

The effect of Underground Water on Heritage Sites
(A case Study on Graeco-Roman Cemeteries in Alexandria)

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Introduction

Egypt's heritage is one of the most important world's historical civilizations that can be traced from the prehistoric period to the various stages of world civilization. Egypt is famous for its ancient civilizations and earliest and most famous monuments of the world¹.

Ancient Egyptian Civilization is one of the sources of modern culture. It attracted and influenced other people of the Ancient world, especially the Greeks and the Romans. The heritage of this civilization is a testimonial writer of their contribution to human progress, development and welfare². Thus, this heritage deserves the best ways for protection and conservation.

Despite Egypt's ancient civilization and cultural heritage treasure, only seven historical sites have been listed in the UNESCO World Heritage List and only one of them is listed in the List of World Heritage in Danger. This study aiming to explore the status of Egypt's heritage sites particularly those in Danger and to discuss the importance of including heritage sites within the World Heritage List³.

¹Teeter,E (2011), *The origins of Egyptian civilization.*, Chicago, Ill, 19; Sayre,R., (2011) *From Space to Place: An Image Atlas of world Heritage Sites in 'Danger List'* , Paris, p. 38-44; Khalil E, Moustafa M (2002) "Underwater Archaeology in Egypt". In: Ruppe C, Barstad J (eds) International handbook of underwater archaeology. Plenum Series in Underwater Archaeology, New York, pp 519–539; Goddio F et al (1998) *Alexandria. The submerged royal quarter: the topography of the submerged royal quarter of the Eastern Harbour of Alexandria.* Periplus, London. 77

² Khalil E, Moustafa M (2002) "Underwater Archaeology in Egypt". In: Ruppe C, Barstad J (eds) International handbook of underwater archaeology. Plenum Series in Underwater Archaeology, New York, pp 519–539.

³ L. Van der Tak, 2013 "Weather- and Climate-related Risks in DC: Nearby Risks: Recent Work in Alexandria", Virginia, *CH2M Hil*; p. 13; Goddio F, Clauss M (2004) *Egypt's sunken treasures.* American University, Cairo, p. 50; Halim H & Kamel Abul-Saadat (2000): A pioneer in Alexandrian underwater archaeology. Underwater archaeology and coastal management. Focus on Alexandria, UNESCO, Paris, pp 46–53.

The study findings conclude the necessity of surveying all heritage sites, particularly those in Danger in order to include them in the World Heritage List for preservation as part of the country's sustainable tourism strategy⁴.

Dangers of Underground Water

Coastal cities (Fig 1) face a high risk from increasingly costly flooding due to sea levels rise, and climate change. Climate change, rapid urbanization, and subsiding land are putting the coastal cities at increasing risk of flooding⁵.

Most of the threatened archaeological sites are found in the Delta and Lower Egypt where urban development is unplanned. The sites are also threatened by subterranean water used by farmers to irrigate agricultural land⁶.

In an attempt to preserve and protect archaeological sites threatened by urban development, Egypt's Supreme Council of Antiquities (SCA) is preparing a list of sites deemed to be at risk, which will spread to archaeological institutes throughout the country. It will be also posted on the SCA website to be promoted internationally.

In 1997, following a conference organized in Alexandria by UNESCO⁷ focusing on the preservation of the underwater cultural heritage of the great city, the Hellenic Institute of Ancient and Mediaeval Alexandrian Studies was formed. The Supreme Council of Antiquities of Egypt granted a concession for the survey of a wide sea area, east of Ancient Cape Lochais, to the Greek Mission. The area of our surveys and excavations covers some ten square kilometers of sea and extends over ten kilometers of littoral⁸.

There are twenty-three campaigns, each of approximately thirty days in duration. A variety of ancient immovable remains and movable artifacts have been found; some were raised, studied, and conserved. Most of them date to Graeco-Roman times, although there are also finds of the late Roman, Early Christians, and Islamic Periods. I will give a brief description of what we have achieved in order to stress that all the ancient remains of the eastern coast of Alexandria are at risk and that

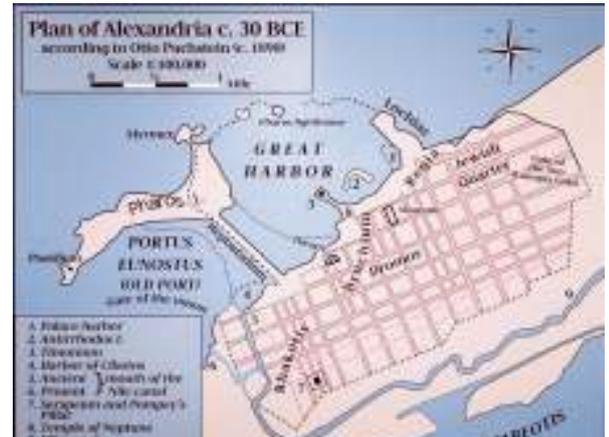


Fig.1 A Plan of Alexandria 30 BC. After; L. Van der Tak, 2013. "Weather- and Climate-related Risks in DC . Pl.1

⁴ L. Van der Tak, Op.cit, 14 ; Khalil. E & Moustafa, Op.cit 540.

⁵ Van der Tak, Op.cit, pp. 16,17 ; Sayre, R., Op.cit, 45.

⁶ Khalil. E & Moustafa, Lo.cit .

⁷ Underwater archaeology and coastal management : focus on Alexandria, UNESCO PUBLISHING, Coastal management sourcebook 2, Paris 2000: towards integrated management of Alexandria's coastal heritage, Coastal region and small island papers 14, Paris, 2003

⁸ Halim H & Kamel Abul-Saadat (2000): A pioneer in Alexandrian underwater archaeology. Underwater archaeology and coastal management. Focus on Alexandria, UNESCO, Paris, pp 46–53; Corbishley, M., (2014); *Pining Down The past Archaeology, Heritage, and Education today*. Durban university of tecknology. p. 289; Van der Tak. Op.cit. p16 , 2013; Sayre, R., Op.cit, P. 47.

a large part has already been destroyed during the late decade⁹. There are over 400 large architectural elements scattered on the sea floor of sub-site Shatby, which is part of the sub grounded Royal quarters.

In the vicinity of the reef, Ibrahimieh, marked as sub-site Ibrahimieh an amazing number of stone anchors and lead components of a gigantic composite anchor have been revealed. Because of its distance from the shore, this reef, which retains more interesting ancient remains, is not at risk. In the shallows, at sub-site Ibrahimieh, the remains of a large stone quarry co-existing with some shaft tombs that were surveyed in a preliminary manner have been completely obliterated by the widening of the coastal road¹⁰.

At sub-site sporting 5, the foundations of a large complex of structures are visible in the shallows and further studies may confirm the hypothesis that this might be part of the tomb Satanic. The dumping of concrete blocks has covered a portion of the ancient remains and threatens the site with complete obliteration. At the El-Hassan Reef, marked as sub-site 6, the remains of several shipwrecks have been spotted at a depth of 12-14 meters. Because of its great distance from the shore, this site is not threatened.

Near Sidi Bishr, there is a vast submerged necropolis. Some burials extend above sea level on the islet of Gezireh Gabr El Khour and the promontory of Bir Massaoud. land excavation of the islet has revealed remains of hypogeum burials and a large amount of pottery. The construction of a number of dikes and the dumping of concrete blocks in the sea is seriously threatening the ancient remains of this site¹¹.

I- Gabbari Tombs

The Gabbari necropolis is situated in the west of the modern city of Alexandria. Recently, while constructing a flyover to connect the desert road from Cairo to Alexandria, a large Hellenistic tomb was uncovered by the mechanical diggers. The necropolis was used by the Greeks who practiced inhumation. The people buried in this part of the necropolis were actually Greeks, as shown by their names and funerary customs, besides the loculi designed for inhumations, shallower niches were cut in then rock to hold funerary urns, the well known Hadara vases¹².

⁹ Corbishley, M., Op.cit. p.190; L. Van der Tak, Op.cit. pp16,17)

¹⁰ Mckenzie, J., (2007)*The Architecture of Alexandria and Egypt, C. 300 B.C. to A.D. 700*, Yale University Press, London, P. 709-7710; Bagnall, S.R (2001). "Archaeological Work on Hellenistic and Roman Egypt, 1995-2000". *American Journal of Archaeology* (Archaeological Institute of America) 105 (2): 227-243.

¹¹Mckenzie, J.,Op.cit, p. 513

¹² AlFouly, A.,(2000) "Voids Investigation at Gabbari Tombs, Alexandria, Egypt. Using Ground Penetrating Radar Technique" *Cairo University, Geology Department*, Egypt, September, 2000, p. 84-90; Hassan., F.,(2002) *Alexandria Graeco Roman Museum A thematic guide*, National Center for Documentation of Cultural and Natural Heritage and The Supreme Council of Antiquities, Egypt, 184.

The portion of the western Graeco- Roman Necropolis at Gabbari was destroyed because of the priority given to a new highway (Fig. 2.). The discoverer of important remains of the *Caesareum* led to a "race" between archaeologists, frantically unearthing artifacts with brushes and scalpels, while bulldozers indiscriminately grabbing soil, stones, and antiquities¹³ .



Fig. 2. El Gabbari Tomb. After: Mckenzie, J., (2007) *The Architecture of Alexandria and Egypt*, Fig 3.

Last, but not least, is the recent discovery and immediate obliteration of the remains of a temple to the goddess Bastet. In the center of Alexandria, while digging the foundations of a massive police building hundreds of artifacts, mainly of votive nature with small statues representing children with cats, were found. After the removal of the finds, all the ancient structural remains were immediately destroyed. The same happened with the foundations of the famed *Bibliotheca Alexandrina* in the heart of the royal Quarters (*the brochium*). These are only some of the most striking examples of antiquities that could very well have co-existed with modern constructions¹⁴ .

This behavior is partially related to the lack of financial means in times of economic crisis. The protection of archeological and cultural heritage is often sacrificed for superficial development. It is the task of component authorities to provide adequate protection for archaeological sites and antiquities, as this stated in the clauses of several international conventions. But there is also a need to educate and inculcate the population with the idea that ancient monuments and artifacts represent a national wealth, a heritage for Egyptians to be proud of sharing with humanity¹⁵ .

¹³ Tzalas H (in press) The underwater archaeological survey of the Greek mission in Alexandria, Egypt (1998–2010), Marine Archaeology Centre, National Institute of Oceanography, Goa, India; p.20.

¹⁴ Ibid, p. 22; Frihy, O. E.; Lotfy, M. F., 1997, Shoreline changes and beach sand sorting along the Northern Sinai Coast of Egypt, Geo. Marine Letters, V.17, no.2.; Mckenzie, J., Op.cit, p. 513

¹⁵ L. Van der Tak, Op.cit, P. 40 ;Tzalas H, Op.cit, P.22,23

II- Abu Mena Region

Abu Mena is located south of Alexandria, between Wadi el-Natrun and Alexandria itself. The church, baptistery, basilicas, public buildings, streets, monasteries, houses, and workshops in this early Christian holy city were built over the tomb of the martyr Menas of Alexandria, who died in 296AD(Fig.3). Menas, who was an officer in Diocletian's army, refused to kill any Christians after they had been defeated by his army, and declared his Christianity publicly. Legend says that after his martyrdom Menas's remains were brought back from Phrygia by camel and buried where the animal refused to walk any more. Water welled up in the desert there, making it possible to grow vines and olive trees, as a result of which it is known as St Menas's Vineyards.¹⁶



Fig. 3. Region of Abu Mena; After. Grossmann, Peter (1986) *Abu Mina: a guide to the ancient pilgrimage center. FigIV.*

Because of rigorous expansion of the cultivated areas, combined with intensive irrigation, this important early Christian site is no longer situated in the desert but has become a 'historic island' in the middle of tomato fields. Due to permanent irrigation the layers of clayey soil immediately underneath the surface have become sodden and eroded or washed out. The cavities that this erosion has created are now falling in, and large parts of the former town of Menas are either threatened by collapse or have already collapsed(Fig.4)¹⁷.



Fig.4. Region of Abu Mena; After. Grossmann, Peter (1986) *Abu Mina: a guide to the ancient pilgrimage center. Fig.V.*

The crypt underneath the vaulted church, which was the starting point of this pilgrimage cult, has only been provisionally filled with sand; as a consequence it is just a matter of time before large parts of the structure will fall in here, as well as in the basilica. Only an immediate end to irrigation, which would lead to the gradual sinking of the groundwater level, as well as scientific investigations to prepare a restoration concept, could save this World Heritage site from destruction.

¹⁶ Geirnaert W. and Leaven M.P. (1992) Composition and history of ground water in the Western Nile Delta. *Journal of Hydrology*, Vol. 138, pp. 169–89.

¹⁷ Talbot & Alice-Mary (2002). "Pilgrimage to Healing Shrines: The Evidence of Miracle Accounts". *Dumbarton Oaks Papers* (Dumbarton Oaks, Trustees for Harvard University) 56: 153–173.

The ruins of the fabled city of St Menas were placed on the UNESCO World Heritage List in 1979 as one of the five most historically important sites in Egypt. Today they are threatened by serious water seepage. It is mentioned that a complete study aiming to protect the tomb of St Mena from further leakage of underground water had been completed last week and the ministry intended to implement the project immediately after gaining the necessary approval. UNESCO had promised to provide finance for the project and several Egyptian businessmen are willing to provide some of the project costs, he said.

The site of Abu Mena was added also to UNESCO's World Heritage in the Danger list in 2001 due to the threat of rising local water tables. The clay soil that surrounds the site becomes unstable when wet and has led to the collapse of cisterns and other structures about the ancient city¹⁸.

The State Party report also provides an overview of threats posed to the property by the raising of the water table in the vicinity of the property, resulting from land reclamation programmed for agricultural development of the region, and from the building of a large road to facilitate movement through the site. The lowering of the water table has resulted in the property's dry clay soils becoming semi-liquid and the collapse of a number of structures. Measures taken by the Supreme Council of Antiquities to counteract this phenomenon has thus far proven insufficient. The State Party concluded this part of its report by summarizing the findings of the 2005 mission (previously reported to the World Heritage Committee).and by describing current plans to respond to the problems¹⁹.

The State Party report notes that a Ministry of Culture project for reducing the water table by 5m has been developed, scheduled to begin soon, has a three year time line for implementation. The report notes the importance of implementing this project in ways cognizant of economic and political aspects and integrating the full participation of the region's farmers, to ensure careful monitoring of hydrological results²⁰.

Conservation issues presented to the World Heritage Committee in 2007 ; *The State Party supplied a "Technical Report on Abu Mina Monastery Site and Underground Water Problems by Dr. Hassan Fahmy Iman (Consultant to the Supreme Council of Antiquities)", which was received on 30 January 2007.*

It was reported that the proposed conservation plan would concentrate on the protection of surface and below-ground archaeological elements during the lowering of the underground water, to monitor the structural stability of all elements. Recent technological developments will be used to assess the structural efficiency of the building materials. An architectural documentation system is to be set up.

¹⁸ Grossmann, Peter (1986) *Abu Mina: a guide to the ancient pilgrimage center*. Cairo.P.17

¹⁹ Mahmoud Abu-Zeid and Safwat Abdel-Dayem, (1991) Variation and trends in agricultural drainage water reuse in Egypt. *Water International*, Vol. 6, no. 4, pp.247–53.

²⁰ Hussein Idris and S. Nour. (1990) Present groundwater status in Egypt and the environmental impact. *Environmental Geology*, Vol. 6, No. 3, pp. 171–7.

Furthermore, deterioration phenomena survey, geotechnical investigations, and structural analysis will be carried out.

The report indicates that a detailed soil investigation was carried out, including monitoring of the ground water level variations, field tests and the production of maps. Based on the data gathered, a proposal is included for the lowering of the water table. A draft outline for a restoration plan is also included, reiterating the recommendations of the experts' mission of 2005.

In February 2007, in response to the request formulated within the Retrospective Inventory exercise, the State Party provided the World Heritage Centre with an appropriate map of the property, clearly indicating its boundaries. The next step is to adopt a buffer zone that would protect the area from development pressure, being not clear enough and not confirmed officially in the report²¹.

Anfoushy Necropolis

The tombs of Anfoushy date to the Ptolemaic era, they consist of seven graves, each of which includes a number between 10 and 15 compartment, and places dedicated to visit the dead, and for living and dining, and is characterized mostly by decoration and murals, and combines those inscriptions of ancient Egyptian and Greek. Unfortunately the groundwater threatens these tombs (Fig. 5.)²².



Fig. 5. the tombs Anfoushy. After . Venit, Marjorie S., (2002) *Monumental Tombs of Ancient Alexandria. Fig XXV.*

The tombs of Anfushy consist of an open courtyard identical to those of Shatby and Mustafa Kamel. Similarly, Anfushy tombs are cut into the limestone rock, and suffer a similar fate as those of Shatby, annually flooded by the rising water table. The main difference between the tombs is, however, the lack of *kline* chambers in Anfushy. Here the cemetery consists primarily of *loculus* burials, but some of the chambers are individual ones, with a central burial in the main chamber attached to a smaller back cult chamber²³.

The Archeological Commission warned of the danger of exposure of archaeological cemeteries in Anfushy area of Alexandria to collapse, due to the increased level of groundwater, which had led to the erosion of the walls, are described in a report commissioned by the Minister of Antiquities, the region that includes months graves Ptolemaic, Romanian and Greek in the Middle East, threatening due to increased humidity, resulting from rising groundwater²⁴.

²¹ L. Van der Tak, Op.cit,P. 41; 222-224. ص. 14 ، ج. 14 ، القاهرة ، القديمة ، الموسوعة مصر القديمة ، ج. 14 ، ص. 222-224. محمد الفلكي: الإسكندرية القديمة، دار الثقافة، الإسكندرية، 1966، ص.127. ■

²² Tzalas H, Op.cit, P.23,24

²³ Ibid, P.24

²⁴ Ibid, P.24

The report pointed out that groundwater caused significant damage in cemeteries, especially that rocky areas, have leaked salts to the walls, leading to fragmentation and thus need fast action to lower the water table down graves from all directions, and to address the main reason for the deterioration of the structural situation as well as to develop an emergency plan for the care of them, given the outstanding role in promoting tourism²⁵.

It is stressed that the plants and trees penetrate the vaults of a number of graves, leading to their destruction, noting that stopped maintenance and repair work caused the deterioration of the structural condition of the graves.

The Commission proposed in its report, a number of requirements that must be provided to protect the tombs, e.g. construction of a specialized insulating walls around them, or the use of underground water absorption, technology, and measures, to prevent graves from collapse or extinction²⁶.

Some of the wall paintings in the Anfoushy chambers are preserved in an excellent state, showing each detail in clear colours. However, while some are exceptional, the majority has suffered from years of annual flooding and the deterioration is getting worse each year. We were fortunate to visit the cemetery when a German archaeologist was working with the constantly flooded tomb, describing to us all the problems they dealt with on a daily basis while trying to document as much as possible things that are still preserved. In order to save this tomb from complete destruction a stationed pump is necessary to continuously clear the area from the rising ground water. Not an easy task and unfortunately too expensive for anyone to deal with so far²⁷.

As you will see from the photos there are some very fine examples of other architectural elements on display in the Anfushy necropolis area. The sarcophagi and



Fig. 6. the walls structures which oversaturated with humidity, saltines and parasites. the tombs Anfoushy. After . Venit, Marjorie S., (2002) *Monumental Tombs of Ancient Alexandria. Fig XXV*



Fig. 7. Growth of the a algae around the loculi. the tombs Anfoushy. After . Venit, Marjorie S., (2002) *Monumental Tombs of Ancient Alexandria. Fig XXIV*

²⁵ Morcos SA (2000) Early discoveries of submarine archaeological sites in Alexandria. Underwater archaeology and coastal management. Focus on Alexandria, UNESCO, Paris, pp 43–51.

²⁶ Agrawala, S., Moehner, A., El Raey, M., (2004). Development and Climate Change in Egypt focus on Coastal Resources and the Nile, Organization for Economic Co-operation and Development, OECD, France. P.15.

²⁷ Ibid, P. 17.

capitals are, of course, a few examples. Anfushy marks a remarkable example of Hellenistic funerary architecture and decoration, and we must count ourselves blessed to have had the opportunity of visiting it as many times as we have as it is in constant threat of complete deterioration. Soon, if no one steps in, these Ptolemaic tombs will be preserved only in the memory of those who visited them, and of course in the written documentation since they were found in the early 1920²⁸.

III- Shatby Necropolis

It is situated in the eastern quarter of the ancient city of Alexandria, overlooking the Mediterranean Sea, before St. Mark College in the city of Alexandria. These tombs present the oldest example of Alexandrian-style burials cut into rock²⁹.

This private Ptolemaic cemetery dates to the 4th century BC, and it is considered to be the oldest in the city, belonging to the first Alexandrian families. Though the Shatby tombs are now above ground in the open air, they were once underground burial vaults. Visitors to the necropolis must descend a number of steps to reach the

lower level of sandy ground where the tombs now stand.

The complex is surrounded by a garden pathway of flowers, shrubbery, and simple statuary, including the remnants of Greco-Roman funerary monuments. The tombs themselves are of modest size, and distinctly Hellenistic in style. Each one is modeled after a typical ancient Greek house, with a doorway that opens into a corridor and two chambers³⁰.

Shatby burials have been cut into the natural rock, used by the first generations of Macedonians in Alexandria. Shatby is Alexandria's oldest Hellenistic cemetery, dating to the 4th century B.C. It was discovered in 1904, east of the ancient Nile canal that led into the Royal Harbour, and close to the Mediterranean coastline, which today causes a continuous water situation to the burial ground as it submerges with the rising of the underground water table (as seen in the photos (Figs, 8,9).

The plan of the main tomb in the necropolis reveals a doorway leading into a hall then into another hall then into an open yard. To the east of the yard, there is a

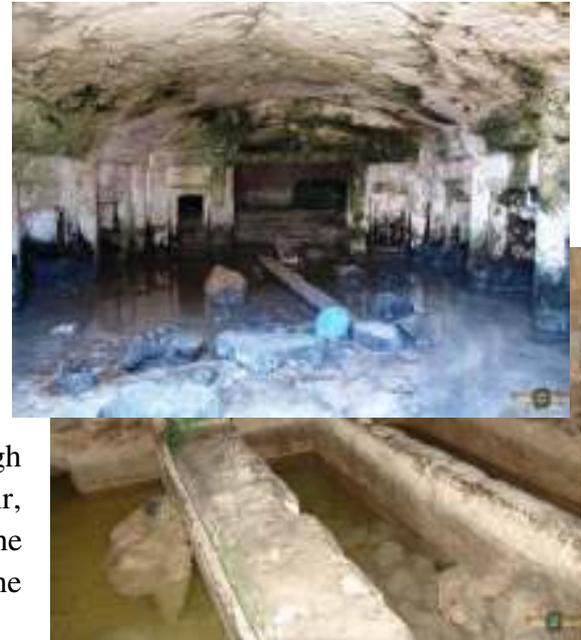


Fig.8. The tomb of shatby drowned by underground water. After; Ezzat Kados(2000),Monuments of Ancient Alexandria. Fig36

²⁸ عزت قادوس: آثار الإسكندرية القديمة، الإسكندرية، 2000، ص.320

²⁹ Tzalas H, Op.cit. 60; Abd-el-Maguid. M.M (2001) Underwater archaeology in Egypt in a century. Proceedings of the 2nd scientific meeting of the Arab archaeologists. Arab Council for Graduate Studies and Scientific Research, Cairo).

³⁰ Morcos,s, Tongring,N., Halim, Y., Awad, M. (2003) "Towards integrated management of Alexandria's coastal heritage.Coastal region and small island" papers 14, UNESCO, Paris,P. 79.

doorway leading to the burial chamber. Every tomb has a doorway, which leads to a corridor and two chambers. Inside one of the tombs a number of vessels, containing human ashes, were found. As for the decorative architecture, the main tomb was ornamented with half pillars, amid which were false doors.

As you can see in the photographs, these tombs were arranged with a central, so called kline burial, consisting of a rock cut bed or sofa into which the deceased was laid down (one of the main differences between Macedonian kline burials and the Alexandrian is in the physical appearance of these beds/sofas: while the Alexandrian ones are hollow, the Macedonians are flat, thus placing the deceased straight on its top). Similar to other Alexandrian cemeteries of Shatby is decorated with Doric (half) columns, and their chambers are decorated with false windows. Although most paint is long gone, it was originally recorded to have sky-blue panels, and an overall decoration which can be compared with the 2nd Pompeian style³¹.

IV- Kom el Shoqafa Cemetery

The Catacombs (meaning underground tunnels) lie in the district of Karmouz to the east of Alexandria. The area was called Kom El-Shoqafa or a pile of shards. This cemetery dates back to the 1st century A.D and was used until the 4th century A.D. It was discovered in 1900 when by pure chance, a donkey drawing cart fell into a pit, which led to the discovery.

The Catacombs in Alexandria are so called because the design was very similar to the Christian Catacombs of Rome. The Alexandrian catacombs was most likely a private tomb, later converted to a public cemetery and It consists of 3 levels cut into the bed rock, a staircase, a rotunda, the *triclinium* or a banquet hall, a vestibule, an antechamber and the burial chamber with three recesses on it; in each recess there is a sarcophagus. The tomb of Kom Shokafa drowned by underground water (Fig. 10)³².



Fig.10. the tomb of Kom Shokafa drowned by underground water. After; Ezzat Kados(2000),Monuments of Ancient Alexandria. Fig41

³¹ عزت قادوس: أثار الإسكندرية القديمة، الإسكندرية، 2000، ص. 311

³² Halim H & Kamel Abul-Saadat (2000): A pioneer in Alexandrian underwater archaeology. Underwater archaeology and coastal management. Focus on Alexandria, UNESCO, Paris, pp 46–53

The protection of Egyptian Cultural Heritage

The only solution for the protection and preservation of Egyptian cultural heritage is the participation of local communities in the management and conservation of archaeological sites.³³

Egyptian cultural heritage is suffering from an endemic incapacity for management, with bureaucracy and inability to see the benefits of change limiting development. The protection of museums and archaeological sites is a national duty and is part of our identity; all stakeholders should co-ordinate and co-operate to protect our heritage in order to pass it on to future generation³⁴.

The aim of this paper is to emphasize that all types of Egyptian heritage are potentially targets for destruction, from ancient Egyptian civilization to Jewish Heritage. To help efforts in protecting sites, the Government should establish a permanent police presence at isolated archaeological sites such as Abu Mena, Dahshur and El Hibeh³⁵.

Conclusions and Recommendations

Egypt's heritage is one of the most important of the world's historical civilizations. The heritage of this civilization are represented in temples, tombs, churches, mosques and, Museums.

Though these monuments are already being protected naturally, but unfortunately this great heritage faced the danger of underwater that is really a major threat to its eternity, especially the coastal cities which are exposed to the danger of underground water. Alexandria is considered one of the important coastal city which is exposed to underground water, especially Graeco-Roman Cemeteries.

Groundwater caused significant damage in cemeteries, especially rocky areas, having leaked salts to the walls, leading to fragmentation and thus need urged fast action to lower the water table down graves from all directions, and to address the main reason for the deterioration of the structural situation, as well as to develop an emergency plan for the care of this heritage.

The Egyptian Ministry of Culture has developed an outstanding project, aiming at lowering the water table by means of draining ditches and pipes, inside and around

³³ Empereur, J.-Y. (2000). "Underwater archaeological investigations of the ancient Pharos". In: Mostafa, M. H. *et al.* (eds.), *Underwater Archaeology and Coastal Management: Focus on Alexandria*. Coastal Management Sourcebooks 2, UNESCO, Paris, pp. 54–59.

³⁴ Mostafa, M. H., Grimal, N. and Nakashima, D.(eds.) (2000). *Underwater Archaeology and Coastal Management: Focus on Alexandria*. Coastal Management Sourcebooks 2, UNESCO, Paris, PP.197.

³⁵ Morcos,s, Tongring,N., Halim, Y., Awad, M. (2003) "Towards integrated management of Alexandria's coastal heritage.Coastal region and small island" papers 14, UNESCO, Paris,P. 79.

the archaeological area. Drained water will be conveyed by gravity into collecting tanks, from which, by means of pumps and through a long pipeline, to the main canals coming from the Nile. The drainage ditches and pipes will also collect the water drained in the area of the Mar Mena Monastery, for which an *ad hoc* project will be developed.

Recommendations

- The competent authorities in Egypt, specially the ministry of Antiquities have to carry out extensive operations of maintenance and restoration of all archaeological sites.
- Contacts should be intensified with international specialized organizations such as UNESCO to insert these sites in the list of human heritage

- Establishment of an efficient system for monitoring the underground water in the archaeological site and in the surrounding zones.
- Consolidated the walls structures which oversaturated with humidity, saltines and parasites.
- Implementation of conservation and management plans
- Lowering of the underground water by means of drainage ditches and pipes, inside and around the archaeological area;
- a) Implementation of a rapid condition survey of all excavated remains and urgent conservation measures in order to provide protection to structures against earth trembling and other forms of damage likely to result from the use of heavy earth-moving equipment;

- Needed a conservation plan which concentrates on the protection of surface and below-ground archaeological elements during the lowering of the underground water, to monitor the structural stability of all elements. Recent technological developments is to be used to assess the structural efficiency of the building materials. An architectural documentation system is to be set up.

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- Darwish I & Abd-el-Maguid MM (2002) Underwater archaeology in Egypt. In: Tzalas H (ed) Tropis VII .1999 :Euro-Med, Murcia, pp 305–309 seventh international symposium on ship construction in antiquity, Pylos, Greece, 1999. Hellenic Institute for the Preservation of Nautical Tradition, Athens, pp 881–889.
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الملخص العربي

ارتفاع منسوب المياه الجوفية خطر يهدد المواقع الأثرية داخل مصر وخاصة منطقة أثار الإسكندرية والمدرجة على قائمة التراث العالمي باليونيسكو لبحث حلول لخفض منسوب المياه الجوفية في المقابر اليونانية الرومانية بالإسكندرية.

تتعرض المقابر الأثرية في منطقة الإسكندرية للانحيار، بسبب زيادة منسوب المياه الجوفية، التي أدت إلى تآكل الجدران، فالمنطقة التي تضم أشهر المقابر البطلمية والرومانية واليونانية في الشرق الأوسط، مهددة بسبب زيادة نسبة الرطوبة، الناتجة عن ارتفاع منسوب المياه الجوفية أحدثت أضراراً كبيرة في المقابر، خاصة المناطق الصخرية، بعد أن تسربت الأملاح إلى الجدران، ما أدى إلى تفتتها، لذلك يجب العمل على خفض منسوب المياه الجوفية أسفل المقابر من جميع الاتجاهات، ومعالجة السبب الرئيسي لتدهور الحالة الإنشائية لها، بالإضافة إلى وضع خطة عاجلة للعناية بها، نظراً لدورها المتميز في تنشيط السياحة. كما أن النباتات والأشجار تخترق أسقف عدد من المقابر، الأمر الذي يؤدي إلى تدميرها، أيضاً توقف أعمال الصيانة والترميم تسبب في تدهور الحالة الإنشائية للمقابر، وضياح النقوش والتصميمات. ويجب الإسراع إلى توفير عدد من الاحتياطات لحماية المقابر، من خلال بناء جدران متخصصة عازلة تحيط بها، أو استخدام تقنية امتصاص المياه الجوفية من المناطق المتضررة، ومعالجة الرسوم الموجودة على الحائط بالتجهيزات اللازمة.