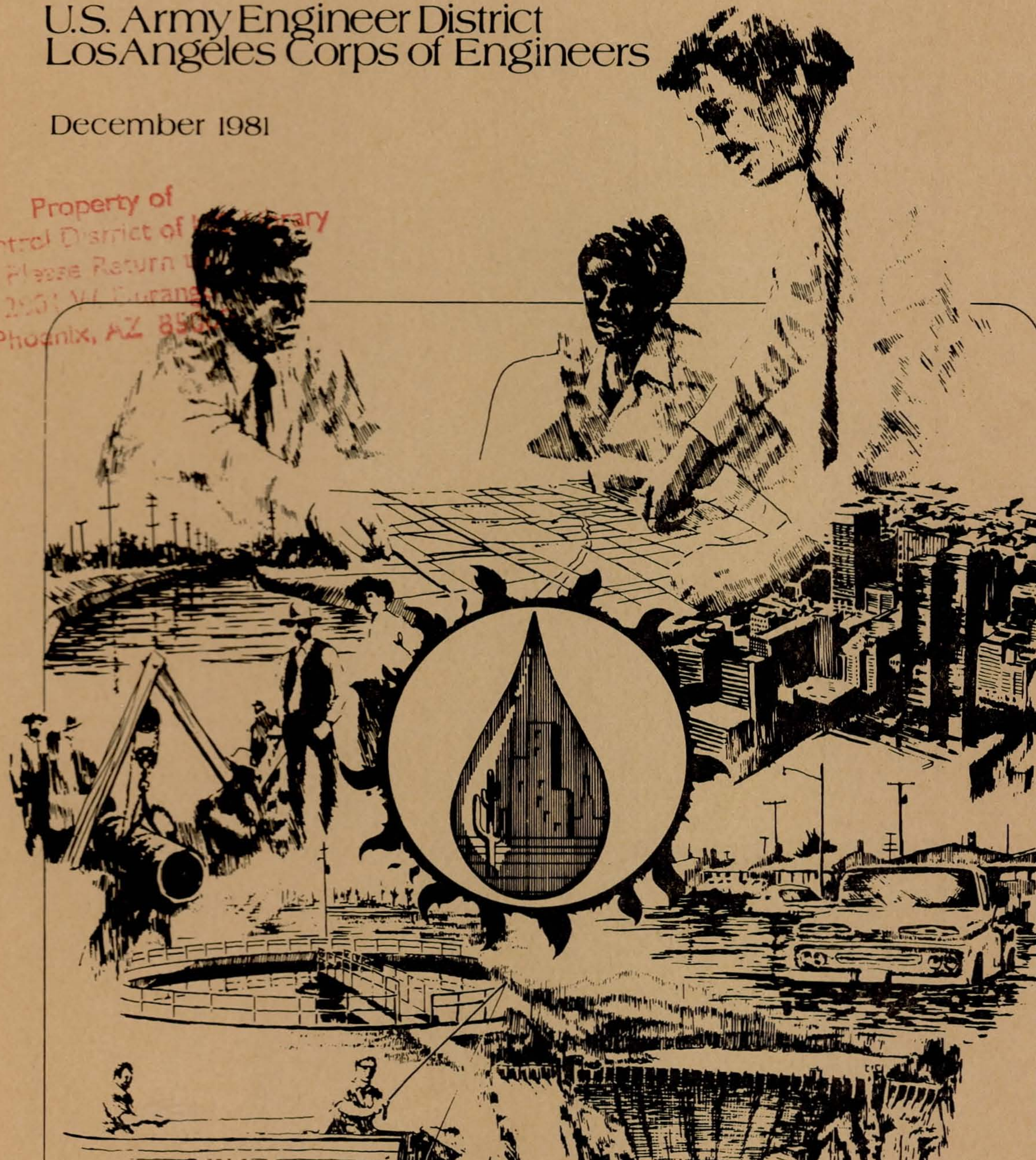
IMPACT ASSESSMENT & EVALUATION APPENDIX

Phoenix Urban Study Final Report

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

December 1981



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PHOENIX URBAN STUDY

FINAL REPORT

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PREFACE

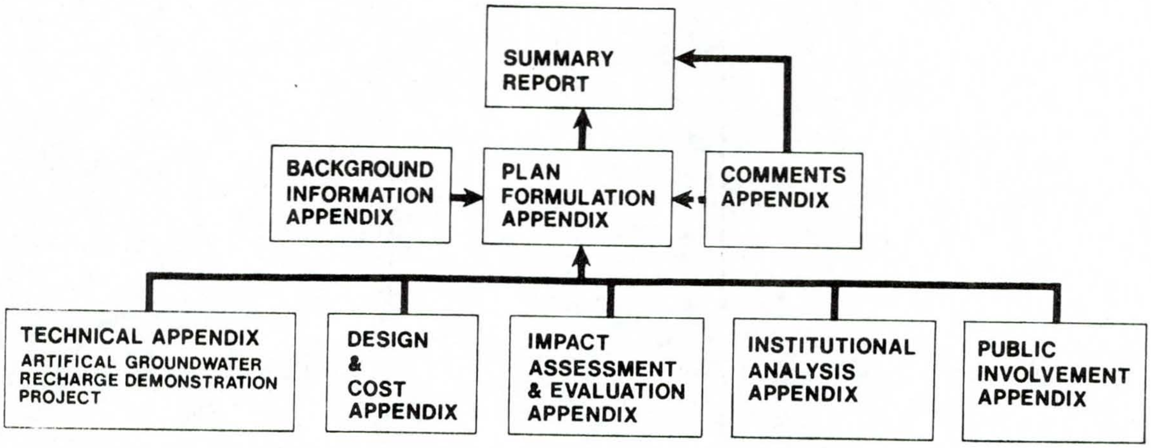
Water has been the single most important factor contributing to the phenomenal growth of the Phoenix metropolitan area. A century ago planners in the Salt River Valley were laying the ground work to develop the limited water resources of the area to provide an adequate supply of water. In so doing they provided the most feasible location for development of a large population center in the entire lower Colorado River Basin. The successful development that resulted from the efforts of these pioneers in water resource planning, however, has placed an even greater demand on today's available water resources. In recognition of the need to extend and refine water resource planning, the U.S. Army Corps of Engineers undertook the Phoenix Urban Study in cooperation with local authorities.

THE STUDY

During the course of the Phoenix Urban Study, water resource plans formulated were consistent with other urban programs and were flexible to allow accommodation of changing social and economic conditions. Because the study interfaced closely with water resource programs of other agencies, special attention was devoted to insuring the study did not duplicate the studies of other agencies, but rather served as an extension and a coordination of these efforts. The Corps dovetailed its Urban Study program with federal, state and local planning to address future and residual water resource problems at the time not under study.

STUDY REPORT

This Impact Assessment and Evaluation Appendix of the Final Report provides discussions of how and why alternatives were evaluated and reasons for their acceptance or rejection. It should provide a clear description of the impacts associated with the alternatives considered. For a diagram showing the organization of the Final Report, see Figure P-1.



Study Report
Organization & Content

FIGURE P-1

CHAPTER I

INTRODUCTION

The purpose of this appendix is to assess the environmental impacts of alternative water resource plans proposed by the Phoenix Urban Study for the metropolitan area of Maricopa County, Arizona (the City of Phoenix and surrounding communities) and to make public the environmental planning process of the study that produced the alternatives. The alternatives were generated and refined within the framework of developing a 208 Water Quality Management Plan as well as flood control and water conservation measures for the Phoenix metropolitan area. Four wastewater treatment management alternatives are the focus of most of this report and represent the next to last stage in a screening process that involved two years of technical studies, reviews by advisory groups and ad hoc committees, and participation by the public. From the four alternatives, one has been chosen to become the "Point Source Metro" portion of the 208 plan.

The 208 planning effort comprised only a part of the Urban Study's investigation of water resource issues in the Phoenix area. The Urban Study also examined eight flood control projects for the region. During the course of the study, however, it became clear that all of the projects, with the exception of Salt River flood control, were infeasible and did not merit further investigations by the Corps of Engineers. Since work on the projects that warranted further study did not progress beyond an initial identification of alternatives, it was not possible or necessary to evaluate the possible effect of environmental and socioeconomic issues on plan development. Possible impacts of Salt River flood control alternatives, however, were identified, and are discussed in this appendix. More detailed evaluation of the impacts of the final Salt River flood control alternatives is to be carried out as a part of the Central Arizona Water Control Study currently being conducted by the Bureau of Reclamation with the assistance of the Corps of Engineers.

The possibilities of achieving water conservation in the Phoenix area made up an important facet of the Urban Study's examination of water resource issues. Two potential projects were investigated. The first of these projects involved diversion of the New River to supplement water supplies in Lake Pleasant. Initial planning for this measure, however, was stopped as the result of institutional constraints and public opposition. As a result, no impact assessment work was accomplished. Possible impacts identified during the early planning process of the New River Diversion Measure have been included in the Plan Formulation Appendix of the Final Report and are not duplicated in this appendix.

The second area of investigation in the Urban Study's water conservation program involved the possibility of achieving conservation through artifical groundwater recharge. This effort resulted in the preparation of the Plan of Study for a Demonstration Recharge Project in the Salt River Valley, which is included in the Final Report as the Technical Appendix. During the course of the preparation of this document, a number of possible impacts resulting from a demonstration project were identified. This Impact Assessment and Evaluation Appendix contains a summary of these. They are discussed in greater detail in the Technical Appendix/Plan of Study.

IMPACT ASSESSMENT METHODOLOGY

The assessment and evaluation of water quality alternative impacts was carried out at a level of detail directly related to the level of detail in plan formulation. Therefore, as the alternatives were refined and examined more closely, the impact assessment and evaluation also become more detailed. At each stage of plan development, from the inital conceptual array of plans to the selection of the final alternatives, impact assessment and evaluation was accomplished by comparing the impacts with existing baseline and expected future conditions as well as with the "No Action" alternative. The results of this assessment then became part of the decision making process for final plan selection. Impact assessment and evaluation for Salt River flood control and artifical groundwater recharge plans also followed this methodology, although the level of detail of the work was not as great as that for the water quality portion of the study.

CHAPTER II

ENVIRONMENTAL BASELINE

This chapter describes the existing environment of the study area. Descriptions of the environment summarize information important to an understanding of environmental consequences of the alternatives and their components.

PHYSICAL CHARACTERISTICS

Location

The Phoenix Urban Study area is located in Maricopa County in south central Arizona. The study area boundary extends north to Lake Pleasant Regional Park, northeast to the Tonto National Forest, east and south to the Pinal County line, west to include the Town of Buckeye, and northwest to the White Tank Mountains. (see the study area on Figure II-1). The study area includes approxi-mately 2,300 square miles with an estimated present population of about 1.3 million persons.

The boundary of the study area was drawn to include those communities that are presently within, or are anticipated in the next 50 years to be within, a contiguous metropolitan area centered around the City of Phoenix, and whose water resource supplies and problems are interrelated. The five major cities in this area include Phoenix, Mesa, Scottsdale, Tempe, and Glendale, which together account for about 93 percent of Maricopa County's population. In addition, the the Salt River, Fort McDowell, and Gila River Indian Communities and Luke and Williams Air Force Bases are partially or completely within the study area.

Climate

The climate of Phoenix is semiarid, characterized by low annual rainfall, hot summers, and mild winters. Maximum daily temperatures range from 65 degrees F (18 degrees C) in January to 105 degrees F (41 degrees C) in July. Low temperatures range from 78 degrees F (26 degrees C) in July to 38 degrees F (3 degrees C) in January. The annual rainfall in Phoenix averages 7 inches per year.

Air Quality

The Phoenix area has long been known for its clean air and clear skies. With its rapid growth, however, Phoenix has experienced increasing air pollution, largely as a result of automobile emissions. The location of the metropolitan area in a broad valley is conducive to the accumulation of air pollutants. In addition, general atmospheric conditions favor the development of temperature inversions that may persist for extended periods of time, allowing ambient pollutant concentrations to exceed levels defined in state and federal standards. Three kinds of air pollutants generally exceed standards in the Phoenix area: ozone, carbon monoxide, and total suspended particulates. More detailed data on air pollutants can be found in Tables II-1 through 5. Because of problems with these air pollutants, the Phoenix metropolitan area has been designated a "nonattainment" area for photochemical oxidants (ozone), carbon monoxide, and total suspended particulates under directives of the Clean Air Act Amendments of 1977.

The Nonattainment Area Plan for Carbon Monoxide and Photochemical Oxidants, Maricopa County Urban Planning Area (December 1978) proposes air quality control strategies that are projected to result in attainment of standards over the next 20 years for these pollutants. The plan is currently under review by the Environmental Protection Agency.

Geology and Soils

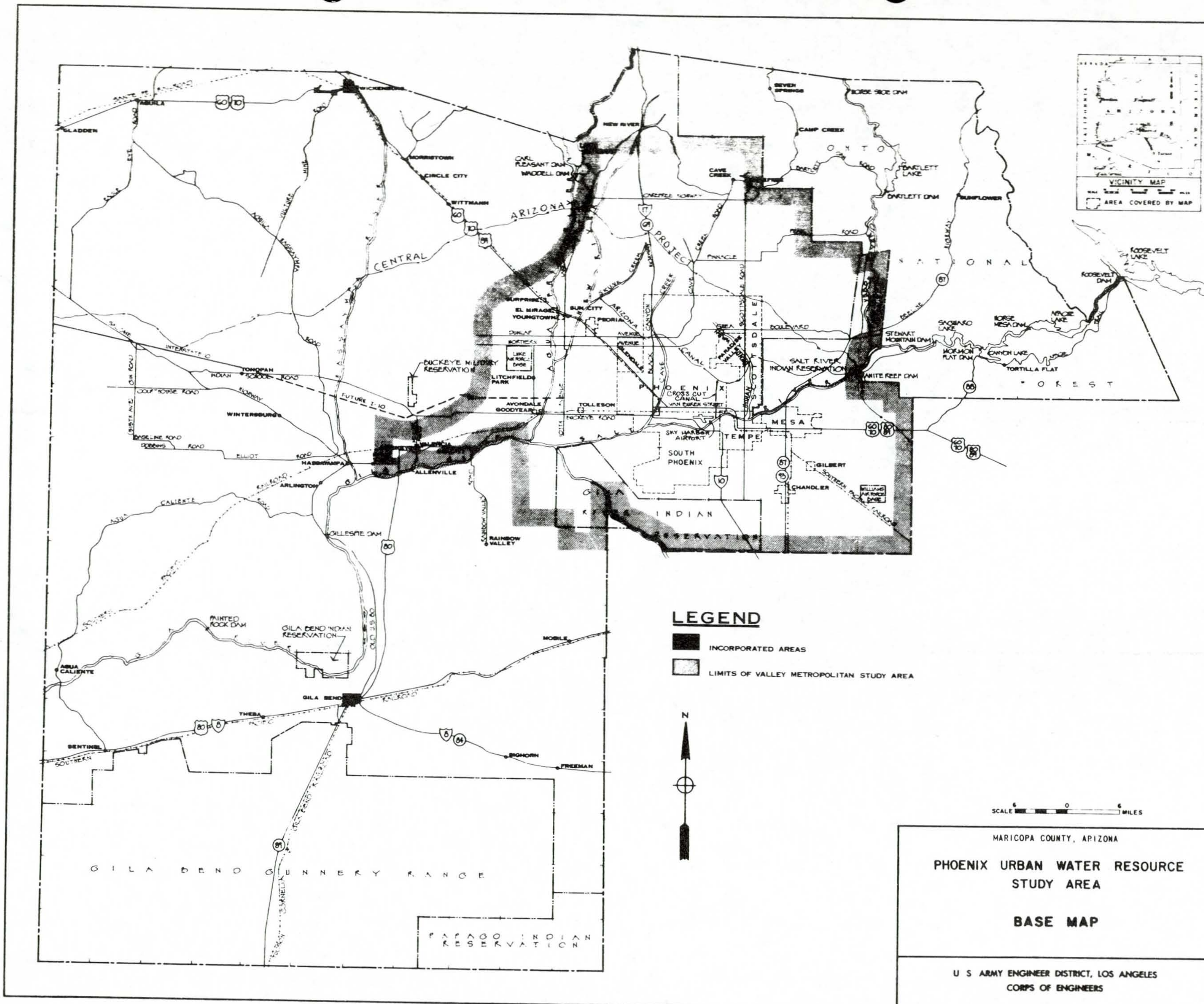
Metropolitan Phoenix is within the Basin and Range Physiographic Province of the western United States, characterized by wide, flat, alluvium-filled valleys surrounded by rugged, low-relief mountain ranges. Phoenix lies within the Salt River Valley and is surrounded by the Phoenix, Salt River, McDowell, Usery, Sierra Estrella, and White Tank Mountains. Uplifting and down faulting of the land surface formed these fault block mountains. Erosion filled the valley with alluvium, which consists of silts, clays, sands, and gravels deposited in layers.

Valley soils are deep, mixed in texture, and low in organic material. Most soils contain adequate amounts of nutrients, and when irrigation is available, good cropland can usually be developed. General soil types are sandy loams, limy clay loams, and limy loams.

Biological Resources

The Phoenix area is part of the lower Sonoran Life Zone, which is part of the Sonoran Desert Formation, one of four desert formations in North America. Natural vegetation in the area is mainly composed of desert communities, although small areas of deciduous forest occur along the banks of water bodies. The major desert communities are paloverde-saguaro on mountain slopes, creosotebush-bursage in the lower drier areas, and desert saltbush in the fine-grained alluvium that fills the valley in the area. Riparian vegetation represents a very low percentage of the total land area and is present only along stream channels and associated terraces and in areas of shallow groundwater.

A great diversity of desert fauna also exists within the area. Most of the fauna occupy the creosotebush-bursage and paloverde-saguaro communities and include the desert kangaroo rat, desert pocket mouse, gambel's quail, black-throated sparrow, desert horned lizard, the Harris' antelope squirrel, cactus mouse, gila woodpecker, desert tortoise, desert iguana, zebra-tailed lizard,



MARICOPA COUNTY, ARIZONA

PHOENIX URBAN WATER RESOURCE STUDY AREA

BASE MAP

U S ARMY ENGINEER DISTRICT, LOS ANGELES
CORPS OF ENGINEERS

FIGURE II-1

and western diamondback rattlesnake. Cropland, which constitutes approximately one-third of the metropolitan area, provides habitat for certain adaptable wildlife species, particularly many species of songbirds and game birds. Other wildlife associated with cropland include the cotton tail rabbit, valley pocket gopher, and gopher snake. Along the major drainages, riparian communities occupy the flood plain where moisture is sufficient to support growth. Cottonwood and mesquite are important tress in the deciduous riparian woodlands community. The invasion of salt cedar in the 1930's and lowered groundwater tables have all but eliminated the cottonwood-mesquite woodlands that were widespread along the Verde, Salt, Gila, and Agua Fria Rivers in the study area before Anglo settlers arrived. Cattail marsh and other wetland habitats also have been subjected to eradication through development, although patches of wetland habitat persist where surface flows exist, such as downstream from the 91st Avenue wastewater treatment plant outfall, along irrigation ditches, and adjacent to impoundments. Riparian communities provide habitat for a great many species of wildlife, particularly nesting birds, and are among the most important links in maintaining the biological diversity and productivity in the area.

Wildlife, particularly birds, are attracted to vegetation in desert washes and along major creeks and rivers. Cottonwood and mesquite provide important nesting, feeding, resting, and roosting sites. A major riparian community, the Fred J. Weiler Green Belt, extends along the Gila River from the Town of Liberty in the southwest portion of the study area nearly 100 miles westward and southwestward to the Town of Date Palm. The Green Belt is a special use area for wildlife under the direction of the U.S. Department of the Interior, Bureau of Land Management, and provides a major habitat for white-winged dove, mourning dove, shorebirds, waterfowl, quail, and other wildlife.

Flows from the 91st Avenue and 23rd Avenue treatment plants contribute to the support of riparian habitat along the Salt River from 91st Avenue to 115th Avenue. At 115th Avenue, near the confluence of the Salt and Gila Rivers, the Arizona Game and Fish Department maintains a wildlife management area. The City of Phoenix has an agreement with the Department to discharge 7,300 acre feet per year (af/yr) of effluent at a constant rate from the 91st Avenue treatment plant to help support this wildlife area.

Both the Federal Government and the State of Arizona have published lists of "special status" biota. The most recent federal list of endangered and threatened wildlife and plants was published in 1979 (U.S. Department of Interior, Fish and Wildlife Service, 1979). The Arizona Native Plant Law (Arizona Revised Statutes, 1976) protects various native plants, among them species of the lily, amaryllis, orchid, orpine, and cactus family. A list of threatened wildlife in Arizona has been prepared by the Arizona Game and Fish Department (1978).

Wildlife on the Federal list in the study area include the peregrine falcon, Yuma clapper rail, and bald eagle. These species also appear on the Arizona Game and Fish Department list of threatened wildlife. Peregrine falcons were sighted in the area in 1971, although they are not known to nest in the area. Bald eagles are located peripheral to the study area along the Verde River in the Fort McDowell Indian Reservation and Bartlett Dam areas. The Yuma clapper rail was sighted in 1970 near 107th Avenue along the Salt River and in 1976 near El Mirage Road on the Gila River.

SURFACE WATER

The study area is entirely within the Gila River drainage basin and is drained by the Gila, Salt, and Agua Fria Rivers and their tributaries. New River, Skunk Creek, Cave Creek, and Indian Bend Wash drain parts of the study area to the Salt and Agua Fria Rivers. The Verde River is a major tributary to the Salt River. The Salt River has a drainage area of 16,040 square miles and the Agua Fria an area of 2,340 square miles. The Salt and Agua Fria flow into the Gila River in the southwestern corner of the study area.

Upstream of the study area, the flows of the Salt, Verde, and Agua Fria Rivers are controlled by dams and reservoirs that provide a steady surface water supply. Joint flow from the Salt and Verde Rivers is distributed at the Granite Reef Diversion Dam to the Arizona Canal and South Canal, from which it is further distributed into the canal system of the Salt River Valley. Flow in the Agua Fria is diverted into the Beardsley Canal. As a consequence of upstream impoundment, some stretches of the Salt and Agua Fria Rivers in the study area are ephemeral, having flows only as the result of releases from the upstream dams or heavy rains on the immediate drainage area. The permanent pools of water in the Salt River result from wastewater treatment plant effluent, stormwater runoff, and return flows from irrigated agricultural land.

Surface Water Quality and Discharge Requirements

The 1972 Water Pollution Control Act Amendments identified three goals for the nation's waters and those are commonly referred to as the 1977, 1983 and 1985 goals. The 1977 goal is a treatment, or effluent, standard rather than a stream standard. It is defined in terms of the level of treatment to be achieved. On the other hand, the 1983 goal is defined in terms of uses to be protected "...wherever attainable, an interim goal of water quality which provides for the protection and propagation of fish, shellfish and wildlife and provides recreation in and on the water..." The 1985 goal calls for the elimination of discharge pollutants into navigable waters by 1985. States were authorized to establish standards to meet these goals.

The Arizona Water Quality Control Council (WQCC) has the authority to establish surface water standards for the State of Arizona. Standards have been established for all the major river systems in the state with the exception of portions of the Salt River from Granite Reef Dam to its confluence with the Gila River and the Gila River from there to Painted Rock Dam. The existing water quality standards have established pollution control technology policies, an anti-degradation policy, definitions of various uses, general standards (water quality limits) applicable to all surface waters, standards for surface water with specific uses, monitoring requirements, exceptions, and identification of surface water designated uses for specific streams. These existing water quality standards are summarized below and in Table II-6.

General Standards Applicable to All Surface Waters Set By The WQCC (Regulation R9-21-206)

All surface waters shall be:

1 Free from substances attributable to domestic or industrial waste or controllable sources that will settle to form sludge or bottom deposits in amounts sufficient to interfere with beneficial uses.

2. Free from floating debris, oil, grease, scum and other floating materials attributable to domestic or industrial waste or other controllable sources in amounts sufficient to be unsightly or in amounts sufficient to interfere with beneficial uses.

3. Free from materials attributable to domestic or industrial waste or other controllable sources in amounts sufficient to produce taste or odor in the water or detectable off-flavor in the flesh of fish, or in amounts sufficient to change the existing color, turbidity or conditions in the receiving stream to such degree as to create a public nuisance.

4. Free from toxic, corrosive, or other deleterious substances attributable to domestic or industrial waste or other controllable sources at levels or combinations sufficient to be toxic to human, animal, plant or aquatic life.

Specific Standards Applicable to All Surface Waters (Regulation R9-21-207)

1. Toxic Substances

Toxic substances shall be kept below levels which are deleterious to human, animal, plant or aquatic life, or in amounts sufficient to interfere with the beneficial use of the water. As a minimum evaluation for the presence of toxic substances, a water shall be evaluated by use of a 96-hour bioassay, guided by the document "Standard Methods for the Examination of Water and Wastewater". The survival of the test organisms shall not be less than that in controls which utilize appropriate experimental water.

2. Radioactivity

The concentration of radioactivity in surface waters of the state shall not:

a. Exceed those limits established by the regulations for the control of ionizing radiation adopted by the State of Arizona Atomic Energy Commission.

b. Result in the accumulation of radioactivity in edible plants, animals and aquatic life that present a hazard to consumers.

c. Be harmful to aquatic life.

Since any human exposure to ionizing radiation is undesirable, the concentration of radioactivity in surface waters will be maintained at the lowest practicable level.

In addition to protecting public health, state surface water standards provide a mechanism for judging progress toward meeting the National Clean Water Goal of the Water Pollution Control Act Amendments. Therefore each state is required under the Act to review its standards every three years, with emphasis on broad public participation, as well as technical updating.

The State of Arizona is currently in the process of reviewing and revising state water quality standards. A series of public meetings were held throughout the state in January, February and March of 1978, on designating water uses to be protected for specific segments and portions of all rivers, streams and lakes in Arizona, and reviewing the associated numerical limits allowed for specific contaminants in the water for each designated protected use.

Final revisions will be adopted by the Water Quality Control Council late in 1979.

As part of this standards review process, a program is underway by the Bureau of Water Quality Control (BWQC) to develop standards for the Middle Gila Basin. Since portions of these ephemeral streams are dominated by effluent from municipal sewage treatment facilities, no water uses were designated for them in 1973 and therefore it was unclear which standards apply. The EPA and Bureau of Water Quality Control have interpreted the "tributary rule" of the state water quality regulations as applying the standards for Painted Rock reservoir to these segments until the state can designate specific uses.

The process being used in the development of the standards is first to identify the uses in the various rivers, and then review the associated numerical limits allowed for contaminants by use. The BWQC will then review the information and determine the standards for the Middle Gila. Once these standards are identified, they will have a direct impact on the quality of effluent that can be discharged by the treatment plants to these watercourses.

Surface Water Quality Monitoring

Currently, water quality data are obtained from a number of different monitoring programs, depending on the basin and stream segment.

A fixed station network (FSN) is operated by the United States Geological Survey (USGS) under a cooperative agreement with the Arizona Department of Health

Services (ADHS), Bureau of Water Quality Control (BWQC). The network consists of 21 stations that are financed in whole or in part by BWQC, and seven stations that are operated by the USGS. Data from all 28 stations are reported to EPA and the state. The USGS also operates other stations across the state. The data from these additional stations are reported to EPA, and are available to the state upon request. This data shows locations of the monitoring stations within Maricopa County. The fixed station network is designed to provide data to establish trends in the various stream segments and to alert the BWQC to current and potential water quality standards violations.

Special monitoring programs, which include intensive surveys, special surveys, compliance monitoring and complaint monitoring, were conducted on selected stream segments during 1976. The Arizona Game and Fish Department, U.S. Bureau of Reclamation, and the U.S. Forest Service collect water quality data in Maricopa County for their various purposes. This data is made available to the BWQC.

Relatively comprehensive information on water quality is available for sampling locations on: 1) the Salt River below Stewart Mountain Dam, 9.5 miles upstream from the Verde River; 2) the Verde River, 1,300 feet below Bartlett Dam; and 3) the Gila River, above diversions to irrigation canals 8 miles downstream from the Hassayampa River. Water quality stations on the Verde and the Salt Rivers provide data on principal sources of surface water supplies delivered in the county, while the station on the Gila River provides data on the principal source of surface water draining the county.

Annual maximum and minimum concentrations that were formed during the five water-year period from 1972 to 1976 in periodically collected samples at the Salt, Verde and Gila water quality stations are presented in Table II-7. Also shown in the table are concentration limits for:

- o The adopted EPA primary and State of Arizona drinking water standards for domestic water supplies.
- o The proposed EPA secondary standards for domestic water supplies. These proposed secondary standards have not been adopted by the State of Arizona and are not enforceable.
- o The proposed (May 1979) Water Quality Control Council surface water standards for the three locations. These standards are based upon the highest protected use as identified by the Council.

An asterisk indicates concentrations that exceed any of the above standards. As may be seen in Table II-7, water from the Verde River has the generally highest quality. An accepted single indicator of water quality is the concentration of total dissolved solids (TDS) in water. The Verde's concentrations of between 116 and 402 milligrams per liter (mg/l) of TDS are lower than those of the Salt River concentrations of between 349 and 788 mg/l. Concentrations in both of these rivers are considerably lower than those in the 202 to 4,740 mg/l range of the Gila River.

Comparing the data shown in Table II-7 with EPA primary and secondary drinking water standards and the proposed surface water standards indicates contravention of standards for a number of constituents, primarily in the Gila River. Concentrations of TDS in the Salt River exceed the EPA proposed secondary standard of 500 mg/l in four out of the five years for which data are provided. TDS concentrations in the Verde River are well within the standard for all five years. TDS concentrations in the Gila River exceed the standard in all three years for which data are provided.

Verde River waters exceed the standards for only one constituent, and that is lead. In the Salt River, concentrations of lead also exceed the standard. In the Gila River, concentrations of fluoride, nitrate, arsenic, cadmium, lead, mercury, and selenium exceed primary and proposed surface water standards; concentrations of sulfate, chloride, and TDS exceed secondary standards.

<u>Classification of Water Segments</u>

The state, in accordance with federal regulations, has designated all surface waters of the state as either water quality limited segments or effluent limited segments.

Water quality limited segments are surface water segments where it is known that water quality does not meet applicable surface water quality standards and is not expected to meet standards even after the application of required effluent limitations.

Effluent limited segments are surface water segments where surface water quality standards are being met or where there is adequate demonstration that water quality will meet standards after the application of required effluent limitations.

Based on the Verde River basin plan and the continuing planning process, the Verde River from Camp Verde to Bartlett Dam (a portion of which lies in Maricopa County) has been classified as a Water Quality Limited Segment. It was so classified because of an inability to meet phosphate standards. The river below this segment has not been listed because it is a regulated river. On the same basis (excessive phosphates), the Salt River, its lakes and tributaries, from the Verde River confluence to its headwaters, has been classified as a Water Quality Limited Segment.

No segment classifications have been made for the remainder of the 208 planning area under any of the basin plans. Also, no waste load allocations have been determined for streams in the planning area, based on: 1) a lack of data upstream of the Granite Reef Dam; and 2) they do not apply downstream of the dam since the stream is ephemeral. However, the BWQC has indicated that nutrients are of primary concern.

GROUNDWATER

Groundwater forms a highly significant portion of the total amount of water used in the study area. Use of groundwater is tied to the land; as land ownership or use changes, groundwater use may also change. Add to this the ongoing effort to create new groundwater legislation, and the result may well affect significantly the movement and future quality of groundwater.

Unlike surface water, there are no water quality standards for groundwater. The only quality standards which apply to groundwater are those of the Safe Drinking Water Act, and are based on EPA regulation (from the National Interim Primary Drinking Water Regulations, 1975) and the state drinking water standards. These standards only apply to groundwater used for drinking in a community supply.

Under the EPA regulations maximum contaminant levels were established for inorganic, organic, microbiologic and radiologic constituents. Little sampling has been done for organic chemical or radiologic constituents in groundwater in Maricopa County. Analyses have shown that the inorganic chemical constituents are the greatest problem, because the other constituents usually are not found in areas of similar hydrogeology to the study area.

The primary standards are:

Constituent	Level (mg/l)
Arsenic	0.05
Barium	1.0
Cadmium	0.01
Chromium	0.05
Fluoride (Phoenix Area)	1.4
Lead	0.05
Mercury	0.002
Nitrate (as N)	10.0
Nitrate (as NO^3)	45.0
Selenium	0.01
Silver	0.05

EPA (1977) also established secondary standards which are based on aesthetic quality of drinking water. Secondary standards are guidelines only and non-enforceable. They have not been adopted by the State of Arizona. These secondary standards are:

Constituent	Level (mg/l)
Chloride	250
Copper	1.0
Foaming Agents	0.5
Hydrogen Sulfide	0.05

Constituent (Cont.)	Level (mg/1) (Cont.)
Iron	0.3
Manganese	0.05
pH	6.5 - 8.5
Sulfate	250
Total Dissolved Solids	500
Zinc	5.0

Groundwater quality is affected not only by natural conditions (although these are the most significant factors), but also by:

- o Irrigation return flow
- o Wastes from feedlots and dairies
- o Urban storm runoff
- o Septic tanks
- o Landfills
- o Industrial waste disposal
- o Wastewater effluent disposal
- o Hydrologic modifications

Specific water quality constituents examined by the Urban Study include:

- o Salinity
- o Chloride
- o Sulfate
- o Hardness
- o Nitrate
- o Fluoride
- o Chromium
- o Arsenic
- o Lead

Salt River Valley

There are two major groundwater areas in the Salt River Valley: the East Basin (referred to as the Paradise Valley-Chandler-Queen Creek subarea) and the West Basin (referred to as the Phoenix-Buckeye subarea). The basins, shown in Figure II-2, consist of water bearing alluvial deposits, separated by natural rock barriers which restrict groundwater movement between the basins.

Groundwater Quantity: Large volumes of water have accumulated in the basins over tens of thousands of years. At the time Anglo settlers came to the Valley the water table near the Salt River was very close to the surface and no more than 100 feet deep in the central portion of the study area. After the construction of Roosevelt Dam in 1911 irrigated agriculture grew and surface water was applied to more lands. Waterlogging started to become a serious problem. The Arizona Legislature responded by empowering irrigation districts to pump water for drainage purposes. Even after waterlogging was no longer a problem, however, pumping continued. Agriculture had continued to grow during and after World War II. All surface water was appropriated and in use, and some irrigation districts were formed which depended totally on groundwater.

Since 1923, it is estimated that over 70 million acre-feet of groundwater have been pumped in the Salt River Valley. The water table continues to decline in the study area because more water is removed than is replaced. During most years, all of the available flow of the major rivers is diverted and very little or no natural recharge occurs in the basin. For the East and West Basins, groundwater decline averages 1.8 feet/year (i.e., a 1970 normalized overdraft of 632,000 acre-feet/year). It is estimated that about 100 million acre-feet of groundwater is stored above a depth of 700 feet and 50 million acre-feet is stored below in the next 500 feet of the basins.

According to the Arizona Water Commission (Baseline Conditions Report, April 1978), groundwater declines in the study area from 1923 to the present ranged from less than 50 feet (at the Salt and Gila Rivers near Buckeye) to more than 420 feet (near Queen Creek). In the metropolitan area the decline has been approximately 150-200 feet. The rates of decline are expected to decrease as agriculture is displaced by urbanization. Pumping of the groundwater has also resulted in changes in the historical direction of groundwater flow in some areas, as shown in Figure II-2.

Groundwater Quality: Groundwater quality varies widely throughout the Salt River Valley, both geographically and vertically.

Salinity has been a more severe problem in the southwest portion of the metro area. Generally, salinity in the West Basin increases toward the southwest.

Daily measurements of electrical conductivity of Gila River water at Gillespie Dam in recent years are available from the files of the U.S. Geological Survey, Phoenix subdistrict office. Chemical analyses of the river flow are available since 1950. The flow at Gillespie Dam greatly decreased in the late 1940's, and this was accompanied by an increase in salinity. Salinity of Gila River water varies inversely with the flow rate. For example, during 1975-76, the electrical conductivity of flows between 30 and 50 cfs ranged from 5,400 to 7,800 micromhos. At a flow rate of about 80 cfs, the electrical conductivity was about 4,000 micromhos and at more than 300 cfs, it was about 300 micromhos. The mean of the daily electrical conductivity measurements has been about 6,000 micromhos in recent years. The salinity of this water is similar to that of shallow groundwater in the Buckeye area.

In the East Basin salinity increases moving to the southeast. Throughout most of the study area, salinity has remained fairly constant since the 1920's. However, levels have increased in the last twenty years near Gilbert (due to irrigation return flow), Chandler (due to changing groundwater movement patterns) and the Goodyear-Liberty area (also due to groundwater changing patterns). Figure II-3 shows the total dissolved solids concentrations in the Basin in 1975-76.

Chloride content is distributed much like salinity in the groundwater and generally exceeded the 250 mg/l secondary standard in the Chandler/Gilbert area, west of Buckeye, and near the confluence of the Agua Fria and Gila Rivers in 1976. Sulfate content equalled or exceeded the 250 mg/l secondary standard in four areas: Buckeye-Liberty, near Tolleson, near Gilbert, and south of Gudalupe (250 mg/l), as shown in Figure II-4.

Nitrate content is a more severe problem in the West Basin where the maximum primary contaminant level of 45 mg/l is exceeded in a large area. The area averages eight miles in width and extends southwest from Deer Valley to the Hassayampa River. There are also scattered locations throughout the basins where 45 mg/l are exceeded. Historical well data indicates that generally nitrate levels are decreasing in most of the West Basin, east of the Agua Fria River. Increases west of the river, primarily in the Buckeye Irrigation District area, are attributable to increased use of sewage effluent for irrigation over the last fifteen years.

Fluoride levels exceed the maximum contaminant level of 1.4 mg/l west of Jackrabbit Road and exceed 3.0 mg/l just west of Buckeye. Higher fluoride levels may be encountered in the future as deeper wells are drilled into the alluvial deposits.

The maximum contaminant level for chromium (hexavalent) is usually not exceeded in the West Basin, but is often surpassed in parts of the Paradise Valley area. The data suggests these higher levels in Paradise Valley are associated with finer-grained facies in the alluvium. Research has shown that higher chromium levels are associated with higher water temperatures.

Arsenic has a similar distribution to hexavalent chromium in Paradise Valley. Contents exceed the maximum contaminant level in some areas. Lead contents exceed the maximum contaminant level in a one-mile wide, ten-mile long area south of the Salt River and east of the Gila River confluence. Nitrate, chromium, arsenic, fluoride, and lead contents in groundwater, however, are largely due to natural factors.

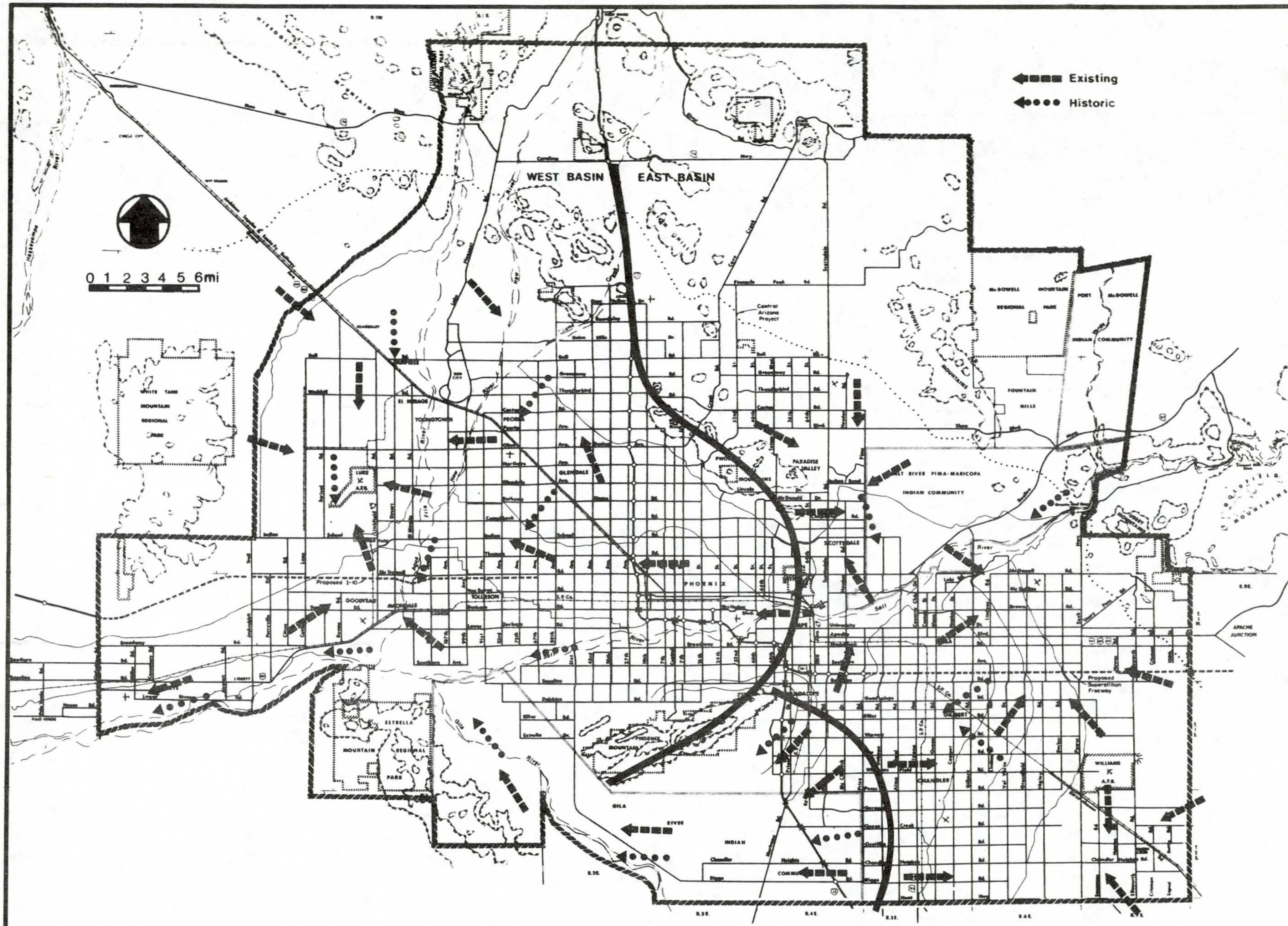
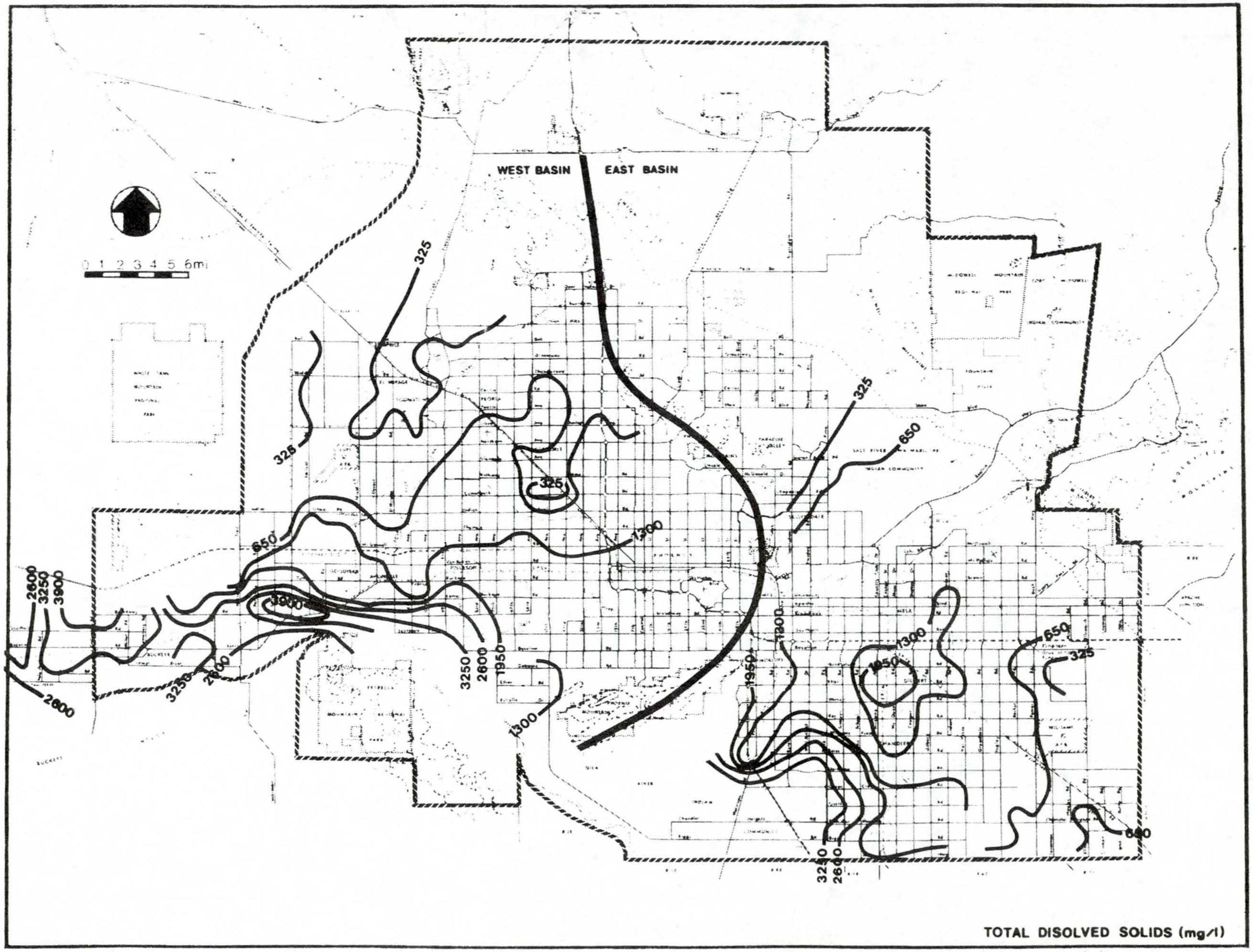


FIGURE II-2

DIRECTION OF GROUNDWATER FLOW



WEST BASIN
EAST BASIN
0 1 2 3 4 5 6mi
325
650
1300
1950
2600
3250
3900
TOTAL DISOLVED SOLIDS (mg/l)

FIGURE II-3

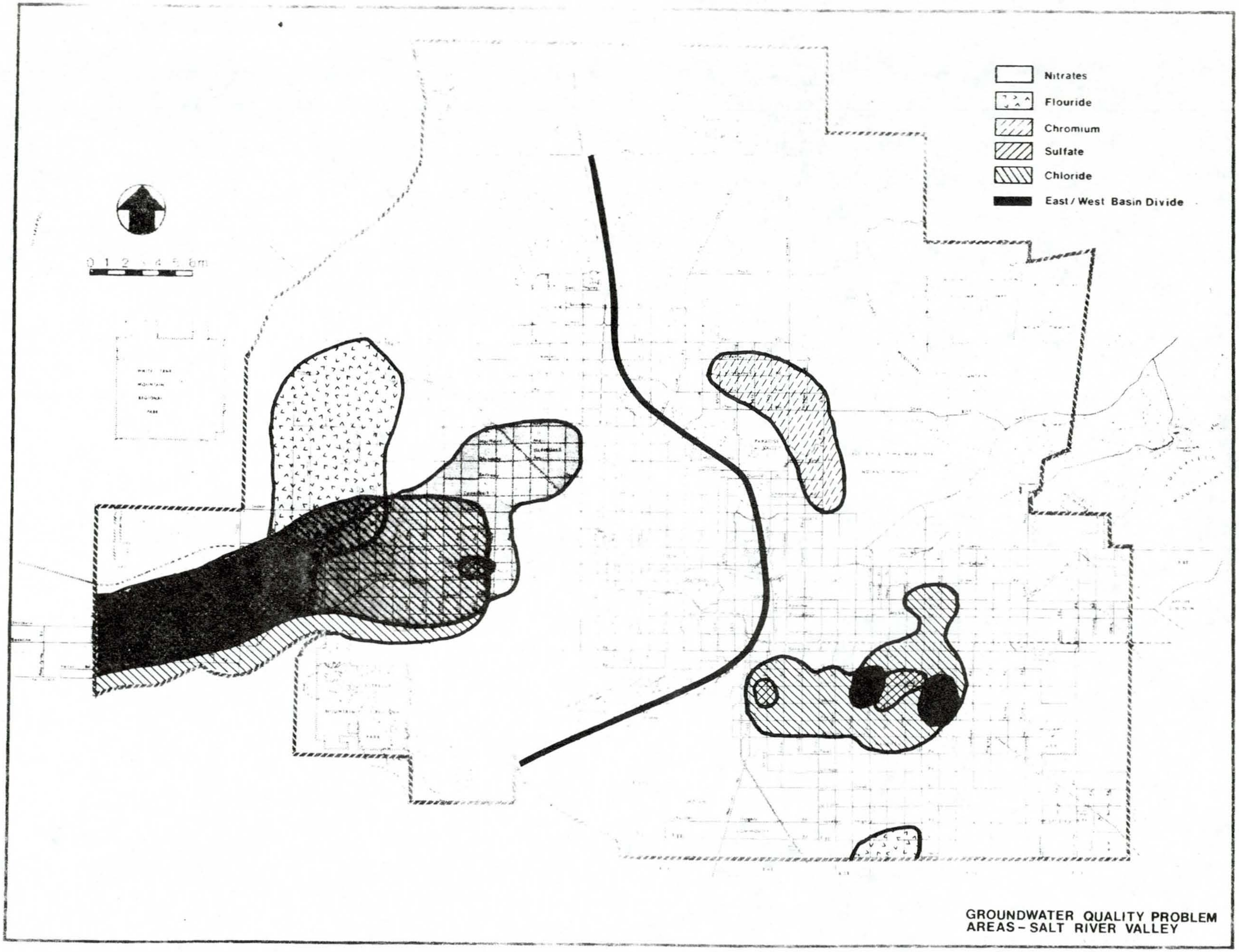

Nitrates
Flouride
Chromium
Sulfate
Chloride
East / West Basin Divide
GROUNDWATER QUALITY PROBLEM AREAS - SALT RIVER VALLEY

FIGURE II-4

SOCIO-ECONOMIC CONDITIONS

According to the U.S. Bureau of the Census, Arizona is presently the fastest growing state in the nation, and Maricopa County reflects the present rapid development occurring statewide. The rapid growth of the county and state populations are shown in Table II-8.

Basic Industries

The three leading industries in Maricopa County are manufacturing, tourism and agriculture. The period from 1960 into the early 70's was one of rapid growth for all economic indicators of Maricopa County and even more rapid change in the composition of economic activity. Manufacturing, retail trade, finance, insurance and real estate services, and government industries grew while agriculture, mining, and transportation declined.

Manufacturing is the number one income producer for Maricopa County, the Phoenix metropolitan area, and the state. The state's manufacturing output grew from $926 million in 1966 to $2.14 billion in 1976. Metropolitan Phoenix's share was $1.60 billion in 1976. The 1977 forecast for Phoenix was $1.86 billion. The number of manufacturing establishments in the Phoenix area grew from 942 in 1971 to 1604 in 1976.

Tourism and travel play a major role in the economy of the study area. As the second leading income producer in Maricopa County in 1976, tourism generated approximately $1.25 billion in revenue, an increase of almost 11 percent over the previous year. The 1977 forecast indicates that this figure should have increased by another 10 percent, reaching $1.38 billion.

While the metro area is not nearly as dependent on agriculture as is the remaining portion of Maricopa County, productivity of farming in the county does have an impact on the economic viability of the Phoenix metropolitan area. Maricopa County has the highest gross farm income of any county in Arizona. The county produces the largest amount of crops and livestock in the state and the fifth largest amount in the nation. Farm marketings in the county was approximately $511 million in 1977, according to the Arizona Crop and Livestock Reporting Services. Total farm income in the county has increased 85.8 percent from $275 million in 1970. But, while farm income has continued to increase, agricultural employment has declined in both absolute numbers and percent of the total employment.

Economic Projections

The social, economic, political and climatic conditions which recently have made the area one of the leading growth areas in the nation will continue. This future economic outlook for the study area is based on a number of assumptions. At the national level, the U.S. economy both in the short term and long term will remain stable and continue to expand. At the local level, a steady immigration of new people to the area will persist, and with the addition of Central Arizona Project (CAP) water and the construction of the Arizona Nuclear

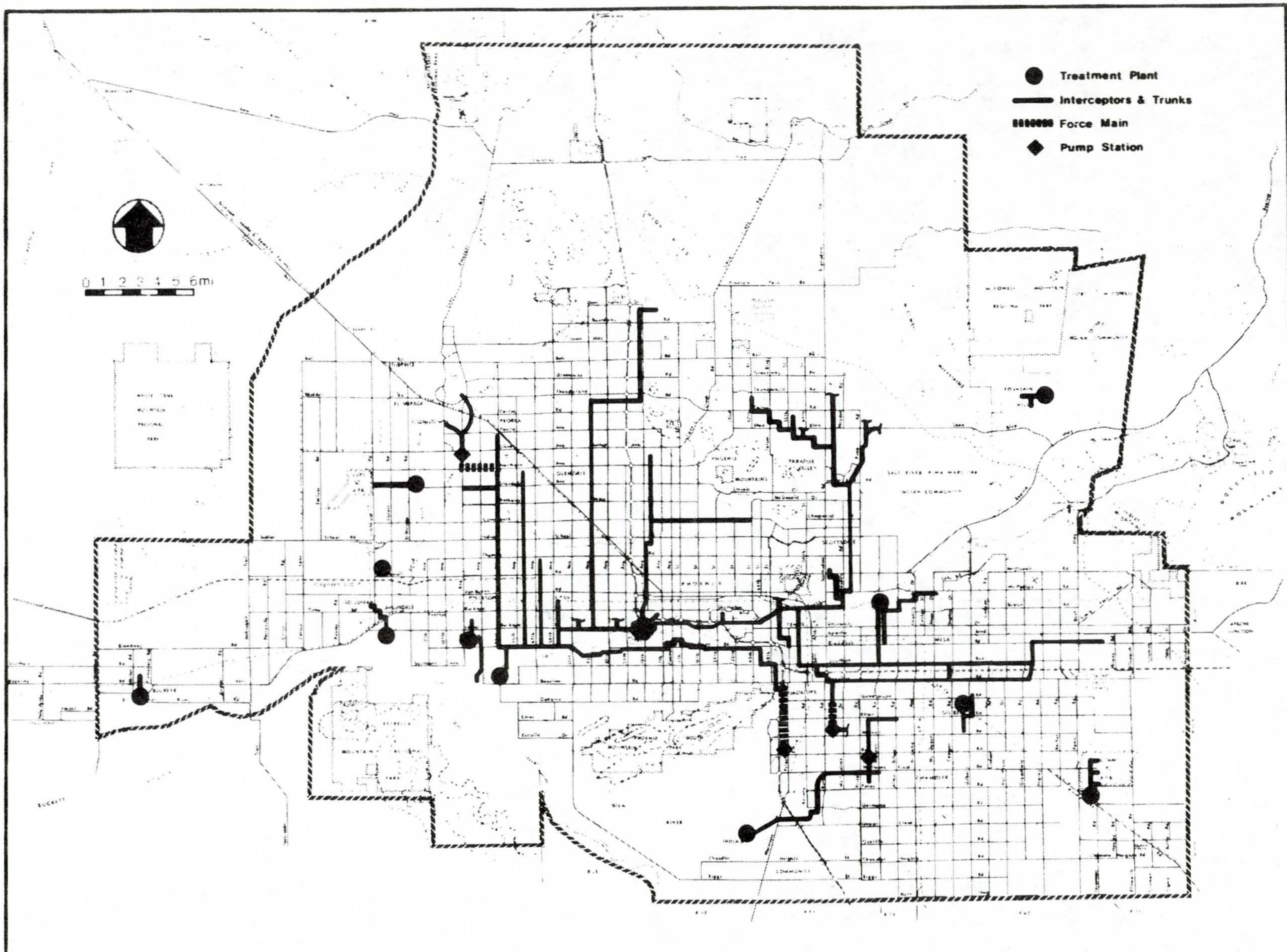


FIGURE II-5

EXISTING SEWER SYSTEM

Station west of Buckeye. APS is the project manager for the station. Three units of 1270 MWe each are scheduled to go on line at Palo Verde in 1982, 1984, and 1986.

Archaeological Resources

The Phoenix area was a major population center during portions of the prehistoric past and contains abundant archaeological remains. Earliest archaeological sites in the area belong to local variants of the Archaic tradition. Archaic sites have been found in the area but are few in number. The Hohokam tradition, which appears about 350 B.C., is the principal cultural complex represented within the area. Known Hohokam sites within the Salt River Valley are reported to be in excess of 800. The majority of these sites, located both along the area's major and tributary river systems and on irrigable lands adjacent to rivers, consist of villages or large permanent habitation sites, or of medium to large-sized shared areas which may also be the remains of habitation sites. In addition, at least seven major prehistoric irrigation canal systems (totalling more than 315 miles in length) are known to have existed within the Salt River Valley. Each of these canal systems is generally associated with one or several major Hohokam village sites.

While many of these sites have been destroyed through urbanization and agricultural development, others have been excavated and reported by archaeologists, thus providing a permanent record of their existence. In addition, the remains of several major sites (for example, Pueblo Grande) have been preserved and restored and are accessible to the general public. Several prehistoric sites, including the Pueblo Grande Ruin (Phoenix), Hohokam-Mormon Canals (Mesa), and Hohokam-Pima Irrigation Sites (Phoenix), have been entered on the National Register of Historic Places. Several other archaeological sites have either been nominated to or are considered to be potentially eligible for inclusion in the State or National Registers of Historic Places.

Historical Resources

An initial survey of historic sites in metropolitan Phoenix prepared for the U.S. Army Corps of Engineers identified more than 550 existing historic sites. Seven sites have been entered on the National Register of Historic Places. They are: Hackett House, Tempe; Farmer Goodwin House, Tempe; Taliesin West, Scottsdale; Rosson House, Phoenix; the Phoenix Carnegie Library and Library Park, Phoenix; Evans House, Phoenix; and the Arizona State Capitol Building, Phoenix. An additional 176 historic sites are considered to be potentially eligible for nomination to either the State or National Registers of Historic Places.

TABLE II-1

FEDERAL AND ARIZONA AMBIENT AIR QUALITY STANDARDS
(Concentrations in ug/m^3 unless noted)

Pollutant	Averaging Time	Federal Primary Standard	Federal Secondary Standard	Arizona Standard
Photochemical Oxidants (Ozone)	1 hour (a)	235 (b)	235 (b)	160
Carbon Monoxide	1 hour (a)	40 (mg/m^3)	40 (mg/m^3)	40 (mg/m^3)
	8 hours (a)	10 (mg/m^3)	10 (mg/m^3)	10 (mg/m^3)
Nitrogen Dioxide	Annual	100	100	100
Sulfur Dioxide	3 hours (a)		1,300	1,300
	24 hours (a)	365		260
	Annual	80		50
Total Suspended Particulates (TSP)	24 hours (a)	260	150	150
	Annual geometric mean	75	60 (c)	75
Hydrocarbons (Nonmethane)	3 hours (a)	160 (c)	160 (c)	160

(a) Federal standard is not to be exceeded more than once a year; state standard is not to be exceeded.

(b) As of April 10, 1979, the federal standard for ozone (photochemical oxidants) was relaxed from 160 ug/m^3 to 235 ug/m^3.

(c) These "standards" are actually guides to be used to monitor progress in attaining other standards.

Source: Arizona Department of Health Services, 1978.

TABLE II-2

1977 OXIDANTS DATA SUMMARY
(Concentrations in ug/m^3)

Nearest City or Town	Site Location	Annual Avgs.	1-Hour Avgs. Maximum	1-Hour Avgs. 2nd High
Phoenix	4732 S. Central	19	187	183
Phoenix	1845 E. Roosevelt	29	310	300
Phoenix	8531 N. 6th St.	27	196	185
Phoenix	15 E. Monroe	35	220	202
Phoenix	1740 W. Adams	33	275	240
Scottsdale	2857 N. Miller Rd.	22	196	189

Source: Arizona Department of Health Services, 1978.

TABLE II-3

1977 CARBON MONOXIDE DATA SUMMARY
(Concentrations in mg/m^3)

Nearest City or Town	Site Location	Annual Avgs.	1-Hr. Avgs. Maximum	1-Hr. Avgs. 2nd High	8-Hr. Avgs. Maximum	8-Hr. Avgs. 2nd High
Mesa	3rd Place & Center	2	24	22	13	11
Phoenix	3300 W. Camelback	2	26	24	22	21
Phoenix	4732 S. Central	2	19	19	11	11
Phoenix	8531 N. 6th St.	2	24	24	10	9
Phoenix	1845 E. Roosevelt	3	31	30	24	23
Phoenix	15 E. Monroe, Valley Bank Annex	3	46	45	21	18
Phoenix	1740 W. Adams	3	38	37	29	23
Scottsdale	2857 N. Miller Rd.	2	31	30	14	14
Scottsdale	13665 N. Scottsdale Rd.	1	7	7	5	4

Source: Arizona Department of Health Services, 1978.

TABLE II-4

1977 PARTICULATES DATA SUMMARY
HIGH-VOLUME SAMPLER
(Concentrations in ug/m^3)

Nearest City or Town	Site Location	Annual Geom. Mean	24-Hr. Avg. Maximum	24-Hr. Avg. 2nd High
Mesa	3rd Place & Center	128	270	259
Phoenix	1845 E. Roosevelt	144	299	254
Phoenix	4732 S. Central	155	390	356
Phoenix	8531 N. 6th Street	109	281	226
Phoenix	241 N. Central, Valley Bank Center, Roof	74	497	417
Phoenix	15 E. Monroe, Valley Bank Annex, 3rd Floor	113	844	678
Phoenix	1740 W. Adams	132	252	246
Phoenix	1845 E. Roosevelt	101	232	202
Scottsdale	2857 N. Miller Rd.	118	273	248
Scottsdale	13665 N. Scottsdale Rd.	179	589	417

Source: Arizona Department of Health Services, 1978.

TABLE II-5

SUMMARY OF TECHNICAL ANALYSIS FOR OZONE AND CARBON MONOXIDE (BASE YEAR 1977)
Phoenix, Arizona

	Ozone	Carbon Monoxide
Standards		
Federal standard (a)	1-hr: 160 ug/m^3	8-hr: 10 mg/m^3
Maximum recorded	310 ug/m^3	29 mg/m^3
Second highest	300 ug/m^3	24 mg/m^3
Number of violations	Approx. 175	Approx. 187
Extent of violations	Most of central metro area	Most of metro area
Emissions	(nonmethane hydrocarbons)	
Traffic (%)	56	95
Nontraffic (%)	44	5
Total emissions	223 tons/day	940 tons/day
Controls		
Present	Vehicle inspection/maintenance, computerize traffic signals, carpooling, mass transit	
Possible future	Vapor recovery Phases I & II	Increased carpooling and mass transit, various voluntary strategies (e.g., modified work schedules)
Attainment		
Goal for attainment of standard	Before December 31, 1985	Before December 31, 1982

(a) See Table 3-4.

Sources: Arizona Department of Health Services, 1978, 1978.

TABLE II-6

SUMMARY OF ARIZONA WATER QUALITY STANDARDS CRITERIA
FOR DESIGNATED BENEFICIAL USES (Amended Dec. 12, 1974)

Standard	Full Body Contact	Partial Body Contact	Domestic & Industrial Water Supply	Cold Water Fishery	Warm Water Fishery	Agri-culture	Aquatic Life & Wildlife
FECAL COLIFORMS (No./100 ml.)							
Geometric mean	200	1000	1000	1000	1000	1000	1000
90% value (for 5 samples over 30 days)	400	2000	2000	2000	2000	2000	2000
pH							
Range	6.5-8.6	6.5-8.6	None	6.5-8.6	6.5-8.6	None	6.5-8.6
Maximum change	+/-0.5	+/-0.5	None	+/-0.5	+/-0.5	None	+/-0.5
TURBIDITY (JTU)							
Streams	Lowest practicable value		None	10	50	None	Lowest practicable value
Lakes	Lowest practicable value		None	25	10	None	Lowest practicable value
DISSOLVED OXYGEN (mg/l)							
Minimum	None	None	None	6.0	6.0	None	None
TEMPERATURE (Deg. F)							
Maximum change	5 Deg.	5 Deg.	None	2 Deg.	5 Deg.	None	No temperature interference
Maximum	93 Deg.	93 Deg.	None	55 (winter) 70 (summer)	93 Deg.	None	No temperature interference

TABLE II-6 (Cont.)

SUMMARY OF ARIZONA WATER QUALITY STANDARDS CRITERIA
FOR DESIGNATED BENEFICIAL USES (Amended Dec. 12, 1974)

Standard	Full Body Contact	Partial Body Contact	Domestic & Industrial Water Supply	Cold Water Fishery	Warm Water Fishery	Agri-culture	Aquatic Life & Wildlife
TOXICS (mg/l)							
Arsenic	0.050	0.050	0.050	0.050	0.050	None	0.050
Barium	1.000	1.000	1.000	0.500	0.500	None	0.500
Boron	None	None	None	None	None	1.000	None
Cadmium	0.010	0.010	0.010	0.010	0.010	None	0.010
Chromium (hexavalent)	0.050	0.050	0.050	0.050	0.050	None	0.050
Copper	1.000	1.000	1.000	0.050	0.050	None	0.050
Cyanide	0.200	0.200	0.200	0.100	0.100	None	0.100
Mercury	0.005	0.005	0.005	0.005	0.005	None	0.005
Lead	0.050	0.050	0.050	0.050	0.050	None	0.050
Phenol	0.001	0.001	0.001	0.001	0.001	None	0.001
Selenium	0.010	0.010	0.010	0.010	0.010	None	0.010
Silver	0.050	0.050	0.050	0.050	0.050	None	0.050
Zinc	5.000	5.000	5.000	0.500	0.500	None	0.500

The U.S. Environmental Protection Agency has proposed the following values for the Verde River and tributaries, except Granite Creek:

PHOSPHATES (expressed as P in mg/l)	
Annual Mean	0.20
90% value	0.30

TABLE II-7

SALT, VERDE AND GILA RIVERS WATER QUALITY
COMPARED TO DOMESTIC AND SURFACE WATER STANDARDS

	Primary							Secondary			
	Arsenic (3)	Cadmium (3)	Chromium (3)	Lead (3)	Mercury (3)	Nitrate (1)	Selenium	Fluoride	Chloride	Sulfate	TDS
Domestic Water Supply Standards (mg/l)	0.05	0.01	0.05(2)	0.05	0.002	10.0	0.01	14-2.0	250	250	500
A. Salt River Below Stewart Mountain Dam (Highest Protected Use-Domestic Water Source)											
Surface Water Standards (mg/l)	0.05	0.01	0.05	0.05	0.002	NS	0.01	NS	NS	NS	NS
1972	-	-	-	-	-	.02-.59	-	.3-.5	300*-320*	34-74	708*-788*
1973	-	-	-	-	-	.00-2.4	-	.2-.5	100-280*	44-75	353-760*
1974	.004-.004	0-0	0-0	0.1*	0-0	.00-.00	.001-.002	.2-.4	99-150	41-49	349-446
1975	.003-.004	.01-.01	0-0	-	0-.0001	0-.02	0-0	.3-.5	150-240	43-62	463-649*
1976	.003-.004	.01-.01	0-.01	0.1*	0-0	.04-.06	0-0	.2-.4	220-280*	44-77	628*-658*
B. Verde River Below Bartlett Dam (Highest Protected Use-Domestic Water Source)											
Surface Water Standards (mg/l)	0.05	0.01	0.05	0.05	0.002	NS	0.01	NS	NS	NS	NS
1972	-	-	-	-	-	.0007-.00029	-	0-.5	15-25	40-81	281-402
1973	-	-	-	-	-	.04-3.6	-	.1-.6	3.6-14	11-48	116-316

TABLE II-7 (Cont.)

SALT, VERDE AND GILA RIVERS WATER QUALITY
COMPARED TO DOMESTIC AND SURFACE WATER STANDARDS

	Primary							Secondary			
	Arsenic (3)	Cadmium (3)	Chromium (3)	Lead (3)	Mercury (3)	Nitrate (1)	Selenium	Fluoride	Chloride	Sulfate	TDS
1974	0.15-0.21	0-0	.01-.01	0.1*	.0-.0	0-.55	0-.003	.2-.6	14-24	42-65	254-364
1975	.009-.018	.01-.01	0-0	0.1*-0.1*	0-.0001	.02-.31	.001-.110	.2-.5	8.5-30	24-80	191-378
1976	.011-0.18	.01-.01	0-.01	0.1*-0.1*	0-.0002	.01-.29	0-.0001	.2-.3	5.7-26	21-69	155-364
C. Gila Rivers above Diversions at Gillespie Dam (Highest Protected Use - Riparian Habitat)											
Surface Water Standards (mg/l)	0.05	0.01	0.05	Less than 0.05	Less than 0.002	NS	0.05	NS	NS	NS	NS
1972	-	-	-	-	-	-	-	-	-	-	-
1973	-	-	-	-	-	-	-	-	-	-	-
1974	.008-.023	.01-.02*	.01-.03	0.1-0.1*	0-.001	9.7-11*	.007-.009	.4-5.6*	1300*-1600*	750*-1100*	3500*-4740*
1975	.009-.011	.01-.01	0-.02	0.1-0.1	001-.003*	0.3-.28	.003-.010*	.2-2.6*	250-1500*	170*-1100*	384-4310*
1976	.012*-0.19*	.01-.01	.02-.02	.1*-.2*	0-.0003	6.8-12*	.0001-.109*	-	-	-	-

Source: U.S. Geological Survey Water Resource Data
*Exceeds USPHS (1962) and/or EPA (1975) limits
(1) Several of nitrate concentrations shown include nitrite expressed as N.
(2) Limit of 0.05 is for hexavalent chromium, whereas, analyses are for chromium undifferentiated.
(3) Analyses shown for arsenic, cadmium, chromium, lead, and mercury are for "total" which is generally higher than "dissolved". The standards do not differentiate between "total" and "dissolved".

TABLE II-8

POPULATION GROWTH, 1960-2000

Year	Arizona*	Maricopa County*
1960 (census)	1,302,160	663,510
1965	1,584,000	852,000
1970 (census)	1,755,400	971,230
1975	2,212,000	1,209,800
1976	2,270,000	1,260,500
1977	2,364,000	1,292,000
1980 (projected)	2,610,000	1,431,000
2000 (projected)	3,939,000	2,181,000

*Census year data from the Bureau of the Census. Others from the Arizona Department of Economic Security.

TABLE II-9

LAND USE IN THE URBAN STUDY AREA*
1975

Use	Acres	Percent of Study Area
Residential	138,163	9.4
Commercial	32,597	2.2
Industrial	20,867	1.4
Transportation	10,490	.7
Open space (dedicated)**	62,664	4.3
Agriculture	366,574	24.9
Natural	840,045	57.1
Total	1,471,400	100.0

*Data from Arthur Beard Engineers (1978) for the more urbanized portion of the study area were aggregated with estimates of land use proportions for the outlying territory by the Natelson Company, using maps prepared by the U.S. Department of Agriculture and the Maricopa Association of Goverments.

**Includes regional parks and recreation areas.

CHAPTER III

WATER QUALITY-POINT SOURCE ALTERNATIVES IMPACT ASSESSMENT

A substantial portion of the Phoenix Urban Study's efforts involved 208 planning for the Phoenix metropolitan area. The term "208" refers to a section within the Federal Water Pollution Control Act Amendments of 1972 (Public Law 92-500). The overall objective of PL 92-500 is to "restore and maintain the chemical, physical, and biological integrity of the nation's waters" (Section 101 (a). As a means to that end, the Act requires the development and implementation of areawide water quality management plans. Section 208 of the Act addresses the specific steps that communities in areas with water quality problems need to take to develop and implement areawide water quality management plans and to qualify for federal grants for constructing wastewater treatment facilities. The overall goal of the 208 plan is to develop physical and institutional systems to improve water quality, including treatment, prevention, conservation, etc. Once the final plan has been approved, the action portions of the plan dictate what various agencies are to do to clean up the waters of the area.

In Arizona, six councils of government were designated by the governor as water quality management planning agencies. The Maricopa Association of Governments (MAG) was charged with developing the Water Quality Management Plan -- or 208 plan -- for Maricopa County.

As provided in Section 208, the Corps of Engineers may be called upon by the governor or the designated planning agency to consult with and provide technical assistance to the agency. The Corps of Engineers, Los Angeles District, through its Phoenix Urban Study, was requested by MAG to provide such assistance. The Corps performed the technical work required in the MAG 208 program for the Phoenix area as part of the Urban Study.

This assessment is associated with the study of point source pollution for the metro Phoenix area. Point sources are stationary, readily identifiable sources of pollution, such as private or municipal waste treatment plants.

The point source portion of the Urban Study focused on wastewater treatment management. The study inventoried collection and treatment facilities, projected wastewater flows for the future, generated a number of alternative wastewater treatment systems, identified specific sites for the construction of proposed collection and treatment facilities, and refined the alternatives.

The various parts of the point source metro investigations were carried out by the U.S. Army Corps of Engineers Phoenix Urban Study, the City of Phoenix and MAG, with the assistance of numerous private consulting firms and individuals. The Corps of Engineers and the City of Phoenix studied wastewater treament alternatives for the eastside and westside communities of the metro area, respectively. The Corps of Engineers was responsible for coordinating all of the metro studies of the 208 program. MAG was responsible for point source studies in the non-metro area, non-point studies in metro and non-metro areas, and for overall coordination of the 208 studies.

As used in this report, "the environment" includes physical elements (land, water, air), biological elements (plants and animals), socioeconomic elements (population, economics, land use), and cultural elements (archaeological resources, historic sites). In essence, these are the elements that surround humankind and support life. "Environmental impacts" are adverse or beneficial changes in the natural or human environment caused by an action. In this portion of the appendix, the impacts of alternate wastewater treatment management plans for metro Phoenix are assessed, or evaluated. The assessment does not address impacts of alternatives developed in the non-point source studies for metro and non-metro areas or in the point source study for the non-metro area. A summary of environmental effects of all parts of the final 208 plan is included in the <u>208 Water Quality Management Plan</u> (June 1978).

Environmental criteria have been applied to selection of wastewater treatment management alternatives throughout the point source portion of the Urban Study. Environmental studies included an environmental inventory, descriptions of existing and future environmental settings, and evaluations of environmental consequences of residual waste (sludge) treatment alternatives, interceptor (sewage line) patterns, and proposed facilities. The assessment is based on the data collected and analyzed during the course of the point source portion of the Urban Study. Because of the volume of material, not all backup data are provided in the report.

PLAN DEVELOPMENT (See Figure III-1)

Point source planning began with the identification of a conceptual array consisting of 36 alternatives. From these, 20 were selected for further study on the basis of cost, technical feasibility, and effluent reuse potential.

Following an extensive review process, four final alternatives were selected for intensive study. The four point source alternatives are described below:

<u>Alternative 1 - 91st Avenue, 23rd Avenue, Tolleson, Gilbert, Chandler</u>: Under this alternative, twelve plants serve the Phoenix metro area to the year 2000 (See Figure III-2).

The existing plants at Buckeye, Sun Lakes, Williams AFB, Fountain Hills, Cave Creek and Sun City West would continue to operate in the future and would be expanded as their service area grew. These plants are common to the four alternatives. The existing 90 mgd 91st Avenue plant would be expanded to 142.5 mgd to serve all service areas except Tolleson/Peoria, portions of Gilbert, and Chandler which are served by their own treatment facilities.

The 91st Avenue plant would be expanded by 30 mgd immediately to handle flows from the contributing service areas. Between 1990 and 1995 an additional expansion to 140 mgd would come on line to handle flows through the year 2000.

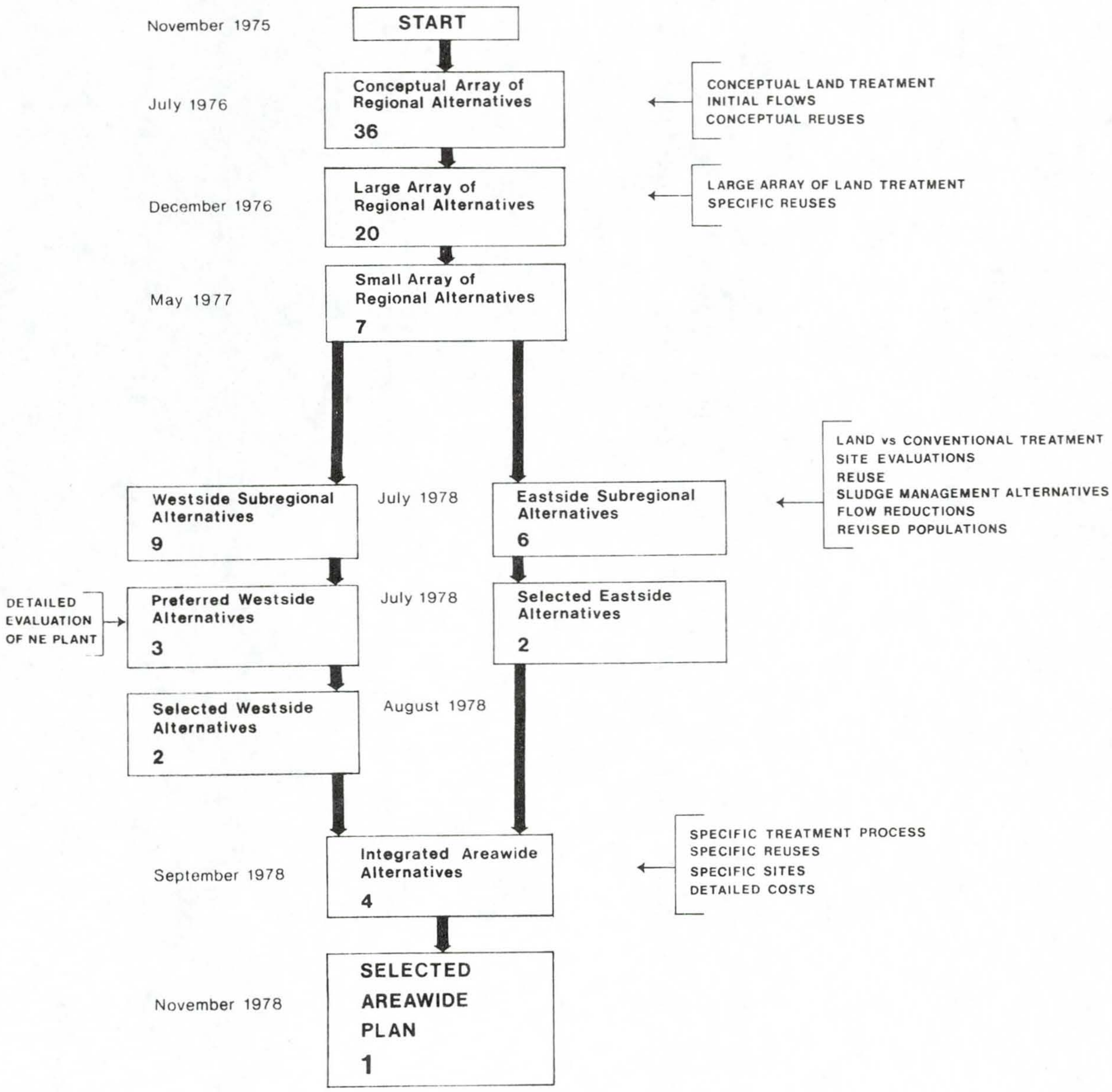

November 1975
START
July 1976
Conceptual Array of Regional Alternatives
36
CONCEPTUAL LAND TREATMENT
INITIAL FLOWS
CONCEPTUAL REUSES
December 1976
Large Array of Regional Alternatives
20
LARGE ARRAY OF LAND TREATMENT
SPECIFIC REUSES
May 1977
Small Array of Regional Alternatives
7
Westside Subregional Alternatives
9
July 1978
Eastside Subregional Alternatives
6
LAND vs CONVENTIONAL TREATMENT
SITE EVALUATIONS
REUSE
SLUDGE MANAGEMENT ALTERNATIVES
FLOW REDUCTIONS
REVISED POPULATIONS
DETAILED EVALUATION OF NE PLANT
Preferred Westside Alternatives
3
July 1978
Selected Eastside Alternatives
2
Selected Westside Alternatives
2
August 1978
September 1978
Integrated Areawide Alternatives
4
SPECIFIC TREATMENT PROCESS
SPECIFIC REUSES
SPECIFIC SITES
DETAILED COSTS
November 1978
SELECTED AREAWIDE PLAN
1

FIGURE III-1

Flows from the northeast Phoenix and portions of Paradise Valley would be served to the 23rd Avenue plant. The plant is designed at 40 mgd and is currently rated at 31 mgd, although the city plans to upgrade it to handle 40 mgd although projected flow to the plant in the year 2000 is 37.2 mgd.

A major new interceptor system and pump stations would be constructed to collect and carry flows to the 91st Avenue plant from Surprise, El Mirage, Youngtown, Glendale, Avondale/Goodyear, Litchfield Park, Luke AFB, Sun City East and Phoenix to a major new interceptor along 99th Avenue. Flows from the northeast area, Mesa, and the northernmost portion of Gilbert would be delivered to 91st Avenue by the existing collection system plus a new relief interceptor along Baseline Road and Southern Avenue. No pumping would be required. A new interceptor system would also be required to collect and carry flows from East Mesa to the Southern Avenue interceptor. Also new interceptors will be required in the northeast area to collect flows to the Hayden interceptor.

Flows from Peoria would be collected and carried to the expanded Tolleson facility via a new interceptor along 99th Avenue. The Tolleson plant, existing capacity 2.5 mgd, would be expanded to handle a year 2000 flow of 7.2 mgd.

Flows from Chandler would be delivered to the expanded plant by the existing sewer system plus new major interceptors along Pecos and Ray Roads. Two separate collection systems would serve the major portion of the Gilbert area; the majority of the north system to be constructed immediately and the south system to be constructed by 1990.

<u>Alternative 2 - 91st Avenue, 23rd Avenue, Tolleson, Gilbert, Chandler, Reems Road:</u> (See Figure III-3). Under this alternative, flows from the metro area would be served as described under Alternative 1, with the exception that flows from Litchfield Park, Avondale and Goodyear would be carried to a new facility at Reems Road via a major new interceptor from Thomas Road to the plant. A new pump station and pressure sewer would be required to lift and carry flows from Litchfield Park to the interceptor. A new lift station would also be required at Reems Road to lift flows to the plant.

The 91st Avenue plant would be expanded to 137.0 mgd by year 2000. A 30 mgd expansion will be constructed immediately to handle flows from the service area to between 1990 and 1995, at which point, an additional expansion would come on line to serve flows through year 2000.

<u>Alternative 3 - 91st Avenue, 23rd Avenue, Tolleson, Gilbert, Chandler, Northeast Area:</u> (See Figure III-4). Under this alternative the Phoenix metro area would be served by thirteen plants. The 91st Avenue plant would be expanded to 133.4 mgd by year 2000 to handle flows from all service areas except Chandler, portions of Gilbert, Tolleson/Peoria and the northeast area. Staging of construction of the expansion is as described under Alternative 1.

Flows from the northeast area (portions of Scottsdale, Phoenix, and Paradise Valley) would be delivered to a new facility located on the Salt River Indian

Community land. A new pump station at Indian Bend Road and Hayden and force main would be required to lift flows to the proposed site. The remaining service areas would be served as described under Alternative 1.

Alternative 4 - 91st Avenue, 23rd Avenue, Tolleson, Gilbert, Chandler, Northeast Area, Reems Road: (See Figure III-5). Under this alternative, fourteen treatment facilities serve the Phoenix metro area. The 91st Avenue plant would be expanded to 127.9 mgd by year 2000 to handle flows from El Mirage, Glendale, Luke AFB, Phoenix, Sun City, Surprise, and Youngtown. Staging of construction would be as previously described with an initial 30 mgd expansion followed by the balance as required.

The remaining service areas would be served as previously described with plants serving Tolleson/Peoria, Chandler, portions of Gilbert, Goodyear/Avondale, Litchfield Park, and portions of northeast Phoenix/Paradise Valley/Scottsdale.

Factors considered in the development and analysis of these alternatives were as follows:

Treatment Process: In the large array, the treatment level used for the plants was secondary. For the small array, the treatment level used was advanced waste treatment to give a level suitable for unrestricted agriculture. These levels were adequate to comparing the alternatives in as much as the costs were relative. At this point, however, more detailed consideration was given to the plant processes. After analysis it was decided that the treatment process for the smaller plants should involve aerated lagoons followed by stabilization ponds. This would result in a substantial saving of costs at the smaller plants. Effluent from the process will be BOD less than or equal to 30 mg/l and SS less than or equal to 135 mg/l. This effluent will meet state requirements for irrigation of restricted crops. At Tolleson, 91st Avenue and 23rd Avenue the existing treatment processes would continue. For the northeast plant the treatment process would be designed to meet unrestricted agriculture. This would be by either a conventional or a land treatment process.

Effluent Disposal: EPA stipulates that, except for aerated lagoons/stabilization ponds of 2.0 mgd or less, all effluent to be discharged to the nation's waters must have a minimum quality of BOD and SS less than or equal to 30 mg/l. Therefore all plants greater than 2.0 mgd must identify specific reuse or disposal options.

Following the technical and environmental analysis of the four areawide alternatives by the MAG 208 staff and consultants, the alternatives were presented to the public, the MAG 208 advisory groups, and the MAG Regional Council. A brochure was prepared that summarized the four alternatives and presented the estimated costs of each. This brochure, Metro 208 Areawide Alternatives (MAG 208 Program, 1978), was distributed to the public and the MAG 208 advisory groups. Presentations were made to the Citizen Advisory Group (CAG), Agricultural Advisory Group (AAG), Technical Advisory Group (TAG), MAG 208 Management Subcommittee, and the MAG 208 Executive Committee. Votes were taken on the alternatives at these advisory group and committee meetings.

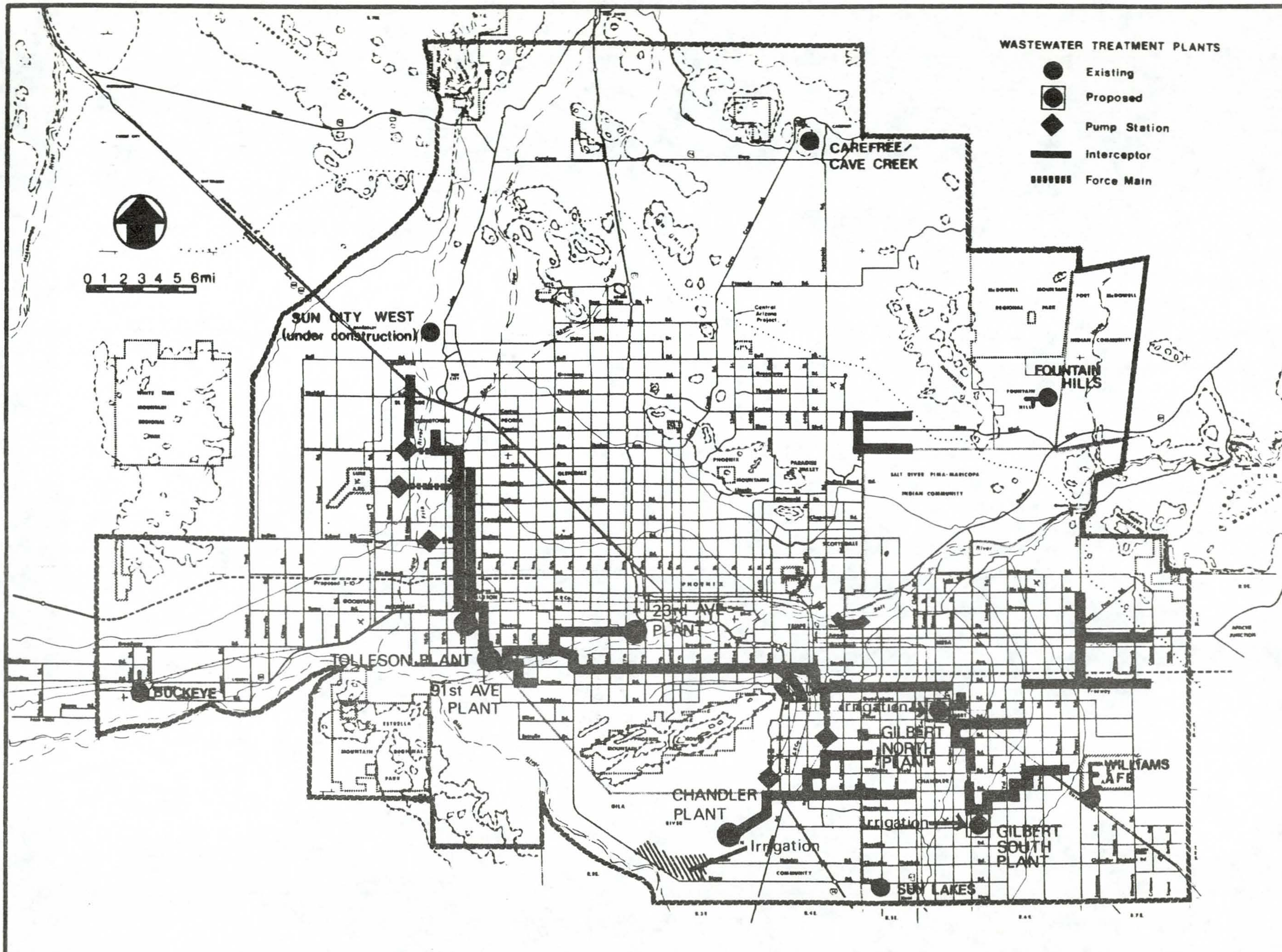


FIGURE III-2

ALTERNATIVE 1

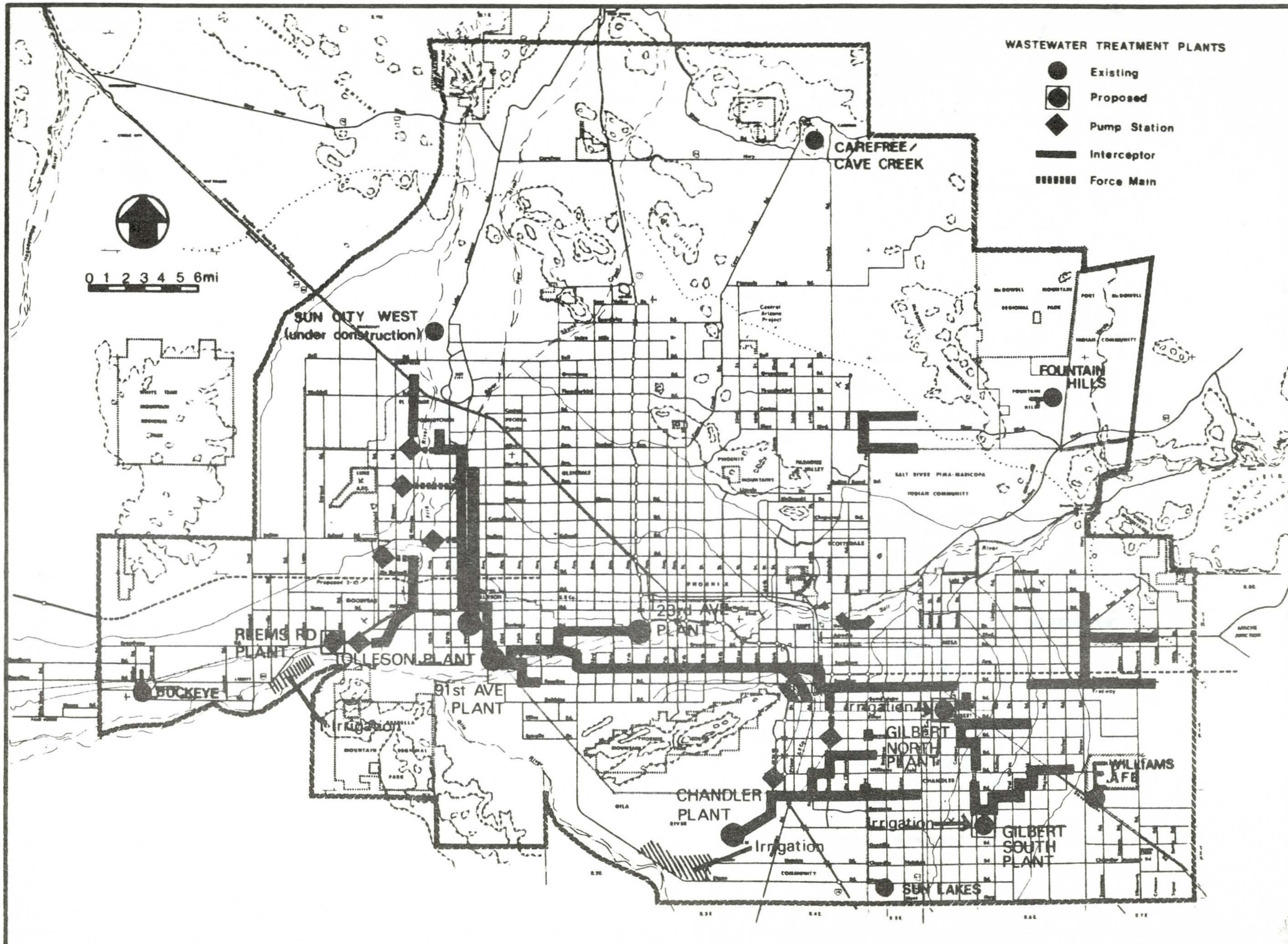


FIGURE III-3

ALTERNATIVE 2

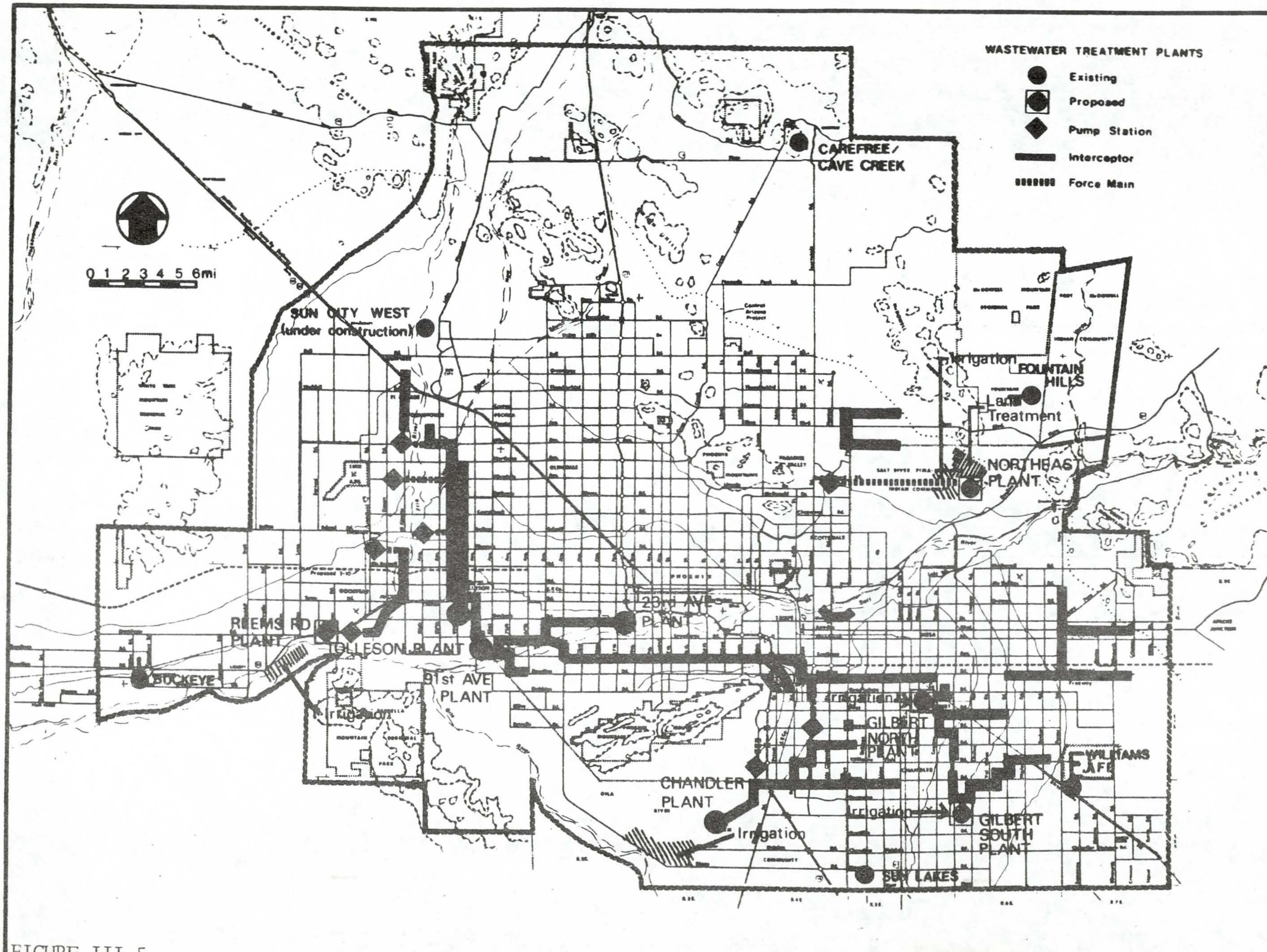


FIGURE III-5

ALTERNATIVE 4

The Citizen Advisory Group (CAG) selected Alternative 4 as the preferred wastewater treatment and collection plan. The group's decision was based on a desire to retain as much effluent as possible for reuse within the generating community, rather than export the water to a regional plant at 91st Avenue. Also, the group viewed this alternative as the most flexible, leaving the most options open for the future on a community level.

The Agricultural Advisory Group (AAG) voted unanimously to select Alternative 2, which includes the Reems Road plant but not the Northeast plant. The group recommended, however, that the Northeast plant be considered for inclusion in the plan at a later date. The reasons the AAG approved Alternative 2 were given as follows:

1. Moderate cost.

2. Existing commitments for effluent from the 91st Avenue plant that might not be met with a Northeast plant.

3. The inclusion of the Northeast plant at this time requiring downsizing of the Southern Avenue interceptor.

4. The fact that the Northeast plant could be built at a later time.

The Technical Advisory Group (TAG) voted unanimously to select Alternative 2. The group's decision was based on two primary concerns: 1) the required downsizing of the Southern Avenue interceptor if the Northeast plant were included in the selected plan; and 2) the need for the Reems Road plant on the westside.

The TAG was concerned that the Southern Avenue interceptor and other downstream interceptors would necessarily be downsized if Alternatives 3 or 4 (which include the Northeast plant) were selected. It was thought that the timing of the Norhteast plant decision was critical. Since the proporsed plant ould be located on Salt River Indian Community lands, extensive negotiations on a long-term agreement for the use of the land and for the proposed effluent-for-groundwater exchange might be required prior to implementation. Should these negotiations fail, the Southern Avenue interceptor and other downstream interceptors would be undersized and would have to be paralleled with relief sewers prior to the year 2000. Thus, it was felt that to exclude the Northeast plant now would ensure adequate capacity in the Southern Avenue interceptor and downstream interceptors. In addition, the Northeast plant could be considered for inclusion at a later date if it is needed.

The second of the group's concerns had to do with the westside communities' growth. It was felt that the Reems Road plant would best serve these communities and would eliminate a costly pumpback system to the 91st Avenue plant.

For reasons similar to those expressed by the advisory groups, the MAG 208 Management Subcommittee and the Executive Committee voted for Alternative 2. The MAG Regional Council tentatively approved the selection of Alternative 2 in November 1978.

A public hearing on the Draft 208 Plan and Draft Environmental Impact Statement on the Point Source Metro Phoenix Alternatives was held on January 15, 1979. Prior to the public hearing, the advisory groups, Management Subcommittee, and Executive Committee made recommendations to the MAG Regional Council. On January 17, 1979, the Regional Council voted to adopt the MAG 208 Draft Plan, which included Alternative 2 as the preferred plan for wastewater collection and treatment in the metro area. On June 27, 1979, the Regional Council adopted the Final 208 Plan, which was essentially the same as the Draft 208 Plan.

IMPACT ASSESSMENT

The following assessment describes environmental impacts of the four project alternatives developed in the point source portion of the Urban Study, as well as impacts of the "No Action" alternative. This alternative assumed no additional, expanded, or improved municipal wastewater treatment facilities, with wastewater treatment needs being met by the existing system and the expanded use of septic tanks or private package plants. The No Action alternative acted as a baseline, or "control", against which the impacts of the project alternatives were compared. The impacts of the project alternatives also were compared against each other.

In general, the No Action alternative would mean the expansion of low density urbanization in an area 65 to 70 percent greater than that projected by MAG in the Guide for Regional Development, Transportation, and Housing. By the year 2000, 45 percent of the population would rely on septic tanks or private package plants for wastewater treatment under this alternative. A proliferation of single-family dwellings on relatively large homesites (to accommodate septic tank use) would occur.

Areawide impacts of the four project alternatives and the No Action alternative were assessed within 13 environmental categories and are summarized below:

Air Quality

Air quality impacts are defined in terms of the consistency or inconsistency between data in the nonattainment area plan (NAAP) and the 208 plan. Population projections used in the 208 program are the same as those used to forecast the effect of control strategies on air quality parameters in the NAAP. No major discrepancies were apparent between the NAAP and the project alternatives on this account. Minor inconsistencies have been found to be associated with the Northeast, Reems Road, and 91st Avenue facilities. These represent shifts in population and not increases, and are so small their impacts are negligible.

Geology and Soils

Geological impacts focus on the exclusion of sand and gravel or other valuable geological materials from extraction due to location of facilities in mineable areas. Major impacts of the alternaties in this category were not apparent.

Surface Water

Environmental changes are related to the availability of treated wastewater which is related to the location of treatment plants. Impacts are mainly seen as beneficial (augmenting community and agricultural water suppies), with the exception of potential instances where effluent does not meet water quality standards or affects public health and aesthetics.

All alternatives would result in more beneficial effects to surface water supplies than would the No Action alternative. Surface water supplies would be increased and redistributed throughout the study area in the form of treated wastewater. The 136,640 acre-feet of treated effluent that would be produced in the year 2000 under the No Action alternative increased by 62 percent (85,240 acre-feet) under the project alternatives.

The redistribution of this water in the study area was most widespread in Alternative 4 because of the addition of both the Northeast and Reems Road plants. The Northeast plant (Alternatives 3 and 4) provided better quality effluent (unrestricted agricultural use) than that discharged by the other plants, and this better quality effluent was distributed in the northeast portion of the study area where water resources enhancement is greatly needed.

Surface water resources were increased in the southwest portion of the study area under all the project alternatives. Additional flows to the Salt River would be of better quality than present-day flows or flows in the No Action alternative. This additional wastewater would be available for energy production, wildlife management, and agricultural irrigation.

Alternatives 1 and 2 would redistribute wastewater less widely than Alternatives 3 and 4. Flows to the Salt River would be greater under Alternatives 1 and 2 and would help to meet commitments for effluent to a greater degree.

Groundwater

Effects on groundwater center around changes in quality and quantity that can occur depending on the location of wastewater discharge in the area.

Under the No Action alternative, groundwater quantity would benefit because there would be more recharge and less export of pumped water. Groundwater quality probably would be affected adversely if septic tanks were used at too great a density.

Among the project alternatives, recharge to the groundwater aquifer would be greatest in Alternative 4 and would provide groundwater enhancement in the southwest and northeast portions of the study area. Benefits in the northeast portion of the study area were absent in Alternatives 1 and 2, which did not include the Northeast facility. In none of the alternatives was groundwater recharge of large enough quantity to qualify this effect as a major regional benefit. Limited local replenishment of the aquifer was likely to occur with land application of effluent.

The beneficial effects of local groundwater replenishment are based on use of suitable irrigation methods to reduce nitrate (nitrogen) levels and on proper reuse siting. Sites should be located a sufficient distance away from municipal well fields and, in the southwest area, they should be placed in a position to help impede the flow of low quality groundwater to the northeast.

A potential adverse impact to groundwater quality in the Gilbert area existsed in all the project alternatives. The proximity of the reuse site of the north Gilbert plant to public supply water wells could have had an adverse effect on water in the wells. The Gilbert facilities (north and south) were common to all alternatives.

Biological Resources

Changes in biological resources can occur through introduction of surface waters into the desert environment of the study area and through removing, degrading, or improving existing terrestrial habitat.

Biological resources would be improved by all project alternatives, in comparison to the No Action alternative. Improvements of resources consists primarily of creation of wetland habitat, which is of high value in the area, through the addition of surface water in the form of aerated lagoons, stabilization ponds, and impoundments for storing treated wastewater for irrigation.

Alternative 1 would introduce at least 320 additional surface acres of water habitat into the study area. The amount of surface water increased two-fold, to at least 640 acres, when the Reems Road facility was added (Alternative 2) and to approximately 863 acres when the Northeast facility was added (Alternative 3). When both the Northeast and Reems Road facilities were added (Alternative 4), the maximum amount of surface water (1,050 acres) would have been gained in the study area. The biological benefits of wetland habitat can be increased by habitat design, including buffer zones around surface water impoundments.

Some loss of terrestrial habitat would occur under all the project alternatives. Alternative 1, which included the least expansion/addition of facilities, would cause the least loss of habitat area, and Alternative 4, which included both the Northeast and Reems Road facilities, would have removed the greatest terrestrial habitat area. Despite losses in terrestrial habitat associated with the project alternatives, biological advantages related to surface water augmentation outweighed disadvantages in this category.

Cultural Resources

Project actions can disturb important archaeological or historical sites, mainly through direct removal of artifacts or structures by construction of facilities or interceptor lines.

No historically sensitive sites are known to be located in areas affected by proposed expansion or contruction of facilities.

Adverse impacts to archaeological resources would occur with all project alternatives due to urbanization. Losses of artifacts would have been less extensive than with the No Action alternative because the area of urbanization assumed for the project alternatives was not as great as for the No Action alternative. Additional archaeological impacts could occur during construction of sewage treatment systems. All of the project alternatives included the 91st Avenue plant, which will require the construction of major sewer lines in the vicinity of the Salt River in the southwest portion of the study area. This area is believed to contain artifacts of archaeological significance. In Alternative 2 and 4, which included the Reems Road facility, more major sewer lines will be built in this sensitive area. Since this area may contain artifacts worthy of protection under federal legislation, corridor surveys to properly align sewer lines are desirable mitigative measures. Surveys are likely to be more extensive in the alternatives including the Reems Road facility.

Public Health and Aesthetics

The incidence of mosquitoes around surface water areas, the likelihood of intentional or inadvertent contact with wastewater, and the likelihood of odors are important environmental consequences of operation of treatment plants. Mitigative measures can reduce or eliminate these impacts. Particular mitigative measures include pesticide control applications, odor suppression techniques, and proper designation of wastewater areas by posting of signs and fencing of enclosures to deter public access.

Land Use

Effects on land use depend on the degree of compatibility of existing and projected land uses employed in the wastewater treatment plan with the MAG regional land use plan. The removal of prime and unique farmlands and changes in rates of urban encroachment on existing agricultural lands are also considered in evaluating land use changes.

Agricultural Land Use: The consequences of the project alternatives on agricultural land use fell into two main categories: 1) the loss of farmland for treatment facility sites, and 2) the continued support of farming due to availability of effluent for irrigation. The more significant impacts were associated with the latter category, and were considered positive.

Loss of farmland in acreage for the four alternatives was as follows: Alternative 1 - 108 acres, Alternative 2 - 254 acres, Alternative 3 - 118 acres, and Alternative 4 - 264 acres. Compared to the total amount of prime farmland in the study area and the loss of farmland because of expected urbanization in the area, losses due to facility siting would be slight.

Support of farming through provision of effluent for irrigation was maximized in Alternative 4 because it includes the largest number of facilities. Effluent used for irrigation generally will replace the use of existing groundwater or other surface water irrigation supplies, thus making this water available for other uses or reducing current overdrafting. The more significant benefits occurred with respect to the Chandler plant (all project alternatives) and the Northeast plant (Alternatives 3 and 4). Both these plants were to be on Indian lands and would supply effluent to replace poorer quality or more expensive pumped groundwater.

Urban Land Use: All alternatives supported the adopted MAG regional development guide which anticipates extensive, though more dense, additional urbanization of the Phoenix area. Two potential regional impacts of the alternatives were associated with the Tolleson plant (Alternatives 1 through 4) and the Northeast plant (Alternatives 3 and 4).

Utilization of existing excess capacity at the Tolleson plant would preclude the need for building moratoria in several northern communities including Glendale, Peoria, and Sun City, allowing continued, planned for growth. If the excess capacity were not used, moratoria in these areas might -- at least temporarily -- shift some urban growth to other locations.

In the northeast, a proposed effluent-for-groundwater exchange between the Salt River Indian Community and the cities of Scottsdale, Phoenix, and Paradise Valley could have provided an additional supply of water to the northeast. This additional water supply potentially could have supported population levels above those currently projected for the cities of Scottsdale and Paradise Valley by MAG. These increased population levels, however, would be redistributed from other locations in the study area and do not represent new regional growth.

Local land use conflicts are expected to be pronounced at the north Gilbert site (Alternatives 1 through 4). The area surrounding and including the proposed plant site is actively urbanizing, and property owners and developers have planned improvements that will not be compatible with the treatment plant. Both the Gilbert and Chandler community land use plans would need modification to accommodate the proposed Gilbert facilities (north and south), and some compensation of property owners adjacent to the north site may be required.

Temporary land use impacts caused by construction of plant facilities and interceptors consist mostly of impaired use of land due to interruption of access and increased noise, dust, and other short-term adverse impacts associated with construction. Interceptor construction will produce more widespread disruption than will facility construction, but little differentiation can be made among the alternatives on this score. Some additional interceptor construction would be required for the Reems Road facility (Alternatives 2 and 4) and the Northeast facility (Alternatives 3 and 4).

The Southern Avenue interceptor, connecting portions of Mesa, Tempe, and Gilbert to the 91st Avenue plant, was included in all project alternatives. This line supplements capacity in the existing Salt River outfall (SRO). Excess capacity now exists in the SRO which could support 80,000 additional people in much of the study area beyond the levels projected by MAG. While this excess capacity could permit redistribution of population within the study area prior to the year 2000, the presence of the interceptor capacity will not, by itself, induce new growth in the area. The City of Phoenix is reserving its owned capacity in the SRO to serve growth in the area beyond the year 2000.

Recreation and Open Space: Wetlands associated with the treatment and storage of effluent for irrigation not only provide an important natural resource but also provide opportunities for recreational land uses such as hunting, picnicking, and bird watching. Under the No Action alternative, no creation of significant wetland was anticipated, whereas the project alternatives contributed to wetland formation. The Northeast plant (Alternatives 3 and 4) contributed most significantly to wetland creation. Any reduction in flows to the 91st Avenue plant, as envisioned in Alternatives 2, 3, and 4, would lessen the amount of effluent available to support existing wetlands along the Salt River after commitments to the Arizona Nuclear Power Project (ANPP) and the Buckeye Irrigation District are met.

Population

Effects upon population were considered in terms of compatability with population projections adopted by MAG. Alternatives 1 through 4 all generally support the projected population growth patterns developed by MAG. These projections call for extensive additional population in the area, distributed in a denser pattern than in the No Action alternative. From a regional perspective, there are no really significant differences among the project alternatives.

Public Facilities and Services

Impacts concern the extent to which the proposed project action would affect existing or proposed public facilities or the operation of service delivery systems. Consideration is also given to secondary impacts in which project actions may alter future revenues to public agencies without a compensating change in the cost or level of services they must provide.

The project alternatives supported planning based upon the MAG regional development guide. Alternative 1 maximized the amount of effluent available to the 91st Avenue treatment plant, and therefore best supported the commitment for sale of effluent to ANPP. With Alternative 2, less effluent would be available to ANPP unless Reems Road effluent also is committed. The presence of the Northeast plant in Alternatives 3 and 4 reduced the amount of effluent available to ANPP further. The least amount of effluent would be provided with Alternative 4, which includes both the Reems Road and Northeast plants.

Economic Activity

Major changes in the level and nature of area economic activity, employment, income, and property values that can be attributed to construction and operation of facilities are identified and interpreted in terms of their importance to the local community and the region. These effects are often closely linked to changes in land use and population.

The project alternatives would have been accompanied by changes in the economy which included reduction in scale of agricultural activity, but not as rapidly as under the No Action alternative. Most sectors of the economy would increase, but the public service sector would not grow as large as under the No Action alternative.

A major portion of the costs for the various alternatives would be spent within the region for construction, supplies, and labor. If major facility construction is initiated during a period of heavy construction activity, it will tend to encourage inflation of materials and labor costs. By contrast, facility construction could have a major counter-cyclical effect if initiated during a depressed construction period.

Direct long-term impacts included employment at facilities and loss in revenues from agricultural production from land required for plant sites both of which would be relatively insignificant.

All of the project alternatives would tend to support continued agricultural activity in their areas through provision of irrigation water. They would all provide additional lower cost irrigation supplies to the Gila River Indian Community to support the tribally-owned Gila Farms operation. Alternatives 3 and 4 would provide additional lower cost irrigation water to the Salt River Indian Community to support expanded agricultural operations.

The availability of effluent for use as cooling water by ANPP's Palo Verde Nuclear Generating Station was considered a beneficial impact. While alternative sources of cooling water could be obtained, redesign of the cooling system to accommodate poorer quality water would be expensive and result in delays.

Public and Institutional Acceptability

All of the point source alternatives would meet the demand for areawide wastewater treatment, so public acceptability issues focused on the choice of sites for treatment and potential reuses of effluent. Significant local objection was probable in the areas around sites for the north Gilbert plant (common to all alternatives) and the Northeast conventional plant (Alternatives 3 and 4) because of new urbanization of these areas. Reaction to expansion of the 91st Avenue plant by the Gila River Indian Community would depend upon the extent to which the proposed upgrading of the existing facility reduces existing odor and insect problems.

Alternatives that reduced the flows at the 91st Avenue and 23rd Avenue treatment plants were opposed by ANPP. The Northeast plant (Alternatives 3 and 4) would reduce flows at the 91st and 23rd Avenue plants by approximately 9 mgd by the year 2000 and would impair the ability of the cities to meet the contractual agreement with ANPP for supply of up to 140,000 af/yr of effluent.

A series of complex legal issues and negotiations would have to be resolved in order to implement the proposed alternatives. Serious jurisdictional issues were raised by the trust status of Indian lands. Owners of property expected to employ effluent for irrigation would have to commit to use through the end of the study period, regardless of prevailing market conditions for crops or possible future interest in converting the land to urban uses.

These negotiations would be required under all the project alternatives. Under Alternatives 3 and 4, negotiations were further complicated by siting of the Northeast facility on Indian tribal lands and siting the effluent reuse fields on allotted Indian lands. Contractual agreements for effluent uses would involve numerous allottees.

Summary

Major impacts of all the alternatives are rated in Figure III-6. The impacts of the No Action alternative have been evaluated on the basis of seven rating categories:

- o Highly Beneficial
- o Beneficial
- o Minor Beneficial
- o No Change
- o Minor Adverse
- o Adverse
- o Highly Adverse

The No Action alternative serves as a "control", to which the project alternatives are compared on the basis of the following ratings:

- o Much Better
- o Better
- o No Change
- o Worse
- o Much Worse

Environmental categories used in the assessment provide the elements for comparison, with the exception of geology/soils which was omitted because of the minor nature of impacts.

Ratings are provided in each environmental category for each alternative with and without mitigation. As may be seen in the impact matrix, mitigation is critical to minimizing adverse impacts in many environmental categories.

Mitigation particularly influences ratings in groundwater, biological resources, cultural resources, aesthetics, public health, and public and institutional acceptability. This applies to all the project alternatives.

The only category that shows a difference among alternatives is surface water. Alternatives 3 and 4 enhance surface water resources to a greater degree than Alternatives 1 and 2. Of the two plants that provide variables in the composition of the alternatives (Reems Road and Northeast facilities), the Northeast facility involves a potential difficulty in resolving conflicts over effluent commitments -- primarily to ANPP. This difficulty is not enough to significantly alter the overall rating of the alternative within which it is contained.

EVALUATION OF SIGNIFICANT ISSUES AND MITIGATION NEEDS

Several environmental issues which require resolution were raised by the environmental assessment.

Future Surface Water Quality Standards

This issue concerns wastewater discharges into the Salt River from the 91st Avenue and 23rd Avenue wastewater treatment plants. Four factors bear on this issue:

- o Surface water quality in the effluent-dominated flow of the Salt River does not meet designated beneficial use (partial body contact) standards that apply to the Salt and Gila Rivers below the 91st Avenue plant.
- o Discharges from the 91st Avenue and 23rd Avenue plants do not meet NPDES permit requirements and goals of the Federal Water Pollution Control Act of 1972 (PL 92-500), as amended.
- o There are present and pending contracts for treated wastewater from the 91st Avenue plant that may result in elimination of most of the discharge to the Salt River.
- o Surface water standards are under revision by the state and may change when revised regulations are adopted by the Water Quality Control Council (WQCC) in 1979.

At this time, Arizona's water quality standards are being reviewed and revised by the WQCC. This process will not be completed until the end of 1979. Until that time, current standards will apply. These include designated beneficial use standards for water bodies in the study area.

For certain segments of the Salt and Gila Rivers no designated uses were assigned when the current regulations were drawn up. Under state regulations, the "tributary rule" (Regulations R9-21-205A) applies to these segments, which

ENVIRONMENTAL CATEGORIES	NO ACTION	ALTERNATIVES 1	2	3	4
AIR QUALITY	MA	■ / ■	■ / ■	■ / ■	■ / ■
SURFACE WATER	A	■ / ■	■ / ■	▲ / ▲	▲ / ▲
GROUND WATER	A	◓ / ■	◓ / ■	◓ / ■	◓ / ■
BIOLOGICAL RESOURCES	MA	■ / ▲	■ / ▲	■ / ▲	■ / ▲
CULTURAL RESOURCES	A	◓ / ■	◓ / ■	◓ / ■	◓ / ■
AESTHETICS	A	◓ / ■	◓ / ■	◓ / ■	◓ / ■
PUBLIC HEALTH	HA	◓ / ■	◓ / ■	◓ / ■	◓ / ■
LAND USE	HA	▲ / ▲	▲ / ▲	▲ / ▲	▲ / ▲
POPULATION	HA	▲ / ▲	▲ / ▲	▲ / ▲	▲ / ▲
PUBLIC FACILITIES AND SERVICES	HA	▲ / ▲	▲ / ▲	▲ / ▲	▲ / ▲
ECONOMIC ACTIVITY	A	■ / ■	■ / ■	■ / ■	■ / ■
PUBLIC AND INSTITUTIONAL ACCEPTABILITY	A	■ / ▲	■ / ▲	■ / ▲	■ / ▲

unmitigated / mitigated

IMPACTS

NO ACTION		ALTERNATIVES COMPARED TO NO ACTION	
HA	HIGHLY ADVERSE	▲	MUCH BETTER
A	ADVERSE	■	BETTER
MA	MILDLY ADVERSE	◓	SAME
M	MINOR	□	WORSE
MB	MILDLY BENEFICIAL	△	MUCH WORSE
B	BENEFICIAL		
HB	HIGHLY BENEFICIAL		

IMPACT SUMMARY

FIGURE III-6

are stretches of the Salt and Gila Rivers dominated by wastewater effluent and agricultural irrigation return flow. The tributary rule holds that, where uses of a watercourse are not specifically designated, the watercourse assumes the use of the nearest downstream segment that is specifically designated. The nearest downstream segment for which designated uses have been set is Painted Rock Lake, approximately 100 miles downstream from the confluence of the Salt and Gila Rivers. Accordingly, standards for Painted Rock Lake (partial body contact, warm water fishery, agriculture, and aquatic life and wildlife) would apply to the segments of the Salt and Gila Rivers for which no uses were designated.

Proposed regulations under review by the WQCC (Spring 1979) call for protection of the beneficial uses of partial body contact, agricultural uses, and riparian habitat in the effluent-dominated stretch of the Salt River. Currently, this flow does not meet existing or proposed standards. Standards in effect will need to be responded to in planning for and designing facilities in the selected 208 plan.

Commitments for sale of effluent will affect the water quality issue. The contract with ANPP calls for the sale of up to 140,000 af/yr of effluent for use at the Palo Verde Nuclear Generating Station near Buckeye. Effluent will be transported directly to the station and to the Buckeye Irrigation District by a pipeline, eliminating the discharge of a large amount of effluent to the Salt River. Actual operating needs of the Palo Verde Station are estimated to be 64,200 af/yr of effluent for the three units. The contract with ANPP calls for the effluent to be treated to the secondary level, while surface water quality standards will require secondary treatment plus disinfection. The amount of effluent discharged to the Salt River will vary with peak water needs of the power plant. The treatment plants will have to be able to treat whatever amount of effluent is not used by ANPP and the Buckeye Irrigation District to the levels required by surface water quality standards.

Groundwater Mitigation

A commitment by responsible parties to employ proper siting and reuse practices in association with the Gilbert, Chandler and Reems Road facilities is required to avoid potential adverse changes in groundwater and well water and to maximize groundwater benefits.

Archaeological Mitigation

The possibility of archaeological artifact occurrence at new treatment system locations, particularly the 91st Avenue and Reems Road locations, may require site investigations. Depending on findings resulting from investigations, system locations may require adjustment or, though unlikely, archaeological excavation may be recommended. At this time, costs for site investigations and possible system adjustments are not known. These will need to be determined by archaeological personnel and parties responsible for plant design and construction.

Public Health and Aesthetics Issues

These issues center around exposure of the public to odors, mosquitoes, and body contact with wastewater. Public criticism of odors and insects believed to be associated with the 91st Avenue and 23rd Avenue treatment plants is a matter of record. The proposed Gilbert facility, due to its proximity to future growth, also may be involved with these issues.

Consistent application of suitable odor and insect suppression techniques, design of buffers to isolate the systems from public access, as well as design of system components to operate properly, particularly during floods, is required to maintain a facility that will protect the public health.

Social and Economic Issues

The manner in which social and economic issues are finally resolved could have a major bearing on the level and local distribution of social and economic benefits and liabilities in the study area. Following is a discussion of the more significant issues still to be resolved.

Site Availability: Several of the satellite treatment plants included in the 208 plan are to be sited in areas expected to urbanize or be under significant development pressure by the year 2000. This is particularly true of the two Gilbert sites.

Some of these plants will not be required for 5 to 12 years. In order to ensure their availability when required, these sites will have to be acquired or optioned well before they can be utilized. Since the plant and reuse configurations being considered for these sites are land intensive, site acquisition costs will be substantial.

Site acquisition will have to be a priority for the Subregional Operating Groups (SROGs) established in these areas. Financing of site acquisition, however, may pose a problem. Since the plants will not be functioning for some time and may be operated by new operating entities, user fees may also be impractical as a way to finance early acquisition. Investigation of funding sources for land acquisition may uncover innovative and unconventional means for early land purchase.

Potential Growth Inducement: The proposed Southern Avenue interceptor will supplement capacity in the existing Salt River Outfall (SRO). Excess capacity in the SRO could accommodate additional population growth in the service area of the interceptor. Land use controls in the affected areas may be required to ensure that growth does not exceed the projected population levels.

Contractual Agreements with Indian Communities: The present Chandler facility is located on the Gila River Indian Reservation. Expansion of the facility would require negotiation of a lease and acquisition of additional land for a third aerated lagoon and holding ponds for effluent. The trust status of Indian lands raises complex jurisdictional and contractual problems for subregional operating groups which can only be resolved by negotiations between the SROG and the Indian community during the detailed planning for the facility.

There is an alternative site for the Chandler plant located just off Gila River Indian Community lands should negotiations reach an impasse and sewage treatment needs of Chandler become critical. Sufficient study of this alternative has been completed to allow for its substitution with a minimum of delay.

Contractual agreements with the Salt River Indian Community would be an important factor should the Northeast plant be added to the 208 plan at a later date. All non-reservation sites identified in the northeast were found to be unacceptable.

Contractual Commitments to the Arizona Nuclear Power Project: Commitments to ANPP for delivery of effluent from the 91st Avenue plant to the Palo Verde Nuclear Generating Station limit the amount of effluent available for agricultural irrigation, fish and wildlife enhancement, and other reuses. ANPP would vigorously oppose the addition of the Northeast plant to the selected plan at a later date. Negotiations could provide an obstacle in scheduling a northeast facility to meet consumer sewage requirements, or, at the worst, preclude any establishment of a northeast facility.

Contracts for Agricultural Reuse of Effluent: The Maricopa County Department of Health Services indicates they will not accept agricultural irrigation as a bona fide reuse unless there is a binding contract with the property owners to take the effluent for an extended period of time. This contract period could range from 20 years to the life of the proposed plant. An earlier proposal for agricultural reuse of effluent from a plant in Sun City was denied because the continued availability of the land for that purpose was not guaranteed.

A contract to accept effluent would preclude a property owner from developing his land into urban uses during the life of the agreement, and may not be acceptable to property owners who anticipate urbanizing their land in the next 20 years. It also would restrict use of the land to cultivation of crops not used directly for human consumption.

Indian lands may be less affected than other areas. The Salt River and Gila River Indian Communities plan to maintain large-scale agricultural operations indefinitely, and no conflict is anticipated.

Windfall Profits for Recipients of Effluent: Pricing of effluent for agricultural reuses will have to be established on a case-by-case basis by each SROG as part of its detailed implementation planning. Pricing is expected to be based upon both the prevailing price for the next most available source of water, and the ability of the re-user to pay. Establishment of a long-term, fixed-price contract based upon today's prices could result in a windfall profit over the long run for the recipient. Failure to provide adequate long-term guarantees on the price of effluent, however, could discourage potential users.

The pricing mechanism finally selected is expected to provide for variable rates tied to, but slightly below, those charged by an alternative water supplier, such as the Central Arizona Project.

Impact of User Charges on Local Revenue Sharing Monies: Section 204 of PL 92-500 specifies the types of user charges which can be levied by the SROG's to pay for wastewater treatment within their service areas. In general, charges must be proportional to use, and a separate schedule is to be provided for industries. There is a basic equity to this system because the users of the services provided are the ones who pay for it.

A recent study of the method used by the federal government to allocate general revenue sharing monies has determined that the level of revenue sharing funds received by state, county, and local governments is highly dependent upon their total tax effort. Revenues raised by special districts and through user fees are not counted as part of the total tax effort. Revenue sharing allocations to the particpating jurisdictions will be lower, therefore, than if wastewater treatment were financed directly by county and local government taxes. Based upon analyses in other areas, Maricopa County and participating local jurisdictions could receive additional federal funds totalling from 15 to 20 percent or more of the anticipated user charges, if these jurisdictions used direct taxes rather than user charges to pay for the wastewater treatment. Total local costs for wasteater treatment are estimated to range from $6.4 to $6.9 million, assuming the federal government pays for 75 percent of all capital costs. General revenue sharing funds lost through use of user charges could range as high as from $960,000 to $1,400,000 per year according to the above figures. It is questionable, however, whether the EPA would approve direct financing of the treatment systems by local government, even if it were politically feasible.

Access to the Regional Treatment System by Smaller Less Affluent Communities:

Under the adopted management system for the 208 plan, individual communities expecting to discharge flows to the 91st Avenue treatment plant must "buy into" the system. The cost to each will be determined by its proportion of all flows going into the plant, multiplied by the total amount of the local (non-federal) share of the initial capital costs. This initial "buy in" amount will probably be financed by bonds in most communities.

A small community such as Guadalupe which does not now have a centralized wastewater treatment system may not have an adequate assessed value to support bonds to pay for both a local collection system and its share of the cost of the expanded treatment plants. The user costs per household also may be excessive, even if the city has adequate bonding capacity to pay for the system. The result may be either a community which cannot afford to participate in the regional system, or a community with households paying a disproportionately high percentage of their income for wastewater collection and treatment.

Kindred problems exist in the following two westside areas:

1. Sun City West/El Mirage/Surprise

   Sun City West proposes to develop its own treatment plant outside the regional wastewater management plan. El Mirage and Surprise do not have the necessary population to support their own system, and may not have an adequate tax base to meet the costs of tying into Peoria or Tolleson facilities.

2. Goodyear/Avondale/Litchfield Park

   Litchfield Park is also considering developing its own plant and excluding Avondale and Goodyear. These communities have limited resources and could have difficulty tying into the proposed Reems Road plant.

Additional study will be required to determine whether these areas can finance their share of the system costs without placing an unusually heavy burden on their residents.

The Redistributional Effect of User Charges on Income: The actual cost of wastewater treatment per household within different parts of the region has not been calculated at this writing. Although the precise impact of these charges on different socioeconomic groups within the region cannot be determined until these rates are available, certain general features are apparent, as outlined below.

The cost of wastewater treatment per household will vary among communities because of differences in the cost of operation and maintenance of local collection systems. In some communities the cost of treatment is expected to be substantially higher than current charges.

Financing operation of the system with user charges provides a basic equity to the system by charging only the users of the system, but imposes a heavier burden on low income households than more affluent ones. A poor household will pay the same for wastewater treatment as an affluent one living in the same area and discharging roughly the same amount of wastewater. This charge will represent a much larger proportion of the poor household's income than it will of the more affluent one. As indicated above, households in some poorer communities may have to pay substantially more for wastewater management than more affluent households in other communities. Both these situations tend to shift income away from poorer households relative to those with more income.

The issues still to be resolved are the extent to which the proposed rates will constitute a hardship for lower income households, methods of financing to mitigate these hardships, and the magnitude and frequency of disparities between rates in different parts of the Phoenix metropolitan area.

CHAPTER IV

FLOOD CONTROL IMPACT ASSESSMENT

Assessment and evaluation of impacts for the Glendale-Maryvale, Cave Creek Below the Arizona Canal, South Phoenix, Old Cross Cut Canal, Upper Indian Bend Wash, Gila Floodway, and Scatter Wash flood control projects were not carried out because plan formulation for these alternatives did not reach a level of detail sufficient to permit such work to begin and because there was clearly no federal interest in these projects. Identification of impacts for flood control alternatives on the Salt River through Phoenix, however, occurred during the course of the Urban Study. At the outset of the study, it had been assumed that an examination would be made only of flooding problems residual to the construction of Orme Dam and Reservoir, a flood control and Central Arizona Project water regulation structure authorized for construction by the Bureau of Reclamation at the confluence of the Salt and Verde Rivers. Assessment work, therefore, was to be limited to the impacts of channelization downstream from Orme.

The deletion of Orme Dam and Reservoir from the Central Arizona Project in April, 1977, as a result of the Carter administration's water policy review, however, caused the Urban Study to modify its approach to both plan formulation and impact assessment for Salt River flood control. Important factors in the administration's decision included socioeconomic impacts resulting from the inundation of the Ft. McDowell Indian Reservation, destruction of archaeological and historic site, and loss of flowing stream recreation, along with environmental impacts associated with flooding the habitat of the southern bald eagle and other wildlife species.

In April, 1977, the Bureau of Reclamation organized the Interagency Task Force on Orme Dam Alternatives to identify and evaluate single-purpose alternatives for CAP regulation and flood control. Alternatives were developed as shown in Figure IV-1. Urban Study personnel participated in this effort. The Environmental/Socioeconomic subcommittee of the Interagency Task Force studied the impacts associated with Orme Dam and its alternatives. The subcommittee concluded the confluence site alternatives presented such severe environmental and socio-economic impacts as to render them unacceptable. It recommended, however, that further detailed studies be made, and this recommendation is being implemented by the Bureau of Reclamation's Central Arizona Water Control Study (CAWCS). It was anticpated that the impact assessment and evaluation needed to select the plan which best accomplishes flood control along the Salt River through metropolitan Phoenix would be performed during Stages II and III of this study. The Phoenix Urban Study helped establish the framework within which the CAWCS was conducted.

During the course of its investigations, the Environmental/Socioeconomic Subcommittee of the Interagency Task Force developed a matrix for the evaluation of the impacts of flood control alternatives. This was used in a preliminary assessment of the impacts of plans considered for further examination in Stage II of the Study of Alternatives. The results of this process for structural alternatives are summarized below:

- o Confluence and Granite Reef Sites - The confluence site, location of the authorized Orme Dam and Reservoir, is expected to produce significant impacts on bald eagle and riparian habitat. Socio-economic impacts would occur with the flooding of archaeological and historic sites, flowing stream recreation areas, and a large portion of the Ft. McDowell Indian Reservation. Smaller structures at the confluence or Granite Reef sites could reduce, but not totally eliminate, these impacts.

- o Cliff Site - The Cliff Site alternative, located on the Verde River immediately upstream from Bartlett Reservoir, should result in the inundation of riparian and bald eagle habitats. Impacts on cultural resources had yet to be assessed.

- o Modified Horseshoe Dam - This alternative would result in impacts to bald eagle habitat and archaeological sites.

- o Modified Roosevelt Dam - Modification of the existing structure, which is itself on the National Register of Historic Places, could impact archaeological sites.

- o New Bartlett Dam - A new dam near the site of the existing Bartlett Dam would impound a reservoir which could impact bald eagle and other wildlife habitat. Archaeological, social, and historical impacts were not yet assessed.

- o Levees - Impacts for selected reaches of levees between Granite Reef Diversion Dam and Gillespie Dam on the Gila River had not yet been assessed.

- o Channelization - Impacts for channelization of the seven reaches of the Salt and Gila Rivers between Granite Reef Diversion Dam and Gillespie Dam had not yet been assessed.

- o Channel Clearing - Clearing of phraeatophytes from the Salt and Gila riverbeds from Granite Reef Diversion Dam to Gillespie Dam to create a 2000-foot floodway would result in probable adverse environmental impacts. A detailed assessment was yet to be made.

The decisions were made on the basis of technical, economic, and engineering considerations. Potential impacts were not viewed as critical factors in selecting alternatives for Stage II of the Central Arizona Water Control Study. During Stage II planning, however, impact assessment and evaluation were incorporated into the decision making process.

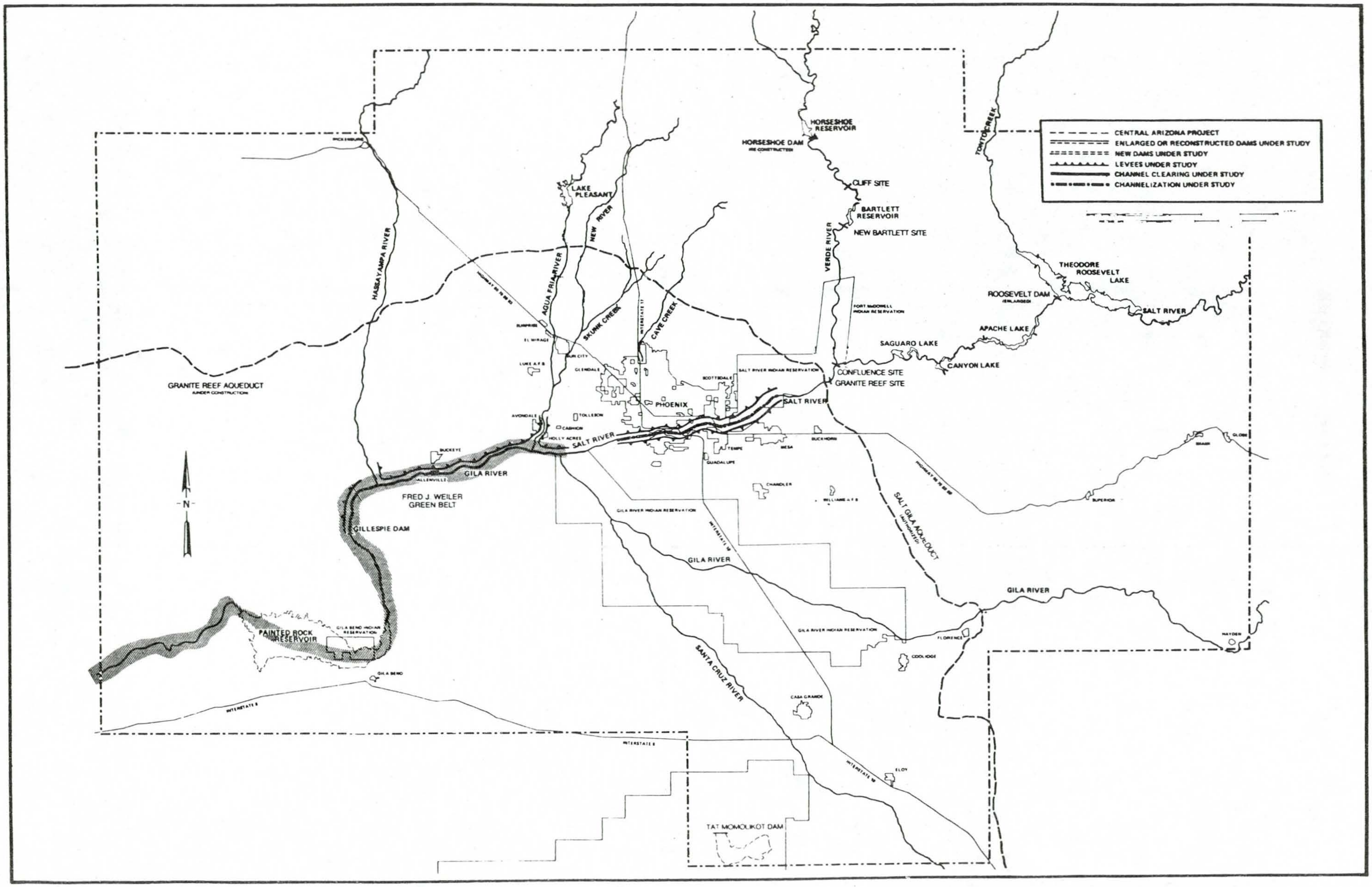

CENTRAL ARIZONA PROJECT
ENLARGED OR RECONSTRUCTED DAMS UNDER STUDY
NEW DAMS UNDER STUDY
LEVEES UNDER STUDY
CHANNEL CLEARING UNDER STUDY
CHANNELIZATION UNDER STUDY
HORSESHOE RESERVOIR
HORSESHOE DAM
CLIFF SITE
BARTLETT RESERVOIR
NEW BARTLETT SITE
VERDE RIVER
TONTO CREEK
THEODORE ROOSEVELT LAKE
ROOSEVELT DAM
SALT RIVER
APACHE LAKE
SAGUARO LAKE
CANYON LAKE
CONFLUENCE SITE
GRANITE REEF SITE
LAKE PLEASANT
NEW RIVER
AGUA FRIA RIVER
HASSAYAMPA RIVER
SKUNK CREEK
CAVE CREEK
GRANITE REEF AQUEDUCT
PHOENIX
SALT RIVER
GILA RIVER
FRED J. WEILER GREEN BELT
GILLESPIE DAM
PAINTED ROCK RESERVOIR
SALT GILA AQUEDUCT
GILA RIVER
SANTA CRUZ RIVER
TAT MOMOLIKOT DAM
N

FIGURE IV-1

CHAPTER V

WATER CONSERVATION IMPACT ASSESSMENT

Planning by the Phoenix Urban Study for water conservation involved two measures. The first of these proposed the diversion of water from the New River north of the study area into the Agua Fria River to augment supplies in Lake Pleasant. Plan formulation for this project, however, was not carried to a level of detail sufficient to permit an adequate assessment and evaluation of possible impacts.

The possibility of achieving water conservation through artificial groundwater recharge also was investigated by the Urban Study. The initial investigations made two key assumptions:

1. An adequate source of floodwaters was available in the study area.

2. The floodwaters could be controlled.

The second assumption necessitated dams on the area's major drainages. Four drainages in the study area were analyzed along with their associated structures: 1) New River and the Corps' authorized New River Dam, 2) Skunk Creek and the Corps' authorized Adobe Dam, 3) Cave Creek and the Corps' authorized Cave Buttes Dam, and 4) Salt River and Orme Dam, as a feature of the Central Arizona Project. Hydrologic studies, however, revealed that the New River, Skunk Creek, and Cave Creek drainages did not generate sufficient average annual volumes to warrant further study for water conservation. Only the Salt River drainage seemed suitable. It was determined, therefore, that the Urban Study would concentrate on examining water conservation through recharge of floodwaters along the Salt. Following the recommended deletion of Orme Dam from the CAP, however, the artificial groundwater recharge study expanded in scope to include water from additional sources, including imported Colorado River water, treated wastewater effluent, and water from the Salt and Verde Rivers, supplied either by floods or controlled Salt River Project releases.

IMPACT ASSESSMENT

Artificial groundwater recharge is a concept of incorporating structural measures and operating criteria so as to increase the amount of surface water that reaches the groundwater reservoirs. In studying groundwater recharge, the Urban Study identified a number of possible impacts associated with such a project in the Salt River channel. These are summarized below. A more detailed assessment of both long and short term impacts is contained in the Technical Appendix.

Vegetation

Aquatic and channel vegetation are expected to stabilize and flourish around the proposed recharge facilities. The vegetation would provide food and shelter for species expected to be reintroduced to this reach of the Salt River channel. At the same time excessive vegetative growth could clog the soil, decrease the water quality, and provide food, shelter, breeding grounds for insect vectors. Excessive vegetative growth on dikes and levees would need to be controlled.

Wildlife

The use of recharge basins as the principle recharge mechanism in the Salt River channel would result in the presence of standing pools of water for periods of time varying with facility type and methods of operation. The presence of additional sources of water could attract wildlife species, particularly waterfowl, not regularly seen in this portion of the Salt-Verde watershed. Standing pools of water, however, also can have negative environmental impacts. If water depth remains constant for long periods of time, spreading basins will more resemble bogs than open pools of water. Algae and weeds may choke the basins and insect vectors could find thriving breeding grounds. The specific effects of standing water need to be addressed in the demonstration project.

Cultural Resources

No archaeological sites within the study area are located in the Salt River channel proper and only the sites at the confluence of Evergreen Drain and the Salt River channel hold the possibility for immediate adverse impact from construction of a recharge facility. These sites, however, already have been disturbed by landfill operations. Any additional effects of a project on cultural resources are likely to be peripheral at worst. Disturbances which might occur will most likely be associated with alignment of access roads and location of service facilities. While all the answers to the problem are not known, it is likely that potential adverse impacts can be minimized through proper site selection and careful positioning of service roads and facilities.

Health and Safety

Potentially adverse effects could be felt from the presence of solid waste and sludge disposal sites within the study area. Unless these sites are taken into account so as to reduce the chance that wastes (and residues thereof) will enter the water environment, they may create vector, leachate, and groundwater contamination problems. Furthermore, such consideration is required under provisions of the Resource Conservation and Recovery Act of 1976.

In this period of concern for public safety, it should be recognized that pools of standing water could pose an unusual attraction to the general public. To provide adequate public safety at the project site, facility security and posting of warning notices should be considered.

Aesthetics

The aesthetics of the study area are likely to be impacted only insofar as the introduction of standing bodies of water enhance or detract from the study area's beauty, or lack thereof.

Soils

With the application of large volumes of water to small areas of land such as occurs in a recharge project, the possibility of waterlogging soils may present a problem. Because waterlogging is a function of specific soil parameters, any problems would be site specific and localized.

The problems of soil compaction, sediment sealing, and potential for aerobic conditions also have been recognized as potential impacts associated with recharge activities.

Surface Hydrology

At the time of the original settlement of the Salt-Verde Watershed, the surface water system was developed for domestic and agricultural use. The surface and groundwater systems were in dynamic equilibrium; the system as a whole being effluent with a constant baseflow. With the development of efficient high capacity irrigation pumps capable of meeting growing agricultural demands, the area's groundwater was developed intensively. Through the years, increased demand from municipal and industrial users has placed additional stress on the system and contributed to the development of a deep cone of depression centered in the areas around the Salt River flood plain. Because the surface water portion of the system has been diverted, stored, and controlled at upstream facilities operated under the authority of the Salt River Project, natural recharge has been greatly decreased in the stretch of the Salt River channel below Granite Reef Diversion Dam.

While the proposed system of recharge is not a flood control method, it is possible that flooding problems in the greater Phoenix metropolitan area could be reduced somewhat in magnitude if recharge facilities in the Salt River channel were used for the capture of releases from upstream facilities. Although current upstream structures are neither designed for, nor operated with, flood control as a major function, flood control and conjunctive use operations theoretically could be coupled. For example, the volume in storage in surface reservoirs could be reduced to accommodate a portion of snowmelt runoff from upstream watersheds. Water released could be recharged in downstream facilities. Flood waters also could be diverted from a stream channel into off stream recharge reducing downstream flood peaks. The demonstration project should be designed to answer these questions. The quantity of water lost to evaporation annually from Arizona reservoirs has been estimated as enough to supply the municipal demands of Tucson for a full year. Subsurface storage of water, via recharge facilities, offers the potential of reducing evaporation losses. However, the precise quantity of water which may be saved from evaporation and other losses by storage in subsurface reservoirs is not yet known.

It is possible that salts and chemical pollutants could increase in concentration with evaporation during storage in surface reservoirs. If so, water with higher salinity levels would be recharged and water quality in the immediate vicinity could deteriorate. A demonstration project should be designed to answer these questions.

Socioeconomic Impacts

The construction of recharge structures may result in minor inconveniences to local residents and commuters. The noise associated with construction could temporarily disturb local businesses and residents. Dust pollution levels can be expected to increase temporarily with the presence of heavy earth-moving equipment in the construction area, but can be minimized by spraying with water.

It is possible that sewer line connections would be temporarily disconnected during construction.

The possibility of the raised water table adversely impacting sand and gravel operations in the Salt River channel is a concern. As such, it must be addressed in any site specific assessment. With the raised water table it is possible also that water users in the area would have less incentive to practice water conservation methods.