

FINAL REPORT

April 15, 2009 – July 30, 2009

ARCE Groundwater Lowering Response Project, Luxor

“Preservation of the Sacred Lakes – Karnak Lake”

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INTRODUCTION

Karnak Sacred Lake

Brief History:

The sacred lake in Karnak temple complex is a large (128 x 83 m) rectangular feature lying just south to the main Amun temple. Such lakes form integral parts of ancient Egyptian temples and were incorporated in temple rituals. At Karnak the lake is a stone-lined basin, accessed by stairways. The lake is probably the one recorded as built by Thutmose III in the earlier Eighteenth Dynasty (mid fifteenth century B.C.) It was used in religious festivals, and for the sacred geese of the presiding god of Karnak temple, Amun; what was interpreted as a fowl house lay just to the south of the lake, and was connected to it by a tunnel. The lake is known to have been modified under the pharaoh Taharqa in the later twenty-fifth dynasty (c 690-664 B.C.) but the precise nature of the changes made at that time are unclear.

The recent lowering of the groundwater has revealed the need for Karnak Sacred Lake to be cleaned and new arrangements to be made in order to maintain a reasonable level of and for proper circulation of water within the lake.

Phase 1– Water level lowering and Weeds and Reeds removal.

In April 15, 2009 to July 30, 2009- the lake conservation project performed an investigation on existing conditions to determine the cleanup plan.

- To control the water level and quality, there is a pump station to the east of the lake assigned to pump out the water from the lake to the Nile through a 10 inch PVC line and there is another 10 inch PVC pipeline conveying the water to the lake from another pump station on Nile.
- The lake investigations led to clear identification of the problem. The problem of the heavy growth of algae, weeds and mucky bottom usually caused by filling the lake using the Nile water, which contains a lot of algae, dissolved oxygen and mud. This water and the sunny warm weather accelerate the growth of these algae and weed in the lake, some of this algae die off then get converted to sediments and nutrients which encourage the growth of more dense algae and weeds.
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- To solve the problem the following steps were performed:
 - 1- Pumped the water from the lake to lower the water level
 - 2- Removed the weeds and reeds from the bottom manually.
 - 3- Filled the lake with the groundwater. This step required to connecting the deep well inside the Karnak temple to the pipelines designed to fill the lake from the Nile. As shown in the diagrams below.
 - 4- Added a chemical dosing system that allows the addition of some chemicals as- Copper sulfate (a dose less than 15 mg/l), Alum or Calcium hypochlorite in suitable concentrations(<4mg/l) which can minimize and control the algae growth.
 - 5- Assigned a boat in the lake with long handle net for regular surface cleaning.

Phase 2 – Final cleanup and operations.

From November 2009 to February 2010 the final cleanup and maintenance training was completed.

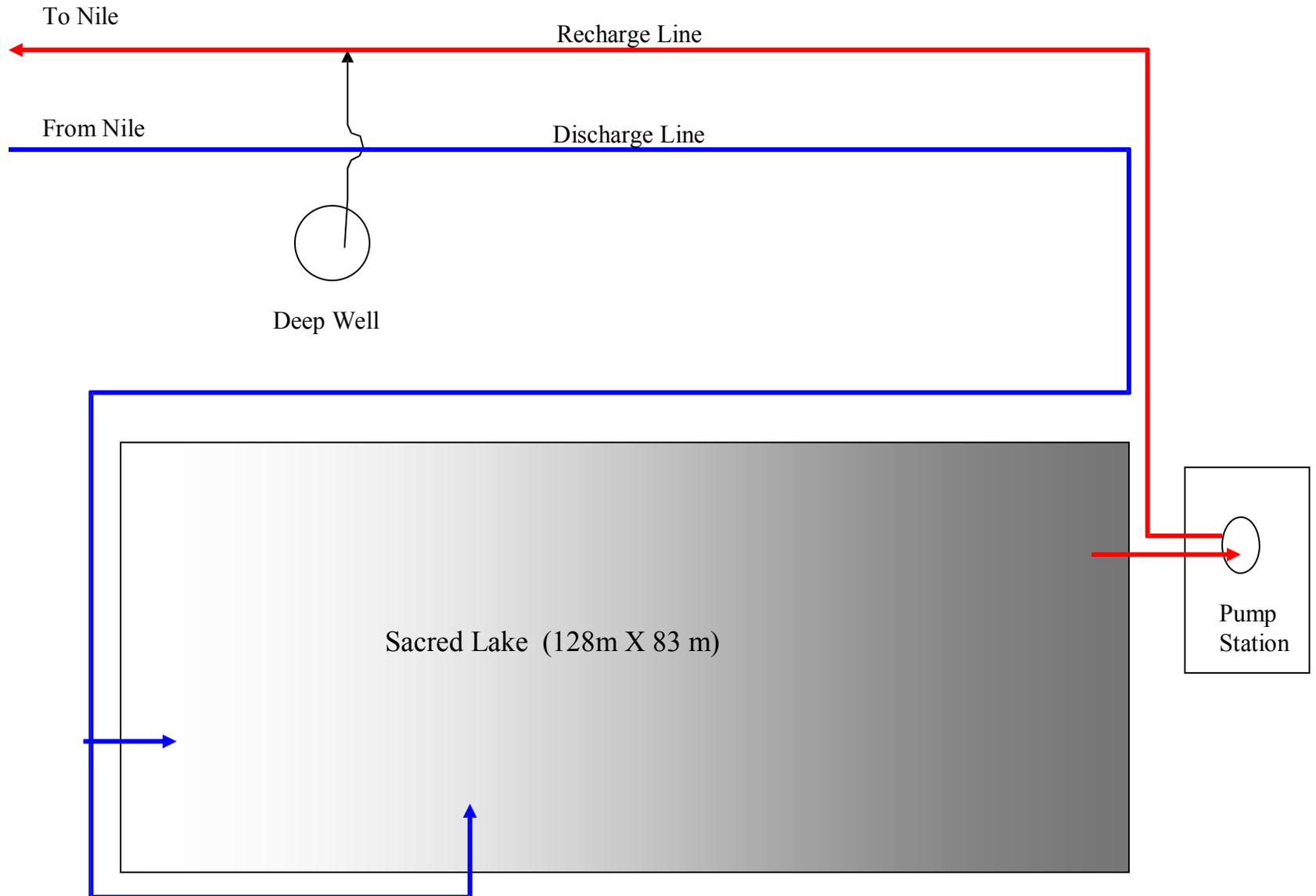
Completed Tasks:

1. Lowered the water surface to inspect the bottom of the lake to detect the new weed growth.
2. Removed the weeds and accumulated organic materials from the bottom.
3. Added Copper sulfate (10 mg/l) as algacide.
4. Refilled the lake with the groundwater with a dose of Hypochlorite and suitable coagulant with pH adjustment.
5. Ran the system, train SCA staff on the Standard Operating Procedure of the system.
6. Handed over the completed work to the SCA.

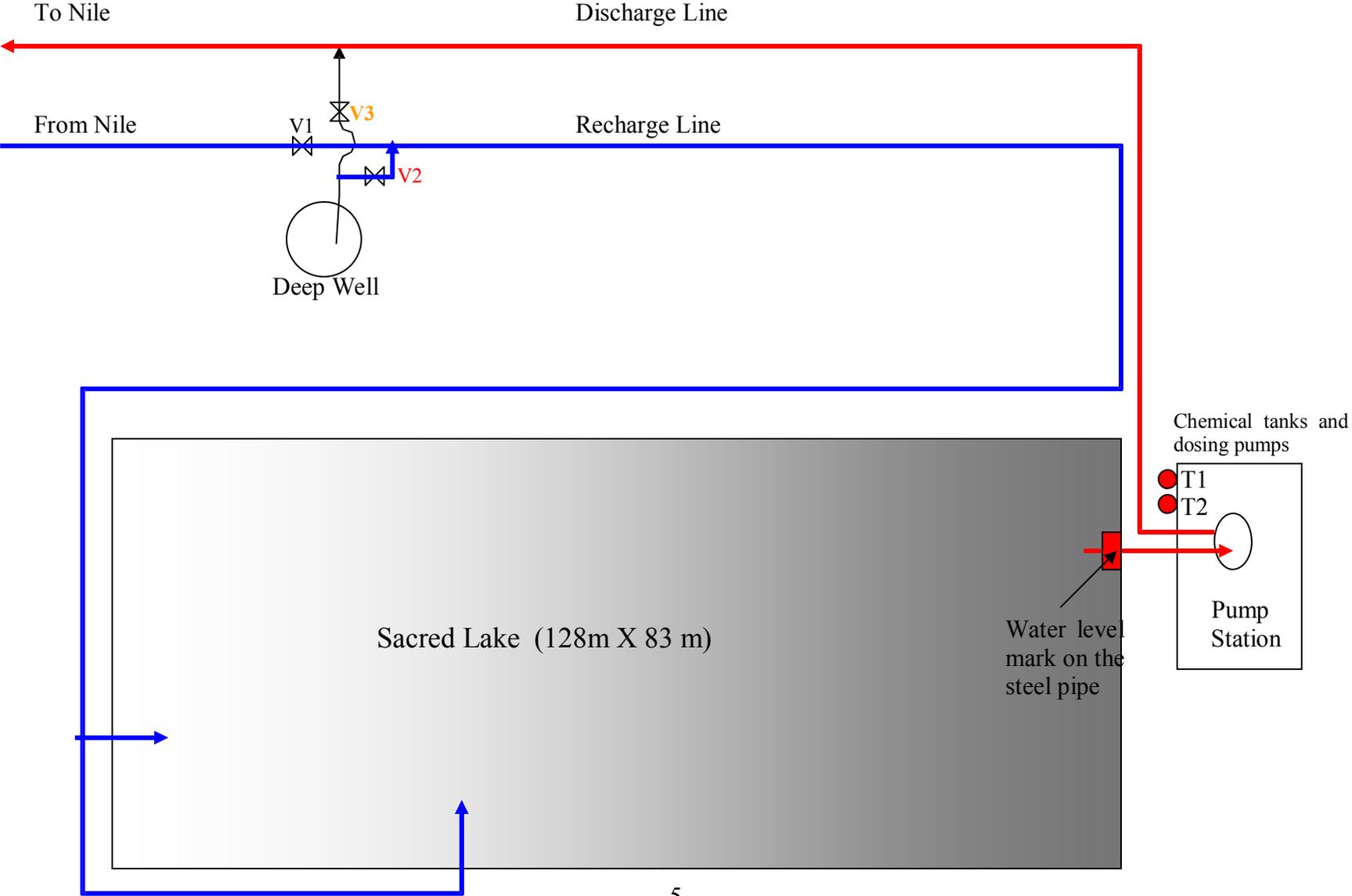
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Pipelines Configuration before Phase One



Pipelines Configuration after Phase One



System Standard Operating Procedure

Karnak temple Sacred Lake water recycling system is initiated to control the algae and weeds growth in the lake. This system is designed to be simple and easy to operate without causing any bad effects or any kind of damage to the ancient lake.

Normal Operation

During normal operation – the water refreshing procedure will be applied for a week after every 30 days period as the following:

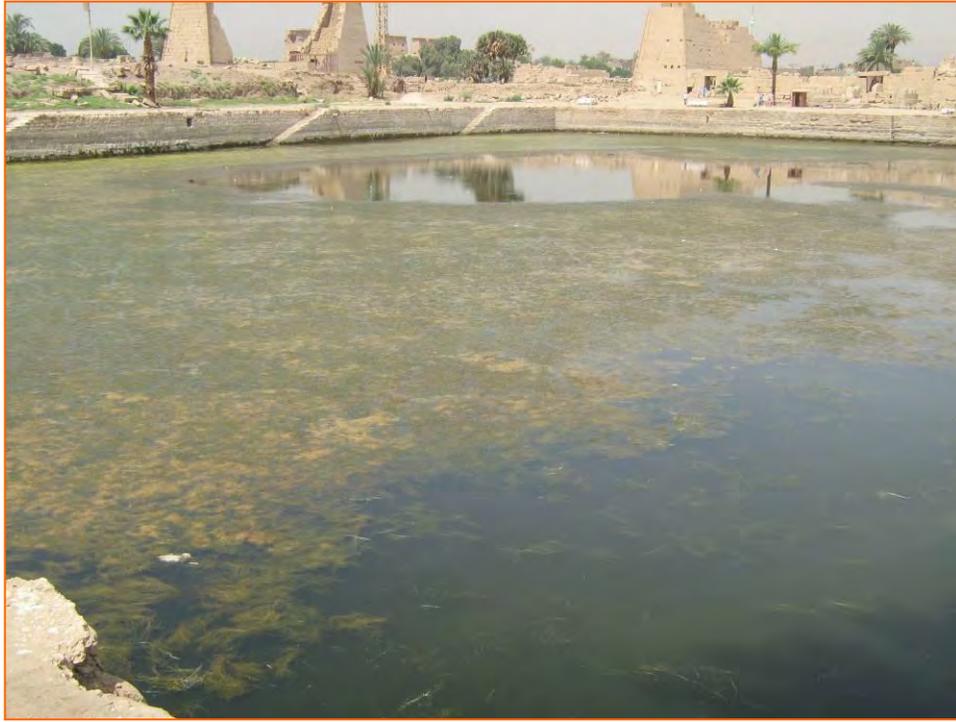
- 1- Ensure that valves V1 and V3 are closed.
- 2- Open valve V2.
- 3- Run one pump in the pump station for 3 days to lower the water level under the Red mark on the steel pipe by about 5 cm.
- 4- Run the deep well and the chlorine dosing system. To run the chlorine system apply the following:
 - a. *Fill the tank (T1) with water.*
 - b. *Add 20 kg of Calcium Hypochlorite powder and stir well to dissolve it totally.*
 - c. *Run the dosing pump on 20 L/hr.*
- 5- Keep the pumps running and watch the water level in the lake; it should not go higher than the red mark. (5 cm above is accepted).
- 6- By the end of the 7 days check the Electric Conductivity, pH, and Salinity of the water. The normal reading within the following:
 1. *pH 6.5 to 7.5 (if higher add acid to adjust)*
 2. *EC. < 1.5 mmohs*
 3. *Salinity <600 ppm*
- 7- Turn off the pumps.
- 8- By the end of this cycle open valve V3 and close valve V2 and keep V1 closed.

In March or in case of high turbidity

This procedure can be applied annually (preferred in March) or when the water is very turbid.

- 1- Lower the water level by pumping the water out to the Nile and discharge the deep well also to the Nile. This can be done by closing valve V1 and V2 and open valve V3 then turn on the dewatering pump for at least 7 days until the water level goes under the red mark by about 10 cm.
- 2- Dissolve 2 kg of the polymer in tank T2.
- 3- Open valve V2 and keep V3 opened.
- 4- Ensure not to run the deep well.
- 5- Turn on the dosing pump on 20 L/hr.
- 6- This procedure will recycle the water between the pump station and the lake to ensure good mixing of the polymer which acts as a strong coagulant to settle the suspended solids that cause the turbidity.
- 7- Apply this polymer addition/recycling procedure for about a week.
- 8- Then go to the normal operation procedure.

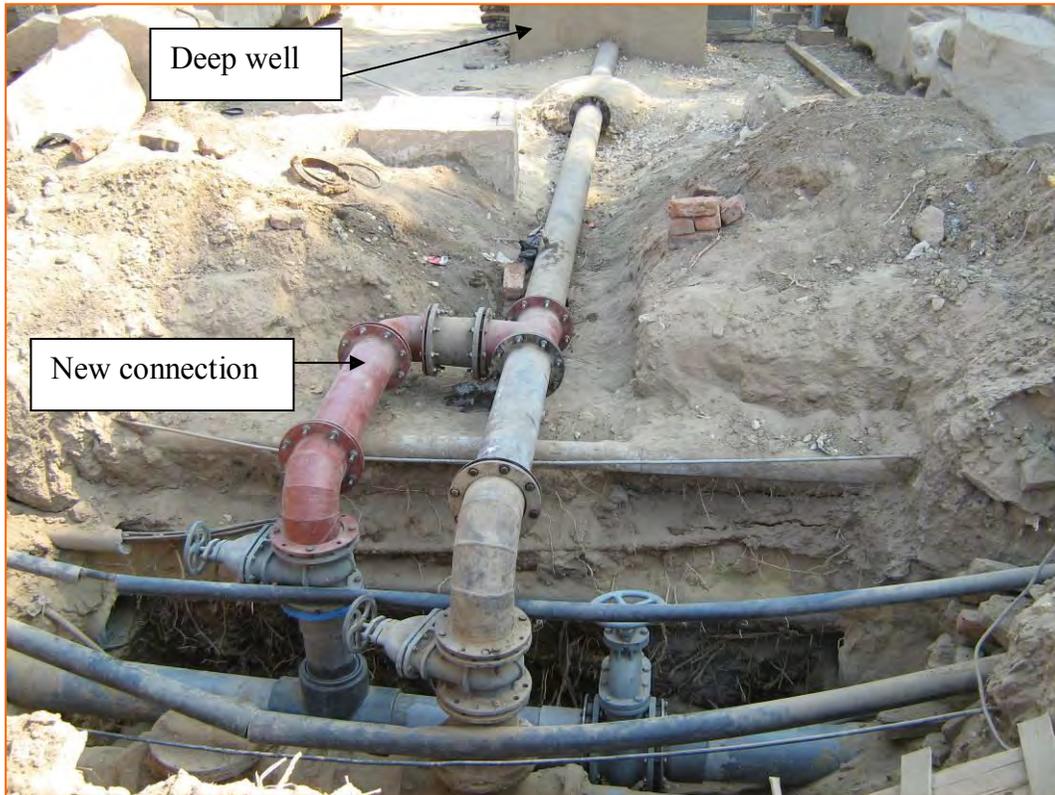
Photos representing the work



(FIG. ABOVE: The lake and the float used to clean it before the project)



(FIG. ABOVE: The lake and the boat, provided by ARCE, used to surface clean the lake)



(FIG. ABOVE: The new connection to feed the lake with groundwater from the deep well)



(FIG. ABOVE :Weed Removal)