FINAL DRAINAGE REPORT
VOLUME I

I-10 CORRIDOR STUDY

16TH STREET TO 40TH STREET

MARCH 1988

SUBMITTED BY:

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ARIZONA
DEPARTMENT OF TRANSPORTATION
HIGHWAY DIVISION

SECTION Bridge Drainage Section

- ☐ PROJECT NO. IR-10-3(257)
- ☐ PERMIT NO:
  - ☐ ENCROACHMENT-USE
  - ☐ OUTDOOR ADVERTISING
- ☐ PARCEL NO: MP 153.0
- ☐ OTHER 16th St - 48th St

62-4304 R3/86

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INTRODUCTION

The drainage report for this section of the I-10 Corridor Study includes the section of I-10 from the I-10/48th Street traffic interchange westward across the Salt River to the I-10/I-17 traffic interchange. At this location, the I-10 Corridor Study divides with the study continuing northward along I-10 to the study limits at Buckeye Road and also continuing westward along I-17 to the study limits at 16th Street, as shown on Figure 1.

The section of I-10 between the 40th and 48th Streets traffic interchanges, was originally included in the earlier Drainage Report from 40th Street to Baseline Road, dated November 1987. Upon review of this section of I-10, as it relates to the remaining downstream drainage system from 40th Street to the 32nd Street outfall, it was determined that the earlier concept was not valid. Therefore, the drainage system for the section of I-10 between the 40th and 48th Street traffic interchanges is reanalyzed in this drainage report, which supercedes the earlier drainage report.

The following conditions and assumptions apply:

1. The existing drainage systems and roadways, as shown on the drawings and as referred to in this drainage report, will include in addition to the existing drainage system and roadways, those drainage systems and roadways which are currently being constructed or have been designed and are awaiting construction. This assumption applies to the following projects:

    A. ADOT Project IR-10-3(204) 16th Street to 28th Street.

    B. ADOT Project IR-10-3(196) - 32nd Street Interchange.

2. The ultimate roadway system used to develop the drainage concepts for this section of the I-10 Corridor Study is in accordance with Functional Plan Alternative C-1, as shown on Figure 1.

3. The agreement limiting discharge into the Tempe Drain and the specified design flows into the North-South Drainage Tunnel as documented in earlier drainage reports, are assumed to be applicable for the ultimate roadway system.

4. The closed components of the existing drainage systems are flowing near capacity for their specified design storm and, therefore, cannot accept additional flows without causing surcharge conditions.

5. The off-site flows presently flowing onto ADOT property, for the section of the I-10 Corridor Study west of the Salt River, remains applicable for the ultimate roadway system.

6. The runoff from the residential development currently flowing through a noise wall onto ADOT right-of-way, as shown on Figure 12 and Figure 10C in Appendix C, is not included in the design of the drainage system.

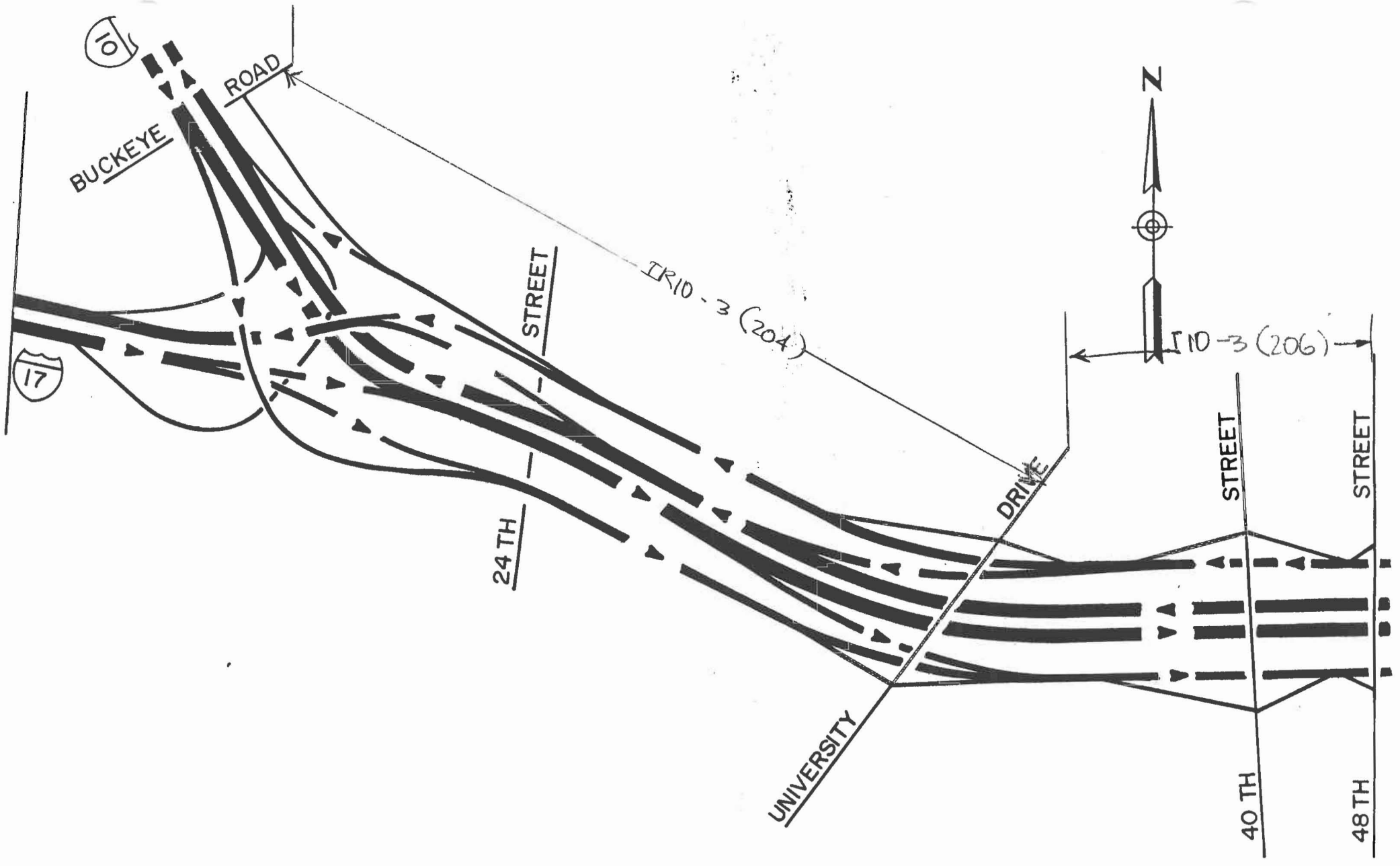

FIGURE 1. SCHEMATIC OF ULTIMATE ROADWAY SYSTEM ACCORDING TO FUNCTIONAL PLAN ALTERNATIVE C-1.

BACKGROUND

As mentioned previously, this section of the I-10 Corridor Study includes the section of I-10 from the I-10/48th Street interchange westward to the I-10/I-17 traffic interchange, then northward along I-10 to the study limits at Buckeye Road and westward along I-17 to the study limits at 16th Street.

Topography

The topography east of the Salt River within the I-10 Corridor Study area, can be described as generally flat, with mild slopes in the east to west direction in the vicinity of I-10. The topography along I-10 from the Salt River to the 24th Street interchange is generally flat with mild slopes in the northeast to southwest direction. From 24th Street westward along I-10 and I-17 to the study limits, the topography remains generally flat with mild slopes in the northeast to southwest direction.

Existing Drainage Systems

For the purposes of presentation in this report, there are eleven existing drainage systems within this section of the I-10 Corridor Study.

The eleven existing drainage systems include closed conduit drainage systems, closed conduit and open channel drainage systems, and drainage systems with retention facilities to provide peak flow attenuation. Flows from these eleven existing drainage systems outfall into either the Salt River, the Tempe Drain, or the North-South Drainage Tunnel through drop shafts located at Buckeye Roadand Mohave Street. Figures 2 through 12 shows the eleven existing drianage systems.

North-South Drainage Tunnel

The the North-South Drainage Tunnel consists of a 21 foot diameter tunnel as it passes under the I-10 Corridor Study area. The North-South Drainage Tunnel runs along the I-10 east right-of-way from Buckeye Road southward to Mohave Street, at which point it runs diagonally from east to west as it crosses under the I-10/I-17 interchange to 20th Street at Watkin Street, it then continues southward where it changes to twin 15-foot by 11-foot box culverts and eventually to an open channel which outfalls into the Salt River.

The 21-foot diameter North-South Drainage Tunnel, as it passes under the study area, has a capacity of 4720 cfs based on the 50-year storm event. Two drop shafts providing discharge into the North-South Drainage Tunnel are located within the study area, one at Mohave Street and another at Buckeye Road.

The North-South Drainage Tunnel, is designed to handle ADOT runoff in addition to all off-site drainage from the 50-year storm event which reaches the right-of-way, including surface flows and all existing and proposed drainage systems flows. The Mohave Street and the Buckeye Road drop shafts are designed to accept 540 and 485 cfs, respectively, as documented in ADOT Project AZI-10-3(224) titled 'East Tunnel Inlets'.

Off-Site Drainage Onto ADOT Right-of-Way

The magnitude of off-site flows onto ADOT right-of-way and their approximate locations are documented in a memorandum by HNTB, the Management Consultant, dated August 9, 1983. The memorandum can be found in Appendix D, of the Final Drainage Design Report for Buckeye Road-Maricopa Freeway and a copy has been inserted in Appendix A of this report. Off-site flows onto ADOT right-of-way are either intercepted by special curb opening inlets along Buckeye Road and Mohave Street, by open ditches along the right-of-way, or by headwall inlets.

Future Developments

The area north of I-10 and I-17 from 28th Interchange westward to 16th Street and along both sides of I-10 from the I-10/I-17 Interchange northward to Buckeye Road are expected to develop in accordance with the Sky Harbor Center proposed master plan.

The Final Drainage Design Report for Buckeye Road-Maricopa Freeway, indicates that the City of Phoenix existing drainage systems within the future development are adequate for existing conditions. With only minor modifications to the existing drainage systems along with implementation of on-site stormwater retention policies, the characteristics of the drainage within this area should not change to any great extent.

Off-site flows onto ADOT right-of-way will continue to be intercepted by special curb opening inlets along Buckeye Road and Mohave Street, by open ditches along the right-of-way, or by headwall inlets.

TABLE 1. EXISTING DRAINAGE AREAS AND THE LOCATION OF THEIR OUTFALLS.

Drainage Area Designation	Location of Outfalls
Drainage Area 1	Discharges through a drop shaft into the North-South Drainage Tunnel located north of Buckeye Road, as shown on Figure 2.
Drainage Area 2	Discharges through a drop shaft into the North-South Drainage Tunnel located north at Mohave Street, as shown on Figures 3.
Drainage Area 3	Discharges into an existing 60-inch diameter conduit along the south right-of-way which conveys the flows westward to the 78" dia. storm drain along 16th Street, as shown on Figure 4.
Drainage Area 4	Discharges into the 78" dia. storm drain along 16th Street, as showm on Figure 5.
Drainage Area 5	Discharges into the 78" dia. storm drain along 16th Street, as shown on Figure 6.
Drainage Area 6	Discharges into a 60-inch diameter storm drain located along the south right-of-way which conveys the flow in the westerly direction to the 78" diameter storm drain along 16th Street, as shown on Figures 6 and 7.
Drainage Area 7	Discharges into an existing 48" dia. storm drain along 24th Street, which eventually discharges to the North-South Drainage Tunnel drop shaft at Mohave Street, as shown on Figures 2, 3 and 8.
Drainage Area 8	Discharges into the same 48-inch diameter conduit used by Drainage Area 7 which eventually discharges into the North-South Drainage Tunnel drop shaft at Mohave Street, as shown on Figures 2, 3 and 9.
Drainage Area 9	Discharges through twin 72-inch diameter culverts into the Salt River, as shown on Figure 10.
Drainage Area 10	Discharges through a 36-inch diameter culvert into the Salt River, as shown on Figure 11.
Drainage Area 11	Discharges through an existing closed conduit drainage system into the Tempe Drain, as shown on Figure 12.

EXISTING DRAINAGE AREAS

The existing drainage systems for this section of the I-10 Corridor Study serve eleven drainage areas, which are designated as Drainage Areas 1 through 11, on Figures 2 through 12. Table 1 lists the eleven drainage areas and the locations of their outfalls.

Figures 2 through 12 shows the eleven drainage areas, their drainage systems, their outfalls, and presents some of the pertinent design flows as documented in the following final drainage reports:

1. Final Drainage Report
   24th Street - Salt River Bridge
   Papago Freeway Project I-10-3(156) P.E.
   Phoenix-Casa Grande Highway
   By: Evans, Kuhn, and Associates, Inc.

2. Final Drainage Design Report
   Buckeye Road-Maricopa Freeway
   Phoenix-Casa Grande Highway
   Project I-10-3(154) P.E.
   By: Stanley Consultants in Association with Hess, Fogt, Roundtree, Inc.

3. Final Drainage Report
   Salt River Bridge to 40th Street
   Phoenix-Casa Grande Freeway
   Project No. I-10-3(196) P.E.
   By: Daniel, Mann, Johnson, and Mendenhall

4. Final Drainage Report, Supplement No. 2
   Salt River Bridge to 40th Street
   Phoenix-Casa Grande Highway
   Project No. IR-10-3(196)
   By: Daniel, Mann, Johnson, and Mendenhall

The 10-year design flows are shown on Figures 2 through 12 without parenthesis or brackets. The 50-year design flows are shown on the figures in parenthesis. The capacities of the drainage system components are shown on the figures in brackets. There are also a few locations within the study area, such as retention sites, where the 100-year design flows are applicable. At these locations, the designation '(100)' will follow the applicable flows.

Drainage Area 1

Drainage Area 1 includes Ramp B-A, Ramp B-B, and the I-10 eastbound and westbound lanes from approximately Sta. 7853+40 northward to the study limits at Buckeye road (Sta. 7840+30), as shown on Figure 2.

Figure 2 is a schematic of the existing drainage system for Drainage Area 1 and includes some of the design flows as documented in the Final Drainage Design Report for Buckeye Road-Maricopa Freeway.

The existing drainage system for Drainage Area 1 consists of inlets, swales, and closed conduits to collect and convey the flows in the northerly and northeasterly direction to the drop shaft at the northeast corner of the I-10/Buckeye Road traffic interchange which discharges the flow into the North-South Drainage Tunnel, as shown on Figure 2.

The existing drainage system is designed to accept all off-site flows, as shown on Figure 2. These off-site flows include overland flows of 35 cfs and 75 cfs from Buckeye Road. The total off-site flow along Buckeye Road is 150 cfs and the Buckeye Road-Maricopa Freeway Final Drainage Design Report assumes the flows to be evenly divided, with 75 cfs to be intercepted by the inlet along Ramp B-A and the remaining 75 cfs to be intercepted by the inlet located along the north curb of Buckeye Road, the latter of which is located outside the study area.

The 10-year and 50-year design flows from Drainage Area 1 through the 54-inch diameter storm drain across Buckeye Road, as documented in the Final Drainage Design Report for Buckeye Road-Maricopa Freeway is estimated at 183.1 and 196.1 cfs, respectively. The 54-inch diameter conduit under Buckeye Road has a full pipe flow capacity of 202 cfs. The maximum allowable discharge into the drop shaft located at Buckeye Road as documented in ADOT Project AZI-10-3(224) 'East Tunnel Inlets' is 486 cfs, which includes the additional flows outside Drainage Area 1.

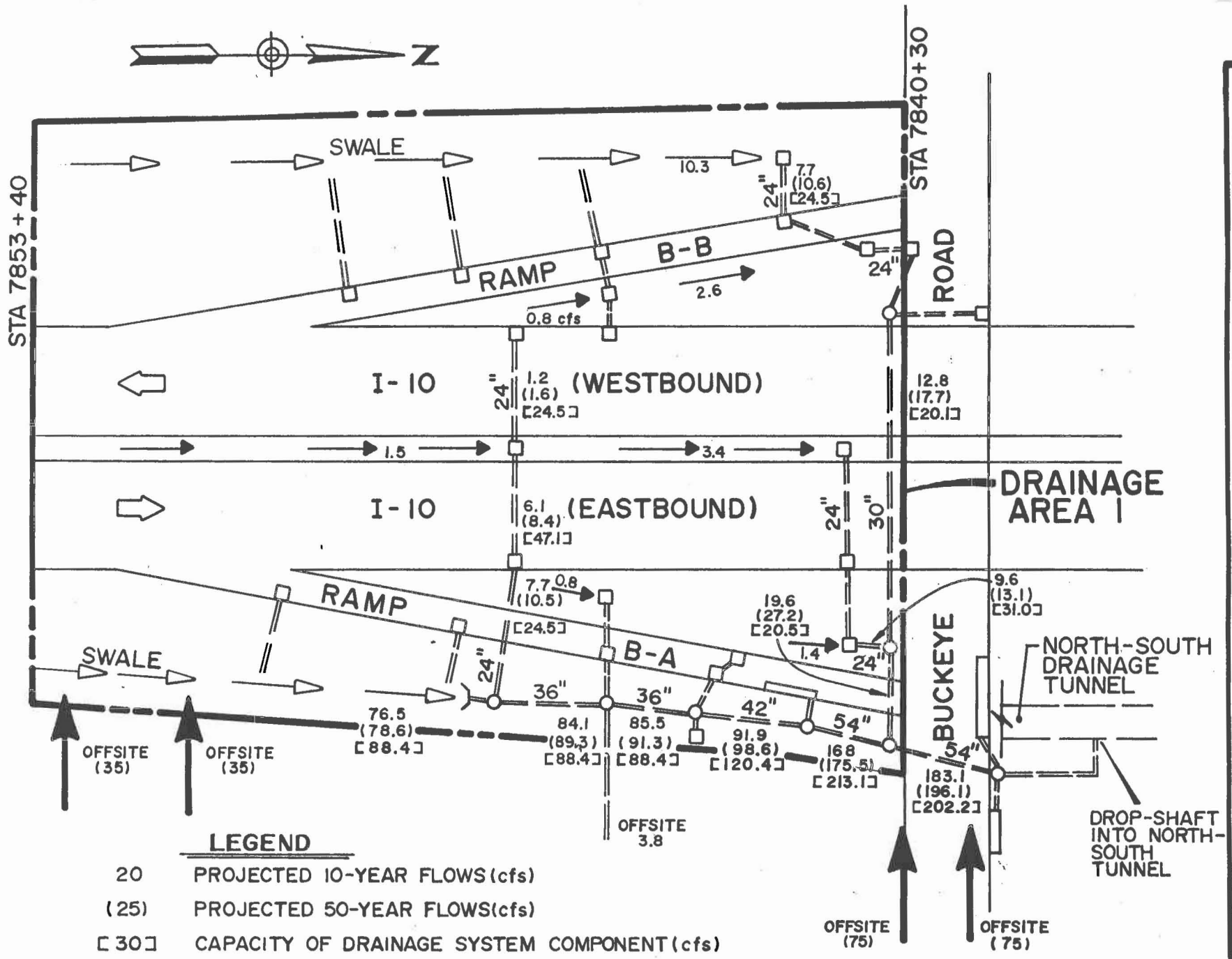

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FIGURE 2. SCHEMATIC OF EXISTING DRAINAGE SYSTEM FOR DRAINAGE AREA 1.

Drainage Area 2

Drainage Area 2 includes two sections of I-10 eastbound and westbound lanes. The first section is from Sta. 7853+40 southward to Sta. 7861+00 and the second section is from Sta. 7870+00 southeastward to Sta. 7880+00, as shown on Figure 3. Drainage Area 2 also includes Ramp 17/W-N from Sta. 230+00 northward to its taper onto I-10 Westbound lanes and Ramp 17/N-W from I-17 Sta. 221+00 northward to its taper onto I-10 eastbound lanes. The I-10 north right-of-way from Sta 7835+00 southward and eastward to Sta. 7892+00 and a section of I-10 west right-of-way from Sta. 7853+00 southward to I-17 Sta. 221+00, also shown on Figure 3.

Figure 3 is a schematic of the existing drainage system for Drainage Area 2 and includes some of the design flows as documented in the Final Drainage Design Report for Buckeye Road-Maricopa Freeway.

The existing drainage system consists of inlets, swales, drainage ditches, and closed conduits to collect and convey flows to the drop shaft located northeast of the I-10/Mohave Street interchange, which in turn discharges into the North-South Drainage Tunnel, as shown on Figure 3.

The existing drainage system is designed to collect and convey ADOT's runoff and all off-site flows draining onto ADOT's right-of-way to the Mohave Street drop shaft, as shown on Figure 3. Off-site flows draining onto ADOT right-of-way includes 200 cfs from Mohave Street, 175 cfs from Cocopah Street, 115 cfs from Pima Road, and 50 cfs from overland flow, as shown on Figure 3. The design flows from south of Mohave Street, as documented in the Final Drainage Design Report for Buckeye Road-Maricopa Freeway are estimated at 154 cfs and 182 cfs for the 10-year and 50-year storm events, respectively. The design flows for the contribution area north of Mohave Street are estimated at 373 and 377 cfs for the 10-year and 50-year storm events, respectively.

The drop shaft located at the northeast corner of the I-10/Mohave Street interchange, has a maximum allowable discharge of 540 cfs into the North-South Drainage Tunnel, as documented in ADOT Project AZI-10-3(224), East Tunnel Inlets.

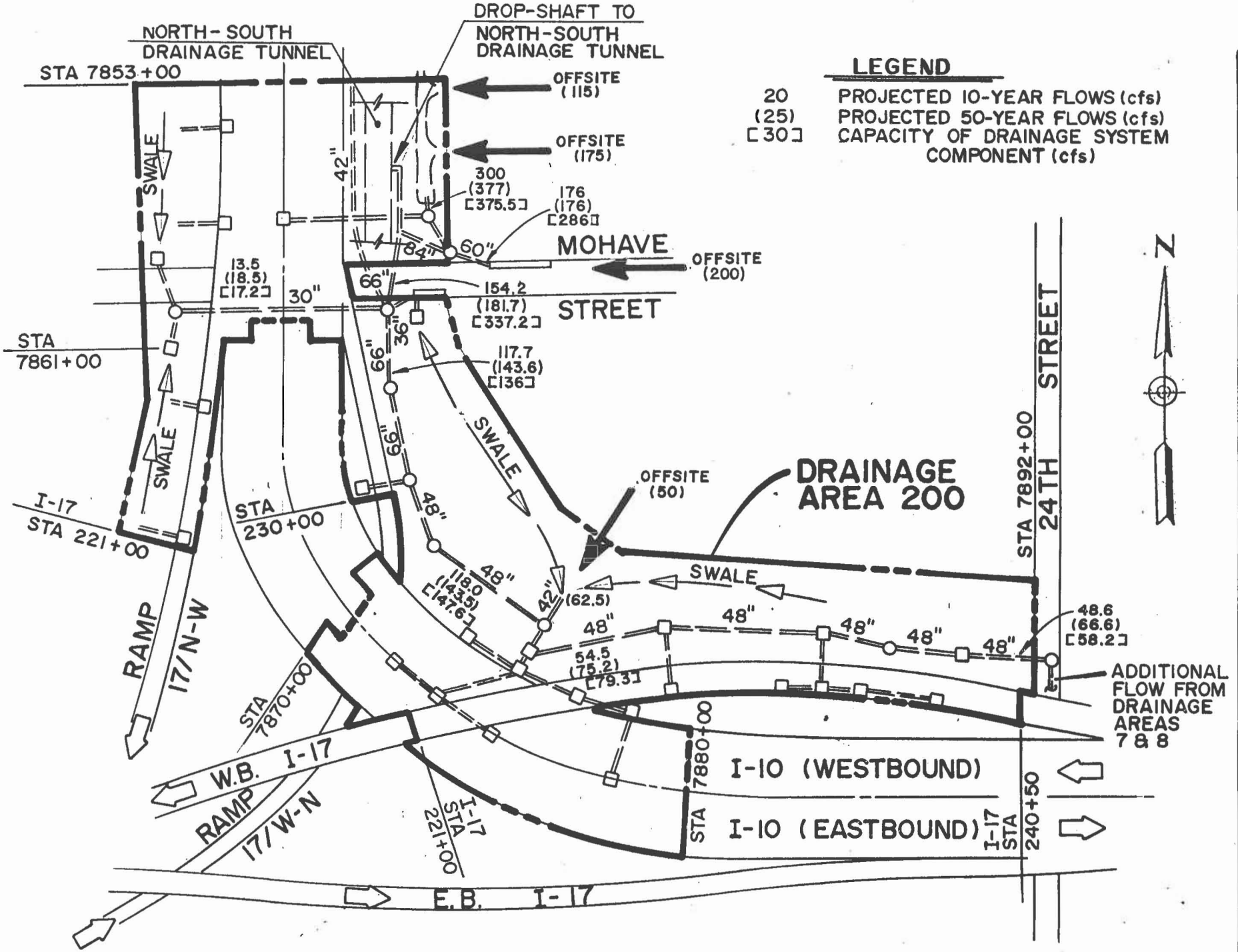

FIGURE 3. SCHEMATIC OF EXISTING DRAINAGE SYSTEM FOR DRAINAGE AREA 2.

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Drainage Area 3

Drainage Area 3 includes the west section of the I-10/I-17 traffic interchange, as shown on Figure 4. Drainage Area 3 is comprised of I-17 eastbound lanes from approximately I-17 Sta. 208+40 eastward to I-17 Sta. 219+50 and I-17 westbound lanes from I-17 Sta. 212+00 eastward to I-17 Sta. 222+00. Also included in Drainage Area 3 is Ramp 17/N-W from I-17 Sta. 212+00 northward to I-17 Sta. 221+00, Ramp 17/W-N from I-17 Sta. 208+40 eastward and northward to I-17 Sta 240+50, and I-10 eastbound and westbound lanes from approximate Sta. 7870+00 northward to Sta. 7861+00.

Figure 4 is a schematic of the existing drainage system for Drainage Area 3 and includes some of the design flows as documented in the Final Drainage Design Report for Buckeye Road-Maricopa Freeway.

The existing drainage system consists of a series of inlets along I-10, Ramp 17/W-N, and Ramp 17/N-W, which collect and convey runoff to the West Included Area, as shown on Figure 4. Ramp 17/W-N is depressed as it crosses under I-17 and I-10 and requires a pumping facility to lift the runoff into the West Included Area.

The West Included Area serves as a detention facility to provide peak flow attenuation for the 100-year storm event, with a maximum outflow of 17.9 cfs, a maximum detention storage of 130,000 cubic feet (approx. 3.0 A-F), and a maximum ponding depth of 2.8 feet. Review of documentation in the Final Drainage Design Report for Buckeye Road-Maricopa Freeway indicates availability of additional detention storage beyond present requirements.

Discharge from the West Included Area is southward through a 24" dia. outlet conduit, upsizing to a 36" dia. conduit after collecting flows from I-17 eastbound and westbound lanes and continuing southward to where it connects into a 60" storm drain. The 60" storm drain flows in the westerly direction from Drainage Area 3 along with additional flows collected from Drainage Area 6, as shown in Figures 4 and 7. The 60" dia. storm drain continues in the westerly direction along I-17 south right-of-way to 16th Street, where it discharges into a 78" dia. storm drain.

The design flow into the 60" storm drain from Drainage Area 3 is estimated at 22.4 cfs for the 100-year storm event.

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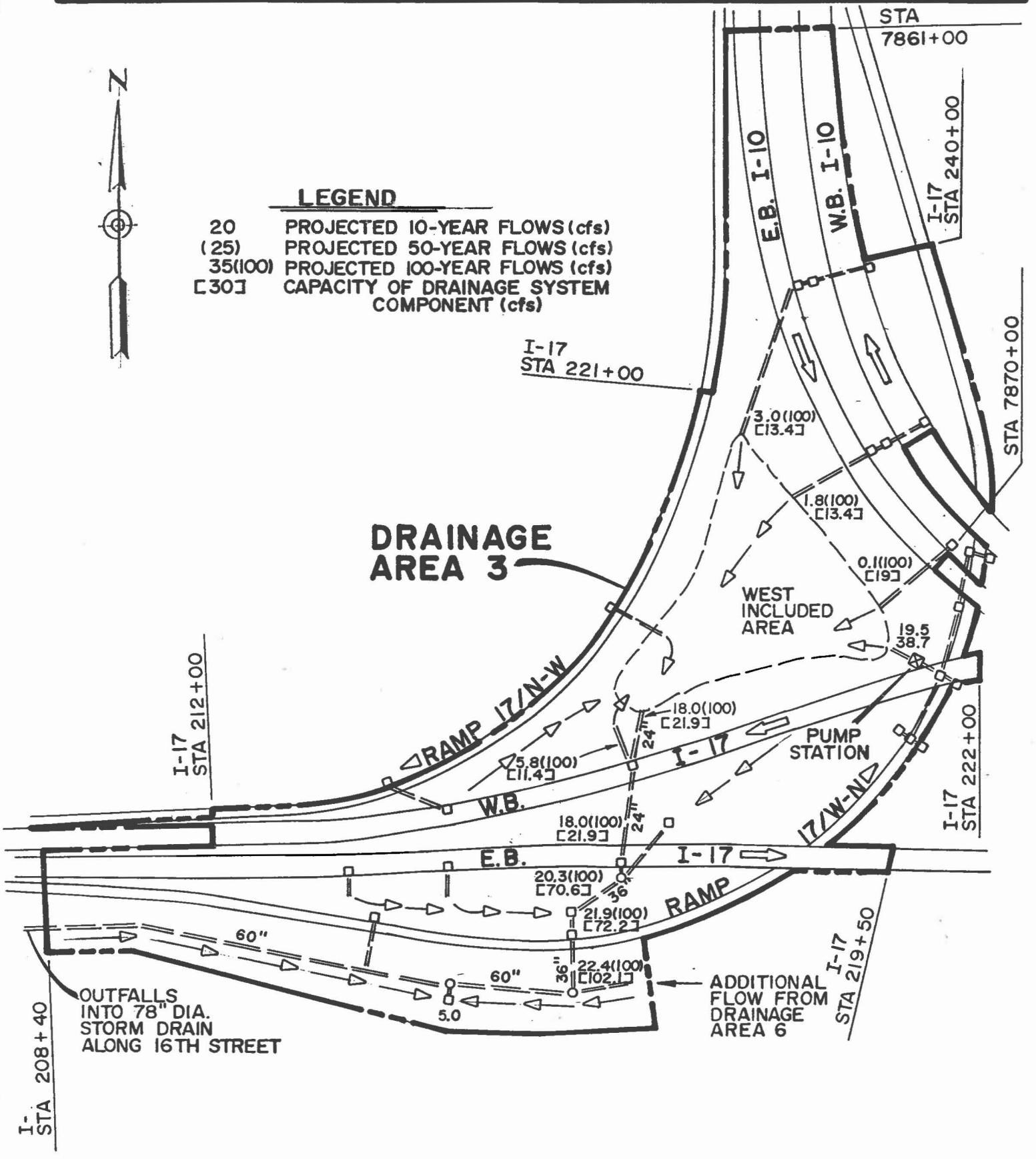

FIGURE 4. SCHEMATIC OF EXISTING DRAINAGE SYSTEM FOR DRAINAGE AREA 3.

Drainage Area 4

Drainage Area 4 includes the I-17 westbound lanes from I-17 Sta. 212+00 westbound to the study limits at 16th Street (I-17 Sta. 188+20) and includes the temporary ramp onto 16th Street. Also included in Drainage area 4 is Ramp 17/N-W from I-17 Sta. 210+90 eastward to its taper onto I-17 westbound lanes and the I-17 north right-of-way, as shown on Figure 5.

Figure 5 is a schematic of the existing drainage system for Drainage Area 4 and includes some of the design flows as documented in the Final Drainage Design Report for Buckeye Road-Maricopa Freeway.

The existing drainage system consists of a series of inlets along the north shoulders of I-17 westbound lanes and Ramp 17/N-W which conveys the pavement flows northward into either a drainage swale or an existing storm drain, as shown on Figure 5. These flows are then conveyed in the westerly direction with discharge into the 78-inch dia. storm drain along 16th Street.

The design flows as shown on Figure 5 represent only those flows from Ramp 17/N-W. The I-17 westbound lanes, as shown on Figure 5, were not part of ADOT Project Buckeye Road-Maricopa Freeway. Therefore, documentation of the drainage system was not included in that drainage report.

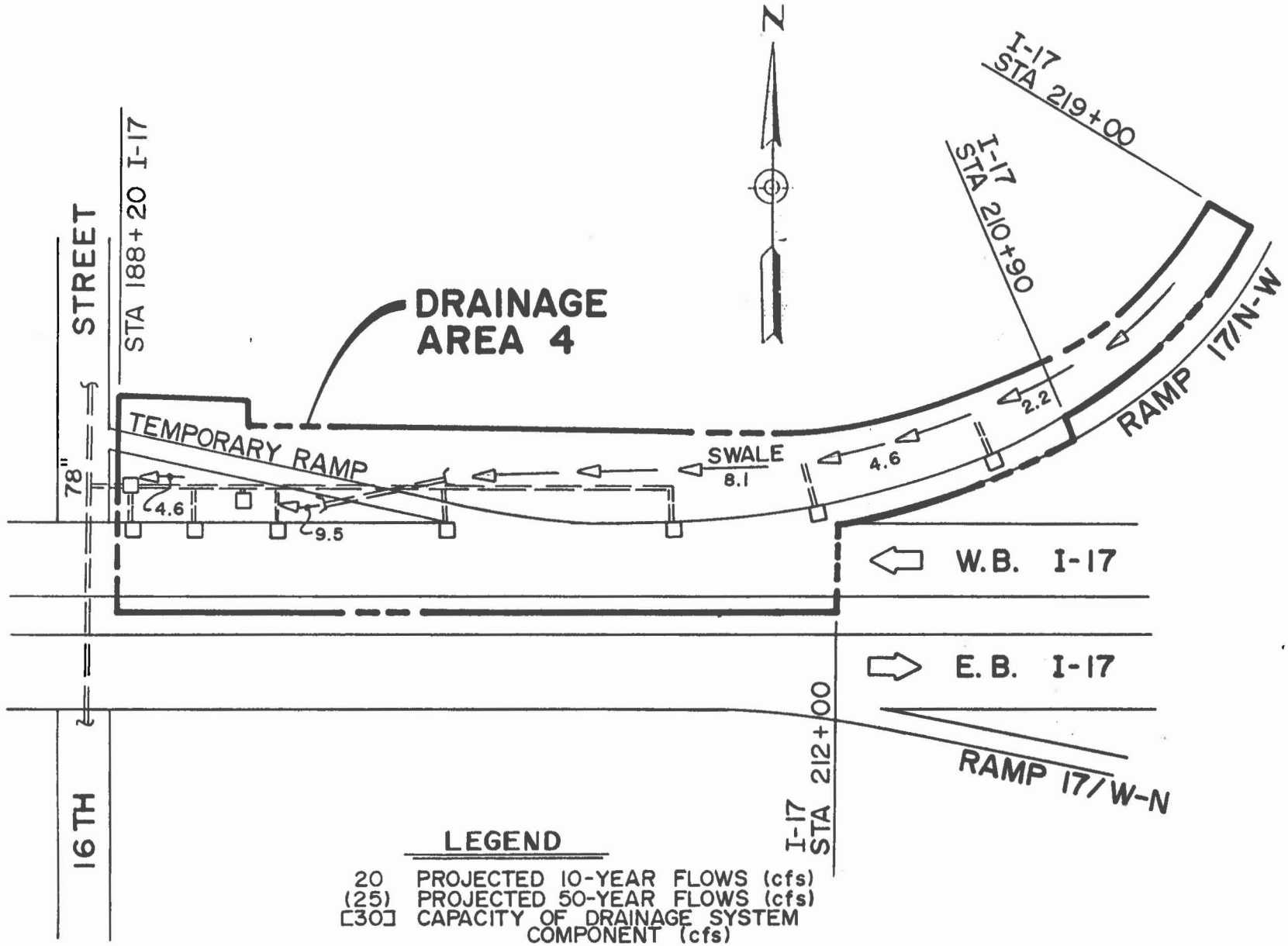

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FIGURE 5. SCHEMATIC OF EXISTING DRAINAGE SYSTEM FOR DRAINAGE AREA 4.

Drainage Area 5

Drainage Area 5 includes the I-17 eastbound lanes from I-17 Sta. 208+30 westward to the study limits at 16th Street (I-17 Sta. 188+20) and Ramp 17/W-N from Sta. 208+30 westward to its taper from I-17 eastbound lanes. Also included in Drainage Area 5 is a section I-17 westbound lanes from I-17 Sta. 212+00 westward to I-17 Sta. 203+90 and the I-17 south right-of-way, as shown on Figure 6.

Figure 6 is a schematic of existing drainage system for Drainage Area 5. There are two separate existing drainage systems within Drainage Area 5.

The first existing drainage system consists of a series of inlets along the south shoulder of the I-17 eastbound lanes. These collect and convey pavement flows southward to an 18-inch dia. storm drain, which in turn conveys these flows in the westerly direction to the 78-inch storm drain along 16th Street, as shown on Figure 6. The second existing drainage system consists of an inlet along the north shoulder of I-17 westbound lanes and another inlet along the south shoulder of Ramp 17/W-N, which collects and conveys flows southward to a 60-inch dia. storm drain, which in turn also conveys the flows to the 78-inch diameter storm drain along 16th Street, as shown on Figure 6.

The I-17 eastbound and westbound lanes along with Ramp 17/W-N were not part of ADOT Project Buckeye Road-Maricopa Freeway and therefore, documentation of the drainage system was not included in that drainage report.

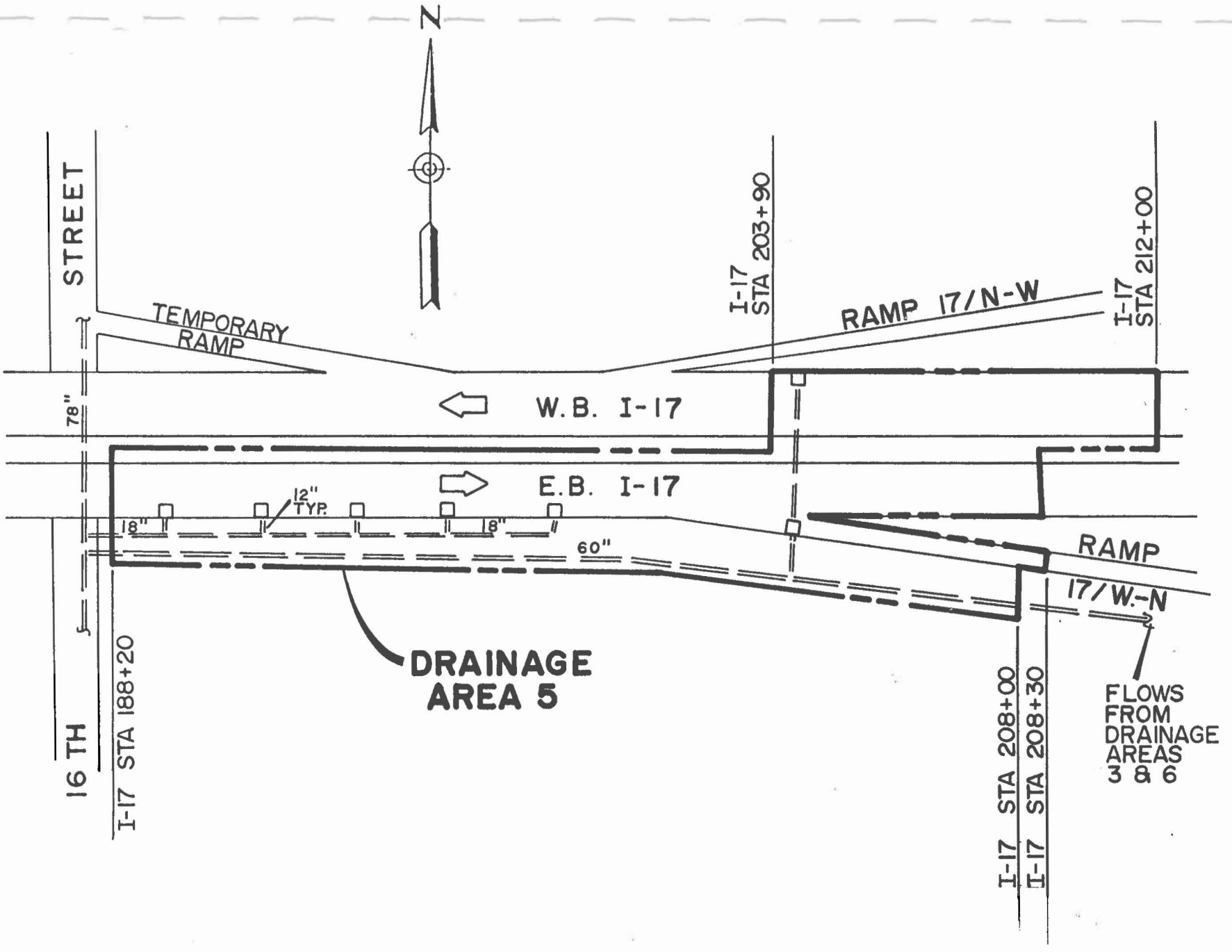

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FIGURE 6. SCHEMATIC OF EXISTING DRAINAGE SYSTEM FOR DRAINAGE AREA 5.

Drainage Area 6

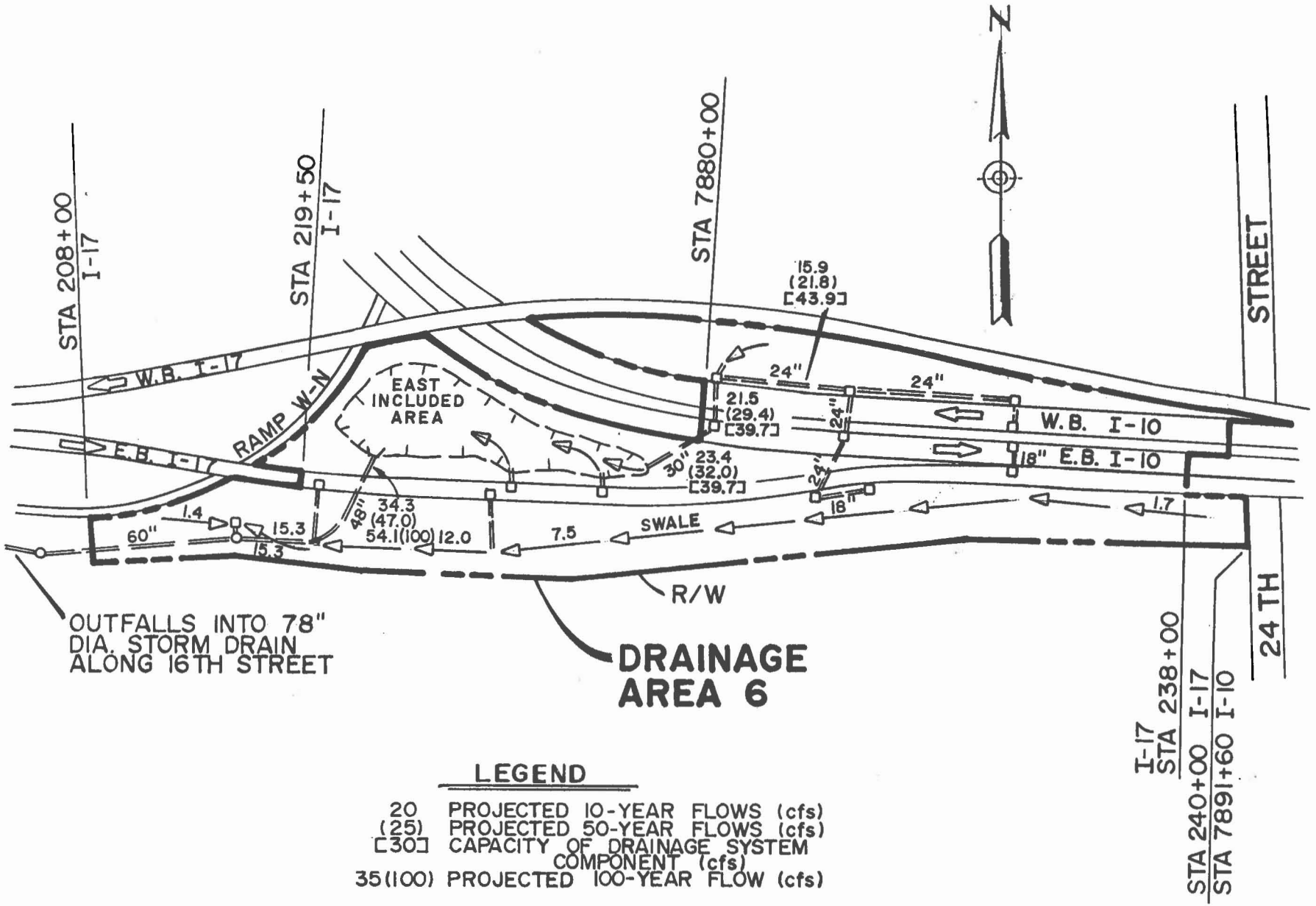
Drainage Area 6 includes the I-10 eastbound and westbound lanes from Sta. 7880+00 eastward to approximately Sta. 7891+60 (I-10/24th Street Traffic Interchange), the I-17 eastbound lanes from I-17 Sta. 219+50 eastward to I-17 Sta. 238+00, the East Included Area, and the south right-of-way, as shown on Figure 7.

Figure 7 is a schematic of the existing drainage system for Drainage Area 6 and includes some of the design flows as documented in the Final Drainage Design Report for Buckeye Road-Maricopa Freeway.

The existing drainage system consists of a series of inlets along I-10 eastbound and westbound lanes and I-17 eastbound lanes which collect and convey pavement flows to the East Included Area. Discharge from the East Included Area is controlled by a 48-inch dia. conduit. Flows from the East Included Areas are in the southerly direction and discharge into a 60-inch storm drain located in the south right-of-way. This in turn conveys the flow in the westerly direction, to the 78-inch dia. storm drain along 16th Street.

The East Included Area is designed for a maximum outflow rate of 47 cfs for the 50-year storm event, with a ponding depth at the 48-inch dia. outlet pipe of 3.4 feet. Documentation from the Final Drainage Design Report for Buckeye Road-Maricopa Freeway indicates availability of additional storage to completely retain runoff from a 100-year, 2-hour storm event should the outlet become plugged.

The design discharge from the East Included Area ia estimated at 34.3 cfs with a ponding depth of 2.5 feet for the 10-year storm event and a discharge rate of 54.1 cfs for the 100-year storm event. The design flows along the south right-of-way is estimated at 15.3 cfs from the east and 1,4 cfs from the west for the 10-year storm event, as shown on Figure 7.



LEGEND

20	PROJECTED 10-YEAR FLOWS (cfs)
(25)	PROJECTED 50-YEAR FLOWS (cfs)
[30]	CAPACITY OF DRAINAGE SYSTEM COMPONENT (cfs)
35(100)	PROJECTED 100-YEAR FLOW (cfs)

FIGURE 7. SCHEMATIC OF EXISTING DRAINAGE SYSTEM FOR DRAINAGE AREA 6.

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Drainage Area 7

Drainage Area 7 includes the I-10 eastbound lanes from approximately Sta. 7892+60 (I-10/24th Street traffic interchange) eastward to Sta. 7901+40, Ramp 24-B from its intersection with 24th Street eastward to Sta. 7901+00, Ramp 24-B infield area, and the south right-of-way from 24th Street (Sta. 7892+60) eastward to Sta. 7904+80, as shown on Figure 8.

Figure 8 is a schematic of the existing drainage system for Drainage Area 7 and includes some of the design flows as documented in the Final Drainage Report for 24th Street to the Salt River Bridge.

The existing drainage system consists of a series of inlets along the south shoulders of I-10 eastbound lanes and Ramp 24-B to collect and convey flows southward to the 30-inch dia. storm drain located in the south right-of-way. The 30-inch dia. storm drain conveys the flows in the westerly direction to 24th Street. At this location, the 30-inch storm drain crosses northward under I-10 and connects to a 48-inch storm drain. The 48-inch dia. storm drain conveys flows from Drainage Area 7, along with flows from Drainage Area 8, to the North-South Drainage Tunnel drop shaft at Mohave Street.

The design flows from Drainage Area 7, as documented in the Final Drainage Report for 24th Street to the Salt River Bridge, are estimated at 19.8 cfs and 23.3 cfs for the 10-year and 50-year storm events, respectively.

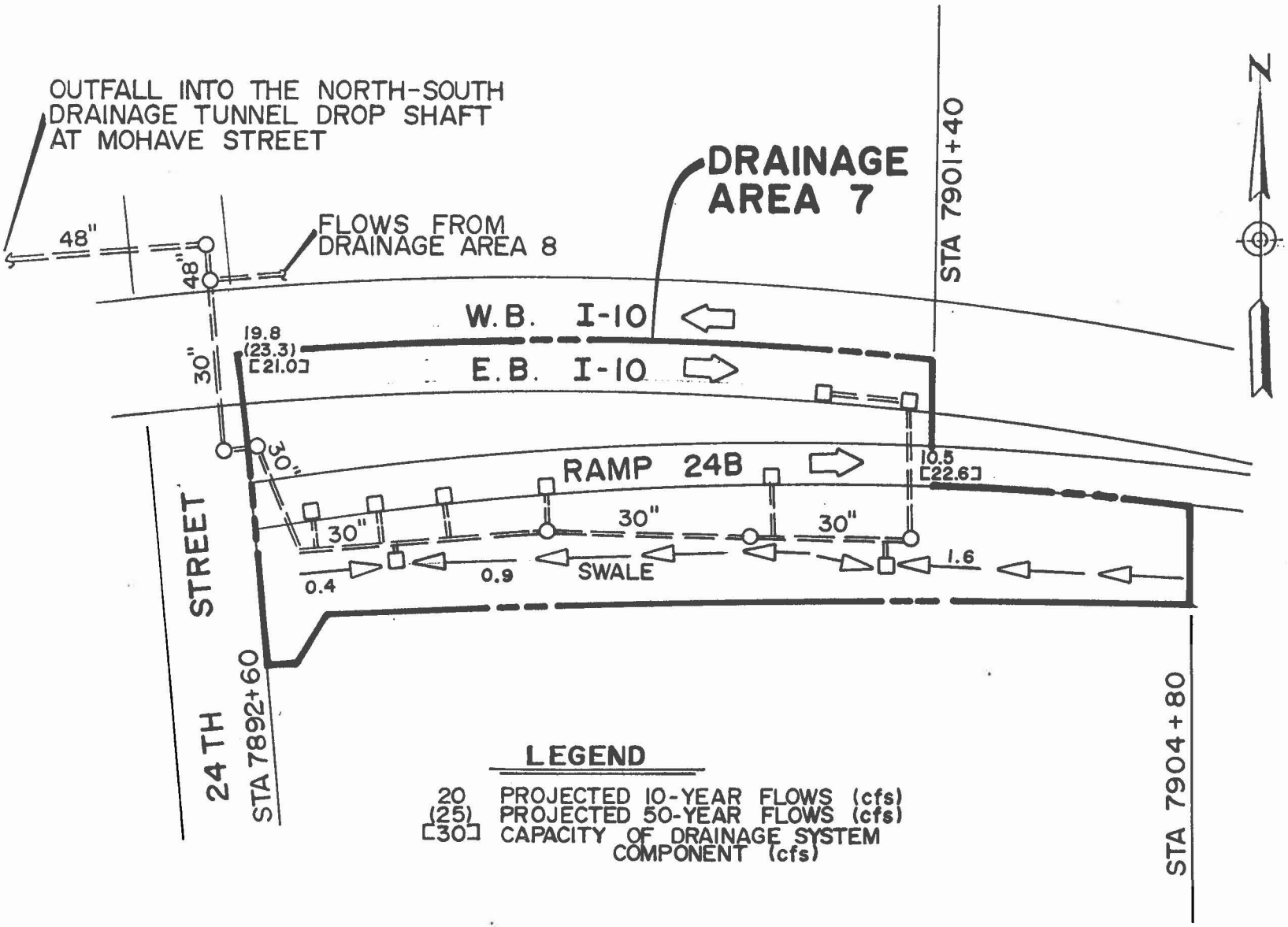

FIGURE 8. SCHEMATIC OF EXISTING DRAINAGE SYSTEM FOR DRAINAGE AREA 7.

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Drainage Area 8

Drainage Area 8 includes Ramp 24-A from its intersection with 24th Street eastward to approximately Sta. 7900+80 and the north right-of-way from 24th Street (Sta. 7892+00) eastward to approximately Sta. 7905+00, as shown on Figure 9.

Figure 9 is a schematic of the existing drainage system for Drainage Area 8 and includes some of the design flows as documented in the Final Drainage Report for 24th Street to the Salt River Bridge.

The existing drainage system consists of a series of inlets and conduits along the south shoulder of Ramp 24-A to collect and convey flows in the northerly direction into either the 5-foot wide riprap trapezoidal channel or the 30-inch storm drain along the north right-of-way, as shown on Figure 9. Flows into the trapezoidal channel are conveyed in the westerly direction to an inlet structure located at Sta. 7896+00, which in turn discharges the flows into the 30-inch dia. storm drain. The 30-inch dia. storm drain conveys the flows in a westerly direction along with other flows collected from Ramp 24A to 24th Street. At 24th Street, flows from Drainage Area 8 along with flows from Drainage Area 7 are discharged into a 48-inch dia. storm drain. The 48-inch storm drain conveys these flows to the North-South Drainage Tunnel drop shaft at Mohave Street.

As documented in the Final Drainage Report for 24th Street to the Salt River Bridge, the design frequency is 10-years for the channels and the conduits, while the 50-year design frequency is used for the culverts. The design flow in the 5.0 foot wide riprap trapezoid channel at the inlet structure (Sta. 7896+00) is estimated at 38.8 cfs for the 10-year storm event. The total flow from the 30-inch dia. storm into the 48-inch dia. storm drain along 24th Street is estimated at 43.1 cfs, for the 10-year storm.

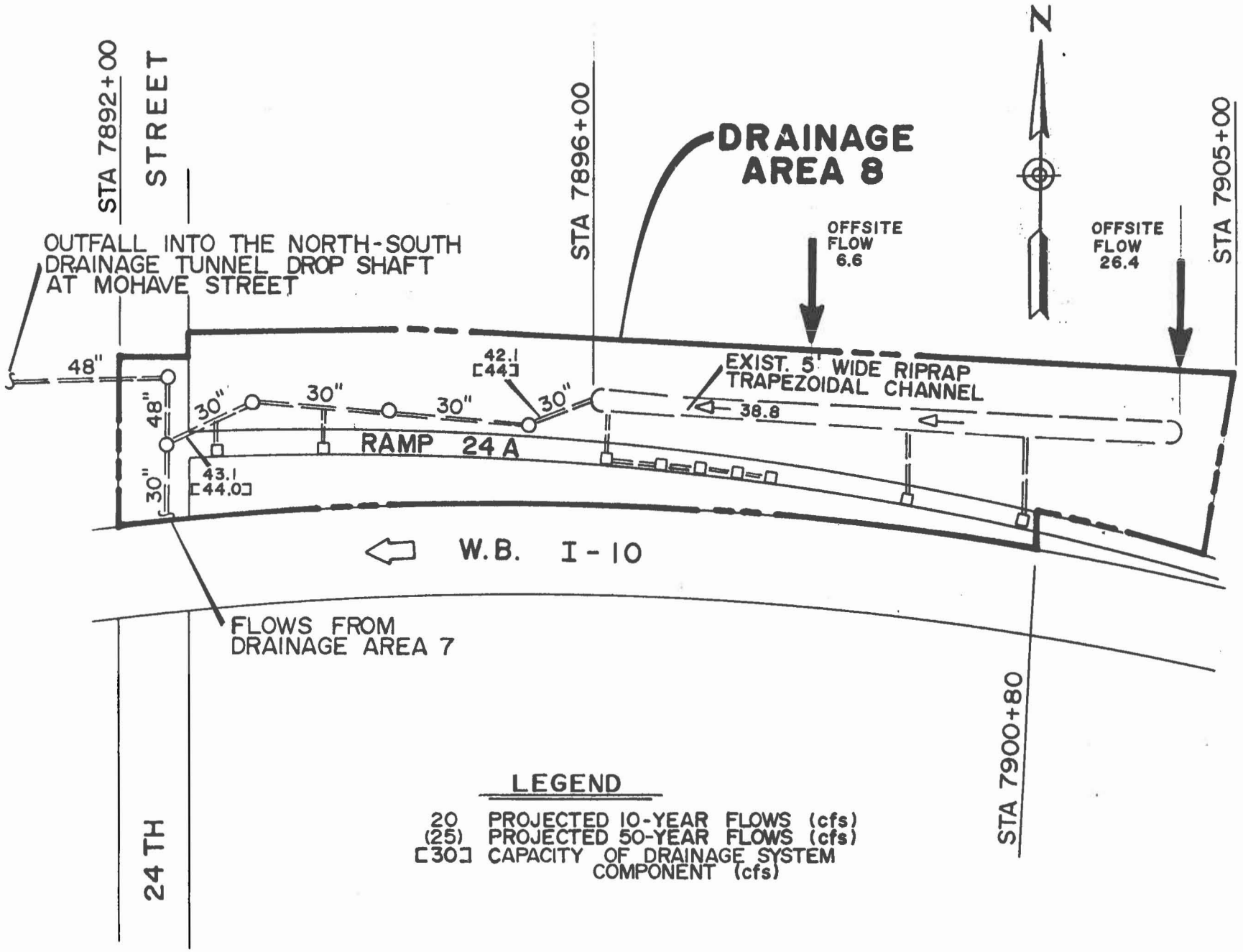

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FIGURE 9. SCHEMATIC OF EXISTING DRAINAGE SYSTEM FOR DRAINAGE AREA 8.

Drainage Area 9

Drainage Area 9 includes the I-10 westbound lanes from the I-10/24th Street traffic interchange (Sta. 7890+00) eastward to the Salt River (Sta. 7941+00), Ramp 24-A from Sta. 7905+00 eastward to its taper from the I-10 westbound lanes, and the north right-of-way from Sta 7905+00 eastward to the Salt River, as shown on Figure 10.

Figure 10 is a schematic of the existing drainage system for Drainage Area 9 and includes some of the design flows as documented in the Final Drainage Report for 24th Street to the Salt River Bridge.

The existing drainage system consists of a series of inlets located along the I-10 median and Ramp 24-A gore area to collect and convey flows northward to the 10-foot wide trapezoidal channel located in the north right-of-way. The trapezoidal channel collects and conveys these flows in the easterly direction, discharging through four, 48-inch dia. culverts, continuing eastward through the trapezoidal channel to twin 72-inch dia. culverts, which in turn discharges the flows into the Salt River, as shown on Figure 10.

Also included in Drainage Area 9 are the off-site flows onto ADOT's north right-of-way, as shown on Figure 10. Review of the Final Drainage Report for 24th Street to the Salt River Bridge indicates that the offsite flows represent the 10-year frequency. The 50-year storm event is used for the design of the culverts. Therefore, the design flows as shown within the 10-foot wide trapezoidal channel on Figure 9 represent the 10-year frequency, while the flow rates as shown at the culverts represent the 50-year frequency.

The inconsistancy between the 10-year design flows in the 10-foot wide trapezoidal channel and the 50-year design flows to size the 4-48 inch dia. culverts and the twin 72-inch dia. culverts can be explained by different methodologies. The sizing of the channel was determined by adding the discharge flows together as the analysis progressed downstream. The design flows for the culverts was determined by calculating a time of concentration for the entire contributing area, obtaining the 50-year intensity, and calculating the rate of flow using the rational method.

The four 48-inch diameter culverts convey the 50-year flow rate of 214 cfs under outlet control conditions with a headwater depth of 4.41 feet.

The twin 72-inch diameter culverts convey the 50-year flow rate of 217 cfs under inlet control conditions with a headwater depth of 3.96 feet. This sets the water surface approximately 6.87 feet below the top of the dike which runs parallel to the Salt River along the west bank, as shown on Figure 10.

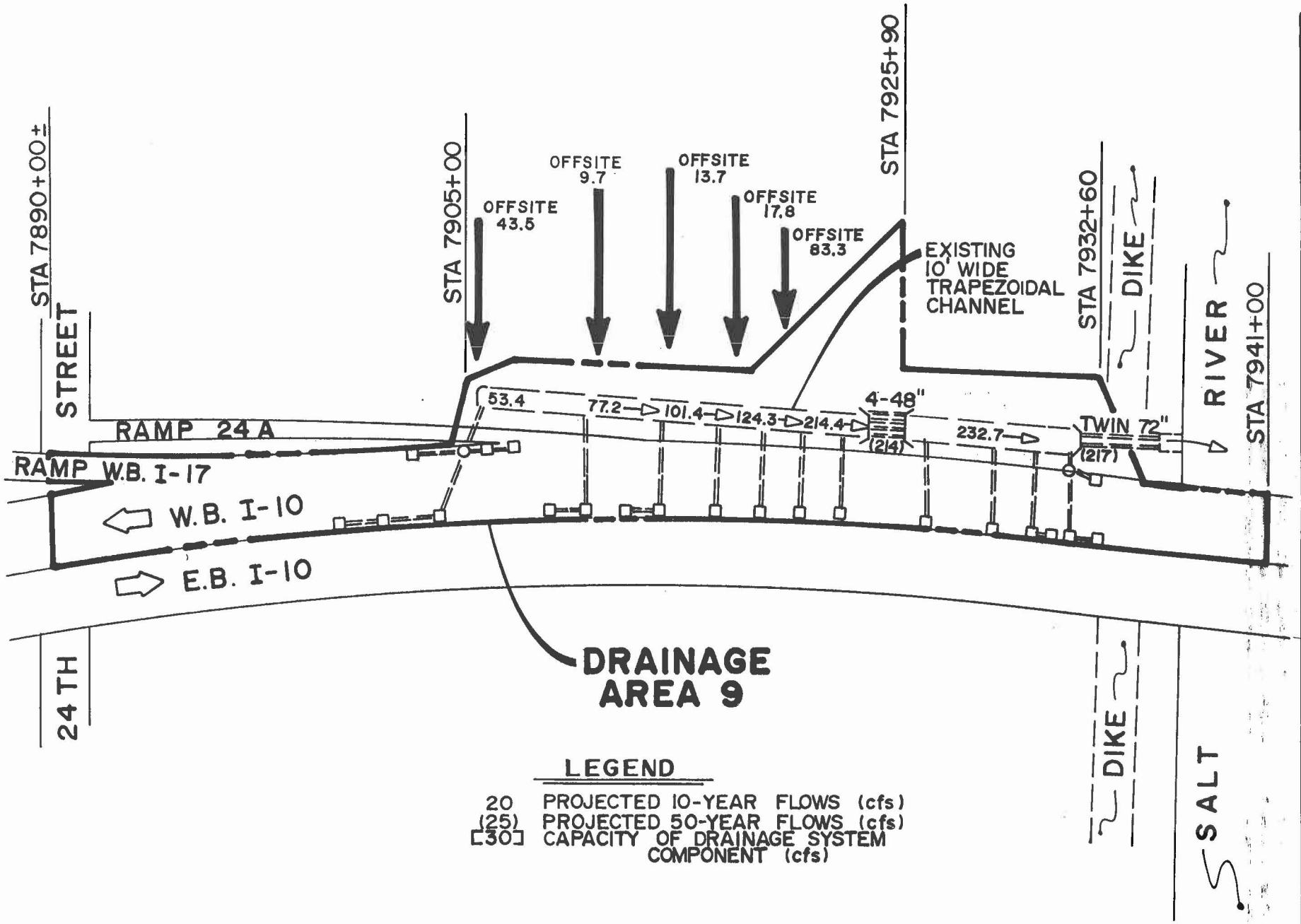

FIGURE 10. SCHEMATIC OF EXISTING DRAINAGE SYSTEM FOR DRAINAGE AREA 9.

Drainage Area 10

Drainage Area 10 includes the I-10 eastbound lanes from Sta. 7901+40 eastward to the Salt River (Sta. 7941+00), Ramp 24-B from Sta. 7901+40 eastward to its taper onto the I-10 eastbound lanes, and the south right-of-way from Sta. 7904+80 eastward to the Salt River, as shown on Figure 11.

Figure 11 is a schematic of the existing drainage system for Drainage Area 10 and includes some of the design flows as documented in the Final Drainage Report for 24th Street to the Salt River Bridge.

The existing drainage system consists of a series of inlets along the south shoulders of I-10 eastbound lanes and Ramp 24-B to collect and convey flows in the southerly direction into either the 5-foot wide trapezoidal channel along the south right-of-way, or the 36-inch dia. storm drain, as shown on Figure 11. Flow collected in the 5-foot wide trapezoidal channel are conveyed in the easterly direction to a 36-inch dia. storm drain which directs the flows into the Salt River.

The 10-year design flow at the inlet structure to the 36-inch storm drain, as documented in the Final Design Report for 24th Street to the Salt River Bridge, is 25.8 cfs. The design flow through the 36-inch storm drain is 32.7 cfs for the 50-year storm event with a projected headwater depth of 5.6 feet.

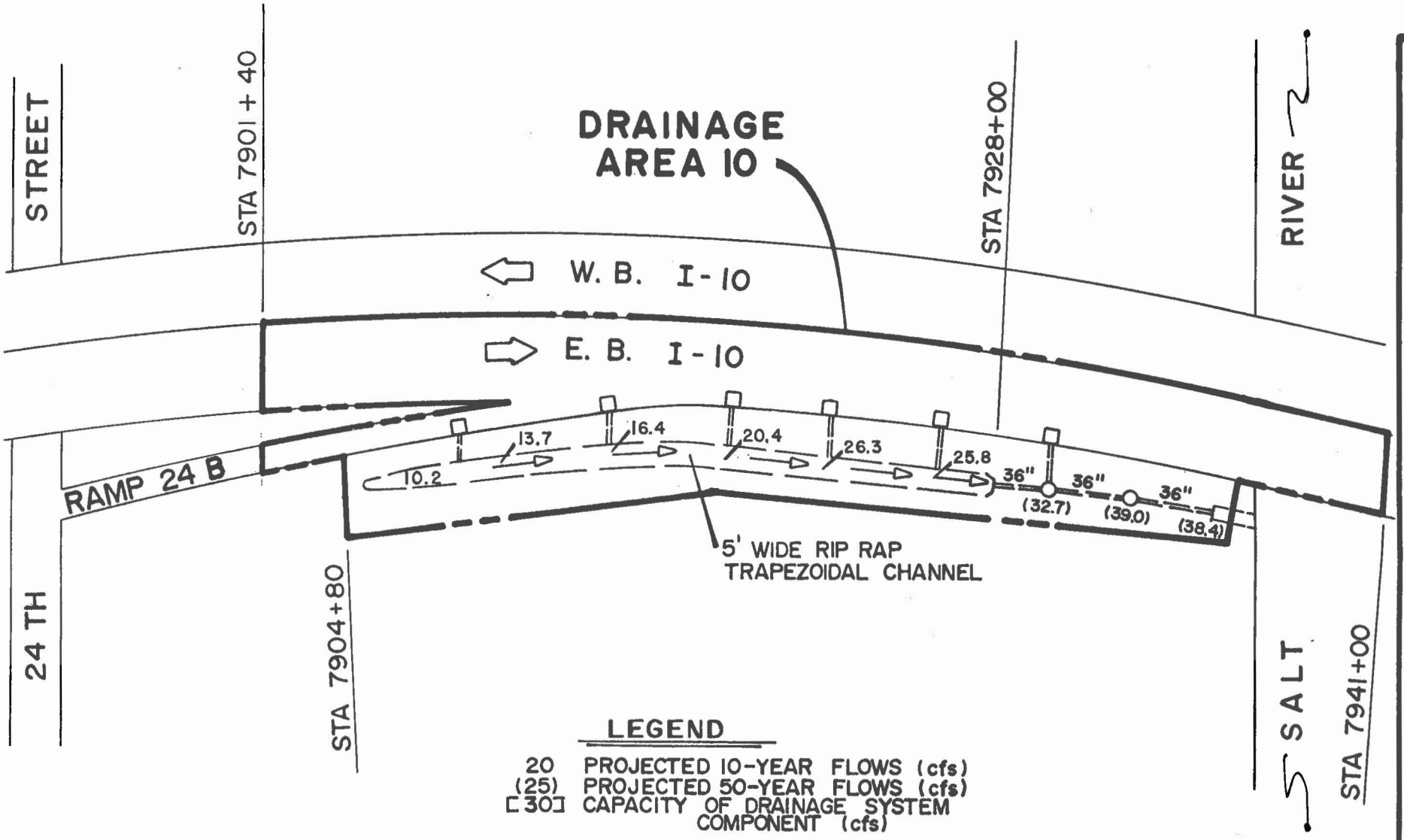

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FIGURE 11. SCHEMATIC OF EXISTING DRAINAGE SYSTEM FOR DRAINAGE AREA 10.

Drainage Area 11

Drainage Area 11 includes the I-10 eastbound and westbound lanes from the Salt River bridge (Sta. 7941+00) eastward to the I-10/48th Street traffic interchange at Sta. 8075+00, the traffic interchanges at University Drive and 40th Street, and the north and south rights-of-way, as shown on Figure 12.

Figure 12 is a schematic of the existing drainage system for Drainage Area 11 and includes some of the design flows as documented in the Final Drainage Design Report for the 32nd Street Interchange, Supplement No. 3.

The section of I-10 located between the 40th Street interchange (Sta. 8027+00) and the 48th Street interchange (Sta. 8075+500 does not have an established drainage system. Pavement runoff from the I-10 westbound lanes flows in the northerly direction onto the north right-of-way. These flows, along with flows from the north right-of-way, are then conveyed overland in the westerly direction to a private retention basin adjacent to 40th Street, belonging to the Pepsi Cola Facility, as showm on Figure 12. Pavement runoff from the I-10 eastbound lanes flow in the southerly direction onto the south right-of-way. These flows, along with flows from the south right-of-way and a residential development whose flows drain northward onto ADOT right-of-way, flow overland in a westerly direction to an inlet located south of Ramp 40B and east of 40th Street which is connected to the City of Phoenix drainage system. The residential development drains in the northerly direction and ponds along the noise wall. Openings have been provided along the noise wall, to allow the flows to discharge onto ADOT south right-of-way.

The projected peak flows for this section of I-10 were calculated in the earlier I-10 Corridor Drainage Report from Baseline Road to 40th Street and the results are duplicated in Table 2. The north right-of-way and the I-10 westbound lanes generate projected peak flows of 7.6 cfs and 12.2 cfs for the 10-year and the 50-year storm events at the Pepsi Cola retention basin, respectively. Runoff volume into the Pepsi-Cola retention basin is approximately 2.0 acre-feet for the 10-year storm event, and approximately 3.3 acre-feet for the 50-year storm event. The south right-of-way and I-10 eastbound lanes generate a projected peak flow of 6.6 cfs and 10.6 cfs for the 10-year and 50-year storm events, respectively. The residential development generates projected peak flows of 48.6 cfs and 79.5 cfs for the 10-year and 50-year storm events, respectively. The combined projected peak flows are 38.4 cfs and 67.9 cfs at the inlet to the Phoenix storm drainage system for the 10-year and 50-year storm events, respectively.

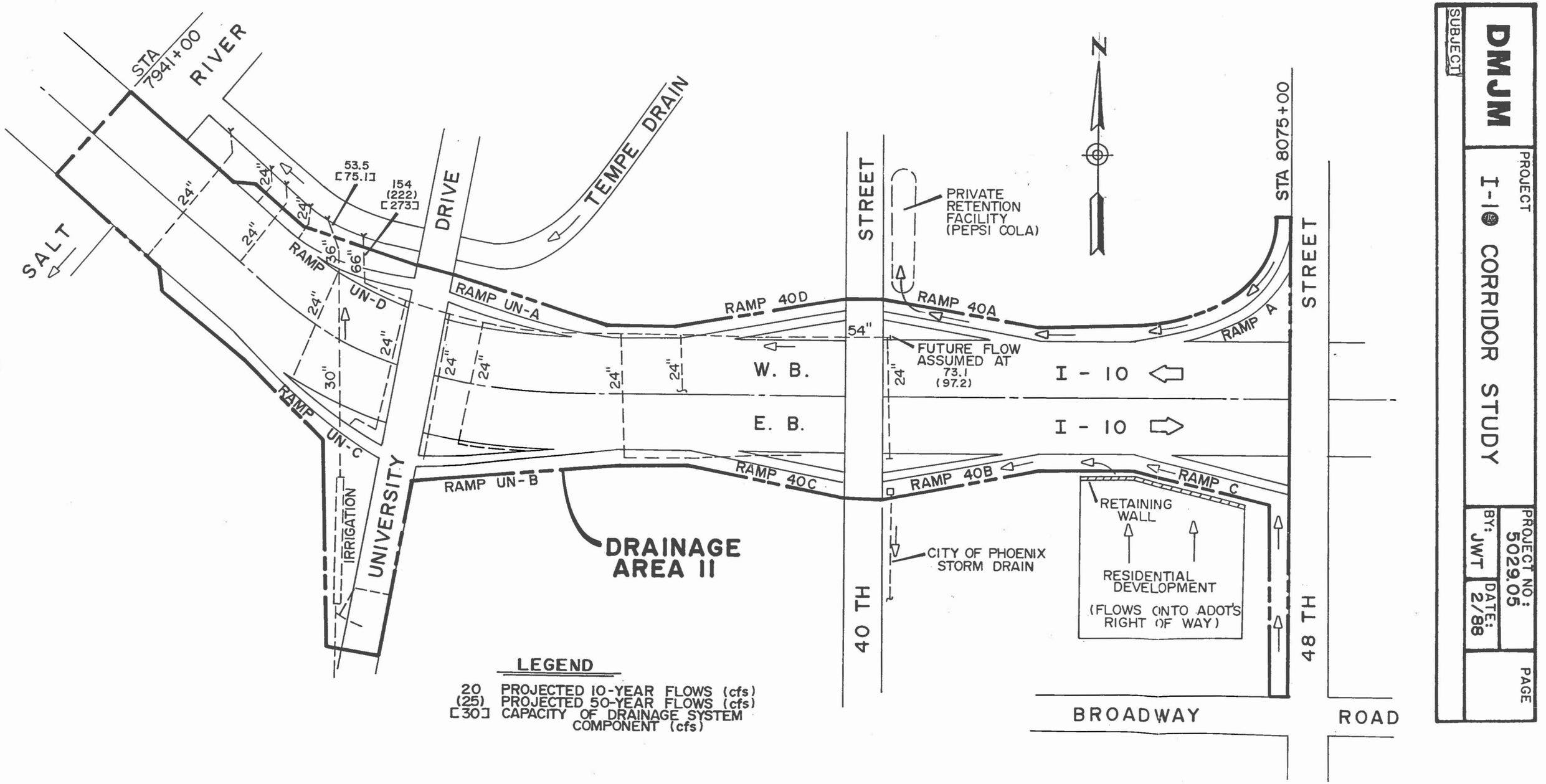

FIGURE 12. SCHEMATIC OF EXISTING DRAINAGE SYSTEM FOR DRAINAGE AREA 11.

Table 2. PROJECTED PEAK FLOWS AND STORAGE VOLUMES FOR THE SECTION OF I-10 BETWEEN 40TH STREET AND 48TH STREET TRAFFIC INTERCHANGES.

AREA	STORM FREQUENCY (YEARS)	PROJECTED PEAK FLOW (CFS)	PROJECTED STORAGE VOLUME (ACRE- FEET)	OUTFALL LOCATION
I-10 Westbound Lanes & North Right-of-Way	10 50	7.6 12.2	2.0 3.3	Pepsi Cola's Retention Facility
Residential Development	10 50	48.6 79.5	-- --	Onto ADOT's South R.O.W.
I-10 Eastbound Lanes & South R.O.W.	10 50	6.6 10.6	--	-- --
Residential Development I-10 Eastbound Lanes, and South R.O.W.	10 50	38.4 67.9	6.9 11.2	Grate Inlet at 40th Street. Connects to the City of Phoenix drainage system

From the I-10/40th Street traffic interchange westward to the Salt River, an existing closed conduit drainage system along the north right-of-way collects and conveys flows from I-10 eastbound and westbound lanes, and the 40th Street and University Drive traffic interchanges westward to the Tempe Drain outfall, as shown on Figure 12. The existing drainage system ranges in size from 66-inch dia. conduit at the outfall located west of the I-10/University Drive Interchange to a 54-inch dia. conduit at its temporary termination point east of I-10/40th Street traffic interchange. From the Salt River eastward to the University Drive outfall, several laterals collect and convey flows from I-10 eastbound and westbound lanes northward into the Tempe Drain.

The drainage design criteria for this section of I-10 was to provide a drainage system to handle the additional I-10 east and west lanes, the HOV lanes, and the original proposed traffic interchanges at University Drive and 40th Street. The projected peak flows at the University Drive outfall is approximately 154 cfs for the 10-year storm event and 221 cfs for the 50-year storm event, which includes the projected future drainage from the section of I-10 between 40th and 48th Street.

ULTIMATE DRAINAGE AREAS

The ultimate drainage systems for this section of the I-10 Corridor Study, in accordance with Functional Plan Alternative C-1, are presented in this section of the drainage report. Design flows as referred to in this section of the report, are those flows as documented in the drainage reports. Future flows as referred to in this report, represent the flows that are projected to occur when the roadway system is completed in accordance with Functional Plan Alternative C-1. Existing drainage systems refers to the drainage system that are in place or will be in place upon completion of current ADOT contracts. Ultimate drainage systems refers to the recommended drainage systems for the roadway system in accordance with Functional Plan Alternative C-1.

The study area is divided into twelve ultimate drainage areas, designated Ultimate Drainage Areas 1 through 12, as shown on Figures 1C through 10C in Appendix C. These twelve ultimate drainage areas are assigned numeric designations of 1 through 12, which corresponds to the numeric designations assigned to the existing drainage areas as presented in the Existing Drainage Areas section. There is one exception, Existing Drainage Area 11 is divided into two ultimate drainage areas, designated Ultimate Drainage Areas 11 and 12, as shown on Figures 6C through 10C in Appendix C.

Figures 1C through 10C in Appendix C, shows the ultimate drainage systems for each of the twelve ultimate drainage areas. Each ultimate drainage system, includes those existing drainage system components to remain part of the ultimate drainage system, those existing drainage system components which require modification or relocation, and the new drainage system components to be added. In addition, these figures also show the existing roadways to remain, the existing roadways to be removed, and the roadways still to be constructed in accordance with Functional Plan Alternative C-1 are also shown.

The remaining portion of this section includes the design assumptions and conditions, the proposed drainage approaches and the recommended ultimate drainage systems.

Design Assumptions and Conditions

The ultimate drainage systems concepts proposed and as presented in this section of the I-10 Corridor Study are based on the following design conditions and assumptions:

- The design flows into the North-South Drainage Tunnel drop shafts, at I-10/Buckeye Road and I-10/Mohave Street interchanges, as documented in ADOT Project 'East Tunnel Inlets', will continue to be applicable for those ultimate drainage areas whose flows discharge to these drop shafts. The ramification of this assumption is that the existing design flows represent the maximum flow rates allowed at the drop shafts and any increase in these flows will have to be handled on-site, prior to their discharge into the North-South Drainage Tunnel.

- The off-site flows onto ADOT right-of-way, as documented in the Final Drainage Design Report for Phoenix-Casa Grande Highway, Buckeye Road-Maricopa Freeway and the Final Drainage Report for Phoenix-Casa Grande Highway, 24th Street to Salt River Bridge will continue to be applicable in the design of the recommended ultimate drainage systems for the twelve ultimate drainage areas.

- The design flow rates and, consequently, the headwater depths at the location of hydraulic transitions from open channel drainage system components to closed conduit drainage system components will represent the maximum flow rates allowed for the ultimate drainage systems at those locations. The importance of this assumption is that the additional flows from future roadways will have to be controlled hydraulically on-site by the open channel components of the ultimate drainage systems.

- Those existing drainage areas whose flows are conveyed to the 78-inch diameter storm drain outfall along 16th Street, as documented in the two drainage reports, represent the maximum allowable flow rates for these ultimate drainage areas. Therefore, additional flows from future roadways will also have to be controlled hydraulically on-site by the open channel components of the ultimate drainage systems.

Proposed Drainage Approaches

Two drainage approaches are proposed for this section of the I-10 Corridor Study, from 16th Street/Buckeye Road to 48th Street. The first drainage approach proposed is for the section of the I-10 Corridor Study west of the Salt River Bridge and includes Ultimate Drainage Areas 1 through 10, as shown on Figures 1C through 4C in Appendix C. The second drainage approach proposed is for the section of the I-10 Corridor Study from the Salt River Bridge eastward to the I-10/48th Street traffic interchange and includes Ultimate Drainage Areas 11 and 12, as shown on Figures 5C through 10C in Appendix C.

Drainage approach--Buckeye Road/16th Street to the Salt River Bridge:

The first drainage approach proposed includes the section of the I-10 Corridor Study west of the Salt River, where the main drainage system components such as trunk lines, open channels and swales, along with the outfalls are already in place or will be in place upon completion of existing ADOT contracts. Future roadways for this section of the I-10 Corridor Study will include the eastbound and westbound collector-distributor roads and several ramps. The drainage approach proposed is to increase the size and thus the storage capacity, of the existing swales and channels as required, in order to handle the additional runoff from future roadways, while maintaining the design flows (as documented in the drainage reports) at the inlet structures (hydraulic transitions from channel flow to closed conduit flow). To summarize, the existing swales and channel components are increased in size at those locations where the additional flows from future roads are discharged. These open channels will function as on-site conveyance/detention facilities while maintaining their design discharges at the inlet structures by increasing their storage capacity. The approach proposed will require up-sizing and, at certain locations, relocating existing swales and open channels.

There will be instances where flows from future roadways will be discharged directly into the closed conduit components of the ultimate drainage systems, thus eliminating the opportunity to provide peak flow attenuation. In these instances, it will be necessary to reduce the channel flows in the ultimate drainage system to compensate.

Drainage Approach--Salt River Bridge to the I-10/48th Street Interchange:

The second drainage approach proposed is for the section of the I-10 Corridor Study from the Salt River Bridge eastward along I-10 to the I-10/48th Street traffic interchange. Future roadways for this section of the I-10 Corridor Study include the eastbound and westbound collector-distributor roads and the modifications to the interchanges at University Drive and 40th Street. The existing closed drainage system along the north right-of-way does not have sufficient capacity to handle the projected future flows from the ultimate roadway system. As a result, the drainage approach proposed is to provide an additional closed drainage system along the south right-of-way from an outfall into the Salt River eastward to approximately 1100 feet west of the I-10/48th Street interchange.

By transferring those flows generated from the I-10 eastbound lanes, excluding H.O.V. lanes, to the proposed south closed drainage system, additional capacity is created in the existing closed drainage system, to include flows from the future westbound collector-distributor roads and the north portions of the University Drive and 40th Street Interchanges.

The proposed closed conduit drainage along the I-10 south right-of-way system will be designed to collect and convey flows from the I-10 eastbound lanes, the future eastbound collector-distributor roads, and the south portions of the interchanges at University Drive and 40th Street in accordance with ADOT design criteria.

Ultimate Drainage Area 1

Ultimate Drainage Area 1 includes the section of the existing I-10 eastbound and westbound lanes from approximately Sta. 7853+40 northward to the Study Limits at Sta. 7840+20. Also included in this drainage area are sections of future Ramps BU-A and BU-B, and sections of the future eastbound and westbound collector-distributor roads, as shown on Figure 1C in Appendix C.

The outfall for Ultimate Drainage Area 1 drainage system remains the North-South Drainage Tunnel drop shaft at Buckeye Road. The Buckeye Road drop shaft has a design flow of 485 cfs, as documented in ADOT project "East Tunnel Inlet". The drainage approach proposed, assumes that the design flows presented in the Final Drainage Design Report, Buckeye Road-Maricopa Freeway, and those flows outside the study area, also discharging to the Buckeye Road drop shaft, when combined, is equivalent to the design flow of 485 cfs. Therefore, additional flows from future roadways within Ultimate Drainage Area 1 will need be handled on-site prior to discharge to the Buckeye Road drop shaft.

The drainage approach proposed is to outlet those flows from the future roadways into either swales or drainage ditches along the right-of-ways, as shown on Figure 1C in Appendix C, then increase their storage capacity, in order to maintain the design headwater depth at the inlets structures to the closed drainage system, thereby maintaining the design flows. These swales and drainage ditches will function as conveyance systems and also as detention facilities in order to provide the necessary peak flow attenuation to reduce the ultimate peak flows to the respective design flows, as documented in the Buckeye Road-Maricopa Freeway Final Drainage Design Report.

The drainage concept proposed, for Ultimate Drainage Area 1, requires relocating the existing swale along the west right-of-way and upsizing it to a drainage ditch, as shown on Figure 1C in Appendix C. Additional flows from the future Ramp BU-B and the future eastbound collector-distributor road are to be discharged into the relocated drainage ditch. The drainage ditch is to be enlarged as required, to maintain the design headwater depth at the inlet structure to the 24-inch storm drain. The Final Drainage Design Report has a design discharge flow of 7.7 cfs for the 10-year frequency storm event (the design headwater depth at the inlet to the 24-inch storm drain was not provided) and a design discharge flow of 10.6 cfs with a headwater depth of 0.78 feet for the 50-year frequency storm event.

The existing swale along the east right-of-way will not require relocation, but will require upsizing to handle the additional flows from future Ramp BU-A and future westbound collector-distributor road. Since some of the future flows will be connected directly to the existing closed conduit drainage system, on-site peak flow attenuation is eliminated. Therefore, the drainage concept proposed is to reduce the discharge in the enlarged channel to below the design discharge at the inlet structure to compensate for those future flows which are discharged directly to the closed drainage system.

The existing swale along the east right-of-way, discharging into the 36-inch storm drain at Sta. 7847+00, has a design flow of 76.5 cfs for the 10-year frequency storm event (the headwater depth at inlet structure was not provided). The 50-year storm event generates a design flow of 78.9 cfs with a headwater depth of 4.9 feet. Note that both design flows include a cumulative off-site flow of 70 cfs.

Ultimate Drainage Area 2

Ultimate Drainage Area 2 includes two sections of the existing I-10 eastbound and westbound lanes from approximately Sta. 7853+40 southward to Sta. 7861+00 and from approximately Sta. 7870+00 eastward to Sta. 7880+00, and the I-17 westbound lanes from approximately I-17 Sta. 227+00 eastward to I-17 Sta. 240+40. Also included in Ultimate Drainage Area 2 are sections of future eastbound and westbound collector-distributor roads and sections of future Ramps Bu-A, Bu-B, and WB T-5 as shown on Figures 1C, 3C, and 4C in Appendix C.

The outfall for Ultimate Drainage Area 2 remains the North-South Drainage Tunnel drop shaft at Mohave Street. The Mohave Street drop shaft has a design flow of 540 cfs, as documented in ADOT Project 'East Inlet Tunnels'. As stated in the design assumptions, the design flow of 540 cfs represents the maximum allowable flow rate that can be discharged into the Mohave Street drop shaft. It is also assumed that the design flows as presented in the Final Drainage Design Report, Buckeye Road-Maricopa Freeway, represent a flow equivalent to the 540 cfs design flow. Therefore, the additional future flows will require peak flow attenuation through on-site detention.

The drainage approach proposed for Ultimate Drainage Area 2 is a combination of relocation and enlargment of existing drainage swales and channels in order to provide the necessary peak flow attentuation through on-site detention in order to reduce the ultimate peak flows to their respective design flows.

The existing swales located west of I-10, both north and south of Mohave Street, as shown on Figure 1C in Appendix C, will require relocation outside the future eastbound collector-distributor road and upsizing. Future flows for the eastbound collector-distributor road along with existing flows from I-10 are to be discharged to the relocated drainage ditch and swale. The drainage ditch and swale are to be increased in size, as necessary, to accommodate the additional flows while maintaining the design flows at the inlet structures to the closed conduit drainage system.

East of the I-10 eastbound lanes and north of Mohave Street, future flows from the westbound collector-distributor road and Ramp BU-A are to be discharged to the existing 10 feet wide drainage ditch, as shown on Figure 1C in Appendix C. Because of the capacity of the 10-foot drainage ditch, the accumulated peak flows from off-site (290 cfs for the 50-year storm event), and the probable difference in time of concentration, the additional future flows will not increase the design flow signicantly to justify modification to the drainage ditch.

The area south of Mohave Street, which includes the northeast portion of the I-10/I-17 traffic interchange, as shown on Figures 3C and 4C in Appendix C, will require a detention facility along with providing additional drainage swales and culverts while relocating existing drainage swales in conflict with future roads. These additional drainage swales will be required north of the future westbound collector-distributor road to collect and convey these flows to the proposed detention facility. The proposed detention facility is to be sized such that the design flow at the inlet structure is maintained.

The location of the proposed detention facility has a design discharge of 62.2 cfs and a headwater depth of 4.3 feet for the 10-year frequency storm event. The swale along the I-10 west right-of-way, north of Mohave Street, has a design flow of 6.8 cfs for the 10-year frequency storm event (the headwater depth was not provided). The swale along the I-10 west right-of-way, south of Mohave Street, has a design flow of 6.7 cfs and a headwater depth of 0.47 feet for the 10-year frequency storm. The 10 foot wide drainage ditch along the I-10 east right-of-way for the area north of Mohave Street has a design flow of 300 cfs for the 10-year frequency storm event with a projected headwater depth of 9.2 feet. Note that the total flow into the 10 foot wide drainage ditch includes a cumulative off-site flow of 290 cfs.

Ultimate Drainage Area 3

Ultimate Drainage Area 3 includes the eastbound and the westbound lanes of I-17 from approximately I-17 Sta 208+40 eastward to approximately I-17 Sta. 220+00, sections of Ramp 17/N-W and Ramp 17/W-N along the south section of the I-10/I-17 interchange, and the west Included Area (detention facility). Also included in Ultimate Drainage Area 3 is a short section of the future eastbound collector-distributor road, as shown on Figures 1C, 2C, and 3C in Appendix C.

The outfall for Ultimate Drainage Area 3 remains the 78-inch diameter storm drain along 16th Street, as shown on Figure 2C in Appendix C. Flows from the West Included Area and other parts of Ultimate Drainage Area 3 are collected in the existing 60-inch diameter storm drain along the south right-of-way and conveyed in a westerly direction along with other flows to the 78-inch diameter storm drain.

The only future flow to be added to Ultimate Drainage Area 3 is from the short section of the future eastbound collector-distributor road, as shown on Figure 3C in Appendix C, whose flows will be discharged into the West Included Area. The remaining sections of the existing drainage system within the Ultimate Drainage 3 Area will remain unchanged. The additional area from the future eastbound collector-distributor road is approximately 0.32 acres of pavement. When compared to the existing area contributing to the West Included Area of 16.06 acres, this amounts to an increase of only 2 percent. Re-analysis of the West Included Area with the additional area from the future eastbound collector-distributor road included results in a slight increase in the peak inflow from 78.1 cfs to 79.9 cfs and also, a small increase in the maximum outflow from 17.9 cfs to 18.4 cfs. The maximum ponding elevation remains at its design stage of 2.8 feet with the maximum storage requirement also remaining at its design capacity of 130,000 cubic feet. The supporting calculations are included in Appendix B. The data and methodology used for re-analysis of the West Included Area is taken from the Final Drainage Design Report for Phoenix-Casa Grande Highway, Buckeye Road-Maricopa Freeway.

Ultimate Drainage Area 4

Ultimate Drainage Area 4 includes the existing I-17 westbound lanes from approximately I-17 Sta. 203+90 westward to the study limits at 16th Street (I-17 Sta. 188+20), and the I-17 north right-of-way from the I-10/I-17 traffic interchange westward to 16th Street, as shown on Figure 2C in Appendix C.

According to Functional Plan Alternative C-1, the ultimate roadway system along this section of I-10, is already in place. Accordingly, the required drainage system is also in place.

Ultimate Drainage Area 5

Ultimate Drainage Area 5 includes the existing I-10 eastbound lanes from approximately I-17 Sta. 208+40 westward to the study limits at 16th Street (I-17 Sta. 188+20), a section of I-17 westbound lanes from I-17 Sta. 212+00 westward to I-17 Sta. 204+00, and the I-17 south right-of-way from the I-10/ I-17 traffic interchange westward to at 16th Street, as shown on Figures 2c and 3C in Appendix C.

According to Functional Plan Alternative C-1, the ultimate roadway system along this section of I-10 is already in place. Accordingly, the required drainage system is also in place.

Ultimate Drainage Area 6

Ultimate Drainage Area 6 includes the existing I-10 eastbound and westbound lanes from approximately Sta. 7880+00 eastward to Sta. 7891+60 (the I-10/24th Street Traffic Interchange). The existing I-17 eastbound lanes from approximately I-17 Sta. 219+50 eastward to I-17 Sta. 238+00, the East Included Area (a detention facility), and the south right-of-way. In addition, the Ultimate Drainage Area 6 also includes the future eastbound collector-distributor road from approximately Sta. 7873+60 eastward to Sta.7905+50 and the future Ramp EB T-1 from its taper from I-17 eastbound lanes eastward to its taper onto the future eastbound collector-distributor road, as shown on Figures 3C and 4C in Appendix C.

The outfall for Ultimate Drainage Area 6 remains the existing 78-inch diameter storm drain along 16th Street (refer to Figure 2C in Appendix C). An existing 60-inch storm drain along the south right-of-way collects and conveys the flows in a westerly direction to the the 78-inch diameter outfall line.

The drainage concept proposed for Ultimate Drainage Area 6 includes the utilization of the existing East Included Area (detention facility), the up-sizing and relocation of existing swales and channels as necessary to handle the additional flows the future eastbound collector-distributor road and Ramp EB T-1, and the installation of culverts under the future Ramp EB T-1 and the eastbound collector-distributor road which will hydraulically control discharge from their contributing areas.

The East Included Area will include an additional drainage area of approximately 0.17 acres of impervious surfaces from the future eastbound collector-distributor road as shown on Figure 3C in Appendix C. Re-analysis of the East Included Area was performed using the methodology as presented in the Final Drawings Design Report for Buckeye Road-Maricopa Freeway, with the additional drainage area included. The results show an increase in the inflow peak flow for the 100-year, 10-min. storm event from 54.1 cfs to 55.1 cfs. This increase in peak flow changes the headwater depth at the 48-inch diameter inlet pipe, from its design depth of 3.4 feet to approximately 3.42 feet as shown on Figure 5B in Appendix B. The minimal increase in headwater depth, does not justify making any change to the East Included Area detention facility. Furthermore, the design results indicated additional storage capacity beyond present design requirements. Thus, the East Included Area is adequately sized to handle the additional flow with its present design. The supporting calculations are included in Appendix B.

The flows from the future Eastbound collector-distributor road and the future Ramp EB T-1 are to be conveyed northward to an existing swale which is up-sized to a drainage ditch, as shown on Figures 3C and 4C in Appendix C. The drainage concept proposed is for the drainage ditch to function as both a conveyance system and a detention facility, thereby reducing the peak flow to its design flow at the proposed culverts. Thus, the proposed culvert under future Ramp EB T-1 regulates the rate of discharge to the 60-inch storm drain along the south right-of-way.

Ultimate Drainage Area 7

Ultimate Drainage Area 7 includes the existing I-10 eastbound lanes from approximately Sta. 7890+70 eastward to Sta.7901+40, existing Ramp 24-B from its intersection with 24th Street eastward to approximately Sta. 7901+00 and Ramp 24-B infield area. Also included in Ultimate Drainage Area 3 are sections of the future eastbound collector-distributor road and Ramp EB T-1 from approximately Sta. 7892+00 eastward to Sta. 7901+00, as shown on Figure 4C in Appendix C.

The outfall for Ultimate Drainage Area 7 remains the 30-inch diameter storm drain along 24th Street. The 30-inch storm drain conveys flows in the northerly direction under I-10, where it connects to a 48-inch diameter storm drain. The 48-inch storm drain then conveys the flows along with flows from Ultimate Drainage Area 8 in a westerly direction, where it combines with other flows and eventually discharges into the North-South Drainage Tunnel through the drop shaft located at Mohave Street.

The drainage concept proposed for Ultimate Drainage Area 7 is to relocate the exiting swale along the I-10 south right-of-way south of the future eastbound collector-distributor road and increase its size to accommodate the additional flows while still maintaining the original design flows at the inlets to the closed conduit components of the drainage system.

Ultimate Drainage Area 8

Ultimate Drainage Area 8 includes existing Ramp 24-A from its 24th Street intersection eastward to approximately Sta. 7900 + 70 and the I-10 north right-of-way. Also included in Ultimate Drainage Area 8 is the future westbound collector-distributor road from approximately Sta. 7892 + 00 eastward to Sta. 7904 + 50, as shown on Figure 4c in Appendix C.

The outfall for Ultimate Drainage Area 8 remains the 30-inch diameter storm drain north of Ramp 24-A which connects into the 48-inch diameter storm drain along 24th Street. Flows from Ultimate Drainage Area 8 along with flows from Ultimate Drainage Area 7 are conveyed westerly and northerly through a closed drainage system along with other flow collected downstream to the North-South Drainage Tunnel drop shaft at Mohave Street.

The drainage concept proposed for Ultimate Drainage Area 8 is to relocate the existing drainage ditch and its inlet structure along the I-10 north right-of-way to north of the future westbound collector-distributor road and increase its size to handle the additional flows from the future westbound collector-distributor road. The relocated and enlarged drainage ditch is to function as both a conveyance system and as a detention facility in order to reduce the future peak flow to the design flow at the inlet structure located at approximately Sta. 7896+00.

Ultimate Drainage Area 9

Ultimate Drainage Area 9 includes the existing I-10 westbound lanes from approximately Sta. 7891 + 60 (I-10/24th Street Traffic Interchange) eastward to the Salt River Bridge at Sta. 7941 +00 and a section of existing Ramp 24-A from Sta. 7900 + 70 eastward to its taper from I-10 westbound lanes. Also included in Ultimate Drainage Area 9 is the future westbound collector-distributor road from approximately Sta. 7900+70 eastward to the Salt River Bridge at Sta. 7941+00, as shown on Figures 4C and 5C in Appendix C.

The outfall for Ultimate Drainage Area 9 remains the Salt River, through twin 72-inch diameter culverts. Off-site drainage onto ADOT right-of-way includes approximately 80.8 acres adjacent to ADOT north right-of-way and the off-site flows of 43.5 cfs, 137 cfs, 17.8 cfs, and 83.3 cfs, as shown on Figures 4C and 5C in Appendix C.

The drainage concept proposed for Ultimate Drainage Area 9 is to enlarge the existing trapezoidal channel along the I-10 north right-of-way in order to provide sufficient storage capacity to maintain the design flows at the four 48-inch diameter culverts and the twin 78-inch diameter culverts. The design flows are documented in the Final Drainage Report, 24th Street to Salt River Bridge and presented earlier in this report in the section designated Existing Drainage Area 9.

From conversation with Sky Harbor Airport Personnel, it appears that the existing off-site flows onto ADOT north right-of-way along this section of I-10 will continue to drain onto the ADOT north right-of-way, even after development of the area between I-10 and the Sky Harbor Airport.

Ultimate Drainage Area 10

Ultimate Drainage Area 10 includes the existing I-10 eastbound lanes from approximately Sta. 7900 + 51 eastward to the Salt River Bridge at Sta. 7941+ 00 and existing Ramp 24-B from Sta. 7901 + 20 eastward to its taper onto the I-10 eastbound lanes. Also included in Ultimate Drainage Area 10 is the future eastbound collector-distributor road from Sta. 7901+20 eastward to the Salt River at Sta. 7941 + 00, as shown on Figures 4C and 5C in Appendix C.

The outfall for Ultimate Drainage Area 10 remains the Salt River, through a 36-inch diameter culvert, as shown on Figure 5C in Appendix C.

The drainage approach proposed for Ultimate Drainage Area 10 is to convey future flows from the proposed eastbound collector-distributor road along with existing flows from I-10 eastbound lanes southward to the 5-foot trapezoidal channel located in the I-10 south right-of-way. The 5-foot trapezoidal channel is to be increased in size to handle the additional flow while maintaining the design discharge at the inlet structure to the 36-inch dia. culvert at Sta. 7928+00.

Ultimate Drainage Area 11

Ultimate Drainage Area 11 consists of approximately 81.5 acres. This includes the existing I-10 westbound lanes and the eastbound and westbound H.O.V. lanes from the Salt River eastward to the I-10/48th Street traffic interchange, and section of I-10 eastbound lanes from approximately Sta. 7962 + 00 eastward to Sta. 7995 + 00. Also to be included in Ultimate Drainage Area 11 is the future westbound collector-distributor road from Salt River eastward to the I-10/48th Street interchange and the north sections of the interchanges at University Drive and 40th Street, as shown on Figures 5C, 6C, 7C, 8C, 9C, and 10C in Appendix C.

The existing closed drainage system begins at its outfall into the Tempe Drain west of I-10/University Drive interchange and continues in the easterly direction along the I-10 north right-of-way to its temporary termination point east of the I-10/40th Street interchange. The existing closed conduit drainage system trunk lines range in size from a 66-inch diameter conduit at its outfall to a 54-inch diameter conduit at its present terminus. The drainage approach proposed is to remove the existing flows from the I-10 eastbound lanes in order to provide the needed capacity in the existing drainage system to accommodate the flows from the future westbound collector-distributor road and the north portions of the interchanges at University Drive and 40th Street. The existing drainage system is also to be extended in the easterly direction from its present terminus eastward along the north right-of-way to the proposed detention facility located in the southwest corner of the I-10/48th Street interchange, as shown on Figures 9C and 10C in Appendix C. The extension of the trunk line along the I-10 north right-of-way is to be designed to collect and convey flows from the I-10 westbound lanes, the eastbound and westbound H.O.V. lanes, the future westbound collector-distributor road and the discharge from the proposed detention facility.

The methodology used for the preliminary design of the extension of the drainage system along with verifying adequate capacity in the downstream existing drainage system is the Rational Method as presented in the ADOT manual 'Hydrologic Design for Highway Drainage in Arizona'. The 10-year frequency storm event was used to size the drainage system. The preliminary design of the proposed detention facility is based on a procedure presented in Chapter 8 of "Urban Stormwater Management," APWA Special Report No. 49. The procedure assumes triangular inflow-outflow hydrographs and assumes the peak outflow occurs on the recession limb of the inflow hydrograph. The procedure also assumes that the peak flow of the inflow hydrograph occurs at the time of concentration. The area between the inflow hydrograph and the outflow hydrograph represents the maximum storage requirement for the detention facility. The peak flow for the outfall hydrograph is established at flow rate that produce a storage requirement at the detention facility that appears that the site can physically accomodate. The 50-year frequency 24-hour storm event was used to size the proposed detention facility. The projected maximum outflow from the proposed detention facility was added to the downstream flows in order to determine the cumulative flow, which was used to size the storm drainage system extension from 40th Street to 48th Street and to check whether the existing downstream drainage system was adequate. The approach of adding the discharge from the proposed detention facility is conservative and appears applicable for preliminary design.

The 10-year rainfall intensities are obtained from the Phoenix, Arizona rainfall intensity-duration-frequency curves, as shown on Figure 1A in Appendix A. The 50-year precipitation values used to size the proposed detention facility are from a procedure provided by ADOT dated April 17, 1987, also included in Appendix A.

The preliminary design of the drainage system for Ultimate Drainage Area 11 generates a conservative peak flow at the outfall into the Tempe Drain of approximately 148 cfs for the 10-year frequency storm event. The projected storage requirement for the proposed detention facility located in the southwest corner of the I-10/48th Street interchange is estimated at 52,500 cubic feet (1.21 acre-feet) for the 50-year, 24-hour storm event using a maximum discharge of 34 cfs through a 36-inch diameter pipe and a projected ponding depth of approximately 3.0 feet. The extension of the existing drainage system from the 40th Street interchange eastward to the proposed 48th Street detention facility ranges in size from a 54-inch diameter conduit at the connection to the existing drainage system to a 36-inch diameter pipe from the proposed detention facility.

The supporting calculations for Ultimate Drainage Area 11 are included in Appendix B. The subarea delineation used in the drainage system design for Ultimate Drainage Area 11 is shown on Figures 1D, 2D and 3D in Appendix D. The subareas are designated DA1A through DA4OA. The areas in acres and the 'C' coefficients for each subarea is presented in Table 1B in Appendix B. The composite 'CA' valves for each subarea in Ultimate Drainage Area 11 is presented in Table 2B in Appendix B.

Ultimate Drainage Area 12

Ultimate Drainage Area 12 consists of approximately 52 acres, which includes the existing I-10 eastbound lanes from the Salt River eastward to the I-10/48th Street interchange, excluding the section of I-10 eastbound lanes from approximately Sta. 7962 +00 eastward to Sta. 7995 + 00, which continues to drain to the existing drainage system located in Ultimate Drainage Area 11. Also to be included in Ultimate Drainage Area 12 is the future eastbound collector-distributor road and the southern half of the interchanges at University Drive and 40th Street, as shown on Figures 5C, 6C, 7C, 8C, 9C, and 10C in Appendix C.

The drainage approach proposed for Ultimate Drainage Area 12 is to provide a new closed conduit drainage system along the I-10 south right-of-way. The new closed conduit drainage system will begin at its outfall into the Salt River and continue in the easterly direction along the I-10 south right-of-way between the I-10 eastbound lanes and the future eastbound collector-distributor road. At the southwest corner of the I-10/40th Street interchange, a detention facility is proposed. The drainage system continues eastward from its outlet into the detention facility to approximately 1100 feet west of the I-10/48th Street interchange. The reason for discharging flows from the proposed drainage system directly to the Salt River, rather than the Tempe Drain, is to avoid the flow limitations enforced when discharging into the Tempe drain.

The purpose of the proposed detention facility is to reduce the size requirements of the conduits downstream through peak flow attenuation. The methodology used to size the proposed drainage system and the proposed detention facility is identical to the methodology presented in Ultimate Drainage Area 11, and will not be repeated.

The preliminary design of the new drainage system for Ultimate Drainage Area 12 generates a peak flow of approximately 74 cfs at the outfall into the Salt River, for the 10-year frequency storm event. The new drainage system ranges in size from a 48-inch diameter conduit at the outfall to a 24-inch diameter conduit at the upstream end. The proposed detention facility at the southwest corner of the I-10/40th Street interchange has a projected storage requirement estimated at 160,700 cubic feet (3.69 acre-feet), with a maximum discharge of 24 cfs through a 24-inch dia. inlet pipe and a projected ponding depth of 2.5 feet to 3.5 feet.

The supporting calculations are included in Appendix B. The subarea delineation used in the drainage system design for Ultimate Drainage Area 12 is shown on Figures 1D, 2D, and 3D in Appendix D. The subareas are designated DA1B through DA31B. The areas in acres and the C-coefficients for each subarea is presented in Table 3B in Appendix B. The composite 'CA' for each subarea in Ultimate Drainage Area 11 is presented in Table 4B in Appendix B.

CONCLUSIONS AND RECOMMENDATIONS

Two drainage approaches are recommended for the section of the I-10 Corridor Study from 16th Street/Buckeye Road to 48th Street.

The first recommended drainage approach is for the study area west of the Salt River and includes Ultimate Drainage Areas 1 through 10. This area has the main components of the ultimate drainage systems already in place and therefore, the approach recommended is to provide onsite detention through modification of existing swales, drainage channels and detention facilities to control the additional flows from future roadways. This approach should minimize modifications to the present drainage systems and providing adequate drainage systems for the ultimate roadway configuration.

The second recommended drainage approach is for the study area from the Salt River eastward to 48th Street. Because the existing closed conduit drainage system along the I-10 north right-of-way is inadequate to accomodate the project flows from the ultimate roadway system for this section of the study area, it is recommended that an additional closed conduit drainage system along the I-10 south right-of-way be constructed from the Salt River eastward to approximately 48th Street. By transferring a portion of the existing flows to the new drainage system, additional capacity will be available in the existing drainage system to accommodate future flows from the future westbound collector-distributor road and the north portions of the interchanges at University Drive and 40th Street. The proposed closed conduit drainage system along the I-10 south right-of-way is presently sized to include only ADOT flows. It may be worth considering, in the final design, to enlarge the proposed drainage system in order to include residential flows presently flowing onto ADOT right-of-way through openings in the noise wall west of the 48th Street Interchange.

In conclusion, the drainage approach recommended for the I-10 Corridor Study area west of the Salt River minimizes modifications to the closed conduit components of the existing drainage systems and thereby reduces costs, while providing drainage systems adequate for the ultimate roadway system. The drainage approach recommended for the study area from the Salt River eastward to the 48th Street interchange allows maximum utilization of the existing closed conduit drainage system. It provides for an additional closed conduit drainage system along the I-10 south right-of-way which eliminates crossing I-10.

REFERENCES

1. American public Works Association, 'Urban Stormwater Management'. APWA Research Foundation and Institute for Water Resources of the American Public Works Association, 1313 East Sixtieth Street, Chicago, Illinois.

2. Arizona Department of Transportation, 'East Tunnel Inlets', Project No. AZI-10-3 (224).

3. Arizona Highway Department, 'Hydrologic Design for Highway Drainage in Arizona', Bridge Division, Arizona Highway Department, December 1, 1968.

4. DMJM, 'Final Drainage Design Report, Supplement No. 3, Phoenix-Casa Grande Highway, Salt River Bridge to 40th Street', Maricopa County, Project IR-10-3(222) P.E., 300 West Clarendon Avenue, Phoenix, Arizona, June 16, 1987.

5. DMJM, 'Supplement to the Final Drainage Design Report, Phoenix-Casa Grande Highway, Salt River Bridge to 40th Street', Maricopa County, Project I-103(162) P.E., 300 West Clarendon Avenue, Phoenix, Arizona, February 1985.

6. Evans, Kuhn and Associates, Inc., 'Final Drainage Design Report, Phoenix-Casa Grande Highway, Buckeye Road-Maricopa Freeway', Project I-10-3(154) P.E., 727 East Bethany Home Road, Phoenix, Arizona, March, 1985.

7. Howard, Needles, Tammen, and Bergendoff, 'Evaluation of Value Engineering Alternatives, Interstate 10 Phoenix-Casa Grande Highway, Inner Loop Drain Tunnels', 2211 East Highland Avenue, Suite 100, Phoenix, Arizona, December, 1983.

8. Stanley Consultants, 'Final Drainage Design Report, Phoenix-Casa Grande Highway, Buckeye Road-Maricopa Freeway', Project No. I-103(154) P.E., Stanley Building, Muscatine, Iowa, February, 1985.

9. U.S. Department of Transportation, 'Hydraulic Charts for the Selection of Highway Culverts', Hydraulic Engineering Circular No. 5, Federal Highway Administration, December, 1965.

APPENDIX A

- Drainage Criteria
- Intensity-Duration-Frequency Curves
- Precipitation Values
- Memorandums: Off-site Flows onto ADOT Right-Of-Way

DRAINAGE CRITERIA

This section summarizes the criteria used in the evaluation of the existing drainage systems located within the I-10 Corridor Study area and used to design the ultimate drainage systems.

REFERENCES

The following publications were used in conjunction with the drainage criteria in this section in evaluating the existing drainage systems and designing the ultimate drainage systems:

1. ADOT Drainage Design Services - Hydrologic Design for Highway Drainage in Arizona, subsequent revisions thereto.

2. ADOT Drainage Design Services - Hydraulic Design Notes distributed in 1969 and 1972.

3. Design of Urban Highway Drainage, "The State of the Art", U.S. Department of Transportation, August 1979.

4. U.S. Department of Transportation, 'Hydraulic Charts for the Selection of Highway Culverts', Hydraulic Engineering Circular No. 5, Federal Highway Administration, December 1985.

5. American Public Works Association; Urban Stormwater Management: APWA Research Foundation and Institute for Water Resources of the American Public Works Association, 1313 East Sixtieth Street, Chicago, Illinois.

SURFACE DRAINAGE

1. Method of Analysis: Rational Method

2. Design Frequency - 10 year and 50-year.

3. Times of Concentration - Figure 2-1, Hydrologic Design for Highway Pavement.

4. Point Precipitation Volumes - Tempe Point Precipitation Values for various storm frequencies as provided by ADOT.

5. 'C' Coefficient:

   a. Paved Surfaces 0.90

   b. Right-of-way 0.50

6. Manning's Roughness Coefficient 'n':

   a. Concrete pavement and shoulder 0.016

   b. Asphaltic concrete pavement and shoulders 0.016

   c. Overland 0.035

   d. Channel 0.025

PAVEMENT DESIGN

This section is limited to the drainage of pavements where an underground sewer system is not required and where pavement runoff must be concentrated at the roadway shoulder to prevent erosion of the embankment face.

1. Storm frequency shall be in accordance with criteria in Section 1.2, Design Frequency, ADOT Manual I, pages 1 and 2.

2. Allowable ponding widths shall be as follows:

Roadway Type	Maximum Spread	Frequency
Rural 4-lane divided	Lt. shoulder width Rt. shoulder width plus 1/2 adjacent traffic lane width	10 years
Urban 4 or 6 lane divided by raised median	Lt. gutter width plus any shoulder width Rt. shoulder, parking or distress lane width plus 1/2 adjacent traffic lane width	10 years

Roadway Type	Maximum Spread	Frequency
4 or 6 lane undivided	Shoulder, parking or distress lane width plus 1/2 adjacent traffic lane width	10 years
2-lane undivided	Gutter and/or shoulder parking or distress lane width	10 years
22' or 24' ramps (Including accel. & decel. lane)	Left - 2' Right - 8'	10 years

STORM SEWERS

1. Methods used in the evaluation of the existing drainage systems and design of the ultimate drainage systems:

   a. Rational Method

2. Design Frequency:

   a. 10 year storm event - design of closed-conduit system when flowing full for Interstate Pavement Drainage.

   b. 50 year storm event - verify that the hydraulic gradient does not exceed an elevation of 6 inches below the low steel of a catch basin grate.

3. Method for Hydraulic Analysis - EXTRAN Program.

4. Manning's 'n':

   a. Concrete Pipe 0.012

   b. Box Culverts 0.015

   c. Corrugated Metal Pipe 0.024

   d. Cast Iron Pipe 0.013

   e. Steel Pipe 0.011

5. Minimum Velocity - Three feet per second desirable for design flow.

6. Minimum Pipe Size - 18" laterals, 24" main line.

7. Maximum length of pipe between manholes or access points:

   a. Under 36 inches 400 ft.

   b. 35-60 inches 500 ft.

   c. Over 60 inches 1,000 ft.

DETENTION/RETENTION FACILITIES

1. 50 year storm event - verify that ponding depth at the detention/retention basins are a minimum 6 inches below subgrade for Interstate Roads.

2. Discharge from detention basins - HEC-5.

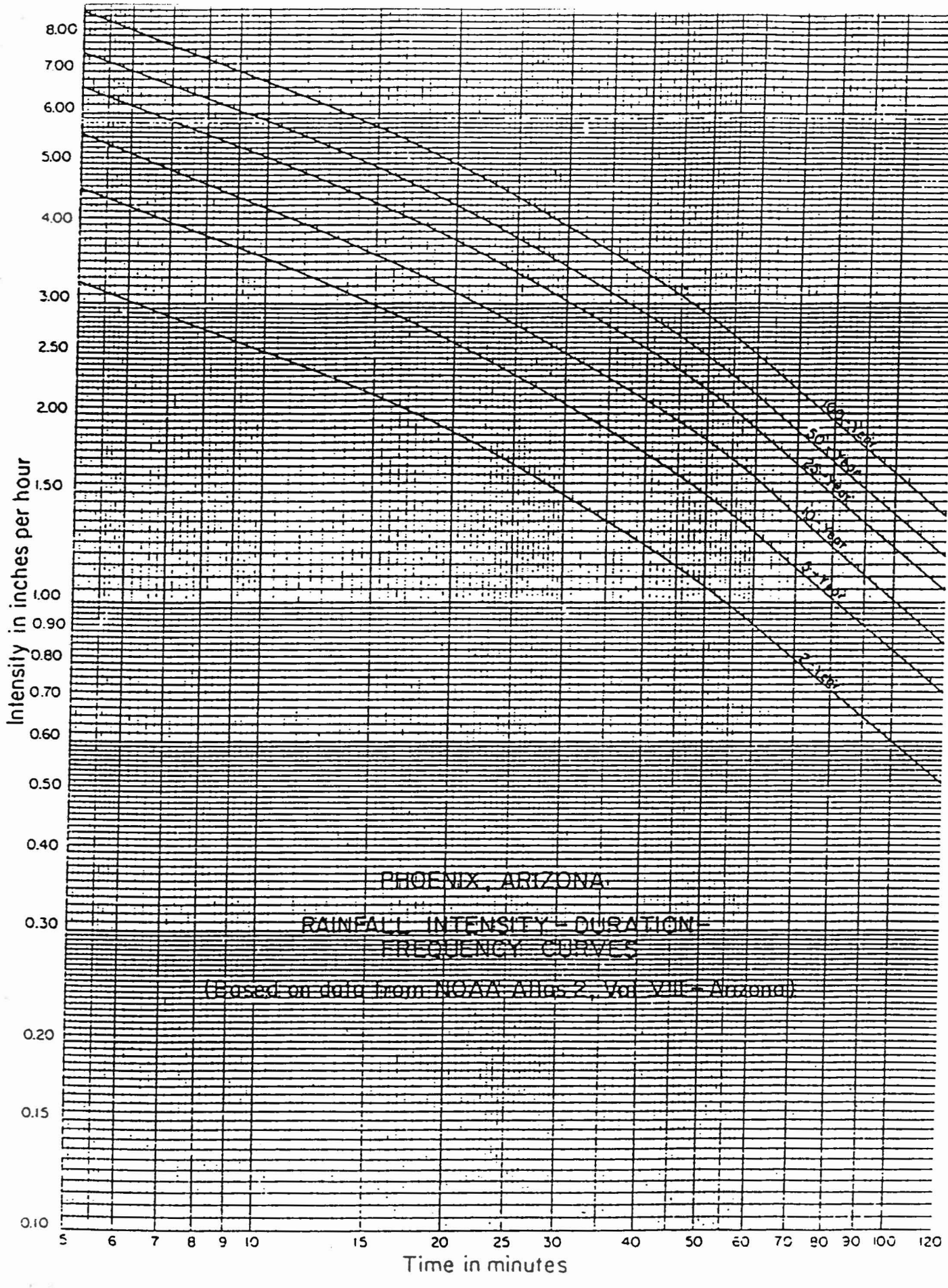

FIGURE 1A. RAINFALL-INTENSITY-DURATION-FREQUENCY CURVES FOR PHOENIX, ARIZONA.

ADDENDUM to "HYDROLOGIC DESIGN FOR HIGHWAY DRAINAGE IN ARIZONA" April 1975

1/5

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	1.10	1.10	1.33	1.33
5	1.59	1.60	1.90	1.90
10	1.92	1.92	2.28	2.29
25	2.33	2.33	2.76	2.76
50	2.71	2.70	3.21	3.20
100	3.08	3.08	3.64	3.64

* TEMPE

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.

Project No. I-10 Corridor Study Station _____

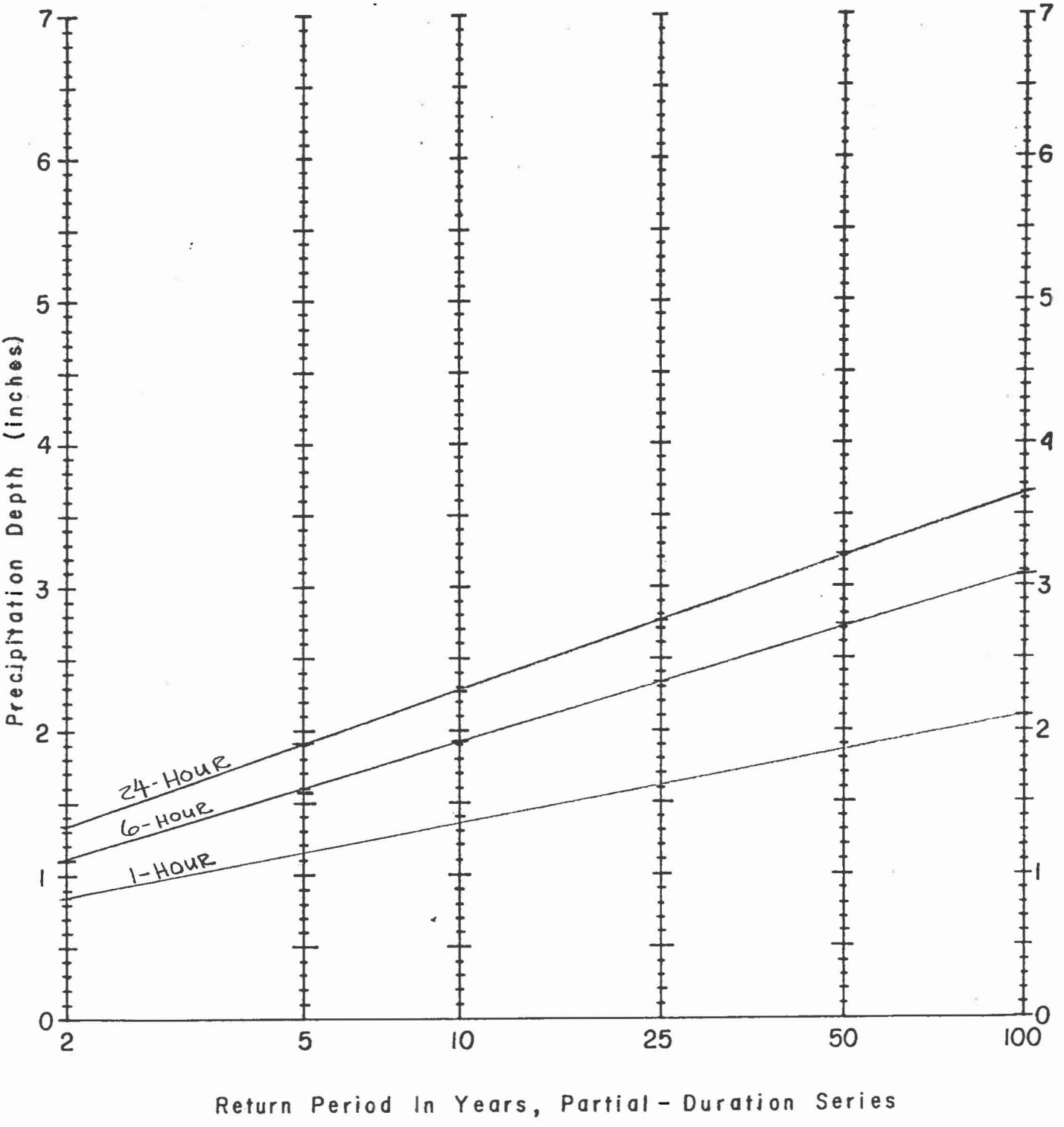

Figure 1 Precipitation Depth Versus Return Period for Partial – Duration Series

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STEP 5

$$P_{1\text{-HOUR},2\text{-YEAR}} = \frac{-0.011 + 0.942\,(P_{6,2})^2}{(P_{24,2})}$$

$$= \frac{-0.011 + 0.942\,(1.10)^2}{(1.33)}$$

$$= 0.8487 \approx 0.85 \text{ INCHES}$$

$$P_{1\text{-HR},100\text{-YR}} = \frac{0.494 + 0.755\,(P_{6,100})^2}{(P_{24,100})}$$

$$= \frac{0.494 + 0.755\,(3.08)^2}{(3.64)}$$

$$= 2.1034 \approx 2.10 \text{ INCHES}$$

STEP 7

10-YEAR: 1-HOUR = 1.35 - INCHES
6-HOUR = 1.92 - INCHES
24-HOUR = 2.29 - INCHES

50-YEAR: 1-HOUR = 1.86 INCHES
6-HOUR = 2.70 INCHES
24-HOUR = 3.20 INCHES

100-YEAR: 1-HOUR = 2.10 INCHES
6-HOUR = 3.08 INCHES
24-HOUR = 3.64 INCHES

STEP 8

10-YEAR:

2-HOUR: $P_2 = 0.341\,P_6 + 0.659\,P_1$
$= 0.341\,(1.92) + 0.659\,(1.35)$
$= 1.54$ INCHES

3-HOUR: $P_3 = 0.569\,P_6 + 0.431\,P_1$
$= 0.569\,(1.92) + 0.431\,(1.35)$
$= 1.67$ INCHES

12-HOUR: $P_{12} = 0.49\,P_{24} + 0.51\,P_6$
$= 0.49\,(2.29) + 0.51\,(1.92)$
$= 2.10$ INCHES

50-YEAR: 2-HOUR: $P_2 = 0.341\,(2.70) + 0.659\,(1.86)$
$= 2.15$ INCHES

3-HOUR: $P_3 = 0.569\,(2.70) + 0.431\,(1.86)$
$= 2.34$ INCHES

12-HOUR: $P_{12} = 0.49\,(3.20) + 0.51\,(2.70)$
$= 2.95$ INCHES

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100-YEAR: 2-HOUR: $P_2 = 0.341(3.08) + 0.659(2.10)$
$= 2.43$ INCHES

3-HOUR: $P_3 = 0.569(3.08) + 0.431(2.10)$
$= 2.66$ INCHES

12-HOUR: $P_{12} = 0.49(3.64) + 0.51(3.08)$
$= 3.35$ INCHES

STEP 9

	PERCENT	10-YR	50-YR	100-Y
5 MIN (0.08 HR)	0.29	0.39	0.54	0.61
10 MIN (0.17 HR)	0.45	0.61	0.84	0.94
15 MIN (0.25 HR)	0.56	0.76	1.04	1.18
20 MIN (0.33 HR)	0.65	0.88	1.21	1.37
25 MIN (0.42 HR)	0.72	0.97	1.34	1.51
30 MIN (0.50 HR)	0.79	1.07	1.47	1.66
35 MIN (0.58 HR)	0.83	1.12	1.54	1.74
40 MIN (0.67 HR)	0.87	1.17	1.62	1.83
45 MIN (0.75 HR)	0.91	1.23	1.69	1.91
50 MIN (0.83 HR)	0.95	1.28	1.77	2.00
60 MIN (1-HR)	1.00	1.35	1.86	2.10

10-YR 1-HR = 1.35 INCHES

50-YR 1-HR = 1.86 INCHES

100-YR 1-HR = 2.10 INCHES

STEP 10 RAINFALL DISTRIBUTION

10-YR: HOUR	RAINFALL	% OF TOTAL RAINFALL
0	—	0
6	$(2.29 - 2.10)/2 = 0.10$	0.044
9	$(2.29 - 1.92)/2 = 0.19$	0.083
10.5	$(2.29 - 1.67)/2 = 0.31$	0.135
11.0	$(2.29 - 1.54)/2 = 0.375$	0.164
11.5	$(2.29 - 1.35)/2 = 0.47$	0.205
11.75	$(2.29 - 1.07)/2 = 0.61$	0.266
11.917	$(2.29 - 0.61)/2 = 0.84$	0.367
11.958	$(2.29 - 0.39)/2 = 0.95$	0.415
12.0	$(2.29)/2 = 1.15$	0.50
12.042	$(2.29 + 0.39)/2 = 1.34$	0.58
12.083	$(2.29 + 0.61)/2 = 1.45$	0.633
12.25	$(2.29 + 1.07)/2 = 1.68$	0.734
12.5	$(2.29 + 1.35)/2 = 1.82$	0.795
13.0	$(2.29 + 1.54)/2 = 1.92$	0.836
13.5	$(2.29 + 1.67)/2 = 1.98$	0.865
15.0	$(2.29 + 1.92)/2 = 2.10$	0.9192
18.0	$(2.29 + 2.10)/2 = 2.20$	0.959

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24.0	(2.29)	1.00

50-YR

HOUR	RAINFALL	% OF TOTAL RAINFALL
0	—	0
6.0	(3.20-2.95)/2 = 0.13	0.0391
9.0	(3.20-2.70)/2 = 0.25	0.078
10.5	(3.20-2.34)/2 = 0.43	0.134
11.0	(3.20-2.15)/2 = 0.53	0.164
11.5	(3.20-1.86)/2 = 0.67	0.209
11.75	(3.20-1.47)/2 = 0.87	0.270
11.917	(3.20-0.84)/2 = 1.18	0.369
11.958	(3.20-0.54)/2 = 1.33	0.416
12.0	(3.20)/2 = 1.6	0.5
12.042	(3.20+0.54)/2 = 1.87	0.584
12.083	(3.20+0.84)/2 = 2.02	0.631
12.25	(3.20+1.47)/2 = 2.34	0.731
12.5	(3.20+1.86)/2 = 2.54	0.791
13.0	(3.20+2.15)/2 = 2.68	0.836
13.5	(3.20+2.34)/2 = 2.77	0.866
15.0	(3.20+2.70)/2 = 2.95	0.922
18.0	(3.20+2.95)/2 = 3.08	0.961
24.0	3.20	1.0

100-YR

Hour	RAINFALL	% OF TOTAL RAINFALL
0	—	0
6.0	(3.64-3.35)/2 = 0.15	0.04
9.0	(3.64-3.08)/2 = 0.28	0.077
10.5	(3.64-2.66)/2 = 0.49	0.135
11.0	(3.64-2.43)/2 = 0.61	0.166
11.5	(3.64-2.10)/2 = 0.77	0.212
11.75	(3.64-1.66)/2 = 0.99	0.272
11.917	(3.64-0.94)/2 = 1.35	0.371
11.958	(3.64-0.61)/2 = 1.52	0.416
12.0	3.64/2 = 1.82	0.50
12.042	(3.64+0.61)/2 = 2.13	0.584
12.083	(3.64+0.94)/2 = 2.29	0.629
12.25	(3.64+1.66)/2 = 2.65	0.728
12.5	(3.64+2.10)/2 = 2.87	0.789
13.0	(3.64+2.43)/2 = 3.04	0.834
13.5	(3.64+2.66)/2 = 3.15	0.865
15.0	(3.64+3.08)/2 = 3.36	0.923
18.0	(3.64+3.35)/2 = 3.49	0.960
24.0	3.64	1.000

MEMORANDUM

TO: Ross Buckett, Phoenix DATE: August 9, 1983

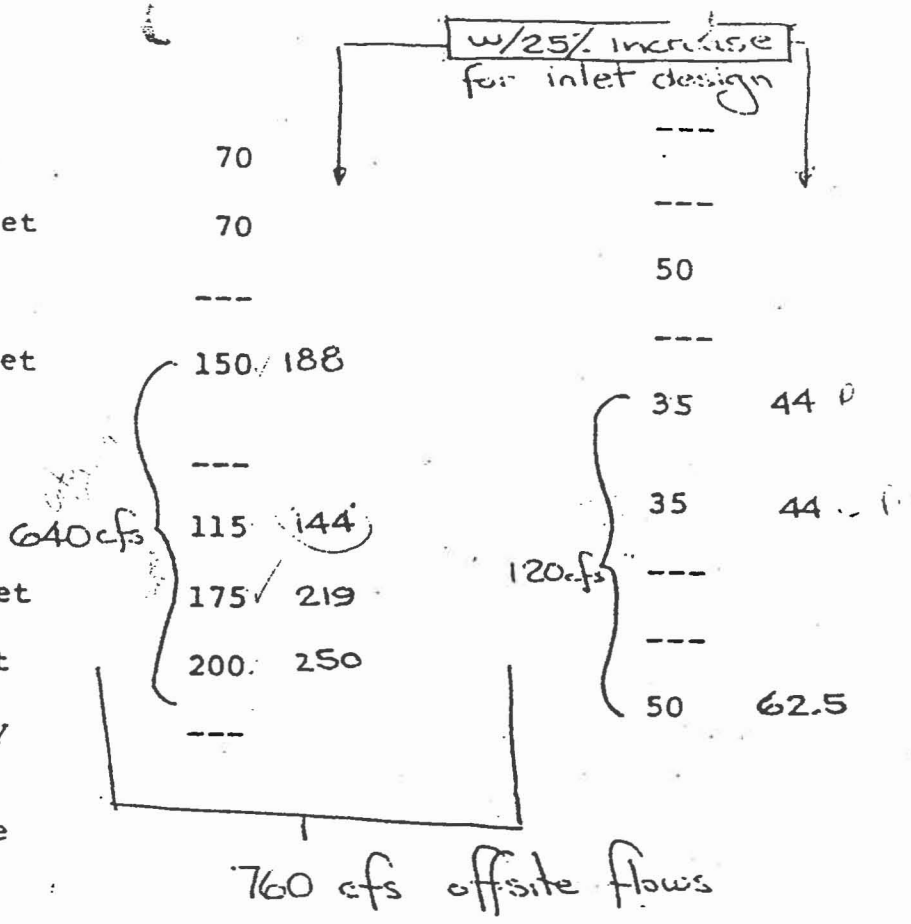
FROM: R. E. Schwab, Kansas City

SUBJECT: Design Discharges
SWCS
Segments C, D, E & F

The discharges listed below are the 50-year design discharges for the design of the Storm Water Collection System. The values are the same as in my July 29, 1983 memo, with the addition of the storm sewer flows and the dropshaft locations and flows.

15th Avenue to Central Avenue

Location	Street Flow (cfs)	Sheet Flow (cfs)	Sewer (cfs)
15th Avenue	---		
		35	
13th Avenue	110		
		25	
11th Avenue	115		
		35	
9th Avenue	175		~~220~~ 155
		60	
7th Avenue	300		
		60	
5th Avenue	170		
		35	
3rd Avenue	100		
		65	
Central Avenue	135		320



cc: Dick Prosence
Steve Schwab

*Dropshaft locations and Q's

tational method peak, not to be used for intercepter design. Value in parenthesis applies for intercepter design.

Flow in future Papago East Storm Sewer

Increase by 25% for design per Steve Schwab

APPENDIX B

- Ultimate Drainage System 3
- Ultimate Drainage System 6
- Ultimate Drainage System 11
- Ultimate Drainage System 12

ULTIMATE DRAINAGE AREA 3

DMJM	PROJECT: I-10 CORRIDOR STUDY	PROJECT NO: 5029.05	PAGE 1/6
		BY: ONJ / DATE: FEB. 1, 88	

SUBJECT RE-ANALYSIS OF WEST INCLUDED AREA FOR ULTIMATE DRAINAGE AREAS

PURPOSE OF ANALYSIS

TO DETERMINE THE AFFECTS OF INCLUDING AN ADDITIONAL DRAINAGE AREA OF 0.32 ACRES FROM FUTURE EASTBOUND COLLECTOR-DISTRIBUTOR ROAD TO THE WEST INCLUDED AREA.

METHOD OF ANALYSIS.

THE SAME PROCEDURES PRESENTED IN THE FINAL DRAINAGE DESIGN REPORT, PHOENIX-CASA GRANDE HIGHWAY, BUCKEYE ROAD-MARICOPA FREEWAY TO DEVELOP THE INFLOW AND OUTFLOW HYDROGRAPHS WILL BE USED IN THE RE-ANALYSIS.

TOPOGRAPHICAL ANALYSIS OF WEST INCLUDED AREA

FROM: FINAL DRAINAGE DESIGN REPORT, PHOENIX-CASA GRANDE HIGHWAY, BUCKEYE ROAD-MARICOPA FREEWAY.

ELEVATION	AREA ($1000\ FT^3$)	STAGE (FT)	CUMULATIVE VOLUME ($1000\ FT^3$)
1092	0.0	0	0.0
1093	30.2	1	15.1
1094	84.7	2	72.5
1095	89.0	3	159.4
1096	93.3	4	250.5
1097	97.9	5	346.0
1098	102.4	6	446.2
1099	107.7	7	551.3
1100	113.0	8	661.6

AREAS CONTRIBUTING TO WEST INCLUDED AREA

FROM: FINAL DRAINAGE DESIGN REPORT, PHOENIX – CASA GRANDE HIGHWAY, BUCKEYE ROAD-MARICOPA FREEWAY.

SOURCE	AREA (ACRES)	'C'	'CA'
ORIGINAL AREAS DESIGNATED BY INLETS AS DOCUMENTED IN THE FINAL DRAINAGE DESIGN MANUAL.			
714	0.9	0.9	0.81
715	1.0	0.9	0.90
716	0.5	0.9	0.45
717	0.65	0.9	0.59
750	0.60	0.9	0.54
751	0.45	0.9	0.41
753	5.55	0.5	2.78

773	0.6	0.9	0.54
M810	0.5	0.5	0.25
M811	0.25	0.5	0.13
M812	0.15	0.5	0.08
S795	0.45	0.9	0.41
837	0.15	0.9	0.14
ADDITIONAL AREA FROM FUTURE EASTBOUND COLLECTOR-DISTRIBUTOR ROAD (REFER TO FIGURE 2C IN APPENDIX C).	0.32	0.9	0.28
		TOTAL	8.31

FLOWS TO PUMP STATION (DISCHARGES INTO WEST INCLUDED AREA)

FROM: FINAL DRAINAGE DESIGN REPORT, PHOENIX-CASA GRANDE HIGHWAY, BUCKEYE ROAD-MARICOPA FREEWAY.

SOURCE	AREA (ACRES)	'C'	'CA'
767	0.35	0.9	0.32
768	0.05	0.9	0.05
769	0.06	0.9	0.05
770	0.21	0.9	0.19
M814	1.10	0.9	0.99
M815	0.55	0.78	0.43
M816	0.3	0.9	0.27
M817	0.65	0.78	0.51
M818	0.62	0.78	0.48
M819	0.42	0.78	0.33
		TOTAL	3.62

TOTAL 'ECA'

$8.31 + 3.62 = 11.93$

WEST INCLUDED AREA INFLOW HYDROGRAPH

$Q = CAI$

$Q = 11.93\ I$

TIME	INTENSITY (IN./HR)	FLOW (CFS)
0	0.0	0.0
5	3.4	40.6
10	6.7	79.9
15	5.7	68.0
20	5.0	59.7
25	4.43	52.8
30	3.98	47.5

DMJM	PROJECT: I-10 CORRIDOR STUDY	PROJECT NO: 5029.05	PAGE 3/6
		BY: DNJ / DATE: FEB 1, 88	

SUBJECT RE-ANALYSIS OF WEST INCLUDED AREA FOR ULTIMATE DRAINAGE AREAS

TIME	INTENSITY (IN./HR.)	FLOW (CFS)
35	3.63	43.3
40	3.4	40.6
45	3.1	37.0
50	2.9	34.6
55	2.7	32.2
60	2.5	29.8
65	2.4	28.6
70	2.2	26.2
75	2.1	25.1
80	1.95	23.3
85	1.85	22.1
90	1.75	20.9
95	1.67	19.9
100	1.6	19.1
105	1.54	18.4
110	1.49	17.8
115	1.42	16.9
120	1.35	16.1

DISCHARGE VS STAGE TABLE

FROM: FINAL DRAINAGE DESIGN REPORT, PHOENIX – CASA GRANDE HIGHWAY, BUCKEYE ROAD – MARICOPA FREEWAY.

48-INCH DIAMETER OUTLET PIPE FROM WEST INCLUDED AREA.

DISCHARGE (CFS)	STAGE (FT)
10	1.12
20	2.98
25	3.84
30	5.0
35	6.3

ASSUMING INLET CONTROL
SQUARE EDGED 24"Ø CONCRETE PIPE WITH FLARED HEADWALL.

DMJM	PROJECT: I-10 CORRIDOR STUDY	PROJECT NO: 5029.05	PAGE 4/6
		BY: ONJ / DATE: FEB. 1, 88	

SUBJECT RE-ANALYSIS OF WEST INCLUDED AREA FOR ULTIMATE DRAINAGE AREA 3

STORAGE INDICATOR TABLE

FROM: FINAL DRAINAGE DESIGN REPORT, PHOENIX - CASA GRANDE HIGHWAY, BUCKEYE ROAD - MARICOPA FREEWAY.

METHODOLOGY: RESERVOIR ROUTING ROUTINE BY R.H. BAUMGARDNER.

STAGE	ELEVATION	DISCHARGE	STORAGE	$\frac{O_2}{2}$	$\frac{S_2}{\Delta t}$	$\frac{S_2}{\Delta t} + \frac{O_2}{2}$
		(CFS)	(FT^3)	(CFS)	(CFS)	(CFS)
	92.0	0.0				
	92.5	2.0	8,000	1.0	26.7	27.7
1.0	93.0	4.0	15,000	2.0	50.0	52.0
	93.5	8.5	40,000	4.25	133.33	137.6
	94.0	12.5	75,000	6.25	250.00	256.25
	94.5	16.0	112,000	8.0	373.3	381.33
	95.0	19.5	155,000	9.25	516.67	525.9
	95.5	22.5	195,000	11.25	650.0	661.3
	96.0	25.0	240,000	12.5	800.0	812.5
	96.5	27.7	295,000	13.85	983.33	997.18
	97.0	30.0	345,000	15.0	1150.0	1165.0

REFER TO FIGURE 4B FOR STORAGE - INDICATOR CURVE.

DMJM	PROJECT: I-10 CORRIDOR STUDY	PROJECT NO: 5029.05	PAGE 5/6
		BY: DNJ DATE: FEB. 1,88	

SUBJECT REANALYSIS OF WEST INCLUDED AREA FOR ULTIMATE DRAINAGE AREA 3

ROUTING TABLE

ROUTING OF INFLOW HYDROGRAPH THROUGH WEST INCLUDE AREA.

TIME (MIN.)	INFLOW (CFS)	$\frac{I_1 + I_2}{2}$	$\frac{S_1}{\Delta t} + \frac{O_1}{2}$	O_1 (CFS)	$\frac{S_2}{\Delta t} + \frac{O_2}{2}$	O_2
0	0	0	0	0	0	
5	40.6	20.3	0	0	20.3	1.6
10	79.9	60.25	20.3	1.6	78.95	5.1
15	68.0	73.95	78.95	5.1	147.8	8.3
20	59.7	63.85	147.8	8.3	203.35	10.8
25	52.8	56.25	203.35	10.8	248.8	12.3
30	47.5	50.15	248.8	12.3	286.65	13.4
35	43.3	45.4	332.05	13.4	318.65	14.0
40	40.6	41.95	318.65	14.0	346.6	14.9
45	37.0	38.8	385.4	14.9	370.5	15.4
50	34.6	35.8	370.5	15.4	390.9	16.1
55	32.2	33.4	390.9	16.1	408.2	16.4
60	29.8	31.0	408.2	16.4	422.8	16.9
65	28.6	29.2	422.8	16.9	435.1	17.1
70	26.2	27.4	435.1	17.1	445.4	17.4
75	25.1	25.65	445.4	17.4	453.7	17.7
80	23.3	24.2	453.7	17.7	460.2	17.9
85	22.1	22.7	460.2	17.9	465.0	18.1
90	20.9	21.5	465.0	18.1	468.4	18.3
95	19.9	20.4	468.4	18.3	470.5	18.4
100	19.1	19.5	470.5	18.4	471.6	18.4
105	18.4	18.75	471.6	18.4	472.0	18.5
110	17.8	18.1	490.1	18.5	471.6	18.4
115	16.9	17.35	471.6	18.4	470.6	18.4
120	16.1	16.5	470.6	18.4	468.7	18.4

DMJM	PROJECT: I-10 Corridor Study	PROJECT NO: 5029.05	PAGE: 6/6
		BY: DMJ / DATE: FEB. 1, 88	

SUBJECT: RE-ANALYSIS OF WEST INCLUDED AREA FOR ULTIMATE DRAINAGE AREA 3

CONCLUSIONS OF THE RE-ANALYSIS OF THE WEST INCLUDED AREA

THE MAXIMUM OUTFLOW IS INCREASED FROM 17.9 CFS TO 18.5 CFS AND THE TIME OF OCCURRANCE OF THE MAXIMUM OUTFLOW INCREASES FROM 100-MINUTES TO 105-MINUTES. THE HEADWATER DEPTH REMAINS UNCHANGED AT 2.8 WITH A CORRESPONDING STORAGE VOLUME OF 130,000 FT^3.

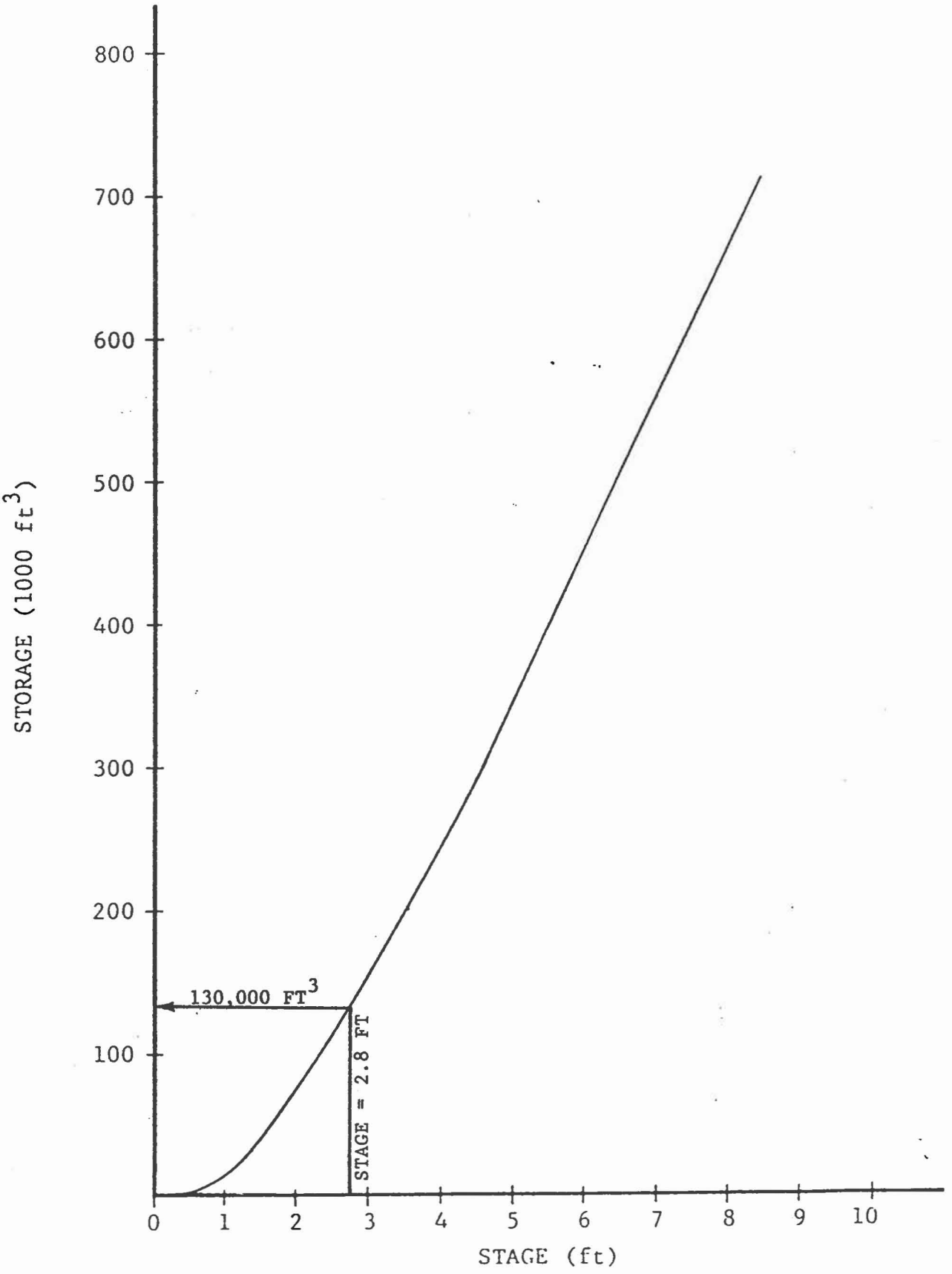


FIGURE 1B. STAGE-STORAGE CUVE FOR WEST INCLUDED AREA (ULTIMATE DRAINAGE AREA 3).

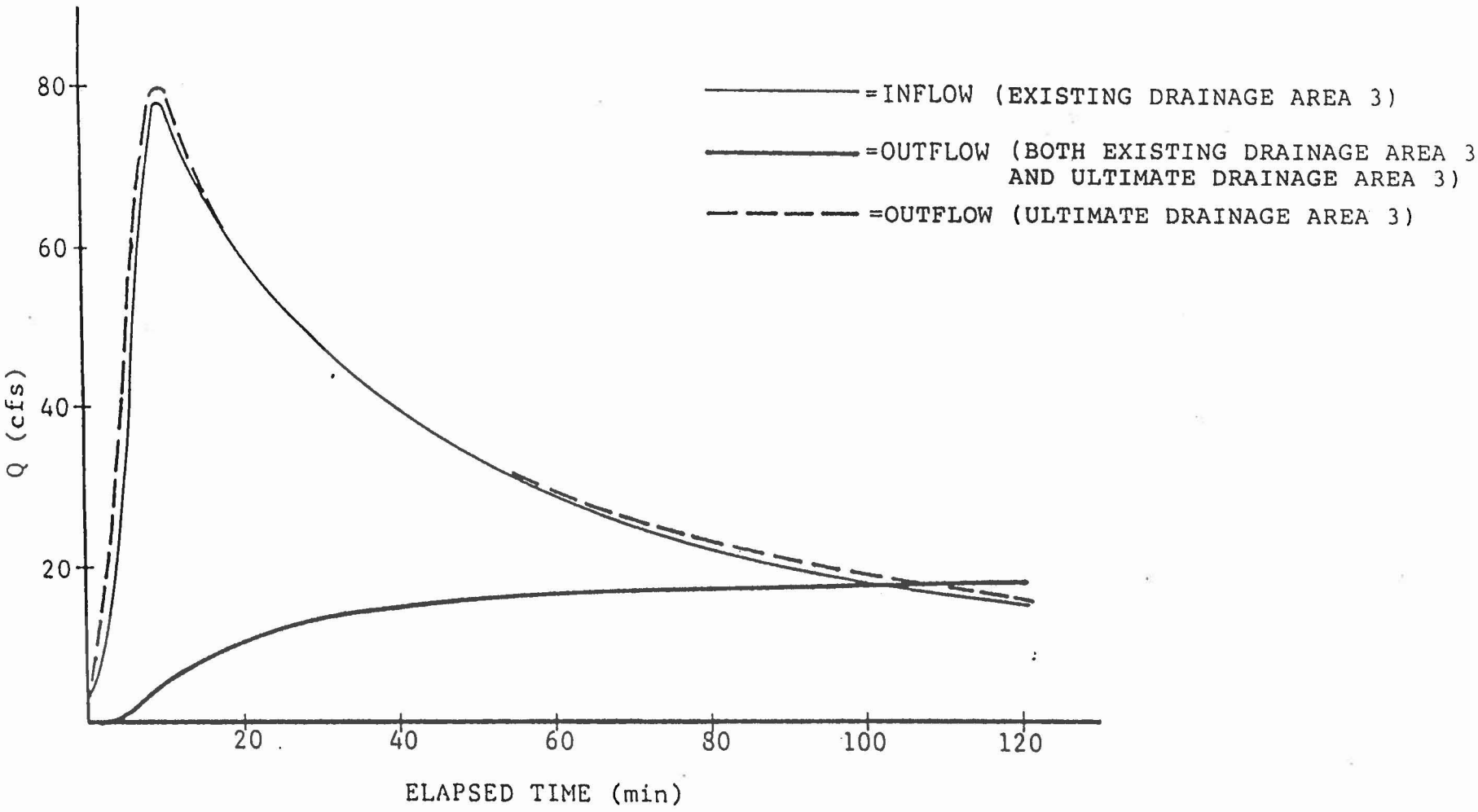
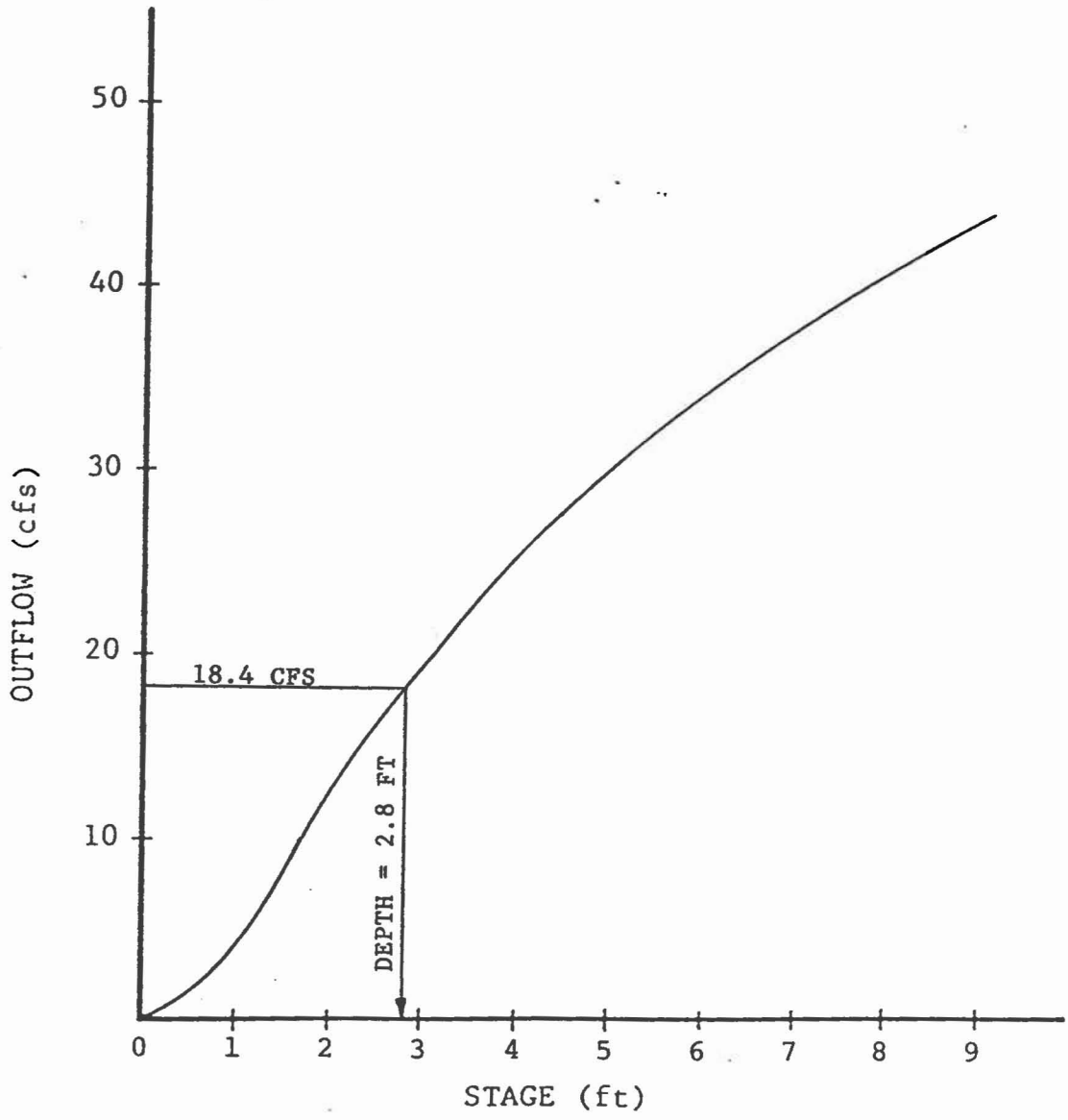


FIGURE 2B. INFLOW-OUTFLOW HYDROGRAPHS FOR WEST INCLUDED AREA (ULTIMATE DRAINAGE AREA 3).



INLET CONTROL: Square edged 24"Ø Concrete Pipe w/ flared headwall.

FIGURE 3B. STAGE-DISCHARGE CURVE FOR WEST INCLUDED AREA (ULTIMATE DRAINAGE AREA 3).

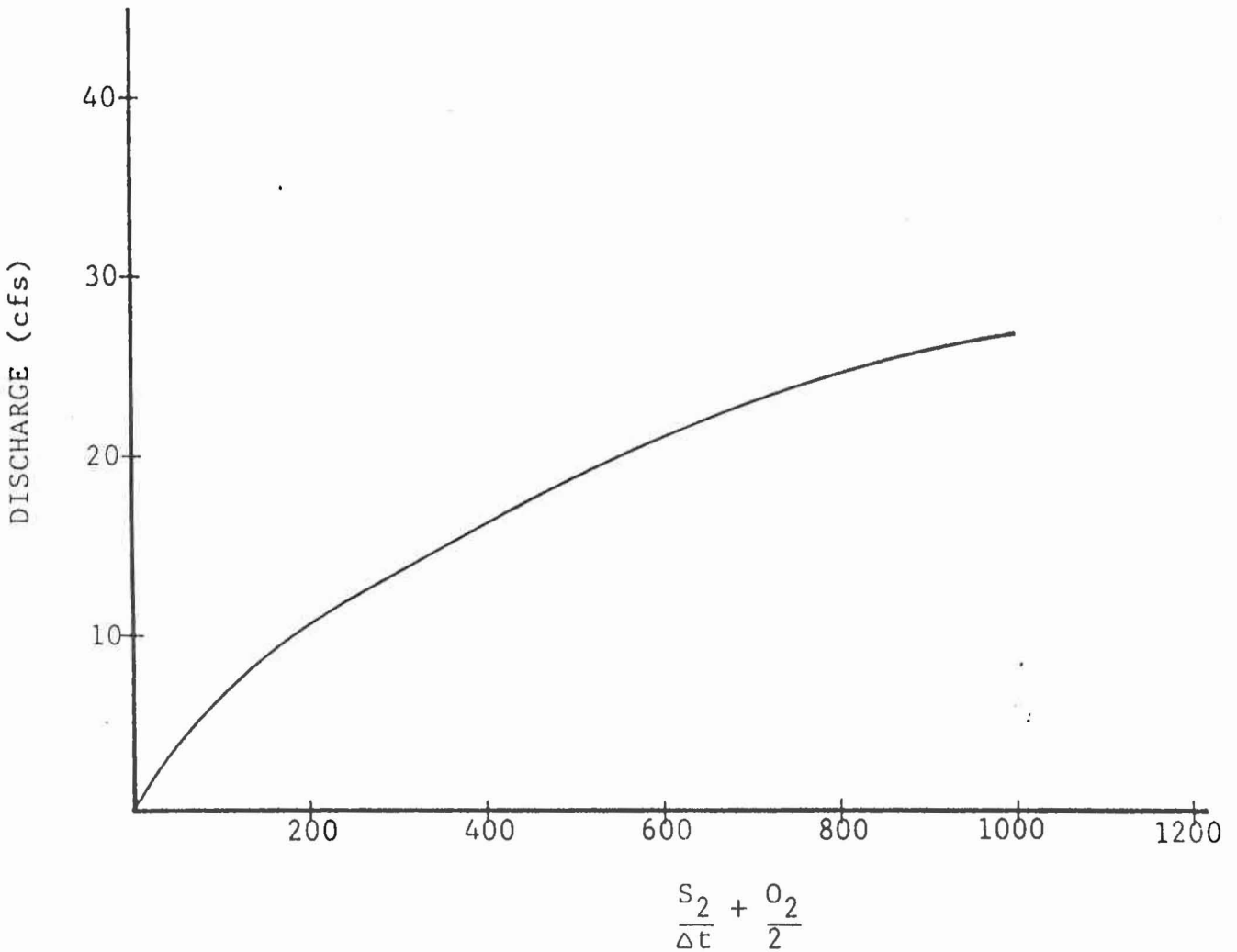


FIGURE 4B. STORAGE-INDICATOR CURVE FOR WEST INCLUDED AREA(ULTIMATE DRAINAGE AREA 3).

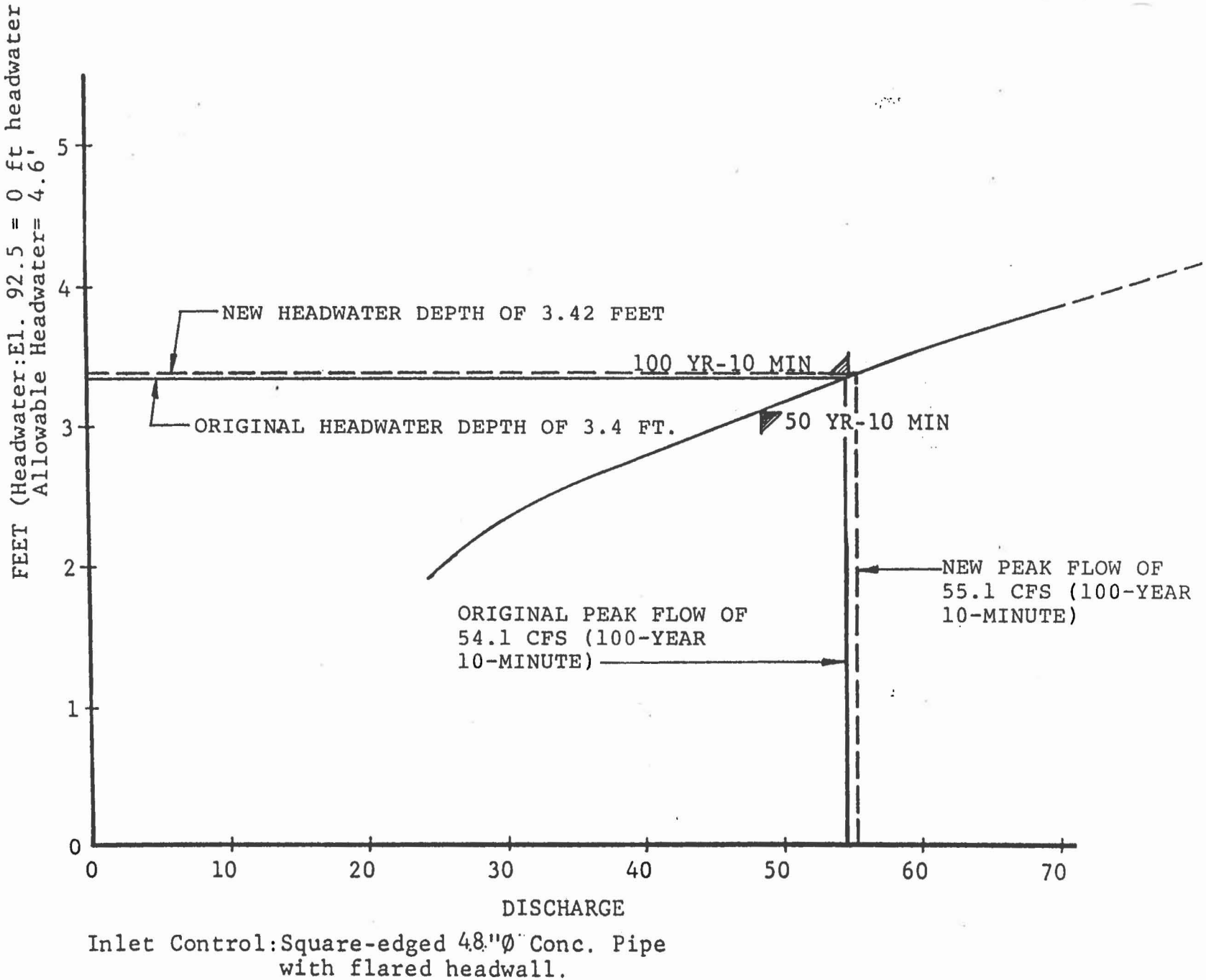


FIGURE 5B. NEW HEADWATER DEPTH FOR EAST INCLUDED AREA(ULTIMATE DRAINAGE AREA 6).

ULTIMATE DRAINAGE AREA 6

DMJM	PROJECT: I-10 CORRIDOR STUDY	PROJECT NO: 5029.05	PAGE 1/
		BY: DNJ / DATE: FEB.2,88	

SUBJECT RE-ANALYSIS OF EAST INCLUDED AREA FOR ULTIMATE DRAINAGE AREA 6

PURPOSE OF ANALYSIS

TO DETERMINE THE AFFECTS OF ADDITIONAL DRAINAGE AREA FROM A FUTURE ROAD TO THE EAST INCLUDED AREA.

ORIGINAL ASSUMPTIONS

REMAINS APPLICABLE IN THE RE-ANALYSIS

1) 100% INLET INTERCEPTION,
2) PIPE FLOW IS LESS THAN 2-MINUTES - SAY 0,
3) T_c MIN = 10 MINUTES.

CONTRIBUTING AREAS 'CA's'

FROM: FINAL DRAINAGE DESIGN REPORT, PHOENIX-CASA GRANDE HIGHWAY, BUCKEYE ROAD-MARICOPA FREEWAY.

SOURCE	'CA'
DRAINAGE AREAS (ORIGINAL) DESIGNATED BY THEIR INLETS	
739	0.32
738	0.36
737	0.23
736	0.63
735	0.45
734	0.18
733	0.63
732	0.27
731	0.23
730	0.45
729	0.45
728	0.50
727	0.80
799	0.59
798	0.27
757 A-C	1.71
ADDITIONAL CONTRIBUTING AREA	0.15

→ Σ CA = 8.22

DMJM	PROJECT: I-10 Corridor Study	PROJECT NO: 5029.05	PAGE 2/
		BY: DMJ / DATE: FEB 2, 88	

SUBJECT RE-ANALYSIS OF EAST INCLUDED AREA FOR ULTIMATE DRAINAGE AREA 6

PROJECTED PEAK FLOWS FOR DIFFERENT FREQUENCY

10-YEAR:

$i = 4.25$ IN./HR.

$Q_{10} = 8.22(4.25)$

$= 34.9$ CFS

50-YEAR

$i = 5.82$ IN./HR.

$Q_{50} = 8.22(5.82)$

$= 47.8$ CFS

100-YEAR

$i = 6.70$ IN./HR

$Q_{100} = 8.22(6.70)$

$= 55.1$ CFS

PROJECTED HEADWATER DEPTH FROM EAST INCLUDED AREA

THE ADDITIONAL AREA OF 0.17 ACRES CONTRIBUTING TO THE EAST INCLUDED AREA INCREASES THE THE 100-YEAR 10-MINUTE STORM EVENT PEAK FLOW FROM 54.1 CFS TO 55.1 CFS. THE INCREASE IN PEAK FLOW INCREASES THE HEADWATER DEPTH AT THE OUTLET FROM 3.40 FT. TO APPROXIMATELY 3.42 FEET. THE INSIGNIFICANT INCREASE IN HEADWATER DEPTH, FOR ALL PRACTICAL PURPOSES, DOES NOT CHANGE THE MAXIMUM DISCHARGE AT THE OUTLET.

ULTIMATE DRAINAGE AREA 11

DMJM	PROJECT: I-10 CORRIDOR STUDY ULTIMATE DRAINAGE AREA II	PROJECT NO: 5029.05	PAGE 1/3
		BY: DNJ DATE: JAN 29,86	

SUBJECT: DETENTION FACILITY AT 48th STREET TRAFFIC INTERCHANGE.

PRELIMINARY CALCULATIONS

ASSUMPTIONS:

a) 100% INLET INTERCEPTION

b) PIPE FLOW TIME IS MINIMAL

c) USE $t_{c\,min}$ = 10 MINUTES

CONTRIBUTING AREA:

D.A. 1: 17.06 ACRES

6.26 ACRES PAVEMENT

10.80 ACRES INFIELD AREAS & RIGHT-OF-WAY

WEIGHTED 'C' COEFFIENT:

USE: C = 0.9 PAVEMENT
C = 0.5 INFIELD AREA & RIGHT-OF-WAY

$$\text{WEIGHTED 'C'} = \frac{6.26(0.9) + 10.80(0.5)}{17.06}$$

$$= 0.6468 \approx 0.65$$

$$CA = 0.65\,(17.06)$$
$$= 11.03$$

PROJECTED PEAK FLOW RATES FOR VARIOUS STORM FREQUENCIES

10-YEAR: $Q = CA\,I$
$= 11.03\ (4.25\ \text{IN/HR})$
$= 46.8\ \text{CFS}$

50-YEAR: $Q = CA\,I$
$= 11.03\ (5.85\ \text{IN./HR})$
$= 64.5\ \text{CFS}$

PROJECTED RUNOFF VOLUME FOR 10-yr 24-HR & 50-yr 24-HR. STORM EVENTS.

10-yr 24-HR = 2.29 INCHES OF PRECIPITATION

$$\text{RUNOFF} = \frac{2.29\ \text{INCHES}}{12\ \text{IN/FT}} \times 0.65 = 0.124\ \text{FT}$$

$$\text{VOLUME} = 0.124\ \text{FT} \times 17.06\ \text{ACRES} \times 43560\ \text{FT/ACRE}$$
$$= 92{,}180\ \text{FT}^3$$

DMJM	PROJECT	PROJECT NO : 5029.05		PAGE 2/3
	I-10 CORRIDOR STUDY ULTIMATE DRAINAGE AREA II	BY: DMJ	DATE: JAN. 28, 88	
SUBJECT DETENTION BASIN AT 48th STREET TRAFFIC INTERCHANGE				

PRELIMINARY CALCULATIONS

50-yr - 24-HR = 3.20 INCHES OF PRECIPITATION

$$\text{RUNOFF} \quad \frac{3.20 \text{ INCHES}}{12 \text{ IN/FT}} \times 0.65 = 0.173 \text{ FT}$$

$$\text{VOLUME} = 0.173 \text{ FT} \times 17.06 \text{ ACRES} \times 43560 \text{ FT}^2/\text{ACRE}$$
$$= 128,560 \text{ FT}^3$$

∴ PRELIMINARY RESULTS

USE 36"ϕ OUTLET PIPE

PONDING DEPTH OF 3.0 FEET

MAXIMUM DISCHARGE = 34 CFS, STORAGE REQUIREMENT:

50-yr = 56,100 FT^3

USE 34 CFS FOR SIZING OF DOWNSTREAM CONDUITS

above calculation for Storage should be by the same method as for D.A. #3. 56,000 cf appears to be considerably on the conservative side.

MS

DMJM	PROJECT: I-10 Corridor Study	PROJECT NO: 5029.05	PAGE 3/3
		BY: DMJ / DATE: JAN. 28, 88	

SUBJECT ULTIMATE DRAINAGE AREA II - DETENTION BASIN AT I-10/48th STREET T.I.

PRELIMINARY DESIGN

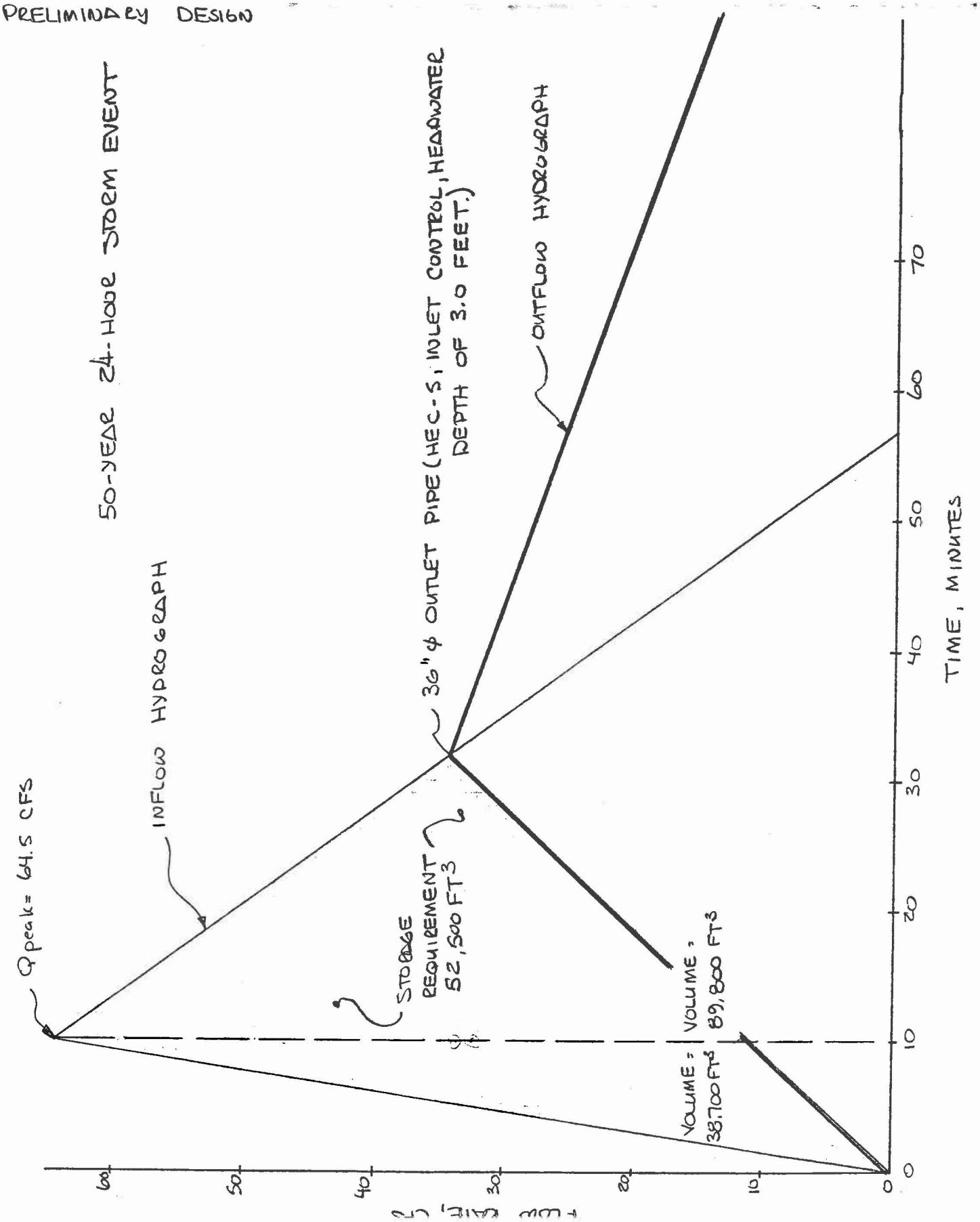


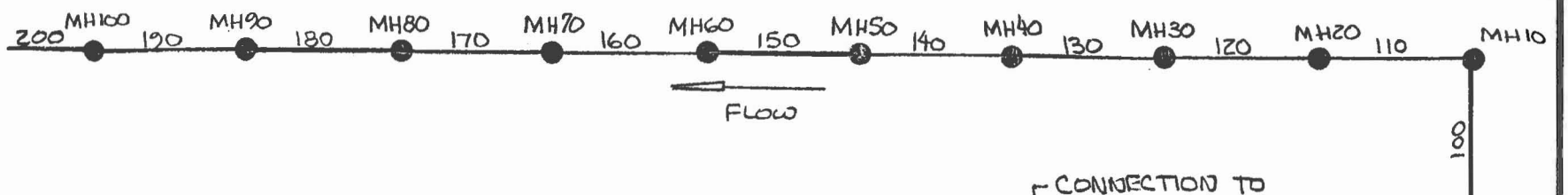
TABLE 1B. SUBAREAS CONTRIBUTING TO ULTIMATE DRAINAGE AREA 11

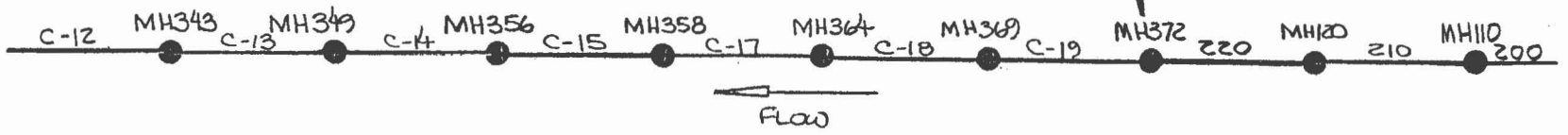
Subarea Designation	Pavement Area (acres)	Infield & Right-of-Way Area (acres)	Total Area (acres)
DA 1A	6.26	10.80	17.06
DA 2A	0.73	0.15	0.88
DA 3A	0.97	0.18	1.15
DA 4A	0.92	0.19	1.11
DA 5A	1.05	2.58	3.63
DA 6A	0.82	0.17	0.99
DA 7A	4.11	0.18	4.29
DA 8A	0.81	0.16	0.97
DA 9A	1.14	0.19	1.33
DA 10A	2.27	0.19	2.46
DA 11A	0.36	--	0.36
DA 12A	1.20	8.55	9.75
DA 13A	0.99	--	0.99
DA 14A	1.16	0.56	1.72
DA 15A	0.38	--	0.38
DA 16A	1.43	1.56	3.00
DA 17A	0.60	1.79	2.39
DA 18A	1.58	--	1.58
DA 19A	1.69	0.25	1.94
DA 20A	0.89	0.20	1.09
DA 21A	2.45	0.18	2.63
DA 22A	0.39	--	0.39
DA 23A	1.67	0.23	1.90
DA 24A	2.55	2.92	5.47
DA 25A	2.56	0.54	3.10
DA 26A	2.74	1.65	4.39
DA 27A	2.11	3.39	5.50
DA 28A	2.07	0.34	2.41
DA 29A	0.50	--	0.50
DA 30A	1.44	1.36	2.80
DA 31A	0.68	--	0.68
DA 32A	0.31	--	0.31
DA 33A	0.94	--	0.94
DA 34A	0.35	--	0.35
DA 35A	2.60	--	2.60
DA 36A	0.99	--	0.99
DA 37A	0.60	--	0.60
DA 38A	5.29	--	5.29
DA 39A	0.18	0.54	0.72
DA 40A	0.40	--	0.40
DA 41A	1.74	--	1.74
TOTAL	60.95	38.85	99.80

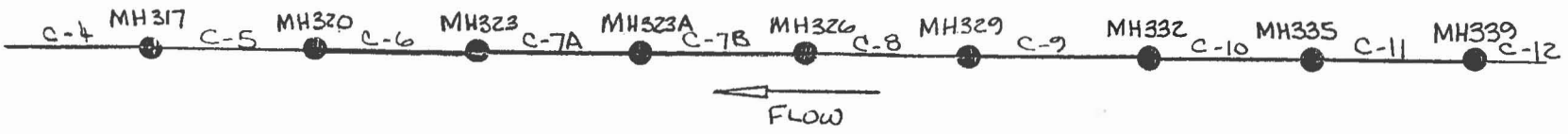
TABLE 2B. DRAINAGE AREAS CAS FOR ULTIMATE DRAINAGE AREA 11

Subarea Designation	Pavement CA	Infield & Right-of-Way CA	CA
DA 1A	5.63	5.40	11.03
DA 2A	0.66	0.08	0.74
DA 3A	0.87	0.09	0.96
DA 4A	0.83	0.10	0.93
DA 5A	0.95	1.29	2.24
DA 6A	0.74	0.09	0.83
DA 7A	3.70	0.09	3.79
DA 8A	0.73	0.08	0.81
DA 9A	1.03	0.10	1.13
DA 10A	2.04	0.10	2.14
DA 11A	0.35	--	0.35
DA 12A	1.08	4.28	5.36
DA 13A	0.89	--	0.89
DA 14A	1.04	0.28	1.32
DA 15A	0.34	--	0.34
DA 16A	1.29	0.78	2.07
DA 17A	0.54	0.90	1.44
DA 18A	1.42	--	1.42
DA 19A	1.52	0.13	1.65
DA 20A	0.80	0.10	0.90
DA 21A	2.21	0.09	2.30
DA 22A	0.35	--	0.35
DA 23A	1.50	0.12	1.62
DA 24A	2.30	1.46	3.76
DA 25A	2.30	0.27	2.57
DA 26A	2.47	0.83	3.30
DA 27A	1.90	1.70	3.60
DA 28A	1.86	0.17	2.03
DA 29A	0.45	--	0.45
DA 30A	1.30	0.68	1.98
DA 31A	0.61	--	0.61
DA 32A	0.28	--	0.85
DA 33A	0.85	--	0.85
DA 34A	0.32	--	0.32
DA 35A	2.34	--	2.34
DA 36A	0.89	--	0.89
DA 37A	0.54	--	0.54
DA 38A	4.76	--	4.76
DA 39A	0.16	0.27	0.43
DA 40A	0.36	--	0.36
DA 41A	1.57	--	1.57

SCHEMATIC OF ULTIMATE DRAINAGE SYSTEM FOR ULTIMATE DRAINAGE AREA 11.







DMJM	PROJECT: I-10 Corridor Study	PAGE
SUBJECT: SCHEMATIC OF ULTIMATE DRAINAGE SYSTEM FOR ULTIMATE DRAINAGE AREA 11.	BY: DMJ DATE: FEB. 3, 88	PROJECT NO: 5029.05

ARIZONA HIGHWAY DEPARTMENT
STRUCTURES SECTION
HYDRAULICS BRANCH

STORM SEWER SYSTEM DESIGN: SEWER CALCULATION SHEET PRELIMINARY DESIGN OF ULTIMATE DRAINAGE AREA 12 DRAINAGE SYSTEM FROM 40th STREET TO 48th STREET (DISCHARGE INTO DETENTION BASIN AT I-10/48th STREET T.I.)

LOCATION DATA

Highway I-10 Corridor Study
Location PHOENIX
Project No. 5029.05

DESIGN DATA

Frequency 10 years
P_6 = 1.92 in. P_{24} = 2.29 in. P_1 = 1.34 in.
Outlet TW Elev. =
Pipe n = 0.012

SEWER CALCULATIONS

Location		Drainage Area			Time of Flow, Min.			I (1)	Q	Sewer Profile				Sewer Design			Hydraulic Grade Line			
Line No.	From - To	No.	Increm. CA	Σ CA	Inlet	Sewer	Design	in./hr	cfs	Crown Elevation Inlet	Crown Elevation Outlet	Length ft.	Slope ft./ft.	Diam. in.	Q full cfs	V f.p.s.	S_f ft./ft.	h_L ft.	Elevation Inlet	Elevation Outlet
					10.0															
300	MH300 TO MH310	1B	0.83	0.83			10.0	4.25	3.5			400	0.0028	24	13.0	3.6				
310	MH310 TO MH320	2B	0.81	1.64		1.85	11.85	4.00	6.6			400	0.0028	24	13.0	4.3				
320	MH320 TO MH330	3B	0.96	2.60		1.55	13.40	3.80	9.9			400	0.0028	24	13.0	4.6				
330	MH330 TO MH340	4B	0.84	3.44		1.45	14.85	3.60	12.3			400	0.0028	24	13.0	4.9				
340	MH340 TO MH350	5B	0.80	4.24		1.36	16.21	3.48	14.8			400	0.0028	30	23.6	5.0				
350	MH350 TO MH360	6B	1.57	5.81		1.33	17.54	3.35	19.5			400	0.0028	30	23.6	4.6				
360	MH360 TO MH370	7B	0.81	6.62		1.45	18.99	3.23	21.4			400	0.0028	30	23.6	4.6				
370	MH370 TO MH380	8B	0.85	7.47		1.45	20.44	3.12	23.3			400	0.0028	36	38.4	5.7				
380	MH380 TO MH390	9B	1.96	9.43		1.17	21.61	3.02	28.5			420	0.0028	36	38.4	5.9				
390	MH390 TO MH400	10B	0.84	10.27		1.19	22.80	2.95	30.3			400	0.0028	36	38.4	6.0				
400	MH400 TO MH410	11B	2.10	12.37		1.11	23.91	2.85	35.3			400	0.0028	36	38.4	6.1				
410	MH410 TO INLET	12B	0.33	12.70		1.09	25.00	2.78	35.3			100	0.0028	36	38.4	6.1				
	TO DETENTION BASIN																			

Computed by: DNJ Checked by: Date: Jan. 31, 1988

(1) PRECIPITATION INTENSITIES FROM NOAA ATLAS 2 VOL. VIII - ARIZONA. REFER TO FIGURE 1A.

ARIZONA HIGHWAY DEPARTMENT
STRUCTURES SECTION
HYDRAULICS BRANCH

TORM SEWER SYSTEM DESIGN: SEWER CALCULATION SHEET PRELIMINARY DESIGN OF ULTIMATE DRAINAGE AREA 12 DRAINAGE SYSTEM FROM 40th STREET TO 40th STREET TO THE SALT RIVER.

LOCATION DATA
Highway I-10 Corridor Study
Location PHOENIX
Project No. 5029.05

DESIGN DATA
Frequency 10 years
P_6 = 1.92 in. P_{24} = 2.29 in. P_1 = 1.34 in.
Outlet TW Elev. =
Pipe n = 0.012

SEWER CALCULATIONS

Location		Drainage Area			Time of Flow, Min.			I (1)	Q (2)	Sewer Profile				Sewer Design			Hydraulic Grade Line			
Line No.	From - To	No.	Increm. CA	Σ CA	Inlet	Sewer	Design	in./hr	cfs	Crown Elevation Inlet	Crown Elevation Outlet	Length ft.	Slope ft./ft.	Diam. in.	Q full cfs	V f.p.s.	S_f ft./ft.	h_L ft.	Elevation Inlet	Elevation Outlet
					10															
420	DETENTION BASIN @ 40th STREET TO MH430	1B-13B	—	—			10	—	24.0			40	0.003	30	24.4	5.5				
430	MH430 TO MH440	—	—	—		0.1	10.1	—	24.0			140	0.003	30	24.4	5.5				
440	MH440 TO MH450	14B	0.74	0.74		0.4	10.5	4.18	27.1			400	0.003	36	39.7	5.8				
450	MH450 TO MH460	15B	0.50	1.24		1.1	11.6	4.00	29.0			400	0.003	36	39.7	6.0				
460	MH460 TO MH470	16B	2.15	3.39		1.1	12.7	3.89	37.2			400	0.003	36	39.7	6.0				
470	MH470 TO MH480	17B	0.79	4.18		1.1	13.8	3.70	39.5			400	0.003	42	59.9	6.4				
480	MH480 TO MH490	18B	0.88	5.06		1.0	14.8	3.60	42.2			400	0.003	42	59.9	6.6				
490	MH490 TO MH500	19B	0.42	5.48		1.0	15.8	3.50	43.2			400	0.003	42	59.9	6.6				
500	MH500 TO MH510	20B	1.80	7.28		1.0	16.8	3.40	48.8			400	0.003	42	59.9	6.8				
510	MH510 TO MH520	21B	0.45	7.73		1.0	17.8	3.30	49.5			400	0.003	42	59.9	6.8				
520	MH520 TO MH530	22B	0.43	8.16		1.0	18.8	3.22	50.3			400	0.003	42	59.9	6.7				
530	MH530 TO MH540	23B	4.10	12.26		1.0	19.8	3.14	62.5			400	0.003	48	85.5	7.2				
540	MH540 TO MH550	24B	0.70	12.96		0.9	20.7	3.08	63.9			130	0.003	48	85.5	7.3				
550	MH550 TO MH560	25B	3.32	16.28		0.3	21.0	3.04	73.5			400	0.003	48	85.5	7.4				
560	MH560 TO MH570	26B	0.47	16.75		0.9	21.9	3.00	74.3			400	0.003	48	85.5	7.4				
570	MH570 TO MH580	27B	0.41	17.16		0.9	22.8	2.95	74.6			400	0.003	48	85.5	7.3				
580	MH580 TO MH590	28B	0.43	17.59		0.9	23.7	2.86	74.3			400	0.003	48	85.5	7.3				
590	MH590 TO MH600	29B	0.64	18.23		0.9	24.6	2.80	75.0			250	0.003	48	85.5	7.1				
600	MH600 TO MH610	—	—	18.23		0.6	25.2	2.76	74.3			270	0.003	48	85.5	7.3				
610	MH610 TO MH620	30B	0.21	18.44		0.6	25.8	2.73	74.3			400	0.003	48	85.5	7.3				
620	MH620 TO SALT RIVER	31B	0.36	18.80		0.9	26.7	2.67	74.2			400	0.003	48	85.5	7.3				

Computed by: DNJ Checked by: Date: FEB. 1, 1988

(1) PRECIPITATE INTENSITIES FROM NOAA ATLAS 2 VOL. VIII - ARIZONA. REFER TO FIGURE 1A.

(2) ALL CALCULATED FLOWS INCLUDE 24 cfs from the I-10/40th STREET T.I. DETENTION FACILITY.

ARIZONA HIGHWAY DEPARTMENT
STRUCTURES SECTION
HYDRAULICS BRANCH

STORM SEWER SYSTEM DESIGN: SEWER CALCULATION SHEET PRELIMINARY DESI

LOCATION DATA

Highway I-10 CORRIDOR STUDY
Location PHOENIX
Project No. 5029.05

DESIGN DATA

Frequency 10
P_6 = 1.92 in. P_{24} = 2.2
Outlet TW Elev. =
Pipe n = 0.012

SEWER CALCULATIONS

Location		Drainage Area			Time of Flow, Min.			I (1)	Q (2)
Line No.	From - To	No.	Increm. CA	Σ CA	Inlet	Sewer	Design	in./hr	cfs
					10.0				
100	DB TO MH 10	1A							34
110	MH 10 TO MH 20	2A	0.74	0.74		1.6	11.6	4.00	37
120	MH 20 TO MH 30	3A	0.96	1.70		1.2	12.8	3.85	40.5
130	MH 30 TO MH 40	4A	0.93	2.63		1.2	14.0	3.70	43.7
140	MH 40 TO MH 50	5A	2.24	4.87		1.2	15.2	3.58	51.4
150	MH 50 TO MH 60	6A	0.83	5.70		1.1	16.3	3.47	53.8
160	MH 60 TO MH 70	7A	3.79	9.49		1.1	17.4	3.33	65.6
170	MH 70 TO MH 80	8A	0.81	10.30		1.1	18.5	3.24	67.4
180	MH 80 TO MH 90	9A	1.13	11.43		1.1	19.6	3.16	70.1
190	MH 90 TO MH 100	10A	2.14						
		11A	0.35	13.92		1.1	20.7	3.08	76.9
200	MH 100 TO MH 110	—	—	13.92		0.8	21.5	3.00	75.8
210	MH 110 TO MH 120	12A	5.36						
		13A	0.89	20.17		0.7	22.2	2.96	93.7
220	MH 120 TO MH 372 (3)	14A	1.32	21.49		0.9	23.1	2.90	96.3
C-19	MH 372 TO MH 369	15A	0.34	21.83		0.2	23.3	2.88	96.9
C-18	MH 369 TO MH 364	16A	2.07	23.90		0.8	24.1	2.83	101.6
C-17	MH 364 TO MH 358	17A	1.44	25.34		0.9	25.0	2.78	104.4
C-15	MH 358 TO MH 356	18A	1.42	26.76		0.2	25.2	2.76	107.9
C-14	MH 356 TO MH 349	—	—	26.76		0.3	25.5	2.73	107.1
C-13	MH 349 TO MH 343	19A	1.65	28.41		0.4	25.9	2.70	110.7
C-12	MH 343 TO MH 339	20A	0.90	29.31		0.8	26.7	2.68	112.6

Computed by: DNJ Checked by: Date: JAN. 28

(1) PRECIPITATION INTENSITIES FROM NOAA ATLAS 2 VOL VIII - ARIZONA, PHOENIX.

(2) ALL CALCULATED FLOWS INCLUDE 34 cfs FROM THE I-10/48th STREET T.I.

(3) PROPOSED STORM DRAINAGE SYSTEM CONNECTS INTO EXISTING STORM D

OF ULTIMATE DRAINAGE SYSTEM FOR ULTIMATE DRAINAGE AREA 11.

years

in. P_1 = 1.34 in.

w : Profile				Sewer Design			Hydraulic Grade Line			
own Elevation		Length ft.	Slope ft./ft.	Diam. in.	Q_{full} cfs	V f.p.s.	S_f ft./ft.	h_L ft.	Elevation	
n t	Outlet								Inlet	Outlet
		450	0.002	36	32	4.8				
		400	0.002	42	48.9	5.6				
		400	0.002	42	48.9	5.7				
		400	0.002	42	48.9	5.6				
		400	0.002	48	69.7	5.9				
		400	0.002	48	69.7	6.0				
		400	0.002	48	69.7	6.3				
		400	0.002	48	69.7	6.3				
		400	0.002	48	69.7	6.3				
		300	0.002	54	95.5	6.6				
		280	0.002	54	95.5	6.4				
		320	0.002	54	95.5	6.1				
		60	0.002	54	95.5	6.1				
		440	0.0043	54	140.0	9.5				
		500	0.0041	54	136.7	9.2				
		161	0.0091	54	203.7	12.7				
		202	0.004	54	135.0	10.7				
		211	0.0026	54	108.9	7.9				
		430	0.0038	54	131.6	9.4				
		377	0.0029	54	115.0	8.2				

FER TO FIGURE 1A.

TENTION FACILITY.

NAGE SYSTEM.

ARIZONA HIGHWAY DEPARTMENT
STRUCTURES SECTION
HYDRAULICS BRANCH

STORM SEWER SYSTEM DESIGN: SEWER CALCULATION SHEET PRELIMINARY DESIG

LOCATION DATA

Highway I-10 Corridor Study
Location PHOENIX
Project No. 5029.05

DESIGN DATA

Frequency 10
P_6 = 1.92 in. P_{24} = 2.29
Outlet TW Elev. =
Pipe n = 0.012

SEWER CALCULATIONS

Location		Drainage Area			Time of Flow, Min.			I (1)	Q (2)	S
Line No.	From - To	No.	Increm. CA	Σ CA	Inlet	Sewer	Design	in./hr	cfs	
C-11	MH339 TO MH335	21A	2.30	31.61		0.8	27.5	2.62	116.8	
C-10	MH335 TO MH332	22A	0.35	31.95		0.7	28.2	2.58	116.4	
C-9	MH332 TO MH329	23A	1.62	33.58		0.4	28.6	2.54	119.3	
C-8	MH329 TO MH326	24A	3.76	37.34		1.0	29.6	2.50	127.4	
C-7B	MH326 TO MH323A	25A	2.57	39.91		1.1	30.7	2.46	132.2	
C-7A	MH323A TO MH323	—	—	39.91		0.5	31.2	2.43	131.0	
C-6	MH323 TO MH320	26A	3.30	43.21		0.4	31.6	2.40	137.7	
C-5	MH320 TO MH317	27A	3.60	46.81		0.6	32.2	2.38	145.4	
C-4	MH317 TO MH314	28A	2.03	48.84		0.6	32.8	2.34	148.3	
C-3	MH314 TO TEMPE DRAIN	29A	0.45	49.29		0.2	33.0	2.32	148.4	

Computed by: DNJ Checked by: Date: JAN. 2

① PRECIPITATION INTENSITIES FROM NOAA ATLAS 2 VOL. VIII - ARIZONA, PHOENIX. RE

② ALL CALCULATED FLOWS INCLUDE 34 CFS FROM THE I-10/48th STREET T.I.

OF ULTIMATE DRAINAGE SYSTEM FOR ULTIMATE DRAINAGE AREA II.

cars
in. P_1 = 1.34 in.

Profile				Sewer Design			Hydraulic Grade Line			
wn Elevation		Length	Slope	Diam.	Q_{full}	V	S_f	h_L	Elevation	
	Outlet	ft.	ft./ft.	in.	cfs	f.p.s.	ft./ft.	ft.	Inlet	Outlet
		273	0.0015	60	109.6	6.5				
		193	0.0027	60	147.8	8.3				
		495	0.0023	60	135.3	8.0				
		500	0.0022	60	132.3	7.5				
		283	0.0039	60	176.2	9.9				
		217	0.0024	60	138.2	8.0				
		362	0.0043	60	184.6	10.4				
		329	0.0024	66	178.6	8.5				
		136	0.0046	66	248.2	10.9				
		300	0.0056	66	272.9	—				

P ...

TO FIGURE 1A.

ENTION FACILITY.

ULTIMATE DRAINAGE AREA 12

DMJM	PROJECT: I-10 CORRIDOR STUDY	PROJECT NO: 5029.05	PAGE 1/3
		BY: DNJ / DATE: JAN. 31, 88	

SUBJECT ULTIMATE DRAINAGE AREA 12 – DETENTION FACILITY AT 40TH STREET T.I.

PRELIMINARY SIZING OF DETENTION BASIN

I. ASSUMPTIONS

A. 100% INLET INTERCEPTION

B. TIME OF PEAK AT DETENTION BASIN OCCURS WHEN THE ENTIRE AREA IS CONTRIBUTING RUNOFF, WHICH ACCORDING TO SEWER CALCULATIONS OCCURS AT 25-MINUTES.

II CONTRIBUTING AREA:

DRAINAGE AREA DESIGNATION	AREA (ACRES)
DA 1B	0.92
DA 2B	0.90
DA 3B	1.19
DA 4B	1.02
DA 5B	0.96
DA 6B	2.50
DA 7B	0.98
DA 8B	1.02
DA 9B	3.20
DA 10B	1.01
DA 11B	3.27
DA 12B	0.37
DA 13B	6.77
TOTAL CONTRIBUTING AREA	24.11 ACRES

III WEIGHTED 'C' COEFFICIENT

USE 0.9 FOR PAVEMENT
0.5 FOR INFIELD AREAS AND RIGHT-O-WAY

$$\text{WEIGHTED 'C'} = \frac{11.95(0.9) + 12.16(0.5)}{24.11}$$

$$= 0.698 \approx 0.70$$

$$CA = 0.70(24.11)$$
$$= 16.87$$

IV PROJECTED PEAK FLOW RATES FOR DIFFERENT STORM FREQUENCIES:

10-YR. $Q = CA\,I$

$Q = 16.87$ (2.78 IN/HR)

$Q = 46.9$ CFS

I – RAINFALL-INTENSITY-DURATION FREQUENCY CURVES. NOAA ATLAS 2, VOL. VIII - ARIZONA

$t_c = 25$ MINUTES

50-YR $Q = CA\,I$

$= 16.87$ (3.45 IN./HR)

$= 58.2$ CFS

DMJM	PROJECT: I-10 CORRIDOR STUDY	PROJECT NO: 5029.05		PAGE: 2/3
		BY: DNJ	DATE: JAN. 31, 86	

SUBJECT: ULTIMATE DRAINAGE AREA 12 - DETENTION FACILITY AT 40th. STREET T. I.

PRELIMINARY SIZING OF DETENTION BASIN

I PROJECTED RUNOFF VOLUME FOR 10-YEAR - 24 HR. & 50-YEAR 24-HR. STORM EVENTS

10-yr 24-Hr: 2.29-INCHES OF PRECIPITATION

$$\text{RUNOFF} = \frac{2.29 \text{ INCHES}}{12 \text{ IN./FT.}} \times 0.70 = 0.1336 \text{ FT.}$$

$$\text{VOLUME} = 0.1336 \text{ FT} \times 24.11 \text{ ACRES} \times 43560 \text{ FT}^2/\text{ACRE}$$

$$= 140,300 \text{ FT}^3$$

50-yr 24-HR. = 3.20 INCHES OF PRECIPITATION

$$\text{RUNOFF} = \frac{3.20 \text{ INCHES}}{12 \text{ IN/FT.}} \times 24.11 \text{ ACRES} \times 43560 \text{ FT}^2/\text{ACRE}$$

$$= 280,060 \text{ FT}^3$$

∴ USE 30-INCH OUTLET PIPE
PONDING DEPTH: 2.5' TO 3.5'
MAXIMUM DISCHARGE = 24 CFS
STORAGE REQUIREMENT (50-yr. STORM EVENT) OF 160,700 FT^3

DMJM	PROJECT: I-10 CORRIDOR STUDY	PROJECT NO: 5029.05	PAGE 3/3
		BY: DNJ / DATE: JAN. 31, 85	

SUBJECT ULTIMATE DRAINAGE AREA 12 - DETENTION BASIN AT 40TH STREET T.I.

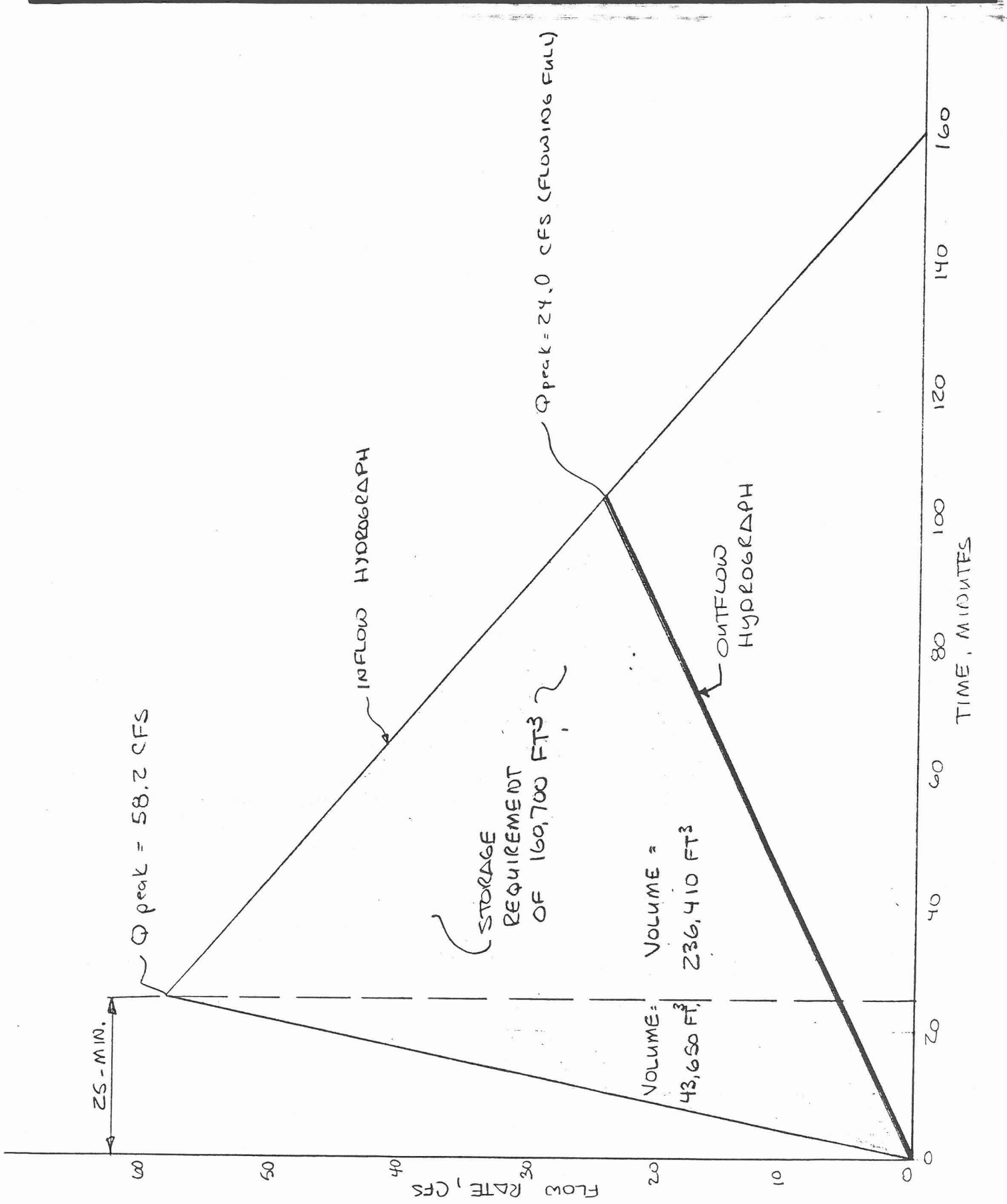


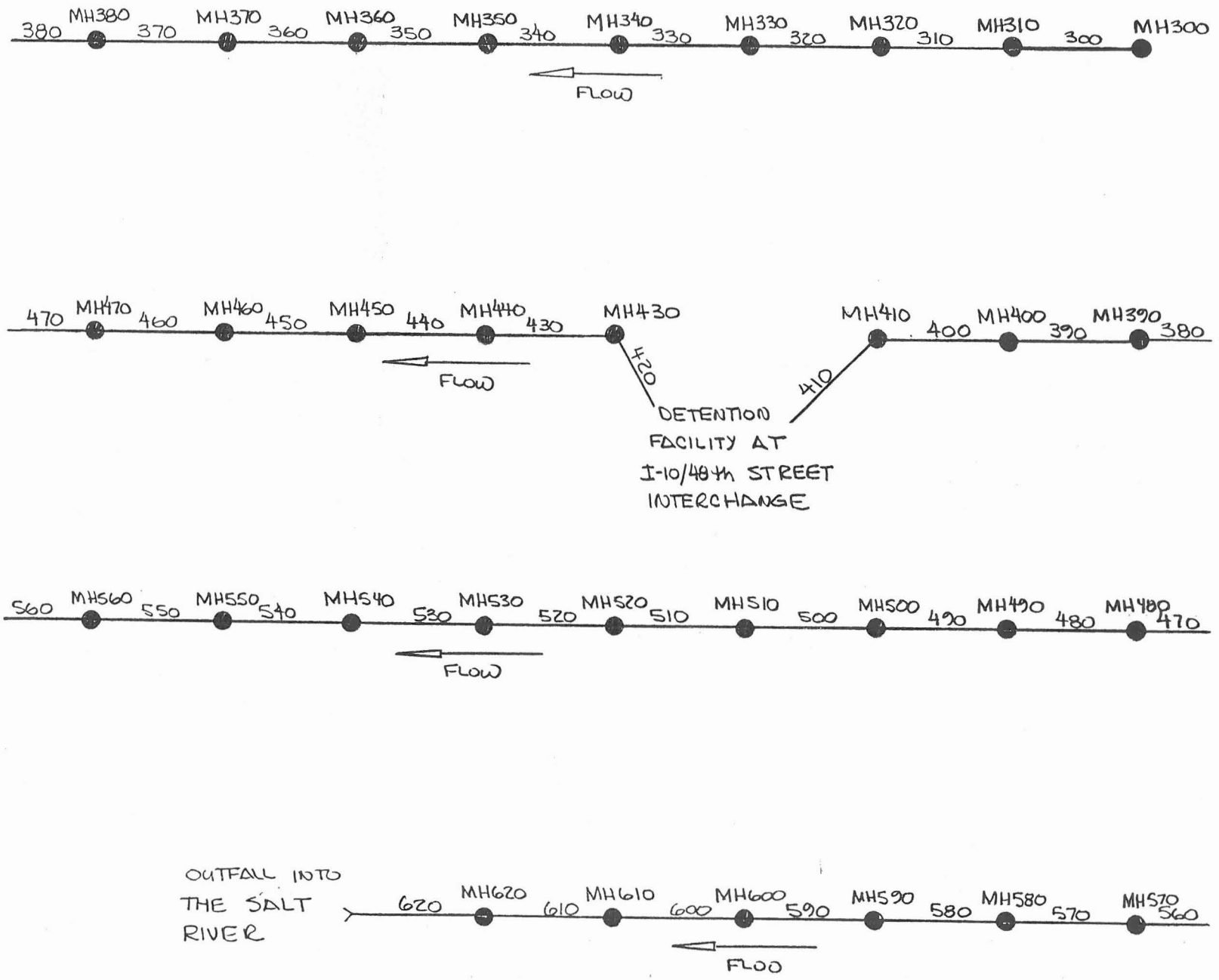
TABLE 3B. DRAINAGE AREAS CONTRIBUTING TO ULTIMATE DRAINAGE AREA FOR ULTIMATE DRAINAGE AREA 12.

Drainage Area Designation	Pavement Area (acres)	Infield & Right-of-Way Area (acres)	Total Area (acres)
DA 1B	0.92	--	0.92
DA 2B	0.90	--	0.90
DA 3B	0.90	0.29	1.19
DA 4B	0.82	0.20	1.02
DA 5B	0.79	0.17	0.96
DA 6B	0.80	1.70	2.50
DA 7B	0.80	0.18	0.98
DA 8B	0.84	0.18	1.02
DA 9B	0.89	2.31	3.20
DA 10B	0.82	0.19	1.01
DA 11B	1.15	2.12	3.27
DA 12B	0.37	--	0.37
DA 13B	1.95	4.82	6.77
DA 14B	0.67	0.27	0.94
DA 15B	0.46	0.18	0.64
DA 16B	1.60	1.41	3.01
DA 17B	0.78	0.18	0.96
DA 18B	0.87	0.19	1.06
DA 19B	0.37	0.18	0.55
DA 20B	0.59	2.53	3.12
DA 21B	0.50	--	0.50
DA 22B	0.48	--	0.48
DA 23B	1.28	5.89	7.17
DA 24B	0.49	0.52	1.01
DA 25B	1.50	3.93	5.43
DA 26B	0.52	--	0.52
DA 27B	0.45	--	0.45
DA 28B	0.48	--	0.48
DA 29B	0.30	0.73	1.03
DA 30B	0.23	--	0.23
DA 31B	0.40	--	0.40
Totals	23.92	28.17	52.09

TABLE 4B. DRAINAGE AREAS & CA FOR ULTIMATE DRAINAGE SYSTEM FOR ULTIMATE DRAINAGE AREA 12.

Subarea Designation	Pavement CA	Infield & Right-of-Way CA	CA
DA 1B	0.83	--	0.83
DA 2B	0.81	--	0.81
DA 3B	0.81	0.15	0.96
DA 4B	0.74	0.10	0.84
DA 5B	0.71	0.09	0.80
DA 6B	0.72	0.85	1.57
DA 7B	0.72	0.09	0.81
DA 8B	0.76	0.09	0.85
DA 9B	0.80	1.16	1.96
DA 10B	0.74	0.10	0.84
DA 11B	1.04	1.06	2.10
DA 12B	0.33	--	0.33
DA 13B	1.76	2.41	4.17
DA 14B	0.60	0.14	0.74
DA 15B	0.41	0.09	0.50
DA 16B	1.44	0.71	2.15
DA 17B	0.70	0.09	0.79
DA 18B	0.78	0.10	0.88
DA 19B	0.33	0.09	0.42
DA 20B	0.53	1.27	1.80
DA 21B	0.45	--	0.45
DA 22B	0.43	--	0.43
DA 23B	1.15	2.95	4.10
DA 24B	0.44	0.26	0.70
DA 25B	1.35	1.97	3.32
DA 26B	0.47	--	0.47
DA 27B	0.41	--	0.41
DA 28B	0.43	--	0.43
DA 29B	0.27	0.37	0.64
DA 30B	0.21	--	0.21
DA 31B	0.36	--	0.36

SCHEMATIC OF ULTIMATE DRAINAGE SYSTEM FOR ULTIMATE DRAINAGE AREA 12.



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SUBJECT SCHEMATIC OF ULTIMATE DRAINAGE SYSTEM FOR ULTIMATE DRAINAGE SYSTEM 12.