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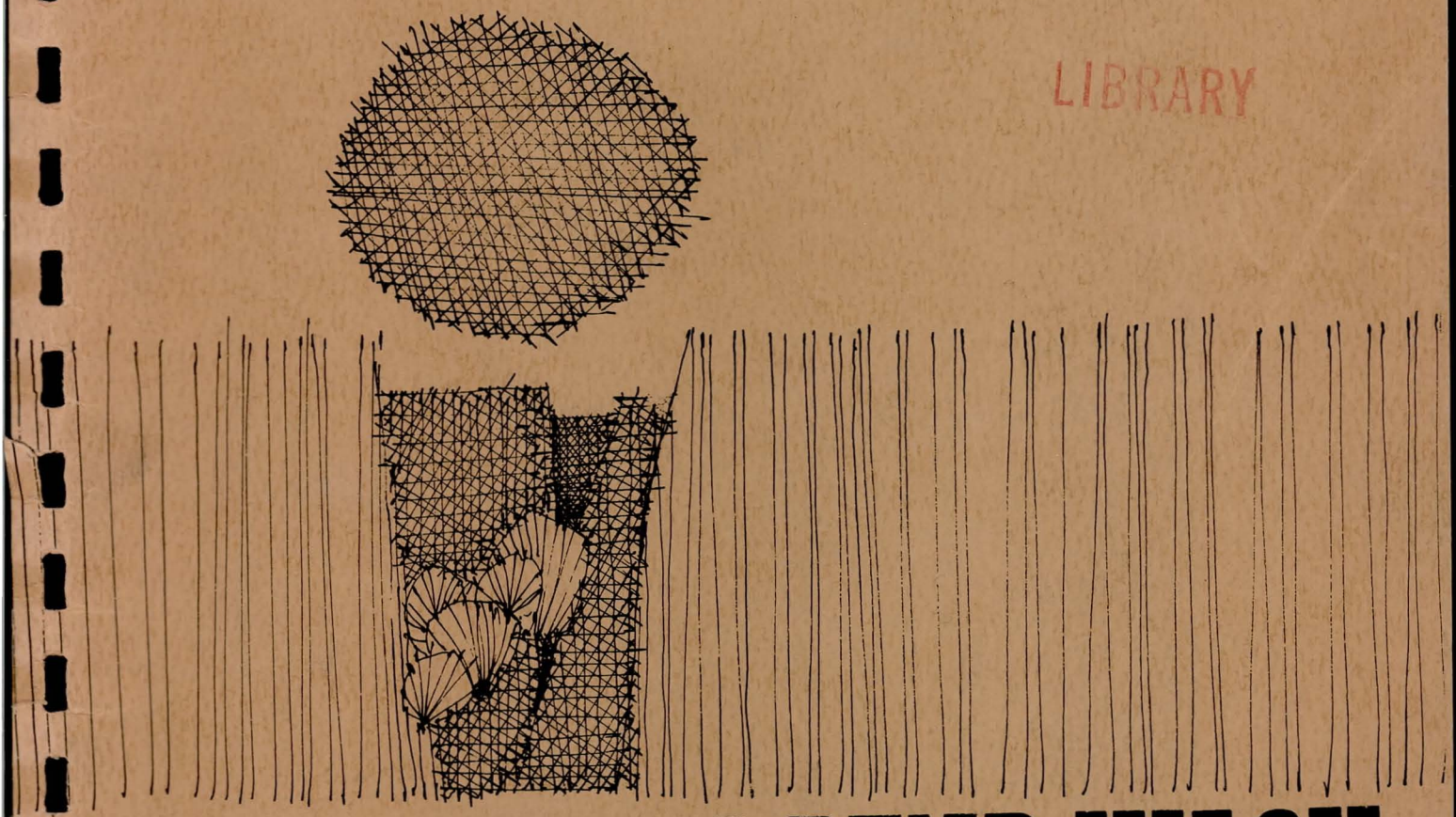

THE INDIAN BEND WASH

January 21, 1972

A. Wayne Smith & Associates

A680.912

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SUBJECT OR TITLE Indian Bend Wash		
REMARKS Attached for your file is a copy of the environmental inventory and ecological analysis of Indian Bend Wash prepared under contract by A. Wayne Smith and Associates.		
TYPED NAME, GRADE AND TITLE FRANK P. CARROLL, Acting Chief, Channels Section	SIGNATURE Clifford W Ford	

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ENVIRONMENTAL INVENTORY

AND

ECOLOGICAL ANALYSIS

OF

THE INDIAN BEND WASH

Submitted to

U. S. Army Engineer District, Los Angeles
Corps of Engineers

By

A. Wayne Smith & Associates
2120 South Rural Road
Tempe, Arizona 85282

As authorized by

Contract No. DACW09-71-C-0055

January 21, 1972

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CHAPTER I

INTRODUCTION AND PERSPECTIVE

A. Objective

The objective of this report is to present the Corps of Engineers with an Environmental Impact Study of the Indian Bend Wash. The study will include information on all aspects related to the Wash. The compilation and analysis of the information will provide the Corps of Engineers with the basis for evaluation of the environmental consequences, both positive and negative of various alternatives.

B. Scope of Study

The scope of the project as directed by the Corps of Engineers is to collect, compile and analyze environmental factors and conditions as they exist or are proposed for the Indian Bend Wash. The project is divided into five major divisions. They are: (1) a general physical description of the project area, (2) an inventory of environmental and ecological elements, (3) identification of environmental problems, (4) evaluation of environmental impact of each project alternative, and (5) conclusions of alternatives based on their environmental impacts. Other factors will also be considered in the report. These factors include topography, climate, geology, soils, hydrology, water quality, flora and fauna, population distribution, land use, recreation, open space and significant historical and archeological sites.

C. Site Location and General Description

The Indian Bend Wash basin, which is a small part of the 58,200 square-mile drainage area of the Gila River, comprises about 224 square miles in south-central Arizona, about ten miles east and northeast of Phoenix. The Indian Bend Wash is a tributary of the Salt River upstream from Phoenix. The basin, (Figure 1) which is entirely within Maricopa County and partly within the Phoenix Metropolitan area, is an elongated area with a maximum north-south length of about 26 miles and a maximum east-west width of about 15 miles. The drainage area is bounded on the east by the McDowell Mountains, on the north and west by Cave Creek drainage area, the southwest by the Phoenix Mountains and on the south by the Salt River. The Arizona Canal flowing from east to west, runs through the lower parts of the area and for low flows acts as a barrier. The mountain area is characterized by rugged terrain and steep gradients, while the lower part of the area is characterized by flat valley land and regular alluvial slopes. Approximately 24% of the area is mountainous and the remaining 76% is on the alluvial plains.

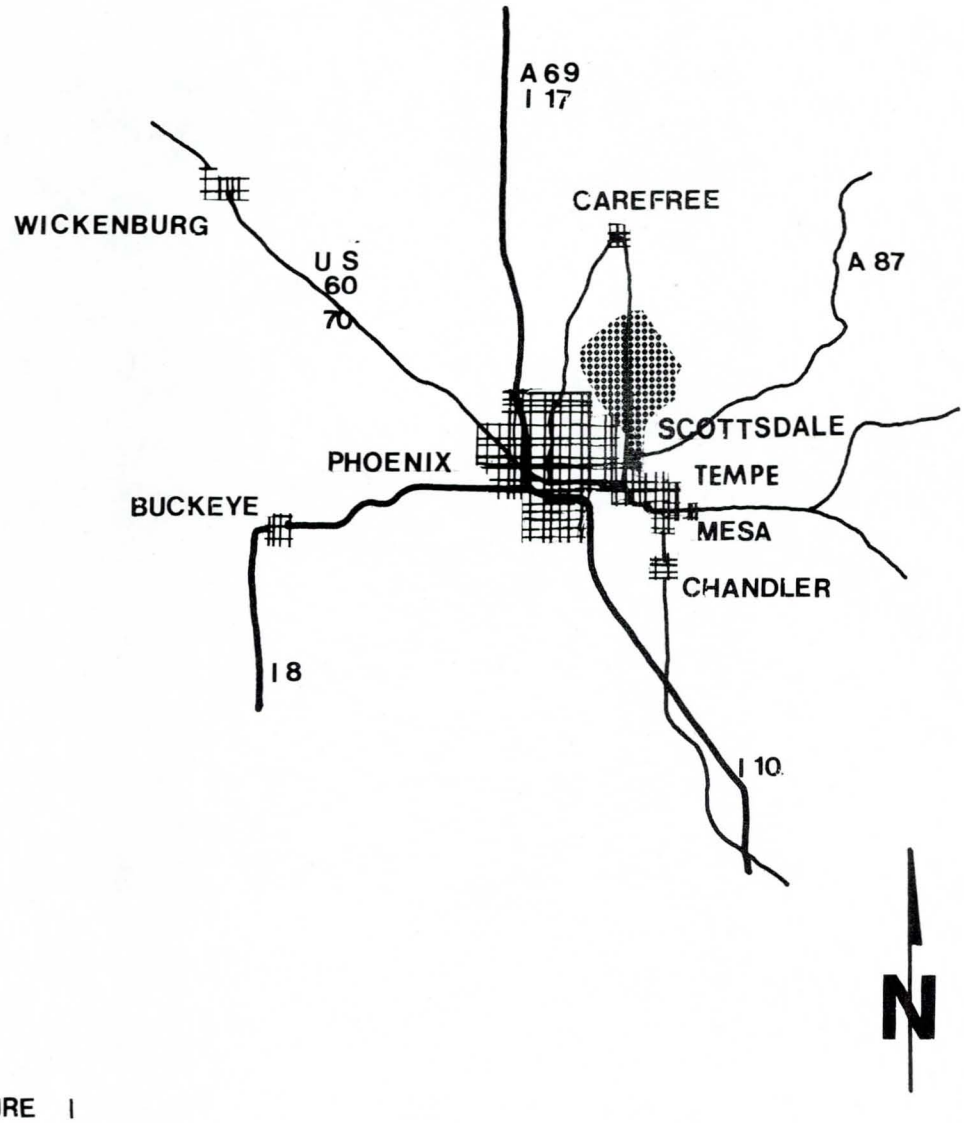


FIGURE 1

VICINITY MAP OF STUDY AREA

STUDY AREA

CHAPTER II

DESCRIPTION AND ANALYSIS OF PHYSICAL ENVIRONMENTAL FACTORS

A series of variable length, parallel ephemeral streams descend the slopes of the mountains to the alluvial plains where the water courses are ill-defined and spread out over large areas. The length of the main water course is approximately 14 miles. Elevations in the area range from about 4,000 feet above mean sea level at McDowell Peak to approximately 1,160 feet at the Salt River near Tempe. The gradient of the main stream range from about 100 feet per mile in the head waters to about 20 feet per mile at the lower end of the considered channel.

A. Geology

The rock materials in the study area vary widely in character (Figure 2). Fine grained, coarse grained, and metamorphosed granites, including Gneiss and Schist, sand stones, breccias, and metamorphosed sedimentary rock and various lava rock including basalt, andesite, rhyolite, volcanic glass and white tuff are present.

B. Edaphology

The soils of the study area are typical of desert and semi-desert regions, being mostly shallow, rocky, and poorly developed (Figure 3).

The soils in the mountains are residual. The valley area occupies a broad plain that has been built up from water deposited soil forming materials and rock debris. These soils consist of various forms of clays and loams. The soils range from coarse material in the upper part to fine materials in the lower part of the area.

C. Hydrology

Of all the physical environmental factors at play in this area, the water factor is the most critical and limiting. Precipitation in the area is low. An average rainfall of 9.5 inches per year falls on the study area. Rainfall is divided about equally between the summer and winter season.

Three types of storms produce precipitation in the Indian Bend Wash study area. They are general winter storms, general summer storms and local thunderstorms.

General ~~summer~~ winter storms occur from November to March. They are usually widespread and may last several days.

General summer storms occur in July and August. They are usually widespread with heavier amounts of rainfall than winter storms and usually last for twenty-four hours, with smaller showers continuing for another three days.

Local thunderstorms may occur at anytime of the year, with heavier amounts of rainfall usually occurring in the hot summer months. They cover comparatively small areas, but may have very intense rainfall for a short period of time (up to three hours). The most severe thunderstorm on record was the August 19, 1954 storm over the Queen Creek drainage area.

No stream flow occurs except immediately following the heavier rains, because climatic and drainage area characteristics are not conducive to continuous runoff. Because of steep gradients, stream flow in the mountains increases rapidly in response to high intensity rainfall and causes high peak, debris-laden floods to flow onto the valley plains below. The percentage of impervious area is increasing appreciably with the suburban development taking place in the study area, thus increasing runoff flows from high and low intensity storms.

Flood-hazard analysis.--The magnitude of the floods used in this report and size of area contributing flows are illustrated in the following table: (see p. 6).

C.P.*	Drainage Area Sq. Mi.	SPF** c.f.s.	Flood Frequency 100-year c.f.s.	50-year c.f.s.	25-year c.f.s.
1	152	72,000	40,000	30,000	21,000
2	90	55,000	30,000	21,000	15,000
3	69	45,000	25,000	18,000	13,000
4	32	25,000	14,000	10,000	7,500
5	9	8,000	4,500	3,300	2,300

Taken from Flood-Plain Information Study for Maricopa County, Arizona Volume I, Indian Bend Wash Report, 1964.

Note: Volumes do not reflect influence of Granite Reef Dam.

* C.P. is Concentration Point as shown on drainage area map (Figure 4).

**SPF is Standard Project Flood in cubic feet per second.

Characteristics

The major flood flows in the Indian Bend Wash area are flash type floods produced by high intensity, relatively short duration thunderstorms. These storms are difficult to predict and consequently, there is insufficient time to protect property from resulting flood damage.

The torrential type of flood flows from the steep mountain slopes and disperses across the alluvial plains in what might be considered sheet flows. The flows are only interrupted and concentrated at times by man-made structures such as the old Verde Canal, Arizona Canal, individual surface drainage systems, and street systems. This flow condition continues until the waters are collected in the Indian Bend Wash main channel. After reaching the main channel of the Wash, floods are then

contained in that channel and its immediate flood plain through Scottsdale and Tempe, below the Arizona Canal to the Salt River.

Ground Water

The Indian Bend Wash basin, formed more than a million years ago, is filled with debris from the surrounding mountains including clay, silt, sand, gravel and boulders. No extensive measurements of the valley fill have been made. However, sufficient information is available to determine that ground water can be reached at 500 feet. Ground water contained in the younger sediments constitutes the main reserve although deep wells have penetrated the oldest sediment layers tapping permeable zones in both deposits.

D. Climatology

The climate of the Indian Bend Wash area is a desert type with low annual rainfall and low relative humidity. The winds are predominately from the west-southwest. Daytime temperatures are high throughout the summer months. The winters are mild. The mean annual temperature is 85°. Killing frosts occur infrequently.

CHAPTER III

ANALYSIS OF ECOLOGICAL FACTORS

A. Natural Community Distribution

Exact delineation of natural communities is difficult because of human influences in the study area (Figure 5). South of the Arizona Canal, the natural community is non-existent. North of the Canal, the communities are somewhat more recognizable. The general distribution of the natural communities in this portion of the study area consists of greasewood and creosote covered foothills and flood plains to mesquite thickets along the channel. However, the drainage area is rapidly being developed into suburban developments. The net result of such influences is an extremely dissected and discontinuous array of natural community segments (See Figure 5). It should be noted that this map is in continual change because of developmental encroachments.

B. Phytosociology

Two general flora communities may be identified with the Indian Bend Wash, (Figure 5) generally delineated at the Arizona Canal. To the north of the Canal, flora may still be found in its natural state. Made up of creosote bush and mesquite, the natural character of the wash still exists in part, in this area. However, this is changing daily by the encroachment of urban developments. An altered ecosystem

has come into existence south of the Canal, because of extensive irrigation and cultivation by man.

Of all the native plants in the area, none are considered rare or in danger of extinction.

Plant Species Found in Foothills

Common Name	Scientific Name
Ocotillo	Fouquieria splendens
Saguaro	Cereus giganteus
Hedgehog	Echinocereus

Plant Species Found in Flood Plain

Common Name	Scientific Name
Common Mesquite	Prosopis juliflora
Creosote Bush	Larrea tridentata
Torrey Wolfberry	Lycium torreyi

Plant Species Found in Flood Channel

Common Name	Scientific Name
Palo Verde	Cercidium floridum
Common Mesquite	Prosopis juliflora
Ironwood	Olneya tesota
Ambrosia Bursage	Franseria ambrosioides
Broom Baccharis	Baccharis sarothroides

Note: Plant identification and spelling based on "Standardized Plant Names", 1942.

C. Animal Speciation

The Indian Bend Wash supports a wide variety of wildlife species. Most of the larger animals are forced to live in the upper portion of the drainage system, because of the encroachment of civilization. However, most of the bird species can be found throughout the entire drainage area.

Following are listings of some of the more numerous species to be found in the Indian Bend Wash study area:

Indicator Animals Species of the Foothills Region

Common Name	Scientific Name
Birds	
Rock Wren	Salpinctes obsoletus
Canyon Wren	Catherpes mexicanus
Redtail Hawk	Buteo jamaicensis
Reptiles	
Diamondback Rattlesnake	Crotalus atrox
Horned Toad	Phrynosoma douglassi
Mammals	
Ringtail Cat	Bassariscus astutus
Skunk (striped)	Mephitis mephitis
Rock Squirrel	Citellus variegatus
Desert Cottontail	Sylvilagus auduboni
Blacktail Jack Rabbit	Lepus californicus

Indicator Animal Species of the Flood Plain Region

Birds

Common Name	Scientific Name
Cactus Wren	Camphylorhynchus brunneicapillum
Brown Towee	Pipilo fuscus
Swanson Hawk	Buteo swainsoni
Mourning Dove	Zenaidura macroura
Ground Dove	Columbigallina passerina
Road Runner	Geococcyx californianus

Reptiles

Sidewinder Rattlesnake	Crotalus cerastes

Mammals

Badger	Taxidea taxus
Kit Fox	Vulpes macrotis
Gray Fox	Urocyon cinereoargenteus
Javelina	Pecari angulatus
Coyote	Canis latrans
Wood Rat	Neotoma albigula
Harvest Mouse	Reithrodontomys megalotis
House Mouse	Mus musculus
Roundtail Ground Squirrel	Citellus tereticaudus

All of these species above are quite common, and none are especially unique or rare. The danger they face from man's development in the area is the loss of habitat.

D. Ecosystem Dynamics: Reactions, Behavior and Movement

The time allowed for the study did not permit a detailed measurement of the interaction between ecosystems. However, there were no indications of unstable populations in any of the areas observed. There seemed to be no signs of overpredation or overparasitism affecting any of the species in the area.

The Wash forms a natural microclimate where plants flourish from subsurface water collected from storms. This area extends from one end of the study area to the other (Figure 6). Although animal movement will occur to some extent in such an area, it would be inhibited by lack of vegetative cover, the presence of street systems and human activities.

E. Ecosystem Dynamics: Natural Recycling and Productivity

Because of the natural characteristics of the arid climate of the region, the plant coverage of the area is sparse. However, there seems to be no problem with recycling or productivity. Most areas examined were thriving and showed little signs of natural decline, but man is taking a heavy toll in the natural coverage because of suburban expansion. South of the Arizona Canal, a man-made environment has come into existence and because of this, recycling is not the problem it is north of the Canal.

F. Ecosystem Dynamics: Aging and Succession

The natural communities found in the Wash are undergoing various changes. These changes must be analyzed in order to predict what will occur in the study area. The following is a list of probable successional trends within the study area, as influenced by the proposed alternatives.

Probable Successional Trends of Natural Communities in Study Area

Status Quo Trends	Structural Alternative Trends
Foothills	
Will persist as sparse creosote, greasewood community. The area will be reduced by urban encroachment.	Will have no impact. Would maintain present climactic state, but subjected to urban encroachment.
Flood Plain	
Will persist as sparse creosote, greasewood community. The area will be reduced by urban encroachment.	No impact. Would maintain present climactic state subjected to urban encroachment.
Concrete Channel	
Will persist as thick mesquite, greasewood community. The area will be reduced by urban encroachment.	Elimination of plants within right-of-way of channel. No impact upon reproduction of other plants within immediate vicinity. Urban encroachment physically controlled.
Open Natural Wash	
No impact except for urban encroachment.	Urban encroachment controlled by zoning. Natural successional trends would continue. Plants would grow or die as in a natural state. No impact.

CHAPTER IV

ANALYSIS OF HUMAN ECOLOGICAL FACTORS

A. Regional Influences and Demographic Characteristics

The Indian Bend Wash is located ten miles northeast of downtown Phoenix. It is adjoined on the west and southwest by the City of Paradise Valley and on the north and northeast by open country. The southern portion of the study area runs through the Cities of Scottsdale and Tempe.

The Indian Bend Wash is criss-crossed throughout its entire course by the street system of the Phoenix Metropolitan area. The southern portion of the Wash except for the considered channel, has been developed into urbanized subdivisions. The northern portion of the Wash is being engulfed by the northern expansion of the Cities of Phoenix and Paradise Valley. Even now, a number of subdivisions have been placed in and around the Wash channel. The southern portion, traversing the City of Scottsdale, is either totally developed in residential neighborhoods and recreational areas or in agriculture. The final section of the Wash, prior to entering the Salt River, is within the City of Tempe and is gradually being developed into industrial uses.

B. Land Use

The land use of the study area can be divided into two categories. North of the Arizona Canal the land is predominately residential and open space. South of the Canal the usage has become highly urbanized.

For the most part, land abutting the northern half of the study area is presently developed or projected to be developed in very low to low density residential communities (Figure 9 and 10). The northern half of the study area has two golf courses located between Double Tree Ranch Road and Indian Bend Road. The McCormick Ranch Development is a good example of land use in this area. By the use of a lake system, low flows will be able to pass over the property by means of a low flow channel and golf course.

The southern half of the study area lies within the two cities of Scottsdale and Tempe. At the time this report was written, there were three golf courses, three city parks, and several open spaces suitable for above mentioned land use within the Wash channel. Because of the recreational facilities in this area, the population density and land values have risen. There are two areas used for agricultural purposes, however, there are plans to develop these areas into parks and golf courses.

The southernmost portion of the Wash is used for a light industrial park. This area lies within the City of Tempe and the City hopes to place a park or open space at the confluence of the Indian Bend Wash and Salt River.

This land use pattern has resulted from the jurisdiction network within the study area. Figure 8 shows a breakdown of private, city and government easements and ownership lines which have caused much fragmentation of present land use. This jurisdiction fragmentation will play an important role in future development.

C. Recreation

The recreational resources found within the Indian Bend Wash are many and varied. The existing golf courses, parks, open spaces, and commercial recreational facilities such as Big Surf, should be planned to integrate into future recreational planning for the area.

Over half the study area lies within a highly developed urban area, therefore, it is important that recreational areas be set aside for present and future requirements. There is a unique opportunity for the Indian Bend Wash to become a recreational system reaching south from Bell Road to the Salt River. The Wash would provide a very outstanding link with the surface hiking and riding trails and the Salt River Trail. As the available open space is engulfed, the existing horse population of seven thousand within the City of Scottsdale, will find it increasingly difficult to find riding areas.

D. Aesthetics

The aesthetic make-up of the Indian Bend Wash is a complex combination of the natural and man-made features, mixed together in such a manner as to form a functional and pleasing environment. This environment must be studied as a whole and not just as a natural or man-made amenity. Present and future residents of the project area must be considered, therefore, public awareness of any decisions must play an important role in future planning for the Wash.

The aesthetics of the portion of the Wash north of the Canal are that of the natural community mixed with encroachment of urban development. This environment is an ever changing one with the addition of golf courses, parks, and new residential areas.

The portion of the Wash south of the Arizona Canal in some respects, is a more stable environment. The natural community is almost non-existent. Therefore, the aesthetics are that of a man-made environment. The City of Scottsdale, with a system of parks, golf courses, and open spaces, has created a very pleasing environment. The aesthetics of this area are quite pleasing. The residents of the area use the facility on a daily basis. People value the opportunity to look at and participate in an open space. Therefore, any decisions reached must be in accordance with the wishes of the residents of the study area and users of existing man-made features.

E. Historical and Archeological Factors

There are no archeological sites of any national importance within the study area. However, there are several minor sites found along the course of the wash. Three areas have been found to be early gathering sites of the Hohokam Indians, dating to 700 A.D. The first of these areas is along the bluffs where the Indian Bend Wash meets the Salt River. The second site location lies between McDowell and Thomas Road. The third area reaches from 64th Street to 32nd Street. Arizona State University Antrhopology Department has asked to be informed if the structural alternatives are to be effected, so that they could pre-inspect the area and observe excavation areas during construction.

There are no histrorical buildings along the Wash, but the Paolo Soleri Foundation lies just north of the main channel at the intersection of Double Tree Ranch Road and 64th Street. It is mentioned because of its cultural contributions to the region, and because of possibilities of damage during construction and of back flooding.

F. Natural Resource Factors

The Indian Bend Wash as a whole is a minerally poor area. There is no meaningful mineral extraction within the study area. However, at the southernmost portion of the Wash, large amounts of sand and gravel are mined from the Salt River bed.

G. Health Factors

The Indian Bend Wash lies in an arid region where stagnant water is not the problem that it is in other regions. Because of this, the health factors that influence other projects do not apply in this area.

H. Emergency Factors

Although many roadway crossings through the Wash would be inundated after a major thunderstorm in the immediate watershed, other routes are available for emergency vehicles such as ambulances or rescue missions. Time lost in circumventing the areas affected could prove to be vital. However, helicopter rescue units are available from Williams Air Force Base and Luke Air Force Base, located near Phoenix.

As the communities expand to the north and east of the Wash, unless a dam was constructed, one or two permanent bridges could prove invaluable in emergencies.

CHAPTER V

DESCRIPTION OF FLOOD CONTROL ALTERNATIVES

There have been many flood control alternatives proposed for the Indian Bend Wash. Time does not allow an in-depth study of each report. However, the following are the solutions being enacted by the various affected communities along the Wash.

The proposed Central Arizona Project (Figure 13) must play some role in the decision making, concerning the Indian Bend Wash. The system of canals and dikes that are proposed in the project area will change the drainage of the entire basin, thus changing the drainage requirements of the Wash.

Flood Control Alternatives

1. Status Quo: (Do-Nothing)

2. Structural:

   a) Concrete trapezoidal channel with energy dissipator at Salt River.
   b) Greenbelt Channel.
   c) Earth bottom trapezoidal channel.

3. Non-Structural:

   a) Regulatory measures (Such as flood way ordinances, flood plain zoning, subdivision regulations and building codes).
   b) Flood Proofing.
   c) Flood Warnings and Emergency Programs.
   d) Flood Insurance.

A. City of Phoenix

1. Status Quo

The status quo alternative has been abandoned by the City of Phoenix, since many of the natural communities are of limited value and haphazard developmental encroachment has become widespread.

2. Structural

The City of Phoenix has chosen the structural alternative for their portion of the Indian Bend Wash. The City has chosen the Wash as the best of three proposed alignments for a freeway system. The proposed alignments are 1) the Indian Bend Wash, 2) 1 mile northeast of the Wash, and 3) between Greenway and Bell Roads running east and west. Factors influencing the choice were population growth based on 1995 data, land use, and present needs.

The ultimate improvement of the Wash planned by the City of Phoenix would be a concrete trapezoidal channel between the northeast and southeast bound lanes of the proposed freeway (Figure 13).

3. Non-Structural

This alternative is out of the question, because the present urban encroachment has already made this alternative obsolete.

B. Town of Paradise Valley

1. Status Quo

The Town of Paradise Valley has chosen the status quo alternative for that portion of the Wash which passes through their boundaries. Paradise Valley does not possess the potential revenue required for structural improvements. Paradise Valley may incorporate some of the proposals included in the Water Resources Associates study for the City of Scottsdale.

2. Structural

This alternative is too costly, since it is penetrating a very small and low density area.

3. Non-Structural

Paradise Valley could follow some type of action along these lines, however, at this time nothing has been proposed.

C. City of Scottsdale

1. Status Quo

The City of Scottsdale has abandoned the status quo concept for a combination of the structural and non-structural idea.

2. Structural

The City of Scottsdale has decided not to pursue the structural alternative due to a study prepared for the City in 1967.(See following paragraph).

3. Non-Structural

Scottsdale is currently abiding by the plan proposed by Water Resources Associates in their report of December, 1967, which calls for a combination of greenbelts, open space, flood plain zoning and subdivision regulation along the channel of the Wash. The report also calls for detention areas to be built north of the City of Scottsdale; however, it is doubtful that the detention basins will ever be constructed.

D. City of Tempe

1. Status Quo

The City of Tempe cannot follow this alternative any longer, because of changes to the flow of the Wash north of their corporate City limits.

2. Structural

Some type of structural alternative must be employed in this portion of the Wash to turn the flow down the Salt River and to dissipate the water.

3. Non-Structural

Because of what the City of Scottsdale has done with the system of parks and open spaces, the City of Tempe is proposing a similar type of non-structural system for a portion of the Wash within their City limits.

CHAPTER VI

CONCLUSIONS

A. Conclusions

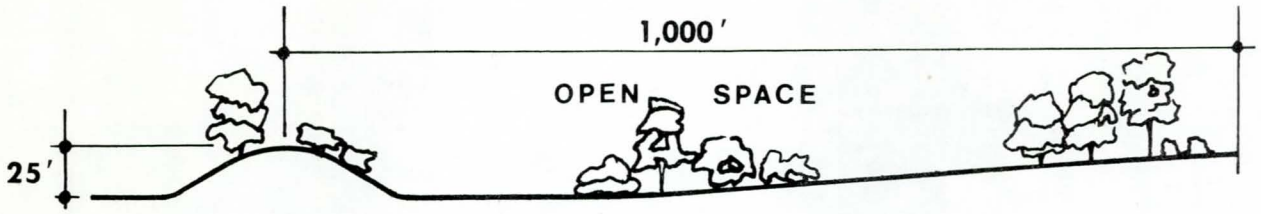
1. Soils in the area seem stable, however, they are susceptible to damage caused by erosion.

2. The structural alternative presented by the proposed Central Arizona Project would help the natural environment by adding to the ground water and allowing for natural evaporation by slowing down runoff.

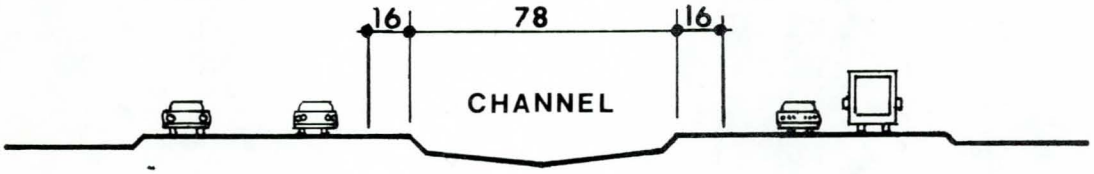
3. The City of Scottsdale proposes a unique alternative. The City has constructed a series of wash parks, which include large lagoons in the Wash basin. These lagoons trap and retain some of the flood waters. This retention allows for the replenishment of ground water, where lagoons are not lined, while providing a recreational lagoon.

4. Hydrological factors of drought, fast runoff, and poor ground water are seriously limiting the development of the natural environment. The structural alternative planned by the City of Phoenix would not allow percolation into the soil, but would increase the runoff and cut down on natural evaporation.

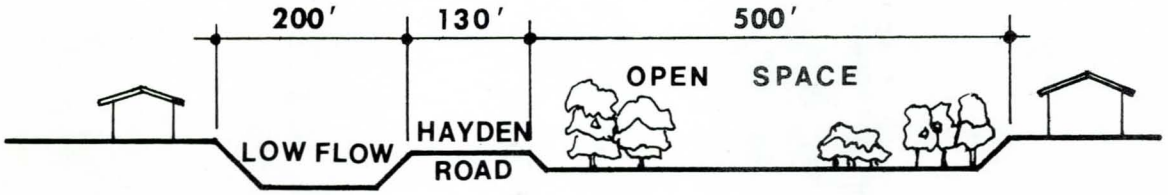
5. The natural community is at the point where urban encroachment will soon render it undefinable. Therefore, any structural alternative would do very little damage to the natural environment. At this point, aesthetics play a paramount role in decision



CENTRAL ARIZONA PROJECT PLAN



CITY OF PHOENIX PLAN



CITY OF SCOTTSDALE PLAN

FIGURE 13

PROPOSED FLOOD CONTROL SYSTEM

making. The City of Scottsdale has tried to blend a functional drainage system into a pleasing setting of parks and open spaces. This environment is a dynamic and ever changing one. Any structural type of alternative followed at this time would do irrevocable damage to the aesthetics of the environment.

6. None of the flora or fauna are what could be called endangered species. The only danger that fauna face is the loss of habitat.

7. The City of Scottsdale has sharply increased land values along the Wash by using it for a series of parks and golf courses, and the land values are some of the highest in the study area. However, if the structural alternatives proposed by the City of Phoenix were followed, land values may not continue to increase at their present rate.

   Examples of how land values have increased as a result of the open space in exemplified by the per Acre cost of land along the Wash. Three of the following four very recent projects embraced the green belt or open space concept, the latter the conventional subdivision approach. The comparison of the affects on land value speaks for itself.

Continental	$25,000/Acre
Camelback Shadows - Camelback & Hayden	$35,000/Acre
Villa San Marcow - Indian School Rd. & Hayden	$22,000/Acre
Hallcraft Chateau de Vie - Granite Reef & McDonald	$8,500/Acre

Those areas along the Indian Bend Wash that are taking advantage of the Wash - as the first three developments above have, with lakes, Golf Course, parks, and open space. This type of use has not only allowed higher density on less land but has been a savings to the Developer in less development cost with higher returns.

8. The non-structural alternative of parks and open space allows the use of more open flat land for recreation. By providing a small channel for normal runoff flows, most storms through the area would not disrupt the open space. Occasionally, on an average of eight times in 100 years, the storm's intensity would require the use of the open space for runoff. It is felt this infrequent disruption is more favorable than the expense of a concrete lined ditch.

9. The aesthetics of the Indian Bend Wash at present are divided into two types. North of the Arizona Canal, a natural environment exists with all of the natural aesthetics associated with the environment. However, south of the Canal a man-made environment has become dominant. The environment has its own aesthetic features that cannot be overlooked. Both of these aesthetic types would be damaged by a structural alternative in the Wash channel.

10. None of the alternatives pose any threat to the historical and archeological areas of the Wash. However, the Department of Anthropology of Arizona State University would like to investigate site proposed for structural alternatives.

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8. General Soil Map, Maricopa County, Arizona, U. S. Department of Agricultural Soil Conservation Service, June, 1969.

9. Mammals of the Southwest Deserts, Southwestern Monuments Association, Globe, Arizona, Copyright 1954.

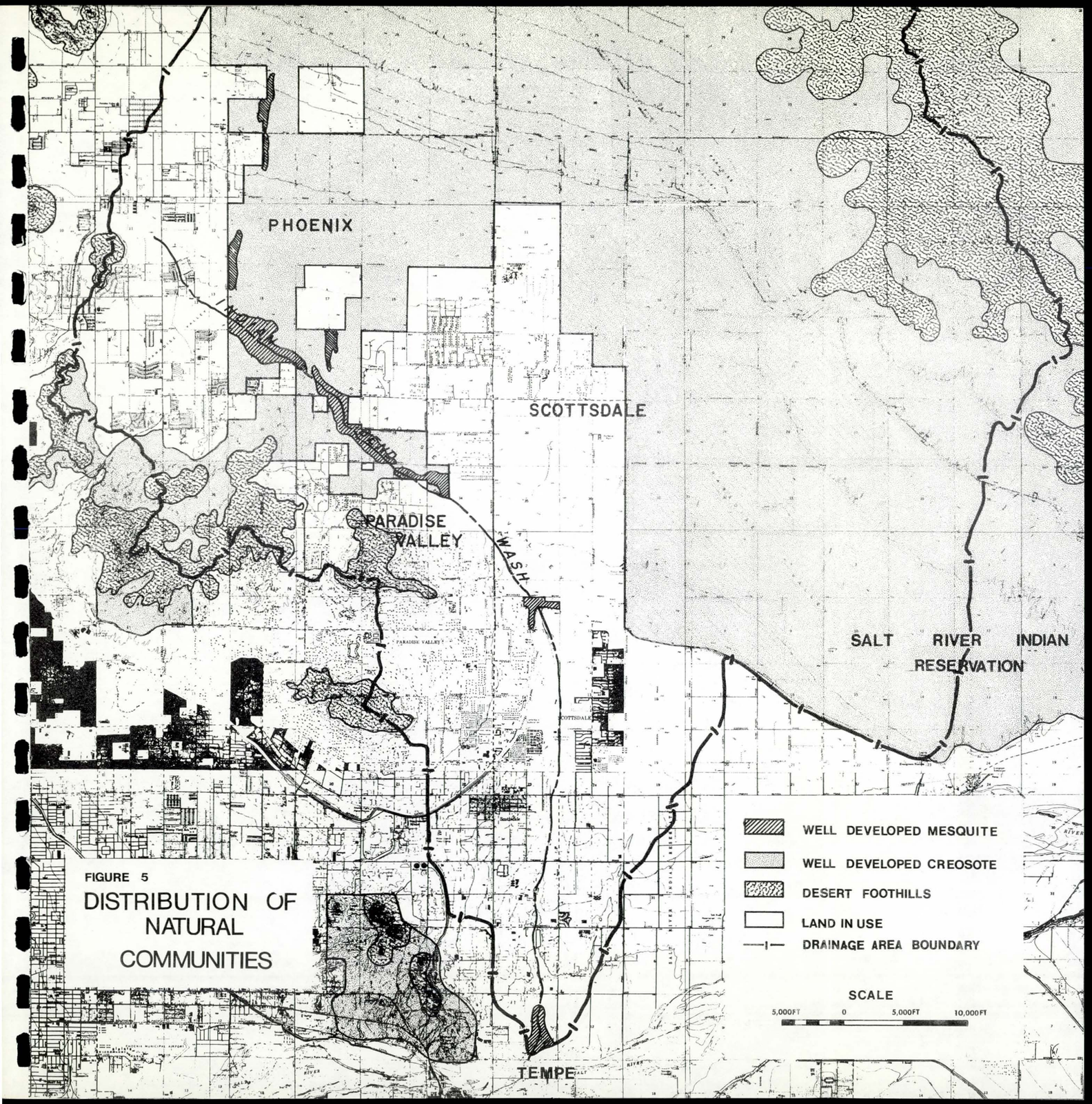

FIGURE 5
DISTRIBUTION OF NATURAL COMMUNITIES

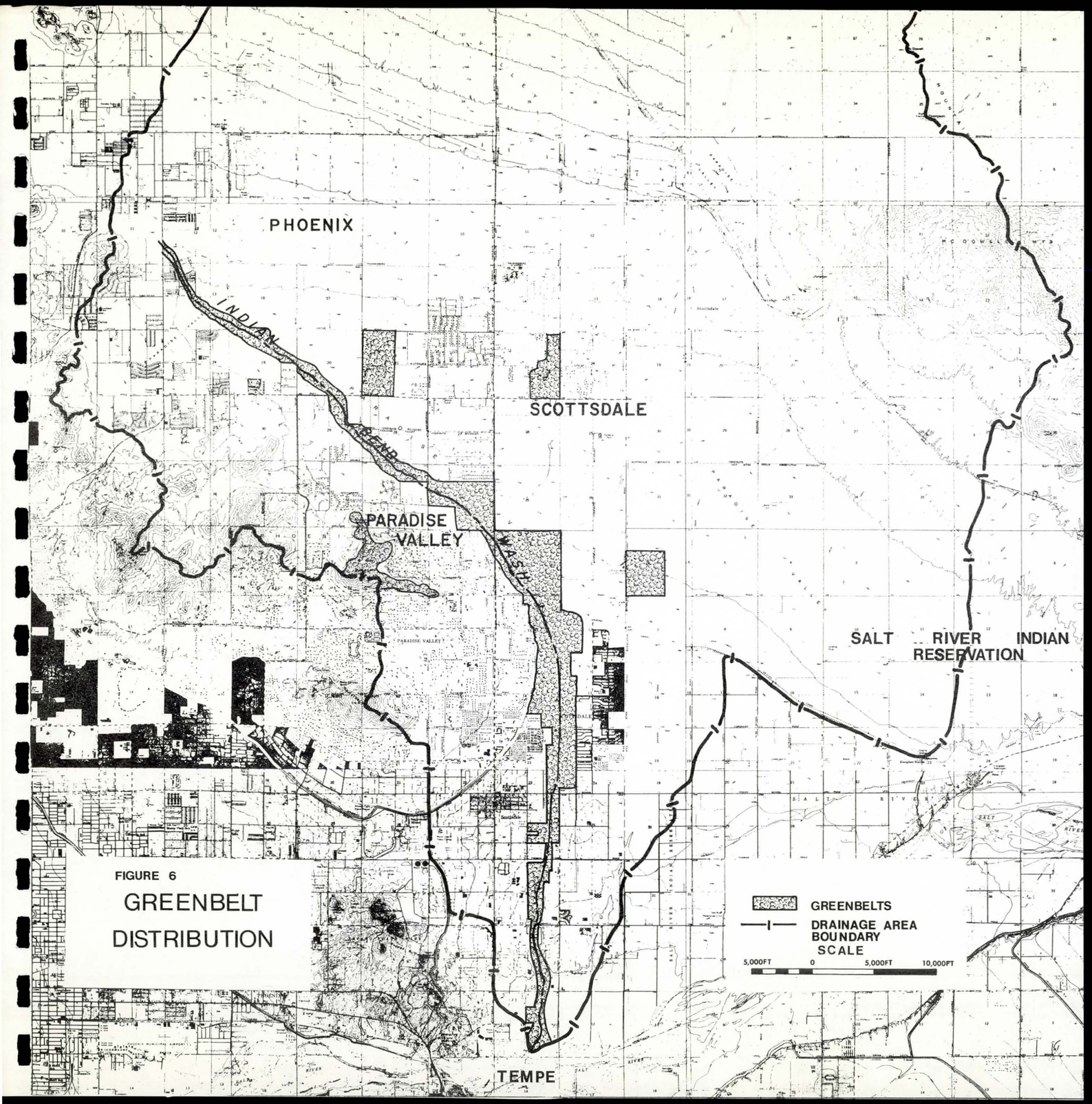

FIGURE 6

GREENBELT DISTRIBUTION

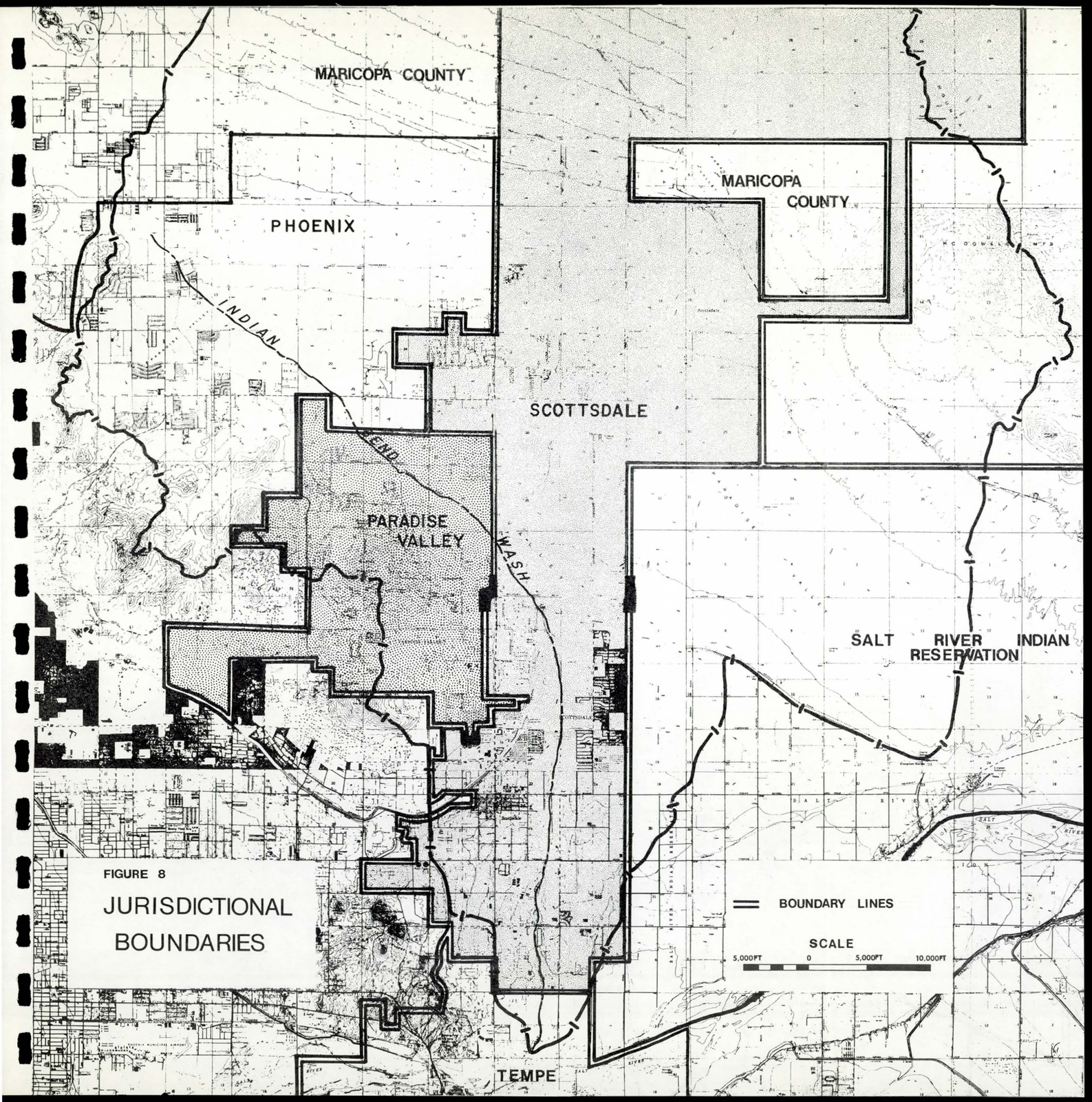

FIGURE 8

JURISDICTIONAL BOUNDARIES

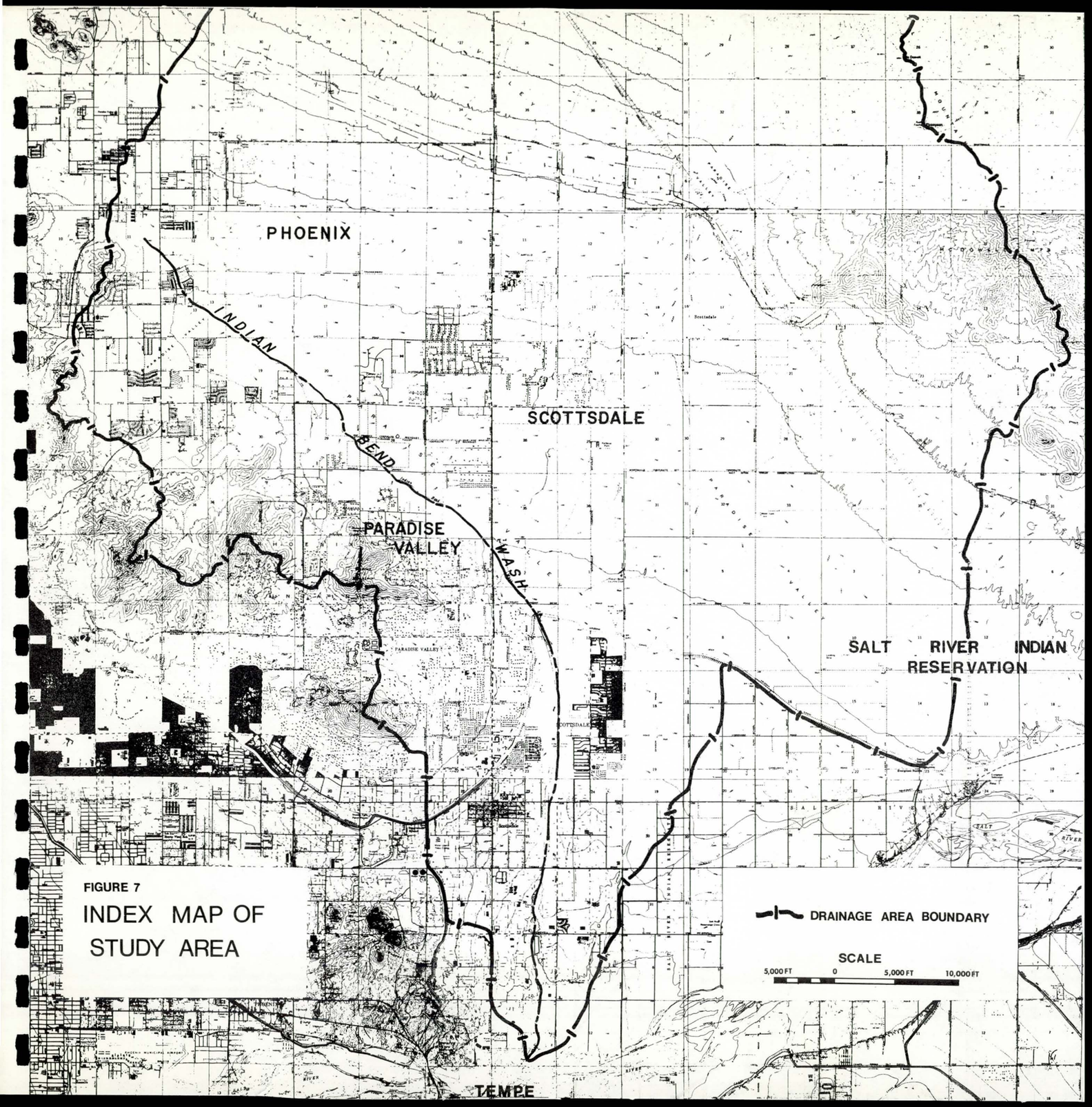

FIGURE 7

INDEX MAP OF STUDY AREA

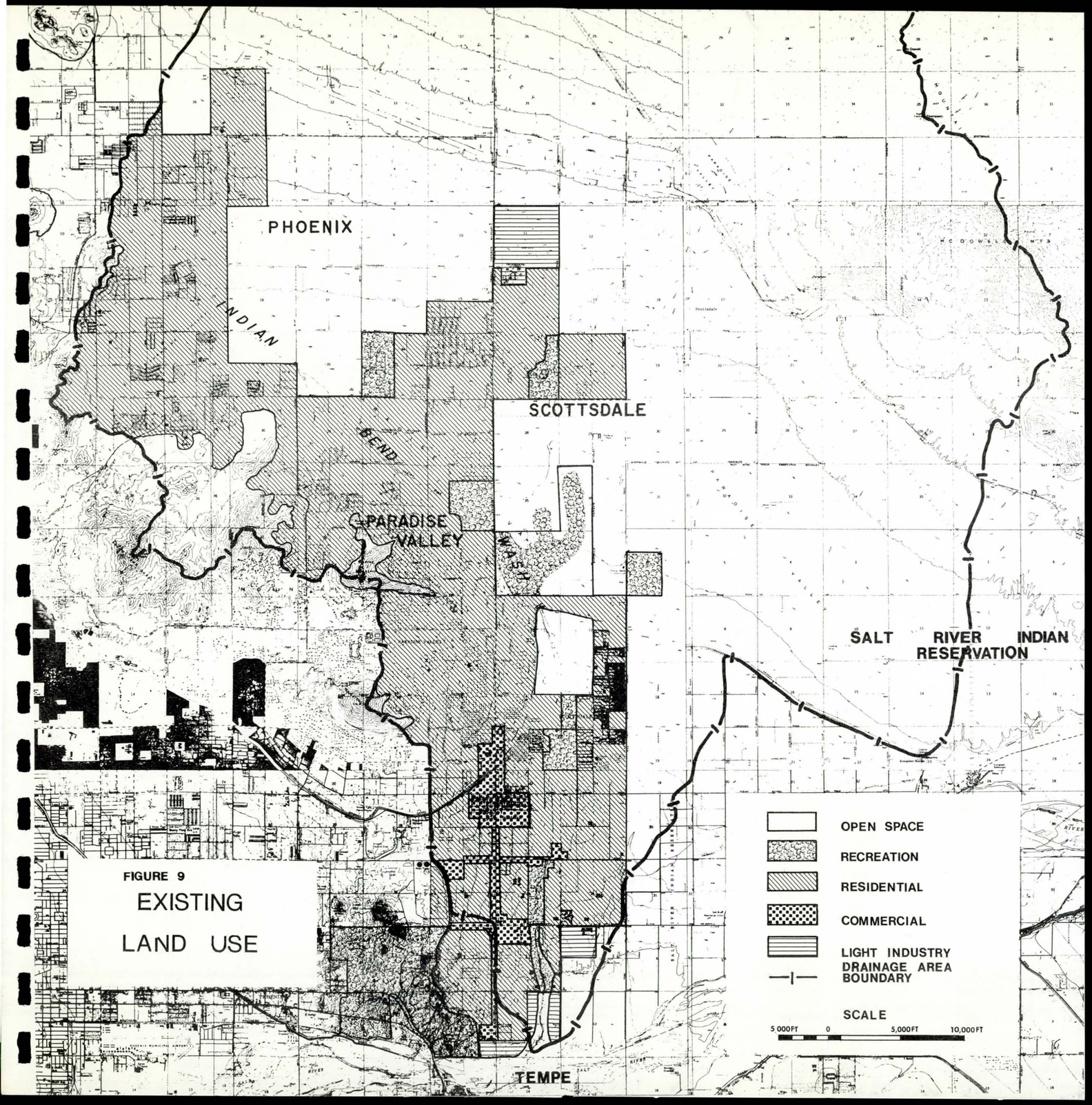

FIGURE 9

EXISTING LAND USE

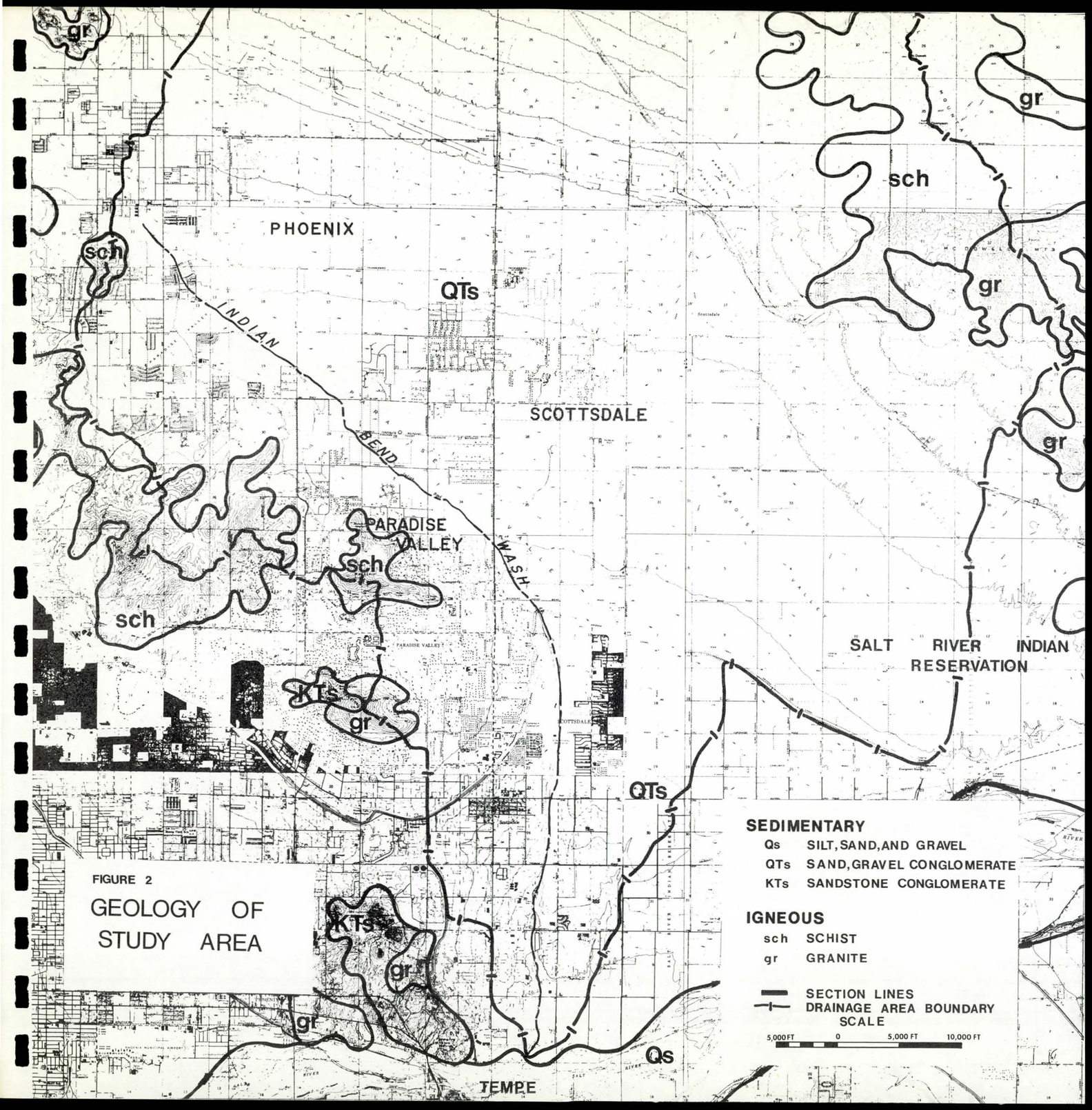

FIGURE 2

GEOLOGY OF STUDY AREA

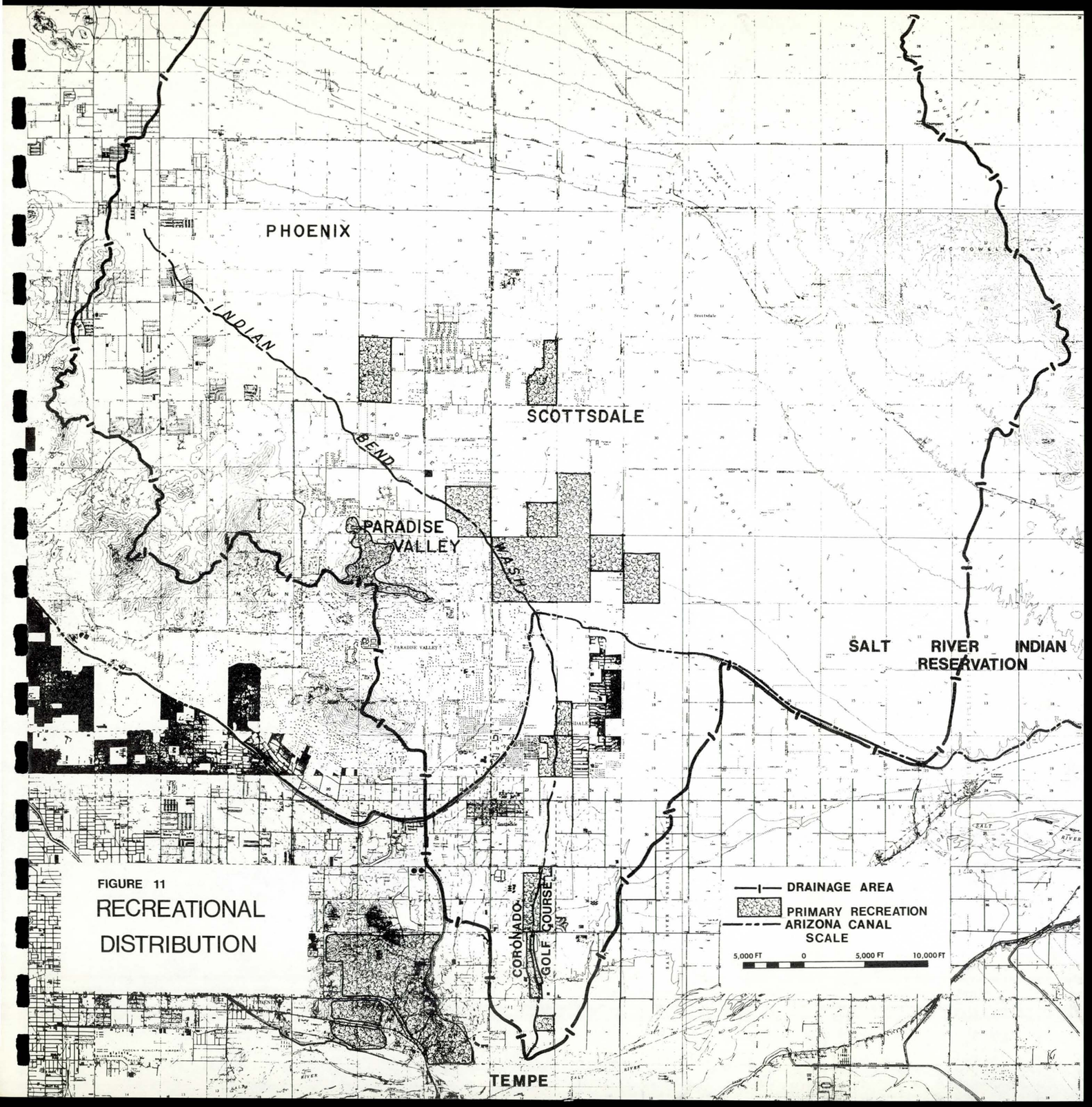

FIGURE 11
RECREATIONAL
DISTRIBUTION

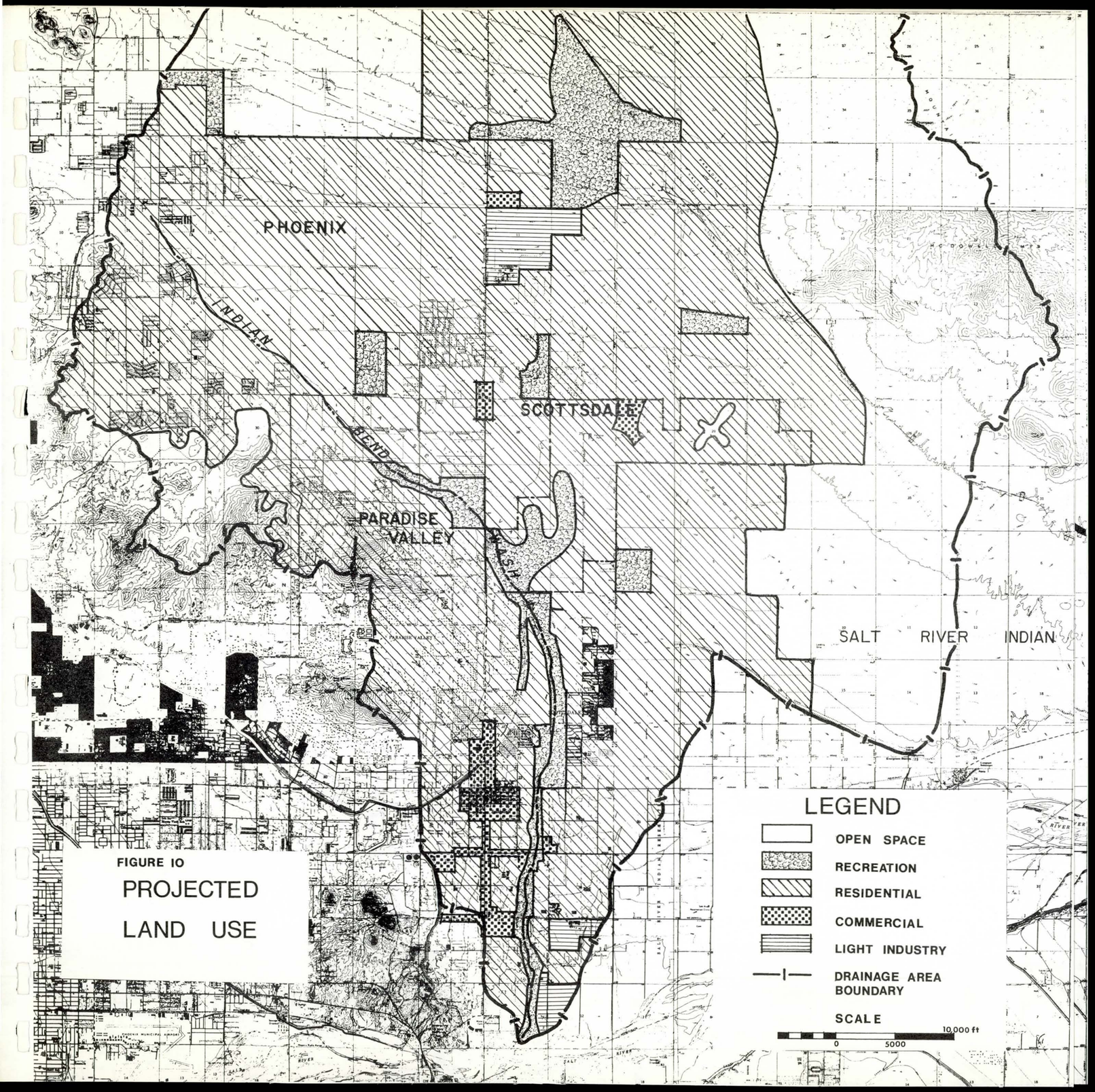

FIGURE 10

PROJECTED

LAND USE

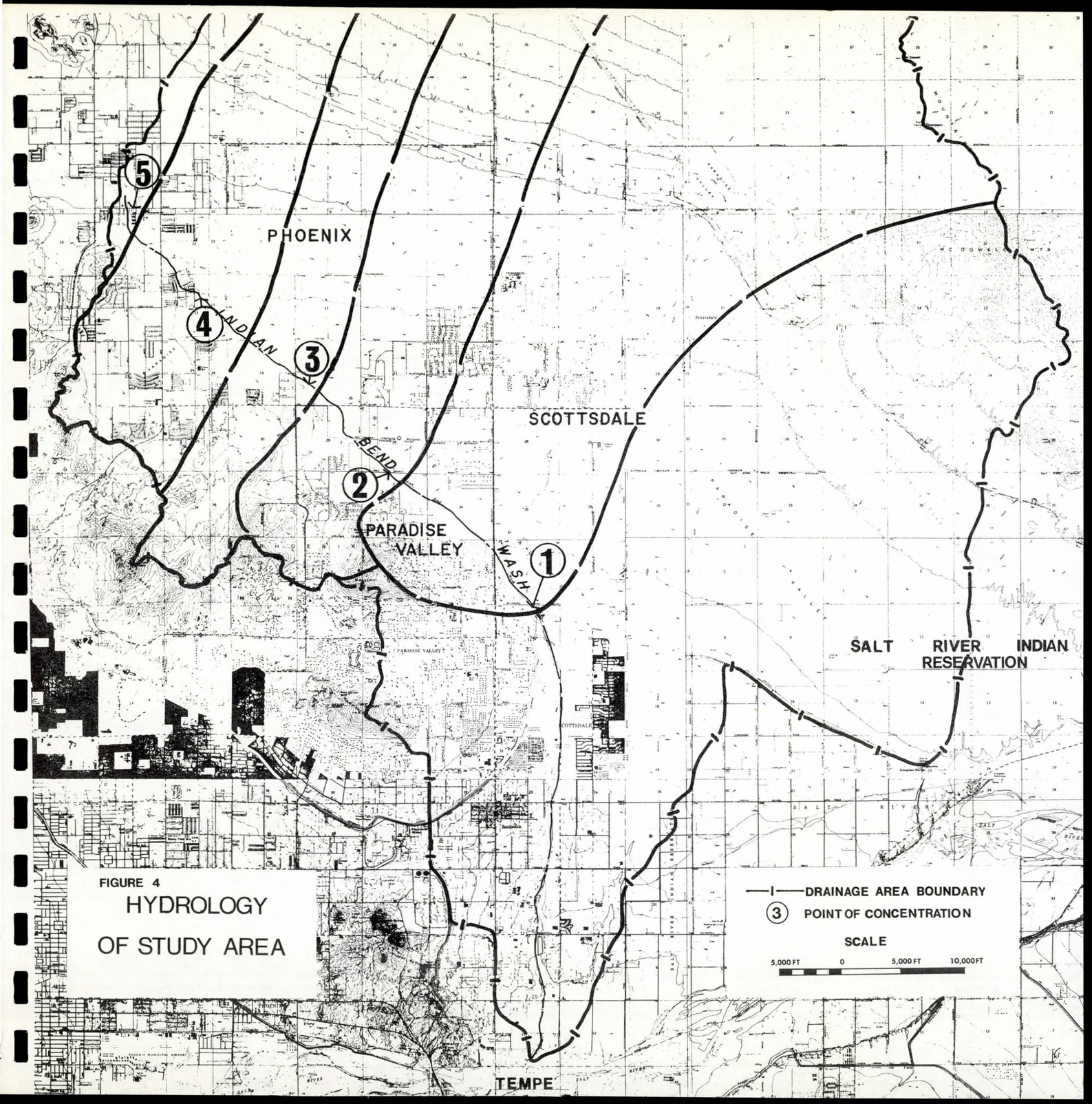

FIGURE 4
HYDROLOGY
OF STUDY AREA

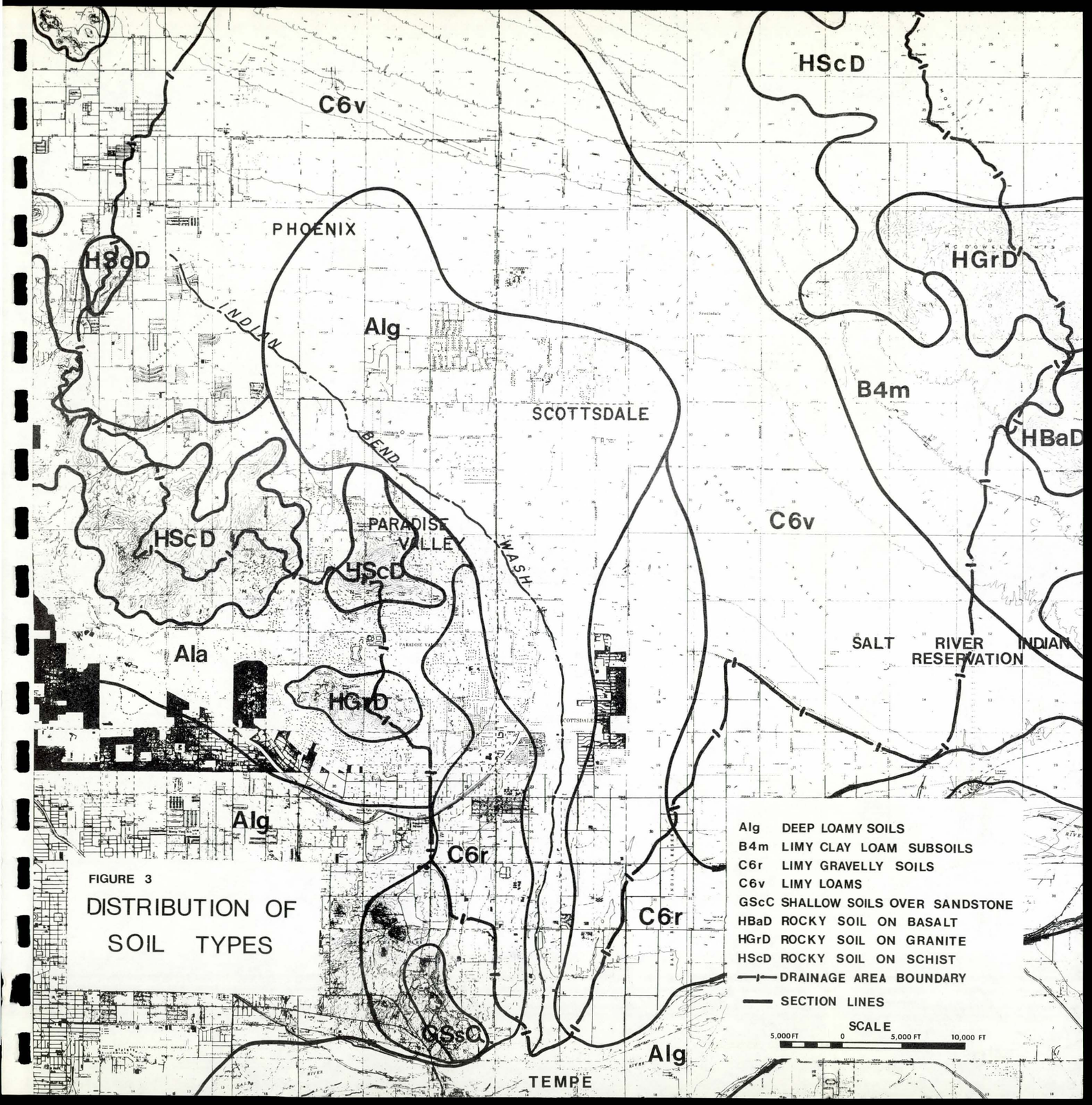

FIGURE 3

DISTRIBUTION OF SOIL TYPES