FINAL

DRAINAGE REPORT

FOR

SUPERSTITION FREEWAY

STATE ROUTE 360
POWER ROAD TO ELLSWORTH ROAD

ADOT PROJECT NO. SBM-028-1-311PE, 511C

STATE OF ARIZONA

DEPARTMENT OF TRANSPORTATION

Prepared By

URS CORPORATION

SEPTEMBER 1988

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Felicia Lerny

Hydrologic Design Manual

for Maricopa County, Arizona

Prepared by the

Special Projects Branch
Hydrology Division
Flood Control District
of Maricopa County

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URS
A PROFESSIONAL SERVICES ORGANIZATION

URS CONSULTANTS
TWO GATEWAY
432 NORTH 44th STREET
SUITE 163
PHOENIX, ARIZONA 85008
TEL: (602) 273-6646

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October 5, 1988

Sverdrup Corporation
Arizona Statewide Management Consultant
432 N. 44th Street, Suite 300
Phoenix, Az 85008

Attention: Mr. Rick Simon

Re: Superstition Freeway
Power Road to Ellsworth Road
Contract No. 85-39
ADOT Project No. SBM-028-1-311PE, 511C

Dear Mr. Simon:

Forwarded herewith are five copies of the sealed Final Drainage Report for the Power Road to Ellsworth Road segment of the Superstition Freeway. This constitutes the final submittal for the Final Drainage Report. The report documents the development of the recommended on-site and off-site drainage system of channels, ponds, collection system and trunklines, which are a part of the three construction phases for this project. Included herein are the background, criteria and methods, hydrology, and hydraulics supporting the final drainage design. In addition, the responses to your final review comments have been incorporated into this report.

If you have questions, please do not hesitate to contact me.

Yours very truly,

URS CONSULTANTS

Rod H. Schrengohst, P.E.
Project Manager

RHS;cle

Enclosures

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Registered Professional Engineer (Civil)
CERTIFICATE NO. 11291
CLIFFORD RAY
ARIZONA, U.S.A.

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EXECUTIVE SUMMARY

This report documents the final drainage design for the three-mile segment of the planned Superstition Freeway (State Highway 360) between Power Road and Ellsworth Road. This report was prepared by URS Corporation under contract to the Arizona Department of Transportation (ADOT).

The project is located in eastern Maricopa County, partially within the City of Mesa corporate limits. The project consists of a six-lane, undivided freeway (with a Jersey Barrier along the centerline) and drainage appurtenances; this segment of the freeway has a depressed profile, with the exception of the Sossaman Channel crossing.

The drainage area tributary to the freeway consists largely of urbanized areas with undeveloped parcels interspersed between the residential and commercial developments. The upper end of the drainage area is bounded by the Central Arizona Project aqueduct, with additional flows being introduced by the aqueduct's over-chutes. Due to the general slope of the land, flows are conveyed to the southwest. Runoff is conveyed by Overland flow in the upper reaches and by collector channels and street conveyance in the lower reaches. This segment of the freeway intercepts several of these channels, including the Hawes Road Channel, the Sossaman Road Channel, and the 72nd Street Channel. Because of the depressed freeway profile, flows must be collected along the north right-of-way line and routed to outfall locations which permit the drainage to pass under the freeway to the south. Flows from the area are ultimately discharged to the Gila River.

The Flood Control District of Maricopa County is currently developing a Master Drainage Plan for the area. Because of its comprehensive nature and recent preparation, the hydrologic modeling of the master plan was used, with appropriate modifications, as a design basis for the freeway off-site drainage concept study. This proved to be inadequate, however, for preliminary design, due primarily to the imprecision of several key assumptions and the required level of detail. A complete off-site hydrologic analysis was performed for preliminary design of this project. The hydrologic calculations of this analysis are reflected in this report.

The recommended design for off-site drainage is to provide conveyance via two concrete-lined channels in combination with detention ponds along the freeway north right-of-way line. The westerly channel (Channel No. 1) will extend from a point to the west of the Sossaman Channel to a connection with the existing ADOT channel east of Power Road; flow will be in a westward direction. The outlet for flows in Channel No. 1 is the Roosevelt Water Conservancy District (RWCD) Floodway. The easterly channel (Channel No. 2) will receive flows at its upstream end from the major detention pond (by Coe and Van Loo) to be constructed to the east of Ellsworth Road as part of the Phase II construction. These flows will be conveyed to the channel by a pipe under Ellsworth Road, from which point the channel will extend westward, discharging to the Sossaman Channel. A connection to the existing East-West Channel will be retained as an interim measure until the major detention pond is constructed. The future Red Mountain/Superstition Freeway interchange will be constructed in the area between Ellsworth and Hawes Roads.

Roadway drainage for the freeway and the crossroads will be accomplished by a series of storm sewer systems with inlets along the cross-road overpasses and the freeway. The storm sewer outfalls will discharge to the right-of-way channels.

The recommended off-site drainage design achieves the design objective of safely conveying off-site runoff around and under the freeway without increasing flooding problems on downstream property. This is achieved by;

a. maintaining minimum freeboard requirements along the channels,

b. not exceeding existing flooding elevations at Power Road for the 50-year and 100-year flood flows,

c. not increasing the net discharge into the RWCD Floodway from the combined freeway discharges.

The recommended on-site drainage design achieves the design objective of draining the roadways for the design storm rainfall.

As currently proposed, the freeway project will be constructed in three phases, as follows:

a. Phase I.

The first phase will include construction of cross-road overpasses (at 72nd Street, Sossaman Road, and Ellsworth Road), box culverts under Sossaman Road and the relocated 72nd Street, storm sewerage associated with the cross-roads, and cross-road paving.

b. Phase II.

This phase includes the major earthwork for the freeway, the off-site drainage system, and the outfall pipe for Storm Sewer Trunkline No. 1.

c. Phase III.

Phase III includes construction of the remainder of the on-site drainage and paving of the mainline and ramps.

It should be noted that the on-site drainage system will not be operational until completion of Phase III construction.

I. INTRODUCTION

A. General

This report documents the hydrologic studies and hydraulic design elements that constitute the preliminary drainage design for the planned segment of the Superstition Freeway (State Highway 360) between Power Road and Ellsworth Road. The design of this segment of the freeway constitutes Arizona Department of Transportation (ADOT) Project No. SBM-028-1-311PE, -511C.

This work was performed by URS Corporation (URS) under ADOT Contract No. 85-39, dated April 24, 1986. The report presents the recommended design of the storm drainage collection system for off-site and on-site runoff.

Subsequent to completion of the Drainage Concept Study, prepared by URS and submitted to and approved by the Management Consultant in 1987, construction of the project and plan submittals were divided into three phases. Elements of the off-site and on-site drainage systems are required in all three construction phases. Phase I encompasses cross-road construction with the associated inlets and storm sewers and those portions of the off-site runoff conveyance system that pass under the cross-roads (i.e., box culverts and pipe). Phase II construction includes the roadway grading, construction of all channels and detention ponds (i.e., off-site runoff conveyance) and installation of the storm sewer outfall line for Channel No. 1. Included in Phase III construction are roadway paving and installation of the inlets, manholes, lateral pipes and the remaining storm sewers (on-site runoff conveyance). Rather than providing a separate drainage report with each submittal, it was determined to be more effective to present the drainage system design in its entirety under the cover of a single drainage report. However, an Interim Drainage Report was prepared by URS in conjunction with the Phase I submittal in order to clarify the phased construction of drainage improvements from Phase I through Phase III.

This report is the Final Drainage Report and incorporates review comments received on this report and on the Phases II and III construction plans.

B. Project Description

The segment of the Superstition Freeway under design will extend the freeway three miles in an easterly direction (from its present terminus vicinity) at Power Road to the vicinity of Ellsworth Road. The freeway will be six lanes, undivided, with provisions to allow it to be expanded to eight lanes in the future. The proposed profile for the roadway will be depressed, varying from 10 ft to 20 ft below existing grade, except for the planned over-crossing of the existing Sossaman Channel. As shown on the vicinity map in Fig. I, the freeway will have diamond traffic interchanges at Sossaman Road and at Ellsworth Road and a grade separation (underpass) at 72nd Street. Hawes Road will continue to terminate at the freeway right-of-way (as it currently does) since the Red Mountain/Superstition Freeway interchange will be constructed immediately to the east of Hawes Road at a future date. The project is located in eastern Maricopa County, partially within the corporate boundaries of the City of Mesa.

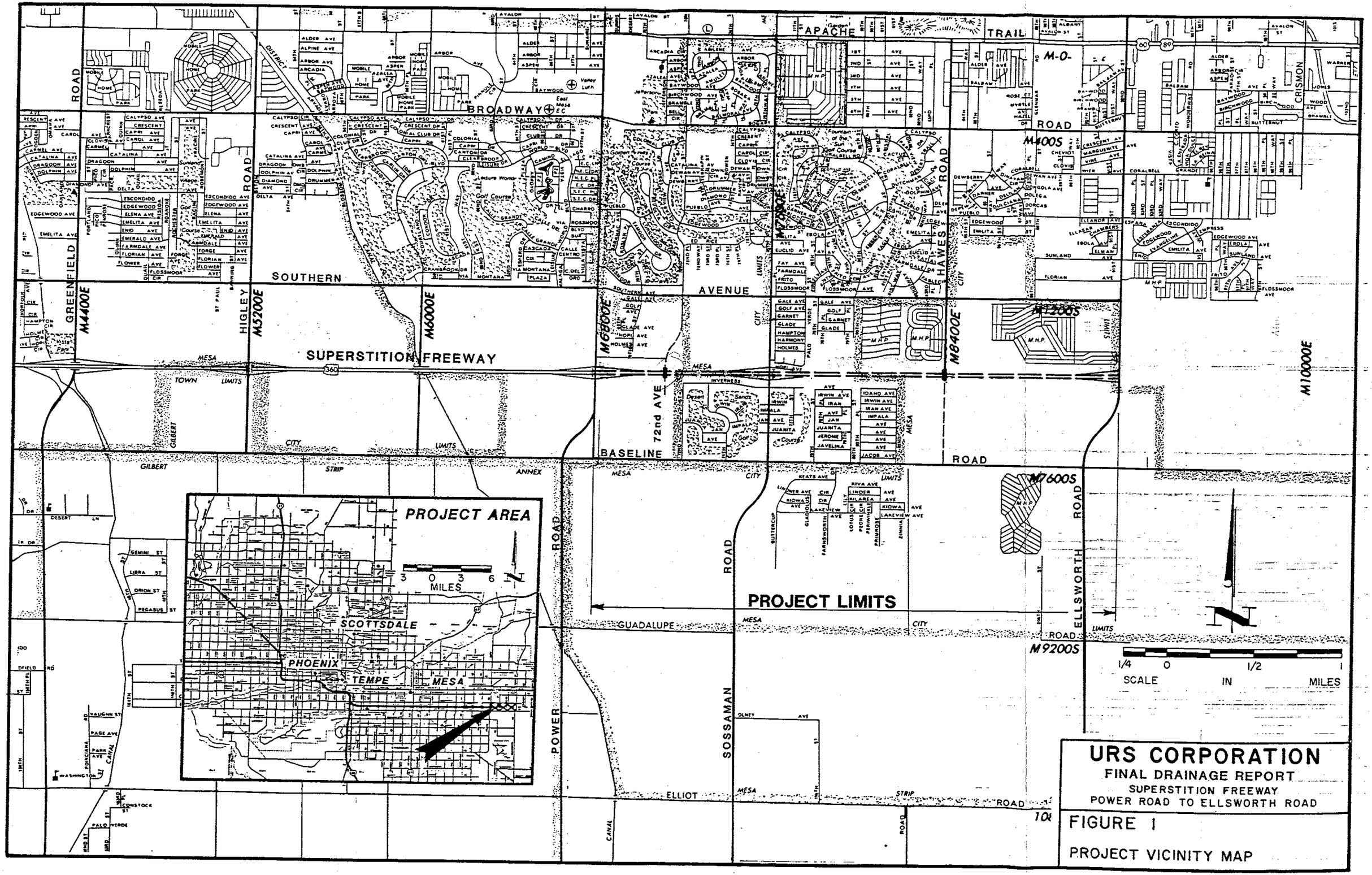


FIGURE 1

PROJECT VICINITY MAP

A corridor approximately 600-ft wide has been reserved for the freeway right-of-way. The horizontal alignment will occupy the southern half of the right-of-way to allow drainage features to be placed within the northern half. This will allow interception and conveyance of flows from the drainage basin, which lies to the north and east of this segment of the freeway.

The freeway section has a constant cross-slope of two percent from centerline to curb line. In depressed sections of the Freeway, landscaped side slopes will extend outward and upward from the edge of the roadway. Side slopes will extend downward and outward at elevated sections.

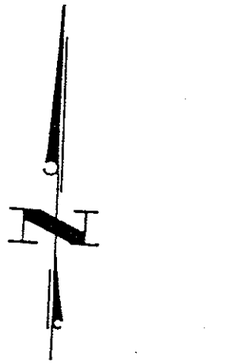
C. Study Area

The study area generally consists of the drainage area tributary to this segment of the freeway. The topography of the project area exhibits relatively little relief, and the land slopes to the southwest at a gradient of generally less than one percent. Land use of the area has been evolving from agricultural to high-density suburban residential and commercial within the last ten years; this process will continue in the foreseeable future.

Historically, flows through the project area were conveyed in a southwesterly direction by sheet flows and numerous small drainageways, as shown on Figure 2, ultimately discharging to the Gila River. Within this area, historic flow patterns have largely been interrupted by the construction of irrigation supply canals, drainage channels, and roadways, and by land leveling and re-grading for agricultural or development purposes. In general, the present drainage features have either an east-to-west, or a north-to-south orientation. Any runoff intercepted by these features is therefore redirected from historic flow paths. Thus, construction of this segment of the freeway will largely not interrupt drainage patterns currently in existence, with exceptions which will be discussed in Chapter IV.

D. Area Drainage Improvements

Local governmental agencies involved in drainage and flood control efforts in the vicinity of the project are the City of Mesa; the Maricopa County Highway Department; and the Flood Control District of Maricopa County (FCDMC). The FCDMC has been working on an area-wide basis with the Federal Soil Conservation Service (SCS) on two flood control projects. The first project is located to the northeast of this segment of the freeway and serves to reduce flood inflows to the area. This project consists of channels, dams, and dikes to divert the runoff from the vicinity of Spook Hill and the Usery and Goldfield Mountains to the Salt River. The second major area of drainage improvement is to the west of this segment of the freeway. It consists of a planned and partially constructed regional floodway, the Roosevelt Water Conservation District Floodway (RWCD Floodway), to convey stormwater flows to the Gila River. The U.S. Bureau of Reclamation's Central Arizona Project aqueduct has also modified drainage patterns in the area. In addition, the FCDMC is currently preparing the "Eastern Maricopa County Area Master Drainage Study" (AMDS) (being done under contract by A-N West, Inc.) (Ref. 1) which addresses the manner in which stormwater originating downstream of the SCS structures will be conveyed to the Floodway. The AMDS and resulting Eastern Maricopa County Master Drainage Plan (MDP) have not yet been adopted.



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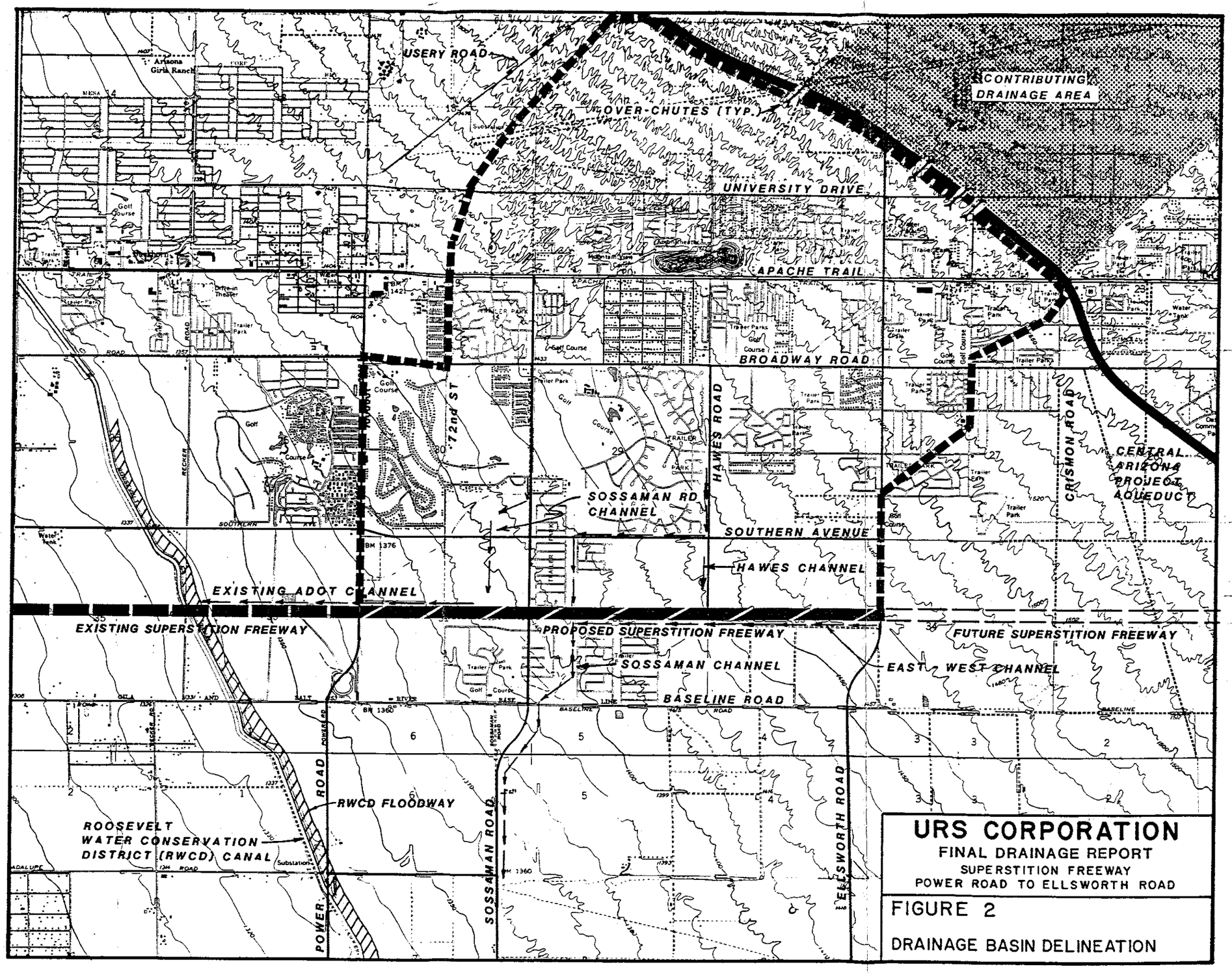

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FIGURE 2

DRAINAGE BASIN DELINEATION

E. Purpose

This drainage study was performed to identify and mitigate any adverse impacts that the freeway will have on existing runoff patterns.

The various elements of this study include:

a. Determination of the hydrology for the on-site drainage design;

b. Recommendation of an on-site conveyance system of inlets and storm sewers;

c. Identification of existing runoff patterns in the area of the project;

d. Determination of the hydrology for the off-site drainage; and

e. Recommendation of an off-site drainage conveyance system, including channels and detention ponds, that will mitigate adverse impacts and will convey off-site flows around or under the freeway to acceptable discharge points.

F. Study Approach

The study was conducted using the following approach:

1. Identification of Existing Drainage Conditions

This phase consisted of conducting a field reconnaissance; performing a field survey, which was supplemental to the roadway cross-section data provided by ADOT; collection and review of existing reports and other information relevant to the study area; meetings with representatives of governmental agencies and engineering consultants working on drainage and other freeway improvements in the area; determination of peak off-site flows entering the freeway corridor; and approximate determination of the existing 100-yr flood plain limits. For off-site flows, existing conditions represent the highest realistic design flows.

Off-site flows arriving at, and flowing along or through, the freeway corridor were determined by computer modeling techniques (HEC-1, Army Corps of Engineers) (Ref. 2.) Flow patterns, areas of local flooding and peak flows were determined at critical points along the freeway corridor. These analyses were performed for storms of 100-year and 50-year return periods. Off-site flows determined in the modeling included any runoff generated in the freeway corridor itself.

2. Design for Conveyance of Off-Site Storm Runoff

This phase consisted of the development of a conveyance system and storm water detention facilities for off-site flows. Off-site flows will be conveyed along the north side of the roadway by means of open channels to suitable crossing points at which conveyance is provided under the roadway. A large detention pond, designed by Coe & Van Loo and to be constructed by ADOT, just north and east of the Ellsworth Road crossing will have as its outlet a 48-in. pipe which will daylight to the west. This pipe is extended to meet the invert of Channel No. 2 (between Ellsworth Road and the Sossaman Channel) and has as its ultimate outfall the Sossaman Channel.

3. Determination of On-Site Flows

Peak design flows for runoff originating on the Freeway itself were determined. These included flows after project construction only.

4. Design for Conveyance of On-Site Flows

On-site flows will be collected by inlets at the cross-roads, along the ramps and along the depressed sections of the freeway. Flows from the inlets will be collected by lateral pipes and discharged into a main trunkline, or directly into the off-site conveyance system. The main trunklines will discharge into the off-site conveyance system. Inlets and laterals will serve to remove storm runoff from the segment of the roadway which is above existing grade.

5. Recommendation of Design for an Efficient and Cost-Effective Storm Water Conveyance System

The design described and depicted in this final drainage report is shown on the Phase I, Phase II and Phase III construction plans for the Superstition Freeway between Power Road and Ellsworth Road. The recommended design represents a cost-effective conveyance system which maintains, as closely as possible, existing drainage patterns and which accommodates future development and planned future area drainage system improvements. Within the right-of-way limits, peak flows from the 100-yr. storm event will be contained within the proposed lined channels without overtopping onto adjacent property.

II. BACKGROUND

A. Existing Drainage Conditions

The overall drainage area which currently contributes runoff to the Superstition Freeway corridor within the project limits is shown on Fig. 2. The upper end of the defined drainage basin is established by the Central Arizona Project (CAP) aqueduct. Although the aqueduct provides a physical barrier, over-chutes across it contribute flood flows from uphill areas. The lower end of the basin is the freeway corridor.

The drainage basin boundaries are defined as follows: The west boundary extends north along Power Road from the freeway corridor to Broadway Road and thence east to 72nd Street. From the intersection of 72nd Street and Broadway Road, the basin boundary extends northward to just north of Apache Trail and thence northeastward to the CAP aqueduct. The basin boundary follows the aqueduct to the southeast (not considering the area contributing to the over-chutes) to Apache Trail. From Apache Trail the boundary extends southwestward to a point approximately 2700-ft east of Ellsworth Road and 600-ft north of Broadway. From there, the boundary extends south for approximately 2400-ft, southwesterly approximately 3500-ft. to Ellsworth Road, and thence southerly along Ellsworth Road to the freeway corridor. The present contribution to flows west of Ellsworth Road from the area east of Ellsworth Road is also considered. The described boundaries are as determined by URS and vary slightly from those of the MDP. The boundaries presented in the MDP include an area east of Ellsworth Road and south of Broadway Road. In the hydrologic analysis performed for the preliminary drainage report, it was determined that at low flows 100 percent of the runoff from this area is tributary to the freeway corridor. Flows exceeding the capacity of the culverts under Ellsworth Road split on the east side of Ellsworth Road. The excess flows overtop the existing channel banks and are conveyed south toward Baseline Road. For the purposes of this report, the eastern boundary is considered to proceed south along Ellsworth Road to the freeway. As indicated, the flow split from the area east of this boundary is included in the analysis. It should be noted that the freeway extension is oriented east-west, and that this alignment traverses the drainage basin diagonally, relative to the direction of historic flows.

The RWCD Canal and the partially completed RWCD Floodway serve to intercept flood flows which originate in the basin. These flows are diverted in a southerly direction, to be discharged to the Gila River.

The historic drainageways have largely been re-defined during the transformation of the basin from an undeveloped condition to agricultural and finally to residential and commercial land use. The various subdivisions have created barriers which serve to divert the sheet flow either due west or due south in lieu of the historic southwesterly flow pattern. The existing drainage pathways typically follow street rights-of-way or other surface drainage courses. Sheet flow occurs across vacant parcels between or around existing developments.

There are several major drainageways, including the Hawes Road Channel, the Sossaman Road Channel, and the 72nd Street Channel, which are intersected by the freeway corridor at the north right-of-way line. For the most part, these drainageways follow established channels which convey the flows to the south or west. A major existing drainage feature is the East-West Channel along the south right-of-way line from Ellsworth Road to the Sossaman Channel. The East-West Channel currently conveys a

portion of the off-site flows which originate east of Ellsworth Road, plus the intercepted sheet flows which cross the corridor. Fig. 3 shows the locations of these major drainageways. For the purposes of this report the drainageways are grouped into four systems as follows:

1. 72nd Street
2. Sossaman Road
3. Hawes/Sossaman System
4. Ellsworth Road/East-West Channel

Brief descriptions of the four systems are provided below:

1. 72nd Street

The 72nd Street drainageway begins at Apache Trail. From Apache Trail to Broadway Road an unimproved drainage and utility easement conveys the flows. At Broadway the flow is channeled into a two-bay 6 ft x 3 ft reinforced concrete box (RCB) culvert which discharges onto the depressed 72nd Street cross-section. From Colonial Club Drive to Southern Avenue, 72nd Street has an inverted cross-section to convey the storm water runoff. 72nd Street is paved for approximately 700 ft south of Southern Avenue. At this point the conveyed runoff enters an unlined channel (flowing southerly) which, in turn, discharges to the unpaved channel running parallel to the north right-of-way line of the Superstition Freeway.

The north right-of-way channel extends from Power Road to the east for approximately 3,000 ft and conveys the 72nd Street and Sossaman Road runoff into the existing Superstition Freeway channel at Power Road. The latter channel is a trapezoidal concrete-lined channel which discharges to the RWCD Floodway.

2. Sossaman Road

The Sossaman Road drainageway begins collecting flows at the Double Knolls in the vicinity of Apache Trial and 81st Street. From this point a small trapezoidal concrete-lined channel conveys flows southwest and forms the north and west boundaries of the Carriage Manor development between 79th Street and Sossaman Road.

At the intersection of Broadway Road and Sossaman Road there is a single 6 ft x 3 ft RCB culvert that conveys the flows southward along the east right-of-way line. At the southeast corner of the intersection, paved rundown channels facilitate the collection of sheet flows in the Broadway Road right-of-way into the Sossaman Road drainageway. From Broadway to Pueblo Way the drainageway is unlined, depressed 2 ft and bounded by the north travel lane and a concrete block security fence. Pueblo Way crosses the drainageway by utilizing a two-bay 6 ft x 3 ft RCB culvert. Between Pueblo Way and Ed Rice Street the collected runoff sheets across a vertical sag in Sossaman Road from the east to the west right-of-way line.

Ed Rice Street crosses the drainageway over a two-bay 6 ft x 3 ft RCB culvert. An unimproved depressed pathway runs southward from Ed Rice Street to Euclid Avenue. At Euclid Avenue the flow path is not clearly defined. Some runoff enters an overgrown side channel which heads west at a 90 degree angle to the direction of the incoming flow. The remaining flows continue southward, in the form of sheet flow and street flow, toward the freeway corridor. The small side channel extends westward

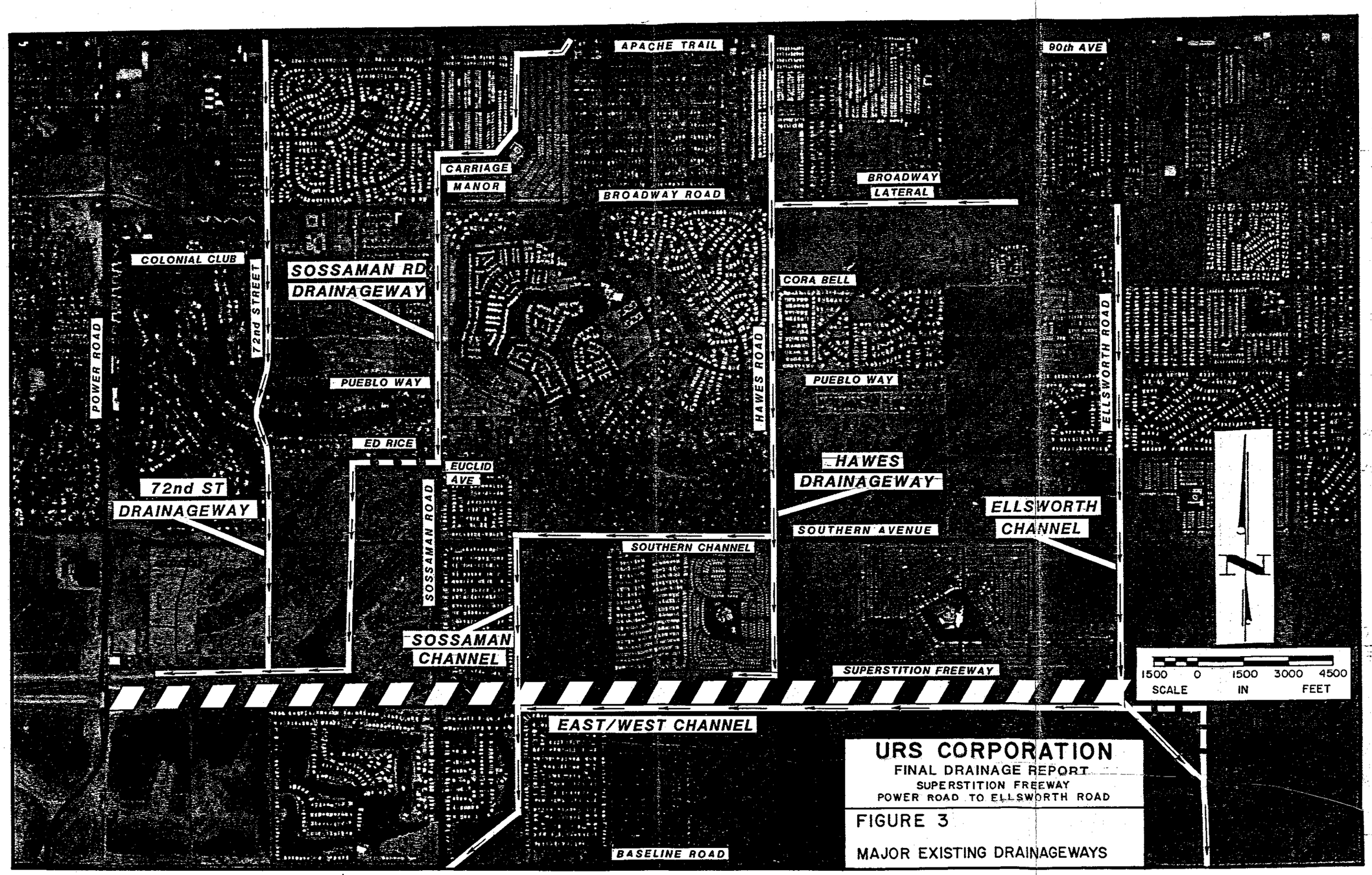

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FIGURE 3

MAJOR EXISTING DRAINAGEWAYS

from Sossaman Road a distance of 1,200 ft, then it turns south and widens to a 30-ft wide by 2-3 ft deep unlined channel. This channel flows south for approximately 3,500 ft to the north right-of-way line of the freeway. At this point, the discharged flows are conveyed westward to the RWCD Floodway as described in the 72nd Street discussion.

A storm sewer, constructed as a part of the recent Sossaman Road: Baseline Road to University Drive, roadway improvement project (Maricopa County Highway Department) serves to convey low flows south along Sossaman Road to the freeway right-of-way. During conditions of high runoff (i.e., during the 50-year and 100-year storm events) the flow patterns are as described above.

3. Hawes/Sossaman System

The Hawes Road drainageway is a north-to-south stormwater collector that receives inflows from the east by the discharge of several laterals. These laterals are located at Broadway Road, Pueblo Way, and Southern Avenue. The laterals collect southwesterly directed sheet flow from undeveloped parcels of land between Southern Avenue and Apache Trail. The principal lateral is at Broadway. On the north side of Broadway Road a recently constructed lined ditch conveys flows westward from 91st Street to Hawes Road. The ditch has a trapezoidal cross-section with a bottom width of 10 to 16 ft and a depth of three to four ft. Between 91st Street and Hawes Road the channel passes through six box culverts. At Hawes Road the channel turns 90 degrees to the south and passes through a new double 10 ft x 6 ft concrete box culvert under Broadway Road. Construction plans for the improvements along Broadway indicate a horizontal curve at the Hawes Road intersection. The resulting super-elevation through the intersection slopes down to the south and has the effect of directing any channel overflow to the south with no flow heading west along Broadway. These improvements were under construction in the late spring of 1987 by the Maricopa County Highway Department.

From Broadway Road to Coral Bell Avenue the Hawes Road drainageway is a well-defined earth channel running parallel to the east right-of-way line. Between Coral Bell Avenue and Pueblo Way, the collected runoff sheets across a vertical sag in Hawes Road from the east to west right-of-way line. From Pueblo Way to Southern Avenue the unlined Hawes Road channel occupies the majority of the right-of-way since the street is not paved. At Southern Avenue the runoff is split and flows are directed both to the south and to the west. Southward-directed flows pass through a two-bay 8 ft x 4 ft RCB culvert. Westward-directed flows are conveyed by means of a concrete-lined side channel. This side channel is approximately 10-ft wide and conveys flows to the Sossaman channel. At its westerly end, the side channel turns 90 degrees to the south under Southern Avenue to enter the Sossaman Channel. The reach of side channel approaching this bend is prone to siltation and must be periodically cleaned.

The Hawes Road drainageway continues southward in a concrete-lined channel from Southern Avenue to the north right-of-way line of the freeway. At the intersection with the north right-of-way line, the channel turns sharply to the west, and the flows are discharged to an earth channel that daylights onto the freeway corridor. The released runoff becomes overland flow that sheets across the freeway right-of-way in a

southwesterly direction for approximately 2,400 ft. The Hawes Road system sheet flow is re-collected by the Sossaman Channel where the channel intersects the south right-of-way line of the freeway.

The Sossaman Channel is unlined and has a varying cross-section between Southern Avenue and Baseline Road. This segment of the channel receives inflows at Southern Avenue, at the south right-of-way line of the freeway (East-West Channel), and at Baseline Road. The stormwater inflow at the freeway south right-of-way line represents the combining of three drainage sub-basin runoff flows:

a. A portion of Ellsworth Channel flow via the East-West Channel,

b. Overland flow from the freeway corridor between Ellsworth Road and the Sossaman Channel, and

c. Overland flow from the daylighted Hawes Road channel.

Flows in the Sossaman Channel are conveyed under Baseline Road through a four-bay 10 ft x 8 ft RCB culvert. The channel continues southward to Guadalupe Road where the flow is daylighted to existing farm land. At Guadalupe Road there is an unlined side channel that directly conveys the runoff westward to Power Road. At Power Road runoff is directed south and eventually reaches the RWCD Floodway.

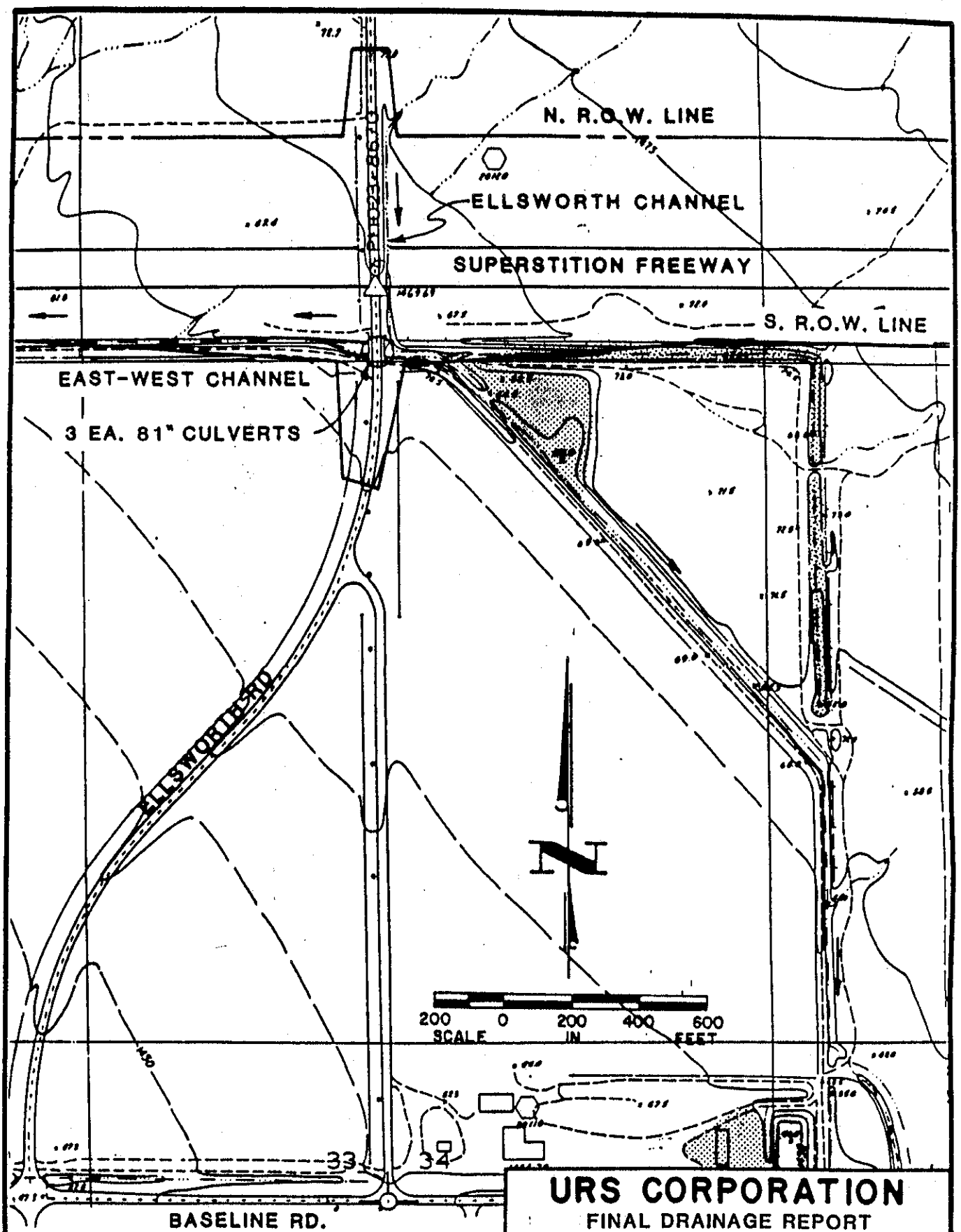
4. Ellsworth/East-West Channel

The planned temporary end of the Superstition Freeway project at Ellsworth Road coincides with the current limits of urban development adjacent to the freeway corridor. Therefore, the drainage patterns east of Ellsworth Road are more representative of natural conditions than are the drainage patterns west of Ellsworth Road. Parallel to the east right-of-way line of Ellsworth Road there is an excavated channel which extends from Broadway Road to the south freeway right-of-way line. This channel flows north-to-south and collects overland runoff. The Ellsworth Channel discharges into the East-West Channel and to the southeast toward a low-lying area leading to Baseline Road.

The present drainageways to the east of Ellsworth Road are depicted on Fig. 4. As indicated, the flows conveyed by the Ellsworth Channel, and overland flow from the northeast, split at Ellsworth Road and the Superstition Freeway south right-of-way line (East-West Channel.) Flows to the East-West Channel are conveyed westward under Ellsworth Road by three 81-in. diameter concrete culverts and thence to the Sossaman Channel. The hydraulic capacity of these culverts has been reduced by sediment which constricts the openings to 1/2 to 3/4 of the pipe diameter.

B. Related Drainage Considerations

There are several related drainage issues which have an influence on the design of the freeway drainage system. The first concerns the East-West Channel. Segments of this channel will be eliminated, since its location along the south right-of-way line is designated for freeway construction. Because this channel currently conveys a portion of the flows from to the east of Ellsworth Road, its removal would increase the flows draining to the south toward Baseline Road, and these flows would have to be detained or retained in order not to aggravate the existing flooding conditions at Baseline Road.



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FINAL DRAINAGE REPORT
SUPERSTITION FREEWAY
POWER ROAD TO ELLSWORTH ROAD

FIGURE 4
EXISTING DRAINAGE PATTERN
AT ELLSWORTH ROAD

The planned drainage improvements associated with the Phase II construction of the Superstition Freeway, will accommodate these flows.

On an interim basis, between construction of Phases I and II, the existing conveyance of storm flows in the present East-West Channel will be maintained in order that ADOT not assume liability for temporarily modifying the present flow conditions. The 5-yr design criteria applies only to temporary diversion during construction. As discussed in more detail below, this replacement conveyance will be provided by constructing an interim ditch system to the east of Ellsworth Road and a pipe crossing under Ellsworth Road to connect the East-West Channel to the present Ellsworth Channel.

In recent years the FCDMC has made improvements to the Sossaman Channel from Baseline Road to Guadalupe Road. These improvements have increased the capacity of this channel. The culvert at Baseline Road was constructed by the Maricopa County Highway Department as part of roadway improvements to Baseline Road and has a capacity of 3,200 cfs, before overtopping (Ref. 3).

As discussed above, flows from the Sossaman Road and 72nd Street drainageways are currently conveyed along the north right-of-way line in an unlined channel. These flows continue westward along the north right-of-way line to the ADOT channel at Power Road. The culvert under Power Road has adequate capacity, as designed and constructed, to convey the existing 50-yr. and 100-yr. flood flows without overtopping Power Road.

According to the MDP, existing and future condition discharges (100-yr) in the RWCD Floodway exceed its design capacity, cited as 4,720 cfs at the freeway crossing. The Power Road to Ellsworth Road segment of the freeway did not contribute to this "present conditions" disparity. Phase II drainage improvements associated with freeway construction will not increase flooding hazards currently existing at the RWCD Floodway and at Power Road.

Since the RWCD floodway is only partially completed at this time, another concern is that backwater from the floodway may raise flood elevations in the ADOT channel east of Power Road. However, since the RWCD Canal banks are approximately 20-ft lower in elevation than the controlling elevations in the ADOT channel east of Power Road, backwater is not anticipated to be a problem. The hydraulic grade lines of the planned channels are addressed in Chapter V.

C. Other Highway Projects that Relate to the Superstition Freeway

The following projects will have an influence on the off-site drainage system for the Superstition Freeway:

	Feature or Project	Owner or Responsible Agency
1.	72nd Street Extension and Overpass	Private Developer/ADOT
2.	Sossaman Road Improvements	Maricopa County Highway Department
3.	Ellsworth Road Improvements	City of Mesa
4.	Red Mountain Freeway	ADOT
5.	Superstition Freeway	ADOT (East)

The Red Mountain Freeway project is currently at the corridor selection stage through the eastern portion of Maricopa County. Recently, the alignment option shown on Fig. 5 was selected. Also, as shown on Fig. 6, there are two directional four-level interchange options for the freeway-to-freeway intersection. Ramps for this interchange will occupy much of the distance from Ellsworth Road to Sossaman Road.

The other highway project that has a significant bearing on the proposed off-site drainage system is the extension of the Superstition Freeway from Ellsworth Road to Ironwood Road. The configuration and construction scheduling for the Ellsworth Road interchange and the detention/retention of flows which are currently conveyed by the Ellsworth Channel and the East-West Channel affect the interim and final off-site drainage designs for this area.

Additional discussion of these projects and methods of accommodating the respective drainage aspects is presented in Chapter V.

D. Future Drainage Conditions

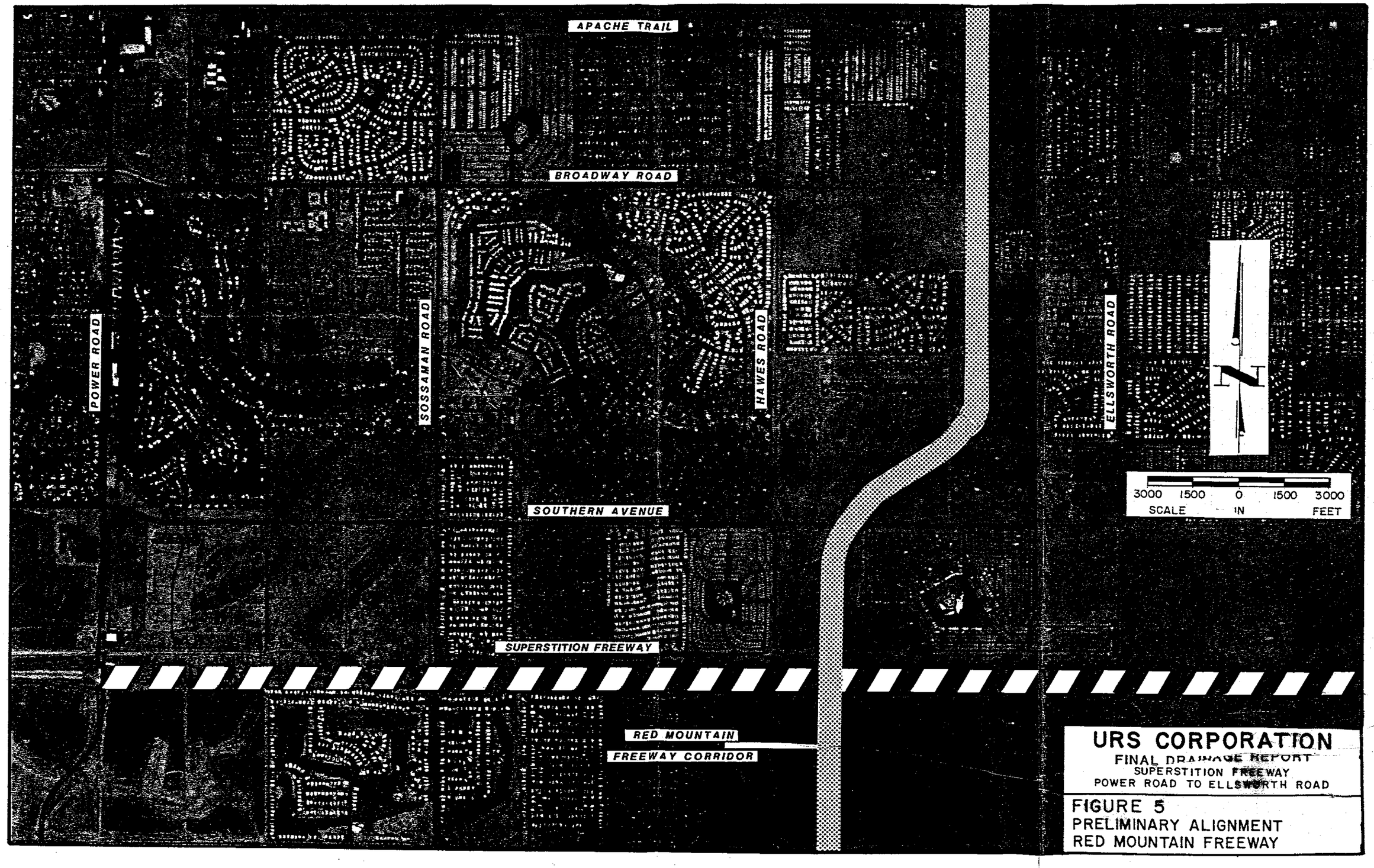
The projected implementation of the MDP will alter present drainage conditions in the vicinity of the freeway. The MDP currently contains recommendations for a system of concrete-lined channels and detention basins to convey runoff from below the SCS flood control structures to the RWCD Floodway. The conceptual configuration of this conveyance system is depicted on Fig. 7.

The following discussion provides an overview of anticipated modifications to the runoff that is tributary to the drainageways which intersect the freeway corridor.

The MDP University-Bush channel will truncate the northern-most segment tributary to the 72nd Street and Sossaman Road drainageways. Runoff from the area between the CAP aqueduct and University Drive will be intercepted and diverted westward to the RWCD Floodway in lieu of flowing southwesterly.

The MDP Ellsworth Channel will divert tributary runoff from the Hawes-Sossaman System. The overland sheet flow which currently enters the Broadway lateral channel at 90th Street will be intercepted at Ellsworth Road and Apache Trail by the new channel. The intercepted runoff will be conveyed south to Elliot Road and then west to the RWCD Floodway.

The present function of the East-West Channel as a relief drainage system for runoff east of Ellsworth Road will be altered when Phase II is completed. The improved Ellsworth channel will create a new drainage basin boundary with all runoff east of Ellsworth Road being conveyed south to a detention pond of about 600 ac ft capacity in the vicinity of the northeast quadrant of the Ellsworth Road - Superstition Freeway interchange. This pond, designed by Coe and Van Loo, has an outlet to the west consisting of a 48-inch diameter pipe which will be gated down to a 24-inch equivalent opening. The pipe will discharge into the planned East-West replacement channel along the north right-of-way line (Channel No. 2). This channel will continue to intercept runoff from the north side of the freeway between Ellsworth Road and the Sossaman Channel.



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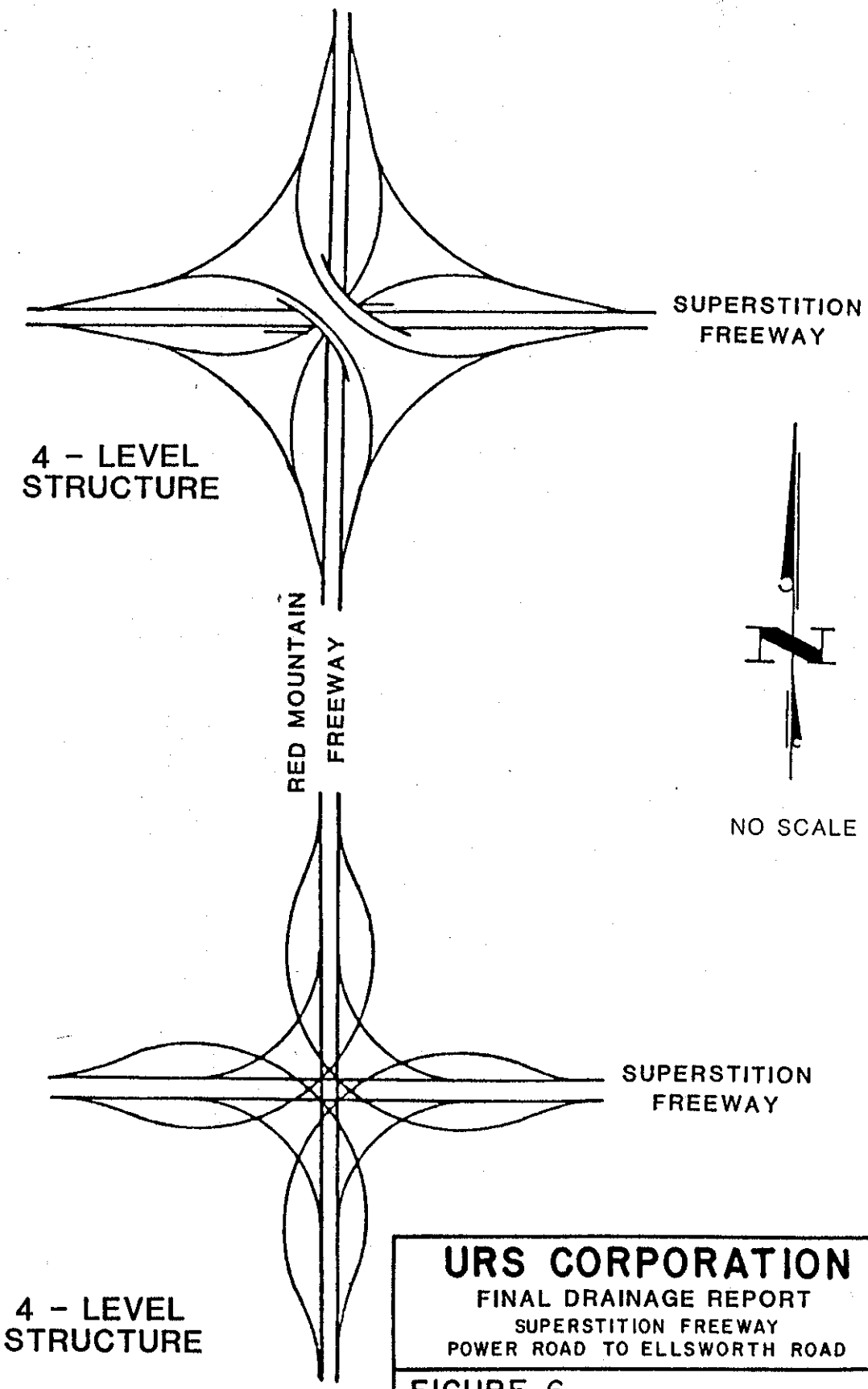
SUPERSTITION FREEWAY
POWER ROAD TO ELLSWORTH ROAD

FIGURE 5
PRELIMINARY ALIGNMENT
RED MOUNTAIN FREEWAY



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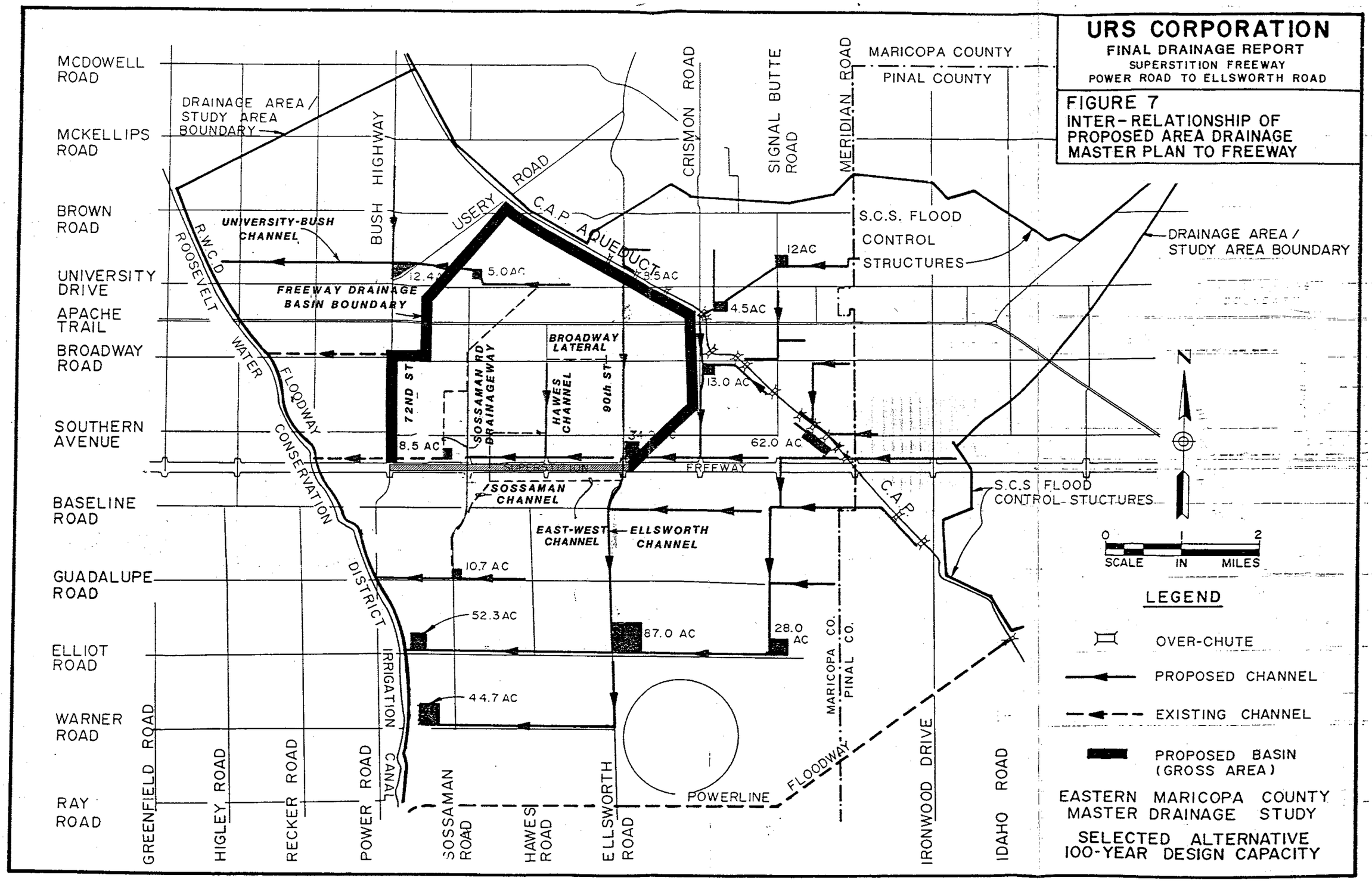
FINAL DRAINAGE REPORT

SUPERSTITION FREEWAY

POWER ROAD TO ELLSWORTH ROAD

FIGURE 6

POSSIBLE FREEWAY TO FREEWAY INTERCHANGE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SUPERSTITION FREEWAY
POWER ROAD TO ELLSWORTH ROAD
FIGURE 7
INTER-RELATIONSHIP OF PROPOSED AREA DRAINAGE MASTER PLAN TO FREEWAY
MCDOWELL ROAD
MCKELLIPS ROAD
BROWN ROAD
UNIVERSITY DRIVE
APACHE TRAIL
BROADWAY ROAD
SOUTHERN AVENUE
BASELINE ROAD
GUADALUPE ROAD
ELLIOT ROAD
WARNER ROAD
RAY ROAD
GREENFIELD ROAD
HIGLEY ROAD
RECKER ROAD
POWER ROAD
SOSSAMAN ROAD
HAWES ROAD
ELLSWORTH ROAD
IRONWOOD DRIVE
IDAHO ROAD
BUSH HIGHWAY
USERY ROAD
CRISMON ROAD
SIGNAL BUTTE ROAD
MERIDIAN ROAD
MARICOPA COUNTY
PINAL COUNTY
DRAINAGE AREA / STUDY AREA BOUNDARY
UNIVERSITY-BUSH CHANNEL
R.W.C.D.
ROOSEVELT WATER CONSERVATION DISTRICT
FLOODWAY
FREEWAY DRAINAGE BASIN BOUNDARY
C.A.P. AQUEDUCT
S.C.S. FLOOD CONTROL STRUCTURES
BROADWAY LATERAL
72ND ST
SOSSAMAN RD DRAINAGEWAY
HAWES CHANNEL
90th ST
SOSSAMAN CHANNEL
EAST-WEST CHANNEL
ELLSWORTH CHANNEL
FREEWAY
POWERLINE
IRRIGATION CANAL
12.4
5.0 AC
8.5 AC
12 AC
4.5 AC
13.0 AC
62.0 AC
10.7 AC
52.3 AC
87.0 AC
28.0 AC
44.7 AC
N
0 1 2
SCALE IN MILES
LEGEND
OVER-CHUTE
PROPOSED CHANNEL
EXISTING CHANNEL
PROPOSED BASIN (GROSS AREA)
EASTERN MARICOPA COUNTY MASTER DRAINAGE STUDY
SELECTED ALTERNATIVE 100-YEAR DESIGN CAPACITY

The MDP is currently being reviewed by the FCDMC and other interested parties. At present, a priority list of the suggested improvements and an implementation schedule have not been adopted.

III. CRITERIA AND METHODS

A. General

The criteria and methods used for the determination of peak flood flows and for the sizing of drainage appurtenances are consistent with those outlined in the "Hydrologic and Hydraulic Training Session" (H & HTS) (Ref. 4), "Hydrologic Design for Highway Drainage in Arizona" (Ref. 5), "Arizona Statewide Management Program - Project Design Guidelines - 1986" (Ref. 6), and the Technical Memoranda that have been issued for this project (Ref. 7).

The intent throughout the design phase was to provide a stormwater conveyance system that will maintain safe driving conditions on the roadway and cause minimal impact to existing drainage patterns in the project area. Every attempt was made to preserve existing flow patterns and flow rates through and from the freeway corridor. Connections were provided for existing drainage improvements north of the freeway corridor to the off-site system. Where future improvement design was unknown or available only in the concept stage, every attempt was made to design on-site and off-site conveyance systems for the most conservative case (i.e., that resulting in the highest peak flow rates).

B. Drainage System Descriptions:

The hydrologic and hydraulic analyses were performed for two distinct drainage systems; off-site drainage and on-site drainage. These terms, as used in this report, are defined as follows:

1. "Off-Site Drainage" consists of:

The quantification of flood flows which originate north of the south right-of-way line of the Superstition Freeway (under existing conditions) and which must be conveyed around or through the proposed freeway by the freeway drainage system; the determination of where those flows will intersect the freeway corridor; and the determination of required facilities for conveyance of those flows along and away from the freeway corridor.

2. "On-Site Drainage" Consists of:

The quantification of flood flows originating within and confined to roadway limits, (freeway, ramps, and cross-roads) including side slopes in areas of cuts, within the freeway corridor; and the determination of the conveyance required to route those flows along and off of the corridor.

These two systems are connected at points where the on-site systems discharge into the off-site conveyance systems.

C. Approach

1. Off-Site Drainage System

Off-site drainage flows are conveyed along the freeway corridor by means of channels and culverts and across the corridor by means of a culvert. Flows are temporarily

stored (where necessary) in detention ponds. In accordance with the construction sequencing that has been determined for this project, segments of the off-site drainage system will be built in Phase I and the remainder will be built in Phase II. However, it was necessary to perform the hydrologic analyses for the system as a whole and subsequently break out the individual design elements for Phases I and II. In some situations interim measures are required to maintain existing flow patterns between completion of Phase I and completion of Phase II construction. The required improvements, the phased construction of these improvements, and the interim measures provided between construction phases are addressed in greater detail in Chapter V.

An initial review of the available information regarding off-site flows led to the conclusion that the MDP-Review Draft was the most recent material available that dealt with the drainage issues in the immediate vicinity of the project. As noted in an antecedent to this report (the Drainage Concept Report), the peak flood flows presented in the MDP were not entirely applicable to the design of the off-site conveyance system for the Superstition Freeway. In addition, the MDP has not yet been officially adopted by the FCDMC. However, the MDP is still regarded as the most likely description of how drainage issues will be treated as the area is developed. Working under this assumption it is clear that peak storm flows at the freeway will be lower under future conditions than they are under existing conditions. Therefore, to provide a conservative design, all off-site conveyance system design was based on accommodation of existing flows.

Several hydrologic analyses utilizing the HEC-1 computer program were conducted by URS to determine the peak flows arriving at, and discharged from, the freeway corridor. These analyses are designated Simulation No. 1, Simulation No. 2 or Simulation No. 3, depending upon the conditions that were assumed for the individual computer run. Simulation No. 1 includes the initial set of computer runs that were performed to determine peak flows at and through the freeway corridor under existing conditions for 50-yr and 100-yr recurrence interval storms. The results of this simulation defined the maximum permissible discharge limits for the proposed off-site conveyance system. Computer runs were then performed, in Simulation No. 2, in which the freeway was assumed to be in place with an interceptor channel located along the north right-of-way line. The results of Simulation No. 2 were compared to those from Simulation No. 1 and it was concluded that detention of storm flows would be required along the freeway. In Simulation No. 3, encompassing the third set of computer runs, the HEC-1 computer program was used as an integral part of the design process to determine locations, sizes, and hydraulic properties of the required detention ponds. Detailed discussions of the HEC-1 runs of Simulation Nos. 1, 2 and 3 are provided in Chapters IV and V.

The freeway design criteria established at the onset of the project for conveyance of off-site flows were conveyance of the peak 50-yr, 24-hr flows with 2.5 ft of freeboard and conveyance of the peak 100-yr, 24-hr flows such that no additional (greater than existing) flooding would occur as a result of freeway construction (Ref. 4 and 5). The criteria for conveyance of the peak 50-yr, 24-hr flows were later revised to conform with the criteria in the "Arizona Statewide Management Program, Project Design Guidelines", which are as follows:

$$\text{Freeboard} = 0.20\left(\text{depth of flow} + \frac{V^2}{2g}\right)$$

$$\text{Minimum Freeboard} = 1.0 \text{ ft}$$

Freeboard depths obtained from the formula given above are compatible with the channel design and with A.D.O.T. criteria. This revision in criteria was made with the concurrence of the Statewide Management Consultant.

The Flood Insurance Rate Map (FIRM), Maricopa County, Arizona, Unincorporated Areas (Ref. 8), indicates that the project area will experience shallow flooding (less than one foot) during a 100-yr storm. No detailed flood elevations are given in the FIRM. Existing channels along the freeway corridor were checked for their capacity to convey 100-yr storm off-site flows. Channel capacities and overtopping are addressed in greater detail in Chapter V.

Similarly, culverts were designed to convey the peak flows from the 100-yr, 24-hr storm at a headwater to depth ratio of approximately one. Culverts were initially sized and designed according to the procedures set forth in Hydraulic Engineering Circular 5 (HEC-5) (Ref. 9). At the time of final design the headwater elevations at all culverts were determined using the HEC-2, Water Surface Profiles computer program from the Army Corps of Engineers (Ref. 10).

All channels were sized based on Manning's equation for open channel flow with backwater curves taken into consideration, as appropriate. Concrete linings were used to assure channel stability. A trapezoidal cross-section with 2 (horizontal) : 1 (vertical) side slopes was chosen to assure adequate channel capacity in a narrow width while concomitantly providing for an easy means of exiting the channel as a safety measure. Longitudinal slope varies. A value of 0.016 was used for the roughness factor ("n").

Water surface profiles, from the outfall points upstream through the proposed conveyance systems, were determined by utilization of the HEC-2 computer program. These profiles were computed to describe water surface elevations at critical points along the system and to demonstrate that the design was within maximum water surface elevation tolerances.

2. On-Site Drainage System

The on-site drainage system consists of inlets, sewer pipes, manholes and subsidiary channels. The only areas contributing runoff to the on-site system are the roadway, the ramps and cross-roads, and the side slopes in locations where the roadway is below existing grade. All off-site runoff north of the roadway is intercepted by the north right-of-way channels and does not enter the on-site system. Runoff generated on the south side of the freeway, between Ellsworth Road and the Sossaman Channel, flows into the existing East-West Channel and thence into the Sossaman Channel. West of the Sossaman Channel runoff generated on the south side of the freeway follows historic overland flow paths to the southwest.

Components of the on-site system will be completed in all three construction phases of the project. Since all but a few components of the on-site system are interconnected, it was necessary to design the system as a whole and then to break out the individual components for the separate phases. The required improvements, phased construction, and interim measures required between phases are described in greater detail in Chapter V.

Due to the difference in complexity and runoff characteristics between the off-site and on-site watersheds, different analytical methods were used to determine design runoff flows for each system. As indicated, a computer model (HEC-1) was utilized to simulate the off-site runoff patterns. For the simpler on-site watersheds, a more applicable analytical method was used for determining peak flows. The Rational Method was used for determining on-site peak flows for both inlet sizing and for storm sewer design.

The criteria and methods employed in the on-site drainage design were those set forth in the "Project Design Guidelines" issued by the Statewide Management Consultant for ADOT. These instruct the consultant to use the "Hydraulic and Hydrologic Training Manual" (ADOT) and the "Hydrologic Design for Highway Drainage" (ADOT) with modifications as noted in the Technical Memoranda. Further instructions are given in the above to use the Hydraulic Engineering Circulars (FHWA) 5 and 12 (Ref. 11) for items not specifically covered in the original references.

The following procedure was used to design the on-site drainage conveyance system:

a. Storm runoff for inlet and storm sewer design was calculated by the Rational Method:

$Q = CiA$ Where Q = Peak runoff rate (cfs)
C = Runoff coefficient (≤ 1)
i = Rainfall intensity corresponding to the estimated time of concentration (t_c)
A = Area (Ac)

The t_c calculation is a combination of the overland flow time of concentration plus the gutter flow time of concentration and is given in minutes. The following items are relevant to the determination of i at each inlet:

i. A Standard Duration Rainfall - Intensity Curve was prepared as described in Appendix A.

ii. t_c for the cross-roads was based on gutter flow only (no overland flow contributed to the cross-street drainage).

iii. t_c for the freeway was based on both overland flow and gutter flow components.

iv. t_c Minimum = 10 min.

v. The maximum calculated t_c for any inlet on the entire project (all Phases) is less than 10 min. (See Appendix A).

vi. t_c = 10 min. was used for all inlets.

vii. A storm with a 10-year return period was used for determining the rainfall intensity for inlet design on the cross-roads since these are at or above grade.

viii. A storm with a 50-year return period was used for determining the rainfall intensity for inlet design on the freeway since over 90% of the inlets

occur on roadway sections that are below existing grade.

ix. Ramps were treated the same as the freeway since bypass from the ramp inlets flows down onto the freeway.

b. Inlet spacing was determined using the following criteria:

Cross-Roads:

i. Inlets are required at all upstream points of curb return (PCRs) and in areas of superelevation to prevent excess flows across roadways.

ii. Inlets are placed at loci where the width of spread of gutter flow (T) for the design storm exceeds one-half of the adjacent traffic lane:

Roadway	Adjacent Traffic Lane Full Width	Adjacent Traffic Lane Half Width
72nd Street	14 feet	7 feet
Sossaman Road	14 feet	7 feet
Ellsworth Road	14 feet	7 feet

iii. Inlets are placed at loci where gutter flow for the design storm results in curb overtopping.

Ramps (including full length of ramp tapers):

i. Inlets are placed at loci where T for the design storm exceeds 8.5 feet.

ii. Inlets are placed at loci where gutter flow for the design storm results in curb overtopping.

Freeway:

i. Inlets are placed at loci where T for the design storm exceeds 16 feet.

ii. Inlets are placed at loci where gutter flow for the design storm results in curb overtopping.

c. Storm Sewer Design

The storm sewer lines to be installed in Phase I are classified as laterals in the overall on-site runoff conveyance system. All but one of these laterals terminate at an inlet or a manhole in Phase I. The exception is the outfall pipe for the four inlets at the north end of Ellsworth Road. This outfall pipe will discharge into the off-site conveyance system.

The storm sewer line to be installed in Phase II is part of the outfall line for Trunkline No. 1. All other storm sewer pipes will be installed in Phase III.

The storm sewers were initially designed employing the following criteria:

i. For any given pipe size and slope Q_{design} is less than or equal to Q_{full} except where surcharging does not result in an HGL with less than 0.5 ft. freebound at an inlet or manhole.

ii. Minimum pipe size is 24 inches

iii. All storm sewer (closed conduit) is Concrete Pipe (n = .013).

iv. On the cross-roads a minimum pipe cover of 2.1 feet is provided to the top of the pipe:

13 inches (pavement depth)
\+ 12 inches (pipe backfill)
25 inches (total)

v. Minimum pipe cover for lateral pipes under the freeway was based on the following criteria:

(a). laterals parallel to and under the gutter flow line have a minimum clearance of three feet from the flow line elevation to the crown of the pipe. This provides a foot of clearance between the lateral and any slotted drains.

(b). laterals crossing under the freeway are set such that a minimum clearance of one foot plus the depth of pavement will be provided with the addition of one lane (each direction) in the future:

17 inches (pavement)
\+ 12 inches (clearance)
29 inches (total)

vi. Minimum pipe covering for the main trunklines was provided such that a minimum covering of one foot of cover (no pavement) will be provided with the addition of one lane (westbound) in the future.

vii. Minimum pipe velocity is three (3) feet per second for Q_{design}

viii. Maximum distance between manholes:

Pipe Diameter (inches)	Maximum Spacing (feet)
<30	330
30 to 45	440
>45	660

3. Interim Conditions

Initially the on-site and off-site drainage systems were designed for the job as a whole without taking phased construction into account. When the construction phases were defined it then became necessary to separate components of the drainage systems into the phases. With construction of one system being split between two or three phases, temporary measures are required to accommodate the interim drainage conditions. A description of the phasing of drainage improvements and required interim measures is presented below:

Phase I: Drainage Improvements - Permanent Construction

- Construction of cross-road inlets with associated laterals, manholes, and outlet pipes.
- Construction of box culverts under 72nd Street and Sossaman Road for future connection to Phase II improvements.
- Construction of a manhole on the east side of Ellsworth Road and a 48-inch concrete pipe under Ellsworth Road for future connection (at the west terminus of the pipe) to Phase II improvements. Connection to the manhole from the east is planned (by others) as a part of the Phase II improvements.
- Removal of the existing triple barrel 81-inch culvert structure under Ellsworth Road and filling of the associated channel as needed to build the ramp segments.

Interim Measures - Temporary Construction

- Provision of sumps or temporary ditches for cross-road laterals that drain directly into the off-site channel system.
- Provision of an interim outlet ditch west to the north right-of-way channel for an existing 48-inch concrete storm drain (by others) under Sossaman Road.
- Rerouting of the Ellsworth Road ditch (running north-south) and the East-West Channel around the ramp segments.
- Provision of 3 x 84-inch interim culverts under Ellsworth Road to convey the rerouted ditch flows west under Ellsworth Road to the East-West Channel on the west side of Ellsworth Road.

Phase II: Drainage Improvements - Permanent Construction

- Construction of Storm Sewer No. 1 from its outfall into the existing concrete lined channel west of Power Road to the manhole at 72nd Street. The manhole will not be constructed in this phase.
- Construction of a "Tee" connection from the inlets at 72nd Street to Storm Sewer No. 1.
- Construction of all of the remaining off-site drainage improvements including channels, the CBC at Sossaman Channel, Sossaman Channel improvements, detention ponds, and access roads.
- Filling of all minor ditches, and erosion rills within the right-of-way that do not function as part of the off-site or on-site drainage systems.
- Removal of the 3 x 84-inch interim pipes under Ellsworth Road.
- Provision of a permanent connection for the 48-inch storm sewer (by others) at Sossaman Road into Channel No. 1.
- Provision of transitions from existing north-south channels into Channel Nos. 1 and 2 at the north right-of-way line.
- Provision of a permanent connection for the 48-inch pipe under Ellsworth Road (detention pond outlet) into Channel No. 2.
- Removal of any temporary culvert plugs on the off-site drainage system.
- Provision for a low flow relief drain from the existing East-West channel into the Sossaman Channel.

Interim Measures

No interim measures are required. The off-site drainage system will be in place at the conclusion of Phase II construction. Isolated components of the Phase III system of inlets and storm sewers will be in place but that system will not become fully operational until completion of Phase III construction. Since the purpose of the on-site system is to remove runoff from the roadway to an outfall point, the on-site system is not required to be fully functional until the roadway is in place. Roadway paving will occur in Phase III after construction of the storm sewer system.

Phase III: Drainage Improvements - Permanent Construction

- Construction of all remaining segments of the on-site drainage system.
- Removal of any temporary pipe plugs in laterals or on Trunkline No. 1.
- Construction of connections from existing manholes at the cross-roads to the main storm sewers along the freeway.
- Construction of collector channels along the toe of slope for the inlets on above-grade sections of the roadway (these channels discharge into the Sossaman Channel).

IV. HYDROLOGY

A. Off-Site

1. Introduction

Off-site drainage includes flood flows that originate north of the southern limits of the freeway right-of-way and that must be conveyed around or through the planned freeway by the freeway drainage system. Off-site drainage requirements were determined by defining the existing hydrology, analyzing the impact of the freeway on the existing hydrology, and defining required drainage improvements. The HEC-1 Flood Hydrograph Package from the Army Corps of Engineers was used in all stages of the hydrologic analyses.

2. Model Description

The HEC-1 Flood Hydrograph Package is a computer model which represents a drainage basin as a system of interconnected hydrologic and hydraulic components. Each component simulates an aspect of the precipitation-runoff process using a set of parameters which characterizes the component and mathematical relations which describe the physical processes. The result of this modeling process is the computation of streamflow hydrographs at locations of interest in the basin.

The watershed of interest is divided into sub-basins, each of which is assumed to be uniform in its runoff characteristics. The hydrologic and hydraulic components of a sub-basin are its area, an infiltration factor, overland flow characteristics, characteristics of collector channels, and main channel characteristics. These components plus rainfall data and flood routing information are employed in the simulation of a flood hydrograph at the outlet of the sub-basin. Hydrographs can be routed along main channels, combined with other hydrographs, routed through reservoirs or diverted (partially or entirely). The runoff of a watershed is simulated by calculation of hydrographs for sub-basins and the subsequent modifications to those hydrographs. Hydrographs can be generated at the watershed outfall and at other locations of interest within the watershed.

The HEC-1 program offers a variety of hydrologic and hydraulic analytical methods for hydrograph generation. This permits the user to tailor the program for use in a specific area (where one methodology may be preferred) or for differing types of watersheds. The Kinematic Wave Routing Method, used in Simulations No. 1, No. 2 and No. 3 (previously described in Chapter III), for hydrograph routing, is the recommended routing method for modeling in urban watersheds. Little or no peak flow attenuation occurs with this type of routing. This is an appropriate reflection of the fact that travel times through urban areas are generally rapid due to the presence of paved streets and channels. For a detailed discussion of the model the reader is referred to the HEC-1 Users Manual.

3. Model Application

As explained in Chapter III, runoff generated from the drainage areas upstream of the freeway, under existing conditions, is greater than that anticipated under fully developed conditions (i.e. with the MDP in place). Using the larger peak runoff values

results in a more conservative design for the freeway drainage system and was used as the basis for design.

Existing conditions were simulated using the HEC-1 model to establish existing runoff patterns and peak flows at the freeway corridor. The results of these initial model runs were used as a baseline in subsequent runs for evaluating the impact of the proposed freeway on storm runoff. In the second simulation the freeway was assumed to be in place with two associated interceptor channels running east to west along the north right-of-way line. Each channel serves to intercept 100 percent of the off-site runoff from the 100-year storm. The eastern channel (Channel No. 2) discharges into the Sossaman Channel at approximate roadway station 930 + 50. The western channel (Channel No. 1) discharges into the existing concrete lined channel at Power Road. The results of Simulation No. 2 were examined to determine the need for detention storage. Increased ponding elevations at existing structures, increased discharges into existing channels, or potential freeway flooding were the criteria used to evaluate the results of the second simulation. The need for detention was established and the HEC-1 program was subsequently used as a design tool to arrive at a final off-site drainage system design. Detention storage could be provided within the right-of-way by a series of smaller ponds, outside the present right-of-way with major facilities, or with a combination of both. **Due to real estate costs in the area, and the impact of constructing and maintaining large ponds, it was decided to attempt to confine detention storage to within the right-of-way; this was ultimately accomplished.** A complete discussion of the design process can be found in Chapter V of this report.

The basic model set-ups for Simulations No. 1 and No. 2 are presented in the following paragraphs. Basin boundaries, sub-basin parameters, major channels, areas of flow division and key outfall points are identified. The results of each simulation are tabulated in terms of peak flows or relevant ponding elevations at key points along the freeway corridor. A discussion of the HEC-1 model as a design tool is reserved for Section V since it was used to describe not only the hydrology but the hydraulic functioning of the off-site drainage system.

a. Simulation No. 1

The general watershed boundaries, major drainageways, and land use characteristics of the watershed upstream of the Superstition Freeway (between Power Road and Ellsworth Road) are described in detail in Chapter II. The sub-basin boundaries, basin parameters and a discussion of the modeling technique used at areas of flow diversions are presented below.

The watershed and sub-basins used for determining the existing hydrology are presented on Fig. 8. Sub-basin boundaries were determined from USGS topographic maps, aerial photographs, field investigations and survey data.

The sub-basin parameters utilized in HEC-1 are as follows:

- Area
- Curve Number (CN - related to land use)
- Overland flow:
  - length
  - slope
  - roughness coefficient (N)

- Typical collector channel;
  - slope
  - length
  - cross-section
  - roughness factor (Manning's "n")
  - percent area of sub-basin drained by collector channel
- Main channel
  - slope
  - length
  - cross-section
  - roughness factor

The parameters for each sub-basin of the existing-conditions watershed are presented in Table 1.

Within the boundaries of the study area, and utilizing the sub-basins of Figure 8, three minor watersheds were identified, as defined by their discharge points from the freeway corridor. Watershed No. 1 discharges through the existing box culvert under Power Road into the existing concrete lined channel west of Power Road. The 72nd Street Channel, the Sossaman Road Channel and the North Right-of-Way Channel flow through this watershed. Watershed No. 2 discharges into the Sossaman Channel at approximate Station 930+50. The Hawes/Sossaman Channel and the East-West Channel (from Ellsworth Road) flow through this watershed. Watershed No. 3 lies immediately to the east of Watershed No. 1. Flows from this watershed are not intercepted by any east-west channels in the right-of-way but currently pass across the right-of-way from north to south as sheet flow. There are no major drainageways flowing through this basin; however, overflows from both the Hawes/Sossaman Channel and the Sossaman Road Channel enter this watershed and traverse the freeway corridor. The contributing sub-basins, flood routing and flow diversion occurring in each of these three minor watersheds is described below. A schematic depiction of the routing model is presented in Figure 9.

Watershed No. 1

The outfall for Watershed No. 1 receives all of the runoff from Sub-Basins No. 33, 34, 35 and 36. At low flows all the runoff from sub-basins 30 and 31 enter Watershed No. 1. At high flows, runoff from these two sub-basins overtops the low flow channels and enters Watershed No. 3. Routing through the sub-basins of Watershed No. 1 occurs in the following manner:

A hydrograph is computed for Sub-basin 30. This hydrograph is routed south through Sub-Basin 31 (R030) along Sossaman Road to Euclid Street. A hydrograph is computed for Sub-Basin 31 and combined (C031) with the routed hydrograph at this point. The Sossaman Road Channel (as described in Chapter II) makes a 90 degree turn to the west along Euclid Street. The channel has a shallow (approximately 3 feet deep) and constricted cross-section at this point. Based on field investigations the maximum capacity of the channel was estimated to be 500 cfs. A flow diversion was introduced at this point (DIV31) such that a maximum of 500 cfs flows west in the Sossaman Road Channel with excess flows proceeding south (through Watershed No. 3) along Sossaman Road. The hydrograph derived from DIV31 for flow to the west is routed west and south (ROD31) through Sub-basin 33 along the Sossaman Road Channel. Although the

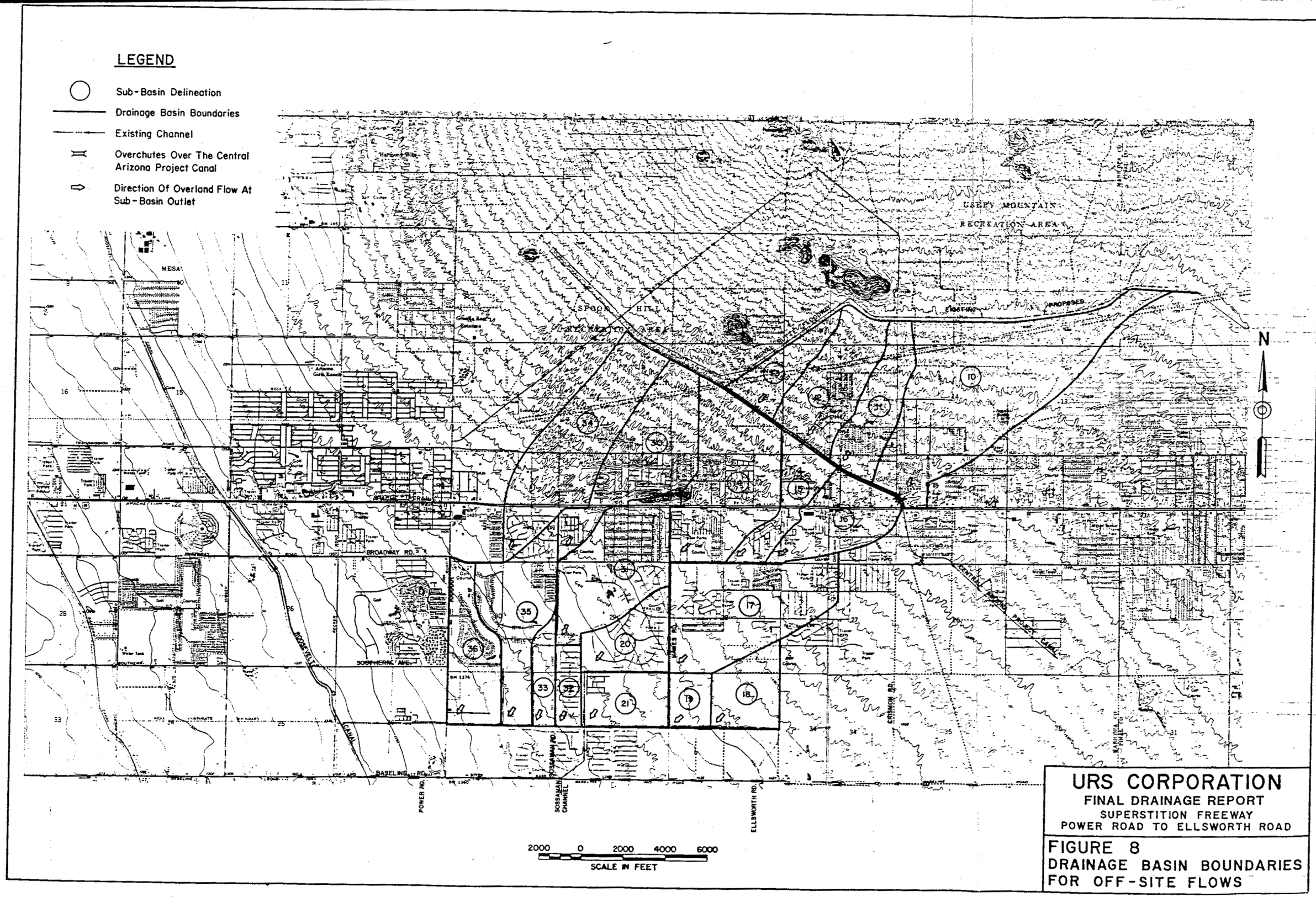
TABLE 1: SUB-BASIN PARAMETERS FOR HEC-1: SIMULATION NO. 1 (EXISTING CONDITIONS)

			Overland Flow Component			Collector Channel Component						Main Channel Component					
Sub-Basin	Area (sq. mi.)	SCS CN	L (Ft.)	S (Ft./Ft.)	N	L (Ft.)	S (Ft./Ft.)	n	Area (%)	B (Ft.)	Z	L (Ft.)	S (Ft./Ft.)	n (Manning's)	Shape	B (Ft.)	Z
10	2.090	82	1.000	0.0150	0.20	4.800	0.0115	0.040	0.1033	2.0	4.00	10.000	0.0102	0.035	Trap	10.0	3.0
11	0.500	83	500	0.0133	0.20	5.700	0.0148	0.040	0.1580	2.0	4.00	1.700	0.0055	0.035	Trap	8.0	1.5
12	0.690	83	500	0.0180	0.20	6.600	0.0174	0.040	0.0710	2.0	4.00	1.060	0.0056	0.035	Trap	8.0	1.5
13	0.350	82	500	0.0230	0.20	3.000	0.0167	0.040	0.0646	2.0	4.00	1.480	0.0042	0.035	Trap	8.0	1.5
14	1.100	83	85	0.0050	0.20	8.500	0.0067	0.050	0.0360	20.0	0.01	2.470	0.0084	0.016	Trap	10.0	1.0
15	0.410	84	85	0.0050	0.20	7.300	0.0150	0.050	0.0820	5.0	3.00	1.790	0.0093	0.016	Trap	16.0	1.0
16	0.590	84	90	0.0050	0.20	5.250	0.0090	0.050	0.1180	20.0	0.01	7.600	0.0102	0.035	Trap	5.0	2.0
17	1.190	84	1.250	0.0100	0.20	6.500	0.0090	0.040	0.1170	2.0	4.00	5.300	0.0068	0.025	Trap	35.0	2.3
18	0.410	84	1.250	0.0050	0.20	2.500	0.0070	0.040	0.0300	2.0	4.00	3.200	0.0075	0.035	Trap	20.0	2.0
19	0.187	84	110	0.0050	0.20	2.200	0.0100	0.035	0.0500	20.0	6.00	2.600	0.0026	0.025	Trap	22.0	2.0
20	0.430	85	150	0.0050	0.20	3.100	0.0061	0.050	0.0350	40.0	0.01	4.000	0.0085	0.025	Trap	8.0	1.2
21	0.370	86	110	0.0050	0.20	2.600	0.0038	0.025	0.0500	40.0	0.01	3.950	0.0060	0.016	Trap	32.9	2.0
30	0.950	86	100	0.0050	0.20	2.000	0.0070	0.025	0.1000	20.0	0.01	9.600	0.0100	0.016	Trap	2.0	1.0
31	0.954	84	1.000	0.0060	0.20	3.995	0.0070	0.025	0.4200	20.0	0.01	3.800	0.0045	0.025	Trap	30.0	3.0
32	0.172	84	200	0.0050	0.20	1.000	0.0050	0.025	0.0100	20.0	0.01	3.900	0.0050	0.025	Trap	20.0	2.0
33	0.211	84	200	0.0050	0.20	2.600	0.0070	0.035	0.0300	20.0	6.00	3.900	0.0050	0.025	Trap	20.0	2.0
34	1.160	84	1.250	0.0060	0.20	10.000	0.0130	0.050	0.3900	10.0	3.00	5.000	0.0080	0.025	Trap	20.0	4.0
35	0.850	84	200	0.0050	0.20	2.600	0.0070	0.025	0.1100	20.0	0.01	7.500	0.0050	0.025	Trap	20.0	2.0
36	0.600	84	300	0.0050	0.20	7.800	0.0060	0.025	0.1500	40.0	0.01	2.530	0.0056	0.035	Trap	65.0	1.0

NOTE: N = Overland Flow Roughness Factor
n = Manning's Roughness Factor
B = Bottom Width of Channel
Z = Horizontal Distance per Foot of Rise on the Channel Side Slopes

By: D. H.

Checked by: GCQ Date: 9/88


LEGEND
Sub-Basin Delineation
Drainage Basin Boundaries
Existing Channel
Overchutes Over The Central Arizona Project Canal
Direction Of Overland Flow At Sub-Basin Outlet
USERY MOUNTAIN RECREATION AREA
SPOOK HILL
MESA
APACHE TRAIL
BROADWAY RD.
SOUTHERN AVE.
BASELINE RD.
ROOSEVELT CANAL
POWER RD.
SOSSAMAN CHANNEL
SOSSAMAN RD.
HAWES RD.
ELLSWORTH RD.
ERSHON RD.
CENTRAL ARIZONA PROJECT CANAL
EXISTING
PROPOSED
N
2000 0 2000 4000 6000
SCALE IN FEET
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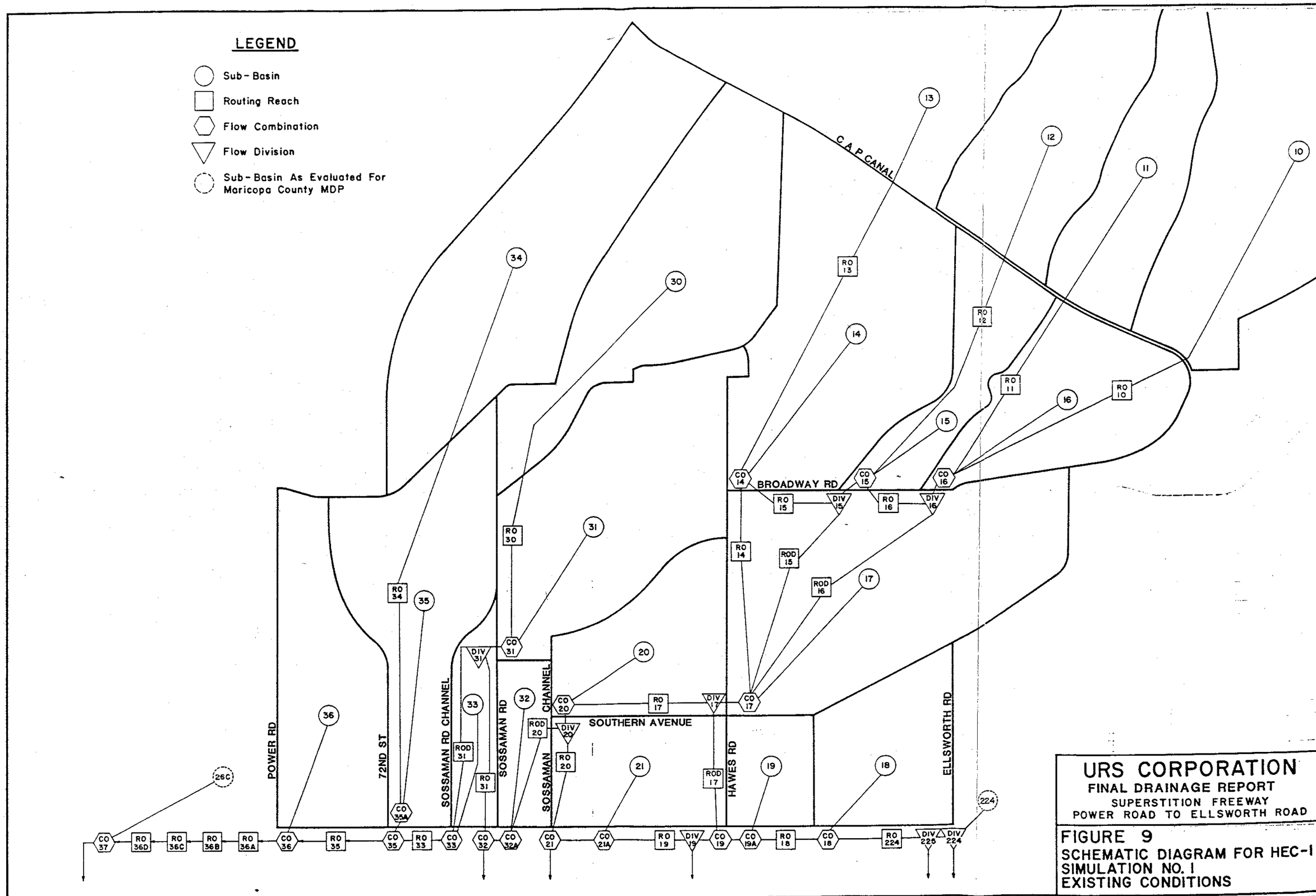
SUPERSTITION FREEWAY
POWER ROAD TO ELLSWORTH ROAD
FIGURE 8
DRAINAGE BASIN BOUNDARIES
FOR OFF-SITE FLOWS



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SUPERSTITION FREEWAY
POWER ROAD TO ELLSWORTH ROAD

FIGURE 9
SCHEMATIC DIAGRAM FOR HEC-1
SIMULATION NO. 1
EXISTING CONDITIONS

Sossaman Road Channel has a limited capacity as it flows west from Sossaman Road, the same channel has a greatly expanded cross-section and capacity in the reach from Euclid Street to the freeway corridor. Runoff from Sub-Basin 33 is readily conveyed south in this channel and is combined (CO33) with the routed runoff at the right-of-way. At this point the Sossaman Road Channel turns 90 degrees to the west and is known as the North Right-of-Way Channel. Flows are routed along the North Right-of-Way Channel (R033) to the outlet of the next basin downstream. Between the Sossaman Road Channel and Power Road the south bank of the North Right-of-Way Channel is one to three feet higher than the north bank. For the purposes of the hydrologic routing it was assumed that the 100-yr., 24-hr. storm flows proceed west with no bank overtopping to the south. Bank overtopping to the north may occur; however, all flows ultimately return to the channel and pass through the box culvert under Power Road. Overtopping flows are assumed to be shallow (1-2 ft.) No specific quantification of overtopping flows was attempted since the proposed channel is designed to carry the 100-yr., 24-hr. storm flows without bank overtopping.

A hydrograph is computed for Sub-basin-34 and is routed (R034) through Sub-basin 35 to the North Right-of-Way Channel. Flows routed through Sub-Basin 35 travel primarily on local streets in the upper part of the sub-basin. Approximately half way through the sub-basin the routed flows enter the 72nd Street Channel and are conveyed by this channel to the freeway corridor. A hydrograph for Sub-Basin 35 is computed and combined (C035A) with the flows routed from the north. A second combination is required (C035) to combine flows from the north with flows from the east. The resulting hydrograph is routed (R035) to the outlet of the next basin downstream. This outlet is the existing box culvert at Power Road.

The hydrograph computed for Sub-Basin 36 is combined (C036) with flows from the east at Power Road. The two-bay 10 foot x 6 foot box culvert at Power Road introduces a constriction in the North Right-of-Way Channel. A preliminary analysis of this constriction was performed for the Drainage Concept Report. The inlet and outlet control nomographs of Hydraulic Engineering Circular No. 5 (HEC-5) were used to determine the required headwater depths for the peak 50-yr. and 100-yr. storm flows. Implicit in these nomographs is the conservative assumption of zero velocity head (i.e. - still water) just upstream of the culvert entrance. A more detailed analysis is provided for preliminary design. Flow through the Power Road box culvert was modeled with HEC-2 using multiple flow rates to determine the relationship of headwater elevation versus flow rate. The procedures used in the HEC-2 program employ a momentum analysis to determine water surface elevations at culverts with piers. In this type of analysis, channel velocity is not assumed to be zero at the upstream face of the culvert. The output from the HEC-2 multiple run was used to establish a discharge versus storage volume table for the HEC-1 routing through the box culvert. The output obtained from the HEC-1 runs indicate that the 50-yr. and 100-yr. water surface elevations, just upstream of the box culvert, are close to the top of bank elevations but do not overtop the north bank. This result differs from the concept report analysis. Using the HEC-5 nomographs, overtopping elevations were obtained at the upstream end of the box culvert. Since the north bank of the existing channel is higher than the area just north of the right-of-way overtopping flows were assumed to flow north and overtop Power Road at the sag vertical curve north of the box culvert. As a result of the more sophisticated analysis used for preliminary design it was determined that, for the proposed design, peak flows must be conveyed through the existing Power Road box culvert without bank overtopping.

The RWCD is considered to be the outfall for Watershed No. 1. Before reaching the RWCD, flows routed from Power Road pass through a basin which lies outside the boundaries described in this report. This external basin is described in the previously referenced draft MDP and is shown as an existing basin on Figure 9 (26C). Flows from this basin are combined with those routed along the North Right-of-Way Channel (C037) resulting in a final hydrograph for flows entering the RWCD Floodway at the freeway corridor. The peak flows obtained from this modeling effort were used as a guideline in evaluating the effects of freeway drainage improvements on flood flows.

Watershed No. 2

The outfall for Watershed No. 2 receives runoff from Sub-Basins 10 through 21, and from the area east of Ellsworth Road (Sub-Basin 224 of the MDP). The East-West Channel, the Hawes Channel, and the Sossaman Channel are the main channels flowing through this watershed. At low flows there is no channel overtopping. At high flows (i.e. 50-yr - 24-hr and 100-yr - 24-hr peak flows) all three channels experience overtopping. Overtopping flows from the Hawes Channel remain within the watershed. Overtopping flows from the East-West Channel flow southwesterly away from the watershed. Overtopping flows from the Sossaman Channel enter Watershed No. 3 and cross the freeway corridor between the Sossaman Channel and Sossaman Road. Routing through the sub-basins of Watershed No. 2 includes diversion tables to account for these flow splits at high flows.

A hydrograph is determined for Sub-Basin 10 and is routed (R010) in a well-defined channel through Sub-Basin 16 to Broadway and 91st Street (approximately 950 ft. west of Ellsworth Road). A hydrograph is computed for Sub-Basin 11 and routed along erosion channels (R011) through Sub-Basin 16 to the same location. The hydrograph for Sub-basin 16 is computed and combined (C016) at Broadway and 91st Street with the routed hydrographs from Sub-basins 11 and 10. At this point the flows enter the newly reconstructed Broadway Channel which runs east-west to Hawes Road. A diversion table (DIV 16) is introduced at this point to account for limited channel capacity at high flows. The overtopping flows are routed (ROD16) southwest to the intersection of the Hawes Channel and Southern Avenue. Flows in the Broadway Channel are routed (R016) to the box culvert at Glenmar Street.

A hydrograph is computed for Sub-Basin 12 and is routed (R012), along local erosion channels, through Sub-Basin 15 to the box culvert at Glenmar Street and the Broadway Channel. The hydrograph for Sub-Basin 15 is calculated and is combined (C015) with the previously routed flows from the east and the north. Another diversion table (DIV15) is introduced to simulate the roadway and culvert overtopping at Glenmar Street at high flows. Flows overtopping Broadway are routed (ROD15) southwest to the intersection of the Hawes Channel and Southern Avenue. Flows remaining in the Broadway Channel are routed (R015) to the intersection of Hawes Road and Broadway.

A hydrograph is calculated for Sub-Basin 13 and is routed (R013) through Sub-Basin 14, via erosion channels and overland flow, to the intersection of Hawes Road and Broadway. The hydrograph for Sub-Basin 14 is calculated and combined (C014) with the hydrographs routed from the east and north.

At this point the Broadway channel makes a 90 degree turn to the south, crosses under Broadway and is known as the Hawes Channel. Flows overtopping the culvert at

Broadway turn south and re-enter the Hawes Channel. The combined flows at this point are routed south (R014) to the intersection of the Hawes Channel and Southern Avenue. The hydrograph for Sub-Basin 17 is computed and combined (C017), at the intersection of Southern Avenue and the Hawes Channel, with the hydrographs routed from the two diversions along Broadway and the hydrograph routed south along the Hawes Channel.

The Hawes Channel crosses under Southern Avenue in a two bay 8 ft x 4 ft concrete box culvert and continues south towards the freeway corridor. The upstream end of a lined channel heading west along the north side of Southern Avenue is adjacent to the upstream edge of the box culvert. The channel and culvert inverts are approximately the same, therefore runoff from the north is split at this point even at low flows. A diversion (DIVI7) was introduced at this point to simulate flow splitting at low and high flows. Flows continuing south are routed (ROD17) in the lined Hawes Channel to the freeway corridor. Flows heading west are routed (R017) via the Southern Avenue Channel to a 90 degree turn and a box culvert under Southern Avenue where they enter the upper end of the Sossaman Channel.

A hydrograph is computed for Sub-Basin 20 and combined (C020) at the box culvert with the flows routed from the east. The culvert under Southern Avenue presents a constriction at high flows. In addition, the Sossaman Channel, to the south of Southern Avenue, has limited capacity. A flow division (DIV20) is introduced at this point to simulate channel overtopping at high flows. Overtopping flows are routed (ROD20), by the local streets, through Sub-Basin 32 (Watershed No. 3) to the freeway corridor. Flows remaining in the Sossaman Channel are routed (R020) south to the freeway corridor.

The contribution of flows from the east side of Ellsworth Road to the East-West Channel is represented in Figure 9 by the MDP Hydrograph 224. The reader is referred to the MDP for the derivation of this hydrograph. The three 81-inch concrete pipes under Ellsworth Road convey stormwater to the East-West Channel, on the west side of Ellsworth Road, at low flows. At high flows the channel banks are overtopped on the east and west side of Ellsworth Road. Two diversions (DIV224 and DIV225) are introduced to simulate these conditions. Flows heading south from these diversions leave the freeway and are of no further interest in this simulation. Flows remaining in the East-West Channel are routed (RO224) west to a point approximately 3200 ft west of Ellsworth Road. A hydrograph is computed for Sub-Basin 18 and combined (C018) with the channel flows in the East-West Channel. Routing proceeds along the Channel (R018) to the Hawes Road right-of-way. A hydrograph for Sub-Basin 19 is computed and combined (CO19A) with the flows routed from the east. This hydrograph is then combined (CO19) with the hydrograph previously routed along the Hawes Channel from the box culvert under Southern Avenue. At this point the capacity of the East-West Channel is exceeded under high flow conditions. A diversion (DIV19) is used here to simulate channel overtopping at high flows. Overtopping flows leave the freeway and have no further significance for this simulation. Flows remaining in the channel are routed (R019) west to the Sossaman Channel. A hydrograph for Sub-Basin 21 is computed and combined (CO21A) with the flows in the East-West Channel. This composite hydrograph is then combined with the previously routed hydrograph from the north to produce a hydrograph of all flows in the Sossaman Channel at the south right-of-way line of the freeway.

Watershed No. 3

Under low flow conditions the outfall for Watershed No. 3 receives runoff from Sub-Basin 32 only. Under varying conditions of higher flows, overtopping flows from Watershed Nos. 1 and 2 enter Watershed No. 3 and cross the freeway corridor. Runoff from Sub-Basin 32 occurs at the freeway right-of-way as overland flow. There are no channels crossing or paralleling the right-of-way in this area. Runoff crosses the freeway corridor as sheet flow.

A hydrograph is computed for Sub-Basin 32 and is combined (CO32A) with the previously routed flows (ROD20) from overtopping of the Sossaman Channel at Southern Avenue. This hydrograph is combined (C032) with previously routed flows (R031) from the diversion at Sossaman Road and Euclid Street. This hydrograph crosses the freeway corridor and is of no further significance in Simulation No. 1.

The flow diversion calculations and storage-routing curves used in Simulation No. 1 are presented in detail in Appendix C. Results of the existing conditions simulation are tabulated in Table 2. A discussion of the results follows the description of Simulation No. 2 at the end of this chapter.

b. Simulation No. 2

Construction of the freeway will alter the runoff patterns within the freeway corridor. The only major channel crossing the corridor is the Sossaman Channel. The freeway profile is below existing grade between Power Road and Ellsworth Road except where it crosses over the Sossaman Channel. This configuration necessitates the construction of channels along the north side of the roadway to intercept off-site runoff and convey it to established outfall drainageways. The two established outfall drainageways in the vicinity of the project are the Sossaman Channel and the RWCD Floodway. The existing channels running east-west within the right-of-way convey low flows to the outfalls but experience overtopping at high flows. There is one segment of the freeway (between the Sossaman Channel and the Sossaman Road Channel) corridor that has no current east-west conveyance. All flows up to the 100 yr. peak flows must be conveyed by the north Right-of-Way Channels without overtopping onto the freeway and without exceeding flood elevations under existing conditions. Flows that, under existing conditions, cross the corridor must be conveyed to new outfalls.

Simulation No. 2 was run to determine the peak flows in these channels, assuming 100 percent interception of off-site runoff, and to determine the effect of 100 percent interception on the peak flows at the design points and outfalls identified in Simulation No. 1.

The routing model of Simulation No. 1 was used as the basis for the model for Simulation No. 2. This was altered in the vicinity of the freeway to eliminate diversions along the freeway corridor and to eliminate the flow through the corridor between the Sossaman Road Channel and Sossaman Channel. The reader is referred to Figures 9 and 10 as an aid in the following discussion.

Figure 10 corresponds to that portion of Figure 9 which depicts the freeway corridor. Since the hydrograph routing upstream of the freeway remains the same for all simulations, only that portion which is changed is shown for Simulations No. 2 and 3. The revised routing scheme is best described starting at the east end of the project.

TABLE 2. SIMULATIONS NO. 1 AND NO. 2: PEAK FLOWS AT CRITICAL AREAS ALONG THE SUPERSTITION FREEWAY

	Location	Peak Flows (cfs) 50-Yr, 24-Hr Storm		100-Yr, 24-Hour Storm	
		Simulation No. 1	Simulation No. 2	Simulation No. 1	Simulation No. 2
1.	RWCD Floodway at the Superstiton Freeway (C037)	1459	2123	1681	2734
2.	Power Road Box Culvert (ROPOW)	1455	2192	1663	2812
3.	72nd Street Box Culvert (proposed) (C035)	1284	1841	1415	2456
4.	Sossaman Road (West Side) (C032)	831	831	1323	1358
5.	Sossaman Road (Box Culvert) (proposed) (C032A)	570	570	943	943
6.	Sossaman Channel at the South Right-of-Way Line (C021)	2982	2344	2998	2579
7.	Overtopping in the East-West Channel East of Ellsworth Road (D 224)	2037	(Stored in Detention Pond - No Overtopping	2687	(Stored in Detention Pond)
8.	Overtopping Along the East-West Channel on the West Side of Ellsworth Road. (Flows head south) (DIV 19) (DIV 225)	558 317	Eliminated Eliminated	796 358	Eliminated Eliminated
9.	Flows in the Existing East-West Channel West of Ellsworth Road (DIV 224) (DIV 225)	1472 1155	(R0224)54 Eliminated	1513 1155	(R0224)62 Eliminated

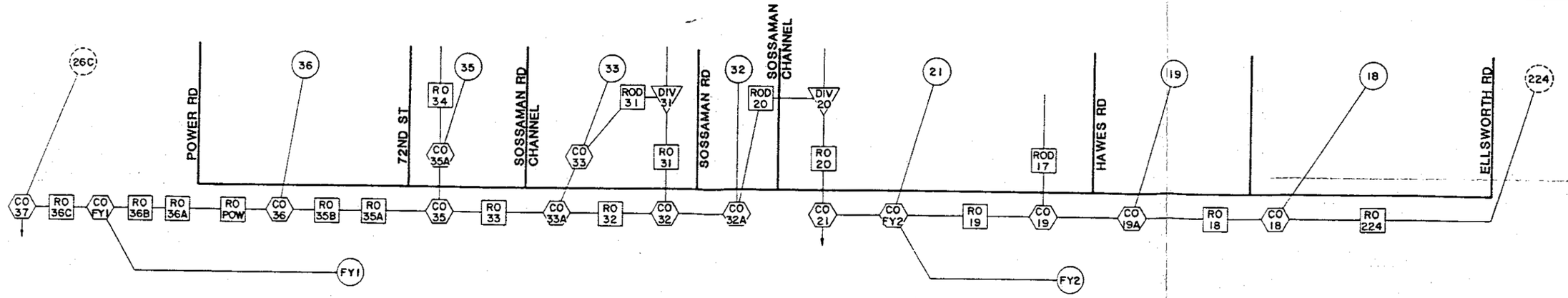

FIGURE 10 - SIMULATION NO. 2
PROPOSED CONDITIONS WITHOUT DETENTION

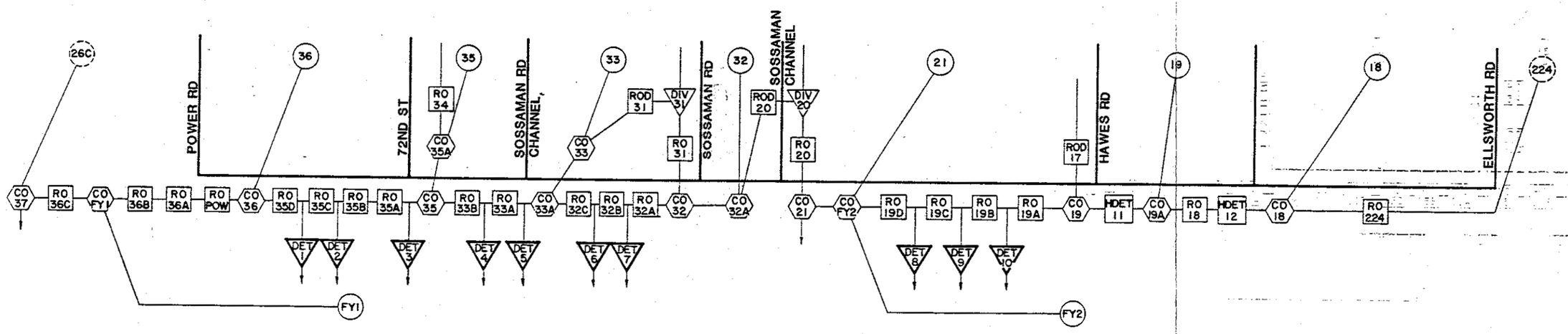

FIGURE 13 - SIMULATION NO. 3
PROPOSED CONDITIONS WITH DETENTION

LEGEND

- Sub-Basin
- Routing Reach
- Flow Combination
- Flow Division
- Detention Pond Division
- Sub-Basin As Evaluated For Maricopa County MDP

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SCHEMATIC DIAGRAMS FOR HEC-1
PROPOSED CONDITIONS

The channel parameters assumed in this simulation are based on flow approximations for the north Right-of-Way Channels which were obtained at the concept level study. These parameters evolved through the final design process to those used in Simulation No. 3.

The routing used in Simulation No. 2 is described for distinct reaches along the freeway (by freeway stationing). For each reach, the Simulation No. 1 routing is described with an explanation of how it was altered for Simulation No. 2

Reach 1: Station 1024+00 to Station 992+00

Flows arriving at Ellsworth Road are divided in Simulation No. 1 at the east and west sides of Ellsworth Road (DIV224 and DIV225). The flow division occurring on the east side is modified in Simulation No. 2 to include a detention pond in the northeast quadrant of the Ellsworth Road/Superstition Freeway Interchange. This detention pond (designed by Coe and Van Loo) will detain all the flows arriving at the east side of Ellsworth. These flows will be metered out of the pond under Ellsworth to the channel along the right-of-way line. The outflow hydrograph (from Coe and Van Loo) used to model the outflow from the pond in Simulation No. 2 replaces the flow division (Div. 224) of Simulation No. 1. The flow division occurring on the west side (DIV225) reflects a limited existing channel capacity for the 100-year peak flows. Since the new channel will convey 100 percent of the 100-year flows this division does not appear in Simulation No. 2. Flows are then routed (RO224) in both simulations to Station 992+00.

The routing length remains the same for the two simulations but the channel parameters (slope, shape, n) change. The existing unlined channel, with a varying slope and cross-section (Simulation No. 1), is replaced with a lined channel of constant slope and cross-section (Simulation No. 2). At Station 992+00 the routed flows are combined with off-site flows from Sub-Basin 18 (CO18) in both simulations.

Reach 2: Station 992+00 to Station 970+00

The combined flows are then routed (RO18) west to Hawes Road at Station 970+00. The routing length for RO18 remains the same in the two simulations but the channel parameters change as described above. At Hawes Road the hydrograph for Sub-Basin 19 is added to the routed flows (CO19A) and that combined hydrograph is added (CO19) to the hydrograph routed from the north along the Hawes Channel. Existing channel capacity at Station 970+00 is restricted, as reflected by the flow diversion (DIV19) in Simulation No. 1. Since all 100-year flows are assumed to remain in the channel in Simulation No. 2, DIV19 is not included in this simulation.

Reach 3: Station 970+00 to Station 930+50

Flows in the channel are routed to the Sossaman Channel at Station 930+50 (RO19). As with the previous routings, the channel parameters change between the two simulations, but the lengths are the same. In Simulation No. 1 the routed hydrograph is first combined with the hydrograph from Sub-Basin 21 (CO21A). The resulting hydrograph is then combined (CO21) with the hydrograph routed from the north along the Sossaman Channel. In Simulation No. 2 the routed hydrograph is combined (COFY2) with runoff from the roadway storm sewer system outfall at the Sossaman Channel and with runoff from Sub-Basin 21. Flows from the east are then routed

(CO21) with those from the north at Sossaman Channel.

Sossaman Channel is the outfall for all on-site and off-site flows between Sossaman Channel and Ellsworth Road in Simulation No. 2. A discussion of the results of Simulation Nos. 1 and 2 at CO21 is presented at the end of this section.

Reach 4 - Station 930+50 to the RWCD Floodway

In Simulation No. 1, some of the flows arriving at the freeway right-of-way within this reach are conveyed as sheet flow across the corridor. These include overtopping flows from the Sossaman Channel (ROD20), runoff from Sub-Basin 32 and flows from Sossaman Road (RO31). In Simulation No. 2, these combined flows (CO32) are routed (RO32) west along the channel to the Sossaman Road Channel. From the Sossaman Road Channel west to Power Road, routing for the two simulations differs only in that Simulation No. 1 models the existing unlined channel and Simulation No. 2 models a lined channel of differing cross-section and slope.

Roadway runoff for the below-grade roadway section between Power Road and the Sossaman Channel is collected in a storm sewer and discharged into the existing lined channel west of Power Road. This hydrograph is combined (COFY 1) with that in the lined channel in Simulation No. 2. Other than this addition, routings through the box culvert at Power Road and along the existing lined channel west of Power Road to the RWCD Floodway are identical in Simulations No. 1 and No. 2.

4. Discussion

Simulation No. 1 was run to establish the baseline flooding conditions along the freeway. Simulation No. 2 was run to determine the effect of the freeway on these flooding conditions. A discussion of the results of both simulations is presented below.

Three major design points were identified in Simulation No. 1. These are the RWCD Floodway, the box culvert at Power Road, and the Sossaman Channel. The RWCD Floodway is the outfall for Channel No. 1 which runs between Power Road and the Sossaman Channel. Channel No. 1 discharges flows through the box culvert at Power Road into an existing lined channel west of Power Road which in turn discharges into the RWCD Floodway. Peak discharges into the RWCD Floodway and ponding at Power Road must be within the limits observed for peak flows under existing conditions (Simulation No. 1). The Sossaman Channel flows north to south through the freeway corridor and provides an outfall for the existing channel between Sossaman Channel and Ellsworth Road and for the proposed channel (Channel No. 2). Peak discharges in the Sossaman Channel at the south right-of-way line must not exceed the maximum peak discharges observed under existing conditions.

In addition to identifying the major design points and the limiting criteria associated with these points, the results of Simulation No. 1 were used to identify existing areas of channel overtopping and flooding. Any overtopping flows heading south across the freeway corridor must be eliminated in the final design since the proposed channels will be on the north side of the freeway.

Copies of the HEC-1 printout for Simulation No. 1 (50-yr. and 100-yr. storm flows) are attached in Appendix C. The results of this simulation at the key areas identified above are presented in Table 2.

From an analysis using HEC-2 the capacity of the Sossaman Channel, through the right-of-way, is estimated to be 1000 cfs before the east bank is overtopped and 1900 cfs before the west bank is overtopped. The peak 100-year flow (2998 cfs) in the Sossaman Channel exceeds the channel capacity (both banks) at the point of discharge for the existing East-West Channel. Overtopping occurs at the south right-of-way line with the overtopping flows proceeding southwest as sheet flow through the adjoining residential area.

In the model used for Simulation No. 2 the channels are located along the north right-of-way line and sufficient channel capacity is assumed to preclude overtopping to the south. The results of Simulation No. 2 at the key areas identified above are presented in Table 2.

The overtopping flows between the Sossaman Channel and Ellsworth Road have been eliminated. These flows are redirected west to the Sossaman Channel on the north side of the freeway. The capacity of the Sossaman Channel is exceeded as in Simulation No. 1. However overtopping occurs on the north side of the freeway, therefore the flows are intercepted by Channel No. 1 instead of sheeting through the adjoining residential area. The flows currently crossing the freeway between Sossaman Road Channel and Sossaman Channel are intercepted by Channel No. 1 and added to the overtopping flows from the Sossaman Channel. At Power Road the additional flows from the east result in overtopping elevations exceeding those for existing conditions. The peak discharges at the RWCD in Simulation No. 2 exceed those of Simulation No. 1 due to the increased flows from the east.

Based on the results of Simulation Nos. 1 and 2 it was concluded that detention is required to maintain peak flows and flood elevations at or below those observed under existing conditions. Overtopping of the Sossaman Channel just upstream of the freeway (ie. - within the right-of-way limits) is extremely undesirable in light of the impact on Channel No. 1. Flooding elevations at Power Road and peak discharges into the RWCD Floodway must be maintained at existing levels.

Having determined this need for detention along Channel No. 1 and Channel No. 2, the HEC-2 and HEC-1 models were used to finalize a design for the off-site drainage system. The results of Simulation No. 1 at the key areas were used as the driving forces in the design process. A discussion of Simulation No. 3 is presented in Chapter V.

B. On-Site

1. Introduction

The on-site drainage includes all runoff from cross-roads, ramps and the freeway. Runoff flows are removed from the roadways and conveyed to suitable discharge points by the on-site drainage system. This system has the following components:

a. Inlets - Intercept runoff on the streets
b. Lateral Pipes - Convey intercepted runoff to the trunklines
c. Trunklines - Convey collected lateral flows to the outfalls
d. Manholes - Provide access to the trunklines and laterals and provide turning points for the trunklines
e. Outfalls - Provide discharge points for collected roadway runoff into off-site channels

Runoff flow calculations and inlet spacing calculations are presented in this chapter. Pipe and outfall design are presented in Chapter V.

The four cross-roads contributing runoff to the on-site drainage system are Power Road, Sossaman Road, 72nd Street and Ellsworth Road. All four streets cross over the freeway and are at or above grade in the vicinity of the freeway right-of-way. There is no overland flow (unpaved) component to the runoff in these areas. There are interchanges at Power Road, Sossaman Road and Ellsworth Road. The ramps from these interchanges are partially in cut and partially in fill. Where they are in cut the on-site runoff is comprised of a paved component and an unpaved (top of cut to pavement) component. In all areas of roadway cut, a berm is provided, on the north side of the roadway, at the top of the cut to prevent off-site flows from entering the roadway. The freeway is in cut for the entire length of the Power Road to Ellsworth Road segment except where it crosses over the Sossaman Channel. In fill areas there is one component to the runoff (paved).

Inlets were provided on the cross-roads within the freeway right-of-way. Inlets placed at low points along the north right-of-way line at Ellsworth Road have outfalls into the off-site drainage system. Determination of specific runoff contributions to these inlets from the north (i.e. outside the right-of-way) is not within the scope of this project. However, all runoff from the north side of the freeway is encompassed in the off-site hydrology analysis, therefore the off-site system design does include contributions from these inlets. Similarly, any storm sewers installed north of the freeway have or will have the off-site system as their outfall. Runoff contributions from these storm sewers have been included in the off-site system.

Specific explanations for the inlet design at these locations are provided below:

<u>Ellsworth Road</u> - The inlets at the north right-of-way are located at the low point of the sag vertical curve of the roadway profile. The existing roadway section north of the right-of-way has no curb and gutter, so no concentrated flows will enter the inlets from the north. If the roadway is improved, with the addition of curb and gutter, it will be the responsibility of the agency initiating the improvements to provide a separate storm sewer for conveyance of flows in Ellsworth Road. It is currently

anticipated that the future storm sewer will have an outlet in the proposed detention pond (by Coe and Van Loo) in the northeast quadrant of the Superstition Freeway/Ellsworth Road interchange. It will be the responsibility of the designer of the future storm sewer to design the inlets along Ellsworth Road such that the flows received from the north, by the sump inlets at the north right-of-way line, do not exceed the permissable width of spread at the sump inlets nor the capacity of the storm sewer installed in this project.

Sossaman Road - The inlet installed at the north right-of-way line will intercept flows from the south as well as from the north. This inlet ties into the 48-inch storm sewer in Sossaman Road (constructed by the Maricopa County Highway Department). It is the responsibility of the designer for this storm sewer to ensure that the gutter flows north of the right-of-way line do not exceed design criteria. The reader is referred to the Maricopa County Highway Department for details of the design of the 48-inch storm sewer in Sossaman Road.

72nd Street - The inlets provided at the north side of the 72nd Street bridge are designed to intercept only the runoff generated within the freeway right-of-way limits. Since it is standard practice to provide 100-percent interception of runoff (for the design storm) at the project limits it is assumed that the storm sewer system in the future 72nd Street roadway will be so designed and that there will be no bypass flows from inlets north of the right-of-way.

2. Procedures

a. General Discussion

A comprehensive procedure for designing a storm sewer system is available in the "Hydrologic and Hydraulic Training Session" (H & HTS) from ADOT. Sample calculation tables follow the text of the H&HTS and are offered as an aid to design. The procedures and the calculation tables in the H&HTS are based on the use of standard ADOT curb and gutter sections and standard catch basins. Due to the use of the special curb and gutter and the special catch basin on the ramps and freeway of this project it was necessary to make selective use of the procedure and tables. Since the grate for the special inlet is available in one size only, slotted drains were employed to increase the interception capability of an inlet (thereby increasing spacing between inlets). The procedures and calculation tables in the H & HTS do not include slotted drain design. Those were modified accordingly to include the design for slotted drains as presented in "Drainage of Highway Pavements" (HEC-12). The reader is referred to H & HTS, Section F, and HEC-12, Section 7.3, for a detailed discussion of the procedures outlined below.

b. Freeway and Ramps

The general procedure used for determining inlet locations along the ramps and the freeway was as follows:

The first inlet location was determined by locating the point at which gutter flow capacity for the 50 yr.-1 hr. storm is reached. The inlet interception capacity was then determined. If the amount of bypass flow (i.e. gutter flow minus intercepted flow) was high in proportion to the total gutter flow, a slotted drain was placed upstream of the inlet. The reduced flow (Q_{red}) arriving at the grated inlet is the gutter flow minus flow intercepted by the slotted drain. The flows intercepted by the grated inlet and bypassing (Q_c) the inlet were recalculated. This procedure was repeated downstream, with the addition of the by-pass flow to the local runoff at the next inlet. This lengthy procedure was shortened in the following manner. It was observed that at the maximum permissable width of spread the ratio of Q_c to the total flow at the inlet (Q_{tot}) for an inlet without a slotted drain was in the range of 0.40 to 0.60. High carryover flows resulted in a close spacing of inlets. To reduce the number of catch basins, a slotted drain was automatically added to each inlet. The length of the slotted drain was then adjusted so that little or no flow bypassed the grated inlet.

The required length of slotted drain was computed (using the appropriate clogging factor) based on the total Q. For the case in which the required length exceeded the design length the slotted drain efficiency (E) was calculated as described in HEC-12, Section 7.3. Q_i and Q_{red} were then determined. A cross-sectional area corresponding to Q_{red} was calculated and flows intercepted by the grated inlet (i.e., all those flows directly above the grade) were determined. Flows bypassing the grated inlet (Q_c) were added to locally generated runoff (Q) at the next slotted drain downstream resulting in the total Q (Q_t) at that slotted drain.

c. Cross-Roads

The general procedure for determining inlet locations on the cross-roads is the same as that used for the ramp and freeway inlets. Inlets were also placed at the upstream points of curb return (PCR's) on the ramps to prevent runoff from crossing over the ramps. The design storm for these cross-road inlets was the 10-yr., 1-hr. storm, as previously discussed in Chapter III.

d. Design Procedure

The ADOT Catch Basin Type 1 (C-15.10) with a Type 1 grate (curb and grate opening) is used on the cross-roads in conjunction with the Type A curb and gutter. ADOT Catch Basin Type 4 (C-15.30) is used in conjunction with barriers at PCRs on approaches to Sossaman and Ellsworth Road bridges. The Special curb and gutter section and the Special Catch Basin are used on the freeway mainline and ramps. The Type A curb and gutter has a conventional vertical curb at the flowline of the gutter whereas the Special curb and gutter has a 3 (vertical) : 1 (horizontal) curb at the gutter flow line. The curb types and catch basin types are illustrated in Appendix B. Slotted drains were employed at all inlets to maximize the interception rates at each inlet, thereby permitting maximum spacing of inlets.

Two "LOTUS" spreadsheets, the Slotted Drain Interception Sheet and the Grate Interception Sheet, were utilized to calculate the runoff interception rates at the slotted drains and at the grated inlets. Interception at the slotted drains is first calculated in the Slotted Drain Interception Sheet, assuming no carryover (Q_c) from the upstream inlets. The reduced flow (Q_{red}), which bypasses the slotted drain and goes

to the grated inlet, is an input value to the Grate Interception Sheet. The flow interception at the grate is calculated based on Q_{red}. Any carryover flow from the grate (Q_c), is then re-entered into the Slotted Drain Interception Sheet and added to the initial Q at the downstream slotted drain. This iterative procedure between the Slotted Drain Interception Sheet and the Grate Interception Sheet is continued until there is agreement between the calculated values of one sheet and the corresponding input values of the other sheet. In the process of the iterations the depth of flow at the curb (d_1) and the width of spread (T) at the slotted drain were checked for conformance with limiting criteria. Slotted drain lengths were adjusted (by 10-foot increments) to achieve maximum efficiency of design.

The design data and interception rates at the slotted drains and grate inlets are combined in the Inlet Summary Sheet.

The steps of the design procedure are explained below:

Step 1: - Determine the PCR station (cross-roads only), sag vertical curve location, or choose a trial location for the inlet (based on the maximum allowable width of spread or d_1 in the gutter) and calculate the peak flow (Q) for that point:

$$Q = CiA$$

	Freeway	Ramps	Cross-Roads
$C_{(paved)}$	0.95	0.95	0.95
$C_{(unpaved)}$	0.60	0.60	NA
Precipitation depth (in)			
1-hr., 50-yr. storm	2.15	2.15	NA
1-hr., 10-yr. storm	NA	NA	1.58
t_c (min.) (See Appendix A)	10	10	10
i (in./hr.)	5.8	5.8	4.3

A = area contributing runoff to inlet (Ac) : Drainage areas on the cross-roads are irregular. These were determined by planimetering. Paved drainage areas for the ramps and freeway were computed by multiplying the width of the roadway times the distance between the upstream inlet and the trial location. Unpaved drainage areas were computed by multiplying the width between the top of the berm (at the top of cut) and the edge of pavement by the distance between the upstream inlet and the trial location. Irregular areas on the freeway were determined by scaling distances and widths on the plans.

Q = Peak run-off (cfs)

Step 2: - Add the bypass flow from the previous inlet (Q_c) to the runoff at the current inlet (Q) to obtain the total runoff (Q_t) at the current inlet.

Step 3: - Calculate the depth of flow in the gutter using the cross-slopes of the roadway, curb (special curb and gutter section only), gutter and the longitudinal roadway slope. The basic equation for determining flow in the gutter is the modified Manning's equation (H&HTS):

$$Q = \left(\frac{0.56}{n\ S_x}\right) S_0^{1/2}\ d_1^{8/3} \qquad ; n = .016$$

Continuous Grade

The above formula was expanded to include the gutter and curb cross-slopes (see derivation in Appendix B):

$$Q = (35\ S_0^{1/2})\left(\frac{d_1^{8/3}}{S_{xg}} - \frac{d_2^{8/3}}{S_{xg}} + \frac{d_2^{8/3}}{S_{xp}} + \frac{d_1^{8/3}}{S_{xc}}\right)$$

where:

S_0	=	Longitudinal roadway slope
d_1	=	Depth of flow at the curb
d_2	=	Depth of flow at the edge of the gutter
	=	d_1 - 0.14 (Freeway and Ramps)
	=	d_1 - 0.10 (Cross-Roads)
S_{xg}	=	Gutter cross-slope
S_{xp}	=	Pavement cross-slope
S_{xc}	=	Curb cross-slope (special curb and gutter section only - this term goes to zero for the Type A curb and gutter section).

In the "LOTUS" spreadsheets, d_1 is iterated until the flow calculated from the above formula is equal to Q_t.

Sag

The value of d_1 for inlets located at sag vertical curves is calculated by a different method. The formula presented above is valid for flows in gutters having a continuous grade and does not apply to sag locations. The depth at the curb in a sump is dependent upon the head required, over the drain or inlet opening, to discharge Q_t or Q_{red} into the receiving structure. At depths less than approximately 0.40 foot these structures operate under weir control. The appropriate formulas are:

Slotted Drains: (HEC-12)

$$Q = C_w \frac{L d_1^{3/2}}{C_f}$$

where:

C_w	=	1.25
C_f	=	Clogging factor = 2
L	=	Actual length of slotted drain (ft)
d_1	=	Depth of flow at curb (ft)
Q	=	Flow at the slotted drain = Q_t (cfs)

or;

$$d_1 = \left(\frac{2Q}{1.25\ L}\right)^{2/3}$$

Grate Inlets (H&HTS)

$$Q = 3.0\ \frac{P}{C_f}\ d_1^{3/2}$$

where:

P	=	Perimeter of grate (not including the side against the curb) (ft)
	=	8.354 (Special)
	=	6.062 (Type 1 and Type 4)
C_f	=	Clogging factor
	=	2 (Special & Type 4)
	=	1 (Type 1)
Q	=	Flow in the gutter (Q_t) (cfs)
d_1	=	Depth of flow at the curb (ft)

or;

$$d_1 = \left(\frac{C_f Q}{3.0\ P}\right)^{2/3}$$

<u>Step 4:</u> - The width of spread (T) is checked at the inlet location using Q_t or Q_{red} and d_1:

$$T = \frac{d1}{S_{xg}} + \frac{d1}{S_{xp}} = \frac{(\text{gutter width})}{S_{xp}}\ (S_{xg});$$

gutter width (Type A) = 2.0 ft.
(Special) = 2.5 ft.

NOTE: When $\frac{d_1}{S_{xg}}$ => gutter width; $\frac{d_1}{S_{xg}}$ = gutter width

Step 5: - The calculated width of spread is compared to the allowable width of spread at the inlet location. If the allowable width is exceeded, the inlet location is moved upstream or the upstream inlet/slotted drain is adjusted to reduce Q_c to the current inlet.

Step 6: - For slotted drains or inlets located on a continuous grade, the length of drain or grate required to intercept 100 percent of Q_t or Q_{red} is computed (including the appropriate clogging factor) based on the following formulas:

Slotted Drain: (HEC-12)

$$L_{req'd} = \left(\frac{K\, Q_t^{\,0.42}\, S_o^{\,0.30}}{(n\, S_{xg})^{0.6}} \right) \times (C_f)$$

where:

Lreq'd	=	Required length (ft)
K	=	0.6
n	=	.016
C_f	=	1.25

Grate Inlets:

$$L_b = \left[\frac{V}{2} (d_1 + d_b)^{1/2} \right] (C_f)$$

where:

d_b	=	Depth of bar in the grate (ft)
	=	0.29 (All types)
V	=	Velocity of flow in the gutter (fps)
L_b	=	Required length of opening before the first cross-bar
C_f (C-15.30)	=	2.00
C_f (Special)	=	2.00
C_f (C-15.10)	=	1.00

Step 7: - The efficiency or interception capacity of the slotted drain or inlet is computed in the following manner:

Slotted Drain - efficiency (HEC-12)

$$E = 1 - \left(\frac{1 - L\ actual}{L\ req'd} \right)^{1.8}$$

Grate Inlet - interception capacity (H&HTS)

Grate inlets are assumed to intercept that flow which is situated directly above the grate. The intercepted flow (Q_i) is directly proportional to the ratio of the cross-sectional flow area directly over the grate to the total cross-sectional flow area in the

$$Q_i = Q_{red} \left(\frac{A_i}{A}\right)$$

This equation is valid only if L_b req'd is less than or equal to L_b actual. If L_b req'd is greater than L_b actual, the slotted drain length is adjusted to reduce Q_{red}.

Step 8: - The reduced flows (Q_{red}) or carryover flows (Q_c) are computed.

Slotted Drain:

$$Q_{red} = Q_t (1-E)$$

Grate Inlet:

$$Q_c = Q_t - Q_i$$

3. Calculation Records

Construction of cross-street inlets will occur in Phase I. The remaining inlets will be constructed in Phase III. Inlet runoff calculations are presented in two tables corresponding to these two phases. Runoff calculations for the Phase I inlets and Phase III inlets are presented in Table 3 and Table 4, respectively. Slotted drain calculations, grate inlet calculations and the Inlet Summary Sheet for Phase I are presented in Table 5, Table 6, and Table 7, respectively. Slotted drain calculations, grate inlet calculations and the Inlet Summary Sheet for Phase III are presented in Table 8, Table 9 and Table 10, respectively. Inlet numbers and locations for ramps and the freeway are presented in Figure 11. Inlet numbers and locations for the cross-roads are presented in Figure 12.

ARIZONA DEPARTMENT OF TRANSPORTATION

LOCATION DATA:
Highway: Superstition Freeway: Phase I
Location: Power Rd. to Ellsworth Rd.
Project No. F-023-1-311

DESIGN DATA:
Frequency: 10 year
P6 = 1.99 in. P24 = 2.30 in. P1 = 1.58 in.
C paved = 0.95

TABLE 3. PHASE I: RUNOFF CALCULATIONS - ON-SITE DRAINAGE

Drainage Area			CA	Tc	i	Q = CiA
No.	Station-Station	(acres)	(.95*AREA)	(min.)	(in./hr.)	(cfs)
	Sossaman Road					
A-1	38+75 LT - 39+79 LT	0.107	0.102	10.0	4.30	0.44
A-2	38+75 RT - 40+28 RT	0.250	0.238	10.0	4.30	1.02
A-3	40+28 RT - 42+65 RT	0.210	0.199	10.0	4.30	0.86
A-4	40+36 LT - 42+65 LT	0.210	0.199	10.0	4.30	0.86
A-5	43+52 RT - 42+65 RT	0.080	0.076	10.0	4.30	0.33
A-6	43+59 LT - 42+65 LT	0.086	0.082	10.0	4.30	0.35
A-7	47+53 LT - 46+35 LT	0.121	0.115	10.0	4.30	0.49
A-8	1+20 LT - 44+11 LT	0.129	0.123	10.0	4.30	0.53
A-22	46+35 LT - 44+30 LT	0.247	0.235	10.0	4.30	1.01
A-23	46+35 RT - 44+30 RT	0.239	0.227	10.0	4.30	0.98
	72nd Street					
A-9	12+50 LT - 14+90 LT	0.187	0.178	10.0	4.30	0.76
A-10	12+50 RT - 14+90 RT	0.187	0.178	10.0	4.30	0.76

Drainage Area			CA	Tc	i	Q = CiA
No.	Station-Station	(acres)	(.95*AREA)	(min.)	(in./hr.)	(cfs)
	Ellsworth Road					
A-11	33+50 LT - 35+79 LT	0.419	0.398	10.0	4.30	1.71
A-12	35+70 LT - 38+34 LT	0.342	0.325	10.0	4.30	1.40
A-13	36+27 - 38+32 (AT MEDIAN)	0.223	0.212	10.0	4.30	0.91
A-14	38+98 RT - 40+92 RT	0.181	0.172	10.0	4.30	0.74
A-15	38+91 LT - 40+92 LT	0.185	0.176	10.0	4.30	0.76
A-16	42+18 LT - 40+92 LT	0.116	0.110	10.0	4.30	0.47
A-17	42+10 RT - 40+92 RT	0.108	0.103	10.0	4.30	0.44
A-18	44+35 LT - 42+68 LT	0.234	0.222	10.0	4.30	0.96
A-19	44+40 RT - 42+66 RT	0.168	0.160	10.0	4.30	0.69
A-20	47+02 LT - 44+40 LT	0.256	0.243	10.0	4.30	1.05
A-21	47+02 RT - 44+40 RT	0.251	0.238	10.0	4.30	1.03

Computed by: J.N. McCammon Date: 5/87 Checked by: GCG Date: 9/88

ARIZONA DEPARTMENT OF TRANSPORTATION

LOCATION DATA
Highway: Superstition Freeway: Phase III
Location: Power Road to Ellsworth Road
Project No. F-028-1-311

DESIGN DATA
Frequency 50 year
P6 = 2.70 in. P24 = 3.20 in. P1 = 2.15 in.
C paved = 0.95 C unpaved = 0.60

TABLE 4. PHASE III: RUNOFF CALCULATIONS - ON-SITE DRAINAGE

Drainage Area		Length	Avg. Width (ft.)		Area (Ac)		Area Total	C x A		C x A	Tc	i	Q
No.	Station-Station	(ft.)	Paved	Unpaved	Paved	Unpaved	(Ac)	Paved	Unpaved	Total	(min)	(in/hr)	(cfs)
A-1	870+00 LT - 875+20 LT	520.0	58.0	38.0	0.692	0.454	1.146	0.658	0.272	0.930	10	5.8	5.4
A-2	870+00 RT - 874+85 RT	485.0	58.0	43.5	0.646	0.464	1.130	0.613	0.291	0.904	10	5.8	5.2
A-3	4+45 - 3+00	145.0	43.5	42.0	0.145	0.140	0.285	0.138	0.084	0.221	10	5.8	1.3
A-4	6+50 - 4+45	205.0	40.0	62.0	0.188	0.292	0.480	0.179	0.175	0.354	10	5.8	2.1
A-5	9+00 - 6+50	250.0	32.5	84.5	0.187	0.485	0.671	0.177	0.291	0.468	10	5.8	2.7
A-6	9+88 - 9+00 W	88.0	28.0	96.0	0.057	0.194	0.251	0.054	0.116	0.170	10	5.8	1.0
A-6	9+88 - 10+55 E	67.0	[1]	97.5	0.078	0.150	0.228	0.074	0.090	0.164	10	5.8	1.0
A-7	10+55 - 11+45	90.0	98.5	99.0	0.204	0.205	0.408	0.193	0.123	0.316	10	5.8	1.8
A-8	11+45 - 877+22 LT	90.0	93.0	101.5	0.192	0.210	0.402	0.183	0.126	0.308	10	5.8	1.8
A-9	877+22 LT - 878+12 LT	90.0	86.0	104.0	0.178	0.215	0.393	0.169	0.129	0.298	10	5.8	1.7
A-10	878+12 LT - 879+12 LT	100.0	78.5	106.0	0.180	0.243	0.424	0.171	0.146	0.317	10	5.8	1.8
A-11	879+12 LT - 880+17 LT	105.0	71.0	107.0	0.171	0.258	0.429	0.163	0.155	0.317	10	5.8	1.8
A-12	880+17 LT - 881+27 LT	110.0	63.5	109.0	0.160	0.275	0.436	0.152	0.165	0.317	10	5.8	1.8
A-13	881+27 LT - 883+70 LT	243.0	59.0	110.5	0.329	0.616	0.946	0.313	0.370	0.683	10	5.8	4.0
A-14	5+00 - 3+00	200.0	32.0	[2]	0.147	0.172	0.319	0.140	0.103	0.243	10	5.8	1.4
A-15	8+30 - 5+00	330.0	29.0	61.0	0.220	0.462	0.682	0.209	0.277	0.486	10	5.8	2.8
A-16	10+35 - 8+30 W	205.0	[3]	60.5	0.180	0.285	0.465	0.171	0.171	0.342	10	5.8	2.0
A-16	10+35 - 11+45 E	110.0	95.0	57.5	0.240	0.145	0.385	0.228	0.087	0.315	10	5.8	1.8
A-17	11+45 - 12+45	100.0	89.5	54.0	0.205	0.124	0.329	0.195	0.074	0.270	10	5.8	1.6
A-18	12+45 - 13+45	100.0	86.0	53.2	0.197	0.122	0.320	0.188	0.073	0.261	10	5.8	1.5

Computed by: J.N. McCammon Date: 5/87 Checked by: _____ Date: _____
Revisions by: D.B. Harelson Date: 2/88 Checked by: GB Date: 9/88

IRREGULAR AREAS:
[1] (28x46)+(21x101)
[2] (50x100)+(50x100)/2
[3] (35x98)+(26x170)

ARIZONA DEPARTMENT OF TRANSPORTATION

LOCATION DATA
Highway: Superstition Freeway: Phase III
Location: Power Road to Ellsworth Road
Project No. F-028-1-311

DESIGN DATA
Frequency 50 year
P6 = 2.70 in. P24 = 3.20 in. P1 = 2.15 in.
C paved = 0.95 C unpaved = 0.60

TABLE 4 PHASE III: RUNOFF CALCULATIONS - ON-SITE DRAINAGE

Drainage Area		Length	Avg. Width (ft.)		Area (Ac)		Area Total	C x A		C x A	Tc	i	Q
No.	Station-Station	(ft.)	Paved	Unpaved	Paved	Unpaved	(Ac)	Paved	Unpaved	Total	(min)	(in/hr)	(cfs)
A-19	13+45 - 879+29 RT	100.0	84.0	56.0	0.193	0.129	0.321	0.183	0.077	0.260	10	5.8	1.5
A-20	879+29 RT - 880+34 RT	105.0	81.5	58.5	0.196	0.141	0.337	0.187	0.085	0.271	10	5.8	1.6
A-21	880+34 RT - 881+38 RT	105.0	79.5	61.5	0.192	0.148	0.340	0.182	0.089	0.271	10	5.8	1.6
A-22	881+38 RT - 882+43 RT	105.0	77.5	66.5	0.187	0.160	0.347	0.177	0.096	0.274	10	5.8	1.6
A-23	882+43 RT - 883+48 RT	105.0	75.0	71.5	0.181	0.172	0.353	0.172	0.103	0.275	10	5.8	1.6
A-24	883+48 RT - 884+78 RT *	45.0	73.0	74.5	0.075	0.077	0.152	0.072	0.046	0.118	10	5.8	0.7
A-25	883+70 LT - 888+40 LT *	385.0	56.0	108.5	0.513	0.959	1.472	0.487	0.575	1.062	10	5.8	6.2
A-26	884+78 RT - 885+57 RT	79.0	71.0	78.0	0.129	0.141	0.270	0.122	0.085	0.207	10	5.8	1.2
A-27	885+57 RT - 886+62 RT	105.0	68.5	82.0	0.165	0.198	0.363	0.157	0.119	0.275	10	5.8	1.6
A-28	886+62 RT - 887+67 RT	105.0	66.5	83.5	0.160	0.201	0.362	0.152	0.121	0.273	10	5.8	1.6
A-29	887+67 RT - 889+77 RT	110.0	65.0	78.5	0.164	0.198	0.362	0.156	0.119	0.275	10	5.8	1.6
A-30	888+40 LT - 892+58 LT	418.0	59.5	106.5	0.571	1.022	1.593	0.542	0.613	1.156	10	5.8	6.7
A-31	888+77 RT - 889+87 RT	110.0	63.0	75.5	0.159	0.191	0.350	0.151	0.114	0.266	10	5.8	1.5
A-32	889+87 RT - 891+03 RT	116.0	61.0	78.5	0.162	0.209	0.371	0.154	0.125	0.280	10	5.8	1.6
A-33	891+03 RT - 893+75 RT	272.0	59.0	78.0	0.368	0.487	0.855	0.350	0.292	0.642	10	5.8	3.7
A-34	892+58 LT - 893+48 LT	90.0	62.0	106.0	0.128	0.219	0.347	0.122	0.131	0.253	10	5.8	1.5
A-35	893+48 LT - 894+38 LT	90.0	63.5	105.5	0.131	0.218	0.349	0.125	0.131	0.255	10	5.8	1.5
A-36	894+38 LT - 895+22 LT	84.0	65.0	105.0	0.125	0.202	0.328	0.119	0.121	0.241	10	5.8	1.4
A-37	895+22 LT - 896+07 LT	85.0	67.0	105.0	0.131	0.205	0.336	0.124	0.123	0.247	10	5.8	1.4
A-38	896+07 LT - 876+92 LT	85.0	69.0	105.0	0.135	0.205	0.340	0.128	0.123	0.251	10	5.8	1.5
A-39	896+92 LT - 897+77 LT	85.0	70.5	105.5	0.138	0.206	0.343	0.131	0.124	0.254	10	5.8	1.5

Computed by: J.N. McCammon Date: 5/87 Checked by: _____ Date:
Revisions by: D.B. Harelson Date: 2/88 Checked by: GES Date: 9/88

* 85 ft. under bridge at 72nd Street

ARIZONA DEPARTMENT OF TRANSPORTATION

LOCATION DATA
Highway: Superstition Freeway: Phase III
Location: Power Road to Ellsworth Road
Project No. F-025-1-311

DESIGN DATA
Frequency 50 year
P6 = 2.70 in. P24 = 3.20 in. P1 = 2.15 in.
C paved = 0.95 C unpaved = 0.60

TABLE 4 PHASE III: RUNOFF CALCULATIONS - ON-SITE DRAINAGE

Drainage Area		Length	Avg. Width (ft.)		Area (Ac)		Area Total	C x A		C x A	Tc	i	Q
No.	Station-Station	(ft.)	Paved	Unpaved	Paved	Unpaved	(Ac)	Paved	Unpaved	Total	(min)	(in/hr)	(cfs)
A-40	893+75 RT - 897+85 RT	410.0	58.0	81.5	0.546	0.767	1.313	0.519	0.460	0.979	10	5.8	5.7
A-41	897+77 LT - 898+57 LT	80.0	72.0	106.0	0.132	0.195	0.327	0.126	0.117	0.242	10	5.8	1.4
A-42	898+57 LT - 899+43 LT	80.0	74.0	106.0	0.136	0.195	0.331	0.129	0.117	0.246	10	5.8	1.4
A-43	899+43 LT - 900+23 LT	80.0	75.5	107.0	0.139	0.197	0.335	0.132	0.118	0.250	10	5.8	1.4
A-44	900+23 LT - 901+03 LT	80.0	77.0	108.5	0.141	0.199	0.341	0.134	0.120	0.254	10	5.8	1.5
A-45	901+03 LT - 901+83 LT	80.0	79.0	109.5	0.145	0.201	0.346	0.138	0.121	0.258	10	5.8	1.5
A-46	901+83 LT - 902+58 LT	75.0	80.5	111.0	0.139	0.191	0.330	0.132	0.115	0.246	10	5.8	1.4
A-47	902+58 LT - 903+33 LT	75.0	82.0	112.0	0.141	0.193	0.334	0.134	0.116	0.250	10	5.8	1.4
A-48	903+33 LT - 904+08 LT	75.0	84.0	113.0	0.145	0.195	0.339	0.137	0.117	0.254	10	5.8	1.5
A-49	897+85 RT - 902+00 RT	415.0	59.0	87.0	0.562	0.829	1.391	0.534	0.497	1.031	10	5.8	6.0
A-50	902+00 RT - 902+85 RT	85.0	63.5	86.0	0.124	0.168	0.292	0.118	0.101	0.218	10	5.8	1.3
A-51	902+85 RT - 903+69 RT	84.0	69.5	86.0	0.134	0.166	0.300	0.127	0.100	0.227	10	5.8	1.3
A-52	903+69 RT - 904+49 RT	80.0	75.0	88.5	0.138	0.163	0.300	0.131	0.098	0.228	10	5.8	1.3
A-53	904+49 RT - 905+24 RT	75.0	80.5	89.5	0.137	0.154	0.293	0.132	0.092	0.224	10	5.8	1.3
A-54	905+24 RT - 905+94 RT	70.0	85.0	81.5	0.137	0.131	0.268	0.130	0.079	0.208	10	5.8	1.2
A-55	905+94 RT - 5+20	75.0	89.5	81.0	0.154	0.139	0.294	0.146	0.084	0.230	10	5.8	1.3
A-56	5+20 - 6+20	100.0	96.0	78.0	0.220	0.179	0.399	0.209	0.107	0.317	10	5.8	1.8
A-57	6+20 - 8+65	245.0	[1]	79.0	0.191	0.444	0.635	0.181	0.267	0.448	10	5.8	2.6
A-58	907+95 RT - 910+65 RT	270.0	58.0	28.0	0.360	0.174	0.533	0.342	0.104	0.446	10	5.8	2.6
A-59	904+08 LT - 14+05	70.0	85.5	114.5	0.137	0.184	0.321	0.131	0.110	0.241	10	5.8	1.4
A-60	14+05 - 14+70	65.0	86.5	115.5	0.129	0.172	0.301	0.123	0.103	0.226	10	5.8	1.3

Computed by: J. N. McCammon Date: 5/87 Checked by: _____ Date: _____
Revised by: D. B. Harelson Date: 2/88 Checked by: CEB Date: 9/88

IRREGULAR AREAS:
[1] (17x101)+(27x245)

ARIZONA DEPARTMENT OF TRANSPORTATION

LOCATION DATA
Highway: Superstition Freeway: Phase III
Location: Power Road to Ellsworth Road
Project No. F-028-1-311

DESIGN DATA
Frequency 50 year
P6 = 2.70 in. P24 = 3.20 in. P1 = 2.15 in.
C paved = 0.95 C unpaved = 0.60

TABLE 4 PHASE III: RUNOFF CALCULATIONS - ON-SITE DRAINAGE

Drainage Area			Avg. Width (ft.)		Area (Ac)		Area	C x A					
No.	Station-Station	Length (ft.)	Paved	Unpaved	Paved	Unpaved	Total (Ac)	Paved	Unpaved	C x A Total	Tc (min)	i (in/hr)	Q (cfs)
A-61	14+70 - 15+25	55.0	87.5	116.0	0.110	0.146	0.257	0.105	0.088	0.193	10	5.8	1.1
A-62	15+25 - 15+75	70.0	89.5	115.5	0.144	0.186	0.329	0.137	0.111	0.248	10	5.8	1.4
A-63	15+95 - 16+65	70.0	93.0	115.5	0.149	0.186	0.335	0.142	0.111	0.253	10	5.8	1.5
A-64	16+65 - 17+40	75.0	97.5	116.5	0.168	0.201	0.368	0.159	0.120	0.280	10	5.8	1.6
A-65	17+40 - 19+85	245.0	[1]	113.5	0.170	0.638	0.808	0.162	0.383	0.545	10	5.8	3.2
A-66	908+20 LT - 910+65 LT	245.0	58.0	31.0	0.326	0.174	0.501	0.310	0.105	0.415	10	5.8	2.4
A-67	19+85 - 21+65	180.0	28.0	105.0	0.116	0.434	0.550	0.110	0.260	0.370	10	5.8	2.1
A-68	21+65 - 23+45	180.0	31.0	87.0	0.128	0.360	0.488	0.122	0.216	0.337	10	5.8	2.0
A-69	23+45 - 27+20	375.0	[2A]	[2B]	0.359	0.249	0.608	0.341	0.149	0.490	10	5.8	2.8
A-70	910+65 LT - 913+20 LT	255.0	58.0	61.5	0.340	0.360	0.700	0.323	0.216	0.539	10	5.8	3.1
A-71	910+65 RT - 913+20 RT	255.0	58.0	55.5	0.340	0.325	0.664	0.323	0.195	0.517	10	5.8	3.0
A-72	8+65 - 11+00	235.0	33.0	63.0	0.178	0.340	0.518	0.169	0.204	0.373	10	5.8	2.2
A-73	913+20 LT - 915+75 LT	255.0	58.0	95.0	0.340	0.556	0.896	0.323	0.334	0.656	10	5.8	3.8
A-74	913+20 RT - 915+75 RT	255.0	58.0	90.5	0.340	0.530	0.869	0.323	0.318	0.640	10	5.8	3.7
A-75	11+00 - 13+00	200.0	41.0	36.5	0.188	0.168	0.356	0.179	0.101	0.279	10	5.8	1.6
A-76	915+75 LT - 917+25 LT	150.0	58.0	121.0	0.200	0.417	0.616	0.190	0.250	0.440	10	5.8	2.6
A-77	915+75 RT - 917+25 RT	150.0	58.0	114.5	0.200	0.394	0.594	0.190	0.237	0.426	10	5.8	2.5
A-78	13+00 - 16+42	342.0	[3A]	[3B]	0.388	0.021	0.409	0.369	0.013	0.381	10	5.8	2.2
A-79	917+25 LT - 920+00 LT *	179.0	58.0	120.0	0.238	0.493	0.731	0.226	0.296	0.522	10	5.8	3.0

Computed by: J.N. McCasson Date: 5/87 Checked by: _____ Date: _____
Revisions by: D.B. Harelson Date: 2/88 Checked by: GS Date: 9/88

IRREGULAR AREAS:
[1] (14x101)+(26x231)
[2A] (32x375)+(56x82)/2+46(27+52)/2
[2B] 57x190
[3A] (44x342)+(26x63)/2+48(19+25)/2
[3B] 10x90

ARIZONA DEPARTMENT OF TRANSPORTATION

LOCATION DATA
Highway: Superstition Freeway: Phase III
Location: Power Road to Ellsworth Road
Project No. F-028-1-311

DESIGN DATA
Frequency 50 year
P6 = 2.70 in. P24 = 3.20 in. P1 = 2.15 in.
C paved = 0.95 C unpaved = 0.60

TABLE 4 PHASE III: RUNOFF CALCULATIONS - ON-SITE DRAINAGE

Drainage Area			Avg. Width (ft.)		Area (Ac)		Area	C x A					
No.	Station-Station	Length (ft.)	Paved	Unpaved	Paved	Unpaved	Total (Ac)	Paved	Unpaved	C x A Total	Tc (min)	i (in/hr)	Q (cfs)
A-80	917+25 RT - 920+00 RT *	179.0	58.0	[1]	0.238	0.500	0.738	0.226	0.300	0.526	10	5.8	3.1
A-81	920+00 LT - 925+00 LT	500.0	58.0	72.0	0.666	0.826	1.492	0.632	0.496	1.128	10	5.8	6.5
A-82	920+00 RT - 925+00 RT	500.0	58.0	81.0	0.666	0.930	1.596	0.632	0.558	1.190	10	5.8	6.9
A-83	2+65 - 1+05	160.0	34.5	0.0	0.127	0.000	0.127	0.120	0.000	0.120	10	5.8	0.7
A-84	4+00 - 1+20	280.0	44.5	0.0	0.286	0.000	0.286	0.272	0.000	0.272	10	5.8	1.6
A-85	6+69 - 4+00 W	269.0	37.0	[2]	0.228	0.046	0.274	0.217	0.028	0.245	10	5.8	1.4
A-85	6+69 - 11+45 E	476.0	[3A]	[3B]	0.467	0.250	0.717	0.444	0.150	0.594	10	5.8	3.4
A-86	925+00 LT - 928+20 LT	320.0	58.0	30.5	0.426	0.224	0.650	0.405	0.134	0.539	10	5.8	3.1
A-87	925+00 RT - 927+85 RT	285.0	58.0	33.5	0.379	0.219	0.599	0.361	0.132	0.492	10	5.8	2.9
A-88	5+49 - 2+65 W	284.0	31.5	[4]	0.205	0.009	0.214	0.195	0.005	0.201	10	5.8	1.2
A-88	5+49 - 10+05 E	456.0	28.5	[5]	0.298	0.046	0.344	0.283	0.028	0.311	10	5.8	1.8
A-89	10+05 - 12+35	230.0	95.0	0.0	0.502	0.000	0.502	0.477	0.000	0.477	10	5.8	2.8
A-90	12+35 - 932+32 RT	220.0	85.0	0.0	0.429	0.000	0.429	0.408	0.000	0.408	10	5.8	2.4
A-91	11+45 - 931+77 LT	255.0	86.0	0.0	0.503	0.000	0.503	0.478	0.000	0.478	10	5.8	2.8
A-92	947+25 LT - 953+20 LT	595.0	58.0	[6]	0.792	0.140	0.932	0.753	0.084	0.837	10	5.8	4.9
A-93	947+25 RT - 953+20 RT	595.0	58.0	[7]	0.792	0.025	0.817	0.753	0.015	0.768	10	5.8	4.5
A-94	953+20 LT - 957+30 LT	410.0	58.0	55.0	0.546	0.518	1.064	0.519	0.311	0.829	10	5.8	4.8
A-95	953+20 RT - 957+30 RT	410.0	58.0	58.5	0.546	0.551	1.097	0.519	0.330	0.849	10	5.8	4.9
A-96	957+30 LT - 961+25 LT	395.0	58.0	61.5	0.526	0.558	1.084	0.500	0.335	0.834	10	5.8	4.8

Computed by: J.N. McCammon Date: 5/87 Checked by: _____ Date: _____
Revisions by: D.B. Hareleson Date: 2/88 Checked by: GCB Date: 9/90

IRREGULAR AREAS:
[1] (122x167)+(12x118)
[2] 45x45
[3A] (98.5x100)+(27x247)+(29.5x129)
[3B] 43.5x250
[4] 5x78
[5] 10x200
[6] 51x120
[7] 20x55
* 96' under bridge at Sossaman Road

ARIZONA DEPARTMENT OF TRANSPORTATION

LOCATION DATA
Highway: Superstition Freeway: Phase III
Location: Power Road to Ellsworth Road
Project No. F-028-1-311

DESIGN DATA
Frequency 50 year
P6 = 2.70 in. P24 = 3.29 in. P1 = 2.15 in.
C paved = 0.95 C unpaved = 0.60

TABLE 4 PHASE III: RUNOFF CALCULATIONS - ON-SITE DRAINAGE

Drainage Area		Length	Avg. Width (ft.)		Area (Ac)		Area	C x A			Tc	i	Q
No.	Station-Station	(ft.)	Paved	Unpaved	Paved	Unpaved	Total (Ac)	Paved	Unpaved	C x A Total	(min)	(in/hr)	(cfs)
A-97	957+30 RT - 961+25 RT	395.0	58.0	[1]	0.526	0.426	0.952	0.500	0.256	0.755	10	5.8	4.4
A-98	961+25 LT - 965+05 LT	380.0	58.0	69.0	0.506	0.602	1.108	0.481	0.361	0.842	10	5.8	4.9
A-99	961+25 RT - 965+05 RT	380.0	58.0	54.5	0.506	0.475	0.981	0.481	0.285	0.766	10	5.8	4.4
A-100	965+05 LT - 968+70 LT	365.0	58.0	76.5	0.486	0.641	1.127	0.462	0.385	0.846	10	5.8	4.9
A-101	965+05 RT - 968+70 RT	365.0	58.0	62.0	0.486	0.520	1.006	0.462	0.312	0.773	10	5.8	4.5
A-102	968+70 LT - 972+15 LT	345.0	58.0	83.0	0.459	0.657	1.117	0.436	0.394	0.831	10	5.8	4.8
A-103	968+70 RT - 972+15 RT	345.0	58.0	61.5	0.459	0.487	0.946	0.436	0.292	0.729	10	5.8	4.2
A-104	972+15 LT - 975+55 LT	340.0	58.0	89.5	0.453	0.699	1.151	0.430	0.419	0.849	10	5.8	4.9
A-105	972+15 RT - 975+55 RT	340.0	58.0	61.0	0.453	0.476	0.929	0.430	0.286	0.716	10	5.8	4.2
A-106	975+55 LT - 978+90 LT	335.0	58.0	95.5	0.446	0.734	1.180	0.424	0.441	0.864	10	5.8	5.0
A-107	975+55 RT - 978-90 RT	335.0	58.0	62.5	0.446	0.481	0.927	0.424	0.288	0.712	10	5.8	4.1
A-108	978+90 LT - 981+95 LT	305.0	58.0	99.5	0.406	0.697	1.103	0.386	0.418	0.804	10	5.8	4.7
A-109	978+90 RT - 981+95 RT	305.0	58.0	62.0	0.406	0.434	0.840	0.386	0.260	0.646	10	5.8	3.7
A-110	981+95 LT - 985+70 LT	375.0	58.0	99.5	0.499	0.857	1.356	0.474	0.514	0.988	10	5.8	5.7
A-111	981+95 RT - 985+70 RT	375.0	58.0	62.5	0.499	0.538	1.037	0.474	0.323	0.797	10	5.8	4.6
A-112	985+70 LT - 989+00 LT	330.0	58.0	97.0	0.439	0.735	1.174	0.417	0.441	0.858	10	5.8	5.0
A-113	985+70 RT - 989+00 RT	330.0	58.0	60.5	0.439	0.458	0.898	0.417	0.275	0.692	10	5.8	4.0
A-114	989+00 LT - 993+30 LT	430.0	58.0	93.5	0.573	0.923	1.496	0.544	0.554	1.098	10	5.8	6.4
A-115	989+00 RT - 997+45 RT	845.0	58.0	57.5	1.125	1.115	2.241	1.069	0.669	1.738	10	5.8	10.1
A-116	993+30 LT - 998+75 LT	545.0	60.0	88.5	0.751	1.107	1.858	0.713	0.664	1.378	10	5.8	8.0
A-117	997+45 RT - 1002+85 RT	540.0	58.0	59.0	0.719	0.731	1.450	0.683	0.439	1.122	10	5.8	6.5

Computed by: J.N. McCasson Date: 5/87 Checked by: _____ Date: _____
Revisions by: D.B. Harelson Date: 2/88 Checked by: GES Date: 9/88

IRREGULAR AREAS:
[1] (43x305)+(20x51)+(63x70)

ARIZONA DEPARTMENT OF TRANSPORTATION

LOCATION DATA
Highway: Superstition Freeway: Phase III
Location: Power Road to Ellsworth Road
Project No. F-028-1-311

DESIGN DATA
Frequency 50 year
P6 = 2.70 in. P24 = 3.20 in. P1 = 2.15 in.
C paved = 0.95 C unpaved = 0.60

TABLE 4 PHASE III: RUNOFF CALCULATIONS - ON-SITE DRAINAGE

Drainage Area		Length	Avg. Width (ft.)		Area (Ac)		Area	C x A					
No.	Station-Station	(ft.)	Paved	Unpaved	Paved	Unpaved	Total (Ac)	Paved	Unpaved	C x A Total	Tc (min)	i (in/hr)	Q (cfs)
A-118	998+75 LT - 999+80 LT	105.0	63.0	85.0	0.152	0.205	0.357	0.144	0.123	0.267	10	5.8	1.5
A-119	999+80 LT - 1000+80 LT	100.0	65.0	82.5	0.149	0.187	0.339	0.142	0.114	0.255	10	5.8	1.5
A-120	1000+80 LT - 1001+75 LT	95.0	67.0	80.0	0.146	0.174	0.321	0.139	0.105	0.243	10	5.8	1.4
A-121	1001+75 LT - 1002+70 LT	95.0	69.0	79.0	0.150	0.172	0.323	0.143	0.103	0.246	10	5.8	1.4
A-122	1002+70 LT - 1003+60 LT	90.0	71.0	77.5	0.147	0.160	0.307	0.139	0.096	0.235	10	5.8	1.4
A-123	1003+60 LT - 1004+50 LT	90.0	73.0	76.5	0.151	0.158	0.309	0.143	0.095	0.238	10	5.8	1.4
A-124	1004+50 LT - 1005+40 LT	90.0	74.5	74.5	0.154	0.154	0.308	0.146	0.092	0.239	10	5.8	1.4
A-125	1005+40 LT - 1006+30 LT	90.0	76.5	75.5	0.158	0.156	0.314	0.150	0.094	0.244	10	5.8	1.4
A-126	1002+85 RT - 1008+00 RT	515.0	60.0	56.0	0.709	0.662	1.371	0.674	0.397	1.071	10	5.8	6.2
A-127	1006+30 LT - 1007+15 LT	85.0	79.0	78.0	0.154	0.152	0.306	0.146	0.091	0.238	10	5.8	1.4
A-128	1007+15 LT - 1008+00 LT	85.0	80.5	80.5	0.157	0.157	0.314	0.149	0.094	0.243	10	5.8	1.4
A-129	1008+00 LT - 1008+85 LT	85.0	82.0	83.5	0.160	0.163	0.323	0.152	0.098	0.250	10	5.8	1.4
A-130	1008+00 RT - 1008+95 RT	95.0	65.0	51.0	0.142	0.111	0.253	0.135	0.067	0.201	10	5.8	1.2
A-131	1008+95 RT - 1009+84 RT	89.0	71.0	48.5	0.145	0.099	0.244	0.138	0.059	0.197	10	5.8	1.1
A-132	1009+84 RT - 1010+74 RT	90.0	77.0	45.0	0.159	0.093	0.252	0.151	0.056	0.207	10	5.8	1.2
A-133	1010+74 RT - 1011+59 RT	85.0	83.0	43.5	0.162	0.085	0.247	0.154	0.051	0.205	10	5.8	1.2
A-134	1011+59 RT - 4+85	75.0	89.0	44.5	0.153	0.077	0.230	0.146	0.046	0.192	10	5.8	1.1
A-135	4+85 - 6+00	115.0	96.0	44.5	0.253	0.117	0.371	0.241	0.070	0.311	10	5.8	1.8
A-136	6+00 - 9+50	350.0	[1]	42.0	0.307	0.337	0.644	0.292	0.202	0.494	10	5.8	2.9
A-137	1013+95 RT - 1016+75 RT	280.0	58.0	27.5	0.373	0.177	0.550	0.354	0.106	0.460	10	5.8	2.7
A-138	1008+85 LT - 1009+70 LT	85.0	83.5	86.0	0.163	0.168	0.331	0.155	0.101	0.255	10	5.8	1.5

Computed by: J.N. McCammon Date: 5/87 Checked by: _____ Date: _____
Revisions by: D.R. Harelson Date: 2/88 Checked by: CCS Date: 9/88

IRREGULAR AREAS:
[1] (43x100)+30?(26+33)/2

ARIZONA DEPARTMENT OF TRANSPORTATION

LOCATION DATA
Highway: Superstition Freeway: Phase III
Location: Power Road to Ellsworth Road
Project No. F-028-1-311

DESIGN DATA
Frequency 50 year
P6 = 2.70 in. P24 = 3.20 in. P1 = 2.15 in.
C paved = 0.95 C unpaved = 0.60

TABLE 4 PHASE III: RUNOFF CALCULATIONS - ON-SITE DRAINAGE

Drainage Area		Length	Avg. Width (ft.)		Area (Ac)		Area Total	C x A		C x A	Tc	i	Q
No.	Station-Station	(ft.)	Paved	Unpaved	Paved	Unpaved	(Ac)	Paved	Unpaved	Total	(min)	(in/hr)	(cfs)
A-139	1009+70 LT - 1010+50 LT	80.0	85.0	88.5	0.156	0.163	0.319	0.148	0.098	0.246	10	5.8	1.4
A-140	1010+50 LT - 14+55	80.0	86.5	90.0	0.159	0.165	0.324	0.151	0.099	0.250	10	5.8	1.5
A-141	14+55 - 15+35	80.0	88.5	93.0	0.163	0.171	0.333	0.154	0.102	0.257	10	5.8	1.5
A-142	15+35 - 16+00	65.0	91.5	95.0	0.137	0.142	0.278	0.130	0.085	0.215	10	5.8	1.2
A-143	16+00 - 17+75	175.0	[1]	93.5	0.174	0.376	0.550	0.165	0.225	0.391	10	5.8	2.3
A-144	1013+15 LT - 1016+75 LT	360.0	77.0	[2]	0.636	0.183	0.819	0.605	0.110	0.714	10	5.8	4.1
A-145	17+75 - 20+25	250.0	28.5	83.5	0.164	0.479	0.643	0.155	0.288	0.443	10	5.8	2.6
A-146	1016+75 LT - 1019+30 LT	255.0	58.0	62.5	0.340	0.366	0.705	0.323	0.220	0.542	10	5.8	3.1
A-147	1016+75 RT - 1019+30 RT	255.0	58.0	55.0	0.340	0.322	0.662	0.323	0.193	0.516	10	5.8	3.0
A-148	19+50 - 16+45	695.0	[3A]	[3B]	0.677	0.087	0.764	0.643	0.052	0.695	10	5.8	4.0
A-149	20+25 - 27+20	695.0	[4A]	[4B]	0.579	0.452	1.031	0.550	0.271	0.821	10	5.8	4.8
A-150	1019+30 LT - 1022+30 LT	300.0	58.0	100.0	0.399	0.689	1.088	0.379	0.413	0.793	10	5.8	4.6
A-151	1019+30 RT - 1022+30 RT	300.0	58.0	87.0	0.399	0.599	0.999	0.379	0.360	0.739	10	5.8	4.3
A-152	1022+30 LT - 1028+50 LT *	524.0	58.0	[5]	0.698	1.239	1.937	0.663	0.743	1.406	10	5.8	8.2
A-153	1022+30 RT - 1028+50 RT *	524.0	58.0	[6]	0.698	1.284	1.982	0.663	0.770	1.433	10	5.8	8.3
A-154	931+77 LT - 934+55 LT	278.0	65.3	0.0	0.417	0.000	0.417	0.396	0.000	0.396	10	5.8	2.3
A-155	932+32 RT - 964+55 RT	223.0	78.6	0.0	0.402	0.000	0.402	0.382	0.000	0.382	10	5.8	2.2

Computed by: J.N. McCammon Date: 5/87 Checked by: _____ Date: _____
Revisions by: D.B. Harelson Date: 2/88 Checked by: GCB Date: 9/88

IRREGULAR AREAS:
[1] (44x94.5)+(26x131)
[2] 30x265
[3A] (40x695)+(27x50)/2+47(19+24)/2
[3B] 20x190
[4A] (32x699)+(40x80)/2+46(25+30)/2
[4B] 63.5x310
[5] (96.5x417)+(110x125)
[6] (105x417)+(110x110.5)
* 96' under bridge at Ellsworth Road

ARIZONA DEPARTMENT OF TRANSPORTATION

LOCATION DATA
Highway: Superstition Freeway: Phase III
Location: Power Road to Ellsworth Road
Project No. F-023-1-311

DESIGN DATA
Frequency 50 year
P6 = 2.79 in. P24 = 3.20 in. P1 = 2.15 in.
C paved = 0.95 C unpaved = 0.60

TABLE 4 PHASE III: RUNOFF CALCULATIONS - ON-SITE DRAINAGE

Drainage Area		Length	Avg. Width (ft.)		Area (Ac)		Area Total	C x A		C x A	Tc	i	Q
No.	Station-Station	(ft.)	Paved	Unpaved	Paved	Unpaved	(Ac)	Paved	Unpaved	Total	(min)	(in/hr)	(cfs)
A-156	934+55 LT - 940+30 LT	575.0	56.5	0.0	0.746	0.000	0.746	0.709	0.000	0.709	10	5.8	4.1
A-157	934+55 RT - 940+30 RT	171.0	74.7	0.0	0.293	0.000	0.293	0.279	0.000	0.279	10	5.8	1.6
A-158	936+26 RT - 937+91 RT	165.0	71.3	0.0	0.270	0.000	0.270	0.257	0.000	0.257	10	5.8	1.5
A-159	937+91 RT - 939+31 RT	140.0	68.3	0.0	0.220	0.000	0.220	0.209	0.000	0.209	10	5.8	1.2
A-160	939+31 RT - 940+76 RT	145.0	65.4	0.0	0.218	0.000	0.218	0.207	0.000	0.207	10	5.8	1.2
A-161	940+30 LT - 947+25 LT	695.0	56.5	0.0	0.901	0.000	0.901	0.856	0.000	0.856	10	5.8	5.0
A-162	940+76 RT - 942+31 RT	155.0	62.4	0.0	0.222	0.000	0.222	0.211	0.000	0.211	10	5.8	1.2
A-163	942+31 RT - 943+78 RT	147.0	59.8	0.0	0.202	0.000	0.202	0.192	0.000	0.192	10	5.8	1.1
A-164	943+78 RT - 945+25 RT	147.0	57.6	0.0	0.194	0.000	0.194	0.185	0.000	0.185	10	5.8	1.1
A-165	945+25 RT - 947+25 RT	200.0	56.5	0.0	0.259	0.000	0.259	0.246	0.000	0.246	10	5.8	1.4

Computed by: J.N. McCammon Date: 5/87 Checked by: _____ Date: _____
Revisions by: D.B. Hareison Date: 2/88 Checked by: ACS Date: 9/88

ARIZONA DEPARTMENT OF TRANSPORTATION

LOCATION DATA: Highway: Superstition Freeway: Phase I
Location: Power Road to Ellsworth Road
Project No. F-023-1-311

DESIGN DATA: Frequency 10 years
P6 = 1.99 in. P24 = 2.30 in. PI = 1.56 in.
T allowable = 7 ft.: n = 0.016

TABLE 5. PHASE I: SLOTTED DRAIN INTERCEPTION SHEET

Inlet No.	Inlet Station	DA No.	Q (cfs)	Qc from	Qc (cfs)	Qt (cfs)	So (ft/ft)	Sx (ft/ft) Gutter	Sx (ft/ft) Pavement	d1 (ft.)	d2 (ft.)	Qtrial (cfs)	T (ft.) allow.	T (ft.) actual	Lt (ft.) actual	Lt (ft.) req'd.	E	Qred (cfs)	
I-1	38+75 LT	A-1	0.44	N/A	0.00	0.44	0.0264	0.0488	0.0200	0.12	0.02	0.44	7.0	3.15	20	13.07	1.00	0.000	
I-2	38+75 RT	A-2	1.02	A-3	0.00	1.02	0.0264	0.0488	0.0200	0.17	0.07	1.13	7.0	5.40	20	18.61	1.00	0.000	
I-3	40+28 RT	A-3	0.86	N/A	0.00	0.86	0.0170	0.0488	0.0200	0.17	0.07	0.86	7.0	5.25	20	15.18	1.00	0.000	
I-4	40+36 LT	A-4	0.86	N/A	0.00	0.86	0.0163	0.0488	0.0200	0.17	0.07	0.86	7.0	5.30	20	14.99	1.00	0.000	
I-5	43+52 RT	A-5	0.33	N/A	0.00	0.33	0.0034	0.0488	0.0200	0.16	0.06	0.33	7.0	4.85	20	6.26	1.00	0.000	
I-6	43+59 LT	A-6	0.35	N/A	0.00	0.35	0.0034	0.0488	0.0200	0.16	0.06	0.35	7.0	5.00	20	6.42	1.00	0.000	
I-7	47+53 LT	A-7	0.49	A-22	0.00	0.49	SUMP	0.0488	0.0200	0.12	0.02	N/A	7.0	2.77	20	20.00	1.00	0.000	(1)
I-8	1+20	A-8	0.53	A-5	0.00	0.53	0.0040	0.0542	0.0200	0.18	0.08	0.53	8.5	6.30	20	7.53	1.00	0.000	
I-9	12+50 LT	A-9	0.76	N/A	0.00	0.76	0.0025	0.0488	0.0200	0.22	0.11	0.76	7.0	7.75	55	8.11	1.00	0.000	(2)
I-10	12+50 RT	A-10	0.76	N/A	0.00	0.76	0.0025	0.0488	0.0200	0.22	0.11	0.76	7.0	7.75	55	8.11	1.00	0.000	(2)
I-11	33+50 LT	A-11	1.71	A-12	0.00	1.71	0.0258	0.0488	0.0200	0.19	0.09	1.70	7.0	6.60	20	22.96	0.98	0.043	
I-12	35+70 LT	A-12	1.40	A-13	0.00	1.40	0.0324	0.0488	0.0200	0.17	0.07	1.40	7.0	5.70	20	22.60	0.98	0.029	
I-13	36+27	A-13	0.91	N/A	0.00	0.91	0.0337	0.0488	0.0200	0.15	0.05	0.92	7.0	4.55	20	19.08	1.00	0.000	
I-14	38+98 RT	A-14	0.74	N/A	0.00	0.74	0.0037	0.0488	0.0200	0.20	0.10	0.74	7.0	7.00	20	9.04	1.00	0.000	
I-15	38+91 LT	A-15	0.76	N/A	0.00	0.76	0.0144	0.0488	0.0200	0.16	0.06	0.76	7.0	5.15	20	13.71	1.00	0.000	
I-16	42+18 LT	A-16	0.47	N/A	0.00	0.47	0.0086	0.0488	0.0200	0.15	0.05	0.47	7.0	4.60	20	9.60	1.00	0.000	
I-17	42+10 RT	A-17	0.44	N/A	0.00	0.44	0.0083	0.0488	0.0200	0.15	0.05	0.44	7.0	4.45	20	9.24	1.00	0.000	
I-18	44+35 LT	A-18	0.96	N/A	0.00	0.96	0.0224	0.0488	0.0200	0.16	0.06	0.97	7.0	5.20	20	17.26	1.00	0.000	
I-19	44+40 RT	A-19	0.69	N/A	0.00	0.69	0.0224	0.0488	0.0200	0.15	0.05	0.69	7.0	4.35	20	15.03	1.00	0.000	
I-20	47+02 LT	A-20	1.05	A-18	0.00	1.05	SUMP	0.0488	0.0200	0.19	0.09	N/A	7.0	6.59	20	20.00	1.00	0.000	(1)
I-21	47+02 RT	A-21	1.03	A-19	0.00	1.03	SUMP	0.0488	0.0200	0.19	0.09	N/A	7.0	6.47	20	20.00	1.00	0.000	(1)
I-22	46+33 LT	A-22	1.01	N/A	0.00	1.01	0.0130	0.0488	0.0200	0.18	0.08	1.02	7.0	6.10	20	14.97	1.00	0.000	
I-23	46+33 RT	A-23	0.98	N/A	0.00	0.98	0.0130	0.0488	0.0200	0.18	0.08	0.98	7.0	6.00	20	14.79	1.00	0.000	

Computed by: S. L. Forvilly Date: 9/87 Checked by: _____ Date: _____
Revisions by: D. B. Harelson Date: 4/88 Checked by: CES Date: 9/88

(1) Slotted Drain: d1= (2Qt/Cw*Li)^(2/3) : Cw = 1.25
(2) Slotted drain extended upstream to point at which T= 7 ft.

ARIZONA DEPARTMENT OF TRANSPORTATION

LOCATION DATA

Highway: Superstition Freeway: Phase I
Location: Power Road to Ellsworth Road
Project No. F-028-1-311

DESIGN DATA: Frequency 10 years
P6 = 1.99 in. P24 = 2.30 in. P1 = 1.58 in.
T allowable = 7 ft. ; n =0.015

TABLE 6. PHASE I: GRATE INTERCEPTION SHEET

Inlet No.	Inlet Station	DA No.	Qred cfs	So ft/ft	Sx (ft./ft.) Gutter	Sx (ft./ft.) Pavement	d1 ft.	d2 ft.	A s. f.	Qtrial cfs	T actual (ft.)	V fps	Grate Type	Ai s. f.	Qi cfs	Lb (ft.) (1) actual	Lb (ft.) (1) req'd.	Qc to area	Qc cfs	
I-1	38+75 LT	A-1	0.00	0.0264	0.0488	0.0200	0.00	0.00	0.000	0.000	0.00	0.00	15.10	0.000	0.00	0.50	0.00	N/A	0.00	
I-2	38+75 RT	A-2	0.00	0.0264	0.0488	0.0200	0.00	0.00	0.000	0.000	0.00	0.00	15.10	0.000	0.00	0.50	0.00	N/A	0.00	
I-3	40+28 RT	A-3	0.00	0.0170	0.0488	0.0200	0.00	0.00	0.000	0.000	0.00	0.00	15.30	0.000	0.00	0.50	0.00	A-2	0.00	(2)
I-4	40+36 LT	A-4	0.00	0.0163	0.0488	0.0200	0.00	0.00	0.000	0.000	0.00	0.00	15.30	0.000	0.00	0.50	0.00	PH.-III	0.00	(2)
I-5	43+52 LT	A-5	0.00	0.0034	0.0488	0.0200	0.00	0.00	0.000	0.000	0.00	0.00	15.30	0.000	0.00	0.50	0.00	A-8	0.00	(2)
I-6	43+59 RT	A-6	0.00	0.0034	0.0488	0.0200	0.00	0.00	0.000	0.000	0.00	0.00	15.30	0.000	0.00	0.50	0.00	PH.-III	0.00	(2)
I-7	47+53 LT	A-7	0.00	SUMP	0.0488	0.0200	0.00	0.00	0.000	N/A	0.00	N/A	15.10	0.000	0.0	0.50	N/A	SUMP	0.00	(3)
I-8	1+20	A-8	0.00	0.0040	0.0542	0.0200	0.00	0.00	0.000	0.000	0.00	0.00	SPECIAL	0.000	0.00	3.40	0.00	PH.-III	0.00	
I-9	12+50 LT	A-9	0.00	0.0025	0.0488	0.0200	0.00	0.00	0.000	0.000	0.00	0.00	15.10	0.000	0.00	0.50	0.00	N/A	0.00	
I-10	12+50 RT	A-10	0.00	0.0025	0.0488	0.0200	0.00	0.00	0.000	0.000	0.00	0.00	15.10	0.000	0.00	0.50	0.00	N/A	0.00	
I-11	33+50 LT	A-11	0.04	0.0258	0.0488	0.0200	0.05	0.00	0.028	0.043	1.07	1.57	15.10	0.028	0.04	0.50	0.46	N/A	0.00	
I-12	35+70 LT	A-12	0.03	0.0324	0.0488	0.0200	0.04	0.00	0.019	0.030	0.89	1.56	15.10	0.019	0.03	0.50	0.45	A-11	0.00	
I-13	36+27	A-13	0.00	0.0337	0.0488	0.0200	0.00	0.00	0.000	0.000	0.00	0.00	15.10	0.000	0.00	0.50	0.00	A-12	0.00	
I-14	38+98 RT	A-14	0.00	0.0037	0.0488	0.0200	0.00	0.00	0.000	0.000	0.00	0.00	15.30	0.000	0.00	0.50	0.00	N/A	0.00	(2)
I-15	38+91 LT	A-15	0.00	0.0144	0.0488	0.0200	0.00	0.00	0.000	0.000	0.00	0.00	15.30	0.000	0.00	0.50	0.00	PH.-III	0.00	(2)
I-16	42+18 LT	A-16	0.00	0.0086	0.0488	0.0200	0.00	0.00	0.000	0.000	0.00	0.00	15.30	0.000	0.00	0.50	0.00	PH.-III	0.00	(2)
I-17	42+10 RT	A-17	0.00	0.0083	0.0488	0.0200	0.00	0.00	0.000	0.000	0.00	0.00	15.30	0.000	0.00	0.50	0.00	N/A	0.00	(2)
I-18	44+35 LT	A-18	0.00	0.0224	0.0488	0.0200	0.00	0.00	0.000	0.000	0.00	0.00	15.10	0.000	0.00	0.50	0.00	A-20	0.00	
I-19	44+40 RT	A-19	0.00	0.0224	0.0488	0.0200	0.00	0.00	0.000	0.000	0.00	0.00	15.10	0.000	0.00	0.50	0.00	A-21	0.00	
I-20	47+02 LT	A-20	0.00	SUMP	0.0488	0.0200	0.00	0.00	0.000	N/A	0.00	N/A	15.10	0.000	0.0	0.50	N/A	SUMP	0.00	(3)
I-21	47+02 RT	A-21	0.00	SUMP	0.0488	0.0200	0.00	0.00	0.000	N/A	0.00	N/A	15.10	0.000	0.0	0.50	N/A	SUMP	0.00	(3)
I-22	46+35 LT	A-22	0.00	0.0130	0.0488	0.0200	0.00	0.00	0.000	0.000	0.00	0.00	15.10	0.000	0.00	0.50	0.00	A-7	0.00	
I-23	46+35 RT	A-23	0.00	0.0130	0.0488	0.0200	0.00	0.00	0.000	0.000	0.00	0.00	15.10	0.000	0.00	0.50	0.00	N/A	0.00	

Computed by: J. N. McCammon Date: 5/87 Checked by: D. B. Hareison Date: 4/88
Revised by: D. B. Hareison Date: 4/88 Checked by: GEB Date: 9/88

(1) Clear length before 1st. crossbar of grate.
(2) No curb opening, clogging factor applied.

(3) Sump Inlet : d1=(Q/(3.0 x P)) exp(2/3)
(for d1 <= 1.4 ft.) ; P = 6.062 ft. (C-15.10)

ARIZONA DEPARTMENT OF TRANSPORTATION

LOCATION DATA: Highway: Superstition Freeway
Location: Power Road to Ellsworth Road
Project No. F-028-1-311

DESIGN DATA: Frequency: 10 Years
P6 = 1.99 in. P24 = 2.30 in. P1 = 1.58 in.
T allowable = 7 ft.: n = 0.016

TABLE 7. PHASE I: INLET SUMMARY SHEET

Inlet No.	Inlet Station	DA No.	Q (cfs)	Inlet Type	Qc From Upstream Grate from	Qc From Upstream Grate (cfs)	Qt at Sl. Drain (cfs)	So (%)	Cross-Slope (%) Gutter	Cross-Slope (%) Pavement	Depth at Curb (ft.)	T actual (ft.)	Slotted Drain Length Actual	Slotted Drain Length Req'd.	Qred (to grate) (cfs)	Grate Length (ft.) Actual(1)	Grate Length (ft.) Req'd.	Qc To Downstream Grate To	Qc To Downstream Grate (cfs)	
I-1	38+75 LT	A-1	0.44	C-15.10	N/A	0.00	0.44	0.0244	0.0488	0.0200	0.12	3.20	20	12.76	0.00	0.50	0.00	NOT PERMITTED	0.00	(2)
I-2	38+75 RT	A-2	1.02	C-15.10	A-3	0.00	1.02	0.0264	0.0488	0.0200	0.17	5.40	20	18.61	0.00	0.50	0.00	NOT PERMITTED	0.00	(2)
I-3	40+28 RT	A-3	0.86	C-15.30	N/A	0.00	0.86	0.0170	0.0488	0.0200	0.17	5.25	20	15.18	0.00	0.50	0.00	A-2	0.00	
I-4	40+36 LT	A-4	0.86	C-15.30	N/A	0.00	0.86	0.0163	0.0488	0.0200	0.17	5.30	20	14.99	0.00	0.50	0.00	PH-III: A-78	0.00	
I-5	43+52 RT	A-5	0.33	C-15.30	N/A	0.00	0.33	0.0034	0.0488	0.0200	0.16	5.85	20	6.26	0.00	0.50	0.00	A-8	0.00	
I-6	43+59 LT	A-6	0.35	C-15.30	N/A	0.00	0.35	0.0034	0.0488	0.0200	0.16	5.00	20	6.42	0.00	0.50	0.00	PH-III: A-69	0.00	
I-7	47+53 LT	A-7	0.49	C-15.10	A-22	0.00	0.49	SUMP	0.0488	0.0200	0.12	2.77	40	18.96	0.00	3.40	N/A	SUMP	0.00	(4)
I-8	1+20 LT	A-8	0.53	Special	A-5	0.00	0.53	0.0040	0.0488	0.0200	0.19	6.55	20	8.02	0.00	0.50	0.00	PH-III: A-84	0.00	
I-9	12+50 LT	A-9	0.76	C-15.10	N/A	0.00	0.76	0.0025	0.0488	0.0200	0.22	7.75	55	8.11	0.00	0.50	0.00	NOT PERMITTED	0.00	(2)(3)
I-10	12+50 RT	A-10	0.76	C-15.10	N/A	0.00	0.76	0.0025	0.0488	0.0200	0.22	7.75	55	8.11	0.00	0.50	0.00	NOT PERMITTED	0.00	(2)(3)
I-11	33+50 LT	A-11	1.71	C-15.10	A-12	0.00	1.71	0.0258	0.0488	0.0200	0.19	6.60	20	22.96	0.43	0.50	0.46	NOT PERMITTED	0.00	(2)
I-12	35+70 LT	A-12	1.40	C-15.10	A-13	0.00	1.40	0.0355	0.0488	0.0200	0.17	5.60	20	23.23	0.40	0.50	0.51	A-11	0.00	
I-13	36+27	A-13	0.91	C-15.10	N/A	0.00	0.91	0.0337	0.0488	0.0200	0.15	4.55	20	19.08	0.00	0.50	0.00	A-12	0.00	
I-14	38+98 RT	A-14	0.74	C-15.30	N/A	0.00	0.74	0.0037	0.0488	0.0200	0.20	7.00	20	9.04	0.00	0.50	0.00	NOT PERMITTED	0.00	(2)
I-15	38+91 LT	A-15	0.76	C-15.30	N/A	0.00	0.76	0.0144	0.0488	0.0200	0.16	5.15	20	13.71	0.00	0.50	0.00	PH-III: A-148	0.00	
I-16	42+18 LT	A-16	0.47	C-15.30	N/A	0.00	0.47	0.0086	0.0488	0.0200	0.15	4.60	20	9.60	0.47	0.50	0.00	PH-III: A-149	0.00	
I-17	42+10 RT	A-17	0.44	C-15.30	N/A	0.00	0.44	0.0083	0.0488	0.0200	0.15	4.45	20	9.24	0.00	0.50	0.00	NOT PERMITTED	0.00	(2)
I-18	44+35 LT	A-18	0.96	C-15.10	N/A	0.00	0.96	0.0224	0.0488	0.0200	0.16	5.20	20	17.26	0.00	0.50	0.00	A-20	0.00	
I-19	44+40 RT	A-19	0.69	C-15.10	N/A	0.00	0.69	0.0224	0.0488	0.0200	0.15	4.35	20	15.03	0.00	0.50	0.00	A-21	0.00	
I-20	47+02 LT	A-20	1.05	C-15.10	A-18	0.00	1.05	SUMP	0.0488	0.0200	0.19	6.59	40	20.29	0.00	0.50	N/A	SUMP	0.00	(4)
I-21	47+02 RT	A-21	1.03	C-15.10	A-19	0.00	1.03	SUMP	0.0488	0.0200	0.19	6.47	40	19.90	0.00	0.50	N/A	SUMP	0.00	(4)
I-22	46+35 LT	A-22	1.01	C-15.10	N/A	0.00	1.01	0.0130	0.0488	0.0200	0.18	6.10	20	14.97	0.00	0.50	0.00	A-7	0.00	
I-23	46+35 RT	A-23	0.98	C-15.10	N/A	0.00	0.98	0.0130	0.0488	0.0200	0.18	6.00	20	14.79	0.00	0.50	0.00	NOT PERMITTED	0.00	(2)

Computed by: J. N. Mc Cammon Date: 5/87
Revised by: D. B. Hareison Date: 4/88

Checked by: D. B. Hareison Date: 4/88
Checked by: GB Date: 9/88

(1) Clear length before 1st. crossbar of grate
(2) Inlet at project limits; no carryover permitted
(3) Slotted drain extended upstream to point at which T = 7 ft.
(4) Additional 20 ft. length provided at ROW line for future (by others) off-site flows.

ARIZONA DEPARTMENT OF TRANSPORTATION

LOCATION DATA
Highway: Superstition Freeway: Phase III
Location: Power Road to Ellsworth Road
Project No. F-028-1-311

DESIGN DATA
Frequency 50 years
P6 = 2.70 in. P24 = 3.20 in. PI = 2.15 in.
Tallow: Mainline = 16.0' Ramps = 8.5'

TABLE B. PHASE III: SLOTTED DRAIN INTERCEPTION SHEET

Inlet No.	Inlet Station	DA No.	Q (cfs)	Qc from	Qc (cfs)	Qt (cfs)	So (ft/ft)	Sx (ft/ft) Gutter	Sx (ft/ft) Pavement	Sx (ft/ft) Curb	d1 (ft.)	d2 (ft.)	Qtrial (cfs)	T (ft.) allow.	T (ft.) actual	Lt (ft.) actual	Lt (ft.) req'd	E	Qred (cfs)
1	870+00 LT	A-1	5.4	N/A	0.0	5.4	0.0044	0.0542	0.0200	0.3333	0.38	0.24	5.4	16.0	14.5	20.00	20.55	0.999	0.0
2	870+00 RT	A-2	5.2	N/A	0.0	5.2	0.0044	0.0542	0.0200	0.3333	0.38	0.24	5.2	16.0	14.3	20.00	20.23	1.000	0.0
3	4+45	A-3	1.3	N/A	0.0	1.3	0.0216	0.0542	0.0240	0.3333	0.19	0.05	1.3	8.5	4.4	10.00	18.21	0.762	0.3
4	6+50	A-4	2.1	A-3	0.0	2.1	0.0281	0.0542	0.0240	0.3333	0.21	0.07	2.1	8.5	5.4	10.00	24.11	0.619	0.8
5	9+00	A-5	2.7	A-4	0.1	2.8	0.0196	0.0542	0.0240	0.3333	0.25	0.11	2.8	8.5	6.9	10.00	24.42	0.613	1.1
6W	9+88	A-6W	1.0	A-5	0.2	1.2	0.0039	0.0542	0.0220	0.3333	0.21	0.07	N/A	8.5	5.7	20.00	20.00	1.000	0.0
6E	9+88	A-6E	1.0	A-7	0.0	1.0	0.0019	0.0542	0.0220	0.3333	0.19	0.05	N/A	8.5	4.8	20.00	20.00	1.000	0.0
7	10+55	A-7	1.8	A-8	0.0	1.8	0.0058	0.0542	0.0200	0.3333	0.26	0.12	1.8	8.5	8.3	10.00	14.07	0.893	0.2
8	11+45	A-8	1.8	A-9	0.0	1.8	0.0058	0.0542	0.0200	0.3333	0.26	0.12	1.8	8.5	8.3	10.00	14.07	0.893	0.2
9	877+22 LT	A-9	1.7	A-10	0.0	1.7	0.0058	0.0542	0.0200	0.3333	0.25	0.11	1.7	8.5	8.0	10.00	13.74	0.904	0.2
10	878+12 LT	A-10	1.8	A-11	0.0	1.8	0.0058	0.0542	0.0200	0.3333	0.26	0.12	1.8	8.5	8.3	10.00	14.07	0.893	0.2
11	879+12 LT	A-11	1.8	A-12	0.0	1.8	0.0058	0.0542	0.0200	0.3333	0.26	0.12	1.8	8.5	8.3	10.00	14.07	0.893	0.2
12	880+17 LT	A-12	1.8	A-13	0.0	1.8	0.0058	0.0542	0.0200	0.3333	0.26	0.12	1.8	8.5	8.3	10.00	14.07	0.893	0.2
13	881+27 LT	A-13	4.0	A-25	1.1	5.1	0.0045	0.0542	0.0200	0.3333	0.37	0.23	5.1	16.0	14.0	20.00	20.20	1.000	0.0
14	5+00	A-14	1.4	N/A	0.0	1.4	0.0233	0.0542	0.0200	0.3333	0.19	0.05	1.4	8.5	5.0	10.00	19.22	0.733	0.4
15	8+30	A-15	2.8	A-14	0.0	2.8	0.0244	0.0542	0.0210	0.3333	0.24	0.10	2.8	8.5	7.1	10.00	26.07	0.581	1.2
16W	10+35	A-16W	2.0	A-15	0.3	2.3	0.0079	0.0542	0.0320	0.3333	0.32	0.18	N/A	8.5	8.1	20.00	20.00	1.000	0.0
16E	10+35	A-16E	1.8	A-17	0.0	1.8	0.0039	0.0542	0.0320	0.3333	0.27	0.13	N/A	8.5	6.6	20.00	20.00	1.000	0.0
17	11+45	A-17	1.6	A-18	0.0	1.6	0.0048	0.0542	0.0320	0.3333	0.26	0.12	1.6	8.5	6.3	10.00	12.66	0.940	0.1
18	12+45	A-18	1.5	A-19	0.0	1.5	0.0048	0.0542	0.0290	0.3333	0.25	0.11	1.5	8.5	6.4	10.00	12.32	0.951	0.1
19	13+45	A-19	1.5	A-20	0.0	1.5	0.0048	0.0542	0.0200	0.3333	0.25	0.11	1.5	8.5	7.9	10.00	12.32	0.951	0.1
20	879+29 RT	A-20	1.6	A-21	0.0	1.6	0.0046	0.0542	0.0200	0.3333	0.25	0.11	1.6	8.5	8.2	10.00	12.66	0.940	0.1

Computed by: S.L. Forvilly Date: 9/87 Checked by: GDS Date: 9/88
Revisions by: D.B. Harelson Date: 2/88 Checked by: _____ Date: _____

ARIZONA DEPARTMENT OF TRANSPORTATION

LOCATION DATA
Highway: Superstition Freeway: Phase III
Location: Power Road to Ellsworth Road
Project No. F-028-1-311

DESIGN DATA
Frequency 50 years
P6 = 2.70 in. P24 = 3.20 in. P1 = 2.15 in.
Tallow: Mainline = 16.0' Ramps = 8.5'

TABLE 8 PHASE III: SLOTTED DRAIN INTERCEPTION SHEET

Inlet		DA	Q	Qc		Qt	So	Sx (ft/ft)			d1	d2	Qtrial	T (ft.)		Lt (ft.)		E	Qred
No.	Station	No.	(cfs)	from	(cfs)	(cfs)	(ft/ft)	Gutter	Pavement	Curb	(ft.)	(ft.)	(cfs)	allow.	actual	actual	req'd		(cfs)
21	880+34 RT	A-21	1.6	A-22	0.0	1.6	0.0048	0.0542	0.0200	0.3333	0.25	0.11	1.6	8.5	8.2	10.00	12.66	0.940	0.1
22	881+38 RT	A-22	1.6	A-23	0.0	1.6	0.0048	0.0542	0.0200	0.3333	0.25	0.11	1.6	8.5	8.2	10.00	12.66	0.940	0.1
23	882+43 RT	A-23	1.6	A-24	0.0	1.6	0.0048	0.0542	0.0200	0.3333	0.25	0.11	1.6	8.5	8.2	10.00	12.66	0.940	0.1
24	883+48 RT	A-24	0.7	A-26	0.0	0.7	0.0048	0.0542	0.0200	0.3333	0.19	0.05	0.7	8.5	5.0	10.00	6.94	1.000	0.0
25	883+70 LT	A-25	6.2	A-30	0.0	6.2	0.0044	0.0542	0.0200	0.3333	0.40	0.26	6.2	16.0	15.4	10.00	21.78	0.669	2.1
26	884+78 RT	A-26	1.2	A-27	0.0	1.2	0.0048	0.0542	0.0200	0.3333	0.23	0.09	1.2	8.5	7.0	10.00	11.22	0.982	0.0
27	885+57 RT	A-27	1.6	A-28	0.0	1.6	0.0048	0.0542	0.0200	0.3333	0.25	0.11	1.6	8.5	8.2	10.00	12.66	0.940	0.1
28	886+62 RT	A-28	1.6	A-29	0.0	1.6	0.0048	0.0542	0.0200	0.3333	0.25	0.11	1.6	8.5	8.2	10.00	12.66	0.940	0.1
29	887+67 RT	A-29	1.6	A-31	0.0	1.6	0.0048	0.0542	0.0200	0.3333	0.25	0.11	1.6	8.5	8.2	10.00	12.66	0.940	0.1
30	888+40 LT	A-30	6.7	A-34	0.0	6.7	0.0044	0.0542	0.0200	0.3333	0.41	0.27	6.7	16.0	15.8	20.00	22.50	0.981	0.1
31	888+77 RT	A-31	1.5	A-32	0.0	1.5	0.0048	0.0542	0.0200	0.3333	0.25	0.11	1.5	8.5	7.9	10.00	12.32	0.951	0.1
32	889+87 RT	A-32	1.6	A-33	0.0	1.6	0.0048	0.0542	0.0200	0.3333	0.25	0.11	1.6	8.5	8.2	10.00	12.66	0.940	0.1
33	891+03 RT	A-33	3.7	A-40	1.3	5.0	0.0048	0.0542	0.0200	0.3333	0.37	0.22	5.0	16.0	13.7	20.00	20.42	0.999	0.0
34	892+58 LT	A-34	1.5	A-35	0.0	1.5	0.0040	0.0542	0.0200	0.3333	0.26	0.12	1.5	8.5	8.3	10.00	11.66	0.970	0.0
35	893+48 LT	A-35	1.5	A-36	0.0	1.5	0.0040	0.0542	0.0200	0.3333	0.26	0.12	1.5	8.5	8.3	10.00	11.66	0.970	0.0
36	894+38 LT	A-36	1.4	A-37	0.0	1.4	0.0040	0.0542	0.0200	0.3333	0.25	0.11	1.4	8.5	7.9	10.00	11.33	0.979	0.0
37	895+22 LT	A-37	1.4	A-38	0.0	1.4	0.0040	0.0542	0.0200	0.3333	0.25	0.11	1.4	8.5	7.9	10.00	11.33	0.979	0.0
38	896+07 LT	A-38	1.5	A-39	0.0	1.5	0.0040	0.0542	0.0200	0.3333	0.26	0.12	1.5	8.5	8.3	10.00	11.66	0.970	0.0
39	896+92 LT	A-39	1.5	A-41	0.0	1.5	0.0040	0.0542	0.0200	0.3333	0.26	0.12	1.5	8.5	8.3	10.00	11.66	0.970	0.0
40	893+75 RT	A-40	5.7	A-49	1.0	6.7	0.0044	0.0542	0.0200	0.3333	0.41	0.27	6.7	16.0	15.8	10.00	22.50	0.653	2.3
41	897+77 LT	A-41	1.4	A-42	0.0	1.4	0.0040	0.0542	0.0200	0.3333	0.25	0.11	1.4	8.5	7.9	10.00	11.33	0.979	0.0
42	898+57 LT	A-42	1.4	A-43	0.0	1.4	0.0040	0.0542	0.0200	0.3333	0.25	0.11	1.4	8.5	7.9	10.00	11.33	0.979	0.0

Computed by: S.L. Forvilly Date: 9/87 Checked by: GCS Date: 9/88
Revisions by: D.B. Harelson Date: 2/88 Checked by: _____ Date: _____

ARIZONA DEPARTMENT OF TRANSPORTATION

LOCATION DATA
Highway: Superstition Freeway: Phase III
Location: Power Road to Ellsworth Road
Project No. F-028-1-311

DESIGN DATA
Frequency 50 years
P6 = 2.70 in. P24 = 3.29 in. P1 = 2.15 in.
Tallow: Mainline = 16.0' Ramps = 8.5'

TABLE 8 PHASE III: SLOTTED DRAIN INTERCEPTION SHEET

Inlet No.	Inlet Station	DA No.	Q (cfs)	Qc from	Qc (cfs)	Qt (cfs)	So (ft/ft)	Sx (ft/ft) Gutter	Sx (ft/ft) Pavement	Sx (ft/ft) Curb	d1 (ft.)	d2 (ft.)	Qtrial (cfs)	T (ft.) allow.	T (ft.) actual	Lt (ft.) actual	Lt (ft.) req'd	E	Qred (cfs)
43	899+43 LT	A-43	1.4	A-44	0.0	1.4	0.0040	0.0542	0.0200	0.3333	0.25	0.11	1.4	8.5	7.9	10.00	11.33	0.979	0.0
44	900+23 LT	A-44	1.5	A-45	0.0	1.5	0.0040	0.0542	0.0200	0.3333	0.26	0.12	1.5	8.5	8.3	10.00	11.66	0.970	0.0
45	901+03 LT	A-45	1.5	A-46	0.0	1.5	0.0040	0.0542	0.0200	0.3333	0.26	0.12	1.5	8.5	8.3	10.00	11.66	0.970	0.0
46	901+83 LT	A-46	1.4	A-47	0.0	1.4	0.0040	0.0542	0.0200	0.3333	0.25	0.11	1.4	8.5	7.9	10.00	11.33	0.979	0.0
47	902+58 LT	A-47	1.4	A-48	0.0	1.4	0.0040	0.0542	0.0200	0.3333	0.25	0.11	1.4	8.5	7.9	10.00	11.33	0.979	0.0
48	903+33 LT	A-48	1.5	A-59	0.0	1.5	0.0040	0.0542	0.0200	0.3333	0.26	0.12	1.5	8.5	8.3	10.00	11.66	0.970	0.0
49	897+85 RT	A-49	6.0	A-50	0.0	6.0	0.0044	0.0542	0.0200	0.3333	0.39	0.25	6.0	16.0	15.1	10.00	21.48	0.676	1.9
50	902+00 RT	A-50	1.3	A-51	0.0	1.3	0.0030	0.0542	0.0200	0.3333	0.26	0.12	1.3	8.5	8.3	10.00	10.07	1.000	0.0
51	902+85 RT	A-51	1.3	A-52	0.0	1.3	0.0030	0.0542	0.0200	0.3333	0.26	0.12	1.3	8.5	8.3	10.00	10.07	1.000	0.0
52	903+69 RT	A-52	1.3	A-53	0.0	1.3	0.0030	0.0542	0.0200	0.3333	0.26	0.12	1.3	8.5	8.3	10.00	10.07	1.000	0.0
53	904+49 RT	A-53	1.3	A-54	0.0	1.3	0.0030	0.0542	0.0200	0.3333	0.26	0.12	1.3	8.5	8.3	10.00	10.07	1.000	0.0
54	905+24 RT	A-54	1.2	A-55	0.0	1.2	0.0030	0.0542	0.0200	0.3333	0.25	0.11	1.2	8.5	7.9	10.00	9.74	1.000	0.0
55	905+94 RT	A-55	1.3	A-56	0.0	1.3	0.0030	0.0542	0.0200	0.3333	0.26	0.12	1.3	8.5	8.3	10.00	10.07	1.000	0.0
56	15+20	A-56	1.8	A-57&58	0.2	2.0	0.0076	0.0542	0.0200	0.3333	0.25	0.11	2.0	8.5	8.2	10.00	15.95	0.830	0.3
57	16+20	A-57	2.6	A-72	0.1	2.7	0.0188	0.0542	0.0200	0.3333	0.24	0.10	2.7	8.5	7.5	10.00	23.75	0.626	1.0
58	907+95 RT	A-58	2.6	A-71	0.5	3.1	0.0044	0.0542	0.0200	0.3333	0.32	0.18	3.1	16.0	11.4	20.00	16.28	1.000	0.0
59	904+08 LT	A-59	1.4	A-60	0.0	1.4	0.0040	0.0542	0.0200	0.3333	0.25	0.11	1.4	8.5	7.9	10.00	11.33	0.979	0.0
60	14+05	A-60	1.3	A-61	0.0	1.3	0.0040	0.0542	0.0200	0.3333	0.24	0.10	1.3	8.5	7.6	10.00	10.98	0.987	0.0
61	14+70	A-61	1.1	A-62	0.0	1.1	0.0040	0.0542	0.0280	0.3333	0.23	0.09	1.1	8.5	5.9	10.00	10.24	0.999	0.0
62	15+25	A-62	1.4	A-63	0.0	1.4	0.0040	0.0542	0.0440	0.3333	0.26	0.12	1.4	8.5	5.3	10.00	11.33	0.979	0.0
63	15+95	A-63	1.5	A-64	0.0	1.5	0.0040	0.0542	0.0460	0.3333	0.27	0.13	1.5	8.5	5.3	10.00	11.66	0.970	0.0
64	16+65	A-64	1.6	A-65&66	0.6	2.2	0.0048	0.0542	0.0460	0.3333	0.30	0.16	2.2	8.5	6.0	10.00	14.47	0.879	0.3

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Revisions by: D.B. Harelson Date: 2/88 Checked by: GES Date: 9/88

ARIZONA DEPARTMENT OF TRANSPORTATION

LOCATION DATA
Highway: Superstition Freeway: Phase III
Location: Power Road to Ellsworth Road
Project No. F-028-1-311

DESIGN DATA
Frequency 50 years
P6 = 2.70 in. P24 = 3.20 in. P1 = 2.15 in.
Tallow: Mainline = 16.0' Ramps = 8.5'

TABLE G PHASE III: SLOTTED DRAIN INTERCEPTION SHEET

Inlet No.	Inlet Station	DA No.	Q (cfs)	Qc from	Qc (cfs)	Qt (cfs)	So (ft/ft)	Sx (ft/ft) Gutter	Sx (ft/ft) Pavement	Sx (ft/ft) Curb	d1 (ft.)	d2 (ft.)	Qtrial (cfs)	T (ft.) allow.	T (ft.) actual	Lt (ft.) actual	Lt (ft.) req'd	E	Qred (cfs)
65	17+40	A-65	3.2	A-67	0.1	3.3	0.0173	0.0542	0.0460	0.3333	0.28	0.14	3.3	8.5	5.5	10.00	25.20	0.597	1.3
66	19+8+20 LT	A-66	2.4	A-70	0.5	2.9	0.0059	0.0542	0.0200	0.3333	0.30	0.16	2.9	16.0	10.3	10.00	17.28	0.789	0.6
67	19+85	A-67	2.1	A-68	0.1	2.2	0.0328	0.0542	0.0200	0.3333	0.21	0.07	2.2	8.5	5.8	10.00	25.75	0.587	0.9
68	21+65	A-68	2.0	A-69	0.2	2.2	0.0478	0.0542	0.0200	0.3333	0.19	0.05	2.2	8.5	5.2	10.00	28.83	0.535	1.0
69	23+45	A-69	2.8	N/A	0.0	2.8	0.0528	0.0542	0.0200	0.3333	0.21	0.07	2.8	8.5	5.8	10.00	32.87	0.479	1.5
70	910+65 LT	A-70	3.1	A-73	0.8	3.9	0.0115	0.0542	0.0200	0.3333	0.29	0.15	3.9	16.0	10.2	10.00	23.91	0.623	1.5
71	910+65 RT	A-71	3.0	A-74	0.7	3.7	0.0115	0.0542	0.0200	0.3333	0.29	0.15	3.7	16.0	9.9	10.00	23.39	0.634	1.4
72	8+65	A-72	2.2	A-75	0.0	2.2	0.0337	0.0542	0.0200	0.3333	0.21	0.07	2.2	8.5	5.8	10.00	25.96	0.583	0.9
73	913+20 LT	A-73	3.8	A-76	0.5	4.3	0.0176	0.0542	0.0200	0.3333	0.28	0.14	4.3	16.0	9.6	10.00	28.31	0.544	2.0
74	913+20 RT	A-74	3.7	A-77	0.5	4.2	0.0176	0.0542	0.0200	0.3333	0.28	0.14	4.2	16.0	9.6	10.00	28.03	0.548	1.9
75	11+00	A-75	1.6	A-78	0.1	1.7	0.0479	0.0542	0.0200	0.3333	0.18	0.04	1.7	8.5	4.3	10.00	25.89	0.585	0.7
76	915+75 LT	A-76	2.6	A-79	1.0	3.6	0.0221	0.0542	0.0200	0.3333	0.26	0.12	3.6	16.0	8.4	10.00	28.13	0.546	1.6
77	915+75 RT	A-77	2.5	A-80	1.2	3.7	0.0221	0.0542	0.0200	0.3333	0.26	0.12	3.7	16.0	8.6	10.00	28.45	0.541	1.7
78	13+00	A-78	2.2	N/A	0.0	2.2	0.0585	0.0542	0.0200	0.3333	0.19	0.05	2.2	8.5	4.8	10.00	30.63	0.509	1.1
79	917+25 LT	A-79	3.0	A-81	1.9	4.9	0.0261	0.0542	0.0200	0.3333	0.28	0.14	4.9	16.0	9.4	10.00	33.66	0.470	2.6
80	917+25 RT	A-80	3.1	A-82	2.2	5.3	0.0261	0.0542	0.0200	0.3333	0.29	0.14	5.3	16.0	9.7	10.00	34.78	0.457	2.9
81	920+00 LT	A-81	6.5	A-86	0.4	6.9	0.0264	0.0542	0.0200	0.3333	0.31	0.17	6.9	16.0	10.9	10.00	38.99	0.413	4.0
82	920+00 RT	A-82	6.9	A-87	0.3	7.2	0.0264	0.0542	0.0200	0.3333	0.31	0.17	7.2	16.0	11.2	10.00	39.70	0.407	4.3
83	2+65	A-83	0.7	N/A	0.0	0.7	0.0029	0.0542	0.0200	0.3333	0.21	0.07	0.7	8.5	5.8	10.00	7.69	1.000	0.0
84	4+00	A-84	1.6	N/A	0.0	1.6	0.0049	0.0542	0.0200	0.3333	0.25	0.11	1.6	8.5	8.1	10.00	12.75	0.937	0.1
85W	6+67	A-85W	1.4	A-94	0.0	1.4	0.0033	0.0542	0.0200	0.3333	0.23	0.09	N/A	8.5	7.0	20.00	20.00	1.000	0.0
85E	6+67	A-85E	3.4	A-91	0.0	3.4	0.0053	0.0542	0.0200	0.3333	0.26	0.12	N/A	8.5	8.5	40.00	40.00	1.000	0.0

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Revisions by: D.B. Harelson Date: 2/88 Checked by: GCS Date: 9/88

ARIZONA DEPARTMENT OF TRANSPORTATION

LOCATION DATA
Highway: Superstition Freeway: Phase III
Location: Power Road to Ellsworth Road
Project No. F-028-1-311

DESIGN DATA
Frequency 50 years
P6 = 2.70 in. P24 = 3.20 in. P1 = 2.15 in.
Tallow: Mainline = 16.0' Ramps = 8.5'

TABLE 8 PHASE III: SLOTTED DRAIN INTERCEPTION SHEET

Inlet		DA	Q	Qc	Qt	So	Sx (ft/ft)			d1	d2	Qtrial	T (ft.)		Lt (ft.)		E	Qred
No.	Station	No.	(cfs)	from	(cfs)	(cfs)	(ft/ft)	Gutter	Pavement	Curb	(ft.)	(ft.)	(cfs)	allow.	actual	actual	req'd		(cfs)
86	925+00 LT	A-86	3.1	N/A	0.0	3.1	0.0240	0.0542	0.0200	0.3333	0.24	0.10	3.1	16.0	7.6	10.00	27.98	0.564	1.4
87	925+00 RT	A-87	2.9	N/A	0.0	2.9	0.0240	0.0542	0.0200	0.3333	0.24	0.10	2.9	16.0	7.4	10.00	26.33	0.577	1.2
88W	5+49	A-88W	1.2	A-83	0.0	1.2	0.0051	0.0542	0.0200	0.3333	0.21	0.07	N/A	8.5	6.0	20.00	20.00	1.000	0.0
88E	5+49	A-88E	1.8	A-89	0.2	2.0	0.0245	0.0542	0.0200	0.3333	0.22	0.08	N/A	8.5	6.5	30.00	30.00	1.000	0.0
89	10+05	A-89	2.8	A-90	0.2	3.0	0.0160	0.0542	0.0460	0.3333	0.27	0.13	3.0	8.5	5.3	10.00	23.65	0.628	1.1
90	12+35	A-90	2.4	A-155	0.1	2.5	0.0236	0.0542	0.0420	0.3333	0.23	0.09	2.5	8.5	4.7	10.00	24.61	0.609	1.0
91	11+45	A-91	2.8	A-154	0.1	2.9	0.0178	0.0542	0.0200	0.3333	0.25	0.11	2.9	8.5	7.9	20.00	24.07	0.959	0.1
92	947+25 LT	A-92	4.9	A-94	0.0	4.9	0.0025	0.0542	0.0200	0.3333	0.40	0.26	4.9	16.0	15.6	20.00	16.65	1.000	0.0
93	947+25 RT	A-93	4.5	A-95	0.4	4.9	0.0025	0.0542	0.0200	0.3333	0.40	0.26	4.9	16.0	15.6	10.00	16.65	0.808	0.9
94	953+20 LT	A-94	4.8	A-96	0.0	4.8	0.0025	0.0542	0.0200	0.3333	0.40	0.26	4.8	16.0	15.5	20.00	16.51	1.000	0.0
95	953+20 RT	A-95	4.9	A-97	0.0	4.9	0.0025	0.0542	0.0200	0.3333	0.40	0.26	4.9	16.0	15.6	10.00	16.65	0.808	0.9
96	957+30 LT	A-96	4.8	A-98	0.4	5.2	0.0025	0.0542	0.0200	0.3333	0.41	0.27	5.2	16.0	16.0	20.00	17.07	1.000	0.0
97	957+30 RT	A-97	4.4	A-99	0.4	4.8	0.0025	0.0542	0.0200	0.3333	0.40	0.26	4.8	16.0	15.5	20.00	16.51	1.000	0.0
98	961+25 LT	A-98	4.9	A-100	0.0	4.9	0.0025	0.0542	0.0200	0.3333	0.40	0.26	4.9	16.0	15.6	10.00	16.65	0.808	0.9
99	961+25 RT	A-99	4.4	A-101	0.4	4.8	0.0025	0.0542	0.0200	0.3333	0.40	0.26	4.8	16.0	15.5	10.00	16.51	0.813	0.9
100	965+05 LT	A-100	4.9	A-102	0.0	4.9	0.0025	0.0542	0.0200	0.3333	0.40	0.26	4.9	16.0	15.6	20.00	16.65	1.000	0.0
101	965+05 RT	A-101	4.5	A-103	0.3	4.8	0.0025	0.0542	0.0200	0.3333	0.40	0.26	4.8	16.0	15.5	10.00	16.51	0.813	0.9
102	968+70 LT	A-102	4.8	A-104	0.4	5.2	0.0025	0.0542	0.0200	0.3333	0.41	0.27	5.2	16.0	16.0	20.00	17.07	1.000	0.0
103	968+70 RT	A-103	4.2	A-105	0.3	4.5	0.0025	0.0542	0.0200	0.3333	0.39	0.25	4.5	16.0	15.1	10.00	16.07	0.827	0.8
104	972+15 LT	A-104	4.9	A-106	0.0	4.9	0.0025	0.0542	0.0200	0.3333	0.40	0.26	4.9	16.0	15.6	10.00	16.65	0.808	0.9
105	972+15 RT	A-105	4.2	A-107	0.3	4.5	0.0025	0.0542	0.0200	0.3333	0.39	0.25	4.5	16.0	15.1	10.00	16.07	0.827	0.8
106	975+55 LT	A-106	5.0	A-108	0.0	5.0	0.0025	0.0542	0.0200	0.3333	0.41	0.27	5.0	16.0	15.8	20.00	16.79	1.000	0.0

Computed by: S.L. Forvilly Date: 9/87 Checked by: CES Date:
Revisions by: D.B. Harelson Date: 2/88 Checked by: CES Date: 9/88

ARIZONA DEPARTMENT OF TRANSPORTATION

LOCATION DATA
Highway: Superstition Freeway: Phase III
Location: Power Road to Ellsworth Road
Project No. F-028-1-311

DESIGN DATA
Frequency 50 years
P6 = 2.70 in. P24 = 3.20 in. P1 = 2.15 in.
Tallow: Mainline = 16.0' Ramps = 8.5'

TABLE 8 PHASE III: SLOTTED DRAIN INTERCEPTION SHEET

Inlet No.	Inlet Station	DA No.	Q (cfs)	Qc from	Qc (cfs)	Qt (cfs)	So (ft/ft)	Sx (ft/ft) Gutter	Sx (ft/ft) Pavement	Sx (ft/ft) Curb	d1 (ft.)	d2 (ft.)	Qtrial (cfs)	T (ft.) allow.	T (ft.) actual	Lt (ft.) actual	Lt (ft.) req'd	E	Qred (cfs)
107	975+55 RT	A-107	4.1	A-109	0.4	4.5	0.0025	0.0542	0.0200	0.3333	0.39	0.25	4.5	16.0	15.1	10.00	16.07	0.827	0.8
108	978+90 LT	A-108	4.7	A-110	0.1	4.8	0.0025	0.0542	0.0200	0.3333	0.40	0.26	4.8	16.0	15.5	20.00	16.51	1.000	0.0
109	978+90 RT	A-109	3.7	A-111	1.3	5.0	0.0025	0.0542	0.0200	0.3333	0.41	0.27	5.0	16.0	15.8	10.00	16.79	0.804	1.0
110	981+95 LT	A-110	5.7	A-112	1.9	7.6	0.0056	0.0542	0.0200	0.3333	0.41	0.27	7.6	16.0	15.8	20.00	25.50	0.937	0.5
111	981+95 RT	A-111	4.6	A-113	1.8	6.4	0.0056	0.0542	0.0200	0.3333	0.39	0.25	6.4	16.0	14.8	10.00	23.73	0.627	2.4
112	985+70 LT	A-112	5.0	A-114	2.4	7.4	0.0085	0.0542	0.0200	0.3333	0.38	0.24	7.4	16.0	14.4	10.00	28.58	0.539	3.4
113	985+70 RT	A-113	4.0	A-115	3.3	7.3	0.0085	0.0542	0.0200	0.3333	0.38	0.24	7.3	16.0	14.3	10.00	28.42	0.542	3.3
114	989+00 LT	A-114	6.4	A-116	2.0	8.4	0.0097	0.0542	0.0200	0.3333	0.39	0.25	8.4	16.0	14.8	10.00	31.36	0.499	4.2
115	989+00 RT	A-115	10.1	A-117	0.0	10.1	0.0094	0.0542	0.0200	0.3333	0.41	0.27	10.1	16.0	16.0	10.00	33.57	0.471	5.3
116	993+30 LT	A-116	8.0	A-118	0.0	8.0	0.0065	0.0542	0.0200	0.3333	0.40	0.26	8.0	16.0	15.7	10.00	27.25	0.561	3.5
117	997+45 RT	A-117	6.5	A-126	0.0	6.5	0.0044	0.0542	0.0200	0.3333	0.40	0.26	6.5	16.0	15.7	20.00	22.22	0.984	0.1
118	998+75 LT	A-118	1.5	A-119	0.0	1.5	0.0044	0.0542	0.0200	0.3333	0.25	0.11	1.5	8.5	8.2	10.00	12.00	0.960	0.1
119	999+80 LT	A-119	1.5	A-120	0.0	1.5	0.0039	0.0542	0.0200	0.3333	0.26	0.12	1.5	8.5	8.5	10.00	11.57	0.972	0.0
120	1000+80 LT	A-120	1.4	A-121	0.0	1.4	0.0036	0.0542	0.0200	0.3333	0.26	0.12	1.4	8.5	8.3	10.00	10.98	0.987	0.0
121	1001+75 LT	A-121	1.4	A-122	0.0	1.4	0.0036	0.0542	0.0200	0.3333	0.26	0.12	1.4	8.5	8.3	10.00	10.98	0.987	0.0
122	1002+70 LT	A-122	1.4	A-123	0.0	1.4	0.0036	0.0542	0.0200	0.3333	0.26	0.12	1.4	8.5	8.3	10.00	10.98	0.987	0.0
123	1003+60 LT	A-123	1.4	A-124	0.0	1.4	0.0036	0.0542	0.0200	0.3333	0.26	0.12	1.4	8.5	8.3	10.00	10.98	0.987	0.0
124	1004+50 LT	A-124	1.4	A-125	0.0	1.4	0.0036	0.0542	0.0200	0.3333	0.26	0.12	1.4	8.5	8.3	10.00	10.98	0.987	0.0
125	1005+40 LT	A-125	1.4	A-127	0.0	1.4	0.0036	0.0542	0.0200	0.3333	0.26	0.12	1.4	8.5	8.3	10.00	10.98	0.987	0.0
126	1002+85 RT	A-126	6.2	A-130	0.0	6.2	0.0040	0.0542	0.0200	0.3333	0.40	0.26	6.2	16.0	15.7	20.00	21.16	0.995	0.0
127	1006+50 LT	A-127	1.4	A-128	0.0	1.4	0.0036	0.0542	0.0200	0.3333	0.26	0.12	1.4	8.5	8.3	10.00	10.98	0.987	0.0
128	1007+15 LT	A-128	1.4	A-129	0.0	1.4	0.0036	0.0542	0.0200	0.3333	0.26	0.12	1.4	8.5	8.3	10.00	10.98	0.987	0.0

Computed by: S.L. Forvilly Date: 9/87 Checked by: CS Date:
Revisions by: D.B. Harelson Date: 2/88 Checked by: Date: 9/88

ARIZONA DEPARTMENT OF TRANSPORTATION

LOCATION DATA
Highway: Superstition Freeway: Phase III
Location: Power Road to Ellsworth Road
Project No. F-028-1-311

DESIGN DATA
Frequency 50 years
P6 = 2.70 in. P24 = 3.20 in. Pt = 2.15 in.
Tallow: Mainline = 16.0' Ramps = 8.5'

TABLE B PHASE III: SLOTTED DRAIN INTERCEPTION SHEET

Inlet No.	Inlet Station	DA No.	Q (cfs)	Qc from	Qc (cfs)	Qt (cfs)	So (ft/ft)	Sx (ft/ft) Gutter	Sx (ft/ft) Pavement	Sx (ft/ft) Curb	d1 (ft.)	d2 (ft.)	Qtrial (cfs)	T (ft.) allow.	T (ft.) actual	Lt (ft.) actual	Lt (ft.) req'd	E	Qred (cfs)
129	1008+00 RT	A-129	1.4	A-138	0.0	1.4	0.0036	0.0542	0.0200	0.3333	0.26	0.12	1.4	8.5	8.3	10.00	10.98	0.987	0.0
130	1008+00 RT	A-130	1.2	A-131	0.0	1.2	0.0026	0.0542	0.0200	0.3333	0.26	0.12	1.2	8.5	8.3	10.00	9.33	1.000	0.0
131	1008+95 RT	A-131	1.1	A-132	0.0	1.1	0.0026	0.0542	0.0200	0.3333	0.25	0.11	1.1	8.5	8.0	10.00	9.00	1.000	0.0
132	1009+84 RT	A-132	1.2	A-133	0.0	1.2	0.0026	0.0542	0.0200	0.3333	0.26	0.12	1.2	8.5	8.3	10.00	9.33	1.000	0.0
133	1010+74 RT	A-133	1.2	A-134	0.0	1.2	0.0026	0.0542	0.0200	0.3333	0.26	0.12	1.2	8.5	8.3	10.00	9.33	1.000	0.0
134	1011+59 RT	A-134	1.1	A-135	0.0	1.1	0.0026	0.0542	0.0200	0.3333	0.25	0.11	1.1	8.5	8.0	10.00	9.00	1.000	0.0
135	4+85	A-135	1.8	A-136	0.0	1.8	0.0067	0.0542	0.0200	0.3333	0.25	0.11	1.8	8.5	8.0	10.00	14.70	0.872	0.2
136	6+00	A-136	2.9	A-137&148	0.2	3.1	0.0209	0.0542	0.0200	0.3333	0.25	0.11	3.1	8.5	8.0	20.00	25.98	0.929	0.2
137	1013+95 RT	A-137	2.7	A-147	0.6	3.3	0.0040	0.0542	0.0200	0.3333	0.33	0.19	3.3	16.0	12.0	10.00	16.24	0.821	0.6
138	1008+85 LT	A-138	1.5	A-139	0.0	1.5	0.0036	0.0542	0.0200	0.3333	0.26	0.12	1.5	8.5	8.5	10.00	11.30	0.980	0.0
139	1009+70 LT	A-139	1.4	A-140	0.0	1.4	0.0036	0.0542	0.0200	0.3333	0.26	0.12	1.4	8.5	8.3	10.00	10.98	0.987	0.0
140	1010+50 LT	A-140	1.5	A-141	0.0	1.5	0.0036	0.0542	0.0200	0.3333	0.26	0.12	1.5	8.5	8.5	10.00	11.30	0.980	0.0
141	14+55	A-141	1.5	A-142	0.0	1.5	0.0036	0.0542	0.0240	0.3333	0.27	0.13	1.5	8.5	7.8	10.00	11.30	0.980	0.0
142	15+35	A-142	1.2	A-143	0.2	1.4	0.0036	0.0542	0.0460	0.3333	0.27	0.13	1.4	8.5	5.3	10.00	10.98	0.987	0.0
143	16+00	A-143	2.3	A-144&145	1.2	3.5	0.0049	0.0542	0.0460	0.3333	0.36	0.22	3.5	8.5	7.2	10.00	17.69	0.777	0.8
144	1013+15 LT	A-144	4.1	A-146	0.6	4.7	0.0040	0.0542	0.0200	0.3333	0.37	0.23	4.7	16.0	14.0	10.00	18.84	0.744	1.2
145	17+75	A-145	2.6	A-149	1.0	3.6	0.0200	0.0542	0.0460	0.3333	0.28	0.14	3.6	8.5	5.5	10.00	27.30	0.560	1.6
146	1016+75 LT	A-146	3.1	A-150	1.8	4.9	0.0042	0.0542	0.0200	0.3333	0.37	0.23	4.9	16.0	14.0	10.00	19.46	0.727	1.3
147	1016+75 RT	A-147	3.0	A-151	1.8	4.8	0.0042	0.0542	0.0200	0.3333	0.37	0.23	4.8	16.0	13.9	10.00	19.29	0.732	1.3
148	7+50	A-148	4.0	N/A	0.0	4.0	0.0335	0.0542	0.0200	0.3333	0.25	0.11	4.0	8.5	8.0	10.00	33.31	0.474	2.1
149	20+25	A-149	4.8	N/A	0.0	4.8	0.0391	0.0542	0.0200	0.3333	0.26	0.12	4.8	8.5	8.5	10.00	37.67	0.426	2.8
150	1019+30 LT	A-150	4.6	A-152	2.6	7.2	0.0087	0.0542	0.0200	0.3333	0.37	0.23	7.2	16.0	14.2	10.00	28.45	0.541	3.3

Computed by: S.L. Forviliv Date: 9/87 Checked by: CES Date:
Revisions by: D.R. Harelson Date: 2/88 Checked by: Date: 9/88

ARIZONA DEPARTMENT OF TRANSPORTATION

LOCATION DATA
Highway: Superstition Freeway: Phase III
Location: Power Road to Ellsworth Road
Project No. F-028-1-311

DESIGN DATA
Frequency 50 years
P6 = 2.70 in. P24 = 3.20 in. P1 = 2.15 in.
Tallow: Mainline = 16.0' Ramps = 8.5'

TABLE 8 PHASE III: SLOTTED DRAIN INTERCEPTION SHEET

Inlet		DA	Q	Qc		Qt	So	Sx (ft/ft)			d1	d2	Qtrial	T (ft.)		Lt (ft.)		E	Qred
No.	Station	No.	(cfs)	from	(cfs)	(cfs)	(ft/ft)	Gutter	Pavement	Curb	(ft.)	(ft.)	(cfs)	allow.	actual	actual	req'd		(cfs)
151	1019+30 RT	A-151	4.3	A-153	2.7	7.0	0.0087	0.0542	0.0200	0.3333	0.37	0.23	7.0	16.0	14.0	10.00	28.12	0.547	3.2
152	1022+30 LT	A-152	8.2	N/A	0.0	8.2	0.0181	0.0542	0.0200	0.3333	0.35	0.21	8.2	16.0	12.8	10.00	37.44	0.428	4.7
153	1022+30 RT	A-153	8.3	N/A	0.0	8.3	0.0181	0.0542	0.0200	0.3333	0.35	0.21	8.3	16.0	12.9	10.00	37.63	0.427	4.8
154	931+77 LT	A-154	2.3	A-156	0.0	2.3	0.0120	0.0542	0.0200	0.3333	0.25	0.11	2.3	8.5	7.8	10.00	19.40	0.729	0.6
155	932+32 RT	A-155	2.2	A-157	0.0	2.2	0.0112	0.0542	0.0200	0.3333	0.25	0.11	2.2	8.5	7.8	10.00	18.65	0.749	0.6
156	934+55 LT	A-156	4.1	A-161	0.4	4.5	0.0078	0.0542	0.0200	0.3333	0.33	0.19	4.5	16.0	11.9	20.00	22.60	0.780	0.1
157	934+55 RT	A-157	1.6	A-158	0.0	1.6	0.0078	0.0542	0.0200	0.3333	0.23	0.09	1.6	8.5	7.2	10.00	14.64	0.874	0.2
158	936+26 RT	A-158	1.5	A-159	0.0	1.5	0.0052	0.0542	0.0200	0.3333	0.25	0.11	1.5	8.5	7.8	10.00	12.62	0.941	0.1
159	937+91 RT	A-159	1.2	A-160	0.0	1.2	0.0028	0.0542	0.0200	0.3333	0.26	0.12	1.2	8.5	8.3	10.00	9.54	1.000	0.0
160	939+31 RT	A-160	1.2	A-162	0.0	1.2	0.0025	0.0542	0.0200	0.3333	0.26	0.12	1.2	8.5	8.3	10.00	9.22	1.000	0.0
161	940+30 LT	A-161	5.0	A-92	0.0	5.0	0.0025	0.0542	0.0200	0.3333	0.41	0.27	5.0	16.0	15.8	10.00	16.79	0.804	1.0
162	940+76 RT	A-162	1.2	A-163	0.0	1.2	0.0025	0.0542	0.0200	0.3333	0.26	0.12	1.2	8.5	8.3	10.00	9.22	1.000	0.0
163	942+31 RT	A-163	1.1	A-164	0.0	1.1	0.0025	0.0542	0.0200	0.3333	0.25	0.11	1.1	8.5	7.9	10.00	8.89	1.000	0.0
164	943+78 RT	A-164	1.1	A-165	0.0	1.1	0.0025	0.0542	0.0200	0.3333	0.25	0.11	1.1	8.5	7.9	10.00	8.89	1.000	0.0
165	945+25 RT	A-165	1.4	A-93	0.4	1.8	0.0025	0.0542	0.0200	0.3333	0.29	0.15	1.8	16.0	10.0	10.00	10.93	0.988	0.0

Computed by: S.L. Forvilly Date: 9/87 Checked by: GEB Date: 9/88
Revisions by: D.B. Harelson Date: 2/88 Checked by: _____ Date: _____

ARIZONA DEPARTMENT OF TRANSPORTATION

LOCATION DATA:
Highway: Superstition Freeway: Phase III
Location: Power Road to Ellsworth Road
Project No. F-028-1-311

DESIGN DATA:
Frequency 50 years
P6 = 2.70 in. P24 = 3.20 in. P1 = 2.15 in.
Tailow: Mainline = 16.0' Ramps = 8.5'

TABLE 9. PHASE III: GRATE INTERCEPTION SHEET

Inlet No.	Inlet Station	DA No.	Qred (cfs)	So (ft/ft)	Sx (ft/ft) Gutter	Sx (ft/ft) Pavement	Sx (ft/ft) Curb	d1 (ft.)	d2 (ft.)	A (s. f.)	Qtrial (cfs)	V (fps)	Grate Type	Ai (s. f.)	Qi (cfs)	Lb (ft.) (1) actual	Lb (ft.) (1) req'd	Qc to area	Qc (cfs)
1	870+00 LT	A-1	0.0	0.0044	0.0542	0.0200	0.3333	0.00	0.00	0.000	0.0	0.00	SPECIAL	0.000	0.0	3.40	0.00	N/A	0.0
2	870+00 RT	A-2	0.0	0.0044	0.0542	0.0200	0.3333	0.00	0.00	0.000	0.0	0.00	SPECIAL	0.000	0.0	3.40	0.00	N/A	0.0
3	4+45	A-3	0.3	0.0216	0.0542	0.0240	0.3333	0.11	0.00	0.130	0.3	2.31	SPECIAL	0.129	0.3	3.40	1.46	A-4	0.0
4	6+50	A-4	0.8	0.0281	0.0542	0.0240	0.3333	0.15	0.01	0.232	0.8	3.44	SPECIAL	0.211	0.7	3.40	2.28	A-5	0.1
5	9+00	A-5	1.1	0.0196	0.0542	0.0240	0.3333	0.18	0.04	0.352	1.1	3.13	SPECIAL	0.291	0.9	3.40	2.14	A-6W	0.2
6	9+88	A-6W	0.0	0.0039	0.0542	0.0220	0.3333	0.00	0.00	0.000	N/A	N/A	SPECIAL	0.000	0.0	3.40	N/A	SUMP	0.0
6	9+88	A-6E	0.0	0.0019	0.0542	0.0220	0.3333	0.00	0.00	0.000	N/A	N/A	SPECIAL	0.000	0.0	3.40	N/A	SUMP	0.0
7	10+55	A-7	0.2	0.0058	0.0542	0.0200	0.3333	0.11	0.00	0.130	0.2	1.54	SPECIAL	0.129	0.2	3.40	0.97	A-6E	0.0
8	11+45	A-8	0.2	0.0058	0.0542	0.0200	0.3333	0.11	0.00	0.130	0.2	1.54	SPECIAL	0.129	0.2	3.40	0.97	A-7	0.0
9	877+22 LT	A-9	0.2	0.0058	0.0542	0.0200	0.3333	0.11	0.00	0.130	0.2	1.54	SPECIAL	0.129	0.2	3.40	0.97	A-8	0.0
10	878+12 LT	A-10	0.2	0.0058	0.0542	0.0200	0.3333	0.11	0.00	0.130	0.2	1.54	SPECIAL	0.129	0.2	3.40	0.97	A-9	0.0
11	879+12 LT	A-11	0.2	0.0058	0.0542	0.0200	0.3333	0.11	0.00	0.130	0.2	1.54	SPECIAL	0.129	0.2	3.40	0.97	A-10	0.0
12	880+17 LT	A-12	0.2	0.0058	0.0542	0.0200	0.3333	0.11	0.00	0.130	0.2	1.54	SPECIAL	0.129	0.2	3.40	0.97	A-11	0.0
13	881+27LT	A-13	0.0	0.0045	0.0542	0.0200	0.3333	0.00	0.00	0.000	0.0	0.00	SPECIAL	0.000	0.0	3.40	0.00	A-12	0.0
14	5+00	A-14	0.4	0.0233	0.0542	0.0200	0.3333	0.12	0.00	0.154	0.4	2.59	SPECIAL	0.151	0.4	3.40	1.66	A-15	0.0
15	8+30	A-15	1.2	0.0244	0.0542	0.0210	0.3333	0.18	0.04	0.371	1.2	3.24	SPECIAL	0.298	0.9	3.40	2.22	A-16W	0.3
16W	10+35	A-16W	0.0	0.0079	0.0542	0.0320	0.3333	0.00	0.00	0.000	N/A	N/A	SPECIAL	0.000	0.0	3.40	N/A	SUMP	0.0
16E	10+35	A-16E	0.0	0.0037	0.0542	0.0320	0.3333	0.00	0.00	0.000	N/A	N/A	SPECIAL	0.000	0.0	3.40	N/A	SUMP	0.0
17	11+45	A-17	0.1	0.0048	0.0542	0.0320	0.3333	0.08	0.00	0.069	0.1	1.46	SPECIAL	0.069	0.1	3.40	0.89	A-16E	0.0
18	12+45	A-18	0.1	0.0048	0.0542	0.0290	0.3333	0.08	0.00	0.069	0.1	1.46	SPECIAL	0.069	0.1	3.40	0.89	A-17	0.0
19	13+45	A-19	0.1	0.0048	0.0542	0.0200	0.3333	0.08	0.00	0.069	0.1	1.46	SPECIAL	0.069	0.1	3.40	0.89	A-18	0.0
20	879+29 RT	A-20	0.1	0.0048	0.0542	0.0200	0.3333	0.08	0.00	0.069	0.1	1.46	SPECIAL	0.069	0.1	3.40	0.89	A-19	0.0

Computed by: S.L. Forvilly Date: 9/87 Checked by: _____ Date: _____
Revisions by: D.R. Harelson Date: 2/88 Checked by: GQ Date: 9/88

ARIZONA DEPARTMENT OF TRANSPORTATION

LOCATION DATA:
Highway: Superstition Freeway: Phase III
Location: Power Road to Ellsworth Road
Project No. F-023-1-311

DESIGN DATA:
Frequency 50 years
P6 = 2.70 in. P24 = 3.20 in. P1 = 2.15 in.
Fallow: Mainline = 16.0' Ramps = 8.5'

TABLE 9 PHASE III: GRATE INTERCEPTION SHEET

Inlet No.	Inlet Station	DA No.	Qred (cfs)	So (ft/ft)	Sx (ft/ft) Gutter	Sx (ft/ft) Pavement	Sx (ft/ft) Curb	d1 (ft.)	d2 (ft.)	A (s. f.)	Qtrial (cfs)	V (fps)	Grate Type	Ai (s. f.)	Qi (cfs)	Lb (ft.) (i) actual	Lb (ft.) (i) req'd	Qc to area	Qc (cfs)
21	880+34 RT	A-21	0.1	0.0048	0.0542	0.0200	0.3333	0.08	0.00	0.069	0.1	1.46	SPECIAL	0.069	0.1	3.40	0.89	A-20	0.0
22	881+38 RT	A-22	0.1	0.0048	0.0542	0.0200	0.3333	0.08	0.00	0.069	0.1	1.46	SPECIAL	0.069	0.1	3.40	0.89	A-21	0.0
23	882+43 RT	A-23	0.1	0.0048	0.0542	0.0200	0.3333	0.08	0.00	0.069	0.1	1.46	SPECIAL	0.069	0.1	3.40	0.89	A-22	0.0
24	883+48 RT	A-24	0.0	0.0048	0.0542	0.0200	0.3333	0.00	0.00	0.000	0.0	0.00	SPECIAL	0.000	0.0	3.40	0.00	A-23	0.0
25	883+70 LT	A-25	2.1	0.0044	0.0542	0.0200	0.3333	0.28	0.14	1.150	2.1	1.83	SPECIAL	0.542	1.0	3.40	1.38	A-13	1.1
26	884+78 RT	A-26	0.0	0.0048	0.0542	0.0200	0.3333	0.00	0.00	0.000	0.0	0.00	SPECIAL	0.000	0.0	3.40	0.00	A-24	0.0
27	885+57 RT	A-27	0.1	0.0048	0.0542	0.0200	0.3333	0.08	0.00	0.069	0.1	1.46	SPECIAL	0.069	0.1	3.40	0.89	A-26	0.0
28	886+62 RT	A-28	0.1	0.0048	0.0542	0.0200	0.3333	0.08	0.00	0.069	0.1	1.46	SPECIAL	0.069	0.1	3.40	0.89	A-27	0.0
29	887+67 RT	A-29	0.1	0.0048	0.0542	0.0200	0.3333	0.08	0.00	0.069	0.1	1.46	SPECIAL	0.069	0.1	3.40	0.89	A-28	0.0
30	888+40 LT	A-30	0.1	0.0044	0.0542	0.0200	0.3333	0.08	0.00	0.069	0.1	1.46	SPECIAL	0.069	0.1	3.40	0.89	A-25	0.0
31	888+77 RT	A-31	0.1	0.0048	0.0542	0.0200	0.3333	0.08	0.00	0.069	0.1	1.46	SPECIAL	0.069	0.1	3.40	0.89	A-29	0.0
32	889+87 RT	A-32	0.1	0.0048	0.0542	0.0200	0.3333	0.08	0.00	0.069	0.1	1.46	SPECIAL	0.069	0.1	3.40	0.89	A-31	0.0
33	891+03 RT	A-33	0.0	0.0048	0.0542	0.0200	0.3333	0.00	0.00	0.000	0.0	0.00	SPECIAL	0.000	0.0	3.40	0.00	A-32	0.0
34	892+58 LT	A-34	0.0	0.0040	0.0542	0.0200	0.3333	0.00	0.00	0.000	0.0	0.00	SPECIAL	0.000	0.0	3.40	0.00	A-30	0.0
35	893+48 LT	A-35	0.0	0.0040	0.0542	0.0200	0.3333	0.00	0.00	0.000	0.0	0.00	SPECIAL	0.000	0.0	3.40	0.00	A-34	0.0
36	894+38 LT	A-36	0.0	0.0040	0.0542	0.0200	0.3333	0.00	0.00	0.000	0.0	0.00	SPECIAL	0.000	0.0	3.40	0.00	A-35	0.0
37	895+22 LT	A-37	0.0	0.0040	0.0542	0.0200	0.3333	0.00	0.00	0.000	0.0	0.00	SPECIAL	0.000	0.0	3.40	0.00	A-36	0.0
38	896+07 LT	A-38	0.0	0.0040	0.0542	0.0200	0.3333	0.00	0.00	0.000	0.0	0.00	SPECIAL	0.000	0.0	3.40	0.00	A-37	0.0
39	896+92 LT	A-39	0.0	0.0040	0.0542	0.0200	0.3333	0.00	0.00	0.000	0.0	0.00	SPECIAL	0.000	0.0	3.40	0.00	A-38	0.0
40	893+75 RT	A-40	2.3	0.0044	0.0542	0.0200	0.3333	0.29	0.15	1.235	2.3	1.86	SPECIAL	0.564	1.0	3.40	1.42	A-33	1.3
41	897+77 LT	A-41	0.0	0.0040	0.0542	0.0200	0.3333	0.00	0.00	0.000	0.0	0.00	SPECIAL	0.000	0.0	3.40	0.00	A-39	0.0
42	898+57 LT	A-42	0.0	0.0040	0.0542	0.0200	0.3333	0.00	0.00	0.000	0.0	0.00	SPECIAL	0.000	0.0	3.40	0.00	A-41	0.0

Computed by: S.L. Forvilly Date: 9/87 Checked by: CGS Date:
Revisions by: D.B. Harelson Date: 2/88 Checked by: Date: 9/88

ARIZONA DEPARTMENT OF TRANSPORTATION

LOCATION DATA:
Highway: Superstition Freeway: Phase III
Location: Power Road to Ellsworth Road
Project No. F-029-1-311

DESIGN DATA:
Frequency 50 years
P6 = 2.70 in. P24 = 3.20 in. P1 = 2.15 in.
Tallow: Mainline = 16.0' Ramps = 8.5'

TABLE 7 PHASE III: GRATE INTERCEPTION SHEET

Inlet No.	Inlet Station	DA No.	Qred (cfs)	So (ft/ft)	Sx (ft/ft) Gutter	Sx (ft/ft) Pavement	Sx (ft/ft) Curb	d1 (ft.)	d2 (ft.)	A is. f.)	Qtrial (cfs)	V (fps)	Grate Type	Ai is. f.)	Qi (cfs)	Lb (ft.) (1) actual	Lb (ft.) (1) req'd	Qc to area	Qc (cfs)
43	899+43 LT	A-43	0.0	0.0040	0.0542	0.0200	0.3333	0.00	0.00	0.000	0.0	0.00	SPECIAL	0.000	0.0	3.40	0.00	A-42	0.0
44	900+23 LT	A-44	0.0	0.0040	0.0542	0.0200	0.3333	0.00	0.00	0.000	0.0	0.00	SPECIAL	0.000	0.0	3.40	0.00	A-43	0.0
45	901+03 LT	A-45	0.0	0.0040	0.0542	0.0200	0.3333	0.00	0.00	0.000	0.0	0.00	SPECIAL	0.000	0.0	3.40	0.00	A-44	0.0
46	901+83 LT	A-46	0.0	0.0040	0.0542	0.0200	0.3333	0.00	0.00	0.000	0.0	0.00	SPECIAL	0.000	0.0	3.40	0.00	A-45	0.0
47	902+58 LT	A-47	0.0	0.0040	0.0542	0.0200	0.3333	0.00	0.00	0.000	0.0	0.00	SPECIAL	0.000	0.0	3.40	0.00	A-46	0.0
48	903+33 LT	A-48	0.0	0.0040	0.0542	0.0200	0.3333	0.00	0.00	0.000	0.0	0.00	SPECIAL	0.000	0.0	3.40	0.00	A-47	0.0
49	897+85 RT	A-49	1.9	0.0044	0.0542	0.0200	0.3333	0.27	0.13	1.058	1.9	1.80	SPECIAL	0.519	0.9	3.40	1.34	A-40	1.0
50	902+00 RT	A-50	0.0	0.0030	0.0542	0.0200	0.3333	0.00	0.00	0.000	0.0	0.00	SPECIAL	0.000	0.0	3.40	0.00	A-49	0.0
51	902+85 RT	A-51	0.0	0.0030	0.0542	0.0200	0.3333	0.00	0.00	0.000	0.0	0.00	SPECIAL	0.000	0.0	3.40	0.00	A-50	0.0
52	903+69 RT	A-52	0.0	0.0030	0.0542	0.0200	0.3333	0.00	0.00	0.000	0.0	0.00	SPECIAL	0.000	0.0	3.40	0.00	A-51	0.0
53	904+49 RT	A-53	0.0	0.0030	0.0542	0.0200	0.3333	0.00	0.00	0.000	0.0	0.00	SPECIAL	0.000	0.0	3.40	0.00	A-52	0.0
54	905+24 RT	A-54	0.0	0.0030	0.0542	0.0200	0.3333	0.00	0.00	0.000	0.0	0.00	SPECIAL	0.000	0.0	3.40	0.00	A-53	0.0
55	905+94 RT	A-55	0.0	0.0030	0.0542	0.0200	0.3333	0.00	0.00	0.000	0.0	0.00	SPECIAL	0.000	0.0	3.40	0.00	A-54	0.0
56	15+20	A-56	0.3	0.0076	0.0542	0.0200	0.3333	0.13	0.00	0.181	0.3	1.66	SPECIAL	0.173	0.3	3.40	1.07	A-55	0.0
57	16+20	A-57	1.0	0.0188	0.0542	0.0200	0.3333	0.17	0.03	0.333	1.0	3.00	SPECIAL	0.269	0.8	3.40	2.04	A-56	0.2
58	907+95 RT	A-58	0.0	0.0044	0.0542	0.0200	0.3333	0.00	0.00	0.000	0.0	0.00	SPECIAL	0.000	0.0	3.40	0.00	A-56	0.0
59	904+08 LT	A-59	0.0	0.0040	0.0542	0.0200	0.3333	0.00	0.00	0.000	0.0	0.00	SPECIAL	0.000	0.0	3.40	0.00	A-48	0.0
60	14+05	A-60	0.0	0.0040	0.0542	0.0200	0.3333	0.00	0.00	0.000	0.0	0.00	SPECIAL	0.000	0.0	3.40	0.00	A-59	0.0
61	14+70	A-61	0.0	0.0040	0.0542	0.0290	0.3333	0.00	0.00	0.000	0.0	0.00	SPECIAL	0.000	0.0	3.40	0.00	A-60	0.0
62	15+25	A-62	0.0	0.0040	0.0542	0.0440	0.3333	0.00	0.00	0.000	0.0	0.00	SPECIAL	0.000	0.0	3.40	0.00	A-61	0.0
63	15+95	A-63	0.0	0.0040	0.0542	0.0460	0.3333	0.00	0.00	0.000	0.0	0.00	SPECIAL	0.000	0.0	3.40	0.00	A-62	0.0
64	16+63	A-64	0.3	0.0048	0.0542	0.0460	0.3333	0.14	0.00	0.210	0.3	1.43	SPECIAL	0.195	0.3	3.40	0.94	A-63	0.0

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Revisions by: D.B. Harelson Date: 2/88 Checked by: Date: 9/88

ARIZONA DEPARTMENT OF TRANSPORTATION

LOCATION DATA:
Highway: Superstition Freeway: Phase III
Location: Power Road to Ellsworth Road
Project No. F-028-1-311

DESIGN DATA:
Frequency 50 years
P6 = 2.70 in. P24 = 3.20 in. P1 = 2.15 in.
Tallow: Mainline = 16.0' Ramps = 8.5'

TABLE 9 PHASE III: GRATE INTERCEPTION SHEET

Inlet No.	Inlet Station	GA No.	Qred (cfs)	So (ft/ft)	Sx (ft/ft) Gutter	Sx (ft/ft) Pavement	Sx (ft/ft) Curb	d1 (ft.)	d2 (ft.)	A (s. f.)	Qtrial (cfs)	V (fps)	Grate Type	Ai (s. f.)	Qi (cfs)	Lb (ft.) (1) actual	Lb (ft.) (1) req'd	Qc to area	Qc (cfs)
65	17+40	A-65	1.3	0.0173	0.0542	0.0460	0.3333	0.19	0.05	0.408	1.3	3.18	SPECIAL	0.322	1.0	3.40	2.21	A-64	0.3
66	908+20 LT	A-66	0.6	0.0059	0.0542	0.0200	0.3333	0.18	0.04	0.373	0.6	1.61	15.30	0.191	0.3	3.25	1.10	A-64	0.3
67	19+85	A-67	0.9	0.0328	0.0542	0.0200	0.3333	0.15	0.01	0.243	0.9	3.71	SPECIAL	0.218	0.8	3.40	2.46	A-65	0.1
68	21+65	A-68	1.0	0.0478	0.0542	0.0200	0.3333	0.15	0.01	0.243	1.0	4.12	SPECIAL	0.218	0.9	3.40	2.73	A-67	0.1
69	23+45	A-69	1.5	0.0528	0.0542	0.0200	0.3333	0.17	0.03	0.306	1.5	4.90	SPECIAL	0.255	1.3	3.40	3.31	A-68	0.2
70	910+65 LT	A-70	1.5	0.0115	0.0542	0.0200	0.3333	0.22	0.08	0.592	1.5	2.54	SPECIAL	0.376	1.0	3.40	1.80	A-66	0.5
71	910+65 RT	A-71	1.4	0.0115	0.0542	0.0200	0.3333	0.21	0.07	0.550	1.4	2.54	SPECIAL	0.361	0.9	3.40	1.80	A-58	0.5
72	8+65	A-72	0.9	0.0337	0.0542	0.0200	0.3333	0.15	0.01	0.243	0.9	3.71	SPECIAL	0.218	0.8	3.40	2.46	A-57	0.1
73	913+20 LT	A-73	2.0	0.0176	0.0542	0.0200	0.3333	0.22	0.08	0.627	2.0	3.19	SPECIAL	0.389	1.2	3.40	2.28	A-70	0.8
74	913+20 RT	A-74	1.9	0.0176	0.0542	0.0200	0.3333	0.22	0.08	0.599	1.9	3.17	SPECIAL	0.379	1.2	3.40	2.26	A-71	0.7
75	11+00	A-75	0.7	0.0479	0.0542	0.0200	0.3333	0.13	0.00	0.181	0.7	3.86	SPECIAL	0.173	0.7	3.40	2.50	A-72	0.0
76	915+75 LT	A-76	1.6	0.0221	0.0542	0.0200	0.3333	0.20	0.06	0.474	1.6	3.38	SPECIAL	0.332	1.1	3.40	2.36	A-73	0.5
77	915+75 RT	A-77	1.7	0.0221	0.0542	0.0200	0.3333	0.20	0.06	0.498	1.7	3.41	SPECIAL	0.342	1.2	3.40	2.39	A-74	0.5
78	13+00	A-78	1.1	0.0585	0.0542	0.0200	0.3333	0.15	0.01	0.229	1.1	4.80	SPECIAL	0.209	1.0	3.40	3.17	A-75	0.1
79	917+25 LT	A-79	2.6	0.0261	0.0542	0.0200	0.3333	0.23	0.09	0.664	2.6	3.91	SPECIAL	0.401	1.6	3.40	2.81	A-76	1.0
80	917+25 RT	A-80	2.9	0.0261	0.0542	0.0200	0.3333	0.24	0.10	0.743	2.9	3.90	SPECIAL	0.427	1.7	3.40	2.83	A-77	1.2
81	920+00 LT	A-81	4.0	0.0264	0.0542	0.0200	0.3333	0.26	0.12	0.952	4.0	4.20	SPECIAL	0.489	2.1	3.40	3.12	A-79	1.9
82	920+00 RT	A-82	4.3	0.0264	0.0542	0.0200	0.3333	0.27	0.13	1.009	4.3	4.26	SPECIAL	0.505	2.1	3.40	3.18	A-80	2.2
83	2+65	A-83	0.0	0.0029	0.0542	0.0200	0.3333	0.00	0.00	0.000	0.0	0.00	SPECIAL	0.000	0.0	3.40	0.00	A-88W	0.0
84	4+00	A-84	0.1	0.0049	0.0542	0.0200	0.3333	0.07	0.00	0.059	0.1	1.70	SPECIAL	0.059	0.1	3.40	1.03	A-85W	0.0
85W	6+69	A-85W	0.0	0.0033	0.0542	0.0200	0.3333	0.00	0.00	0.000	N/A	N/A	SPECIAL	0.000	0.0	3.40	N/A	SUMP	0.0
85E	6+69	A-85E	0.0	0.0053	0.0542	0.0200	0.3333	0.00	0.00	0.000	N/A	N/A	SPECIAL	0.000	0.0	3.40	N/A	SUMP	0.0

Computed by: S.L. Forvilly Date: 9/87 Checked by: CCS Date:
Revisions by: D.B. Harelson Date: 2/88 Checked by: Date: 9/88

ARIZONA DEPARTMENT OF TRANSPORTATION

LOCATION DATA:
Highway: Superstition Freeway: Phase III
Location: Power Road to Ellsworth Road
Project No. F-028-1-311

DESIGN DATA:
Frequency 50 years
P6 = 2.70 in. P24 = 3.20 in. P1 = 2.15 in.
Tallow: Mainline = 16.0' Ramps = 8.5'

TABLE 9 PHASE III: GRATE INTERCEPTION SHEET

Inlet No.	Inlet Station	DA No.	Qred (cfs)	So (ft/ft)	Sx (ft/ft) Gutter	Sx (ft/ft) Pavement	Sx (ft/ft) Curb	d1 (ft.)	d2 (ft.)	A (s. f.)	Qtrial (cfs)	V (fps)	Grate Type	Ai (s. f.)	Qi (cfs)	Lb (ft.) (1) actual	Lb (ft.) (1) req'd	Qc to area	Qc (cfs)
86	925+00 LT	A-86	1.4	0.0240	0.0542	0.0200	0.3333	0.19	0.05	0.404	1.4	3.46	SPECIAL	0.303	1.0	3.40	2.39	A-81	0.4
87	925+00 RT	A-87	1.2	0.0240	0.0542	0.0200	0.3333	0.18	0.04	0.353	1.2	3.40	SPECIAL	0.279	0.9	3.40	2.32	A-82	0.3
88W	5+49	A-88W	0.0	0.0035	0.0542	0.0200	0.3333	0.00	0.00	0.000	N/A	N/A	SPECIAL	0.000	0.0	3.40	N/A	SUMP	0.0
88E	5+49	A-88E	0.6	0.0055	0.0542	0.0200	0.3333	0.43	0.29	3.317	N/A	N/A	SPECIAL	0.980	0.2	3.40	N/A	SUMP	0.4
89	10+05	A-89	1.1	0.0160	0.0542	0.0460	0.3333	0.19	0.05	0.391	1.1	2.81	SPECIAL	0.312	0.9	3.40	1.95	A-88E	0.2
90	12+35	A-90	1.0	0.0236	0.0542	0.0420	0.3333	0.17	0.03	0.312	1.0	3.20	SPECIAL	0.265	0.8	3.40	2.17	A-89	0.2
91	11+45	A-91	0.1	0.0178	0.0542	0.0460	0.3333	0.06	0.00	0.039	0.1	2.59	SPECIAL	0.039	0.1	3.40	1.53	A-85E	0.0
92	947+25 LT	A-92	0.0	0.0025	0.0542	0.0200	0.3333	0.00	0.00	0.000	0.0	0.00	SPECIAL	0.000	0.0	3.40	0.00	A-161	0.0
93	947+25 RT	A-93	0.9	0.0025	0.0542	0.0200	0.3333	0.23	0.09	0.711	0.9	1.27	SPECIAL	0.417	0.5	3.40	0.91	A-165	0.4
94	953+20 LT	A-94	0.0	0.0025	0.0542	0.0200	0.3333	0.00	0.00	0.000	0.0	0.00	SPECIAL	0.000	0.0	3.40	0.00	A-92	0.0
95	953+20 RT	A-95	0.9	0.0025	0.0542	0.0200	0.3333	0.23	0.09	0.711	0.9	1.27	SPECIAL	0.417	0.5	3.40	0.91	A-93	0.4
96	957+30 LT	A-96	0.0	0.0025	0.0542	0.0200	0.3333	0.00	0.00	0.000	0.0	0.00	SPECIAL	0.000	0.0	3.40	0.00	A-94	0.0
97	957+30 RT	A-97	0.0	0.0025	0.0542	0.0200	0.3333	0.00	0.00	0.000	0.0	0.00	SPECIAL	0.000	0.0	3.40	0.00	A-95	0.0
98	961+25 LT	A-98	0.9	0.0025	0.0542	0.0200	0.3333	0.23	0.09	0.711	0.9	1.27	SPECIAL	0.417	0.5	3.40	0.91	A-96	0.4
99	961+25 RT	A-99	0.9	0.0025	0.0542	0.0200	0.3333	0.23	0.09	0.711	0.9	1.27	SPECIAL	0.417	0.5	3.40	0.91	A-97	0.4
100	965+05 LT	A-100	0.0	0.0025	0.0542	0.0200	0.3333	0.00	0.00	0.000	0.0	0.00	SPECIAL	0.000	0.0	3.40	0.00	A-98	0.0
101	965+05 RT	A-101	0.9	0.0025	0.0542	0.0200	0.3333	0.23	0.09	0.711	0.9	1.27	SPECIAL	0.417	0.5	3.40	0.91	A-99	0.4
102	968+70 LT	A-102	0.0	0.0025	0.0542	0.0200	0.3333	0.00	0.00	0.000	0.0	0.00	SPECIAL	0.000	0.0	3.40	0.00	A-100	0.0
103	968+70 RT	A-103	0.8	0.0025	0.0542	0.0200	0.3333	0.23	0.09	0.695	0.8	1.15	SPECIAL	0.411	0.5	3.40	0.83	A-101	0.3
104	972+15 LT	A-104	0.9	0.0025	0.0542	0.0200	0.3333	0.23	0.09	0.711	0.9	1.27	SPECIAL	0.417	0.5	3.40	0.91	A-102	0.4
105	972+15 RT	A-105	0.8	0.0025	0.0542	0.0200	0.3333	0.23	0.09	0.695	0.8	1.15	SPECIAL	0.411	0.5	3.40	0.83	A-103	0.3
106	975+55 LT	A-106	0.0	0.0025	0.0542	0.0200	0.3333	0.00	0.00	0.000	0.0	0.00	SPECIAL	0.000	0.0	3.40	0.00	A-104	0.0

Computed by: S.L. Forvilly Date: 9/87 Checked by: GCS Date:
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ARIZONA DEPARTMENT OF TRANSPORTATION

LOCATION DATA:
Highway: Superstition Freeway: Phase III
Location: Power Road to Ellsworth Road
Project No. F-028-1-311

DESIGN DATA:
Frequency 50 years
P6 = 2.70 in. P24 = 3.20 in. PI = 2.15 in.
Tallow: Mainline = 16.0' Ramps = 8.5'

TABLE 9 PHASE III: GRATE INTERCEPTION SHEET

Inlet No.	Inlet Station	DA No.	Qred (cfs)	So (ft/ft)	Sx (ft/ft) Gutter	Sx (ft/ft) Pavement	Sx (ft/ft) Curb	d1 (ft.)	d2 (ft.)	A (s. f.)	Qtrial (cfs)	V (fps)	Grate Type	Ai (s. f.)	Qi (cfs)	Lb (ft.) (1) actual	Lb (ft.) (1) req'd	Qc to area	Qc (cfs)
107	975+55 RT	A-107	0.8	0.0025	0.0542	0.0200	0.3333	0.23	0.09	0.695	0.8	1.15	SPECIAL	0.411	0.5	3.40	0.83	A-105	0.3
108	978+70 LT	A-108	0.0	0.0025	0.0542	0.0200	0.3333	0.00	0.00	0.000	0.0	0.00	SPECIAL	0.000	0.0	3.40	0.00	A-106	0.0
109	978+90 RT	A-109	1.0	0.0025	0.0542	0.0200	0.3333	0.24	0.10	0.776	1.0	1.29	SPECIAL	0.437	0.6	3.40	0.94	A-107	0.4
110	981+95 LT	A-110	0.5	0.0056	0.0542	0.0200	0.3333	0.17	0.03	0.324	0.5	1.54	SPECIAL	0.265	0.4	3.40	1.05	A-108	0.1
111	981+95 RT	A-111	2.4	0.0056	0.0542	0.0200	0.3333	0.28	0.14	1.171	2.4	2.05	SPECIAL	0.547	1.1	3.40	1.55	A-109	1.3
112	985+70 LT	A-112	3.4	0.0085	0.0542	0.0200	0.3333	0.30	0.16	1.324	3.4	2.57	SPECIAL	0.585	1.5	3.40	1.97	A-110	1.9
113	985+70 RT	A-113	3.3	0.0085	0.0542	0.0200	0.3333	0.29	0.15	1.279	3.3	2.58	SPECIAL	0.574	1.5	3.40	1.97	A-111	1.8
114	989+00 LT	A-114	4.2	0.0097	0.0542	0.0200	0.3333	0.31	0.17	1.487	4.2	2.83	SPECIAL	0.624	1.8	3.40	2.19	A-112	2.4
115	989+00 RT	A-115	5.3	0.0094	0.0542	0.0200	0.3333	0.33	0.19	1.790	5.3	2.96	SPECIAL	0.691	2.0	3.40	2.34	A-113	3.3
116	993+30 LT	A-116	3.5	0.0065	0.0542	0.0200	0.3333	0.31	0.17	1.487	3.5	2.35	SPECIAL	0.624	1.5	3.40	1.82	A-114	2.0
117	997+45 RT	A-117	0.1	0.0044	0.0542	0.0200	0.3333	0.08	0.00	0.069	0.1	1.46	SPECIAL	0.069	0.1	3.40	0.89	A-115	0.0
118	998+75 LT	A-118	0.1	0.0044	0.0542	0.0200	0.3333	0.10	0.00	0.107	0.1	0.93	SPECIAL	0.107	0.1	3.40	0.58	A-116	0.0
119	999+80 LT	A-119	0.0	0.0039	0.0542	0.0200	0.3333	0.00	0.00	0.000	0.0	0.00	SPECIAL	0.000	0.0	3.40	0.00	A-118	0.0
120	1000+80 LT	A-120	0.0	0.0036	0.0542	0.0200	0.3333	0.00	0.00	0.000	0.0	0.00	SPECIAL	0.000	0.0	3.40	0.00	A-119	0.0
121	1001+75 LT	A-121	0.0	0.0036	0.0542	0.0200	0.3333	0.00	0.00	0.000	0.0	0.00	SPECIAL	0.000	0.0	3.40	0.00	A-120	0.0
122	1002+70 LT	A-122	0.0	0.0036	0.0542	0.0200	0.3333	0.00	0.00	0.000	0.0	0.00	SPECIAL	0.000	0.0	3.40	0.00	A-121	0.0
123	1003+60 LT	A-123	0.0	0.0036	0.0542	0.0200	0.3333	0.00	0.00	0.000	0.0	0.00	SPECIAL	0.000	0.0	3.40	0.00	A-122	0.0
124	1004+50 LT	A-124	0.0	0.0036	0.0542	0.0200	0.3333	0.00	0.00	0.000	0.0	0.00	SPECIAL	0.000	0.0	3.40	0.00	A-123	0.0
125	1005+40 LT	A-125	0.0	0.0036	0.0542	0.0200	0.3333	0.00	0.00	0.000	0.0	0.00	SPECIAL	0.000	0.0	3.40	0.00	A-124	0.0
126	1002+85 RT	A-126	0.0	0.0040	0.0542	0.0200	0.3333	0.00	0.00	0.000	0.0	0.00	SPECIAL	0.000	0.0	3.40	0.00	A-117	0.0
127	1006+50 LT	A-127	0.0	0.0036	0.0542	0.0200	0.3333	0.00	0.00	0.000	0.0	0.00	SPECIAL	0.000	0.0	3.40	0.00	A-125	0.0
128	1007+15 LT	A-128	0.0	0.0036	0.0542	0.0200	0.3333	0.00	0.00	0.000	0.0	0.00	SPECIAL	0.000	0.0	3.40	0.00	A-127	0.0

Computed by: S.L. Forvilly Date: 9/87 Checked by: GEG Date: 9/88
Revisions by: D.B. Harelson Date: 2/88 Checked by: Date:

ARIZONA DEPARTMENT OF TRANSPORTATION

LOCATION DATA:
Highway: Superstition Freeway: Phase III
Location: Power Road to Ellsworth Road
Project No. F-023-1-311

DESIGN DATA:
Frequency 50 years
P6 = 2.70 in. P24 = 3.20 in. P1 = 2.15 in.
Tailow: Mainline = 16.0' Ramps = 8.5'

TABLE 9 PHASE III: GRATE INTERCEPTION SHEET

Inlet No.	Inlet Station	DA No.	Qred (cfs)	So (ft/ft)	Sx (ft/ft) Gutter	Sx (ft/ft) Pavement	Sx (ft/ft) Curb	d1 (ft.)	d2 (ft.)	A (s. f.)	Qtrial (cfs)	V (fps)	Grate Type	Ai (s. f.)	Qi (cfs)	Lb (ft.) (1) actual	Lb (ft.) (1) req'd	Qc to area	Qc (cfs)
129	1008+00 LT	A-129	0.0	0.0036	0.0542	0.0200	0.3333	0.00	0.00	0.000	0.0	0.00	SPECIAL	0.000	0.0	3.40	0.00	A-128	0.0
130	1008+00 RT	A-130	0.0	0.0026	0.0542	0.0200	0.3333	0.00	0.00	0.000	0.0	0.00	SPECIAL	0.000	0.0	3.40	0.00	A-126	0.0
131	1008+95 RT	A-131	0.0	0.0026	0.0542	0.0200	0.3333	0.00	0.00	0.000	0.0	0.00	SPECIAL	0.000	0.0	3.40	0.00	A-130	0.0
132	1009+84 RT	A-132	0.0	0.0026	0.0542	0.0200	0.3333	0.00	0.00	0.000	0.0	0.00	SPECIAL	0.000	0.0	3.40	0.00	A-131	0.0
133	1010+74 RT	A-133	0.0	0.0026	0.0542	0.0200	0.3333	0.00	0.00	0.000	0.0	0.00	SPECIAL	0.000	0.0	3.40	0.00	A-132	0.0
134	1011+59 RT	A-134	0.0	0.0026	0.0542	0.0200	0.3333	0.00	0.00	0.000	0.0	0.00	SPECIAL	0.000	0.0	3.40	0.00	A-133	0.0
135	4+85	A-135	0.2	0.0067	0.0542	0.0200	0.3333	0.12	0.00	0.154	0.2	1.29	SPECIAL	0.151	0.2	3.40	0.83	A-134	0.0
136	6+00	A-136	0.2	0.0209	0.0542	0.0200	0.3333	0.10	0.00	0.107	0.2	1.86	SPECIAL	0.107	0.2	3.40	1.16	A-135	0.0
137	1013+95 RT	A-137	0.6	0.0040	0.0542	0.0200	0.3333	0.19	0.05	0.427	0.6	1.41	SPECIAL	0.312	0.4	3.40	0.97	A-136	0.2
138	1008+85 LT	A-138	0.0	0.0036	0.0542	0.0200	0.3333	0.00	0.00	0.000	0.0	0.00	SPECIAL	0.000	0.0	3.40	0.00	A-129	0.0
139	1009+70 LT	A-139	0.0	0.0036	0.0542	0.0200	0.3333	0.00	0.00	0.000	0.0	0.00	SPECIAL	0.000	0.0	3.40	0.00	A-138	0.0
140	1010+50 LT	A-140	0.0	0.0036	0.0542	0.0200	0.3333	0.00	0.00	0.000	0.0	0.00	SPECIAL	0.000	0.0	3.40	0.00	A-139	0.0
141	14+55	A-141	0.0	0.0036	0.0542	0.0240	0.3333	0.00	0.00	0.000	0.0	0.00	SPECIAL	0.000	0.0	3.40	0.00	A-140	0.0
142	15+35	A-142	0.0	0.0036	0.0542	0.0460	0.3333	0.00	0.00	0.000	0.0	0.00	SPECIAL	0.000	0.0	3.40	0.00	A-141	0.0
143	16+00	A-143	0.8	0.0049	0.0542	0.0460	0.3333	0.21	0.07	0.481	0.8	1.66	SPECIAL	0.361	0.6	3.40	1.18	A-142	0.2
144	1013+15 LT	A-144	1.2	0.0040	0.0542	0.0200	0.3333	0.24	0.10	0.776	1.2	1.55	15.30	0.271	0.4	3.25	1.13	A-143	0.8
145	17+75	A-145	1.6	0.0200	0.0542	0.0460	0.3333	0.21	0.07	0.462	1.6	3.46	SPECIAL	0.351	1.2	3.40	2.44	A-143	0.4
146	1016+75 LT	A-146	1.3	0.0042	0.0542	0.0200	0.3333	0.25	0.11	0.826	1.3	1.57	SPECIAL	0.452	0.7	3.40	1.15	A-144	0.6
147	1016+75 RT	A-147	1.3	0.0042	0.0542	0.0200	0.3333	0.25	0.11	0.826	1.3	1.57	SPECIAL	0.452	0.7	3.40	1.15	A-137	0.6
148	9+50	A-148	2.1	0.0335	0.0542	0.0200	0.3333	0.20	0.06	0.511	2.1	4.11	SPECIAL	0.347	1.4	3.40	2.89	A-136	0.7
149	20+25	A-149	2.8	0.0391	0.0542	0.0200	0.3333	0.22	0.08	0.599	2.8	4.68	SPECIAL	0.379	1.8	3.40	3.33	A-145	1.0
150	1019+30 LT	A-150	3.3	0.0087	0.0542	0.0200	0.3333	0.29	0.15	1.279	3.3	2.58	SPECIAL	0.574	1.5	3.40	1.97	A-146	1.8

Computed by: S.L. Forville Date: 9/87 Checked by: GS Date: 9/88
Revisions by: D.B. Harelson Date: 2/88 Checked by: _____ Date: _____

ARIZONA DEPARTMENT OF TRANSPORTATION

LOCATION DATA:
Highway: Superstition Freeway: Phase III
Location: Power Road to Ellsworth Road
Project No. F-029-1-311

DESIGN DATA:
Frequency 50 years
P6 = 2.70 in. P24 = 3.20 in. PI = 2.15 in.
Tallow: Mainline = 16.0' Ramps = 8.5'

TABLE 9 PHASE III: GRATE INTERCEPTION SHEET

Inlet No.	Inlet Station	DA No.	Qred (cfs)	So (ft/ft)	Sx (ft/ft) Gutter	Sx (ft/ft) Pavement	Sx (ft/ft) Curb	d1 (ft.)	d2 (ft.)	A (s. f.)	Qtrial (cfs)	V (fps)	Grate Type	Ai (s. f.)	Qi (cfs)	Lb (ft.) (1) actual	Lb (ft.) (1) req'd	Qc to area	Qc (cfs)
151	1019+50 RT	A-151	3.2	0.0087	0.0542	0.0200	0.3333	0.29	0.15	1.257	3.2	2.55	SPECIAL	0.569	1.4	3.40	1.94	A-147	1.8
152	1022+50 LT	A-152	4.7	0.0181	0.0542	0.0200	0.3333	0.29	0.15	1.257	4.7	3.74	SPECIAL	0.569	2.1	3.40	2.85	A-150	2.6
153	1022+50 RT	A-153	4.8	0.0181	0.0542	0.0200	0.3333	0.29	0.15	1.299	4.8	3.72	SPECIAL	0.577	2.1	3.40	2.94	A-151	2.7
154	931+77 LT	A-154	0.6	0.0120	0.0542	0.0200	0.3333	0.15	0.01	0.243	0.5	2.47	SPECIAL	0.218	0.5	3.40	1.64	A-91	0.1
155	932+32 RT	A-155	0.6	0.0112	0.0542	0.0200	0.3333	0.16	0.02	0.281	0.6	2.14	SPECIAL	0.241	0.5	3.40	1.43	A-90	0.1
156	934+55 LT	A-156	0.1	0.0078	0.0542	0.0200	0.3333	0.06	0.00	0.039	0.0	2.59	SPECIAL	0.039	0.1	3.40	1.53	A-154	0.0
157	934+55 RT	A-157	0.2	0.0078	0.0542	0.0200	0.3333	0.11	0.00	0.130	0.2	1.54	SPECIAL	0.129	0.2	3.40	0.97	A-155	0.0
158	936+26 RT	A-158	0.1	0.0052	0.0542	0.0200	0.3333	0.08	0.00	0.069	0.1	1.46	SPECIAL	0.069	0.1	3.40	0.89	A-157	0.0
159	937+91 RT	A-159	0.0	0.0028	0.0542	0.0200	0.3333	0.00	0.00	0.000	0.0	0.00	SPECIAL	0.000	0.0	3.40	0.00	A-158	0.0
160	939+31 RT	A-160	0.0	0.0025	0.0542	0.0200	0.3333	0.00	0.00	0.000	0.0	0.00	SPECIAL	0.000	0.0	3.40	0.00	A-159	0.0
161	940+30 LT	A-161	1.0	0.0025	0.0542	0.0200	0.3333	0.24	0.10	0.776	1.0	1.29	SPECIAL	0.437	0.6	3.40	0.94	A-156	0.4
162	940+76 RT	A-162	0.0	0.0025	0.0542	0.0200	0.3333	0.00	0.00	0.000	0.0	0.00	SPECIAL	0.000	0.0	3.40	0.00	A-160	0.0
163	942+31 RT	A-163	0.0	0.0025	0.0542	0.0200	0.3333	0.00	0.00	0.000	0.0	0.00	SPECIAL	0.000	0.0	3.40	0.00	A-162	0.0
164	943+78 RT	A-164	0.0	0.0025	0.0542	0.0200	0.3333	0.00	0.00	0.000	0.0	0.00	SPECIAL	0.000	0.0	3.40	0.00	A-163	0.0
165	945+25 RT	A-165	0.0	0.0025	0.0542	0.0200	0.3333	0.00	0.00	0.000	0.0	0.00	SPECIAL	0.000	0.0	3.40	0.00	A-164	0.0

Computed by: S.L. Forvilly Date: 9/87 Checked by: GCS Date: 9/88
Revisions by: D.B. Hareison Date: 2/88 Checked by: _____ Date: _____

ARIZONA DEPARTMENT OF TRANSPORTATION

LOCATION DATA
Highway: Superstition Freeway: Phase III
Location: Power Road to Ellsworth Road
Project No. F-028-1-311

DESIGN DATA:
Frequency 50 years
P6 = 2.70 in. P2A = 3.20 in. P1 = 2.15 in.
Tailow: Mainline = 16.0' Ramps = 8.5'

TABLE 10. PHASE III: INLET SUMMARY SHEET

Inlet No.	Inlet Station	DA No.	Q (cfs)	Grate Type	Qc from Upstream Grate from	Qc from Upstream Grate (cfs)	Qt at Sl. Drain (cfs)	So (%)	Cross-Slope (%) Gutter	Cross-Slope (%) Pavement	Depth at Curb (ft.)	T actual (ft)	Slotted Drain Length actual	Slotted Drain Length req'd	Qred (to grate) (cfs)	Lt (ft.) actual	Lt (ft.) req'd	Qc to area	Qc (cfs)
1	870+00 LT	A-1	5.4	SPECIAL	N/A	0.0	5.4	0.0044	0.0542	0.0200	0.38	14.5	20.00	20.55	0.0	3.40	0.00	N/A	0.0
2	870+00 RT	A-2	5.2	SPECIAL	N/A	0.0	5.2	0.0044	0.0542	0.0200	0.38	14.3	20.00	20.23	0.0	3.40	0.00	N/A	0.0
3	4+45	A-3	1.3	SPECIAL	N/A	0.0	1.3	0.0216	0.0542	0.0240	0.19	4.4	10.00	16.21	0.3	3.40	1.46	A-4	0.0
4	6+50	A-4	2.1	SPECIAL	A-3	0.0	2.1	0.0281	0.0542	0.0240	0.21	5.4	10.00	24.11	0.8	3.40	2.28	A-5	0.1
5	9+00	A-5	2.7	SPECIAL	A-4	0.1	2.8	0.0196	0.0542	0.0240	0.25	6.9	10.00	24.42	1.1	3.40	2.14	A-6W	0.2
6W	9+88	A-6W	1.0	SPECIAL	A-5	0.2	1.2	0.0039	0.0542	0.0220	0.21	5.7	20.00	20.00	0.0	3.40	N/A	SUMP	0.0
6E	9+88	A-6E	1.0	SPECIAL	A-7	0.0	1.0	0.0019	0.0542	0.0220	0.19	4.8	20.00	20.00	0.0	3.40	N/A	SUMP	0.0
7	10+55	A-7	1.8	SPECIAL	A-8	0.0	1.8	0.0058	0.0542	0.0200	0.26	8.3	10.00	14.07	0.2	3.40	0.97	A-6E	0.0
8	11+45	A-8	1.8	SPECIAL	A-9	0.0	1.8	0.0058	0.0542	0.0200	0.26	8.3	10.00	14.07	0.2	3.40	0.97	A-7	0.0
9	877+22 LT	A-9	1.7	SPECIAL	A-10	0.0	1.7	0.0058	0.0542	0.0200	0.25	8.0	10.00	13.74	0.2	3.40	0.97	A-8	0.0
10	878+12 LT	A-10	1.8	SPECIAL	A-11	0.0	1.8	0.0058	0.0542	0.0200	0.26	8.3	10.00	14.07	0.2	3.40	0.97	A-9	0.0
11	879+12 LT	A-11	1.8	SPECIAL	A-12	0.0	1.8	0.0058	0.0542	0.0200	0.26	8.3	10.00	14.07	0.2	3.40	0.97	A-10	0.0
12	880+17 LT	A-12	1.8	SPECIAL	A-13	0.0	1.8	0.0058	0.0542	0.0200	0.26	8.3	10.00	14.07	0.2	3.40	0.97	A-11	0.0
13	881+27 LT	A-13	4.0	SPECIAL	A-25	1.1	5.1	0.0045	0.0542	0.0200	0.37	14.0	20.00	20.20	0.0	3.40	0.00	A-12	0.0
14	5+00	A-14	1.4	SPECIAL	N/A	0.0	1.4	0.0233	0.0542	0.0200	0.19	5.0	10.00	19.22	0.4	3.40	1.66	A-15	0.0
15	8+30	A-15	2.8	SPECIAL	A-14	0.0	2.8	0.0244	0.0542	0.0210	0.24	7.1	10.00	26.07	1.2	3.40	2.22	A-16W	0.3
16W	10+35	A-16W	2.0	SPECIAL	A-15	0.3	2.3	0.0079	0.0542	0.0320	0.32	8.1	20.00	20.00	0.0	3.40	N/A	SUMP	0.0
16E	10+35	A-16E	1.8	SPECIAL	A-17	0.0	1.8	0.0039	0.0542	0.0320	0.27	6.6	20.00	20.00	0.0	3.40	N/A	SUMP	0.0
17	11+45	A-17	1.6	SPECIAL	A-16	0.0	1.6	0.0048	0.0542	0.0320	0.26	6.3	10.00	12.66	0.1	3.40	0.89	A-16E	0.0
18	12+45	A-18	1.5	SPECIAL	A-17	0.0	1.5	0.0048	0.0542	0.0290	0.25	6.4	10.00	12.32	0.1	3.40	0.89	A-17	0.0
19	13+45	A-19	1.5	SPECIAL	A-20	0.0	1.5	0.0048	0.0542	0.0200	0.25	7.9	10.00	12.32	0.1	3.40	0.89	A-18	0.0
20	879+29 RT	A-20	1.6	SPECIAL	A-21	0.0	1.6	0.0048	0.0542	0.0200	0.25	8.2	10.00	12.66	0.1	3.40	0.89	A-19	0.0
21	880+34 RT	A-21	1.6	SPECIAL	A-22	0.0	1.6	0.0048	0.0542	0.0200	0.25	8.2	10.00	12.66	0.1	3.40	0.89	A-20	0.0

Computed by: S.L. Forvilly Date: 9/87 Checked by: _____ Revisions by : D.R. Harelson Date: 2/88 Checked by: GQ 9/88

ARIZONA DEPARTMENT OF TRANSPORTATION

LOCATION DATA
Highway: Superstition Freeway: Phase III
Location: Power Road to Ellsworth Road
Project No. F-028-1-311

DESIGN DATA:
Frequency 50 years
P6 = 2.70 in. P2A = 3.20 in. P1 = 2.15 in.
Tallow: Mainline = 16.0' Ramps = 8.5'

TABLE 10. PHASE III: INLET SUMMARY SHEET

Inlet No.	Inlet Station	DA No.	Q (cfs)	Grate Type	Qc from Upstream Grate from	Qc from Upstream Grate (cfs)	Qt at Sl. Drain (cfs)	So (%)	Cross-Slope (%) Gutter	Cross-Slope (%) Pavement	Depth at Curb (ft.)	T actual (ft)	Slotted Drain Length actual	Slotted Drain Length req'd	Qred (to grate) (cfs)	Lt (ft.) actual	Lt (ft.) req'd	Qc to area	Qc (cfs)
22	881+38 RT	A-22	1.6	SPECIAL	A-23	0.0	1.6	0.0048	0.0542	0.0200	0.25	8.2	10.00	12.66	0.1	3.40	0.89	A-21	0.0
23	882+43 RT	A-23	1.6	SPECIAL	A-24	0.0	1.6	0.0048	0.0542	0.0200	0.25	8.2	10.00	12.66	0.1	3.40	0.89	A-22	0.0
24	883+48 RT	A-24	0.7	SPECIAL	A-26	0.0	0.7	0.0048	0.0542	0.0200	0.19	5.0	10.00	8.94	0.0	3.40	0.00	A-23	0.0
25	883+70 LT	A-25	6.2	SPECIAL	A-30	0.0	6.2	0.0044	0.0542	0.0200	0.40	15.4	10.00	21.78	2.1	3.40	1.38	A-13	1.1
26	884+78 RT	A-26	1.2	SPECIAL	A-27	0.0	1.2	0.0048	0.0542	0.0200	0.23	7.0	10.00	11.22	0.0	3.40	0.00	A-24	0.0
27	885+57 RT	A-27	1.6	SPECIAL	A-28	0.0	1.6	0.0048	0.0542	0.0200	0.25	8.2	10.00	12.66	0.1	3.40	0.89	A-26	0.0
28	886+62 RT	A-28	1.6	SPECIAL	A-29	0.0	1.6	0.0048	0.0542	0.0200	0.25	8.2	10.00	12.66	0.1	3.40	0.89	A-27	0.0
29	887+67 RT	A-29	1.6	SPECIAL	A-34	0.0	1.6	0.0048	0.0542	0.0200	0.25	8.2	10.00	12.66	0.1	3.40	0.89	A-28	0.0
30	888+40 LT	A-30	6.7	SPECIAL	A-34	0.0	6.7	0.0044	0.0542	0.0200	0.41	15.8	20.00	22.50	0.1	3.40	0.89	A-25	0.0
31	888+77 RT	A-31	1.5	SPECIAL	A-32	0.0	1.5	0.0048	0.0542	0.0200	0.25	7.9	10.00	12.32	0.1	3.40	0.89	A-29	0.0
32	889+67 RT	A-32	1.6	SPECIAL	A-33	0.0	1.6	0.0048	0.0542	0.0200	0.25	8.2	10.00	12.66	0.1	3.40	0.89	A-31	0.0
33	891+03 RT	A-33	3.7	SPECIAL	A-40	1.3	5.0	0.0048	0.0542	0.0200	0.37	13.7	20.00	20.42	0.0	3.40	0.00	A-32	0.0
34	892+58 LT	A-34	1.5	SPECIAL	A-35	0.0	1.5	0.0040	0.0542	0.0200	0.26	8.3	10.00	11.66	0.0	3.40	0.00	A-30	0.0
35	893+48 LT	A-35	1.5	SPECIAL	A-36	0.0	1.5	0.0040	0.0542	0.0200	0.26	8.3	10.00	11.66	0.0	3.40	0.00	A-34	0.0
36	894+38 LT	A-36	1.4	SPECIAL	A-37	0.0	1.4	0.0040	0.0542	0.0200	0.25	7.9	10.00	11.33	0.0	3.40	0.00	A-35	0.0
37	895+22 LT	A-37	1.4	SPECIAL	A-38	0.0	1.4	0.0040	0.0542	0.0200	0.25	7.9	10.00	11.33	0.0	3.40	0.00	A-36	0.0
38	896+07 LT	A-38	1.5	SPECIAL	A-39	0.0	1.5	0.0040	0.0542	0.0200	0.26	8.3	10.00	11.66	0.0	3.40	0.00	A-37	0.0
39	896+92 LT	A-39	1.5	SPECIAL	A-41	0.0	1.5	0.0040	0.0542	0.0200	0.26	8.3	10.00	11.66	0.0	3.40	0.00	A-38	0.0
40	893+75 RT	A-40	5.7	SPECIAL	A-49	1.0	6.7	0.0044	0.0542	0.0200	0.41	15.8	10.00	22.50	2.3	3.40	1.42	A-33	1.3
41	897+77 LT	A-41	1.4	SPECIAL	A-42	0.0	1.4	0.0040	0.0542	0.0200	0.25	7.9	10.00	11.33	0.0	3.40	0.00	A-39	0.0
42	898+57 LT	A-42	1.4	SPECIAL	A-43	0.0	1.4	0.0040	0.0542	0.0200	0.25	7.9	10.00	11.33	0.0	3.40	0.00	A-41	0.0
43	899+43 LT	A-43	1.4	SPECIAL	A-44	0.0	1.4	0.0040	0.0542	0.0200	0.25	7.9	10.00	11.33	0.0	3.40	0.00	A-42	0.0
44	900+23 LT	A-44	1.5	SPECIAL	A-45	0.0	1.5	0.0040	0.0542	0.0200	0.26	8.3	10.00	11.66	0.0	3.40	0.00	A-43	0.0

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ARIZONA DEPARTMENT OF TRANSPORTATION

LOCATION DATA
Highway: Superstition Freeway: Phase III
Location: Power Road to Ellsworth Road
Project No. F-028-1-311

DESIGN DATA:
Frequency 50 years
P6 = 2.70 in. P2A = 3.20 in. P1 = 2.15 in.
Tailow: Mainline = 16.0' Ramps = 8.5'

TABLE 10. PHASE III: INLET SUMMARY SHEET

Inlet No.	Inlet Station	DA No.	Q (cfs)	Grate Type	Qc from Upstream Grate from	Qc from Upstream Grate (cfs)	Qt at Sl. Drain (cfs)	Sp (%)	Cross-Slope (%) Gutter	Cross-Slope (%) Pavement	Depth at Curb (ft.)	T actual (ft)	Slotted Drain Length actual	Slotted Drain Length req'd	Qred (to grate) (cfs)	Lt (ft.) actual	Lt (ft.) req'd	Qc to area	Qc (cfs)
45	901+03 LT	A-45	1.5	SPECIAL	A-46	0.0	1.5	0.0040	0.0542	0.0200	0.26	8.3	10.00	11.66	0.0	3.40	0.00	A-44	0.0
46	901+83 LT	A-46	1.4	SPECIAL	A-47	0.0	1.4	0.0040	0.0542	0.0200	0.25	7.9	10.00	11.33	0.0	3.40	0.00	A-45	0.0
47	902+58 LT	A-47	1.4	SPECIAL	A-48	0.0	1.4	0.0040	0.0542	0.0200	0.25	7.9	10.00	11.33	0.0	3.40	0.00	A-46	0.0
48	903+33 LT	A-48	1.5	SPECIAL	A-59	0.0	1.5	0.0040	0.0542	0.0200	0.26	8.3	10.00	11.66	0.0	3.40	0.00	A-47	0.0
49	897+85 RT	A-49	6.0	SPECIAL	A-50	0.0	6.0	0.0044	0.0542	0.0200	0.39	15.1	10.00	21.48	1.9	3.40	1.34	A-40	1.0
50	902+00 RT	A-50	1.3	SPECIAL	A-51	0.0	1.3	0.0030	0.0542	0.0200	0.26	8.3	10.00	10.07	0.0	3.40	0.00	A-49	0.0
51	902+85 RT	A-51	1.3	SPECIAL	A-52	0.0	1.3	0.0030	0.0542	0.0200	0.26	8.3	10.00	10.07	0.0	3.40	0.00	A-50	0.0
52	903+69 RT	A-52	1.3	SPECIAL	A-53	0.0	1.3	0.0030	0.0542	0.0200	0.26	8.3	10.00	10.07	0.0	3.40	0.00	A-51	0.0
53	904+49 RT	A-53	1.3	SPECIAL	A-54	0.0	1.3	0.0030	0.0542	0.0200	0.26	8.3	10.00	10.07	0.0	3.40	0.00	A-52	0.0
54	905+24 RT	A-54	1.2	SPECIAL	A-55	0.0	1.2	0.0030	0.0542	0.0200	0.25	7.9	10.00	9.74	0.0	3.40	0.00	A-53	0.0
55	905+94 RT	A-55	1.3	SPECIAL	A-56	0.0	1.3	0.0030	0.0542	0.0200	0.26	8.3	10.00	10.07	0.0	3.40	0.00	A-54	0.0
56	5+20	A-56	1.8	SPECIAL	A-57&58	0.2	2.0	0.0076	0.0542	0.0200	0.25	8.2	10.00	15.95	0.3	3.40	1.07	A-55	0.0
57	6+20	A-57	2.6	SPECIAL	A-72	0.1	2.7	0.0188	0.0542	0.0200	0.24	7.5	10.00	23.75	1.0	3.40	2.04	A-56	0.2
58	907+95 RT	A-58	2.6	SPECIAL	A-71	0.5	3.1	0.0044	0.0542	0.0200	0.32	11.4	20.00	16.28	0.0	3.40	0.00	A-56	0.0
59	904+08 LT	A-59	1.4	SPECIAL	A-60	0.0	1.4	0.0040	0.0542	0.0200	0.25	7.9	10.00	11.33	0.0	3.40	0.00	A-48	0.0
60	14+05	A-60	1.3	SPECIAL	A-61	0.0	1.3	0.0040	0.0542	0.0200	0.24	7.6	10.00	10.98	0.0	3.40	0.00	A-59	0.0
61	14+70	A-61	1.1	SPECIAL	A-62	0.0	1.1	0.0040	0.0542	0.0280	0.23	5.9	10.00	10.24	0.0	3.40	0.00	A-60	0.0
62	15+25	A-62	1.4	SPECIAL	A-63	0.0	1.4	0.0040	0.0542	0.0440	0.26	5.3	10.00	11.33	0.0	3.40	0.00	A-61	0.0
63	15+95	A-63	1.5	SPECIAL	A-64	0.0	1.5	0.0040	0.0542	0.0460	0.27	5.3	10.00	11.66	0.0	3.40	0.00	A-62	0.0
64	16+65	A-64	1.6	SPECIAL	A-65&66	0.6	2.2	0.0048	0.0542	0.0460	0.30	6.0	10.00	14.47	0.3	3.40	0.94	A-63	0.0
65	17+40	A-65	3.2	SPECIAL	A-67	0.1	3.3	0.0173	0.0542	0.0460	0.28	5.5	10.00	25.20	1.3	3.40	2.21	A-64	0.3
66	906+20 LT	A-66	2.4	15.30	A-70	0.5	2.9	0.0059	0.0542	0.0200	0.30	10.3	10.00	17.28	0.6	3.25	1.10	A-64	0.3
67	19+85	A-67	2.1	SPECIAL	A-68	0.1	2.2	0.0328	0.0542	0.0200	0.21	5.8	10.00	25.75	0.9	3.40	2.46	A-65	0.1

Computed by: S.L. Forvilly Date: 9/87 Checked by: _____ Revisions by : D.R. Harelson Date: 2/88 Checked by: GCG 9/88

ARIZONA DEPARTMENT OF TRANSPORTATION

LOCATION DATA
Highway: Superstition Freeway: Phase III
Location: Power Road to Ellsworth Road
Project No. F-02B-1-311

DESIGN DATA:
Frequency 50 years
P6 = 2.70 in. P2A = 3.20 in. P1 = 2.15 in.
Tailow: Mainline = 16.0' Ramps = 8.5'

TABLE 10. PHASE III: INLET SUMMARY SHEET

Inlet No.	Inlet Station	DA No.	Q (cfs)	Grate Type	Qc from Upstream Grate from	Qc from Upstream Grate (cfs)	Qt at Sl. Drain (cfs)	So (%)	Cross-Slope (%) Gutter	Cross-Slope (%) Pavement	Depth at Curb (ft.)	T actual (ft)	Slotted Drain Length actual	Slotted Drain Length req'd	Qred (to grate) (cfs)	Lt (ft.) actual	Lt (ft.) req'd	Qc to area	Qc (cfs)
68	21+65	A-68	2.0	SPECIAL	A-69	0.2	2.2	0.0478	0.0542	0.0200	0.19	5.2	10.00	28.83	1.0	3.40	2.73	A-67	0.1
69	23+45	A-69	2.8	SPECIAL	N/A	0.0	2.8	0.0528	0.0542	0.0200	0.21	5.8	10.00	32.87	1.5	3.40	3.31	A-68	0.2
70	910+65 LT	A-70	3.1	SPECIAL	A-73	0.8	3.9	0.0115	0.0542	0.0200	0.29	10.2	10.00	23.91	1.5	3.40	1.80	A-66	0.5
71	910+65 RT	A-71	3.0	SPECIAL	A-74	0.7	3.7	0.0115	0.0542	0.0200	0.29	9.9	10.00	23.39	1.4	3.40	1.80	A-58	0.5
72	8+65	A-72	2.2	SPECIAL	A-75	0.0	2.2	0.0337	0.0542	0.0200	0.21	5.8	10.00	25.96	0.9	3.40	2.46	A-57	0.1
73	913+20 LT	A-73	3.8	SPECIAL	A-76	0.5	4.3	0.0176	0.0542	0.0200	0.28	9.6	10.00	28.31	2.0	3.40	2.28	A-70	0.8
74	913+20 RT	A-74	3.7	SPECIAL	A-77	0.5	4.2	0.0176	0.0542	0.0200	0.28	9.6	10.00	28.03	1.9	3.40	2.26	A-71	0.7
75	11+00	A-75	1.6	SPECIAL	A-78	0.1	1.7	0.0479	0.0542	0.0200	0.18	4.3	10.00	25.89	0.7	3.40	2.50	A-72	0.0
76	915+75 LT	A-76	2.6	SPECIAL	A-79	1.0	3.6	0.0221	0.0542	0.0200	0.26	8.4	10.00	28.13	1.6	3.40	2.36	A-73	0.5
77	915+75 RT	A-77	2.5	SPECIAL	A-80	1.2	3.7	0.0221	0.0542	0.0200	0.26	8.6	10.00	28.45	1.7	3.40	2.39	A-74	0.5
78	13+00	A-78	2.2	SPECIAL	N/A	0.0	2.2	0.0585	0.0542	0.0200	0.19	4.8	10.00	30.63	1.1	3.40	3.17	A-75	0.1
79	917+25 LT	A-79	3.0	SPECIAL	A-81	1.9	4.9	0.0261	0.0542	0.0200	0.28	9.4	10.00	33.66	2.6	3.40	2.81	A-76	1.0
80	917+25 RT	A-80	3.1	SPECIAL	A-82	2.2	5.3	0.0261	0.0542	0.0200	0.29	9.7	10.00	34.78	2.9	3.40	2.83	A-77	1.2
81	920+00 LT	A-81	6.5	SPECIAL	A-86	0.4	6.9	0.0264	0.0542	0.0200	0.31	10.9	10.00	38.99	4.0	3.40	3.12	A-79	1.9
82	920+00 RT	A-82	6.9	SPECIAL	A-87	0.3	7.2	0.0264	0.0542	0.0200	0.31	11.2	10.00	39.70	4.3	3.40	3.18	A-80	2.2
83	2+65	A-83	0.7	SPECIAL	N/A	0.0	0.7	0.0029	0.0542	0.0200	0.21	5.8	10.00	7.69	0.0	3.40	0.00	A-85W	0.0
84	4+00	A-84	1.6	SPECIAL	N/A	0.0	1.6	0.0049	0.0542	0.0200	0.25	8.1	10.00	12.73	0.1	3.40	1.03	A-85W	0.0
85W	6+69	A-85W	1.4	SPECIAL	A-84	0.0	1.4	0.0033	0.0542	0.0200	0.23	7.0	20.00	20.00	0.0	3.40	N/A	SUMP	0.0
85E	6+69	A-85E	3.4	SPECIAL	A-91	0.0	3.4	0.0053	0.0542	0.0200	0.26	8.5	40.00	40.00	0.0	3.40	N/A	SUMP	0.0
86	925+00 LT	A-86	3.1	SPECIAL	N/A	0.0	3.1	0.0240	0.0542	0.0200	0.24	7.6	10.00	27.08	1.4	3.40	2.39	A-81	0.4
87	925+00 RT	A-87	2.9	SPECIAL	N/A	0.0	2.9	0.0240	0.0542	0.0200	0.24	7.4	10.00	26.33	1.2	3.40	2.32	A-82	0.3
88W	5+49	A-88W	1.2	SPECIAL	A-83	0.0	1.2	0.0051	0.0542	0.0200	0.21	6.0	20.00	20.00	0.0	3.40	N/A	SUMP	0.0
88E	5+49	A-88E	1.8	SPECIAL	A-89	0.2	2.0	0.0145	0.0542	0.0200	0.22	6.5	30.00	30.00	0.0	3.40	N/A	SUMP	0.4

Computed by: S.L. Forville Date: 9/87 Checked by: _____ Revisions by : D.R. Harelson Date: 2/88 Checked by: GG 9/88

ARIZONA DEPARTMENT OF TRANSPORTATION

LOCATION DATA
Highway: Superstition Freeway: Phase III
Location: Power Road to Ellsworth Road
Project No. F-028-1-311

DESIGN DATA:
Frequency 50 years
P6 = 2.70 in. P2A = 3.20 in. P1 = 2.15 in.
Tailow: Mainline = 16.0' Ramps = 8.5'

TABLE 10. PHASE III: INLET SUMMARY SHEET

Inlet No.	Inlet Station	DA No.	Q (cfs)	Grate Type	Qc from Upstream Grate from	Qc from Upstream Grate (cfs)	Qt at Sl. Drain (cfs)	So (%)	Cross-Slope (%) Gutter	Cross-Slope (%) Pavement	Depth at Curb (ft.)	T actual (ft)	Slotted Drain Length actual	Slotted Drain Length req'd	Qred (to grate) (cfs)	Lt (ft.) actual	Lt (ft.) req'd	Qc to area	Qc (cfs)
89	10+05	A-89	2.8	SPECIAL	A-90	0.2	3.0	0.0160	0.0542	0.0460	0.27	5.3	10.00	23.65	1.1	3.40	1.95	A-88E	0.2
90	12+35	A-90	2.4	SPECIAL	A-155	0.1	2.5	0.0236	0.0542	0.0420	0.23	4.7	10.00	24.61	1.0	3.40	2.17	A-89	0.2
91	11+45	A-91	2.8	SPECIAL	A-154	0.1	2.9	0.0178	0.0542	0.0200	0.25	7.9	20.00	24.07	0.1	3.40	1.53	A-85E	0.0
92	947+25 LT	A-92	4.9	SPECIAL	A-94	0.0	4.9	0.0025	0.0542	0.0200	0.40	15.6	20.00	16.65	0.0	3.40	0.00	A-161	0.0
93	947+25 RT	A-93	4.5	SPECIAL	A-95	0.4	4.9	0.0025	0.0542	0.0200	0.40	15.6	10.00	16.65	0.9	3.40	0.91	A-165	0.4
94	953+20 LT	A-94	4.8	SPECIAL	A-96	0.0	4.8	0.0025	0.0542	0.0200	0.40	15.5	20.00	16.51	0.0	3.40	0.00	A-92	0.0
95	953+20 RT	A-95	4.9	SPECIAL	A-97	0.0	4.9	0.0025	0.0542	0.0200	0.40	15.6	10.00	16.65	0.9	3.40	0.91	A-93	0.4
96	957+30 LT	A-96	4.8	SPECIAL	A-98	0.4	5.2	0.0025	0.0542	0.0200	0.41	16.0	20.00	17.07	0.0	3.40	0.00	A-94	0.0
97	957+30 RT	A-97	4.4	SPECIAL	A-99	0.4	4.8	0.0025	0.0542	0.0200	0.40	15.5	20.00	16.51	0.0	3.40	0.00	A-95	0.0
98	961+25 LT	A-98	4.9	SPECIAL	A-100	0.0	4.9	0.0025	0.0542	0.0200	0.40	15.6	10.00	16.65	0.9	3.40	0.91	A-96	0.4
99	961+25 RT	A-99	4.4	SPECIAL	A-101	0.4	4.8	0.0025	0.0542	0.0200	0.40	15.5	10.00	16.51	0.9	3.40	0.91	A-97	0.4
100	965+05 LT	A-100	4.9	SPECIAL	A-102	0.0	4.9	0.0025	0.0542	0.0200	0.40	15.6	20.00	16.65	0.0	3.40	0.00	A-98	0.0
101	965+05 RT	A-101	4.5	SPECIAL	A-103	0.3	4.8	0.0025	0.0542	0.0200	0.40	15.5	10.00	16.51	0.9	3.40	0.91	A-99	0.4
102	968+70 LT	A-102	4.8	SPECIAL	A-104	0.4	5.2	0.0025	0.0542	0.0200	0.41	16.0	20.00	17.07	0.0	3.40	0.00	A-100	0.0
103	968+70 RT	A-103	4.2	SPECIAL	A-105	0.3	4.5	0.0025	0.0542	0.0200	0.39	15.1	10.00	16.07	0.8	3.40	0.83	A-101	0.3
104	972+15 LT	A-104	4.9	SPECIAL	A-106	0.0	4.9	0.0025	0.0542	0.0200	0.40	15.6	10.00	16.65	0.9	3.40	0.91	A-102	0.4
105	972+15 RT	A-105	4.2	SPECIAL	A-107	0.3	4.5	0.0025	0.0542	0.0200	0.39	15.1	10.00	16.07	0.8	3.40	0.83	A-103	0.3
106	975+55 LT	A-106	5.0	SPECIAL	A-108	0.0	5.0	0.0025	0.0542	0.0200	0.41	15.8	20.00	16.79	0.0	3.40	0.00	A-104	0.0
107	975+55 RT	A-107	4.1	SPECIAL	A-109	0.4	4.5	0.0025	0.0542	0.0200	0.39	15.1	10.00	16.07	0.8	3.40	0.83	A-105	0.3
108	978+90 LT	A-108	4.7	SPECIAL	A-110	0.1	4.8	0.0025	0.0542	0.0200	0.40	15.5	20.00	16.51	0.0	3.40	0.00	A-106	0.0
109	978+90 RT	A-109	3.7	SPECIAL	A-111	1.3	5.0	0.0025	0.0542	0.0200	0.41	15.8	10.00	16.79	1.0	3.40	0.94	A-107	0.4
110	981+95 LT	A-110	5.7	SPECIAL	A-112	1.9	7.6	0.0056	0.0542	0.0200	0.41	15.8	20.00	25.50	0.5	3.40	1.05	A-108	0.1
111	981+95 RT	A-111	4.6	SPECIAL	A-113	1.8	6.4	0.0056	0.0542	0.0200	0.39	14.8	10.00	23.73	2.4	3.40	1.55	A-109	1.3

Computed by: S.L. Forvilly Date: 9/87 Checked by: _____ Revisions by : D.B. Harelson Date: 2/88 Checked by: GCS 9/88

ARIZONA DEPARTMENT OF TRANSPORTATION

LOCATION DATA
Highway: Superstition Freeway: Phase III
Location: Power Road to Ellsworth Road
Project No. F-028-1-311

DESIGN DATA:
Frequency 50 years
P6 = 2.70 in. P24 = 3.20 in. P1 = 2.15 in.
Tailow: Mainline = 16.0' Ramps = 8.5'

TABLE 10. PHASE III: INLET SUMMARY SHEET

Inlet No.	Inlet Station	DA No.	Q (cfs)	Grate Type	Qc from Upstream Grate from	Qc from Upstream Grate (cfs)	Qt at Sl. Drain (cfs)	So (%)	Cross-Slope (%) Gutter	Cross-Slope (%) Pavement	Depth at Curb (ft.)	T actual (ft)	Slotted Drain Length actual	Slotted Drain Length req'd	Qred (to grate) (cfs)	Lt (ft.) actual	Lt (ft.) req'd	Qc to area	Qc (cfs)
112	985+70 LT	A-112	5.0	SPECIAL	A-114	2.4	7.4	0.0085	0.0542	0.0200	0.38	14.4	10.00	28.58	3.4	3.40	1.97	A-110	1.9
113	985+70 RT	A-113	4.0	SPECIAL	A-115	3.3	7.3	0.0085	0.0542	0.0200	0.38	14.3	10.00	28.42	3.3	3.40	1.97	A-111	1.8
114	989+00 LT	A-114	6.4	SPECIAL	A-116	2.0	8.4	0.0097	0.0542	0.0200	0.39	14.8	10.00	31.36	4.2	3.40	2.19	A-112	2.4
115	989+00 RT	A-115	10.1	SPECIAL	A-117	0.0	10.1	0.0094	0.0542	0.0200	0.41	16.0	10.00	33.57	5.3	3.40	2.34	A-113	3.3
116	993+30 LT	A-116	8.0	SPECIAL	A-118	0.0	8.0	0.0065	0.0542	0.0200	0.40	15.7	10.00	27.25	3.5	3.40	1.82	A-114	2.0
117	997+45 RT	A-117	6.5	SPECIAL	A-126	0.0	6.5	0.0044	0.0542	0.0200	0.40	15.7	20.00	22.22	0.1	3.40	0.89	A-115	0.0
118	998+75 LT	A-118	1.5	SPECIAL	A-119	0.0	1.5	0.0044	0.0542	0.0200	0.25	8.2	10.00	12.00	0.1	3.40	0.58	A-116	0.0
119	999+80 LT	A-119	1.5	SPECIAL	A-120	0.0	1.5	0.0039	0.0542	0.0200	0.26	8.5	10.00	11.57	0.0	3.40	0.00	A-118	0.0
120	1000+80 LT	A-120	1.4	SPECIAL	A-121	0.0	1.4	0.0036	0.0542	0.0200	0.26	8.3	10.00	10.98	0.0	3.40	0.00	A-119	0.0
121	1001+75 LT	A-121	1.4	SPECIAL	A-122	0.0	1.4	0.0036	0.0542	0.0200	0.26	8.3	10.00	10.98	0.0	3.40	0.00	A-120	0.0
122	1002+70 LT	A-122	1.4	SPECIAL	A-123	0.0	1.4	0.0036	0.0542	0.0200	0.26	8.3	10.00	10.98	0.0	3.40	0.00	A-121	0.0
123	1003+60 LT	A-123	1.4	SPECIAL	A-124	0.0	1.4	0.0036	0.0542	0.0200	0.26	8.3	10.00	10.98	0.0	3.40	0.00	A-122	0.0
124	1004+50 LT	A-124	1.4	SPECIAL	A-125	0.0	1.4	0.0036	0.0542	0.0200	0.26	8.3	10.00	10.98	0.0	3.40	0.00	A-123	0.0
125	1005+40 LT	A-125	1.4	SPECIAL	A-127	0.0	1.4	0.0036	0.0542	0.0200	0.26	8.3	10.00	10.98	0.0	3.40	0.00	A-124	0.0
126	1002+85 RT	A-126	6.2	SPECIAL	A-130	0.0	6.2	0.0040	0.0542	0.0200	0.40	15.7	20.00	21.16	0.0	3.40	0.00	A-117	0.0
127	1006+30 LT	A-127	1.4	SPECIAL	A-128	0.0	1.4	0.0036	0.0542	0.0200	0.26	8.3	10.00	10.98	0.0	3.40	0.00	A-125	0.0
128	1007+15 LT	A-128	1.4	SPECIAL	A-129	0.0	1.4	0.0036	0.0542	0.0200	0.26	8.3	10.00	10.98	0.0	3.40	0.00	A-127	0.0
129	1008+00 RT	A-129	1.4	SPECIAL	A-138	0.0	1.4	0.0036	0.0542	0.0200	0.26	8.3	10.00	10.98	0.0	3.40	0.00	A-128	0.0
130	1008+00 RT	A-130	1.2	SPECIAL	A-131	0.0	1.2	0.0026	0.0542	0.0200	0.26	8.3	10.00	9.33	0.0	3.40	0.00	A-126	0.0
131	1008+95 RT	A-131	1.1	SPECIAL	A-132	0.0	1.1	0.0026	0.0542	0.0200	0.25	8.0	10.00	9.00	0.0	3.40	0.00	A-130	0.0
132	1009+84 RT	A-132	1.2	SPECIAL	A-133	0.0	1.2	0.0026	0.0542	0.0200	0.26	8.3	10.00	9.33	0.0	3.40	0.00	A-131	0.0
133	1010+74 RT	A-133	1.2	SPECIAL	A-134	0.0	1.2	0.0026	0.0542	0.0200	0.26	8.3	10.00	9.33	0.0	3.40	0.00	A-132	0.0
134	1011+59 RT	A-134	1.1	SPECIAL	A-135	0.0	1.1	0.0026	0.0542	0.0200	0.25	8.0	10.00	9.00	0.0	3.40	0.00	A-133	0.0

Computed by: S.L. Forvilly Date: 9/87 Checked by: _____ Revisions by : D.R. Harelson Date: 2/88 Checked by: CEJ 9/88

ARIZONA DEPARTMENT OF TRANSPORTATION

LOCATION DATA
Highway: Superstition Freeway: Phase III
Location: Power Road to Ellsworth Road
Project No. F-026-1-311

DESIGN DATA:
Frequency 50 years
P6 = 2.70 in. P2A = 3.20 in. P1 = 2.15 in.
Tailow: Mainline = 16.0' Ramps = 8.5'

TABLE 10. PHASE III: INLET SUMMARY SHEET

Inlet No.	Inlet Station	DA No.	Q (cfs)	Grate Type	Qc from Upstream Grate: from	Qc from Upstream Grate: (cfs)	Qt at Sl. Drain (cfs)	So (%)	Cross-Slope (%): Gutter	Cross-Slope (%): Pavement	Depth at Curb (ft.)	T actual (ft)	Slotted Drain Length: actual	Slotted Drain Length: req'd	Qred (to grate) (cfs)	Lt (ft.): actual	Lt (ft.): req'd	Qc to area	Qc (cfs)
135	14+85	A-135	1.6	SPECIAL	A-136	0.0	1.6	0.0067	0.0542	0.0200	0.25	8.0	10.00	14.70	0.2	3.40	0.83	A-134	0.0
136	16+00	A-136	2.9	SPECIAL	A-137&148	0.2	3.1	0.0209	0.0542	0.0200	0.25	8.0	20.00	25.48	0.2	3.40	1.16	A-135	0.0
137	1013+45 RT	A-137	2.7	SPECIAL	A-147	0.6	3.3	0.0040	0.0542	0.0200	0.33	12.0	10.00	16.24	0.6	3.40	0.57	A-136	0.2
138	1006+85 LT	A-138	1.5	SPECIAL	A-139	0.0	1.5	0.0036	0.0542	0.0200	0.26	8.5	10.00	11.30	0.0	3.40	0.00	A-129	0.0
139	1009+70 LT	A-139	1.4	SPECIAL	A-140	0.0	1.4	0.0036	0.0542	0.0200	0.26	8.3	10.00	10.98	0.0	3.40	0.00	A-138	0.0
140	1010+50 LT	A-140	1.5	SPECIAL	A-141	0.0	1.5	0.0036	0.0542	0.0200	0.26	8.5	10.00	11.30	0.0	3.40	0.00	A-139	0.0
141	14+55	A-141	1.5	SPECIAL	A-142	0.0	1.5	0.0036	0.0542	0.0240	0.27	7.8	10.00	11.30	0.0	3.40	0.00	A-140	0.0
142	15+35	A-142	1.2	SPECIAL	A-143	0.2	1.4	0.0036	0.0542	0.0460	0.27	5.3	10.00	10.98	0.0	3.40	0.00	A-141	0.0
143	16+00	A-143	2.3	SPECIAL	A-144&145	1.2	3.5	0.0049	0.0542	0.0460	0.36	7.2	10.00	17.69	0.8	3.40	1.18	A-142	0.2
144	1013+15 LT	A-144	4.1	15.30	A-146	0.6	4.7	0.0040	0.0542	0.0200	0.37	14.0	10.00	18.84	1.2	3.25	1.13	A-143	0.8
145	17+75	A-145	2.6	SPECIAL	A-149	1.0	3.6	0.0200	0.0542	0.0460	0.28	5.5	10.00	27.30	1.6	3.40	2.44	A-143	0.4
146	1016+75 LT	A-146	3.1	SPECIAL	A-150	1.8	4.9	0.0042	0.0542	0.0200	0.37	14.0	10.00	19.46	1.3	3.40	1.15	A-144	0.6
147	1016+75 RT	A-147	3.0	SPECIAL	A-151	1.8	4.8	0.0042	0.0542	0.0200	0.37	13.9	10.00	19.29	1.3	3.40	1.15	A-137	0.6
148	19+50	A-148	4.0	SPECIAL	N/A	0.0	4.0	0.0335	0.0542	0.0200	0.25	8.0	10.00	33.31	2.1	3.40	2.89	A-136	0.7
149	20+25	A-149	4.8	SPECIAL	N/A	0.0	4.8	0.0391	0.0542	0.0200	0.26	8.5	10.00	37.67	2.8	3.40	3.33	A-145	1.0
150	1019+30 LT	A-150	4.6	SPECIAL	A-152	2.6	7.2	0.0067	0.0542	0.0200	0.37	14.2	10.00	25.45	3.3	3.40	1.97	A-146	1.8
151	1019+30 RT	A-151	4.3	SPECIAL	A-153	2.7	7.0	0.0067	0.0542	0.0200	0.37	14.0	10.00	28.12	3.2	3.40	1.94	A-147	1.8
152	1022+30 LT	A-152	8.2	SPECIAL	N/A	0.0	8.2	0.0161	0.0542	0.0200	0.35	12.8	10.00	37.44	4.7	3.40	2.85	A-150	2.6
153	1022+30 RT	A-153	8.3	SPECIAL	N/A	0.0	8.3	0.0151	0.0542	0.0200	0.35	12.9	10.00	37.63	4.8	3.40	2.84	A-151	2.7
154	1931+77 LT	A-154	2.3	SPECIAL	A-156	0.0	2.3	0.0120	0.0542	0.0200	0.25	7.8	10.00	19.40	0.6	3.40	1.64	A-91	0.1
155	1932+32 RT	A-155	2.2	SPECIAL	A-157	0.0	2.2	0.0112	0.0542	0.0200	0.25	7.8	10.00	18.65	0.6	3.40	1.43	A-90	0.1
156	1934+55 LT	A-156	4.1	SPECIAL	A-161	0.4	4.5	0.0078	0.0542	0.0200	0.33	11.9	20.00	22.60	0.1	3.40	1.53	A-154	0.0
157	1934+85 RT	A-157	1.6	SPECIAL	A-158	0.0	1.6	0.0078	0.0542	0.0200	0.23	7.2	10.00	14.64	0.2	3.40	0.97	A-155	0.0

Computed by: S.L. Forvill Date: 5/87 Checked by: _____ Revisions by: D.P. Marelech Date: 1/88 Checked by: GLS 9/88

ARIZONA DEPARTMENT OF TRANSPORTATION

LOCATION DATA
Highway: Superstition Freeway: Phase III
Location: Power Road to Ellsworth Road
Project No. F-025-1-311

DESIGN DATA:
Frequency 50 years
P6 = 2.70 in. P24 = 3.20 in. P1 = 2.15 in.
Allow: Mainline = 16.0' Ramps = 8.5'

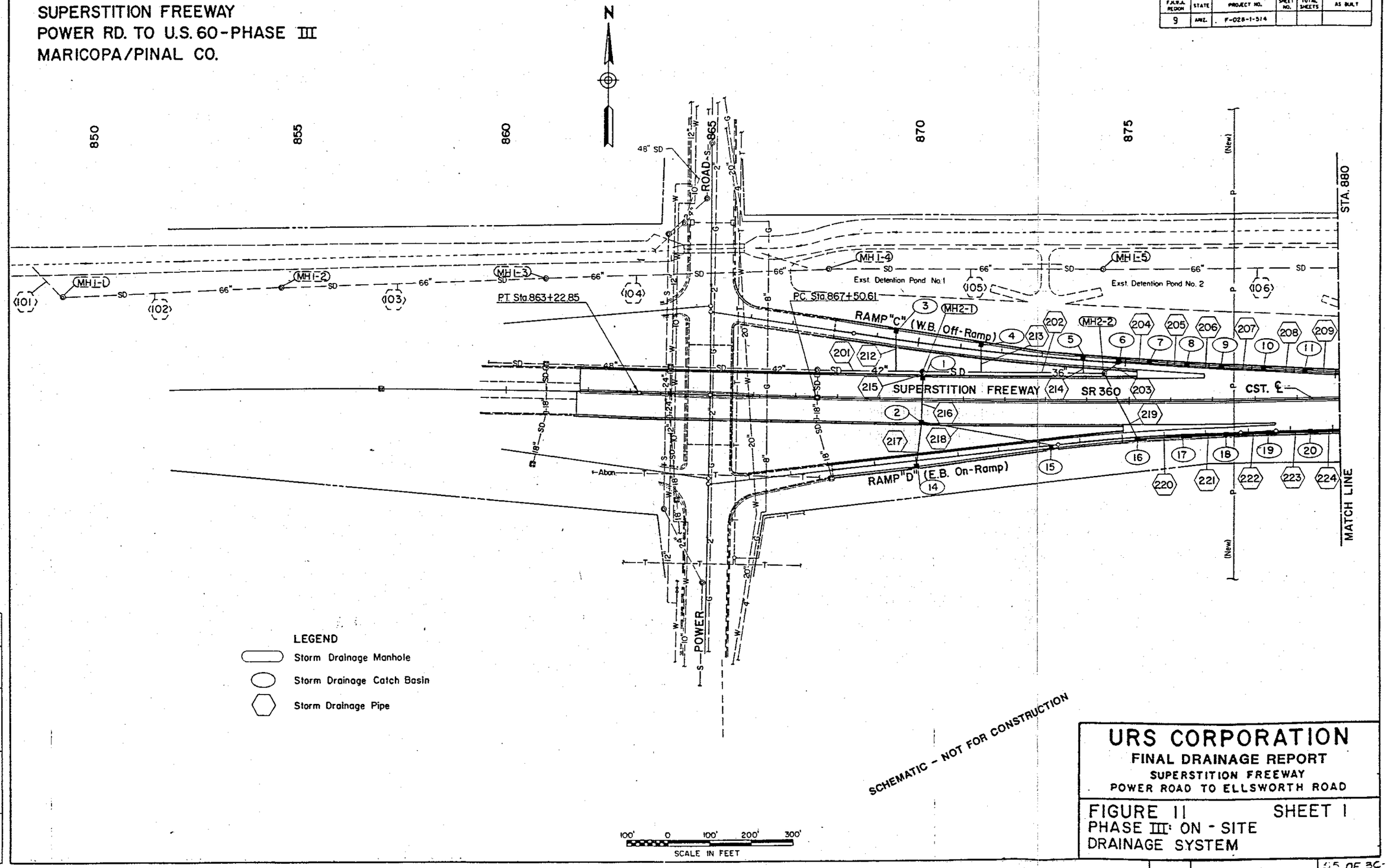
TABLE 10. PHASE III: INLET SUMMARY SHEET

Inlet No.	Inlet Station	DA No.	Q (cfs)	Grate Type	Qc from Upstream Grate from	Qc from Upstream Grate (cfs)	Qt at Sl. Drain (cfs)	So (%)	Cross-Slope (%) Gutter	Cross-Slope (%) Pavement	Depth at Curb (ft.)	T actual (ft)	Slotted Drain Length actual	Slotted Drain Length req'd	Qred (to grate) (cfs)	Lt (ft.) actual	Lt (ft.) req'd	Qc to area	Qc (cfs)
158	936+26 RT	A-158	1.5	SPECIAL	A-159	0.0	1.5	0.0052	0.0542	0.0200	0.25	7.8	10.00	12.62	0.1	3.40	0.89	A-157	0.0
159	937+91 RT	A-159	1.2	SPECIAL	A-160	0.0	1.2	0.0028	0.0542	0.0200	0.26	8.3	10.00	9.54	0.0	3.40	0.00	A-158	0.0
160	939+31 RT	A-160	1.2	SPECIAL	A-162	0.0	1.2	0.0025	0.0542	0.0200	0.26	8.3	10.00	9.22	0.0	3.40	0.00	A-159	0.0
161	940+30 LT	A-161	5.0	SPECIAL	A-52	0.0	5.0	0.0025	0.0542	0.0200	0.41	15.8	10.00	16.77	1.0	3.40	0.94	A-156	0.4
162	940+76 RT	A-162	1.2	SPECIAL	A-163	0.0	1.2	0.0025	0.0542	0.0200	0.26	8.3	10.00	9.22	0.0	3.40	0.00	A-160	0.0
163	942+31 RT	A-163	1.1	SPECIAL	A-164	0.0	1.1	0.0025	0.0542	0.0200	0.25	7.9	10.00	8.89	0.0	3.40	0.00	A-162	0.0
164	943+78 RT	A-164	1.1	SPECIAL	A-165	0.0	1.1	0.0025	0.0542	0.0200	0.25	7.9	10.00	8.89	0.0	3.40	0.00	A-163	0.0
165	945+25 RT	A-165	1.4	SPECIAL	A-93	0.4	1.8	0.0025	0.0542	0.0200	0.29	10.0	10.00	10.93	0.0	3.40	0.00	A-164	0.0

Checked By - CEJ 9/88

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	ARIZ.	F-028-1-314			

SUPERSTITION FREEWAY
POWER RD. TO U.S. 60-PHASE III
MARICOPA/PINAL CO.

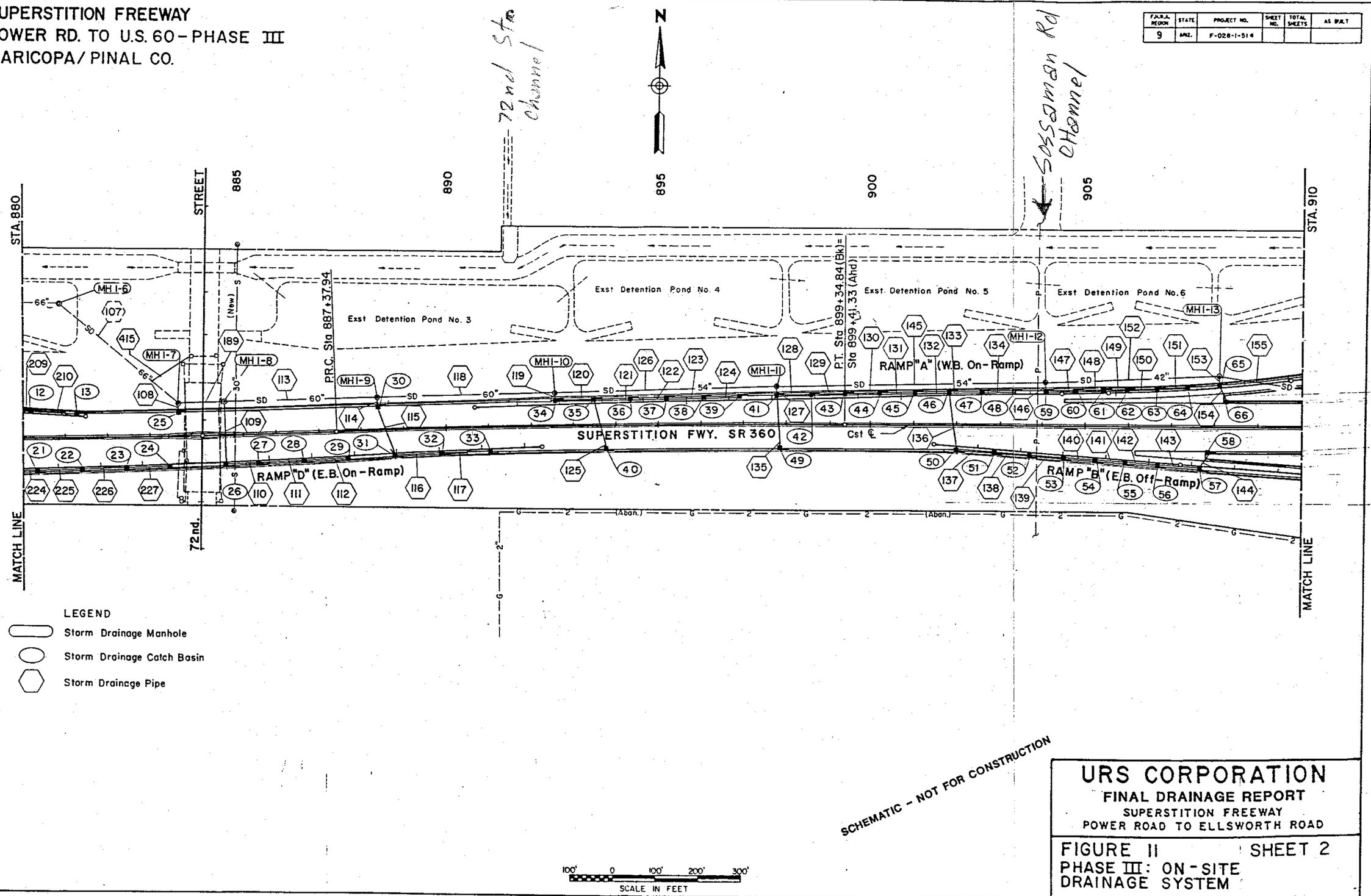


URS CORPORATION
FINAL DRAINAGE REPORT
SUPERSTITION FREEWAY
POWER ROAD TO ELLSWORTH ROAD

FIGURE 11 SHEET 1
PHASE III: ON - SITE
DRAINAGE SYSTEM

SUPERSTITION FREEWAY
POWER RD. TO U.S. 60 - PHASE III
MARICOPA/ PINAL CO.

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	ARIZ.	F-028-1-514			



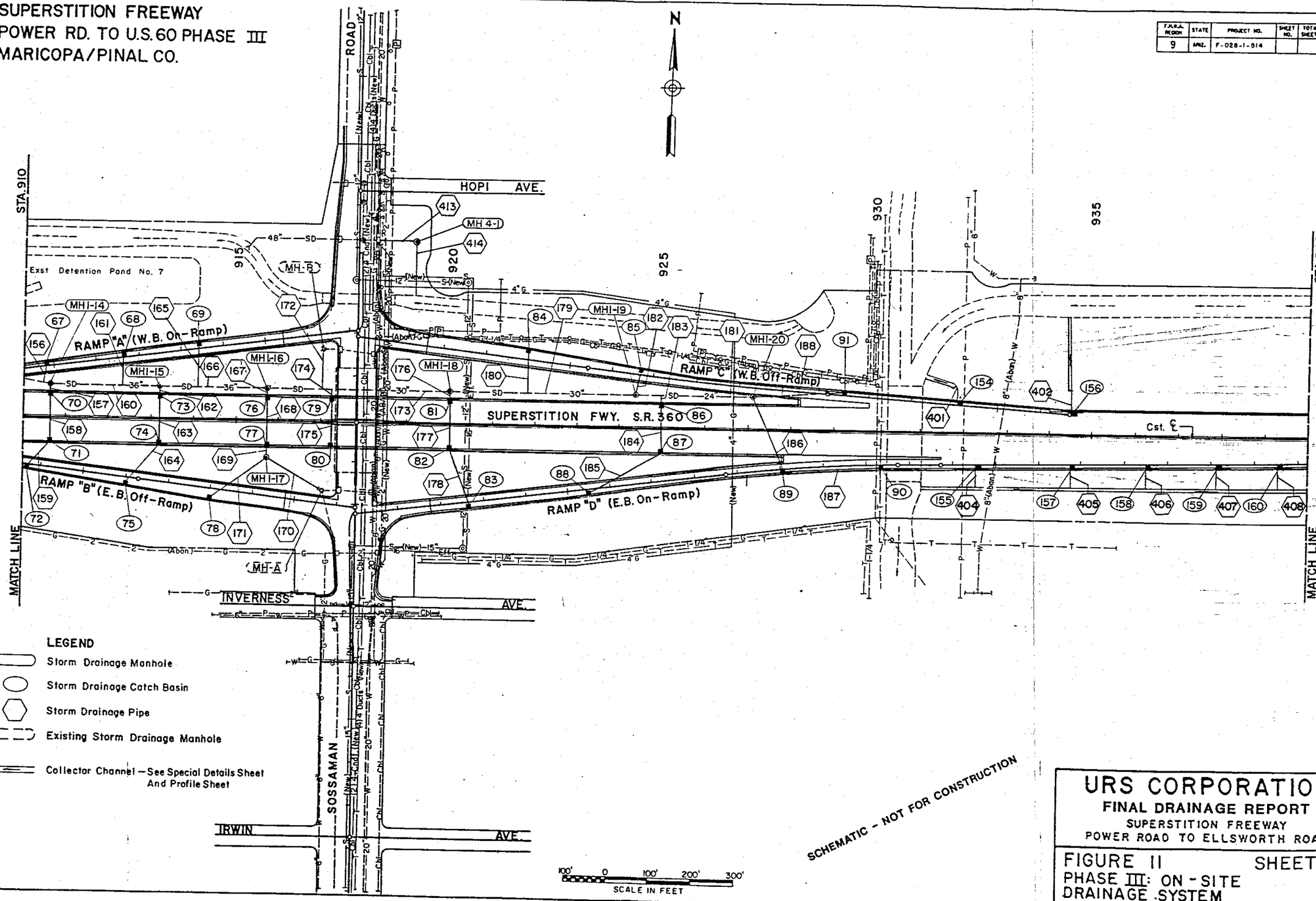
URS CORPORATION
FINAL DRAINAGE REPORT
SUPERSTITION FREEWAY
POWER ROAD TO ELLSWORTH ROAD

FIGURE 11 SHEET 2
PHASE III: ON-SITE DRAINAGE SYSTEM

SURVEY NO.	FINISHED PLANS	REVISIONS	LOCATION	DATE

SUPERSTITION FREEWAY
POWER RD. TO U.S. 60 PHASE III
MARICOPA/PINAL CO.

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	ARIZ.	F-028-1-514			



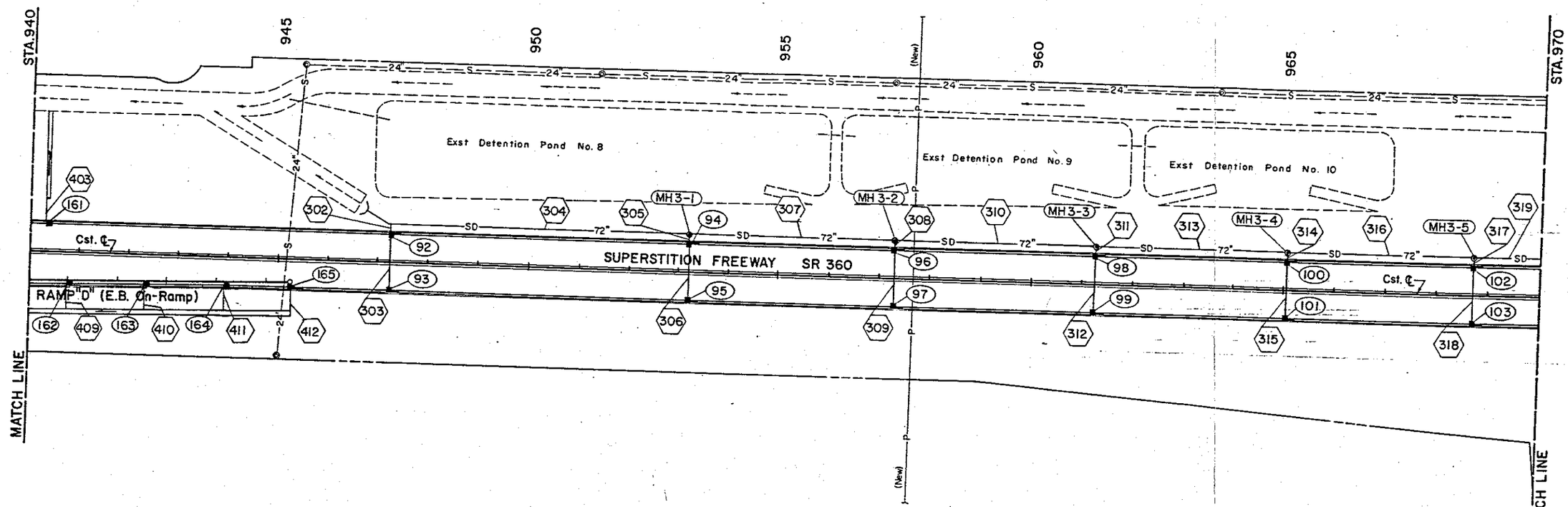
URS CORPORATION
FINAL DRAINAGE REPORT
SUPERSTITION FREEWAY
POWER ROAD TO ELLSWORTH ROAD

FIGURE 11 SHEET 3
PHASE III: ON-SITE DRAINAGE SYSTEM

57 OF 3C-35

SUPERSTITION FREEWAY
POWER RD. TO U.S. 60-PHASE III
MARICOPA/PINAL CO.

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	ARIZ.	F-028-1-914			



LEGEND

Storm Drainage Manhole

Storm Drainage Catch Basin

Storm Drainage Pipe

Collector Channel – See Special Details Sheet And Profile Sheet

SCHEMATIC - NOT FOR CONSTRUCTION

100' 0 100' 200' 300'
SCALE IN FEET

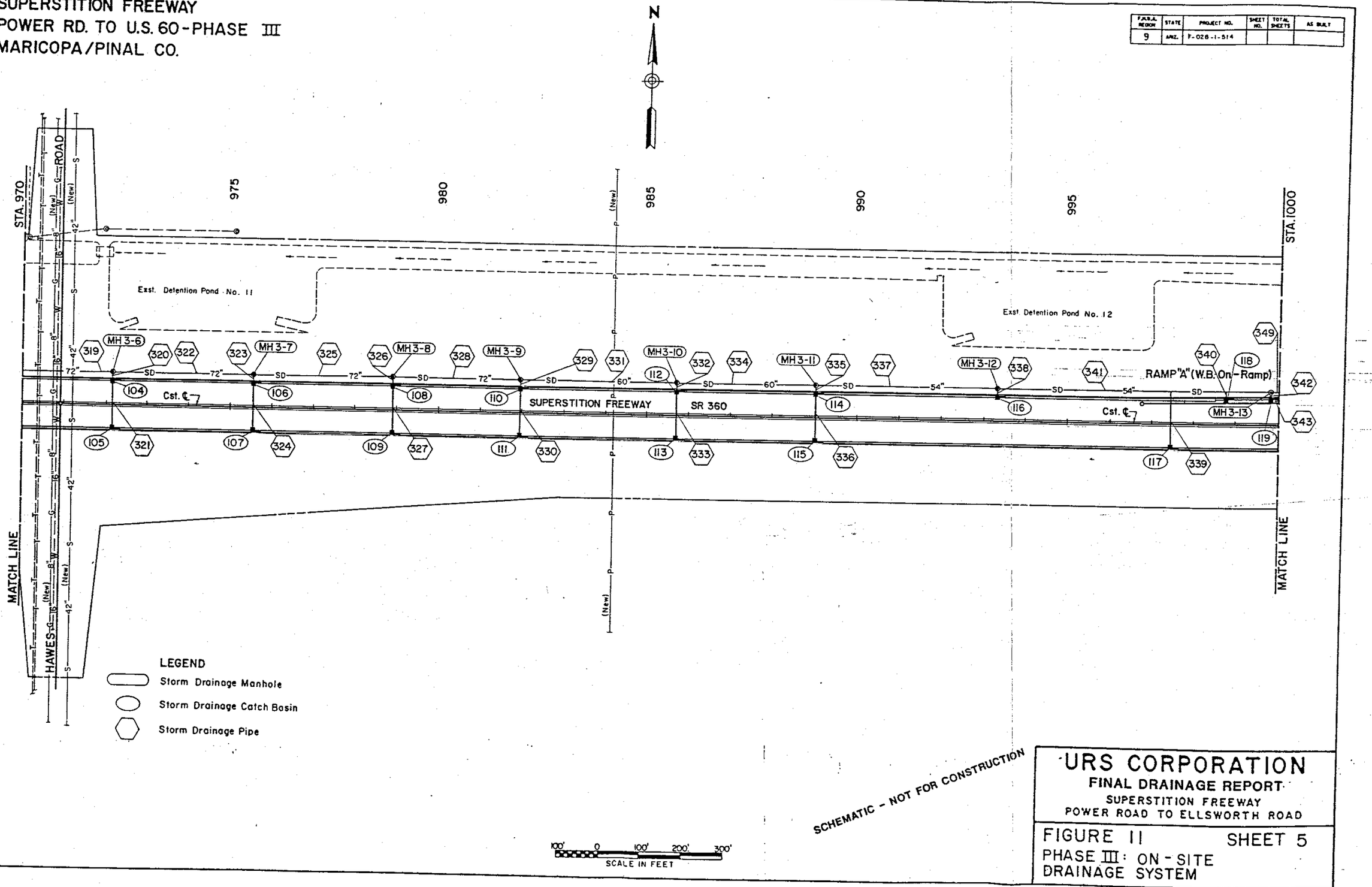
URS CORPORATION
FINAL DRAINAGE REPORT
SUPERSTITION FREEWAY
POWER ROAD TO ELLSWORTH ROAD

FIGURE 11 SHEET 4
PHASE III: ON - SITE DRAINAGE SYSTEM

53 OF 36-36

SUPERSTITION FREEWAY
POWER RD. TO U.S. 60-PHASE III
MARICOPA/PINAL CO.

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	ARIZ.	F-028-1-514			



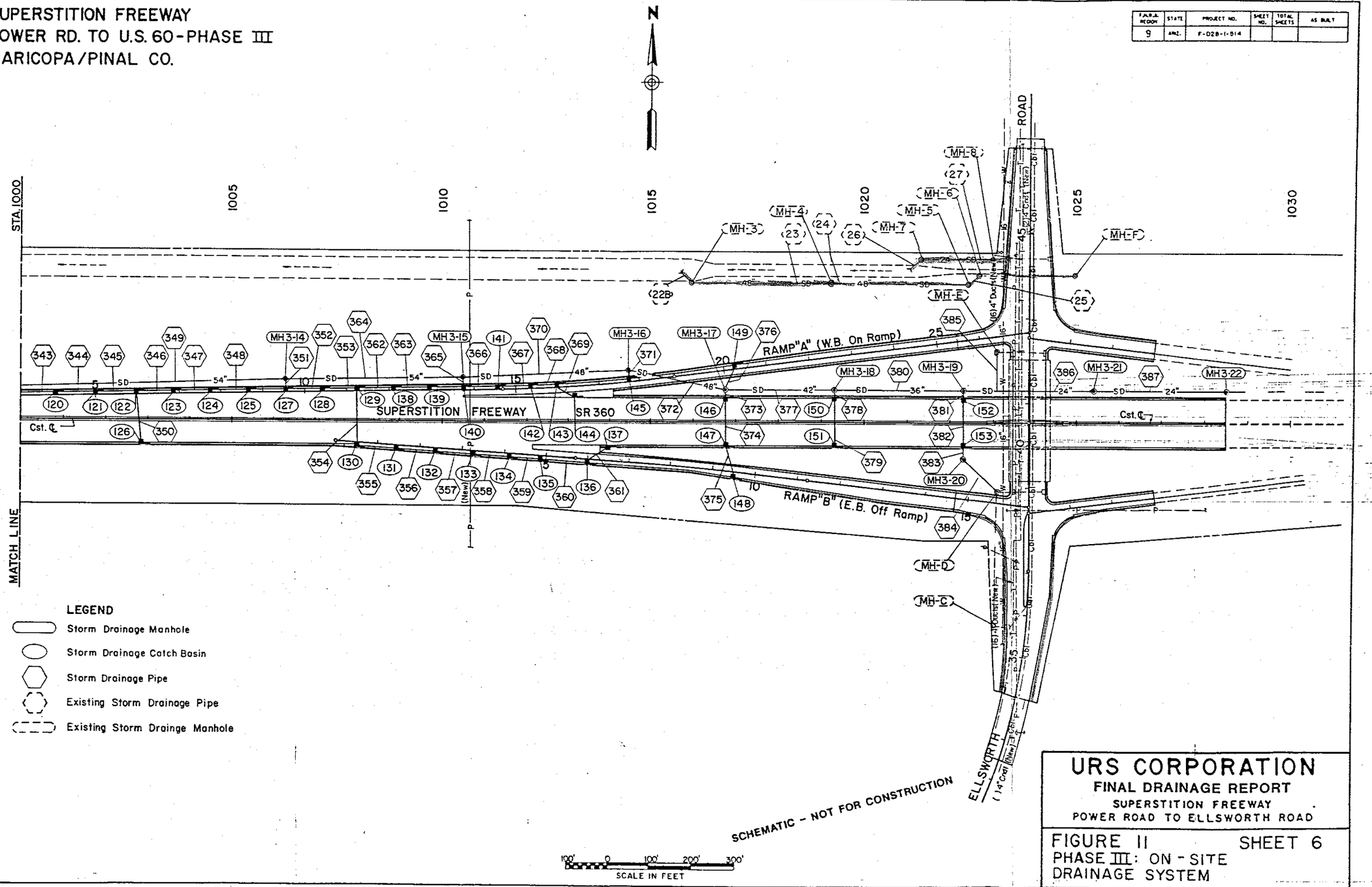
SCHEMATIC - NOT FOR CONSTRUCTION

URS CORPORATION
FINAL DRAINAGE REPORT
SUPERSTITION FREEWAY
POWER ROAD TO ELLSWORTH ROAD

FIGURE 11 SHEET 5
PHASE III: ON-SITE DRAINAGE SYSTEM

SUPERSTITION FREEWAY
POWER RD. TO U.S. 60-PHASE III
MARICOPA/PINAL CO.

F.A.P.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	ARIZ.	F-028-1-814			



LEGEND

- Storm Drainage Manhole
- Storm Drainage Catch Basin
- Storm Drainage Pipe
- Existing Storm Drainage Pipe
- Existing Storm Drainge Manhole

URS CORPORATION
FINAL DRAINAGE REPORT
SUPERSTITION FREEWAY
POWER ROAD TO ELLSWORTH ROAD

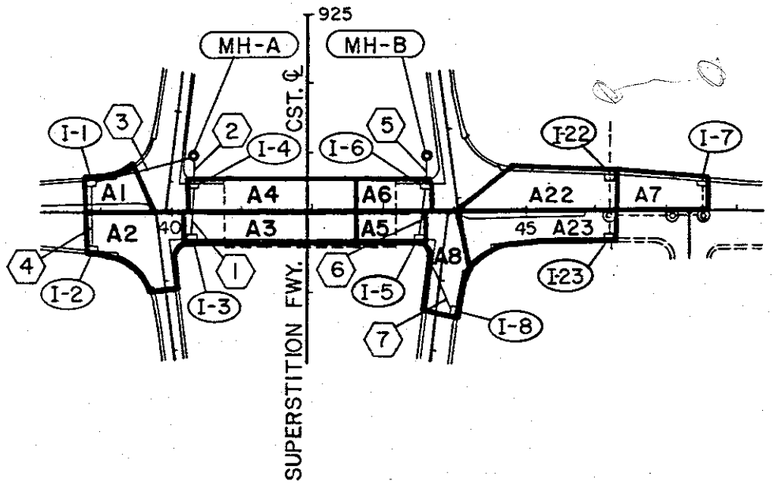
FIGURE II SHEET 6
PHASE III: ON-SITE
DRAINAGE SYSTEM

LEGEND

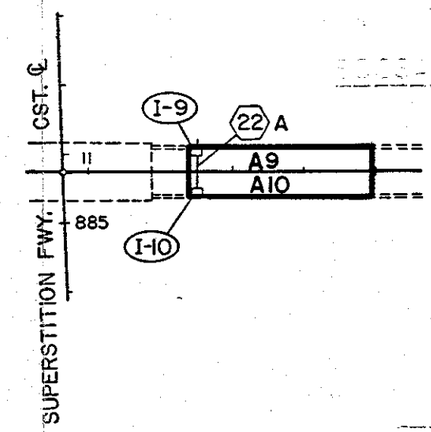
Storm Drainage Manhole

Storm Drainage Catch Basin

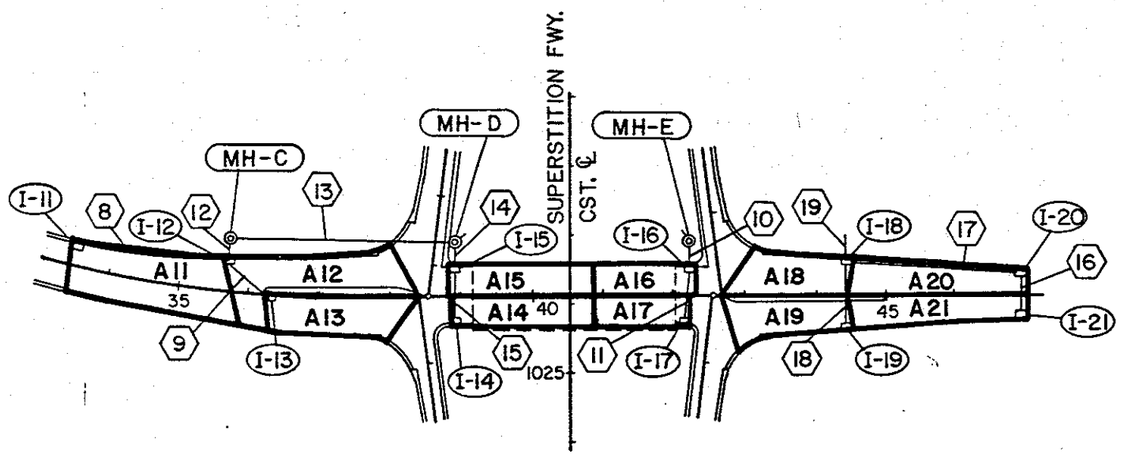
Storm Drainage Pipe



SOSSAMAN RD.



72nd ST.



ELLSWORTH RD.

N

100 0 100 200 300

SCALE IN FEET

URS CORPORATION

FINAL DRAINAGE REPORT

SUPERSTITION FREEWAY

POWER ROAD TO ELLSWORTH ROAD

FIGURE 12

PHASE I ON-SITE DRAINAGE SYSTEM

V. HYDRAULICS

A. On-Site

The hydraulic design for the on-site drainage system consists of the storm sewer design and calculation of the hydraulic gradeline for the storm sewer system under peak flow conditions. The procedure employed for storm sewer design is given below. This procedure was used for the entire storm sewer system, regardless of phasing. Inlets were designed for the current freeway cross-section. The trunklines were sized to accommodate flows from the proposed future expansion of the Superstition Freeway. Design flows (Q) are derived from the inlet design tables and multiplied by the factor 1.03 (Appendix B).

Storm sewers were initially sized to flow full (or almost full). After the system was laid out with initial pipe sizes and slopes, the hydraulic gradeline was checked by starting with the tailwater elevation at the storm sewer outfall and calculating the head losses up throughout the storm sewer system. The hydraulic gradelines were checked against the maximum permissible water surface elevations (6-in. below the inlet grate elevation or manhole rim elevation) and adjustments were made to pipe sizes or slopes as required. Surcharging is permissible as long as the hydraulic gradelines remain below the maximum permissible elevations.

1. Storm Sewer Design

Step 1:
Size the pipe coming out of the uppermost inlet for any given storm sewer run.

a. Values for CA, T_c, and Q are those calculated for the first inlet

b. Assume that the inlet intercepts 100 percent of the flow (conservative assumption)

c. Size the outlet pipe so that at the desired slope the calculated full pipe flow (Q_{full}) is greater than or equal to Q:

$$D = \left(\frac{n\,Q}{0.463\,S^{1/2}}\right)^{3/8}$$

(Manning's Equation, Design of Small Dams, Table B-3) (Ref. 12)

Where:	Q	=	Q design (cfs)
	D	=	Pipe diameter (ft)
	n	=	Manning's coefficient (.013)
	S	=	Pipe slope (ft/ft)

Step 2:
Size all subsequent pipes in the storm sewer run.

a. CA at the next inlet is equal to the sum of all contributing upstream CA values.

b. T_c is equal to the initial t_c plus travel time (t_t) in the upstream storm sewer:

$V = Q/A$ where,	V	=	Velocity (fps)
	Q	=	Q design (cfs)
	A	=	Cross-sectional area of Q (sf)
$t_t = L/(60V)$ where,	t_t	=	Travel time in pipe (min)
	V	=	Velocity (fps)

c. Compute T_c for downstream inlets: If t_c + the sum of t_t in the upstream pipes is less than 10 minutes (minimum T_c), use a T_c total of 10 minutes. This is a more conservative approach than using an initial T_c of 10 minutes and adding subsequent t_t values to it. Therefore, the value of T_c is equal to 10 minutes until t_c + sum t_t's reaches a value greater than 10 minutes.

d. Find a new Q for the pipe run:

$$Q = CiA$$

i = Rainfall intensity (in./hr.) at time = T_c

e. At locations of pipe size changes, maintain common crown elevations and lower the invert of the larger diameter pipe.

There are three trunklines providing conveyance for the on-site flows from the Superstition Freeway between Power Road and Ellsworth Road. The first two, Trunklines No. 1 and 2, discharge into the existing lined channel west of Power Road. Trunkline No. 3 discharges into the Sossaman Channel.

The sizing and locating of Trunkline No. 1 was largely dependent upon the capacity of Trunkline No. 2. Trunkline No. 2 is the extension of an existing 42 inch storm sewer at Power Road which has an outfall into the existing lined channel at Station 840+77.4. When the roadway segment for the Val Vista to Power Road Section was constructed the design concept plan for the Freeway extension east of Power Road included a crest vertical curve in the roadway profile approximately 2540 feet east of Power Road. The trunkline was sized using the contributing drainage area between the crest of the curve and Power Road. During final roadway design the crest vertical curve was eliminated from the roadway profile. One consequence of this was the increase in drainage area contributing runoff to the existing trunkline. The capacity of the existing trunkline was determined. The upper limits of the roadway area generating that quantity of runoff then defined the maximum extension (Trunkline No. 2) of the existing trunkline. The existing trunkline is extended, as Trunkline No. 2, to Sta. 881+27. The upstream end of Trunkline No. 1 lies just west of the Sossaman Channel at Sta. 927+10. Trunkline No. 1 discharges into the existing concrete lined channel, east of Power Road, at Sta. 849+30.

Trunkline No. 1 was sized in the usual manner, starting at the upstream end and proceeding downstream. Since the roadway is in cut, the profile of the storm sewer follows that of the roadway. Between Sta. 849+30 and 883+70, Trunkline No. 1 receives no additional on-site flows. At Sta. 883+70 the roadway is in approximately 22 feet of

cut. The invert of the storm sewer is approximately 12 feet below the roadway profile grade (at the center line). The invert of the north right-of-way channel in that area (Channel No. 1) is approximately 22 feet higher than that of the storm sewer. In order to match inverts in the shortest distance possible between the channel and the storm sewer, Trunkline No. 1 was turned to the north and then to the west at a flatter grade than that of the roadway profile. The flattest grade permissible, without violation of the design criteria, was used in order to daylight the trunkline as far east as possible. Using this alignment, Trunkline No. 1 daylights into the existing lined channel at Station 849+30, approximately 850 feet farther east than the daylight point would be if the vertical and horizontal alignments of the storm sewer were to follow those of the roadway.

Trunkline No. 3 is sized to convey all on-site flows from Station 1028+50 to Station 953+20, plus additional on-site flows from the next section of roadway east of Ellsworth Road, to an outfall into Channel No. 2. Peak flows in Trunkline No. 3 at the upstream end were determined by Coe and Van Loo as a part of their design for the segment of the Superstition Freeway east of Ellsworth Road. The roadway slopes down to the west between Stations 1028+50 and 865+00 and is above grade between Stations 953+50 and 926+20. At all other points, between Power Road and Ellsworth Road, the freeway is in cut. On the east side of the Sossaman Channel, the profile of the roadway grade is flatter than the slope of the existing ground, with the result that the roadway, while maintaining a downward slope to the west, is in cut from Ellsworth Road to approximate Station 954+00 and is at or above grade in the vicinity of the Sossaman Channel. The invert of Trunkline No. 3, while maintaining a downward slope to the west, is likewise rising relative to the existing ground. The pipe ends and opens into a channel at the point at which it is no longer feasible to maintain minimum cover over the top of the pipe. This "subsidiary channel" has an outfall into Channel No. 2 at Sta. 943+36.

2. Hydraulic Grade Line Determination

The hydraulic grade line in each storm sewer was checked to ascertain that the water surface elevations remain 0.5 foot below the inlet grate elevations and the manhole rim elevations under peak flow conditions. The starting water surface elevations at the outfalls of Trunkline No. 1 and No. 3 were obtained from water surface profiles in the respective channels previously computed using the HEC-2, Water Surface Profiles Computer program. The hydraulic grade line at any inlet or manhole was determined by two methods; (1) surcharged pipe conditions and (2) non-surcharged pipe conditions. The resulting water surface elevations were compared and the higher elevation was taken to be the hydraulic gradeline elevation. The specific procedures are designed below:

<u>Step 1:</u>
Obtain the downstream water surface elevation (WSEL) for initial conditions (HEC-2 output) or obtain the energy gradeline (EGL) from calculations for the downstream line.

<u>Step 2:</u>
Assuming full pipe flow, calculate the pipe velocity and velocity head ($V^2/2g$) based on the design flow (design Q) and the current pipe diameter.

Step 3:
The "friction slope" (S_f) is calculated according to the following formula:

$$S_f = \frac{(nV)^2}{(2.21)(R^{4/3})}$$

where n = .013

V = Velocity (full flow)(fps)

R = Hydraulic radius

$= \frac{D}{4}$

Step 4:
Calculate the friction loss (h_L) in the pipe:

$$h_L = S_f \times L$$

Step 5:
Calculate all relevant form losses for the current pipe. Form losses include losses at the following locations:

- inlets
- manholes
- "tee" connections
- bends
- pipe outfalls

Inlet, manhole and "tee" connection losses are all types of junction losses. The general formula used for computing junction losses is (Ref. No. 19):

$$H_j = \frac{V_o^2}{2g} - \left(\frac{Q_{L1}}{Qo}\right)\left(0.3\,\frac{V^2_{L1}}{2g}\right) - \frac{Q_{L2}}{Qo}\left(0.3\,\frac{V^2_{L2}}{2g}\right) - \left(\frac{Q_u}{Qo}\right)\left(\frac{V_u^2}{2g}\right)$$

where; H_j = Change in elevation across the manhole due to junction losses (ft.)

Q_o = Discharge in the current pipe (downstream of junction) (cfs)

Q_{L1} = Discharge in lateral pipe No. 1 (cfs)

Q_{L2} = Discharge in lateral pipe No. 2 (if applicable)(cfs)

Q_u = Discharge in the upstream pipe (cfs)

V_o = Velocity in the current pipe (downstream of junction) (fps)

V_{L1} = Velocity in lateral pipe No. 1 (fps)

V_{L2} = Velocity in lateral pipe No. 2 (if applicable)(fps)

V_u = Velocity in the upstream pipe (fps)

Bend losses are computed by (Ref. No. 20):

$$H_b = k_b \left(\frac{V_o^2}{2_g}\right) \qquad \text{where} \qquad k_b = .25 \left(\frac{\phi}{90}\right)^{1/2}$$

ϕ = Most severe angle found in the storm sewer system (conservative value) = 90°

k_b = 0.25

Expansion losses at the outfall points of Trunkline No. 1 and Trunkline No. 3 are calculated by (Ref. No. 20):

$$H_e = k_e \left(\frac{V_o^2}{2_g}\right) \quad ; \quad k_e = 0.6$$

Step 6:
Calculate the upstream EGL:

$$\text{EGL (upstream)} = \text{EGL (downstream)} + h_L + \text{sum of form losses}$$

Step 7:
Calculate the water surface elevation (WSEL) at the upstream end of the current pipe:

$$\text{WSEL (upstream)} = \text{EGL (upstream)} - \frac{V_o^2}{2g}$$

Step 8:
Determine the normal depth of flow (d_n) in the pipe, by Manning's equation, for the design flow.

Step 9:
Determine the velocity of the design flow at normal depth (V_n).

Step 10:
Determine the entrance loss into the upstream end of the pipe using the velocity at normal depth (Ref. No. 18):

$$H_{ent} = 0.2 \frac{V_n^2}{2g}$$

Step 11:
Determine the WSEL at the upstream end of the current pipe:

$$\text{WSEL} = d_n + H_{ent} + \text{pipe invert (upstream end)}$$

Step 12:
Calculate the associated EGL:

$$\text{EGL} = \text{WSEL} + \frac{V_o^2}{2g}$$

ARIZONA DEPARTMENT OF TRANSPORTATION
LOCATION DATA: Highway: Superstition Freeway: Phase I
Location: Power Road to Ellsworth Road
Project No. F-028-1-311

(1)- Formula #1 = Qn/(D^8/3)(S^1/2)
(2)- Ref. No. 12: Table B-3

TABLE 11. PHASE I: STORM SEWER SIZING TABLE

Location		Contributing Drainage					Time of Concentration (Min.)								(1). (2)	(2)			Travel	
Line No.	From-To	Inc. No.	Inc. CA	Sum Upstream CA	Total CA	Inlet	Sewer (Tt)	Design	i (in./hr.)	Q= CiA (cfs)	Slope (ft./ft.)	Diam. (in.)	Formula # 1	A/D^2	Velocity (fps)	Length ft.	Time (Tt) (min.)	Downstream Line No.
1	I-3 to I-4	A-3	0.199	0.000	0.199	0.43		10.00	5.80	1.15	0.0050	24	0.0334	0.0976	2.96	78.0	0.44	2
2	I-4 to MH-A	A-4	0.199	0.199	0.398	0.43	0.44	10.00	5.80	2.31	0.1022	24	0.0148	0.0550	10.50	37.0	0.06	PHIII: 170
3	I-1 to MH-A	A-1	0.102	0.238	0.340	0.40	0.31	10.00	5.80	1.97	0.0110	24	0.0385	0.1077	4.58	159.0	0.58	PHIII: 170
4	I-2 to I-1	A-2	0.238	0.000	0.238	0.40		10.00	5.80	1.38	0.0190	24	0.0205	0.0691	4.99	92.0	0.31	3
5	I-6 to MH-B	A-6	0.082	0.199	0.281	0.57	1.14	10.00	5.80	1.63	0.0269	24	0.0203	0.0688	5.93	36.0	0.10	PHIII: 172
6	I-5 to I-6	A-5	0.076	0.123	0.199	0.57	0.66	10.00	5.80	1.15	0.0040	24	0.0374	0.1056	2.73	78.0	0.48	5
7	I-8 to I-5	A-8	0.123	0.000	0.123	0.57		10.00	5.80	0.71	0.0050	24	0.0207	0.0695	2.57	102.0	0.66	6
8	I-11 to I-12	A-11	0.398	0.000	0.398	1.04		10.00	5.80	2.31	0.0058	24	0.0621	0.1511	3.82	212.0	0.93	12
9	I-13 to I-12	A-13	0.212	0.000	0.212	0.29		10.00	5.80	1.23	0.0712	24	0.0094	0.0402	7.65	65.0	0.14	12
10	I-16 to MH-E	A-16	0.110	0.103	0.213	0.42	0.39	10.00	5.80	1.24	0.0953	24	0.0082	0.0364	8.49	38.0	0.07	PHIII: 385
11	I-17 to I-16	A-17	0.103	0.000	0.103	0.42		10.00	5.80	0.60	0.0117	24	0.0113	0.0456	3.28	77.0	0.39	10
12	I-12 to MH-C	A-12	0.325	0.610	0.935	1.04	0.93	10.00	5.80	5.42	0.0025	24	0.2221	0.3803	3.57	29.0	0.14	13
13	MH-C to MH-D	A-13	0.000	0.935	0.935	1.04	1.07	10.00	5.80	5.42	0.0025	24	0.2221	0.3803	3.57	306.0	1.43	PHIII: 384
14	I-15 to MH-D	A-15	0.176	0.172	0.348	0.41	0.37	10.00	5.80	2.02	0.1200	24	0.0119	0.0473	10.66	36.0	0.06	PHIII: 384
15	I-14 to I-15	A-14	0.172	0.000	0.172	0.41		10.00	5.80	1.00	0.0091	24	0.0214	0.0713	3.50	78.0	0.37	14
16	I-21 to I-20	A-21	0.238	0.000	0.238	0.36		10.00	5.80	1.38	0.0045	24	0.0421	0.1148	3.01	65.0	0.36	17
17	I-20 to I-18	A-20	0.243	0.238	0.481	0.36	0.36	10.00	5.80	2.79	0.0025	24	0.1142	0.2339	2.98	260.0	1.45	19
18	I-19 to I-18	A-19	0.160	0.000	0.160	0.54		10.00	5.80	0.93	0.0043	24	0.0290	0.0882	2.63	98.0	0.62	19
19	I-18 to MH-8	A-18	0.220	0.641	0.861	0.36	1.81	10.00	5.80	4.99	0.0030	24	0.1867	0.3345	3.73	37.0	0.17	PHII Chan.

Computed by: J. N. Mc Cammon Date: 5/87 Checked by: ACG Date: 9/88

ARIZONA DEPARTMENT OF TRANSPORTATION
LOCATION DATA: Highway: Superstition Freeway: Phase I
Location: Power Road to Ellsworth Road
Project No. F-023-1-311

(1)- Formula #1 = Qn/(D^8/3)(S^1/2)
(2)- Ref. No. 12: Table 8-3

TABLE II. PHASE I: STORM SEWER SIZING TABLE

Location		Contributing Drainage				Time of Concentration (Min.)							(1). (2)	(2)			Travel	
Line No.	From-To	Inc. No.	Inc. CA	Sum Upstream CA	Total CA	Inlet	Sewer (Tt)	Design	i (in./hr.)	Q= CiA (cfs)	Slope (ft./ft.)	Diam. (in.)	Formula # 1	A/D^2	Velocity (fps)	Length ft.	Time (Tt) (min.)	Downstream Line No.
20	MH-F to MH-6	OUTFALL LINE FOR (FUTURE) DETENTION POND (BY COE & VAN LOO) - PHASE II CONSTRUCTION									0.0022	48				226.0		25
21	UNDER ELLSWORTH RD BRIDGE	INTERIM CONVEYANCE (MATCHES EXISTING PIPES) - TO BE REMOVED AFTER CONST. OF POND (CVL)									0.0056	3-84	% CHANNEL # 2 (URS): PHASE II			280.0	CONSTRUCTION	
22A	I-10 to I-9	A-10	0.178	0.000	0.178	1.92		10.00	5.80	1.03	0.0055	24	0.0285	0.0872	2.96	65.0	0.37	415
22B	MH-3 to CHN 2	OUTFALL LINE FOR (FUTURE) DETENTION POND (BY COE & VAN LOO) - PHASE II CONSTRUCTION									0.0011	48				19.0		109
23	MH-3 to MH-4	OUTFALL LINE FOR (FUTURE) DETENTION POND (BY COE & VAN LOO) - PHASE II CONSTRUCTION									0.0022	48				316.0		22B
24	MH-4 to MH-5	OUTFALL LINE FOR (FUTURE) DETENTION POND (BY COE & VAN LOO) - PHASE II CONSTRUCTION									0.0022	48				320.0		23
25	MH-5 to MH-6	OUTFALL LINE FOR (FUTURE) DETENTION POND (BY COE & VAN LOO) - PHASE II CONSTRUCTION									0.0022	48				32.0		24
26	MH-7 to CHN 2	N/A	N/A	0.861	0.861		2.47	10.00	5.80	4.99	0.0109	24	0.0979	0.2094	5.96	30.0	0.08	PHII Chan.
27	MH-7 to MH-8	N/A	N/A	0.861	0.861		1.98	10.00	5.80	4.99	0.0109	24	0.0979	0.2094	5.96	176.0	0.49	26
413	I-23 to MH 4-1	A-23	0.227	0.000	0.227	1.00		10.00	5.80	1.32	0.0140	24	0.0228	0.0745	4.42	49.0	0.18	PHII 414

Computed by: J. N. Mc Cameon Date: 5/87 Checked by: CB Date: 9/88

ARIZONA DEPARTMENT OF TRANSPORTATION

LOCATION DATA: Highway: Superstition Freeway: Phase I
Location: Power Road to Ellsworth Road
Project No. F-028-1-311

DESIGN DATA: Frequency: 10 years
P6 = 1.99 in. P24 = 2.30 in. P1 = 1.58 in.
Pipe n = 0.013

TABLE 12. PHASE I: HYDRAULIC GRADELINE CALCULATIONS

Line No.	From-To	Design Q (cfs)	Diam. (in.)	TWSEL.	Sewer Profile Crown Elevation Dnstm.	Sewer Profile Crown Elevation Upstm.	Sewer Profile L (ft.)	Sewer Profile Slope (ft/ft)	V full (fps)	Hydraulic Grade Line Sf (ft/ft)	hL (ft.)	WSEL. Upstm.	Normal Depth	Inv. Upstm.	WSEL. Upstm.	HGL @ Upstm. End	Rim/Inlet Elev. (ft.)	Freeboard (El.-HGL) (ft.)
2	I-4 to MH-A	2.35	24	1376.39	1400.98	1397.20	37.0	0.1022	0.75	0.0001	0.00	1376.39	0.25	1398.98	1399.23	1399.23	1404.02	4.79
1	I-3 to I-4	1.19	24	1399.23	1401.74	1401.34	78.0	0.0050	0.38	0.0000	0.00	1399.23	0.37	1399.74	1400.11	1400.11	1408.88	8.77
3	I-1 to MH-A	0.50	24	1376.39	1396.45	1394.70	159.0	0.0110	0.16	0.0000	0.00	1376.39	0.20	1394.45	1394.65	1394.65	1400.31	5.66
4	I-2 to I-1	0.28	24	1394.65	1398.20	1396.45	92.0	0.0190	0.09	0.0000	0.00	1394.65	0.13	1396.20	1396.33	1396.33	1400.07	3.74
5	I-6 to MH-B	2.19	24	1372.74	1401.27	1400.30	36.0	0.0269	0.70	0.0001	0.00	1372.74	0.33	1399.27	1399.60	1399.60	1405.59	5.99
6	I-5 to I-6	1.68	24	1399.60	1401.58	1401.27	78.0	0.0040	0.53	0.0001	0.00	1399.60	0.46	1399.58	1400.04	1400.04	1405.69	5.65
7	I-8 to I-5	1.21	24	1400.04	1402.09	1401.58	102.0	0.0050	0.39	0.0000	0.00	1400.04	0.37	1400.09	1400.46	1400.46	1404.39	3.93
10	I-16 to MH-E	0.92	24	1447.51	1473.82	1470.20	38.0	0.0953	0.29	0.0000	0.00	1447.51	0.16	1471.82	1471.98	1471.98	1476.88	4.90
11	I-17 to I-16	0.46	24	1471.78	1474.82	1473.92	77.0	0.0117	0.15	0.0000	0.00	1471.78	0.19	1472.82	1473.01	1473.01	1476.95	3.94
13	MH-C to MH-D	5.69	24	1449.11	1455.89	1455.14	306.0	0.0025	1.81	0.0007	0.20	1449.31	1.00	1453.89	1454.89	1454.89	1463.00	8.11
12	I-12 to MH-C	5.69	24	1454.89	1455.96	1455.89	29.0	0.0025	1.81	0.0007	0.02	1454.91	1.00	1453.96	1454.96	1454.96	1466.16	11.20
9	I-13 to I-12	1.10	24	1454.96	1467.55	1462.92	65.0	0.0712	0.35	0.0000	0.00	1454.96	0.19	1465.55	1465.74	1465.74	1470.75	5.01
8	I-11 to I-12	1.58	24	1454.96	1457.18	1455.96	212.0	0.0058	0.59	0.0001	0.01	1454.97	0.74	1455.18	1455.92	1455.92	1460.42	4.50
14	I-15 to MH-D	1.44	24	1449.11	1473.00	1468.68	36.0	0.1200	0.46	0.0000	0.00	1449.11	0.19	1471.00	1471.19	1471.19	1476.03	4.84
15	I-14 to I-15	0.70	24	1471.19	1474.50	1473.79	78.0	0.0091	0.22	0.0000	0.00	1471.19	0.25	1472.50	1472.75	1472.75	1476.72	3.97

Computed by: J. M. Mc Cammon Date: 5/87 Checked by: CES Date: 9/88

ARIZONA DEPARTMENT OF TRANSPORTATION

LOCATION DATA: Highway: Superstition Freeway: Phase I
Location: Power Road to Ellsworth Road
Project No. F-028-1-311

DESIGN DATA: Frequency: 10 years
P6 = 1.99 in. P24 = 2.30 in. P1 = 1.58 in.
Pipe n = 0.013

TABLE 12. PHASE I: HYDRAULIC GRADELINE CALCULATIONS

Line No.	From-To	Design Q (cfs)	Diam. (in.)	TWSEL.	Sewer Profile: Crown Elevation Dnsta.	Crown Elevation Upsta.	L (ft.)	Slope (ft/ft)	Hydraulic Grade Line: V full (fps.)	Sf (ft/ft)	hL (ft.)	WSEL. Upsta.	Normal Depth	Inv. Upsta.	WSEL. Dnsta.	HGL @ Upsta. End	Rim/Inlet Elev. (ft.)	Freeboard (El.-HGL) (ft.)
19	I-18 to DITCH	5.89	24	1466.15	1466.27	1466.16	37.0	0.0030	1.87	0.0007	0.03	1466.18	0.97	1464.26	1465.23	1466.18	1473.16	6.98
17	I-20 to I-18	2.93	24	1466.18	1466.96	1466.27	260.0	0.0025	0.93	0.0002	0.05	1466.23	0.69	1464.92	1465.61	1466.23	1469.53	3.30
16	I-21 to I-20	1.39	24	1466.23	1467.21	1466.92	65.0	0.0045	0.44	0.0000	0.00	1466.23	0.74	1465.21	1465.95	1466.23	1469.53	3.30
18	I-19 to I-18	1.44	24	1466.23	1470.81	1470.39	98.0	0.0043	0.46	0.0000	0.00	1466.23	0.78	1468.81	1469.59	1469.59	1473.13	3.54
21	ELLSWORTH RD.		78		1465.37	1463.80	280.0	0.0056	0.00	0.0000	N/A	N/A	N/A	1458.87	N/A	N/A		N/A
22A	I-9 to I-10	0.76	24	1378.91	1379.27	1378.91	65.0	0.0055	0.24	0.0000	0.30	1379.21	0.06	1377.27	1377.33	1379.21	1381.53	2.32
22B	CHN 2 to MH-3	*(1)	48	N/A	1456.91	1456.89	19	0.0011			N/A	N/A	N/A	1452.92	N/A	N/A	1463.00	N/A
23	MH-3 to MH-4	*(1)	48	N/A	1457.61	1456.92	316	0.0022			N/A	N/A	N/A	1453.62	N/A	N/A	1465.20	N/A
24	MH-4 to MH-5	*(1)	48	N/A	1458.32	1457.62	320	0.0022			N/A	N/A	N/A	1454.33	N/A	N/A	1467.10	N/A
25	MH-5 to MH-6	*(1)	48	N/A	1458.38	1458.33	32	0.0022			N/A	N/A	N/A	1454.39	N/A	N/A	1469.70	N/A
20	MH-6 to MH-F	*(1)	48	N/A	1458.89	1458.39	226.0	0.0022			N/A	N/A	N/A	1454.76	N/A	N/A	1469.80	N/A

*(1) Outfall for future Detention Pond (by others) - See Drainage Report by Coe and Van Loo for design flow information

Computed by: J. N. Mc Cammon Date: 5/87 Checked by: GCS Date: 9/88

LOCATION DATA

Highway: Superstition Freeway
Location: Power Road to Ellsworth Road
Project No. F-028-1-311

TABLE 13. PHASE II AND III: STORM SEWER FLOW CALCULATIONS

Location		Drainage Area				Time of Concentration (Tc min.)												Travel		
Line No.	From-To	Inc. No.	Inc. CA	SUM Upstream CA	Total CA	Inlet	Sewer (Tt)	Total Tc	Design	i in./hr.	Q=CiAEf cfs	Slope ft./ft.	Diam. in.	Formula #1	A/D^2	Velocity fps.	Length ft.	Time (Tt) (min.)	Downstream Line No.
101	MH1-1 to Outfall	N/A	0.000	28.829	28.829		1.13	17.68	17.68	4.65	138.1	0.0029	66	0.3536	0.5447	8.38	80	0.16	Exist Chnl
102	MH1-2 to MH1-1	N/A	0.000	28.829	28.829		1.34	16.55	16.55	4.70	139.6	0.0024	66	0.3929	0.5937	7.77	527	1.13	101
103	MH1-3 to MH1-2	N/A	0.000	28.829	28.829		1.40	15.20	15.20	4.90	145.5	0.0025	66	0.4014	0.6046	7.96	641	1.34	102
104	MH1-4 to MH1-3	N/A	0.000	28.829	28.829		1.36	13.80	13.80	5.10	151.4	0.0025	66	0.4177	0.6257	8.00	672	1.40	103
105	MH1-5 to MH1-4	N/A	0.000	28.829	28.829		1.31	12.44	12.44	5.30	157.4	0.0025	66	0.4341	0.6477	8.03	655	1.36	104
106	MH1-6 to MH1-5	N/A	0.000	28.829	28.829		0.85	11.13	11.13	5.60	166.3	0.0025	66	0.4587	0.6826	8.05	633	1.31	105
107	MH1-7 to MH1-6	N/A	0.000	28.829	28.829		0.16	10.28	10.28	5.75	170.7	0.0025	66	0.4710	0.7854	7.19	368	0.85	106
108	I-25 to MH1-7	A-25	1.062	0.000	1.062	3.77		3.77	10.00	5.80	6.3	0.0027	24	0.2500	0.4164	3.81	15	0.07	107
109	I-26 to MH1-8	A-26	0.207	0.823	1.030		0.25	2.08	10.00	5.80	6.2	0.0037	24	0.2071	0.3614	4.26	141	0.55	189
110	I-27 to I-26	A-27	0.275	0.548	0.823		0.43	1.83	10.00	5.80	4.9	0.0080	24	0.1125	0.2314	5.31	79	0.25	109
111	I-28 to I-27	A-28	0.273	0.275	0.548		0.52	1.40	10.00	5.80	3.3	0.0049	24	0.0958	0.2061	3.97	102	0.43	110
112	I-29 to I-28	A-29	0.275	0.000	0.275	0.88		0.88	10.00	5.80	1.6	0.0049	24	0.0481	0.1260	3.26	102	0.52	111
113	MH1-9 to MH1-8			26.737	26.737		0.67	9.55	10.00	5.80	159.7	0.0052	60	0.3939	0.5950	10.74	358	0.56	189
114	I-30 to MH1-9	A-30	1.156	1.198	2.344		0.42	3.51	10.00	5.80	14.0	0.0035	24	0.4846	0.7854	4.46	17	0.06	113
115	I-31 to I-30	A-31	0.266	0.922	1.188		0.39	3.09	10.00	5.80	7.1	0.0046	24	0.2142	0.3705	4.79	122	0.42	114
116	I-32 to I-31	A-32	0.250	0.642	0.922		0.46	2.70	10.00	5.80	5.5	0.0048	24	0.1628	0.3025	4.55	107	0.39	115
117	I-33 to I-32	A-33	0.642	0.000	0.642	2.24		2.24	10.00	5.80	3.8	0.0047	24	0.1145	0.2344	4.09	112	0.46	116
118	MH1-10 to MH1-9			24.393	24.393		1.05	8.88	10.00	5.80	145.7	0.0050	60	0.3665	0.5601	10.41	416	0.67	113
119	I-34 to MH1-10	A-34	0.253	2.227	2.480		0.28	3.98	10.00	5.80	14.8	0.0080	24	0.3391	0.5262	7.04	15	0.04	118
120	I-35 to I-34	A-35	0.255	1.972	2.227		0.49	3.70	10.00	5.80	13.3	0.0039	24	0.4362	0.6505	5.11	87	0.28	119
121	I-36 to I-35	A-36	0.241	0.752	0.993		0.34	1.87	10.00	5.80	5.9	0.0056	24	0.1623	0.3018	4.91	87	0.30	120
122	I-37 TO I-36	A-37	0.247	0.505	0.752		0.38	1.53	10.00	5.80	4.5	0.0039	24	0.1473	0.2812	3.99	82	0.34	121
123	I-38 TO I-37	A-38	0.251	0.254	0.505		0.47	1.15	10.00	5.80	3.0	0.0039	24	0.0989	0.2109	3.58	82	0.38	122

Q=CiAEf: Ef = Factor accounting for future expansion of Roadway

Computed by: J.N. McCammon Checked by: CCB 9/88

LOCATION DATA

Highway: Superstition Freeway
Location: Power Road to Ellsworth Road
Project No. F-028-1-311

TABLE 13. PHASE II AND III: STORM SEWER FLOW CALCULATIONS

Location		Drainage Area				Time of Concentration (Tc min.)				i	Q=CiAEf	Slope	Diam.	Formula	A/D^2	Velocity	Travel			
Line No.	From-To	Inc. No.	Inc. CA	SUM Upstream CA	Total CA	Inlet	Sewer (Tt)	Total Tc	Design	in./hr.	cfs	ft./ft.	in.	#1		fps.	Length ft.	Time (Tt) (min.)	Downstream Line No.
124	I-39 TO I-38	A-39	0.254	0.000	0.254	0.68		0.68	10.00	5.80	1.5	0.0039	24	0.0497	0.1291	2.94	82	0.47	123
125	I-40 TO I-35	A-40	0.977	0.000	0.977	3.21		3.21	10.00	5.80	5.8	0.0033	24	0.2084	0.3633	4.03	118	0.49	120
126	MH1-11 TO MH1-10			21.913	21.913		1.16	7.83	10.00	5.80	130.9	0.0041	54	0.4615	0.7854	8.23	517	1.05	118
127	I-41 TO MH1-11	A-41	0.242	5.335	5.577		0.38	6.01	10.00	5.80	33.3	0.0063	30	0.4740	0.7854	6.79	16	0.04	126
128	I-42 TO I-41	A-42	0.246	4.058	4.304		0.22	5.63	10.00	5.80	25.7	0.0051	30	0.4066	0.6112	6.73	77	0.19	127
129	I-43 TO I-42	A-43	0.250	3.808	4.058		0.22	5.42	10.00	5.80	24.2	0.0039	30	0.4383	0.6536	5.93	77	0.22	128
130	I-44 TO I-43	A-44	0.254	3.554	3.808		0.23	5.20	10.00	5.80	22.7	0.0039	30	0.4113	0.6172	5.90	77	0.22	129
131	I-45 TO I-44	A-45	0.258	3.296	3.554		0.26	4.97	10.00	5.80	21.2	0.0034	30	0.4112	0.6170	5.51	77	0.23	130
132	I-46 TO I-45	A-46	0.246	3.050	3.296		0.46	4.70	10.00	5.80	19.7	0.0026	30	0.4360	0.6504	4.84	77	0.26	131
133	I-47 TO I-46	A-47	0.250	0.254	0.504		0.41	1.01	10.00	5.80	3.0	0.0065	24	0.0765	0.1753	4.29	72	0.28	132
134	I-48 TO I-47	A-48	0.254	0.000	0.254	0.60		0.60	10.00	5.80	1.5	0.0039	24	0.0497	0.1291	2.94	72	0.41	133
135	I-49 TO I-41	A-49	1.031	0.000	1.031	3.21		3.21	10.00	5.80	6.2	0.0071	24	0.1497	0.2845	5.41	123	0.38	127
136	I-50 TO I-46	A-50	0.218	2.328	2.546		0.25	4.24	10.00	5.80	15.2	0.0025	24	0.6228	0.7854	4.84	135	0.46	132
137	I-51 TO I-50	A-51	0.227	2.101	2.328		0.26	3.99	10.00	5.80	13.9	0.0044	24	0.4293	0.6409	5.43	82	0.25	136
138	I-52 TO I-51	A-52	0.228	1.873	2.101		0.27	3.73	10.00	5.80	12.6	0.0044	24	0.3874	0.5865	5.35	82	0.26	137
139	I-53 TO I-52	A-53	0.224	1.649	1.873		0.27	3.46	10.00	5.80	11.2	0.0034	24	0.3929	0.5936	4.71	77	0.27	138
140	I-54 TO I-53	A-54	0.208	1.441	1.649		0.26	3.19	10.00	5.80	9.9	0.0032	24	0.3565	0.5482	4.49	72	0.27	139
141	I-55 TO I-54	A-55	0.230	1.211	1.441		0.28	2.93	10.00	5.80	8.6	0.0031	24	0.3166	0.4988	4.31	67	0.26	140
142	I-56 TO I-55	A-56	0.317	0.894	1.211		0.30	2.65	10.00	5.80	7.2	0.0033	24	0.2579	0.4262	4.24	72	0.28	141
143	I-57 TO I-56	A-57	0.448	0.446	0.894		0.11	2.35	10.00	5.80	5.3	0.0076	24	0.1254	0.2503	5.33	97	0.30	142
144	I-58 TO I-57	A-58	0.446	0.000	0.446	2.24		2.24	10.00	5.80	2.7	0.0291	24	0.0320	0.0946	7.04	45	0.11	143
145	MH1-12 TO MH1-11			16.336	16.336		0.72	6.67	10.00	5.80	97.6	0.0043	54	0.3505	0.5410	8.91	621	1.16	126
146	I-59 TO MH1-12	A-59	0.241	1.200	1.441		0.24	2.97	10.00	5.80	8.6	0.0025	24	0.3525	0.5434	3.96	16	0.07	145

Q=CiAEf: Ef = Factor accounting for future expansion of Roadway

Computed by: J.N. McCammon Checked by: GCB 9/88

LOCATION DATA

Highway: Superstition Freeway
Location: Power Road to Ellsworth Road
Project No. F-028-1-311

TABLE 13. PHASE II AND III: STORM SEWER FLOW CALCULATIONS

Location		Drainage Area				Time of Concentration (Tc min.)				i	Q=CiAEf	Slope	Diam.	Formula	A/D^2	Velocity	Travel		
Line No.	From-To	Inc. No.	Inc. CA	SUM Upstream CA	Total CA	Inlet	Sewer (Tt)	Total Tc	Design	in./hr.	cfs	ft./ft.	in.	#1		fps.	Length ft.	Time (Tt) (min.)	Downstream Line No.
147	I-60 TO I-59	A-60	0.226	0.974	1.200		0.27	1.83	10.00	5.80	7.2	0.0043	24	0.2238	0.3825	4.69	67	0.24	146
148	I-61 TO I-60	A-61	0.193	0.781	0.974		0.25	1.56	10.00	5.80	5.8	0.0029	24	0.2212	0.3792	3.84	62	0.27	147
149	I-62 TO I-61	A-62	0.248	0.533	0.781		0.31	1.32	10.00	5.80	4.7	0.0027	24	0.1838	0.3305	3.53	52	0.25	148
150	I-63 TO I-62	A-63	0.253	0.280	0.533		0.37	1.01	10.00	5.80	3.2	0.0039	24	0.1044	0.2192	3.63	67	0.31	149
151	I-64 TO I-63	A-64	0.250	0.000	0.280	0.64		0.64	10.00	5.80	1.7	0.0039	24	0.0548	0.1385	3.02	67	0.37	150
152	MH1-13 TO MH1-12			14.895	14.895		0.49	5.95	10.00	5.80	89.0	0.0050	42	0.5793	0.7854	9.25	400	0.72	145
153	I-65 TO MH1-13	A-65	0.545	0.415	0.960		0.12	2.12	10.00	5.80	5.7	0.0053	24	0.1613	0.3005	4.77	17	0.06	152
154	I-66 TO I-65	A-66	0.415	0.000	0.415	2.00		2.00	10.00	5.80	2.5	0.0185	24	0.0373	0.1055	5.88	41	0.12	153
155	MH1-14 TO MH1-13			13.935	13.935		0.34	5.46	10.00	5.80	83.2	0.0049	42	0.5475	0.7854	8.65	255	0.49	152
156	I-67 TO TEE	A-67	0.370	0	0.370	1.44		1.44	10.00	5.80	2.2	0.0911	24	0.0150	0.0555	9.95	44	0.07	155
157	I-70 TO MH1-14	A-70	0.539	0.890	1.429		0.40	2.46	10.00	5.80	8.5	0.0053	24	0.2401	0.4041	5.28	17	0.05	155
158	I-71 TO I-70	A-71	0.517	0.373	0.890		0.18	2.06	10.00	5.80	5.3	0.0050	24	0.1539	0.2904	4.58	110	0.40	157
159	I-72 TO I-71	A-72	0.373	0.000	0.373	1.88		1.88	10.00	5.80	2.2	0.0404	24	0.0227	0.0743	7.49	80	0.18	158
160	MH1-15 TO MH1-14			12.136	12.136		0.33	5.12	10.00	5.80	72.5	0.0131	36	0.4399	0.6557	12.29	251	0.34	155
161	I-68 TO TEE	A-68	0.337	0.000	0.337	1.40		1.40	10.00	5.80	2.0	0.1081	24	0.0125	0.0490	10.28	73	0.12	160
162	I-73 TO MH1-15	A-73	0.656	0.919	1.575		0.40	3.44	10.00	5.80	9.4	0.0050	24	0.2724	0.4444	5.29	18	0.06	160
163	I-74 TO I-73	A-74	0.640	0.279	0.919		0.25	3.05	10.00	5.80	5.5	0.0050	24	0.1590	0.2973	4.62	110	0.40	162
164	I-75 TO I-74	A-75	0.279	0.000	0.279	2.80		2.80	10.00	5.80	1.7	0.0660	24	0.0133	0.0510	8.17	121	0.25	163
165	I-69 TO TEE	A-69	0.490	0.000	0.490	2.88		2.88	10.00	5.80	2.9	0.1407	24	0.0160	0.0580	12.61	95	0.13	166
166	MH1-16 TO MH1-15			10.224	10.224		0.48	4.79	10.00	5.80	61.1	0.0150	36	0.3463	0.5353	12.68	251	0.33	169
167	I-76 TO MH1-16	A-76	0.440	1.325	1.765		0.35	2.31	10.00	5.80	10.5	0.0339	24	0.1172	0.2383	11.06	18	0.03	166
168	I-77 TO I-76	A-77	0.426	0.899	1.325		0.04	1.96	10.00	5.80	7.9	0.0053	24	0.2226	0.3810	5.19	110	0.35	167
169	MH1-17 TO I-77			0.899	0.899		0.30	1.92	10.00	5.80	5.4	0.0635	24	0.0436	0.1177	11.41	26	0.04	168

Q=CiAEf: Ef = Factor accounting for future expansion of Roadway Computed by: J.N. McCasson Checked by: GCS 9/88

LOCATION DATA

Highway: Superstition Freeway
Location: Power Road to Ellsworth Road
Project No. F-028-1-311

TABLE 13. PHASE II AND III: STORM SEWER FLOW CALCULATIONS

Location		Drainage Area				Time of Concentration (Tc min.)												Travel		
Line No.	From-To	Inc. No.	Inc. CA	SUM Upstream CA	Total CA	Inlet	Sewer (Tt)	Total Tc	Design	i in./hr.	Q=CiAEf cfs	Slope ft./ft.	Diam. in.	Formula #1	A/D^2	Velocity fps.	Length ft.	Time (Tt) (min.)	Downstream Line No.
170	MH-A TO MH1-17		0.518	0.000	0.518	1.62		1.62	10.00	5.80	3.1	0.1154	24	0.0187	0.0647	11.96	146	0.20	169
171	I-78 TO MH1-17	A-78	0.381	0.000	0.381	1.60		1.60	10.00	5.80	2.3	0.0718	24	0.0174	0.0616	9.24	165	0.30	169
172	MH-B TO MH1-16		0.466	0.000	0.466	2.09		2.09	10.00	5.80	2.8	0.2649	24	0.0111	0.0449	15.50	85	0.09	173
173	MH1-18 TO MH1-16			7.969	7.969		0.58	4.31	10.00	5.80	47.6	0.0261	30	0.3323	0.5185	14.49	421	0.48	166
174	I-79 TO TEE	A-79	0.522	0.526	1.048		0.46	2.62	10.00	5.80	6.3	0.0056	24	0.1713	0.3141	4.98	18	0.06	173
175	I-80 TO I-79	A-80	0.526	0.000	0.526	2.16		2.16	10.00	5.80	3.1	0.0050	24	0.0910	0.1986	3.95	110	0.46	174
176	I-81 TO MH1-18	A-81	1.128	1.310	2.438		0.36	2.61	10.00	5.80	14.6	0.0050	24	0.4217	0.6315	5.77	18	0.05	173
177	I-82 TO I-81	A-82	1.190	0.120	1.310		0.32	2.25	10.00	5.80	7.8	0.0050	24	0.2266	0.3859	5.07	110	0.36	176
178	I-83 TO I-82	A-83	0.120	0.000	0.120	1.93		1.93	10.00	5.80	0.7	0.1056	24	0.0045	0.0241	7.45	144	0.32	177
179	MH1-19 TO MH1-18			4.017	4.017		0.44	3.73	10.00	5.80	24.0	0.0270	30	0.1649	0.3054	12.57	436	0.58	173
180	I-84 TO TEE	A-84	0.272	0.000	0.272	1.36		1.36	10.00	5.80	1.6	0.1216	24	0.0095	0.0405	10.03	99	0.16	179
181	MH1-20 TO MH1-19			2.906	2.906		0.69	3.13	10.00	5.80	17.4	0.0187	24	0.2599	0.4288	10.12	266	0.44	179
182	I-85 TO MH1-19	A-85	0.839	0.000	0.839	3.53		3.53	10.00	5.80	5.0	0.0695	24	0.0587	0.1036	11.54	59	0.09	179
183	I-86 TO TEE	A-86	0.537	1.004	1.543		0.37	3.30	10.00	5.80	9.2	0.0050	24	0.2669	0.4375	5.27	18	0.06	181
184	I-87 TO I-86	A-87	0.492	0.512	1.004		0.83	2.91	10.00	5.80	6.0	0.0050	24	0.1737	0.3172	4.73	110	0.39	183
185	I-88 TO I-87	A-88	0.512	0.000	0.512	2.08		2.08	10.00	5.80	3.1	0.0050	24	0.0886	0.1948	3.93	195	0.83	184
186	I-89 TO MH1-20	A-89	0.477	0.408	0.885		0.60	2.44	10.00	5.80	5.3	0.0050	24	0.1531	0.2592	4.57	169	0.69	181
187	I-90 TO I-89	A-90	0.408	0.000	0.408	1.84		1.84	10.00	5.80	2.4	0.0227	24	0.0331	0.0970	6.28	227	0.60	186
188	I-91 TO MH1-20	A-91	0.478	0.000	0.478	2.00		2.00	10.00	5.80	2.9	0.0235	24	0.0381	0.1071	6.67	211	0.53	181
189	MH1-6 TO MH1-7		1.03	27.767	27.767		0.57	10.12	10.12	5.75	164.5	0.0051	66	0.3176	0.5001	10.87	104	0.16	107
201	MH2-1 TO EXMH	A-3	0.221	8.932	9.153		1.35	6.05	10.00	5.80	54.7	0.0028	42	0.4757	0.7854	5.68	246	0.72	Exst. 42"
202	MH2-2 TO MH2-1	A-4,A-5	0.822	5.547	6.369		0.64	4.70	10.00	5.80	38.0	0.0025	36	0.5284	0.7854	5.38	436	1.35	201
203	I-6 TO MH2-2	A-6	0.334	2.556	2.890		0.22	3.93	10.00	5.80	17.3	0.0052	30	0.2704	0.4416	6.25	48	0.13	202

Q=CiAEf: Ef = Factor accounting for future expansion of Roadway

Computed by: J.N. McCamach Checked by: GEJ 9/88

LOCATION DATA

Highway: Superstition Freeway
Location: Power Road to Ellsworth Road
Project No. F-023-1-311

TABLE 13. PHASE II AND III: STORM SEWER FLOW CALCULATIONS

Location		Drainage Area				Time of Concentration (Tc min.)												Travel		
Line No.	From-To	Inc. No.	Inc. CA	SUM Upstream CA	Total CA	Inlet	Sewer (Tt)	Total Tc	Design	i in./hr.	Q=CiAEf cfs	Slope ft./ft.	Diam. in.	Formula #1	A/D^2	Velocity fps.	Length ft.	Time (Tt) (min.)	Downstream Line No.
204	I-7 TO I-6	A-7	0.316	2.249	2.556		0.24	3.71	10.00	5.50	15.3	0.0044	24	0.4713	0.7854	4.86	64	0.22	203
205	I-8 TO I-7	A-8	0.308	1.932	2.240		0.25	3.47	10.00	5.80	13.4	0.0057	24	0.3629	0.5557	6.02	87	0.24	204
206	I-9 TO I-8	A-9	0.298	1.634	1.932		0.26	3.22	10.00	5.80	11.5	0.0056	24	0.3158	0.4978	5.80	87	0.25	205
207	I-10 TO I-9	A-10	0.317	1.317	1.634		0.30	2.96	10.00	5.80	9.8	0.0057	24	0.2647	0.4343	5.61	87	0.26	206
208	I-11 TO I-10	A-11	0.317	1.000	1.317		0.34	2.66	10.00	5.80	7.9	0.0058	24	0.2115	0.3671	5.36	97	0.30	207
209	I-12 TO I-11	A-12	0.317	0.683	1.000		0.40	2.32	10.00	5.80	6.0	0.0058	24	0.1606	0.2995	4.99	102	0.34	208
210	I-13 TO I-12	A-13	0.683	0.000	0.683	1.92		1.92	10.00	5.80	4.1	0.0058	24	0.1097	0.2272	4.49	107	0.40	209
211	NOT USED																		
212	I-3 TO TEE	A-3	0.221	0.000	0.221	3.21		3.21	10.00	5.80	1.3	0.1396	24	0.0072	0.0333	9.91	99	0.17	201
213	I-4 TO TEE	A-4	0.354	0.000	0.354	1.68		1.68	10.00	5.80	2.1	0.1150	24	0.0129	0.0496	10.66	68	0.11	202
214	I-5 TO TEE	A-5	0.468	0.000	0.468	2.00		2.00	10.00	5.80	2.8	0.0622	24	0.0230	0.0749	9.33	41	0.07	202
215	I-1 TO MH2-1	A-1	0.930	1.633	2.563		0.45	3.09	10.00	5.80	15.3	0.0020	30	0.3866	0.5856	4.18	5	0.02	201
216	I-2 TO I-1	A-2	0.904	0.729	1.633		1.05	2.65	10.00	5.80	9.3	0.0026	24	0.3917	0.5921	4.12	110	0.45	215
217	I-14 TO I-2	A-14	0.243	0.000	0.243	1.60		1.60	10.00	5.80	1.5	0.1211	24	0.0085	0.0374	9.70	104	0.18	216
218	I-15 TO I-2	A-15	0.486	0.000	0.486	1.42		1.42	10.00	5.80	2.9	0.0110	24	0.0567	0.1417	5.12	322	1.05	216
219	I-16 TO MH2-2	A-16	0.657	2.000	2.657		0.30	4.06	10.00	5.80	15.9	0.0025	30	0.3585	0.5505	4.61	178	0.64	202
220	I-17 TO I-16	A-17	0.270	1.730	2.000		0.30	3.76	10.00	5.80	11.9	0.0057	24	0.3240	0.5079	5.88	107	0.30	219
221	I-18 TO I-17	A-18	0.261	1.469	1.730		0.30	3.46	10.00	5.80	10.3	0.0051	24	0.2963	0.4740	5.45	97	0.30	220
222	I-19 TO I-18	A-19	0.260	1.209	1.469		0.34	3.16	10.00	5.80	8.8	0.0053	24	0.2468	0.4125	5.32	97	0.30	221
223	I-20 TO I-19	A-20	0.271	0.938	1.209		0.37	2.82	10.00	5.80	7.2	0.0046	24	0.2180	0.3752	4.81	97	0.34	222
224	I-21 TO I-20	A-21	0.271	0.667	0.938		0.41	2.44	10.00	5.80	5.6	0.0047	24	0.1673	0.3087	4.54	102	0.37	223
225	I-22 TO I-21	A-22	0.274	0.393	0.667		0.48	2.04	10.00	5.80	4.0	0.0048	24	0.1178	0.2391	4.17	102	0.41	224
226	I-23 TO I-22	A-23	0.275	0.118	0.393		0.68	1.56	10.00	5.80	2.3	0.0047	24	0.0701	0.1648	3.56	102	0.48	225

Q=CiAEf: Ef = Factor accounting for future expansion of Roadway Computed by: J.N. McCammon Checked by: GR 9/88

LOCATION DATA

Highway: Superstition Freeway
Location: Power Road to Ellsworth Road
Project No. F-028-1-311

TABLE 13. PHASE II AND III: STORM SEWER FLOW CALCULATIONS

Location		Drainage Area				Time of Concentration (Tc min.)												Travel		
Line No.	From-To	Inc. No.	Inc. CA	SUM Upstream CA	Total CA	Inlet	Sewer (Ft)	Total Tc	Design	i in./hr.	Q=CiAEf cfs	Slope ft./ft.	Diam. in.	Formula #1	A/D^2	Velocity fps.	Length ft.	Time (Ft) (min.)	Downstream Line No.
227	I-24 TO I-23	A-24	0.118	0.000	0.118	0.88		0.88	10.00	5.80	0.7	0.0047	24	0.0211	0.0705	2.50	102	0.68	226
301	NOT USED																		
302	I-92 TO TEE	A-92	0.837	0.768	1.605		0.54		10.00	5.80	9.6	0.0869	24	0.0666	0.1589	15.09	16	0.02	304
303	I-93 TO I-92	A-93	0.768	0.000	0.768	4.81		4.81	10.00	5.80	4.6	0.0025	24	0.1879	0.3361	3.41	110	0.54	302
304	MH3-1 TO OUTFALL			44.429	44.429		0.90	18.70	18.70	4.40	201.4	0.0040	72	0.3482	0.5379	10.40	646	1.04	EXST. CH.
305	I-94 TO MH3-1	A-94	0.829	0.849	1.678		0.52	3.81	10.00	5.80	10.0	0.0079	24	0.2309	0.3913	6.40	14	0.04	304
306	I-95 TO I-94	A-95	0.849	0.000	0.849	3.29		3.29	10.00	5.80	5.1	0.0025	24	0.2077	0.3622	3.50	110	0.52	305
307	MH3-2 TO MH3-1			41.146	41.146		0.77	17.90	17.90	4.50	190.7	0.0025	72	0.4171	0.6248	8.48	406	0.80	304
308	I-96 TO MH3-2	A-96	0.834	0.755	1.589		0.54	3.56	10.00	5.80	9.5	0.0079	24	0.2187	0.3760	6.31	14	0.04	307
309	I-97 TO I-96	A-97	0.755	0.000	0.755	3.02		3.02	10.00	5.80	4.5	0.0025	24	0.1847	0.3318	3.40	110	0.54	308
310	MH3-3 TO MH3-2			39.557	39.557		0.74	17.13	17.13	4.65	189.5	0.0025	72	0.4144	0.6211	8.47	391	0.77	307
311	I-98 TO MH3-3	A-98	0.842	0.766	1.608		0.54	3.58	10.00	5.80	9.6	0.0079	24	0.2213	0.3795	6.33	14	0.04	310
312	I-99 TO I-98	A-99	0.766	0.000	0.766	3.04		3.04	10.00	5.80	4.6	0.0025	24	0.1874	0.3354	3.41	110	0.54	311
313	MH3-4 TO MH3-3			37.949	37.949		0.71	16.39	16.39	4.75	185.7	0.0025	72	0.4061	0.6106	8.45	376	0.74	310
314	I-100 TO MH3-4	A-100	0.846	0.773	1.619		0.54	3.50	10.00	5.80	9.7	0.0079	24	0.2228	0.3812	6.34	14	0.04	313
315	I-101 TO I-100	A-101	0.773	0.000	0.773	2.96		2.96	10.00	5.80	4.6	0.0025	24	0.1891	0.3377	3.42	110	0.54	314
316	MH3-5 TO MH3-4			36.330	36.330		0.68	15.67	15.67	4.85	181.5	0.0025	72	0.3970	0.5989	8.42	361	0.71	313
317	I-102 TO MH3-5	A-102	0.831	0.729	1.560		0.54	3.34	10.00	5.80	9.3	0.0079	24	0.2147	0.3710	6.28	14	0.04	316
318	I-103 TO I-102	A-103	0.729	0.000	0.729	2.80		2.80	10.00	5.80	4.4	0.0025	24	0.1783	0.3226	3.37	110	0.54	317
319	MH3-6 TO MH3-5			34.770	34.770		0.67	14.99	14.99	4.95	177.3	0.0025	72	0.3877	0.5869	8.39	341	0.68	316
320	I-104 TO MH3-6	A-104	0.849	0.716	1.565		0.55	3.19	10.00	5.80	9.3	0.0071	24	0.2272	0.3867	6.04	14	0.04	319
321	I-105 TO I-104	A-105	0.716	0.000	0.716	2.64		2.64	10.00	5.80	4.3	0.0025	24	0.1751	0.3192	3.35	110	0.55	320
322	MH3-7 TO MH3-6			33.205	33.205		0.66	14.32	14.32	5.00	171.0	0.0025	72	0.3740	0.5701	8.33	336	0.67	319

Q=CiAEf: Ef = Factor accounting for future expansion of Roadway

Computed by: J.N. McCasson Checked by: GES 9/88

LOCATION DATA

Highway: Superstition Freeway
Location: Power Road to Ellsworth Road
Project No. F-028-1-311

TABLE 13. PHASE II AND III: STORM SEWER FLOW CALCULATIONS

Location		Drainage Area				Time of Concentration (Tc min.)											Travel		
Line No.	From-To	Inc. No.	Inc. CA	SUM Upstream CA	Total CA	Inlet	Sewer (Tt)	Total Tc	Design	i in./hr.	Q=CiAEF cfs	Slope ft./ft.	Diam. in.	Formula #1	A/D^2	Velocity fps.	Length ft.	Time (Tt) (min.)	Downstream Line No.
323	I-106 TO MH3-7	A-106	0.864	0.712	1.576		0.53	3.17	10.00	5.80	9.4	0.0079	24	0.2169	0.3738	6.30	14	0.04	322
324	I-107 TO I-106	A-107	0.712	0.000	0.712	2.64		2.64	10.00	5.80	4.3	0.0028	24	0.1646	0.3049	3.47	110	0.53	323
325	MH3-8 TO MH3-7			31.629	31.629		0.61	13.66	13.66	5.10	166.1	0.0025	72	0.3634	0.5563	8.30	331	0.66	322
326	I-108 TO MH3-8	A-108	0.804	0.646	1.450		0.54	2.94	10.00	5.80	8.7	0.0064	24	0.2217	0.3798	5.70	14	0.04	325
327	I-109 TO I-108	A-109	0.646	0.000	0.646	2.40		2.40	10.00	5.80	3.9	0.0028	24	0.1493	0.2840	3.40	110	0.54	326
328	MH3-9 TO MH3-8			30.179	30.179		0.63	13.05	13.05	5.20	161.6	0.0025	72	0.3535	0.5446	8.24	301	0.61	325
329	I-110 TO MH3-9	A-110	0.988	0.797	1.785		0.48	3.52	10.00	5.80	10.7	0.0100	24	0.2183	0.3756	7.10	14	0.03	328
330	I-111 TO I-110	A-111	0.797	0.000	0.797	3.04		3.04	10.00	5.80	4.8	0.0034	24	0.1672	0.3085	3.86	110	0.48	329
331	MH3-10 TO MH3-9			28.394	28.394		0.57	12.42	12.42	5.30	155.0	0.0043	60	0.4204	0.6295	9.85	371	0.63	328
332	I-112 TO MH3-10	A-112	0.858	0.692	1.550		0.37	2.93	10.00	5.80	9.3	0.0073	24	0.2219	0.3801	6.09	15	0.04	331
333	I-113 TO I-112	A-113	0.692	0.000	0.692	2.56		2.56	10.00	5.80	4.1	0.0075	24	0.0977	0.2091	4.94	110	0.37	332
334	MH3-11 TO MH3-10			26.844	26.844		0.61	11.85	11.85	5.40	149.3	0.0040	60	0.4198	0.6287	9.50	326	0.57	331
335	I-114 TO MH3-11	A-114	1.098	1.738	2.836		0.26	6.99	10.00	5.80	16.9	0.0420	24	0.1693	0.3113	13.61	15	0.02	334
336	I-115 TO I-114	A-115	1.738	0.000	1.738	6.73		6.73	10.00	5.80	10.4	0.0101	24	0.2115	0.3671	7.07	110	0.26	335
337	MH3-12 TO MH3-11			24.008	24.008		0.88	11.24	11.24	5.55	137.2	0.0071	54	0.3836	0.5822	11.64	426	0.61	334
338	I-116 TO MH3-12	A-116	1.378	0.000	1.378	4.41		4.41	10.00	5.80	8.2	0.1838	24	0.0393	0.1093	18.33	16	0.01	337
339	I-117 TO TEE	A-117	1.122	0.000	1.122	4.16		4.16	10.00	5.80	6.7	0.0226	24	0.0913	0.1991	8.42	134	0.27	341
340	I-118 TO TEE	A-118	0.267	0.000	0.267	0.84		0.84	10.00	5.80	1.6	0.0853	24	0.0112	0.0452	8.82	17	0.03	341
341	MH3-13 TO MH3-12			22.630	22.630		1.25	10.35	10.35	5.75	134.0	0.0080	54	0.3529	0.5439	12.17	646	0.88	337
342	I-119 TO MH3-13	A-119	0.255	2.516	2.771		0.34	5.48	10.00	5.80	16.6	0.0394	24	0.1707	0.3133	13.21	16	0.02	341
343	I-120 TO I-119	A-120	0.243	2.273	2.516		0.35	5.14	10.00	5.80	15.0	0.0037	24	0.5059	0.7854	4.78	97	0.34	342
344	I-121 TO I-120	A-121	0.246	2.027	2.273		0.32	4.79	10.00	5.80	13.6	0.0035	24	0.4699	0.7854	4.32	92	0.35	343
345	I-122 TO I-121	A-122	0.235	1.792	2.027		0.38	4.47	10.00	5.80	12.1	0.0035	24	0.4191	0.6276	4.82	92	0.32	344

Q=CiAEF: EF = Factor accounting for future expansion of Roadway

Computed by: J.N. McCammon Checked by: GES 9/88

LOCATION DATA

Highway: Superstition Freeway
Location: Power Road to Ellsworth Road
Project No. F-028-1-311

TABLE 13. PHASE II AND III: STORM SEWER FLOW CALCULATIONS

Location		Drainage Area				Time of Concentration (Tc min.)				i	Q=CiAEf	Slope	Diam.	Formula	A/D^2	Velocity	Travel		
Line No.	From-To	Inc. No.	Inc. CA	SUM Upstream CA	Total CA	Inlet	Sewer (Tt)	Total Tc	Design	in./hr.	cfs	ft./ft.	in.	#1		fps.	Length ft.	Time (Tt) (min.)	Downstream Line No.
346	I-123 TO I-122	A-123	0.238	0.483	0.721		0.43	1.65	10.00	5.80	4.3	0.0036	24	0.1470	0.2808	3.83	87	0.38	345
347	I-124 TO I-123	A-124	0.239	0.244	0.483		0.50	1.22	10.00	5.80	2.9	0.0034	24	0.1013	0.2146	3.36	87	0.43	346
348	I-125 TO I-124	A-125	0.244	0.000	0.244	0.72		0.72	10.00	5.80	1.5	0.0039	24	0.0478	0.1255	2.90	87	0.50	347
349	MH3-14 TO M3-13			18.470	18.470		0.85	9.11	10.00	5.80	110.3	0.0038	54	0.4216	0.6313	8.63	646	1.25	341
350	I-126 - I-122	A-126	1.071	0.000	1.071	4.09		4.09	10.00	5.80	6.4	0.0049	24	0.1871	0.3351	4.77	122	0.43	345
351	I-127 TO MH3-14	A-127	0.238	3.261	3.499		0.19	8.26	10.00	5.80	20.9	0.0063	30	0.2974	0.4753	7.04	16	0.04	349
352	I-128 TO I-127	A-128	0.243	3.018	3.261		0.20	8.06	10.00	5.80	19.5	0.0067	30	0.2888	0.4398	7.09	82	0.19	351
353	I-129 TO I-128	A-129	0.250	2.768	3.018		0.51	7.86	10.00	5.80	18.0	0.0067	24	0.4510	0.6709	6.72	82	0.20	352
354	I-130 TO I-129	A-130	0.201	2.066	2.267		0.26	5.55	10.00	5.80	13.5	0.0035	24	0.4687	0.7854	4.31	133	0.51	353
355	I-131 TO I-130	A-131	0.197	1.869	2.066		0.35	5.29	10.00	5.80	12.3	0.0055	24	0.3407	0.5281	5.84	92	0.26	354
356	I-132 TO I-131	A-132	0.207	1.662	1.869		0.35	4.95	10.00	5.80	11.2	0.0026	24	0.4483	0.6673	4.18	87	0.35	355
357	I-133 T I-132	A-133	0.205	1.457	1.662		0.33	4.59	10.00	5.80	9.9	0.0026	24	0.3987	0.6011	4.13	87	0.35	356
358	I-134 TO I-133	A-134	0.192	1.265	1.457		0.30	4.26	10.00	5.80	8.7	0.0027	24	0.3430	0.5507	4.10	82	0.33	357
359	I-135 TO I-134	A-135	0.311	0.954	1.265		0.36	3.96	10.00	5.80	7.6	0.0028	24	0.2924	0.4692	4.03	72	0.30	358
360	I-136 TO I-135	A-136	0.494	0.460	0.954		0.15	3.60	10.00	5.80	5.7	0.0067	24	0.1426	0.2747	5.19	112	0.36	359
361	I-137 TO I-136	A-137	0.460	0.000	0.460	3.45		3.45	10.00	5.80	2.7	0.0227	24	0.0373	0.1055	6.51	60	0.15	360
362	I-138 TO I-129	A-138	0.255	0.246	0.501		0.47	7.35	10.00	5.80	3.0	0.0073	24	0.0717	0.1675	4.47	82	0.31	353
363	I-139 TO I-138	A-139	0.246	0.000	0.246	0.64		0.64	10.00	5.80	1.5	0.0037	24	0.0482	0.1262	2.91	82	0.47	362
364	MH3-15 TO MH3-14			14.971	14.971		0.82	6.88	10.00	5.80	87.4	0.0036	54	0.3511	0.5417	8.15	416	0.85	349
365	I-140 TO MH3-15	A-140	0.250	1.577	1.827		0.30	3.88	10.00	5.80	10.9	0.0468	24	0.1012	0.2143	12.73	16	0.02	364
366	I-141 TO I-140	A-141	0.257	1.320	1.577		0.33	3.58	10.00	5.80	9.4	0.0030	24	0.3522	0.5430	4.34	77	0.30	363
367	I-142 TO I-141	A-142	0.215	1.105	1.320		0.25	3.25	10.00	5.80	7.9	0.0025	24	0.3229	0.5065	3.89	77	0.33	366
368	I-143 TO I-142	A-143	0.391	0.714	1.105		0.13	3.01	10.00	5.80	6.6	0.0034	24	0.2318	0.3724	4.21	62	0.25	367

Q=CiAEf: Ef = Factor accounting for future expansion of Roadway

Computed by: J.N. McCaxmon Checked by: ACS 9/88

LOCATION DATA

Highway: Superstition Freeway
Location: Power Road to Ellsworth Road
Project No. F-028-1-311

TABLE 13. PHASE II AND III: STORM SEWER FLOW CALCULATIONS

Location		Drainage Area				Time of Concentration (Tc min.)				i	Q=CiAEf	Slope	Diam.	Formula	A/D^2	Velocity	Travel Time (Tt)		
Line No.	From-To	Inc. No.	Inc. CA	SUM Upstream CA*	Total CA	Inlet	Sewer (Tt)	Total Tc	Design	in./hr.	cfs	ft./ft.	in.	#1		fps.	Length ft.	Time (min.)	Downstream Line No.
369	I-144 TO I-143	A-144	0.714	0.000	0.714	2.88		2.88	10.00	5.80	4.3	0.0171	24	0.0668	0.1592	6.70	51	0.13	368
370	MH3-16 TO MH3-15			13.144	13.144		0.38	6.06	10.00	5.80	78.5	0.0039	48	0.4054	0.6098	8.05	394	0.82	364
371	I-145 TO MH3-16	A-145	0.443	0.000	0.443	4.81		4.81	10.00	5.80	2.6	0.0275	24	0.0327	0.0960	6.89	16	0.04	370
372	MH3-17 TO MH3-16			12.701	12.701		0.44	5.66	10.00	5.80	75.9	0.0069	48	0.2945	0.4718	10.05	230	0.38	370
373	I-146 TO MH3-17	A-146	0.542	1.211	1.753		0.31	5.24	10.00	5.80	10.5	0.0200	24	0.1516	0.2872	9.12	16	0.03	372
374	I-147 TO I-146	A-147	0.516	0.695	1.211		0.12	4.93	10.00	5.80	7.2	0.0080	24	0.1656	0.3063	5.90	110	0.31	373
375	I-148 TO I-147	A-148	0.695	0.000	0.695	4.81		4.81	10.00	5.80	4.2	0.0649	24	0.0334	0.0975	10.65	75	0.12	374
376	I-149 TO MH3-17	A-149	0.821	0.000	0.821	4.83		4.83	10.00	5.80	4.9	0.0617	24	0.0404	0.1115	11.00	58	0.09	372
377	MH3-18 TO MH3-17			10.127	10.127		0.55	4.34	10.00	5.80	60.5	0.0069	42	0.3353	0.5215	9.47	251	0.44	372
378	I-150 TO MH3-18	A-150	0.793	0.739	1.532		0.36	2.76	10.00	5.80	9.2	0.0094	24	0.1933	0.3432	6.67	17	0.04	377
379	I-151 TO I-150	A-151	0.739	0.000	0.739	2.40		2.40	10.00	5.80	4.4	0.0080	24	0.1011	0.2142	5.15	110	0.36	378
380	MH3-19 TO MH3-18			8.595	8.595		0.47	3.78	10.00	5.80	51.3	0.0069	36	0.4292	0.6408	8.90	296	0.55	377
381	I-152 TO MH3-19	A-152	1.406	2.716	4.122		0.29	2.05	10.00	5.80	24.6	0.0289	24	0.2966	0.4743	12.98	18	0.02	380
382	I-153 TO I-152	A-153	1.433	1.283	2.716		0.05	1.75	10.00	5.80	16.2	0.0059	24	0.4325	0.6454	6.29	110	0.29	381
383	MH3-20 TO I-153		0.000	1.283	1.283		0.15	1.70	10.00	5.80	7.7	0.0211	24	0.1080	0.2247	8.53	26	0.05	382
384	MH-D TO MH3-20		0.000	1.283	1.283	1.55		1.55	10.00	5.80	7.7	0.0474	24	0.0721	0.1681	11.40	105	0.15	383
385	MH-E TO MH3-19		0.000	0.213	0.213		0.00	3.31	10.00	5.80	1.3	0.1930	24	0.0059	0.0290	10.96	88	0.13	386
386	MH3-21 TO MH3-19		0.000	4.473	4.473		0.47	3.31	10.00	5.80	26.7	0.0178	24	0.4101	0.6156	10.85	306	0.47	380
* 387	MH3-22 TO MH3-21		0.000	4.260	4.260	2.84		2.84	10.00	5.80	25.4	0.0178	24	0.3905	0.5905	10.77	306	0.47	386
414	MH4-1 to CHN 1			0.227	0.227	0.36	0.17	0.53	10.00	5.80	1.4	0.0140	24	0.0235	0.0761	4.46	142	0.53	CHN 1
415	I-9 to TEE	A-9	0.178	0.178	0.356	1.92	0.37	2.29	10.00	5.80	2.1	0.2685	24	0.0084	0.0370	14.37	98	0.11	107

*Upstream areas: inlet and storm design by Coe & Van Loo

Q=CiAEf: Ef = Factor accounting for future expansion of Roadway

Computed by: J.N. McCamson Checked by: GeS 9/88

LOCATION DATA
Highway: Superstition Freeway
Location: Power Road to Ellsworth Road
Project No. F-028-1-311

DESIGN DATA
Frequency 50 years
P6= 2.70 in. P24= 3.20 in. P1= 2.15 in.
Outlet TW Elev. = 1342.31

TABLE 14. PHASE II AND PHASE III: HYDRAULIC GRADE LINE CALCULATIONS

Location				Sewer Profile						HGL for Surcharged Pipe						HGL for Non-Surcharged Pipe						HGL @	Rim/Inlet	Freeboard
No.	From-To	Qdesign (cfs)	Diam. (in.)	EGL Dnsta.	Crown Elevation Upsta.	Crown Elevation Dnsta.	L (ft.)	Slope (ft/ft)	Vfull (fps)	V^2/2g (ft.)	SF (ft/ft)	hL (ft.)	Total Form loss	EGL Upsta.	WSEL Upsta.	Normal Depth	Velocity (fps)	Inv. Upsta.	Entrance Loss	EGL Upsta.	WSEL Upsta.	Upsta. End	Elev. (ft.)	(El.-HGL) (ft.)
TRUNK LINE NO. 1 ("100" SERIES)																								
101	MH1-1 to Outfall	170.7	66	1343.11	1344.28	1344.05	80.0	0.0029	7.19	0.80	0.0026	0.21	0.15	1343.47	1342.67	4.27	8.38	1338.78	0.22	1344.36	1343.27	1343.27	1356.90	13.63
102	MH1-2 to MH1-1	170.7	66	1344.36	1345.56	1344.29	527.0	0.0024	7.19	0.80	0.0025	1.36	0.00	1345.72	1344.92	5.50	7.77	1340.06	0.19	1346.69	1345.75	1345.75	1360.60	14.85
103	MH1-3 to MH1-2	170.7	66	1346.69	1347.18	1345.57	641.0	0.0025	7.19	0.80	0.0026	1.66	0.00	1348.34	1347.54	5.50	7.96	1341.68	0.20	1348.36	1347.38	1347.54	1364.20	16.66
104	MH1-4 to MH1-3	170.7	66	1348.34	1348.88	1347.19	672.0	0.0025	7.19	0.80	0.0026	1.74	0.00	1350.08	1349.27	5.50	8.00	1343.38	0.20	1350.07	1349.08	1349.27	1358.90	9.63
105	MH1-5 to MH1-4	170.7	66	1350.08	1350.54	1348.89	655.0	0.0025	7.19	0.80	0.0026	1.69	0.00	1351.77	1350.97	5.50	8.03	1345.04	0.20	1351.74	1350.74	1350.97	1360.30	9.33
106	MH1-6 to MH1-5	170.7	66	1351.77	1352.15	1350.55	635.0	0.0025	7.19	0.80	0.0026	1.64	0.14	1353.55	1352.74	5.50	8.05	1346.65	0.20	1353.36	1352.35	1352.74	1361.60	8.86
107	MH1-7 to MH1-6	170.7	66	1353.55	1353.08	1352.16	368.0	0.0025	7.19	0.80	0.0026	0.95	0.22	1354.72	1353.92	5.50	7.19	1347.58	0.16	1354.04	1353.24	1353.92	1359.40	5.48
189	MH1-8 TO MH1-7	164.5	66	1354.72	1353.63	1353.10	104.0	0.0051	6.92	0.74	0.0024	0.25	0.00	1354.97	1354.22	3.35	10.87	1348.13	0.37	1353.68	1351.84	1354.22	1359.80	5.58
113	MH1-9 to MH1-8	159.7	60	1354.97	1355.45	1353.60	358.0	0.0052	8.13	1.03	0.0038	1.35	0.24	1356.55	1355.52	3.55	10.74	1350.45	0.36	1356.15	1354.36	1355.52	1361.50	5.98
118	MH1-10 to MH1-9	145.7	60	1356.55	1357.54	1355.47	416.0	0.0050	7.42	0.86	0.0031	1.30	0.00	1357.85	1357.00	3.36	10.41	1352.54	0.34	1357.92	1356.24	1357.00	1363.20	6.20
126	MH1-11 TO MH1-10	130.9	54	1357.85	1359.70	1357.56	517.0	0.0041	8.23	1.05	0.0044	2.29	0.56	1360.70	1359.65	4.50	8.25	1355.20	0.21	1360.96	1359.91	1359.91	1366.00	6.09
145	MH1-12 TO MH1-11	97.6	54	1360.96	1362.36	1359.72	621.0	0.0043	6.14	0.58	0.0025	1.53	0.00	1362.49	1361.91	2.94	8.91	1357.86	0.25	1362.28	1361.05	1361.91	1368.30	6.39
152	MH1-13 TO MH1-12	89.0	42	1362.49	1364.38	1362.38	400.0	0.0050	9.25	1.33	0.0078	3.13	0.36	1365.97	1364.64	3.50	9.25	1360.88	0.27	1365.97	1364.65	1364.65	1370.00	5.35
155	TEE 156 TO MH1-13	83.2	42	1365.97	1365.56	1364.40	237.0	0.0049	8.65	1.16	0.0068	1.62	0.00	1367.60	1366.43	3.50	8.65	1362.06	0.23	1366.96	1365.79	1366.43	N/A	N/A
159	MH1-14 TO TEE 156	83.2	42	1367.60	1365.64	1365.56	18.0	0.0047	8.65	1.16	0.0068	0.12	0.10	1367.82	1366.65	3.50	8.65	1362.14	0.23	1367.04	1365.87	1366.65	1371.00	4.35
160	TEE 161 TO MH1-14	72.5	36	1367.82	1367.85	1365.68	166.0	0.0131	10.26	1.63	0.0118	1.96	0.00	1369.77	1368.14	2.34	12.29	1364.85	0.47	1370.00	1367.66	1368.14	N/A	N/A
150	MH1-15 TO TEE 161	72.5	36	1369.77	1368.96	1367.85	85.0	0.0131	10.26	1.63	0.0118	1.00	0.65	1371.43	1369.80	2.34	12.29	1365.96	0.47	1371.11	1368.77	1369.80	1373.50	3.70
166	TEE 165 TO MH1-15	61.1	36	1371.43	1370.36	1369.02	89.0	0.0150	8.64	1.16	0.0084	0.75	0.00	1372.18	1371.02	1.93	12.68	1367.36	0.50	1372.29	1369.79	1371.02	N/A	N/A
168	MH1-16 TO TEE 165	61.1	36	1372.18	1372.78	1370.36	162.0	0.0150	8.64	1.16	0.0084	1.36	0.01	1373.54	1372.39	1.94	12.68	1369.78	0.50	1374.71	1372.22	1372.39	1378.40	6.01
173	TEE 172 TO MH1-16	47.6	30	1373.54	1376.17	1372.86	127.0	0.0261	9.70	1.46	0.0135	1.71	0.00	1375.25	1373.79	1.57	14.69	1373.67	0.67	1379.26	1375.91	1373.91	N/A	N/A
175	TEE 174 TO TEE 172	47.6	30	1379.26	1376.72	1376.17	21.0	0.0261	9.70	1.46	0.0135	0.28	0.00	1379.54	1378.08	1.57	14.69	1374.22	0.67	1379.81	1376.46	1378.08	N/A	N/A
173	MH1-18 TO TEE 172	47.6	30	1379.54	1383.85	1376.72	273.0	0.0261	9.70	1.46	0.0135	3.67	1.24	1384.46	1383.00	1.57	14.69	1381.35	0.67	1386.74	1383.59	1383.59	1389.40	5.81

Computed by: J.N. McCammon Date: 5/87 Checked by: GeS Date: 9/88

LOCATION DATA
Highway: Superstition Freeway
Location: Power Road to Ellsworth Road
Project No. F-028-1-311

DESIGN DATA
Frequency 50 years
P6= 2.70 in. P24= 3.20 in. P1= 2.15 in.
Outlet TW Elev. = 1342.31

TABLE 14. PHASE II AND PHASE III: HYDRAULIC GRADE LINE CALCULATIONS

Location				Sewer Profile						HGL for Surcharged Pipe						HGL for Non-Surcharged Pipe						HGL @	Rim/Inlet	Freeboard
No.	From-To	Qdesign (cfs)	Diam. (in.)	EGL Upsta.	Crown Upsta.	Elevation Dnsta.	L (ft.)	Slope (ft/ft)	Vfull (fps)	V^2/2g (ft.)	Sf (ft/ft)	hL (ft.)	Total form loss	EGL Upsta.	WSEL Upsta.	Normal Depth	Velocity (fps)	Inv. Upsta.	Entrance Loss	EGL Upsta.	WSEL Upsta.	Upsta. End	Elev. (ft.)	(El.-HGL) (ft.)
179	TEE 180 TO MH1-18	24.0	30	1386.94	1388.86	1383.95	182.0	0.0270	4.89	0.37	0.0034	0.62	0.00	1387.56	1387.19	1.03	12.57	1386.36	0.49	1390.34	1387.88	1387.88	N/A	N/A
179	MH1-19 TO TEE 180	24.0	30	1390.34	1395.70	1388.86	254.0	0.0270	4.89	0.37	0.0034	0.87	0.03	1391.23	1390.96	1.03	12.57	1393.20	0.49	1397.18	1394.72	1394.72	1400.50	5.78
181	TEE 183 TO MH1-19	17.4	24	1397.18	1396.88	1395.79	58.0	0.0187	5.53	0.47	0.0059	0.34	0.00	1397.52	1397.04	1.07	10.12	1394.83	0.32	1397.86	1396.27	1397.04	N/A	N/A
181	MH1-20 TO TEE 183	17.4	24	1397.52	1400.77	1396.88	208.0	0.0187	5.53	0.47	0.0059	1.22	0.47	1399.21	1396.74	1.07	10.12	1398.77	0.32	1401.75	1400.16	1400.16	1405.20	5.04
108	25 to MH1-7	6.3	24	1354.72	1353.15	1353.11	15.0	0.0027	2.02	0.06	0.0008	0.01	0.06	1354.79	1354.73	1.05	3.81	1351.15	0.05	1352.47	1352.25	1354.73	1357.01	2.28
109	26 to MH1-8	6.2	24	1354.97	1353.91	1353.39	141.0	0.0037	1.96	0.06	0.0007	0.10	0.04	1355.12	1355.06	0.94	4.26	1351.91	0.06	1353.19	1352.90	1355.06	1357.19	2.13
110	27 to 26	4.9	24	1355.12	1354.56	1353.93	79.0	0.0080	1.57	0.04	0.0005	0.04	0.03	1355.18	1355.14	0.67	5.31	1352.56	0.09	1353.76	1353.32	1355.14	1357.59	2.45
111	28 to 27	3.3	24	1355.18	1355.08	1354.56	102.0	0.0049	1.04	0.02	0.0002	0.02	0.01	1355.22	1355.20	0.62	3.97	1353.08	0.05	1353.99	1353.75	1355.20	1358.09	2.89
112	29 to 28	1.6	24	1355.22	1355.58	1355.08	102.0	0.0049	0.52	0.00	0.0001	0.01	0.00	1355.23	1355.22	0.43	3.26	1353.58	0.03	1354.21	1354.05	1355.22	1358.59	3.37
114	30 to MH1-9	14.0	24	1356.55	1355.53	1355.47	17.0	0.0035	4.46	0.31	0.0038	0.07	0.30	1356.92	1356.61	2.00	4.46	1353.53	0.06	1355.90	1355.59	1356.61	1359.08	2.47
115	31 to 30	7.1	24	1356.92	1356.11	1355.55	122.0	0.0046	2.26	0.08	0.0010	0.12	0.06	1357.10	1357.02	0.96	4.79	1354.11	0.07	1355.49	1355.14	1357.02	1359.12	2.10
116	32 to 31	5.5	24	1357.10	1356.64	1356.13	107.0	0.0048	1.75	0.05	0.0006	0.06	0.03	1357.20	1357.15	0.82	4.55	1354.64	0.06	1355.85	1355.52	1357.15	1359.65	2.50
117	33 to 32	3.8	24	1357.20	1357.19	1356.66	112.0	0.0047	1.22	0.02	0.0003	0.03	0.02	1357.25	1357.23	0.68	4.09	1355.19	0.05	1356.18	1355.92	1357.23	1360.20	2.97
119	34 to MH1-10	14.8	24	1357.85	1357.70	1357.58	15.0	0.0080	4.72	0.35	0.0043	0.06	0.18	1358.10	1357.75	1.27	7.04	1355.70	0.15	1357.89	1357.12	1357.75	1360.86	3.11
120	35 to 34	13.3	24	1358.10	1358.06	1357.72	87.0	0.0039	4.23	0.28	0.0035	0.30	0.25	1358.65	1358.37	1.54	5.11	1356.06	0.08	1358.09	1357.68	1358.37	1361.22	2.85
121	36 to 35	5.9	24	1358.65	1358.57	1358.08	87.0	0.0056	1.87	0.06	0.0007	0.06	0.03	1358.74	1358.68	0.82	4.91	1356.57	0.07	1357.84	1357.46	1358.68	1361.58	2.90
122	37 TO 36	4.5	24	1358.74	1358.91	1358.59	82.0	0.0039	1.43	0.03	0.0004	0.03	0.02	1358.79	1358.76	0.77	3.99	1356.91	0.05	1357.98	1357.73	1358.76	1361.92	3.16
123	38 TO 37	3.0	24	1358.79	1359.25	1358.93	82.0	0.0039	0.96	0.01	0.0002	0.01	0.01	1358.82	1358.80	0.63	3.58	1357.25	0.04	1358.12	1357.92	1358.80	1362.26	3.46
124	39 TO 38	1.5	24	1358.82	1359.59	1359.27	82.0	0.0039	0.48	0.00	0.0000	0.00	0.00	1358.83	1358.82	0.44	2.94	1357.59	0.03	1358.19	1358.06	1358.82	1362.60	3.78
125	40 TO 35	5.8	24	1358.10	1358.48	1358.09	118.0	0.0033	1.86	0.05	0.0007	0.08	0.05	1358.23	1358.18	0.94	4.03	1356.48	0.05	1357.72	1357.47	1358.18	1361.43	3.25

Computed by: J.N. McCammon Date: 5/87 Checked by: Gel Date: 9/88

LOCATION DATA
Highway: Superstition Freeway
Location: Power Road to Ellsworth Road
Project No. F-028-1-311

DESIGN DATA
Frequency 50 years
P6= 2.70 in. P24= 3.20 in. P1= 2.15 in.
Outlet TW Elev. = 1342.31

TABLE 14. PHASE II AND PHASE III: HYDRAULIC GRADE LINE CALCULATIONS

Location				Sewer Profile						HGL for Surcharged Pipe					HGL for Non-Surcharged Pipe						HGL @	Rim/Inlet	Freeboard
No.	From-To	Qdesign (cfs)	Diam. (in.)	EGL Dnsta.	Crown Elevation Upsta.	Crown Elevation Dnsta.	L (ft.)	Slope (ft/ft)	Vfull (fps)	V^2/2g (ft.)	Sf (ft/ft)	hL (ft.)	Total form loss	EGL Upsta.	WSEL Upsta.	Normal Depth	Velocity (fps)	Inv. Upsta.	Entrance Loss	EGL Upsta.	WSEL Upsta.	Upsta. End	Elev. (ft.)	(El.-HGL) (ft.)
127	41 TO MH1-11	33.3	30	1360.96	1359.83	1359.73	16.0	0.0063	6.79	0.72	0.0066	0.11	0.56	1361.63	1360.91	2.50	6.79	1357.33	0.14	1360.69	1359.97	1360.91	1362.94	2.03
128	42 TO 41	25.7	30	1361.63	1360.24	1359.85	77.0	0.0051	5.24	0.43	0.0039	0.30	0.07	1362.00	1361.58	1.82	6.73	1357.74	0.14	1360.41	1359.70	1361.58	1363.26	1.68
129	43 TO 42	24.2	30	1362.00	1360.56	1360.26	77.0	0.0039	4.94	0.38	0.0033	0.27	0.07	1362.34	1361.96	1.94	5.93	1358.06	0.11	1360.66	1360.11	1361.96	1363.57	1.61
130	44 TO 43	22.7	30	1362.34	1360.88	1360.58	77.0	0.0039	4.63	0.33	0.0031	0.24	0.06	1362.63	1362.30	1.83	5.90	1358.38	0.11	1360.86	1360.32	1362.30	1363.89	1.59
131	45 TO 44	21.2	30	1362.63	1361.15	1360.89	77.0	0.0034	4.33	0.29	0.0027	0.21	0.06	1362.90	1362.61	1.84	5.51	1358.65	0.09	1361.05	1360.58	1362.61	1364.21	1.60
132	46 TO 45	19.7	30	1362.90	1361.35	1361.15	77.0	0.0026	4.01	0.25	0.0023	0.18	0.16	1363.24	1362.99	1.93	4.84	1358.85	0.07	1361.22	1360.85	1362.99	1364.54	1.55
133	47 TO 46	3.0	24	1363.24	1361.83	1361.36	72.0	0.0065	0.96	0.01	0.0002	0.01	0.01	1363.27	1363.25	0.55	4.29	1359.83	0.06	1360.72	1360.44	1363.25	1364.84	1.59
134	48 TO 47	1.5	24	1363.27	1362.13	1361.85	72.0	0.0039	0.48	0.00	0.0000	0.00	0.00	1363.27	1363.27	0.44	2.94	1360.13	0.03	1360.73	1360.60	1363.27	1365.14	1.87
135	49 TO 41	6.2	24	1361.63	1360.23	1359.36	123.0	0.0071	1.96	0.06	0.0007	0.09	0.06	1361.78	1361.72	0.78	5.41	1358.23	0.09	1359.56	1359.10	1361.72	1363.23	1.51
136	50 TO 46	15.2	24	1363.24	1361.19	1360.85	135.0	0.0025	4.84	0.36	0.0045	0.61	0.17	1364.02	1363.66	2.00	4.84	1359.19	0.07	1361.63	1361.26	1363.66	1364.99	1.33
137	51 TO 50	13.9	24	1364.02	1362.06	1361.70	82.0	0.0044	4.43	0.30	0.0038	0.31	0.08	1364.41	1364.11	1.52	5.43	1360.06	0.09	1362.13	1361.67	1364.11	1365.24	1.13
138	52 TO 51	12.6	24	1364.41	1362.44	1362.08	82.0	0.0044	4.00	0.25	0.0031	0.25	0.07	1364.74	1364.49	1.40	5.35	1360.44	0.09	1362.37	1361.93	1364.49	1365.49	1.00
139	53 TO 52	11.2	24	1364.74	1362.72	1362.46	77.0	0.0034	3.56	0.20	0.0024	0.19	0.06	1364.99	1364.79	1.42	4.71	1360.72	0.07	1362.55	1362.21	1364.79	1365.73	0.94
140	54 TO 53	9.9	24	1364.99	1362.96	1362.73	72.0	0.0032	3.14	0.15	0.0019	0.14	0.05	1365.17	1365.02	1.32	4.49	1360.96	0.06	1362.65	1362.34	1365.02	1365.96	0.94
141	55 TO 54	8.6	24	1365.17	1363.17	1362.96	67.0	0.0031	2.74	0.12	0.0014	0.10	0.05	1365.32	1365.20	1.21	4.31	1361.17	0.06	1362.73	1362.44	1365.20	1366.17	0.97
142	56 TO 55	7.2	24	1365.32	1363.41	1363.17	72.0	0.0033	2.30	0.08	0.0010	0.07	0.05	1365.44	1365.36	1.06	4.24	1361.41	0.06	1362.81	1362.53	1365.36	1366.41	1.05
143	57 TO 56	5.3	24	1365.44	1364.16	1363.42	97.0	0.0076	1.70	0.04	0.0006	0.05	0.05	1365.54	1365.50	0.71	5.33	1362.16	0.09	1363.40	1362.96	1365.50	1367.17	1.67
144	58 TO 57	2.7	24	1365.54	1365.52	1364.21	45.0	0.0291	0.85	0.01	0.0001	0.01	0.01	1365.56	1365.55	0.36	7.04	1363.52	0.15	1364.80	1364.03	1365.55	1367.80	2.05
146	59 TO MH1-12	8.6	24	1362.49	1362.42	1362.38	16.0	0.0025	2.74	0.12	0.0014	0.02	0.05	1362.56	1362.45	1.31	3.96	1360.42	0.05	1362.02	1361.77	1362.45	1363.42	2.97
147	60 TO 59	7.2	24	1362.56	1362.72	1362.43	67.0	0.0043	2.28	0.08	0.0010	0.07	0.04	1362.67	1362.59	0.98	4.69	1360.72	0.07	1362.11	1361.77	1362.59	1365.71	3.12
148	61 TO 60	5.8	24	1362.67	1362.91	1362.73	62.0	0.0029	1.83	0.05	0.0007	0.04	0.03	1362.73	1362.68	0.97	3.84	1360.91	0.05	1362.16	1361.93	1362.68	1365.93	3.25

Computed by: J.N. McCamaon Date: 5/87 Checked by: GCS Date: 9/88

LOCATION DATA
Highway: Superstition Freeway
Location: Power Road to Ellsworth Road
Project No. F-023-1-311

DESIGN DATA
Frequency 50 years
P6= 2.79 in. P24= 3.20 in. P1= 2.15 in.
Outlet TW Elev. = 1342.31

TABLE 14. PHASE II AND PHASE III: HYDRAULIC GRADE LINE CALCULATIONS

Location				Sewer Profile						HGL for Surcharged Pipe						HGL for Non-Surcharged Pipe						HGL @	Rim/Inlet	Freebard
No.	From-To	Qdesign (cfs)	Diam. (in.)	EGL Dnsta.	Crown Elevation Upsta.	Crown Elevation Dnsta.	L (ft.)	Slope (ft/ft)	Vfull (fps)	V^2/2g (ft.)	Sf (ft/ft)	hL (ft.)	Total Form loss	ESL Upsta.	WSEL Upsta.	Normal Depth	Velocity (fps)	Inv. Upsta.	Entrance Loss	EGL Upsta.	WSEL Upsta.	Upsta. End	Elev. (ft.)	(El.-HGL) (ft.)
149	62 TO 61	4.7	24	1362.73	1363.05	1362.91	52.0	0.0027	1.49	0.03	0.0004	0.02	0.02	1362.78	1362.75	0.88	3.53	1361.05	0.04	1362.16	1361.97	1362.75	1366.05	3.30
150	63 TO 62	3.2	24	1362.78	1363.32	1363.06	67.0	0.0039	1.01	0.02	0.0002	0.01	0.01	1362.81	1362.79	0.63	3.63	1361.32	0.04	1362.21	1362.01	1362.79	1366.31	3.52
151	64 TO 63	1.7	24	1362.81	1363.60	1363.34	67.0	0.0039	0.53	0.00	0.0001	0.00	0.00	1362.82	1362.81	0.47	3.02	1361.60	0.03	1362.24	1362.09	1362.81	1366.59	3.78
153	65 TO MH1-13	5.7	24	1365.97	1364.49	1364.40	17.0	0.0053	1.83	0.05	0.0006	0.01	0.05	1366.04	1365.99	0.81	4.77	1362.49	0.07	1363.73	1363.38	1365.99	1366.96	0.97
154	66 TO 65	2.5	24	1366.04	1365.29	1364.53	41.0	0.0185	0.79	0.01	0.0001	0.00	0.01	1366.05	1366.04	0.38	5.88	1363.29	0.11	1364.32	1363.78	1366.04	1367.76	1.72
156	67 TO TEE	2.2	24	1367.60	1368.97	1364.96	44.0	0.0911	0.70	0.01	0.0001	0.00	0.01	1367.61	1367.60	0.25	9.95	1366.97	0.31	1369.06	1367.52	1367.60	1371.21	3.61
157	70 TO MH1-14	8.5	24	1367.82	1363.75	1365.66	17.0	0.0053	2.72	0.11	0.0014	0.02	0.09	1367.93	1367.81	1.02	5.28	1363.75	0.09	1365.29	1364.86	1367.81	1369.30	1.49
158	71 TO 70	5.3	24	1367.93	1366.32	1365.77	110.0	0.0050	1.69	0.04	0.0006	0.06	0.05	1368.04	1367.99	0.79	4.58	1364.32	0.07	1365.50	1365.18	1367.99	1369.30	1.31
159	72 TO 71	2.2	24	1368.04	1369.62	1366.39	80.0	0.0404	0.71	0.01	0.0001	0.01	0.01	1368.05	1368.04	0.30	7.49	1367.62	0.17	1368.97	1368.10	1368.10	1371.78	3.68
161	68 TO TEE	2.0	24	1369.77	1374.93	1367.50	73.0	0.1018	0.64	0.01	0.0001	0.01	0.01	1369.79	1369.78	0.23	10.29	1372.93	0.33	1375.13	1373.49	1373.49	1377.18	3.69
162	73 TO MH1-15	9.4	24	1371.43	1368.80	1368.71	18.0	0.0050	2.99	0.14	0.0017	0.03	0.11	1371.57	1371.43	1.10	5.29	1366.80	0.09	1368.43	1367.99	1371.43	1372.33	0.90
163	74 TO 73	5.5	24	1371.57	1369.37	1368.82	110.0	0.0050	1.75	0.05	0.0006	0.06	0.05	1371.69	1371.64	0.81	4.62	1367.37	0.07	1368.58	1368.24	1371.64	1372.33	0.69
164	75 TO 74	1.7	24	1371.69	1377.47	1369.48	121.0	0.0660	0.53	0.00	0.0001	0.01	0.00	1371.70	1371.70	0.23	8.17	1375.47	0.21	1376.95	1375.91	1375.91	1379.66	3.75
165	69 TO TEE	2.9	24	1372.18	1383.44	1370.07	95.0	0.1407	0.93	0.01	0.0002	0.02	0.01	1372.20	1372.19	0.25	12.61	1381.44	0.49	1384.66	1382.19	1382.19	1385.75	3.56
167	76 TO MH1-16	10.5	24	1373.54	1373.21	1372.60	18.0	0.0339	3.36	0.17	0.0022	0.04	0.10	1373.68	1373.51	0.69	11.06	1371.21	0.38	1374.18	1372.28	1373.51	1376.82	3.31
168	77 TO 76	7.9	24	1373.68	1373.85	1373.27	110.0	0.0053	2.52	0.10	0.0012	0.13	0.07	1373.89	1373.79	0.98	5.19	1371.85	0.08	1373.33	1372.91	1373.79	1376.82	3.03
169	MH1-17 TO 77	5.4	24	1373.89	1375.61	1373.96	26.0	0.0635	1.71	0.05	0.0006	0.01	0.04	1373.95	1373.90	0.41	11.41	1373.61	0.40	1376.45	1374.43	1374.43	1380.70	6.27
170	MH-A TO MH1-17	3.1	24	1376.45	1394.24	1377.39	146.0	0.1154	0.99	0.02	0.0002	0.03	0.02	1376.49	1376.48	0.27	11.96	1392.24	0.44	1395.18	1392.96	1392.96	1400.40	7.44

Computed by: J.N. McCasson Date: 5/87 Checked by: GEJ Date: 9/88

LOCATION DATA
Highway: Superstition Freeway
Location: Power Road to Ellsworth Road
Project No. F-028-1-311

DESIGN DATA
Frequency 50 years
P6= 2.70 in. P24= 3.20 in. P1= 2.15 in.
Outlet TW Elev. = 1342.31

TABLE 14. PHASE II AND PHASE III: HYDRAULIC GRADE LINE CALCULATIONS

Location				Sewer Profile					HGL for Surcharged Pipe							HGL for Non-Surcharged Pipe						HGL @	Rim/Inlet	Freebard
No.	From-To	Qdesign (cfs)	Diam. (in.)	EGL Dnsta.	Crown Elevation Dnsta.	Crown Elevation Upsta.	L (ft.)	Slope (ft/ft)	Vfull (fps)	V^2/2g (ft.)	Sf (ft/ft)	hL (ft.)	Total form loss	EGL Upsta.	WSEL Upsta.	Normal Depth	Velocity (fps)	Inv. Upsta.	Entrance Loss	EGL Upsta.	WSEL Upsta.	Upsta. End	Elev. (ft.)	(El.-HGL) (ft.)
171	178 TO MH1-17	2.3	24	1376.45	1387.59	1375.74	165.0	0.0718	0.72	0.01	0.0001	0.02	0.01	1376.48	1376.47	0.26	9.24	1385.59	0.27	1387.45	1386.12	1386.12	1389.28	3.16
172	MH-9 TO TEE	2.8	24	1379.26	1398.77	1376.25	85.0	0.2649	0.89	0.01	0.0002	0.01	0.01	1379.29	1379.27	0.21	15.50	1376.77	0.75	1401.46	1397.73	1397.73	1403.50	5.77
174	179 TO TEE	6.3	24	1379.54	1376.59	1376.49	18.0	0.0056	1.99	0.06	0.0008	0.01	0.05	1379.61	1379.55	0.84	4.98	1374.59	0.08	1375.90	1375.51	1379.55	1380.14	0.59
175	180 TO 79	3.1	24	1379.61	1377.16	1376.61	110.0	0.0050	1.00	0.02	0.0002	0.02	0.02	1379.65	1379.63	0.60	3.95	1375.16	0.05	1376.05	1375.81	1379.63	1380.14	0.51
176	181 TO MH1-18	14.6	24	1386.94	1383.99	1383.90	18.0	0.0050	4.64	0.33	0.0041	0.07	0.28	1387.30	1386.96	1.50	5.77	1381.99	0.10	1384.11	1383.59	1383.59	1387.54	3.95
177	182 TO 81	7.8	24	1384.11	1334.56	1384.01	110.0	0.0050	2.49	0.10	0.0012	0.13	0.11	1384.35	1384.25	0.99	5.07	1382.56	0.08	1384.03	1383.63	1383.63	1387.54	3.91
178	183 TO 82	0.7	24	1384.03	1399.94	1384.73	144.0	0.1056	0.23	0.00	0.0000	0.00	0.00	1384.03	1384.03	0.14	7.45	1397.94	0.17	1399.11	1398.25	1398.25	1402.20	3.95
180	184 TO TEE	1.6	24	1390.34	1400.80	1388.76	99.0	0.1216	0.52	0.00	0.0001	0.01	0.00	1390.35	1390.34	0.20	10.03	1398.80	0.31	1400.87	1399.31	1399.31	1403.07	3.76
182	185 TO MH1-19	5.0	24	1397.18	1399.94	1395.84	59.0	0.0695	1.60	0.04	0.0005	0.03	0.04	1397.24	1397.20	0.39	11.54	1397.94	0.41	1400.81	1398.75	1398.75	1402.14	3.39
183	186 TO TEE	9.2	24	1397.52	1396.97	1396.88	18.0	0.0050	2.93	0.13	0.0017	0.03	0.10	1397.64	1397.51	1.09	5.27	1394.97	0.09	1396.58	1396.15	1397.51	1400.63	3.12
184	187 TO 86	6.0	24	1397.64	1397.54	1396.99	110.0	0.0050	1.91	0.06	0.0007	0.08	0.06	1397.78	1397.73	0.85	4.73	1395.54	0.07	1396.80	1396.46	1397.73	1400.63	2.90
185	188 TO 87	3.1	24	1397.78	1398.53	1397.56	195.0	0.0050	0.97	0.01	0.0002	0.04	0.01	1397.83	1397.82	0.59	3.93	1396.53	0.05	1397.41	1397.17	1397.82	1401.54	3.72
186	189 TO MH1-20	5.3	24	1401.75	1401.76	1400.82	189.0	0.0050	1.68	0.04	0.0005	0.10	0.04	1401.89	1401.85	0.79	4.57	1399.76	0.06	1400.94	1400.62	1401.85	1405.37	3.52
187	190 TO 89	2.4	24	1401.89	1406.96	1401.80	227.0	0.0227	0.78	0.01	0.0001	0.03	0.01	1401.93	1401.92	0.36	6.28	1404.96	0.12	1406.06	1405.44	1405.44	1409.09	3.65
188	191 TO MH1-20	2.9	24	1401.75	1405.81	1400.86	211.0	0.0235	0.91	0.01	0.0002	0.03	0.01	1401.80	1401.78	0.39	6.67	1403.81	0.14	1405.03	1404.34	1404.34	1407.95	3.61

Computed by: J.N. McCammon Date: 5/87 Checked by: CES Date: 9/88

ARIZONA DEPARTMENT OF TRANSPORTATION

LOCATION DATA
Highway: Superstition Freeway
Location: Power Road to Ellsworth Road
Project No. F-028-1-311

DESIGN DATA
Frequency 50 years
P6= 2.70 in. P24= 3.20 in. P1= 2.15 in.
Outlet TW Elev. = 1346.70

TABLE 14. PHASE II AND PHASE III: HYDRAULIC GRADE LINE CALCULATIONS

Location				Sewer Profile						HGL for Surcharged Pipe						HGL for Non-Surcharged Pipe								
No.	From-To	Qdesign (cfs)	Diam. (in.)	EGL Dnsta.	Crown Elevation Upsta.	Crown Elevation Dnsta.	L (ft.)	Slope (ft/ft)	Vfull (fps)	V^2/2g (ft.)	Sf (ft/ft)	hL (ft.)	Total form loss	EGL Upsta.	WSEL Upsta.	Normal Depth	Velocity (fps)	Inv. Upsta.	Entrance Loss	ESL Upsta.	WSEL Dnsta.	HGL @ Upsta. End	Rim/Inlet Elev. (ft.)	Freeboard (El.-HGL) (ft.)
TRUNK LINE NO. 2 (*200* SERIES)																								
201	TEE 212 TO EXMH	54.7	42	1347.20	1347.21	1346.70	183.0	0.0029	5.68	0.50	0.0030	0.54	0.00	1347.74	1347.24	3.50	5.68	1343.71	0.10	1347.81	1347.31	1347.31	N/A	N/A
201	MH2-1 TO TEE 212	54.7	42	1347.91	1347.39	1347.21	63.0	0.0029	5.68	0.50	0.0030	0.19	0.18	1348.17	1347.67	3.50	5.68	1343.89	0.10	1347.99	1347.49	1347.67	1351.60	3.93
202	TEE 213 TO MH2-1	38.0	36	1348.17	1347.75	1347.41	135.0	0.0025	5.38	0.45	0.0033	0.44	0.00	1348.61	1348.16	3.00	5.38	1344.75	0.09	1348.29	1347.84	1348.16	N/A	N/A
202	TEE 214 TO TEE 213	38.0	36	1348.61	1348.35	1347.75	249.0	0.0024	5.38	0.45	0.0033	0.81	0.00	1349.42	1348.97	3.00	5.38	1345.35	0.09	1348.89	1348.44	1348.97	N/A	N/A
202	MH2-2 TO TEE 214	38.0	36	1349.42	1348.48	1348.35	52.0	0.0025	5.38	0.45	0.0033	0.17	0.40	1349.99	1349.54	3.00	5.38	1345.48	0.09	1349.02	1348.57	1349.54	1353.40	3.86
212	3 TO TEE	1.3	24	1347.81	1360.52	1346.70	99.0	0.1396	0.42	0.00	0.0000	0.00	0.00	1347.82	1347.82	0.17	9.91	1358.52	0.30	1360.52	1359.00	1359.00	1362.83	3.83
215	1 TO MH2-1	15.3	30	1348.17	1347.42	1347.41	5.0	0.0020	3.12	0.15	0.0014	0.01	0.06	1348.24	1348.09	1.75	4.18	1344.92	0.05	1346.99	1346.72	1348.09	1350.98	2.89
216	2 TO 1	9.8	24	1348.24	1347.71	1347.42	110.0	0.0026	3.11	0.15	0.0019	0.20	0.15	1348.59	1348.44	1.40	4.12	1345.71	0.05	1347.43	1347.17	1348.44	1350.98	2.54
217	14 TO 2	1.5	24	1348.59	1360.46	1347.89	104.0	0.1211	0.46	0.00	0.0000	0.00	0.00	1348.60	1348.59	0.19	9.70	1358.48	0.29	1360.42	1358.96	1358.96	1362.76	3.80
218	15 TO 2	2.9	24	1348.59	1351.28	1347.73	322.0	0.0110	0.92	0.01	0.0002	0.05	0.01	1348.65	1348.64	0.47	5.12	1349.28	0.08	1350.24	1349.83	1349.83	1354.30	4.47
213	4 TO TEE	2.1	24	1348.61	1355.24	1347.42	68.0	0.1150	0.67	0.01	0.0001	0.01	0.01	1348.63	1348.62	0.23	10.66	1353.24	0.35	1355.59	1353.82	1353.82	1357.51	3.69
214	5 TO TEE	2.8	24	1349.42	1350.49	1347.94	41.0	0.0622	0.89	0.01	0.0002	0.01	0.01	1349.44	1349.43	0.30	9.33	1348.49	0.27	1350.41	1349.06	1349.43	1352.68	3.25
203	6 TO MH2-2	17.3	30	1349.99	1349.24	1348.99	48.0	0.0052	3.52	0.19	0.0018	0.08	0.03	1350.11	1349.92	1.37	6.25	1346.74	0.12	1348.84	1348.23	1349.92	1352.32	2.40
204	7 TO 6	15.3	24	1350.11	1349.54	1349.26	64.0	0.0044	4.86	0.37	0.0046	0.29	0.12	1350.52	1350.16	2.00	4.86	1347.54	0.07	1349.98	1349.61	1350.16	1352.55	2.39
205	8 TO 7	13.4	24	1350.52	1350.06	1349.56	87.0	0.0057	4.26	0.28	0.0035	0.30	0.10	1350.93	1350.65	1.33	6.02	1348.06	0.11	1350.06	1349.50	1350.65	1353.07	2.42
206	9 TO 8	11.5	24	1350.93	1350.57	1350.08	87.0	0.0056	3.67	0.21	0.0026	0.23	0.08	1351.24	1351.03	1.21	5.80	1348.57	0.10	1350.41	1349.88	1351.03	1353.58	2.55
207	10 TO 9	9.8	24	1351.24	1351.09	1350.59	87.0	0.0057	3.11	0.15	0.0019	0.16	0.07	1351.47	1351.32	1.08	5.61	1349.09	0.10	1350.76	1350.27	1351.32	1354.10	2.78
208	11 TO 10	7.9	24	1351.47	1351.67	1351.11	97.0	0.0058	2.50	0.10	0.0012	0.12	0.05	1351.64	1351.55	0.95	5.36	1349.67	0.09	1351.15	1350.71	1351.55	1354.68	3.13
209	12 TO 11	6.0	24	1351.64	1352.28	1351.69	102.0	0.0058	1.90	0.05	0.0007	0.07	0.04	1351.75	1351.70	0.81	4.99	1350.28	0.08	1351.56	1351.17	1351.70	1355.29	3.59

Computed by: J.N. McCammon Date: 5/87 Checked by: GES Date: 9/88

ARIZONA DEPARTMENT OF TRANSPORTATION

LOCATION DATA
Highway: Superstition Freeway
Location: Power Road to Ellsworth Road
Project No. F-028-1-311

DESIGN DATA
Frequency 50 years
P6= 2.70 in. P24= 3.20 in. PI= 2.15 in.
Outlet TW Elev. = 1346.70

TABLE 14. PHASE II AND PHASE III: HYDRAULIC GRADE LINE CALCULATIONS

Location				Sewer Profile						HGL for Surcharged Pipe						HGL for Non-Surcharged Pipe						HGL @	Rim/Inlet	Freeboard
No.	From-To	Qdesign (cfs)	Diam. (in.)	EGL Dnsta.	Crown Elevation Dnsta.	Crown Elevation Upsta.	L (ft.)	Slope (ft/ft)	Vfull (fps)	V^2/2g (ft.)	SF (ft/ft)	hL (ft.)	Total Form loss	EGL Dnsta.	WSEL Upsta.	Normal Depth	Velocity (fps)	Inv. Upsta.	Entrance Loss	EGL Dnsta.	WSEL Upsta.	Dnsta. End	Elev. (ft.)	(El.-HGL) (ft.)
210	13 TO 12	4.1	24	1351.75	1352.92	1352.30	107.0	0.0058	1.30	0.03	0.0003	0.03	0.03	1351.81	1351.79	0.66	4.49	1350.92	0.06	1351.96	1351.65	1351.79	1355.93	4.14
219	16 TO MH2-2	15.9	30	1349.99	1349.43	1348.98	178.0	0.0025	3.23	0.16	0.0015	0.27	0.04	1350.30	1350.14	1.65	4.61	1346.93	0.07	1348.97	1348.64	1350.14	1352.71	2.57
220	17 TO 16	11.9	24	1350.30	1350.05	1349.44	107.0	0.0057	3.80	0.22	0.0028	0.30	0.08	1350.68	1350.45	1.23	5.88	1348.05	0.11	1349.93	1349.39	1350.45	1353.06	2.61
221	18 TO 17	10.3	24	1350.68	1350.56	1350.07	97.0	0.0051	3.29	0.17	0.0021	0.20	0.07	1350.94	1350.78	1.17	5.45	1348.56	0.09	1350.28	1349.82	1350.78	1353.57	2.79
222	19 TO 18	8.8	24	1350.94	1351.09	1350.58	97.0	0.0053	2.79	0.12	0.0015	0.15	0.05	1351.14	1351.02	1.04	5.32	1349.09	0.09	1350.66	1350.22	1351.02	1354.10	3.08
223	20 TO 19	7.2	24	1351.14	1351.56	1351.11	97.0	0.0046	2.30	0.08	0.0010	0.10	0.04	1351.29	1351.20	0.96	4.81	1349.56	0.07	1350.95	1350.59	1351.20	1354.57	3.37
224	21 TO 20	5.6	24	1351.29	1352.06	1351.58	102.0	0.0047	1.78	0.05	0.0006	0.06	0.03	1351.38	1351.33	0.83	4.54	1350.06	0.06	1351.27	1350.95	1351.33	1355.07	3.74
225	22 TO 21	4.0	24	1351.38	1352.57	1352.08	102.0	0.0048	1.27	0.02	0.0003	0.03	0.02	1351.43	1351.41	0.69	4.17	1350.57	0.05	1351.58	1351.31	1351.41	1355.58	4.17
226	23 TO 22	2.3	24	1351.43	1353.07	1352.59	102.0	0.0047	0.75	0.01	0.0001	0.01	0.01	1351.45	1351.44	0.53	3.56	1351.07	0.04	1351.83	1351.63	1351.63	1356.08	4.45
227	24 TO 23	0.7	24	1351.83	1353.57	1353.09	102.0	0.0047	0.22	0.00	0.0000	0.00	0.00	1351.83	1351.83	0.29	2.50	1351.57	0.02	1351.98	1351.88	1351.88	1356.58	4.70

Computed by: J.M. McCamson Date: 5/87 Checked by: CGS Date: 9/88

LOCATION DATA
Highway: Superstition Freeway
Location: Power Road to Ellsworth Road
Project No. F-028-1-311

DESIGN DATA
Frequency 50 years
P6= 2.70 in. P24= 3.20 in. P1= 2.15 in.
Outlet T# Elev. = 1411.70

TABLE 14. PHASE II AND PHASE III: HYDRAULIC GRADE LINE CALCULATIONS

Location				Sewer Profile						HGL for Surcharged Pipe						HGL for Non-Surcharged Pipe						HGL @	Rim/Inlet	Freeboard
No.	From-To	Qdesign (cfs)	Diam. (in.)	EGL Dnsta.	Crown Elevation Upsta.	Crown Elevation Dnsta.	L (ft.)	Slope (ft/ft)	Vfull (fps)	V^2/2g (ft.)	Sf (ft/ft)	hL (ft.)	Total form loss	EGL Upsta.	WSEL Upsta.	Normal Depth	Velocity (fps)	Inv. Upsta.	(Entrance) Loss	EGL Dnsta.	WSEL Dnsta.	Upsta. End	Elev. (ft.)	(El.-HGL) (ft.)
TRUNK LINE NO. 3 (SERIES "300")																								
304	MH3-1 TO OUTFALL	201.4	72	1411.70	1418.37	1415.80	646.0	0.0040	7.12	0.79	0.0023	1.46	0.24	1413.39	1412.61	3.89	10.40	1412.37	0.34	1413.28	1416.60	1416.60	1422.00	5.40
307	MH3-2 TO MH3-1	190.7	72	1418.28	1419.40	1418.39	406.0	0.0025	6.75	0.71	0.0020	0.82	0.01	1419.11	1418.41	4.46	8.48	1415.40	0.22	1419.20	1418.08	1418.41	1423.10	4.69
310	MH3-3 TO MH3-2	189.5	72	1419.11	1420.38	1419.41	391.0	0.0025	6.70	0.70	0.0020	0.75	0.04	1419.93	1419.23	4.44	8.47	1414.38	0.22	1420.16	1419.04	1419.23	1424.30	5.07
313	MH3-4 TO MH3-3	185.7	72	1419.93	1421.34	1420.39	376.0	0.0025	6.57	0.67	0.0019	0.72	0.04	1420.70	1420.03	4.34	8.45	1415.34	0.22	1421.01	1419.90	1420.03	1425.60	5.57
316	MH3-5 TO MH3-4	181.5	72	1420.70	1422.25	1421.35	361.0	0.0025	6.42	0.64	0.0018	0.66	0.04	1421.40	1420.76	4.28	8.42	1416.25	0.22	1421.85	1420.75	1420.76	1426.00	5.24
319	MH3-6 TO MH3-5	177.3	72	1421.40	1423.12	1422.26	341.0	0.0025	6.27	0.61	0.0018	0.60	0.06	1422.06	1421.45	4.19	8.39	1417.12	0.22	1422.62	1421.52	1421.52	1426.70	5.18
322	MH3-7 TO MH3-6	171.0	72	1422.62	1423.97	1423.13	336.0	0.0025	6.05	0.57	0.0016	0.55	0.04	1423.21	1422.64	4.09	8.33	1417.97	0.22	1423.35	1422.27	1422.64	1428.10	5.46
325	MH3-8 TO MH3-7	166.1	72	1423.21	1424.81	1423.98	331.0	0.0025	5.88	0.54	0.0015	0.51	0.04	1423.76	1423.22	4.00	8.30	1418.81	0.21	1424.09	1423.02	1423.22	1428.60	5.38
328	MH3-9 TO MH3-8	161.6	72	1423.76	1425.57	1424.82	301.0	0.0025	5.72	0.51	0.0015	0.44	0.00	1424.20	1423.69	3.93	8.24	1419.57	0.21	1424.77	1423.71	1423.71	1429.50	5.79
331	MH3-10 TO MH3-9	155.0	60	1424.77	1427.18	1425.58	371.0	0.0043	7.89	0.97	0.0035	1.31	0.10	1426.18	1425.21	3.73	9.85	1422.18	0.30	1427.72	1426.21	1426.21	1431.70	5.49
334	MH3-11 TO MH3-10	149.3	60	1427.72	1428.50	1427.20	326.0	0.0040	7.60	0.90	0.0033	1.07	0.00	1428.79	1427.89	3.74	9.50	1423.50	0.28	1428.92	1427.52	1427.89	1434.20	6.31
337	MH3-12 TO MH3-11	137.2	54	1428.79	1431.56	1428.52	426.0	0.0071	8.63	1.16	0.0049	2.07	0.08	1430.94	1429.78	3.12	11.64	1427.06	0.42	1432.71	1430.60	1430.60	1438.70	8.10
341	TEE 339 TO MH3-12	134.0	54	1432.71	1434.89	1431.59	413.0	0.0080	8.43	1.10	0.0046	1.92	0.00	1434.62	1433.52	2.94	12.17	1430.39	0.46	1436.09	1433.79	1433.79	N/A	N/A
341	TEE 340 TO TEE 339	134.0	54	1436.09	1435.93	1434.89	130.0	0.0080	8.43	1.10	0.0046	0.60	0.00	1436.70	1435.59	2.94	12.17	1431.43	0.46	1437.13	1434.83	1435.59	N/A	N/A
341	MH3-13 TO TEE 340	134.0	54	1436.70	1436.79	1435.93	103.0	0.0080	8.43	1.10	0.0046	0.48	0.47	1437.64	1436.54	2.94	12.17	1432.29	0.46	1437.99	1435.69	1436.54	1442.30	5.76
349	MH3-14 TO M3-13	110.3	54	1437.64	1439.26	1436.82	646.0	0.0038	6.94	0.75	0.0031	2.03	0.33	1440.01	1439.26	3.38	8.63	1434.76	0.23	1439.53	1438.37	1439.26	1447.20	7.94
364	MH3-15 TO MH3-14	89.4	54	1440.01	1440.78	1439.28	416.0	0.0036	5.62	0.49	0.0021	0.86	0.00	1440.87	1440.38	2.93	8.15	1436.28	0.21	1440.45	1439.42	1440.38	1447.70	7.32
370	MH3-16 TO MH3-15	78.5	48	1440.87	1443.76	1440.81	394.0	0.0075	6.25	0.61	0.0030	1.18	0.12	1442.17	1441.56	2.31	8.05	1439.76	0.20	1443.28	1442.27	1442.27	1450.70	8.43
372	MH3-17 TO MH3-16	75.9	48	1443.28	1444.43	1443.78	230.0	0.0028	6.04	0.57	0.0028	0.64	0.13	1444.04	1443.48	3.26	10.05	1440.43	0.31	1445.57	1444.00	1444.00	1448.90	4.90
377	MH3-18 TO MH3-17	60.5	42	1445.57	1445.70	1444.45	251.0	0.0050	6.29	0.61	0.0036	0.91	0.00	1446.48	1445.86	2.48	9.47	1442.20	0.28	1446.35	1444.95	1445.86	1451.60	5.74
380	MH3-19 TO MH3-18	51.3	36	1446.48	1447.77	1445.72	296.0	0.0069	7.26	0.82	0.0059	1.75	0.10	1448.33	1447.51	2.28	8.90	1444.77	0.25	1446.52	1447.29	1447.51	1453.60	6.09

Computed by: J.M. McCammon Date: 5/87 Checked by: CGB Date: 9/88

LOCATION DATA
Highway: Superstition Freeway
Location: Power Road to Ellsworth Road
Project No. F-028-1-311

DESIGN DATA
Frequency 50 years
P6= 2.70 in. P24= 3.20 in. P1= 2.15 in.
Outlet TW Elev. = 1411.70

TABLE 14. PHASE II AND PHASE III: HYDRAULIC GRADE LINE CALCULATIONS

Location				Sewer Profile						HGL for Surcharged Pipe						HGL for Non-Surcharged Pipe						HGL @	Rim/Inlet	Freebard
No.	From-To	@design (cfs)	Diam. (in.)	EGL Dnsta.	Crown Elevation Upsta.	Crown Elevation Dnsta.	L (ft.)	Slope (ft/ft)	Vfull (fps)	V^2/2g (ft.)	Sf (ft/ft)	hL (ft.)	Total Form loss	EGL Upstm.	WSEL Upstm.	Normal Depth	Velocity (fps)	Inv. Upsta.	Entrance Loss	EGL Upsta.	WSEL Upsta.	Upsta. End	Elev. (ft.)	(El.-HGL) (ft.)
386	TEE 385 TO MH3-19	25.7	24	1448.33	1449.14	1447.82	74.0	0.0178	8.51	1.12	0.0139	1.03	0.00	1449.36	1448.24	1.46	10.85	1447.14	0.37	1450.80	1448.97	1448.97	N/A	N/A
386	MH3-21 TO TEE 385	25.7	24	1450.80	1453.26	1449.14	232.0	0.0178	8.51	1.12	0.0139	3.23	0.15	1454.13	1453.06	1.46	10.85	1451.26	0.37	1454.92	1453.09	1453.09	1459.20	6.11
387	MH3-22 TO MH3-21	25.4	24	1454.92	1453.79	1453.34	306.0	0.0173	8.10	1.02	0.0126	3.87	1.02	1459.81	1458.79	1.41	10.77	1456.79	0.36	1460.36	1458.56	1458.79	1464.50	5.71
302	192 TO TEE	9.6	24	1413.16	1415.72	1414.33	16.0	0.0869	3.05	0.14	0.0018	0.03	0.13	1415.32	1415.17	0.51	15.09	1413.72	0.71	1418.47	1414.94	1414.94	1419.10	4.16
303	193 TO 92	4.6	24	1416.47	1416.16	1415.89	110.0	0.0025	1.46	0.03	0.0004	0.05	0.03	1418.55	1418.52	0.89	3.41	1414.16	0.04	1415.27	1415.09	1415.09	1419.10	4.01
305	194 TO MH3-1	10.0	24	1418.28	1417.37	1417.26	14.0	0.0079	3.19	0.16	0.0020	0.03	0.14	1418.44	1418.28	1.00	6.40	1415.37	0.13	1417.13	1416.50	1418.28	1420.59	2.31
306	195 TO 94	5.1	24	1418.44	1417.65	1417.38	110.0	0.0025	1.61	0.04	0.0005	0.06	0.04	1418.54	1418.50	0.94	3.50	1415.65	0.04	1416.82	1416.63	1418.50	1420.59	2.09
308	196 TO MH3-2	9.5	24	1419.11	1418.40	1418.29	14.0	0.0079	3.02	0.14	0.0018	0.02	0.13	1419.26	1419.12	0.97	6.31	1416.40	0.12	1418.11	1417.49	1419.12	1421.62	2.50
309	197 TO 96	4.5	24	1419.26	1418.68	1418.41	110.0	0.0025	1.44	0.03	0.0004	0.04	0.03	1419.34	1419.31	0.88	3.40	1416.68	0.04	1417.78	1417.60	1419.31	1421.62	2.31
311	198 TO MH3-3	9.6	24	1419.93	1419.38	1419.27	14.0	0.0079	3.06	0.15	0.0018	0.03	0.13	1420.09	1419.94	0.97	6.33	1417.38	0.12	1419.10	1418.48	1419.94	1422.60	2.66
312	199 TO 98	4.6	24	1420.09	1419.66	1419.39	110.0	0.0025	1.46	0.03	0.0004	0.04	0.03	1420.16	1420.13	0.89	3.41	1417.66	0.04	1418.77	1418.59	1420.13	1422.60	2.47
314	100 TO MH3-4	9.7	24	1420.70	1420.33	1420.22	14.0	0.0079	3.08	0.15	0.0018	0.03	0.13	1420.85	1420.71	0.98	6.34	1418.33	0.12	1420.06	1419.43	1420.71	1423.55	2.84
315	101 TO 100	4.6	24	1420.85	1420.61	1420.34	110.0	0.0025	1.47	0.03	0.0004	0.05	0.03	1420.93	1420.90	0.89	3.42	1418.61	0.04	1419.72	1419.54	1420.90	1423.55	2.65
317	102 TO MH3-5	9.3	24	1421.40	1421.24	1421.13	14.0	0.0079	2.97	0.14	0.0017	0.02	0.12	1421.55	1421.41	0.96	6.28	1419.24	0.12	1420.93	1420.32	1421.41	1424.46	3.05
318	103 TO 102	4.4	24	1421.55	1421.52	1421.25	110.0	0.0025	1.39	0.03	0.0004	0.04	0.03	1421.62	1421.59	0.87	3.37	1419.52	0.04	1420.60	1420.42	1421.59	1424.46	2.87
320	104 TO MH3-6	9.3	24	1422.62	1422.11	1422.01	14.0	0.0071	2.98	0.14	0.0017	0.02	0.12	1422.77	1422.63	0.99	6.04	1420.11	0.11	1421.78	1421.21	1422.63	1425.33	2.70
321	105 TO 104	4.3	24	1422.77	1422.39	1422.12	110.0	0.0025	1.36	0.03	0.0004	0.04	0.03	1422.83	1422.80	0.86	3.35	1420.39	0.03	1421.46	1421.28	1422.80	1425.33	2.53

Computed by: J.N. McCasson Date: 5/87 Checked by: Gel Date: 9/88

LOCATION DATA
Highway: Superstition Freeway
Location: Power Road to Ellsworth Road
Project No. F-029-1-311

DESIGN DATA
Frequency 50 years
P6= 2.70 in. P24= 3.20 in. P1= 2.15 in.
Outlet TW Elev. = 1411.70

TABLE 14. PHASE II AND PHASE III: HYDRAULIC GRADE LINE CALCULATIONS

Location				Sewer Profile						HGL for Surcharged Pipe					HGL for Non-Surcharged Pipe							
No.	From-To	Qdesign (cfs)	Diam. (in.)	EGL Dsnsta.	Crown Elevation Upsta.	Crown Elevation Dsnsta.	L (ft.)	Slope (ft/ft)	Yfull (fps)	V^2/2g (ft.)	Sf (ft/ft)	hL (ft.)	Total Form loss	EGL Upsta.	WSEL Upsta.	Normal Depth	Velocity (fps)	Inv. Upsta.	Entrance Loss	EGL Upsta.	WSEL Upsta.	HGL @ Upsta. End	Rim/Inlet Elev. (ft.)	Freeboard (El.-HGL) (ft.)
323	106 TO MH3-7	9.4	24	1423.21	1422.92	1422.81	14.0	0.0079	3.00	0.14	0.0017	0.02	0.13	1423.36	1423.22	0.96	6.30	1420.92	0.12	1422.62	1422.01	1423.22	1426.18	2.96
324	107 TO 106	4.3	24	1423.36	1423.24	1422.93	110.0	0.0028	1.35	0.03	0.0004	0.04	0.03	1423.43	1423.40	0.82	3.49	1421.24	0.04	1422.29	1422.10	1423.40	1426.18	2.78
326	108 TO MH3-8	8.7	24	1423.76	1423.76	1423.67	14.0	0.0064	2.76	0.12	0.0015	0.02	0.11	1423.89	1423.77	0.97	5.70	1421.76	0.10	1423.34	1422.83	1423.77	1427.02	3.25
327	109 TO 108	3.9	24	1423.89	1424.08	1423.77	110.0	0.0028	1.23	0.02	0.0003	0.03	0.02	1423.94	1423.92	0.78	3.40	1422.08	0.04	1423.07	1422.90	1423.92	1427.02	3.10
329	110 TO MH3-9	10.7	24	1424.77	1424.59	1424.45	14.0	0.0100	3.39	0.18	0.0022	0.03	0.16	1424.96	1424.78	0.97	7.10	1422.59	0.16	1424.49	1423.71	1424.78	1427.93	3.15
330	111 TO 110	4.8	24	1424.96	1424.98	1424.61	110.0	0.0034	1.52	0.04	0.0004	0.05	0.04	1425.05	1425.01	0.83	3.86	1422.98	0.05	1424.09	1423.86	1425.01	1427.93	2.92
332	112 TO MH3-10	9.3	24	1427.72	1426.18	1426.07	15.0	0.0073	2.95	0.13	0.0017	0.03	0.12	1427.87	1427.73	0.97	6.09	1424.18	0.12	1425.84	1425.27	1427.73	1430.02	2.29
333	113 TO 112	4.1	24	1427.87	1427.02	1426.20	110.0	0.0075	1.32	0.03	0.0003	0.04	0.03	1427.93	1427.90	0.62	4.94	1425.02	0.08	1426.10	1425.72	1427.90	1430.02	2.12
335	114 TO MH3-11	16.9	24	1428.79	1428.56	1427.93	15.0	0.0420	5.39	0.45	0.0056	0.08	0.35	1429.22	1428.77	0.84	13.61	1426.56	0.57	1430.85	1427.97	1428.77	1432.82	4.05
336	115 TO 114	10.4	24	1429.22	1429.79	1428.68	110.0	0.0101	3.30	0.17	0.0021	0.23	0.17	1429.62	1429.45	0.95	7.07	1427.79	0.16	1429.67	1428.89	1429.45	1432.82	3.37
338	116 TO MH3-12	8.2	24	1432.71	1434.59	1431.65	16.0	0.1837	2.62	0.11	0.0013	0.02	0.11	1432.83	1432.73	0.39	18.83	1432.59	1.10	1439.59	1434.08	1434.08	1436.98	2.90
339	117 TO TEE	6.7	24	1436.09	1436.73	1433.70	134.0	0.0226	2.13	0.07	0.0009	0.12	0.07	1436.28	1436.21	0.60	8.42	1434.73	0.22	1436.65	1433.55	1436.21	1439.91	3.70
340	118 TO TEE	1.6	24	1436.70	1436.33	1434.88	17.0	0.0853	0.51	0.00	0.0000	0.00	0.00	1436.70	1436.70	0.21	8.82	1434.33	0.24	1435.99	1434.79	1436.70	1440.55	3.85
342	119 TO MH3-13	16.6	24	1437.64	1437.87	1437.01	16.0	0.0537	5.27	0.43	0.0054	0.09	0.11	1437.84	1437.41	0.77	13.21	1435.87	0.54	1439.89	1437.18	1437.41	1440.98	3.57
343	120 TO 119	15.0	24	1437.84	1438.33	1437.97	97.0	0.0037	4.78	0.36	0.0044	0.43	0.09	1438.36	1438.00	2.00	4.78	1436.33	0.07	1438.76	1438.40	1438.40	1441.34	2.94
344	121 TO 120	13.6	24	1438.76	1438.67	1438.35	92.0	0.0035	4.32	0.29	0.0036	0.33	0.08	1439.17	1438.88	2.00	4.32	1436.67	0.06	1439.02	1438.73	1438.88	1441.68	2.80
345	122 TO 121	12.1	24	1439.17	1439.01	1438.69	92.0	0.0035	3.85	0.23	0.0029	0.26	0.21	1439.65	1439.41	1.49	4.82	1437.01	0.07	1438.94	1438.58	1439.41	1442.02	2.61
346	123 TO 122	4.3	24	1439.65	1439.34	1439.03	87.0	0.0036	1.37	0.03	0.0004	0.03	0.02	1439.70	1439.67	0.78	3.83	1437.34	0.05	1438.39	1438.16	1439.67	1442.35	2.68
347	124 TO 123	2.9	24	1439.70	1439.66	1439.36	87.0	0.0034	0.92	0.01	0.0002	0.01	0.01	1439.72	1439.71	0.63	3.36	1437.66	0.04	1438.50	1438.33	1439.71	1442.67	2.96

Computed by: J.N. McCammon Date: 5/87 Checked by: GCS Date: 9/88

LOCATION DATA
Highway: Superstition Freeway
Location: Power Road to Ellsworth Road
Project No. F-028-1-511

DESIGN DATA
Frequency 50 years
P6= 2.70 in. P24= 3.20 in. P1= 2.15 in.
Outlet TW Elev. = 1411.70

TABLE 14. PHASE II AND PHASE III: HYDRAULIC GRADE LINE CALCULATIONS

Location				Sewer Profile					HGL for Surcharged Pipe								HGL for Non-Surcharged Pipe						HGL @	Rim/Inlet	Freebard
No.	From-To	Qdesign (cfs)	Diam. (in.)	EGL Dnsta.	Crown Elevation Upsta.	Dnsta.	L (ft.)	Slope (ft/ft)	Vfull (fps)	V^2/2g (ft.)	Sf (ft/ft)	hL (ft.)	Total form loss	ESL Upsta.	WSEL Upsta.	Normal Depth	Velocity (fps)	Inv. Upsta.	Entrance Loss	EGL Upsta.	WSEL Upsta.	Upsta. End	Elev. (ft.)	(El.-HGL) (ft.)
348	125 TO 124	1.5	24	1439.72	1440.02	1439.68	87.0	0.0039	0.46	0.00	0.0000	0.00	0.00	1439.73	1439.73	0.43	2.90	1438.02	0.03	1438.61	1438.48	1439.73	1442.99	3.26
350	126 TO 122	6.4	24	1439.65	1439.32	1438.72	122.0	0.0049	2.04	0.06	0.0008	0.10	0.06	1439.81	1439.74	0.88	4.77	1437.32	0.07	1438.63	1438.27	1439.74	1442.29	2.55
351	127 TO MH3-14	20.9	30	1440.01	1439.39	1439.29	16.0	0.0063	4.26	0.28	0.0026	0.04	0.05	1440.11	1439.82	1.46	7.04	1436.99	0.15	1439.27	1438.50	1439.32	1443.32	3.50
352	128 TO 127	19.5	30	1440.11	1439.96	1439.41	82.0	0.0067	3.97	0.24	0.0023	0.18	0.00	1440.29	1440.05	1.37	7.09	1437.46	0.16	1439.76	1438.98	1440.05	1443.62	3.57
353	129 TO 128	16.0	24	1440.29	1440.53	1439.98	82.0	0.0067	5.74	0.51	0.0063	0.52	0.29	1441.10	1440.59	1.59	6.72	1438.53	0.14	1440.96	1440.26	1440.59	1443.93	3.34
354	130 TO 129	13.3	24	1441.10	1441.02	1440.55	133.0	0.0035	4.31	0.29	0.0036	0.48	0.07	1441.65	1441.36	2.00	4.31	1439.92	0.06	1441.37	1441.08	1441.36	1444.31	2.95
355	131 TO 130	12.3	24	1441.65	1441.55	1441.04	92.0	0.0055	3.93	0.24	0.0030	0.27	0.06	1441.99	1441.75	1.27	5.84	1439.55	0.11	1441.46	1440.93	1441.75	1444.56	2.81
356	132 TO 131	11.2	24	1441.99	1441.79	1441.56	87.0	0.0026	3.55	0.20	0.0024	0.21	0.06	1442.26	1442.06	1.57	4.15	1439.79	0.05	1441.69	1441.42	1442.06	1444.79	2.73
357	133 TO 132	9.9	24	1442.26	1442.02	1441.79	87.0	0.0026	3.16	0.16	0.0019	0.17	0.05	1442.48	1442.32	1.42	4.13	1440.02	0.05	1441.76	1441.49	1442.32	1445.03	2.71
358	134 TO 133	8.7	24	1442.48	1442.24	1442.02	82.0	0.0027	2.77	0.12	0.0015	0.12	0.04	1442.64	1442.52	1.28	4.10	1440.24	0.05	1441.84	1441.58	1442.52	1445.25	2.73
359	135 TO 134	7.6	24	1442.64	1442.44	1442.24	72.0	0.0028	2.41	0.09	0.0011	0.08	0.05	1442.77	1442.68	1.16	4.03	1440.44	0.05	1441.90	1441.65	1442.68	1445.44	2.76
360	136 TO 135	5.7	24	1442.77	1443.20	1442.45	112.0	0.0067	1.81	0.05	0.0006	0.07	0.05	1442.89	1442.84	0.76	5.19	1441.20	0.08	1442.46	1442.05	1442.84	1446.21	3.37
361	137 TO 136	2.7	24	1442.89	1444.60	1443.24	60.0	0.0227	0.87	0.01	0.0001	0.01	0.01	1442.92	1442.90	0.38	6.51	1442.60	0.13	1443.77	1443.12	1443.12	1446.73	3.61
362	138 TO 129	3.0	24	1441.10	1441.15	1440.55	82.0	0.0073	0.95	0.01	0.0002	0.01	0.01	1441.13	1441.12	0.53	4.47	1439.15	0.06	1440.05	1439.74	1441.12	1444.24	3.12
363	139 TO 138	1.5	24	1441.13	1441.49	1441.17	82.0	0.0039	0.47	0.00	0.0000	0.00	0.00	1441.14	1441.14	0.44	2.91	1439.49	0.03	1440.08	1439.95	1441.14	1444.54	3.40
365	140 TO MH3-15	10.9	24	1440.87	1441.75	1440.97	16.0	0.0487	3.47	0.19	0.0023	0.04	0.07	1440.97	1440.79	0.64	12.73	1439.75	0.50	1443.40	1440.89	1440.89	1444.83	3.94
366	141 TO 140	9.4	24	1443.40	1442.06	1441.83	77.0	0.0030	3.00	0.14	0.0017	0.13	0.06	1443.60	1443.46	1.31	4.34	1440.06	0.06	1441.72	1441.43	1443.46	1445.06	1.60
367	142 TO 141	7.9	24	1443.60	1442.25	1442.06	77.0	0.0025	2.51	0.10	0.0012	0.09	0.04	1443.73	1443.63	1.24	3.89	1440.25	0.05	1441.77	1441.53	1443.63	1445.25	1.62
368	143 TO 142	6.6	24	1443.73	1442.47	1442.26	62.0	0.0034	2.10	0.07	0.0009	0.05	0.06	1443.84	1443.78	1.00	4.21	1440.47	0.05	1441.80	1441.53	1443.78	1445.48	1.70
369	144 TO 143	4.3	24	1443.84	1443.38	1442.51	51.0	0.0171	1.36	0.03	0.0004	0.02	0.03	1443.89	1443.86	0.51	6.70	1441.38	0.14	1442.73	1442.03	1443.86	1446.81	2.95

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ARIZONA DEPARTMENT OF TRANSPORTATION

LOCATION DATA
Highway: Superstition Freeway
Location: Power Road to Ellsworth Road
Project No. F-028-1-311

DESIGN DATA
Frequency 50 years
P6= 2.70 in. P24= 3.20 in. P1= 2.15 in.
Outlet TW Elev. = 1346.70

TABLE 14 PHASE III: HYDRAULIC GRADE LINE CALCULATIONS

Location				Sewer Profile						HGL for Surcharged Pipe						HGL for Non-Surcharged Pipe						HGL @	Rim/Inlet	Freeboard
No.	From-To	Qdesign (cfs)	Diam. (in.)	EGL Dnstm.	Crown Elevation Upstm.	Crown Elevation Dnstm.	L (ft.)	Slope (ft/ft)	Vfull (fps)	V^2/2g (ft.)	Sf (ft/ft)	hL (ft.)	Total form loss	EGL Upstm.	WSEL Upstm.	Normal Depth	Velocity (fps)	Inv. Upstm.	Entrance Loss	EGL Upstm.	WSEL Upstm.	Upstm. End	Elev. (ft.)	(El.-HGL) (ft.)
371	145 TO MH3-16	2.6	24	1443.28	1444.79	1444.35	16.0	0.0275	0.84	0.01	0.0001	0.00	0.01	1443.29	1443.28	0.36	6.89	1442.79	0.15	1444.03	1443.30	1443.30	1446.33	3.03
373	146 TO MH3-17	10.5	24	1445.57	1443.92	1443.60	16.0	0.0200	3.33	0.17	0.0021	0.03	0.12	1445.72	1445.55	0.79	9.12	1441.92	0.26	1444.26	1442.97	1445.55	1447.85	2.30
374	147 TO 146	7.2	24	1445.72	1444.84	1443.96	110.0	0.0080	2.30	0.08	0.0010	0.11	0.08	1445.91	1445.83	0.83	5.90	1442.84	0.11	1444.32	1443.77	1445.83	1447.85	2.02
375	148 TO 147	4.2	24	1445.91	1450.37	1445.50	75.0	0.0649	1.32	0.03	0.0003	0.03	0.03	1445.96	1445.94	0.36	10.65	1448.37	0.35	1450.85	1449.09	1449.09	1453.40	4.31
376	149 TO MH3-17	4.9	24	1445.57	1448.20	1444.62	58.0	0.0617	1.56	0.04	0.0005	0.03	0.04	1445.64	1445.60	0.40	11.00	1446.20	0.38	1448.85	1446.97	1446.97	1451.29	4.32
378	150 TO MH3-18	9.2	24	1446.48	1445.00	1444.84	17.0	0.0094	2.91	0.13	0.0016	0.03	0.12	1446.62	1446.49	0.90	6.67	1443.00	0.14	1444.73	1444.04	1446.49	1448.93	2.44
379	151 TO 150	4.4	24	1446.62	1445.90	1445.02	110.0	0.0080	1.41	0.03	0.0004	0.04	0.03	1446.69	1446.66	0.63	5.15	1443.90	0.08	1445.03	1444.62	1446.66	1448.93	2.27
381	152 TO MH3-19	24.6	24	1448.33	1447.83	1447.31	18.0	0.0289	7.84	0.95	0.0118	0.21	0.68	1449.22	1448.27	1.16	12.98	1445.83	0.52	1450.13	1447.52	1448.27	1451.54	3.27
382	153 TO 152	16.2	24	1450.13	1448.56	1447.91	110.0	0.0059	5.16	0.41	0.0051	0.57	0.37	1451.07	1450.65	1.53	6.29	1446.56	0.12	1448.83	1448.21	1448.21	1451.54	3.33
383	MH3-20 TO 153	7.7	24	1448.83	1449.67	1449.12	26.0	0.0212	2.44	0.09	0.0011	0.03	0.02	1448.87	1448.78	0.66	8.53	1447.67	0.23	1449.68	1448.55	1448.55	1455.30	6.75
384	MH-D TO MH3-20	7.7	24	1449.68	1454.73	1449.75	105.0	0.0474	2.44	0.09	0.0011	0.12	0.09	1449.89	1449.80	0.53	11.40	1452.73	0.40	1455.68	1453.67	1453.67	1472.70	19.03
385	MH-E TO TEE	1.3	24	1450.80	1466.12	1449.14	88.0	0.1930	0.41	0.00	0.0000	0.00	0.00	1450.80	1450.80	0.16	10.96	1464.12	0.37	1466.52	1464.65	1464.65	1473.40	8.75
414	MH4-1 to CHN 1	1.4	24	1398.80	1398.26	1396.19	142.0	0.0146	0.45	0.00	0.0000	0.01	0.00	1398.81	1398.81	0.31	4.46	1396.26	0.06	1396.94	1396.63	1398.81	1400.80	1.99
415	II-9 to TEE	2.1	24	1353.92	1378.36	1352.05	98.0	0.2685	0.67	0.01	0.0001	0.01	0.01	1353.94	1353.93	0.19	14.37	1376.36	0.64	1380.39	1377.19	1377.19	1381.53	4.34

Computed by: J.N. McCammon Date: 5/87 Checked by: GCS Date: 9/88

Step 13:
Compare the two calculated WSEL's and choose the higher to be the Hydraulic Grade Line (HGL) at the upstream end of the current pipe.

Step 14:
Compare the HGL with the rim elevation (at manholes) or grate elevation (at inlets). A 0.5 foot freeboard allowance must be maintained at these locations.

Step 15:
The EGL associated with the selected WSEL is used as the downstream EGL for the next pipe upstream. Steps 2 through 14 are repeated.

3. Calculation Records

Calculations for the Phase I storm sewer are presented in Tables 11 and 12. The calculations for the remaining storm sewer systems of Phases II and III are presented together in Tables 13 and 14.

B. Off-Site

1. Introduction

The off-site drainage conveyance system consists of two lined channels, running along the north right-of-way, with associated box culverts and detention ponds. Detention is required, as demonstrated in Chapter IV, to mitigate the effects of the freeway on the flooding conditions in the vicinity of the freeway for the 100 yr. - 24 hr. storm runoff. No specific attempt was made to improve existing flood protection measures for property adjacent to the freeway; however, such benefits are a necessary result for segments of the off-site system design. An objective of the design process was that construction of the channels, detention ponds, box culverts and other drainage appurtenances be restricted to the right-of-way limits.

Modeling of the combined channel and detention pond systems required the use of the HEC-1: Flood Hydrograph Package and HEC-2: Water Surface Profiles computer programs. These programs were used to provide design data for the various components of the off-site drainage system and to simulate the entire system upon completion of design. These modeling efforts are described in the following sections. The HEC-1 discussion precedes the HEC-2 discussion.

2. Design Procedure

Design of the off-site system occurred in three stages:

Stage 1 - Detention pond volumes and channels were approximated in several iterations of the HEC-1 computer program to determine the required locations, sizes and number of detention ponds.

Stage 2 - Channel design was completed. The HEC-2 computer program was used to define the water surface profiles in the channels for a range of flows. Final adjustment of the pond designs followed.

Stage 3 - The HEC-1 input was modified to reflect the final adjustments and results were tabulated as a part of the drainage report. The HEC-2 input was modified to reflect the additions and removal of peak flows along each channel at points of channel intersections and at detention ponds. The water surface profiles for the 50-yr. and 100-yr. storms were calculated using the final HEC-2 runs.

Simulation No. 3 included the use of the HEC-1 as a design tool in Stage 1 and as a means of defining the completed design in Stage 3. A detailed description of Stages 1, 2 and 3, as related to the HEC-1 simulations, follows.

Stage 1

The computer iterations run in Simulation No. 3 were based on modifications of the model used in Simulation No. 2. The modeling of runoff contributions to the freeway corridor from the sub-basins north of the north right-of-way line is constant throughout Simulation Nos. 1, 2 and 3. Of the four channels entering the right-of-way (Hawes, Sossaman, Sossaman Road and 72nd St.), it is anticipated that only the 72nd Street Channel will be relocated at some point in the future. The information available at the time of the Simulation No. 3 analysis indicated that 72nd Street will be relocated to the west (to the current bridge location). A 72 in. storm sewer is planned as a part of the future 72nd St. roadway improvements. Relocation of the existing channel to the west along the proposed relocated roadway is under consideration; however plans for relocation of the channel and location of the storm sewer had not been finalized at the time of the analysis. It was not anticipated that any of these improvements would be in place in the near future. Uncertainties regarding the timing of the 72nd Street improvements and the acceptance and implementation of the MDP resulted in the decision to use the current location of the 72nd Street drainageway as a basis for design of the off-site drainage conveyance system.

The initial concept for attenuation of peak flows included the use of on-line detention ponds. On-line ponds are reservoirs on the lined channels. Each one contains a low flow channel through the detention structure and a restricted outlet. Routing through a structure of this type is accomplished in HEC-1 by inserting a storage volume vs. discharge table in the input data. Several pond configurations were investigated on Channels No. 1 and No. 2. The results of this analysis indicated that the required peak discharges and ponding elevations at the critical areas could not be met with on-line detention. Further investigation revealed that the inflow hydrographs to each on-line ponds contained sufficient volume that the ponds were filling up before the desired peak flow attenuation was achieved. Two solutions were proposed to solve this problem. The first was to acquire additional right-of-way and construct large "regional" detention ponds north of the freeway. This was considered undesirable in light of high land acquisition costs. The second solution was to provide off-line detention ponds that would serve to remove only the peak of the hydrograph, thereby attenuating the peak flood flows with minimal volume requirements. An off-line pond design involves the use of a side weir in the lined channel into a detention area that is parallel to, but not a part of, the lined channel. The latter option was investigated and found to be a viable solution for detention of 50-yr. and 100-yr. storm runoff.

Approximate detention pond locations were chosen based on the right-of-way space available and on the areas of point discharge of off-site flows to the freeway corridor. For each trial pond location a flow division was introduced into the HEC-1 model. In a series of HEC-1 iterations these flow divisions were modified such that the desired ponding elevations and outfall discharges were met. Each flow division in the HEC-1 program results in a hydrograph for the diverted flow as well as a hydrograph for the non-diverted flow. The hydrograph for the diverted flow was used to obtain the required volume for the pond associated with that division. The initial channel parameters and the available area between the top of the roadway berm and the channel defined the limits of each pond. If the volume required for the pond exceeded the available volume it was then necessary to proceed through another iteration using new division locations while maintaining the same criteria regarding ponding elevations and outfall discharges. Due to the high ponding requirements and the paucity of space available for ponding, it was necessary ultimately to provide a series of twelve ponds. The function of ten of these ponds (off-line ponds) is to permit passage of low flows through the system while impounding the higher flows. 12

Flow diversion to an off-line pond from a channel is accomplished in the following manner. A flow constrictor is provided in the form of a concrete beam spanning the channel just downstream of each side weir. The flow constrictors vary in height above the channel invert. Each constrictor is designed to permit passage of the low flows in the channel. The bottom of the beam is placed such that at flows exceeding the maximum desired low flow, ponding occurs upstream of the constrictor. A side flow weir is located in the channel bank just upstream of the flow constrictor. An increase in the ponding depth at the constrictor thus increases the head over the weir crest. The constrictor thus has the effect of restricting higher pass-through flows and facilitating weir flow into the off-line ponds. The off-line ponds discharge back into the channels via constricted outlet pipes. The discharge of each outlet pipe is relatively low, compared to the rate of inflow over the weir. Outlet pipes are sized to drain the detention ponds within 24 hours from the end of the storm event.

The two remaining ponds (on-line ponds) function as reservoirs. Routing through these ponds was handled using normal reservoir routing with storage discharge tables. The purpose of these ponds is to delay and attenuate hydrograph peaks. The volume of flows entering these ponds is small enough that it is feasible to provide on-line detention in those areas, within the right-of-way.

Stage 2

Having determined the maximum available volume at each pond location and the channel configuration, the HEC-2 program was used to model the hydraulic functioning of each flow constrictor throughout a range of flow rates. A graph of headwater vs. constrictor flow was plotted for each constrictor. This information was then used to set the height and length of each side flow weir to meet the maximum pond inflow (Q_{100}) at the maximum desired headwater for the constrictor. Final diversion tables for the HEC-1 input were obtained as a result of this operation (see Appendix C). At the completion of Stage 2, detention pond locations and volumes, channel geometry, flow constrictor heights and weir locations and configurations were finalized. Final pond volumes and flow diversions were obtained from the HEC-1 output.

Stage 3

The channel geometries and channel flows for Channels No. 1 and 2 were defined at the completion of Stage 2. This information was then used to make final adjustments to the HEC-2 model in the areas of the flow constrictors. Final HEC-2 runs were obtained to determine the 50-yr. and 100-yr. water surface profiles in Channels No. 1 and 2. Headwater elevations obtained at each constrictor were back-checked for consistency with those used in the HEC-1 runs. At the end of Stage 3 the computer modeling effort and the hydraulic design for the off-site drainage conveyance system were complete.

The routing models (HEC-1 and HEC-2) that describe the design of the off-site drainage conveyance system are the final product of Simulation No. 3. These are described below with references to the procedures used for determining weir flow and capacities of flow constrictors.

HEC-1: Flood Hydrograph Package

The routing model for Simulation No. 2 was used as the basis of the routing model for Simulation No. 3. Simulation No. 2 was altered to include on-line and off-line detention ponds along the north side of the freeway. As with Simulation No. 2, the routing north of the north right-of-way line is taken from Simulation No. 1. The channel parameters of Simulation No. 2 were altered as required for Simulation No. 3 to accommodate revised channel flows.

As discussed in Chapter IV, the need for detention along the freeway was determined at the conclusion of Simulation No. 2. Following a careful analysis of the results of Simulations No. 1 and No. 2 the following objectives were formulated for the design of channels and detention ponds:

Channel No. 2: Ellsworth Road to the Sossaman Channel: Design Objectives

- Channel design will accommodate the 50-yr. and 100-yr. peak flows to eliminate existing overtopping conditions (for the 100-yr. flows) along the East-West Channel. Overland flows and concentrated flows from Hawes Channel, the detention pond east of Ellsworth Road (by others), and the on-site storm sewer system will be conveyed by Channel No. 2 to the Sossaman Channel.

- The Sossaman Channel will be improved to increase the channel capacity through the right-of-way. The existing capacity through the right-of-way is exceeded at the point where the East-West Channel discharges into it. The capacity through the right-of-way will be increased to convey the 100-year storm flows without channel overtopping (within the right-of-way) on the north side of the freeway.

- Detention ponding will be provided upstream of the Sossaman Channel to limit discharges from Channel No. 2 such that the combination of flows from the north and flows from the east, in the Sossaman Channel, will not exceed the channel capacity (within the right-of-way) during the 100-yr. storm event and such that the same combination of flows for the 50-yr. storm event are conveyed with the appropriate freeboard.

- The net peak discharges for the 50-yr. and 100-yr. storms from the Superstition Freeway right-of-way between the Sossaman Channel and Ellsworth Road will not differ substantially from the existing conditions discharges.

- Detention ponds locations will be chosen to maximize their effectiveness in peak flow reduction.

Channel No. 1: The Sossaman Channel to Power Road: Design Objectives

- Channel design will accommodate the 50-yr. and 100-yr. peak flows to eliminate existing channel overtopping along the north channel bank. Overland flows, and the concentrated flows at Sossaman Road, the Sossaman Road Channel, and the 72nd Street channel will be intercepted by Channel No. 1 and conveyed to the box culvert at Power Road.

- Detention ponding will be provided to restrict the 50-yr. and 100-yr. peak flows at Power Road such that the channel banks at Power Road are not overtopped during the 100-yr. flood event.

- Culvert design at 72nd Street and Sossaman Road will permit passage of the 50-yr. and 100-yr. storm peak flows with no channel overtopping.

- Detention pond locations will be chosen to maximize their effectiveness in peak flow reduction.

- The net peak discharges into the RWCD Floodway for the 50-yr. and 100-yr. storms, from the Superstition Freeway right-of-way between Power Road and the Sossaman Channel, will not differ substantially from the existing conditions discharges.

Simulation No. 1 was described in terms of three minor watersheds. In Simulation No. 2 the discharge from Watershed No. 3 was added to that of Watershed No. 1. This situation is maintained in Simulation No. 3. Channel No. 1 conveys discharges from Watersheds No. 1 and No. 3. Channel No. 2 conveys discharges from Watershed No. 2. Routing for Simulation No. 3 is described in terms of Channels No. 1 and No. 2. The reader is referred to Figs. 9 and 13 as an aid in the following discussion.

Channel No. 2: Routing Description

A regional detention pond with an approximate volume of 600 ac.-ft. is planned (by others) for the northeast quadrant of the Ellsworth Road - Superstition Freeway Interchange as a part of the Ellsworth Road to Ironwood Road segment of the Superstition Freeway extension. The inflow to this pond is represented by SUB224 in Fig. 13. The pond discharges to the west through a 48-in. concrete pipe which will be constricted to an open area equivalent to a 24 inch pipe. The maximum anticipated discharge from the pond, during flooding conditions, is 61 cfs. Discharges from the regional pond are routed west (RO224) to Sta. 992+00. The 48 in. pipe connects to a manhole east of Ellsworth Road at approximate Sta. 1024+90. Another 48-in. pipe carries pond discharges from the manhole west, under Ellsworth Road, to an outfall into Channel No. 2 at Sta. 1015+75. Hydrograph routing in this application of the HEC-1 model does not result in significant peak flow attenuation (less than one percent). Therefore the routing of the pond discharges through the

48-in. RCP and lined channel to Sta. 992+00 was accomplished in one step. At Sta. 992+00 the channel flows are combined (CO18) with flows from Sub-Basin 18. The combined flows enter Detention Pond No. 12. This is an on-line detention pond. Low flows pass directly through the pond in a low flow channel, to the pond outlet structure. The outlet structure consists of four 24-in. concrete pipes under a trapezoidal weir. Low flows pass through the pipes without ponding. At higher flows the outlet structure serves to restrict discharges from the detention pond with a corresponding storage of flood flows in the pond. The trapezoidal weir is provided to prevent pond bank overtopping at the highest design flows. The routing through the outlet structure for Pond 12 (HDET12) is represented by a table equating storage volume in the pond with pond elevation and discharge through the outlet structure. #12

The resulting hydrograph is routed (RO18) along the lined channel from Sta. 992+00 to Sta. 997+00.

A hydrograph is computed for Sub-Basin 19 (SUB19) and combined (CO19A) with the hydrograph routed from Sta. 992+00.

The combined flows enter Detention Pond No. 11, which is situated just east of the Hawes Channel. Detention Pond No. 11 is an on-line pond and has four 24-in. concrete pipes under a trapezoidal weir as an outlet structure. This pond functions in the same manner as does Pond No. 12. Both ponds reduce the peak flows along the channel and delay the hydrograph peaks. This peak-delaying results in an offset of these peak flows from peak flows of other inflow hydrographs along the channel and assists in the reduction of peak flows at the Sossaman Channel. The routing through the outlet structure for Pond No. 11 (HDET11) is represented by a table equating storage volume in the pond with pond elevation and with discharge through the outlet structure. #11

The resulting hydrograph is combined (CO19) with the flows routed from the north (ROD17) along the Hawes Channel. The combined flows are routed (RO19A) from the Hawes Channel (Sta. 972+00) to Pond No. 10 (Sta. 966+24).

The remaining detention ponds on Channel No. 2 (i.e., Ponds No. 8, No. 9 and No. 10) are off-line ponds. The off-line ponds attenuate peak flood flows but do not delay the attenuated peak. The following is a general description of how the off-line ponds function.

The proposed channel and the off-line pond are parallel to one another but are separate. The channel is connected to the pond by a rectangular weir in the south side of the channel. A flow constrictor, in the form of a 2.5 ft. to 3.0 ft. deep concrete beam, is provided just downstream of the side flow weir. The crest of the weir is placed at or slightly above the elevation of the low chord of the flow constrictor. At flows corresponding to flow depths at or lower than the height of the constrictor opening, flow through the constrictor is computed by open channel flow and no flow occurs over the weir. As flow depths in the channel increase, the flow through the constrictor transitions to pressure flow and ponding occurs on the upstream side of the constrictor. This ponding creates a head over the weir and results in discharge into the detention pond. As the storm hydrograph recedes, flow depths in the channel decrease below the weir crest and flow into the ponds ceases. Design

The inflow hydrograph to any off-line pond is determined by the inflow hydrograph to the weir-constrictor system, the height of the constrictor beam above the channel invert, the length of the weir and the elevation of the weir crest. Rating curves (discharge vs. headwater) were obtained from multiple HEC-2 runs at each constrictor

after constrictor heights were chosen. Weir lengths and crest elevations were determined by a trial and error method. A length and a crest elevation were chosen. A rating curve was then established to equate the headwater at the constrictor (h_I) with headwater over the weir (H_w). The constrictor headwater was equated with a flow through the constrictor (Q_o) and the weir headwater was equated with a flow over the weir (Q_w). The sum of $Q_o + Q_w$ is equal to the inflow to the constrictor-weir system (Q_I). From this final step a table of inflow (Q_I) vs. diverted flow (Q_w) was determined for the HEC-1 input. Diverted flows for the off-line ponds were not returned to the channel in the model. Pond flows will be released slowly back into the channel through small diameter outfall pipes (within 24 hours after the end of the storm) after the peak flows have passed by. Design

At each detention pond an initial HEC-1 run was obtained using the detention pond diversion table for the first iteration of the weir height and length. The required pond volume for the pond inflow hydrograph was compared with the available pond volume. Adjustments were made, as required, to the weir length and height and the procedure described above was repeated until a satisfactory inflow hydrograph was obtained. The flow diversions described below represent the final iteration of the above described procedure.

A flow division is introduced at Detention Pond No. 10 (DET10). The resulting channel hydrograph is routed (RO19B) from Constrictor No. 10 to Constrictor No. 9 (Sta. 966+24 to Sta. 961+21). A flow division is introduced at Detention Pond No. 9 (DET9). The resulting channel hydrograph is routed to Constrictor No. 8 (RO19C) (Sta. 955+21) where a third flow division (DET8) is introduced. The resulting channel hydrograph is routed west (RO19D) to the Sossaman Channel. Routing Detail

A hydrograph is computed for local Sub-Basin 21 (SUB21). A separate hydrograph is computed for the on-site runoff between Ellsworth Road the Sossaman Channel (SUBFY2). These two hydrographs are combined with the routed hydrograph (COFY2). This represents the total flow from the east into the Sossaman Channel at the freeway. The inflow hydrograph from the east is combined (CO21) with the previously computed inflow hydrograph from the north. The hydrograph at CO21 represents the total flow in the Sossaman Channel on the north side of the freeway.

Channel No. 1:

The routing description at the east end of Channel No. 1, including the flow split at the Sossaman Channel and Southern Avenue and through CO32, is the same as in Simulation No. 1. The peak flows at CO32A were used to size the Sossaman Road box culvert. The point CO32 is on the west side of Sossaman Road where the flows from the Sossaman Road enter Channel No. 1. This combined hydrograph is routed (RO32A) west to off-line Detention Pond No. 7 (Sta. 916+96 to Sta. 913+24). A flow division is introduced at Constrictor No. 7 (DET7) and the resulting channel hydrograph is routed (RO32B) west to off-line Detention Pond No. 6 (Sta. 913+24 to Sta. 907+24). A flow division is introduced at Constrictor No. 6 (DET6) and the resulting channel hydrograph is routed (RO32C) west to the Sossaman Road Channel.

The routing upstream on the Sossaman Road Channel is described in Simulation No. 1. The Sossaman Road Channel flows and local sub-basin flows are combined at CO33. These flows are then combined (CO33A) with the routed hydrograph from Constrictor No. 6. Constrictor No. 5 and off-line Detention Pond No. 5 are located immediately downstream of the Sossaman Road Channel. A flow division is introduced at Constrictor No. 5 (DET5) and the resulting hydrograph is routed west (RO33A) to off-line Detention Pond No. 4 (Sta. 890+24 to Sta. 884+00). A flow division is introduced at Constrictor No. 4 (DET4) and the resulting channel hydrograph is routed (RO33B) to the 72nd Street Channel (Sta. 897+24 to Sta. 890+24).

The routing for the 72nd Street Channel is described in Simulation No. 1. At point CO35 flows routed from the north are combined with the routed hydrograph from Constrictor No. 4. Detention Pond No. 3 is located immediately downstream of the 72nd Street Channel. A flow division is introduced (DET3) at Constrictor No. 3 and the resulting channel hydrograph is routed (RO35A) to the 72nd Street box culvert (Sta. 890+24 to Sta. 884+00). A second routing (RO35B) takes the hydrograph to off-line Detention Pond No. 2 (Sta. 879+20). A flow division is introduced at Constrictor No. 2 (DET2). The resulting channel hydrograph is routed west (RO35C) to off-line Detention Pond No. 1 (Sta. 879+20). A flow division is introduced (DET1) at Constrictor No. 1 and the resulting channel hydrograph is routed (RO35D) to Power Road. The local flows for Sub-Basin 36 are added-in at this point (CO36) and the combined hydrograph is routed (ROPOW) through the Power Road box culvert.

The resulting hydrograph is routed along the existing lined channel 2500 ft. west of Power Road (RO36A and RO36B, two routings for slope change) to the point where on-site Trunkline No. 1 discharges into the channel. The hydrograph for on-site flows is computed (SUBFY1) and added to the main channel hydrograph (COFY1). The combined hydrograph is routed (RO36C) to the RWCD Floodway and combined (CO37) with local flows (as described in Simulation No. 1). The flows at CO37 represent the total contribution to the RWCD Floodway from the east along the Superstition Freeway corridor.

Design parameters describing the constrictor geometry, weir geometry and flow characteristics through the constrictor - weir system are included in Appendix C.

HEC-2: Water Surface Profiles

The HEC-2 program was used to establish 50- and 100 year water surface profiles in Channels No. 1 and 2 and to determine the existing 50- and 100- year headwater depths at the Power Road box culvert. Water surface profiles were established by inserting flow rates, determined with the HEC-1 program, at appropriate locations in HEC-2 data files. Channel No. 1 is modeled from the RWCD Floodway to its upstream end. Channel No. 2 is modeled in three segments. The first segment of Channel No. 2 extends from the confluence of Channel No. 2 with the Sossaman Channel to the outlet of Pond 11. The second extends from the downstream end of Pond 11 to the outlet of Pond 12. The third segment extends from the downstream end of Pond 12 to the upstream end of Channel No. 2. In addition, the Sossaman Channel was modeled from the grade control weirs downstream of Baseline Road to the intersection with the north R.O.W. line of the Superstition Freeway. The outfall channel for Storm Sewer Trunkline No. 3 (subsidiary channel) was modeled from its intersection with Channel No. 2 to the storm sewer outfall. Headwater depths at the Power Road box culvert

were established by simulating the existing channel from the RWCD Floodway to the upstream end of the gunite lining just east of Power Road.

The channels were modeled assuming sub-critical flow initially. Channel segments in which super-critical flow occurs were identified from the initial simulations and were subsequently modeled assuming super-critical flow. These segments include the box culverts under Power Road, 72nd Street and Sossaman Road, as well as a section of Channel No. 2 from the grade break below the diversion structure for Pond 8 (STA 947+40) to the grade break above the confluence with the Sossaman Channel (STA 935+00). Although flow in the existing channel downstream from Power Road is super-critical, this segment of channel was simulated super-critically for proposed flows only. The segment downstream from Power Road was simulated super-critically to evaluate the tailwater at the outfall for Storm Sewer Trunkline No. 1. The precise location of the water surface profile in this section of channel was not determined for the existing 50- and 100-year flows.

Water surface elevations were determined at appropriate control locations to initiate the water surface profile simulations. For the sub-critical flow simulation of Channel No. 1 and the simulation of the existing channel from the RWCD Floodway to the end of the gunite lining, it was assumed that the existing channel will be bank full at the RWCD Floodway. This assumption is considered to be conservative since it is presumed that the water surface elevation in the RWCD Floodway would be lower than the bank elevation during the 100-year flood. Using this starting assumption, the sub-critical simulations indicate that flow becomes super-critical between the RWCD Floodway and Power Road and that the assumed starting depth has no effect on water surface elevations upstream from Power Road.

The initial flow depth condition for the first segment of Channel No. 2 was determined by simulating a section of the Sossaman Channel from the grade control weirs downstream of Baseline Road to its confluence with Channel No. 2. Flow is critical at the weirs, thereby providing the model with a known starting depth for the first segment of Channel No. 2. Starting depths for the second and third segments of Channel No. 2 were obtained from the peak stage values calculated for Ponds 11 and 12 from the HEC-1 model.

Initial conditions for the super-critical simulations were established based on the results of the sub-critical simulations. Stations where flow becomes critical can be identified from these simulations. These are used as starting points for the segments modeled super-critically. Since flow is critical at these locations, an initial depth is known. These sections are then modeled super-critically to a downstream point where the sub-critical model is valid.

Channel geometry is represented in the HEC-2 program using cross-sections, the lengths between cross-sections and loss coefficients. Cross-sections are placed at the upstream and downstream ends of transition sections, at grade breaks and on the upstream and downstream sides of diversion beams. Although flow over diversion weirs is not modeled directly using HEC-2, cross-sections are also placed at the downstream end of each diversion weir. A description of each cross-section location and station can be found in Table 15. Cross-section offsets are referenced to the channel centerline, which has a value of 500. Typical cross-sections with standard depths, bottom widths and side slopes are used to represent some cross-sections. However,

TABLE 15: SUMMARY OF HEC-2 RESULTS FOR CHANNELS NOS. 1 AND 2

Description of cross-section location	STATION	Type of Flow	HEC-1 TITLE	Invert elev.	50 yr Flow	100 yr Flow	50 yr crit.	50 yr w.s.	50 yr Depth	50 yr Vel.	50 yr F. B.	100 yr crit.	100 yr w.s.	S. Bank elev	N. Bank elev.	Free-board
Upstream end of Power Road Box Culvert	865+57	Critical	ROPOW	1358.0	1583	1651	0.0	1365.5	7.5	9.8	1367.3	0.0	1366.3	1367.5	1367.5	no
Upstream end of transition to Power Road box culvert	866+67	Sub-critical	DET1	1358.2	1301	1307	1363.0	1366.8	8.6	4.6	1368.5	1363.0	1367.4	1367.6	1367.5	no
Downstream end of Pond 1 overflow spillway (top of bank)	867+01	Sub-critical	DET1	1358.7	1301	1307	1363.5	1366.8	8.1	5.0	1368.5	1363.5	1367.4	1368.0	1367.7	no
Downstream end of Pond 1 overflow spillway (begining of crest)	867+02	Sub-critical	DET1	1358.7	1301	1307	1363.6	1366.8	8.1	5.0	1368.5	1363.5	1367.4	1368.0	1367.7	no
Upstream end of Pond 1 overflow spillway (end of crest)	867+78	Sub-critical	DET1	1359.2	1301	1307	1364.1	1366.7	7.5	5.6	1368.3	1364.0	1367.4	1368.5	1368.0	no
Upstream end of Pond 1 overflow spillway (top of bank)	867+79	Sub-critical	DET1	1359.2	1301	1307	1364.0	1366.7	7.5	5.6	1368.3	1364.0	1367.4	1368.5	1368.0	no
Grade break below diversion structure for Pond 1	871+40	Sub-critical	DET1	1361.3	1301	1307	1366.0	1366.3	5.0	10.0	1367.6	1366.1	1367.7	1370.2	1370.2	yes
Downstream end of transition section below Pond 1 diversion structure	871+73	Sub-critical	DET1	1361.4	1301	1307	1366.2	1366.3	4.9	10.1	1367.6	1366.2	1367.1	1370.4	1370.3	yes
Upstream end of transition section below Pond 1 diversion structure	871+83	Sub-critical	DET1	1361.4	1301	1307	1365.9	1367.1	5.7	7.7	1368.4	1365.9	1367.4	1370.4	1370.3	yes
Downstream side of flow constrictor for Pond 1 diversion structure	871+93	Sub-critical	DET1	1361.4	1301	1307	1365.9	1367.1	5.7	7.7	1368.4	1365.9	1367.4	1370.5	1370.4	yes
Upstream side of flow constrictor for Pond 1 diversion structure	871+97	Sub-critical	DET1	1361.4	1301	1307	0.0	1368.7	7.2	5.6	1370.2	0.0	1369.1	1370.5	1370.4	yes
Downstream end of Pond 1 diversion weir	872+02	Sub-critical	DET2	1361.5	1380	1425	1366.1	1368.6	7.1	6.0	1370.1	1366.1	1369.0	1370.5	1370.4	yes
Downstream end of transition section above Pond 1 diversion structure	872+37	Sub-critical	DET2	1361.5	1380	1425	1366.1	1368.6	7.1	6.0	1370.2	1366.2	1369.0	1370.7	1370.5	yes
Upstream end of transition section above Pond 1 diversion structure	872+47	Sub-critical	DET2	1361.5	1380	1425	1366.5	1368.6	7.0	6.5	1370.1	1366.6	1369.0	1370.7	1370.5	yes
Slope break upstream from Pond 1 diversion structure	873+00	Sub-critical	DET2	1361.6	1380	1425	1366.6	1368.6	6.9	6.6	1370.1	1366.7	1369.0	1371.1	1370.5	yes
Grade break below diversion structure for Pond 2	878+39	Critical	DET2	1364.8	1380	1425	1369.7	1369.7	4.9	10.8	1371.1	1369.9	1369.8	1374.0	1373.7	yes
Downstream end of transition section below Pond 2 diversion structure	878+85	Sub-critical	DET2	1364.9	1380	1425	1369.8	1370.2	5.4	9.6	1371.6	1369.9	1370.3	1374.3	1374.1	yes
Upstream end of transition section below Pond 2 diversion structure	878+95	Sub-critical	DET2	1364.9	1380	1425	1369.5	1370.8	5.9	7.8	1372.1	1369.6	1370.9	1374.4	1374.2	yes
Downstream side of flow constrictor for Pond 2 diversion structure	879+05	Sub-critical	DET2	1364.9	1390	1425	1369.5	1370.8	5.9	7.8	1372.2	1369.6	1370.9	1374.5	1374.3	yes
Upstream side of flow constrictor for Pond 2 diversion structure	879+09	Sub-critical	DET2	1364.9	1380	1425	0.0	1372.0	7.1	6.1	1373.5	0.0	1372.2	1374.5	1374.3	yes
Downstream end of Pond 2 diversion weir	879+14	Sub-critical	DET3	1364.9	1558	1650	1369.9	1371.9	6.9	7.1	1373.4	1369.6	1372.2	1374.5	1374.3	yes
Downstream end of transition section above Pond 2 diversion structure	879+74	Sub-critical	DET3	1365.0	1558	1650	1370.0	1371.9	6.9	7.2	1373.4	1369.6	1372.2	1375.1	1374.9	yes
Upstream end of transition section above Pond 2 diversion structure	879+84	Sub-critical	DET3	1365.1	1558	1650	1370.4	1371.8	6.7	7.9	1373.3	1370.1	1372.0	1375.2	1375.0	yes

TABLE 15: SUMMARY OF HEC-2 RESULTS FOR CHANNELS NOS. 1 AND 2

Description of cross-section location	STATION	Type of Flow	HEC-1 TITLE	Invert elev.	50 yr Flow	100 yr Flow	50 yr crit.	50 yr w.s.	50 yr Depth	50 yr Vel.	50 yr F. B.	100 yr crit.	100 yr w.s.	S. Bank elev	N. Bank elev.	Free-board
Slope break upstream from Pond 2 diversion structure	879+99	Sub-critical	DET3	1365.1	1558	1650	1370.4	1371.8	6.7	7.9	1373.3	1370.9	1372.0	1375.4	1375.2	yes
Grade break below transition for 72nd Street box culvert	883+00	Super-critical	DET3	1369.5	1558	1650	1374.8	1373.8	4.3	14.8	1375.4	1375.0	1373.9	1377.8	1377.8	yes
Downstream end of transition section below 72nd Street box culvert	883+48	Super-critical	DET3	1369.8	1558	1650	1375.1	1374.0	4.2	15.1	1375.6	1375.2	1374.1	1378.4	1378.4	yes
Downstream end of 72nd Street box culvert	883+73	Super-critical	DET3	1370.0	1558	1650	1374.9	1373.9	3.9	16.0	1375.4	1375.1	1374.0	1379.5	1379.5	yes
Upstream end of 72nd Street box culvert	885+11	Super-critical	DET3	1370.9	1558	1650	0.0	1374.5	3.6	17.2	1376.1	0.0	1374.7	1380.4	1380.4	yes
Upstream end of transition section above 72nd Street box culvert	885+37	Super-critical	DET3	1371.0	1558	1650	1376.9	1375.8	4.8	15.1	1377.5	1377.0	1376.0	1380.3	1380.3	yes
Grade break below diversion structure for Pond 3	889+45	Critical	DET3	1373.2	1558	1650	1379.1	1379.1	5.8	11.3	1380.6	1379.2	1379.2	1383.0	1382.9	yes
Downstream end of transition section below Pond 3 diversion structure	889+88	Sub-critical	DET3	1373.3	1558	1650	1379.2	1379.6	6.3	10.1	1381.1	1379.3	1379.7	1383.2	1383.1	yes
Upstream end of transition section below Pond 3 diversion structure	889+98	Sub-critical	DET3	1373.3	1558	1650	1378.3	1380.5	7.2	6.9	1382.1	1378.5	1380.7	1383.3	1383.2	yes
Downstream side of flow constrictor for Pond 3 diversion structure	890+08	Sub-critical	DET3	1373.4	1558	1650	1378.3	1380.5	7.2	6.9	1382.1	1378.5	1380.7	1383.3	1383.2	yes
Upstream side of flow constrictor for Pond 3 diversion structure	890+12	Sub-critical	DET3	1373.4	1558	1650	0.0	1381.4	8.0	5.9	1383.1	0.0	1381.7	1383.4	1383.3	yes
Downstream end of Pond 3 diversion weir	890+17	Sub-critical	CO35	1373.4	1672	1848	1378.6	1381.3	8.0	6.4	1383.0	1378.8	1381.6	1383.4	1383.3	yes
Downstream end of transition section above Pond 3 diversion structure	890+77	Sub-critical	CO35	1373.5	1672	1848	1378.7	1381.3	7.8	6.6	1383.0	1379.0	1381.6	1383.9	1383.5	yes
Upstream end of transition section above Pond 3 diversion structure	890+87	Sub-critical	CO35	1373.5	1672	1848	1379.6	1381.1	7.5	8.2	1382.8	1379.9	1381.4	1383.9	1383.5	yes
Slope upstream from Pond 3 diversion structure	891+03	Sub-critical	CO35	1373.5	1672	1848	1379.6	1381.1	7.5	8.2	1382.8	1379.9	1381.4	1384.0	1383.6	yes
72nd Street Channel	891+59	Sub-critical	DET4	1374.3	1077	1110	1379.1	1381.8	7.5	5.3	1383.4	1379.1	1382.2	1384.4	1384.2	yes
Grade break below diversion structure for Pond 4	896+45	Critical	DET4	1378.9	1077	1110	1383.7	1383.7	4.8	10.4	1385.0	1383.8	1383.8	1387.7	1388.4	yes
Downstream end of transition section below Pond 4 diversion structure	896+68	Sub-critical	DET4	1379.0	1077	1110	1383.8	1384.1	5.1	9.5	1385.4	1383.8	1384.2	1387.8	1388.8	yes
Upstream end of transition section below Pond 4 diversion structure	896+78	Sub-critical	DET4	1379.0	1077	1110	1383.0	1385.0	6.0	6.1	1386.3	1383.0	1385.1	1387.9	1389.0	yes
Downstream side of flow constrictor for Pond 4 diversion structure	896+68	Sub-critical	DET4	1379.0	1077	1110	1383.0	1385.0	6.0	6.1	1386.3	1383.1	1385.1	1387.9	1389.2	yes
Upstream side of flow constrictor for Pond 4 diversion structure	896+92	Sub-critical	DET4	1379.0	1077	1110	0.0	1385.7	6.7	5.3	1387.1	0.0	1385.8	1388.0	1389.2	yes
Downstream end of Pond 4 diversion weir	896+97	Sub-critical	DET5	1379.0	1219	1276	1383.3	1385.6	6.5	6.1	1387.0	1383.5	1385.7	1388.0	1389.3	yes
Downstream end of transition section above Pond 4 diversion structure	897+57	Sub-critical	DET5	1379.1	1219	1276	1383.4	1385.6	6.4	6.2	1387.0	1383.6	1385.7	1388.4	1389.4	yes

TABLE 15: SUMMARY OF HEC-2 RESULTS FOR CHANNELS NOS. 1 AND 2

Description of cross-section location	STATION	Type of Flow	HEC-1 TITLE	Invert elev.	50 yr Flow	100 yr Flow	50 yr crit.	50 yr w.s.	50 yr Depth	50 yr Vel.	50 yr F. B.	100 yr crit.	100 yr w.s.	S. Bank elev	N. Bank elev.	Free-board
Upstream end of transition section above Pond 4 diversion structure	897+67	Sub-critical	DET5	1379.2	1219	1276	1384.3	1385.3	6.1	8.2	1386.7	1384.4	1385.4	1388.5	1389.4	yes
Slope break upstream from Pond 4 diversion structure	898+03	Sub-critical	DET5	1379.2	1219	1276	1384.3	1385.5	6.1	8.2	1386.8	1384.5	1385.4	1388.6	1389.4	yes
Grade break below diversion structure for Pond 5	902+44	Critical	DET5	1382.6	1219	1276	1387.7	1387.7	5.1	10.7	1389.1	1387.8	1387.8	1391.7	1390.6	yes
Downstream end of transition section below Pond 5 diversion structure	902+62	Sub-critical	DET5	1382.6	1219	1276	1387.7	1388.1	5.5	9.7	1389.5	1387.9	1388.2	1391.9	1390.7	yes
Upstream end of transition section below Pond 5 diversion structure	902+72	Sub-critical	DET5	1382.6	1219	1276	1386.9	1389.0	6.4	6.3	1390.4	1387.1	1389.2	1392.0	1390.7	yes
Downstream side of flow constrictor for Pond 5 diversion structure	902+82	Sub-critical	DET5	1382.6	1219	1276	1386.9	1389.0	6.4	6.3	1390.4	1387.1	1389.2	1392.0	1390.8	yes
Upstream side of flow constrictor for Pond 5 diversion structure	902+86	Sub-critical	DET5	1382.6	1219	1276	0.0	1389.7	7.1	5.5	1391.2	0.0	1390.0	1392.1	1390.8	no
Downstream end of Pond 5 diversion weir	902+91	Sub-critical	CD33A	1382.6	1359	1495	1387.2	1389.6	6.9	6.3	1391.1	1387.5	1389.9	1392.1	1390.8	no
Downstream end of transition section above Pond 5 diversion structure	903+90	Sub-critical	CD33A	1382.8	1359	1495	1387.4	1389.6	6.8	6.5	1391.1	1387.7	1389.9	1392.6	1391.5	yes
Upstream end of transition section above Pond 5 diversion structure	904+00	Sub-critical	CD33A	1382.9	1359	1495	1387.9	1389.5	6.7	7.3	1391.0	1388.1	1389.8	1392.6	1391.6	yes
Sossaman Road Channel	904+01	Sub-critical	DET6	1382.9	761	876	1386.8	1390.2	7.3	3.9	1391.7	1387.2	1390.5	1392.6	13.0	yes
Slope Break above transition section for Pond 5	904+04	Sub-critical	DET6	1382.9	761	876	1386.9	1390.2	7.3	3.9	1391.7	1387.2	1390.5	1392.6	1391.6	yes
Grade break below diversion structure for Pond 6	906+44	Critical	DET6	1386.2	761	876	1390.1	1390.1	4.0	9.6	1391.2	1390.5	1390.5	1394.3	1393.2	yes
Downstream end of transition section below Pond 6 diversion structure	906+56	Sub-critical	DET6	1386.2	761	876	1390.1	1390.5	4.3	8.6	1391.6	1390.5	1390.9	1394.4	1393.2	yes
Upstream end of transition section below Pond 6 diversion structure	906+66	Sub-critical	DET6	1386.2	761	876	1389.4	1391.3	5.1	5.4	1392.4	1389.7	1391.7	1394.5	1393.2	yes
Downstream side of flow constrictor for Pond 6 diversion structure	906+76	Sub-critical	DET6	1386.2	761	876	1389.5	1391.3	5.0	5.4	1392.4	1389.8	1391.7	1394.5	1393.2	yes
Upstream side of flow constrictor for Pond 6 diversion structure	906+80	Sub-critical	DET6	1386.2	761	876	0.0	1391.7	5.5	4.8	1392.9	0.0	1392.4	1394.6	1393.2	yes
Downstream end of Pond 6 diversion weir	906+85	Sub-critical	DET7	1386.2	810	1057	1389.6	1391.7	5.4	5.2	1392.8	1390.2	1392.3	1394.6	1393.2	yes
Downstream end of transition section above Pond 6 diversion structure	907+45	Sub-critical	DET7	1386.4	810	1057	1389.8	1391.7	5.3	5.3	1392.8	1390.3	1392.3	1395.0	1393.7	yes
Upstream end of transition section above Pond 6 diversion structure	907+55	Sub-critical	DET7	1386.4	810	1057	1390.5	1391.4	5.1	7.2	1392.6	1391.1	1392.0	1395.1	1393.8	yes
Slope break upstream from Pond 6 diversion structure	908+04	Sub-critical	DET7	1386.5	810	1057	1390.7	1391.4	4.9	7.9	1392.6	1391.3	1391.9	1395.4	1394.4	yes
Grade break below diversion structure for Pond 7	912+44	Critical	DET7	1389.6	810	1057	1393.8	1393.8	4.2	9.9	1394.9	1394.4	1394.4	1397.1	1396.7	yes
Downstream end of transition section below Pond 7 diversion structure	912+71	Sub-critical	DET7	1389.6	810	1057	1393.8	1394.4	4.8	7.8	1395.6	1394.4	1395.2	1397.2	1396.9	yes

TABLE 15: SUMMARY OF HEC-2 RESULTS FOR CHANNELS NOS. 1 AND 2

Description of cross-section location	STATION	Type of Flow	HEC-1 TITLE	Invert elev.	50 yr Flow	100 yr Flow	50 yr crit.	50 yr w.s.	50 yr Depth	50 yr Vel.	50 yr F. B.	100 yr crit.	100 yr w.s.	S. Bank elev.	N. Bank elev.	Free-board
Upstream end of transition section below Pond 7 diversion structure	912+81	Sub-critical	DET7	1389.7	810	1057	1393.1	1395.0	5.4	5.3	1396.2	1393.6	1395.8	1397.2	1397.0	yes
Downstream side of flow constrictor for Pond 7 diversion structure	912+91	Sub-critical	DET7	1389.7	810	1057	1393.1	1395.5	5.8	5.3	1396.7	1393.6	1395.8	1397.3	1397.1	yes
Upstream side of flow constrictor for Pond 7 diversion structure	912+95	Sub-critical	DET7	1389.7	810	1057	0.0	1395.4	5.8	4.8	1396.7	0.0	1396.8	1397.3	1397.2	yes
Downstream end of Pond 7 diversion weir	913+00	Sub-critical	CD32	1389.7	831	1375	1393.2	1395.5	5.8	4.9	1396.7	1394.3	1396.7	1397.3	1397.2	yes
Downstream end of transition section above Pond 7 diversion structure	913+60	Sub-critical	CD32	1389.8	831	1375	1393.3	1395.3	5.4	5.1	1396.4	1394.4	1396.7	1397.6	1397.4	yes
Upstream end of transition section above Pond 7 diversion structure	913+70	Critical	CD32	1389.8	831	1375	1394.1	1394.1	4.3	6.7	1395.1	1395.3	1395.3	1397.6	1397.5	yes
Downstream end of transition below Sossaman Road Box	916+61	Super-critical	CD32	1390.5	831	1375	1394.8	1393.4	2.8	7.6	1394.1	1396.0	1394.2	1398.5	1398.5	yes
Downstream end of Sossaman Road box culvert	916+96	Critical	CD31	1393.0	1016	763	1395.1	1396.8	3.8	11.1	1397.9	1397.6	1398.1	1400.5	1400.5	yes
Upstream end of Sossaman Road box culvert	918+64	Super-critical	CD31	1394.1	1016	763	0.0	1395.4	1.3	13.3	1396.2	0.0	1397.3	1401.5	1401.5	yes
Upstream end of transition section above Sossaman Road box culvert	919+05	Super-critical	CD31	1394.4	1016	763	1397.0	1396.2	1.8	12.1	1397.0	1399.4	1398.0	1399.7	1400.3	yes
Slope break at begining of access ramp	927+01	Critical	CD31	1399.7	1016	763	1402.3	1402.3	2.6	8.1	1403.1	1404.8	1404.8	1405.7	1406.2	yes
Upstream end of Channel No. 1	928+06	Sub-critical	CD31	1400.0	1016	763	1402.6	1402.9	2.9	9.6	1403.7	1405.0	1404.2	14.0	14.0	yes
																yes
Downstream end of transition to Sossaman Channel culvert under freeway	1+00	Sub-critical	CD21	1401.0	1981	2011	1405.7	1406.6	5.6	8.9	1407.9	1406.5	1406.5	1408.5	1408.5	yes
Downstream end of Sossaman Channel box culvert under freeway	930+49	Sub-critical	CD21	1401.2	1981	2011	1403.9	1407.7	6.5	3.9	1409.0	1407.7	1407.7	1408.5	1408.5	yes
Upstream end of Sossaman Channel box culvert under freeway	930+50	Sub-critical	CD21	1401.6	1981	2011	0.0	1407.9	6.3	4.1	1409.2	1408.0	1408.0	1409.6	1410.0	yes
Downstream end of transition from Sossaman Channel to Channel No. 2	930+51	Sub-critical	CD21	1401.6	1951	2011	1404.4	1407.9	6.3	4.1	1409.2	1404.4	1408.0	1409.6	1410.0	yes
Upstream end of transition from Sossaman Channel to Channel No. 2	930+52	Sub-critical	CDFY2	1401.7	816	866	1405.7	1407.9	6.1	4.3	1409.2	1405.8	1407.9	1409.7	1409.7	yes
Grade break to insure that flows are sub-critical at box culvert	935+00	Super-critical	CDFY2	1402.7	816	866	1406.8	1407.9	5.2	14.1	1409.6	1407.0	1405.9	1412.0	1412.3	yes
Channel for Storm Sewer 3 outfall	943+36	Super-critical	DET8	1408.2	606	618	1411.7	1412.0	3.8	11.0	1413.1	1411.8	1412.2	1416.0	1416.1	yes
Grade break	947+00	Super-critical	DET8	1410.9	606	618	1414.4	1413.4	2.5	14.2	1414.5	1414.4	1413.4	1420.8	1419.4	yes
Grade break below diversion structure for Pond 8	954+40	Critical	DET8	1416.0	606	618	1419.5	1419.5	3.5	9.1	1420.5	1419.6	1419.6	1423.4	1423.5	yes
Downstream end of transition section below Pond 8 diversion structure	954+61	Sub-critical	DET8	1416.1	606	618	1419.6	1419.9	3.8	8.1	1420.9	1419.6	1419.9	1423.5	1423.6	yes

TABLE 15: SUMMARY OF HEC-2 RESULTS FOR CHANNELS NOS. 1 AND 2

Description of cross-section location	STATION	Type of Flow	HEC-1 TITLE	Invert elev.	50 year Flow	100 yea Flow	50 yr crit.	50 yr w.s.	50 yr Depth	50 yr Vel.	50 yr F. B.	100 yr crit.	100 yr w.s.	S. Bank elev	N. Bank elev.	Free-board
Upstream end of transition section below Pond 8 diversion structure	954+71	Sub-critical	DET8	1416.1	606	618	1418.9	1420.6	4.5	4.9	1421.6	1419.0	1420.7	1423.5	1423.7	yes
Downstream side of flow constrictor for Pond 8 diversion structure	954+81	Sub-critical	DET8	1416.1	606	618	1418.9	1420.6	4.5	5.0	1421.6	1419.0	1420.7	1423.6	1423.8	yes
Upstream side of flow constrictor for Pond 8 diversion structure	954+85	Sub-critical	DET8	1416.1	606	618	0.0	1421.5	5.3	4.0	1422.6	0.0	1421.6	1423.6	1423.8	yes
Downstream end of Pond 8 diversion weir	954+90	Sub-critical	DET9	1416.1	770	805	1419.4	1421.3	5.2	5.2	1422.5	1419.5	1421.4	1423.6	1423.8	yes
Downstream end of transition section above Pond 8 diversion structure	955+50	Sub-critical	DET9	1416.3	770	805	1419.5	1421.4	5.1	5.3	1422.5	1419.6	1421.4	1424.0	1424.2	yes
Upstream end of transition section above Pond 8 diversion structure	955+60	Sub-critical	DET9	1416.3	770	805	1420.3	1421.1	4.8	7.4	1422.2	1420.4	1421.2	1424.2	1424.2	yes
Slope break upstream from Pond 8 diversion structure	956+00	Sub-critical	DET9	1416.4	770	805	1420.4	1421.1	4.8	7.5	1422.2	1420.5	1421.2	1424.9	1424.2	yes
Grade break below diversion structure for Pond 9	960+40	Critical	DET9	1419.1	770	805	1423.1	1423.1	4.0	9.6	1424.2	1423.2	1423.2	1426.9	1431.0	yes
Downstream end of transition section below Pond 9 diversion structure	960+61	Sub-critical	DET9	1419.2	770	805	1423.2	1423.5	4.3	8.9	1424.6	1423.3	1423.5	1427.0	1431.1	yes
Upstream end of transition section below Pond 9 diversion structure	960+71	Sub-critical	DET9	1419.2	770	805	1422.5	1424.3	5.1	5.4	1425.4	1422.6	1424.4	1427.0	1431.2	yes
Downstream side of flow constrictor for Pond 9 diversion structure	960+81	Sub-critical	DET9	1419.2	770	805	1422.5	1424.3	5.1	5.4	1425.4	1422.6	1424.4	1427.1	1431.3	yes
Upstream side of flow constrictor for Pond 9 diversion structure	960+85	Sub-critical	DET9	1419.2	770	805	0.0	1425.3	6.1	4.3	1426.6	0.0	1425.5	1427.1	1431.4	yes
Downstream end of Pond 9 diversion weir	960+90	Sub-critical	DET10	1419.2	913	1002	1422.9	1425.2	6.0	5.2	1426.5	1423.1	1425.4	1427.1	1431.4	yes
Downstream end of transition section above Pond 9 diversion structure	961+50	Sub-critical	DET10	1419.4	913	1002	1423.0	1425.2	5.9	5.4	1426.5	1423.2	1425.4	1427.5	1431.5	yes
Upstream end of transition section above Pond 9 diversion structure	961+60	Sub-critical	DET10	1419.4	913	1002	1423.8	1425.0	5.6	7.1	1426.3	1424.0	1425.2	1427.6	1431.5	yes
Slope break upstream from Pond 9 diversion structure	962+00	Sub-critical	DET10	1419.5	913	1002	1423.8	1425.0	5.6	7.2	1426.3	1424.1	1425.2	1427.9	1431.8	yes
Grade break below diversion structure for Pond 10	965+45	Critical	DET10	1421.7	913	1002	1426.1	1426.1	4.4	10.0	1427.3	1426.3	1426.3	1430.0	1432.3	yes
Downstream end of transition section below Pond 10 diversion structure	965+64	Sub-critical	DET10	1421.8	913	1002	1426.2	1426.2	4.4	10.0	1427.4	1426.4	1426.4	1430.1	1432.4	yes
Upstream end of transition section below Pond 10 diversion structure	965+74	Sub-critical	DET10	1421.8	913	1002	1425.4	1427.4	5.5	5.7	1428.6	1425.6	1427.6	1430.2	1432.4	yes
Downstream side of flow constrictor for Pond 10 diversion structure	965+84	Sub-critical	DET10	1421.8	913	1002	1425.4	1427.4	5.5	5.7	1428.6	1425.6	1427.6	1430.2	1432.5	yes
Upstream side of flow constrictor for Pond 10 diversion structure	965+88	Sub-critical	DET10	1421.8	913	1002	0.0	1428.4	6.5	4.6	1429.7	0.0	1428.9	1430.3	1432.5	yes
Downstream end of Pond 10 diversion weir	965+93	Sub-critical	CD19	1421.8	991	1198	1425.7	1428.3	6.5	0.0	1429.6	1426.1	1428.8	1430.3	1432.5	yes
Downstream end of transition section above Pond 10 diversion structure	966+53	Sub-critical	CD19	1422.0	991	1198	1425.8	1428.3	6.4	5.2	1429.7	1426.2	1428.8	1430.5	1433.6	yes

TABLE 15: SUMMARY OF HEC-2 RESULTS FOR CHANNELS NOS. 1 AND 2

Description of cross-section location	STATION	Type of Flow	HEC-1 TITLE	Invert elev.	50 yr Flow	100 yr Flow	50 yr crit.	50 yr w.s.	50 yr Depth	50 yr Vel.	50 yr F. B.	100 yr crit.	100 yr w.s.	S. Bank elev	N. Bank elev.	Free-board
Upstream end of transition section above Pond 10 diversion structure	966+63	Sub-critical	CD19	1422.0	991	1198	1426.6	1428.2	6.2	6.7	1429.5	1427.1	1428.6	1430.5	1433.7	yes
Slope break upstream from Pond 10 diversion structure	967+05	Sub-critical	CD19	1422.1	991	1198	1426.7	1428.2	6.1	6.8	1429.5	1427.1	1428.7	1430.6	1434.3	yes
Hawes Road	970+11	Sub-critical	HDET11	1425.6	124	138	1426.9	1429.0	3.4	1.9	1429.7	1427.0	1429.6	1435.7	1435.4	yes
Outlet from Pond 11	971+53	Sub-critical	HDET11	1427.4	124	138	1428.8	1428.8	1.4	6.1	1429.2	1428.9	1429.5	1436.9	1436.9	yes
Downstream end of Pond 11	972+11	Sub-critical	HDET11	1427.8	124	138	1429.2	1433.3	5.5	0.4	1434.4	1429.3	1434.3	1435.8	1437.7	yes
Downstream end of berm in Pond 11	973+00	Sub-critical	HDET11	1428.3	124	138	1429.7	1433.3	5.0	0.5	1434.3	1429.8	1434.3	1436.5	1437.9	yes
Mid-point of Pond 11	975+00	Sub-critical	HDET11	1429.5	124	138	1431.1	1433.3	3.8	0.6	1434.0	1431.2	1434.3	1438.2	1438.7	yes
Upstream end of Pond 11	976+84	Sub-critical	HDET11	1430.6	124	138	1432.0	1433.3	2.6	1.0	1433.8	1432.0	1434.3	1439.7	1439.7	yes
Inlet to Pond 11	977+00	Sub-critical	HDET12	1430.8	112	128	1432.1	1433.2	2.4	2.7	1433.7	1432.2	1434.2	1438.2	1439.8	yes
Outlet of Pond 12	991+64	Critical	HDET12	1439.5	112	128	1440.8	1440.8	1.3	6.0	1441.2	1440.9	1440.9	1449.5	1447.7	yes
Downstream end of Pond 12	992+11	Sub-critical	HDET12	1439.8	112	128	1441.1	1444.5	4.7	0.5	1445.5	1441.2	1445.5	1448.2	1450.2	yes
Downstream end of berm in Pond 12	993+00	Sub-critical	HDET12	1440.3	112	128	1441.6	1444.5	4.2	0.7	1445.4	1441.7	1445.5	1447.3	1450.3	yes
Mid-point of Pond 12	995+00	Sub-critical	HDET12	1441.5	112	128	1442.9	1444.5	3.0	0.8	1445.1	1442.9	1445.5	1448.3	1450.0	yes
Upstream end of Pond 12	996+89	Sub-critical	HDET12	1442.7	112	128	1444.0	1444.5	1.9	1.9	1444.9	1444.1	1445.5	1449.1	1450.9	yes
Inlet channel to Pond 12	997+00	Sub-critical	SUB224	1442.7	54	62	1443.5	1444.5	1.9	1.8	1444.9	1443.5	1445.5	1448.8	1451.0	yes
48 inch storm sewer outfall	1015+75	Sub-critical	SUB224	1452.8	54	62	1453.6	1453.6	0.8	4.9	1453.9	1453.7	1453.7	1462.8	1463.2	yes
Grade break	1016+00	Sub-critical	SUB224	1452.9	54	62	1453.8	1453.8	0.8	4.9	1454.0	1453.8	1453.8	1463.0	1463.5	yes
Grade break	1016+62	Sub-critical	SUB224	1459.2	54	62	1460.0	1460.0	0.8	4.9	1460.2	1460.1	1460.1	1463.8	1463.4	yes
24 inch storm sewer outfall	1021+14	Sub-critical	SUB224	1461.9	54	62	1462.7	1462.7	0.9	4.9	1462.9	1462.8	1462.8	1466.6	1467.0	yes

TABLE 15: SUMMARY OF HEC-2 RESULTS FOR CHANNELS NOS. 1 AND 2

Description of cross-section location	STATION	Type of Flow	HEC-1 TITLE	Invert elev.	50 yr Flow	100 yr Flow	50 yr crit.	50 yr w.s.	50 yr Depth	50 yr Vel.	50 yr F. B.	100 yr crit.	100 yr w.s.	S. Bank elev	N. Bank elev.	Free-board
Upstream end of box culvert under freeway for Sossaman Channel	930+50	Sub-critical	CD21-CDF	1401.6	1208	1146	1404.1	1407.6	6.2	2.5	1409.1	1404.3	1408.0	1409.6	1410.0	yes
Downstream end of transition from Sossaman Channel to the box culvert	931+72	Sub-critical	CD21-CDF	1401.7	1208	1146	1404.3	1407.7	6.0	4.0	1409.0	1404.6	1408.0	1409.6	1410.0	yes
Upstream end of transition from Sossaman Channel to the box culvert	932+18	Sub-critical	CD21-CDF	1401.9	1208	1146	1406.1	1407.3	5.4	7.4	1408.6	1406.3	1407.8	1409.7	1410.0	yes
Sossaman Channel at the Superstition Freeway North Right of Way line	934+27	Sub-critical	CD21-CDF	1402.6	1208	1146	1407.1	1407.1	4.3	10.0	1408.3	1407.3	1407.7	1409.7	1410.0	yes
Intersection of Storm Sewer No. 3 outfall channel with Channel No. 2	943+36	Critical	SUBFY2	1408.2	131	148	1410.3	1411.7	3.5	11.3	1412.8	1410.3	1411.7	1416.0	1416.0	yes
Downstream end of Storm Sewer No. 3 outfall channel	944+00	Sub-critical	SUBFY2	1406.5	131	148	1410.5	1411.6	3.1	3.4	1412.3	1410.5	1411.7	1416.1	1416.1	yes
Storm Sewer No. 3 outfall channel 30 feet downstream from outfall	946+30	Critical	SUBFY2	1409.6	131	148	1411.0	1411.6	2.0	6.4	1412.2	1411.0	1411.7	1416.9	1416.9	yes
Upstream end of Storm Sewer No. 3 outfall channel	946+60	Critical	SUBFY2	1409.7	131	148	1411.7	1411.7	2.0	6.7	1412.2	1411.7	1411.8	1417.1	1417.1	yes

TABLE 16. HEC-2 SPECIAL BRIDGE PARAMETERS

Structure	Bridge Opening (ft)	Obstruct. Width (ft)	X-Sect. Area (sq. ft)	Side Slopes (H/V)	Pier Shape Coeff.	Total Loss Coeff.	Weir Flow Coeff.	Bridge Bottom (ft)	Bridge Top (ft)	Chan. Invert (ft)
Power Road box culvert	21.0	1.0	120.0	0.0	1.25	1.56	2.65	1364.00	1368.20	1358.00
Pond 1 diversion	20.0	0.0	142.5	1.7	0.00	1.56	2.65	1366.44	1369.52	1361.44
Pond 2 diversion	20.0	0.0	161.4	1.7	0.00	1.56	2.65	1370.40	1373.48	1364.90
72nd Street box culvert	25.0	1.0	192.0	0.0	1.25	1.56	2.65	1378.89	1379.89	1370.89
Pond 3 diversion	20.0	0.0	205.8	1.6	0.00	1.56	2.65	1380.05	1383.13	1373.35
Pond 4 diversion	20.0	0.0	159.5	1.6	0.00	1.56	2.65	1384.53	1387.61	1379.00
Pond 5 diversion	20.0	0.0	177.6	1.6	0.00	1.56	2.65	1388.63	1391.71	1382.63
Pond 6 diversion	20.0	0.0	132.9	1.6	0.00	1.56	2.65	1391.02	1394.10	1386.22
Pond 7 diversion	20.0	0.0	141.4	1.6	0.00	1.56	2.65	1394.72	1397.80	1389.68
Sossaman Road box culvert	21.0	1.0	120.0	0.0	1.25	1.56	2.65	1400.12	1401.12	1394.12
Freeway box culvert at the Sossaman Channel	77.0	5.0	432.0	0.0	1.25	1.56	2.65	1407.61	1410.11	1401.61
Pond 8 diversion	20.0	0.0	89.6	1.6	0.00	1.56	2.65	1419.63	1422.71	1416.13
Pond 9 diversion	20.0	0.0	105.6	1.6	0.00	1.56	2.65	1423.23	1426.31	1419.23
Pond 10 diversion	20.0	0.0	122.4	1.6	0.00	1.56	2.65	1426.32	1429.40	1421.83

cross-sections from the downstream end of the transition section below each diversion weir to the upstream end of the transition section above each weir are modeled precisely. Lengths between cross-sections are based on freeway stationing except where the channels curve, at which locations true lengths are used. Frictional effects are represented by Manning's "n" values of 0.016 for the channels and 0.035 for overbank areas. Expansion coefficients of 0.30 and contraction coefficients of 0.10 are used for both channels.

Diversion beams and box culverts are represented by the HEC-2 special bridge method which computes losses through a structure. The special bridge method determines if the flow is classified as low flow, pressure flow, weir flow or a combination of these. Low flow is treated as open channel flow, pressure flow is evaluated as orifice flow and weir flow is evaluated based on the standard weir equation. Further discussion of this method can be found in the HEC-2 User's Manual (Army Corps of Engineers, 1982). In addition to cross-section data, this method requires values for the bottom width of the bridge opening, the width of any obstructions, the cross-sectional area and side slopes of the opening, as well as the elevation of the bridge top and bottom at a number of locations on the cross-section. Pier shape, total energy loss and weir discharge coefficients are also required. Values for these coefficients were determined from the HEC-2 users manual (Army Corps of Engineers, 1982). Parameter values used to model the box culverts and diversion beams using the special bridge method can be found in Table 16.

Since flows are diverted at the off-line ponds and added at other locations, the flow rate being simulated changes at several locations along the channels. The removal of flow at the off-line ponds was represented by inserting a new flow rate at the downstream end of each diversion weir. These flow rates were determined from HEC-1 simulations and are shown in Table 15. For sub-critical simulations, the new flow at the downstream end of each weir corresponds to the flow rate in the channel upstream of the diversion structure. The new flow rate at the downstream end of each weir corresponds to the flow rate in the channel downstream from the diversion structure for super-critical runs. The addition of flow at the 72nd Street Channel and other locations was also represented by changes in the flow rate being simulated. The flow rates associated with the addition or removal of flow, and the corresponding HEC-1 designations are shown in Table 15.

Results of the 50- and 100-yr simulations are presented graphically in Figure 14. The following HEC-2 output files documenting the simulations described can be found in Appendix C.

CHNL1100.OUT- Sub-critical simulation of 100-yr flows in Channel No. 1 from the RWCD Floodway to the upstream end of the channel.

CHNL150.OUT- Sub-critical simulation of 50-yr flows in Channel No. 1 from the RWCD Floodway to the upstream end of the channel.

CHNL2100.OUT- Sub-critical simulations of 100-yr flows in; a) Channel No. 2 from the grade control weirs in the Sossaman Channel downstream of Baseline Road to the outlet from Pond 11; b) the Sossaman Channel to the right-of- way and c) the outfall channel from Storm Sewer No. 3.

CHNL250.OUT- Sub-critical simulations of 50- yr flows in; a) Channel No. 2 from the grade control weirs in the Sossaman Channel downstream from Baseline Road to the outlet from Pond 11; b) the Sossaman channel to the right-of-way and c) the outfall channel from Storm Sewer No. 3.

CH211100.OUT- Sub-critical simulation of 100-yr flows in Channel No. 2 from the downstream end of Pond 11 to the outlet of Pond 12.

CH21150.OUT- Sub-critical simulation of 50-yr flows in Channel No. 2 from the downstream end of Pond 11 to the outlet of Pond 12.

CH212100.OUT- Sub-critical simulation of 100-yr flows from the downstream end of Pond 12 to the upstream end of Channel No. 2.

CH21250.OUT- Sub-critical simulation of 50-yr flows from the downstream end of Pond 12 to the upstream end of Channel No. 2.

SPOW100.OUT- Super-critical simulation of 100-yr flows in Channel No. 1 from the grade break below the diversion structure for Pond 2 (Sta 878+39) to the RWCD Floodway (STA 816+16).

SPOW50.OUT- Super-critical simulation of 50- yr flows in Channel No. 1 from the grade break below the diversion structure for Pond 2 (Sta 878+39) to the RWCD Floodway (Sta 816+16).

S72ND100.OUT- Super-critical simulation of 100-yr flows in Channel No. 1 from the grade break below the diversion structure for Pond 3 (Sta 889+45) to the grade break above the diversion structure for Pond 2 (Sta 879+99).

S72ND50.OUT- Super-critical simulation of 50- yr flows in Channel No. 1 from the grade break below the diversion structure for Pond 3 (Sta 889+45) to the grade break above the diversion structure for Pond 2 (Sta 879+99).

SSOSS100.OUT- Super-critical simulation of 100-yr flows in Channel No. 1 from the grade break above the Sossaman Road box culvert (Sta 919+05) to the upstream end of the transition section above the Pond 7 diversion structure (Sta 913+70).

SSOSS50.OUT- Super-critical simulation of 50-yr flows in Channel No. 1 from the grade break above the Sossaman Road box culvert (Sta 919+05) to the upstream end of the transition section above the Pond 7 diversion structure (Sta 913+70).

SCHN2100.OUT- Super-critical simulation of Channel No. 2 from the grade break at Sta 947+00 to the grade break above the transition to the Sossaman Channel (Sta 935+00).

SCHN250.OUT- Super-critical simulation of Channel No. 2 from the grade break at STA 947+00 to the grade break above the transition to the Sossaman Channel (Sta 935+00).

The super-critical simulations confirm that the flow in those segments identified as having critical depth (from the results of the sub-critical simulations) is super-critical except for that segment which includes the Power Road box culvert. The HEC-2 special note "Hydraulic Jump Downstream", obtained at the Power Road box culvert, prompted the modeling of the culvert super-critically. However, the HEC-2 special

note "Bridge Drowns Upstream Profile", obtained when the culvert is simulated super-critically, indicates that flow is sub-critical on the upstream side of the culvert and super-critical downstream.

In addition to indicating the governing flow regime at each cross-section, Table 15 provides values for the 50- and 100-yr water surface elevations, the channel invert elevation, the 50-yr depth of flow, the 50-yr velocity of flow and the north and south channel bank elevations. Also shown is the minimum allowable bank elevation at each cross-section. This elevation, the required freeboard (FB), was calculated using the following equation:

$$FB = 0.2 \times \left(\frac{V^2}{2g} + D\right)$$

where V = Velocity (fps)

G = Gravitational acceleration (32.2 ft/s^2)

D = Depth of flow (ft)

In the vicinity of the diversion structure for Pond 5, the minimum allowable bank elevation required, to meet freeboard requirements is higher than the existing bank elevation. The required freeboard will be achieved by adding a curbing to effectively raise the channel bank elevation; local drainage to the north of the curbing will be allowed to flow to the west and then around the curbing and into the channel.

The other location in the off-site drainage system where minimum allowable bank elevation (i.e.: freeboard) requirements are not met is along the north side of Channel No. 1 to the east of Power Road. This occurs under proposed flow conditions; these flows are higher than existing condition flows due to the interception of cross-freeway flows. This problem has its origins in the limited capacity of the Power Road box culvert, specifically in the backwater (head) created in order to pass proposed flows, and in the need to allow flows to enter the channel from the north on the east side of Power Road. Flows from the 50- and 100-yr storm events will, however, be confined within the channel and flooding from these events will not be greater than flooding under existing conditions. The system of detention ponds along Channel No. 1 within the right-of-way is designed to effect maximum reductions in peak flows and there is no additional capacity within the present system to achieve freeboard requirements. The development which is currently occurring to the north of the freeway between Power Road and Sossaman Road will have on-site stormwater detention facilities that will, when constructed, reduce peak flows into Channel No. 1, relative to the proposed flows of this analysis. This should serve to reduce storm flows at the Power Road box culvert, although details are unavailable at the present time.

The flow division tables representing the off-line ponds in the HEC-1 model were derived using the HEC-2 program. Division tables were obtained at each weir by determining the flow rates that occur over a weir for a given flow rate arriving at the weir from upstream. The weir flow rate and the corresponding upstream channel (inflow) rate were determined by first assuming a flow rate downstream of the diversion structure and simulating the structure with HEC-2 using that flow rate. The depth of water at the upstream face of the diversion beam was determined from this simulation and was used in conjunction with the height of the weir crest to calculate the flow rate over the weir. The corresponding flow rate arriving at the weir from

the upstream channel was determined by adding the flow over the weir to the assumed flow rate downstream. This procedure was used for a range of flow rates at each diversion structure to arrive at the flow division tables presented in Appendix C. A more detailed description of this procedure can be found in Appendix C along with the HEC-2 output files CH1ROUTA.OUT, CH1ROUTB.OUT and CH2ROUTA.OUT which were used to derive the flow division tables presented.

Changes in flow rates along the channels due to the addition or removal of flow were not modeled in the HEC-2 simulations that were used to derive the flow division tables. This simplification was later evaluated to insure that backwater effects on upstream diversion structures due to downstream structures did not invalidate the division tables. The division tables were inserted in the HEC-1 model and a 100-yr. simulation was performed. Flow rate values along Channels No. 1 and 2 obtained from this simulation were placed at appropriate locations in the HEC-2 data files and the system was simulated. Depths at the upstream face of each diversion beam determined from these simulations were compared to depths determined by interpolating between the depths corresponding to flow rates in the flow division tables just greater and just less than the 100-yr. flow rate under consideration. Backwater effects were not a factor in the division tables except at the diversion structure for Pond No. 1.

The backwater effect at the diversion structure for Pond No. 1 was evaluated through an iterative procedure using the HEC-1 and HEC-2 programs. An initial diversion table was derived using the procedure described above and a 100-yr. HEC-1 simulation was then performed. The hydrographs at the RWCD Floodway, the outfall of Storm Sewer No. 1, the Power Road box culvert, and the upstream and downstream ends of the diversion weir for Pond No. 1 were obtained. For a selected time increment, values from these hydrographs were inserted into a HEC-2 data file for Channel No. 1 and the system was simulated.

A water surface elevation at the upstream face of the beam was determined and the flow over the diversion weir was calculated using the standard weir formula. When the flow over the weir for the selected time increment was calculated this value was subtracted from the corresponding flow reaching the weir to obtain a new estimate of the flow passing the diversion structure. The average of this value and the value used in the previous HEC-2 simulation was substituted into the HEC-2 data file and the system was simulated again. This process was repeated until the flow rates passing the diversion structure and over the diversion weir did not change between consecutive HEC-2 simulations. The entire procedure was repeated for a number of time increments so that the HEC-2 flow division table representing Pond No. 1 could be revised for a range of flow rates.

The revised HEC-1 flow division table was used in a second 100-yr. HEC-1 simulation and revised hydrographs were obtained. Values from these hydrographs were used in the procedure described above to obtain a second revision of the HEC-1 flow division table. The process was repeated until values in the HEC-1 flow division table for Pond No. 1 did not change from one iteration to the next.

Storage discharge tables representing ponding at Power Road in the HEC-1 model were developed by simulating a range of flows through the box culvert under Power Road with the HEC-2 program. Using the depths determined from these simulations, the available channel storage for a given flow rate was calculated using the FORTRAN program CHASTO (see Appendix C). The existing gunite lined channel was simulated to

derive the storage discharge relationship for Simulation 1, and the planned channel configuration was used to derive the storage verses discharge relationship for Simulations 2 and 3. The HEC-2 output files EPOWROUT.OUT, CH1ROUTA.OUT and CH1ROUTB.OUT used to derive these relationships are presented in Appendix C.

OFF-LINE PONDS: Flood Routing

Each off-line pond was initially sized to accommodate the full volume of the inflow weir hydrograph (obtained from HEC-1 output) at the corresponding diversion beam structure. A subsequent flood routine was performed for each set of connected ponds to: a) confirm maximum pond volume requirements at each pond; b) determine maximum water surface elevations in each pond and c) determine the required length of time (starting from the beginning of the design storm) to drain each set of connected ponds.

A "LOTUS" spreadsheet was used to model the discharge into and out of each pond. The description of this spreadsheet and the routine tables for each set of ponds is presented in Appendix C. At each time step of the routing calculations, the discharge flows into the receiving channels were compared to the channel flow. In those instances where the discharge flow had a significant effect on the channel flow, the tailwater surface elevation in the channel was adjusted to reflect the additional flows.

The pond sets, volume requirements, maximum water surface elevations and draining times are listed in Table 17. Discharge pipe sizes for each pond were selected to ensure that each pond set be drained within 24 hours after the end of the storm period. A 24-hour storm was used for design therefore, the maximum permissible drain time is 48 hours.

3. Discussion

The components of the off-site drainage system modeled in Simulation No. 3 are shown in detail on the construction plans for Phase III. An overview of the system of channels and ponds is presented (as existing conditions) in Figure 13 (Phase III - On-site drainage system). All channels have a trapezoidal cross-section and are concrete lined. Longitudinal slopes, depths and bottom widths vary to accommodate the varying flow rates along the channels. In the areas of the flow constrictors for the off-line detention ponds, a flat slope (0.2 percent) is provided to ensure minimal velocities and flat water surface profiles through the channel section containing the side flow weir. Channel side slopes through the flow constrictor-side weir areas are 1.5 horizontal to 1 vertical; these transition to two horizontal to one vertical in all other channel sections. The peak flows at critical areas along the freeway for Simulation Nos. 1 and 3 are presented in Table 18.

Following the recommendation of the soils consultant, all detention ponds will have reinforced concrete slope paving on the 2 horizontal to 1 vertical side slopes and 12 in. of soil cement on the pond bottoms. Soil cement is provided between inter-connected detention ponds. A depressed section along the top of each pond bank is provided on the off-line ponds to permit excess flows to discharge safely into downstream ponds or into the channel. All depressed sections are set above the 100-yr. peak water-surface elevations and are lined with soil cement.

TABLE 17. RESULTS OF OFF-LINE POND ROUTING

Pond No.	Maximum Volume (Ac-Ft)	Maximum WSEL (Ft)	Time to Drain (Hr)	"LOTUS" Filename
	Set "A"		38	RouteA (1-5)
1.	8.89	66.78		
2.	16.41	68.99		
	Set "B"		31	RouteB (1-9)
3.	10.06	78.59		
4.	11.95	82.31		
5.	14.30	84.73		
6.	9.26	88.80		
7.	14.30	92.58		
	Set "C"		31	RouteC (1-5)
8.	24.91	19.92		
9.	13.16	21.10		
10.	14.26	24.42		
	137.5			
	On-Line Ponds			
11	10.09			
12	10.78			
Total	158.37			

TABLE 18. SIMULATIONS NO. 1 AND NO. 3: PEAK FLOWS AT CRITICAL AREAS ALONG THE SUPERSTITION FREEWAY

	Location	Peak Flows (cfs) 50-Yr, 24-Hr Storm		100-Yr, 24-Hour Storm	
		Simulation No. 1	Simulation No. 3	Simulation No. 1	Simulation No. 3
1.	RWCD Floodway at the Superstiton Freeway (C037)	1459	1611	1681	1717
2.	Power Road Box Culvert (ROPOW)	1455	1583	1663	1656
3.	72nd Street Box Culvert (proposed) (C035)	1284	1672	1415	1847
4.	Sossaman Road (West Side) (C032)	831	831	1323	1375
5.	Sossaman Road (Box Culvert) (proposed) (C032A)	570	570	943	928
6.	Sossaman Channel at the South Right-of-Way Line (C021)	2982	1981	2998	2011
7.	Overtopping in the East-West Channel East of Ellsworth Road (D 224)	2037	(Stored in Detention Pond - No Overtopping	2687	(Stored in Detention Pond)
8.	Overtopping Along the East-West Channel on the West Side of Ellsworth Road. (Flows head south) (D 19) (D 225)	558 317	Eliminated Eliminated	796 358	Eliminated Eliminated
9.	Flows in the Existing East-West Channel West of Ellsworth Road (DIV 224) (DIV 225)	1472 1155	(R0224)54 Eliminated	1513 1155	(R0224)62 Eliminated

As described previously, the low flow channel is contained within the pond for the on-line detention ponds (see Fig. C-3, Appendix C). At the lower end of the pond, the low flow channel is notched into the pond bottom. Approximately 80 feet upstream of the pond outlet, the longitudinal slope of the pond bottom changes from the channel slope (greater than 0.2 percent) to 0.2 percent. Progressing upstream, the channel invert rises above the pond invert. A berm, two feet higher than the channel invert, is provided between the channel and the pond. Low flows will pass directly through the channel to the pond outlet without ponding. A channel slope steeper than 0.2 percent is maintained to prevent sediment deposition at low flows. At higher flows the berm will be overtopped and ponding will occur at the outlet. It is anticipated that the heavier sediment particles will remain within the confines of the low flow channel, thereby facilitating periodic maintenance.

The off-line pond configurations have been described previously. The channel bank overtopping of the Sossaman Channel, which affects property south of the right-of-way, is not eliminated, but the magnitude of the overtopping flows is reduced.

Channel No. 1 has a transition section leading directly into the Power Road box culvert. Channel No. 2 has a curved transition leading into the Sossaman Channel on the upstream side of the box culvert under the Superstition Freeway. Additional channel-to-channel transition sections are provided at the Sossaman Road channel and the 72nd Street channel. The Sossaman Road channel enters Channel No. 1 on the upstream side of Constrictor No. 5. At peak design flows, ponding will occur at this location on Channel No. 1, therefore a curved transition from the Sossaman Road channel is not required. The 72nd Street channel enters Channel No. 1 between constrictors No. 3 and No. 4. A concrete lined transition is provided at the confluence of the two channels. A lined channel transition is likewise provided at the Hawes Channel junction with Channel No. 2.

All channels and detention ponds are provided with maintenance access roads.

The results of Simulation No. 3, at the critical areas previously identified, are presented in Table No. 10 along with the corresponding flows of Simulation No. 1. The 50-year and 100-year discharges into the RWCD Floodway increase by 163 cfs and 55 cfs, respectively. However, the discharges into the Sossaman Channel for the 50-year and 100-year storm events decrease by 1028 cfs, and 980 cfs, respectively. The ultimate outfall for flows from the Sossaman Channel is the RWCD Floodway. The net direct discharge from the freeway right-of-way to the RWCD is therefore reduced by 865 cfs and 925 cfs for the 50-year and 100-year storm events, respectively.

Overland flow across the freeway right-of-way, expressed as point C032 in Simulation No. 1, is eliminated in Simulation No. 2. Additional bank overtopping flows along the existing East-West Channel (east of the Sossaman Channel) (DIV225, and DIV19) are also eliminated. All of these flows ultimately discharge into the RWCD Floodway under existing conditions. Their elimination serves to further reduce discharges (indirect) from the Superstition Freeway right-of-way into the RWCD Floodway. Additional benefit is realized by property owners immediately south of the right-of-way in those areas where existing flooding (overland flows and bank overtopping) will be eliminated.

Other benefits that will be realized upon construction of the off-site drainage system will be control of floodwaters through the freeway right-of-way and elimination of erosion potential in the unlined channels currently traversing the freeway right-of-

way. The channel bank overtopping of the Sossaman Channel, which affects property south of the right-of-way is not eliminated but the magnitude of the overtopping flows is reduced.

Three concrete box culverts will be constructed as part of the off-site drainage system. These are the 72nd Street culvert, the Sossaman Road culvert and the Sossaman Channel culvert under the freeway. The flows obtained from the results of Simulation No. 3 at these three locations were used to size the box culverts. All three culverts were initially sized using the inlet and outlet control nomographs of HEC-5 (see culvert worksheets in Appendix B). Upon completion of the HEC-1 Simulation No. 3 modeling, 50-year and 100-year peak discharges were used as input to an HEC-2 Water Surface Profiles run to check the hydraulic gradeline along the channels and through the box culverts. The hydraulic gradelines for the 50-year and 100-year peak discharges along Channels No. 1 and No. 2 are presented in Figure 14.

Flows passing through the Power Road box culvert are represented as point ROPOW in all the simulations. The previously referred-to hydraulic gradelines indicate that the 100-year water surface profile is equal to the top of the north channel bank at the upstream end of the Power Road box culvert. However, this elevation is higher than the depressed return flow section (from Detention Pond No. 1) of the south channel bank. As soon as ponded water reaches the top of the depressed section, flows will spill into Pond No. 1 at the downstream end and a new equilibrium of flow through the box, pond storage and water surface elevation (lower than shown on the hydraulic gradeline) will be reached. The modeling of this situation is necessarily complex. The results, as shown in this report, represent a conservatively high water surface elevation and still meet the criterion of no bank overtopping for the 100-year peak flows, further analysis to define the exact 100-year water surface elevation at Power Road was considered to be unnecessary.

The Sossaman Channel culvert under the Superstition Freeway serves to convey flows from the north (Sossaman Channel) and from the east (Channel No. 2) under the freeway to the existing unlined channel south of the right-of-way. The Sossaman Channel is currently unlined from Southern Avenue to past Baseline Road, south of the freeway. Concrete lining will be provided through the right-of-way to improve channel capacity and to reduce erosion potential. The previously mentioned channel transition, for Channel No. 2, at the Sossaman Channel will also be lined with concrete slope paving. A mild slope and broad radius of curvature (r=3 x (top width of flow in the channel)) will be provided to ensure that flow through the transition is sub-critical and smooth. The top of the channel lining for the west bank of the Sossaman Channel will be of sufficient height to ensure that the required free board is maintained for the 50-year peak flows (See Figure 14).

Clearance under the Superstition Freeway at the Sossaman Channel is limited. A multiple box culvert, of a width greater than the existing channel bottom width, was required to convey flows under the freeway without excessive headwater requirements at the upstream end of the culvert. A structure will be constructed, at the downstream end of the culvert, between the culvert and the south right-of-way line, to provide a transition from the wider channel cross-section back to the narrower existing channel cross-section. A cutoff wall will be constructed to protect the channel lining from head cutting. The east bank of the transition structure will block the existing unlined East-West Channel at its discharge point into the Sossaman Channel. Since segments of the East-West Channel lie outside the right-of-way, it is not feasible to

SUPERSTITION FREEWAY
POWER RD. TO U.S. 60-PHASE II
MARICOPA/PINAL CO.

FEDERAL REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	ARIZ.	F-028-1-513			

P & M BM # P-9 Aluminum Cap Set In Sidewalk Of Southeast Corner Power Rd. Overpass At SR 360 Stamped. -Elev. 1371.52

Construction ℄ Station	Offset To ℄ Channel	Offset To North Top Bank	Elevation At North Top Bank	Offset To South Top Bank	Elevation At South Top Bank	Comments
868+63	398.1	24.9	1368.4	26.1	1369.0	P.T. Horizontal Curve
869+00	398.9	24.9	1368.4	26.1	1369.0	
870+00	401.0	24.9	1369.0	25.9	1369.5	
871+00	402.7	26.0	1370.1	25.8	1370.0	
872+00	404.0	25.2	1370.4	25.4	1370.5	
872+02	404.0	25.2	1370.4	25.4	1370.5	
872+27	404.3	25.1	1370.4	25.6	1370.7	See Pond No.1, Sht. 2C-50
873+00	405.0	25.7	1370.5	26.9	1371.1	

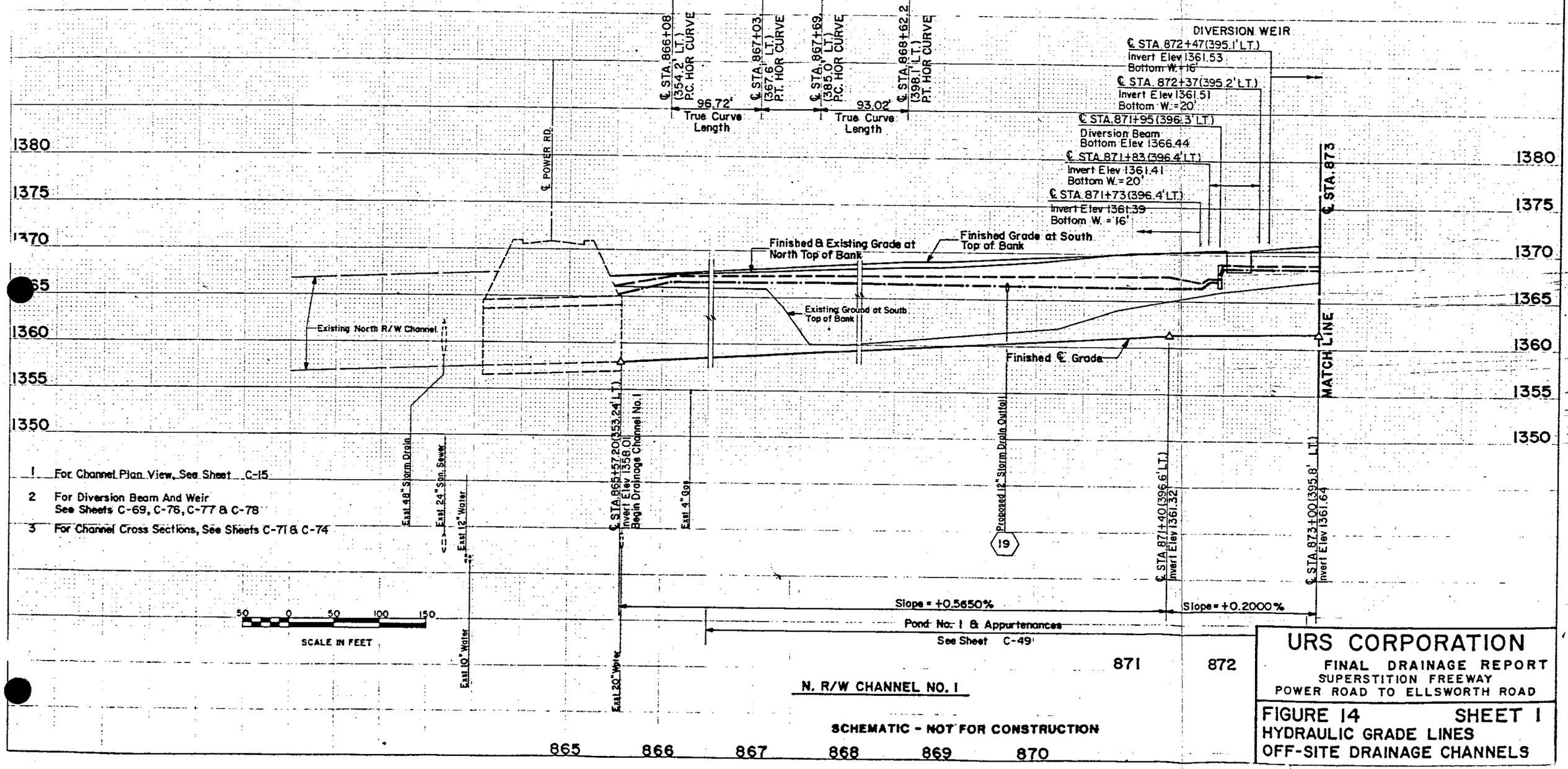
LEGEND

—·— 50 Yr. Hydraulic Grade Line

— — — 100 Yr. Hydraulic Grade Line

NOTE: Slopes Shown Are Based On True Lengths Between Grade Breaks.

Station & Offsets Reflect Radial Stake-Out Due To Superstition Freeway ℄ Being In A Curve Segment.



1 For Channel Plan View, See Sheet C-15

2 For Diversion Beam And Weir See Sheets C-69, C-76, C-77 & C-78

3 For Channel Cross Sections, See Sheets C-71 & C-74

URS CORPORATION
FINAL DRAINAGE REPORT
SUPERSTITION FREEWAY
POWER ROAD TO ELLSWORTH ROAD

FIGURE 14 SHEET 1
HYDRAULIC GRADE LINES
OFF-SITE DRAINAGE CHANNELS

SUPERSTITION FREEWAY
POWER RD. TO U.S. 60 - PHASE II
MARICOPA/PINAL CO.

Construction ℄ Station	Offset To ℄ Channel	Offset To North Top Bank	Elevation At North Top Bank	Offset To South Top Bank	Elevation At South Top Bank	Comments
874+00	405.7	25.8	1371.1	26.8	1371.6	
875+00	406.0	25.8	1371.7	26.6	1372.1	
876+00	406.0	25.4	1372.1	26.6	1372.7	
877+00	405.6	25.3	1372.6	26.7	1373.3	
878+00	404.9	25.7	1373.4	26.5	1373.8	
879+00	403.8	25.8	1374.2	26.2	1374.4	
879+14	403.6	26.0	1374.3	26.3	1374.5	
879+64	402.9	26.7	1374.8	27.0	1375.0	See Pond No. 2, Sht. 2C-51
880+00	402.4	28.2	1375.2	28.6	1375.4	
881+00	400.6	27.0	1376.1	27.8	1376.5	
882+00	398.5	25.8	1377.0	25.8	1377.0	
883+00	396.1	24.5	1377.8	24.5	1377.8	
883+47	394.8	—	—	24.9	1378.3	
883+49	394.8	24.9	1378.3	—	—	72nd St. C.B.C. Wingwalls
885+37	389.3	—	—	24.6	1380.3	
885+37	389.3	24.5	1380.3	—	—	72nd St. C.B.C. Wingwalls

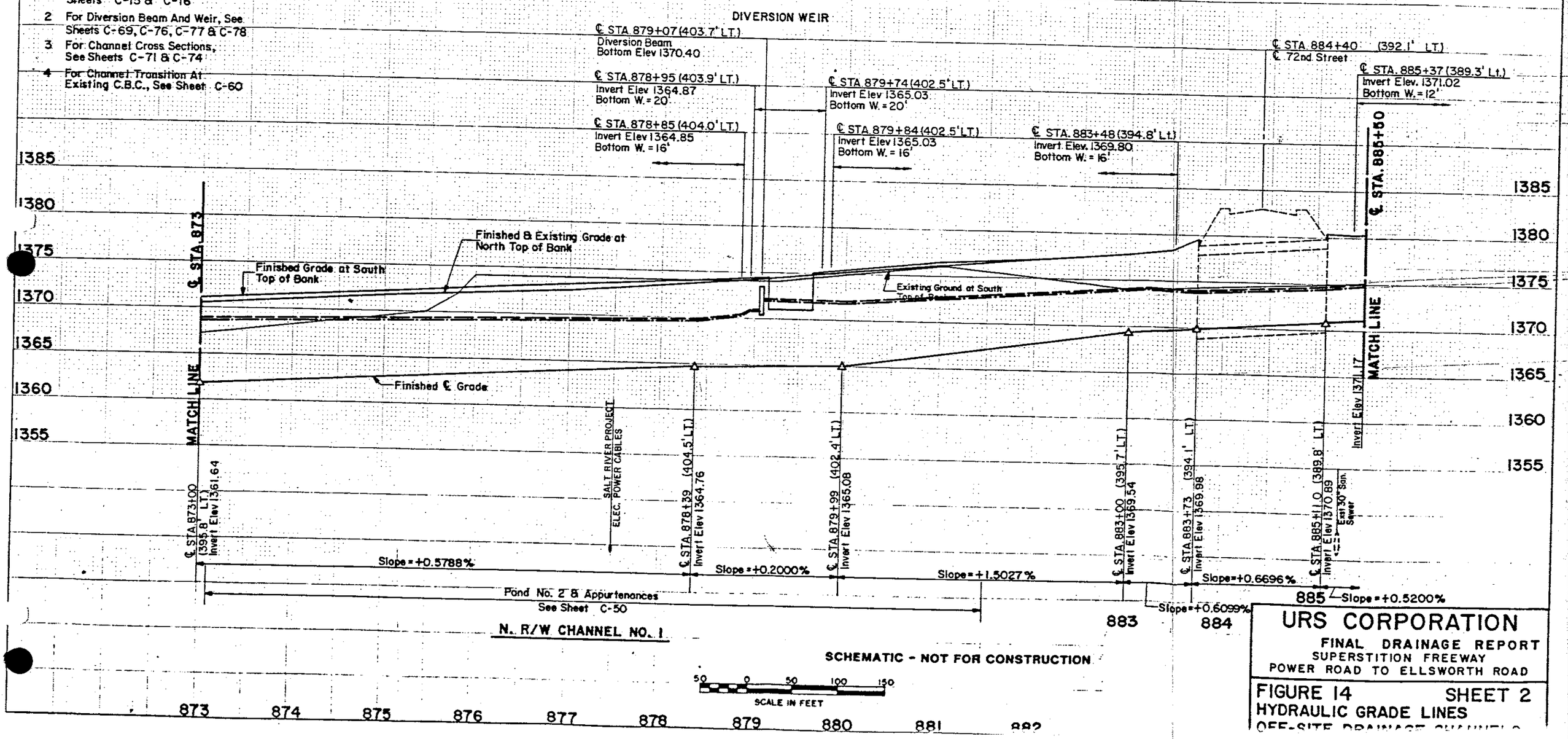
F.A.H.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	ARIZ.	F-028-1-513			

P & M BM # P-9 Aluminum Cap Set In Sidewalk Of Southeast Corner Power Rd. Overpass At SR 360 Stamped. Elev. 1371.52

NOTE: Slopes Shown Are Based On True Lengths Between Grade Breaks.
Station & Offsets Reflect Radial Stake-Out Due To Superstition Freeway ℄ Being On A Curve Segment.

LEGEND
—·—·— 50 Yr. Hydraulic Grade Line
— — — 100 Yr. Hydraulic Grade Line

1 For Channel Plan View, See Sheets C-15 & C-16
2 For Diversion Beam And Weir, See Sheets C-69, C-76, C-77 & C-78
3 For Channel Cross Sections, See Sheets C-71 & C-74
4 For Channel Transition At Existing C.B.C., See Sheet C-60



URS CORPORATION
FINAL DRAINAGE REPORT
SUPERSTITION FREEWAY
POWER ROAD TO ELLSWORTH ROAD

FIGURE 14 SHEET 2
HYDRAULIC GRADE LINES
OFF-SITE DRAINAGE CHANNELS

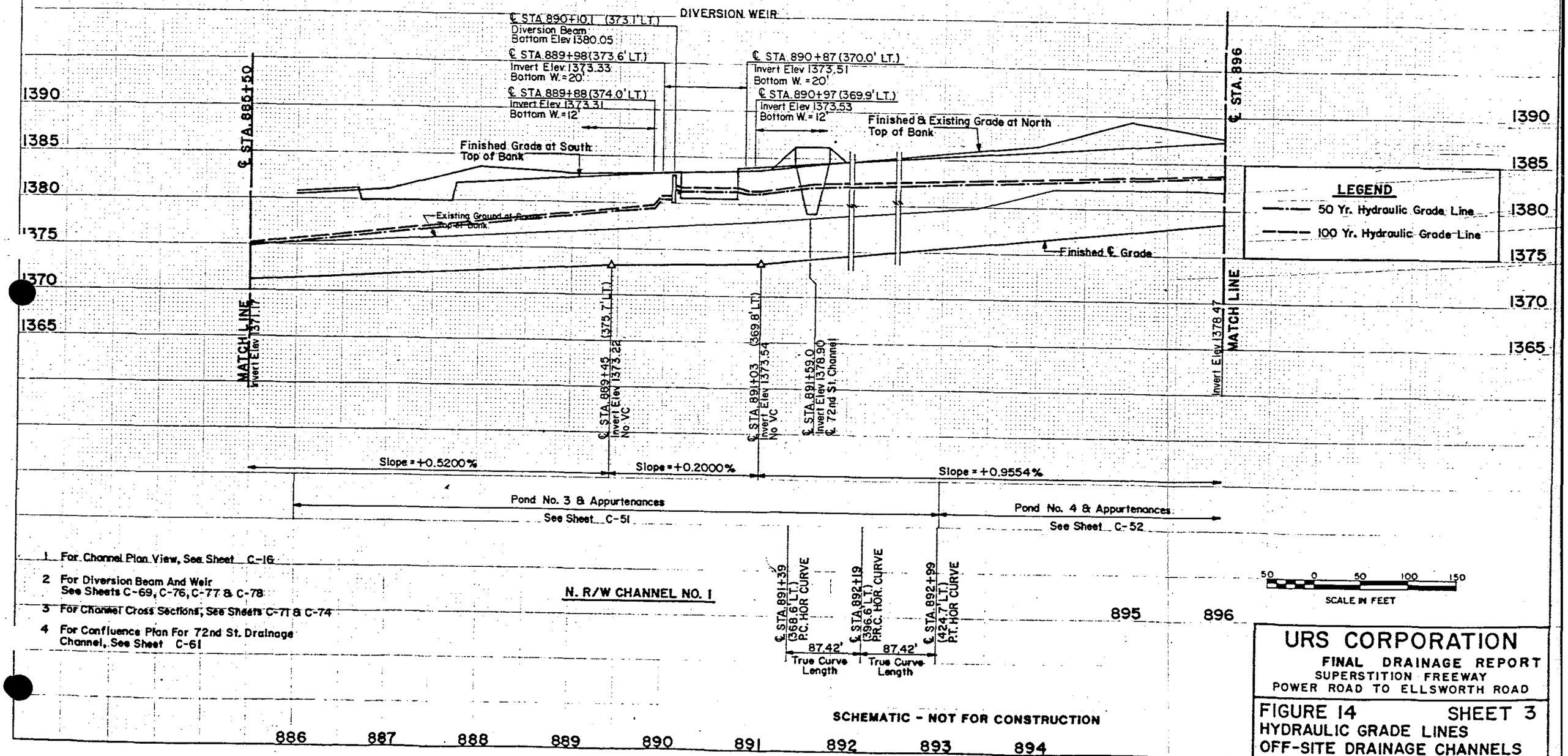
SUPERSTITION FREEWAY
POWER RD. TO U.S. 60-PHASE II
MARICOPA/PINAL CO.

Construction ℄ Station	Offset To ℄ Channel	Offset To North Top Bank	Elevation At North Top Bank	Offset To South Top Bank	Elevation At South Top Bank	Comments
886+00	389.5	24.3	1380.5	24.9	1380.8	
886+67	387.6	24.1	1380.8	24.9	1381.2	
887+74	383.4	23.3	1381.0	25.1	1381.9	See Pond No. 3, Sht. C-51
888+00	381.8	28.3	1383.6	19.3	1382.1	
889+00	377.5	25.2	1382.6	19.4	1382.7	
890+17	372.8	25.9	1383.3	26.1	1383.4	
890+77	370.8	26.0	1383.5	26.7	1383.9	See Pond No. 3, Sht. C-51
891+00	369.9	26.1	1383.6	26.9	1384.0	See 72nd St. Drainage Channel, Sht. C-61.
893+00	424.7	26.2	1385.7	25.6	1385.4	
894+00	422.1	26.1	1386.6	24.9	1386.0	
895+00	419.9	29.8	1389.4	24.4	1386.7	
896+00	419.0	24.5	1387.7	23.9	1387.4	

FEDERAL REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	ARIZ.	F-028-1-513			

P & M BM # P-9 Aluminum Cap Set In Sidewalk Of Southeast Corner Power Rd. Overpass At S R 360 Stamped. Elev. 1371.52

NOTE: Slopes Shown Are Based On True Lengths Between Grade Breaks.
Station & Offsets Reflect Radial Stake-Out Due To Superstition Freeway ℄ Being In A Curve Segment.



1. For Channel Plan View, See Sheet C-16
2. For Diversion Beam And Weir See Sheets C-69, C-76, C-77 & C-78
3. For Channel Cross Sections, See Sheets C-71 & C-74
4. For Confluence Plan For 72nd St. Drainage Channel, See Sheet C-61

SCHEMATIC - NOT FOR CONSTRUCTION

URS CORPORATION
FINAL DRAINAGE REPORT
SUPERSTITION FREEWAY
POWER ROAD TO ELLSWORTH ROAD

FIGURE 14 SHEET 3
HYDRAULIC GRADE LINES
OFF-SITE DRAINAGE CHANNELS

SUPERSTITION FREEWAY
POWER RD. TO U.S. 60 - PHASE II
MARICOPA/PINAL CO.

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	ARIZ.	F-028-1-513			

P & M BM # P-9 Aluminum Cap Set In Sidewalk Of Southeast Corner Power Rd. Overpass At SR 360 Stamped Elev. 1371.52

1 For Channel Plan View, See Sheet C-16

2 For Diversion Beam And Weir, See Sheets C-69, C-76, C-77 & C-78

3 For Channel Cross Sections, See Sheets C-71 & C-74

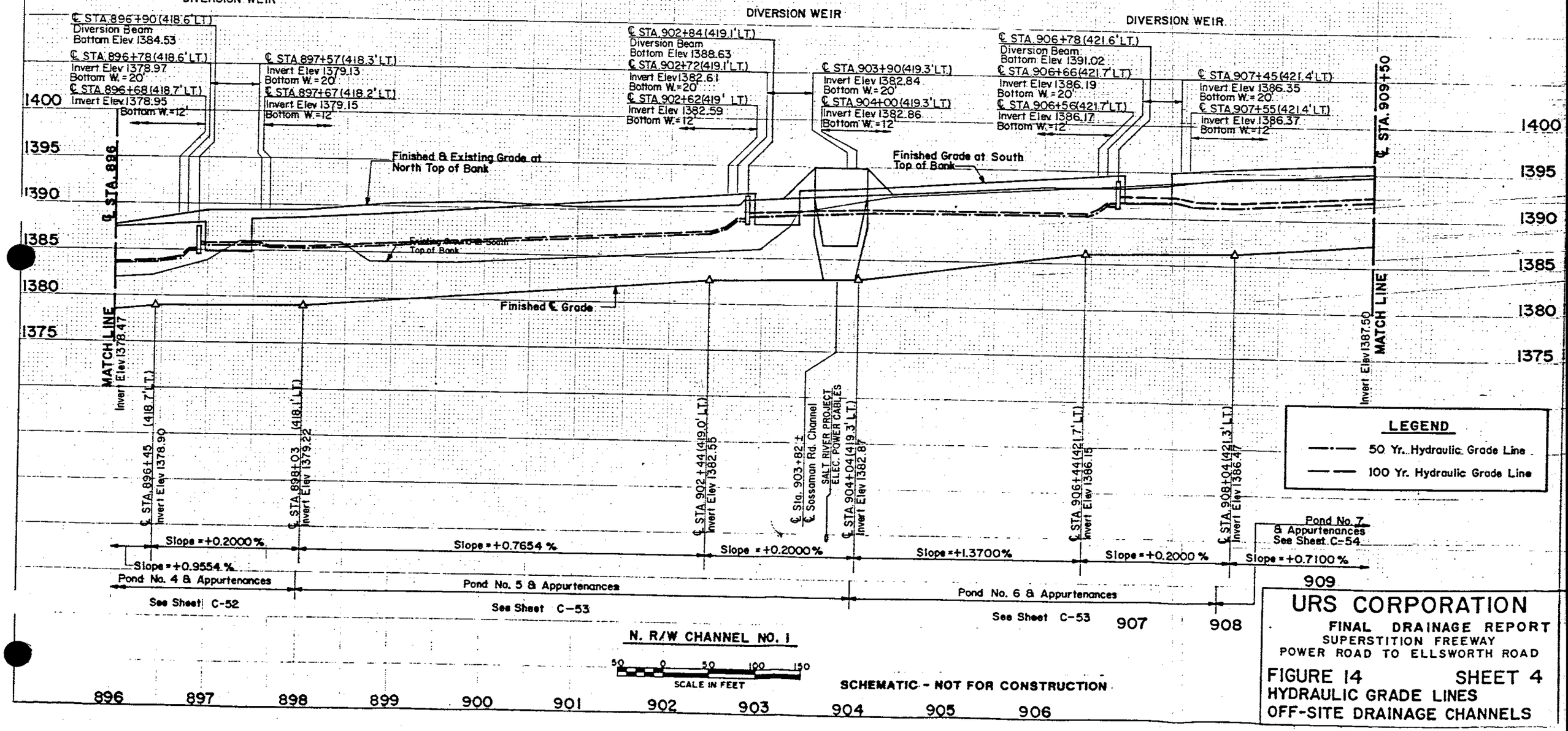
For Confluence Plan For Sossaman Rd. Drainage Channel, See Sheet C-62

Construction ℄ Station	Offset To ℄ Channel	Offset To North Top Bank	Elevation At North Top Bank	Offset To South Top Bank	Elevation At South Top Bank	Comments
896+97	418.5	26.5	1389.3	24.4	1388.0	
897+47	418.3	26.5	1389.4	24.9	1388.4	See Pond No. 4, Sht. 2C-52
898+00	418.1	26.4	1389.4	24.8	1388.6	
899+00	418.1	26.7	1390.3	24.5	1389.2	
900+00	418.4	25.8	1390.6	24.4	1389.9	
901+00	418.6	23.5	1390.2	24.5	1390.7	
902+00	418.7	22.4	1390.4	24.4	1391.4	
902+91	419.1	23.0	1390.8	25.1	1392.1	
903+41	419.2	23.4	1391.1	25.4	1392.4	See Pond No. 5, Sht. 2C-53 & Sossaman Rd. Channel
904+00	419.1			25.5	1392.6	
905+00	420.4	22.6	1392.5	24.2	1393.3	
906+00	421.7	21.1	1393.1	22.9	1394.0	
906+85	421.6	21.2	1393.2	23.4	1394.6	
907+35	421.5	21.6	1393.6	23.7	1394.9	See Pond No. 6, Sht. 2C-53
908+00	421.3	21.9	1394.4	23.9	1395.4	
909+00	421.7	20.7	1394.5	23.5	1395.9	

NOTE: Slopes Shown Are Based On True Lengths Between Grade Breaks.

Station & Offsets Reflect Radial Stake-Out Due To Superstition Freeway ℄ Being In A Curve Segment.

Between Sta. 902+75 And Sta. A 6" Vertical Curb Shall Be Constructed On The North Top Of Bank, See Sheet C-71.



URS CORPORATION

FINAL DRAINAGE REPORT
SUPERSTITION FREEWAY
POWER ROAD TO ELLSWORTH ROAD

FIGURE 14 SHEET 4
HYDRAULIC GRADE LINES
OFF-SITE DRAINAGE CHANNELS

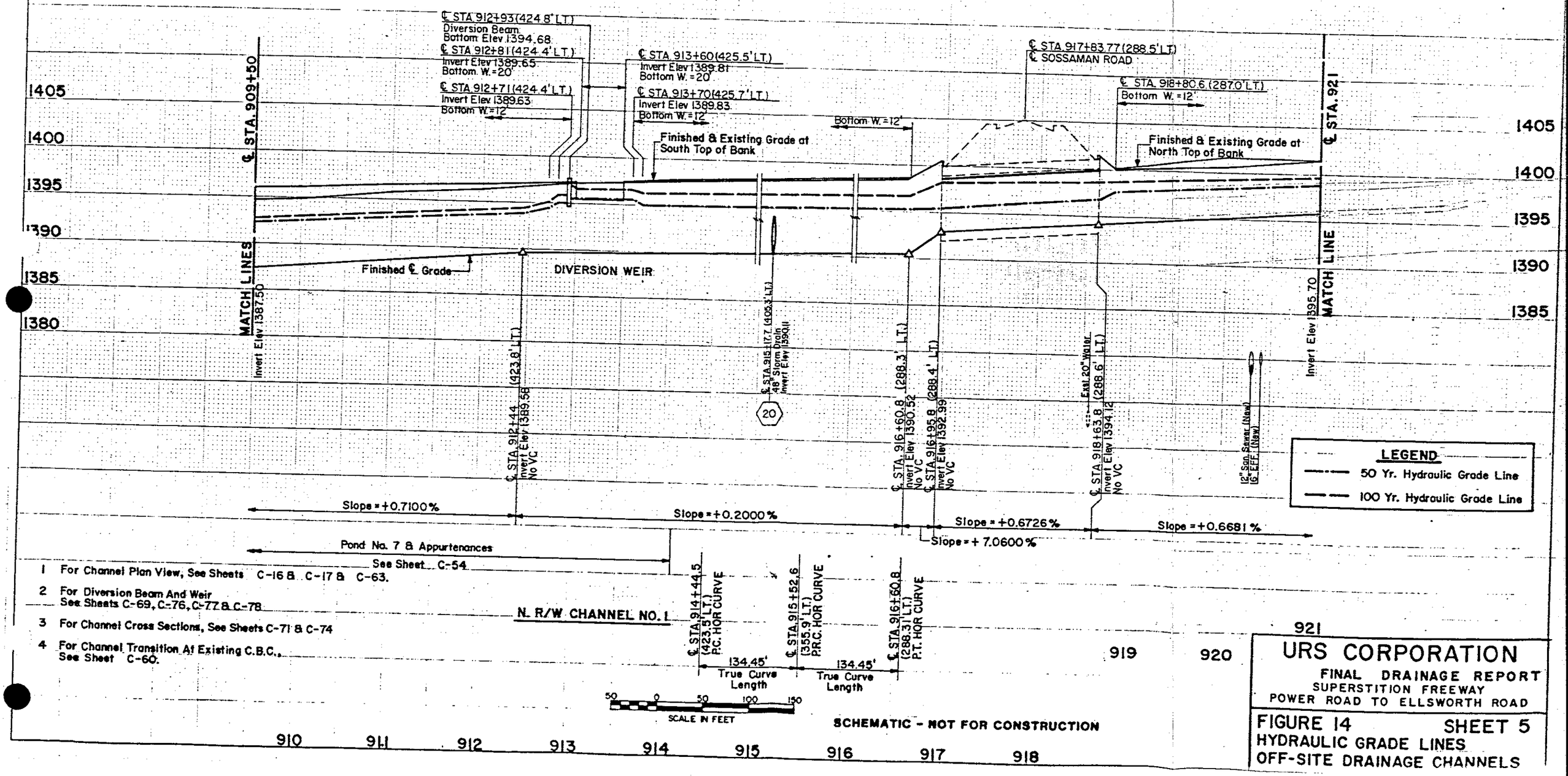
SUPERSTITION FREEWAY
POWER RD. TO U.S. 60 - PHASE II
MARICOPA/PINAL CO.

Construction ℄ Station	Offset To ℄ Channel	Offset To North Top Bank	Elevation At North Top Bank	Offset To South Top Bank	Elevation At South Top Bank	Comments
910+00	422.2	20.1	1394.9	22.7	1396.2	
911+00	422.6	20.5	1395.8	22.1	1396.6	
912+00	423.1	20.1	1396.3	21.3	1396.9	
913+00	422.8	22.0	1397.2	22.2	1397.3	
913+50	422.5	22.2	1397.4	22.3	1397.5	See Pond No. 7, Sht. 2C-54
914+00	422.3	21.4	1397.6	22.2	1397.8	
916+60.7	288.3	22.0	1398.5	—	—	
916+60.8	288.3	—	—	21.9	1398.5	
918+79	287.2	—	—	16.5	1399.5	See Sossaman Rd. C.B.C. Sht. C-60
918+82.2	286.9	17.5	1400.0	—	—	
920+00	275.8	19.1	1401.6	17.1	1400.6	
921+00	269.4	16.8	1401.4	16.8	1401.4	

F.A.R.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	ARIZ.	F-028-1-513			

P & M BM # P-9 Aluminum Cap Set In Sidewalk Of Southeast Corner Power Rd. Overpass At SR 360 Stamped. -Elev. 1371.52

NOTE: Slopes Shown Are Based On True Lengths Between Grade Breaks.



1 For Channel Plan View, See Sheets C-16 & C-17 & C-63.

2 For Diversion Beam And Weir See Sheets C-69, C-76, C-77 & C-78

3 For Channel Cross Sections, See Sheets C-71 & C-74

4 For Channel Transition At Existing C.B.C., See Sheet C-60.

URS CORPORATION
FINAL DRAINAGE REPORT
SUPERSTITION FREEWAY
POWER ROAD TO ELLSWORTH ROAD

FIGURE 14 SHEET 5
HYDRAULIC GRADE LINES
OFF-SITE DRAINAGE CHANNELS

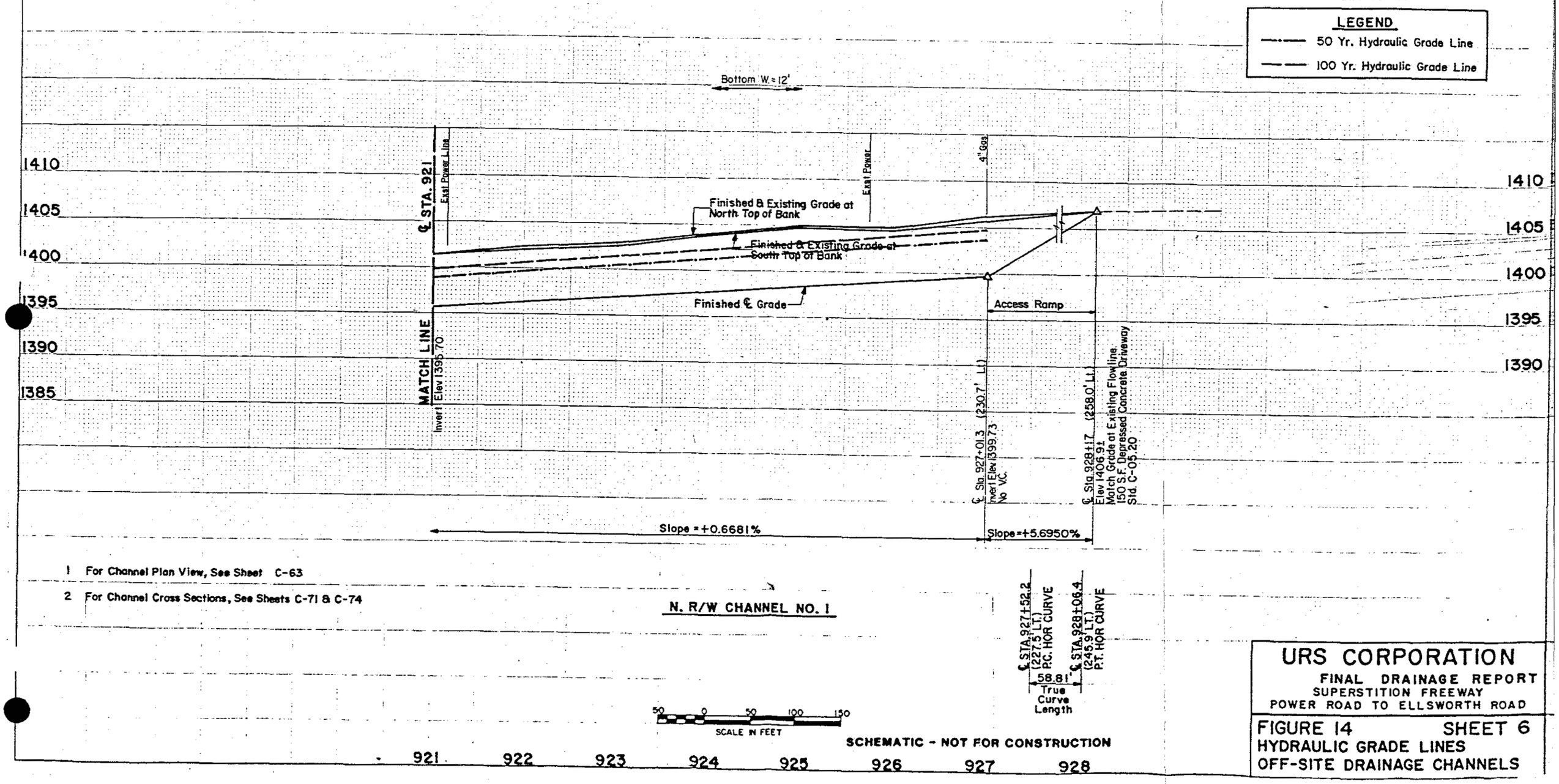
SUPERSTITION FREEWAY
POWER RD. TO U.S. 60-PHASE II
MARICOPA/PINAL CO.

Construction ℄ Station	Offset To ℄ Channel	Offset To North Top Bank	Elevation At North Top Bank	Offset To South Top Bank	Elevation At South Top Bank	Comments
922+00	263.0	18.1	1402.4	17.3	1402.0	
923+00	256.6	17.7	1402.9	16.9	1402.5	
924+00	250.2	18.6	1404.0	18.2	1403.8	
925+00	243.8	19.3	1405.0	18.7	1404.7	
926+00	237.4	17.7	1404.9	16.9	1404.5	
927+00	231.0	18.8	1406.2	18.0	1405.7	
928+17	Match Grade At Existing Cul-De-Sac					

FAHWA REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	ARIZ.	F-028-1-513			

P & M BM # P-9 Aluminum Cap Set In Sidewalk Of Southeast Corner Power Rd. Overpass At SR 360 Stamped Elev. 1371.52

NOTE: Slopes Shown Are Based On True Lengths Between Grade Breaks.



URS CORPORATION
FINAL DRAINAGE REPORT
SUPERSTITION FREEWAY
POWER ROAD TO ELLSWORTH ROAD

FIGURE 14 SHEET 6
HYDRAULIC GRADE LINES
OFF-SITE DRAINAGE CHANNELS

SUPERSTITION FREEWAY
POWER RD. TO U.S. 60–PHASE II
MARICOPA/PINAL CO.

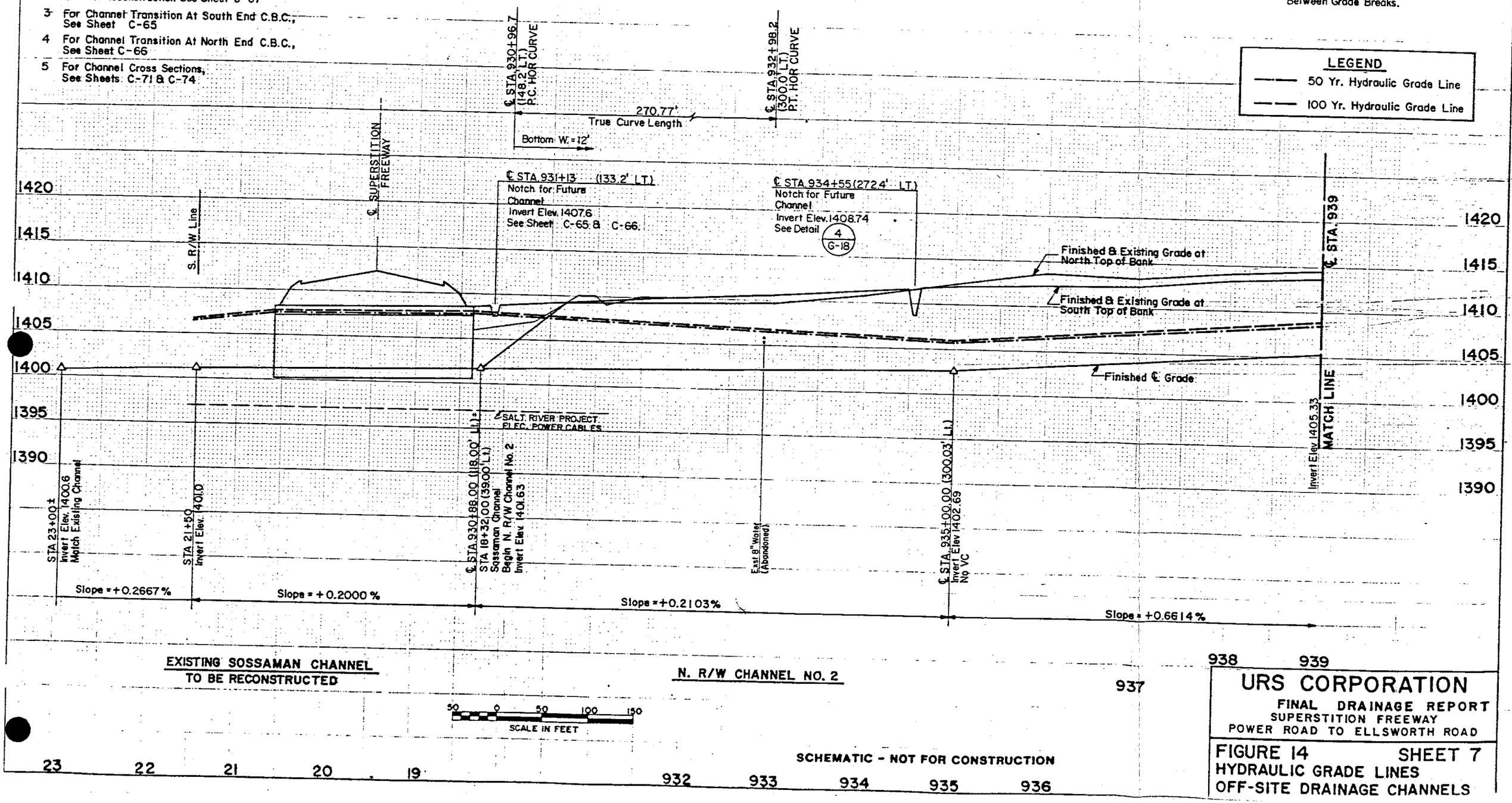
Construction ℄ Station	Offset To ℄ Channel	Offset To North Top Bank	Elevation At North Top Bank	Offset To South Top Bank	Elevation At South Top Bank	Comments
930+88	118.0					
933+00	300.0	22.9	1409.7	24.7	1410.6	Begin Channel No. 2, See Shts C-64 & C-65
934+00	300.0	24.6	1410.8	25.6	1411.3	
934+48	300.0	—	—	24.1	1411.6	
934+62	300.0	—	—	24.3	1411.7	See Detail 4, Sht. G-18
935+00	300.0	25.2	1412.3	24.6	1412.0	
936+00	301.2	26.7	1413.7	23.9	1412.3	
937+00	302.3	24.6	1413.3	22.8	1412.4	
938+00	303.4	24.9	1414.1	23.3	1413.3	
939+00	304.5	24.3	1414.5	22.7	1413.7	

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	ARIZ.	F-028-1-513			

BM#37 4" BC Set In ℄ Pavement Ellsworth Rd. Cst Sta. 22+82.80 (Survey Sta 37+17.71) Elev 1454.33

NOTE: Slopes Shown Are Based On True Lengths Between Grade Breaks.

1. For Channel Plan View, See Sheet C-17
2. For Confluence Plan And Coninuation Of Sossaman Channel Reconstruction See Sheet C-67
3. For Channel Transition At South End C.B.C., See Sheet C-65
4. For Channel Transition At North End C.B.C., See Sheet C-66
5. For Channel Cross Sections, See Sheets C-71 & C-74



SCHEMATIC - NOT FOR CONSTRUCTION

URS CORPORATION
FINAL DRAINAGE REPORT
SUPERSTITION FREEWAY
POWER ROAD TO ELLSWORTH ROAD

FIGURE 14 SHEET 7
HYDRAULIC GRADE LINES
OFF-SITE DRAINAGE CHANNELS

SUPERSTITION FREEWAY
POWER RD. TO U.S.60-PHASE II
MARICOPA/PINAL CO.

1 For Channel Plan View, See Sheets C-17 & C-18.

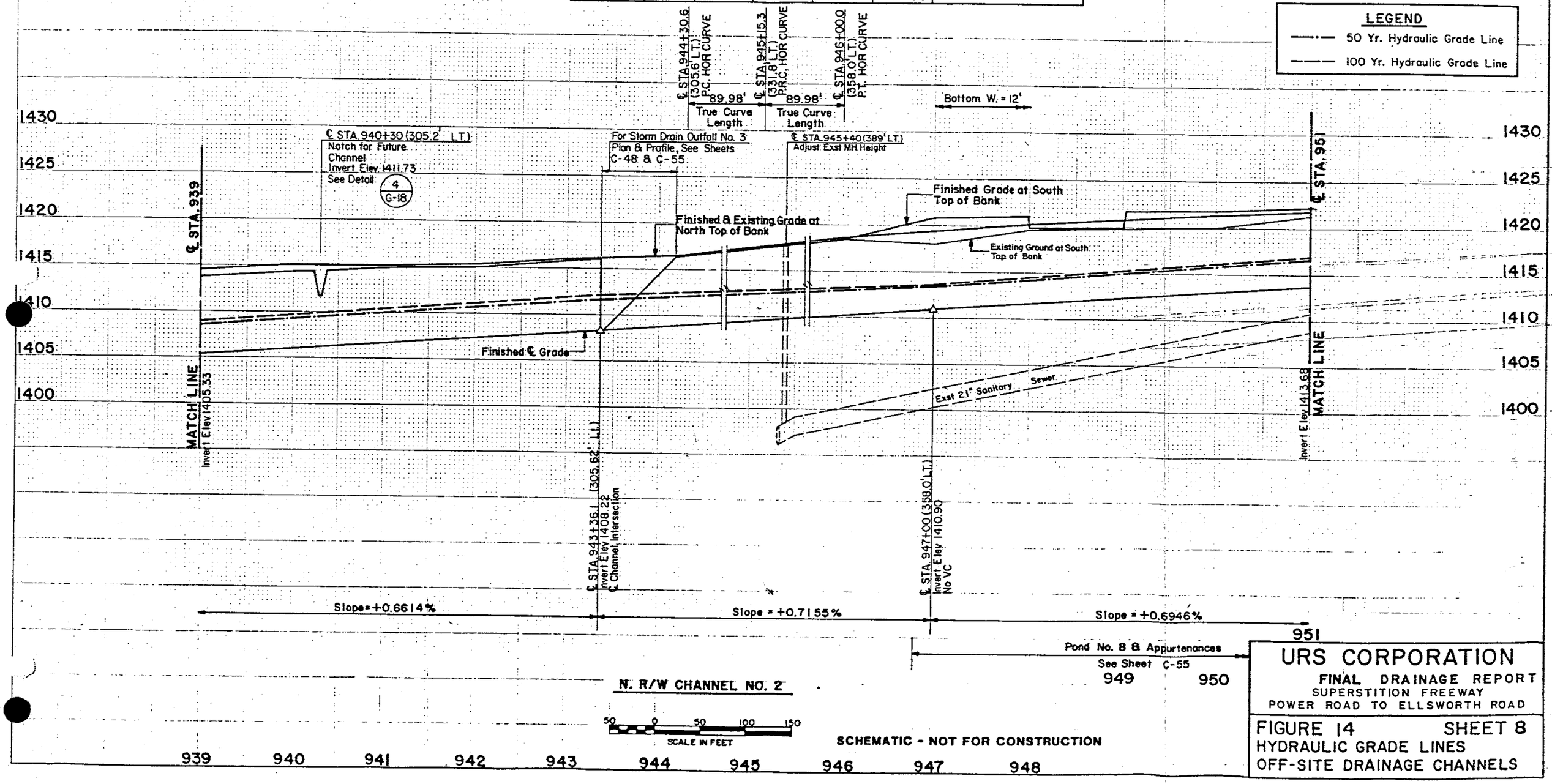
2 For Channel Cross Sections, See Sheet C-71 & C-74

Construction ℄ Station	Offset To ℄ Channel	Offset To North Top Bank	Elevation At North Top Bank	Offset To South Top Bank	Elevation At South Top Bank	Comments
940+00	305.6	24.2	1415.1	22.6	1414.3	
940+23	305.6	—	—	22.6	1414.4	See Detail 4, Sht. G-18
940+37	305.6	—	—	22.5	1414.5	
941+00	305.6	22.9	1415.1	22.3	1414.8	
942+00	305.6	22.0	1415.3	21.4	1415.0	
943+00	305.6	22.0	1416.0	21.6	1415.8	
943+36.1	305.6	21.7	1416.1	21.6	1416.0	
944+18.5	305.6	21.3	1416.5	21.0	1416.3	See Channel No. 3, Shts C-48 & C-55
946+00	358.0	22.8	1418.6	22.4	1418.4	
947+00	358.0	23.0	1419.4	25.8	1420.8	
947+98	358.0	23.2	1420.2	25.2	1421.2	
949+03	360.0	22.8	1420.7	24.6	1421.6	See Pond No. 8, Sht. C-55
950+00	360.0	22.6	1421.3	23.6	1421.8	
951+00	360.0	21.8	1421.6	23.0	1422.2	

FHWA REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	ARIZ.	F-028-1-513			

BM#37 4" BC Set In ℄ Pavement Ellsworth Rd. Cst Sta. 22+82.80 (Survey Sta. 37+17.71) Elev 1454.33

NOTE: Slopes Shown Are Based On True Lengths Between Grade Breaks.



URS CORPORATION
FINAL DRAINAGE REPORT
SUPERSTITION FREEWAY
POWER ROAD TO ELLSWORTH ROAD

FIGURE 14 SHEET 8
HYDRAULIC GRADE LINES
OFF-SITE DRAINAGE CHANNELS

SUPERSTITION FREEWAY
POWER RD. TO U.S. 60-PHASE II
MARICOPA/PINAL CO.

1 For Channel Plan View, See Sheet C-18.

2 For Channel Cross Sections, See Sheets C-71 & C-74

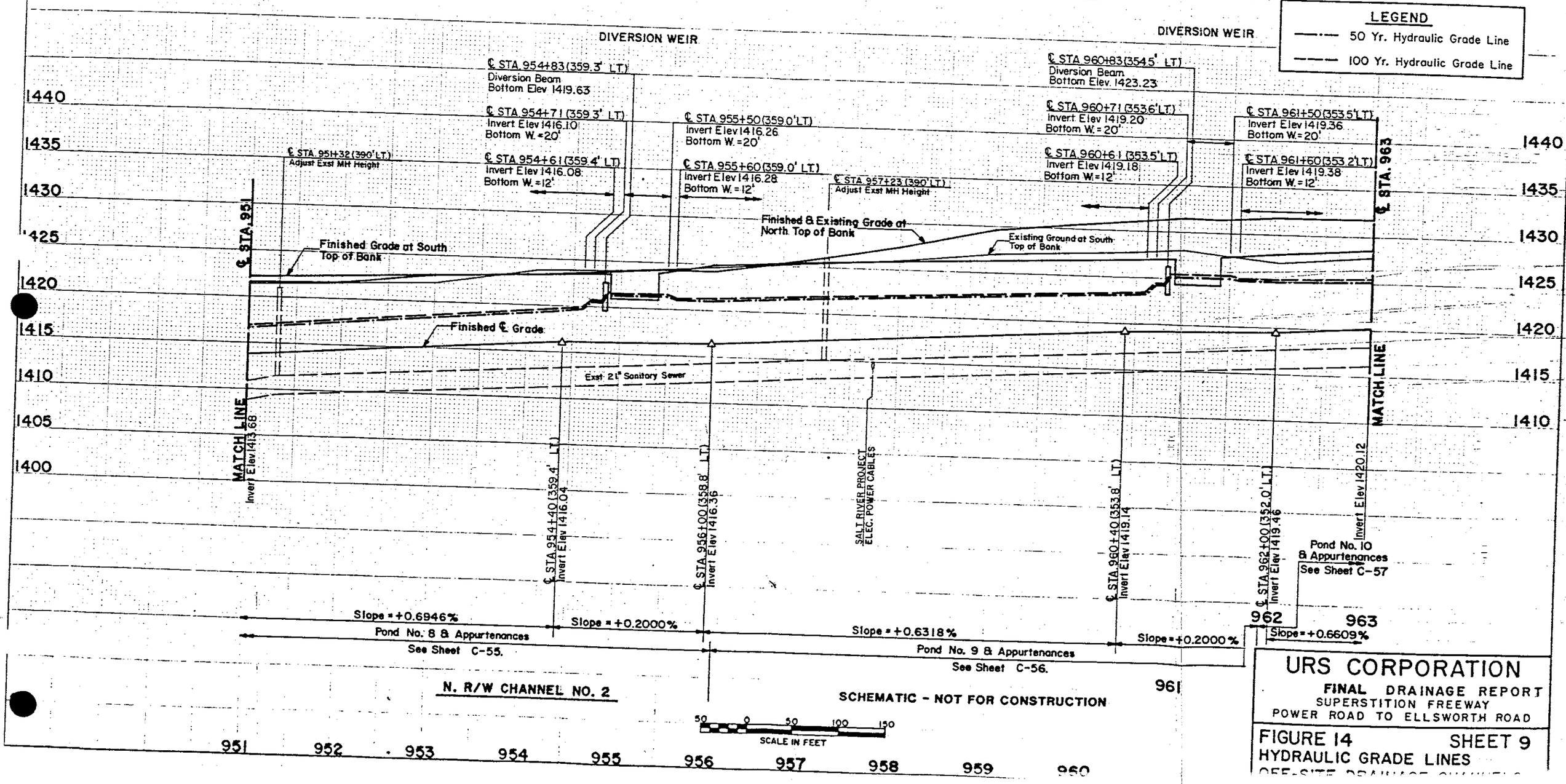
3 For Diversion Beam And Weir, See Sheets C-69, C-76, C-77 & C-78

Construction ℄ Station	Offset To ℄ Channel	Offset To North Top Bank	Elevation At North Top Bank	Offset To South Top Bank	Elevation At South Top Bank	Comments
952+00	360.0	20.9	1421.8	22.3	1422.5	
953+00	360.0	20.3	1422.9	21.7	1422.9	
954+00	359.6	20.3	1423.3	21.1	1423.3	
954+90	359.2	22.3	1423.8	21.9	1423.6	
955+40	359.0	22.7	1424.2	22.1	1423.8	See Pond No. 8, Sht. C-55
956+00	358.8	21.7	1424.2	23.1	1424.9	
957+00	358.4	23.4	1425.7	23.0	1425.5	
958+00	358.0	25.6	1427.4	22.6	1425.9	
959+00	354.0	28.7	1429.6	22.1	1426.3	
960+00	353.0	29.4	1430.6	21.6	1426.7	
960+90	354.8	29.5	1431.4	22.6	1427.1	
961+40	353.8	29.3	1431.4	22.9	1427.4	See Pond No. 9, Sht. C-56
962+00	352.0	30.7	1431.8	22.9	1427.9	
963+00	354.0	29.4	1431.8	23.0	1428.6	

FAI BLA REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	ARIZ.	F-028-1-513			-

BM#37 4" BC Set In ℄ Pavement Ellsworth Rd. Cst Sta. 22+82.80 (Survey Sta. 37+17.71) Elev 1454.33

NOTE: Slopes Shown Are Based On True Lengths Between Grade Breaks.



URS CORPORATION
FINAL DRAINAGE REPORT
SUPERSTITION FREEWAY
POWER ROAD TO ELLSWORTH ROAD

FIGURE 14 SHEET 9
HYDRAULIC GRADE LINES
OFF-SITE DRAINAGE CHANNELS

SUPERSTITION FREEWAY
POWER RD. TO U.S. 60-PHASE II
MARICOPA/PINAL CO.

1 For Channel Plan View, See Sheets C-18 & C-19

2 For Outlet Control Structure For Pond No. 11, See Sheet C-70

3 For Diversion Beam And Weir, See Sheets C-69, C-76, C-77 & C-78

4 For Confluence Plan For Hawes Road Drainage Channel, See Sheet C-67

5 For Channel Cross Sections, See Sheets C-71 & C-74

6 For Pond 11 Profile Information, See Sheet C-58

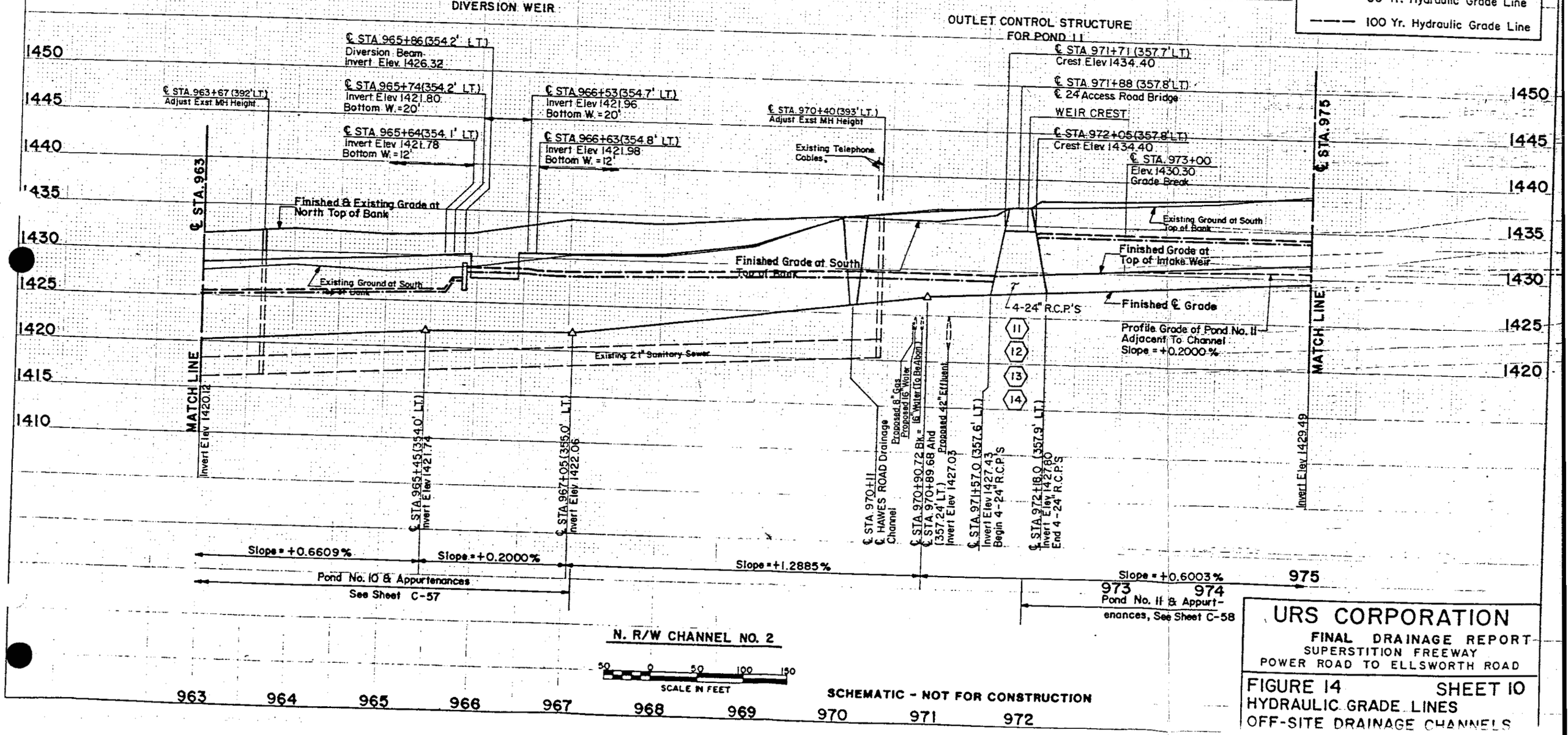
Construction ℄ Station	Offset To ℄ Channel	Offset To North Top Bank	Elevation At North Top Bank	Offset To South Top Bank	Elevation At South Top Bank	Comments
964+00	353.0	29.4	1432.5	22.8	1429.2	
965+00	353.7	27.5	1432.2	22.5	1429.7	
965+93	354.3	27.1	1432.5	22.5	1430.3	
966+43	354.6	28.3	1433.4	23.7	1430.5	See Pond No. 10, Sht. C-57
967+00	355.0	30.5	1434.3	23.1	1430.6	
968+00	355.7	27.6	1434.1	21.0	1430.8	
969+00	356.3	26.7	1434.9	21.3	1432.2	
969+96.54	356.9	25.3	1435.5	25.0	1435.3	
970+28.20	357.1	24.5	1435.4	25.0	1435.7	See Hawes Rd. Drainage Channel, Sht. C-67
971+00	357.4	22.4	1435.3	24.6	1436.4	
971+66	357.7	23.3	1436.1			
971+76	357.7			25.4	1436.9	See Pond No. 11, Sht. C-58
972+10	357.8	25.8	1437.7			
972+14	357.9			10.0	1429.8	See Pond No. 11, Sht. C-58
973+00	358.2	25.2	1437.9	10.0	1430.3	
974+00	358.6	24.8	1438.3	10.0	1430.9	
975+00	359.0	24.4	1438.7	10.0	1431.5	

F.A.H.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	ARIZ.	F-028-1-513			

BM#37 4"BC Set In ℄ Pavement Ellsworth Rd. Cst Sta. 22+82.80 (Survey Sta. 37+17.71) Elev 1454.33

NOTE: Slopes Shown Are Based On True Lengths Between Grade Breaks.

LEGEND
—·— 50 Yr. Hydraulic Grade Line
— — 100 Yr. Hydraulic Grade Line



URS CORPORATION
FINAL DRAINAGE REPORT
SUPERSTITION FREEWAY
POWER ROAD TO ELLSWORTH ROAD

FIGURE 14 SHEET 10
HYDRAULIC GRADE LINES
OFF-SITE DRAINAGE CHANNELS

SUPERSTITION FREEWAY
POWER RD. TO U.S. 60-PHASE II
MARICOPA/PINAL CO.

1 For Channel Plan View, See Sheet C-19

2 For Channel Cross Sections, See Sheets C-71 & C-74

3 For Pond II Profile Information, See Sheets

Construction ℄ Station	Offset To ℄ Channel	Offset To North Top Bank	Elevation At North Top Bank	Offset To South Top Bank	Elevation At South Top Bank	Comments
976+00	358.8	24.6	1439.4	10.0	1432.1	See Pond No.11, Sht. C-58
977+00	358.6	24.3	1439.8	24.9	1440.1	
978+00	358.4	26.8	1441.9	27.0	1441.8	
979+00	358.2	26.4	1442.1	26.4	1442.1	
980+00	358.0	25.8	1442.4	25.2	1442.1	
981+00	358.2	26.0	1443.1	25.0	1442.6	
982+00	358.4	24.4	1442.9	24.4	1442.9	
983+00	358.6	24.6	1443.0	24.0	1443.3	
984+00	358.8	24.4	1444.1	23.8	1443.8	
985+00	359.0	24.2	1444.6	23.4	1444.2	
986+00	358.6	24.8	1445.5	24.2	1445.2	
987+00	358.2	26.0	1446.7	26.0	1446.7	

F.A.R.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	ARIZ.	F-028-1-513			

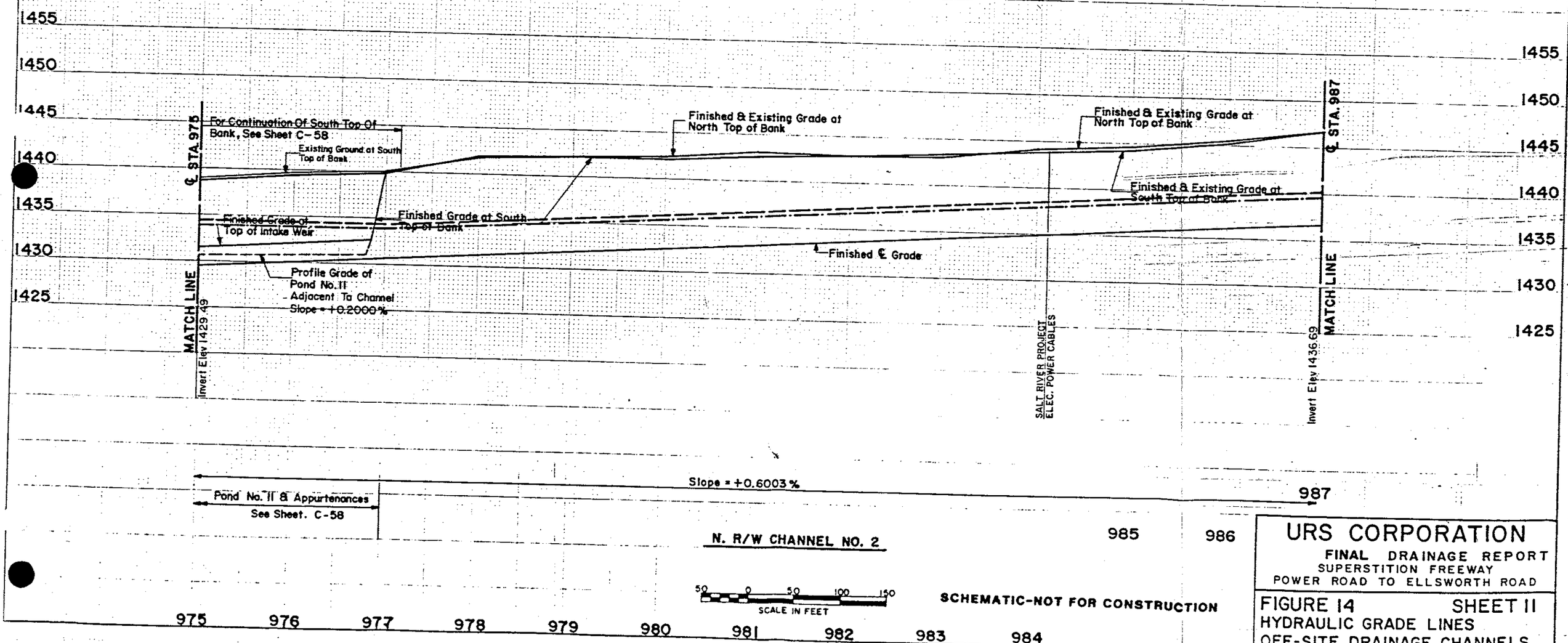
BM#37 4"BC Set In ℄ Pavement Ellsworth Rd. Cst Sta. 22+82.80 (Survey Sta. 37+17.71) Elev 1454.33

NOTE: Slopes Shown Are Based On True Lengths Between Grade Breaks.

LEGEND

—·— 50 Yr. Hydraulic Grade Line

— — — 100 Yr. Hydraulic Grade Line



URS CORPORATION
FINAL DRAINAGE REPORT
SUPERSTITION FREEWAY
POWER ROAD TO ELLSWORTH ROAD

FIGURE 14 SHEET 11
HYDRAULIC GRADE LINES
OFF-SITE DRAINAGE CHANNELS

SUPERSTITION FREEWAY
POWER RD. TO U.S. 60-PHASE II
MARICOPA/PINAL CO.

Construction ℄ Station	Offset To ℄ Channel	Offset To North Top Bank	Elevation At North Top Bank	Offset To South Top Bank	Elevation At South Top Bank	Comments
988+00	357.8	25.6	1447.1	25.2	1446.9	
989+00	357.4	26.0	1447.9	26.0	1447.9	
990+00	357.0	26.4	1448.7	25.4	1448.2	
991+00	357.6	25.2	1448.7	24.6	1448.4	
991+84	358.0	26.9	1450.0	26.5	1449.8	
992+00	358.2	26.5	1450.0	—	—	See Pond No.12, Sht. C-59
992+16	358.3	-	—	10.0	1441.8	
993+00	358.8	26.0	1450.3	10.0	1442.3	
994+00	359.4	25.6	1450.7	10.0	1442.9	
995+00	360.0	23.0	1450.0	10.0	1443.5	
996+00	360.0	23.8	1451.0	9.8	1444.0	
997+00	360.0	21.4	1450.4	21.6	1450.5	See Pond No.12, Sht. C-59
998+00	360.0	19.1	1449.8	21.7	1451.1	
999+00	360.0	20.8	1451.2	22.2	1451.9	

FAHWA REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	ARIZ.	F-028-1-513			

BM# 37 4" BC Set In ℄ Pavement Ellsworth Rd.
Cst Sta. 22+82.80 (Survey Sta. 37+17.71)
Elev 1454.33

1 For Channel Plan View, See Sheet C-19

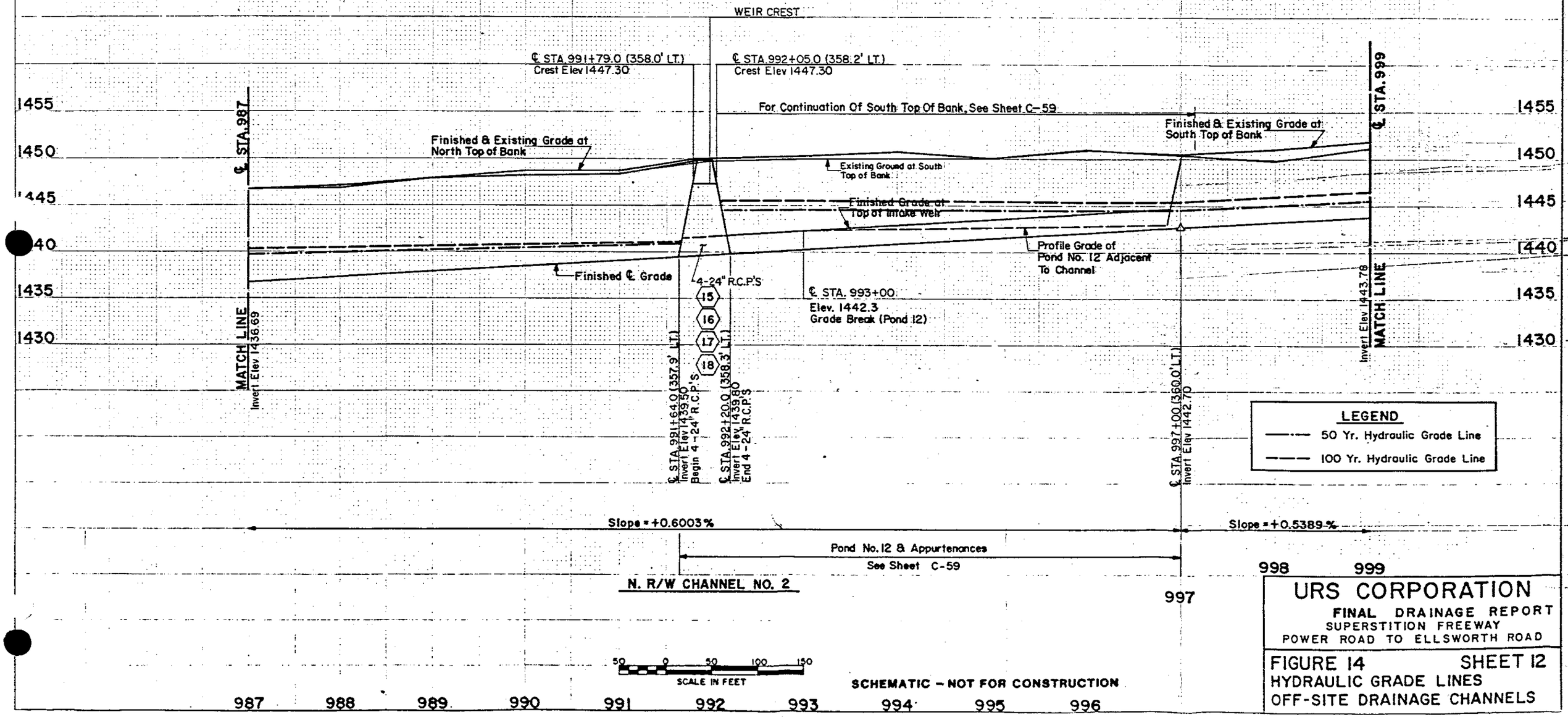
2 For Outlet Control Structure For Pond No.12, See Sheet C-70

3 For Channel Cross Sections, See Sheets C-71 & C-74

4 For Pond 12 Profile Information, See Sheet C-59

NOTE: Slopes Shown Are Based On True Lengths Between Grade Breaks.

OUTLET CONTROL STRUCTURE
FOR POND NO. 12



URS CORPORATION
FINAL DRAINAGE REPORT
SUPERSTITION FREEWAY
POWER ROAD TO ELLSWORTH ROAD

FIGURE 14 SHEET 12
HYDRAULIC GRADE LINES
OFF-SITE DRAINAGE CHANNELS

SUPERSTITION FREEWAY
POWER RD. TO U.S. 60-PHASE II
MARICOPA/PINAL CO.

1 For Channel Plan View, See Sheet C-19 & C-20.
2 For Channel Cross Sections, See Sheets C-71 & C-74

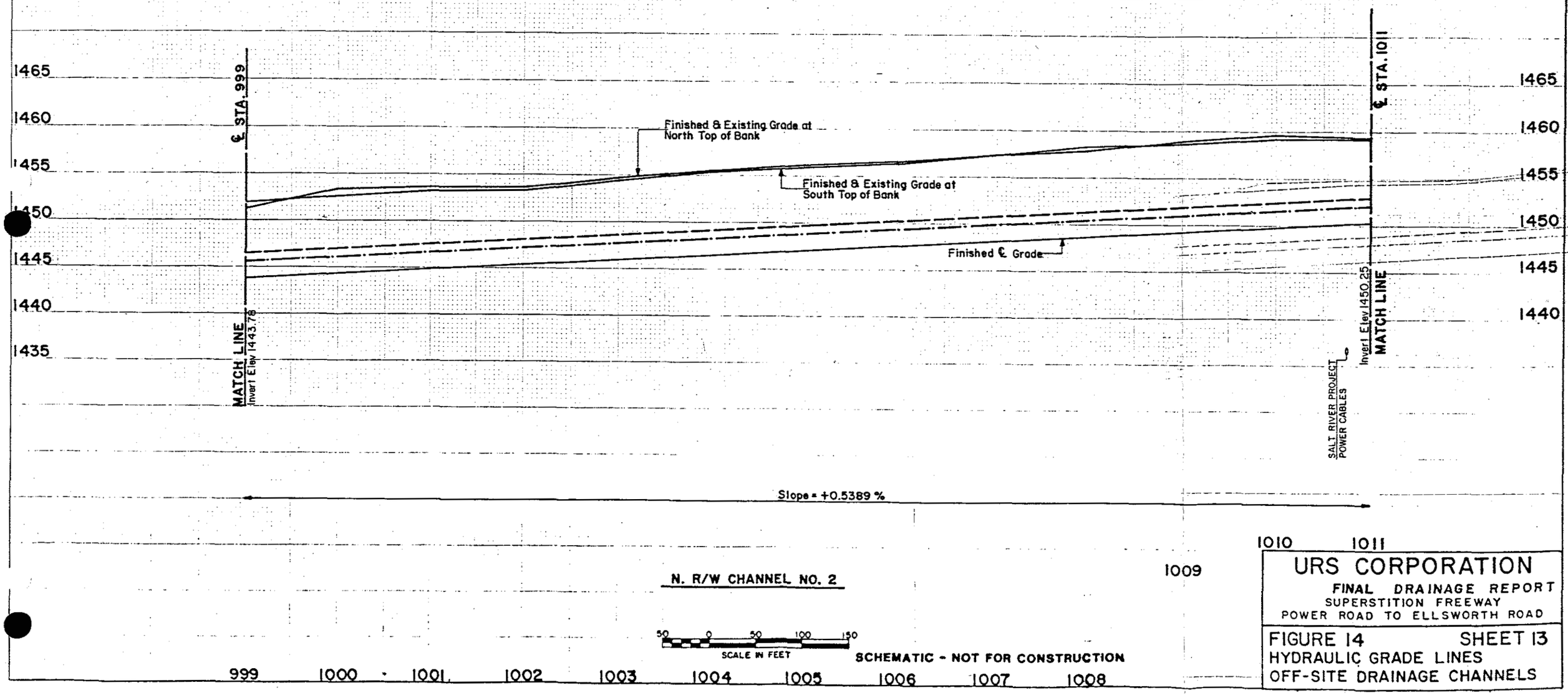
Construction ℄ Station	Offset To ℄ Channel	Offset To North Top Bank	Elevation At North Top Bank	Offset To South Top Bank	Elevation At South Top Bank	Comments
1000+00	360.0	24.2	1453.4	22.6	1452.6	
1001+00	361.0	23.5	1453.6	22.7	1453.2	
1002+00	362.0	22.4	1453.6	21.8	1453.3	
1003+00	361.3	23.5	1454.7	22.9	1454.4	
1004+00	360.7	24.1	1455.5	23.7	1455.3	
1005+00	360.0	24.2	1456.1	23.8	1455.9	
1006+00	359.8	23.9	1456.5	23.5	1456.3	
1007+00	359.6	24.2	1457.2	24.2	1457.2	
1008+00	359.4	24.3	1457.8	25.3	1458.3	
1009+00	359.2	25.5	1458.9	24.9	1458.6	
1010+00	359.0	25.8	1459.6	25.0	1459.2	
1011+00	358.8	24.1	1459.3	23.9	1459.2	

FEDERAL REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	ARIZ.	F-028-1-513			

BM#37 4"BC Set In ℄ Pavement Ellsworth Rd. Cst Sta. 22+82.80 (Survey Sta. 37+17.71) Elev 1454.33

NOTE: Slopes Shown Are Based On True Lengths Between Grade Breaks.

LEGEND
50 Yr. Hydraulic Grade Line
100 Yr. Hydraulic Grade Line



URS CORPORATION
FINAL DRAINAGE REPORT
SUPERSTITION FREEWAY
POWER ROAD TO ELLSWORTH ROAD

FIGURE 14 SHEET 13
HYDRAULIC GRADE LINES
OFF-SITE DRAINAGE CHANNELS

SUPERSTITION FREEWAY
POWER RD. TO U.S. 60-PHASE II
MARICOPA/PINAL CO.

1 For Channel Plan View, See Sheet C-20

2 For 24" And 48" Storm Drain Plan And Profile, See Sheet C-68

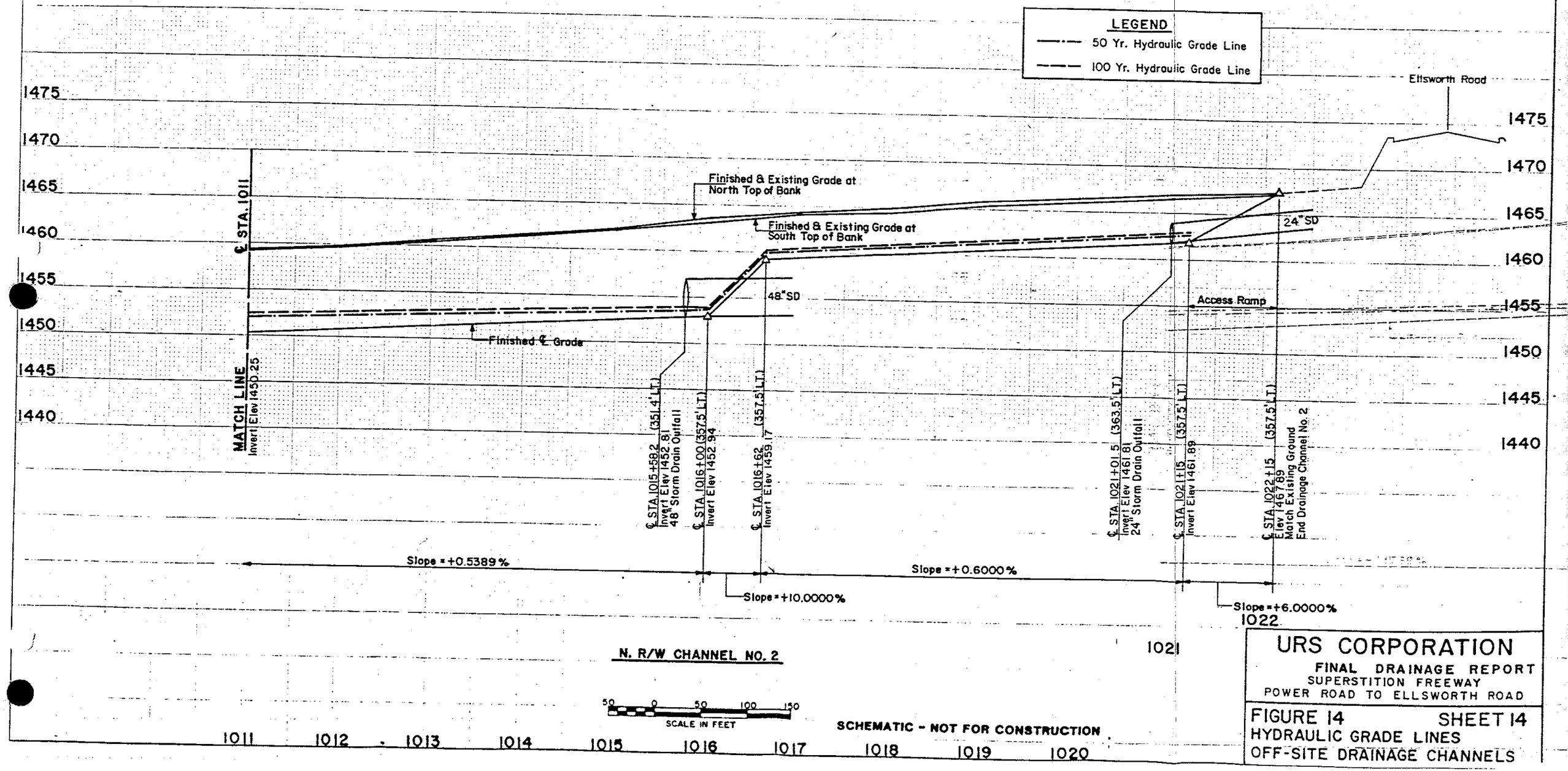
3 For Channel Cross Sections, See Sheets C-71 & C-74

Construction ℄ Station	Offset To ℄ Channel	Offset To North Top Bank	Elevation At North Top Bank	Offset To South Top Bank	Elevation At South Top Bank	Comments
1012+00	358.6	24.0	1459.8	23.8	1459.7	
1013+00	358.4	24.6	1460.6	24.2	1460.4	
1014+00	358.2	25.1	1461.4	24.7	1461.2	
1015+00	358.0	25.6	1462.2	25.4	1462.1	
1016+00	357.5	27.1	1463.5	26.1	1463.0	
1016+62	357.5	14.5	1463.4	15.3	1463.8	
1017+00	357.5	15.6	1464.2	15.2	1464.0	
1018+00	357.5	15.8	1464.9	14.8	1464.4	
1019+00	357.5	16.4	1465.8	15.4	1465.3	
1020+00	357.5	16.2	1466.3	15.4	1465.9	
1021+00	357.5	16.2	1466.9	15.4	1466.5	
1021+15	357.5	16.2	1467.0	15.4	1466.6	
1022+15	357.5	6.0	1467.4	6.0	1467.1	End Channel No. 2

FEDERAL REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS-BUILT
9	ARIZ.	F-028-1-513			

BM#37 4" BC Set In ℄ Pavement Ellsworth Rd. Cst Sta 22+82.80 (Survey Sta. 37+17.71) Elev 1454.33

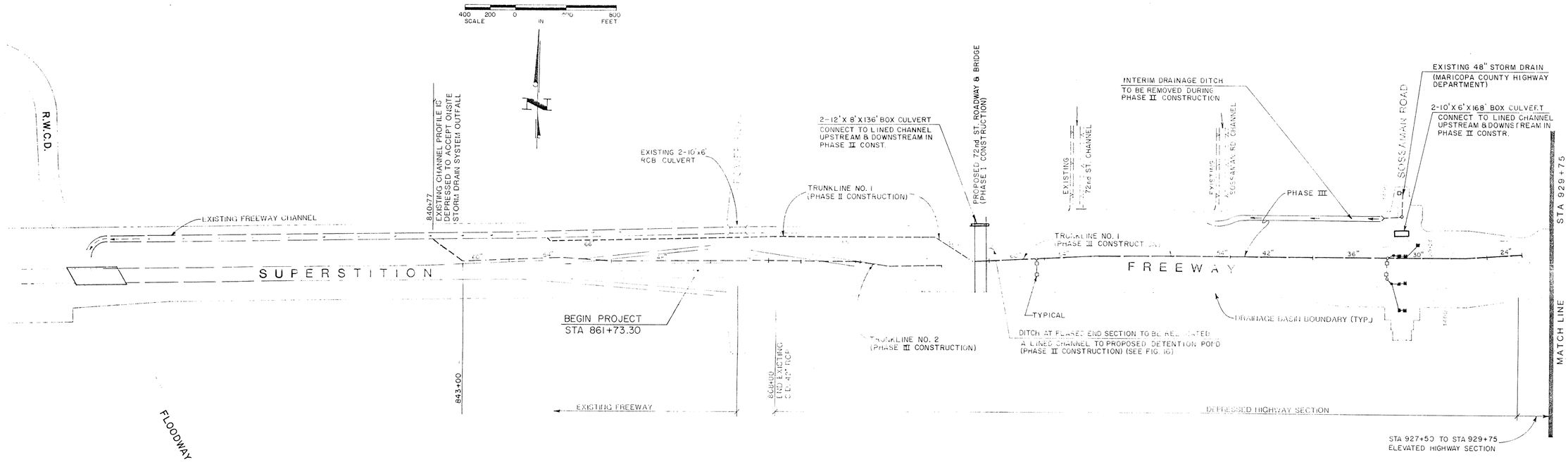
NOTE: Slopes Shown Are Based On True Lengths Between Grade Breaks.

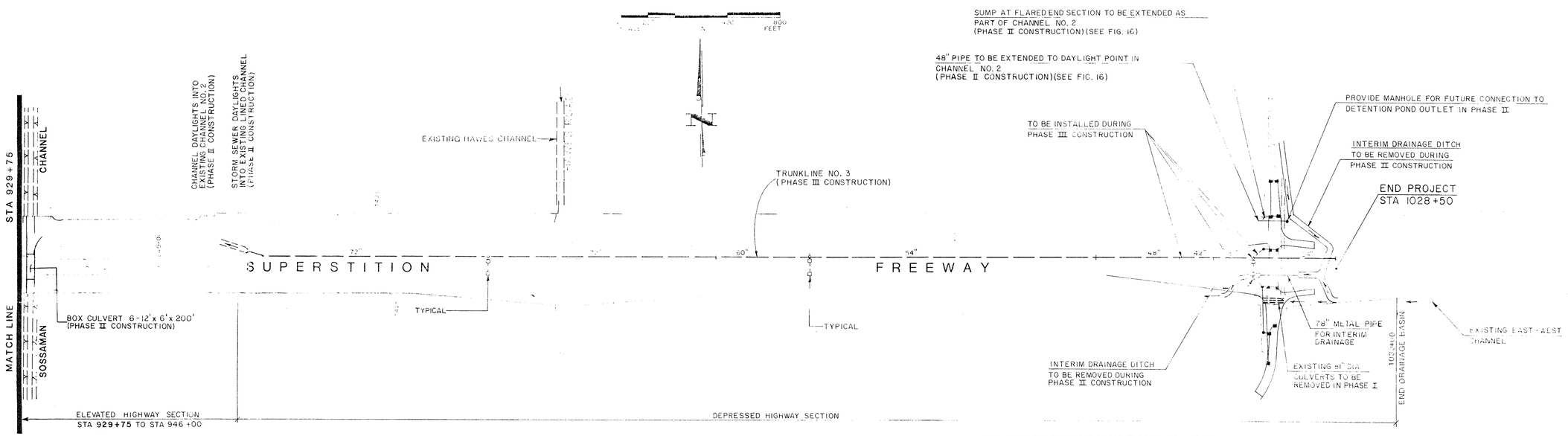


URS CORPORATION

FINAL DRAINAGE REPORT
SUPERSTITION FREEWAY
POWER ROAD TO ELLSWORTH ROAD

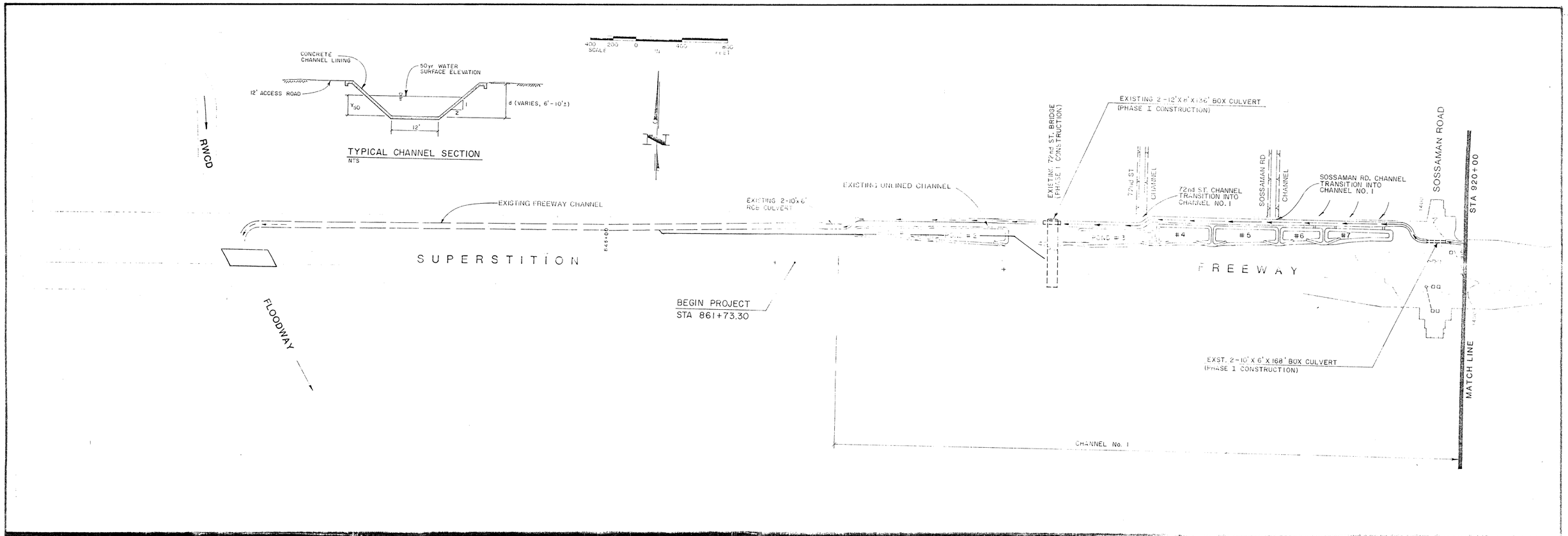
FIGURE 14 SHEET 14
HYDRAULIC GRADE LINES
OFF-SITE DRAINAGE CHANNELS





URS CORPORATION
FINAL DRAINAGE REPORT
SUPERSTITION FREEWAY
POWER ROAD TO ELLSWORTH ROAD

FIGURE 15, PHASE I AND PHASE III
DRAINAGE IMPROVEMENTS



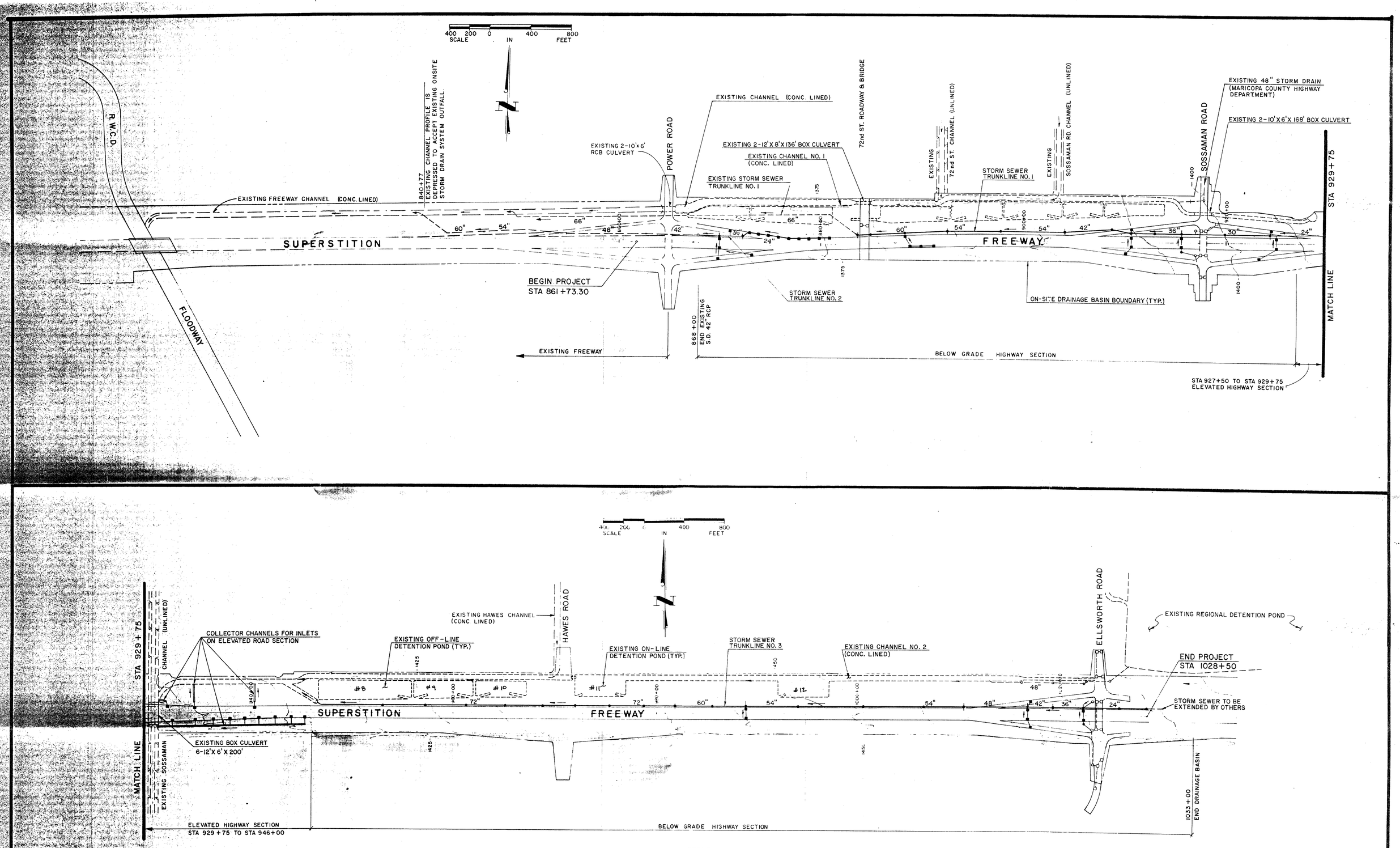
URS CORPORATION

FINAL DRAINAGE REPORT

SUPERSTITION FREEWAY

POWER ROAD TO ELLSWORTH ROAD

FIGURE 16 PHASE II DRAINAGE IMPROVEMENTS



LEGEND

- ■ PROPOSED INLET
- □ EXISTING INLET
- ● PROPOSED MANHOLE
- ○ EXISTING MANHOLE
- — PROPOSED STORM SEWER
- ↕ PIPE SIZE CHANGE THROUGH MANHOLE

NOTE:
INLETS SHOWN ARE REPRESENTATIVE ONLY.
SEE PHASES II & III CONSTRUCTION DRAWINGS FOR LOCATION INFORMATION.

URS CORPORATION
FINAL DRAINAGE REPORT
SUPERSTITION FREEWAY
POWER ROAD TO ELLSWORTH ROAD

FIG. 17 PHASE III
DRAINAGE IMPROVEMENTS

fill in the channel, even though the major sources of flows into the channel will be eliminated after construction of the off-site drainage system. A 36-in. pipe will be placed through the east bank of the concrete transition structure to provide an outlet for flows in the East-West Channel.

The off-site drainage system is designed to convey 50-year and 100-year peak discharges from the upstream watershed in its existing condition. The effects of future development in the watershed, while increasing the amount of runoff from the watershed, are expected to reduce the peak flow rates at the freeway right-of-way due to the current detention/retention requirements of the City of Mesa and Maricopa County. The MDP, if implemented, will result in a large reduction of peak flows at the freeway right-of-way. The schedule for finalization, adoption and implementation of the MDP are as yet undetermined.

The locations of the off-line detention ponds are crucially positioned with respect to the contributing point inflows at the 72nd Street Channel, the Sossaman Road Channel and the Hawes Channel. Under the current runoff conditions in the upstream watershed, any relocation of these channels would adversely affect the proper functioning of the off-site drainage system. It is possible that with increased detention ponding being provided, in conjunction with future development upstream, the channels' locations may be altered without detriment to the off-site drainage system. A careful analysis is strongly advised before channel relocation for the 72nd Street Channel, the Sossaman Road Channel or the Hawes Channel is undertaken.

C. Construction Phasing

The following discussion pertains to the drainage improvements required for Phases I, II and III. Each construction phase will be concurrent with similar phases of the next two roadway segments to the east. Interim drainage provisions are also described, as are crucial construction sequences within phases. Figures 15, 16 and 17 provide a schematic overview of Phase I, Phase II and Phase III drainage improvements.

1. PHASE I

a. Sossaman Road:

Manhole A is the outfall for inlets I-1, I-2, I-3 and I-4. Manhole B is the outfall for inlets I-5, I-6 and I-8. Both of these manholes will be connected to the storm sewer trunkline in Phase III. The trunkline will be approximately 22-27 ft. below the inverts of the manholes, therefore and no tail water effect is anticipated for either of the Phase I storm sewer runs.

A double 10' x 6' x 168' concrete box culvert, at Station 44 + 90, is required for the off-site drainage conveyance system. The connecting channels upstream and downstream of this culvert will be constructed during Phase II (See Figure 16). The culvert will be buried during the interim period between Phases I & II. There is no existing east-west flow under Sossaman Road, therefore no interim drainage provisions are required. Wing walls are not provided since the future (Phase II) channel will be formed with transition sections up to the box inlet and outlet.

In conjunction with, or slightly before, Phase I construction, the Maricopa County Highway Department (County) will be constructing roadway improvements, including a 48-inch storm drain, along Sossaman Road. Upon completion by the County, the pipe will terminate approximately 105 ft west of the Sossaman Road centerline below grade with a temporary plug. During Phase I construction the plug will be removed and an interim inlet ditch will be constructed west to the Sossaman Road Channel. This interim outfall for the storm drain is provided mainly to obviate construction of a sump at the outfall of the storm drain. During Phase II, the 48-inch storm drain will be extended to a concrete lined channel which will run east-west and replace existing unlined ditches and channels.

As a part of the storm sewer system in Sossaman Road, the County will install an 18-inch lateral pipe (Station 47 + 53) extending to the west side of the road. This is the location where the Sossaman Road detour merges with the existing roadway. Upon completion of the curb and gutter and inlet (I-7), the 18-inch pipe will be connected to the inlet.

b. <u>72nd Street</u>:

Two inlets (I-9 and I-10) are required just before the upstream end of the 72nd Street bridge to prevent excess flows from entering the bridge. The two inlets are connected by a 24-inch lateral pipe which in turn has an outfall to the east side of the roadway (See Figure 12). In the interim period between Phases I and II this pipe will have an outfall into a ditch which drains north to an existing unlined channel. In Phase II the ditch will be relocated to the east to a detention pond just east of 72nd Street. (See Figure 15).

A double 12 ft x 8 ft x 136 ft concrete box culvert is required at Station 14 + 68.5 (centerline of box). As at Sossaman Road, the culvert will be a part of the off-site drainage conveyance system but will be constructed during Phase I. Unlike Sossaman Road there is an existing unlined channel in this area which runs east-west along the north right-of-way line of the freeway. This channel is dry except during rainstorms. Some provision is required to permit storm runoff to continue flowing along this channel after 72nd Street is constructed. The inverts of the box culvert and future (Phase II) channel are lower than those of the existing channel by approximately four feet. After construction the inside of the box culvert will be back-filled to match the existing channel inverts to maintain a flow path under 72nd street. Some realignment of the existing channel is necessary at the culvert inlet and outlet. During Phase II the box will be cleaned out and connected, with transition sections, to a lined channel. Wing walls will not be constructed at the ends of the box culvert since the future (Phase II) channel will be constructed, with transition sections, up to the box inlet and outlet.

c. <u>Ellsworth Road</u>:

Manhole D is the outfall for inlets I-11, I-12, I-13, I-14 and I-15. Manhole E is the outfall for inlets I-16 and I-17. Both of these manholes will be connected to the storm sewer trunkline in Phase III. The trunkline will be approximately 8-19 feet below the inverts of the manholes, therefore no tail water effect is anticipated for either of the storm sewer runs.

Inlets I-18, I-19, I-20 and I-21 have a common outfall in a 24-inch pipe at Station 44 + 35. This pipe will have an interim outfall into a sump (below the roadway) which will be extended as pipe in Phase II. The pipe will extend, via the north right-of-way channel, to a discharge point at Sossaman Channel (See Figure 2).

A large regional detention pond is planned (by others) in the north-east quadrant of the Ellsworth Road interchange. The outlet for this pond will be a 48-inch pipe extending to the west and ultimately discharging into the off-site drainage conveyance system. Only that segment of the pipe which lies under Ellsworth Road will be constructed during Phase I. A manhole (MH-F) is provided at the east end of the pipe for future connection (by others) to the pond outlet. In Phase II the west end of the pipe will be extended to the west to a point where it discharges into a lined channel.

An existing unlined ditch along the east side of Ellsworth Road conveys storm runoff to the south right-of-way line of the freeway. This connects to an existing unlined channel running from east to west along the south right-of-way line of the freeway. Three 81-inch pipes provide conveyance for channel flows under Ellsworth Road. Of these three pipes one is almost completed silted in and the other is largely blocked by debris. The remaining pipe is partially silted up. The entire system conveys flows only during periods of excess rainfall (i.e., rainfall events producing runoff).

These culverts and approximately 200 - 300 ft of the upstream and downstream channels will be obstructed and filled in by the construction associated with Phase I. Furthermore, the whole system will be rendered obsolete by the Phase II conveyance system of detention ponds and lined channels (along the north right-of-way line). Drainage for the interim condition will be accommodated by providing an interim system of unlined ditches and a culvert that will maintain existing flow patterns until the Phase II improvements have been constructed. On the east side of Ellsworth Road the north-south ditch and the east-west ditch will be rerouted around the east ends of the Ellsworth ramps (See Figure 15). These two ditches will be combined into a single ditch which flows west. Three temporary 84-inch RCPS will be provided under the Ellsworth Road detour and under the Ellsworth bridge. West of Ellsworth Road these pipes will discharge into an unlined channel which will then connect back to the existing east-west channel west of the ramp terminus. The 81-inch pipes will be removed during Phase I. During Phase II, after the off-site conveyance system is in place, the interim ditches will be filled in and the 84-inch pipes will be removed.

d. Summary:

The drainage improvements to be installed in Phase I are isolated segments of a larger system which will provide conveyance for on-site and off-site storm runoff within the right-of-way of the Superstition Freeway. These isolated segments must be built in conjunction with cross-road construction (i.e., Phase I) but will not be fully operational until the drainage improvements associated with Phases II and III are completed.

2. PHASE II

Phase II construction includes completion of the off-site drainage system, a segment of Trunkline No. 1, roadway grading and removal of the interim ditches and pipes constructed in Phase I.

Channel No. 1 will be constructed from Power Road to the east side of Sossaman Road. Channel transitions will be provided at the 72nd St. box culvert and at the Sossaman Road box culvert. It will be necessary to clean the 72nd St. box culvert to the proposed channel invert in order to connect the channel with the culvert. The plywood plugs at either end of the Sossaman Road box culvert will be removed. The existing 48-in. storm sewer along Sossaman Road (by others) will be extended to an outfall on the side of Channel No. 1. The interim outlet ditch, constructed in Phase I, will be filled.

Off-line detention ponds 1 through 7 will be constructed along Channel No. 1 as shown on the Phase II construction plans. The interim outfall ditch for the 72nd St. inlets will be filled and a new outfall will be provided into off-line Detention Pond No. 3 Following excavation of Pond No. 1 and Pond No. 2, but prior to the placing of channel lining, Trunkline No. 1 will be constructed through the area of pond excavation. The storm sewer crossing under Power Road will be accomplished by means of a jacked pipe.

Channel transitions at the confluences with the 72nd Street Channel and the Sossaman Road Channel will be included in Phase II construction.

Channel No. 2 will be constructed from the Sossaman Channel to the west side of Ellsworth Road. The 48-in. pipe under Ellsworth Road will be extended west to an outfall into Channel No. 2. The outfall pipe for the storm sewer system on the north end of Ellsworth Road will be extended to an outfall into the channel. A "subsidiary channel" (ie - the outfall channel for Trunkline No. 3) will be constructed from Channel No. 2 up to the headwall of the outfall for Trunkline No. 3; the headwall will not be constructed.

Off-site detention ponds 8-10 will be constructed. A channel transition will be provided at the confluence of Hawes Channel and Channel No. 2.

Improvements to the Sossaman Channel are included in Phase II. The box culvert under the Superstition Freeway, the downstream transition section, the upstream transition section and the channel lining through the right-of-way will be constructed in Phase II. The 24-in. pipe under the east bank of the downstream transition structure will be placed at this time.

The interim ditches east of Ellsworth, constructed in Phase I, will be filled and the 78-in. pipe under Ellsworth Road will be removed.

The removal of the 78-in. pipe under Ellsworth Road and the filling of the associated interim ditches must be carefully timed with construction of elements of the off-site drainage system being provided (by others) east of Ellsworth Road. Runoff that, under existing conditions, arrives at Ellsworth Road and discharges into the East-West Channel will be intercepted by a large detention pond on the north-east quadrant of the Ellsworth Road - Superstition Freeway Interchange and will be directed west into Channel No. 1 through a restricted orifice. Care must be taken to provide for detention and conveyance of these flows before the existing conveyance is removed. The following construction sequence, within Phase II, indicates how this may be accomplished:

a. Construct the Sossaman Channel box culvert under the freeway, the channel improvements upstream of the freeway, and the transition into Channel No. 2.

b. Construct Channel No. 2 with all detention ponds and the transition at the Hawes Channel.

c. Construct the downstream improvements on the Sossaman Channel on the west side; leave the East-West Channel discharge point open.

d. Construct the large detention pond in the northeast quadrant of the Ellsworth Road - Superstition Freeway Interchange and connect to the manhole on the east side of Ellsworth Road that was constructed in Phase I (provides a connection to Channel No. 2).

e. Immediately finish the downstream transition structure on the east bank of the Sossaman Channel. Provide the 24-in. relief pipe at this time for the East-West Channel.

f. Remove the 78-in. pipe and the interim ditches under Ellsworth.

g. Perform the necessary roadway grading under Ellsworth Road. Channel No. 2 should be in place and fully operational before the roadway grading at Ellsworth Road is initiated.

Grading and filling of minor ditches and erosion rills will follow the major construction segments of Phase II. The off-site drainage system will be completed and in place at the conclusion of Phase II construction.

3. PHASE III

The remaining elements of the on-site drainage system will be constructed in Phase III. Trunkline No. 1 will be extended to its eastern terminus; Trunklines No. 2 and No. 3 will be constructed. All associated manholes, lateral pipes, and inlets will be provided at this time. Connections to Trunklines No. 1 and No. 3 will be made to the existing storm sewer systems (from Phase I) at Sossaman Road and Ellsworth Road, respectively. A manhole will be provided at the eastern terminus of Trunkline No. 3 to permit extension of this trunkline (by others) to the east.

All elements of the on-site and off-site drainage systems will be in place and fully functional at the conclusion of the Phase III construction sequence.

IV CONCLUSIONS AND RECOMMENDATIONS

Conclusions of the Final Drainage Report are as follows:

1. The "existing condition" flows are an appropriate design basis for the off-site drainage system.

2. The off-site drainage system of channels and detention ponds described in this report and shown on the construction plans for Phases I, II and III are adequately designed to convey the 50- yr and the 100-yr storm flows through the freeway right-of-way with appropriate freeboard. The exception to meeting the freeboard requirement occurs upstream of Power Road, as discussed in Chapter V; the requirement of not exceeding present 100-yr flooding elevations is met without exception.

3. Construction of Channel No. 2 will result in the elimination of bank overtopping between Ellsworth Road and the Sossaman Channel, and will result in lower overtopping flows of the Sossaman Channel south of the freeway right-of-way.

4. All drainage improvements are contained within the freeway right-of-way.

5. The proper functioning of the off-site drainage system is particularly sensitive to the construction sequencing within Phase II, and care should be taken to ensure that Channel No. 2 is fully operational before the interim ditch and pipe (from Phase I) for the East-West Channel are removed.

6. The on-site drainage system of inlets, laterals, manholes and trunklines, as described in this report and as shown on the construction plans for Phases I, II, and III, are adequately designed to convey the 10-yr and 50-yr storm runoff away for the crossroads and freeway (including ramps), respectively.

7. Relocation of the 72nd Street Channel, the Sossaman Channel, or the Hawes Channel should not be undertaken without prior analysis of the effects of such action on the proper functioning of the off-site drainage system.

Finally, it is the recommendation of URS Consultants that the off-site and on-site drainage facilities, as described in this report and as shown on the construction plans for Phases I, II and III be adopted as the final drainage system design. Furthermore, it is recommended that the construction sequencing of drainage improvements, both between and within construction phases, be conducted as described in this report.

REFERENCES

1. "Eastern Maricopa County Master Drainage Plan." Review Draft, A-N West, Inc., July 10, 1986.

2. "HEC-1 Flood Hydrograph Package," Users Manual, U.S. Army Corps of Engineers, The Hydrologic Engineering Center, September 1981 (Revised January 1985).

3. "Preliminary Submittal - Design Review and Analysis for Sossaman Road Drainage Channel," B.R. Jolly, Consulting Engineer - Water Resources, May 16, 1980.

4. "Hydrologic and Hydraulic Training Session," Arizona Highway Department, Structures Section, Hydraulics Division, Revised December 1973.

5. "Hydrologic Design for Highway Drainage in Arizona," Arizona Highway Department, Bridge Division, Revised March 1969.

6. "Arizona Statewide Management Program - Project Design Guidelines," Prepared for Arizona Department of Transportation by Sverdrup Corporation, Arizona Statewide Management Consultant, October 1986.

7. Project Design Memoranda for Contract No. 85-39 for ADOT Project No. SBM-028-311PE, -511C by the Arizona Statewide Management Consultant.

8. Flood Insurance Rate Map, FEMA, Maricopa County, Arizona, and Unincorporated Areas, Effective Date: July 2, 1979.

9. "Hydraulic Design of Highway Culverts," U.S. Department of Transportation, Federal Highway Administration, Hydraulic Design Series No. 5, Report No. FHWA-IP-85-15, September 1985.

10. "HEC-2 Water Surface Profiles," Users Manual, U.S. Army Corps of Engineers, The Hydrologic Engineering Center, September, 1982.

11. "Drainage of Highway Culverts," U.S. Department of Transportation, Federal Highway Administration, Hydraulic Engineering Circular No. 12, FHWA-TS-84-202, March 1984.

12. "Design of Small Dams," U.S. Bureau of Reclamation, 1977.

13. "Drainage Report for the Superstition Freeway (Val Vista to Power Road Section)," ADOT, May 1981.

14. "RWCD Floodway TR-20 Model Schematic and Drainage Boundary Map," Soil Conservation Service, 1974.

15. "Superstition Freeway Conceptual Study for Drainage (Tempe Canal to RWCD Canal)," Yost and Gardner, February 1975.

16. "Summary Report for Flood Control, Gila Floodway, Maricopa and Pinal Counties, Arizona," U.S. Army Corps of Engineers, Los Angeles District, September 1977.

APPENDIX A

PRECIPITATION DATA AND PROCEDURES

ADDENDUM to "HYDROLOGIC DESIGN FOR HIGHWAY DRAINAGE IN ARIZONA" April 1975

Steps to be used to determine precipitation values for various durations and return periods.

STEP 1. From the precipitation maps in the manual "Hydrologic Design for Highway Drainage in Arizona", determine the precipitation values for the 6 and 24 hour duration storms for return periods of 2, 5, 10, 25, 50 and 100 years. Tabulate these values in Table 1 in the column headed 'Map Values'

TABLE 1

Return Period (Years)	Precipitation Values (inches)			
	6 hour duration		24 hour duration	
	Map Value	Corrected Value	Map Value	Corrected Value
2	1.20	1.24	1.40	1.40
5	1.60	1.68	1.90	1.95
10	1.90	1.99	2.30	2.30
25	2.40	2.37	2.90	2.77
50	2.70	2.70	3.20	3.20
100	3.00	3.06	3.60	3.60

NOTE: There is a possibility of making an error while reading the maps because, (1) a site is not easy to locate precisely on a series of 12 maps, (2) there may be some slight registration differences in printing, and (3) precise interpolation between isolines is difficult. In order to minimize any errors in reading the maps, these values should be plotted on the diagram "Precipitation Depth versus Return Period" Fig. 1.

STEP 2. Plot these values on the diagram "Precipitation Depth versus Return Period" Fig. 1.

STEP 3. Draw a line of best fit through the 6 hour precipitation values and another line through the 24 hour precipitation values.

STEP 4. Tabulate the values represented by the lines of best fit, obtained in Step 3, in the column of Table 1 entitled "Corrected Value".

NOTE: The 1 hour precipitation value is needed to determine the 2 and 3 hour values as well as the 5, 10, 15 and 30 minute values.

STEP 5. Using the 6 and 24 hour values for the 2 year and 100 year return periods, from Table 1 (corrected values), solve the following equations to determine the 1 hour values:

$$Y_2 = -0.011 + 0.942 \ (X_1^2/X_2)$$

$$Y_{100} = 0.494 + 0.755 \ (X_3^2/X_4)$$

where Y_2 = 2 year 1 hour value
Y_{100} = 100 year 1 hour value
X_1 = 2 year 6 hour value from Table 1
X_2 = 2 year 24 hour value from Table 1
X_3 = 100 year 6 hour value from Table 1
X_4 = 100 year 24 hour value from Table 1

STEP 6. To determine 1 hour precipitation values for the other return periods, first plot the 2 year 1 hour value and the 100 year 1 hour value on Figure 1. Connect the two points by a straight line. The values on this line will give the 1 hour precipitation values for the various return periods.

STEP 7. To determine the 2 and 3 hour precipitation values, use the following formulae with data for the appropriate return period from Table 1 (corrected values):

2 hour = 0.341 (6 hour) + 0.659 (1 hour)
3 hour = 0.569 (6 hour) + 0.431 (1 hour)

An alternate method in lieu of the above equations is to use Fig. 2-2 (revised 4-75).

STEP 8. The 12 hour precipitation value for any return period is determined by the following equation:

$$P_{12\ hr} = P_{24\ hr} - .51\ (P_{24\ hr} - P_{6\ hr})$$

STEP 9. To determine precipitation values for durations less than 1 hour for any return period, the following relationships apply:

Duration (Minutes)	5	10	15	30
Ratio to one hour	.29	.45	.57	.79

Calculation of 1-hour, 2-year and 1-hour, 100-year Rainfall Values

$X_1 = 1.24$

$X_2 = 1.40$

$X_3 = 3.00$

$X_4 = 3.60$

$y_{2yr} = -0.011 + 0.942\ (1.24^2/1.40)$

$y_{2yr} = 1.024$-inches

$y_{100yr} = 0.494 + 0.755\ (3.00^2/3.60)$

$y_{100yr} = 2.382$-inches

Project No. _____ Station _____

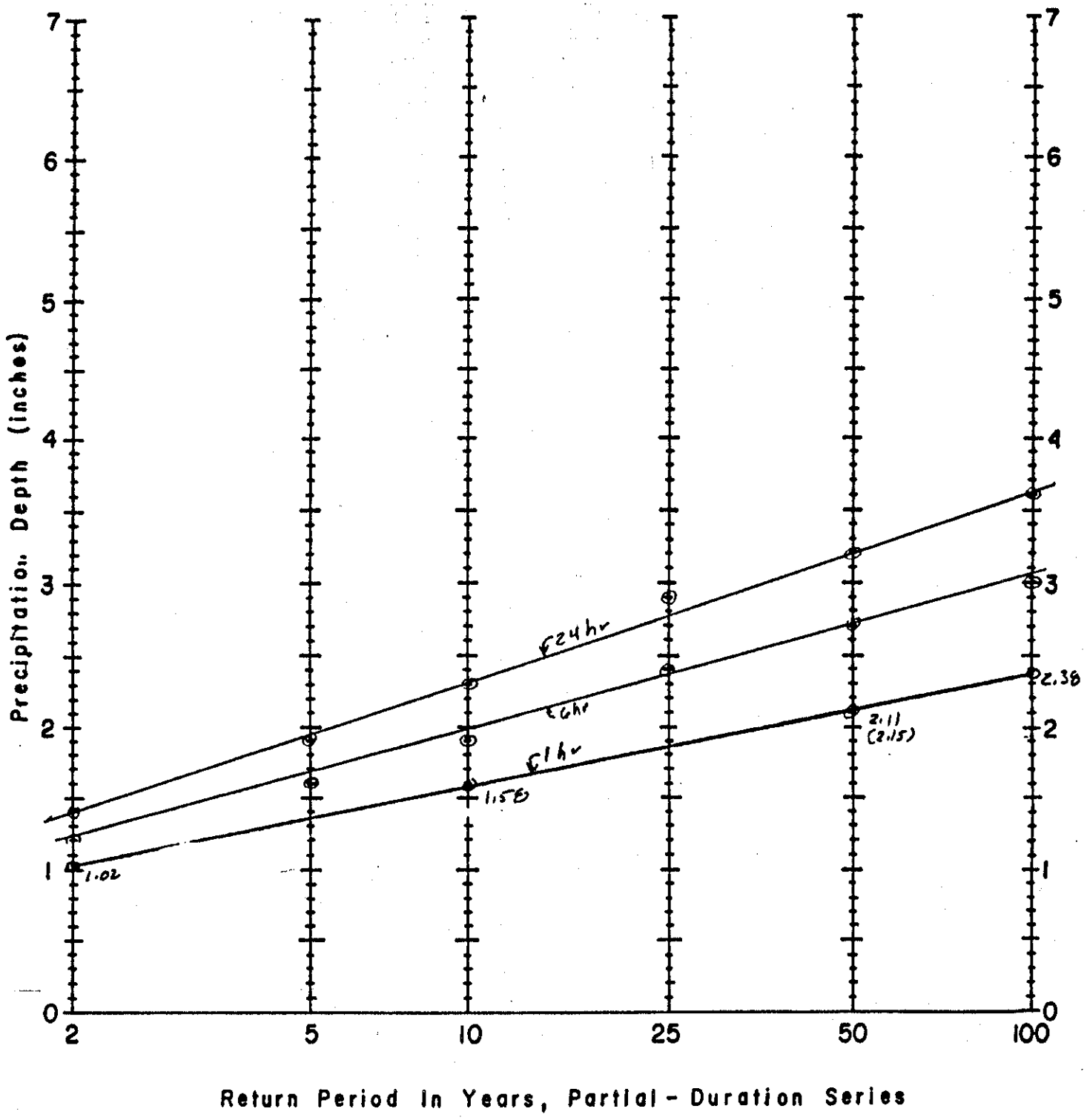


Figure 1 Precipitation Depth Versus Return Period for Partial-Duration Series

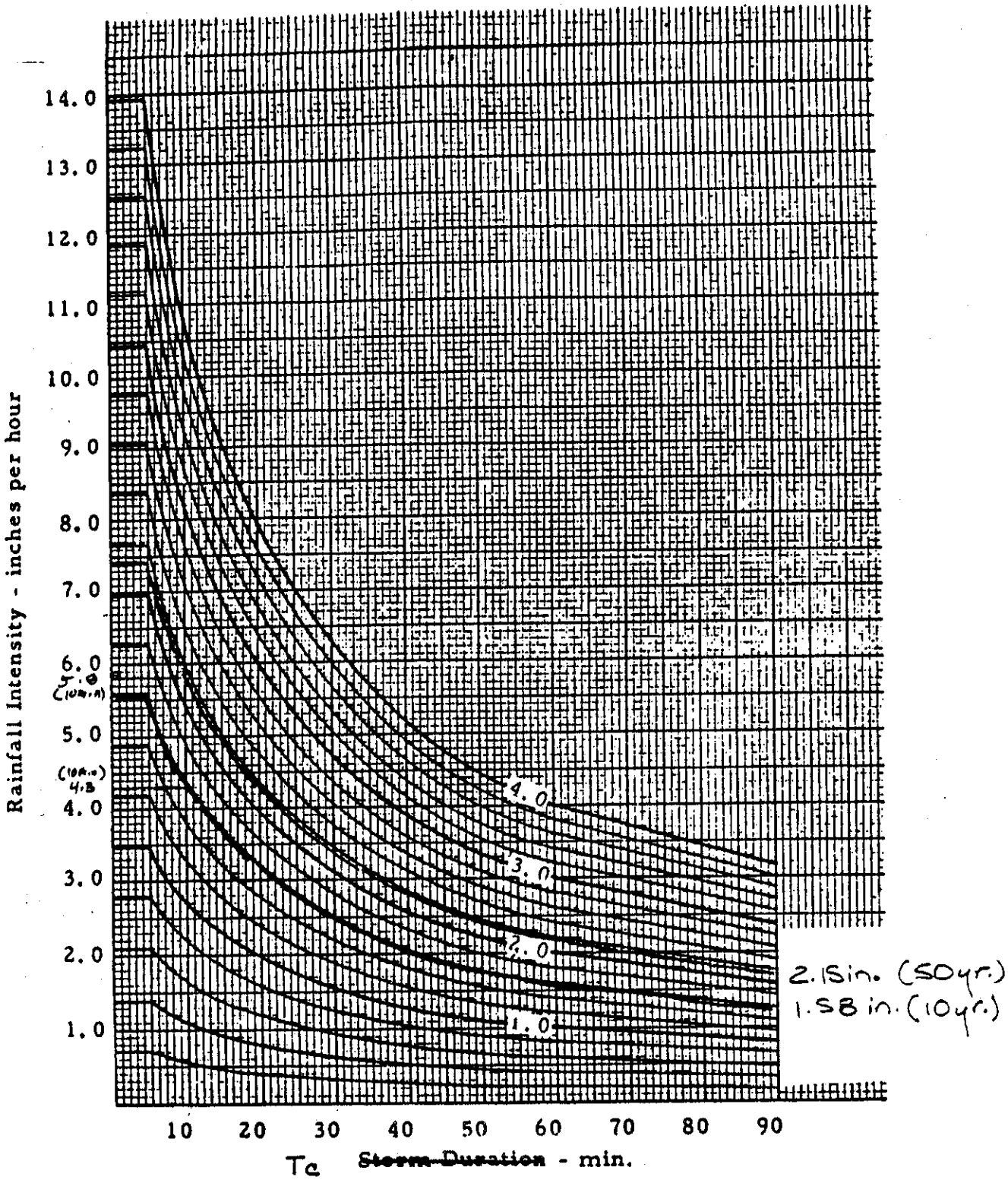


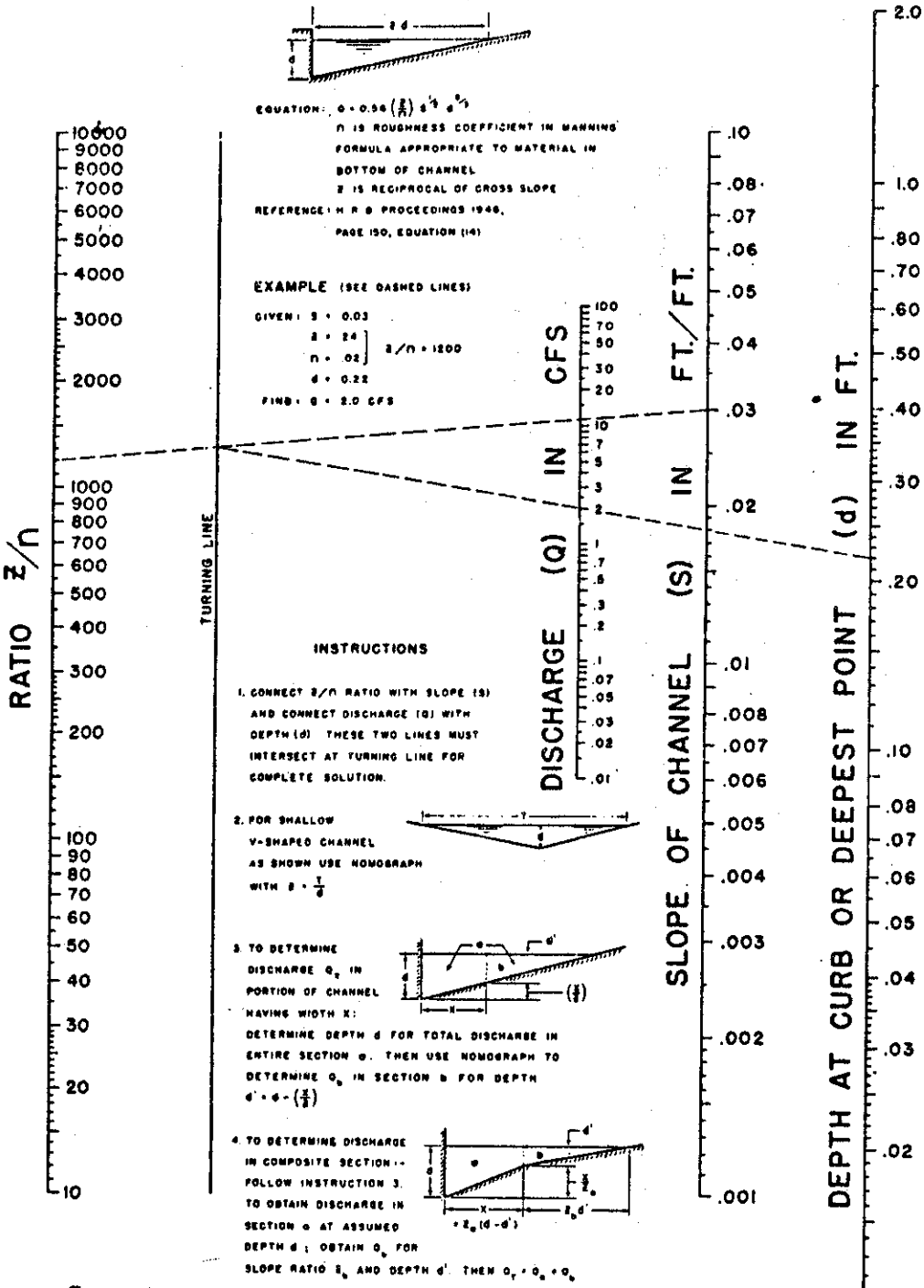
Fig. 3-2

STANDARD DURATION RAINFALL - INTENSITY CURVES

Based on:
Weather Bureau
Technical Paper No. 40

APPENDIX B

COMPUTATION PROCEDURES



Concrete gutter troweled finish	0.012
Asphalt pavement	
(1) Smooth texture	0.013
(2) Rough texture	0.016
Concrete gutter with asphalt pavement	
(1) Smooth	0.013
(2) Rough	0.015
Concrete pavement	
(1) Float finish	0.014
(2) Broom finish	0.016
	0.016

For gutters with small slope where sediment may accumulate, increase all above values of "n" by 0.002.

NOMOGRAPH FOR FLOW IN TRIANGULAR CHANNELS

AHD
Structures Section
Hydraulics Branch
10-15-72

Chart 1

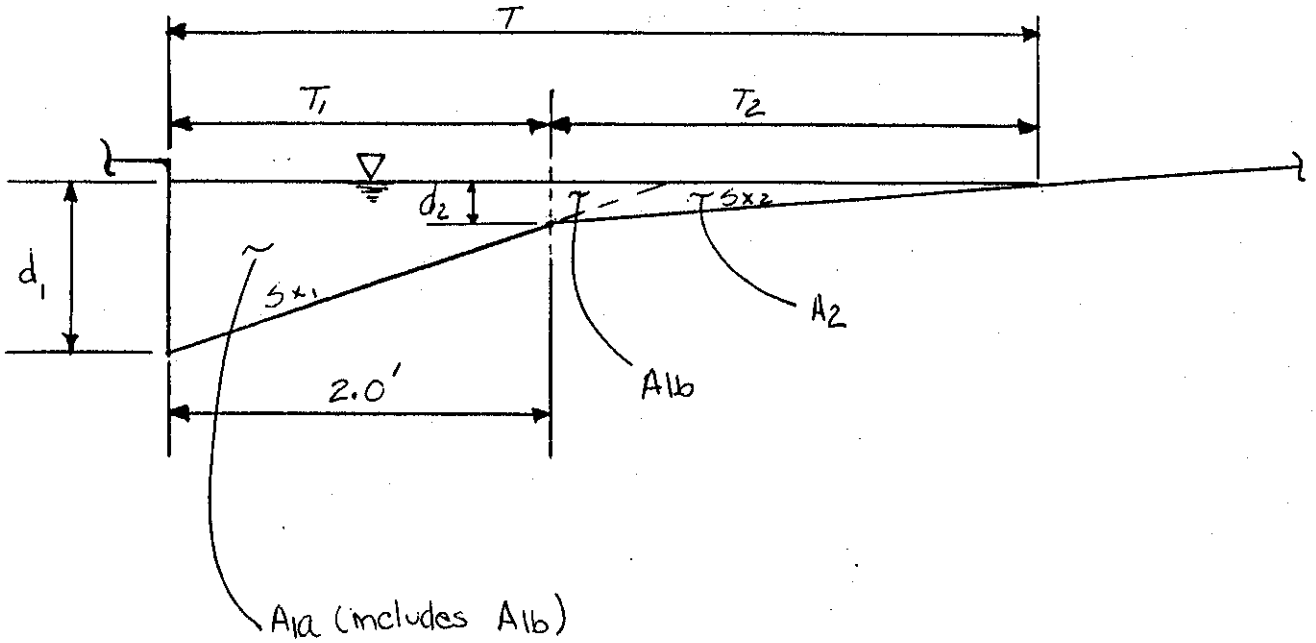
FHWA
HEC #12

URS CORPORATION
TWO GATEWAY
SUITE 163, 432 NORTH 44TH STREET
PHOENIX, ARIZONA 85008
TEL: (602) 273-6646

SUPERSTITION FREEWAY (Power Road to Ellsworth Road)
ADOT Project No. F—028—1—311
Contract No. 85—39 URS Job No. 6114—6501— 40

DATE 2/23/87 BY GCS CHECKED (DH 2/25/87) (date/by)

SUBJECT FLOW IN GUTTER: COMPOSITE X-SECTION (TYPE A CURB & GUTTER) PAGE 1 OF 3



$$Q = 0.56 \frac{z}{n} S_o^{1/2} d^{8/3}$$ (Ref.: "Hydrologic & Hydraulic Training Session", ADOT.)

if Q is known find d_1 by:

where $n = .016$

$d_2 = d_1 - 0.10$

$S_{x_1} = 0.05$ '/'

S_{x_2} = varies

$T = \frac{d_2}{S_{x_2}} + 2' = \cancel{50d_2 + 2'}$ $50d_2 + 2'$

$$Q_{1a} = \frac{0.56}{n} \frac{1}{S_{x_1}} S_o^{1/2} d_1^{8/3}$$

$$Q_{1b} = \frac{0.56}{n} \frac{1}{S_{x_1}} S_o^{1/2} d_2^{8/3}$$

$$Q_2 = \frac{0.56}{n} \frac{1}{S_{x_2}} S_o^{1/2} d_2^{8/3}$$

$$Q_{TOT} = Q_{1a} - Q_{1b} + Q_2$$

$$Q_{TOT} = \frac{0.56}{n} S_o^{1/2} \left[\frac{d_1^{8/3}}{S_{x_1}} - \frac{d_2^{8/3}}{S_{x_1}} + \frac{d_2^{8/3}}{S_{x_2}} \right]$$

$$Q_{TOT} = 35 S_o^{1/2} \left[\frac{d_1^{8/3}}{S_{x_1}} + d_2^{8/3} \left(\frac{1}{S_{x_2}} - \frac{1}{S_{x_1}} \right) \right]$$

$$Q_{TOT} = 35 S_o^{1/2} \left[20 d_1^{8/3} + d_2^{8/3} \left(\frac{1}{S_{x_2}} - 20 \right) \right]$$

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ADOT Project No. F-028-1-311
Contract No. 85-39 URS Job No. 6114-6501-40

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SUBJECT FLOW IN GUTTER - TYPE "A" PAGE 2 OF 3

$$Q = 35\, S_o^{1/2} \left[\frac{d_1^{8/3}}{S_{x_1}} + d_2^{8/3} \left(\frac{1}{S_{x_2}} - \frac{1}{S_{x_1}} \right) \right]$$

$d_2 = d_1 - 0.10$

$S_{x_1} = .05\%$, $1/S_{x_1} = 20$

$$Q = 35 S_o^{1/2} \left[20 d_1^{8/3} + (d_1 - 0.10)^{8/3} \left(\frac{1}{S_{x_2}} - 20 \right) \right]$$

Procedure:
- Q is calculated for a given inlet location (Q_1)
- Find S_o & S_{x_2} at that location
- Assume d_1 & compute Q (Q_2)
- Compare the two Q's and adjust d_1 until Q_2 is approximately equal to Q_1

HP 41CV:

```
01 LBL Q
02 S= ?
03 PROMPT
04 √X
05 35
06 *
07 STO 10
08 SX2= ?
09 PROMPT
10 1/X
11 20
12 -
13 STO 11
14 LBL QD
15 d1 = ?
16 PROMPT
17 STO 12
18 2.6667
19 Y↑X
20 20
21 *
22 STO 13
23 RCL 12
24 0.10
25 -
26 2.6667
27 Y↑X
28 RCL 11
29 *
30 RCL 13
31 +
32 RCL 10
33 *
34 Q=
35 ARCL X
36 AVIEW
37 STOP
38 GOTO QD
39 END
```

Check results of run against gutter flow nomograph (chart 1 - from FHWA HEC #12)

EX. $S_o = .020\%$, $S_{x_2} = .020\%$
$Q = 1.10$ cfs.

LBL Q : d (ft)	Q (cfs)
.15	.68
.16	1.00
.17	1.00
.175	1.10

$Z_1/n = 1250$, $Z_2/n = 3125$, $d_1 = .175'$
$Q = .9 - .05 + .25 = 1.10$ cfs

OK } FROM NOMOGRAPH

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DATE 2/23/87 BY GCG CHECKED CPG 2/25/87 (date/by)

SUBJECT FLOW IN GUTTER : TYPE "A" PAGE 3 OF 3

with d_1 established find
T_1 & T_2 :

$T_1 = 2'$ (for $d_1 \geq .10'$)

$T_2 = (d_1 - .10)(1/S_{x2})$

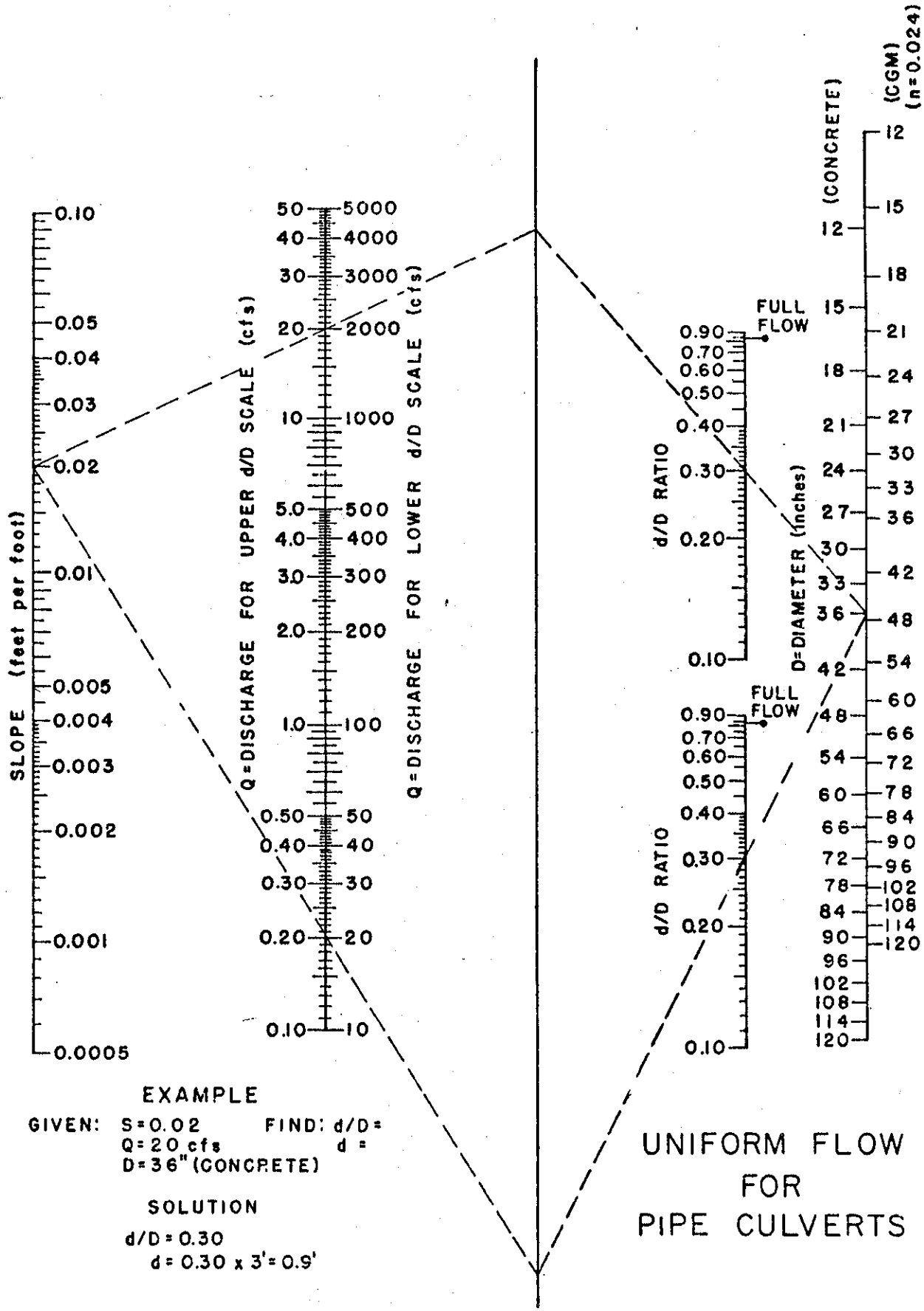
$$A_i = [(d_1 + d_2)/2] \times 2 = d_1 + d_2$$

$$A = \left[\frac{(d_1 + d_2)}{2}\right] 2 + \left(\frac{d_2 T_2}{2}\right) = d_1 + d_2 + \frac{d_2 T_2}{2}$$

$$Q_i = \frac{A_i}{A} Q$$

```
LBL QI
d1 = ?
PROMPT , STO 19   (d1)
d2 = ?
PROMPT
STO 20   (d2)
+   (d1+d2)
STO 21
SX2 = ?
PROMPT
1/X
RCL 19
.1
-
*   (T2)
RCL 20
*
2
/
RCL 21
+
1/X
RCL 21
*
~~Ai~~ RATIO =
~~AVIE~~ ARCL X
AVIEW
STOP
GOTO QI
END
```

check against hand calculations ✓



EXAMPLE

GIVEN: S=0.02 FIND: d/D=
Q=20 cfs d =
D=36" (CONCRETE)

SOLUTION

d/D=0.30
d=0.30 x 3'=0.9'

UNIFORM FLOW
FOR
PIPE CULVERTS

URS CORPORATION
TWO GATEWAY
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SUPERSTITION FREEWAY (Power Road to Ellsworth Road)
ADOT Project No. F—028—1—311
Contract No. 85—39 URS Job No. 6114—6501— 40

DATE 3/1/87 BY J. N. McCamman CHECKED CGS (date/by)

SUBJECT MAXIMUM POSSIBLE TIME OF CONCENTRATION (t_c) PAGE 1 OF

MINIMUM GRADE ON PROJECT : $S_o = 0.0025$

MAXIMUM ALLOWABLE SPREAD (T) (FROM BACK OF CURB - SPECIAL C&G)

: $T_{II} = 17.20'$

$T_I = 0$

$T_I / T_{II} = 0$ & $T_{AVG} / T_{II} = 0.65$

$\therefore (T_{AVG} / T_{II})\, T_{II} = 11.18'$

$Q_{AVG} = 1.77$ CFS

$T_{AVG} = 11.18'$

$T_{A\text{-}AVG} = 10.32'$

$d_{1\text{-}AVG} = 0.286'$

$d_{2\text{-}AVG} = 0.156'$

$$A_{AVG} = 0.5\left[\frac{d_1^2}{0.333} + 2.50(d_1 + d_2) + \frac{d_2^2}{0.02}\right] = 1.28 \text{ SF}$$

$V_{AVG} = Q_{AVG} / A_{AVG} = 1.77/1.28 = 1.38$ FPS

ASSUME MAX. DISTANCE BETWEEN INLETS = 775 FT. ; $\frac{775}{1.38 \times 60} = 9.4$ min.

FROM HEC-12 :

$$t_c \text{ (OVERLAND FLOW)} = \frac{K L^{0.6} n^{0.6}}{i^{0.4} s^{0.3}};$$

t_c (OVERLAND FLOW) = 0.51 min

K = 56

$i = 5.8$ in/hr.

$s = .25$ (4:1 Embankment slope)

$L = 95'$

$n = .025$

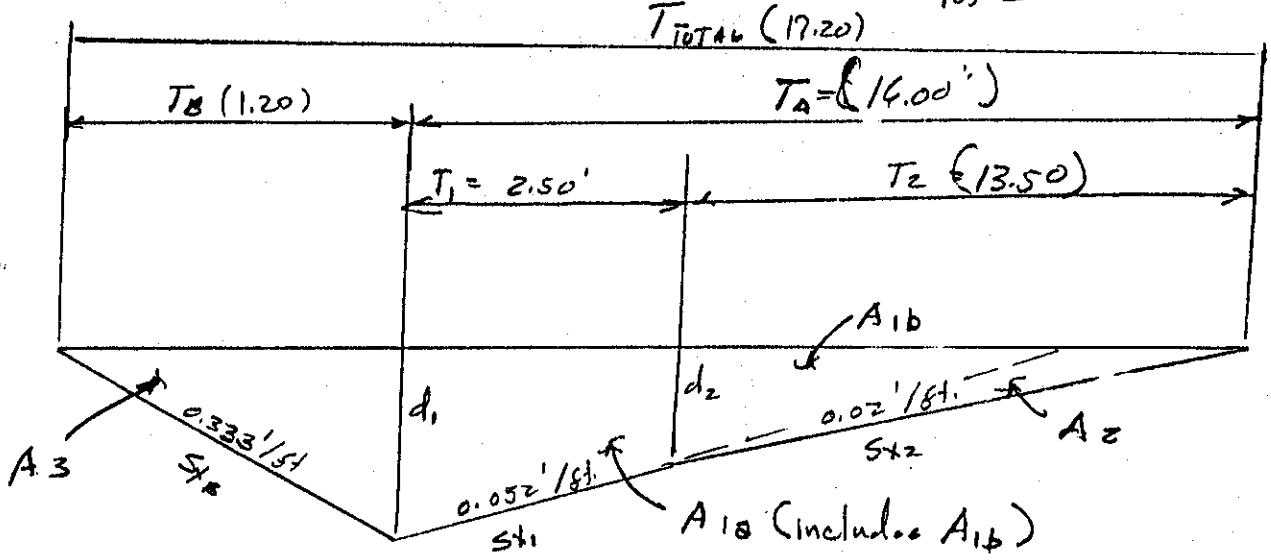
t_c = time of conc. (sec.)

MAX. t_c = 9.4 min + 0.5 min = 9.9 min.

A MINIMUM OF t_c = 10 MIN. IS REQUIRED ON THIS PROJECT

Checked by GJ 9/88

Exhibit D
1 of 2



$d_2 = d_1 - 0.13$
$n = 0.016$
$Z_1 = 1/S_{x1}$
$Z_2 = 1/S_{x2}$
$Z_3 = 1/S_{xB}$

$d_2 = T_2 \cdot S_{x2}$
$= (13.50)(0.02)$
$\rightarrow d_2 = 0.27$ (for full)

$d_1 = d_2 + T_1 \cdot S_{x1}$

$\rightarrow d_1 = 0.40$ (for full)

$$Q = 0.56\, Z/n\, S_0^{1/2}\, d^{8/3}$$

$$Q_{1a} = \frac{0.56 \cdot S_0^{1/2}}{n} \cdot \frac{d_1^{8/3}}{S_{x1}}$$

$$Q_{1b} = \frac{0.56 \cdot S_0^{1/2}}{n} \cdot \frac{d_2^{8/3}}{S_{x1}}$$

$$Q_2 = \frac{0.56 \cdot S_0^{1/2}}{n} \frac{d_2^{8/3}}{S_{x2}}$$

$$Q_3 = \frac{0.56 \cdot S_0^{1/2}}{n} \frac{d_1^{8/3}}{S_{xB}}$$

$$Q_{TOTAL} = Q_{1a} - Q_{1b} + Q_2 + Q_3$$

$$Q_{TOTAL} = \frac{0.56 \cdot S_0^{1/2}}{n} \left[\frac{d_1^{8/3}}{S_{x1}} - \frac{d_2^{8/3}}{S_{x1}} + \frac{d_2^{8/3}}{S_{x2}} + \frac{d_1^{8/3}}{S_{xB}} \right]$$

$$A = \tfrac{1}{2}\left[\frac{d_1^2}{S_{xB}} + (d_1 + d_2)2.50 + \frac{d_2^2}{S_{x2}} \right]$$

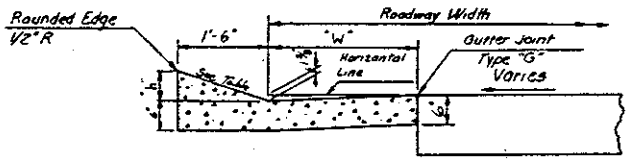
For $d_1 = 0.40$ (full)

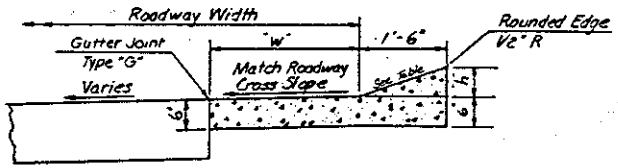
$$A = \tfrac{1}{2}\left[\frac{0.16}{0.333} + (0.40 + 0.27)2.50 + \frac{0.0729}{.02} \right]$$

$$= \tfrac{1}{2}\left[0.4805 + 1.0675 + 3.6450 \right]$$

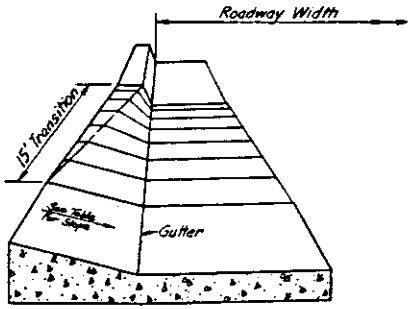
$A = 2.597$ s.f.

SPECIAL C AND G TYPE	CURB HEIGHT "h"	GUTTER WIDTH "w"	SLOPE
B	6"	2'-6"	3:1
C	3"	2'-6"	6:1





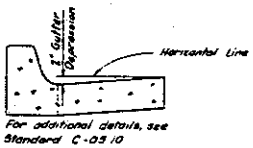
SPECIAL CURB AND GUTTER
TYPE B AND C



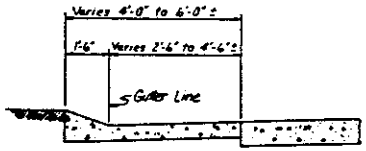
PERSPECTIVE VIEW

GENERAL NOTES:

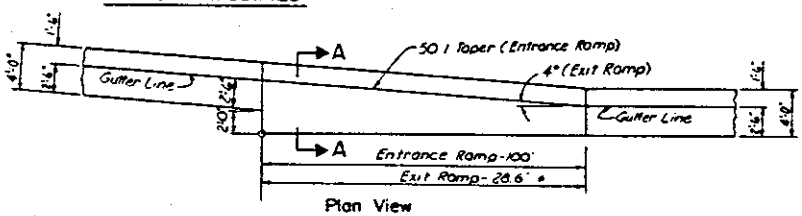
1.) All concrete shall be Class "S" (f'c = 2500 psi).
2.) All gutter flow lines shall be traveled to an accurate grade for a width of 2'. The remainder of curb and gutter shall be textured longitudinally to a light broom finish.
3.) For Special Curb and Gutter with slotted drain, See Slotted Drain Details.
4.) 1" Deep scored joints to be placed to match adjacent joints in PCCP. 1/2" bituminous joint filler shall be placed where the curb and gutter abutts, slotted drains, catch basins, curb returns, etc.
5.) Special Curb and Gutter h=6" transitions to Special Curb and Gutter h=3" in 15 ft.
6.) For additional general notes and dimensions, See C-05.10.



C-05.10 CURB & GUTTER
TYPE "A" MODIFIED



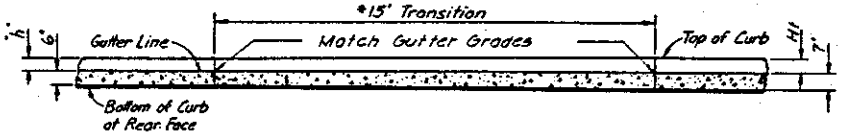
Section A-A



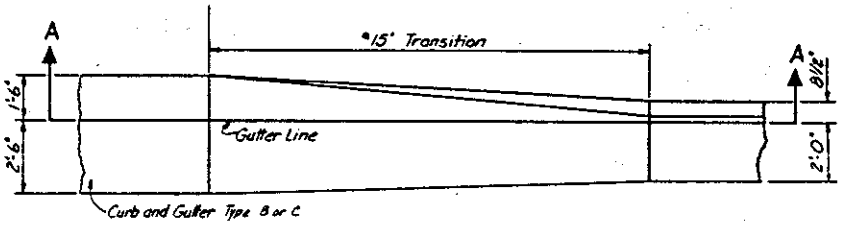
Plan View

MODIFIED SPECIAL CURB & GUTTER — AT RAMP TAPERS

* Dimension may vary where exit occurs on curves, see plans.



SECTION A-A



* Use 10'-0" Transition between A.D.O.T. and City of Phoenix Curb & Gutter

PLAN VIEW

SPECIAL CURB AND GUTTER TRANSITION

DETAIL APPROVED BY URBAN HIGHWAY ENGINEER	STATE OF ARIZONA DEPARTMENT OF TRANSPORTATION DIVISION OF HIGHWAY URBAN HIGHWAY DETAILS	REV
APPROVED FOR DISTRIBUTION	SPECIAL CURB AND GUTTER TRANSITION TYPE "A"	DETAIL NO UC-40

URS CORPORATION
TWO GATEWAY
SUITE 163, 432 NORTH 44TH STREET
PHOENIX, ARIZONA 85008
TEL: (602) 273-6646

SUPERSTITION FREEWAY (Power Road to Ellsworth Road)
ADOT Project No. F–028–1–311
Contract No. 85–39 URS Job No. 6114–6501– 40

DATE 26 Mai 87 BY J.N. McCammon CHECKED 4/28 / 2/88 (date/by)

SUBJECT DISCUSSION OF ALLOWANCES FOR FUTURE EXPANSION PAGE ___ OF ___

THE ADDITION OF ONE LANE, ON EACH SIDE OF THE SUPERSTITION FREEWAY, WILL INCREASE THE ℄ TO ℄ WIDTH FROM 57' TO 69', THUS INCREASING THE PAVED AREAS BY A MULTIPLYING FACTOR OF 1.21. ASSUMING A RELATED DECREASE IN THE UNPAVED AREA WIDTH FROM 110' TO 98', THE UNPAVED AREA IS DECREASED BY A MULTIPLYING FACTOR OF 0.89.

PRESENT CONSTRUCTION

$A_P/A = 0.34$ $C_P = 0.323$ $(0.95 \times 0.34 = 0.323)$

$A_U/A = 0.66$ $C_U = 0.396$ $(0.60 \times 0.66 = 0.396)$

$C_{COMPOSITE} = 7.19$

FUTURE CONSTRUCTION

$A_P/A = 0.41$ $C_P = 0.390$

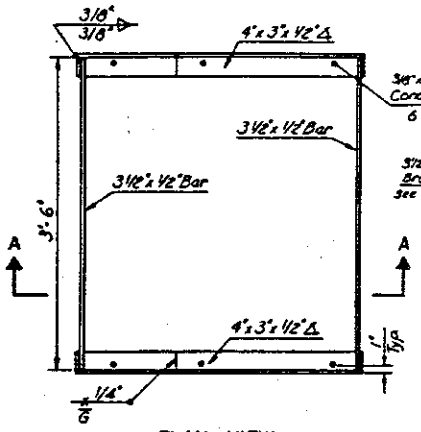
$A_U/A = 0.59$ $C_U = 0.354$

$C_{COMPOSITE} = 0.744$

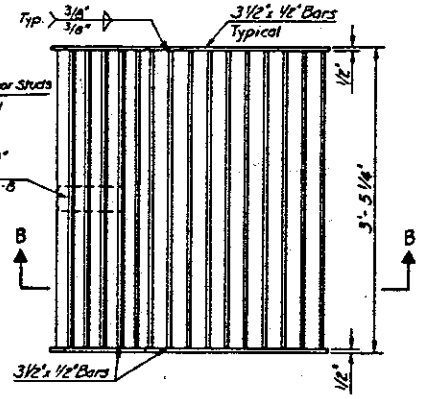
$$\frac{\text{FUTURE } C_{COMPOSITE}}{\text{PRESENT } C_{COMPOSITE}} = \frac{0.744}{0.719} = 1.03$$

ALL Q'S USED IN SIZING PHASE III STORM DRAINS ARE TO BE MULTIPLIED BY A FACTOR OF 1.03 TO PROVIDE FOR INCREASED RUNOFF FOR FUTURE FREEWAY EXPANSION OF ONE LANE ON EACH SIDE.

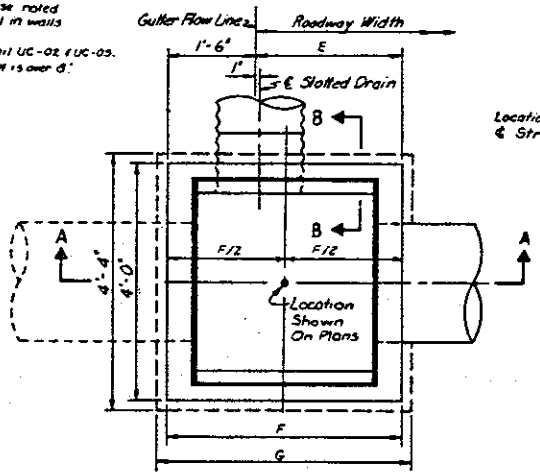
General Notes
1) All concrete shall be Class "B" (f'c = 2500 p.s.i.)
2) All reinforcing steel shall conform to 1003-1,2 Grade 40.
3) All reinforcing steel shall have 2" min. clear cover unless otherwise noted
4) Reinforcing steel shall be No. 4 rebar, 12" c to c horiz. & vertical in walls
5) Pipe can be placed in any wall
6) For more information & dimensions of Slotted Drains see Detail UC-02 & UC-03.
7) In the wall section "B", T = 6" when H = 8' or less or T = 8" when H is over 8'.



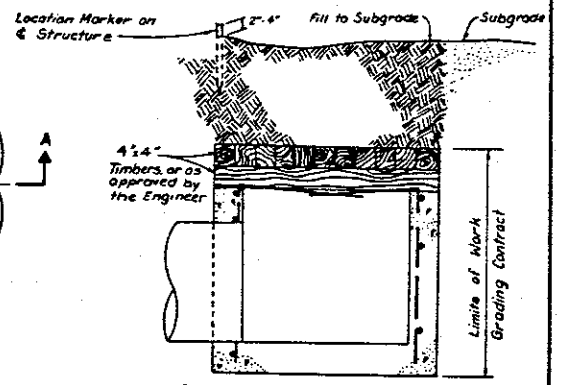
PLAN VIEW
FRAME



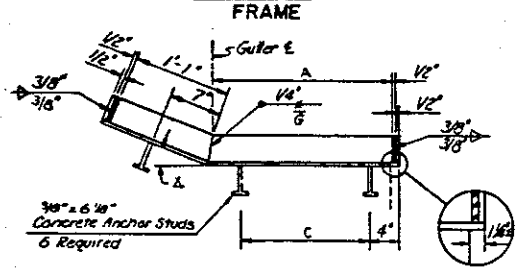
PLAN VIEW
GRATE



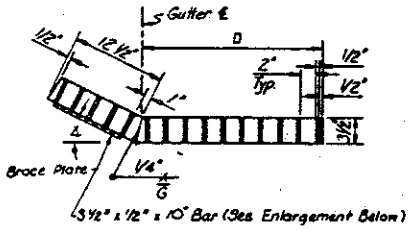
PLAN VIEW



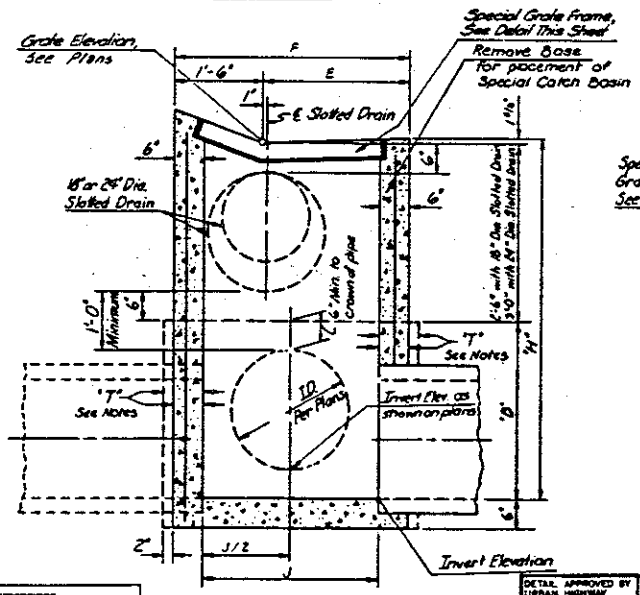
TIMBER CAP DETAIL



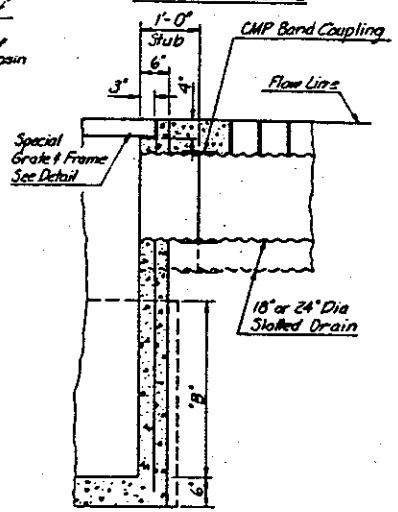
SECTION A-A



SECTION B-B



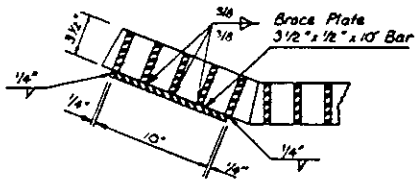
SECTION A-A



SECTION B-B

NOTES

1) All Structural Steel shall be in accordance with A.S.T.M. Spec's A-36.
2) All Reinforcement Steel shall conform to 1003-1,2. Grade 40.
3) All Welding shall be in accordance with A.D.O.T. specifications.
4) The completed Grate assembly (Frame & Grate) shall be given two shop coats of No. 1 paint.
5) The installation and inspection of steel studs welded to steel acting as connection devices to the concrete shall conform to the American Welding Society's Structural Welding Code (AWS D1.1), Specifications 4.21-4.27



BRACE PLATE

Special Curb & Gutter Dimensions

Type	Curb Height	Gutter Width	Catch Basin Frame			Catch Basin Grate		Catch Basin			
			A	C	Δ	D	Δ	E	F	G	J
B	6"	2'-6"	2'-0"	1'-4"	21° 32'08"	2'-0"	21° 32'08"	2'-6"	4'-0"	4'-4"	3'-0"
C	3"	2'-6"	2'-0"	1'-4"	10° 46'04"	2'-0"	10° 46'04"	2'-6"	4'-0"	4'-4"	3'-0"

SPECIAL CATCH BASIN
FRAME & GRATE

SPECIAL CATCH BASIN

DETAIL APPROVED BY URBAN HIGHWAY ENGINEER
APPROVED FOR DISTRIBUTION

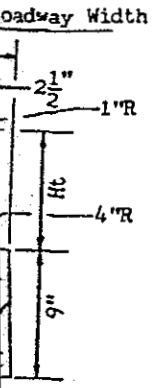
STATE OF ARIZONA
DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAY
URBAN HIGHWAY DETAILS

REV.

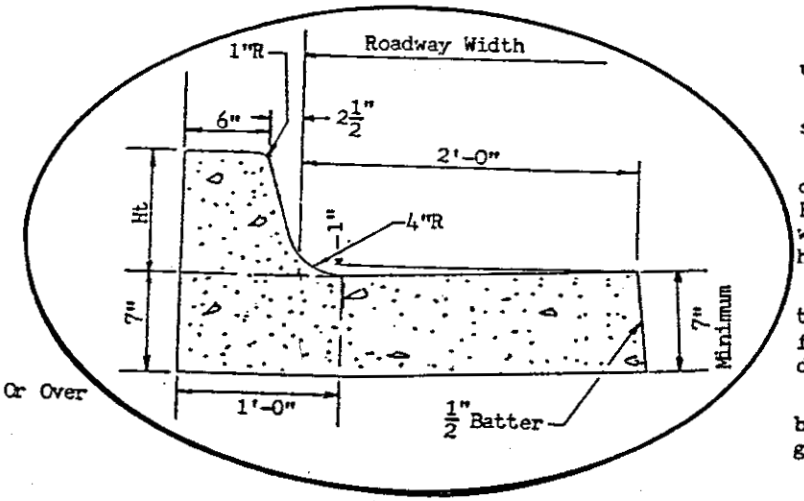
SPECIAL CATCH BASIN DETAILS

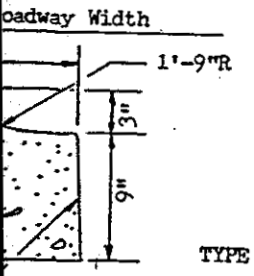
DETAIL NO. UC-01

CURB & GUTTER

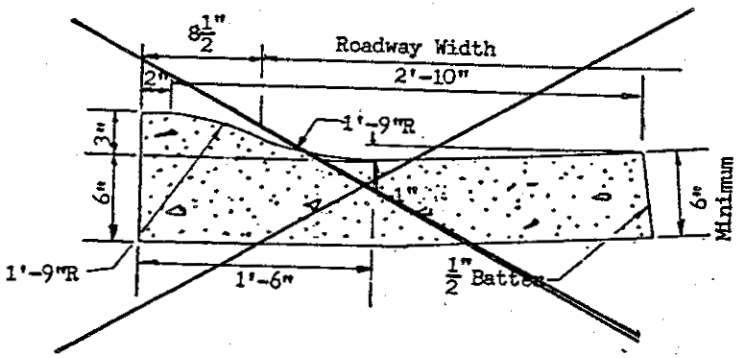


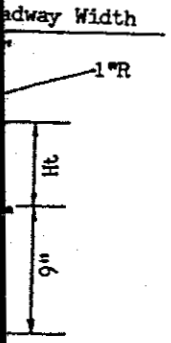
TYPE A
For 6" Curb Height Or Over



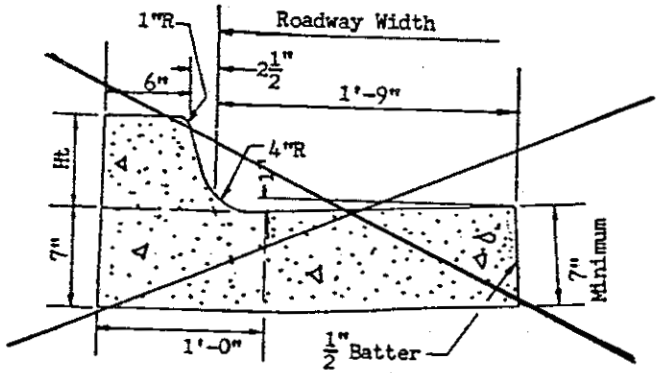


TYPE F





TYPE G



GENERAL NOTES:

SINGLE CURB, AND CURB AND GUTTER:

1. Single curb, and curb and gutter may be constructed by the use of forms or the concrete may be extruded.

2. When the roadway section slopes away from the gutter, the slope of the gutter shall match the roadway cross slope.

3. Two inch deep contraction joints shall be placed in the curb and the gutter at locations which match the joints in adjacent Portland cement concrete pavement and at approximate 15 foot centers when adjacent to asphaltic concrete pavement. Joints shall be either hand tooled or sawed.

4. One half inch thick expansion joints shall be located at tangent points in curb returns, at structures and at maximum 60 foot intervals. The ½ inch joint filler shall extend the full depth of the concrete.

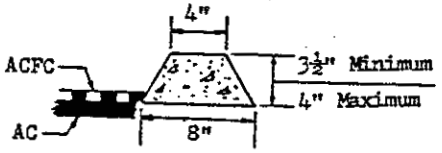
5. Concrete shall be finished with a steel trowel followed by brushing with a fine brush along the length of the curb and gutter.

6. All exposed edges and hand tooled joints shall be finished with a tool having a ¼ inch radius unless a larger radius is indicated.

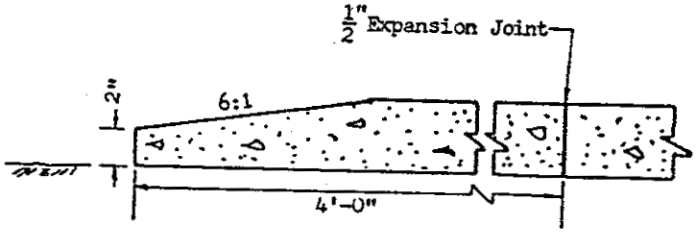
EMBANKMENT CURB:

1. No additional finishing will be required after extrusion or removal of the forms when curb resents a neat appearance and the surface is uniform in texture and color.

2. The curb shall conform to the cross section as shown except that the horizontal dimensions shall not vary more than ½ inch

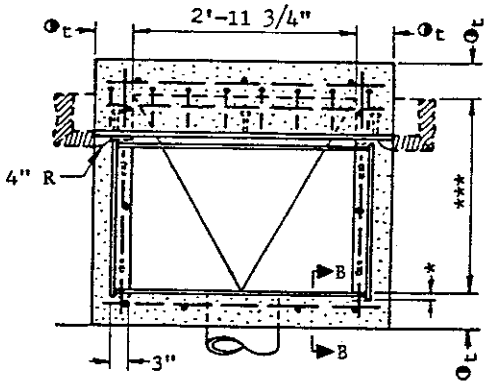


EMBANKMENT CURB

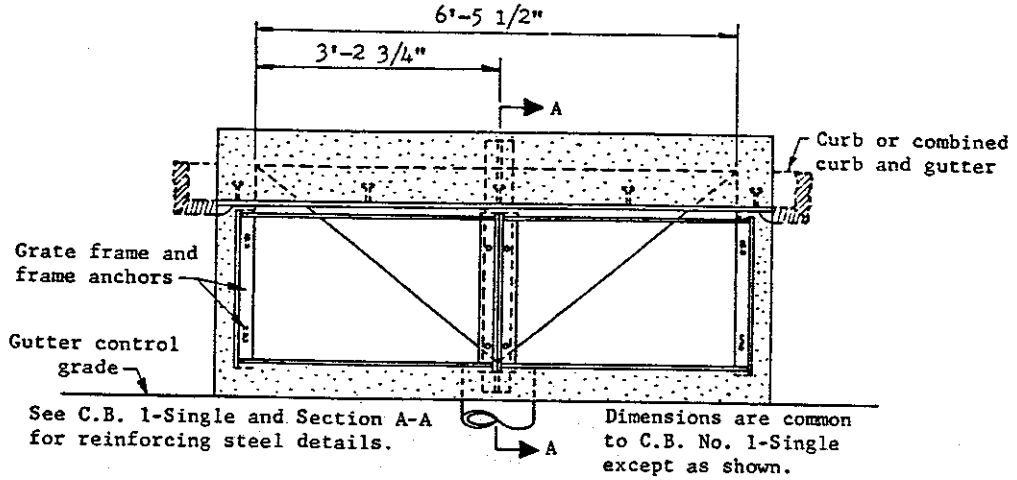


CURB TERMINAL SECTION

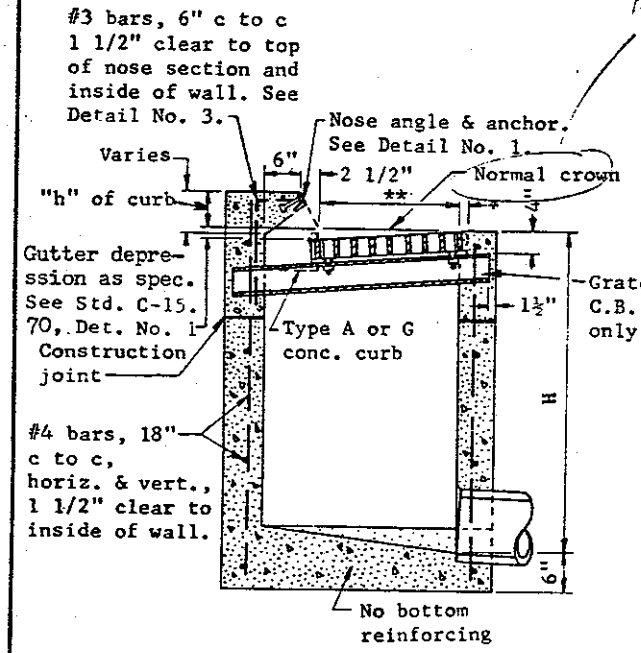
DESIGN APPROVED	STATE OF ARIZONA DEPARTMENT OF TRANSPORTATION DIVISION OF HIGHWAYS STANDARD DRAWINGS	REV. 1/83
APPROVED FOR DISTRIBUTION	SINGLE CURB, CURB & GUTTER	DRAWING NO.



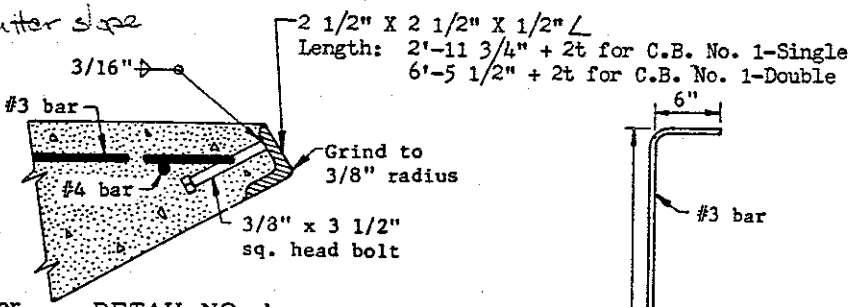
PLAN-CATCH BASIN TYPE 1 - SINGLE



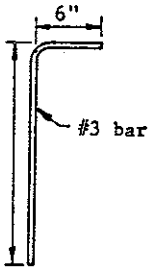
PLAN-CATCH BASIN TYPE 1 - DOUBLE



SECTION A-A

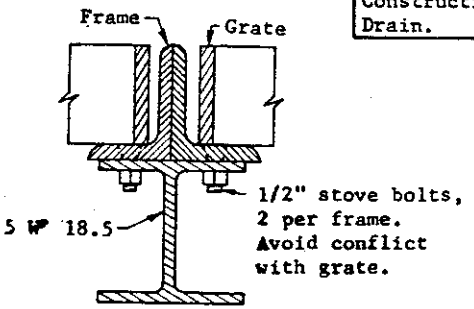


DETAIL NO. 1

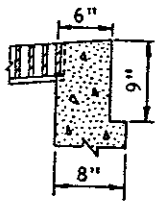


DETAIL NO. 3

NOTE: Provide Std. C-15.70 Construction Drain.



DETAIL NO. 2



SECTION B-B

Use this section when t = 8"

GE

Pipes can be p
Floor shall ha
minimum 4:1 slope
All structural
Welding shall
Welding Specificat
Grate, frame,
one shop coat of N
Concrete shall
Construction j
to meet field cond
Any specified
to opening accordi
Curb opening ar
and Type 1-Double
for each inch of "h
See Std. C-15.70
For grate and f
areas, see Stds. C-
*3/4" for lon
bar grates.
** 2'-0" for LW
grates. 1'-6" for
grates. Use 1'-6"
*** 2'-8½" for
grates. 2'-2½" for
grates.
t=6" when H i
over 8". See Sect.

DESIGN APPROVED

APPROVED FOR DISTRIBUTION

DEPAR

CA

APPENDIX C

COMPUTER PROGRAMS:

- INPUT AND OUTPUT LISTINGS
- SUPPORTING DATA

DESCRIPTION OF HEC-1 AND HEC-2 OUTPUT FILES

HEC-1 OUTPUT FILES

SIMULATION NO. 1

EX50.OUT- Pre-construction existing conditions; 50 year precipitation.

EXI.0UT- Pre-construction existing conditions; 100 year precipitation.

SIMULATION NO. 2

PR50.OUT- Post-construction conditions with no detention in place. 50 year precipitation.

PRO.OUT- Post-construction conditions with no detention in place. 100 year precipitation.

SIMULATION NO. 3

PD50.OUT- Post-construction conditions with detention in place. 50 year precipitation.

PROD.OUT- Post-construction conditions with detention in place. 100 year precipitation.

HEC-2 OUTPUT FILES

CHANNEL NO. 1

CHNL150.OUT- Sub-critical simulation of 50-year flows from the RWCD Floodway to the upstream end of the channel.

CHNL1100.OUT- Sub-critical simulation of 100-year flows from the RWCD Floodway to the upstream end of the channel.

SPOWR50.OUT- Super-critical simulation of 50- year flows from the grade break below the diversion structure for Pond 2 (STA 878+39) to the RWCD Floodway (STA 816+16).

SPOWR100.OUT- Super-critical simulation of 100-year flows from the grade break below the diversion structure for Pond 2 (STA 878+39) to the RWCD Floodway (STA 816+16).

S72ND50.OUT- Super-critical simulation of 50- year flows from the grade break below the diversion structure for Pond 3 (STA 889+45) to the grade break above the diversion structure for Pond 2 (STA 879+99).

S72ND100.OUT- Super-critical simulation of 100-year flows from the grade break below the diversion structure for Pond 3 (STA 889+45) to the grade break above the diversion structure for Pond 2 (STA 879+99).

SSOSS50.OUT- Super-critical simulation of 50- year flows from the grade break above the Sossaman Road box culvert (STA 919+05) to the upstream end of the transition section above the Pond 7 diversion structure (STA 913+70).

SSOSS100.OUT- Super-critical simulation of 100-year flows from the grade break above the Sossaman Road box culvert (STA 919+05) to the upstream end of the transition section above the Pond 7 diversion structure (STA 913+70).

CH1ROUTA.OUT- Sub-critical simulation of flows ranging from 600 to 1250 cfs. Used to derive flow division tables representing off-line ponds.

CH1ROUTB.OUT- Sub-critical simulation of flows ranging from 1300 to 1950 cfs. Used to derive flow division tables representing off-line ponds.

EPOWROUT.OUT- Backwater curve from the RWCD Floodway to the upstream end of the existing lined channel above Power Road for a range of flows.

CHANNEL NO. 2

CHNL250.OUT- Sub-critical simulations of 50- year flows in a) Channel No. 2 from the grade control weirs in the Sossaman Channel downstream from Baseline Road to the outlet from Pond 11; b) the Sossaman channel to the right-of-way and c) the outfall channel from Storm Sewer No. 3.

CHNL2100.OUT- Sub-critical simulations of 100-year flows in a) Channel No. 2 from the grade control weirs in the Sossaman Channel downstream of Baseline Road to the outlet from Pond 11; b) the Sossaman Channel to the right-of- way and c) the outfall channel from Storm Sewer No. 3.

SCHN250.OUT- Super-critical simulation from the grade break at STA 947+00 to the grade break above the transition to the Sossaman Channel (STA 935+00).

SCHN2100.OUT- Super-critical simulation from the grade break at STA 947+00 to the grade break above the transition to the Sossaman Channel (STA 935+00).

CH21150.OUT- Sub-critical simulation of 50- year flows from the downstream end of Pond 11 to the outlet of Pond 12.

CH211100.OUT- Sub-critical simulation of 100-year flows from the downstream end of Pond 11 to the outlet of Pond 12.

CH21250.OUT- Sub-critical simulation of 50-year flows from the downstream end of Pond 12 to the upstream end of the channel.

CH212100.OUT- Sub-critical simulation of 100-year flows from the downstream end of Pond 12 to the upstream end of the channel.

CH2ROUTA.OUT- Sub-critical of flows ranging from 400 to 1050 cfs. Used to derive flow division tables for off-line detention ponds.

FLOW DIVISION TABLES - EXISTING CONDITIONS

HEC-1 Descriptor DIV16

Flow division at Broadway and 90th Street caused by a box culvert under 90th which restricts flow in the channel along Broadway.

Procedure

1. Calculate the flow rate in the channel and on the north side of Broadway at a water surface elevation equal to the elevation of the centerline of Broadway using Mannings equation. Assume that no flow travels south at this water surface elevation.

2. Calculate the flow rate in the channel and on the north side of Broadway at water surface elevations 0.5 feet and 1.0 feet above the centerline of Broadway using Mannings equation.

3. Calculate the flow rate which would travel south over Broadway with the equation $Q=CLH^{3/2}$ with C=2.65 and an assumed weir length of 150 feet for the water surface elevations used in Number 2.

Result

Flow In	0	1185	1585
Flow West	0	1045	1185
Flow South	0	140	400

HEC-1 Descriptor DIV15

Flow division at Broadway and Glenmar Road caused by a box culvert under Glenmar Road which restricts flow in the channel along Broadway.

Procedure - Same as DIV16

Result

Flow In	0	735	1405	2460
Flow West	0	735	1265	2260
Flow South	0	0	140	400

HEC-1 Descriptor DIV17

Flow division at Hawes and Southern caused by a 90 degree bend in the channel which directs flows to the west and a box culvert under southern which allows flows to continue to the south.

Procedure:

1. Determine the depths of flow in the channel downstream from the box culvert for a range of flow rates.

2. Based on these depths and flow rates, determine the headwater depth at the upstream end of the culvert using the nomograph for outlet control from HEC-5.

3. For the headwater depths in Number 2, determine if overtopping of southern occurs. If overtopping occurs, calculate the flow south over the road using the formula for 1/2 the flow through a V notch weir ($Q = C_w$ 8/15 tan $(2g)^{1/2} H^{5/2}$). Where Cw equals 0.59 and tan was determined from the slope of Southern.

4. Determine the total flow south downstream from the box culvert by summing the flows found in Number 3 with the flows that would pass through the box culvert.

5. Using the headwater depths found in two and the geometry of the channel continuing west along Southern, calculate a range of flow rates in the channel with Manning's equation (n = 0.025, S = 0.0085).

6. Sum the flows found in Number 5 with the total flows continuing south to find the total flow reaching the flow division.

Result

Flow In	0	1400	1450	2350	6115
Flow South	0	525	615	815	2230
Flow West	0	875	835	1535	3885

HEC-1 Descriptor DIV20

Flow division caused by a lack of capacity in the Sossaman Channel between Southern Avenue and the R.O.W. as well as the 90-degree bend in the channel where it passes below Southern.

Procedure:

1. Since any overtopping of the channel upstream from the box culvert or along the channel between Southern and the R.O.W. would cause flow to the west, assume that overtopping in both locations can be represented in the HEC-1 model by one flow division.

2. Determine the capacity of the box culvert below Southern for a headwater elevation equal to the elevation of the low point in the channel bank upstream from the box culvert.

3. Determine the capacity of the channel between Southern and the R.O.W. through a HEC-2 backwater analysis from the grade control structures downstream from Baseline Road.

4. Since the capacity of the channel between Southern and the R.O.W. is more limiting than the capacity of the box culvert, values obtained from the HEC-2 backwater analysis were used in the flow division table.

5. Since significant overtopping would occur upstream from Southern at the 90 degree bend, the physical location of the flow division was represented in the HEC-1 model at the upstream side of the box culvert.

Result

Flow In	0	1208	5000
Flow South	0	1208	1208
Flow West	0	0	3792

HEC-1 Descriptor DIV224 (Simulation No. 1 - Existing Conditions)
Flow division east of Ellsworth Road caused by the 81-inch pipes which restrict flows under Ellsworth.

Procedure

1. For a headwater depth equal to the total depth of the channel upstream from the pipes determine the flow through the pipes using the appropriate inlet control nomograph from HEC-5.

2. Repeat Number 1 for headwater depths 1.0 foot and 2.0 feet greater than the total depth of the channel.

3. Calculate the capacity of the channel upstream from the pipes using Manning's equation with n=0.045 and S=0.01.

4. Assume that ponding will be one foot greater than the depth of the channel at the upstream end of the pipes when the channel is flowing at capacity (2712 cfs).

5. Assume that ponding will be two feet greater than the depth of the channel at the upstream end of the pipes when the channel is flowing at 5,000 cfs.

6. Determine the flow to the south by subtracting the flow through the pipes from the flows reaching the flow division.

Result

Flow In	0	1275	2712	5000
Flow West	0	1275	1425	1560
Flow South	0	0	1287	3440

HEC-1 Descriptor DIV225

Flow division caused by a lack of capacity in the existing North R.O.W. channel between Ellsworth and approximately Station 992+00.

Procedure

1. Calculate the channel capacity for the north R.O.W. channel at a number of locations using data on the channel geometry and Manning's equation with n=0.035 to find the limiting capacity.

2. For a flow rate greater than the anticipated maximum flow rate, subtract the limiting flow rate in the channel.

Result

Flow In	0	1155	2000
Flow West	0	1155	1155
Flow South	0	0	845

HEC-1 Descriptor DIV19

Flow division caused by a lack of channel capacity in the existing North R.O.W. channel between Hawes Road and the Sossaman Channel.

Procedure

1. Same as DIV225

Result

Flow In	0	1600	3000
Flow West	0	1600	1600
Flow South	0	0	1400

HEC-1 Descriptor DIV31

Flow division caused by a sharp bend in the Sossaman Road Channel at the intersection of Sossaman Road and Euclid Avenue.

Procedure

1. Field investigations indicated that the approximate capacity of the Sossaman Road Channel is 500 cfs.

2. It was assumed that any flow in excess of 500 cfs would continue south along Sossaman Road from Euclid Avenue.

Result

Flow In	0	500	10000
Flow In Channel	0	500	500
Flow Down Road	0	0	9500

FLOW DIVISION TABLES FOR OFF-LINE PONDS

Procedure for deriving off-line pond flow division tables for Ponds No. 2 through No. 10:

1) Assume a flow rate downstream from a given diversion structure (Q_o) and simulate the structure using HEC-2.

2) From the HEC-2 simulation, determine the water surface elevation at the upstream face of the diversion beam (h_I)

3) Using the water-surface elevation at the upstream face of the diversion beam (h_I) and the elevation of the crest of the diversion weir, determine the head over the weir crest (H_W).

4) Using the head over the weir crest (H_W) and the formula $Q_W = CLH_W^{3/2}$ (C=3.0; L = length of the weir crest), calculate the flow over the weir (Q_W) for the assumed downstream flow rate (Q_o).

5) Determine the flow rate arriving (Q_I) at the diversion structure by adding the weir flow (Q_W) to the flow passing the structure (Q_o).

6) Repeat steps 1 through 5 for a range of flow rates passing the structure (Q_o) for each structure.

7) H_{OR} = Depth of the opening between the bottom of the diversion beam and the channel invert.

Pond No. 1	Q_o	h_I	H_W	Q_W	Q_I
H_{OR} = 5.00'	1158	1367.87	0	0	1158
Weir Elev=1367.87'	1255	1368.41	0.54	30	1285
Weir Length = 25'	1289	1368.60	0.73	47	1336
C = 3.0	1307	1368.70	0.83	57	1363
	1307	1368.71	0.84	58	1365
	1293	1368.98	1.11	88	1381
	1322	1369.07	1.20	98	1420
Pond No. 2					
H_{OR} = 5.5'	1171	1370.96	0	0	11.71
Weir Elev=1370.96'	1200	1371.10	0.14	8	1208
Weir Length = 50'	1250	1371.34	0.38	35	1285
C = 3.0	1300	1371.59	0.63	75	1375
	1350	1371.84	0.88	124	1473
	1400	1372.09	1.13	180	1580
	1450	1372.34	1.38	243	1693
	1500	1372.60	1.64	315	1815
Pond No. 3					
H_{OR} = 6.70'	1375	1380.65	0	0	1375
Weir Elev=1380.65'	1400	1380.75	0.10	6	1406
Weir Length = 60'	1450	1380.95	0.30	30	1480
C = 3.0	1500	1381.15	0.50	64	1564
	1550	1381.35	0.70	105	1655
	1600	1381.56	0.91	156	1756
	1650	1381.76	1.11	211	1861
	1700	1381.96	1.31	270	1970

Pond No. 4

H_{OR} = 5.53'	877	1384.71	0	0	877
Weir Elev = 1384.71'	900	1384.82	0.11	5	905
Weir Length = 50'	950	1385.05	0.34	30	980
C = 3.0	1000	1385.29	0.58	66	1066
	1050	1385.53	0.82	111	1161
	1100	1385.78	1.07	166	1266
	1150	1386.02	1.31	225	1375

Pond No. 5

H_{OR} = 6.00'	1005	1388.74	0	0	1005
Weir Elev = 1388.74'	1050	1388.94	0.20	13	1063
Weir Length = 50	1100	1389.16	0.42	41	1141
C = 3.0	1150	1389.38	0.64	77	1227
	1200	1389.60	0.86	120	1320
	1250	1389.83	1.09	171	1421
	1300	1390.06	1.32	227	1527

Pond No. 6

H_{OR} = 4.80'	685	1391.28	0	0	685
Weir Elev = 1391.28'	700	1391.36	0.08	3	703
Weir Length = 50'	750	1391.63	0.35	31	781
C = 3.0	800	1391.91	0.63	75	875
	850	1392.18	0.90	128	978
	900	1392.46	1.18	192	1092
	950	1392.74	1.46	265	1215

Pond No. 7

H_{OR} = 5.04'	770	1395.24	0	0	770
Weir Elev = 1395.24'	800	1395.40	0.16	10	810
Weir Length = 50'	850	1395.67	0.43	42	892
C = 3.0	900	1395.94	0.70	88	988
	950	1396.21	0.97	143	1093
	1000	1396.48	1.24	207	1207
	1050	1396.76	1.52	281	1331
	1100	1397.04	1.80	362	1462

Pond No. 8

H_{OR} = 3.5'	464	1420.41	0	0	464
Weir Elev = 1420.41'	500	1420.68	0.27	21	521
Weir Length = 50'	550	1421.05	0.64	77	627
C = 3.0	600	1421.42	1.01	152	752
	650	1421.81	1.40	248	898

Pond No. 9

H_{OR} = 4.0'	626	1424.34	0	0	626
Weir Elev = 1424.34'	650	1424.50	0.16	10	660
Weir Length = 50'	700	1424.83	0.49	51	751
C = 3.0	750	1425.16	0.82	111	861
	800	1425.50	1.16	187	987
	850	1425.85	1.51	278	1128

Pond No. 10

H_{OR} = 4.5'	807	1427.74	0	0	807
Weir Elev = 1427.74'	850	1427.99	0.25	19	879
Weir Length = 50	900	1428.29	0.55	61	961
C = 3.0	950	1428.60	0.86	120	1070
	1000	1428.91	1.17	190	1190
	1050	1429.22	1.48	270	1320

STORAGE DISCHARGE TABLES FOR PONDS 11 AND 12

Storage was calculated at selected water surface elevations using the program "PONVOL".

Discharge from the RCP pipes was determined from HEC-5, Chart 2 for inlet control. Inlet control was verified by determining flow rates for outlet control using a worst case tailwater found with HEC-2.

Flow over the overflow weirs was found with the equation $Q = CLH^{3/2}$ for Pond 11 and the tables below.

Pond 11

W.S. Elev.	Storage (acre-ft)	Corrected Storage (acre-ft)	Discharge: Pipes (cfs)	Discharge: Weir (cfs)	Discharge: Ramp Volume (cfs)	Discharge: Total (cfs)
1427.8	0	0	0	0	0	0
1429.8	0.11	0	0.11	52	0	52
1431.8	1.87	0.002	1.87	100	0	100
1433.8	5.90	0.02	5.88	132	0	132
1434.4	7.15	0.05	7.10	140	0	140
1434.8	8.01	0.06	7.96	144	18.2	162
1435.8	10.18	0.09	10.09	160	119.3	279

Pond 12

W.S. Elev.	Storage (acre-ft)	Ramp Volume (acre-ft)	Discharge: Corrected Storage (acre-ft)	Discharge: Pipes (cfs)	Discharge: Weir (cfs)	Discharge: Total (cfs)
1439.8	0	0	0	0	0	0
1441.8	0.11	9	0.11	52	9	52
1443.8	1.81	0.001	1.81	100	0	100
1445.8	5.74	0.01	5.73	132	0	132
1447.3	8.87	0.03	8.84	152	0	152
1447.8	9.95	0.03	9.92	160	49	209
1448.2	20.82	0.04	10.78	164	121	285

$$Q = \frac{5.671\,[\,(b + z_y)\,y\,]^{1.5}}{(b + Zz_y)^{0.5}}$$ for Pond 12

with
- C = 3.0
- L = the length of the rectangular weir = 24 ft.
- H = the height of water over the weir crest.
- b = the bottom width of the trapazoidal weir.
- z = the side slope (H/V) of the trapazoidal.
- y = the height of water over the weir crest.

STORAGE VERSUS DISCHARGE RELATIONSHIPS AT POWER ROAD

Water surface elevations associated with given flow rates were determined through HEC-2 simulations. Water surface elevations at Sta 866+00 were used to calculate storage volumes since water surface elevations at this location were slightly higher than those at the box face. Storage volumes were calculated with the Fortran Program "CHASTO".

The same procedure used to develop the storage versus discharge relationship for Simulation No. 1 was used for Simulation Nos. 2 and 3, except water surface elevations at Sta 866+07 were used to calculate volumes.

SIMULATION NO. 1 - Existing Conditions

W.S. Elev.	Storage (acre-ft)	Discharge (cfs)
1358.2	0	0
1362.2	0.582	500
1362.9	0.780	700
1363.3	0.897	900
1363.5	0.956	1000
1364.0	1.108	1200
1364.6	1.299	1400
1365.4	1.570	1500
1366.1	1.826	1600
1366.9	2.138	1700
1367.3	2.317	1800

SIMULATIONS NO. 2 AND NO. 3

W.S. Elev.	Storage (acre-ft)	Discharge (cfs)
1358.0	0	0
1362.1	1.394	600
1363.2	2.228	800
1364.1	3.203	1000
1365.0	4.197	1200
1365.8	5.150	1400
1366.2	5.596	1500
1366.7	6.310	1600
1367.6	7.409	1700
1368.3	8.430	1800
1368.4	9.209	1900

FORTRAN PROGRAM - CHASTO

Calculates the volume of water stored in a channel reach at a given water surface elevation.

The program **CHASTO** was used to estimate the available storage volume in Channel No. 1 at varying water surface elevations at the upstream end of the Power Road box culvert. The storage volumes were used to develop a storage discharge routing table for use in the HEC-1 computer model for flood hydrographs. Calculations were based on the simplifying assumption that the water surface would be horizontal from the box culvert upstream to its intersection with the channel invert. Actual backwater effects on the water surface were simulated by the HEC-2 program. Input data for this program include:

- The horizontal and vertical coordinates shown in Figure C-1 for each cross-section.
- The station of each cross-section.
- The average ground slope perpendicular to the channel on both sides of the channel (average for all cross-sections).
- A water surface elevation.

The cross-sectional area below the water surface elevation at each cross-section is calculated along with the distances between cross-sections. The volume stored in the channel and in the adjacent overbank area is calculated using average end areas. A complete listing of this program along with definitions for the variables used can be found following the flow chart shown on Figure C-2.

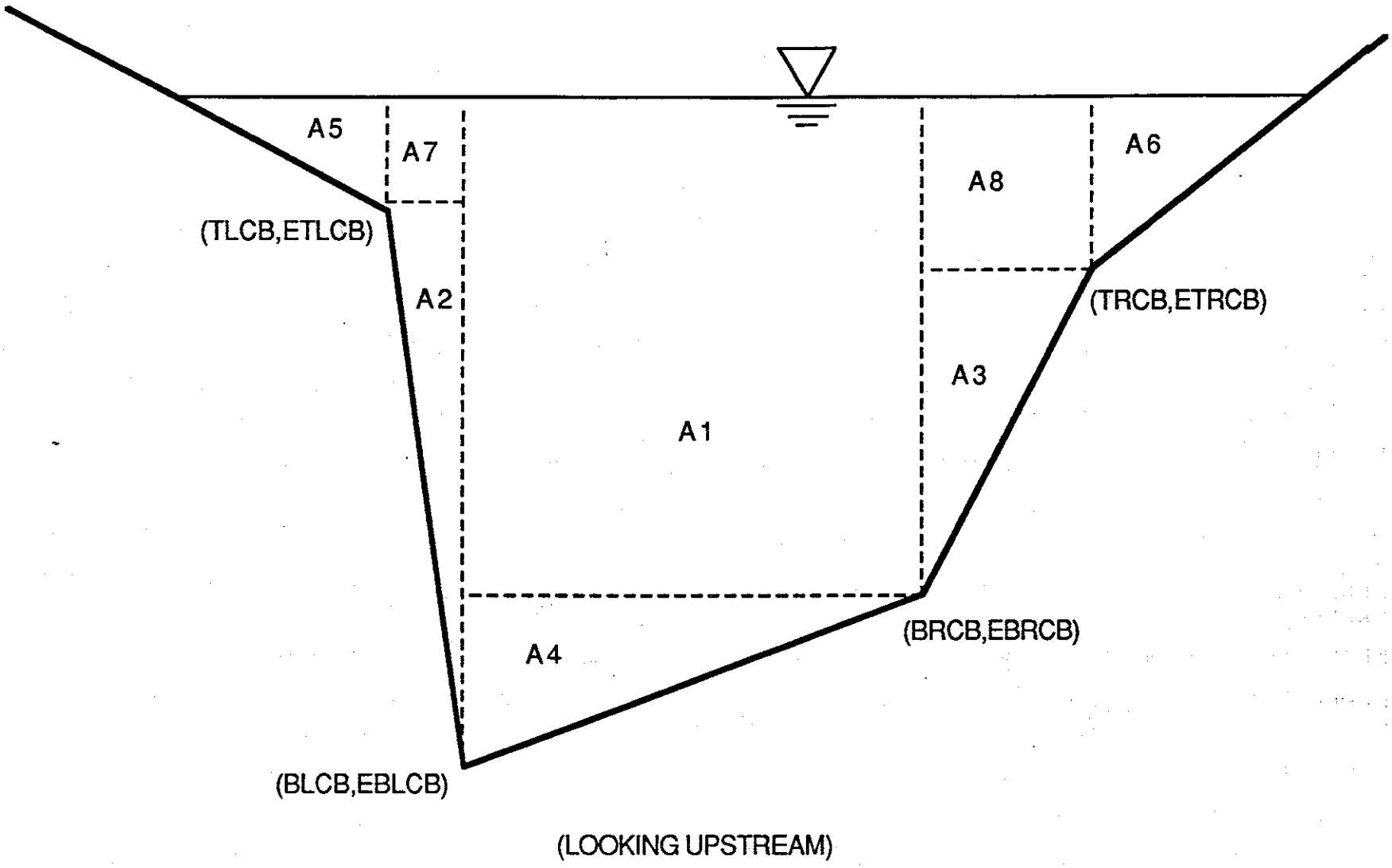


FIGURE C-1. CHANNEL CROSS-SECTION

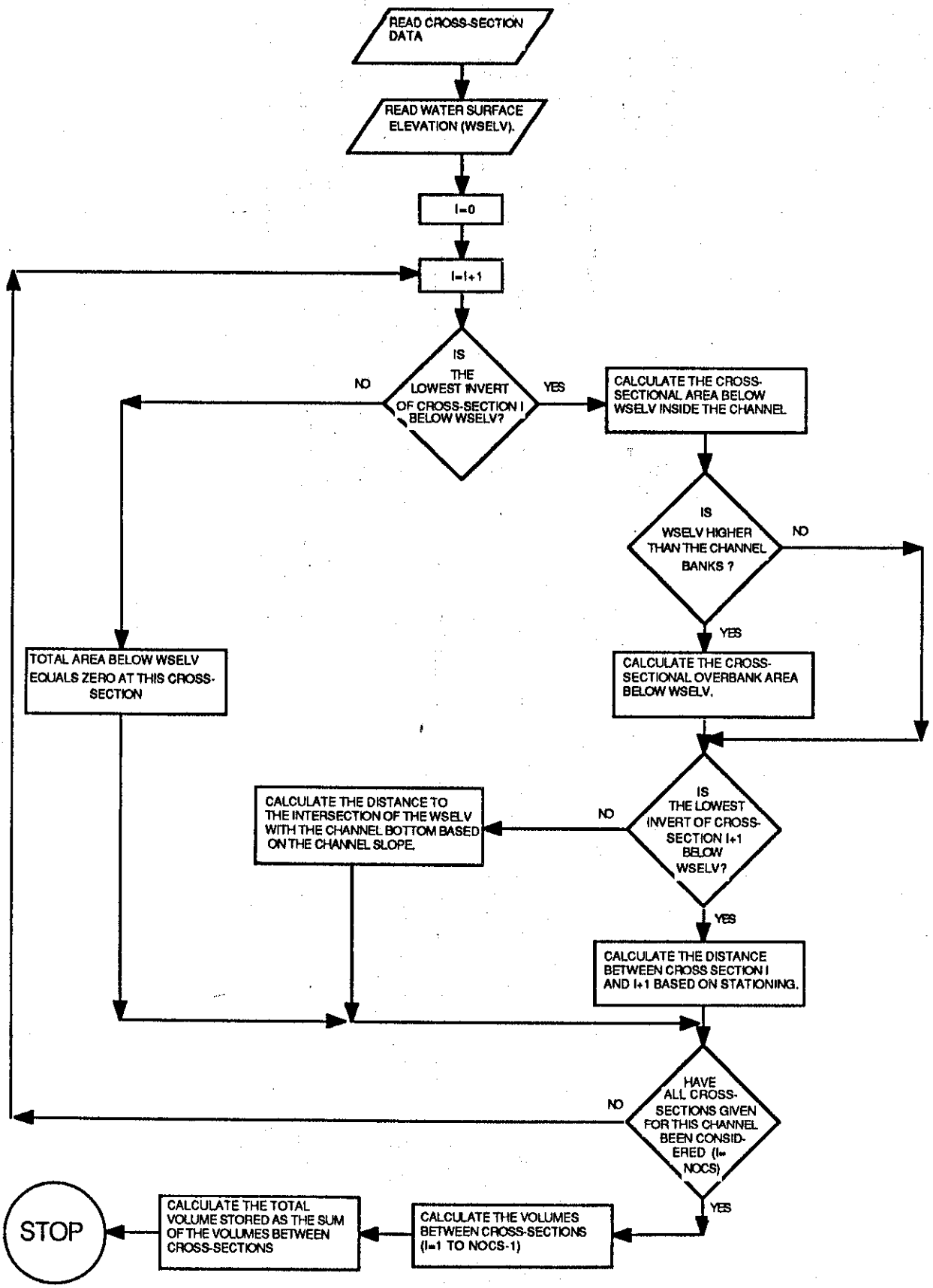


FIGURE C-2. FLOW CHART FOR CHASTO.

VARIABLES USED IN CHASTO

A1	The rectangular component of area over the channel bottom (ft^2).
A2	The triangular component of area over the left channel bank looking upstream (ft^2).
A3	The triangular component of area over the right channel bank looking upstream (ft^2).
A4	The triangular component of area over the channel bottom (ft^2).
A5	The triangular component of area over the left overbank area looking upstream (ft^2).
A6	The triangular component of area over the right overbank area looking upstream (ft^2).
A7	The rectangular component of area over the left channel bank when the water surface elevation is greater than the elevation of the top of the left channel bank (looking upstream).
A8	The rectangular component of area over the right channel bank when the water surface elevation is greater than the elevation of the top of the right channel bank (looking upstream).
ATOT(I)	Total cross-sectional area under water at Station I (ft^2).
AV1	Average channel invert elevation at Station I.
AV2	Average channel invert elevation at Station I - 1.
BRCB(I)	Offset from the construciton centerline of the bottom of the right channel bank (looking upstream) at Station I (ft).
BLCB(I)	Offset from the construction centerline of the bottom of the left channel bank (looking upstream) at Station I (ft).
DIST(I)	Distance between Station I and Station I + 1 or the distance from Station I to the intersection of the water surface with the channel bottom (ft).
EBRCB(I)	Elevation of the bottom of the right channel bank (looking upstream) at Station I (ft).
EBLCB(I)	Elevation of the bottom of the left channel bank (looking upstream) at Station I (ft).
ETRCB(I)	Elevation of the top of the right channel bank (looking upstream) at Station I (ft).

ETLCB(I)	Elevation of the top of the left channel bank (looking upstream) at Station I (ft).
FRAC	The proportion of the distance between stations which will be below water when the water surface intersects the channel bottom between Stations.
I	Subscript for the cross section under consideration.
NFILE	Flag which indicates that input data has been stored in a data file. If NFILE = 1, data will be read from a file.
NOCS	Number of cross sections considered by the program.
OBSR	Right overbank slope (looking upstream) perpendicular to the channel as a ratio of horizontal to vertical distance.
OBSL	Left overbank slope (looking upstream) perpendicular to the channel as a ratio of horizontal to vertical distance.
STA(I)	The station under consideration. The program assumes 100 foot stationing.
TRCB(I)	Offset of the top of the right channel bank (looking upstream) from the construction center-line at Station I (ft).
TLCB(I)	Offset of the top of the left channel bank (looking upstream) from the construction center-line at Station I (ft).
VOL	Component of volume between station I and station I + 1 (ft^3).
VOLTOT	Total volume in cubic feet.
VOLUME	Total volume in acre-feet.
WSELV	Water surface elevation (ft).

User: DEN106

-at

<OPS183>PROJ>PJ6114>DATA>HEC2>CHASTO.FOR

```
*****************************************************************************************************************
*****************************************************************************************************************

WWWW  WWWWW W   W   W    WWW    WWW
W   W W     WW  W  WW   W   W  W
W   W W     W W W   W   W   W W
W   W WWWW  W W W   W   W W W WWWW
W   W W     W W W   W   W   W W   W
W   W W     W  WW   W   W   W W   W
WWWW  WWWWW W   W  WWW   WWW   WWW


 WWW  W   W  WWW   WWW  WWWWW  WWW        WWWWW  WWW  WWWW
W   W W   W W   W W   W    W   W   W      W      W   W W   W
W     W   W W   W W        W   W   W      W      W   W W   W
W     WWWWW WWWWW  WWW     W   W   W      WWWW   W   W WWWW
W     W   W W   W     W    W   W   W      W      W   W W W
W   W W   W W   W W   W   W   W   W  WW  W      W   W W  W
 WWW  W   W W   W  WWW    W    WWW   WW  W       WWW  W   W

*****************************************************************************************************************
*****************************************************************************************************************
```

[Spooler rev 20.0.6HB (c) Prime Computer, Inc., 1986]

Label: PRT136 -form NEC1

Pathname: <OPS183>PROJ>PJ6114>DATA>HEC2>CHASTO.FOR
File last modified: 88-06-06.21:24:24.Mon

Spooled: 88-06-06.21:26:24.Mon
Started: 88-06-06.21:26:12.Mon on: AMI.C by: PR1

```
      PROGRAM CHASTO
C
C     PROGRAM TO CALCULATE THE STORAGE VOLUME EAST OF POWER
C     ROAD FROM THE EXISTING TOPOGRAPHY
C
       DIMENSION TLCB(20),ETLCB(20), BLCB(20), EBLCB(20), BRCB(20),
     :           EBRCB(20), TRCB(20), ETRCB(20), ATOT(20), DIST(20),
     :           STA(20)
      CHARACTER NAME*30,TITLES*80
C
C     READ CROSS SECTION DATA
C
      WRITE(*,*) 'ENTER 1 IF DATA IS IN EXISTING FILE'
      READ(*,200) NFILE
      IF(NFILE.EQ.1) GO TO 500
      WRITE(*,*) 'ENTER NUMBER OF CROSS-SECTIONS'
      READ(*,200) NOCS
      WRITE(*,*) 'ENTER NAME OF FILE FOR UNIT 2'
      WRITE(2,900) NOCS
  900 FORMAT(1X,I3)
C
      WRITE(*,*) 'ENTER UP TO 30 CHARACTER NAME'
      READ(*,1001) NAME
 1001 FORMAT(A30)
      WRITE(2,1002) NAME
 1002 FORMAT(1X,A30)
      WRITE(2,*)'  STA     TLCB   ETLCB   BLCB   EBLCB   BRCB   EBRCB'
      DO 1  I=1,NOCS
      WRITE(*,*) 'ENTER STATION'
      READ(*,100) STA(I)
      WRITE(*,*) 'ENTER OFFSET OF TOP OF LEFT BANK'
      READ(*,100) TLCB(I)
      WRITE(*,*) 'ENTER ELEV. OF TOP OF LEFT BANK'
      READ(*,100) ETLCB(I)
      WRITE(*,*) 'ENTER OFFSET OF BOTTOM OF LEFT BANK'
      READ(*,100) BLCB(I)
      WRITE(*,*) 'ENTER ELEV. OF BOTTOM OF LEFT BANK'
      READ(*,100) EBLCB(I)
      WRITE(*,*) 'ENTER OFFSET OF BOTTOM OF RIGHT BANK'
      READ(*,100) BRCB(I)
      WRITE(*,*) 'ENTER ELEV. OF BOTTOM OF RIGHT BANK'
      READ(*,100) EBRCB(I)
      WRITE(*,*) 'ENTER OFFSET OF TOP OF RIGHT BANK'
      READ(*,100) TRCB(I)
      WRITE(*,*) 'ENTER ELEV. OF TOP OF RIGHT BANK'
      READ(*,100) ETRCB(I)
      WRITE(2,901) STA(I), TLCB(I), ETLCB(I), BLCB(I), EBLCB(I),
     :                BRCB(I), EBRCB(I), TRCB(I), ETRCB(I)
  901 FORMAT(1X,9F10.1)
    1 CONTINUE
C
C      READ OVERBANK CHARACTERISTICS
C
      WRITE(*,*) 'ENTER LEFT OVER-BANK SLOPE'
      READ(*,100) OBSL
      WRITE(*,*) 'ENTER RIGHT OVER-BANK SLOPE'
      READ(*,100) OBSR
      WRITE(2,902) OBSL, OBSR
  902 FORMAT(1X,2F10.2)
C
```

```
      CLOSE(2)
C
      GO TO 600
  500 CONTINUE
C
C     READ DATA FROM FILE EXIPOW IF POSSIBLE
C
      WRITE(*,42)
   42 FORMAT(1X,'ENTER NAME OF EXISTING FILE FOR UNIT 2',/)
      READ(2,200) NOCS
      WRITE(*,899) NOCS
  899 FORMAT(1X,I3)
      READ(2,1001) NAME
      WRITE(*,1002)NAME
      READ(2,1003) TITLES
 1003 FORMAT(A80)
      WRITE(*,1004) TITLES
 1004 FORMAT(1X,A80)
      DO 2 I=1,NOCS
      READ(2,950) STA(I),TLCB(I),ETLCB(I),BLCB(I),EBLCB(I),BRCB(I),
     :            EBRCB(I),TRCB(I),ETRCB(I)
  950 FORMAT(1X,9F10.1)
      WRITE(*,955)STA(I),TLCB(I),ETLCB(I),BLCB(I),EBLCB(I),BRCB(I),
     :            EBRCB(I),TRCB(I),ETRCB(I)
  955 FORMAT(1X,9F8.2)
    2 CONTINUE
C
C     READ OVERBANK CHARACTERISTICS
C
      READ(2,951) OBSL,OBSR
  951 FORMAT(2F10.2)
C
  600 CONTINUE
C
C     READ WATER SURFACE ELEVATION
C
      WRITE(*,*) 'ENTER WATER SURFACE ELEVATION'
      READ(*,100) WSELV
       IF(WSELV.EQ.0.0) GO TO 1000
C
C     CALCULATE DISTANCES BETWEEN CROSS SECTIONS
C
      DO 3 I=2,NOCS
      DIST(I-1)=(STA(I)-STA(I-1))*100.
      IF(WSELV.LT.EBLCB(I).OR.WSELV.LT.EBRCB(I)) IFLAG=1
      IF(IFLAG.NE.1) GO TO 601
      AV1=(EBLCB(I)+EBRCB(I))/2.
      AV2=(EBLCB(I-1)+EBRCB(I-1))/2.
      FRAC=(WSELV-AV2)/(AV1-AV2)
      DIST(I-1)=DIST(I-1)*FRAC
      IFLAG=0
  601 CONTINUE
    3 CONTINUE
C
C     CALCULATE CROSS SECTIONAL AREAS
C
      DO 4 I=1, NOCS
      A1=0.0
      A2=0.0
      A3=0.0
```

```
      A4=0.0
      A5=0.0
      A6=0.0
      A7=0.0
      A8=0.0
C
C     CALCULATE RECTANGULAR AREA BETWEEN CHANNEL BANKS
C
      IF(EBLCB(I).GT.EBRCB(I)) D=WSELV-EBLCB(I)
      IF(EBLCB(I).LE.EBRCB(I)) D=WSELV-EBRCB(I)
      A1=(BLCB(I)-BRCB(I))*D
      IF(WSELV.LT.EBLCB(I).OR.WSELV.LT.EBRCB(I)) A1=0.0
C
C     CALCULATE TRIANGULAR AREA OVER LEFT CHANNEL BANK
C
      A2=0.5*(WSELV-EBLCB(I))*(TLCB(I)-BLCB(I))
      IF(WSELV.GT.ETLCB(I)) THEN
      A2=0.5*(ETLCB(I)-EBLCB(I))*(TLCB(I)-BLCB(I))
      ENDIF
      IF(WSELV.LT.EBLCB(I)) A2=0.0
C
C     CALCULATE TRIANGULAR AREA OVER RIGHT CHANNEL BANK
C
      A3=0.5*(WSELV-EBRCB(I))*(BRCB(I)-TRCB(I))
      IF(WSELV.GT.ETRCB(I)) THEN
      A3=0.5*(ETRCB(I)-EBRCB(I))*(BRCB(I)-TRCB(I))
      ENDIF
      IF(WSELV.LT.EBRCB(I))  A3=0.0
C
C     CALCULATE TRIANGULAR AREA OVER POND BOTTOM
C
      A4=0.5*ABS(EBRCB(I)-EBLCB(I))*(BLCB(I)-BRCB(I))
      IF(WSELV.LT.EBRCB(I).AND.WSELV.LT.EBLCB(I)) A4=0.0
C
C     CALCULATE TRIANGULAR AREA FOR LEFT OVERBANK
C
      A5=0.5*OBSL*ABS(WSELV-ETLCB(I))**2.
      IF(WSELV.LT.ETLCB(I)) A5=0.0
C
C     CALCULATE TRIANGULAR AREA FOR RIGHT OVERBANK
C
      A6=0.5*OBSR*ABS(WSELV-ETRCB(I))**2.
      IF(WSELV.LT.ETRCB(I)) A6=0.0
C
C     CALCULATE RECTANGULAR AREA OVER LEFT CHANNEL BANK
C
      IF(WSELV.LT.ETLCB(I)) GO TO 602
      A7=(TLCB(I)-BLCB(I))*(WSELV-ETLCB(I))
  602 CONTINUE
C
C     CALCULATE RECTANGULAR AREA OVER RIGHT CHANNEL BANK
C
      IF(WSELV.LT.ETRCB(I)) GO TO 603
      A8=(BRCB(I)-TRCB(I))*(WSELV-ETRCB(I))
  603 CONTINUE
C
C     CALCULATE TOTAL AREA FOR CROSS SECTION I
C
      ATOT(I)=A1+A2+A3+A4+A5+A6+A7+A8
C     WRITE(*,848) A1,A2,A3,A4,A5,A6,ATOT(I), STA(I)
```

```
C 848 FORMAT(1X, 'AREAS', 8F8.2)
C
    4 CONTINUE
C
C     CALCULATE VOLUMES USING AVERAGE END AREAS
C
      VOLTOT=0.0
      DO 5 I=2,NOCS
      VOL=((ATOT(I)+ATOT(I-1))/2.)*DIST(I-1)
      VOLTOT=VOLTOT+VOL
C     WRITE(*,849) VOL, VOLTOT, STA(I)
C 849 FORMAT(1X, 'VOL, VOLTOT, STATION', 3F10.2)
    5 CONTINUE
C
C     WRITE VOLUME FOR WSELV
C
      VOLUME=VOLTOT/43560.
      WRITE(*,850) VOLUME, WSELV
  850 FORMAT(1X, 'VOLUME (ACRE-FT) = ', F10.3, '  AT WATER SURFACE', F10.2)
      GO TO 600
 1000 CONTINUE
  100 FORMAT(F10.2)
  200 FORMAT(I3)
      END
```

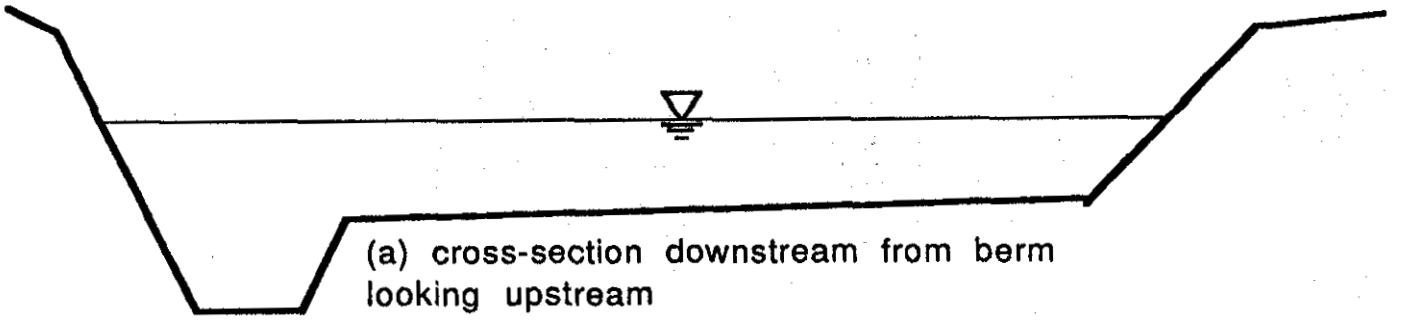
FORTRAN PROGRAM - PONVOL

Calculates the volume of water stored in an on-line detention pond at a given water surface elevation.

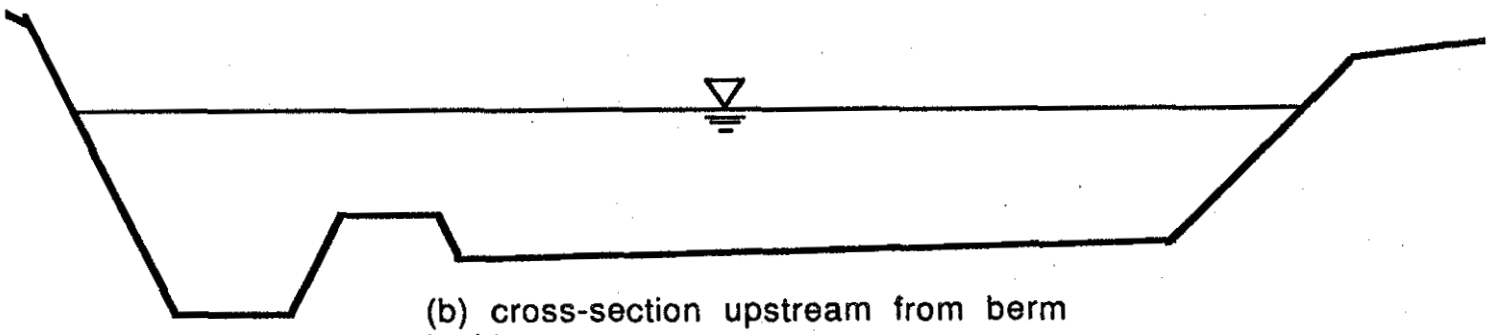
The program **PONVOL** was used to calculate the storage volume of the on-line detention ponds. Each on-line pond has a trapezoidal low flow channel along one side. The longitudinal slope of the pond bottom is shallower than that of the channel bottom as shown in Figure C-3. Storage volumes calculated by this program were used to develop storage discharge routing tables to represent Ponds 11 and 12 in the HEC-1 model of Simulation Number 3. Data required by this program include:

- Stationing of the east and west toes of the slopes inside the ponds.
- Offsets and elevations of the tops of the pond banks at a number of cross-sections.
- The stationing of the cross sections.
- The bottom width, depth and slope of the low flow channel.
- The longitudinal and transverse slope of the pond bottom.
- The station where the pond slope begins to differ from the channel slope, which occurs at the downstream end of the berm separating the low flow channel from the pond bottom.
- The top width of the berm separating the low flow channel from the pond bottom.
- The channel invert at the downstream end of the pond.
- The bank side slopes (Horizontal run/Vertical rise).
- The average slope of the overbanks perpendicular to the pond.
- The water surface elevation (WSELV).

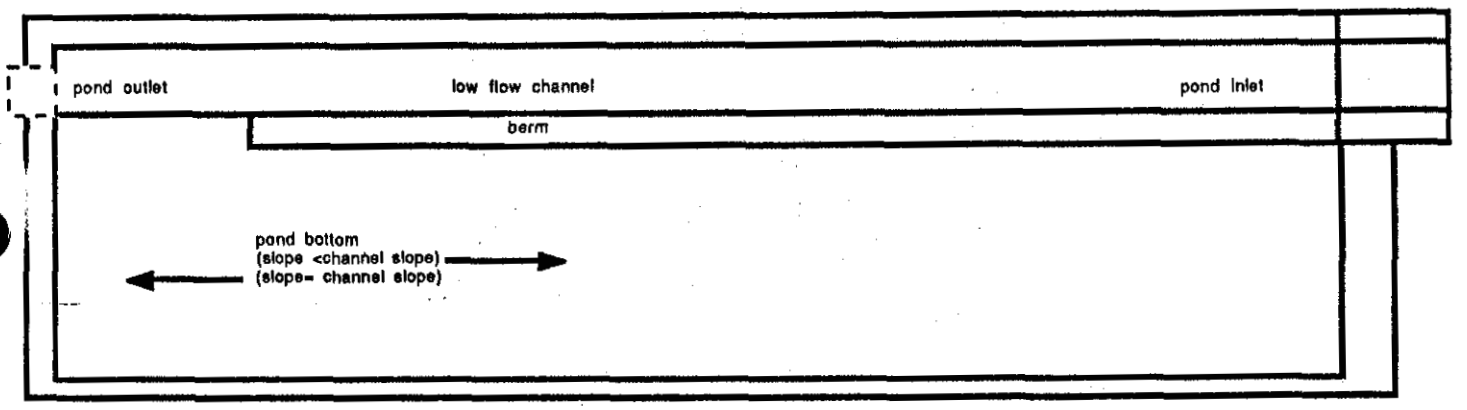
The total cross-sectional area below the given water surface elevation is calculated at each cross-section along with the distances between cross sections. From this information, the volume stored in the pond between the east and west toes of slope is calculated using the average end area method. The volume stored over the end slopes of the pond is calculated separately (Refer to Figure C-4) and added to this volume to find the total volume. A listing of this program along with definitions for the variables can be found following the flow chart shown on Figure C-5.



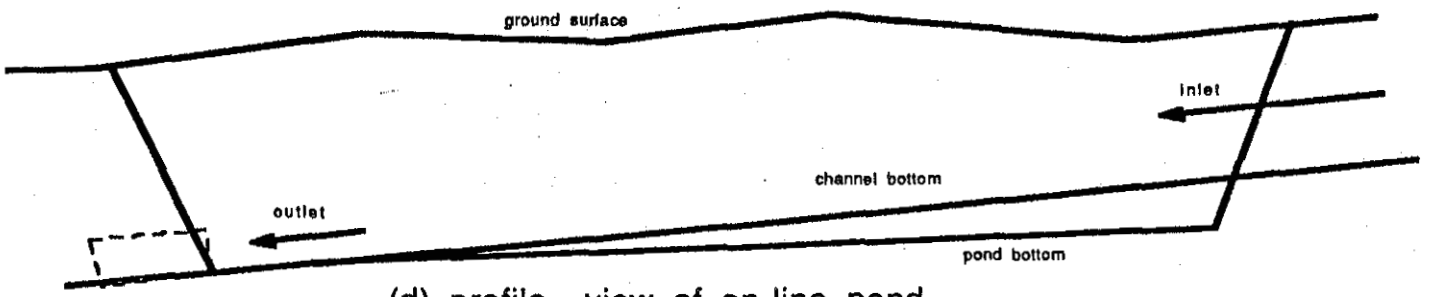
(a) cross-section downstream from berm looking upstream



(b) cross-section upstream from berm looking upstream



(c) plan view of on-line pond



(d) profile view of on-line pond

FIGURE C-3. ON-LINE POND.

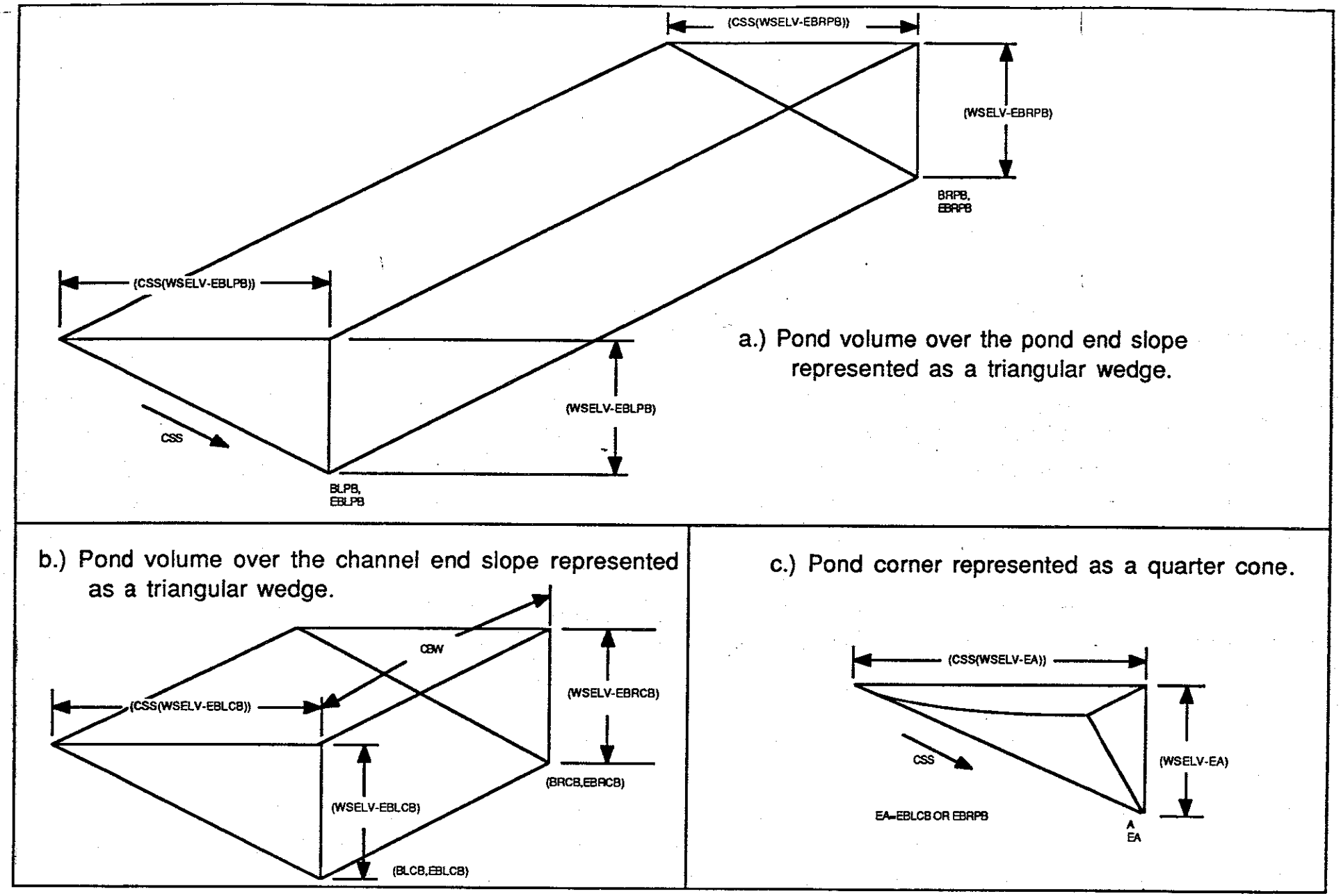


Figure C-4. End Slope and Corner Volumes.

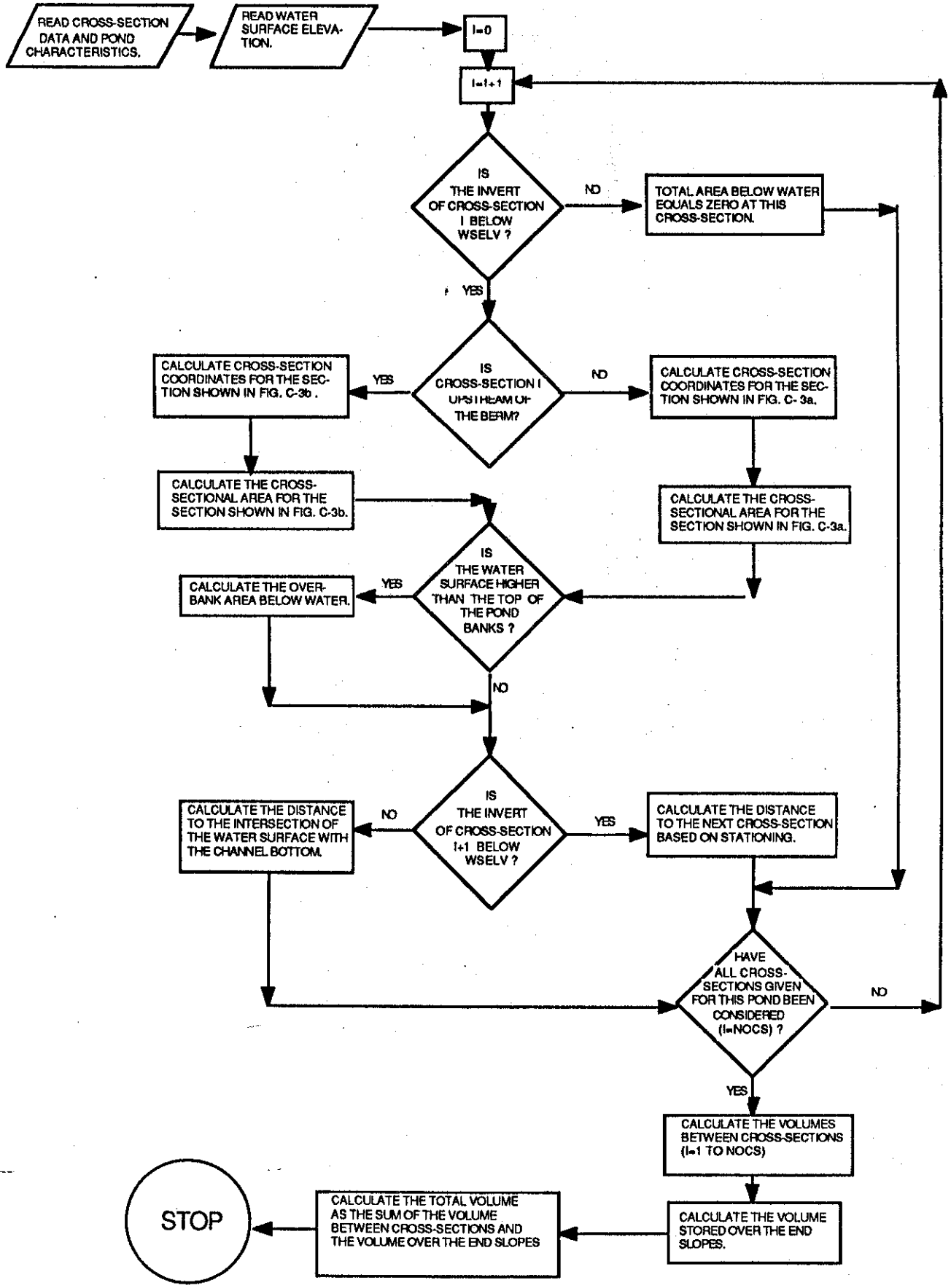


FIGURE C-5. FLOW CHART FOR PONVOL.

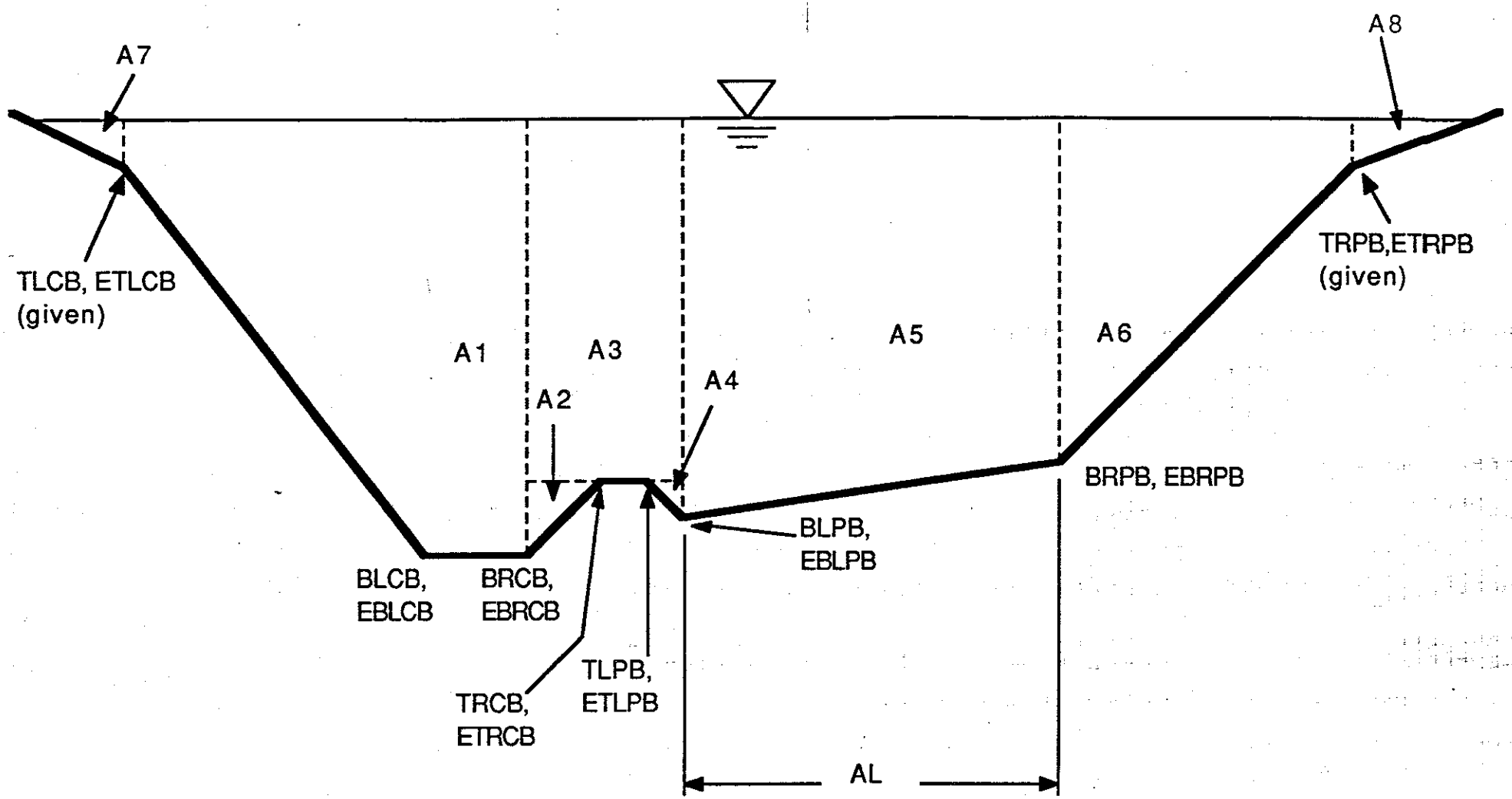


FIGURE C-6. ON-LINE POND CROSS-SECTION UPSTREAM OF BEGINING OF BERM (Looking upstream).

VARIABLES USED IN PONVOL

A1 TO A8	Cross-sectional area components (ft^2). See Figure C-6.
AL	Horizontal distance between BLPB(I) and BRPB(I) (ft).
ATOT(I)	Total cross-sectional area below WSELVI at Station I(ft^2).
BBSTA	Downstream station of the beginning of the berm separating the pond bottom from the low flow channel. (100 ft. stationing).
BERM	Top width of the berm separating the pond bottom from the low flow channel.
BRCB(I)	Offset of the bottom of the right channel bank (looking upstream) at Station I (ft).
BRPB(I)	Offset of the bottom of the right pond bank (looking upstream) at Station I.
BLCB(I)	Offset of the bottom of the left channel bank (looking upstream) at Station I (ft).
BLPB(I)	Offset of the bottom of the left pond bank (looking upstream) at Station I (ft).
CBW	Bottom width of the low flow channel (ft).
CORCO	Coefficient determined to simplify formula for calculating volume stored in pond corners. It is the portion of the formula for the volume of 1/4 of cone that will remain constant for all corners.
CSS	Channel side slope (Horizontal/Vertical).
DENOM	Variable used to calculate the distance from cross section I to the intersection of the water surface with the channel bottom if the water surface is below the invert of cross section I+1.
DEPTH	The difference between the water surface elevation and the channel invert at Station I (ft).
DIST(I)	Distance between cross-section I and cross section I+1 (ft).
DLF	Depth of the low flow channel (ft).
EBRCB(I)	Elevation of the bottom of the right channel bank at station I looking upstream (ft).
EBRPB(I)	Elevation of the bottom of the right pond bank at station I looking upstream (ft).
EBLCB(I)	Elevation of the bottom of the left channel bank (looking upstream) at Station I (ft).

EBLPB(I)	Elevation of the bottom of the left pond bank (looking upstream) at Station I (ft).
ELINV(I)	Low flow channel invert elevation at Station I (ft).
ETRCB(I)	Elevation of the top of the right channel bank (looking upstream) at Station I (ft).
ETRPB(I)	Elevation of the top of the right pond bank at Station I (looking upstream) (ft).
ETLCB(I)	Elevation of the top of the left channel bank at station I (looking upstream) (ft).
ETLPB(I)	Elevation of the top of the left pond bank at station I (looking upstream) (ft).
HEAD	Alpha-numeric characters used to label data.
H	The height of the berm at a Station relative to the pond bottom (ft).
I	Subscript for cross-sectional data.
IFLAG	Flag that stops the calculation of distances between cross-sections if the watersurface is below the invert of upstream cross-sections.
L	The diffrence in stationing between the current cross-section I and the beginning of the berm.
LINE2	Alpha-numeric characters used to label data.
NAME	80 alpha-numeric characters naming an input file.
NFP	Flag indicating data will be read from an input file (=1) or from the screen.
NOCS	Number of cross sections considered by the program.
OBSR	Right overbank slope looking upstream (Horizontal/Vertical).
OBSL	Left overbank slope looking upstream (Horizontal/Vertical).
PBS	Longitudinal pond bottom slope (Vertical/Horizontal).
PCS	Pond cross slope (Vertical/Horizontal).
SLOPE	Longitudinal bottom slope of the low flow channel. (Vertical/Horizontal).
STA(I)	The station under consideration. The program assumes 100 foot stationing.
TRCB(I)	Offset of the top of the right channel bank (looking upstream) at Station I (ft).

TRPB(I)	Offset of the top of the right pond bank (looking upstream) at Station I (ft).
TLCB(I)	Offset of the top of the left channel bank (looking upstream) at Station I (ft).
TLPB(I)	Offset of the top of the left pond bank (looking upstream) at Station I (ft).
VCORCD	Volume stored over the downstream channel corner (ft^3) (see Figure C-4).
VCORPU	Volume stored over the upstream pond corner (ft^3) (see Figure C-4).
VLMCHD	Volume stored over the downstream end slope above the channel bottom (see Figure C-4).
VLMPDD	Volume stored over the downstream end slope above the pond bottom (ft^3) (see Figure C-4).
VLMPDU	Volume stored over the upstream end slope above the pond bottom (ft^3) (see Figure C-4).
VOL(I)	Volume of water between station I and I+1 (ft^3).
VOLTOT	Total volume stored for program ft^3).
VOLUME	Total volume stored in the pond in acre feet.
WSELV	Water surface elevation considered for program run.
XNVERT	Low flow channel invert at the downstream end of the pond.

User: DEN106 at

<OPS183>PROJ>PJ6114>DATA>HEC2>PONVOL.FOR

```
*****************************************************************************************
*****************************************************************************************

WWWW  WWWWW W   W   W    WWW    WWW
W   W W     WW  W  WW   W   W  W
W   W W     W W W   W   W   W W
W   W WWWW  W W W   W   W W W WWWW
W   W W     W W W   W   W   W W   W
W   W W     W  WW   W   W   W W   W
WWWW  WWWWW W   W  WWW   WWW   WWW


WWWW   WWW  W   W W   W  WWW  W           WWWWW  WWW  WWWW
W   W W   W WW  W W   W W   W W           W     W   W W   W
W   W W   W W W W W   W W   W W           W     W   W W   W
WWWW  W   W W W W W   W W   W W           WWWW  W   W WWWW
W     W   W W W W W   W W   W W           W     W   W W W
W     W   W W  WW  W W  W   W W       WW  W     W   W W  W
W      WWW  W   W   W    WWW  WWWWW   WW  W      WWW  W   W

*****************************************************************************************
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```

[Spooler rev 20.0.6HB (c) Prime Computer, Inc., 1986]

Label: PRT061 -form NEC1

Pathname: <OPS183>PROJ>PJ6114>DATA>HEC2>PONVOL.FOR
File last modified: 88-05-29.11:38:00.Sun

Spooled: 88-06-06.07:49:20.Mon
Started: 88-06-06.07:51:20.Mon on: AMLC by: PR1

```
      PROGRAM PONVOL
C
C     PROGRAM TO CALCULATE THE VOLUME OF A TRAPAZOIDAL
C     DETENTION BASIN WITH A TRAPAZOIDAL LOW FLOW CHANNEL
C     RUNNING ALONG ONE EDGE.  THE BASIN HAS A SLOPED BOTTOM
C     AND SLOPED SIDES.
C
C
      REAL L
      COMMON/CONTROL/NFP,NOCS,I,NAME
C
      COMMON/INPUT/STA(25),TLCB(25),ETLCB(25),TRPB(25),ETRPB(25),
     :             ELINV(25),DIST(25),CBW,DLF,CSS,PCS,OBSL,OBSR,
     :             PBS,BERM,BBSTA,SLOPE
C
      COMMON/AREA/ ATOT(25), WSELV1, VOL, VOLTOT
C
      COMMON/COORD/ BLCB(25),EBLCB(25),BRCB(25),EBRCB(25),BRPB(25),
     :              EBRPB(25), TRCB(25), ETRCB(25), TLPB(25),
     :              ETLPB(25), BLPB(25), EBLPB(25)
C
      NOR=0
  998 CONTINUE
      IF(NOR.NE.0) GO TO 999
C
C     READ INPUT DATA
C
      CALL INDATA
C
C     CALCULATE AREAS FOR EACH CROSS SECTION
C
  999 CONTINUE
      NOR=1
      WRITE(*,10)
   10 FORMAT(1X,'ENTER WATER SURFACE ELEVATION OR RETURN TO QUIT')
C
C     CALCULATE CROSS SECTIONAL AREA FOR THIS WATER SURFACE
C
      READ(*,100) WSELV1
      IF(WSELV1.EQ.0.0) GO TO 2000
      DO 1 I=1,NOCS
      CALL BOTTOM
      CALL XSECT
    1 CONTINUE
C
C     CALCULATE VOLUMES BETWEEN EACH CROSS SECTION
C     AND FIND THE TOTAL BY SUMMING THEM TOGETHER
C
      CALL VOLUME
      WRITE(*,1002) VOLTOT, WSELV1
      GO TO 998
 2000 CONTINUE
 1002 FORMAT(1X,'VOLUME (ACRE-FT)=',F10.2,'  AT ELEVATION',F10.2)
  100 FORMAT(F10.2)
  200 FORMAT(I1)
      END
```

User: DEN106 -at

<OPS183>PROJ>PJ6114>DATA>HEC2>INDATA.FOR

```
*****************************************************************************************************
*****************************************************************************************************

WWWW  WWWWW W   W   W    WWW    WWW
W   W W     WW  W  WW   W   W  W
W   W W     W W W   W   W   W W
W   W WWWW  W W W   W   W W W WWWW
W   W W     W W W   W   W   W W   W
W   W W     W  WW   W   W   W W   W
WWWW  WWWWW W   W  WWW   WWW   WWW


 WWW  W   W WWWW   WWW  WWWWW  WWW        WWWWW  WWW  WWWW
  W   WW  W W   W W   W   W   W   W       W     W   W W   W
  W   W W W W   W W   W   W   W   W       W     W   W W   W
  W   W W W W   W WWWWW   W   WWWWW       WWWW  W   W WWWW
  W   W W W W   W W   W   W   W   W       W     W   W W W
  W   W  WW W   W W   W   W   W   W   WW  W     W   W W  W
 WWW  W   W WWWW  W   W   W   W   W   WW  W      WWW  W   W

*****************************************************************************************************
*****************************************************************************************************
```

[Spooler rev 20.0.6HB (c) Prime Computer, Inc., 1986]

Label: PRT062 -form NEC1

Pathname: <OPS183>PROJ>PJ6114>DATA>HEC2>INDATA.FOR
File last modified: 88-05-29.11:39:12.Sun

Spooled: 88-06-06.07:47:24.Mon
Started: 88-06-06.07:52:12.Mon on: AML.C by: PR1

```
      SUBROUTINE INDATA
C
C     SUBROUTINE TO READ INPUT DATA AND CALCULATE THE
C     COORDINATES OF THE BOTTOM OF THE DETENTION POND
C     AT THE BANK
C
      COMMON/CONTROL/NFP,NOCS,I,NAME
C
      COMMON/INPUT/STA(25),TLCB(25),ETLCB(25),TRPB(25),ETRPB(25),
     :             ELINV(25),DIST(25),CBW,DLF,CSS,PCS,OBSL,OBSR,
     :             PBS,BERM,BBSTA,SLOPE
C
      COMMON/AREA/ ATOT(25), WSELV1, VOL, VOLTOT
C
      COMMON/COORD/ BLCB(25),EBLCB(25),BRCB(25),EBRCB(25),BRPB(25),
     :              EBRPB(25), TRCB(25), ETRCB(25), TLPB(25),
     :              ETLPB(25), BLPB(25), EBLPB(25)
C
      CHARACTER HEAD*80, LINE2*80, NAME*80
C
C     READ TYPICAL CROSS SECTION DATA
C
      WRITE(*,23)
   23 FORMAT(1X,'ENTER  1 IF CROSS SECTION DATA IS IN A DATA FILE')
      READ(*,200) NFP
      IF(NFP.EQ.1) GO TO 903
      WRITE(*,10)
   10 FORMAT(1X,'ENTER NAME TO IDENTIFY POND')
      READ(*,1004) NAME
      WRITE (*,11)
   11 FORMAT(1X,'ENTER INVERT ELEVATION AT DOWNSTREAM X-SECTION')
      READ(*,100) XNVERT
      WRITE(*,12)
   12 FORMAT(1X,'ENTER CHANNEL SLOPE')
      READ(*,100) SLOPE
      WRITE(*,13)
   13 FORMAT(1X,'ENTER THE BOTTOM WIDTH OF THE LOW FLOW CHANNEL')
      READ(*,100) CBW
      WRITE(*,14)
   14 FORMAT(1X,'ENTER DEPTH OF LOW FLOW CHANNEL')
      READ(*,100) DLF
      WRITE(*,15)
   15 FORMAT(1X,'ENTER SIDE SLOPE VALUE (HORIZ./VERT.)')
      READ(*,100) CSS
      WRITE(*,16)
   16 FORMAT(1X,'ENTER POND CROSS SLOPE VALUE (VERT./HORIZ.)')
      READ(*,100) PCS
      WRITE(*,17)
   17 FORMAT(1X,'ENTER STATION FOR BERM BEGINING
 RETURN FOR NO BERM')
      READ(*,100) BBSTA
      WRITE(*,18)
   18 FORMAT(1X,'ENTER BERM TOP WIDTH
 RETURN FOR NO BERM')
      READ(*,100) BERM
      WRITE(*,19)
   19 FORMAT(1X,'ENTER POND BOTTOM SLOPE
 RETURN IF SAME AS CHANNEL')
      READ(*,100) PBS
      WRITE(*,20)
```

```
   20 FORMAT(1X,'ENTER OUTSIDE OVERBANK SLOPE (H/V)')
      READ(*,100) OBSL
      WRITE(*,21)
   21 FORMAT(1X,'ENTER INSIDE OVERBANK SLOPE (H/V)')
      READ(*,100) OBSR
      WRITE(*,22)
   22 FORMAT(1X,'ENTER THE NUMBER OF CROSS SECTIONS CONSIDERED')
      READ(*,200) NOCS
      WRITE(*,30)
   30 FORMAT(1X,'ENTER NAME FOR DATA STORAGE FILE FOR UNIT 2')
      WRITE(2,1005) NAME
      WRITE(2,1006)NOCS
      WRITE(2,1007) XNVERT,SLOPE,CBW,DLF,CSS,PCS
      WRITE(2,1008) BBSTA,BERM,PBS,OBSL,OBSR
      WRITE(2,24)
   24 FORMAT(7X,'STATION',6X,'BANK',8X,'BANK',8X,'BANK',
     :        7X,'BANK',/,19X,'OFFSET',4X,'ELEVATION',
     :        5X,'OFFSET',4X,'ELEVATION')
C
C     IF CROSS SECTION DATA IS NOT IN FILE POND, READ IT FROM
C     THE SCREEN
C
      DO 1 I=1,NOCS
      WRITE(*,25)
   25 FORMAT(1X,'ENTER CROSS SECTION STATION (PROGRAM ASSUMES 100',/,
     :        1X,'FOOT STATIONING)')
      READ(*,100) STA(I)
      WRITE(*,26)
   26 FORMAT(1X,'ENTER THE HORIZONTAL COORDINATE OF THE TOP',/,
     : 1X,'OF THE OUTSIDE BANK')
      READ(*,100) TLCB(I)
      WRITE(*,27)
   27 FORMAT(1X,'ENTER THE ELEVATION OF THE TOP OF THE',/,
     : 1X,'OUTSIDE BANK')
      READ(*,100) ETLCB(I)
      WRITE(*,28)
   28 FORMAT(1X,'ENTER THE HORIZONTAL COORDINATE OF THE TOP',/,
     : 1X,'OF THE INSIDE BANK')
      READ(*,100) TRPB(I)
      WRITE(*,29)
   29 FORMAT(1X,'ENTER THE ELEVATION OF THE TOP OF THE INSIDE',/,
     : 1X,'POND BANK')
      READ(*,100) ETRPB(I)
      ELINV(I)= XNVERT + SLOPE*(STA(I)-STA(1))*100.
C
C     WRITE VALUES READ FROM THE SCREEN TO A DATA FILE
C
      WRITE(2,300) STA(I), TLCB(I), ETLCB(I), TRPB(I), ETRPB(I)
    1 CONTINUE
      CLOSE(2)
      GO TO 904
  903 CONTINUE
C
C     READ CROSS SECTION DATA FROM FILE IF THAT FILE EXISTS
C
      WRITE(*,31)
   31 FORMAT(1X,'ENTER NAME OF DATA FILE FOR UNIT 5',/)
      READ(5,500) NAME
      READ(5,200) NOCS
      READ(5,101)XNVERT,SLOPE,CBW,DLF,CSS,PCS
```

```
      SUBROUTINE INDATA


      READ(5,102)BBSTA,BERM,PBS,OBSL,OBSR
      WRITE(*,103)NAME,XNVERT,SLOPE,CBW,DLF,CSS,PCS
      WRITE(*,104)PBS,OBSL,OBSR,BERM,BBSTA
  103 FORMAT(/,1X,'POND CHARACTERISTICS ',A30,/,1X,'OUTLET INVERT=',
     :        F10.2,10X,'CHANNEL SLOPE=',F11.4,9X,'CHANNEL WIDTH=',
     :           F15.2,/,1X,'CHANNEL DEPTH=',F10.2,10X,'SIDE ',
     :         'SLOPES (H/V)=',F7.2,9X,'POND CROSS SLOPE (V/H)=',F6.4)
  104 FORMAT(1X,'POND SLOPE (V/H)=', F7.4,10X,
     :       'LEFT OVERBANK (H/V)=', F5.1, 9X,'RIGHT OVERBANK (H/V)=',
     :        F8.1,/,1X,'BERM WIDTH=',F13.2,10X,'BERM BEGINS AT STA',
     :        F7.2,/,1X,'TOP OF BANK OFFSETS AND ELEVATIONS',/)
C
      READ(5,500) HEAD
      READ(5,500) LINE2
      WRITE(*,500) HEAD
      WRITE(*,500)LINE2
      DO 2 I=1,NOCS
      READ(5,400) STA(I),TLCB(I),ETLCB(I),TRPB(I),ETRPB(I)
      ELINV(I)=XNVERT + SLOPE*(STA(I)-STA(1))*100.
      WRITE(*,300) STA(I),TLCB(I),ETLCB(I),TRPB(I),ETRPB(I)
    2 CONTINUE
      CLOSE(5)
      IF(PBS.EQ.0.0) PBS=SLOPE
  904 CONTINUE
  100 FORMAT(F10.2)
  101 FORMAT(F10.2,F10.5,3F10.2,F10.5)
  102 FORMAT(2F10.2,F10.5,2F10.2)
  200 FORMAT(I2)
  300 FORMAT(1X, 5F12.2)
  400 FORMAT(1X,5F12.2)
  500 FORMAT(A80)
 1004 FORMAT(A30)
 1005 FORMAT(1X,A30)
 1006 FORMAT(I2)
 1007 FORMAT(1X,F10.2,F10.5,3F10.2,F10.5)
 1008 FORMAT(1X,2F10.2,F10.5,2F10.2)
      END
```

User: DEN106 -at

<OPS183>PROJ>PJ6114>DATA>HEC2>BOTTOM.FOR

```
*****************************************************************************************
*****************************************************************************************

WWWW  WWWWW W   W   W    WWW    WWW
W   W W     WW  W  WW   W   W  W
W   W W     W W W   W   W   W W
W   W WWWW  W W W   W   W W W WWWW
W   W W     W W W   W   W   W W   W
W   W W     W  WW   W   W   W W   W
WWWW  WWWWW W   W  WWW   WWW   WWW


WWWW   WWW  WWWWW WWWWW  WWW  W   W       WWWWW  WWW  WWWW
W   W W   W   W     W   W   W WW WW       W     W   W W   W
W   W W   W   W     W   W   W W W W       W     W   W W   W
WWWW  W   W   W     W   W   W W W W       WWWW  W   W WWWW
W   W W   W   W     W   W   W W   W       W     W   W W W
W   W W   W   W     W   W   W W   W   WW  W     W   W W  W
WWWW   WWW    W     W    WWW  W   W   WW  W      WWW  W   W

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```

[Spooler rev 20.0.6HB (c) Prime Computer, Inc., 1986]

Label: PRT063 -form NEC1

Pathname: <OPS183>PROJ>PJ6114>DATA>HEC2>BOTTOM.FOR
File last modified: 88-05-29.11:40:28.Sun

Spooled: 88-06-06.07:48:56.Mon
Started: 88-06-06.07:51:44.Mon on: AMLC by: PR1

```
      SUBROUTINE BOTTOM
C
C
C     CALCULATE COORDINATES FOR THE BOTTOM OF THE OUTSIDE
C     CHANNEL BANK, THE BOTTOM OF THE INSIDE CHANNEL BANK,
C     THE TOP OF THE INSIDE CHANNEL BANK, THE TOP OF THE
C     OUTSIDE POND BANK, THE BOTTOM OF THE OUTSIDE POND BANK
C     AND THE BOTTOM OF THE INSIDE POND BANK.
C
      COMMON/CONTROL/NFP,NOCS,I,NAME
C
      COMMON/INPUT/STA(25),TLCB(25),ETLCB(25),TRPB(25),ETRPB(25),
     :             ELINV(25),DIST(25),CBW,DLF,CSS,PCS,OBSL,OBSR,
     :             PBS,BERM,BBSTA,SLOPE
C
      COMMON/AREA/ ATOT(25), WSELV1, VOL, VOLTOT
C
      COMMON/COORD/ BLCB(25),EBLCB(25),BRCB(25),EBRCB(25),BRPB(25),
     :              EBRPB(25), TRCB(25), ETRCB(25), TLPB(25),
     :              ETLPB(25), BLPB(25), EBLPB(25)
C
      BLCB(I)=TLCB(I)-CSS*(ETLCB(I)-ELINV(I))
      EBLCB(I)=ELINV(I)
      BRCB(I)=BLCB(I)-CBW
      EBRCB(I)=ELINV(I)
      TRCB(I)=BRCB(I)-CSS*DLF
      ETRCB(I)=ELINV(I)+DLF
C
C     IF A BERM IS NOT PRESENT OUTSIDE POND BANK COORDINATES EQUAL
C     INSIDE CHANNEL BANK COORDINATES.
C
      TLPB(I)=TRCB(I)
      ETLPB(I)=ETRCB(I)
      BLPB(I)=TLPB(I)
      EBLPB(I)=ETLPB(I)
C
C     OUTSIDE POND BANK COODINATES IF A BERM IS PRESENT
C
      IF(STA(I).GT.BBSTA.AND.BBSTA.NE.0.0) THEN
      TLPB(I)=TRCB(I)-BERM
      L=STA(I)-BBSTA
      SLPDIF=SLOPE-PBS
      H=L*SLPDIF*100.
      BLPB(I)=TLPB(I)-CSS*H
      EBLPB(I)=ETLPB(I)-H
      ENDIF
C
C     CALCULATE THE COORDINATES OF THE BOTTOM OF THE RIGHT
C     CHANNEL BANK BY SOLVING TWO SIMULTANEOUS EQUATIONS.
C
      AL= (CSS*(ETRPB(I)-EBLPB(I))-BLPB(I)+TRPB(I))/(CSS*PCS-1.)
      BRPB(I)=BLPB(I)-AL
      EBRPB(I)=(AL*PCS)+EBLPB(I)
C
C     WRITE BANK COORDINATES TO SCREEN
C
C     WRITE(*,100) STA(I)
C 100 FORMAT(1X,'BANK OFFSETS AND ELEVATIONS AT STATION',F8.2)
C     WRITE(*,101)TLCB(I),ETLCB(I),BLCB(I),EBLCB(I),BRCB(I),EBRCB(I),
C    :            TRCB(I),ETRCB(I),TLPB(I),ETLPB(I),BLPB(I),EBLPB(I),
```

User: DEN106 -at

<OPS183>PROJ>PJ6114>DATA>HEC2>XSECT.FOR

```
*****************************************************************************************
*****************************************************************************************

WWWW  WWWWW W   W   W    WWW    WWW
W   W W     WW  W  WW   W   W  W
W   W W     W W W   W   W   W W
W   W WWWW  W W W   W   W W W WWWW
W   W W     W W W   W   W   W W   W
W   W W     W  WW   W   W   W W  - W
WWWW  WWWWW W   W  WWW   WWW   WWW


W   W  WWW  WWWWW  WWW  WWWWW       WWWWW  WWW  WWWW
W   W W   W W     W   W   W         W     W   W W   W
 W W  W     W     W       W         W     W   W W   W
  W    WWW  WWWW  W       W         WWWW  W   W WWWW
 W W      W W     W       W         W     W   W W W
W   W W   W W     W   W   W     WW  W     W   W W  W
W   W  WWW  WWWWW  WWW    W     WW  W      WWW  W   W

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```

[Spooler rev 20.0.6H8 (c) Prime Computer, Inc., 1986]

Label: PRT064 -form NEC1

Pathname: <OPS183>PROJ>PJ6114>DATA>HEC2>XSECT.FOR
File last modified: 88-05-29.11:41:24.Sun

Spooled: 88-06-06.07:50:04.Mon
Started: 88-06-06.07:53:20.Mon on: AMLC by: PR1

```
      SUBROUTINE XSECT
C
C
      COMMON/CONTROL/NFP,NOCS,I,NAME
C
      COMMON/INPUT/STA(25),TLCB(25),ETLCB(25),TRPB(25),ETRPB(25),
     :             ELINV(25),DIST(25),CBW,DLF,CSS,PCS,OBSL,OBSR,
     :             PBS,BERM,BBSTA,SLOPE
C
      COMMON/AREA/ ATOT(25), WSELV1, VOL, VOLTOT
C
      COMMON/COORD/ BLCB(25),EBLCB(25),BRCB(25),EBRCB(25),BRPB(25),
     :              EBRPB(25), TRCB(25), ETRCB(25), TLPB(25),
     :              ETLPB(25), BLPB(25), EBLPB(25)
C
C     INITIALIZE VARIABLES
C
      A1=0.0
      A2=0.0
      A3=0.0
      A4=0.0
      A5=0.0
      A6=0.0
      A7=0.0
      A8=0.0
C
C     IF THE WATER LEVEL IS BELOW THE INVERT OF THIS CROSS SECTION
C     RETURN TO THE MAIN PROGRAM
C
      IF(WSELV1.LT.ELINV(I)) GO TO 7
C
C     CALCULATE TRAPAZOIDAL AREA OVER CHANNEL BOTTOM AND LEFT SIDE
C
      DEPTH=WSELV1-ELINV(I)
      A1=(DEPTH*CSS/2.+CBW)*DEPTH
C
C     CALCULATE TRIANGULAR AREA OVER RIGHT CHANNEL SIDE SLOPE
C
      A2=0.5*CSS*DEPTH**2.
      IF(WSELV1.GE.ETRCB(I)) A2=0.5*CSS*DLF**2.
C
C     CALCULATE THE RECTANGULAR AREA OVER THE BERM, THE RIGHT
C     CHANNEL SIDE SLOPE AND THE LEFT POND SIDE SLOPE.
C
      IF(WSELV1.GT.EBLPB(I)) THEN
      A3=(BRCB(I)-BLPB(I))*(WSELV1-ETRCB(I))
      ENDIF
      IF(WSELV1.LE.ETRCB(I)) A3=0.0
C
C     CALCULATE TRIANGULAR AREA OVER BERM SIDE SLOPE (LEFT POND
C     SIDE SLOPE).
C
      IF(WSELV1.GT.EBLPB(I)) THEN
      A4=0.5*CSS*(WSELV1-EBLPB(I))**2.
      ENDIF
      IF(WSELV1.LE.EBLPB(I)) A4=0.0
      IF(WSELV1.GT.ETRCB(I)) A4=0.5*CSS*(ETRCB(I)-EBLPB(I))**2.
      IF(BERM.EQ.0.0) A4=0.0
C
C     CALCLATE TRAPAZOIDAL AREA OVER THE POND BOTTOM
```

```
C
      IF( WSELV1 GT EBLPB(I). AND. WSELV1. GT EBRPB(I)) THEN
      A5=((WSELV1-EBLPB(I))+(WSELV1-EBRPB(I)))/2. *(BLPB(I)-BRPB(I))
      ENDIF
      IF(WSELV1. LT EBRPB(I). AND WSELV1. GT. EBLPB(I)) THEN
      A5=1. /(PCS*2. )*(WSELV1-EBLPB(I))**2.
      ENDIF
      IF(WSELV1. LE. EBLPB(I)) A5=0. 0
C
C     CALCULATE TRIANGULAR AREA OVER THE RIGHT POND SIDE SLOPE.
C
      IF(WSELV1 GT. EBRPB(I)) THEN
      A6=0. 5*CSS*(WSELV1-EBRPB(I))**2.
      ENDIF
      IF(WSELV1 LE. EBRPB(I)) A6=0. 0
C
C     CALCULATE OVERBANK AREAS
C
      IF(WSELV1 GT. ETRPB(I)) THEN
      OVERR=0. 5*CSS*(WSELV1-ETRPB(I))**2.
      A7= 0 5*OBSR*((WSELV1-ETRPB(I))**2. 0)-OVERR
      ENDIF
      IF(WSELV1 GT. ETLCB(I)) THEN
      OVERL=0. 5*CSS*(WSELV1-ETLPB(I))**2.
      A8= 0 5*OBSL*((WSELV1-ETLCB(I))**2. 0)-OVERL
      ENDIF
C
C     CALCULATE TOTAL AREA AS THE SUM OF THE COMPONENT AREAS
C
    7 CONTINUE
      ATOT(I)=A1+A2+A3+A4+A5+A6+A7+A8
C
C     WRITE(*,101) A1,A2,A3,A4,A5,A6,A7,A8,ATOT(I),STA(I)
C 101 FORMAT(1X,'A1=',F8. 2,1X,'A2=',F8. 2,1X,'A3=',F8. 2,1X,'A4=',F8. 2,
C            1X,'A5=',F8 2,1X,'A6=', F8. 2,1X,'A7=',F8. 2,1X,'A8=',F8. 2,
C            1X,'TOTAL AREA=',F8 2,1X,'AT STATION',F8. 2)
C
      END
```

```
C     :                BRPB(I),EBRPB(I),TRPB(I),ETRPB(I)
C 101  FORMAT(1X,'TLCB=',F8.2,1X,'ETLCB=',F8.2,1X,'BLCB=',F8.2,1X,
C     :          'EBLCB=',F8.2,1X,'BRCB=',F8.2,1X,'EBRCB=',F8.2,1X,
C     :          'TRCB=',F8.2,1X,'ETRCB=',F8.2,/,1X,'TLPB=',F8.2,1X,
C     :          'ETLPB=',F8.2,1X,'BLPB=',F8.2,1X,'EBLPB=',F8.2,1X,
C     :          'BRPB=',F8.2,1X,'EBRPB=',F8.2,1X,'TRPB=',F8.2,1X,
C     :          'ETRPB=',F8.2)
C
      END
```

User: DEN106 -at

<OPS183>PROJ>PJ6114>DATA>HEC2>VOLUME.FOR

```
*****************************************************************************************************
*****************************************************************************************************


WWWW  WWWWW W   W   W    WWW    WWW
W   W W     WW  W  WW   W   W  W
W   W W     W W W   W   W   W W
W   W WWWW  W W W   W   W W W WWWW
W   W W     W W W   W   W   W W   W
W   W W     W  WW   W   W   W W   W
WWWW  WWWWW W   W  WWW   WWW   WWW



W   W  WWW  W     W   W W   W WWWWW       WWWWW  WWW  WWWW
W   W W   W W     W   W WW WW W           W     W   W W   W
W   W W   W W     W   W W W W W           W     W   W W   W
W   W W   W W     W   W W W W WWWW        WWWW  W   W WWWW
W   W W   W W     W   W W   W W           W     W   W W W
 W W  W   W W     W   W W   W W       WW  W     W   W W  W
  W    WWW  WWWWW  WWW  W   W WWWWW   WW  W      WWW  W   W


*****************************************************************************************************
*****************************************************************************************************
```

[Spooler rev 20.0.6HB (c) Prime Computer, Inc., 1986]

Label: PRT065 -form NEC1

Pathname: <OPS183>PROJ>PJ6114>DATA>HEC2>VOLUME.FOR
File last modified: 88-05-29.11:42:20.Sun

Spooled: 88-06-06.07:48:08.Mon
Started: 88-06-06.07:52:00.Mon on: AMLC by: PR1

```
      SUBROUTINE VOLUME
C
C
      COMMON/CONTROL/NFP,NOCS,I,NAME
C
      COMMON/INPUT/STA(25),TLCB(25),ETLCB(25),TRPB(25),ETRPB(25),
     :             ELINV(25),DIST(25),CBW,DLF,CSS,PCS,OBSL,OBSR,
     :             PBS,BERM,BBSTA,SLOPE
C
      COMMON/AREA/ ATOT(25), WSELV1, VOL, VOLTOT
C
      COMMON/COORD/ BLCB(25),EBLCB(25),BRCB(25),EBRCB(25),BRPB(25),
     :              EBRPB(25), TRCB(25), ETRCB(25), TLPB(25),
     :              ETLPB(25), BLPB(25), EBLPB(25)
C
C     INITIALIZE VARIABLES
C
      VOLTOT=0.0
      VLMCHD=0.0
      VLMCHD=0.0
      VLMBER=0.0
      VLMPDD=0.0
      VLMPDU=0.0
      VCORPU=0.0
      VCORPD=0.0
      VCORCD=0.0
      NSTPS=NOCS-1
C
C     CALCULATE DISTANCES BETWEEN CROSS SECTIONS
C
      DO 1 I=1,NSTPS
      DIST(I)=(STA(I+1)-STA(I))*100.
      IF(WSELV1.GT.ELINV(I+1)) GO TO 1
      IF(IFLAG.EQ.1) GO TO 1
      IFLAG=1
      DIST(I)=(WSELV1-ELINV(I))/SLOPE
    1 CONTINUE
      IFLAG=0
C
C     CALCULATE VOLUME OF BASIN
C
C     CALCULATE THE VOLUME OVER THE DOWNSTREAM END SLOPE ALONG
C     THE POND BOTTOM
C
      I=1
      IF(WSELV1.GE.EBRPB(I)) THEN
      AVEDEP=0.5*((WSELV1-ETRCB(I))+(WSELV1-EBRPB(I)))
      VLMPDD=(TRCB(I)-BRPB(I))*AVEDEP**2.
      ENDIF
C
C     CALCULATE VOLUME OVER POND END SLOPE IF POND BOTTOM IS NOT
C     COVERED
C
      IF(WSELV1.LT.EBRPB(I).AND.WSELV1.GT.ETRCB(I)) THEN
      AVEDEP=0.5*(WSELV1-ETRCB(I))
      PNDWID=((WSELV1-ETRCB(I))/(EBRPB(I)-ETRCB(I)))*(TRCB(I)-BRPB(I))
      VLMPDD=PNDWID*AVEDEP**2.
      ENDIF
C
C     CALCULATE THE VOLUME OVER THE DOWNSTREAM END SLOPE ALONG
```

```
C     THE CHANNEL BOTTOM.
C
      VLMCHD=CBW*(WSELV1-ELINV(I))**2.
C
C     CALCULATE VOLUME IN DOWNSTREAM POND CORNER USING THE FORMULA
C     FOR THE VOLUME OF 1/4 OF A CONE.
C
      CORCO=(1./4.)*(1./3.)*(3.1416)
      IF(WSELV1.GT.EBRPB(I)) THEN
      VCORPD =CORCO*(WSELV1-EBRPB(I))*(CSS*(WSELV1-EBRPB(I)))**2.
      ENDIF
C
C     CALCULATE VOLUME OVER LOW FLOW CHANNEL CORNER AT THE
C     DOWNSTREAM END USING THE FORMULA FOR 1/4 OF A CONE.
C
      VCORCD =CORCO*(WSELV1-ELINV(I))*(CSS*(WSELV1-ELINV(I)))**2
C
C     CALCULATE THE VOLUME OVER THE UPSTREAM END SLOPE ALONG THE
C     POND BOTTOM AND IN THE UPSTREAM CORNER OF THE POND.
C
      I=NOCS
      IF(WSELV1.GT EBRPB(I)) THEN
      VLMPDU=(BLPB(I)-BRPB(I))*(WSELV1-(.5*(EBLPB(I)+EBRPB(I))))**2.
      VCORPU= CORCO*(WSELV1-EBRPB(I))*(CSS*(WSELV1-EBRPB(I)))**2
      ENDIF
C
C     SUM VOLUMES OVER UPSTREAM AND DOWNSTREAM END SLOPES
C
      VENDDN=VLMCHD+VLMPDD+VCORCD+VCORPD
      VENDUP=VLMPDU+VCORPU
C     WRITE(*,999)VENDDN,VENDUP
C 999 FORMAT(/,1X,'VOLUME OVER DOWNSTREAM END',F10.2,/1X,
C    :            'VOLUME OVER UPSTREAM END',F10.2)
C
C     CALCULATE TOTAL VOLUME USING AVERAGE END AREAS
C
      DO 2, I=2,NOCS
      VOL=((ATOT(I)+ATOT(I-1))/2.)*DIST(I-1)
      VOLTOT=VOLTOT+VOL
    2 CONTINUE
      VOLTOT=VOLTOT+VENDDN+VENDUP
      VOLTOT=VOLTOT/43560.
      END
```

FLOOD ROUTING THROUGH PONDS CONNECTED IN SERIES

"LOTUS" SPREADSHEETS ROUTE A, ROUTE B AND ROUTE C

Problem: In general, the outlet for a given off-line pond is the inlet to the next pond downstream. Due to the inter-connection between ponds, routing of flood flows through any pond in the system must take into account upstream and downstream pond inflows and outflows. As run-off flows out of one pond and into another, the water surface elevations in the two ponds change relative to each other, thereby changing the discharge characteristics.

Solution: This problem is addressed in the LOTUS spreadsheet "ROUTE";

(1) Assume an outflow, at time = t, for each pond.

(2) Calculate the change in reservoir volume for each pond:

$$\left(\frac{AVGI - AVGO}{43{,}560}\right) \times 60 \times t = VOL;$$

AVGI	=	Average inflow (cfs)
AVGO	=	Average outflow (cfs)
t	=	Time increment (min.)
VOL	=	Change in storage volume (Ac-Ft)

(3) VOL is added to the previously determined volume total sum (SUM VOL) to determine the current reservoir volume.

(4) Using the water surface elevations associated with each reservoir volume, determine H between ponds and the total head at any given pond.

(5) Determine the discharges from each pond using inlet and outlet control nomographs; the lower value is chosen as the controlling flow.

(6) Compare the initially assumed outflow to the calculated outflow and adjust until convergence is reached between the two.

The table is set up so that only the initially assumed discharge values have to be changed - all other calculations (including WSEL and interpolated nomograph values) are automatically performed by the spreadsheet.

USING LOTUS SPREADSHEET "OFFLINE.WK1" FOR FLOOD ROUTING THROUGH PONDS CONNECTED IN SERIES

FIRST TIME STEP

Certain values which are automatically calculated in subsequent time steps must be initialized in Step No. 1:

Iw(t-1)	=	Iw(t) of previous time step (initialize in Step. No. 1)
Ip(t-1)		[for any pond [within a time step] = Op(t-1) [from the upstream pond of the same time step.] Ip(t-1) = 0 for uppermost pond.
Ip(t)	=	same as above (Op(t); Ip(t) = 0 for uppermost pond.
Ip(t-1)	=	Ip(t) of previous time step
Op(t-1)	=	Op(t) of previous time step (initialize in Step No. 1).
Op(t)	=	This is always an input value and is changed until conveyance is achieved (explained in more detail below).
SUM VOL	=	[for any pond within a time step] = SUM VOL (of previous time step; same pond) + DELTA VOL (of same time pond and time step). SUM VOL (initial) = 0.0 + DELTA VOL (when starting with empty ponds).
WSEL	=	This is always an input value; WSEL is read off a graph of WSEL vs. VOL (unique graph for each pond). This is accomplished with interpolation tables as the graphs are essentially described by 3-4 points each.
		WSEL's are automatically adjusted for each new Op(t) value which then results in new calculated outflows. The calculated outflow (for each pond) must match the assumed outflow before the iteration is complete.

ROUTING TABLES FOR THE OFF-LINE PONDS

FORMULAS

COLUMN DESCRIPTOR	COMMENTS/FORMULAS
Pond No.	Number of pond as described in the plans. The upstream-most pond in a given series is listed first.
INFLOW/WEIR Iw(t-1)	Inflow to the pond over the weir for the previous time step (initial value = 0.0). Table retrieves value from Iw(t-1) - previous time step.
Iw(t)	Inflow to the pond over the weir for the current time step input value from the operator.
/PIPE Ip(t-1)	Inflow to the pond through the discharge pipe of the next pond upstream, for the previous time step. This value is equivalent to Op(t) of the pond immediately upstream. Table retrieves value from Op(t-1) - same time step.
Ip(t)	Inflow to the pond through the discharge pipe of the next pond upstream, at the current time step. This value is equivalent to Op(t-1) of the pond immediately upstream table retrieves value from Op(t-1) -same time step.
/AVGI	Average inflow formula: $AVGI = \frac{Iw(t-1)+Iw(t) + Ip(t-1) + Ip(t)}{2}$
OUTFLOW/PIPE Op(t-1)	Outflow through the discharge pipe (to the downstream pond or to the receiving channel), for the previous time step. Table retrieves value from Op(t-1) (same pond) - previous time step.
Op(t)	Outflow through the discharge pipe (to the downstream pond or to the receiving channel), for the current time step. Input value from the operator; this value is adjusted until convergence with Q_{out} is achieved.
/AVGO	Average outflow formula: $AVGO = \frac{Op(t-1) + Op(t)}{2}$
DELTA VOL.	Change in volume (Ac-Ft) between the previous and current time steps. Formula: (this will have a negative value when a pond is draining).

DELTA VOL =

$$\frac{(AVGI - AVGO) * (\text{LENGTH OF TIME INCREMENT (SEC.)})}{43{,}560 \text{ SF/Ac.}}$$

SUM VOL	Cumulative volume of previous time step plus DELTA VOL of current time step. Formula and retrieval (table retrieves SUM VOL of same pond at previous time step) + DELTA VOL = SUM VOL.
WSEL	The table determines the WSEL corresponding to the SUM VOL of the current time step by interpolation. In the interpolation tables each column tests the current value of SUM VOL against two volume values on the VOL VS WSEL table. If the value of SUM VOL lies between the two given volume values a value for the water surface elevation is calculated by interpolation. If the value of SUM VOL is outside the limits described in that column the value of that cell is set to zero. Within a row of interpolation cells for any pond only one will have a non-zero value. WSEL is obtained by summing all the interpolation cells. Formula and retrieval: WSEL = sum of the retrieved values of the interpolation table.
Ha-Hb	Difference in water surface elevations between that of current pond and next pond downstream. Formula: Ha - Hb = WSEL (current) - WSEL (downstream pond or channel WSEL)
PIPE DIAM.	Diameter of the discharge pipe of the current pond. Input by operator; fixed value for any given routing (in.).
L	Length of the discharge pipe at the current pond. Input by operator; fixed value for any given routing.
Q_{out} (outlet control)	Discharge through the outlet pipe of the current pond as determined by outlet control. Formula:

$$Q_{out} = \left(\frac{2g(Ha - Hb)}{1 + Ke + \frac{29 \times n^2 \times L}{R^{1.33}}}\right)^{1/2} \times A$$

; $g = 32.2\ FPS^2$

; $Ke = 0.5$

; $n = .013$

; $A = \left(\frac{DIAM}{12}\right)^2 \left(\frac{\pi}{4}\right)$

; $A = 0.0055(DIAM^2)$

; $R = A/P = D/4$

; $R = \frac{DIAM}{4x12}$

$$Q_{out} = \left(\frac{64.4\ (Ha - Hb)}{1.5 + (0.0049 \times (L)/(DIAM/48)^{1.333})}\right)^{1/2} \times 0.0055\ (DIAM^2)$$

inv. at pond out. or chan.	Invert elevation at the current pond outlet (i.e.: lowest point of current pond), or the invert of the receiving channel, whichever applies. Input value; fixed value for any given routing.
H	Headwater depth at the current pond outlet. <u>Formula</u>: H = (WSEL) - (inv. @ Pond out.);
HW/D	Headwater/diameter: for use in inlet control calculations. <u>Formula</u>: $HW/D = \frac{H}{\frac{DIAM}{12}} = (12 \times H)/DIAM$
Q_{out} (inlet control)	Discharge through outlet pipe of current pond based on inlet control. Interpolation tables are used as described above for WSEL. <u>Formula</u>: Q_{out} = sum of the retrieved values of the interpolation table
Q_{out} at time = t (lower Q)	Choose the lower of Q_{out} (outlet control) and Q_{out} (inlet control) as the controlling discharge. This Q_{out} is then tested against Op(t-1) for convergence (by operator) and Op(t-1) is then adjusted until convergence is achieved.

DESCRIPTION OF HEC-1 AND HEC-2 OUTPUT FILES

HEC-1 OUTPUT FILES

SIMULATION NO. 1

EX50.OUT- Pre-construction existing conditions; 50 year precipitation.

EXI.0UT- Pre-construction existing conditions; 100 year precipitation.

SIMULATION NO. 2

PR50.OUT- Post-construction conditions with no detention in place. 50 year precipitation.

PRO.OUT- Post-construction conditions with no detention in place. 100 year precipitation.

SIMULATION NO. 3

PD50.OUT- Post-construction conditions with detention in place. 50 year precipitation.

PROD.OUT- Post-construction conditions with detention in place. 100 year precipitation.

HEC-2 OUTPUT FILES

CHANNEL NO. 1

CHNL150.OUT- Sub-critical simulation of 50-year flows from the RWCD Floodway to the upstream end of the channel.

CHNL1100.OUT- Sub-critical simulation of 100-year flows from the RWCD Floodway to the upstream end of the channel.

SPOWR50.OUT- Super-critical simulation of 50- year flows from the grade break below the diversion structure for Pond 2 (STA 878+39) to the RWCD Floodway (STA 816+16).

SPOWR100.OUT- Super-critical simulation of 100-year flows from the grade break below the diversion structure for Pond 2 (STA 878+39) to the RWCD Floodway (STA 816+16).

S72ND50.OUT- Super-critical simulation of 50- year flows from the grade break below the diversion structure for Pond 3 (STA 889+45) to the grade break above the diversion structure for Pond 2 (STA 879+99).

S72ND100.OUT- Super-critical simulation of 100-year flows from the grade break below the diversion structure for Pond 3 (STA 889+45) to the grade break above the diversion structure for Pond 2 (STA 879+99).

SSOSS50.OUT- Super-critical simulation of 50- year flows from the grade break above the Sossaman Road box culvert (STA 919+05) to the upstream end of the transition section above the Pond 7 diversion structure (STA 913+70).

SSOSS100.OUT- Super-critical simulation of 100-year flows from the grade break above the Sossaman Road box culvert (STA 919+05) to the upstream end of the transition section above the Pond 7 diversion structure (STA 913+70).

CH1ROUTA.OUT- Sub-critical simulation of flows ranging from 600 to 1250 cfs. Used to derive flow division tables representing off-line ponds.

CH1ROUTB.OUT- Sub-critical simulation of flows ranging from 1300 to 1950 cfs. Used to derive flow division tables representing off-line ponds.

EPOWROUT.OUT- Backwater curve from the RWCD Floodway to the upstream end of the existing lined channel above Power Road for a range of flows.

CHANNEL NO. 2

CHNL250.OUT- Sub-critical simulations of 50- year flows in a) Channel No. 2 from the grade control weirs in the Sossaman Channel downstream from Baseline Road to the outlet from Pond 11; b) the Sossaman channel to the right-of-way and c) the outfall channel from Storm Sewer No. 3.

CHNL2100.OUT- Sub-critical simulations of 100-year flows in a) Channel No. 2 from the grade control weirs in the Sossaman Channel downstream of Baseline Road to the outlet from Pond 11; b) the Sossaman Channel to the right-of- way and c) the outfall channel from Storm Sewer No. 3.

SCHN250.OUT- Super-critical simulation from the grade break at STA 947+00 to the grade break above the transition to the Sossaman Channel (STA 935+00).

SCHN2100.OUT- Super-critical simulation from the grade break at STA 947+00 to the grade break above the transition to the Sossaman Channel (STA 935+00).

CH21150.OUT- Sub-critical simulation of 50- year flows from the downstream end of Pond 11 to the outlet of Pond 12.

CH211100.OUT- Sub-critical simulation of 100-year flows from the downstream end of Pond 11 to the outlet of Pond 12.

CH21250.OUT- Sub-critical simulation of 50-year flows from the downstream end of Pond 12 to the upstream end of the channel.

CH212100.OUT- Sub-critical simulation of 100-year flows from the downstream end of Pond 12 to the upstream end of the channel.

CH2ROUTA.OUT- Sub-critical of flows ranging from 400 to 1050 cfs. Used to derive flow division tables for off-line detention ponds.

FILE: ROUTEA1 Superstition Freeway: Power Road to Ellsworth Road Arizona Department of Transportation Project No.:

Routing through Ponds 1 - 2 ROUTING TABLE FOR THE OFFLINE PONDS
File 1

TIME STEP: 12:15 Depth of flow in channel = 6.40 (ft.) Q = 1076 cfs

POND NO.	INFLOW (CFS) WEIR Iw(t-1)	Iw(t)	PIPE Io(t-1)	Io(t)	AVG. I (cfs)	OUTFLOW (CFS) PIPE Oo(t-1)	Oo(t)	AVG. O (CFS)	DELTA VOL (Ac.-Ft.)	SUM VOL (Ac.-Ft.)	WSEL (Ft.)	Ha- Hb (Ft.)	PIPE DIAM. (in)	L (ft)	Qout (outlet control) (cfs)	Inv. at Pond out. or chan. (ft)	H (ft)	HW/D	Qout (inlet control) (cfs)	Qout at time= t (lower Q) (cfs)
2	0	98	0	0	49.0	0.00	9.89	4.95	0.91	0.91	1361.08	1.29	18	66	9.89	1360.00	1.08	0.7	4.00	4.0
1	0	30	0	9.89	19.9	0.00	0.00	0.00	0.41	0.41	1359.79	0.00	36	116	0.00	1358.70	1.09	0.4	8.02	0.0
CHAN. 1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1364.70	N/A	N/A	N/A	N/A	1358.30	N/A	N/A	N/A	N/A

TIME STEP: 12:30 Depth of flow in channel = 9.10 (ft.) Q =1643 cfs

POND NO.	INFLOW (CFS) WEIR Iw(t-1)	Iw(t)	PIPE Io(t-1)	Io(t)	AVG. I (cfs)	OUTFLOW (CFS) PIPE Oo(t-1)	Oo(t)	AVG. O (CFS)	DELTA VOL (Ac.-Ft.)	SUM VOL (Ac.-Ft.)	WSEL (Ft.)	Ha- Hb (Ft.)	PIPE DIAM. (in)	L (ft)	Qout (outlet control) (cfs)	Inv. at Pond out. or chan. (ft)	H (ft)	HW/D	Qout (inlet control) (cfs)	Qout at time= t (lower Q) (cfs)
2	98	210	0	0	154.0	9.89	11.47	10.68	2.96	3.87	1363.17	1.74	18	66	11.47	1360.00	3.17	2.1	13.32	11.5
1	30	98	9.89	11.47	74.7	0.00	0.00	0.00	1.54	1.96	1361.44	0.00	36	116	0.00	1358.70	2.74	0.9	29.96	0.0
CHAN. 1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1367.40	N/A	N/A	N/A	N/A	1358.30	N/A	N/A	N/A	N/A

TIME STEP: 12:45 Depth of flow in channel = 9.10 (ft.) Q = 1648 cfs

POND NO.	INFLOW (CFS) WEIR Iw(t-1)	Iw(t)	PIPE Io(t-1)	Io(t)	AVG. I (cfs)	OUTFLOW (CFS) PIPE Oo(t-1)	Oo(t)	AVG. O (CFS)	DELTA VOL (Ac.-Ft.)	SUM VOL (Ac.-Ft.)	WSEL (Ft.)	Ha- Hb (Ft.)	PIPE DIAM. (in)	L (ft)	Qout (outlet control) (cfs)	Inv. at Pond out. or chan. (ft)	H (ft)	HW/D	Qout (inlet control) (cfs)	Qout at time= t (lower Q) (cfs)
2	210	158	0	0	184.0	11.47	11.04	11.26	3.57	7.44	1364.94	1.61	18	66	11.04	1360.00	4.94	3.3	17.77	11.0
1	98	88	11.47	11.04	104.3	0.00	0.00	0.00	2.15	4.11	1363.33	0.00	36	116	0.00	1358.70	4.63	1.5	59.00	0.0
CHAN. 1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1367.40	N/A	N/A	N/A	N/A	1358.30	N/A	N/A	N/A	N/A

FILE: ROUTEA1 Superstition Freeway: Power Road to Ellsworth Road Arizona Department of Transportation Project No.:

Routing through Ponds 1 - 2 ROUTING TABLE FOR THE OFFLINE PONDS
File 1

TIME STEP: 13:00 Depth of flow in channel = 8.70 (ft.) Q = 1571 cfs

POND NO.	INFLOW (CFS) WEIR Iw(t-1)	Iw(t)	PIPE Io(t-1)	Io(t)	AVG. I (cfs)	OUTFLOW (CFS) PIPE Oo(t-1)	Oo(t)	AVG. O (CFS)	DELTA VOL (Ac.-Ft.)	SUM VOL (Ac.-Ft.)	WSEL (Ft.)	Ha- Hb (Ft.)	PIPE DIAM. (in)	L (ft)	Qout (outlet control) (cfs)	Inv. at Pond out. or chan. (ft)	H (ft)	HW/D	Qout (inlet control) (cfs)	Qout at time= t (lower Q) (cfs)
2	150	140	0	0	149.0	11.04	10.57	10.81	2.86	10.30	1366.26	1.47	18	66	10.57	1360.00	6.26	4.2	21.11	10.6
1	88	58	11.04	10.57	83.8	0.00	0.00	0.00	1.73	5.84	1364.79	0.00	36	116	0.00	1358.70	6.09	2.0	80.69	0.0
CHAN. 1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1367.00	N/A	N/A	N/A	N/A	1358.30	N/A	N/A	N/A	N/A

TIME STEP: 13:15 Depth of flow in channel = 8.20 (ft.) Q = 1480 cfs

POND NO.	INFLOW (CFS) WEIR Iw(t-1)	Iw(t)	PIPE Io(t-1)	Io(t)	AVG. I (cfs)	OUTFLOW (CFS) PIPE Oo(t-1)	Oo(t)	AVG. O (CFS)	DELTA VOL (Ac.-Ft.)	SUM VOL (Ac.-Ft.)	WSEL (Ft.)	Ha- Hb (Ft.)	PIPE DIAM. (in)	L (ft)	Qout (outlet control) (cfs)	Inv. at Pond out. or chan. (ft)	H (ft)	HW/D	Qout (inlet control) (cfs)	Qout at time= t (lower Q) (cfs)
2	140	139	0	0	139.5	10.57	11.15	10.86	2.66	12.95	1367.50	1.64	18	66	11.15	1360.00	7.50	5.0	24.22	11.1
1	58	57	10.57	11.15	68.4	0.00	0.00	0.00	1.41	7.25	1365.86	0.00	36	116	0.00	1358.70	7.16	2.4	88.89	0.0
CHAN. 1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1366.50	N/A	N/A	N/A	N/A	1358.30	N/A	N/A	N/A	N/A

TIME STEP: 13:30 Depth of flow in channel = 8.00 (ft.) Q = 1445 cfs

POND NO.	INFLOW (CFS) WEIR Iw(t-1)	Iw(t)	PIPE Io(t-1)	Io(t)	AVG. I (cfs)	OUTFLOW (CFS) PIPE Oo(t-1)	Oo(t)	AVG. O (CFS)	DELTA VOL (Ac.-Ft.)	SUM VOL (Ac.-Ft.)	WSEL (Ft.)	Ha- Hb (Ft.)	PIPE DIAM. (in)	L (ft)	Qout (outlet control) (cfs)	Inv. at Pond out. or chan. (ft)	H (ft)	HW/D	Qout (inlet control) (cfs)	Qout at time= t (lower Q) (cfs)
2	139	110	0	0	124.5	11.15	12.07	11.61	2.33	15.29	1366.58	1.92	18	66	12.07	1360.00	8.58	5.7	26.94	12.1
1	57	47	11.15	12.07	63.6	0.00	22.48	11.24	1.08	8.34	1366.66	0.36	36	116	22.47	1358.70	7.96	2.7	95.03	22.5
CHAN. 1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1366.30	N/A	N/A	N/A	N/A	1358.30	N/A	N/A	N/A	N/A

FILE: ROUTEA1 Superstition Freeway: Power Road to Ellsworth Road Arizona Department of Transportation Project No.:

Routing through Ponds 1 - 2 ROUTING TABLE FOR THE OFFLINE PONDS
File 1

TIME STEP: 13:45 Depth of flow in channel = 7.50 (ft.) Q = 1336 cfs

POND NO.	INFLOW (CFS) WEIR Iw(t-1)	Iw(t)	PIPE Io(t-1)	Io(t)	AVG. I (cfs)	OUTFLOW (CFS) PIPE Oo(t-1)	Oo(t)	AVG. O (CFS)	DELTA VOL (Ac.-Ft.)	SUM VOL (Ac.-Ft.)	WSEL (Ft.)	Ha- Hb (Ft.)	PIPE DIAM. (in)	L (ft)	Qout (outlet control) (cfs)	Inv. at Pond out. or chan. (ft)	H (ft)	HW/D	Qout (inlet control) (cfs)	Qout at time= t (lower Q) (cfs)
2	110	0	0	0	55.0	12.07	12.95	12.51	0.83	16.16	1368.99	2.21	18	66	12.95	1360.00	8.99	6.0	27.97	12.9
1	47	3	12.07	12.95	37.5	22.48	37.04	29.76	0.16	8.50	1366.78	0.98	36	116	37.04	1358.70	8.08	2.7	95.94	37.0
CHAN. 1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1365.80	N/A	N/A	N/A	N/A	1358.30	N/A	N/A	N/A	N/A

TIME STEP: 14:00 Depth of flow in channel = 6.40 (ft.) Q = 1071 cfs

POND NO.	INFLOW (CFS) WEIR Iw(t-1)	Iw(t)	PIPE Io(t-1)	Io(t)	AVG. I (cfs)	OUTFLOW (CFS) PIPE Oo(t-1)	Oo(t)	AVG. O (CFS)	DELTA VOL (Ac.-Ft.)	SUM VOL (Ac.-Ft.)	WSEL (Ft.)	Ha- Hb (Ft.)	PIPE DIAM. (in)	L (ft)	Qout (outlet control) (cfs)	Inv. at Pond out. or chan. (ft)	H (ft)	HW/D	Qout (inlet control) (cfs)	Qout at time= t (lower Q) (cfs)
2	0	0	0	0	0.0	12.95	13.79	13.37	-0.28	15.89	1368.86	2.50	18	66	13.79	1360.00	8.86	5.9	27.65	13.8
1	3	0	12.95	13.79	14.9	37.04	48.17	42.61	-0.57	7.92	1366.35	1.65	36	116	48.17	1358.70	7.65	2.6	92.69	48.2
CHAN. 1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1364.70	N/A	N/A	N/A	N/A	1358.30	N/A	N/A	N/A	N/A

FILE: ROUTER2 Superstition Freeway: Power Road to Ellsworth Road Arizona Department of Transportation Project No.:

Routing through Ponds 1 - 2
File 2

ROUTING TABLE FOR THE OFFLINE PONDS

POND NO.	WEIR Iw(t-1)	WEIR Iw(t)	PIPE Io(t-1)	PIPE Io(t)	AVG. I (cfs)	PIPE Oo(t-1)	PIPE Oo(t)	AVG. O (CFS)	DELTA VOL (Ac.-Ft.)	SUM VOL (Ac.-Ft.)	WSEL (Ft.)	Ha- Hb (Ft.)	PIPE DIAM. (in)	L (ft)	Qout (outlet control) (cfs)	Inv. at Pond out. or chan. (ft)	H (ft)	HW/D	Qout (inlet control) (cfs)	Qout at time= t (lower Q) (cfs)
2	0	0	0	0	0.0	13.79	15.92	14.86	-0.61	15.28	1368.58	3.34	18	66	15.92	1360.00	8.58	5.7	26.93	15.9
1	0	0	13.79	15.92	14.9	48.17	54.71	51.44	-1.51	6.41	1365.24	2.14	36	116	54.71	1358.70	6.54	2.2	84.10	54.7
CHAN. 1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1363.10	N/A	N/A	N/A	N/A	1358.30	N/A	N/A	N/A	N/A

TIME STEP: 15:00 Depth of flow in channel = 3.90 (ft.) Q = 579 cfs

POND NO.	WEIR Iw(t-1)	WEIR Iw(t)	PIPE Io(t-1)	PIPE Io(t)	AVG. I (cfs)	PIPE Oo(t-1)	PIPE Oo(t)	AVG. O (CFS)	DELTA VOL (Ac.-Ft.)	SUM VOL (Ac.-Ft.)	WSEL (Ft.)	Ha- Hb (Ft.)	PIPE DIAM. (in)	L (ft)	Qout (outlet control) (cfs)	Inv. at Pond out. or chan. (ft)	H (ft)	HW/D	Qout (inlet control) (cfs)	Qout at time= t (lower Q) (cfs)
2	0	0	0	0	0.0	15.92	17.91	16.92	-0.70	14.58	1368.25	4.23	18	66	17.91	1360.00	8.25	5.5	26.11	17.9
1	0	0	15.92	17.91	16.9	54.71	50.57	52.64	-1.48	4.93	1364.02	1.82	36	116	50.57	1358.70	5.32	1.8	69.64	50.6
CHAN. 1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1362.20	N/A	N/A	N/A	N/A	1358.30	N/A	N/A	N/A	N/A

TIME STEP: 15:30 Depth of flow in channel = 3.20 (ft.) Q = 479 cfs

POND NO.	WEIR Iw(t-1)	WEIR Iw(t)	PIPE Io(t-1)	PIPE Io(t)	AVG. I (cfs)	PIPE Oo(t-1)	PIPE Oo(t)	AVG. O (CFS)	DELTA VOL (Ac.-Ft.)	SUM VOL (Ac.-Ft.)	WSEL (Ft.)	Ha- Hb (Ft.)	PIPE DIAM. (in)	L (ft)	Qout (outlet control) (cfs)	Inv. at Pond out. or chan. (ft)	H (ft)	HW/D	Qout (inlet control) (cfs)	Qout at time= t (lower Q) (cfs)
2	0	0	0	0	0.0	17.91	19.28	18.60	-0.77	13.81	1367.89	4.90	18	66	19.28	1360.00	7.89	5.3	25.22	19.3
1	0	0	17.91	19.28	18.6	50.57	45.77	48.17	-1.22	3.71	1362.99	1.49	36	116	45.77	1358.70	4.29	1.4	53.85	45.8
CHAN. 1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1361.50	N/A	N/A	N/A	N/A	1358.30	N/A	N/A	N/A	N/A

FILE: PDOUTEA2 Superstition Freeway: Power Road to Ellsworth Road Arizona Department of Transportation Project No.:

Routing through Ponds 1 - 2
File 2

ROUTING TABLE FOR THE OFFLINE PONDS

TIME STEP: 16:00 Depth of flow in channel = 2.70 (ft.) Q = 407 cfs

POND NO.	WEIR Iw(t-1)	WEIR Iw(t)	PIPE Io(t-1)	PIPE Io(t)	AVG. I (cfs)	PIPE Qo(t-1)	PIPE Qo(t)	AVG. Q (CFS)	DELTA VOL (Ac.-Ft.)	SUM VOL (Ac.-Ft.)	WSEL (Ft.)	Ha- Hb (Ft.)	PIPE DIAM. (in)	L (ft)	Qout (outlet control) (cfs)	Inv. at Pond out. or chan. (ft)	H (ft)	HW/D	Qout (inlet control) (cfs)	Qout at time= t (lower Q) (cfs)
2	0	0	0	0	0.0	19.28	20.13	19.71	-0.81	12.99	1367.52	5.34	18	66	20.13	1360.00	7.52	5.0	24.26	20.1
1	0	0	19.28	20.13	19.7	45.77	40.61	43.19	-0.97	2.74	1362.18	1.18	36	116	40.61	1358.70	3.48	1.2	41.31	40.6
CHAN. 1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1361.00	N/A	N/A	N/A	N/A	1358.30	N/A	N/A	N/A	N/A

TIME STEP: 16:30 Depth of flow in channel = 2.30 (ft.) Q = 330 cfs

POND NO.	WEIR Iw(t-1)	WEIR Iw(t)	PIPE Io(t-1)	PIPE Io(t)	AVG. I (cfs)	PIPE Qo(t-1)	PIPE Qo(t)	AVG. Q (CFS)	DELTA VOL (Ac.-Ft.)	SUM VOL (Ac.-Ft.)	WSEL (Ft.)	Ha- Hb (Ft.)	PIPE DIAM. (in)	L (ft)	Qout (outlet control) (cfs)	Inv. at Pond out. or chan. (ft)	H (ft)	HW/D	Qout (inlet control) (cfs)	Qout at time= t (lower Q) (cfs)
2	0	0	0	0	0.0	20.13	20.67	20.40	-0.84	12.15	1367.13	5.63	18	66	20.67	1360.00	7.13	4.8	23.28	20.7
1	0	0	20.13	20.67	20.4	40.61	35.37	37.99	-0.73	2.01	1361.49	0.89	36	116	35.38	1358.70	2.79	0.9	30.82	30.8
CHAN. 1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1360.60	N/A	N/A	N/A	N/A	1358.30	N/A	N/A	N/A	N/A

TIME STEP: 17:00 Depth of flow in channel = 2.00 (ft.) Q = 309 cfs

POND NO.	WEIR Iw(t-1)	WEIR Iw(t)	PIPE Io(t-1)	PIPE Io(t)	AVG. I (cfs)	PIPE Qo(t-1)	PIPE Qo(t)	AVG. Q (CFS)	DELTA VOL (Ac.-Ft.)	SUM VOL (Ac.-Ft.)	WSEL (Ft.)	Ha- Hb (Ft.)	PIPE DIAM. (in)	L (ft)	Qout (outlet control) (cfs)	Inv. at Pond out. or chan. (ft)	H (ft)	HW/D	Qout (inlet control) (cfs)	Qout at time= t (lower Q) (cfs)
2	0	0	40.61	0	20.3	20.67	21.53	21.10	-0.83	12.12	1367.11	6.11	18	66	21.53	1360.00	7.11	4.7	23.24	21.5
1	0	0	20.67	21.53	21.1	35.37	31.27	33.32	-0.50	1.51	1361.00	0.70	36	116	31.27	1358.70	2.30	0.9	23.23	23.2
CHAN. 1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1360.30	N/A	N/A	N/A	N/A	1358.30	N/A	N/A	N/A	N/A

FILE: ROUTER2 Superstition Freeway: Power Road to Ellsworth Road Arizona Department of Transportation Project No.:

Routing through Ponds 1 - 2 ROUTING TABLE FOR THE OFFLINE PONDS
File 2

TIME STEP: 17:30 Depth of flow in channel = 1.80 (ft.) Q = 276 cfs

POND NO.	INFLOW (CFS) WEIR Iw(t-1)	INFLOW (CFS) WEIR Iw(t)	INFLOW (CFS) PIPE Io(t-1)	INFLOW (CFS) PIPE Io(t)	AVG. I (cfs)	OUTFLOW (CFS) PIPE Oo(t-1)	OUTFLOW (CFS) PIPE Oo(t)	AVG. O (CFS)	DELTA VOL (Ac.-Ft.)	SUM VOL (Ac.-Ft.)	WSEL (Ft.)	Ha- Hb (Ft.)	PIPE DIAM. (in)	L (ft)	Qout (outlet control) (cfs)	Inv. at Pond out. or chan. (ft)	H (ft)	HW/D	Qout (inlet control) (cfs)	Qout at time= t (lower Q) (cfs)
2	0	0	0	0	0.0	21.53	21.40	21.47	-0.69	11.23	1366.79	6.03	18	66	21.40	1360.00	6.70	4.5	22.20	21.4
1	0	0	21.53	21.4	21.5	31.27	28.12	29.70	-0.34	1.17	1360.66	0.56	36	116	28.12	1358.70	1.96	0.7	18.12	18.1
CHAN. 1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1360.10	N/A	N/A	N/A	N/A	1358.30	N/A	N/A	N/A	N/A

TIME STEP: 18:00 Depth of flow in channel = 1.60 (ft.) Q = 250 cfs

POND NO.	INFLOW (CFS) WEIR Iw(t-1)	INFLOW (CFS) WEIR Iw(t)	INFLOW (CFS) PIPE Io(t-1)	INFLOW (CFS) PIPE Io(t)	AVG. I (cfs)	OUTFLOW (CFS) PIPE Oo(t-1)	OUTFLOW (CFS) PIPE Oo(t)	AVG. O (CFS)	DELTA VOL (Ac.-Ft.)	SUM VOL (Ac.-Ft.)	WSEL (Ft.)	Ha- Hb (Ft.)	PIPE DIAM. (in)	L (ft)	Qout (outlet control) (cfs)	Inv. at Pond out. or chan. (ft)	H (ft)	HW/D	Qout (inlet control) (cfs)	Qout at time= t (lower Q) (cfs)
2	0	0	0	0	0.0	21.40	21.12	21.26	-0.88	10.35	1366.29	5.83	18	66	21.12	1360.00	6.29	4.2	21.18	21.1
1	0	0	21.4	21.12	21.3	28.12	26.81	27.47	-0.26	0.91	1360.41	0.51	36	116	26.81	1358.79	1.71	0.6	14.26	14.3
CHAN. 1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1359.90	N/A	N/A	N/A	N/A	1358.30	N/A	N/A	N/A	N/A

FILE: ROUTE3 Superstition Freeway: Power Road to Ellsworth Road Arizona Department of Transportation Project No.:

Routing through Ponds 1 - 2 ROUTING TABLE FOR THE OFFLINE PONDS
File 3

TIME STEP: 18:30 Depth of flow in channel = 1.6 (ft.) Q = 729 cfs

POND NO.	WEIR Iw(t-1)	WEIR Iw(t)	PIPE Io(t-1)	PIPE Io(t)	AVG. I (cfs)	PIPE Oo(t-1)	PIPE Oo(t)	AVG. O (CFS)	VOL (Ac.-Ft.)	SUM VOL (Ac.-Ft.)	WSEL (Ft.)	Ha- Hb (Ft.)	PIPE DIAM. (in)	L (ft)	Qout (outlet control) (cfs)	Inv. at Pond out. or chan. (ft)	H (ft)	HW/D	Qout (inlet control) (cfs)	Qout at time= t (lower Q) (cfs)
2	0	0	0	0	0.0	21.12	20.66	20.89	-0.86	9.49	1365.89	5.63	18	66	20.66	1360.00	5.89	3.9	20.16	20.2
1	0	0	21.12	20.66	20.9	26.81	22.46	24.64	-0.15	0.76	1360.26	0.36	36	116	22.47	1358.70	1.56	0.5	11.92	11.9
CHAN. 1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1359.90	N/A	N/A	N/A	N/A	1358.30	N/A	N/A	N/A	N/A

TIME STEP: 19:00 Depth of flow in channel = 1.40 (ft.) Q = 212 cfs

POND NO.	WEIR Iw(t-1)	WEIR Iw(t)	PIPE Io(t-1)	PIPE Io(t)	AVG. I (cfs)	PIPE Oo(t-1)	PIPE Oo(t)	AVG. O (CFS)	VOL (Ac.-Ft.)	SUM VOL (Ac.-Ft.)	WSEL (Ft.)	Ha- Hb (Ft.)	PIPE DIAM. (in)	L (ft)	Qout (outlet control) (cfs)	Inv. at Pond out. or chan. (ft)	H (ft)	HW/D	Qout (inlet control) (cfs)	Qout at time= t (lower Q) (cfs)
2	0	0	0	0	0.0	20.66	20.17	20.42	-0.84	8.64	1365.50	5.36	18	66	20.17	1360.00	5.50	3.7	19.13	19.2
1	0	0	20.66	20.17	20.4	22.46	24.64	23.55	-0.13	0.63	1360.13	0.43	36	116	24.64	1358.70	1.43	0.5	10.51	10.5
CHAN. 1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1359.70	N/A	N/A	N/A	N/A	1358.30	N/A	N/A	N/A	N/A

TIME STEP: 19:30 Depth of flow in channel = 1.30 (ft.) Q = 197 cfs

POND NO.	WEIR Iw(t-1)	WEIR Iw(t)	PIPE Io(t-1)	PIPE Io(t)	AVG. I (cfs)	PIPE Oo(t-1)	PIPE Oo(t)	AVG. O (CFS)	VOL (Ac.-Ft.)	SUM VOL (Ac.-Ft.)	WSEL (Ft.)	Ha- Hb (Ft.)	PIPE DIAM. (in)	L (ft)	Qout (outlet control) (cfs)	Inv. at Pond out. or chan. (ft)	H (ft)	HW/D	Qout (inlet control) (cfs)	Qout at time= t (lower Q) (cfs)
2	0	0	22.46	0	11.2	20.17	20.16	20.17	-0.37	8.27	1365.32	5.35	18	66	20.15	1360.00	5.32	3.5	18.74	18.7
1	0	0	20.17	20.16	20.2	24.64	22.79	23.72	-0.15	0.48	1359.97	0.37	36	116	22.80	1358.70	1.27	0.4	9.32	9.3
CHAN. 1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1359.60	N/A	N/A	N/A	N/A	1358.30	N/A	N/A	N/A	N/A

FILE: ROUTE3 Superstition Freeway: Power Road to Ellsworth Road Arizona Department of Transportation Project No.:

Routing through Ponds 1 - 2 ROUTING TABLE FOR THE OFFLINE PONDS
File 3

TIME STEP: 20:00 Depth of flow in channel = 1.20 (ft.) Q = 194 cfs

POND NO.	WEIR Iw(t-1)	WEIR Iw(t)	PIPE Io(t-1)	PIPE Io(t)	AVG. I (cfs)	PIPE Oo(t-1)	PIPE Oo(t)	AVG. O (CFS)	DELTA VOL (Ac.-Ft.)	SUM VOL (Ac.-Ft.)	WSEL (Ft.)	Ha- Hb (Ft.)	PIPE DIAM. (in)	L (ft)	Qout (outlet control) (cfs)	Inv. at Pond out. or chan. (ft)	H (ft)	HW/D	Qout (inlet control) (cfs)	Qout at time= t (lower Q) (cfs)
2	0	0	0	0	0.0	20.16	19.76	19.96	-0.82	7.45	1364.94	5.15	18	66	19.76	1360.00	4.94	3.3	17.78	17.8
1	0	0	20.16	19.76	20.0	22.79	20.34	21.57	-0.07	0.41	1359.79	0.29	36	116	20.33	1358.70	1.09	0.4	8.03	8.0
CHAN. 1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1359.50	N/A	N/A	N/A	N/A	1358.30	N/A	N/A	N/A	N/A

TIME STEP: 20:30 Depth of flow in channel = 1.20 (ft.) Q = 173 cfs

POND NO.	WEIR Iw(t-1)	WEIR Iw(t)	PIPE Io(t-1)	PIPE Io(t)	AVG. I (cfs)	PIPE Oo(t-1)	PIPE Oo(t)	AVG. O (CFS)	DELTA VOL (Ac.-Ft.)	SUM VOL (Ac.-Ft.)	WSEL (Ft.)	Ha- Hb (Ft.)	PIPE DIAM. (in)	L (ft)	Qout (outlet control) (cfs)	Inv. at Pond out. or chan. (ft)	H (ft)	HW/D	Qout (inlet control) (cfs)	Qout at time= t (lower Q) (cfs)
2	0	0	0	0	0.0	19.76	19.10	19.43	-0.80	6.65	1364.57	4.81	18	66	19.10	1360.00	4.57	3.0	16.84	16.8
1	0	0	19.76	19.1	19.4	20.34	19.13	19.74	-0.01	0.40	1359.76	0.26	36	116	19.14	1358.70	1.06	0.4	7.78	7.8
CHAN. 1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1359.50	N/A	N/A	N/A	N/A	1358.30	N/A	N/A	N/A	N/A

TIME STEP: 21:00 Depth of flow in channel = 1.10 (ft.) Q = 164 cfs

POND NO.	WEIR Iw(t-1)	WEIR Iw(t)	PIPE Io(t-1)	PIPE Io(t)	AVG. I (cfs)	PIPE Oo(t-1)	PIPE Oo(t)	AVG. O (CFS)	DELTA VOL (Ac.-Ft.)	SUM VOL (Ac.-Ft.)	WSEL (Ft.)	Ha- Hb (Ft.)	PIPE DIAM. (in)	L (ft)	Qout (outlet control) (cfs)	Inv. at Pond out. or chan. (ft)	H (ft)	HW/D	Qout (inlet control) (cfs)	Qout at time= t (lower Q) (cfs)
2	0	0	20.34	0	10.2	19.10	18.90	19.00	-0.36	6.29	1364.40	4.71	18	66	18.90	1360.00	4.40	2.9	16.41	16.4
1	0	0	19.1	18.9	19.0	19.13	20.17	19.65	-0.03	0.37	1359.69	0.29	36	116	20.17	1358.70	0.99	0.3	7.26	7.3
CHAN. 1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1359.40	N/A	N/A	N/A	N/A	1358.30	N/A	N/A	N/A	N/A

FILE: ROUTEA3 Superstition Freeway: Power Road to Ellsworth Road Arizona Department of Transportation Project No.:

Routing through Ponds 1 - 2 ROUTING TABLE FOR THE OFFLINE PONDS

File 3

TIME STEP: 21:30 Depth of flow in channel = 1.00 (ft.) Q = 156 cfs

POND NO.	INFLOW (CFS) WEIR Iw(t-1)	Iw(t)	PIPE Ip(t-1)	Ip(t)	AVG. I (cfs)	OUTFLOW (CFS) PIPE Op(t-1)	Op(t)	AVG. O (CFS)	DELTA VOL (Ac.-Ft.)	SUM VOL (Ac.-Ft.)	WSEL (Ft.)	Ha- Hb (Ft.)	PIPE DIAM. (in)	L (ft)	Qout (outlet control) (cfs)	Inv. at Pond out. (or chan.) (ft)	H (ft)	HW/D	Qout (inlet control) (cfs)	Qout at time= t (lower Q) (cfs)
2	0	0	0	0	0.0	18.90	18.42	18.66	-0.77	5.51	1364.04	4.47	18	66	18.42	1360.00	4.04	2.7	15.51	15.5
1	0	0	18.9	18.42	18.7	20.17	19.38	19.78	-0.05	0.33	1359.57	0.27	36	116	19.33	1358.70	0.87	0.3	6.36	6.4
CHAN.	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1359.30	N/A	N/A	N/A	N/A	1358.30	N/A	N/A	N/A	N/A

TIME STEP: 22:00 Depth of flow in channel = 1.00 (ft.) Q = 148 cfs

POND NO.	INFLOW (CFS) WEIR Iw(t-1)	Iw(t)	PIPE Ip(t-1)	Ip(t)	AVG. I (cfs)	OUTFLOW (CFS) PIPE Op(t-1)	Op(t)	AVG. O (CFS)	DELTA VOL (Ac.-Ft.)	SUM VOL (Ac.-Ft.)	WSEL (Ft.)	Ha- Hb (Ft.)	PIPE DIAM. (in)	L (ft)	Qout (outlet control) (cfs)	Inv. at Pond out. (or chan.) (ft)	H (ft)	HW/D	Qout (inlet control) (cfs)	Qout at time= t (lower Q) (cfs)
2	0	0	0	0	0.0	18.42	17.70	18.06	-0.75	4.76	1363.65	4.13	18	66	17.70	1360.00	3.65	2.4	14.52	14.5
1	0	0	18.42	17.7	18.1	19.38	17.60	18.49	-0.02	0.31	1359.52	0.22	36	116	17.59	1358.70	0.82	0.3	6.02	6.0
CHAN.	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1359.30	N/A	N/A	N/A	N/A	1358.30	N/A	N/A	N/A	N/A

FILE: F3UTEN4 Superstition Freeway: Power Road to Ellsworth Road Arizona Department of Transportation Project No.:

Routing through Ponds 1 - 3 ROUTING TABLE FOR THE OFFLINE PONDS
File 4

TIME STEP: 23:00 Depth of flow in channel = 0.9 (Ft.) Q = 176 cfs

POND No.	INFLOW (CFS) WEIR Iw(t-1)	Iw(t)	PIPE Io(t-1)	Io(t)	AVG. I (cfs)	OUTFLOW (CFS) PIPE Oo(t-1)	Oo(t)	AVG. O (CFS)	DELTA VOL (Ac.-Ft.)	SUM VOL (Ac.-Ft.)	WSEL (Ft.)	Ha- Hb (Ft.)	PIPE DIAM. (in)	L (ft)	Qout (outlet control) (cfs)	Inv. at Pond out. or chan. (ft)	H (ft)	HW/D	Qout (inlet control) (cfs)	Qout at time= t (lower Q) (cfs)
2	0	0	0	0	0.0	17.70	16.26	16.98	-1.40	3.36	1362.99	3.48	18	66	16.25	1360.00	2.90	1.9	12.63	12.6
1	0	0	17.7	16.26	17.0	17.80	17.34	17.47	-0.04	0.27	1359.42	0.22	36	116	17.36	1358.70	0.72	0.2	5.24	5.2
CHAN. 1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1359.20	N/A	N/A	N/A	N/A	1358.30	N/A	N/A	N/A	N/A

TIME STEP: 00:00 Depth of flow in channel = 0.80 (Ft.) Q = 125 cfs

POND No.	INFLOW (CFS) WEIR Iw(t-1)	Iw(t)	PIPE Io(t-1)	Io(t)	AVG. I (cfs)	OUTFLOW (CFS) PIPE Oo(t-1)	Oo(t)	AVG. O (CFS)	DELTA VOL (Ac.-Ft.)	SUM VOL (Ac.-Ft.)	WSEL (Ft.)	Ha- Hb (Ft.)	PIPE DIAM. (in)	L (ft)	Qout (outlet control) (cfs)	Inv. at Pond out. or chan. (ft)	H (ft)	HW/D	Qout (inlet control) (cfs)	Qout at time= t (lower Q) (cfs)
2	0	0	0	0	0.0	16.26	14.94	15.60	-1.29	2.07	1362.21	2.94	18	66	14.94	1360.00	2.21	1.5	10.74	10.7
1	0	0	16.26	14.94	15.6	17.34	15.22	16.28	-0.06	0.21	1359.27	0.17	36	116	15.25	1358.70	0.57	0.2	4.15	4.2
CHAN. 1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1359.10	N/A	N/A	N/A	N/A	1358.30	N/A	N/A	N/A	N/A

TIME STEP: 01:00 Depth of flow in channel = 0.70 (Ft.) Q = 108 cfs

POND No.	INFLOW (CFS) WEIR Iw(t-1)	Iw(t)	PIPE Io(t-1)	Io(t)	AVG. I (cfs)	OUTFLOW (CFS) PIPE Oo(t-1)	Oo(t)	AVG. O (CFS)	DELTA VOL (Ac.-Ft.)	SUM VOL (Ac.-Ft.)	WSEL (Ft.)	Ha- Hb (Ft.)	PIPE DIAM. (in)	L (ft)	Qout (outlet control) (cfs)	Inv. at Pond out. or chan. (ft)	H (ft)	HW/D	Qout (inlet control) (cfs)	Qout at time= t (lower Q) (cfs)
2	0	0	0	0	0.0	14.94	12.30	13.62	-1.13	0.94	1361.12	2.00	18	66	12.30	1360.00	1.12	0.7	4.23	4.2
1	0	0	14.94	12.3	13.6	15.22	13.30	14.26	-0.05	0.16	1359.13	0.13	36	116	13.27	1358.70	0.43	0.1	3.12	3.1
CHAN. 1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1359.00	N/A	N/A	N/A	N/A	1358.30	N/A	N/A	N/A	N/A

FILE: ROUTE4 Superstition Freeway: Power Road to Ellsworth Road Arizona Department of Transportation Project No.:

Routing through Ponds 1 - 2 ROUTING TABLE FOR THE OFFLINE PONDS
File 4

TIME STEP: 02:00 Depth of flow in channel = 0.50 (ft.) Q = 75 cfs

POND NO.	INFLOW (CFS) WEIR Iw(t-1)	Iw(t)	PIPE Ip(t-1)	Ip(t)	AVG. I (cfs)	OUTFLOW (CFS) PIPE Op(t-1)	Op(t)	AVG. O (CFS)	DELTA VOL (Ac.-Ft.)	SUM VOL (Ac.-Ft.)	WSEL (Ft.)	Ha- Hb (Ft.)	PIPE DIAM. (in)	L (ft)	Qout (outlet control) (cfs)	Inv. at Pond out. or chan. (ft)	H (ft)	HW/D	Qout (inlet control) (cfs)	Qout at time= t (lower Q) (cfs)
2	0	0	0	0	0.0	12.30	9.43	10.87	-0.90	0.04	1360.05	1.17	18	66	9.43	1360.00	0.05	0.0	0.14	0.1
1	0	0	12.3	9.43	10.9	13.30	10.66	11.98	-0.09	0.07	1358.83	0.08	36	116	10.66	1358.70	0.18	0.1	1.33	1.3
CHAN. 1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1358.80	N/A	N/A	N/A	N/A	1358.30	N/A	N/A	N/A	N/A

TIME STEP: 03:00 Depth of flow in channel = 0.40 (ft.) Q = 40 cfs

POND NO.	INFLOW (CFS) WEIR Iw(t-1)	Iw(t)	PIPE Ip(t-1)	Ip(t)	AVG. I (cfs)	OUTFLOW (CFS) PIPE Op(t-1)	Op(t)	AVG. O (CFS)	DELTA VOL (Ac.-Ft.)	SUM VOL (Ac.-Ft.)	WSEL (Ft.)	Ha- Hb (Ft.)	PIPE DIAM. (in)	L (ft)	Qout (outlet control) (cfs)	Inv. at Pond out. or chan. (ft)	H (ft)	HW/D	Qout (inlet control) (cfs)	Qout at time= t (lower Q) (cfs)
2	0	0	0	0	0.0	9.43	0.00	4.72	-0.39	-0.35	0.00	ERR	18	66	ERR	1360.00	-1360.00	-906.7	-3626.67	ERR
1	0	0	9.43	0	4.7	10.66	7.40	9.03	-0.36	-0.29	ERR	ERR	36	116	ERR	1358.70	ERR	ERR	ERR	ERR
CHAN. 1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1358.70	N/A	N/A	N/A	N/A	1358.30	N/A	N/A	N/A	N/A

FILE: ROUTE31

Routing through Ponds 3 - 7
File 1

Superstition Freeway: Power Road to Ellsworth Road
Project No.:
Arizona Department of Transportation

ROUTING TABLE FOR THE OFFLINE PONDS

TIME STEP: 12:15 Depth of flow in channel = 4.35 (ft.) Q = 1423 cfs

POND NO.	INFLOW (CFS) WEIR Iw(t-1)	WEIR Iw(t)	PIPE Ip(t-1)	PIPE Ip(t)	AVG. I (cfs)	OUTFLOW (CFS) PIPE Op(t-1)	PIPE Op(t)	AVG. O (CFS)	DELTA VOL (Ac.-Ft.)	SUM VOL (Ac.-Ft.)	WSEL (Ft.)	Ha- Hb (Ft.)	PIPE DIAM. (in)	L (ft)	Qout (outlet control) (cfs)	Inv. at Pond out. or chan. (ft)	H (ft)	HW/D	Qout (inlet control) (cfs)	Qout at time= t (lower Q) (cfs)
7	0	0	0	0	0.0	0	0.00	0.0	0.00	0.00	1376.00	0.80	18	91	7.21	1376.00	0.00	0.0	0.00	0.0
6	0	0	0	0	0.0	0	0.00	0.0	0.00	0.00	1375.20	1.20	24	81	17.61	1375.20	0.00	0.0	0.00	0.0
5	0	0	0	0	0.0	0	0.00	0.0	0.00	0.00	1374.00	0.92	30	73	25.88	1374.00	0.00	0.0	0.00	0.0
4	0	20	0	0	10.0	0	17.16	8.6	0.03	0.03	1373.08	0.19	36	83	17.17	1373.00	0.08	0.0	0.58	0.6
3	0	56	0	17.16	36.6	0	0.00	0.0	0.76	0.76	1372.89	0.00	42	106	0.00	1371.60	1.29	0.4	12.53	0.0
CHAN. 1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1375.65	N/A	N/A	N/A	N/A	1371.30	N/A	N/A	N/A	N/A

TIME STEP: 12:30 Depth of flow in channel = 4.74 (ft.) Q = 1636 cfs

POND NO.	INFLOW (CFS) WEIR Iw(t-1)	WEIR Iw(t)	PIPE Ip(t-1)	PIPE Ip(t)	AVG. I (cfs)	OUTFLOW (CFS) PIPE Op(t-1)	PIPE Op(t)	AVG. O (CFS)	DELTA VOL (Ac.-Ft.)	SUM VOL (Ac.-Ft.)	WSEL (Ft.)	Ha- Hb (Ft.)	PIPE DIAM. (in)	L (ft)	Qout (outlet control) (cfs)	Inv. at Pond out. or chan. (ft)	H (ft)	HW/D	Qout (inlet control) (cfs)	Qout at time= t (lower Q) (cfs)
7	0	158	0	0	79.0	0	12.07	6.0	1.51	1.51	1380.18	2.24	18	91	12.07	1376.00	4.18	2.8	15.86	12.1
6	0	111	0	12.07	61.5	0	19.11	9.6	1.07	1.07	1377.94	1.41	24	81	19.11	1375.20	2.74	1.4	17.89	17.9
5	0	216	0	19.11	117.6	0	31.08	15.5	2.11	2.11	1376.52	1.33	30	73	31.09	1374.00	2.52	1.0	23.31	23.3
4	20	174	0	31.08	112.5	17.16	20.71	18.9	1.93	1.96	1375.20	0.28	36	83	20.72	1373.00	2.20	0.7	21.67	20.7
3	56	203	17.16	20.71	148.4	0	0.00	0.0	3.07	3.82	1374.92	0.00	42	106	0.00	1371.60	3.32	0.9	46.32	0.0
CHAN. 1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1376.04	N/A	N/A	N/A	N/A	1371.30	N/A	N/A	N/A	N/A

FILE: ROUTEB1

Routing through Ponds 3 - 7
File 1

Superstition Freeway: Power Road to Ellsworth Road
Project No.:
Arizona Department of Transportation

ROUTING TABLE FOR THE OFFLINE PONDS

TIME STEP: 12:45 Depth of flow in channel = 4.60 (ft.) Q = 1560 cfs

POND NO.	INFLOW (CFS) WEIR Iw(t-1)	Iw(t)	PIPE Ip(t-1)	Ip(t)	AVG. I (cfs)	OUTFLOW (CFS) PIPE Op(t-1)	Op(t)	AVG. O (CFS)	DELTA VOL (Ac.-Ft.)	SUM VOL (Ac.-Ft.)	WSEL (Ft.)	Ha- Hb (Ft.)	PIPE DIAM. (in)	L (ft)	Qout (outlet control) (cfs)	Inv. at Pond out. or chan. (ft)	H (ft)	HW/D	Qout (inlet control) (cfs)	Qout at time= t (lower Q) (cfs)
7	158	305	0	0	231.5	12.07	15.51	13.8	4.50	6.01	1386.33	3.70	18	91	15.51	1376.00	10.33	6.9	28.00	15.5
6	111	175	12.07	15.51	156.8	19.11	27.19	23.2	2.76	3.84	1382.63	2.86	24	81	27.19	1375.20	7.43	3.7	41.28	27.2
5	216	211	19.11	27.19	236.7	31.08	36.36	33.7	4.19	6.30	1379.77	1.82	30	73	36.36	1374.00	5.77	2.3	53.53	36.4
4	174	177	31.08	36.36	209.2	20.71	42.33	31.5	3.67	5.63	1377.95	1.15	36	83	42.32	1373.00	4.95	1.7	63.92	42.3
3	203	90	20.71	42.33	178.0	0	50.81	25.4	3.15	6.98	1376.80	0.90	42	106	50.81	1371.60	5.20	1.5	81.46	50.8
CHAN. 1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1375.90	N/A	N/A	N/A	N/A	1371.30	N/A	N/A	N/A	N/A

TIME STEP: 13:00 Depth of flow in channel = 4.55 (ft.) Q = 1529 cfs

POND NO.	INFLOW (CFS) WEIR Iw(t-1)	Iw(t)	PIPE Ip(t-1)	Ip(t)	AVG. I (cfs)	OUTFLOW (CFS) PIPE Op(t-1)	Op(t)	AVG. O (CFS)	DELTA VOL (Ac.-Ft.)	SUM VOL (Ac.-Ft.)	WSEL (Ft.)	Ha- Hb (Ft.)	PIPE DIAM. (in)	L (ft)	Qout (outlet control) (cfs)	Inv. at Pond out. or chan. (ft)	H (ft)	HW/D	Qout (inlet control) (cfs)	Qout at time= t (lower Q) (cfs)
7	305	219	0	0	262.0	15.51	12.51	14.0	5.12	11.13	1388.87	2.41	18	91	12.51	1376.00	12.87	8.6	28.00	12.5
6	175	146	15.51	12.51	174.5	27.19	33.01	30.1	2.98	6.82	1386.46	4.22	24	81	33.02	1375.20	11.26	5.6	56.14	33.0
5	211	172	27.19	33.01	221.6	36.36	40.87	38.6	3.78	10.08	1382.23	2.30	30	73	40.86	1374.00	8.25	3.3	71.37	40.9
4	177	158	36.36	40.87	206.1	42.33	60.77	51.6	3.19	8.83	1379.95	2.37	36	83	60.77	1373.00	6.95	2.3	87.29	60.8
3	90	66	42.33	60.77	129.6	50.81	70.40	60.6	1.42	8.40	1377.58	1.73	42	106	70.40	1371.60	5.98	1.7	96.03	70.4
CHAN. 1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1375.85	N/A	N/A	N/A	N/A	1371.30	N/A	N/A	N/A	N/A

FILE: ROUTE82

Routing through Ponds 3 - 7
File 2

Superstition Freeway: Power Road to Ellsworth Road
Project No.:
Arizona Department of Transportation

ROUTING TABLE FOR THE OFFLINE PONDS

TIME STEP: 13:15 Depth of flow in channel = 4.53 (ft.) Q = 1520 cfs

POND NO.	INFLOW (CFS) WEIR Iw(t-1)	Iw(t)	PIPE Ip(t-1)	Ip(t)	AVG. I (cfs)	OUTFLOW (CFS) PIPE Op(t-1)	Op(t)	AVG. O (CFS)	DELTA VOL (Ac.-Ft.)	SUM VOL (Ac.-Ft.)	WSEL (Ft.)	Ha- Hb (Ft.)	PIPE DIAM. (in)	L (ft)	Qout (outlet control) (cfs)	Inv. at Pond out. or chan. (ft)	H (ft)	HW/D	Qout (inlet control) (cfs)	Qout at time= t (lower Q) (cfs)
7	219	42	0	0	130.5	12.51	15.97	14.2	2.40	13.53	1392.41	3.93	18	91	15.97	1376.00	16.41	10.9	28.00	16.0
6	146	66	12.51	15.97	120.2	33.01	33.65	33.3	1.80	8.62	1388.48	4.38	24	81	33.65	1375.20	13.28	6.6	59.00	33.7
5	172	126	33.01	33.65	182.3	40.87	43.25	42.1	2.90	12.98	1384.10	2.57	30	73	43.25	1374.00	10.10	4.0	80.39	43.3
4	158	135	40.87	43.25	188.6	60.77	71.87	66.3	2.53	11.36	1381.53	3.31	36	83	71.87	1373.00	8.53	2.8	99.37	71.9
3	66	66	60.77	71.87	132.3	70.4	82.58	76.5	1.15	9.55	1378.22	2.39	42	106	82.58	1371.60	6.62	1.9	107.82	82.6
CHAN. 1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1375.83	N/A	N/A	N/A	N/A	1371.30	N/A	N/A	N/A	N/A

TIME STEP: 13:30 Depth of flow in channel = 4.41 (ft.) Q = 1454 cfs

POND NO.	INFLOW (CFS) WEIR Iw(t-1)	Iw(t)	PIPE Ip(t-1)	Ip(t)	AVG. I (cfs)	OUTFLOW (CFS) PIPE Op(t-1)	Op(t)	AVG. O (CFS)	DELTA VOL (Ac.-Ft.)	SUM VOL (Ac.-Ft.)	WSEL (Ft.)	Ha- Hb (Ft.)	PIPE DIAM. (in)	L (ft)	Qout (outlet control) (cfs)	Inv. at Pond out. or chan. (ft)	H (ft)	HW/D	Qout (inlet control) (cfs)	Qout at time= t (lower Q) (cfs)
7	42	0	0	0	21.0	15.97	15.66	15.8	0.11	13.64	1392.58	3.78	18	91	15.66	1376.00	16.58	11.1	28.00	15.7
6	66	0	15.97	15.66	48.8	33.65	32.43	33.0	0.33	8.94	1388.80	4.07	24	81	32.43	1375.20	13.60	6.8	59.00	32.4
5	126	5	33.65	32.43	98.5	43.25	41.95	42.6	1.16	14.13	1384.73	2.42	30	73	41.95	1374.00	10.73	4.3	82.93	41.9
4	135	50	43.25	41.95	135.1	71.87	76.19	74.0	1.26	12.62	1382.31	3.72	36	83	76.19	1373.00	9.31	3.1	105.40	76.2
3	66	26	71.87	76.19	120.0	82.58	90.78	86.7	0.69	10.24	1378.59	2.88	42	106	90.78	1371.60	6.99	2.0	114.87	90.8
CHAN. 1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1375.71	N/A	N/A	N/A	N/A	1371.30	N/A	N/A	N/A	N/A

FILE: ROUTEB2

Routing through Ponds 3 - 7
File 2

Superstition Freeway: Power Road to Ellsworth Road
Project No.:
Arizona Department of Transportation

ROUTING TABLE FOR THE OFFLINE PONDS

TIME STEP: 13:45 Depth of flow in channel = 3.87 (ft.) Q = 1175 cfs

POND NO.	INFLOW (CFS) WEIR Iw(t-1)	Iw(t)	PIPE Ip(t-1)	Ip(t)	AVG. I (cfs)	OUTFLOW (CFS) PIPE Op(t-1)	Op(t)	AVG. O (CFS)	DELTA VOL (Ac.-Ft.)	SUM VOL (Ac.-Ft.)	WSEL (Ft.)	Ha- Hb (Ft.)	PIPE DIAM. (in)	L (ft)	Qout (outlet control) (cfs)	Inv. at Pond out. or chan. (ft)	H (ft)	HW/D	Qout (inlet control) (cfs)	Qout at time= t (lower Q) (cfs)
7	0	0	0	0	0.0	15.66	15.30	15.5	-0.32	13.32	1392.07	3.60	18	91	15.30	1376.00	16.07	10.7	28.00	15.3
6	0	0	15.66	15.3	15.5	32.43	31.43	31.9	-0.34	8.60	1388.46	3.82	24	81	31.43	1375.20	13.26	6.6	59.00	31.4
5	5	0	32.43	31.43	34.4	41.95	42.18	42.1	-0.16	13.98	1384.64	2.45	30	73	42.18	1374.00	10.64	4.3	82.58	42.2
4	50	0	41.95	42.18	67.1	76.19	75.65	75.9	-0.18	12.43	1382.20	3.67	36	83	75.65	1373.00	9.20	3.1	104.52	75.7
3	26	0	76.19	75.65	88.9	90.78	98.02	94.4	-0.11	10.13	1378.53	3.36	42	106	98.02	1371.60	6.93	2.0	113.71	98.0
CHAN. 1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1375.17	N/A	N/A	N/A	N/A	1371.30	N/A	N/A	N/A	N/A

TIME STEP: 14:00 Depth of flow in channel = 3.21 (ft.) Q = 865 cfs

POND NO.	INFLOW (CFS) WEIR Iw(t-1)	Iw(t)	PIPE Ip(t-1)	Ip(t)	AVG. I (cfs)	OUTFLOW (CFS) PIPE Op(t-1)	Op(t)	AVG. O (CFS)	DELTA VOL (Ac.-Ft.)	SUM VOL (Ac.-Ft.)	WSEL (Ft.)	Ha- Hb (Ft.)	PIPE DIAM. (in)	L (ft)	Qout (outlet control) (cfs)	Inv. at Pond out. or chan. (ft)	H (ft)	HW/D	Qout (inlet control) (cfs)	Qout at time= t (lower Q) (cfs)
7	0	0	0	0	0.0	15.3	14.93	15.1	-0.31	13.01	1391.57	3.43	18	91	14.93	1376.00	15.57	10.4	28.00	14.9
6	0	0	15.3	14.93	15.1	31.43	30.66	31.0	-0.33	8.27	1388.14	3.63	24	81	30.65	1375.20	12.94	6.5	59.00	30.7
5	0	0	31.43	30.66	31.0	42.18	44.45	43.3	-0.25	13.72	1384.51	2.72	30	73	44.45	1374.00	10.51	4.2	82.02	44.4
4	0	0	42.18	44.45	43.3	75.65	74.42	75.0	-0.66	11.78	1381.79	3.55	36	83	74.42	1373.00	8.79	2.9	101.39	74.4
3	0	0	75.65	74.42	75.0	98.02	103.28	100.7	-0.53	9.60	1378.24	3.73	42	106	103.28	1371.60	6.64	1.9	108.30	103.3
CHAN. 1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1374.51	N/A	N/A	N/A	N/A	1371.30	N/A	N/A	N/A	N/A

FILE: ROUTEB3

Routing through Ponds 3 - 7
File 3

Superstition Freeway: Power Road to Ellsworth Road
Project No.:
Arizona Department of Transportation

ROUTING TABLE FOR THE OFFLINE PONDS

TIME STEP: 14:15 Depth of flow in channel = 2.86 (ft.) Q = 715 cfs

POND NO.	INFLOW (CFS) WEIR Iw(t-1)	Iw(t)	PIPE Ip(t-1)	Ip(t)	AVG. I (cfs)	OUTFLOW (CFS) PIPE Op(t-1)	Op(t)	AVG. O (CFS)	DELTA VOL (Ac.-Ft.)	SUM VOL (Ac.-Ft.)	WSEL (Ft.)	Ha- Hb (Ft.)	PIPE DIAM. (in)	L (ft)	Qout (outlet control) (cfs)	Inv. at Pond out. or chan. (ft)	H (ft)	HW/D	Qout (inlet control) (cfs)	Qout at time= t (lower Q) (cfs)
7	0	0	0	0	0.0	14.93	14.64	14.8	-0.31	12.70	1391.09	3.30	18	91	14.64	1376.00	15.09	10.1	28.00	14.6
6	0	0	14.93	14.64	14.8	30.66	29.88	30.3	-0.32	7.95	1387.79	3.45	24	81	29.88	1375.20	12.59	6.3	59.00	29.9
5	0	0	30.66	29.88	30.3	44.45	46.06	45.3	-0.31	13.41	1384.33	2.92	30	73	46.06	1374.00	10.33	4.1	81.34	46.1
4	0	0	44.45	46.06	45.3	74.42	73.98	74.2	-0.60	11.18	1381.42	3.51	36	83	73.98	1373.00	8.42	2.8	98.54	74.0
3	0	0	74.42	73.98	74.2	103.28	103.54	103.4	-0.60	9.00	1377.91	3.75	42	106	103.54	1371.60	6.31	1.8	102.13	102.1
CHAN. 1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1374.16	N/A	N/A	N/A	N/A	1371.30	N/A	N/A	N/A	N/A

TIME STEP: 14:30 Depth of flow in channel = 2.65 (ft.) Q = 626 cfs

POND NO.	INFLOW (CFS) WEIR Iw(t-1)	Iw(t)	PIPE Ip(t-1)	Ip(t)	AVG. I (cfs)	OUTFLOW (CFS) PIPE Op(t-1)	Op(t)	AVG. O (CFS)	DELTA VOL (Ac.-Ft.)	SUM VOL (Ac.-Ft.)	WSEL (Ft.)	Ha- Hb (Ft.)	PIPE DIAM. (in)	L (ft)	Qout (outlet control) (cfs)	Inv. at Pond out. or chan. (ft)	H (ft)	HW/D	Qout (inlet control) (cfs)	Qout at time= t (lower Q) (cfs)
7	0	0	0	0	0.0	14.64	14.39	14.5	-0.30	12.40	1390.61	3.19	18	91	14.39	1376.00	14.61	9.7	28.00	14.4
6	0	0	14.64	14.39	14.5	29.88	29.14	29.5	-0.31	7.64	1387.43	3.29	24	81	29.14	1375.20	12.23	6.1	59.00	29.1
5	0	0	29.88	29.14	29.5	46.06	47.28	46.7	-0.35	13.06	1384.14	3.07	30	73	47.28	1374.00	10.14	4.1	80.56	47.3
4	0	0	46.06	47.28	46.7	73.98	73.73	73.9	-0.56	10.62	1381.07	3.48	36	83	73.73	1373.00	8.07	2.7	95.85	73.7
3	0	0	73.98	73.73	73.9	103.54	101.92	102.7	-0.60	8.40	1377.58	3.63	42	106	101.92	1371.60	5.98	1.7	96.03	96.0
CHAN. 1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1373.95	N/A	N/A	N/A	N/A	1371.30	N/A	N/A	N/A	N/A

TIME STEP: 14:45 Depth of flow in channel = 2.47 (ft.) Q = 558 cfs

POND NO.	INFLOW (CFS) WEIR Iw(t-1)	Iw(t)	PIPE Ip(t-1)	Ip(t)	AVG. I (cfs)	OUTFLOW (CFS) PIPE Qp(t-1)	Qp(t)	AVG. Q (CFS)	DELTA VOL (Ac.-Ft.)	SUM VOL (Ac.-Ft.)	WSEL (Ft.)	Ha- Hb (Ft.)	PIPE DIAM. (in)	L (ft)	Qout (outlet control) (cfs)	Inv. at Pond out. or chan. (ft)	H (ft)	HW/D	Qout (inlet control) (cfs)	Qout at time= t (lower Q) (cfs)
7	0	0	0	0	0.0	14.39	14.13	14.3	-0.29	12.11	1390.15	3.87	18	91	14.13	1376.00	14.15	9.4	28.00	14.1
6	0	0	14.39	14.13	14.3	29.14	28.57	28.9	-0.30	7.34	1387.07	3.16	24	81	28.57	1375.20	11.87	5.9	58.50	28.6
5	0	0	29.14	28.57	28.9	47.28	48.10	47.7	-0.39	12.67	1383.91	3.18	30	73	48.10	1374.00	9.91	4.0	79.66	48.1
4	0	0	47.28	48.1	47.7	73.73	73.48	73.6	-0.54	10.08	1380.73	3.46	36	83	73.48	1373.00	7.73	2.6	93.29	73.5
3	0	0	73.73	73.48	73.6	101.92	100.07	101.0	-0.57	7.83	1377.27	3.50	42	106	100.07	1371.60	5.67	1.6	96.24	90.2
CHAN. 1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1373.77	N/A	N/A	N/A	N/A	1371.30	N/A	N/A	N/A	N/A

TIME STEP: 15:00 Depth of flow in channel = 2.32 (ft.) Q = 502 cfs

POND NO.	INFLOW (CFS) WEIR Iw(t-1)	Iw(t)	PIPE Ip(t-1)	Ip(t)	AVG. I (cfs)	OUTFLOW (CFS) PIPE Qp(t-1)	Qp(t)	AVG. Q (CFS)	DELTA VOL (Ac.-Ft.)	SUM VOL (Ac.-Ft.)	WSEL (Ft.)	Ha- Hb (Ft.)	PIPE DIAM. (in)	L (ft)	Qout (outlet control) (cfs)	Inv. at Pond out. or chan. (ft)	H (ft)	HW/D	Qout (inlet control) (cfs)	Qout at time= t (lower Q) (cfs)
7	0	0	0	0	0.0	14.13	13.87	14.0	-0.29	11.82	1389.69	2.96	18	91	13.87	1376.00	13.69	9.1	28.00	13.9
6	0	0	14.13	13.87	14.0	28.57	28.20	28.4	-0.30	7.04	1386.72	3.07	24	81	28.20	1375.20	11.52	5.8	57.15	28.2
5	0	0	28.57	28.2	28.4	48.1	48.52	48.3	-0.41	12.26	1383.65	3.24	30	73	48.52	1374.00	9.65	3.9	78.59	48.5
4	0	0	48.1	48.52	48.3	73.48	73.16	73.3	-0.52	9.57	1380.41	3.43	36	83	73.16	1373.00	7.41	2.5	90.82	73.2
3	0	0	73.48	73.16	73.3	100.07	98.03	99.1	-0.53	7.30	1376.98	3.36	42	106	98.04	1371.60	5.38	1.5	84.80	84.8
CHAN. 1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1373.62	N/A	N/A	N/A	N/A	1371.30	N/A	N/A	N/A	N/A

FILE: ROUTEB4

Routing through Ponds 3 - 7
File 4

Superstition Freeway: Power Road to Ellsworth Road
Project No.:
Arizona Department of Transportation

ROUTING TABLE FOR THE OFFLINE PONDS

TIME STEP: 15:15 Depth of flow in channel = 2.18 (ft.) Q = 456 cfs

POND NO.	INFLOW (CFS) WEIR Iw(t-1)	Iw(t)	PIPE Ip(t-1)	Ip(t)	AVG. I (cfs)	OUTFLOW (CFS) PIPE Op(t-1)	Op(t)	AVG. O (CFS)	DELTA VOL (Ac.-Ft.)	SUM VOL (Ac.-Ft.)	WSEL (Ft.)	Ha- Hb (Ft.)	PIPE DIAM. (in)	L (ft)	Qout (outlet control) (cfs)	Inv. at Pond out. or chan. (ft)	H (ft)	HW/D	Qout (inlet control) (cfs)	Qout at time= t (lower Q) (cfs)
7	0	0	0	0	0.0	13.87	14.60	14.2	-0.29	12.04	1390.03	3.28	18	91	14.60	1376.00	14.03	9.4	28.00	14.6
6	0	0	13.87	14.6	14.2	28.20	29.30	28.8	-0.30	7.06	1386.74	3.32	24	81	29.30	1375.20	11.54	5.8	57.24	29.3
5	0	0	28.2	29.3	28.8	48.52	49.82	49.2	-0.42	11.91	1383.42	3.41	30	73	49.82	1374.00	9.42	3.8	77.70	49.8
4	0	0	48.52	49.82	49.2	73.16	70.77	72.0	-0.47	8.93	1380.01	3.21	36	83	70.77	1373.00	7.01	2.3	87.77	70.8
3	0	0	73.16	70.77	72.0	98.03	97.48	97.8	-0.53	6.98	1376.80	3.32	42	106	97.48	1371.60	5.20	1.5	81.47	81.5
CHAN. 1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1373.48	N/A	N/A	N/A	N/A	1371.30	N/A	N/A	N/A	N/A

TIME STEP: 15:45 Depth of flow in channel = 1.97 (ft.) Q = 383 cfs

POND NO.	INFLOW (CFS) WEIR Iw(t-1)	Iw(t)	PIPE Ip(t-1)	Ip(t)	AVG. I (cfs)	OUTFLOW (CFS) PIPE Op(t-1)	Op(t)	AVG. O (CFS)	DELTA VOL (Ac.-Ft.)	SUM VOL (Ac.-Ft.)	WSEL (Ft.)	Ha- Hb (Ft.)	PIPE DIAM. (in)	L (ft)	Qout (outlet control) (cfs)	Inv. at Pond out. or chan. (ft)	H (ft)	HW/D	Qout (inlet control) (cfs)	Qout at time= t (lower Q) (cfs)
7	0	0	0	0	0.0	14.60	14.07	14.3	-0.59	11.44	1389.09	3.05	18	91	14.07	1376.00	13.09	8.7	28.00	14.1
6	0	0	14.6	14.07	14.3	29.30	28.61	29.0	-0.60	6.46	1386.04	3.17	24	81	28.61	1375.20	10.84	5.4	54.49	28.6
5	0	0	29.3	28.61	29.0	49.82	49.72	49.8	-0.86	11.05	1382.87	3.40	30	73	49.72	1374.00	8.87	3.5	75.48	49.7
4	0	0	49.82	49.72	49.8	70.77	70.82	70.8	-0.87	8.06	1379.47	3.21	36	83	70.82	1373.00	6.47	2.2	83.61	70.8
3	0	0	70.77	70.82	70.8	97.48	92.41	94.9	-1.00	5.98	1376.26	2.99	42	106	92.41	1371.60	4.66	1.3	71.27	71.3
CHAN. 1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1373.27	N/A	N/A	N/A	N/A	1371.30	N/A	N/A	N/A	N/A

FILE: ROUTER4

Routing through Ponds 3 - 7
File 4

Superstition Freeway: Power Road to Ellsworth Road
Project No.:
Arizona Department of Transportation

ROUTING TABLE FOR THE OFFLINE PONDS

TIME STEP: 16:15 Depth of flow in channel = 1.80 (ft.) Q = 329 cfs

POND NO.	INFLOW (CFS) WEIR Iw(t-1)	WEIR Iw(t)	PIPE Ip(t-1)	PIPE Ip(t)	AVG. I (cfs)	OUTFLOW (CFS) PIPE Qo(t-1)	PIPE Qo(t)	AVG. O (CFS)	DELTA VOL (Ac.-Ft.)	SUM VOL (Ac.-Ft.)	WSEL (Ft.)	Ha- Hb (Ft.)	PIPE DIAM. (in)	L (ft)	Qout (outlet control) (cfs)	Inv. at Pond out. or chan. (ft)	H (ft)	HW/D	Qout (inlet control) (cfs)	Qout at time= t (lower Q) (cfs)
7	0	0	0	0	0.0	14.07	14.80	14.4	-0.60	10.85	1388.73	3.37	18	91	14.79	1376.00	12.73	8.5	28.00	14.8
6	0	0	14.07	14.8	14.4	28.61	28.12	28.4	-0.58	5.88	1385.36	3.06	24	81	28.12	1375.20	10.16	5.1	51.87	28.1
5	0	0	28.61	28.12	28.4	49.72	49.50	49.6	-0.88	10.17	1382.30	3.37	30	73	49.50	1374.00	8.30	3.3	71.78	49.5
4	0	0	49.72	49.5	49.6	70.82	70.11	70.5	-0.86	7.20	1378.93	3.15	36	83	70.12	1373.00	5.93	2.0	78.99	70.1
3	0	0	70.82	70.11	70.5	92.41	87.59	90.0	-0.81	5.17	1375.78	2.68	42	106	87.59	1371.60	4.18	1.2	62.43	62.4
CHAN. 1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1373.10	N/A	N/A	N/A	N/A	1371.30	N/A	N/A	N/A	N/A

TIME STEP: 16:45 Depth of flow in channel = 1.65 (ft.) Q = 283 cfs

POND NO.	INFLOW (CFS) WEIR Iw(t-1)	WEIR Iw(t)	PIPE Ip(t-1)	PIPE Ip(t)	AVG. I (cfs)	OUTFLOW (CFS) PIPE Qo(t-1)	PIPE Qo(t)	AVG. O (CFS)	DELTA VOL (Ac.-Ft.)	SUM VOL (Ac.-Ft.)	WSEL (Ft.)	Ha- Hb (Ft.)	PIPE DIAM. (in)	L (ft)	Qout (outlet control) (cfs)	Inv. at Pond out. or chan. (ft)	H (ft)	HW/D	Qout (inlet control) (cfs)	Qout at time= t (lower Q) (cfs)
7	0	0	0	0	0.0	14.80	15.47	15.1	-0.63	10.22	1388.42	3.68	18	91	15.47	1376.00	12.42	8.3	28.00	15.5
6	0	0	14.8	15.47	15.1	28.12	27.86	28.0	-0.53	5.35	1384.74	3.00	24	81	27.87	1375.20	9.54	4.8	49.46	27.9
5	0	0	28.12	27.86	28.0	49.50	49.15	49.3	-0.88	9.29	1381.73	3.32	30	73	49.15	1374.00	7.73	3.1	67.69	49.1
4	0	0	49.5	49.15	49.3	70.11	68.96	69.5	-0.84	6.36	1378.41	3.05	36	83	68.96	1373.00	5.41	1.8	71.01	69.0
3	0	0	70.11	68.96	69.5	87.59	83.10	85.3	-0.65	4.52	1375.37	2.42	42	106	83.10	1371.60	3.77	1.1	54.63	54.6
CHAN. 1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1372.95	N/A	N/A	N/A	N/A	1371.30	N/A	N/A	N/A	N/A

FILE: ROUTE85

Routing through Ponds 3 - 7
File 5

Superstition Freeway: Power Road to Ellsworth Road
Project No.:
Arizona Department of Transportation

ROUTING TABLE FOR THE OFFLINE PONDS

TIME STEP: 17:15 Depth of flow in channel = 1.56 (ft.) Q = 257 cfs

POND NO.	INFLOW (CFS) WEIR Iw(t-1)	Iw(t)	PIPE Ip(t-1)	Ip(t)	AVG. I (cfs)	OUTFLOW (CFS) PIPE Op(t-1)	Op(t)	AVG. O (CFS)	DELTA VOL (Ac.-Ft.)	SUM VOL (Ac.-Ft.)	WSEL (Ft.)	Ha- Hb (Ft.)	PIPE DIAM. (in)	L (ft)	Qout (outlet control) (cfs)	Inv. at Pond out. or chan. (ft)	H (ft)	HW/D	Qout (inlet control) (cfs)	Qout at time= t (lower Q) (cfs)
7	0	0	0	0	0.0	15.47	16.01	15.7	-0.65	9.57	1388.10	3.94	18	91	16.00	1376.00	12.10	8.1	28.00	16.0
6	0	0	15.47	16.01	15.7	27.86	27.76	27.8	-0.50	4.85	1384.15	2.98	24	81	27.77	1375.20	8.95	4.5	47.20	27.8
5	0	0	27.86	27.76	27.8	49.15	48.75	49.0	-0.87	8.42	1381.17	3.27	30	73	48.75	1374.00	7.17	2.9	63.64	48.8
4	0	0	49.15	48.75	49.0	68.96	67.03	68.0	-0.79	5.57	1377.90	2.88	36	83	67.03	1373.00	4.90	1.6	63.21	63.2
3	0	0	68.96	67.03	68.0	83.10	78.69	80.9	-0.53	3.99	1375.03	2.17	42	106	78.68	1371.60	3.43	1.0	48.28	48.3
CHAN. 1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1372.86	N/A	N/A	N/A	N/A	1371.30	N/A	N/A	N/A	N/A

TIME STEP: 17:45 Depth of flow in channel = 1.46 (ft.) Q = 231 cfs

POND NO.	INFLOW (CFS) WEIR Iw(t-1)	Iw(t)	PIPE Ip(t-1)	Ip(t)	AVG. I (cfs)	OUTFLOW (CFS) PIPE Op(t-1)	Op(t)	AVG. O (CFS)	DELTA VOL (Ac.-Ft.)	SUM VOL (Ac.-Ft.)	WSEL (Ft.)	Ha- Hb (Ft.)	PIPE DIAM. (in)	L (ft)	Qout (outlet control) (cfs)	Inv. at Pond out. or chan. (ft)	H (ft)	HW/D	Qout (inlet control) (cfs)	Qout at time= t (lower Q) (cfs)
7	0	0	0	0	0.0	16.01	16.67	16.3	-0.68	8.89	1387.76	4.28	18	91	16.66	1376.00	11.76	7.8	28.00	16.7
6	0	0	16.01	16.67	16.3	27.76	27.28	27.5	-0.46	4.39	1383.49	2.88	24	81	27.28	1375.20	8.29	4.1	44.61	27.3
5	0	0	27.76	27.28	27.5	48.75	48.49	48.6	-0.87	7.54	1380.61	3.23	30	73	48.49	1374.00	6.61	2.6	59.59	48.5
4	0	0	48.75	48.49	48.6	67.03	64.27	65.7	-0.70	4.87	1377.38	2.65	36	83	64.27	1373.00	4.38	1.5	55.11	55.1
3	0	0	67.03	64.27	65.7	78.69	75.03	76.9	-0.46	3.52	1374.73	1.97	42	106	75.03	1371.60	3.13	0.9	42.75	42.7
CHAN. 1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1372.76	N/A	N/A	N/A	N/A	1371.30	N/A	N/A	N/A	N/A

TIME STEP: 18:15 Depth of flow in channel = 1.39 (ft.) Q = 210 cfs

POND NO.	INFLOW (CFS) WEIR Iw(t-1)	Iw(t)	PIPE Ip(t-1)	Ip(t)	AVG. I (cfs)	OUTFLOW (CFS) PIPE Qp(t-1)	Qp(t)	AVG. O (CFS)	DELTA VOL (Ac.-Ft.)	SUM VOL (Ac.-Ft.)	WSEL (Ft.)	Ha- Hb (Ft.)	PIPE DIAM. (in)	L (ft)	Qout (outlet control) (cfs)	Inv. at Pond out. or chan. (ft)	H (ft)	HW/D	Qout (inlet control) (cfs)	Qout at time= t (lower Q) (cfs)
7	0	0	0	0	0.0	16.67	17.24	17.0	-0.70	8.19	1387.42	4.58	18	91	17.24	1376.00	11.42	7.6	28.00	17.2
6	0	0	16.67	17.24	17.0	27.28	26.86	27.1	-0.42	3.97	1382.84	2.79	24	81	26.86	1375.20	7.64	3.8	42.10	26.9
5	0	0	27.28	26.86	27.1	48.49	47.75	48.1	-0.87	6.67	1380.05	3.13	30	73	47.75	1374.00	6.05	2.4	55.55	47.8
4	0	0	48.49	47.75	48.1	64.27	61.83	63.1	-0.62	4.25	1376.91	2.45	36	83	61.83	1373.00	3.91	1.3	48.01	48.0
3	0	0	64.27	61.83	63.1	75.03	71.20	73.1	-0.42	3.11	1374.46	1.77	42	106	71.20	1371.60	2.86	0.8	37.78	37.8
CHAN. 1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1372.69	N/A	N/A	N/A	N/A	1371.30	N/A	N/A	N/A	N/A

TIME STEP: 18:45 Depth of flow in channel = 1.32 (ft.) Q = 194 cfs

POND NO.	INFLOW (CFS) WEIR Iw(t-1)	Iw(t)	PIPE Ip(t-1)	Ip(t)	AVG. I (cfs)	OUTFLOW (CFS) PIPE Qp(t-1)	Qp(t)	AVG. O (CFS)	DELTA VOL (Ac.-Ft.)	SUM VOL (Ac.-Ft.)	WSEL (Ft.)	Ha- Hb (Ft.)	PIPE DIAM. (in)	L (ft)	Qout (outlet control) (cfs)	Inv. at Pond out. or chan. (ft)	H (ft)	HW/D	Qout (inlet control) (cfs)	Qout at time= t (lower Q) (cfs)
7	0	0	0	0	0.0	17.24	17.70	17.5	-0.72	7.47	1387.06	4.82	18	91	17.70	1376.00	11.06	7.4	28.00	17.7
6	0	0	17.24	17.7	17.5	26.86	26.98	26.9	-0.39	3.58	1382.23	2.82	24	81	26.98	1375.20	7.03	3.5	39.76	27.0
5	0	0	26.86	26.98	26.9	47.75	46.15	47.0	-0.83	5.85	1379.42	2.93	30	73	46.15	1374.00	5.42	2.2	51.01	46.1
4	0	0	47.75	46.15	47.0	61.83	59.40	60.6	-0.56	3.69	1376.49	2.26	36	83	59.40	1373.00	3.49	1.2	41.51	41.5
3	0	0	61.83	59.4	60.6	71.20	67.81	69.5	-0.37	2.74	1374.23	1.61	42	106	67.81	1371.60	2.63	0.8	33.40	33.4
CHAN. 1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1372.62	N/A	N/A	N/A	N/A	1371.30	N/A	N/A	N/A	N/A

FILE: ROUTEB6

Routing through Ponds 3 - 7
File 6

Superstition Freeway: Power Road to Ellsworth Road
Project No.:
Arizona Department of Transportation

ROUTING TABLE FOR THE OFFLINE PONDS

TIME STEP: 19:15 Depth of flow in channel = 1.26 (ft.) Q = 180 cfs

POND NO.	INFLOW (CFS) WEIR Iw(t-1)	WEIR Iw(t)	PIPE Ip(t-1)	PIPE Ip(t)	AVG. I (cfs)	OUTFLOW (CFS) PIPE Op(t-1)	PIPE Op(t)	AVG. O (CFS)	DELTA VOL (Ac.-Ft.)	SUM VOL (Ac.-Ft.)	WSEL (Ft.)	Ha- Hb (Ft.)	PIPE DIAM. (in)	L (ft)	Qout (outlet control) (cfs)	Inv. at Pond out. or chan. (ft)	H (ft)	HW/D	Qout (inlet control) (cfs)	Qout at time= t (lower Q) (cfs)
7	0	0	0	0	0.0	17.70	18.09	17.90	-0.74	6.73	1386.69	5.04	18	91	18.09	1376.00	10.69	7.1	28.00	18.1
6	0	0	17.7	18.09	17.9	26.98	26.99	26.99	-0.38	3.20	1381.65	2.82	24	81	27.00	1375.20	6.45	3.2	37.49	27.0
5	0	0	26.98	26.99	27.0	45.15	44.62	45.39	-0.76	5.09	1378.83	2.74	30	73	44.61	1374.00	4.83	1.9	46.79	44.6
4	0	0	46.15	44.62	45.4	59.40	56.94	58.17	-0.53	3.16	1376.10	2.08	36	83	56.95	1373.00	3.10	1.0	35.46	35.5
3	0	0	59.4	56.94	58.2	67.81	64.54	66.18	-0.33	2.41	1374.02	1.46	42	106	64.53	1371.60	2.42	0.7	29.44	29.4
CHAN. 1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1372.56	N/A	N/A	N/A	N/A	1371.30	N/A	N/A	N/A	N/A

TIME STEP: 19:45 Depth of flow in channel = 1.21 (ft.) Q = 168 cfs

POND NO.	INFLOW (CFS) WEIR Iw(t-1)	WEIR Iw(t)	PIPE Ip(t-1)	PIPE Ip(t)	AVG. I (cfs)	OUTFLOW (CFS) PIPE Op(t-1)	PIPE Op(t)	AVG. O (CFS)	DELTA VOL (Ac.-Ft.)	SUM VOL (Ac.-Ft.)	WSEL (Ft.)	Ha- Hb (Ft.)	PIPE DIAM. (in)	L (ft)	Qout (outlet control) (cfs)	Inv. at Pond out. or chan. (ft)	H (ft)	HW/D	Qout (inlet control) (cfs)	Qout at time= t (lower Q) (cfs)
7	0	0	0	0	0.0	18.09	18.42	18.26	-0.75	5.98	1386.32	5.22	18	91	18.42	1376.00	10.32	6.9	28.00	18.4
6	0	0	18.09	18.42	18.3	26.99	26.92	26.96	-0.36	2.84	1381.09	2.80	24	81	26.92	1375.20	5.89	2.9	35.33	26.9
5	0	0	26.99	26.92	27.0	44.62	43.17	43.90	-0.70	4.39	1378.29	2.56	30	73	43.16	1374.00	4.29	1.7	42.89	42.9
4	0	0	44.62	43.17	43.9	56.94	54.49	55.72	-0.49	2.67	1375.73	1.90	36	83	54.49	1373.00	2.73	0.9	29.84	29.8
3	0	0	56.94	54.49	55.7	64.54	61.33	62.94	-0.30	2.11	1373.83	1.32	42	106	61.33	1371.60	2.23	0.6	25.88	25.9
CHAN. 1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1372.51	N/A	N/A	N/A	N/A	1371.30	N/A	N/A	N/A	N/A

FILE: ROUTE85

Routing through Ponds 3 - 7
File 6

Superstition Freeway: Power Road to Ellsworth Road
Project No.:
Arizona Department of Transportation

ROUTING TABLE FOR THE OFFLINE PONDS

TIME STEP: 20:15 Depth of flow in channel = 1.16 (ft.) Q = 157 cfs

POND NO.	WEIR Iw(t-1)	WEIR Iw(t)	PIPE Ip(t-1)	PIPE Ip(t)	AVG. I (cfs)	PIPE Op(t-1)	PIPE Op(t)	AVG. O (CFS)	DELTA VOL (Ac.-Ft.)	SUM VOL (Ac.-Ft.)	WSEL (Ft.)	Ha- Hb (Ft.)	PIPE DIAM. (in)	L (ft)	Qout (outlet control) (cfs)	Inv. at Pond out. or chan. (ft)	H (ft)	HW/D	Qout (inlet control) (cfs)	Qout at time= t (lower Q) (cfs)
7	0	0	0	0	0.0	18.42	18.48	18.45	-0.76	5.21	1383.82	5.26	18	91	18.46	1376.00	9.82	6.5	28.00	18.5
6	0	0	18.42	18.48	18.5	26.92	26.74	26.83	-0.35	2.50	1380.56	2.77	24	81	26.74	1375.20	5.36	2.7	33.25	26.7
5	0	0	26.92	26.74	26.8	43.17	41.76	42.47	-0.65	3.74	1377.79	2.40	30	73	41.76	1374.00	3.79	1.5	39.29	39.3
4	0	0	43.17	41.76	42.5	54.49	52.11	53.30	-0.45	2.23	1375.39	1.74	36	83	52.11	1373.00	2.39	0.8	24.69	24.7
3	0	0	54.49	52.11	53.3	61.33	58.38	59.86	-0.27	1.84	1373.65	1.19	42	106	58.38	1371.60	2.05	0.6	22.65	22.6
CHAN. 1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1372.46	N/A	N/A	N/A	N/A	1371.30	N/A	N/A	N/A	N/A

TIME STEP: 20:45 Depth of flow in channel = 1.13 (ft.) Q = 149 cfs

POND NO.	WEIR Iw(t-1)	WEIR Iw(t)	PIPE Ip(t-1)	PIPE Ip(t)	AVG. I (cfs)	PIPE Op(t-1)	PIPE Op(t)	AVG. O (CFS)	DELTA VOL (Ac.-Ft.)	SUM VOL (Ac.-Ft.)	WSEL (Ft.)	Ha- Hb (Ft.)	PIPE DIAM. (in)	L (ft)	Qout (outlet control) (cfs)	Inv. at Pond out. or chan. (ft)	H (ft)	HW/D	Qout (inlet control) (cfs)	Qout at time= t (lower Q) (cfs)
7	0	0	0	0	0.0	18.48	17.52	18.00	-0.74	4.47	1384.73	4.72	18	91	17.52	1376.00	8.73	5.8	27.32	17.5
6	0	0	18.48	17.52	18.0	26.74	26.34	26.54	-0.35	2.15	1380.01	2.68	24	81	26.34	1375.20	4.81	2.4	31.13	26.3
5	0	0	26.74	26.34	26.5	41.76	40.36	41.06	-0.60	3.14	1377.33	2.24	30	73	40.37	1374.00	3.33	1.3	33.57	33.6
4	0	0	41.76	40.36	41.1	52.11	49.79	50.95	-0.41	1.82	1375.09	1.59	36	83	49.78	1373.00	2.09	0.7	19.98	20.0
3	0	0	52.11	49.79	51.0	58.38	55.24	56.81	-0.24	1.60	1373.50	1.07	42	106	55.24	1371.60	1.90	0.5	19.75	19.8
CHAN. 1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1372.43	N/A	N/A	N/A	N/A	1371.30	N/A	N/A	N/A	N/A

FILE: ROUTEB7

Routing through Ponds 3 - 7
File 7

Superstition Freeway: Power Road to Ellsworth Road
Project No.:
Arizona Department of Transportation

ROUTING TABLE FOR THE OFFLINE PONDS

TIME STEP: 21:15 Depth of flow in channel = 1.09 (ft.) Q = 141 cfs

POND NO.	INFLOW (CFS) WEIR Iw(t-1)	Iw(t)	PIPE Ip(t-1)	Ip(t)	AVG. I (cfs)	OUTFLOW (CFS) PIPE Op(t-1)	Op(t)	AVG. O (CFS)	DELTA VOL (Ac.-Ft.)	SUM VOL (Ac.-Ft.)	WSEL (Ft.)	Ha- Hb (Ft.)	PIPE DIAM. (in)	L (ft)	Qout (outlet control) (cfs)	Inv. at Pond out. or chan. (ft)	H (ft)	HW/D	Qout (inlet control) (cfs)	Qout at time= t (lower Q) (cfs)
7	0	0	0	0	0.0	17.5	16.84	17.2	-0.71	3.76	1383.70	4.36	18	91	16.84	1376.00	7.70	5.1	24.72	16.8
6	0	0	17.52	16.84	17.2	26.34	25.18	25.8	-0.35	1.80	1379.33	2.45	24	81	25.18	1375.20	4.13	2.1	28.52	25.2
5	0	0	26.34	25.18	25.8	40.4	38.83	39.6	-0.57	2.57	1376.88	2.07	30	73	38.83	1374.00	2.88	1.2	27.87	27.9
4	0	0	40.37	38.83	39.6	49.79	47.53	48.7	-0.37	1.45	1374.81	1.45	36	83	47.53	1373.00	1.81	0.6	15.71	15.7
3	0	0	49.79	47.53	48.7	55.24	52.64	53.9	-0.22	1.38	1373.36	0.97	42	106	52.64	1371.60	1.76	0.5	17.17	17.2
CHAN. 1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1372.39	N/A	N/A	N/A	N/A	1371.30	N/A	N/A	N/A	N/A

TIME STEP: 21:45 Depth of flow in channel = 1.06 (ft.) Q = 134 cfs

POND NO.	INFLOW (CFS) WEIR Iw(t-1)	Iw(t)	PIPE Ip(t-1)	Ip(t)	AVG. I (cfs)	OUTFLOW (CFS) PIPE Op(t-1)	Op(t)	AVG. O (CFS)	DELTA VOL (Ac.-Ft.)	SUM VOL (Ac.-Ft.)	WSEL (Ft.)	Ha- Hb (Ft.)	PIPE DIAM. (in)	L (ft)	Qout (outlet control) (cfs)	Inv. at Pond out. or chan. (ft)	H (ft)	HW/D	Qout (inlet control) (cfs)	Qout at time= t (lower Q) (cfs)
7	0	0	0	0	0.0	16.84	16.16	16.5	-0.68	3.08	1382.70	4.02	18	91	16.16	1376.00	6.70	4.5	22.21	16.2
6	0	0	16.84	16.16	16.5	25.18	24.03	24.6	-0.33	1.46	1378.68	2.23	24	81	24.03	1375.20	3.48	1.7	23.83	23.9
5	0	0	25.18	24.03	24.6	38.83	37.22	38.0	-0.55	2.01	1376.45	1.90	30	73	37.22	1374.00	2.45	1.0	22.38	22.4
4	0	0	38.83	37.22	38.0	47.53	45.31	46.4	-0.35	1.10	1374.55	1.32	36	83	45.31	1373.00	1.55	0.5	11.72	11.7
3	0	0	47.53	45.31	46.4	52.64	49.90	51.3	-0.20	1.18	1373.23	0.87	42	106	49.90	1371.60	1.63	0.5	15.85	15.8
CHAN. 1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1372.36	N/A	N/A	N/A	N/A	1371.30	N/A	N/A	N/A	N/A

FILE: ROUTER7

Routing through Ponds 3 - 7
File 7

Superstition Freeway: Power Road to Ellsworth Road
Project No.:
Arizona Department of Transportation

ROUTING TABLE FOR THE OFFLINE PONDS

TIME STEP: 22:15 Depth of flow in channel = 1.03 (ft.) Q = 127 cfs

POND NO.	INFLOW (CFS) WEIR Iw(t-1)	Iw(t)	PIPE Ip(t-1)	Ip(t)	AVG. I (cfs)	OUTFLOW (CFS) PIPE Op(t-1)	Op(t)	AVG. O (CFS)	DELTA VOL (Ac.-Ft.)	SUM VOL (Ac.-Ft.)	WSEL (Ft.)	Ha- Hb (Ft.)	PIPE DIAM. (in)	L (ft)	Qout (outlet control) (cfs)	Inv. at Pond out. or chan. (ft)	H (ft)	HW/D	Qout (inlet control) (cfs)	Qout at time= t (lower Q) (cfs)
7	0	0	0	0	0.0	16.16	15.46	15.8	-0.65	2.42	1381.75	3.68	18	91	15.46	1376.00	5.75	3.8	19.82	15.5
6	0	0	16.16	15.46	15.8	24.03	22.92	23.5	-0.32	1.14	1378.07	2.03	24	81	22.92	1375.20	2.87	1.4	18.97	19.0
5	0	0	24.03	22.92	23.5	37.22	35.52	36.4	-0.53	1.48	1376.04	1.74	30	73	35.53	1374.00	2.04	0.8	17.10	17.1
4	0	0	37.22	35.52	36.4	45.31	43.09	44.2	-0.32	0.78	1374.30	1.19	36	83	43.09	1373.00	1.30	0.4	9.56	9.6
3	0	0	45.31	43.09	44.2	49.9	47.35	48.6	-0.18	1.00	1373.11	0.78	42	106	47.35	1371.60	1.51	0.4	14.71	14.7
CHAN. 1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1372.33	N/A	N/A	N/A	N/A	1371.30	N/A	N/A	N/A	N/A

TIME STEP: 22:45 Depth of flow in channel = 1.01 (ft.) Q = 122 cfs

POND NO.	INFLOW (CFS) WEIR Iw(t-1)	Iw(t)	PIPE Ip(t-1)	Ip(t)	AVG. I (cfs)	OUTFLOW (CFS) PIPE Op(t-1)	Op(t)	AVG. O (CFS)	DELTA VOL (Ac.-Ft.)	SUM VOL (Ac.-Ft.)	WSEL (Ft.)	Ha- Hb (Ft.)	PIPE DIAM. (in)	L (ft)	Qout (outlet control) (cfs)	Inv. at Pond out. or chan. (ft)	H (ft)	HW/D	Qout (inlet control) (cfs)	Qout at time= t (lower Q) (cfs)
7	0	0	0	0	0.0	15.46	14.70	15.1	-0.62	1.80	1380.78	3.33	18	91	14.70	1376.00	4.78	3.2	17.37	14.7
6	0	0	15.46	14.7	15.1	22.92	22.77	22.8	-0.32	0.82	1377.45	2.01	24	81	22.77	1375.20	2.25	1.1	14.01	14.0
5	0	0	22.92	22.77	22.8	35.52	31.83	33.7	-0.45	1.03	1375.45	1.39	30	73	31.82	1374.00	1.45	0.6	9.50	9.5
4	0	0	35.52	31.83	33.7	43.09	40.46	41.8	-0.33	0.44	1374.05	1.05	36	83	40.46	1373.00	1.05	0.4	7.72	7.7
3	0	0	43.09	40.46	41.8	47.35	44.54	45.9	-0.17	0.83	1373.00	0.69	42	106	44.54	1371.60	1.40	0.4	13.64	13.6
CHAN. 1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1372.31	N/A	N/A	N/A	N/A	1371.30	N/A	N/A	N/A	N/A

FILE: ROUTE86

Routing through Ponds 3 - 7
File 8

Superstition Freeway: Power Road to Ellsworth Road
Project No.:
Arizona Department of Transportation

ROUTING TABLE FOR THE OFFLINE PONDS

TIME STEP: 23:45 Depth of flow in channel = 0.96 (ft.) Q = 112 cfs

POND NO.	WEIR Iw(t-1)	WEIR Iw(t)	PIPE Io(t-1)	PIPE Io(t)	AVG. I (cfs)	PIPE Oo(t-1)	PIPE Oo(t)	AVG. O (CFS)	DELTA VOL (Ac.-Ft.)	SUM VOL (Ac.-Ft.)	WSEL (Ft.)	Ha- Hb (Ft.)	PIPE DIAM. (in)	L (ft)	Qout (outlet control) (cfs)	Inv. at Pond out. or chan. (ft)	H (ft)	HW/D	Qout (inlet control) (cfs)	Qout at time= t (lower Q) (cfs)
7	0	0	0	0	0.0	13.6	10.4	12.0	-0.99	1.04	1379.22	1.68	18	91	10.44	1376.00	3.22	2.1	13.43	10.4
6	0	0	13.6	10.449	12.0	19.3	14.7	17.0	-0.41	0.87	1377.54	1.14	24	81	17.14	1375.20	2.34	1.2	14.72	14.7
5	0	0	19.3	14.7	17.0	27.7	21.8	24.7	-0.64	1.95	1376.40	0.85	30	73	24.85	1374.00	2.40	1.0	21.77	21.8
4	0	0	27.7	21.75	24.7	31.7	27.2	29.4	-0.39	2.44	1375.55	1.42	36	83	47.01	1373.00	2.55	0.9	27.17	27.2
3	0	0	31.7	27.15	29.4	36.1	31.7	33.9	-0.37	2.60	1374.14	1.88	42	106	73.28	1371.60	2.54	0.7	31.72	31.7
CHAN. 1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1372.26	N/A	N/A	N/A	N/A	1371.30	N/A	N/A	N/A	N/A

TIME STEP: 00:45 Depth of flow in channel = 0.9 (ft.) Q = 101 cfs

POND NO.	WEIR Iw(t-1)	WEIR Iw(t)	PIPE Io(t-1)	PIPE Io(t)	AVG. I (cfs)	PIPE Oo(t-1)	PIPE Oo(t)	AVG. O (CFS)	DELTA VOL (Ac.-Ft.)	SUM VOL (Ac.-Ft.)	WSEL (Ft.)	Ha- Hb (Ft.)	PIPE DIAM. (in)	L (ft)	Qout (outlet control) (cfs)	Inv. at Pond out. or chan. (ft)	H (ft)	HW/D	Qout (inlet control) (cfs)	Qout at time= t (lower Q) (cfs)
7	0	0	0	0	0.0	10.449	5.1	7.8	-0.64	0.39	1377.27	0.45	18	91	5.39	1376.00	1.27	0.8	5.12	5.1
6	0	0	10.449	5.1	7.8	14.7	9.0	11.9	-0.34	0.53	1376.82	0.89	24	81	15.18	1375.20	1.62	0.8	8.98	9.0
5	0	0	14.7	9	11.9	21.75	15.7	18.7	-0.57	1.38	1375.93	0.73	30	73	23.06	1374.00	1.93	0.8	15.73	15.7
4	0	0	21.75	15.749	18.7	27.15	21.8	24.5	-0.47	1.97	1375.20	1.32	36	83	45.39	1373.00	2.20	0.7	21.75	21.8
3	0	0	27.15	21.75	24.5	31.7	26.9	29.3	-0.40	2.20	1373.86	1.67	42	106	69.11	1371.60	2.28	0.7	26.91	26.9
CHAN. 1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1372.21	N/A	N/A	N/A	N/A	1371.30	N/A	N/A	N/A	N/A

FILE: ROUTE88

Routing through Ponds 3 - 7
File 8

Superstition Freeway: Power Road to Ellsworth Road
Project No.:
Arizona Department of Transportation

ROUTING TABLE FOR THE OFFLINE PONDS

TIME STEP: 01:45 Depth of flow in channel = 0.6 (ft.) Q = 70 cfs

POND NO.	INFLOW (CFS) WEIR Iw(t-1)	INFLOW (CFS) WEIR Iw(t)	INFLOW (CFS) PIPE Ip(t-1)	INFLOW (CFS) PIPE Ip(t)	INFLOW (CFS) AVG. I (cfs)	OUTFLOW (CFS) PIPE Op(t-1)	OUTFLOW (CFS) PIPE Op(t)	OUTFLOW (CFS) AVG. O (CFS)	DELTA VOL (Ac.-Ft.)	SUM VOL (Ac.-Ft.)	WSEL (Ft.)	Ha- Hb (Ft.)	PIPE DIAM. (in)	L (ft)	Qout (outlet control) (cfs)	Inv. at Pond out. or chan. (ft)	H (ft)	HW/D	Qout (inlet control) (cfs)	Qout at time= t (lower Q) (cfs)
7	0	0	0	0	0.0	5.1	1.2	3.1	-0.26	0.14	1376.44	0.39	18	91	5.03	1376.00	0.44	0.3	1.17	1.2
6	0	0	5.1	1.15	3.1	9	3.4	6.2	-0.25	0.28	1376.05	0.75	24	81	13.91	1375.20	0.85	0.4	3.39	3.4
5	0	0	9	3.4	6.2	15.749	7.6	11.7	-0.45	0.93	1375.30	0.52	30	73	19.48	1374.00	1.30	0.5	7.63	7.6
4	0	0	15.749	7.6	11.7	21.75	15.3	18.5	-0.56	1.41	1374.78	1.20	36	83	43.19	1373.00	1.78	0.6	15.26	15.3
3	0	0	21.75	15.25	18.5	26.949	21.3	24.1	-0.47	1.73	1373.58	1.64	42	106	68.52	1371.60	1.98	0.6	21.34	21.3
CHAN. 1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1371.94	N/A	N/A	N/A	N/A	1371.30	N/A	N/A	N/A	N/A

TIME STEP: 02:45 Depth of flow in channel = 0.5 (ft.) Q = 50 cfs

POND NO.	INFLOW (CFS) WEIR Iw(t-1)	INFLOW (CFS) WEIR Iw(t)	INFLOW (CFS) PIPE Ip(t-1)	INFLOW (CFS) PIPE Ip(t)	INFLOW (CFS) AVG. I (cfs)	OUTFLOW (CFS) PIPE Op(t-1)	OUTFLOW (CFS) PIPE Op(t)	OUTFLOW (CFS) AVG. O (CFS)	DELTA VOL (Ac.-Ft.)	SUM VOL (Ac.-Ft.)	WSEL (Ft.)	Ha- Hb (Ft.)	PIPE DIAM. (in)	L (ft)	Qout (outlet control) (cfs)	Inv. at Pond out. or chan. (ft)	H (ft)	HW/D	Qout (inlet control) (cfs)	Qout at time= t (lower Q) (cfs)
7	0	0	0	0	0.0	1.15	0.6	0.9	-0.07	0.07	1376.21	0.59	18	91	6.20	1376.00	0.21	0.1	0.56	0.6
6	0	0	1.15	0.55	0.9	3.4	1.7	2.6	-0.14	0.14	1375.62	0.75	24	81	13.90	1375.20	0.42	0.2	1.68	1.7
5	0	0	3.4	1.7	2.6	7.6	4.9	6.3	-0.31	0.62	1374.87	0.49	30	73	18.92	1374.00	0.87	0.3	4.68	4.9
4	0	0	7.6	4.9	6.3	15.25	10.1	12.7	-0.53	0.88	1374.38	1.12	36	83	41.77	1373.00	1.38	0.5	10.11	10.1
3	0	0	15.25	10.1	12.7	21.349	16.1	18.7	-0.50	1.23	1373.26	1.50	42	106	65.51	1371.60	1.66	0.5	16.14	16.1
CHAN. 1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1371.76	N/A	N/A	N/A	N/A	1371.30	N/A	N/A	N/A	N/A

FILE: ROUTECI Superstition Freeway: Power Road to Ellsworth Road Arizona Department of Transportation Project No.:

Routing through Ponds 8 - 10 ROUTING TABLE FOR THE OFFLINE PONDS
File 1

TIME STEP: 12:15 Depth of flow in channel = 1.44 (ft.) Q = 76 cfs

POND NO.	INFLOW (CFS) WEIR Iw(t-1)	Iw(t)	PIPE Io(t-1)	Io(t)	AVG. I (cfs)	OUTFLOW (CFS) PIPE Oo(t-1)	Oo(t)	AVG. O (CFS)	DELTA VOL (Ac.-Ft.)	SUM VOL (Ac.-Ft.)	WSEL (Ft.)	Ha- Hb (Ft.)	PIPE DIAM. (in)	L (ft)	Qout (outlet control) (cfs)	Inv. at Pond out. or chan. (ft)	H (ft)	HW/D	Qout (inlet control) (cfs)	Qout at time= t (lower Q) (cfs)
10	0	0	0	0	0.0	0	0	0.0	0.00	0.00	1415.80	3.10	18	76	14.35	1415.80	0.00	0.0	0.00	0.0
9	0	0	0	0	0.0	0	0	0.0	0.00	0.00	1412.70	1.80	36	72	54.03	1412.70	0.00	0.0	0.00	0.0
8	0	0	0	0	0.0	0	0	0.0	0.00	0.00	1410.90	0.00	36	203	0.00	1410.90	0.00	0.0	0.00	0.0
CHAN. 1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1411.94	N/A	N/A	N/A	N/A	1410.50	N/A	N/A	N/A	N/A

TIME STEP: 12:30 Depth of flow in channel = 3.76 (ft.) Q = 456 cfs

POND NO.	INFLOW (CFS) WEIR Iw(t-1)	Iw(t)	PIPE Io(t-1)	Io(t)	AVG. I (cfs)	OUTFLOW (CFS) PIPE Oo(t-1)	Oo(t)	AVG. O (CFS)	DELTA VOL (Ac.-Ft.)	SUM VOL (Ac.-Ft.)	WSEL (Ft.)	Ha- Hb (Ft.)	PIPE DIAM. (in)	L (ft)	Qout (outlet control) (cfs)	Inv. at Pond out. or chan. (ft)	H (ft)	HW/D	Qout (inlet control) (cfs)	Qout at time= t (lower Q) (cfs)
10	0	0	0	0	0.0	0	0	0.0	0.00	0.00	1415.80	2.89	18	76	14.33	1415.80	0.00	0.0	0.00	0.0
9	0	42	0	0	21.0	0	30.93	15.5	0.11	0.11	1412.91	0.59	36	72	30.93	1412.70	0.21	0.1	1.56	1.6
8	0	104	0	30.93	67.5	0	0	0.0	1.39	1.39	1412.32	0.00	36	203	0.00	1410.90	1.42	0.5	10.43	0.0
CHAN. 1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1414.26	N/A	N/A	N/A	N/A	1410.50	N/A	N/A	N/A	N/A

TIME STEP: 12:45 Depth of flow in channel = 4.2 (ft.) Q = 570 cfs

POND NO.	INFLOW (CFS) WEIR Iw(t-1)	Iw(t)	PIPE Io(t-1)	Io(t)	AVG. I (cfs)	OUTFLOW (CFS) PIPE Oo(t-1)	Oo(t)	AVG. O (CFS)	DELTA VOL (Ac.-Ft.)	SUM VOL (Ac.-Ft.)	WSEL (Ft.)	Ha- Hb (Ft.)	PIPE DIAM. (in)	L (ft)	Qout (outlet control) (cfs)	Inv. at Pond out. or chan. (ft)	H (ft)	HW/D	Qout (inlet control) (cfs)	Qout at time= t (lower Q) (cfs)
10	0	149	0	0	74.5	0	15.06	7.5	1.38	1.38	1417.87	3.19	18	76	15.06	1415.80	2.07	1.4	9.94	9.9
9	42	173	0	15.06	115.0	30.93	41.29	36.1	1.63	1.74	1414.68	1.05	36	72	41.30	1412.70	1.98	0.7	18.40	18.4
8	104	173	30.93	41.29	175.6	0	0.00	0.0	3.63	5.02	1413.63	0.00	36	203	0.00	1410.90	2.73	0.9	29.88	0.0
CHAN. 1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1414.70	N/A	N/A	N/A	N/A	1410.50	N/A	N/A	N/A	N/A

FILE: ROUTEC1 Superstition Freeway: Power Road to Ellsworth Road Arizona Department of Transportation Project No.:

Routing through Ponds 8 - 10 ROUTING TABLE FOR THE OFFLINE PONDS
File 1

TIME STEP: 13:00 Depth of flow in channel = 4.23 (ft.) Q = 579 cfs

POND NO.	INFLOW (CFS) WEIR Iw(t-1)	Iw(t)	PIPE Io(t-1)	Io(t)	AVG. I (cfs)	OUTFLOW (CFS) PIPE Oo(t-1)	Oo(t)	AVG. O (CFS)	DELTA VOL (Ac.-Ft.)	SUM VOL (Ac.-Ft.)	WSEL (Ft.)	Ha- Hb (Ft.)	PIPE DIAM. (in)	L (ft)	Qout (outlet control) (cfs)	Inv. at Pond out. or chan. (ft)	H (ft)	HW/D	Qout (inlet control) (cfs)	Qout at time= t (lower Q) (cfs)
10	149	193	0	0	171.0	15.06	16.42	15.7	3.21	4.59	1420.56	3.79	18	76	16.42	1415.80	4.76	3.2	17.33	16.4
9	173	196	15.06	16.42	200.2	41.29	49.94	45.6	3.19	4.94	1416.77	1.54	36	72	49.94	1412.70	4.07	1.4	50.41	49.9
8	175	187	41.29	49.94	226.6	0	23.56	11.8	4.44	9.46	1415.23	0.50	36	203	23.56	1410.90	4.33	1.4	54.43	23.6
CHAN. 1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1414.73	N/A	N/A	N/A	N/A	1410.50	N/A	N/A	N/A	N/A

TIME STEP: 13:15 Depth of flow in channel = 4.22 (ft.) Q = 576 cfs

POND NO.	INFLOW (CFS) WEIR Iw(t-1)	Iw(t)	PIPE Io(t-1)	Io(t)	AVG. I (cfs)	OUTFLOW (CFS) PIPE Oo(t-1)	Oo(t)	AVG. O (CFS)	DELTA VOL (Ac.-Ft.)	SUM VOL (Ac.-Ft.)	WSEL (Ft.)	Ha- Hb (Ft.)	PIPE DIAM. (in)	L (ft)	Qout (outlet control) (cfs)	Inv. at Pond out. or chan. (ft)	H (ft)	HW/D	Qout (inlet control) (cfs)	Qout at time= t (lower Q) (cfs)
10	193	133	0	0	163.0	16.42	17.55	17.0	3.02	7.61	1423.07	4.33	18	76	17.55	1415.80	7.27	4.8	23.65	17.5
9	196	171	16.42	17.55	200.5	49.94	58.68	54.3	3.02	7.96	1418.74	2.12	36	72	58.68	1412.70	6.04	2.0	80.33	58.7
8	187	177	49.94	58.68	236.3	23.56	45.83	34.7	4.17	13.63	1416.62	1.90	36	203	45.83	1410.90	5.72	1.9	75.71	45.8
CHAN. 1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1414.72	N/A	N/A	N/A	N/A	1410.50	N/A	N/A	N/A	N/A

TIME STEP: 13:30 Depth of flow in channel = 4.18 (ft.) Q = 567 cfs

POND NO.	INFLOW (CFS) WEIR Iw(t-1)	Iw(t)	PIPE Io(t-1)	Io(t)	AVG. I (cfs)	OUTFLOW (CFS) PIPE Oo(t-1)	Oo(t)	AVG. O (CFS)	DELTA VOL (Ac.-Ft.)	SUM VOL (Ac.-Ft.)	WSEL (Ft.)	Ha- Hb (Ft.)	PIPE DIAM. (in)	L (ft)	Qout (outlet control) (cfs)	Inv. at Pond out. or chan. (ft)	H (ft)	HW/D	Qout (inlet control) (cfs)	Qout at time= t (lower Q) (cfs)
10	133	53	0	0	93.0	17.55	17.37	17.5	1.56	9.17	1424.22	4.24	18	76	17.37	1415.80	8.42	5.6	26.55	17.4
9	171	131	17.55	17.37	168.5	58.68	60.43	59.6	2.25	10.21	1419.98	2.25	36	72	60.43	1412.70	7.28	2.4	69.81	60.4
8	177	160	58.68	60.43	228.1	45.83	58.05	51.9	3.64	17.27	1417.73	3.05	36	203	58.05	1410.90	6.83	2.3	86.35	58.1
CHAN. 1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1414.68	N/A	N/A	N/A	N/A	1410.50	N/A	N/A	N/A	N/A

FILE: ROUTEC1 Superstition Freeway: Power Road to Ellsworth Road Arizona Department of Transportation Project No.:

Routing through Ponds 8 - 10 ROUTING TABLE FOR THE OFFLINE PONDS
File 1

TIME STEP: 13:45 Depth of flow in channel = 4.15 (ft.) Q = 558 cfs

POND NO.	WEIR Iw(t-1)	WEIR Iw(t)	PIPE Ip(t-1)	PIPE Ip(t)	AVG. I (cfs)	PIPE Op(t-1)	PIPE Op(t)	AVG. O (CFS)	DELTA VOL (Ac.-Ft.)	SUM VOL (Ac.-Ft.)	WSEL (Ft.)	Ha- Hb (Ft.)	PIPE DIAM. (in)	L (ft)	Qout (outlet control) (cfs)	Inv. at Pond out. or chan. (ft)	H (ft)	HW/D	Qout (inlet control) (cfs)	Qout at time= t (lower Q) (cfs)
10	53	8	0	0	30.5	17.37	16.14	16.8	0.28	9.45	1424.42	3.66	18	76	16.14	1415.80	8.62	5.7	27.05	16.1
9	131	95	17.37	16.14	129.8	60.43	58.34	59.4	1.45	11.66	1420.76	2.10	36	72	58.34	1412.70	8.06	2.7	95.80	58.3
8	160	143	60.43	58.34	210.9	58.05	66.61	62.3	3.07	20.33	1418.66	4.91	36	203	66.61	1410.90	7.76	2.6	93.51	66.6
CHAN. 1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1414.65	N/A	N/A	N/A	N/A	1410.50	N/A	N/A	N/A	N/A

TIME STEP: 14:00 Depth of flow in channel = 4.00 (ft.) Q = 517 cfs

POND NO.	WEIR Iw(t-1)	WEIR Iw(t)	PIPE Ip(t-1)	PIPE Ip(t)	AVG. I (cfs)	PIPE Op(t-1)	PIPE Op(t)	AVG. O (CFS)	DELTA VOL (Ac.-Ft.)	SUM VOL (Ac.-Ft.)	WSEL (Ft.)	Ha- Hb (Ft.)	PIPE DIAM. (in)	L (ft)	Qout (outlet control) (cfs)	Inv. at Pond out. or chan. (ft)	H (ft)	HW/D	Qout (inlet control) (cfs)	Qout at time= t (lower Q) (cfs)
10	8	0	0	0	4.0	16.14	14.99	15.6	-0.24	9.21	1424.26	3.16	18	76	14.99	1415.80	8.46	5.6	26.63	15.0
9	95	45	16.14	14.99	85.6	58.34	52.55	55.4	0.62	12.29	1421.10	1.70	36	72	52.57	1412.70	8.40	2.8	98.37	52.6
8	143	118	58.34	52.55	185.9	66.61	73.54	70.1	2.39	22.73	1419.39	4.89	36	203	73.54	1410.90	8.49	2.8	99.10	73.5
CHAN. 1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1414.50	N/A	N/A	N/A	N/A	1410.50	N/A	N/A	N/A	N/A

FILE: ROUTEC2

Arizona Department of Transportation Project No.:

Pond routing through Ponds 8 - 10 ROUTING TABLE FOR THE OFFLINE PONDS
File 2

TIME STEP: 14:15 Depth of flow in channel = 3.43 (ft.) Q = 382 cfs

POND NO.	WEIR Iw(t-1)	WEIR Iw(t)	PIPE Io(t-1)	PIPE Io(t)	AVG. I (cfs)	PIPE Oo(t-1)	PIPE Oo(t)	AVG. O (CFS)	DELTA VOL (Ac.-Ft.)	SUM VOL (Ac.-Ft.)	WSEL (Ft.)	Ha- Hb (Ft.)	PIPE DIAM. (in)	L (ft)	Qout (outlet control) (cfs)	Inv. at Pond out. or chan. (ft)	H (ft)	HW/D	Qout (inlet control) (cfs)	Qout at time= t (lower Q) (cfs)
10	0	0	0	0	0.0	14.99	14.72	14.9	-0.31	8.90	1424.04	3.05	18	76	14.72	1415.80	8.24	5.5	26.08	14.7
9	45	1	14.99	14.72	37.9	52.55	43.28	47.9	-0.21	12.08	1420.99	1.16	36	72	43.28	1412.70	8.29	2.8	97.53	43.3
8	118	80	52.55	43.28	146.9	73.54	80.77	77.2	1.44	24.17	1419.83	5.90	36	203	80.77	1410.00	9.83	3.3	109.37	80.8
CHAN.	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1413.93	N/A	N/A	N/A	N/A	1410.50	N/A	N/A	N/A	N/A

TIME STEP: 14:30 Depth of flow in channel = 2.9 (ft.) Q = 212 cfs

POND NO.	WEIR Iw(t-1)	WEIR Iw(t)	PIPE Io(t-1)	PIPE Io(t)	AVG. I (cfs)	PIPE Oo(t-1)	PIPE Oo(t)	AVG. O (CFS)	DELTA VOL (Ac.-Ft.)	SUM VOL (Ac.-Ft.)	WSEL (Ft.)	Ha- Hb (Ft.)	PIPE DIAM. (in)	L (ft)	Qout (outlet control) (cfs)	Inv. at Pond out. or chan. (ft)	H (ft)	HW/D	Qout (inlet control) (cfs)	Qout at time= t (lower Q) (cfs)
10	0	0	0	0	0.0	14.72	14.86	14.8	-0.31	8.60	1423.82	3.10	18	76	14.86	1415.80	8.02	5.3	25.53	14.9
9	1	0	14.72	14.86	15.3	43.28	35.86	39.6	-0.50	11.58	1420.72	0.79	36	72	35.86	1412.70	8.02	2.7	95.46	35.9
8	80	36	43.28	35.86	97.6	80.77	84.93	82.9	0.30	24.48	1419.92	6.52	36	203	84.93	1410.00	9.92	3.3	110.08	84.9
CHAN.	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1413.40	N/A	N/A	N/A	N/A	1410.50	N/A	N/A	N/A	N/A

TIME STEP: 14:45 Depth of flow in channel = 2.67 (ft.) Q = 152 cfs

POND NO.	WEIR Iw(t-1)	WEIR Iw(t)	PIPE Io(t-1)	PIPE Io(t)	AVG. I (cfs)	PIPE Oo(t-1)	PIPE Oo(t)	AVG. O (CFS)	DELTA VOL (Ac.-Ft.)	SUM VOL (Ac.-Ft.)	WSEL (Ft.)	Ha- Hb (Ft.)	PIPE DIAM. (in)	L (ft)	Qout (outlet control) (cfs)	Inv. at Pond out. or chan. (ft)	H (ft)	HW/D	Qout (inlet control) (cfs)	Qout at time= t (lower Q) (cfs)
10	0	0	0	0	0.0	14.86	14.88	14.9	-0.31	8.29	1423.60	3.11	18	76	14.88	1415.80	7.80	5.2	24.99	14.9
9	0	0	14.86	14.88	14.9	35.86	34.50	35.2	-0.42	11.16	1420.49	0.73	36	72	34.50	1412.70	7.79	2.6	93.73	34.5
8	36	11	35.86	34.5	58.7	84.93	85.34	85.1	-0.55	23.93	1419.76	6.59	36	203	85.34	1410.00	9.76	3.3	108.80	85.3
CHAN.	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1413.17	N/A	N/A	N/A	N/A	1410.50	N/A	N/A	N/A	N/A

FILE: ROUTEC2

Arizona Department of Transportation Project No.:

Pond routing through Ponds 8 - 10 ROUTING TABLE FOR THE OFFLINE PONDS
File 2

TIME STEP: 15:00 Depth of flow in channel = 2.67 (ft.) Q = 144 cfs

POND NO.	INFLOW (CFS) WEIR Iw(t-1)	Iw(t)	PIPE Io(t-1)	Io(t)	AVG. I (cfs)	OUTFLOW (CFS) PIPE Qp(t-1)	Qp(t)	AVG. Q (CFS)	DELTA VOL (Ac.-Ft.)	SUM VOL (Ac.-Ft.)	WSEL (Ft.)	Ha- Hb (Ft.)	PIPE DIAM. (in)	L (ft)	Qout (outlet control) (cfs)	Inv. at Pond out. or chan. (ft)	H (ft)	HW/D	Qout (inlet control) (cfs)	Qout at time= t (lower Q) (cfs)
10	0	0	0	0	0.0	14.88	14.89	14.9	-0.31	7.98	1423.39	3.12	18	76	14.89	1415.80	7.59	5.1	24.44	14.9
9	0	0	14.88	14.89	14.9	34.5	35.69	35.1	-0.42	10.74	1420.27	0.79	36	72	35.69	1412.70	7.57	2.5	92.01	35.7
8	11	0	34.5	35.69	40.6	85.34	83.53	84.4	-0.91	23.02	1419.48	6.31	36	203	83.53	1410.00	9.48	3.2	106.69	83.5
CHAN. 1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1413.17	N/A	N/A	N/A	N/A	1410.50	N/A	N/A	N/A	N/A

TIME STEP: 15:15 Depth of flow in channel = 2.6 (ft.) Q = 143 cfs

POND NO.	INFLOW (CFS) WEIR Iw(t-1)	Iw(t)	PIPE Io(t-1)	Io(t)	AVG. I (cfs)	OUTFLOW (CFS) PIPE Qp(t-1)	Qp(t)	AVG. Q (CFS)	DELTA VOL (Ac.-Ft.)	SUM VOL (Ac.-Ft.)	WSEL (Ft.)	Ha- Hb (Ft.)	PIPE DIAM. (in)	L (ft)	Qout (outlet control) (cfs)	Inv. at Pond out. or chan. (ft)	H (ft)	HW/D	Qout (inlet control) (cfs)	Qout at time= t (lower Q) (cfs)
10	0	0	0	0	0.0	14.89	14.85	14.9	-0.31	7.68	1423.13	3.10	18	76	14.85	1415.80	7.33	4.9	23.79	14.8
9	0	0	14.89	14.85	14.9	35.69	36.91	36.3	-0.44	10.30	1420.03	0.84	36	72	36.91	1412.70	7.33	2.4	90.19	36.9
8	0	0	35.69	36.91	36.3	83.53	82.05	82.8	-0.96	22.06	1419.19	6.09	36	203	82.05	1410.00	9.19	3.1	104.45	82.0
CHAN. 1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1413.10	N/A	N/A	N/A	N/A	1410.50	N/A	N/A	N/A	N/A

TIME STEP: 15:45 Depth of flow in channel = 2.6 (ft.) Q = 142 cfs

POND NO.	INFLOW (CFS) WEIR Iw(t-1)	Iw(t)	PIPE Io(t-1)	Io(t)	AVG. I (cfs)	OUTFLOW (CFS) PIPE Qp(t-1)	Qp(t)	AVG. Q (CFS)	DELTA VOL (Ac.-Ft.)	SUM VOL (Ac.-Ft.)	WSEL (Ft.)	Ha- Hb (Ft.)	PIPE DIAM. (in)	L (ft)	Qout (outlet control) (cfs)	Inv. at Pond out. or chan. (ft)	H (ft)	HW/D	Qout (inlet control) (cfs)	Qout at time= t (lower Q) (cfs)
10	0	0	0	0	0.0	14.85	14.82	14.8	-0.61	7.06	1422.62	3.09	18	76	14.82	1415.80	6.82	4.5	22.51	14.8
9	0	0	14.85	14.82	14.8	36.91	37.77	37.3	-0.93	9.37	1419.53	0.88	36	72	37.76	1412.70	6.83	2.3	86.36	37.8
8	0	0	36.91	37.77	37.3	82.05	78.33	80.2	-1.77	20.29	1418.65	5.55	36	203	78.33	1410.00	8.65	2.9	100.31	78.3
CHAN. 1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1413.10	N/A	N/A	N/A	N/A	1410.50	N/A	N/A	N/A	N/A

FILE: ROUTEC2 Arizona Department of Transportation Project No.:

Pond routing through Ponds 8 - 10 ROUTING TABLE FOR THE OFFLINE PONDS
File 2

TIME STEP: 16:15 Depth of flow in channel = 2.5 (ft.) Q = 138 cfs

POND NO.	INFLOW (CFS) WEIR Iw(t-1)	Iw(t)	PIPE Io(t-1)	Io(t)	AVG. I (cfs)	OUTFLOW (CFS) PIPE Oo(t-1)	Oo(t)	AVG. O (CFS)	DELTA VOL (Ac.-Ft.)	SUM VOL (Ac.-Ft.)	WSEL (Ft.)	Ha- Hb (Ft.)	PIPE DIAM. (in)	L (ft)	Qout (outlet control) (cfs)	Inv. at Pond out. or chan. (ft)	H (ft)	HW/D	Qout (inlet control) (cfs)	Qout at time= t (lower Q) (cfs)
10	0	0	0	0	0.0	14.82	14.82	14.8	-0.61	6.45	1422.11	3.09	18	76	14.82	1415.80	6.31	4.2	21.23	14.8
9	0	0	14.82	14.82	14.8	37.77	37.50	37.6	-0.94	8.43	1419.02	0.87	36	72	37.50	1412.70	6.32	2.1	82.47	37.5
8	0	0	37.77	37.5	37.6	78.33	75.5	76.9	-1.62	18.67	1418.16	5.16	36	203	75.50	1410.00	8.16	2.7	96.53	75.5
CHAN. 1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1413.00	N/A	N/A	N/A	N/A	1410.50	N/A	N/A	N/A	N/A

TIME STEP: 16:45 Depth of flow in channel = 2.5 (ft.) Q = 133 cfs

POND NO.	INFLOW (CFS) WEIR Iw(t-1)	Iw(t)	PIPE Io(t-1)	Io(t)	AVG. I (cfs)	OUTFLOW (CFS) PIPE Oo(t-1)	Oo(t)	AVG. O (CFS)	DELTA VOL (Ac.-Ft.)	SUM VOL (Ac.-Ft.)	WSEL (Ft.)	Ha- Hb (Ft.)	PIPE DIAM. (in)	L (ft)	Qout (outlet control) (cfs)	Inv. at Pond out. or chan. (ft)	H (ft)	HW/D	Qout (inlet control) (cfs)	Qout at time= t (lower Q) (cfs)
10	0	0	0	0	0.0	14.82	14.93	14.9	-0.61	5.84	1421.60	3.14	18	76	14.93	1415.80	5.80	3.9	19.94	14.9
9	0	0	14.82	14.93	14.9	37.5	35.58	36.5	-0.90	7.53	1418.46	0.78	36	72	35.49	1412.70	5.76	1.9	76.38	35.5
8	0	0	37.5	35.58	36.5	75.5	71.99	73.7	-1.54	17.13	1417.69	4.69	36	203	71.99	1410.00	7.69	2.6	92.94	72.0
CHAN. 1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1413.00	N/A	N/A	N/A	N/A	1410.50	N/A	N/A	N/A	N/A

FILE: ROUTEC3 Superstition Freeway: Power Road to Ellsworth Road Arizona Department of Transportation Project No.:

Routing through Ponds 8 - 10 ROUTING TABLE FOR THE OFFLINE PONDS
File 3

TIME STEP: 17:15 Depth of flow in channel = 2.5 (ft.) Q = 127 cfs

POND NO.	INFLOW (CFS) WEIR Iw(t-1)	Iw(t)	PIPE Ip(t-1)	Ip(t)	AVG. I (cfs)	OUTFLOW (CFS) PIPE Op(t-1)	Op(t)	AVG. O (CFS)	DELTA VOL (Ac.-Ft.)	SUM VOL (Ac.-Ft.)	WSEL (Ft.)	Ha- Hb (Ft.)	PIPE DIAM. (in)	L (ft)	Qout (outlet control) (cfs)	Inv. at Pond out. or chan. (ft)	H (ft)	HW/D	Qout (inlet control) (cfs)	Qout at time= t+1 (lower Q) (cfs)
10	0	0	0	0	0.0	14.93	15.19	15.1	-0.62	5.22	1421.08	3.25	18	76	15.19	1415.80	5.28	3.5	18.64	15.2
9	0	0	14.93	0	7.5	35.58	25.48	30.5	-0.95	6.58	1417.84	0.40	36	72	25.48	1412.70	5.14	1.7	66.81	25.5
8	0	0	35.58	25.48	30.5	71.99	70.06	71.0	-1.67	16.32	1417.44	4.44	36	203	70.06	1410.00	7.44	2.5	91.03	70.1
CHAN. 1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1413.00	N/A	N/A	N/A	N/A	1410.50	N/A	N/A	N/A	N/A

TIME STEP: 17:45 Depth of flow in channel = 2.4 (ft.) Q = 120 cfs

POND NO.	INFLOW (CFS) WEIR Iw(t-1)	Iw(t)	PIPE Ip(t-1)	Ip(t)	AVG. I (cfs)	OUTFLOW (CFS) PIPE Op(t-1)	Op(t)	AVG. O (CFS)	DELTA VOL (Ac.-Ft.)	SUM VOL (Ac.-Ft.)	WSEL (Ft.)	Ha- Hb (Ft.)	PIPE DIAM. (in)	L (ft)	Qout (outlet control) (cfs)	Inv. at Pond out. or chan. (ft)	H (ft)	HW/D	Qout (inlet control) (cfs)	Qout at time= t+1 (lower Q) (cfs)
10	0	0	0	0	0.0	15.19	14.79	15.0	-0.62	4.60	1420.57	3.08	18	76	14.79	1415.80	4.77	3.2	17.35	14.8
9	0	0	15.19	14.79	15.0	25.48	30.22	27.9	-0.53	6.05	1417.49	0.56	36	72	30.23	1412.70	4.79	1.6	61.48	30.2
8	0	0	25.48	30.22	27.9	70.06	66.74	68.4	-1.68	14.64	1416.93	4.03	36	203	66.74	1410.00	6.93	2.3	87.12	66.7
CHAN. 1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1412.90	N/A	N/A	N/A	N/A	1410.50	N/A	N/A	N/A	N/A

TIME STEP: 18:15 Depth of flow in channel = 2.3 (ft.) Q = 113 cfs

POND NO.	INFLOW (CFS) WEIR Iw(t-1)	Iw(t)	PIPE Ip(t-1)	Ip(t)	AVG. I (cfs)	OUTFLOW (CFS) PIPE Op(t-1)	Op(t)	AVG. O (CFS)	DELTA VOL (Ac.-Ft.)	SUM VOL (Ac.-Ft.)	WSEL (Ft.)	Ha- Hb (Ft.)	PIPE DIAM. (in)	L (ft)	Qout (outlet control) (cfs)	Inv. at Pond out. or chan. (ft)	H (ft)	HW/D	Qout (inlet control) (cfs)	Qout at time= t+1 (lower Q) (cfs)
10	0	0	0	0	0.0	14.79	14.60	14.7	-0.61	3.99	1420.06	3.00	18	76	14.59	1415.80	4.26	2.8	16.07	14.6
9	0	0	14.79	14.6	14.7	30.22	30.61	30.4	-0.65	5.40	1417.07	0.58	36	72	30.61	1412.70	4.37	1.5	54.98	30.6
8	0	0	30.22	30.61	30.4	66.74	63.87	65.3	-1.44	13.20	1416.49	3.69	36	203	63.87	1410.00	6.49	2.2	83.76	63.9
CHAN. 1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1412.80	N/A	N/A	N/A	N/A	1410.50	N/A	N/A	N/A	N/A

FILE: ROUTEC3 Superstition Freeway: Power Road to Ellsworth Road Arizona Department of Transportation Project No.:

Routing through Ponds 8 - 10 ROUTING TABLE FOR THE OFFLINE PONDS
File 3

TIME STEP: 18:45 Depth of flow in channel = 2.3 (ft.) Q = 106 cfs

POND NO.	INFLOW (CFS) WEIR Iw(t-1)	Iw(t)	PIPE Ip(t-1)	Ip(t)	AVG. I (cfs)	OUTFLOW (CFS) PIPE Op(t-1)	Op(t)	AVG. O (CFS)	DELTA VOL (Ac.-Ft.)	SUM VOL (Ac.-Ft.)	WSEL (Ft.)	Ha- Hb (Ft.)	PIPE DIAM. (in)	L (ft)	Qout (outlet control) (cfs)	Inv. at Pond out. or chan. (ft)	H (ft)	HW/D	Qout (inlet control) (cfs)	Qout at time= t+1 (lower Q) (cfs)
10	0	0	0	0	0.0	14.6	14.42	14.5	-0.50	3.39	1419.57	2.92	18	76	14.42	1415.80	3.77	2.5	14.82	14.4
9	0	0	14.6	14.42	14.5	30.61	29.94	30.3	-0.65	4.74	1416.64	0.55	36	72	29.94	1412.70	3.94	1.3	48.45	29.9
8	0	0	30.61	29.94	30.3	63.87	60.31	62.1	-1.31	11.88	1416.09	3.29	36	203	60.31	1410.00	6.09	2.0	80.69	60.3
CHAN. 1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1412.80	N/A	N/A	N/A	N/A	1410.50	N/A	N/A	N/A	N/A

TIME STEP: 19:15 Depth of flow in channel = 2.2 (ft.) Q = 101 cfs

POND NO.	INFLOW (CFS) WEIR Iw(t-1)	Iw(t)	PIPE Ip(t-1)	Ip(t)	AVG. I (cfs)	OUTFLOW (CFS) PIPE Op(t-1)	Op(t)	AVG. O (CFS)	DELTA VOL (Ac.-Ft.)	SUM VOL (Ac.-Ft.)	WSEL (Ft.)	Ha- Hb (Ft.)	PIPE DIAM. (in)	L (ft)	Qout (outlet control) (cfs)	Inv. at Pond out. or chan. (ft)	H (ft)	HW/D	Qout (inlet control) (cfs)	Qout at time= t+1 (lower Q) (cfs)
10	0	0	0	0	0.0	14.42	14.23	14.3	-0.59	2.80	1419.07	2.85	18	76	14.23	1415.80	3.27	2.2	13.58	13.6
9	0	0	14.42	14.23	14.3	29.94	29.81	29.9	-0.64	4.10	1416.22	0.55	36	72	29.81	1412.70	3.52	1.2	42.01	29.8
8	0	0	29.94	29.81	29.9	60.31	57.35	58.8	-1.20	10.69	1415.67	2.97	36	203	57.35	1410.00	5.67	1.9	75.01	57.3
CHAN. 1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1412.70	N/A	N/A	N/A	N/A	1410.50	N/A	N/A	N/A	N/A

TIME STEP: 19:45 Depth of flow in channel = 2.1 (ft.) Q = 91 cfs

POND NO.	INFLOW (CFS) WEIR Iw(t-1)	Iw(t)	PIPE Ip(t-1)	Ip(t)	AVG. I (cfs)	OUTFLOW (CFS) PIPE Op(t-1)	Op(t)	AVG. O (CFS)	DELTA VOL (Ac.-Ft.)	SUM VOL (Ac.-Ft.)	WSEL (Ft.)	Ha- Hb (Ft.)	PIPE DIAM. (in)	L (ft)	Qout (outlet control) (cfs)	Inv. at Pond out. or chan. (ft)	H (ft)	HW/D	Qout (inlet control) (cfs)	Qout at time= t+1 (lower Q) (cfs)
10	0	0	0	0	0.0	14.23	14.06	14.1	-0.58	2.21	1418.59	2.78	18	76	14.06	1415.80	2.79	1.9	12.35	12.4
9	0	0	14.23	14.06	14.1	29.81	29.21	29.5	-0.63	3.47	1415.81	0.53	36	72	29.22	1412.70	3.11	1.0	35.65	29.2
8	0	0	29.81	29.21	29.5	57.33	54.45	55.9	-1.09	9.60	1415.28	2.68	36	203	54.45	1410.00	5.28	1.8	68.98	54.4
CHAN. 1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1412.60	N/A	N/A	N/A	N/A	1410.50	N/A	N/A	N/A	N/A

FILE: ROUTEC3 Superstition Freeway: Power Road to Ellsworth Road Arizona Department of Transportation Project No.:

Routing through Ponds 8 - 10 ROUTING TABLE FOR THE OFFLINE PONDS
File 3

TIME STEP: 20:15 Depth of flow in channel = 2 (ft.) Q = 86 cfs

POND NO.	INFLOW (CFS) WEIR Iw(t-1)	Iw(t)	PIPE Ip(t-1)	Ip(t)	AVG. I (cfs)	OUTFLOW (CFS) PIPE Op(t-1)	Op(t)	AVG. O (CFS)	DELTA VOL (Ac.-Ft.)	SUM VOL (Ac.-Ft.)	WSEL (Ft.)	Ha- Hb (Ft.)	PIPE DIAM. (in)	L (ft)	Qout (outlet control) (cfs)	Inv. at Pond out. or chan. (ft)	H (ft)	HW/D	Qout (inlet control) (cfs)	Qout at time= t+1 (lower Q) (cfs)
10	0	0	0	0	0.0	14.06	13.85	14.0	-0.58	1.64	1418.11	2.70	18	76	13.85	1415.80	2.31	1.5	11.14	11.1
9	0	0	14.06	13.85	14.0	29.21	28.22	28.7	-0.61	2.86	1415.41	0.49	36	72	28.22	1412.70	2.71	0.9	29.54	28.2
8	0	0	29.21	28.22	28.7	54.45	51.71	53.1	-1.01	8.59	1414.92	2.42	36	203	51.71	1410.00	4.92	1.6	63.41	51.7
CHAN. 1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1412.50	N/A	N/A	N/A	N/A	1410.50	N/A	N/A	N/A	N/A

TIME STEP: 20:45 Depth of flow in channel = 2 (ft.) Q = 83 cfs

POND NO.	INFLOW (CFS) WEIR Iw(t-1)	Iw(t)	PIPE Ip(t-1)	Ip(t)	AVG. I (cfs)	OUTFLOW (CFS) PIPE Op(t-1)	Op(t)	AVG. O (CFS)	DELTA VOL (Ac.-Ft.)	SUM VOL (Ac.-Ft.)	WSEL (Ft.)	Ha- Hb (Ft.)	PIPE DIAM. (in)	L (ft)	Qout (outlet control) (cfs)	Inv. at Pond out. or chan. (ft)	H (ft)	HW/D	Qout (inlet control) (cfs)	Qout at time= t+1 (lower Q) (cfs)
10	0	0	0	0	0.0	13.85	13.42	13.6	-0.56	1.07	1417.56	2.53	18	76	13.42	1415.80	1.76	1.2	8.09	8.1
9	0	0	13.85	13.42	13.6	28.22	26.92	27.6	-0.58	2.28	1415.03	0.45	36	72	26.93	1412.70	2.33	0.8	23.77	23.8
8	0	0	28.22	26.92	27.6	51.71	48.02	49.9	-0.92	7.67	1414.59	2.09	36	203	48.02	1410.00	4.59	1.5	58.32	48.0
CHAN. 1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1412.50	N/A	N/A	N/A	N/A	1410.50	N/A	N/A	N/A	N/A

FILE: ROUTEC4 Superstition Freeway: Power Road to Ellsworth Road Arizona Department of Transportation Project No.:

Routing through Ponds 6 - 10 ROUTING TABLE FOR THE OFFLINE PONDS
File 4

TIME STEP: 21:15 Depth of flow in channel = 1.9 (ft.) Q = 81 cfs

POND NO.	INFLOW (CFS) WEIR Iw(t-1)	Iw(t)	PIPE Ip(t-1)	Ip(t)	AVG. I (cfs)	OUTFLOW (CFS) PIPE Op(t-1)	Op(t)	AVG. O (CFS)	DELTA VOL (Ac.-Ft.)	SUM VOL (Ac.-Ft.)	WSEL (Ft.)	Ha- Hb (Ft.)	PIPE DIAM. (in)	L (ft)	Qout (outlet control) (cfs)	Inv. at Pond out. or chan. (ft)	H (ft)	HW/D	Qout (inlet control) (cfs)	Qout at time= t (lower Q) (cfs)
10	0	0	0	0	0.0	13.42	13.22	13.3	-0.55	0.52	1417.01	2.46	18	76	13.21	1415.80	1.21	0.8	4.76	4.8
9	0	0	13.42	0	6.7	26.92	21.98	24.5	-0.73	1.55	1414.55	0.30	36	72	21.99	1412.70	1.85	0.6	16.42	16.4
8	0	0	26.92	21.98	24.5	48.02	45.29	46.7	-0.92	6.75	1414.26	1.86	36	203	45.29	1410.00	4.26	1.4	53.25	45.3
CHAN. 1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1412.40	N/A	N/A	N/A	N/A	1410.50	N/A	N/A	N/A	N/A

TIME STEP: 21:45 Depth of flow in channel = 1.9 (ft.) Q = 80 cfs

POND NO.	INFLOW (CFS) WEIR Iw(t-1)	Iw(t)	PIPE Ip(t-1)	Ip(t)	AVG. I (cfs)	OUTFLOW (CFS) PIPE Op(t-1)	Op(t)	AVG. O (CFS)	DELTA VOL (Ac.-Ft.)	SUM VOL (Ac.-Ft.)	WSEL (Ft.)	Ha- Hb (Ft.)	PIPE DIAM. (in)	L (ft)	Qout (outlet control) (cfs)	Inv. at Pond out. or chan. (ft)	H (ft)	HW/D	Qout (inlet control) (cfs)	Qout at time= t (lower Q) (cfs)
10	0	0	0	0	0.0	13.22	10.64	11.9	-0.49	0.03	1415.86	1.59	18	76	10.64	1415.80	0.06	0.0	0.17	0.2
9	0	0	13.22	10.64	11.9	21.98	22.94	22.5	-0.44	1.11	1414.27	0.32	36	72	22.94	1412.70	1.57	0.5	12.06	12.1
8	0	0	21.98	22.94	22.5	45.29	41.32	43.3	-0.86	5.89	1413.94	1.54	36	203	41.32	1410.00	3.94	1.3	48.48	41.3
CHAN. 1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1412.40	N/A	N/A	N/A	N/A	1410.50	N/A	N/A	N/A	N/A

TIME STEP: 22:15 Depth of flow in channel = 1.9 (ft.) Q = 79 cfs

POND NO.	INFLOW (CFS) WEIR Iw(t-1)	Iw(t)	PIPE Ip(t-1)	Ip(t)	AVG. I (cfs)	OUTFLOW (CFS) PIPE Op(t-1)	Op(t)	AVG. O (CFS)	DELTA VOL (Ac.-Ft.)	SUM VOL (Ac.-Ft.)	WSEL (Ft.)	Ha- Hb (Ft.)	PIPE DIAM. (in)	L (ft)	Qout (outlet control) (cfs)	Inv. at Pond out. or chan. (ft)	H (ft)	HW/D	Qout (inlet control) (cfs)	Qout at time= t (lower Q) (cfs)
10	0	0	0	0	0.0	10.64	0.00	5.3	-0.22	-0.19	0.00	0.00	18	76	0.00	1415.80	-1415.80	-943.9	-3775.47	-3775.5
9	0	0	10.64	0	5.3	22.94	13.97	18.5	-0.54	0.57	1413.76	0.12	36	72	13.99	1412.70	1.06	0.4	7.75	7.7
8	0	0	22.94	13.97	18.5	41.32	36.97	39.1	-0.85	5.04	1413.64	1.24	36	203	36.97	1410.00	3.64	1.2	43.75	37.0
CHAN. 1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1412.40	N/A	N/A	N/A	N/A	1410.50	N/A	N/A	N/A	N/A

FILE: ROUTEC4 Superstition Freeway: Power Road to Ellsworth Road Arizona Department of Transportation Project No.:

Routing through Ponds 8 - 10 ROUTING TABLE FOR THE OFFLINE PONDS
File 4

TIME STEP: 22:45 Depth of flow in channel = 1.8 (ft.) Q = 79 cfs

POND NO.	INFLOW (CFS) WEIR Iw(t-1)	Iw(t)	PIPE Io(t-1)	Ip(t)	AVG. I (cfs)	OUTFLOW (CFS) PIPE Oo(t-1)	Op(t)	AVG. O (CFS)	DELTA VOL (Ac.-Ft.)	SUM VOL (Ac.-Ft.)	WSEL (Ft.)	Ha- Hb (Ft.)	PIPE DIAM. (in)	L (ft)	Qout (outlet control) (cfs)	Inv. at Pond out. or chan. (ft)	H (ft)	HW/D	Qout (inlet control) (cfs)	Qout at time= t (lower Q) (cfs)
10	0	0	0	5.3	2.7	0	0	0.0	0.11	-0.08	0.00	0.00	18	76	0.00	1415.80	-1415.80	-943.9	-3775.47	-3775.5
9	0	0	0	20.2	10.1	13.97	12.29	13.1	-0.13	0.44	1413.52	0.09	36	72	12.27	1412.70	0.82	0.3	6.04	6.0
8	0	0	13.97	30.9	22.4	36.97	35.37	36.2	-0.57	4.47	1413.43	1.13	36	203	35.37	1410.00	3.43	1.1	40.61	35.4
CHAN. 1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1412.30	N/A	N/A	N/A	N/A	1410.50	N/A	N/A	N/A	N/A

TIME STEP: 23:45 Depth of flow in channel = 1.8 (ft.) Q = 78 cfs

POND NO.	INFLOW (CFS) WEIR Iw(t-1)	Iw(t)	PIPE Io(t-1)	Ip(t)	AVG. I (cfs)	OUTFLOW (CFS) PIPE Oo(t-1)	Op(t)	AVG. O (CFS)	DELTA VOL (Ac.-Ft.)	SUM VOL (Ac.-Ft.)	WSEL (Ft.)	Ha- Hb (Ft.)	PIPE DIAM. (in)	L (ft)	Qout (outlet control) (cfs)	Inv. at Pond out. or chan. (ft)	H (ft)	HW/D	Qout (inlet control) (cfs)	Qout at time= t (lower Q) (cfs)
10	0	0	0	0	0.0	0	0.00	0.0	0.00	-0.08	0.00	0.00	18	76	0.00	1415.80	-1415.80	-943.9	-3775.47	-3775.5
9	0	0	0	0	0.0	12.29	0.00	6.1	-0.51	-0.06	0.00	0.00	36	72	0.00	1412.70	-1412.70	-470.9	*********	-10359.8
8	0	0	12.29	0	6.1	35.37	22.39	28.9	-1.88	2.59	1412.75	0.45	36	203	22.40	1410.00	2.75	0.9	30.22	22.4
CHAN. 1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1412.30	N/A	N/A	N/A	N/A	1410.50	N/A	N/A	N/A	N/A

TIME STEP: 00:45 Depth of flow in channel = 1.7 (ft.) Q = 76 cfs

POND NO.	INFLOW (CFS) WEIR Iw(t-1)	Iw(t)	PIPE Io(t-1)	Ip(t)	AVG. I (cfs)	OUTFLOW (CFS) PIPE Oo(t-1)	Op(t)	AVG. O (CFS)	DELTA VOL (Ac.-Ft.)	SUM VOL (Ac.-Ft.)	WSEL (Ft.)	Ha- Hb (Ft.)	PIPE DIAM. (in)	L (ft)	Qout (outlet control) (cfs)	Inv. at Pond out. or chan. (ft)	H (ft)	HW/D	Qout (inlet control) (cfs)	Qout at time= t (lower Q) (cfs)
10	0	0	0	0	0.0	0	0.00	0.0	0.00	-0.08	0.00	0.00	18	76	0.00	1415.80	-1415.80	-943.9	-3775.47	-3775.5
9	0	0	0	0	0.0	0	0.00	0.0	0.00	-0.06	0.00	0.00	36	72	0.00	1412.70	-1412.70	-470.9	*********	-10359.8
8	0	0	0	0	0.0	22.39	9.40	15.9	-1.31	1.28	1412.28	0.08	36	203	9.40	1410.00	2.28	0.8	22.96	9.4
CHAN. 1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1412.20	N/A	N/A	N/A	N/A	1410.50	N/A	N/A	N/A	N/A

FILE: ROUTEC4 Superstition Freeway: Power Road to Ellsworth Road Arizona Department of Transportation Project No.:

Routing through Ponds 8 - 10 ROUTING TABLE FOR THE OFFLINE PONDS
File 4

TIME STEP: 01:45 Depth of flow in channel = 1.60 (ft.) Q = 74 cfs

POND NO.	INFLOW (CFS) WEIR Iw(t-1)	Iw(t)	PIPE Ip(t-1)	Ip(t)	AVG. I (cfs)	OUTFLOW (CFS) PIPE Op(t-1)	Op(t)	AVG. O (CFS)	DELTA VOL (Ac.-Ft.)	SUM VOL (Ac.-Ft.)	WSEL (Ft.)	Ha- Hb (Ft.)	PIPE DIAM. (in)	L (ft)	Qout (outlet control) (cfs)	Inv. at Pond out. or chan. (ft)	H (ft)	HW/D	Qout (inlet control) (cfs)	Qout at time= t (lower Q) (cfs)
10	0	0	0	0	0.0	0	0.00	0.0	0.00	-0.08	0.00	0.00	18	76	0.00	1415.80	-1415.80	-943.9	-3775.47	-3775.5
9	0	0	0	0	0.0	0	0.00	0.0	0.00	-0.06	0.00	0.00	36	72	0.00	1412.70	-1412.70	-470.9	*********	-10359.8
8	0	0	0	0	0.0	9.4	2.34	5.9	-0.49	0.79	1412.10	0.00	36	203	2.33	1410.00	2.10	0.7	20.28	2.3
CHAN. 1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1412.10	N/A	N/A	N/A	N/A	1410.50	N/A	N/A	N/A	N/A

TIME STEP: 02:45 Depth of flow in channel = 1.40 (ft.) Q = 70 cfs

POND NO.	INFLOW (CFS) WEIR Iw(t-1)	Iw(t)	PIPE Ip(t-1)	Ip(t)	AVG. I (cfs)	OUTFLOW (CFS) PIPE Op(t-1)	Op(t)	AVG. O (CFS)	DELTA VOL (Ac.-Ft.)	SUM VOL (Ac.-Ft.)	WSEL (Ft.)	Ha- Hb (Ft.)	PIPE DIAM. (in)	L (ft)	Qout (outlet control) (cfs)	Inv. at Pond out. or chan. (ft)	H (ft)	HW/D	Qout (inlet control) (cfs)	Qout at time= t (lower Q) (cfs)
10	0	0	0	0	0.0	0	0.00	0.0	0.00	-0.08	0.00	0.00	18	76	0.00	1415.80	-1415.80	-943.9	-3775.47	-3775.5
9	0	0	0	0	0.0	0	0.00	0.0	0.00	-0.06	0.00	0.00	36	72	0.00	1412.70	-1412.70	-470.9	*********	-10359.8
8	0	0	0	0	0.0	2.34	4.69	3.5	-0.29	0.50	1412.00	0.10	36	203	10.52	1410.00	2.00	0.7	18.67	19.5
CHAN. 1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1411.90	N/A	N/A	N/A	N/A	1410.50	N/A	N/A	N/A	N/A

FILE: ROUTEC5 Superstition Freeway: Power Road to Ellsworth Road Arizona Department of Transportation Project No.:

Routing through Ponds 8 - 10 ROUTING TABLE FOR THE OFFLINE PONDS
File 5

TIME STEP: 03:45 Depth of flow in channel = 1.37 (ft.) Q = 69 cfs

POND NO.	INFLOW (CFS) WEIR Iw(t-1)	Iw(t)	PIPE Ip(t-1)	Ip(t)	AVG. I (cfs)	OUTFLOW (CFS) PIPE Op(t-1)	Op(t)	AVG. O (CFS)	DELTA VOL (Ac.-Ft.)	SUM VOL (Ac.-Ft.)	WSEL (Ft.)	Ha- Hb (Ft.)	PIPE DIAM. (in)	L (ft)	Qout (outlet control) (cfs)	Inv. at Pond out. or chan. (ft)	H (ft)	HW/D	Qout (inlet control) (cfs)	Qout at time= t (lower Q) (cfs)
10	0	0	0	0	0.0	0	0	0.0	0.00	0.00	1415.80	3.10	18	76	14.85	1415.80	0.00	0.0	0.00	0.0
9	0	0	0	0	0.0	0	0	0.0	0.00	0.00	1412.70	0.82	36	72	36.46	1412.70	0.00	0.0	0.00	0.0
8	0	0	0	0	0.0	4.69	3.32	4.0	-0.33	0.17	1411.88	0.01	36	203	3.37	1410.00	1.88	0.6	16.83	3.4
CHAN. 1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1411.87	N/A	N/A	N/A	N/A	1410.50	N/A	N/A	N/A	N/A

TIME STEP: 04:45 Depth of flow in channel = 1.35 (ft.) Q = 67 cfs

POND NO.	INFLOW (CFS) WEIR Iw(t-1)	Iw(t)	PIPE Ip(t-1)	Ip(t)	AVG. I (cfs)	OUTFLOW (CFS) PIPE Op(t-1)	Op(t)	AVG. O (CFS)	DELTA VOL (Ac.-Ft.)	SUM VOL (Ac.-Ft.)	WSEL (Ft.)	Ha- Hb (Ft.)	PIPE DIAM. (in)	L (ft)	Qout (outlet control) (cfs)	Inv. at Pond out. or chan. (ft)	H (ft)	HW/D	Qout (inlet control) (cfs)	Qout at time= t (lower Q) (cfs)
10	0	0	0	0	0.0	0	7	3.5	-0.29	-0.29	0.00	0.00	18	76	0.00	1415.80	-1415.80	-943.9	-3775.47	-3775.5
9	0	0	0	7	3.5	0	0	0.0	0.29	0.29	1413.24	2.15	36	72	59.08	1412.70	0.54	0.2	3.94	3.9
8	0	0	0	0	0.0	3.32	0	1.7	-0.14	0.03	1411.08	0.00	36	203	0.00	1410.00	1.08	0.4	7.95	0.0
CHAN. 1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1411.85	N/A	N/A	N/A	N/A	1410.50	N/A	N/A	N/A	N/A

TIME STEP: 05:45 Depth of flow in channel = 1.34 (ft.) Q = 66 cfs

POND NO.	INFLOW (CFS) WEIR Iw(t-1)	Iw(t)	PIPE Ip(t-1)	Ip(t)	AVG. I (cfs)	OUTFLOW (CFS) PIPE Op(t-1)	Op(t)	AVG. O (CFS)	DELTA VOL (Ac.-Ft.)	SUM VOL (Ac.-Ft.)	WSEL (Ft.)	Ha- Hb (Ft.)	PIPE DIAM. (in)	L (ft)	Qout (outlet control) (cfs)	Inv. at Pond out. or chan. (ft)	H (ft)	HW/D	Qout (inlet control) (cfs)	Qout at time= t (lower Q) (cfs)
10	0	0	0	0	0.0	7	0.1	3.6	-0.29	-0.58	0.00	0.00	18	76	0.00	1415.80	-1415.80	-943.9	-3775.47	-3775.5
9	0	0	7	0.1	3.6	0	0.1	0.1	0.29	0.58	1413.77	2.67	36	72	65.75	1412.70	1.07	0.4	7.88	7.9
8	0	0	0	0.1	0.1	0	0	0.0	0.00	0.04	1411.11	0.00	36	203	0.00	1410.00	1.11	0.4	8.13	0.0
CHAN. 1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1411.83	N/A	N/A	N/A	N/A	1410.50	N/A	N/A	N/A	N/A

FILE: ROUTECS Superstition Freeway: Power Road to Ellsworth Road Arizona Department of Transportation Project No.:

Routing through Ponds 8 - 10 ROUTING TABLE FOR THE OFFLINE PONDS
File 5

TIME STEP: 06:45 Depth of flow in channel = 1.33 (ft.) Q = 65 cfs

POND NO.	INFLOW (CFS) WEIR Iw(t-1)	Iw(t)	PIPE Ip(t-1)	Ip(t)	AVG. I (cfs)	OUTFLOW (CFS) PIPE Op(t-1)	Op(t)	AVG. O (CFS)	DELTA VOL (Ac.-Ft.)	SUM VOL (Ac.-Ft.)	WSEL (Ft.)	Ha- Hb (Ft.)	PIPE DIAM. (in)	L (ft)	Qout (outlet control) (cfs)	Inv. at Pond out. or chan. (ft)	H (ft)	HW/D	Qout (inlet control) (cfs)	Qout at time= t (lower Q) (cfs)
10	0	0	0	0	0.0	0.1	0.05	0.1	-0.01	-0.59	0.00	0.00	18	76	0.00	1415.80	-1415.80	-943.9	-3775.47	-3775.47
9	0	0	0.1	0.05	0.1	0.1	0.1	0.1	-0.00	0.58	1413.77	2.61	36	72	65.11	1412.70	1.07	0.4	7.85	7.9
8	0	0	0.1	0.1	0.1	0	0	0.0	0.01	0.04	1411.16	0.00	36	203	0.00	1410.00	1.16	0.4	8.48	0.0
CHAN. 1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1411.83	N/A	N/A	N/A	N/A	1410.50	N/A	N/A	N/A	N/A

TIME STEP: 07:45 Depth of flow in channel = 1.32 (ft.) Q = 64 cfs

POND NO.	INFLOW (CFS) WEIR Iw(t-1)	Iw(t)	PIPE Ip(t-1)	Ip(t)	AVG. I (cfs)	OUTFLOW (CFS) PIPE Op(t-1)	Op(t)	AVG. O (CFS)	DELTA VOL (Ac.-Ft.)	SUM VOL (Ac.-Ft.)	WSEL (Ft.)	Ha- Hb (Ft.)	PIPE DIAM. (in)	L (ft)	Qout (outlet control) (cfs)	Inv. at Pond out. or chan. (ft)	H (ft)	HW/D	Qout (inlet control) (cfs)	Qout at time= t (lower Q) (cfs)
10	0	0	0	0	0.0	0.05	0	0.0	-0.00	-0.59	0.00	0.00	18	76	0.00	1415.80	-1415.80	-943.9	-3775.47	-3775.5
9	0	0	0.05	0	0.0	0.1	0	0.1	-0.01	0.57	1413.76	2.58	36	72	64.67	1412.70	1.06	0.4	7.77	7.8
8	0	0	0.1	0	0.1	0	0	0.0	0.00	0.05	1411.18	0.00	36	203	0.00	1410.00	1.18	0.4	8.66	0.0
CHAN. 1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1411.82	N/A	N/A	N/A	N/A	1410.50	N/A	N/A	N/A	N/A

TIME STEP: 08:45 Depth of flow in channel = 1.32 (ft.) Q = 64 cfs

POND NO.	INFLOW (CFS) WEIR Iw(t-1)	Iw(t)	PIPE Ip(t-1)	Ip(t)	AVG. I (cfs)	OUTFLOW (CFS) PIPE Op(t-1)	Op(t)	AVG. O (CFS)	DELTA VOL (Ac.-Ft.)	SUM VOL (Ac.-Ft.)	WSEL (Ft.)	Ha- Hb (Ft.)	PIPE DIAM. (in)	L (ft)	Qout (outlet control) (cfs)	Inv. at Pond out. or chan. (ft)	H (ft)	HW/D	Qout (inlet control) (cfs)	Qout at time= t (lower Q) (cfs)
10	0	0	0	0	0.0	0	0	0.0	0.00	-0.59	0.00	0.00	18	76	0.00	1415.80	-1415.80	-943.9	-3775.47	-3775.5
9	0	0	0	0	0.0	0	0	0.1	-0.01	0.56	1413.74	2.56	36	72	64.47	1412.70	1.04	0.3	7.65	7.7
8	0	0	0	0	0.0	0	0	0.0	0.00	0.05	1411.18	0.00	36	203	0.00	1410.00	1.18	0.4	8.66	0.0
CHAN. 1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1411.82	N/A	N/A	N/A	N/A	1410.50	N/A	N/A	N/A	N/A

FILE: ROUTEC5 Superstition Freeway: Power Road to Ellsworth Road Arizona Department of Transportation Project No.:

Routing through Ponds 8 - 10 ROUTING TABLE FOR THE OFFLINE PONDS
File 5

TIME STEP: 09:45 Depth of flow in channel = 1.31 (ft.) Q = 63 cfs

POND NO.	INFLOW (CFS) WEIR Iw(t-1)	Iw(t)	PIPE Ip(t-1)	Ip(t)	AVG. I (cfs)	OUTFLOW (CFS) PIPE Op(t-1)	Op(t)	AVG. O (CFS)	DELTA VOL (Ac.-Ft.)	SUM VOL (Ac.-Ft.)	WSEL (Ft.)	Ha- Hb (Ft.)	PIPE DIAM. (in)	L (ft)	Qout (outlet control) (cfs)	Inv. at Pond out. or chan. (ft)	H (ft)	HW/D	Qout (inlet control) (cfs)	Qout at time= t (lower Q) (cfs)
10	0	0	0	0	0.0	0	0	0.0	0.00	-0.59	0.00	0.00	18	76	0.00	1415.80	-1415.80	-943.9	-3775.47	-3775.5
9	0	0	0	0	0.0	0	0	0.0	0.00	0.56	1413.74	0.00	36	72	0.00	1412.70	1.04	0.3	7.65	0.0
8	0	0	0	0	0.0	0	0	0.0	0.00	0.05	1411.18	0.00	36	203	0.00	1410.00	1.18	0.4	8.66	0.0
CHAN. 1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1411.81	N/A	N/A	N/A	N/A	1410.50	N/A	N/A	N/A	N/A

TIME STEP: 11:45 Depth of flow in channel = 1.29 (ft.) Q = 62 cfs

POND NO.	INFLOW (CFS) WEIR Iw(t-1)	Iw(t)	PIPE Ip(t-1)	Ip(t)	AVG. I (cfs)	OUTFLOW (CFS) PIPE Op(t-1)	Op(t)	AVG. O (CFS)	DELTA VOL (Ac.-Ft.)	SUM VOL (Ac.-Ft.)	WSEL (Ft.)	Ha- Hb (Ft.)	PIPE DIAM. (in)	L (ft)	Qout (outlet control) (cfs)	Inv. at Pond out. or chan. (ft)	H (ft)	HW/D	Qout (inlet control) (cfs)	Qout at time= t (lower Q) (cfs)
10	0	0	0	0	0.0	0	0	0.0	0.00	-0.59	0.00	0.00	18	76	0.00	1415.80	-1415.80	-943.9	-3775.47	-3775.5
9	0	0	0	0	0.0	0	0	0.0	0.00	0.56	1413.74	0.00	36	72	0.00	1412.70	1.04	0.3	7.65	0.0
8	0	0	0	0	0.0	0	0	0.0	0.00	0.05	1411.18	0.00	36	203	0.00	1410.00	1.18	0.4	8.66	0.0
CHAN. 1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1411.79	N/A	N/A	N/A	N/A	1410.50	N/A	N/A	N/A	N/A

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This file call number: A440.305
Name: Final Drainage Report for Superstition Freeway - State Route 360, Power Road to Ellsworth Road
Date: (1988)