US Army Corps
of Engineers
Los Angeles District

General Investigations

R-4 Package

North Scottsdale Drainage Area, Arizona

RECONNAISSANCE STUDY
FLOOD CONTROL AND RELATED PURPOSES

Flood Control Act of 1938

RECONNAISSANCE REPORT
FLOOD CONTROL AND RELATED PURPOSES

NORTH SCOTTSDALE DRAINAGE AREA, ARIZONA

May, 1996

US ARMY CORPS OF ENGINEERS

LOS ANGELES DISTRICT

Planning Section C
3636 North Central Avenue, Suite 740
Phoenix, Arizona 85012-1936

EXECUTIVE SUMMARY

Executive Summary to be provided with the final report.

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CHAPTER 1
STUDY AUTHORITY

1.0 STUDY AUTHORITY

This report provides an interim response under Public Law 761, Seventy-fifth Congress, known as the Flood Control Act of 1938. The name of the study authority is the Gila River and Tributaries. The name of the interim response contained in this report is the North Scottsdale Drainage Area (formerly, McDowell Mountains). Congress provided renewed commitment for the authority by adopting House Resolution 2425 on May 17, 1994.

CHAPTER 2
PURPOSE AND SCOPE

2.0 General Purpose

The overall objective of a reconnaissance study is to accomplish the following four tasks:

1) Define the problems and opportunities, and identify potential solutions,

2) Determine whether planning should proceed further into a feasibility phase, based on a preliminary determination of the Federal interest. The Federal interest is based on costs, benefits, and environmental impacts of the identified potential solutions, and if potential solutions are consistent with current Army policies and budgetary priorities,

3) Provide an estimate of time and costs needed to conduct the feasibility phase, if recommended, and

4) Assess the level of interest and support of non-Federal sponsors in the identified potential solutions.

2.1 Specific Purpose

The specific purpose of this study was to define flooding and related problems in the McDowell Mountains alluvial fan areas in the Cities of Scottsdale and Phoenix in Maricopa County, Arizona. The location and study area are shown in Figures 2-1 and 2-2.

2.2 Study Scope

The scope of this study consists of identifying problems and needs associated with flooding and related water resources concerns; formulating alternative measures to prevent future flood damages and maximize National Economic Development benefits; and identify the opportunity and role for continuing Corps participation in flood control and related water resources planning.

The study area was defined in coordination with the Cities of Scottsdale and Phoenix, the Flood Control District of Maricopa County, and the State of Arizona. Letters of support were received from each and are displayed in figures 2-3, 2-4, 2-5, and 2-6. The City of Scottsdale identified the Reata Pass, Beardsley Wash and the upper portion of Rawhide Wash flood zones as specific problem areas to be evaluated during the reconnaissance study. The City of Phoenix

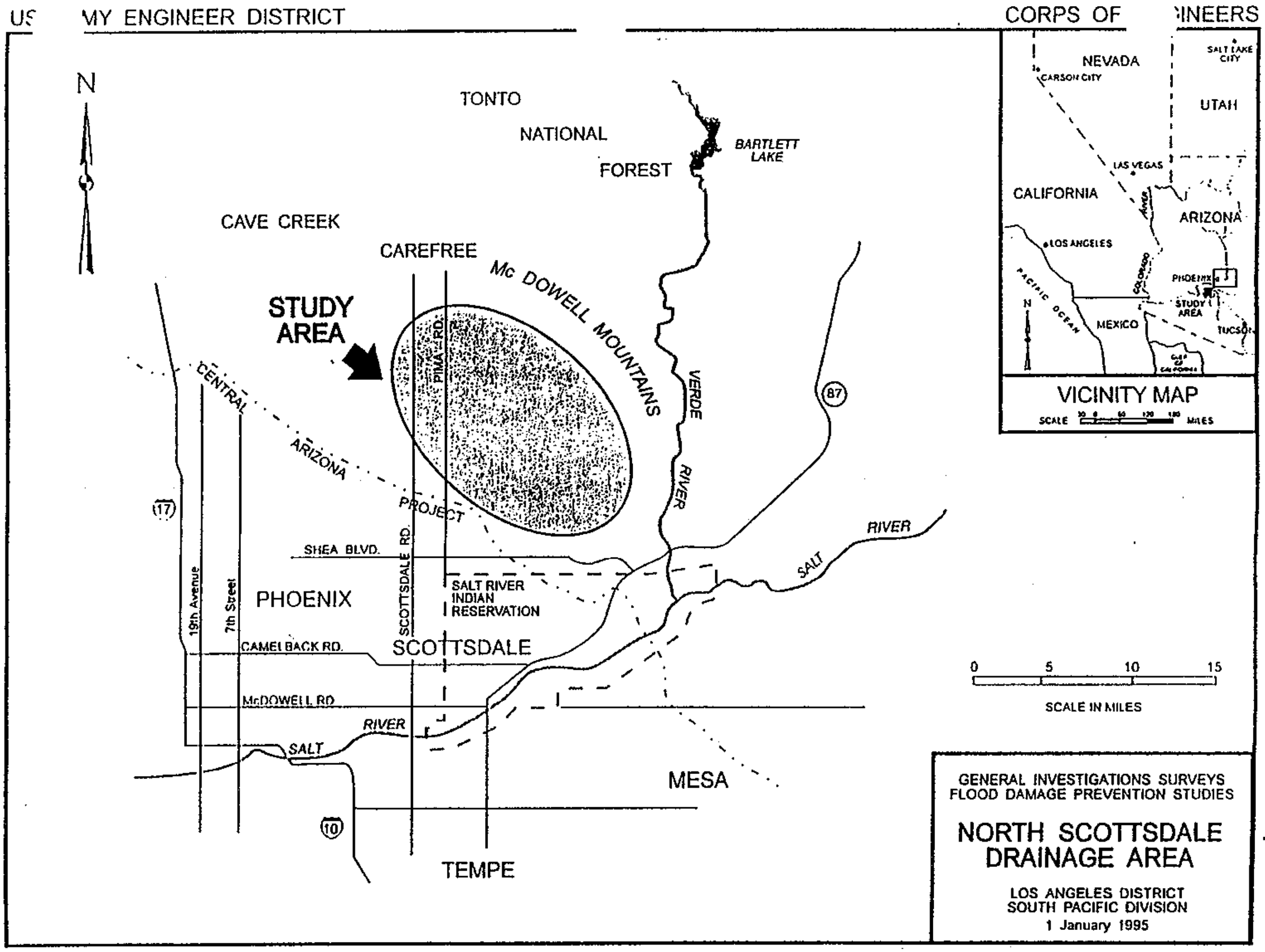
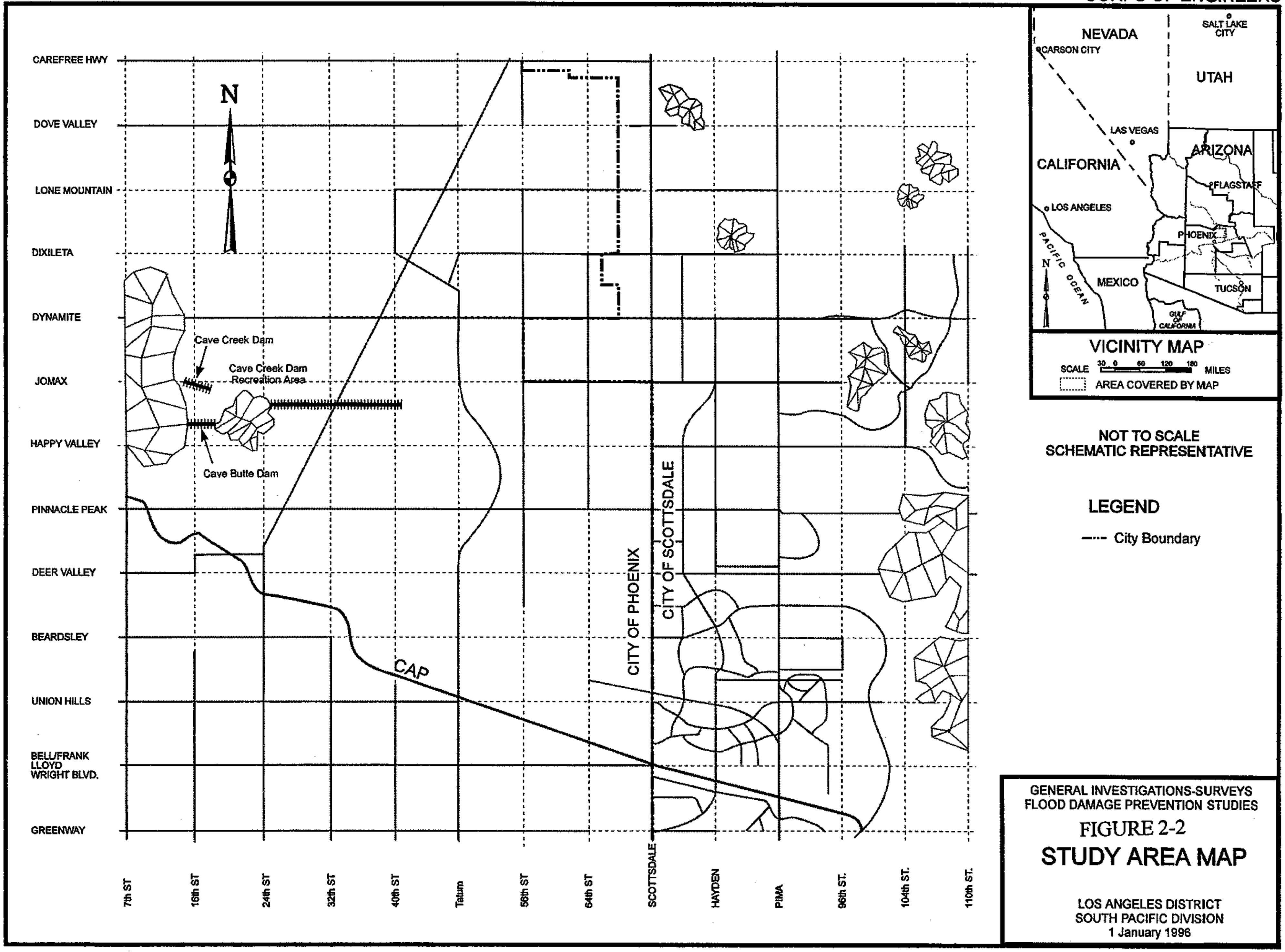

US MY ENGINEER DISTRICT
CORPS OF INEERS
N
TONTO
NATIONAL
FOREST
BARTLETT LAKE
CAVE CREEK
CAREFREE
Mc DOWELL MOUNTAINS
STUDY AREA
PIMA RD.
VERDE
RIVER
87
CENTRAL
ARIZONA
PROJECT
17
SHEA BLVD.
SCOTTSDALE RD.
SALT RIVER INDIAN RESERVATION
PHOENIX
19th Avenue
7th Street
CAMELBACK RD.
SCOTTSDALE
McDOWELL RD
RIVER
SALT
SALT
RIVER
MESA
10
TEMPE
0 5 10 15
SCALE IN MILES
NEVADA
CARSON CITY
SALT LAKE CITY
UTAH
LAS VEGAS
CALIFORNIA
ARIZONA
LOS ANGELES
PACIFIC OCEAN
PHOENIX
STUDY AREA
MEXICO
TUCSON
VICINITY MAP
SCALE MILES
GENERAL INVESTIGATIONS SURVEYS
FLOOD DAMAGE PREVENTION STUDIES
NORTH SCOTTSDALE DRAINAGE AREA
LOS ANGELES DISTRICT
SOUTH PACIFIC DIVISION
1 January 1995

FIGURE 2-1

U. S. ARMY ENGINEERING DISTRICT

CORPS OF ENGINEERS



GENERAL INVESTIGATIONS-SURVEYS
FLOOD DAMAGE PREVENTION STUDIES

FIGURE 2-2
STUDY AREA MAP

LOS ANGELES DISTRICT
SOUTH PACIFIC DIVISION
1 January 1996

FLOOD CONTROL DISTRICT
of
Maricopa County

2801 West Durango Street • Phoenix, Arizona 85009
Telephone (602) 506-1501
Fax (602) 506-4601
TDD (602) 506-5897

Neil S. Erwin, P.E., Chief Engineer and General Manager

MAR 1 1 1994

Mr. Robert Joe
Chief of Planning Division
Los Angeles District
U.S. Army Corps of Engineers
Post Office Box 2711
Los Angeles, California 90053-2325

SUBJECT: Reconnaissance Study for McDowell Mountain Alluvial Fan Region

Dear Mr. Joe:

This letter is sent to reaffirm our request of August 24, 1992, to the Corps of Engineers to conduct a Reconnaissance Study for the McDowell Mountain alluvial fan region. Since our request, urbanization of the area, which includes portions of Phoenix, Scottsdale and unincorporated Maricopa County, has continued at a steady pace, and planning activity for new developments has accelerated rapidly. In December 1993, the Federal Emergency Management Agency formally adopted special hazard floodplain designations for approximately 25 square miles of the 100-square mile McDowell Mountain watershed. This designation affects several existing subdivisions as well as large areas of master-planned property.

Despite recent financial contributions from Scottsdale and the Flood Control District, additional funding will be critical to properly complete the necessary flood control and drainage infrastructure. Therefore, the City of Scottsdale and the Flood Control District of Maricopa County reiterate their request that the Corps of Engineers give high priority to the initiation of a Reconnaissance Study in the McDowell Mountain alluvial fan region. Enclosed is a copy of a letter from the City of Scottsdale which confirms its continuing support for the study. A copy of our August 24, 1992, request is also enclosed for your reference.

We look forward to working closely with the Corps and our Congressional delegation in developing a comprehensive solution to this serious flooding threat. I am available to meet with you at your earliest convenience to discuss this request in greater detail.

Sincerely,

Neil S. Erwin, P.E.

Enclosures

cc: Senator DeConcini
Senator McCain
Congressman Kyl
Frank Fairbanks, City Manager, Phoenix
Dick Bowers, City Manager, Scottsdale
Joe Dixon, Corps of Engineers, Phoenix

FIGURE 2-3

FLOOD CONTROL DISTRICT
of
Maricopa County

2801 West Durango Street • Phoenix, Arizona 85009
Telephone (602) 506-1501
Fax (602) 506-4601
TDD (602) 506-5897

Stanley L. Smith, Jr., P.E., Acting Chief Engineer and General Manager

AUG 2 4 1992

Mr. Robert Joe, Chief of Planning Division
Los Angeles District
U.S. Army Corps of Engineers
Post Office Box 2711
Los Angeles, California 90053-2325

SUBJECT: Reconnaissance Study for McDowell Mountain Alluvial Fan Region

Dear Mr. Joe:

Recent studies conducted by the Federal Emergency Management Agency and local agencies have identified the potential for serious flood damages in the approximately 100-square mile McDowell Mountain alluvial fan region. Portions of the alluvial fan are in the Cities of Phoenix and Scottsdale and unincorporated Maricopa County. Pockets of urbanization currently exist in areas subject to alluvial fan-type flooding. Major urbanization is projected to occur in this region in the near future, due to the availability of large tracts of highly desirable vacant land and the impending construction of a new freeway.

A regional drainage perspective is necessary if the alluvial fan area is to develop in an orderly, economic manner that optimizes the utility of necessary flood control measures. We are encouraged by the plan that has been developed by the Corps of Engineers for a similar alluvial fan area in western Las Vegas, Nevada. Therefore, the Cities of Phoenix and Scottsdale and the Flood Control District of Maricopa County request that the Corps of Engineers give high priority to the initiation of a Reconnaissance Study in the McDowell Mountain alluvial fan region. Enclosed are copies of letters of support that I have received from the City Managers of Phoenix and Scottsdale.

We look forward to working closely with the Corps and our Congressional delegation in developing a comprehensive solution to this serious flooding threat. I am available to meet with you at your earliest convenience to discuss this request in greater detail.

Sincerely,

8/24

Stanley L. Smith, Jr., P.E.
Acting Chief Engineer and General Manager

Enclosures

cc: Senator DeConcini
Senator McCain
Congressman Kyl
Frank Fairbanks, City Manager, Phoenix
Dick Bowers, City Manager, Scottsdale
Joe Dixon, Corps of Engineers, Phoenix

FIGURE 2-4

Office of the City Manager

February 23, 1994

Mr. Neil Irwin
Chief Engineer & General Manager
Maricopa County Flood Control District
2801 W. Durango Street
Phoenix, AZ 85009

Dear Mr. Irwin:

This letter is to request that the Flood Control District solicit a reconnaissance level study from the U.S. Army Corps of Engineers for the McDowell Mountain flood control project located in Scottsdale and Phoenix. This request is similar to the one we made last year.

As you know, this is a very important flood protection project, and despite the contributions of Scottsdale and the Flood Control District, additional funding will be critical to proper completion of the necessary work.

The City is grateful for all the help your staff has provided to us on this project.

Sincerely,

Dick Bowers
City Manager

c: James Matteson, City of Phoenix

3939 CIVIC CENTER BOULEVARD ■ SCOTTSDALE, ARIZONA 85251 ■ PHONE (602) 994-2422

FIGURE 2-5

City of Phoenix
STREET TRANSPORTATION DEPARTMENT

Winner of the Carl Bertelsmann Prize for
BEST RUN CITY IN THE WORLD

September 6, 1995

Mr. John Drake
Department of the Army
Los Angeles District, Corps of Engineers
Planning Section C
3636 North Central Avenue, Suite 740
Phoenix, Arizona 85012-1936

Dear Mr. Drake:

RE: RECONNAISSANCE STUDY OF THE RAWHIDE WASH FLOOD ZONE AND REATA/BEARDSLEY WASH FLOOD ZONES

Enclosed are the following materials for your use:

1) Floodplain Delineation Study for Tributary Flow Area: Wash 6A (Coe & Van Loo)

2) Flood analysis for Reach 11 dikes Hayden/Rhodes Aqueduct Central Arizona Project (Bureau of Reclamation)

3) Pima Freeway Drainage System - Desert Ridge (BRW)

4) Flood characteristics of FEMA Site A of the Scottsdale Flood Insurance Study (Hajalmarson)

5) Rawhide Wash Detention Basin Feasibility Study (Final Report) for Rawhide Wash Regional Improvement Committee

6) Miscellaneous material in packet from Development Services Department

The City of Phoenix is interested in participating in the Reconnaissance Study. Should you have any further questions, please contact Brian Butler at 262-4051.

Sincerely,

James H. Matteson, P.E.
Street Transportation Department

Raymond U. Acuña, P.E.
Floodplain Manager

JHM/RUA/BB/aff/950906g

Attachments

c: Mr. Callow
Mr. Blakley
Mr. Butler

200 West Washington Street, Fifth Floor, Phoenix, Arizona 85003-1611 602-262-6284

FIGURE 2-6

identified the lower portion of the Rawhide Wash and Flood Zones 5 and 6 as areas to be evaluated. Prior studies, reports and existing information, as identified in Chapter 3, was utilized to the maximum extent possible in performing the study and analyses.

An analysis and evaluation of an array of project alternatives is presented. The reconnaissance study will conclude with a recommendation that the study effort proceed into the feasibility phase of planning if positive alternatives are identified which fully comply with the objectives stated in Section 2.1 above.

CHAPTER 3
PRIOR STUDIES, REPORTS AND EXISTING WATER PROJECTS

3.0 Prior Studies and Reports

Several prior studies and reports provided valuable reference information and were utilized for this reconnaissance study:

New River and Phoenix City Streams, Design Memorandum I & II, LA District Corps of Engineers, 1974 & 1982 respectively

Reata Pass/Beardsley Wash Alignment Study, Alluvial Fan Task Force, November 1992, City of Scottsdale, Arizona

Rawhide/Pinnacle Peak Wash Alignment Study, Alluvial Fan Task Force, November 1992, City of Scottsdale, Arizona

Rawhide Wash Specific Option, City of Scottsdale Desert Greenbelt Project, December 1994, The Greiner Team

Reata/Beardsley Washes Specific Option, City of Scottsdale Desert Greenbelt Project, January 1995, The Greiner Team

Preliminary Design Phase I Study Report, The Desert Greenbelt, June 1994, City of Scottsdale

Flood Characteristics of FEMA Site 6A of the Scottsdale Flood Insurance Study, Flood Control District of Maricopa County, June 1994, Hjalmar W. Hjalmarson, P.E.

Final Report, Volumes I, II, and III, Desert Greenbelt Project, City of Scottsdale, June 1995, The Greiner Team

3.1 Existing Water Projects

3.1.1 Indian Bend Wash

Indian Bend Wash (IBW) is a Corps project planned in the 1960's and completed construction in 1984. The project is south of the study area. Rawhide, Pinnacle Peak, Beardsley, and Reata Pass washes were part of the upper Indian Bend Wash watershed prior to construction of the Central Arizona Project Granite Reef Aqueduct which severed these washes flowing into IBW. IBW is a greenbelt flood control project that has won national awards and recognition. IBW is the model for which the Scottsdale has planned for flood control in the study area except with more desert landscaping instead of green grass and ball fields found in IBW.

3.1.2 Central Arizona Project & Dikes

As mentioned above the Central Arizona Project Granite Reef Aqueduct is the southern boundary of the study area. CAP brings Arizona's share of Colorado River water to central Arizona. This section of the CAP was completed in 198?. Dikes on the north side of the CAP protect the aqueduct from damage caused by the washes. There is no outlet for these retention basins. They are the terminus for Rawhide, Pinnacle Peak, Reata Pass, and Beardsley Washes. The basins accommodate recreation in the form of golf courses and equestrian arenas.

3.1.3 Cave Buttes Dam

Cave Buttes Dam is part of the New River and Phoenix Vicinity Streams and is another Corps project. The Project was planned in 1960's and completed construction in 1993. Fans 5 and 6 of the northwest portion of the study area drain into Cave Buttes Dam as part of Cave Creek Reach of the Project.

Figure 3-1 shows the relationship between these existing structures and the study area.

3.2 MASTER PLANNING

The study area encompasses the cities of Phoenix and Scottsdale, a portion of Maricopa County, and State lands. Each has master planning responsibilities within their jurisdictions. State lands master plans parcels when they have determined to sell the land. Maricopa has an indirect role in infrastructure master planning coordinating between the cities. The cities of Phoenix and Scottsdale both have master plans for the study area. Scottsdale drainage master plan is in an advanced phase. Scottsdale's Desert Greenbelt plan is under design. The Desert Greenbelt design covers Reata/Beardsley, Pinnacle Peak and Rawhide Washes.

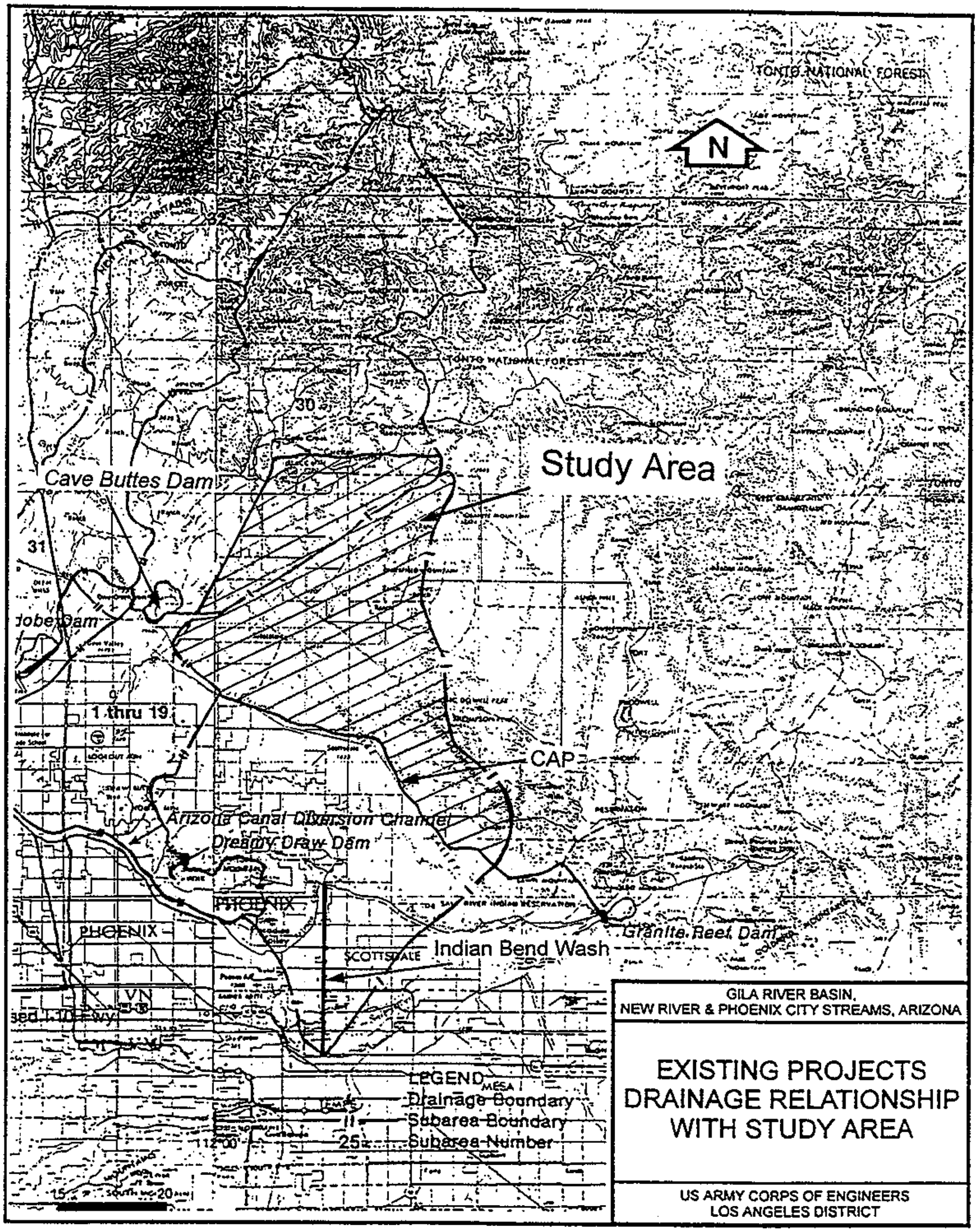

TONTO NATIONAL FOREST
N
Study Area
Cave Buttes Dam
31
30
Jobe Dam
1 thru 19
CAP
Arizona Canal Diversion Channel
Dreamy Draw Dam
PHOENIX
PHOENIX
SCOTTSDALE
Indian Bend Wash
Granite Reef Dam
LEGEND
MESA
Drainage Boundary
Subarea Boundary
25
Subarea Number
GILA RIVER BASIN,
NEW RIVER & PHOENIX CITY STREAMS, ARIZONA
EXISTING PROJECTS
DRAINAGE RELATIONSHIP
WITH STUDY AREA
US ARMY CORPS OF ENGINEERS
LOS ANGELES DISTRICT

FIGURE 3-1

CHAPTER 4
PROBLEMS AND OPPORTUNITIES

4.0 General

Problems and opportunities were identified, defined, and assessed through coordination with local and regional agencies, the public involvement process, site assessments, interpretation of prior studies and reports, and review of existing water projects. An initial screening of problems and opportunities included flooding and flood control, environmental habitat preservation, and recreation. Specific problems and opportunities were based on an assessment of the existing and expected future without project conditions, as described in the following sections.

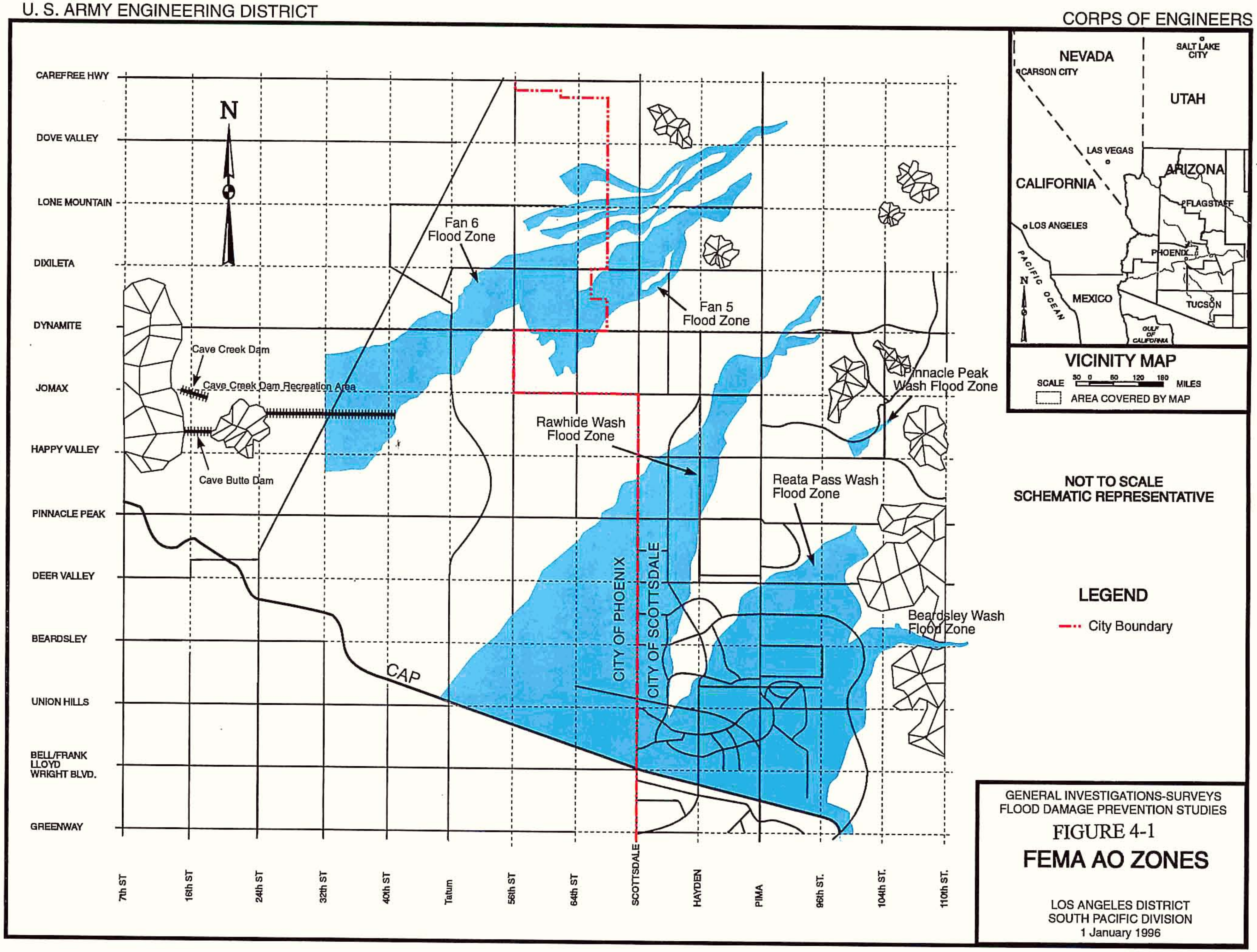
4.1 Existing Conditions

4.1.1 Study Area

The study area is located in the north Scottsdale and Northeast Phoenix portions of the Phoenix Metropolitan area, Maricopa County, Arizona (Figure 2-1). The area is bordered by the Central Arizona Project (CAP) Granite Reef Aqueduct to the south, McDowell Mountain to the east, Desert Mountain to the north, and Cave Creek drainage (Cave Creek Road) to the west. The area is typical of Sonoran Desert with numerous shallow washes that trend northeast to southwest. The lower portions of the drainage area is made up of six alluvial fan areas, Reata Pass, Beardsley, Pinnacle Peak, Rawhide, Fan 5, and Fan 6. These fans have been depicted on figure 4-1.

Reata Pass Wash fan begins just north of where Pinnacle Peak Road ends. The predominate wash heads southward, along the foot of the McDowell Mountains. When the Wash reaches the Beardsley Road alignment it moves southwest until the 96th Street alignment. The wash then moves south until it reaches the Bureau of Reclamation /WestWorld retention basin. The lower Beardsley Wash begins in the McDowell Mountains and heads westward before turning southwest and meeting the Reata Pass Wash near the Bell Road alignment and the 96th Street alignment. The northern tributary of Beardsley Wash joins the Reata Pass Wash near the Beardsley Road alignment.

The next alluvial fans to the north are Pinnacle Peak and Rawhide Washes. Pinnacle Peak wash alluvial fan apex is located just south of Jomax Road alignment and 104th Street. The wash moves in a southwesterly direction. The Flood zone is truncated at Happy Valley Road because the depth is below one foot. The sheet flow, though, continues and presents a flooding problem at Pima Road. Rawhide Wash starts just north of Dynamite Road and 96th Street alignment moving in a southwesterly direction crossing into the city of Phoenix and terminating in BOR/TPC basin.



GENERAL INVESTIGATIONS-SURVEYS
FLOOD DAMAGE PREVENTION STUDIES

FIGURE 4-1
FEMA AO ZONES

LOS ANGELES DISTRICT
SOUTH PACIFIC DIVISION
1 January 1996

Fans 5 and 6 are located at the north/northwest part of the study area. Fans 5 and 6 are formed by washes which originate north of the Rawhide Wash and drain in a southwesterly direction. Fan 5 encompasses approximately 1,254 acres within the boundaries of the City of Scottsdale. Fan 6 consists of approximately 2,906 acres, of which 986 acres are located in Scottsdale, and 1,920 acres are located in Phoenix.

As several washes converge, the Fan 5 overflow boundary widens considerably southwest of Dixileta Drive and Scottsdale Road. The Fan 5 drainage area continues to widen as it extends southwesterly nearly to 56th street.

The upstream end of Fan 6 (which is located directly above Fan 5) originates near the intersection of Dove Valley and Pima Roads in the City of Scottsdale. However, the drainage fan does not begin to widen substantially until it reaches 64th Street. Fan 6 continues to spread in a southwesterly direction into the City of Phoenix south of Dixileta Drive. The downstream limit of the fan extends to Cave Creek Road.

4.1.2 Alluvial Fans

Streamflow from intense rainstorms emanates from the confined upstream channels of North Scottsdale's washes and proceeds downstream onto the relatively flat valley area below. Canyon outlets form the apex of each fan, which represents the highest point of elevation on the fan. As described in FEMA's "Alluvial Fans: Hazards and Management" publication (February 1989, page 2), flow leaving the apex of a fan spreads onto the upper-fan area, where it may either follow a pre-existing path cut from past flood events or cut a new path down slope. As the topography flattens, the channels widen and become shallower, losing velocity and depositing sediment and debris. Toward the base of the fan, water velocities are reduced as the fan surface becomes more uniform, its slope flattens and water infiltrates the soil surface. In these areas, sheet flow flooding is common.

Alluvial fans represent severe flood hazard areas due to the unpredictable location and high velocity of their flowpaths during flooding, which usually occurs with little or no advance warning time. According to FEMA (page 3), "An often-overlooked 'hazard' is the tendency to underestimate both the potential and severity of alluvial fan flood events. The infrequent rainfall, gently-sloping terrain, and often long time spans between successive flood contribute to a sense of complacency regarding the existence of possible flood hazards. Though the intense rainstorms which produce fan floods occur randomly, they nevertheless can develop very rapidly at any time, and can recur with any frequency."

4.1.3 Geology and Soils

The mountain area is characterized by rugged terrain and steep gradients, the lower part of the area is regular alluvial slopes. Elevations range from about 4,034 feet above sea level at

McDowell Peak to 1520 feet at the CAP aqueduct. The basement complex in the mountainous area consists of Precambrian schist and metaigneous rocks that have been intruded by igneous rocks, e.g., granite, andesite, etc. The younger bedrock exposed in the nearby mountains consists of Tertiary sandstone, siltstone, and conglomerates. The depth of alluvium in the valley ranges from about 500 to about 1500 feet. This alluvium consists of silts, sand, gravel, and cobbles in various stages of cementation.

4.1.4 Vegetation and Wildlife

Sonoran desert scrub and Sonoran riparian woodland are the primary vegetation types within the study area. Vegetation densities vary within the study area, with the greatest densities occurring along the washes and at higher elevations. The washes support numerous large trees (including **palo verde** (Cercidium sp. and Parkinsonia aculeata), **ironwood** (Olneya tesota), and **mesquite** (Prosopis sp)) and thick underbrush. Wash bottoms generally consist of decomposed granite and are typically devoid of smaller vegetation due to hydrologic processes. **Saguaros** (Cereus giganteus) are common in the interwash areas, especially at higher elevations, as are several other cactus species and **ocotillo** (Fouquieria splendens).

A large number of wildlife species are characteristic of Sonoran Desert communities, with the potential for more species to occur along well vegetated drainages. Birds reported in the study area include **Gambel's quail** (Callipepla gambelii), **roadrunner** (Geococcyx californianus), **mourning dove** (Zenaida macroura), **Gila woodpecker** (Melanerpes uropygialis), **northern flicker** (Colaptes auratus), **black-throated sparrow** (Amphispiza bilineata) and **cactus wren** (Campylorhynchus brunneicapillus). Raptors reported included **Harris hawk** (Parabuteo unicinctus), **red-tailed hawk** (Buteo jamaicensis). **Mule deer** (Odocoileus hemionus) utilize the washes, particularly in the eastern and northeastern portions of the study area. Densities of mule deer are fairly low, estimated at two to three animals per square mile. **Javelina** (Tayassu tajacu) are abundant in the area and use washes for shelter during the day. Small mammals which occur in the project area include **coyote** (Canis latrans), **desert cottontail** (Sylvilagus audubonii) and several species of **ground squirrels** (Spermophilus sp.) and **pocket mice** (Perognathus sp.). It is likely that many reptiles live in the area including **tree lizard** (Urosaurus ornatus), **whiptail lizard** (Cnemidophorus sp.), **regal horned lizard** (Phrynosoma sp.), **gopher snake** (Pituophis melanoleuscus), **coachwhip** (Masticophis flagellum) and **western diamondback rattlesnake** (Crotalus atrox).

Special status species include the following: plants protected by the Arizona Native Plant Law; wildlife listed as threatened, endangered or candidates by the Arizona Game and Fish Department; and plants or wildlife listed by the U.S. Fish and Wildlife Service. The **American peregrine falcon** (Falco peregrinus anatum) is the only Federally-listed endangered species potentially occurring in the study area (according to the 1995 Desert Greenbelt Study), and it is also listed as a candidate species by the state of Arizona. (Updated species lists from the U.S. Fish and Wildlife Service and the Arizona Department of Game and Fish are forthcoming for this reconnaissance study.) Although peregrines have been seen in urban areas, they usually breed in remote, rugged areas with large cliffs for nesting. It is unlikely that a locally-acceptable flood control project (one that retains the natural character as much as possible) would adversely alter potential habitat or result in a decrease in the prey base for the peregrine falcon.

Other special status species in the study area include the **cactus ferruginous-pygmy owl** (Glaucidium brasilianum, Federal Proposed Endangered), and the following candidate Category 2 species: **mastiff bat** (Eumops perotis), **California leaf-nosed bat** (Macrotus californicus), **Yavapai Arizona pocket mouse** (Perognathus amplus amplus), **loggerhead shrike** (Lanius ludovicianus), **chuckwalla** (Sauromalus obesus obesus) and the Sonoran population of the **desert tortoise** (Gopherus agassizii). The Mojave population of the desert tortoise, located in California, northwestern Arizona, southwestern Utah, and southern Nevada, is Federally listed as Threatened.

4.1.5 Land Use and Population

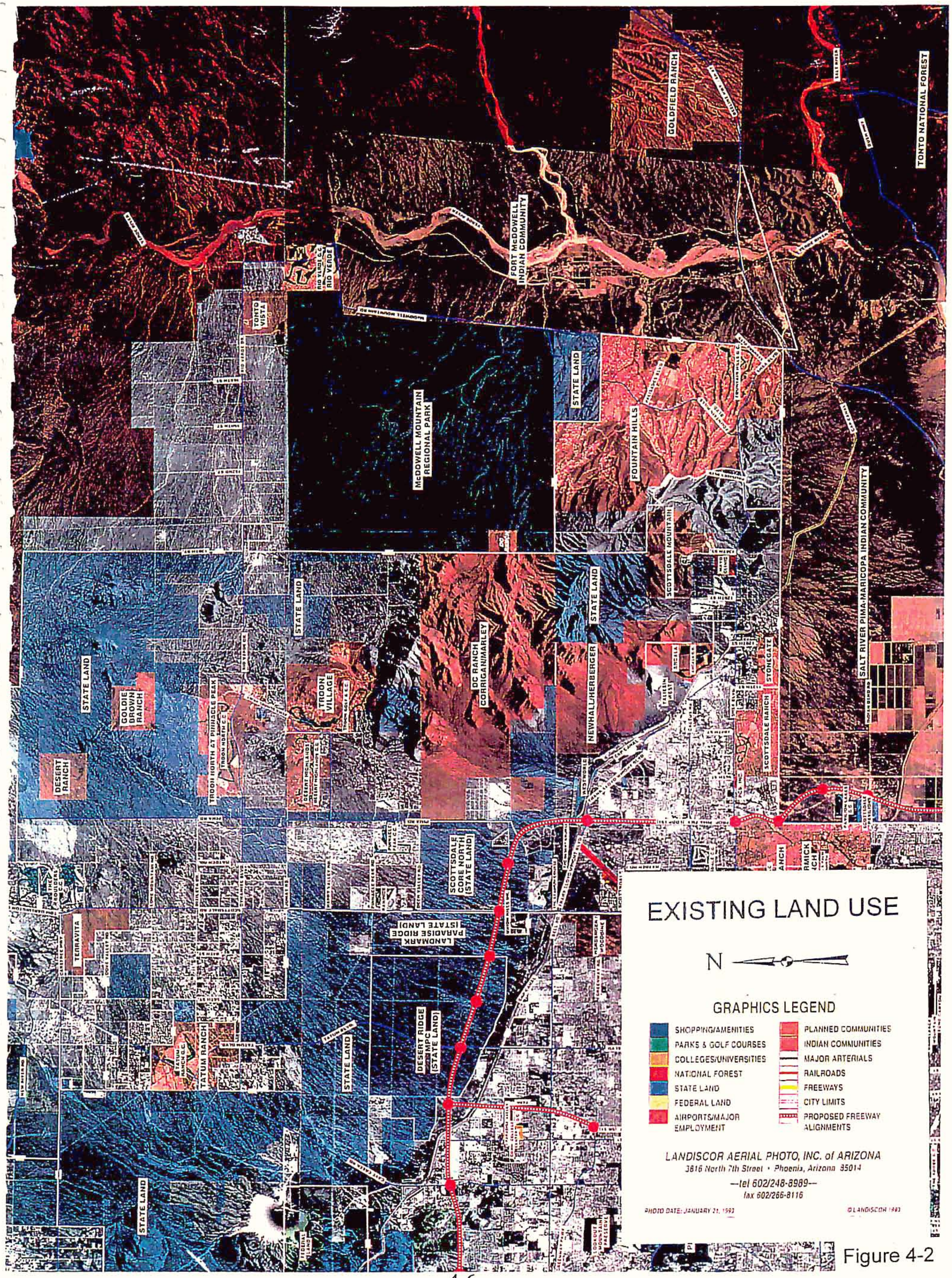
The City of Phoenix, along with the cities of Scottsdale, Tempe, Glendale, Mesa and Chandler, comprise the Phoenix metropolitan area. According to the U.S. Census, the Phoenix metropolitan area's 1990 population exceeded 2.1 million.

The City of Phoenix population in 1980 was 789,704 and in 1990 983,392. The Arizona Department of Economic Security estimates the City Population at 1,051,515 in July 1994. The City of Scottsdale has the fifth largest population of all of the incorporated communities in the Phoenix metropolitan area. From 1980 to 1990, Scottsdale's population grew 47 percent, from 88,412 to 130,069. By January 1, 1995, Scottsdale's population grew an additional 22.6 percent to 159,404 (representing an annual compound growth rate of approximately 4.2 percent).

The combined area of the five alluvial fans in the study area totals 17,210 acres, of which 11,290 acres (or 66 percent) are located in the City of Scottsdale, and 5,920 acres (or 34 percent) are located in the City of Phoenix. The predominant zoning is single family residents with supporting businesses. There are several Planned Communities existing and projected (figure 4-2). Development buildout is projected to occur in 2040.

Scottsdale's Planning and Community Development Department ("PCDD") has developed growth projections for the city based upon four different future development scenarios, ranging from low density/low growth to high density/high growth. By the year 2015, the Scottsdale's population is forecast to range from 201,980 under the low-growth scenario to 308,230 under the high-growth scenario.

Scottsdale's PCDD has defined 5 separate planning zones, each representing different geographic sections of the city. The Scottsdale portions of the 100-year floodplains are encompassed within three of these planning zones -- Zones "C", "D" and "E".


EXISTING LAND USE
N
GRAPHICS LEGEND
SHOPPING/AMENITIES
PARKS & GOLF COURSES
COLLEGES/UNIVERSITIES
NATIONAL FOREST
STATE LAND
FEDERAL LAND
AIRPORTS/MAJOR EMPLOYMENT
PLANNED COMMUNITIES
INDIAN COMMUNITIES
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FREEWAYS
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PROPOSED FREEWAY ALIGNMENTS
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—tel 602/248-8989—
fax 602/266-8116
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GOLDFIELD RANCH
FORT McDOWELL INDIAN COMMUNITY
RIO VERDE
TONTO VISTA
McDOWELL MOUNTAIN REGIONAL PARK
STATE LAND
FOUNTAIN HILLS
SCOTTSDALE MOUNTAIN
SALT RIVER PIMA-MARICOPA INDIAN COMMUNITY
STONEGATE
SCOTTSDALE RANCH
NEWHALL/HERBERGER
DC RANCH CORRIGAN/MARLEY
TROON VILLAGE
TROON NORTH & PINNACLE PEAK
GOLDIE BROWN RANCH
DESERT RANCH
SCOTTSDALE CORE NORTH (STATE LAND)
LANDMARK PARADISE RIDGE (STATE LAND)
TERRAVITA
TATUM RANCH
DESERT RIDGE MPC (STATE LAND)

Figure 4-2

Zone C encompasses approximately 58 square miles. The total population within Zone C was approximately 43,140 as of January 1, 1995. It should be noted that most of the population within this zone is located in the southern portion (south of Bell Road), whereas the floodplain only extends through the northern half of Zone C, which is currently primarily undeveloped. Based upon the four future development scenarios described earlier, Zone C's population is projected to range from 75,990 to 109,700 by the year 2015. Approximately 40 percent of the land available for future development in Zone C is located within the floodplain.

The northern portion of the alluvial fans formed by Rawhide, Beardsley and Reata Pass Washes is located in Zone "D". This zone encompasses about 36 square miles. The area is characterized by low density, desert-oriented upscale residences. Zone D's population at January 1995 totaled 6,880. By the year 2015, this zone's population is projected to range from 10,030 to 34,880. Approximately 12 percent of the land available for future development in Zone C is located within the floodplain.

Portions of Fans 5 and 6 are located in Zone "E". This zone encompasses about 58 square miles. The area is low density and desert-oriented, appealing to middle class homeowners looking for an alternative to an urban setting. Zone E's population at January 1995 totaled 2,290. By the year 2015, this zone's population is projected to reach approximately 36,760. Approximately nine percent of the land available for future development in Zone E is located within the floodplain.

The Phoenix portion of the Rawhide Wash floodplain (west of Scottsdale Road) is currently undeveloped, except for an Arabian horse ranch (Tom Chauncy Arabians). However, two major developments which will eventually encompass most of the area are currently in the planning phases. The Maricopa County Association of Governments (MAG) and the City of Phoenix Planning Department have developed population projections for Traffic Analysis Zones (TAZ's) in the area. The Phoenix portion of the Rawhide Wash floodplain is located within seven different TAZ's. These TAZ's are projected to reach build out by the year 2040 with a population of over 33,000 . Over 50 percent of this growth is expected to take place within floodplain boundaries, based upon the ratios of the total area in each TAZ to the portions of each TAZ within the floodplain.

The Phoenix portion of Fan 6 (west of 56th Street) is also primarily undeveloped. For the four TAZ's in which the Phoenix portion of Fan 6 is located, the population is projected to reach over 32,500 by the year 2060. Approximately 40 percent of this growth is expected to take place within Fan 6 boundaries, based upon the proportion of Fan 6 land area to total land area for each TAZ.

4.2 Expected Future Conditions

4.2.1 Land Use and Population

The development opportunities within the Phoenix metropolitan are becoming restricted. Developable areas are restricted by the National Forest on the East and North, and Native American Lands on the South and Southeast (figure 4-2). As development expands to accommodate population growth, developers are developing alluvial fan areas in the study area.

The Northeast Phoenix Metro area is very desirable for the views and the high desert environment. This high desert environment enables Saguaro Cactus and other region trademark vegetation and wildlife to prosper. The proximity to recreational opportunities provided by open space such as McDowell Mountain and Roosevelt Lake contribute to the desirability of the area.

By the year 2000, the Phoenix metropolitan area population is projected to reach over 2.8 million (U.S. Census). Maricopa County contains approximately 58% of the total Arizona population, comprising nearly 65% of the State's population growth since 1980. The estimated population of Maricopa County at the second quarter of 1995 was estimated at 2,420,000, compared to a 1990 figure of approximately 2,122,000 and a 1980 figure of about 1,509,000. Overall, it is apparent that the study area, being located in Maricopa County, is affected by the relatively rapid growth in population.

4.2.2 Vegetation and Wildlife

As development occurs vegetation and wildlife will be restricted to pockets and corridors were development has not occurred.

4.2.3 Geology and Soils

Generally the geology and soils will remain the same. Changes will occur do to development but the underlying geology will not be affected. Soils will change only in the fact that urbanization will occur covering existing soils.

4.2.4 Alluvial Fans

Many of the smaller washes that braid the fan will be built over by development. Most of the land available for development is already owned by developers or by the State Land Department. State Land will be sold at public auction to master developers in parcel sizes of 300 acres such as Desert Ridge and Paradise Ridge. Other development will take place in large planned communities in parcels ranging from 160 to 640 acres. These developments will be flood-proofed to FEMA standards (see section 4.3.3) to be removed from the flood zone. The flood proofing will go in piecemeal, which will result in a relatively costly and inefficient flood protection system.

4.2.5 Study Area

In general, the study area will change drastically from it's current conditions with the rapid development.

4.3 Specific Problems and Opportunities

The major problems specific to the study area is inundation damages, flood insurance, alluvial fan flooding and the FEMA requirements for flood proofing.

4.3.1 Inundation Damages and Emergency Cleanup

Although there has not been a significant flood in the North Scottsdale area in recent years, the City has been required to make expenditures for repairs and preventative maintenance due to minor flooding and associated erosion. During 1993 and 1994, Scottsdale, alone, has spent $121,231 on contract repairs and maintenance. Clean up costs city of Scottsdale wide, including barricades and sand bags, totaled $27,000 in 1993 and $32,275 in 1994. These amounts do not include expenditures made by private developments for repairs, maintenance and clean-up or the city of Phoenix. Existing flood damage to residential structures is displayed in Table 4-1 below. The opportunity exist to reduce existing inundation damage

4.3.2 Flood Insurance

The Cities of Scottsdale and Phoenix are participants in the National Flood Insurance Program (NFIP). FEMA, which administers the NFIP, identifies and delineates special flood hazard areas on flood insurance rate maps (FIRMs) for communities participating in the NFIP. FEMA established preliminary FIRMs for North Scottsdale and surrounding areas in July 1991. In addition to delineating special flood hazard areas, the FIRMs provided base flood elevations for the 100-year flood event. An opportunity exist to reduce expenditures for flood insurance in the study area.

4.3.3 Alluvial Fans

The 100-year overflow area is comprised of alluvial fans. Alluvial fans are triangular or fan shaped, gently sloping landforms which often provide attractive development sites due to their commanding views. Alluvial fans are located primarily in western states, where infrequent but intense storms typical of arid climates combined with abrupt changes in topography create the necessary conditions for fan formulation.

FEMA has established minimum requirements which developers within special flood hazard areas must comply with in order to meet NFIP regulations and to be eligible for flood insurance coverage. These requirements are addressed in Chapter 44 of the Code of Federal Regulations, Part 60.3 and include:

1) The first floor must be elevated above the highest adjacent grade to at least as high as the depth number specified on the flood insurance map (FIRM), which is equal to the depth of flooding in the 100-year event;

2) Adequate drainage paths around structures on slopes must be provided, with floodwater guided around and away from proposed structures; and

3) Floodflow cannot be deflected onto adjacent properties.

Compliance with these minimum requirements enables developers to build within the 100-year floodplain. However, the structures (once they are built) are still considered to be susceptible to damage during the 100-year flood event. For example, a structure with a the first-floor level at or above the 100-year flood depth could still be damaged during a 100-year event, since its foundation could be exposed to floodwater. Communities participating in the NFIP must assure developments within their communities comply with the minimum FEMA requirements to remain eligible for participation in the program.

A developer can submit an application to FEMA requesting a letter of map amendment or letter of map revision to be removed from the 100-year floodplain. Section 65.13 of FEMA's "National Flood Insurance Program and Related Regulations" (revised October 1, 1993) identifies the procedures which must be followed and the types of information FEMA requires to recognize on a NFIP floodplain map that a structural flood control measure provides protection from the base flood in an area subject to alluvial fan flooding. Section 65.13 specifically states: "In general, elevations of a parcel of land or a structure by fill or other means, will not serve as a basis for removing areas subject to alluvial fan flooding from an area of special flood hazards. FEMA will credit on NFIP maps only major structural flood control measures whose design and construction are supported by sound engineering analyses which demonstrate that the measures will effectively eliminate alluvial fan flood hazards from the area protected by such measures." FEMA's review criteria require that the construction include elements which:

1) Do not cause the disturbance of natural flood processes on the fan;

2) Allow for the safe collection passage, and disposal of flood-related water, sediment and debris without negative impact on adjacent property;

3) Address erosion, sour, deposition, impact and hydrostatic forces; and

4) Provide that the design and maintenance of the project elements be coordinated with the local jurisdiction and/or agency responsible for flood control within the community.

By meeting the above requirements, a development may be removed from the floodplain, thereby eliminating flood insurance requirements for structures within the development. The cost for this removal averages $20,000 acre. An opportunity exist to forego these expenditure for flood proofing with a comprehensive flood control system.

The following table summarizes annualized without project damages in the study area. The flood proofing cost do not include real estate required for flood proofing.

Table 4-1
Summary of Without Project Annual Damages
(In $1,000's)

	Beardsley/ Reata Pass Fan	Rawhide Wash Fan	Fan 5	Fan 6	Total
Inundation	$203.0	$115.9	NC	NC	$318.9
Future Flood proofing Costs	$2,852.8	$3,804.5	$579.0	$912.3	$8,148.6
Emergency/Clean Up	$10.2	$5.8	NC	NC	$15.9
Flood Insurance Costs	NS	NS	NS	NS	$88.1
Total	$3,066.0	$3,926.2	$579.0	$912.3	$8,571.5

NC: Not Calculated/Included
NS: Not Segregated by Fan

4.4 Planning Objectives and Constraints

4.4.1 General Planning Objectives

The primary objective of Federal water and related land resources project planning is to solve the problems in ways which take advantage of opportunities to contribute to the National

Economic Development (NED). Contributions to NED are increases in the net value of the national output of goods and services. The solutions must be accomplished consistent with protecting the Nation's environment, pursuant to national environmental statutes, applicable Executive Orders, and other Federal planning requirements. The plans considered during this reconnaissance study have been formulated to take advantage of opportunities in ways that meet these general objectives.

4.4.2 Specific Planning Objectives

The water resource problems, opportunities and constraints identified in this study area are summarized in the following specific planning objectives for this reconnaissance study:

1) Reduce public and private flood related inundation damages and costs to residential commercial and industrial property, and to bridges and road crossings within the study area. This could be accomplished through detention and channelization combinations implemented effectively to reduce damages in the problem areas.

2) Reduce transportation-related damages and reductions in transportation efficiencies caused by flooding of roadways.

3) Develop a comprehensive Federal project for flood control which would:

    a. Address specific flooding characteristics which affect existing development on the alluvial fan.

    b. Provide an acceptable means of capturing and conveying alluvial fan flows into and through a formal flood-control system.

    c. Include detention basins to reduce peak discharges and to ensure that the comprehensive system of flood water collection on the fan would not increase flood flows or worsen flooding conditions downstream in the existing developed areas.

    d. Provide an opportunity to implement a comprehensive flood-control plan on the alluvial fan that would comply with FEMA guidance for total fan protection.

    e. Reduce NED losses for on-going and future development costs required to comply with FEMA and City of Scottsdale flood-control requirements on the alluvial fan.

    f. Reduce the land requirements for flood control.

g. Provide a framework for responding to future urban development drainage requirements in a wise and orderly manner consistent with Executive Order 11988.

h. Eliminate the requirement for FEMA flood insurance.

4) Design alternatives to match existing and proposed improvements where possible to take advantage of these local improvements and to be consistent with the future flood-control plans of the local community.

4.4.3 Planning Constraints

Planning constraints are overriding concerns that must be considered in formulating plans or potential solutions. They may be of such importance that they severely affect the plan formulation or even void a potential plan from further consideration. Several potential constraints were identified for the study area as follows:

1) Endangered Species: The study area is located in an area that may contain some endangered or threatened species. Any potential project will be required under the Endangered Species Act to not jeopardize threatened or endangered species or to destroy or adversely modify their habitat. It will be necessary for the U.S. Army Corps of Engineers to conduct a formal consultation with the U.S. Fish and Wildlife Service during the feasibility phase of study.

2) Displacement of People: The Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970 requires that any local sponsor acquiring land for a project involving the Federal government comply with provisions of the act. The Act pertains to providing people displaced by the project, or whose use of their property is otherwise affected, with proper compensation for their inconvenience, and assistance in relocation, if necessary.

3) Rapid Growth: The explosive growth in the area creates serious constraints in potential flood-control solutions. It is difficult to determine the direction of growth and the ultimate population density. The extent of development at project year one is difficult to predict. Development could also affect where the future problem areas might be. Land acquisition potential by the local sponsor is a major concern during the plan formulation.

4) Real Estate: Real-estate costs vary considerably in the study area and can significantly affect project costs. Real-estate estimates for economic evaluations need to be based on the highest and best use of the land

5) Alluvial Fan Flows: Unpredictable storm centerings make the flows from the alluvial fan difficult to predict. Flood flows often occur over wide areas and may not be confined to specific channels. Sediment loads may be high. Developing flood-control solutions on alluvial fans often requires innovative engineering and planning approaches.

6) State Lands: The State of Arizona owns land that could be affected by a flood-control solution in North Scottsdale. The Arizona State Land Department has expressed an interest in the project and will be reviewing and commenting on project studies and alternatives.

CHAPTER 5
PLAN FORMULATION

5.0 General

This chapter presents the plan formulation rationale used during this reconnaissance study to develop evaluate and compare the array of candidate plans which have been considered. The alternative plans considered are discussed in addition to economics and cost implementation criteria.

The plan formulation process discussed in this chapter consisted of the following major steps:

1. Description and specification of flooding and water resources related problems and opportunities in the study area,
2. Identification of planning objectives and constraints within the study area,
3. Formulation of preliminary alternatives plans,
4. Evaluation and comparison of alternative plans,
5. Selection of recommended plan,
6. Identification of potential feasibility study efforts, goals, objectives, and alternatives.

Plan formulation is a creative and analytical process in which alternative plans are formulated with the intent of solving the identified problem while maximizing the NED objective. The alternative plans considered are based upon available data and information at the time they were formulated. Plan formulation is a dynamic process. As input data changed or as new information became available, alternatives were revised or new plans formulated when opportunistic to do so.

5.1 *Criteria and Rationale*

5.1.1 Flood Control Measures

The plan formulation process involved identifying a wide variety of flood control measures which could be used to meet the planning objectives. The measures provide the basis for formulating alternative plans. The following list identifies the various measures that were considered as a means of meeting the planning objectives:

* Detention basins to reduce peak flows and lower the frequency of damaging flows

* Channel improvements to increase channel capacities, reduce flood damages through certain reaches, and convey to a safe and adequate point of disposal for flood flows

* Collector channels for the capture of sheet flow on the alluvial fans

* Diversion of flood waters between washes or manmade channels to take advantage of the various capacities in the most advantageous manner.

A number of plans were developed by the Corps in cooperation with the local sponsor and evaluated relative to the effectiveness and acceptability. The preliminary plans present below have been formulated to reduce the highest flood related damages in the study area and to maximize net benefits while minimizing adverse environmental and social effects.

Federal participation is limited to flood control, which is defined by the Flood Control Act of 1944 and modified by the Water Resources Development Act of 1986 to include "channel and major drainage improvements and flood prevention improvements". In urban or urbanizing areas, provisions of a basic drainage system to collect and convey local runoff is a non-Federal responsibility. Water damage problems may be addressed under the Federal flood control authorities downstream from the point where the flood discharges are greater than 800 cubic feet per second (cfs) for the 10 percent flood (one chance in ten of being exceeded in any given year). Drainage areas of less than 1.5 square miles are assumed to lack adequate discharge to meet the above criterion. Exceptions may be granted in areas of hydrologic disparity producing limited discharges for the 10 percent flood but in excess of 1,800 cfs for the one percent flood.

5.1.2 Evaluation Criteria

The effectiveness and acceptability of alternatives were evaluated with respect to engineering, economic, environmental, and social criteria.

5.1.3 Initial Screening of Alternative Measures

A wide range of alternative methods of flood damage reduction was evaluated on an initial screening level prior to selecting specific alternatives for detailed evaluation. Screening alternatives included:

Non-Structural Measures

Relocation of Existing Structures. Existing structures could be purchased to allow floodplain residents to move away from the floodplain. Purchased structures could be removed. Relocation has the advantage that no constructed channel or associated environmental impact would be necessary.

Relocation was not considered beyond the initial screening level because it would be effective only for a relatively few older structures on the floodplain, and it would have no effect on future development. The study area is currently developing rapidly with residential housing. Flood-protection costs for new development are very high, and constitute the major potential NED benefit of a flood-control project.

Flood Proofing of Existing Structures. Existing structures in the floodplain could be flood-proofed by installing sealants to walls and doors, installing individual flood walls or dikes, or by being raised above the floodplain.

Flood proofing was not considered beyond the initial screening level because, as a Federal project, it would be effective only for a relatively few older structures on the floodplain, and it would have no effect on future development. Future development would be required to install flood-proofing on an individual basis, resulting in a piecemeal, costly and inefficient system.

Structural Measures

Detention/Retention. Detention or retention of flood flows can reduce flood peaks to levels that are within the capacity of existing channels. Detention/retention is considered a potentially viable method of flood control in the study area and was considered in the development and evaluation of alternatives.

Lined Flood-Control Channels. Lined flood-control channels are a versatile and effective method of conveying detained or natural flood flows and were considered in the development and evaluation of alternatives.

Unlined Flood-Control Channels Unlined flood-control channels have the advantage that they can provide flood protection without the aesthetic disadvantages of lined channels. Unlined channels, with bank protection on the sides only, are favored by the City of Scottsdale and the City of Phoenix in their desert greenbelt concept and were considered as potential solutions for this area.

Unlined channels require more right-of-way and maintenance than lined channels.

Unlined flood-control channels, with lined sides, were considered more appropriate for the Reata/Beardsly wash area for the reason that this area is currently relatively undeveloped. The lack of development allows more latitude in the selection of channel type and alignment.

Furthermore, the unlined channel concept is favored by the City of Scottsdale for their desert greenbelt plan.

Lined channels were considered more appropriate for all areas outside the Reata/Beardsly wash area for the reason that these areas are currently more developed than Reata/Beardsly. Right-of-way and channel alignment options are more limited in a developed area. It was considered that lined channels would provide a more efficient method of flood control within these limitations.

Detention was not considered on Fans 5 and 6 (See Figure 4-1) and the Reata/Beardsly Wash. Fans currently drain to the Cave Butte Dam, which acts as a detention basin. Furthermore, the middle and upstream ends of the Fan 5 and 6 flood zones, which would be the most-likely locations for a detention basin, are currently developed.

The City of Scottsdale currently has a plan for installing desert greenbelt channels on the Reata/Beardsly Wash. This plan, adopted at the reconnaissance level of this study, has no provision for detention. Detention could be considered as an option for this wash in the Feasibility stage, if necessary.

5.1.4 Without Project Conditions

The without project conditions for plan formulation are:

1. The Scottsdale Desert Greenbelt project is assumed not to be in place prior to potential authorization of a Federal project. In the event the feature is constructed it will be incorporated as an integral and compatible part of a Federal project alternative, the feature would be considered as part of the plan.

2. Developers will floodproof future structures to meet FEMA requirements and remove them from the flood zone and the flood insurance program.

3. The method of floodproofing used by developers will be the "moat" concept with natural channels required by zoning laws.

4. Developer buildout in the study area will occur by 2040.

5.2 Preliminary Alternatives

5.2.1 No Action Plan

Under this measure, the Corps of Engineers would take no action to alleviate the flood problems in the study area. The study area would continue to experience flood damages in response to unpredictable storm events. The private and public urban structures would continue to be affected by flooding, erosion, emergency cleanup and repair measures, and land use change. The no action plan is synonymous to the future without project condition. The effect of such flooding and disruption to the community would likely increase the physical and emotional suffering of the affected residents.

All future development will need to provide floodproofing to the properties. This would result in a piecemeal and relatively inefficient system over the alluvial fan areas.

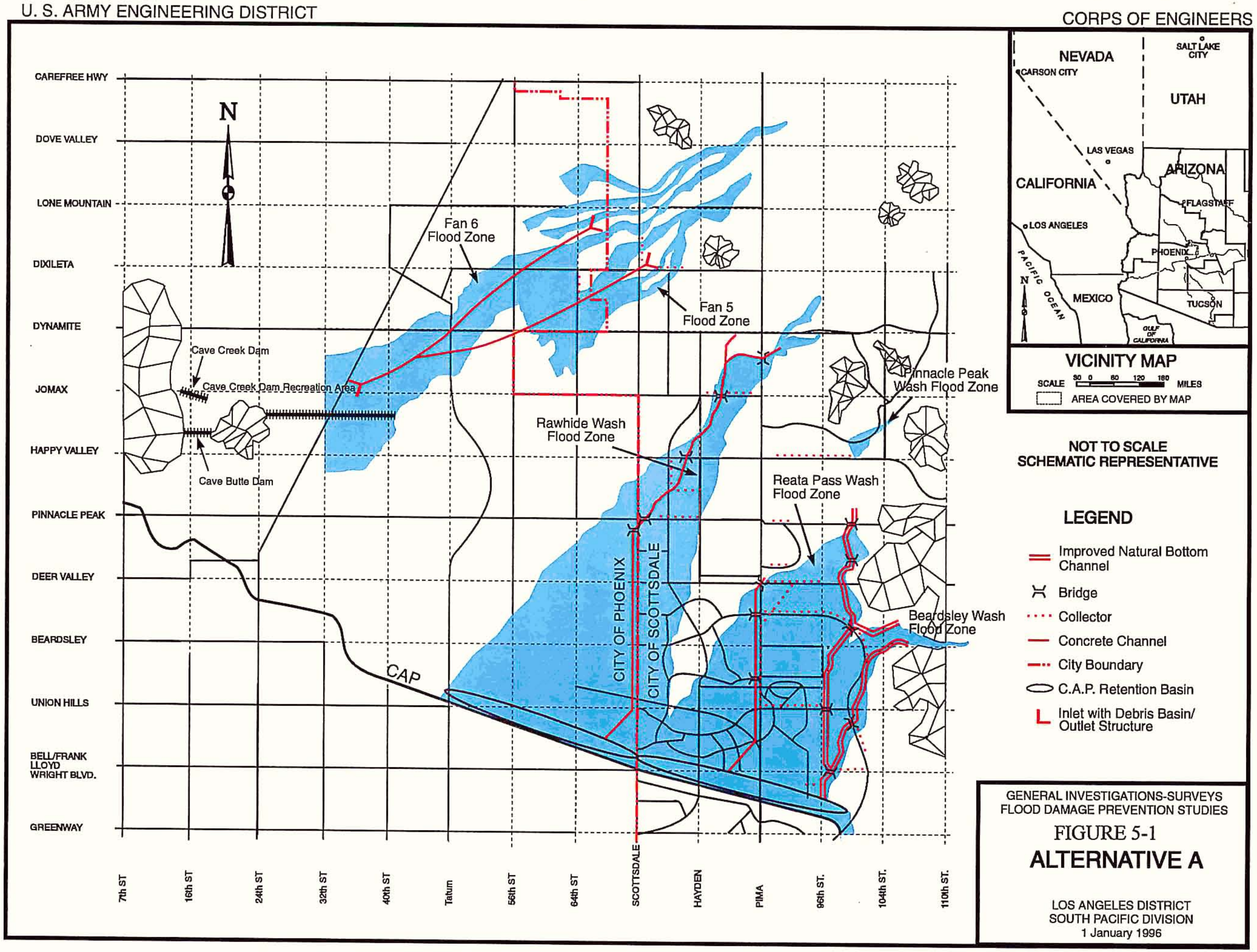
5.2.2 Alternative A

This alternative consists of 1) concrete channels to capture flood flows from Fan 5 and Fan 6 and then discharge into the Cave Creek Reservoir, 2) a concrete channel to collect flows from the apex of Rawhide Wash alluvial fan and discharge into the existing detention basins adjacent to the CAP canal, 3) a concrete channel along Pima Road from Deer Valley Road to carry flood flows and discharge into the CAP detention basins, and 4) improved natural channels beginning from the apexes of Reata Wash and Beardsley Wash fans and discharge flood waters into the CAP detention basins.

Figure 5-1 presents the scheme of Alternative A along with the FEMA AO Zone floodplains delineated for each of the alluvial fan washes. As shown in the figure, numerous lateral drains would also be provided to bring street runoff to the main channels. The drainage channels proposed under this alternative would be designed to capture the 100-year flood peak flows and eliminate flooding in the existing and future development areas.

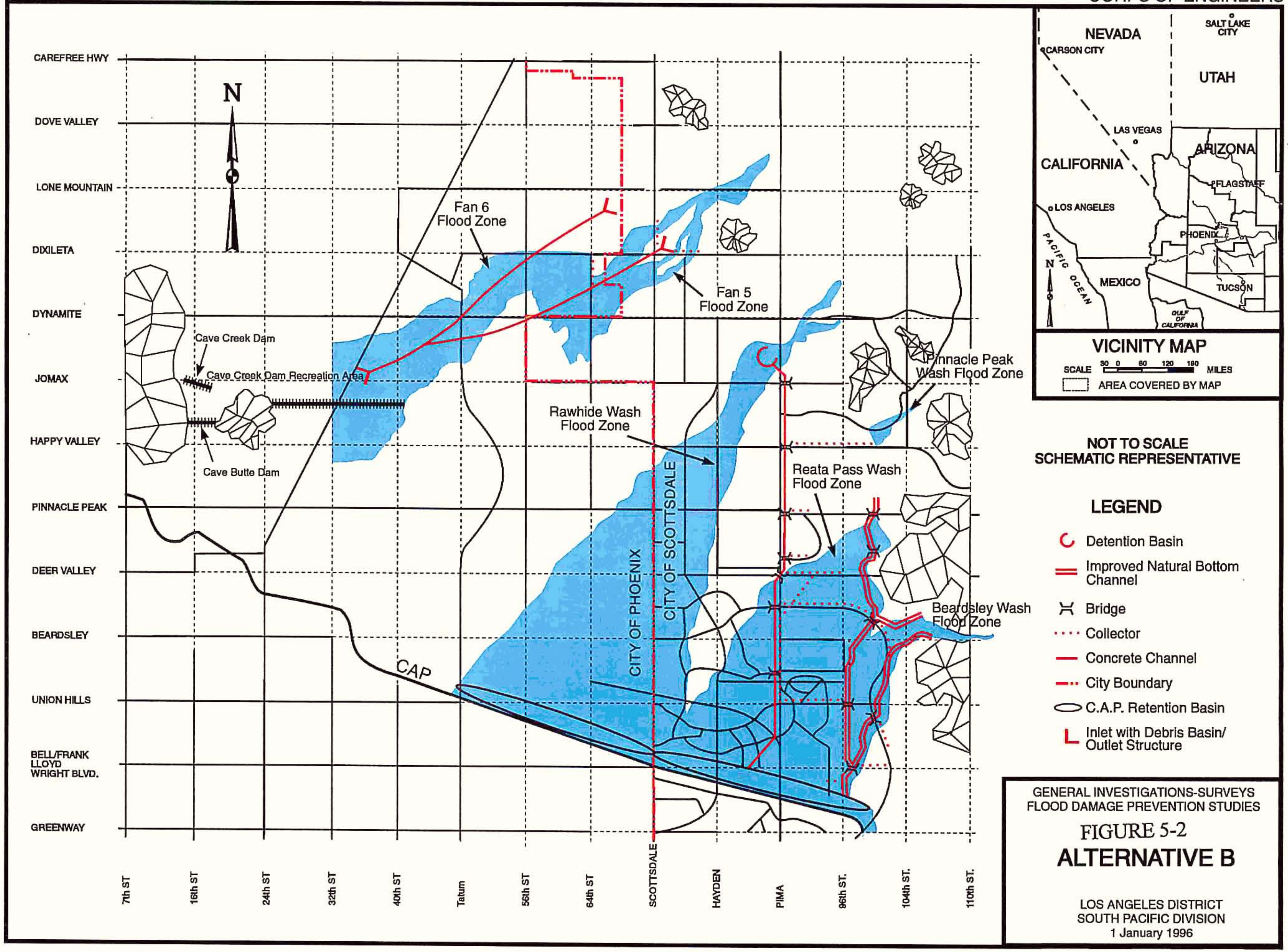
5.2.3 Alternative B

Under this alternative, the concrete channel proposed for Rawhide Wash would be replaced with a detention basin at a location north of Jomax Road and east of Pima Road. The Pima Road concrete channel would then be extended north to the corner of Jomax and Pima to catch reduced flows from the detention basin outlet. The concrete channel and natural channel concept developed under Alternative A to convey flows from Beardsley Wash, Reata Wash, and Fans 5 and 6 would remain unchanged. A conceptual layout of the drainage system is presented in Figure 5-2.


U. S. ARMY ENGINEERING DISTRICT
CORPS OF ENGINEERS
CAREFREE HWY
DOVE VALLEY
LONE MOUNTAIN
DIXILETA
DYNAMITE
JOMAX
HAPPY VALLEY
PINNACLE PEAK
DEER VALLEY
BEARDSLEY
UNION HILLS
BELL/FRANK LLOYD WRIGHT BLVD.
GREENWAY
7th ST
16th ST
24th ST
32th ST
40th ST
Tatum
56th ST
64th ST
SCOTTSDALE
HAYDEN
PIMA
96th ST.
104th ST.
110th ST.
N
Fan 6 Flood Zone
Fan 5 Flood Zone
Cave Creek Dam
Cave Creek Dam Recreation Area
Cave Butte Dam
Rawhide Wash Flood Zone
Pinnacle Peak Wash Flood Zone
Reata Pass Wash Flood Zone
Beardsley Wash Flood Zone
CITY OF PHOENIX
CITY OF SCOTTSDALE
CAP
NEVADA
CARSON CITY
SALT LAKE CITY
UTAH
LAS VEGAS
CALIFORNIA
ARIZONA
FLAGSTAFF
LOS ANGELES
PHOENIX
PACIFIC OCEAN
MEXICO
TUCSON
GULF OF CALIFORNIA
N
VICINITY MAP
SCALE 30 0 60 120 180 MILES
AREA COVERED BY MAP
NOT TO SCALE
SCHEMATIC REPRESENTATIVE
LEGEND
Improved Natural Bottom Channel
Bridge
Collector
Concrete Channel
City Boundary
C.A.P. Retention Basin
Inlet with Debris Basin/ Outlet Structure
GENERAL INVESTIGATIONS-SURVEYS
FLOOD DAMAGE PREVENTION STUDIES
FIGURE 5-1
ALTERNATIVE A
LOS ANGELES DISTRICT
SOUTH PACIFIC DIVISION
1 January 1996

U. S. ARMY ENGINEERING DISTRICT

CORPS OF ENGINEERS



The detention basin avoids the need for a costly concrete channel along Rawhide Wash and yet removes flooding by diverting flows into the adjacent Pima Road channel.

5.2.4 Alternative C

This alternative is similar to Alternative B, with the exception that the detention basin proposed for Rawhide Wash would be modified to outlet the reduced discharge directly to the downstream natural wash instead of divert to the Pima Road channel as shown in Alternative B. A conceptual scheme is shown in Figure 5-3.

5.3 Comparison of the Preliminary Alternatives

The three alternatives were evaluated at a preliminary level of detail to determine which alternative would be most cost effective and meet the required level of flood protection. All three proposed alternatives essentially would provide the same level of protection to the developments on the alluvial fan areas. They all have the same drainage concept of flood containment for Beardsley Wash, Reata Wash, Fan 5, and Fan 6.

For Rawhide Wash, Alternative A utilizes concrete channels to convey the 100-year flood and discharge to the CAP detention basins so that to the properties currently in the alluvial fan flood zone can be removed out of the 100-year floodplain. Instead of constructing approximately a seven mile long concrete channel, Alternatives B and C propose a detention basin near the upstream end of the Rawhide Wash fan to significantly reduce the 100-year flood peak discharge and eliminate the downstream flooding problem.

Based upon a qualitative comparison, the detention basin concept for Rawhide Wash would be a much less expensive alternative than the concrete channel to achieve the same level of flood protection. Therefore, Alternatives B and C are preferred to Alternative A.

Under Alternative B, the decreased flood outflows from the Rawhide Wash detention basin would be diverted through a storm drain or a concrete channel to the Pima Road channel. A field reconnaissance conducted at the project site indicated that the existing grade in the area would not accommodate the required elevations at the channel inlet and basin outlet locations. Additional excavations of the Pima Road channel would be necessary to meet the slope requirement. On the other hand, Alternative C proposes a basin outlet to directly discharge the reduced outflows into the natural water course along the Rawhide Wash alluvial fan, which drains into the CAP detention basins. It appears that on the basis of cost and engineering, Alternative C presents a more feasible concept than Alternative B for Rawhide Wash.

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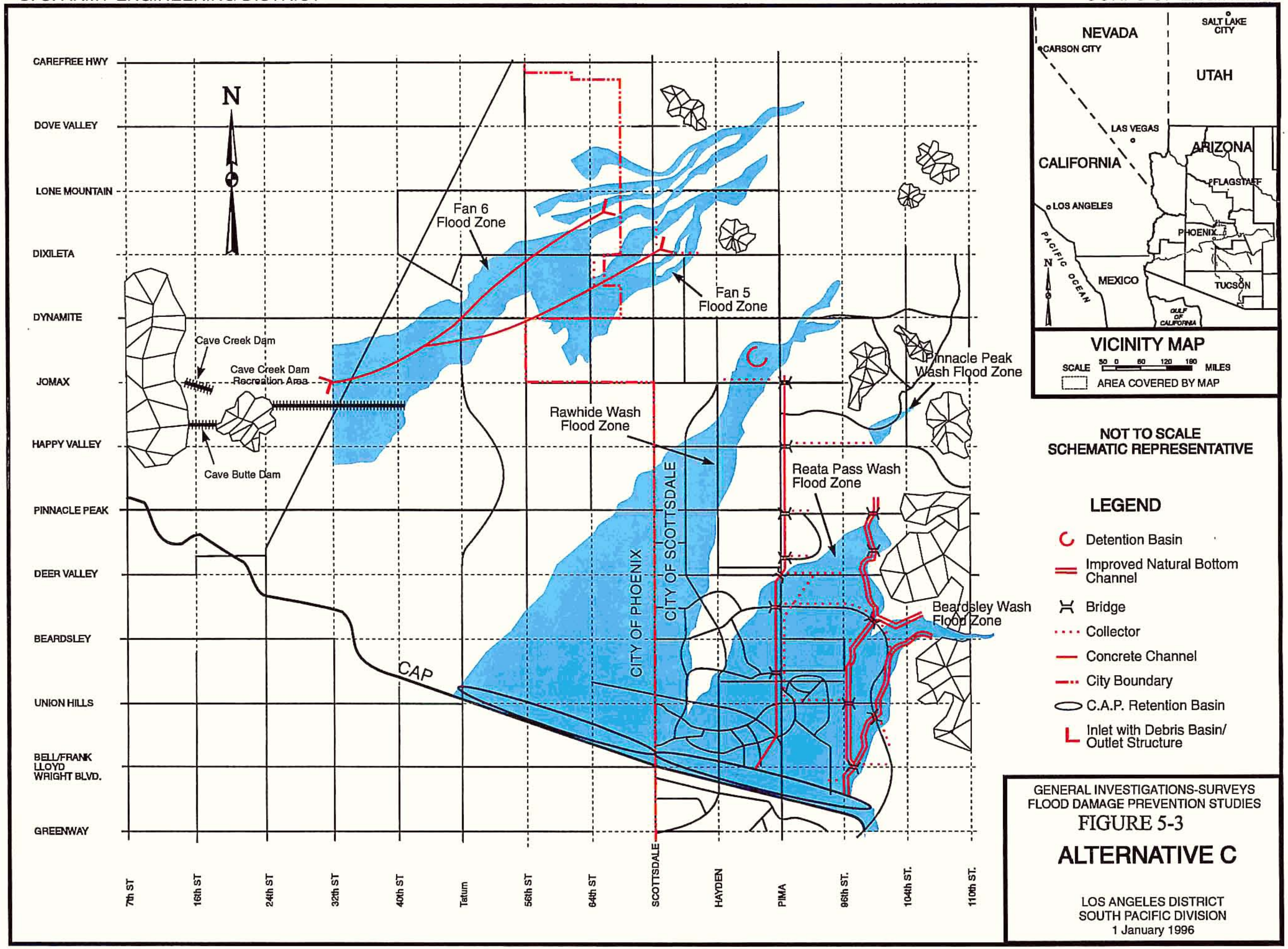


GENERAL INVESTIGATIONS-SURVEYS
FLOOD DAMAGE PREVENTION STUDIES

FIGURE 5-3

ALTERNATIVE C

LOS ANGELES DISTRICT
SOUTH PACIFIC DIVISION
1 January 1996

The Pima Wash channel would drain into an existing detention basin constructed for the protection of the Central Arizona Project canal. Introduction of Rawhide Wash flows into this detention basin would increase inflow rates and volumes to the detention basin and may result in decreased detention basin capacity or level of protection.

In light of the above preliminary comparison, Alternative C was chosen as the flood protection plan for the North Scottsdale study area.

5.4 Proposed Plan

As shown on Figure 5-3, the proposed flood protection plan consists of the following components: 1) improved natural channels on Reata and Beardsley Washes, 2) a concrete channel adjacent to Pima Road extending from the intersection with Jomax Road on the north to the CAP detention basins, 3) a detention basin on Rawhide Wash located north of Jomax Road and west of Pima Road, and 4) concrete channels through Fans 5 and 6. The following paragraphs provide more detailed descriptions of each of the project components and their associated hydraulic and economic benefits.

1) Improved Natural Channels on Reata and Beardsly Washes: This channel system is part of the Scottsdale Desert Greenbelt Project proposed by the City of Scottsdale and consists of two channels which carry flows safely from the fax apexes through North Scottsdale and to the Central Arizona Project (CAP) detention basins. The Reata and Beardsley Natural Channels capture flow from the upstream locations of the fans and combine them at Bell Road just east of 96th Street where the flow continues southward to the CAP (see Figure 5-3). These natural channels will be contained by constructed berms placed strategically so as to contain the future conditions 100-year event. The design flow rates range from 3,800 cfs at the upstream tributaries to 15,000 cfs at the downstream end of the channel system.

2) Pima Road Channel: The Pima Road Channel will be a concrete channel along Pima Road from Deer Valley Road down to the CAP. It will capture flows from the Pinnacle Peak Wash fan as well as flows generated between the Reata Wash channel and Pima Road. The channel will contain the 100-year flood peak discharges ranging from 4,300 cfs to 7,500 cfs.

3) Rawhide Wash Detention Basin: The Rawhide Wash FEMA flood zone begins at 96th Street near Dynamite, and the fan begins to spread out at Happy Valley and Hayden Roads. The proposed detention basin was therefore located north of Jomax Road , south of Dynamite Road, and between Hayden and Pima Roads. The 100-year inflow to the detention basin was estimated to be 12,400 cfs and

outflow was to be reduced to 380 cfs. This discharge will be small enough to ensure that runoff on the fan will remain below one foot in depth.

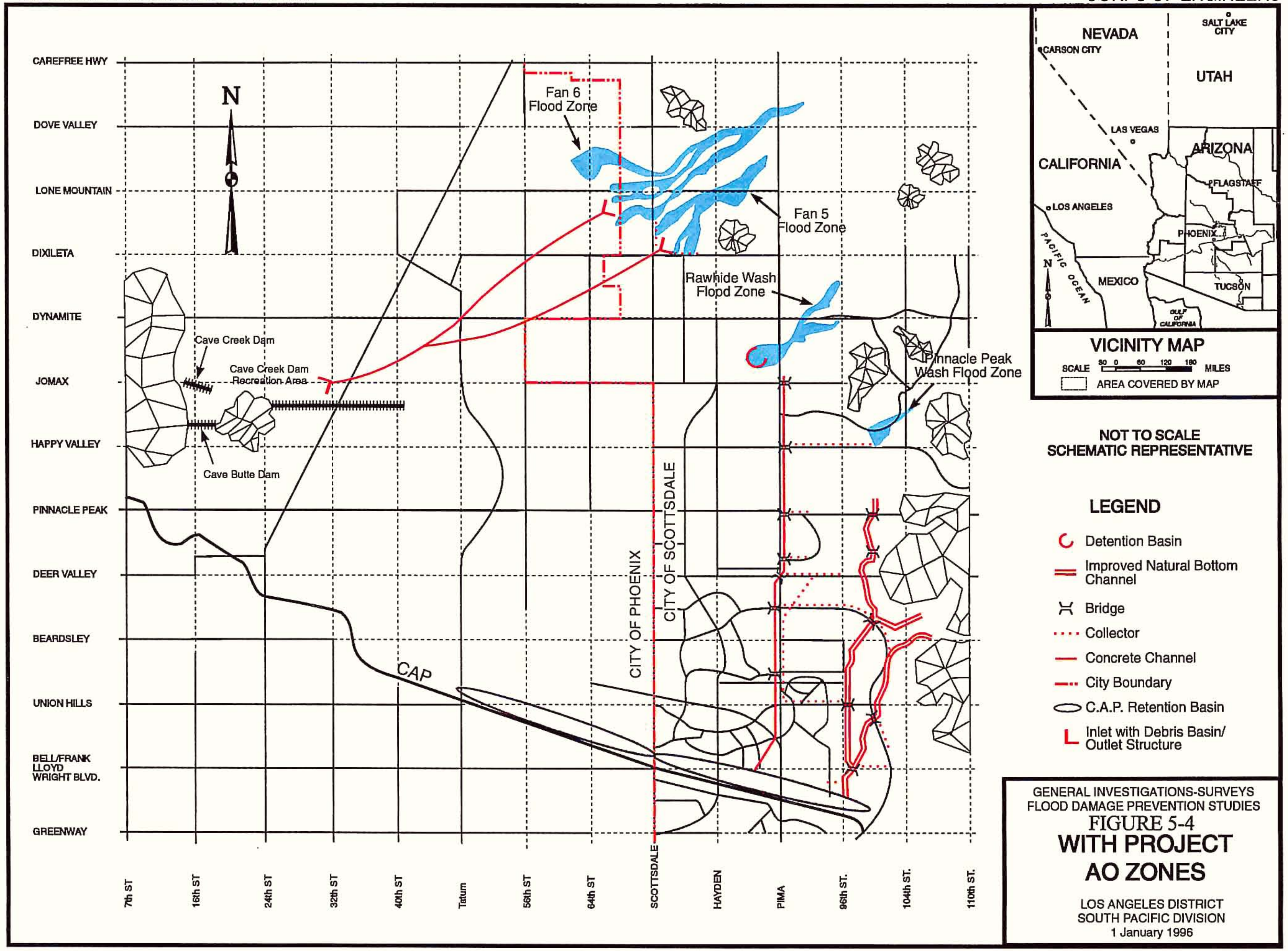
4) Fans 5 and 6 Concrete Channels: As shown on Figure 5-3, the Fan 5 channel begins at the intersection of Dixileta and Scottsdale Road with lateral drains bringing runoff from ½ mile north and ½ mile east. The channel runs southwest to ¼ mile past Dynamite Road after which it runs west to Cave Creek Road where discharges are released to the Cave Creek Reservoir. The Fan 6 channel begins with an inlet structure east of 64th Street, and between Dixileta and Lone Mountain. This channel runs southwest to the confluence with Channel 5 at ½ mile beyond Tatum and Dynamite. Based upon the hydrologic analysis, the design discharges were estimated to be 3,400 cfs for both Fan 5 and 6 channels and 6,800 cfs when combined at the confluence.

The proposed flood protection plan are expected to eliminate the 100-year flood zone in the study area designated by FEMA. A post-project floodplain map is illustrated by Figure 5-4.

The NED benefits from the proposed flood control plan were identified by the preliminary economic analysis (Appendix C), which include 1) inundation reduction benefits, 2) savings in future floodproofing costs, 3) reductions in emergency and cleanup costs, and 4) savings in flood insurance administrative costs. The total annualized benefits were estimated to be $10,940,000.

Project costs for the proposed plan including construction, PE&D, S&A, and land have been estimated. Figure 5-5 presents a cost summary for each of the project components described above. The total project cost is $84,335,000. The annualized amount including O&M was estimated to be $9,117,000.

The annual benefits and costs for the proposed project are $10,940,000 and $9,117,000. Therefore, the benefit/cost ratio is 1.2.



GENERAL INVESTIGATIONS-SURVEYS
FLOOD DAMAGE PREVENTION STUDIES
FIGURE 5-4
WITH PROJECT AO ZONES

LOS ANGELES DISTRICT
SOUTH PACIFIC DIVISION
1 January 1996

SUMMARY TABLE

21-Feb-96

NORTH SCOTTSDALE RECONNAISSANCE STUDY
PROPOSED PLAN SUMMARY

	FEATURE	CHANNEL LENGTH	UNIT	UNIT PRICE WITHOUT CONTINGENCY	TOTAL COST WITHOUT CONTINGENCY	20% CONTINGENCY	TOTAL COST WITH CONTINGENCY	UNIT PRICE WITH CONTINGENCY
09	REATA PASS/BEARDSLEY WASH	3,800	LF	$1,932	$7,339,800	$1,468,000	$8,807,800	$2,300
09	PIMA ROAD CHANNEL	19,900	LF	$1,576	$31,355,200	$6,271,000	$37,626,200	$1,900
04	RAWHIDE DETENTION BASIN	6,200	LF	$955	$5,922,100	$1,184,400	$7,106,500	$1,100
09	UPPER REATA PASS CHANNEL	9,800	LF	$397	$3,886,400	$777,300	$4,663,700	$500
09	FAN NO. 5	22,500	LF	$153	$3,452,400	$690,500	$4,142,900	$200
09	FAN NO. 6	18,100	LF	$235	$4,257,900	$851,600	$5,109,500	$300
09	FAN NOS. 5&6	3,000	LF	$347	$1,042,100	$208,400	$1,250,500	$400
	TOTAL CONSTRUCTION COST				$57,255,900		$68,707,100	
30-	PE&D	1	LS	$6,298,149	$6,298,100	$1,574,500	$7,872,600	
31-	S & A	1	LS	$3,607,122	$3,607,100	$801,800	$4,508,900	
01-	LANDS & DAMAGES	735.52	AC				$3,246,560	
	TOTAL PROJECT COST				$87,161,100		$84,335,160	

FIGURE 5-5

CHAPTER 6
PRELIMINARY FINANCIAL ANALYSIS

The City of Scottsdale, City of Phoenix and Maricopa County Flood Control District fully support the results of the reconnaissance study, as indicated in their letters of support and intent. The sponsor's interest in providing additional flood control on the watercourses studied is reflected in the many previous studies and reports prepared by the City. However, the scope of the solutions to the alluvial fan flooding within the North Scottsdale study area are beyond the means of any one individual, developers, or the local jurisdictions.

Further planning, engineering and design, and construction can be conducted through a cost-shared feasibility study. The cost-sharing principles will be in accordance with the Water Resources Development Act of 1986, as amended. The costs of the feasibility study, determined through a Project Study Plan negotiated with the local sponsor, would be cost-shared 50-50 between the Federal Government and the sponsor. At least one-half of the local sponsors share may be provided by in-kind study efforts.

At this time, the City of Scottsdale and the City of Phoenix are the anticipated local sponsor of a cost-shared feasibility study.

CHAPTER 7
COORDINATION AND PUBLIC INVOLVEMENT

Non-federal views and preferences were obtained to assist in identifying the study area, the problems and opportunities within the selected study area, and potential flood-control alternatives to address the perceived problems. The non-federal views were obtained through coordination and communication with local, state and Federal agencies and through participation in public forums conducted by the City of Scottsdale regarding the Desert Greenbelt concept.

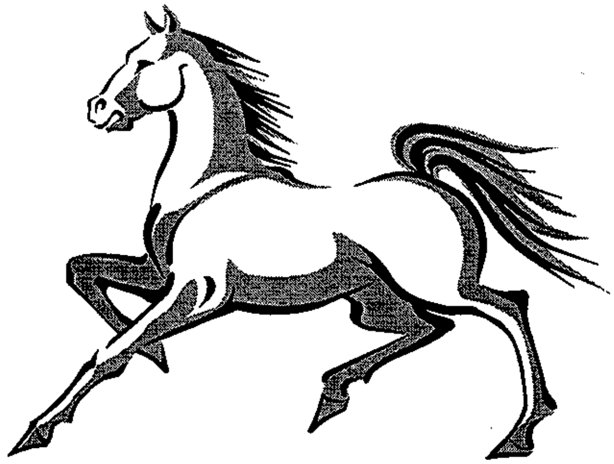
CHAPTER 8
RECOMMENDATIONS

The results of the reconnaissance study indicate that there is at least one flood-control plan that appears to be technically feasible, economically-justified, and environmentally sound according to the Federal water resources project planning criteria. Based on the results of the evaluations of the flooding and related problems, and the opportunities to solve these problems, feasibility studies appear warranted to complete the plan formulation and evaluation processes for the Fans 5 and 6, Rawhide, Pima Road and Reata/Beardsly watercourses.

I recommend that a cost-shared flood-control study be initiated for the North Scottsdale Drainage Area, Arizona. The feasibility studies will identify the National Economic Development Plans and any locally-preferred plans. An Environmental Impact Statement will be performed for each study. Additionally, the studies will select a plan for recommendation of construction.

APPENDIX A: HYDROLOGY

NORTH SCOTTSDALE



HYDROLOGY FOR NORTH SCOTTSDALE RECONNAISSANCE STUDY (R4)

U.S. ARMY CORPS OF ENGINEERS
FEBRUARY 1996

NORTH SCOTTSDALE RECONNAISSANCE STUDY

LIST OF TABLES

I. INTRODUCTION

A. PURPOSE AND SCOPE.

1. General. This section presents the hydrologic analysis performed to support the reconnaissance study on North Scottsdale/Phoenix, Arizona. Basic meteorologic and hydrologic characteristics of the watershed are presented along with methods and procedures used to determine discharge-frequency relationships and to model the rainfall runoff process. The study area is shown on plate 1.

2. Results. The hydrologic results determined during this study consist of peak discharge-frequency values at specified locations shown on plate 1. The results presented are for conditions of without additional flood control project improvements and for both present (1995) and future (2025) conditions of development. Peak discharges for 2- , 10- , 50- , 100- , and 500-year frequencies are listed in tables 2 and 3. Typical discharge-frequency curves are shown on plate 10.

B. PREVIOUS STUDIES.

The City of Scottsdale has performed numerous hydrologic studies within the study area for the purpose of delineating flood plains as well as for designing public roads and flood control channels. A discussion of the last five hydrologic studies performed in the study area follows.

1. Water Resource Associates (WRA). In July 1992 Robert Ward of Water Resource Associates (WRA) performed a study based on previous studies entitled "Final Report Upper Indian Bend Wash Regional Drainage and Flood Control Plan Prepared for City of Scottsdale", dated July 6, 1992. The Hydrologic Engineering Center (HEC-1) Flood Hydrograph Program and the following rainfall-runoff methods were utilized:.

(a) SCS Type IIA rainfall distribution was used.

(b) kinematic wave method was used to generate the subarea hydrographs.

(c) kinematic wave method was used to route the hydrograph flows.

The WRA results were compared with previous determinations using methods from Eychaner[1], Pima County[2], TR-55[3], and Roeske[4]. For the North Scottsdale area six concentration points with 0.27 - 1.8 square mile drainage areas were compared. Results from each method of analysis were higher than WRA for three concentration points and lower than WRA for the other three except for TR-55 for which results were always lower than the WRA results. Pima County results never varied more than 30% from WRA, and when the other methods exceeded 30% difference, they were lower than WRA. From previous studies Pima County 100-year discharges may be comparable to those generated by COE methods.

2. Sensitivity analysis by Robert Ward. Water Resource Associates Inc. sensitivity analysis documented changes to above report in a letter to Mr. William Erickson Floodplain Administrator for the City of Scottsdale, Subject: *Second Revision to FIS Hydrology, North*

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[1] Peak discharge regression equations presented in "Estimation of Magnitude and Frequency of Floods in Pima County, Arizona, With Comparisons of Alternative Methods", USGS Water Resources Investigations Report 84-4142, Table 1, J.H. Eychaner, August 1984.

[2] Peak discharge regression equations presented in "Methods for Estimating the Magnitude and Frequency of Floods in Arizona", USGS Report: ADOT-RS-15(121), R.H. Roeske, September 1978.

[3] Graphical peak discharge method presented in "Urban Hydrology for Small Watersheds", Technical Release 55, Soil Conservation Service, USDA, June 1986.

[4] Peak discharge methodology presented in "Hydrology Manual for Engineering Design and Floodplain Management Within Pima County, Arizona", Pima County Department of Transportation Flood Control District, September 1979.

Scottsdale And Phoenix, dated February 3, 1992. This analysis adjusted the above methods to meet FEMA's responses to the WRA study. The following methods were used in the HEC-1 program.

(a) 100-yr rainfall depths (5-minute to 6-hour from NOAA Atlas) and HEC-1 hypothetical distribution were used to define the rainfall pattern.

(b) Singular channel routings were performed using modified Puls routing method with normal depth determinations from 8 point cross-sections.

© The velocity for channel routing was assumed to be 7 feet per second (ft/s).

(d) 100-year and 2-year discharges were determined with the antecedent moisture condition (AMC) being reduced from 2 for the 100-year to 1 for the 2-year event.

3. FEMA. FEMA accepted results from the sensitivity analysis as well as 10-, 50- and 500- year frequency discharges proposed by the City of Scottsdale in 1992. FEMA performed their FAN analysis in order to determine depths for the Flood Insurance Rate Maps now in effect. (Although the complete Flood Insurance Study for this area, dated December 3, 1993, was not obtained, portions of the analysis and all HEC-1 models were provided by the City of Scottsdale.) The additional frequencies were determined by the City of Scottsdale using a skew of zero as suggested by FEMA, and the 100- and 2- year peak discharges from the Robert Ward sensitivity analysis. Thus, using log-probability paper, a straight line was drawn between the 2- and 100-year discharges in order to determine the 10-, 50-, and 500-year peak discharges. Results from the FEMA study are presented in table 1.

4. Greiner Engineers. The City of Scottsdale hired Greiner Engineers to perform a hydrologic study in this area for the purpose of designing a flood control channel system. The resulting report is titled "City of Scottsdale Desert Greenbelt Project", dated June 1995. They used the FEMA accepted hydrologic models with changes in subareas where deemed necessary, and changes to reflect with project 100-year future conditions. The specific project hydrology reports from west to east were 1) Rawhide Wash, 2) Pima Road Channel, and 3) Reata/Beardsley Wash.

5. COE Studies. The COE has studied much of the Phoenix area in detail. Projects such as Indian Bend Wash, the Arizona Canal Diversion Channel (ACDC), the Agua Fria River Levees, as well as several dams have been constructed by the COE. The hydrologic basis for design for these projects were described in two reports: 1) Gila River Basin, New River and Phoenix City Streams Design Memorandum No. 2, Hydrology Part I dated 1974, and 2) Gila River Basin, New River and Phoenix City Streams Design Memorandum No. 2, Hydrology Part II dated 1982. (Refer to II.B.2.c. for methodology.)

C. EXISTING FLOOD PLAIN DELINEATIONS.

In 1992 FEMA approved the discharges sent for review by the City of Scottsdale (refer to section I.B.3. on FEMA). The discharges were for six fan apex locations as shown on plate 2. Effective May 5 1995, however, the Rawhide Wash fan/floodplain was revised as requested by the City of Scottsdale. An area of about 0.5 sq. mi. was removed from the AO zone (plate 3) between Pinnacle Peak Road and approximately 1200 feet north of Jomax Road. The rest of the flood plain remains as it was accepted in 1992. The entire flood plain delineation is shown on plate 4.

II. STUDY AREA

A. GENERAL DESCRIPTION OF DRAINAGE AREA.

1. Location. This study area is located in northern Scottsdale and Phoenix, Arizona. It's boundaries include the McDowell Mountains on the East, Granite Reef Aqueduct (part of CAP) on the South, and Cave Creek Road on the West. The area is shown on plate 1.

2. Attributes. The drainage area has considerable variation in topographic features. The McDowell Mountains in the eastern portion of the watershed are characterized by very rocky, steep-sloped terrain which is the source area for the creation of several alluvial fans. When excessive rates of rain fall on these mountains, steep slopes and highly impervious soils cause rapid and large rates of runoff. Alluvial fans exist along the toe of the mountain slopes and flow in a southwesterly direction. Transitory flow patterns and poorly defined channels make hydrologic modeling difficult. Bank full capacities of the small braided washes in the plain range from 25 to 250 cfs, and cannot contain larger floods such as the 100-yr event. Flow patterns are difficult to predict because of the alterations to channel geometry caused by rapid erosion and sediment deposition. During a large event the discharge from a specific drainage area could cause runoff through a range of areas depending on this erosion and deposition which are impossible to predict.

B. FLOOD PROBLEM.

The North Scottsdale area terrain consists of steep mountains which deposit large amounts of sediment and water onto a dry, flat, and sandy desert with moderate vegetation. Some of the areas are alluvial fans while others seem to have more defined channels. Flood producing desert storms are usually summer thunderstorms which last only a few hours. Further description of this area can be found in the New River And Phoenix City Streams Hydrology Part II Design Memorandum dated 1982, or other reports previously mentioned in I.B.. Flooding occurs when an intense thunderstorm drops rain in the McDowell Mountains where it quickly flows down to the desert floor picking up sediment as it goes. When it reaches the flat slopes, the velocity decreases. Flooding is caused when large flows from the Mc Dowell Mountians reach the poorly defined desert floor channels. Channels formed by previous storms can change direction as they fill up with debris, or the water cuts new channels in different directions. As such the unpredictability of the flow path makes it difficult to determine where each flood could occur.

III. HYDROLOGIC ANALYSIS

A. DISCHARGES AT FAN APEX.

1. General. Peak discharges at and above the fan apexes (plate 2) were adopted from WRA, FEMA and Greiner Engineers Reports for present and future conditions without project for the 2-, 10-, 50-, 100-, and 500- year events (table 1). The following describes the analysis done to confirm the viability of these peak discharges.

2. 100-Year Frequency. A reconnaissance study requires that existing hydrologic results be considered if available. North Scottsdale has not been studied in detail by the COE. However, the COE has performed studies on many nearby drainage areas. For purposes of the reconnaissance study it was decided to generate discharges for a sample area using accepted COE methods, and compare the results with the results from the Greiner Engineers Report (ref. I.B.4.).in order to confirm the Greiner and FEMA hydrologic results. The COE analysis and comparison of results are described below.

a. COE Methodology. A rainfall runoff model for 100-year present conditions without project was developed for subareas 30N, 31A, 34R, and 35N (fig. 3 of Pima Road. Channel Hydrology Rept.. By Greiner) using the same methods used in the Phoenix Hydrology Part II Report which was the basis for the Arizona Canal Diversion Channel (a COE Phoenix Project). The North Scottsdale model used the Queen Creek August 1954, 6-hour summer thunderstorm transposed to the study area. The S-graph and basin lag were used to generate the unit hydrograph. Rainfall loss rate parameters, determined from previous experience of studies in the area, were applied to the Queen Creek storm to determine excess rainfall. The excess rainfall was applied to the unit hydrograph to produce a flood hydrograph. This hydrograph was then multiplied by .45 in order to determine the 100-year peak discharge. The 0.45 ratio was determined in the Phoenix Hydrology Part II Report. The Muskingum routing method was used to route the subarea hydrographs downstream with velocities of 4 ft/s for overland flow, and 8 - 15 ft/s for channelized flow. These velocities were determined after reviewing both FEMA and Greiner work which used actual events to determine routing velocities. Storage coefficients "X" range from 0 to 0.5 (0 being overland flow and .5 being direct translation). Natural channel X values of 0.1 to 0.3 were derived from previous experience with similar terrain. The input file for the HEC-1 model is presented in table 6.

b. Comparison of Previous Work to COE Methods. A comparison of the above COE model results and the Greiner model results was made in order to determine whether the Greiner model presented reasonable results. The following table presents the results which will be discussed below. The Corps results were determined using two sets of routing velocities. First with existing conditions (no channelization, col. 4) and then with velocities similar to Greiner Engineers' model (col. 5).

COMPARISON OF COE AND GREINER HEC-1 PEAK DISCHARGE VALUES

Location	DA mi^2	Greiner Engineers (cfs)	Corps of Engineers (cfs)		Difference (%)
Routing Velocity	---	8 - 15 fps	4 - 5 fps(1)	7 - 15 fps(2)	---
30N	0.76	970	990	990	2
30N to Happy Valley Road	0.76	920	910	950	1 to 2
3 Combined at 31A	3.47	4300	3400	4000	26 to 8

(1) No channelization
(2) Velocities similar to Greiner Engineers (with channelization)

(1) **Subarea 30N.** As shown on plate 5, the Greiner Engineers model generated a peak discharge of 970 cfs for subarea 30N and the COE model generated a peak discharge of 990 cfs for a difference of only 2 %. The COE model generated more volume through the intense portion of the hydrograph and less at the tail end. This is because of the different rainfall patterns used in each model.

(2) ***Subarea 30N Routed to CP 31A.*** The above area hydrograph was routed about 5000 feet at a rate of 4 ft/s for no channelization and 8 ft/s to match the Greiner model routing velocity. As seen from the above table and plate 6 which compares Greiner's resulting hydrograph with the COE 4 fps hydrograph, the two model results are still very close. As seen in plate 6 the Greiner hydrograph was not attenuated as much as the COE hydrograph because of higher routing velocities. Because routing becomes increasingly important as one moves downstream on the fan, discharges beyond the fan apexes were not determined using

Greiner's report for without project conditions.

*(3) **Three Combined at CP 31A.*** Plate 7 shows the combined hydrograph of three subareas generated and routed to Pima Road and Happy Valley Road as determined first by Greiner Engineers and then by the COE using routing velocities of 4 & 5 fps. It can be seen that even with different methods of analysis, the end result is that Greiner Engineer's hydrograph is within 26 % of the COE. The Greiner Engineers hydrograph is larger partly because each subarea (other than 30N) had a higher peak, and partly because Greiner routing velocities were higher and thus caused more critical combining of the subarea hydrographs. For purposes of a reconnaissance level study, this is reasonably close and therefore the FEMA/Greiner peak discharges were used down to the apex of the fans. Beyond the fan apex, without project discharges were not readily available. See III.B. for a discussion of additional locations.

c. Adoption of Previous Work. The peak discharges from FEMA/Greiner will be used for locations down to the delineated fan apexes for all frequencies for present and future conditions with adjustments made for rounding using engineering judgement. See plate 2 for location and table 1 for a summary of discharges. For a discussion of other frequencies, please see Section I.B.3., and III.,A.,3.(following). Discharges for additional locations were determined as described in Section III.B.

3. Discharge - Frequency Curves. In order to determine the viability of other frequencies determined by local interests and accepted by FEMA, a comparison of different discharge-frequency curves was made.

a. The City of Scottsdale used the 2-year and 100-year peak discharges along with an assumption of zero skew (as recommended by FEMA) in order to determine other frequencies for each location. Of the nine fan locations presented in table 1 (fan 1 - 4) the average 2-yr/100-yr ratio was determined. Given Q_{100} = 10,000 cfs and this information, an average curve shape was drawn as shown on plate 8. Also shown are the upper and lower limits of this curve given the same Q_{100} = 10,000 cfs. Because the terrain varies from one fan area to another, a wide range of frequency curve slopes resulted. Physical characteristics such as length of watercourse, slope, and basin - n effect how the subarea hydrograph will be shaped for each subarea. They also effect peak discharges differently for large versus small storms.

b. The COE discharge frequency relationships presented in the Hydrology Part II Report were determined through a frequency analysis of actual runoff data from an urbanized area near Phoenix. The ratios are as follows:

N-Year	N-yr / SPF
SPF	1.0
100	0.45
50	0.32
25	0.21
10	0.12

This relationship is plotted on plate 8.

c. The Regional Method for Pima County[5] applies several equations with drainage area as a variable in order to define a discharge-frequency curve. The equations read as follows.

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[5] Reference - "Estimation of Magnitude and Frequency of Floods in Pima County, AZ with Comparisons of Alternative Methods." A Water Resources Investigations Report 84-4142 by U.S. Geological Survey, August 1984, pg 7.

$$\text{Log } RQ_2 = 2.051 + 0.551(\log D.A.) - 0.011(\log D.A.)$$

$$\text{Log } RQ_{10} = 2.648 + 0.605(\log D.A.) - 0.045(\log D.A.)$$

$$\text{Log } RQ_{100} = 3.08 + 0.643(\log D.A.) - 0.066(\log D.A.)$$

$$\text{Log } RQ_{500} = 3.297 + 0.662(\log D.A.) - 0.077(\log D.A.)$$

These equations are approximations of the full equations which have area, mean elevation, main channel length, slope, and shape factor as variable inputs. For purposes of frequency curve shape, the approximate method was sufficient. A drainage area of 10 sq. mi. was used in the above equations and the results plotted on plate 8.

d. A comparison of these discharge frequency curves is presented in plate 8. They were based on an area of 10 square miles, or a 100-year peak discharge of 10,000 cfs as indicated on the plate. The COE and Pima County curves indicate that WRA generated and FEMA accepted 2-year discharge is too small. However an actual event on McDowell Mt. Lost Dog Wash, in which at least a 2-year rainfall event (unknown time frame, but typical storm for the area) was recorded, generated runoff which was observed to be nondamaging. The recorded rainfall was put into the 1992 runoff model, and discharges of a similar magnitude to that observed were generated.[6] In addition, the COE curve represents a fully developed area which would cause the more frequent events to be higher than an undeveloped area such as North Scottsdale. Also important is the fact that recent (10-year) history seems to indicate that the 2-year discharges generated by WRA and accepted by FEMA are more reasonable. Therefore, the discharge frequency relationships adopted by FEMA will be adopted for the reconnaissance level of this study for the fan apexes, and the average FEMA discharge - frequency relationships will

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[6] Reference - conversation with Robert Ward in Sept. 1995 (previously of WRA).

be used across the fans.. Additional research and analysis by the COE during the feasibility study will most likely derive a curve which is between the FEMA and COE curves.

B. HYDROLOGIC ANALYSIS FOR ADDITIONAL LOCATIONS.

1. 100-Year Present Conditions.

a. Fan Areas. In order to determine 100-year discharges downstream of the fan apexes (plate 2), a discharge to drainage area curve was developed. 100-year peak apex discharges from the Greiner reports were plotted on the enveloping curve of peak discharges in streams in the Phoenix area (plate 9). A curve was then drawn through these points and parallel to the existing enveloping curve for present as well as future conditions. Using this curve may result in slightly higher discharges for locations with greater than 20 mi^2 drainage areas, however this was the best information available at the time.

1. It should be noted that 100-year peak discharges downstream of the fan apexes were available from the Greiner study with a channel project, but without project were not. In addition, revising Greiner Engineers' model to reflect present without project conditions would have been too complex for this level of study.

2. In order to determine the actual 100-year peak discharges along strategic lines (plate 1), the contributing drainage area was determined using the WRA subarea map (plate 11) while taking into account subarea delineation changes which occurred after the WRA Report (ref. Greiner Hydrology Reports dated Feb 1995 for an explanation of subareas).[7]

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[7] For each line of discharge, a unique drainage area was determined. Where the line stopped part way through a subarea, a portion of that subarea was included relative to the proportion of frontal which it represented.

The peak discharge per square mile was then determined from the discharge/drainage area curve (plate 9), and consequently the peak discharge by multiplying the above number by the drainage area. The resulting peak discharges are presented in table 2.

b. Fans 5 - 6. Discharges for fans 5 and 6 (plate 1) were taken from the Coe & Van Loo Consultant's September 7, 1994 report titled Floodplain Delineation Study For Distributary Flow Area: Wash 6A. Discharges are presented in tables 2A and 3A, and flood lines are shown on plate 1. The discharges were determined using the same modeling procedures as previously discussed and used by Greiner Engineers. However, the area was not considered to be a fan, so modeling of the area was continued past the APEX location by designating specific flow paths for each stream.

2. Discharge - Frequency Ratios. N-year to 100-year ratios for new concentration points were determined by compiling n-year to 100-year ratios of FEMA's report (discharges shown on table 1) and adopting specific ratios for each frequency (plate 10). The peak discharges derived from these ratios are listed in table 2. The adopted ratios are as follows.

N-Year	N-Year/100-Year
500	3.285
100	1.0
50	0.5596
10	0.1110
2	0.0082

3. Present Versus Future Conditions. The Greiner Engineers Study determined 100-

year future conditions peak discharges by adjusting the percent impervious cover values in the HEC-1 computer model to account for development. These future conditions peak discharges were plotted on plate 9 as were the present conditions discharges. With few points to go by, the discharge - drainage area curve was drawn parallel to the present conditions curve. The future conditions 100-year peak discharges were then determined in the same way as the present conditions. The same N-yr / 100-yr ratios were used for future conditions as present conditions (ref. III.b.2.).

It should be noted that Greiner Engineers also modified the model to account for a proposed freeway system (Outer Loop) and other assumed future hydrologic barriers. However the COE did not include such assumptions because the designs are not completed. Thus only concentration points upstream of these future structures were used to determine the above future / present conditions ratio..

4. Results. Peak discharges for without project conditions are presented in tables 2-3, and their locations are shown on plate 1. They include present and future conditions for the 2-, 10-, 50-, 100-, and 500- year frequencies. Discharge-frequency curves for concentration point OF7 and at the C.A.P. for the Rawhide Wash fan are shown on plate 10. It can be seen that the future conditions curve is parallel to the present condition as is expected based on how they were developed. It would be more accurate for the lower frequency future conditions discharges to be further from present conditions than that of the higher frequencies, however no information exists to determine the extent of the separation. The future conditions lower frequency (2-year) discharges, although slightly low for future relative to present conditions, may or may not result in slightly lower future without project damages which would result in a conservative (underestimation of a) benefit to cost ratio. All discharges are considered reasonable for reconnaissance level work. Should this project proceed to feasibility level, a COE runoff model will be required in order to complete the hydrology.

IV WITH PROJECT

A. PROJECT FORMULATION.

Several flood control projects have been considered and formulated by local interests. From these project proposals, the study team considered several different combinations of channels and detention basins. However, only one project (alternative C) has been studied in detail because, through engineering judgement, it was determined to be less expensive than other project alternatives being considered. For further information on other alternatives considered, please see chapter 5 of the main portion of this report. The following discussion describes a comprehensive system of five channels, and one detention basin as shown on plate 12.

B. Desert GREENBELT PROJECT.

This proposed project (described in detail in the main report) consists of three channel systems which carry flows safely from the fan apexes through North Scottsdale and to the Central Arizona Project (CAP) detention basins.

1. Reata/Beardsley Washes. The Reata and Beardsley Natural Channels capture flow from fans 1 and 2, and combine them at Bell Road just east of 96th Street where the flow continues southward to the CAP (see plate 12). These natural channels will be contained by constructed berms placed strategically so as to contain the future conditions 100-year event. Discharges were computed and presented in the Scottsdale Desert Greenbelt Reata Pass /Beardsley Wash Hydrology Report by Greiner Inc. dated February 1995. These discharges (table 7) were generated as described in the Without Project Section of this report, and have been accepted as reasonable for reconnaissance level analyses.

2. Pima Road Channel. The Pima Road Channel will be a concrete channel along Pima Road from Jomax Road down to the CAP. It will capture flow from fan 3 as well as flows generated between Reata Channel and Pima Road. The discharges (table 7) for this channel were also developed by Greiner Inc. (documented in the City of Scottsdale Desert Greenbelt Project, Pima Road Channel Hydrology Report, dated February 1995) and accepted for reconnaissance level purposes as described in the Without Project Section of this report. In addition to the channel, a water park south of Union Hills and west of Pima Road will reduce the peak from 7500 cfs to 2300 cfs. The outflow follows a channel down to a CAP detention site.

C. RAWHIDE WASH DETENTION BASIN.

1. Location. The Rawhide Wash FEMA flood zone begins at 96th Street near Dynamite, but remains containable down to Hayden and Deer Valley Road. Down stream of this point, the uncertainty of the direction of flow make capture difficult. Although delineated flood flows begin upstream (East) of Pima Road, an additional drainage area contributes to the flood flows west of Pima and north of Jomax. In addition, undeveloped State land is located between Pima and Hayden Roads and north of Jomax. This was the upstream most site available which could capture the flood producing flows from each contributing stream. The fan begins to spread out at Happy Valley and Hayden Roads. The proposed reservoir was therefore located north of Jomax, south of Dynamite, and between Hayden and Pima Roads.

2. Structure. The 100-year inflow to the detention basin is 12,400 cfs and outflow was be reduced to 380 cfs. This discharge will be small enough to ensure that runoff on the fan will remain below one foot in depth. The alignment of the structure and the storage-elevation relationships were taken from CH2M HILL's report titled Rawhide Wash Detention Basin Feasibility Study Final Report for Rawhide Wash Regional Improvement Committee, dated March 1995. Of the four alternatives presented in the report, alternative 1 was chosen because it 1.) avoided an archaeological site, and 2.) resulted in the least outflow from the dam which would reduce the cost of any downstream channelization. The elevation-storage relationships and outlet equations are presented in table 8, and the inflow and outflow hydrographs are shown on plate 13. The Hydrograph for Happy Valley Road is presented on plate 14.

3. Downstream Flows. Because the goal of the project is to reduce flows to less than one foot for the 100-year event, laterals to the Rawhide Wash downstream of the detention basin were not included unless overland flows with project exceeded one foot in depth. Downstream discharges were confirmed to be less than one foot by using the methods described in the without project section of this report and plate 9. Computations and results are shown on plate 15. Since depths remained less than one foot with the detention basin, no laterals were included in the design.

D. CHANNELS FOR FANS 5 AND 6.

1. Location. Fans 5 and 6 have been modeled by CH2M HILL as described in the without project section on fans 5 and 6. No known hydrology existed for a with project condition. Two channels were studied which follow the alignment shown on plate 12. Channel 5 begins at the intersection of Dixeleta and Scottsdale Road, where laterals 1 and 2 bring runoff from ½ mile north and ½ mile east. The channel runs southwest to 1/4 mile past Dynamite Road after which it runs west to Cave Creek Road where discharges are released to the Cave Creek Reservoir. Channel 6 begins with an inlet structure east of 64th Street, and between Dixileta and Lone Mountain. This channel runs southwest to the confluence with Channel 5 at ½ mile beyond Tatum and Dynamite.

2. Channel and Lateral Design Discharges. Design discharges were taken directly from the without project analysis. Potential lateral locations were selected without modeling additional flow to the main channels, and the necessity of the laterals was studied. Laterals 1 and 2 (plate 16) capture and direct flow into channel 5, however no laterals were proposed for the inlet to channel 6 because an inlet structure was determined to be sufficient to capture the intended flow. Discharges into laterals 3, 4, 5, and 6 were determined using the same Corps methods (described in III.A.) used to check the previous hydrology in the area. Basin parameters and routing are presented in table 9.

a. Laterals 3 and 5. Discharges contributing to laterals 3 and 5 were determined in order to assess whether depths exceeded one foot prior to reaching the lateral. The one foot depth was determined as the requirement for constructing a lateral because the goal of this project was to get the area out of the FEMA flood delineation zone in order to reduce flood proofing costs. Discharges and resulting depths are presented in plate 16. Manning's n of 0.075 was recommended by Hydraulics Section, however a Manning's n of 0.15 was also checked since the 0.15 was used in the Phoenix and Old Cross Cut area in previous studies. Even the extremely high n of 0.15 did not result in depths which exceeded 0.5 feet in depth. Therefore laterals 3 and 5 were eliminated.

b.. Laterals 4 and 6. Discharges to laterals 4 and 6 (plate 16) were then determined by routing the discharges from subareas at laterals 3 and 5, and combining them with flows generated from the additional area. Again with a Manning's n of 0.075 or 0.15, the depths did not exceed 0.5 feet so laterals 4 and 6 were eliminated from the channel design.

c. Elimination of Lateral Channels. Although it is evident that such laterals may be requested by local agencies or developers, this study has determined that they are not required to achieve the goal of the project and were therefore not included in the project plan.

E. SUMMARY AND RESULTS.

The discharges shown in table 7 and plate 12 present a comprehensive plan to reduce 100-year flood depths to less than one foot. The discharges determined using Greiner's or CH2M HILL's models will be subject to Corps modeling during the Feasibility stage of this study. For reconnaissance level studies, the results are reasonable.

TABLE 1
DISCHARGE FREQUENCY RELATIONSHIPS
USED IN FEMA'S 1993 FIS - (PRESENT CONDITIONS) [1]

Concentration Point	Drainage Area (mi^2)	500 -Year (cfs)	100-Year (cfs)	50-Year (cfs)	10-Year (cfs)	2-Year (cfs)
FAN 1A CP 2070	1.46	14,981 15,000	4083 4100	2148 2200	348 350	17 20
FAN 1B CP 2051	1.79	15,663 16,000	3661 3700	1787 1800	234 240	8 10
FAN 2A CP 2000	0.80	7572 7600	2036 2100	1063 1100	169 170	8 10
FAN 2B CP 51	7.87	29,836 30,000	9949 10,000	5782 5800	1243 1300	97 100
FAN 3 CP 35N	0.46	3021 3000	887 900	482 500	86 90	5 10
FAN 4A CP 25S	0.63	3544 3600	1360 1400	848 850	222 220	24 30
FAN 4B CP 25N	0.78	3620 3600	1210 1200	706 710	153 160	12 10
FAN 4C CP 24	1.78	10,918 11,000	3629 3600	2108 2100	452 450	35 40
FAN 4D CP 21.2 [2]	9.70	20,276 20,000 [2]	6912 6900 [2]	4062 4100 [2]	901 900 [2]	74 80 [2]
N-YR / 100-YR [3]	---	3.285	1.00	0.5596	0.1110	0.0082

(1) Lower number is rounded from reported number above it. Concentration points are shown on plate 2.

(2) Superseded - These discharges were revised by Greiner Engineers Rawhide Wash Study dated 1994. The revised discharge of Q_{100} = 10,000 cfs has a 13.81 mi^2 drainage area because of additional contributing drainage area to the same CP. Refer to CP OF7 in table 2 for approximate revised discharges for all frequencies.

(3) Average of n-yr/100-yr ratios from above rows.

TABLE 1A.
DISCHARGE FREQUENCY RELATIONSHIPS USED IN FEMA'S 1993 FIS - (PRESENT CONDITIONS)(1)

(Additional CP's provided by Scottsdale.
Lower number is rounded from reported number above it.)

LOCATION	Drainage Area (mi^2)	100-Year (cfs)	2-Year (cfs)	500-Year (cfs)(1)	50-Year (cfs)(1)	10-Year (cfs)(1)
FAN 5R CP 1477	3.09	2849 2900	28 30	8400	1700	3500
FAN 6R CP 1441	3.32	3382 3400	18 20	12,000	1900	3400
FAN 6R CP 1390S	0.43	562 560	12 10	1400	370	100
FAN 6R CP 1392N	1.49	1475 1500	14 20	4400	860	190

(1) These frequencies were not published prior to the R4.
They were determined by using the same procedure that was used for other fans which assumed a skew of 0.

Most of the Concentration Points used for Reata Pass analysis are inconsistent w/ Greine's study i.e. They don't match.

Looking at these #s & the future conditions w/ Project analysis the peak flows have turned out to be higher than w/no project.

TABLE 2
NORTH SCOTTSDALE, ARIZONA
DISCHARGE FREQUENCY RELATIONSHIPS
PRESENT CONDITIONS WITHOUT PROJECT

Concentration Point	Drainage Area (mi^2)	500 - Year (cfs)	100- Year (cfs)	50- Year (cfs)	10- Year (cfs)	2- Year (cfs)	100-Yr not rounded(4)
N-YR / 100-YR RATIO	---	3.285	1.0	0.5596	0.1110	0.0082	100-YR
---REATA PASS AND BEARDSLEY WASH FLOOD LINES ---							
S-47	3.58	17000	5300	3000	590	43	5300
C-48	7.46	30,000	9300	5200	1000	76	9300
C-51 OR C-50 APEX	7.87	30,000(1)	10,000(1)	5800(1)	1300(1)	97(1)	9949(1)
R4 AT S-2005	8.82	36000	11000	6200	1200	90	11,000
R3	10.01	33000	10000	5600	1100	82	10,000
B4	1.84	13000	3900	2200	430	32	3900
B3	1.52	7900	2400	1300	270	20	2400
MAX AT R2A (2)	10.73	31000	9300	5200	1000	77	9335
MAX AT B2A (2)	11.75	37000	11000	6200	1200	92	11,163
COMB. MAX. OF R2A & B2A (2)	22.48	56000	17000	9600	1900	140	17,085
MAX AT R2 (2)	11.56	33000	10000	5600	1100	82	10,000
MAX AT B2 (2)	15.49	43000	13000	7300	1400	110	13,000
COMB. MAX. OF R2 & B2 (2)	19.18	56000	17000	9500	1900	140	17,000
MAX AT R1 (2)	15.33	43000	13000	7300	1400	110	13,000
MAX AT B1 (2)	17.73	46000	14000	7800	1600	110	14,000

Concentration Point	Drainage Area (mi^2)	500 - Year (cfs)	100- Year (cfs)	50- Year (cfs)	10- Year (cfs)	2- Year (cfs)	100-Yr not rounded(4)
N-YR / 100-YR RATIO	—	3.285	1.0	0.5596	0.1110	0.0082	100-YR
COMB. MAX. OF R1 & B1 (2)	25.19	59000	18000	10100	2000	150	18,000
C.A.P. West of Pima Rd.	16.20	46000	14000	7800	1600	110	14,000
C.A.P. East of Pima Rd.	18.32	49000	15000	8400	1700	120	15,000
—RAWHIDE WASH FLOOD LINES—							
OF1 (3)	1.94	12000	3600	2000	400	29	3575
OF2 S-24	2.27	11000	3400	1900	380	28	3431
OF3 (3) S-25	1.41	8000	2400	1300	270	20	2400
OF4 C-26	3.68	18000	5600	3100	620	46	5569
OF5 (3)	3.84	18000	5500	3100	610	45	5478
OF6 (3)	13.70	34000	10000	5800	1100	80	10,335
OF7 (3)	13.71	34000	10000	5800	1200	90	10,400
RAW4	15.89	36000	11000	6100	1200	90	10,964
RAW3	22.80	52000	16000	9000	1700	130	15,732
RAW2	25.83	58000	18000	9800	1900	140	17,564
RAW1	33.05	67000	20000	11500	2300	170	20,491
C.A.P. from Rawhide Tributary.	34.18	70000	21000	11900	2400	170	21,192

(1) Discharges taken from FEMA's FIS dated 1992.
(2) COMB.= combined : MAX.= maximum
(3) Discharges interpreted from Greiner *HEC-1* model.
(4) This column was used for computations in table. Use column 4 for 100-yr discharges.

TABLE 2A.
NORTH SCOTTSDALE, ARIZONA
DISCHARGE FREQUENCY RELATIONSHIPS
PRESENT CONDITIONS WITHOUT PROJECT
FANS 5 AND 6

Flood line Concentration Point	Drainage Area (mi^2)	500-Year (cfs)	100-Year (cfs)	50-Year (cfs)	10-Year (cfs)	2-Year (cfs)	100-Yr not rounded(4)
N-YR / 100-YR RATIO	---	3.285	1.0	0.5596	0.1110	0.0082	100-YR
---FAN 5---							
FL51 CP 210	>6.26	9200	2800	1600	310	23	2799
FL52 CP 210A	5.60	8800	2700	1500	300	22	2689
FL53 CP 6WR	4.67	6400	2000	1100	220	16	1950
FL54 CP 6ER	4.25	3600	1100	600	120	9	1105
--- FAN 6 ---							
FL61 CP C141	15.86	7800	2400	1300	260	20	2380
FL62 CP C135	14.97	10000	3000	1700	340	25	3034
FL63 CP C121	7.56	8100	2500	1400	280	20	2480
FL64 CP C110D	4.18	8700	2700	1500	300	22	2662
FL65 CP C40	6.01	680	210	120	23	2	207

TABLE 3.
NORTH SCOTTSDALE, ARIZONA
DISCHARGE FREQUENCY RELATIONSHIPS
FUTURE CONDITIONS WITHOUT PROJECT

Concentration Point	Drainage Area (mi²)	500 -Yr (cfs)	100-Yr (cfs)	50-Yr (cfs)	10-Yr (cfs)	2-Yr (cfs)	100-Yr not rounded (5)
N-YR / 100-YR RATIO	---	3.285	1.0	0.5596	0.1110	0.0082	100-YR
---REATA PASS AND BEARDSLEY WASH FLOOD LINES ---							
S-47	3.58	19000	5800	3200	640	48	5800
C-48	7.46	36000	11000	6200	1200	90	11,000
C-51 OR C-50 APEX	7.87	36000	11000(1)	6200	1400(3)	100(3)	11,100
R4 AT S-2005	8.82	39000	12000	6700	1300	98	12,000
R3	10.01	36000	11000	6200	1200	90	11,000
B4 CP-C2132	1.84	13000	4000	2200	440	33	4000
B3	2.0	12000	3800	2100	420	31	3800
MAX AT R2A (2)	10.73	34000	10000	5800	1200	85	10,408
MAX AT B2A (2)	11.75	41000	12000	7000	1400	100	12,455
COMB. MAX. OF R2A & B2A (2)	22.48	63000	19000	11000	2100	160	19,108
MAX AT R2 (2)	11.56	36000	11000	6200	1200	90	11,000
MAX AT B2 (2)	15.49	49000	15000	8400	1700	120	15,000
COMB. MAX. OF R2 & B2 (2)	19.18	62000	19000	11000	2100	160	19,000
MAX AT R1 (2)	15.33	49000	15000	8400	1700	120	15,000
MAX AT B1 (2)	17.73	53000	16000	9000	1800	130	16,000

Concentration Point	Drainage Area (mi^2)	500 -Yr (cfs)	100-Yr (cfs)	50-Yr (cfs)	10-Yr (cfs)	2-Yr (cfs)	100-Yr not rounded (5)
N-YR / 100-YR RATIO	—	3.285	1.0	0.5596	0.1110	0.0082	100-YR
COMB. MAX. OF R1 & B1 (2)	25.19	66000	20000	11200	2200	160	20,000
C.A.P. West of Pima Rd.	16.20	53000	16000	9000	1800	130	16,000
C.A.P. East of Pima Rd.	18.32	56000	17000	9500	1900	140	17,000
---RAWHIDE WASH FLOOD LINES---							
OF1	1.94	12000	3800	2100	420	31	3777
OF2 AT CP S-24	2.27	12000	3600	2000	400	30	3621
OF3 AT CP S-25	1.41	8000	2500	1400	280	21	2507
OF4 AT CP C-26	3.68	19000	5800	3300	650	48	5820
OF5	3.68(4)	18000	5600	3100	620	46	5626
OF6	13.70	40000	12000	6900	1400	100	12,289
OF7	13.71	40000	12000	6900	1400	100	12,300
RAW4	15.89	41000	13000	7000	1400	100	12,553
RAW3	22.80	59000	18000	10000	2000	150	18,012
RAW2	25.83	66000	20000	11000	2200	170	20,147
RAW1	33.05	77000	23000	13000	2600	190	23,466
C.A.P.	34.18	80000	24000	14000	2700	200	24,268

(1) Discharges taken from FEMA's FIS dated 1992.
(2) COMB = combined : MAX. = maximum
(3) Discharges interpreted from Greiner HEC-1 model.
(4) Diversion of areas 22-25 only occurs in present conditions.
(5) This column was used for computations in table. Use column 4 for 100-yr discharges

TABLE 3A.
NORTH SCOTTSDALE, ARIZONA
DISCHARGE FREQUENCY RELATIONSHIPS
FUTURE CONDITIONS WITHOUT PROJECT
FANS 5 AND 6 (1)

Flood line Concentration Point	Drainage Area (mi^2)	500 - Year (cfs)	100- Year (cfs)	50- Year (cfs)	10- Year (cfs)	2- Year (cfs)	100-Yr not rounded (4)
N-YR / 100-YR RATIO	--	3.285	1.0	0.5596	0.1110	0.0082	100-YR
—FAN 5 —							
FL51 CP 210	>6.26	10000	3100	1700	340	25	3107
FL52 CP 210A	5.60	9800	3000	1700	330	24	2985
FL53 CP 6WR	4.67	7100	2200	1200	240	18	2165
FL54 CP 6ER	4.25	4000	1200	690	140	10	1227
— FAN 6 —							
FL61 CP C141	15.86	8700	2600	1500	290	22	2642
FL62 CP C135	14.97	11000	3400	1900	370	28	3368
FL63 CP C121	7.56	9000	2800	1500	310	23	2753
FL64 CP C110D	4.18	9700	3000	1700	330	24	2955
FL65 CP C40	6.01	760	230	130	30	2	230

(1) Future = 1.11(Present)

TABLE 4.
NORTH SCOTTSDALE, ARIZONA
FANS 5 AND 6
100-YEAR PRESENT CONDITIONS
DISCHARGES AND FLOW WIDTHS

Flood Line	Location	Drainage Area (mi^2)	100-Year Peak (cfs)	100-Year Rounded (cfs)	Flood Line Length (ft)
--- FAN 5 ---					
FL51 CP 210	CP 210 combined with routed CP 300	>6.26	2799	2800	5300
FL52 CP 210A	CP 300 combined with CP 210A	5.60	2689	2700	3600
FL53 CP 6WR	CP 202 (6W) routed + part of area 210	4.67	1950	2000	1300
FL54 CP 6ER	CP 205 (6E) routed + part of area 300	4.25	1105	1100	1800
--- FAN 6 ---					
FL61 CP C141	As described in HEC-1 output	15.86	2380(1)	2400	5400
FL62 CP C135	CP C135 + C50 Peak flows	14.97	3034	3000	3400
FL63 CP C121	As described in HEC-1 output	7.56	2480	2500	3100
FL64 CP C110D	Half way between C110 and C120	4.18	2662	2700	1200
FL65 CP C40	As described in HEC-1 output	6.01	207(2)	210	400

(1) This is basically FL62 routed with a small area added.
(2) Most water has been diverted westward.

TABLE 5.
NORTH SCOTTSDALE, ARIZONA
FANS 5 AND 6
100-YEAR PRESENT CONDITIONS
DISCHARGES AND FLOW WIDTHS (1)

Flood Line Conc. Pt.	Location	Drainage Area (mi^2)	100-Year Peak (cfs)	100-Year Rounded (cfs)	Flood Line Length (ft)
— FAN 5 —					
FL51 CP 210	CP 210 combined with routed CP 300	>6.26	3107	3100	5300
FL52 CP 210A	CP 300 combined with CP 210A	5.60	2985	3000	3600
FL53 CP 6W	CP 202 (6W) routed + part of area 210	4.67	2165	2200	1300
FL54 CP 6ER	CP 205 (6E) routed + part of area 300	4.25	1227	1200	1800
— FAN 6 —					
FL61 CP C141	As described in HEC-1 output	15.86	2642	2600	5400
FL62 CP C135	CP C135 + C50 Peak flows	14.97	3368	3400	3400
FL63 CP C121	As described in HEC-1 output	7.56	2753	2800	3100
FL64 CP C110D	Half way between C110 and C120	4.18	2955	3000	1200
FL65 CP C40	As described in HEC-1 output	6.01	230	230	400

(1) Future = 1.11 (Present)

TABLE 6

COE HYDROLOGIC MODEL HEC-1 INPUT

```
ID   NORTH SCOTTSDALE RECON. STUDY
ID   100-YR FREQ. - 6-HR STORM - PIMA RD. AT HAPPY VALLEY RD.
ID   J. FISCHER     18 JULY 1995     FILE = SCOTT1.DAT
ID   VELOCITY = 4 FPS.
IT   5 18JUL95   0005   192
IO   1
KK  30N
KM  RUNOFF FROM JOMAX ROAD - SUBAREA 30N
BA  0.76         .45
$P   10    3.4   6.23    0    2.2
$U  1.99   .85   251   .035    17
LE  0.38    1     2     0    6.6
KK  31A
KM  SUBAREA 30N ROUTED TO CP 31A
RM   4   .35    .2
KK  34R
BA  1.36         .45
$U  2.8    1.3   186   .035    17
LE  0.38    1     2     0   11.7
KK  35N
KM  SUBAREA 35N
BA  .4563        .45
$U  1.10   0.6   200   0.04    17
LE  0.38    1     2     0   31.8
KK  34R1
KM  ROUTE SUBAREA 35N TO CP 34R1
RM   4   .31    .1
KK  31A
KM  ROUTE CP 34R1 THROUGH CHANNEL ALONG H.V.RD. TO CP 31A
RM   4   .36    .2
KK  31A
KM  COMBINE 2 SUBAREAS (35N AND 34R) AT CP 31A
HC   2
KK  31A
KM  SUBAREA 31A
BA  .798         .45
$U  1.61   0.95   323   .035    17
LE  0.38    1     2     0    9.1
KK  31A
HC   3
ZZ
```

TABLE 7
WITH PROJECT DESIGN DISCHARGES.
100-YEAR FUTURE CONDITIONS

Concentration Point	Location	Drainage Area (mi^2)	100-Year Discharge
--BEARDSLEY WASH--			
2070	Fan Apex 1A	1.46	4100
2140	Southwest of Beardsley Rd. And 104th Street	2.00	3800
BR (C2160B)	Near Union Hills Dr. at T.P.P.	3.06	4900
CR	U/S of Reata Channel Near Bell Rd & T.P.P.	3.29	5400
--REATA CHANNEL--			
51	Fan Apex 2B	7.87	11,000
2051	Fan Apex 1B	1.79	3700[(1)]
AR	Upstream of T.P.P.	11.69	13,000
DR	Union Hills Rd.	12.33	12,000
ER	Confl. W/ Beardsley at Bell Rd.	19.27	15,000
FR	@ C.A.P.	19.50	15,000
--PIMA CANNEL--			
AP	Jomax R.	0.76	1000
BP	Happy Valley Rd.	3.37	4300
CP	Pinnacle Peak Rd.	4.62	5200
DP	Los Gatos Dr.	5.00	5300
EP	Deer Valley Rd.	6.62	6600
FP	T.P.P.	7.02	6800
GP	Beardsley Rd.	7.87	7300
HP	Hualapai Dr.	7.87	7300
IP	Union Hills Dr.	8.40	7500
RC11	at C.A.P.	11.28	2300

TABLE 7. (Continued)

Concentration Point	Location	Drainage Area (mi^2)	100-Year Discharge
--RAWHIDE WASH--			
CP21H	Det. Basin Inflow	13.62	12,400
CP21HD	Det. Basin Outflow	0	380
CP27	R.H.W. @ C.A.P	1.19	2100
--CHANNEL 5--			
FL54	East Inlet	~4.67	2200
FL53	North Inlet	~4.25	1200
CH5	Scottsdale Rd. To 56th Street	~8.92	3000
CH5	56th St. to Upstream of Channel 6	~10.75	3400
CH5+6	Confl. W/ Channel 6	~14.93	6800
CHOUT	Outlet at Cave Cr. Res.	~14.93	6800
--CHANNEL 6--			
FL64	Inlet Structure	4.18	3400
CH6	U/S of Channel 5	4.18	3400

(1) Ref. FEMA Model where storm centering was smaller and therefore had a larger point rainfall.

TABLE 8.
RAWHIDE WASH DETENTION BASIN
RATING TABLE

Elevation (ft)	Storage (Ac-Ft)
2120.5	0
2121	1.4
2122	11.9
2126	12.9
2127	19.4
2131	21.5
2132	28.7
2136	30.9
2138	45.1
21.58	62.6
21.60	64
21.62	65.3
21.64	66.7
21.66	68.1
21.68	69.5

Low Level Outlet

$$Q = C\,A\,(2\,g\,\overset{e}{h})$$

Spillway

$$Q = C\,\overset{e}{L}\,h$$

Q = Discharge in cfs
h = head of water in ft.

Low Level Outlet:

C = 0.6
A = 14.1
e = 0.5
g = 32.2 ft/s

Outlet Elev. = 2122 ft.

Spillway:

C = 3.2
L = 200 feet
e = 1.5

Crest Elev. = 2158 ft.

TABLE 9.
BASIN CHARACTERISTICS AND ROUTING PARAMETERS FOR FANS 5 AND 6 LATERALS.

(Refer to plate 16 for discharge results.)

Subarea Contributing to	D.A. (mi^2)	L (mi)	L_{CA} (mi)	Slope (ft/mi)	Basin n	PIMP %
Lateral 3	0.76	1.3	0.65	100	0.03	35
Lateral 4	1.07	1.18	0.59	93	0.03	35
Lateral 5	0.26	1.15	0.58	130	0.03	35
Lateral 6	1.0	2.42	1.21	210	0.03	35

STORM CENTERING (RAINFALL DEPTHS)

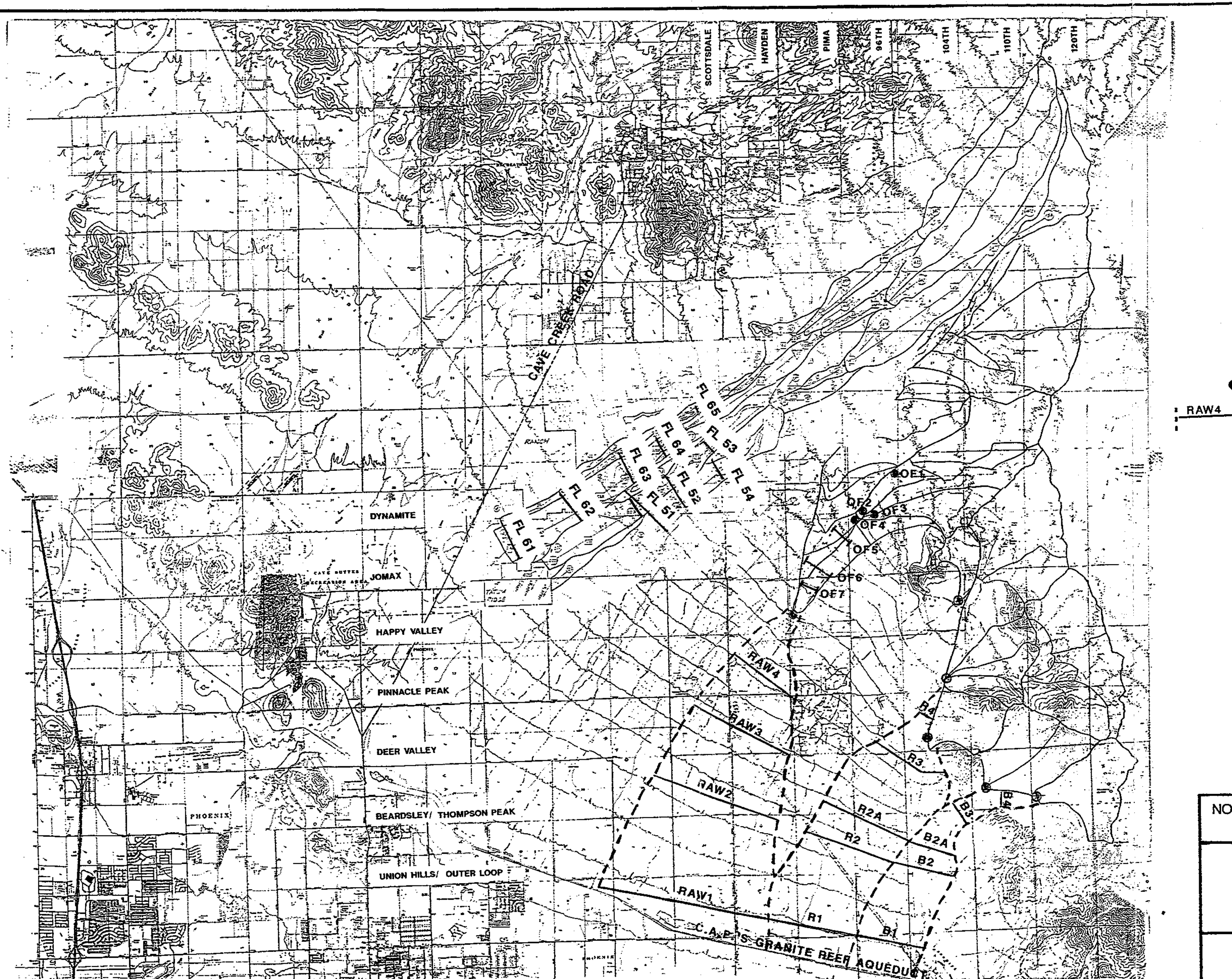
	Design of Laterals 3, 5, & 6	Design of Lateral 4
DRAIN	0.76, 0.26, & 1.26	1.83
TRAIN	6.33	6.30
CN	2.1	2.1

ROUTING PARAMETERS

Routing Lateral	Routing Distance (ft)	Velocity (ft/s)(1)	Time (hours)	NRCHS	X(2)
3 to 4	6220	2.5	0.69	8	0
5 to 6	12,800	2	1.778	21	0

(1) Reference Hydraulics Section for Velocity. *(Manning's n values used in the lateral design were 0.03.).*

(2) Muskingum X as described in text for without project.

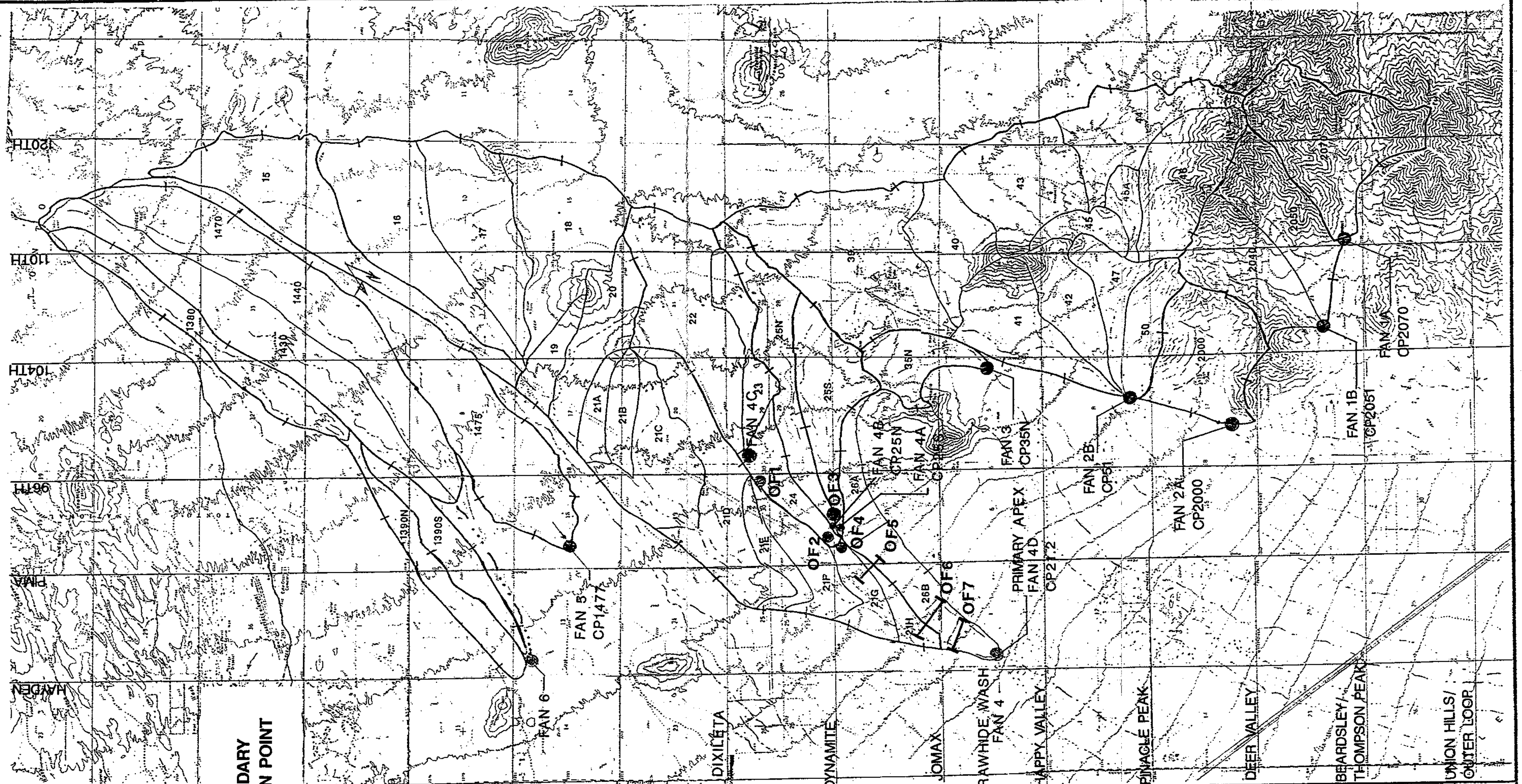


NORTH SCOTTSDALE RECONNAISSANCE
SCOTTSDALE ARIZONA

GENERAL AREA AND LOCATIONS OF PEAK DISCHARGES

U. S. ARMY CORPS OF ENGINEERS
LOS ANGELES DISTRICT

PLATE 1



LEGEND

SUBAREA BOUNDARY

CONCENTRATION POINT

SCALE 1" = 5128'

0 — 1 MILE

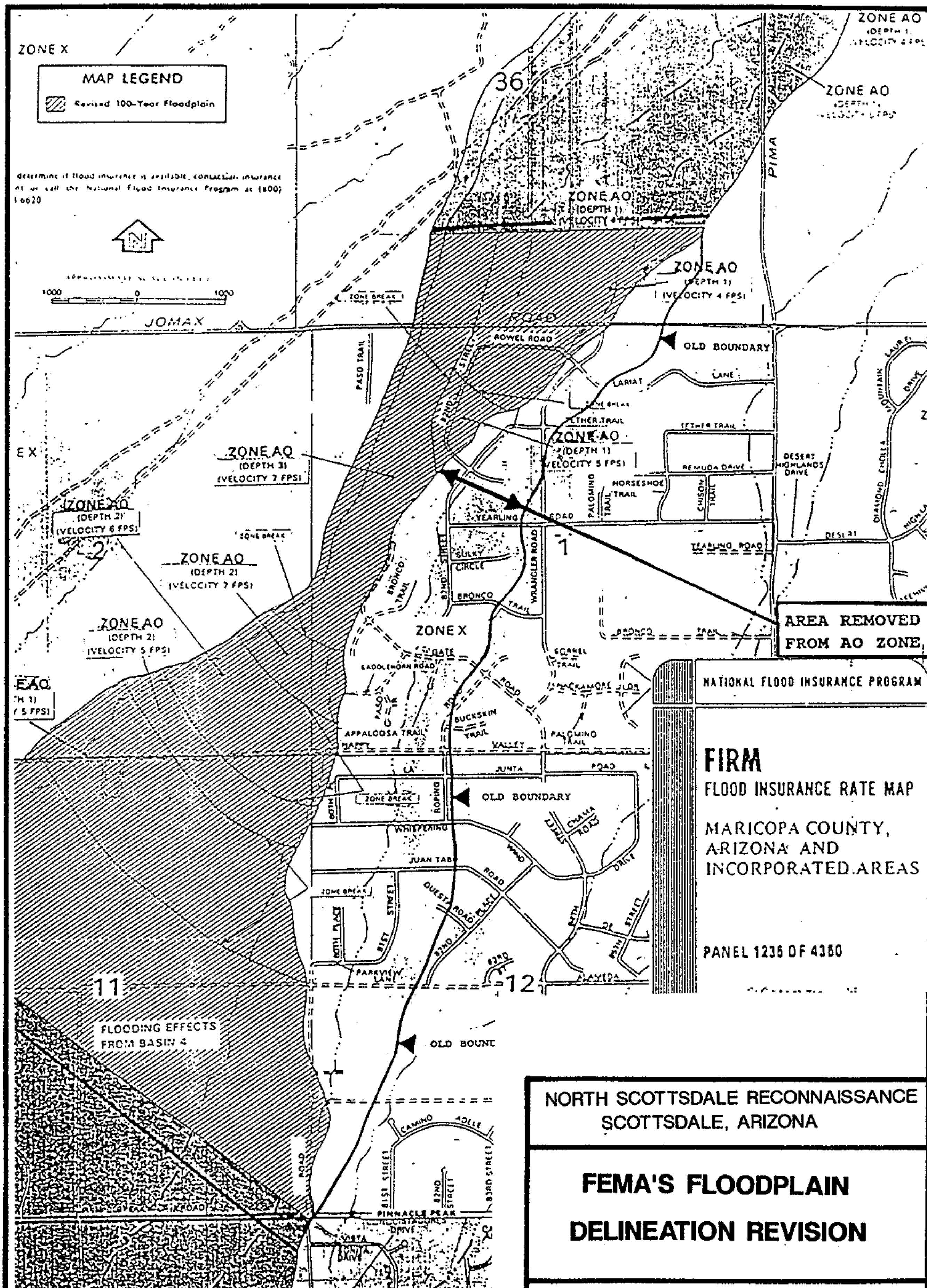
N

NORTH SCOTTSDALE RECONNAISSANCE
SCOTTSDALE, ARIZONA

SUBAREA MAP OF FAN APEXES

U. S. ARMY CORPS OF ENGINEERS
LOS ANGELES DISTRICT

PLATE 2

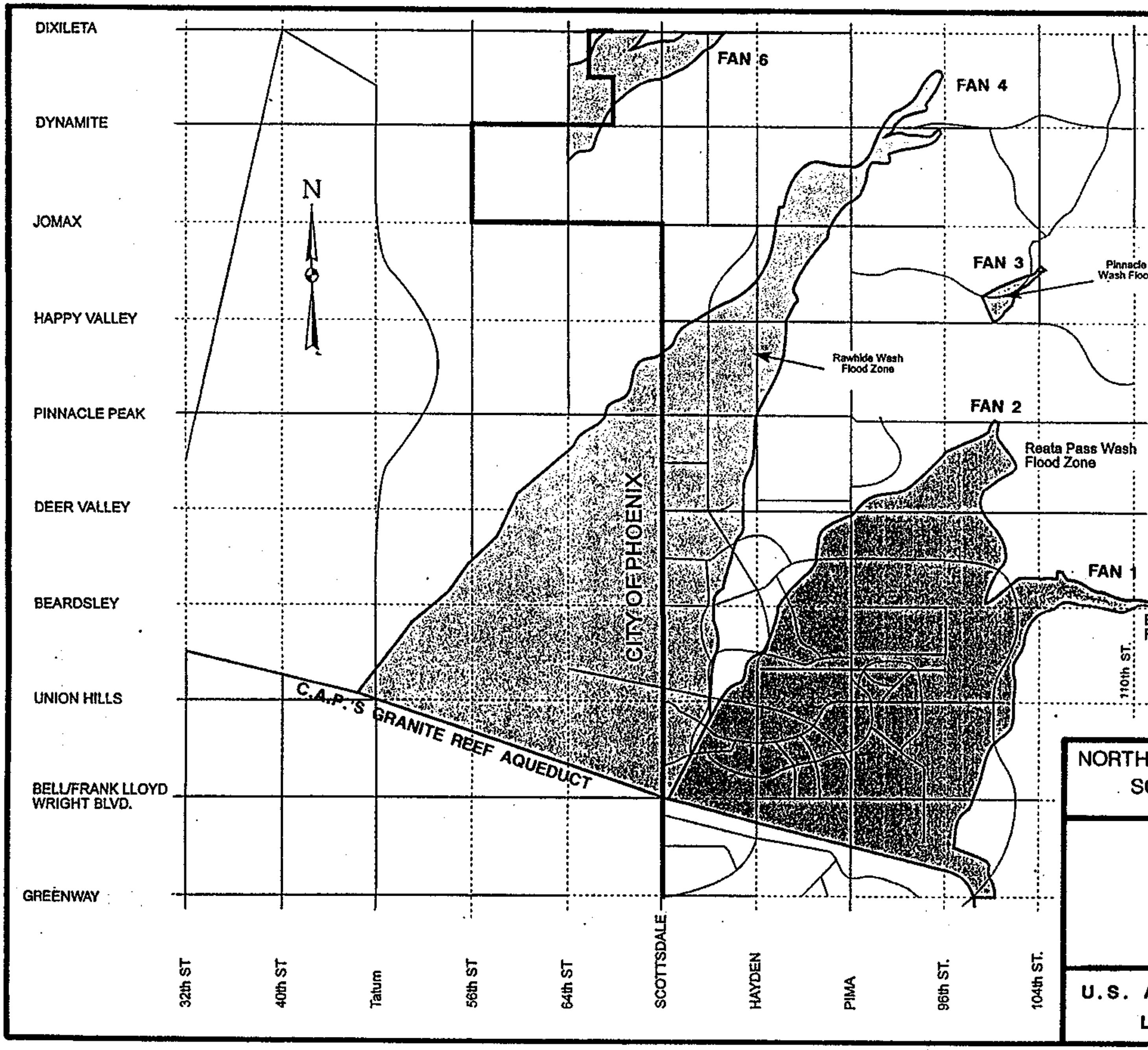


NORTH SCOTTSDALE RECONNAISSANCE
SCOTTSDALE, ARIZONA

FEMA'S FLOODPLAIN DELINEATION REVISION

U.S. ARMY CORPS OF ENGINEERS
LOS ANGELES DISTRICT

PLATE 3

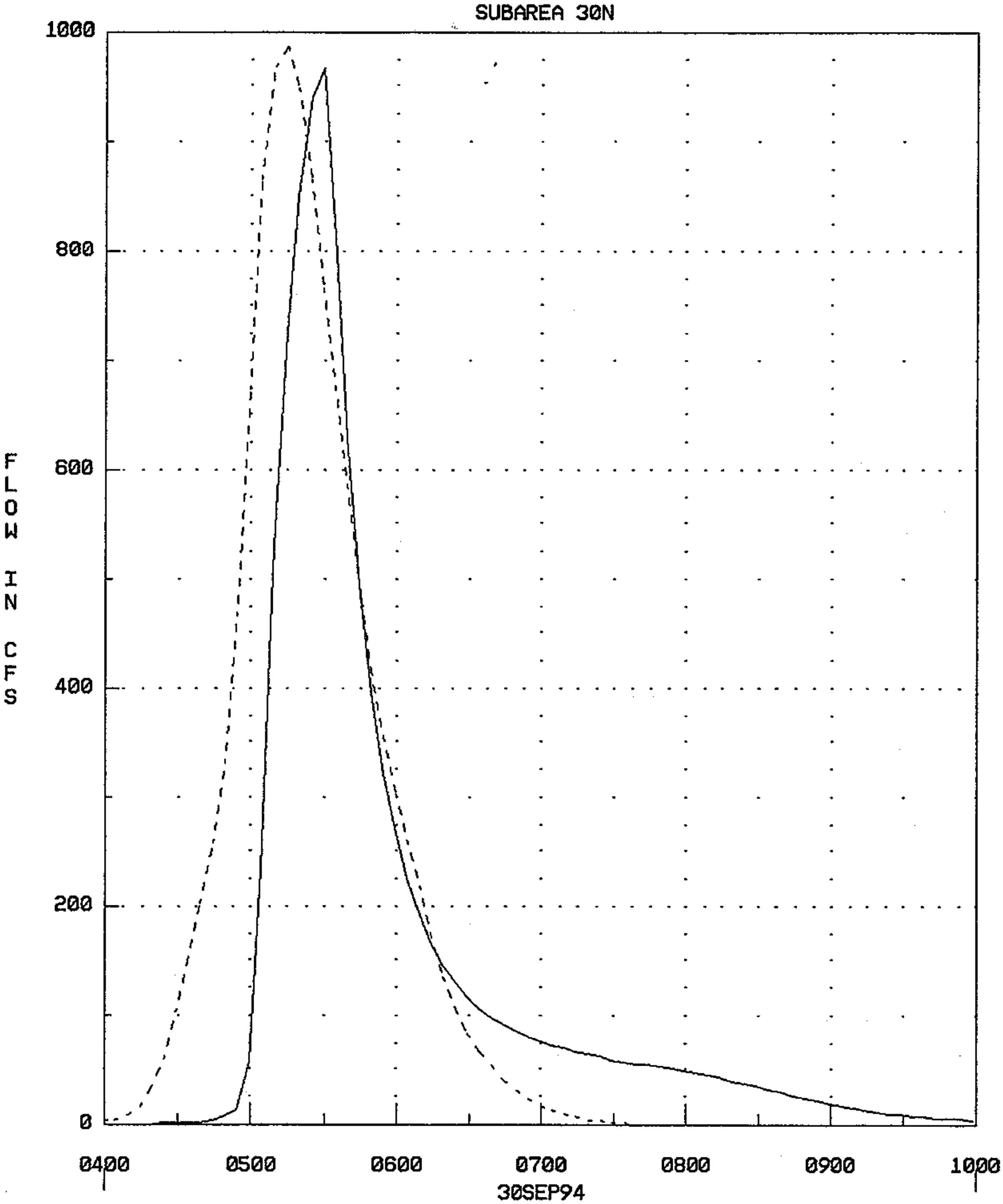


NORTH SCOTTSDALE RECONNAISSANCE
SCOTTSDALE, ARIZONA

FLOODPLAIN DELINEATION

U.S. ARMY CORPS OF ENGINEERS
LOS ANGELES DISTRICT

PLATE 4

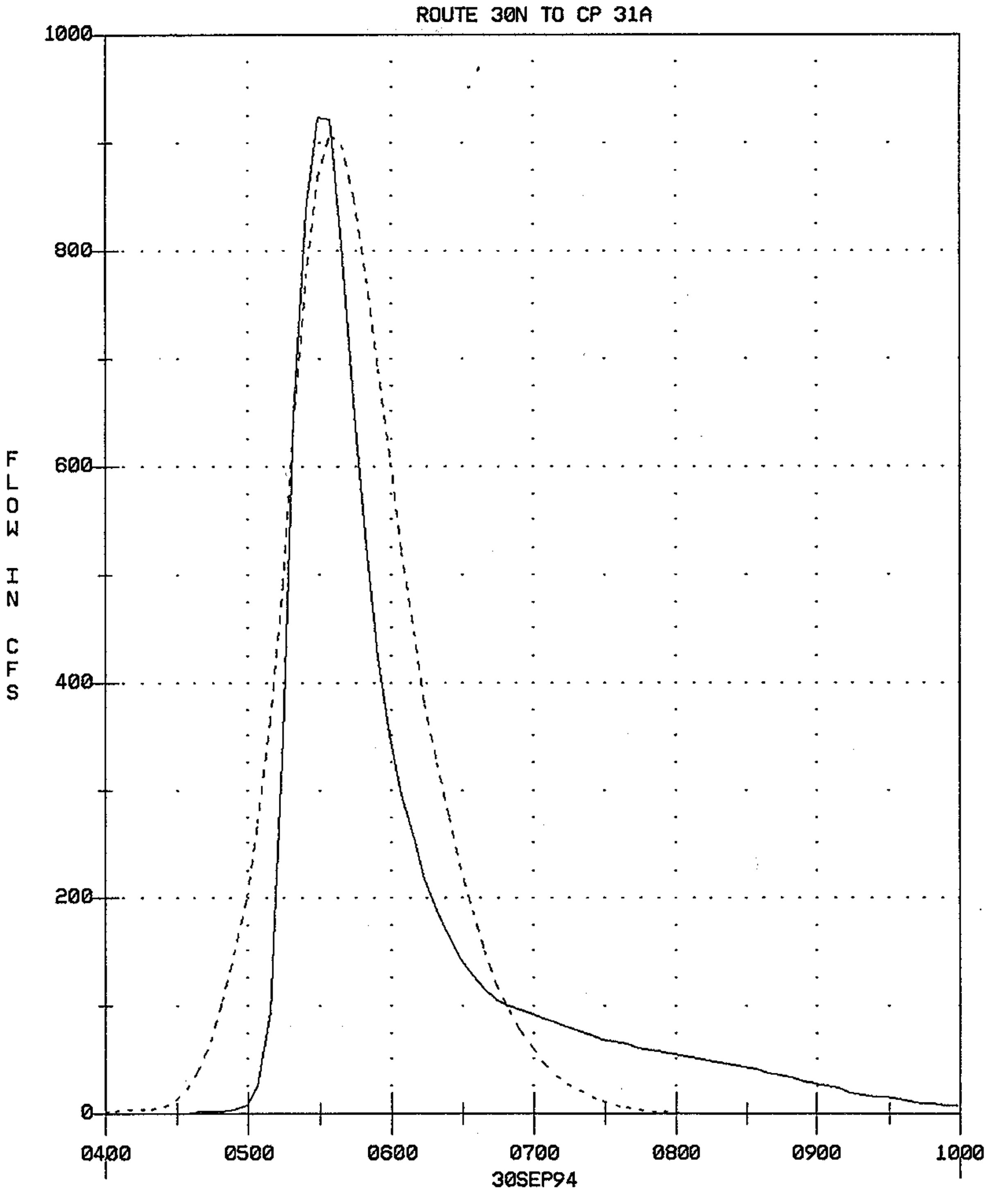


COE MODEL
GREINER MODEL

NORTH SCOTTSDALE RECONNAISSANCE
SCOTTSDALE, ARIZONA

HYDROGRAPH OF 100-YR FLOOD FROM SUBAREA 30N

U.S. ARMY CORPS OF ENGINEERS
LOS ANGELES DISTRICT



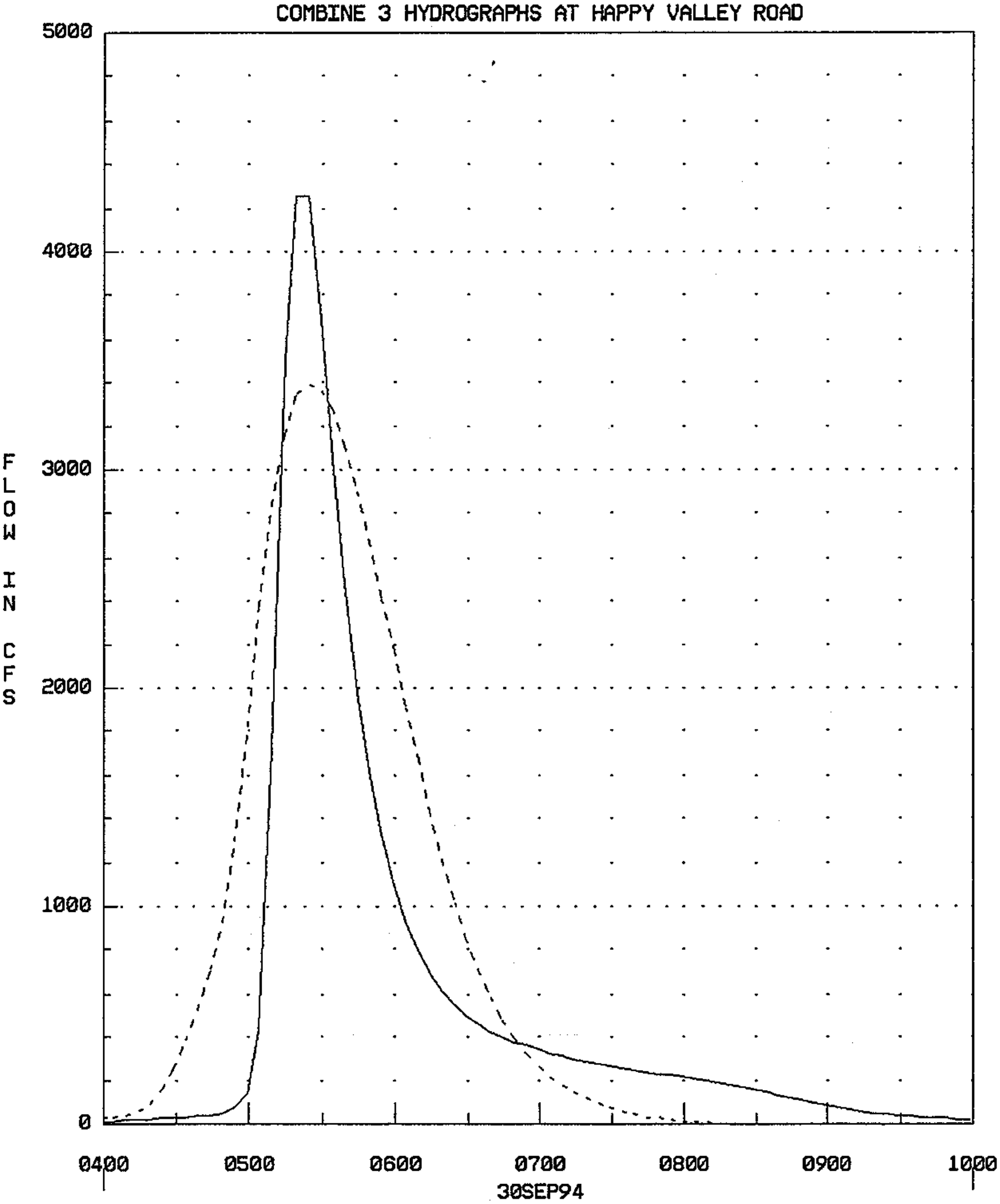
COE MODEL
GREINER MODEL

NORTH SCOTTSDALE RECONNAISSANCE
SCOTTSDALE, ARIZONA

HYDROGRAPH OF 100-YEAR
FLOOD FROM SUBAREA 30N
ROUTED TO CP 31A

U.S. ARMY CORPS OF ENGINEERS
LOS ANGELES DISTRICT

PLATE 6

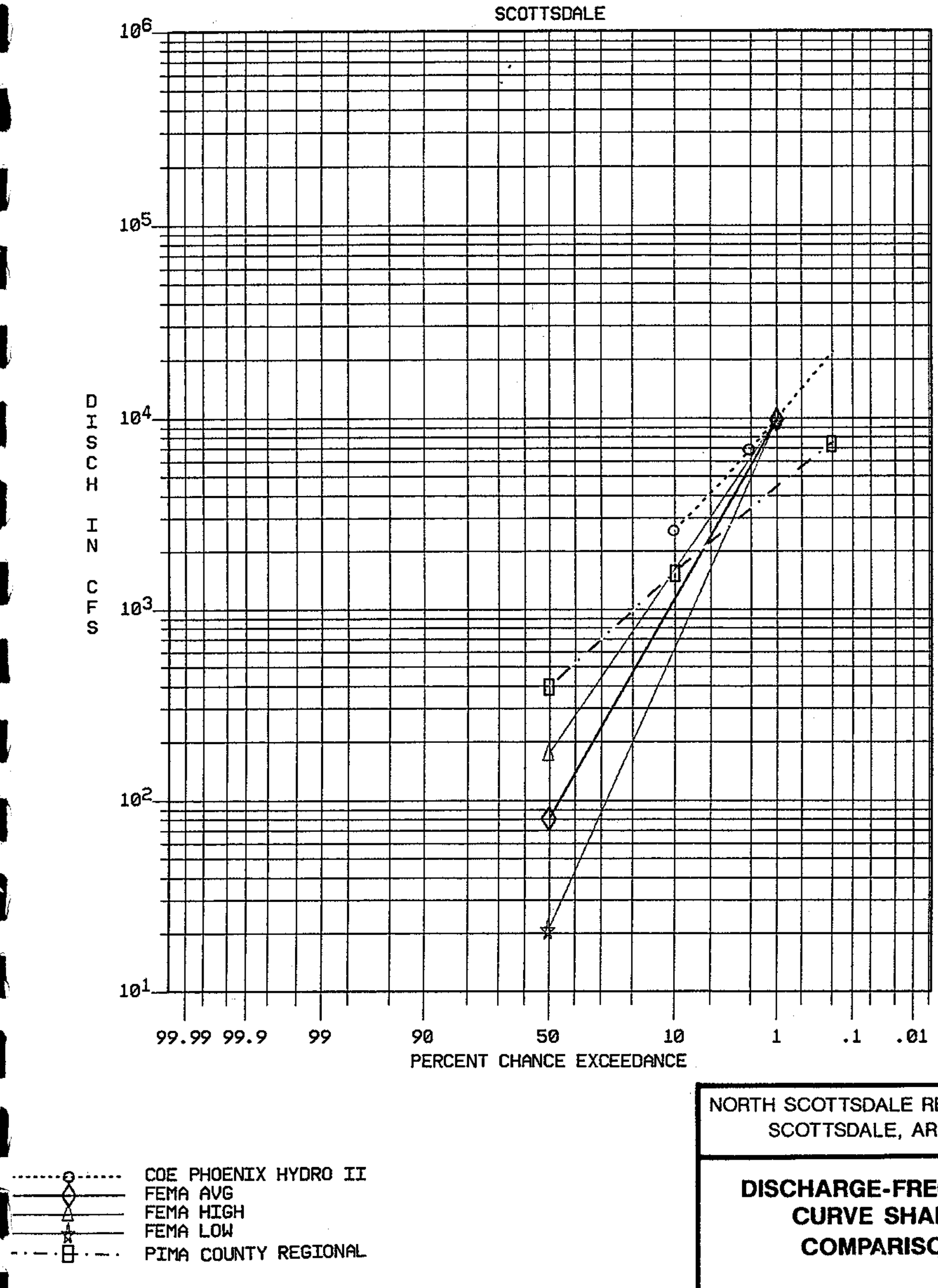


COE MODEL
GREINER MODEL

NORTH SCOTTSDALE RECONNAISSANCE
SCOTTSDALE, ARIZONA

HYDROGRAPH OF 100-YR FLOOD AT PIMA RD & HAPPY VALLEY RD

U.S. ARMY CORPS OF ENGINEERS
LOS ANGELES DISTRICT

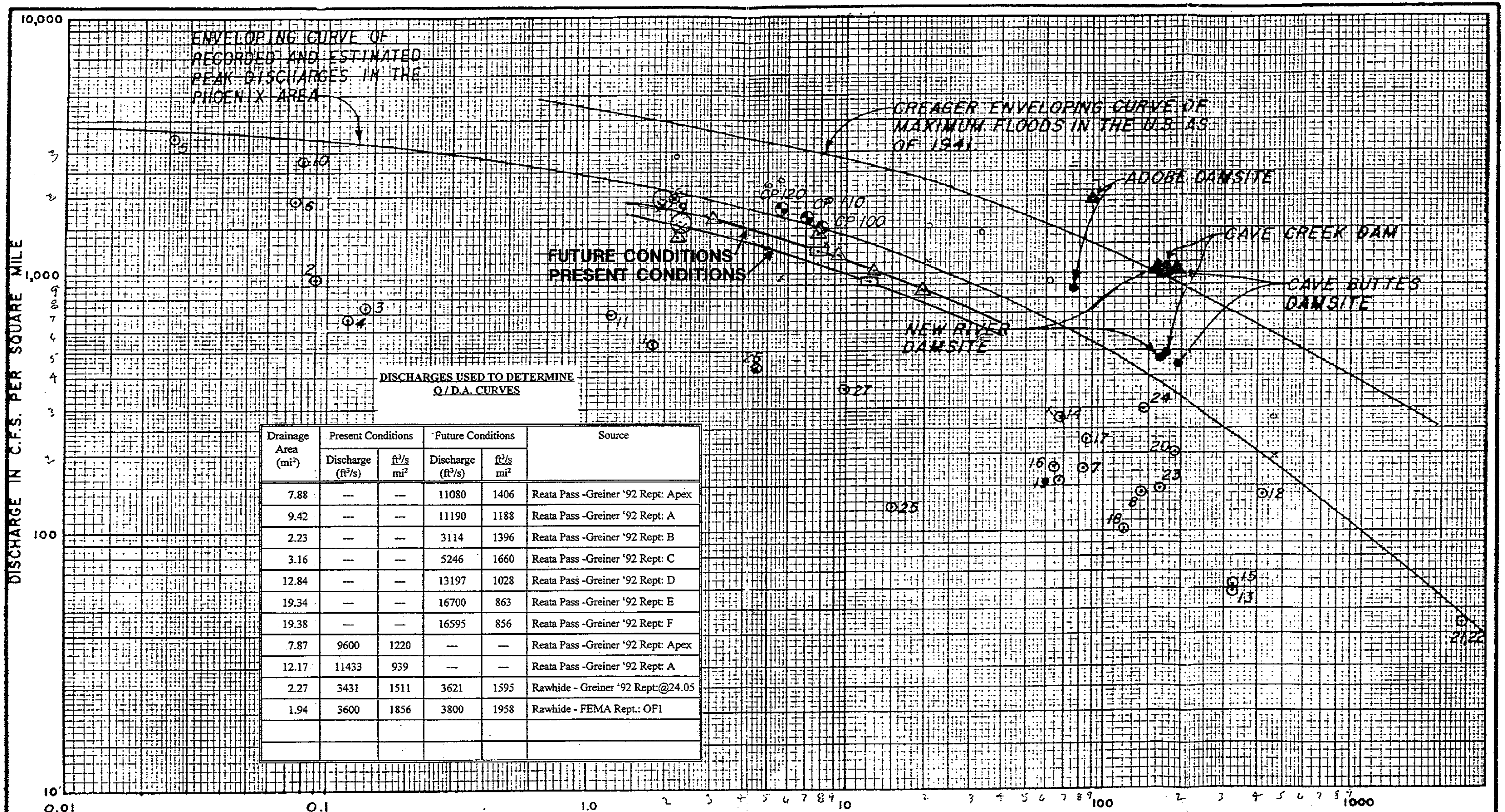


NORTH SCOTTSDALE RECONNAISSANCE
SCOTTSDALE, ARIZONA

DISCHARGE-FREQUENCY CURVE SHAPE COMPARISON

U.S. ARMY CORPS OF ENGINEERS
LOS ANGELES DISTRICT

PLATE 8



DISCHARGES USED TO DETERMINE Q / D.A. CURVES

Drainage Area (mi²)	Present Conditions Discharge (ft³/s)	Present Conditions ft³/s / mi²	Future Conditions Discharge (ft³/s)	Future Conditions ft³/s / mi²	Source
7.88	—	—	11080	1406	Reata Pass -Greiner '92 Rept: Apex
9.42	—	—	11190	1188	Reata Pass -Greiner '92 Rept: A
2.23	—	—	3114	1396	Reata Pass -Greiner '92 Rept: B
3.16	—	—	5246	1660	Reata Pass -Greiner '92 Rept: C
12.84	—	—	13197	1028	Reata Pass -Greiner '92 Rept: D
19.34	—	—	16700	863	Reata Pass -Greiner '92 Rept: E
19.38	—	—	16595	856	Reata Pass -Greiner '92 Rept: F
7.87	9600	1220	—	—	Reata Pass -Greiner '92 Rept: Apex
12.17	11433	939	—	—	Reata Pass -Greiner '92 Rept: A
2.27	3431	1511	3621	1595	Rawhide - Greiner '92 Rept:@24.05
1.94	3600	1856	3800	1958	Rawhide - FEMA Rept.: OF1

LEGEND

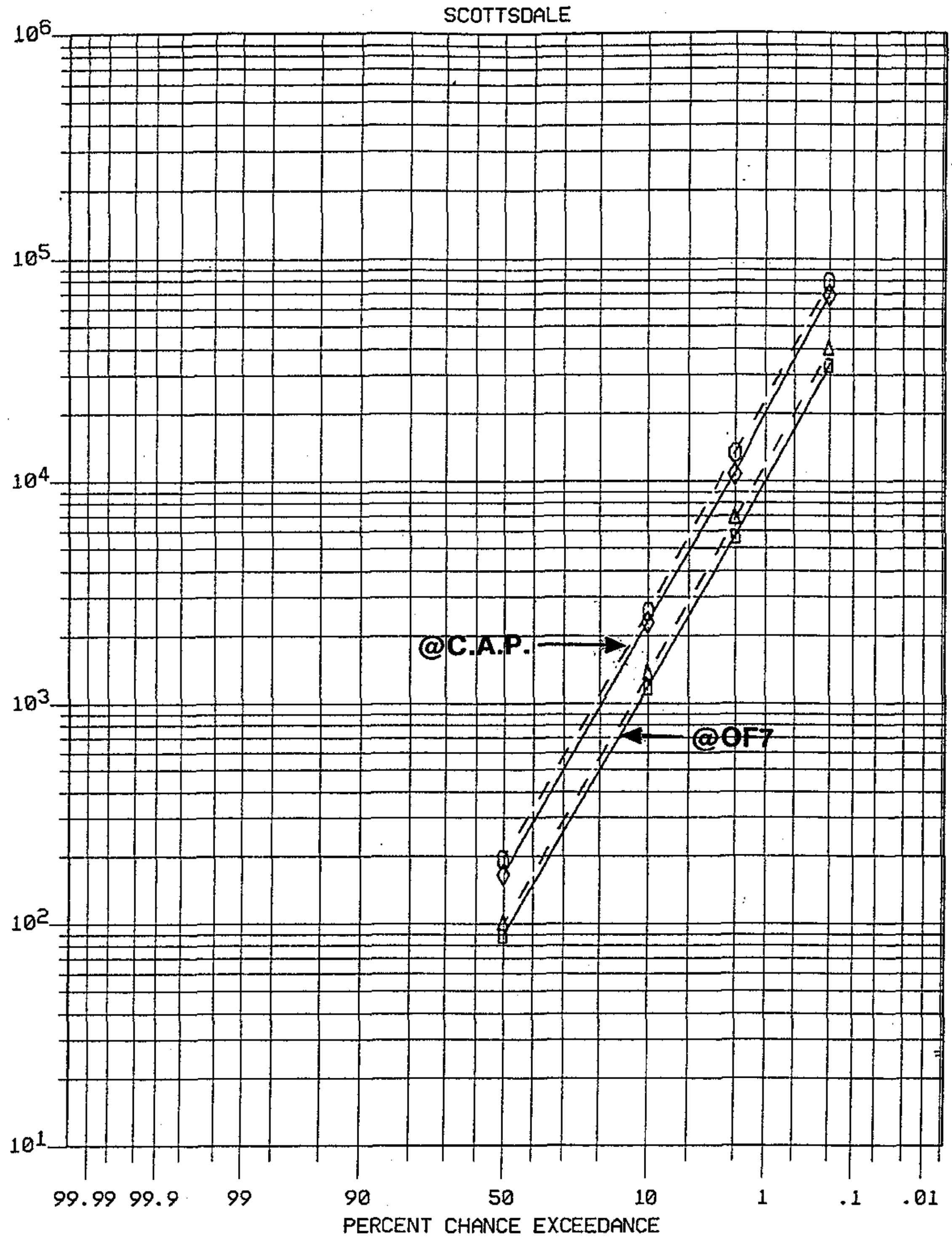
- ⊙5 *PEAK DISCHARGE OF MAJOR RECORDED FLOOD*
- ▲ *PROBABLE MAXIMUM FLOOD PEAK DISCHARGE AT DAM OR DAMSITE*
- ● *STANDARD PROJECT FLOOD PEAK DISCHARGE AT DAM OR DAMSITE*
- CP110 *STANDARD PROJECT FLOOD PEAK DISCHARGE AT CLIPPER WASH CONCENTRATION POINT*

- △ **REATA FUTURE**
- ⊡ **REATA PRESENT**
- × **RAWHIDE PRESENT**
- ⊙ **RAWHIDE FUTURE**

NORTH SCOTTSDALE RECONNAISSANCE
SCOTTSDALE, ARIZONA

100 - YEAR DISCHARGE VERSUS DRAINAGE AREA CURVES

U.S. ARMY CORPS OF ENGINEERS
LOS ANGELES DISTRICT



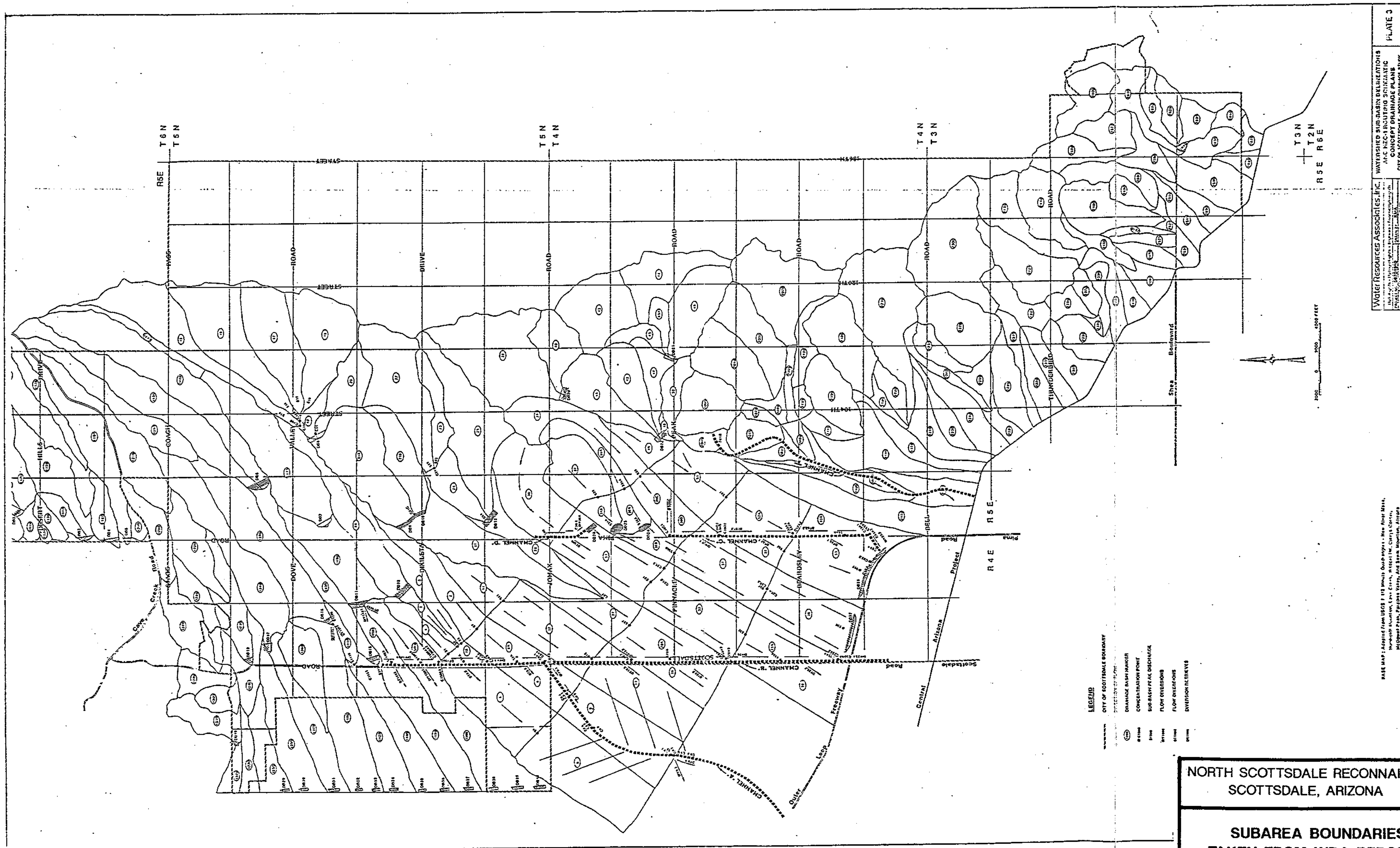
RAWHIDE WASH FAN	D.A. SQ. MI.
@CAP FUTURE	34.18
@CAP PRESENT	34.18
@OF7 PRESENT	13.71
@OF7 FUTURE	13.71

REFER TO TABLES 2 AND 3 FOR PEAK DISCHARGES

NORTH SCOTTSDALE RECONNAISSANCE
SCOTTSDALE, ARIZONA

TYPICAL DISCHARGE-FREQUENCY CURVES FOR THE STUDY AREA

U.S. ARMY CORPS OF ENGINEERS
LOS ANGELES DISTRICT



NORTH SCOTTSDALE RECONNAISSANCE
SCOTTSDALE, ARIZONA

SUBAREA BOUNDARIES
TAKEN FROM WRA REPORT
DATED JULY 1992

U.S. ARMY CORPS OF ENGINEERS
LOS ANGELES DISTRICT

U. S. ARMY ENGINEERING DISTRICT

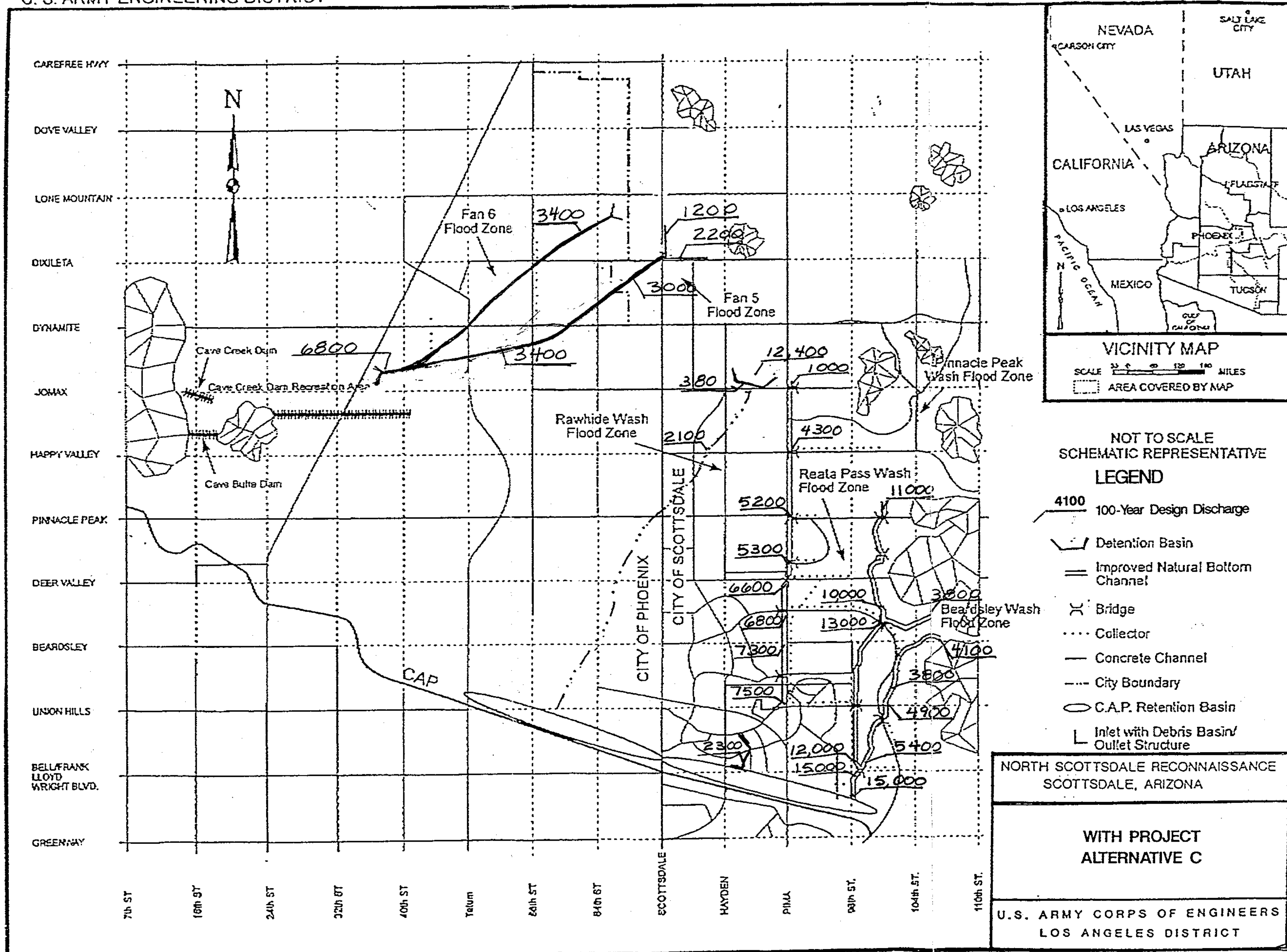
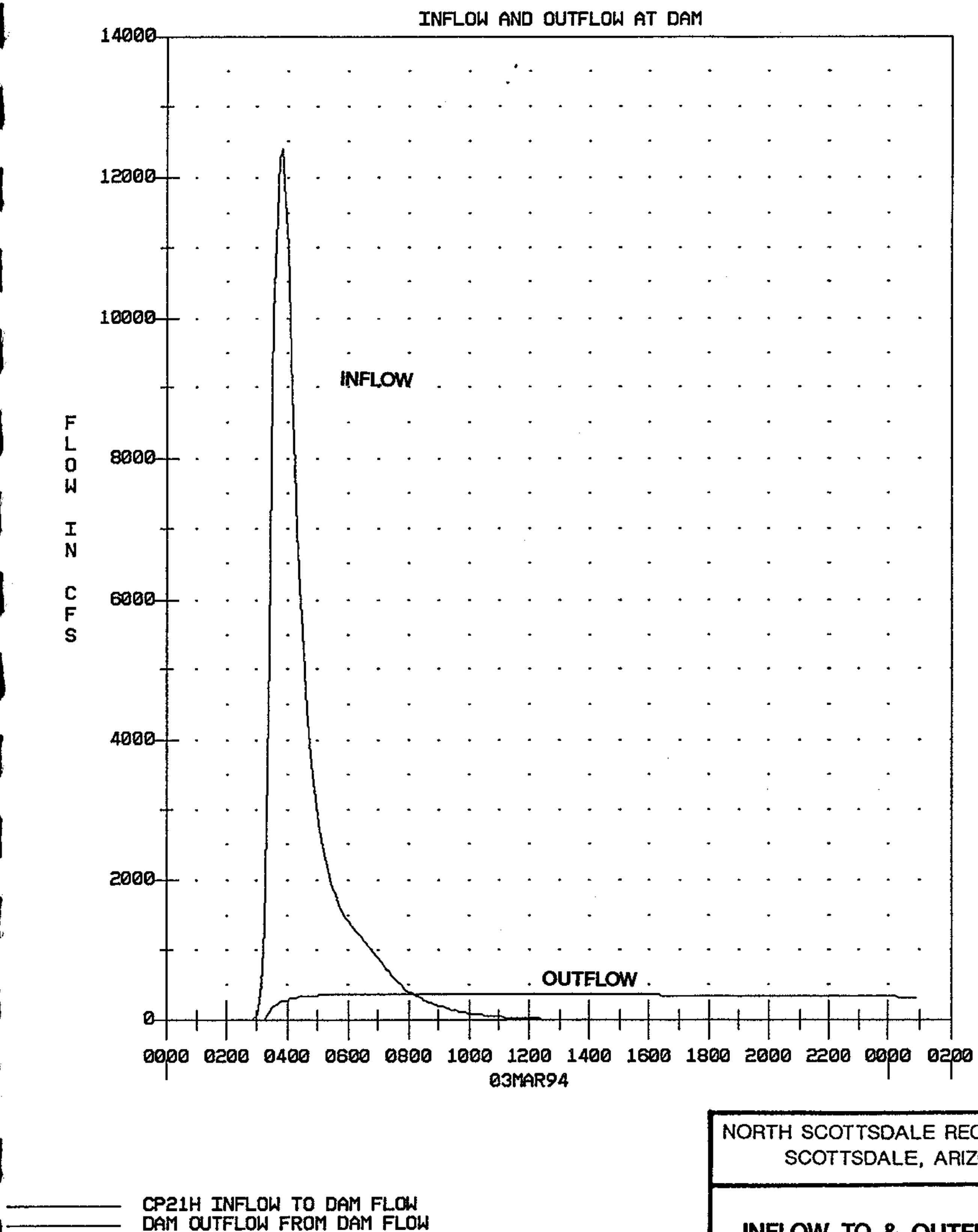


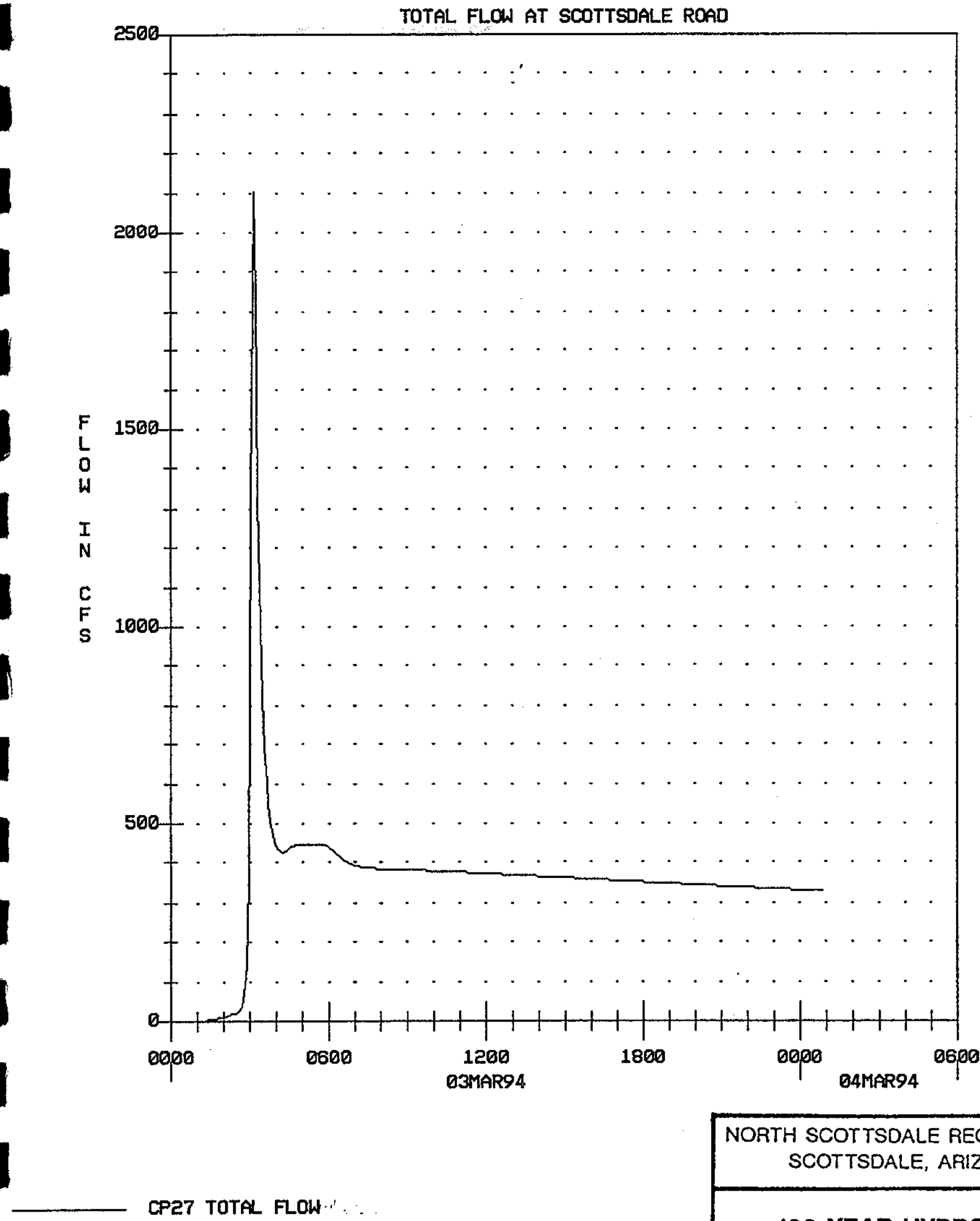
PLATE 12



NORTH SCOTTSDALE RECONNAISSANCE
SCOTTSDALE, ARIZONA

INFLOW TO & OUTFLOW FROM RAWHIDE DETENTION BASIN

U.S. ARMY CORPS OF ENGINEERS
LOS ANGELES DISTRICT

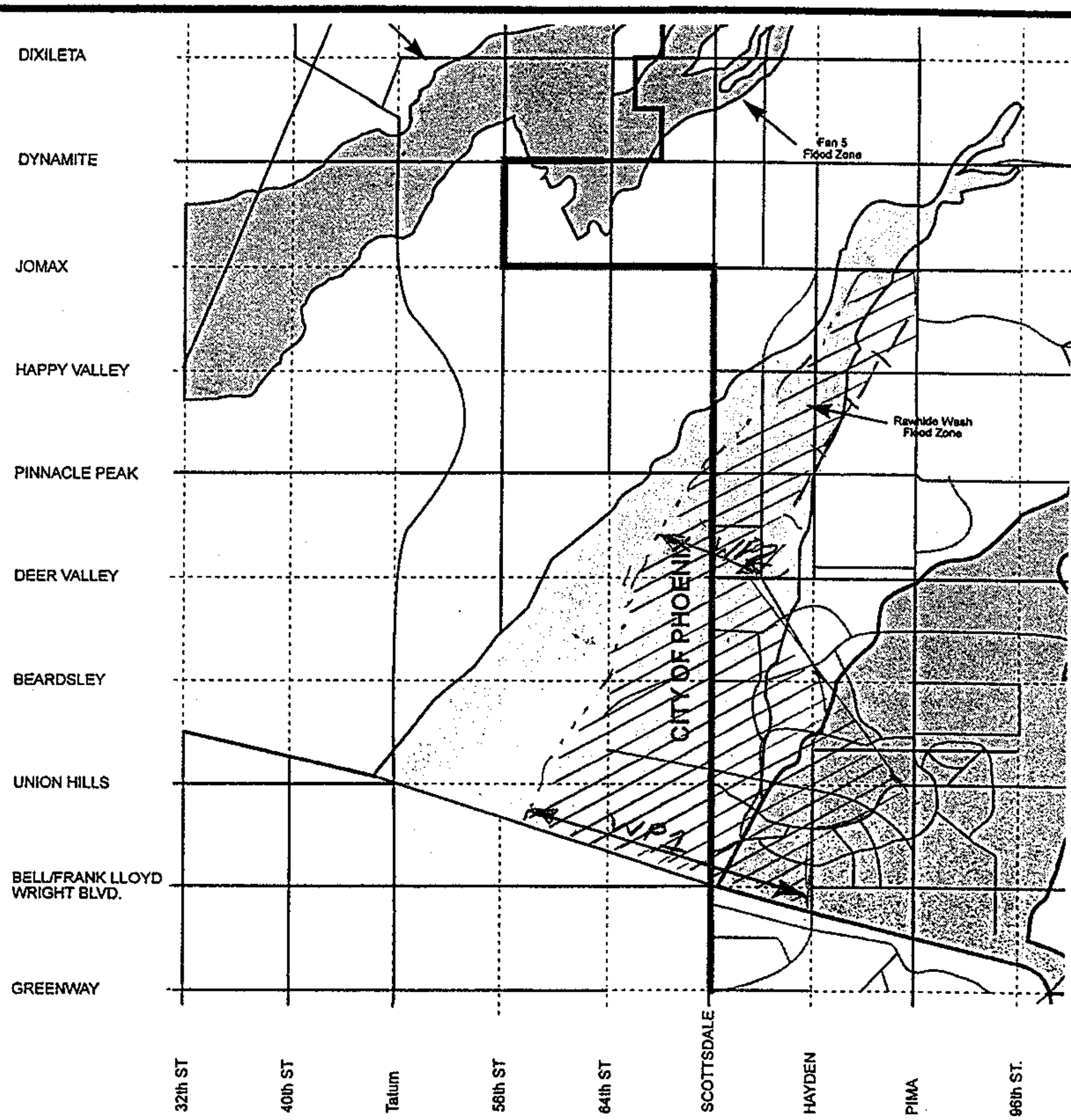


NORTH SCOTTSDALE RECONNAISSANCE
SCOTTSDALE, ARIZONA

100-YEAR HYDROGRAPH AT HAPPY VALLEY ROAD WITH RAWHIDE DETENTION BASIN

U.S. ARMY CORPS OF ENGINEERS
LOS ANGELES DISTRICT

PLATE 14



Flood Line	L (ft)	DA (mi²)	Q/DA (cfs/mi²)	Q (cfs)	Q/L (cfs/ft)	Depth (ft)
WP1	11,700	6.16	1340	8300	.71	0.15
WP2	4700	2.63	1700	4500	.96	0.23

WP1 = Flood line along CAP from Hayden to Rawhide Wash.

WP2 = Flood line along Power lines from Deer Valley ½ mi east of Scottsdale to Rawhide Wash 1/3 mi north of Deer Valley.

L = Length along flood line

DA = Drainage area

Q/DA = Flow per drainage area from curve on plate 9

Q = Q/DA x DA

d = Depth along flood line $= \frac{Q/L\ (0.07)}{1.486(0.0143)^{1/2}}^{\,3/2}$

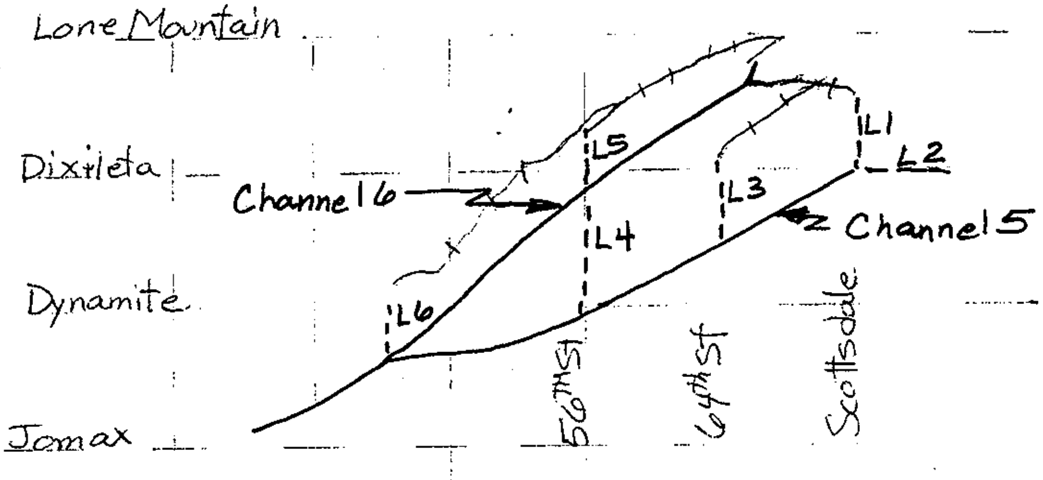
where 0.07 = Manning's n from Hydraulics

and 0.0.43 = slope ft/ft along flow path

NORTH SCOTTSDALE RECONNAISSANCE
SCOTTSDALE, ARIZONA

100-YEAR RAWHIDE WASH FAN DEPTHS WITH PROJECT ALTERNATIVE C

U.S. ARMY CORPS OF ENGINEERS
LOS ANGELES DISTRICT



Location	Q_{100} (ft^3/s)	L (ft)	S (ft/ft)	d (ft)*
Lateral 3	1100	3000	.02	.3
Lateral 4	1600**	4500	.02	.29
Lateral 5	400	1500	.02	.24
Lateral 6	1200-1300**	2800	.02	.34

$$* \; d = \left(\frac{Qn}{1.486 (S)^{.5} L} \right)^{.6}$$ with n = .075 as per Hydraulics Section

Q = discharge along lateral
L = lateral length
S = slope of flow path
n = manning's n
d = depth

Since all depths are less than one foot, no laterals are required.

** Represents design without laterals 3 and 5.

NORTH SCOTTSDALE RECONNAISSANCE
SCOTTSDALE, ARIZONA

FAN 5 AND 6
LATERAL DESIGN COMPUTATIONS
& RESULTING FLOOD DEPTHS

U.S. ARMY CORPS OF ENGINEERS
LOS ANGELES DISTRICT

APPENDIX B: HYDRAULICS

CESPL-ED-HH (335-2-5C) 21 February 1996

MEMORANDUM FOR CESPL-PD-WC, ATTN: John Drake

SUBJECT: North Scottsdale Arizona, Drainage Area Reconnaissance Study (Area's 5 and 6 and Review Comment Responses)

DRAFT

1. References:

a. Memorandum For Record, "Subject: North Scottsdale Drainage Area, Arizona R-3 Conference, undated memorandum, by Ira D. Young. The conference was held on 19 January 1996 in the Los Angeles District Office.

b. Memorandum For CESPL-PD-WC, "Subject: North Scottsdale Arizona, Drainage Area Reconnaissance Study", dated 18 January 1996 by CESPL-ED-HH, Brian Tracy.

c. City of Scottsdale Desert Greenbelt Project Final Report dated June 1995; developed by the Greiner Team; 3 volumes.

d. Memorandum For Record, "Subject: Preliminary Hydraulic Designs of Flood Control Protection for Theoretical Parcels of Land on an Alluvial Fan in Las Vegas, Nevada", dated 1 August 1989, by Craig Baba.

e. Hydrology package for North Scottsdale, Arizona: Discharge Frequency Relationships, Present Conditions and Future Conditions without Project Discharges for Alluvial Fans 5 and 6; package dated 29 November 1995.

f. Topographic USGS Quadrangle maps of Arizona at a scale of 1"=2000 feet and 10 foot contour intervals; Union Hills (1964), Currys Corner (1964), Cave Creek(1965)

g. "Rawhide Wash Detention Basin Feasibility Study" Final Report, dated March 1995.

h. Text- "Open Channel Hydraulics" by Chow, dated 1959.

i. Text- "Handbook of Hydraulics" by King and Brater, 5th Edition, dated 1963.

2. This memorandum documents the completion of tasks requested by the Study Manager (John Drake CESPL-PD-WC). Specifically, the requested hydraulic support involved the following tasks: (a.) Response to R-3 Conference questions (ref. 1.a) concerning the flood proofing channel designs that were developed to protect typical development complex areas from the future without project 100 year frequency storm as documented in the 18 January 1996 CESPL-ED-HH Memorandum For Record (ref. 1. b.); (b.) Support CESPL-PD-WE with flood depth, discharge and other related overflow information relative to the flood frequency events of the 2-, 10-, 50-, 100-, and 500 year storms; (c.) Develop hydraulic designs to protect the development, located on Alluvial Fans 5 and 6, from the future without project 100 year frequency storm event.

Note, the remaining part of the Reconnaissance Study's proposed project consists of a detention basin on Rawhide Wash, a concrete channel adjacent to Pima Road from Jomax Road south to the Bureau of Reclamation retention basins, and improved natural bottom channels on Reata Pass and Beardsley Wash. These proposed project feature elements were designed by the Greiner Team and documented in their " City of Scottsdale Desert Greenbelt Project Final Report" dated June 1995 (ref 1.c.). The total proposed project is shown on Enclosure 1.

3. Specific details relative to the requested work in item 2 above are provided below:

a. Listed below are the original questions(ref. 1.a.) and our associated responses concerning the flood proofing designs that were conceived for the protection of typical development complex areas, on the Reata, Beardsley and Rawhide Washes watershed, from the future without project 100 year frequency storm event:

Question 1 - Discuss justification for Mannings roughness coefficient used for grass lined channels.

Response 1 - The Mannings roughness coefficient of 0.022 was adopted from the grass lined channel designs that were generated in support of the Las Vegas Feasibility Study (ref. 1.d.).

Question 2 - Review slopes and freeboard used for moat channel designs for reasonableness, cost assumptions; discuss how they compare with a similar project such as Tropicana/Flamingo.

Response 2 - The proposed project was designed with grass lined channels having channel invert slopes of about 0.001, with maximum permissible velocities of approximately 8 feet per second (fps). The corresponding cross section's geometric dimensions were established for an optimized hydraulically efficient condition. The comparable natural channel design from the Las Vegas Feasibility Study correlated to the "Secondary Channel" system of trapezoidal earth channels with invert slopes of 0.0027 to 0.0227 and a Manning's "n" value of 0.030. The associated velocities varied from 5 to 11 feet per second.

There is no channel freeboard in the design with the exception of the south and west segments of the moat channels since the top of the outside banks of these two channel segments function as weiring outlet features for the full length of their respective channels. The inside banks of these two channel segments incorporate one foot of freeboard in order to secure an effective weir head. The concept of essentially leaving freeboard out of the channel designs was to assure that any drainage exceeding the system's design capacity would cross over and maintain the pre- project overflow pattern.

Question 3 - Add discussion of why all channel legs were designed to carry 100% of the flow, instead of some percentage of it.

Response 3 - Since the 100 year frequency flood event can, theoretically (according to FEMA), occur at any location or point along the perimeter of the north and east side segment of the moat channels, then, all of the channels segments (including the interior sections) had to be commensurately sized to carry the full 100 year frequency storm event.

b. <u>Develop Alluvial Fan 5 and 6 overflow depths and associated probabilities for the present</u>

FEB-23-1996 17:35 FROM CESPL-ED-HR (US ARMY COE) TO 917144762064 P.05

and future conditions without project 2-, 50-, 100-, and 500 year storm events. -

The peak discharge package information (ref. 1.e.) for the above flood frequency events were provided by CESPL-ED-HE.

The alluvial fans, as shown on Enclosures 2.0 and 2.1, were analyzed by using the Dawdy's (1979) approach (the details of which are presented in ref. 1.b.). The results for the alluvial fan flood zones containing Reata, Beardsley, and Rawhide Washes are summarized and enclosed on Enclosures 3.0 to 3.3

c. Develop hydraulic designs (Encls. 4.0 through 4.5) to protect development located on Alluvial Fans 5 and 6 from the future without project 100 year frequency storm event.

The study area is comprised of two alluvial fans which are adjacent to each other. They are located several miles northwest of Rawhide Wash and they are bounded by Lone Mountain Road on the northside, Scottsdale Road on the east side, Cave Creek Road on the westside, and Happy Valley Road on the southside. Information that was used in the design process, such as ground slopes and flow paths, were extracted from USGS maps (ref. 1.f.). Manning "n" values (roughness coefficients), which were used in a normal depth analysis, came from the texts of Chow, and King and Brater (refs. 1.g. and 1.h respectively) and from field inspection. The channel design flow that was used for each of the fans was 3,400 cubic feet per second (cfs). The two principle fan channels converge at the confluence near 40th Street, and need to contain a combined flow of 6,800 cfs. All of the flood flows from the two fan areas eventually enters Cave Butte Dam reservoir and/or the Cave Creek Dam recreational area.

The following are some of the major design features of the proposed project associated with the detail plans contained in Enclosures 4.0 though 4.5:

- Concrete channels convey the flood waters from the upstream to the downstream end of both fans and were either developed with or contain the following features:

(1) Rectangular cross sections.

(2) Mannings Roughness Coefficient of 0.014.

(3) Flow velocities maintained with Froude numbers >>1.

(4) An assumptive requirement of approximately 13 new bridges over the major roads within the study area.

- Swale channels catch the surface runoff (upstream bank is at ground level) and then transports the water into debris basins (located at the upstream end of the concrete channels). The critical hydraulic design parameters associated with this study element were:

(1) Maintenance of a subcritical flow velocity limit of approximately 6 feet per second (fps).

(2) Mannings coefficient of roughness of 0.035.

(3) Earthen trapezoidal cross section, planted with selected grasses and conveniently spaced small desert plants.

(4) Channel cross section side slopes of 10:1 for the larger channels and 5:1 for the smaller ones.

FEB-23-1996 17:36 FROM CESPL-ED-HR (US ARMY COE) TO 917144762064 P.07

(5) Channel slopes that varied between 0.005 and 0.008.

- Debris Basins are located at the inlets of the concrete channels. The principle hydraulic design parameter for these basins are:

(1) Volume of each debris basin was calculated by using the Rawhide Wash average annual detention basin sediment yield (3.9 acre-feet/year) multiplied by the ratio of each drainage area to the Rawhide Wash drainage area (ref. 1.g.)

(2) Assumption that the basins will be immediately cleaned out and readied for full use before the next design event storm occurs.

- Other Structures that would be required to facilitate the overall design involved the following:

(1) Outlet structure near Cave Creek Road and Jomax Road.

(2) Confluence structure near 40th Street.

(3) 36 inch diameter RCP drain with a 48 inch CMP perforated riser in each debris basin.

(4) Transition structures(four).

4. If you have any questions or need further assistance, please contact Theodore Yee at X6993.

BRIAN G. TRACY, PE

Chief Hydraulics Section

CF (wo/encl)

CESPL-ED

CESPL-ED-H

CESPL-ED-HE

CESPL-ED-HH

TRACY

CESPL-ED-HH

MASHBURN

CESPL-ED-HH

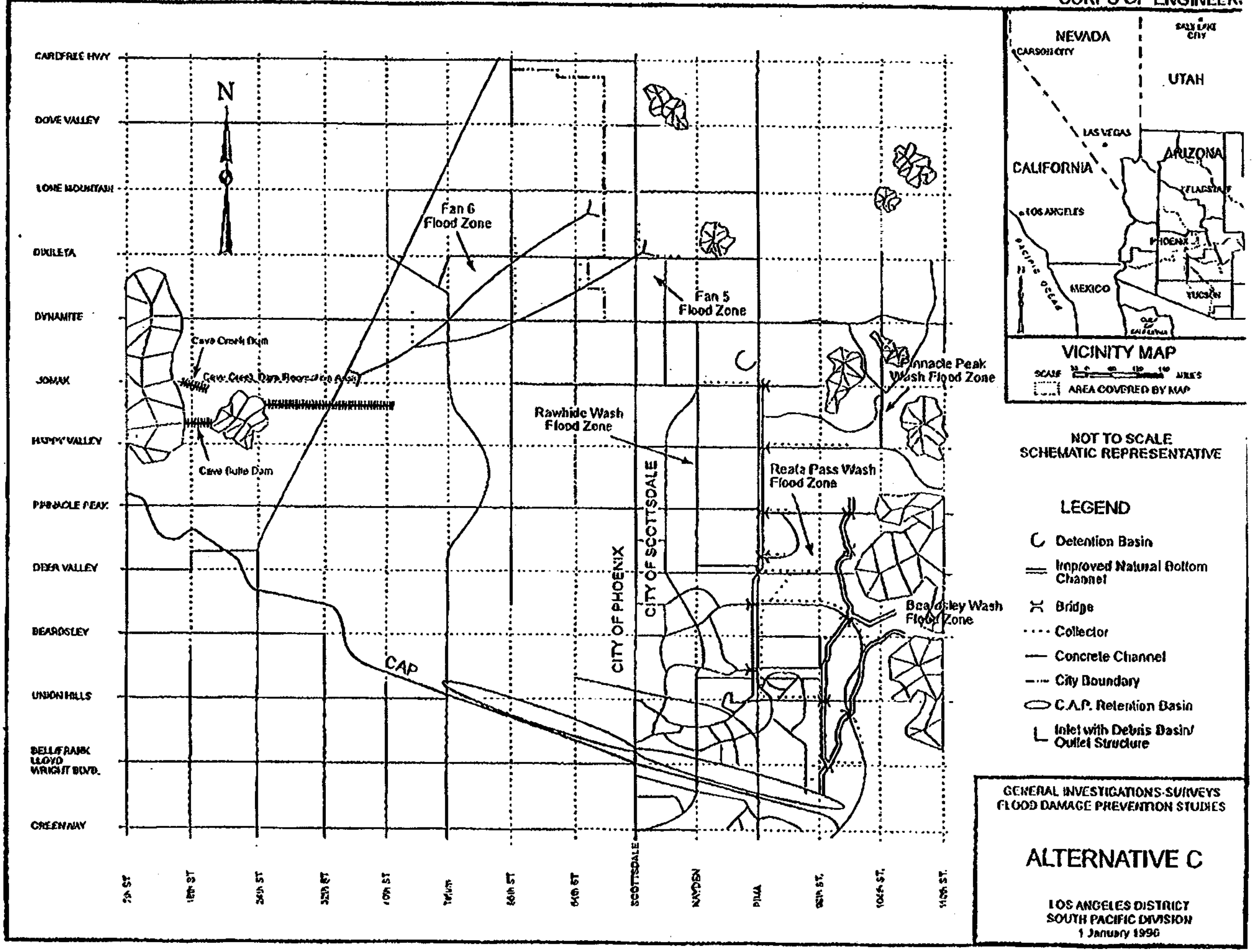
YEE

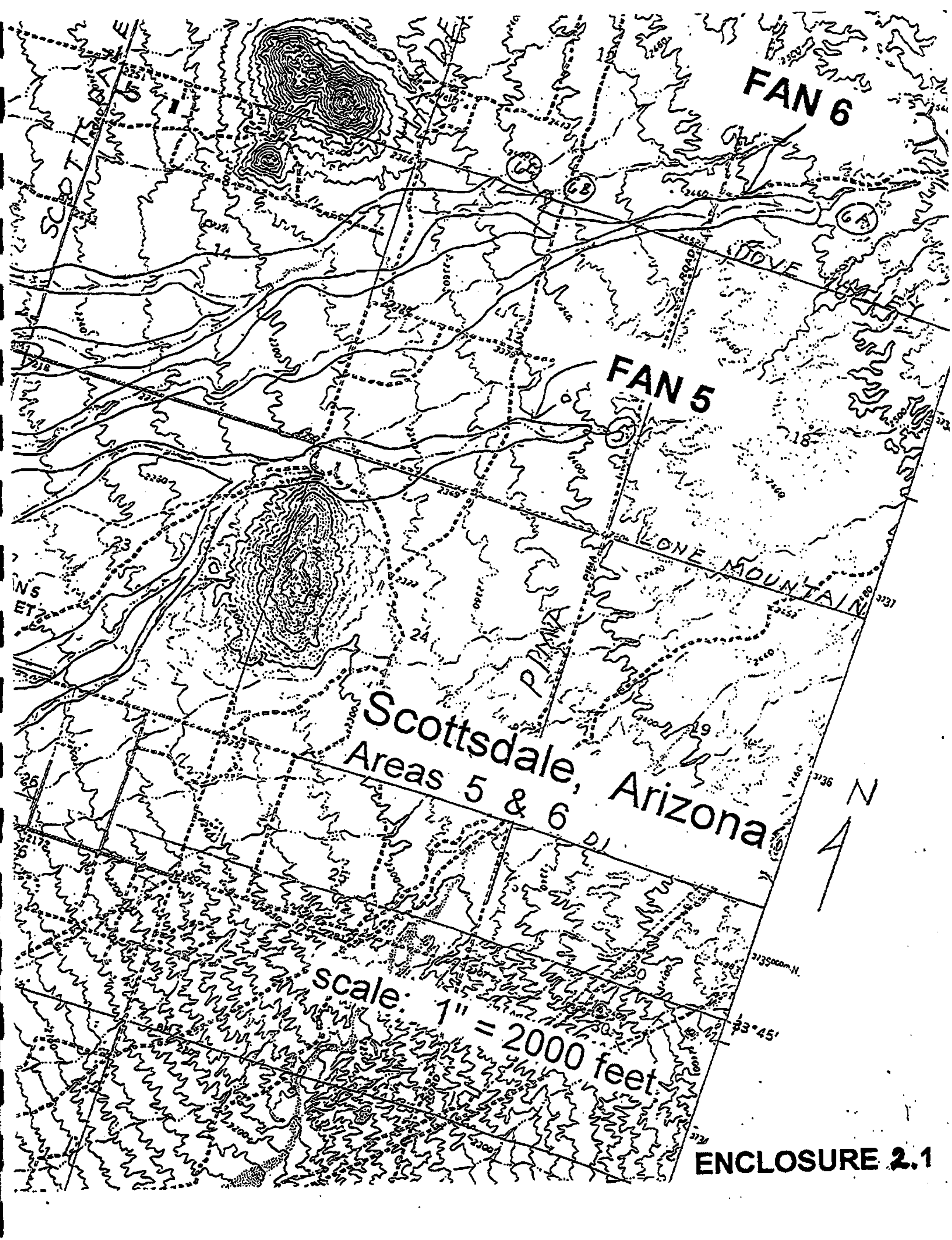
CESPL-ED-HH

ENCLOSURE 1.6

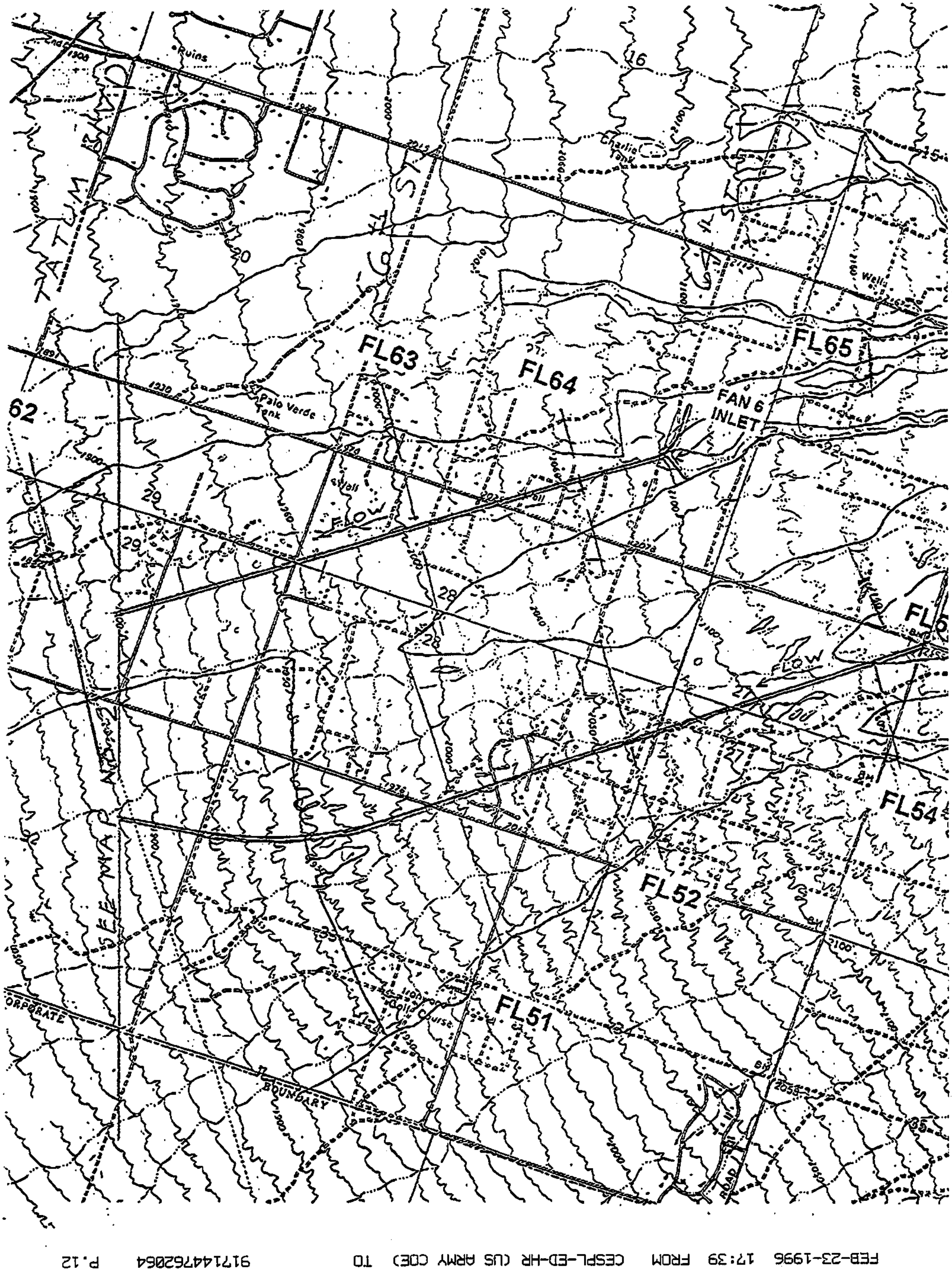
U. S. ARMY ENGINEERING DISTRICT

CORPS OF ENGINEERS





ENCLOSURE 2.1



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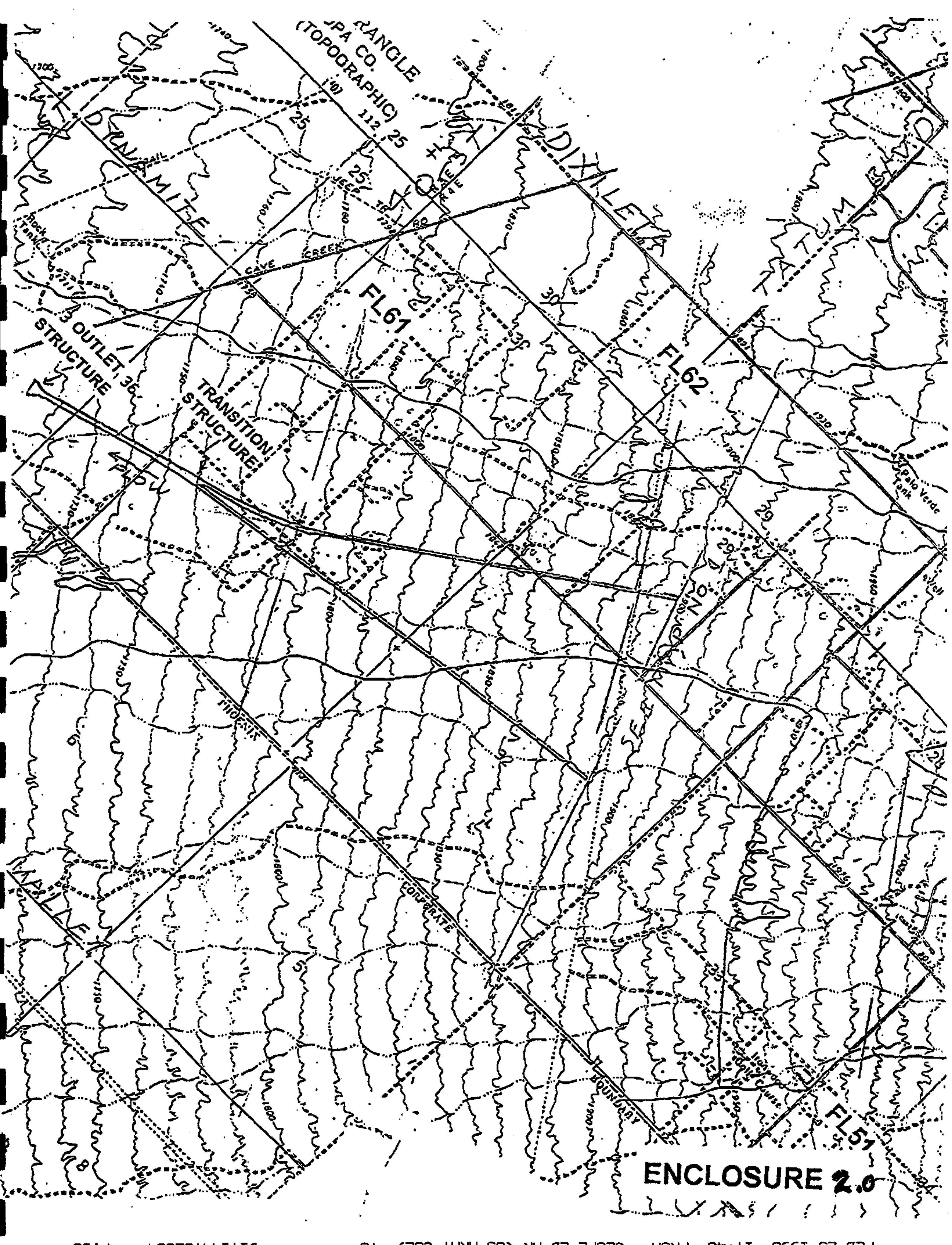


ENCLOSURE 2.0

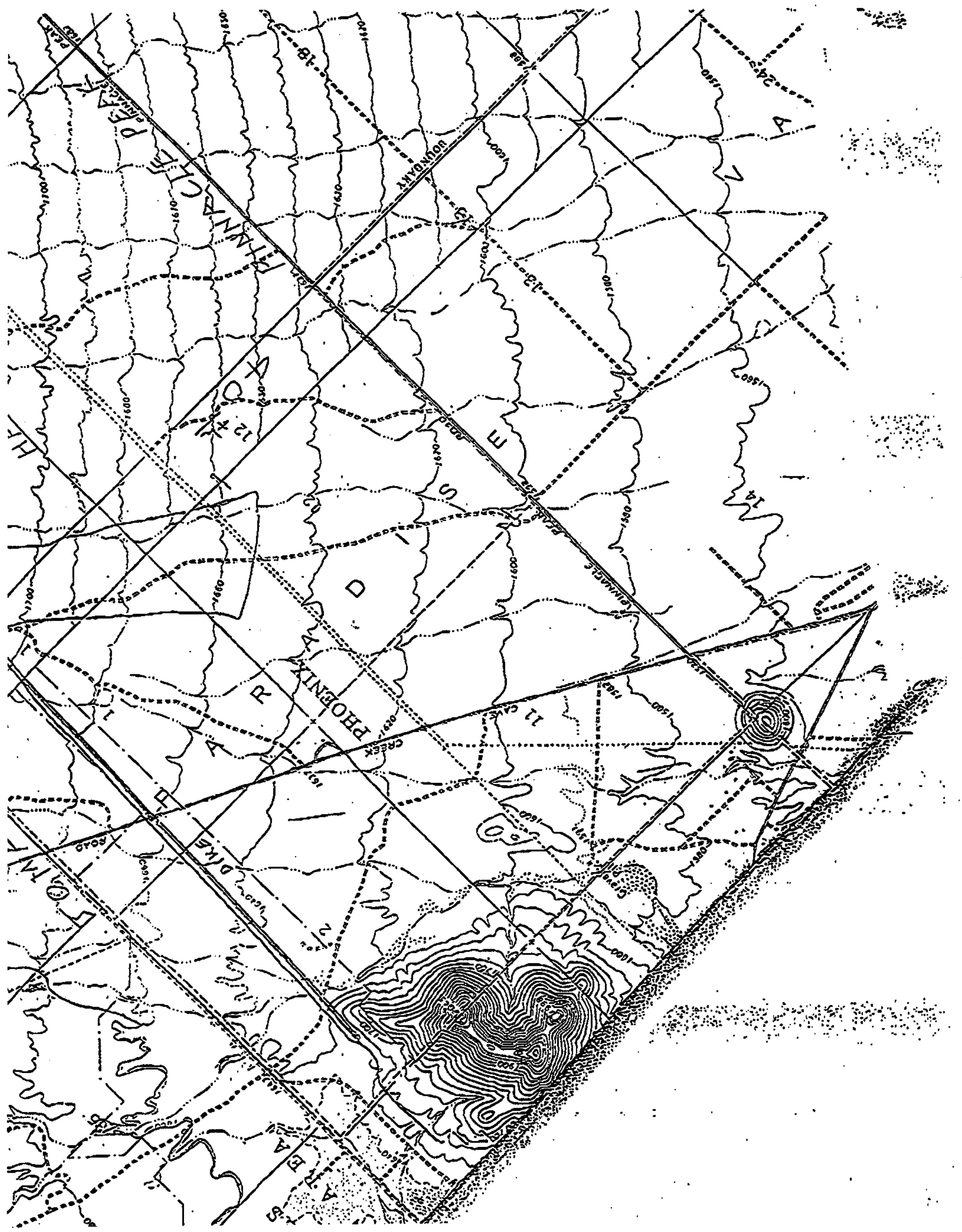

PHOENIX
BOUNDARY
CREEK
PINNACLE PEAK

TABLE 1

NORTHSCOTTSDALE FAN 5
PRESENT CONDITIONS W/O PROJECT

Cross Section in River Miles from Jomax-40th Intersection	Frequency in years	Annual Exceedance Probability (Pc)	Discharge in cu. ft./sec. (Q)	Depth in feet (D)	Velocity in ft/sec (V)	Width in feet (W_1)	Floodplain Width in feet (W_2)	* Pc%	**Py%
2.9 Mi.	500	.002	9200	2.7	9.0	381.2	5300	7.2	.014
	100	.010	2800	1.7	7.1	236.9		4.5	.045
FL51	50	.020	1600	1.3	6.3	189.4		3.6	.072
	10	.100	310	0.7	4.5	98.2		1.9	.190
	2	.500	23	0.2	2.7	34.7		0.7	.350
	500	.002	8800	2.6	8.9	374.5	3400	11.0	.022
3.5 Mi.	100	.010	2700	1.7	7.0	233.4		6.9	.069
	50	.020	1500	1.3	6.2	184.5		5.4	.108
FL52	10	.100	300	0.7	4.5	96.9		2.9	.290
	2	.500	22	0.2	2.7	34.1		1.0	.500
	500	.002	6400	2.3	8.3	329.7	1300	25.4	.051
4.5 Mi.	100	.010	2000	1.5	6.9	198.7		15.3	.153
	50	.020	1100	1.2	5.9	163.0		12.5	.250
FL53	10	.100	220	0.6	4.2	85.6		6.6	.660
	2	.500	16	0.2	2.5	30.0		2.3	1.150
	500	.002	3600	1.9	7.4	261.9	1100	23.8	.048
4.4 Mi.	100	.010	1100	1.2	5.9	163.0		14.8	.148
	50	.020	600	0.9	5.2	127.9		11.6	.232
FL54	10	.100	120	0.5	3.8	67.2		6.1	.610
	2	.500	9	0.2	2.2	23.8		2.2	1.100

+CAP = Central Arizona Canal

*Pc = Probability that any point (flow width) on the cross section (floodplain) width will be flooded given that the n-year event occcurs.

**Py = Probability that any point on the cross section will be flooded in any given year by the n-year event or greater.

ENCLOSURE 3.c

TABLE 2

NORTHSCOTTSDALE FAN 5
FUTURE CONDITIONS W/O PROJECT

Cross Section in River Miles from Jomax-40th Intersection	Frequency in years	Annual Exceedance Probability (Pc)	Discharge in cu. ft./sec. (Q)	Depth in feet (D)	Velocity in ft/sec (V)	Width in feet (W_1)	Floodplain Width in feet (W_2)	* Pc%	**Py%
2.9 Mi.	500	.002	10000	2.8	9.5	378.2	5300	7.1	.014
	100	.010	3100	1.7	7.5	236.7		4.5	.045
	50	.020	1700	1.4	6.7	186.2		3.5	.070
FL51	10	.100	340	0.7	6.8	97.8		1.8	.185
	2	.500	25	0.3	2.9	34.4		0.6	.325
3.5 Mi.	500	.002	9800	2.8	9.4	375.2	3400	11.0	.022
	100	.010	3000	1.7	7.5	233.7		6.9	.069
	50	.020	1700	1.4	6.7	186.2		5.5	.110
FL52	10	.100	330	0.7	4.8	96.6		2.8	.284
	2	.500	24	0.2	2.8	33.9		1.0	.598
4.5 Mi.	500	.002	7100	2.4	8.9	329.8	1300	25.4	.051
	100	.010	2200	1.5	7.0	206.4		15.9	.159
	50	.020	1200	1.2	6.2	162.0		12.5	.249
FL53	10	.100	240	0.6	4.5	85.1		6.5	.654
	2	.500	18	0.2	2.7	30.2		2.3	1.161
4.4Mi.	500	.002	4000	1.9	7.9	262.1	1100	23.8	.048
	100	.010	1200	1.2	6.2	162.0		14.7	.147
	50	.020	690	1.0	5.6	129.8		11.8	.236
FL54	10	.100	140	0.5	4.0	68.6		6.2	.623
	2	.500	10	0.2	2.4	23.9		2.2	1.085

*CAP = Central Arizona Canal
*Pc = Probability that any point (flow width) on the cross section (floodplain) width will be flooded given that the n-year event occcurs.
**Py = Probability that any point on the cross section will be flooded in any given year by the n-year event or greater.

ENCLOSURE 2.1

TABLE 3

NORTHSCOTTSDALE FAN 6

PRESENT CONDITIONS W/O PROJECT

Cross Section in River Miles from Jomax-40th Intersection	Freq-uency in years	Annual Exceed-ance Probab-ility (Pc)	Discharge in cu. ft./sec. (Q)	Depth in feet (D)	Velocity in ft/sec (V)	Width in feet (W_1)	Floodplain Width in feet (W_2)	* Pc%	**Py%
0.7 Mi. FL61	500	.002	7800	2.5	9.0	342.4	5200	6.6	.013
	100	.010	2400	1.6	7.1	213.7		4.1	.041
	50	.020	1300	1.2	6.3	167.2		3.2	.064
	10	.100	260	0.6	4.6	87.8		1.7	.169
	2	.500	20	0.2	2.7	31.5		0.6	.303
1.9 Mi. FL62	500	.002	10000	2.8	9.5	378.2	3600	10.5	.021
	100	.010	3000	1.7	7.5	233.7		6.5	.065
	50	.020	1700	1.4	6.7	186.2		5.2	.103
	10	.100	340	0.7	4.8	97.8		2.7	.272
	2	.500	25	0.3	2.9	34.4		1.0	.478
3.0 Mi. FL63	500	.002	8100	2.6	9.1	347.6	3400	10.2	.020
	100	.010	2500	1.6	7.2	217.2		6.4	.064
	50	.020	1400	1.3	6.4	172.3		5.1	.101
	10	.100	280	0.7	4.6	90.5		2.7	.266
	2	.500	20	0.2	2.7	31.5		0.9	.463
3.6 Mi. FL64	500	.002	8700	2.6	9.2	357.7	1300	27.5	.055
	100	.010	2700	1.7	7.3	224.0		17.2	.172
	50	.020	1500	1.3	6.5	177.1		13.6	.272
	10	.100	300	0.7	4.7	93.0		7.2	.716
	2	.500	22	1.2	2.8	32.7		2.5	1.258
4.5 Mi. FL65	500	.002	680	1.0	5.5	129.0	500	25.8	.052
	100	.010	210	0.6	4.4	80.7		16.1	.161
	50	.020	120	0.5	3.9	64.5		12.9	.258
	10	.100	23	0.2	2.8	33.3		6.7	.666
	2	.500	2	0.1	1.7	12.5		2.5	1.254

*CAP = Central Arizona Canal
*Pc = Probability that any point (flow width) on the cross section (floodplain) width will be flooded given that the n-year event occcurs.
**Py = Probability that any point on the cross section will be flooded in any given year by the n-year event or greater.

ENCLOSURE 3.2

TABLE 4

NORTHSCOTTSDALE FAN 6
FUTURE CONDITIONS W/O PROJECT

Cross Section in River Miles from Jomax-40th Intersection	Freq-uency in years	Annual Exceed-ance Probab-ility (Pc)	Discharge in cu. ft./sec. (Q)	Depth in feet (D)	Velocity in ft/sec (V)	Width in feet (W_1)	Floodplain Width in feet (W_2)	* Pc%	**Py%
0.7 Mi.	500	.002	8700	2.6	9.2	357.7	5200	6.9	.014
	100	.010	2600	1.6	7.2	220.7		4.2	.042
	50	.020	1500	1.3	6.5	177.1		3.4	.068
FL61	10	.100	290	0.7	4.7	91.8		1.8	.176
	2	.500	22	0.2	2.8	32.7		0.6	.315
1.9 Mi.	500	.002	11000	2.9	9.7	392.9	3600	10.9	.022
	100	.010	3400	1.8	7.6	245.6		6.8	.068
	50	.020	1900	1.4	6.8	194.6		5.4	.108
FL62	10	.100	370	0.7	4.9	101.2		2.8	.281
	2	.500	28	0.3	2.9	39.0		1.0	.500
3.0 Mi.	500	.002	9000	2.7	9.3	362.6	3400	10.7	.021
	100	.010	2800	1.7	7.4	227.3		6.7	.067
	50	.020	1500	1.3	6.5	177.1		5.2	.104
FL63	10	.100	310	0.7	4.7	94.2		2.8	.277
	2	.500	23	0.2	2.8	33.3		1.0	.490
3.6 Mi.	500	.002	9700	2.8	9.4	373.6	1300	28.7	.057
	100	.010	3000	1.7	7.5	233.7		18.0	.180
	50	.020	1700	1.4	6.7	186.2		14.3	.286
FL64	10	.100	330	0.7	4.8	96.6		7.4	.743
	2	.500	24	0.2	2.8	33.9		2.6	1.303
4.5 Mi.	500	.002	760	1.0	5.7	134.9	500	27.0	.054
	100	.010	230	0.6	4.5	83.6		16.7	.167
	50	.020	130	0.5	4.0	66.6		13.3	.266
FL65	10	.100	30	0.3	3.0	37.0		7.4	.741
	2	.500	2	0.1	1.7	12.5		2.5	1.254

*CAP = Central Arizona Canal

*Pc = Probability that any point (flow width) on the cross section (floodplain) width will be flooded given that the n-year event occcurs.

**Py = Probability that any point on the cross section will be flooded in any given year by the n-year event or greater.

ENCLOSURE 5.3

COMPUTATION SHEET

PROJECT: NORTH SCOTTSDALE

ITEM: PLAN VIEW LAYOUT

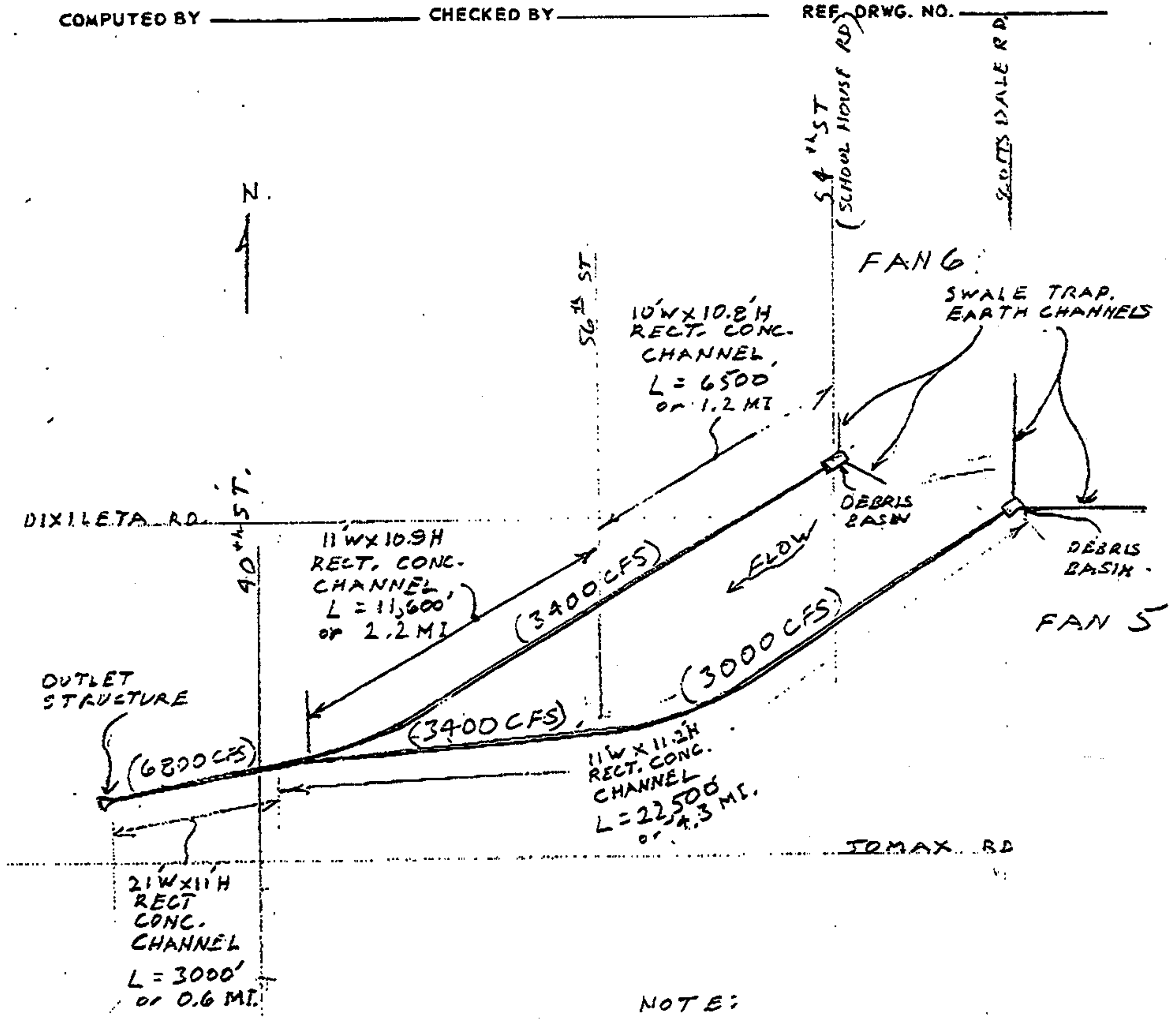
COMPUTED BY ____ CHECKED BY ____

SHEET NO. 1 OF 6 SHEETS

DATE ________, 19 96

FILE ____

REF. DRWG. NO. ____



Note:
FAN 5 Conc. Chan. has 6 bridges
FAN 6 Conc. Chan has 6 bridges
Chan. D.S of 40th St. has 1 bridge

NO SCALE

SPD FORM 1 OCT 74 284

ENCLOSURE 4.0

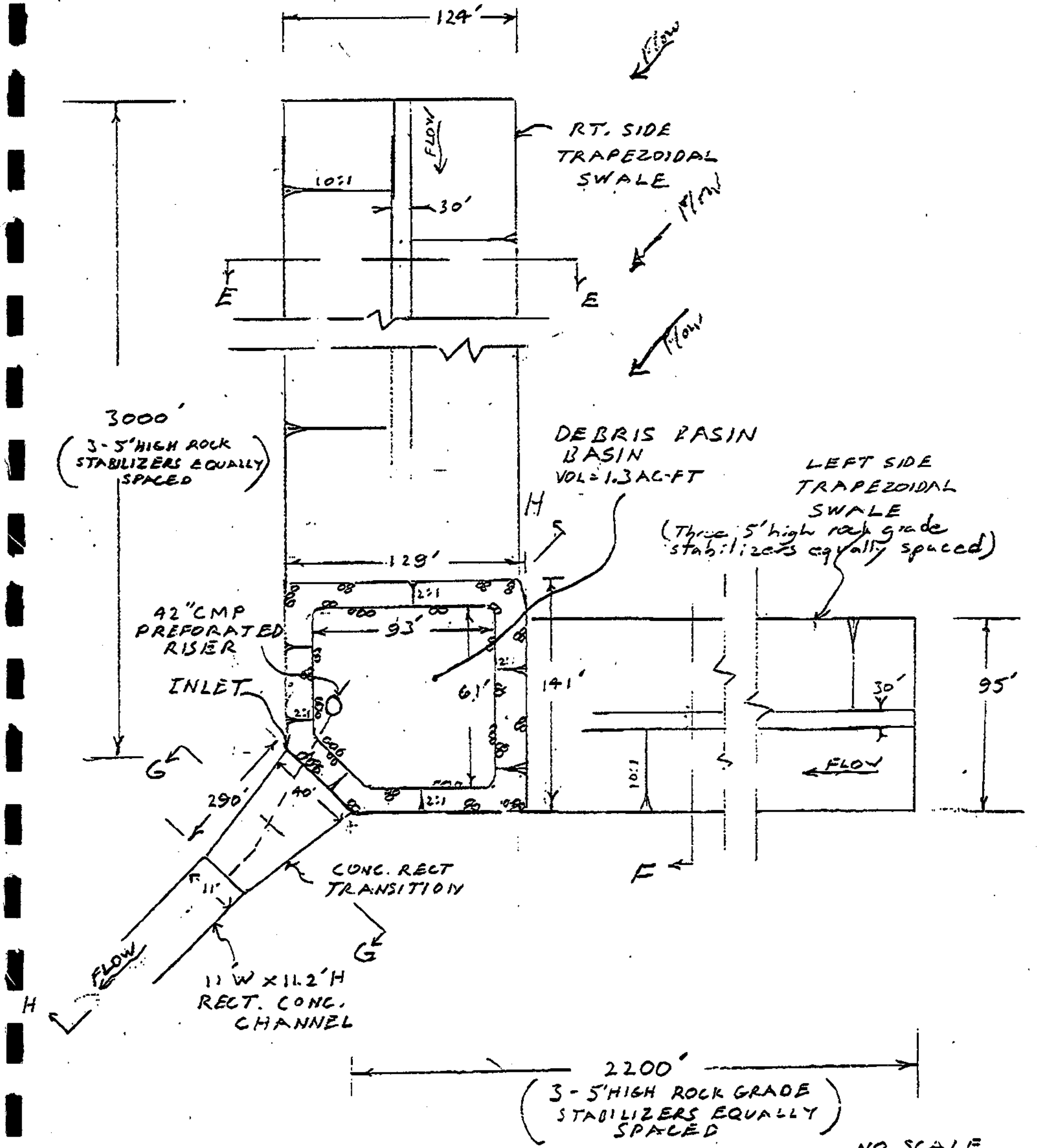
COMPUTATION SHEET

PROJECT: NORTH SCOTSDALE
SHEET NO. 2 OF 6 SHEETS

ITEM: FAN 5 - INLET & CONNECTING SWALE CHANNELS & DEBRIS BASIN
DATE: ______, 1996

FILE: ______

COMPUTED BY: ______ CHECKED BY: ______
REF. DRWG. NO. ______



ENCLOSURE 4.1

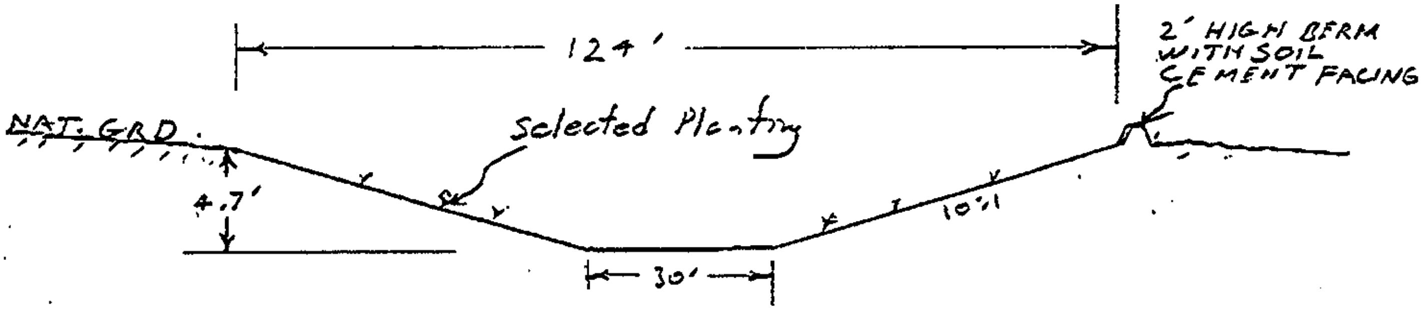
SPD FORM OCT 74 284

COMPUTATION SHEET

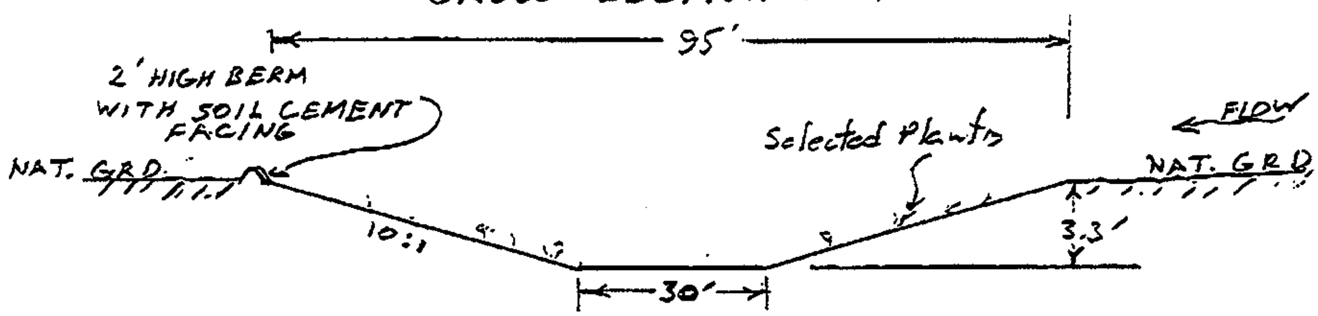
PROJECT: NORTH SCOTTSDALE — SHEET NO. 3 OF 6 SHEETS
ITEM: FAN 5 - CROSS SECTIONS — DATE ______, 1996
FILE ______
COMPUTED BY ______ CHECKED BY ______ REF. DRWG. NO. ______

(NOTE: REFER TO SHT 2) FOR CROSS SECTION LOCATIONS

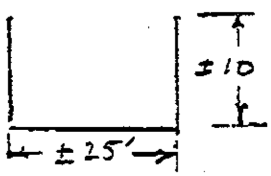
CROSS SECTION E-E



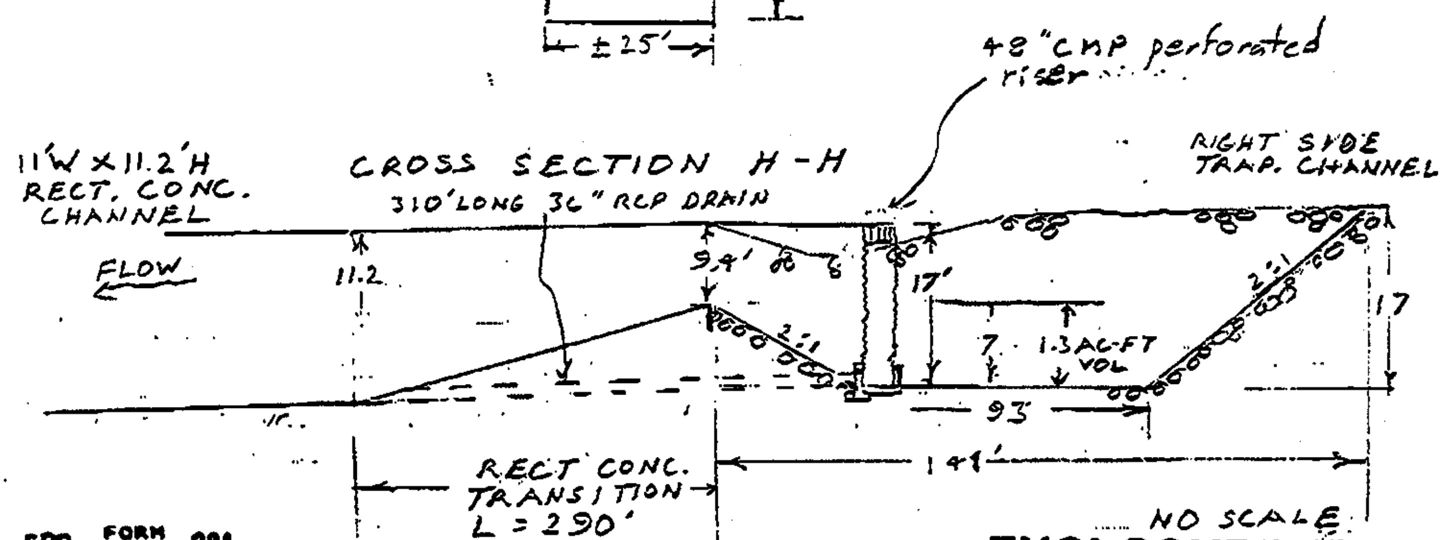
CROSS SECTION F-F



CROSS SECTION G-G
(Average Cross section of Transition)



CROSS SECTION H-H



NO SCALE

SPD FORM OCT 74 284

ENCLOSURE 4.2

COMPUTATION SHEET

PROJECT NORTH SCOTTSDALE

ITEM FAN & INLET & SEDIMENT BASIN & SWALE CHANNELS

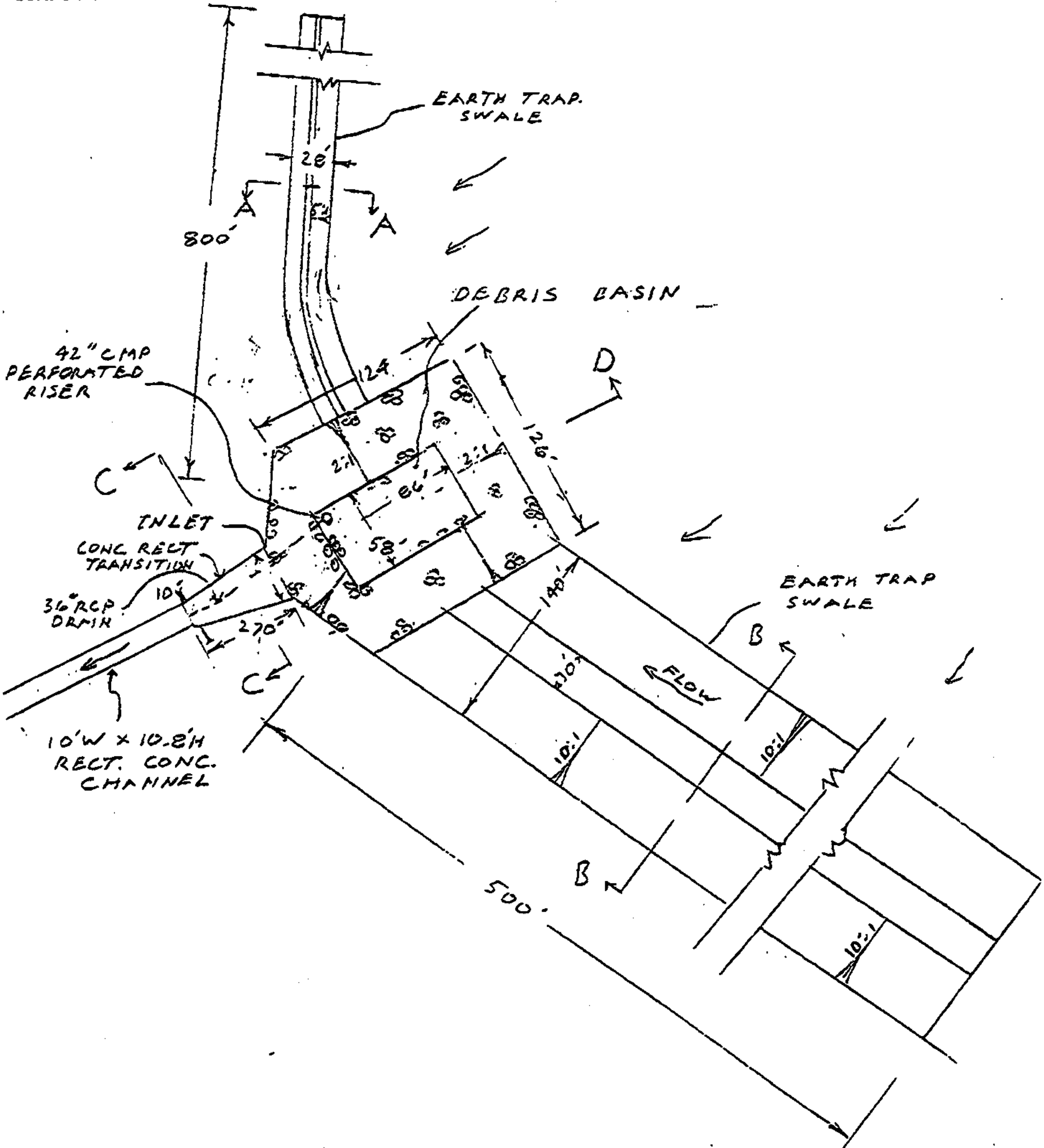
SHEET NO. 4 OF 6 SHEETS

DATE ______, 1996

FILE ______

COMPUTED BY ______ CHECKED BY ______

REF. DRWG. NO. ______



NO SCALE

SPD FORM OCT 74 284

ENCLOSURE 4.3

COMPUTATION SHEET

PROJECT ____________ SHEET NO. 5 OF 6 SHEETS

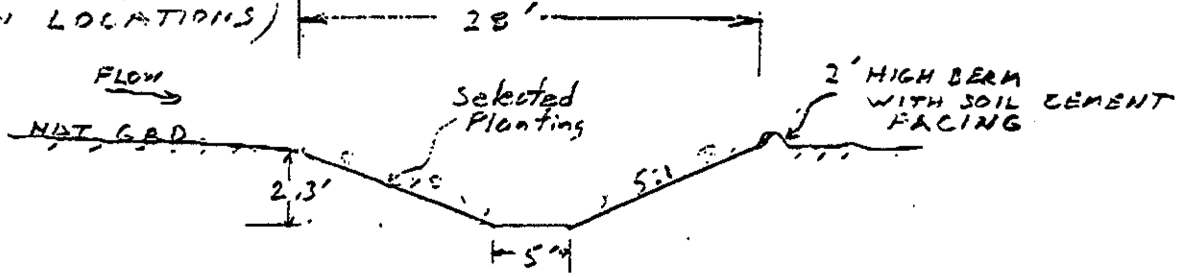
ITEM FAN 6 - CROSS SECTIONS DATE ________, 1996

FILE ________

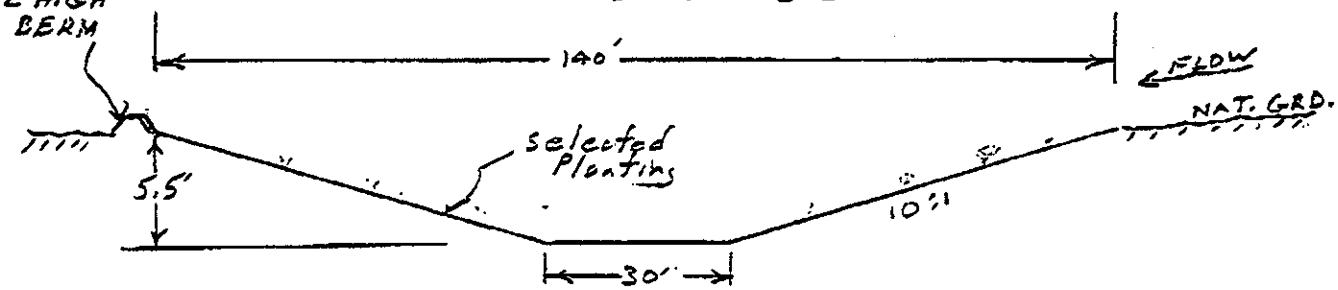
COMPUTED BY ________ CHECKED BY ________ REF. DRWG. NO. ________

(Note: REFER TO SHT 4 FOR CROSS SECTION LOCATIONS)

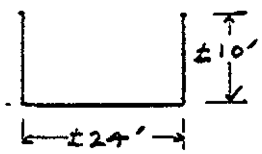
CROSS SECTION A-A



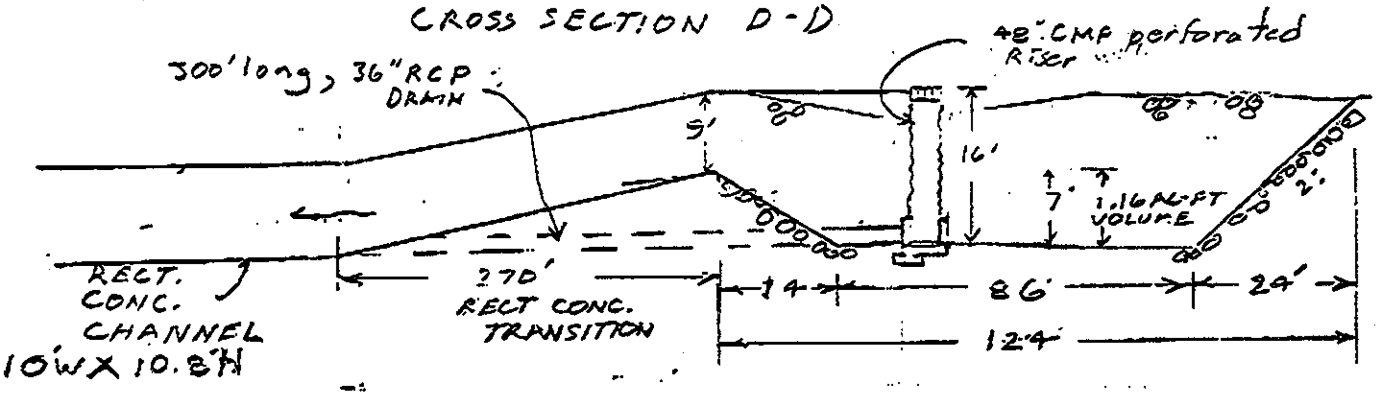
CROSS SECTION B-B



CROSS SECTION C-C
(Represents Average cross section of Transition)



CROSS SECTION D-D



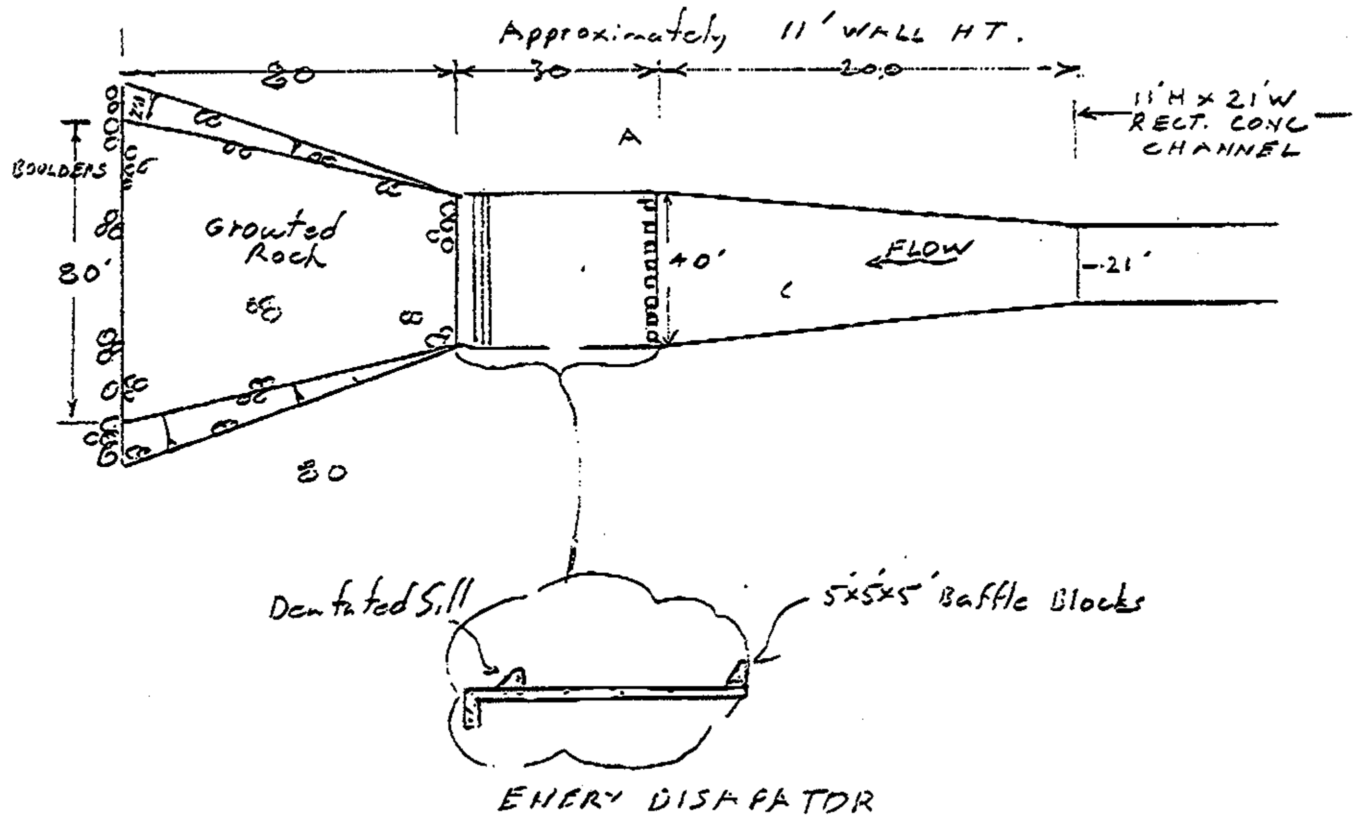
COMPUTATION SHEET

PROJECT ______________ SHEET NO. 6 OF 6 SHEETS

ITEM FAN 5 & 6 OUTLET STRUCTURE DATE ________, 1996

Between Cave Crk Rd & 40th St. FILE ______

COMPUTED BY ________ CHECKED BY ________ REF. DRWG. NO. ________



SPD FORM OCT 74 284

ENCLOSURE 4.5

APPENDIX C: COST ESTIMATES

P.2

DRAFT

SUMMARY TABLE

21-Feb-96

NORTH SCOTTSDALE RECONNAISSANCE STUDY
PROPOSED PLAN SUMMARY

	FEATURE	CHANNEL LENGTH	UNIT	UNIT PRICE WITHOUT CONTINGENCY	TOTAL COST WITHOUT CONTINGENCY	20% CONTINGENCY	TOTAL COST WITH CONTINGENCY	UNIT PRICE WITH CONTINGENCY
09	REATA PASS/BEARDSLEY WASH	3,800	LF	$1,932	7,339,800	1,468,000	8,807,800	$2,300
09	PIMA ROAD CHANNEL	19,900	LF	$1,576	31,355,200	6,271,000	37,626,200	$1,900
04	RAWHIDE DETENTION BASIN	6,200	LF	$955	5,922,100	1,184,400	7,106,500	$1,100
09	UPPER REATA PASS CHANNEL	9,800	LF	$397	3,886,400	777,300	4,663,700	$500
09	FAN NO. 5	22,500	LF	$153	3,452,400	690,500	4,142,900	$200
09	FAN NO. 6	18,100	LF	$235	4,257,900	851,600	5,109,500	$300
09	FAN NO. 5&6	3,000	LF	$347	1,042,100	208,400	1,250,500	$400
	TOTAL CONSTRUCTION COST				$57,255,900		$68,707,100	
30--	PE&D	1	LS	$6,298,149	6,298,100	1,574,500	7,872,600	
31--	S & A	1	LS	$3,607,122	3,607,100	901,800	4,508,900	
01--	LANDS & DAMAGES	735.52	AC				$3,246,560	
	TOTAL PROJECT COST				$67,161,100		$84,335,160	

NOTES:

(1) Real Estate Cost from Study Manager.

(2) Contingency percentage is based on ER 1110-2-1302 dated 31 March 1994, recommedation of 20% contingency factor which represents a reasonable percentage for the Reconnaissance stage.

(3) Eleven percent (11%) of Total Construction for PE&D.

(4) Six and a half percent (6.3%) of Total Construction for S&A.

FEB 21 '96 15:47

DRAFT

TABLE 1

FILE: A:\SCOT96_R.WQ1

20-Feb-96

NORTH SCOTTSDALE RECONNAISSANCE STUDY
Reata Pass/Beardsley Wash

ITEM NO.	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	COST WITHOUT CONTINGENCY	CONTINGENCY	COST WITH CONTINGENCY	CONTINGENCY PERCENT
09—	CHANNELS AND CANALS							
0902.B	EXCAVATION (SHORT HAUL)	87,215	CY	$1.38	120,400	24,100	144,500	20.0%
0902.B	SOIL CEMENT	20,270	CY	$9.00	182,400	36,500	218,900	20.0%
0902.B	FLOODWALL TYPE "B"	400	LF	$415.00	166,000	33,200	199,200	20.0%
0902.B	SOIL CEMENT LEVEE	49,000	SF	$80.00	3,920,000	784,000	4,704,000	20.0%
0902.B	SIGNAGE	1	LS	$8,800.00	8,800	1,800	10,600	20.0%
0902.B	REVEGATATION	1,656,600	SF	$0.95	1,574,000	314,800	1,888,800	20.0%
090--	SALVAGE/REVEGATATION	2,907,000	SF	$0.45	1,308,200	261,600	1,569,800	20.0%
090--	AESTHETIC TREATMENT	1	LS	$60,000.00	60,000	12,000	72,000	20.0%
					0	0	0	0.0%
					0	0	0	0.0%
					0	0	0	0.0%
	TOTAL CONSTRUCTION COST				$7,339,800		$8,807,800	
30--	PE&D	1	LS	$807,378.00	807,400	161,500	968,900	20.0%
31--	S & A	1	LS	$462,407.40	462,400	92,500	554,900	20.0%
01--	LANDS & DAMAGES	435	AC	$3,000.00			1,305,000	
	TOTAL PROJECT COST				$8,609,600		$11,636,600	

NOTES:

(1) Real Estate Cost from Project Manager.

(2) Contingency percentage is based on ER 1110-2-1302 dated 31 March 1994, recommedation of 20% contingency factor which represents a reasonable percentage for the Reconnaissance stage.

(3) Eleven percent (11%) of Total Construction for PE&D.

(4) Six and 1/3 percent (6.3%) of Total Construction for S&A.

FEB 21 '96 15:47

P.4

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TABLE 2

20-Feb-96

NORTH SCOTTSDALE RECONNAISSANCE STUDY Pima Road Channel								
ITEM NO.	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	COST WITHOUT CONTINGENCY	CONTINGENCY	COST WITH CONTINGENCY	CONTINGENCY PERCENT
09—	CHANNELS AND CANALS							
0902.B	EXCAVATION (SANDY GRAVEL)	325,758	CY	$2.45	798,100	159,600	957,700	20.0%
0902.B	EXCAVATION (SHORT HAUL)	188,282	CY	$1.38	259,800	52,000	311,800	20.0%
0902.B	CONCRETE	1,100	SF	$21.00	23,100	4,600	27,700	20.0%
0902.B	8" REINFORCEMENT CONCRETE LINING	1,815,830	SF	$12.75	23,151,800	4,630,400	27,782,200	20.0%
0902.B	SIGNAGE	1	LS	$10,000.00	10,000	2,000	12,000	20.0%
0902.B	REVEGATATION	688,000	LF	$0.93	634,600	126,900	761,500	20.0%
	SALVAGE/REVEGATATION	3,439,000	SF	$0.45	1,547,600	309,500	1,857,100	20.0%
	GRADE CONTROL STRUCTURES	12	EA	$12,120.00	145,400	29,100	174,500	20.0%
	BRIDGES (< 150')	44,080	SF	$54.00	2,380,300	476,100	2,856,400	20.0%
	BRIDGES (> 150')	32,800	SF	$60.00	1,968,000	393,600	2,361,600	20.0%
	UTILITY RELOC (DRP EX LINE)	7	EA	$12,000.00	84,000	16,800	100,800	20.0%
	UTILITY RELOC (DRP EX STBOUT)	8	EA	$2,400.00	19,200	3,800	23,000	20.0%
	AESTHETIC TREATMENT	1	LS	$240,000.00	240,000	48,000	288,000	20.0%
	EMERGENCY ACCESS	6	EA	$15,550.00	93,300	18,700	112,000	20.0%
					0	0	0	0.0%
					0	0	0	0.0%
	TOTAL CONSTRUCTION COST				$31,356,200		$37,628,300	
30–	PE&D	1	LS	$3,449,072.00	3,449,100	689,800	4,138,900	20.0%
31–	S & A	1	LS	$1,975,377.00	1,975,400	395,100	2,370,500	20.0%
01–	LANDS & DAMAGES	143	AC	$3,000.00			429,000	0.0%
	TOTAL PROJECT COST				$36,779,700		$44,564,700	

NOTES:

(1) Real Estate Cost from Project Manager.

(2) Contingency percentage is based on ER 1110-2-1302 dated 31 March 1994, recommedation of 20% contingency factor which represents a reasonable percentage for the Reconnaissance stage.

(3) Eleven percent (11%) of Total Construction for PE&D.

(4) Six and 1/3 percent (6.3%) of Total Construction for S&A.

FEB 21 '96 15:48

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TABLE 3

20-Feb-96

NORTH SCOTTSDALE RECONNAISSANCE STUDY
Rawhide Detention Basin

ITEM NO.	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	COST WITHOUT CONTINGENCY	CONTINGENCY	COST WITH CONTINGENCY	CONTINGENCY PERCENT
04— DAMS								
030--	RESERVOIR CONSTRUCTION	1	LS	$2,600,000.00	2,600,000	520,000	3,120,000	20.0%
041--	EARTH DAM EMBANKMENT CONSTR	1	LS	$1,600,000.00	1,600,000	320,000	1,920,000	20.0%
042--	SPILLWAY	1	LS	$866,200.00	866,200	173,200	1,039,400	20.0%
04--	DOWNSTREAM IMPROVEMENT	1	LS	$35,890.00	35,900	7,200	43,100	20.0%
04--	SITE DEVELOPMENT	1	LS	$820,000.00	820,000	164,000	984,000	20.0%
								0.0%
								0.0%
								0.0%
								0.0%
								0.0%
								0.0%
	TOTAL CONSTRUCTION COST				$5,922,100		$7,106,500	
30--	PE&D	1	LS	$651,431.00	651,400	130,300	781,700	20.0%
31--	S & A	1	LS	$373,092.30	373,100	74,600	447,700	20.0%
01--	LANDS & DAMAGES	80	AC	$5,000.00			400,000	0.0%
	TOTAL PROJECT COST				$6,946,600		$8,735,900	

NOTES:

(1) Real Estate Cost fiom Project Manager.

(2) Contingency percentage is based on ER 1110-2-1302 dated 31 March 1994, recommedation of 20% contingency factor which represents a reasonable percentage for the Reconnaissance stage.

(3) Eleven percent (1·%) of Total Construction for PE&D.

(4) Six and 1/3 percent (6.3%) of Total Construction for S&A.

DRAFT

TABLE 4

20-Feb-96

ITEM NO.	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	COST WITHOUT CONTINGENCY	CONTINGENCY	COST WITH CONTINGENCY	CONTINGENCY PERCENT
NORTH SCOTTSDALE RECONNAISSANCE STUDY Upper Reata Pass Channel								
09--- CHANNELS AND CANALS								
0902.B	EXCAVATION	86,763	CY	$2.45	212,600	42,500	255,100	20.0%
0902.B	RIP-RAP	5,555	CY	$40.00	222,200	44,400	266,600	20.0%
0902.B	GABIONS	3,333	SY	$75.00	250,000	50,000	300,000	20.0%
0902.B	SOIL CEMENT	12,544	CY	$9.00	112,900	22,600	135,500	20.0%
0902.B	8" REINFORCED CONCR LINING	29,000	SF	$12.75	369,800	74,000	443,800	20.0%
0902.B	LEVEE TYPE "B"	1,100	LF	$420.00	462,000	92,400	554,400	20.0%
0902.B	FLOODWALL TYPE "A"	300	LF	$240.00	72,000	14,400	86,400	20.0%
0902.B	COMBINATION FLOODWALL\LEVEE TYPE "A"	3,900	LF	$250.00	975,000	195,000	1,170,000	20.0%
	SIGNAGE	1	LS	$12,000.00	12,000	2,400	14,400	20.0%
	EMERGENCY ACCESS	1	EA	$17,940.00	17,900	3,600	21,500	20.0%
	REVEGATION	328,000	SF	$0.95	311,600	62,300	373,900	20.0%
	SALVAGE/REVEGATION	328,000	SF	$0.45	147,600	29,500	177,100	20.0%
	BRIDGES (< 150')	8,560	SF	$55.00	470,800	94,200	565,000	20.0%
	AESTHETIC TREATMENT	1	LS	$250,000.00	250,000	50,000	300,000	20.0%
	TOTAL CONSTRUCTION COST				$3,886,400		$4,663,700	
30--	PE&D	1	LS	$427,504.00	427,500	85,500	513,000	20.0%
31--	S & A	1	LS	$252,616.00	252,600	50,500	303,100	20.0%
01--	LANDS & DAMAGES	40	AC	$3,000.00			1,000,000	
	TOTAL PROJECT COST				$4,566,500		$6,479,600	

NOTES:

(1) Real Estate Cost from Project Manager.

(2) Contingency percentage is based on ER 1110-2-1302 dated 31 March 1994, recommedation of 20% contingency factor which represents a reasonable percentage for the Reconnaissance stage.

(3) Eleven percent (11%) of Total Construction for PE&D.

(4) Six and 1/3 percent (6.3%) of Total Construction for S&A.

DRAFT

TABLE 5

20-Feb-96

NORTH SCOTTSDALE RECONNAISSANCE STUDY
Fan No. 5

ITEM NO.	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	COST WITHOUT CONTINGENCY	CONTINGENCY	COST WITH CONTINGENCY	CONTINGENCY PERCENT
09—	CHANNELS AND CANALS							
0902.B	EXCAVATION	447,821	CY	$2.00	895,600	179,100	1,074,700	20.0%
0902.B	COMPACTION	179,383	CY	$2.58	462,800	92,600	555,400	20.0%
0902.B	SOIL CEMENT BERMS	5,784	CY	$9.50	54,900	11,000	65,900	20.0%
0902.B	SELECTED PLANTING	14	AC	$1,200.00	16,200	3,200	19,400	20.0%
0902.B	GROUTED STONES	3,476	CY	$90.00	312,800	62,600	375,400	20.0%
0902.B	INLET TOWER (48" CMP)	1	EA	$11,960.00	12,000	2,400	14,400	20.0%
0902.B	DRAIN PIPE (36" RCP)	310	LF	$67.00	20,800	4,200	25,000	20.0%
	CONCRETE CHANNEL	11,967	CY	$125.00	1,495,900	299,200	1,795,100	20.0%
	BRIDGES (6 EA)	3,024	SF	$60.00	181,400	36,300	217,700	20.0%
					0	0	0	0.0%
					0	0	0	0.0%
					0	0	0	0.0%
	TOTAL CONSTRUCTION COST				$3,452,400		$4,143,000	
30--	PE&D	1	LS	$379,764.00	379,800	76,000	455,800	20.0%
31--	S & A	1	LS	$217,501.20	217,500	43,500	261,000	20.0%
01--	LANDS & DAMAGES	19	AC	$3,000.00			57,000	
	TOTAL PROJECT COST				$4,049,700		$4,916,600	

NOTES:

(1) Real Estate Cost from Project Manager.

(2) Contingency percentage is based on ER 1110-2-1302 dated 31 March 1994, recommedation of 20% contingency factor which represents a reasonable percentage for the Reconnaissance stage.

(3) Eleven percent (11%) of Total Construction for PE&D.

(4) Six and 1/3 percent (6.3%) of Total Construction for S&A.

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TABLE 6 **DRAFT**

20-Feb-96

NORTH SCOTTSDALE RECONNAISSANCE STUDY
Fan No. 6

ITEM NO.	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	COST WITHOUT CONTINGENCY	CONTINGENCY	COST WITH CONTINGENCY	CONTINGENCY PERCENT
09—	CHANNELS AND CANALS							
0902.B	EXCAVATION	303,308	CY	$2.00	606,600	121,300	727,900	20.0%
0902.B	COMPACTION	140,261	CY	$2.58	361,900	72,400	434,300	20.0%
0902.B	SOIL CEMENT BERMS	1,460	CY	$9.50	13,900	2,800	16,700	20.0%
0902.B	SELECTED PLANTING	2	AC	$1,200.00	2,600	500	3,100	20.0%
0902.B	GROUTED STONES	1,030	CY	$90.00	92,700	18,500	111,200	20.0%
0902.B	INLET TOWER (48" CMP)	1	EA	$12,000.00	12,000	2,400	14,400	20.0%
0902.B	DRAIN PIPE (36" RCP)	300	LF	$68.00	20,400	4,100	24,500	20.0%
	CONCRETE CHANNEL	23,888	CY	$125.00	2,985,600	597,200	3,583,000	20.0%
	BRIDGES (6 EA)	2,700	SF	$60.00	162,000	32,400	194,400	20.0%
					0	0	0	0.0%
					0	0	0	0.0%
					0	0	0	0.0%
	TOTAL CONSTRUCTION COST				$4,257,900		$5,109,500	
30–	PE&D	1	LS	$468,369.00	468,400	93,700	562,100	20.0%
31–	S & A	1	LS	$268,247.70	268,200	53,600	321,800	20.0%
01–	LANDS & DAMAGES	15.32	AC	$3,000.00			45,960	
	TOTAL PROJECT COST				$4,994,500		$6,039,360	

NOTES:

(1) Real Estate Cost from Project Manager.

(2) Contingency percentage is based on ER 1110-2-1302 dated 31 March 1994, recommedation of 20% contingency factor which represents a reasonable percentage for the Reconnaissance stage.

(3) Eleven percent (11%) of Total Construction for PE&D.

(4) Six and 1/3 percent (6.3%) of Total Construction for S&A.

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P.8

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TABLE 7

20-Feb-96

NORTH SCOTTSDALE RECONNAISSANCE STUDY
Fan No. 5&6

ITEM NO.	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	COST WITHOUT CONTINGENCY	CONTINGENCY	COST WITH CONTINGENCY	CONTINGENCY PERCENT
09---	CHANNELS AND CANALS							
0902.B	EXCAVATION	79,075	CY	$2.00	158,200	31,600	189,800	20.0%
0902.B	COMPACTATION	27,515	CY	$2.58	71,000	14,200	85,200	20.0%
0902.B	CONCRETE	5,896	CY	$125.00	737,000	147,400	884,400	20.0%
0902.B	GROUTED STONE APON	330	CY	$80.00	26,400	5,300	31,700	20.0%
0902.B	BRIDGE	900	SF	$55.00	49,500	9,900	59,400	20.0%
					0	0	0	0.0%
					0	0	0	0.0%
					0	0	0	0.0%
					0	0	0	0.0%
	TOTAL CONSTRUCTION COST				$1,042,100		$1,250,500	
30--	PE&D	1	LS	$114,631.00	114,600	22,900	137,500	20.0%
31--	S & A	1	LS	$65,652.30	65,700	13,100	78,800	20.0%
01--	LANDS & DAMAGES	3.2	AC	$3,000.00			9,600	
	TOTAL PROJECT COST				$1,222,400		$1,476,400	

NOTES:

(1) Real Estate Cost from Project Manager.

(2) Contingency percentage is based on ER 1110-2-1302 dated 31 March 1994, recommedation of 20% contingency factor which represents a reasonable percentage for the Reconnaissance stage.

(3) Eleven percent (11%) of Total Construction for PE&D.

(4) Six and 1/3 percent (6.3%) of Total Construction for S&A.

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APPENDIX D: ECONOMICS

US Army Corps
of Engineers®

Los Angeles District

NORTH SCOTTSDALE, ARIZONA
RECONNAISSANCE STUDY

R4 ECONOMIC APPENDIX

Economics & Social Analysis Section
February 1996

North Scottsdale Reconnaissance Study
Economic Appendix

Table of Contents

1.0 INTRODUCTION

1.1 PURPOSE

The purpose of this economic reconnaissance report is to describe the without project conditions in the alluvial fan floodplains which originate in North Scottsdale, Arizona, and evaluate preliminary flood control alternatives to determine if there is federal interest.

1.2 METHODOLOGY

Without project conditions will be expressed in terms of expected annual flood damages and costs. The analysis employs the currently established discount rate of 7 5/8 percent. The period of analysis is 50 years, and flood damages are computed at October 1995 price levels.

2.0 STUDY AREA

2.1 100-YEAR OVERFLOW AREA

Delineations of the 100-year overflow areas in the study area were obtained from FEMA flood insurance rate maps. Exhibit 1 (page 2) shows the delineation of the 100-year overflow areas, which encompass approximately 11,290 acres in North Scottsdale, as well as approximately 5,920 acres in incorporated and unincorporated areas of the City of Phoenix.

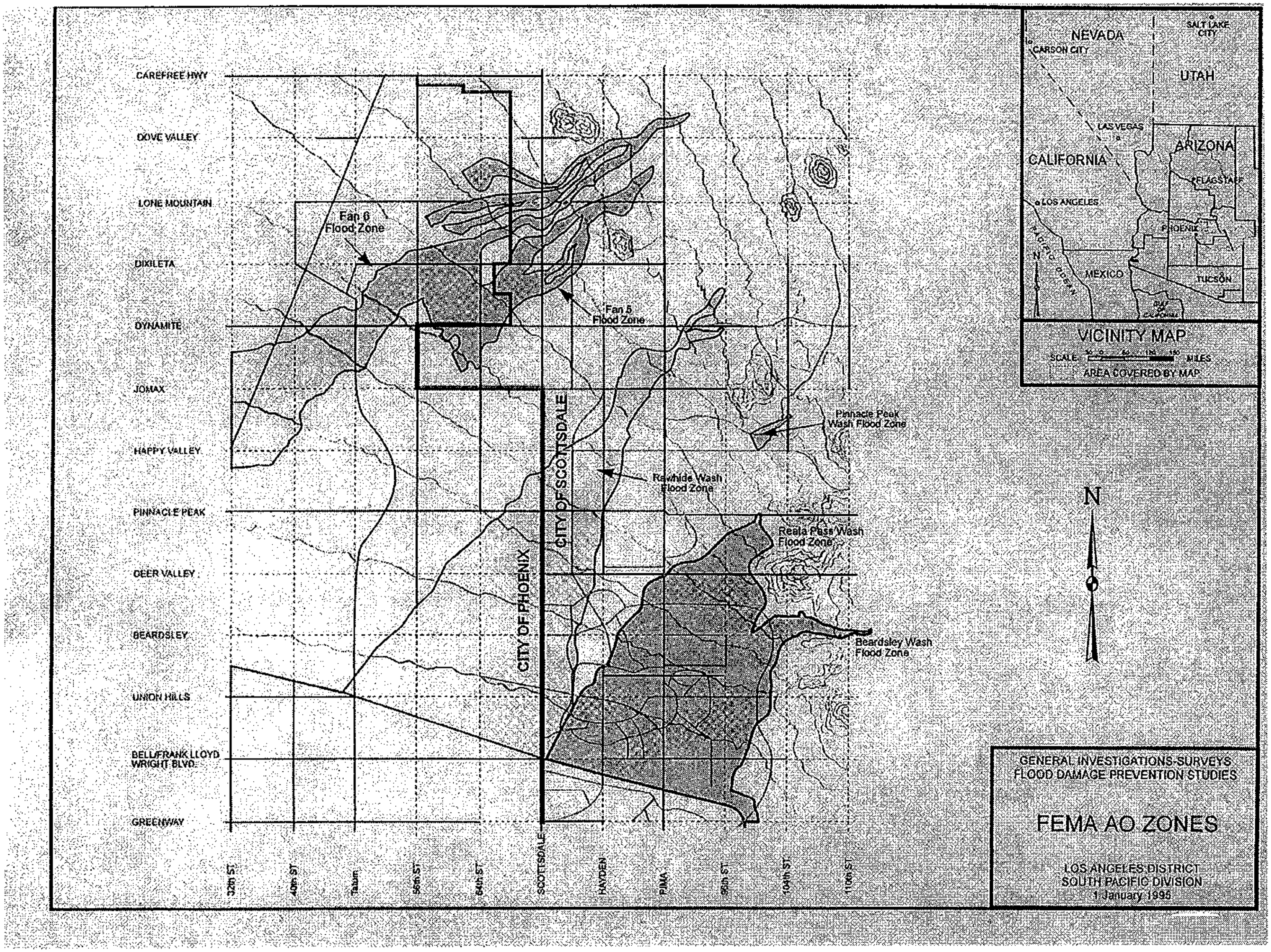
The overflow areas are comprised of alluvial fans. As will be described later, alluvial fans exhibit erratic flowpaths during flooding. Therefore, the exact location of flooding during an actual flood event cannot be accurately predicted. The overflow boundaries displayed on Exhibit 1 depict the entire area which could be subject to flooding during a 100-year event. The flowpath during an actual flood event would be located somewhere within these boundaries. However, the width of the overflow area during an actual flood event would only represent a narrow strip within the boundaries depicted on Exhibit 1.

As shown on Exhibit 1, there are five alluvial fans in the study area. The three primary fans are those formed by the Rawhide, Beardsley, and Reata Pass washes. There are two additional fans located north of these fans, which are identified as Fans 5 and 6.

2.1.1 Rawhide Wash

The Rawhide Wash alluvial fan encompasses approximately 3,160 acres east of Scottsdale Road in North Scottsdale, and approximately 4,000 acres west of Scottsdale Road in incorporated and unincorporated areas of the City of Phoenix. As shown on Exhibit 1, Rawhide wash originates north of Dynamite Boulevard and east of Pima Road. Runoff from tributaries and the main wash flows to the southwest along narrow braided washes crossing Jomax Road, Happy Valley Road and Pinnacle Peak Road prior to emptying onto state land within the City of Phoenix west of Scottsdale Road. The Rawhide Wash 100-year overflow area widens considerably south of its apex (which is

EXHIBIT 1: STUDY AREA MAP



located just north of Happy Valley Road) and extends south to the Central Arizona Project canal.

2.1.2 Beardsley and Reata Pass Washes

The combined alluvial fan areas of Beardsley and Reata Pass washes encompass approximately 5,890 acres in North Scottsdale. Beardsley and Reata Pass washes are located southeast of Rawhide wash. Reata Pass wash originates at the mouth of a canyon south of Pinnacle Peak Road and west of the McDowell Mountain Range. Its apex begins breaking out of its natural path and creates a drainage fan that spreads to the southwest, bordered to the east by the foothills of the McDowell Mountains and spreading west nearly to Scottsdale Road. The toe, or southern boundary of the fan, ends north of the CAP.

A second mountain canyon drains into the Beardsley wash, which adds to stormwater runoff on the alluvial fan area. There are two separate branches of the Beardsley wash located south and east of the Reata Pass wash apex that drain southwesterly across the Reata Pass fan.

2.1.3 Fans 5 and 6

Fans 5 and 6 are formed by washes which originate north of the Rawhide Wash and drain in a southwesterly direction. Fan 5 encompasses approximately 1,254 acres within incorporated and unincorporated portions of the City of Scottsdale. Fan 6 consists of approximately 2,906 acres, of which 986 acres are located in Scottsdale, and 1,920 acres are located in Phoenix[1].

As several washes converge, the Fan 5 overflow boundary widens considerably southwest of Dixileta Drive and Scottsdale Road. The Fan 5 drainage area continues to widen as it extends southwesterly nearly to 56th street.

The upstream end of Fan 6 (which is located directly above Fan 5) originates near the intersection of Dove Valley and Pima Roads in the City of Scottsdale. However, the drainage fan does not begin to widen substantially until it reaches 64th Street. Fan 6 continues to spread in a southwesterly direction into the City of Phoenix south of Dixileta Drive. The downstream limit of the fan extends to Cave Creak Road.

2.2 POPULATION

2.2.1 Phoenix Metropolitan Area

The City of Phoenix, along with the cities of Scottsdale, Tempe, Glendale, Mesa and Chandler, comprise the Phoenix metropolitan area. According to the U.S. Census, the Phoenix metropolitan

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[1]Note: Portions of both Fan 5 and Fan 6 are located within Maricopa County land boundaries. For simplification purposes, acreage estimates were divided between the Cities of Phoenix and Scottsdale according to City planning unit/zone boundaries. Scottsdale Planning Zone E's western boundary extends to 56th Street, which has been used as the dividing line between Phoenix and Scottsdale for these acreage estimates.

area's 1990 population exceeded 2.1 million. By the year 2000, the Phoenix metropolitan area's population is projected to reach over 2.8 million.

2.2.2 Scottsdale

The City of Scottsdale has the fifth largest population of all of the incorporated communities in the Phoenix metropolitan area. From 1980 to 1990, Scottsdale's population grew 47 percent, from 88,412 to 130,069. By January 1, 1995, Scottsdale's population grew an additional 22.6 percent to 159,404 (representing an annual compound growth rate of approximately 4.2 percent).

Scottsdale's Planning and Community Development Department ("PCDD") has developed growth projections for the city based upon four different future development scenarios, ranging from low density/low growth to high density/high growth. By the year 2015, the Scottsdale's population is forecast to range from 201,980 under the low-growth scenario to 308,230 under the high-growth scenario.

2.2.3 Study Area

The combined area of the five alluvial fans in the study area totals 17,210 acres, of which 11,290 acres (or 66 percent) are located in the City of Scottsdale, and 5,920 acres (or 34 percent) are located in the City of Phoenix.

<u>Scottsdale</u>

Scottsdale's PCDD has defined 5 separate planning zones, each representing different geographic sections of the city. The Scottsdale portions of the 100-year floodplains are encompassed within three of these planning zones -- Zones "C", "D" and "E".

Planning Zone "C"

The southern portion of the alluvial fans formed by Rawhide, Beardsley and Reata Pass Washes resides within Planning Zone "C". Zone C encompasses approximately 58 square miles and is bounded on the north by Deer Valley Road, on the south by the CAP Canal and Double Tree Ranch Road, on the west by Scottsdale Road, and on the east by 136th Street. The total population within Zone C was approximately 43,140 as of January 1, 1995. It should be noted that most of the population within this zone is located in the southern portion (south of Bell Road), whereas the floodplain only extends through the northern half of Zone C, which is currently primarily undeveloped. Based upon the four future development scenarios described earlier, Zone C's population is projected to range from 75,990 to 109,700 by the year 2015. Analysis of aerial photography, area maps and field surveys indicate that approximately 40 percent of the land available for future development in Zone C is located within the floodplain.

Planning Zone "D"

The northern portion of the alluvial fans formed by Rawhide, Beardsley and Reata Pass Washes is located in Zone "D". This zone encompasses about 36 square miles and is bounded on the north by Jomax Road and Dixileta Drive, on the south by Deer Valley Road, on the west by Scottsdale Road, and on the east by 136th Street. The area is characterized by low density, desert-oriented upscale residences. Zone D's population at January 1995 totaled 6,880. By the year 2015, this zone's population is projected to range from 10,030 to 34,880. Analysis of aerial photography, area maps and surveys indicate that approximately 12 percent of the land available for future development in Zone C is located within the floodplain.

Planning Zone "E"

Portions of Fans 5 and 6 are located in Zone "E". This zone encompasses about 58 square miles and is bounded on the north by Jenny Lynn Road, on the south by Jomax Road and Dixileta Drive, on the west by 56th Street, and on the east by 136th Street. The area is low density and desert-oriented, appealing to middle class homeowners looking for an alternative to an urban setting. Zone E's population at January 1995 totaled 2,290. By the year 2015, this zone's population is projected to reach approximately 36,760. Analysis of aerial photography, area maps and surveys indicate that approximately nine percent of the land available for future development in Zone E is located within the floodplain.

Phoenix

The Phoenix portion of the Rawhide Wash floodplain (west of Scottsdale Road) is currently undeveloped, except for an Arabian horse ranch (Tom Chauncy Arabians). However, two major developments which will eventually encompass most of the area are currently in the planning phases. The Maricopa County Association of Governments (MAG) and the City of Phoenix Planning Department have developed population projections for Traffic Analysis Zones (TAZ's) in the area. The Phoenix portion of the Rawhide Wash floodplain is located within seven different TAZ's. These TAZ's are projected to reach buildout by the year 2040 with a population of over 33,000 . Over 50 percent of this growth is expected to take place within floodplain boundaries, based upon the ratios of the total area in each TAZ to the portions of each TAZ within the floodplain.

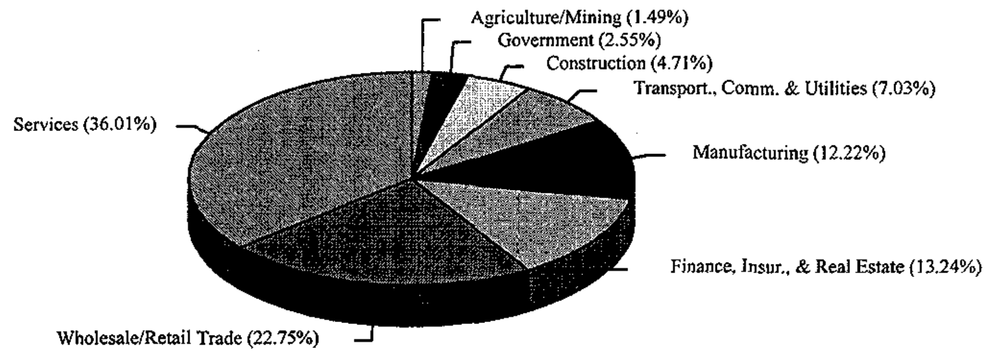
The Phoenix portion of Fan 6 (west of 56th Street) is also primarily undeveloped. For the four TAZ's in which the Phoenix portion of Fan 6 is located, the population is projected to reach over 32,500 by the year 2060. Approximately 40 percent of this growth is expected to take place within Fan 6 boundaries, based upon the proportion of Fan 6 land area to total land area for each TAZ.

2.3 EMPLOYMENT AND ECONOMY

According to the 1990 U.S. Census, the median annual family income of Scottsdale residents was approximately $48,200. This figure ranked near the top for all Arizona communities and was nearly

34% higher than the metropolitan Phoenix median family income of $36,078. The following graph provides a breakdown of Scottsdale's employment by major industry classification.

EXHIBIT 2
Scottsdale Employment By Industry



As shown on Exhibit 2, 72 percent of Scottsdale's workforce is employed in the service, trade and finance sectors. For the Metro Phoenix area as a whole, these sectors only accounted for 62% of total employment. However, the government sector only accounted for 2.5% of Scottsdale's employment, relative to 13.5% for the Metro Phoenix area.

According to Scottsdale's Economic Development Department (EDD), tourism is Scottsdale's largest industry, generating over $1.5 billion in economic activity annually and providing about 25% of the City's jobs. Over 3,500 new hotel rooms have been added in the area since 1980, and three more hotels adding 311 additional rooms are in the planning and construction phases.

However, Scottsdale has diversified its economic base beyond tourism with an increasing number of retail establishments and insurance, health care and other service companies. Table 1 below displays Scottsdale's ten largest employers as of July 1994.

Table 1
Ten Largest Employers in Scottsdale

Company	Employees	Company	Employees
Motorola	5,000	Phoenician Resort	1,200
Scottsdale Memorial Health Systems	3,053	Mayo Clinic	1,200

Scottsdale Unified School District	2,000	Scottsdale Princess Resort	1,150
PCS Health Systems	1,400	Scottsdale Insurance Company	955
City of Scottsdale	1,300	Super Valu, Inc.	950

According to the EDD, Scottsdale is now the largest net importer of labor of all communities in the Phoenix Metro area. From 1980 to 1990, Scottsdale's job growth increased over 90%, while its population only increased by 47%. With the exception of 1992, Scottsdale's average annual unemployment rate has been below 4.0% -- lower than Metro Phoenix and State averages. For the first three months of 1995, Scottsdale's average unemployment rate was only 2.7%. Scottsdale's EDD projects continued job growth and low unemployment rates for the City into the foreseeable future.

Construction activity, as measured by new building permits issued, has increased in each of the last four fiscal years. Scottsdale issued 1,621 permits in 1990/1991; 2,288 in 1991/1992; 2,495 in 1992/1993; and 4,595 in 1993/1994. The EDD attributed the large increase in 1993/1994 to the recovery of the Arizona housing market and a number of aggressive builders from California. Annualized permits issued through March 1995 totaled 4,727, indicating continued strong growth in residential construction. Since it contains most of the available land area in the city, the North Scottsdale area is expected to experience a significant amount of development in the future.

3.0 FLOOD PROBLEM

3.1 NATURE OF FLOOD PROBLEM

The 100-year overflow area is comprised of alluvial fans. Alluvial fans are triangular or fan shaped, gently sloping landforms which often provide attractive development sites due to their commanding views. Alluvial fans are located primarily in western states, where infrequent but intense storms typical of arid climates combined with abrupt changes in topography create the necessary conditions for fan formulation.

Streamflow from intense rainstorms emanates from the confined upstream channels of North Scottsdale's washes and proceeds downstream onto the relatively flat valley area below. Canyon outlets form the apex of each fan, which represents the highest point of elevation on the fan. As described in FEMA's "Alluvial Fans: Hazards and Management" publication (February 1989, page 2), flow leaving the apex of a fan spreads onto the upper-fan area, where it may either follow a pre-existing path cut from past flood events or cut a new path downslope. As the topography flattens, the channels widen and become shallower, losing velocity and depositing sediment and debris. Toward the base of the fan, water velocities are reduced as the fan surface becomes more uniform, its slope flattens and water infiltrates the soil surface. In these areas, sheet flow flooding is common.

Alluvial fans represent severe flood hazard areas due to the unpredictable location and high velocity of their flowpaths during flooding, which usually occurs with little or no advance warning time. According to FEMA (page 3), "An often-overlooked 'hazard' is the tendency to underestimate both the potential and severity of alluvial fan flood events. The infrequent rainfall, gently-sloping terrain, and often long time spans between successive flood contribute to a sense of complacency regarding the existence of possible flood hazards. Though the intense rainstorms which produce fan floods occur randomly, they nevertheless can develop very rapidly at any time, and can recur with any frequency."

3.2 HISTORICAL FLOODING

With only a few exceptions, existing development in the study area is sparse, and most of it has taken place in the past decade. As a result, historical flood damages in the study area have been insignificant. Representatives of the Maricopa County Flood Control District and the City of Scottsdale did not have any information regarding historical inundation damages to structures in the study area, citing the small amount of development (relative to the more densely populated areas of Phoenix and Scottsdale) and the fact that there have been few flood events during the period since development in the study area has taken place.

Although inundation damages during the past few years have been negligible, the City has been required to make expenditures for repairs and preventative maintenance due to minor flooding and associated erosion. During 1993 and 1994, Scottsdale spent $121,231 on contract repairs and maintenance. Clean up costs city wide, including barricades and sand bags, totaled $27,000 in 1993 and $32,275 in 1994. These amounts do not include expenditures made by private developments for repairs, maintenance and clean-up.

In addition, motorists on occasion have tried to navigate through flooded dip crossings (usually despite posted road signs and barricades). As a result, Scottsdale's Emergency Management Department has been required to send an emergency team to assist these motorists. The City's Emergency Services Director indicated that a "Stupid Motorists Bill" has been developed, which requires such motorists to reimburse the City for all or part of the costs incurred.

4.0 FLOODPLAIN INVENTORY

The Rawhide, Beardsley, and Reata Pass floodplains were surveyed in July 1995 to determine the number and type of existing structures and other property susceptible to damage (fans 5 and 6 will be surveyed for the R4 Reconnaissance Report). Inventoried floodplain structures were categorized as follows:

- Single Family Residential
- Mobile Home
- Office
- Commercial
- Other/miscellaneous
- Multi-Family Residential
- Hotel
- Restaurants
- Public Gathering Facilities

4.1 MAJOR EXISTING DEVELOPMENTS

The following represent the primary existing developments in the 100-year floodplain:

Scottsdale Princess Resort/Hotel: This large, plush resort, which is located near the toe of the Rawhide Wash alluvial fan between Scottsdale and Hayden Roads, includes about 600 rooms, a large conference center, restaurants, retail shops and two golf courses. In addition, there are several residential subdivisions located north and east of the resort, including Crown Point, Princess Views, Crown Court, Alkazar, and Resort Suites.

Los Portones: This 136 acre development is located in the Rawhide Wash alluvial fan at the northeast corner of Scottsdale Road and Pinnacle Peak Road. It is now almost completely developed -- mostly with single-family residences. This development also includes the "Pinnacle of Scottsdale Mall", which contains a Safeway grocery store, a First Interstate Bank, and various other retail establishments.

Vistana: A portion of the Rawhide wash runs through this development, which is comprised of about 131 acres and is located south of Jomax Road between Hayden and Pima Roads. Vistana contains many large, upscale single-family residences. As a result of recent studies conducted by the Federal Emergency Management Agency (FEMA), a large portion of this development has been removed from the FEMA designated 100-year floodplain.

Troon North: Troon North is a residential development located near the apex of Rawhide Wash north of Dynamite Road. Structures in the northern portion of the development are located within the 100-year floodplain.

Ironwood Village: This 286 acre development is located in the Beardsley/Reata Pass alluvial fan area east of Pima Road. With approximately 600 completed residential structures, this is the largest existing development in the study area. More homes are still under construction.

Pima Acres: Pima Acres is located just north of Ironwood Village. There are currently less than 30 structures completed in this development, which is zoned at ½ to 1 dwelling units per acre. This development is characterized by large-sized lots with large high-quality residences.

Pinnacle Peak Vistas/Heights: This development is located east of Pima Road, north of Deer Valley and south of Pinnacle Peak Road, and is just south of the Reata Pass wash apex. It contains large upscale residences. Many of the homes feature over 4,000 square feet of living area and sell for over $500,000.

Other significant developments in the North Scottsdale study area include: Rawhide (a western theme park just south of the Los Portones development which contains shopping, arenas and cookout areas); and Westworld (which contains arenas, stables, and restaurants and holds horse shows, rodeos, and similar events).

4.2 DEFINITION OF REACHES

Hydrologic and hydraulic analyses has been conducted to derive discharges, depths of flooding and widths of flooding by event for various cross sections along each fan in the study area. Cross sections were located near the primary areas of existing development and where there are significant differences in hydrologic and topographical characteristics. Existing structures in the floodplain have been categorized according to the cross section to which they are closest. The cross sections for which there is existing development within close proximity include: R1, R2, R2A, R4, and CWP1 in the Reata Pass alluvial fan area; RAW1, RAW3, RAW4, OF2, and OF7 in the Rawhide alluvial fan area; FL51, FL52, FL53, and FL54 in Fan 5; and FL61, FL62, FL63, FL64, and FL65 in Fan 6 . Structure and content values, damages by event, and expected annual inundation damages will be computed for structures located near each of these cross sections.

4.3 NUMBER OF STRUCTURES

Table 2 displays the total number and type of structures in the floodplain. It is important to note that the number of structures displayed on Table 2 represents structures in the 100-year overflow area boundaries which could possibly be flooded. As described in Section 2.1, the study area is subject to alluvial fan flooding, in which the exact location of the flowpath is uncertain. As such, only a small "strip" within the 100-year overflow area boundary will be flooded during an actual flood event. All structures in the 100-year overflow area boundary were counted because it is hydraulically impossible to determine exactly where the "strip" will be located when flooding occurs.

Table 2
North Scottsdale Study Area
Total Number of Structures

Structure Type	Bearsley/Reata Pass Fans	Rawhide Wash Fan	Fan 5	Fan 6	Total
SFR	786	421	276	274	1757
MFR	118	0	3	0	121
MH	0	0	0	22	22
Office	9	7	0	0	16
Commercial	6	24	0	0	30
Industrial/Farm	3	10	3	16	32
Hotel (Buildings)	5	0	0	0	5
Public	6	7	0	0	13
TOTAL	933	469	282	312	1996

4.4 VALUE OF STRUCTURES

The total value of structures in the floodplain has been estimated using the following methodology:

1) Square footage estimates were made based upon: a) information obtained from local subdivision rental offices; 2) unit dimensions from aerial photographs; and 3) visual estimates made during the field survey.
2) Structures were categorized according to construction classification.
3) Condition and age were noted from field surveys.
4) Structure replacement value multipliers were obtained from Marshall & Swift Valuation Service. These multipliers reflect structure type, construction type and construction quality.
5) Adjustments were made to the multipliers to reflect current cost levels for the Scottsdale, Arizona area.
6) Adjusted square foot multipliers were applied to square footage estimates for each structure.

4.5 VALUE OF CONTENTS

Content values were calculated as a percentage of the corresponding replacement values of structures. The following ratios were applied:

Structure Type	Ratio
Single Family Residences	50%
Multi-Family-Residences	50%
Mobile Home	50%
Hotel	100%
Office	109%
Restaurants	102%
Commercial	147%
Public	24%
Industrial/Farm	113%

The above content percentages are based upon previous studies performed in the L.A. District.

Table 3 (pages 12 through 15) provides a detail of structure and content values by cross section. As shown on Table 3, the combined value of structures and contents in the floodplain is nearly $440 million.

Table 3
North Scottsdale Study Area
Value of Structures & Contents (Beardsley/Reata Pass Fans)

Cross Section R1	#	Struct. Value	Content Value	%	Avg. Struct.	Avg. Content
SFR	95	$13,540,045	$6,770,022	50%	$142,527	$71,263
MFR	95	$25,144,423	$12,572,211	50%	$264,678	$132,339
Office	5	$2,543,972	$2,772,929	109%	$508,794	$554,586
Commercial	4	$918,629	$1,103,292	120%	$229,657	$275,823
Industrial/Farm	1	$261,037	$294,972	113%	$261,037	$294,972
Hotel (Buildings)	5	$6,742,327	$6,742,327	100%	$1,348,465	$1,348,465
Public	6	$15,402,995	$3,696,719	24%	$2,567,166	$616,120
Total	211	$64,553,428	$33,952,473	53%	$305,940	$160,912
Cross Section R2	#	Struct. Value	Content Value	%	Avg. Struct.	Avg. Content
SFR	578	$62,234,269	$31,117,135	50%	$107,672	$53,836
MFR	22	$2,628,170	$1,314,085	50%	$119,462	$59,731
Total	600	$64,862,440	$32,431,220	50%	$108,104	$54,052
Cross Section R2A	#	Struct. Value	Content Value	%	Avg. Struct.	Avg. Content
SFR	22	$4,378,651	$2,189,326	50%	$199,030	$99,515
Total	22	$4,378,651	$2,189,326	50%	$199,030	$99,515
Cross Section R4	#	Struct. Value	Content Value	%	Avg. Struct.	Avg. Content
SFR	91	$27,619,453	$13,809,727	50%	$303,510	$151,755
Total	91	$27,619,453	$13,809,727	50%	$303,510	$151,755
Cross Section CWP1	#	Struct. Value	Content Value	%	Avg. Struct.	Avg. Content
Office	4	$285,842	$311,568	109%	$71,460	$77,892
Commercial	2	$811,197	$827,421	102%	$405,599	$413,711
Industrial/Farm	2	$317,410	$358,673	113%	$158,705	$179,337
Total	8	$1,414,449	$1,497,662	106%	$176,806	$187,208

Continued on next page.

Table 3 Continued
North Scottsdale Study Area
Value of Structures & Contents (Rawhide Wash Fan)

Cross Section RAW1	#	Struct. Value	Content Value	%	Avg. Struct.	Avg. Content
SFR	3	$166,847	$83,424	50%	$55,616	$27,808
Office	3	$239,451	$261,001	109%	$79,817	$87,000
Industrial/Farm	5	$434,627	$491,129	113%	$86,925	$98,226
Total	11	$840,925	$835,554	99%	$76,448	$75,959

Cross Section RAW3	#	Struct. Value	Content Value	%	Avg. Struct.	Avg. Content
Office	4	$138,201	$150,639	109%	$34,550	$37,660
Commercial	22	$2,498,373	$2,817,057	113%	$113,562	$128,048
Industrial/Farm	5	$222,809	$251,775	113%	$44,562	$50,355
Public	6	$578,311	$138,795	24%	$96,385	$23,132
Total	37	$3,437,694	$3,358,265	98%	$92,911	$90,764

Cross Section RAW4	#	Struct. Value	Content Value	%	Avg. Struct.	Avg. Content
SFR	363	$51,862,950	$25,931,475	50%	$142,873	$71,437
Commercial	2	$9,380,767	$13,789,728	147%	$4,690,384	$6,894,864
Public	1	$219,707	$52,730	24%	$219,707	$52,730
Total	366	$61,463,424	$39,773,933	65%	$167,933	$108,672

Cross Section OF2	#	Struct. Value	Content Value	%	Avg. Struct.	Avg. Content
SFR	21	$2,584,122	$1,292,061	50%	$123,053	$61,527
Total	21	$2,584,122	$1,292,061	50%	$123,053	$61,527

Cross Section OF7	#	Struct. Value	Content Value	%	Avg. Struct.	Avg. Content
SFR	34	$5,814,274	$2,907,137	50%	$171,008	$85,504
Total	34	$5,814,274	$2,907,137	50%	$171,008	$85,504

Continued on next page.

Table 3 Continued
North Scottsdale Study Area
Value of Structures & Contents (Fans 5&6)

Cross Section FL51	#	Struct. Value	Content Value	%	Avg. Struct.	Avg. Content
SFR	113	$8,954,968	$4,477,484	50%	$79,248	$39,624
MFR	3	$985,293	$492,647	50%	$328,431	$164,216
Total	116	$9,940,261	$4,970,131	50%	$85,692	$42,846
Cross Section FL52	#	Struct. Value	Content Value	%	Avg. Struct.	Avg. Content
SFR	66	$5,526,278	$2,763,139	50%	$83,731	$41,866
Industrial/Farm	3	$140,658	$158,943	113%	$46,886	$52,981
Total	69	$5,666,936	$2,922,082	52%	$82,130	$42,349
Cross Section FL53	#	Struct. Value	Content Value	%	Avg. Struct.	Avg. Content
SFR (Total)	76	$12,010,383	$6,005,192	50%	$158,031	$79,016
Cross Section FL54	#	Struct. Value	Content Value	%	Avg. Struct.	Avg. Content
SFR (Total)	21	$1,969,822	$984,911	50%	$93,801	$46,901
Cross Section FL61	#	Struct. Value	Content Value	%	Avg. Struct.	Avg. Content
SFR	81	$5,239,651	$2,619,825	50%	$64,687	$32,344
MH	8	$164,244	$82,122	50%	$20,531	$10,265
Industrial/Farm	8	$205,201	$231,877	113%	$25,650	$28,985
Total	97	$5,609,096	$2,933,825	52%	$57,826	$30,246
Cross Section FL62	#	Struct. Value	Content Value	%	Avg. Struct.	Avg. Content
SFR	18	$1,039,566	$519,783	50%	$57,754	$28,877
MH	7	$184,021	$92,010	50%	$26,289	$13,144
Industrial/Farm	4	$94,183	$106,427	113%	$23,546	$26,607
Total	29	$1,317,770	$718,220	55%	$45,440	$24,766
Cross Section FL63	#	Struct. Value	Content Value	%	Avg. Struct.	Avg. Content
SFR	90	$5,558,181	$2,779,091	50%	$61,758	$30,879
MH	3	$57,236	$28,618	50%	$19,079	$9,539
Industrial/Farm	2	$37,735	$42,640	113%	$18,867	$21,320
Total	95	$5,653,152	$2,850,349	50%	$59,507	$30,004
Cross Section FL64	#	Struct. Value	Content Value	%	Avg. Struct.	Avg. Content
SFR	70	$3,638,056	$1,819,028	50%	$51,972	$25,986
MH	4	$87,260	$43,630	50%	$21,815	$10,907
Industrial/Farm	2	$34,445	$38,923	113%	$17,222	$19,461
Total	76	$3,759,761	$1,901,580	51%	$49,471	$25,021
Cross Section FL65	#	Struct. Value	Content Value	%	Avg. Struct.	Avg. Content
SFR (Total)	15	$990,689	$495,345	50%	$66,046	$33,023

Continued on Next Page

Table 3 Continued
North Scottsdale Study Area
Value of Structures & Contents (Summary)

TOTAL (Reata /Beardsley)	#	Struct. Value	Content Value	%	Avg. Struct.	Avg. Content
SFR	786	$107,772,418	$53,886,209	50%	$137,115	$68,558
MFR	118	$27,772,418	$13,886,297	50%	$235,361	$117,680
Office	9	$2,829,813	$3,084,497	109%	$314,424	$342,722
Commercial	6	$1,729,826	$1,930,713	112%	$288,304	$321,786
Industrial/Farm	3	$578,447	$653,645	113%	$192,816	$217,882
Hotel (Buildings)	5	$6,742,327	$6,742,327	100%	$1,348,465	$1,348,465
Public	6	$15,402,995	$3,696,719	24%	$2,567,166	$616,120
Total	594	$162,828,420	$83,880,407	52%	$174,521	$89,904
TOTAL (Rawhide)	#	Struct. Value	Content Value	%	Avg. Struct.	Avg. Content
SFR	421	$60,428,193	$30,214,097	50%	$143,535	$71,767
Office	7	$377,651	$411,640	109%	$53,950	$58,806
Commercial	24	$11,879,140	$16,606,785	140%	$494,964	$691,949
Industrial/Farm	10	$657,436	$742,903	113%	$65,744	$74,290
Public	7	$798,018	$191,524	24%	$114,003	$27,361
Total	594	$74,140,439	$48,166,950	65%	$158,082	$102,701
TOTAL (Fan 5)	#	Struct. Value	Content Value	%	Avg. Struct.	Avg. Content
SFR	276	$28,461,451	$14,230,725	50%	$103,121	$51,561
MFR	3	$985,293	$492,647	50%	$328,431	$164,216
Industrial/Farm	3	$140,658	$158,943	113%	$46,886	$52,981
Total	282	$29,587,402	$14,882,315	50%	$104,920	$52,774
TOTAL (Fan 6)	#	Struct. Value	Content Value	%	Avg. Struct.	Avg. Content
SFR	274	$16,466,143	$8,233,072	50%	$60,095	$30,048
MH	22	$492,761	$246,380	50%	$22,398	$11,199
Industrial/Farm	16	$371,564	$419,867	113%	$23,223	$26,242
Total	594	$17,330,467	$8,899,319	51%	$55,546	$28,523
GRAND TOTAL (All Reaches)	#	Struct. Value	Content Value	%	Avg. Struct.	Avg. Content
SFR	1757	$213,128,205	$106,564,103	50%	$121,302	$60,651
MFR	121	$28,796,577	$14,398,288	50%	$237,988	$118,994
MH	22	$492,761	$246,380	50%	$22,398	$11,199
Office	16	$3,207,465	$3,496,137	109%	$200,467	$218,509
Commercial	30	$13,608,966	$18,537,499	13600%	$453,632	$617,917
Industrial/Farm	32	$1,748,105	$1,975,359	113%	$54,628	$61,730
Hotel (Buildings)	5	$6,742,327	$6,742,327	100%	$1,348,465	$1,348,465
Public	13	$16,201,013	$3,888,243	24%	$1,246,232	$299,096
Total	1996	$283,925,420	$155,848,336	55%	$142,247	$78,080

5.0 FLOODPLAIN DAMAGE EVALUATION (EXISTING DEVELOPMENT)

This section describes the methodology used to compute the damages expected to be sustained in the North Scottsdale floodplain to existing development. These damages include inundation to floodplain structures and contents.

5.1 DAMAGES BY FLOOD EVENT

Inundation damages to existing structures have been calculated for the 10, 50, 100 and 500 year events for present without-project conditions. The following methodology was employed:

1) Estimated first-floor elevations were noted during the floodplain survey.

2) Average flood depths for the 10, 50, 100 and 500-year floods were provided by the Hydraulics Section. Note that these flood depths only apply to a narrow "strip" which could be located anywhere within the 100-year overflow boundary during an actual flood event.

3) Inundation depths for each structure were determined by subtracting the first floor elevation from the appropriate average flood depth. These inundation depths are based upon the assumption that the structure will be located within the path of flooding during a flood event.

4) Structure and content damages were estimated as a percentage of structure and content values. The percentages, provided by the Federal Emergency Management Agency (1994), vary according to structure type and inundation depth.

5) The probability that a particular structure would be located within the flowpath (and therefore sustain damages) during a given flood event was estimated by dividing the width of flooding for the event by the width of the entire floodplain at the location (cross section) of the structure.

6) Structure and content damage estimates were discounted by applying the probabilities discussed in 5) above.

The Hydraulics Section has estimated the non-damaging event as the two year event for the entire study area except for several of the existing developments which have substantial flood control infrastructure in place, including the Princess Resort, Ironwood Village, and Los Portones. Table 4 (pages 17-20) details structure and content damages by event for each cross section under existing without-project conditions.

Table 4
North Scottsdale Study Area (Beardsley/Reata Pass Fans)
Structures & Content Damages By Event -- Present Conditions

R1	10 YR		50YR		100 YR		500 YR	
	STRUC	CONT	STRUC	CONT	STRUC	CONT	STRUC	CONT
SFR	$42,509	$25,591	$105,314	$76,406	$165,316	$112,282	$325,091	$204,736
MFR	$66,114	$39,801	$195,573	$141,890	$306,998	$208,513	$603,708	$380,204
Office	$2,333	$2,382	$19,787	$22,866	$31,060	$33,460	$61,080	$80,129
Commercial	$1,452	$1,777	$7,428	$9,380	$11,348	$13,655	$22,128	$32,335
Industrial/Farm	$1,066	$1,277	$2,671	$3,134	$3,624	$4,432	$6,507	$9,680
Hotel	$0	$0	$52,442	$55,597	$82,320	$81,357	$161,881	$194,832
Public	$1,920	$432	$98,355	$22,195	$144,785	$33,828	$335,683	$90,203
Total	$115,394	$71,252	$481,571	$331,468	$745,451	$487,527	$1,516,078	$992,119
R2	10 YR		50YR		100 YR		500 YR	
	STRUC	CONT	STRUC	CONT	STRUC	CONT	STRUC	CONT
SFR	$0	$0	$341,271	$161,066	$481,874	$369,540	$1,228,786	$802,598
MFR	$0	$0	$14,538	$11,625	$29,572	$20,085	$56,427	$35,749
Total	$0	$0	$355,809	$172,691	$511,445	$389,625	$1,285,212	$838,347
R2A	10 YR		50YR		100 YR		500 YR	
	STRUC	CONT	STRUC	CONT	STRUC	CONT	STRUC	CONT
SFR	$5,553	$2,971	$21,771	$13,232	$33,433	$21,553	$82,127	$53,459
Total	$5,553	$2,971	$21,771	$13,232	$33,433	$21,553	$82,127	$53,459
R4	10 YR		50YR		100 YR		500 YR	
	STRUC	CONT	STRUC	CONT	STRUC	CONT	STRUC	CONT
SFR	$135,424	$59,528	$516,163	$358,260	$757,091	$530,372	$1,631,531	$1,048,324
Total	$135,424	$59,528	$516,163	$358,260	$757,091	$530,372	$1,631,531	$1,048,324
CWP1	10 YR		50YR		100 YR		500 YR	
	STRUC	CONT	STRUC	CONT	STRUC	CONT	STRUC	CONT
Office	$446	$412	$1,278	$1,433	$1,837	$2,151	$4,204	$5,279
Commercial	$1,482	$1,056	$3,153	$3,688	$5,133	$5,521	$11,849	$13,770
Industrial/Farm	$359	$380	$933	$1,118	$1,459	$1,629	$2,811	$3,823
Total	$2,287	$1,848	$5,365	$6,239	$8,429	$9,301	$18,864	$22,871

Continued on next page

Table 4 Continued
North Scottsdale Study Area (Rawhide Wash Fan)
Structures & Content Damages By Event -- Present Conditions

RAW1	**10 YR**		**50YR**		**100 YR**		**500 YR**	
	STRUC	**CONT**	**STRUC**	**CONT**	**STRUC**	**CONT**	**STRUC**	**CONT**
SFR	$338	$205	$1,151	$718	$1,595	$966	$3,323	$1,972
Office	$501	$642	$1,654	$1,872	$2,151	$2,537	$4,570	$5,993
Industrial/Farm	$1,183	$1,417	$3,194	$3,907	$4,052	$5,243	$9,454	$11,940
Total	$2,022	$2,264	$5,999	$6,496	$7,798	$8,746	$17,346	$19,905
RAW3	10 YR		50YR		100 YR		500 YR	
	STRUC	CONT	STRUC	CONT	STRUC	CONT	STRUC	CONT
Office	$270	$260	$948	$986	$1,504	$1,749	$3,221	$4,175
Commercial	$7,844	$10,189	$23,518	$26,327	$34,494	$41,920	$61,417	$90,788
Industrial/Farm	$700	$929	$2,134	$2,383	$3,093	$3,783	$5,486	$8,162
Public	$1,816	$512	$5,538	$1,314	$8,028	$2,085	$14,240	$4,499
Total	$10,629	$11,890	$32,137	$31,009	$47,119	$49,537	$84,365	$107,624
RAW4	10 YR		50YR		100 YR		500 YR	
	STRUC	CONT	STRUC	CONT	STRUC	CONT	STRUC	CONT
SFR	$0	$0	$406,865	$311,731	$654,189	$464,975	$1,396,881	$889,686
Commercial	$0	$0	$87,556	$136,452	$136,991	$199,022	$259,707	$437,176
Public	$0	$0	$2,051	$522	$3,208	$761	$6,083	$1,672
Total	$0	$0	$496,472	$448,705	$794,389	$664,757	$1,662,670	$1,328,533
OF2	10 YR		50YR		100 YR		500 YR	
	STRUC	CONT	STRUC	CONT	STRUC	CONT	STRUC	CONT
SFR	$35,027	$14,163	$72,195	$41,394	$91,076	$70,222	$229,818	$156,492
Total	$35,027	$14,163	$72,195	$41,394	$91,076	$70,222	$229,818	$156,492
OF7	10 YR		50YR		100 YR		500 YR	
	STRUC	CONT	STRUC	CONT	STRUC	CONT	STRUC	CONT
SFR	$39,832	$19,848	$210,630	$115,639	$342,060	$239,100	$826,204	$544,321
Total	$39,832	$19,848	$210,630	$115,639	$342,060	$239,100	$826,204	$544,321

Continued on next page

Table 4 Continued
North Scottsdale Study Area (Fans 5&6)
Structures & Content Damages By Event -- Present Conditions

	2 YR		10 YR		50YR		100 YR		500 YR	
FL51	STRUC	CONTENT	STRUC	CONTENT	STRUC	CONTENT	STRUC	CONTENT	STRUC	CONTENT
SFR	$0	$0	$19,911	$8,076	$48,069	$34,356	$60,086	$42,945	$141,816	$98,669
MFR	$0	$0	$2,799	$1,132	$5,303	$4,241	$6,629	$5,301	$16,983	$11,535
Total	$0	$0	$22,710	$9,207	$53,372	$38,596	$66,715	$48,245	$158,799	$110,204
FL52	STRUC	CONTENT	STRUC	CONTENT	STRUC	CONTENT	STRUC	CONTENT	STRUC	CONTENT
SFR	$0	$0	$13,091	$5,293	$43,357	$27,168	$55,400	$34,714	$120,740	$85,960
Industrial/Farm	$0	$0	$610	$577	$1,335	$1,660	$1,705	$2,122	$3,852	$4,432
Total	$0	$0	$13,701	$5,871	$44,691	$28,828	$57,105	$36,836	$124,592	$90,393
FL53	STRUC	CONTENT	STRUC	CONTENT	STRUC	CONTENT	STRUC	CONTENT	STRUC	CONTENT
SFR (Total)	$0	$0	$14,314	$5,788	$74,969	$32,021	$170,154	$81,919	$489,197	$311,942
FL54	STRUC	CONTENT	STRUC	CONTENT	STRUC	CONTENT	STRUC	CONTENT	STRUC	CONTENT
SFR (Total)	$0	$0	$2,998	$1,212	$10,223	$4,682	$13,043	$5,974	$61,978	$33,480
FL61	**2 YR**		**10 YR**		**50YR**		**100 YR**		**500 YR**	
	STRUC	CONTENT	STRUC	CONTENT	STRUC	CONTENT	STRUC	CONTENT	STRUC	CONTENT
SFR	$0	$0	$10,039	$4,059	$24,530	$12,584	$31,914	$22,476	$75,137	$52,437
MH	$0	$0	$131	$24	$607	$148	$1,697	$491	$5,099	$1,824
Industrial/Farm	$0	$0	$522	$523	$982	$1,248	$1,557	$1,899	$3,418	$3,972
Total	$0	$0	$10,691	$4,606	$26,119	$13,980	$35,168	$24,865	$83,653	$58,232
FL62	STRUC	CONTENT	STRUC	CONTENT	STRUC	CONTENT	STRUC	CONTENT	STRUC	CONTENT
SFR	$0	$0	$2,575	$1,041	$8,082	$5,229	$10,102	$6,536	$25,745	$17,438
MH	$0	$0	$36	$7	$1,140	$249	$1,425	$311	$10,628	$3,830
Industrial/Farm	$0	$0	$380	$402	$952	$1,141	$1,190	$1,426	$2,692	$3,292
Total	$0	$0	$2,991	$1,450	$10,174	$6,618	$12,717	$8,273	$39,065	$24,561
FL63	STRUC	CONTENT	STRUC	CONTENT	STRUC	CONTENT	STRUC	CONTENT	STRUC	CONTENT
SFR	$0	$0	$18,055	$7,353	$41,828	$30,406	$52,490	$38,156	$125,882	$86,900
MH	$0	$0	$47	$9	$564	$154	$708	$194	$2,604	$884
Industrial/Farm	$0	$0	$152	$161	$374	$448	$470	$563	$985	$1,155
Total	$0	$0	$18,254	$7,523	$42,766	$31,009	$53,668	$38,913	$129,470	$88,939
FL64	STRUC	CONTENT	STRUC	CONTENT	STRUC	CONTENT	STRUC	CONTENT	STRUC	CONTENT
SFR	$0	$0	$31,098	$12,574	$73,969	$53,131	$93,549	$67,194	$220,995	$153,809
MH	$0	$0	$0	$0	$682	$126	$863	$159	$7,448	$2,151
Industrial/Farm	$0	$0	$371	$392	$911	$1,091	$1,152	$1,380	$2,423	$2,843
Total	$0	$0	$31,469	$12,967	$75,562	$54,348	$95,564	$68,734	$230,866	$158,803
FL65	STRUC	CONTENT	STRUC	CONTENT	STRUC	CONTENT	STRUC	CONTENT	STRUC	CONTENT
SFR (Total)	$0	$0	$4,962	$2,006	$19,106	$7,725	$23,845	$9,642	$38,212	$23,004

Continued on Next Page

Table 4 Continued
North Scottsdale Study Area (Summary)
Structures & Content Damages By Event -- Present Conditions

TOTAL	2 YR		10 YR		50YR		100 YR		500 YR	
Reata/Beard	**STRUC**	**CONT**	**STRUC**	**CONTENT**	**STRUC**	**CONTENT**	**STRUC**	**CONTENT**	**STRUC**	**CONTENT**
SFR	$0	$0	$183,487	$88,090	$984,519	$608,964	$1,437,714	$1,033,747	$3,267,535	$2,109,118
MFR	$0	$0	$66,236	$39,898	$210,482	$153,767	$337,107	$228,940	$661,087	$416,590
Office	$0	$0	$2,779	$2,794	$21,066	$24,299	$32,898	$35,611	$65,284	$85,407
Commercial	$0	$0	$2,934	$2,825	$10,581	$13,068	$16,481	$19,176	$33,977	$46,105
Industrial/Farm	$0	$0	$1,425	$1,657	$3,604	$4,252	$5,082	$6,061	$9,318	$13,503
Hotel	$0	$0	$0	$0	$52,442	$55,597	$82,320	$81,357	$161,881	$194,832
Public	$0	$0	$1,920	$432	$98,355	$22,195	$144,785	$33,828	$335,683	$90,203
Total	$0	$0	$258,781	$135,696	$1,381,048	$882,142	$2,056,387	$1,438,720	$4,534,765	$2,955,758
Rawhide	**STRUC**	**CONT**	**STRUC**	**CONTENT**	**STRUC**	**CONTENT**	**STRUC**	**CONTENT**	**STRUC**	**CONTENT**
SFR	$0	$0	$75,197	$34,215	$690,841	$469,481	$1,088,921	$775,262	$2,456,226	$1,592,472
Office	$0	$0	$771	$902	$2,601	$2,857	$3,655	$4,287	$7,791	$10,168
Commercial	$0	$0	$7,844	$10,189	$111,074	$162,779	$171,485	$240,941	$321,124	$527,964
Industrial/Farm	$0	$0	$1,883	$2,346	$5,328	$6,289	$7,145	$9,026	$14,940	$20,101
Public	$0	$0	$1,816	$512	$7,589	$1,835	$11,237	$2,846	$20,323	$6,171
Total	$0	$0	$87,509	$48,165	$817,433	$643,242	$1,282,443	$1,032,363	$2,820,403	$2,156,876
Fan 5	**STRUC**	**CONT**	**STRUC**	**CONTENT**	**STRUC**	**CONTENT**	**STRUC**	**CONTENT**	**STRUC**	**CONTENT**
SFR	$0	$0	$50,315	$20,369	$176,618	$98,227	$298,683	$165,552	$813,731	$530,052
MFR	$0	$0	$2,799	$1,132	$5,303	$4,241	$6,629	$5,301	$16,983	$11,535
Industrial/Farm	$0	$0	$610	$577	$1,335	$1,660	$1,705	$2,122	$3,852	$4,432
Total	$0	$0	$53,723	$22,078	$183,255	$104,128	$307,017	$172,975	$834,566	$546,019
Fan 6	**STRUC**	**CONT**	**STRUC**	**CONTENT**	**STRUC**	**CONTENT**	**STRUC**	**CONTENT**	**STRUC**	**CONTENT**
SFR	$0	$0	$66,729	$27,034	$167,515	$109,074	$211,901	$144,004	$485,970	$333,587
MH	$0	$0	$214	$39	$2,994	$677	$4,693	$1,154	$25,778	$8,689
Industrial/Farm	$0	$0	$1,425	$1,479	$3,219	$3,929	$4,369	$5,268	$9,517	$11,262
Total	$0	$0	$68,367	$28,552	$173,728	$113,680	$220,963	$150,426	$521,266	$353,538
GRAND	**2 YR**		**10 YR**		**50YR**		**100 YR**		**500 YR**	
TOTAL	**STRUC**	**CONT**	**STRUC**	**CONTENT**	**STRUC**	**CONTENT**	**STRUC**	**CONTENT**	**STRUC**	**CONTENT**
SFR	$0	$0	$375,727	$169,709	$2,019,492	$1,285,746	$3,037,218	$2,118,566	$7,023,462	$4,565,229
MFR	$0	$0	$69,034	$41,030	$215,784	$158,007	$343,736	$234,241	$678,070	$428,125
MH	$0	$0	$214	$39	$2,994	$677	$4,693	$1,154	$25,778	$8,689
Office	$0	$0	$3,550	$3,696	$23,667	$27,156	$36,553	$39,897	$73,075	$95,576
Commercial	$0	$0	$10,778	$13,014	$121,656	$175,847	$187,966	$260,118	$355,101	$574,069
Industrial/Farm	$0	$0	$5,342	$6,059	$13,486	$16,131	$18,301	$22,476	$37,628	$49,299
Hotel	$0	$0	$0	$0	$52,442	$55,597	$82,320	$81,357	$161,881	$194,832
Public	$0	$0	$3,736	$944	$105,944	$24,030	$156,022	$36,675	$356,006	$96,374
Total	$0	$0	$468,380	$234,492	$2,555,464	$1,743,192	$3,866,809	$2,794,483	$8,711,001	$6,012,191

As the study area develops over time, resulting in increased discharges and depths and widths of flooding, inundation damages to existing development are projected to escalate. As will be described in detail in Section 6.3.1, projected buildout varies from the year 2025 for the Beardsley/Reata Pass fan to the year 2060 for Fan 6. However, most of the study area is expected to be built out by the year 2030. Thus, damages by event for existing development are expected to peak by about that year.

The Hydrology Section has estimated future discharges associated with build-out development conditions for each cross section. These discharges will be utilized to calculate future expected annual damages and equivalent annual damages in the following section.

5.2 ANNUAL DAMAGE CALCULATIONS

The damages expected to result from each of the various sized floods used in the analysis were weighted by the probability of occurrence of each flood. Annual damages were then calculated by using standard damage-frequency integration techniques, and applying the capital recovery factor (partial payment series) for a 7 5/8 percent discount rate. The expected annual flood damage (EAD) *Computation program* developed by the Hydrologic Engineering Center in Davis, California was used for these computations.

As described in the previous section, discharges for both existing (1995) and future (varying by fan) conditions were input into the EAD program. The program utilizes the future discharges to project increases in damages by event over the period of analysis. Equivalent annual damages represent a uniform distribution of annual values and are computed by discounting and amortizing each year's expected annual damage value over the period of analysis. The discounting and amortization takes into account the time value of money associated with damage values.

Equivalent annual damages by reach and structure type are shown on Tables 6 and 7, respectively.

Table 6
North Scottsdale Study Area
Equivalent Annual Structure & Content Damages by Structure Type
(In $1,000's)

	Structure	Content	Total
SFR	$185.4	$109.4	$294.8
MFR	$24.8	$16.1	$40.9
Mobile Home	$0.3	$0.1	$0.4
Office	$2.1	$2.3	$4.4
Commercial	$9.2	$13.1	$22.3
Industrial/Farm	$1.7	$1.9	$3.6
Hotel	$3.3	$3.6	$6.9
Public	$7.3	$1.8	$9.1
TOTAL	$234.1	$148.3	$382.4

As shown above, total equivalent annual damages equate to $382,400. Damages to existing residential development (SFR, MFR and MH) account for $336,100, or 88% of total damages.

Table 7
North Scottsdale Study Area
Equivalent Annual Damages by Reach
(In $1,000's)

R1	$81.1	
R2	$35.0	
R2A	$3.7	
R4	$81.8	
CWP1	$1.4	
Total -- Beardsley/Reata Pass Fans		$203.0
RAW1	$1.4	
RAW3	$7.5	
RAW4	$59.4	
OF2	$14.4	
OF7	$33.2	
Total -- Rawhide Wash Fan		$115.9
FL51	$10.2	
FL52	$7.3	
FL53	$12.7	
FL54	$1.8	
Total -- Fan 5		$32.0
FL61	$4.8	
FL62	$1.7	
FL63	$8.2	
FL64	$14.2	
FL65	$2.6	
Total -- Fan 6		$28.9
GRAND TOTAL		$382.4

The above table shows that equivalent annual damages to existing structures in the Beardsley/Reata Pass alluvial fans represent about 53% of total damages, and equivalent annual damages to existing structures in the Rawhide Wash alluvial fan represent about 30% of total damages. Equivalent annual damages to Fans and 6 each represent less than 10% of total damages.

6.0 FLOODPLAIN DAMAGE EVALUATION (FUTURE DEVELOPMENT)

Costs associated with future development in the floodplain consist of future floodproofing expenditures made by developers to comply with alluvial fan development restrictions. In the section which follows, alluvial fan development restrictions will be discussed, floodplain development projections will be presented, and expected future floodproofing expenditures will be quantified.

6.1 ALLUVIAL FAN DEVELOPMENT RESTRICTIONS

6.1.1 FEMA Restrictions

The City of Scottsdale is a participant in the National Flood Insurance Program (NFIP). FEMA, which administers the NFIP, identifies and delineates special flood hazard areas on flood insurance rate maps (FIRMs) for communities participating in the NFIP. FEMA established preliminary FIRMs for North Scottsdale and surrounding areas in July 1991. In addition to delineating special flood hazard areas, the FIRMs provided base flood elevations for the 100-year flood event. FEMA received appeals from the cities of Scottsdale and Phoenix and Maricopa County relating to information contained on the FIRMs. These appeals were taken into consideration by FEMA and resulted in revised FIRMs for the area in 1993.

FEMA has established <u>minimum</u> requirements which developers within special flood hazard areas must comply with in order to meet NFIP regulations and to be eligible for flood insurance coverage. These requirements are addressed in Chapter 44 of the Code of Federal Regulations, Part 60.3 and include:

1) The first floor must be elevated above the highest adjacent grade to at least as high as the depth number specified on the flood insurance map (FIRM), which is equal to the depth of flooding in the 100-year event;

2) Adequate drainage paths around structures on slopes must be provided, with floodwater guided around and away from proposed structures; and

3) Floodflow cannot be deflected onto adjacent properties.

Compliance with these minimum requirements enables developers to build within the 100-year floodplain. However, the structures (once they are built) are still considered to be susceptible to damage during the 100-year flood event. For example, a structure with a the first-floor level at or above the 100-year flood depth could still be damaged during a 100-year event, since its foundation could be exposed to floodwater. Communities participating in the NFIP must assure developments within their communities comply with the minimum FEMA requirements to remain eligible for participation in the program.

A developer can submit an application to FEMA requesting a letter of map amendment or letter of map revision to be removed from the 100-year floodplain. Section 65.13 of FEMA's "National Flood Insurance Program and Related Regulations" (revised October 1, 1993) identifies the procedures which must be followed and the types of information FEMA requires to recognize on a NFIP floodplain map that a structural flood control measure provides protection from the base flood in an area subject to alluvial fan flooding. Section 65.13 specifically states: "In general, elevations of a parcel of land or a structure by fill or other means, will not serve as a basis for removing areas subject to alluvial fan flooding from an area of special flood hazards. FEMA will credit on NFIP maps only major structural flood control measures whose design and construction are supported by sound engineering analyses which demonstrate that the measures will effectively eliminate alluvial fan flood hazards from the area protected by such measures." FEMA's review criteria require that the construction include elements which:

1) Do not cause the disturbance of natural flood processes on the fan;

2) Allow for the safe collection passage, and disposal of flood-related water, sediment and debris without negative impact on adjacent property;

3) Address erosion, scour, deposition, impact and hydrostatic forces; and

4) Provide that the design and maintenance of the project elements be coordinated with the local jurisdiction and/or agency responsible for flood control within the community.

By meeting the above requirements, a development may be removed from the floodplain, thereby eliminating flood insurance requirements for structures within the development.

6.1.2 City of Scottsdale Restrictions

Section 37 of the City of Scottsdale's Revised Code details requirements for developments within special flood hazard areas. Section 37-41 (a) specifies that development is prohibited if it would create hazards to life or property by increasing the potential for flooding either on the property to be developed or on adjacent property or to any other property. Further, a watercourse may not be altered unless a professional engineer certifies that the alterations do not increase the flood levels and will not increase flooding hazards within, upstream or downstream of the altered portion of the watercourse.

Section 37-42 states that the developer must submit reports, construction plans and other data to the City as necessary for the floodplain administrator to determine that all proposed building sites will be reasonably safe from flooding.

In accordance with Section 37-42 (6), the first floor level of residential structures in FEMA designated AO zones must be elevated above the highest adjacent grade at least as high as the depth number specified on the FIRM (the 100-year flood depth). Section 37-42 (7) states that non-residential structures may have first-floor elevations lower than the 100-year flood depth if other floodproofing measures are provided which will result in equivalent protection.

6.1.3 Comparison of FEMA vs. City of Scottsdale Restrictions

The City of Scottsdale's regulations are consistent with FEMA's minimum requirements for floodplain development. However, they do not meet FEMA's requirements for removal from the 100-year floodplain. Accordingly, it is possible to develop within the floodplain without providing protection up to the 100-year flood event. However, those purchasing structures within the development via Federally-insured loans would be required to purchase flood insurance.

According to Mr. Karl Mohr of FEMA's Office of Risk Assessment, flood insurance purchase requirements can have a very adverse impact on the marketability of structures within such developments, especially if there are nearby developments located outside the FIRM boundary. He stated that most alluvial fan developers therefore strive to meet FEMA's requirements for removal from the FIRM delineated floodplain.

6.1.4 Floodproofing for Existing Developments

After FEMA developed its preliminary FIRMs for the North Scottsdale area in 1991, several private developments made appeals for removal from the FIRM-delineated 100-year floodplain. Los Portones and Ironwood Village were the two major developments in the study area for which appeals were made. Both applications were rejected by FEMA despite the fact that both had elevated structures on fill and provided channelization through the development.

A letter dated January 4, 1993 from Mr. John Matticks, Assistant Administrator for FEMA, to Mr. Herbert Drinkwater, the City of Scottsdale's Mayor, stated the following regarding FEMA's rejection of the appeal for the Los Portones development:

> *Field inspection and the review of available aerial photographs and topographic maps indicate that the flow path of a major flood below the apex of Basin 4 is not certain. Therefore, a flood control measure cannot depend on the flow being delivered to its upstream end...Because it is not certain that all of the flow expected once in 100 years would be in the channel at the upstream end of the improvements we cannot credit the channel on our maps with providing protection from alluvial fan flooding.*

Ironwood Village's flood control measures include a collector channel and seven channels which convey flood waters through the development. FEMA rejected a FIRM revision for Ironwood Village, in part, because none of the channels individually could convey the flow from a 100-year flood event (although they could collectively). In addition, Mr. Crossman stated that FEMA determined that since there was no improved channelization upstream of the development, channelization through the development could quickly become obstructed with sediment. The same letter from FEMA referenced above stated the following regarding its rejection of a FIRM map revision for Ironwood Village:

> *Because of the potential failure of the system resulting from part of the collector channel filling up with sediment and/or resulting from a flow distribution other than the specific design distribution, we cannot credit the system on our maps as providing protection from alluvial fan flooding in the area.*

According to Mr. Karl Mohr of FEMA, there are two primary considerations which are often inadequately addressed by developers in their floodproofing efforts on alluvial fans:

1) The flood control system must have the ability to capture flood flows upstream of the development regardless of the angle and location of these flows. This criteria is especially difficult to meet on alluvial fans, since the angle and location of floodflows is highly uncertain and can change from event to event.

2) The flood control system cannot become obstructed with sediment.

Although meeting FEMA's requirements for removal from an alluvial fan floodplain can be difficult and costly, Mr. Mohr stated that there have been developments which have been successful in doing so. He stated that successful floodproofing measures have often included combinations of walls/berms/levees and channelization which diverts the flows away from structures within the development. He stressed that developers can submit preliminary designs for review to FEMA. After reviewing the designs, FEMA will then either provide approval or will state what modifications would be necessary in order to meet compliance with Section 65.13.

Based upon conversations with representatives of and information furnished by FEMA and the City of Scottsdale, the following analyses will assume that under the without-project condition, future development within the study area would be in conformance with Section 65.13 of FEMA's regulations. It follows from this assumption that future development under the without project condition would: 1) be protected from flooding up to the 100-year event; and 2) would not be subject to NFIP requirements for flood insurance.

6.2 ALLUVIAL FAN OWNERSHIP

6.2.1 Scottsdale

Most of the alluvial fan area within the City of Scottsdale is owned by private developers. Section 4.1 described the major existing developments in the 100-year floodplain. Major proposed development areas in North Scottsdale are described below:

Gray Hawk: This 2,379 acre development is located south of Dear Valley Road between Scottsdale and Pima Roads and is in the initial construction phase. According to the City of Scottsdale's *Growth and Development Report* (June 1994), Gray Hawk has received approval for the construction of over 7,000 residential units, six hotels, and 550 acres of commercial and office space. The western portion of Gray Hawk will be located in the Rawhide Wash alluvial fan, and the eastern portion will be located in the Beardsley/Reata Pass alluvial fan area.

Scottsdale Core South: This proposed project is located between Scottsdale and Pima Roads, just north of the CAP canal. The site, which is currently in the design phase, will encompass 1,299 acres, including a regional shopping center, an auto mall, and two parks. It is situated at the toe of the Beardsley/Reata Pass alluvial fan.

Sonoran Hills: Sonoran Hills, which is currently undeveloped, will eventually include 241 acres of residences, 35 acres of commercial/office space, and a school. It is located south of Pinnacle Peak Road and west of Hayden Road in the Rawhide Wash alluvial fan.

Pinnacle Reserve: Located in the Rawhide Wash alluvial fan south of Happy Valley Road between Scottsdale and Miller Roads, this 100 acre project is currently undeveloped. Once completed, it will contain approximately 300 single-family residences.

Corrigan Marley (D.C. Ranch): This project will be by far the largest in the study area. The development will encompass 8,388 acres (or approximately 13 square miles) north of Bell Road, east of Pima Road and south of Deer Valley Road in the Beardsley/Reata Pass wash alluvial fan areas. It will include 6,652 acres of residences, 118 acres for hotels and resorts, 383 acres of industrial, commercial and office space, and 1,188 acres of open space.

Most of the floodplain land not included in the previously discussed developments is either County or State owned.

6.2.2 Phoenix

Most of the alluvial fan area west of Scottsdale Road in the City of Phoenix is owned by the State of Arizona. However, two major developments are currently in the planning phases.

Desert Ridge: A syndication of developers known as Northeast Phoenix Partners will develop Desert Ridge. Desert Ridge will encompass approximately 5,723 acres bounded by the CAP on the south, 32nd Street on the west, Pinnacle Peak on the north, and 64th Street on the east. The State is in the process of disposing of the property through public auction. Approximately 1,284 acres have been sold thus far. Additional acreage (most likely in 300 to 600 acre parcels) will be sold as the infrastructure in the area is developed.

Paradise Ridge: This development will be approximately 2,230 acres in size, bounded by the CAP on the south, 64th Street on the west, Pinnacle Peak on the north, and Scottsdale Road on the west. No land has yet been auctioned off for this development. However, a representative from the Arizona State Land Department indicated that the State would probably sell either all or half of the total area to master developers under a participation contract, whereby the State would receive a portion of the profits generated by the master developer from selling smaller parcels to residential and commercial builders.

6.3 PROJECTED ALLUVIAL FAN DEVELOPMENT

6.3.1 Beardsley & Reata Pass Floodplains

Land Available for Development

The Beardsley, and Reata Pass floodplains are comprised of approximately 5,890 acres, most of which are developable. An analyses of aerial photographs indicates that approximately 900 acres have already been developed. Thus, there are approximately 4,990 acres available for development. Based upon information obtained from Scottsdale's PCDD, approximately 75.8% of this area (or 3,782 acres) will be devoted to residential development, with the remaining 24.2% of the area (or 1,208 acres) devoted to employment uses.

Residential Development Projections

In addition to the population projections described in Section 2.2, the City of Scottsdale has developed residential development projections for the North Scottsdale area. Population and dwelling units (DU) for Planning Zones C and D were projected through the year 2015 based upon four different growth assumptions for the City. A representative of Scottsdale's Planning Department has stated that it is uncertain which pattern of growth will eventually be realized, noting that the nature of growth in the area will be based in large part on policy decisions which have yet to be made. Therefore, averages of the four growth scenarios will be utilized for purposes of this analysis. The following table summarizes the average growth projections for Zones C and D.

Table 8
City of Scottsdale
Planning Zones C & D
Summary of Population and Dwelling Unit Projections

	Planning Zone C		Planning Zone D	
Year	DU	Population	Dwelling Units	Population
1995	20,470	43,140	3,190	6,880
2000	27,836	53,076	5,167	12,283
2005	35,176	66,680	7,264	17,093
2010	42,531	77,790	9,287	21,810
2015	49,883	93,903	11,318	26,538

In order to determine the portion of growth within Zones C and D expected to occur within the Beardsley/Reata Pass floodplain, the total amount of land available for development within each zone has been compared to the total amount of land available within the floodplain portion of the zone (see below).

TABLE 9
Beardsley/Reata Pass Floodplains
Floodplain Acreage vs. Total Acreage in Planning Zones C & D

	Zone C			Zone D		
	Total	In Floodplain	%	Total	In Floodplain	%
Developable	20,919	5,455	26.1%	15,995	435	2.7%
Developed	5,993	770	12.8%	2,642	130	4.9%
Available	14,926	4,685	31.4%	13,353	305	2.2%

Based upon the above data, it has been assumed that 31 percent of the projected residential development within Zone C will take place in the Beardsley/Reata Pass floodplain, and 2 percent within Zone D will take place in the Beardsley/Reata Pass floodplain. Table 10 (page 26) details the projected incremental floodplain development by 5-year interval. Residential acreage projections are also shown on Table 10. These projections have been calculated by dividing projected dwelling units by dwelling units per acre for each density category.

As shown on Table 10, residential floodplain development is projected to occur at a rate of about 670 acres every five years, or about 134 acres per year. As described earlier, approximately 3,782 acres of the 4,990 acres available for development are assumed to be devoted to residential uses at buildout. At a development rate of 134 acres per year, the portion of the Beardsley/Reata Pass floodplain devoted to residential uses will be built out by the year 2025. This corresponds with estimates made by representatives of the City of Scottsdale that Planning Zones C and D will be built out between the years 2020 and 2025.

TABLE 10
BEARDSLEY & REATA PASS ALLUVIAL FAN FLOODPLAINS
PROJECTED INCREMENTAL FLOODPLAIN DEVELOPMENT
By 5 Year Increments

Year	DU/Acre	Zone C Total DU	Zone C Total Population	Beardsley/Reata Pass Floodplain (31%) DU	Beardsley/Reata Pass Floodplain (31%) Population	Zone D Total DU	Zone D Total Population	Beardsley/Reata Pass Floodplain (2%) DU	Beardsley/Reata Pass Floodplain (2%) Population	Total - Beardsley/Reata Pass Floodplain DU	Total - Beardsley/Reata Pass Floodplain Population	Total - Beardsley/Reata Pass Floodplain DU Acres
Base (1995)	0.4	--	--	--	--	--	--	--	--	--	--	--
	1	--	--	--	--	--	--	--	--	--	--	--
	2-4	--	--	--	--	--	--	--	--	--	--	--
	4-8	--	--	--	--	--	--	--	--	--	--	--
	9+	--	--	--	--	--	--	--	--	--	--	--
	Total	--	--	--	--	--	--	--	--	--	--	--
	DU/Acre											
2000	0.4	32	64	10	20	336	960	7	19	16	39	41
	1	737	1,027	228	318	722	2,125	14	43	243	361	243
	2-4	1,900	4,137	589	1,282	479	1,593	10	32	598	1,314	199
	4-8	1,967	1,583	610	491	267	475	5	10	615	500	102
	9+	2,731	3,126	847	969	173	250	3	5	850	974	85
	Total	7,366	9,936	2,283	3,080	1,977	5,403	40	108	2,323	3,188	671
	DU/Acre											
2005	0.4	31	79	10	24	336	873	7	17	16	42	41
	1	737	1,896	228	588	737	1,880	15	38	243	625	243
	2-4	1,873	4,917	581	1,524	478	1,233	10	25	590	1,549	197
	4-8	1,966	2,929	609	908	375	580	7	12	617	920	103
	9+	2,734	3,783	848	1,173	173	245	3	5	851	1,178	85
	Total	7,341	13,604	2,276	4,217	2,097	4,810	42	96	2,318	4,313	669
	DU/Acre											
2010	0.4	32	81	10	25	336	868	7	17	16	43	41
	1	737	1,898	228	588	707	1,873	14	37	243	626	243
	2-4	1,887	4,917	585	1,524	479	1,238	10	25	594	1,549	198
	4-8	1,967	2,931	610	909	328	490	7	10	616	918	103
	9+	2,733	1,283	847	398	173	250	3	5	851	403	85
	Total	7,355	11,111	2,280	3,444	2,023	4,718	40	94	2,320	3,539	670
	DU/Acre											
2015	0.4	31	84	10	26	336	873	7	17	16	43	41
	1	737	1,901	228	589	722	1,883	14	38	243	627	243
	2-4	1,886	4,920	585	1,525	478	1,238	10	25	594	1,550	198
	4-8	1,966	2,926	609	907	323	488	6	10	616	917	103
	9+	2,732	6,283	847	1,948	173	248	3	5	850	1,953	85
	Total	7,352	16,113	2,279	4,995	2,031	4,728	41	95	2,320	5,090	669
2020										2,320	5,090	669
2025										1,505	3,302	434
2030												
		TOTAL								13,105	24,521	3,782

Beardsley/Reata	Weight %	Employment %	Wtd Avg.
% of Floodplain in Zone C	94%	25.4%	23.8%
% of Floodplain in Zone D	6%	5.8%	0.4%
Employment % of Floodplain			24.20%
Residential % of Floodplain			75.80%
Total Avail. Floodplain Acres			4990
Floodplain Acres -- Employment			1208
Floodplain Acres -- Residential			3782

Employment Area Development Projections

As described previously, of the 4,990 acres available for development in the Beardsley/Reata Pass floodplain, it has been estimated that approximately 1,208 acres will be devoted to employment uses. Intervening growth projections for employment area acreage were not available. Therefore, residential acreage growth rates were utilized to derive employment acreage growth projections (i.e., employment acreage is assumed to develop at the same rate as residential acreage). The resulting development rate for employment acreage is about 214 acres every five years, or 43 acres per year.

Summary

Table 11 summarizes growth projections for the Beardsley and Reata Pass alluvial fan floodplains.

Table 11
Beardsley/Reata Pass Floodplain
Summary of Growth Projections

Year	DU Acres	Emplmt Acres	Total Acres	Incremental
1995	--	--	--	--
2000	671	214	885	885
2005	1,340	428	1,767	882
2010	2,009	642	2,651	884
2015	2,679	855	3,534	883
2020	3,348	1,069	4,417	883
2025	3,782	1,208	4,990	573

Note: Figures do not include existing development

6.3.2 Rawhide Wash Floodplain

The Rawhide Wash floodplain is comprised of approximately 7,160 acres. About 3,160 acres (or 44%) are located in the City of Scottsdale (east of Scottsdale Road), and about 4,000 acres (or 56%) are located in the City of Phoenix. Separate projection data was obtained for both the Scottsdale and Phoenix portions of the floodplain. Therefore, the following sections will detail separate development projections for each portion of the Rawhide Wash floodplain.

6.3.2.1 Scottsdale Portion of Rawhide Wash Floodplain

Land Available for Development

The Scottsdale portion of the Rawhide Wash floodplain consists of about 3,160 developable acres. An analyses of aerial photographs indicates that approximately 640 acres have already been developed. Thus, there are approximately 2,520 acres available for development. Based upon information obtained from Scottsdale's PCDD, approximately 85% of this area (or 2,140 acres) will be devoted to residential development, with the remaining 15% of the area (or 380 acres) devoted to employment uses.

Residential Development Projections

In order to determine the portion of growth within Scottsdale's Planning Zones C and D expected to occur within the Rawhide Wash floodplain, the total amount of land available for development within each zone has been compared to the total amount of land available within the floodplain portion of the zone (see below).

TABLE 12
Rawhide Wash Floodplain
Floodplain Acreage vs. Total Acreage in Planning Zones C & D

	Zone C			Zone D		
	Total	In Floodplain	%	Total	In Floodplain	%
Developable	20,919	1,395	6.7%	15,995	1,765	11.0%
Developed	5,993	200	3.3%	2,642	440	16.7%
Available	14,926	1,195	8.0%	13,353	1,325	10.0%

Based upon the above data, it has been assumed that 8% percent of the projected residential development within Zone C will take place in the Rawhide Wash floodplain, and 10 percent within Zone D will take place in the Rawhide Wash floodplain. Table 13 (page 33) details the projected incremental floodplain development by 5-year interval. Residential acreage projections are also shown on Table 13. These projections have been calculated by dividing projected dwelling units by dwelling units per acre for each density category.

As shown on Table 13, residential floodplain development is projected to occur at a rate of about 342 acres every five years, or about 68 acres per year. As described earlier, approximately 2,140 acres of the 2,520 acres available for development are assumed to be devoted to residential uses at buildout. At a development rate of 68 acres per year, the portion of the Rawhide Wash floodplain devoted to residential uses will be built out by the year 2027. This corresponds with estimates made by representatives of the City of Scottsdale that Planning Zones C and D will be built out by about the year 2025.

Employment Area Development Projections

As described previously, of the 2,520 acres available for development in the Rawhide Wash floodplain, it has been estimated that approximately 380 acres will be devoted to employment uses. Intervening growth projections for employment area acreage were not available. Therefore, residential acreage growth rates were utilized to derive employment acreage growth projections (i.e., employment acreage is assumed to develop at the same rate as residential acreage). The resulting development rate for employment acreage is about 61 acres every five years, or 12 acres per year.

TABLE 13
RAWHIDE WASH ALLUVIAL FAN FLOODPLAIN -- SCOTTSDALE PORTION
PROJECTED INCREMENTAL FLOODPLAIN DEVELOPMENT
By 5 Year Increments

		Zone C Total		Rawhide Wash Floodplain (8%)		Zone D Total		Rawhide Wash Floodplain (10%)		Total - Rawhide Wash Floodplain		
Year	DU/Acre	DU	Population	DU	Population	DU	Population	DU	Population	DU	Population	DU Acres
Base (1995)	0.4	--	--	--	--	--	--	--	--	--	--	--
	1	--	--	--	--	--	--	--	--	--	--	--
	2-4	--	--	--	--	--	--	--	--	--	--	--
	4-8	--	--	--	--	--	--	--	--	--	--	--
	9+	--	--	--	--	--	--	--	--	--	--	--
	Total	--	--	--	--	--	--	--	--	--	--	--
	DU/Acre											
2000	0.4	32	64	3	5	336	960	34	96	36	101	90
	1	737	1,027	59	82	722	2,125	72	213	131	295	131
	2-4	1,900	4,137	152	331	479	1,593	48	159	200	490	67
	4-8	1,967	1,583	157	127	267	475	27	48	184	174	31
	9+	2,731	3,126	218	250	173	250	17	25	236	275	24
	Total	7,366	9,936	589	795	1,977	5,403	198	540	787	1,335	342
	DU/Acre											
2005	0.4	31	79	2	6	336	873	34	87	36	94	90
	1	737	1,896	59	152	737	1,880	74	188	133	340	133
	2-4	1,873	4,917	150	393	478	1,233	48	123	198	517	66
	4-8	1,966	2,929	157	234	375	580	37	58	195	292	32
	9+	2,734	3,783	219	303	173	245	17	25	236	327	24
	Total	7,341	13,604	587	1,088	2,097	4,810	210	481	797	1,569	345
	DU/Acre											
2010	0.4	32	81	3	7	336	868	34	87	36	93	90
	1	737	1,898	59	152	707	1,873	71	187	130	339	130
	2-4	1,887	4,917	151	393	479	1,238	48	124	199	517	66
	4-8	1,967	2,931	157	235	328	490	33	49	190	284	32
	9+	2,733	1,283	219	103	173	250	17	25	236	128	24
	Total	7,355	11,111	588	889	2,023	4,718	202	472	791	1,361	341
	DU/Acre											
2015	0.4	31	84	2	7	336	873	34	87	36	94	90
	1	737	1,901	59	152	722	1,883	72	188	131	340	131
	2-4	1,886	4,920	151	394	478	1,238	48	124	199	517	66
	4-8	1,966	2,926	157	234	323	488	32	49	190	283	32
	9+	2,732	6,283	219	503	173	248	17	25	236	527	24
	Total	7,352	16,113	588	1,289	2,031	4,728	203	473	791	1,762	343
2020										791	1,762	343
2025										791	1,762	343
2030										194	432	84
		TOTAL								4,942	9,982	2,140

Rawhide Wash	Weight %	Employment %	Wtd Avg.
% of Floodplain in Zone C	47%	25.4%	12%
% of Floodplain in Zone D	53%	5.8%	3%
Employment % of Floodplain			15.09%
Residential % of Floodplain			84.91%
Total Avail. Floodplain Acres			2520
Floodplain Acres -- Employment			380
Floodplain Acres -- Residential			2140

Summary

Table 14 summarizes growth projections for the Scottsdale Portion of the Rawhide Wash alluvial fan floodplain.

Table 14
Rawhide Wash Floodplain (Scottsdale Portion)
Summary of Growth Projections

Year	DU Acres	Emplmt Acres	Total Acres	Incremental
1995	--	--	--	--
2000	342	61	403	403
2005	687	122	809	406
2010	1,028	183	1,211	402
2015	1,371	243	1,614	403
2020	1,713	304	2,018	404
2025	2,056	365	2,421	403
2027	2,140	380	2,520	99

Note: Figures do not include existing development

6.3.2.2 Phoenix Portion of Rawhide Wash Floodplain

Land Available for Development

The Phoenix portion of the Rawhide Wash alluvial fan (which is located west of Scottsdale Road, south of Happy Valley Road, east of Tatum Boulevard and North of the CAP), encompasses nearly 4,000 acres. Portions of the floodplain are located in seven different Traffic Analyses Zones (TAZ's), which are used as planning units by the Maricopa County Association of Governments (MAG) and the City of Phoenix. The table which follows shows the total area of each TAZ, the portion of each represented by the floodplain, and the estimated amount of floodplain acres available for future development.

Table 15 Rawhide Wash Floodplain - Phoenix Portion TAZ and Floodplain Acreage				
TAZ	Total Acres	Floodplain (%)	Floodplain Acres	Available
75	3,174	20%	635	624
114	461	50%	230	227
115	442	75%	331	293
116	1,056	100%	1,056	1,056
141	576	20%	115	92
142	781	100%	781	700
172	826	100%	826	537
Total	7,315		3,974	3,528

Note: Figures not exact due to rounding

The figures above detailing acreage available for development exclude non-developable land, such as areas devoted to canals or with steep hills, as well as existing development. However, other than a ranch located in TAZ 172, the Phoenix portion of the floodplain is almost completely undeveloped.

Based upon information obtained from MAG and the City of Phoenix, at buildout, floodplain acreage will be allocated between residential and employment uses as follows:

Table 16 Rawhide Wash Floodplain - Phoenix Portion Allocation of Floodplain Acreage (at Buildout)					
TAZ	Available Acres	Residential	%	Employment	%
75	624	555	89%	69	11%
114	227	227	100%	0	0%
115	293	234	80%	59	20%
116	1,056	1,024	97%	32	3%
141	92	8	8%	85	92%
142	700	53	8%	647	92%
172	537	335	62%	202	38%
Total	3,528	2,435	69%	1,093	31%

Residential Development Projections

Population and dwelling unit projections by TAZ were obtained from the City of Phoenix Planning Department. The ratio of floodplain land area to total land area for each TAZ was applied to aggregate population and dwelling unit projections to derive projections for the floodplain. Table 17 (page 37) details these projections. As indicated on Table 17, the rate of growth is expected to increase substantially through the year 2020 and then decline thereafter, with buildout projected by the year 2040.

The dwelling unit growth rates (per Table 17) were utilized to derive projections of residential development in acres through buildout. Table 18 summarizes the results.

Table 18
Rawhide Wash Floodplain -- Phoenix Portion
Residential Growth Projections (In Acres)

	TAZ								
Year	75	114	115	116	141	142	172	Total	Incr
1995	--	--	--	--	--	--	--	--	--
2000	13	0	0	74	1	7	44	139	139
2005	59	23	24	103	2	16	100	327	189
2010	228	54	59	355	4	28	178	905	578
2015	341	102	105	893	5	32	201	1,678	773
2020	434	126	129	1,090	6	42	266	2,093	414
2025	519	151	157	1,013	8	53	335	2,235	142
2030	554	182	190	1,020	8	53	335	2,342	107
2035	554	211	219	1,020	8	53	335	2,400	58
2040	555	227	234	1,024	8	53	335	2,435	35

Notes: Figures not exact due to rounding
Does not include existing development

Employment Area Development Projections

As described previously, of the 3,528 acres available for development in the Phoenix portion of the Rawhide Wash floodplain, it has been estimated that approximately 1,093 will be devoted to employment uses. Intervening growth projections for employment area acreage were not available. Therefore, residential acreage growth rates were utilized to derive employment acreage growth projections (i.e., employment acreage is assumed to develop at the same rate as residential acreage). Table 19 summarizes the results.

TABLE 17
RAWHIDE WASH FLOODPLAIN GROWTH PROJECTIONS
CITY OF PHOENIX
Traffic Analysis Zones (Total Area)

	75		114		115		116		141		142		172		Total		Incremental Increases	
Year	Pop.	DU	Pop.	DU	Pop.	DU	Pop.	DU	Pop.	DU	Pop.	DU	Pop.	DU	Pop.	DU	Pop.	DU
1995	31	12	0	0	0	0	0	0	0	0	0	0	2	1	33	13	--	--
2000	284	114	0	0	0	0	196	78	111	50	154	70	154	70	899	382	866	369
2005	1290	516	882	353	694	278	273	109	252	115	349	158	350	159	4090	1687	3191	1305
2010	5020	2008	2054	822	1685	674	944	378	445	202	615	279	618	281	11381	4643	7291	2956
2015	7503	3001	3834	1534	3007	1203	2379	952	505	230	697	317	700	318	18625	7554	7244	2910
2020	9565	3826	4744	1898	3691	1476	2901	1160	668	304	922	419	926	421	23417	9504	4792	1950
2025	11427	4571	5696	2278	4465	1786	2698	1079	841	382	1162	528	1166	530	27455	11155	4038	1651
2030	12212	4885	6888	2755	5413	2165	2716	1086	841	382	1162	528	1166	530	30398	12332	2943	1177
2035	12212	4885	7961	3184	6238	2495	2707	1083	841	382	1162	528	1166	530	32287	13087	1889	756
2040	**12218**	**4887**	**8578**	**3431**	**6678**	**2671**	**2726**	**1090**	**841**	**382**	**1162**	**528**	**1166**	**530**	**33369**	**13520**	1082	433
2045	12218	4887	8578	3431	6678	2671	2726	1090	841	382	1162	528	1166	530	33369	13520	0	0
Pop/DU		*2.50*		*2.50*		*2.50*		*2.50*		*2.20*		*2.20*		*2.20*		*2.47*		

Traffic Analysis Zones (In Floodplain)

	75 (20%)		114 (50%)		115 (75%)		116 (100%)		141 (20%)		142 (100%)		172 (100%)		Total		Incremental Increases	
	Pop.	DU	Pop.	DU	Pop.	DU	Pop.	DU	Pop.	DU	Pop.	DU	Pop.	DU	Pop.	DU	Pop.	DU
1995	6	2	0	0	0	0	0	0	0	0	0	0	2	1	8	3	--	--
2000	57	23	0	0	0	0	196	78	22	10	154	70	154	70	583	251	575	248
2005	258	103	441	176	521	208	273	109	50	23	349	158	350	159	2242	937	1659	686
2010	1004	402	1027	411	1264	506	944	378	89	40	615	279	618	281	5561	2296	3319	1359
2015	1501	600	1917	767	2255	902	2379	952	101	46	697	317	700	318	9550	3902	3989	1606
2020	1913	765	2372	949	2768	1107	2901	1160	134	61	922	419	926	421	11936	4882	2386	981
2025	2285	914	2848	1139	3349	1340	2698	1079	168	76	1162	528	1166	530	13676	5607	1741	724
2030	2442	977	3444	1378	4060	1624	2716	1086	168	76	1162	528	1166	530	15158	6199	1482	593
2035	2442	977	3981	1592	4679	1871	2707	1083	168	76	1162	528	1166	530	16305	6658	1146	459
2040	**2444**	**977**	**4289**	**1716**	**5009**	**2003**	**2726**	**1090**	**168**	**76**	**1162**	**528**	**1166**	**530**	**16963**	**6921**	659	263
2045	2444	977	4289	1716	5009	2003	2726	1090	168	76	1162	528	1166	530	16963	6921	0	0

TAZ	Acres	In Floodplain	FP Acres
75	3174.4	20%	635
114	460.8	50%	230
115	441.6	75%	331
116	1056	100%	1056
141	576	20%	115
142	780.8	100%	781
172	825.6	100%	826
	7315.2		3974

Table 19
Rawhide Wash Floodplain -- Phoenix Portion
Employment Area Growth Projections (In Acres)

	TAZ								
Year	75	114	115	116	141	142	172	Total	Incr
1995	--	--	--	--	--	--	--	--	--
2000	2	0	0	2	11	86	27	127	127
2005	7	0	6	3	25	194	61	296	169
2010	28	0	15	11	45	342	107	548	252
2015	42	0	26	28	51	388	121	657	109
2020	54	0	32	32	67	513	160	861	204
2025	65	0	39	32	85	647	202	1,069	207
2030	69	0	47	32	85	647	202	1,082	13
2035	69	0	55	32	85	647	202	1,089	7
2040	69	0	59	32	85	647	202	1,093	4

Notes: Figures not exact due to rounding
Does not include existing development

Summary

Table 20 summarizes growth projections for the Phoenix portion of the Rawhide Wash floodplain.

Table 20
Rawhide Wash Alluvial Fan Floodplain - Phoenix Portion
Summary of Growth Projections

Year	DU Acres	Emplmt Acres	Total Acres	Incremental
1995	--	--	--	--
2000	139	127	266	266
2005	327	296	623	357
2010	905	548	1,453	830
2015	1,678	657	2,335	882
2020	2,093	861	2,954	619
2025	2,235	1,069	3,304	350
2030	2,342	1,082	3,424	120
2035	2,396	1,089	3,485	61
2040	2,435	1,093	3,528	43

6.3.2.3 Rawhide Wash Floodplain -- Summary of Growth Projections

Table 21 displays the combined growth projections for both the Scottsdale and Phoenix portions of the Rawhide Wash alluvial fan floodplain.

Table 21
Rawhide Wash Alluvial Fan Floodplain (Total)
Summary of Growth Projections

Year	Scottsdale	Phoenix	Total Acres	Incremental
1995	--	--	--	
2000	403	266	669	669
2005	809	623	1,432	763
2010	1,211	1,453	2,664	1,232
2015	1,614	2,335	3,950	1,286
2020	2,018	2,954	4,972	1,022
2025	2,421	3,303	5,725	753
2030	2,520	3,424	5,944	219
2035	2,520	3,485	6,005	61
2040	2,520	3,528	6,048	43

Note: Does not include existing development

6.3.3 Fan 5

Land Available for Development

Fan 5 is comprised of approximately 1,254 acres, most of which are developable. An analysis of aerial photographs indicates that approximately 70% of the floodplain (or 878 acres) is available for development. Based upon information obtained from Scottsdale's PCDD, approximately 94% of this area (or 825 acres) will be devoted to residential development, with the remaining 6% of the area (or 53 acres) devoted to employment uses.

Residential Development Projections

Fan 5 is located within Scottsdale Planning Zone E boundaries. The following table summarizes the average growth projections for Planning Zone E.

Table 22 City of Scottsdale Planning Zone E Summary of Population and Dwelling Unit Projections		
Year	DU	Population
1995	1,080	2,290
2000	4,454	11,253
2005	7,838	19,763
2010	10,997	27,615
2015	14,595	36,758

In order to determine the portion of growth within Zone E expected to occur within the Fan 5 floodplain, the total amount of land available for development within the zone has been compared to the total amount of land available within the floodplain portion of the zone (see below).

TABLE 23
Fan 5 Floodplain
Floodplain Acreage vs. Total Acreage in Planning Zone E

	Total	In Floodplain	%
Total Area	37,376	1,254	3.4%
Available	23,195	878	3.8%

Based upon the above data, it has been assumed that 4 percent of the projected residential development within Zone E will take place in the Fan 5 floodplain. Table 24 (page 41) details the projected incremental floodplain development by 5-year interval. Residential acreage projections are also shown on Table 24. These projections have been calculated by dividing projected dwelling units by dwelling units per acre for each density category.

As shown on Table 24, residential floodplain development is projected to occur at a rate of about 120 acres every five years, or about 24 acres per year. As described earlier, approximately 825 acres of the 878 acres available for development are assumed to be devoted to residential uses at buildout. At a development rate of 120 acres per year, the portion of Fan 5 devoted to residential uses will be built out by the year 2030. This area is expected to be built out at a later date than the alluvial fan areas in Zones C and D, since it is located further from the core of existing development.

TABLE 24
FAN 5
PROJECTED INCREMENTAL FLOODPLAIN DEVELOPMENT
By 5 Year Increments

Year	DU/Acre	Zone E Total DU	Zone E Population	FAN 5 Floodplain (4%) DU	FAN 5 Floodplain (4%) Population	FAN 5 Floodplain (4%) DU Acres
Base (1995	0.4	--	--	--	--	--
	1	--	--	--	--	--
	2-4	--	--	--	--	--
	4-8	--	--	--	--	--
	9+	--	--	--	--	--
	Total	--	--	--	--	--
	DU/Acre					
2000	0.4	653	1,785	26	71	65
	1	746	2,055	30	82	30
	2-4	1,607	4,518	64	181	21
	4-8	218	343	9	14	1
	9+	151	263	6	11	1
	Total	3,374	8,963	135	359	119
	DU/Acre					
2005	0.4	653	1,695	26	68	65
	1	757	1,970	30	79	30
	2-4	1,607	4,258	64	170	21
	4-8	217	330	9	13	1
	9+	151	258	6	10	1
	Total	3,384	8,510	135	340	119
	DU/Acre					
2010	0.4	653	1,698	26	68	65
	1	751	1,952	30	78	30
	2-4	1,319	3,508	53	140	18
	4-8	269	405	11	16	2
	9+	170	290	7	12	1
	Total	3,160	7,852	126	314	115
	DU/Acre					
2015	0.4	653	1,695	26	68	65
	1	752	1,953	30	78	30
	2-4	1,895	5,008	76	200	25
	4-8	167	255	7	10	1
	9+	132	233	5	9	1
	Total	3,598	9,143	144	366	122
2020				138	348	120
2025				138	348	120
2030				126	319	110
		TOTAL		943	2,394	825

FAN 5	
Employment % of Floodplain	6%
Residential % of Floodplain	94%
Total Avail. Floodplain Acres	878
Floodplain Acres -- Employment	53
Floodplain Acres -- Residential	825

Employment Area Development Projections

As described previously, of the 878 acres available for development in Fan 5, it has been estimated that approximately 53 acres will be devoted to employment uses. Intervening growth projections for employment area acreage were not available. Therefore, residential acreage growth rates were utilized to derive employment acreage growth projections (i.e., employment acreage is assumed to develop at the same rate as residential acreage). The resulting development rate for employment acreage is about 8 acres every five years.

Summary

Table 25 summarizes growth projections for Fan 5.

Table 25
Fan 5 Floodplain
Summary of Growth Projections

Year	DU Acres	Emplmt Acres	Total Acres	Incremental
1995	--	--	--	--
2000	119	8	126	126
2005	238	15	253	127
2010	353	23	375	122
2015	475	30	505	130
2020	595	38	633	128
2025	715	46	761	128
2030	825	53	878	117

Note: Figures do not include existing development

6.3.4 Fan 6

The Fan 6 floodplain is comprised of approximately 2,906 acres. About 986 acres (or 34%) are located in the Scottsdale Planning Zone E (east of 56th Street), and about 1,920 acres (or 66%) are located in the City of Phoenix. Separate projection data was obtained for both the Scottsdale and Phoenix portions of the floodplain. Therefore, the following sections will detail separate development projections for each portion of the Fan 6 floodplain.

6.3.4.1 Scottsdale Portion of Fan 6

Land Available for Development

The Scottsdale portion of Fan 6 is comprised of approximately 986 acres, most of which are developable. An analyses of aerial photographs indicates that approximately 70% of the floodplain (or 690 acres) is available for development. Based upon information obtained from Scottsdale's PCDD, approximately 94% of this area (or 649 acres) will be devoted to residential development, with the remaining 6% of the area (or 41 acres) devoted to employment uses.

Residential Development Projections

The Scottsdale portion of Fan 6 is located within the boundaries of Planning Zone E. In order to determine the portion of growth within Zone E expected to occur within the Fan 6 floodplain, the total amount of land available for development within the zone has been compared to the total amount of land available within the floodplain portion of the zone (see below).

TABLE 26
Fan 6 Floodplain -- Scottsdale Portion
Floodplain Acreage vs. Total Acreage in Planning Zone E

	Total	In Floodplain	%
Total Area	37,376	986	2.6%
Available	23,195	690	3.0%

Based upon the above data, it has been assumed that 3 percent of the projected residential development within Zone E will take place in the Fan 6 floodplain. Table 27 (page 44) details the projected incremental floodplain development by 5-year interval. Residential acreage projections are also shown on Table 27. These projections have been calculated by dividing projected dwelling units by dwelling units per acre for each density category.

As shown on Table 27, residential floodplain development is projected to occur at a rate of about 90 acres every five years, or about 18 acres per year. As described earlier, approximately 649 acres of the 690 acres available for development are assumed to be devoted to residential uses at buildout. At a development rate of 90 acres per year, the portion of Fan 6 devoted to residential uses will be built out by the year 2030. This area is expected to be built out at a later date than the alluvial fan areas in Zones C and D, since it is located further from the core of existing development.

TABLE 27
FAN 6 FLOODPLAIN -- SCOTTSDALE PORTION
PROJECTED INCREMENTAL FLOODPLAIN DEVELOPMENT
By 5 Year Increments

		Zone E Total		FAN 6 Floodplain (3%)		
Year	**DU/Acre**	**DU**	**Population**	**DU**	**Population**	**DU Acres**
Base (1995	0.4	--	--	--	--	--
	1	--	--	--	--	--
	2-4	--	--	--	--	--
	4-8	--	--	--	--	--
	9+	--	--	--	--	--
	Total	--	--	--	--	--
	DU/Acre					
2000	0.4	653	1,785	20	54	49
	1	746	2,055	22	62	22
	2-4	1,607	4,518	48	136	16
	4-8	218	343	7	10	1
	9+	151	263	5	8	0
	Total	3,374	8,963	101	269	89
	DU/Acre					
2005	0.4	653	1,695	20	51	49
	1	757	1,970	23	59	23
	2-4	1,607	4,258	48	128	16
	4-8	217	330	7	10	1
	9+	151	258	5	8	0
	Total	3,384	8,510	102	255	89
	DU/Acre					
2010	0.4	653	1,698	20	51	49
	1	751	1,952	23	59	23
	2-4	1,319	3,508	40	105	13
	4-8	269	405	8	12	1
	9+	170	290	5	9	1
	Total	3,160	7,852	95	236	86
	DU/Acre					
2015	0.4	653	1,695	20	51	49
	1	752	1,953	23	59	23
	2-4	1,895	5,008	57	150	19
	4-8	167	255	5	8	1
	9+	132	233	4	7	0
	Total	3,598	9,143	108	274	92
2020				106	267	92
2025				106	267	92
2030				106	267	92
2035				19	48	17
		TOTAL		742	1,883	649

FAN 6	
Employment % of Floodplain	6%
Residential % of Floodplain	94%
Total Avail. Floodplain Acres	690
Floodplain Acres -- Employment	41
Floodplain Acres -- Residential	649

Employment Area Development Projections

As described previously, of the 690 acres available for development in Scottsdale portion of Fan 6, it has been estimated that approximately 41 acres will be devoted to employment uses. Intervening growth projections for employment area acreage were not available. Therefore, residential acreage growth rates were utilized to derive employment acreage growth projections (i.e., employment acreage is assumed to develop at the same rate as residential acreage). The resulting development rate for employment acreage is about 6 acres every five years, or slightly over an acre per year.

Summary

Table 28 summarizes growth projections for the Scottsdale portion of Fan 6.

Table 28
Fan 6 Floodplain -- Scottsdale Portion
Summary of Growth Projections

Year	DU Acres	Emplmt Acres	Total Acres	Incremental
1995	--	--	--	--
2000	89	6	95	95
2005	178	11	190	95
2010	265	17	282	92
2015	356	23	379	97
2020	448	29	477	98
2025	540	34	575	98
2030	632	40	673	98
2030	649	41	690	17

Note: Figures do not include existing development

6.3.4.2 Phoenix Portion of Fan 6

Land Available for Development

The Phoenix portion of Fan 6 (west of 56th Street), encompasses about 1,920 acres. Portions of the floodplain are located in four different Traffic Analyses Zones (TAZ's). The table which follows shows the total area of each TAZ, the portion of each represented by the floodplain, and the estimated amount of floodplain acres available for future development.

Table 29
Fan 6 - Phoenix Portion
TAZ and Floodplain Acreage

TAZ	Total Acres	Floodplain (%)	Floodplain Acres	Available
43	557	25%	139	91
44	653	80%	522	375
58	1,715	20%	343	295
59	1,811	50%	906	854
Total	4,736		1,910	1,614

Note: Figures not exact due to rounding

Based upon information obtained from MAG and the City of Phoenix, at buildout, floodplain acreage will be allocated between residential and employment uses as follows:

Table 30
Fan 6 - Phoenix Portion
Allocation of Floodplain Acreage (at Buildout)

TAZ	Available Acres	Residential	%	Employment	%
43	91	84	93%	6	7%
44	375	375	100%	0	0%
58	295	292	99%	3	1%
59	854	854	100%	0	0%
Total	1,614	1,605	99%	9	1%

Residential Development Projections

Population and dwelling unit projections by TAZ were obtained from the City of Phoenix Planning Department. The ratio of floodplain land area to total land area for each TAZ was applied to aggregate population and dwelling unit projections to derive projections for the floodplain. Table 31 (page 47) details these projections. The projected buildout year for the area is 2060. As indicated on Table 31, the rate of growth is expected to vary substantially. A representative of the Phoenix Planning Department indicated that a Subregional Allocation Model was utilized to develop these projections. The growth rate variations were attributed in part to the expected timing of the construction of major roadways. The model determines which areas are most-likely to develop first. After these areas are built out, the model then chooses the next most-likely area to develop, based upon the locations of existing contiguous development.

TABLE 31
FAN 6 FLOODPLAIN GROWTH PROJECTIONS
CITY OF PHOENIX
Traffic Analysis Zones (Total Area)

	43		44		58		59		Total		Incremental Increase	
Year	Pop.	DU	Pop.	DU	Pop.	DU	Pop.	DU	Pop.	DU	Pop.	DU
1995	135	54	209	84	180	72	114	46	638	256	--	--
2000	846	338	209	84	186	74	152	61	1393	557	755	301
2005	2684	1074	552	221	194	78	543	217	3973	1589	2580	1032
2010	5670	2268	600	240	1156	462	2577	1031	10003	4001	6030	2412
2015	5670	2268	619	248	1288	515	2845	1138	10422	4169	419	168
2020	5670	2268	647	259	1525	610	3129	1252	10971	4388	549	220
2025	5670	2268	647	259	1823	729	3467	1387	11607	4643	636	254
2030	5670	2268	647	259	2265	906	4016	1606	12598	5039	991	396
2035	5670	2268	647	259	4295	1718	6253	2501	16865	6746	4267	1707
2040	5670	2268	647	259	6450	2580	8676	3470	21443	8577	4578	1831
2045	5670	2268	647	259	8621	3448	11402	4561	26340	10536	4897	1959
2050	5670	2268	776	310	8621	3448	11402	4561	26469	10588	129	52
2055	5670	2268	1790	716	8621	3448	11402	4561	27483	10993	1014	406
2060	5670	2268	3600	1440	10068	4027	13207	5283	32545	13018	5062	2025
Pop/DU		*2.50*		*2.50*		*2.50*		*2.50*		*2.50*		

Traffic Analysis Zones (In Floodplain)

	43 (25%)		44 (80%)		58 (20%)		59 (50%)		Total		Incremental Increase	
	Pop.	DU	Pop.	DU	Pop.	DU	Pop.	DU	Pop.	DU	Pop.	DU
1995	34	14	167	67	36	14	57	23	294	118	--	--
2000	212	85	167	67	37	15	76	30	492	197	198	79
2005	671	268	442	177	39	16	272	109	1423	569	931	372
2010	1418	567	480	192	231	92	1289	515	3417	1367	1994	798
2015	1418	567	495	198	258	103	1423	569	3593	1437	176	70
2020	1418	567	518	207	305	122	1565	626	3805	1522	212	85
2025	1418	567	518	207	365	146	1734	693	4033	1613	229	91
2030	1418	567	518	207	453	181	2008	803	4396	1758	363	145
2035	1418	567	518	207	859	344	3127	1251	5921	2368	1525	610
2040	1418	567	518	207	1290	516	4338	1735	7563	3025	1643	657
2045	1418	567	518	207	1724	690	5701	2280	9360	3744	1797	719
2050	1418	567	621	248	1724	690	5701	2280	9464	3785	103	41
2055	1418	567	1432	573	1724	690	5701	2280	10275	4110	811	324
2060	1418	567	2880	1152	2014	805	6604	2641	12915	5166	2640	1056

TAZ	Acres	In Floodplain	FP Acres
43	557	25%	139
44	653	80%	522
58	1715	20%	343
59	1811	50%	906
	4736		1910

The dwelling unit growth rates (per Table 31) were utilized to derive projections of residential development in acres through buildout. Table 32 summarizes the results.

Table 32
Fan 6 Floodplain -- Phoenix Portion
Residential Growth Projections (In Acres)

	TAZ					
Year	43	44	58	59	Total	Incr
1995	--	--	--	--	--	--
2000	11	0	0	2	13	13
2005	39	38	0	28	105	92
2010	84	43	29	161	317	212
2015	84	45	33	178	340	23
2020	84	48	40	196	368	28
2025	84	48	49	219	400	32
2030	84	48	62	254	448	48
2035	84	48	122	400	654	206
2040	84	48	185	558	875	221
2045	84	48	249	736	1,117	242
2050	84	63	249	736	1,132	15
2055	84	175	249	736	1,244	112
2060	84	375	292	854	1,605	361

Notes: Figures not exact due to rounding
Does not include existing development

Employment Area Development Projections

As described previously, of the 1,614 acres available for development in the Phoenix portion of Fan 6, it has been estimated that only 9 acres will be devoted to employment uses. Intervening growth projections for employment area acreage were not available. Therefore, residential acreage growth rates were utilized to derive employment acreage growth projections (i.e., employment acreage is assumed to develop at the same rate as residential acreage). Table 33 summarizes the results.

Table 33 Fan 6 Floodplain -- Phoenix Portion Employment Area Growth Projections (In Acres)						
	TAZ					
Year	43	44	58	59	Total	Incr
1995	--	--	--	--	--	--
2000	1	0	0	0	1	1
2005	3	0	0	0	3	2
2010	6	0	0	0	6	3
2015	6	0	0	0	6	0
2020	6	0	0	0	6	0
2025	6	0	0	0	6	0
2030	6	0	1	0	7	1
2035	6	0	1	0	7	0
2040	6	0	2	0	8	1
2045	6	0	3	0	9	1
2050	6	0	3	0	9	0
2055	6	0	3	0	9	0
2060	6	0	3	0	9	0

Note: Does not include existing development

Summary

Table 34 summarizes growth projections for the Phoenix portion of Fan 6.

Table 34 Rawhide Wash Alluvial Fan Floodplain - Phoenix Portion Summary of Growth Projections				
Year	DU Acres	Emplmt Acres	Total Acres	Incremental
1995	--	--	--	--
2000	13	1	14	14
2005	105	3	108	94
2010	317	6	323	215
2015	340	6	346	23
2020	369	6	375	29
2025	400	6	406	31
2030	449	7	456	50
2035	654	7	661	205
2040	876	8	884	223
2045	1,118	9	1,127	243
2050	1,132	9	1,141	14
2055	1,244	9	1,253	112
2060	1,605	9	1,614	361

6.3.4.3 Fan 6 -- Summary of Growth Projections

Table 35 displays the combined growth projections for both the Scottsdale and Phoenix portions of Fan 6.

Table 35
Fan 6 Floodplain (Total)
Summary of Growth Projections

Year	Scottsdale	Phoenix	Total Acres	Incremental
1995	--	--	--	
2000	95	14	109	109
2005	253	108	297	188
2010	282	323	605	308
2015	379	346	726	121
2020	477	375	853	127
2025	575	406	981	128
2030	673	456	1,128	147
2035	690	661	1,352	224
2040	690	884	1,575	223
2045	690	1,127	1,817	242
2050	690	1,141	1,831	14
2055	690	1,253	1,944	113
2060	690	1,614	2,305	361

Note: Does not include existing development

6.3.5 Growth Projections -- Summary

Table 36 summarizes buildout conditions for all fans in the study area. Table 37 displays population projections by fan.

Table 36
All Fans
Buildout Conditions Summary

	Rawhide	Beard/Reata	Fan 5	Fan 6	Total		
Total Acres	7160	5890	1254	2906	17210		
Developed/Undevelopable	1112	900	376	602	2990	17.4%	
Available	6048	4990	878	2304	14220	82.6%	
Residential	4575	3782	825	2254	11436		80.4%
Employment	1473	1208	53	51	2785		19.6%
Population	26946	24521	2394	14503	68364		
Dwelling Units	11863	13105	943	5790	31701		
Pop/DU	2.3	1.9	2.5	2.5	2.5		
DU/Acre	2.6	3.5	1.1	2.6	2.8		

Note: Pop. & DU projections exclude existing development

Table 37
All Fans
Summary of Population Projections

Year	Rawhide	Beard/Reata	Fan 5	Fan 6	Total	Increase
2000	1918	3188	359	467	5932	5932
2010	9826	11040	1013	3883	25762	19830
2020	19724	21219	1727	4811	47482	21720
2030	25141	24521	2394	5937	57992	10510
2040	26946	24521	2394	9152	63012	5020
2050	26946	24521	2394	11052	64913	1900
2060	26946	24521	2394	14503	68364	3451

Note: Excludes existing population

The Maricopa County Association of Governments has projected the population of the Cities of Phoenix and Scottsdale to increase by approximately 1.132 million between the years 2000 and 2040. As shown in Table 37, the combined population growth for all fans is projected at 57,080 over the same period. Thus, the projected growth within the study area alluvial fans represents about five percent of the total projected growth for the Cities of Scottsdale and Phoenix.

6.4 PROJECTED FLOODPROOFING EXPENDITURES

6.4.1 Introduction

In order to project future floodproofing expenditures, estimated floodproofing costs per acre must be applied to the development projections presented in Section 6.3. As discussed in Section 6.1, it has been assumed that, under without project conditions, the alluvial fan would be developed in compliance with FEMA requirements for removal from the 100-year floodplain. Floodproofing costs per acre must therefore reflect the costs of meeting FEMA's requirements.

Research revealed little data regarding historical floodproofing expenditures made by developers, due primarily to the small amount of existing development in the study area. In addition, FEMA's criteria for floodproofing in AO Zones, as detailed in *Alluvial Fans: Hazards and Management*, was not published until 1989. Floodproofing measures implemented prior to that date would likely be considered inadequate compared to the new more stringent standards. Therefore, costs incurred for floodproofing prior to 1989 would not be representative of what developers would be required to expend now to floodproof their developments.

Ironwood Village and Los Portones are the two primary existing developments in the floodplain. Approximately $1 million was spent on floodproofing for a 40 acre subdivision of Los Portones. This equates to $25,000 per acre, which does not include engineering and design. At least $3 million (or $10,500 per acre) was spent of flood control infrastructure for Ironwood Village.

As discussed earlier in this report, attempts were made to obtain FIRM map revisions for both Ironwood Village and Los Portones. FEMA considered the floodproofing designs inadequate and rejected both applications. Accordingly, it would be inappropriate to utilize floodproofing expenditures for these developments to project future floodproofing expenditures in the study area. It should be noted that the flood control infrastructure for these developments had already been designed and was either under construction or constructed prior to FEMA's 1989 publication of alluvial fan flood protection criteria. Thus, the designs were developed without full knowledge of what criteria would have to be met. Future developers would not be posed with this same problem.

Data was obtained for two developments which are currently in the beginning phases of construction. Perimeter Center, which will be part of Scottsdale Core South, is currently under construction. It will include approximately 2 million square feet of office space on about 200 acres. The developer has estimated that between $3 million and $4 million will be spent on flood control (or between $15,000 and $20,000 per acre).

According to a representative of Grayhawk Development, 1,600 acres of the Grayhawk development are projected to be built out within 15 years. This development will include 3,500 homes. Out of a total infrastructure budget of $35 million, roughly 12.5% will be spent on drainage and flood control. This equates to about $2,734 per acre. However, these estimates are based upon the assumption that Scottsdale's proposed Desert Greenbelt flood control project will eventually be built. Thus, flood control expenditures primarily represent interim measures to be taken until the Desert Greenbelt is functional.

Due to the lack of sufficient and applicable historical data, the following projections of future floodproofing costs will rely on floodproofing design and cost estimates developed by the Los

Angeles District.

6.4.2 Rawhide, Beardsley & Reata Pass Fans

Floodproofing expenditures are a function of the size of a development. For example, on a per acre basis, floodproofing expenditures for a 640 acre parcel will be less than those for a 160 acre parcel due to associated economies of scale. Conversations with developers, representatives from the Cities of Phoenix and Scottsdale and the Arizona State Land Department indicate that the alluvial fan area will be developed in large lot sizes. Most of the land available for development is either already owned by developers or is owned by the State of Arizona. Developers contacted indicated that infrastructure (including roads, drainage and flood control) for their developments will be installed on a large-scale basis -- ranging from 160 to 640 acres or even more. Once the infrastructure is completed, smaller sized lots (e.g. 40 to 80 acres) will be sold to homebuilders or commercial builders.

Representatives of the State of Arizona have indicated that State-owned land will probably be sold off in large lot sizes (i.e. 300 acres or more) through public auction to master developers. For example, Desert Ridge and Paradise Ridge are two master planned communities which comprise most of the Phoenix portion of the alluvial fan floodplain. The State is in the process of developing disposition plans for the property and has already sold over 1,200 acres.

Separately-owned smaller lots (of less than 40 acres) represent a small portion of the total floodplain. In addition, developers can (and have) purchased these smaller lots to form larger parcels for development. It has therefore been assumed that only a negligible portion of the floodplain will be developed in small lot sizes.

Based upon this analyses, future floodproofing expenditures will be derived based upon the expected floodproofing costs for three sizes of developments: 160 acres; 320 acres; and 640 acres. The Hydraulics Section has developed floodproofing designs for each of these development sizes. Based upon these designs, the Cost Estimating Section has developed cost estimates for each development size. These costs are summarized below.

Table 38
Rawhide, Beardsley & Reata Pass Fans
Floodproofing Costs Per Acre

Parcel Size	Construction Cost	PE&D	S&A	Total	Per Acre
160	$4,965,600	$546,200	$298,000	$5,809,800	$36,311
320	$7,044,800	$774,900	$458,000	$8,277,700	$25,868
640	$11,156,800	$1,227,200	$725,200	$13,109,200	$20,483
Average					$27,554

Note that these cost estimates do not include the costs of real estate required for the floodproofing infrastructure. However, according to Mr. Mark Landsiedel of the City of Scottsdale, most of the North Scottsdale floodplain is regulated by Scottsdale's *Environmentally Sensitive Land Ordinance*. This ordinance requires that developers set aside substantial portions of their developments as open space. According to Mr. Landsiedel, the land which is set aside for flood control does not represent a loss in utility for the developer, since in most cases, the developer would have been required to set aside the land anyway as open space. Eliminating floodproofing requirements for individual developers would not result in a significant amount of additional land available for development.

The floodproofing costs shown on Table 38 were based upon designs involving natural (rather than concrete) channels. Because of the importance placed by the local community upon preserving the natural desert environment to the greatest extent possible, it is likely that developers would be required to provide natural channel floodproofing alternatives to successfully market their properties.

As shown on Table 38, floodproofing costs on a per acre basis ranged from \$20,483 to \$36,311, with an average of \$27,554. It has been assumed that the three development sizes will be equally represented (in total land area) in future floodplain development in the Beardsley, Reata Pass and Rawhide Wash fans. Therefore, the average cost of \$27,554 will be utilized for this analyses. This per acre cost has been applied to the acreage development projections presented in Section 6.3 to calculate future floodproofing expenditures. Tables 39 and 40 (pages 55-56) present projected floodproofing expenditures for the Beardsley/Reata Pass alluvial fan and Rawhide wash alluvial fan, respectively.

6.4.3 Fans 5 & 6

Fans 5 and 6 have less land available for development than the Rawhide and Reata/Beardsley fans. In addition, existing development within the fans is dispersed unevenly, leaving fewer large lot sizes available for future development. Accordingly, it has been assumed that Fans 5 and 6 will be developed in smaller lot sizes than the Rawhide, Beardsley and Reata Pass fans.

Based upon an analysis of the land available for development, as well as historical and projected development patterns, a representative future floodproofing cost has been derived from a weighted average of floodproofing costs for three parcel sizes: one acre, 40 acres, and 160 acres.

One acre parcel sizes will be developed in areas where there is existing development, and there is insufficient contiguous land available for larger developments. Floodproofing for one acre parcels consists of elevating structures on fill one foot above the one hundred year flood depth and providing local drainage infrastructure. The expected floodproofing cost for the one acre parcel size has been estimated at \$4,326 per acre, of which \$923 represents the cost of fill for one single family structure (assuming one structure per acre) and \$3,403 represents the cost of drainage. These cost estimates are based upon research completed for the *Tortolita Drainage Area, Arizona Reconnaissance Study (1996)*. It has been assumed that 25 percent of the land available for development in Fans 5 and 6 will be developed in this manner.

TABLE 39

FLOODPROOFING COST PROJECTIONS

BEARDSLEY/REATA PASS ALLUVIAL FAN FLOODPLAINS

Year	DU	DU Acres	Emplmt Acres	Cumulative Total Acres	Incremental Acres	Floodproofing Cost/Acre	Floodproofing Cost
2000	2323	671	214	885	--		
2001	2786	805	257	1062	176	$27,554	$4,860,892
2002	3250	939	300	1238	176	$27,554	$4,860,892
2003	3713	1072	342	1415	176	$27,554	$4,860,892
2004	4177	1206	385	1591	176	$27,554	$4,860,892
2005	4640	1340	428	1767	176	$27,554	$4,860,892
2006	5105	1474	471	1944	177	$27,554	$4,869,340
2007	5569	1608	513	2121	177	$27,554	$4,869,340
2008	6033	1742	556	2298	177	$27,554	$4,869,340
2009	6497	1875	599	2474	177	$27,554	$4,869,340
2010	6961	2009	642	2651	177	$27,554	$4,869,340
2011	7425	2143	684	2828	177	$27,554	$4,866,585
2012	7889	2277	727	3004	177	$27,554	$4,866,585
2013	8353	2411	770	3181	177	$27,554	$4,866,585
2014	8817	2545	813	3358	177	$27,554	$4,866,585
2015	9280	2679	855	3534	177	$27,554	$4,866,585
2016	9744	2813	898	3711	177	$27,554	$4,866,585
2017	10208	2946	941	3887	177	$27,554	$4,866,585
2018	10672	3080	984	4064	177	$27,554	$4,866,585
2019	11136	3214	1026	4241	177	$27,554	$4,866,585
2020	11600	3348	1069	4417	177	$27,554	$4,866,585
2021	12064	3482	1112	4594	177	$27,554	$4,866,585
2022	12528	3616	1155	4770	177	$27,554	$4,866,585
2023	12992	3750	1197	4947	177	$27,554	$4,866,585
2024	13105	3782	1208	4990	43	$27,554	$1,173,119
2025	13105	3782	1208	4990	0	$27,554	$0

Net Present Value (Years 2005-2055, 1995 dollars)	$48,299,747
Annualized (50 years, 7 5/8%)	$3,778,727

Note: Figures do not include existing development

TABLE 40

FLOODPROOFING COST PROJECTIONS

RAWHIDE WASH ALLUVIAL FAN FLOODPLAIN

	Cumulative Acres			Incremental	Floodproofing	Floodproofing
Year	Scottsdale	Phoenix	Total	Acres	Cost/Acre	Cost
2000	403	266	669	--		
2001	484	338	822	153	$27,554	$4,204,251
2002	565	409	974	153	$27,554	$4,204,251
2003	647	481	1127	153	$27,554	$4,204,251
2004	728	552	1280	153	$27,554	$4,204,251
2005	809	623	1432	153	$27,554	$4,204,251
2006	889	789	1679	246	$27,554	$6,789,009
2007	970	955	1925	246	$27,554	$6,789,009
2008	1050	1121	2171	246	$27,554	$6,789,009
2009	1131	1287	2418	246	$27,554	$6,789,009
2010	1211	1453	2664	246	$27,554	$6,789,009
2011	1292	1630	2921	257	$27,554	$7,084,094
2012	1372	1806	3178	257	$27,554	$7,084,094
2013	1453	1982	3435	257	$27,554	$7,084,094
2014	1534	2159	3693	257	$27,554	$7,084,094
2015	1614	2335	3950	257	$27,554	$7,084,094
2016	1695	2459	4154	204	$27,554	$5,633,375
2017	1776	2583	4359	204	$27,554	$5,633,375
2018	1856	2707	4563	204	$27,554	$5,633,375
2019	1937	2830	4767	204	$27,554	$5,633,375
2020	2018	2954	4972	204	$27,554	$5,633,375
2021	2098	3024	5122	151	$27,554	$4,147,897
2022	2179	3094	5273	151	$27,554	$4,147,897
2023	2260	3164	5423	151	$27,554	$4,147,897
2024	2340	3234	5574	151	$27,554	$4,147,897
2025	2421	3303	5725	151	$27,554	$4,147,897
2026	2502	3328	5829	105	$27,554	$2,885,119
2027	2520	3352	5872	42	$27,554	$1,164,778
2028	2520	3376	5896	24	$27,554	$662,184
2029	2520	3400	5920	24	$27,554	$662,184
2030	2520	3424	5944	24	$27,554	$662,184
2031	2520	3436	5956	12	$27,554	$336,641
2032	2520	3448	5968	12	$27,554	$336,641
2033	2520	3460	5980	12	$27,554	$336,641
2034	2520	3473	5993	12	$27,554	$336,641
2035	2520	3485	6005	12	$27,554	$336,641
2036	2520	3493	6013	9	$27,554	$238,567
2037	2520	3502	6022	9	$27,554	$238,567
2038	2520	3511	6031	9	$27,554	$238,567
2039	2520	3519	6039	9	$27,554	$238,567
2040	2520	3528	6048	9	$27,554	$238,567

Net Present Value (Years 2005-2055, 1995 dollars)	$64,413,456
Annualized (50 years, 7 5/8%)	$5,039,381

Note: Figures do not include existing development

Most of the remaining available land is expected to develop in parcel sizes of less than 80 acres. The floodproofing cost for a 40 acre parcel size is considered to be representative. The expected cost to floodproof a 40 acre parcel to meet FEMA requirements for removal from the 100-year floodplain was also obtained from research completed for the *Tortolita Drainage Area, Arizona Reconnaissance Study.* Like North Scottsdale, the Tortolita study area is comprised of alluvial fans and experiences similar types of flooding. The requirements to floodproof a development in the two areas is therefore considered to be similar. The estimated total floodproofing cost for a 40 acre parcel is $1,400,721, including contingency. This represents $35,018 on a per acre basis. To develop an average floodproofing cost, this parcel size has been assigned a weight of 65 percent.

The remaining ten percent of the available land in Fans 5 and 6 is assumed to be developed in larger parcel sizes (greater than 100 acres). The floodproofing cost for the 160 acre parcel size developed in Section 6.4.2 has been utilized to represent these larger developments. As shown on Table 38, the floodproofing cost per acre for the 160 acre development size is $36,311. The weighted average floodproofing cost per acre for Fans 5 and 6 is calculated below.

Table 41
Fans 5 & 6
Floodproofing Costs Per Acre

Parcel Size	Total Cost	Cost Per Acre	Weight
One acre	$1,037	$4,326	25%
40 Acres	$1,400,721	$35,018	65%
160 Acres	$5,809,800	$36,311	10%
Weighted Avg.		$27,474	

The weighted average cost per acre of $27,474 has been applied to the acreage development projections presented in Section 6.3 to calculate future floodproofing expenditures. Tables 42 and 43 (pages 58-59) present projected floodproofing expenditures for Fans 5 and 6, respectively.

6.5 PROJECTED INUNDATION DAMAGES

Projected inundation damages to future development have not been calculated. It has been assumed that under without-project conditions, future development would comply with FEMA's requirements for removal from the 100-year floodplain. Therefore, damages to future development would only take place for flood events greater than the 100-year event. These damages would be discounted significantly and therefore would represent a negligible proportion of total without project damages.

TABLE 42

FLOODPROOFING COST PROJECTIONS

FAN 5 FLOODPLAIN

Year	DU	DU Acres	Emplmt Acres	Cumulative Total Acres	Incremental Acres	Floodproofing Cost/Acre	Floodproofing Cost
2000	135	119	8	126	--		
2001	162	142	9	151	25	$27,474	$695,572
2002	189	166	11	177	25	$27,474	$695,572
2003	216	190	12	202	25	$27,474	$695,572
2004	243	214	14	227	25	$27,474	$695,572
2005	270	238	15	253	25	$27,474	$695,572
2006	296	261	17	277	25	$27,474	$674,164
2007	321	284	18	302	25	$27,474	$674,164
2008	346	307	20	326	25	$27,474	$674,164
2009	371	330	21	351	25	$27,474	$674,164
2010	397	353	23	375	25	$27,474	$674,164
2011	425	377	24	401	26	$27,474	$714,493
2012	454	402	26	427	26	$27,474	$714,493
2013	483	426	27	453	26	$27,474	$714,493
2014	512	451	29	479	26	$27,474	$714,493
2015	541	475	30	505	26	$27,474	$714,493
2016	568	499	32	531	26	$27,474	$701,475
2017	596	523	33	557	26	$27,474	$701,475
2018	623	547	35	582	26	$27,474	$701,475
2019	651	571	36	608	26	$27,474	$701,475
2020	679	595	38	633	26	$27,474	$701,475
2021	706	619	40	659	26	$27,474	$701,475
2022	734	643	41	684	26	$27,474	$701,475
2023	761	667	43	710	26	$27,474	$701,475
2024	789	691	44	735	26	$27,474	$701,475
2025	817	715	46	761	26	$27,474	$701,475
2026	842	737	47	784	23	$27,474	$643,018
2027	867	759	48	808	23	$27,474	$643,018
2028	892	781	50	831	23	$27,474	$643,018
2029	918	803	51	854	23	$27,474	$643,018
2030	943	825	53	878	23	$27,474	$643,018
2031	943	825	53	878	0	$27,474	$0

Net Present Value (Years 2005-2055, 1995 dollars)	$7,713,719
Annualized (50 years, 7 5/8%)	$603,482

Note: Figures do not include existing development

TABLE 43
FLOODPROOFING COST PROJECTIONS
FAN 6 FLOODPLAIN

Year	Cumulative Acres Scottsdale	Phoenix	Total	Incremental Acres	Floodproofing Cost/Acre	Floodproofing Cost
2000	95	14	109	--		
2001	114	33	147	38	$27,474	$1,036,771
2002	133	52	184	38	$27,474	$1,036,771
2003	152	70	222	38	$27,474	$1,036,771
2004	171	89	260	38	$27,474	$1,036,771
2005	190	108	297	38	$27,474	$1,036,771
2006	208	151	359	62	$27,474	$1,690,124
2007	226	194	421	62	$27,474	$1,690,124
2008	245	237	482	62	$27,474	$1,690,124
2009	263	280	544	62	$27,474	$1,690,124
2010	282	324	605	62	$27,474	$1,690,124
2011	301	328	629	24	$27,474	$665,042
2012	321	333	653	24	$27,474	$665,042
2013	340	338	678	24	$27,474	$665,042
2014	360	342	702	24	$27,474	$665,042
2015	379	347	726	24	$27,474	$665,042
2016	399	353	751	25	$27,474	$695,387
2017	418	359	777	25	$27,474	$695,387
2018	438	364	802	25	$27,474	$695,387
2019	457	370	827	25	$27,474	$695,387
2020	477	376	853	25	$27,474	$695,387
2021	497	382	878	26	$27,474	$707,703
2022	516	388	904	26	$27,474	$707,703
2023	536	394	930	26	$27,474	$707,703
2024	555	400	956	26	$27,474	$707,703
2025	575	407	981	26	$27,474	$707,703
2026	594	416	1011	29	$27,474	$806,893
2027	614	426	1040	29	$27,474	$806,893
2028	634	436	1070	29	$27,474	$806,893
2029	653	446	1099	29	$27,474	$806,893
2030	673	456	1128	29	$27,474	$806,893
2031	690	497	1187	59	$27,474	$1,619,285
2032	690	538	1229	41	$27,474	$1,134,121
2033	690	579	1270	41	$27,474	$1,134,121
2034	690	621	1311	41	$27,474	$1,134,121
2035	690	662	1352	41	$27,474	$1,134,121
2036	690	706	1397	44	$27,474	$1,221,241
2037	690	751	1441	44	$27,474	$1,221,241
2038	690	795	1486	44	$27,474	$1,221,241
2039	690	840	1530	44	$27,474	$1,221,241
2040	690	884	1575	44	$27,474	$1,221,241
2041	690	933	1623	48	$27,474	$1,332,405
2042	690	981	1672	48	$27,474	$1,332,405
2043	690	1030	1720	48	$27,474	$1,332,405
2044	690	1078	1769	48	$27,474	$1,332,405
2045	690	1127	1817	48	$27,474	$1,332,405
2046	690	1130	1820	3	$27,474	$78,452
2047	690	1132	1823	3	$27,474	$78,452
2048	690	1135	1826	3	$27,474	$78,452
2049	690	1138	1829	3	$27,474	$78,452
2050	690	1141	1831	3	$27,474	$78,452
2051	690	1163	1854	22	$27,474	$616,670
2052	690	1186	1876	22	$27,474	$616,670
2053	690	1208	1899	22	$27,474	$616,670
2054	690	1231	1921	22	$27,474	$616,670
2055	690	1253	1944	22	$27,474	$616,670
2056	690	1326	2016	72	$27,474	$1,984,559
2057	690	1398	2088	72	$27,474	$1,984,559
2058	690	1470	2160	72	$27,474	$1,984,559
2059	690	1542	2233	72	$27,474	$1,984,559
2060	690	1614	2305	72	$27,474	$1,984,559

Net Present Value (Years 2005-2055, 1995 dollars)	$13,576,922
Annualized (50 years, 7 5/8%)	$1,062,189

Note: Figures do not include existing development

7.0 OTHER DAMAGES

7.1 EMERGENCY/CLEAN UP COSTS

There is very little data available regarding historical flood damages in the study area, since the alluvial fan has only recently begun to experience significant development activity and still remains primarily undeveloped. According to Mr. Colis Lovely, Transportation/Drainage Planner for the City of Scottsdale, the area experienced flooding in 1992 and 1993, during which several cars were washed down a wash. Neither the Maricopa County Flood Control District nor the City had estimates regarding the frequency of these events or additional information regarding flood damages.

Scottsdale's Municipal Services Department estimated contract repairs and maintenance expenditures for 1993 and 1994 at $121,231. These figures included repairing dip sections and other road repairs. Clean up costs for the entire city of Scottsdale, including barricades and sand bags, totaled $27,000 in 1993 and $32,275 in 1994. Information regarding the proportion of these costs attributable to the North Scottsdale study area was not available. Further, these amounts do not include expenditures made by private developments for repairs, maintenance and clean-up.

Due to the lack of necessary historical data for the study area, expected annual emergency and clean-up costs have been estimated based upon research and analysis conducted for prior Corps flood-control studies involving alluvial fans. Prior Corps studies indicate that combined emergency and clean-up costs represent between three and nine percent of equivalent annual inundation damages. For purposes of this analysis, combined annual emergency and clean-up costs for the study area will be estimated at 5 percent of equivalent annual inundation damages. Table 44 below details expected annual emergency and clean-up costs by fan.

Table 44
Expected Annual Emergency/Cleanup Damages
(In $1,000's)

Fan	Expected Annual Inundation Damages	Emerg/Cleanup Damages (5%)
Beardsley/Reata Pass	$203.0	$10.15
Rawhide Wash	$115.9	$5.80
Fan 5	$32.0	$1.60
Fan 6	$31.5	$1.58
Total	$382.4	$19.00

7.2 FLOOD INSURANCE EXPENDITURES

Those people either constructing a new home or purchasing an existing home in an alluvial fan floodplain (AO Zones) via a federally-insured loan are required to purchase FEMA flood insurance. In addition, some banks mandate the purchase of flood insurance even if the mortgage is not insured by a federal agency. The amount of the premiums paid by policyholders is comprised of two components: 1) funding for NFIP administrative and overhead costs, including policywriting, floodplain management, salaries, etc.; and 2) funding for payouts after flood events. The amounts paid by policyholders for administrative and overhead costs represents an National Economic Development (NED) loss, since this money would not have to be expended if the properties were not located in a floodplain.

The maximum amount of coverage per policy is $250,000 for building structures and $100,000 for contents. For homes meeting FEMA's minimum development requirements, the charge per policy for the maximum amount of coverage is $324 per year. Premiums are higher for homes which are not elevated or do not otherwise meet FEMA's requirements. Overhead and administrative costs represent about $122 per policy.

Flood insurance policy data was obtained from FEMA by zip code to estimate the number of properties in the study area covered by flood insurance. This data indicates that there are about 776 properties covered by flood insurance in the study area. Approximately $214,683 in premiums are collected annually on these policies, which provide roughly $117.8 million in coverage. This indicates that the average premium and amount of coverage per policy are $277 and $151,800, respectively. About $94,700 of the premiums paid by policyholders represents overhead and administrative costs, which represents an NED loss.

8.0 WITHOUT PROJECT SUMMARY

The following table summarizes annualized without project damages in the study area.

Table 45
Summary of Without Project Annual Damages
(In $1,000's)

	Beardsley/ Reata Pass Fan	Rawhide Wash Fan	Fan 5	Fan 6	Total
Inundation	$203.0	$115.9	$32.0	$31.5	$382.4
Future Floodproofing Costs	$3,778.7	$5,039.4	$603.5	$1,062.2	$10,483.8
Emergency/Clean Up	$10.2	$5.8	$1.6	$1.6	$19.2
Flood Insurance Costs	NS	NS	NS	NS	$94.7
Total	$3,991.9	$5,161.1	$637.1	$1,095.3	$10,980.1

NS: Not Segregated by Fan

9.0 WITH PROJECT CONDITIONS

9.1 NED BENEFITS OF WITH PROJECT CONDITIONS

All of the alternatives which were analyzed meet FEMA criteria for protection from the 100-year flood. With this in mind, the calculation of NED benefits from flood control is the same for all alternatives. NED benefits include:

1) Inundation reduction benefits;
2) Savings in future floodproofing expenditures;
3) Reductions in emergency and clean up costs; and
4) Savings in flood insurance administrative costs.

9.1.1 Inundation Reduction Benefits

Inundation reduction benefits are equal to the difference between the damages without project and the residual damages with project (for flood frequencies greater than the 100 year event). With-project equivalent annual damages and damages reduced are detailed on the tables below.

Table 46
North Scottsdale Study Area
Without-Project Equivalent Annual Structure & Content Damages
& Damages Reduced by Structure Type
(In $1,000's)

		With Project	Damages Reduced
SFR	Struct	$18.3	$167.1
	Cont	$12.1	$97.3
MFR	Struct	$1.6	$23.2
	Cont	$1.1	$15.0
MH	Struct	$0.0	$0.2
	Cont	$0.0	$0.1
Office	Struct	$0.2	$1.9
	Cont	$0.2	$2.1
Com	Struct	$1.2	$8.1
	Cont	$1.8	$11.3
Ind/Farm	Struct	$0.1	$1.2
	Cont	$0.1	$1.8
Hotel	Struct	$0.4	$3.0
	Cont	$0.4	$3.2
Public	Struct	$0.8	$6.5
	Cont	$0.2	$1.6
TOTAL		$38	$344

Table 47 North Scottsdale Study Area Equivalent Annual Damages & Damages Reduced by Reach (In $1,000's)		
	With Project	Damages Reduced
R1	$5.6	$75.5
R2	$7.5	$27.5
R2A	$0.3	$3.4
R4	$5.9	$75.9
CWP1	$0.1	$1.3
Total -- Beardsley/Reata Pass Fans	**$19.4**	**$183.6**
RAW1	$0.1	$1.3
RAW3	$0.4	$7.1
RAW4	$10.7	$48.8
OF2	$0.8	$13.6
OF7	$2.9	$30.2
Total -- Rawhide Wash Fan	**$14.9**	**$101.0**
FL51	$0.5	$9.7
FL52	$0.4	$6.9
FL53	$1.4	$11.3
FL54	$0.2	$1.6
Total -- Fan 5	**$2.5**	**$29.5**
FL61	$0.3	$4.6
FL62	$0.1	$1.6
FL63	$0.4	$7.8
FL64	$0.7	$13.5
FL65	$0.1	$2.4
Total -- Fan 6	**$1.6**	**$29.9**
GRAND TOTAL	**$38**	**$344**

9.1.2 Savings in Future Floodproofing Expenditures

By far the largest NED benefit resulting from project construction is savings in future floodproofing expenditures. The NED benefit which accrues to a federally sponsored alluvial fan flood control project in the North Scottsdale study area is in the nature of an efficiency of scale. As it is projected, the study area alluvial fans over time are going to develop without the intervention of the federal government. This development will be piecemeal with various small scale methods to meet FEMA's floodproofing requirements. As such, for the nation the potential exists that a single unified measure to control alluvial fan flooding may be less costly in terms of the diversion of national resources than the projected piecemeal approach, e.g., if 100 developers were to ~~individually~~ expend a total of $10 million to control flooding, but a comprehensive system to protect all of these developers existed and had a cost of $9 million, the construction of the comprehensive system would be in the nation's interest as it represents a savings (resources not diverted) of $1 million.

In this analysis, the NED benefit for federal flood control is measured by the difference between the federal cost to build a comprehensive flood control system and the equivalent present day value of the future piecemeal system which would be developed without federal intervention. The present day measure of the future piecemeal system is the net present value (NPV) of the estimated future expenditures. Amortization of the NPV over 50 years at 7 5/8% converts the NPV figure to an annual figure comparable to that of expected annual inundation damage for ease in comparisons of benefits and costs. The amortized value of the piecemeal system for all fans has been calculated at $10.5 million (see Table 45). Thus, the NED benefit is equal to the difference between this cost and the annualized federal costs for a comprehensive flood control system. Estimated costs for the proposed comprehensive flood control system will be analyzed separately in Section 9.2.

9.1.3 Savings in Emergency/Clean Up Costs

Emergency and cleanup costs will be reduced under with project conditions, as the proposed alternatives will provide flood protection up to the 100-year event. With-project equivalent annual damages and damages reduced are detailed on the table below.

Table 48
North Scottsdale Study Area
Emergency & Clean Up Costs
Equivalent Annual Damages & Damages Reduced by Reach
(In $1,000's)

	With Project	Damages Reduced
Beardsley/Reata Pass Fans	$1.0	$9.2
Rawhide Wash Fan	$0.7	$5.1
Fan 5	$0.1	$1.5
Fan 6	$0.1	$1.5
TOTAL	**$1.9**	**$17.3**

9.1.4 Savings in Flood Insurance Administrative Costs

As indicated above, all proposed alternatives meet FEMA 100 year requirements. In meeting these requirements, homeowners in the alluvial fans will no longer be required to purchase flood insurance. Therefore, annual flood insurance administration costs of $94,700 calculated in Section 7.2 are eliminated, which also represents an NED benefit.

9.1.5 Summary of Annual Benefits

Table 49 below summarizes annual project benefits.

Table 49
North Scottsdale Study Area
Annual Benefits
(In $1,000's)

	Annual Benefits
Inundation Reduction	$344
Future Floodproofing Costs Foregone	$10,484
Reductions in Emergency/Clean up costs	$17
Savings in Flood Insurance Admin. Costs	$95
TOTAL	**$10,940**

9.2 PROJECT ALTERNATIVES

9.2.1 General Characteristic of Alternatives

Several potential alternatives were identified which would provide flood protection for the study area alluvial fans. The primary criteria for any proposed plan is that it must provide 100-year flood protection. Otherwise, future expenditures by developers for floodproofing would still be required by FEMA, and full realization of the benefits of economies in scale in floodproofing would not be realized. In addition, property owners in the floodplain would still be required to purchase flood insurance. From the alternatives which were identified, a proposed plan was selected. Cost estimates were developed for the proposed plan, which is described below.

9.2.2 Proposed Plan

The proposed plan consists of the following components:

1) A detention basin on Rawhide Wash northwest of Jomax Road and Pima Road;
2) A concrete channel adjacent to Pima Road extending from Jomax Road on the north to the Bureau of Reclamation detention basin below Bell Road;
3) Improved natural channels on Reata Pass and Beadsley washes; and
4) Concrete channels through Fans 5 and 6.

Hydrologic and Hydraulic engineering analysis indicates that the proposed alternative would meet FEMA's requirements for 100-year alluvial fan flood protection.

9.2.3 Project Costs

Civil design estimates the cost (including contingencies, PE&D, S&A and real estate) of the proposed plan as follows:

Table 50
Project Costs
(In $1,000s)

Construction Cost	$84,335
Interest During Construction	$17,555
Gross Investment	$101,891
Annualized (7.625%, 50 yrs)	$7,971
O&M	$1,145
Total Annual Costs	$9,117

10.0 BENEFIT/COST ANALYSIS

The annual benefits and costs for the proposed project are $10,940,000 and $9,117,000, respectively. Thus, net benefits are equal to $1,823,000, and the benefit/cost ratio is 1.2x.

APPENDIX E: REAL ESTATE

RECONNAISSANCE COST ESTIMATE

for

NORTH SCOTTSDALE DRAINAGE AREA
FLOOD CONTROL ALTERNATIVES

for

PLANNING SECTION C
PHOENIX ARIZONA PROJECT OFFICE

by

DEPARTMENT OF THE ARMY
LOS ANGELES DISTRICT, CORPS OF ENGINEERS
PHOENIX ARIZONA REAL ESTATE OFFICE

1 DECEMBER 1995

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RECONNAISSANCE LEVEL COST ESTIMATE

NORTH PHOENIX AND SCOTTSDALE
DRAINAGE AREA

1. AUTHORITY

This report is prepared in response to ENG service request #95-6042 RH from Planning Section C, Phoenix Office, dated 2 May 1995.

2. PURPOSE

Under consideration is the feasibility of various flood control protection measures for stormwater management. The greater area is situated in North Phoenix and North Scottsdale and more specifically is identified as Fans 5 and 6, Rawhide, Beardsley, and Reata Pass washes. Implementation of various alternatives will impact area real estate and this report outlines property values within the study area. This region has experienced significant development which has enhanced the hazard from flooding. Implementing flood control measures will remove the area from a FEMA AO zone, thus eliminating the need for flood insurance and will result in reduced development costs.

3. CONTINGENCY

A contingency factor has not been applied as the size of the take areas have not been identified. It would be expected that a 25% contingency factor and a 10% severance factor would be applied. The contingency and severance factors are based on (1) the level of the report, (2) time constraints, (3) unknown condemnation settlements, (4) undetected improvements, (5) minor project design changes, (6) unknown property splits, and (7) market data availability.

4. FUNCTION

The value estimates developed in this reconnaissance level report will be used to indicate the potential cost of the Real Estate requirements for the North Phoenix/Scottsdale Drainage Area. This report is for internal planning purposes to determine the potential real estate costs associated with the proposed flood control alternatives. It has not been completed for acquisition purposes and should not be used for funding purposes.

5. DATE OF VALUE

The date of value is November 1995, latest inspection, and the date of the report is 1 December 1995.

6. SPECIAL FEATURES

This cost estimate does not include any supplemental value for subsurface mineral deposits and/or rights. The physical inspection of the area and aerial maps covering some of the area did not indicate any ongoing mining operations within the project area. Market data did not appear to reflect any enhancement to values resulting from potential mineral rights. Mineral rights such as oil and gas, sand and gravel, could potentially affect the cost estimate.

7. RECOMMENDED ESTATE

The recommended estate to be acquired will be the fee simple interest on retention basins and the just compensation for the taking will be 100% of the fair market value. Channel way easements may be required on washes without recreational requirements, and the just compensation for an easement would be estimated at 20% of the fair market fee value. Where recreational paths are incorporated, the entire fee simple interest will need to be acquired.

8. DEFINITIONS

Market Value: The most probable price which a property should bring in a competitive and open market under all conditions requisite to a fair sale, the buyer and seller, each acting prudently, knowledgeably and assuming the price is not affected by undue stimulus. Implicit in this definition is the consummation of a sale as of a specified date and the passing of title from seller to buyer under conditions whereby: (1) buyer and seller are typically motivated; (2) both parties are well informed or well advised, and each acting in what he considers his own best interest: (3) a reasonable time is allowed for exposure in the open market; (4) payment is made in terms of cash in U.S dollars or in terms of financial arrangements comparable thereto; and (5) the price represents the normal consideration for the property sold unaffected by special or creative financing or sales concessions granted by anyone associated with the sale.

Highest and Best Use: The use, from reasonably probable and legal use of vacant land or an improved property, which is physically possible, appropriately supported, financially feasible, and results in the highest value. The four criteria that highest and best use must meet are legal permissibility, physical possibility, financial feasibility, and maximum profitability.[1]

It is important to note that highest and best use is not determined through subjective analysis by the property owner, the developer, or the appraiser. It is shaped by the competitive forces of the market in which it is located. The four criteria of legal permissibility, physical possibility, financial feasibility, and maximal productivity are always considered in that order, for it makes no difference that a property is maximally productive or even financially feasible for a given use if is legally prohibited or physically impossible to develop the property to that use.

A detailed highest and best use analysis of each parcel is considered beyond the scope of this reconnaissance level cost estimate. Generally it can be concluded that the study area will experience substantial residential growth as many master-planned communities are either being planned or developed. This increase will create a demand for neighborhood commercial centers. As of this report date the primary uses of lands within the study area would be to hold for investment, residential, commercial, multi-family, office, resort, and/or a combination of the above.

9. ASSUMPTIONS AND LIMITING CONDITIONS

This report and the value estimates it contains are expressly subject to the following:

A. No responsibility is assumed for matters which are legal in nature.

B. The information and the data secured by the appraiser, oral and written, is considered to be from reliable sources; however, no guarantee is made as to its absolute accuracy.

C. If any of the valuation estimates developed in this report are used in another report or document, this report should be cited as the source by footnote.

D. Maps and other illustrations used herein are for illustration and are provided only to assist the reader in visualizing the property. They are believed to be reliable and indicative of the property, but are not represented as legal surveys, nor for legal reference.

E. Any adjustment, revision or change in the application of data or values as they appear in this report will invalidate same,

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[1] The Dictionary of Real Estate Appraisal, 3rd edition, Chicago:Appraisal Institute, 1993, page 171.)

unless approved by the Phoenix Real Estate Office.

F. This report is based on data available at the time of the study, and no conditions exist that were not discoverable through a normal, diligent investigation. If additional information is received at a later date, that information could affect the valuation estimate.

G. Possession of this report or a copy of this report does not carry with it the right to publication or reproduction without the written consent of the Phoenix Real Estate Office.

H. A general area inspection was conducted August and November 1995 to determine the uses of area lands. All the lands within the project area were not inspected due to the vast size of the study area. Access through all channel ways is not possible due to thick brush and environmental sensitive areas. Aerial maps, topographic maps, and assessor data were utilized to supplement the data gathered from the on site area inspection. At feasibility level aerial maps are absolutely necessary, and inspection could be completed by airplane or helicopter.

I. The values estimated in this report are based on the assumption that title is clear and marketable, free of liens such as mortgages, deeds of trust, and judgments. Title will be taken subject to existing public easements and assessment bonds. This report is based on the property being under prudent and responsible ownership and management.

J. This report's scope has been limited to a reconnaissance level estimate of value. The property owners were not contacted as of the report date, and inspection of the general area was conducted from available public roadways. This report should not be used for funding purposes and has only been completed for planning purposes. If serious consideration is given to the acquisition of lands under the various alternatives another request will be required to prepare a detailed real estate planning report. The detailed real estate planning report will go into significantly greater detail which would permit use for funding purposes.

10. SITE INSPECTION DATE

The general area of North Phoenix and North Scottsdale was inspected on August and November 1995.

11. GENERAL PROJECT AND AREA DESCRIPTION

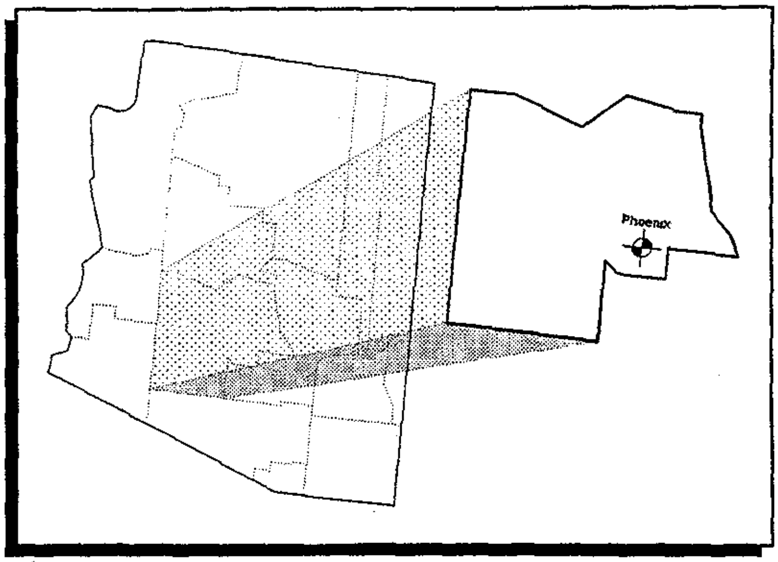


Figure 1

The study area is located in south central Arizona in Maricopa County. Phoenix is the Arizona State Capitol and the Maricopa County Seat. Arizona is the sixth largest state in the United States in land area and twenty-fourth in total population. Arizona has historically been among the leading states in important indices of growth, such as growth of non-farm wage and salary employment, growth of personal income and population growth. For example, according to statistics released in 1989 regarding growth from 1978 through 1988, Arizona ranked second in nonagricultural job growth, with a 53.5% increase during this period; third in growth of personal income, a 178.1% increase; and second in population growth, with an increase of 37.6%. These figures are rather impressive, considering the 1980-1982 recession in Arizona economy and a slowing of growth in these categories beginning in 1986. In addition, U.S. Census Bureau projections for the Phoenix area from 1990 to 2000, as compared to 292 other metropolitan areas, rank the area second in income growth, with a projected 43% increase during the decade; third in job growth, a 29% projected increase; and third in population growth, with a 24% growth projection.

According to 1990 census data, Arizona had an estimated population of 3,665,000 people at that time, indicating an increase of approximately 35% from 1980, compared to an increase in total United States population of about 10% over the same time span. These factors serve to demonstrate that Arizona has experienced a fairly rapid rate of growth in several categories. However, based on various measures of annual growth, the Arizona economy was nearing recession during 1989 and 1990, and was in a recession in 1991. Casualties of the recession included a significant number of business failures, although failures began to lessen in 1992. While employment and personal income in Arizona are still on the rise, growth in these categories in 1991 was the weakest since 1982 but improved by 4.9% in 1994. An economic recovery appears to be underway in Arizona, although its strength remains somewhat below that of previous recoveries. In addition, leading economists and business research firms forecast population growth figures for 1995 and 1996 at 5.0% and 4.5%, respectively.

Depending on the point in the economic cycle, 50% to 75% of the population growth can be attributed to net migration, with the balance due to natural increase (more births than deaths). This proportion is higher in the Phoenix metropolitan area and lower in rural areas of Arizona. Moreover, it is noted that the present population growth rate continues to be greater than the national rate. Phoenix still remains an attractive alternative to other cities as evidenced by Arizona State University's net in-migration figure of 9,000+/- for the 2nd quarter of 1995.

Rapid growth from in-migration hides the fact that many people leave the state. In an average year, net in-migration to Arizona totals about 65,000, there are approximately 190,000 people migrating in and there is about an out-migration of 125,000. For every three people who move to the state, two are on the way out. The ratio exceeds 1.5 during economic booms but falls to less than 1.33 during recessions.

Migration and economic growth have a two-way relationship, each stimulating the other. Population drives the economy long-term, but economic performance largely dictates population growth in the short term. Net migration to Arizona drops significantly during economic recessions because there is a lack of employment.

Population projections by the Arizona Department of Economic Security include statewide totals of 3,946,975 in 1993 and 4,831,775 in 2002. At this rate, Arizona population would exceed the five million mark in slightly more than ten years. Similar projections for Maricopa County include populations of 2,420,000 in the second quarter of 1995 and a projection of 2,850,000 in 2002. Thus, the County population may likely exceed three million by the year 2005. This is important in appraising properties in central Arizona, since an increase in population creates demand for additional residential,

Population Growth

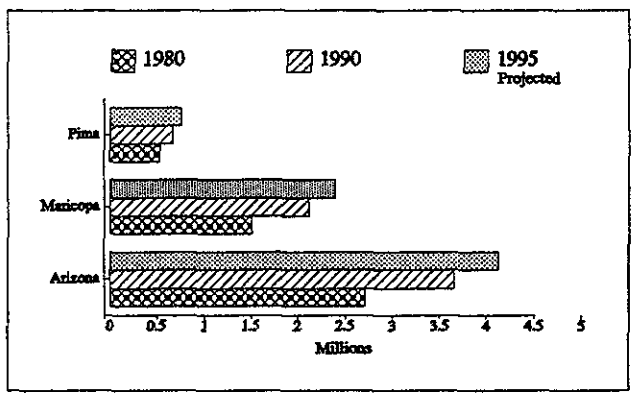


Figure 2 Based on data from the Arizona Department of Economic Security, Population Statistics Unit

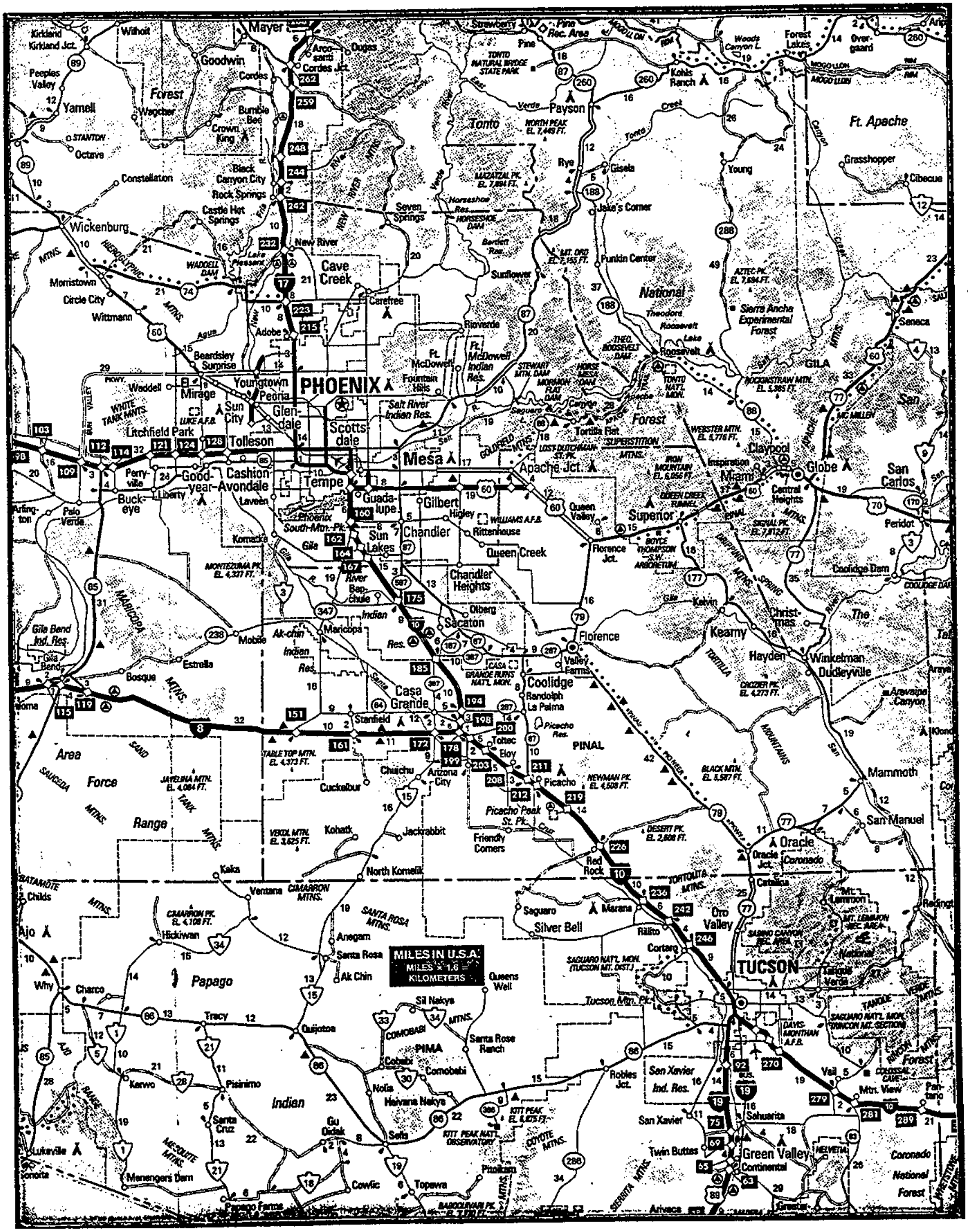
commercial and industrial property and affects the value of such properties with this increasing demand. Another growth element is the area's location as a crossroad, between densely populated California and the Texas market, just as the border states are positioning to take advantage of the North American Free Trade Agreement (NAFTA). Opportunities from the anticipated passage of NAFTA include positioning the Phoenix area as a transportation hub between Mexico and Canada, as well as reinforcing the area as a wholesale distribution center between California and Texas.

Maricopa County contains approximately 58% of the total Arizona population, comprising nearly 65% of the State's population growth since 1980. The estimated population of Maricopa County at the second quarter of 1995 was estimated at 2,420,000, compared to a 1990 figure of approximately 2,122,000 and a 1980 figure of about 1,509,000. Overall, it is apparent that the study area, being located in Maricopa County, is affected by the relatively rapid growth in population. People are moving here because of jobs and the belief that life in Phoenix promises to be better than where they were previously located.

Arizona contains a total land area of approximately 113,909 square miles. Topographical and meteorological diversity characterize the State, which is roughly divided on a northwest to southeast diagonal between warm deserts to the south and high plateaus and mountains to the north. In Maricopa County there are low mountain ranges, desert valleys and man-made lakes, with 1,300 miles of canals crisscrossing the County's central agricultural district. Maricopa County contains a total land area of nearly 9,127 square miles and a total water area of 98.4 square miles. Of this, the Federal Government owns or controls 59% (including Indian controlled lands), the State of Arizona and local governments own or control 11%, with the remaining 30% being in private ownership.

In the high country, the winters are cold, but summers are cool and pleasant. In the desert, winters are warm and pleasant and summers are blistering hot and dry. Some form of air conditioning for buildings and automobiles is a must to provide comfortable year-round living. Daily high temperatures in the Phoenix area during winter months average in the mid 70's to mid 80's, and highs in the summer generally exceed 110 degrees. Winter lows average in the high 30's to high 40's, with summer lows typically in the 80's.

The average annual rainfall is around 7 inches, and the study area experiences 315 sunny days. Typically there is a period in the later summer months of July and August when warm, moist tropical air traverses the region, bringing scattered thunderstorms. Often these thunderstorms are severe enough to result in dust storms, flash flooding and temporary flooding in low lying areas.



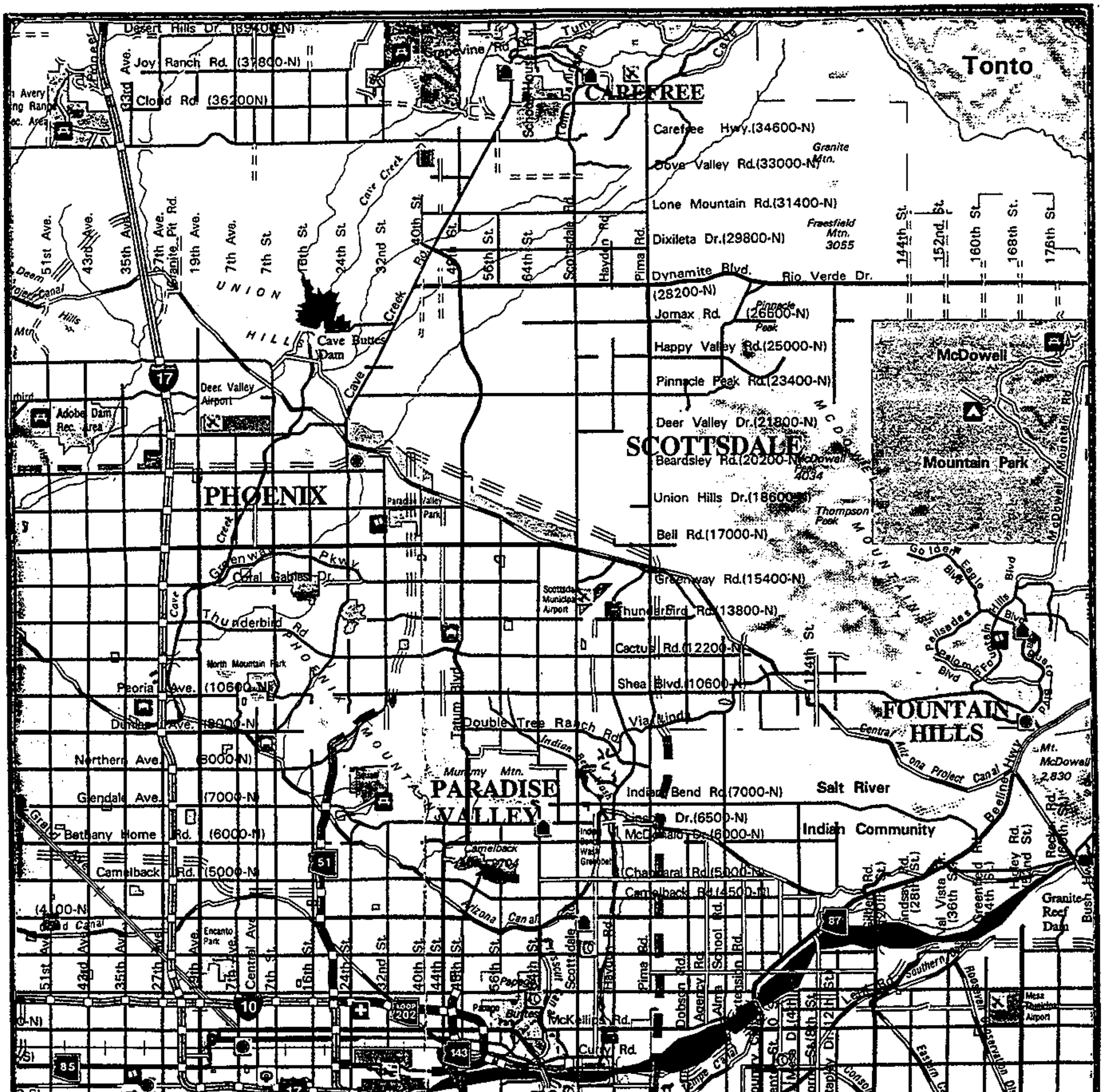
Mayer
Kirkland
Kirkland Jct.
Wilhoit
Peeples Valley
Goodwin
Cordes Jct.
Cordes
Yarnell
Forest
Crown King
Octave
Constellation
Black Canyon City
Rock Springs
Castle Hot Springs
Wickenburg
New River
Cave Creek
Carefree
Morristown
Circle City
Wittmann
Adobe
Beardsley
Surprise
Waddell
Mirage
Youngtown
Peoria
Sun City
Glendale
PHOENIX
Scottsdale
Litchfield Park
Tolleson
Perryville
Goodyear
Avondale
Cashion
Buckeye
Liberty
Palo Verde
Arlington
Laveen
Tempe
Mesa
Guadalupe
Gilbert
Higley
Chandler
Sun Lakes
Rittenhouse
Queen Creek
Chandler Heights
Komatke
Maricopa
Mobile
Gila Bend
Estrella
Bosque
Casa Grande
Stanfield
Arizona City
Eloy
Toltec
Picacho
Coolidge
Florence
Valley Farms
Randolph
La Palma
Sacaton
Olberg
Strawberry
Pine
Payson
Rye
Gisela
Kohls Ranch
Forest Lakes
Overgaard
Young
Ft. Apache
Grasshopper
Cibecue
Jake's Corner
Punkin Center
Sunflower
Rio Verde
Ft. McDowell
Fountain Hills
Roosevelt
National
Apache Jct.
Queen Valley
Superior
Florence Jct.
Miami
Globe
Claypool
Inspiration
Central Heights
San Carlos
Peridot
Coolidge Dam
Seneca
Kelvin
Kearny
Christmas
Hayden
Winkelman
Dudleyville
Mammoth
San Manuel
Oracle
Oracle Jct.
Catalina
Oro Valley
TUCSON
Marana
Saguaro
Silver Bell
Rillito
Cortaro
Red Rock
Friendly Corners
Picacho Peak St. Pk.
Jackrabbit
Kohatk
North Komelik
Chuichu
Cuckelbur
Kaka
Ventana
Childs
Ajo
Why
Charco
Hickiwan
Santa Rosa
Anegam
Ak Chin
Queens Well
Sil Nakya
Quijotoa
Tracy
Papago
Indian
PIMA
Santa Rose Ranch
Cobabi
Comobabi
Nolia
Haivana Nakya
Sells
Gu Oidak
Topawa
Cowlic
Pisinimo
Kerwo
Santa Cruz
Lukeville
Sonoita
Menenger's Dam
Papago Farms
Robles Jct.
San Xavier Ind. Res.
San Xavier
Sahuarita
Twin Buttes
Green Valley
Continental
Arivaca
Vail
Mtn. View
Pantano
Coronado National Forest
Area Force Range
MILES IN U.S.A.
MILES X 1.6 = KILOMETERS

Water is a precious commodity in the desert, but Phoenix has sufficient supplies to support its continued growth. Sources of water for municipal and industrial use in the region are from the Salt and Verde River watersheds and their dams, Lake Pleasant on the Auga Fria River, groundwater, and water transported to Phoenix via the Central Arizona Project Canal. Arizona's landmark groundwater law from 1980 requires a safe yield of groundwater. Through recycling, groundwater recharge and conservation, the groundwater management goals can be achieved. It is important to recognize that over 80% of the water utilized in Arizona is for agriculture, while agriculture only contributes 2% of the state's gross economic product.

Arizona is internationally renowned for its pleasant desert winters, its natural beauty, varied recreational activities and diverse backgrounds. Tourism is considered an important industry for the state. A distinct part of the tourism industry in metropolitan Phoenix is the annual influx of winter visitors. Especially in eastern Maricopa County, there are vast numbers of mobile home units. The units are occupied for about five to six months of the winter season by "snowbirds," or residents of northern locals that experience bitter cold harsh winters. Most of the snowbirds are retired persons. The Center for Business Research at ASU, reports that Phoenix area mobile home parks and RV/travel trailer parks contain 101,000 units as of February 1995. Valleywide occupancy rates during February 1995 were 91% for mobile home spaces and 98% for RV\travel trailer spaces.

Maricopa County's climate enhances cultural and recreational activities. The area's park systems range from quiet desert settings that encourage hiking, picnicking, camping and horseback riding, to more developed facilities with game courts, playgrounds, boating and fishing lagoons, and golf courses. Professional sports, such as baseball, basketball, football and hockey, yearly professional golf and tennis events, horse and dog racing, auto racing, and cultural pursuits ranging from symphony to theater and numerous art galleries, shows and museums are all located in the area. People can enjoy hunting, fishing, water sports and snow skiing within a two hour drive of the metropolitan area. Prehistoric Indian dwellings, ghost towns and other historical monuments are characteristic of the many attractions available in the area.

Transportation systems include Interstate Freeways and numerous U.S. and State Highways, freight and passenger railroads, Greyhound Bus and Phoenix Transit, and numerous taxi cab and trucking companies. In 1990, Interstate 10's final eleven miles were completed through the heart of Phoenix, culminating the construction of the main southern transportation route crossing the nation from east coast to west coast. Additionally, an ambitious freeway construction plan is continuing in the Phoenix area. Sky Harbor International Airport is located in Phoenix, and there are



Tonto
CAREFREE
Desert Hills Dr.
Joy Ranch Rd. (37800-N)
Cloud Rd. (36200N)
Grapevine Rd
Carefree Hwy.(34600-N)
Granite Mtn.
Cave Valley Rd.(33000-N)
Lone Mountain Rd.(31400-N)
Dixileta Dr.(29800-N)
Fraesfield Mtn. 3055
Dynamite Blvd.
Rio Verde Dr.
(28200-N)
Jomax Rd.
Pinnacle Peak
(26600-N)
Happy Valley Rd.(25000-N)
Pinnacle Peak Rd.(23400-N)
Deer Valley Dr.(21800-N)
Beardsley Rd.(20200-N)
McDowell Peak 4034
Union Hills Dr.(18600-N)
Thompson Peak
Bell Rd.(17000-N)
Greenway Rd.(15400-N)
Thunderbird Rd.(13800-N)
Cactus Rd.(12200-N)
Shea Blvd.(10600-N)
McDowell
Mountain Park
MC DOWELL MOUNTAINS
SCOTTSDALE
FOUNTAIN HILLS
144th St.
152nd St.
160th St.
168th St.
176th St.
124th St.
Golden Eagle Blvd
Palisades Blvd
Saguaro Blvd
Central Arizona Project Canal
Mt. McDowell 2,830
51st Ave.
43rd Ave.
35th Ave.
27th Ave.
Granite Pit Rd.
19th Ave.
7th Ave.
7th St.
16th St.
24th St.
32nd St.
40th St.
48th St.
56th St.
64th St.
Scottsdale Rd.
Hayden Rd.
Pima Rd.
Cave Creek
Cave Creek Rd.
UNION HILLS
Cave Buttes Dam
Deer Valley Airport
Adobe Dam Rec. Area
PHOENIX
Paradise Valley Park
Greenway Pkwy
Coral Gables Dr.
Thunderbird Rd
North Mountain Park
PHOENIX MOUNTAINS
Peoria Ave. (10600-N)
Dunlap Ave. (8000-N)
Northern Ave. (8000-N)
Glendale Ave. (7000-N)
Bethany Home Rd. (6000-N)
Camelback Rd. (5000-N)
Tatum Blvd
Double Tree Ranch Rd
Via Linda
Indian Bend Wash
Mummy Mtn.
PARADISE VALLEY
Camelback Mtn.
Indian Bend Rd.(7000-N)
Lincoln Dr.(6500-N)
McDonald Dr.(6000-N)
Chaparral Rd.(5000-N)
Camelback Rd.(4500-N)
Salt River
Indian Community
Scottsdale Municipal Airport
Arizona Canal
Encanto Park
Central Ave.
Papago Buttes Park
McKellips Rd.
Curry Rd.
Dobson Rd.
Alma School Rd.
Country Club Dr.
Gilbert Rd.
Lindsay Rd.
Val Vista
Greenfield Rd.
Higley Rd.
Recker Rd.
Granite Reef Dam
Bush Hwy
Beeline Hwy
Southern Pacific
Mesa Falcon Field Airport
Eastern Canal
Roosevelt Conservation District Canal
Consolidated Canal
Tempe Canal
Apache Blvd.
Main St.
Broadway Rd.(4400-S)
TEMPE
MESA
Western Canal
GUADALUPE
Kiwanis Park
GILBERT
South Mountain Park
Galveston St.(14000-S)
Chandler Heights Blvd.(15600-S)
CHANDLER
NORTON'S CORNER
HIGLEY
LAVEEN
17
51
10
143
202
85
87
89
60

seven regional airports in the area. Sky Harbor Airport has experienced phenomenal increases in total number of passengers arriving and departing, presently almost triple the activity logged ten years ago, with continual construction and expansion of the facilities taking place. Communications in the area include statewide telephone service, numerous AM and FM radio stations, and television, including the three major networks, various independent stations, as well as cable TV service. There are two widely circulated newspapers and numerous smaller daily and weekly papers serving the various communities. Utilities in Maricopa County are provided by many firms. Electricity is available from Arizona Public Service and Salt River Project; natural gas from Southwest Gas Company; telephone service from U.S. West Communications; water from Salt River Project, municipalities and several small water companies; and sewer service is available in many areas, provided by the municipalities.

The Phoenix metropolitan area is served by 55 school districts with 353 elementary and 58 high schools. There are also approximately 40 parochial schools and 40 private schools in the area. Arizona State University, Arizona's largest university with an enrollment of about 43,000, is located in Tempe and Glendale (west campus). Ten additional institutions of higher learning and numerous private technical and business colleges are located in the area, as well. Furthermore, there are more than 1,350 churches of various denominations serving the population.

The tax structure consists of general property taxes, a general sales tax, income taxes, estate taxes, and gasoline and motor vehicle license taxes. Arizona has an effective property tax rate of 0.66%, compared to a national average of 1.15%. Counties, cities and community colleges are limited to an increase in total property tax levies of 2% over the previous year's levels, as adjusted, and the valuation of locally valued property is limited to a 10% growth over the prior year's limited value. The maximum tax liability for owner occupied residential property is 1% of full cash value. Property taxes will vary from county to county, within each school district, as well as by property use.

The State imposes a sales tax of 5% on most business activities. In addition to the state tax rate, many municipalities and counties impose a 1% to 2% tax on tax bases which are generally less broad the state's base. The sales tax on food was repealed in 1980. An income tax is levied on residents and nonresidents earning income in Arizona. Income tax credits are allowed for elderly low-income taxpayers and renters. An estate tax return is required to be filed with the Arizona Department of Revenue when the gross estate exceeds $600,000.00. In addition, there are gasoline and diesel fuel taxes, annual vehicle registrations fees, and an ad valorem vehicle license tax. Overall, the estimated burden of major state and local taxes for a family of four falls below the national average.

The relative cost of living in the Phoenix area compares favorably with many metropolitan areas. Although the cost of living indexes for Phoenix and Tempe are slightly higher than the national average, and Scottsdale's index reflects an approximate 5% greater living expense than the U.S. average, the indexes for the area are significantly lower than indexes for San Diego, Los Angeles, Seattle, Philadelphia and Miami. The actual overall percentage change in the 1994 Metropolitan Phoenix Consumer Price Index was 3.3%, slightly higher than the 1993 gain. Through the third quarter of 1995 the percentage increase was at 4.5%.

Historically, principal industries in Arizona have been agriculture, mining, trade and services. Through the years, there has been a shift in the State's industrial structure, with significant declines in mining and agriculture in relation to other sectors. Presently, the most important sectors are considered to be services, trade, manufacturing and government, each contributing more than 10% to the total Arizona personal income. If gross product is used as the base of measurement, the finance, insurance and real estate industry must be added to this group. Construction and transportation, communication and public utilities are also important categories, and tourism is a major industry which consists of a portion of several major sectors. The industrial structure is much like the national structure, except that manufacturing is slightly less important in Arizona while retail trade and government are somewhat more significant.

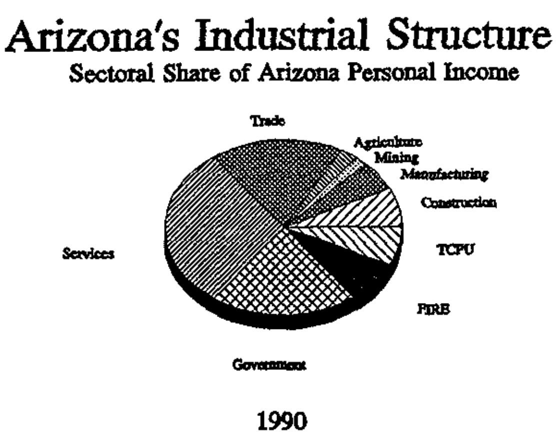


Figure 3 Based on data from the U.S. Department of Commerce, Bureau of Economic Analysis

Agriculture and mining remain dominant forces of the local economy in some parts of rural Arizona, and Maricopa County is the largest producer of crops and livestock in the State, with substantial amounts of agricultural produce shipped from the area to other parts of the nation. However, their shares of employment and gross product are comparatively small, each contributing roughly only 2% to the total Arizona personal income. Although the actual output of mining and agriculture has not necessarily declined, growth in these industries has been much slower than that of other industries. That is, the explosive growth of the urbanized areas has overwhelmed these rural industrial sectors. Moreover, these changes in the economy did not occur recently. Mining declined first, replaced by government, and agriculture declined more recently, replaced by manufacturing and, later, by services. By the mid 1960's, the area's economic structure already closely resembled that of today.

For both the State and Maricopa County over the past two years, the leading industrial sector in total employment was services, followed by trade, government and manufacturing (particularly high -technology production led by such companies as Motorola, Honeywell Bull, Intel, McDonnell Douglas and Goodyear Aerospace). Currently, more than seventy-five percent of new job creation is in services and trade, which is roughly comparable to, although slightly higher than the national average. These industries thrive on tourism, with perhaps as many as ten million people visiting the Phoenix area annually. Visitors, in turn, bring jobs to hotels, restaurants, stores and other related businesses. Since more than 50% of the people employed in the Phoenix area are in the services and trade industries, tourism is an important industry impacting the area. Area retail sales in 1994 were strong, increasing approximately 14.3%. This is in stark contrast when compared to the anemic 1.9% growth of 1991. Retail sales for 1996 are projected to increase 7.0% in Maricopa County. Thus, retail sales is presently one of the best performing economic indicators throughout the State and County.

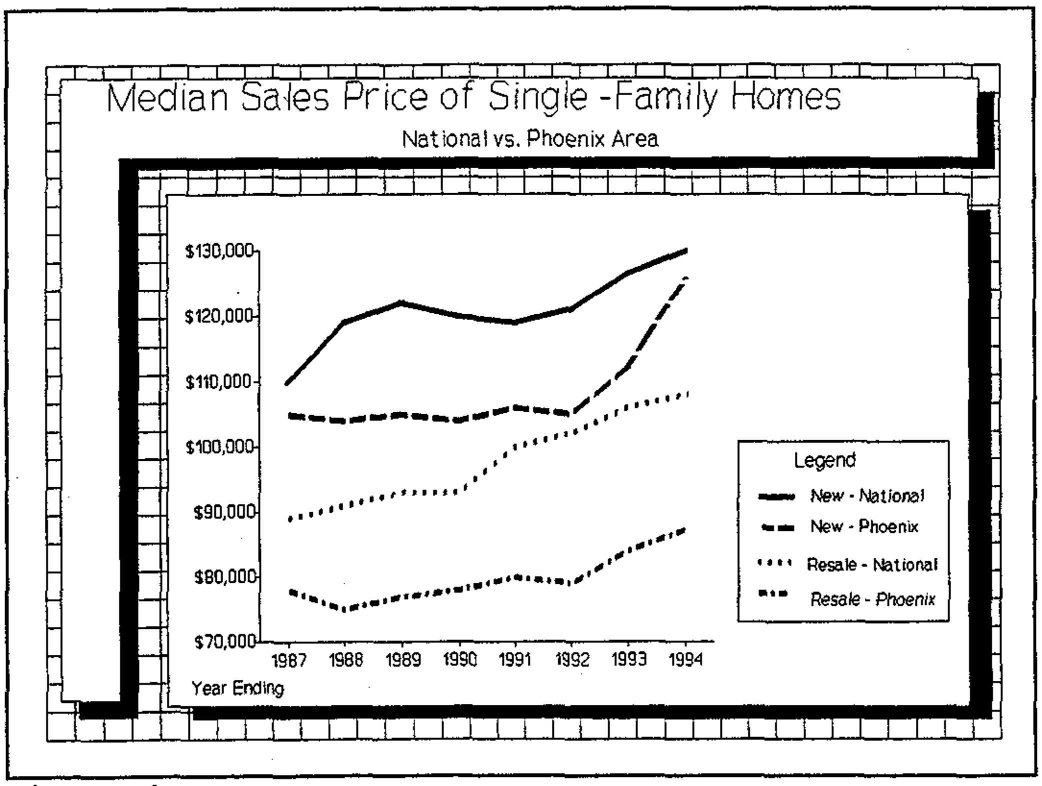


Figure 4

New single family home sales is presently another well performing economic indicator. Construction employment is far more important in Maricopa County than it is nationwide, and, excepting single family homes, nearly every facet of the real estate market in Arizona and Maricopa County is over-built. This contributed to major loss of jobs in construction in Maricopa County, with more than 20,000 jobs lost after the peak of construction in the mid 1980's. However, construction employment grew in 1994 by about 9% in the metropolitan area, a gain of approximately 5,800 new jobs. The total dollar value of all building permits issued in 1994 was up nearly 40% over 1993 for both the County and the State. Most of the increase in construction employment and building permits can be attributed to the single family housing market. For example, home sales in Maricopa County in 1994, including attached and detached units, totalled 56,310 sales, a 11.4% increase over 1993. Furthermore, total housing units authorized in the County in 1994 was 22% greater than in 1993. Another factor with positive impact on the local housing market is affordability. Not only are the components of affordability (household earnings, interest rates, housing prices and amount of down payment) positive, but also, housing in the Phoenix area remains more affordable than in the nation as a whole. Although statistics are still being tabulated for 1995, indications are that new home sales during the year continued to improve as mortgage rates declined.

In terms of the apartment market, this sector was one of the first markets to retreat in the late 1980's and one of the first to recover in the early 1990's. Shifting factors affecting this market include high buyer interest, lower vacancy rates, increasing rents, decreasing foreclosures and a low rate of new development activity. In the last three years, the sales volume of apartments in Maricopa County has set records, and the market has been one of the most active in the nation. Over this period, the market has seen an average transfer of more than 25,000 units annually, representing the sale of nearly one-third of all county units.

Investors are coming from all regions of the nation, as well as abroad, and they are motivated by the ability to buy below replacement cost in all but the high end of the market, as well as the relatively low unit prices compared to other parts of the country. Apartment vacancies peaked in 1988 at 17%, and the end of the 3 quarter of 1995 were at 4%. Moreover, rents are increasing, and it is believed that rents will increase significantly in 1995 and 1996. The list of apartment projects in foreclosure and available for purchase is dwindling, and building is increasing only slightly, with most development occurring in the high end niche of the market. Only about 1,800 units were permitted in 1993, but the total number of permits issued in 1994 totaled 6,015, a 234% increase. Overall, most experts agree that apartment pricing has begun to trend up, and it is anticipated that this trend will continue in the near future. The following graph on apartment vacancy shows that the apartment market has recovered in terms of vacancy.

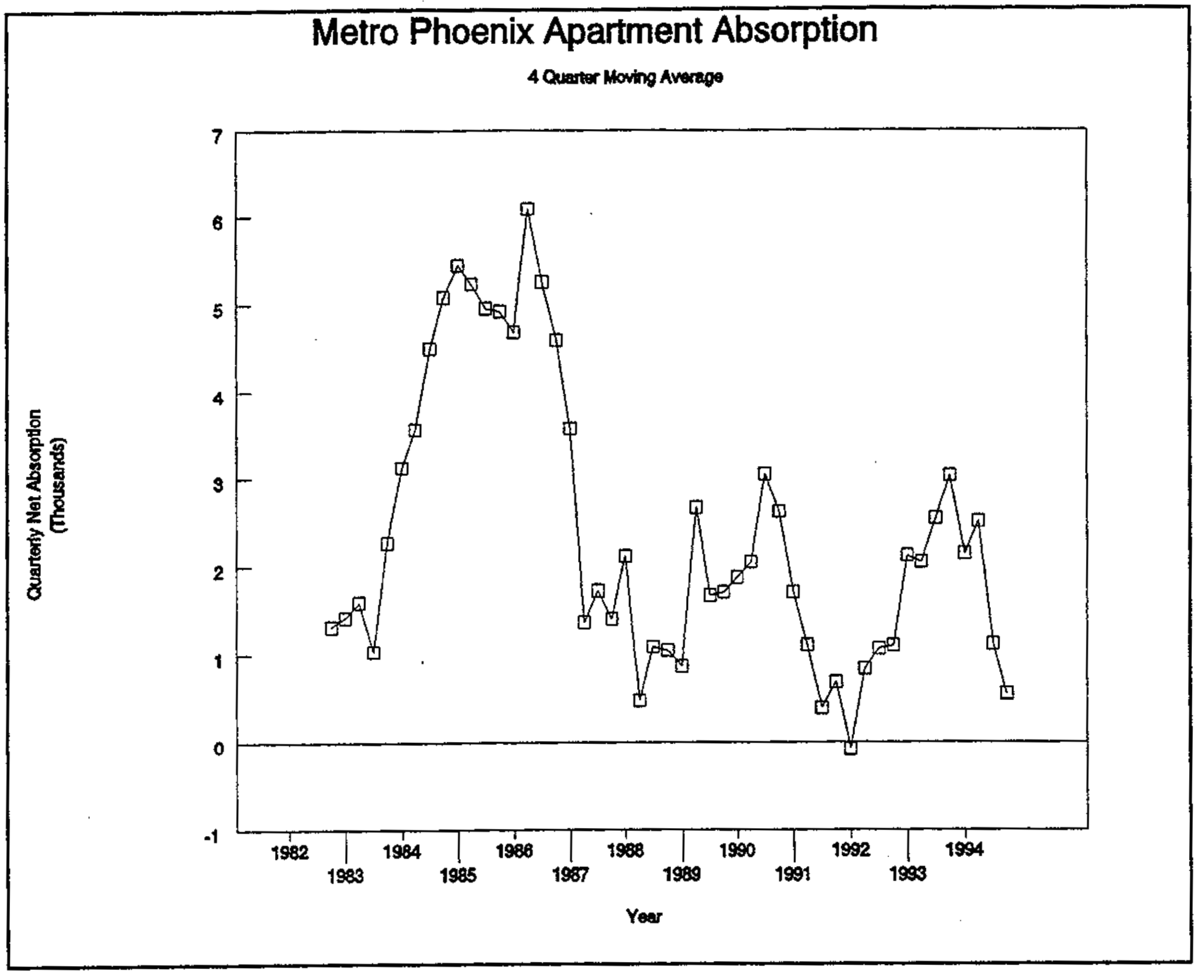


Figure 5

Regarding nonresidential construction, most sectors continue to be on the upswing. The improved economy has stimulated construction activity and has increased the movement of thousands of new companies, primarily from California and the midwest, to the Valley of the Sun. The commercial real estate market is beginning to show signs of strong improvement. The office vacancy rate in the Phoenix area continues to improve, after peaking over 25% by early 1991. Absorption in 1992 was the greatest it has been since 1988, with year-end vacancy at 19.2% compared to a reported 21.6% vacancy at the beginning of the year. With no new office construction in 1992, the inventory actually decreased by more than 200,000 square feet due to demolition, although this represents less than 0.4% of the total inventory. Moreover, there were no new building permits for speculative office buildings in the Phoenix area for the third year in a row. The supply of bank and RTC owned properties has been greatly reduced. Other predictions for the office market are that more buildings will be demolished, there will be a growing shortage of large contiguous blocks of available space, and office building values may begin to increase.

The vacancy rate in the Phoenix office market has not been less than 20% since 1984, and at the end of the 3rd quarter 1995 the overall vacancy rate was 13.5%. The absorption gains occurring during the second and third quarters of 1995 indicate that the office market is in a recovery stage. The trend of positive absorption gains, rental rate increases and swindling office supply are anticipated to carry well into 1996

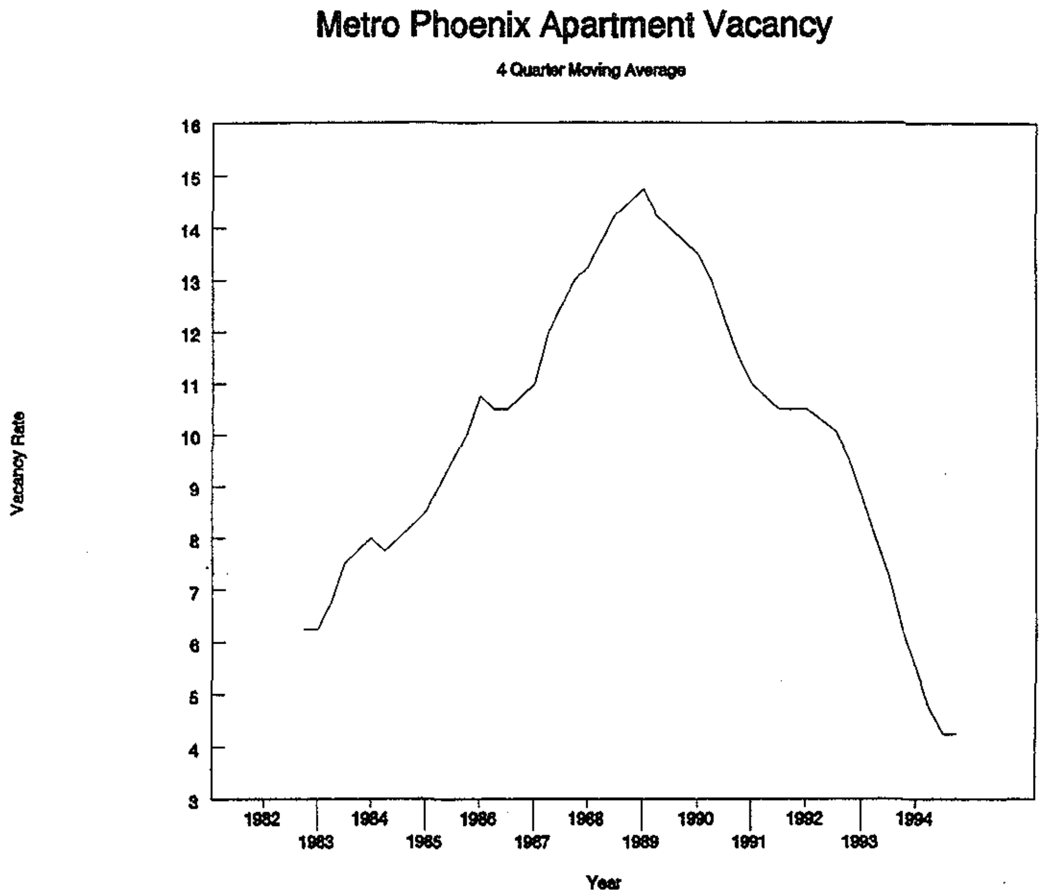


Figure 6

In 1992, the industrial market also began to show signs of improvement. For example, absorption was the greatest ever recorded, and vacancies decreased to 13.6% by year-end, the first time in the past ten years that the vacancy factor for industrial space has dropped significantly. Moreover, there has been an increase in activity from out-of-state companies looking at the Phoenix area, especially from California. Reasons for the apparent recovery in the industrial market would include the fact that Arizona is a right to work state with relatively lower workmen's compensation expenses, Phoenix has an excellent labor base, and buildings can be leased for almost half as much as compared to similar buildings in, say, the Los Angeles area. Another reason for recovery is the area's proximity to the west coast as a distribution center and access to the entire nation by easy air transportation. In addition, availability of newer and moderately priced industrial warehouses and manufacturing facilities in the area is a positive aspect. In 1995, lease rates continued to firm as availability diminished and demand continued. Furthermore, west coast companies will continue to investigate the area as expenses and environmental concerns continue to push companies out of the California market.

Retail building in Phoenix surged in 1986 and 1987, and the space was absorbed. However, the emergence of numerous high-powered retailers into the Phoenix area has started to produce casualties in the area's retail market. Because of the number of new large volume retailers establishing strongholds in the market, the effect on smaller retailers and vacancy rates became more pronounced as the "category" retailers extended their reach. Small retailers face many challenges presented by the local and national economy, and financing is scarce for the small shop tenants and businesses. However, both leasing and investment in this market sector was reported to be rather brisk in 1995, with considerably more activity than the previous year. Overall vacancy in the third quarter of 1995 decreased slightly to 9.04% compared to the second quarter of 9.3%. Based upon the excellent gains in leasing and investment in 1994, as well as the positive retail sales economic indications, it is projected that 1996 activity in this market may out pace 1995, with a continued positive direction. The real measure of the market's recovery is apparent upon review of the new projects coming on-line as well as the projects currently under construction. A total of over 1.9 million square fee concentrated in 17 projects is under way in 1995 throughout the metropolitan area. As the population and employment continue to increase the present active trend is expected to continue.

The land market has also seen some recovery in 1993, 1994 and into 1995. The inventory of finished building lots acceptable in size, location and configuration for the home building industry was effectively used up. This is not to say that there is no land available for development, nor that the value of all land has begun to appreciate. However, 1992 and 1993 saw many changes in the market that reflect the recovery in area real estate. For example, land developers have reentered the market, more out-of-state builders have entered, the pool of equity investors has increased, and the control and effect of the RTC has diminished. Builders and developers bought land, not merely small in-fill parcels to continue ongoing subdivisions, but new, larger tracts of land for new projects. Areas that had remained largely undeveloped are now seeing new construction, and, due to the strength of the single family housing market, many multi-family zoned parcels have been down-zoned and developed to single family uses. It is anticipated that residential land prices will rise in 1996.

Conclusion:

The underlying force for growth in the metro Phoenix area and much of the Southwest has always been population growth. Factors needed to sustain the recovery include continued low interest rates, continued positive net migration, job growth and the direction of regional and national economies. Historically, metropolitan Phoenix growth and economic trends have appeared to trail those of southern California, but a decoupling took place in the last half of the 1980's that has changed this relationship. As a result of several natural disasters in the California area over the past two years, the in-migration from California to Phoenix has increased and the Phoenix area is frequently more preferred for those in the midwest and east seeking to relocate in the Southwest. The growth of the metropolitan Phoenix economy has therefore benefitted, while the California economy is still in a slump.

The Arizona real estate industry turned around in 1993 and showed strong improvement in 1994. The trend has continued during 1995, and is expected to carry through into 1996. The single-family sector dominated the initial stages of this recovery. Rapidly declining interest rates and improving affordability have been the related forces driving the single-family market. As affordability decreased with increasing interest rates and higher home prices in the latter half of 1993, a gradual recovering multi-family residential market has clearly evolved into a landlord's and seller's market.

The office market is well on the way to recovery, it touched bottom in 1993 with a resilient bounce in regards to buyer demand. Improving occupancies, significantly higher rents in the better markets such as north Scottsdale, and depleted RTC and lender-owned product has created investor enthusiasm not seen for many years.

There has been an issuance of 26,626 housing permits in Maricopa County in 1994, and 20,333 through the third quarter of 1995. This is credited with fueling the recovery of the retail sector of the valley's real estate market. This trend is expected to continue as more retail space is added, including a number of new neighborhood centers. While the current retail growth is dominated by new "power center" retail space, the next wave of retail growth may well be in neighborhood shopping centers serving the many recently developed residential neighborhoods.

Industrial expansion over the past two years has been fueled by owner/user and build-to-suit activity. We began to see some speculative activity in the second half of 1994 due to the shrinking supply of available space. We expect an increase in speculative activity in 1996 along with continued strong owner/user activity.

In summary, the economic forecast for metropolitan Phoenix is for continued growth supported by the growth taking place in the national economy. It is unlikely that the local economy would be able to buck a national recession; however, a national recession is not imminent and, in fact, most economists do not expect the next downturn will occur for at least another two to three years.

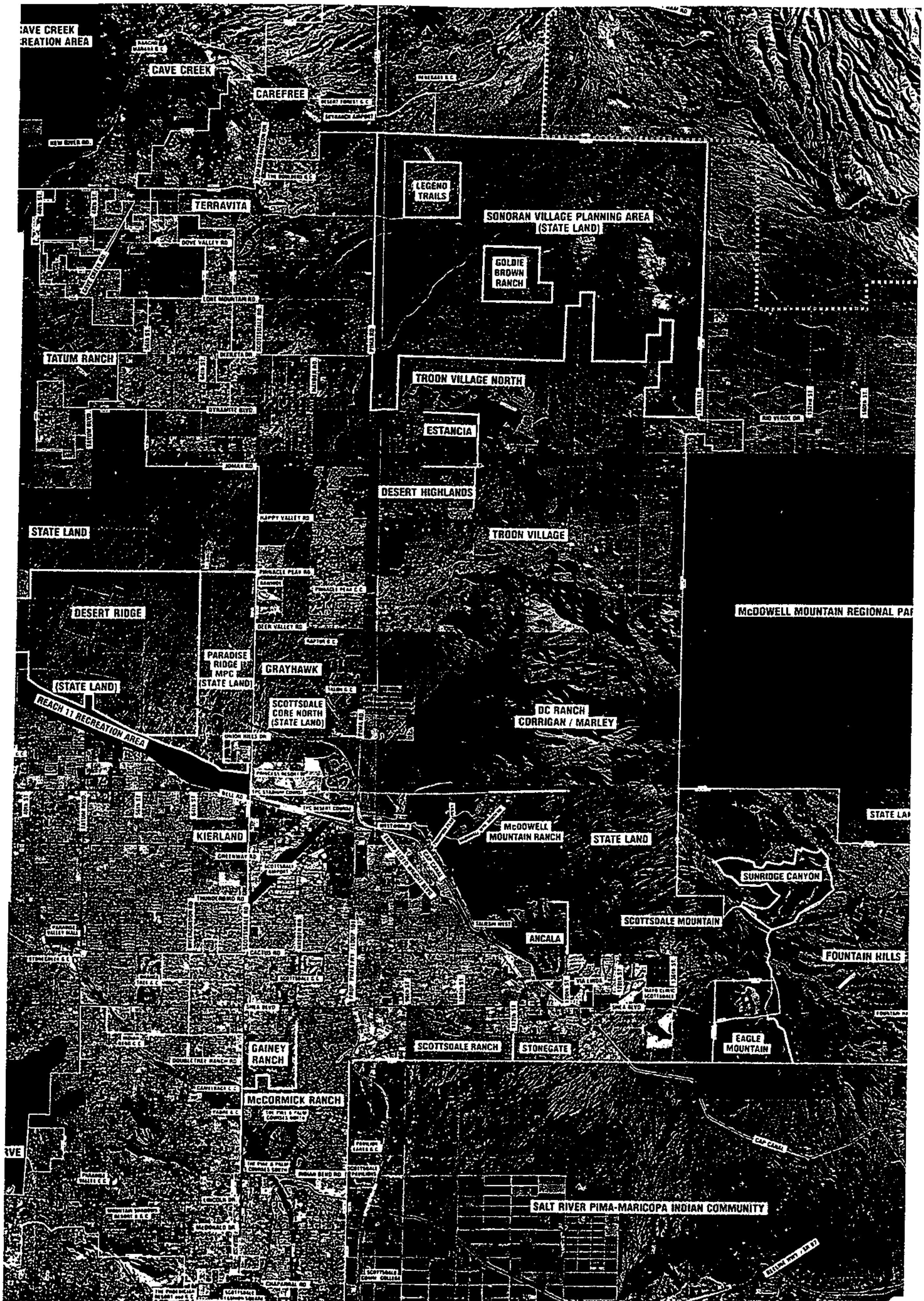
Growth is currently occurring with low inflation, and there is little pressure for interest rates to rise. At some point, rates could reach the level where they would significantly slow the single-family residential market, which would filter throughout the economy. This is not currently considered to be a real problem as good economic news is outweighing the bad news.

Several years past, the Phoenix area was red-lined as an area to avoid for real estate investing. This situation has changed 180 degrees as the valley now has a reputation both nationally and internationally as being a strong economic area for real estate and business investments. Underlying the region's real estate industry is a diversified, growing economy with a reasonably well educated, young work force. Arizona's economy, as well as that of maricopa County, is expected to enjoy strong growth and outperform the nation in terms of expansion.

12. STUDY AREA DESCRIPTION

The study area is situated in the incorporated boundaries of the City of Phoenix and the City of Scottsdale. The study area is characterized primarily by undeveloped desert and highly developed lands encompassing several major planning areas. The City of Scottsdale is divided into several planning areas, including Old Town, Indian Bend, East Shea, Eagle Ridge, Central Arizona Project(CAP) Corridor, Tonto Foothills and Black Mountain.

The Phoenix General Plan identifies nine different urban villages, as well as four peripheral areas, within the city boundaries. These villages are identified as Deer Valley, North Mountain, Paradise Valley, Alhambra, Maryvale, Camelback East, Encanto, Central City and South Mountain. The peripheral areas, designated



AVE CREEK
REATION AREA
CAVE CREEK
CAREFREE
TERRAVITA
LEGEND TRAILS
SONORAN VILLAGE PLANNING AREA (STATE LAND)
GOLDIE BROWN RANCH
TATUM RANCH
TROON VILLAGE NORTH
ESTANCIA
DESERT HIGHLANDS
STATE LAND
TROON VILLAGE
DESERT RIDGE
McDOWELL MOUNTAIN REGIONAL PA
PARADISE RIDGE MPC (STATE LAND)
GRAYHAWK
(STATE LAND)
REACH 11 RECREATION AREA
SCOTTSDALE CORE NORTH (STATE LAND)
DC RANCH CORRIGAN / MARLEY
STATE LA
KIERLAND
McDOWELL MOUNTAIN RANCH
STATE LAND
SUNRIDGE CANYON
SCOTTSDALE MOUNTAIN
ANCALA
FOUNTAIN HILLS
GAINEY RANCH
SCOTTSDALE RANCH
STONEGATE
EAGLE MOUNTAIN
McCORMICK RANCH
RVE
SALT RIVER PIMA-MARICOPA INDIAN COMMUNITY
SCOTTSDALE

as Areas A through D, are located on the fringes of the most populated areas of the Phoenix metropolitan area. Area A is generally located west of Interstate 17, between Van Buren Road and north of the Gila River. Area B is generally located southeast of South Mountain. Area C is situated north of the Central Arizona Project and south of Jomax Road. Area D comprises the northerly reaches of the city, essentially between Jomax Road and the Carefree Highway.

The study area is situated in the northeast portion of metropolitan Phoenix, approximately fifteen miles northeast of the Phoenix Central Business District (CBD). The area boundaries may be described as follows:

On the North: The towns of Cave Creek and Carefree, and the Carefree Highway, are located to the north.

On the South: The Central Arizona Project Canal and Frank Lloyd Wright Boulevard.

On the East: The McDowell Mountains provide a natural physical barrier.

On the West: For the purposes of the study 32 Street has been designated as the western boundary.

The area development pattern features distinct residential districts separated by a large expanse of undeveloped Sonoran Desert. Residential development north of the CAP canal is typically widely dispersed and consists of single-family residences on larger lots. Large, higher density master planned communities, however, are emerging in this area. Although several master planned communities are currently in the planning and development stages, a majority of the land north of the CAP canal, particularly west of Scottsdale Road, remains under the ownership of the Arizona State Land Department.

Phoenix Peripheral Areas C and D

Peripheral Areas C and D are largely undeveloped Sonoran Desert and mountain lands featuring major natural drainage ways in the north, less defined drainage pattern in the northeast and south, and large man-made storm water retention basins in the central area north of the Central Arizona Project canal. Vegetation is comprised of small trees, bushes, shrubs and flowering ground cover typical of the Sonoran Desert. Tall saguaro cacti form an addition in higher elevations. The topography includes low undulating hillsides, mountains vistas, wide open spaces, wide washes and a number of deep, narrow arroyos in rolling terrain. An additional attraction is the approximate 1,500 to 1,800 foot elevation, which can provide summer temperatures several degrees cooler than experienced in central Phoenix locations.

The ownership of a great deal of land north of the Central Arizona Project canal by the State of Arizona, and the lack of public infrastructure, has limited the development of the area north of the Central Arizona Project canal to large lot zoning. In the late 1980's, the City of Phoenix reconsidered growth policies and advanced planning efforts have recognized this area's significant growth potential. With recognized land use, transportation and infrastructure plans in place, private investment in residential real estate development is beginning to occur.

The most notable development to date is the master planned community of Tatum Ranch, located at Cave Creek Road and Tatum Boulevard. The master developer of this 1,400 acre master plan is Suncor Development Company, a subsidiary of Pinnacle West Capital Corporation. Tatum Ranch, which is a golf course community, was the first master planned community within the City of Phoenix located north of the Central Arizona Project canal.

A master planned community is currently in the development stages for the area west of the 64th Street alignment and south of Pinnacle Peak Road. This plan is known as Desert Ridge and encompasses approximately 5,700 acres, and it is anticipated to be in four phases. Phase One has begun and home construction is under way and the Sumitomo Corp. will be constructing a 500,000 square feet facility. The City of Phoenix, Planning Department indicated that the total plan calls for nearly 22,000 dwelling units, 7.2 million square feet of commercial floor area, two golf courses and a resort, three elementary schools, two middle schools, and a high school. Desert Ridge is being designed to be the Village core for Phoenix Peripheral Area C.

Just in the planning stages is a master planned community which will be called Paradise Ridge. It will be located along the west side of Scottsdale Road between the Central Arizona Project canal and Pinnacle Peak Road. Although a specific plan has not yet been proposed, it is the appraiser's understanding that the necessary studies are underway. Hard zoning is in place for the 2,200 acre Paradise Ridge, but the State Lands Department needs to go through their bid process. The location of Paradise Ridge is directly east of Desert Ridge. Paradise Ridge will not likely come on line until further development occurs at Desert Ridge due to the current distance to offsites.

Currently, low density residential uses are scattered throughout the area and are the predominant development. The emphasis is on large homes and lots surrounded by the natural desert environment. Generally, roads are unpaved with the exception of several principal arterial roadways. Those roadways which are paved are typically constructed to rural standards without curb, gutter or sidewalks. Commercial activities between the CAP canal and the Cave Creek/Carefree areas are limited to horse stables, the Rawhide theme park, the Scottsdale Princess Resort, and several neighborhood retail centers on Pinnacle Peak Road at Scottsdale Road and Pima Road.

North Scottsdale

The City of Scottsdale has been widely known for its progressive community standards, quality of life and first-class resort atmosphere. Recent development interest has been motivated by the annexation of vast tracts of land in the northern foothill environs. North Scottsdale can generally be described as being situated north and east of the intersection of Lincoln Boulevard and Scottsdale Road. Examination of the area surrounding the City of Scottsdale would indicate that north is the only expansion possible for the city. Growth for the City of Scottsdale is constrained on the south by the City of Tempe, on the west by the City of Phoenix, and on the east by mountain preserves and the Salt River Pima-Maricopa Indian Reservation.

It is evident that the master planned community concept is in full swing in the North Scottsdale area. Major planned communities include Scottsdale Ranch, Ironwood Village, Stonegate, Gainey Ranch, Troon Village, Troon North, Pinnacle Peak, Los Portones, Scottsdale Mountain Estates, Desert Mountain and, most recently, Terravita. There are also several major proposed master planned communities, including Scottsdale Core North and Scottsdale Core South. Both of these projects are located along the east side of Scottsdale Road, south of Deer Valley Road. Scottsdale Core North will be comprised primarily of low to medium density residential development, while Scottsdale Core South will be characterized by commercial, office, industrial and multi-family development.

Overall, the northern portion of the study area can be described as one which is undergoing some transition from vacant desert lands to planned residential communities. As development continues over the next several decades in the northern part of the study area, commercial development will likely increase as the demand increases due to a rising residential population.

The Maricopa Association of Governments' (MAG) Expressway Plan will play a significant role in the development of the study area as the proposed and planned freeways are completed. The Outer Loop, designated as State Highway 101, will be the most significant highway affecting the study area. The northeast portion of the Outer Loop, once completed, will extend north from the Superstition Freeway (U.S. Highway 60) along the Pima Road corridor, then veer west to follow the Beardsley Road alignment, and connect with

Interstate 17. The Outer Loop is planned across several proposed master planned communities in the study area, including Desert Ridge, Paradise Ridge, Scottsdale Core North and Scottsdale Core South. The Outer Loop will also be in close proximity to McCormick Ranch and Scottsdale Ranch. Completion of this portion of the freeway system, however, is expected to be in the neighborhood of ten to fifteen years.

There are five alluvial fans in the study area. The three primary fans are those formed by the Rawhide, Beardsley, and Reata Pass washes. There are two additional fans located to the north and are identified as Fans 5 and 6.

Rawhide Wash

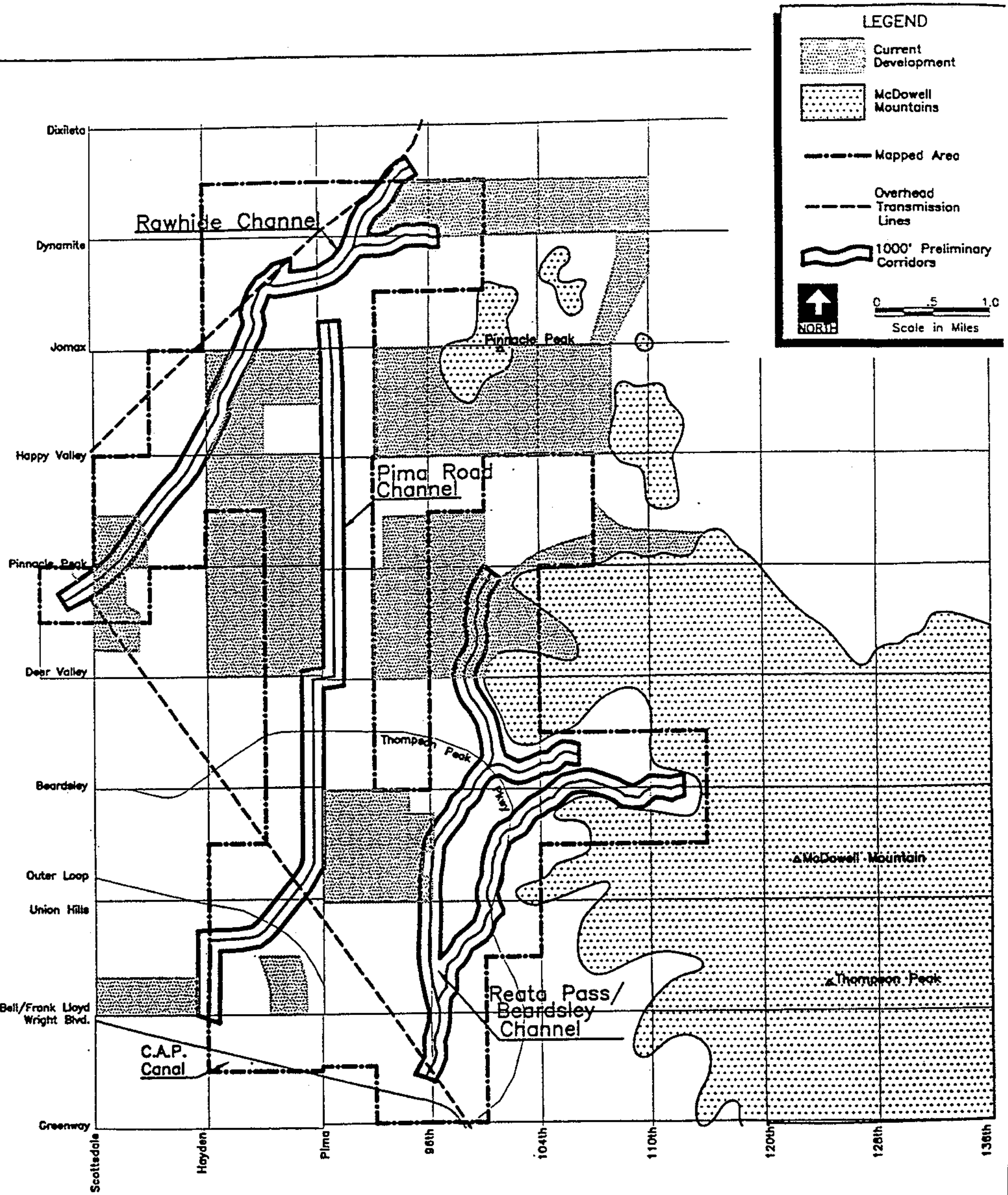
The Rawhide Wash alluvial fan encompasses approximately 3,160 acres east of Scottsdale Road in North Scottsdale. West of Scottsdale in Phoenix there are approximately 4,000 acres. Rawhide wash originates north of Dynamite Boulevard and east of Pima Road. Runoff from tributaries and the main wash flows to the southwest along narrow braided washes crossing Jomax Road, Happy Valley Road and Pinnacle Peak Road prior to emptying onto state land in Phoenix. The Rawhide Wash 100 year overflow area widens considerably south of its apex and extends south to the CAP.

Beardsley and Reata Pass Washes

The combined alluvial fan areas of Beardsley and Reata Pass washes encompass approximately 5,890 acres in North Scottsdale. Beardsley and Reata Pass washes are located southeast of Rawhide wash. Reata Pass Wash originates at the mouth of a canyon south of Pinnacle Peak Road and west of the McDowell Mountain Range. Its apex begins breaking out of its natural path and creates a drainage fan that spreads out to the southwest, bordered to the east by the foothills of the McDowell Mountains and spreading west nearly to Scottsdale Road. The toe, or southern boundary of the fan, ends at the CAP.

Pima Road Channel

This channel will run parallel to Pima Road and does not follow an existing wash alignment. North of Deer Valley Road, the channel will be on the east and will shift to the west side south of Deer Valley Road. The channel begins near Jomax Road and continues fairly straight south where it will eventually release into the Tournament Player's Club desert golf course retention basin. Land uses along Pima Road include low to moderate density residential communities with commercial and office at Pinnacle Peak Road.


LEGEND
Current Development
McDowell Mountains
Mapped Area
Overhead Transmission Lines
1000' Preliminary Corridors
NORTH
0 .5 1.0
Scale in Miles
Dixileta
Dynamite
Jomax
Happy Valley
Pinnacle Peak
Deer Valley
Beardsley
Outer Loop
Union Hills
Bell/Frank Lloyd Wright Blvd.
Greenway
Scottsdale
Hayden
Pima
96th
104th
110th
120th
128th
136th
Rawhide Channel
Pima Road Channel
Reata Pass/ Beardsley Channel
C.A.P. Canal
Pinnacle Peak
Thompson Peak
McDowell Mountain
Thompson Peak

Fans 5 and 6

Fans 5 and 6 are formed by washes which originate north of Rawhide Wash and drain in a southwesterly direction. Fan 5 encompasses approximately 1,254 acres within incorporated and unincorporated portions of the City of Scottsdale. Fan 6 consists of approximately 2,906 acres, of which 986 acres are in Scottsdale and the balance, 1,920 acres, in Phoenix.

As several washes converge, the Fan 5 overflow boundary widens considerably southwest of Dixileta Drive and Scottsdale Road. The Fan 5 drainage area continues to widen as it extends southwesterly nearly to 56th street.

The upstream end of Fan 6 originates near the intersection of Dove Valley and Pima Roads in Scottsdale. However, the drainage fan does not begin to widen substantially until it reaches 64th street. Fan 6 continues to spread in a southwesterly direction into Phoenix south of Dixileta Drive. The limit to the downstream flows extends to Cave Creek Road.

13. VALUATION

The project property values are based on comparable sales and additional sales information derived from various knowledgeable sources in the market place. All comparable sales data is contained in backup files maintained in the Arizona Real Estate project office. Listed are a range of values for property types by use.

The estimate of values for the various lands was relied upon from the sales comparison approach. This approach to value is based upon the principle of substitution which contends that when several similar or commensurate properties are available, the one with the lowest price attracts the greatest demand. No one will pay more for a tract than the cost of acquiring an equally desirable substitute tract.

No two properties are exactly alike, so it is necessary to develop some common unit of comparison. This might be the price per square foot, the price per acre, the price per section, or the price per site. Due to the size of the subject properties and the comparable sales available, a comparison on a price per acre basis and on a price per square foot is felt to be most meaningful. Since properties do differ in characteristics, it is necessary to adjust comparable sales for features which differ from the subject property. These include such items as size, shape, location, access, terrain and vegetation.

The income and cost approaches were not analyzed in this reconnaissance cost estimate due to the limited extent of this report. The income approach may have some limited use in estimating value, but it is felt that more support would be relied upon from the market approach. The cost approach would apply where there building improvements. There may be some building improvements located within the study area that could be affected depending on the alternative to be implemented.

The majority of the properties within the project area are within a designated flood plain or are at least partially within a flood zone. An effort was made to utilize sales within the area which are similarly affected by the identified alluvial floodplains. The majority of the area is an alluvial fan with countless spine washes which often braid. The question is whether or not property values are adversely impacted by being located within the flood plain. One could reason that properties situated completely out of a flood plain tend to develop higher selling prices per unit than those affected by a flood zone, everything else being equal.

Some of the area is for long term development, likely 10 - 15+ years. However significant development is occurring through out the study area. The sale prices of large vacant tracts with long term development do not appear to be adversely influenced by being in the floodplain. The purchases are made as either a speculative investment, or for development to be completed in phases.

Conversely, a tract of land with more immediate development potential can be examined in a number ways. A developer can typically use the wash areas for open space. The wash areas are a distinctive feature which often adds character to the property and may actually enhance the value. If the tract has considerable wash area the developer may have the option of density transfer. With density transfer the same number of dwelling units can still be constructed on the tract, therefore very minimal impact.

If the sales price of properties are analyzed on a gross acreage basis this includes the entire tract with wash areas. If the sales price of properties were done on a net of wash area, the per unit comparison factor would be higher. However, the same conclusion of value should be reached assuming all other factors being equal.

It should also be realized that in some specific situations a property's value could be impacted by the floodplain. If a property consisted strictly of just a wash and no developable area one would reason an impact would result. The properties in the project area typically consist of developable area with some wash area traversing a tract. It would be very difficult to quantify a percentage or dollar amount of adjustment thus the selected comparable sales should have similar features. Also they would be analyzed on a gross acreage basis to include the entire tract.

Project real estate values are based on comparable sales data, obtained from various knowledgeable sources working in the local real estate market. Comparable sales data is contained in backup files maintained in the Appraisal Branch. Listed below is a general range of value within the study area. It should be realized that as specific property information is provided some properties may possibly be outside the general data.

RESIDENTIAL ACREAGE

CITY	ZONING
Phoenix	R-43
Phoenix	R1-8/S-1
Scottsdale	R1-190
Scottsdale	R1-10/14
Scottsdale	R1-35/43ESL
Scottsdale	R1-5/8

RESIDENTIAL LOTS

Value range is on a per unit lot basis.

ZONING	TYPICAL LOT SIZE
R-2	4,500 sq. ft.
R1-6	6,000 sq. ft.
R1-8/10	10,000 sq. ft.
R1-18ESL	18,000 sq.ft.
R1-35	35,000 sq. ft.
R1-43	43,000 sq. ft.
R1-190	4.5+/- acres

14. PUBLIC LAW 91-646 AND PL 100-17

Public Law 91-646 and Public Law 100-17 regarding relocation costs of persons or businesses have not been included in this report. This report's level of detail did not consider each parcel that would be impacted by the proposed detention basin(s) and channel way easements. The current allocation is $22,500 for residential relocation and $20,000 for business.

15. CONTAMINATION AND TOXIC CONCERNS

The general area has been inspected and there were not noted to be any hazardous or toxic concerns. It should be noted that the study area cover over 15,000 acres. A detailed acre by acre inspection was not conducted due to the level of this report, time constraints and lack of access into a majority of the project area.
The appraiser is not qualified to detect hazardous or toxic substances, nor qualified to determine the effect, if any, of unknown or known substances. The cost estimate is based on the project area being free of hazardous waste contamination, and should an assessment indicate an adverse condition exists the conclusions of this report may require some sort of revision.

16. <u>COST ESTIMATE</u>

As of the report date specific take areas, easement areas, or temporary work areas and the size of areas have not been identified. As of the report date, a detailed engineer's plan and profile of the channel(s) were not available for the appraiser's review. An amendment to this report will be necessary as information regarding the characteristics of the project are supplied to the appraiser. The following format would be utilized to tabulate the real estate costs for those areas impacted by the flood control project.

Land Type	
1 _____+/- acres of desert land,	$
2 _____+/- residential	$
3 _____+/- commercial	$
Improvements	$
Contingencies 25% of land and improvements	$
Severance Damages @ 10%	$
Relocation Costs (PL 91-646) As of this report date it is unknown whether any residences would be relocated within the proposed project area.	$
Total estimated cost for Tortolita Drainage Area	$ 0
Rounded to	$

17. CERTIFICATION

I certify that, to the best of my knowledge and belief:

I personally inspected the study area of the subject of the report, and have considered the pertinent facts affecting the value thereof.

The facts and data reported by the appraiser and used in this report are true and correct.

That all market data pertaining to the final value estimate has been accumulated from various sources and, where possible, personally examined and verified as to details, motivation and validity.

That the reported analyses, opinions, and conclusions are limited only by the assumptions and limiting conditions stated in this review report, and are my personal, unbiased professional analyses, opinions and conclusions.

I have no present or prospective interest in the property that is the subject of this report and I have no personal interest or bias with respect to the parties involved.

My compensation is not contingent on an action or event resulting from the analyses, opinions, or conclusions in, or the use of, this report.

Significant professional assistance to the undersigned was provided in the format and preparation of the demographic data contained in this report.[2] The valuation analysis and conclusions of market value are the sole work product of this appraiser.

Date: 1 December 1995

Brian Kirchner

Brian Kirchner
Cal. Certified General Appraiser
AG 018950

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[2] Demographic data was obtained from Appraisal Sciences Ltd., and Winius Montandon, Inc.

STATEMENT OF PROFESSIONAL QUALIFICATIONS
for
BRIAN KIRCHNER

Professional Experience

Department of the Army, Los Angeles District, Phoenix Project Office, Corps of Engineers April 1994

Department of the Army, Sacramento District, Corps of Engineers September 1991 to April 1994

Independent real estate appraiser conducting assignments in Northern California May 1990 to August 1991

Agricultural real estate appraiser for Western Farm Credit Bank in Sacramento, Ca. July 1987 to May 1990

Loan Officer/Appraiser for Farm Credit Association of Woodland, Woodland California
May 1986 to July 1987 - Appraisal work performed 50% of the time.

Professional Licenses

State of California Real Estate Salesperson License expiration 11/97

State of California Certified General Appraiser, AG 018950, Issued 03/94

Education

California State University, Chico: Bachelor of Science Degree
May 1984

Monterey Peninsula Junior College: Associate of Arts Degree
May 1981

Successfully completed courses:

December 1986	Real Estate Principles, TRI-REALTORS
May 1987	A-10 Fundamentals of Appraisal*
January 1988	A-20 Principles of Rural Appraisal*
August 1998	Report Writing Seminar*
December 1988	A-30 Advanced Rural Appraisal*
March 1991	A-12 Code of Ethics and Uniform Standards of Professional Appraisal Practice*
August 1992	The Appraisal of Partial Acquisitions**
November 1993	Legal Aspects of Real Estate and Agency Relationships
December 1993	Environmental Contamination in Real Estate**
November 1994	Basic Income Capitalization***
December 1994	Advanced Income Capitalization***

*American Society of Farm Managers and Rural Appraisers
**International Right Of Way Association
***Appraisal Institute

APPENIDX F: ENVIRONMENTAL

Draft
Environmental Evaluation

for
North Scottsdale, Maricopa County, Arizona

Reconnaissance Study

February 1996

TABLE OF CONTENTS

EXECUTIVE SUMMARY

This environmental evaluation (EE) has been prepared in order to identify potential environmental effects associated with flood control measures that could be proposed for the north Scottsdale and northeast Phoenix City areas. This document addresses the environmental resources as they exist today, and the potential effects associated with and the no action alternative as well as various flood control measures.

The results of this reconnaissance level analysis suggests the costs of mitigation would vary greatly between the alternatives. The actual costs of the mitigation for each of the alternatives has not been determined as there are numerous factors which will only be apparent when the project is studied in greater detail during the feasibility phase where the extent of short- and long-term effects are qualified and quantified. Where adverse effects are unavoidable appropriate mitigation measures will need to be developed.

This evaluation is not a National Environmental Policy Act (NEPA) document. It is to be used in the planning process to assist in the identification of a viable solution to flooding problem in the north Scottsdale and northeast Phoenix City areas. Any future NEPA document must be formally coordinated with Federal, State and local agencies, interested citizens and groups, and affected landowners.

1.0 INTRODUCTION

1.1 Authority.

The Los Angeles District is proceeding with a reconnaissance level study of the flood problems in the area, as authorized by the Flood Control Act of 1938, Gila River and Tributaries.

1.2 Purpose of Study.

The purpose of the study is to complete a reconnaissance study and report to determine if there is a Federal interest in participating in a solution to the flood control problem in this area. The protection measures would be designed to protect the people and property, in the proposed project area outlined below, from damages caused by floods.

2.0 NEED FOR ACTION

2.1 General Description of Project Area.

The project area is located in Maricopa County, Arizona, in the northern section of the City of Scottsdale and the northeastern section of the City of Phoenix (See Figure 1). This study, if carried forward, should present a project designed to contain a 100-year flood hazard. The reconnaissance-level alternatives that have been developed for this project are described below (See Section 3).

2.2 Scope of this Environmental Evaluation.

The scope of this environmental evaluation consists of addressing the environmental issues within the study area, as they exist today, and the potential effects of a project or the future without the project on the wildlife, human and cultural resources of the area. Identification of resources include biological, cultural, land use, recreation, water quality, air quality, noise, aesthetics and hazardous and toxic waste parameters. This reconnaissance level environmental evaluation is based on existing data and literature input from the study team. A more detailed investigation and analysis will be undertaken during the feasibility phase.

2.3 Study Area Description.

The study area is bounded by the following surface features:(all of the streets are not fully constructed) Dixileta Road on the north; 110th Street on the east; the Central Arizona Project canal on the south; and 32th Street on the west (See Figure 2).

The project area is alluvial terrain gently sloping to the south and west with ill-defined streambeds. The Washes, that cause the flood hazard, being studied are: (from north to south) Fan 6, Fan 5, Rawhide, Pinnacle Peak, Reata Pass and Beardsley. In total, the area of these Washes being studied, covers an area of approximately 27 square miles. The eastern area is composed of mountains that drain south and southwestward into the cities of Scottsdale and Phoenix. The highest elevation in this drainage basin is McDowell Peak, at 4034 feet above sea level, on the eastern side of the study area. The lowest elevation is 1520 feet in the area of the Central Arizona Project Canal, on the south side of the study area.

2.4 Current Conditions

In the past water and sheet flows in the project area has been observed, but damage has been minimal in dollars. During the 1970's and 80's growth in the east and northeastern portion of the Phoenix metropolitan area led to an expanded residential and commercial sector in the project area and as a result many homes and businesses were constructed. At present approximately 70% of the study is undeveloped, and 30% developed. The increased development has led to the possibility of significant lost of property, and perhaps the lose of life, in any future high water events.

3.0 ALTERNATIVES CONSIDERED

3.1 Alternative 1. <u>Without Project (The "No Action" Alternative)</u>.

This alternative would assume no flood control features are constructed in the area. No additional measures would be taken to change the current flooding problem. Studies have shown that periodic flooding would continue during the foreseeable future, eventually resulting in a possible greater loss of life, roads, homes, utility lines, and other facilities and infrastructure within the study area.

3.2 Alternative 2. <u>Build Detention/Retention Basins</u>.

This alternative would involve the construction of several new detention/retention basins within the project area. These basins would act as temporary storage and/or briefly delay water moving through the project area to prevent the high water that could flood the area.

3.3 Alternative 3. Increase the Capacity of Drainage Channels.

This alternative would involve enlarging the capacity of the channels that currently exist in the project area. With larger channels the flood flows would pass through the developed areas more rapidly and therefore prevent damage.

3.4 Alternative 4. Flood-proofing Existing Structures.

This alternative would involve flood proofing the existing structures in the flood prone areas. This could be a feature to keep flood waters away from structures (i.e. levees) or some method of raising structures above the flood hazard elevation.

3.5 Alternative 5. Installation of a Flood Warning System.

This alternative would involve the construction of a precipitation and/or stream gaging system in the higher elevations of the drainage basins that channel runoff into the project area. With sufficient warning time, this system could warn those persons in the flood hazard area to vacate the area and/or remove property before flooding occurred.

3.6 Alternative 6. Removal of structures from the Flood areas.

This alternative would involve the removal of homes, businesses, roads and other structures that are in jeopardy from flooding. It could also lead to zoning ordinances that would prohibit any future building in flood pron areas.

4.0 EXISTING ENVIRONMENT

4.1 Biological Resources

4.1.1 Vegetation

A. General

Sonoran desert scrub and Sonoran riparian woodland are the primary vegetation types within the study area. Vegetation densities vary within the study area, with the greatest densities occurring along the washes and at higher elevations. The washes support numerous large trees (including **palo verde** (Cercidium and Parkinsonia sp.), **ironwood** (Olneya tesota), and **mesquite** (Prosopis sp)) and thick underbrush (unidentified, but probably including **brittlebush** (Encelia farinosa), **creosote bush** (Larrea tridentata)). Wash bottoms generally consist of decomposed granite and are typically devoid of smaller vegetation due to hydrologic processes. **Saguaros** (Carnegiea giganteus) are common in the interwash areas, especially at higher elevations, as are several other cactus species such as **ocotillo** (Fouquieria splendens).

Ironwood plays a critical role in maintaining the ecological diversity of the Sonoran Desert as documented in "Ironwood: An Ecological and Cultural Keystone of the Sonoran Desert" (Nabhan and Carr, 1994). The ironwood is a keystone species that maintains the structure and function of Sonoran desert habitats. Recent studies in Sonoran desert environments strongly associate significant levels of wildlife species diversity with the presence of ironwood communities and suggest that losses to this vegetative component would negatively affect some wildlife species (Tewksbury and Petrovich, 1994). Some even propose the ironwood as a factor beneficial to maintaining population ranges of woodpeckers and pygmy owls (Phillips, et al., 1964).

Two biological subdivisions of the Sonoran Desert which occur in the study area are the Arizona Uplands and Lower Colorado River Valley. Much of the study area is characterized by an ecotone (transition zone) of the two subdivisions. Species common to both occur there. Drainages (dry washes) support desert riparian (xeroriparian) associations which are characterized by larger trees and denser understories.

1. *Arizona Uplands Subdivision:* This habitat type is found at upper elevational limits of the Sonoran Desert in areas with distinct biseasonal rainfall. It characterizes the interwash communities in the study area. Foothill palo verde and ironwood are the dominant tree species. These occur as isolated individuals, not dense woodlands. Shrub cover is relatively dense and consists of **triangle-leaf bursage** (Ambrosia sp.), **ratany**

(_Krameria parvifolia_), and **brittlebush** (_Encelia farinosa_). **Creosote bush** (_Larrea tridentata_) is present, though it is more common in the transition zone. Cacti are a major component, particularly saguaro. Other cacti species include **barrel** (_Ferocacuts acanthodes_), **prickly pear** (_Opuntia_ spp.), several species of **cholla** (_Opuntia_ sp.), and **hedgehog** (_Echinocereus engelmannii_).

2. Lower Colorado River Valley Subdivision: This occurs from the Phoenix area, south and southwest to the Colorado River and into Mexico. It is characterized by shrubby vegetation, primarily creosote bush/bursage associations and very few cacti. Larger trees are virtually non-existent. This habitat type is also common in interwash areas.

The recently-created McDowell Mountains Park Preserve adjoins the study area. Development is restricted from occurring in that preserve. A goal of this study should be to ensure that a wildlife corridor is maintained, connecting remaining habitat areas in the study area with this preserve. Recreation trails could also be established for non-intrusive activities such as hiking and horse-back riding.

B. Specific Drainages

The June 1994 "Desert Greenbelt" study (Greiner, 1994) describes specific reaches of existing and proposed channels in the study area. The report details existing vegetation and surrounding land uses in these areas. Except in areas of existing development, desert riparian vegetation occurs along the drainages. Dominant tree species include palo verde and ironwood. Desert riparian areas along Rawhide Wash are generally quite dense, with a mix of ironwood and palo verde trees, and scattered saguaros. Mesquite trees are a minor component. The locally-proposed Pima Road Channel (proposed as part of the Desert Greenbelt Plan) traverses numerous small drainages which support sparse stands of palo verde. No natural washes parallel its alignment, however, and so it lacks a density and clustering of vegetation characteristic of the other corridors in the Desert Greenbelt Plan. Much of this area consists of undisturbed desert scrub, including a number of saguaros. Although it is not a natural wash, the Pima Road Channel (if constructed) could provide sufficient open space and vegetative cover to be utilized as a wildlife corridor. The Reata and Beardsley washes contain some relatively dense stands of mature ironwood and palo verde. Ironwood is more common along the southern portions and several large individuals exist. The McDowell Mountains rise sharply to the east of upper Reata Wash.

C. Fans 5 and 6

Previous field surveys for this reconnaissance study did not include fans 5 and 6, located north of the other drainages in the study area, and these fans were not included in the Desert Greenbelt study. Vegetation and wildlife in these areas are likely similar to the other washes in the study area (such as Rawhide Wash). Sonoran desert scrub would be expected to occur outside of normal inundation areas, and Sonoran riparian vegetation would occur on the banks of the "channels" through the alluvial fans.

4.1.2 Wildlife

A large number of wildlife species are characteristic of Sonoran Desert communities, with the potential for more species to occur along well vegetated drainages. Birds observed during field visits conducted for the Desert Greenbelt study (Greiner, 1995) include **Gambel's quail** (Callipepla gambelii), **roadrunner** (Geococcyx californianus), **mourning dove** (Zenaida macroura), **Gila woodpecker** (Melanerpes uropygialis), **northern flicker** (Colaptes auratus), **black-throated sparrow** (Amphispiza bilineata) and **cactus wren** (Campylorhynchus brunneicapillus). Raptors observed included **Harris hawk** (Parabuteo unicinctus), **red-tailed hawk** (Buteo jamaicensis) and an unidentified **owl**. **Mule deer** (Odocoileus hemionus) utilize the washes, particularly in the eastern and northeastern portions of the study area. Densities of mule deer are fairly low, estimated at two to three animals per square mile. **Javelina** (Tayassu tajacu) are abundant in the area and use washes for shelter during the day. Mammals which occur in the project area include **coyote** (Canis latrans), **desert cottontail** (Sylvilagus audubonii), several species of **ground squirrels** (Spermophilus sp.) and **pocket mice** (Perognathus sp.). It is likely that many reptiles live in the area including **tree lizard** (Urosaurus ornatus), **whiptail lizard** (Cnemidophorus sp.), **regal horned lizard** (Phrynosoma sp.), **gopher snake** (Pituophis melanoleuscus), **coachwhip**

(Masticophis flagellum) and **western diamondback rattlesnake** (Crotalus atrox).

4.2 Threatened and Endangered Species.

Special status species include the following: plants protected by the Arizona Native Plant Law; wildlife listed as threatened, endangered or candidates by the Arizona Game and Fish Department; and plants or wildlife listed by the U.S. Fish and Wildlife Service. The **American peregrine falcon** (Falco peregrinus anatum) is the only Federally-listed endangered species potentially occurring in the study area (according to the 1995 Desert Greenbelt Study), and it is also listed as a candidate species by the state of Arizona. Although peregrines have been seen in urban areas, they usually breed in remote, rugged areas with large cliffs for nesting. It is unlikely that a locally-acceptable flood control project (one that retains the natural character as much as possible) would adversely alter potential habitat or result in a decrease in the prey base for the peregrine falcon.

The U.S. Fish and Wildlife Service (USFWS) lists a total of thirteen Federally-listed Threatened or Endangered species, and one Proposed Endangered Species, as potentially occurring in Maricopa County (see Attachment 2). Endangered cactus species, the **lesser long-nosed bat** (Leptonycteris curasoae yerbabuenae, Federally-listed as Endangered), and the **cactus ferruginous pygmy owl** (Glaucidium brasilianum, Proposed as Endangered), in particular, may occur within the study area. Several other listed species do not occur or are not likely to occur in the study area, due to range limitations or specific habitat requirements (such as permanent water). Species not likely to occur in the study area include **Sonoran pronghorn**, **desert pupfish**, **Gila topminnow**, **razorback sucker**, and **Yuma clapper rail**. More extensive investigations of habitat requirements, and cursory surveys, would likely show that other listed species also do not occur in the area.

Other special status species in the study area include the following candidate Category 2 species: **mastiff bat** (Eumops perotis), **California leaf-nosed bat** (Macrotus californicus), **Yavapai Arizona pocket mouse** (Perognathus amplus amplus), **loggerhead shrike** (Lanius ludovicianus), **chuckwalla** (Sauromalus obesus obesus) and the Sonoran population of the **desert tortoise** (Gopherus agassizii). (The Mojave population of the desert tortoise, located in California, northwestern Arizona, southwestern Utah, and southern Nevada, is Federally listed as Threatened.) The Arizona Department of Game and Fish (ADGF) list of special status species potentially occurring in the study area is also included in Attachment 2.

4.3 Cultural Resources.

A records and literature search has been conducted at the Arizona Office of Historic Preservation. Results of The search showed that approximately half of the area of potential effects (APE) has ben surveyed for the presence of cultural resources. The records check provided information on 38 archeological sites within or near the APE. The sites range include rock art sites, small lithic/sherd scatters to very large Hohokam villages.

A preliminary visit to the project location showed that the area is either covered with alluvium or is heavily developed. There is a strong probability the cultural resources may be located on or adjacent to the alluvial fans. Information on how many of the listed sites, if any, have been excavated will need to be gathered. There is a possibility that many of the sites within the APE may be eligible for listing in the National Register of Historic Places.

4.4 Land Use.

Land uses in the project area range from residential, to commercial, to recreation, to cattle grazing. The land use regulations in the area are the responsibility of the cities of Scottsdale and Phoenix, or the land owners.

4.5 Recreation.

Recreational uses in the project area at present are limited to uses that are compatible with land ownership and the amount of open space. These activities include, but are not limited to: horse riding, biking, hiking, etc.

4.6 Water Quality

Ambient water quality is probably quite good for surface and ground water. There are no industries or other common pollution sources in the area. The natural processes inherent in undeveloped alluvial fans would assure good water in this area.

4.7 Air Quality.

Air quality is also quite good, with the possible exception of PM 10, during periods of high winds. There is a lack of common pollution sources in the area.

4.8 Noise.

Noise in the project area is primarily the result of natural background sources including wildlife and domesticated animals. Traffic noise is limited as a result of the rural atmosphere of the community, except in the vicinity of major roads and streets.

4.9 Aesthetics.

The aesthetics of the area are very pleasing. The natural terrain and regional vegetation presents a desert looking environment. Mountains are generally visible in most directions during periods of good visibility.

4.10 Hazardous and Toxic Waste.

There are no known hazardous or toxic dump sites in the area, however there may be unknown sites present, or there may be discharges of waste currently occurring from either agricultural lands or from the residential areas due to usage of chemicals or from livestock.

5.0 ENVIRONMENTAL IMPACTS.

5.1 Future Without Project, (No Action Alternative)

5.1.1 Biological Resources

The U.S. Fish and Wildlife Service (USFWS) and other agencies would likely argue that Corps involvement in this project would lead to increased development in the area. The Corps would likely contend that development is expected to continue throughout this area, with or without this project (or Corps involvement in this project). Each developer would be responsible for providing flood protection for individual projects, and this would result in a "mish-mash" of various types of flood protection measures. The overall impact could be even more severe than the degree of impact expected from a comprehensive solution. Some areas, however, may not be directly impacted by any individual flood control measure or development; whereas these same areas may be affected by the locally-preferred proposal. In these cases, the future (without project) conditions would be continued growth of vegetation, and ecosystem development. Populations of wildlife would likely expand, initially, as surrounding habitat areas are lost to development or flood control. Increased competition and predation would eventually limit population growth. If the remaining habitat is small and completely isolated, genetic mutations or catastrophic events could eventually lead to population reductions, or even localized elimination of some species.

5.1.2 Threatened and Endangered Species

Impacts to threatened and endangered species (if they occur in the area) would likely be similar to other plants and wildlife, as discussed above. Individual flood protection measures would likely be designed to avoid impacts to known populations of endangered plants or animals, but continued development of the area would eventually destroy habitat required by these species. Nesting areas of the peregrine falcon would likely not be directly affected, but increased development may reduce foraging habitat. Increased public access to the McDowell Mountains may cause disturbance of nesting sites.

5.2 Future With a Project

5.2.1 Biological Resources

Impacts from future developments would occur as discussed above, with or without this project. A comprehensive solution may result in fewer overall impacts to Sonoran desert plants and wildlife, although impacts in some specific areas may be greater than would otherwise occur. The locally preferred solution (a "Desert Greenbelt") would use natural washes wherever possible and preserve the desert environment and natural character of the area. Specific alternatives are not currently available for analysis, but potential impacts from general types of flood control solutions (including concrete channels, detention basins, and others) are discussed below.

Concrete Channels and Debris Basins

Construction of concrete channels throughout the study area would result in direct and indirect impacts to the entire floodplain. It would result in a complete loss of vegetation within the construction zone, and loss or degradation of vegetation adjacent to the channels. Many of these plants (such as ironwood, palo verde, and mesquite) depend on, or benefit from, groundwater infiltration within the drainages, especially during flood or large storm events (even though there may not be a permanent aquifer). Arid plants such as cactus, creosote bush, and brittle bush would likely obtain sufficient moisture through rainfall.

Some vegetation may grow within or on the perimeter of the debris basins. Maintenance of the debris basins, however, would periodically remove any vegetation within those structures. Concrete channels would not normally support any habitat, but in the absence of debris basins, vegetation can sometimes grow in areas where sediment has deposited. This would not be likely to occur with this alternative.

The capture of sediment and flood flows within basins and concrete channels would completely change the character of the entire alluvial fan. Vegetation, soil moisture, and possibly even sediment type would change throughout the smaller drainages that criss-cross the floodplain. Many of these drainages would no longer carry flows (except from direct rainfall, or from floods that exceed channel capacity). Smaller washes would be effectively de-watered, as channelized washes would concentrate flows and not allow for sheet flow within the alluvial fan. (The without-project condition, however, would eventually result in development of much of this area, resulting in significant losses to vegetation, wildlife, and floodplain habitat.) Alternatives should be investigated that allow a flow of water to smaller washes in the alluvial fan.

Concrete channel alternatives could result in significant impacts to wildlife corridors. A wildlife corridor can be defined as a somewhat linear landscape feature with sufficient width buffer that allows safe animal movement between two patches of habitat or between habitat and sources of essential resources. It is useful to differentiate between regional and local wildlife corridors. Regional corridors link two or more large areas of natural open space, and can link different populations of a species. Local corridors allow resident animals access to necessary resources (such as food, cover, water) that otherwise may be impeded by development or natural barriers. Drainages and dense vegetation within the study area provide both regional and local corridors for wildlife. Some species, for instance, may use these drainages to migrate between McDowell Mountain Regional Park and other open space areas. (Encroaching development, however, will continue to diminish the area's potential as a regional wildlife corridor.) Construction of concrete channels, and the significant loss of vegetation within and between major drainages associated with this alternative, would severely limit wildlife use throughout the floodplain.

To reduce impacts, these channels may be designed to incorporate open-space corridors along one or both sides, for the entire length of the system. These corridors may be "landscaped" using native vegetation, including plants removed during construction. Vegetation planted along-side concrete channels would need to be drought-tolerant species that could survive with infrequent rainfall, not dependent on flood flows. Desert plants, however, are often difficult to successfully replace. Many years are required for the ecosystem to fully develop, and the severe climate would likely cause high mortality to newly planted vegetation. Mitigation sites for desert riparian plants are also very limited. Riparian plants require high groundwater or frequent inundation. For more information, see Section 8.0 (Mitigation Needs).

Some plant species are protected by the Arizona Native Plant Law and the Scottsdale Native Plant Ordinance (for example, palo verde, ironwood, and velvet mesquite; and saguaro, barrel, and hedgehog cactus). In compliance with the Native Plant Law (see Appendix A), the Arizona Department of Agriculture would need to be notified before any protected plants are removed, transplanted, or destroyed. A native plant salvage plan and grading permit would be required per the Scottsdale Native Plant Ordinance. The plan would be reviewed by the Development Review Board. When these plants are removed, they are often re-used for landscaping.

Disturbance of the natural environment from construction activities could create enhanced opportunities for non-native plant species, such as salt cedar (Tamarisk sp.). These "exotics" have relatively little or no habitat value, and tend to crowd out valuable native species. A weed abatement program, or the planting of native species after construction, could be effective in reducing this intrusion.

Some slow-moving wildlife species could be killed during construction activities, and the impoundment or channelization of water could have a positive or negative impact on foraging activities of other species.

Soft-Bottom Channels (Levees)

This alternative may involve excavation of channels, and would include construction of collectors and levees, with complete loss of vegetation within the construction footprint. Some re-vegetation would occur within the channels and outside of the levees. Unless alternatives to traditional soil cement or concrete levees are used, however, the levees themselves would not support any vegetation. Soft-bottom channels would allow rain and storm water to infiltrate into the ground. This groundwater recharge would support the growth of desert riparian vegetation within and adjacent to the channels. Channels should be designed wide enough to accommodate both flood flows and vegetation, to reduce maintenance requirements (and impacts). This would result in a larger area of immediate, direct impact (if excavation of channels is required), but would provide more space for eventual vegetation re-growth.

Soft-bottom channels would likely be used as a wildlife corridor, connecting open space areas and providing habitat in an increasingly urban environment. The more vegetation that grows within and adjacent to these channels, the more valuable the corridor would be. Width of the corridor is also an important factor. The longer the distance an animal must travel to find food, water, or other resources (especially larger animals such as mule deer), the wider the corridor should be.

Impacts to major and minor drainages between channels, including impacts to vegetation and other elements of the floodplain, would be similar to those described above. As with all construction alternatives, there would be an increased potential for the establishment and spread of non-native species such as tamarisk.

Detention Basins

Detention basins would likely retain water for only a short time, and then slowly release flows through the improved channels. There may be an increase in vegetation behind any detention basins that would be constructed, because water would be detained there for a longer period of time than occurs naturally. A slow release of water from the basins could produce an increase in vegetation downstream, as well. High velocity flood water can destroy vegetation and remove topsoil, and does not percolate as well as slower moving flows. The Fish and Wildlife Service, however, would likely express concern with any changes in natural water flow. They would require specific information regarding new flood pool areas that are now normally dry, as well as effects to normally flooded areas. In addition, slower flows may infiltrate/evaporate in upstream areas, and not travel as far downstream as occurs naturally. This could result in loss of vegetation in downstream areas.

Ponding and slow release of water could result in a change of vegetation type, as well as density. Willows and cottonwoods, for instance, may grow in these areas, instead of (or as well as) mesquite and palo verde. Flooding would not occur, however, to remove mature and dead vegetation, and allow younger plants to grow. A dynamic system (that supports a greater variety of plants and wildlife) may be replaced with a stable, maturing system.

The USFWS, ADGF, and the EPA had previously commented on earlier studies involving the possible construction of a detention basin on Rawhide Wash. Agency representatives stated a concern for potential downstream impacts specifically direct and indirect impacts that may result from changes to Rawhide Wash's hydrological characteristics (including impacts to vegetation and wildlife). Additionally, some agencies were concerned with potential impacts from additional in-channel flood control activities that may occur after a detention basin is constructed. Corps (Regulatory?)

concern for downstream impacts to jurisdictional waters of the U.S. was primarily for the stretch between the proposed detention basin upstream of Jomax Road and the point at which side tributaries or washes confluence with Rawhide Wash (CH2M Hill, 1995). Specifically, since the detention basin may reduce the peak discharge rate, depth, and width of the ordinary highwater flood, the concern is that flood water will not reach some areas within the existing jurisdictional areas. As tributaries join Rawhide Wash, this differential area is reduced as the watershed area increases. The first major side tributary that confluences with Rawhide Wash downstream of Jomax Road is about ½ mile downstream of Happy Valley Road, although numerous smaller tributaries join Rawhide Wash in this reach.

Flowage Easements (Natural Channels)

The use of natural channels to convey water would likely be the environmentally preferred method of flood control. To meet flood control objectives, however, this would likely require the construction of detention basins, with impacts as described above. At this time, it is assumed that development would not be allowed to occur in flowage easements. Benefits would partly depend on the width of those easements relative to the width of channel/levee systems. If development is allowed to occur right up to the boundary, then the habitat value they provide would be somewhat lessened (but still greatly preferred over concrete channels).

5.2.2 Threatened and Endangered Species

If it is determined that the project area may support Federally-listed threatened or endangered species, and that the species may be affected by a project proposal, then the Corps would need to prepare a Biological Assessment and begin formal Section 7 Consultation with the Fish and Wildlife Service. This process would require surveys for these species, or species likely to be Federally-listed prior to construction. If the natural character of the area is preserved to the maximum extent practicable, impacts to threatened or endangered species would likely be avoided, or minimized. Construction activities may be restricted to certain times of the year, to avoid sensitive nesting or parenting periods of migratory birds, or to take advantage of hibernating periods of other species (such as the desert tortoise). Impacts to nesting and foraging areas of the peregrine falcon would likely be similar to the "without project" condition.

5.3 Cultural Resources

It is not known how extensive adverse effects to cultural resources may be as a result of the proposed project. There is a very high likelihood that a significant number of archeological sites will be affected by construction impacts. However, This cannot be fulled assessed until a thorough records and literature search is completed at the Arizona state Museum and a field survey of unsurveyed properties within the APE is completed. The survey will identify any as yet unknown cultural resources as well as updating the status of known archeological sites.

5.4 Land Use

Possible land usage of the area will be affected by this proposed project. However, since the entire project area is within the city limits of Scottsdale and Phoenix these cities will control possible uses via zoning ordinances.

5.5 Recreation

Many possibilities exist for expanded recreation in this area. Much of the present open space could be utilized for the usual activities that people in the valley enjoy engaging in, i.e. horse riding, hiking, biking, bird watching, etc.

5.6 Water Quality

It is not anticipated that water quality will be impacted to any significant degree. However, specific plans will be required and reviewed by pertinent agencies to make a judgement on this matter.

"Dip crossings" of the major roads in the area would probably be retained for the major water channels in the area. This could affect water quality during rains, if traffic volume increased and caused increased erosion near the roads during high water events.

5.7 Air Quality

Air quality will remain about the current level without the project or increase gradually as the area develops.

5.8 Noise

Without the project noise levels will remain at the current level or increase gradually as the area develops.

5.9 Aesthetics

Without the project the aesthetics of the area will continue to be diverse and the area become more residential.

5.10 Hazardous and Toxic Waste

The project area is far removed from most present possible sources of hazardous wastes. However, there is always the chance that there were sources or disposal of wastes in this area in the past. Before any possible construction could take place a comprehensive search would be need to be conducted.

6.0 LEGAL COMPLIANCE

6.1 Applicable Federal Environmental Statues

If a feasibility study is recommended, a NEPA document will be required to address all project environmental resources and issues. The environmental document will be prepared in accordance with the requirements of Section 102 of this Act and with the Council of Environmental Quality Regulations for implementing the Procedural Provisions of the National Environmental Policy Act.

Other environmental laws and regulations that will be complied with in the environmental documentation include, but are not limited to, the Clean Water Act, the Clean Air Act, the National Historic Preservation Act, the Endangered Species Act of 1973, and the Migratory Bird Treaty Act.

6.2 Cost estimate for feasibility study environmental documentation.

The following preliminary cost estimate is for the preparation of an Environmental Impact Statement (EIS). If issues and/or concerns for this area are found to be less than those requiring an EIS, the estimated costs for an Environmental Assessment (EA) is $125,000.

Cost estimate for an EIS:

"Notice of Intent" (NOI) Preparation	$ 600
Scoping meetings	5,000
Coordination	4,000
Oversight of Draft EIS	18,000
Ecological/Biological Support	8,000
Cultural Resources Support	10,000
Review	9,000
"Record of Decision" Preparation	800
Travel and Miscellaneous	6,000
SUBTOTAL	$ 61,400

Possible Contracts:

A & E Negotiations	$ 3,600
U.S. Fish and Wildlife Service (Coordination & a Coordination Act Report)	28,000
Environmental Firm (to write & research EIS)	72,000
Cultural Resources Survey	34,000
SUBTOTAL	$137,600
GRAND TOTAL	$199,000

6.3 Possible Mitigations

Additional cultural resources surveys will need to be completed within the APE. The APE needs to be 100 percent surveyed to identify any potential historic properties. National Register evaluations of any sites that may be impacted as a result of the project would need to be conducted. This level of effort may require archival research and/or subsurface test excavations. The results of these studies would need to be coordinated with the SHPO pursuant to Section 106 of the National Historic Preservation Act. If any archeological or historic sites are determined to eligible for listing in the National Register of Historic Places, mitigation efforts will Need to be developed and agreed to in a Memorandum of Agreement (MOA). The MOA would be a document between the COE, SHPO, and the Advisory Council on Historic Preservation.

Biological Resources: Changes to the natural water flow need to be specified, and all possible effects to biological and water resources need to be identified (and quantified). Commitments should be made to avoid impacts wherever possible. Incremental and HEP analyses would be required to determine impacts and develop mitigation plans. Mitigation may involve changes to the design of the preferred alternative, to avoid impacts. For instance, alternative bank stabilization techniques and wider channels may be proposed. The USFWS would provide a Coordination Act Report.

Endangered Species: Surveys for the presence of endangered species within the project area would probably need to be undertaken prior to construction. Commitments for these surveys should be made in the feasibility stage environmental document. Where sensitive plant species area found, and where avoidance is not possible, the appropriate resource agencies would be contacted, and arrangements may be made for seed collection. Commitments should also be made in the feasibility document to avoid the nesting or breeding seasons of endangered species in sensitive areas, whenever possible.

Mitigation

The following potential mitigation measures were identified during public meetings conducted during the Desert Greenbelt study:

- Preserve the native Sonoran Desert and natural character of the area (avoidance).
- Avoid removing significant stands of palo verde, ironwood, and mesquite trees where possible. Comply with the Arizona Native Plant Law.
- Minimize future maintenance requirements (implement plant materials and embankment stabilization treatments which require limited maintenance).
- Landscape (revegetate) with native vegetation, including salvaged plants from the construction zone, using temporary irrigation systems to assure initial growth. Minimize the amount of grass used.

- Select mitigation treatments which remain stable in the greatest event storm practicable.

- Incorporate colors, scale, materials, and texture that blend visually with surrounding land forms, structures and vegetation. Use wide and shallow channels.

- Limit the erosion potential while maintaining the natural character of the desert setting.

- PIMA ROAD CHANNEL - From an environmental aspect, the western alignment is preferred north of Jomax Road with no preference south of Jomax Road

- Safety issues: (1) A narrow trapezoidal cross-section is preferred to a rectangular cross-section; (2) The rectangular cross-section would require security fencing.

- Prohibit motorized vehicles in the channels.

- Provide access at strategic points for public and wildlife - maintain a wildlife corridor.

More specifically, a primary concern would be direct and indirect disturbance to native vegetation, and loss of wildlife corridors due to construction of basins, levees, and channels. Significant impacts would require mitigation. Channels may be designed to incorporate open-space corridors along one or both sides, for the entire length of the system. These corridors may be "landscaped" using native vegetation, including plants removed during construction. Desert plants, however, are often difficult to successfully replace. Many years are required for the ecosystem to fully develop, and the severe climate would likely cause high mortality to newly planted vegetation. Mitigation sites for desert riparian plants are also very limited. Riparian plants require high groundwater or frequent inundation. Irrigation systems would likely be impractical, particularly for a long period of time. Vegetation planted along-side concrete channels, therefore, would need to be drought-tolerant species that could survive with infrequent rainfall, not dependent on flood flows. Soft-bottom channels and flowage easements, however, could support more desert-riparian species, such as palo verde. To maintain value as a wildlife corridor, and to decrease "edge effect" (related to predation and competition), these corridors would need to be significantly wider than usual channel rights-of-way. (Exact widths cannot be specified without additional research on which species would use these corridors, and their specific habitat requirements.) In general, the longer the distance between populations or food sources (the longer an animal needs to travel), the wider the corridor would need to be.

Mitigation (re-planting) ratios may be similar to the requirements stipulated in the Pima County Riparian Protection Ordinance. Pima County is also located in Arizona, and the mitigation requirements in that ordinance are specific to Sonoran desert riparian vegetation, similar to that found in the Scottsdale study area. The ordinance includes on-site mitigation standards for various types of riparian vegetation. First, impacts must be avoided to the extent practicable. If further mitigation is required, the ordinance specifies minimum sizes of mitigation areas (1:1 replacement ratio for impacts to xeric-riparian species), and densities and types of vegetation planted. For instance, mitigation for impacts to xeric-riparian species, medium to high-density (as occurring in the study area), would include planting 60-75 trees per acre and about 135 shrubs per acre. Species planted would be chosen from an approved plant list. On-site mitigation (adjacent to the area impacted) would be required, if it is possible.

Some plant species are also protected by the Arizona Native Plant Law (for example, palo verde, ironwood, and velvet mesquite; and saguaro, barrel, and hedgehog cactus). In compliance with the Native Plant Law (see Attachment 1), the Arizona Department of Agriculture would need to be notified before any protected plants are removed, transplanted, or destroyed. When these plants are removed, they are often re-used for landscaping.

The City of Scottsdale's Environmentally Sensitive Lands Ordinance (ESLO) stipulates that "all landscaping required within public easements, or other areas to be dedicated to the City, and in common areas should utilize native plan types and densities to match the existing landscape character (p. 800-3, <u>Design Guidelines and Policies for Environmentally Sensitive Lands</u>, 1992.)

Disturbance of the natural environment from construction activities could create enhanced opportunities for non-native plant species, such as salt cedar (<u>Tamarisk</u> sp.). These "exotics" have relatively little or no habitat value, and tend to crowd out valuable native species. A weed abatement program, or the planting of native species after construction, could be effective in reducing this intrusion.

7.0 COORDINATION

Future draft environmental documents could include coordination with Federal, State, and local agencies including, but not limited to the following:

U. S. Forest Service
U. S. Environmental Protection Agency
U. S. Fish and Wildlife Service
U.S. Soil Conservation Service
Arizona Department of Environmental Quality
Arizona Regional Water Quality Control Board
Arizona Department of Fish and Game
Arizona State Historic Preservation Office

Coordination has been initiated with the U.S. Fish and Wildlife Service and the Arizona Department of Fish and Game. Species lists and letters of comment have been received from both agencies. Prior to any ground disturbing activities coordination with the State Historic Preservation Officer (SHPO) will need to be completed in order for the proposed project to be in compliance with Section 106 of the National Historic Preservation Act (36 CFR 800). A letter is being prepared to request initial comments from SHPO pursuant to 36 CFR 800.4.

8.0 PREPARERS

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Hayley Lovan	Ecologist

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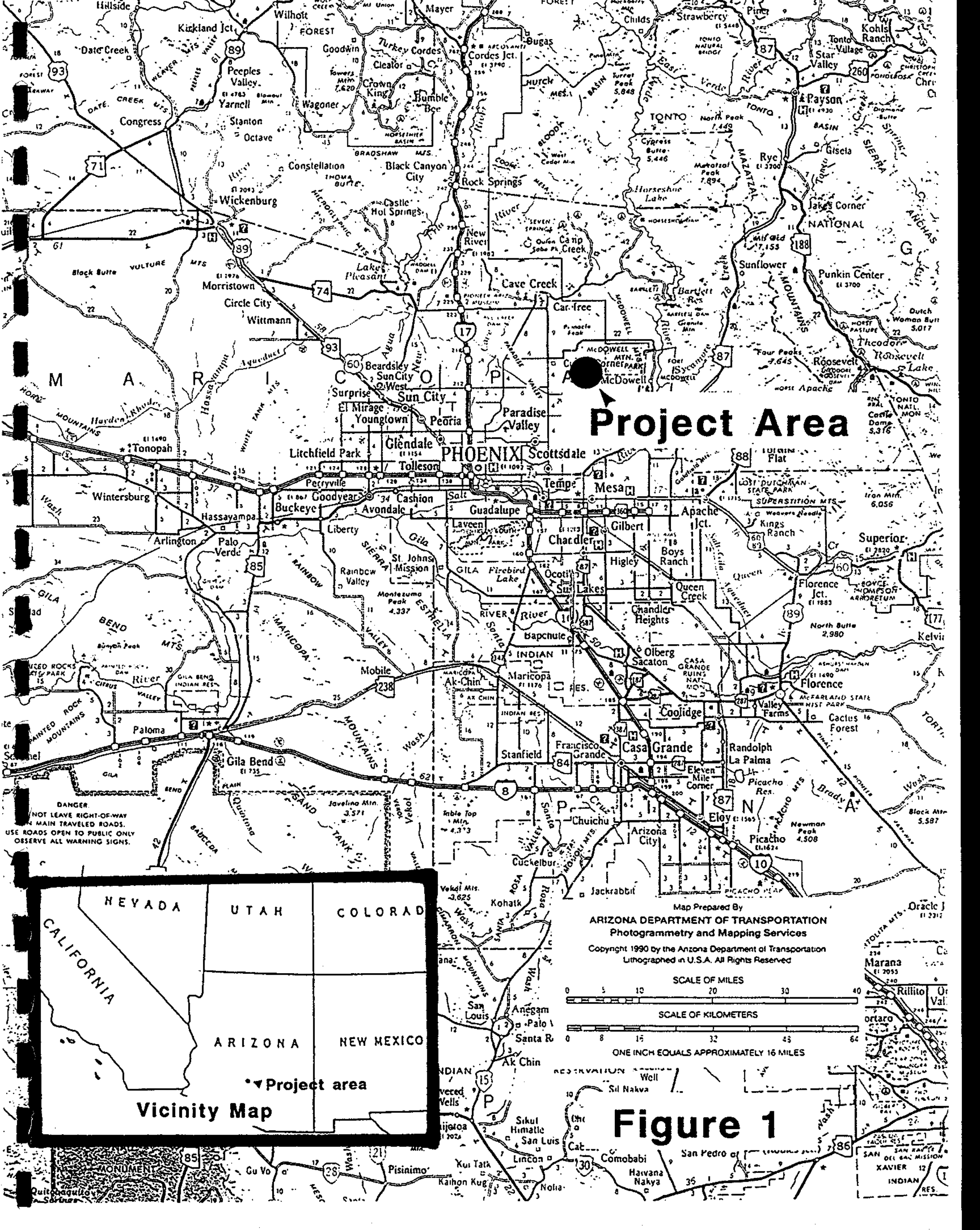
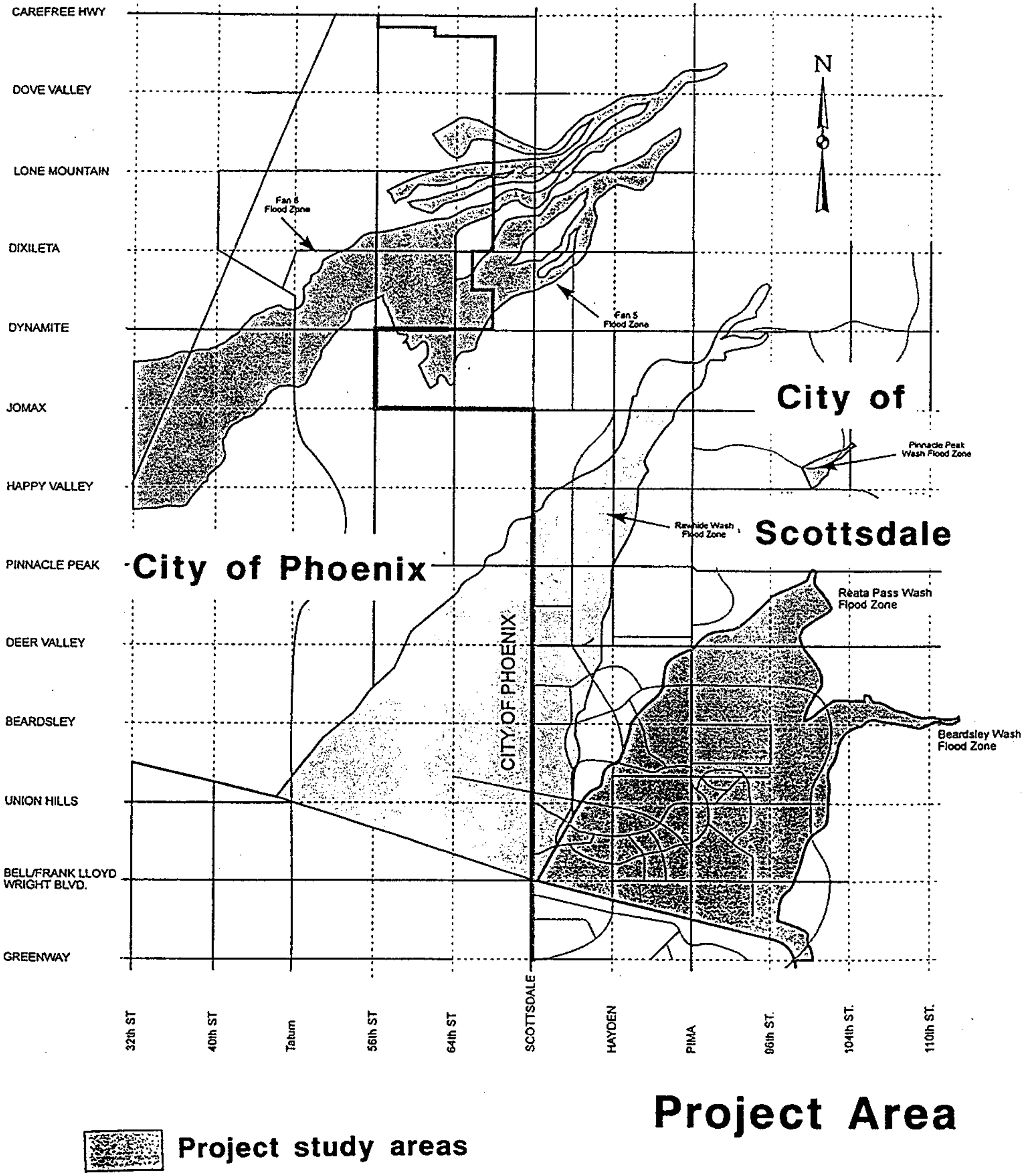

Project Area
PHOENIX
Scottsdale
Tempe
Mesa
Chandler
Gilbert
Glendale
Peoria
Sun City
Paradise Valley
Wickenburg
Casa Grande
Florence
Coolidge
Eloy
Gila Bend
Payson
Cave Creek
McDowell
M A R I C O P A
DANGER
NOT LEAVE RIGHT-OF-WAY
MAIN TRAVELED ROADS.
USE ROADS OPEN TO PUBLIC ONLY
OBSERVE ALL WARNING SIGNS.
Map Prepared By
ARIZONA DEPARTMENT OF TRANSPORTATION
Photogrammetry and Mapping Services
Copyright 1990 by the Arizona Department of Transportation
Lithographed in U.S.A. All Rights Reserved
SCALE OF MILES
0 5 10 20 30 40
SCALE OF KILOMETERS
0 8 16 32 48 64
ONE INCH EQUALS APPROXIMATELY 16 MILES
NEVADA
UTAH
COLORADO
CALIFORNIA
ARIZONA
NEW MEXICO
Project area
Vicinity Map

Figure 1



Project Area

Figure 2

Effective 9/21/91

ARIZONA NATIVE PLANT LAW

Arizona Revised Statutes, Chapter 7

ARTICLE 1. PROTECTION

3-901. Definitions

In this chapter, unless the context otherwise requires:

1. "Associate director" means the associate director of the division.

2. "Division" means the plant industries division of the Arizona department of agriculture.

3. "State agency" means any agency or political subdivision of the state.

4. "State land" includes land owned by this state or by a state agency.

3-902. Administration and enforcement

The director shall administer and oversee the enforcement of this chapter.

3-903. Protected group of plants; botanical names govern; categories of protected plants; power to add or remove plants; annual hearing

A. The protected group of native plants shall include, and protected native plants shall be, any plant or part of a plant, except, unless otherwise specifically included, its seeds or fruit, which is growing wild on state land or public land or on privately owned land without being propagated or cultivated by human beings and which is included by the director on any of the definitive lists of protected categories of protected native plants described in this section. The director by definitive lists may divide any protected category into subcategories which are to receive different treatment under the rules adopted under this article to conserve or protect such plants. In the preparation of each list of plants within a protected category or subcategory the director shall list by botanical names all of those protected plants which are to fall within the protection of that category or subcategory. The botanical names of the listed plants govern in all cases in the interpretation of this article and any rules adopted under this article.

B. The director shall establish by rule the lists of plants in the following categories of protected native plants:

1. Highly safeguarded native plants to be afforded the exclusive protections including the use of scientific or threatened collection and salvage permits, provided this category in this chapter. This category includes those species of native plants and parts of plants, including the seeds and fruit, whose prospects for survival in this state are in jeopardy or which are in danger of extinction throughout all or a significant portion of their ranges, and those native plants which are likely within the foreseeable future to become jeopardized or in danger of extinction throughout all or a significant portion of their ranges. This category also includes those

Appendix 1

plants resident to this state and listed as endangered, threatened, or category 1 in the federal endangered species act of 1973 (P.L. 93-205; 87 Stat. 884; 16 United States Codes 1531 et seq.), as amended, and any regulations adopted under that act.

2. Salvage restricted native plants to be afforded the exclusive protections involving the use of salvage permits, tags and seals provided in this chapter. This category includes those native plants which are not included in the highly safeguarded category but are nevertheless subject to a high potential for damage by theft or vandalism.

3. Export restricted plants to be afforded the exclusive protection, involving the use of safeguards against their overdepletion through interstate sale or shipment, provided in this chapter. This category includes those protected native plants which are not included in the highly safeguarded category but are nevertheless subject to overdepletion if their exportation from this state is permitted.

4. Salvage assessed native plants to be afforded the exclusive protections, involving the use of salvage tags and seals and annual salvage permits, provided in this chapter. This category includes those native plants which are not included in either the highly safeguarded or salvage restricted categories but nevertheless have a sufficient value if salvaged to support the cost of salvage tags and seals.

5. Harvest restricted native plants to be afforded the exclusive protections involving the use of harvest permits and wood receipts provided in this chapter. This category includes those native plants which are not included in the highly safeguarded category but are subject to excessive harvesting or overcutting because of the intrinsic value of their by-products, fiber or woody parts.

C. The director by rule may add or remove a native plant to or from the protected group or any of the categories of protected native plants.

D. The director shall hold a public hearing on native plants at least every twelve months after giving notice as required by section 3-912, subsection B.

3-904. <u>Destruction of protected plants by private landowners; notice; exception</u>

A. Except in an emergency, this chapter does not prevent the destruction of protected native plants or clearing of land or cleaning or removing protected native plants from a canal, lateral ditch, survey line, building site or road or other right-of-way by the owner of the land or the owner's agent if:

1. The land is in private ownership.

2. The protected native plants are not transported from the land or offered for sale.

3. The owner or the owner's agent notifies the department pursuant to this section of the intended destruction at least:

(a.) Twenty days before the plants are destroyed over an area of less than one acre.

(b.) Thirty days before the plants are destroyed over an area of one acre or more but less than forty acres.

(c.) Sixty days before the plants are destroyed over an area of forty acres or more.

4. The protected plants are destroyed within one year of the date of destruction disclosed in the notice given the department in paragraph 3 of this subsection.

B. The notice under subsection A, paragraph 3, subdivision (a) may be oral or written. The notice under subsection A, paragraph 3, subdivisions (b) and (c) must be in writing. The notice under subsection A, paragraph 3, whether written or oral, shall include:

1. The name and address of the owner of the land and, if the owner is not a resident of this state, the name and address of the owner's agent in this state to be contacted regarding the destruction or salvage of the native plants.

2. The earliest date that destruction of the protected native plants will begin.

3. A general description of the area in which the protected native plants wil be destroyed.

4. Whether the owner intends to allow salvage of the plants to be destroyed.

C. The director by rule shall:

1. Prescribe the form and content of the notice which shall be adequate and comply with subsection B and shall provide landowners with copies of the notice on request.

2. Provide for an alternative procedure in cases in which the landowner is not required to notify the department in writing. The alternative procedure shall include:

(a) Oral notification by the landowners to the department.

(b) Preparation by the department of a written notice form. The department shall transmit a confirming copy to the landowner, and the owner may not begin destruction of protected native plants until he receives the written confirmation and the time prescribed under subsection A, paragraph 3 has elapsed.

D. The written notice form, whether completed by the landowner or the department, shall include the following notice in bold-faced type:

Notice: Consent of the landowner is required before entering any lands described in this notice.

E. Within five working days after receiving the notice required under this section the department shall post a copy of the notice in a conspicuous location in the public area of the division office that administers the department activities in the county where the land is located on which the native plants are to be destroyed. The division shall also mail a copy of the notice to any salvage operator or interested party that has requested notice of such activities occurring during the current calendar year. The director by rule may establish and the associate director shall collect a reasonable fee from those receiving copies of the notice to cover the cost of providing this notice.

F. If the department receives a notice of intended destruction under subsection A, paragraph 3 and subsequently receives a complete and correct application for a salvage permit executed by the owner of the land or his agent for any highly safeguarded or salvage restricted native plants intended to be destroyed under the notice, the department shall facilitate the prompt salvage of the plants by issuing a permit, and any associated tags and seals, within four working days.

G. The notice requirements of subsection A, paragraph 3 do not apply to the destruction of native plants that occurs in the normal course of mining, commercial farming and stock raising operations if the plants are destroyed over an area of less than one acre and, if the area exceeds one acre, any notice required by subsection A, paragraph 3, may be given by oral notice.

H. This section does not apply to the destruction of protected native plants on individually owned residential property of ten acres or less where initial construction has already occurred.

3-905. Destruction of protected plants by state

A. Except in an emergency, if a state agency proposes to remove or destroy protected native plants over an area of state land exceeding one-fourth acre, the agency shall notify the department in writing as provided in section 3-904 at least sixty days before the plants are destroyed, and any such destruction must occur within one year of the date of destruction disclosed in the notice. The department shall post and disseminate copies of the notice as provided in section 3-904, subsection E. This state and its agencies and political subdivisions are exempt from any fees established for salvaged plants.

B. If the director determines that the proposed action by the state agency may affect a highly safeguarded plant, he shall consult with the state agency and other appropriate parties and use the best scientific data available to issue a written finding as to whether the proposed action would appreciably reduce the likelihood of survival or recovery of the plant taxon in this state. If the determination is affirmative, the director shall also specify reasonable, prudent and distinct alternatives to the proposed project that can be implemented and are consistent with conserving the plant taxon.

C. The director shall adopt rules for the disposal and salvage of native plants subject to removal or destruction by a state agency either under permit to other government agencies or nonprofit organizations or sale to the general public or commercial dealers. The department may issue permits to donate, sell, salvage or harvest the plants after it ascertains the validity of the request and determines the kinds and approximate number of the plants involved. The permit shall specify the number and species of protected native plants and the area from which they may be taken.

3-906. Collection and salvage of protected plants; procedures, permits, tags and seals; duration; exception

A. Except as provided in this chapter a person shall not take, transport or have in his possession any protected native plant taken from the original growing site in this state without having in his possession a valid permit issued by the division. The division shall issue permits in either a name or business name. A permit to take, transport or possess native plants is nontransferable, except that a permittee, by subcontract or otherwise, may allow its agents to work under the permit if the permittee remains primarily responsible for the actions of persons acting under his expressed or implied authority.

B. Permits applicable to highly safeguarded native plants may be issued only for collection for scientific purposes or for the noncommercial salvage of highly safeguarded native plants whose existence is threatened by intended destruction, or by their location or by a change in land usage, and if the permit may enhance the survival of the affected species.

C. Permits issued for the salvage of salvage assessed native plants shall be issued for a period of one calendar year without respect to the land from which the plants will later be taken. The associated tags and seals shall be issued individually or in bulk on payment of any fees required under section 3-913, subsection A, without respect to the specific plants for which the will be used. All such tags and seals remain valid for use in subsequent years as long as the permit is renewed.

D. The division shall provide tags and seals for each permit issued for taking, transporting or possessing highly safeguarded, salvage restricted or salvaged assessed native plants. The director by rule shall establish procedures and forms for permits, tags and seals to be issued for the collection and salvage of highly safeguarded native plants and the salvage of salvage restricted and salvage assessed native plants. The director by rule may establish and modify the form and character of the tags and seals described in this section. All such tags and seals shall be attached to the plants at the time of taking and before transporting. It is unlawful to remove a tag or seal from a protected native plant that has been taken and tagged pursuant to this article before the plant has been transplanted at its designated site. A tag or seal may be removed only by a designated agent of the division or by the owner of the plant.

E. This section does not apply to the transporting of protected native plants by a landowner or his agent from one of his properties to another if the plants are not offered for sale.

3-907. Cutting or removal of harvest restricted plants for their by-products, fiber or wood; procedures; exceptions

A. The division shall provide harvest or wood permits, and wood receipts with each wood permit, authorizing the taking, transporting or possessing of harvest restricted native plants cut or removed for manufacturing or processing purposes, for their by-products, fiber or wood. It is unlawful for a person to take, transport or possess such a plant for its by-products, fiber or wood if he is not in possession of a permit and any required receipt. A permit or receipt is not transferable by the permittee or his agent, nor may it be used by anyone other than the person to whom it was issued, except that the permittee shall transfer the receipt to the purchaser as proof of ownership of the wood covered by the receipt.

B. A person in possession of a valid permit for the removal of dead plants, wood, fiber or other by-products issued by the United States department of agriculture or the United States department of the interior from lands under the administration of the United States forest service or the United States bureau of land management is exempt from the permit required by subsection A.

C. This chapter shall not be construed to prohibit any person from cutting, removing, transporting or possessing any harvest restricted native plant or part for manufacturing or processing purposes in amounts of one hundred pounds or less, or any such plant or part as wood in amount of two cords or less in quantity from land owned or leased by that person, other than state-owned land or other public land or from land if the owner has given written consent to the person to cut, remove, transport or use the plant, or its fiber or wood.

D. This section does not apply to the use of dead wood for branding fires or at permissible camping or cooking sites for camping or cooking fires or cutting, removing, transporting or possessing dead harvest restricted plants or the dead parts from such plants from land owned or leased by the person.

3-908. Prohibited acts; use of permits, tags, seals and receipts

A. Except as provided in this chapter, it is unlawful for a person to destroy, dig up, mutilate, collect, cut, harvest or take any living highly safeguarded native plant or the living parts of any highly safeguarded native plant, including seeds or fruit, or any other living protected native plant or the living parts of any other protected plant, except seeds or fruit, from state land or public land without obtaining any required permit, tags, seals or receipts from the department, or from private land without obtaining written permission from the landowner, and any required permit, tags, seals or receipts from the department. It is unlawful for a person to falsify any paper or document issued to give permission for a person to take native plants of the protected group or to take more protected native plants than authorized by the permit or to take protected native plants from areas other than authorized by the permit.

B. Permits issued for the removal of protected native plants, or any parts of protected native plants, except permits issued for the salvage of salvage assessed native plants, shall be granted only on submission to the division of an application executed by both the landowner or his agent and the party who intends to be the permittee, after being completed by either or both, and are valid for a stated period of time to allow the permittee to remove the specific amount of plants, by-products, fiber or wood stated in the permit, or that period of time stated by the landowner as part of the landowner's permission, whichever is shorter. The permit expires on the termination date shown on the permit, when the tags and seals issued with the permit have been attached to the plants covered by the permit and the plants are no longer in the possession of the permittee or when the receipts have been transferred to the purchaser of the wood covered by the receipts.

C. A permit is valid for taking plants or parts of plants listed on the permit but not removed from the land described in the permit until the permit's expiration or for one year from the date of issuance, whichever occurs first, except that for any permit the tags and seals, or receipts issued therewith but not yet used by the permittee become invalid if the land on which the plants are growing, and described in the permit, changes ownership, unless the new owner certified in writing that the permittee may continue taking the plants or parts of plants as specified on the permit.

D. It is unlawful for a person or scientific or educational institution to misuse a permit in any manner. A permittee shall make permits, tags, seals and receipts available for inspection by the department or any peace officer as provided for in this chapter. A tag, seal or receipt is invalid unless it is issued with a valid permit. A permit is invalid unless it bears the required tag numbers or receipt numbers on its face. It is unlawful to alter or deface any permit, tag, seal or receipt.

E. The director may give written permission for a person or a scientific institution to take a definite number of specified plants in a protected group from areas specified by the department for scientific purposes. In addition the director may give written permission for a person to take specific plants or parts of plants not in the highly safeguarded category from areas specified by the department for salvage or for manufacturing or processing purposes or for the cutting or removal of wood and assess reasonable and proper fees for such taking of the plants or parts of the plants. The director may give written permission for a landowner to transfer specified plants in the protected group from land he owns to another property owned by him, and such permits shall be exempt from fees.

3-909. <u>Shipment of plants; exhibition of permit and certificate of inspection to carrier; sale of highly safeguarded plants</u>

A. No person or common carrier may transport a plant, or any part of a plant, belonging to the protected group, nor receive or possess a protected native plant for transportation within or without this state, except for manufactured wood articles, unless the person offering the plant for shipment exhibits to the person or common carrier a valid written permit for the transportation of the plant or part of a plant and has securely and properly attached a valid required native plant tag and seal to the plant. If for transport without the state, the plant shall also bear a certificate of inspection by the department. All protected native plant species or varieties, if not grown in Arizona and imported into this state, shall be declared at an Arizona agricultural inspection station or a district office of the department and proceed to their destination under quarantine orders issued by agents of the department employed at such station or office.

B. Plants of the protected group which are shipped into this state shall be accompanied by all permits, tags and seals required by the exporting state or country.

C. It is unlawful for a person to commercially sell or offer for commercial sale in interstate commerce any highly safeguarded native plant or in the course of interstate commercial activity to deliver, receive, carry, transport or ship by any means any such plant in furtherance of a commercial sale or offer for commercial sale.

D. The seller of export restricted native plants shall make a good faith effort to sell the export restricted native plants within the state prior to export.

3-910. Compiling information; reports; native plant surveys; investigations; technical advisory board

A. At the request of any person, including a state or federal agency, and if the person provides the department with a suitable description of the land in question, the director may enter into agreements with any such person to conduct native plant surveys on the applicable private or state land. Unless the survey is limited to the simple determination of whether or not protected species exist on the land, the department may collect fees as reimbursement for the services which are reasonably based on the time factor, vegetation density and acreage. Notwithstanding section 35-148, subsection A, the director shall deposit any monies received under this subsection in the fund established under section 3-913.

B. The director by rule may require written reports from persons engaged in salvaging or harvesting protected native plants as to the location and quantities of protected native plants and their parts which have been salvaged or harvested under this chapter. The director by rule may make the filing of these reports a condition to the issuance or renewal of any permits, tags, seals or receipts provided for in this chapter.

C. The department may conduct investigations of the status of all species of native plants in order to develop information relative to population distribution, habitat needs, limiting factors and other biological data and to determine measures and requirements, including transplantation and propagation, necessary for their conservation or survival. If protected native plants or significant communities of such plants are vulnerable to depletion from their collection or harvest as a commercial resource, the department may collect statistical information and conduct investigations to determine what harvests are sustainable without depleting the plants or plant communities or destroying significant habitat provided by such plants or plant communities.

D. The director may appoint utilize and contract with a technical advisory board to annually review the numbers of native plants harvested and salvaged in order to assess whether plant species, communities or populations are being depleted, to recommend revisions to the protected categories and to recommend priorities for additional monitoring and scientific study. The board shall consist of representatives of the scientific community, including the botanical and zoological fields, and representatives from the native plant industries, including salvage, revegetation, propagation, landscaping and harvest concerns.

3-911. <u>Conservation and public education</u>

A. The department may conserve the highly safeguarded native plants including the use, and encouraging the use, of all methods and procedures that are necessary to bring the highly safeguarded native plants to the point where they are no longer in need of federal protection as endangered or threatened plants or state protection as highly safeguarded native plants. These methods and procedures include all activities associated with scientific resource management such as research, census, law enforcement, habitat protection and maintenance, propagation and transplantation.

B. The department shall encourage commercial businesses engaged in land development or other activities conducted on private land to salvage protected native plants to the greatest extent feasible.

C. The department may produce, and collect reasonable fees for, seminars, courses, pamphlets and other educational programs and publications concerning the effect, intent and interpretation of this chapter, the identification, nature or condition of protected native plants and the feasibility and techniques for their conservation and salvage for presentation and dissemination to:

1. State agencies and political subdivisions, including state and local law enforcement agencies and counties or municipalities which have enacted or consider enacting ordinances preserving protected native plants.

2. Real estate and other commercial businesses engaged in land development and other activities conducted on private land.

3. Landowners and the public at large.

4. Persons or entities that are convicted of violating this chapter or rules and ordinances adopted pursuant to this chapter and that are ordered by the court to attend educational classes or programs as part of their sentences.

D. Notwithstanding section 35-148, subsection A, the director shall deposit any monies received under this section in the fund established under section 3-913.

3-912. <u>Rules; additional notice requirements</u>

A. The director shall adopt rules to enforce this chapter pursuant to title 41, chapter 6.

B. In addition to the notice requirements prescribed in title 41, chapter 6, at least thirty days before any hearing at which a new rule or a change in a rule will be considered the department shall send a copy of the notice by first class mail to persons or entities requesting notice pursuant to section 3-904, subsection E.

3-913. Fiscal provisions; fees; Arizona protected native plant fund

A. The department shall collect nonrefundable fees for issuing permits, tags, seals and receipts under this article, except for scientific purposes, from landowners moving protected plants from one of their properties to another, or from the independent owner of residential property of ten acres or less if no such plants are to be offered for sale.

B. The director shall establish the amount of the fee by rule to reasonably reflect the cost to the department for administering this chapter or to reflect the value of the service, permits, tag, seal or receipt, including at least the following amounts:

1. For cereus giganteu (saguaro), at least three dollars for each plant.

2. For native plants which the director determines to be useful for revegetation and which cannot be salvaged economically at a higher fee, at least twenty-five cents per plant.

3. For all other native plants, at least two dollars for each plant.

4. For all receipts for live harvest restricted native plants cut or removed for wood, at least one dollar per cord.

5. For a permit for the by-products or fiber or harvest restricted native plants, at least one dollar per ton.

C. The Arizona protected native plant fund is established. All fees, civil penalties and other monies collected under this chapter shall be transferred to the state treasurer for credit to the fund. Ninety per cent of the monies deposited with the state treasurer constitute a separate and permanent fund for use of the director to administer and enforce this chapter, and ten per cent shall be credited to the state general fund.

3-914. Board of supervisors; power to preserve plants

The board of supervisors of each county is authorized to adopt and enforce ordinances not in conflict with law for the preservation of protected groups of plants.

3-915. Exemptions

This chapter does not apply to existing canals, laterals, ditches, electrical transmission and distribution facilities, rights-of-way and other facilities, structures or equipment owned, operated used or otherwise possessed by public service corporations and special districts established under title 48, chapter 11, 12, 17, 18, 19, 21 or 22.

ARTICLE 2. ENFORCEMENT

3-931. Enforcement powers and procedures

A. An employee, officer or agent of the department may enter in or on any premises or other place, train, vehicle or other means of transportation within or entering this state, if he has reason to believe there is present or on such premises or means of transportation a protected native plant taken, transported or possessed in violation of this chapter.

B. A power granted pursuant to this chapter to any person may be exercised by a deputy, inspector or agent of the authorized person. A person who is authorized to enforce this chapter, including an employee of a state, the United States or an Indian tribe with which cooperative agreements have been made by the director, has powers of a peace officer to enforce this chapter. It is unlawful to interfere with or hinder the actions of a peace officer or an officer or employee of the department in the enforcement of this chapter.

C. In the enforcement of this chapter, a peace officer or an officer or employee of the department may make arrests without warrant for a violation of this chapter which he may witness and may confiscate, or seize by the attachment of a "warning hold" notice, any protected native plant found without a valid and properly affixed tag and seal when required by this chapter, or any plant by-product, fiber or wood from protected native plants found in the possession of a person without a valid receipt if a receipt is required under this chapter. It is unlawful to move or otherwise handle or dispose of any protected plant or part of a plant held under a "warning hold" notice, except with the express written permission of the enforcing officer, and for the specified purpose. Plants, by-products, fiber or wood confiscated under this subsection, if not released to the person from whom they were seized before such time, shall be disposed of by the department or pursuant to court order at the conclusion of the proceedings.

D. Devices, equipment or vehicles used in the illegal taking, transportation, destruction or mutilation of protected native plants may be seized by a peace officer or officer of the department on a temporary basis, not to exceed one working day, to permit the protected native plants or parts of plants involved in the illegal act to be moved to a secure location.

E. An officer, employee or agent of the department who is duly authorized to enforce this chapter, in addition to peace officers, may enforce title 41, chapter 4.1, article 4 and section 13-3702 and section 13-3702.01. Such an officer, employee or agent may make an arrest without warrant for violations witnessed by the officer, employee or agent and may confiscate archaeological and other specimens or objects if unlawfully excavated or collected.

3-932. Violation; classification; penalties

A. A person commits theft of protected native plants if, without the express consent of the landowner, the person knowingly removes or destroys any protected native plants from private or state land. Theft of protected native plants with a value of:

1. One thousand five hundred dollars or more is a class 4 felony.

2. At least seven hundred fifty dollars but less than one thousand five hundred dollars is a class 5 felony.

3. At least five hundred dollars but less than seven hundred fifty dollars is class 6 felony.

4. Less than five hundred dollars is a class 1 misdemeanor.

B. A knowing violation of this chapter involving either the misuse of permits, tags, seals, or receipts, or the collection, salvage, harvest, transportation or possession of protected plants without any required permits, tags, seals or receipts is a class 1 misdemeanor. A subsequent conviction for a violation of this subsection is a class 6 felony.

C. All other violations of this chapter are class 3 misdemeanors except that if a prior conviction is a class 3 misdemeanor, a subsequent conviction is a class 2 misdemeanor, and if a prior conviction is a class 2 misdemeanor, a subsequent conviction is a class 1 misdemeanor.

D. From and after June 30, 1990, on conviction of any violation of this chapter the director may request of the court that the convicted person, or a responsible person from a convicted entity, be ordered to attend educational classes or programs pursuant to section 3-911, subsection C.

E. On conviction of a violation of this chapter, the director may also request of the court as a provision of the sentence, the revocation of all permits issued to the person convicted and the permittee shall be required to surrender any unused tags or seals or receipts to the division, and the division shall not issue new or additional permits to the permittee for a period of one year from the date of conviction. The director may further request of the court that the sentence include a provision prohibiting a person convicted of a violation of this chapter from engaging in the salvage of protected native plants or acting as agent for any other permittee for a period of up to one year. In considering any such request to revoke or deny permits or prohibit work in salvage or with another permittee the court shall consider:

1. The nature of the offense.

2. The nature of any prior convictions.

3. The overall performance record by the convicted party in terms of its violations of this chapter compared to its efforts to salvage native plants as intended by this chapter.

3-933. Violation; civil penalty

A. The knowing violation of this chapter or a rule, order or ordinance issued or adopted under this chapter is punishable by a civil penalty in an amount of not more than five thousand dollars.

B. The director may bring an action in superior court in the county in which a violation of this chapter or any rule or order is alleged to have occurred. On the finding of a knowing violation by the defendant in any such action the court may impose the civil penalty provided by this section in an amount as it deems appropriate for each violation.

C. Each day of violation constitutes a separate offense.

3-934. Injunction; violation; civil penalty

A. The department's legal counsel, on request of a private party or the director, or the county attorney of the county in which a violation of this chapter or any rule or order issued or adopted under section 3-912 or section 3-914 is alleged to have occurred may bring an action in the county requesting the court to enjoin or otherwise restrain the defendant from further violations of this chapter or the rule or order. If the alleged violation occurs through the actions of a state agency, the agency may be made a party defendant.

B. A person who violates an order or injunction issued by a court of competent jurisdiction pursuant to this section, in addition to any other penalty or remedy for contempt of court, shall forfeit and pay to this state a civil penalty of not more than ten thousand dollars for each violation as the court deems just and proper. For purposes of this section, the superior court in the county issuing any order or injunction retains jurisdiction. The attorney general or legal counsel for the department acting in the name of this state may petition for recovery of civil penalties pursuant to this section.

Environmental Evaluation
for
North Scottsdale Reconnaissance Study

prepared by Richard Perry
Archeologist
Environmental Planning Section October 26, 1995

1. Existing Environment

A records and literature search has been conducted at the Arizona Office of Historic Preservation. Results of The search showed that approximately half of the area of potential effects (APE) has ben surveyed for the presence of cultural resources. The records check provided information on 38 archeological sites within or near the APE. The sites range include rock art sites, small lithic/sherd scatters to very large Hohokam villages.

A preliminary visit to the project location showed that the area is either covered with alluvium or is heavily developed. There is a strong probability the cultural resources may be located adjacent to the alluvial fan. Information on how many of the listed sites, if any, have been excavated will need to be gathered. There is a possibility that many of the sites within the APE may be eligible for listing in the National Register of Historic Places.

2. Environmental effects

It is not known how extensive adverse effects to cultural resources may be as a result of the proposed project. There is a very high likelihood that a significant number of archeological sites will be affected by construction impacts. However, This cannot be fulled assessed until a thorough records and literature search is completed at the Arizona state Museum and a field survey of unsurveyed properties within the APE is completed. The survey will identify any as yet unknown cultural resources as well as updating the status of known archeological sites.

3. Coordination

No coordination has been initiated yet. Prior to any ground disturbing activities coordination with the State Historic Preservation Officer (SHPO) will need to be completed in order the National Historic Preservation Act (36 CFR 800). A letter is being prepared to request initial comments from SHPO pursuant to 36 CFR 800.4.

4. Feasibility Report needs

Additional cultural resources surveys will need to be completed within the APE. The APE needs to be 100 percent surveyed to identify any potential historic properties. National Register evaluations of any sites that may be impacted as a result of the project would need to be conducted. This level of effort may require archival research and/or subsurface test excavations. The results of these studies would need to be coordinated with the SHPO pursuant to Section 106 of the National Historic Preservation Act. If any archeological or historic sites are determined to eligible for listing in the National Register of Historic Places, mitigation efforts will Need to be developed and agreed to in a Memorandum of Agreement (MOA). The MOA would be a document between the COE, SHPO, and the Advisory Council on Historic Preservation.

A cost estimate for conducting the survey of unremaining unsurveyed portions should be approximately $43,000.00. The breakdown would be:

A/E Contract Negotiations	- 3,000.00
Hired labor	- 10,000.00
Contract	- 30,000.00

This is a very preliminary figure since the exact acreage that may need to be surveyed is not known at this time.

October 31, 1995

DRAFT

SCOPE OF WORK
FOR COORDINATION ON
NORTH SCOTTSDALE AND NORTHEAST PHOENIX DRAINAGE AREA
RECONNAISSANCE STUDY
MARICOPA COUNTY, ARIZONA FY 1996

U.S. Army Corps of Engineers
Los Angeles District

U.S. Fish and Wildlife Service
Ecological Services
Phoenix Field Office
Mr. Don Metz, Supervisor
Federal Projects
2321 West Royal Palm Road
Phoenix, Arizona 85021

1. STATUS

The North Scottsdale and Northeast Phoenix Drainage Area flood control study is at the reconnaissance level.

2. STUDY DESCRIPTION

a. Study Area and Problem Identification - The study area is located in Maricopa County, Arizona. The area is composed of mountainous regions to the northeast that drain south and southwestward into the cities of Scottsdale and Phoenix (see Figure 1). The highest elevation in this drainage basin is McDowell Peak, at 4034 feet above sea level, on the eastern side of the study area. The lowest elevation is 1520 feet in the area of the Central Arizona Project Canal, on the south side of the study area. The majority of the study area is terrain gently sloping to the south with ill-defined streambeds. Major drainages include Rawhide, Reata Pass, and Beardsley washes, and "Fans 5 and 6," located north of Rawhide Wash.

The numerous streams originating in the mountains and foothills surrounding the basin carry highly erodible soils onto the basin floor, forming large alluvial fans of deposited sediment. These fans develop at the transition from the steep mountain slopes to the basin floor. The mountain streams meander across the fans in ill-defined and often changing paths, sometimes causing an erratic shifting of flow patterns. As a result, much of the basin floor is subject to flooding. Rapid and spatially unpredictable erosion and deposition along many stream banks have also occurred.

b. Study Plans - In recent years, growth in the east and northeastern portion of the Phoenix metropolitan area lead to a greatly expanded residential and commercial sector in the study area. Plans for future development in the study area exist with or without Corps involvement. A comprehensive solution for drainage of the entire fan needs to be formulated, so that floodplain management can be administered in a responsible manner. The City of Scottsdale has been investigating basin-wide flood-control alternatives in the study area, to protect existing and future developments. The City's preferred alternative would maintain the natural character of the desert environment to the maximum extent practicable, creating what they refer to as a "Desert Greenbelt."[1]

The purpose of this study is to determine Federal interest in implementing flood control or flood protection solutions in the North Scottsdale and Northeast Phoenix Drainage Area. Structural and non-structural solutions will be studied. The Corps of Engineers' study will likely emphasize the locally-preferred alternative, but other solutions may also be evaluated. The reconnaissance study will include a description of the existing conditions, and will briefly evaluate the potential costs, benefits, and environmental considerations associated with the proposed potential solutions. If Federal interest is identified, the proposed solutions, as well as other alternatives would likely be evaluated in greater detail during a Feasibility Study. Potential structural flood control solutions that will be studied at the reconnaissance level include channelization and detention basins.

3. WORK TO BE ACCOMPLISHED BY THE U.S. FISH AND WILDLIFE SERVICE

The USFWS shall coordinate with the Corps of Engineers (Corps) by providing input to the Corps on biological resources within the study area, data gaps in biological information, and suggested studies to fill those data gaps. One field coordination meeting may be arranged.

In addition, the USFWS shall provide a Planning Aid Letter to the Corps by 15 December 1995. The Planning Aid Letter shall include (but is not limited to) the following: (1) a description and qualitative assessment of the existing biological environment within the study area, including identification of sensitive biological resources; (2) the potential for Federally-listed Threatened, Endangered, and Candidate species within the study area; (3) an identification of data gaps in biological information; and (4) proposed studies to fill those data gaps. As time and funding allow, the USFWS shall also provide an analysis of potential environmental impacts from the various possible flood control solutions, and recommendations for avoidance, reduction, or mitigation of expected impacts.

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[1] Refer to the June 1995 City of Scottsdale Desert Greenbelt Project Final Report, Volumes 1-3, prepared by The Greiner Team.

4. EXCHANGE OF INFORMATION

The Corps will provide the USFWS with necessary information, maps, and support documents, as needed. The Corps will also keep the USFWS informed of reconnaissance-level alternatives, as they develop. The USFWS will provide information informally to the Corps as needed, and a Planning Aid Letter to the Corps by 15 December 1995.

5. REIMBURSABLE FUND AGREEMENT

It is understood that all work will be accomplished in fiscal year 1996. Furthermore, it is understood that the USFWS will not agree to cancel the signed Scope of Work, and will expend funds at the agreed upon level, whether or not the Corps is able to provide input agreed upon in this Scope of Work. If the Corps cannot perform its responsibilities under this Scope of Work in fiscal year 1996, the Service would not be required to provide the Planning Aid Letter, and a new funding agreement will be reached whenever the study is re-initiated.

6. AGENCY CONTACT PERSONS

Study Manager: Mr. John Drake (602) 640-2003

Environmental Coordinator: Mr. David Compas (213) 894-0244

Biologist: Ms. Hayley Lovan (213) 894-0237

USFWS Biologist: Mr. Ron McKinstry (602) 640-2720

7. FUNDING

FY 1996: $5,000 Previous Funding by District: 0

SUBMITTED:

____

Robert S. Joe
Chief, Planning Division
Corps of Engineers

ACCEPTED:

____

Michael Speer
Regional Director
U.S. Fish and Wildlife Service

November 1, 1995

Office of the Chief
Environmental Resources Branch

Mr. Sam Spiller, State Supervisor
U.S. Dept. of the Interior
Fish and Wildlife Service
3616 West Thomas Road, Suite 6
Phoenix, Arizona 85019

Dear Mr. Spiller:

The Los Angeles District of the U.S. Army Corps of Engineers has initiated a reconnaissance study of the North Scottsdale and Northeast Phoenix Drainage Area, located in Maricopa County, Arizona. The study area is composed of mountainous regions to the northeast that drain south and southwestward into the cities of Scottsdale and Phoenix (see Figure 1). The highest elevation in this drainage basin is McDowell Peak, at 4034 feet above sea level, on the eastern side of the study area. The lowest elevation is 1520 feet in the area of the Central Arizona Project Canal, on the south side of the study area. The majority of the study area is terrain gently sloping to the south with ill-defined streambeds. Major drainages include Rawhide, Reata Pass, and Beardsley washes, and "Fans 5 and 6," located north of Rawhide Wash.

The City of Scottsdale has been investigating basin-wide flood-control alternatives in the study area, to protect existing and future developments. The City's preferred alternative would maintain the natural character of the desert environment to the maximum extent practicable. The purpose of this reconnaissance study is to determine Federal interest in implementing flood control or flood protection solutions in the North Scottsdale and Northeast Phoenix Drainage Area. Structural and non-structural solutions will be studied. The Corps of Engineers' study will likely emphasize the locally-preferred alternative, but other solutions may also be evaluated. The reconnaissance study will include a description of the existing conditions, and will briefly evaluate the potential costs, benefits, and environmental considerations associated with the proposed potential solutions. If Federal interest is identified, the proposed solutions, as well as other alternatives would likely be evaluated in greater detail during a Feasibility Study.

Please provide a current list of any endangered, threatened, or candidate species, pursuant to the Endangered Species Act of 1973, that may occur in the study area. Please include the locations of proposed or designated critical habitat for these species, within the study area. You may send this list to:

Ms. Hayley Lovan
U.S. Army Corps of Engineers
Environmental Resources Branch
P.O. Box 2711
Los Angeles, California 90053-2325

Please respond to this species list request within thirty (30) days of receipt of this letter. Should you require additional information or have any questions, you may contact Ms. Hayley Lovan, Environmental Coordinator, at (213) 894-0237.

Thank you for your assistance in this matter.

Sincerely,

Robert S. Joe
Chief, Planning Division

Enclosures

United States Department of the Interior
Fish and Wildlife Service
Arizona Ecological Services Field Office
2321 W. Royal Palm Road, Suite 103
Phoenix, Arizona 85021-4951
(602) 640-2720 Fax (602) 640-2730

In Reply Refer To:
AESO/SE
2-21-96-I-065

November 21, 1995

Ms. Hayley Lovan
U.S. Army Corps of Engineers
Environmental Resources Branch
P.O. Box 2711
Los Angeles, California 90053-2325

RE: Reconnaissance Study of the North Scottsdale and Northeast Phoenix Drainage Area

Dear Ms. Lovan:

This letter responds to your November 3, 1995, request for a list of species which are listed as threatened, endangered, or are proposed to be listed as such under the Endangered Species Act of 1973, as amended (Act), which may potentially occur in your project area. The enclosed list may include candidate species as well. In the past, the U.S. Fish and Wildlife Service has provided project-specific species lists and information. However, staff reductions no longer permit us to provide this detailed level of assistance. We regret any inconvenience this may cause you and hope the enclosed county list of species will be helpful. In future communications regarding this project, please refer to consultation number 2-21-96-I-065.

The enclosed list of the endangered, threatened, proposed, and candidate species includes all those potentially occurring anywhere in the county, or counties, where your project occurs. Please note that your project area may not necessarily include all or any of these species. The information provided includes general descriptions, habitat requirements, and other information for each species on the list. Also on the enclosed list is the Code of Federal Regulations (CFR) citation for each listed or proposed species. Additional information can be found in the CFR and is available at most public libraries. This information should assist you in determining which species may or may not occur within your project area. Site-specific surveys could also be helpful and may be needed to verify the presence or absence of a species or its habitat as required for the evaluation of proposed project-related impacts.

Endangered and threatened species are protected by Federal law and must be considered prior to project development. If the action agency determines that listed species or critical habitat may be adversely affected by a federally funded, permitted, or authorized activity, the action agency must request formal consultation with the Service. If the action agency determines that the planned action may jeopardize a proposed species or destroy or adversely modify proposed critical habitat, the action agency must enter into a section 7 conference with the Service.

Appendix 2

Candidate species are those which are being considered for addition to the list of threatened or endangered species. Candidate species are those for which there is sufficient information to support a proposal for listing. Although candidate species have no legal protection under the Act, we recommend that they be considered in the planning process in the event that they become listed or proposed for listing prior to project completion.

If any proposed action occurs in or near areas with trees and shrubs growing along watercourses, known as riparian habitat, the Service recommends the protection of these areas. Riparian areas are critical to biological community diversity and provide linear corridors important to migratory species. In addition, if the project will result in the deposition of dredged or fill materials into waterways or dredging in waterways, we recommend you contact the Army Corps of Engineers which regulates these activities under Section 404 of the Clean Water Act.

The State of Arizona protects some plant and animal species not protected by Federal law. We recommend you contact the Arizona Game and Fish Department and the Arizona Department of Agriculture for State-listed or sensitive species in your project area.

The Service appreciates your efforts to identify and avoid impacts to listed and sensitive species in your project area. If we may be of further assistance, please contact Tom Gatz.

Sincerely,

Sam F. Spiller
Field Supervisor

Enclosure

cc: Director, Arizona Game and Fish Department, Phoenix, AZ

LISTED TOTAL= 13

NAME: ARIZONA AGAVE *AGAVE ARIZONICA*

STATUS: ENDANGERED CRITICAL HABITAT: No RECOVERY PLAN: No CFR: 49 FR 21055, 05-18-1984

DESCRIPTION: HAS ATTRACTIVE ROSETTES OF BRIGHT GREEN LEAVES WITH DARK MAHOGANY MARGINS. FLOWER: BORNE ON SUB-UMBELLATE INFLORESCENCES.

ELEVATION RANGE: 3000-6000 FT.

COUNTIES: GILA, YAVAPAI, MARICOPA

HABITAT: TRANSITION ZONE BETWEEN OAK-JUNIPER WOODLAND & MOUNTAIN MAHOGANY-OAK SCRUB

SCATTERED CLONES IN NEW RIVER MOUNTAINS AND SIERRA ANCHA. USUALLY FOUND ON STEEP, ROCKY SLOPES. POSSIBLY MAZATAL MOUNTAINS SHOULD BE LOOKED FOR WHEREVER THE RANGES OF Agave toumeyana var. bella AND Agave chrystantha OVERLAP.

NAME: ARIZONA CLIFFROSE *PURSHIA SUBINTEGRA*

STATUS: ENDANGERED CRITICAL HABITAT: No RECOVERY PLAN: Yes CFR: 49 FR 22326 5-29-84

DESCRIPTION: EVERGREEN SHRUB OF THE ROSE FAMILY (ROSEACEAE). BARK PALE SHREDDY. YOUNG TWIGS WITH DENSE HAIRS. LEAVES 1-5 LOBES AND EDGES CURL DOWNWARD (REVOLUTE). FLOWERS: 5 WHITE OR YELLOW PETALS <0.5 INCH LONG.

ELEVATION RANGE: <4000 FT.

COUNTIES: GRAHAM YAVAPAI MARICOPA MOHAVE

HABITAT: CHARACTERISTIC WHITE SOILS OF TERTIARY LIMESTONE LAKEBED DEPOSITS CAN BE SEEN FROM A DISTANCE.

NAME: ARIZONA HEDGEHOG CACTUS *ECHINOCEREUS TRIGLOCHIDIATUS ARIZONICUS*

STATUS: ENDANGERED CRITICAL HABITAT: No RECOVERY PLAN: No CFR: 44 FR 61556,10-15-1979

DESCRIPTION: DARK GREEN CYLINDROID 2.5-12 INCHES TALL, 2-10 INCHES IN DIAMETER, SINGLE OR IN CLUSTERS. 1-3 GRAY OR PINKISH CENTRAL SPINES LARGEST DEFLEXED AND 5-11 SHORTER RADIAL SPINES. FLOWER: BRILLIANT RED, SIDE OF STEM IN APRIL- MAY

ELEVATION RANGE: 3700-5200 FT.

COUNTIES: MARICOPA, GILA, PINAL

HABITAT: ECOTONE BETWEEN INTERIOR CHAPPARAL AND MADREAN EVERGREEN WOODLAND

OPEN SLOPES, IN NARROW CRACKS BETWEEN BOULDERS, AND IN UNDERSTORY OF SHRUBS. THIS VARIETY IS BELIEVED TO INTERGRADE AT THE EDGES OF ITS DISTRIBUTION WITH VARIETIES MELANCANTHUS AND NEOMEXICANUS CAUSING SOME CONFUSION IN IDENTIFICATION.

LISTED, PROPOSED, AND CANDIDATE CATEGORY-1 SPECIES FOR THE FOLLOWING COUNTY: *MARICOPA*

NAME: LESSER LONG-NOSED BAT *LEPTONYCTERIS CURASOAE YERBABUENAE*

STATUS: ENDANGERED CRITICAL HABITAT: No RECOVERY PLAN: No CFR: 53 FR 38456, 09-30-88

DESCRIPTION: ELONGATED MUZZLE, SMALL LEAF NOSE, AND LONG TONGUE. YELLOWISH BROWN OR GRAY ABOVE AND CINNAMON BROWN BELOW. TAIL MINUTE AND APPEARS TO BE LACKING. EASILY DISTURBED.

ELEVATION RANGE: <6000 FT.

COUNTIES: COCHISE, PIMA, SANTA CRUZ, GRAHAM, PINAL, MARICOPA

HABITAT: DESERT SCRUB HABITAT WITH AGAVE AND COLUNMNAR CACTI PRESENT AS FOOD PLANTS

DAY ROOSTS IN CAVES AND ABANDONED TUNNELS. FORAGES AT NIGHT ON NECTAR, POLLEN, AND FRUIT OF PANICULATE AGAVES AND COLUMNAR CACTI. THIS SPECIES IS MIGRATORY AND IS PRESENT IN ARIZONA, USUALLY FROM APRIL TO SEPTMBER AND SOUTH OF THE BORDER THE REMAINDER OF THE YEAR.

NAME: SONORAN PRONGHORN *ANTILOCAPRA AMERICANA SONORIENSIS*

STATUS: ENDANGERED CRITICAL HABITAT: No RECOVERY PLAN: Yes CFR: 32 FR 4001, 03-11-67

DESCRIPTION: BUFF ON BACK AND WHITE BELOW, HOOFED WITH SLIGHTLY CURVED BLACK HORNS HAVING A SINGLE PRONG. SMALLEST AND PALEST OF THE PRONGHORN SUBSPECIES.

ELEVATION RANGE: 2000-4000 FT.

COUNTIES: PIMA, YUMA, MARICOPA

HABITAT: BROAD, INTERMOUNTAIN ALLUVIAL VALLEYS WITH CREOSOTE-BURSAGE & PALO VERDE-MIXED CACTI ASSOCIATIONS

TYPICALLY, BAJADAS ARE USED AS FAWNING AREAS AND SANDY DUNE AREAS PROVIDE FOOD SEASONALLY. HISTORIC RANGE WAS PROBABLY LARGER THAN EXISTS TODAY. THIS SUBSPECIES ALSO OCCURS IN MEXICO.

NAME: DESERT PUPFISH *CYPRINODON MACULARIUS*

STATUS: ENDANGERED CRITICAL HABITAT: Yes RECOVERY PLAN: Yes CFR: 51 FR 10842, 03-31-1986

DESCRIPTION: SMALL (2 INCHES) SMOOTHLY ROUNDED BODY SHAPE WITH NARROW VERTICAL BARS ON THE SIDES. BREEDING MALES BLUE ON HEAD AND SIDES WITH YELLOW ON TAIL. FEMALES & JUVENILES TAN TO OLIVE COLORED BACK AND SILVERY SIDES.

ELEVATION RANGE: <5000 FT.

COUNTIES: LA PAZ, PIMA, GRAHAM, MARICOPA, PINAL, YAVAPAI, SANTA CRUZ

HABITAT: SHALLOW SPRINGS, SMALL STREAMS, AND MARSHES. TOLERATES SALINE & WARM WATER

CRITICAL HABITAT INCLUDES QUITOBAQUITO SPRING, PIMA COUNTY, PORTIONS OF SAN FELIPE CREEK, CARRIZO WASH, AND FISH CREEK WASH, IMPERIAL COUNTY, CALIFORNIA. TWO SUBSPECIES ARE RECOGNIZED: DESERT PUPFISH (C. m. macularis) AND QUITOBAQUITO PUPFISH (C. m. eremus).

NAME: GILA TOPMINNOW *POECILIOPSIS OCCIDENTALIS OCCIDENTALIS*

STATUS: ENDANGERED CRITICAL HABITAT: No RECOVERY PLAN: Yes CFR: 32 FR 4001, 03-11-1967

DESCRIPTION: SMALL (2 INCHES), GUPPY-LIKE, LIVE BEARING, LACKS DARK SPOTS ON ITS FINS. BREEDING MALES ARE JET BLACK WITH YELLOW FINS.

ELEVATION RANGE: <4500 FT.

COUNTIES: GILA, PINAL, GRAHAM, YAVAPAI, SANTA CRUZ, PIMA, MARICOPA, LA PAZ

HABITAT: SMALL STREAMS, SPRINGS, AND CIENEGAS VEGETATED SHALLOWS

NAME: RAZORBACK SUCKER *XYRAUCHEN TEXANUS*

STATUS: ENDANGERED CRITICAL HABITAT: Yes RECOVERY PLAN: No CFR: 55 FR 21154, 05-22-1990; 59 FR 13374, 03-21-1994

DESCRIPTION: LARGE (UP TO 3 FEET AND UP TO 16 POUNDS) LONG, HIGH SHARP-EDGED KEEL-LIKE HUMP BEHIND THE HEAD. HEAD FLATTENED ON TOP. OLIVE-BROWN ABOVE TO YELLOWISH BELOW.

ELEVATION RANGE: <6000 FT.

COUNTIES: GREENLEE, MOHAVE, PINAL, YAVAPAI, YUMA, LA PAZ, MARICOPA (REFUGIA), GILA, COCONINO, GRAHAM

HABITAT: RIVERINE & LACUSTRINE AREAS, GENERALLY NOT IN FAST MOVING WATER AND MAY USE BACKWATERS

SPECIES IS ALSO FOUND IN HORSESHOE RESERVOIR (MARICOPA COUNTY).

NAME: AMERICAN PEREGRINE FALCON *FALCO PEREGRINUS ANATUM*

STATUS: ENDANGERED CRITICAL HABITAT: No RECOVERY PLAN: Yes CFR: 35 FR 16047, 10-13-70; 35 FR 8495, 06-02-70

DESCRIPTION: A RECLUSIVE, CROW-SIZED FALCON SLATY BLUE ABOVE WHITISH BELOW WITH FINE DARK BARRING. THE HEAD IS BLACK AND APPEARS TO BE MASKED OR HELMETED. WINGS LONG AND POINTED. LOUD WAILING CALLS ARE GIVEN DURING BREEDING PERIOD.

ELEVATION RANGE: 3500-9000 FT.

COUNTIES: MOHAVE COCONINO NAVAJO APACHE SANTA CRUZ MARICOPA COCHISE YAVAPAI GILA PINAL PIMA GREENLEE GRAHAM

HABITAT: CLIFFS AND STEEP TERRAIN USUALLY NEAR WATER OR WOODLANDS WITH ABUNDANT PREY

THIS IS A WIDE RANGING MIGRATORY BIRD THAT USES A VARIETY OF HABITATS. BREEDING BIRDS ARE YEAR-ROUND RESIDENTS. OTHER BIRDS WINTER AND MIGRATE THROUGH ARIZONA. SPECIES IS ENDANGERED FROM REPRODUCTIVE FAILURE FROM PESTICIDES.

NAME: BALD EAGLE *HALIAEETUS LEUCOCEPHALUS*

STATUS: THREATENED CRITICAL HABITAT: No RECOVERY PLAN: Yes CFR: 60 FR 35999, 07-12-95

DESCRIPTION: LARGE, ADULTS HAVE WHITE HEAD AND TAIL. HEIGHT 28 - 38"; WINGSPAN 66 - 96". 1-4 YRS DARK WITH VARYING DEGREES OF MOTTLED BROWN PLUMAGE. FEET BARE OF FEATHERS.

ELEVATION RANGE: VARIES FT.

COUNTIES: YUMA, LA PAZ, MOHAVE, YAVAPAI, MARICOPA, PINAL, COCONINO, NAVAJO, APACHE, SANTA CRUZ, PIMA, GILA, GRAHAM

HABITAT: LARGE TREES OR CLIFFS NEAR WATER (RESERVOIRS, RIVERS AND STREAMS) WITH ABUNDANT PREY

SOME BIRDS ARE NESTING RESIDENTS WHILE A LARGER NUMBER WINTERS ALONG RIVERS AND RESERVOIRS. AN ESTIMATED 200 TO 300 BIRDS WINTER IN ARIZONA. ONCE ENDANGERED (32 FR 4001, 03-11-1967; 43 FR 6233, 02-14-78) BECAUSE OF REPRODUCTIVE FAILURES FROM PESTICIDE POISONING AND LOSS OF HABITAT, THIS SPECIES WAS DOWN LISTED TO THREATENED ON AUGUST 11, 1995. ILLEGAL SHOOTING, DISTURBANCE, LOSS OF HABITAT CONTINUES TO BE A PROBLEM.

NAME: MEXICAN SPOTTED OWL *STRIX OCCIDENTALIS LUCIDA*

STATUS: THREATENED CRITICAL HABITAT: Yes RECOVERY PLAN: Yes CFR: 56 FR 14678, 04-11-91

DESCRIPTION: MEDIUM SIZED WITH DARK EYES AND NO EAR TUFTS. BROWNISH AND HEAVILY SPOTTED WITH WHITE OR BEIGE.

ELEVATION RANGE: 4100-9000 FT.

COUNTIES: MOHAVE, COCONINO, NAVAJO, APACHE, YAVAPAI, GRAHAM, GREENLEE, COCHISE, SANTA CRUZ, PIMA, PINAL, GILA, MARICOPA

HABITAT: NESTS IN CANYONS AND DENSE FORESTS WITH MULTI-LAYERED FOLIAGE STRUCTURE

GENERALLY NESTS IN OLDER FORESTS OF MIXED CONIFER OR PONDERSA PINE/GAMBEL OAK TYPE, IN CANYONS, AND USE VARIETY OF HABITATS FOR FORAGING. SITES WITH COOL MICROCLIMATES APPEAR TO BE OF IMPORTANCE OR ARE PREFERED.

NAME: SOUTHWESTERN WILLOW FLYCATCHER *EMPIDONAX TRAILLII EXTIMUS*

STATUS: ENDANGERED CRITICAL HABITAT: Yes RECOVERY PLAN: No CFR: 60 FR 10694, 02-27-95

DESCRIPTION: SMALL PASSERINE (ABOUT 6") GRAYISH-GREEN BACK AND WINGS, WHITISH THROAT, LIGHT OLIVE-GRAY BREAST AND PALE YELLOWISH BELLY. TWO WINGBARS VISIBLE. EYE-RING FAINT OR ABSENT.

ELEVATION RANGE: <8500 FT.

COUNTIES: YAVAPAI, GILA, MARICOPA, MOHAVE, COCONINO, NAVAJO, APACHE, PINAL, LA PAZ, GREENLEE, GRAHAM, YUMA, PIMA, COCHISE, SANTA CRUZ

HABITAT: COTTONWOOD/WILLOW & TAMARISK VEGETATION COMMUNITIES ALONG RIVERS & STREAMS

MIGRATORY RIPARIAN OBLIGATE SPECIES THAT OCCUPIES BREEDING HABITAT FROM LATE APRIL TO SEPTEMBER. DISTRIBUTION WITHIN ITS RANGE IS RESTRICTED TO RIPARIAN CORRIDORS. DIFFICULT TO DISTINGUISH FROM OTHER MEMBERS OF THE EMPIDONAX COMPLEX BY SIGHT ALONE. TRAINING SEMINAR REQUIRED FOR THOSE CONDUCTING FLYCATCHER SURVEYS.

NAME: YUMA CLAPPER RAIL *RALLUS LONGIROSTRIS YUMANENSIS*

STATUS: ENDANGERED CRITICAL HABITAT: No RECOVERY PLAN: Yes CFR: 32 FR 4001, 03-11-67; 48 FR 34182, 07-27-83

DESCRIPTION: WATER BIRD WITH LONG LEGS AND SHORT TAIL. LONG SLENDER DECURVED BILL. MOTTLED BROWN ON GRAY ON ITS RUMP. FLANKS AND UNDERSIDES ARE DARK GRAY WITH NARROW VERTICAL STRIPES PRODUCING A BARRING EFFECT.

ELEVATION RANGE: <4500 FT.

COUNTIES: YUMA, LA PAZ, MARICOPA, PINAL, MOHAVE

HABITAT: FRESH WATER AND BRACKISH MARSHES

SPECIES IS ASSOCIATED WITH DENSE EMERGENT RIPARIAN VEGETATION. REQUIRES WET SUBSTRATE (MUDFLAT, SANDBAR) WITH DENSE HERBACEOUS OR WOODY VEGETATION FOR NESTING AND FORAGING. CHANNELIZATION AND MARSH DEVELOPMENT ARE PRIMARY SOURCES OF HABITAT LOSS.

PROPOSED TOTAL= 1

NAME: **CACTUS FERRUGINOUS PYGMY-OWL** *GLAUCIDIUM BRASILIANUM CACTORUM*

STATUS: PROPOSED ENDANGERED CRITICAL HABITAT: No RECOVERY PLAN: No CFR: 59 FR 63975, 12-12-94

DESCRIPTION: SMALL (APPROX. 7"), DIURNAL OWL REDDISH BROWN OVERALL WITH CREAM-COLORED BELLY STREAKED WITH REDDISH BROWN. SOME INDIVIDUALS ARE GRAYISH BROWN

ELEVATION RANGE: <4000 FT.

COUNTIES: MARICOPA, YUMA, SANTA CRUZ, GRAHAM, GREENLEE, PIMA, PINAL, GILA, YAVAPAI

HABITAT: MATURE COTTONWOOD/WILLOW, MESQUITE BOSQUES, AND DESERT SCRUB

RANGE LIMIT IN ARIZONA IS FROM NEW RIVER (NORTH) TO GILA BOX (EAST) TO CABEZA PRIETA MOUNTAINS (WEST). ONLY A FEW DOCUMENTED SITES WHERE THIS SPECIES PERSISTS ARE KNOWN, ADDITIONAL SURVEYS ARE NEEDED. CRITICAL HABITAT HAS BEEN PROPOSED FOR THIS SPECIES.

THE STATE OF ARIZONA
GAME & FISH DEPARTMENT
2221 West Greenway Road, Phoenix, Arizona 85023-4399 (602) 942-3000

Governor
Fife Symington
Commissioners:
Chairman, Arthur Porter, Phoenix
Nonie Johnson, Snowflake
Michael M. Golightly, Flagstaff
Herb Guenther, Tacna
Fred Belman, Tucson
Director
Duane L. Shroufe
Deputy Director
Thomas W. Spalding

December 12, 1995

Ms. Hayley Lovan
U.S. Army Corps of Engineers
Environmental Resources Branch
P.O. Box 2711
Los Angeles, California 90053-2325

Re: Proposed Reconnaissance Study of North Scottsdale and Northeast Phoenix Drainage Area, Maricopa County, Arizona

Dear Ms. Lovan:

The Arizona Game and Fish Department (Department) has reviewed the November 3, 1995 letter from Mr. Robert S. Joe, regarding special status species occurring in the vicinity of the above-referenced study area. The following comments are provided for your consideration.

The Department's Heritage Data Management System has been accessed and current records show that the special status species listed below have been documented as occurring in the project vicinity.

COMMON NAME	SCIENTIFIC NAME	STATUS
California leaf-nosed bat	Macrotus californicus	C2,SC,S
cave myotis	Myotis velifer	C2
Gila monster	Heloderma suspectum	S
Harris' hawk	Parabuteo unicinctus	S
Hohokam agave	Agave murpheyi	C2,S,HS
lesser long-nosed bat	Leptonycteris curasoae yerbabuenae	LE,SE,S
Townsend's big-eared bat	Plecotus townsendii pallescens	C2
Sonoran desert tortoise	Gopherus agassizii	C2,SC,S

STATUS DEFINITIONS

LE - **Listed as Endangered** by the U.S. Fish & Wildlife Service (USFWS) under the Endangered Species Act of 1973 (ESA). Species which are in imminent jeopardy of extinction.

C2 - **Category 2 Candidate** as identified by the USFWS under ESA. Species being considered for listing as Threatened or Endangered, pending more information.

SE - **State Endangered** on the Department's Threatened Native Wildlife in Arizona (TNW) list. Species extirpated from

Arizona since the mid-1800's, or for which extinction or extirpation is highly probable without recovery efforts.

SC - **State Candidate** on the Department's TNW list. Species with known or suspected threats, though substantial population declines from historical levels have not been documented.

S - Classified as **Sensitive** by the Regional Forester, when occurring on lands managed by the Forest Service.

HS - **Highly Safeguarded**, as defined by Arizona Native Plant Law (1993).

Enclosed is a copy of the Department's October 11, 1995 comment letter to the Arizona Regulatory Field Office (ARFO) regarding the subject greenbelt project. Although portions of the project proposal have since been clarified, the Department believes many important issues have yet to be addressed, including those outlined below.

Level of Environmental Analysis

The Department continues to emphasize the importance of a detailed environmental assessment (EA) of the proposed project. Such an assessment is an important component of the Department's evaluation of potential effects to wildlife, wildlife habitat and wildlife-related recreational activities. Although the project's total acreage of long-term disturbance or permanent loss of wildlife habitat has not been identified, the Department believes these impacts have the potential to be locally significant. In our October 11, 1995 response to ARFO, concerning the City of Scottsdale's (City) scoping report, the Department recommended the preparation of an EA to address significant issues related to the loss of wildlife habitat. In addition, Mr. Joe's letter of November 3, 1995 does not identify a proposed level of environmental analysis which would be completed for the project in accordance with the National Environmental Policy Act (NEPA).

The Department is concerned that conclusions normally drawn from the NEPA process are proposed for implementation without adequate input from natural resource agencies or the public. For example, Mr. Joe's letter refers to the City's preferred alternative for the project. It is unclear how this alternative became preferred, however it would appear to have been in the absence of public or resource agency input.

Mr. Joe's letter states that the City's preferred alternative "would maintain the natural character of the desert environment to the maximum extent practicable." Although an admirable intent, this statement points to an evaluation of only one design alternative without comparison to other alternatives and their associated impacts on wildlife resources. The Department encourages the Corps of Engineers (Corps) to consider wildlife and wildlife habitat issues as an integral part of the design and alternative selection process.

Applicability of Nationwide Permits

It is the Department's understanding that ARFO intends to permit the proposed greenbelt project through the Nationwide Permit process. As currently described, the various portions of the project are closely related, both functionally and spatially. Therefore, it is difficult for the Department to view these project segments as separate and distinct actions. We believe that to do so is not consistent with the spirit of the NEPA process, as no public input or detailed analysis would be sought as a function of the Categorical Exclusion determination for Nationwide Permits.

Cumulative Impacts

Previously permitted impacts to jurisdictional waters in the project vicinity are readily apparent. The Department recognizes and encourages the streamlining purpose of the Nationwide Permit program, however, we cannot ignore the cumulative effects of this program to wildlife habitat within the proposed study area. If implemented, the Department encourages the Corps to include an analysis of cumulative impacts as a function of the Reconnaissance Study.

In summary, the Department supports the development of a Reconnaissance Study for the North Scottsdale and Northeast Phoenix Drainage Area. We believe that such a study would be very beneficial in facilitating resolution of the issues discussed above. The Department would appreciate the opportunity to review in advance the proposed flood control or flood protection solutions to be studied to insure adequate consideration of wildlife resources.

Thank you for the opportunity to provide this information. If you have any questions, please contact me at (602) 789-3605.

Sincerely,

Ron Christofferson

Ron Christofferson
Project Evaluation Coordinator
Habitat Branch

RAC:GBC:gc

cc: Kelly Neal, Regional Supervisor, Region VI, Mesa
Cindy Lester, Corps of Engineers, AZ Regulatory Office

AGFD# 11-13-95(03)

Enclosures (1)

THE STATE OF ARIZONA

GAME & FISH DEPARTMENT

2221 West Greenway Road, Phoenix, Arizona 85023-4399 (602) 942-3000

October 11, 1995

Ms. Cindy Lester
U.S. Army Corps of Engineers
Arizona Regulatory Field Office
3636 North Central Avenue, Suite 760
Phoenix, Arizona 85012-1936

Re: City of Scottsdale Desert Greenbelt Project; Upper Reata Pass Wash, Reata Pass/Beardsley Wash, and Pima Road Channel

Dear Ms. Lester:

The Arizona Game and Fish Department (Department) has reviewed the City of Scottsdale's scoping documents for the Desert Greenbelt Project prepared by The Greiner Team. The Department provides the following information concerning this project.

The Department's Heritage Data Management System has been accessed and current records show that the special status species listed below have been documented as occurring in the project vicinity.

COMMON NAME	SCIENTIFIC NAME	STATUS
California leaf-nosed bat	*Macrotus californicus*	C2,SC,S
cave myotis	*Myotis velifer*	C2
Gila monster	*Heloderma suspectum*	S
Harris' hawk	*Parabuteo unicinctus*	S
Hohokam agave	*Agave murpheyi*	C2,S,HS
lesser long-nosed bat	*Leptonycteris curasoae verbabuenae*	LE,SE,S
Townsend's big-eared bat	*Plecotus townsendii pallescens*	C2
Sonoran desert tortoise	*Gopherus agassizii*	C2,SC,S

STATUS DEFINITIONS

LE - Listed as Endangered by the U.S. Fish & Wildlife Service (USFWS) under the Endangered Species Act of 1973 (ESA). Species which are in imminent jeopardy of extinction.

C2 - Category 2 Candidate as identified by the USFWS under ESA. Species being considered for listing as Threatened or Endangered, pending more information.

SE - **State Endangered** on the Department's Threatened Native Wildlife in Arizona (TNW) list. Species extirpated from Arizona since the mid-1800's, or for which extinction or extirpation is highly probable without recovery efforts.

SC - **State Candidate** on the Department's TNW list. Species with known or suspected threats, though substantial population declines from historical levels have not been documented.

S - Classified as **Sensitive** by the Regional Forester, when occurring on lands managed by the Forest Service.

HS - **Highly Safeguarded**, as defined by Arizona Native Plant Law (1993).

The Department has taken an active role in providing wildlife-related guidance and suggestions to developers and land planners in the Phoenix metropolitan area. We have assisted developers within the proposed greenbelt areas in avoiding or minimizing the impacts of their developments on wildlife habitat. A primary issue is the retention of natural wash channels, which serve as movement corridors for wildlife and provide food, cover, and water for a multitude of wildlife species. Though the scoping documents prepared by The Greiner Team are not detailed enough to effectively evaluate potential impacts of the proposed greenbelt, we anticipate it may negatively affect previous efforts by the Department and property owners to maintain natural wash corridors.

The quantity of direct impacts to waters within the Corps of Engineers' jurisdiction as a result of the proposed action is unclear. Although the proposed action is only summarized, it appears as though all existing vegetation would be removed in most areas of the greenbelts. The Department requests these potential direct impacts to wildlife habitat be quantified.

In addition, many smaller washes could be effectively de-watered if the channelized washes gather flows from numerous smaller washes, and do not allow for sheet flows within the alluvial fan. Therefore, the occasional seasonal flooding across the floodplain which serves to revitalize these smaller drainages could be eliminated. These indirect impacts to smaller washes in the alluvial fan should also be quantified.

The Department believes the potential for wildlife habitat losses and for impacts to previously established avoidance mitigation are issues of significance. Therefore, we recommend a formal Environmental Assessment (EA) be prepared to address these issues. This document should evaluate potential cumulative and direct impacts to the named washes, and the loss of wildlife habitat values as a result of de-watering smaller washes. Impacts to wildlife corridors and fragmentation of habitat also should be addressed.

We further recommend the EA include a reasonable range of action alternatives, including alternatives that address design features that allow flow of water to smaller washes in the alluvial fan. Culverts located within the stabilized bank could be designed to limit the quantity of water that flows to the smaller washes, thus eliminating flood potential, while still maintaining wildlife habitat in the smaller washes.

In order to facilitate adequate evaluation of the project, the EA should include the project's purpose and need, design details for the proposed action, proposed mitigation measures, and quantification of direct and indirect impacts to all wash habitats affected by the project. Because bank stabilization involves the removal of most natural vegetation along wash banks, we recommend minimizing this component of the proposal. Also, revegetation should be accomplished with native plant species indigenous to the project area.

Thank you for the opportunity to provide this information. The Department would appreciate the opportunity to discuss this project further, and to review the draft EA when it becomes available. In addition, we believe that additional scoping comments for an EA should be solicited when a more detailed project description is available. If you have any questions or comments about the above issues, please contact me at (602) 789-3605.

Sincerely,

Ron Christofferson

Ron Christofferson
Project Evaluation Coordinator
Habitat Branch

RAC:GBC:gc

cc: Kelly Neal, Regional Supervisor, Region VI, Mesa
Collis Lovely, Transportation Department, City of Scottsdale

AGFD# 09-13-95(17)

APPENDIX G: GEOTECHNICAL

NORTH SCOTTSDALE RECONNAISSANCE STUDY

GEOTECHNICAL APPENDIX

FEBRUARY, 1996

LOS ANGELES DISTRICT, U.S. ARMY CORPS OF ENGINEERS

GEOTECHNICAL APPENDIX

TABLE OF CONTENTS

GILA RIVER, NORTH SCOTTSDALE DRAINAGE AREA, ARIZONA
GEOTECHNICAL APPENDIX

1. TOPOGRAPHY

The North Scottsdale Drainage Area lies north of the city of Scottsdale and Northeast of the Phoenix Metropolitan area. It is located in the Paradise Valley and Northern Scottsdale areas. It is bordered by the Central Arizona Project (CAP) to the south, McDowell Mountain to the east, Desert Mountain to the north, and Cave Creek drainage to the west. The drainage area consists of rugged, sparsely vegetated mountains with steep gradients. The gradient of the headwaters of the streams in the McDowell Mountains is about 300 feet per mile. The valley land is fairly flat alluvial desert plain which gently slopes southwestward. The desert lowland gradients range from 20 feet per mile in the lower reaches to 150 feet per mile in the upper reaches at the base of the mountains. Elevations in the drainage areas range from about 4,034 feet above mean sea level at McDowell Peak to approximately 1,510 feet above mean sea level at the intersection of Pima Road and the CAP. Streams within the drainage area are ephemeral, flowing only during and immediately after heavy rainfall.

2. GEOLOGY

The North Scottsdale Drainage Area lies within the Sonoran Desert of the Basin and Range Physiographical Province. The topography of the area is largely the result of tectonic activity that ended by the late Tertiary (4 - 10 m.y. ago). This activity, called the Basin and Range disturbance was basically a stretching of the land surface and included periods when basins were partially or totally closed to drainage. These closed drainages resulted in the deposition of large amounts of very fine sediment, with some locations forming evaporite deposits. Local deposits were intruded by volcanic events which provided flows and other volcanic debris. In present times, the mountains are being eroded and deposited primarily as alluvial fans and in channels and major floodplain drainages. The mountainous areas are composed primarily of Precambrian granitics and schists. The younger bedrock exposed in the nearby mountains consists of Tertiary sandstone, siltstone and conglomerates. Extrusive basalt, rhyolite, tuff, and andesite are also present locally.

The study area occupies a broad fairly smooth alluvial plain formed primarily of older and more recent alluvial deposits. The depth of the alluvial deposits ranges from approximately 500' to about 1,500' and consists of silt, sand, gravel, and cobbles. They are divided into three stratigraphic units: lower alluvium, middle alluvium, and upper alluvium. The lower alluvium consists chiefly of partially to moderately cemented sand and gravel that contains beds of clay and silt. The deposits are generally 200 to 400 feet thick in the Scottsdale area. The middle alluvium consists mainly of partially cemented silt, silty sand, and gravel with caliche present near the mountain flanks. The deposits are more than 1,000 feet thick. The upper alluvium is partially cemented, but locally near Phoenix and the McDowell Mountains the alluvium becomes moderately to well cemented (USGS, 1968).

A field reconnaissance was conducted by COE geologists on 6 February 1996. During this reconnaissance, it was determined that the degree of cementation within the study area consisted of only partial surficial cementation in Reata Pass and Beardsley Washes. No surficial cementation was observed at Fans 5 & 6 concrete channels and the Rawhide Wash proposed detention basin sites. Further investigations would be necessary to determine the degree of cementation at depths below the ground surface if excavation is required during construction.

3. SOILS

The U.S. Department of Agriculture, Soil Conservation Service divides soils into soil associations to differentiate them by land types and soil patterns. Four soil association types are found within the study area.

1. The Rock Land Association consists of strongly sloping to very steep areas of rock outcrop and of gravelly soils that are shallow or very shallow over rock. They are found mainly on the sides of mountains, on the base of mountains, and on buttes and ledges. These areas are often dissected by deep drainageways in which runoff is rapid and active geologic erosion is taking place.

2. The Antho-Valencia Association consists of deep, nearly level and gently sloping soils on alluvial fans. They are well drained sandy loams and gravelly sandy loams.

3. The Laveen Association consists of well-drained, deep soils on old alluvial fans and terraces. They are composed of calcareous loams and gravelly sandy loams.

4. The Mohall-Contine Association consists of well-drained, deep soils on old alluvial fans. These soils are composed of clay loams and sandy clay loams.

4. GROUNDWATER

Groundwater occurs throughout most of the study area, including the hardrock areas. Much of the groundwater, is found in the basin-fill deposits and often referred to as the main aquifer system. The hardrock areas are primarily composed of igneous, metamorphic, and highly consolidated sedimentary rocks. These areas form the divides between the individual sub-basins and act as barriers to groundwater movement. Groundwater is often limited and variable in quantity in hardrock areas, but may be found in the fractures, on pediments, under stream channels, small buried basins, and sometimes flowing from springs. The groundwater in the basin-fill deposits in the interiors of the sub-basins are informally classified into four units of ascending order of stratigraphic position. Their hydrogeologic characteristics tend to be variable within the units as well as between units. As a group these units function as a single aquifer system within each sub-basin.

The pre-Basin and Range sediments are composed primarily of fanglomerate and alluvial deposits that are generally highly consolidated. The lower basin fill is generally composed of weakly to highly consolidated fanglomerate and alluvial deposits. These units tend to be relatively coarse around the basin fringes and grade to a finer grained material toward the interiors. This unit is often very thick, gypsiferous in places and may contain extensive evaporites and volcanics. A large amount of groundwater is stored within this unit, with production varying from high to low depending upon the location due to the presence of fine-grained deposits, degree of cementation, and other factors. The upper basin fill is generally composed of unconsolidated to moderately consolidated fanglomerate and alluvial deposits. It is normally coarser than the lower unit with fewer evaporites, much less thick, and is partially dewatered in places. Perched or semi-perched conditions exist in the Paradise Valley area due to fine-grained deposits which impede vertical migration of groundwater. The stream alluvium is found along the major drainages and composed of unconsolidated alluvial deposits. It serves as a conduit for the recharge of the lower units (Hammet, et al, 1995).

The study area is located in the East Salt River sub-basin. The groundwater depth in the project area has varied greatly in the past. Between the years of 1946 to 1972, groundwater drops as great as 250 feet occurred. Large population growth resulted in over pumping of groundwater in the area. A general rise in water levels in the study area were indicated by the detailed water surveys of the fall and winter from 1981 to 1992. Pumpage was reduced compared to the recent past with an abundance of surface water available in many areas and much of this surface water resulting in incidental recharge. In the outer parts of the groundwater sub-basin, there has continued to be a decline in water levels where extensive groundwater development has not occurred. With no major source for recharge, it is postulated that a migration to relatively distant groundwater depressions is taking place at a rate faster than replinishment. Major groundwater depressions are centered in the Scottsdale-Paradise Valley area. These groundwater depressions are the result of extensive groundwater withdrawals that over time, have exceeded the rate of replenishment . Water-level or head differences within the study area exist, and are a result of fine-grained deposits in the upper basin fill which inhibit the downward movement of water and result in perched groundwater conditions. The water levels within the study area range from 100 feet to over 400 feet below the ground surface (Hammet, et al, 1995).

5. SUBSIDENCE

No major subsidence or earth fissures have occurred in the North Scottsdale drainage area. Based on adjusted U.S. Coast Guard and Geodetic Survey level data, it is indicated that only a slight amount of subsidence of less than 1 foot has occurred in the past within the vicinity of the project area. Subsidence in the future should not exceed the total amount of subsidence that has occurred within the project vicinity. No related damage due to subsidence has been reported to any existing structure near the site. With no significant subsidence expected, adverse impact due to differential settlement would not be expected.

6. FAULTING

The close of the Cretaceous and the early Tertiary periods was a time of great mountain building in Western North America. The Laramide Orogeny uplifted this portion of the continent and with it most of the mountain ranges in Arizona. During this time, igneous intrusive rocks and a large variety of volcanics formed within the mountains. The Basin and Range disturbance of middle Miocene time, a tectonic event responsible for producing the deep basins and high ranges characteristic of present-day Basin and Range physiography, resulted from movement along deep-seated, high-angle normal faults. The Basin and Range province in Arizona has been considered tectonically inactive since the waning of the Basin and Range disturbance during the Pliocene as shown in part by the extensive pedimentation of mountain blocks.

7. SEISMICITY

The project site is located within Zone 1 of the Seismic Zone Map of Contiguous States in ER 1110-2-1806. The study area is located within a region of low seismic potential. The most significant fault in the state is approximately 40 miles long and is located north-northeast of Globe, about 100 miles from the study area. Fourty-seven earthquakes of maximum intensity IV to VI (modified-Mercalli intensity scale) have occurred within a 250-mile radius of the project area from 1852 through 1974. The highest intensity earthquake, IX, occurred in 1852 near Yuma, about 200 miles southwest of the project area. The closest epicenter to the project was 1973, approximately 71 miles northeast, at Prescott, and had intensities of IV and V. The largest known event in the history of Arizona was the intensity VIII, 1910 earthquake, located 75 miles northeast of Flagstaff and approximately 180 miles from the project area.

8. CONSTRUCTION MATERIALS

A. Quarry Stone

There are no known operating hard rock quarry sites in the vicinity of the project. Graded cobblestones that would meet the requirements for stonework could be obtained from rock processing plants along the Salt River in the Phoenix metropolitan area. The maximum size stone available would be about 3 feet in diameter.

B. Sources of Concrete Aggregates

Concrete aggregate sources investigated in previous studies are described below. Each general source is identified by the stream from which materials are taken. Future studies would require re-evaluation of these sources in accordance with SPD policy. Additionally, on site sources will be investigated and evaluated for production of portland and asphaltic cement concrete, Roller Compacted Concrete (RCC), and soil cement.

Salt River: Sands and gravels from the Salt River are historically the oldest producing sources of aggregates for the Phoenix area. Coarse aggregates and cobbles are generally present in sizes to 300 mm. In some cases material as large as 600 mm is available. Some deposits have run out of sizes larger than gravels. The percentage of sand in these sources is adequate for economical concrete construction.

Cave Creek: The Cave Creek sources have cobbles to 600 mm. A sufficient quantity of coarse aggregates is available. Some of the plants are importing sand from the Agua Fria River.

Agua Fria River: The Agua Fria sources are the youngest sources being mined in the Phoenix area at this time. The maximum size of material generally varies between 300 to 450 mm, with a larger proportion of sand than other sources. The Agua Fria sources should have sufficient material to satisfy all construction needs.

C. Cement

There are two major producers of cement in the state of Arizona who are presently producing cements which are pre-qualified by the Waterways Experiment Station for use in Corps of Engineer's projects. These plants are the Phoenix Portland Cement Corporation at Clarkdale, approximately 150 kilometers north of the project site; and the Arizona Portland Cement Company at Rillito approximately 190 kilometers southeast of the project site. Additional cements would be available from the California Portland Cement Company, at Colton, California, approximately 580 kilometers west of the project site.

There are two cement plants producing Type III cement which conforms to ASTM Specification C 150. These are the Genstar Cement Co. plant at Stockton, California approximately 1000 kilometers northwest of the project site and the Calaveras Cement Co at San Andreas, California approximately 1250 kilometers northwest of the project site.

Recently cements produced in Mexico have been imported to the United States and have been used in the Tucson area.

D. Pozzolan

In accordance with current Federal Regulations the option to use flyash, a pozzolanic admixture, as a substitute for Portland Cement will be allowed in the production of concrete for the North Scottsdale Study. Concrete generally produced in the area at the present time uses pozzolan to offset reactivities between the cement and silicates in the aggregate and to reduce the heat of hydration. Flyash, proven to be suitable in the past, would be available from a plant near Page, Arizona, approximately 640 kilometers north of the project site, and from a plant at Cochise, Arizona, approximately 300 kilometers southeast of the project site.

E. Admixtures

Two types of admixtures are used extensively by concrete producers in the Phoenix area. These are air-entraining admixtures and water reducing admixtures. Some high range water reducing admixtures have been used. It is anticipated that all classes of admixtures will be used in construction of the North Scottsdale Projects.

F. Water

Sufficient water suitable for concrete construction would be available at existing concrete plants. It the Contractor elects to erect an onsite batch plant, water most likely could be obtained from local municipalities.

9. ENGINEERING CONSIDERATIONS

For a reconnaissance level study, the following Geotechnical considerations are recommended:

1. Based on the available information, proposed structures at the site should not be effected by subsidence and associated fissures. Additional field investigations and evaluations of existing data will be required in future studies to define potential for subsidence and earth fissure hazard zones along proposed structural alignments.

2. The relatively consistent flat slopes does not lend itself to confining drainages. Additional excavation and grading will be required to establish positive drainage paths to collect and convey flows to proposed debris basin sites.

3. Ease of excavation is not completely known at this time. It appears that some of the surficial soils are partially or lightly cemented. Cementation with depth is unknown and would be established, in detail, by future field investigations.

4. Production of soil cement would be easiest in the Fan 5 and Fan 6 Flood zones and the Rawhide Wash Flood Zone. The materials in these areas are generally sands and silts, with little coarse material available. This estimate is based on surficial observations and will have to be specifically quantified by detailed explorations during subsequent studies. RCC could possibly be produced by importation of coarse aggregate materials from other sites.

5. Production of RCC would be easiest in the Beardsley Wash and the Reata Pass Flood Zones. A full range of particle sizes are available for aggregate production. Subsequent design phases will require investigations and analysis to validate properties of materials available for both soil cement and RCC if selected as design options.

6. An update of existing aggregate and stone sources and availability of materials will be required as part of subsequent studies.

10. REFERENCES

U.S. Army Corps of Engineers, May 1975, Gila River Basin, Arizona, Indian Bend Wash, Design Memorandum No. 1, Los Angeles District.

U.S. Army Corps of Engineers, May 1975, Maricopa County, Arizona, Recreation Master Plan, Design Memorandum No. 2, Los Angeles District.

U.S. Army Corps of Engineers, January 1978, Gila River Basin, Arizona, Indian Bend Wash, Design Memorandum No. 3, Los Angeles District.

U.S. Army Corps of Engineers, October 1973, Final Environmental Statement, Indian Bend Wash, Arizona, Los Angeles District.

Hammett B.A., Herther, R.L., Maps showing ground-water conditions in the Phoenix Active Management Area: Maricopa, Pinal, and Yavapai Counties, Arizona - 1992, open file report 27, USGS.

U.S. Army Corps of Engineers, June 1983, Arizona Regional Seismic Assessment, Los Angeles District.

Soil Conservation Service, November 1974, Soil Survey, Eastern Maricopa and Northern Pinal Counties Area, Arizona, U. S. Department of Agriculture.

U.S.G.S., May 1968, Ground Water in Paradise Valley, Maricopa County, Arizona