Studying the Groundwater in and Around the Osireion, Abydos, Egypt

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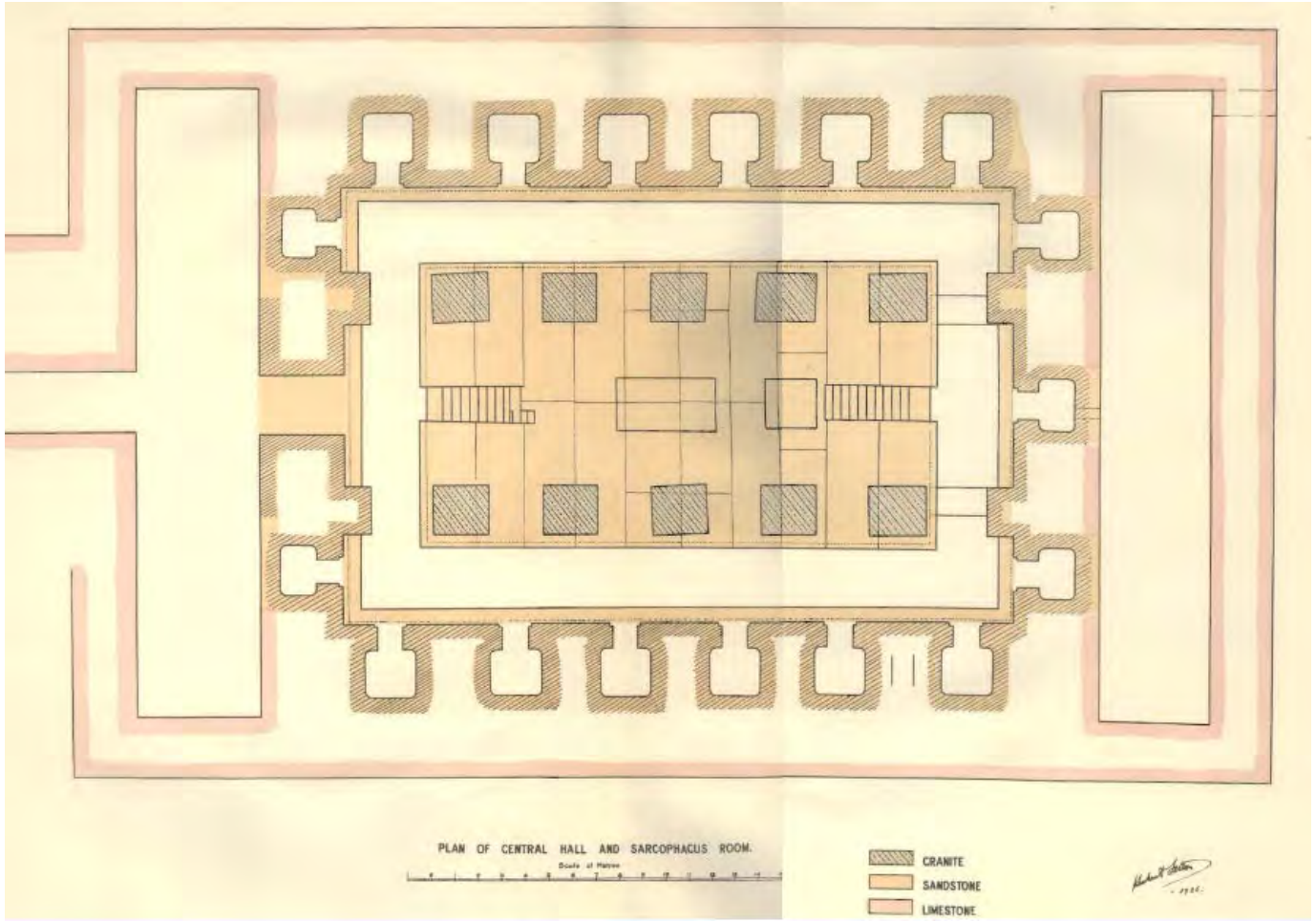
The Osireion

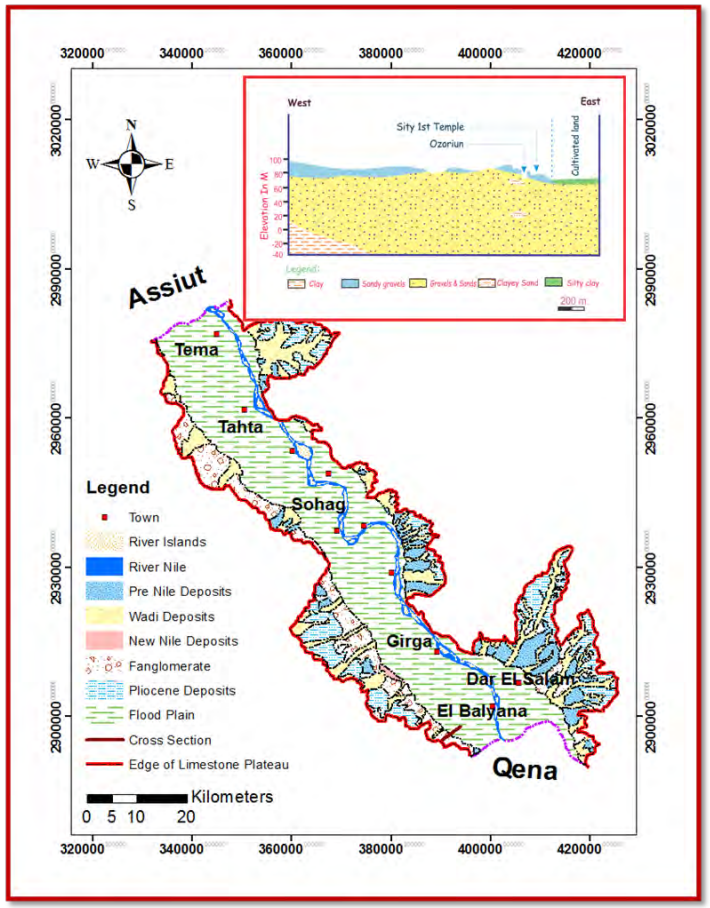
The Osirieon is unusual:

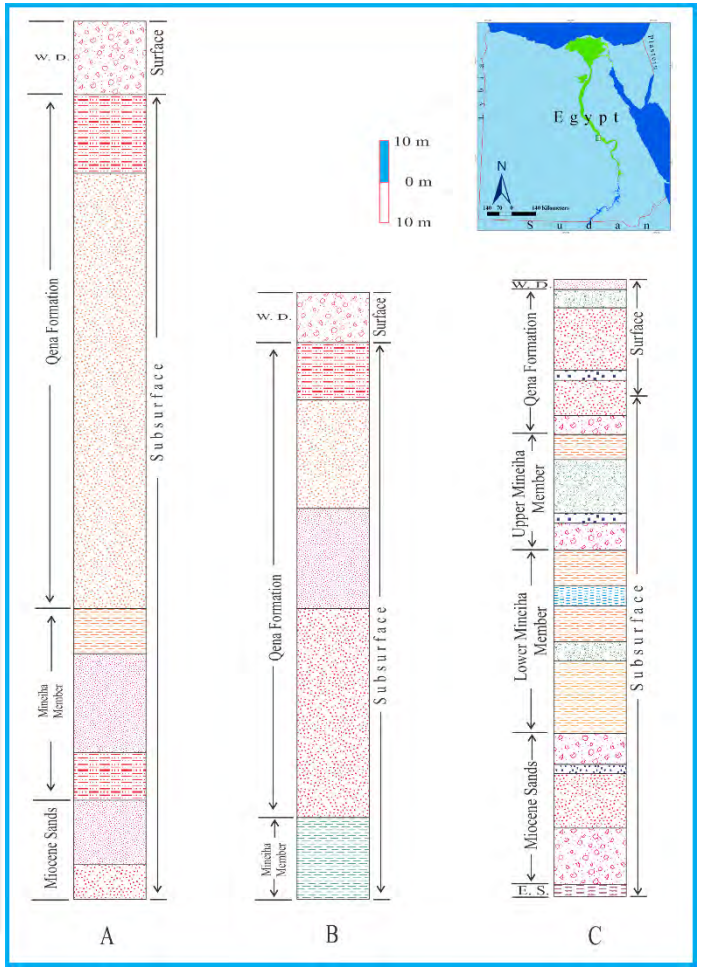
- It is a low-lying, largely sub-terranean structure.
- The core of the Osirieon was built with huge granite blocks.
- The temple is unusual in the way that it was built to interact with groundwater.

Layout of The Osireion



Geology of the site





- The oldest exposed rocks in the area are Esna Shale, with only the top 25 to 30m exposed in the study area.
- The overlying unit is a thick hard limestone section (Thebes Formation) forming the top of the scarp and plateau surface with an exposed thickness averaging + 80m and constantly increases in thickness westward.
- Both the Esna and the Thebes Formations belong to the Early Eocene.
- The pediment surface is covered by Quaternary sands and gravel getting to be muddy towards the east.
- The mud section (+ 5m) overlooking the Osireion is known as the Dendara Formation which represents the first Ethiopian sediment brought by the Nile from Ethiopia
- The Qena Sands near the Abydos Temple are truncated by overlying silt lenses which appear to have been deposited as channel fill sediments by another river. Some evidence suggests that this stream was perpendicular to the north-south river which deposited the Qena Sand. This silt has a maximum thickness of 3 m at the middle part of the lens but tapers in both directions from the channel center to the point (more or less 50m on either side of the axis of the channel)

Project Objectives

The aim of this study is to:

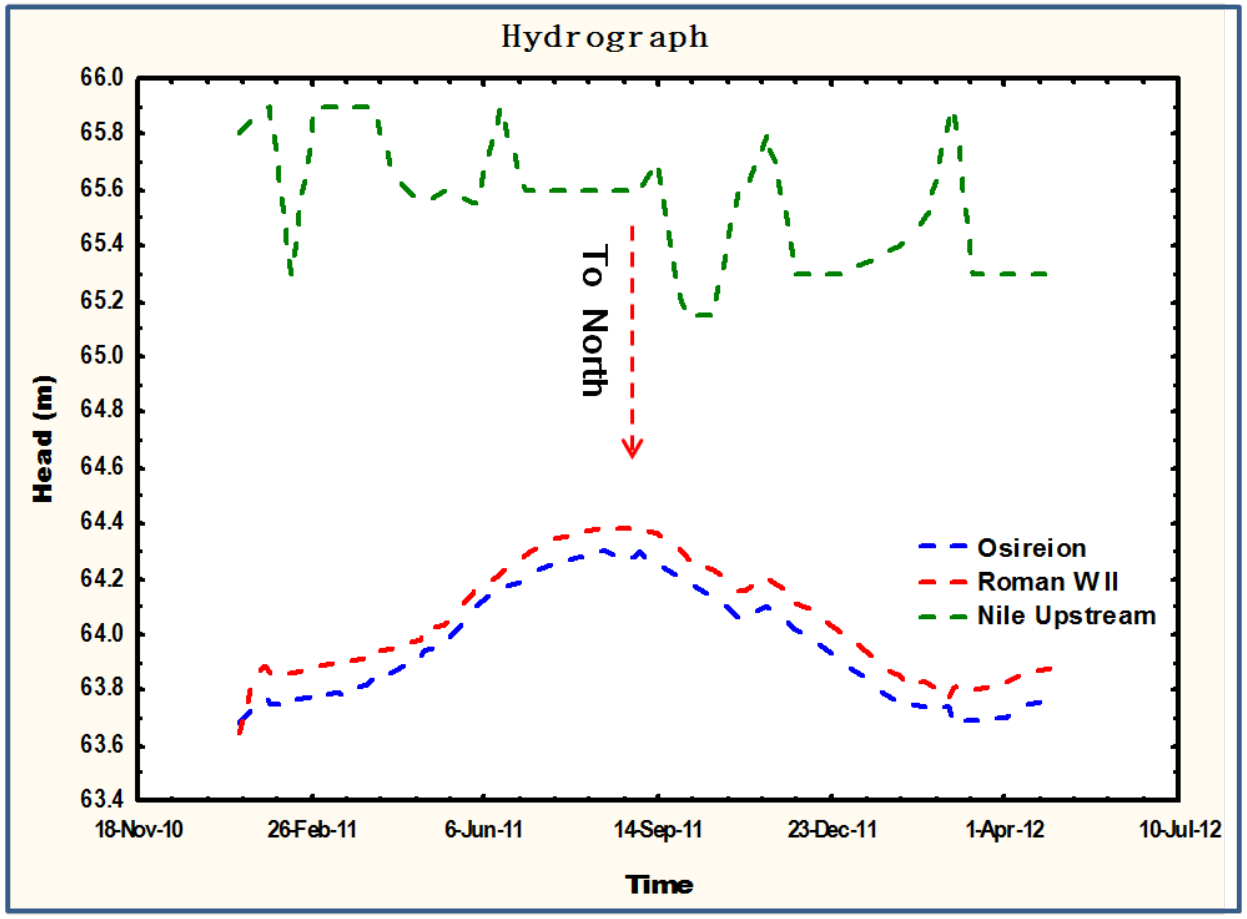
- Investigate the source of water in the Osireion
- Understand and conceptualize the flow direction and flow regime in the area.
- Determine how the water gets into the western recess on the central island.
- Investigate the age of the groundwater, using C14 analysis.

Detrimental Affects of Water

Capillary action draws shallow groundwater up into the archaeological remains.

Leading to scaling and exfoliation of the ancient carved and decorated masonry.

Water Levels Over Time in the Nile vs. those in the Osireion and Roman Well



Osireion to Roman well = 100m
Osireion to the Nile River = 11km

Existing Pumping System Around the Osireion for Water Level Control

Dataloggers

In July 2023, three *In-Situ* Aqua TROLL 200 dataloggers were installed in and around the Osireion.

This is the first time this technology has been used in an archaeology project in Egypt.

- The 1st datalogger was installed directly inside the Osireion western canal.
- The 2nd datalogger was installed 100m west of the Osireion.
- The 3rd datalogger was installed in a newly drilled well 315m south-west of the Osireion.

The selection of the two sites outside the Osireion is based on the supposed direction of groundwater flow in the area *(ref:Abdel Moneim 1999 and RIGW 2006).*

The dataloggers are a compact, modular system for measuring water levels, water conductivity, and temperature.

Readings are taken automatically at four-hour intervals in each well, which will allow a detailed database of groundwater levels and groundwater characteristics to be developed.

The location of the three loggers

Installing the new observation well and establishing ground elevation

Using the data logger

Downloaded data

In-Situ This file can be opened directly in Microsoft Excel (or you can Export a CSV) How can I auto-import these files?

Location Properties
Location Name = Aziz
Location ID = e4a56f38-e9b1-4d5d-9ba5-3e71d7707c1f
Latitude = 28.18154 °
Longitude = 31.91978 °

Report Properties
Start Time = 2023-08-20 10:10:08.423
Duration = 36.00:00:01
Readings = 217
Time Offset = 03:00:00

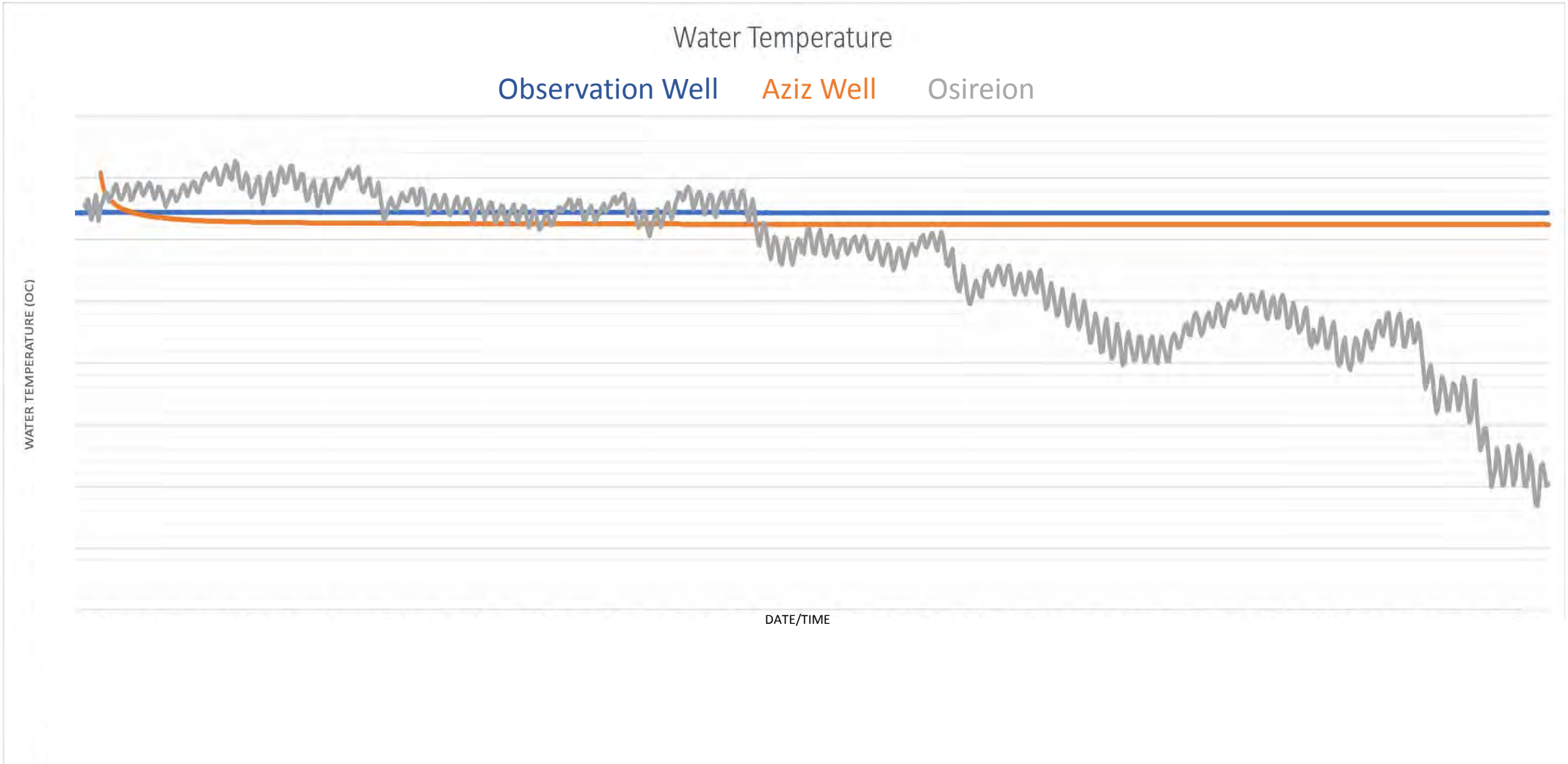
Instrument Properties
Device Model = Aqua TROLL 200
Device SN = 955055
Device Firmware = 2.01

Log Properties
Log Name = Aziz-sep_23
Log Type = Linear
Log File Number = 2
Log ID = 5f609199-d202-5115-8142-38683836a17d
Interval = 04:00:00

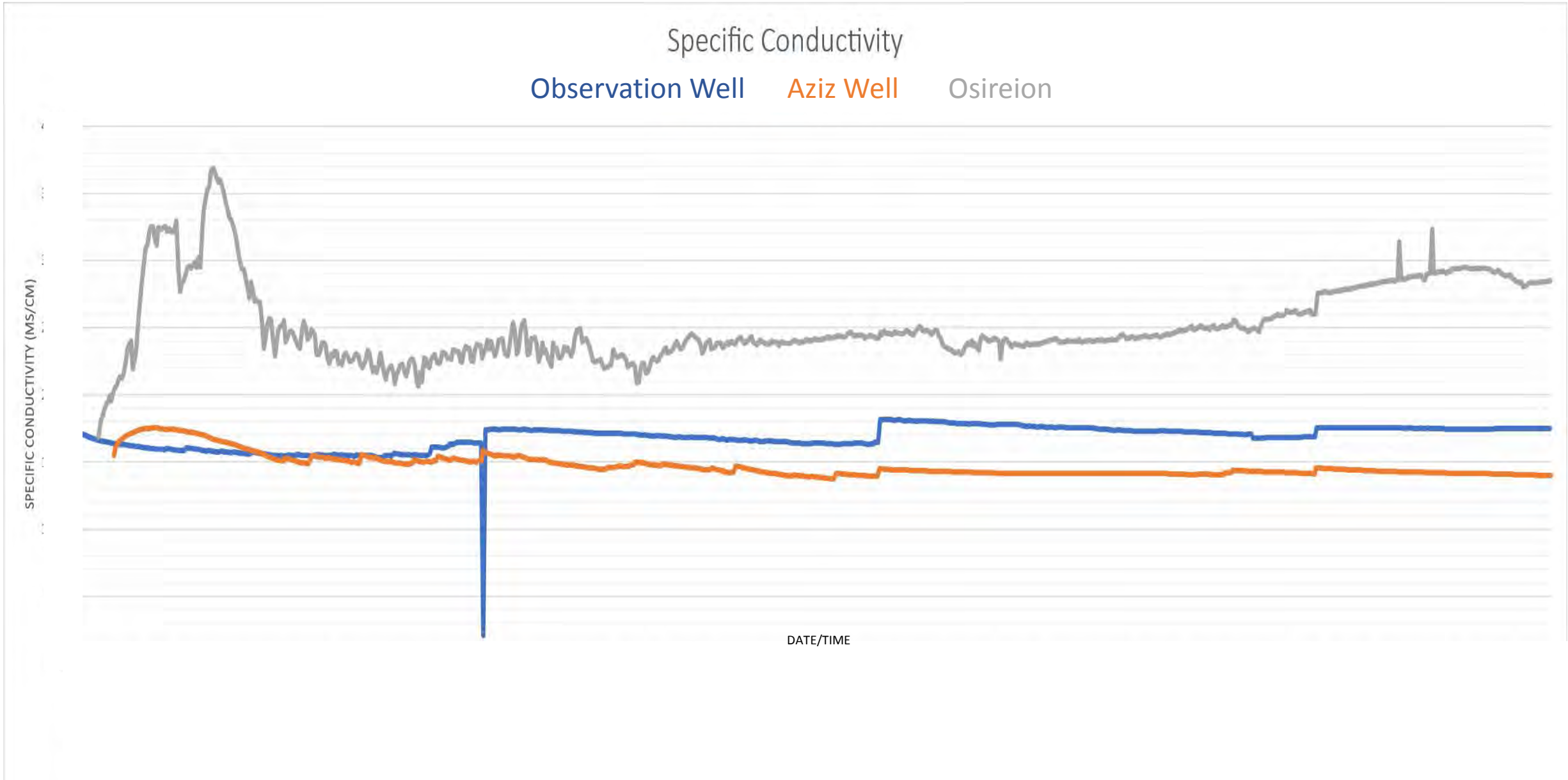
Water Pressure
Water Temperature
Depth to water
Actual Conductivity
Specific Conductivity
Salinity
Total Dissolved Solids
Resistivity
Density

Date Time	Pressure (psi) (955055)	Temperature (°C) (955055)	Depth to Water (m) (955055)	Actual Conductivity (µS/cm) (955055)	Specific Conductivity (µS/cm) (955055)	Salinity (PSU) (955055)	Total Dissolved Solids (ppm) (955055)	Resistivity (Ω-cm) (955055)	Density (g/cm³) (955055)
2023-08-20 10:10:08.423	4.011352	27.54889	19.12112	1659.976	1582.914	0.8066989	1028.894	602.4183	0.9969712
2023-08-20 14:10:08.423	4.744928	27.52148	18.60485	1652.234	1576.318	0.8031799	1024.607	605.2412	0.9969763
2023-08-20 18:10:08.423	4.743266	27.52184	18.60602	1645.738	1570.111	0.7998641	1020.572	607.63	0.9969737
2023-08-20 22:10:08.423	4.737131	27.52075	18.61034	1638.499	1563.235	0.7961925	1016.103	610.3146	0.9969713
2023-08-21 02:10:08.423	4.741948	27.52084	18.60695	1632.43	1557.442	0.7930997	1012.338	612.5837	0.9969689
2023-08-21 06:10:08.423	4.74403	27.52066	18.60548	1629.697	1554.84	0.7917103	1010.646	613.6111	0.996968
2023-08-21 10:10:08.423	4.743363	27.52048	18.60596	1624.229	1549.629	0.7889292	1007.259	615.6765	0.9969659
2023-08-21 14:10:08.423	4.748189	27.52084	18.60256	1619.751	1545.346	0.7866439	1004.475	617.3788	0.996964
2023-08-21 18:10:08.423	4.746746	27.52039	18.60357	1627.142	1552.41	0.7904137	1009.067	614.5744	0.996967
2023-08-21 22:10:08.423	4.740109	27.52021	18.60824	1621.096	1546.646	0.7873378	1005.32	616.8667	0.9969648
2023-08-22 02:10:08.423	4.747263	27.51984	18.60321	1620.078	1545.686	0.7868254	1004.696	617.2542	0.9969645
2023-08-22 06:10:08.423	4.7477	27.51975	18.6029	1625.349	1550.717	0.7895101	1007.966	615.2526	0.9969665
2023-08-22 10:10:08.423	4.745225	27.51949	18.60464	1619.395	1545.044	0.786483	1004.279	617.5145	0.9969643
2023-08-22 14:10:08.423	4.751936	27.51875	18.59992	1616.156	1541.974	0.7848452	1002.283	618.7523	0.9969634
2023-08-22 18:10:08.423	4.748746	27.51857	18.60217	1620.672	1546.289	0.7871473	1005.088	617.0278	0.9969651
2023-08-22 22:10:08.423	4.744106	27.51894	18.60543	1616.263	1542.071	0.7848969	1002.346	618.7113	0.9969634
2023-08-23 02:10:08.423	4.748705	27.51839	18.6022	1611.503	1537.545	0.7824824	999.404	620.5389	0.9969617
2023-08-23 06:10:08.423	4.751829	27.51849	18.6	1605.349	1531.671	0.7793496	995.5861	622.9175	0.9969593
2023-08-23 10:10:08.423	4.750059	27.51812	18.60124	1620.862	1546.482	0.7872506	1005.213	616.9557	0.9969653
2023-08-23 14:10:08.423	4.757135	27.51821	18.59626	1615.159	1541.039	0.7843462	1001.675	619.134	0.9969631
2023-08-23 18:10:08.423	4.75226	27.51785	18.59969	1620.318	1545.97	0.7869775	1004.881	617.163	0.9969652
2023-08-23 22:10:08.423	4.747796	27.51794	18.60283	1615.536	1541.406	0.7845421	1001.914	618.9895	0.9969633
2023-08-24 02:10:08.423	4.757235	27.5173	18.59619	1610.083	1536.221	0.7817765	998.5436	621.0859	0.9969614
2023-08-24 06:10:08.423	4.754822	27.5173	18.59789	1603.921	1530.341	0.7786407	994.7218	623.4722	0.996959
2023-08-24 10:10:08.423	4.755849	27.51758	18.59717	1603.371	1529.809	0.7783571	994.376	623.6859	0.9969588
2023-08-24 14:10:08.423	4.761315	27.51686	18.59332	1597.268	1524.006	0.7752631	990.6039	626.0689	0.9969566
2023-08-24 18:10:08.423	4.759326	27.51722	18.59472	1592.84	1519.771	0.7730054	987.8513	627.8094	0.996955

Processed Data: temperature



Processed Data: Specific conductivity



Preliminary Results

The project is at a very early stage in the data-gathering process, however, the existing data indicates:

- That the water within the Osireion has distinct characteristics, making it unlikely that it comes from the same source as the other two monitoring wells.
- Samples from all three sites are currently with an Egyptian laboratory to validate the data collected so far.
- Seasonal variations in groundwater conditions need to be established – we are very keen to establish the conditions over winter.
- More data collection will be necessary before firm conclusions and/or hypotheses can be reached.
- We hope to be able to provide updates at future conferences.