

WATER AND ANTIQUITY

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TABLE OF CONTENTS

I.	Introduction	1 - 2
	A. Statement of the Problem	1
	B. Archaeological Resources	1 - 2
II.	The City in Antiquity	2 - 5
III.	Water and Society	6 - 8
IV.	Country Specific Discussion	8 - 21
	A. Egypt	8 - 10
	B. Israel, West Bank/Gaza, Jordan	10 - 19
	1. Introduction	10 - 11
	2. Early Antiquity	11 - 12
	3. Late Antiquity	12
	4. Specific Sites	
	a. Israel	12 - 14
	b. West Bank/Gaza	14 - 15
	c. Jordan	15 - 19
	C. Oman	19 - 21
V.	Conclusions	21 - 26

I. Introduction

A. Statement of the Problem

"Water and Antiquity" addresses ancient water practices in the Arab Republic of Egypt (Egypt), Israel, the West Bank/Gaza (WB/G), the Hashemite Kingdom of Jordan (Jordan) and the Sultanate of Oman (Oman). The water systems implemented in antiquity were integrated into wider systems relating to urban/town/village planning and to the agricultural/economic base for the populations. Because of the minimal rainfall in all of the countries under consideration, the inhabitants of the ancient world were conscientious caretakers of their water resources. By concentrating on ancient water practices within the Near East/North Africa region, it is possible to place modern water problems within a temporal context. Specific ways in which the ancient populations of the modern countries used and conserved water will assist in solutions to present problems and contribute to the understanding of "best practices" as being developed by the GreenCOM Project.

B. Archaeological Resources

Archaeological resources are one element of tangible cultural resources. They are the material culture remains (MCRs) left by past inhabitants of a place. What constitutes an archaeological resource varies by country. An acceptable definition is that archaeology pertains to all remains from "yesterday" back to the first evidences of human habitation. Identifying "yesterday" as the starting point has meant the formation of "ethnoarchaeology". Ethnoarchaeology uses modern tangible, i.e., housing construction techniques, and intangible, i.e., household sleeping patterns, cultural resources to assist in formulating interpretations of the past. Most nation-states and individuals, however, have specific time periods in mind. For example, the Jordanian definition of archaeology is MCRs pre-dating A.D. 1700, the middle of the Ottoman period (A.D. 1516-1918); and, in the case of human burials, the end-date is set with the Byzantine period (A.D. 324-631).

Near Eastern archaeologists discuss data using generally agreed upon period designations. There is often discussion of specific dates and there is some variance in the names of the periods, depending on the modern country in which the archaeologist is working.

MCRs are anything that humans altered as part of their lifestyles. Familiar examples of MCRs are: pottery; architectural remains, e.g., standing columns, theaters; decorative and utilitarian objects made from clay, stone, metal, glass; inscriptions, preferably excavated in situ; tessellated (mosaic) pavements. MCRs are interpreted in the particular and in association with other MCRs in order to understand the social history of the past at a particular place or site and for regions.

As archaeology has developed, it has become multi-disciplinary with in-depth analyses of past flora and fauna and natural environmental systems contributing to interpretations. In effect, the study of, for example, past dietary practices and how previous populations molded their natural environment are being assessed like other MCRs. The study of ancient water systems is an excellent example of the integration of "traditional" archaeological methodology with the natural sciences. The painstaking and time-consuming archaeological process of survey, excavation, recording and interpretation gives substance to how people lived and used their environment in the past.

In the last thirty years, archaeological research has increased in all of the countries under consideration. Only recently, however, has the inclusion of archaeological resources into the development process started to take place. Initial steps included these resources as part of the tourism base. What is being realized is that there is far more to these resources, as they may help us to understand how humans lived compatibly with the natural environment.

This paper concentrates on those MCRs germane to water and water use as understood archaeologically. A distinction is made between early antiquity and late antiquity in each of the countries under consideration. Early antiquity includes the long prehistoric periods. Late antiquity is generally understood to extend to the coming of Islam. As this varies between regions, this parameter is difficult. For the purposes of this paper, late antiquity includes the Islamic caliphates through the Mamluk (end date A.D. 1516). Where applicable, specific references are made to caliphates. Although references are made to the Ottoman period, it is viewed as distinct from late antiquity. What needs to be noted is that archaeological interpretation does not necessarily coincide with textually documented historical events. Because an event occurred, this does not mean that the MCRs changed from one day to the next. Changes were gradual in nature and usually not a result of governmental decree. Exceptions do exist, however. For example, the Hellenistic (Ptolemaic period, fourth century B.C.) in Egypt evidences abrupt alterations in architecture and pottery; and, during the reign of the Umayyad Caliph Abdul-Malek (early eighth century A.D.), coinage was changed by decree.

II. The City in Antiquity

The "city" in antiquity is often discussed in relationship to specific sites and their regional context. The development of archaeology as a discipline and the influence of natural environmental studies on archaeology means a more integrated approach to the founding of cities is emerging. Scholarship defined the placement of cities by the need for protection, location on a trade route and the availability of water, often in relationship to agricultural activity. What was assumed was that

a natural rise in the topography was chosen in order to be able to view the surrounding countryside and that cities existed because of trade. Now, however, it seems clear that political considerations were a factor in choosing locales and that engineering skills frequently overcame the lack of naturally available resources.

For all of the countries with which this paper is concerned, archaeologists have had different emphases. Until recently, Egyptologists focussed on tombs, preferably from the elite, and temples. There are exceptions to this in Egyptology, e.g., Amarna. In modern Israel, WB/G and Jordan, emphasis was on the large urban/town mounds (tell/tall). These tells were created by successive layers of habitation, sometimes destruction layers due to war or a natural occurrence as an earthquake or fire, often becoming increasingly higher merely because of debris accumulation. For the most part, urban centers were researched in isolation from the surrounding area, thus the emphasis placed on the identification of city-states. Textual documentation from early antiquity supported the approach that concentrated on the visible urban/town tells disassociated from the surrounding areas.

As emphasis was placed on cities mentioned in a text, e.g., Egyptian, Assyrian, Babylonian or Biblical, it was the cities that formed the research focus, particularly in the Near East as differentiated from North Africa. The result was detailed descriptions of cities and interpretations of MCRs which were evolutionary/devolutionary in nature. There was little attention paid to continuity or intra/inter-site settlement patterns. New research efforts aim not only to re-evaluate previously excavated MCRs within a concept of social history but to incorporate the urban-tell site into its cultural and natural surroundings. Excellent examples are: Lachish, Hazor, Tell el-Hesi, Tell Halif, Beth She'an (Israel); Jericho, Khirbet Bir Zeit (WB); Jerash, Pella, Irbid, 'Amman (Jordan); Tell Muqdam, Tell el-Maskhuta, Tell Dab'a (Egypt).

In the prehistoric periods, ca. 7500 B.C., Pre-Pottery Neolithic period, large population agglomerates, e.g., 'Ain Ghazal (Jordan), Jericho (WB), Ma'adi (Egypt), and the Dhofar (region of Oman) have been elucidated. There is hesitation to define areas such as these as "cities". If the broad definition of an administrative/economic center is used, then these types of settlements may qualify; at the least, they are "incipient" cities. Without the corroborative textual documentation, scholarship hesitates to name these places "cities". Study of the MCRs on a regional basis is leading to the inescapable conclusion that there were prehistoric "networks"; nevertheless, without the accoutrements of what has traditionally defined a city, i.e., a wall, it is unlikely that these types of sites will be viewed within the definition of "city". The settlement concentrations were near springs, often straddling them as in the case of 'Ain Ghazal. Access to Nile River water was essential in Egypt. Water in domestic units was stored in

containers and brought to the unit. Little remains archaeologically to detail how this was done. Animal skins were probably used, much the way present bedouin store water, before the introduction of pottery, ca. 6000 B.C. Regional surveys attest fifth millennium B.C. settlements located near springs or seasonal running water, e.g., the Wadi Ziqlab survey, Jordan. As well, shaft-like wells were cut through the bedrock to tap the water table, e.g., Tell Irbid, Jordan and Ma'adi, Egypt.

In the fourth millennium B.C., sites are archaeologically identified as cities. This interpretation is a result of analyses of the built environment, as the textual documentation does not pre-date ca. 2500 B.C. "City" is generally equated with the architectural elements of the built environment. Components of this environment were: a fortification wall; city gates, central temple/governmental area, designated installations relating to the religious/administrative structure, shops, domestic dwellings, a water system. Located outside of the city walls, there was a necropolis; and, in the case of Egypt, designated "suburban" type areas that seemed to have related to social stratification within the society, i.e., worker communities. Throughout the region, mud-brick was the primary structural building material often with stone substructures for units within the city. City walls were mud-brick in earlier periods and then stone. Street patterns can best be described as "random", without the implication that there was lack of planning. The focus of the city was the religious/administrative center and the king/ruler. The king/ruler was the earthly representation of a major god in a vast pantheon.

In late antiquity, urban systems were altered due to population changes and different expectations of the citizenry. For Egypt, the beginning of late antiquity is usually discussed as beginning with the Hellenistic conquest. With the Ptolemaic period, sudden and drastic changes were introduced. However, city-planning was altered in Egypt, i.e., Alexandria, by the Romans as it was in modern Israel, the WB/G, and Jordan, although this was somewhat later in Egypt, i.e., 30 B.C.

The Romans (first century B.C.) who unified the region and introduced a different concept of the built-environment. Roman engineering skills, emanating from the Greek-Hellenistic world, forever altered the concept of the city. It remained essentially the same until the 'Ayyubid (A.D. 1187-1260) and Mamluk (A.D. 1260-1516) periods, partially the western Crusader period of the twelfth and thirteenth centuries A.D. The Romans introduced the orthogonal (block-system) street plan, stoned paved streets with sidewalks demarcated by colonnades, and esplanades, along with specifically delineated marketplaces, bath-complexes, amphitheatres, theaters, odeons, hippodromes, and a civic or forum area which was a modification of the Greek agora. All of the urban elements were constructed of well-cut and ordered masonry. Although an order was maintained, following the Roman period, the architectural elements

became smaller and mortar was used more consistently. The temple remained a central focus within the city with the one dedicated to the city-god taking precedence, as it had in early antiquity. Cities were still encircled by walls and gates were maintained. This was less for reasons of warfare than for the differentiation of the space from the surrounding countryside. The Romans viewed the city in a sectioned manner, clearly differentiating between public and private space, as well as determining segments or quarters of the cities for particular populations. Whereas this existed in earlier antiquity, it is with the Romans that this is clarified.

Because of the Roman administrative system, it was possible to maintain the differentiation in space. Once this system, often referred to as the polis-system disintegrated, space was used in an almost random fashion. Scholarship on the city originally established a dichotomy between the "ideal" of the Roman planned city and that of the Islamic city, identified as "random" or "spontaneous". Archaeological data from sites in Israel, WB/G and Jordan, however, indicate that alterations in the city-plan were a result of several forces before and after the advent of Islam.

Once the Roman administrative system was replaced by the developing Christian church, known as the Byzantine period, the definitions of public and private space began to be altered. Almost every Roman city bears witness to the use of public space, e.g., the streets, sidewalks and esplanades, for the construction of churches. In other words, the replacement of the Roman administration and aristocracy with the Church hierarchy meant an alteration in how people viewed the cities. The power of the Church also led to the dissolution of the public areas, e.g., theaters, odeons, hippodromes, as seen, for example, at Beth She'an (Israel), Jarash (ancient Gerasa, Jordan) and Madaba (Jordan). There is also some evidence for the same phenomenon occurring in Egypt from Alexandria. Archaeological data indicates that this process of encroachment continued throughout the early caliphates of Islamic rule, but it also indicates that the integrity of the city was essentially maintained with regional variation.

Byzantine specialists continue to discuss "Byzantium" in modern Israel, WB/G and Jordan following the Muslim take-over of the region, completed by A.D. 642. This is because Byzantium continued in Anatolia (Turkey) until the fall of Constantinople (Istanbul) in A.D. 1483. It is only recently that Near Eastern archaeologists have viewed the material evidence of the Muslim take-over and the subsequent administrative reordering of the region as part of the longue duree and not as a break in the archaeological/historical "record" of a site or region. Practically what has occurred is that the study of Islamic civilization/s is no longer merely the perview of textual and art historians.

III. Water and Society

In antiquity, there was some consistency in how the ancient inhabitants of the countries under consideration understood their water resources. Springs, rivers and annual rainfall were the sources which enabled the settling of areas and allowed for agricultural production. There is little textual evidence to indicate a population or state overly concerned with managing the water resources; rather, it appears that this was a "given". That is to say, the population needed water, so accommodations were made. Archaeological data indicate efficient and intricate systems that utilized all available sources.

Although water was viewed religiously in early antiquity, this view was through the prism of the agricultural cycle and tied to the concept of "dying (winter) and rising (spring)" gods. The Greeks, both separately and as the Romans altered Greek concepts, connected beauty with the body and public spaces. The former led to the institution of the bath-complex, as well as the development of art, and the latter to fountains and the enhancement of garden areas. The baths played a role in ancient society as a gathering place, a place to conduct business comfortably. The fountains and gardens were controlled public space, enhancing the quality of public life, and refining private life.

Several examples of bath complexes exist: Alexandria (Egypt), Gadara (Jordan, modern Umm Qeis) and Caesarea Maritima (Israel). Whereas the first two exhibit the normal system of changing-, cold-, tepid-, hot-room, Caesarea Maritima has a swimming pool and seems to have been a more luxuriant establishment than the normal public bath. The Gadara bath was typically altered in the Umayyad period to a two room installation, a cold- and hot-room. It was used at least through the beginning of the 'Abbasid period (A.D. 750-945). Pipes brought the water to the installations from the main water canal or system. In the case of Caesarea Maritima, the lead pipe system emanated from the high aqueduct. In the case of Gadara, it can be assumed it emanated from the recently excavated bedrock-cut canal/channel system.

In the Jordanian desert, three of the so-called "Desert Castles", dating to the Umayyad and 'Abbasid periods, also have bath complexes. One has been excavated at Azraq; another is Hammam as-Sarakh, part of the Qasr Hallabat complex; and, the most famous is Qusayr 'Amr. Little remains of the Azraq bath. Until recently water was plentiful in Azraq, as it was an oasis. The water has been piped to modern Irbid and the capital of Jordan, 'Amman; as well, the damming of the wadis in Syria prohibits the normal water flow following the winter rains. Hammam as-Sarakh is located beyond Qasr Hallabat in what is barren desert today. In antiquity, however, there was substantial water. The landscape is dotted with an intricate reservoir system. Qusayr 'Amr is a World Heritage site, famous for the frescoes throughout the bath complex. Water

was supplied to Hammam as-Sarakh and Qusayr 'Amr by wells, cisterns and reservoirs. The wells, cisterns and reservoirs were made of cut stone and then plastered.

In the Yarmouk River Valley there is the famous hot springs complex of ancient Gadara. This was excavated by Israeli archaeologists following acquisition of the area. It forms part of the total picture of ancient Gadara. Hot springs were used in antiquity as curative centers and another type of bathing complex. Pella (Jordan) also had a hot spring, known and used throughout antiquity. It is still being used today, although the complex has been moved to another spot.

Evidence for public fountains, nymphaeums, is more limited. Current excavations of the traditionally identified nymphaeum in 'Amman (Philadelphia of the Roman and Byzantine periods, Jordan) have not unearthed pipes; thus, bringing into question the identification. Both Pella (Jordan) and Gadara (Jordan) have nymphaeums; however, the piping system, made of clay pipes, is clear only at Pella. Throughout the late antique cities, basins which may have been fountains have been discovered. However, only at Caesarea Maritima has a fountain been excavated which dates to the earliest Islamic occupation of the city. A public area was re-aligned both by the late Byzantines and the early Muslims. The fountain was built of stone, plastered and had one outlet channel. The addition of a small fountain at the south end of the esplanade must have enhanced this public area.

The Islamic view of gardens, fountains and appreciation of water is well-known. It is the preserved elite houses of the later Islamic caliphates or the modification of these in the Ottoman period and the famous mosques of Cairo and Damascus to which reference is generally made. Analysis indicates that the appreciation of water is not unique to Islam. The deities in the pagan pantheons also related to water; and, both Christianity and Judaism abound with symbolism relating to water. It is not surprising that all three monotheistic religions revere water: they emanate from an area where it was a resource gained at great effort.

What differentiates Islam from Christianity and Judaism is succinctly placed within the framework that the ultimate control of the resource rests with 'Allah, God, and that water, particularly rain is a sign of his mercy. Humans may create this mercy or peaceful existence within the garden. The garden was to be found in public as well as private space, although examples do not exist in the countries under consideration here. The song of the garden fountain with the tranquility of the plants was to create paradise on earth.

The development of the Islamic city reflects a difference in the understanding of public and private space. The wide streets of the Roman period gradually became narrower as discussed above, and

there is a turning inward to the closed courtyard. It could be argued, however, that the Roman/Byzantine domestic units exhibited the same characteristic. The best documentation for this from Pella (Jordan). If nothing else, this became more pronounced following Islamic rule. There is a difference in the development of the Islamic city between the Near East and North Africa. In the latter, the Fatamids seem to have had a major influence in altering the urban plan. Whereas the block plan was utilized previously, the radial plan was introduced. Each city-quarter maintained its own public baths and mosque/school (madrasah) complexes, sometimes several. Only Caesarea Maritima evidences this change in the city plan for the later Islamic periods in the region of modern Israel, WB/Gaza and Jordan.

IV. Country Specific Discussion

A. Egypt

Egypt is bifurcated by the Nile River with the delta region in the north. The two main tributaries, the Blue Nile and the Atbara rivers, emanate from the mountainous Ethiopian plateau. The river forms a flat-bottomed valley which is eight to sixteen kilometers in width (five to ten miles). To the West and the East of the river there is desert. The eastern desert extends to the Red Sea, beyond is the Sinai. Water in the Sinai is limited, with a few small streams in the southern mountains. These drain towards Suez and Aqaba. To date, there is no evidence of damming systems in the Sinai as in other countries under consideration. The water table below the western desert is extensive and creates the oases. Over two-thirds of the country is encompassed by this western desert. Agriculture is localized to the Nile Valley and the delta, which totals approximately 1/50th of the land. The construction of the Aswan Dam in 1970 was to facilitate and regulate the Nile River inundations. Unfortunately, there are negative outcomes: the soil is not being replenished because the silt is no longer present, thus salinity is increasing.

Before the nineteenth century controls, the Nile River flooded the valley and the delta in July. This created a lake-type effect. Settlements were connected by causeways until the water receded in October/November. The water was guided to large earthen basins which acted as cisterns and by irrigation canals. When the waters receded, fertile silt remained which was planted. It was unnecessary to add more water to the soil. Once the crops were harvested in April/May, the land was left without irrigation until the next rain. This aerated the soil and prohibited salt accumulation. It is this cycle which marked the ancient Egyptian year: inundation by the Nile River (ahket), planting and growing (peret) and the drought (shemu). The ancient Egyptians maintained this cycle throughout antiquity. The population was low, probably not exceeding four to five million. The state was concerned about the grain yield for tax purposes and rents, but does not seem to

have been concerned about irrigation or water use. This may imply that water regulation was locally managed.

The "Scorpion" macehead, which is prehistoric or predynastic, shows a king building an irrigation canal. This limestone MCR is interpreted as showing the unification of lower and upper Egypt with the scenes depicting victory (the first register: dead birds suspended from the identifications of the southern tribes), reorganization (the second register: the king building the canal), and peace (the third register: an agricultural scene). Lacking textual documentation, it would seem that the Egyptian state was not dependent on the control of the Nile.

Until ca. 1350 B.C. (the eighteenth dynasty), the water system was dependent on the Nile River inundation and wells. Wells were cut through the overlying sand, to the bedrock and below to the sand above the water table. Human labor then brought the water up by means of a ramp-like system. It would appear that there were no steps, thus, giving the indication that the laborers were expendable. Both administrative/governmental and private dwellings had wells. Gardens were maintained by the basin, quasi-cistern, system.

During the eighteenth dynasty, the shaduf was developed. This was a simple device based on a leverage system: a pole with a counterweight at one end and a bucket to lift the water. Prior to the intense development of Egypt in the last century, this was the only mechanical device used for water transportation. The use of the shaduf indicates an increase in cistern-held water in all likelihood. Evidence for this system archaeologically is in tomb paintings, i.e., Thebes and Amarna.

The Nile River was a source for trade and navigation as well. The "Canal of the Pharaohs" linked the river with the Red Sea through the Wadi Tumilat. The first evidence for the canal dates to sixth century B.C. Persian sources. It was rebuilt by the Romans under Trajan, according to Ptolemy, a second century A.D. geographer. 'Amr ibn al-As, the Muslim conqueror and governor of Egypt, repaired the canal and reopened it in A.D. 641/2. It remained open until Mansur, the second 'Abbasid caliph, closed it, fearing the rebellious forces of Mecca and Medina. Muhammad 'Ali reopened it in the early nineteenth century to serve his agricultural development schemes. Remaining today are the soil embankments from the canal.

Fustat, now on the edge of industrial modern Cairo and one of the poorer districts of the city, was initially a military encampment for the conquering Muslim-Arab forces. Founded in A.D. 641, the encampment grew into an organized city with distinct quarters. It was mostly destroyed by the retreating Umayyads in A.D. 750 and rebuilt by the 'Abbasids. The city grew taking into consideration the changing courses of the Nile River, utilizing it for potable

water as well as waste disposal. Archaeological data on Fustat are not completely published; and there are only passing and general statements on the water system. Visible at the site are terra cotta (clay) pipes which undoubtedly served for both potable and waste water. The structures are built on bedrock and the piping system is above ground.

B. Israel, West Bank/Gaza, Jordan

1. Introduction

Topographically, the area encompassed by Israel, WB/Gaza and Jordan is divided by the Jordan Rift Valley, steep plateaus rise to the East and West. Within the Jordan Rift Valley is the Jordan River, leading to the Dead Sea, the mostly dry Wadi 'Araba (Hebrew: 'Arava), and finally the Gulf of Aqaba/Eilat. There are springs, streams and considerable water run-off during good rainy seasons (November through March). Water flows both towards the Jordan Rift Valley and away from it. In the West, the mountainous plateau leads to the coastal plain of the Mediterranean Sea. In the East, the mountains flatten into a fertile plateau which gradually leads to the steppic and desert regions of Jordan. To the north is the Kinneret (Hebrew)/Lake Tiberias (Arabic), the Biblical Sea of Galilee, fed by the run-off from the mountains to the north and in the Golan. North of Lake Tiberias are the remains of Lake Hula, mostly ruined within the recent past. The Yarmouk River forms part of the modern border between Jordan and Syria and flows towards the Jordan Rift Valley. As in antiquity, the water table is being tapped throughout the region. Modern population growth has placed extreme stress on available resources. Nineteenth century American and European explorers and travellers describe the Jordan River as having rapids and torrents of water: an illusionary image when the river is viewed today.

The modern designations of Israel, the WB/G and Jordan (as well as Lebanon and Syria, not considered in this discussion) formed a "bridge" in antiquity between Egypt and Turkey, as well as between the area of modern Iraq, ancient Assyria, and the Mediterranean Sea. The region was at the crossroads of several civilizations. It was known as "Bilad ash-Sham" (the northern region or "Greater Syria"), following the Muslim take-over of the Near East (mid-seventh century A.D.). It is geographically, historically and politically comparable but not homogeneous. City-state confederations of early antiquity partially became the well-known late Iron Age Kingdoms (ca. 900 B.C.-the sixth century B.C.), e.g., Israelite, Ammonite, Amorite, Moabite, Edomite. The earliest evidence for the Nabataean Kingdom points to a later formation date, i.e., the fourth century B.C. The provincial system developed by the Romans, who conquered the region between 65-63 B.C., the modifications of this system under the Byzantines and the altering to the ajnad (provincial) system of the Muslims reflects the geographical and political heterogeneity, while at the same time

recognizing similarities.

During the last century, there has been considerable archaeological research undertaken in the region. Thus, several archaeological possibilities exist as examples of how past inhabitants carefully managed their resources. Emphasis is placed here on late antique examples for reasons identified in the "scope of work".

2. Early Antiquity

In early antiquity, there are the famous water tunnel systems of Jerusalem, Gibeon, Megiddo, Gezer and Hazor, all of which are located west of the Jordan River. Less well-known are the comparable systems east of the Jordan River at the 'Amman Citadel and at Tell Irbid. At the 'Amman Citadel, the water table was tapped. Visible today is the entrance to the system, a large bedrock-cut cistern, bedrock cut channels, a few steps and pre-Roman alterations of the system. However, parts of the system are being used for municipal storage. At Tell Irbid, the water table was tapped. No steps have been found; however, a rock-cut channel system has been explored. This was reused from the Roman period, when a large reservoir was added on the summit of the tell, to the recent past. In Jerusalem, Gibeon and Megiddo, natural springs were manipulated. Groundwater dissolved the bedrock, allowing water to "bubble" or form pools. As the urban centers developed, it became clear that the water source had to be intramural for defensive purposes. The water source, either spring or the tapping of the water table, was protected by covering it initially; later, stairs were constructed to the source. Megiddo, Hazor and Tell as-Sa'idiyeh (Jordan, in the Jordan Rift Valley) are excellent examples.

Within the cities, there were cisterns. These developed from shafts cut following the line of the bedrock, similar to those in Egypt, to "bottle-neck" ones in the Iron Age (ca. 1200-332 B.C.). The bottle-neck cisterns appear in cross-section as a globular, decanter shape. If they were not cut from the bedrock, they were constructed of stone and then plaster-lined. Cisterns had a water impermeable surface, usually with a high lime content. They were filled by rainwater as well as human means. These, like grain storage pits/bins, had to be cleaned to avoid contamination.

This urban system was paralleled by careful husbanding of water sources in the surrounding agricultural land. Water was dammed in the wadis (valleys), using the topography and gravity, and channelled to agricultural areas. The dams were constructed of stone and mortar as were the channels. Cisterns like those in the urban areas are to be found throughout farmlands. Whereas modern irrigation systems have replaced this basic system throughout the Jordan Rift Valley and in Israel, it is still being used in the West Bank and in parts of Jordan. The fields are dotted with cisterns, which, according to oral history, were not always

constructed within living memory. Water was and is removed from these using a rope and bucket/container. Minimal archaeological excavation has been undertaken of the field wall and wadi-damming systems. Where there has been excavation, indications are that these have their roots in early antiquity.

3. Late Antiquity

The generally accepted date for the division between "early" and "late" antiquity for this region is A.D. 70; however, this is specific to the historical event of the First Jewish Revolt which occurred in the Roman province of Palaestina Prima (modern Israel and WB/Gaza) and is believed to have altered the administrative concepts of the Romans. A more applicable date might be the advent of the Romans in the first century B.C. The population increases of late antiquity, as well as the definitions of urban, demanded an alteration in the control of the water resources. With the institution of different requirements for the built-environment, planning of water resource allocation became paramount.

Throughout the region of Israel, WB/Gaza and Jordan, there are several archaeological sites which might be chosen as representative of late antique urban development with parallel development of water resource management. The sites discussed below are representative of alterations necessitated by the changes in a world view.

4. Specific Sites

a. Israel

Caesarea Maritima, Qasariyeh following the Muslim take-over, is located on the coast of Israel mid-way between Haifa and Tel Aviv-Jaffa. It is partially owned by Kibbutz Sedot Yam, Kibbutz Migan Michael, the Caesarea Development Corporation and the Orthodox Patriarchate in Jerusalem. The antiquities are controlled by the Israel Antiquities Authority.

The site was built by Herod the Great in honor of the emperor Caesarea Augustus. It was completed ca. 20 B.C. and was a planned Roman city built de novo near a Hellenistic watchtower/settlement, "Straton's Tower". To the north, another Hellenistic site, Crocodiliopolis, was incorporated into the "suburban" area of the city and may have played a role in water management. The river of the same name would have been a source of fresh water. As well, it may have played a role in the extensive dam system built by the Romans both for water control and for fish-farming. This area is presently located within Kibbutz Migan Michael. It is likely that the dam system was connected to the high aqueduct and may have controlled rainwater as well. The fish-farming may have used both fresh water and salt water.

The city of Caesarea Maritima, which became the capital of the province of Palaestina Prima, was organized around the harbor, named Sebastos. The location for the city and the harbor was not, to say the least, the most advisable: there was no natural harbor, water sources were few, and the construction of the city on the coastal sand required superior engineering skills. In order to secure his position with the Roman conquerors, Herod and his successors were able to procure the necessary skilled labor as well as import quantities of items, e.g., marble from all over the known world. Caesarea flourished as an urban area in the classical sense at least through the beginning of the 'Abbasid period (ca. the early part of the ninth century A.D.). The city was enclosed by a wall and it contained all of the accoutrements of the built environment, e.g., a hippodrome, amphitheater, theater, civic area, etc. One of the baths is discussed above.

It was a center for early Christianity: the Apostle Paul was imprisoned there, some of the first converts were in the city, and, Origen, one of the church fathers, worked in Caesarea. During the Muslim take-over, Caesarea Maritima held out against Moawiyah ibn-Sufiyan and his troops. There were malaria swamps in the vicinity, probably to the south in the area of modern Hadera. Moawiyah removed his troops from the area, conquered the north, allowing the Byzantine Christian elites of the city time to flee. In A.D. 642, Caesarea was the last southern urban area to capitulate to the Muslim armies. Like other cities in Bilad ash-Sham, it seems to have suffered from the intense earthquake of A.D. 747 and the change in the caliphal capital from Damascus of the Umayyads to Baghdad of the 'Abbasids. It was no more than a town/village by the coming of the Crusaders. They built the castle above the earlier central civic area. It was taken over at the end of the thirteenth century by Muslims. Late Islamic historiographers and chroniclers discuss in detail the water, the farming with water buffaloes, the purity of the bread from Caesarea and the beauty of the site.

In order for the city to exist, the water sources had to be found, managed and controlled. Initially, water was brought by means of a high aqueduct, i.e., an above ground aqueduct. This tapped the water source in the foothills approximately nine kilometers to the west. Bedrock-cut channels reached the water source, which by a gravity system flowed to the city. The aqueduct was made of well-cut stone, was arched and had an incline to force water flow. At first, there was only one water channel; a second was added probably in the second century A.D. This gives an indication of increased population and water needs. Sections of the high aqueduct have been excavated by Avram Negev, an Israeli scholar, and by the Joint Expedition to Caesarea Maritima. Although most of the high aqueduct is no longer visible because of the encroachment of the Mediterranean Sea, there are sections still along the coast to the north of the Crusader Fortress. Negev found an inscription identifying the Tenth Roman Legion as being responsible for the

construction of the first half of the high aqueduct.

In the fourth/fifth centuries A.D., the high aqueduct was augmented by a low aqueduct. This was undoubtedly necessary due to an increase in population (cf. III.B.3.c, below). The low aqueduct ran parallel to the high aqueduct, entering the city from the north. The low aqueduct was essentially a covered, ground-level channel. It was constructed of stone, plaster-lined and had a low, arched cover.

Few domestic units have been excavated at Caesarea Maritima. Those that have been indicate well/cistern systems within them and do not evidence piping off of the aqueducts. This may indicate that the city controlled only the water resources for the public areas and not those within the private areas. In the Fatimid through Mamluk periods, deep wells were excavated, sometimes reusing the earlier cisterns. It would seem that the aqueduct system was in total disrepair.

An intricate sewer system has been delineated which was flushed by sea action. The stone-paved streets had sewers below them. Where sewers intersected, there was a stone-capped manhole. To avoid seepage, the sewers were plaster-lined. The large sewer openings to the sea are still visible to the north of the Crusader Fortress. Architectural analysis indicates that these were reused throughout the Islamic caliphates. Gerasa has a similar street-sewer system, but is unclear how the system was cleaned and maintained.

b. West Bank/Gaza

Sites on the West Bank and in Gaza generally show the same growth as those discussed for Israel and Jordan.

Archaeologists on the West Bank are concentrating on the Jericho area, Khirbet Bir Zeit and recently rescue excavations in Jenin. None of these excavations have been published as yet. The Jenin excavations were recently completed by the WB office of the Department of Antiquities. A water tunnel was excavated which is purported to be as impressive as the one at Megiddo.

Jericho shows shifting settlement patterns with Tell as-Sultan, the early antique site, Tell an-Nitla, the late antique site, and Hisham's Palace, the Umayyad and 'Abbasid periods complex. There have also been recent salvage archaeological excavations conducted by the Department of Antiquities in downtown Jericho. The springs in Jericho were tapped and utilized in antiquity; however, little attention has yet been placed on water management. New excavations are being planned for Hisham's Palace. It is likely that natural environmental issues will be taken into consideration.

Hisham's Palace was started by the last Umayyad caliph. The palace complex is a monumental structure containing several rooms as well

as courtyards. Like contemporary sites in Jordan, it evidences the merging of western and eastern art and architectural motifs. Until recently, it was assumed that the palace went out of use when the A.D. 747 earthquake occurred. This has been shown to be erroneous by reanalysis of the MCRs. Original excavations, conducted by the British archaeologist R. Hamilton, concentrated on art historical elements of the palace. The new project will likely address issues relating to: the relationship of this installation to the so-called "Desert Castles" in Jordan, the relationship of this site to the earlier ones in the vicinity, and natural environmental factors. One of the outstanding parts of the palace is the tessellated pavement (mosaic), depicting the "tree of life", in the bath complex. The bath complex was restored in the 1980's. It is unclear whether new research will incorporate this structure. The clay water pipes leading to the bath were visible.

Excavations at Khirbet Bir Zeit began in the summer of 1996. This is the training project for Bir Zeit University's undergraduate archaeology program. Emphasis is placed on how humans used the natural environment throughout the time periods represented at the site, Iron Age (ca. 1200 B.C.) through the Ottoman period. Even though this is a new project, there is the potential for the necessary data.

The intensity of modern population constraints exacerbate the situation in Gaza. Development of modern Gaza City is taking into consideration the wadi system and the preservation of antiquities. Little remains of the late antique accommodations along this strip of the of the Mediterranean Sea coast, however.

Nablus, ancient Roman and Byzantine period Neapolis, along with Tell Balatah (Biblical Shechem, Arabic Sichem) and the near-by site of Samaria/Sebaste afford an opportunity to parallel Caesarea Maritima and earlier sites as well as those in Jordan. With the excellent Ottoman period elite housing in Nablus, the continuance of the internal cistern system and private gardens might be a theme. Samaria/Sebaste almost directly parallels Caesarea Maritima in terms of the built environment; and, Tell Balatah evidences the cistern systems discussed above for early antique sites.

c. Jordan

Jordan is topographically and climatically disparate in nature, as compared to Israel and the WB/Gaza. Four ecological zones exist; humans adapted to these zones in different ways in antiquity. This discussion separates the country into the North and the South, while drawing parallels throughout.

Northwestern Jordan was an urban area in both early and late antiquity. During late antiquity, the region was known as the Decapolis: an administrative/governmental confederation of cities, first formed during the Hellenistic period (332-65 B.C.). Six of

these were located in modern Jordan: 'Amman/Philadelphia, Jarash/Gerasa, Beit Ras/Capitolias, Wadi Quweilebeh/Abila, Umm Qeis/Gadara and Tabaqat Fahl/Pella. (Note that following the Muslim take-over of the area, the modern names were reused, e.g., Capitolias was again Beit Ras.) One, Beisan (early antique and modern Beth She'an)/Scythopolis) was located in Palaestina Prima, modern Israel; and the others were in modern Syria. These and several other cities in Jordan, e.g., Madaba, Rabba/Aeropolis, were planned Roman cities which were gradually altered throughout the remainder of the late antique period.

The "trichora" cities of antiquity, Gadara, Abila and Capitolias, are chosen as representative of urban development and as regards water management. The three cities were intimately connected politically and culturally in late antiquity; whereas Gerasa, Pella and Scythopolis were linked. It should be recognized that all of the late antique cities have evidence for water management. Developmental parallels also exist between the trichora cities and those in the Golan and in the eastern Hauran of modern Jordan and Syria. These cities were famous in antiquity for agricultural produce. Beit Ras/Capitolias was renown for its wine in pre- and early Islamic Arabia.

Nineteenth century explorers and travellers note a high aqueduct, similar to the one at Caesarea Maritima, between Gadara and Capitolias. No evidence of this exists today; however, archaeological survey indicates a low aqueduct between at least Capitolias and Kufr Jayez, northwest of Beit Ras/Capitolias towards Gadara. Only one section of this was found on survey. In construction, it paralleled the Caesarea Maritima low aqueduct, although it was no longer covered. Kufr Jayez was the site of a Roman villa/farmstead; this seems to have continued throughout late antiquity.

Abila and Gadara have similar water systems. Bedrock-cut channels were hewn to tap the water table. The force of the water as well as gravity allowed it to flow within the channels. The German Protestant Institute excavations of this system at Gadara make it the most visible. The Abila and Gadara systems brought water to the cities from at least five kilometers away. Springs and subterranean sources were tapped. In both systems, there were ground-level shafts which enabled maintenance of the systems, access to water, and, were probably rainwater collection shafts. Although the Gadara system has been traced within the city, the Abila one has not. Whereas there are springs in the immediate vicinity of both Abila and Gadara, there are none at Capitolias.

Capitolias was founded following the First Jewish Revolt for political reasons. The landscape does not easily lend itself to the formation of a city. In all likelihood, the first settlement was a military/administrative plan that gradually developed into the city. The city was constructed on a bedrock outcrop, the

highest point north of 'Ajlun. The water system, still partially visible, was unique in this region. At the highest point, the bedrock was cut into an intricate rain run-off channel system. These debouched into large cisterns. The cisterns were originally pockets in the bedrock, enlarged by chiselling and then plastered. The cisterns were also filled by transporting water from springs. Because of the positioning of the cisterns, it would seem that water usage was regulated.

Sometime in the fourth century A.D., the low aqueduct mentioned above was added and a large intramural reservoir. Both the cisterns and the reservoir held water within living memory. The three internal buttressing arches on the south side of the reservoir suggest a refurbishing in the 'Abbasid period.

The cisterns were subdivided in the Mamluk period and in the early Ottoman period by randomly-sized stone walls which were plastered. The reservoir was resurface in the early Ottoman period. Neither pipes nor a waste water system have been excavated at Capitolias. Abila, Gadara and Pella also do not evidence a waste water system, whereas Gerasa does.

As no domestic units have been excavated at the three sites, it is difficult to determine what the system was. However, it would appear, based on the number of pottery water jar fragments that the household system was the transportation of water from a central locale. This is supported by the comparative data from the domestic units excavated at Pella.

Five kilometers south of Capitolias is Irbid, the second largest modern city in Jordan. Irbid was Arbela of the Roman and Byzantine periods and was a planned Roman city as well, although not one of the Decapolis cities. It too has evidence of early antique water systems, mentioned above; and, from the available evidence, parallels the trichora cities in late antiquity.

Interestingly, the cities of southern Jordan, e.g., Madaba, although planned in a similar fashion as the northern cities, relied on a different cistern water system. At Madaba, sections of one of the Roman paved streets have been excavated. These sections are higher in the center to allow for rainwater run-off into large, plaster-lined, underground cisterns. Two of these have been investigated archaeologically. There were also at least two large reservoirs within late antique Madaba. In all cases, the cisterns and reservoirs seem to have supplied municipal needs and some domestic uses, with these being augmented by cisterns/wells.

To the east of the Decapolis region, there is a series of sites in the Hauran, the steppic region of Jordan. These sites exemplify a different understanding of urban and can be considered local in character. All of these sites are striking as the standing remains are of basalt. Although there are no in situ inscriptions, most

scholars would agree that these sites belonged to the late antique tribe the Ghassanids, who converted to Christianity and were the "buffers" for Byzantium, as the Lakhmids were the "buffers" for the Sasanian Persians.

The most thoroughly researched of these eastern sites is Umm al-Jimal, the ancient name of which is unknown. The city/town developed around a second/third century Roman military installation. No waste water system is known; however, there was an intricate sheltered cistern and reservoir system. As in Egypt and Oman, the cisterns needed to be sheltered to avoid evaporation of the water. Out of 158 structures identified at Umm al-Jimal, 123 are domestic units. The majority of these units had cisterns which were covered and protected. The large reservoirs have outlet channels which lead to some of the domestic unit cisterns.

Whereas the small wadis surrounding the trichora cities were managed to allow channeling of water resources into cisterns and probably the low aqueduct system, depressions and wadis were dammed surrounding Umm al-Jimal. In order to farm in the trichora area, field walls were constructed on the slopes of the hills. Field walls halted soil erosion while at the same time helped to retain water in the soil. Field walls were/are constructed of randomly-sized stones, dry-laid, and have two faces with a rubble-core filling. Based on regional survey, it is now clear that the entire landscape of the Hauran was dotted with farmsteads which likely relied on the large settlements as central marketplaces. By damming the wadis and depressions, it was possible to preserve rainfall and plant at least one grain crop per year. Field walls are not as prevalent as the landscape is mostly flat.

Several archaeologists have surveyed and excavated sites in the Hauran and steppic region of Jordan. What is becoming increasingly clear is that the region was inhabited from earliest antiquity to the present, although there were shifts in the settlement patterns. The image of the "desert" is erroneous and more a result of Ottoman period to modern eurocentric interpretations.

In the South, the premiere example of water management systems is to be found at Petra, a World Heritage site. Petra, famous as one of the central places for the Nabataean Kingdom, was inhabited throughout the late antique periods. In A.D. 106, the Nabataean Kingdom acquiesced to the Roman legions under Trajan; and, their empire was incorporated into the Roman one. Having controlled the trade routes from the Arabian (Persian) Gulf to the Mediterranean Sea, and from the Arabian Peninsula to Damascus, the Nabataeans were an influential force in the ancient world. Once Petra was under Roman control, aspects of the Roman built-environment were added, e.g., the theater. Recent excavations conducted by the American Center of Oriental Research (ACOR), a US non-governmental organization, have elucidated aspects of the Byzantine period occupation through the excavation of two churches. Crusader

occupation was investigated in the 1980's.

There have been several purposive surveys conducted in the Petra area. All of these have identified aspects of the water management system around Petra. However, it is the Petra National Trust (PNT), a Jordanian non-governmental organization presently conducting two studies relating to water management in ancient Petra, which will finally enable an analysis of the system. Both studies are to be completed by January, 1997. The first of these studies has as its goal the elimination of yearly flooding of the siq, the impressive wadi entrance to Petra. Although it has always been assumed that all physical remains of water management at Petra date to the Nabataean period, the study indicates that this may not be case. In other words, the system was first devised by the Nabataeans and then maintained and altered by later inhabitants. What is evident is that an intricate system existed in the wadis and on the plateaus above the siq in order to preserve it. Rainwater was channeled by a system of dams to large cisterns and catchment areas. The dams were constructed of unhewn and hewn blocks. Smaller channels led from the cisterns to allow cultivation on the plateaus. In antiquity, running water was allowed to flow through rock-cut channels along the wadis debouching into the siq, as well as along it. These channels have recently been cleaned by the Department of Antiquities and are clearly visible. The completion of this study will allow for a more integrated interpretation of how the various populations lived within the Petra region.

The PNT is also conducting the archaeological survey of the modern water and waste water pipelines being installed for Wadi Mousa, the town at the entrance to Petra, and the surrounding towns/villages. Although this survey does not have the ancient water system as a priority, there is considerable new information emerging relating to the habitation history of the designated Petra Regional Authority area, that is the "park". There are springs present in the "park" which will be tapped for the modern lines and were undoubtedly integrated in antiquity as well.

C. Oman

Oman presents a somewhat different geographical and archaeological picture from the other countries under consideration. Population increases and shifts to the urban centers has created the necessity to desalinate sea water along the 2,092 kilometer coast. The northern section is mountainous with an eastern and western range. The south is separated by desert and in the southwest this merges into the Rub' al-Khali, "Empty Quarter", shared with Saudi Arabia and Yemen. Dhofar, the southern region, is well-watered in the coastal plain during the summer monsoon season and there are forested mountains behind the plain. Although the mountains receive more rain, the yearly rainfall averages only 104mm (four inches). This is equivalent to Egypt and parts of Israel, WB/Gaza

and Jordan. The difference, however, is that these countries have fresh water sources.

Until the exploitation of oil in 1967, Oman was a rural country with villages clustered at the base of the mountains. Part of the population was also nomadic. Most people were engaged in subsistence agriculture and fishing. Traders are mostly Indian-Shi'ite Muslims. A distinction was made between the various groups, including the mountain people originating in Yemen. The two major population centers today are Muscat, the capital in the north, and Salalah in the south.

There have been several US and European archaeological projects since the 1950's. These have concentrated on the prehistoric periods, rock art, epigraphic evidence and those relating to the frankincense trade. In general terms, habitation of Oman parallels that of the other countries under consideration. The northern part of the country was oriented towards trade and the sea, whereas the southern was oriented towards South Arabia because of the frankincense trade. The Portuguese conquered the area in 1507, as they did most of the Gulf coast. They constructed trading forts which are only now of interest to Omani and other scholars.

Human habitation dates to approximately 8000 B.C. Sites are defined as "scatters", concentrated areas of lithics; "middens", areas where refuse was accumulated; or, as ones having structures. The descriptions of this early habitation focus on seafaring and pastoral-nomadism. The composite of site near Muscat, Ras al-Hamrah, indicate far-reaching trade connections. The quantity of stone mortars, pestles and containers from the southern site of Uruq ibn-Hamuda may indicate a more permanent settlement than those in the north do.

Between 3400 and 1900 B.C., habitation centered around the oases. Hili 8, a northern site, shows both animal and plant domestication. Mesopotamian textual documentation (ca. 3400 B.C.) identifies the peninsula as Dilmun and famous for copper, stone and incense. By the Old Akkadian period (ca. 2300 B.C.), Oman is specifically known as Magan and was exploited for its copper (the wadis Jizzi and Samad). There seems to have been a population shift during this period with the original inhabitants moving to the mountains and new peoples from Mesopotamia, Iran and the Indus Valley inhabiting the coastal areas and the base of the mountains.

During the Iron Age (1300-300 B.C.), settlements are discussed only as agricultural towns, villages at the mouths of wadis and around oases or as fortifications. By implication, the water management system was probably wells and a system of channels prior to the introduction of the falaj/qanat (Arabic for "channel") system of irrigation in the sixth century B.C.

This is the most significant archaeological remain relating to water. The system was introduced by the Persians, and is paralleled not only by those in Iran but in Afghanistan as well. Labor migration to the cities, following the exploitation of oil, has meant that the population has left the rural settlements and the system has fallen into disrepair. The system is an integrated one that collected the water in wells, filtered it through gravel and then by gravity it descended through tunnels and some open canals. This allowed for both domestic and irrigation use of the water. Terraces were added for agricultural production. These were tiered, allowing for three crops to be grown on one plot: dates at the upper level; limes, bananas or mangoes in the middle; and, alfalfa, wheat or sorghum at the bottom. (Dates and sorghum were domesticated in the third millennium B.C.)

Hellenistic period occupation, including Parthian, is well-documented textually, e.g., Pliny and Ptolemy, and archaeologically at sites along the coast such as Mleiha and Sohar. These sites were mostly taken over by the following Sasanian (Persian/Iranian) conquerors. Northern Oman came under Islamic rule quickly; however, there was conflict between the caliphates and the local Imamate, the Ibadi. As trade increased in the early Islamic period, Muscat grew and far reaching connections with China, Africa and India. The southern part of Oman, including sea trade, was controlled by the 'Abbasids rather than the Ibadi. Raysut is an example of harbor and coastline control during this period. Portuguese controlled introduced a different type of fortification system, now seen at Nizwa and Jilani.

V. Conclusions

A. Country Specific

1. Egypt

The review of the archaeological data indicates that a basic theme from antiquity could be developed. This would use MCRs from all periods, the "Scorpion" macehead, tomb paintings of the shaduf, archival photographs of the Cairo gardens which have early roots (i.e., not those designed by the French or British), and the piping system in Fustat. Alexandria might be included as well. Polish excavations since 1960 have preserved aspects of the Hellenistic and Roman periods city, e.g., the theater and the bath. There is no specific mention of water management. Development of Alexandria, starting with Muhammad 'Ali in the nineteenth century, has obscured most of the ancient city.

2. Israel, West Bank/Gaza, Jordan

a. Israel: Using Caesarea Maritima as an ancient "best practice" for Israel affords several visual opportunities. The standing aqueduct is spectacular, the rock-cut channels are visible, as are

remains of the low aqueduct, the sea-flushed sewage system and the sewers in the ancient paved streets. The Roman dam and fish-farming system is still visible. As a late antique controlled and integrated urban environment Caesarea is unparalleled. However, the drawback to the site is that it is being encroached upon daily. Photography would have to be excessively careful. The early antique system at Megiddo could be juxtaposed with the one at Caesarea Maritima.

b. **WB/Gaza:** For the WB/Gaza, it is appropriate to utilize aspects of Jenin, Jericho, Khirbet Bir Zeit and the Gaza development projects together, similar to what is suggested for Egypt.

c. **Jordan:** The juxtaposition of the northern and southern sections of the country places emphasis on the various ways in which humans adapted to their environment. The similarities between the Hauran wadi-system and those of Petra could be highlighted. Notably, archaeological survey and excavation in the Negev (Arabic: Negeb) indicates the same system. According to the reports, there was intense development in the Negev during the Umayyad period.

d. **General:** There is an opportunity to highlight late antique cities throughout the region, i.e., one major city from each area. As well, since the wadi damming system, cisterns, canals and field walls are evidenced throughout the region, it might be possible to place emphasis on the careful husbanding and control of water by the ancient populations.

3. **Oman**

Oman presents limited options, as the water system has fallen into disrepair. It might be possible to choose a northern and a southern site as exemplary and illustrate the technologically positive aspects of the ancient system.

B. **Notes to the Text**

1. **Overall Notes**

a. Each country has a responsible antiquities agency with a director and centralized in the capital. The country is then separated into districts. It is the centralized bureau that maintains the maps, pictures and finds.

b. Where antiquities are linked with tourism, as in Jordan, care needs to be taken to coordinate through the antiquities agency.

c. Excellent libraries are available in Egypt, Israel, WB/Gaza and Jordan. The Oman library is in its initial stages; however, it is being enhanced.

d. Archival techniques are recent. GreenCOM should not expect to find necessary photographs, for example, filed in an easily accessible manner.

e. Individual excavators are responsible for their data. They, as well as the in-country authorities, must be contacted for photographs, analyses, etc.

2. Notes on Egypt

a. The Egyptian Antiquities Authority (EAA) is directed by Dr. A. Nur edh-Din.

b. Most "coffee-table" books will have pictures of tomb scenes as well as the "Scorpion" macehead. Cf. **Atlas of Ancient Egypt** (page 79). For images of the **shaduf** cf. Hilary Wilson, **Egyptian Food and Drink** (Shire Egyptology, No. 9), page 20: tomb painting from Thebes.

c. Tell Dab'a is being excavated/researched by an Austrian scholar, M. Bietak. The resource for the Wadi Tumilat (cf. Carol A. Redmount, "The Wadi Tumilat and the 'Canal of the Pharaohs'", **Journal of Near Eastern Studies**, 54/2 (1995): 127-135) information, Tell Muqdam and Tell Maskhuta is Dr. Carol Redmount, University of California, Department of Near Eastern Studies, Berkeley, CA.

d. Fustat is famous. There are some publications available, but they are not complete. The best source is the American University in Cairo (AUC). Professor George Scanlon, Department of Islamic Art and Archaeology, directed excavations there; he is now professor emeritus. Also, cf. Wladyslaw B. Kubiak, **Al-Fustat: Its Foundation and Early Urban Development**. 1987: The American University in Cairo Press.

e. Because of the number of Islamic period monuments in Cairo in particular, there is a different "tradition" relating to Islamic archaeology in Egypt. It has centered on art and architecture as opposed to stratigraphic archaeology.

f. The main US contact in Egypt is the American Research Center in Egypt (ARCE). This is an independent organization of US scholars involved in research in Egypt. The address is: 2 Medan Qasr Al-Dubbarah, Garden City, Cairo.

3. Notes on Israel

a. The Israel Antiquities Authority (IAA) actively conducts surveys and excavations. These are often in conjunction with United States universities and organizations as well as with Canadian and European. There are several journals that detail the results of the IAA's activities, e.g., the **Israel Exploration Journal**, 'Atiqot.

The director of the IAA is: A. Druri.

b. Archaeological excavations are on-going at Caesarea Maritima as it is being developed for tourism. Since the 1960's several groups have excavated at the site: the IAA, the Joint Expedition to Caesarea Maritima (a consortium of U.S. and Canadian universities), Israeli universities. Presently, there is a consortium of US and Israeli scholars researching the site. Contact with the consortium may be made through Dr. Kenneth Holum, History Department, University of Maryland, College Park, MD. The Joint Expedition to Caesarea Maritima was directed by Dr. Robert J. Bull, Drew University, Madison, NJ. He is presently professor emeritus. There are two major Israeli contacts: Dr. Avnar Raban, Haifa University for the underwater archaeology; Dr. Yosi Patrigh, Haifa University, for current land excavations. It should be noted that there was a Smithsonian Institutes exhibit of Caesarea Maritima artifacts in the mid-1980's; however, this concentrated on the Roman city, not the continuance of the city. There is a copious bibliography on the site; and, there have been several popular articles published. The harbor was highlighted by the National Geographic Magazine in the 1980's. There is ample photographic material available.

c. There is scholarly disagreement about the amount of rainfall in antiquity. It seems likely that there was far more throughout the Byzantine period to the mid-Ottoman period. This is partially based on the fact that the Umayyads imported and were able to grow sugar, rice and bananas in the region. There is mounting evidence to indicate this in what are now considered desert regions as well, e.g., the Negev and the so-called "Desert Castles" of Jordan. For information on the Negev cf. M. Haimon, *Bulletin of the American Schools of Oriental Research*, 1995.

d. US archaeological interests are served by the W. F. Albright Institute, located on Salah edh-Din street. The Albright is one of the American Schools of Oriental Research. It is directed by Dr. S. Gittin. The Albright has consistently received US government funding and is an excellent source of information, including archival.

4. Notes on the West Bank/Gaza

a. The Palestine Authority has two main offices for the Department of Antiquities: one in Gaza and one on the West Bank. The WB office is headed by Dr. Hamdan Taha; the Gaza office is headed by Dr. M. Sadiq. Recently antiquities was placed in the Ministry of Tourism.

b. The Ministry of Planning (contact: Dr. M. Ajjour) has worked closely with Sadiq in Gaza. This is particularly important as the available land for construction is minimal. Water resource allocation for the modern population was discussed in December,

1995, at the EcoPeace Conference at Tantur. There is a conscientious effort to include the antiquities and the natural resources into the overall planning, e.g., the wadi outside of Gaza City, which was used in antiquity, is being preserved for both reasons.

c. Besides the Department of Antiquities, there are two institutions with which GreenCOM might associate. The first is Bir Zeit University, the Palestine Institute of Archaeology. Director: Dr. Khaled Nashef. The second is the Al-Quds Open University, Institute of Islamic Archaeology. Director: Dr. Marwan Abu Khalaf. Publications are in the initial stages and will appear in Arabic initially.

d. Historically, US scholars related to Palestine through the Albright Institute. Following 1967, US scholars did not excavate on the WB nor in Gaza; and, relationships with Palestinian institutions were tenuous while relationships with individual scholars were maintained. Since 1994, this situation is changing for the WB.

e. There is an advantage to using the Khirbet Bir Zeit project. It is understood to be an environmental archaeology one; that is, the natural environment is being taken seriously in order to interpret the social history. As this is a project being directed by Palestinians, it may eliminate the potential problem of highlighting a system, i.e., the cisterns and/or wadi damming systems, which may be viewed by the present population as being anachronistic.

5. Notes on Jordan

a. The Department of Antiquities of Jordan, for several years within the Ministry of Tourism and Antiquities, publishes the **Annual of the Department of Antiquities (ADAJ)**. Tri-annually, there is the **Studies in the History and Archaeology of Jordan Conference** which results in a publication of the same name (**SHAJ**). The Department of Antiquities is directed by: Dr. Ghazi Bisheh. He is also the director of excavations for Qasr Hallabat.

b. The Department of Antiquities has a valuable resource in the G. Lankaster Harding photographic collection. Harding was the British Mandate director of antiquities. The collection dates to the 1930's through early 1950's. It could easily be used in filming.

c. Mentioned in the discussion on early antiquity are Tell as-Sa'diyeh and Tell Irbid. Contact: Mr. Jonathan Tubb, West Asiatic Collection, British Museum, London for the former; contact: Dr. C. J. Lenzen, 18047 Stewart Ave., Homewood, Illinois for the latter.

d. For the trichora cities contact: Dr. C. J. Lenzen, as above; and the German Protestant Archaeological Institute in 'Amman.

e. The Petra National Trust (PNT) is a Jordanian non-governmental organizational whose mandate is the preservation of Petra. The executive director is: Ms. Aysar Akrawi. Phone and Fax: 962-6-686338.

f. The excavations in Aqaba, Islamic 'Ayla, are not discussed as to date there is little information concerning water management.

g. ACOR, located in 'Amman, is the Jordanian equivalent to the Albright Institute; the director is Dr. Pierre Bikai. Phone: 962-6-846117.

h. There has been considerable emphasis placed on the tessellated pavements in Jordan and in Israel; and, there is a growing interest in Egypt. The pavements do depict flora, fauna and water. Most of these date to the Byzantine period, although there are some which date to the Umayyad and 'Abbasid periods. Not all of the latter were built by Christian communities under Islamic rule. Using selected ones would enhance any video. The most famous is the Madaba Mosaico Map (ca. A.D. 560) which shows cities, towns and villages significant to Christianity in modern Israel, WB/Gaza, Jordan and Egypt. As well, the map depicts flora, fauna and major water bodies. There is a major drawback, however,; that is, the prohibition against images in Islam.

6. Notes on Oman

a. The *Journal of Oman Studies* is a valuable resource. It has traditionally concentrated on language issues; however, recently more stratigraphic archaeological data are being presented. This is particularly true for the prehistoric periods.

b. Dr. Philip MacCumber, an Australian geologist who has extensive archaeological experience with the Australian team that worked at Pella (Jordan), is presently on contract to the Omani government. He is exploring the mountain and desert regions for new water sources. From contacts, the author is aware that MacCumber is also identifying archaeological resources. He is an invaluable resource and can be contacted through the Omani Ministry of Water.

c. The European, Australian and US archaeologists working in Oman are non-resident. Dr. Moawiyah Ibrahim, Sultan Qaboos University, Department of Archaeology, is an invaluable resource. He is instrumental in developing the archaeological department at the university.