PHOENIX, ARIZONA

I-10 INNER LOOP
STORM DRAINAGE
VALUE ENGINEERING STUDY

BACKGROUND INFORMATION

OCTOBER 5, 1982

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EXECUTIVE SUMMARY

A. PURPOSE OF REPORT

THE PURPOSE OF THIS REPORT IS TO PRESENT THE RESULTS OF STUDIES RELATIVE TO STORM DRAINAGE ALONG THE I-10 INNER LOOP IN PHOENIX. THE STUDY IS COMPRISED OF TWO ELEMENTS:

1. COMPUTE THE HYDROLOGY OF THE DRAINAGE AREA CONTRIBUTING STORMWATER FLOW ALONG THE INNER LOOP'S EAST-WEST CORRIDOR, LOCATED APPROXIMATELY 0.25 MILE SOUTH OF MCDOWELL ROAD, FROM ITS INTERSECTION WITH I-17 TO THE END OF THE CORRIDOR AT APPROXIMATELY 21ST STREET.

2. DEVELOP AND EVALUATE ALTERNATIVE CONCEPTS WHICH SAFELY CONDUCT STORMWATER AWAY FROM THE PROPOSED FREEWAY FOR STORMS EQUAL TO AND LESS THAN THE 50-YEAR FREQUENCY STORM EVENT, WITHOUT INUNDATION OF THE FREEWAY.

THE FINAL PRODUCT OF THIS REPORT IS A RECOMMENDED ALTERNATIVE DESIGN FOR THE OFF-SITE FREEWAY STORM DRAIN SYSTEM.

B. SUMMARY OF HYDROLOGY

1. DRAINAGE AREA CHARACTERISTICS

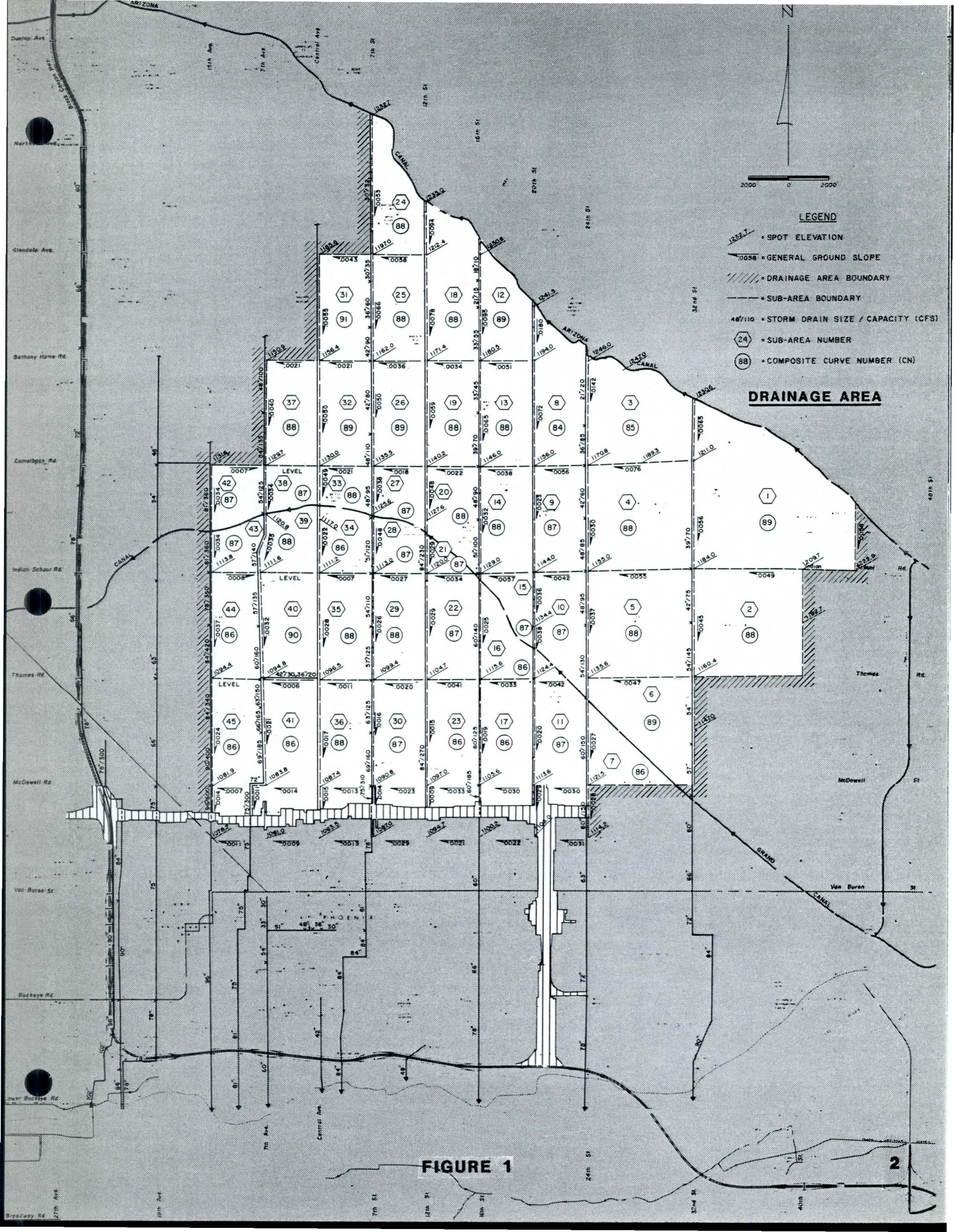
THE DRAINAGE AREA ESTABLISHED FOR THE I-10 INNER LOOP'S EAST-WEST CORRIDOR IS SHOWN ON FIGURE 1. AN INDEX MAP FOR PHOENIX, ARIZONA IS SHOWN ON FIGURE 8 ON PAGE 16. THE ARIZONA CANAL DIVERSION CHANNEL (ACDC), WHICH IS A MAJOR CORPS OF ENGINEERS FLOOD CONTROL PROJECT, IS ASSUMED TO BE IN PLACE FOR THE PURPOSES OF THIS REPORT, AND THEREFORE PROVIDES PROTECTION OF THE DRAINAGE AREA FROM FLOWS ORIGINATING NORTH OF THE ARIZONA CANAL.

THE WESTERN PORTION OF THE DRAINAGE AREA INCLUDES CAVE CREEK WASH, A FLOOD PLAIN WHICH HAS BEEN ALMOST COMPLETELY DEVELOPED AS AN URBAN AREA.

THE INNER LOOP DRAINAGE AREA INCLUDES APPROXIMATELY 24 SQUARE MILES IN NORTH-CENTRAL AND NORTH-EAST PHOENIX.

THE AREA HAS BEEN ALMOST COMPLETELY URBANIZED WITH A COMBINATION OF COMMERCIAL AND RESIDENTIAL LAND USE. WITHIN THE CENTRAL AVENUE CORRIDOR, CURRENT AND FUTURE ZONING ALLOWS FOR THE REDEVELOPMENT OF THE CORRIDOR INTO A HIGHRISE COMMERCIAL, OFFICE AND RESIDENTIAL DISTRICT.

STORM DRAINAGE IN THE INNER LOOP DRAINAGE AREA IS CURRENTLY PROVIDED BY EXISTING CITY OF PHOENIX STORM DRAINS AND BY SURFACE FLOWS WHICH GENERALLY FOLLOW THE MAJOR STREET PATTERN IN PHOENIX. FUTURE STORM DRAINS BEING PLANNED BY THE CITY WILL AUGMENT THE EXISTING DRAINS TO PROVIDE FOR THE TWO-YEAR FREQUENCY STORM.


N
2000 0 2000
LEGEND
• SPOT ELEVATION
• GENERAL GROUND SLOPE
• DRAINAGE AREA BOUNDARY
• SUB-AREA BOUNDARY
• STORM DRAIN SIZE / CAPACITY (CFS)
• SUB-AREA NUMBER
• COMPOSITE CURVE NUMBER (CN)
DRAINAGE AREA
ARIZONA CANAL
GRAND CANAL
Dunlap Ave
Glendale Ave
Bethany Home Rd
Camelback Rd
Indian School Rd
Thomas Rd
McDowell Rd
Van Buren St
Buckeye Rd
Lower Buckeye Rd
Broadway Rd
7th Ave
Central Ave
7th St
12th St
16th St
20th St
24th St
32nd St
40th St
FIGURE 1
2

STORM DRAINAGE IS REDUCED WITHIN THE DRAINAGE AREA BY THE ON-SITE RETENTION OF STORM WATER ON LARGE COMMERCIAL PROPERTIES AND BY RESIDENCES WHICH ARE FLOOD IRRIGATED.

FUTURE DEVELOPMENT WITHIN THE DRAINAGE AREA WILL CONSIST OF FILLING IN THE REMAINING UNDEVELOPED PARCELS SCATTERED THROUGHOUT THE AREA, AND THE REDEVELOPMENT OF THE CENTRAL AVENUE CORRIDOR INTO AN UPTOWN BUSINESS DISTRICT.

2. METHOD OF COMPUTING HYDROLOGY

THE METHOD OF ANALYSIS USED FOR THE DETERMINATION OF HYDROLOGY ON THE INNER LOOP DRAINAGE AREA IS THE SOIL CONSERVATION SERVICE TR-20 COMPUTER PROGRAM. THE PROGRAM'S FLEXIBILITY AND CAPABILITIES ALLOW ITS USE IN COMPLEX URBAN DRAINAGE PROJECTS, AS IS THE CASE FOR THE I-10 INNER LOOP.

THE RAINFALL INTENSITY AND DISTRIBUTION FOR 50- AND 100-YEAR FREQUENCY STORMS WHICH WERE USED IN THE COMPUTATION OF HYDROLOGY ARE IN ACCORDANCE WITH NATIONAL WEATHER SERVICE VALUES FOR TOTAL PRECIPITATION, WITH RAINFALL DISTRIBUTION MADE IN ACCORDANCE WITH THE 24-HOUR RAINFALL DISTRIBUTION CURRENTLY USED BY THE CITY OF PHOENIX. AREAL REDUCTION OF THE RAINFALL INTENSITY BASED ON THE SIZE OF THE DRAINAGE AREA WAS NOT RECOMMENDED.

USING THE ABOVE RAINFALL PATTERN, AND THE DRAINAGE AREA CHARACTERISTICS, THE HYDROLOGY OF THE INNER LOOP DRAINAGE AREA WAS COMPUTED BY THE TR-20 PROGRAM. RESULTS OF THE PROGRAM ARE SUMMARIZED IN FIGURE 2 FOR THE 50-YEAR STORM, AND IN FIGURE 3 FOR 100-YEAR STORM.

3. ESTIMATED FLOWS AT THE DURANGO CURVE

FLOWS IN CAVE CREEK WASH AT THE DURANGO CURVE OF I-17 WERE ESTIMATED BY UTILIZING THE CAVE CREEK HYDROLOGY DEVELOPED BY THE CORPS OF ENGINEERS IN CONJUNCTION WITH THE ARIZONA CANAL DIVERSION CHANNEL, AND THE RESULTS OF THE HYDROLOGY FOR THE I-10 INNER LOOP AS DESCRIBED ABOVE.

USING THIS DATA, THE 50-YEAR FLOW IN CAVE CREEK AT THE DURANGO CURVE WAS ESTIMATED TO BE 5771 CUBIC FEET PER SECOND (CFS).

C. HYDRAULIC DESIGN CONCEPTS

USING THE HYDROLOGY AS DESCRIBED ABOVE, CONCEPTS FOR COLLECTING THESE FLOWS ALONG THE I-10 INNER LOOP AND FOR DISCHARGING INTO THE SALT RIVER WERE EVALUATED FOR FEASIBILITY.

1. PRELIMINARY CONCEPTS

TWO CONCEPTS WERE IDENTIFIED IN THE SCOPE OF WORK:

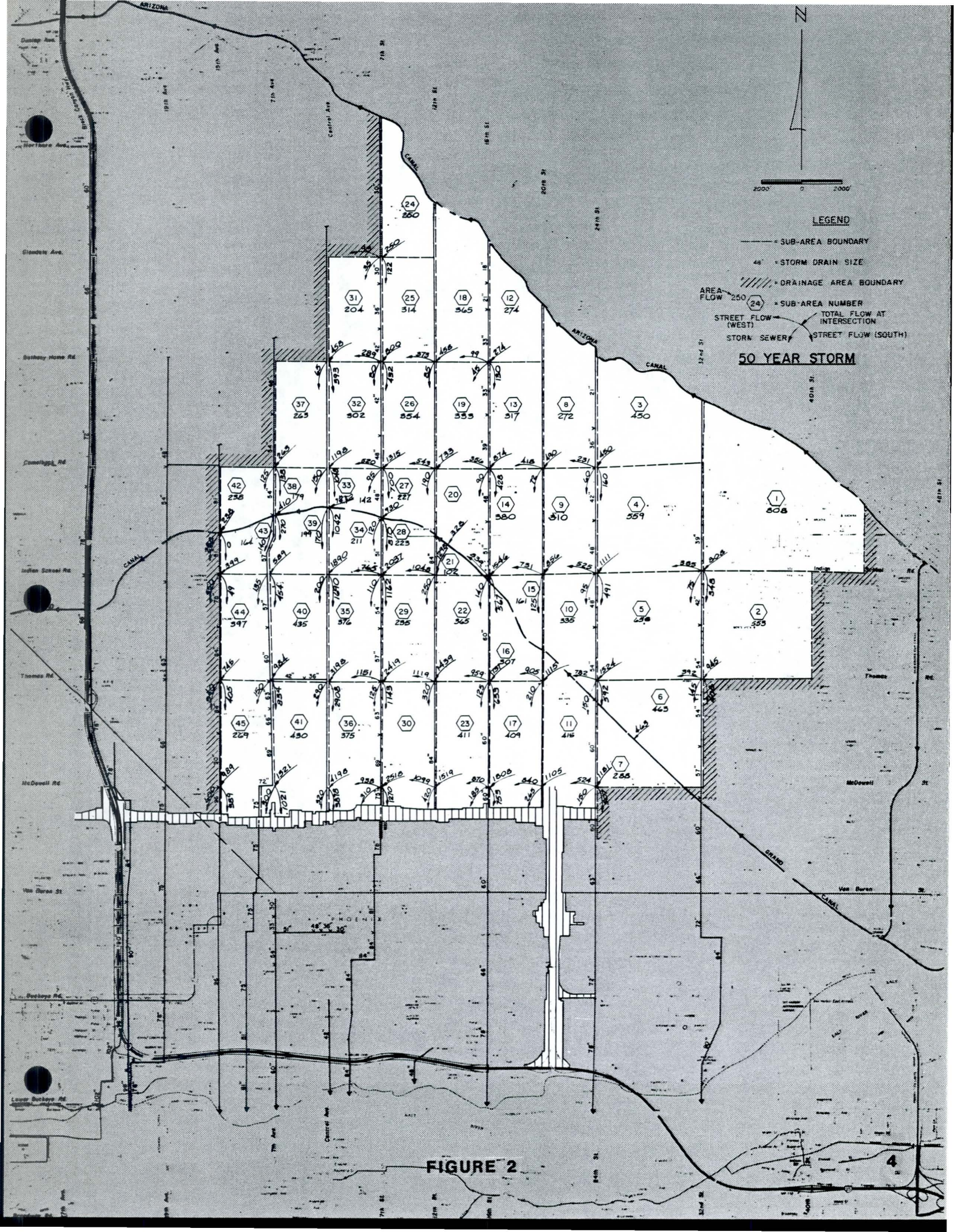

N
2000' 0 2000'
LEGEND
= SUB-AREA BOUNDARY
48" = STORM DRAIN SIZE
= DRAINAGE AREA BOUNDARY
AREA FLOW 250 (24) = SUB-AREA NUMBER
STREET FLOW (WEST)
TOTAL FLOW AT INTERSECTION
STORM SEWER
STREET FLOW (SOUTH)
50 YEAR STORM
ARIZONA CANAL
GRAND CANAL
Glendale Ave.
Bethany Home Rd.
Camelback Rd.
Indian School Rd.
Thomas Rd.
McDowell Rd.
Van Buren St.
Buckeye Rd.
Lower Buckeye Rd.
Black Canyon Hwy.
Northern Ave.
19th Ave
7th Ave
Central Ave
12th St
16th St
20th St
24th St
32nd St
40th St
48th St
Indian
Thomas
McDowell
Van Buren
24 250
31 204
25 314
18 565
12 274
37 225
32 302
26 854
19 333
13 517
8 272
3 450
42 238
38
33 142
27 227
20
14 580
9 310
4 559
1 808
39
43
34 211
28 223
21 102
44 397
40 435
35 376
29 286
22 345
15 161
10 335
5 436
2 555
16 307
45 229
41 430
36 375
30
23 411
17 409
11 416
6 463
7 288

FIGURE 2

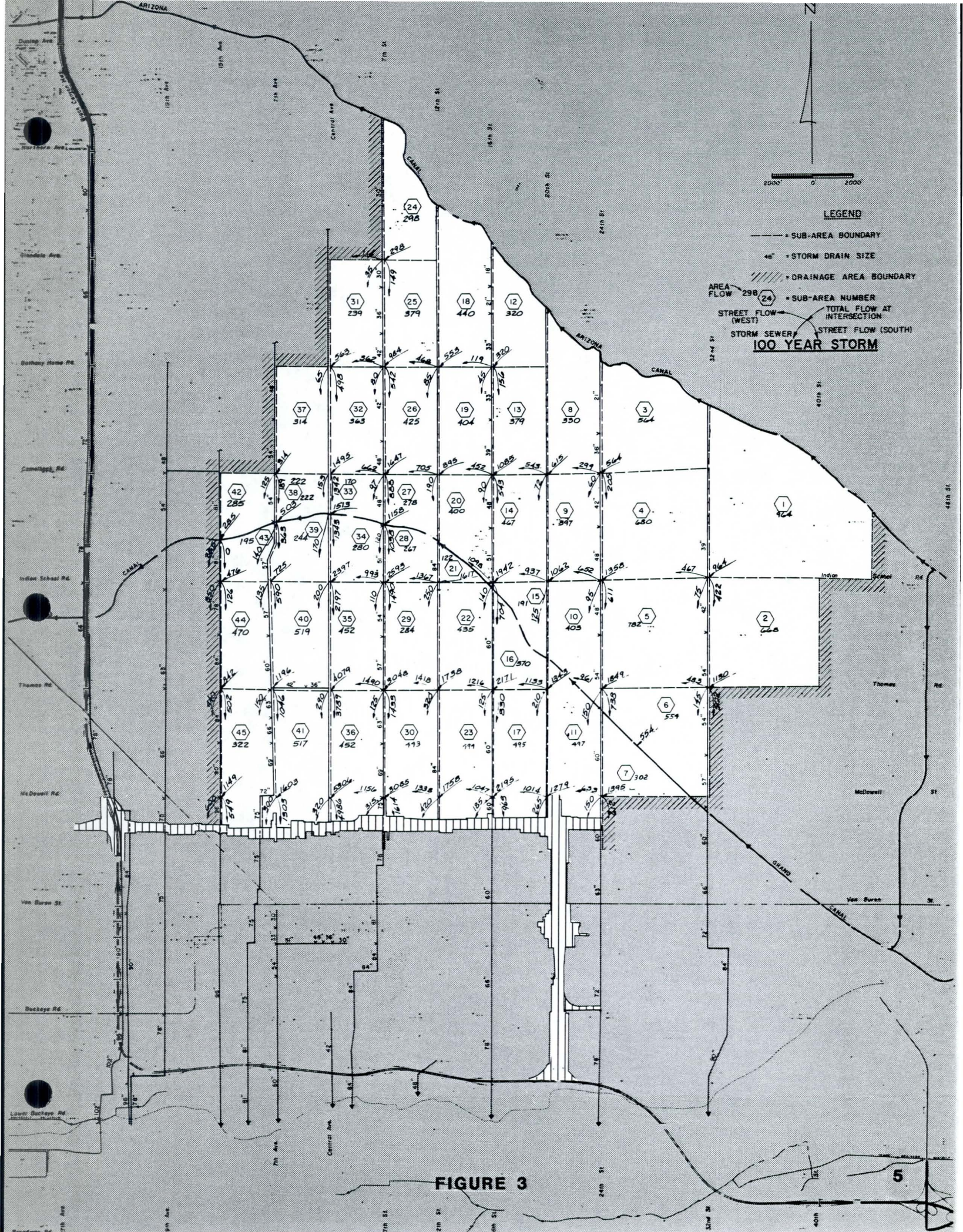

N
2000' 0 2000'
LEGEND
SUB-AREA BOUNDARY
48" STORM DRAIN SIZE
DRAINAGE AREA BOUNDARY
AREA FLOW 298 (24) SUB-AREA NUMBER
STREET FLOW (WEST)
TOTAL FLOW AT INTERSECTION
STORM SEWER
STREET FLOW (SOUTH)
100 YEAR STORM
ARIZONA CANAL
CANAL
GRAND CANAL
Dunlap Ave
Northern Ave
Glendale Ave
Bethany Home Rd
Camelback Rd
Indian School Rd
Thomas Rd
McDowell Rd
Van Buren St
Buckeye Rd
Lower Buckeye Rd
19th Ave
7th Ave
Central Ave
7th St
12th St
16th St
20th St
24th St
32nd St
40th St
48th St
Indian School Rd
Thomas Rd
McDowell St
Van Buren St

FIGURE 3

PRELIMINARY CONCEPT I: COLLECT ALL STORMWATER ALONG THE I-10 INNER LOOP, EAST OF APPROXIMATELY 15TH AVENUE, FOR DISCHARGE TO THE SALT RIVER, INCLUDING PORTIONS OF CAVE CREEK FLOWS AT BOTH THE I-10 ALIGNMENT AND AT THE DURANGO CURVE.

PRELIMINARY CONCEPT II: COLLECT ALL STORMWATER ALONG THE I-10 INNER LOOP, INCLUDING ALL OF THE CAVE CREEK FLOW, FOR DISCHARGE TO THE SALT RIVER.

BASED ON EVALUATION OF CONSTRUCTION COSTS AND RIGHT-OF-WAY REQUIRED, PRELIMINARY CONCEPT II WAS ELIMINATED FROM FURTHER CONSIDERATION.

THE FOLLOWING ADDITIONAL CONCEPTS WERE ALSO EVALUATED FOR FEASIBILITY IN CONDUCTING INNER LOOP STORM WATER FLOWS TO THE RIVER:

- USE OF EXISTING AND FUTURE STORM DRAINS
- USE OF BRIDGES AS HYDRAULIC STRUCTURES
- PEAK DISCHARGE REDUCTION BY STORMWATER RETENTION
- INTERCEPT FLOWS ABOVE INNER LOOP ALIGNMENT
- OUTFALL TUNNELS TO THE RIVER
- OPEN CHANNELS
- JOINT-USE FACILITIES

AFTER DISCUSSION OF EACH OF THE ABOVE, IT WAS CONCLUDED THAT ONLY THE ADDITIONAL CONCEPTS INVOLVING THE USE OF EXISTING STORM DRAINS, OUTFALL TUNNELS, AND JOINT-USE FACILITIES SHOULD BE CONSIDERED ANY FURTHER.

2. ALTERNATE CONCEPT FORMULATION

USING THE GENERAL CONCEPTS NOTED ABOVE, FOUR ALTERNATIVES WERE FORMULATED FOR ADDITIONAL EVALUATION. EACH OF THE ALTERNATIVES UTILIZE BOX CULVERTS AND/OR CONCRETE PIPE TO COLLECT THE 50-YEAR STORM RUNOFF ALONG THE INNER LOOP, AND THE OUTFALLS IN EACH ALTERNATIVE ARE CAPABLE OF DISCHARGING THIS 50-YEAR FLOW INTO THE SALT RIVER, WITH THE RIVER FLOWING AT ITS 10-YEAR LEVEL.

ALTERNATIVE I UTILIZES BOX CULVERT OUTFALLS INSTALLED UNDER THE FOLLOWING STREETS:

- I-17 NORTHBOUND FRONTAGE ROAD
- 1ST AVENUE
- 11TH STREET

FIGURE 4 SHOWS A GENERAL LAYOUT OF ALTERNATIVE I.

ALTERNATIVE II ALSO UTILIZES BOX CULVERT OUTFALLS, AT THE FOLLOWING LOCATIONS:

- I-17 NORTHBOUND FRONTAGE ROAD
- 1ST AVENUE
- 11TH STREET
- 20TH STREET (NORTH-SOUTH LEG OF I-10)

FIGURE 5 SHOWS THE GENERAL LAYOUT OF ALTERNATIVE II, WHICH IS SIMILAR TO ALTERNATIVE I EXCEPT THAT FLOWS ALONG THE I-10 ALIGNMENT EAST OF 16TH STREET ARE TAKEN TO THE SALT RIVER BY AN OUTFALL LOCATED ALONG THE NORTH-SOUTH LEG OF I-10.

ALTERNATIVE III UTILIZES A 30-FOOT DIAMETER TUNNEL UNDER 15TH AVENUE TO CONDUCT ALL FLOWS TO THE SALT RIVER FROM THE I-10 ALIGNMENT. FIGURE 6 SHOWS THE LAYOUT OF ALTERNATIVE III.

ALTERNATIVE IV UTILIZES TWO 20-FOOT DIAMETER TUNNELS, ONE UNDER 15TH AVENUE AND THE OTHER UNDER CENTRAL AVENUE, FOR DISCHARGES TO THE RIVER. FIGURE 7 SHOWS THE LAYOUT OF ALTERNATIVE IV.

3. EVALUATION OF ALTERNATIVES

THE FOUR ALTERNATIVES DESCRIBED ABOVE WERE THEN EVALUATED ON THE BASIS OF THE FOLLOWING PARAMETERS:

- CONSTRUCTION COSTS
- OPERATION AND MAINTENANCE COSTS
- RIGHT-OF-WAY REQUIREMENTS
- TIME OF COMPLETION/TRAFFIC CONTROL
- DISPOSAL OF EXCESS MATERIALS
- ENVIRONMENTAL EFFECTS
- POSSIBLE JOINT USE OF FACILITIES

EACH ALTERNATIVE WAS THEN EVALUATED AND RANKED FOR EACH OF THE PARAMETERS LISTED ABOVE, AND A COMPOSITE RANKING MADE, AS SHOWN BELOW. A RANKING OF 1 INDICATES THE MOST FAVORABLE.

SUMMARY OF RANKINGS

ELEMENTS	ALTERNATIVES I	II	III	IV
INSTALLED COSTS	3	4	1	2
OPERATION AND MAINTENANCE COSTS	1	1	3	2
RIGHT-OF-WAY REQUIREMENTS	3	4	1	2
TIME OF COMPLETION/TRAFFIC CONTROL	3	4	1	2
DISPOSAL OF MATERIALS	3	4	1	2
UTILITY CONFLICTS	3	4	2	1
ENVIRONMENTAL EFFECTS	3	4	1	2
JOINT-USE POTENTIAL	2	1	4	3

GENERAL GEOLOGY

A. GENERAL

The City of Phoenix is located in the Salt River Valley which is in the intermontane Phoenix Basin of the Lowland or Sonoran Desert Section of the Basin and Range Physiographic Province. The Basin and Range Province is separated from the Colorado Plateau Province by the Mogollon Rim located in Central Arizona. This escarpment marks the source of the Salt River and the southern margin of the gently tilted sedimentary rocks of the Colorado Plateau.

The Salt River Valley is an alluvial plain located southwest of the Colorado Plateau. The river emerges from a narrow canyon east of Phoenix into the broad valley containing coarse granular deposits and finer alluvial fan deposits. The Agua Fria, Gila, and the New Rivers and the Cave, Skunk, and Queen Creeks have created similar, but less extensive deposits.

In the valley near Phoenix, isolated mountain peaks partially buried by valley fill protrude above the plain, resulting in an abrupt transition from plain to mountain. The topography of the valley is generally flat to gently sloping. The valley floor, sloping to the southwest at about 30-ft. per mile, is punctuated with isolated mountain tips, which reach heights of 1,200 to 3,000 ft. above the plain.

B. GEOLOGIC HISTORY

The Pre-Cambrian formations remaining in evidence in the Phoenix area consist of remnants of gneisses, granite, and quartzite.

Through much of geologic time (at least since the Cambrian Period) there has been a structural trough in the southwest corner of Arizona. Sedimentation was occurring in the valley during the Paleozoic time, and the sedimentary rocks were displaced during the late Triassic Period and tilted by normal faulting. The results were the up-faulted mountains and down-faulted basins which form the basins and ranges of this physiographic province. The fault axes generally trend northwest-southeast and the mountain blocks, basins, and drainage reflect this orientation. The Phoenix area drainage has been to the southwest since Late Triassic times, when Central Arizona was uplifted.

The Triassic orogeny was followed by a period of erosion and sedimentation which filled the intermontane basins with several thousand feet of sediments. The Colorado Plateau north of the Mogollon Rim was elevated near the end of the Cretaceous Period, after which late Pliocene volcanism deposited several thousand feet of volcanic rock that capped the mountains and intruded the sediments.

Coarse granular and alluvial fan materials were deposited during the Tertiary and Quaternary periods. This was caused by uplift of the high plateau country north of the Mogollon Rim which began in the Cretaceous period and involved a corresponding subsidence of the area to the south and west. These orogenic movements resulted in deep erosion of the highland country and rapid filling of the valley areas.

A more recent erosional phase of the Salt River, associated with a period of drier climate is evidenced in the Mesa Area by terraces of coarse granular material located about 50 ft. above the present channel. These terrace levels are obscured in the Phoenix area by alluvial fan deposits.

C. STRATIGRAPHY AND LITHOLOGY OF THE PHOENIX BASIN DEPOSITS

The stratigraphy of the Phoenix Basin is characteristic of an intermontane basin. Streams flowing from the north and east deposit coarse grained sediments in stream channels that cross the subsiding basin. Along the margins of the mountains, the steam-transported coarse-grained material spread toward the basin as alluvial fans.

In areas outside the normal stream channels, where overflow circulation was restricted, the fine-grain sediments were deposited by sheet floods and intermittent flows from small drainages. The fine sediments consist of silty sands, silty and sandy clays with lesser amounts of highly plastic clays, and occasionally clean sands. Locally, evaporites occur in the upper portions of the valley fill and consist mainly of gypsum while halite is typical in the lower depths.

The source rocks comprising the valley fill in the Phoenix Basin are of varied lithology.

Major contributing areas and their principal rock types are as follows. The Phoenix Mountains, eight miles north of the city, consist of quartzites. Camelback Mountain, located near the northeast corner of Phoenix, consists of sandstone breccia and a coarse conglomerate overlying a granite and gneiss surface. Southeast of Phoenix, near Tempe, a coarse grained granite interspersed with basalt dikes can be found as well as a sedimentary series consisting of sandstone, breccia, and conglomerate capped by shale and andesite. The Salt River Mountains, south of the area, consist of a fine-grained biotite granite. The McDowell, Goldfield, and Superstition Mountains (all about 30 miles east to northeast of Phoenix, and drained by the Salt River) are composed chiefly of rhyolite and quartz latite. The majority of these rocks are durable, with high crushing strength, swelling clays. Some of the igneous rocks, however, weather into unstable, swelling clays. The relative occurrence of the various rock types in the alluvium is described in Chapter IV.

THE COARSE SAND AND GRAVEL DEPOSITS ARE KNOWN TO BE SEVERAL HUNDRED FEET THICK AT MANY LOCATIONS IN THE PHOENIX AREA. A DEEP WELL IN THE AREA, FOR EXAMPLE, WAS DRILLED TO A DEPTH OF 2,784 FT. WITHOUT REACHING BEDROCK. WELL LOGS IN THE AREA INDICATE THAT THE COARSE SAND AND GRAVEL AVERAGES FROM 100 TO 300 FT. THICK AND OVERLIES ABOUT 600 FT. OF CLAY AND SILT WHICH MAY BE OF LACUSTRINE ORIGIN.

D. DRAINAGE, GROUNDWATER, AND AREAL SUBSIDENCE

THE SALT RIVER DRAINAGE AREA IS ABOUT 13,700 SQ. MI. THE SOURCE OF THE SALT RIVER IS NEAR THE MOGOLLON RIM AND IT FLOWS ABOUT 1.5 MILES SOUTH OF THE PROJECT LOCATION IN A WEST-SOUTH-WESTERLY DIRECTION TOWARD ITS CONFLUENCE WITH THE GILA RIVER. THE REGION RECEIVES ITS 1- TO 10-INCH ANNUAL RAINFALL IN HEAVY CONCENTRATION, WITH FLASH FLOODING BEING COMMON. THE ARID CLIMATE OF THE PHOENIX IS TYPIFIED BY LONG HOT SUMMERS AND SHORT MILD WINTERS. BECAUSE EVAPORATION EXCEEDS 60 INCHES, WATER BECOMES A PRIME COMMODITY.

THE VALLEY FILL IS A LARGE STORAGE RESERVOIR AND AN IMPORTANT SOURCE OF WATER NECESSARY TO THE REGIONAL ECONOMY. IN THE AGRICULTURAL AREAS DEEP WELLS HAVE PENETRATED THE SEDIMENTS AND HAVE CAUSED THE WATER TABLE TO DECLINE 150 FT. BETWEEN 1941 AND 1961. THE U. S. GEOLOGICAL SURVEY STATES THAT THE WATER TABLE IN THE DOWNTOWN AREA HAS NOT DROPPED IN THE LAST TEN YEARS. THE WATER LEVELS MAY VARY LOCALLY, HOWEVER, WITH WATER "PERCHED" ON IMPERMEABLE LAYERS. THIS WATER MAY ORIGINATE FROM RAINFALL, IRRIGATION LOSSES, RIVER SEEPAGE, OR RESIDUAL WATER THAT IS TEMPORARILY TRAPPED AS THE WATER TABLE DECLINES. NO GROUNDWATER WAS ENCOUNTERED DURING THE SUBSURFACE INVESTIGATION FOR THIS PROJECT.

CONSOLIDATION OF THE LOOSE SEDIMENTS, AS WELL AS THE SEMI-CONSOLIDATED ROCKS, MAY OCCUR BECUASE OF THE INCREASED EFFECTIVE STRESSES WHEN THE GROUNDWATER IS LOWERED. THE RESULTING SUBSIDENCE IS ACCOMPANIED BY VERTICAL, AND SOMETIMES HORIZONTAL, SOIL DISPLACEMENT WHICH IS ASSOCIATED WITH CRACKS APPEARING ON THE EARTH SURFACE.

THE FOLLOWING LOCATIONS IN THE PHOENIX REGION HAVE EARTH CRACKS. IN THE BLACK CANYON AREA ABOUT 45 MILES NORTH OF PHOENIX THERE IS A FISSURE OCCURRING IN BASALT AND SEMI-CONSOLIDATED SEDIMENTARY ROCKS. A 10- TO 15-FT. VERTICAL DISPLACEMENT IS ASSOCIATED WITH A NORMAL FAULT. THERE IS NO SIGNIFICANT HORIZONTAL MOVEMENT.[1] IN THE CHANDLER HEIGHTS AREA ABOUT 30 MILES SOUTHEAST OF PHOENIX, FISSURES PARALLEL THE EXPOSED SEGMENT OF THE SANTAN MOUNTAINS. THE EARTH MATERIAL HAS ALSO PULLED APART BUT THERE IS NO DIFFERENTIAL HORIZONTAL OR VERTICAL MOVEMENT.(2) AT LUKE AFB, ABOUT 15 MILES NORTHWEST OF PHOENIX AN EARTH FISSURE ABOUT ONE MILE IN LENGTH HAS BEEN CAUSED BY GROUND WATER WITHDRAWAL.(3,4) IN PINAL COUNTY, ALONG THE WEST SIDE OF THE PICACHO MOUNTAINS EAST OF ELOY, INTERSTATE 10 AND A PARALLELING RAILROAD TRACK REQUIRE PERIODIC MAINTENANCE WHERE THEY CROSS A FRACTURE.

MEASUREMENTS INDICATE AS MUCH AS 7 FT. OF SUBSIDENCE AT THIS LOCATION.(5,6) FACTORS OTHER THAN GROUND WATER WITHDRAWAL, SUCH AS DEEP-SEATED STRUCTURAL MOVEMENTS, MAY HAVE BEEN AFFECTING THE EARTH MOVEMENTS IN SOME OF THE CITED CASES.

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(1) ROBINSON, G. M. AND D. E. PETERSON: "NOTES ON EARTH FISSURES IN SOUTHERN ARIZONA," USGS CIRCULAR 446, 1962.

(2) IBID.

(3) IBID.

(4) STULIK, R. S. AND F. R. TWENTER: "GEOLOGY AND GROUNDWATER OF THE LUKE AREA, MARICOPA COUNTY, ARIZONA," USGS WATER SUPPLY PAPER 1779-P, 1964.

(5) ROBINSON, G. M. AND D. E. PETERSON: "NOTES ON EARTH FISSURES IN SOUTHERN ARIZONA," USGS CIRCULAR 446, 1962.

(6) FIELDNOTES, ARIZONA BUREAU OF MINES, VOL. 2, NO. 3, SEPT. 1972.

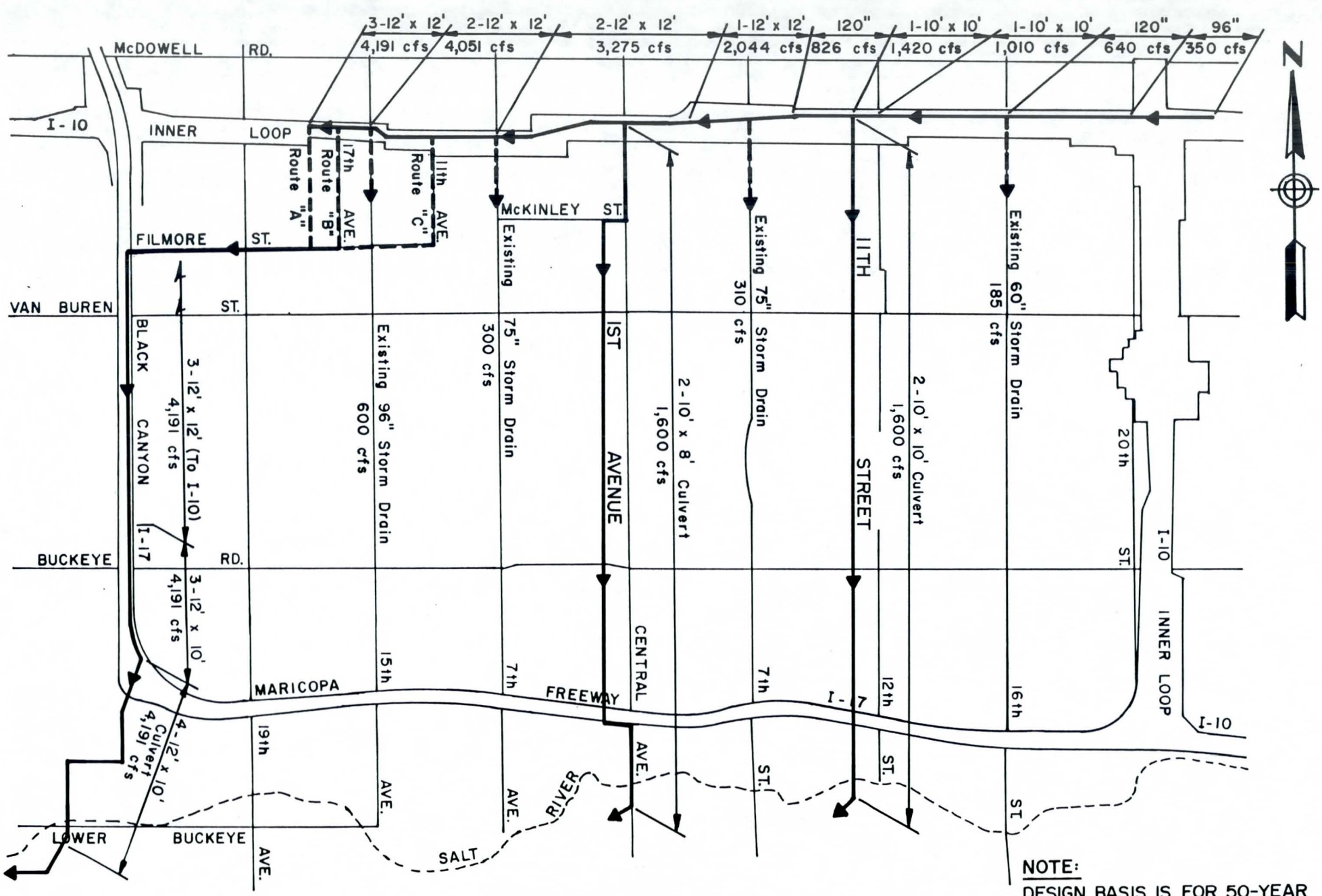
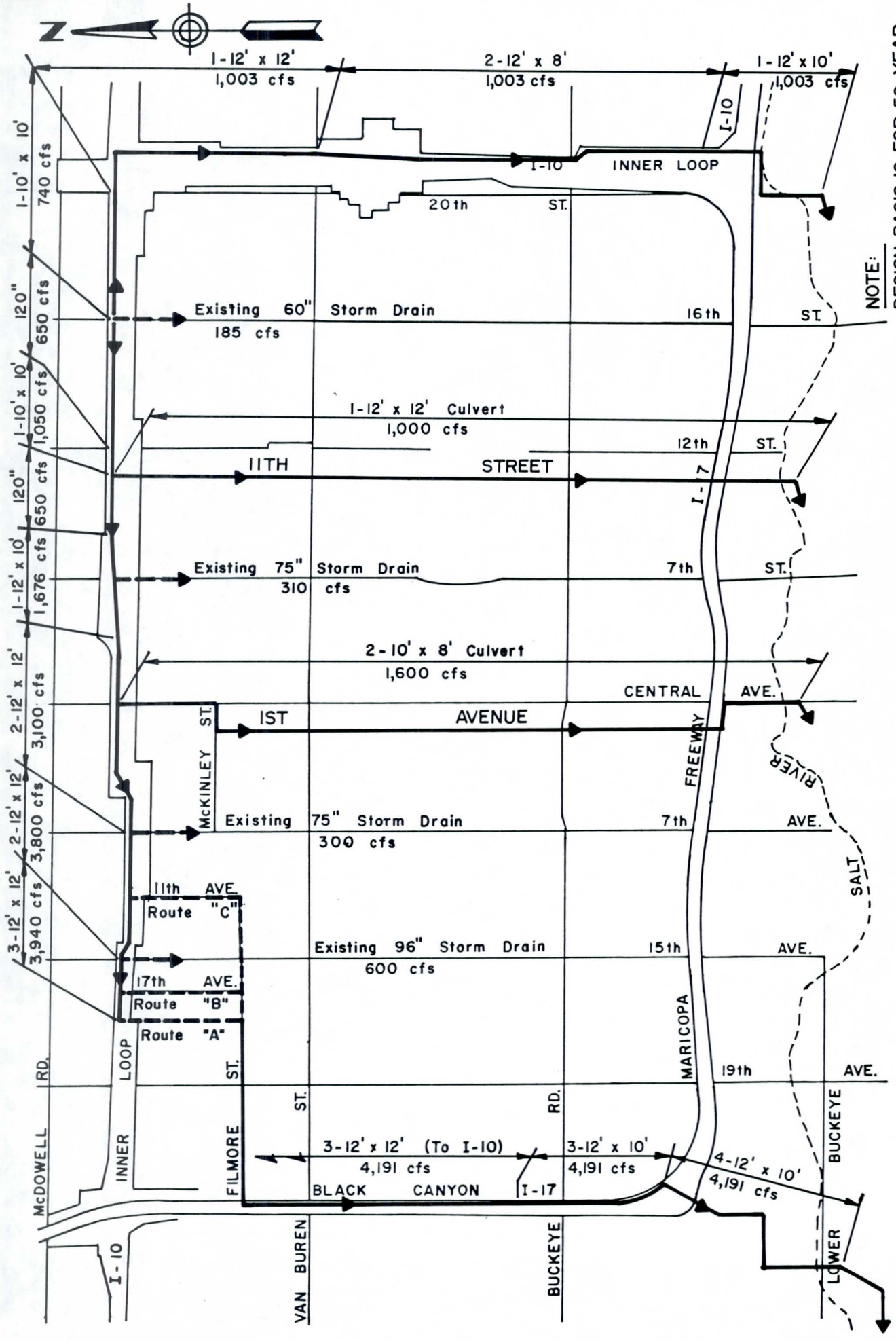


FIGURE 4

NOTE:
DESIGN BASIS IS FOR 50-YEAR FREQUENCY STORM.

ALTERNATE CONCEPT I
GENERAL PLAN AND FLOW SCHEMATIC



NOTE: DESIGN BASIS IS FOR 50-YEAR FREQUENCY STORM.

Sept., 1982

ALTERNATE CONCEPT II
GENERAL PLAN AND FLOW SCHEMATIC

FIGURE 5

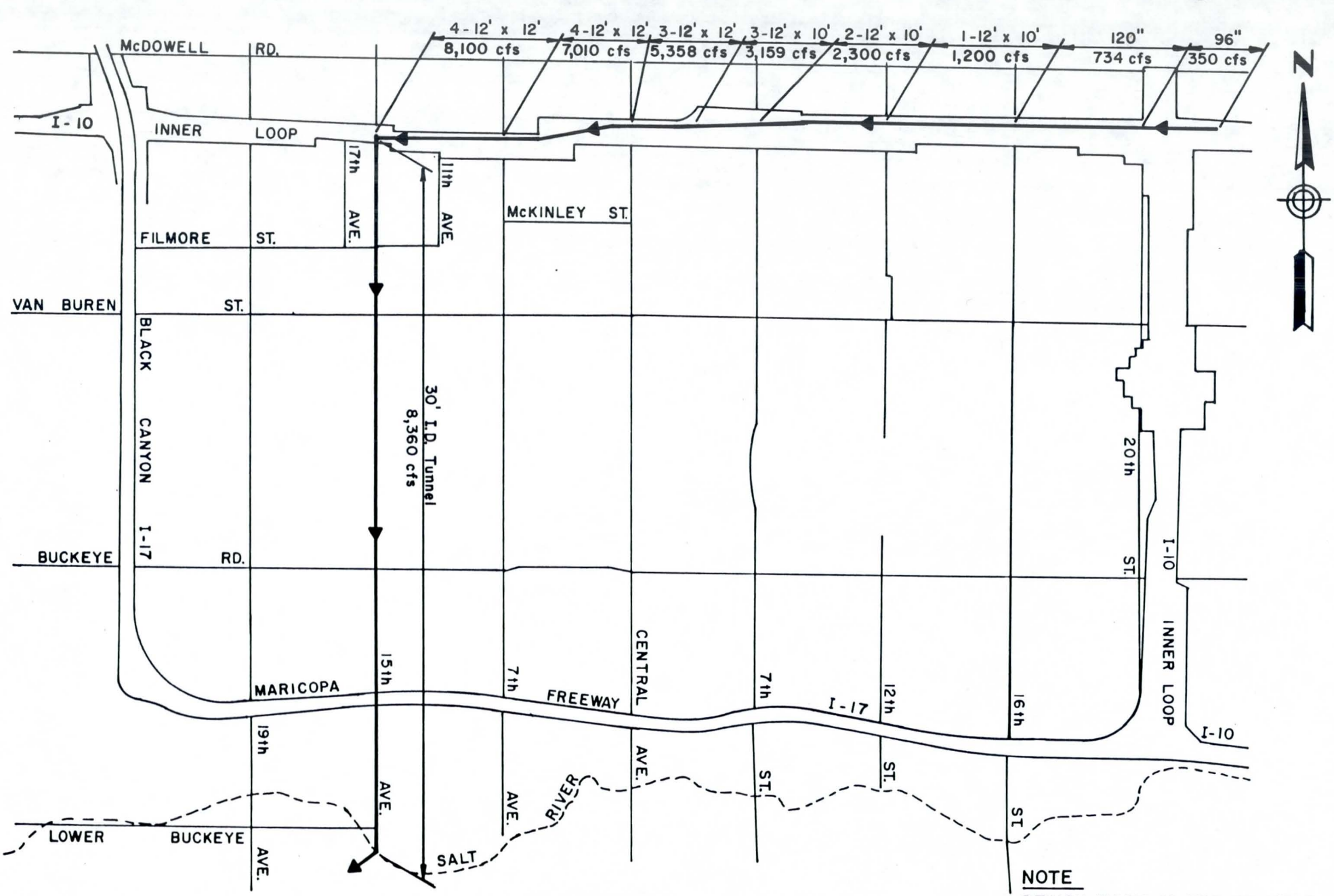


FIGURE 6

ALTERNATE CONCEPT III
GENERAL PLAN AND FLOW SCHEMATIC

NOTE
DESIGN BASIS IS FOR 50-YEAR FREQUENCY STORM.

arthur beard engineers, inc.

Sept., 1982

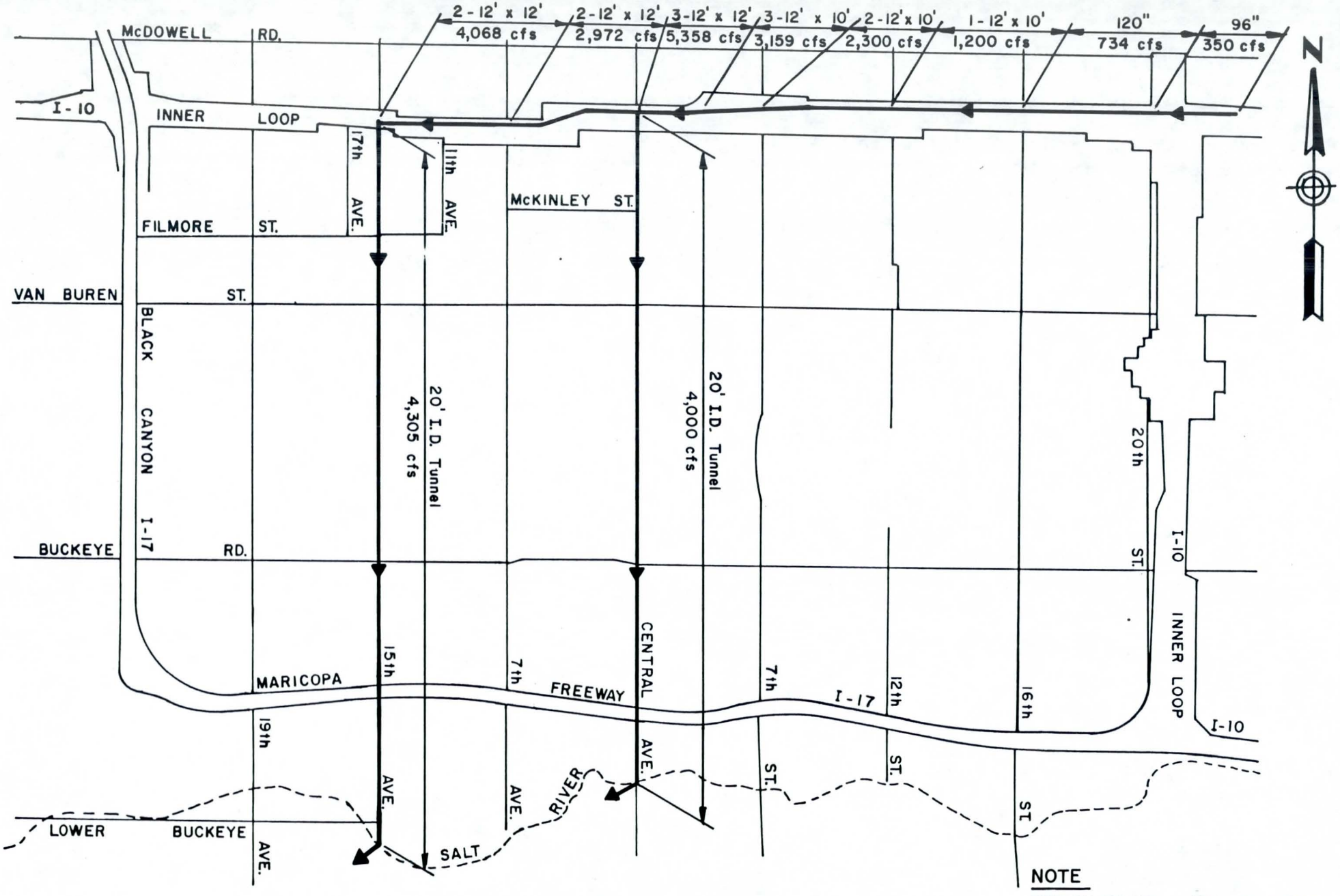


FIGURE 7

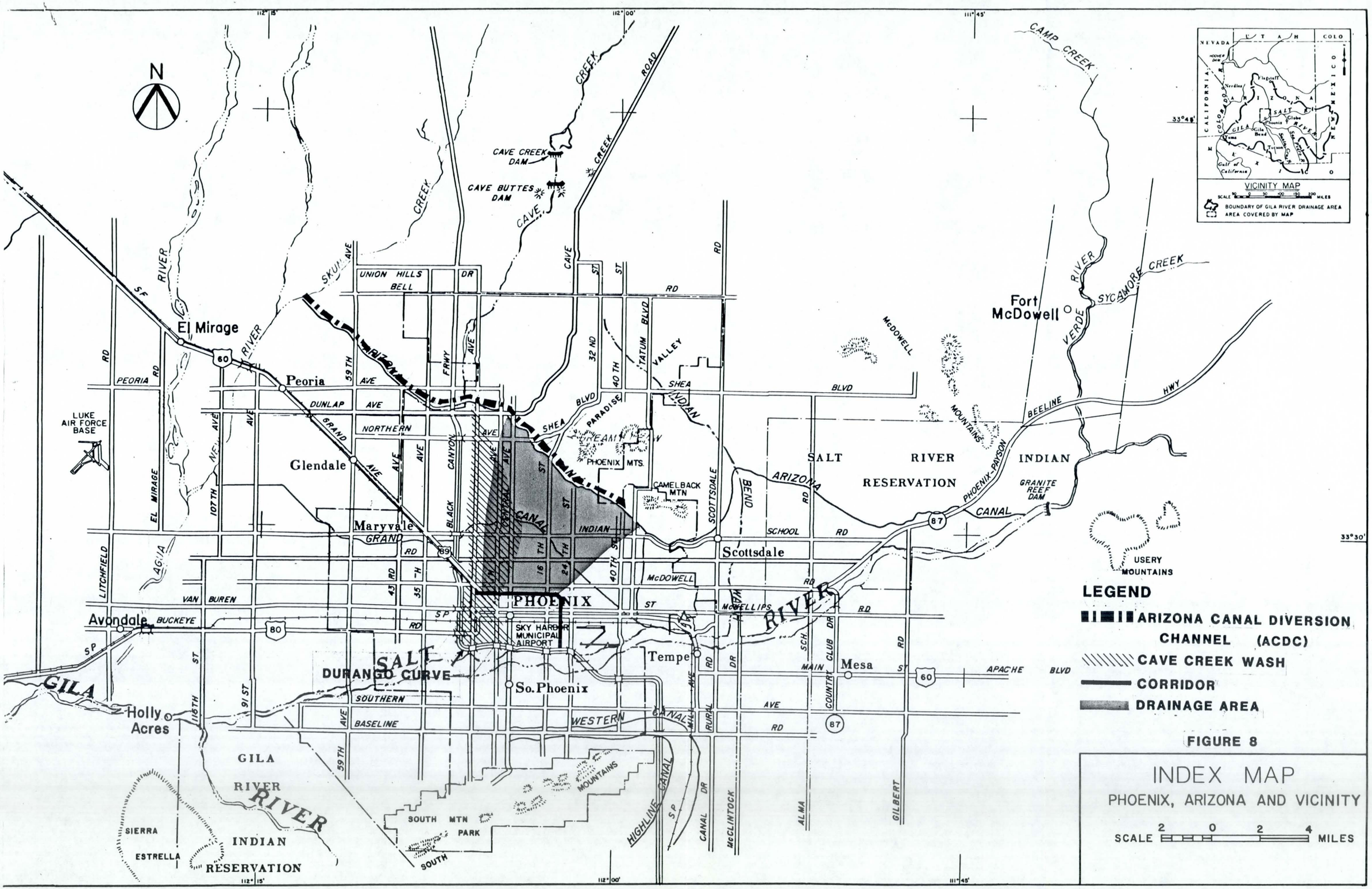
ALTERNATE CONCEPT IV
GENERAL PLAN AND FLOW SCHEMATIC

NOTE

DESIGN BASIS IS FOR 50-YEAR FREQUENCY STORM.

arthur beard engineers, inc.

Sept., 1982



LEGEND

- ARIZONA CANAL DIVERSION CHANNEL (ACDC)
- CAVE CREEK WASH
- CORRIDOR
- DRAINAGE AREA

FIGURE 8

INDEX MAP

PHOENIX, ARIZONA AND VICINITY

SCALE 2 0 2 4 MILES

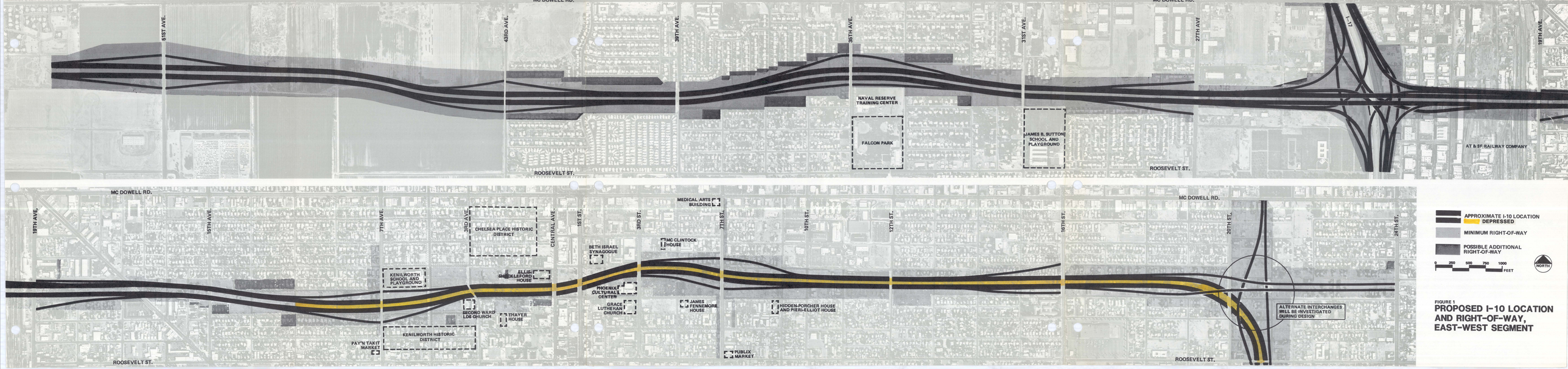


FIGURE 1

PROPOSED I-10 LOCATION AND RIGHT-OF-WAY, EAST-WEST SEGMENT

HOWARD NEEDLES TAMMEN & BERGENDOFF

September 30, 1982

	CH ENG	/	HYDRO
	ASST		LMgt
	ADMIN		SUSP
	C & O		FILE
	ENGR		DESTROY
	FINANCE		
REMARKS			

Mr. Dave Johnson
Flood Control District of Maricopa County
3335 West Durango
Phoenix, AZ 85009

Dear Mr. Johnson:

We are pleased that you will be able to participate in the Value Engineering brainstorming session on the I-10 Inner Loop storm drainage system in Phoenix. The purpose of this session will be to generate ideas and concepts worthy of further evaluation in an attempt to reduce the construction cost of this system.

I am attaching some background information for your use in preparing for this session:

An index map of Phoenix and Vicinity
Map of Interstate 10 project area
Executive Summary of the other consultant's work
Map of the Drainage Area
50-year Flow Routing Map
100-year Flow Routing Map
Schematic Layout of four (4) alternatives proposed by the consultant
Brief Discussion of the Salt River Valley Geology

I am also attaching a preliminary copy of our brainstorming session agenda. Please note that there will be a tour of the project area originating at HNTB's office on Monday, October 4 to acquaint persons not familiar with the characteristics of the drainage area.

We look forward to seeing you and to working with you on this project.

Sincerely,

HOWARD NEEDLES TAMMEN & BERGENDOFF

Robert D. Miller

Robert D. Miller

RDM:jp
Attachments

Architects Engineers Planners

2211 East Highland Street, Suite 100, Phoenix, Arizona 85016, 602 957-1931

Partners James F. Finn PE, Paul L. Heineman PE, Gerard F. Fox PE, William M. Wachter PE, Browning Crow PE, Charles T. Hennigan PE, Edgar B. Johnson PE, Daniel J. Watkins PE, Ralph E. Myers FAIA, Daniel J. Spigai PE, John L. Cotton PE, Francis X. Hall PE, Robert S. Coma PE, Donald A Dupies PE, William Love AIA, William C. Meredith PE

Associates Daniel J. Appel PE, Robert W. Richards PE, Don R. Ort PE, Frederick H. Sterbenz PE, Robert B. Kollmar PE, Kendall T. Lincoln CPA, Jack P. Shedd PE, Roberts W. Smithem PE, Jack C. Thompson PE, Richard D. Beckman PE, John A. Eggen, Jr. AIA, Lloyd H. Bakan, Harry D. Bertossa PE, Ralph E. Robison PE, Cecil P. Counts PE, Stephen G. Goddard PE, Harvey K. Hammond, Jr. PE, Stanley I. Mast PE, Robert D. Miller PE, Robert W. Anzia PE, Marvin C. Gersten PE, Cary C. Goodman AIA, Walter Sharko PE, Gordon H. Slaney, Jr. PE, James L. Tuttle, Jr. PE, James O. Russell, PE, Hugh E. Schall, PE

Offices Alexandria, VA, Atlanta, Baton Rouge, Boston, Cape Coral, FL, Casper, WY, Charleston, SC, Charleston, WV, Chicago, Cleveland, Dallas, Denver, Fairfield, NJ, Houston, Indianapolis, Kansas City, Los Angeles, Miami, Milwaukee, Minneapolis, Newark, DE, New York, Orlando, Overland Park, KS, Philadelphia, Phoenix, Seattle, Tampa, Tucson, Tulsa, Penang, Malaysia, Rio de Janeiro, Brazil

PHOENIX, ARIZONA

I-10 INNER LOOP

STORM DRAINAGE SYSTEM

VALUE ENGINEERING STUDY
BRAINSTORMING GROUP

A G E N D A
(Preliminary)

Monday, October 4, 1982

HNTB I-10 Project Management Ofc.
2211 East Highland Avenue
Phoenix, Arizona (602) 957-1931

1:45 P.M.	Initial Briefing of Project Area
2:00 P.M.	Field Tour of Project Area. Transportation Provided
4:30 P.M.	Return to HNTB Open Discussion Refreshments

Tuesday, October 5, 1982

Ramada Townehouse
100 W. Clarendon Avenue
Phoenix, AZ (602) 279-9811

8:00 A.M.	Project Introduction
9:30 A.M.	Break
9:45 A.M.	First Brainstorming - Speculative Phase - Two Groups
11:30 A.M.	General Discussion - Combined Groups
12:00 Noon	Lunch - (Provided)
1:00 P.M.	Second Brainstorming - Analytical Two Groups
2:45 P.M.	Break
3:00 P.M.	General Discussion - Combined Groups
3:30 P.M.	Summary and Consensus - Combined Groups
4:30 P.M.	Adjournment

HOWARD NEEDLES TAMMEN & BERGENDOFF

I-10 PROJECT MANAGEMENT

September 27, 1982