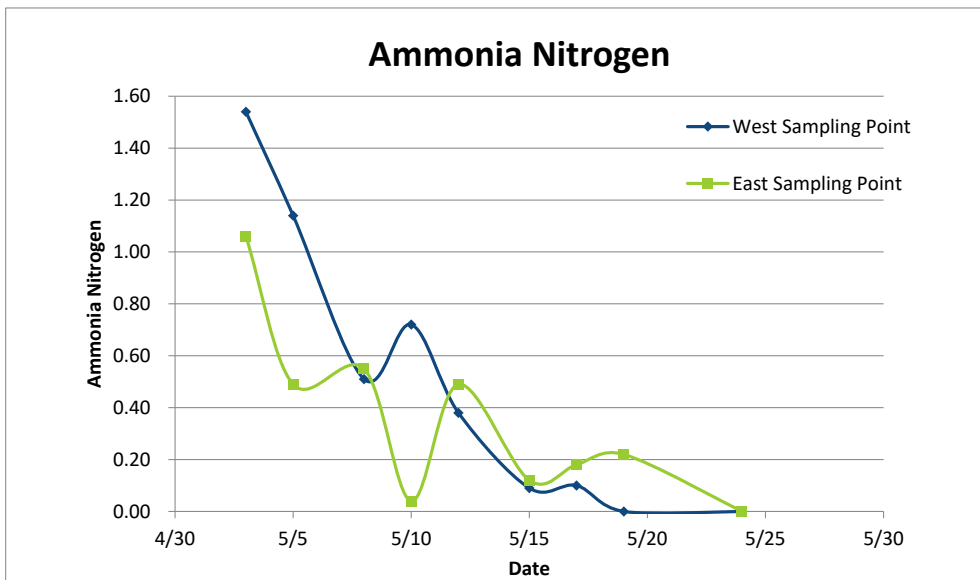
## Results



Within **two weeks** of dosing BiOWiSH™ Aqua, TN was reduced to comply with Standard IV (TN ≤ 1.5 ppm).



Within **ten days** of dosing BiOWiSH™ Aqua, TP was reduced to comply with Standard IV (TP ≤ 0.3 ppm).



The effects on ammonia nitrogen levels were even more dramatic. Ten days after the initial dosing of BiOWiSH™ Aqua, ammonia N levels were < 0.1 ppm (realizing over **90% reduction** from initial values).

The powerful microbial blend formulated into BiOWiSH™ Aqua can express the needed enzymes to promote rapid nutrient elimination, while enabling the existing microorganisms in the ecosystem to make better use of the available nutrient resources. This rapid degradation in ammonia, coupled with increased nitrogen elimination, contribute to combined NH<sub>3</sub>-N and TN reductions. Changes in the microbial composition of the water body and improved nutrient absorption by existing flora contribute to TP reductions in the water column. The rate of algae and surface plant growth was recorded upon each dosing event. Manual surface cleaning was the most time consuming of the pre-BiOWiSH™ application weekly activities. After one week dosing BiOWiSH™ Aqua, manual cleaning could be stopped as maintenance noted a dramatic reduction in the rate of surface plant growth.



**Fig. 1** Water before weekly manual cleaning



**Fig. 2** Two days after manual cleaning, before BiOWiSH™



**Fig. 3** One week after dosing BiOWiSH™ Aqua



**Fig. 4** Ten days after dosing BiOWiSH™ Aqua



**Fig. 5** Two weeks after dosing BiOWiSH™ Aqua

## Conclusion

Bioaugmentation with BiOWiSH™ Aqua has proven to be a sustainable, low cost, all-natural means to replace the use of chemicals. Additionally, this solution reduced the labor needed to maintain water quality within the National Water Standard IV. BiOWiSH™ Aqua's robust biochemistry provides a powerful, easy-to-dose biological alternative to the regular maintenance of the different types of water bodies in the 2.9 km<sup>2</sup> Summer Palace.

Implementing such a biological tool in this high-profile location visited by over 15 million tourists a year will realize significant cost savings. It will also avoid the use of large quantities of harsh chemicals from being used in a protected environment every year.



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