

NanoBubble Solutions Limited



## **Project to Eliminate Blue-Green Algae at the Outer Moat of the Imperial Palace Hibiya, Tokyo**

### **Project Overview**

#### **Translator's Note**

The Algae problem of the Imperial Palace Moat, Tokyo, has been reported on many occasions in the Japanese media, especially the Hibiya Outer Moat, which is the main focus of this project. Located at the water gate output point, it has a problem not only with Algae layers, but also odour in the main entrance of the Royal Palace. The Japanese Government investigated many solutions, but finally decided that Anzai Kantetsu Co. Ltd., should be involved in this project, using its patented Nanobubble technology.

Normally, a direct government commission is only granted to large scale companies with capital of US\$10 million or more. However, due to the forthcoming Tokyo Olympics 2020, a quick and sustainable solution for the future was crucial. Therefore for Anzai Kantetsu to be invited to participate is a very rare and exceptional case as this is one of the most prestigious commissions in Japan.

The original report consists of 40 pages. I've summarized the main part into the 6 pages below.

Regards,  
Aki Takagi  
October, 2018



## **Project to Eliminate Blue-Green Algae at the Outer Moat of the Imperial Palace Hibiya Moat (Extracts taken from longer report).**

Commissioner: Government of Japan

Technology Supplier : Ansai Kantetsu Co., Ltd, Yokohama

Place: The Imperial Palace Hibiya Moat

### **1. Project Aims:**

Improvement of the water environment of the Imperial Palace Hibiya Moat towards the Tokyo Olympic Games 2020. Removal of Blue-Green Algae and ongoing sustainable measures. Diffusion Prevention of suspended matter and Algae in the downstream of the other moat areas.

### **2. Background:**

Hibiya Moat, which is the object to this project, is located at the point where the westbound water stream around the Imperial Palace and the eastbound water stream join together, and the numerical value of Chlorophyll is extremely high. The numerical value of Chlorophyll in Hibiya Moat was 910  $\mu\text{g}$  / litre, which was more than 12 times compared with 14  $\mu\text{g}$  / litre of the Gaisen Moat, the west side waterway and 78  $\mu\text{g}$  / litre of the Babasakimon Moat, the eastern waterway, and urgent unsustainable measures were required for the upcoming Tokyo Olympics in 2020.

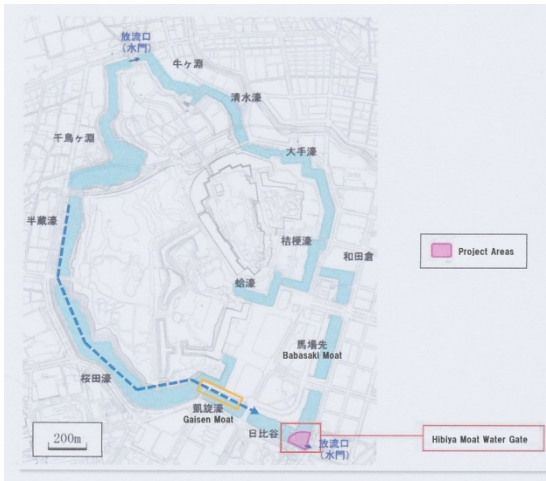


Fig.1 Imperial Palace Outer Moat



Fig.2 Project Site – Hibiya Outer Moat

No.	Moats	7/28	8/5	8/10	8/19	8/26	8/31	9/8	9/16	9/21	9/30
1	桜田濠(上流)										
2	桜田濠(中流)										
3	桜田濠(下流)										
4	桜田濠(二重橋濠側)										
5	凱旋濠(上流)										
6	凱旋濠(下流)										
7	蛤濠(上流)										
8	蛤濠(下流)										
9	半蔵濠(上流)										
10	半蔵濠(下流)										
11	千鳥ヶ淵(上流)										
12	千鳥ヶ淵(中流)										
13	Chidorigafuchi Moat										
14	千ヶ瀬(上流)										
15	千ヶ瀬(下流)										
16	清水濠(上流)										
17	清水濠(下流)										
18	大手濠(上流)										
19	大手濠(中流)										
20	大手濠(下流)										
21	桔梗濠(大手濠側)										
22	桔梗濠(蛤濠側)										
23	和田倉濠(上流)										
24	和田倉濠(下流)										
25	馬場先濠(上流)										
26	馬場先濠(下流)										
27	Hibiya Moat (West)										
28	Hibiya Moat (East)										
29	Hibiya Watergate										

Table 1 Distribution of Blue-Green Algae by Moat

	2012年8月19日	1 Sakurada	2 Gaien	3 Hibiya	4 Babasaki
Time	9:25	9:55	8:55	9:05	
Weather	晴	晴	晴	晴	
Temperature (°C)	32.6	33.9	31.5	32.2	
Water Temperature (°C)	30.6	30.8	30.7	30.0	
Transparency (cm)	3.3	2.0	2	1.3	
Transparency (m)	1.0	2.0	0.1	0.4	
Depth	2.2	2.0	1.2	1.0	
Ph	9.6	9.0	7.1	8.7	
BOD (mg/L)	1.4	1.6	57	9.9	
COD (mg/L)	8.8	9.3	180	17	
Mass of suspended matter (mg/L)	1	10	200	23	
DO (mg/L)	11.4	10.1	12.2	9.7	
N (mg/L)	0.41	0.77	20	2.1	
P (mg/L)	0.006	0.007	0.87	0.0005	
Chlorophyll Chl-1 $\mu\text{g/L}$	1.2	1.4	0.10	10	
Phaeo-Pigment ( $\mu\text{g/L}$ )	3.1	2.7	300	33	
Total ( $\mu\text{g/L}$ )	15.1	16.7	1300	111	
Nitrate nitrogen (mg/L)	0.0005	0.0007	0.006	0.0005	
Nitrite nitrogen (mg/L)	0.0005	0.0005	0.0005	0.0005	
Ammonia nitrogen (mg/L)	0.01	0.08	0.13	0.38	
Dissolved organic nitrogen (mg/L)	0.21	0.41	18	1.3	
Soluble organic nitrogen (mg/L)	0.39	0.29	2.0	0.47	
Phosphate-phosphorus (mg/L)	0.001	0.001	0.006	0.0002	
Suspended Particulate Phosphorus (mg/L)	0.0024	0.011	0.83	0.009	
Dissolved phosphorus (mg/L)	0.002	0.006	0.032	0.0022	
Turbidity	4	6	170	17	

Table 2 Data - Hibiya Moat

### 3. Water Improvement Conditions:

Transparency 1m min.

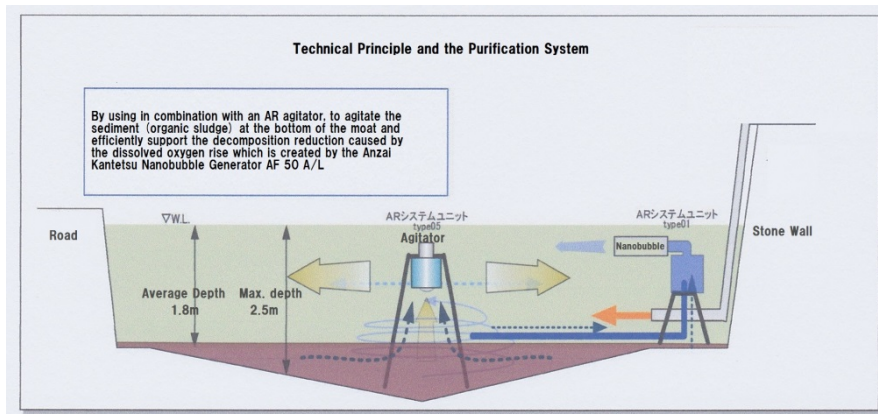
Chlorophyll Value Chl-a 25  $\mu\text{g}$  / litre.

T-P 0.05 mg / litre. max.

to be satisfied.

### 4. Technical Principle and the Purification System:

By using in combination with an AR agitator, to agitate the sediment (organic sludge) at the bottom of the moat and efficiently support the decomposition reduction caused by the dissolved oxygen rise which is created by the Anzai Kantetsu Nanobubble Generator AF 50 A/L.



**Fig.3 Purification System**

Power Source: 100V single phase or 200V three phase power supply required.

Electricity Consumption of Equipment: 48 KW / Daily

Monitoring: By monitoring cameras and having a stable Internet connection required for camera operation.

Equipment Noise: There is almost no sound accompanying equipment operation.

## 5. Site Schematic:

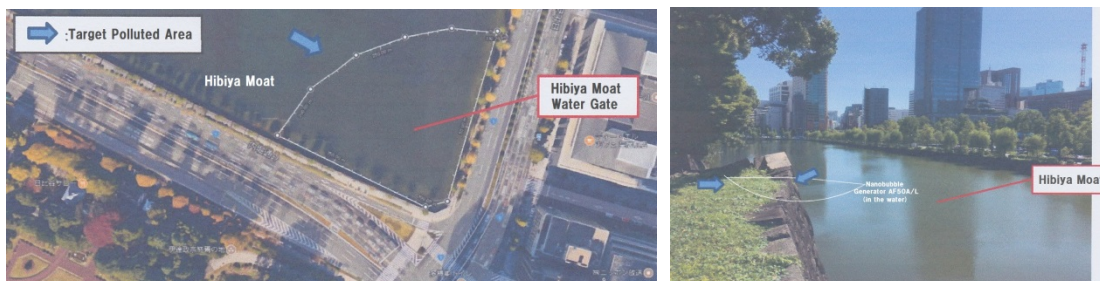
Hibiya Moat Area: 35,884 m<sup>2</sup>

Deepest part: 4 m

Average depth: 1.4-2.5 m

Water Volume of Hibiya Moat: 72,000 m<sup>3</sup>

In-flow water volume: 3,000-14,000 m<sup>3</sup> (daily max.)



**Fig.4 & 5 Target Polluted Area**

## 6. Project Period:

August, 2018 - September, 2018

## 7. The Results Evaluation Method

In addition to the Chlorophyll Value (Chl-a) of Blue-Green Algae, the evaluation was also made visually by the specialist based on the following criteria.

Evaluation Levels:

- Level 1 Transparency rises and light green natural water color is back
- Level 2 Lacks transparency, but Blue-Green Algae have been eliminated
- Level 3 Blue-Green Algae remaining and still lack of transparency.
- Level 4 Blue-Green Algae blown by the wind overlap to form a layer, and it has a strong odor.





Criteria	Reference Photographs
<div><div></div><div> : 【 Level 1 】</div><div>Water transparency increases and light green colour returns</div></div>	
<div><div></div><div> : 【 Level 2 】</div><div>Lacks transparency, and Blue-Green Algae have been eliminated</div></div>	
<div><div></div><div> : 【 Level 3 】</div><div>Lacks transparency, Blue-Green Algae still remaining</div></div>	
<div><div></div><div> : 【 Level 4 】</div><div>Blue-Green Algae blown by the wind overlap to form a thick layer and has a bad odour</div></div>	

Fig.6 Visual evaluation  
Monitoring cameras to be introduced for observing the level of Blue-Green Algae.

8. Results

Regarding the Hibiya Moat project, water sampling for evaluation was conducted in the following three locations:

		Starting Data A		Final Data B	1-(B/A)
		Sample Test	2018年8月9日	2018年8月9日	2018年9月28日
Watergate	Chlorophyll a (μg/L)		910	42	200
					78% Down
Boat House			—	—	64

		Starting Data A		Final Data B	1-(B/A)
		Sample Test	2017年8月9日	2018年9月12日	2018年9月28日
Watergate	T - P (mg/L)		0.87	0.061	0.064
					93% Down
	Transparency			12.4	32.5
	C O D (mg/L)		180	11	8
Boat House	S S (mg/L)		280	13	8
					97% Down
	T - P (mg/L)		—	0.055	0.025
	Transparency			15.8	50
Boat House	C O D (mg/L)			10	7.1
	S S (mg/L)			11	4

Table.3 The result

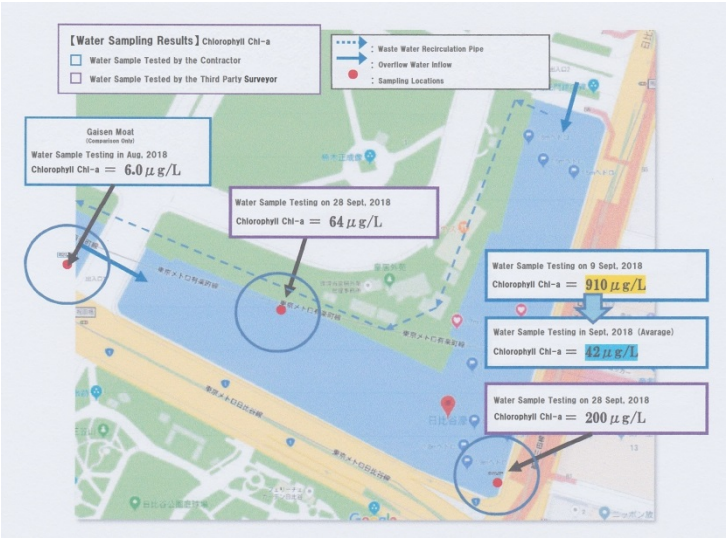


Fig.7 The result

Results Summary

- a. **Chlorophyll Value - Chl-a (μg/litre)** fell to 200 from the initial 910 and improved by 78%.
- b. **T - P (mg / litre)** decreased to 0.064 from the initial 0.87, achieving an improvement rate of 93%. (<0.05 mg)
- c. **COD (mg / litre)** decreased to 8 from the original 180, achieving 96% improvement.
- d. **SS (mg / litre)** decreased to 8 from the initial 280, achieving an improvement of 97%.

**e. Transparency** achieved 1m or more as initially targeted.

Certificates & Data issued by the Tokyo Metropolitan Water Authority attached.  
(See attached PDF)

Therefore, it is believed that the Nanobubbles will exert similar effects in purifying water quality throughout the entire moat of the Imperial Palace, and also prove that adoption over the whole water environmental improvement projects toward Tokyo Olympics with the appropriate technology.

October, 2018

**Imperial Palace**  
**Government of Japan**



**Mr Anzai reviewing the water**



**Quality of water after treatment**

**NanoBubble Solutions Limited**

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