



MASTER PLAN FOR THE
PROTECTION & USE OF

PETRA NATIONAL PARK

OFF-SITE

MASTER PLAN FOR THE
PROTECTION & USE OF

PETRA NATIONAL PARK

U.S.D. HISTORICAL AND
ARCHAEOLOGICAL PRESERVATION
ROOM 1200 AS

*Cover: Banded sandstone ceiling of the Triclinium
(Festive Hall) in Wadi Farasa, Petra
Cover design suggested by John Funari
Photo by Paul F. Spangle.*



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FOREWORD

As used today, the English word Park is based on the latin word Parcere, a piece of land spared from materialistic use and reserved for pleasure and enjoyment. Generally, National Parks are established to preserve outstanding examples of national heritage. They are, in a sense, great outdoor museums requiring only such developments as are needed for the areas' protection and administration and as required for the comfort understanding and convenience of those who visit them for the recreation and inspiration they offer. Commercial uses such as farming, livestock grazing, hunting and mining are inconsistent with this concept.

This plan has been prepared as a management document to be used as a guide for the use, development, interpretation, protection and general administration of Petra National Park. As such it cannot be considered the final, unchangeable, long-range plan. Instead, because man's requirements change, it should be used as a control document to guide the future development and use of the park in ways that will assure its protection and continuing use as a viable national resource.

Imaginative and rapid action within the framework of sound fiscal planning by the Government of Jordan is required to bring the concepts embodied in this plan into being.

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The work of the team could not have been accomplished without the cooperation and assistance of the government and people of Jordan. It would be impossible to acknowledge every individual who gave freely of their time and effort in the preparation of this plan, but the team wishes to recognize the following officials for their assistance.

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The support and encouragement of Mr. John Funari, Director of USAID/Jordan and his entire staff, particularly Mr. Anthony Schwarzwald and the Tourism Division, was especially noteworthy.

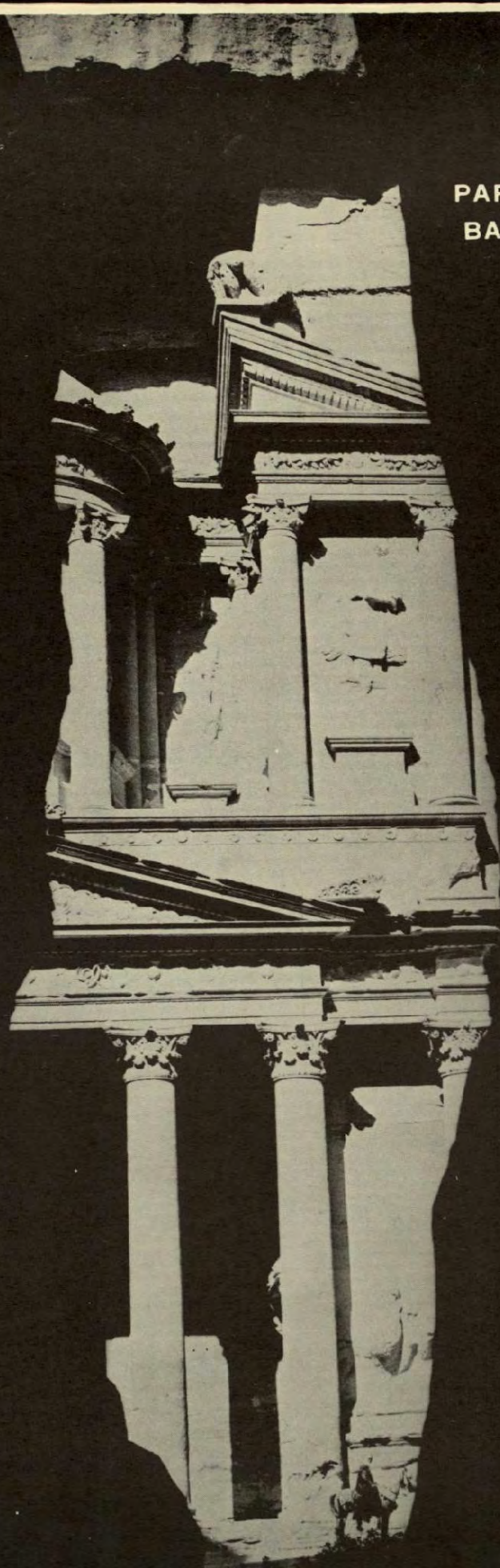
An integral part of the planning included the participation of a staff of counterparts drawn from various ministries. The assistance of these technicians was invaluable and hopefully, this staff will continue the work when the U.S. team completes its assignment. These counterparts are considered a part of:

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Amman, Jordan
June, 1968

PARK RESOURCES AND
BASIC INFORMATION





1. A Neolithic site at Baidha

2. An Iron Age village at Wadi Musa

3. El Dier is a classical representation of the carved stone architecture of the Nabataeans.

4. The colonnaded paved street identifies Roman influence at Petra

5. El Wu'eira was probably a Crusader outpost of nearly Shobak



Human History Petra is to most visitors, a place of great beauty and mystery. Its remoteness, the magnificence of the rockcut tombs and temples, and the ruggedness of the surroundings, combine to overshadow its historical significance; a city that played a long, and sometimes important role in the history of Arabia and the Near East.

The relative abundance of water at the upper reaches of Wadi Musa and its tributaries has been a magnet attracting men for many thousands of years. Tools of palaeolithic men have been found in the vicinity and there are several Neolithic villages, notably the pre-pottery site at Beida which has been partially excavated by Diana Kirkbride of the British Academy. At Beida is "the largest uninterrupted exposure of early Neolithic habitation (ca. 6800 B.C.) yet excavated".

At the present time no sites of either the Chalcolithic or Bronze Ages have been found in the immediate vicinity of Petra. In such a favorable location, however, it seems probable that such sites exist and, in time, will be found.

It was during the Iron Age that Petra began to assume importance. By the 14th century B.C. the Edomite Kingdom was established with its capital at Sela (Rock). Sela was, as was normal in those days, both the secular and religious capital of the Edomites. Their principal shrine, the Great High Place, was probably on Umm al Biyarra which also seems to have served as a place of refuge in times of danger.

In the 7th century B.C. there appeared on the scene a semitic tribe from southern Arabia—the Nabataeans. Probably leading a nomadic life in the region east of the northern portion of the Red Sea, the Nabataeans apparently raided caravans plying the main routes between southern Arabia and the Mediterranean time after time. Over a period of two or three hundred years however, they gradually became more sedentary in their habits.



1. Most small wadis were dammed
2. Entire hillsides were terraced to slow runoff and trap soil
3. Large cisterns (Masonry wall on the right) stored water for the long dry summers
4. Channels were carved in the wadi walls to transport water
5. Elaborate aqueducts spanned gorges and open places



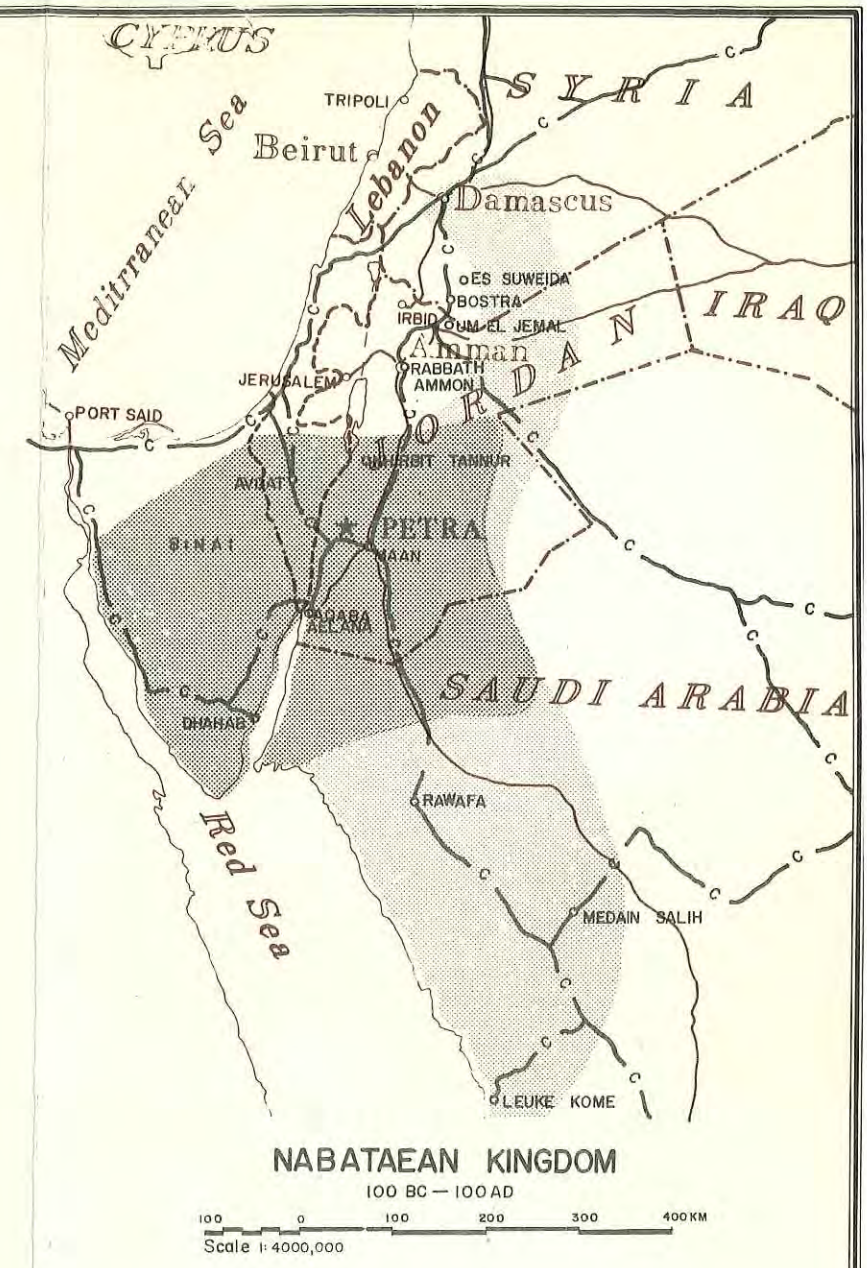
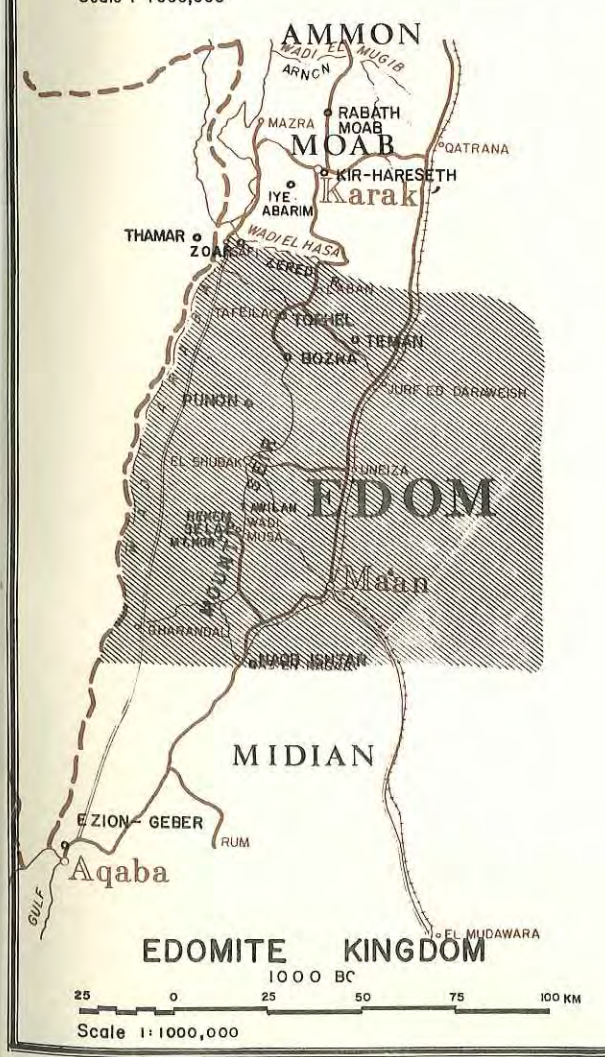
Much of southern Palestine was unoccupied during the 4th century B.C. because of the Jewish captivity in Babylon. The Edomites either moved or were pushed into the void and their former home of Sela was quickly occupied by Nabataeans.

Now well established in northern Arabia the Nabataeans, rather than raiding caravans, derived their principal income from protecting the caravans from other raiders, exacting tribute for this work.

It is not known just when the Nabataeans began to construct the rock-cut tombs and temples and the great water conservation projects for which they are now famous. Quite likely some work of the sort had been going on from the time they moved into the former Edomite stronghold but it seems it was only after the beginning of the Hellenistic period (late 4th century B.C.) that much construction was done. The sudden Greek influence in the eastern Mediterranean affected many different peoples in a similar manner. It was at this time also that the name Sela was changed to its Greek equivalent Petra.

Early rock-cut structures at Petra show stylistic influences from both Assyria and Egypt modified into something which is recognizably Nabataean.

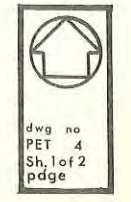
Even though Petra is famous for its rock-cut monuments, the great Nabataean contribution to life in this arid land was in the field of water conservation. Throughout the areas in which they lived, the Nabataeans terraced the hillsides, built water catchment and distribution devices and constructed reservoirs and cisterns. Their engineering skills were remarkable and the works they completed enabled the Nabataeans to maintain a rather large agricultural population in a land which now supports only scattered nomadic tribal groups.



LEGEND

EDOMITE KINGDOM CA 1000 BC	
ROMAN ROADS	
ROMAN ROADS UNCERTAIN	
ROMAN ROADS 2ND CLASS	
ROMAN ROADS 2ND CLASS UNCERTAIN	
CARAVAN ROUTES	
NABATAEAN KINGDOM CA 100 BC 100 AD	
AREA UNDER NABATAEAN CONTROL	

HISTORICAL AND ARCHEOLOGICAL BASE MAP
PETRA NATIONAL PARK



dwg no
 PET 4
 Sh.1 of 2
 pdge

OTTOMAN EMPIRE

1918

1812 BURKHARDTS VISIT

1517

CRUSADES

1300

1200 CRUSADERS ABANDON PETRA
1116 BALDWIN I OF JERUSALEM ORDERS
PETRA FORTIFIED

1000

ARAB CONQUEST

640

640 PETRA PROBABLY ABANDONED

BYZANTINE EMPIRE

330

FOURTH CENTURY BISHOPRIC OF PETRA
273 PALMYRA DESTROYED, PETRA TRADE
REVIVES BRIEFLY
200 PETRA'S TRADE DIMINISHES, CITY DECLINES

ROMAN PERIOD

106

NABATAEAN KINGDOM BECOMES A
ROMAN PROVINCE
FREQUENT WARS WITH THE JEWS
PERIOD OF NABATAEAN EXPANSION
SELA BECOMES KNOWN AS PETRA
KINGDOM INCLUDED MUCH OF SOUTHERN JORDAN
AND SINAI WITH IMPORTANT COMMERCIAL CENTERS
FROM RED SEA TO DAMASCUS
CULTURE REFLECTS STRONG GREEK
INFLUENCE.

AD AD
62 BC BC

HELLENISTIC PERIOD

311

311 PETRA SACKED BY ANTIGONUS

PERSIAN PERIOD

400

400 NABATAEANS IN PETRA
REMAINS OF THIS PERIOD FOUND IN PETRA

LATE IRON AGE

549

646 NABATAEANS MENTIONED IN ASSYRIAN WRITINGS
700 NABATAEANS MOVED FROM SOUTHERN ARABIA
AND LOCATE SOUTH AND EAST OF EDOM
BEGINNING OF HISTORICAL RECORDS

EARLY IRON AGE

950

EDOMITE COPPER MINES WERE IMPORTANT TO
ENTIRE SOUTHEAST MEDITERRANEAN AREA

LATE BRONZE AGE

1200

EDOMITE KINGDOM ESTABLISHED, RELIGIOUS
CENTER AT SELA (PETRA)

1600

HISTORICAL CHRONOLOGY

PETRA NATIONAL PARK



Dwg. no.
PET 5
page

The ancient city of Petra was located at a considerable distance from any large spring. Water was brought to the city by the Nabataeans and Romans via aqueducts from springs at the site of the present village of Wadi Musa. This supply was supplemented by rainwater collected and stored in cisterns and by diverting the seasonal wadi flows.

The effectiveness of Nabataean engineering has been demonstrated in the Negev where Nabataean terracing and water catchment devices have been repaired and put to modern use. There, agriculturalists now live on lands which had reverted to desert.

The power of the Nabataean Kingdom increased and at times they controlled lands which extended from the Red Sea to Damascus; they also occupied the entire Sinai Peninsula and much of the lands east of the Rift Valley in southern Jordan.

At the height of Nabataean power they met head on another nation which also was at the height of its power- Rome.

Rome gradually checked many Nabataean activities and finally, in A.D. 106, absorbed Nabataea into the Roman Empire. During the 2nd century A.D. there was a flurry of building activity at Petra and several tombs and temples in a classical style of Roman architecture were built as well as the paved road and Qasr el Bint.

New trade routes, through Palmyra, began to replace the older routes about this time and Petra declined in importance. By the 5th century it was an unimportant Byzantine provincial town, but the seat of a bishopric. Apparently Petra was abandoned by the time of the Islamic occupation in the 7th century. Crusader forts were built and occupied at Petra for a short period during the 12th century and then the ancient city was lost to the western world until it was visited by Burckhardt in 1812.

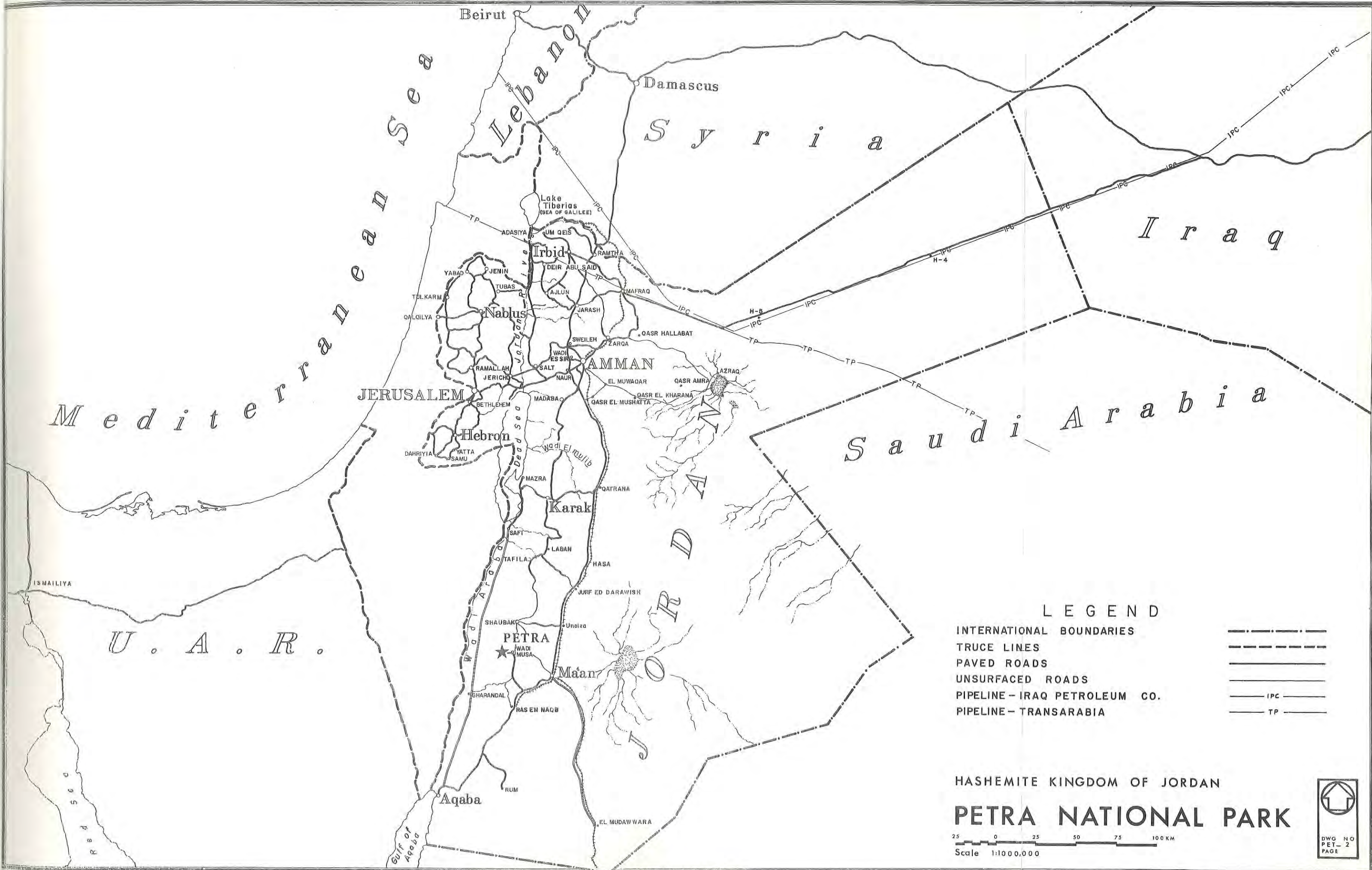
For almost a hundred years after Burckhardt's visit few foreigners had either the means or the endurance necessary to visit secluded Petra. A number of explorers found their way to the ancient city and published written and pictorial descriptions. The ancient city gradually became famous as a place of great beauty but one extremely difficult of access. It was not until about 1900 that serious studies were first made and even later, after 1920, that scientific excavations began to provide evidence of the historic development of the site. Publicity based on scientific expeditions led to touristic promotion of Petra as one of the major sights for Middle East tourists.

Access To The Park

The proposed Petra National Park, located in southern Jordan, is about two-hundred and sixty kilometers (about 161 miles) south of the capital city of Amman and 138 km (about 85 miles) from Aqaba, Jordan's outlet to the Red Sea.

The major access route is by way of Amman southward along the Desert Highway to the road junction eighteen kilometers beyond the town of Ma'an. Here a secondary paved highway, a single lane two-way road, leaves the Desert Highway and heading northwest goes through the villages of Ail, Basta, and Wadi Musa (El Ji) to the park entrance at the Petra rest-house. An alternate road to the park entrance via Ail, Taiyiba, and Wadi Musa, provides a spectacular view of Petra's sandstone massifs and Wadi Araba beyond.

The other access route from Amman parallels the ancient Kings' Highway by way of Madaba, Karak, Tafila, and Shaubak to Wadi Musa and the park entrance. This route provides opportunities to visit several areas of historical interest and provides spectacular vistas of the major wadis that dissect the Jordan Plateau as well as magnificent views of Wadi Araba. The road is paved from Amman to a point shortly beyond Tafila. While the highway is two-way, the narrow pavement width over much of its length requires passing vehicles to drive onto the

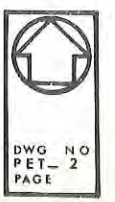


LEGEND

- INTERNATIONAL BOUNDARIES - - - - -
- TRUCE LINES
- PAVED ROADS = = = = =
- UNSURFACED ROADS _ _ _ _ _
- PIPELINE - IRAQ PETROLEUM CO. — IPC —
- PIPELINE - TRANSARABIA — TP —

HASHEMITE KINGDOM OF JORDAN

PETRA NATIONAL PARK



DWG NO
PET-2
PAGE

SAFI 38 KM.

KARAK 71 KM.

AMMAN 155 KM.

DARAWISH

SHAUBAK

DRAWING No. PET-4 PAGE

PROPOSED
PETRA
NATIONAL PARK

WADI MUSA

TAIYIBA

MA'AN

RAS EN NAQB

UNDER CONSTRUCTION (1969)

UNDER CONSTRUCTION (1966)

QUWEIRA

AQABA

REGIONAL LOCATION

PETRA NATIONAL PARK

10 0 10 20 30 KM.

Scale 1 : 250,000



dwg. no.
PET - 3
page



shoulders of the road. Much of it southward from the end of the pavement to Wadi Musa is good quality, graded road. There are, however, some very rough sections between Tafila and Shaubak which are hazardous for automobile travel. This access route requires considerably more driving time than the Desert Highway. Improvements on this road are under way but no completion date has been scheduled by the Ministry of Public Works.

Places of significant historical or archaeological interest that may be visited along the Desert Highway or the Kings' Highway as part of a journey to Petra are listed in Appendix - A- .

A road from Aqaba to Safi is now under construction along the eastern side of Wadi Araba. It will pass about 10 kilometers beyond the park's western boundary.

Table Of Distances

<u>From</u>	<u>To</u>	<u>Kilometers</u>	<u>Miles</u>
Amman	Petra		
	via the Desert Highway	262	161
	via the Kings' Highway	303	190
Jerusalem	Petra		
	via the Desert Highway	350	220
	via the Kings' Highway	391	245
Petra	Wadi Rum	85	54
	Aqaba	138	85

Travel to the Park is usually by taxi, rented car, private car, or tour bus. A daily commercial bus runs between the village of Wadi Musa and Ma'an where taxis or commercial busses may be taken to the north or to the south.

**Access Within
The Park** Access into the Park from the resthouse for most visitors is by foot or on horseback. There has been increasing use of helicopters to transport important persons to and from the Park. Vehicle traffic into the main ruins area in the basin by way of the world famous Siq has unjustifiably increased at a alarming rate and has mocked Lankaster Harding's perceptive statement that "The whirr of engines and shriek of klaxons is not for Petra" and that "The gaunt red mountains and vast mausoleums of a departed race have nothing in common with modern civilizations, and ask nothing of it except to be appreciated at their true value - as one of the greatest wonders ever wrought by Nature and Man".

Terrain The terrain of the park and its immediate vicinity is divided from east to west into three zones. To the east is the high limestone escarpment of the Jordan Plateau; in the center are the rugged, severely eroded, varied colored sandstone massifs so characteristic of Petra, and to the west are the massive alluvial fans which form the sides of Wadi Araba. The drainage pattern of the area is from the escarpment of the Jordan Plateau westwardly to Wadi Araba and is characterized by systems of wadis that within the park are major torrent channels. To the immediate north and south of the park the terrain features have similar characteristics.

Climate The climate of the park and its immediate environs is a Mediterranean type characterized by hot, dry summers; and cold, wet winters. Rainfall, which varies as the elevation changes along the escarpment, ranges from less than 50 millimeters mean annual in Wadi Araba, to 100-200 millimeters along the escarpment of the Jordan Plateau. Major wet periods in descending order of maximum rainfall are winter (December - February) , spring (March - May), and fall (September - November); virtually no rain falls during the summer (June - August). Snows and frosts are characteristic of the higher elevations of the

escarpment and the plateau, and major winter storms cut telephone lines and wash out sections of road or block them with snow. While the Desert Highway is usually back in service within from 24 to 48 hours after such a storm, repairs and snow removal of lesser roads including the park entrance road may take up to a week. Westerly to southwesterly winds predominate throughout the year. Weather records available for Ma'an and Aqaba appear in Appendix -B- .

Tribal Use

The approximately 200 members of the Bdul Bedouin tribe occupy land within the park boundary from Wadi Sabra to Jebel Beida including the Petra Basin area. Their uses of the land include wheat and barley dry-farming, irrigation from wells of small plots of potatoes and tomatoes, hunting and trapping of what little wildlife remains in the park, and herding sizeable numbers of black goats and a few sheep. They keep donkeys and a few camels, but have no horses. The men are employed from time to time as laborers on archeological projects within the tribal territory. They also dig in the antiquity sites of the park, particularly in the Petra Basin, seeking artifacts to sell to the tourists. The Bdul have established a number of soft drink shacks in areas of tourist concentration.

Various trails pass through the park, providing traditional routes of travel for Bedouins from Wadi Araba to the Jordan Plateau. The intensity of use of these trails is not known but it is believed they are not major access routes.

Other Uses

In the Petra Basin is a school which has about thirty pupils, a hotel and restaurant (Nazzal's Camp), and a Department of Antiquities' Museum. Parts of the hotel, the museum, living quarters for employees, and storage areas utilize antiquity caves. Even the Khazna, the most famous temple of Petra, has not escaped this disgraceful fate; one of its chambers has been boarded up for storage.

Land Status

The park is within the boundaries of the Ma'an Governorate. All of the land area within the park boundaries is in government ownership except 831 dunums along the Wadi Musa - Taiyiba Road and 183 dunums at the park headquarters. The Bdul tribe has traditional rights of use of park lands.

Village Relationship

The village of Wadi Musa adjacent to the park is a small agrarian community producing wheat, barley, vegetables, olives, grapes, figs, apples, and apricots. Located here are the offices of the Director of the District (the representative of the Ma'an Governorate), the Police Post, and a school. A small Suq serves the needs of the villagers.

There is no hospital or pharmacy; a doctor usually makes weekly visits from Ma'an. The men of the village provide horses for tourist use and provide labor for projects within the park. It is suspected that some of them, like the Bdul, deal in illegally excavated artifacts and at least one individual makes ceramic reproductions of Nabataean artifacts which are bought by tourists as authentic antiquities.



Park Resources

Introduction

Throughout the world specific sites have been recognized as primary representatives of civilizations of bygone eras. Persepolis recalls the splendor of ancient Persia; Rome preserves the grandeur that was the western Roman empire; Istanbul memorializes the pages of Byzantine history; and Petra, with its fabulous array of tombs and temples laboriously hewn in multi-colored sandstone, reflects the era of the Nabataeans, a tribe of desert dwellers who burst upon the scene as common brigands, quickly developed an empire stretching from the Red Sea to Damascus, and then fell to the mighty empire of Rome.

In the 150 years since its rediscovery, Petra has become a magnet, attracting visitors from all parts of the world. Even the glittering prose of travel writers cannot adequately describe the grandeur of Petra and the beauty of its setting, for Petra is a resource which must be accorded treatment worthy of its international importance.

To plan effectively for the development and use of Petra as a National Park, it has been necessary to examine the total resources of the area and evaluate the part each resource will play in the development of Petra as a National Park. Some resources are vital to development sections; water soil and rock characteristics, etc. Others, scenery, plant and animal life, are the resources that if properly utilized, will enhance the primary resource, the historical scene.

Major Plant Communities

Three major plant communities, controlled by elevation and soil types, are found within the proposed park. The higher ridges of the eastern boundary contain a southern extension of the Mediterranean Woodland with remnants of a climax forest of oak-juniper. Soils within this community are derived mainly from limestone. Scattered junipers are found throughout the sandstone areas of the park on higher hills or in narrow,



Five distinct plant communities
may be seen at Petra.

1. Remnants of juniper woodlands
2. Low shrubs on the higher slopes
3. Nearly barren plains leading to Wadi Araba
4. Lush growths of oleander in the main wadis
5. Hanging gardens in narrow wadis



shaded valleys.

The second community found on the open slopes above the sandstone zone and on higher interior slopes is a typical steppe association dominated by dwarf shrubs, primarily represented by *Artemisia*. Limestone soils predominate.

The third community, the sandy Hammada Desert, is found throughout the spreading wadis of the western section draining into Wadi Araba.

Specialized Communities

Specialized conditions have created two additional plant communities within the heart of the sandstone zone. Available moisture in a number of wadis, usually subsurface, has permitted a luxurious growth of oleanders and other moisture-loving plants to form green strands throughout the relatively barren interior.

Extremely narrow clefts through the sandstone massifs create micro-climatic conditions favoring ferns, mosses, and other typically cool climate vegetation.

Misuse

Misuse of the vegetative resources of the park area through overgrazing, removal to allow cultivation, and removal of trees and shrubs for firewood has had far-reaching effects on the region. Destruction of the vegetative cover has allowed accelerated erosion, destructive to the land and to the antiquities. In addition to the erosion factor, the disturbance of the vegetative balance has no doubt affected the native wildlife population.

The centuries of misuse of the vegetation of the region cannot be corrected overnight, but it is clear that the adverse practices mentioned above must be stopped before the park area becomes a biological desert.

Lack of adequate research precludes the preparation of a natural history base map showing vegetation patterns. This base map can be prepared when adequate research data becomes available.

A preliminary check list of plants is attached as Appendix -C-.

Wildlife Misuse The wide range of habitats within the Park area has, in the past, supported an interesting assortment of fauna, but the destruction of vegetative cover along with unrestricted hunting has eliminated or reduced animal life.

Corrective Measures Improvement of the vegetative habitat and the prohibition of hunting within the park will allow the natural or artificial repopulation of vanished or scarce wildlife species to add to the enjoyment of park visitors. Of primary importance are the Nubian ibex, fallow deer, and mountain gazelle.

Appendix -D- contains partial checklists of the fauna of the region. As noted in the vegetation section, no wildlife base map is included due to the lack of adequate research.

Geological Features The most significant geological features in the park are the dissected rounded masses of red and white sandstones of the Paleozoic era. It is in the two major sandstone series, the reddish Quweira series capped by the light colored Ram sandstone, that the Nabataeans carved their spectacular structures.

Of equal interest is the Wadi Araba, the extension of the Jordan Valley south of the Dead Sea. This valley is one segment of the famous Rift Valley extending from southern Lebanon through the length of Jordan and the Gulf of Aqaba into Africa.



Very few, if any, large animals remain in the Petra area. The re-establishment of (1) Ibex and (2) Gazelles will add to the scenic values of the park.



The accompanying geologic map graphically describes the array of geologic layers exposed throughout the park as a result of rejuvenated drainage to the Rift Valley. Exposed, are strata representing Pre-Cambrian, Paleozoic, Mesozoic, and Cenozoic.

Water Sources

Springs are the main source of water in the vicinity of the proposed park. For many centuries people lived near the springs and constructed terraced fields irrigated by gravity flow. Today the best springs near the proposed park are being used and little water is available for new users.

Certain alluvial filled valleys within the proposed boundary may contain subsurface stream flow. This resource is known to be used within the proposed Park from the dug wells in the channel of Wadi Musa below Nazzals' Camp, and in Wadi Turkamaniya.

Perennial surface flow occurs at certain points of Wadi Musa in the narrow rocky gorge below Petra. For reasons of distance and possible contamination this is not considered to be a satisfactory water source.

There are no deep wells in the region and no exploratory drill holes are known to the Park study team. It is not likely that ground-water, other than perched aquifers of limited supply, occurs much higher than the level of Wadi Araba to the west of the proposed Park. Even so, this source, deep ground-water, appears to be the only one available for development on the west side of the Park (the Wadi Araba side) and may be the only source, albeit an expensive source, for greatly expanded use at the Petra Entrance or in Petra Basin. Water sources are shown on the General Utilities drawing, and details are discussed in the Developed Area portion of this plan. Because of this situation extensive studies of possible water sources should be conducted by the Natural Resources Authority of the G.O.J.

Water Quality

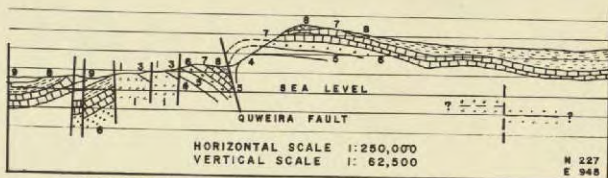
No information is available to the team on the mineral or bacteriological content of the water currently being used in the Petra area. However the conditions of the land surface, with human and animal excrement scattered about indicates that any surface water supplies would be contaminated.

Fault Systems

The Quweira Fault, a major wrench fault, begins twenty-five kilometers southeast of Aqaba, goes northward through the town of Quweira, and ends as a series of northwest - southeast branching tension faults between Petra and Shaubak. The fault movements produce steps leading to Wadi Araba.

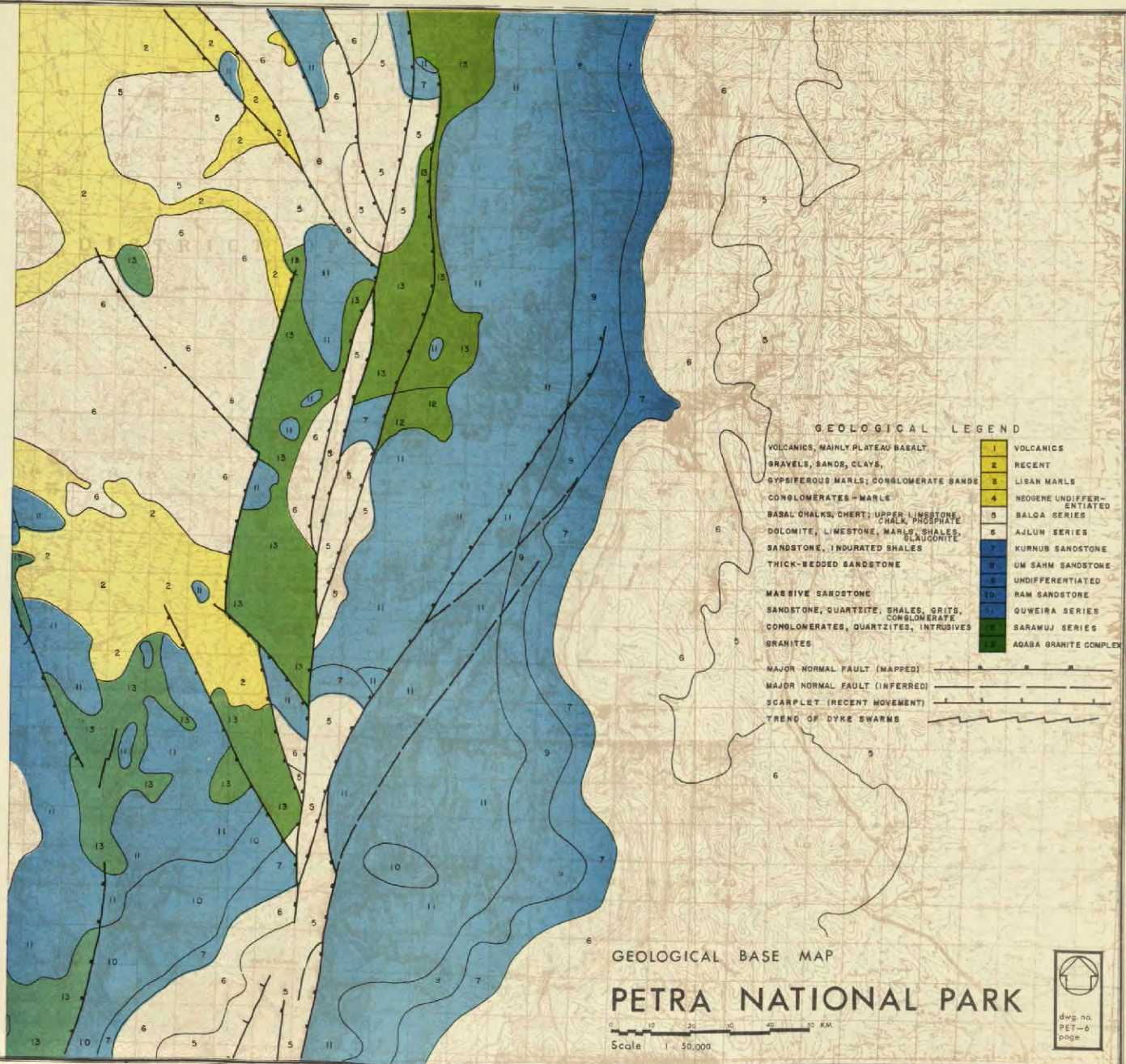
Er Risha, a major fault that is still active, begins on the west side of the Gulf of Aqaba, crosses the Wadi Araba diagonally about 8 kilometers from Petra, continues to Wadi Hasa where it heads northerly along the east shore of the Dead Sea.

Data on earthquake frequency and magnitude are not available.



GEOLOGICAL CROSS-SECTION N 227 to N 967
E 946 to E 142

- | | |
|-------------------------|----------------------------|
| 1 AQABA GRANITE COMPLEX | 7 AJLUN SERIES |
| 2 SARAWUJ SERIES | 8 BALQA SERIES |
| 3 QUWEIRA SERIES | 9 NEOGENE UNDIFFERENTIATED |
| 4 RAM SANDSTONE | 10 LISAN SERIES |
| 5 UM SAHM SANDSTONE | 11 SUPERFICIAL DEPOSITS |
| 6 KURNUB SANDSTONE | 12 PLATEAU BASALTS |



GEOLOGICAL LEGEND

- | | | |
|--|----|-----------------------|
| VOLCANICS, MAINLY PLATEAU BASALT | 1 | AGABA GRANITE COMPLEX |
| GRAVELS, SANDS, CLAYS, | 2 | |
| GYPSEIFEROUS MARLS; CONGLOMERATE SANDS | 3 | |
| CONGLOMERATES - MARLS | 4 | |
| BASAL CHALKS, CHERT; UPPER LIMESTONE, CHALK, MARGARITE | 5 | |
| DOLOMITE, LIMESTONE, MARLS, SHALES, GLAUCONITE | 6 | |
| SANDSTONE, INDURATED SHALES | 7 | |
| THICK-BEDDED SANDSTONE | 8 | |
| MASSIVE SANDSTONE | 9 | |
| SANDSTONE, QUARTZITE, SHALES, GRITS, CONGLOMERATE | 10 | |
| CONGLOMERATES, QUARTZITES, INTRUSIVES | 11 | |
| GRANITES | 12 | |
| | 13 | |

- MAJOR NORMAL FAULT (MAPPED) ————
- MAJOR NORMAL FAULT (INFERRED) - - - - -
- SCARPLET (RECENT MOVEMENT) ————
- TREND OF DYKE SWARMS ————

GEOLOGICAL BASE MAP

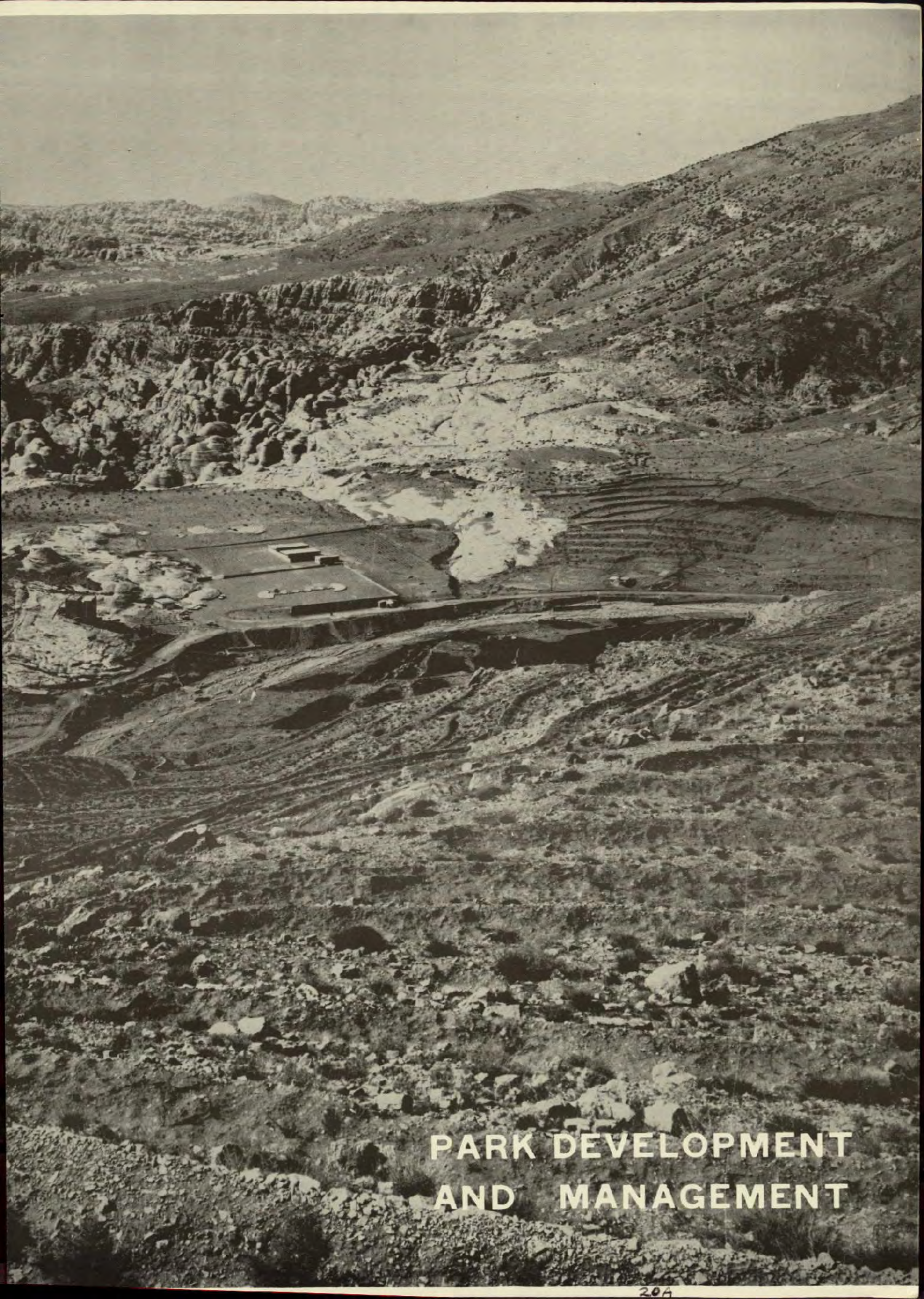
PETRA NATIONAL PARK

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PET-6
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**PARK DEVELOPMENT
AND MANAGEMENT**

National Park Establishment

Petra as defined here is an area combining exceptional historical and scenic values which give meaning and substance to Jordan's heritage. Measured with National Parks elsewhere, Petra will stand as one of the great national parks of the world. The GOJ should therefore consider these proposed boundaries and following agreement upon the area to be included, take whatever legislative and administrative action which is required to have the area designated as a National Park.

Park Boundaries

The area selected for inclusion within the park is believed to be sufficient to protect the archeological and historical features which tell the total Petra story. Additionally, lands have been included which are needed to protect the historic and scenic resource, to demonstrate historic conservation practices, and provide unobtrusive development sites necessary for public use and management facilities.

East Boundary

As shown on the adjoining map, the east boundary is drawn between the village of Wadi Musa and the existing Parks Division development west of the village. In order to protect the park approach road as it leaves the village from undesirable private development, a short segment should be included within the park boundary and limited to agriculture and contiguous property access uses.

South Boundary

The south boundary has been selected to include Wadi Sabra with its remains of historic copper mining and smelting operations. A portion of the Taiyiba road has also been included within this boundary to protect from uncontrolled development this highly scenic road approach to the park.

West Boundary

On the west, the park boundary has been drawn to include the massif that forms the highly scenic, rugged eastern skyline of Wadi Araba. Jebel Harun and its pinnacle shrine marking Aaron's tomb is located within this portion of the park.

North Boundary

On the north, the boundary has been set to include a very scenic and historically interesting portion of lower Wadi Musa as well as the vast neolithic site at Beldha. This portion of the park is also believed to have been the site of a great Nabataean trading center that flourished during the first century.

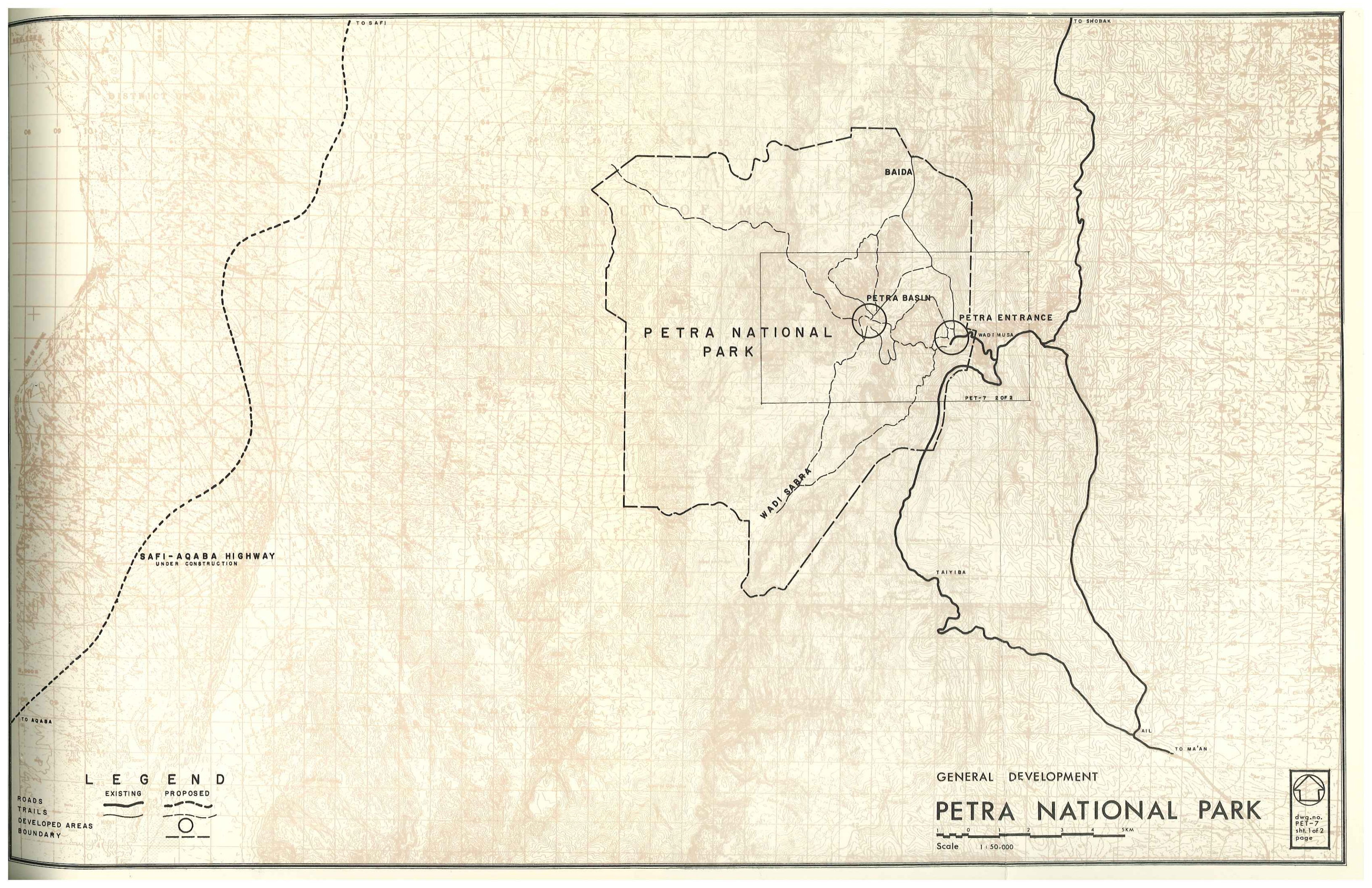
LAND MANAGEMENT

Land Misuse

Now a despoiled, severely exploited land, long abused by the combined forces of man and the natural forces of wind, water, and gravity, this area comprising approximately 122 square kilometers, is today the range of sedentary Bedouin tribes who with their goats, guns, plows and their endless quest for antiquities are, without malice, quickly converting this area to a wasteland ultimately fit for neither Bedouin nor tourist.

Bedouin Resettlement

Resettlement of the Bdul tribe is one of the most urgent requirements of this plan if the Government is to preserve and develop Petra as one of the great National Parks of the world. It is recognized that resettlement is not proposed lightly nor should it be taken as a simple exercise in the physical movement of a people from one place to another. Accordingly, it is recommended that the practical and effective way to accomplish the preservation of the resources of Petra from the destructive effects of human habitation is to resettle the approximately 200 members of the Bdul tribe now living within the proposed park boundary and to close all of the park



SAFI-AQABA HIGHWAY
UNDER CONSTRUCTION

PETRA NATIONAL
PARK

BAIDA

PETRA BASIN

PETRA ENTRANCE

WADI MUSA

WADI SABRA

TAIYIBA

AIL

TO MA'AN

TO SAFI

TO SHOBAK

TO AQABA

LEGEND

EXISTING

PROPOSED



ROADS
TRAILS
DEVELOPED AREAS
BOUNDARY

GENERAL DEVELOPMENT

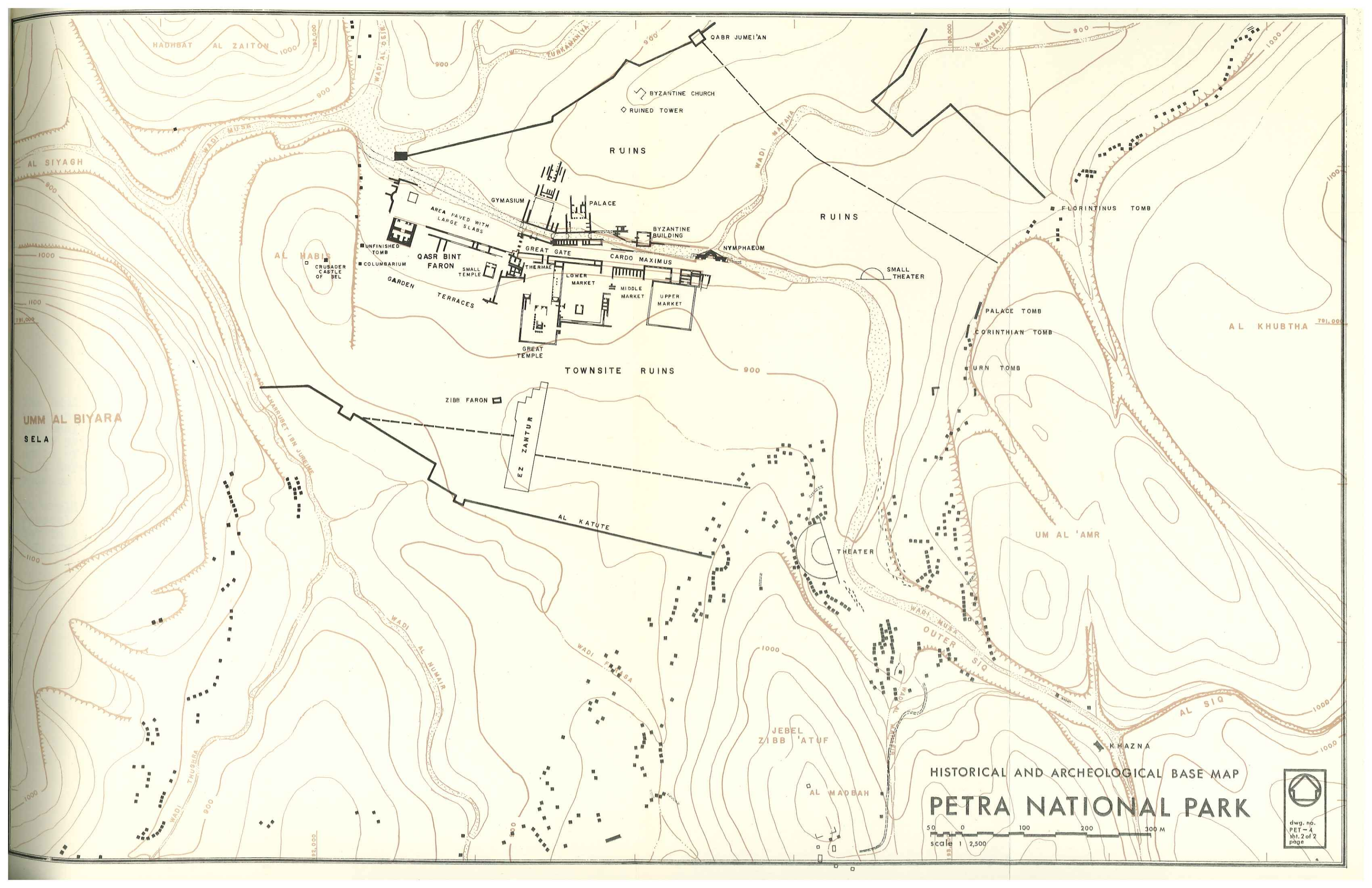
PETRA NATIONAL PARK



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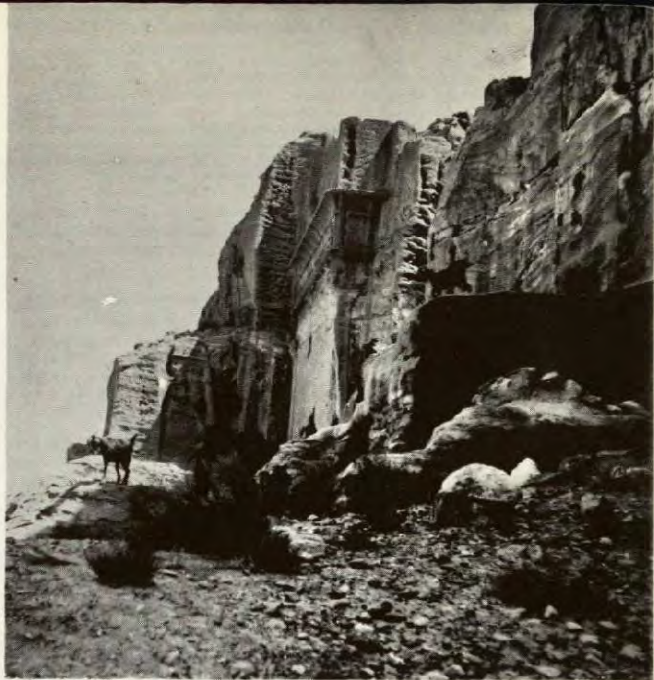
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PET-7
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HISTORICAL AND ARCHEOLOGICAL BASE MAP
PETRA NATIONAL PARK

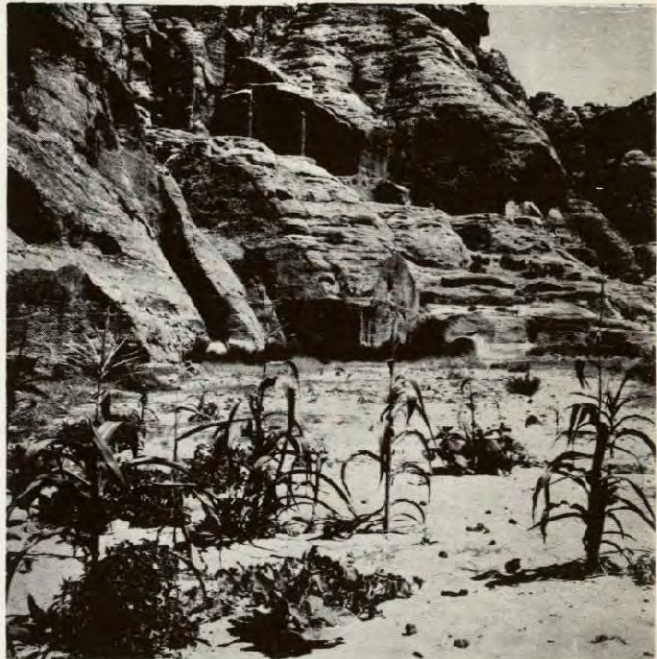
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The Bdul of Petra lead a precarious existence based on their herds of goats and meager farm plots. Not only are these people caught up in an unending cycle of poverty, but their quest for life here is damaging to the historic remains of Petra.

It would be better for the Bdul to be resettled elsewhere to improve their lot in life as this resettled tribesman now enjoys.



lands to further settlement, livestock grazing, farming, wood and plant gathering, mining, mineral exploration, and shooting.

The Government has projects in the el Jafr, al Hussainye, and al-Qarien areas of the Ma'an Governorate under the supervision of the Department of Research, Ministry of Agriculture and in cooperation with the United Nations in which members of the al Huwaitat tribe have been settled. For each Bedouin family this program provides:

- 50 dunums of land suitable for farming.
- A water supply.
- A house.
- The land and the house are leased to each family.
- Seed, tools, equipment, and training in farming techniques along with food for sustenance are provided.
- A general guarantee is made to the tribesmen that they will be at least as well off as they were before resettlement.
- If the tribesmen farm successfully for five years, they are allowed to purchase the house and land using long-term, low interest loans.

The overall objective of this program is to help the tribesmen to take up successfully a village-farming way of life with such social benefits as basic education and medical help being provided. The effectiveness of this on-going program cannot be evaluated fully for several years due to the inherently slow nature of human reactions to exercises in planned culture change. To date, the program is considered successful, the tribesmen are farming, and they are living in the houses built for them.

To give the proposed resettlement of the Bdul tribe a better chance of success, it is recommended that an adequate Socio-cultural study of the Bdul tribe precede any attempt to move them. The kind of study proposed is within the capabilities of the staff of the Department of Sociology and Philosophy of the University of Jordan and could probably be completed in six months time.

The support of the highest level of leadership of the country should be obtained as to the necessity of the resettlement of the tribe and the closing of the park to non-park uses.

Watershed Protection

Along with their stone carving skills the Nabataeans developed a phenomenal hydraulic ability, manifested in the remnants of numerous water control systems. Hillside terraces slowed the run-off of rainfall by requiring water to seep from one level to another. Small dams built like stairsteps in the wadis also cut down the force, and loss, of the torrential flows that raced down the wadis during the short rainy season. Sand and soil, trapped behind these small rock dams and barriers retained moisture and was used by the Nabataeans for vineyards and groves, providing fruit and shade.

Just as these historical installations have been reopened or re-established elsewhere in the Kingdom, and neighboring lands, there is urgent need and compelling justification at Petra to do the same in order:- (1) to protect the irreplaceable antiquities within the park. (2) to guard against possible loss of life in case of flash floods and (3) to conserve water which is so vital to the restoration of plant and animal life. The details of the proposed improvements are discussed on pages 55 through 57

Watershed management is a basic requirement to the prevention of damage to the historic scene as shown here.



Protection Of Historical - Archeological Resources

Conservation Of Historic Structures

Protection of the antiquities of Petra should be a primary function of the Parks Division through properly planned development and visitor control. Interpretation should also play a part in the protection by drawing attention to the loss of irreplaceable antiquities through ignorance. The physical protection of Petra's antiquities from the forces of nature should be provided through the consolidation activities of Department of Antiquities technicians.

Without doubt Petra is one of the great remaining treasures of the ancient world, yet this treasure is so fragile that the forces of nature will take an annual toll of the temples, tombs and dwellings which are the most prominent remains of the old Nabataean city.

The delicate nature of the ruins is such that when the protection and preservation of the ruins is in conflict with desires or convenience of park visitors the ruins should be given precedence. Of primary concern is the fact that it is the existence of these particular structures which is the basis for the creation of the Park.

Almost all the construction of Petra was of, or in, sandstone which is soft, friable and poorly consolidated. When subjected to erosion by water, wind-driven sand, and human use, the sandstone yields readily and there is nothing that can be done to totally stop this action. Efforts, however, will be directed towards slowing this destruction as much as possible.

Inventory Of Historic Structures

The most urgent need for Petra at the present time is an inventory of historic structures. This will require a large scale topographic map of the park locating all exposed historic remains. This should be a prerequisite for consolidation of sites, planning future research and for development of long

range visitor facilities within the Park. The detailed maps prepared by Brunnow and Domazewski are not to scale but are accurate enough that they can be used as a start for the preparation of a proper historic base map. In addition, there will soon be published by Peter Parr of the University of London a map of the city area of Petra. It is not known how much in addition to the city this map will include.

The inventory should be supplemented by a narrative including a summary of all known work at each individual monument, sketches and measurements and, most important, a statement of its present physical condition together with recommendations for protection and consolidation.

The Department of Antiquities in cooperation with the Parks Department, using the above described inventory, should prepare an overall, comprehensive, long-range consolidation plan that would serve as the basis to support budget requests for funds for this extremely critical resource preservation requirement.

Consolidation Policy

The Department of Antiquities approach to consolidation of monumental structures is pointed heavily towards taking a ruin apart and rebuilding it using newly cut stones to replace damaged original masonry. For the reasons discussed on pages 30 - 35 of this plan, this practice should be stopped and a policy of in situ consolidation adopted.

Restriction On Excavations

Further excavations of the ruins at Petra should stop immediately and for several years to come until all exposed ruins are consolidated or proper protective measures are taken. During the past 10 years several small scale excavations have been done by the Department of Antiquities or by archeologists from foreign countries.

The results have been that an appalling number of walls, stairs, and other architectural features have been exposed without being consolidated. These exposed features, for the most part

built from 1,700 to 1,900 years ago, are constructed of the soft, friable sandstones of the Petra Basin. They are showing already the signs of accelerated destruction caused by wind, water, and human use. The stair case in front of "Qasr el Bint", the steps to the "Lower Market", the "Byzantine Suq" along the "Cardo Maximus", a small house near the "Palace Tomb", and the area south of the gate excavated last Spring are but a few examples of consolidation needed because of excavations of the past. Also, there are many structures exposed by natural erosion, structures free-standing above the present surface of the surrounding ruins, and numerous rock-carved structures that are in dire need of consolidation in order to preserve them as significant tourist attractions. The total consolidation needs of ruins now exposed at Petra could well use the budgeted funds of the Department of Antiquities for the next five to ten years. Yet excavations continue without proper consolidation and preservation efforts.

Criteria For Excavations

Archeological excavations should not be resumed at Petra until the following requirements are met:

First, the Department of Antiquities, in conjunction with the Parks Department should prepare a comprehensive, long-range, problem oriented plan of research for the proposed Petra National Park. This plan should evaluate all prior excavations, assess what is known from these excavations and from historical resources, and identify specific problems for which archeological research could provide the needed answer. A secondary objective of the research plan would be to identify ruins which should be excavated for display to the tourists; and just as important ruins or areas which should be excavated for information and then re-covered with earth.

Second, the Department of Antiquities and the Parks Department should both adopt the policy that no excavations will be undertaken without adequate funding to insure the consolidation or preservation of the site and its artifacts.

Third, all excavations at Petra funded by the GOJ should conform to the requirements of this Master Plan and the research plan proposed above.

Fourth, all excavations of Nabataean and later periods funded by the GOJ should adhere to the highest standard of scientific technique and should be undertaken only under the direct field supervision of a thoroughly experienced Greco-Roman archeologist who has achieved the doctorate level of education. Excavations of sites from earlier periods should meet the same requirements except that the archeologist in charge should be thoroughly experienced and academically trained in the particular period in which he expects to excavate.

Fifth, proposals for excavation of ruins in the Park sponsored by foreign archeological institutions should conform to the standards outlined above. The GOJ, however, should fund and undertake the necessary consolidation or preservation requirements.

If the present practices of the GOJ with respect to excavation, consolidation, and preservation of the ruins of Petra are continued, irreparable damage will be done to the ruins of the Petra Basin and significant archeological findings determined by scientific excavations based upon problem-oriented research plans will be lost forever. Some of the more serious consolidation and preservation needs are discussed on the following pages and in Appendix -E- .

Conservation Categories

Conservation of the ruins at Petra falls into three categories: (1) conservation of the site as a whole; (2) conservation of structures hewn from sandstone masses, and (3) conservation of free standing structures.

Site Protection

The ancient city of Petra lies in a basin in which three drainage areas meet - those of Wadi Musa, and its two principal tributaries, Wadi Mataha and Wadi Turkumanyah. Each of these has a drainage area sufficiently large that it poses a threat to the city area of Petra each rainy season. After the disastrous flood of 1963 in which 28 tourists lost their lives in the Siq, a diversion dam was built across Wadi Musa at the head of the Siq and this portion of the stream course no longer is as dangerous as before. Waters from the upper reaches of Wadi Musa are now diverted by the Siq dam into Wadi Mataha forcing it to carry more than its share of any general flood. The worst feature of the new arrangement is that Wadi Mataha joins Wadi Musa in the heart of Petra and its lower course points like an arrow at the Nymphaeum and the colonnaded street.

A few hundred meters below the junction of the two streams dirt from recent excavations has been dumped into the bed of Wadi Musa so constricting the channel that an additional hazard has been created. Flood waters could easily choke the channel at this point and cause irreparable damage to ancient remains on either side of the stream.

At about the same time the dam was built across Wadi Musa a long and unsightly retaining wall was constructed on both sides of Wadi Musa from the Nymphaeum to the Monumental Arch near Qasr el Bint. This revetment was intended to protect the Nymphaeum and paved street, but it has been seriously undermined by the stream. This channel should be stabilized. The existing revetment walls should be faced with sandstone of a size and pattern to be in sympathy with the Roman period ruins.

Elsewhere in this plan a proposal is presented to construct a system of check dams and hillside terraces throughout the Wadi Musa drainage as did the Nabataeans. Such a basin-wide system of water controls, regularly maintained, seems the only practical means of preserving both ruins and terrain.



An excess of rainfall runoff carried by Wadi Musa because of overgrazing forced the construction of a revetment to protect the Roman period structures - continued excess water is now undermining this revetment.

The dumping of excavation debris has restricted the flow of Wadi Musa causing further erosion upstream.

In addition, erosion by human activity should be controlled. This also is proposed in another section of the Master Plan but is added here to give additional stress. The Bdul tribe should be resettled out of the area to halt the farming and browsing which damage the site and, above all, to end the illicit and apparently never-ending digging for relics to be sold to visitors.

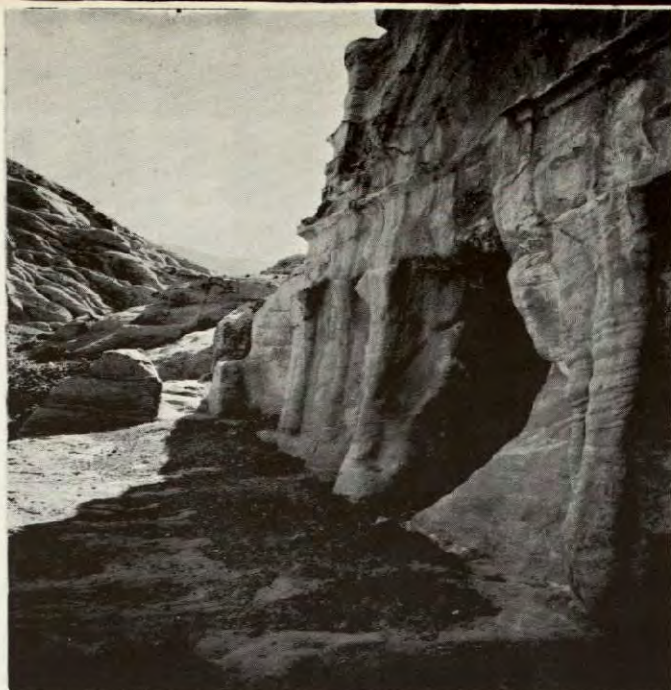
Protection Of Carved Structure

Much of the sandstone of Petra, and particularly the varicolored-red beds, is being eroded at an alarming rate. At the present time the most effective means of slowing such erosion is to spray or paint the sandstone with a penetrating rock hardener. Properly applied these hardeners are remarkably effective and make the stone hard, resistant to wear and do not change the external appearance of the rock. Such a treatment is expensive. A description of one of these chemicals, of American manufacture and their application costs, is in Appendix -F- .

Protection Of Free- Standing Structures

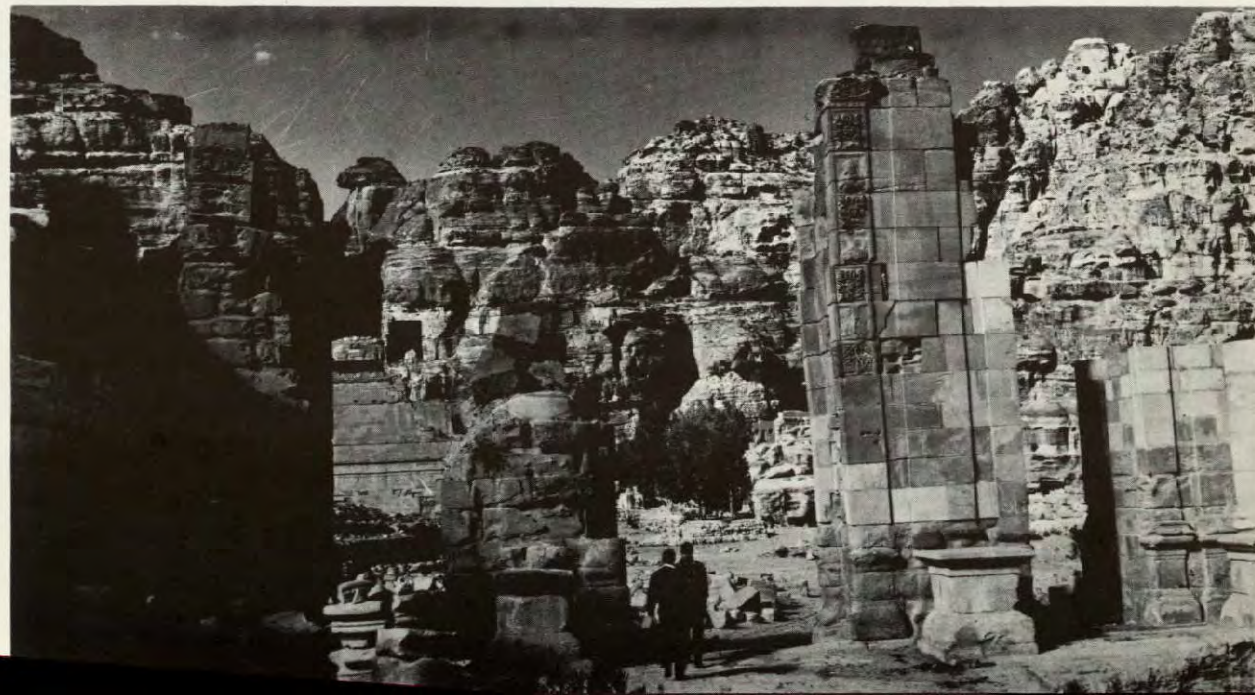
There are only a few free-standing structures at Petra; chief among these is Qasr el Bint with some lesser buildings such as the monumental gate, the scena of the theatre and the partially excavated portions of the baths.

Before entering into any discussion of the care and maintenance of masonry walls it will be well to quote Mr. T. A. Bailey of the Department of Public Works, Ancient Buildings, of the United Kingdom. He wrote in: Notes on the Repair and Preservation of ancient monuments and historic Buildings. "No defective masonry which can possibly be secured in situ should be taken down". It is much too easy for a technician to be carried away by his own skill when making necessary repairs to ancient structures and end up with something which may be structurally sound but entirely out of keeping with what it proposes to be.



(A) The Obelisk Tomb,
(B) Qasr El Bint, and
(C) The monumental Gate are
examples of the effects
of wind erosion at Petra.
Major structures will
require preservative
treatment to reduce this
erosion.

A



Some recent work at the monumental gate is a case in point. A number of stones in some of the lower courses of the gate were replaced or reset. The stones were very neatly dressed and mortared with cement. The result is that those courses of stone have all the appearance of fine modern masonry and clash with the appearance of the masonry above, which is in a fairly precarious condition and needs consolidation.

It has been proposed to take down the upper portion of the gate and to rebuild it - using the same stones - plus a few new ones to replace those which are badly cracked. To do this would be to destroy the entire aspect of the gate and create a caricature of a ruin in modern masonry.

The free standing structures are ruins and they should be preserved as ruins. The days when the stones were neatly dressed and the structures presented a solid appearance are long gone and an attempt should not be made to re-create those days.

Where masonry blocks of the gate have separated and rubble has entered the widened joints, additional pressure has been exerted so that much of the upper portion of the structure is becoming unstable. The joints can be raked, some of the rubble core removed, the entire upper portions of the gate can be jacketed, and the masonry jacked back far enough so that with epoxies, pins, and internal braces, the structure will once more be in equilibrium and will still look like a ruin. A delicate job - but not an impossible one.

The other free standing structures of the site, notably Qasr el Bint, should be approached in the same manner. The temple has suffered much damage by earthquakes in the past and a number of stones in the faces of the walls as well as the remaining portion of the arched entrance appear in danger of falling. A comparison of the walls today with photographs published by Brunnow and Domaszewski in 1904, show that little change has taken place during the past 65 years. This

indicates that the walls are not in immediate danger of collapse (unless from some hidden weakness) and that there is probably time to make a detailed survey of the entire structure and then proceed with carefully planned consolidation of the temple which Peter Parr has termed, "one of the most important surviving Hellenistic buildings in the Near East". Here also, it is of the utmost importance to preserve Qasr el Bint as a ruin - a handsome relic of the past.

Introduction Of The Visitor To The Park

Scenic Approach At present visitors are routed from the Desert Highway past Ain Musa and through the village of Wadi Musa to the rest-house area. To better prepare the visitor for the rugged and scenic expanse of the park, it is proposed that they be routed through Taiyiba. This road offers an extensive over-view of the entire area. Along part of this scenic approach overlooks with orientation exhibits should be developed.

Visitor Center The focal point of all visitor activities will be the park visitor center. Arriving visitors will be channeled into this facility so that their needs may be taken care of in an orderly fashion. Circulation and facilities within the visitor center will be as follows:

Manned Information Facility The information station will serve as a filter to provide basic information-orientation and direction to visitors. Here a clerk-cashier would be stationed to collect park entrance fees.

Toilets Adjacent to the entrance will be conspicuously marked toilets.

Information Orientation Exhibits A large illustrated map of the park will denote trails and other available activities. Multilingual labels should be provided as well as multilingual map folders.

Accommodations Facility At this facility all transactions for accommodations, horse rentals, campground fees, or guides may be completed.

Audio - Visual Exhibits A brief audio-visual program would provide further orientation to the park. Multilingual audio equipment should be available. Appendix -G- outlines the presentation.

Museum Exhibits Exhibits should be provided in the visitor center. Appendix -H- outlines the exhibit content and treatment.

Publications Center It is recommended that this be the central sales point for all park publications and authorized souvenirs. Appendix -I- outlines the number of publications and their contents.

From the visitor center visitors have the option of going to their rooms, to the restaurant, lunch terrace, or to the park trails (foot or horse).

The Trail System The major visitor activity within the park should be a personal exposure to the scenic and historic features of the park on a network of foot and horse trails. The trails should be designed to be used as guided or self-guiding trails. Most of the trails will feature alternate return routes for maximum exposure to park features. Trail route markers and site markers should be color coded for identification. Each trail should be supported by guide booklets available in Arabic, English, French, German and Italian to provide a welcoming and friendly individual approach. Appendix -J- outlines the trails according to a priority of development.

Personal Services A staffing chart is included in another section of the Master Plan, but it is necessary here to spell out the activities of the uniformed staff in the fields of information and interpretation. The initial visitor contact at the visitor center information desk will have a direct effect on the attitude of the visitor to the park, the park system and even to the country. It is therefore necessary to provide the best trained personnel available for the initial contact duty. To ensure a uniform quality of personal contact, the uniformed staff should rotate their assignments between the following duties:

- Visitor center information desk
- The contact station in Inner Petra
- The contact point near the Roman Theater
- Trail roving assignment
- Evening program duties
- Special tours

Evening Programs The concentration of overnight accommodations (hotels and a campground) in one general area will facilitate the development of evening programs. Evening programs can be a very useful extension of the information-interpretation activity, utilizing personal services, audio-visual presentations, and demonstrations. Programs may also be developed to encourage tourists to visit other National Parks and points of interest throughout Jordan. Each program should also include entertainment of a type that will feature the folk arts; singing, dancing, and the playing of native instruments such as the rebaba and the shepherd's pipe.

Guide Services Although trail information - interpretation should be primarily geared to self-guided activities, there will be a demand for personal guides. Many, if not all, of the agency-arranged tour groups will be accompanied by their own guides. In any operation of this type, there will be a need for guide service for

special guests and as mentioned in the personal services section, members of the uniformed staff should be available for this duty. For the independent tourists, guides should be made available through a National Visitor Center which will be proposed for development in Amman. No guide should be permitted to operate in Petra National Park until he has been licensed by the Tourism Authority. It is further recommended that the Parks Department be represented on the guide-licensing board to assure adequate service to park visitors.

Concessions

Lodging And Camping

Development of accommodations at the park entrance to meet a broad range of visitor preferences, satisfying both national and international visitors, will be necessary. One day round-trips to the Petra Basin will probably continue as the most popular activity. However, development of camping and expansion of lodging facilities should be placed in high priority for use of visitors interested in a longer and more complete park visit through trips to El Dier, the Great High Place, Beida, and other outlying points of interest.

Interior Development

Within the fragile core area of the park, one primary site for visitor services, limited to rest, refreshment, and information should be developed. By concentrating intensive use to one carefully selected and well planned site, visitor damage to park values along with concession problems of supply and cleanup will be greatly reduced.

The present overnight facility Nazzals' Camp, located within the Park's most important concentration of Roman period ruins, is a gross intrusion and constitutes an intolerable violation of Petra's historical integrity. Negotiations pointed at the removal of Nazzals' Camp from the Petra Basin are of paramount importance to the future of the Park and should be a high priority item in the park development program.

A well designed and maintained system of foot and horse trails, connecting the park entrance development with outlying interest points, should remove the need for overnight accommodations within the Park by placing these points within day-use distances.

Single Concessioner Concept

Impressions visitors form and keep of travels are often closely related to the means used to make possible their outings. Unpleasant experiences stemming from transport or accommodation can serve to shorten a visitor's stay, or cancel a return. Further, unpleasant vacation experiences recalled at home of badly prepared food or substandard hotel accommodations can often mar otherwise glowing reports of distant and unusual places.

To assure a high standard of visitor supporting services and to effect better coordination of these facilities with government managed elements of the park and with the tourism industry, proposals in this plan are directed at the use of one government regulated operating company for the entire park. This company would be responsible for all revenue producing activities including lodging, food service, and transportation.

Single Concessioner Advantages

The advantages of a single company operating under a long term contract are impressive. In addition to the usual advantages associated with large business enterprise, i.e. quantity buying and volume sales, problems at Petra stemming from isolation such as warehousing, food preparation and transportation would be merged, eliminating the costly duplication of specialized facilities and equipment. Additionally, and of importance to park authorities, will be the administrative advantage of dealing with a unified professionally managed organization, capable of providing complete visitor support services on an individual or package basis to meet the growing popularity of prepaid group travel.

Horse Rentals

Traditionally, horse rentals have been an important element to the economy of Wadi Musa. At present approximately 300 horses with almost as many owners are available on an "as needed" basis. No organization of horse rentals now exists with the exception of very loose controls over the individual horse owners exercised by the Parks Division. These controls are primarily concerned with fees and horse rotation.

Safety standards relating to horses and their equipment are either nonexistent or are unenforced. The most important need is to discontinue the practice of leading horses along park trails. Visitors should be given the option of having full control of their mounts. Steps should be taken to improve the quality of the horses and horse trappings.

There is need to organize the Wadi Musa horse owners into an organization which effectively controls the horse rental operation. Such an organization would work both to the administrative advantage of the Park concessioner and to the individual horse owners themselves by giving them the strength of a unified voice in the affairs of their activities.

Village Economic Benefits And Zoning

Just as tourism benefits the visitor, it also benefits the visited, provided proper safeguards are implemented. At the present time a drive through the village of Wadi Musa constitutes an important bonus to Petra visitors. A view of this unusually attractive terraced and well watered oasis and its village life is a scene of Jordan which should be kept to satisfy the curiosity international visitors have for other peoples, surroundings, and customs. This does not mean that the village should not enjoy the economic and social benefits resulting from increased tourism at Petra. Certainly every advantage should be taken of the increased job situations and expanded business opportunities, generated by the Park, to raise the living standards of the village. However, without a clear, well conceived plan to control the future growth of Wadi Musa, the values that presently give the village its

touristic appeal will most certainly be destroyed. Without proper zoning control the village approach road to the Park entrance will inescapably fester into a linear proliferation of substandard shops, all vieing for the dinar of bewildered visitors who will view the village as more of an obstacle than as an attraction.

Zoning Proposal To protect these meaningful touristic values, a zoning plan for the village of Wadi Musa should be prepared and implemented by the Ministry of Interior for Municipal and Rural Affairs in cooperation with the Parks Division of the Tourism Authority. The implementation of this plan should preceed further major construction at the Park entrance discussed in a later section.

GENERAL DEVELOPMENT

The development areas proposed in this Master Plan are conceived to meet the expected large number of visitors entering Petra via the traditional Siq route. While this route provides the unique entrance to the Petra Basin and the dramatic visual impact of the Khazna, it creates areas of intense concentration of visitor activity with unbalanced distribution of the visitors through the park. In order to protect the fragility of the resource, development is recommended at two compact sites-both removed from visual intrusion on the major resources. The visitor will be placed in visual contact with every aspect of the park but through the location of trails and access points, physical contact with the park features will be kept to a minimum.

Description Of Development

The Petra entrance area is planned as the visitor staging and dispersal point. Development elements here can be arranged to relate one to the other thus accomplishing the purpose of orienting the visitor and starting him on his way into the heart of Petra. The primary trail system is directed away from the development and toward Petra. Architectural accents to attract the visitor into the logical sequence of reception and orientation should be developed to accelerate visitor movement through the development area. In this area should be the only park overnight accommodations - a hotel and campground - and the center of park administration and operations.

Only one development is proposed for Petra Basin; a secondary information and park staff station, public toilets, and a snack bar - lunch area. This development should provide visitor comforts in a relaxing atmosphere. Shade, shelter, and informality will complement the serenity of the setting. Architectural and landscape treatment should be designed to permit a free flow from one facility to another without a sense of herding or crowding.

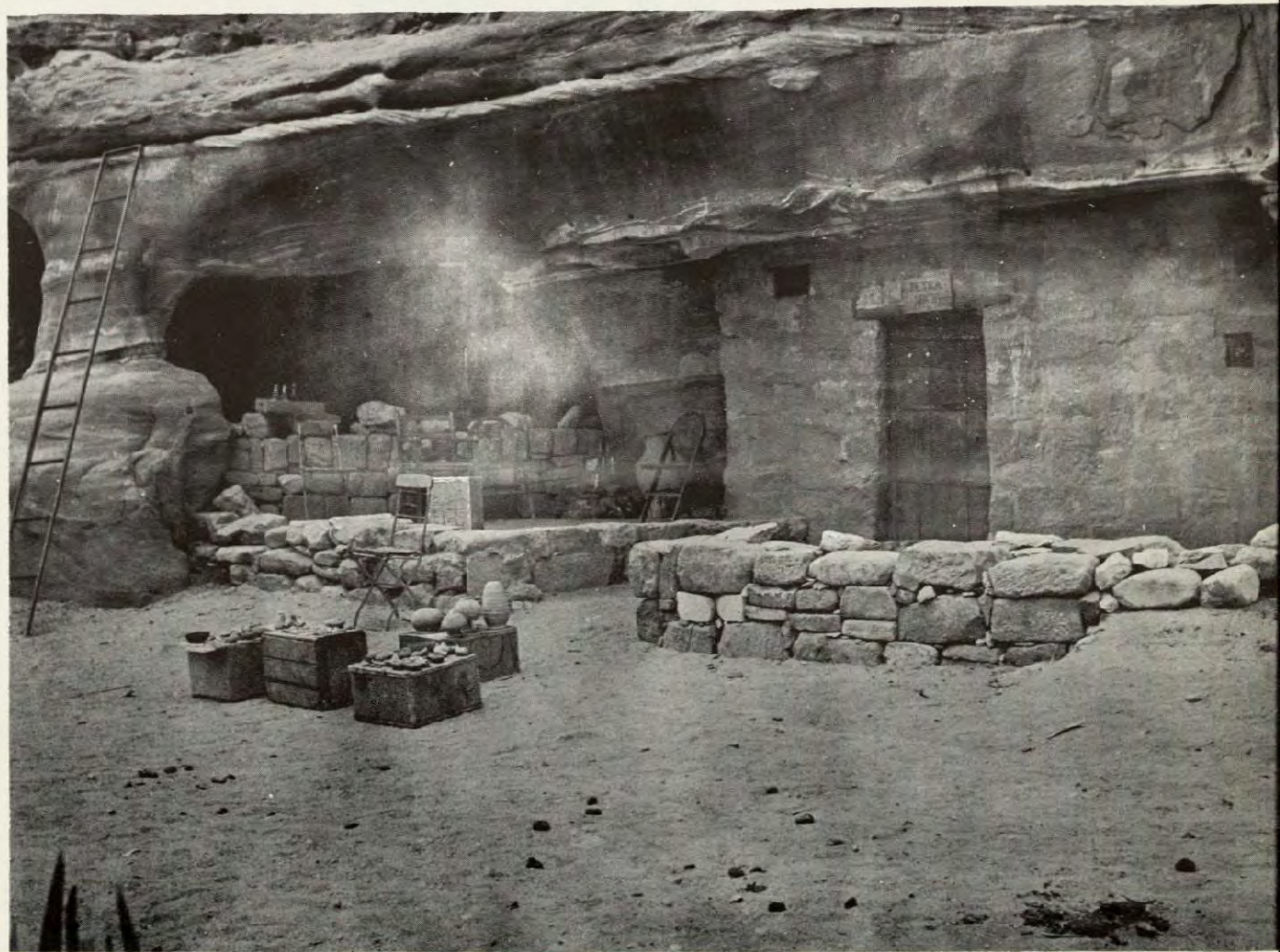
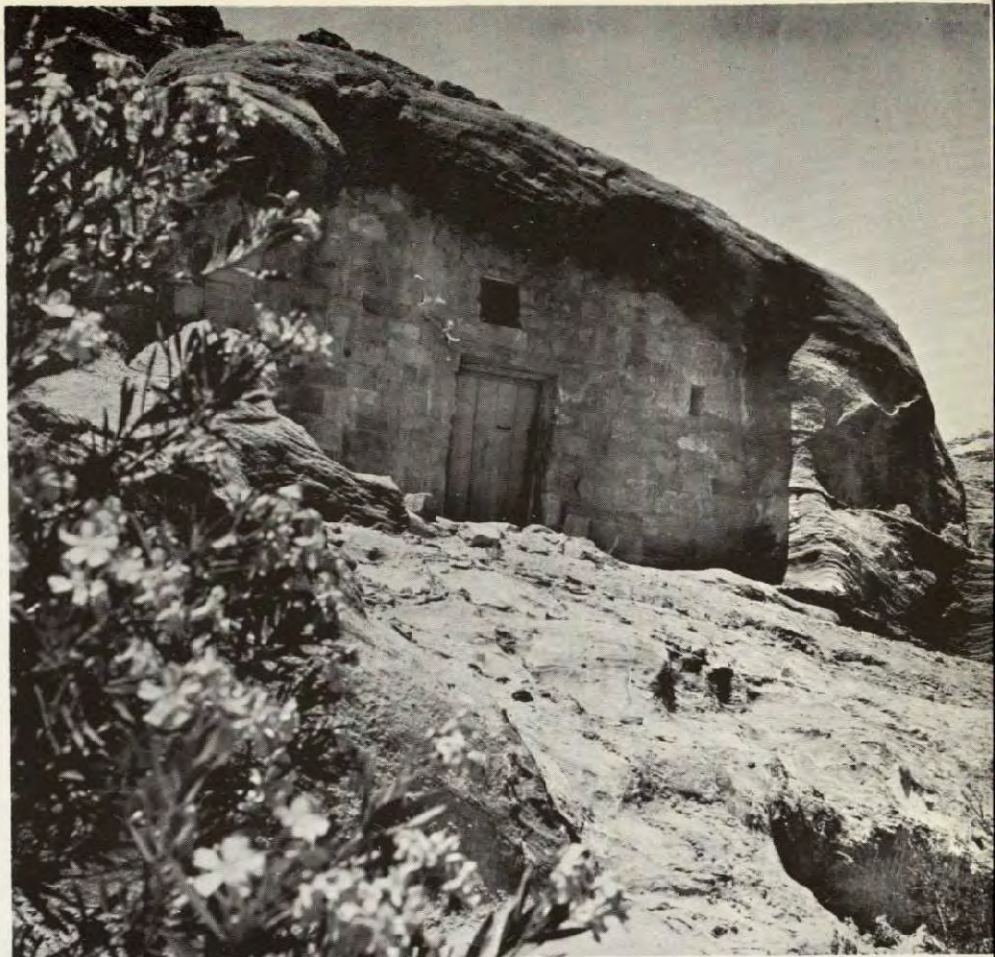
Development Restrictions

All construction and maintenance activities involving ground disturbance should first be concurred in by the Department of Antiquities. In the planning stage, all sites of permanent construction should be investigated by the Department of Antiquities to determine their archeological significance. Such investigations should determine the nature of the site, the need for salvage excavation, or if the site should be restricted rather than used for facility development. In case of disagreement between the Parks Division and the Department of Antiquities regarding these activities the matter should be submitted to the Minister for his decision.

The Park Division construction and maintenance supervisors should be alert to the recognition of artifacts and ruins uncovered in the course of their work. When antiquities are discovered, work in the area should be suspended until the importance of the site can be evaluated by Department of Antiquities representatives.

There should be no construction of facilities on or in conjunction with archeological ruins or historic structures in the Park. Existing uses of caves for habitation, soft drink sales, equipment and storage, and trash disposal (including Nazzals' Camp, the museum offices, and post office) should be discontinued. The recently constructed walls of these caves should be removed and the interiors cleaned and restored to a natural appearance or back filled and graded to a natural slope. Where existing structures, trails, and utilities are designated in this Master Plan "to be obliterated", these existing facilities should be removed and the site restored to the natural landforms. All construction debris resulting from this operation should be buried as a part of the land restoration project or removed to the sites assigned to refuse disposal and salvage storage areas.

Local Bedouins Mar the historic scene by walling up tombs and Nabataean caves for living quarters and through their indiscriminant digging in search of relics to sell.



The Architectural Theme

Stark contrasts are everywhere evident throughout the landscape of Petra. The contrasting shapes, textures, and colors of the landforms create a dominant pattern. The development should be designed to be in sympathy with the landscape and become an organic part of it.

The architectural theme should relate to hot, arid summers, to prolonged periods of bright cloudless skies, and to piercing winter winds. The structures should be functional in design and provide the required shelter in a contemporary manner that in no way mocks or intrudes upon the archeological ruins and their setting.

In the Petra Basin the character of the developments should reflect the contrasts of a change of scale from the gigantic land forms and architectural facades which are Petra to intimate clusters of new facilities; and from the high open areas of the Park to shaded sheltered structures of the development.

The design of the major visitor structures should be assertive - the character should be one of immediate identification as a place to go for orientation and dispersal through the development and to the Park - a friendly and cheerful place that will proclaim the Jordanian Park Division presence without monumentality or "official" character.

The architectural theme in a minor key but with the same standard of design excellence should prevail for the hotel, administrative, housing and maintenance structures.

Design Standards

Structures requiring large spaces should be designed of smaller asymmetrical unit-clusters that avoid monumentality. This should help to create a human scale that will invite the visitor rather than impress him. Small structures should be

designed to conform to the physical features of the landscape and should not call attention to themselves as separate features. All development from trail signs to major structures should utilize design concepts, construction materials, and colors that will maintain a spirit of dignified enjoyment.

By using traditional materials, domestic scale and forms, combined with modern technology, a new regional architectural style can be evolved that is appropriate to the site and designed to produce shelter from the extremes of heat, wind, and light. Design excellence should be the criterion for all development. There should be no attempt to standardize just for the sake of design expediency.

Screening of day-use facilities from the major archeological resources, and supporting facilities from the public use areas, should be accomplished primarily by siting and planting. Architectural elements such as courtyards and compounds should be integrated into the design to provide security and privacy.

Access

A new park entrance is proposed from the Desert Highway- Wadi Musa Road at Ail. Here the existing Taiyiba Road commences and continues to Wadi Musa through the village of Taiyiba. Although it is quite narrow and its alignment is somewhat tortuous, this route offers a spectacular overview of Petra and the dramatic formations to the south.

Before the Park can accommodate peak visitor loads access roads should be upgraded to a minimum of seven meters in width and realigned. The distance from the Desert Highway on the Wadi Musa road is 31 km., and via Taiyiba 38.5 km.

A landing area should be designated for helicopters at the entrance development. Landing of helicopters in other sections of the park should be prohibited.

Circulation

Circulation within the Park, with the exception of the entrance development, should be accomplished solely by means of an extensive system of pedestrian and horse trails. Pedestrians should have the use of all trails. However, horses should be limited to designated horse trails. Tethering points should be provided where necessary so that equestrians can dismount and traverse spur trails which are limited to pedestrians, i.e. Snake Monument trail, trail to Umm el Biyara. Most of the trails should be designed as loops to allow more visitor exposure to the monuments and natural scenery.

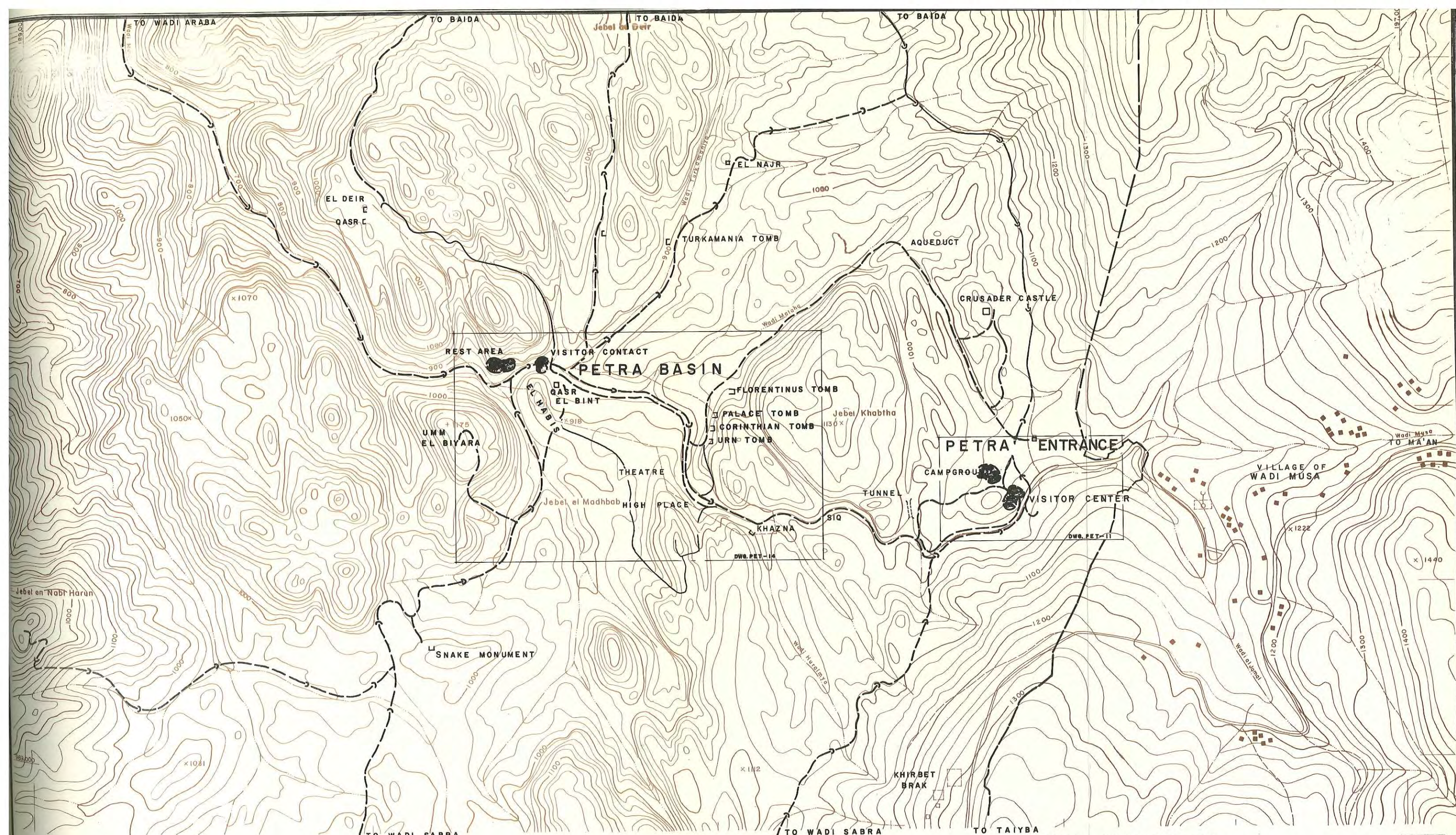
Trail Standards

Standards of construction for trails should vary according to type and volume of traffic. Generally trails within the vicinity of the entrance development and within Petra Basin should be built to a high standard to accommodate heavy traffic whereas outlying trails should be simple graded trails with obstructions removed and some construction required to ease grades on steeper sections. Horse trails following wadi bottoms will require removal of obstructions. Where steps are required it is important that the riser-tread relationship be constant in any one run of steps. The maximum dimension for risers should be 15 cm. Whenever possible the relationship should be 15 cm riser to 30 cm tread. If steeper runs are required handrails should be provided and the relationship should be a maximum of 20 cm riser to 25 cm tread.

A list of the individual trails and the types of construction is included in Appendix -J-.

Minor Roads

The Petra Entrance development will require a minor road system serving the campground, visitor parking at the visitor center and short spurs to the hotel, staff housing, and maintenance areas. Roads should not penetrate the Petra Basin. However, servicing of the day use development and emergency access can be handled with electric carts operating on the horse trail to

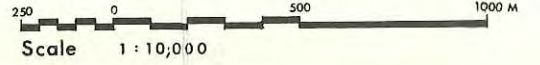


LEGEND

DEVELOPMENT	EXISTING	PROPOSED
ROADS		
TRAILS (HORSE)		
TRAILS (FOOT)		
BOUNDARY		

GENERAL DEVELOPMENT

PETRA NATIONAL PARK



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PET-7
sh. 2 of 2
page



Before this section of Wadi Musa can be used for horse and emergency vehicular travel, runoff must be controlled and the wadi bottom stabilized.

the Petra Basin trailhead. The bottom of Wadi Musa from the Nymphaeum to the Petra Basin trailhead will require stabilization to accommodate these carts and to protect structures along the Roman street from water erosion.

A list of individual roads at the entrance development is included in Appendix -J-.

Roadside Overlook

Parking overlooks should be developed along the Wadi Musa Road - Taiyiba entrance road at points of historical interest or high scenic value.

Utilities

It is proposed that water systems for the Park be designed and managed on the basis of the following criteria.

Water : Design Criteria

1. All overnight facilities and all food serving and toilet facilities should be constructed with piped water systems.
2. There should be no water works in the area of important historical and archeological remains. Further, no water works should be visible or otherwise intrude on areas of outstanding scenic value.
3. Water should be supplied of a quality which meets the bacteriological, chemical, physical and radiological requirements of the World Health Organization.
4. The quantity of water to be provided should be as follows:

	<u>Liters per day</u>	
	<u>1975</u>	<u>1985</u>
Hotel (per person)	120	180
Campground (per tent camper)	70	100
Campground - trailers & self-contained camping vehicles (per person)	100	150
Day-use, at Entrance points (per person)	30	40

	<u>Liters per day</u>	
	<u>1975</u>	<u>1985</u>
Day-use, within Petra Basin (per person)	10	15
Permanent residents, staff (per person)	200	300

The daily rates shown above for 1975 are 50% of the present rates in recreation areas in the United States as published in Environmental Health Practice in Recreational Areas, US Public Health Service. For 1985 it is assumed that the rates will rise to 75% of U.S. experience.

5. Water pressure, at the fixtures, should be not less than 1.0 Kilogram per square centimeter (15 psi) nor more than 4.2 Kilograms per square centimeter (60 psi).
6. Storage reservoirs, with gravity flow to the points of use, should be provided with capacity equal to 12 days demand where there is gravity flow from the source and equal to 20 days demand where the water is pumped from the source.
7. Water quantity and pressure for firefighting should be limited to the requirements for domestic uses.

The general features of proposed water systems meeting these criteria are shown in the Developed Area portion of this plan, pages 65 to 68

Sewerage:

Disposal Methods

The terrain of the proposed Park presents several difficulties with respect to the disposal of sewage. There are no bodies of water to which treated sewage could be discharged. Except for the Wadi Araba side there are few places level enough to permit the use of stabilization ponds. Disposal of effluent underground is made difficult by the scarcity of suitable soils and by the possibility of contaminating spring or well

supplies. Nevertheless, this latter method, that of underground disposal, offers the best possibilities.

It is proposed that sewer systems for the Park be designed and managed on the basis of the following criteria:

1. Except for certain remote sites, provisions should be made for water-carriage systems of sewage disposal. At remote sites pit toilets should be used, or, if there is a small supply of water and suitable soil available for underground effluent disposal, "Pullman" type toilets could be provided. Chemical or burn out toilets should not be used as the operation and maintenance of these types of units present such problems as would make them unsatisfactory.
2. Treatment should be by septic tank and underground disposal of effluent. No sewage or effluent should be discharged on the surface of the ground.
3. The systems should be designed for a quantity of sewage equal in volume to the water supply.

Electric Power

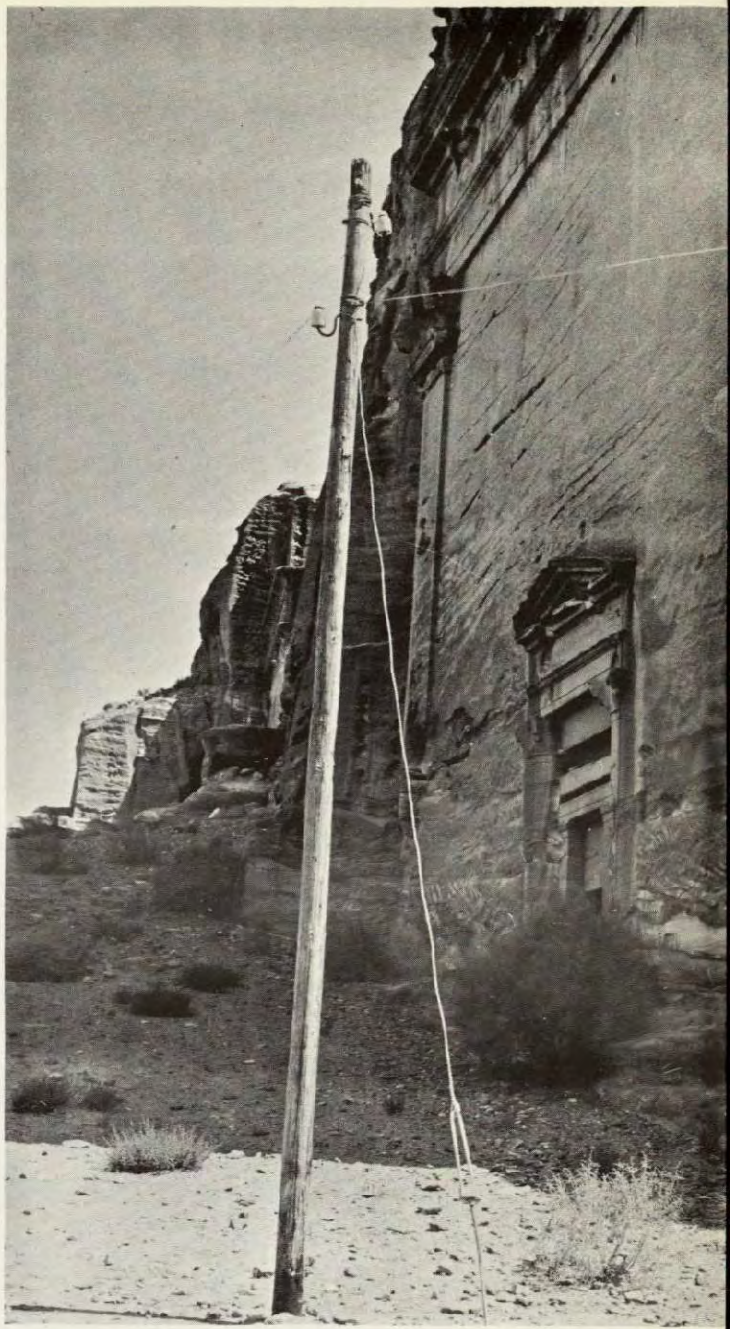
Enjoyment of the Park places two requirements on electric power. One, that adequate electric power be available at buildings providing for the needs of the visitors and the staff and, no less important, that the generating plants and transmission lines not intrude on the sights and sounds of the Park.

The following criteria are proposed for electric power supplied to the Park:

1. The voltage and cycles should conform to the current in general use throughout Jordan, that is, 220 volts, 50 cycles.

A total disregard of the integrity of Petra in the interest of modern development has marred the view of the Khazna and other structures.

This telephone line must be relocated or buried to preserve the scenic values.



2. Where possible and economically feasible, connection should be made to power sources outside the park boundary.
3. Transmission lines within the park boundary should be placed underground to protect scenic values.
4. Generating plants should be located and constructed so as to keep sounds at a minimum.

Details of proposed power systems are shown in the Developed Area Section of this Master Plan.

Communications Systems

Communication systems within the Park are required, to meet the needs of the Park administrative staff, the concession operators, and the visitors for rapid and reliable communication to points within and outside the Park. As with electric power installations, communication facilities should not visually intrude on the Park features.

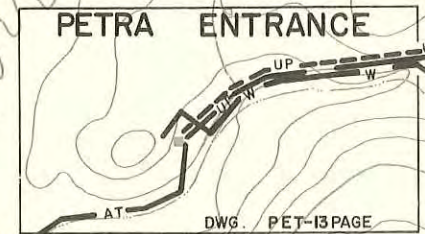
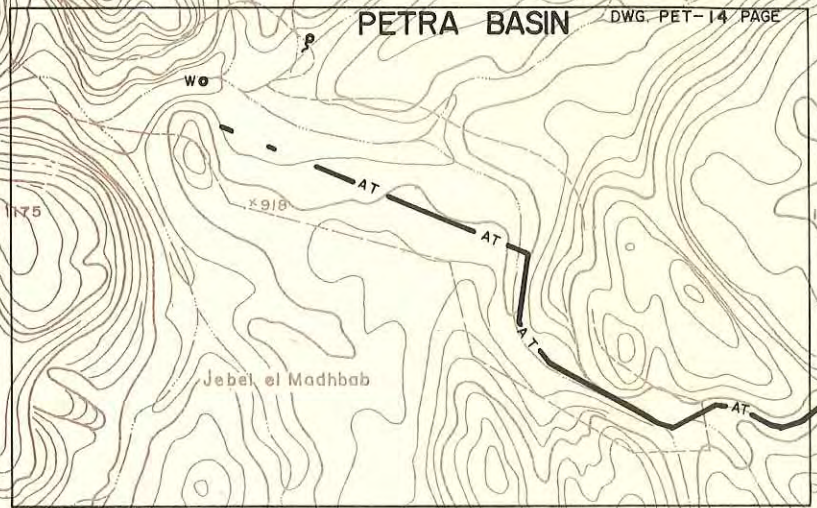
The following general criteria are proposed for communication systems within the Park:

1. Park headquarters, the major center of public use concentration at the Park entrance, should be connected with both the local Wadi Musa telephone system and with a long distance system either via telephone cable with multiple circuits or microwave.
2. A private branch exchange is necessary between park headquarters and points of visitor concentration within the Park.
3. A local, line-of-sight, low powered radio system (walki-talki) should be established for use by the Park staff.
4. The existing overhead telephone line should be removed from the Siq and any new telephone lines should be placed underground.

SPRING FLOW DATA LITERS PER SECOND

REF NO.	NAME	RECORDED FLOWS			CLASS	TOTAL DISSOLVED SOLIDS PPM
		MAX	MTN	MEAN		
DG 20	MUSA	7.90	3.86	6.30	A	390
DG 21	BO'BO'	3.15	0.85	1.20	B	480
DG 21A	BO'BO' TAHTA	1.12	0.72	0.98	C	
DG 22	JILWAKH TAHTA	1.96	0.85	1.05	B	390
DG 23	JILWAKH FOUGA	3.05	0.35	0.72	B	370
DG 23A	RAS JILWAKH				B	
DG 24	SAKEENEH	1.48	0.50	0.95	B	330
DG 25	MUSA IBN AMRA	0.15	TRACE	TRACE	C	670
DG 26	SHALLALEL	0.87	0.20	0.30	C	480
DG 27	ES SARAB	0.70	0.09	0.34	C	540
DG 28	DAWAWI	0.59	0.10	0.21	C	540
DG 29	IBRAIKH	0.23	0.02	0.13	G	640
DG 30	ZARRABI	2.40	0.25	0.72	B	
DG 31	MISHKAREH	0.85	0.02	0.10	C	840
DG 32	HAJLAH TAHTA	0.30	0.21	0.27	C	510
DG 32A	HAJLAH FOUGA	0.15	0.03	0.07	C	690
DG 33	EL MAGHASIL	0.38	0.14	0.21	C	670
DG 34	MALBOON	0.85	0.44	0.65	C	670
DG 35	AL BASSAH	0.47	0.30	0.37	C	
DG 36	READAN FOUGA	0.30	0.06	0.16	C	
DG 37	READAN TAHTA	0.14	0.04	0.10	C	
DG 40	SIDER	4.96	1.73	3.20	A	420
DG 46	ES SHAHABIYEH	1.18	0.40	0.73	C	580
DG 47	UM QAWADEES	0.24	POOL	0.06	C	
DG 48	INEIHA	0.30	0.09	0.24	C	300
DG 49	EL HABLEH	0.14	0.09	0.10	C	490
DG 50	IRBA'AT	0.15	0.03	0.11	C	
DG 51	MALEH FOUGA			0.15	C	390
DG 52	HAMRA	0.15	0.07	0.10	C	650
DG 53	JABER			0.15	C	730
DG 54	SEIL SUYYAGH	20.0	6.4	4.0	C	410
DG 55	IBRAIKH	0.81	0.10	0.23	C	600
DG 56	AMOUN FOUGA	0.98	0.31	0.38	C	460
DG 57	AMOUN TAHTA	0.56	0.14	0.25	C	480
DG 58	UM MAQAR	0.62	0.04	0.08	C	290
TOTALS		56.84	13.67	23.91		

DATA FROM REVIEW OF SPRING FLOW DATA TECHNICAL PAPER NO. 60 NRA DEC 1966

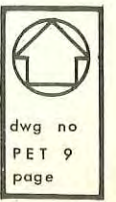
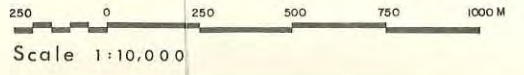


LEGEND

- | | | | |
|-----------------------------------|--------|----------|----------------|
| WATER PIPELINE | — W — | PROPOSED | - - - W - - - |
| TELEPHONE LINE — AERIAL | — AT — | | |
| TELEPHONE LINE — UNDERGROUND | — UT — | | - - - UP - - - |
| ELECTRIC POWER LINE — UNDERGROUND | — UP — | | - - - UP - - - |
| SPRING | ⊙ | | |
| WELL | ○ W | | |

GENERAL DEVELOPMENT UTILITIES

PETRA NATIONAL PARK



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PET 9
page

5. Microwave stations, radio repeater stations or other communication equipment should not be located where they will intrude on the scenery within the Park.
6. There should be no Post Office within the Park.

Refuse Disposal

The Park Organization should include personnel and equipment for the collection and disposal of garbage and other solid wastes.

Past methods of disposal have included dumping into tombs, wadis, and on nearby land. These methods should be stopped. It is proposed that a sanitary landfill be established in the vicinity of the Park entrance.

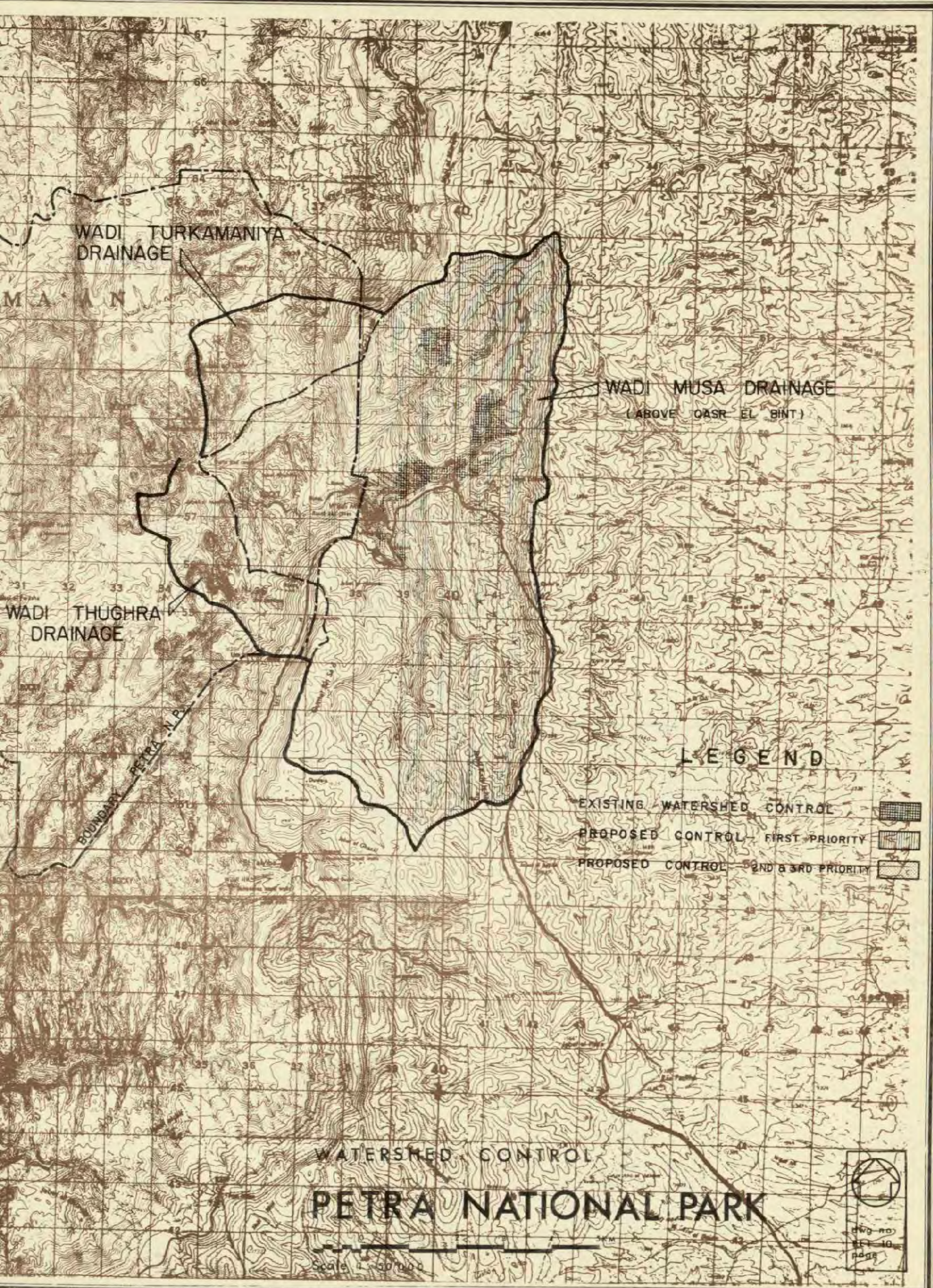
Watershed Protection

The Nabataeans, in order to maintain a rather large population in what must have been a considerable degree of luxury, made themselves masters of water conservation methods. A network of agricultural terraces and water diversion and collection devices covered the hills and valleys of the Petra area. It seems safe to say that Nabataean water conservation was so efficient that only rarely would flood waters escape the retarding structures and flow down the wadis.

To follow the practices established by the Nabataeans it is recommended that the protection of the watershed of Wadi Musa above the Roman street be included in the first phase development. The scope of the work, shown on sheet PET-10, would include wadi check dams, hillside terraces, and the re-establishment of vegetative cover. In addition to new ground cover, soil and water conservation will improve existing farm land providing new agricultural opportunities for crops, groves, and orchards outside the park. The watershed includes approximately 55,000 dunums of land of which 15 percent is within the Park. Since most of the watershed is outside the boundary of the park, it will be necessary for this work to



Some erosion control work has been done, but much more will be required to protect Petra for future generations.



WADI TURKAMANIYA
DRAINAGE

WADI MUSA DRAINAGE
(ABOVE OASR EL BINT)

WADI THUGHRA
DRAINAGE

BOUNDARY PETRA N.P.

LEGEND

- EXISTING WATERSHED CONTROL 
- PROPOSED CONTROL - FIRST PRIORITY 
- PROPOSED CONTROL - 2ND & 3RD PRIORITY 

WATERSHED CONTROL

PETRA NATIONAL PARK

Scale 1:50,000



be planned, constructed, and maintained by other agencies in cooperation and coordination with the Park program. Wadis and hillsides within the Park would be controlled by works constructed under the Park Division development program.

Maintenance and improvement of this system within the park should be a continuing project in the management of the Park.

In order to be effective, the sequence of check dam construction must start in the extreme upper reaches of each water course. Therefore, no check dams should be constructed in the Petra Basin until the protective works are completed in all the tributaries of Wadi Musa above the area of the Roman-Nabataean occupation. The construction sequence for the hillside terraces is similar in that construction should start from the ridge and proceed downhill. However, hillside terraces and planting can be completed prior to completion of the entire system of check dams.

The procedure for planning and construction of this soil and water protection system will necessitate operating agreements with interested ministries or agencies, completion of a detailed survey of the watershed area, determination of the extent and design of the structures, designation of new land uses and the scope of replanting, and establishment of procedures for improvement and maintenance of the entire system. All decisions should be coordinated with Park objectives.

Nabataean dams and hillside terraces within the Park should be rebuilt improved and expanded. Both rebuilt and new dams should utilize native stone in sizes and methods similar to the Nabataean work. Where possible channels should be constructed to divert water from the wadi check dams onto the terraces. Outside the park, standard engineering construction methods and materials may be used for the protective works.

Standards of design and construction, and estimated construction cost are in appendix -K- .

Petra Entrance

The Petra Entrance development area adjacent to the village of Wadi Musa should be the focal point for park visitors. Overnight facilities and the operating center for park management with the necessary headquarters, maintenance areas, and staff quarters should be located here. The selection of this site is dictated by its proximity to the entrance of the Siq and the existence of present facilities. Since the landscape has been disturbed it is the best use of the resource to construct the new facilities on this site and take advantage of existing structures and utilities as they meet approved design criteria. The total cost of the improvements recommended for the entrance area is estimated at JD 469,000 including contingencies, plans, supervision etc. (See Appendix -L-).

Character Of Site

The site is located in the contact zone between the limestone ridges of the Transjordan plateau and the sandstone massifs that characterize Petra. A buff colored sandstone hill dominates the development scene. Smaller hemispherical domes with Nabataean caves are evident to the west and north. To the east and south the verdant multi-terraced village, fields and orchards of Wadi Musa complete a varied and interesting vista.

Visitor Center

The location of the facilities about the existing resthouse and parking terrace is designed for optimum relationships and circulation: pedestrian, vehicle, and horse. When the visitor leaves his vehicle on the parking terrace, he is greeted visually and actually by the visitor center which is oriented to be the first and only building he can enter from the parking area. Here the visitor is provided with basic information, toilet facilities, and the opportunity to make arrangements for his stay in Petra. Below the entrance level of the visitor center complex will be the park headquarters and maintenance area.

CAMPGROUND
 PHASE I 50 SITES
 PHASE II 150 SITES

GROUP CAMPSITE

HELICOPTER LANDING AREA

SEASONAL QUARTERS

HOUSING AREA

PERMANENT QUARTERS

TO WADI MUSA →

WADI MUSA

HOTEL

MAINTENANCE

VISITOR CENTER

STABLES

GUEST ROOMS

LUNCH

DINING

GUEST ROOMS

FOOT TRAIL FROM PETRA BASIN

HORSE TRAIL TO PETRA BASIN

THEATRE

FOOT TRAIL TO PETRA BASIN

LEGEND

	EXISTING	PROPOSED PHASE I	PROPOSED PHASE II	OBLITERATE
BUILDINGS				
ROADS				
TRAILS (FOOT)				
TRAILS (HORSE)				
WALLS				
WADIS				
BOUNDARY				

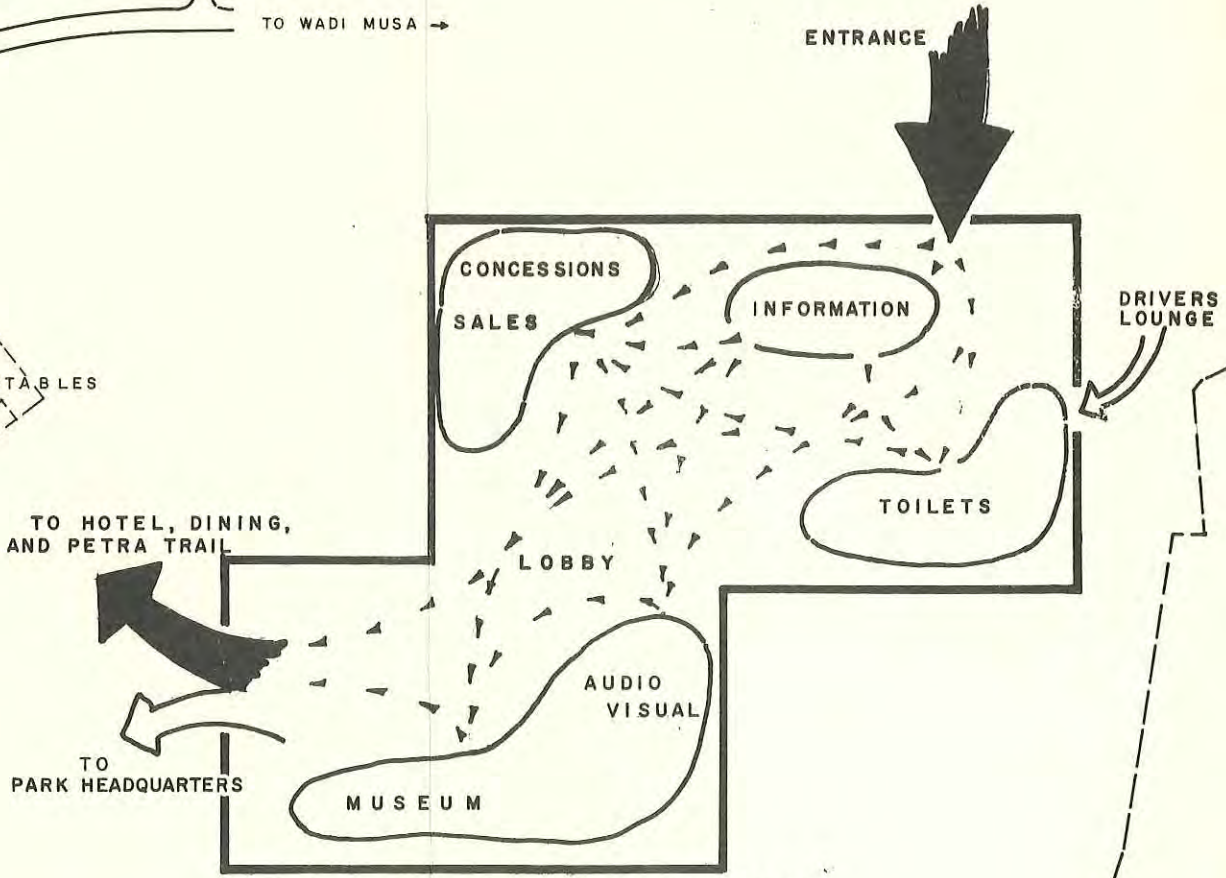
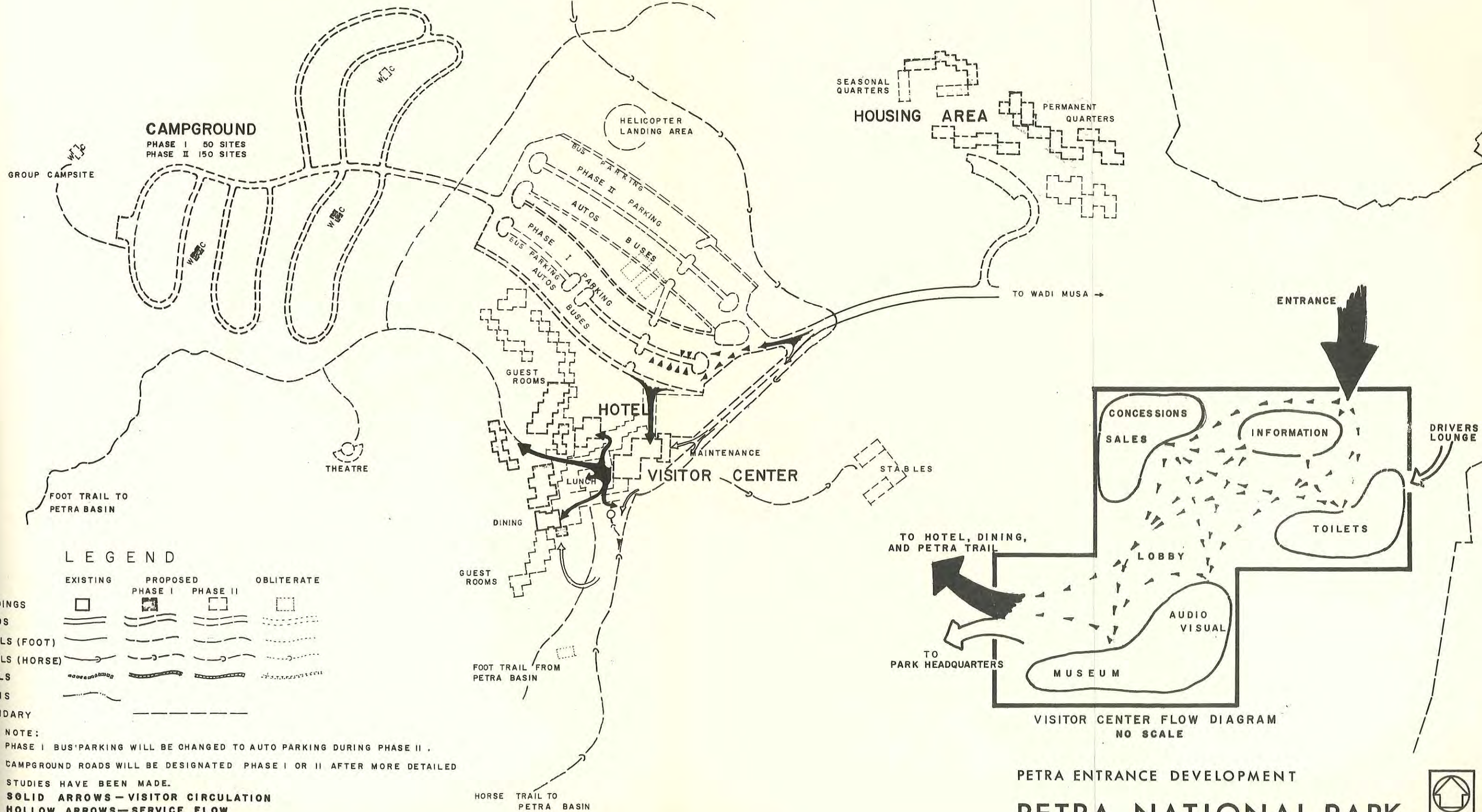
NOTE:
 PHASE I BUS PARKING WILL BE CHANGED TO AUTO PARKING DURING PHASE II.
 CAMPGROUND ROADS WILL BE DESIGNATED PHASE I OR II AFTER MORE DETAILED STUDIES HAVE BEEN MADE.

PETRA ENTRANCE DEVELOPMENT

PETRA NATIONAL PARK



DWG NO
 PET 11
 PAGE



VISITOR CENTER FLOW DIAGRAM
NO SCALE

LEGEND

	EXISTING	PROPOSED PHASE I	PROPOSED PHASE II	OBLITERATE
BUILDINGS	[Solid line box]	[Dashed line box]	[Dotted line box]	[Dash-dot line box]
ROADS	[Solid line]	[Dashed line]	[Dotted line]	[Dash-dot line]
TRAILS (FOOT)	[Solid line with arrow]	[Dashed line with arrow]	[Dotted line with arrow]	[Dash-dot line with arrow]
TRAILS (HORSE)	[Solid line with arrow]	[Dashed line with arrow]	[Dotted line with arrow]	[Dash-dot line with arrow]
WALLS	[Solid line]	[Dashed line]	[Dotted line]	[Dash-dot line]
WADIS	[Wavy line]	[Wavy line]	[Wavy line]	[Wavy line]
BOUNDARY	[Dashed line]	[Dashed line]	[Dashed line]	[Dashed line]

NOTE:
 PHASE I BUS PARKING WILL BE CHANGED TO AUTO PARKING DURING PHASE II.
 CAMPGROUND ROADS WILL BE DESIGNATED PHASE I OR II AFTER MORE DETAILED STUDIES HAVE BEEN MADE.
SOLID ARROWS - VISITOR CIRCULATION
HOLLOW ARROWS - SERVICE FLOW

PETRA ENTRANCE DEVELOPMENT
PETRA NATIONAL PARK



The open plaza between the visitor center and resthouse is the pivotal point in the circulation pattern. Shaded terraces will provide an opportunity for rest and reflective thoughts; from here the visitor has the option of beginning his trip into Petra by foot or horse, getting settled in his room in the resthouse, having refreshments in the lunch area, or having a meal in the snack bar or dining room. In this plaza, evening interpretive programs and entertainment may be provided. An outdoor theater is proposed for phase two to accommodate the evening programs.

The visitor center and park headquarters is the initial contact point. It is also the center for park administration and operations. Here, the visitor receives his first impression of the Jordanian National Park operation. The visitor center lobby is in a sense the entrance to the park - providing visitor information, orientation, public toilets, and other visitor needs. This should be designed as a space to encourage a leisurely flow from one function to another. A continuation of this visitor flow should be to the museum exhibits and audio-visual devices. Light and sound will be controlled by a series of baffles rather than doors.

Since the audio-visual orientation will be shown to large groups of people and for a short duration, the design of the audio-visual space should not be limited to a static presentation in a traditional auditorium. Rather than the standard seating configuration the visitor may sit on continuous benches or lean against a rail. The audio-visual program and the interpretive exhibits should be integrated into one space. Visitor comfort is of prime consideration in the visitor center. Materials for interior finish should be simple, easy to maintain, and tastefully combined with light and color to complement the architectural character of the building, but not to be merely decorative. The building should be centrally heated. The inclusion of a cooling system in the phase two construction program should be a requirement for all public spaces of the visitor center. A lounge for bus and taxi drivers should be off the public spaces of the visitor center. This should be

a shaded sheltered rest area with toilets and a small kitchen for preparing and serving tea and coffee.

Administrative And Maintenance Spaces

The park headquarters portion of this complex should house offices for the park superintendent and his staff, a library-conference room, a communication center, a first aid room, and storage and work rooms. These facilities would be shared with Department of Antiquities representatives on the site in the course of their research and consolidation duties.

The maintenance area of this complex should be the operating base for all park and concession maintenance and antiquity projects - buildings, utilities, roads and trails, vehicles and equipment, and consolidation of ruins. This area would house shop offices, work shops, vehicle work bays, tool and parts storage, bulk storage, and oil and fuel storage. This facility should be located where it will not be visible from the visitor use area. The structures should close upon themselves to form working compounds and storage courtyards. Here should be the only maintenance, warehousing, and outdoor storage facility in the park. The existing storage room, warehouses, equipment rooms, reservoir, etc. should be obliterated as part of this development program.

Staff Quarters

Rental of adequate housing for staff personnel in the village of Wadi Musa is not feasible. Quarters for the park staff, permanent and seasonal, Department of Antiquities and key concession personnel should be constructed adjacent to the Petra Entrance Development. There should be no quarters constructed within other areas of the park.

The residential area is proposed as a unit of structures clustered against the hillside to be visually in context with the village of Wadi Musa although within the park boundary. They are oriented for surveillance of the entrance facilities. The architectural scale, forms, and materials should be in

Architectural elements of the Resthouse as shown in this interior photograph overwhelm and even partially conceal the forecourt columns and side rooms of this Nabatean tomb.



Enlargement of the Resthouse will introduce strong horizontal architectural elements to break the excessive vertical appearance of this structure.



character with the local domestic buildings. Housing should provide all modern facilities and optimum floor areas with varying arrangements of one to three bedroom units. Seasonal quarters providing semi-private dormitory rooms and efficiency type (one room) apartments should also be part of this development. Fourteen house units and eight seasonal units are proposed for phase one. This should be expanded to twenty houses and fourteen seasonal units by 1985.

Hotel

The proposed overnight accommodations should be constructed adjacent to the existing resthouse which would then become an integral of the new hotel facility. This hotel should be designed to operate as a model high standard touristic hotel, offering one class accommodations - with or without bath at moderate prices. This hotel should set the standard for privately operated overnight accommodations outside the park. To meet the immediate needs, resulting from the closing of Nazzals' Camp, additions to the existing resthouse should include; 50 double rooms with baths, an enlarged dining room and lobby, and the necessary ancillary services. This addition would meet the projected requirement for hotel accommodations in 1975. The extent of further expansion of this facility should be determined by an evaluation of actual travel patterns in the next five years.

Existing Accommodations

The existing resthouse, occupying the site of the major Nabataean tomb, Al Khan, was designed to be superimposed on the architectural elements of this edifice. Unfortunately the capitals of the columns and rooms of the forecourt were hidden by changes in design of the resthouse lobby that took place during construction. As a result, the facade of the tomb is overwhelmed by the structures of the resthouse. The design resulted in an unnecessary massing of the building into a multi-story plan with resulting aesthetic and functional problems.

The plan is not efficient and facilities are not sufficient for a good hotel operation. There are two floors with a total of only eight guest rooms, sharing common toilets and showers. One of these rooms is used by the resident staff. The remaining rooms are crowded with a third bed and often accommodate a family of five in the peak season. Use of space in the lobby is poorly managed. There is inadequate space for food and beverage storage, no space for a hotel office, and no provision for janitor supplies and equipment storage on the main or the guest floors. Although the rest house operates all year around there is no heating of the building and no domestic hot water in the showers and wash rooms.

Proposed Alterations And Additions

The proposal of this plan would effect minimum alterations to the existing resthouse. The guest rooms should be refurbished to easily accommodate a third bed. Domestic hot water should be supplied to all toilet rooms and showers. A new kitchen with all necessary supporting functions should be constructed. The present lobby would then become a snack bar and the existing kitchen would become a mechanical room for the central heating plant. Air conditioning should be provided only in the dining room and snack bar by a package unit installed in the existing space.

The new portions of the hotel should include a lobby and lounge, administrative offices, storage and laundry, and guest rooms with baths. These new structures should be designed as one story buildings clustered on the hillside above and beside the existing resthouse in order to mitigate the excessive vertical proportions of this three story mass. These units should be designed to be shaded during the day by structures or planting, and can be easily ventilated to take advantage of the cooling effect of the evening breezes. Dining terraces would extend from the building and near by would be an open lunch area serving refreshments from a kiosk.

Camping

Camping in Petra National Park should be limited to the Petra entrance area campground and should be operated by the concessioner. The site of the campground is physically and visually removed from the concentration of visitor activities at the visitor center and hotel. However, this site is located in the circulation pattern so the camper will receive the same information and orientation as the non-camping visitor. The campground can be serviced by the utility distribution system constructed for the entire development area. Camp sites will be developed adjacent to parking pull-outs constructed along the campground loop roads. These parking pull-outs can be expanded into trailer spurs when trailer camping becomes popular. "Rotel" units - buses with sleeping trailers - can be accommodated at a widened section of the campground entrance road. The alignment of the loop road follows the natural land forms with the camp sites being leveled and terraced in sympathy with the existing landscape. Each camp site should be provided with a table.

Buildings housing toilets, showers, and storage rooms should be located to accommodate the maximum number of camp sites within a walking distance of 50 meters. There should be no fixed structures for cooking, eating, or sleeping in the campground. Water points and trash receptacles should be provided at key points. It is anticipated that campers will purchase their necessary provisions in Wadi Musa village or elsewhere.

Trees and shrubs should be planted to provide shade and a sense of privacy at the camp sites and between areas of the loop. There should be no attempt to plant ground cover at the camp sites.

The first phase development should provide facilities for 50 camp sites. The area designated for camping can be expanded to 150 sites, which is maximum capacity for camping at this development area. When visitors fill this campground to capacity there will be a need for limiting the duration of each campers stay as well as considering construction of new

campgrounds in the secondary development areas.

Ancillary Structures

The existing stables and taxi-bus drivers lounge should be obliterated. The stables should be relocated on the flat across Wadi Musa below the maintenance area. This work should be accomplished when the parking lot is enlarged in the second phase of development. These new facilities should include stables for fifty horses and horsemen's toilets and shelter. This complex should provide minimum facilities with electricity, water, and sewage.

UTILITIES

Water: Sources And Existing System

The only sources of water within the proposed boundary in the vicinity of the Park Entrance are Ein Ibraikh and Ein Amoun located near the Taiyiba road. This water is being used for irrigation of fields and for domestic purposes by a few nearby inhabitants. The combined flows of these springs at times of minimum flow is about 4.7 cubic meters per day.

The village of Wadi Musa is located below the relatively large spring of Ein Musa and around several smaller springs. The location and discharge of these springs is shown on drawing PET-13. The combined flow of these 30 springs, all outside the proposed park, is about 300 cubic meters per day maximum, 100 m³/day minimum and 160 m³/day mean. This water is used for domestic purposes by the 4000 inhabitants of Wadi Musa and for irrigation. The crops irrigated are grains, fruits, and olives, the three often combined on the small terraced plots of the village.

The municipal water system consists of a concrete enclosure over Ein Musa supplying water by gravity through a two inch galvanized steel pipeline 2.5 km. long to a 50 cubic meter concrete reservoir located at the main road inter-section in the village. Several canals lead from Ein Musa and provisions have been made for the filling of containers at the spring. Smaller springs at various

points in or near the village have facilities for filling containers which the villagers carry to their homes. Water is piped to 32 individual houses and is metered. The connection charge is 7 dinar. Monthly charges for metered connections are 50 fils per cubic meter for the first 10 m³, 80 fils per m³ thereafter. The average daily consumption is 6 cubic meters for all 32 connections or 187 liters per day per house.

The water of Ein Musa contains about 390 parts per million total dissolved solids which indicates an acceptable mineral quality. Other than this, the chemical and bacteriological qualities of the Ein Musa water were not ascertained, but a brief examination of the village system showed the piped water to be reasonably well protected from contamination. The future domestic water needs of the village are estimated as follows:

	<u>1975</u>	<u>1985</u>
Population	4700	7000
Per capita consumption, liters per day	35	50
Daily consumption, cubic meters	165	343

It is apparent that if the population of the village increases, or if a majority of the houses are connected to the water system even without an increase in population, there will be a shortage of domestic water before 1975.

A one-inch diameter steel pipeline connected to the village system leads 2200 meters to the present entrance development. Water is stored in a 54 cubic meter concrete reservoir. From this point it is distributed to public toilets, the resthouse, stables and drivers toilets. The system is gravity flow. The static water pressure at the ground floor of the rest house is 1.3 kg/cm² (20 psi). This portion of the system is owned and operated by the Tourism Authority.

General features of the village system and of the park entrance system are shown on drawing PET-13.

**Future
Demand &
Proposed
System**

The future water needs of park visitors and administrative operations are estimated as follows: (calculations are based on average daily visits during the peak month of April).

<u>1975</u>	<u>Daily Demand Liters</u>
121 Hotel guests @ 120 liters	14,520
81 Tent campers @ 70 liters	5,670
81 Trailer & self contained campers @ 100 liters	8,100
527 Day visitors @ 30 liters	15,810
86 Permanent residents, staff families @ 200 liters	<u>17,200</u>
Total 1975 demand	61,300 (61.3m ³)
1975 reservoir capacity needed = 12 days @ 61m ³	= 732 m ³
 <u>1985 -Phase two development</u>	
225 Hotel guests @ 180 liters	40,500
340 Tent campers @ 100 liters	34,000
510 Trailer and self-contained units @ 150 liters	76,500
2040 Day visitors @ 40 liters	81,600
110 Permanent residents, staff families 300 liters	<u>33,000</u>
Total 1985 demand	265,600 (265.6 m ³)
1985 reservoir capacity needed = 12 days @ 265.6 m ³	= 3187 m ³

It appears unlikely that even the 1975 demand could be met by drawing from the village system, let alone the 1985 demand. As a first priority, a new water source must be found if the Park is to be developed and visitation approaches the predictions of this master plan.

It is proposed that a hydro-geologic study be undertaken under the Jordan National Resources Authority to determine the availability of ground-water or of an alternate water source.

Even with the limitation of the Wadi Musa village supply it is proposed to continue to draw from that source to the extent water is available.

To meet the 1975 demand it is proposed that the water system be improved as follows:

Replace 1-inch portions of the present line from the village with 2-inch steel pipe.

Install a water meter on the supply line to provide data for estimating future needs.

Install a hypochlorinator on the supply line. Perhaps this could be a gas chlorinator if chlorine cylinders and trained operators become available.

Construct a new concrete reservoir, sited so as not to be visible, with a capacity of 750 cubic meters at an elevation of 1057 meters so as to provide a static pressure varying from 1.3 k/cm^2 (20 PSI) to 2.8 k/cm^2 (43 PSI) at the points of use.

Construct new distribution lines to the places of use making use of existing lines wherever possible.

Existing Sewerage The existing resthouse is served by a sewage disposal system consisting of 4-inch diameter sewers leading to a makeshift septic tank (a rock-cut tomb). Effluent from the "septic tank" is carried by a 4-inch sewer to a concrete box located in the gravel bed of Wadi Musa. The box is intended to act as a dry well discharging the effluent underground. The separate public toilets have a sewer leading to a septic tank with an effluent line connected to the resthouse system. A separate system with a septic tank serves the toilets in the drivers building. The system was constructed by the Tourism Authority in various stages between 1962 and 1967.

The resthouse portion of the system was operating satisfactorily during the winter of 1967-1968. The public toilet system shows signs of inadequate grade of the sewer lines, there being accumulations of sludge in the manholes. The rest rooms were locked during most of 1967 and continued to be locked during the course of the study for this Master Plan so there was no opportunity to determine if this portion of the sewage system was working.

It is judged that the present system will be inadequate for the facilities proposed in this plan and a complete new system will have to be constructed.

Since some of the campground facilities are to be located northwest of the dividing ridge above the resthouse, a separate system will be required for that area. Furthermore, the proposed staff housing area is at such a distance from the main development that a second separate disposal system will be required.

Proposed Sewerage

The main development will produce about 60 cubic meters of sewage per day during the peak season in 1975. It is proposed that a new septic tank be constructed with a capacity of 60 cubic meters allowing 24 hours retention. An effluent line will lead across Wadi Musa to an absorption field designed to dispose of the waste fluid underground.

Separate septic tank and absorption trench systems should be constructed for the campground and for the staff housing.

The systems are shown on drawing PET-13.

Electric Power

The resthouse is presently served by a power plant owned and operated by the Tourism Authority. The plant consists of two diesel-electric sets located in an ancient rock-cut tomb near the resthouse. Electricity is generated and distributed at

220 volts, 50 cycle, the transmission line being an underground cable. The plant is presently (1968) being operated from about 11 am to 10:30 pm each day.

Existing Village System

The village of Wadi Musa has a power plant constructed in 1967, consisting of two 35 KVA, three phase, 230/400 volt 50 cycle diesel-electric sets with control equipment for parallel operation. Power at 400 volts for street lighting and 230 volts for house connection is distributed by this system. The present village load has not been determined but it is expected that the load will soon grow to the capacity of the plant.

Sixty houses (of the 800 in the village) and two mosques were connected to the system in early 1968 and the occupants of an additional 140 houses have asked to be connected. The house connection charge is 7 dinar and the monthly energy charge is 65 fils per KW/Hr for the first 10 KW/Hr, 50 fils per KW/Hr for the next 10, and 25 fils per KW/Hr thereafter.

To provide for electricity at Petra Entrance in 1975 it is proposed that, in cooperation with the Ministry of the Interior for Municipal and Rural Affairs and the Ministry of Public Works, the capacity of the village power plant be enlarged and that the park entrance development be connected to the village system by means of an underground transmission line.

The cave housing the existing plant should be restored and made available for public display. The generating sets should be retained for emergency use but housed in a suitable building.

Communications

The resthouse is presently connected with the village of Wadi Musa by a single telephone line. There is an overhead telephone line from the village to Ma'an and thence to other points in Jordan. However, the line was out of service much of the time during the winter of 1967-68 because of storm damage.

CAMPGROUND
 PHASE I 50 SITES
 PHASE II 150 SITES

GROUP CAMPSITE

SEASONAL QUARTERS

HOUSING AREA

PERMANENT QUARTERS

HELICOPTER LANDING AREA

PHASE II PARKING

AUTOS

BUSES

PHASE I PARKING

AUTOS

BUSES

EXISTING POWER PLANT

GUEST ROOMS

EXISTING RESERVOIR

HOTEL

MAINTENANCE

VISITOR CENTER

STABLES

DINING

GUEST ROOMS

EXISTING SEWER TO BE CONNECTED TO NEW SYSTEM

CESSPOOL

FOOT TRAIL FROM PETRA BASIN

HORSE TRAIL TO PETRA BASIN

PROPOSED UNDERGROUND POWER CABLE FROM VILLAGE POWER PLANT

PROPOSED TO REPLACE EXISTING 1" INCH WATER LINE WITH 2" INCH PIPE

PROPOSED TO PLACE TELEPHONE LINE UNDERGROUND

UTILITIES LEGEND

EXISTING PROPOSED OBLITERATE

WATER PIPELINE	— W —	— W —	— W —
SEWER	— S —	— S —	— S —
SEPTIC TANK	SOT	SOT	SOT
ABSORPTION TRENCH	— A —	— A —	— A —
TELEPHONE LINE - AERIAL	— AT —	— AT —	— AT —
TELEPHONE LINE - UNDERGROUND	— UT —	— UT —	— UT —
POWER LINE - UNDERGROUND	— UP —	— UP —	— UP —

LEGEND

	EXISTING	PROPOSED PHASE I	PROPOSED PHASE II	OBLITERATE
BUILDINGS	[Solid Box]	[Dashed Box]	[Dotted Box]	[Cross-hatched Box]
ROADS	[Solid Line]	[Dashed Line]	[Dotted Line]	[Cross-hatched Line]
TRAILS (FOOT)	[Solid Line]	[Dashed Line]	[Dotted Line]	[Cross-hatched Line]
TRAILS (HORSE)	[Line with Ticks]	[Line with Ticks]	[Line with Ticks]	[Line with Ticks]
WALLS	[Line with Dots]	[Line with Dots]	[Line with Dots]	[Line with Dots]
WADIS	[Wavy Line]	[Wavy Line]	[Wavy Line]	[Wavy Line]
BOUNDARY	[Dashed Line]	[Dashed Line]	[Dashed Line]	[Dashed Line]

NOTE:
 PHASE I BUS PARKING WILL BE CHANGED TO AUTO PARKING DURING PHASE II.
 CAMPGROUND ROADS WILL BE DESIGNATED PHASE I OR II AFTER MORE DETAILED STUDIES HAVE BEEN MADE.

PETRA ENTRANCE DEVELOPMENT UTILITIES

PETRA NATIONAL PARK



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Operation of the Park and the hotel will require that there be adequate and reliable telephone communication including long distance lines with population centers in Jordan and elsewhere.

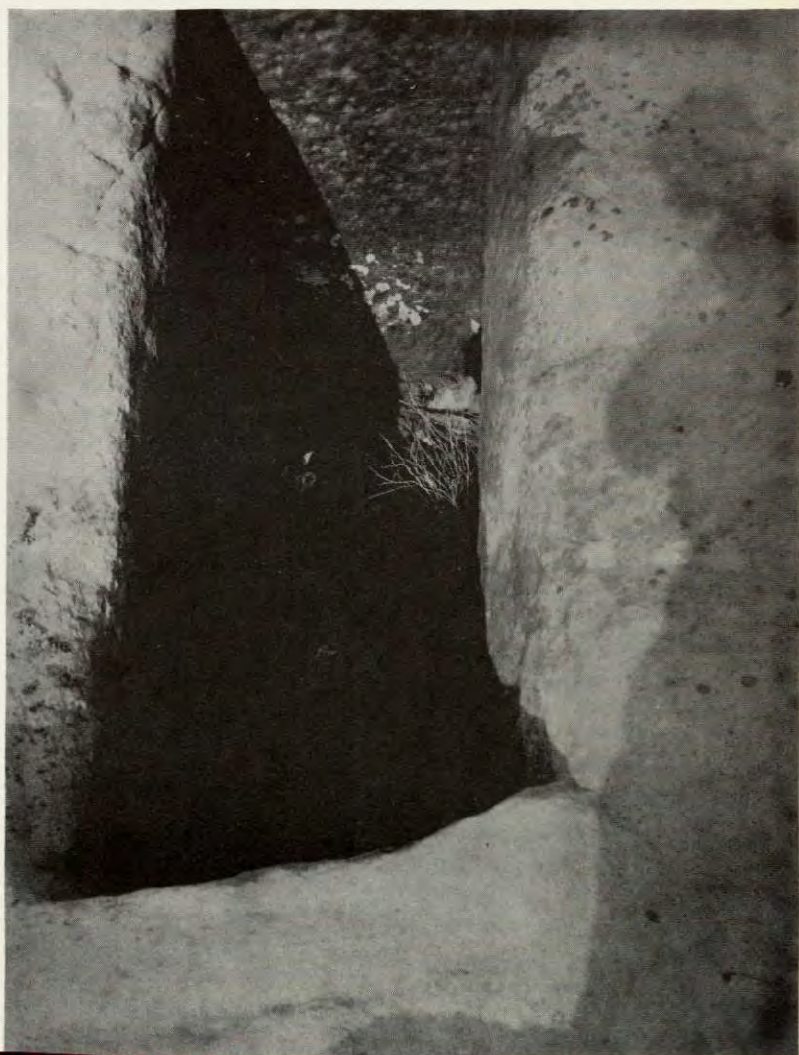
Refuse Disposal

At present there is no systematic collection and disposal of garbage and other solid wastes at the resthouse. Trash at times has been dumped in several of the tombs in the vicinity and cans and broken glass are strewn on the rock slopes near the resthouse.

It is proposed that a sanitary landfill be established at a nearby site outside the Park and that a program of regular collection and disposal be started.

Tombs now containing trash should be cleaned out and made available for display to visitors.

Tombs and other structures have suffered the ignominious fate of garbage pits. A sanitary landfill will solve this problem.



Petra Basin

Character Of Area

The Petra Basin development area located in Wadi Musa beyond the Roman street is the only proposed visitor use facility inside Petra. Here would be located a secondary visitor information station, public toilets, lunch service and eating terraces, a Ranger station and ancillary storage and equipment rooms. The total cost of this development is estimated at JD 110,000 including contingencies, supervision etc. (See Appendix L).

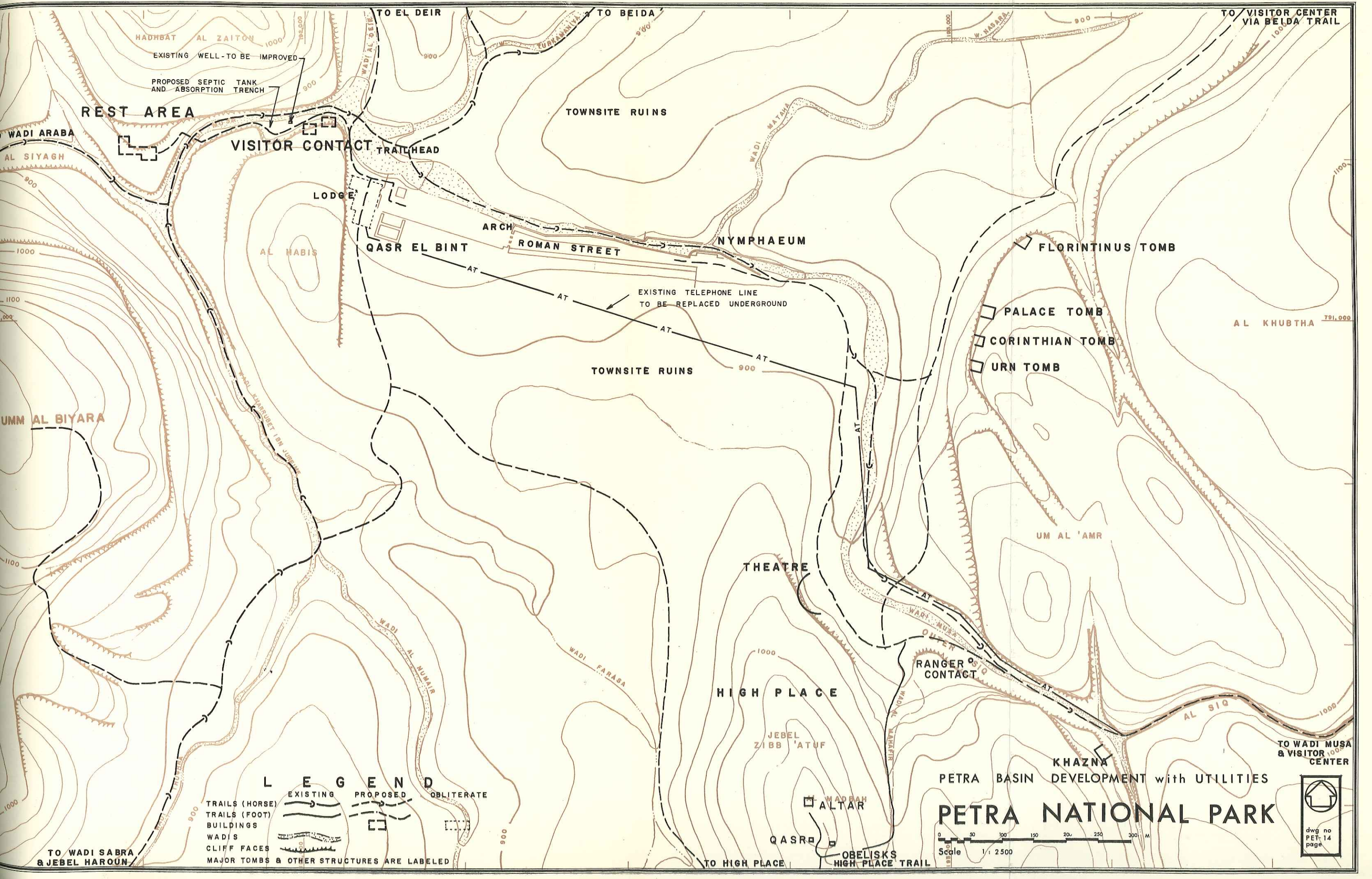
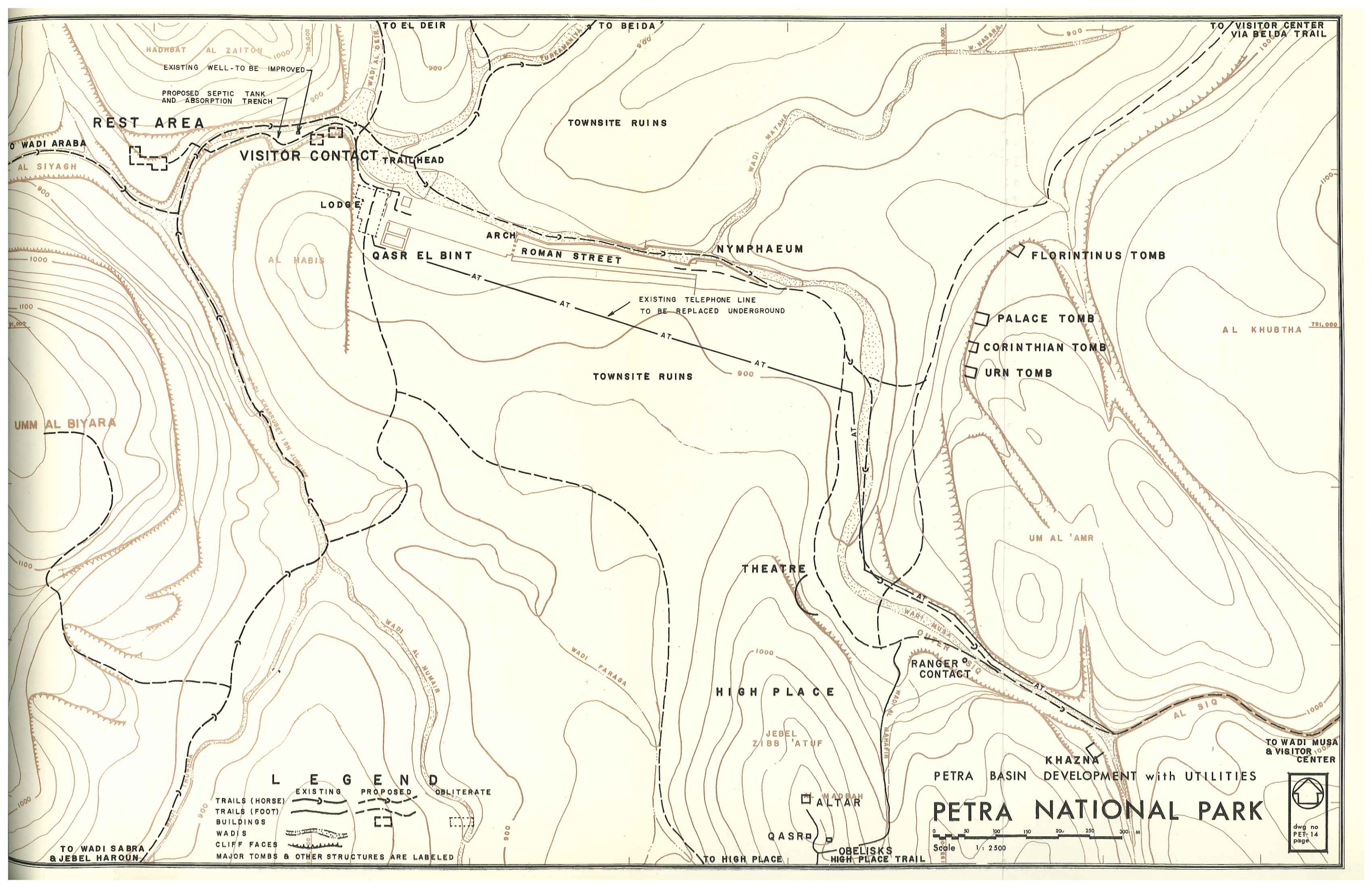
The site selected is physically and visually removed from remnants of the Roman period and the panorama of tomb facades and caves of the Petra Basin. This site near the hub of interpretive trail heads and termini will be the focal point of intense day-use, particularly during the lunch hours.

The day-use site is in a magnificent canyon dominated by the massive heights of Al Habis, Umm Al Biyarra, and Al Siyagh honey-combed with nondescript cave openings so typical of the Petra landscape. Scale and form are so immense, color and light so bold that the development facilities must be designed to provide the visitor with a human frame of reference for vertical and horizontal scale as well as shade and shelter from the intensities of light, heat, and wind.

Site Location

This site is located on the alluvial bench in Wadi Musa below the confluence of wadis Al Deir and Turkamaniya and the sandstone benches beyond. The design of public use facilities here must recognize the possibility of infrequent high water and the need to minimize the intrusion of this development on the historic setting.

The narrow limited size of the site dictates a linear character of structures connected by terraces and wide foot paths.



REST AREA

VISITOR CONTACT TRAILHEAD

LODGE

QASR EL BINT

ARCH
ROMAN STREET

NYMPHAEUM

FLORINTINUS TOMB

PALACE TOMB

CORINTHIAN TOMB

URN TOMB

THEATRE

HIGH PLACE

JEBEL ZIBB 'ATUF

RANGER CONTACT

KHAZNA

PETRA BASIN DEVELOPMENT with UTILITIES

PETRA NATIONAL PARK



dwg no
PET-14
page

LEGEND

- TRAILS (HORSE) EXISTING
- TRAILS (FOOT) PROPOSED
- BUILDINGS EXISTING
- WADIS EXISTING
- CLIFF FACES EXISTING
- MAJOR TOMBS & OTHER STRUCTURES ARE LABELED

TO WADI SABRA & JEBEL HAROUN

TO HIGH PLACE

OBELISKS HIGH PLACE TRAIL

TO WADI MUSA & VISITOR CENTER

TO WADI ARABA

TO EL DEIR

TO BEIDA

TO VISITOR CENTER VIA BELDA TRAIL

UMM AL BIYARA

AL HABIS

AL KHUBTHA

UM AL 'AMR

WADBAH ALTAR

QASRA

HADHBAT AL ZAITON
EXISTING WELL - TO BE IMPROVED
PROPOSED SEPTIC TANK AND ABSORPTION TRENCH

TOWNSITE RUINS

TOWNSITE RUINS

EXISTING TELEPHONE LINE TO BE REPLACED UNDERGROUND

AT

AT

AT

AT

AT

AT

AT

AT

AT

AT

AT

AT

AT

AT

Site Development The development of the site is dictated by two visitor needs; information and accommodations; toilets and food. Free circulation is planned with a logical flow sequence controlled by the location of the various buildings. The Ranger station will incorporate space for visitor information, first-aid, staff toilets, lockers, and a bunk room. The public toilets should be designed to accommodate the anticipated operating use of this area by more than 300 people an hour. Pre-packaged food should be dispensed from a self-service counter with a back bar for preparation of hot beverages. Shelters from sun, rain, and wind should be provided on the lunch terraces. Storage and equipment rooms should be provided within this complex to meet the needs of the operation.

Utilities

Water Sources And Existing System

Water sources are limited in the Petra Basin area. The Nabataean and Roman inhabitants brought water from springs in the vicinity of the present village of Wadi Musa supplemented by collection and storage of rain water. There also may have been works to divert, settle, and store the occasional flow of the wadis.

There is one small spring in the basin located 300 meters north of Qasr El Bint and surface flow appears in Wadi Musa about 700 meters below Qasr El Bint. The present Bedouin inhabitants make use of these sources, and the Wadi Musa source is diverted to irrigate crops on small plots in the lower Siq. The Jordan Natural Resources Authority has installed many stream gauging stations in Petra. The location of one of these stations is on Wadi Musa in the Siq below the Basin. The site and flow data of this station is shown on drawing PET-14.

Nazzal's Camp is supplied with water from a well, owned and operated by the Government, located at the edge of the channel of Wadi Musa at the point shown on drawing PET-14.

The well is equipped with a pump delivering water through a 1-inch pipe exposed on the face of the cliff piped to four galvanized steel tanks located in a cave on the cliff face above the well. Water is delivered by pipeline to Nazzal's Camp. The water is not treated. Its chemical and bacteriological qualities are not known to the study team.

Future Demand And Proposed System

The water needs of the facilities proposed for Petra Basin based on the criteria shown on page 50 are estimated to be as follows:

1975

Visitors per day (average during peak month)	730 persons
Average daily use per visitor	10 liters
Water demand	7 m ³ per day

1985

Visitors per day (average during peak month)	3100 persons
Average daily use per visitor	15 liters
Water demand	46 m ³ per day

It is expected that the existing well will supply the demand of 1975 but that a new source will have to be developed before 1985.

It is proposed that the existing water system be improved with the following features:

The well enclosure should be reconstructed to fit the development plan.

A new pump should be installed.

A new concealed pipeline should be constructed from the pump to the reservoir.

A hypochlorinator should be installed on the line between the pump and the reservoir.

Storage tanks with capacity expanded to 84 cubic meters should be moved to a site not intruding on antiquities and at an elevation of about 30 meters above the development site so as to provide a static pressure of 3 kilograms per square centimeter (45 psi) at the place of use.

Sewerage

At present sewage from Nazzal's Camp is discharged into four cesspools.

Sewage from the toilets rest rooms and other buildings would be disposed of in a septic tank located approximately 30 meters downstream from the well. Effluent would be carried approximate

50 meters farther downstream where it will be disposed of underground by an absorption trench.

Electric Power

The existing facilities in Petra Basin are supplied with electricity by an electric generator located in a cave near Nazzal's Camp. The system is owned and operated by the Camp's owner.

The day-use development proposed by this Master Plan requires electric power. It is expected that the power demand of 1975 can be met by a plant with two 5kw diesel-electric sets. It is proposed that 50 cycle single phase current be generated and distributed at 220 volts.

Communications

The existing Nazzal's camp in Petra Basin is served by a two-wire telephone line connected with the village of Wadi Musa via the Siq.

A post office is located in one of the ancient caves in the cliff west of Qasr El Bint.

The overhead telephone line is not compatible with the region of ancient rock carved monuments and scenic splendor. It is proposed that the overhead line be removed. The post office should be closed and the site restored when the Bedouin have been settled elsewhere.

Management of the Park and safety of the visitor require that there be some method of rapid communication between Park Headquarters and the point of visitor concentration in Petra Basin. It is proposed that this be by means of a private branch exchange with an underground telephone cable between headquarters and Petra Basin.

Refuse Disposal

At present garbage and other solid wastes from Nazzal's Camp are dumped on the hillside behind and in a cave within Petra Basin. It is proposed in the future that refuse from the day-use area be collected and hauled out of the basin for disposal in a sanitary landfill near the Park entrance.

Secondary Developments

Secondary development areas as proposed in this Master Plan are planned to be part of the phase two development schedule. No part of this proposal should be started until the recommendations for phase one development are substantially completed.

It is anticipated that secondary entrance facilities with park contact - information centers, minimal staff facilities, and limited overnight and food accommodations may be warranted in Seil Wadi Musa and Beida. The feasibility of developing these areas will become apparent following the completion of the Aqaba-Safi road and the Kings Highway when there may be pressure for more direct road access to the park from these new routes. The scheduling of development as outlined in this Master Plan should be rigidly adhered to. No approach roads for use of the general public should be constructed to the outlying parts of the park until the need for these developments has been carefully evaluated.

As new archeological sites are discovered and the flora and fauna of the area become re-established there may be interest in additional loop trails to the remote points in the park. Along these trails there could be primitive camps at existing water points to provide for lunch and overnight stops. The major use of these loop trails and camps would be by guided parties.

Park Administration

Present Arrangement

At present the management of Petra as an antiquity site falls between two arms of the Ministry of Tourism and Antiquities. The Department of Antiquities has overall land management responsibility for the site and the Parks Division of the Tourism Authority has responsibility for the development and operation of Petra's limited visitor amenities. In a broad sense, the Parks Division, through its operation of specific tourist facilities and services, functions as a permittee to the Department of Antiquities.

Role Of Parks Division

Once national park status has been given to this area there will be need within the Ministry to realign Antiquities-Parks responsibilities which will recognize and support the justifiably dominant role to be taken by the Parks Division in the future administration of this area. Moreover, such realignment of G.O.J. public administration should give the National Parks Division primary responsibility for all future planning, implementation, and control of Petra as a land management entity. It is anticipated that legislation now in preparation will clarify and strengthen the responsibilities of the departments involved.

The continuing important role of the Department of Antiquities should be to furnish scientific support to the Parks Division in the fields of research, and consolidation.

Role Of Antiquities Department

To insure protection of Petra's archeological and historical values all future construction and other land-disturbing activities should be implemented only in accordance with the Petra Master Plan and with the mutual concurrence of the heads of both the Parks Division of the Tourism Authority and the Department of Antiquities.

Park Staff

The designation of Petra as a National Park will present an opportunity to create Jordan's first national park staff. Properly organized, this staff can serve as a model for other national parks within the Kingdom.

As a training areas, it can also serve as a park personnel recruitment reservoir for future national parks.

Staff Organization

Superintendent

As field representative of the Director of the National Parks Division of the Jordan Tourism Authority the superintendent would be the chief administrative official of the Park. He would provide interpretation of policy and general direction and guidance on all activities concerned with the management of the Park and service to its visitors. As head of the Park he would program park activities and be responsible for the Park's public relations by cooperating and actively participating with national organizations, both public and private, sharing common or related interests in conservation, the promotion of tourism, and recreation.

Administrative Officer

This employee would be responsible for all administrative services and would supervise and direct the activities of park personnel concerned with fiscal accounting, procurement and property, personnel, records management, and administrative reports.

Chief Of Visitor Services

Supervision, direction, and training of the uniformed Park Ranger force would be the primary responsibility of this employee who would function as the Chief Ranger. Programs relating to visitor information, interpretation, protection of park resources and the protection of park visitors would be the broad areas of his responsibility.

Specific activities of his staff should include:

Protection Of Park Property

Continued routine and random surveillance of all park property to deter vandalism, domestic livestock grazing, loss of antiquities through illicit digging, and shooting and trapping of park wildlife.

Law Enforcement Enforcement of park regulations. These regulations should be brought to the attention of visitors through information and interpretive media. Should there be need for additional law enforcement personnel, assistance will be requested from the Wadi Musa Police Post.

Fire Protection All permanent structures should be built, in so far as possible, with fire resisting materials. Buildings and ranger vehicles should be equipped with fire extinguishers. Routine inspections should be made pointed at the identification of fire hazards.

Search And Rescue Aided by mobile, narrow band, two way radios, search and rescue would be a responsibility of the ranger force who will be taught, in the course of their training, rescue techniques.

First Aid Training of rangers in first aid should be mandatory in order to provide assistance to visitors and employees who suffer physical injury. An electric cart, fitted with a litter, would be maintained on a standby basis to move the badly injured over horse trails to park headquarters for subsequent movement to an appropriate hospital.

Chief Of Maintenance This employee, qualified in a broad field of construction activities, would have supervisory responsibility for the maintenance and repair of all modern structures and utilities within the park. These responsibilities should be separated into the following major activities, each headed by foremen:

**Roads , Trails ,
Parking Areas ,
And Grounds** Maintenance activities would be concerned with preventive and corrective measures necessary to keep roads, trails, parking areas, and grounds in safe, clean, and as-built

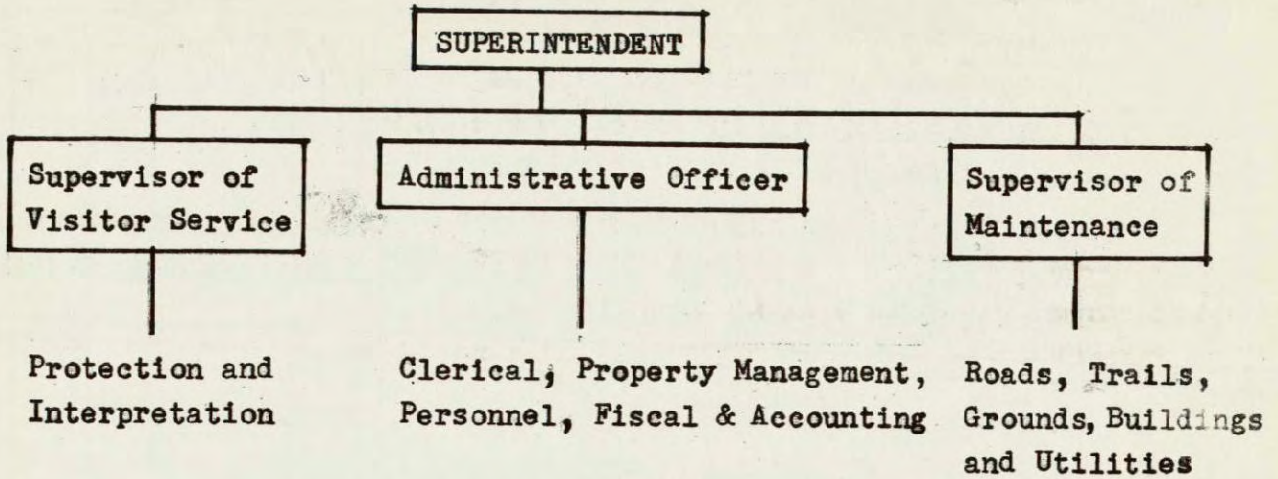
condition taking into consideration normal wear and age. Maintenance and repair work requiring heavy or specialized equipment should be performed under a standing agreement between the Ministry of Tourism and Antiquities and the Ministry of Public Works. The collection of litter in areas and along trails of high visitor concentration would be carried on as a day-to-day maintenance operation. Through interpretive media, visitors would be encouraged to use litter and garbage receptacles. The collection of roadside litter would also be done on a routine basis.

Buildings And Utilities

As with road, trail and grounds maintenance, rigid standards designed to assure a high degree of upkeep and cleanliness of buildings and other public use facilities should never be relaxed. Over the world these factors contribute heavily to the impressions people keep of their travels. Activities concerned with keeping buildings, fixed mechanical equipment, and utilities in efficient, clean, and safe operating condition should be done on a routine basis. Repair and preventative maintenance of concession leased buildings and facilities should be done under agreement by park maintenance personnel on a reimbursable time and materials basis.

Signs And Markers A comprehensive informational and interpretive sign and way-side exhibit program, designed and controlled by the Visitor Services Division to assist the visitor in the use and understanding of the park, should be maintained by the buildings and utilities personnel.

Staff Organization



See Appendix M for Staffing detail and cost estimate.

Warehouse and Maintenance Shops
 Toilet Buildings (campground)

Utilities:

Water system reconstruction
 Electrical system
 Sewage system
 Telephone system
 Radio system (two - way)

Roads and Trails

Entrance Road-Parking Terrace Redevelopment
 Campground Roads
 Staff housing service road
 Visitor Center - Staff housing trail
 Visitor Center to Campground trail

Miscellaneous

Campground Development
 Lunch Terrace Development

Basin Development

Buildings:

Visitor contact station
 Refreshment bar

Utilities:

Water system redevelopment
 Electrical system
 Sewage system

Miscellaneous

Lunch Terrace Development
 Planting

	Year					
	1	2	3	4	5	6
Warehouse and Maintenance Shops						
Toilet Buildings (campground)						
<u>Utilities:</u>						
Water system reconstruction						
Electrical system						
Sewage system						
Telephone system						
Radio system (two - way)						
<u>Roads and Trails</u>						
Entrance Road-Parking Terrace Redevelopment						
Campground Roads						
Staff housing service road						
Visitor Center - Staff housing trail						
Visitor Center to Campground trail						
<u>Miscellaneous</u>						
Campground Development						
Lunch Terrace Development						
<u>Basin Development</u>						
<u>Buildings:</u>						
Visitor contact station						
Refreshment bar						
<u>Utilities:</u>						
Water system redevelopment						
Electrical system						
Sewage system						
<u>Miscellaneous</u>						
Lunch Terrace Development						
Planting						

Staffing *

Superintendent
 Administrative Officer
 Personnel Clerk
 Property Clerk
 Fiscal Accounting Clerk
 Stenographer
 Supervisor of Visitor Services
 Rangers, permanent
 Rangers, seasonal
 Supervisor of Maintenance
 Foreman
 Mechanics
 Storekeeper
 Equipment Operators
 Laborers

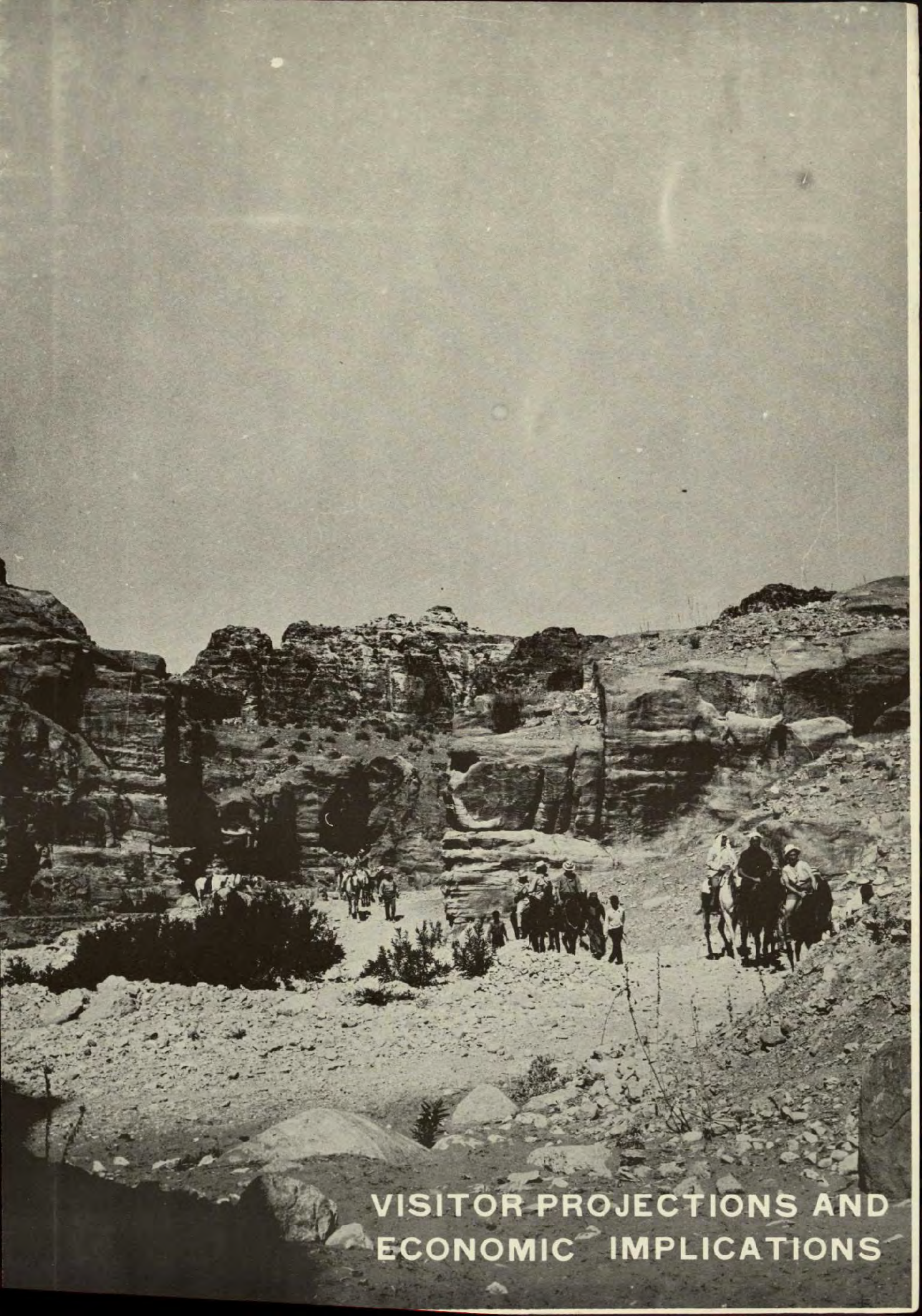
	Year					
	1	2	3	4	5	6
Superintendent						
Administrative Officer						
Personnel Clerk						
Property Clerk						
Fiscal Accounting Clerk						
Stenographer						
Supervisor of Visitor Services						
Rangers, permanent						
Rangers, seasonal						
Supervisor of Maintenance						
Foreman						
Mechanics						
Storekeeper						
Equipment Operators						
Laborers						

Cost Estimates and Yearly Expenditures

In thousands, JD, 1968 price indices

	Year					
	1	2	3	4	5	6
Land Acquisition & Boundary Identification	44	85				
Identification & Protection of the Archeological Resource now exposed	30	45	60	50	30	30
Capital Costs & Watershed Protection	235	260	174	118	111	85

* items not included in cost estimates.



**VISITOR PROJECTIONS AND
ECONOMIC IMPLICATIONS**

Visitor Projections

Any projections of the number of future visitors to Petra which are made at this time are, at best, tenuous. This is attributable to two major factors: (1) the uncertain political situation and (2) the inadequate statistics which are available. With regard to the second point, virtually no records were kept prior to 1964 on visitors to individual sites in Jordan. In addition, the statistics since 1964 do not break down the visitors into categories such as peak-hour, peak-day, group arrivals, average length of stay, nationality etc.

The available statistics show that April is the peak month of visitation with August as the second busiest month. This corresponds to the Easter and European holiday seasons. The next busiest months, March, May and September, all have visitor counts of approximately the same magnitude. As shown in Figure 2B, over 31,800 tourists visited Petra in 1966 and the average of the years 1964-66 was over 25,700.

Because of the problems associated with the lack of either detailed or historical statistics, the best method of developing projections seemed to be to make some correlations with the most recent projections of tourist arrivals. In this case, projections made by the Battelle Memorial Institute under AID sponsorship on airport development and the Annual Reports of the Ministry of Tourism and Antiquities have been used. It should be pointed out that both sources do not consider Jordanian nationals as tourists. It is anticipated that a substantial number of visitors at Petra will be Jordanians so the projections ultimately developed are, if anything, on the conservative side. For example, statistics for the years 1964-66 show that about 15% of all visitors to Petra during those years were Jordanians. This could easily be 20-25% of the total following the establishment of a national park.

Using the Ministry statistics for 1964-66, it was found that slightly more than 5% of all tourists visiting Jordan went to Petra (see Figure 1B). The same 5% figure was applied to Battelle's medium projections for the years 1970 through 1985

(see Figure IA) in order to estimate visitors at Petra. As shown in Figure, IB, average annual visits to Petra could reach 610,000 by 1985.

It should be pointed out that the Battelle projections were made prior to the June war when Jordan had the benefit of Jerusalem as a touristic attraction. Therefore, one is tempted to immediately conclude that the projections developed by correlation with the Battelle study must be overestimated. Several factors mitigate against such a conclusion. First of all, as mentioned above, the Battelle figures exclude Jordanian nationals and therefore could reasonably be increased by 15-25%. Secondly, several possible future developments will undoubtedly increase Petra's percentage of the total visitors to the country, which conservatively has been kept at 5% throughout the study period. They are: (1) the development of Aqaba as an internationally known resort, (2) the possible development of a ferry service between Aqaba and Suez, (3) the active promotion of Petra as an overnight stop as part of a package tour and (4) the existence of better facilities which by themselves induce more visitors to the Park.

The latter point is almost a truism whenever good facilities are constructed and properly maintained. An example is construction of the access road into Petra which undoubtedly has a profound influence upon the decisions made by individual tourists to visit Petra. By the same token, the existence of the facilities proposed in this plan will have a similar effect upon future tourists by either encouraging them to visit Petra, remain there longer or even stay overnight.

In attempting to develop visitor projections, the importance of political stability cannot be overestimated. In the absence of any sort of political settlement, the estimates are probably high. If a political settlement is reached which results in a return to conditions roughly similar to those existing at the time of the Battelle study (return of the West Bank and Arab Jerusalem but only one way crossing of borders), the projections are probably low. If, on the other hand, a settlement is reached which would also allow unrestricted crossings, the

projected number of visitors easily could be doubled.

**Economic
Implications**

The economic implications of the points mentioned above are far-reaching for Jordan. While recognizing that the future of tourism in Jordan is linked to a great measure to the political stability of the area, certain facts become apparent when investment in tourism is considered. For example, one could take the total investment made in tourism by the GOJ from its own budget as well as foreign donor sources since 1958 (estimated at \$5.5 million), add to it estimated private investment in tourism over the same 10 year period (estimated at approximately \$20 - 25 million) and compare that total with the revenue realized in 1966 alone of over \$33 million. The economic importance of tourism is also shown in the large number of people employed in related industries prior to the hostilities.

Tourism in Jordan made impressive gains prior to last June and was virtually Jordan's "leading sector". This is emphasized by the fact that during the first half of 1967, it replaced remittances as the country's leading foreign exchange earner. The importance of tourism is shown by the following statistics:

<u>Tourist Arrivals:</u>		<u>% Increase over Previous Year</u>
1962	210,000	
1963	320,000	52
1964	390,000	21
1965	500,000	28
1966	617,000	23
1967	253,800 (up to the end of April)	21 (assuming total 1967 of 750,000)

<u>Tourism Income in Dollars</u>		<u>% Increase over Previous Year</u>
1962	14,140,000	
1963	19,750,000	39
1964	22,500,000	14
1965	26,800,000	19
1966	33,800,000	26
1967	Not Available	

Employment in Tourism Related Ind. % Increased over Previous Year

1963	3,800	
1964	4,500	18.5
1967	7,500 (up to the end of April)	66

It is difficult to make a detailed economic analysis of the specific investments proposed herein. The most valid approach is to make a sensitivity analysis. The sensitivity analysis is a means of estimating in approximate terms the various factors which come to play in an economic evaluation. If by making a sensitivity analysis, it can be shown that the returns required to make the project economic are clearly within the realm of future possibility, there is no need to undertake a detailed and exact economic evaluation.

The question then is whether or not the total estimated expenditures of JD 976,200 proposed can be expected to be recovered in benefits to the economy over a reasonable period of time.

Figure 4A has projected the costs and benefits over a 6 year period only. The future benefits and costs have been expressed in terms of their present values by having been discounted at 15%. The figure 15% has been arbitrarily selected as the opportunity cost of capital, which is the annual return investors in Jordan would expect to receive from alternative investments. The calculations show that if the benefits derived at Petra are of the magnitude of \$ 8.75 (JD. 3.125) per tourist visit all of the costs will be recovered within six years, an extremely short pay-back period. Clearly, this is within reason and the realm of future possibility especially since the total cost of the proposed watershed development has been included and no attempt has been made to estimate additional benefits derived from this development. In addition, the analysis does not take into account the multiplier effect which means that each dollar spent in the economy generates a certain number of additional expenditures. Addition of these factors would, of course, make the proposal more attractive. Therefore, the proposals contained in the report are considered to be economically desirable.

Year	Capital Costs and Watershed Protection	Land Acquisition and Boundary Identification	Identification & Protection of Ruins	Operation and Maintenance	Total	Present Worth @ 15%
0	658	123	84	-	865	865
1	686	238	126	-	1050	913
2	487	-	168	42	697	527
3	230	-	140	42	412	271
4	311	-	84	42	437	250
5	238	-	84	42	364	181
6	-	-	-	42	42	18
						<u>3,025</u>

Year	Number of Tourists x \$5.00	Present Worth @ 15%	Number of Tourists x \$10.00	Present Worth @ 15%
0	64,000	320.0	64,000	640.0
1	74,200	371.1	74,200	742.2
2	86,100	430.5	86,100	861.0
3	99,900	500.0	99,900	999.0
4	115,000	575.0	115,000	1150.0
5	145,000	725.0	145,000	1450.0
		<u>313.4</u>		<u>626.8</u>
		1,724.7		3,453.0

\$3,025 = approximately 75% of the difference between \$1724.7 & \$3,453.0
 175% of \$5.00 = \$8.75 which is approximate "break-even" expenditure required.

ANNUAL VISITS

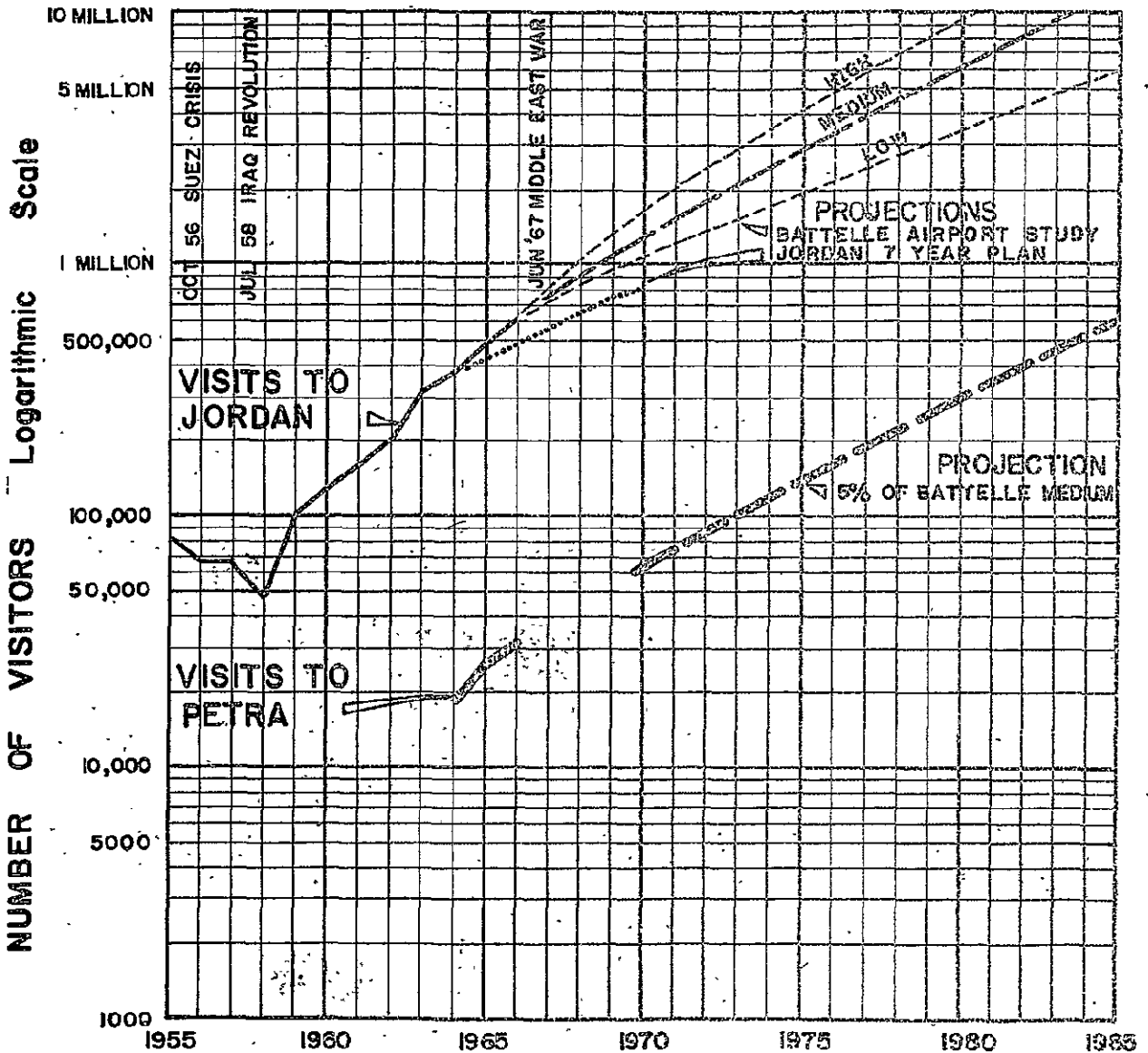
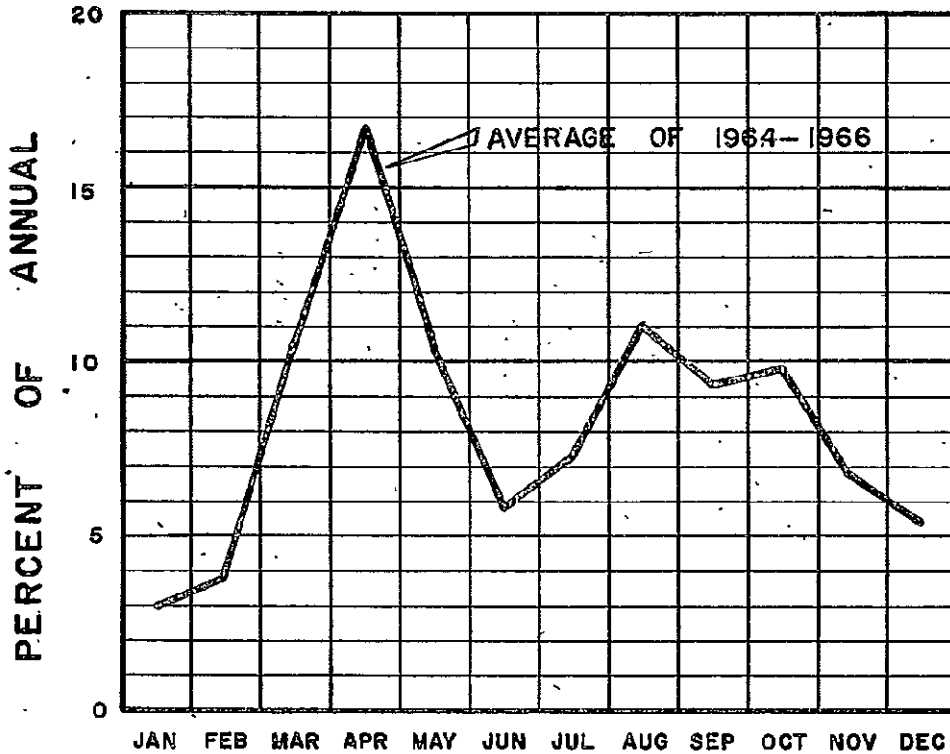


FIGURE 1A

	YEAR	VISITS TO JORDAN	VISITS TO PETRA		
			NUMBER	PERCENT OF TOTAL	ANNUAL INCREASE PERCENT
ACTUAL	1964	387,343	18,713	4.83	20
	1965	501,346	26,805	5.34	43
	1966	616,873	31,843	5.16	19
	1967				
	AVG. 64-65	501,855	25,787	5.11	27
PROJECTION	1970	1,280,000	84,000	6.0	20
	1975	2,900,000	145,000	5.0	16
	1980	6,000,000	300,000	5.0	15.5
	1985	12,200,000	610,000	5.0	15

FIGURE 1B

MONTHLY VISITS



JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC
 FIGURE 2A

TABULATION OF MONTHLY VISITS

MONTH	ACTUAL MONTHLY VISITS				PROJECTION, VISITORS PER MONTH				
	AVERAGE 64-66		1966	1967	1968	1970	1975	1980	1985
	NUMBER	% OF ANNUAL							
JAN	879	3.0	1889			1900	4000	9000	18300
FEB	984	3.8	919			2400	5500	11400	23200
MAR	2577	10.6	2083			6800	15400	31800	64600
APR	4469	16.8	6202			10700	24300	50400	102500
MAY	2633	10.4	3069			8600	15100	31200	63500
JUN	1544	5.8	2255			3700	8400	17400	35400
JUL	1891	7.3	2447			4700	10600	21900	44500
AUG	2866	11.1	3509			7200	16100	33300	67700
SEP	2410	9.3	2966			5900	13500	27900	56700
OCT	2490	9.8	3130			6300	14200	29400	59800
NOV	1664	6.7	1502			4300	9700	20100	40900
DEC	1382	5.4	1772			3500	7800	16200	32900
YEAR	25,787	1.00	31,843			64,000	145,000	300,000	610,000

FIGURE 2B

DAILY VISITS - PROJECTIONS

YEAR	AVERAGE DAILY DURING PEAK MONTH OF APRIL	PEAK DAY 200 PERCENT OF APRIL AVERAGE
1966 ACTUAL	210	420
1970	360	720
1975	610	1620
1980	1680	3370
1985	3400	6800

FIGURE 3A

↑
DESIGN LOADS

TABULATION OF PREDICTED DAILY VISITS BY TYPE OF ACCOMODATION

ACCOMODATION	AVERAGE DAILY VISITS PEAK MONTH OF APRIL EQUIVALENT TO 20TH HIGHEST DAY OF THE YEAR (PERCENT OF TOTAL DAILY VISITS IN PARENTHESES)			
	1970	1975	1980	1985
HOTEL GUESTS	54 (15)	121 (15)	252 (15)	510 (15)
TENT CAMPERS	18 (5)	81 (10)	168 (10)	310 (10)
CAMPERS WITH TRAILERS OR OTHER SELF CONTAINED UNITS	18 (5)	81 (10)	252 (15)	510 (15)
DAY VISITORS ENTRANCE AREA	252 (65)	527 (65)	1008(60)	2040(60)
TOTAL DAILY VISITS	360	810	1680	3400
DAY VISITORS TO PETRA BASIN	320 (90)	730(90)	1510 (90)	3100(90)
PERMANENT RESIDENTS STAFF FAMILIES		86		110

FIGURE 3B

PUBLIC RELATIONS

An effective and dynamic national parks program will require the full understanding and backing of the people of Jordan and their government. To best obtain this support, it is recommended that a Kingdom-wide public relations campaign be initiated by the Ministry of Culture and Information directed at the promotion of National Parks - What are they? What can they do for Jordan and her people? Why are they important? Because of the long range social and economic implications of the development of a National Park System, there should be heavy emphasis placed at all levels on a school-oriented program.

Jordan's ongoing international tourist promotion program should take full advantage of the added quality both real and implied which will be given to Petra with national park status.

GLOSSARY

- Audio-visual:** Using electronic devices, a presentation in sound or pictures, or both. Examples: A tape-recorded message, a motion picture.
- Campground:** An area with an organized plan, having defined roads, parking spaces, places to camp, sanitary facilities & water supply.
- Campground loop road:** A road through a campground that returns to meet its own starting point.
- Campsite:** A clearly marked area of ground within a campground for use of an individual person, a family, or a group of persons.
- Concessioner:** The individual or group that holds a contract to operate within a park facilities and services needed by park visitors. Examples: Rental of horses; providing accommodations, food service, sale of souvenirs, etc.
- Contact station:** Any designated place where Park employees meet the visitor to provide informational and interpretive services.
- Day-use:** Visitor activity in a park that does not involve staying overnight.
- Development areas:** A place in a park where facilities for visitor use or park use are concentrated.
- Diorama:** An interpretive exhibit consisting of modeled figures usually in miniature in a three dimensional setting which merges into a carved painted background.

Hypochlorinator: A mechanical device to inject liquid chlorine into a water line.

Information: General factual, directional, and regulatory information not primarily directed toward interpretation.

Interpretation: An activity which presents the inspirational, educational, and recreational values of a park in such ways that visitors may obtain understanding, appreciation, and enjoyment from a park visit. It does not mean translation from one language to another.

Interpretive shelters: A type of structure used at an outside exhibit for the protection of the visitor or the exhibit from the weather and which marks a location for interpretation.

Kiosk: A small booth or building.

Lunch area: An area provided with tables at a place convenient for visitors to stop for lunch.

Microclimate: Climatic conditions in a relatively small area that are markedly different from those of the surrounding area; due mainly to drastic differences in exposure and temperatures as between the two areas.

Overlook: A place provided with parking or standing space and other facilities as needed for the use of visitors in viewing a scenic feature.

Park headquarters: The location of the main administrative facilities of the park.

Peak day: A term used to describe the 24-hour day in which the greatest number of visitors arrive at a park.

Peak hour: A term used to describe the hour during the day in which the greatest number of visitors arrive at a park.

Peak month: A term used to describe the month in which the greatest number of visitors arrive at a park.

Plant community: All of the plants characteristically associated together in a particular kind of an environment.

Salvage Excavation: Excavation of an archaeological site in accordance with accepted standards of research before the construction of roads, buildings, or other kinds of construction that would destroy or disturb archaeological remains.

Sanitary land fill: A method of disposal of garbage and other solid refuse. In a sanitary landfill operation, the refuse is spread, compacted, and then covered with a layer of earth.

Seasonal quarters: A place to live for employees who work only part of the year in a park.

Self-guided trail: A trail system, or part of a trail system, that has devices (such as guide booklets, signs, exhibits) which, without the services of a guide present to the visitor a significant story of the area through which the trail passes.

Snack bar: A small shop that serves a limited variety of foods to the public.

Stabilization ponds (sewage): A method of disposal of liquid organic wastes (raw or settled sewage) by containing the sewage in a small, shallow, artificial lake. The process depends mainly on sunlight and the presence of micro-organisms (algae) to convert organic wastes to stable, inoffensive residue. Other names used are: Sewage, Lagoon, Oxidation, Pond.

Visitation: A term used to express the volume of park visits or public use of parks.

Visitor center: A facility consisting of a building or a combination of buildings which serves as the main information, orientation, reception, visitor service, and interpretive center for visitors to a park.

Visitor use, public use, park use: The presence and activities of visitors within a park.

Toilet, burn-out: A W.C. that disposes of wastes by burning at high temperatures inside of the toilet unit.

Toilet, chemical: A W.C. that holds wastes in a tank of chemicals. The tank must be emptied periodically and new chemicals added.

Toilet, pullman: W.C. that uses small amounts of water.

Trailer spur: A paved space for parking a trailer off a loop road.

Trail head: The beginning of a trail.

Appendix A Points of Interest to and from Petra

Jordan is a vast outdoor museum of archeological and historical sites. Inaccessability, lack of excavation, or present day towns built upon the ruins of the previous ancient towns limit the number of sites that tourists will visit on a trip to Petra via the Kings' Highway. A visitor might want to stop at one or more of the following places:

- a. Madaba, famous for a 6th Century A.D., mosaic map of Palestine.
- b. Dhiban, location of the finding of the Moabite Stone (8th Century B.C.)
- c. Karak, Crusader castle of 12th Century A.D. with later Arab period use.
- d. Mauta, site of the first battle fought between the Arabs and the Byzantines in 632 A.D.
- e. Mazar, mosque that is the burial place of two martyrs of the Battle of Mauta.
- f. Dhat Ras, one of the largest Nabataean sites in Jordan.
- g. Khirbet et Tannur, Nabataean temple of Atargatis and Hadad.
- h. Shoubak, crusader castle of Mons Realis, later an Arab castle of Chaldaeon Shoubak.

A tourist taking the Desert Highway will find few sites along the way. Qatrana Station and Qal'at Hasa have pilgrim forts.

Most of the sites along both highways while interesting are not interpreted which is a discouraging fact to visitors and simply serves to hurry them on their way to their destination at Petra.

Visitors staying overnight at Petra can continue southward along the Desert Highway to Wadi Rum (spectacular scenery) or to Aqaba (port city and resort area)

Appendix B Regional Climatic Conditions

Weather records available for Ma'an and Aqaba are charted below and give indication of the range, variation, and extremes of climate in the park and its vicinity. There are several stream-flow gauging stations located in Petra. These stations, now under the control of the Natural Resources Authority, were installed at various times by foreign experts for different water studies. There is no consistent data from these stations because the recording units have not been kept in continuous operation. There are rain gauges at the Petra school and Wadi Musa school; data, however, from these stations have not been available for use in this plan.

		Temperature		Rain	Humidity
		<u>Mean Maximum</u>	<u>Mean Minimum</u>	<u>mm.</u>	<u>%</u>
WINTER	AQABA	23.2	10.5	6.0	48
(Dec. Feb.)	MA'AN	19.0	3.1	6.3	65
SPRING	AQABA	31.4	16.7	2.6	34
(Mar. May)	MA'AN	24.3	9.3	2.5	45
SUMMER	AQABA	40.0	24.8	0.0	30
(June Aug.)	MA'AN	34.3	17.0	0.0	33
FALL	AQABA	46.9	19.5	0.9	39
(Sept. Nov.)	MA'AN	27.5	11.3	1.5	43

Appendix C Flora of Petra

The following list of plants has been gleaned from Post's Flora of Syria, Palestine, and Sinai. The list is not meant to be a complete catalog of the flora of Petra, but it may be useful as a basis for a future catalog to be prepared after a botanical survey has been made and a park herbarium is established.

RANUNCULACEAE (Crowfoot Family)	Adonis Dentata Delphinium Pygmaea	Toothed Pheasant's-eye Dwarf Larkspur
PAPAVERACEAE (Poppy Family)	Roemeria Dodecandra Glaucium Arabicum " Dimidiatum Hypecoum Procumbens " Dimidiatum	Oriental Horned Poppy Arabian " "
FUMARIACEAE (Fumitory Family)	Fumaria Parviflora	Small-Flowered Fumitory
CRUCIFERAE (Mustard Family)	Moretia Canescens Mathiola Arabica Eremobium Lineare Arabidopsis Pumila Sisymbrium Schimperii " Septulatum " Rigidulum Malcomia Africana " Torulosa Lobularia Lybica Lepidium Latifolium Erucaria Hispanica " Polysperma Schimperia Arabica Diplotaxis Harra F. Hispida Diplotaxis Acris Savignya Parviflora Schouwia Schimperii	Small Rocket Large-Flowered Rocket Virginia Stock Pepperwort Pink Mustard Hairy Rocket Small-Flowered Honesty
CAPPARIDACEAE (Caper Family)	Cleome Arabica Capparis Sicula " Parviflora	Common Caper Small-Flowered Caper
RESIDACEAE (Mignonette Family)	Reseda Muricata Caylusea Canescens	Prickly Mignonette Hoary Mignonette
CISTACEAE (Rock Rose Family)	Helianthemum Ventosum " Kabiricum " Ellipticum	Sun-Rose Cairo Sun-Rose

POLYGALACEAE (Milkwort Family)	Polygala Scoparia	Milkwort
CARYOPHYLLIACEAE (Pink Family)	Dianthus Multipunctatus " Judaicus	Wild Pink
	Gypsophila Rokejeka	
	Silene Coniflora " Linearis " Libanotica	Catchfly
	Alsine Meyerl	Sandwort
	Spergularia Media	Downy Spurry
BARONYGHIACEAE (Whitlow-Wort Family)	Paronychia Flavescens Paronychia Argentea " Lenticulata	Whitlow-Wort Mtn. Knotgrass Desert Whitlow-Wort
	Gymnocarpus Decandrum Pteranthus Dichotomus	
PORTULACACEAE (Purslane Family)	Portulaca Oleracea	Common Purslane
TAMARICACEAE (Tamarisk Family)	Reaumuria Hirtella " Alternifolia Tamarix Mannifera " Articulata	Manna Tamarisk Jointed "
FRANKENIACEAE (Sea Heath Family)	Frankenia Revoluta	Sea Heath
MALVACEAE (Mallow Family)	Malva Sylvestris Oxyloba " Rotundifolia " Parviflora Microcarpa	Common Mallow Dwarf Mallow Cheese-Weed
GERANIACEAE	Erodium Circutarium " Hirtum	Alfilaria
ZYGOPHYLLIACEAE (Caltrop Family)	Fagonia Bruguieri " Myriacantha Fagonia Grandiflora Xygophyllum Simplex	Fagonia Sparse-Glandulosa Simple-Leaved Bean Caper
RUTACEAE (Rue Family)	Haplophyllum Blanchel " Tuberculatum	
ANACARDIACEAE (TEREBINTHACEAE) Cashew or Terebinth Family)	Rhus Tripartita Pistacia Terebinthus " Mutica	Sumach Palastina Terebinth
RHAMMACEAE (Buckthorn Family)	Ziziphus Spina-Christi	Syrian Christ-Thorn

PAPILIONACEAE (Fabaceae Pea Family)	Retama Raetam	White Broom
	Ononis Natrix	Shrubby Rest-Harrow
	" Vaginalis	Sheathed " "
	Trigonella Stellata	
	Medicago Sativa	Alfalfa, Lucerne
	" Litoralis Tribuloides	Coast Medick
	" Hispida Denticulata	Bur Clover
	Trifolium Dicroanthum	Clover
	" Xerocephalum	Clover
	Trifolium Nigrescens	Clover
	Lotus Palustris	Bird's-Foot Trefoil
	" Pusillus Major	" "
	Tetragonolotus Palaestinus	Pal. Winged-Pea
	Hippocrepis Bisiliqua	Horseshoe Vetch
	" Constricta	" "
	Psoralea Bituminosa	Scurf Pea
	Psoralea Flaccida	Scurf Pea
	Colutea Istria	Aleppo Colutea
	Astragalus Fatmensis	Milk Vetch
	" Eremophilus	"
	" Corrugatus	"
	" Tenuirugis	"
	" Annularis	"
" Brachyceras	"	
" Cretaceus	"	
" Alexandrinus	Alexandrian Milk Vetch	
" Sieberi Racemosus		
" Cruentiflorus		
" Spinosus		
Onobrychis Crista-Galli	Cock's-Comb	
" Wettsteinii		
Alhagi Maurorum	Sinai Manna	
CAESALPINIACEAE (Senna Family)	Ceratonia Siliqua	St. John's Bread, Carob
MIMOSACEAE (Mimosa Family)	Prosopis Stephaniana	
ROSACEAE (Rose Family)	Crataegus Azarole	Common Hawthorn
FICOIDACEAE (MESEMBRYACEAE)	Mesembryanthemum Nodiflorum	Egyptian Fig Marigold
Fig Marifold Family	Mesembryanthemum Forskahlei Forskal	Fig Marigold
	Aizoon Hispanicum	Spanish Aizoon
	" Canariens	Purslane-Leaved Aizoon
UMBELLIFERAE (Parsley, Carrot Family)	Bupleurum Heterophyllum	Hare's-Ear
	" Gerardi Patens	Hare's-Ear
	Apium Graveolens	Smallage, Celery
	" Nodiflorum	Procumbent Marshwort or Water Parsnip
	Ridolfia Segetum	Ridolfia
	Pituranthos Tortuosa	
	" Triradiata	
	Pimpinella Cretica	Cretan Burnet Saxifrage
	Arabica	
	Pimpinella Petraea	

	Foeniculum Vulgare	Common Fennel
	Ferula Communis	Common Giant Fennel
	Chaetosciadium	Hairy-Seeded Chervil
	Trichospermum	
	Torilis Neglecta	Syrian Hemlock Chervil
	Caualis Leptophylla	Fine-Leaved Bur Parsley
ARALIACEAE	Hedera Helix	English Ivy
(Ivy or Ginseng Family)		
CAPRIFOLIACEAE	Lonicera Etrusca	Italian Honeysuckle
(Honeysuckle Family)		
RUBIACEAE	Rubia Tinctorum	Madder
(Madder Family)	" Peregrina	Madder
	" Tenuifolia Eburnea	Madder
	Asperula Humifusa Pycnantha	Woodroof
	Galium Canum Musciforme	Bedstraw
	" Petrae	
VALERIANACEAE	Valerianella Szovitsiana	Cornsalad
(Valerian Family)		
DIPSACACEAE	Scabiosa Olivieri	Scabious
(Teasel Family)	" Aucheri	Scabious
	Pteroccephalus Sanctus	Sinai Scabious
COMPOSITAE	Erigeron Trilobus	Fleabane
(Composite Family)	Asteriscus Graveolens	Stinkwort
	Anvillea Garcini	Arabian Oxeye
	Inula Viscosa	Clammy Inula
	Pulicaria Arabica	Arabian Fleabane
	Iphiona Mucronata	Spiny Goldy-Loeks
	Varthemia Montana	Mtn. " "
	Hochstetteria Schimperii	
	Leyssera Capillifolia	
	Gymnarrhena Micrantha	
	Filago Spathulate Prostrate	Broad-Leaved Cudweed
	Ifloga Spicata	
	Achillea Santolina	Santolina Milfoil
	Achillea Fragrantissima	Sweet-Smelling
		Lavender Cotton
	Pyrethrum Santolinedes	Sinai Feverfew
	Cotula Cinerea	Ashy Cotula
	Artemisia Herba-Alba	Herba-Alba
	Laxiflora	
	Calendula Aegyptica	Egyptian Marigold
	Suberostris	
	Triptaris Vaillantii	
	Echinops Glaberrimus	Smooth Globe Thistle
	Ghardinia Orientalis	
	Carlina Libanotica	Lebanon Carline Thistle
	Microcephala	
	Carduus Pycnocephalus	Plumeless Thistle
	Onopordon Ambiguum	Cotton Thistle
	Jurinea Steachelinae	
	Rhaponticum Fusillum	Dwarf Centaury
	Amberboa Lippii	Egyptian Centaury

	<i>Centaurea Ammocyanus</i>	Sand Centaury
	" <i>Damascena</i>	Damascus Centaury
	" <i>Eryngioides</i>	
	" <i>Iberica</i>	
	<i>Carthamus Lanatus</i>	Distaff Thistle
	" <i>Glaucus</i>	Smooth Safflower
	" <i>Syriacum</i>	Syrian "
	<i>Scolymus Hispanicus</i>	Spanish Oyster-Plant
	<i>Tolpis Virgata</i>	Tall Tolpis
	<i>Scorzonera Intricata</i>	Viper's Grass
	<i>Petraea</i>	
	<i>Taraxacum Megalorrhizon</i>	Fall Dandelion
	<i>Sonchus Maritimus</i>	Sea Sow Thistle
	<i>Launaea Cassiniana</i>	
	" <i>Nudicaulis</i>	Naked Launaea
	" <i>Fallax</i>	
	" <i>Massauiensis</i>	
PRIMULACEAE (Primrose Family)	<i>Anagallis Latifolia</i>	Broad-Leaved Pimpernel
APOCYNACEAE (Dogbane Family)	<i>Nerium Oleander</i>	Oleander
ASCLEPIADACEAE (Milkweed Family)	<i>Pentstemon Spiralis</i>	
	<i>Daemia Tomentosa</i>	
	<i>Cynanchum Acutum</i>	
	<i>Gomphocarpus Sinaicus</i>	
	<i>Boucerosia Aaronis</i>	
BORAGINACEAE (ASPERIFOLACEAE) Borage Family	<i>Heliotropium Rotundifolium</i>	Round-Leaved Heliotrope
	<i>Anchusa Strigosa</i>	Prickly Alkanet
	<i>Onosma Syriacum</i>	Syrian Golden-Drop
	" <i>Stellulatum</i>	"
	<i>Pellidum</i>	
	<i>Echiochilon Fruiticosum</i>	
	<i>Alhanna Orientalis</i>	Yellow or Bugloss
	<i>Angustifolia</i>	Alkanet
SOLANACEAE (Potato or Nightshade Family)	<i>Lycium Arabicum</i>	Arabian Boxthorn
	<i>Hyoscyamus Aureus</i>	Golden-Flowered Henbane
SCROPHULARIACEAE (Figwort Family)	<i>Verbascum Sinaiticum</i>	Sinai Mullein
	" <i>Rotundifolium</i>	Round-Leaved Mullein
	" <i>Schimberianum</i>	
	<i>Celsia Parviflora</i>	Small-Flowered Celsia
	<i>Anarrhinum Orientalis</i>	
	<i>Linaria Floribunda</i>	Toadflax
	" <i>Lanigera</i>	Woolly Toadflax
	<i>Linaria Macilenta</i>	Toadflax
	<i>Scrophularia Heterophylla</i>	Figwort
	<i>Veronica Macrostachya</i>	Speedwell

LABIATAE (Mint Family)	Lavandula Coronopifolia	Lavender
	Mentha Rotundifolia	Round-Leaved Mint
	Tomentosa	
	" Longifolia	Horse Mint
	Origanum Maru	
	Aegyptiacum	Hyssop
	Thymus Serphyllum	Wild Thyme
	Angustifolius	
	Ziziphora Tenuior	Spear-Leaved Ziziphora
	Salvia Pinardi	Sage
	" Palaestina	Sage
	" Lanigera	Wrinkle-Leaved Sage
	" Aegyptiaca	Egyptian Sage
	" Deserti	Desert Sage
	Scutellaria Fruticosa	Skullcap
	" Sibthorpii	Florentine Skulleap
	Ballota Undulata	Common Black Horehound
	" Rugosa	Wrinkle-Leaved B. "
	Otostegia Moluccoides	
	Phlomis Aurea	Jerusalem Sage
" Platystegia	"	
Ajuga Tridactylites	Bugle	
Teucrium Polium	Germander	
Album		
" Pilosum	Sinai Germander	
PLANTAGINACEAE (Plantain Family)	Plantago Major	Great Plantain, Waybread
	" Albicans	Woolly "
	" Bellardi	
	" Psyllium	Clammy Plantain, Fleawor
CHENOPODIACEAE (SALSOIACEAE) Goosefoot Family	Atriplex Palaestina	Palestine Orache
	Salsola Inermis	Unarmed Saltwort
	Salsola Rigida Tenuifolia	Saltwort
	Noaea Mucronata	
	Anabasis Setifera	Anabasis
POLYGONACEAE (Knotweed or Buckwheat Family)	Calligonum Comosum	Calligonum
NYCTAGINACEAE (Four-O-Clock Family)	Boerhavia Verticillata	Hogweed
THYMELAEACEAE (Daphne or Mezerdeum Family)	Dapne Linearifolia	Narrow-Leaved Dapne
	Thymelaea Hirsuta	Shaggy Sparrow-Wort
LORANTHACEAE (Mistletoe Family)	Viscum Cruciatum	Oriental Mistletoe
EUPHORBIACEAE (Spurge Family)	Chrozophora Tinctoria	Officinal Croton
MORACEAE (Mulberry Family)	Ficus Carica Genuina	Common Fig
	" Pseudo	
	Sycomorus	False Sycomore
FAGACEAE	Quercus Coccifera	
	Calliprinos	Kermes Oak

IRIDACEAE (Iris Family)	Iris Petrana	Petra Iris
AMARYLLIDACEAE (Amaryllis Family)	Sternbergia Macrantha	Large-Flowered Sternbergia
LILIACEAE (Lily Family)	Colchicum Bulbocodioides	Meadow Saffron
	" Steveni	Steven's M. "
	Urginea Maritima	Sea Squill
	Asphodelus Aestivus	Tall Asphodel
	" Fistulosus	Onion-Leaved Asphodel
	Asparagus Acutifolius	Acute-Leaved Asparagus
	" Aphyllus	Prickly "
JUNCACEAE (Rush Family)	Juncus Maritimus	Sea Hard Rush
	Arabicus	
	Juncus Punctoriosis	
	Schimperi	
CYPERACEAE (Sedge Family)	Fimbristylis Dichotoma	Annual Clubrush
	Carex Stenophylla	
	Pachystylis	Narrow-Leaved Sedge
GRAMINEAE (Grass Family)	Pennisetum Ciliare	Ciliated Cenchrus
	Andropogon Hirtus	Hairy Beargrass
	Aristida Ciliata	Triple-Awned Grass
	" Caloptila	
	Stipa Parviflora	Small-Flowered Feather Grass
	Agrostis Verticillata	Creeping Bent Grass
	Tetrapogon Villosus	
	Phragmites Communis	
	Stenophylla	Common Reed
	Melica Minuta	
	Parviflora	Small Melic Grass
	Festuca Elatior Pratensis	Fescue Grass
	Bromus Squarrosus	
	Lanuginosus	Corn Brome
Gymnosperms		
PINACEAE	Cupressus Sempervirens	Evergreen Cypress
	Horizontalis	
	Juniperus Phoenicia	Phoenician Juniper
GNETACEAE (Gnetum Family)	Ephedra Camplopoda	Leafless Shrubby Horsetail
	" Alte	Leafy "
CRYPTOGAMS-FLOWERLESS PLANTS		
POLYPODIACEAE (Common Fern Family)	Ceterach Officinatum	Miltwaste, Rustyback Fern
	Notholaena Lanuginosa	Fleecy Fern
	Cheilanthes Fragrans	Sweet Lip Fern
	Adiantum Capillus-Veneris	True Maidenhair Fern

Appendix D Fauna of Petra

MAMMALS:

<u>Name</u>	<u>Habitat</u>	<u>Remarks</u>
Nubian Ibex (Capra Ibex Nubiana)	Sandstone Mtn. Areas	Probably Extinct in Park Area, But Found to North
Mountain Gazelle (Gazella Gazella)	Above Sandstone Zone	Probably Extinct in Park Area
Fallow Deer (Dama Dama)	Desert Wadis Below Sandstone Mtns.	Probably Extinct In Park But May Drift In From W. Araba
Cheetah (Acinonyx Jubatus)	Sandstone Mtn. Areas	Questionable, But Known To Be Associated With Ibex
Wolf (Canis Lupus)	Interior	Small Pack Recorded In Naqb Valley Several Years Ago, But Poisoned Out
Striped Hyena (Hyaena Hyaena)	Throughout	Reported Occasionally
Sand Fox (Vulpes Rueppelli)		Commonly Seen Along Approach Highway

Many Smaller Mammals are no doubt in area, but no accurate reports available.

BIRDS:

The following partial list represents those birds actually observed and reported.

Fan-Tailed Raven (Corvus Rhipidurus)
Tristan's Grackle (Onychoganthus Tristami)
Sinai Rose-Finch (Erythrina Sinoica)
Cretzschmar's Bunting (Emberiza Caesia)
Rock Sparrow (Petroina Petroina)
Pale Rock Sparrow (Petroina.Brachydactyla)
Blue Rock Thrush (Monticola Solitarius)
Bonelli's Eagle (Hieraetus Fasciatus)
White Stork (Ciconia Ciconia)
Rock Dove (Columbia Livia)
Rock Partridge (Alectoris Graeca)
Sand Partridge (Ammoperdix Heyi)

REPTILES:

Very little is known of the reptilian fauna of the region and even a partial checklist cannot be included here.

Appendix E Consolidation and Conservation Projects

Restriction Of Traffic

All vehicle traffic on the paved street should be prohibited. The Roman street will not bear the weight of vehicles and it already shows signs of breaking. Horse traffic should also be kept off this high-crowned roadway.

Roman Theater

Recent wall consolidation of the scaena and stage of the Roman period theatre should be undone. It is recommended that the new stonework and the poorly erected columns be removed and the rubble-cored walls stabilized as they were when excavated.

The Siq

It is proposed in this plan to make a firm roadway through the Siq. The gradient of the Wadi floor will be made constant. At the same time flood-deposited fill in the gorge should be removed. Remnants of the ancient roadway through the Siq are visible at several spots and there are places where a considerable amount of fill has covered what remains of the road. Work in the Siq should be preceded by careful archaeological investigations to expose whatever remains of the historic road. All existing portions of the roadway should be consolidated.

The Khazna

The area immediately in front of the Khazna should be cleared of debris and any structures consolidated. This work would be protected by the rebuilding of two ancient check dams located south of the structure. The rebuilt column should be plastered, so that its appearance will not be so completely out of keeping with the original structure.

Other Sandstone Structures

Sandstone steps. On the south side of the paved street are steps that probably had a fairly long life when the inhabitants of Petra were shod with soft sandals or went barefoot. Today's visitors to the city, however, wear heavier shoes with leather soles and the steps are disintegrating rapidly. They should

be sprayed with a rock-hardener to reduce the speed of erosion. If this cannot be done immediately it might be desirable to cover the steps with earth in order to preserve them.

The Nabataean trails to High places, reservoirs or other destinations were frequently cut into sandstone and, where this was done on steep grades, steps were cut into the stone. Today it becomes necessary to use these same trails for they frequently were laid in the only feasible means of access to some of the sites.

Wherever possible new trails should be made to parallel the old ones but there will be instances where that will be impossible. In such cases the old steps should be sprayed with a rock-hardener if the steps are still usable. If the steps have become severely damaged and eroded, then new steps should be cut into the stones and these sprayed with a hardener.

Monumental Gateway And Qasr El Bint

The important work needed at these related ruins is:

- a. Rake joints around displaced masonry, clear rubble core where it has forced stones out of position, jacket the sections of the arch or wall and force stones back towards their original positions. It will probably be impossible to re-set each stone in its original position, and this is not necessarily desirable. Broken stones should be welded with an epoxy. The structure requires strengthening by internal pins, tension rods, or braces and new structural core. The top of each remaining portion of the arch or wall should be capped with a water repellent material to prevent continued damage to the structure by percolating waters. Care must be taken to protect ornamental stone work and applied plaster ornament.
- b. The missing horizontal tension beams on Qasr El Bint should be replaced with structural concrete and new wooden faces applied and sprayed with a wood preservative-pentachlorophenol which will cause no change in their appearance.

e. The arch over the entrance to the temple should be carefully grouted with mortar or epoxy. The arch voussoirs and haunch requires careful checking for incipient failure. If structural reinforcement is necessary a new reinforcing beam should be hidden and the extrados of the arch and the members of the arch hung from the new beam.

Appendix F Pencapsula - A Preservative Agent for Sandstone and Other Materials

Pencapsula, a synthetic resin, was developed for use in the National Park Service ruins stabilization program by the Texas Refinery Corporation of Fort Worth. Extensive applications and tests of it have been made since 1962 and this is a summary of the results achieved.

Pencapsula is a non-toxic viscid petrochemical which, for use, must be diluted with one of the petroleum-derived solvents. Excellent results are to be had with either mineral spirits or kerosene in the proportions of 1 part Pencapsula to 5 parts solvent. Application is best made as a spray at very low pressure (not more than 10-12 psi); we used both 3 gallon garden sprayers and 20 gallon orchard sprayers with excellent results.

It is imperative, to insure a successful treatment, that the Pencapsula be allowed to penetrate the surface of whatever material is being sprayed. Pencapsula does not form a film or membrane on the surface but is carried into the material by the solvent and then encapsulates the constituent members of the mass. This leaves open the normal tiny interstices which exist between the particles of any material and permits the normal "breathing" made necessary by changes in atmospheric and hydrostatic pressure and thus reduces any tendency for the treated portion of the material to spall.

Penetration into the sandstone should be at least 2 centimeters. Any additional penetration adds to the efficiency of the treatment. In order to achieve penetration it is necessary to spray and re-spray an area several times until capillary action carries Pencapsula into the material. In applying the Pencapsula it is usually necessary to cut or drill into the wall to determine the amount of penetration.

Once a relationship between the quantity of spray and an area of surface has been determined then it is simple enough to apply

1 gallon of dilute Pencapsula to, for instance, 100 square feet of wall surface.

"Penetration" is the important word in this instance, not, "coverage".

For purposes of estimating costs one can treat about 100-150 square feet of adobe wall surface with 1 gallon of the diluted Pencapsula; on other materials the coverage is about twice as much. A single application, well applied, is sufficient. Pencapsula is inert and one application should last for 18-20 years.

Depending on the material a treated surface will look damp for as long as six months, while the solvent is evaporating from the wall. After that there is no color change or glaze. Even though the solvent remains in the wall for a comparatively long time Pencapsula hardens and becomes effective within 24 hours.

The equipment needed to apply Pencapsula is simple, and inexpensive. The actual application can best be done with common hand operated garden sprayers with tank capacities of 3 or 4 gallons. Access to the monument for spraying the stone would be by tubular steel scaffolding - of which the Department of Antiquities has an adequate supply. Two or three men, each with a sprayer, plus one other man to mix the Pencapsula and help move the scaffolding should be able to spray all surfaces of a monument such as El Khazna in four days and much of the time would be spent in erecting or dismantling the scaffolding.

One gallon of diluted Pencapsula (1 part Pencapsula to 5 parts solvent) should successfully stabilize between 3 and 4 square meters of the Petra sandstone. Again the Khazna may be used as an example to estimate the cost of treating one monument. There are approximately 2700 square meters of rock surface at the Khazna and it is advocated that the entire structure be sprayed.

It will cost approximately 1.500 JD to spray 4 square meters of sandstone. Counting only the cost of the Pencapsula, the solvent, and labor it can be estimated that to spray the entire structure will cost about 1013 JDs.

Appendix G Audio Visual Programs

1. Orientation:

The A-V program recommended as a part of the introduction to the park consists of a brief automatic slide-tape program. This program would be designed to enhance the introductory personal contact, exhibits, and publications available to assist the visitors in planning their activities. It is highly recommended that the audio components be capable of transmitting in the 5 languages mentioned in the trail guide section of the plan.

2. Evening Programs:

A number of A-V programs, both movies and slides, should be assembled for use of the evening programs. These programs would include orientation of other points of interest in Jordan as well as specialized programs concerning various aspects of Petra.

Appendix H Exhibits

1. Visitor Center Orientation:

Exhibits in the lobby of the visitor center should be designed to assist the visitors in planning their activities while at Petra. The primary exhibit would be a large scale map of the park with an accent on the trail system. Trails should be color coded to match the color coded trail markers and guide books. Specific points of interest would be keyed to illustrations. Identification would be keyed to a pocket map printed in the 5 languages proposed for use.

Other exhibits would assist visitors in planning trips to other points of interest within the country.

2. Interpretive Exhibits:

These exhibits would display two major themes; the people of Petra and the artifacts of Petra. To describe the people it would be necessary to graphically compare them with other cultures of the world on a time scale. The time span will range from the Neolithic to the present. Each major occupational period would refer to a specific site within the park to stimulate trail useage.

The artifact display would allow the use of those artifacts too small or fragile to be displayed on-site. Each display would contain in-depth interpretation of the manufacture, use, or significance of the object. Dioramas or original artwork concerning the in-depth treatment would enhance the subject matter.

Wherever possible it should be the policy to let the exhibits speak for themselves, thus obviating the need for multilingual labels. Where labelling is necessary, it might be accomplished by small multilingual printed guides.

3. On-Site Exhibits:

Wherever possible, it should be the policy to utilize the principle of exhibiting objects in place, taking into consideration protection of the object. On-site exhibits would be a part of the trail tours.

Appendix I Publications

It is our recommendation that the principle of self guiding activities be emphasized at Petra. The primary reason for this concept is the use of the area by a large number of foreign tourists. The mechanics of multilingual labelling are a formidable task and it would be much easier to depend on multilingual publications. Another reason for the use of self-guiding activities is to reduce the dependence on guides. At best, personal guides are mediocre in their knowledge of the history of Petra and they are prone to apply their own individual interpretations that vary widely from guide to guide.

The scope of the publications should be as follows:

1. The general park folder containing a brief description of Petra and a park map. This and the following publications might be available in Arabic, English, French, German and Italian. As travel increases, it may be necessary to expand the language coverage.
2. A guide to the exhibit room.
3. A series of trail guides, color-coded to match the park trails and the lobby trail map.
4. A historical handbook to describe the antiquities in more depth.
5. A natural history guide to the plants, animals, and geology of the park.
6. As travel increases there will no doubt be an increasing demand for publications, particularly for semi-scientific reports on archeological projects in progress.

Appendix J Trail & Roads System

Foot Trails:

1. Visitor Center to Siq Entrance via the campground area.
825 m.* , 2.5 m wide.
Section, type A., some steps required, some rock carving required, some portions of trail where it crosses rock outcrops will be narrowed to 1m. in width.
2. Siq Entrance to Visitor Center via Wadi Musa
825 m, 2.5 m. wide.
3. Siq Trail.
1.35 km., wall to wall, Section, type B. large accumulations of water deposited rock to be cleared out or crushed on site for base material.
4. Exit of Siq to Roman Street
875 m., 3m wide, Section type A.
5. Qasr El Bint/Wadi trail to Visitor Contact and Day Use Area
50 m., Section type C.
6. Qasr El Bint to Wadi Sabra trail head
650 m., 2.5 m. wide, Section type A.
7. Qasr El Bint to Roman Soldier tomb
1.05 km., 2.5 m. wide, Section type A.
8. Roman Soldier tomb to Highplace
950 m., present standards, however some reconstruction necessary to ease steep runs of steps and some hand rails are required.
9. Qasr El Bint to El Deir trail head
650 m., 2.5 m. wide, Section type A.
10. To El Deir
1.85 km., present standards

11. El Deir to Siq Barid and Baidha trail junction
1.75 km., 1.5-2 m wide, graded trail.
12. Theatre - Wadi Mataha - Sidd El Ma'ajin - Visitor Center trail.
 - a. Theatre to Florentinus Tomb
550 m., 2.5 m. wide, Section type A.
 - b. Florentinus Tomb to Crusader Castle trail junction
2.5 km., 2-2.5m. wide, graded trail
 - c. Crusader Castle junction to Visitor Center
600 m., 2.5 m. wide, Section type A.
13. Spur to Roman reservoir
150 m., 2.5 m. wide, Section type A.
14. Theatre to Highplace
700 m., present standards. See note under No. 7 for additional construction.
15. Umm Al Biyarra Spur
850 m., 2 m. wide, graded trail
16. Snake Monument Spur
250 m. 2 m. wide graded trail

Horse Trails:

1. Visitor Center to Siq Entrance.
1 km., 3m. wide, graded trail
2. Siq Trail
See note No. 3 under foot trails
3. Siq exit to Nymphaeum
875 m., 3 m. wide, graded trail
4. Nymphaeum to Petra Basin trailhead
700 m., wadi bottom to be stabilized to prevent erosion of monuments and will also provide access for electric supply vehicles.

5. Petra Basin trailhead - Wadi Araba trail
12 km., 3 m. wide graded trail
6. Petra Basin trailhead - Wadi Sabra trail
8.75 km., 3 m. wide, graded trail
7. Jebel Haroun Spur
2.8 km., 3 m. wide, graded trail
8. Petra Basin trailhead - Beida trail (via Wadi El Nu'eisra
Esh Sharqiye)
4.5 km., 3 m. wide, graded trail
9. Petra Basin trailhead, via Turkamaniya tomb to Beida trail
3.2 km., 3 m. wide, graded trail
10. Wadi Sabra - Siq entrance
6.5 km., 3 m. wide, graded trail
11. Visitor Center - Beida trail
6.75 km., 3 m. wide, graded trail

* All distances are approximate and were arrived at by map measure. They do not reflect switchbacks and vertical distance. These distances will be measured in the field.
Type A Section - crushed stone with asphalt binder.
Type B Section - crushed stone without asphalt binder.
Type C Section - concrete construction.

Roads:

1. Entrance Road
175 m. 6 m. wide, cross section A.
2. Campground Roads
1.375 km., 5 m. wide, cross section B.
3. Staff housing service road
175 m. 5 m. wide, cross section B.

Appendix K

Preliminary Estimated Cost of Watershed Control on 1968 price indices.

Cost Per Hectare

Work proposed includes terracing hillsides with Gradoni terraces with an average distance of 15 meters between terraces, Seedling trees planted at 3 meter intervals along terraces and check dams constructed in torrent channels to reduce sediment transport and to turn water onto terraces. Cost includes 75 waterings of each tree over the first season.

<u>WALLS:</u> Gradoni terraces and check dams 667 meters of walls per hectare at 0.420 JD per m.	280 JD
<u>TREES:</u> 222 Seedlings per hectare at 0.050	11 JD
<u>WATER-</u> 222 trees per hectare @ 0.060 each	<u>13 JD</u>
<u>ING :</u> Cost Per Hectare	304 JD
Cost Per Acre	\$ 345

Cost of Control of Watershed of Wadi Musa & Tributaries

Assuming 10% to 25% of Gross Area, less areas already under control, will be terraced and planted.

	Gross Area Hectares	Percent Control Needed	Existing Control Hectares	Additional Control Needed Hectares	Cost Dinars
<u>INSIDE PARK</u>					
Wadi Musa above Roman Street	943	25%	138	98	29,800
Wadi Turkamaniya-2nd Priority	693	10%	none	69	21,000
Wadi Thughra - 3rd Priority	<u>665</u>	10%	<u>none</u>	<u>67</u>	<u>20,400</u>
Subtotal	2301		138	234	71,200
<u>OUTSIDE PARK</u>					
Wadi Musa	<u>4585</u>	25%	<u>360</u>	<u>786</u>	<u>239,000</u>
Total	6886		498	1020	310,200
10% Contingencies					31,020
10% Plans & Surveys					<u>31,020</u>
TOTAL					JD 372,200

Appendix L

Preliminary Estimated Development costs of Public and Staff Use Facilities* required for year 1975 (Phase I) based on 1968 price indices.

SUMMARY

<u>Building and Utilities</u>	JD 358,000
<u>Roads and Trails</u>	JD 145,000
Subtotal	JD 503,000
20% for Plans, Surveys and Supervision	JD 100,600
Subtotal	JD 603,600
Total Construction Cost (Rounded)	<u>JD 604,000</u>

* Exclusive of Land Costs, Purchase of Nazzal's Camp, Watershed Protection, highway improvements, consolidation (inventory of structures, Penscapsula etc.), publications, and carry-on studies, etc.

Preliminary Cost Estimates for Buildings Construction thru 1975 - Phase I.

Petra Entrance Development

	<u>Cost, Dinars</u>
825 m ² Visitor Center and Headquarters Building	
@ JD 30/m ²	24,750
Lobby	250 m ²
Information	
Concessions- reservations and sales	
Circulation	
Public Toilets from Lobby	50 m ²
Exhibits & Audio-Visual	200 m ²
Administration Offices	160 m ²
Conference - Library	35 m ²
Work Room & Storage	65 m ²

Cost, Dinar

First Aid Room	10 m ²
Communications Center	10 m ²
Drivers' Lounge & Toilets	15 m ²
Staff Toilets	10 m ²
Circulation	<u>20 m²</u>
Total	825 m ²

2300 m² Hotel @ JD 40/m²

92,000

Lobby and Office	100 m ²
Lounge with Bar	150 m ²
Public Toilets	30 m ²
Guest Rooms with Bath, 50 each	1500 m ²
Guest Rooms without Baths, 8 each	existing
Guest Toilets	"
Dining Room and Snack Bar	"
Public Toilets from Dining Room	"
Kitchen	100 m ²
Food Storage receiving and Trash	75 m ²
Employees Dining Room	15 m ²
Employees Lockers & Toilets	30 m ²
Laundry	100 m ²
Storage	50 m ²
Circulation	140 m ²
Mechanical Equipment Room	existing
Lunch Area Service	<u>10 m²</u>
Total	2300 m ²

400 m² Maintenance Building @ JD 20/m²

8,000

Office and Shops	40 m ²
Vehicle Bays	100 m ²
Warehouse	60 m ²
Outdoor Storage Shelters	120 m ²
Mechanical Equipment and generator room	<u>80 m²</u>
Total	400 m ²

	<u>Cost, Dinars</u>
Subtotal Cost Petra Basin Development	14,800
Total Cost for Building 10% Contingencies	265,550
Total Cost for Buildings (rounded)	292,000

Preliminary Cost Estimate for Utilities Construction for year 1975 (Phase I)

Petra Entrance Development

1 each Well, 500 meters deep, with pump	15,000
1 each Reinforced Concrete Reservoir, 750 m ³	11,000
200 m. Steel pipe water lines, 3", @ 2.0 JD/m.	400
1600m. Steel pipe water lines, 2", @ 1.50 JD /m.	2,400
200 m. Steel pipe water lines, 3/4"-1" @ 1.00 JD/m.	200
1 lot Miscellaneous control equipment	<u>2,000</u>
Subtotal Water System	31,000
1000m. Clay Sewer, 6", @ 3.00 JD/m.	3,000
1 each Septic Tank, concrete, 30 m ³	250
1 each Septic Tank, concrete, 17 m ³	150
3 each Septic Tank, concrete, 14 m ³ @ 100 JD.	300
320m. Absorption Trench @ 2.50 JD/m.	<u>800</u>
Subtotal Sewer System	4,500
1200m. Electric Power Line, Underground @ 3 JD/m.	3,600
1000m. Telephone Line, Underground @ 2 JD/m.	<u>2,000</u>
Subtotal Petra Entrance	41,100

Petra Basin

1 each Reinforced Concrete Reservoir, 140 m ³ .	5,000
200 m. Steel pipe water line, 2"-2" @ 1.50.	300
1 each Well improvement, incl. pump, hypochlorinator	<u>2,700</u>
Water System Subtotal	8,000
100m. Clay Sewer pipe, 6" @ 3.0 JD/m.	300
1 each Septic Tank, concrete 7 m ³	100
40 m. Absorption Trench @ 2.50 JD/m.	<u>100</u>
Sewer System Subtotal	500

1 sum	Electric Generating Plant, building w/2-5kw	3,000
	sets including distribution lines	
3700m.	Telephone Line, underground @ 2 JD/m.	<u>7,400</u>
	Subtotal Petra Basin	<u>18,900</u>
	Total	60,000
	10% Contingencies	6,000
	Total for Utilities	66,000

Preliminary Cost Estimate for Roads and Trails construction
for year 1975 (Phase I)

<u>Petra Entrance Development</u>		<u>Cost, Dinars</u>
150 m.	Entrance Road 6 m. wide @ JD 3/m ²	2,700
3219 m ²	Parking @ JD 2/m ²	6,438
1200 m	Campground Roads 5m. " @ JD 2/m ²	12,000
237 m	Service Roads 5m. wide @ JD 2/m ²	2,370
3000 m ²	Walks & Terraces @ JD 1,500/m ²	<u>4,500</u>
	Subtotal	28,008
<u>Petra Basin Development</u>		
1500 m ²	Walks & Terraces @ JD 1.500/m ²	2,250
	Subtotal	2,250
<u>Park Trails</u>		
10 km	Trails - horse 2m. wide @ JD 1.200/m ²	24,000
40 km	Trails - foot 2m. wide @ JD .400/m ²	32,000
1 each	Misc. Improvements	<u>5,000</u>
	Subtotal	61,000
	Total	91,258
	10% Contingencies	9,125
	Total for roads and trails (rounded)	100,400

Preliminary Estimated Foreign Exchange Cost for Capital
Development and Operation thru Year 1975 (Phase I) based
on 1968 Prices.*

Item	Net Cost	Percentage and Cost Attributed to Foreign Exchange	
<u>Buildings</u> - general construction	JD 120,550	15%	JD 18,082
mechanical contracts	JD 80,000	50%	JD 40,000
movable furniture, fixtures, & equipment	JD 65,000	80%	<u>JD 52,000</u>
Subtotal			JD110,082
<u>Utilities</u> - sewage	JD 5,000	30%	JD 1,500
water	JD 39,000	40%	JD 15,600
electricity	JD 6,600	60%	JD 3,960
communications	JD 9,400	70%	<u>JD 6,580</u>
subtotal			JD 27,640
<u>Roads & Trails</u>	JD 91,258	10%	JD 9,125
<u>Plans & Surveys</u>	JD 100,600	5%	JD 5,030
<u>Watershed Protection</u>	JD 25,000	100%	JD 25,000
TOTAL (rounded)			JD180,000 or (\$507,600)

* Estimates are broadly based and total may vary \pm 25%.

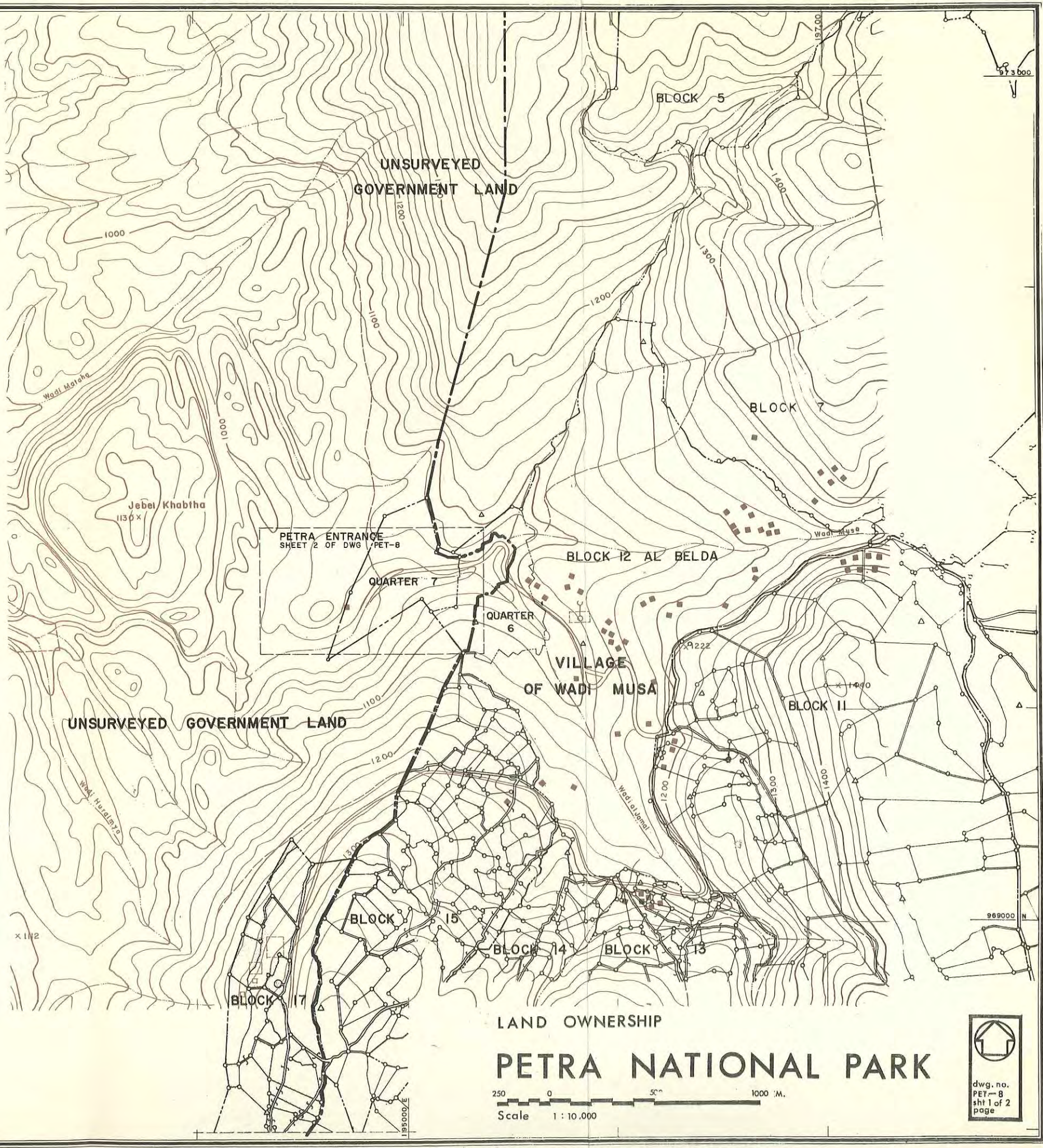
Appendix M

Preliminary Phase I Staffing and Costs

<u>No.</u>	<u>Position</u>	<u>Annual</u>	<u>Total</u>
		<u>Salary</u>	<u>Annual</u>
		<u>JD</u>	<u>JD</u>
1	Park Superintendent	600	600
1	Administrative Officer	420	420
1	Personnel Clerk	216	216
1	Property Clerk	216	216
1	Fiscal Accounting Clerk	240	240
1	Stenographer	288	288
1	Supervisor of Visitor Services	480	480
6	Park Rangers, Permanent	360	2160
8	Park Rangers, Seasonal	80*	640
1	Supervisor of Maintenance	420	420
2	Foremen	360	720
4	Equipment Operators	216	864
2	Storekeepers	180	360
2	Mechanics	240	480
8	Laborers, Permanent	144	1152
8	Laborers, Seasonal	<u>48*</u>	<u>384</u>
			9651
	Annual Payroll (rounded)	JD 10,000	
	Estimated Operation, and maintenance materials, supplies and equipment rental: (Rule of thumb ratio:) (50% of personal services)		<u>5,000</u>
	Total Annual Operation and Maintenance		JD 15,000

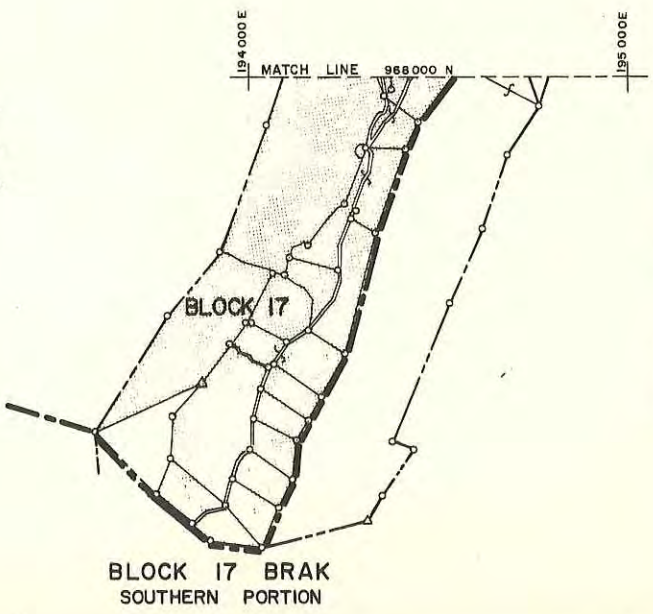
* 4 months

73000 N
190000 E
190000 E
73000 N



LEGEND

- PROPERTY CORNER (ANGLE IRON OR TEE) ○
- PROPERTY LINE ———
- BLOCK LINE - - - - -
- PROPOSED PARK BOUNDARY - - - - -
- PRIVATE LAND WITHIN PROPOSED PARK [shaded area]



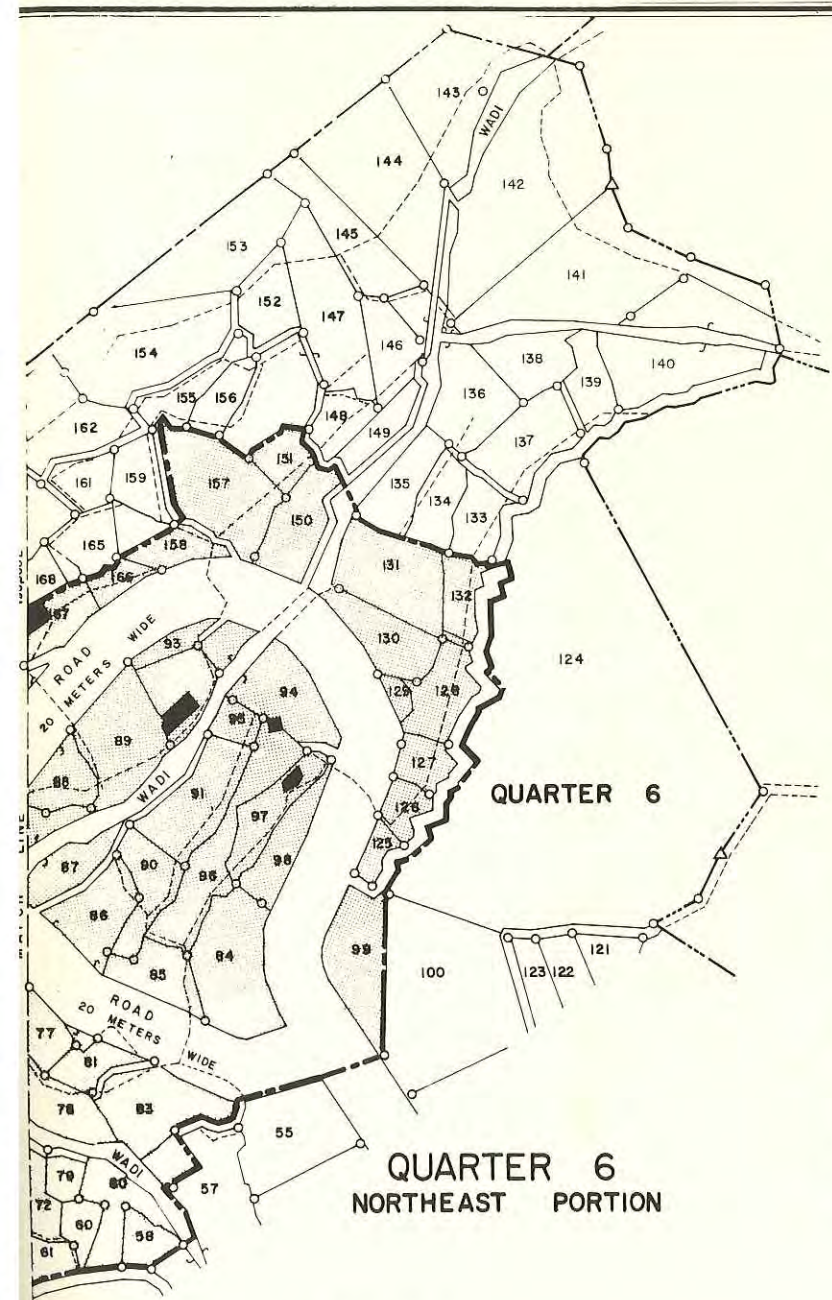
LAND OWNERSHIP

PETRA NATIONAL PARK

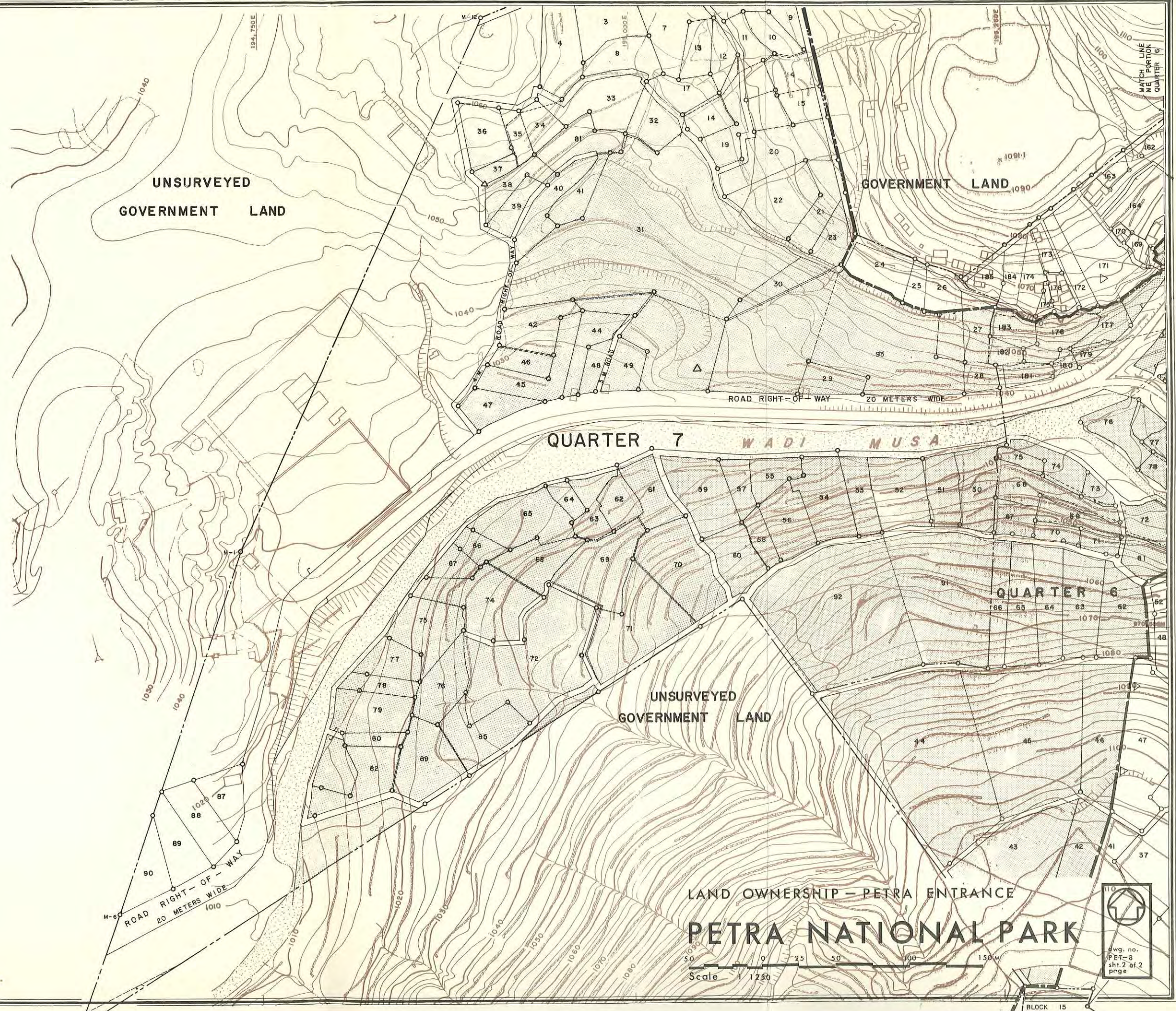
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PET-8
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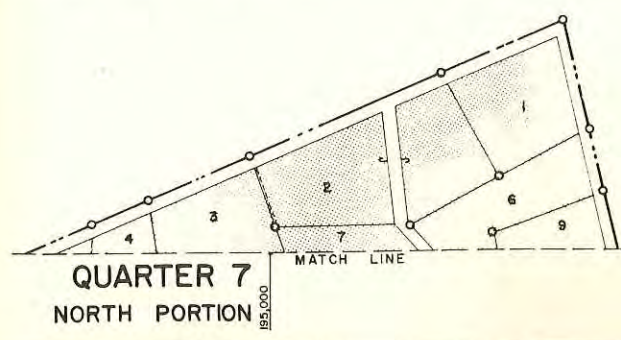


**QUARTER 6
NORTHEAST PORTION**



**QUARTER 7
NORTH PORTION**

- LEGEND**
- BLOCK 12 AL BELDA QUARTERS 6 & 7
 - PROPERTY CORNER (ANGLE IRON OR TEE) ○
 - BLOCK LINE ———
 - QUARTER LINE - - - - -
 - PROPERTY LOT LINE ———
 - PRIVATE LAND WITHIN PROPOSED PARK [shaded box]
 - PROPOSED PARK BOUNDARY - - - - -



LAND OWNERSHIP - PETRA ENTRANCE
PETRA NATIONAL PARK



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page

Appendix N Land & Boundary Survey Costs

The purchase price of all private lands including improvements within the proposed park as shown on drawing No. PET-15, sheet 1 & 2, is estimated at 127,500 dinar.

Figure 5 below gives a breakdown of the estimated costs. Land and building values are based on the sale price of 4 lots (Block 12, Quarter 7, Lots 87-90 incl.) to the Government in 1967. Adjustments have been made for the relative value of the lands.

Figure 5 Land Costs

Block 12, Quarter 6, Village of Wadi Musa	
Land 64.9 dunums @ avg. 213 JD.	13,780 JD
Buildings (4) 200 sq. meters @ 5 JD.	1,000.
Block 12, Quarter 7, Village of Wadi Musa	
Land 117.6 dunums @ avg. 245 JD.	28,790 JD
Buildings (2) 50 sq. meters @ 5 JD.	250
Block 17, Tayiba Road	
Land 831 dunums @ avg. 100 JD.	83,100 JD
Buildings (est) 100 sq. meters @ 5 JD.	<u>500</u>
Total 1013.5 dunums, 350 m ² buildings	127,410 JD
Total Land Costs (Rounded)	127,500 JD

Cost of Boundary Survey

Cost based on making a traverse of the boundary with transit and tape and making permanent markers (SCRIBED ANGLE IRON) every 100 meters.

Cost Estimate

700 JD

Appendix O Mapping of Petra

Existing Published Maps

The maps listed below were used in the preparation of this Master Plan. Most of the maps are at too small a scale to show details of the antiquity sites. Those maps which were prepared in the past specifically to show the antiquities are more in the nature of sketches rather than accurate maps.

1. UK War Office and Air Ministry and US Army Map Service, Topographic Map NH 36 (Cairo) of Series 1301, scale 1: 1,000,000, 1960. This map, together with three others of the series was used to produce the overall map of Jordan showing the location of the Park.
2. US Army Map Service Topographic Maps NH 36-8, NH 36-12, NH 37-5, and NH 37-9 of series K 502, Scale 1: 250,000. Edition 3-AMS, 1961.
3. UK Royal Engineers, Topographic Maps, South Levant Series 1:100,000 scale sheet NH-36-L3 'Ein el Weiba, First Edition 1946 and sheet NH-36-L5 Gharandal, Edition 1-GSGS 1944, reprinted 1957.
4. US Army Map Service, Topographic maps 3050 I, 3050 II, 3050 III, 3050 IV, 3150 III and 3150 IV of Series K737, scale 1:50,000, Editions 1-AMS 1959 or provisional printing (undated). This series of maps covers the entire Kingdom of Jordan in 183 sheets. The two sheets of this series covering the area within the proposed park boundary were compiled from aerial photographs taken in 1961 and from other data furnished by the Jordan Department of Lands and Surveys. These maps are the most detailed produced to date of the area of concentration of antiquity sites of Petra and environs. However the scale is too small (1 centimeter = $\frac{1}{2}$ kilometer) to serve as a base for locating individual sites.

5. Jordan Department of Lands and Surveys, Archeological Map of the Hashemite Kingdom of Jordan, sheets 2 and 3, Scale 1:250,000, 1949.
6. Jordan Ministry of the Interior for Municipal and Rural Affairs, Topographic Map of Wadi Musa, scale 1:1250, 1967.
This map, in 5 sheets, was produced from aerial photography by Aero-Precisa, Beirut for town planning purposes. Mapping extends to the west only as far as the Petra Entrance Rest House. Coverage is shown on drawing PET-15 Index of Mapping, attached to this report.
7. Brunnow, R.E. and Domaszewski, A.V.; Die Provincia Arabia, Vol. I, verlag Von Karl J. Trubner, Strassburg 1905. This publication contains detailed sketch maps of Petra including an overall map of Petra Basin and the Siq carrying a scale indication of 1:10,000. The map is useful in showing general locations of archeological features but scale distortion and stylized relief make the map inadequate as an accurate archaeological base map. The overall scale of the sketch has been found to be about 1:6850.
8. Kennedy, A.B.W., Petra, Its History and Monuments, Country Life Press, London, 1925. This publication contains mosaics of aerial photographs taken in 1923 and a sketch map of the Petra area extending to the north to include Beida. These were the only aerial photos available to the Park planning team and the Petra Basin drawings of this Master Plan were based partly on the Kennedy mosaics.

9. Wiegand, Theodor (editor); Wissenschaftliche Veroffentlichen des Deutches - Turkischen Denkmalschutz - Commandos; Heft III - Petra Berlin. 1921. This publication contains a map of the ruins along the Roman Street. This map was the most detailed available to the study team.

Proposed Mapping

In the course of this Master Plan study mapping by plane table of the entrance development site was undertaken by members of the American team and Jordanian counterparts. Control traverses were run by transit and tape and palestine grid coordinates were calculated for permanent control points. Mapping was done at a scale of 1:500 with a contour interval of 1 meter. Completed mapping is shown by the shaded area on the Index of Mapping, Drawing No. PET-15.

In addition to the above work a layout for topographic sheets of Petra Basin at the same scale (1:500) was prepared as shown on drawing PET-15. A control traverse was run by transit and tape through the Siq to Nazzal's Camp and returned to the entrance area by another route via Wadi Mataha. Palestine grid coordinates for these points were calculated but no actual mapping was done. It is estimated that it would cost 5400 JD. to complete the survey of Petra Basin by the Plane table method.

As an alternate to mapping the basin by plane table an estimate was received from Aero Precisa, Beirut of the cost of mapping by aerial photography. In addition to mapping of the basin the estimate includes mapping a larger area extending from Es Sabra to Beida of a scale of 1:2500.

The estimate is as follows:

LEGEND

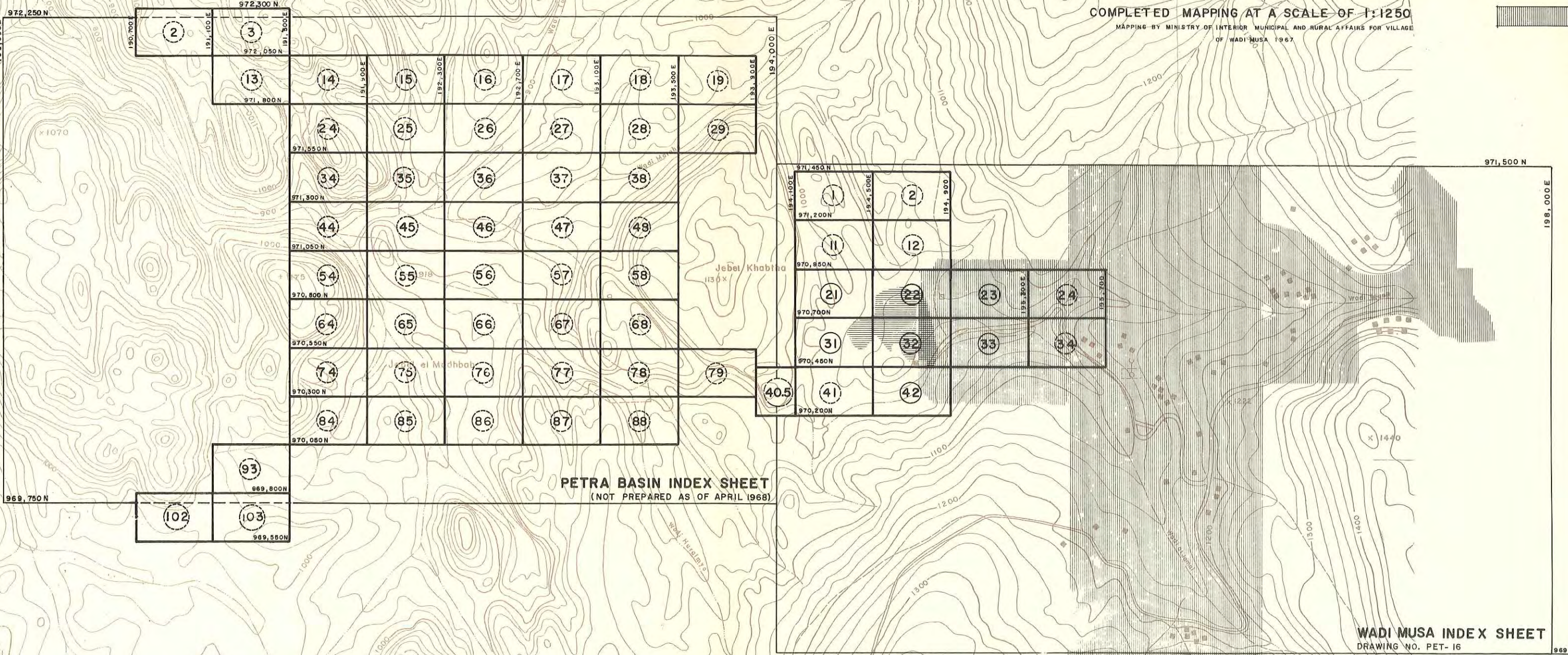
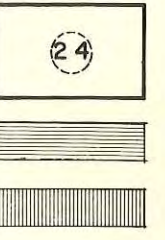
PROPOSED TOPOGRAPHIC SHEETS AT 1:500 SCALE

CIRCLED NUMBER IS THE SHEET NUMBER
A SOLID CIRCLE INDICATES SHEET HAS BEEN STARTED
SHEETS ON WADI MUSA INDEX ARE DWG. NO. PET-16

COMPLETED MAPPING AT A SCALE OF 1:500

COMPLETED MAPPING AT A SCALE OF 1:1250

MAPPING BY MINISTRY OF INTERIOR MUNICIPAL AND RURAL AFFAIRS FOR VILLAGE
OF WADI MUSA 1967



PETRA BASIN INDEX SHEET
(NOT PREPARED AS OF APRIL 1968)

WADI MUSA INDEX SHEET
DRAWING NO. PET-16

INDEX OF TOPOGRAPHIC MAPPING

PETRA NATIONAL PARK



dwg. no.
PET-15
page

Aerial Photographs		\$ 5,000
500 hectares	1:4000 scale	
7200 hectares	1:15000 scale	
Topographic Maps	1:500 scale	9,150
Topographic Maps	1:2500 scale	<u>14,250</u>
	Total	\$28,400
	Approximately 10,000 JD	

Recommendation

It is recommended that mapping by aerial photography of the entire Park be done at a scale of 1:5000 (rather than 1:2500) with a 10 meter contour interval and that the areas of concentration of antiquities (Petra Basin, Beida, Siq Barid) be mapped at a scale of 1:500 by aerial photography with extensive supplemental plane table work to map all features of antiquity. This recommendation extends the area for which the Aereo Precisa estimate was prepared but reduces the scale of the overall mapping. It is estimated that the work recommended here would cost approximately 12,000 dinars.

SELECTED BIBLIOGRAPHY

Battelle Memorial Institute

- 1967 Report on Jordan Airports' Feasibility Study
by James W. Fay and others. Battelle Memorial
Institute, Columbus, Ohio.

Bennett, Crystal M.

- 1962 "The Nabateans in Petra"
Archaeology 15(4), pp. 233-243

Brunnow, R. E. and Alfred V. Domaszewski

- 1905 Die Provincia Arabia, 3 Vols
Strassburg, (Verlag Von Karl J. Trubner)

Burckhardt, John Lewis

- 1822 Travels in Syria & the Holy Land
Murray, London

Glueck, Nelson

- 1965 Deities and Dolphins
Farrar, Straus & Giroux, New York

Government of Transjordan

- 1939 Report on the Water Resources of Transjordan
and their Development by M.G. Ionides incorporat-
ing a Report on Geology, Soils and Minerals by
G. S. Blake.
Crown Agents for the Colonies, London

Hammond, Philip C.

- 1964 "The Excavation of the Main Theatre at Petra.
Annual, Dept. of Antiquities of Jordan Vol.
VIII & IX, Amman.

- 1964 "Rose - Red City of Petra"
Natural History, February, 1964, pp.14-25.

- 1967 "Desert Waterworks of the Ancient Nabataeans"
Natural History, June-July, 1967, pp.37-43.

Harding, G. Lankester

- 1959 Antiquities of Jordan
Lutterworth Press, London

Hashemite Kingdom of Jordan

- 1959 "Handbook of the Geology of Jordan" by David J. Burdon (to accompany and explain the three sheets of the 1:250,000 Geological Map of Jordan East of the Rift by Albert M. Quennell)
Benham and Company Ltd. Colchester
- 1964 "Tourism Statistics," Numbers 1-3
1966
- 1967 "Tourism Statistics," Quarters 1-3, Ministry of Tourism & Antiquities, Amman.
- 1966 "Review of Springflow Data." Technical Paper No. 40.
Natural Resources Authority, Amman.
- 1967 "Torrent Training works in Wadi Sommn." A Detailed Demonstration Programme by Ivo M. Godeh. Project for Training and Demonstration in afforestation and Forest Management. Project Interim Report No. 15
Ministry of Agriculture, Dept. of Forestry, Amman.

Hoade, Eugene

- 1966 "East of the Jordan"
Franciscan Press, Jerusalem.

Horsefield, G. & A.

- 1938 "Sela-Petra, the Rock, of Edom and Nabateane: The Excavations"
Quarterly of the Dept. of Antiquities of Palestine, III (3), pp. 87-115.

Horsefield, G. & Agnes Conway

- 1930 "Historical & Topographical Notes on Edom: With an Account of the First Excavations at Petra".
Geographical Journal, 76 (5), pp 369 ff.

Kennedy, Alexander, B. W. (Sir)

- 1925 Petra, Its History and Monuments Country Life Press, London.

Kirkbride, Diana

- 1960 "A short Account of the Excavations at Petra in 1955 and 1956".
Annual, Dept. of Antiquities of Jordan Vol. IV & V, Amman.

Kirkbride, Diana

- 1962 "Excavation of the Pre-Pottery Neolithic Village at Seyl Aqlat, Beidah" Annual, Dept. of Antiquities of Jordan Vol. VI & V, Amman.

Moscato, Sabatino

- 1957 "Ancient Semitic Civilizations" G.P. Putnam's Sons, New York.

Mountfort, Guy

- 1965 "Portrait of a Desert" Houghton Mifflin Co., Boston

Murray, M.A. & J.C. Ellis

- 1940 "A Street in Petra" Bernard Quaritch, London

Parr, Peter J.

- 1962 "Nabataean Sanctuary Near Petra" Annual, Dept. of Antiquities of Jordan Vols. VI & VII, Amman

- 1963 "The Capital of the Nabataeans" Scientific American, October 1963.

Parr, Peter J. & Father J. Starky

- 1963 "Three Altars from Petra" Annual, Dept. of Antiquities of Jordan Vols. VI & VII, Amman.

Peake, Frederick G.

- 1958 "History and Tribes of Jordan" University of Miami Press, Coral Gables, Fla.

Polunin, Oleg and Anthony Huxley

- 1966 "Flowers of the Mediterranean" Houghton Mifflin Co., Boston

Poore, M. E. D. & V. C. Robertson

- 1964 "An Approach to the Rapid Description and Mapping of Biological Habitats" The Sub-commission on conservation of terrestrial Biological communities of the International Biological Programme; the Nature Conservancy, London.

Post, George E.

1932 "Flora of Syria, Palestine & Sinai"
Vol. I, Second Edition, Revised by John
E. Dinsmore
American Press, Beirut.

1933 "Flora of Syria, Palestine & Sinai"
Vol. II, Second Edition, Revised by John
E. Dinsmore.
American Press, Beirut.

Smith, George Adam

1966 "The Historical Geography of the Holy Land,
25th Edition"
Fontana Library, London and Glasgow.

Starcky, Jean

1955 "The Nabataeans, A Historical Sketch"
Biblical Archaeologist, XVIII (4) pp 84-105.

Van Beak, G. W.

1960 "Frankincense and Myrrh"
Biblical Archaeologist, XXIII (3) pp. 70-95.

Wiegand, Theodor (Editor)

1921 "Wissenschaftliche Veroffentlichen Des Deuteshes
Turkischen Denkmalshutz"
Commandos - Vol. III - "Petra"
Berlin.

Wright, G. R. H.

1962 "The Khazne at Petra: A Review"
Annual, Dept. of Antiquities of Jordan
Vols. VI & VII, pp. 24-54, Amman.

Zohary, Michael

1962 "Plant Life of Palestine"
The Ronald Press Company, New York

