DESIGN MEMORANDUM

SOUTHEAST PHOENIX REGIONAL DRAINAGE BASIN

Formerly

48TH STREET DETENTION BASIN

City of Phoenix
Street Transportation Department
Project No. ST-83120008

Flood Control District of Maricopa County
PCN 630-01-30

June, 1999

HDR Engineering, Inc
2141 East Highland Avenue, Suite 250
Phoenix, Arizona 85016

DMV 1/9/99

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Introduction

In 1996 HDR completed a master drainage plan for the rapidly developing area in the vicinity of South 48th Street and Chandler Boulevard for the City of Phoenix. A large regional detention basin was included at 48th Street and Pecos Road, identified as the 48th Street Detention Basin. In 1998 the City of Phoenix also designated the basin site as a city park and purchased 34 acres at the northeast corner of 48th Street and Pecos Road for the multi-purpose facility. In 1998 the Flood Control District of Maricopa County became a financial participant in the project and the basin site was expanded to 63 acres. The project was renamed the "Southeast Phoenix Regional Drainage Basin Project".

The Arizona Department of Transportation (ADOT) also became a participant in 1998 and is providing assistance to the City by advance acquisition of the additional acreage for the basin as part of the right-of-way acquisition activities for the I-10/SR202L Traffic Interchange. ADOT is primarily involved because of the interim interchange (Pecos Road Connector) project and because the 48th Street basin replaces ADOT's Basin 15 in the original design concept for the interchange. The onsite drainage from the interchange will be discharged to the basin.

In early 1999 the City contracted with HDR to complete the design of the 48th Street Detention Basin. This report is submitted with plans, specification and cost estimate at the 75% submittal level.

General Description

The purpose of the Southeast Phoenix Regional Drainage Basin Project is to provide flood control and storm water management benefits to public, residential and commercial property within and downstream of the nearly five square-mile Southeast Phoenix Regional Basin watershed. The project is intended to significantly reduce flooding of the intersection at 48th Street and Chandler Boulevard and property south and east of the intersection. It is also anticipated to reduce flooding of Salt River Valley Water User's

Association (SRP) irrigation facilities in the vicinity. The basin is designed to protect to the 100-year level.

The attached figure entitled "Conceptual Drainage Channel Plan" shows the conceptual plan for the channels that are proposed to discharge to the basin. The channel plan was originally developed in 1996 for the 48th Street Improvement District project that was not implemented. Therefore, neither the 48th Street nor the 50th Street channels south of Chandler Boulevard are constructed at this time. The channels are generally being provided by individual developers as development proceeds along these corridors. North of Chandler Boulevard the channel system is mostly in place as shown. In January 1999, the City of Phoenix requested the realignment of the channel now shown along the 50th Street corridor.

The project consists of a large primary detention basin and associated facilities to retain and treat initial storm water flows into the basin. The primary basin will be turfed and landscaped to provide a large open and grassed area for regional park development. The general plan for the basin is shown in Sheet C-1. The basin complex includes a 351 acre-foot primary detention basin (Primary Basin), a 46 acre-foot equalization/sedimentation basin (EQ Basin), and two storm water treatment cells.

Structures in the basin include a 400-foot long spillway from the EQ Basin to the Primary Basin and a 10-foot long weir/overflow structure at the basin outlet to prevent overtopping of the basin. A number of gate and headwall structures are required for the basin piping system shown in Sheets and D-1 and 2. Basin piping consists of 24-inch RCP piping to transfer water to and from the water quality cells. A 2500 gpm capacity pump station, identified as the Water Quality Pump Station, has three variable frequency (VFD) submersible electric pumps (2-1000gpm, 1-500 gpm) to pump "first flush" storm water retained in the EQ basin to the treatment cells.

A second pump station, the Evacuation Pump Station (EPS), is required to dewater the basin complex at a maximum discharge rate of 10 cfs to SRP's tailwater ditch along Pecos Road until the primary 42" RCP outlet can be connected to the Santan Channel. The EPS contains two 10-cfs (1-primary and 1-backup) submersible electric pumps with VFD's. The EPS will be the only means to dewater the basin complex storm water until the City obtains a permit from the Gila River Indian Community (GRIC) to discharge to the Santan Channel. In the interim period, the basin will not provide the full 100-year protection that will be provided when the 42-inch outlet is functional.

Part of 42" permanent outlet to the Santan Channel will be constructed in this phase of the project including the overflow weir structure and outlet gate structure (See Sheet D-2). The remaining 42" line that is located primarily on GRIC land will be constructed when the discharge permit is obtained. Plans and sections of the Evacuation and the Water Quality pump stations are shown on Sheets PS-1 through PS-6, respectively.

The primary function of the Treatment Cells is to provide passive treatment of the "first flush" storm water. The details of the design of the cells are shown on Sheets TC-1 and TC-2. Dr. Martin Karpiscak of the University of Arizona Office of Arid Lands Research developed the conceptual plan for the cells as described in the attached report entitled *Stormwater Treatment Facility Conceptual Plan*, April 1999 (See Appendix A). The treatment cells serve as a Best Management Practice (BMP) to meet GRIC water quality criteria. Other BMP's for storm water provided by the basin complex include sedimentation and erosion control.

The primary basin will also serve as a multi-purpose park and recreation facility. The City of Phoenix intends to develop facility as a regional park, and the primary basin will be landscaped and turfed for that purpose as shown on Sheets L-1 and L-2.

Miscellaneous items in the basin complex include a 12-foot wide O & M asphalt concrete road around the perimeter of the basin, a concrete access ramp in the EQ basin, perimeter lighting, a 4-foot wide low flow channel for the length of the lower basin, chain link fence around the EQ Basin, and handrails along the spillway crest and spillway retaining walls (See Sheets C-14 through 16).

Hydrology

The basin hydrologic design is based upon a 100-year 24-hour HEC-1 model of the contributing watershed. Several HEC-1 models were developed prior to the selection of the current adopted design model. In December 1998, HDR submitted a draft Hydrology Report that included a number of models based upon FCDMC's 6-hour and 24-hour storm durations and ADOT's 24-hour storm duration. Several revisions were made to the models to respond primarily to FCDMC review comments and the Hydrology Report (Revised) was resubmitted March 9, 1999. The text of that report is included in Appendix C, as that report documented the hydrologic approach, the various HEC-1 models that were evaluated and the responses to agency reviews that led to the selection of the current design model.

The Hydrology Report (Revised) recommended, and the participants agreed, to use HDR's ADOT/FCDMC SEVRDS[1] 100-year 24-hour model (File Name: SVRD48th.DAT) as the basic basin design model. The SEVRDS model with the 48th Street basin included is preferred because the basin outlet will ultimately be connected to the Santan Channel[2] and because the ADOT version of the 100-yr 24-hour event model is somewhat more conservative than the FCDMC version. Furthermore, the model includes the SEVRDS/Santan Channel system HEC-1 model on a common time scale which allows the impact of 48th Street outflows on the Santan Channel peak flow to be evaluated at the confluence. However, the SVRD48th model was slightly modified following submittal of the revised Hydrology Report to respond to three concerns:

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[1] Southeast Valley Regional Drainage System sponsored by the Flood Control District of Maricopa County (FCDMC).

[2] Santan Channel is an Arizona Department of Transportation (ADOT) project that is part of SEVRDS.

1. ADOT lowered the inlet CBC (shown as "Future ADOT 4-10x6 Box Culvert") by four feet which in turn required the Equalization Basin to be lowered, resulting in increased storage volume.
2. ADOT changed the outflow rating from SEVRDS Basin B and the new rating needed to be incorporated into the model. The resulting model was renamed the NEWSVR48.DAT model.
3. HDR proposed that an uncontrolled outflow weir be placed at the basin outlet to avoid having to raise the basin another two to three feet to contain the entire 100-year 24-hour flow volume. A 10-foot long weir placed at elevation 1159 limits the high water level in the basin to approximately elevation 1161 and provides one foot of freeboard as requested by the FCDMC. Also, the uncontrolled discharges from the basin that occur late in the storm were determined not to increase the 100-year peak discharge in the Santan Channel. (See Sheet D-4 for details of the Overflow Weir Structure).

The NEWSVRD48th.DAT design model printout is included in Appendix B along with the correspondence concerning the three issues discussed above. Key results of the model include:

1. The peak flow Q100 at ADPMP (EQ Basin inflow) is 3760 cfs at 12:27.
2. The inflow is routed through the EQ Basin and over the 400' spillway at El. 1158 with weir coefficient of 2.64 corresponding to a broad-crested weir. The peak flow over the spillway is 3760 cfs at 12:30. The HWL in the EQ Basin is 1160.3.
3. The spillway flow is routed through the Primary Basin (STB15) and out the 42-inch outflow pipe when the level reaches the Overflow Weir Structure El. 1159. The overflow weir is modeled as a sharp-crested weir with coefficient 3.33. The peak outflow is 93 cfs at HWL 1161.0 and time 20:30. This allows one foot of freeboard to the top of the basin at El. 1162.
4. The Basin B siphon outflow rating received from ADOT 4/1/99 (DMJM) at the front end of the HEC-1 model is routed through the Santan Outfall Channel to the confluence with the 42-inch outflow pipe from the Southeast Phoenix basin. The peak flow in the Santan Channel at the confluence (CGILAW) is 905 cfs occurring at 13:63.
5. When the 93-cfs outflow at 20:30 is combined with the 905 cfs at 13:63 the combined flow peak is unchanged at R10W. This leads to the conclusion that the uncontrolled outflow from the weir structure does not increase the design peak flow of the Santan Outfall Channel.

Basin 15

In the model and in some correspondence with FCDMC and ADOT, the basin is called "Basin 15". The name derives from the original Arizona Department of Transportation (ADOT) South Mountain Freeway/I-10 interchange concept design that included a large regional detention basin known as Basin 15. The Southeast Phoenix regional basin essentially replaces Basin 15 and serves the same function as the original basin. The

volume of storm water from I-10/Santan Freeway interchange that was previously planned to be pumped to the original Basin 15 can be accommodated in the 48th Street basin. The NEWSVR48 model includes a complete sub-model of the interchange on-site discharge to the 48th Street basin. The site plan shows the preliminary location of ADOT's interchange pump station. The location of this pump station is being evaluated by ADOT at this time.

Design Approach

Basin Routing

The routing of storm water through the basin complex is as follows:

- The 48th Street and I-10/Santan TI collector channels to the 48th Street basin will at some time in the future deliver storm water to the EQ Basin via the freeway 4(10x6) CBC and the interchange infield and pump station discharge piping.
- The initial flows up to 46 acre-feet will be retained in the EQ Basin. These are the "first flush" volumes that will be retained in the EQ Basin and later pumped to the Treatment Cells for polishing.
- Flows exceeding the capacity of the EQ Basin will discharge over the 400-foot long primary spillway into the primary basin. Flows will initially fill the lower basin. Flows exceeding approximately the two-year return period event will begin to flood the upper level of the primary basin.
- Initially, the primary basin will be dewatered by pumping to the Salt River Project's unlined tailwater ditch along Pecos Road at a rate not exceeding 10 cfs.[3] The interim Evacuation Pump Station is provided for this purpose.
- Ultimately, the primary basin will be dewatered by 42-inch gravity outflow pipe to the SEVRDS Santan Channel as shown on Sheet D-2.
- The Water Quality Pump Station (Sheet PS-4) is a small triplex station designed to transfer "first flush" flows contained in the EQ basin to the water quality cells for treatment. The pumps are equipped with variable frequency drives to adjust flow deliveries to the cells from approximately 250 gpm to 2500 gpm.
- Treated storm water from the cells will either be recycled back to the EQ Basin through to 24-inch RCP gravity pipeline or discharged to the low flow channel that will direct flows to the gated 42-inch outflow pipe.
- Gate Structures. The gate structures shown on D-1 and D-2 are equipped with manually operated gates. All of the gates are assumed to be normally in a closed position. They will be manually opened when it is desired to pump flows to the treatment cells or dewater the basin complex. The City of Phoenix has specifically requested that none of the operations in the basin complex be automated other than the irrigation system.

[3] A permit from SRP for this connection is in process.

Water Quality Design

Storm water quality arises as an issue in this project because the proposed ultimate outfall is the Santan Channel that will discharge to the Gila Drain Floodway. ADOT is in the process of obtaining a discharge permit from the Gila River Indian Community DEQ to allow the Santan Channel to discharge to the floodway. Because the City ultimately expects to discharge storm water to the Santan Channel, it is anticipated that the City will also need to obtain discharge permits from both ADOT and the GRIC. One of the primary conditions of the ADOT's permit is that "first flush" storm water is to be treated in a passive storm water treatment system.

The 48th Street basin complex contains an equalization/sedimentation basin, a pump station and two treatment cells that comprise the water quality system. This system is very similar to the system being planned for Basin B of the SEVRDS/Santan Channel project. The main design features of this system are the EQ Basin volume and the proposed operation of the treatment cells.

Equalization Basin/Sedimentation Basin Design

The purpose of the EQ Basin is two-fold. As an equalization basin, the purpose is to capture the "first flush" storm water runoff from the contributing watershed. When this initial runoff volume is satisfied, additional runoff will overflow into the primary basin. The term "equalization" refers to the fact that when this basin reaches the spillway crest (El. 1158) additional flows are forced over the spillway into the primary basin. When the primary basin reaches the spillway level, the levels of the two basins will equalize.

The second purpose is to provide sedimentation that is desired before the "first flush" volume is pumped to the vegetated treatment cells. The settling that occurs in this basin is considered to be a Best Management Practice (BMP) for improving storm water quality. The basin will also capture debris from the watershed that can be removed as required. A concrete access ramp is provided for that purpose.

If the EQ Basin fills to the spillway crest, it will take a minimum of approximately 9 days to pump retained flows to the treatment cells at the maximum design pumping capacity of 5.6 cfs. The actual pumping rate to the treatment cells will depend upon the quality of the water entering and leaving the cells. Resident time for treatment up to 10 days or more could result on much longer times to dewater the EQ Basin. Several days residence time in the EQ Basin is likely sufficient to settle out most of the settleable solids in storm water. Conserving the available water supply to keep the vegetation alive in the vegetated cell will also be a factor that will govern how the treatment system is operated. It is recommended that at least 8 to 10 acre-feet of storm water be retained in EQ Basin for recycling through the vegetated basin during extended dry periods to minimize the need to use city tap water.

There is no firm regulatory definition of "first flush" volume. A conservative approach is to provide 1/4-inch of volume for the "effective" part of the watershed. In this context,

the effective part of the watershed is considered to be the part of the watershed that is directly connected impervious cover (i.e. mostly streets, driveways, parking lots and directly connected roof drains). As this is a difficult number to precisely measure, guidelines for determining this factor are given in Flood Control District of Maricopa County's *Hydrologic Design Manual* (1995). The effective impervious area is conservatively estimated to be 40% of the total area. The five square mile watershed is predominantly single-family residential of medium density, and there is some limited multi-family housing and commercial property. The 40% was estimated from aerial photographs and Table 4.2a (p. 4-15a) of the HDM.

This is consistent with the assumptions for the Southeast Valley Drainage System's Basin B as outlined in *Design Memorandum for Southeast Valley Regional Drainage System Storm Water Management*, ADOT, September, 1996 and *Initial Drainage Report, Santan Freeway: 56th Street to Price Road and Gila Drain Floodway to Basin B*, ADOT, September 12, 1996.

Computation of Equalization Basin Volume:

Watershed Area = 5 square miles = 3200 acres
Depth of "first flush" runoff = 1/4-inch= 0.0208 ft.
Directly connected impervious percentage = 40% = 0.40

Total Capture Volume = 3200 x 0.0208 x 0.4 = <u>26.6 acre-ft.</u> The total storage in the EQ Basin will exceed this number by approximately 20 acre-feet. Therefore, up to 20 acre-feet could be retained in the basin to irrigate the vegetated treatment cell during dry periods.

Treatment Cell Design

There are two treatment cells. One will be vegetated and the other will not vegetated at this time. The conceptual design report in Appendix A presents the advantages and disadvantages of surface, subsurface and various hybrid systems that have been evaluated by the Office of Arid Lands Studies. After much discussion on the cost to control mosquitoes in surface and hybrid systems, the SEVRDS partners decided upon using a more expensive first cost subsurface treatment system that can be operated for short periods of time as a surface flow system. A similar system is proposed for this project. Both cells will have a two-foot thick layer of river run rock mulch of one to three-inch size that will provide a porous media for subsurface flow and treatment, and will keep the vegetation alive in the vegetated cell without propagating mosquitoes.

The primary function of both of the cells is to reduce relatively low concentrations of nutrients such as Nitrogen and Phosphorous, and suspended solids. Constructed wetlands are often used to "polish" wastewater effluent such as the City's Tres Rios project. The daily flow volumes and the concentrations, both of which are predictable for wastewater effluent, are not predictable for storm water. The concentration of these constituents in typical first flush storm water, as estimated in the ADOT references above, is quite low.

However, storms producing a significant amount of runoff in Phoenix occur very unpredictably, and concentrations of any particular storm can vary considerably from one event to the next. Low initial concentrations and unpredictability of runoff volumes argue against a design approach based upon a residence time. Instead, the basins will be designed to have a great deal of flexibility in operation, as follows:

1. The Water Quality Pump Station has pumping range 250 gpm to 2500 gpm to the cells. Three pumps are provided and any number can be run at any rate within the range of VFD's. A Doppler flow meter on the 12" DIP discharge line will allow the operator to manually adjust the flow rate to the cells.
2. Treated storm water can be discharged to the low flow channel or recycled to the EQ Basin for storage and/or further treatment.
3. A City water supply is also provided to maintain the vegetated cells during dry periods. A 4" water service will be connected to the City's 12" water main on the east side of 48th Street. The 4" main will split into two 2" supply lines, one to each cell. Each of the 2" lines will also have a propeller meter to allow the operator to determine the volume of water going into the cell.
4. When desired, such as when the EQ Basin is full and the water quality is relatively good, the cells can be operated for several days or more as a surface flow system to evacuate excess water in the EQ Basin. The flows can likely be maintained at a high enough rate to prevent mosquito development and if quality is an issue the flows can be recycled indefinitely.
5. The Equalization basin is equipped with a direct drain to the primary basin low flow channel should the basin require rapid dewatering. Because the EQ Basin is four feet deeper than the low flow channel, the EQ Basin cannot be completely dewatered by gravity. The bottom five feet will have to be dewatered by pumping if it is desired to dry out the EQ Basin for periodic cleaning and maintenance.

Basin Evacuation/Dewatering Plan

The primary basin functions as a retention basin up to the overflow weir level. In the interim, the EPS will dewater the basin at a maximum rate of 10 cfs. If the basin fills, it will take two to three weeks of continuous pumping to completely dewater the basin. When the 42-inch outflow pipe is connected, the full basin (100-year event) can be dewatered in approximately two days. Although this exceeds the recommended evacuation time of 36 hours, the recommended time will be exceeded only in very rare events exceeding the 50-year event.

Outfall Plan

The future outfall to Santan Channel is configured as a 42-inch pipeline. A gate structure at the outlet will have a manually operated slide gate that will normally be closed. This gate will be opened to dewater the basin post event when adequate capacity in the Santan Channel is available. Manhole 108 (Sheet D-2) is designated as the location for the flow monitoring and sampling equipment this is anticipated to be required for the discharge

permit, although the specific requirements are not known at the present time. It is likely that this equipment will be installed when the 42-inch outlet pipe is connected to the Santan Channel.

Temporary Channel and 48" CMP Inflow

A "Temporary 48" CMP Drain" is shown in the site plan (See Sheet C-1). The temporary pipe will provide an outlet for storm water that is directed to the SRP's existing tailwater ditch along the west side of 48th Street. SRP currently plans to vacate this ditch when new facilities are constructed on the east side of 48th Street. When ADOT constructs the 4-10'x6' CBC undercrossing of the freeway, the temporary pipe will be removed.

Utilities

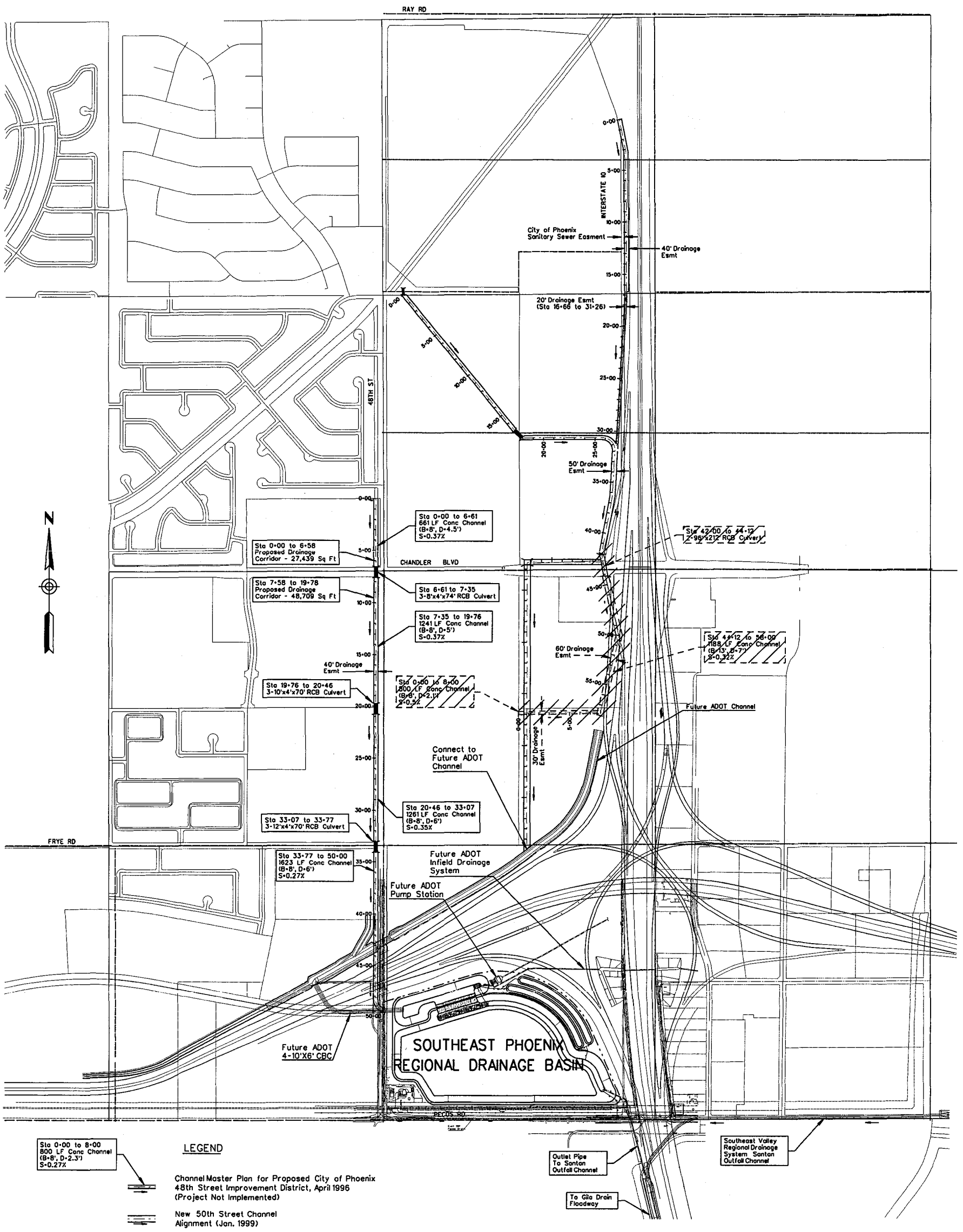
Many existing utilities border the project along Pecos Road and 48th Street (See Sheet C-4). The design of the basin has specifically avoided relocations. However, there are several pipe and utility crossings along Pecos Road and 48th Street that require care during installation to avoid impacts. Specifically, the 48-inch CMP is limited to this size because it must be installed over the 18" Sanitary Sewer and under the 12" water line in 48th Street. The 12" DIP EPS force main to the Pecos Drain will be constructed above the twin 24" sanitary force mains along the Pecos Road alignment, while the 42" RCP conduit will be installed under these lines.

The pump stations will require power feeds from SRP's 12kv lines along 48th Street and along Pecos Road. Also, 2" and 4" water service connections to the City's 12" water main along 48th Street will supply the vegetated treatment cells and the landscaping.

Maintenance

The maintenance and operation of the vegetated treatment system and the associated pump station and EQ Basin will require significant effort. The maintenance of the vegetated treatment system is discussed in the treatment system report (Appendix A, p. 45). It is recommended that the system be frequently monitored and sampled for a period of up to two years by experienced personnel to optimize the performance of the system and to compare the performance of the vegetated and non-vegetated cells. Thereafter the system operation and sampling functions can be taken over by properly trained City forces.

It is emphasized that the operation and maintenance costs on an annual basis could be considerable when all costs are accounted for including labor, power and water. These are difficult to assess until the specific requirements of the permit are known.



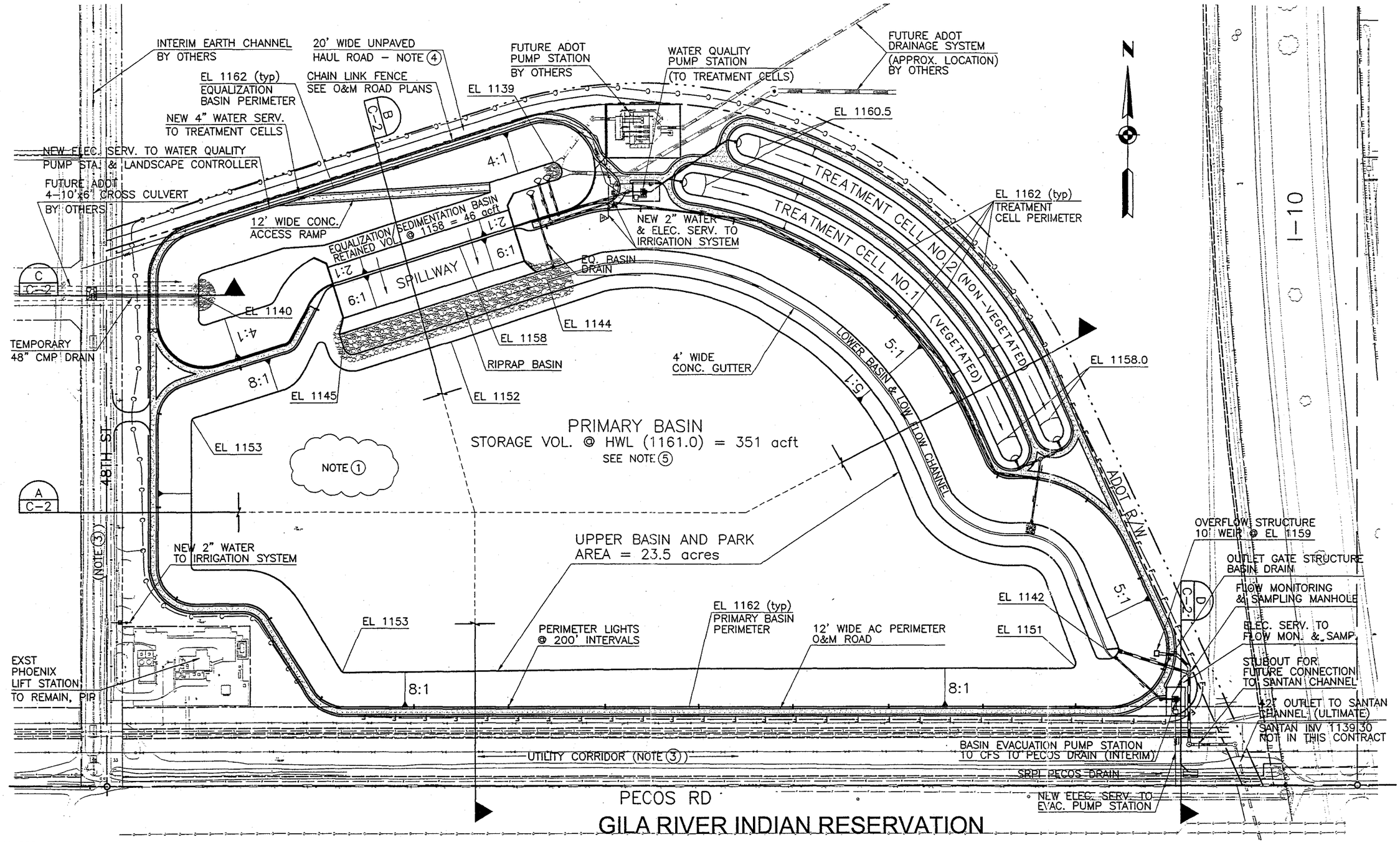
CITY OF PHOENIX, ARIZONA

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

HDR ENGINEERING, INC.
2141 E. HIGHLAND, STE 250
PHOENIX, ARIZONA 85016

CONCEPTUAL DRAINAGE CHANNEL PLAN
SOUTHEAST PHOENIX REGIONAL DRAINAGE BASIN PROJECT

FCD PCN 630-01-30
PHOENIX PROJECT NO. ST-83120008
JUNE 1999



NOTES:

1. APPROX. 65,000 CY MAY BE EXCAVATED FROM THIS GENERAL AREA PRIOR TO CONSTRUCTION. SEE GRADING PLANS.
3. SEE SHEET C-4 FOR IDENTIFIED EXISTING UTILITIES.
4. HAUL ROAD TO BE GRADED IN THIS CONTRACT. SEE GRADING PLANS. MAY SERVE AS FUTURE ADOT PUMP STATION ACCESS (BY OTHERS).
5. PRIMARY BASIN TO BE TURFED AND IRRIGATED. SEE LANDSCAPE PLANS.

Two working days before you dig, CALL FOR THE BLUE STAKES 263-1100 Blue Stake Center CALL COLLECT

CITY OF PHOENIX, ARIZONA	SOUTHEAST PHOENIX REGIONAL DRAINAGE BASIN PROJECT FCD PCN 630-01-30 PHOENIX PROJECT NO. ST-83120008		75% SUBMITTAL PRELIMINARY NOT FOR CONSTRUCTION
FLOOD CONTROL DISTRICT OF MARICOPA COUNTY	GENERAL PLAN		
HDR ENGINEERING, INC. 2141 E. HIGHLAND, STE 250 PHOENIX, ARIZONA 85016	DR MLJ DATE: 4/99 · DES MLJ DATE: 4/99 · CK JJZ DATE: 4/99 · SHEET NO. ## · TOTAL SHEETS ## · AS BUILT SCALE: 1"=100'		SHEET C-1

NO.	DESCRIPTION	REV BY	CKD BY	DATE

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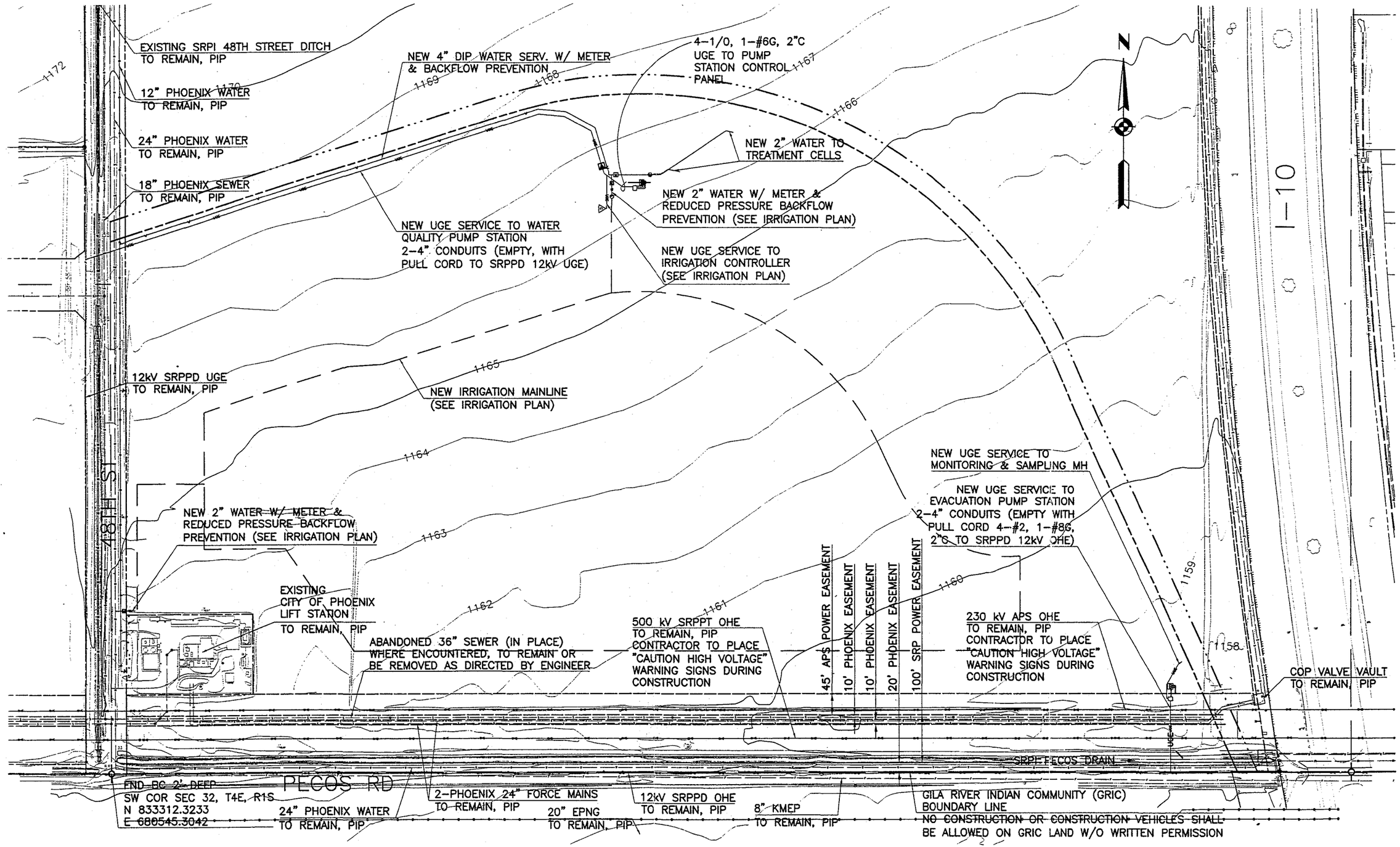

GILA RIVER INDIAN RESERVATION

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CITY OF PHOENIX, ARIZONA

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

HDR ENGINEERING, INC.
2141 E. HIGHLAND, STE 250
PHOENIX, ARIZONA 85016

SOUTHEAST PHOENIX REGIONAL DRAINAGE BASIN PROJECT
FCD PCN 630-01-30
PHOENIX PROJECT NO. ST-83120008

EXISTING CONDITIONS AND UTILITIES

DR	MLJ	DES	MLJ	CK	JJZ	SHEET NO.	TOTAL SHEETS	AS BUILT
DATE:	4/99	DATE:	4/99	DATE:	4/99	##	##	
SCALE:	1"=100'							

75% SUBMITTAL
PRELIMINARY
NOT FOR CONSTRUCTION

SHEET C-4

REVISION BY CITY OF PHOENIX					
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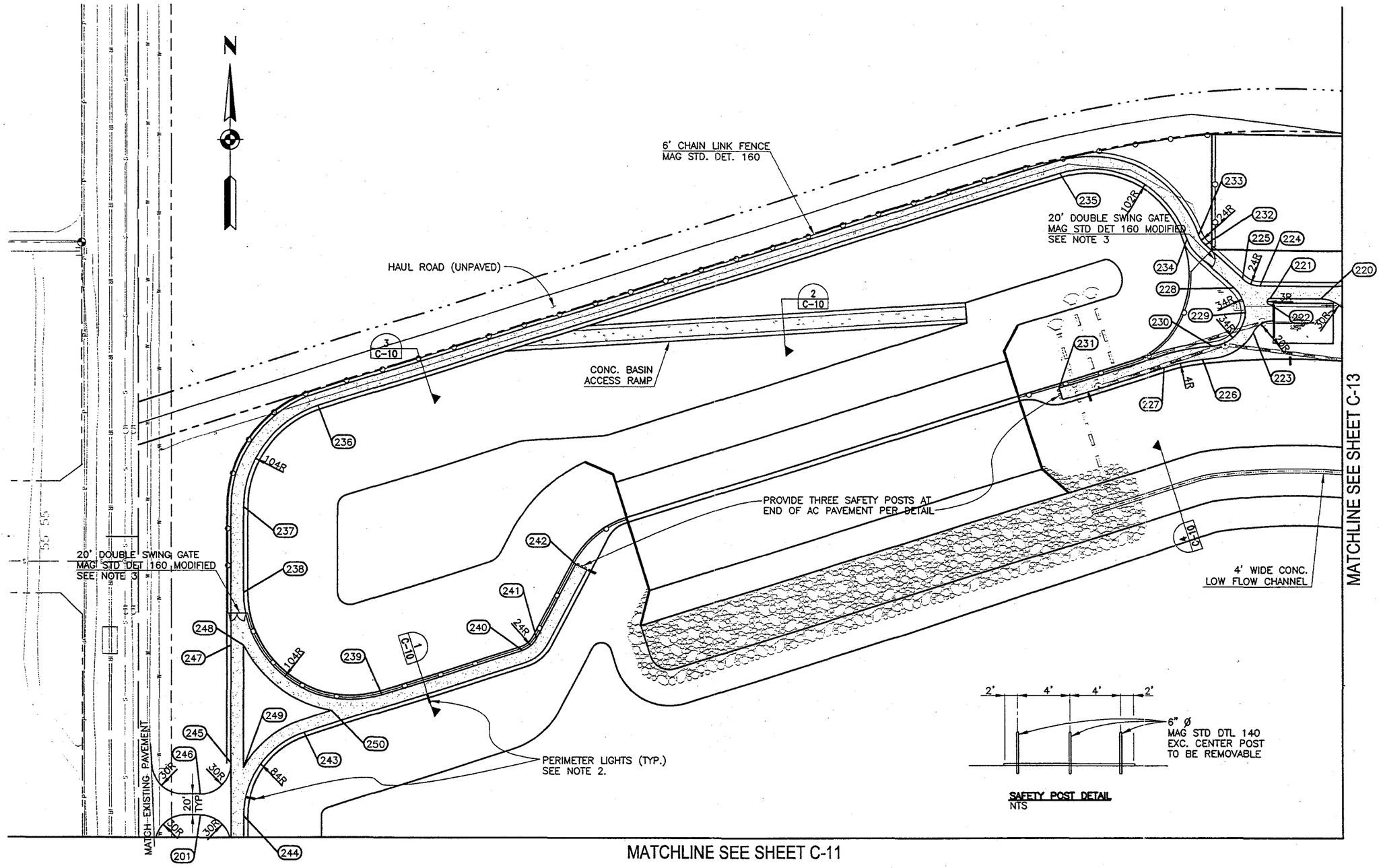

NOTES:

1. BENCHMARK IS 1/2" REBAR AT N 833344.4956, E 680503.7967, EL 1164.11
2. PERIMETER LIGHTS TO BE PLACED AT 200' INTERVALS 2' FROM EDGE OF PAVEMENT OR AS OTHERWISE DIRECTED BY THE ENGINEER.
3. SUBSTITUTE (2) 10' WIDE GATES FOR (2) 12' WIDE GATES SHOWN IN MAG STD. DET. 160.

KEY MAP

THIS SHEET	SEE SHEET C-13
SEE SHEET C-11	SEE SHEET C-12

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CITY OF PHOENIX, ARIZONA

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

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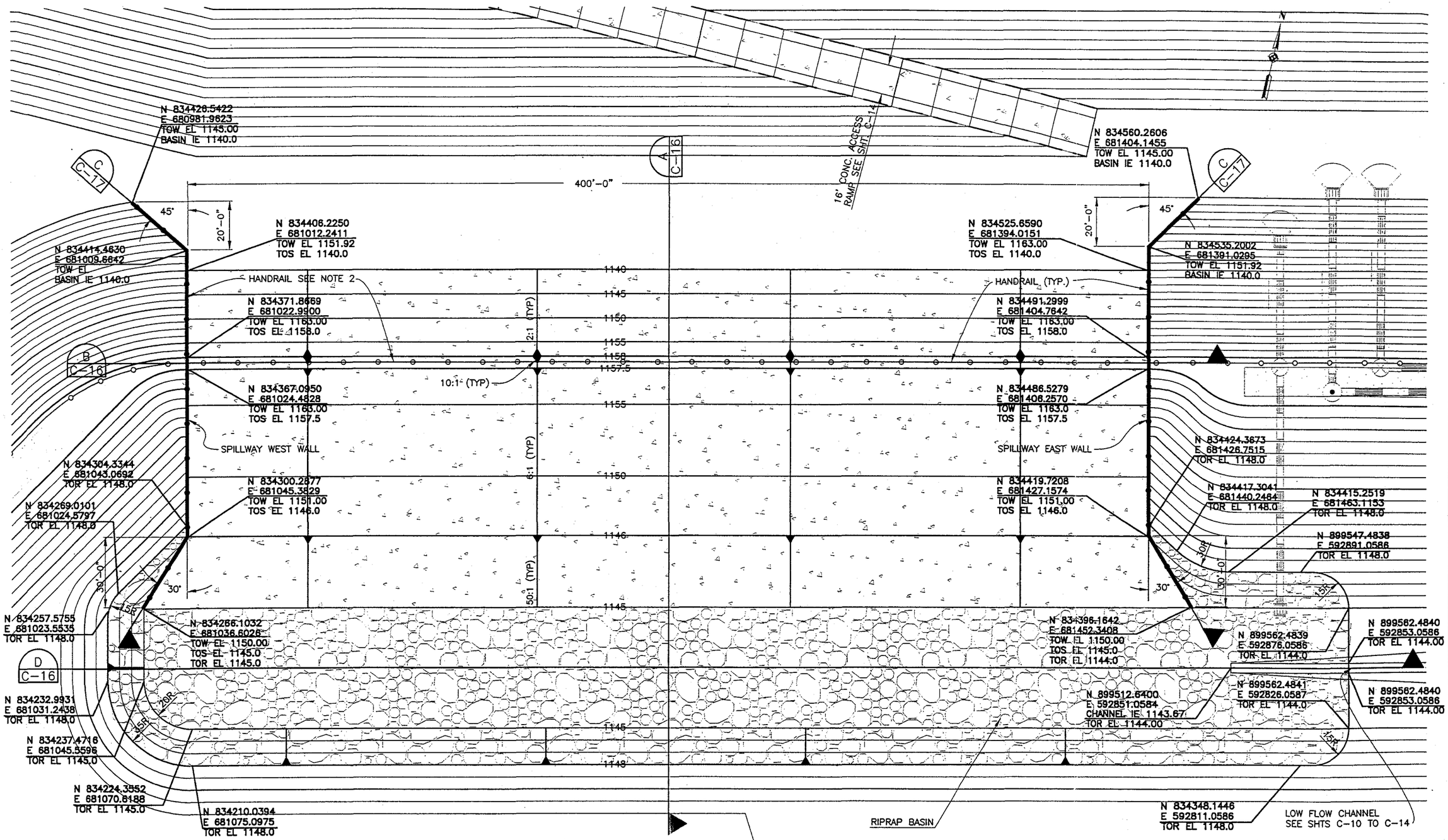
SOUTHEAST PHOENIX REGIONAL DRAINAGE BASIN PROJECT
FCD PCN 630-01-30
PHOENIX PROJECT NO. ST-83120008

O & M ROAD, FENCING AND LIGHTING PLAN

DR	JOM	DES	MLJ	CK	JJZ	SHEET NO.	TOTAL SHEETS	AS BUILT
DATE:	6/99	DATE:	6/99	DATE:	6/99	##	##	
SCALE:	1"=50'							

75% SUBMITTAL
PRELIMINARY
NOT FOR CONSTRUCTION

SHEET C-14



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REVISION BY CITY OF PHOENIX

NOTES:

1. BENCHMARK IS 1/2" REBAR AT N 833344.4956, E 680503.7967, EL 1164.14
2. HANDRAIL TO BE PROVIDED ALONG SPILLWAY CREST CENTERLINE AND EAST AND WEST SPILLWAY WALLS, SEE HANDRAIL DETAILS SHEET C-18.

ABBREVIATIONS:

TOR = TOP OF RIPRAP
TOS = TOP OF SPILLWAY SLAB
TOW = TOP OF WALL

Two working days before you dig, CALL FOR THE BLUE STAKES 263-1100 Blue Stake Center CALL COLLECT

CITY OF PHOENIX, ARIZONA

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

HDR ENGINEERING, INC.
2141 E. HIGHLAND, STE 250
PHOENIX, ARIZONA 85016

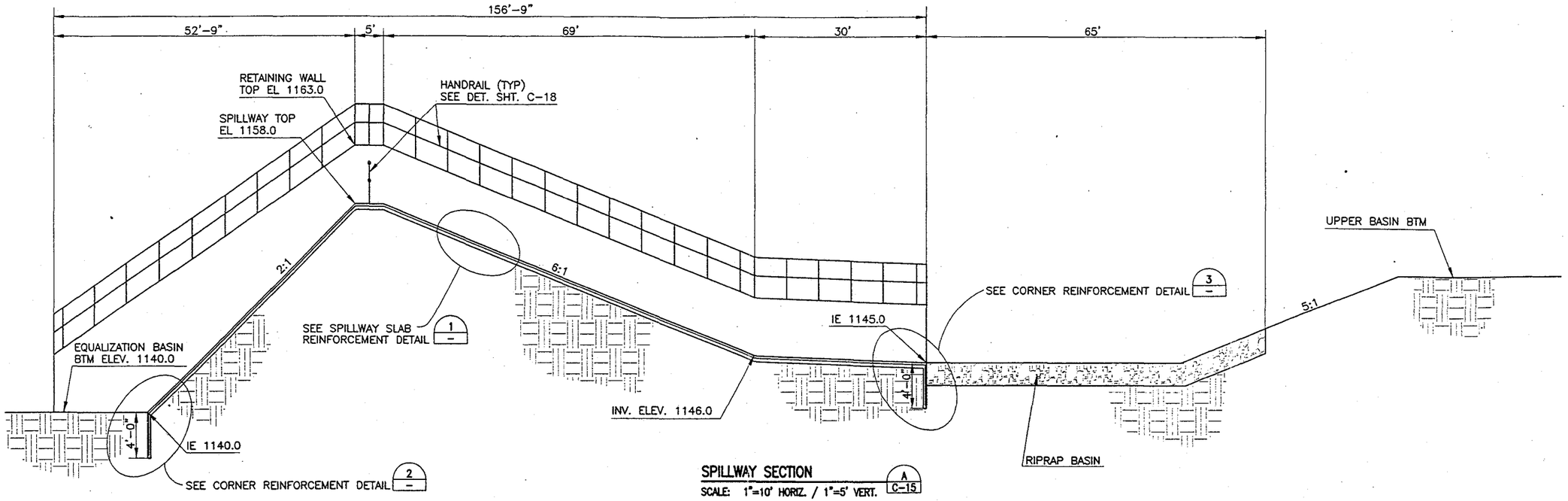
SOUTHEAST PHOENIX REGIONAL DRAINAGE BASIN PROJECT
FCD PCN 630-01-30
PHOENIX PROJECT NO. ST-83120008

SPILLWAY PLAN

DR	MLJ	DES	MLJ	CK	JJZ	SHEET NO.	TOTAL SHEETS	AS BUILT
DATE:	6/99	DATE:	6/99	DATE:	6/99	##	##	
SCALE:	1"=100'							

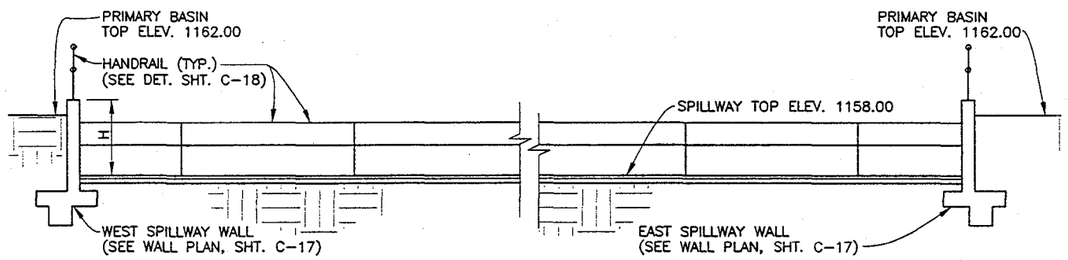
75% SUBMITTAL
PRELIMINARY
NOT FOR CONSTRUCTION

SHEET C-15



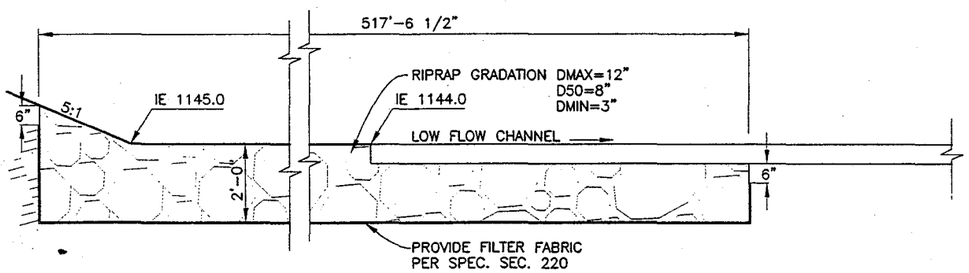
SPILLWAY SECTION (A / C-15)

SCALE: 1"=10' HORIZ. / 1"=5' VERT.



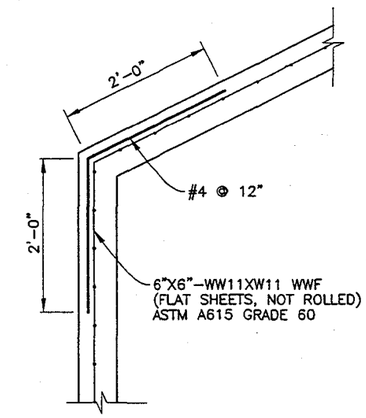
SPILLWAY SECTION (B / C-15)

SCALE: NTS



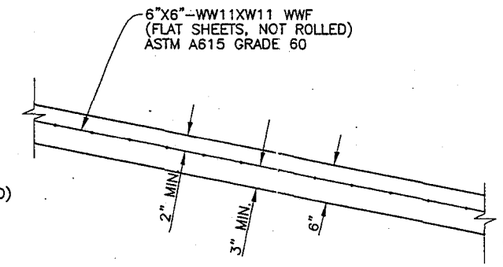
RIP RAP BASIN SECTION (D / C-15)

SCALE: NTS



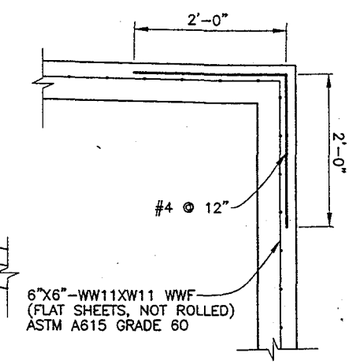
CORNER REINFORCEMENT DETAIL (2 / -)

SCALE: NTS



SPILLWAY SLAB REINFORCEMENT DETAIL (1 / -)

SCALE: NTS



CORNER REINFORCEMENT DETAIL (3 / -)

SCALE: NTS

REVISION BY CITY OF PHOENIX					
NO.	DESCRIPTION	REV BY	CKD BY	DATE	

REVISION BY CITY OF PHOENIX					
NO.	DESCRIPTION	REV BY	CKD BY	DATE	

REVISION BY CITY OF PHOENIX					
NO.	DESCRIPTION	REV BY	CKD BY	DATE	

Two working days before you dig, CALL FOR THE BLUE STAKES
263-1100
Blue Stake Center
CALL COLLECT

CITY OF PHOENIX, ARIZONA

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

HDR ENGINEERING, INC.
2141 E. HIGHLAND, STE 250
PHOENIX, ARIZONA 85016

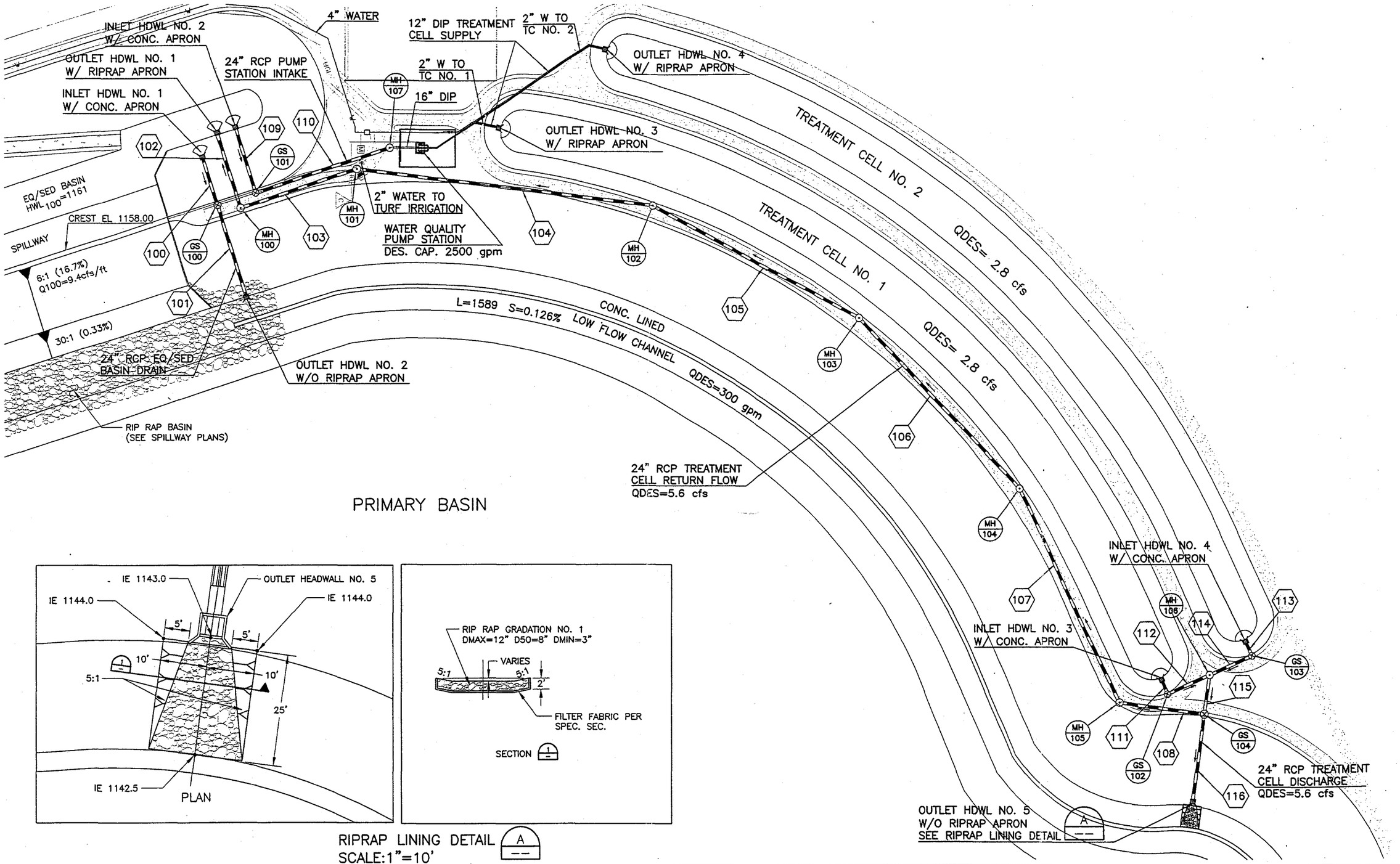
SOUTHEAST PHOENIX REGIONAL DRAINAGE BASIN PROJECT
FCD PCN 630-01-30
PHOENIX PROJECT NO. ST-83120008

SPILLWAY SECTIONS AND DETAILS

DR MLJ	DES MLJ	CK JJZ	SHEET NO.	TOTAL SHEETS	AS BUILT
DATE: 6/99	DATE: 6/99	DATE: 6/99			
SCALE: AS SHOWN			##	##	

75% SUBMITTAL
PRELIMINARY
NOT FOR CONSTRUCTION

SHEET C-16



PRIMARY BASIN

RIPRAP LINING DETAIL A
SCALE:1"=10'

NO.	DESCRIPTION	REV BY	CKD BY	DATE

REVISION BY CITY OF PHOENIX

NO.	DESCRIPTION	REV BY	CKD BY	DATE

REVISION BY CITY OF PHOENIX

NO.	DESCRIPTION	REV BY	CKD BY	DATE

REVISION BY CITY OF PHOENIX

Two working days before you dig, CALL FOR THE BLUE STAKES 263-1100 Blue Stake Center CALL COLLECT

CITY OF PHOENIX, ARIZONA

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

HDR ENGINEERING, INC.
2141 E. HIGHLAND, STE 250
PHOENIX, ARIZONA 85016

SOUTHEAST PHOENIX REGIONAL DRAINAGE BASIN PROJECT
FCD PCN 630-01-30
PHOENIX PROJECT NO. ST-83120008

BASIN PIPING PLAN

DR	MLJ	DES	MLJ	CK	JJZ	SHEET NO.	TOTAL SHEETS	AS BUILT
DATE:	6/99	DATE:	6/99	DATE:	6/99	##	##	
SCALE:	1"=50'							

75% SUBMITTAL
PRELIMINARY
NOT FOR
CONSTRUCTION

SHEET D-1

NO.	DESCRIPTION	REV BY	CKD BY	DATE

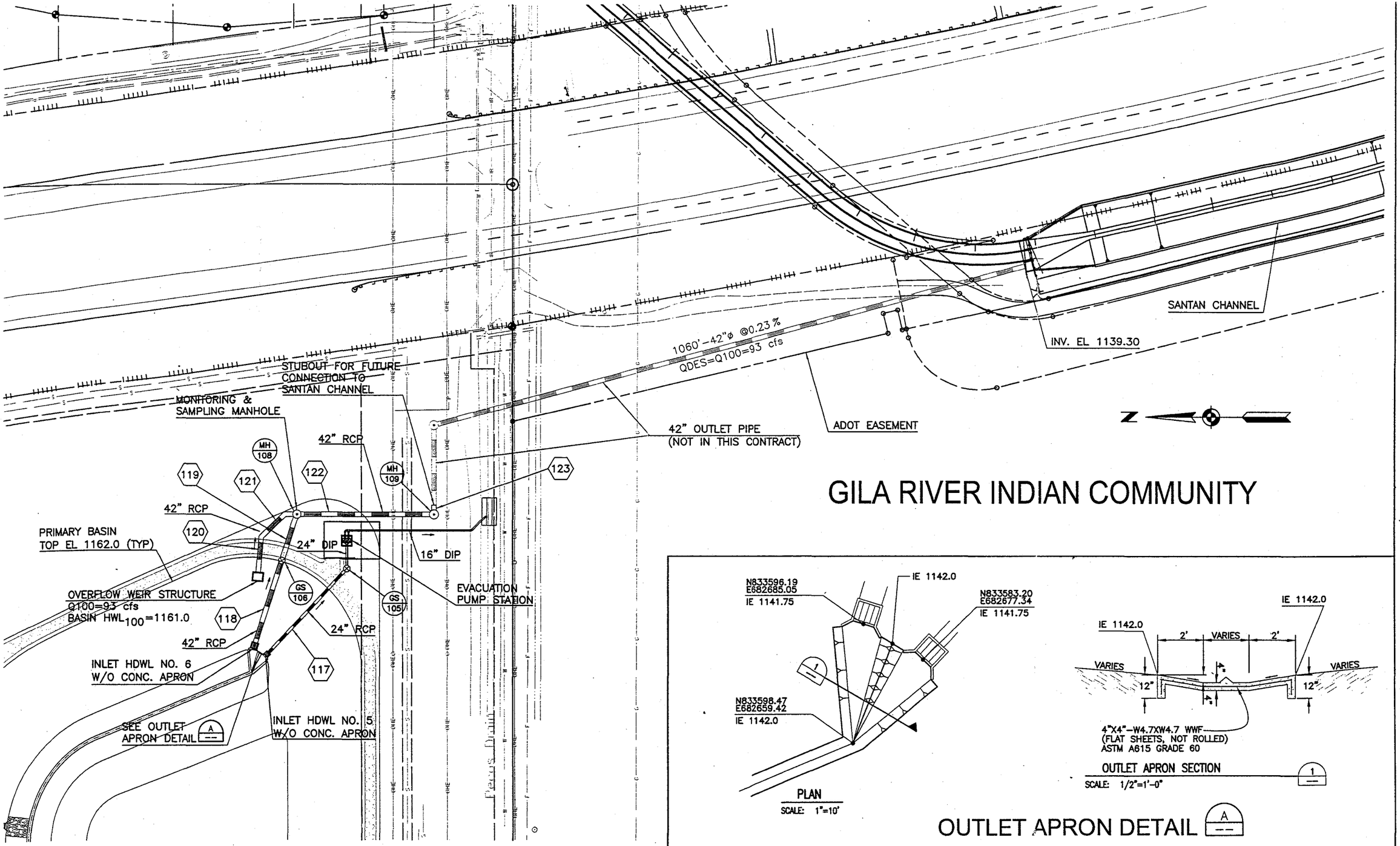
REVISION BY CITY OF PHOENIX

NO.	DESCRIPTION	REV BY	CKD BY	DATE

REVISION BY CITY OF PHOENIX

NO.	DESCRIPTION	REV BY	CKD BY	DATE

REVISION BY CITY OF PHOENIX

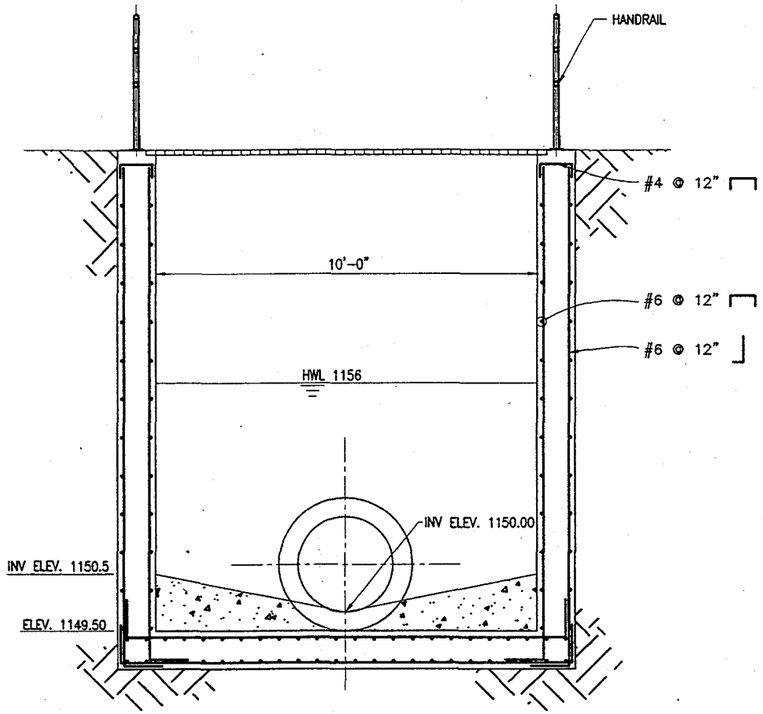


GILA RIVER INDIAN COMMUNITY

OUTLET APRON DETAIL A

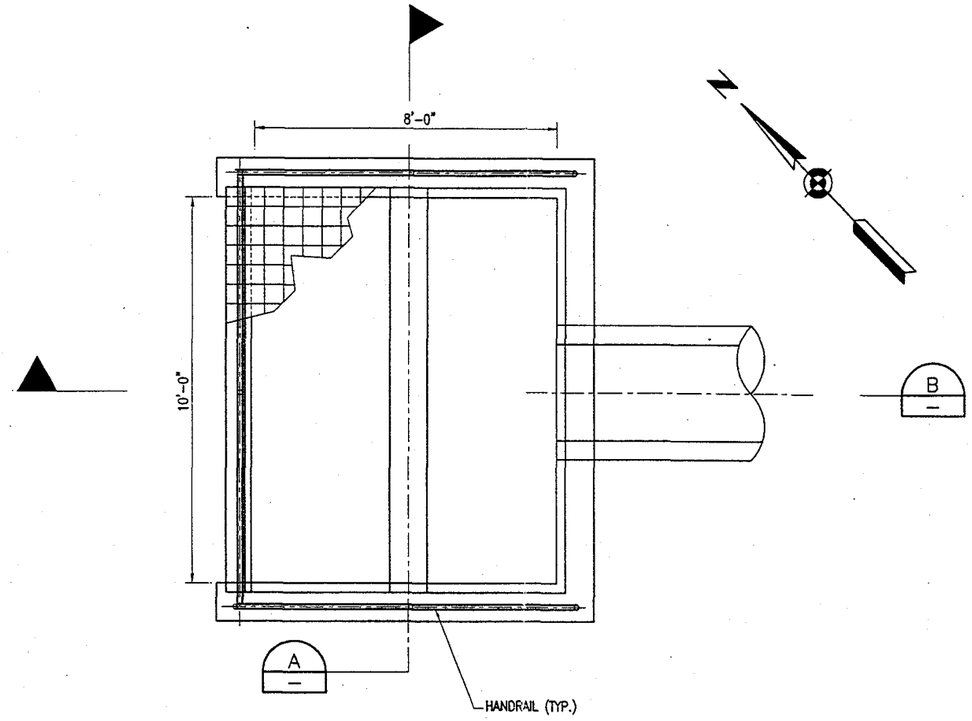
Two working days before you dig, CALL FOR THE BLUE STAKES 263-1100 Blue Stake Center CALL COLLECT

CITY OF PHOENIX, ARIZONA	SOUTHEAST PHOENIX REGIONAL DRAINAGE BASIN PROJECT FCD PCN 630-01-30 PHOENIX PROJECT NO. ST-83120008		75% SUBMITTAL PRELIMINARY NOT FOR CONSTRUCTION
FLOOD CONTROL DISTRICT OF MARICOPA COUNTY	OUTLET PIPING PLAN		
HDR ENGINEERING, INC. 2141 E. HIGHLAND, STE 250 PHOENIX, ARIZONA 85016	DR MLJ DATE: 6/99 · DES MLJ DATE: 6/99 · CK JJZ DATE: 6/99 · SHEET NO. ## · TOTAL SHEETS ## · AS BUILT SCALE: 1"=10'		SHEET D-2



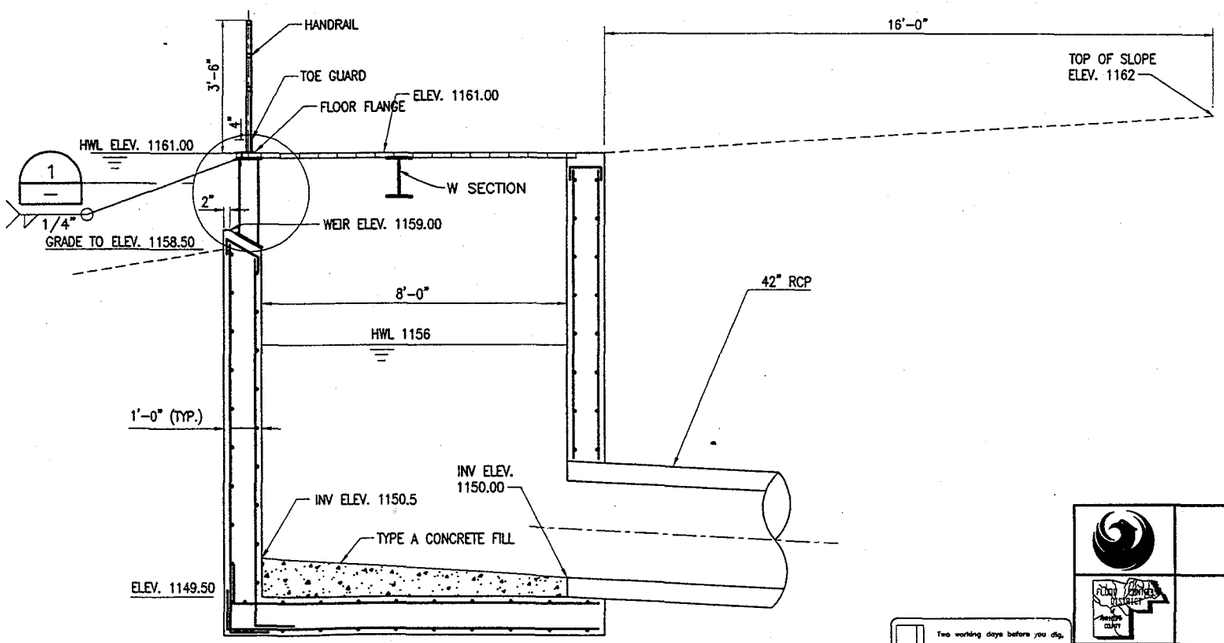
SECTION A

SCALE: 1/2" = 1'-0"



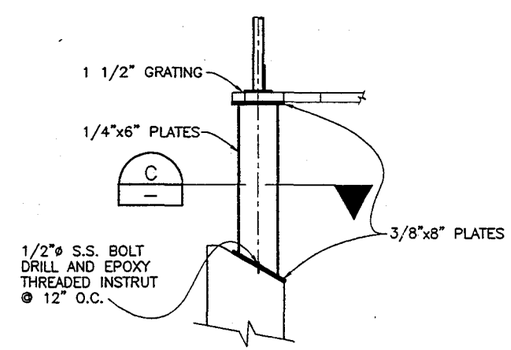
PLAN

SCALE: 1/2"=1'-0"



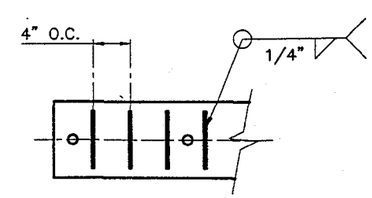
SECTION B

SCALE: 1/2" = 1'-0"



DETAIL 1

SCALE: 1" = 1'-0"



SECTION C

SCALE: 1" = 1'-0"

REVISION BY CITY OF PHOENIX				
NO.	DESCRIPTION	REV BY	CKD BY	DATE

REVISION BY CITY OF PHOENIX				
NO.	DESCRIPTION	REV BY	CKD BY	DATE

REVISION BY CITY OF PHOENIX				
NO.	DESCRIPTION	REV BY	CKD BY	DATE

Two working days before you dig, CALL FOR THE BLUE STAKES 263-1100 Blue Stake Center CALL COLLECT

CITY OF PHOENIX, ARIZONA

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

HDR ENGINEERING, INC.
2141 E. HIGHLAND, STE 250
PHOENIX, ARIZONA 85016

SOUTHEAST PHOENIX REGIONAL DRAINAGE BASIN PROJECT
FCD PCN 630-01-30
PHOENIX PROJECT NO. ST-83120008

OVERFLOW WEIR STRUCTURE

DR	HJ	DES	DJS	CK	JJZ	SHEET NO.	TOTAL SHEETS	AS BUILT
DATE:	6/99	DATE:	6/99	DATE:	6/99	##	##	
SCALE:	1/2"=1'-0"							

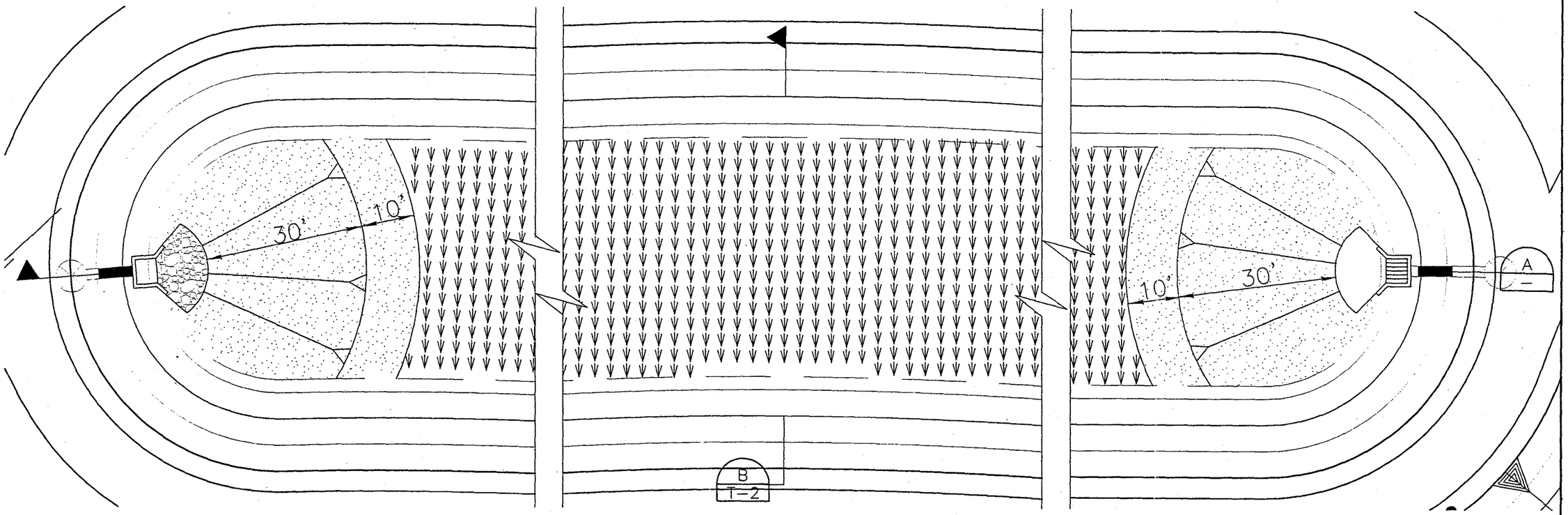
75% SUBMITTAL
PRELIMINARY
NOT FOR
CONSTRUCTION

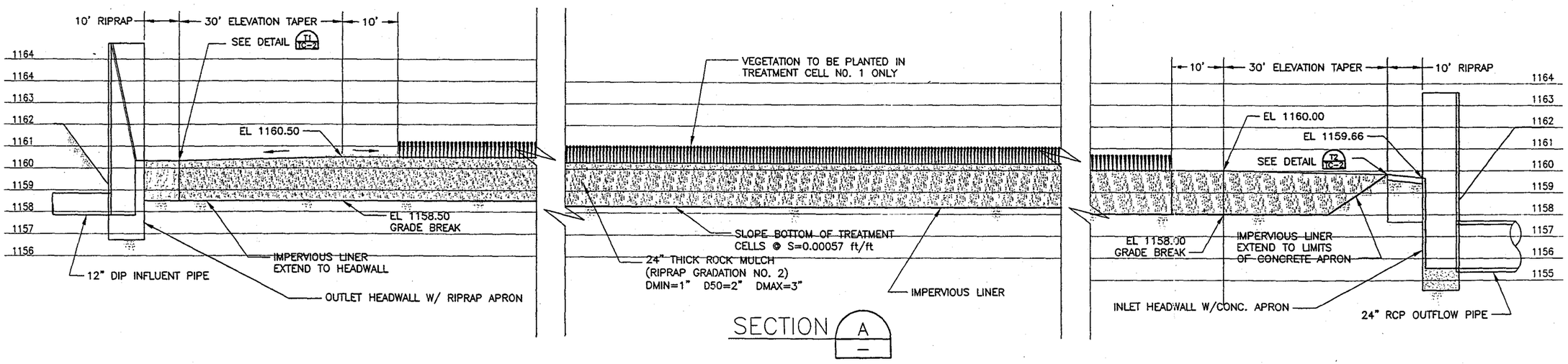
SHEET D-4

REVISION BY CITY OF PHOENIX				
NO.	DESCRIPTION	REV BY	CKD BY	DATE

REVISION BY CITY OF PHOENIX				
NO.	DESCRIPTION	REV BY	CKD BY	DATE

REVISION BY CITY OF PHOENIX				
NO.	DESCRIPTION	REV BY	CKD BY	DATE





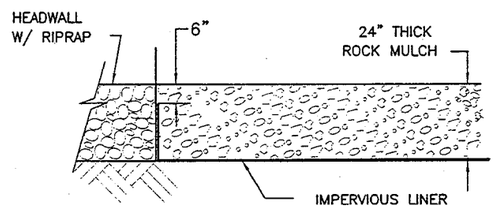
Two working days before you dig, CALL FOR THE BLUE STAKES
263-1100
Blue Stake Center
CALL COLLECT

CITY OF PHOENIX, ARIZONA	SOUTHEAST PHOENIX REGIONAL DRAINAGE BASIN PROJECT FCD PCN 630-01-30 PHOENIX PROJECT NO. ST-83120008						75% SUBMITTAL PRELIMINARY NOT FOR CONSTRUCTION
FLOOD CONTROL DISTRICT OF MARICOPA COUNTY	TREATMENT CELL PLAN AND SECTION						
HDR ENGINEERING, INC. 2141 E. HIGHLAND, STE 250 PHOENIX, ARIZONA 85016	DR MLJ DATE: 6/99	DES MLJ DATE: 6/99	CK JJZ DATE: 6/99	SHEET NO.	TOTAL SHEETS	AS BUILT	SHEET TC-1
	SCALE: NTS			##	##		

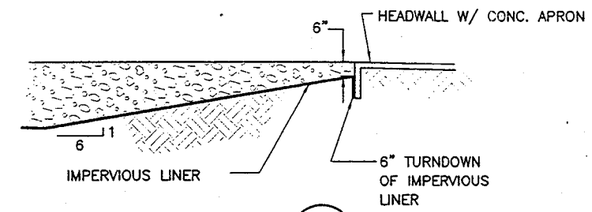
REVISION BY CITY OF PHOENIX				
NO.	DESCRIPTION	REV BY	CKD BY	DATE

REVISION BY CITY OF PHOENIX				
NO.	DESCRIPTION	REV BY	CKD BY	DATE

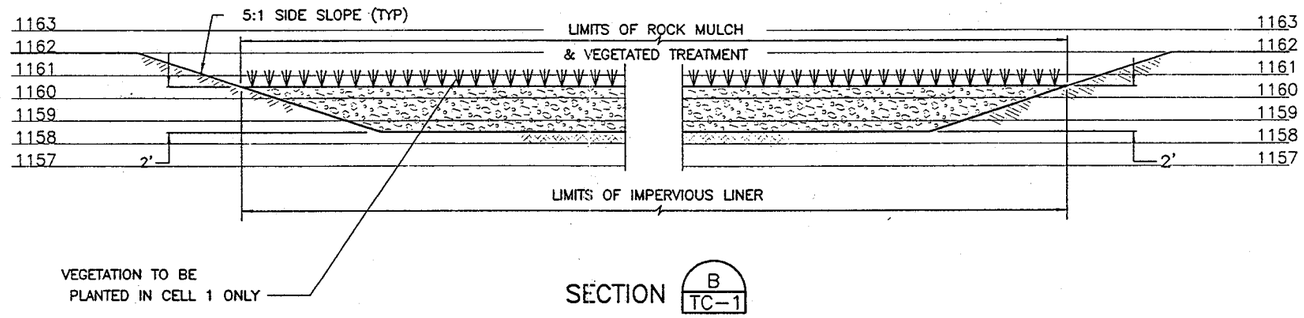
REVISION BY CITY OF PHOENIX				
NO.	DESCRIPTION	REV BY	CKD BY	DATE



DETAIL T1 / TC-1



DETAIL T2 / TC-1



SECTION B / TC-1

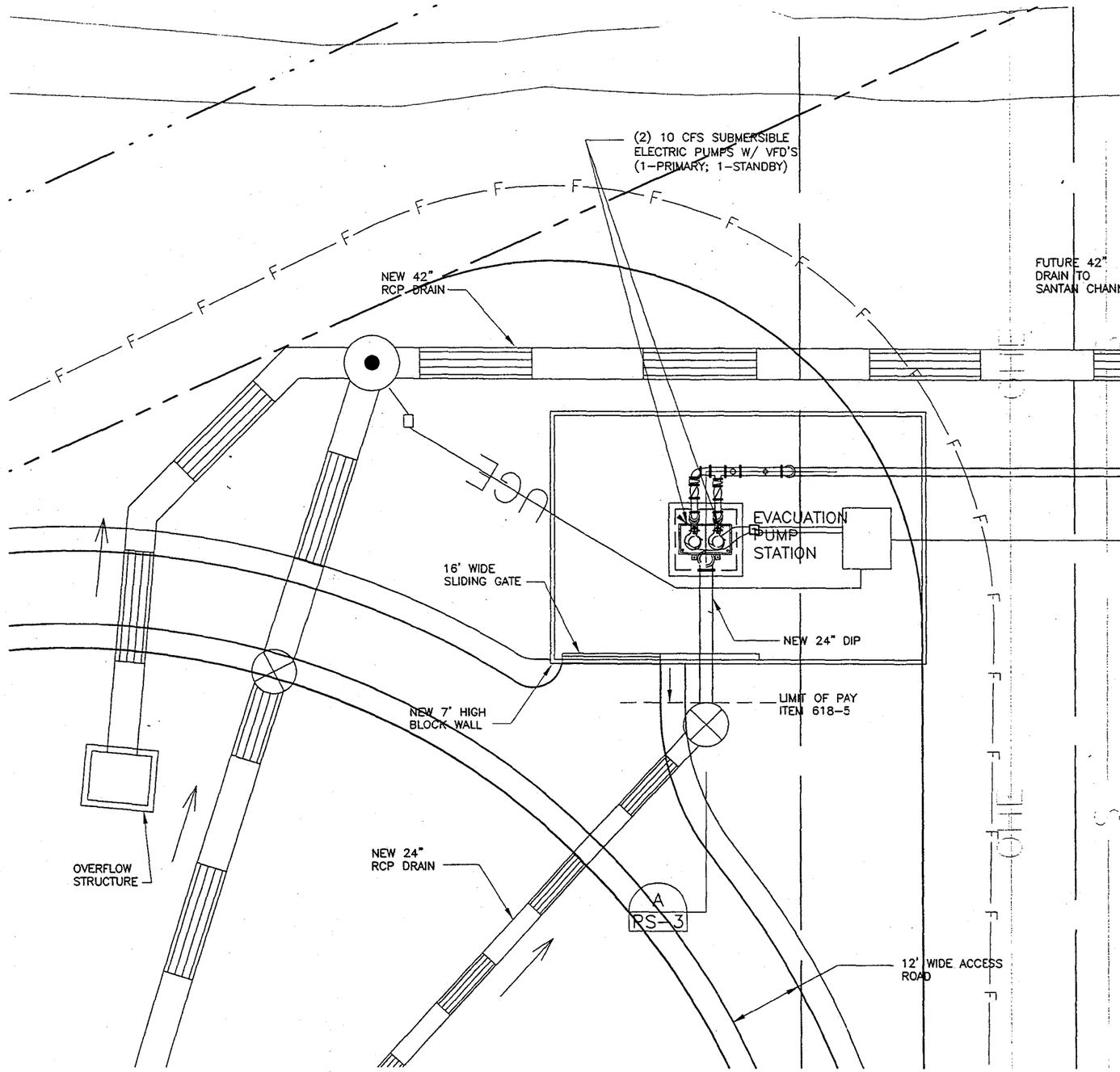
Two working days before you dig, CALL FOR THE BLUE STAKES
263-1100
Blue Stake Center
CALL COLLECT

CITY OF PHOENIX, ARIZONA	SOUTHEAST PHOENIX REGIONAL DRAINAGE BASIN PROJECT FCD PCN 630-01-30 PHOENIX PROJECT NO. ST-83120008							75% SUBMITTAL PRELIMINARY NOT FOR CONSTRUCTION
FLOOD CONTROL DISTRICT OF MARICOPA COUNTY	TREATMENT CELL DETAILS							
HDR ENGINEERING, INC. 2141 E. HIGHLAND, STE 250 PHOENIX, ARIZONA 85016	DR MLJ DATE: 4/99	DES MLJ DATE: 4/99	CK JJZ DATE: 4/99	SHEET NO.	TOTAL SHEETS	AS BUILT		SHEET TC-2
	SCALE: NTS			##	##			

REVISION BY CITY OF PHOENIX				
NO.	DESCRIPTION	REV BY	CKD BY	DATE

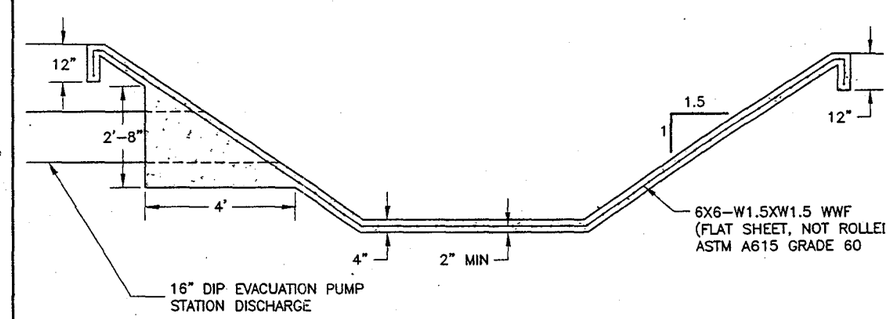
REVISION BY CITY OF PHOENIX				
NO.	DESCRIPTION	REV BY	CKD BY	DATE

REVISION BY CITY OF PHOENIX				
NO.	DESCRIPTION	REV BY	CKD BY	DATE



PLAN

SCALE: 1"=10'

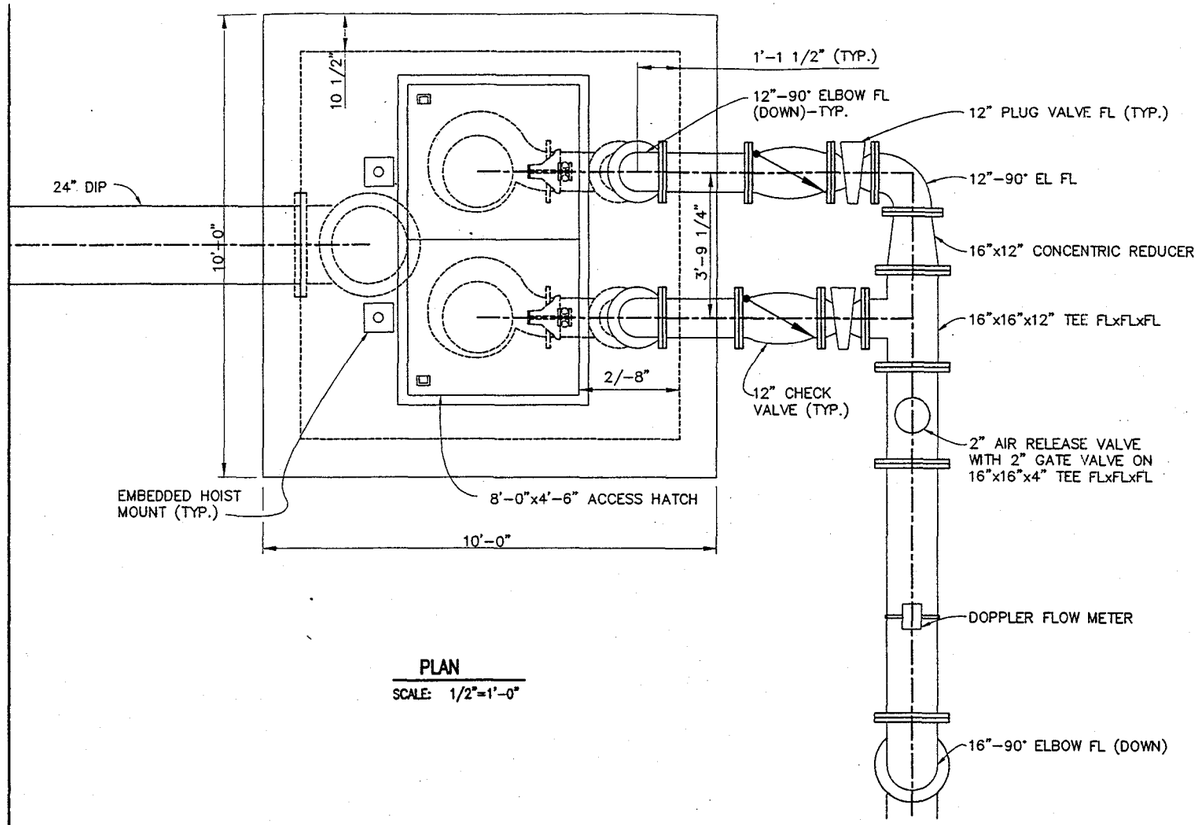


PECOS DRAIN LINING DETAIL 1

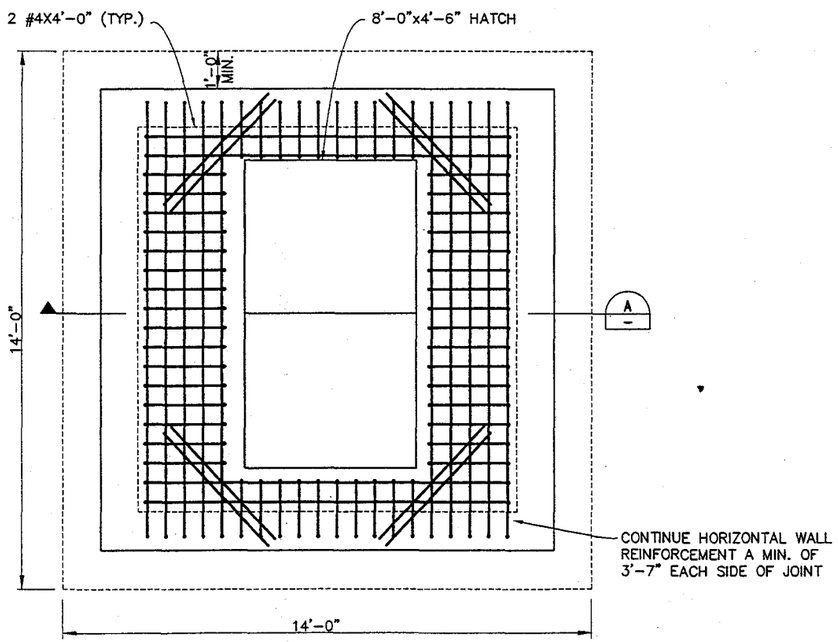
SCALE: 1"=2'

Two working days before you dig, CALL FOR THE BLUE STAKES 263-1100 Blue Stake Center CALL COLLECT

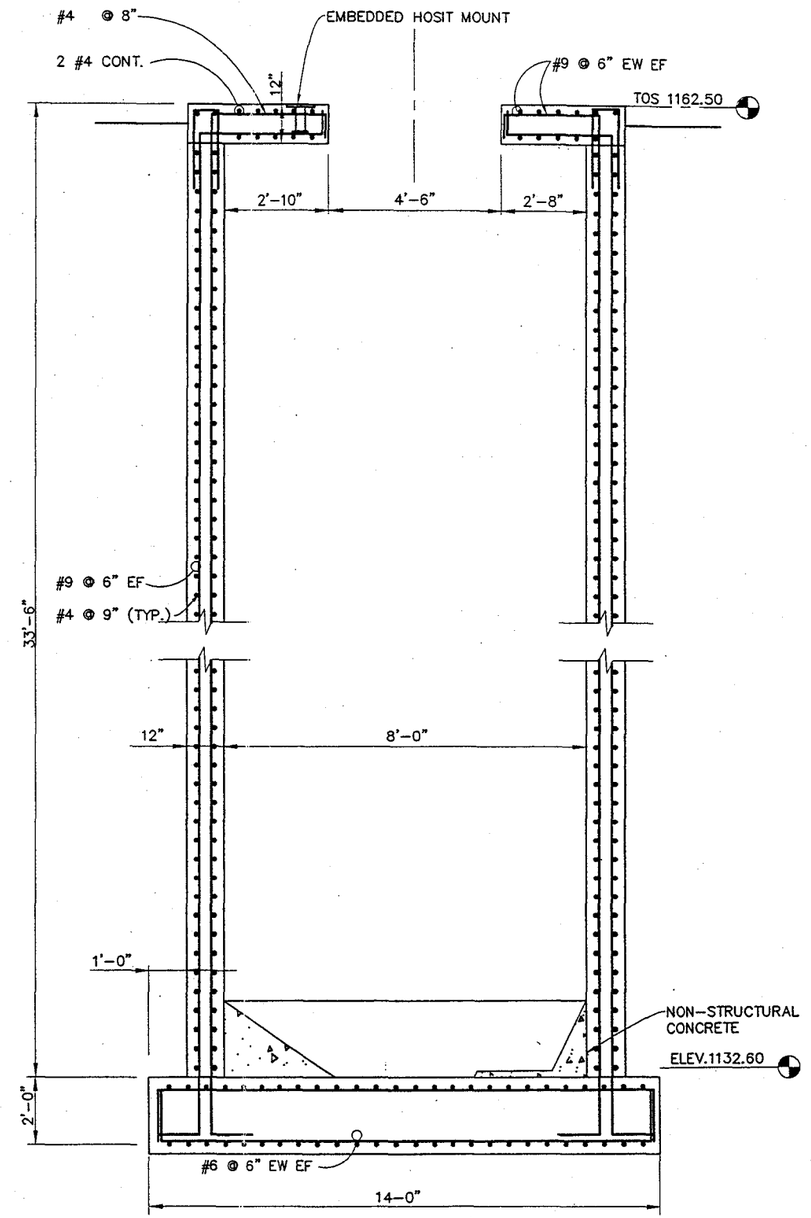
CITY OF PHOENIX, ARIZONA	SOUTHEAST PHOENIX REGIONAL DRAINAGE BASIN PROJECT FCD PCN 630-01-30 PHOENIX PROJECT NO. ST-83120008							75% SUBMITTAL PRELIMINARY NOT FOR CONSTRUCTION
FLOOD CONTROL DISTRICT OF MARICOPA COUNTY	EVACUATION PUMP STATION PLAN							
HDR ENGINEERING, INC. 2141 E. HIGHLAND, STE 250 PHOENIX, ARIZONA 85016	DR MLJ DATE: 4/99	DES MLJ DATE: 4/99	CK JJZ DATE: 4/99	SHEET NO. ##	TOTAL SHEETS ##	AS BUILT		SHEET PS-1
	SCALE:							



PLAN
SCALE: 1/2"=1'-0"



PLAN
SCALE: 1/2"=1'-0"



NOTE:

1. PIPE PENETRATIONS NOT SHOWN.

SECTION A
SCALE: 1/2"=1'-0"

REVISION BY CITY OF PHOENIX

NO.	DESCRIPTION	REV BY	CKD BY	DATE

REVISION BY CITY OF PHOENIX

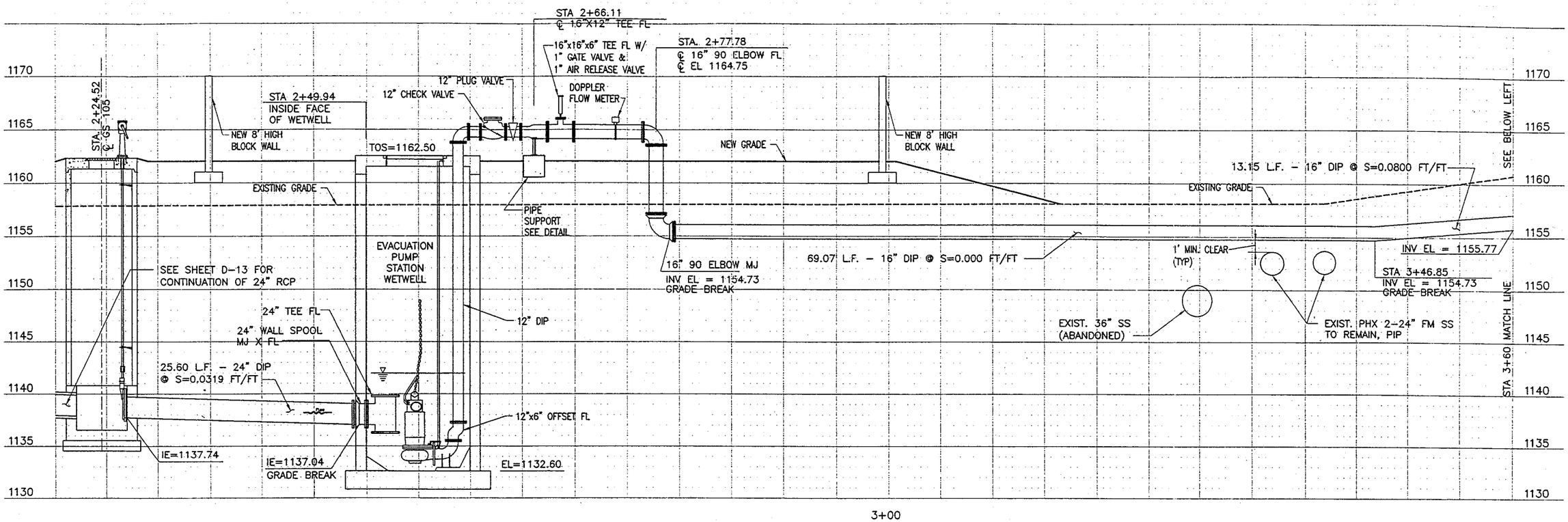
NO.	DESCRIPTION	REV BY	CKD BY	DATE

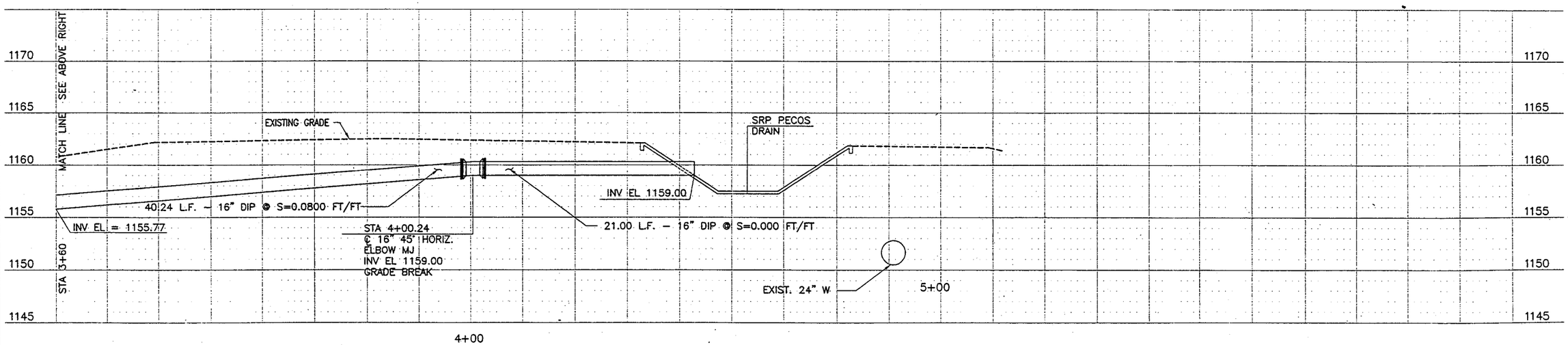
REVISION BY CITY OF PHOENIX

NO.	DESCRIPTION	REV BY	CKD BY	DATE

Two working days before you dig, CALL FOR THE BLUE STAKES 263-1100 Blue Stake Center CALL COLLECT

CITY OF PHOENIX, ARIZONA	SOUTHEAST PHOENIX REGIONAL DRAINAGE BASIN PROJECT FCD PCN 630-01-30 PHOENIX PROJECT NO. ST-83120008							75% SUBMITTAL PRELIMINARY NOT FOR CONSTRUCTION
FLOOD CONTROL DISTRICT OF MARICOPA COUNTY	EVACUATION PUMP STATION SECTIONS AND DETAILS							
HDR ENGINEERING, INC. 2141 E. HIGHLAND, STE 250 PHOENIX, ARIZONA 85016	DR JOM DATE: 6/99	DES DJS DATE: 6/99	CK JJZ DATE: 6/99	SHEET NO. ##	TOTAL SHEETS ##	AS BUILT		SHEET PS-2
	SCALE: NTS							





REVISION BY CITY OF PHOENIX

NO.	DESCRIPTION	REV BY	CKD BY	DATE

REVISION BY CITY OF PHOENIX

NO.	DESCRIPTION	REV BY	CKD BY	DATE

REVISION BY CITY OF PHOENIX

NO.	DESCRIPTION	REV BY	CKD BY	DATE

Two working days before you dig, CALL FOR THE BLUE STAKES 263-1100 Blue Stake Center CALL COLLECT

CITY OF PHOENIX, ARIZONA

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

HDR ENGINEERING, INC.
2141 E. HIGHLAND, STE 250
PHOENIX, ARIZONA 85016

SOUTHEAST PHOENIX REGIONAL DRAINAGE BASIN PROJECT
FCD PCN 630-01-30
PHOENIX PROJECT NO. ST-83120008

EVCUATION PUMP STATION PIPING PROFILE

DR JRR	DES DJS	CK JJZ	SHEET NO.	TOTAL SHEETS	AS BUILT
DATE:	DATE: 6/99	DATE: 6/99			
SCALE: 1"=5' HORIZ. & VERT.			##	##	

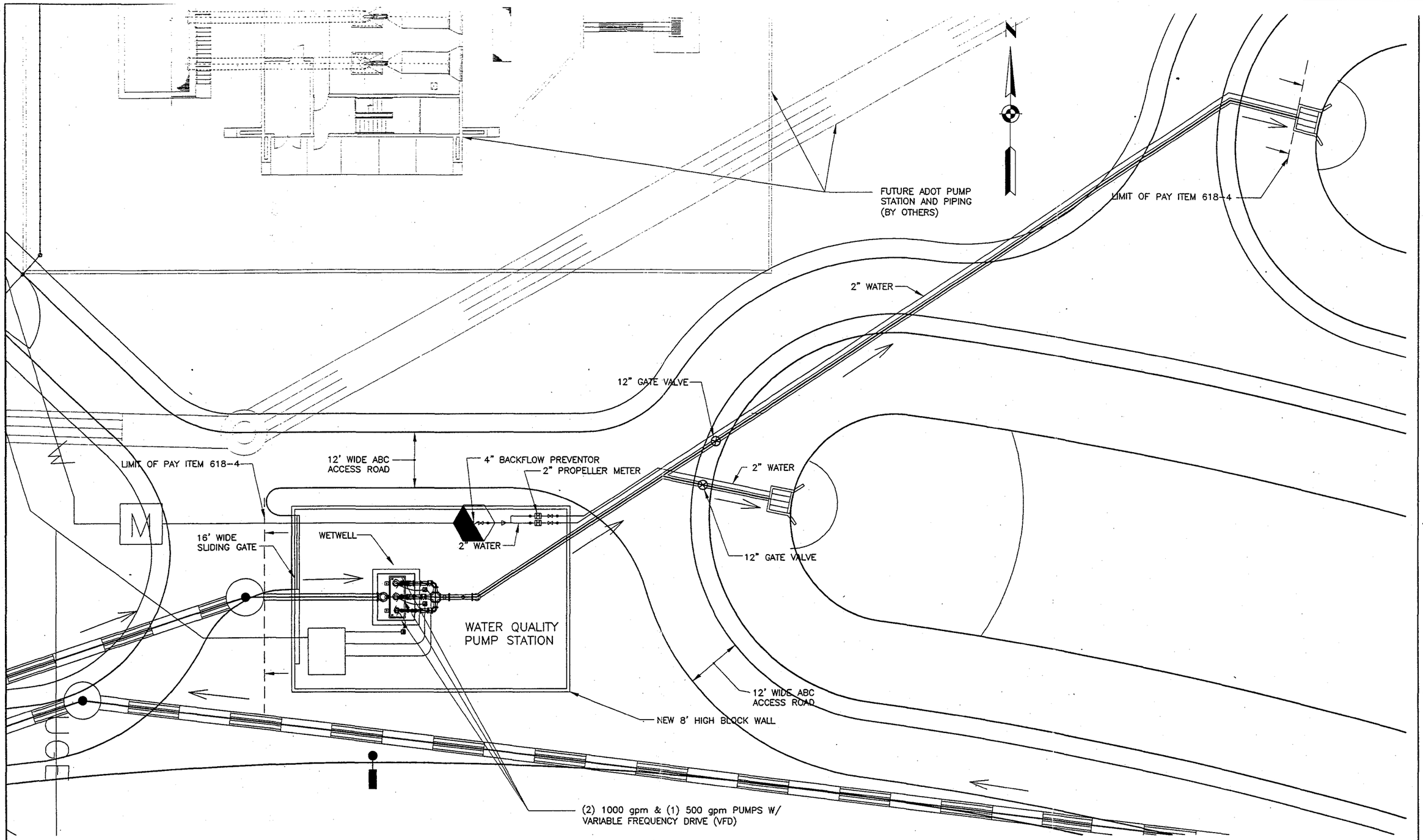
75% SUBMITTAL
PRELIMINARY
NOT FOR
CONSTRUCTION

SHEET PS-3

REVISION BY CITY OF PHOENIX				
NO.	DESCRIPTION	REV BY	CKD BY	DATE

REVISION BY CITY OF PHOENIX				
NO.	DESCRIPTION	REV BY	CKD BY	DATE

REVISION BY CITY OF PHOENIX				
NO.	DESCRIPTION	REV BY	CKD BY	DATE

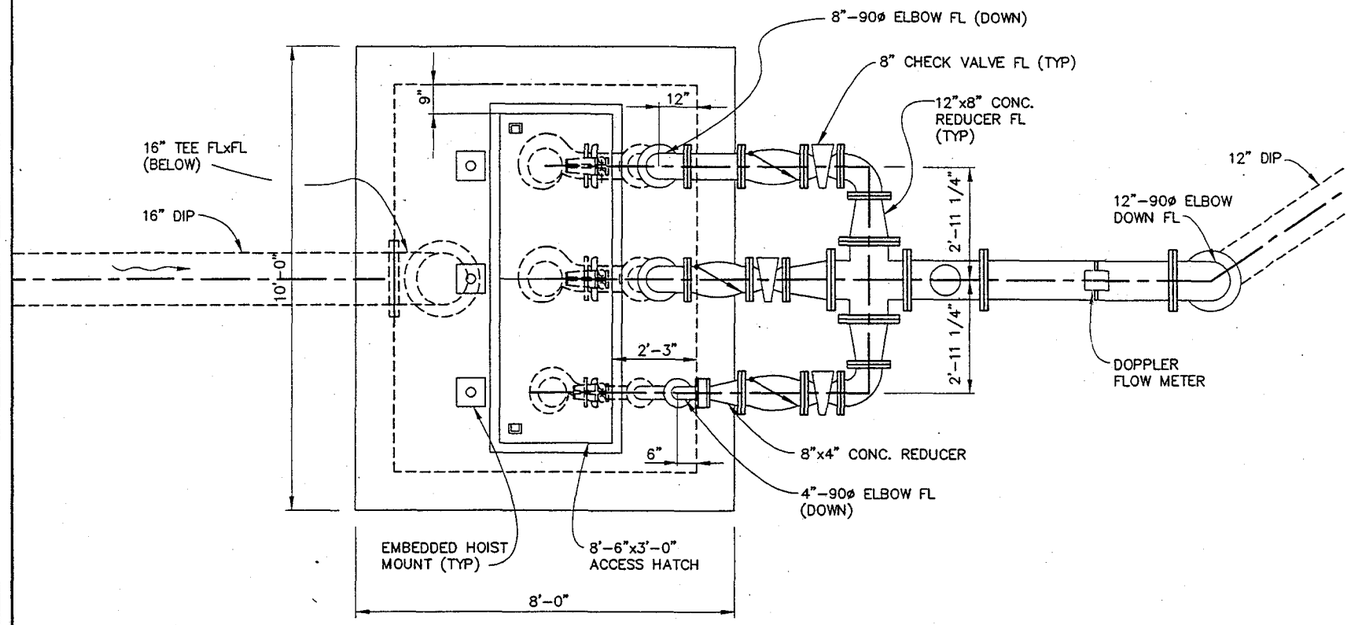


PLAN

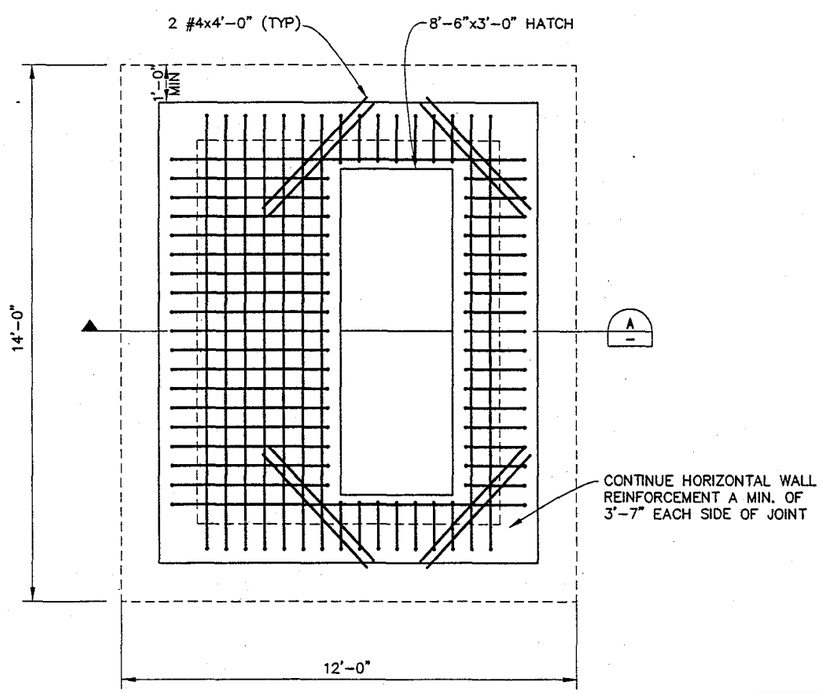
SCALE: 1"=10'

Two working days before you dig, CALL FOR THE BLUE STAKES 263-1100 Blue Stake Center CALL COLLECT

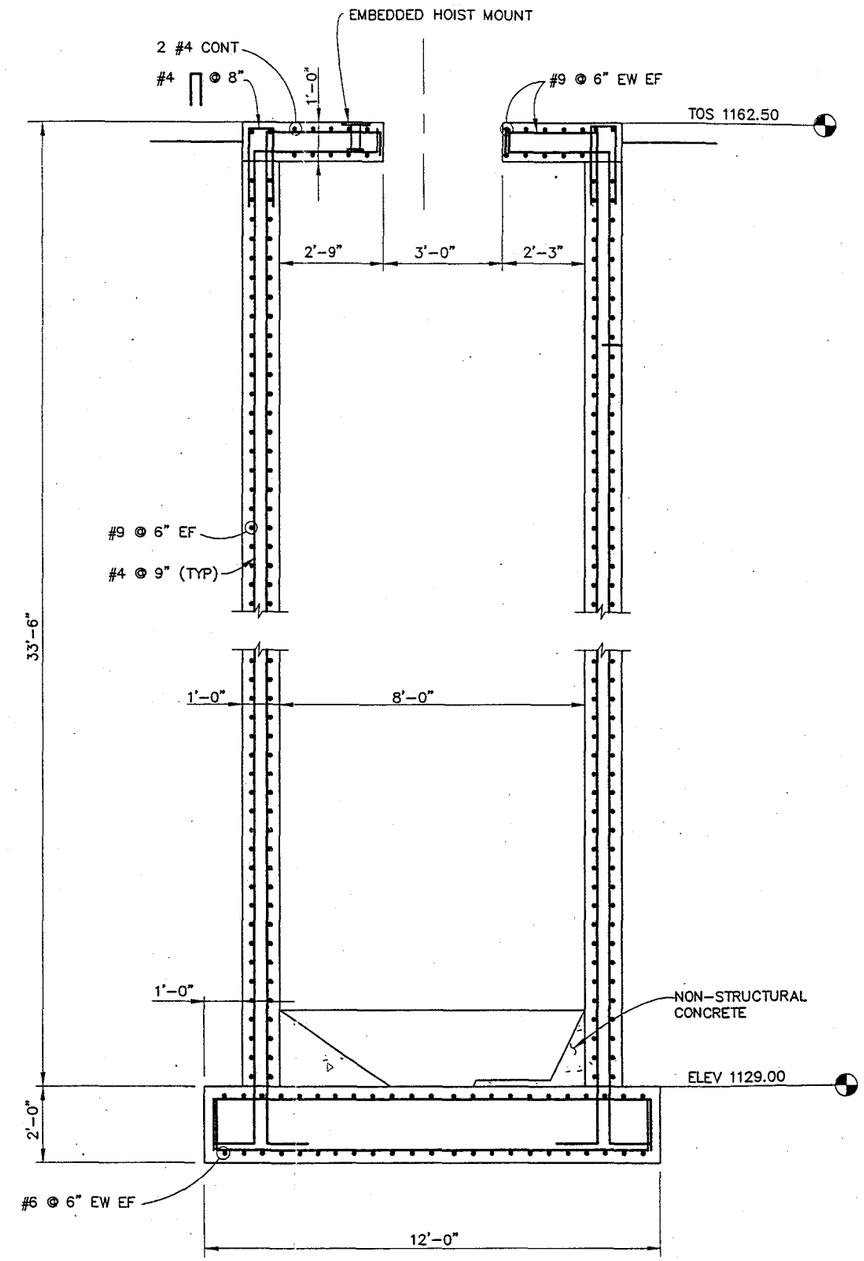
CITY OF PHOENIX, ARIZONA	SOUTHEAST PHOENIX REGIONAL DRAINAGE BASIN PROJECT FCD PCN 630-01-30 PHOENIX PROJECT NO. ST-83120008						75% SUBMITTAL PRELIMINARY NOT FOR CONSTRUCTION
FLOOD CONTROL DISTRICT OF MARICOPA COUNTY	WATER QUALITY PUMP STATION PLAN						
HDR ENGINEERING, INC. 2141 E. HIGHLAND, STE 250 PHOENIX, ARIZONA 85016	DR MLJ DATE: 6/99	DES MLJ DATE: 6/99	CK JJZ DATE: 6/99	SHEET NO.	TOTAL SHEETS	AS BUILT	SHEET PS-4
	SCALE: AS SHOWN			##	##		



PLAN
SCALE: 1/2"=1'-0"



PLAN
SCALE: 1/2"=1'-0"



SECTION A
SCALE: 1/2"=1'-0"

NOTE:
1. PIPE PENETRATION NOT SHOWN.

REVISION BY CITY OF PHOENIX

NO.	DESCRIPTION	REV BY	CKD BY	DATE

REVISION BY CITY OF PHOENIX

NO.	DESCRIPTION	REV BY	CKD BY	DATE

REVISION BY CITY OF PHOENIX

NO.	DESCRIPTION	REV BY	CKD BY	DATE

Two working days before you dig, CALL FOR THE BLUE STAKES
263-1100
Blue Stake Center
CALL COLLECT

CITY OF PHOENIX, ARIZONA

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

HDR ENGINEERING, INC.
2141 E. HIGHLAND, STE 250
PHOENIX, ARIZONA 85016

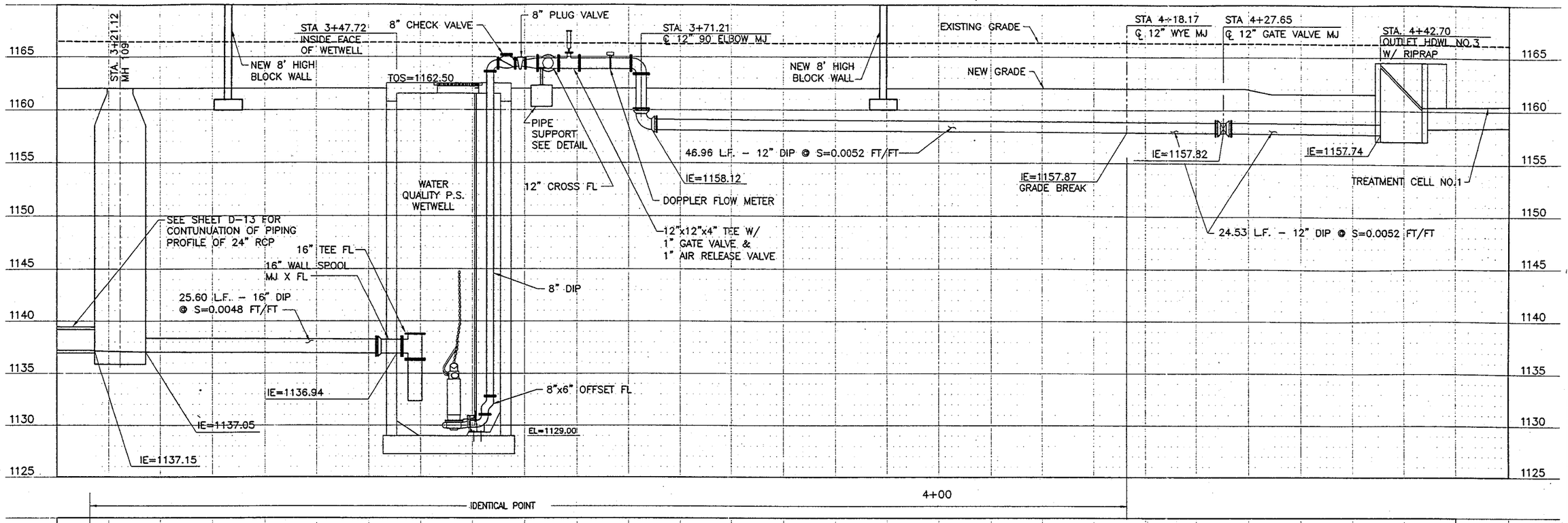
SOUTHEAST PHOENIX REGIONAL DRAINAGE BASIN PROJECT
FCD PCN 630-01-30
PHOENIX PROJECT NO. ST-83120008

WATER QUALITY PUMP STATION SECTIONS AND DETAILS

DR	JOM	DES	DJS	CK	JJZ	SHEET NO.	TOTAL SHEETS	AS BUILT
DATE:	6/99	DATE:	6/99	DATE:	6/99	##	##	
SCALE:	NTS							

75% SUBMITTAL
PRELIMINARY
NOT FOR CONSTRUCTION

SHEET PS-5



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PHOENIX, ARIZONA 85016

SOUTHEAST PHOENIX REGIONAL DRAINAGE BASIN PROJECT
FCD PCN 630-01-30
PHOENIX PROJECT NO. ST-83120008

WATER QUALITY PUMP STATION PIPING PROFILES

DR	MLJ	DES	MLJ	CK	JJZ	SHEET NO.	TOTAL SHEETS	AS BUILT
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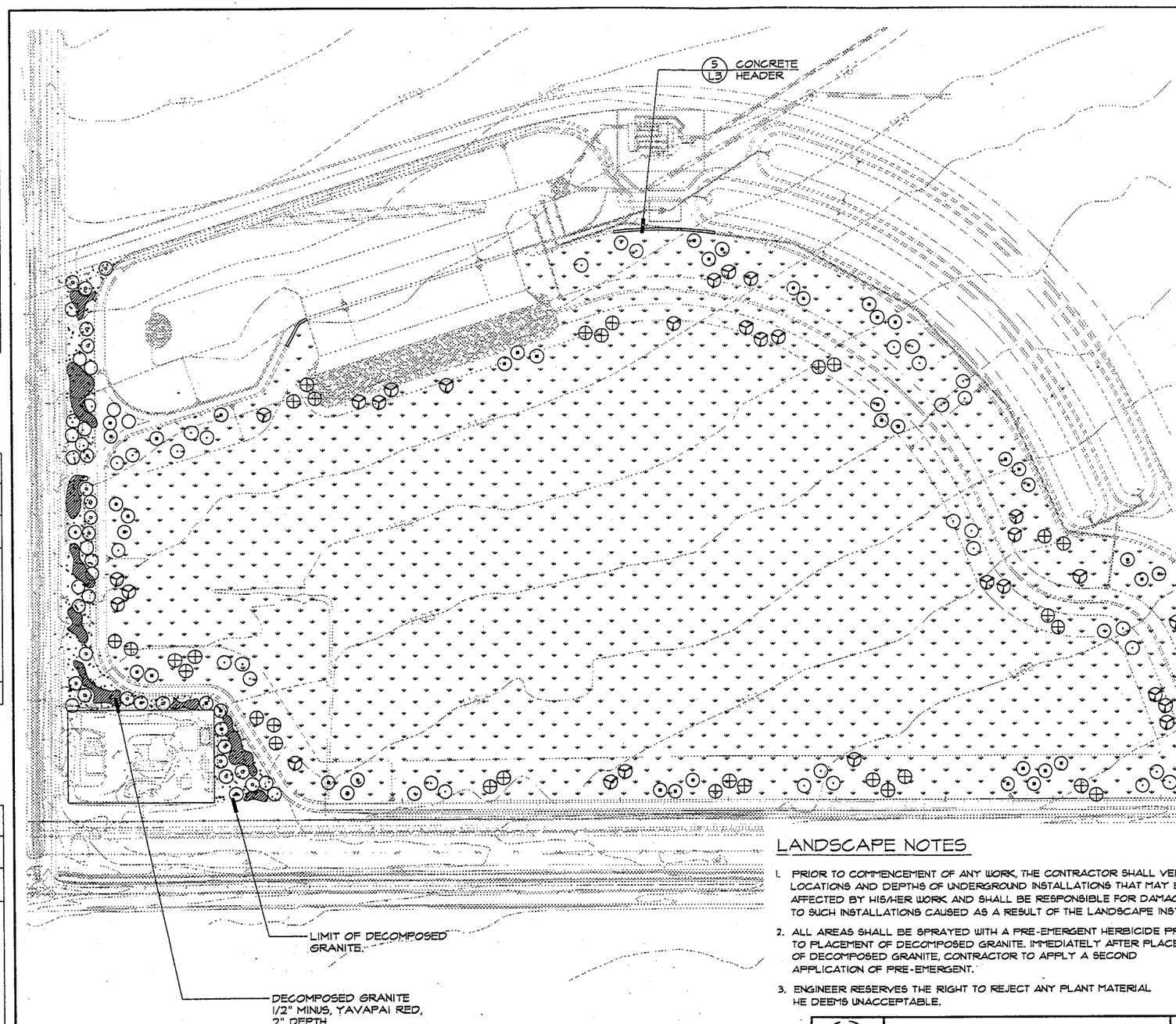

LANDSCAPE LEGEND

SYMBOL	BOTANICAL NAME	COMMON NAME	SIZE	QTY.
TREES:				
	CERCIDIUM FLORIDUM	BLUE PALO VERDE	24" BOX	21
	FRAXINUS VELUTINA	ARIZONA ASH	24" BOX	30
	OLNEYA TESOTA	IRONWOOD	24" BOX	20
	PISTACHIA CHINENSIS	CHINESE PISTACHE	24" BOX	36
	PROSOPIS CHILENSIS	CHILEAN MESQUITE	24' BOX	51
	QUERCUS SP.	RED ROCK OAK	24" BOX	29
SHRUBS:				
	AGAVE SPP.	AGAVE	5 GAL	
	BAILEYA MULTIRADIATA	DESERT MARIGOLD	1 GAL	
	CAESALPINIA PULCHERRIMA	RED BIRD OF PARADISE	5 GAL	
	DALEA SP.	DALEA	5 GAL	
	CALLIANDRA CALIFORNICA	RED FAIRY DUSTER	5 GAL	
	HESPERALOE FUNIFERA	COAHUILAN HESPERALOE	5 GAL	
	JUSTICIA SP.	JUSTICIA	5 GAL	
	LEUCOPHYLLUM SP.	TEXAS RANGER	5 GAL	
	PENSTEMON SP.	PENSTEMON	1 GAL	
	SALVIA SP.	SAGE	5 GAL	

GROUNDCOVER:

TURF

INERT GROUNDCOVER:

DECOMPOSED GRANITE

N

LANDSCAPE NOTES

1. PRIOR TO COMMENCEMENT OF ANY WORK, THE CONTRACTOR SHALL VERIFY LOCATIONS AND DEPTHS OF UNDERGROUND INSTALLATIONS THAT MAY BE AFFECTED BY HIS/HER WORK AND SHALL BE RESPONSIBLE FOR DAMAGES TO SUCH INSTALLATIONS CAUSED AS A RESULT OF THE LANDSCAPE INSTALLATION.
2. ALL AREAS SHALL BE SPRAYED WITH A PRE-EMERGENT HERBICIDE PRIOR TO PLACEMENT OF DECOMPOSED GRANITE. IMMEDIATELY AFTER PLACEMENT OF DECOMPOSED GRANITE, CONTRACTOR TO APPLY A SECOND APPLICATION OF PRE-EMERGENT.
3. ENGINEER RESERVES THE RIGHT TO REJECT ANY PLANT MATERIAL HE DEEMS UNACCEPTABLE.
4. ALL TREE LOCATIONS TO BE STAKED AND APPROVED BY THE ENGINEER PRIOR TO INSTALLATION.
5. SUBSTITUTION SHALL NOT BE ALLOWED UNLESS AUTHORIZED IN WRITING BY THE ENGINEER.
6. ALL TREE AND SHRUB PLANTINGS SHALL BE BACKFILLED WITH A SOIL MIX COMPRISED OF FOUR PARTS SCREENED NATIVE SOIL BY VOLUME ONE PART FOREST MULCH BY VOLUME. 12 oz. SOIL SULFHER AND 4 oz ACTIVATED CHARCOAL.

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LANDSCAPE PLAN

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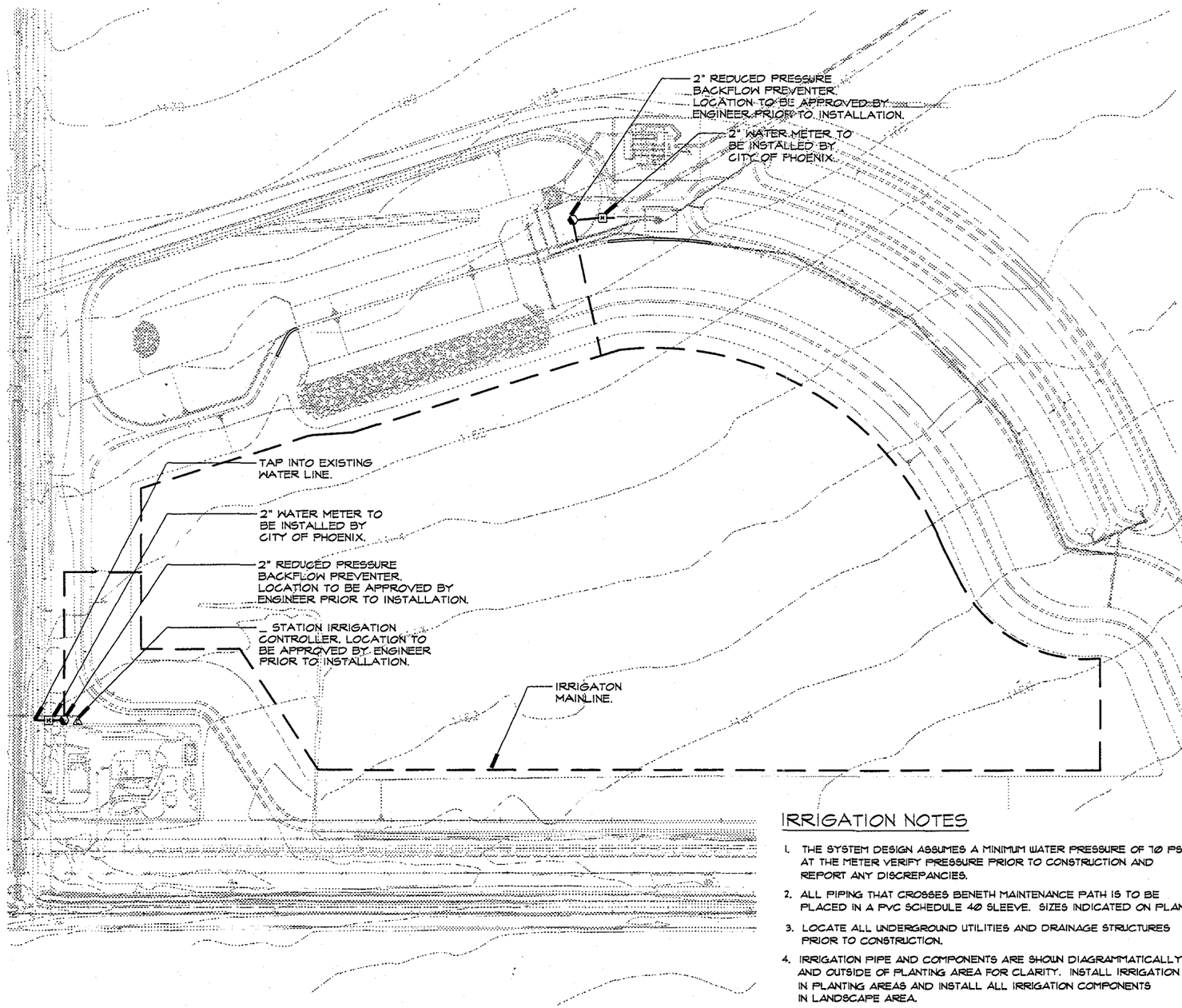

IRRIGATION LEGEND

SYMBOL	BRAND	MODEL #	DESCRIPTION
	FEBCO	825 YD	3" REDUCED PRESSURE BACKFLOW PREVENTER
	NIBCO	T-113-IRR	GATE VALVE
	RAINBIRD	PEB	TURF VALVE ASSEMBLY
	RAINBIRD	PEB	DRIP VALVE ASSEMBLY
	RAINBIRD	PSL-L30X REY-075-200 MX	PRESSURE REGULATOR/ WYE STRAINER
	BOWSMITH	ML 220	MULTI OUTLET EMITTER (2.0 gpm)
	RAINBIRD	F4-PC-SS-14	TURF ROTOR (PART CIRCLE X 12.4 gpm)
	RAINBIRD	F4-SS-14	TURF ROTOR (FULL CIRCLE X 12.4 gpm)
	RAINBIRD	ESP	IRRIGATION CONTROLLER
	PEPCO		FLUSH END CAP
— —			SCH. 40 PVC MAINLINE
— — —			SCH. 40 PVC LATERAL
=====			SCH. 40 PVC SLEEVE

IRRIGATION NOTES

1. THE SYSTEM DESIGN ASSUMES A MINIMUM WATER PRESSURE OF 70 PSI AT THE METER VERIFY PRESSURE PRIOR TO CONSTRUCTION AND REPORT ANY DISCREPANCIES.
2. ALL PIPING THAT CROSSES BENETH MAINTENANCE PATH IS TO BE PLACED IN A PVC SCHEDULE 40 SLEEVE. SIZES INDICATED ON PLANS.
3. LOCATE ALL UNDERGROUND UTILITIES AND DRAINAGE STRUCTURES PRIOR TO CONSTRUCTION.
4. IRRIGATION PIPE AND COMPONENTS ARE SHOWN DIAGRAMMATICALLY AND OUTSIDE OF PLANTING AREA FOR CLARITY. INSTALL IRRIGATION PIPE IN PLANTING AREAS AND INSTALL ALL IRRIGATION COMPONENTS IN LANDSCAPE AREA.
5. ALL DRIP LATERALS ARE TO BE 3/4" SCH 40 PVC. ALL OTHER PIPING SIZED AS SHOWN ON PLAN.
6. THE CONTRACTOR IS RESPONSIBLE FOR VERIFYING THE LOCATION OF ALL UNDERGROUND UTILITIES THAT MAY BE AFFECTED BY HIS/HER WORK AND SHALL BE RESPONSIBLE FOR DAMAGES TO SUCH INSTALLATIONS CAUSED AS A RESULT OF HIS/HER WORK.
7. COORDINATE IRRIGATION WORK WITH PLANTING PLANS TO AVOID CONFLICTING LOCATIONS BETWEEN PIPING AND PLANT PITS.
8. IF IT BECOMES NECESSARY TO RELOCATE OR ALTER VALVES, PIPING, ETC. DUE TO CHANGE IN SITE CONDITIONS, CONTRACTOR SHALL OBTAIN WRITTEN APPROVAL FROM THE ENGINEER PRIOR TO STARTING THESE REVISIONS.

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IRRIGATION PLAN

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APPENDIX A

REPORT

STORMWATER TREATMENT FACILITY CONCEPTUAL PLAN

Dr. Martin M. Karpiscak
Office of Arid Lands Studies
University of Arizona

Office of Arid Lands Studies

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TUCSON ARIZONA

1955 E. Sixth Street
Tucson, Arizona, 85719-5224
Telephone: (520) 621-1955
FAX: (520) 621-3816
The OALS Home Page (WWW)
http://ag.arizona.edu/OALS/oals.html

April 29, 1999

Jerry Zovne
Water Resources Section Manager
HDR Engineering, Inc.
2141 East Highland Avenue
Suite 250
Phoenix AZ 85016-3226

Dear Jerry:

Enclosed please find one (1) copy of the draft report for the Stormwater Treatment Facility Conceptual Plan for the 48th Street Detention Basin Project, City of Phoenix Project No. ST83120008. I anticipate that there may be further changes to the text for the final version.

Please call (520-621-8589) if you have any questions. Thank you.

Sincerely,

Martin M. Karpiscak
Research Scientist

Enclosure

DRAFT

STORMWATER TREATMENT FACILITY CONCEPTUAL PLAN

48th Street Detention Basin Project

City of Phoenix Project No. ST83120008

Prepared by

Martin M. Karpiscak
Office of Arid Lands Studies
The University of Arizona
1955 East 6th Street
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Submitted to

HDR Engineering, Inc.
5353 North 16th Street
Phoenix Arizona 85016-3226

April 1999

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48th STREET DETENTION BASIN PROJECT

I. INTRODUCTION

All wastewater treatment technologies require the use of natural processes such as microbial reactions or gravity for sedimentation. The great advantage of a constructed wetland or ecosystem for water quality enhancement is that these systems do not require large amounts of energy generated from fossil energy sources nor elaborate treatment facilities.

Natural wetlands are typically called marshes, swamps, or bogs. These natural areas are vegetated with dense and, many times, diverse plant communities that can provide habitat for birds, reptiles, mammals, amphibians, invertebrates, as well as complex microbial communities. Thus, these ecosystems can be rich, complex "natural communities" that perform as nature's mechanism for enhancing water quality.

The use of a constructed wetland for treating various types of wastewater is a relatively recent adaptation of the use of nature's own water treating "facility". The oldest full-scale constructed wetland system has been operating for only about 20 years. There are 3 major types of constructed wetland systems currently in use: floating aquatic plants (FAP), subsurface flow (SSF), and surface flow (SF), also called free water surface (FWS). The use of these systems is rapidly expanding for the treatment of many types of wastewater, including stormwater (Schueler, 1992; Olson, 1993).

Some of the major components of a constructed wetland that can impact the efficiency of the treatment process include: plant species, soils, detritus, microbial species, and presence/ab-

sence of animals. These components are in turn influenced by water depth, air/water temperature, pH, and dissolved oxygen (Reed *et al.*, 1995).

Stormwater quality has become a major concern, especially in urban areas. Stormwater runoff from urban areas can contain high levels of nutrients, sediments, residues from exhaust fumes, and other contaminants (Environet, 1997). A study conducted in Ontario indicated that bacteria and heavy metals, principally lead, zinc and cadmium, were of primary concern from stormwater runoff. Contaminants from industrial and residential activities were found to already impact the local river. Typically reported were illicit discharges arising from poor housekeeping practices, especially in industrial areas (Environet, 1997).

Carefully designed and built constructed wetland treatment systems can serve as a component of a facility to treat non-point source (NPS) pollution problem occurring in stormwater runoff (Schueler, 1992; Olson, 1993). A constructed wetland can remove many of the NPS contaminants found in stormwater runoff by biological, chemical and physical means, in much the same way as a natural wetland or more conventional treatment systems. These engineered wetlands can be designed to treat specific contaminants, enhance flood control, and provide many of the ancillary benefits of natural wetlands such as wildlife habitat, aesthetically pleasing open space and recreational opportunities (Environet, 1997).

Constructed wetland basins, cells, raceways, or ponds can act as natural filters by trapping sediments. Macrophytes (emergent or aquatic vegetation) growing within the cells can utilize nutrients such as phosphates and nitrates. They can also take up and use and/or concentrate heavy metals contained in the stormwater or the sediment. The primary design parameters for a

constructed wetland include: hydraulics, detention times, flow rates, water velocities, aquatic vegetation and fauna, access for maintenance, and harvesting and monitoring.

During a study conducted in Bayswater, Perth, Australia (Environet, 1997), samples were taken at the inlet and outlet of the two wetland basins designed for stormwater runoff under steady flow conditions. Cage structures with weirs are situated at the outlet of each wetland. Both wetlands successfully filter sediment, but the efficiency is dependent on the design of each wetland. The following results from the water sampling were obtained. Values are expressed as the mean.

Species	Inlet (mg/l)	Outlet (mg/l)
Total Suspended Solids	16.3	6.6
Volatile Suspended Solids	9.5	6.6
NO_3-N	3.1	1.7
Total Kjeldahl Nitrogen	1.0	0.9
Heavy Metals	<0.02	<0.02
Total Phosphorus	some samples higher in outflow than inflow, particularly for samples taken after rainfall	

Aquatic species in the basins include *Typha orientalis*, *Potamogeton cripus*, *Juncus pallidus*, *Juncus krassii*, *Cyperus rotundus*, *Bolboschoenus caldwellii*, and *Avena satira,* with *Juncus pallidus* as the dominant species.

II. TRADITIONAL STORMWATER TREATMENT SYSTEM DESIGNS

Introduction

Stormwater detention basins can be designed with aesthetic features and can provide for water quality improvements. Some have termed these areas "biofilters". Included in these are shallow water marshes, reasonably flooded basins, and wet and dry meadows (Ferlow, 1993).

Ponding stills the stormwater and permits silts and sediments as well as their attached pollutants to settle out and sometimes bind with bottom sediments. Soluble pollutants are probably best removed in a permanent pond, emergent wetland or by means of extended runoff retention, utilizing microbial activity within a shallow intermittently wet scrub shrub brush habitat (Ferlow, 1993). Pollutant removal will vary seasonally with the highest removal rates occurring in summer.

Detention/Retention Systems

Most stormwater detention ponds dry out quickly under arid conditions. Often, during the rainy season, the water levels in these ponds remain at or near the outflow structures. Stormwater entering a detention area under these conditions displaces an equivalent amount of water that usually overflows to an adjacent man-made or natural drainage system. The detention pond acts as a sink or trap where pollutants picked up by the initial surge of stormwater settle out before leaving the detention pond. These ponds are usually referred to as "Wet-detention systems" (O'Meara and Purcell, 1993).

By contrast, retention areas are designed to hold stormwater until the effects of percolation and evapotranspiration return the area to its normal dry state. Since these stormwater retention areas are designed to dry out rapidly, they are usually called "dry-retention systems" (O'Meara

and Purcell, 1993). The Equalization Basin in the proposed complex represents a dry-retention system. First-flush stormwater is retained and is slowly discharged to the treatment cells, providing primary sedimentation.

Wet Detention Ponds

A wet detention pond is a pond that is specifically designed, built and/or modified to maintain a permanent pool of water within a designated area and that relies on physical, biological, and chemical processes to remove pollutants from stormwater runoff. Pollutants removed include sediment, organic matter, dissolved metals, and nutrients. In addition, wet detention ponds control stormwater flow that prevents downstream flooding. As stormwater enters the pond, treated water is displaced and discharged into a receiving body of water. Enhanced treatment of stormwater runoff can be achieved through extended detention and the use of aquatic plants in the perimeter of the pond or by the addition of a constructed wetland. Sediment removal can also be increased through the use of sediment traps in the perimeter of the pond. Sediment removal can also be increased through the use of a sediment forebay (EnviroSense, 1997).

Before construction of a pond begins, local, state, and federal permits should be confirmed and approved for all aspects of construction including wetlands, water quality, dam safety, grading, erosion control, and land use. Wet detention ponds rely on the existence of a permanent pool of water within the pond and, therefore, should be placed in areas with adequate baseflow from groundwater or from other sources to maintain an adequate water level. Soils under the pond should have a low permeability (10^{-5} to 10^{-6} cm/sec) to ensure future existence of the pond. Placement should take into consideration a location that allows for maximum detention volume while requiring minimal earth removal, thus lowering construction costs. Pond construction

should not be considered near land constraints such as utilities or underlying bedrock (EnviroSense, 1997).

Pollutant removal in the pond is determined using one of two methods: solids settling and eutrophication. The solids settling method relies on pollutant removal through sedimentation and the eutrophication method removes nutrients using natural biological processes. According to the National Urban Runoff Program (NURP), up to two-thirds of the sediments, trace metals, and nutrients are removed as a result of sedimentation within 24 hours. Other studies that looked at biological removal suggest hydraulic residence times (HRTs) close to two weeks to get adequate phosphorus removal (EnviroSense, 1997). Documented removal efficiencies for wet detention ponds are as follows:

	Percent Removal	
Parameter	**Schueler, 1992[1]**	**Hartigan, 1988[2]**
Total Suspended Solids	50-90	80-90
Total Phosphorous	30-90	
Soluble Nutrients	40-80	50-70
Lead		70-80
Zinc		40-50
Biochemical Oxygen Demand		20-40
Chemical Oxygen Demand		20-40

[1]hydraulic residence time varies
[2]hydraulic residence time of 2 weeks

Two ratios are useful at predicting pollutant removal efficiencies: volume ratio and area ratio. Volume ratio (VB/VR) is the ratio of permanent pool storage (VB) to the mean storm runoff (VR). Area ratio (A/As) is the ratio of the contributing drainage area (A) to the permanent pool surface area (As). Both of these ratios are correlated with treatment efficiencies. Large

volume ratios result in increased retention and treatment between storms while low pollutant efficiencies are achieved with low volume ratios (EnviroSense, 1997).

Pool depth can play a critical role in pollutant removal and storage, but caution should be taken when increasing the depth of the pool. A pond with an HRT of two weeks would function optimally at depth ranges from 3 to 9 feet; shallower depths with the same pond surface area have shorter HRTs (EnviroSense, 1997).

Water within the pond is discharged through an outlet. A wet pond outlet consists of a vertical riser, either concrete or corrugated metal, attached to a horizontal barrel that conveys stormwater flow under the embankment to a receiving stream. The outlet is designed to pass excess water while maintaining a permanent pool. Risers are typically placed in or on the edge of the embankment and are capped with a trash rack to prevent clogging (EnviroSense, 1997). Due to the intermittent occurrences of runoff events in the Phoenix area and the high evaporation rates, a wet-detention pond would require large quantities of supplemental water to maintain the aquatic system. Therefore, a wet detention pond is not recommended for this project.

Maintenance

As with any stormwater best management practice (BMP), proper maintenance will be required to ensure proper functioning of the pond (EnviroSense, 1997). Proper maintenance may include any or all of the following:

- Clearing trash and debris
- Conducting routine inspections of the embankment and spillway to check structural integrity and look for signs of erosion or animal habitation
- Conducting periodic repairs on the embankment, emergency spillway, inlet, and outlet

- Maintaining that outfall area (i.e., replacing rip-rap, removing sediments, etc.)

Sediments collected by the wet detention pond typically meet toxicity limits and can be land-filled safely. Testing of the sediments may be required if the upstream drainage area is industrial and/or results in highly contaminated runoff. Non-toxic sediments can also be disposed on site, but away from the high water line to prevent their re-entry into the pond. The removal of sediments in a pond may be necessary every 20 years. This can be decreased to every 50 years if a sediment forebay is used prior to the wet pond. The sediment forebay would require maintenance every 5 to 7 years (EnviroSense, 1997).

Disadvantages

Pond construction should not be considered near land constraints such as utilities, underlying bedrock, or abundant landfills or wildcat dumps. Sediments from upstream industrial or highly contaminated runoff areas may be a hazardous waste requiring special disposal/treatment (EnviroSense, 1997). To our knowledge, the watershed that would drain into the proposed facility does not have an unusually high potential for extremely contaminated runoff, although hazardous spills can and do happen in any urban watershed.

Economic Analysis

Budgeting for construction of a wet detention pond should include costs for permitting, designing, constructing, and maintaining the pond. Costs will vary for permitting from state to state as will the construction of a pond in a developing area versus a developed area. Developing areas tend to be less costly, as there are less problems with existing utility and structure constraints. An average cost for a 1-acre, 5-foot deep pond with a storage volume of 180,000

cubic feet is $75,000 (EnviroSense, 1997). Costs for the recommended plants in the treatment cells are needed as well as annual maintenance costs.

Annual maintenance and operation costs typically range between 3 to 5 percent of construction costs. Maintenance costs include sediment removal, grass mowing, nuisance control (problematic animals), trash removal, routine inspections, and monitoring and sampling. On-site sediment disposal should be utilized when possible, as costs can be reduced by as much as 50 percent (EnviroSense, 1997).

Planting costs vary depending on the design of the system, the plant species used and the type of plant material used. It is estimated that planting costs for wetlands would be in the area of $2,000 to $5,000 per acre with adjacent landscaping costing as much as $20,000.

III. CONSTRUCTED WETLAND DESIGN ALTERNATIVES

There are several design alternatives for treatment of water at the 48th Street Detention Basin Project. These can be described as free water surface wetland (FWS), subsurface flow wetland (SSF), aquatic ponds, an "arid wetland", and planted filter strips.

Free Water Surface

The most used wetland design for large-scale constructed wetlands in the United States is the free water surface wetland. This system is typical of what would be found in nature. It has areas of open water as well as dense stands of emergent and sometimes submerged plants. The dominate species are cattail, bulrush, and common reed. Some of these systems are planted with additional species to enhance the wildlife habitat value of the system. Less costly to build than a subsurface flow wetland, this system has all the problems of open water, i.e. potential mosquito issues.

Subsurface Flow

The subsurface flow wetland design is widely used for many small-scale systems such as at individual residences. It also can be designed to operate in a vertical mode, not only the typical horizontal flow. Plant species usually employed are the same as in the free water surface wetland. The major problems associated with this design are the cost of gravel or other media to support the emergent plants and the potential for the media to clog over time.

Aquatic Pond

Aquatic ponds typically are covered by floating macrophytic plants such as water hyacinth and duckweed. These ponds can vary in depth and shape and can be lined or unlined, depending on water quality, depth of water, and permit requirements. Both water hyacinths and duckweed

require harvesting. Mosquitoes can be present because of the open water surface, especially that created during harvesting of the plants.

Planted Filter Strips

Another possible alternative treatment design is an overland flow system. This typically consists primarily of grass or grasslike plants through which large volumes of water flow on a very regular basis. *Cynodon dactylon* (Bermuda grass) might be a candidate species. This plant is a particularly aggressive weed that can withstand some degree of inundation, high salt levels, and almost anything that man can try as a weed control method. Because of allergy concerns, the plant would likely have to be harvested regularly. Mosquitoes are also known to breed in well-watered Bermuda grass. This type of system is basically a meadow and must be planted with a water-tolerant grass or sedge. It can be operated in a continuous mode with 1 to 5 cm of water depth. In any case, supplemental water would be required to maintain the plants. Olson (1993) reported that one water-tolerant grass species that has been used in this kind of system is *Phalaris arundinacea* (reed canary grass). Canary grass has been found growing in parts of Arizona.

"Arid Wetland"

A variation on the concept of planted filter strips could be called an "arid wetland". This type of wetland can be created with plants that are adapted to periodic flooding and can be found growing in similar conditions in Arizona. An example of this type of wetland is the St. David cienega near Benson, Arizona. This kind of wetland is not suitable for permanent flooding, but requires that periodic flooding occur. Two of the most likely candidate plant species for this type of wetland are *Hilaria mutica* (Tobosa grass) and *Prosopis juliflora* (mesquite).

This particular type of wetland has never been built. Therefore, many questions would need to be addressed such as length of the period of inundation, depth of inundation, treatment efficiency, plant species composition, etc. This experimental system if successful, however, might prove to be suitable for many arid portions of Arizona that have limited periods of adequate water availability combined with long periods of little or no water. Floodwater mosquitoes might prove to be a problem. Other types of mosquitoes also could become a problem if long periods of inundation are possible (see section below on Mosquitoes). Another possible issue could be weed control, although dense stands of established *Hilaria* should out-compete most other weeds.

"Hybrid' System

An experimental system currently under development at the Constructed Ecosystems Research Facility in Tucson might provide operational flexibility. This system could be operated as a surface flow system as well as a subsurface flow system if mosquito breeding became a significant problem. If required to control mosquito larvae, exposed surface water could be concentrated in deep zones that would have little cover for larvae in and around emergent vegetation, thus making it easier to control breeding (see Section VII).

IV. WETLAND OPERATIONS

Control Mechanisms

There are only a few control mechanisms for operating a wetland system. These include variation of influent flow, loading rates, water level within the cells, rotation in the use of individual cells, and variations in pretreatment. Vegetation management options include species selective removal, and the control of fire (Kadlec and Knight, 1996).

At the 48th Street Detention Basin facility, the supply of water will be controlled with external water applied as necessary to establish and maintain the treatment cells. The water can be recycled and therefore, a traditional "residence" or "detention" time approach to design is not meaningful.

"Time???"

Created wetland biofilters require a period of time to establish, stabilize, and grow into a viable functioning wetland. This may involve 2 to 5-plus years, as each system is different and dependent upon the specific site conditions related to the hydraulic regime. For example, a pond or permanent shallow marsh biofilter may be an almost "instant" wetland success with dense growth achieved in one season, whereas an intermittently wet and dry scrub brush biofilter will require at least several growing seasons to become established and several more years to present a natural stable visual character (Ferlow, 1993). If the "arid wetland" or a "hybrid" concept is chosen, then the 48th Street Detention Basin facility could have two different types of wetland.

Pond biofilters, used as landscape features, have the potential to be impacted by run-off-carried debris and petroleum products which "float" across the surface and degrade general visual quality. These aesthetic impacts can be significantly reduced through construction of a stone-

lined, heavily vegetated, bowl-shaped "trap" at the inlets. Entering runoff must pass through the rough stone layer and plant material growth. A significant percentage of the "floatables" will be caught and held at this point. "Trap" locations should be designed for easy access and periodic removal of the collected materials (Ferlow, 1993). At the 48th Street Detention Basin facility, there are trash racks at the inlet to the cells and at the outlets from the cells.

To ensure the potential for reasonable success, created wetland biofilters require detailed construction monitoring and maintenance during their time of establishment. Water levels must be checked, adjusted, and stabilized at optimum levels. Water elevation fluctuations of several inches can change the type from wetland-oriented to upland, or drown desired plants. Undesirable pioneer plant growth must be controlled or weeded out until desirable higher-quality vegetation has had time to become established and has a reasonable chance for continuance. Once established, the desirable wetland vegetation appears to have the potential to complete reasonably with the more aggressive weed species (Ferlow, 1993).

In a newly-created biofilter, wildlife impacts may have to be controlled to manageable levels, at least until the ecosystem can survive what might be considered normal wildlife predation impacts. For example, fine tuning of "normal" water level in a shallow marsh biofilter may be necessary to limit the habitat value of the created wetland for species that have the potential for negative impacts on the recently planted vegetation (Ferlow, 1993).

As a created wetland biofilter grows and matures, it may change in visual character and habitat type from the original design. Rainfall cycles, water levels, natural plant growth patterns, and wildlife utilization will play a role in and the establishment of wetland functional values (Ferlow, 1993).

Though designed with the same basic standards, healthy functioning biofilters display quite diverse results. When correctly sited within the development plan, created wetland biofilters provide strong visual interest in the landscape and act as natural open-space buffers (Ferlow, 1993).

The strong natural visual values, open-space elements, wildlife habitat characteristics, run-off control features, and water-borne materials reduction within created wetland biofilters represent positive environmental conditions (Ferlow, 1993.)

Water Requirements

In order to maintain a typical constructed wetland planted with bulrush, cattail, or common reed that is designed to capture and treat stormwater runoff in Phoenix, supplementary water will be required. Based on the water required by traditional agricultural crops such as cotton, alfalfa, and pecans, and on a pan evaporation rate of about 9,000 mm (108 inches) annually, it can be estimated that about 3 m (9 feet) of water will be required annually if significant amounts of water are not lost to seepage. In metro Phoenix, only 5 to 10 storm events on average per year will produce adequate precipitation to yield stormwater runoff to the 48th Street Detention Basin system.

For design purposes, the evapotranspiration rate should be estimated as 80 percent of pan evaporation for the greater Phoenix area. This would be about the same as a lake evaporation rate. In the continuing discussion over the issue of evapotranspirational losses from aquatic systems and wetlands, the general consensus is that shading from floating aquatic plants or emergent species decreases evaporation from the water surface, but plants continue to transpire. Therefore, the effect is that the presence or absence of plants results in about the same rate of

water loss (Reed *et al.*, 1995). Preliminary data indicate that, after about one year of operation, evapotranspirational and seepage losses from the Sweetwater Wetlands in Tucson are over 40 percent of the incoming water. At Tres Rios in the Greater Phoenix area, overall water loss has been reported to be approximately 12 to 15 percent with 3 to 5 percent being attributed to evapotranspirational losses or about 5 to 6 feet (Wass, 1998).

The use of supplemental water in arid Arizona may create some negative public perceptions and negative press. It is critical, therefore, that low quality water or water that is currently not being used for productive purposes be applied and that this information be well-documented and clearly stated in any information distributed about the system.

Single- Vs. Multi-celled System

It is generally agreed in the engineering community that a constructed wetland should be designed as a multi-celled system. The presence of multi-cells provides operational flexibility from a perspective of water availability as well as for maintenance and/or repair. Planting individual cells with different species facilitates operation of the system. The use of a single-cell system should be avoided.

Animals and the System

As noted above, the presence of water and plants will attract many animals. Most of these will have little impact on the operation of the wetland facility. However, rabbits and/or herbivores can denude a recently-planted area rapidly. Inundation of 15 cm (6 inches) will prevent rabbits from browsing newly planted material. Areas that are not inundated will need to be fenced to prevent destruction of the plants. This applies even to desert plants such as mesquite. Once established, most of the plant species can readily endure browsing by rabbits, deer, or other

mammals. At the 48th Street Detention Basin facility, the Basin site will be fenced. However, some animals will still be able to enter the system unless the fencing is specifically designed to exclude them.

Typically, birds have minimal direct impact on the plants, but the presence of large numbers of birds at particular times of the year can adversely impact the quality of the water leaving the wetland. The birds also will introduce seeds, especially cattail, from other areas and can add significantly to the organic waste load.

Overall, it will be impossible to exclude birds, mammals, insects, and other animals from the system. Therefore, the only control measures that should be undertaken are as noted above for initial plant protection or as mentioned in the section under mosquito control.

Public Access

The presence of water and a diverse plant community in an arid area such as the proposed siting for the 48th Street Detention Basin project will attract birds and other animals whether or not the wetland is designed to do so. The presence of birds and other animals will, in turn, draw the attention of people. In Tucson, at the Sweetwater Wetlands and to a lesser degree at the 91st Avenue Wetland in Phoenix, the public's presence has been encouraged. The opportunity for the public to visit and view these systems is very positive from both a multiple use concept as well as from a public educational and public relations aspect. Nevertheless, inviting the public into the wetland environment has some significant consequences. The first of these is the cost of designing the system to accommodate the presence of the public. At the Sweetwater Wetlands, paved paths, restroom facilities, overlooks, parking, signage, and other amenities are being provided at significant costs. At 91st Avenue, fewer amenities are provided. At both facilities, the issue of

liability and protecting the public are of concern. The presence of mosquitoes at 91st Avenue raises issues of public perception and safety as well. The Sweetwater facility is too new to evaluate the issue of mosquitoes at that location.

From the standpoint of the Arizona Department of Transportation (ADOT) and Maricopa County, the least costly, lowest maintenance and most easily implemented alternative would be to exclude the public. A possible compromise would be to post signage around the facility informing the public about the facility and its purpose, and only permitting occasional visits by organized groups.

The decision to use this facility as strictly a fenced operational facility with little if any public access will eliminate the need to maintain the 48th Street Detention Basin facility in a manner required by public aesthetics or for public access. Maintenance, therefore, will be dictated by operational concerns.

Weed Control

The presence of weeds at the site is to be expected, both within and around the wetland cells. One of the major weeds to be expected around the cells in the dry areas is likely to be *Salsola kali* (Russian thistle or tumbleweed). Other annual and perennial weeds are also to be expected. These can be controlled readily by minimizing soil disturbance, using pre-emergent herbicides and/or Roundup® or other weeding methods. An important concern, however, is if these herbicides should get into the water stream flowing in the wetland cells.

Within the wetland cells, cattail is the most likely herbaceous weed and can be removed by hand until the other desired species are firmly established. At that time, the desired species should maintain themselves. Around the edge of the cells, *Tamarix chinesis* (salt cedar) and

Cynodon dactylon sp. (Bermuda grass) will be present. It is strongly recommended that any young seedlings of both salt cedar and Bermuda grass be removed immediately, because once established, these prolific seedling exotic plants will rapidly become major components of the plant community as well as major pests. Also, once established, they are difficult, if not impossible, to remove and/or control. It would require extensive, repeated physical control as well as the use of selected herbicides. Control of these species, however, has proven to be very difficult.

Within the "arid wetland," weeds will tend to be a greater problem unless one or some combination of several options are used to control their development: (1) the use of pre-emergent herbicides, (2) the use of Roundup®, (3) mechanical control (blading, mowing, hoeing), (4) development of a dense ground cover, or (5) the use of a rock or other mulch cover. Weeds that could be expected in this area are both dry land weeds such as tumbleweed and careless weed (*Amanthus palmeri*) as well as other weeds such as Bermuda grass (*Cynodon dactylon*).

The use of decomposed granite on the sides of any of the wetland system is unlikely to completely prevent the growth of weeds. Water is likely to wick up the sides in sufficient quantities to support the growth of weeds. A geotextile liner at the surface would provide a very good barrier to weed development. However, the cost for material and installation would likely be substantial and the liner would be subject to damage. If the liner were buried, the wicking problem would still occur and weeds would still have to be removed.

Water Depth

Water depth in surface flow (SF) constructed wetland treatment systems affects the growth, survival, and reproduction of plants, the detention time, the ability of oxygen to diffuse from the

atmosphere into the water, and the composition of the microbial community. Typical operational water depths in SF constructed wetland treatment systems range from about 15 to 60 cm (0.5 to 2 feet). When combined with high organic loadings, greater depths provide poor root oxygenation and poor plant growth. Water depth in SF systems should be adjusted to optimize plant growth, especially during start-up, as long as treatment goals are being accomplished. Outlet structures should be designed to permit water depths ranging from zero up to the maximum design depth (Knight *et al.*, 1995). Gates with weirs can be used to control the depth of water at the 48th Street Detention Basin facility with the typical operational depth above the planting media being 15 to 30 cm (0.5 to 1 foot).

Bed depth of subsurface flow (SSF) constructed wetland is typically the most important factor in system cost. The Water Pollution Control Federation (1990) recommends a bed depth of 30 to 90 cm (1 to 3 feet). European designers who have applied this technology to hundreds of systems (Cooper, 1990) recommend a bed depth of about 60 cm (2 feet). Green and Upton's (1994) estimate of a bed width requirement of about 0.4 m per m^3/d of flow for tertiary treatment is based on a bed depth of 60 cm (2 feet) and the use of 5 to 10 mm (0.2 to 0.4 inches) gravel with a bed slope less than 5 percent and a steady state hydraulic conductivity of 1×10^{-3} m/s. Recommended bed widths for secondary treatment of settled wastewater are wider at 0.85 to 2 m per m^3/d (Cooper, 1990).

Soils/Substrate

Surface flow or free water systems usually use on-site soils as a substrate for plant growth. A constructed wetland can be built on almost any soil type and on gravel, but preferred soils are loams and sands because of the ability of plants to develop extensive root systems and to propagate

through rhizome development. Loamy soils are advantageous because of their fertility and texture. Clays may have excellent fertility, but their texture hinders root penetration and diffusion of oxygen and other gases to and from the roots. Preferred wetland construction includes from 15 to 30 cm (0.5 to 1 foot) of loamy or sandy topsoil within the wetland to provide an adequate substrate for the rooting of wetland plants (Knight *et al.*, 1995). Suitable topsoil (medium to sandy textured) should be used for a FWS at the 48th Street Detention Basin facility.

Substrate conditions are much more critical to the design of SSF wetlands than they are to SF systems. Subsurface flow wetlands have been constructed with substrates ranging from coarse sands to pea gravels with diameters of less than 1 cm (0.4 inch) to large rocks (up to 10 to 15 cm [4 to 6 inches] in diameter). Excessive fines associated with SSF substrate can result in hydraulic failure and should be avoided. Media permeability must be determined to permit appropriate design. If permeability is not determined correctly or the design is inadequate, surface flows will result. Gravel should be used at the 48th Street Detention Basin facility if an SSF system is desired. The gravel should be about 2.5 cm (1 inch) in diameter. This same gravel should be used as the planting media if the "hybrid" system is chosen.

Liner Requirements

Underlying soil permeability must be considered in the design of a constructed wetland. The most desirable soil permeability is less than 10^{-6} to 10^{-7} m/s (0.14 to 0.014 inches/hr). Lining is sometimes needed to decrease soil permeability and thus reduce seepage losses through the bottom of the wetland. Lining can consist of installing artificial materials, such as a geomembrane, or placing a layer of less permeable soils in the bottom of the wetland. Mechanical

compaction of existing or imported soils can also be effective in creating a less permeable barrier to seepage.

Generally, liners will be required for constructed wetlands receiving primary wastewater (including SSF systems receiving septic tank effluents), but not for systems receiving secondary or tertiary quality wastewater. Systems designed with multiple cells may only require liners in those cells receiving primary effluent. If the effluent discharged from one cell to another is of secondary quality or higher, a liner may not be required in the downstream cells.

A liner also may be used to prevent excessive loss of wastewater that is intended for some other beneficial use, such as landscape irrigation or wildlife habitat. In these cases, lining may be partial to reduce infiltration through particularly permeable site soils and may be accomplished by adding less permeable subsoils or top soils to portions of the site.

A liner will add significant cost and, in some instances, may hamper performance of the system. At some sites where site and/or soil characteristics can be demonstrated to perform hydrologically like a liner, no liner may be required (Knight *et al.*, 1995). Existing soils in the cells at the 48th Street Detention Basin facility are fairly tight and typically these should seal over time. Possible loss of water to the ground could be checked if desired to verify actual conditions. This could be achieved by installation of monitoring wells or the use of neutron probe monitoring or some combination of these two techniques.

High length-to-width ratios are useful to minimize short-circuiting. However, Knight *et al.* (1995) recommend ratios of 1:1 to 2:1 because of the increased cost of construction resulting from increasing the ratio of berm to volume to treatment area. They also recommend the use of

deep zones or low parallel berms to help reduce short circuiting. Their suggestions on design did not address the issue of maintaining access for the control of mosquitoes.

The cost for a constructed surface flow wetland is about $32,600/ha ($13,200/ac), while subsurface flow systems are about $350.000/ha ($141,000/ac) (Knight *et al.*, 1995).

V. PLANT MATERIALS OPTIONS

Although a wide variety of aquatic plants have been planted in constructed wetlands, the most commonly used plants in free water surface constructed wetlands for wastewater treatment are *Typha* sp. (cattail), *Scirpus* sp. (bulrush), and *Phragmites australis* (common reed). Less commonly used are *Juncus* sp. (rushes) and *Carex* sp. (sedges). The three major species spread rapidly, provide large surface areas for microbial attachment, and have high potential for pollutant removal that is well-documented. Cattail and bulrush species are commonly used in free water surface wetlands in the United States while common reed is used most in Europe.

Species of bulrush have the greatest wildlife habitat potential. However, three-square bulrush has been observed as possibly impeding the free movement of *Gambusia*, thus creating enhanced conditions for mosquitoes. Cattail provide somewhat lower habitat value, while common reed has little habitat value. *The Arizona Guidance Manual* (Knight *et al.*, 1995) provides an extensive listing of other Arizona plant species with potential for use in constructed wetlands (Appendix A). Most of these plants would be difficult to obtain and little, if any, documentation exist on the suitability and effectiveness of these other species for water quality improvement. Below is a discussion of pros and cons of the major plant genera as presented in Reed *et al.* (1995):

> **Cattail:** Typical varieties: *Typha angustifolia*, narrow-leaf cattail; *T. latifolia*, broad-leaf cattail. Distribution: worldwide. Optimum pH: 4-10. Salinity tolerance: narrow leaf, 15-30 ppt; broad leaf, <1 ppt. Growth: rapid, via rhizomes, spreads laterally, dense cover in <1 yr with plant spacing 0.6 m (2 ft). Relatively shallow root penetration in gravel ≈0.3 m (1 ft). Annual yield: ≈30 (dw) mt/ha (14 tons/ac). Tissue: (dw basis) ≈45% C, 14% N; 2% P; 30% solids. Habitat values: seeds and roots a food source for water birds, muskrat, nutria, and beaver; nesting cover for birds. Hydroperiod: can be permanently inundated >0.3 m (1 ft), can also tolerate drought. Commonly used on many FWS and

SF wetlands in the United States. The relatively shallow root penetration is not desirable for SF systems without adjustment in design depth of the bed. (page 179)

Bulrush: Typical varieties: *Scirpus acutus*, hardstem bulrush, common tule; *S. cypernius*, wool grass; *S. fluviatilis*, river bulrush; *S. robustus*, alkali bulrush; *S. validus*, soft-stem bulrush; *S. lacustris*, bulrush. Distribution: worldwide. Optimum pH: 4-9. Salinity tolerance: hardstem, wool grass, river, soft stem: 0-5 ppt, alkali, Olney's, 25 ppt. Growth: alkali bulrush, wool grass, river bulrush moderate, dense cover in 1 yr with plant spacing 0.3 m (1 ft); all others moderate to rapid, dense cover in 1 yr with plant spacing 0.3-0.6 m (1-2 ft). Deep root penetration in gravel ≈0.6 m (2 ft). Annual yield: ≈20 (dw) mt/ha (9 tons/ac). Tissue: (dw basis) ≈18% N; 2% P; 30% solids. Habitat values: seeds and rhizomes a food source for many water birds, muskrat, nutria, and fish; nesting area for fish when inundated. Hydroperiod: can be permanently inundated, hardstem up to 1 m (3 ft), most others 0.15-0.3 m (0.5-1 ft), some can tolerate drought conditions. Commonly used on many SF constructed wetlands in the United States. (page 179)

Reeds: Typical varieties: *Phragmites australis*, common reed, wild reed. Distribution: worldwide. Optimum pH: 2-8. Salinity tolerance: <45 ppt. Growth: very rapid, via rhizomes, lateral spread ≈1 m/yr (3 ft/yr), very dense cover in 1 yr with plants spaced at 0.6 m (2 ft). Deep root penetration in gravel ≈0.4 m (1.5 ft). Annual yield: ~40 (dw) mt/ha (18 tons/ac). Tissue: (dw basis) ≈45% C, 20% N; 2% P; 40% solids. Habitat values: low food value for most birds and animals, some value as nesting cover for birds and animals. Hydroperiod: can be permanently inundated, up to ≈1 m (3 ft), also very drought resistant. Considered by some to be an invasive pest species in natural wetlands in the United States. Very successful utilization at constructed wastewater treatment wetlands in the United States. The dominant species used for this purpose in Europe. Because of its low food value, this species is not subject to the damage caused by muskrat and nutria that has occurred in constructed wetlands supporting other plant species. (pages 179-180)

Rushes: Typical varieties: *Juncus articulatus*, jointed rush; *J. balticus*, Baltic rush; *J. effusus*, soft rush. Distribution: worldwide. Optimum pH: 5-7.5. Salinity tolerance: 0-<25 ppt depending on type. Growth: very slow, via rhizomes, lateral spread <0.1 m/yr (<0.3 ft/yr), dense cover in 1 yr with plants spaced at 0.15 m (0.5 ft). Annual yield: 50 (dw) mt/ha (45 tons/ac). Tissue: (dw basis) ≈15% N; 2% P; 50% solids. Habitat values: food for many bird species, roots food for muskrat. Hydroperiod: some types can sustain permanent inundation up to <0.3 m (1 ft), prefers dry-down periods. Other plants better suited as the major species for wastewater wetlands; rushes are well suited as a peripheral planting for habitat enhancement. (page 180)

Sedges. Typical varieties: *Carex aquatilis*, water sedge; *C. lacustris*, lake sedge; *C. stricata*, tussock sedge. Distribution: worldwide. Optimum pH: 5-7.5. Salinity tolerance: <0.5 ppt. Growth: moderate to slow, via rhizomes, lateral spread <0.15 m/yr (0.5 ft/yr), dense cover in 1 yr with plants spaced at 0.15 m (0.5 ft). Annual yield: <5

(dw) mt/ha (<4 tons/ac). Tissue: (dw basis) ≈1% N; 0.1% P; 50% solids. Habitat values: food source for numerous birds and moose. Hydroperiod: some types can sustain permanent inundation, others need a dry-down period. Other plants are better suited as the major species for wastewater wetlands; sedges are well suited as a peripheral planting for habitat enhancement. (page 180)

Floating Species: The species most likely to occur incidentally in FWS wetlands are *Lemna* sp. (duckweed). The presence of duckweed on the water surface of a wetland can be both beneficial and detrimental. The benefit occurs because the growth of algae is suppressed; the detrimental effect is the reduction in transfer of atmospheric oxygen at the water surface because of the duckweed mat. The growth rate of this plant is very rapid, and the annual yield can be 20 (dw) mt/ha (18 tons/ac) or more. The tissue composition is: (dw basis) ≈6 N, ≈2% P; 5% solids. Salinity tolerance: <0.5 ppt. Habitat values: food source for ducks and other water birds, muskrat, and beaver. The presence of duckweed on FWS wetlands cannot be prevented, since the plant also tolerates partial shade. Open-water zones in FWS wetlands should be large enough so that wind action can periodically break up and move any duckweed mat to permit desirable reaeration. The decomposition of the unplanned duckweed may also impose an unexpected seasonal nitrogen load on the system. (page 181)

A key to successful plant establishment of the species noted above is the propagation of these plants from good rhizomes or seedlings. In addition, it is critical that these be planted between April and September, with spring planting times significantly superior to fall. After planting, the plants must be kept in wet soil without deep flooding (usually 5 to 15 cm [2 to 6 inches]). If the small propagules are inundated too deeply, they will not develop.

Plant materials typically come in a variety of forms:

- container-grown plants
- wild-harvested material
- existing facilities
- bare root stock
- seed

Typically prices for plant materials are:

- Herbaceous species, bare root: $0.35 to $0.70
- Woody species: $0.40 (15 cm [~6 inches]) to $41.00 (3 m [10 foot])

Container-grown materials offer several advantages over other plant materials:

- Minimal transplant shock because the root system remains intact
- Better growth rate because the entire plant remains intact
- Greater flexibility in planting time because the plant undergoes minimal shock

Note that on a per acre basis, the cost for plants is from $2,000 to $5,000 per acre depending on the species of plant materials used, the method of planting, time of year, and performance guarantee requirements.

Recommended plant spacing for bulrush, cattail, and common reed is typically 1 m (3 feet) between transplants, whether they be root balls or rhizomes. Operational water depth is typically 15 to 30 cm (6 to 12 inches). Deep zones 2 m (6 feet) in depth can be used to help mix the flow within the individual cells. These zones, if they are perpendicular to the flow of long and narrow ponds, can also provide access as well as habitat for *Gambusia* and thus facilitate mosquito control. These deep areas need to be greater in width than the emergent vegetation or >6 m (18 feet).

No full-scale system has been built to use submerged aquatic plants (Etnier and Guterstam, 1997) and there are little data for designing systems based on submerged plants as a major component of the system (Etnier and Guterstam, 1997; Reed *et al.*, 1995). Species studied for these systems include: pennywort (*Hydrocotyle umbellata*) (the most commonly studied plant), pondweed (*Potamogeton amplifolius)*, water-milfoil (*Myriophyllum heterophyllam*), hornwort (*Certophyllum demersum*), and fanwort (*Cabomba caroliniana*). Guntenspergen, *et al.* (1989)

reported that *Egeria densa*, *Elodea nuttalii* and *Myriophyllum aquaticum* were tested for use in constructed wetlands.

The following submergent species are found in Arizona (Knight *et al.*, 1995):

Common Name	Scientific Name
Arrow-head	*Sagittaria cuneata*
Horned-pondweed	*Zannichellia palustris*
Hornwort	*Ceratophyllum demersum*
Naiad	*Najas maritima*
Pondweed	*Potamogeton crispus*
Pondweed	*Potamogeton foliosus*
Water buttercup	*Ranunculus aquatilus*
Water-milfoil	*Myriophyllum sibiricum*
Water-weed	*Elodea canadensis*

Submergent plants listed for use at the Sweetwater Wetlands in Tucson were *Potamageton* spp. and *Ceratophyllum* spp.

Currently, plants adaptations to their environment as well as their effects on water quality are only beginning to be understood. Submerged plants only grow well in oxygenated water and so their use in wastewater with a high organic content likely would be limited. Nevertheless, some submergent species likely would do well in various zones of the deep areas of the "hybrid" and traditional systems. The most likely candidates are unknown. It is suggested that the availability of plant material as listed above from local sources used as the determining criteria for species selection.

Some potential wetland plant species are regulated as noxious weeds. None of the recommended species are found on the list as of the date of this report. Appendix B contains a listing of the noxious weeds and noxious weed regulations.

Plant materials and information may be obtained from:

Western Sods Arid Adapted Revegetation
P.O. Box 10610
Casa Grande Arizona 85230
Mobile Phone: (602)320-1232
Phoenix phone: (602)268-8811 or 1-800-832-8873
Fax: (602)836-2146

Aquatic and Wetland Nurseries
9999 Weld County Road 25
Fort Lupton, Colorado 80621
Phone: (303)857-6157
Fax: (303)857-2455
- OR -
P.O. Box 82
Avondale, Arizona 85323

VI. MOSQUITOES

Introduction

In North America north of Mexico, there are now known to be 171 species of mosquitoes. These insects are important because they are not only pests, but also they are vectors for diseases such as eastern encephalitis, St. Louis encephalitis, dengue fever, malaria, and filariasis (Darsie, 1997).

Mosquito Production

Mosquito species of Arizona occupy an array of habitats and environmental conditions. Habitats for larval mosquitoes include lake edges, ponds, ditches, bogs, swamps, marshes, springs, snowmelt pools, rock pools, slow reaches of streams, floodwater or overflow depressions, tree holes, and containers (e.g., artificial containers such as rain barrels, cans, and tires) (Laird, 1988). The major requirement for mosquito larval development is standing water, the duration of which can be as little as one week. Food and protective cover are also critical. The high reproductive rate of the mosquito can rapidly bring about nuisance levels (Tennessen, 1993).

Mosquitoes are common in natural wetlands, so their presence in constructed wetlands is to be expected. The availability of standing water, high nutrient levels, and plant cover in constructed wetlands offers an ideal medium for larval growth. Anaerobic, bacteria-laden water has been found to be attractive to ovipositing females (Gerhard, 1959; Rockett, 1987). The potential for mosquito problems in nutrient-enriched constructed wetlands and the annoyance and vector capabilities of some species require consideration of alternatives for mosquito control early in the design and operation process.

In Arizona around the turn of the century, many wetland areas that provided suitable aquatic habitats for a variety of mosquito species were eliminated. This occurred as rivers and streams were driven underground by excessive pumping of groundwater. However, with the rapid growth of population in recent years, many ponds, lakes and other areas suitable as mosquito habitat are being created.

The diversion of stormwater can both dump pollutants into riparian systems and also greatly diminish the amount of stormwater that enters recharge areas for replenishing the groundwater. To alleviate these water quality and supply problems, various types of stormwater detention/retention areas are being incorporated into new commercial and residential developments. Some established developments also are retrofitted with stormwater retention and detention systems. The widespread use of these stormwater systems also may lead to increased mosquito production unless adequate precautions are taken (O'Meara and Purcell, 1993).

In Arizona, detention ponds for holding stormwater runoffs usually do not produce mosquitoes in sufficient numbers to cause major problems because they rapidly dry out. A similar type of invasion can occur in detention ponds that receive both stormwater and wastewater. Wide fluctuations in water levels, especially when they are frequent events, may make the detention system a suitable habitat for floodwater mosquitoes. Floating and rooted aquatic plants may foster the growth of some populations of mosquitoes (O'Meara and Purcell, 1993).

Although stormwater entering retention systems is supposed to percolate into the ground within 72 hours, retention areas often remain wet for longer periods. Floodwater mosquitoes are normally the first to appear in retention areas. Later in the rainy season, it is not uncommon to

find *Culex* spp., especially if grass cuttings have been accumulating in these areas (O'Meara and Purcell, 1993).

Overall, abundant populations of pest and disease-vectoring mosquitoes are much more frequently associated with retention systems than they are with detention systems. Moreover, it is much easier to achieve long-term mosquito abatement in detention areas. Retention systems, however, are much more effective for improving water quality than are mere detention systems. Therefore, water management experts often recommend the installation of retention systems for new developments.

In Arizona, an additional consideration in regard to mosquitoes and constructed wetlands is the possibility that the presence of the dense vegetation itself in the wetland cells will act as an attractant for adult mosquitoes. Thus, even if the development of larvae is controlled by design and/or application of larvicidal agents, there could be some additional adult mosquitoes in and around the wetland.

Control Considerations

Local mosquito control programs should be actively involved in the planning and approval stages for all new stormwater management schemes. If retention areas are placed at these sites, then a dual retention/detention system might be the best approach for both stormwater management and mosquito abatement. With proper design and construction, excess water in the retention part of the system can be sent to the detention pond, thus reducing the chances for mosquito production (O'Meara and Purcell, 1993).

Detention ponds should receive only stormwater. Banks on detention ponds should be steep, but not too steep to hinder mowing and other maintenance activities. Deeper ponds are preferable to shallow ones (O'Meara and Purcell, 1993).

Weed control around ponds is important and proper maintenance procedures should be followed to prevent possible mosquito breeding areas. The presence of a mechanical aerator, such as a fountain in the middle of the pond, often makes the site more visually attractive, deters the growth of unwanted vegetation, and makes the habitat more suitable for fish (O'Meara and Purcell, 1993).

The bottoms of retention areas should be free of depressions where water might accumulate and remain for periods sufficient to allow mosquito production. Mowing and other maintenance operations should be done without producing ruts. Grass cuttings and other types of debris should be removed from retention areas. Long-term responsibilities for proper maintenance of retention areas should be clearly stipulated (O'Meara and Purcell, 1993).

Once a retention system has been installed at an inappropriate location (e.g., on a site where the water table is too close to the surface), not much can be done to change the situation without eliminating the system. Under these conditions, mosquitoes must be controlled with larvicide. For a larvicide operation to be effective, it must be supported with a quality inspection program. The widespread occurrence of potential mosquito breeding sites in retention areas greatly increases the costs and man-power needs of inspection programs. Perhaps, through educational programs directed at the general public, we could generate more service requests for the control of mosquito larvae and fewer for adult mosquito control (O'Meara and Purcell, 1993).

The mosquito problems generated by various types of detention/retention systems, their solutions and control costs, should not be neglected when local governments are in the process of creating stormwater utilities. However, these items probably will receive adequate attention only if representatives of the local mosquito control district actively participate in the design phase (O'Meara and Purcell, 1993).

The abundance of organic matter and the presence of high populations of microorganisms found in a constructed wetland appears to be a factor impacting mosquito population densities. Higher population densities of mosquitoes appear to be present in constructed wetlands compared to natural wetlands (Tennessen, 1993). The species found in greatest abundance is the genus *Culex*. They are called "filth breeders" because they are known to be attracted to the presence of high levels of organic material in wastewater (O'Meara and Evans, 1983). *Culex* ssp. will do well in high-quality treated-effluent or in stormwater if the water is present for an extended period of time.

In areas controlled by the Tennessee Valley Authority, a level of 0.25 larvae per dipper sample near human residences usually results in a request to apply adulticide (Tennessen, 1993). The presence of high populations of *Gambusia affinis* (mosquito fish) as well as invertebrate predators did not remove the problem with mosquitoes in studies conducted in Kentucky (Tennessen, 1993).

Some problems with controlling mosquitoes in a constructed wetland can be readily overcome during the initial engineering of the system. Narrow paths between cells should be widened to facilitate movement around the cells. These would permit better access around cells so that mowing or other heavy equipment could control tall weeds that tend to deflect application

materials from backpack blowers. Large cells tend to be more difficult to treat, thus increasing costs. Slug injection of insecticide would probably save effort, but it would require that dispersal of the material be adequate and reasonably uniform (Tennessen, 1993).

There is also potential for breeding "nuisance mosquitoes" in large numbers. "Floodwater mosquitoes," which include species in the genera *Psorophora* and *Aedes*, breed in areas where the ground is periodically flooded and re-flooded. Even though these mosquitoes are not disease vectors, they can be an annoyance to residents by virtue of their large numbers. The "arid wetland" cells will receive water periodically (up to 10 cm [4 inches] deep) to maintain soil saturation. The periodic soaking of soil may create large populations of floodwater mosquitoes as is known to occur in many desert areas.

The construction of a typical wetland will likely create habitat for "permanent water breeding mosquitoes" such as *Culex* and *Anopheles* species. These permanent water mosquitoes prefer breeding in shallow water with emergent vegetation that will be abundant through out any surface wetland. *Culex* mosquitoes, especially *Culex tarsalis*, is a known vector for mosquito-borne encephalitis viruses, including St. Louis encephalitis (SLE) and western equine encephalitis (WEE). Both of these viruses may be pathogenic to humans, and WEE is also pathogenic to horses. Both of these viruses have been isolated in mosquitoes collected in Maricopa County in past years (Table 1). A wetland will also attract birds to the area, and many birds serve as carriers of encephalitis virus and thus provide the source of virus to local mosquito populations. The proximity of these systems to development increases the public health concern (Levy, 1994).

With these concerns in mind, it is necessary to incorporate an effective mosquito surveillance and control program into the plan. Some of the mosquito prevention options include

Table 1. Maricopa County Mosquito Species.

Species	Vector Capability[a]	Other
Anopheles franciscanus		
Aedes dorsalis *Aedes nigromaculis* *Aedes vexans*	CE, EEE, WEE	Dog heartworm
Culex peus *Culex quinquefasciatus* *Culex tarsalis* *Culex thriambus*	SLE, WEE CE, SLE, WEE	
Culiseta incidens *Culiseta inornata*	JBE, SLE, WEE	
Psorophora confinnis[b] *Psorophora signipennis*		

[a] CE: California group Encephalitis
JBE: Japanese B Encephalitis
EEE: Eastern Equine Encephalitis
SLE: St. Louis Encephalitis
WEE: Western Equine Encephalitis

[b] These species lay their eggs on the ground. The eggs can lie dormant for months or years and hatch readily in the presence of water.

Sources:

1. G.A. Moshiri (ed.), *Constructed Wetlands for Water Quality Improvement*. Lewis Publishers, Boca Raton, Florida. 1993. p. 598.
2. T.G. Engethaler, Maricopa County Vector Control, Written communication. Phoenix, Arizona. 1995.
3. R. Matheson, *A Handbook of the Mosquitoes of North America*. Charles C. Thomas Publisher, Springfield, Illinois. 1929. p. 34.

modifying the habitat to prevent successful breeding, such as creating steeper banks, deeper water, and/or faster water flow or movement, etc. However, since these modifications would adversely affect the primary function of the project to treat wastewater, these alternatives are not an option (Levy, 1994).

Another option is to introduce natural controls into the habitat such as mosquito-eating fish, but the use of fish alone in the wetland/cells would not be sufficient to prevent all mosquito breeding. Successful mosquito control using fish is contingent upon (1) introducing an effective larvivore such as mosquito fish (*Gambusia affinis*), and (2) that the fish have easy access to the mosquito larvae. In the Tres Rios wetland/cells, the presence of emergent vegetation has reduced or denied accessability of fish to many isolated pockets of mosquito larvae. Also, the plan is contradictory in that it calls for introducing *Gambusia* into the wetland/cells, but also suggests using only native Arizona species. *Gambusia affinis* is not only an introduced species, but it tends to out-compete native Arizona fish such as top-minnow and pup fish. Unfortunately, using native fish species for mosquito control, such as pup fish or top minnow, is even less effective than *Gambusia* due to differences in feeding habits among the species. This does not preclude the introduction of fish (native or non-native) into the cells. It only suggests that fish alone will not control the mosquito problem (Levy, 1994).

The best (if not only) option/strategy to address the mosquito issue is to incorporate a plan that involves regular monitoring and control of mosquito breeding. Mosquito breeding should be checked weekly (preferably) by conducting "larval dipping surveys" and following up with application of an appropriate larvicide where breeding is found. A pupaecide, Altosid®, was used in Arcata, California, to control mosquitoes (Rogers, 1997). Altosid® is a sustained release

mosquito growth regulator that prevents adult mosquito emergence. This product is manufactured by Zoecon Corporation, Dallas, Texas. Altosid® should be not be applied to known fish habitat.

Another option is 5 percent Skeeter Abate®, an insecticide that is used for control of mosquito and midge larvae. This material is manufactured by Clarke Mosquito Control Products, Inc., Roselle, Illinois (1-800-323-5727). Skeeter Abate® can be toxic to birds, fish and other aquatic organisms. However, when applied at labeled rates, it has been shown not to affect non-target species and is approved for use in drinking water.

Larvicides with BTI (*Bacillus thuringiensis israeliensis*) are both effective and selective in killing mosquito larvae without affecting other aquatic invertebrates. BTI comes in granule, pellet, and liquid formulations. The granules and pellets can be applied safely and easily without expensive equipment. Other larvicide options are also available including growth regulators and mosquito larviciding oils. Whatever control measures are used, efficacy of larvicide treatments should be checked with post-treatment dipping surveys (Levy, 1994).

A recently developed alternative, *Bacillus sphaericus* (BS), has been produced by Abbott laboratories and is being tested in the metropolitan Phoenix area.

Developing an efficient and effective larviciding program will be easier and cheaper than developing a mosquito adulticiding program. However, an effective larviciding program is contingent upon (1) having access to mosquito breeding areas, (2) having staff and time available to conduct surveys and apply larvicides, and (3) having a budget for purchasing pesticide. The large area involved may require one half-time employee and sufficient larvicide to treat up to 16 acres every two weeks. The dense growth of vegetation such as cattail and bulrush may eventually

hamper mosquito surveillance and control efforts, so measures should also be taken to maintain accessability to shallow water environments (Levy, 1994).

Various other agents, such as Malathion and Pyrethrins, are available for control of adult mosquitoes. According to Clarke, Mosquito Control Products, Inc., Dursban® (ultra low volume), an adulticide, has been used successfully and is one of the least toxic organophosphates. These products, however, would not eliminate the potential breeding within the wetland cells. Dursban® also has been used as a prehatch preventative for mosquito larvae in detention basins (Melvin, 1998).

The public health and nuisance concerns associated with mosquito breeding are important issues, and they must be addressed (Levy, 1994).

For information regarding mosquitoes, contact

Arizona Department of Health Services
Disease Prevention Services
Vector-borne and Zoortic Disease Section
3815 North Black Canyon Highway
Phoenix Arizona 85015
(602)230-5918 or (602)230-5919

Department of Environmental Services
Division of Field Services
Office of Vector Control
4707 East Washington
Phoenix Arizona 85034
(602)273-0895

VII. RECOMMENDATIONS

Wetland Design

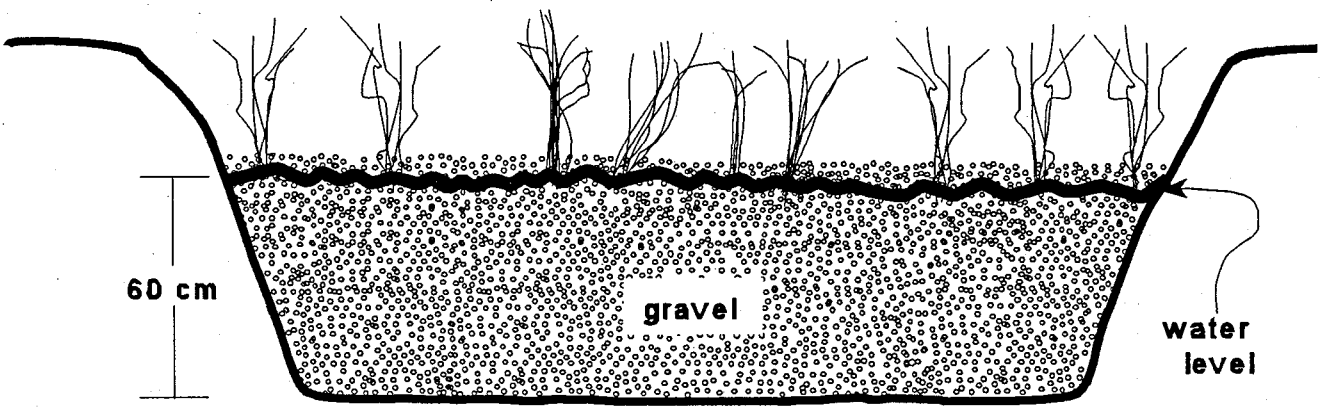
Four options are presented for the 48th Street Detention Basin facility and each of these is discussed briefly as to the pros and cons of the particular design option. It is recommended that one of the four design options be used at the site. The first option listed below is suggested as the best alternative for the proposed site.

The recommended option is to create a dual-cell subsurface flow wetland or vegetated treatment system (VTS). This design option will minimize any potential mosquito control problems and is likely to provide the most treatment per unit area. The biggest difficulties to the use of this alternative are the initial cost of the gravel and the potential for the gravel to clog over time. These systems have, however, proven to be effective at many sites and appear to be growing in popularity. One of the two cells of the VTS should be planted randomly with one or more plant species. The other cell should be unplanted and used to compare the treatment effectiveness of the planted cell versus a cell that contains only the gravel media (Figure 1). The water level in both cells should be maintained just below the surface of the gravel. During large storms, however, the cells could be flooded to a depth of 15 to 30 cm (6 to 12 inches) for brief periods without damage to the plants.

The second option is to create a "hybrid system" that will have a surface flow wetland appearance with the potential mosquito control ability of a subsurface flow wetland. This system would be operated typically as a surface flow wetland with water 15 to 30 cm (6 to 12 inches) above the gravel surface (Figure 2) with the side slope as regular and steeply sloping as possible. Planting beds would be about 30 m (100 feet) in width and alternating deep zones would be about

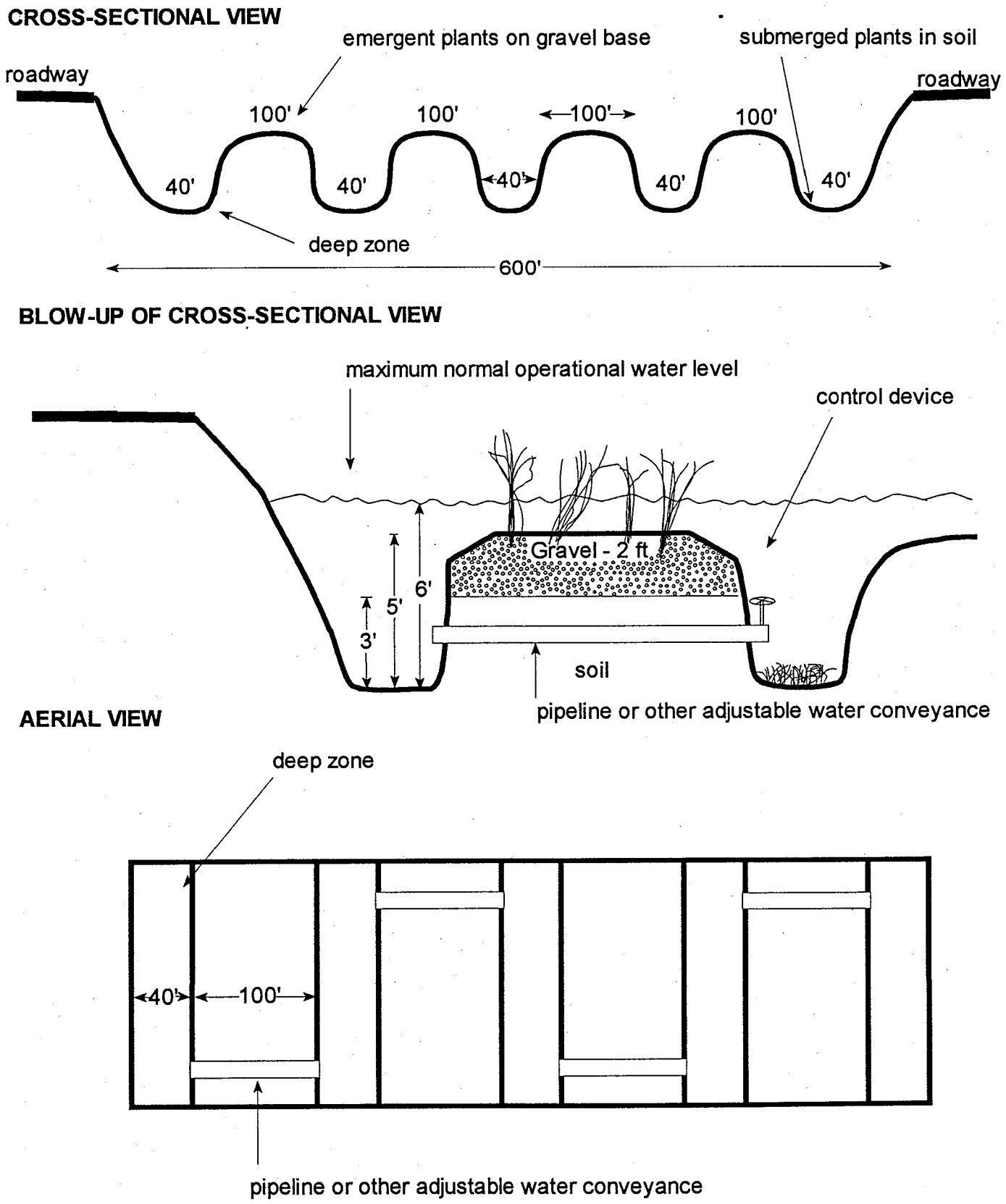
13 m (40 feet) in width. If mosquito larvae become a problem, water levels would be reduced to approximately 5 to 10 cm (2 to 4 inches) below the surface level of the gravel media. This lower water level should eliminate areas of exposed water covered by dense vegetation and thus also eliminate prime mosquito breeding habitat. Treatment would still occur as water flowed

Figure 1. Vegetated Treatment System (VTS).



through the planted gravel beds placed on the ridges of the wetland beds. *Gambusia* would retreat to deep water zones and mosquito larvae should be vulnerable in the open water of the deep zones. If clogging occurs in the gravel or more flow is required, water flow through pipes or another water conveyance set in the ridges along alternating sides of the wetland planting beds could be controlled with a valve or other flow device. Water would move from compartment to compartment, maintaining flow throughout the system. Again, this design would provide the appearance of a surface flow system with the potential benefit of maximum ability to control the development of mosquito larvae, although at a somewhat diminished treatment capacity. This system is currently under development and study at the Constructed Ecosystems Research Facility

Figure 2. "Hybrid" Free Water Surface/Subsurface Flow Wetland System.



in Tucson, but is not recommended at this time because it is costly, still in the experimental stage, and would require more operation and maintenance than the VTS system recommended above.

The third option is to construct a typical surface flow wetland with three deep zones placed at intervals of about 50 m (150 feet) with smaller open areas at the influent and effluent points. The shallow emergent zones would operate at 15 to 30 cm (6 to 12 inches) of water depth. The deep zones would be about 25 m (75 feet) in width and 1 to 1.5 m (4 to 6 feet) in depth set perpendicular to the water flow. This option is more traditional and would provide maximum treatment at minimal capital cost. It is also the most likely choice to create a mosquito breeding control problem. Therefore, this option is not recommended for the 48th Street Detention Basin project.

The forth option is to build an "arid wetland". This system is completely theoretical in concept and design. It would provide the most creative option for the possible use of wetlands in the drier areas of Arizona where there is little if any supplemental water available to maintain a more traditional wetland system. In this option, plant species used would be those native to cienegas in the deserts of south central Arizona (see Plant section above for suggested species). Mosquito control is an unexplored issue although the ability to dry out the system should decrease concern about *Culex* spp. Floodwater mosquitoes are a possible concern although the use of Dursban® as a prehatch treatment might address this issue. This option, however, would preclude the possibility of storing significant amounts of water within the wetland cells during particularly wet periods since the plant species within the "arid wetland" could not withstand long periods of deep water (30 cm [12 inches]). This alternative is not recommended, at this time, because of its theoretical nature.

Plants

If the recommended option is chosen, one of the two cells of the VTS should be planted randomly with both *Scirpus olneyi* (three-square bulrush) and *Scirpus validus* (soft-stem bulrush). The transplants should be placed about 1 m (3 feet) apart in alternating rows that are set perpendicular to the flow of water. This will provide an overall wetland appearance and some plant diversity. These two species have been grown successfully both in constructed wetlands in Arizona and in gravel media, and should be readily available from suppliers.

Emergent plants for the "hybrid" and surface flow wetland options should consist of the following species: *Scirpus validus* (soft-stem bulrush), *Phragmites australis* (common reed) and *Typha domingensis* (cattail). It is suggested that common reed be the predominant species in both the typical surface and "hybrid" systems. This is an aggressive species that has been used extensively for constructed wetlands, especially in Europe. Although common reed is not considered a noxious weed in Arizona and is found growing in Maricopa County, it could escape. Cattail could be used in place of common reed if there were concerns about its escaping. Cattail likely will enter the system without being purposely planted. The use of another species such as soft-stem bulrush would provide diversity to the plant community. As noted previously, little is known about submergent species for the deep zones. It is suggested, therefore, that potential suppliers be asked about availability and planting recommendations for the submergent species listed previously in the section on plants.

Soil

The planting substrate for the VTS should not contain soil. The cells should be filled to a depth of about 60 cm (2 feet) with 2.5 to 7.5 cm (1 to 3 inch) gravel. In the "hybrid" system,

plants will be placed in 2.5 cm (1 inch) gravel. The gravel depth would be 60 cm (2 feet). In the traditional wetland, it is recommended that a medium to sandy textured soil be used.

Mosquito Control

Mosquito breeding should not be an issue in the VTS except in small areas of surface water around contact boxes, etc. *Gambusia* should be added to the system in both the "hybrid" and traditional options. *Gambusia* will not be appropriate for either the VTS or the "arid wetland". For the "arid wetland", mosquito control would be similar to other detention/retention ponds currently operated by Arizona Department of Transportation.

Monitoring/Research

Monitoring of water quality should be conducted to establish and document the effectiveness of the system option(s) chosen for implementation. Water samples should be taken at least monthly and as required by storm events (Table 2).

Routine Maintenance

Routine maintenance and operational activities for any of the options discussed above should include most of the following:

1. Inspection for proper operation of all pumps and outflow gates as well as for appropriate water levels within the system [daily]
2. Removal or application of weed control agents for salt cedar, tumbleweed and other undesirable plant species [weekly during the growing season]
3. Mosquito larvae monitoring by dipping if surface water is present [weekly during the growing season (primarily during March through November)]

Table 2. Monitoring Parameters, Sampling Points and Suggested Frequency.

Parameter	Points	Suggested Minimum Frequency
Flow*	Inflow and Outflow	Daily
Water Stage*	In Each Cell	Daily
Biochemical Oxygen Demand (BOD_5)	Inflow and Outflow	Monthly/Following Each Event
Dissolved Organic Carbon (DOC)	Inflow and Outflow	Monthly/Following Each Event
Biodegradable Dissolved Organic Carbon (BDOC)	Inflow and Outflow	Monthly/Following Each Event
Total Suspended Solids (TSS)	Inflow and Outflow	Monthly/Following Each Event
pH	Inflow and Outflow	Monthly/Following Each Event
Dissolved Oxygen (DO)	Inflow and Outflow	Monthly/Following Each Event
Temperature	Inflow and Outflow	Monthly/Following Each Event
Conductivity	Inflow and Outflow	Monthly/Following Each Event
Nitrogen Species	Inflow and Outflow	Monthly/Following Each Event
Total Phosphorous	Inflow and Outflow	Monthly/Following Each Event
Chloride	Inflow and Outflow	Monthly/Following Each Event
Sulfate	Inflow and Outflow	Monthly/Following Each Event
Total and Fecal Coliform	Inflow and Outflow	Monthly/Following Each Event
Selected parasites and other microbial pathogens	Inflow and Outflow	Monthly/Following Each Event
Selected metals and other parameters	Inflow and Outflow	After Major Storm Events

* Equipment is available for remote monitoring of this parameter and for some of the other suggested parameters.

Safety and health concerns during sample collection are dependent on the types of contaminants in the stormwater. Metals and phosphorus, for instance, require caution in handling. They are skin irritants. Protection should be worn when handling contaminants like fecal coliform. Proper personal protection equipment is, therefore, recommended whenever water samples are collected.

4. Application of larvicides to the wetland system [weekly or as needed during the growing season]
5. Cleaning of trash and debris [monthly]
6. Inspection of embankments and structural integrity for signs of erosion or animal habitation; check fencing and other equipment and structures [monthly]
7. Repairs to system components [as required]

Active and aggressive control of water weeds and undesirable plant species is vital. Every effort should be made to eradicate all salt cedar plants as soon as observed by physical removal, including the roots. Use a preemergent herbicide for control of most other weeds outside the treatment cells. However, if preemergent herbicide application is unsuccessful in stopping weed growth, other weeds growing along the banks also should be physically removed or killed while still small by carefully applying Roundup®.

Harvesting of the plant biomass within the wetland cells is not a routine annual maintenance item from a treatment perspective. When needed, burning is the easiest and least expensive method to use. However, air quality problems within the Valley likely will preclude this option under most circumstances. Mechanical or hand harvesting, therefore, may occasionally be required. Data on harvesting frequency requirements do not exist and it is suggested that harvesting not be conducted, in general, as a routine maintenance activity.

It is estimated that during the start-up period, an average of about 16 hours of on-site time per week would be required to operate and maintain the wetland system, perform field measurements, monitoring and research, and collect water samples. After the start-up and research period are completed, routine operation and maintenance should require on average only

about 4 hours per week. Typically, one individual could carry out these activities although additional assistance would be required periodically. It also might be beneficial to occasionally have two employees work as a team for a shorter period of time.

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APPENDICES

APPENDIX A

Selected Arizona Wetland and Riparian Plants

Table A. Selected Arizona Wetland and Riparian Plants.[a]

Common Name and Species	Growth Form/ Habit	Hydrologic Regime	Soil/Substrate	Geographic Range	Elevation	Frequency of Occurrence	Comments
Alder *(Alnus oblongifolia)*	TR/SH	HY	SI/CO	CP/CH	5000-7500	FR	Often forms tall closed-canopy riparian woodland but also forms thickets along less stable water courses checking erosion; A. tenuifolia occurs at higher elevations (7500-9500') in Arizona
Annual rush *(Juncus bufonius)*	AN	HY/ME	CL/SA-T	BR	<3000	FR	The only annual rush, often very abundant over large areas
Arizona walnut *(Juglans major)*	TR	HY/ME	SI/CO	CH	4000-6000	FR	Large deciduous tree forming shady groves along streams and on flood plains; suspected of releasing allelopathogens into the soil; seedlings available through the Arizona State Land Department
Arrow-grass *(Triglochin concinna)*	PE	HY	NP	CP	6000-7000	IN	Rushlike perennial of wet soil; T. maritima also occurs in Arizona
Arrow-head *(Sagittaria cuneata)*	EM/SU	HY/SE-AQ	CI/SA	CP/CH/BR	<7000	IN	Leafy perennial spreading by rhizomes in wet soil; leaves submerged when water is present; similar species of Arizona include S. graminea, S. latifolia, S. longiloba, and S. greggii
Arrow-weed *(Tessaria sericea)*	PE	HY	CL/SA-T	BR	<4000	FR	Similar to seep-willow (Baccharis salicifolia) in habit and belongs to the same family; flowers pale lavender; often placed within the genus Pluchea
Azolla *(Azolla filiculoides)*	FL	AQ	N/A	CH/BR	2000-4000	IN	Clones of small leaves often cover large surface areas; technically a fern but similar in habit to the flowering plant Lemna (duck-weed)
Betony *(Stachys coccinea)*	PE	HY/ME	SI/CO	CH/BR	<8000	FR	Very attractive perennial with dark green leaves and bright red flowers; easily propagated; available from local nurseries
Bulrush *(Scirpus acutus)*	EM/PE	SE/HY	NP	CP/CH/BR	2500-9000	FR	Spreads by thick rhizomes forming dense tule-like masses of dark green terete stems generally ca. 2m tall (up to 5m); easily propagated by rhizomes; similar species or commonly-used synonyms include S. californicus (< 3500') and S. validus (2500-9000'); S. pallidus (<9000), S. americanus (< 6000'), and S. olneyi (< 7000,) have three-edged stems

Table A. (Continued)

Common Name and Species	Growth Form/ Habit	Hydrologic Regime	Soil/Substrate	Geographic Range	Elevation	Frequency of Occurrence	Comments
Bulrush *(Scirpus paludosus)*	EM/PE	SE/HY	NP	CH/BR	<5000	IN	Habit similar to sedges, generally < 1m tall
Button-bush *(Cephalanthus occidentalis)*	SH	HY/ME	SI/SA	CH/BR	<5000	IN	Handsome shrub to 2.5m tall with large leaves; prefers wet soil along streams
Cattail *(Typha domingensis)*	EM/PE	SE/HY	NP	CP/CH/BR	<4000	FR	Easily established, fast growing perennial spreading by rhizomes forming extensive thickets (tules) in shallow (< ca. 1m) water or mud; very important waterfowl habitat; seeds are wind- disperses en masse; shoots above ground die back each year
Cattail *(Typha latifolia)*	EM/PE	SE/HY	NP	CH/BR	3500-7500	IN	Very similar to T. dominguensis but occurs generally at higher elevations within Arizona
Columbine *(Aquilegia chrysantha)*	PE	HY/ME	SI/SA	CP/CH/BR	>3000	FR	Large showy bright green leaves and yellow flowers; shade tolerant; rhizomes easily divided and transplanted; this is the most common and widespread species but several others occur in Arizona
Cottonwood *(Populus angustifolia)*	TR	HY/ME	NP	CP/CH	5000-7000	FR	More similar in appearance to some willows (Salix) than to P. fremontii; P. acuminata is a species morpholocally intermediate between P. angustifolia and P. fremontii
Cottonwood *(Populus fremontii)*	TR	HY	NP	CH/BR	<6000	FR	Common and abundant deciduous tree with a large canopy; fruit wind-dispersed en masse
Coyote willow *(Salix exigua)*	SH	HY	SI/CO	CP/CH/BR	<9500	FR	Deciduous shrub spreading by rhizomes forming extensive tule-like areas along perennial waterways; easily propagated from shoots of the previous year
Duckweed *(Lemna gibba)*	FL	AQ	N/A	CP/CH/BR	<7000	FR	Often covers large surfaces of still or slow moving water; easily transplanted by casting a few live individuals; grows rapidly; an important species for waterfowl; although other species of the genus occur in Arizona, this is the most common and easily recognized; L. minor is also common

Table A. (Continued)

Common Name and Species	Growth Form/ Habit	Hydrologic Regime	Soil/Substrate	Geographic Range	Elevation	Frequency of Occurrence	Comments
Flat-sedge *(Cyperus niger)*	PE	HY/ME	SI/SA	CP/CH/BR	3000-7000	FR	One of the more common of ca. 25 species of the genus that occur in Arizona; similar in habit to the true sedge (Carex) but not as important in terms of bank stabilization
Godding willow *(Salix gooddingii)*	SH/TR	HY	SI/CO	CH/BR	<7000	FR	Common and abundant, often large deciduous tree of Arizona's middle and lower elevations; easily propagated from stems ca. 1" in diameter
Heliotrope *(Heliotropium curassavicum)*	PE	HY/ME	CL/SA-VT	CH/BR	<5000	FR	A low dark green succulent with small white flowers; often abundant but not usually dense
Hierba-mansa *(Anemopsis californica)*	PE	SE/ME	SI/SA-T	CH/BR	2000-5000	IN	Often forms thick masses in wet saline soil; frequently-used folk medicine
Horned-pondweed *(Zannichellia palustris)*	SU	AQ	N/A	CP/CH/BR	<8000	IN	The thin bright green grass-like leaves often occur in abundance near the surface of ponds and slow-moving waterways
Hornwort *(Ceratophyllum demersum)*	SU	AQ	N/A	CP/CH/BR	2000-6500	IN	Forms large masses under the surface of motionless or slow-moving water; restricts swimming and boat travel
Horsetail *(Equisetum laevigatum)*	EM/PE	SE/HY	SI/SA	CP/CH	4000-8000	FR	Spreads by rhizomes in wet and moist soils, often covering extensive areas; E. hiemale is another common species which occurs in Arizona
Knot grass *(Paspalum distichum)*	PE	HY	SI/SA	CH/BR	<4000	FR	Forms extensive stoloniferous masses along stream banks and in other areas of moist soil
Knotweed *(Polygonum amphibium)*	EM/PE	SE	NP	CP	5000-9000	FR	Often forms large masses in shallow water; the infloresences are tinged pink and conspicuous in full flower
Knotweed *(Polygonum bistortoides)*	PE	HY	NP	CH	8500-1100	FR	See P. fusiforme
Knotweed *(Polygonum coccineum)*	EM/PE	SE	NP	CP/CH/BR	2500-7000	IN	Similar to P. amphibium in habit but occurs also at lower elevations in Arizona
Knotweed *(Polygonum fusiforme)*	PE	HY	CL/SA	CH/BR	<4500	FR	One of several species of knotweed that often occur in abundance on wet soil; see also P. persicaria and P. bistortoides

Table A. (Continued)

Common Name and Species	Growth Form/ Habit	Hydrologic Regime	Soil/Substrate	Geographic Range	Elevation	Frequency of Occurrence	Comments
Knotweed *(Polygonum persicaria)*	PE	HY	NP	CP	5000-7000	FR	See P. fusiforme
Lobelia *(Lobelia cardinalis)*	PE	HY	CL/SA	CP/CH/BR	3000-7500	FR	The most common and abundant of the Arizona lobelias; often a significant element of the flora along water courses; flowers bright red and showy; rhizomes and corms are easily transplanted
Locust *(Robinia neomexicana)*	SH/TR	HY/ME	NP	CP/CH	4000-8500	FR	Large shrub or small tree with very showy clusters of white to violet flowers; large prickles deter pedestrian mobility; spreads by rhizomes forming large thickets; very fast growing and rhizomes easily transplanted
Manna grass *(Glyceria borealis)*	PE	HY	CL/SA	CP	7500-9000	FR	A tall graceful grass; three additional species occur in Arizona
Monkey-flower *(Mimulus cardinalis)*	PE	SE/HY	SI/CO	CP/CH/BR	2000-8500	IN	An attractive perennial with bright orange-red flowers; prefers seeps; similar to M. eastwoodiae, a stoloniferous species
Monkey-flower *(Mimulus guttatus)*	PE	SE/HY	SI/SA	CP/CH/BR	<9500	FR	Ubiquitous in wet soil; spreading by rhizomes and stolons; large and showy when in or near perennial water; flowers yellow; several other species of yellow monkey-flower occur in Arizona
Naiad *(Najas maritima)*	SU	AQ	N/A	BR	<4000	IN	
Nettle *(Urtica gracilis)*	HY	HY	CL/SA	CP/CH/BR	<9000	IN	Fast-growing leafy perennial spreading by rhizomes; herbage with stinging hairs
Paint-brush *(Castilleja minor)*	AN	HY	SI/SA	CP/CH/BR	3000-7500	IN	A thin annual to ca. 1m tall; top of stem has conspicuous red bracts when flowering
Panic grass *(Dichanthelium oligosanthes)*	PE	HY/ME	CL/SA	CH/BR	3000-6000	FR	Spreads by stolons; prefers moist sandy banks
Pepperwort *(Marsilea vestita)*	FL	AQ	N/A	CP/CH/BR	1500-7000	IN	The attractive clover-like leaves of this aquatic fern often cover large surface areas on still or slow-moving water

Table A. (Continued)

Common Name and Species	Growth Form/ Habit	Hydrologic Regime	Soil/Substrate	Geographic Range	Elevation	Frequency of Occurrence	Comments
Pink-stars *(Centaurium calycosum)*	AN	HY	SI/SA-T	CH/BR	<6000	FR	A thin annual of alkali seeps with showy pink flowers
Pondweed *(Potamageton crispus)*	SU	AQ	N/A	CH	3500-6000	IN	A species only recently discovered within Arizona which indicates that it is possibly a recent introduction; forms olive-green masses at and below the surface of still or slow-moving water no more than ca. 2m deep; the wavy margins of the leaves make them rather attractive
Pondweed *(Potamogeton foliosus)*	SU	AQ	NP	CP/CH/BR	<8500	FR	Forms green masses at and below the surface of still or slow-moving water gen. < ca. 1m deep; similar species that occur in Arizona are P. pectinatus (1000-5000'), P. pusillus (>6000'), and the submergent form of P. diversifolius (5000-7500')
Pondweed *(Potamogeton nodosus)*	FL	AQ/SE	NP	CP/CH/BR	<8000	FR	The oval leaves lie flat on the surface covering large areas where the water is no more than ca. 1m deep; similar species that occur in Arizona include P. natans (>8000'), P. gramineus (>5000), and the floating form of P. diversifolius (5000-7500')
Reed *(Phragmites communis)*	PE	HY	SI/SA-T	CH/BR	<6000	IN	Spreading by thick rhizomes to form extensive tule communities
Rose *(Rosa woodsii)*	SH	HY/ME	SI/CO	CP/CH	4000-9000	FR	Prickly shrubs spreading by rhizomes, often forming extensive masses along streambanks and moist in rocky drainage bottoms; flowers pink, showy; fruit valuable food for wildlife; the species is often split into several species or varieties
Rush *(Juncus balticus)*	EM/PE	SE/HY	CL/SA	CP/CH/BR	3000-7000	FR	A common species usually forming extensive, dense stands of wiry dark green stems; a good soil stabilizer; one of numerous species that occur in Arizona; rhizomes are easily divided and transplanted
Rush *(Juncus xiphioides)*	EM/PE	SE/HY	SI/CO	CP/CH/BR	>3500	FR	A common rush with flat, iris-like leaves; the group is taxonomically confusing and numerous synonyms are found in the literature

Table A. (Continued)

Common Name and Species	Growth Form/ Habit	Hydrologic Regime	Soil/Substrate	Geographic Range	Elevation	Frequency of Occurrence	Comments
Salt grass *(Distichlis spicata)*	PE	HY/ME	CL/SA-VT	CP/CH/BR	<7000	FR	This common sod-forming grass often occurs singularly in saline soils
Sedge *(Carex praegracilis)*	PE	HY	SI/SA	CP/CH	>3000	FR	Forms grass-like masses in wet meadows and along shallow waterways; an excellent soil stabilizer
Sedge *(Carex senta)*	PE	HY	SI/SA	CP/CH/BR	>2000	FR	One of the most common and elegant of the sedges; its roots, rhizomes and stems are very dense and are therefore useful for bank stabilization; ca. 50 species of Carex occur in Arizona and many are similar in habit and habitat preference to C. senta.
Sedge *(Carex siccata)*	PE	HY	SI/SA	CP	>8000	FR	A common sedge of higher elevations
Seep-willow *(Baccharis salicifolia)*	SH	HY/ME	SI/CO	CH/BR	<5000	FR	Often forming dense thickets 2-3m tall; not a true willow but similar to coyote willow (Salix exidua) but evergreen and more drought-tolerant; releases myriads of wind-born seeds in fall; often referred to as B. glutinosa
Spike-rush *(Eleocharis macrostachya)*	EM/PE	SE/HY	CL/SA-T	CP/CH/BR	<8000	IN	Although several species of spikerush occur in Arizona, this species is the most frequent and abundant
Spike-rush *(Eleocharis rostellata)*	EM/PE	SE/HY	CL/SA-T	CP/CH/BR	<8000	IN	One of the most salt-tolerant of the spike-rushes
Sycamore *(Platanus wrightii)*	TR	HY	NP	CH/BR	2000-6000	FR	Large deciduous tree with white trunks; often forming closed canopy riparian woodlands
Toad-flax *(Linaria texana)*	AN	HY/ME	SI/SA	CH/BR	1500-5000	IN	Tall annual with dark blue flowers
Triodanis *(Triodanis perfoliata)*	AN	HY/ME	CL/SI	CP/CH/BR	<7500	IN	In wet soil of warmer climates grows tall (ca. 1m) with showy purple flowers
Velvet ash *(Fraxinus velutina)*	TR	HY/ME	SI/CO	CP/CH/BR	2000-7000	FR	A common and abundant deciduous tree along intermittent and perennial streams especially in the mid-elevations of Arizona; morphologically variable; seedlings available through the Arizona State Land Department

Table A. (Continued)

Common Name and Species	Growth Form/ Habit	Hydrologic Regime	Soil/Substrate	Geographic Range	Elevation	Frequency of Occurrence	Comments
Water birch *(Betula fontinalis)*	TR/SH	HY/ME	NP	CP	7000-8000	IN	Primarily a streamside tree with smooth, glossy, red-brown bark
Water buttercup *(Ranunculus aquatilus)*	SU	AQ	NP	CP/CH	4500-9000	FR	Forms delicate masses of thin leaves and stems in shallow slow-moving or still water; flowers white, emergent; R. circinatus is a similar Arizona species
Water lupine *(Lupinus latifolius)*	PE	HY	SI/SA	CH	5000-6000	IN	Leafy perennial often forming large masses to 1.5m tall along waterways; flowers large but not colorful; common only in the Prescott area; L. latifolius var. leucanthus is the from found in Arizona and it is often referred to as L. parishii
Water speedwell *(Veronica anagallis-aquatica)*	EM/PE	SE/HY	NP	CP/CH/BR	<7000	FR	Forms leafy, often extensive, patches along perennial stream banks; V. americana (< 9500') is a similar Arizona species
Water-milfoil *(Myriophyllum sibiricum)*	SU/FL	AQ	N/A	CP/CH	5000-9000	IN	Forms masses of feathery vegetation on and below the surface of still or slow- moving water; M. brasiliense is also known from Arizona
Water-pimpernel *(Samolus valerandi)*	PE	SE/HY	NP	CH/BR	<5000	IN	An attractive perennial for its thin green leaves; often locally abundant along perennial streams
Water-plantain *(Alisma plantago-aquatica)*	EM	SE	CL/SA	CP/CH	4000-8000	FR	Similar to A. subcordatum
Water-plantain *(Alisma subcordatum)*	EM	SE	CL/SA	CP/CH	5000-7000	FR	Fibrous roots, leaves mostly emersed, blades broadly ovate, leaves occasionally floating, flowering in summer
Water-weed *(Elodea canadensis)*	FL/SU	AQ	N/A	CP/CH	4000-8000	IN	Forms masses on and below the surface of still or slow-moving water
Willow *(Salix laevigata)*	TR	HY	SI/CO	CP/CH/BR	2000-7000	FR	Large deciduous shrub or tree; easily propagated from green shoots ca. 1" in diameter; similar Arizona species include S. lasiolepis (4000-7500') and S. bonplandiana (5000-6500')

Table A. (Continued)

*This table illustrates the diversity of native plants that can be used in wetlands constructed for wastewater treatment. This list includes species, such as cattail that have long been associated with wetland wastewater treatment systems and other plants whose efficiency for wastewater treatment have not been demonstrated. Included with this list are general information regarding the geographic distribution within the state, frequency of occurance, typical hydrologic regime, soil preference, and elevational range. The availability in nurseries of these and other wetland plants not listed can not be quaranteed. During the early planning phases of a constructed wetland project, after funding and construction schedules are known, it would be prudent to contract-grow in advance those plants that will not be collected from wild populations.

(Growth Form/Habit = SHrub, TRee, PErennial herb, ANnual, VIne, SUbmergent, EMmergent, FLoating; Typical Hydrologic Regime = AQuatic, SEmi-aquatic, HYdroriparian, MEsoriparian; Soil Preference = CLay, SIlt, SAnd, GRavel, CObble, No Preference (When known the salt tolerance of a given species is included as a modifier as follows: Not Tolerant, Moderately Tolerant, Very Tolerant.); Geographic Range = Basin & Range, Central Highlands, Colorado Plateau Elevation Range = reported in feet above MSL Frequency of Occurance (Natural Populations) = INfrequent, FRequent, Frequent & Abundant.)

APPENDIX B

Noxious Weed Regulations and Noxious Weed Lists

facsimile
TRANSMITTAL

To: Martin Karpicak
University of Arizona

Fax #: 520/621-3816

Re: Noxious Weed Regulations and Noxious Weed Lists

Date: June 1, 1998

Pages: 1

Attached you will find copies of the Two Noxious Weed Regulations currently on the books. These are enforced by the Arizona Department of Agriculture. The Agency also enforces the Federal Noxious Weed Act of 1974.

Listed below are those **aquatic** or **semiaquatic** plant species regulated under the State's noxious weed regulations:

Catergory: Regulated Noxious Weeds
Floating Water Hyacinth *Eichhornia crassipes*

Catergory: Prohibited Noxious Weeds
Alligatorweed - *Alternantherea philozeroides*
Anchored Waterhyacinth - *Eichhornia azurea*
Aquatic Morningglory - *Ipomoea aquatica*
Hydrilla - *Hydrilla verticillata*
Purple Loosestrife - *Lythrum salicaria*
Torpedo Grass - *Panicum repens*
Water-chestnut - *Trapa natans*

When I faxed you the Noxious Weed Regulations earlier today I neglected to include Purple Loosestrife in the above list of regulated aquatic weeds. I apologize for any inconvenience this may have caused.

Thank you,
Everett

FROM:

Everett L. Hall
Noxious Weed Program Manager
Arizona Department of Agriculture
1688 West Adams Street
Phoenix, Arizona 85007

602/542-3309
Fax: 602/542-0999

State of Arizona
Noxious Weed Regulations

Regulation R3-4-244 "Regulated and Restricted Noxious Weeds"
Regulation R3-4-245 "Prohibited Noxious Weeds"

Plant Services Division
Arizona Department of Agriculture
August 1996

Definitions

Exotic Organism:

A plant or animal that is **NOT** native (indigenous) to the region, area or locale in which it occurs. It can be introduced intentionally or unintentionally.

Weed:

A plant that is competitive, persistent and pernicious. It interferes with human activities and as a result is **UNDESIRABLE.**[1]

Noxious Weed:

A weed **SPECIFIED BY LAW OR REGULATION** for being particularly undesirable, destructive and difficult to control.[2]

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1. Ross, Merrill and Carole A. Lembi "Applied Weed Science". Minneapolis: Burgess Publishing Company. 340pp. Illus. 1985.

2. California Weed Conference "Principles of Weed Control in California". El Macero, CA: Thomson Publications. 474pp. Illus. 1985.

Categories of Noxious Weeds

Regulated Noxious weeds

Regulated Noxious Weeds are those exotic plant species which are **WELL ESTABLISHED AND GENERALLY DISTRIBUTED** in Arizona. These plants are recognized to have undesirable characteristics and economic/environmental significance as to justify regulation under certain circumstances.

Restricted Noxious weeds

Restricted Noxious Weeds are those exotic plant species having noxious characteristics and are of economic and/or environmental significance. They **OCCUR** in Arizona in isolated infestations or very low populations.

Prohibited Noxious Weeds

Prohibited Noxious Weeds are those exotic plant species with known undesirable qualities of economic and/or environmental significance. The plants **ARE NOT KNOWN TO OCCUR** in Arizona.

Noxious Weed Regulations
Changes in Noxious Weed Listings

After July 1998

R3-4-245 "Prohibited Noxious Weeds"

Removed from regulation completely:
Kikuyugrass (*Pennisetum clandestinum*)

Added as a Prohibited Noxious Weed:
Tropical Soda-apple (*Solanum viarum*)

R3-4-244 "Restricted Noxious Weeds and Regulated Noxious Weeds

Moved from Restricted Noxious Weed Category and placed in Regulated Noxious Weed Category:
Floating Waterhyacinth (*Eichhornia crassipes*)

After September 1998

R3-4-244 "Restricted Noxious Weeds and Regulated Noxious Weeds"

Added as a Restricted Noxious Weed:
Sweet Resinbush (*Euryops subcarnosus* subsp. *vulgaris*)

ARIZONA DEPARTMENT OF AGRICULTURE
CHAPTER 4. PLANT SERVICES DIVISION

SECTION	ARTICLE 2. QUARANTINE
R3-4-244.	Regulated and Restricted Noxious Weeds
R3-4-245.	Prohibited Noxious Weeds

R3-4-244. Regulated and Restricted Noxious Weeds

A. Definitions. In addition to the definitions provided in A.R.S. § 3-201, the following shall apply to this rule:
   1. "Infested area" means each individual container in which the pest is found or the specific area which harbors the pest.
   2. "Regulated pest" means any of the following plant species, including viable plant parts (stolons, rhizomes, cuttings and seed, except agricultural, vegetable and ornamental seed for planting purposes), which are regulated noxious weeds:
      a. *Cenchrus echinatus* L. -- Southern sandbur
      b. *Cenchrus incertus* M.A. Curtis -- Field sandbur
      c. *Convolvulus arvensis* L. -- Field bindweed
      d. *Medicago* [redacted] *polymorpha* L. -- Burclover
      e. *Portulaca oleracea* L. -- Common purslane
      f. *Tribulus terrestris* L. -- Puncturevine
   3. "Restricted pest" means any of the following plant species, including viable plant parts (stolons, rhizomes, cuttings and seed, except agricultural, vegetable and ornamental seed for planting purposes), which are restricted noxious weeds:
      a. *Acroptilon repens* (L.) DC. -- Russian knapweed
      b. *Aegilops cylindrica* Host. -- Jointed goatgrass
      c. *Alhagi pseudalhagi* (Bieb.) Desv. -- Camelthorn
      d. *Cardaria draba* (L.) Desv. -- Globed-podded hoary cress (Whitetop)
      e. *Centaurea diffusa* L. -- Diffuse knapweed
      f. *Centaurea maculosa* L. -- Spotted knapweed
      g. *Centaurea solstitialis* L. -- Yellow starthistle (St. Barnaby's thistle)
      h. *Cuscuta* spp. -- Dodder
      i. *Eichhornia crassipes* (Mart.) Solms -- Floating waterhyacinth
      j. *Elytrigia repens* (L.) Nevski -- Quackgrass
      k. *Halogeton glomeratus* (M. Bieb.) C.A. Mey -- Halogeton
      l. *Helianthus ciliaris* DC. -- Texas blueweed
      m. *Ipomoea triloba* L. -- Three-lobed morning glory
      n. *Linaria genistifolia* var. *dalmatica* -- Dalmation toadflax
      o. *Onopordum acanthium* L. -- Scotch thistle

B. Area under quarantine: All infested areas within the state.

C. The following commodities are hosts or carriers of the regulated or restricted pest:
   1. All plants and plant parts other than those categorized as a regulated or restricted pest;
   2. Forage, straw and feed grains;
   3. Live and dead flower arrangements;
   4. Ornamental displays; and

5. Any appliance, construction or dredging equipment, boat, boat trailer or related equipment, or any other vehicle with soil attached or carrying plant debris.

D. The Department may quarantine any commodity or area infested or contaminated with a regulated pest and notify the owner or carrier of the restrictions and treatments listed in subsections (F) and (G). If the regulated pest is not quarantined, the Department shall provide the grower with technical information on effective weed control activities through integrated pest management.

E. The Department shall quarantine any commodity or area infested or contaminated with a restricted pest and shall notify the owner or carrier of the restrictions and treatments of the pest listed in subsections (F) and (G).

F. Restrictions.

1. No regulated or restricted pest or commodity infested or contaminated with a regulated or restricted pest shall be moved to a non-infested area unless the Director issues a permit for the transporting or propagating of such pest.
2. The owner or the owner's representative shall notify the Department at least two working days in advance of moving contaminated equipment from the infested area.
3. The Department may inspect all equipment within two working days after the request to inspect the equipment is made.

G. Treatments.

1. The owner or the owner's representative shall treat all soil and debris from the equipment used in the quarantined area to such a degree that it is free of the regulated or restricted pest before the equipment is moved from the infested area. Removal or destruction of the weed and weed seed shall be accomplished through one of the following methods:
   a. Autoclaving.
      i. Dry heat. The commodity shall be heated for 15 minutes at 212°F;
      ii. Steam heat. The commodity shall be heated for 15 minutes at 212°F.
   b. Fumigating with ethylene oxide, chamber only; The commodity shall be fumigated with 1,500 mg/L for four hours in a chamber pre-heated to 115-125°F.
   c. High pressure water spray;
   d. Crushing;
   e. Incinerating; or
   f. Burying in a sanitary landfill to a depth of six feet.
2. The owner or the owner's representative shall treat the infested area, including the area within the crop, rangeland, ditchbank, roadside, private property or body of water, with treatments based on an integrated pest management program appropriate to the commodity. The treatments shall take place under the direction of an inspector and shall include:
   a. Reshipment from the state;
   b. Manual removal;
   c. Application of a herbicide;
   d. Biological control including insects, fungi, nematodes or microbes; or
   e. Any other treatment approved by the Director.

EFFECTIVE July 10, 1995

R3-4-245. Prohibited Noxious Weeds

A. Definition. In addition to the definitions provided in A.R.S. § 3-201, the following shall apply to this rule:

1. "Infested area" means each individual container in which the pest is found, the specific area which

harbors the pest, or any shipment which has not been released to the receiver and is found to be infested with a pest.

2. "Pest" means any of the following plant species, including viable plant parts (stolons, rhizomes, cuttings and seed, except agricultural, vegetable and ornamental seed for planting purposes), which are prohibited noxious weeds:

a. *Alternanthera philoxeroides* (Mart.) Griseb. -- Alligator weed
b. *Cardaria chalepensis* (L.) Hand-Muzz -- Lens podded hoary cress
c. *Cardaria pubescens* (C.A. Mey) Jarmolenko -- Hairy whitetop
d. *Carduus acanthoides* L. -- Plumeless thistle
e. *Centaurea calcitrapa* L. -- Purple starthistle
f. *Centaurea iberica* Trev. ex Spreng. -- Iberian starthistle
g. *Centaurea sulphurea* L. -- Sicilian starthistle
h. *Centaurea squarrosa* Willd. -- Squarrose knapweed
i. *Chondrilla juncea* L. -- Rush skeletonweed
j. *Cirsium arvense* L. Scop. -- Canada thistle
k. *Coronopus squamatus* (Forskal) Ascherson -- Creeping wartcress (Coronopus)
l. *Cucumis melo* L. var. Dudaim Naudin -- Dudaim melon (Queen Anne's melon)
m. *Drymaria arenarioides* H.B.K. -- Alfombrilla (Lightningweed)
n. *Eichhornia azurea* (SW) Kunth. -- Anchored waterhyacinth
o. *Euphorbia esula* L. -- Leafy spurge
p. *Hydrilla verticillata* Royale -- Hydrilla (Florida-elodea)
q. *Ipomoea* spp. -- Morning glory. All species except *Ipomoea carnea*, Mexican bush morning glory; *Ipomoea triloba*, three-lobed morning glory (which is considered a restricted pest); and *Ipomoea aborescens*, morning glory tree.
r. *Isatis tinctoria* L. -- Dyers woad
s. *Lythrum salicaria* L. -- Purple loosestrife
t. *Nassella trichotoma* (Nees.) Hack. -- Serrated tussock
u. *Orobanche ramosa* L. -- Branched broomrape
v. *Panicum repens* L. -- Torpedo grass
w. *Peganum harmala* L. -- African rue (Syrian rue)
x. *Pennisetum clandestinum* Hochst. ex. Chiov. -- Kikuyu grass
y. *Rorippa austriaca* (Crantz.) Bess. -- Austrian fieldcress
z. *Senecio jacobaea* L. -- Tansy ragwort
aa. *Solanum carolinense* L. -- Carolina horsenettle
bb. *Sonchus arvensis* L. -- Perennial sowthistle
cc. *Stipa brachychaeta* Godr. -- Puna grass
dd. *Striga* spp. -- Witchweed
ee. *Trapa natans* L. -- Water-chestnut

B. Area under quarantine: All states, districts and territories of the United States except Arizona.

C. The following commodities are hosts or carriers of the pest:

1. All plants and plant parts other than those categorized as a pest;
2. Forage, straw and feed grains;
3. Live or dead flower arrangements;
4. Ornamental displays; and
5. Any appliance, construction or dredging equipment, boat, boat trailer or related equipment, or any other vehicle with soil attached or carrying plant debris.

D. The Department shall quarantine any commodity infested or contaminated with a pest and shall notify the owner or carrier of the methods of removing the pest from the commodity. The Department shall

reject any shipment not released to the receiver and reship to the shipper.

E. Restrictions:

1. No pest or commodity infested or contaminated with a pest shall be admitted into the state unless the Director issues a permit for the transporting or propagating of such pest.
2. The Department shall regulate the movement of the commodity out of a quarantined area within the state until the pest is eradicated. Any shipment or lot of a commodity infested or contaminated with a pest arriving in the state in violation of this quarantine shall, pursuant to A.R.S. § 3-205(A), be immediately reshipped from the state, or be treated or destroyed using one of the following methods:
   a. Fumigating with ethylene oxide, chamber only. The commodity shall be fumigated with 1,500 mg/L for four hours in a chamber pre-heated to 115-125°F;
   b. Incinerating;
   c. Burying in a sanitary landfill to a depth of six feet;
   d. Application of a herbicide; or
   e. Any other treatment approved by the Director.

EFFECTIVE July 10, 1995

Arizona Noxious weeds
Alphabetical Listing of Botanical Names

Acroptilon repens **- Asteraceae (R,I)**[1]
Russian Knapweed - Sunflower Family

Aegilops cylindrica **- Poaceae (R,I)**
Jointed Goatgrass - Grass Family

Alhagi pseudalhagi **- Fabaceae (R,I)**
Camelthorn - Legume Family

Alternanthera philoxeroides **- Onagraceae (P,U)**
Alligatorweed - Evening-primrose Family

Cardaria pubescens **- Brassicaceae (P,U)**
Hairy Whitetop - Mustard Family

Cardaria chalepensis **- Brassicaceae (P,U)**
Lens-podded Hoarycress - Mustard Family

Cardaria draba **- Brassicaceae (R,I)**
Globe-podded Hoarycress

Carduus acanthoides **- Asteraceae (P,U)**
Plumeless Thistle - Sunflower Family

Cenchrus incertus **- Poaceae (G,N)**
Southern Sandbur - Grass Family

Cenchrus echinatus **- Poaceae (G,A)**
Field Sandbur - Grass Family

Centaurea calcitrapa **- Asteraceae (P,U)**
Purple Starthistle - Sunflower Family

Centaurea diffusa **- Asteraceae (R,I)**
Diffuse Knapweed - Sunflower Family

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1. **(G) - Regulated Noxious Weeds (R) - Restricted Noxious Weeds (P) - Prohibited Noxious Weeds U - Not known to occur in Arizona; I - Introduced into Arizona; N - Naturalized after being introduced into Arizona; A - Native to Arizona.**

Centaurea iberica **- Asteraceae (P,U)**
Iberian Starthistle - Sunflower Family

Centaurea maculosa **- Asteraceae (R,I)**
Spotted Knapweed - Sunflower Family

Centaurea solstitialis **- Asteraceae (R,I)**
Yellow Starthistle - Sunflower Family

Centaurea squarrosa **- Asteraceae (P,U)**
Squarrose Knapweed - Sunflower Family

Centaurea sulphurea **- Asteraceae (P,U)**
Sicilian Starthistle - Sunflower Family

Chondrilla juncea **- Asteraceae (P,U)**
Rush Skeletonweed - Sunflower Family

Cirsium arvense **- Asteraceae (P,U)**
Canada Thistle - Sunflower Family

Convolvulus arvensis **- Convolvulaceae (G,N)**
Field Bindweed - Morning Glory Family

Coronopus squamatus - Brassicaceae (P,U)
Creeping Wartcress - Mustard Family

Cucumis melo var. dudaim **- Cucurbitaceae (P,U)**
Dudaim Melon - Cucurbit Family

Cuscuta **spp. - Convolvulaceae (R,I.A)**
Dodder - Morning Glory Family

Drymaria arenarioides **- Caryophyllaceae (P,U)**
Alfombrilla - Pink Family

Eichhornia azurea **- Ponteridaceae (P,U)**
Anchored Waterhyacinth - Pickerelweed Family

Eichhornia crassipes **- Ponteridaceae (G,I)**
Floating Waterhyacinth - Pickerelweed Family

Elytrigia repens **- Poaceae (R,I)**

Quackgrass - Grass Family

Euphorbia esula **- Euphorbiaceae (P.U)**
Leafy Spurge - Spurge Family

Halogeton glomeratus **- Chenopodiaceae (R,I)**
Halogeton - Goosefoot Family

Helianthus ciliaris **- Asteraceae (P,A)**
Blueweed - Sunflower Family

Hydrilla verticillata **- Hydrocharitaceae (P,U)**
Hydrilla - Frogs-bit Family

Ipomoea **spp. - Convolvulaceae (P,I,A)[2]**
Morning Glory - Morning Glory Family

Ipomoea triloba **- Convolvulaceae (R,I)**
Three-lobed Morning Glory

Isatis tinctoria **- Brassicaceae (R,U)**
Dyers Woad - Mustard Family

Linaria genistifolia **subsp.** ***dalmatica*** **- Schrophulariaceae (R,I)**
Dalmation Toadflax - Figwort Family

Lythrum salicaria **- Lythraceae (P,U)**
Purple Loosestrife - Loosestrife Family

Medicago polymorpha **- Fabaceae (G,N)**
Burclover - Legume Family

Nasella trichotoma **- Poaceae (P,U)**
Serrated Tussock - Grass Family

Onopordum acanthium **- Asteraceae (R,I)**
Scotch Thistle - Sunflower Family

Orobanche ramosa **- Orobanchaceae (P,U)**

---

2. **Excepting Morning Glory Tree (*I.arborescens*) and Mexican Morning Glory Bush (*I. fistulosa*). These species are not regulated in Arizona.**

Branched Broomrape - Broomrape Family

***Panicum repens* - Poaceae (P,U)**
Torpedo Grass - Grass Family

***Peganum harmala* - Zygophyllaceae (P,U)**
African Rue - Caltrop Family

Pennisetum clandestinum* - *Poaceae (P,U)
Kikuyu Grass - Grass Family

***Portulaca oleracea* - Portulaceae (G,N)**
Common Purslane - Portulaca Family

***Rorippa austriaca* - Brassicaceae (P,U)**
Austrian Fieldcress - Mustard Family

***Senecio jacobaea* - Asteraceae (P,U)**
Tansy Ragwort - Sunflower Family

***Solanum carolinense* - Solanaceae (P,U)**
Carolina Horsenettle - Nightshade Family

***Sonchus arvensis* - Asteraceae (P,U)**
Perennial Sowthistle - Sunflower Family

***Stipa brachychaeta* - Poaceae (P,U)**
Puna Grass - Grass Family

***Striga* spp. - Schrophulariaceae (P,U)**
Witchweed - Figwoirt Family

***Trapa natans* - Trapaceae (P,U)**
Water-chestnut - Water-chestnut Family

***Tribulus terrestris* - Zygophyllaceae (G,N)**
Puncture-vine - Caltrop Family

APPENDIX B

HEC-1 MODEL DOCUMENTATION AND CORRESPONDENCE

AND

NEWSVR48.OUT (HEC-1 MODEL PRINT-OUT)

Transmittal

HDR File No. 00167346

HDR Engineering, Inc.
Suite 250 Telephone
2141 E. Highland Ave. (602) 508-6600
Phoenix, Arizona 85016-4736

Date: Tuesday, April 06, 1999

48th Street Detention Basin Design
City of Phoenix
Street Transportation Department
Project No. ST83120008

To: **Art Glover, City of Phoenix**
Don Rerick, FCDMC
Javier Guana, ADOT

From: **Jerry Zovne**

Copy:

Re: **Revised HEC-1 Model**
Copy:

We Are Sending You: **Attached** **Via:** **Hand Deliver**
The Following Items:

Copies	Date	No.	Description
1ea	4/6/99	1	Memo on HEC-1 Model Revisions
1ea	4/6/99	1	HEC-1 printout & Diskette
1ea	4/1/99	1	Basin B outflow rating spreadsheet
1ea	3/99	1	I-10/sr202L Cross-culvert Design by DMJM

These are transmitted as indicated below:

For review by the respective agencies

Remarks:

Signed Jerry Zovne

To	Project Team/48th Street Basin Project
From	Jerry Zovne
Date	Tuesday, April 06, 1999
Subject	Hydrology- Revised HEC-1 24-hour Model ADOT RCB

HDR

Memorandum

I) Attached is the revised ADOT-SEVRDS HEC-1 model print-out and diskette w/ the model.

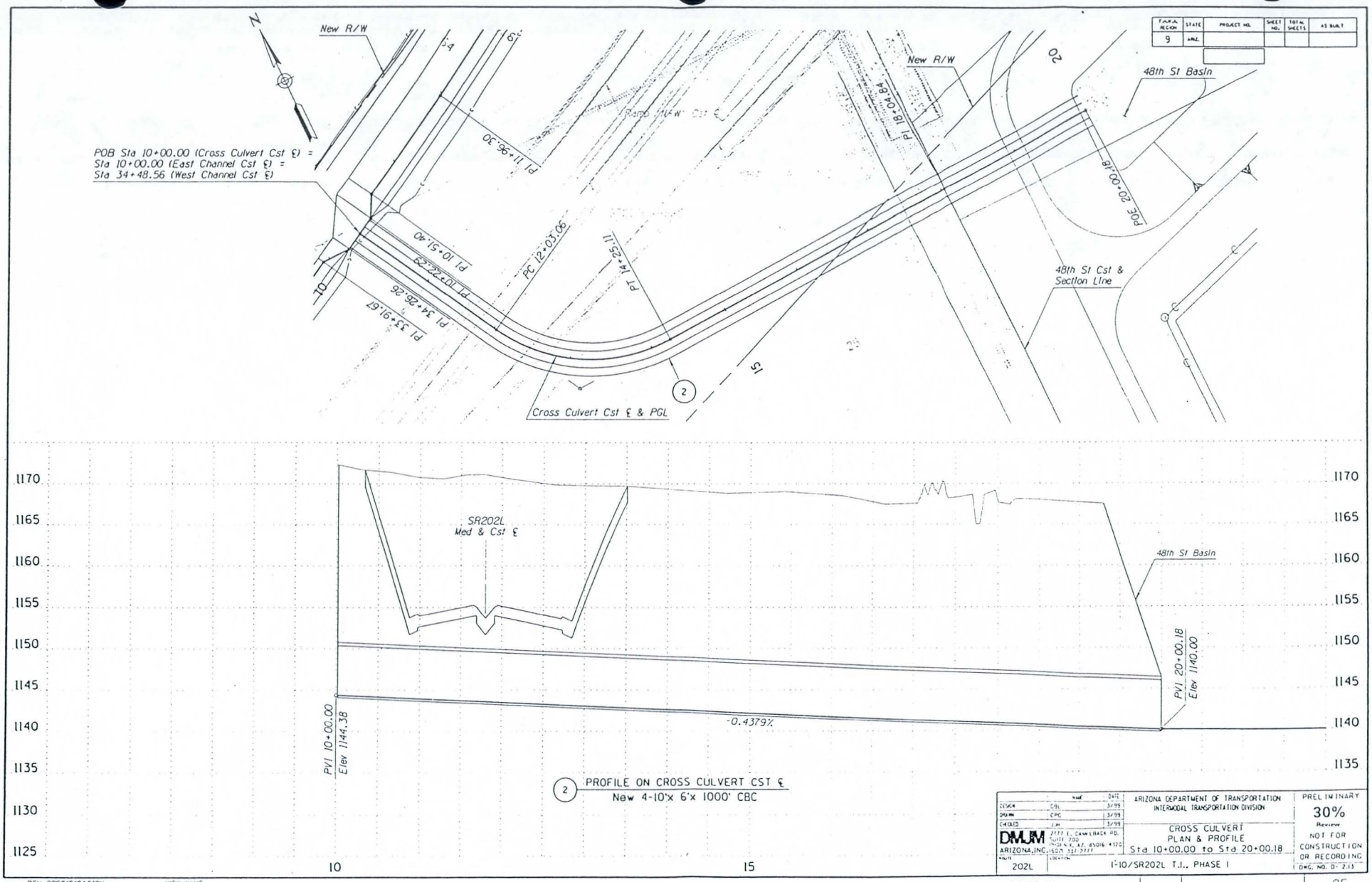
The model is proposed as the design model, and incorporates the following revisions from the previous model (SVRD48th):

1. A new Basin B outflow hydrograph from DMJM 4/2/99 replaces the previous outflow rating. The rating is attached. This replaces the entire SEVRDS HEC-1 model upstream of Basin B. The outflow was routed to I-10W to develop the hydrograph at the confluence of the Santan Channel and the outflow from the 48th Street overflow weir. The SEVRDS peak flow at I-10W is 905 cfs at 13.63(hr) without 48th Street added.
2. Five subbasins of HDR's 48th Street 24-hour (ADOT) HEC-1 model bordering the I-10/Santan TI (Pecos Road Connector) were modified by Premier Engineering for DMJM 3/30/99. (See *Preliminary Drainage Report (30% Design) Pecos Road Connector, March 1999*) These changes are noted in the HEC-1 model. They result in a minor increase in offsite drainage area.
3. As a result of Item 2, HDR reduced the size of subbasin B15 to the actual basin site area.
4. The 48th Street basin volume-elevation rating was adjusted to a maximum height of 1162. Several runs were made to set the appropriate weir elevation. The present model has an 8-foot weir set at elevation 1160. This results in a basin HWL of 1161.78 and a peak outflow of 57 cfs occurring at 23.97(hr). The combined flow at I-10W does not exceed the Basin B peak outflow of 905 cfs.

We believe this model serves the purposes of the respective agencies as the general basin design model.

II) The plan and profile of the ADOT RCB into the 48th Street basin was included in the Preliminary Drainage Report referred to above and the plan is attached. The plan shows an invert elevation of 1140. HDR has lowered the Equalization Basin elevation to 1140 in the model and this will reflected in the plans for the basin.

F.A.H.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	ARIZ.				



2 PROFILE ON CROSS CULVERT CST ℄
New 4-10'x 6'x 1000' CBC

	NAME	DATE
DESIGN	CBL	3/99
DRAWN	CPC	3/99
CHECKED	JJH	3/99

DMJM ARIZONA, INC. 2777 E. CAMELBACK RD. SUITE 700 PHOENIX, AZ. 85016-4120 (602) 337-2777

ARIZONA DEPARTMENT OF TRANSPORTATION
INTERMODAL TRANSPORTATION DIVISION

CROSS CULVERT
PLAN & PROFILE
Sta 10+00.00 to Sta 20+00.18

PRELIMINARY
30%
Review
NOT FOR CONSTRUCTION OR RECORDING

202L | I-10/SR202L T.I., PHASE I | D-G. NO. D- 2.13

TRACS NO. | OF

cccccDGNcSPECIFICATIONccccc
ccccSYSTIMEccccc
VIEW NAME:

sa01/prod/dgn/sldpp6.dgn Mar. 28, 1999 12:57:36 DMJM Arizona,Inc.

Zovne, Jerry

From: Zovne, Jerry
Sent: Friday, April 02, 1999 11:47 AM
To: 'Minch, Jeff'
Subject: RE: Basin B Preliminary Routing

Thanks Jeff. It is all there.

Have you routed the Outlet flows to the west side of I-10 where 48th Street will connect? I am substituting your outlet flow hydrograph from the spreadsheet into our SVRDS48th model and deleteing everything above that location. Then routing to the confluence to verify that 48th St. does not impact. This will be the ADOT 48th Street model that will be used to design the basin.

Have you made a determination on the RCB crossing into the 48th St. Basin Eq. Basin? We need the invert elevation of the outlet of that RCB for our Eq. Basin design.

Jerry Zovne

-----Original Message-----
From: Minch, Jeff [mailto:MinchJ@dmjm.com]
Sent: Thursday, April 01, 1999 11:14 AM
To: Zovne, Jerry
Cc: Lyles, Judy
Subject: RE: Basin B Preliminary Routing
Importance: High

The data should have been further down on the spreadsheet. I have attached another copy showing where the calculations begin. Inflow equals outflow when the calculations end. If you have any other questions, just let me know.

Jeff
<< File: hdr2.xls >>

-----Original Message-----
From: Zovne, Jerry [mailto:JZOVNE@hdrinc.com]
Sent: Thursday, April 01, 1999 10:01 AM
To: 'Minch, Jeff'
Subject: RE: Basin B Preliminary Routing

Jeff:
The attached file has links to other documents that were not sent. The only data filled in on the sheet is Time. Please resend the full document. I will be sending you the revised 48th Street ADOT /HEC-1 file this afternoon or tomorrow.

Thanks!

Jerry Zovne
602 508-6696

-----Original Message-----
From: Minch, Jeff [mailto:MinchJ@dmjm.com]
Sent: Thursday, March 25, 1999 4:16 PM
To: 'Jerry Zovne'
Cc: Lyles, Judy; Waung, Paul
Subject: Basin B Preliminary Routing
Importance: High

Jerry:

I have attached the most current routing spreadsheet for the Basin B complex for your use on determining the impact of the 48th Street Basin on the Santan Outfall Channel. Could you send your most current HEC-1 model for the revised 48th Street Basin. ADOT (Tony Regis) asked that we to incorporate your revised basin into the I-10/SR202L Pecos Road Connector, Phase I, 30% submittal. Thank you for your assistance.

Jeff

<< File: Book2.xls >>

BASIN COMPLEX ROUTING

Time (hrs)	Inflow (cfs)	Inflow Σ Vol. ac-ft	Q (cfs) into Eq. Basin	Controlling WSE (ft)	Eq. Bsn & Forebay Tot. Vol.	Outlet Siphon Q (cfs)	Weir Q (cfs)	Weir Coeff. C_{RATIO}	Weir Coeff. C_{sub}	Weir Vol. Into Basin B (ac-ft)	Continuity Check Inflow= Outflow	Basin B WSE (ft)	Total Storage (ac-ft)	From HEC-RAS Model Gila Drain WSE (ft)	Kyrene WSE (ft)	Inlet WSE (ft)	Comments
10.00																	
10.08																	
10.17																	
10.25																	
10.33																	
10.42																	
10.50	0	0.00															
10.58	0	0.00															
10.67	0	0.00															
10.75	0	0.00	0														
10.83	1	0.01	1	1138.5	0.0								0.01				
10.92	8	0.06	8	1138.6	0.1								0.06				
11.00	15	0.17	15	1138.7	0.2								0.17				
11.08	10	0.23	10	1138.7	0.2								0.23				
11.17	7	0.28	7	1138.8	0.3								0.28				
11.25	5	0.32	5	1138.8	0.3								0.32				
11.33	4	0.34	4	1138.8	0.3								0.34				
11.42	4	0.37	4	1138.9	0.4								0.37				
11.50	5	0.41	5	1138.9	0.4								0.41				
11.58	10	0.48	10	1139.0	0.5								0.48				
11.67	14	0.57	14	1139.1	0.6								0.57				
11.75	27	0.76	27	1139.3	0.8								0.76				
11.83	42	1.05	42	1139.6	1.0								1.05				
11.92	48	1.38	48	1139.8	1.4								1.38				
12.00	49	1.71	49	1140.0	1.7								1.71				
12.08	48	2.05	48	1140.2	2.0								2.05				
12.17	112	2.82	112	1140.6	2.8								2.82				
12.25	338	5.14	338	1141.9	5.1								5.14				
12.33	624	9.44	624	1143.9	9.4								9.44				
12.42	806	14.99	806	1145.8	15.0								14.99				
12.50	941	21.47	941	1147.8	21.5	0					0		21.47				
12.58	1044	28.66	914	1149.7	28.7	130					0		28.66				
12.67	1115	36.34	679	1151.6	36.3	436	0	0.00	1.00	0.00	0	1129.3	36.34				
12.75	1146	44.24	0	1153.0	42.6	755	391	0.00	1.00	2.70	0	1129.7	45.32				
12.83	1350	53.53		1153.1	43.0	775	575	0.00	1.00	6.66	0	1130.3	49.66				
12.92	1713	65.33		1153.2	43.6	806	907	0.00	1.00	12.90	0	1131.2	56.48				
13.00	1991	79.04		1153.3	44.0	828	1163	0.00	1.00	20.91	0	1131.9	64.88				
13.08	2196	94.17		1153.4	44.2	843	1353	0.00	1.00	30.23	0	1132.7	74.47				
13.17	2359	110.41		1153.4	44.5	855	1504	0.00	1.00	40.58	0	1133.5	85.04				
13.25	2523	127.79		1153.4	44.7	866	1657	0.00	1.00	52.00	0	1134.4	96.65				
13.33	2683	146.27		1153.5	44.8	877	1806	0.00	1.00	64.44	0	1135.4	109.28				
13.42	2800	165.55		1153.5	45.0	884	1916	0.00	1.00	77.63	0	1136.3	122.61				
13.50	2870	185.32		1153.5	45.1	888	1982	0.00	1.00	91.28	0	1137.1	136.33				
13.58	**2890**	**205.22**		**1153.5**	**45.1**	**890**	**2000**	**0.00**	**1.00**	**105.06**	**0**	**1137.9**	**150.13**				
13.67	2826	224.68		1153.5	45.0	886	1940	0.00	1.00	118.42	0	1138.7	163.43				
13.75	2656	242.98		1153.5	44.8	875	1781	0.00	1.00	130.69	0	1139.4	175.50				
13.83	2382	259.38		1153.4	44.5	857	1525	0.00	1.00	141.19	0	1140.0	185.68				
13.92	2107	273.89		1153.3	44.1	837	1270	0.00	1.00	149.94	0	1140.5	194.07				
14.00	1958	287.38		1153.3	43.9	826	1132	0.00	1.00	157.74	0	1140.9	201.67				
14.08	2015	301.25		1153.3	44.0	830	1185	0.00	1.00	165.90	0	1141.4	209.91				
14.17	2139	315.98		1153.3	44.2	839	1300	0.00	1.00	174.85	0	1141.8	219.02				
14.25	2138	330.71		1153.3	44.2	839	1299	0.00	1.00	183.80	0	1142.3	227.97				
14.33	2071	344.97		1153.3	44.1	834	1237	0.00	1.00	192.32	0	1142.8	236.40				
14.42	2020	358.88		1153.3	44.0	830	1190	0.00	1.00	200.51	0	1143.2	244.52				
14.50	1982	372.53		1153.3	44.0	828	1154	0.00	1.00	208.46	0	1143.6	252.42				
14.58	1968	386.09		1153.3	43.9	826	1142	0.00	1.00	216.32	0	1144.0	260.26				
14.67	1953	399.54		1153.3	43.9	825	1128	0.00	1.00	224.09	0	1144.4	268.01				
14.75	1912	412.71		1153.3	43.9	822	1090	0.00	1.00	231.60	0	1144.8	275.46				
14.83	1849	425.44		1153.2	43.8	817	1032	0.00	1.00	238.70	0	1145.2	282.48				
14.92	1783	437.72		1153.2	43.7	812	971	0.00	1.00	245.39	0	1145.6	289.07				
15.00	1737	449.68		1153.2	43.6	808	929	0.00	1.00	251.79	0	1145.9	295.40				

BASIN COMPLEX ROUTING

Time (hrs)	Inflow (cfs)	Inflow Σ Vol. ac-ft	Q (cfs) into Eq. Basin	Controlling WSE (ft)	Eq. Bsn & Forebay Tot. Vol.	Outlet Siphon Q (cfs)	Weir Q (cfs)	Weir Coeff. C_{RATIO}	Weir Coeff. C_{sub}	Weir Vol. Into Basin B (ac-ft)	Continuity Check Inflow= Outflow	Basin B WSE (ft)	Total Storage (ac-ft)	From HEC-RAS Model Gila Drain WSE (ft)	Kyrene WSE (ft)	Inlet WSE (ft)	Comments
15.08	1685	461.29		1153.2	43.5	804	881	0.00	1.00	257.86	0	1146.2	301.39				
15.17	1625	472.48		1153.2	43.4	799	826	0.00	1.00	263.54	0	1146.5	306.99				
15.25	1576	483.33		1153.2	43.4	795	781	0.00	1.00	268.92	0	1146.8	312.29				
15.33	1531	493.88		1153.1	43.3	791	740	0.00	1.00	274.02	0	1147.0	317.32				
15.42	1492	504.15		1153.1	43.2	788	704	0.00	1.00	278.87	0	1147.2	322.11				
15.50	1465	514.24		1153.1	43.2	785	680	0.00	1.00	283.56	0	1147.5	326.75				
15.58	1424	524.05		1153.1	43.1	782	642	0.00	1.00	287.98	0	1147.7	331.11				
15.67	1373	533.51		1153.1	43.0	777	596	0.00	1.00	292.08	0	1147.9	335.12				
15.75	1304	542.49		1153.1	42.9	770	534	0.00	1.00	295.76	0	1148.1	338.68				
15.83	1196	550.72		1153.0	42.7	760	436	0.00	1.00	298.77	0	1148.2	341.49				
15.92	1075	558.13		1153.0	42.5	747	328	0.00	1.00	301.03	0	1148.3	343.51				
16.00	1001	565.02		1152.9	42.3	738	263	0.00	1.00	302.84	0	1148.4	345.17				
16.08	1033	572.13		1152.9	42.4	742	291	0.00	1.00	304.84	0	1148.5	347.24				
16.17	1131	579.92		1153.0	42.6	753	378	0.00	1.00	307.45	0	1148.7	350.04				
16.25	1155	587.88		1153.0	42.6	756	399	0.00	1.00	310.20	0	1148.8	352.84				
16.33	1128	595.65		1153.0	42.6	753	375	0.00	1.00	312.78	0	1148.9	355.37				
16.42	1098	603.21		1153.0	42.5	749	349	0.00	1.00	315.18	0	1149.0	357.72				
16.50	1074	610.61		1153.0	42.5	747	327	0.00	1.00	317.44	0	1149.1	359.92				
16.58	1052	617.85		1153.0	42.4	744	308	0.00	1.00	319.56	0	1149.3	362.00				
16.67	1031	624.95		1152.9	42.4	742	289	0.00	1.00	321.55	0	1149.3	363.95				
16.75	1010	631.91		1152.9	42.4	739	271	0.00	1.00	323.42	0	1149.4	365.77				
16.83	993	638.75		1152.9	42.3	737	256	0.00	1.00	325.18	0	1149.5	367.50				
16.92	988	645.55		1152.9	42.3	737	251	0.00	1.00	326.91	0	1149.6	369.22				
17.00	973	652.25		1152.9	42.3	735	238	0.00	1.00	328.54	0	1149.7	370.82				
17.08	943	658.75		1152.9	42.2	732	211	0.00	1.00	330.00	0	1149.8	372.22				
17.17	919	665.08		1152.9	42.2	729	190	0.00	1.00	331.31	0	1149.8	373.47				
17.25	902	671.29		1152.9	42.1	727	175	0.00	1.00	332.52	0	1149.9	374.64				
17.33	886	677.39		1152.9	42.1	725	161	0.00	1.00	333.63	0	1149.9	375.72				
17.42	871	683.39		1152.9	42.1	723	148	0.00	1.00	334.65	0	1150.0	376.70				
17.50	855	689.28		1152.9	42.0	721	134	0.00	1.00	335.58	0	1150.0	377.59				
17.58	842	695.08		1152.8	42.0	719	123	0.00	1.00	336.43	0	1150.1	378.41				
17.67	835	700.83		1152.8	42.0	718	117	0.00	1.00	337.23	0	1150.1	379.20				
17.75	834	706.57		1152.8	42.0	718	116	0.00	1.00	338.03	0	1150.2	380.00				
17.83	783	711.96		1152.8	41.9	711	72	0.00	1.00	338.52	0	1150.2	380.37				
17.92	691	716.72		1152.7	41.4	686	5	0.00	1.00	338.55	0	1150.2	379.94				
18.00	628	721.05		1152.5	40.2	628	0	0.00	1.00	338.55	0	1150.2	378.80				
18.08	663	725.61		1152.6	40.9	663	0	0.00	1.00	338.55	0	1150.2	379.48				
18.17	775	730.95		1152.8	41.8	710	65	0.00	1.00	339.00	0	1150.2	380.83				
18.25	839	736.73		1152.8	42.0	719	120	0.00	1.00	339.83	0	1150.3	381.81				
18.33	851	742.59		1152.9	42.0	720	131	0.00	1.00	340.73	0	1150.3	382.74				
18.42	848	748.43		1152.9	42.0	720	128	0.00	1.00	341.61	0	1150.3	383.61				
18.50	845	754.25		1152.8	42.0	719	126	0.00	1.00	342.48	0	1150.4	384.47				
18.58	841	760.04		1152.8	42.0	719	122	0.00	1.00	343.32	0	1150.4	385.31				
18.67	840	765.83		1152.8	42.0	719	121	0.00	1.00	344.16	0	1150.5	386.14				
18.75	840	771.61		1152.8	42.0	719	121	0.00	1.00	344.99	0	1150.5	386.97				
18.83	841	777.40		1152.8	42.0	719	122	0.00	1.00	345.83	0	1150.5	387.82				
18.92	842	783.20		1152.8	42.0	719	123	0.00	1.00	346.68	0	1150.6	388.67				
19.00	844	789.02		1152.8	42.0	719	125	0.00	1.00	347.54	0	1150.6	389.53				
19.08	846	794.84		1152.8	42.0	719	127	0.00	1.00	348.41	0	1150.7	390.41				
19.17	850	800.70		1152.9	42.0	720	130	0.00	1.00	349.31	0	1150.7	391.31				
19.25	863	806.64		1152.9	42.0	722	141	0.00	1.00	350.28	0	1150.8	392.32				
19.33	865	812.60		1152.9	42.0	722	143	0.00	1.00	351.27	0	1150.8	393.31				
19.42	853	818.47		1152.9	42.0	720	133	0.00	1.00	352.18	0	1150.9	394.19				
19.50	848	824.31		1152.9	42.0	720	128	0.00	1.00	353.07	0	1150.9	395.07				
19.58	849	830.16		1152.9	42.0	720	129	0.00	1.00	353.96	0	1150.9	395.96				
19.67	845	835.98		1152.8	42.0	719	126	0.00	1.00	354.82	0	1151.0	396.81				
19.75	819	841.62		1152.8	41.9	716	103	0.00	1.00	355.53	0	1151.0	397.46				
19.83	747	846.76		1152.8	41.8	706	41	0.00	1.00	355.81	0	1151.0	397.56				
19.92	646	851.21		1152.5	40.6	646	0	0.00	1.00	355.81	0	1151.0	396.41				
20.00	579	855.20		1152.2	39.3	579	0	0.00	1.00	355.81	0	1151.0	395.08				
20.08	622	859.48		1152.4	40.1	622	0	0.00	1.00	355.81	0	1151.0	395.94				

BASIN COMPLEX ROUTING

Time (hrs)	Inflow (cfs)	Inflow Σ Vol. ac-ft	Q (cfs) into Eq. Basin	Controlling WSE (ft)	Eq. Bsn & Forebay Tot. Vol.	Outlet Siphon Q (cfs)	Weir Q (cfs)	Weir Coeff. C_{RATIO}	Weir Coeff. C_{sub}	Weir Vol. Into Basin B (ac-ft)	Continuity Check Inflow= Outflow	Basin B WSE (ft)	Total Storage (ac-ft)	From HEC-RAS Model Gila Drain WSE (ft)	Kyrene WSE (ft)	Inlet WSE (ft)	Comments
20.17	756	864.69		1152.8	41.8	708	48	0.00	1.00	356.14	0	1151.1	397.93				
20.25	828	870.39		1152.8	42.0	717	111	0.00	1.00	356.91	0	1151.1	398.86				
20.33	845	876.21		1152.8	42.0	719	126	0.00	1.00	357.77	0	1151.1	399.77				
20.42	846	882.04		1152.8	42.0	719	127	0.00	1.00	358.65	0	1151.2	400.64				
20.50	847	887.87		1152.9	42.0	720	127	0.00	1.00	359.52	0	1151.2	401.52				
20.58	848	893.71		1152.9	42.0	720	128	0.00	1.00	360.41	0	1151.2	402.41				
20.67	849	899.56		1152.9	42.0	720	129	0.00	1.00	361.30	0	1151.3	403.30				
20.75	850	905.41		1152.9	42.0	720	130	0.00	1.00	362.19	0	1151.3	404.20				
20.83	852	911.28		1152.9	42.0	720	132	0.00	1.00	363.10	0	1151.4	405.11				
20.92	853	917.16		1152.9	42.0	720	133	0.00	1.00	364.01	0	1151.4	406.02				
21.00	855	923.04		1152.9	42.0	721	134	0.00	1.00	364.94	0	1151.5	406.95				
21.08	855	928.93		1152.9	42.0	721	134	0.00	1.00	365.86	0	1151.5	407.88				
21.17	855	934.82		1152.9	42.0	721	134	0.00	1.00	366.79	0	1151.5	408.81				
21.25	856	940.72		1152.9	42.0	721	135	0.00	1.00	367.72	0	1151.6	409.74				
21.33	855	946.60		1152.9	42.0	721	134	0.00	1.00	368.65	0	1151.6	410.66				
21.42	856	952.50		1152.9	42.0	721	135	0.00	1.00	369.58	0	1151.7	411.60				
21.50	855	958.39		1152.9	42.0	721	134	0.00	1.00	370.51	0	1151.7	412.52				
21.58	856	964.28		1152.9	42.0	721	135	0.00	1.00	371.44	0	1151.8	413.46				
21.67	854	970.17		1152.9	42.0	720	134	0.00	1.00	372.36	0	1151.8	414.37				
21.75	824	975.84		1152.8	41.9	717	107	0.00	1.00	373.10	0	1151.8	415.04				
21.83	741	980.94		1152.8	41.7	704	37	0.00	1.00	373.35	0	1151.8	415.06				
21.92	634	985.31		1152.5	40.4	634	0	0.00	1.00	373.35	0	1151.8	413.72				
22.00	565	989.20		1152.2	39.0	565	0	0.00	1.00	373.35	0	1151.8	412.34				
22.08	609	993.40		1152.4	39.9	609	0	0.00	1.00	373.35	0	1151.8	413.22				
22.17	752	998.57		1152.8	41.8	707	45	0.00	1.00	373.66	0	1151.9	415.44				
22.25	836	1004.33		1152.8	42.0	718	118	0.00	1.00	374.47	0	1151.9	416.44				
22.33	856	1010.23		1152.9	42.0	721	135	0.00	1.00	375.40	0	1151.9	417.42				
22.42	870	1016.22		1152.9	42.1	722	148	0.00	1.00	376.42	0	1152.0	418.47				
22.50	869	1022.20		1152.9	42.0	722	147	0.00	1.00	377.43	0	1152.0	419.48				
22.58	857	1028.11		1152.9	42.0	721	136	0.00	1.00	378.37	0	1152.1	420.39				
22.67	851	1033.97		1152.9	42.0	720	131	0.00	1.00	379.27	0	1152.1	421.27				
22.75	849	1039.81		1152.9	42.0	720	129	0.00	1.00	380.16	0	1152.2	422.16				
22.83	848	1045.65		1152.9	42.0	720	128	0.00	1.00	381.04	0	1152.2	423.04				
22.92	847	1051.49		1152.9	42.0	720	127	0.00	1.00	381.92	0	1152.2	423.92				
23.00	845	1057.31		1152.8	42.0	719	126	0.00	1.00	382.78	0	1152.3	424.78				
23.08	844	1063.12		1152.8	42.0	719	125	0.00	1.00	383.64	0	1152.3	425.63				
23.17	843	1068.93		1152.8	42.0	719	124	0.00	1.00	384.50	0	1152.4	426.49				
23.25	841	1074.72		1152.8	42.0	719	122	0.00	1.00	385.34	0	1152.4	427.32				
23.33	839	1080.50		1152.8	42.0	719	120	0.00	1.00	386.17	0	1152.4	428.15				
23.42	838	1086.27		1152.8	42.0	718	120	0.00	1.00	386.99	0	1152.5	428.97				
23.50	836	1092.02		1152.8	42.0	718	118	0.00	1.00	387.80	0	1152.5	429.78				
23.58	835	1097.78		1152.8	42.0	718	117	0.00	1.00	388.61	0	1152.6	430.58				
23.67	838	1103.55		1152.8	42.0	718	120	0.00	1.00	389.43	0	1152.6	431.41				
23.75	817	1109.17		1152.8	41.9	716	101	0.00	1.00	390.13	0	1152.6	432.06				
23.83	731	1114.21		1152.8	41.6	700	31	0.00	1.00	390.34	0	1152.6	431.99				
23.92	610	1118.41		1152.4	39.9	610	0	1.00	0.00	390.34	0	1152.6	430.23				
24.00	523	1122.01		1152.0	38.2	523	0	1.00	0.00	390.34	0	1152.6	428.49				
24.08	560	1125.87		1152.1	38.9	560	0	1.00	0.00	390.34	0	1152.6	429.23				
24.17	711	1130.76		1152.7	41.5	693	18	0.00	1.00	390.46	0	1152.6	431.98				
24.25	799	1136.27		1152.8	41.9	713	86	0.00	1.00	391.05	0	1152.7	432.94				
24.33	810	1141.85		1152.8	41.9	715	95	0.00	1.00	391.71	0	1152.7	433.62				
24.42	806	1147.40		1152.9	42.4	741					65		439.17				
24.50	801	1152.91		1153.1	43.3	792					9		444.69				
24.58	794	1158.38		1153.2	43.4	794					0		450.15				
24.67	787	1163.80		1153.1	43.2	787					0		444.11				
24.75	780	1169.17		1153.1	43.1	780					0		443.36				
24.83	772	1174.49		1153.1	42.9	772					0		442.51				
24.92	763	1179.75		1153.0	42.8	763					0		441.55				
25.00	754	1184.94		1153.0	42.6	754					0		440.59				

Zovne, Jerry

From: Zovne, Jerry
Sent: Thursday, April 15, 1999 4:16 PM
To: 'Don Rerick - FCDX'
Cc: 'Art Glover'; 'Brian Butler'
Subject: RE: 48th Street Basin, HEC-1 Model

Don:
I have tested placing a 10' weir at EL 1159 in lieu of an 8' weir at 1160. It produces a HWL of 1161, allowing one ft. FB. There is no impact to the Santan Channel. I offer this as an alternative to changing the basin footprint that effects virtually every plan sheet we cut to date.

Jerry Zovne

-----Original Message-----
From: Don Rerick - FCDX [mailto:djr@mail.maricopa.gov]
Sent: Thursday, April 15, 1999 1:59 PM
To: 'aglover@ci.phoenix.az.us'; 'bbutler@ci.phoenix.az.us'; 'jzovne@hdrinc.com'
Cc: Amir Motamedi - FCDX; Afshin Ahouraiyan - FCDX; Don Rerick - FCDX
Subject: FW: 48th Street Basin, HEC-1 Model

Art, Brian, Jerry,

Please find included in the message from Amir (below) the FCD review comments on the hydrology repot. All previous comments appear to have been addressed. However, the District believes it is important to achieve one foot of freeboard above the 100-yr. WSE ion the basin. This should be easily accomplished by 9' more fill on the berm, which extending into the transmission easement should not be a problem.

Thanks.

> -----Original Message-----
> From: Amir Motamedi - FCDX
> Sent: Thursday, April 15, 1999 11:53 AM
> To: Don Rerick - FCDX
> Cc: Afshin Ahouraiyan - FCDX
> Subject: 48th Street Basin, HEC-1 Model
>
> Don,
>
> I have reviewed the subject report from HDR dated 4/6/99 (included HEC-1
> model, HEC-1 Report, Basin B outflow and I-10/SR202 cross culvert design)
> and have the following comments:
>
> 1- The HEC-1 is based on the current scheme for the operation of the
> basin which requires:
> a- The primary gated outlet (48" gated outlet) to be closed
> during the storm.
> b- The emergency spillway will discharge into the 48" outlet
> from an 8' spillway.
>
> any changes to this operation scheme will effect the flows and will have
> to be approved by FCD/ADOT.
>
> 2- I recommend maintaining at least 1 foot of freeboard for the design
> event. This can be achieved through several means such as raising the
> berm 0.75 feet on the south side.
>
> 3- Certain parameters such as the final stage storage, outlet pipe
> capacity, and the spillway capacity may need refinement as we get into the
> final design phase. The design hydrology must also be refined as these
> data become available. I do not foresee any major changes to the flows or
> volumes due to these refinements.
>

> 4- The cross culvert design was more an information item. The equal.
> basin bottom elevation has been lowered to match ADOT's design for the
> cross culvert.
>

Please call me at 506-4871 if you have any questions.
>
> Thanks
>
> Amir

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1****************************************                    ****************************************
*                                      *                    *                                      *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)  *                    *   U.S. ARMY CORPS OF ENGINEERS       *
*            JUN 09 1992               *                    *   HYDROLOGIC ENGINEERING CENTER      *
*           VERSION 4.0.3E             *                    *         609 SECOND STREET            *
*                                      *                    *      DAVIS, CALIFORNIA 95616         *
*  RUN DATE  04/20/99  TIME  13:38:26  *                    *          (916) 551-1748              *
*                                      *                    *                                      *
****************************************                    ****************************************

                                    X     X  XXXXXXX   XXXXX          X
                                    X     X  X        X     X        XX
                                    X     X  X        X              X
                                    XXXXXXX  XXXX     X        XXXXX  X
                                    X     X  X        X              X
                                    X     X  X        X     X        X
                                    X     X  XXXXXXX   XXXXX        XXX

THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL   LOSS RATE:GREEN AND AMPT INFILTRATION
KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM

1                                                HEC-1 INPUT                                                PAGE  1

      LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

        1           ID        FN: NewSVR48.DAT  4/2/ 1999   Provide 1' FB 4/15/99
        2           ID        100 YR 24 HR MODEL W/ HYPOTHETICAL STORM
        3           ID        HDR Engineering, Inc.
        4           ID        This model has the following revisions from the previous models.
        5           ID        1. Current concept for the 48th Street/Basin 15 replaces the previous
        6           ID           48th Street basin model.
        7           ID        2. The 48th Street Detention Basin is configured not to discharge to
        8           ID           the Santan Channel until the weir overflow level 1159.0 is
        9           ID           reached.  This is 3.0 ft below Top of Basin El 1162.
       10           ID        3. Although the 48th Street Basin discharges during the storm, outflows
       11           ID           are delayed so that the design discharge at the confluence w/ Santan
       12           ID           Channel is not exceeded during the 100-year event.
       13           ID        4. Model incorporates revised DA's for subbasins 522D&E and 519E,F&G
       14           ID           per Premier HEC-1 in I-10/202L Prelim Drain Report for Pecos
       15           ID           Connector 3/30/99
       16           ID        5. Model incorporates DMJM Basin B Outfall Siphon rating per spreadsheet
       17           ID           4/1/99.  Outfall is routed to W. side of I-10 at confluence w/ 48th
       18           ID           Street Basin discharge.
       19           ID        ***********************************************************************
       20           IT       2                    750
       21           IO       5
                   *DIAGRAM

       22           KK    BASB
       23           KM        BASIN B OUTFALL SIPHON TO SANTAN CHANNEL PER DMJM 4/1/99
       24           KO       1
       25           BA   29.79
       26           IN       5
       27           QI    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00       0
       28           QI    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00       0
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 29          QI    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00       0
 30          QI    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00       0
 31          QI    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00       0
 32          QI       0       0       0       0       0       0       0       0       0       0
 33          QI       0       0       0       0       0       0       0       0       0       0
 34          QI       0       0       0       0       0       0       0       0       0       0
 35          QI       0       0       0       0       0       0       0       0       0       0
 36          QI       0       0       0       0       0       0       0       0       0       0
 37          QI       0       0       0       0       0       0       0       0       0       0
 38          QI       0       0       0       0       0       0       0       0       0       0
 39          QI       0       0       0       0       0       0       0       0       0       0
 40          QI       0       0       0       0       0       0       0       0       0       0
 41          QI       0       0       0       0       0       0       0       0       0       0
 42          QI       0     130     436     755     775     806     828     843     855     866
 43          QI     877     884     888     890     886     875     857     837     826     830
 44          QI     839     839     834     830     828     826     825     822     817     812
 45          QI     804     799     795     791     788     785     782     777     770     760
 46          QI     747     738     742     753     756     753     749     747     744     742
 47          QI     739     737     737     735     732     729     727     725     723     721
 48          QI     719     718     718     711     686     628     663     710     719     720
 49          QI     720     719     719     719     719     719     719     719     719     720
 50          QI     722     722     720     720     720     719     716     706     646     579
 51          QI     622     708     717     719     719     720     720     720     720     720
 52          QI     720     721     721     721     721     721     721     721     721     720
 53          QI     717     704     634     565     609     707     718     721     722     722
1                                          HEC-1 INPUT                                          PAGE  2

LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 54          QI     721     720     720     720     720     719     719     719     719     719
 55          QI     718     718     718     718     716     700     610     523     560     693
 56          QI     713     715     741     792     794     787     780     772     763     754
             *
             *

 57          KK  Rtgila
 58          KM       Route thru SANTAN OUTFALL CHANNEL TO 56th Street
 59          RD    2500   .0008    .015            TRAP      8     2.0
             *

 60          KK  GilaAe
 61          KM   BASIN EAST OF 56th STR. AND WEST OF GILA DRAIN
 62          PH            4.5    0.77    1.50    2.64    2.89    3.06    3.37    3.68    4.00
             * CURVE NUMBER ASSUMED.  AREA ASSUMED DEVELOPED AS
             * COMMERCIAL/INDUSTRIAL
 63          BA   0.097
 64          LS              80
 65          UD    0.25
             *

 66          KK  CGilaE
 67          KM       Add hydrograph to Santan discharge - above I-10 structures
 68          HC       2
             *

 69          KK   RBI10
 70          KM       Route 2-10x8 box culvert to West of I-10 at Conf w/ 48th St. Outlet
 71          RD    3100   .0765   0.013            DEEP      20       0
             *
             * NEW BASIN GILAAW

 72          KK  GilaAw
 73          KM   BASIN WEST OF 56th STR. AND EAST OF I-10
 74          KM   CURVE NUMBER ASSUMED.  AREA ASSUMED DEVELOPED AS
 75          KM   COMMERCIAL/INDUSTRIAL
 76          BA   0.111
 77          LS              80
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 78          UD     .23
             *

 79          KK  CGILAW
 80          KO      1
 81          KM   ADD HYDROGRAPHS FROM RBI10 AND GILAAW
 82          HC      2
             * ******************************************************************************
             * BEGIN 48TH STREET DETENTION BASIN MODEL
             * ******************************************************************************

 83          KK      M1
 84          KM        Mountain Area 1
 85          PH            4.5    0.77    1.50    2.64    2.89    3.06    3.37    3.68    4.00
 86          BA    .280
             * IA = 0.25 as per Maricopa Drainage Design Manual (Vol. 1) Table 4.1
 87          LS     .25      98
1                                          HEC-1 INPUT                                          PAGE  3

LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 88          UD    .252

 89          KK    RtC1
 90          KM        Route M1 flow to split
 91          RS       1    FLOW      -1
 92          RC   0.035   0.035   0.035    2300    0.02
 93          RX       3       4       5      20      45      55      65      66
 94          RY     4.5     4.4     4.3     1.0     1.0     2.0     5.0     5.1

 95          KK      M2
 96          KM        Mountain Area 2
 97          BA    .200
             * IA = 0.25 as per Maricopa Drainage Design Manual (Vol. 1) Table 4.1
 98          LS     .25      98
 99          UD    .190

100          KK    RtC2
101          KM        Route M2 flow to split
102          RS       1    FLOW      -1
103          RC   0.035   0.035   0.035     900    0.02
104          RX       3       4       5      20      25      35      45      46
105          RY     4.5     4.4     4.3     1.0     1.0     2.0     5.0     5.1

106          KK      A1
107          KM       Developed Area 1
108          BA    .041
109          LS              80
110          UD    .169

111          KK   COMB1
112          KM   Combine flows
113          HC       3

114          KK   Splt1
115          KM      Channel splits (divert flow out of model)
116          DT   Splt1
117          DI       0      50     100     150     200     250     500
118          DQ       0      30      60      90     120     150     300

119          KK    RtC3
120          KM        Route flows from split to next tributary
121          RS       1    FLOW      -1
122          RC   0.035   0.035   0.035     600    0.02
123          RX       3       4       5      20      75      85      95      96
124          RY     4.5     4.4     4.3     1.0     1.0     2.0     5.0     5.1
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```
 125          KK      M3
 126          KM        Mountain Area 3
 127          BA    .029
              * IA = 0.25 as per Maricopa Drainage Design Manual (Vol. 1) Table 4.1
 128          LS     .25      98
 129          UD    .035
1                                        HEC-1 INPUT                                          PAGE  4

LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


 130          KK    RtC4
 131          KM        Route flows To convergence of tributary.
 132          RS       1    FLOW      -1
 133          RC   0.035   0.035   0.035    1100    0.02
 134          RX       3       4       5      20      35      45      55      56
 135          RY     4.5     4.4     4.3     1.0     1.0     2.0     5.0     5.1

 136          KK      A2
 137          KM        Developed  Area 2
 138          BA    .020
 139          LS              81
 140          UD    .115

 141          KK   COMB2
 142          KM        Combine, M3, A2, Flows from split
 143          HC       3

 144          KK    RtC5
 145          KM   Route combined flows from convergence of tributary to weir of detention basin
 146          RS       1    FLOW      -1
 147          RC   0.035   0.035   0.035    1500    0.02
 148          RX       3       4       5      20      75      85      95      96
 149          RY     4.5     4.4     4.3     1.0     1.0     2.0     5.0     5.1

 150          KK      M4
 151          KM        Mountain Area 4
 152          BA    .380
              * IA = 0.25 as per Maricopa Drainage Design Manual (Vol. 1) Table 4.1
 153          LS     .25      98
 154          UD    .525

 155          KK    RtR1
 156          KM        Route Mountain flows to weir  (through streets in area 4)
 157          RS       1    FLOW      -1
 158          RC   0.012   0.012   0.012    1600    0.02
              * CHANNEL GEOMETRY EXTENDED TO STABILIZE ROUTING
 159          RX       2      18      19      20      50      51      52      68
 160          RY     2.2     2.0     1.5     1.0     1.0     1.5     2.0     2.2

 161          KK      A3
 162          KM        Developed Area 3
 163          BA    .036
 164          LS              81
 165          UD    .145

 166          KK      A4
 167          KM        Developed Area 4
 168          BA    .067
 169          LS              84
 170          UD    .139
1                                        HEC-1 INPUT                                          PAGE  5

LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


 171          KK   COMB3
```

```
172          KM        Combine A3, A4, M4, and routed flows (RtC5)
173          HC       4

174          KK    RET1
175          KM        Flows spill over the weir to retention basin (Divert Flow)
176          DT    RET1    4.61
177          DI       0     200     400     600     800    1000
178          DQ       0       0       4      17      37      63

179          KK    RtC6
180          KM        Route flows in channel to next split in channel
181          RS       1    FLOW      -1
182          RC   0.035   0.035   0.035    1200    0.02
183          RX       3       4       5      20      45      55      65      66
184          RY     4.5     4.4     4.3     1.0     1.0     2.0     5.0     5.1

185          KK      A5
186          KM        Developed Area 5
187          BA    .030
188          LS              85
189          UD    .137

190          KK   COMB4
191          KM        Combine A5 and routed flows
192          HC       2
             * splt2 revised using South Mountain run data (70-30 SPLIT)

193          KK   Splt2
194          KM         Channel splits (Flow diverted from model)
195          DT   Splt2
196          DI       0    1000    1500
197          DQ       0     300     450

198          KK    RtC7
199          KM        Route flows from split to 38th St & Knox RD
200          RS       1    FLOW      -1
201          RC   0.035   0.035   0.035    1800    0.02
202          RX       8       9      10      20      30      35      40      41
203          RY     4.5     4.4     4.3     1.0     1.0     2.0     5.0     5.1
             *     Flows from Area 6b flow through the streets to Knox Rd and 40th St.
             *     All flow is assumed to stay in road.

204          KK     A6a
205          KM        Developed Area 6a
206          BA    .038
207          LS              84
208          UD    .159
```



```
LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

209          KK  COMB2A
210          HC       2

211          KK    RtC8
212          KM        Route flows from A6a through channel to Knox and 40th St
213          RS       1    FLOW      -1
214          RC   0.035   0.035   0.035    1000    0.01
215          RX       8       9      10      20      30      35      40      41
216          RY     5.1     4.4     4.3     1.0     1.0     2.0     5.0     5.1

217          KK     A6b
218          KM        Developed Area 6b
219          BA    .019
220          LS              84
221          UD    .137
```

```
222          KK    RtR2
223          KM        Route flows through Knox Rd from 38th St to 40th St
224          RS       1    FLOW      -1
225          RC   0.012   0.012   0.012    1000    0.02
226          RX       7       8       9      10      75      76      77      78
227          RY     2.1     2.0     1.5     1.0     1.0     1.5     2.0     2.1

228          KK      R1
229          KM        Road segment on Knox Rd from 37th St to 40th St.
230          BA    .007
231          LS             100
232          UD    .145

233          KK   Comb5
234          KM   Combine flows from Area 6b and Road 1
235          HC       2

236          KK   DivR1
237          KM       Flow across Knox Road
238          DT   DivR1
239          DI       0      50     100     150     200     500    1000
240          DQ       0      50     100     150     200     250     250
             *  If flows from Area 6b and Road 1 can be carried on Knox Rd, no diversion to
             *  channel.  If they cannot be carried, then excess diverted to channel.
             *  Capacity of channel (based on Manning's equation) is 250 cfs.
             *

241          KK      A7
242          KM        Developed Area 7
243          BA    .008
244          LS             84
245          UD    .115
1                                          HEC-1 INPUT                                          PAGE  7

LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

246          KK   Comb6
247          KM   Combine flows in channel at 40th St and Knox Rd
248          HC       3

249          KK    RtC9
250          KM       Route flows from Knox to Ranch Circle North
251          RS       1    FLOW      -1
252          RC   0.035   0.035   0.035    1150    0.01
             * CHANNEL GEOMETRY EXTENDED TO STABILIZE ROUTING ORIGINAL RX AND
             * RY:
             * RX   0       1      10      20      30      40      49      50
             * RY 4.5     4.4     4.3     1.0     1.0     4.0     4.1     4.2
253          RX       0       1      10      20      30      40      49      50
254          RY       6     4.4     4.3     1.0     1.0     4.0     4.1       6

255          KK      A8
256          KM       Developed Area 8
257          BA    .058
258          LS             84
259          UD    .217

260          KK      R2
261          KM       Road segment on Ranch Circle North from 37th PL to Channel near 40th St.
262          BA    .006
263          LS             100
264          UD    .130

265          KK     A29
266          KM       Area 29 - Trail area from Knox to Ranch Circle North
```

```
 267          BA   0.006
 268          LS              85
 269          UD   0.091

 270          KK   COMB7
 271          KM        Combine flows from A8, Road 2, and A29
 272          HC       4

 273          KK   RtC10
 274          KM        Route flows from Ranch Circle N to Ray Road
 275          RS       1    FLOW      -1
 276          RC   0.035   0.035   0.035    1150    0.01
              * CHANNEL GEOMETRY EXTENDED TO STABILIZE ROUTING. ORIG. RX & RY:
              * RX   0       1       10      20      30      40      49      50
              * RY 4.5     4.4     4.3     1.0     1.0     4.0     4.1     4.2
 277          RX       0       1       10      20      30      40      49      50
 278          RY       6     4.4     4.3     1.0     1.0     4.0     4.1       6

 279          KK      A9
 280          KM        Developed Area 9
 281          BA    .040
 282          LS              85
 283          UD    .201
1                                        HEC-1 INPUT                                          PAGE  8

LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


 284          KK     A30
 285          KM       Area 30 - Trail area from Ranch Circle North to Ray Road
 286          BA   0.006
 287          LS              85
 288          UD   0.091

 289          KK   COMB8
 290          KM        Combine flows from A9, A30, and routed flows
 291          HC       3

 292          KK   SPLT3
 293          KM        Split along Ray Rd near 40th St. (Divert flows to park)
 294          DT   Splt3
 295          DI       0      74     145     234     340     462     600     750
 296          DQ       0      20      43      72     107     131     140     140

 297          KK   RtC11
 298          KM       Route flows along Ray Road from split at 40th St to Ranch Circle N
 299          RS       1    FLOW      -1
 300          RC   0.035   0.035   0.035    1600    0.01
              * CHANNEL GEOMETRY EXTENDED TO STABILIZE ROUTING. ORIG. RX & RY:
              * RX   8       9       10      20      30      35      40      41
              * RY 4.5     4.4     4.3     1.0     1.0     2.0     5.0     5.1
 301          RX       8       9       10      20      30      35      40      41
 302          RY       6     4.4     4.3     1.0     1.0     2.0     5.0       6

 303          KK     A11
 304          KM       Developed Area 11
 305          BA    .034
 306          LS              84
 307          UD    .161

 308          KK     A12
 309          KM       Developed Area 12
 310          BA    .002
 311          LS              85
 312          UD    .067

 313          KK   DvA12
```

```
314          KM      Simulate Detention Area for Development A12
315          DT   DvA12    0.07
316          DI       0      50     100     150     200     250     500
317          DQ       0      50     100     150     200     250     500

318          KK   Comb9
319          KM      Combine flows from A11 & A12
320          HC       2

321          KK    RtR3
322          KM        Route flows from A11 & A12 to Ray Rd
323          RS       1    FLOW      -1
324          RC   0.012   0.012   0.012    1900    0.01
325          RX       0       8       9      10      60      61      62      70
326          RY     2.1     2.0     1.5     1.0     1.0     1.5     2.0     2.1
1                                        HEC-1 INPUT                                                    PAGE  9

LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

327          KK     A10
328          KM        Developed Area 10
329          BA    .042
330          LS              85
331          UD    .133

332          KK   DvA10
333          KM      Simulate Detention Area for Development A10
334          DT   DvA10    2.16
335          DI       0      50     100     150     200     250     500
336          DQ       0      50     100     150     200     250     500

337          KK      R3
338          KM        Road Segment on Ranch Circle N 40TH ST TO RAY
339          BA    .007
340          LS             100
341          UD    .158

342          KK      R4
343          KM       Road segment on Ray Rd from 40TH ST TO RANCH CIRCLE N
344          BA    .005
345          LS             100
346          UD    .125

347          KK  Comb10
348          KM       Combine flow from A10, Road3, Road4, and RtR3
349          HC       5

350          KK   RtC12
351          KM       Route combined flows (along Ray Road from Ranch Circle N to 44th ST)
352          RS       1    FLOW      -1
353          RC   0.035   0.035   0.035    1000    0.01
             * CHANNEL GEOMETRY EXTENDED TO STABILIZE ROUTING. ORIG. RX & RY:
             * RX   7       8       9      10      30      31      32      33
             * RY 5.2     5.1     5.0     1.0     1.0     5.0     5.1     5.2
354          RX       7       8       9      10      30      31      32      33
355          RY       7     5.1     5.0     1.0     1.0     5.0     5.1       7
             *
             *     At this point, the model returns to Knox Road and 40th Street to
             *     simulate flows carried down Knox Road from 40th Street to 44th Street.
             *     Returning flows from R1:

356          KK   RetR1
357          KM       Return (to model) the flow coming down Knox Rd
358          DR   DivR1

359          KK    RtR4
```

```
 360          KM        Route flows through Knox Rd from 40th St to 44th St.
 361          RS       1    FLOW      -1
 362          RC   0.012   0.012   0.012    2600    0.01
 363          RX       7       8       9      10      75      76      77      78
 364          RY     2.1     2.0     1.5     1.0     1.0     1.5     2.0     2.1
1                                          HEC-1 INPUT                                                    PAGE 10

LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


 365          KK      R6
 366          KM        Road segment on Knox Rd from 40th St to 44th St.
 367          BA    .009
 368          LS              100
 369          UD    .217

 370          KK     A13
 371          KM        Developed Area 13
 372          BA    .001
 373          LS               87
 374          UD    .058

 375          KK   DvA13
 376          KM      Simulate Detention Area for Development A13
 377          DT   DvA13    0.10
 378          DI       0      50     100     150     200     250     500
 379          DQ       0      50     100     150     200     250     500

 380          KK  Comb11
 381          KM        Combine flows from A13, R6 and from R1 (DivR1)
 382          HC       3

 383          KK   RtC13
 384          KM        Route flows from Knox and 44th St to middle of 44th St (entrance to schl)
 385          RS       1    FLOW      -1
 386          RC   0.035   0.035   0.035    1100    0.01
 387          RX      13      14      15      20      30      35      36      37
 388          RY     4.7     4.6     4.5     1.0     1.0     4.5     4.6     4.7

 389          KK     A14
 390          KM        Developed Area 14
 391          BA    .076
 392          LS               79
 393          UD    .233

 394          KK   DvA14
 395          KM      Simulate Detention Area for Development A14
 396          DT   DvA14    4.24
 397          DI       0      50     100     150     200     250     500
 398          DQ       0      50     100     150     200     250     500

 399          KK     R7a
 400          KM        Road Segment on 44th St from Knox Rd to Midway between Knox and Ray Rd
 401          BA    .004
 402          LS              100
 403          UD    .100

 404          KK  Comb12
 405          KM        Combine R7a, A14, and combined flows at A13
 406          HC       3
1                                          HEC-1 INPUT                                                    PAGE 11

LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


 407          KK   RtC14
 408          KM        ROUTE combined flows to Ray Road
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```
409          RS       1    FLOW      -1
410          RC   0.035   0.035   0.035    1100    0.01
411          RX      13      14      15      20      30      31      35      36
412          RY     4.5     4.4     4.3     1.0     1.0     2.0     5.0     5.1

413          KK     A15
414          KM       Developed Area 15
415          BA    .047
416          LS              88
417          UD    .083

418          KK     A31
419          KM       Developed Area 31
420          BA    .005
421          LS              92
422          UD    .113

423          KK     R7b
424          KM        Road Segment on 44th St from Midway between Knox and Ray Rd to Ray Rd
425          BA    .004
426          LS             100
427          UD    .100

428          KK      R5
429          KM       Road Segment on Ray Rd from Ranch Circle North to 44th St
430          BA    .004
431          LS             100
432          UD    .083

433          KK  Comb13
434          KM      Combine flows
435          HC       6

436          KK   RtC15
437          KM       Route flows in channel along Ray Rd from 44th St to clogged pipes
438          RS       1    FLOW      -1
439          RC   0.035   0.035   0.035     500   0.008
             * CHANNEL GEOMETRY EXTENDED TO STABILIZE ROUTING. ORIG. RX & RY:
             * RX   0       5      10      20      40      50      55      60
             * RY 4.7     4.6     4.5     1.0     1.0     4.5     4.6     4.7
440          RX       0       5      10      20      40      50      55      60
441          RY       6     4.6     4.5     1.0     1.0     4.5     4.6       6
             *    At this point, there are 3-48" pipes at Ray Road where the water was
             *    designed to flow; however, a field visit showed that the pipes were
             *    clogged, and therefore the flow will be carried along Ray Road.

442          KK    RtR5
443          KM       Route flows along Ray Rd from clogged pipes to 46th Place
444          RS       1    FLOW      -1
445          RC   0.012   0.012   0.012    1000   0.008
             * CHANNEL GEOMETRY EXTENDED TO STABILIZE ROUTING. ORIG. RX & RY:
             * RX   0       8       9      10      90      91      92     100
             * RY 2.1     2.0     1.5     1.0     1.0     1.5     2.0     2.1
1                                          HEC-1 INPUT                                                    PAGE 12

LINE         ID.......1.......2.......3.......4.......5.....:.6.......7.......8.......9......10

446          RX       0       8       9      10      90      91      92     100
447          RY     2.3     2.0     1.5       1       1     1.5       2     2.3

448          KK    R12A
449          KM        Road segment on Ray Rd from 44th St to 46th PL
450          BA   0.005
451          LS             100
452          UD   0.127

453          KK     A16
```

```
454          KM       Developed Area 16
455          BA    .015
456          LS              92
457          UD    .089

458          KK   DvA16
459          KM      Simulate Detention Area for Development A16
460          DT   DvA16   1.28
461          DI       0      50     100     150     200     250     500
462          DQ       0      50     100     150     200     250     500

463          KK     A17
464          KM       Developed Area 17
465          BA    .072
466          LS              88
467          UD    .233

468          KK  Comb14
469          KM       Combine flows from A16, A17, R12a, RtR5, RtC15
470          HC       4

471          KK    RtR6
472          KM       Route combined flows along Ray Rd from 46th PL to 48th St
473          RS       1    FLOW      -1
474          RC   0.012   0.012   0.012    1100   0.008
             * CHANNEL GEOMETRY EXTENDED TO STABILIZE ROUTING. ORIG. RX & RY:
             * RX   0       8       9      10      90      91      92     100
             * RY 2.1     2.0     1.5     1.0     1.0     1.5     2.0     2.1
475          RX       0       8       9      10      90      91      92     100
476          RY     2.3       2     1.5       1       1     1.5       2     2.3

477          KK    R12b
478          KM         Road segment on Ray Rd from 46th PL to 48th St
479          BA   0.005
480          LS              100
481          UD   0.127

482          KK  Com14a
483          HC       2
             *    At this point, 50% of flow coming down Ray Road (flow in southern portion
             *    of the street) is assumed to flow south down 48th St and into the channel
             *    flowing south down 48th St.
             *    The other 50% of the flow is combined with the flow coming down 48th Street
             *    north of the intersection. Ray Road is assumed to take all of the flow up
             *    to capacity, at which time the excess flow continues south down 48th St.
1                                    HEC-1 INPUT                                    PAGE 13

LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

484          KK  48-Sth
485          KM      Simulate flow coming down Ray and flowing down 48th Street
486          DT  48-Est
487          DI       0      50     100     200     500    1000    1500    2000
488          DQ       0      25      50     100     250     500     750    1000

489          KK     A18
490          KM      Developed Area 18 (church)
491          BA    .005
492          LS              84
493          UD    .082

494          KK      R8
495          KM        Road Segment on Knox Rd from 44th St to 46th St
496          BA    .003
497          LS              100
498          UD    .092
```

```
499          KK  Comb15
500          KM       Combine flows from R8 and A18
501          HC       2

502          KK    RtR7
503          KM       Route flows along Knox Road from A18 to 47th St
504          RS       1    FLOW      -1
505          RC   0.012   0.012   0.012     950    0.01
506          RX       0       8       9      10      75      76      77      85
507          RY     2.1     2.0     1.5     1.0     1.0     1.5     2.0     2.1

508          KK      R9
509          KM        Road Segment on Knox Rd from 46th St to 47th St
510          BA    .002
511          LS             100
512          UD    .075

513          KK     A19
514          KM        Developed Area 19
515          BA    .038
516          LS              85
517          UD    .217

518          KK  Comb16
519          KM        Combine flows from R9, A19, and RtR7
520          HC       3

521          KK    RtR8
522          KM       Route Combined Flows on Knox Rd from 46th St to 47th St
523          RS       1    FLOW      -1
524          RC   0.012   0.012   0.012     800    0.01
525          RX       0       8       9      10      75      76      77      85
526          RY     2.1     2.0     1.5     1.0     1.0     1.5     2.0     2.1
```



```
LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

527          KK     A20
528          KM       Developed Area 20
529          BA    .020
530          LS              85
531          UD    .142

532          KK   DvA20
533          KM      Simulate Detention Area for Development A20
534          DT   DvA20    1.22
535          DI       0      50     100     150     200     250     500
536          DQ       0      50     100     150     200     250     500

537          KK     R10
538          KM        Road segment on Knox Rd from 47th St to 48th St
539          BA    .004
540          LS             100
541          UD    .083

542          KK  Comb17
543          KM        Combine flows from A20, R10, and RtR8
544          HC       3

545          KK    RtR9
546          KM       Route flows along 48th St from Knox Rd to Ray Rd
547          RS       1    FLOW      -1
548          RC   0.012   0.012   0.012    2100   0.008
549          RX       0       8       9      10      90      91      92     100
550          RY     2.1     2.0     1.5     1.0     1.0     1.5     2.0     2.1
```

```
                 *
                 *     Note:   Developments A21, A23, A24, and A25 drain to basin behind KMart.
                 *             Area 21 runoff:   capacity of pipe to basin, remaining heads
                 *                               south down 48th street to Ray Road

551              KK     A21
552              KM       Developed Area 21
553              BA    .075
554              LS              85
555              UD    .275

556              KK  21-Sth
557              KM      Simulate Diversion for Development 21
558              DT  21-Est
559              DI       0      50      60      70     100     200     500
560              DQ       0      50      60      70      70      70      70

561              KK   RtR10
562              KM       Route flows along 48th St from Development A21 to Ray Rd
563              RS       1    FLOW      -1
564              RC   0.012   0.012   0.012    1000   0.008
565              RX       0       8       9      10      80      81      82      90
566              RY     2.1     2.0     1.5     1.0     1.0     1.5     2.0     2.1
1                                              HEC-1 INPUT                                                    PAGE 15

LINE             ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

567              KK     R11
568              KM       Road segment on 48th St from Knox to Ray Rd
569              BA    .008
570              LS             100
571              UD    .216

572              KK     A22
573              KM        Developed Area 22
574              BA    .033
575              LS              92
576              UD    .099

577              KK   DvA22
578              KM      Simulate Detention Area for Development A22
579              DT   DvA22    2.75
580              DI       0      50     100     150     200     250     500
581              DQ       0      50     100     150     200     250     500

582              KK  Retn48
583              KM       Return divided flow from Ray Road as it reaches 48th ST.
584              DR  48-Est

585              KK  Comb18
586              KM    Combine A21, A22, R11, RtR10, and Dv48th
587              HC       5

588              KK  RaySth
589              KM       Split at 48th St and Ray - Capacity of 1/2 of Ray Rd is 140 cfs.
590              DT  RayEst
591              DI       0      50     100     140     300     500    1000
592              DQ       0      50     100     140     140     140     140

593              KK  Comb19
594              KM    Combine split flows from ray and flows carried down 1/2 of Ray Road
595              HC       2

596              KK   RtC16
597              KM       Route flows along 48th St to Detention Basin
598              RS       1    FLOW      -1
```

```
599          RC   0.012   0.012   0.012    2000   0.008
600          RX      13      14      15      20      30      55      56      57
601          RY     4.5     4.4     4.3     1.0     1.0     4.3     4.4     4.5

602          KK     A27
603          KM       Developed Area 27
604          BA    .036
605          LS              92
606          UD    .540
1                                        HEC-1 INPUT                                                    PAGE 16

LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


607          KK   RtC17
608          KM       Route flows along 48th St to Detention Basin
609          RS       1    FLOW      -1
610          RC   0.012   0.012   0.012    2000   0.008
611          RX      13      14      15      20      45      55      56      57
612          RY     4.5     4.4     4.3     1.0     1.0     4.3     4.4     4.5

613          KK     A28
614          KM       Developed Area 28
615          BA    .216
616          LS              84
617          UD    .383

618          KK     R13
619          KM        Road segment of 48th St from Ray Rd to detention basin
620          BA   0.007
621          LS             100
622          UD   0.235

623          KK  Comb20
624          KM       Combine flows from A27, A28, R13, and RtC16 (flows from 48th St and Ray)
625          HC       4

626          KK    RET2
627          KM       Retention Basin - At 48th Street and Thistle Landing
628          RS       1    STOR       0       0
629          SV       0    25.2    27.3    29.5    31.8    34.1    36.4
630          SE    11.5      19    19.5      20    20.5      21    21.5
631          SS      19     150       3     1.5
632          SL      13     7.1     0.6     0.5

633          KK    East
634          KM       Account for flow traveling south through pipe and east over road (weir)
635          DT   South
636          DI       0      41      45      48      53      58      65      73      84      85
637          DI      91     108     140     192     269     375     516     696     920
638          DQ       0      41      45      48      53      58      65      73      84      84
639          DQ      85      85      85      85      85      85      85      85      85
             *
             * DITCH PARAMETERS ASSUMED. 10'BW, 2:1SS, n=0.015, D=5'
             * LENGTH ASSUMED. SLOPE ASSUMED SIMILAR TO PREVIOUS ROUTING.

640          KK  RtEAST
641          KM        ROUTE EAST SPLIT TO BOTTOM OF PEPPERWOOD BASIN C
642          RS       4    FLOW      -1
643          RC    .035    .015    .035    2600    .006
644          RX       0       5      10      22      32      44      54      64
645          RY       6       6       6       0       0       6       6       6
             *
1                                        HEC-1 INPUT                                                    PAGE 17

LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10
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```
646          KK       C
647          KM   FROM PEPPERWOOD REPORT
648          BA    0.06
             * CN ASSUMED 85 (COMMERCIAL, B SOIL)
649          LS              85
650          UD    0.09
             *

651          KK   COMBC
652          KM   COMBINE FLOW FROM BASIN C AND EAST SPLIT
653          HC       2
             *

654          KK     RtC
655          KM   ROUTE COMBINED FLOWS TO BOTTOM OF BASIN B
656          RS       2    FLOW
657          RC    .015    .015    .015    1050   .0035
658          RX       0      10      20      32      42      54      64      74
659          RY       6       6       6       0       0       6       6       6
             *

660          KK       B KYRENE SCHOOL DISTRICT
661          KM   CN ASSUMED TO BE 85 (COMMERCIAL, B SOIL)
662          BA    0.06
663          LS              85
664          UD    0.09
             *

665          KK   COMBB
666          KM   COMBINE HYDROGRAPHS FROM RTC AND BASIN B
667          HC       2
             * ******************* FLOWS TO RET 3 CONCENTRATION POINT
             * ************************
             *
             *     Note:   Developments A21, A23, A24, and A25 drain to basin behind KMart.
             *             Area 21 runoff:   capacity of pipe to basin, remaining heads
             *                               south down 48th street to Ray Road
             *             Area 23 runoff:   70% retained on-site, 30% to basin
             *             Area 24 runoff:   All to basin
             *             Area 25 runoff:   All to basin

668          KK  Retn21
669          KM       Return flow from Development 21 that travels through pipe
670          DR  21-Est

671          KK    RtP1
672          KM       Route flows from development 21 to basin  (36" pipe)
673          RS       1    FLOW      -1
674          RC   0.013   0.013   0.013    1320   0.008
675          RX     4.8     4.9       5       6       7       8     8.1     8.2
676          RY     3.0     2.0     1.5       0       0     1.5     2.0     3.0
```



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LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

677          KK     A25
678          KM       Developed Area 25
679          BA    .043
680          LS              85
681          UD    .226

682          KK  Comb21
683          KM       Combine flows from A25 and RtP1 (routed flows from A21)
684          HC       2
```

```
685          KK    RtP2
686          KM       Route flows from A21 and A25 to basin  (54" pipe)
687          RS       1    FLOW      -1
688          RC   0.013   0.013   0.013     100   0.008
689          RX     4.9       5       6       7     7.5     8.5     9.5     9.6
690          RY     4.5     2.3     1.0       0       0     1.0     2.3     4.5

691          KK     A23
692          KM       Developed Area 23
693          BA    .039
694          LS              85
695          UD    .200

696          KK   DvA23
697          KM      Simulate Detention Area for Development A23
698          DT    ST23    2.37
699          DI       0      50     100     150     200     250     500
700          DQ       0      50     100     150     200     250     500

701          KK   RtC18
702          KM       Route flows through park
703          RS       1    FLOW      -1
704          RC   0.035   0.035   0.035    1000   0.008
705          RX      10      20      50     100     150     200     230     240
706          RY     2.5     2.3     1.0       0       0     1.0     2.3     2.5
             * A24 - CN CHANGED FROM 85 TO 65 BASED ON PLANS FOR CITY PARK.
             *       10% @ CN=98 AND 90% @CN=61 (FROM TR-55)

707          KK     A24
708          KM       Developed Area 24
709          BA    .064
710          LS              65
711          UD    .285

712          KK  Comb22
713          KM       Combine flows from A21 & A25 (RtP2), A23 (RtC18), A24
714          HC       3

715          KK    RET3
716          KM      Retention Basin - in south portion of A24 (north of KMart - A26)
717          RS       1    STOR       0       0
718          SV       0    0.59    2.68    5.01    7.58     9.0
719          SE    20.5      21      22      23      24      25
720          SS      24     100       3     1.5
```



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LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

721          SL      21   13.14     0.6     0.5

722          KK   RtC19
723          KM       Route flows along I-10 in channel from Basin
724          RS       1    FLOW      -1
725          RC   0.035   0.035   0.035     700   0.008
726          RX      13      14      15      20      45      55      56      57
727          RY     4.5     4.4     4.3     1.0     1.0     4.3     4.4     4.5

728          KK     A26
729          KM        Developed Area 26
730          BA    .048
731          LS              92
732          UD   ..089

733          KK   DvA26
734          KM      Simulate Detention Area for Development A26
735          DT    ST26    4.04
736          DI       0      50     100     150     200     250     500
```

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737          DQ       0      50     100     150     200     250     500

738          KK  RtnRay
739          KM       Return divided flow from Ray and 48th ST
740          DR  RayEst

741          KK   RtR11
742          KM       Route flows along Ray Rd
743          RS       1    FLOW      -1
744          RC   0.012   0.012   0.012    2000   0.008
745          RX       0       8       9      10      90      91      92     100
746          RY     2.1     2.0     1.5     1.0     1.0     1.5     2.0     2.1

747          KK     R14
748          KM        Road Segment along Ray from 48th to I-10
749          BA    .008
750          LS              100
751          UD    .186

752          KK  Comb23
753          KM       Combine flows from A26, R14, RtR11, and RtC19 (basin)
754          HC       4
             * DIV520, DIVBOX, & ADDBOX FROM HDR SOUTH MOUNTAIN RUN.

755          KK  DIV520 DIVERT WEIR FLOW THRU EQUIP. CROSSING UNDER EB OFF-RAMP
756          KM   FROM HDR SOUTH MONTAIN RUN
757          DT  DIVBOX
758          DI       0     100     200     300     400     500
759          DQ       0       0      60     143     230     320

760          KK  DIVBOX RETREIVE FLOW THRU EQUIPMENT CROSSING
761          DR  DIVBOX
             * NOTE: FLOW RE-COMBINES AT APPROX. BOTTOM OF BASIN A1
1                                    HEC-1 INPUT                                    PAGE 20

LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

762          KK  ADDBOX RE-COMBINE FLOW DIVERTED THRU EQUIP. CROSSING.
763          KM   RE-COMBINE FLOW DIVERTED THRU EQUIP. CROSSING
764          HC       2
             *

765          KK   RTE23 ROUTE CHANNEL FLOW SOUTH ALONG I-10 TO COMBB
766          KM   ASSUME BW=10', 2:1ss, D=5', n=0.015, s & l FROM SOUTH MONTAIN RUN
767          RS       1    FLOW      -1
768          RC    .015    .015    .015    4000   .0099
769          RX       0      10      20      30      40      50      60      70
770          RY       5       5       5       0       0       5       5       5
             *
             * PEPPERWOOD MODEL, MODIFIED TO REFLECT NEW DEVELOPMENT PLANS
             * EAST OF 48th
             * FROM RAY ROAD TO CHANDLER BLVD.  NO LOCAL RETENTION CONSIDERED.
             *

771          KK     VA1 VESTAR PHASE I & II DEVELOPMENTS.
772          KM   ASSUMED COMMERCIAL (ZONING R-3), B SOILS, AREA FROM KIMLEY HORN
773          KM   GRADING PLAN
774          BA    0.11
775          LS              85
776          UD    0.17
             *
             *

777          KK   RTEA1 ROUTE A1 TO A2 VIA DITCH ON I-10 R.O.W.
778          KM   ASSUME BW=10', 2:1ss, D=5', n=0.015
779          RS       1    FLOW
```

```
780          RC    .015    .015    .015    1320    .002
781          RX       0      10      20      30      40      50      60      70
782          RY       5       5       5       0       0       5       5       5
             *

783          KK     VA2 MARK DEVELOPMENT APARTMENTS, COMMERCE PARK I & II
784          KM   CN ASSUMES COMMERCIAL AND APARTMENT DEVELOPMENT ON B SOIL
785          BA    0.17
786          LS              85
787          UD    0.19
             *

788          KK   COMBA
789          KM   COMBINE A1 & A2 HYDROGRPAHS
790          HC       2
             *

791          KK  STORA2
792          KM   RETENTION CELL IN SE CORNER OF BASIN VA2.
             * SEE KIMLEY/HORN GRADING & DRAINAGE PLANS
793          RS       1    STOR      -1
794          SQ       0    0.01    1500
795          SV       0   21.44   21.44
             *
1                                        HEC-1 INPUT                                          PAGE 21

LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

796          KK   RTEA2 ROUTE A2 TO B VIA DITCH ON I-10 R.O.W.
797          KM   ASSUME BW=10', 2:1ss, D=5', n=0.015
798          RS       1    FLOW
799          RC    .015    .015    .015    1320    .008
800          RX       0      10      20      30      40      50      60      70
801          RY       5       5       5       0       0       5       5       5
             *

802          KK   COMBB
803          KM   COMBINE HYDROGRAPHS RTE23,RTEA2 AND COMBB
804          HC       3
             *

805          KK     RtB
806          KM   ROUTE FLOW TO BOTTOM OF PEPPERWOOD BASIN F @Chandler & 50th
807          RS       2    FLOW
808          RC    .015    .015    .015    2220    .006
809          RX       0       5      10      22      32      44      54      64
810          RY       6       6       6       0       0       6       6       6
             *

811          KK       D PEPPERWOOD BASIN D
812          KM   CN ASSUMED COMMERCIAL, B SOILS
813          BA     .03
814          LS              85
815          UD      .1
             *
             *

816          KK       E PEPPERWOOD BASIN E
817          KM   CN ASSUMED COMMERCIAL, B SOILS
818          BA     .03
819          LS              85
820          UD      .1
             *
             *
             *
             *
```

```
821          KK       F PEPPERWOOD BASIN F
822          KM   CN ASSUMED, COMMERCIAL, B SOILS
823          BA     .04
824          LS              85
825          UD     .09
             *

826          KK   COMBF
827          KM   COMBINE HYDROGRAPHS FROM BASINS D, E, F AND RTB
828          HC       4
             *
1                                        HEC-1 INPUT                                          PAGE 22

LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

829          KK    RTEF
830          KM   ROUTE FLOW THROUGH CONCRETE CHANNEL ALONG 50TH   TO BOTTOM
831          KM   OF DA522A
832          RS       1    FLOW      -1
833          RC    .015    .015    .015    1320    .005
834          RX       0      10      20      32      42      54      64      74
835          RY       8       6       6       0       0       6       6       8
             *
             * ORIG. BASIN 522A THRU 522D MODIFIED TO REFLECT FUTURE DEVELOPMENT
             * AND DRAINAGE CORRIDORS.  ORIG. BASINS HAD CN OF 81
             * ASSUMED FOR NEW BASINS.
             *

836          KK  DA522A
837          BA   0.058
838          LS              85
839          UD     .17

840          KK  AD522A
841          HC       2

842          KK  RT522A
843          KM   ROUTE COMBINED FLOW THROUGH CONC. CHANNEL ALONG 50TH
844          RS       1    FLOW      -1
845          RC    .015    .015    .015    1200    .005
846          RX       0      10      20      32      42      54      64      74
847          RY       8       6       6       0       0       6       6       8
             *
             * ****BEGIN I-10/CHANDLER BLVD TI ON-SITE TO COLLECTOR CHAN*****

848          KK    DA10  UPPER 1-10 DRAINAGE AREAS WHICH DRAIN TO WEST CHANNEL
849          BA    .006
850          LS              92
851          UD     .10

852          KK    DA11
853          BA   .0019
854          LS              98
855          UD     .10

856          KK    DA12
857          BA   .0079
858          LS              91
859          UD     .10

860          KK   ADD12
861          HC       3

862          KK   RTE12
863          RD     140   .0036    .012            CIRC     2.5
```

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1                                          HEC-1 INPUT                                          PAGE 23

        LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

         864          KK    DA13
         865          BA   .0026
         866          LS            90.1
         867          UD     .10

         868          KK   RTE13
         869          RD     300   .0017    .012           CIRC     2.0

         870          KK    DA14
         871          BA   .0043
         872          LS            88.4
         873          UD     .10

         874          KK   ADD14
         875          HC       3

         876          KK   RTE14
         877          RD    1060   .0029    .012           CIRC     4.0

         878          KK    DA15
         879          BA   .0050
         880          LS            90.9
         881          UD     .10

         882          KK    DA16
         883          BA   .0016
         884          LS              98
         885          UD     .10

         886          KK    DA17
         887          BA   .0052
         888          LS            90.6
         889          UD     .10

         890          KK    DA18
         891          BA   .0017
         892          LS            90.7
         893          UD     .10

         894          KK   ADD17
         895          HC       5

         896          KK   RTE18
         897          KM   ONSITE FLOW FROM I-10 NORTH - CHANDLER BLVD. TO COLLECTOR
         898          KM   CHANNEL
         899          RD     380   .0008    .012           CIRC     4.5
                      * *****END I-10/ CHANDLER/TI MODEL *****

         900          KK  DA522C
         901          BA   0.044
         902          LS              85
         903          UD    0.14
1                                          HEC-1 INPUT                                          PAGE 24

        LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

         904          KK  AD522C
         905          KM   COMBINE HYDROGRAPHS FROM I-10 AND DA522C
         906          HC       2

         907          KK  RT522C
```

```
908          KM   ROUTE FLOW THROUGH CONC. ADOT CHANNEL TO BOTTOM OF DA522D
909          RS      1     FLOW      -1
910          RC    .015    .015    .015    1450    .003
911          RX       0      10      20      32      42      54      64      74
912          RY       6       6       6       0       0       6       6       6
             *
             * AREAS FOR DA522D & DA522E BASED ON ALIGNMENT SHOWN IN SOUTH
             * MOUNTAIN REPORT.

913          KK  DA522D
             * BA 0.024   Area Modified by Premier 3/30/99
914          BA   0.034
915          LS              85
916          UD     .13

917          KK  DA522B
918          BA   0.058
919          LS              85
920          UD     .17
             *

921          KK  AD522D
922          KM  COMBINE HYDROGRAPHS FROM RT522A,RT522C,DA522B AND DA522D
923          HC       4

924          KK  RT522D
925          KM   ROUTE COMBINED FLOW THROUGH CONC. ADOT CHANNEL TO BOT OF 522E
926          RS      1     FLOW      -1
927          RC    .015    .015    .015    1490    .003
928          RX       0      10      20      32      42      54      64      74
929          RY      10       8       6       0       0       6       8      10
             *

930          KK  DA522E
             * BA    .05  Area Modified by Premier 3/30/99
931          BA   0.035
932          LS              85
933          UD    0.09

934          KK  AD522E
935          KM   COMBINE HYDROGRAPHS FROM RT522D, RT522B, AND DA522E
936          HC       2
             *
             *
             *
             *
             * ****************************
             * THE FOLLOWING IS FROM THE HDR SOUTH MOUNTAIN MODEL
1                                    HEC-1 INPUT                                    PAGE 25

LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

937          KK   DA513  (CVL195) CVL data
938          BA  0.0879
939          LS              85
940          UD   0.204

941          KK   DA514  (CVL197) CVL data
942          BA  0.0564
943          LS            84.1
944          UD   0.144

945          KK   DA515  (CVL199) CVL data
946          BA  0.0466
947          LS              84
948          UD   0.186
```

```
949          KK   AD515  Combine 515, 514 and 513
950          HC       3

951          KK   RT515  Channel info from Clouse plans.
952          RS       1    FLOW      -1
953          RC   0.040   0.020   0.040    2600  0.0059
954          RX      80      90     100     106     116     122     132     142
955          RY      10      10      10       6       6      10      10      10

956          KK   DA517  (CVL320) CVL data
957          BA  0.1700
958          LS              77
959          UD   0.258
             * RETREIVE SOUTH SPLIT AT 48th & THISTLE (KIMLEY/HORN DATA)

960          KK   South
961          KM   RETREIVE SOUTH SPLIT FROM 48th & THISTLE
962          DR   South
             * CONTINUE WITH HDR SOUTH MONTAIN DATA

963          KK   AD517  Add in 517
964          HC       3

965          KK   RT517  Assumed channel shape based on estimated 48th St. cross-section.
966          RS       1    FLOW      -1
967          RC   0.020   0.025   0.040     850   0.005
968          RX      78      80     100     112     116     118     122     222
969          RY      12     9.6      10    9.76    7.76    7.76      10      12

970          KK   DA518
971          BA   0.099
972          LS              81
973          UD    0.58
1                                    HEC-1 INPUT                                    PAGE 26

LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

974          KK   AD518  Combine 518 with flow moving south in 48th St.
975          HC       2
             * HDR SOUTH MOUNTAIN RUN SHOWS SPLIT AT 48th & CHANDLER. ASSUME THAT
             * SPLIT HAS BEEN CORRECTED, AND ALL FLOW GOES SOUTH ALONG 48th.
             * ORIGINAL SPLIT CARDS:
             * KKDIV518 Assume 50-50 split at 48th & Chandler IC.
             * DT DIVSE
             * DI      0    2000
             * DQ      0    1000
             *
             *
             * CHANNEL GEOMETRY FOR RT518 HAS BEEN EXTENDED TO STABILIZE ROUTING
             * ORIG. RX & RY:
             * RX  80      90     100     105     110     115     125     135
             * RY10.4    10.2      10       5       5      10    10.2    10.4
             * RT518 MODIFIED TO REFLECT NEW CONC. CHANNEL PARALLEL TO 48th STR.
             * ORIGINAL CARDS
             *  RT518  Assume channel size based on existing tail-water ditch.
             * RS   1    FLOW      -1
             * RC 0.035   0.025   0.035    3600  0.0061
             * RX  50      90     100     105     110     115     125     165
             * RY  11    10.2      10       5       5      10    10.2      11

976          KK   RT518
977          KM   ROUTE FLOW TO BOTTOM OF 519B
978          RS       1    FLOW      -1
979          RC    .015    .015    .015    1320    .005
980          RX       0      10      20      30      40      50      60      70
```

```
981          RY       5       5       5       0       0       5       5       5
             *
             * ORIGINAL BASINS 519a AND 519b SPLIT UP TO REFLECT EXPECTED ROAD AND
             * DRAINAGE PATTERNS.  ORIGINAL DATA:
             * KKDA519a
             * BA0.22
             * LS          81
             * UD0.62
             * KKAD519a  Combine 519a and flow from N. at 48th & SMF.
             * HC   2
             *
             * ORIGINAL RETRIEVAL CARDS FOR SPLIT AT 48th & CHANDLER DELETED.
             *
             * KK DIVSE   Retrieve SE part of diversion from 48th St and Chandler Blvd IC.
             * DR DIVSE
             * KK  RTSE  Route to approx 50th St. thru assumed channel overland
             * RS     5    FLOW      -1
             * RC 0.035   0.035   0.035    3100   0.005
             * RX    80      90     100     110     610     620     630     640
             * RY    10      10      10       9       9      10      10      10
             *
             * KKDA519b
             * BA 0.322
             * LS          85
             * UD0.43
             *
             * KKRT519b  Assume channel size and route 519b back to 48th St.
             * RS   1    FLOW      -1
             * RC 0.035   0.018   0.035    2800  0.0011
             * RX  80      90     100     112     124     136     146     156
             * RY  10      10      10       4       4      10      10      10
             * KKAD519b  Combine all flows approx. 400ft West of 48th St. Design Q - C219.
             * HC   3
             *
             * MODIFIED AREAS
             *
1                                        HEC-1 INPUT                                        PAGE 27

LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

982          KK  DA519A
983          BA   0.046
984          LS              85
985          UD    0.13
             *

986          KK  RT519A
987          KM   ROUTE EAST TO END OF 519B (AT 48th STR.)
988          RS       1    FLOW      -1
989          RC    .015    .015    .015    2750    .003
990          RX       0      10      20      30      40      50      60      70
991          RY       5       5       5       0       0       5       5       5
             *

992          KK  DA519B
993          BA   0.136
994          LS              85
995          UD    0.19
             *

996          KK  AD519B
997          KM   COMBINE HYDROGRAPHS FROM RT518, RT519A, & DA519B
998          HC       3
             *

999          KK  RT519B
```

```
1000          KM   ROUTE COMBINED HYDROGRAPHS SOUTH TO WEST SIDE OF 48th & FRYE
1001          RS       1    FLOW      -1
1002          RC    .015    .015    .015    1320    .006
1003          RX       0      10      20      32      42      54      64      74
1004          RY       6       6       6       0       0       6       6       6
              *

1005          KK  DA519C
1006          BA   0.116
1007          LS              85
1008          UD    0.19
              *

1009          KK  RT519C
1010          KM   ROUTE FLOW EAST TO 48th & FRYE
1011          RS       1    FLOW      -1
1012          RC    .015    .015    .015     900    .002
1013          RX       0      10      20      30      40      50      60      70
1014          RY       5       5       5       0       0       5       5       5
              *

1015          KK  DA519D
1016          BA    .078
1017          LS              85
1018          UD     .19
              *
```



```
LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

1019          KK  AD519D
1020          KM   COMBINE HYDROGRAPHS FROM RT519B, RT519C, & DA519D
1021          HC       3
              *

1022          KK  RT519D
1023          KM   ROUTE FLOW TO ADOT CHANNEL
1024          RS       1    FLOW      -1
1025          RC    .015    .015    .015     800    .008
1026          RX       0      10      20      32      42      54      64      74
1027          RY       6       6       6       0       0       6       6       6
              *

1028          KK  DA519G   Area Moved by Premier 3/30/99
1029          BA    .032
1030          LS              85
1031          UD     .11
              *

1032          KK  AD519G   Combine Added by Premier 3/30/99
1033          KM           COMBINE HYDROGRAPHS FROM DA519G,RT519D,AD522E
1034          HC       3
              *

1035          KK  DA519E
              * BA  .031   Area Modified by Premier 3/30/99
1036          BA   0.052
1037          LS              85
1038          UD     .11
              *

1039          KK  RT519E
1040          KM   ROUTE FLOW THROUGH ADOT CHANNEL TO BOTTOM OF DA519F
1041          RS       1    FLOW      -1
1042          RC    .015    .015    .015    2200    .002
1043          RX       0      10      20      32      42      54      64      74
```

```
1044          RY       6       6       6       0       0       6       6       6
              *

1045          KK  DA519F
              * BA  .099  Area Modified by Premier 3/30/99
1046          BA    0.14
1047          LS              85
1048          UD     .23
              *

1049          KK  AD519F
1050          KM   COMBINE HYDROGRAPHS FROM RT519E AND DA519F
1051          HC       2
              *
              * KKDA519G  Area Deleted by Premier 3/30/99
              * BA 0.032
              * LS              85
              * UD   .11
              *
1                                        HEC-1 INPUT                                                PAGE 29

LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

1052          KK  AD519G    Combine Modified by Premier 3/30/99
1053          KM   COMBINE HYDROGRAPHS FROM AD519F, DA519G, RT519D, & AD522E   .
1054          HC       2
              *

1055          KK  RTI-10
1056          KM   ROUTE FLOWS THROUGH OPEN CHANNEL ACROSS I-10 R.O.W.
1057          KM   SIMULATES (3) 10X6 RCBC
1058          RS       1    FLOW      -1
1059          RC    .012    .012    .012     750    .002
1060          RX       0       5       9      10      40      41      45      50
1061          RY      10       8       6       0       0       6       8      10
              *  ADD ADITIONAL AREA FOR BASN 15 AND AREA WEST OF BASIN

1062          KK      B1 Area west of Basin 15
1063          KM   CN=85 assumed (commercial, B soil)
1064          BA   0.106
1065          LS              85
1066          UD    0.16
              *

1067          KK   RTEB1
1068          KM   Route flow to Basin 15
1069          RS       1    FLOW      -1
1070          RC    .015    .015    .015    3000    .005
1071          RX       0      10      20      30      40      50      60      70
1072          RY       5       5       5       0       0       5       5       5
              *

1073          KK  ADI-10
1074          KM   COMBINE HYDROGRAPHS FROM RTI-10 AND RTEB1
1075          HC       2
              *

1076          KK     B15
1077          KM   Drainage Area of Retention Basin 15
              * BA 0.129     Area Reduced by HDR to actual site area = 63.1 acres
1078          BA    .099
1079          LS              85
1080          UD    0.25
              *

1081          KK  ADBA15
```

```
1082          KM   COMBINE HYDROGRAPHS FROM ADI-10 AND B15
1083          HC       2
              *
              *     PRICE ROAD HYDROLOGY
              *     I-10 AND SOUTH MOUNTAIN FREEWAY INTERCHANGE
              *     ON-SITE INFIELD BASIN ROUTING, ON-SITE COLLECTION AND PUMP STATION
              *     DISCHARGE COMBINED FLOW @ PMP TO EQUALIZATION BASIN
1                                   HEC-1 INPUT                                          PAGE 30

LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


1084          KK    DA01
1085          BA   .0099
1086          LS            95.7
1087          UD    0.10

1088          KK   RTE01
1089          RD     840   .0094    .012           CIRC     2.5

1090          KK    DA02
1091          BA   .0075
1092          LS            94.8
1093          UD    0.10

1094          KK    DA03
1095          BA   .0047
1096          LS            89.6
1097          UD     .10

1098          KK   ADD03   ADD HYD. 01 THRU 03
1099          HC       3

1100          KK   RTE03
1101          RD     490   .0074    .012           CIRC     3.5

1102          KK    DA04
1103          BA   .0038
1104          LS            93.4
1105          UD     .10

1106          KK    DA05
1107          BA   .0066
1108          LS            90.4
1109          UD     .10

1110          KK   ADD05
1111          HC       3

1112          KK   RTE05
1113          RD     685   .0045    .012           CIRC     4.0

1114          KK    DA06
1115          BA   .0088
1116          LS            90.7
1117          UD     .10

1118          KK   ADD06
1119          HC       2

1120          KK   RTE06
1121          RD     700   .0045    .012           CIRC     4.0
1                                   HEC-1 INPUT                                          PAGE 31

LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10
```

```
1122          KK    DA07
1123          BA   .0203
1124          LS            81.3
1125          UD     .10

1126          KK   ADD07
1127          HC       2

1128          KK   RTE07
1129          RD     605   .0022    .012            CIRC       5

1130          KK    DA08
1131          BA   .0056
1132          LS            94.8
1133          UD     .10

1134          KK   RTE08
1135          RD     700   .0072    .012            CIRC     2.5

1136          KK   ADD08
1137          HC       2

1138          KK    DA09
1139          BA   .0284
1140          LS            80.8
1141          UD     .10

1142          KK   ADD09
1143          HC       2

1144          KK    PUMP  96" STORAGE RCP'S
1145          KM          L=1070 FEET     200 CFS STATION
1146          RS       1    ELEV    1132       0
1147          SV       0     .24    0.62    0.99    1.24
1148          SE    1132    1134    1136    1138    1140
1149          SQ     .01     .02     .03     .04     .05
1150          WP                            PUMP
1151          WP    1134      50    1133    PUMP
1152          WP    1135      50    1134    PUMP
1153          WP    1136      50    1135    PUMP
1154          WP    1136      50    1133    PUMP

1155          KK   PUMPR
1156          WR    PUMP

1157          KK    PUMP
1158          HC       2

1159          KK    DA19
1160          BA   .0112
1161          LS            75.6
1162          UD     .10
1                                   HEC-1 INPUT                                    PAGE 32

LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


1163          KK   RTE19
1164          RK     150  .00670    .012            CIRC     2.5

1165          KK    DA20
1166          BA   .0104
1167          LS            90.7
1168          UD     .10

1169          KK   ADD20
1170          HC       2
```

```
1171          KK   RTE20
1172          RK      90   .0028    .012            CIRC     3.5

1173          KK    DA21
1174          BA   .0016
1175          LS              98
1176          UD     .10

1177          KK   ADD21
1178          HC       2

1179          KK   RTE21
1180          RK      90   .0028    .012            CIRC       4

1181          KK    DA22
1182          BA   .0133
1183          LS            91.3
1184          UD     .10

1185          KK   ADD22
1186          HC       2

1187          KK   RTE22
1188          RK     260   .0028    .012            CIRC     4.5

1189          KK    DA23
1190          BA   .0319
1191          LS            81.5
1192          UD     .10

1193          KK   ADD23
1194          HC       2

1195          KK   RTE23  INFIELD AREA - 30" OUTLET (INLET CONTROL) basin 12
1196          RS       1   STOR     0.0
1197          SV       0   0.24    0.91    7.44
1198          SE    1160   1161    1162    1165
1199          SQ       0      0       4      25
1                                   HEC-1 INPUT                                          PAGE 33

LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


1200          KK    DA24
1201          BA   .0025
1202          LS              98
1203          UD     .10

1204          KK   ADD24
1205          HC       2

1206          KK    DA25
1207          BA   .0195
1208          LS            84.4
1209          UD     .10

1210          KK   ADD25
1211          HC       2

1212          KK   RTE25  INFIELD AREA - 24" OUTLET (INLET CONTROL) basin 11
1213          RS       1   STOR     0.0
1214          SV       0     .16     .91   13.37
1215          SE    1159   1160    1161    1165
1216          SQ       0      0       4      30

1217          KK    DA26
```

```
1218          BA   .0156
1219          LS            78.5
1220          UD     .10

1221          KK   ADD26
1222          HC       2

1223          KK   RTE26  INFIELD AREA - 18" OUTLET (INLET CONTROL) basin 10
1224          RS       1    STOR     0.0
1225          SV       0    0.01    1.91    5.31
1226          SE    1158    1159    1160    1161
1227          SQ       0       0     3.4       9

1228          KK    DA27
1229          BA   .0253
1230          LS            84.3
1231          UD     .10

1232          KK   ADD27
1233          HC       2

1234          KK   RTE27  INFIELD AREA - 24" OUTLET (INLET CONTROL) basin 9
1235          RS       1    STOR     0.0
1236          SV       0    0.01    1.34    3.53
1237          SE  1157.9  1158.4    1160    1161
1238          SQ       0       0       9      17
1                                   HEC-1 INPUT                                    PAGE 34

LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


1239          KK    DA28
1240          BA   .0025
1241          LS              98
1242          UD     .10

1243          KK   ADD28
1244          HC       2

1245          KK    DA29
1246          BA   .0286
1247          LS            83.5
1248          UD     .10

1249          KK   ADD29
1250          HC       2

1251          KK   RTE29  INFIELD AREA - 24" OUTLET (INLET CONTROL) basin 8
1252          RS       1    STOR     0.0
1253          SV       0     .01    0.02    4.41
1254          SE  1157.0  1157.5    1159    1161
1255          SQ       0       0       8      23

1256          KK     PMP
1257          KM        ADD INFIELD RUNOFF AND PUMP STATION OUTFLOW
1258          KM        COMBINED DISCHARGE TO EQUALIZATION BASIN
1259          HC       2
              * ****END INTERCHANGE ON-SITE MODEL*****

1260          KK   ADPMP  combine flows from IC onsite pumpstation and route thru basin.
1261          KO       1
1262          HC       2
              *
              * *****Original ADOT BASIN 15 Design Concept not used in this run.
              * KK DET  Route thru detention basin S. side of SMF, outlet to Gila Floodw
              * KM        thru 54" RCP.
              * RS     1    STOR       0
```

```
                    * SV      0    13.8    23.0   118.9   221.8   243.2   264.9   286.9   309.2   331
                    * SE   1143  1144.5    1145    1150    1155    1156    1157    1158    1159    11
                    * SQ      0      13      20      79      98     102     105     108     111     1
                    *
                    *
                    * ***********************************************************************
                    * PREVIOUS BASIN 15 ROUTINE KEPT FOR RECORD PURPOSES ONLY
                    *
                    * ***********************************************************************
                    * ***********************************************************************
                    * Begin Basin 15/48th Street Detention Basin Routing
                    * ***********************************************************************
1                                                HEC-1 INPUT                                          PAGE 35

LINE                ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

1263                KK   B15FF
1264                KM   DIVERT FIRST 46 ac-ft EQUALIZATION BASIN
1265                KM   EQ BASIN RETAINS 46.0 AC-FT TO OVERFLOW ELEV. 1158
1266                KM   SPILLWAY CREST IS 400 ft BROAD CRESTED WEIR 10 FT WIDE
1267                KO       2
1268                RS       1    STOR       0
1269                SV       0      46      59      63
1270                SE    1140    1158    1161    1162
1271                SS    1158     400    2.64     1.5
                    *

1272                KK   STB15
1273                KM        ROUTE MAIN VOLUME INTO BASIN 15
1274                KM        100-YR  6-HOUR MULTI-USE BASIN WITH 1' FREEBORAD
1275                KM        TOP OF BASIN, INCLUDING FREEBOARD, AT ELEV. 1162.
1276                KM        LOW LEVEL/BASIN DRAIN--42" RCP TO SANTAN CHAN. CLOSED
1277                KM        L=10' WEIR OVERFLOW  TO 42" OUTLET SET AT EL 1159
1278                KM        PRIMARY BASIN LOW POINT IS AT 1151
1279                KO       2
1280                RS       1    STOR
1281                SV       0    31.0    67.6   130.7   231.1   270.2   310.4   351.5   394.0
1282                SE    1142    1151    1153    1155    1158    1159    1160    1161    1162
1283                SS    1159      10    3.33     1.5
                    *
                    * ***********************************************************************
                    * ***********************************************************************
                    * **************END SMF 48TH ST FILE*************************************
                    * ***********************************************************************
                    * ***********************************************************************
                    *

1284                KK   I10W
1285                KM         Combine SMF/I10/S.48th flow from Basin 15 with Santan Channel Flow
1286                HC       2
                    *

1287                KK   RI10W
1288                KM       Route from SMF/I10/Santan TI to Gila Drain Floodway
1289                RS       1    FLOW      -1
1290                RC    .035   0.018   0.035    4000    .002
1291                RX       0       2      14      26      36      49      61      63
1292                RY    1153    1154    1153    1147  1146.5    1153    1154    1153
                    *
                    * ID      Gila Floodway offsite Hydrology                          <GILA1b>
                    * ID      Proposed Floodway using detention basins
                    * ID      HYDROLOGY FOR SEGMENT 1 of GILA FLOODWAY
                    * ID      I-10 TO 44th STREET
                    * ID      Inflow hydrographs from other analyses
                    * ID      Cells for detention - I10 to the Treatment Plant
                    * ID      100 year 24-Hour Storm - Aug 18, 1992   HDR - PHX
```

```
                    * IT    10                    2000
                    * IO     4       0       0
                    * DIAGRAM
                    *
                    * KKCGilaB
                    * KM      Outflow hydrograph from Santan Freeway drainage system
                    * KM      Outflow Hydrograph at Maricopa Road and I-10
                    * BA30.859
                    * IN     5
                    *
                    *  ***************QI LINES DELETED**********************
                    *  ****************************************************
                    * KKDETI10
                    * KM      Outflow hydrograph from South Mountain Freeway
                    * KM      Detention Basin @ interchange
                    * BA 4.083
                    * IN     5
                    * *****************QI LINES DELETED********************
                    * ****************************************************
                    *
                    * KK CGila
                    * KM      Combine Santan & east So. Mt. Frwy Q's @ U/S end of Gila Floodway
                    * HC     2
                    *
1                                          HEC-1 INPUT                                          PAGE 36

        LINE        ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

        1293        KK  R1Gila
        1294        KM       Route inflow through first cell of Gila Floodway
        1295        KM        Revised embankment of cell 1
        1296        RS       1    STOR       0
        1297        SV     0.0     1.8    9.25    14.8    29.8    37.5    45.2    61.0
        1298        SE    34.5    35.5    36.5    37.0    38.0    38.5    39.0    40.0
        1299        SQ     0.0     7.4    23.0    30.0    40.0   281.6   720.0  1954.7
                    *

        1300        KK  R2Gila
        1301        KM       Route inflow through second cell of Gila Floodway
        1302        KM        Revised embankment of cell 2
        1303        RS       1    STOR       0
        1304        SV     0.0     4.2    15.6    24.9    49.5    62.4    75.2   101.4
        1305        SE    30.5    31.5    32.5    33.0    34.0    34.5    35.0    36.0
        1306        SQ     0.0     7.4    23.0    30.0    40.0   281.6   720.0  1954.7
                    *

        1307        KK  R3Gila
        1308        KM       Route inflow through third cell of Gila Floodway
        1309        KM        Revised grading of cell 3
        1310        RS       1    STOR       0
        1311        SV     0.0     0.2    10.9    43.5    55.0    67.3    94.9
        1312        SE    21.9    22.0    24.0    26.0    26.5    27.0    28.0
        1313        SQ     0.0     1.0    23.2    44.2   376.7   981.6  2687.3
                    *
                    * ***************************************************************************
                    * ***************************************************************************
                    *
        1314        ZZ
1
              SCHEMATIC DIAGRAM OF STREAM NETWORK
 INPUT
  LINE      (V) ROUTING          (--->) DIVERSION OR PUMP FLOW

   NO.      (.) CONNECTOR        (<---) RETURN OF DIVERTED OR PUMPED FLOW

    22        BASB
```

```
                V
                V
   57       Rtgila
                .
                .
   60           .       GilaAe
                .            .
                .            .
   66       CGilaE............
                V
                V
   69        RBI10
                .
                .
   72           .       GilaAw
                .            .
                .            .
   79       CGILAW............
                .
                .
   83           .          M1
                .           V
                .           V
   89           .        RtC1
                .            .
                .            .
   95           .            .          M2
                .            .           V
                .            .           V
  100           .            .        RtC2
                .            .            .
                .            .            .
  106           .            .            .        A1
                .            .            .         .
                .            .            .         .
  111           .       COMB1.........................
                .            .
                .            .
  116           .            .-------->   Splt1
  114           .       Splt1
                .           V
                .           V
  119           .        RtC3
                .            .
                .            .
  125           .            .          M3
                .            .           V
                .            .           V
  130           .            .        RtC4
                .            .            .
                .            .            .
  136           .            .            .        A2
                .            .            .         .
                .            .            .         .
  141           .       COMB2.........................
                .           V
                .           V
  144           .        RtC5
                .            .
                .            .
  150           .            .          M4
                .            .           V
                .            .           V
  155           .            .        RtR1
                .            .            .
                .            .            .
  161           .            .            .        A3
```

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                .          .          .
166             .          .          .          A4
                .          .          .           .
                .          .          .           .
171             .     COMB3.....................
                .          .
                .          .
176             .          .------->   RET1
174             .     RET1
                .        V
                .        V
179             .     RtC6
                .          .
                .          .
185             .          .        A5
                .          .         .
                .          .         .
190             .     COMB4............
                .          .
                .          .
195             .          .------->   Splt2
193             .     Splt2
                .        V
                .        V
198             .     RtC7
                .          .
                .          .
204             .          .       A6a
                .          .         .
                .          .         .
209             .    COMB2A............
                .        V
                .        V
211             .     RtC8
                .          .
                .          .
217             .          .       A6b
                .          .         V
                .          .         V
222             .          .      RtR2
                .          .         .
                .          .         .
228             .          .         .         R1
                .          .         .          .
                .          .         .          .
233             .          .    Comb5............
                .          .         .
                .          .         .
238             .          .         .------->   DivR1
236             .          .    DivR1
                .          .         .
                .          .         .
241             .          .         .         A7
                .          .         .          .
                .          .         .          .
246             .     Comb6.......................
                .        V
                .        V
249             .     RtC9
                .          .
                .          .
255             .          .        A8
                .          .         .
                .          .         .
260             .          .         .         R2
                .          .         .          .
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265          .          .          .          .        A29
             .          .          .          .          .
270          .      COMB7..........................................
             .          V          .          .          .
             .          V          .          .          .
273          .      RtC10          .          .          .
             .          .          .          .          .
             .          .          .          .          .
279          .          .       A9 .          .          .
             .          .          .          .          .
             .          .          .          .          .
284          .          .          .       A30 .          .
             .          .          .          .          .
             .          .          .          .          .
289          .      COMB8..........................
             .          .          .          .          .
             .          .          .          .          .
294          .          .-------> Splt3       .          .
292          .      SPLT3          .          .          .
             .          V          .          .          .
             .          V          .          .          .
297          .      RtC11          .          .          .
             .          .          .          .          .
             .          .          .          .          .
303          .          .      A11 .          .          .
             .          .          .          .          .
             .          .          .          .          .
308          .          .          .       A12 .          .
             .          .          .          .          .
             .          .          .          .          .
315          .          .          .          .-------> DvA12
313          .          .          .     DvA12 .          .
             .          .          .          .          .
             .          .          .          .          .
318          .          .     Comb9...........
             .          .          V          .          .
             .          .          V          .          .
321          .          .     RtR3 .          .          .
             .          .          .          .          .
             .          .          .          .          .
327          .          .          .       A10 .          .
             .          .          .          .          .
             .          .          .          .          .
334          .          .          .          .-------> DvA10
332          .          .          .     DvA10 .          .
             .          .          .          .          .
             .          .          .          .          .
337          .          .          .          .        R3 .
             .          .          .          .          .
             .          .          .          .          .
342          .          .          .          .          .        R4
             .          .          .          .          .          .
             .          .          .          .          .          .
347          .     Comb10.......................................................
             .          V          .          .          .
             .          V          .          .          .
350          .      RtC12          .          .          .
             .          .          .          .          .
             .          .          .          .          .
358          .          .          .<-------  DivR1      .
356          .          .     RetR1 .          .          .
             .          .          V          .          .
             .          .          V          .          .
359          .          .     RtR4 .          .          .
             .          .          .          .          .
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```
365                    R6
                        .
370                     .          A13
                        .           .
377                     .           .-------> DvA13
375                     .       DvA13
                        .           .
380                 Comb11.......................
                        V
                        V
383                 RtC13
                        .
389                     .          A14
                        .
396                     .           .-------> DvA14
394                     .      DvA14
                        .
399                     .          R7a
                        .           .
404                 Comb12.......................
                        V
                        V
407                 RtC14
                        .
413                     .          A15
                        .
418                     .          A31
                        .           .
423                     .           .          R7b
                        .           .           .
428                     .           .           .          R5
                        .           .           .           .
433             Comb13..............................................
                    V
                    V
436             RtC15
                    V
                    V
442             RtR5
                        .
448                 R12A
                        .
453                     .          A16
                        .
460                     .           .-------> DvA16
458                     .      DvA16
                        .
463                     .          A17
                        .           .
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468          .      Comb14.................................
             .          V
             .          V
471          .        RtR6                                .
             .          .
             .          .
477          .          .        R12b
             .          .          .
             .          .          .
482          .      Com14a............
             .          .
             .          .
486          .          .-------> 48-Est
484          .      48-Sth
             .          .
             .          .
489          .          .         A18
             .          .          .
             .          .          .
494          .          .          .          R8
             .          .          .          .
             .          .          .          .
499          .          .      Comb15............
             .          .          V
             .          .          V
502          .          .        RtR7
             .          .          .
             .          .          .
508          .          .          .          R9
             .          .          .          .
             .          .          .          .
513          .          .          .          .         A19
             .          .          .          .           .
             .          .          .          .           .
518          .          .      Comb16........................
             .          .          V
             .          .          V
521          .          .        RtR8
             .          .          .
             .          .          .
527          .          .          .         A20
             .          .          .          .
             .          .          .          .
534          .          .          .          .-------> DvA20
532          .          .          .      DvA20
             .          .          .          .
             .          .          .          .
537          .          .          .          .         R10
             .          .          .          .           .
             .          .          .          .           .
542          .          .      Comb17........................
             .          .          V
             .          .          V
545          .          .        RtR9
             .          .          .
             .          .          .
551          .          .          .         A21
             .          .          .          .
             .          .          .          .
558          .          .          .          .-------> 21-Est
556          .          .          .      21-Sth
             .          .          .          V
             .          .          .          V
561          .          .          .      RtR10
             .          .          .          .
             .          .          .          .
567          .          .          .          .         R11
```

```
572                                                A22
                                                    .
579                                                 .-------> DvA22
577                                            DvA22
                                                    .
584                                                 .<------- 48-Est
582                                                 .   Retn48
                                                    .
585                  Comb18.........................................
                          .
590                       .-------> RayEst
588                  RaySth
                          .
593             Comb19.....
                     V
                     V
596              RtC16
                     .
602                     A27
                         V
                         V
607                  RtC17
                          .
613                       .        A28
                          .         .
618                       .         .        R13
                          .         .         .
623             Comb20.................................
                     V
                     V
626               RET2
                     .
635                  .-------> South
633               East
                     V
                     V
640             RtEAST
                     .
646                  .         C
                     .         .
651              COMBC.....
                     V
                     V
654                RtC
                     .
660                  .         B
                     .         .
665              COMBB.....
                     .
670                  .         .<------- 21-Est
```

```
668                 Retn21
                       V
                       V
671                  RtP1
                       .
                       .
677                    .        A25
                       .         .
                       .         .
682                 Comb21.........
                       V
                       V
685                  RtP2
                       .
                       .
691                    .        A23
                       .         .
                       .         .
698                    .         .------->    ST23
696                    .      DvA23
                       .         V
                       .         V
701                    .      RtC18
                       .         .
                       .         .
707                    .         .        A24
                       .         .         .
                       .         .         .
712                 Comb22......................
                       V
                       V
715                  RET3
                       V
                       V
722                 RtC19
                       .
                       .
728                    .        A26
                       .         .
                       .         .
735                    .         .------->    ST26
733                    .      DvA26
                       .         .
                       .         .
740                    .         .          .<-------  RayEst
738                    .         .     RtnRay
                       .         .          V
                       .         .          V
741                    .         .      RtR11
                       .         .         .
                       .         .         .
747                    .         .         .        R14
                       .         .         .         .
                       .         .         .         .
752                 Comb23...................................
                       .
                       .
757                    .-------> DIVBOX
755                 DIV520
                       .
                       .
761                    .         .<-------  DIVBOX
760                    .      DIVBOX
                       .         .
                       .         .
762                 ADDBOX.........
                       V
```

```
765                 V
                 RTE23
771                          VA1
                              V
                              V
777                       RTEA1
783                                          VA2
788                       COMBA.............
                              V
                              V
791                      STORA2
                              V
                              V
796                       RTEA2
802            COMBB.......................
                 V
                 V
805             RtB
811                           D
816                                   E
821                                                   F
826            COMBF.................................
                 V
                 V
829             RTEF
836                       DA522A
840           AD522A............
                 V
                 V
842           RT522A
848                         DA10
852                                     DA11
856                                                 DA12
860                       ADD12.......................
                             V
                             V
862                       RTE12
```

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864                          DA13
                              V
                              V
868                          RTE13
                              .
870                           .        DA14
                              .          .
874                      ADD14.......................
                             V
                             V
876                      RTE14
                              .
878                           .        DA15
                              .          .
882                           .        DA16
                              .          .
886                           .          .        DA17
                              .          .          .
890                           .          .          .        DA18
                              .          .          .          .
894                      ADD17.............................................
                             V
                             V
896                      RTE18
                              .
900                           .      DA522C
                              .        .
904                      AD522C............
                             V
                             V
907                      RT522C
                              .
913                           .      DA522D
                              .        .
917                           .        .      DA522B
                              .        .        .
921                 AD522D...................................
                        V
                        V
924                 RT522D
                        .
930                     .      DA522E
                        .        .
934                 AD522E............
                        .
937                     .      DA513
                        .        .
941                     .        .      DA514
                        .        .        .
945                     .        .        .        DA515
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                 .          .          .          .          .
                 .          .          .          .          .
 949             .          .      AD515.......................
                 .          .          V
                 .          .          V
 951             .          .      RT515
                 .          .          .
                 .          .          .
 956             .          .          .      DA517
                 .          .          .          .
                 .          .          .          .
 962             .          .          .          .<-------   South
 960             .          .          .      South
                 .          .          .          .          .
                 .          .          .          .          .
 963             .          .      AD517.......................
                 .          .          V
                 .          .          V
 965             .          .      RT517
                 .          .          .
                 .          .          .
 970             .          .          .      DA518
                 .          .          .          .
                 .          .          .          .
 974             .          .      AD518............
                 .          .          V
                 .          .          V
 976             .          .      RT518
                 .          .          .
                 .          .          .
 982             .          .          .     DA519A
                 .          .          .          V
                 .          .          .          V
 986             .          .          .     RT519A
                 .          .          .          .
                 .          .          .          .
 992             .          .          .          .     DA519B
                 .          .          .          .          .
                 .          .          .          .          .
 996             .          .     AD519B.......................
                 .          .          V
                 .          .          V
 999             .          .     RT519B
                 .          .          .
                 .          .          .
1005             .          .          .     DA519C
                 .          .          .          V
                 .          .          .          V
1009             .          .          .     RT519C
                 .          .          .          .
                 .          .          .          .
1015             .          .          .          .     DA519D
                 .          .          .          .          .
                 .          .          .          .          .
1019             .          .     AD519D.......................
                 .          .          V
                 .          .          V
1022             .          .     RT519D
                 .          .          .
                 .          .          .
1028             .          .          .     DA519G
                 .          .          .          .
                 .          .          .          .
1032             .     AD519G.......................
                 .          .
                 .          .
1035             .          .     DA519E
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                 .          .          V
                 .          .          V
1039             .          .     RT519E
                 .          .          .
                 .          .          .
1045             .          .          .     DA519F
                 .          .          .          .
                 .          .          .          .
1049             .          .     AD519F...........
                 .          .          .
                 .          .          .
1052             .     AD519G...........
                 .          V
                 .          V
1055             .     RTI-10
                 .          .
                 .          .
1062             .          .         B1
                 .          .          V
                 .          .          V
1067             .          .      RTEB1
                 .          .          .
                 .          .          .
1073             .     ADI-10...........
                 .          .
                 .          .
1076             .          .        B15
                 .          .          .
                 .          .          .
1081             .     ADBA15...........
                 .          .
                 .          .
1084             .          .       DA01
                 .          .          V
                 .          .          V
1088             .          .      RTE01
                 .          .          .
                 .          .          .
1090             .          .          .       DA02
                 .          .          .          .
                 .          .          .          .
1094             .          .          .          .       DA03
                 .          .          .          .          .
                 .          .          .          .          .
1098             .          .     ADD03.......................
                 .          .          V
                 .          .          V
1100             .          .     RTE03
                 .          .          .
                 .          .          .
1102             .          .          .       DA04
                 .          .          .          .
                 .          .          .          .
1106             .          .          .          .       DA05
                 .          .          .          .          .
                 .          .          .          .          .
1110             .          .     ADD05.......................
                 .          .          V
                 .          .          V
1112             .          .     RTE05
                 .          .          .
                 .          .          .
1114             .          .          .       DA06
                 .          .          .          .
                 .          .          .          .
1118             .          .     ADD06...........
                 .          .          V
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                    V
1120            RTE06
                    .
                    .
1122                .        DA07
                    .          .
                    .          .
1126            ADD07............
                    V
                    V
1128            RTE07
                    .
                    .
1130                .        DA08
                    .          V
                    .          V
1134                .      RTE08
                    .          .
                    .          .
1136            ADD08............
                    .
                    .
1138                .        DA09
                    .          .
                    .          .
1142            ADD09............
                    V
                    V
1150                .-------->    PUMP
1144             PUMP
                    .
                    .
1156                .          .<-------    PUMP
1155                .      PUMPR
                    .          .
                    .          .
1157             PUMP............
                    .
                    .
1159                .        DA19
                    .          V
                    .          V
1163                .      RTE19
                    .          .
                    .          .
1165                .          .        DA20
                    .          .          .
                    .          .          .
1169                .      ADD20............
                    .          V
                    .          V
1171                .      RTE20
                    .          .
                    .          .
1173                .          .        DA21
                    .          .          .
                    .          .          .
1177                .      ADD21............
                    .          V
                    .          V
1179                .      RTE21
                    .          .
                    .          .
1181                .          .        DA22
                    .          .          .
                    .          .          .
1185                .      ADD22............
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                    .         .         .         V
                    .         .         .         V
1187                .         .         .      RTE22
                    .         .         .         .
1189                .         .         .         .        DA23
                    .         .         .         .          .
1193                .         .         .      ADD23............
                    .         .         .         V
                    .         .         .         V
1195                .         .         .      RTE23
                    .         .         .         .
1200                .         .         .         .        DA24
                    .         .         .         .          .
1204                .         .         .      ADD24............
                    .         .         .         .
1206                .         .         .         .        DA25
                    .         .         .         .          .
1210                .         .         .      ADD25............
                    .         .         .         V
                    .         .         .         V
1212                .         .         .      RTE25
                    .         .         .         .
1217                .         .         .         .        DA26
                    .         .         .         .          .
1221                .         .         .      ADD26............
                    .         .         .         V
                    .         .         .         V
1223                .         .         .      RTE26
                    .         .         .         .
1228                .         .         .         .        DA27
                    .         .         .         .          .
1232                .         .         .      ADD27............
                    .         .         .         V
                    .         .         .         V
1234                .         .         .      RTE27
                    .         .         .         .
1239                .         .         .         .        DA28
                    .         .         .         .          .
1243                .         .         .      ADD28............
                    .         .         .         .
1245                .         .         .         .        DA29
                    .         .         .         .          .
1249                .         .         .      ADD29............
                    .         .         .         V
                    .         .         .         V
1251                .         .         .      RTE29
                    .         .         .         .
1256                .         .      PMP............
                    .         .         .
1260                .      ADPMP............
                    .         V
```

```
                .          V
 1263           .       B15FF
                .          V
                .          V
 1272           .       STB15
                .          .
                .          .
 1284       I10W ............
                V
                V
 1287       RI10W
                V
                V
 1293      R1Gila
                V
                V
 1300      R2Gila
                V
                V
 1307      R3Gila
```

(***) RUNOFF ALSO COMPUTED AT THIS LOCATION

```
1*****************************************
*                                       *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *
*              JUN 09 1992              *
*            VERSION 4.0.3E             *
*                                       *
*  RUN DATE  04/20/99  TIME  13:38:26   *
*                                       *
*****************************************
```

```
*************************************
*                                   *
*    U.S. ARMY CORPS OF ENGINEERS   *
*    HYDROLOGIC ENGINEERING CENTER  *
*          609 SECOND STREET        *
*       DAVIS, CALIFORNIA 95616     *
*           (916) 551-1748          *
*                                   *
*************************************
```

```
FN: NewSVR48.DAT  4/2/ 1999   Provide 1' FB 4/15/99
100 YR 24 HR MODEL W/ HYPOTHETICAL STORM
HDR Engineering, Inc.
This model has the following revisions from the previous models.
1. Current concept for the 48th Street/Basin 15 replaces the previous
   48th Street basin model.
2. The 48th Street Detention Basin is configured not to discharge to
   the Santan Channel until the weir overflow level 1159.0 is
   reached.  This is 3.0 ft below Top of Basin El 1162.
3. Although the 48th Street Basin discharges during the storm, outflows
   are delayed so that the design discharge at the confluence w/ Santan
   Channel is not exceeded during the 100-year event.
4. Model incorporates revised DA's for subbasins 522D&E and 519E,F&G
   per Premier HEC-1 in I-10/202L Prelim Drain Report for Pecos
   Connector 3/30/99
5. Model incorporates DMJM Basin B Outfall Siphon rating per spreadsheet
   4/1/99.  Outfall is routed to W. side of I-10 at confluence w/ 48th
   Street Basin discharge.
*************************************************************************

  21 IO          OUTPUT CONTROL VARIABLES
                       IPRNT           5  PRINT CONTROL
                       IPLOT           0  PLOT CONTROL
                       QSCAL          0.  HYDROGRAPH PLOT SCALE

     IT          HYDROGRAPH TIME DATA
                        NMIN           2  MINUTES IN COMPUTATION INTERVAL
                       IDATE      1    0  STARTING DATE
                       ITIME        0000  STARTING TIME
                          NQ         750  NUMBER OF HYDROGRAPH ORDINATES
                      NDDATE      2    0  ENDING DATE
```

```
                    NDTIME        0058  ENDING TIME
                    ICENT           19  CENTURY MARK

                COMPUTATION INTERVAL    0.03 HOURS
                     TOTAL TIME BASE   24.97 HOURS

          ENGLISH UNITS
               DRAINAGE AREA          SQUARE MILES
               PRECIPITATION DEPTH    INCHES
               LENGTH, ELEVATION      FEET
               FLOW                   CUBIC FEET PER SECOND
               STORAGE VOLUME         ACRE-FEET
               SURFACE AREA           ACRES
               TEMPERATURE            DEGREES FAHRENHEIT


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


            **************
            *            *
  22 KK     *      BASB  *
            *            *
            **************

  24 KO          OUTPUT CONTROL VARIABLES
                       IPRNT           1  PRINT CONTROL
                       IPLOT           0  PLOT CONTROL
                       QSCAL          0.  HYDROGRAPH PLOT SCALE

  26 IN          TIME DATA FOR INPUT TIME SERIES
                       JXMIN           5  TIME INTERVAL IN MINUTES
                      JXDATE      1    0  STARTING DATE
                      JXTIME           0  STARTING TIME

              SUBBASIN RUNOFF DATA

  25 BA          SUBBASIN CHARACTERISTICS
                       TAREA       29.79  SUBBASIN AREA
                                                          ***
*****************************************************************************************************************************
                                                HYDROGRAPH AT STATION     BASB
*****************************************************************************************************************************
                                 *                                *                                *
   DA MON HRMN  ORD      FLOW    *  DA MON HRMN  ORD      FLOW    *  DA MON HRMN  ORD      FLOW    *  DA MON HRMN  ORD      FLOW
                                 *                                *                                *
    1     0000   1        0.     *   1     0616  189        0.     *   1     1232  377       52.     *   1     1848  565      719.
    1     0002   2        0.     *   1     0618  190        0.     *   1     1234  378      104.     *   1     1850  566      719.
    1     0004   3        0.     *   1     0620  191        0.     *   1     1236  379      191.     *   1     1852  567      719.
    1     0006   4        0.     *   1     0622  192        0.     *   1     1238  380      314.     *   1     1854  568      719.
    1     0008   5        0.     *   1     0624  193        0.     *   1     1240  381      436.     *   1     1856  569      719.
    1     0010   6        0.     *   1     0626  194        0.     *   1     1242  382      564.     *   1     1858  570      719.
    1     0012   7        0.     *   1     0628  195        0.     *   1     1244  383      691.     *   1     1900  571      719.
    1     0014   8        0.     *   1     0630  196        0.     *   1     1246  384      759.     *   1     1902  572      719.
    1     0016   9        0.     *   1     0632  197        0.     *   1     1248  385      767.     *   1     1904  573      720.
    1     0018  10        0.     *   1     0634  198        0.     *   1     1250  386      775.     *   1     1906  574      720.
    1     0020  11        0.     *   1     0636  199        0.     *   1     1252  387      787.     *   1     1908  575      721.
    1     0022  12        0.     *   1     0638  200        0.     *   1     1254  388      800.     *   1     1910  576      722.
    1     0024  13        0.     *   1     0640  201        0.     *   1     1256  389      810.     *   1     1912  577      722.
    1     0026  14        0.     *   1     0642  202        0.     *   1     1258  390      819.     *   1     1914  578      722.
    1     0028  15        0.     *   1     0644  203        0.     *   1     1300  391      828.     *   1     1916  579      722.
    1     0030  16        0.     *   1     0646  204        0.     *   1     1302  392      834.     *   1     1918  580      721.
```

1	0032	17	0.	*	1	0648	205	0.	*	1	1304	393	840.	*	1	1920	581	720.
1	0034	18	0.	*	1	0650	206	0.	*	1	1306	394	845.	*	1	1922	582	720.
1	0036	19	0.	*	1	0652	207	0.	*	1	1308	395	850.	*	1	1924	583	720.
1	0038	20	0.	*	1	0654	208	0.	*	1	1310	396	855.	*	1	1926	584	720.
1	0040	21	0.	*	1	0656	209	0.	*	1	1312	397	859.	*	1	1928	585	720.
1	0042	22	0.	*	1	0658	210	0.	*	1	1314	398	864.	*	1	1930	586	720.
1	0044	23	0.	*	1	0700	211	0.	*	1	1316	399	868.	*	1	1932	587	720.
1	0046	24	0.	*	1	0702	212	0.	*	1	1318	400	873.	*	1	1934	588	719.
1	0048	25	0.	*	1	0704	213	0.	*	1	1320	401	877.	*	1	1936	589	718.
1	0050	26	0.	*	1	0706	214	0.	*	1	1322	402	880.	*	1	1938	590	717.
1	0052	27	0.	*	1	0708	215	0.	*	1	1324	403	883.	*	1	1940	591	716.
1	0054	28	0.	*	1	0710	216	0.	*	1	1326	404	885.	*	1	1942	592	712.
1	0056	29	0.	*	1	0712	217	0.	*	1	1328	405	886.	*	1	1944	593	708.
1	0058	30	0.	*	1	0714	218	0.	*	1	1330	406	888.	*	1	1946	594	694.
1	0100	31	0.	*	1	0716	219	0.	*	1	1332	407	889.	*	1	1948	595	670.
1	0102	32	0.	*	1	0718	220	0.	*	1	1334	408	890.	*	1	1950	596	646.
1	0104	33	0.	*	1	0720	221	0.	*	1	1336	409	889.	*	1	1952	597	619.
1	0106	34	0.	*	1	0722	222	0.	*	1	1338	410	888.	*	1	1954	598	592.
1	0108	35	0.	*	1	0724	223	0.	*	1	1340	411	886.	*	1	1956	599	588.
1	0110	36	0.	*	1	0726	224	0.	*	1	1342	412	882.	*	1	1958	600	605.
1	0112	37	0.	*	1	0728	225	0.	*	1	1344	413	877.	*	1	2000	601	622.
1	0114	38	0.	*	1	0730	226	0.	*	1	1346	414	871.	*	1	2002	602	656.
1	0116	39	0.	*	1	0732	227	0.	*	1	1348	415	864.	*	1	2004	603	691.
1	0118	40	0.	*	1	0734	228	0.	*	1	1350	416	857.	*	1	2006	604	710.
1	0120	41	0.	*	1	0736	229	0.	*	1	1352	417	849.	*	1	2008	605	713.
1	0122	42	0.	*	1	0738	230	0.	*	1	1354	418	841.	*	1	2010	606	717.
1	0124	43	0.	*	1	0740	231	0.	*	1	1356	419	835.	*	1	2012	607	718.
1	0126	44	0.	*	1	0742	232	0.	*	1	1358	420	830.	*	1	2014	608	719.
1	0128	45	0.	*	1	0744	233	0.	*	1	1400	421	826.	*	1	2016	609	719.
1	0130	46	0.	*	1	0746	234	0.	*	1	1402	422	828.	*	1	2018	610	719.
1	0132	47	0.	*	1	0748	235	0.	*	1	1404	423	829.	*	1	2020	611	719.
1	0134	48	0.	*	1	0750	236	0.	*	1	1406	424	832.	*	1	2022	612	719.
1	0136	49	0.	*	1	0752	237	0.	*	1	1408	425	835.	*	1	2024	613	720.
1	0138	50	0.	*	1	0754	238	0.	*	1	1410	426	839.	*	1	2026	614	720.
1	0140	51	0.	*	1	0756	239	0.	*	1	1412	427	839.	*	1	2028	615	720.
1	0142	52	0.	*	1	0758	240	0.	*	1	1414	428	839.	*	1	2030	616	720.
1	0144	53	0.	*	1	0800	241	0.	*	1	1416	429	838.	*	1	2032	617	720.
1	0146	54	0.	*	1	0802	242	0.	*	1	1418	430	836.	*	1	2034	618	720.
1	0148	55	0.	*	1	0804	243	0.	*	1	1420	431	834.	*	1	2036	619	720.
1	0150	56	0.	*	1	0806	244	0.	*	1	1422	432	832.	*	1	2038	620	720.
1	0152	57	0.	*	1	0808	245	0.	*	1	1424	433	831.	*	1	2040	621	720.
1	0154	58	0.	*	1	0810	246	0.	*	1	1426	434	830.	*	1	2042	622	720.
1	0156	59	0.	*	1	0812	247	0.	*	1	1428	435	829.	*	1	2044	623	720.
1	0158	60	0.	*	1	0814	248	0.	*	1	1430	436	828.	*	1	2046	624	720.
1	0200	61	0.	*	1	0816	249	0.	*	1	1432	437	827.	*	1	2048	625	720.
1	0202	62	0.	*	1	0818	250	0.	*	1	1434	438	826.	*	1	2050	626	720.
1	0204	63	0.	*	1	0820	251	0.	*	1	1436	439	826.	*	1	2052	627	720.
1	0206	64	0.	*	1	0822	252	0.	*	1	1438	440	825.	*	1	2054	628	721.
1	0208	65	0.	*	1	0824	253	0.	*	1	1440	441	825.	*	1	2056	629	721.
1	0210	66	0.	*	1	0826	254	0.	*	1	1442	442	824.	*	1	2058	630	721.
1	0212	67	0.	*	1	0828	255	0.	*	1	1444	443	823.	*	1	2100	631	721.
1	0214	68	0.	*	1	0830	256	0.	*	1	1446	444	821.	*	1	2102	632	721.
1	0216	69	0.	*	1	0832	257	0.	*	1	1448	445	819.	*	1	2104	633	721.
1	0218	70	0.	*	1	0834	258	0.	*	1	1450	446	817.	*	1	2106	634	721.
1	0220	71	0.	*	1	0836	259	0.	*	1	1452	447	815.	*	1	2108	635	721.
1	0222	72	0.	*	1	0838	260	0.	*	1	1454	448	813.	*	1	2110	636	721.
1	0224	73	0.	*	1	0840	261	0.	*	1	1456	449	810.	*	1	2112	637	721.
1	0226	74	0.	*	1	0842	262	0.	*	1	1458	450	807.	*	1	2114	638	721.
1	0228	75	0.	*	1	0844	263	0.	*	1	1500	451	804.	*	1	2116	639	721.
1	0230	76	0.	*	1	0846	264	0.	*	1	1502	452	802.	*	1	2118	640	721.
1	0232	77	0.	*	1	0848	265	0.	*	1	1504	453	800.	*	1	2120	641	721.
1	0234	78	0.	*	1	0850	266	0.	*	1	1506	454	798.	*	1	2122	642	721.
1	0236	79	0.	*	1	0852	267	0.	*	1	1508	455	797.	*	1	2124	643	721.
1	0238	80	0.	*	1	0854	268	0.	*	1	1510	456	795.	*	1	2126	644	721.
1	0240	81	0.	*	1	0856	269	0.	*	1	1512	457	793.	*	1	2128	645	721.
1	0242	82	0.	*	1	0858	270	0.	*	1	1514	458	792.	*	1	2130	646	721.
1	0244	83	0.	*	1	0900	271	0.	*	1	1516	459	790.	*	1	2132	647	721.

1	0246	84	0.	*	1	0902	272	0.	*	1	1518	460	789.	*	1	2134	648	720.
1	0248	85	0.	*	1	0904	273	0.	*	1	1520	461	788.	*	1	2136	649	719.
1	0250	86	0.	*	1	0906	274	0.	*	1	1522	462	787.	*	1	2138	650	718.
1	0252	87	0.	*	1	0908	275	0.	*	1	1524	463	786.	*	1	2140	651	717.
1	0254	88	0.	*	1	0910	276	0.	*	1	1526	464	784.	*	1	2142	652	712.
1	0256	89	0.	*	1	0912	277	0.	*	1	1528	465	783.	*	1	2144	653	707.
1	0258	90	0.	*	1	0914	278	0.	*	1	1530	466	782.	*	1	2146	654	690.
1	0300	91	0.	*	1	0916	279	0.	*	1	1532	467	780.	*	1	2148	655	662.
1	0302	92	0.	*	1	0918	280	0.	*	1	1534	468	778.	*	1	2150	656	634.
1	0304	93	0.	*	1	0920	281	0.	*	1	1536	469	776.	*	1	2152	657	606.
1	0306	94	0.	*	1	0922	282	0.	*	1	1538	470	773.	*	1	2154	658	579.
1	0308	95	0.	*	1	0924	283	0.	*	1	1540	471	770.	*	1	2156	659	574.
1	0310	96	0.	*	1	0926	284	0.	*	1	1542	472	766.	*	1	2158	660	591.
1	0312	97	0.	*	1	0928	285	0.	*	1	1544	473	762.	*	1	2200	661	609.
1	0314	98	0.	*	1	0930	286	0.	*	1	1546	474	757.	*	1	2202	662	648.
1	0316	99	0.	*	1	0932	287	0.	*	1	1548	475	752.	*	1	2204	663	687.
1	0318	100	0.	*	1	0934	288	0.	*	1	1550	476	747.	*	1	2206	664	709.
1	0320	101	0.	*	1	0936	289	0.	*	1	1552	477	743.	*	1	2208	665	714.
1	0322	102	0.	*	1	0938	290	0.	*	1	1554	478	740.	*	1	2210	666	718.
1	0324	103	0.	*	1	0940	291	0.	*	1	1556	479	739.	*	1	2212	667	719.
1	0326	104	0.	*	1	0942	292	0.	*	1	1558	480	740.	*	1	2214	668	720.
1	0328	105	0.	*	1	0944	293	0.	*	1	1600	481	742.	*	1	2216	669	721.
1	0330	106	0.	*	1	0946	294	0.	*	1	1602	482	746.	*	1	2218	670	722.
1	0332	107	0.	*	1	0948	295	0.	*	1	1604	483	751.	*	1	2220	671	722.
1	0334	108	0.	*	1	0950	296	0.	*	1	1606	484	754.	*	1	2222	672	722.
1	0336	109	0.	*	1	0952	297	0.	*	1	1608	485	755.	*	1	2224	673	722.
1	0338	110	0.	*	1	0954	298	0.	*	1	1610	486	756.	*	1	2226	674	722.
1	0340	111	0.	*	1	0956	299	0.	*	1	1612	487	755.	*	1	2228	675	721.
1	0342	112	0.	*	1	0958	300	0.	*	1	1614	488	754.	*	1	2230	676	721.
1	0344	113	0.	*	1	1000	301	0.	*	1	1616	489	752.	*	1	2232	677	721.
1	0346	114	0.	*	1	1002	302	0.	*	1	1618	490	751.	*	1	2234	678	720.
1	0348	115	0.	*	1	1004	303	0.	*	1	1620	491	749.	*	1	2236	679	720.
1	0350	116	0.	*	1	1006	304	0.	*	1	1622	492	748.	*	1	2238	680	720.
1	0352	117	0.	*	1	1008	305	0.	*	1	1624	493	747.	*	1	2240	681	720.
1	0354	118	0.	*	1	1010	306	0.	*	1	1626	494	746.	*	1	2242	682	720.
1	0356	119	0.	*	1	1012	307	0.	*	1	1628	495	745.	*	1	2244	683	720.
1	0358	120	0.	*	1	1014	308	0.	*	1	1630	496	744.	*	1	2246	684	720.
1	0400	121	0.	*	1	1016	309	0.	*	1	1632	497	743.	*	1	2248	685	720.
1	0402	122	0.	*	1	1018	310	0.	*	1	1634	498	742.	*	1	2250	686	720.
1	0404	123	0.	*	1	1020	311	0.	*	1	1636	499	741.	*	1	2252	687	720.
1	0406	124	0.	*	1	1022	312	0.	*	1	1638	500	740.	*	1	2254	688	719.
1	0408	125	0.	*	1	1024	313	0.	*	1	1640	501	739.	*	1	2256	689	719.
1	0410	126	0.	*	1	1026	314	0.	*	1	1642	502	738.	*	1	2258	690	719.
1	0412	127	0.	*	1	1028	315	0.	*	1	1644	503	737.	*	1	2300	691	719.
1	0414	128	0.	*	1	1030	316	0.	*	1	1646	504	737.	*	1	2302	692	719.
1	0416	129	0.	*	1	1032	317	0.	*	1	1648	505	737.	*	1	2304	693	719.
1	0418	130	0.	*	1	1034	318	0.	*	1	1650	506	737.	*	1	2306	694	719.
1	0420	131	0.	*	1	1036	319	0.	*	1	1652	507	736.	*	1	2308	695	719.
1	0422	132	0.	*	1	1038	320	0.	*	1	1654	508	735.	*	1	2310	696	719.
1	0424	133	0.	*	1	1040	321	0.	*	1	1656	509	734.	*	1	2312	697	719.
1	0426	134	0.	*	1	1042	322	0.	*	1	1658	510	733.	*	1	2314	698	719.
1	0428	135	0.	*	1	1044	323	0.	*	1	1700	511	732.	*	1	2316	699	719.
1	0430	136	0.	*	1	1046	324	0.	*	1	1702	512	731.	*	1	2318	700	718.
1	0432	137	0.	*	1	1048	325	0.	*	1	1704	513	730.	*	1	2320	701	718.
1	0434	138	0.	*	1	1050	326	0.	*	1	1706	514	729.	*	1	2322	702	718.
1	0436	139	0.	*	1	1052	327	0.	*	1	1708	515	728.	*	1	2324	703	718.
1	0438	140	0.	*	1	1054	328	0.	*	1	1710	516	727.	*	1	2326	704	718.
1	0440	141	0.	*	1	1056	329	0.	*	1	1712	517	726.	*	1	2328	705	718.
1	0442	142	0.	*	1	1058	330	0.	*	1	1714	518	725.	*	1	2330	706	718.
1	0444	143	0.	*	1	1100	331	0.	*	1	1716	519	725.	*	1	2332	707	718.
1	0446	144	0.	*	1	1102	332	0.	*	1	1718	520	724.	*	1	2334	708	718.
1	0448	145	0.	*	1	1104	333	0.	*	1	1720	521	723.	*	1	2336	709	718.
1	0450	146	0.	*	1	1106	334	0.	*	1	1722	522	722.	*	1	2338	710	717.
1	0452	147	0.	*	1	1108	335	0.	*	1	1724	523	721.	*	1	2340	711	716.
1	0454	148	0.	*	1	1110	336	0.	*	1	1726	524	721.	*	1	2342	712	710.
1	0456	149	0.	*	1	1112	337	0.	*	1	1728	525	720.	*	1	2344	713	703.
1	0458	150	0.	*	1	1114	338	0.	*	1	1730	526	719.	*	1	2346	714	682.

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    1    0500  151      0.  *   1    1116  339      0.  *   1    1732  527     719.  *   1    2348  715     646.
    1    0502  152      0.  *   1    1118  340      0.  *   1    1734  528     718.  *   1    2350  716     610.
    1    0504  153      0.  *   1    1120  341      0.  *   1    1736  529     718.  *   1    2352  717     575.
    1    0506  154      0.  *   1    1122  342      0.  *   1    1738  530     718.  *   1    2354  718     540.
    1    0508  155      0.  *   1    1124  343      0.  *   1    1740  531     718.  *   1    2356  719     530.
    1    0510  156      0.  *   1    1126  344      0.  *   1    1742  532     715.  *   1    2358  720     545.
    1    0512  157      0.  *   1    1128  345      0.  *   1    1744  533     712.  *   2    0000  721     560.
    1    0514  158      0.  *   1    1130  346      0.  *   1    1746  534     706.  *   2    0002  722     613.
    1    0516  159      0.  *   1    1132  347      0.  *   1    1748  535     696.  *   2    0004  723     666.
    1    0518  160      0.  *   1    1134  348      0.  *   1    1750  536     686.  *   2    0006  724     697.
    1    0520  161      0.  *   1    1136  349      0.  *   1    1752  537     663.  *   2    0008  725     705.
    1    0522  162      0.  *   1    1138  350      0.  *   1    1754  538     640.  *   2    0010  726     713.
    1    0524  163      0.  *   1    1140  351      0.  *   1    1756  539     635.  *   2    0012  727     714.
    1    0526  164      0.  *   1    1142  352      0.  *   1    1758  540     649.  *   2    0014  728     715.
    1    0528  165      0.  *   1    1144  353      0.  *   1    1800  541     663.  *   2    0016  729     720.
    1    0530  166      0.  *   1    1146  354      0.  *   1    1802  542     682.  *   2    0018  730     731.
    1    0532  167      0.  *   1    1148  355      0.  *   1    1804  543     701.  *   2    0020  731     741.
    1    0534  168      0.  *   1    1150  356      0.  *   1    1806  544     712.  *   2    0022  732     761.
    1    0536  169      0.  *   1    1152  357      0.  *   1    1808  545     715.  *   2    0024  733     782.
    1    0538  170      0.  *   1    1154  358      0.  *   1    1810  546     719.  *   2    0026  734     792.
    1    0540  171      0.  *   1    1156  359      0.  *   1    1812  547     719.  *   2    0028  735     793.
    1    0542  172      0.  *   1    1158  360      0.  *   1    1814  548     720.  *   2    0030  736     794.
    1    0544  173      0.  *   1    1200  361      0.  *   1    1816  549     720.  *   2    0032  737     791.
    1    0546  174      0.  *   1    1202  362      0.  *   1    1818  550     720.  *   2    0034  738     788.
    1    0548  175      0.  *   1    1204  363      0.  *   1    1820  551     720.  *   2    0036  739     786.
    1    0550  176      0.  *   1    1206  364      0.  *   1    1822  552     720.  *   2    0038  740     783.
    1    0552  177      0.  *   1    1208  365      0.  *   1    1824  553     719.  *   2    0040  741     780.
    1    0554  178      0.  *   1    1210  366      0.  *   1    1826  554     719.  *   2    0042  742     777.
    1    0556  179      0.  *   1    1212  367      0.  *   1    1828  555     719.  *   2    0044  743     774.
    1    0558  180      0.  *   1    1214  368      0.  *   1    1830  556     719.  *   2    0046  744     770.
    1    0600  181      0.  *   1    1216  369      0.  *   1    1832  557     719.  *   2    0048  745     767.
    1    0602  182      0.  *   1    1218  370      0.  *   1    1834  558     719.  *   2    0050  746     763.
    1    0604  183      0.  *   1    1220  371      0.  *   1    1836  559     719.  *   2    0052  747     759.
    1    0606  184      0.  *   1    1222  372      0.  *   1    1838  560     719.  *   2    0054  748     756.
    1    0608  185      0.  *   1    1224  373      0.  *   1    1840  561     719.  *   2    0056  749     754.
    1    0610  186      0.  *   1    1226  374      0.  *   1    1842  562     719.  *   2    0058  750     754.
    1    0612  187      0.  *   1    1228  375      0.  *   1    1844  563     719.  *
    1    0614  188      0.  *   1    1230  376      0.  *   1    1846  564     719.  *
                            *                       *                                 *
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  PEAK FLOW      TIME                          MAXIMUM AVERAGE FLOW
                                     6-HR        24-HR        72-HR      24.97-HR
+   (CFS)        (HR)
                                  (CFS)
+     890.       13.57                 776.         381.         366.         366.
                                (INCHES)          0.242        0.475        0.475        0.475
                                 (AC-FT)            385.         755.         755.         755.

                                CUMULATIVE AREA =   29.79 SQ MI

MANE2 NPLAN,NSTM        1       0


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            **************
            *            *
   79 KK    *   CGILAW   *
            *            *
            **************

   80 KO          OUTPUT CONTROL VARIABLES
                        IPRNT           1  PRINT CONTROL
                        IPLOT           0  PLOT CONTROL
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                    QSCAL          0.  HYDROGRAPH PLOT SCALE
                        ADD HYDROGRAPHS FROM RBI10 AND GILAAW

  82 HC          HYDROGRAPH COMBINATION
                      ICOMP          2  NUMBER OF HYDROGRAPHS TO COMBINE
                                                          ***
MANE2 NPLAN,NSTM       1       0
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HYDROGRAPH AT STATION CGILAW
SUM OF 2 HYDROGRAPHS

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DA	MON	HRMN	ORD	FLOW	DA	MON	HRMN	ORD	FLOW	DA	MON	HRMN	ORD	FLOW	DA	MON	HRMN	ORD	FLOW
1		0000	1	0.	1		0616	189	0.	1		1232	377	222.	1		1848	565	723.
1		0002	2	0.	1		0618	190	0.	1		1234	378	203.	1		1850	566	723.
1		0004	3	0.	1		0620	191	0.	1		1236	379	185.	1		1852	567	723.
1		0006	4	0.	1		0622	192	0.	1		1238	380	168.	1		1854	568	723.
1		0008	5	0.	1		0624	193	0.	1		1240	381	152.	1		1856	569	723.
1		0010	6	0.	1		0626	194	0.	1		1242	382	142.	1		1858	570	723.
1		0012	7	0.	1		0628	195	0.	1		1244	383	165.	1		1900	571	723.
1		0014	8	0.	1		0630	196	0.	1		1246	384	274.	1		1902	572	723.
1		0016	9	0.	1		0632	197	0.	1		1248	385	422.	1		1904	573	723.
1		0018	10	0.	1		0634	198	0.	1		1250	386	555.	1		1906	574	723.
1		0020	11	0.	1		0636	199	0.	1		1252	387	652.	1		1908	575	723.
1		0022	12	0.	1		0638	200	0.	1		1254	388	720.	1		1910	576	724.
1		0024	13	0.	1		0640	201	0.	1		1256	389	766.	1		1912	577	724.
1		0026	14	0.	1		0642	202	0.	1		1258	390	797.	1		1914	578	725.
1		0028	15	0.	1		0644	203	0.	1		1300	391	819.	1		1916	579	725.
1		0030	16	0.	1		0646	204	0.	1		1302	392	834.	1		1918	580	725.
1		0032	17	0.	1		0648	205	0.	1		1304	393	845.	1		1920	581	725.
1		0034	18	0.	1		0650	206	0.	1		1306	394	853.	1		1922	582	725.
1		0036	19	0.	1		0652	207	0.	1		1308	395	859.	1		1924	583	724.
1		0038	20	0.	1		0654	208	0.	1		1310	396	865.	1		1926	584	724.
1		0040	21	0.	1		0656	209	0.	1		1312	397	870.	1		1928	585	724.
1		0042	22	0.	1		0658	210	0.	1		1314	398	874.	1		1930	586	724.
1		0044	23	0.	1		0700	211	0.	1		1316	399	878.	1		1932	587	724.
1		0046	24	0.	1		0702	212	0.	1		1318	400	882.	1		1934	588	723.
1		0048	25	0.	1		0704	213	0.	1		1320	401	885.	1		1936	589	723.
1		0050	26	0.	1		0706	214	0.	1		1322	402	889.	1		1938	590	723.
1		0052	27	0.	1		0708	215	0.	1		1324	403	892.	1		1940	591	722.
1		0054	28	0.	1		0710	216	0.	1		1326	404	895.	1		1942	592	721.
1		0056	29	0.	1		0712	217	0.	1		1328	405	898.	1		1944	593	720.
1		0058	30	0.	1		0714	218	0.	1		1330	406	900.	1		1946	594	717.
1		0100	31	0.	1		0716	219	0.	1		1332	407	902.	1		1948	595	712.
1		0102	32	0.	1		0718	220	0.	1		1334	408	904.	1		1950	596	704.
1		0104	33	0.	1		0720	221	0.	1		1336	409	905.	1		1952	597	691.
1		0106	34	0.	1		0722	222	0.	1		1338	410	905.	1		1954	598	675.
1		0108	35	0.	1		0724	223	0.	1		1340	411	905.	1		1956	599	657.
1		0110	36	0.	1		0726	224	0.	1		1342	412	904.	1		1958	600	640.
1		0112	37	0.	1		0728	225	0.	1		1344	413	903.	1		2000	601	628.
1		0114	38	0.	1		0730	226	0.	1		1346	414	900.	1		2002	602	623.
1		0116	39	0.	1		0732	227	0.	1		1348	415	896.	1		2004	603	627.
1		0118	40	0.	1		0734	228	0.	1		1350	416	891.	1		2006	604	639.
1		0120	41	0.	1		0736	229	0.	1		1352	417	886.	1		2008	605	656.
1		0122	42	0.	1		0738	230	0.	1		1354	418	879.	1		2010	606	672.
1		0124	43	0.	1		0740	231	0.	1		1356	419	873.	1		2012	607	687.
1		0126	44	0.	1		0742	232	0.	1		1358	420	866.	1		2014	608	698.
1		0128	45	0.	1		0744	233	0.	1		1400	421	859.	1		2016	609	707.
1		0130	46	0.	1		0746	234	0.	1		1402	422	854.	1		2018	610	712.
1		0132	47	0.	1		0748	235	0.	1		1404	423	849.	1		2020	611	716.
1		0134	48	0.	1		0750	236	0.	1		1406	424	847.	1		2022	612	719.
1		0136	49	0.	1		0752	237	0.	1		1408	425	846.	1		2024	613	720.

1	0138	50	0.	*	1	0754	238	0.	*	1	1410	426	846.	*	1	2026	614	721.
1	0140	51	0.	*	1	0756	239	0.	*	1	1412	427	847.	*	1	2028	615	722.
1	0142	52	0.	*	1	0758	240	0.	*	1	1414	428	848.	*	1	2030	616	722.
1	0144	53	0.	*	1	0800	241	0.	*	1	1416	429	849.	*	1	2032	617	723.
1	0146	54	0.	*	1	0802	242	0.	*	1	1418	430	849.	*	1	2034	618	723.
1	0148	55	0.	*	1	0804	243	0.	*	1	1420	431	849.	*	1	2036	619	723.
1	0150	56	0.	*	1	0806	244	0.	*	1	1422	432	848.	*	1	2038	620	723.
1	0152	57	0.	*	1	0808	245	0.	*	1	1424	433	847.	*	1	2040	621	723.
1	0154	58	0.	*	1	0810	246	0.	*	1	1426	434	846.	*	1	2042	622	723.
1	0156	59	0.	*	1	0812	247	0.	*	1	1428	435	844.	*	1	2044	623	723.
1	0158	60	0.	*	1	0814	248	0.	*	1	1430	436	843.	*	1	2046	624	723.
1	0200	61	0.	*	1	0816	249	0.	*	1	1432	437	842.	*	1	2048	625	723.
1	0202	62	0.	*	1	0818	250	0.	*	1	1434	438	841.	*	1	2050	626	723.
1	0204	63	0.	*	1	0820	251	0.	*	1	1436	439	840.	*	1	2052	627	723.
1	0206	64	0.	*	1	0822	252	0.	*	1	1438	440	839.	*	1	2054	628	723.
1	0208	65	0.	*	1	0824	253	0.	*	1	1440	441	838.	*	1	2056	629	723.
1	0210	66	0.	*	1	0826	254	0.	*	1	1442	442	837.	*	1	2058	630	723.
1	0212	67	0.	*	1	0828	255	0.	*	1	1444	443	836.	*	1	2100	631	724.
1	0214	68	0.	*	1	0830	256	0.	*	1	1446	444	835.	*	1	2102	632	724.
1	0216	69	0.	*	1	0832	257	0.	*	1	1448	445	834.	*	1	2104	633	724.
1	0218	70	0.	*	1	0834	258	0.	*	1	1450	446	832.	*	1	2106	634	724.
1	0220	71	0.	*	1	0836	259	0.	*	1	1452	447	831.	*	1	2108	635	724.
1	0222	72	0.	*	1	0838	260	0.	*	1	1454	448	829.	*	1	2110	636	724.
1	0224	73	0.	*	1	0840	261	0.	*	1	1456	449	827.	*	1	2112	637	724.
1	0226	74	0.	*	1	0842	262	0.	*	1	1458	450	825.	*	1	2114	638	724.
1	0228	75	0.	*	1	0844	263	0.	*	1	1500	451	823.	*	1	2116	639	724.
1	0230	76	0.	*	1	0846	264	0.	*	1	1502	452	820.	*	1	2118	640	724.
1	0232	77	0.	*	1	0848	265	0.	*	1	1504	453	818.	*	1	2120	641	724.
1	0234	78	0.	*	1	0850	266	0.	*	1	1506	454	815.	*	1	2122	642	724.
1	0236	79	0.	*	1	0852	267	0.	*	1	1508	455	813.	*	1	2124	643	724.
1	0238	80	0.	*	1	0854	268	0.	*	1	1510	456	810.	*	1	2126	644	724.
1	0240	81	0.	*	1	0856	269	0.	*	1	1512	457	808.	*	1	2128	645	724.
1	0242	82	0.	*	1	0858	270	0.	*	1	1514	458	806.	*	1	2130	646	724.
1	0244	83	0.	*	1	0900	271	0.	*	1	1516	459	804.	*	1	2132	647	724.
1	0246	84	0.	*	1	0902	272	0.	*	1	1518	460	803.	*	1	2134	648	724.
1	0248	85	0.	*	1	0904	273	0.	*	1	1520	461	801.	*	1	2136	649	724.
1	0250	86	0.	*	1	0906	274	0.	*	1	1522	462	799.	*	1	2138	650	723.
1	0252	87	0.	*	1	0908	275	0.	*	1	1524	463	798.	*	1	2140	651	723.
1	0254	88	0.	*	1	0910	276	0.	*	1	1526	464	797.	*	1	2142	652	722.
1	0256	89	0.	*	1	0912	277	0.	*	1	1528	465	795.	*	1	2144	653	720.
1	0258	90	0.	*	1	0914	278	0.	*	1	1530	466	794.	*	1	2146	654	717.
1	0300	91	0.	*	1	0916	279	0.	*	1	1532	467	792.	*	1	2148	655	711.
1	0302	92	0.	*	1	0918	280	0.	*	1	1534	468	791.	*	1	2150	656	700.
1	0304	93	0.	*	1	0920	281	0.	*	1	1536	469	789.	*	1	2152	657	686.
1	0306	94	0.	*	1	0922	282	0.	*	1	1538	470	788.	*	1	2154	658	668.
1	0308	95	0.	*	1	0924	283	0.	*	1	1540	471	785.	*	1	2156	659	648.
1	0310	96	0.	*	1	0926	284	0.	*	1	1542	472	783.	*	1	2158	660	630.
1	0312	97	0.	*	1	0928	285	0.	*	1	1544	473	780.	*	1	2200	661	617.
1	0314	98	0.	*	1	0930	286	0.	*	1	1546	474	777.	*	1	2202	662	611.
1	0316	99	0.	*	1	0932	287	0.	*	1	1548	475	774.	*	1	2204	663	615.
1	0318	100	0.	*	1	0934	288	0.	*	1	1550	476	770.	*	1	2206	664	628.
1	0320	101	0.	*	1	0936	289	0.	*	1	1552	477	765.	*	1	2208	665	646.
1	0322	102	0.	*	1	0938	290	0.	*	1	1554	478	761.	*	1	2210	666	666.
1	0324	103	0.	*	1	0940	291	0.	*	1	1556	479	757.	*	1	2212	667	682.
1	0326	104	0.	*	1	0942	292	0.	*	1	1558	480	754.	*	1	2214	668	695.
1	0328	105	0.	*	1	0944	293	0.	*	1	1600	481	751.	*	1	2216	669	705.
1	0330	106	0.	*	1	0946	294	0.	*	1	1602	482	750.	*	1	2218	670	712.
1	0332	107	0.	*	1	0948	295	0.	*	1	1604	483	750.	*	1	2220	671	717.
1	0334	108	0.	*	1	0950	296	0.	*	1	1606	484	751.	*	1	2222	672	720.
1	0336	109	0.	*	1	0952	297	0.	*	1	1608	485	753.	*	1	2224	673	722.
1	0338	110	0.	*	1	0954	298	0.	*	1	1610	486	755.	*	1	2226	674	723.
1	0340	111	0.	*	1	0956	299	0.	*	1	1612	487	757.	*	1	2228	675	723.
1	0342	112	0.	*	1	0958	300	0.	*	1	1614	488	759.	*	1	2230	676	724.
1	0344	113	0.	*	1	1000	301	0.	*	1	1616	489	759.	*	1	2232	677	724.
1	0346	114	0.	*	1	1002	302	0.	*	1	1618	490	759.	*	1	2234	678	724.
1	0348	115	0.	*	1	1004	303	0.	*	1	1620	491	759.	*	1	2236	679	724.
1	0350	116	0.	*	1	1006	304	0.	*	1	1622	492	758.	*	1	2238	680	723.

1	0352	117	0.	*	1	1008	305	0.	*	1	1624	493	757.	*	1	2240	681	723.
1	0354	118	0.	*	1	1010	306	0.	*	1	1626	494	756.	*	1	2242	682	723.
1	0356	119	0.	*	1	1012	307	0.	*	1	1628	495	755.	*	1	2244	683	723.
1	0358	120	0.	*	1	1014	308	0.	*	1	1630	496	754.	*	1	2246	684	723.
1	0400	121	0.	*	1	1016	309	0.	*	1	1632	497	753.	*	1	2248	685	723.
1	0402	122	0.	*	1	1018	310	0.	*	1	1634	498	752.	*	1	2250	686	723.
1	0404	123	0.	*	1	1020	311	0.	*	1	1636	499	751.	*	1	2252	687	723.
1	0406	124	0.	*	1	1022	312	0.	*	1	1638	500	750.	*	1	2254	688	722.
1	0408	125	0.	*	1	1024	313	0.	*	1	1640	501	749.	*	1	2256	689	722.
1	0410	126	0.	*	1	1026	314	0.	*	1	1642	502	747.	*	1	2258	690	722.
1	0412	127	0.	*	1	1028	315	0.	*	1	1644	503	746.	*	1	2300	691	722.
1	0414	128	0.	*	1	1030	316	0.	*	1	1646	504	745.	*	1	2302	692	722.
1	0416	129	0.	*	1	1032	317	0.	*	1	1648	505	745.	*	1	2304	693	722.
1	0418	130	0.	*	1	1034	318	0.	*	1	1650	506	744.	*	1	2306	694	722.
1	0420	131	0.	*	1	1036	319	0.	*	1	1652	507	743.	*	1	2308	695	722.
1	0422	132	0.	*	1	1038	320	0.	*	1	1654	508	743.	*	1	2310	696	722.
1	0424	133	0.	*	1	1040	321	0.	*	1	1656	509	742.	*	1	2312	697	721.
1	0426	134	0.	*	1	1042	322	0.	*	1	1658	510	742.	*	1	2314	698	721.
1	0428	135	0.	*	1	1044	323	0.	*	1	1700	511	741.	*	1	2316	699	721.
1	0430	136	0.	*	1	1046	324	0.	*	1	1702	512	740.	*	1	2318	700	721.
1	0432	137	0.	*	1	1048	325	0.	*	1	1704	513	739.	*	1	2320	701	721.
1	0434	138	0.	*	1	1050	326	0.	*	1	1706	514	738.	*	1	2322	702	721.
1	0436	139	0.	*	1	1052	327	0.	*	1	1708	515	737.	*	1	2324	703	721.
1	0438	140	0.	*	1	1054	328	0.	*	1	1710	516	736.	*	1	2326	704	721.
1	0440	141	0.	*	1	1056	329	0.	*	1	1712	517	735.	*	1	2328	705	721.
1	0442	142	0.	*	1	1058	330	0.	*	1	1714	518	734.	*	1	2330	706	721.
1	0444	143	0.	*	1	1100	331	0.	*	1	1716	519	733.	*	1	2332	707	720.
1	0446	144	0.	*	1	1102	332	0.	*	1	1718	520	732.	*	1	2334	708	720.
1	0448	145	0.	*	1	1104	333	0.	*	1	1720	521	731.	*	1	2336	709	720.
1	0450	146	0.	*	1	1106	334	1.	*	1	1722	522	730.	*	1	2338	710	720.
1	0452	147	0.	*	1	1108	335	1.	*	1	1724	523	729.	*	1	2340	711	720.
1	0454	148	0.	*	1	1110	336	1.	*	1	1726	524	728.	*	1	2342	712	719.
1	0456	149	0.	*	1	1112	337	1.	*	1	1728	525	728.	*	1	2344	713	718.
1	0458	150	0.	*	1	1114	338	1.	*	1	1730	526	727.	*	1	2346	714	714.
1	0500	151	0.	*	1	1116	339	1.	*	1	1732	527	726.	*	1	2348	715	707.
1	0502	152	0.	*	1	1118	340	1.	*	1	1734	528	725.	*	1	2350	716	694.
1	0504	153	0.	*	1	1120	341	2.	*	1	1736	529	725.	*	1	2352	717	676.
1	0506	154	0.	*	1	1122	342	2.	*	1	1738	530	724.	*	1	2354	718	653.
1	0508	155	0.	*	1	1124	343	2.	*	1	1740	531	724.	*	1	2356	719	628.
1	0510	156	0.	*	1	1126	344	2.	*	1	1742	532	723.	*	1	2358	720	604.
1	0512	157	0.	*	1	1128	345	2.	*	1	1744	533	722.	*	2	0000	721	585.
1	0514	158	0.	*	1	1130	346	3.	*	1	1746	534	721.	*	2	0002	722	575.
1	0516	159	0.	*	1	1132	347	3.	*	1	1748	535	718.	*	2	0004	723	577.
1	0518	160	0.	*	1	1134	348	3.	*	1	1750	536	714.	*	2	0006	724	591.
1	0520	161	0.	*	1	1136	349	4.	*	1	1752	537	708.	*	2	0008	725	613.
1	0522	162	0.	*	1	1138	350	5.	*	1	1754	538	698.	*	2	0010	726	637.
1	0524	163	0.	*	1	1140	351	7.	*	1	1756	539	687.	*	2	0012	727	660.
1	0526	164	0.	*	1	1142	352	8.	*	1	1758	540	675.	*	2	0014	728	678.
1	0528	165	0.	*	1	1144	353	11.	*	1	1800	541	667.	*	2	0016	729	691.
1	0530	166	0.	*	1	1146	354	14.	*	1	1802	542	664.	*	2	0018	730	702.
1	0532	167	0.	*	1	1148	355	17.	*	1	1804	543	667.	*	2	0020	731	711.
1	0534	168	0.	*	1	1150	356	21.	*	1	1806	544	674.	*	2	0022	732	720.
1	0536	169	0.	*	1	1152	357	26.	*	1	1808	545	684.	*	2	0024	733	731.
1	0538	170	0.	*	1	1154	358	32.	*	1	1810	546	694.	*	2	0026	734	744.
1	0540	171	0.	*	1	1156	359	39.	*	1	1812	547	702.	*	2	0028	735	757.
1	0542	172	0.	*	1	1158	360	49.	*	1	1814	548	709.	*	2	0030	736	768.
1	0544	173	0.	*	1	1200	361	63.	*	1	1816	549	714.	*	2	0032	737	776.
1	0546	174	0.	*	1	1202	362	84.	*	1	1818	550	718.	*	2	0034	738	782.
1	0548	175	0.	*	1	1204	363	113.	*	1	1820	551	720.	*	2	0036	739	785.
1	0550	176	0.	*	1	1206	364	153.	*	1	1822	552	722.	*	2	0038	740	786.
1	0552	177	0.	*	1	1208	365	199.	*	1	1824	553	723.	*	2	0040	741	786.
1	0554	178	0.	*	1	1210	366	248.	*	1	1826	554	723.	*	2	0042	742	785.
1	0556	179	0.	*	1	1212	367	292.	*	1	1828	555	723.	*	2	0044	743	783.
1	0558	180	0.	*	1	1214	368	325.	*	1	1830	556	723.	*	2	0046	744	780.
1	0600	181	0.	*	1	1216	369	345.	*	1	1832	557	723.	*	2	0048	745	778.
1	0602	182	0.	*	1	1218	370	352.	*	1	1834	558	723.	*	2	0050	746	775.
1	0604	183	0.	*	1	1220	371	347.	*	1	1836	559	723.	*	2	0052	747	771.

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    1    0606  184      0.   *   1    1222  372     333.   *   1    1838  560     723.   *   2    0054  748     768.
    1    0608  185      0.   *   1    1224  373     313.   *   1    1840  561     723.   *   2    0056  749     765.
    1    0610  186      0.   *   1    1226  374     290.   *   1    1842  562     723.   *   2    0058  750     762.
    1    0612  187      0.   *   1    1228  375     266.   *   1    1844  563     723.   *
    1    0614  188      0.   *   1    1230  376     243.   *   1    1846  564     723.   *
                                *                           *                           *
 ***********************************************************************************************************************

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                    6-HR       24-HR       72-HR     24.97-HR
+   (CFS)       (HR)
                                  (CFS)
+     905.      13.63              785.        386.        371.        371.
                               (INCHES)      0.243       0.479       0.479       0.479
                                (AC-FT)       389.        766.        766.        766.

                            CUMULATIVE AREA =   30.00 SQ MI

MANE2 NPLAN,NSTM        1      0
MANE2 NPLAN,NSTM        1      0
MANE2 NPLAN,NSTM        1      0
MANE2 NPLAN,NSTM        1      0
MANE2 NPLAN,NSTM        1      0
MANE2 NPLAN,NSTM        1      0
MANE2 NPLAN,NSTM        1      0
MANE2 NPLAN,NSTM        1      0
MANE2 NPLAN,NSTM        1      0

 WARNING --- ROUTED OUTFLOW (    824.) IS GREATER THAN MAXIMUM OUTFLOW (    822.) IN STORAGE-OUTFLOW TABLE

 WARNING --- ROUTED OUTFLOW (    866.) IS GREATER THAN MAXIMUM OUTFLOW (    822.) IN STORAGE-OUTFLOW TABLE

 WARNING --- ROUTED OUTFLOW (    892.) IS GREATER THAN MAXIMUM OUTFLOW (    822.) IN STORAGE-OUTFLOW TABLE

 WARNING --- ROUTED OUTFLOW (    907.) IS GREATER THAN MAXIMUM OUTFLOW (    822.) IN STORAGE-OUTFLOW TABLE

 WARNING --- ROUTED OUTFLOW (    912.) IS GREATER THAN MAXIMUM OUTFLOW (    822.) IN STORAGE-OUTFLOW TABLE

 WARNING --- ROUTED OUTFLOW (    909.) IS GREATER THAN MAXIMUM OUTFLOW (    822.) IN STORAGE-OUTFLOW TABLE

 WARNING --- ROUTED OUTFLOW (    899.) IS GREATER THAN MAXIMUM OUTFLOW (    822.) IN STORAGE-OUTFLOW TABLE

 WARNING --- ROUTED OUTFLOW (    884.) IS GREATER THAN MAXIMUM OUTFLOW (    822.) IN STORAGE-OUTFLOW TABLE

 WARNING --- ROUTED OUTFLOW (    865.) IS GREATER THAN MAXIMUM OUTFLOW (    822.) IN STORAGE-OUTFLOW TABLE

 WARNING --- ROUTED OUTFLOW (    844.) IS GREATER THAN MAXIMUM OUTFLOW (    822.) IN STORAGE-OUTFLOW TABLE
MANE2 NPLAN,NSTM        1      0
MANE2 NPLAN,NSTM        1      0
MANE2 NPLAN,NSTM        1      0
MANE2 NPLAN,NSTM        1      0
MANE2 NPLAN,NSTM        1      0
MANE2 NPLAN,NSTM        1      0
MANE2 NPLAN,NSTM        1      0
MANE2 NPLAN,NSTM        1      0
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MANE2 NPLAN,NSTM        1      0
MANE2 NPLAN,NSTM        1      0
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MANE2 NPLAN,NSTM        1      0
MANE2 NPLAN,NSTM        1      0
MANE2 NPLAN,NSTM        1      0
MANE2 NPLAN,NSTM        1      0
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MANE2 NPLAN,NSTM	1	0
MANE2 NPLAN,NSTM	1	0
MANE2 NPLAN,NSTM	1	0
MANE2 NPLAN,NSTM	1	0
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MANE2 NPLAN,NSTM	1	0
MANE2 NPLAN,NSTM	1	0
MANE2 NPLAN,NSTM	1	0
MANE2 NPLAN,NSTM	1	0

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MANE2 NPLAN,NSTM        1       0
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MANE2 NPLAN,NSTM        1       0
MANE2 NPLAN,NSTM        1       0

*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

            **************
            *            *
1260 KK     *     ADPMP  *       combine flows from IC onsite pumpstation and route thru basin.
            *            *
            **************

1261 KO          OUTPUT CONTROL VARIABLES
                       IPRNT           1  PRINT CONTROL
                       IPLOT           0  PLOT CONTROL
                       QSCAL          0.  HYDROGRAPH PLOT SCALE

1262 HC          HYDROGRAPH COMBINATION
                       ICOMP           2  NUMBER OF HYDROGRAPHS TO COMBINE
                                                                  ***
MANE2 NPLAN,NSTM        1       0
*****************************************************************************************************************************************

                                                HYDROGRAPH AT STATION    ADPMP
                                                     SUM OF  2 HYDROGRAPHS

*****************************************************************************************************************************************
                                 *                                 *                                 *                                 *
   DA MON HRMN  ORD      FLOW    *  DA MON HRMN  ORD      FLOW    *  DA MON HRMN  ORD      FLOW    *  DA MON HRMN  ORD      FLOW
                                 *                                 *                                 *
    1     0000   1        0.     *   1     0616  189        1.    *   1     1232  377     2685.    *   1     1848  565      122.
    1     0002   2        0.     *   1     0618  190        1.    *   1     1234  378     2797.    *   1     1850  566      121.
    1     0004   3        0.     *   1     0620  191        1.    *   1     1236  379     3280.    *   1     1852  567      121.
    1     0006   4        0.     *   1     0622  192        1.    *   1     1238  380     3580.    *   1     1854  568      120.
    1     0008   5        0.     *   1     0624  193        1.    *   1     1240  381     3551.    *   1     1856  569      119.
    1     0010   6        0.     *   1     0626  194        1.    *   1     1242  382     3411.    *   1     1858  570      119.
    1     0012   7        0.     *   1     0628  195        1.    *   1     1244  383     3250.    *   1     1900  571      118.
    1     0014   8        0.     *   1     0630  196        1.    *   1     1246  384     3067.    *   1     1902  572      117.
    1     0016   9        0.     *   1     0632  197        1.    *   1     1248  385     2835.    *   1     1904  573      117.
    1     0018  10        0.     *   1     0634  198        1.    *   1     1250  386     2666.    *   1     1906  574      116.
    1     0020  11        0.     *   1     0636  199        1.    *   1     1252  387     2506.    *   1     1908  575      115.
    1     0022  12        0.     *   1     0638  200        1.    *   1     1254  388     2397.    *   1     1910  576      115.
    1     0024  13        0.     *   1     0640  201        1.    *   1     1256  389     2251.    *   1     1912  577      114.
    1     0026  14        0.     *   1     0642  202        1.    *   1     1258  390     2069.    *   1     1914  578      114.
    1     0028  15        0.     *   1     0644  203        1.    *   1     1300  391     1948.    *   1     1916  579      113.
    1     0030  16        0.     *   1     0646  204        1.    *   1     1302  392     1829.    *   1     1918  580      112.
    1     0032  17        0.     *   1     0648  205        1.    *   1     1304  393     1720.    *   1     1920  581      112.
    1     0034  18        0.     *   1     0650  206        1.    *   1     1306  394     1625.    *   1     1922  582      111.
    1     0036  19        0.     *   1     0652  207        1.    *   1     1308  395     1584.    *   1     1924  583      111.
```

1	0038	20	0.	*	1	0654	208	1.	*	1	1310	396	1499.	*	1	1926	584	110.
1	0040	21	0.	*	1	0656	209	1.	*	1	1312	397	1374.	*	1	1928	585	110.
1	0042	22	0.	*	1	0658	210	1.	*	1	1314	398	1306.	*	1	1930	586	110.
1	0044	23	0.	*	1	0700	211	1.	*	1	1316	399	1240.	*	1	1932	587	109.
1	0046	24	0.	*	1	0702	212	1.	*	1	1318	400	1179.	*	1	1934	588	159.
1	0048	25	0.	*	1	0704	213	1.	*	1	1320	401	1123.	*	1	1936	589	108.
1	0050	26	0.	*	1	0706	214	1.	*	1	1322	402	1071.	*	1	1938	590	108.
1	0052	27	0.	*	1	0708	215	1.	*	1	1324	403	1022.	*	1	1940	591	107.
1	0054	28	0.	*	1	0710	216	1.	*	1	1326	404	975.	*	1	1942	592	107.
1	0056	29	0.	*	1	0712	217	1.	*	1	1328	405	933.	*	1	1944	593	107.
1	0058	30	0.	*	1	0714	218	1.	*	1	1330	406	893.	*	1	1946	594	106.
1	0100	31	0.	*	1	0716	219	1.	*	1	1332	407	905.	*	1	1948	595	106.
1	0102	32	0.	*	1	0718	220	1.	*	1	1334	408	869.	*	1	1950	596	105.
1	0104	33	0.	*	1	0720	221	1.	*	1	1336	409	786.	*	1	1952	597	104.
1	0106	34	0.	*	1	0722	222	1.	*	1	1338	410	756.	*	1	1954	598	103.
1	0108	35	0.	*	1	0724	223	1.	*	1	1340	411	726.	*	1	1956	599	102.
1	0110	36	0.	*	1	0726	224	1.	*	1	1342	412	698.	*	1	1958	600	101.
1	0112	37	0.	*	1	0728	225	1.	*	1	1344	413	671.	*	1	2000	601	99.
1	0114	38	0.	*	1	0730	226	1.	*	1	1346	414	645.	*	1	2002	602	98.
1	0116	39	0.	*	1	0732	227	1.	*	1	1348	415	621.	*	1	2004	603	97.
1	0118	40	0.	*	1	0734	228	1.	*	1	1350	416	600.	*	1	2006	604	96.
1	0120	41	0.	*	1	0736	229	1.	*	1	1352	417	579.	*	1	2008	605	95.
1	0122	42	0.	*	1	0738	230	1.	*	1	1354	418	560.	*	1	2010	606	94.
1	0124	43	0.	*	1	0740	231	1.	*	1	1356	419	542.	*	1	2012	607	94.
1	0126	44	0.	*	1	0742	232	2.	*	1	1358	420	526.	*	1	2014	608	93.
1	0128	45	0.	*	1	0744	233	2.	*	1	1400	421	509.	*	1	2016	609	92.
1	0130	46	0.	*	1	0746	234	2.	*	1	1402	422	544.	*	1	2018	610	92.
1	0132	47	0.	*	1	0748	235	2.	*	1	1404	423	530.	*	1	2020	611	91.
1	0134	48	0.	*	1	0750	236	2.	*	1	1406	424	466.	*	1	2022	612	90.
1	0136	49	0.	*	1	0752	237	2.	*	1	1408	425	452.	*	1	2024	613	90.
1	0138	50	0.	*	1	0754	238	2.	*	1	1410	426	439.	*	1	2026	614	89.
1	0140	51	0.	*	1	0756	239	2.	*	1	1412	427	427.	*	1	2028	615	88.
1	0142	52	0.	*	1	0758	240	2.	*	1	1414	428	415.	*	1	2030	616	88.
1	0144	53	0.	*	1	0800	241	2.	*	1	1416	429	405.	*	1	2032	617	87.
1	0146	54	0.	*	1	0802	242	2.	*	1	1418	430	394.	*	1	2034	618	87.
1	0148	55	0.	*	1	0804	243	2.	*	1	1420	431	384.	*	1	2036	619	86.
1	0150	56	0.	*	1	0806	244	2.	*	1	1422	432	373.	*	1	2038	620	86.
1	0152	57	0.	*	1	0808	245	2.	*	1	1424	433	364.	*	1	2040	621	85.
1	0154	58	0.	*	1	0810	246	2.	*	1	1426	434	357.	*	1	2042	622	135.
1	0156	59	0.	*	1	0812	247	2.	*	1	1428	435	349.	*	1	2044	623	84.
1	0158	60	0.	*	1	0814	248	2.	*	1	1430	436	342.	*	1	2046	624	84.
1	0200	61	1.	*	1	0816	249	2.	*	1	1432	437	336.	*	1	2048	625	83.
1	0202	62	1.	*	1	0818	250	2.	*	1	1434	438	329.	*	1	2050	626	83.
1	0204	63	1.	*	1	0820	251	2.	*	1	1436	439	323.	*	1	2052	627	82.
1	0206	64	1.	*	1	0822	252	2.	*	1	1438	440	318.	*	1	2054	628	82.
1	0208	65	1.	*	1	0824	253	2.	*	1	1440	441	362.	*	1	2056	629	81.
1	0210	66	1.	*	1	0826	254	2.	*	1	1442	442	357.	*	1	2058	630	81.
1	0212	67	1.	*	1	0828	255	2.	*	1	1444	443	302.	*	1	2100	631	80.
1	0214	68	1.	*	1	0830	256	2.	*	1	1446	444	298.	*	1	2102	632	80.
1	0216	69	1.	*	1	0832	257	2.	*	1	1448	445	294.	*	1	2104	633	79.
1	0218	70	1.	*	1	0834	258	2.	*	1	1450	446	289.	*	1	2106	634	79.
1	0220	71	1.	*	1	0836	259	2.	*	1	1452	447	285.	*	1	2108	635	79.
1	0222	72	1.	*	1	0838	260	2.	*	1	1454	448	282.	*	1	2110	636	78.
1	0224	73	1.	*	1	0840	261	2.	*	1	1456	449	278.	*	1	2112	637	78.
1	0226	74	1.	*	1	0842	262	2.	*	1	1458	450	274.	*	1	2114	638	77.
1	0228	75	1.	*	1	0844	263	2.	*	1	1500	451	271.	*	1	2116	639	77.
1	0230	76	1.	*	1	0846	264	2.	*	1	1502	452	268.	*	1	2118	640	77.
1	0232	77	1.	*	1	0848	265	2.	*	1	1504	453	265.	*	1	2120	641	76.
1	0234	78	1.	*	1	0850	266	2.	*	1	1506	454	262.	*	1	2122	642	76.
1	0236	79	1.	*	1	0852	267	2.	*	1	1508	455	259.	*	1	2124	643	75.
1	0238	80	1.	*	1	0854	268	2.	*	1	1510	456	256.	*	1	2126	644	75.
1	0240	81	1.	*	1	0856	269	2.	*	1	1512	457	253.	*	1	2128	645	75.
1	0242	82	1.	*	1	0858	270	2.	*	1	1514	458	250.	*	1	2130	646	74.
1	0244	83	1.	*	1	0900	271	2.	*	1	1516	459	247.	*	1	2132	647	74.
1	0246	84	1.	*	1	0902	272	2.	*	1	1518	460	244.	*	1	2134	648	74.
1	0248	85	1.	*	1	0904	273	2.	*	1	1520	461	241.	*	1	2136	649	73.
1	0250	86	1.	*	1	0906	274	2.	*	1	1522	462	238.	*	1	2138	650	73.

1	0252	87	1.	*	1	0908	275	2.	*	1	1524	463	236.	*	1	2140	651	73.
1	0254	88	1.	*	1	0910	276	2.	*	1	1526	464	283.	*	1	2142	652	72.
1	0256	89	1.	*	1	0912	277	2.	*	1	1528	465	231.	*	1	2144	653	72.
1	0258	90	1.	*	1	0914	278	2.	*	1	1530	466	228.	*	1	2146	654	72.
1	0300	91	1.	*	1	0916	279	2.	*	1	1532	467	226.	*	1	2148	655	71.
1	0302	92	1.	*	1	0918	280	2.	*	1	1534	468	224.	*	1	2150	656	71.
1	0304	93	1.	*	1	0920	281	2.	*	1	1536	469	222.	*	1	2152	657	71.
1	0306	94	1.	*	1	0922	282	2.	*	1	1538	470	220.	*	1	2154	658	70.
1	0308	95	1.	*	1	0924	283	2.	*	1	1540	471	218.	*	1	2156	659	70.
1	0310	96	1.	*	1	0926	284	2.	*	1	1542	472	216.	*	1	2158	660	70.
1	0312	97	1.	*	1	0928	285	2.	*	1	1544	473	214.	*	1	2200	661	119.
1	0314	98	1.	*	1	0930	286	2.	*	1	1546	474	212.	*	1	2202	662	69.
1	0316	99	1.	*	1	0932	287	3.	*	1	1548	475	210.	*	1	2204	663	69.
1	0318	100	1.	*	1	0934	288	3.	*	1	1550	476	208.	*	1	2206	664	69.
1	0320	101	1.	*	1	0936	289	3.	*	1	1552	477	207.	*	1	2208	665	68.
1	0322	102	1.	*	1	0938	290	3.	*	1	1554	478	205.	*	1	2210	666	68.
1	0324	103	1.	*	1	0940	291	3.	*	1	1556	479	254.	*	1	2212	667	68.
1	0326	104	1.	*	1	0942	292	3.	*	1	1558	480	202.	*	1	2214	668	68.
1	0328	105	1.	*	1	0944	293	3.	*	1	1600	481	200.	*	1	2216	669	67.
1	0330	106	1.	*	1	0946	294	3.	*	1	1602	482	199.	*	1	2218	670	67.
1	0332	107	1.	*	1	0948	295	3.	*	1	1604	483	198.	*	1	2220	671	67.
1	0334	108	1.	*	1	0950	296	4.	*	1	1606	484	196.	*	1	2222	672	67.
1	0336	109	1.	*	1	0952	297	4.	*	1	1608	485	195.	*	1	2224	673	66.
1	0338	110	1.	*	1	0954	298	4.	*	1	1610	486	194.	*	1	2226	674	66.
1	0340	111	1.	*	1	0956	299	4.	*	1	1612	487	193.	*	1	2228	675	66.
1	0342	112	1.	*	1	0958	300	4.	*	1	1614	488	191.	*	1	2230	676	66.
1	0344	113	1.	*	1	1000	301	5.	*	1	1616	489	190.	*	1	2232	677	65.
1	0346	114	1.	*	1	1002	302	5.	*	1	1618	490	189.	*	1	2234	678	65.
1	0348	115	1.	*	1	1004	303	5.	*	1	1620	491	188.	*	1	2236	679	65.
1	0350	116	1.	*	1	1006	304	6.	*	1	1622	492	186.	*	1	2238	680	65.
1	0352	117	1.	*	1	1008	305	6.	*	1	1624	493	185.	*	1	2240	681	64.
1	0354	118	1.	*	1	1010	306	6.	*	1	1626	494	184.	*	1	2242	682	64.
1	0356	119	1.	*	1	1012	307	7.	*	1	1628	495	233.	*	1	2244	683	64.
1	0358	120	1.	*	1	1014	308	7.	*	1	1630	496	182.	*	1	2246	684	64.
1	0400	121	1.	*	1	1016	309	8.	*	1	1632	497	181.	*	1	2248	685	63.
1	0402	122	1.	*	1	1018	310	8.	*	1	1634	498	180.	*	1	2250	686	63.
1	0404	123	1.	*	1	1020	311	9.	*	1	1636	499	179.	*	1	2252	687	63.
1	0406	124	1.	*	1	1022	312	9.	*	1	1638	500	178.	*	1	2254	688	63.
1	0408	125	1.	*	1	1024	313	10.	*	1	1640	501	176.	*	1	2256	689	63.
1	0410	126	1.	*	1	1026	314	10.	*	1	1642	502	175.	*	1	2258	690	62.
1	0412	127	1.	*	1	1028	315	11.	*	1	1644	503	174.	*	1	2300	691	62.
1	0414	128	1.	*	1	1030	316	11.	*	1	1646	504	173.	*	1	2302	692	62.
1	0416	129	1.	*	1	1032	317	12.	*	1	1648	505	172.	*	1	2304	693	62.
1	0418	130	1.	*	1	1034	318	12.	*	1	1650	506	171.	*	1	2306	694	62.
1	0420	131	1.	*	1	1036	319	13.	*	1	1652	507	170.	*	1	2308	695	61.
1	0422	132	1.	*	1	1038	320	64.	*	1	1654	508	169.	*	1	2310	696	61.
1	0424	133	1.	*	1	1040	321	14.	*	1	1656	509	168.	*	1	2312	697	61.
1	0426	134	1.	*	1	1042	322	15.	*	1	1658	510	167.	*	1	2314	698	61.
1	0428	135	1.	*	1	1044	323	16.	*	1	1700	511	166.	*	1	2316	699	61.
1	0430	136	1.	*	1	1046	324	17.	*	1	1702	512	165.	*	1	2318	700	60.
1	0432	137	1.	*	1	1048	325	18.	*	1	1704	513	164.	*	1	2320	701	60.
1	0434	138	1.	*	1	1050	326	19.	*	1	1706	514	214.	*	1	2322	702	60.
1	0436	139	1.	*	1	1052	327	20.	*	1	1708	515	163.	*	1	2324	703	60.
1	0438	140	1.	*	1	1054	328	21.	*	1	1710	516	162.	*	1	2326	704	60.
1	0440	141	1.	*	1	1056	329	22.	*	1	1712	517	161.	*	1	2328	705	109.
1	0442	142	1.	*	1	1058	330	23.	*	1	1714	518	160.	*	1	2330	706	59.
1	0444	143	1.	*	1	1100	331	24.	*	1	1716	519	159.	*	1	2332	707	59.
1	0446	144	1.	*	1	1102	332	25.	*	1	1718	520	158.	*	1	2334	708	59.
1	0448	145	1.	*	1	1104	333	26.	*	1	1720	521	157.	*	1	2336	709	59.
1	0450	146	1.	*	1	1106	334	28.	*	1	1722	522	156.	*	1	2338	710	59.
1	0452	147	1.	*	1	1108	335	29.	*	1	1724	523	155.	*	1	2340	711	58.
1	0454	148	1.	*	1	1110	336	31.	*	1	1726	524	155.	*	1	2342	712	58.
1	0456	149	1.	*	1	1112	337	82.	*	1	1728	525	154.	*	1	2344	713	58.
1	0458	150	1.	*	1	1114	338	34.	*	1	1730	526	153.	*	1	2346	714	58.
1	0500	151	1.	*	1	1116	339	35.	*	1	1732	527	152.	*	1	2348	715	58.
1	0502	152	1.	*	1	1118	340	37.	*	1	1734	528	151.	*	1	2350	716	57.
1	0504	153	1.	*	1	1120	341	39.	*	1	1736	529	150.	*	1	2352	717	57.

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    1    0506  154        1.   *    1    1122  342       41.   *    1    1738  530      150.   *    1    2354  718       57.
    1    0508  155        1.   *    1    1124  343       43.   *    1    1740  531      149.   *    1    2356  719       57.
    1    0510  156        1.   *    1    1126  344       46.   *    1    1742  532      148.   *    1    2358  720       57.
    1    0512  157        1.   *    1    1128  345       50.   *    1    1744  533      147.   *    2    0000  721       57.
    1    0514  158        1.   *    1    1130  346       53.   *    1    1746  534      146.   *    2    0002  722       57.
    1    0516  159        1.   *    1    1132  347      107.   *    1    1748  535      196.   *    2    0004  723       56.
    1    0518  160        1.   *    1    1134  348      112.   *    1    1750  536      145.   *    2    0006  724       56.
    1    0520  161        1.   *    1    1136  349       71.   *    1    1752  537      144.   *    2    0008  725       56.
    1    0522  162        1.   *    1    1138  350       85.   *    1    1754  538      143.   *    2    0010  726       55.
    1    0524  163        1.   *    1    1140  351      102.   *    1    1756  539      143.   *    2    0012  727       54.
    1    0526  164        1.   *    1    1142  352      121.   *    1    1758  540      142.   *    2    0014  728       53.
    1    0528  165        1.   *    1    1144  353      145.   *    1    1800  541      141.   *    2    0016  729       52.
    1    0530  166        1.   *    1    1146  354      175.   *    1    1802  542      140.   *    2    0018  730       51.
    1    0532  167        1.   *    1    1148  355      264.   *    1    1804  543      140.   *    2    0020  731       50.
    1    0534  168        1.   *    1    1150  356      317.   *    1    1806  544      139.   *    2    0022  732       48.
    1    0536  169        1.   *    1    1152  357      370.   *    1    1808  545      138.   *    2    0024  733       47.
    1    0538  170        1.   *    1    1154  358      435.   *    1    1810  546      137.   *    2    0026  734       46.
    1    0540  171        1.   *    1    1156  359      520.   *    1    1812  547      137.   *    2    0028  735       45.
    1    0542  172        1.   *    1    1158  360      621.   *    1    1814  548      136.   *    2    0030  736       43.
    1    0544  173        1.   *    1    1200  361      763.   *    1    1816  549      135.   *    2    0032  737       42.
    1    0546  174        1.   *    1    1202  362      970.   *    1    1818  550      134.   *    2    0034  738       41.
    1    0548  175        1.   *    1    1204  363     1329.   *    1    1820  551      133.   *    2    0036  739       40.
    1    0550  176        1.   *    1    1206  364     1862.   *    1    1822  552      132.   *    2    0038  740       39.
    1    0552  177        1.   *    1    1208  365     2397.   *    1    1824  553      131.   *    2    0040  741       38.
    1    0554  178        1.   *    1    1210  366     2956.   *    1    1826  554      131.   *    2    0042  742       37.
    1    0556  179        1.   *    1    1212  367     3419.   *    1    1828  555      130.   *    2    0044  743       36.
    1    0558  180        1.   *    1    1214  368     3703.   *    1    1830  556      129.   *    2    0046  744       35.
    1    0600  181        1.   *    1    1216  369     3814.   *    1    1832  557      128.   *    2    0048  745       35.
    1    0602  182        1.   *    1    1218  370     3797.   *    1    1834  558      127.   *    2    0050  746       34.
    1    0604  183        1.   *    1    1220  371     3695.   *    1    1836  559      176.   *    2    0052  747       33.
    1    0606  184        1.   *    1    1222  372     3537.   *    1    1838  560      126.   *    2    0054  748       33.
    1    0608  185        1.   *    1    1224  373     3348.   *    1    1840  561      125.   *    2    0056  749       32.
    1    0610  186        1.   *    1    1226  374     3145.   *    1    1842  562      124.   *    2    0058  750       32.
    1    0612  187        1.   *    1    1228  375     2952.   *    1    1844  563      124.   *
    1    0614  188        1.   *    1    1230  376     2804.   *    1    1846  564      123.   *
                                   *                          *                                 *
*****************************************************************************************************************************

  PEAK FLOW      TIME                          MAXIMUM AVERAGE FLOW
                                    6-HR        24-HR        72-HR      24.97-HR
+   (CFS)        (HR)
                              (CFS)
+    3814.       12.27          809.         231.         222.         222.
                          (INCHES)        1.656        1.889        1.889        1.889
                           (AC-FT)         401.         458.         458.         458.

                          CUMULATIVE AREA =    4.55 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


            **************
            *            *
 1263 KK    *     B15FF  *
            *            *
            **************

 1267 KO          OUTPUT CONTROL VARIABLES
                        IPRNT          2  PRINT CONTROL
                        IPLOT          0  PLOT CONTROL
                        QSCAL         0.  HYDROGRAPH PLOT SCALE

                 HYDROGRAPH ROUTING DATA
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1268 RS          STORAGE ROUTING
                      NSTPS          1  NUMBER OF SUBREACHES
                       ITYP       STOR  TYPE OF INITIAL CONDITION
                     RSVRIC       0.00  INITIAL CONDITION
                          X       0.00 WORKING R AND D COEFFICIENT

1269 SV            STORAGE        0.0      46.0      59.0      63.0

1270 SE          ELEVATION    1140.00   1158.00   1161.00   1162.00

1271 SS          SPILLWAY
                      CREL    1158.00  SPILLWAY CREST ELEVATION
                     SPWID     400.00  SPILLWAY WIDTH
                      COQW       2.64  WEIR COEFFICIENT
                      EXPW       1.50  EXPONENT OF HEAD
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COMPUTED OUTFLOW-ELEVATION DATA

OUTFLOW	0.00	0.00	1.45	11.59	39.11	92.71	181.07	312.89	496.86	741.66
ELEVATION	1140.00	1158.00	1158.01	1158.05	1158.11	1158.20	1158.31	1158.44	1158.60	1158.79
OUTFLOW	1056.00	1448.56	1928.03	2503.11	3182.49	3974.85	4888.89	5933.30	7116.77	8448.00
ELEVATION	1159.00	1159.23	1159.49	1159.78	1160.09	1160.42	1160.78	1161.16	1161.57	1162.00

COMPUTED STORAGE-OUTFLOW-ELEVATION DATA

STORAGE	0.00	46.00	46.05	46.21	46.48	46.86	47.34	47.93	48.62	49.42
OUTFLOW	0.00	0.00	1.45	11.61	39.10	92.69	181.03	312.90	496.91	741.72
ELEVATION	1140.00	1158.00	1158.01	1158.05	1158.11	1158.20	1158.31	1158.44	1158.60	1158.79
STORAGE	50.33	51.35	52.47	53.70	55.04	56.49	58.04	59.00	59.64	61.27
OUTFLOW	1056.00	1448.65	1927.93	2503.23	3182.50	3974.96	4889.03	5487.14	5933.38	7116.68
ELEVATION	1159.00	1159.23	1159.49	1159.78	1160.09	1160.42	1160.78	1161.00	1161.16	1161.57
STORAGE	63.00									
OUTFLOW	8448.00									
ELEVATION	1162.00									

*** WARNING *** MODIFIED PULS ROUTING MAY BE NUMERICALLY UNSTABLE FOR OUTFLOWS BETWEEN 5933. TO 8448.
THE ROUTED HYDROGRAPH SHOULD BE EXAMINED FOR OSCILLATIONS OR OUTFLOWS GREATER THAN PEAK INFLOWS.
THIS CAN BE CORRECTED BY DECREASING THE TIME INTERVAL OR INCREASING STORAGE (USE A LONGER REACH.)

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HYDROGRAPH AT STATION B15FF

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DA	MON	HRMN	ORD	OUTFLOW	STORAGE	STAGE	DA	MON	HRMN	ORD	OUTFLOW	STORAGE	STAGE	DA	MON	HRMN	ORD	OUTFLOW	STORAGE	STAGE
1		0000	1	0.	0.0	1140.0	1		0820	251	0.	0.6	1140.2	1		1640	501	179.	47.3	1158.3
1		0002	2	0.	0.0	1140.0	1		0822	252	0.	0.6	1140.2	1		1642	502	178.	47.3	1158.3
1		0004	3	0.	0.0	1140.0	1		0824	253	0.	0.6	1140.2	1		1644	503	177.	47.3	1158.3
1		0006	4	0.	0.0	1140.0	1		0826	254	0.	0.6	1140.2	1		1646	504	176.	47.3	1158.3
1		0008	5	0.	0.0	1140.0	1		0828	255	0.	0.6	1140.2	1		1648	505	174.	47.3	1158.3
1		0010	6	0.	0.0	1140.0	1		0830	256	0.	0.6	1140.2	1		1650	506	173.	47.3	1158.3
1		0012	7	0.	0.0	1140.0	1		0832	257	0.	0.6	1140.2	1		1652	507	172.	47.3	1158.3
1		0014	8	0.	0.0	1140.0	1		0834	258	0.	0.6	1140.2	1		1654	508	171.	47.3	1158.3
1		0016	9	0.	0.0	1140.0	1		0836	259	0.	0.6	1140.2	1		1656	509	170.	47.3	1158.3
1		0018	10	0.	0.0	1140.0	1		0838	260	0.	0.6	1140.2	1		1658	510	169.	47.3	1158.3
1		0020	11	0.	0.0	1140.0	1		0840	261	0.	0.6	1140.2	1		1700	511	168.	47.3	1158.3
1		0022	12	0.	0.0	1140.0	1		0842	262	0.	0.6	1140.2	1		1702	512	167.	47.3	1158.3
1		0024	13	0.	0.0	1140.0	1		0844	263	0.	0.6	1140.2	1		1704	513	166.	47.3	1158.3
1		0026	14	0.	0.0	1140.0	1		0846	264	0.	0.6	1140.2	1		1706	514	176.	47.3	1158.3

1	0028	15	0.	0.0	1140.0	*	1	0848	265	0.	0.6	1140.2	*	1	1708	515	181.	47.3	1158.3
1	0030	16	0.	0.0	1140.0	*	1	0850	266	0.	0.6	1140.3	*	1	1710	516	173.	47.3	1158.3
1	0032	17	0.	0.0	1140.0	*	1	0852	267	0.	0.6	1140.3	*	1	1712	517	168.	47.3	1158.3
1	0034	18	0.	0.0	1140.0	*	1	0854	268	0.	0.7	1140.3	*	1	1714	518	165.	47.3	1158.3
1	0036	19	0.	0.0	1140.0	*	1	0856	269	0.	0.7	1140.3	*	1	1716	519	163.	47.2	1158.3
1	0038	20	0.	0.0	1140.0	*	1	0858	270	0.	0.7	1140.3	*	1	1718	520	161.	47.2	1158.3
1	0040	21	0.	0.0	1140.0	*	1	0900	271	0.	0.7	1140.3	*	1	1720	521	160.	47.2	1158.3
1	0042	22	0.	0.0	1140.0	*	1	0902	272	0.	0.7	1140.3	*	1	1722	522	158.	47.2	1158.3
1	0044	23	0.	0.0	1140.0	*	1	0904	273	0.	0.7	1140.3	*	1	1724	523	157.	47.2	1158.3
1	0046	24	0.	0.0	1140.0	*	1	0906	274	0.	0.7	1140.3	*	1	1726	524	156.	47.2	1158.3
1	0048	25	0.	0.0	1140.0	*	1	0908	275	0.	0.7	1140.3	*	1	1728	525	155.	47.2	1158.3
1	0050	26	0.	0.0	1140.0	*	1	0910	276	0.	0.7	1140.3	*	1	1730	526	155.	47.2	1158.3
1	0052	27	0.	0.0	1140.0	*	1	0912	277	0.	0.7	1140.3	*	1	1732	527	154.	47.2	1158.3
1	0054	28	0.	0.0	1140.0	*	1	0914	278	0.	0.7	1140.3	*	1	1734	528	153.	47.2	1158.3
1	0056	29	0.	0.0	1140.0	*	1	0916	279	0.	0.7	1140.3	*	1	1736	529	152.	47.2	1158.3
1	0058	30	0.	0.0	1140.0	*	1	0918	280	0.	0.7	1140.3	*	1	1738	530	151.	47.2	1158.3
1	0100	31	0.	0.0	1140.0	*	1	0920	281	0.	0.7	1140.3	*	1	1740	531	150.	47.2	1158.3
1	0102	32	0.	0.0	1140.0	*	1	0922	282	0.	0.7	1140.3	*	1	1742	532	150.	47.2	1158.3
1	0104	33	0.	0.0	1140.0	*	1	0924	283	0.	0.7	1140.3	*	1	1744	533	149.	47.2	1158.3
1	0106	34	0.	0.0	1140.0	*	1	0926	284	0.	0.7	1140.3	*	1	1746	534	148.	47.2	1158.3
1	0108	35	0.	0.0	1140.0	*	1	0928	285	0.	0.8	1140.3	*	1	1748	535	157.	47.2	1158.3
1	0110	36	0.	0.0	1140.0	*	1	0930	286	0.	0.8	1140.3	*	1	1750	536	163.	47.2	1158.3
1	0112	37	0.	0.0	1140.0	*	1	0932	287	0.	0.8	1140.3	*	1	1752	537	155.	47.2	1158.3
1	0114	38	0.	0.0	1140.0	*	1	0934	288	0.	0.8	1140.3	*	1	1754	538	151.	47.2	1158.3
1	0116	39	0.	0.0	1140.0	*	1	0936	289	0.	0.8	1140.3	*	1	1756	539	148.	47.2	1158.3
1	0118	40	0.	0.0	1140.0	*	1	0938	290	0.	0.8	1140.3	*	1	1758	540	145.	47.1	1158.3
1	0120	41	0.	0.0	1140.0	*	1	0940	291	0.	0.8	1140.3	*	1	1800	541	144.	47.1	1158.3
1	0122	42	0.	0.0	1140.0	*	1	0942	292	0.	0.8	1140.3	*	1	1802	542	143.	47.1	1158.3
1	0124	43	0.	0.0	1140.0	*	1	0944	293	0.	0.8	1140.3	*	1	1804	543	142.	47.1	1158.3
1	0126	44	0.	0.0	1140.0	*	1	0946	294	0.	0.8	1140.3	*	1	1806	544	141.	47.1	1158.3
1	0128	45	0.	0.0	1140.0	*	1	0948	295	0.	0.8	1140.3	*	1	1808	545	140.	47.1	1158.3
1	0130	46	0.	0.0	1140.0	*	1	0950	296	0.	0.8	1140.3	*	1	1810	546	139.	47.1	1158.3
1	0132	47	0.	0.0	1140.0	*	1	0952	297	0.	0.9	1140.3	*	1	1812	547	138.	47.1	1158.3
1	0134	48	0.	0.0	1140.0	*	1	0954	298	0.	0.9	1140.3	*	1	1814	548	137.	47.1	1158.3
1	0136	49	0.	0.0	1140.0	*	1	0956	299	0.	0.9	1140.3	*	1	1816	549	136.	47.1	1158.3
1	0138	50	0.	0.0	1140.0	*	1	0958	300	0.	0.9	1140.3	*	1	1818	550	136.	47.1	1158.3
1	0140	51	0.	0.0	1140.0	*	1	1000	301	0.	0.9	1140.4	*	1	1820	551	135.	47.1	1158.3
1	0142	52	0.	0.0	1140.0	*	1	1002	302	0.	0.9	1140.4	*	1	1822	552	134.	47.1	1158.2
1	0144	53	0.	0.0	1140.0	*	1	1004	303	0.	0.9	1140.4	*	1	1824	553	133.	47.1	1158.2
1	0146	54	0.	0.0	1140.0	*	1	1006	304	0.	0.9	1140.4	*	1	1826	554	132.	47.1	1158.2
1	0148	55	0.	0.0	1140.0	*	1	1008	305	0.	1.0	1140.4	*	1	1828	555	131.	47.1	1158.2
1	0150	56	0.	0.0	1140.0	*	1	1010	306	0.	1.0	1140.4	*	1	1830	556	131.	47.1	1158.2
1	0152	57	0.	0.0	1140.0	*	1	1012	307	0.	1.0	1140.4	*	1	1832	557	130.	47.1	1158.2
1	0154	58	0.	0.0	1140.0	*	1	1014	308	0.	1.0	1140.4	*	1	1834	558	129.	47.1	1158.2
1	0156	59	0.	0.0	1140.0	*	1	1016	309	0.	1.0	1140.4	*	1	1836	559	138.	47.1	1158.3
1	0158	60	0.	0.0	1140.0	*	1	1018	310	0.	1.1	1140.4	*	1	1838	560	143.	47.1	1158.3
1	0200	61	0.	0.0	1140.0	*	1	1020	311	0.	1.1	1140.4	*	1	1840	561	136.	47.1	1158.3
1	0202	62	0.	0.0	1140.0	*	1	1022	312	0.	1.1	1140.4	*	1	1842	562	131.	47.1	1158.2
1	0204	63	0.	0.0	1140.0	*	1	1024	313	0.	1.1	1140.4	*	1	1844	563	128.	47.1	1158.2
1	0206	64	0.	0.0	1140.0	*	1	1026	314	0.	1.2	1140.5	*	1	1846	564	126.	47.0	1158.2
1	0208	65	0.	0.0	1140.0	*	1	1028	315	0.	1.2	1140.5	*	1	1848	565	125.	47.0	1158.2
1	0210	66	0.	0.0	1140.0	*	1	1030	316	0.	1.2	1140.5	*	1	1850	566	124.	47.0	1158.2
1	0212	67	0.	0.0	1140.0	*	1	1032	317	0.	1.2	1140.5	*	1	1852	567	123.	47.0	1158.2
1	0214	68	0.	0.0	1140.0	*	1	1034	318	0.	1.3	1140.5	*	1	1854	568	122.	47.0	1158.2
1	0216	69	0.	0.0	1140.0	*	1	1036	319	0.	1.3	1140.5	*	1	1856	569	121.	47.0	1158.2
1	0218	70	0.	0.0	1140.0	*	1	1038	320	0.	1.4	1140.6	*	1	1858	570	120.	47.0	1158.2
1	0220	71	0.	0.0	1140.0	*	1	1040	321	0.	1.5	1140.6	*	1	1900	571	119.	47.0	1158.2
1	0222	72	0.	0.0	1140.0	*	1	1042	322	0.	1.6	1140.6	*	1	1902	572	119.	47.0	1158.2
1	0224	73	0.	0.0	1140.0	*	1	1044	323	0.	1.6	1140.6	*	1	1904	573	118.	47.0	1158.2
1	0226	74	0.	0.0	1140.0	*	1	1046	324	0.	1.7	1140.6	*	1	1906	574	117.	47.0	1158.2
1	0228	75	0.	0.0	1140.0	*	1	1048	325	0.	1.7	1140.7	*	1	1908	575	117.	47.0	1158.2
1	0230	76	0.	0.1	1140.0	*	1	1050	326	0.	1.8	1140.7	*	1	1910	576	116.	47.0	1158.2
1	0232	77	0.	0.1	1140.0	*	1	1052	327	0.	1.8	1140.7	*	1	1912	577	115.	47.0	1158.2
1	0234	78	0.	0.1	1140.0	*	1	1054	328	0.	1.9	1140.7	*	1	1914	578	115.	47.0	1158.2
1	0236	79	0.	0.1	1140.0	*	1	1056	329	0.	1.9	1140.8	*	1	1916	579	114.	47.0	1158.2
1	0238	80	0.	0.1	1140.0	*	1	1058	330	0.	2.0	1140.8	*	1	1918	580	114.	47.0	1158.2
1	0240	81	0.	0.1	1140.0	*	1	1100	331	0.	2.0	1140.8	*	1	1920	581	113.	47.0	1158.2

1	0242	82	0.	0.1	1140.0	*	1	1102	332	0.	2.1	1140.8	*	1	1922	582	112.	47.0	1158.2
1	0244	83	0.	0.1	1140.0	*	1	1104	333	0.	2.2	1140.9	*	1	1924	583	112.	47.0	1158.2
1	0246	84	0.	0.1	1140.0	*	1	1106	334	0.	2.3	1140.9	*	1	1926	584	111.	47.0	1158.2
1	0248	85	0.	0.1	1140.0	*	1	1108	335	0.	2.3	1140.9	*	1	1928	585	111.	47.0	1158.2
1	0250	86	0.	0.1	1140.0	*	1	1110	336	0.	2.4	1140.9	*	1	1930	586	110.	47.0	1158.2
1	0252	87	0.	0.1	1140.0	*	1	1112	337	0.	2.6	1141.0	*	1	1932	587	110.	46.9	1158.2
1	0254	88	0.	0.1	1140.0	*	1	1114	338	0.	2.7	1141.1	*	1	1934	588	120.	47.0	1158.2
1	0256	89	0.	0.1	1140.0	*	1	1116	339	0.	2.8	1141.1	*	1	1936	589	125.	47.0	1158.2
1	0258	90	0.	0.1	1140.0	*	1	1118	340	0.	2.9	1141.1	*	1	1938	590	118.	47.0	1158.2
1	0300	91	0.	0.1	1140.0	*	1	1120	341	0.	3.0	1141.2	*	1	1940	591	114.	47.0	1158.2
1	0302	92	0.	0.1	1140.0	*	1	1122	342	0.	3.1	1141.2	*	1	1942	592	111.	47.0	1158.2
1	0304	93	0.	0.1	1140.0	*	1	1124	343	0.	3.3	1141.3	*	1	1944	593	109.	46.9	1158.2
1	0306	94	0.	0.1	1140.0	*	1	1126	344	0.	3.4	1141.3	*	1	1946	594	108.	46.9	1158.2
1	0308	95	0.	0.1	1140.0	*	1	1128	345	0.	3.5	1141.4	*	1	1948	595	107.	46.9	1158.2
1	0310	96	0.	0.1	1140.0	*	1	1130	346	0.	3.7	1141.4	*	1	1950	596	106.	46.9	1158.2
1	0312	97	0.	0.1	1140.0	*	1	1132	347	0.	3.9	1141.5	*	1	1952	597	106.	46.9	1158.2
1	0314	98	0.	0.1	1140.0	*	1	1134	348	0.	4.2	1141.6	*	1	1954	598	105.	46.9	1158.2
1	0316	99	0.	0.1	1140.0	*	1	1136	349	0.	4.4	1141.7	*	1	1956	599	104.	46.9	1158.2
1	0318	100	0.	0.1	1140.0	*	1	1138	350	0.	4.7	1141.8	*	1	1958	600	103.	46.9	1158.2
1	0320	101	0.	0.1	1140.0	*	1	1140	351	0.	4.9	1141.9	*	1	2000	601	102.	46.9	1158.2
1	0322	102	0.	0.1	1140.0	*	1	1142	352	0.	5.2	1142.0	*	1	2002	602	101.	46.9	1158.2
1	0324	103	0.	0.1	1140.0	*	1	1144	353	0.	5.6	1142.2	*	1	2004	603	99.	46.9	1158.2
1	0326	104	0.	0.1	1140.0	*	1	1146	354	0.	6.0	1142.4	*	1	2006	604	98.	46.9	1158.2
1	0328	105	0.	0.1	1140.0	*	1	1148	355	0.	6.6	1142.6	*	1	2008	605	97.	46.9	1158.2
1	0330	106	0.	0.1	1140.0	*	1	1150	356	0.	7.4	1142.9	*	1	2010	606	96.	46.9	1158.2
1	0332	107	0.	0.1	1140.0	*	1	1152	357	0.	8.4	1143.3	*	1	2012	607	95.	46.9	1158.2
1	0334	108	0.	0.1	1140.0	*	1	1154	358	0.	9.5	1143.7	*	1	2014	608	95.	46.9	1158.2
1	0336	109	0.	0.1	1140.0	*	1	1156	359	0.	10.8	1144.2	*	1	2016	609	94.	46.9	1158.2
1	0338	110	0.	0.1	1140.0	*	1	1158	360	0.	12.4	1144.8	*	1	2018	610	93.	46.9	1158.2
1	0340	111	0.	0.1	1140.0	*	1	1200	361	0.	14.3	1145.6	*	1	2020	611	92.	46.9	1158.2
1	0342	112	0.	0.1	1140.0	*	1	1202	362	0.	16.7	1146.5	*	1	2022	612	92.	46.8	1158.2
1	0344	113	0.	0.1	1140.0	*	1	1204	363	0.	19.8	1147.8	*	1	2024	613	91.	46.8	1158.2
1	0346	114	0.	0.1	1140.1	*	1	1206	364	0.	24.2	1149.5	*	1	2026	614	91.	46.8	1158.2
1	0348	115	0.	0.1	1140.1	*	1	1208	365	0.	30.1	1151.8	*	1	2028	615	90.	46.8	1158.2
1	0350	116	0.	0.1	1140.1	*	1	1210	366	0.	37.5	1154.7	*	1	2030	616	89.	46.8	1158.2
1	0352	117	0.	0.1	1140.1	*	1	1212	367	13.	46.2	1158.1	*	1	2032	617	89.	46.8	1158.2
1	0354	118	0.	0.1	1140.1	*	1	1214	368	2181.	53.0	1159.6	*	1	2034	618	88.	46.8	1158.2
1	0356	119	0.	0.1	1140.1	*	1	1216	369	3476.	55.6	1160.2	*	1	2036	619	88.	46.8	1158.2
1	0358	120	0.	0.1	1140.1	*	1	1218	370	3760.	56.1	1160.3	*	1	2038	620	87.	46.8	1158.2
1	0400	121	0.	0.1	1140.1	*	1	1220	371	3748.	56.1	1160.3	*	1	2040	621	86.	46.8	1158.2
1	0402	122	0.	0.1	1140.1	*	1	1222	372	3634.	55.9	1160.3	*	1	2042	622	95.	46.9	1158.2
1	0404	123	0.	0.1	1140.1	*	1	1224	373	3469.	55.6	1160.2	*	1	2044	623	100.	46.9	1158.2
1	0406	124	0.	0.2	1140.1	*	1	1226	374	3277.	55.2	1160.1	*	1	2046	624	94.	46.9	1158.2
1	0408	125	0.	0.2	1140.1	*	1	1228	375	3085.	54.8	1160.0	*	1	2048	625	90.	46.8	1158.2
1	0410	126	0.	0.2	1140.1	*	1	1230	376	2914.	54.5	1160.0	*	1	2050	626	88.	46.8	1158.2
1	0412	127	0.	0.2	1140.1	*	1	1232	377	2774.	54.2	1159.9	*	1	2052	627	86.	46.8	1158.2
1	0414	128	0.	0.2	1140.1	*	1	1234	378	2747.	54.2	1159.9	*	1	2054	628	85.	46.8	1158.2
1	0416	129	0.	0.2	1140.1	*	1	1236	379	2987.	54.7	1160.0	*	1	2056	629	84.	46.8	1158.2
1	0418	130	0.	0.2	1140.1	*	1	1238	380	3359.	55.4	1160.2	*	1	2058	630	83.	46.8	1158.2
1	0420	131	0.	0.2	1140.1	*	1	1240	381	3537.	55.7	1160.2	*	1	2100	631	82.	46.8	1158.2
1	0422	132	0.	0.2	1140.1	*	1	1242	382	3489.	55.6	1160.2	*	1	2102	632	81.	46.8	1158.2
1	0424	133	0.	0.2	1140.1	*	1	1244	383	3353.	55.4	1160.2	*	1	2104	633	81.	46.8	1158.2
1	0426	134	0.	0.2	1140.1	*	1	1246	384	3186.	55.0	1160.1	*	1	2106	634	80.	46.8	1158.2
1	0428	135	0.	0.2	1140.1	*	1	1248	385	2993.	54.7	1160.0	*	1	2108	635	80.	46.8	1158.2
1	0430	136	0.	0.2	1140.1	*	1	1250	386	2793.	54.3	1159.9	*	1	2110	636	79.	46.8	1158.2
1	0432	137	0.	0.2	1140.1	*	1	1252	387	2623.	53.9	1159.8	*	1	2112	637	79.	46.8	1158.2
1	0434	138	0.	0.2	1140.1	*	1	1254	388	2483.	53.7	1159.8	*	1	2114	638	78.	46.8	1158.2
1	0436	139	0.	0.2	1140.1	*	1	1256	389	2359.	53.4	1159.7	*	1	2116	639	78.	46.8	1158.2
1	0438	140	0.	0.2	1140.1	*	1	1258	390	2203.	53.1	1159.6	*	1	2118	640	78.	46.8	1158.2
1	0440	141	0.	0.2	1140.1	*	1	1300	391	2051.	52.7	1159.6	*	1	2120	641	77.	46.7	1158.2
1	0442	142	0.	0.2	1140.1	*	1	1302	392	1924.	52.5	1159.5	*	1	2122	642	77.	46.7	1158.2
1	0444	143	0.	0.2	1140.1	*	1	1304	393	1813.	52.2	1159.4	*	1	2124	643	76.	46.7	1158.2
1	0446	144	0.	0.2	1140.1	*	1	1306	394	1709.	52.0	1159.4	*	1	2126	644	76.	46.7	1158.2
1	0448	145	0.	0.2	1140.1	*	1	1308	395	1631.	51.8	1159.3	*	1	2128	645	76.	46.7	1158.2
1	0450	146	0.	0.2	1140.1	*	1	1310	396	1565.	51.6	1159.3	*	1	2130	646	75.	46.7	1158.2
1	0452	147	0.	0.2	1140.1	*	1	1312	397	1470.	51.4	1159.2	*	1	2132	647	75.	46.7	1158.2
1	0454	148	0.	0.2	1140.1	*	1	1314	398	1379.	51.2	1159.2	*	1	2134	648	75.	46.7	1158.2

1	0456	149	0.	0.2	1140.1	*	1	1316	399	1305.	51.0	1159.1	*	1	2136	649	74.	46.7	1158.2
1	0458	150	0.	0.2	1140.1	*	1	1318	400	1239.	50.8	1159.1	*	1	2138	650	74.	46.7	1158.2
1	0500	151	0.	0.2	1140.1	*	1	1320	401	1178.	50.6	1159.1	*	1	2140	651	73.	46.7	1158.2
1	0502	152	0.	0.2	1140.1	*	1	1322	402	1122.	50.5	1159.0	*	1	2142	652	73.	46.7	1158.2
1	0504	153	0.	0.2	1140.1	*	1	1324	403	1070.	50.4	1159.0	*	1	2144	653	73.	46.7	1158.2
1	0506	154	0.	0.2	1140.1	*	1	1326	404	1023.	50.2	1159.0	*	1	2146	654	72.	46.7	1158.2
1	0508	155	0.	0.2	1140.1	*	1	1328	405	978.	50.1	1158.9	*	1	2148	655	72.	46.7	1158.2
1	0510	156	0.	0.2	1140.1	*	1	1330	406	936.	50.0	1158.9	*	1	2150	656	72.	46.7	1158.2
1	0512	157	0.	0.2	1140.1	*	1	1332	407	912.	49.9	1158.9	*	1	2152	657	71.	46.7	1158.2
1	0514	158	0.	0.2	1140.1	*	1	1334	408	896.	49.9	1158.9	*	1	2154	658	71.	46.7	1158.2
1	0516	159	0.	0.2	1140.1	*	1	1336	409	852.	49.7	1158.9	*	1	2156	659	71.	46.7	1158.2
1	0518	160	0.	0.2	1140.1	*	1	1338	410	800.	49.6	1158.8	*	1	2158	660	70.	46.7	1158.2
1	0520	161	0.	0.2	1140.1	*	1	1340	411	762.	49.5	1158.8	*	1	2200	661	78.	46.8	1158.2
1	0522	162	0.	0.2	1140.1	*	1	1342	412	730.	49.4	1158.8	*	1	2202	662	84.	46.8	1158.2
1	0524	163	0.	0.3	1140.1	*	1	1344	413	703.	49.3	1158.8	*	1	2204	663	79.	46.8	1158.2
1	0526	164	0.	0.3	1140.1	*	1	1346	414	677.	49.2	1158.7	*	1	2206	664	75.	46.7	1158.2
1	0528	165	0.	0.3	1140.1	*	1	1348	415	651.	49.1	1158.7	*	1	2208	665	73.	46.7	1158.2
1	0530	166	0.	0.3	1140.1	*	1	1350	416	627.	49.0	1158.7	*	1	2210	666	72.	46.7	1158.2
1	0532	167	0.	0.3	1140.1	*	1	1352	417	605.	49.0	1158.7	*	1	2212	667	70.	46.7	1158.2
1	0534	168	0.	0.3	1140.1	*	1	1354	418	584.	48.9	1158.7	*	1	2214	668	69.	46.7	1158.2
1	0536	169	0.	0.3	1140.1	*	1	1356	419	564.	48.8	1158.7	*	1	2216	669	69.	46.7	1158.2
1	0538	170	0.	0.3	1140.1	*	1	1358	420	546.	48.8	1158.6	*	1	2218	670	68.	46.7	1158.2
1	0540	171	0.	0.3	1140.1	*	1	1400	421	529.	48.7	1158.6	*	1	2220	671	68.	46.7	1158.2
1	0542	172	0.	0.3	1140.1	*	1	1402	422	528.	48.7	1158.6	*	1	2222	672	68.	46.7	1158.2
1	0544	173	0.	0.3	1140.1	*	1	1404	423	533.	48.7	1158.6	*	1	2224	673	67.	46.7	1158.2
1	0546	174	0.	0.3	1140.1	*	1	1406	424	512.	48.7	1158.6	*	1	2226	674	67.	46.7	1158.2
1	0548	175	0.	0.3	1140.1	*	1	1408	425	482.	48.6	1158.6	*	1	2228	675	67.	46.7	1158.2
1	0550	176	0.	0.3	1140.1	*	1	1410	426	463.	48.5	1158.6	*	1	2230	676	66.	46.7	1158.2
1	0552	177	0.	0.3	1140.1	*	1	1412	427	447.	48.4	1158.6	*	1	2232	677	66.	46.7	1158.2
1	0554	178	0.	0.3	1140.1	*	1	1414	428	433.	48.4	1158.5	*	1	2234	678	66.	46.7	1158.2
1	0556	179	0.	0.3	1140.1	*	1	1416	429	421.	48.3	1158.5	*	1	2236	679	65.	46.7	1158.2
1	0558	180	0.	0.3	1140.1	*	1	1418	430	409.	48.3	1158.5	*	1	2238	680	65.	46.7	1158.2
1	0600	181	0.	0.3	1140.1	*	1	1420	431	398.	48.2	1158.5	*	1	2240	681	65.	46.7	1158.2
1	0602	182	0.	0.3	1140.1	*	1	1422	432	388.	48.2	1158.5	*	1	2242	682	65.	46.7	1158.2
1	0604	183	0.	0.3	1140.1	*	1	1424	433	378.	48.2	1158.5	*	1	2244	683	65.	46.7	1158.2
1	0606	184	0.	0.3	1140.1	*	1	1426	434	368.	48.1	1158.5	*	1	2246	684	64.	46.7	1158.2
1	0608	185	0.	0.3	1140.1	*	1	1428	435	360.	48.1	1158.5	*	1	2248	685	64.	46.7	1158.2
1	0610	186	0.	0.3	1140.1	*	1	1430	436	352.	48.1	1158.5	*	1	2250	686	64.	46.7	1158.2
1	0612	187	0.	0.3	1140.1	*	1	1432	437	345.	48.0	1158.5	*	1	2252	687	64.	46.7	1158.2
1	0614	188	0.	0.3	1140.1	*	1	1434	438	338.	48.0	1158.5	*	1	2254	688	63.	46.7	1158.2
1	0616	189	0.	0.3	1140.1	*	1	1436	439	332.	48.0	1158.5	*	1	2256	689	63.	46.6	1158.1
1	0618	190	0.	0.3	1140.1	*	1	1438	440	326.	48.0	1158.5	*	1	2258	690	63.	46.6	1158.1
1	0620	191	0.	0.3	1140.1	*	1	1440	441	333.	48.0	1158.5	*	1	2300	691	63.	46.6	1158.1
1	0622	192	0.	0.3	1140.1	*	1	1442	442	347.	48.1	1158.5	*	1	2302	692	62.	46.6	1158.1
1	0624	193	0.	0.3	1140.1	*	1	1444	443	338.	48.0	1158.5	*	1	2304	693	62.	46.6	1158.1
1	0626	194	0.	0.3	1140.1	*	1	1446	444	318.	47.9	1158.4	*	1	2306	694	62.	46.6	1158.1
1	0628	195	0.	0.3	1140.1	*	1	1448	445	307.	47.9	1158.4	*	1	2308	695	62.	46.6	1158.1
1	0630	196	0.	0.3	1140.1	*	1	1450	446	300.	47.9	1158.4	*	1	2310	696	62.	46.6	1158.1
1	0632	197	0.	0.4	1140.1	*	1	1452	447	294.	47.8	1158.4	*	1	2312	697	61.	46.6	1158.1
1	0634	198	0.	0.4	1140.1	*	1	1454	448	289.	47.8	1158.4	*	1	2314	698	61.	46.6	1158.1
1	0636	199	0.	0.4	1140.1	*	1	1456	449	285.	47.8	1158.4	*	1	2316	699	61.	46.6	1158.1
1	0638	200	0.	0.4	1140.1	*	1	1458	450	281.	47.8	1158.4	*	1	2318	700	61.	46.6	1158.1
1	0640	201	0.	0.4	1140.1	*	1	1500	451	277.	47.8	1158.4	*	1	2320	701	61.	46.6	1158.1
1	0642	202	0.	0.4	1140.1	*	1	1502	452	273.	47.7	1158.4	*	1	2322	702	60.	46.6	1158.1
1	0644	203	0.	0.4	1140.1	*	1	1504	453	270.	47.7	1158.4	*	1	2324	703	60.	46.6	1158.1
1	0646	204	0.	0.4	1140.1	*	1	1506	454	267.	47.7	1158.4	*	1	2326	704	60.	46.6	1158.1
1	0648	205	0.	0.4	1140.1	*	1	1508	455	264.	47.7	1158.4	*	1	2328	705	68.	46.7	1158.2
1	0650	206	0.	0.4	1140.1	*	1	1510	456	261.	47.7	1158.4	*	1	2330	706	73.	46.7	1158.2
1	0652	207	0.	0.4	1140.2	*	1	1512	457	258.	47.7	1158.4	*	1	2332	707	69.	46.7	1158.2
1	0654	208	0.	0.4	1140.2	*	1	1514	458	255.	47.7	1158.4	*	1	2334	708	66.	46.7	1158.2
1	0656	209	0.	0.4	1140.2	*	1	1516	459	252.	47.7	1158.4	*	1	2336	709	63.	46.7	1158.2
1	0658	210	0.	0.4	1140.2	*	1	1518	460	249.	47.6	1158.4	*	1	2338	710	62.	46.6	1158.1
1	0700	211	0.	0.4	1140.2	*	1	1520	461	246.	47.6	1158.4	*	1	2340	711	61.	46.6	1158.1
1	0702	212	0.	0.4	1140.2	*	1	1522	462	243.	47.6	1158.4	*	1	2342	712	60.	46.6	1158.1
1	0704	213	0.	0.4	1140.2	*	1	1524	463	240.	47.6	1158.4	*	1	2344	713	59.	46.6	1158.1
1	0706	214	0.	0.4	1140.2	*	1	1526	464	249.	47.6	1158.4	*	1	2346	714	59.	46.6	1158.1
1	0708	215	0.	0.4	1140.2	*	1	1528	465	253.	47.7	1158.4	*	1	2348	715	58.	46.6	1158.1

1	0710	216	0.	0.4	1140.2	*	1	1530	466	242.	47.6	1158.4	*	1	2350	716	58.	46.6	1158.1
1	0712	217	0.	0.4	1140.2	*	1	1532	467	235.	47.6	1158.4	*	1	2352	717	58.	46.6	1158.1
1	0714	218	0.	0.4	1140.2	*	1	1534	468	230.	47.6	1158.4	*	1	2354	718	58.	46.6	1158.1
1	0716	219	0.	0.4	1140.2	*	1	1536	469	227.	47.5	1158.4	*	1	2356	719	58.	46.6	1158.1
1	0718	220	0.	0.4	1140.2	*	1	1538	470	224.	47.5	1158.4	*	1	2358	720	57.	46.6	1158.1
1	0720	221	0.	0.4	1140.2	*	1	1540	471	221.	47.5	1158.4	*	2	0000	721	57.	46.6	1158.1
1	0722	222	0.	0.4	1140.2	*	1	1542	472	219.	47.5	1158.3	*	2	0002	722	57.	46.6	1158.1
1	0724	223	0.	0.4	1140.2	*	1	1544	473	217.	47.5	1158.3	*	2	0004	723	57.	46.6	1158.1
1	0726	224	0.	0.4	1140.2	*	1	1546	474	215.	47.5	1158.3	*	2	0006	724	57.	46.6	1158.1
1	0728	225	0.	0.4	1140.2	*	1	1548	475	213.	47.5	1158.3	*	2	0008	725	56.	46.6	1158.1
1	0730	226	0.	0.5	1140.2	*	1	1550	476	211.	47.5	1158.3	*	2	0010	726	56.	46.6	1158.1
1	0732	227	0.	0.5	1140.2	*	1	1552	477	210.	47.5	1158.3	*	2	0012	727	55.	46.6	1158.1
1	0734	228	0.	0.5	1140.2	*	1	1554	478	208.	47.5	1158.3	*	2	0014	728	55.	46.6	1158.1
1	0736	229	0.	0.5	1140.2	*	1	1556	479	218.	47.5	1158.3	*	2	0016	729	54.	46.6	1158.1
1	0738	230	0.	0.5	1140.2	*	1	1558	480	223.	47.5	1158.4	*	2	0018	730	53.	46.6	1158.1
1	0740	231	0.	0.5	1140.2	*	1	1600	481	212.	47.5	1158.3	*	2	0020	731	52.	46.6	1158.1
1	0742	232	0.	0.5	1140.2	*	1	1602	482	206.	47.5	1158.3	*	2	0022	732	51.	46.6	1158.1
1	0744	233	0.	0.5	1140.2	*	1	1604	483	203.	47.4	1158.3	*	2	0024	733	50.	46.6	1158.1
1	0746	234	0.	0.5	1140.2	*	1	1606	484	200.	47.4	1158.3	*	2	0026	734	49.	46.5	1158.1
1	0748	235	0.	0.5	1140.2	*	1	1608	485	198.	47.4	1158.3	*	2	0028	735	48.	46.5	1158.1
1	0750	236	0.	0.5	1140.2	*	1	1610	486	196.	47.4	1158.3	*	2	0030	736	46.	46.5	1158.1
1	0752	237	0.	0.5	1140.2	*	1	1612	487	195.	47.4	1158.3	*	2	0032	737	45.	46.5	1158.1
1	0754	238	0.	0.5	1140.2	*	1	1614	488	193.	47.4	1158.3	*	2	0034	738	44.	46.5	1158.1
1	0756	239	0.	0.5	1140.2	*	1	1616	489	192.	47.4	1158.3	*	2	0036	739	43.	46.5	1158.1
1	0758	240	0.	0.5	1140.2	*	1	1618	490	191.	47.4	1158.3	*	2	0038	740	42.	46.5	1158.1
1	0800	241	0.	0.5	1140.2	*	1	1620	491	190.	47.4	1158.3	*	2	0040	741	41.	46.5	1158.1
1	0802	242	0.	0.5	1140.2	*	1	1622	492	188.	47.4	1158.3	*	2	0042	742	40.	46.5	1158.1
1	0804	243	0.	0.5	1140.2	*	1	1624	493	187.	47.4	1158.3	*	2	0044	743	39.	46.5	1158.1
1	0806	244	0.	0.5	1140.2	*	1	1626	494	186.	47.4	1158.3	*	2	0046	744	38.	46.5	1158.1
1	0808	245	0.	0.5	1140.2	*	1	1628	495	197.	47.4	1158.3	*	2	0048	745	37.	46.5	1158.1
1	0810	246	0.	0.5	1140.2	*	1	1630	496	202.	47.4	1158.3	*	2	0050	746	37.	46.5	1158.1
1	0812	247	0.	0.5	1140.2	*	1	1632	497	192.	47.4	1158.3	*	2	0052	747	36.	46.4	1158.1
1	0814	248	0.	0.5	1140.2	*	1	1634	498	187.	47.4	1158.3	*	2	0054	748	35.	46.4	1158.1
1	0816	249	0.	0.6	1140.2	*	1	1636	499	183.	47.3	1158.3	*	2	0056	749	35.	46.4	1158.1
1	0818	250	0.	0.6	1140.2	*	1	1638	500	181.	47.3	1158.3	*	2	0058	750	34.	46.4	1158.1
						*							*						

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PEAK FLOW	TIME		MAXIMUM AVERAGE FLOW			
			6-HR	24-HR	72-HR	24.97-HR
+ (CFS)	(HR)					
		(CFS)				
+ 3760.	12.30		737.	207.	199.	199.
		(INCHES)	1.507	1.698	1.698	1.698
		(AC-FT)	365.	412.	412.	412.

PEAK STORAGE	TIME	MAXIMUM AVERAGE STORAGE			
		6-HR	24-HR	72-HR	24.97-HR
+ (AC-FT)	(HR)				
56.	12.30	49.	26.	25.	25.

PEAK STAGE	TIME	MAXIMUM AVERAGE STAGE			
		6-HR	24-HR	72-HR	24.97-HR
+ (FEET)	(HR)				
1160.33	12.30	1158.68	1150.03	1149.64	1149.64

CUMULATIVE AREA = 4.55 SQ MI

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            *            *
1272 KK     *    STB15   *
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          *            *
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1279 KO          OUTPUT CONTROL VARIABLES
                       IPRNT          2  PRINT CONTROL
                       IPLOT          0  PLOT CONTROL
                       QSCAL         0.  HYDROGRAPH PLOT SCALE

               HYDROGRAPH ROUTING DATA

1280 RS          STORAGE ROUTING
                       NSTPS          1  NUMBER OF SUBREACHES
                        ITYP       STOR  TYPE OF INITIAL CONDITION
                      RSVRIC       0.00  INITIAL CONDITION
                           X       0.00 WORKING R AND D COEFFICIENT

1281 SV            STORAGE        0.0      31.0      67.6     130.7     231.1     270.2     310.4     351.5     394.0

1282 SE          ELEVATION     1142.00   1151.00   1153.00   1155.00   1158.00   1159.00   1160.00   1161.00   1162.00

1283 SS          SPILLWAY
                       CREL    1159.00  SPILLWAY CREST ELEVATION
                      SPWID      10.00  SPILLWAY WIDTH
                       COQW       3.33  WEIR COEFFICIENT
                       EXPW       1.50  EXPONENT OF HEAD

                                                    ***

                                          COMPUTED OUTFLOW-ELEVATION DATA

          OUTFLOW       0.00      0.00      0.03      0.24      0.80      1.90      3.71      6.41     10.18     15.19
        ELEVATION    1142.00   1159.00   1159.01   1159.04   1159.08   1159.15   1159.23   1159.33   1159.45   1159.59

          OUTFLOW      21.63     29.67     39.49     51.27     65.18     81.41    100.13    121.53    145.77    173.03
        ELEVATION    1159.75   1159.93   1160.12   1160.33   1160.56   1160.81   1161.08   1161.37   1161.68   1162.00

                                       COMPUTED STORAGE-OUTFLOW-ELEVATION DATA

          STORAGE       0.00     31.00     67.60    130.70    231.10    270.20    271.69    273.55    276.16    279.50
          OUTFLOW       0.00      0.00      0.00      0.00      0.00      0.00      0.24      0.80      1.90      3.71
        ELEVATION    1142.00   1151.00   1153.00   1155.00   1158.00   1159.00   1159.04   1159.08   1159.15   1159.23

          STORAGE     283.60    288.44    294.02    300.35    307.42    310.40    315.35    324.10    333.61    343.89
          OUTFLOW       6.41     10.18     15.19     21.63     29.67     33.30     39.49     51.27     65.18     81.41
        ELEVATION    1159.33   1159.45   1159.59   1159.75   1159.93   1160.00   1160.12   1160.33   1160.56   1160.81

          STORAGE     351.50    355.04    367.24    380.23    394.00
          OUTFLOW      94.19    100.14    121.53    145.76    173.03
        ELEVATION    1161.00   1161.08   1161.37   1161.68   1162.00
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                                          HYDROGRAPH AT STATION    STB15

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                                                *                                                *
 DA MON HRMN ORD  OUTFLOW  STORAGE   STAGE *  DA MON HRMN ORD  OUTFLOW  STORAGE   STAGE *  DA MON HRMN ORD  OUTFLOW  STORAGE   STAGE
                                                *                                                *
  1     0000   1      0.      0.0  1142.0 *   1     0820 251      0.      0.0  1142.0 *   1     1640 501     69.    335.9  1160.6
  1     0002   2      0.      0.0  1142.0 *   1     0822 252      0.      0.0  1142.0 *   1     1642 502     69.    336.2  1160.6
  1     0004   3      0.      0.0  1142.0 *   1     0824 253      0.      0.0  1142.0 *   1     1644 503     70.    336.5  1160.6
  1     0006   4      0.      0.0  1142.0 *   1     0826 254      0.      0.0  1142.0 *   1     1646 504     70.    336.8  1160.6
  1     0008   5      0.      0.0  1142.0 *   1     0828 255      0.      0.0  1142.0 *   1     1648 505     71.    337.0  1160.6
  1     0010   6      0.      0.0  1142.0 *   1     0830 256      0.      0.0  1142.0 *   1     1650 506     71.    337.3  1160.7
  1     0012   7      0.      0.0  1142.0 *   1     0832 257      0.      0.0  1142.0 *   1     1652 507     71.    337.6  1160.7
  1     0014   8      0.      0.0  1142.0 *   1     0834 258      0.      0.0  1142.0 *   1     1654 508     72.    337.9  1160.7
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1	0016	9	0.	0.0	1142.0	*	1	0836	259	0.	0.0	1142.0	*	1	1656	509	72.	338.2	1160.7
1	0018	10	0.	0.0	1142.0	*	1	0838	260	0.	0.0	1142.0	*	1	1658	510	73.	338.4	1160.7
1	0020	11	0.	0.0	1142.0	*	1	0840	261	0.	0.0	1142.0	*	1	1700	511	73.	338.7	1160.7
1	0022	12	0.	0.0	1142.0	*	1	0842	262	0.	0.0	1142.0	*	1	1702	512	74.	338.9	1160.7
1	0024	13	0.	0.0	1142.0	*	1	0844	263	0.	0.0	1142.0	*	1	1704	513	74.	339.2	1160.7
1	0026	14	0.	0.0	1142.0	*	1	0846	264	0.	0.0	1142.0	*	1	1706	514	74.	339.5	1160.7
1	0028	15	0.	0.0	1142.0	*	1	0848	265	0.	0.0	1142.0	*	1	1708	515	75.	339.8	1160.7
1	0030	16	0.	0.0	1142.0	*	1	0850	266	0.	0.0	1142.0	*	1	1710	516	75.	340.0	1160.7
1	0032	17	0.	0.0	1142.0	*	1	0852	267	0.	0.0	1142.0	*	1	1712	517	76.	340.3	1160.7
1	0034	18	0.	0.0	1142.0	*	1	0854	268	0.	0.0	1142.0	*	1	1714	518	76.	340.5	1160.7
1	0036	19	0.	0.0	1142.0	*	1	0856	269	0.	0.0	1142.0	*	1	1716	519	77.	340.8	1160.7
1	0038	20	0.	0.0	1142.0	*	1	0858	270	0.	0.0	1142.0	*	1	1718	520	77.	341.0	1160.7
1	0040	21	0.	0.0	1142.0	*	1	0900	271	0.	0.0	1142.0	*	1	1720	521	77.	341.3	1160.8
1	0042	22	0.	0.0	1142.0	*	1	0902	272	0.	0.0	1142.0	*	1	1722	522	78.	341.5	1160.8
1	0044	23	0.	0.0	1142.0	*	1	0904	273	0.	0.0	1142.0	*	1	1724	523	78.	341.7	1160.8
1	0046	24	0.	0.0	1142.0	*	1	0906	274	0.	0.0	1142.0	*	1	1726	524	78.	341.9	1160.8
1	0048	25	0.	0.0	1142.0	*	1	0908	275	0.	0.0	1142.0	*	1	1728	525	79.	342.1	1160.8
1	0050	26	0.	0.0	1142.0	*	1	0910	276	0.	0.0	1142.0	*	1	1730	526	79.	342.3	1160.8
1	0052	27	0.	0.0	1142.0	*	1	0912	277	0.	0.0	1142.0	*	1	1732	527	79.	342.5	1160.8
1	0054	28	0.	0.0	1142.0	*	1	0914	278	0.	0.0	1142.0	*	1	1734	528	80.	342.8	1160.8
1	0056	29	0.	0.0	1142.0	*	1	0916	279	0.	0.0	1142.0	*	1	1736	529	80.	343.0	1160.8
1	0058	30	0.	0.0	1142.0	*	1	0918	280	0.	0.0	1142.0	*	1	1738	530	80.	343.1	1160.8
1	0100	31	0.	0.0	1142.0	*	1	0920	281	0.	0.0	1142.0	*	1	1740	531	81.	343.3	1160.8
1	0102	32	0.	0.0	1142.0	*	1	0922	282	0.	0.0	1142.0	*	1	1742	532	81.	343.5	1160.8
1	0104	33	0.	0.0	1142.0	*	1	0924	283	0.	0.0	1142.0	*	1	1744	533	81.	343.7	1160.8
1	0106	34	0.	0.0	1142.0	*	1	0926	284	0.	0.0	1142.0	*	1	1746	534	81.	343.9	1160.8
1	0108	35	0.	0.0	1142.0	*	1	0928	285	0.	0.0	1142.0	*	1	1748	535	82.	344.1	1160.8
1	0110	36	0.	0.0	1142.0	*	1	0930	286	0.	0.0	1142.0	*	1	1750	536	82.	344.3	1160.8
1	0112	37	0.	0.0	1142.0	*	1	0932	287	0.	0.0	1142.0	*	1	1752	537	82.	344.5	1160.8
1	0114	38	0.	0.0	1142.0	*	1	0934	288	0.	0.0	1142.0	*	1	1754	538	83.	344.7	1160.8
1	0116	39	0.	0.0	1142.0	*	1	0936	289	0.	0.0	1142.0	*	1	1756	539	83.	344.9	1160.8
1	0118	40	0.	0.0	1142.0	*	1	0938	290	0.	0.0	1142.0	*	1	1758	540	83.	345.1	1160.8
1	0120	41	0.	0.0	1142.0	*	1	0940	291	0.	0.0	1142.0	*	1	1800	541	84.	345.2	1160.8
1	0122	42	0.	0.0	1142.0	*	1	0942	292	0.	0.0	1142.0	*	1	1802	542	84.	345.4	1160.9
1	0124	43	0.	0.0	1142.0	*	1	0944	293	0.	0.0	1142.0	*	1	1804	543	84.	345.6	1160.9
1	0126	44	0.	0.0	1142.0	*	1	0946	294	0.	0.0	1142.0	*	1	1806	544	84.	345.7	1160.9
1	0128	45	0.	0.0	1142.0	*	1	0948	295	0.	0.0	1142.0	*	1	1808	545	85.	345.9	1160.9
1	0130	46	0.	0.0	1142.0	*	1	0950	296	0.	0.0	1142.0	*	1	1810	546	85.	346.0	1160.9
1	0132	47	0.	0.0	1142.0	*	1	0952	297	0.	0.0	1142.0	*	1	1812	547	85.	346.2	1160.9
1	0134	48	0.	0.0	1142.0	*	1	0954	298	0.	0.0	1142.0	*	1	1814	548	85.	346.3	1160.9
1	0136	49	0.	0.0	1142.0	*	1	0956	299	0.	0.0	1142.0	*	1	1816	549	86.	346.5	1160.9
1	0138	50	0.	0.0	1142.0	*	1	0958	300	0.	0.0	1142.0	*	1	1818	550	86.	346.6	1160.9
1	0140	51	0.	0.0	1142.0	*	1	1000	301	0.	0.0	1142.0	*	1	1820	551	86.	346.7	1160.9
1	0142	52	0.	0.0	1142.0	*	1	1002	302	0.	0.0	1142.0	*	1	1822	552	86.	346.9	1160.9
1	0144	53	0.	0.0	1142.0	*	1	1004	303	0.	0.0	1142.0	*	1	1824	553	87.	347.0	1160.9
1	0146	54	0.	0.0	1142.0	*	1	1006	304	0.	0.0	1142.0	*	1	1826	554	87.	347.1	1160.9
1	0148	55	0.	0.0	1142.0	*	1	1008	305	0.	0.0	1142.0	*	1	1828	555	87.	347.2	1160.9
1	0150	56	0.	0.0	1142.0	*	1	1010	306	0.	0.0	1142.0	*	1	1830	556	87.	347.4	1160.9
1	0152	57	0.	0.0	1142.0	*	1	1012	307	0.	0.0	1142.0	*	1	1832	557	87.	347.5	1160.9
1	0154	58	0.	0.0	1142.0	*	1	1014	308	0.	0.0	1142.0	*	1	1834	558	88.	347.6	1160.9
1	0156	59	0.	0.0	1142.0	*	1	1016	309	0.	0.0	1142.0	*	1	1836	559	88.	347.7	1160.9
1	0158	60	0.	0.0	1142.0	*	1	1018	310	0.	0.0	1142.0	*	1	1838	560	88.	347.9	1160.9
1	0200	61	0.	0.0	1142.0	*	1	1020	311	0.	0.0	1142.0	*	1	1840	561	88.	348.0	1160.9
1	0202	62	0.	0.0	1142.0	*	1	1022	312	0.	0.0	1142.0	*	1	1842	562	89.	348.1	1160.9
1	0204	63	0.	0.0	1142.0	*	1	1024	313	0.	0.0	1142.0	*	1	1844	563	89.	348.3	1160.9
1	0206	64	0.	0.0	1142.0	*	1	1026	314	0.	0.0	1142.0	*	1	1846	564	89.	348.4	1160.9
1	0208	65	0.	0.0	1142.0	*	1	1028	315	0.	0.0	1142.0	*	1	1848	565	89.	348.5	1160.9
1	0210	66	0.	0.0	1142.0	*	1	1030	316	0.	0.0	1142.0	*	1	1850	566	89.	348.6	1160.9
1	0212	67	0.	0.0	1142.0	*	1	1032	317	0.	0.0	1142.0	*	1	1852	567	89.	348.7	1160.9
1	0214	68	0.	0.0	1142.0	*	1	1034	318	0.	0.0	1142.0	*	1	1854	568	90.	348.7	1160.9
1	0216	69	0.	0.0	1142.0	*	1	1036	319	0.	0.0	1142.0	*	1	1856	569	90.	348.8	1160.9
1	0218	70	0.	0.0	1142.0	*	1	1038	320	0.	0.0	1142.0	*	1	1858	570	90.	348.9	1160.9
1	0220	71	0.	0.0	1142.0	*	1	1040	321	0.	0.0	1142.0	*	1	1900	571	90.	349.0	1160.9
1	0222	72	0.	0.0	1142.0	*	1	1042	322	0.	0.0	1142.0	*	1	1902	572	90.	349.1	1160.9
1	0224	73	0.	0.0	1142.0	*	1	1044	323	0.	0.0	1142.0	*	1	1904	573	90.	349.2	1160.9
1	0226	74	0.	0.0	1142.0	*	1	1046	324	0.	0.0	1142.0	*	1	1906	574	90.	349.2	1160.9
1	0228	75	0.	0.0	1142.0	*	1	1048	325	0.	0.0	1142.0	*	1	1908	575	90.	349.3	1160.9

1	0230	76	0.	0.0	1142.0	*	1	1050	326	0.	0.0	1142.0	*	1	1910	576	91.	349.4	1160.9
1	0232	77	0.	0.0	1142.0	*	1	1052	327	0.	0.0	1142.0	*	1	1912	577	91.	349.4	1160.9
1	0234	78	0.	0.0	1142.0	*	1	1054	328	0.	0.0	1142.0	*	1	1914	578	91.	349.5	1161.0
1	0236	79	0.	0.0	1142.0	*	1	1056	329	0.	0.0	1142.0	*	1	1916	579	91.	349.6	1161.0
1	0238	80	0.	0.0	1142.0	*	1	1058	330	0.	0.0	1142.0	*	1	1918	580	91.	349.6	1161.0
1	0240	81	0.	0.0	1142.0	*	1	1100	331	0.	0.0	1142.0	*	1	1920	581	91.	349.7	1161.0
1	0242	82	0.	0.0	1142.0	*	1	1102	332	0.	0.0	1142.0	*	1	1922	582	91.	349.8	1161.0
1	0244	83	0.	0.0	1142.0	*	1	1104	333	0.	0.0	1142.0	*	1	1924	583	91.	349.8	1161.0
1	0246	84	0.	0.0	1142.0	*	1	1106	334	0.	0.0	1142.0	*	1	1926	584	91.	349.9	1161.0
1	0248	85	0.	0.0	1142.0	*	1	1108	335	0.	0.0	1142.0	*	1	1928	585	92.	349.9	1161.0
1	0250	86	0.	0.0	1142.0	*	1	1110	336	0.	0.0	1142.0	*	1	1930	586	92.	350.0	1161.0
1	0252	87	0.	0.0	1142.0	*	1	1112	337	0.	0.0	1142.0	*	1	1932	587	92.	350.0	1161.0
1	0254	88	0.	0.0	1142.0	*	1	1114	338	0.	0.0	1142.0	*	1	1934	588	92.	350.1	1161.0
1	0256	89	0.	0.0	1142.0	*	1	1116	339	0.	0.0	1142.0	*	1	1936	589	92.	350.2	1161.0
1	0258	90	0.	0.0	1142.0	*	1	1118	340	0.	0.0	1142.0	*	1	1938	590	92.	350.3	1161.0
1	0300	91	0.	0.0	1142.0	*	1	1120	341	0.	0.0	1142.0	*	1	1940	591	92.	350.3	1161.0
1	0302	92	0.	0.0	1142.0	*	1	1122	342	0.	0.0	1142.0	*	1	1942	592	92.	350.4	1161.0
1	0304	93	0.	0.0	1142.0	*	1	1124	343	0.	0.0	1142.0	*	1	1944	593	92.	350.4	1161.0
1	0306	94	0.	0.0	1142.0	*	1	1126	344	0.	0.0	1142.0	*	1	1946	594	92.	350.5	1161.0
1	0308	95	0.	0.0	1142.0	*	1	1128	345	0.	0.0	1142.0	*	1	1948	595	93.	350.5	1161.0
1	0310	96	0.	0.0	1142.0	*	1	1130	346	0.	0.0	1142.0	*	1	1950	596	93.	350.6	1161.0
1	0312	97	0.	0.0	1142.0	*	1	1132	347	0.	0.0	1142.0	*	1	1952	597	93.	350.6	1161.0
1	0314	98	0.	0.0	1142.0	*	1	1134	348	0.	0.0	1142.0	*	1	1954	598	93.	350.6	1161.0
1	0316	99	0.	0.0	1142.0	*	1	1136	349	0.	0.0	1142.0	*	1	1956	599	93.	350.7	1161.0
1	0318	100	0.	0.0	1142.0	*	1	1138	350	0.	0.0	1142.0	*	1	1958	600	93.	350.7	1161.0
1	0320	101	0.	0.0	1142.0	*	1	1140	351	0.	0.0	1142.0	*	1	2000	601	93.	350.7	1161.0
1	0322	102	0.	0.0	1142.0	*	1	1142	352	0.	0.0	1142.0	*	1	2002	602	93.	350.7	1161.0
1	0324	103	0.	0.0	1142.0	*	1	1144	353	0.	0.0	1142.0	*	1	2004	603	93.	350.8	1161.0
1	0326	104	0.	0.0	1142.0	*	1	1146	354	0.	0.0	1142.0	*	1	2006	604	93.	350.8	1161.0
1	0328	105	0.	0.0	1142.0	*	1	1148	355	0.	0.0	1142.0	*	1	2008	605	93.	350.8	1161.0
1	0330	106	0.	0.0	1142.0	*	1	1150	356	0.	0.0	1142.0	*	1	2010	606	93.	350.8	1161.0
1	0332	107	0.	0.0	1142.0	*	1	1152	357	0.	0.0	1142.0	*	1	2012	607	93.	350.8	1161.0
1	0334	108	0.	0.0	1142.0	*	1	1154	358	0.	0.0	1142.0	*	1	2014	608	93.	350.8	1161.0
1	0336	109	0.	0.0	1142.0	*	1	1156	359	0.	0.0	1142.0	*	1	2016	609	93.	350.8	1161.0
1	0338	110	0.	0.0	1142.0	*	1	1158	360	0.	0.0	1142.0	*	1	2018	610	93.	350.8	1161.0
1	0340	111	0.	0.0	1142.0	*	1	1200	361	0.	0.0	1142.0	*	1	2020	611	93.	350.8	1161.0
1	0342	112	0.	0.0	1142.0	*	1	1202	362	0.	0.0	1142.0	*	1	2022	612	93.	350.8	1161.0
1	0344	113	0.	0.0	1142.0	*	1	1204	363	0.	0.0	1142.0	*	1	2024	613	93.	350.8	1161.0
1	0346	114	0.	0.0	1142.0	*	1	1206	364	0.	0.0	1142.0	*	1	2026	614	93.	350.8	1161.0
1	0348	115	0.	0.0	1142.0	*	1	1208	365	0.	0.0	1142.0	*	1	2028	615	93.	350.8	1161.0
1	0350	116	0.	0.0	1142.0	*	1	1210	366	0.	0.0	1142.0	*	1	2030	616	93.	350.8	1161.0
1	0352	117	0.	0.0	1142.0	*	1	1212	367	0.	0.0	1142.0	*	1	2032	617	93.	350.8	1161.0
1	0354	118	0.	0.0	1142.0	*	1	1214	368	0.	3.0	1142.9	*	1	2034	618	93.	350.8	1161.0
1	0356	119	0.	0.0	1142.0	*	1	1216	369	0.	10.8	1145.1	*	1	2036	619	93.	350.7	1161.0
1	0358	120	0.	0.0	1142.0	*	1	1218	370	0.	20.8	1148.0	*	1	2038	620	93.	350.7	1161.0
1	0400	121	0.	0.0	1142.0	*	1	1220	371	0.	31.1	1151.0	*	1	2040	621	93.	350.7	1161.0
1	0402	122	0.	0.0	1142.0	*	1	1222	372	0.	41.3	1151.6	*	1	2042	622	93.	350.7	1161.0
1	0404	123	0.	0.0	1142.0	*	1	1224	373	0.	51.1	1152.1	*	1	2044	623	93.	350.7	1161.0
1	0406	124	0.	0.0	1142.0	*	1	1226	374	0.	60.4	1152.6	*	1	2046	624	93.	350.7	1161.0
1	0408	125	0.	0.0	1142.0	*	1	1228	375	0.	69.1	1153.0	*	1	2048	625	93.	350.7	1161.0
1	0410	126	0.	0.0	1142.0	*	1	1230	376	0.	77.4	1153.3	*	1	2050	626	93.	350.7	1161.0
1	0412	127	0.	0.0	1142.0	*	1	1232	377	0.	85.2	1153.6	*	1	2052	627	93.	350.7	1161.0
1	0414	128	0.	0.0	1142.0	*	1	1234	378	0.	92.9	1153.8	*	1	2054	628	93.	350.7	1161.0
1	0416	129	0.	0.0	1142.0	*	1	1236	379	0.	100.7	1154.1	*	1	2056	629	93.	350.7	1161.0
1	0418	130	0.	0.0	1142.0	*	1	1238	380	0.	109.5	1154.3	*	1	2058	630	93.	350.6	1161.0
1	0420	131	0.	0.0	1142.0	*	1	1240	381	0.	119.0	1154.6	*	1	2100	631	93.	350.6	1161.0
1	0422	132	0.	0.0	1142.0	*	1	1242	382	0.	128.7	1154.9	*	1	2102	632	93.	350.6	1161.0
1	0424	133	0.	0.0	1142.0	*	1	1244	383	0.	138.1	1155.2	*	1	2104	633	93.	350.5	1161.0
1	0426	134	0.	0.0	1142.0	*	1	1246	384	0.	147.1	1155.5	*	1	2106	634	93.	350.5	1161.0
1	0428	135	0.	0.0	1142.0	*	1	1248	385	0.	155.6	1155.7	*	1	2108	635	92.	350.5	1161.0
1	0430	136	0.	0.0	1142.0	*	1	1250	386	0.	163.6	1156.0	*	1	2110	636	92.	350.4	1161.0
1	0432	137	0.	0.0	1142.0	*	1	1252	387	0.	171.0	1156.2	*	1	2112	637	92.	350.4	1161.0
1	0434	138	0.	0.0	1142.0	*	1	1254	388	0.	178.1	1156.4	*	1	2114	638	92.	350.4	1161.0
1	0436	139	0.	0.0	1142.0	*	1	1256	389	0.	184.7	1156.6	*	1	2116	639	92.	350.3	1161.0
1	0438	140	0.	0.0	1142.0	*	1	1258	390	0.	191.0	1156.8	*	1	2118	640	92.	350.3	1161.0
1	0440	141	0.	0.0	1142.0	*	1	1300	391	0.	196.9	1157.0	*	1	2120	641	92.	350.2	1161.0
1	0442	142	0.	0.0	1142.0	*	1	1302	392	0.	202.4	1157.1	*	1	2122	642	92.	350.2	1161.0

1	0444	143	0.	0.0	1142.0	*	1	1304	393	0.	207.5	1157.3	*	1	2124	643	92.	350.2	1161.0
1	0446	144	0.	0.0	1142.0	*	1	1306	394	0.	212.4	1157.4	*	1	2126	644	92.	350.1	1161.0
1	0448	145	0.	0.0	1142.0	*	1	1308	395	0.	217.0	1157.6	*	1	2128	645	92.	350.1	1161.0
1	0450	146	0.	0.0	1142.0	*	1	1310	396	0.	221.4	1157.7	*	1	2130	646	92.	350.0	1161.0
1	0452	147	0.	0.0	1142.0	*	1	1312	397	0.	225.5	1157.8	*	1	2132	647	92.	350.0	1161.0
1	0454	148	0.	0.0	1142.0	*	1	1314	398	0.	229.5	1158.0	*	1	2134	648	92.	349.9	1161.0
1	0456	149	0.	0.0	1142.0	*	1	1316	399	0.	233.2	1158.1	*	1	2136	649	91.	349.9	1161.0
1	0458	150	0.	0.0	1142.0	*	1	1318	400	0.	236.7	1158.1	*	1	2138	650	91.	349.8	1161.0
1	0500	151	0.	0.0	1142.0	*	1	1320	401	0.	240.0	1158.2	*	1	2140	651	91.	349.8	1161.0
1	0502	152	0.	0.0	1142.0	*	1	1322	402	0.	243.2	1158.3	*	1	2142	652	91.	349.7	1161.0
1	0504	153	0.	0.0	1142.0	*	1	1324	403	0.	246.2	1158.4	*	1	2144	653	91.	349.7	1161.0
1	0506	154	0.	0.0	1142.0	*	1	1326	404	0.	249.1	1158.5	*	1	2146	654	91.	349.6	1161.0
1	0508	155	0.	0.0	1142.0	*	1	1328	405	0.	251.8	1158.5	*	1	2148	655	91.	349.6	1161.0
1	0510	156	0.	0.0	1142.0	*	1	1330	406	0.	254.5	1158.6	*	1	2150	656	91.	349.5	1161.0
1	0512	157	0.	0.0	1142.0	*	1	1332	407	0.	257.0	1158.7	*	1	2152	657	91.	349.5	1161.0
1	0514	158	0.	0.0	1142.0	*	1	1334	408	0.	259.5	1158.7	*	1	2154	658	91.	349.4	1160.9
1	0516	159	0.	0.0	1142.0	*	1	1336	409	0.	261.9	1158.8	*	1	2156	659	91.	349.4	1160.9
1	0518	160	0.	0.0	1142.0	*	1	1338	410	0.	264.2	1158.8	*	1	2158	660	91.	349.3	1160.9
1	0520	161	0.	0.0	1142.0	*	1	1340	411	0.	266.3	1158.9	*	1	2200	661	90.	349.3	1160.9
1	0522	162	0.	0.0	1142.0	*	1	1342	412	0.	268.4	1159.0	*	1	2202	662	90.	349.2	1160.9
1	0524	163	0.	0.0	1142.0	*	1	1344	413	0.	270.4	1159.0	*	1	2204	663	90.	349.2	1160.9
1	0526	164	0.	0.0	1142.0	*	1	1346	414	0.	272.3	1159.1	*	1	2206	664	90.	349.2	1160.9
1	0528	165	0.	0.0	1142.0	*	1	1348	415	1.	274.1	1159.1	*	1	2208	665	90.	349.1	1160.9
1	0530	166	0.	0.0	1142.0	*	1	1350	416	2.	275.8	1159.1	*	1	2210	666	90.	349.1	1160.9
1	0532	167	0.	0.0	1142.0	*	1	1352	417	3.	277.5	1159.2	*	1	2212	667	90.	349.0	1160.9
1	0534	168	0.	0.0	1142.0	*	1	1354	418	4.	279.2	1159.2	*	1	2214	668	90.	349.0	1160.9
1	0536	169	0.	0.0	1142.0	*	1	1356	419	5.	280.7	1159.3	*	1	2216	669	90.	348.9	1160.9
1	0538	170	0.	0.0	1142.0	*	1	1358	420	6.	282.2	1159.3	*	1	2218	670	90.	348.9	1160.9
1	0540	171	0.	0.0	1142.0	*	1	1400	421	6.	283.7	1159.3	*	1	2220	671	90.	348.8	1160.9
1	0542	172	0.	0.0	1142.0	*	1	1402	422	8.	285.1	1159.4	*	1	2222	672	90.	348.8	1160.9
1	0544	173	0.	0.0	1142.0	*	1	1404	423	9.	286.6	1159.4	*	1	2224	673	89.	348.7	1160.9
1	0546	174	0.	0.0	1142.0	*	1	1406	424	10.	288.0	1159.4	*	1	2226	674	89.	348.6	1160.9
1	0548	175	0.	0.0	1142.0	*	1	1408	425	11.	289.3	1159.5	*	1	2228	675	89.	348.6	1160.9
1	0550	176	0.	0.0	1142.0	*	1	1410	426	12.	290.6	1159.5	*	1	2230	676	89.	348.5	1160.9
1	0552	177	0.	0.0	1142.0	*	1	1412	427	13.	291.8	1159.5	*	1	2232	677	89.	348.4	1160.9
1	0554	178	0.	0.0	1142.0	*	1	1414	428	14.	293.0	1159.6	*	1	2234	678	89.	348.4	1160.9
1	0556	179	0.	0.0	1142.0	*	1	1416	429	15.	294.1	1159.6	*	1	2236	679	89.	348.3	1160.9
1	0558	180	0.	0.0	1142.0	*	1	1418	430	16.	295.2	1159.6	*	1	2238	680	89.	348.2	1160.9
1	0600	181	0.	0.0	1142.0	*	1	1420	431	18.	296.3	1159.6	*	1	2240	681	89.	348.2	1160.9
1	0602	182	0.	0.0	1142.0	*	1	1422	432	19.	297.3	1159.7	*	1	2242	682	89.	348.1	1160.9
1	0604	183	0.	0.0	1142.0	*	1	1424	433	20.	298.3	1159.7	*	1	2244	683	88.	348.1	1160.9
1	0606	184	0.	0.0	1142.0	*	1	1426	434	21.	299.3	1159.7	*	1	2246	684	88.	348.0	1160.9
1	0608	185	0.	0.0	1142.0	*	1	1428	435	22.	300.3	1159.7	*	1	2248	685	88.	347.9	1160.9
1	0610	186	0.	0.0	1142.0	*	1	1430	436	23.	301.2	1159.8	*	1	2250	686	88.	347.9	1160.9
1	0612	187	0.	0.0	1142.0	*	1	1432	437	24.	302.1	1159.8	*	1	2252	687	88.	347.8	1160.9
1	0614	188	0.	0.0	1142.0	*	1	1434	438	25.	302.9	1159.8	*	1	2254	688	88.	347.7	1160.9
1	0616	189	0.	0.0	1142.0	*	1	1436	439	26.	303.8	1159.8	*	1	2256	689	88.	347.7	1160.9
1	0618	190	0.	0.0	1142.0	*	1	1438	440	27.	304.6	1159.9	*	1	2258	690	88.	347.6	1160.9
1	0620	191	0.	0.0	1142.0	*	1	1440	441	27.	305.5	1159.9	*	1	2300	691	87.	347.5	1160.9
1	0622	192	0.	0.0	1142.0	*	1	1442	442	28.	306.3	1159.9	*	1	2302	692	87.	347.4	1160.9
1	0624	193	0.	0.0	1142.0	*	1	1444	443	29.	307.2	1159.9	*	1	2304	693	87.	347.4	1160.9
1	0626	194	0.	0.0	1142.0	*	1	1446	444	30.	308.0	1159.9	*	1	2306	694	87.	347.3	1160.9
1	0628	195	0.	0.0	1142.0	*	1	1448	445	31.	308.8	1160.0	*	1	2308	695	87.	347.2	1160.9
1	0630	196	0.	0.0	1142.0	*	1	1450	446	32.	309.5	1160.0	*	1	2310	696	87.	347.2	1160.9
1	0632	197	0.	0.0	1142.0	*	1	1452	447	33.	310.3	1160.0	*	1	2312	697	87.	347.1	1160.9
1	0634	198	0.	0.0	1142.0	*	1	1454	448	34.	311.0	1160.0	*	1	2314	698	87.	347.0	1160.9
1	0636	199	0.	0.0	1142.0	*	1	1456	449	35.	311.7	1160.0	*	1	2316	699	87.	347.0	1160.9
1	0638	200	0.	0.0	1142.0	*	1	1458	450	36.	312.4	1160.0	*	1	2318	700	86.	346.9	1160.9
1	0640	201	0.	0.0	1142.0	*	1	1500	451	37.	313.0	1160.1	*	1	2320	701	86.	346.8	1160.9
1	0642	202	0.	0.0	1142.0	*	1	1502	452	37.	313.7	1160.1	*	1	2322	702	86.	346.7	1160.9
1	0644	203	0.	0.0	1142.0	*	1	1504	453	38.	314.3	1160.1	*	1	2324	703	86.	346.7	1160.9
1	0646	204	0.	0.0	1142.0	*	1	1506	454	39.	315.0	1160.1	*	1	2326	704	86.	346.6	1160.9
1	0648	205	0.	0.0	1142.0	*	1	1508	455	40.	315.6	1160.1	*	1	2328	705	86.	346.5	1160.9
1	0650	206	0.	0.0	1142.0	*	1	1510	456	41.	316.2	1160.1	*	1	2330	706	86.	346.5	1160.9
1	0652	207	0.	0.0	1142.0	*	1	1512	457	41.	316.8	1160.2	*	1	2332	707	86.	346.5	1160.9
1	0654	208	0.	0.0	1142.0	*	1	1514	458	42.	317.4	1160.2	*	1	2334	708	86.	346.4	1160.9
1	0656	209	0.	0.0	1142.0	*	1	1516	459	43.	318.0	1160.2	*	1	2336	709	86.	346.4	1160.9

1	0658	210	0.	0.0	1142.0	*	1	1518	460	44.	318.5	1160.2	*	1	2338	710	85.	346.3	1160.9
1	0700	211	0.	0.0	1142.0	*	1	1520	461	45.	319.1	1160.2	*	1	2340	711	85.	346.2	1160.9
1	0702	212	0.	0.0	1142.0	*	1	1522	462	45.	319.6	1160.2	*	1	2342	712	85.	346.2	1160.9
1	0704	213	0.	0.0	1142.0	*	1	1524	463	46.	320.2	1160.2	*	1	2344	713	85.	346.1	1160.9
1	0706	214	0.	0.0	1142.0	*	1	1526	464	47.	320.7	1160.3	*	1	2346	714	85.	346.0	1160.9
1	0708	215	0.	0.0	1142.0	*	1	1528	465	47.	321.3	1160.3	*	1	2348	715	85.	345.9	1160.9
1	0710	216	0.	0.0	1142.0	*	1	1530	466	48.	321.8	1160.3	*	1	2350	716	85.	345.9	1160.9
1	0712	217	0.	0.0	1142.0	*	1	1532	467	49.	322.4	1160.3	*	1	2352	717	85.	345.8	1160.9
1	0714	218	0.	0.0	1142.0	*	1	1534	468	50.	322.9	1160.3	*	1	2354	718	84.	345.7	1160.9
1	0716	219	0.	0.0	1142.0	*	1	1536	469	50.	323.4	1160.3	*	1	2356	719	84.	345.6	1160.9
1	0718	220	0.	0.0	1142.0	*	1	1538	470	51.	323.8	1160.3	*	1	2358	720	84.	345.6	1160.9
1	0720	221	0.	0.0	1142.0	*	1	1540	471	52.	324.3	1160.3	*	2	0000	721	84.	345.5	1160.9
1	0722	222	0.	0.0	1142.0	*	1	1542	472	52.	324.8	1160.3	*	2	0002	722	84.	345.4	1160.9
1	0724	223	0.	0.0	1142.0	*	1	1544	473	53.	325.2	1160.4	*	2	0004	723	84.	345.3	1160.9
1	0726	224	0.	0.0	1142.0	*	1	1546	474	54.	325.7	1160.4	*	2	0006	724	84.	345.3	1160.8
1	0728	225	0.	0.0	1142.0	*	1	1548	475	54.	326.1	1160.4	*	2	0008	725	84.	345.2	1160.8
1	0730	226	0.	0.0	1142.0	*	1	1550	476	55.	326.6	1160.4	*	2	0010	726	83.	345.1	1160.8
1	0732	227	0.	0.0	1142.0	*	1	1552	477	55.	327.0	1160.4	*	2	0012	727	83.	345.0	1160.8
1	0734	228	0.	0.0	1142.0	*	1	1554	478	56.	327.4	1160.4	*	2	0014	728	83.	345.0	1160.8
1	0736	229	0.	0.0	1142.0	*	1	1556	479	57.	327.8	1160.4	*	2	0016	729	83.	344.9	1160.8
1	0738	230	0.	0.0	1142.0	*	1	1558	480	57.	328.3	1160.4	*	2	0018	730	83.	344.8	1160.8
1	0740	231	0.	0.0	1142.0	*	1	1600	481	58.	328.7	1160.4	*	2	0020	731	83.	344.7	1160.8
1	0742	232	0.	0.0	1142.0	*	1	1602	482	59.	329.1	1160.5	*	2	0022	732	83.	344.6	1160.8
1	0744	233	0.	0.0	1142.0	*	1	1604	483	59.	329.5	1160.5	*	2	0024	733	83.	344.6	1160.8
1	0746	234	0.	0.0	1142.0	*	1	1606	484	60.	329.9	1160.5	*	2	0026	734	82.	344.5	1160.8
1	0748	235	0.	0.0	1142.0	*	1	1608	485	60.	330.3	1160.5	*	2	0028	735	82.	344.4	1160.8
1	0750	236	0.	0.0	1142.0	*	1	1610	486	61.	330.7	1160.5	*	2	0030	736	82.	344.3	1160.8
1	0752	237	0.	0.0	1142.0	*	1	1612	487	61.	331.1	1160.5	*	2	0032	737	82.	344.2	1160.8
1	0754	238	0.	0.0	1142.0	*	1	1614	488	62.	331.4	1160.5	*	2	0034	738	82.	344.1	1160.8
1	0756	239	0.	0.0	1142.0	*	1	1616	489	63.	331.8	1160.5	*	2	0036	739	82.	344.0	1160.8
1	0758	240	0.	0.0	1142.0	*	1	1618	490	63.	332.1	1160.5	*	2	0038	740	81.	343.9	1160.8
1	0800	241	0.	0.0	1142.0	*	1	1620	491	64.	332.5	1160.5	*	2	0040	741	81.	343.7	1160.8
1	0802	242	0.	0.0	1142.0	*	1	1622	492	64.	332.8	1160.5	*	2	0042	742	81.	343.6	1160.8
1	0804	243	0.	0.0	1142.0	*	1	1624	493	65.	333.2	1160.6	*	2	0044	743	81.	343.5	1160.8
1	0806	244	0.	0.0	1142.0	*	1	1626	494	65.	333.5	1160.6	*	2	0046	744	81.	343.4	1160.8
1	0808	245	0.	0.0	1142.0	*	1	1628	495	66.	333.9	1160.6	*	2	0048	745	80.	343.3	1160.8
1	0810	246	0.	0.0	1142.0	*	1	1630	496	66.	334.2	1160.6	*	2	0050	746	80.	343.2	1160.8
1	0812	247	0.	0.0	1142.0	*	1	1632	497	67.	334.6	1160.6	*	2	0052	747	80.	343.0	1160.8
1	0814	248	0.	0.0	1142.0	*	1	1634	498	67.	334.9	1160.6	*	2	0054	748	80.	342.9	1160.8
1	0816	249	0.	0.0	1142.0	*	1	1636	499	68.	335.2	1160.6	*	2	0056	749	80.	342.8	1160.8
1	0818	250	0.	0.0	1142.0	*	1	1638	500	68.	335.6	1160.6	*	2	0058	750	79.	342.7	1160.8
						*							*						

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PEAK FLOW	TIME		MAXIMUM AVERAGE FLOW			
			6-HR	24-HR	72-HR	24.97-HR
+ (CFS)	(HR)					
		(CFS)				
+ 93.	20.30		90.	35.	33.	33.
		(INCHES)	0.184	0.284	0.284	0.284
		(AC-FT)	44.	69.	69.	69.

PEAK STORAGE	TIME	MAXIMUM AVERAGE STORAGE			
		6-HR	24-HR	72-HR	24.97-HR
+ (AC-FT)	(HR)				
351.	20.27	349.	169.	162.	162.

PEAK STAGE	TIME	MAXIMUM AVERAGE STAGE			
		6-HR	24-HR	72-HR	24.97-HR
+ (FEET)	(HR)				
1160.98	20.30	1160.94	1151.60	1151.23	1151.23

CUMULATIVE AREA = 4.55 SQ MI

MANE2 NPLAN,NSTM 1 0
1

RUNOFF SUMMARY

FLOW IN CUBIC FEET PER SECOND
TIME IN HOURS, AREA IN SQUARE MILES

	OPERATION	STATION	PEAK FLOW	TIME OF PEAK	AVERAGE FLOW FOR MAXIMUM PERIOD 6-HOUR	24-HOUR	72-HOUR	BASIN AREA	MAXIMUM STAGE	TIME OF MAX STAGE
+	HYDROGRAPH AT	BASB	890.	13.57	776.	381.	366.	29.79		
+	ROUTED TO	Rtgila	888.	13.67	774.	376.	361.	29.79		
+	HYDROGRAPH AT	GilaAe	162.	12.30	19.	5.	5.	0.10		
+	2 COMBINED AT	CGilaE	896.	13.63	779.	381.	366.	29.89		
+	ROUTED TO	RBI10	896.	13.67	779.	380.	366.	29.89		
+	HYDROGRAPH AT	GilaAw	193.	12.27	22.	6.	6.	0.11		
+	2 COMBINED AT	CGILAW	905.	13.63	785.	386.	371.	30.00		
+	HYDROGRAPH AT	M1	784.	12.27	96.	27.	26.	0.28		
+	ROUTED TO	RtC1	758.	12.33	96.	27.	26.	0.28		
+									3.20	12.33
+	HYDROGRAPH AT	M2	640.	12.20	69.	19.	18.	0.20		
+	ROUTED TO	RtC2	638.	12.23	69.	19.	18.	0.20		
+									4.01	12.23
+	HYDROGRAPH AT	A1	83.	12.20	8.	2.	2.	0.04		
+	3 COMBINED AT	COMB1	1416.	12.27	173.	48.	46.	0.52		
+	DIVERSION TO	Splt1	850.	12.27	104.	29.	28.	0.52		
+	HYDROGRAPH AT	Splt1	567.	12.27	69.	19.	18.	0.52		
+	ROUTED TO	RtC3	565.	12.30	69.	19.	18.	0.52		
+									2.31	12.30
+	HYDROGRAPH AT	M3	148.	12.07	10.	3.	3.	0.03		
+	ROUTED TO	RtC4	132.	12.10	10.	3.	3.	0.03		
+									2.09	12.10
+	HYDROGRAPH AT	A2	49.	12.17	4.	1.	1.	0.02		

+	3 COMBINED AT	COMB2	644.	12.27	83.	23.	22.	0.57	
+	ROUTED TO	RtC5	633.	12.30	83.	23.	22.	0.57	
+									2.39 12.30
+	HYDROGRAPH AT	M4	700.	12.57	131.	36.	35.	0.38	
+	ROUTED TO	RtR1	698.	12.60	131.	36.	35.	0.38	
+									2.15 12.60
+	HYDROGRAPH AT	A3	81.	12.20	7.	2.	2.	0.04	
+	HYDROGRAPH AT	A4	172.	12.17	16.	4.	4.	0.07	
+	4 COMBINED AT	COMB3	1304.	12.37	237.	65.	63.	1.05	
+	DIVERSION TO	RET1	103.	12.37	9.	2.	2.	1.05	
+	HYDROGRAPH AT	RET1	1201.	12.37	228.	63.	61.	1.05	
+	ROUTED TO	RtC6	1197.	12.40	228.	63.	61.	1.05	
+									3.80 12.40
+	HYDROGRAPH AT	A5	80.	12.17	7.	2.	2.	0.03	
+	2 COMBINED AT	COMB4	1236.	12.37	235.	65.	62.	1.08	
+	DIVERSION TO	Splt2	371.	12.37	70.	19.	19.	1.08	
+	HYDROGRAPH AT	Splt2	865.	12.37	164.	45.	44.	1.08	
+	ROUTED TO	RtC7	862.	12.40	164.	45.	44.	1.08	
+									4.56 12.40
+	HYDROGRAPH AT	A6a	92.	12.20	9.	2.	2.	0.04	
+	2 COMBINED AT	COMB2A	913.	12.37	173.	48.	46.	1.12	
+	ROUTED TO	RtC8	912.	12.40	173.	48.	46.	1.12	
+									5.32 12.40
+	HYDROGRAPH AT	A6b	49.	12.17	4.	1.	1.	0.02	
+	ROUTED TO	RtR2	47.	12.20	4.	1.	1.	0.02	
+									1.15 12.20

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+        HYDROGRAPH AT
                          R1      26.   12.17        3.        1.        1.     0.01
+        2 COMBINED AT
                       Comb5      72.   12.20        7.        2.        2.     0.03
+        DIVERSION TO
                       DivR1      72.    0.00        7.        2.        2.     0.03
+        HYDROGRAPH AT
                       DivR1       0.    0.00        0.        0.        0.     0.03
+        HYDROGRAPH AT
                          A7      22.   12.13        2.        1.        0.     0.01
+        3 COMBINED AT
                       Comb6     920.   12.40      175.       48.       46.     1.15
+        ROUTED TO
+                       RtC9     917.   12.43      175.       48.       46.     1.15
+                                                                              5.19      12.43
+        HYDROGRAPH AT
                          A8     121.   12.27       13.        4.        4.     0.06
+        HYDROGRAPH AT
                          R2      23.   12.17        2.        1.        1.     0.01
+        HYDROGRAPH AT
                         A29      19.   12.13        1.        0.        0.     0.01
+        4 COMBINED AT
                       COMB7    1021.   12.40      192.       53.       51.     1.23
+        ROUTED TO
+                      RtC10    1017.   12.43      192.       53.       51.     1.23
+                                                                              5.36      12.43
+        HYDROGRAPH AT
                          A9      90.   12.23       10.        3.        3.     0.04
+        HYDROGRAPH AT
                         A30      19.   12.13        1.        0.        0.     0.01
+        3 COMBINED AT
                       COMB8    1086.   12.40      203.       56.       54.     1.27
+        DIVERSION TO
                       Splt3     140.   12.40       43.       12.       12.     1.27
+        HYDROGRAPH AT
                       SPLT3     946.   12.40      160.       44.       42.     1.27
+        ROUTED TO
+                      RtC11     940.   12.43      160.       44.       42.     1.27
+                                                                              5.36      12.43
+        HYDROGRAPH AT
                         A11      82.   12.20        8.        2.        2.     0.03
+        HYDROGRAPH AT
                         A12       7.   12.10        0.        0.        0.     0.00
+        DIVERSION TO
                       DvA12       5.   12.10        0.        0.        0.     0.00
         HYDROGRAPH AT
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+		DvA12	7.	12.10	0.	0.	0.	0.00		
	2 COMBINED AT									
+		Comb9	86.	12.20	8.	2.	2.	0.04		
	ROUTED TO									
+		RtR3	78.	12.27	8.	2.	2.	0.04		
+									1.29	12.27
	HYDROGRAPH AT									
+		A10	114.	12.17	10.	3.	3.	0.04		
	DIVERSION TO									
+		DvA10	114.	12.23	4.	1.	1.	0.04		
	HYDROGRAPH AT									
+		DvA10	99.	12.23	6.	2.	2.	0.04		
	HYDROGRAPH AT									
+		R3	25.	12.17	3.	1.	1.	0.01		
	HYDROGRAPH AT									
+		R4	19.	12.13	2.	1.	1.	0.00		
	5 COMBINED AT									
+		Comb10	1060.	12.40	178.	49.	47.	1.36		
	ROUTED TO									
+		RtC12	1056.	12.43	178.	49.	47.	1.36		
+									5.89	12.43
	HYDROGRAPH AT									
+		RetR1	72.	12.20	7.	2.	2.	0.00		
	ROUTED TO									
+		RtR4	56.	12.30	7.	2.	2.	0.00		
+									1.20	12.30
	HYDROGRAPH AT									
+		R6	28.	12.23	3.	1.	1.	0.01		
	HYDROGRAPH AT									
+		A13	4.	12.07	0.	0.	0.	0.00		
	DIVERSION TO									
+		DvA13	4.	12.50	0.	0.	0.	0.00		
	HYDROGRAPH AT									
+		DvA13	1.	12.50	0.	0.	0.	0.00		
	3 COMBINED AT									
+		Comb11	83.	12.27	10.	3.	3.	0.01		
	ROUTED TO									
+		RtC13	80.	12.33	10.	3.	3.	0.01		
+									2.42	12.33
	HYDROGRAPH AT									
+		A14	126.	12.30	15.	4.	4.	0.08		
	DIVERSION TO									
+		DvA14	126.	12.57	9.	2.	2.	0.08		
	HYDROGRAPH AT									
+		DvA14	68.	12.57	6.	2.	2.	0.08		
	HYDROGRAPH AT									

+		R7a	17.	12.13	1.	0.	0.	0.00		
	3 COMBINED AT									
+		Comb12	122.	12.57	17.	5.	5.	0.09		
	ROUTED TO									
+		RtC14	111.	12.60	17.	5.	5.	0.09		
+									2.71	12.60
	HYDROGRAPH AT									
+		A15	165.	12.10	12.	3.	3.	0.05		
	HYDROGRAPH AT									
+		A31	18.	12.13	2.	0.	0.	0.00		
	HYDROGRAPH AT									
+		R7b	17.	12.13	1.	0.	0.	0.00		
	HYDROGRAPH AT									
+		R5	18.	12.10	1.	0.	0.	0.00		
	6 COMBINED AT									
+		Comb13	1195.	12.40	212.	59.	56.	1.51		
	ROUTED TO									
+		RtC15	1192.	12.40	212.	59.	56.	1.51		
+									5.30	12.40
	ROUTED TO									
+		RtR5	1192.	12.43	212.	59.	56.	1.51		
+									2.18	12.43
	HYDROGRAPH AT									
+		R12A	19.	12.13	2.	1.	1.	0.00		
	HYDROGRAPH AT									
+		A16	57.	12.10	5.	1.	1.	0.01		
	DIVERSION TO									
+		DvA16	57.	12.23	3.	1.	1.	0.01		
	HYDROGRAPH AT									
+		DvA16	34.	12.23	2.	1.	1.	0.01		
	HYDROGRAPH AT									
+		A17	167.	12.27	19.	5.	5.	0.07		
	4 COMBINED AT									
+		Comb14	1340.	12.40	235.	65.	63.	1.60		
	ROUTED TO									
+		RtR6	1337.	12.43	235.	65.	63.	1.60		
+									2.26	12.43
	HYDROGRAPH AT									
+		R12b	19.	12.13	2.	1.	1.	0.00		
	2 COMBINED AT									
+		Com14a	1343.	12.43	236.	66.	63.	1.61		
	DIVERSION TO									
+		48-Est	671.	12.43	118.	33.	32.	1.61		
	HYDROGRAPH AT									
+		48-Sth	671.	12.43	118.	33.	32.	1.61		
	HYDROGRAPH AT									

+		A18	15.	12.10	1.	0.	0.	0.00		
	HYDROGRAPH AT									
+		R8	13.	12.10	1.	0.	0.	0.00		
	2 COMBINED AT									
+		Comb15	28.	12.10	2.	1.	1.	0.01		
	ROUTED TO									
+		RtR7	25.	12.17	2.	1.	1.	0.01		
+									1.12	12.17
	HYDROGRAPH AT									
+		R9	9.	12.10	1.	0.	0.	0.00		
	HYDROGRAPH AT									
+		A19	82.	12.27	9.	2.	2.	0.04		
	3 COMBINED AT									
+		Comb16	107.	12.23	12.	3.	3.	0.05		
	ROUTED TO									
+		RtR8	106.	12.27	12.	3.	3.	0.05		
+									1.29	12.27
	HYDROGRAPH AT									
+		A20	53.	12.17	5.	1.	1.	0.02		
	DIVERSION TO									
+		DvA20	53.	12.30	2.	1.	1.	0.02		
	HYDROGRAPH AT									
+		DvA20	37.	12.30	2.	1.	1.	0.02		
	HYDROGRAPH AT									
+		R10	18.	12.10	1.	0.	0.	0.00		
	3 COMBINED AT									
+		Comb17	147.	12.30	16.	4.	4.	0.07		
	ROUTED TO									
+		RtR9	126.	12.37	16.	4.	4.	0.07		
+									1.31	12.37
	HYDROGRAPH AT									
+		A21	144.	12.33	18.	5.	5.	0.08		
	DIVERSION TO									
+		21-Est	70.	12.33	14.	4.	4.	0.08		
	HYDROGRAPH AT									
+		21-Sth	74.	12.33	4.	1.	1.	0.08		
	ROUTED TO									
+		RtR10	70.	12.37	4.	1.	1.	0.08		
+									1.24	12.37
	HYDROGRAPH AT									
+		R11	25.	12.23	3.	1.	1.	0.01		
	HYDROGRAPH AT									
+		A22	123.	12.13	10.	3.	3.	0.03		
	DIVERSION TO									
+		DvA22	123.	12.23	6.	1.	1.	0.03		
	HYDROGRAPH AT									

+		DvA22	80.	12.23	5.	1.	1.	0.03		
+	HYDROGRAPH AT	Retn48	671.	12.43	118.	33.	32.	0.00		
+	5 COMBINED AT	Comb18	913.	12.40	145.	40.	39.	0.19		
+	DIVERSION TO	RayEst	140.	12.40	65.	20.	20.	0.19		
+	HYDROGRAPH AT	RaySth	773.	12.40	80.	20.	19.	0.19		
+	2 COMBINED AT	Comb19	1442.	12.40	198.	53.	51.	1.80		
+	ROUTED TO	RtC16	1433.	12.43	198.	53.	51.	1.80		
+									4.27	12.43
+	HYDROGRAPH AT	A27	58.	12.60	11.	3.	3.	0.04		
+	ROUTED TO	RtC17	57.	12.67	11.	3.	3.	0.04		
+									1.38	12.67
+	HYDROGRAPH AT	A28	330.	12.43	50.	14.	13.	0.22		
+	HYDROGRAPH AT	R13	21.	12.27	3.	1.	1.	0.01		
+	4 COMBINED AT	Comb20	1821.	12.43	261.	70.	67.	2.06		
+	ROUTED TO	RET2	1674.	12.53	241.	67.	64.	2.06		
+									21.30	12.53
+	DIVERSION TO	South	85.	12.53	75.	26.	25.	2.06		
+	HYDROGRAPH AT	East	1589.	12.53	166.	41.	40.	2.06		
+	ROUTED TO	RtEAST	1587.	12.57	166.	41.	40.	2.06		
+									4.93	12.57
+	HYDROGRAPH AT	C	185.	12.13	14.	4.	4.	0.06		
+	2 COMBINED AT	COMBC	1618.	12.57	180.	45.	44.	2.12		
+	ROUTED TO	RtC	1619.	12.60	180.	45.	44.	2.12		
+									5.68	12.60
+	HYDROGRAPH AT	B	185.	12.13	14.	4.	4.	0.06		
+	2 COMBINED AT	COMBB	1644.	12.60	194.	49.	47.	2.17		

	HYDROGRAPH AT								
+		Retn21	70.	12.13	14.	4.	4.	0.00	
	ROUTED TO								
+		RtP1	70.	12.27	14.	4.	4.	0.00	
+									2.44 12.37
	HYDROGRAPH AT								
+		A25	91.	12.27	10.	3.	3.	0.04	
	2 COMBINED AT								
+		Comb21	161.	12.27	24.	7.	6.	0.04	
	ROUTED TO								
+		RtP2	161.	12.27	24.	7.	6.	0.04	
+									3.42 12.27
	HYDROGRAPH AT								
+		A23	88.	12.23	9.	3.	2.	0.04	
	DIVERSION TO								
+		ST23	88.	12.40	5.	1.	1.	0.04	
	HYDROGRAPH AT								
+		DvA23	62.	12.40	5.	1.	1.	0.04	
	ROUTED TO								
+		RtC18	35.	12.57	5.	1.	1.	0.04	
+									0.33 12.57
	HYDROGRAPH AT								
+		A24	45.	12.40	6.	2.	2.	0.06	
	3 COMBINED AT								
+		Comb22	201.	12.30	35.	10.	9.	0.15	
	ROUTED TO								
+		RET3	104.	12.80	34.	10.	9.	0.15	
+									23.71 12.80
	ROUTED TO								
+		RtC19	104.	12.87	34.	10.	9.	0.15	
+									2.04 12.87
	HYDROGRAPH AT								
+		A26	184.	12.10	14.	4.	4.	0.05	
	DIVERSION TO								
+		ST26	184.	12.20	8.	2.	2.	0.05	
	HYDROGRAPH AT								
+		DvA26	118.	12.20	7.	2.	2.	0.05	
	HYDROGRAPH AT								
+		RtnRay	140.	12.03	65.	20.	20.	0.00	
	ROUTED TO								
+		RtR11	140.	12.73	65.	20.	20.	0.00	
+									1.33 12.90
	HYDROGRAPH AT								
+		R14	26.	12.20	3.	1.	1.	0.01	
	4 COMBINED AT								
+		Comb23	320.	12.23	109.	33.	31.	0.20	
	DIVERSION TO								

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+                    DIVBOX    161.  12.23    29.    7.    7.   0.20
        HYDROGRAPH AT
+                    DIV520    160.  12.23    79.   25.   24.   0.20
        HYDROGRAPH AT
+                    DIVBOX    161.  12.23    29.    7.    7.   0.00
        2 COMBINED AT
+                    ADDBOX    320.  12.23   109.   33.   31.   0.20
        ROUTED TO
+                     RTE23    290.  12.37   109.   33.   31.   0.20
+                                                                      1.78    12.37
        HYDROGRAPH AT
+                       VA1    268.  12.20    26.    7.    7.   0.11
        ROUTED TO
+                     RTEA1    256.  12.23    26.    7.    7.   0.11
+                                                                      2.56    12.23
        HYDROGRAPH AT
+                       VA2    394.  12.23    41.   11.   11.   0.17
        2 COMBINED AT
+                     COMBA    650.  12.23    67.   18.   18.   0.28
        ROUTED TO
+                    STORA2    317.  12.50    26.    8.    7.   0.28
        ROUTED TO
+                     RTEA2    267.  12.57    26.    8.    7.   0.28
+                                                                      1.80    12.57
        3 COMBINED AT
+                     COMBB   2164.  12.60   328.   89.   86.   2.66
        ROUTED TO
+                       RtB   2166.  12.60   328.   89.   86.   2.66
+                                                                      5.74    12.60
        HYDROGRAPH AT
+                         D     91.  12.13     7.    2.    2.   0.03
        HYDROGRAPH AT
+                         E     91.  12.13     7.    2.    2.   0.03
        HYDROGRAPH AT
+                         F    124.  12.13    10.    3.    3.   0.04
        4 COMBINED AT
+                     COMBF   2210.  12.60   351.   96.   92.   2.76
        ROUTED TO
+                      RTEF   2193.  12.63   351.   96.   92.   2.76
+                                                                      6.00    12.63
        HYDROGRAPH AT
+                    DA522A    141.  12.20    14.    4.    4.   0.06
        2 COMBINED AT
+                    AD522A   2229.  12.63   365.  100.   96.   2.82
        ROUTED TO
+                    RT522A   2212.  12.63   365.  100.   96.   2.82
+                                                                      6.02    12.63
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+	HYDROGRAPH AT	DA10	22.	12.13	2.	0.	0.	0.01	
+	HYDROGRAPH AT	DA11	8.	12.13	1.	0.	0.	0.00	
+	HYDROGRAPH AT	DA12	29.	12.13	2.	1.	1.	0.01	
+	3 COMBINED AT	ADD12	59.	12.13	5.	1.	1.	0.02	
+	ROUTED TO	RTE12	58.	12.13	5.	1.	1.	0.02	
+	HYDROGRAPH AT	DA13	9.	12.13	1.	0.	0.	0.00	
+	ROUTED TO	RTE13	9.	12.13	1.	0.	0.	0.00	
+	HYDROGRAPH AT	DA14	14.	12.13	1.	0.	0.	0.00	
+	3 COMBINED AT	ADD14	82.	12.13	7.	2.	2.	0.02	
+	ROUTED TO	RTE14	79.	12.17	7.	2.	2.	0.02	
+	HYDROGRAPH AT	DA15	18.	12.13	1.	0.	0.	0.00	
+	HYDROGRAPH AT	DA16	7.	12.13	1.	0.	0.	0.00	
+	HYDROGRAPH AT	DA17	19.	12.13	1.	0.	0.	0.01	
+	HYDROGRAPH AT	DA18	6.	12.13	0.	0.	0.	0.00	
+	5 COMBINED AT	ADD17	126.	12.13	11.	3.	3.	0.04	
+	ROUTED TO	RTE18	118.	12.17	11.	3.	3.	0.04	
+	HYDROGRAPH AT	DA522C	117.	12.17	11.	3.	3.	0.04	
+	2 COMBINED AT	AD522C	235.	12.17	21.	6.	6.	0.08	
+	ROUTED TO	RT522C	234.	12.20	21.	6.	6.	0.08	
+									2.19 12.20
+	HYDROGRAPH AT	DA522D	93.	12.17	8.	2.	2.	0.03	
+	HYDROGRAPH AT	DA522B	141.	12.20	14.	4.	4.	0.06	
+	4 COMBINED AT	AD522D	2320.	12.63	408.	111.	107.	2.99	

+	ROUTED TO	RT522D	2318.	12.67	408.	111.	107.	2.99		
+									6.81	12.67
+	HYDROGRAPH AT	DA522E	108.	12.13	8.	2.	2.	0.04		
+	2 COMBINED AT	AD522E	2327.	12.67	416.	114.	109.	3.02		
+	HYDROGRAPH AT	DA513	196.	12.23	21.	6.	6.	0.09		
+	HYDROGRAPH AT	DA514	143.	12.17	13.	4.	3.	0.06		
+	HYDROGRAPH AT	DA515	105.	12.23	11.	3.	3.	0.05		
+	3 COMBINED AT	AD515	434.	12.20	45.	12.	12.	0.19		
+	ROUTED TO	RT515	390.	12.30	45.	12.	12.	0.19		
+									7.16	12.30
+	HYDROGRAPH AT	DA517	245.	12.33	30.	8.	8.	0.17		
+	HYDROGRAPH AT	South	85.	12.37	75.	26.	25.	0.00		
+	3 COMBINED AT	AD517	706.	12.33	147.	46.	44.	0.36		
+	ROUTED TO	RT517	690.	12.37	146.	46.	44.	0.36		
+									11.53	12.37
+	HYDROGRAPH AT	DA518	104.	12.67	20.	6.	5.	0.10		
+	2 COMBINED AT	AD518	757.	12.37	167.	52.	50.	0.46		
+	ROUTED TO	RT518	753.	12.40	167.	52.	50.	0.46		
+									3.55	12.40
+	HYDROGRAPH AT	DA519A	126.	12.17	11.	3.	3.	0.05		
+	ROUTED TO	RT519A	102.	12.23	11.	3.	3.	0.05		
+									1.38	12.23
+	HYDROGRAPH AT	DA519B	315.	12.23	33.	9.	9.	0.14		
+	3 COMBINED AT	AD519B	1065.	12.33	209.	64.	61.	0.64		
+	ROUTED TO	RT519B	1063.	12.37	209.	64.	61.	0.64		
+									4.04	12.37

+	HYDROGRAPH AT	DA519C	269.	12.23	28.	8.	7.	0.12		
+	ROUTED TO	RT519C	264.	12.27	28.	8.	7.	0.12	2.61	12.27
+	HYDROGRAPH AT	DA519D	181.	12.23	19.	5.	5.	0.08		
+	3 COMBINED AT	AD519D	1438.	12.33	254.	76.	73.	0.84		
+	ROUTED TO	RT519D	1438.	12.33	254.	76.	73.	0.84	4.37	12.33
+	HYDROGRAPH AT	DA519G	93.	12.13	8.	2.	2.	0.03		
+	3 COMBINED AT	AD519G	3206.	12.63	678.	192.	185.	3.89		
+	HYDROGRAPH AT	DA519E	152.	12.13	12.	3.	3.	0.05		
+	ROUTED TO	RT519E	124.	12.20	12.	3.	3.	0.05	1.72	12.20
+	HYDROGRAPH AT	DA519F	295.	12.27	34.	9.	9.	0.14		
+	2 COMBINED AT	AD519F	412.	12.27	46.	13.	12.	0.19		
+	2 COMBINED AT	AD519G	3361.	12.63	724.	205.	197.	4.08		
+	ROUTED TO	RTI-10	3335.	12.63	723.	205.	197.	4.08	6.67	12.63
+	HYDROGRAPH AT	B1	266.	12.20	25.	7.	7.	0.11		
+	ROUTED TO	RTEB1	239.	12.27	25.	7.	7.	0.11	1.92	12.27
+	2 COMBINED AT	ADI-10	3422.	12.63	749.	211.	203.	4.19		
+	HYDROGRAPH AT	B15	200.	12.30	24.	6.	6.	0.10		
+	2 COMBINED AT	ADBA15	3600.	12.27	772.	218.	210.	4.29		
+	HYDROGRAPH AT	DA01	40.	12.13	3.	1.	1.	0.01		
+	ROUTED TO	RTE01	39.	12.13	3.	1.	1.	0.01		
+	HYDROGRAPH AT	DA02	30.	12.13	2.	1.	1.	0.01		

+	HYDROGRAPH AT	DA03	16.	12.13	1.	0.	0.	0.00	
+	3 COMBINED AT	ADD03	85.	12.13	7.	2.	2.	0.02	
+	ROUTED TO	RTE03	84.	12.13	7.	2.	2.	0.02	
+	HYDROGRAPH AT	DA04	15.	12.13	1.	0.	0.	0.00	
+	HYDROGRAPH AT	DA05	24.	12.13	2.	1.	1.	0.01	
+	3 COMBINED AT	ADD05	122.	12.13	10.	3.	3.	0.03	
+	ROUTED TO	RTE05	119.	12.17	10.	3.	3.	0.03	
+	HYDROGRAPH AT	DA06	32.	12.13	3.	1.	1.	0.01	
+	2 COMBINED AT	ADD06	150.	12.13	13.	4.	3.	0.04	
+	ROUTED TO	RTE06	148.	12.17	13.	4.	3.	0.04	
+	HYDROGRAPH AT	DA07	54.	12.13	4.	1.	1.	0.02	
+	2 COMBINED AT	ADD07	199.	12.17	17.	5.	5.	0.06	
+	ROUTED TO	RTE07	193.	12.17	17.	5.	4.	0.06	
+	HYDROGRAPH AT	DA08	22.	12.13	2.	1.	0.	0.01	
+	ROUTED TO	RTE08	22.	12.13	2.	1.	0.	0.01	
+	2 COMBINED AT	ADD08	215.	12.17	19.	5.	5.	0.07	
+	HYDROGRAPH AT	DA09	74.	12.13	6.	2.	2.	0.03	
+	2 COMBINED AT	ADD09	284.	12.17	24.	7.	7.	0.10	
+	PUMP FLOW TO	PUMP	200.	12.10	24.	7.	6.	0.10	
+	HYDROGRAPH AT	PUMP	0.	12.27	0.	0.	0.	0.10	
+									1142.42 12.27
+	HYDROGRAPH AT	PUMPR	200.	12.10	24.	7.	6.	0.00	
+	2 COMBINED AT	PUMP	200.	12.27	24.	7.	6.	0.10	

+	HYDROGRAPH AT	DA19	23.	12.13	2.	1.	0.	0.01	
+	ROUTED TO	RTE19	23.	12.13	2.	1.	0.	0.01	
+	HYDROGRAPH AT	DA20	37.	12.13	3.	1.	1.	0.01	
+	2 COMBINED AT	ADD20	60.	12.13	5.	1.	1.	0.02	
+	ROUTED TO	RTE20	60.	12.13	5.	1.	1.	0.02	
+	HYDROGRAPH AT	DA21	7.	12.13	1.	0.	0.	0.00	
+	2 COMBINED AT	ADD21	67.	12.13	5.	2.	1.	0.02	
+	ROUTED TO	RTE21	67.	12.13	5.	2.	1.	0.02	
+	HYDROGRAPH AT	DA22	49.	12.13	4.	1.	1.	0.01	
+	2 COMBINED AT	ADD22	115.	12.13	9.	3.	2.	0.04	
+	ROUTED TO	RTE22	114.	12.13	9.	3.	2.	0.04	
+	HYDROGRAPH AT	DA23	85.	12.13	7.	2.	2.	0.03	
+	2 COMBINED AT	ADD23	199.	12.13	16.	4.	4.	0.07	
+	ROUTED TO	RTE23	19.	12.67	13.	4.	4.	0.07	
+									1164.19 12.67
+	HYDROGRAPH AT	DA24	10.	12.13	1.	0.	0.	0.00	
+	2 COMBINED AT	ADD24	21.	12.20	13.	4.	4.	0.07	
+	HYDROGRAPH AT	DA25	58.	12.13	5.	1.	1.	0.02	
+	2 COMBINED AT	ADD25	78.	12.13	18.	6.	5.	0.09	
+	ROUTED TO	RTE25	11.	15.87	11.	5.	5.	0.09	
+									1162.14 15.90
+	HYDROGRAPH AT	DA26	37.	12.13	3.	1.	1.	0.02	
+	2 COMBINED AT	ADD26	41.	12.13	13.	6.	5.	0.11	
	ROUTED TO								

+		RTE26	8.	21.70	8.	3.	3.	0.11			
+									1160.84	21.80	
+	HYDROGRAPH AT	DA27	75.	12.13	6.	2.	2.	0.03			
+	2 COMBINED AT	ADD27	75.	12.13	10.	5.	5.	0.13			
+	ROUTED TO	RTE27	11.	12.63	9.	4.	4.	0.13			
+									1160.27	12.63	
+	HYDROGRAPH AT	DA28	10.	12.13	1.	0.	0.	0.00			
+	2 COMBINED AT	ADD28	17.	12.17	9.	5.	5.	0.13			
+	HYDROGRAPH AT	DA29	82.	12.13	7.	2.	2.	0.03			
+	2 COMBINED AT	ADD29	99.	12.13	15.	6.	6.	0.16			
+	ROUTED TO	RTE29	16.	12.80	14.	6.	6.	0.16			
+									1160.10	12.80	
+	2 COMBINED AT	PMP	216.	12.50	37.	13.	12.	0.26			
+	2 COMBINED AT	ADPMP	3814.	12.27	809.	231.	222.	4.55			
+	ROUTED TO	B15FF	3760.	12.30	737.	207.	199.	4.55			
+									1160.33	12.30	/ Spillway Peak Flow EQ Basin HWL
+	ROUTED TO	STB15	93.	20.30	90.	35.	33.	4.55			
+									1160.98	20.30	/ Primary Basin HWL
+	2 COMBINED AT	I10W	905.	13.63	834.	421.	405.	34.54			
+	ROUTED TO	RI10W	903.	13.73	833.	416.	400.	34.54			
+									1152.10	13.73	
+	ROUTED TO	R1Gila	880.	14.00	828.	393.	377.	34.54			
+									39.13	14.00	
+	ROUTED TO	R2Gila	847.	15.60	812.	354.	340.	34.54			
+									35.10	15.60	
+	ROUTED TO	R3Gila	825.	16.30	807.	322.	309.	34.54			
+									26.87	16.30	

1

SUMMARY OF KINEMATIC WAVE - MUSKINGUM-CUNGE ROUTING
(FLOW IS DIRECT RUNOFF WITHOUT BASE FLOW)

							INTERPOLATED TO COMPUTATION INTERVAL		
ISTAQ	ELEMENT	DT	PEAK	TIME TO	VOLUME	DT	PEAK	TIME TO	VOLUME

```
                                          PEAK                                  PEAK
                              (MIN)     (CFS)     (MIN)     (IN)     (MIN)     (CFS)     (MIN)      (IN)
          Rtgila  MANE         2.00    887.58    820.00     0.47      2.00    887.58    820.00      0.47

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.7563E+03 EXCESS=0.0000E+00 OUTFLOW=0.7463E+03 BASIN STORAGE=0.1015E+02 PERCENT ERROR=   0.0

           RBI10  MANE         1.09    895.97    819.08     0.47      2.00    895.95    820.00      0.47

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.7561E+03 EXCESS=0.0000E+00 OUTFLOW=0.7548E+03 BASIN STORAGE=0.1333E+01 PERCENT ERROR=   0.0

           RTE12  MANE         0.28     58.49    727.97     3.12      2.00     58.45    728.00      3.12

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.2632E+01 EXCESS=0.0000E+00 OUTFLOW=0.2631E+01 BASIN STORAGE=0.2454E-04 PERCENT ERROR=   0.0

           RTE13  MANE         1.19      8.88    728.44     2.90      2.00      8.80    728.00      2.90

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.4031E+00 EXCESS=0.0000E+00 OUTFLOW=0.4021E+00 BASIN STORAGE=0.7006E-04 PERCENT ERROR=   0.2

           RTE14  MANE         2.00     79.44    730.00     3.02      2.00     79.44    730.00      3.02

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.3663E+01 EXCESS=0.0000E+00 OUTFLOW=0.3655E+01 BASIN STORAGE=0.1848E-03 PERCENT ERROR=   0.2

           RTE18  MANE         1.09    118.59    729.27     3.01      2.00    117.85    730.00      3.01

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.5860E+01 EXCESS=0.0000E+00 OUTFLOW=0.5809E+01 BASIN STORAGE=0.1255E-03 PERCENT ERROR=   0.9

           RTE01  MANE         1.22     39.51    728.56     3.48      2.00     39.18    728.00      3.48

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.1839E+01 EXCESS=0.0000E+00 OUTFLOW=0.1839E+01 BASIN STORAGE=0.1194E-03 PERCENT ERROR=   0.0

           RTE03  MANE         0.64     84.37    728.46     3.32      2.00     83.76    728.00      3.32

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.3910E+01 EXCESS=0.0000E+00 OUTFLOW=0.3909E+01 BASIN STORAGE=0.6340E-04 PERCENT ERROR=   0.0

           RTE05  MANE         1.00    120.19    729.07     3.23      2.00    118.61    730.00      3.23

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.5600E+01 EXCESS=0.0000E+00 OUTFLOW=0.5596E+01 BASIN STORAGE=0.1161E-03 PERCENT ERROR=   0.1

           RTE06  MANE         0.98    148.16    729.92     3.17      2.00    147.98    730.00      3.17

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.6991E+01 EXCESS=0.0000E+00 OUTFLOW=0.6986E+01 BASIN STORAGE=0.1012E-03 PERCENT ERROR=   0.1

           RTE07  MANE         1.04    193.51    729.77     2.82      2.00    193.31    730.00      2.82
```

```
CONTINUITY SUMMARY (AC-FT) - INFLOW=0.9290E+01 EXCESS=0.0000E+00 OUTFLOW=0.9268E+01 BASIN STORAGE=0.1139E-03 PERCENT ERROR=   0.2

            RTE08  MANE        1.27     21.95    728.86      3.39      2.00     21.74    728.00        3.39

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.1011E+01 EXCESS=0.0000E+00 OUTFLOW=0.1011E+01 BASIN STORAGE=0.1016E-03 PERCENT ERROR=   0.0

            RTE19  MANE        0.16     23.15    728.26      1.69      2.00     23.05    728.00        1.69

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.1011E+01 EXCESS=0.0000E+00 OUTFLOW=0.1010E+01 BASIN STORAGE=0.1393E-09 PERCENT ERROR=   0.0

            RTE20  MANE        0.16     60.28    728.13      2.31      2.00     60.21    728.00        2.31

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.2655E+01 EXCESS=0.0000E+00 OUTFLOW=0.2655E+01 BASIN STORAGE=0.4107E-09 PERCENT ERROR=   0.0

            RTE21  MANE        0.11     66.67    728.16      2.40      2.00     66.60    728.00        2.40

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.2975E+01 EXCESS=0.0000E+00 OUTFLOW=0.2975E+01 BASIN STORAGE=0.1052E-08 PERCENT ERROR=   0.0

            RTE22  MANE        0.24    114.77    728.25      2.63      2.00    114.39    728.00        2.63

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.5121E+01 EXCESS=0.0000E+00 OUTFLOW=0.5121E+01 BASIN STORAGE=0.1636E-07 PERCENT ERROR=   0.0


*** NORMAL END OF HEC-1 ***
```

APPENDIX C

TEXT OF:

HYDROLOGY REPORT (REVISED)
48TH STREET DETENTION BASIN PROJECT
March, 1999

HYDROLOGY REPORT (REVISED)

48TH STREET DETENTION BASIN PROJECT

City of Phoenix

Street Transportation Department

Project No. ST-83120008

March, 1999

HDR Engineering, Inc
2141 East Highland Avenue, Suite 250
Phoenix, Arizona 85016

HDR

Introduction

This report presents the results of a hydrologic study for the City of Phoenix 48th Street Detention Basin Project. The report contains the hydrologic design criteria and models that were used to prepare the conceptual design for the basin. The city recently approved the plan for this regional basin shown in the attached *48th Street Detention Basin Site Plan* March 1999. Other agencies that are participating at this time are the Flood Control District of Maricopa County (District) and the Arizona Department of Transportation (ADOT). This is a revised report, and reflects minor changes in response to comments received from the District. The changes to the HEC-1 models and response to the review comments is provided in Appendix A.

In 1996 HDR completed a master drainage plan for the vicinity of 48th Street and Chandler Boulevard for the City of Phoenix. A channel collection system and large regional detention basin known as the 48th Street Detention Basin was included in that plan. The channel collection system is shown in the attached graphic entitled City of Phoenix 48th Street Detention Basin Project, dated January 1999 . Since 1996 the City of Phoenix has abandoned efforts to form an improvement district to construct the channel system and has concentrated primarily on the design and construction of the 48th Street Detention Basin. However, the city has continued to use the 1996 channel design concept as a basis for approving development plans. A channel collection system similar to that shown in the 1996 plan, with a revised location of the I-10 channel along 50th Street, will likely be constructed as development proceeds.[1] The current versions of the hydrology models in this report use the 50th Street alignment.

The hydrology for the original master plan and for the current detention basin plan was developed from previous hydrologic models that were prepared by HDR and by developers in the upper watershed contributing to this area. The previous models were modified to adapt the model to new and planned development in the watershed and to be consistent with Flood Control District of Maricopa County criteria for regional drainage systems. The report presents the criteria used to update the models for this project and the application to the sizing and design of the 48th Street basin.

Background

Hydrologic models for the contributing drainage basin have been in existence since prior to 1991. In 1992 HDR prepared a HEC-1[2] model for this area based upon a TR-20 model prepared by another consultant in 1991(Ref. 1). HDR's model was for the purpose of preparing drainage design concepts for the South Mountain Freeway /I-10 interchange for the ADOT. Details of the model, including watershed description, modifications and model runs are included in the Concept Drainage Report for South Mountain Freeway (Ref. 2). Sheet 5 of 5 from that report entitled "Segment V Drainage Area Map" (in

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[1] In January 1999 the City of Phoenix directed HDR to relocate the channel south of Chandler Boulevard from an I-10 alignment to a 50th Street alignment.

[2] U.S. Army Corps of Engineers, Hydrologic Engineering Center *Flood Hydrograph Package, Version 4.0.3E* (HEC-1), June 9, 1992.

Appendix C) shows the contributing watershed at that time when the watershed was only approximately 60% developed. There was virtually no development south of Ray Road and east of 48th Street at that time. In preparing the 1992 model to design Basin 15 and the interchange channel collection system, HDR added the large subbasins to the east of 48th Street and to the south of Ray Road and the Highline Canal as undeveloped large tracts of land. The model was developed as an existing condition model.

In subsequent years the model was added to and refined by others as development proceeded. By 1995 considerable development had occurred in the watershed that was reflected in a more detailed model developed for the *Master Watershed Study for 48th Street and Ray Road* (Ref. 3). The HEC-1 model prepared for this study was significantly more detailed than previous models. HDR field verified the model and extended it to 48th Street and Pecos area to develop the 1996 storm water master plan. Revisions to the model by HDR included more detailed subdividing of the previously undeveloped areas adjacent to the proposed collector channels in HDR's plan.

HDR developed the channel network in the 1996 plan based partly upon planned developments for which there was a drainage plan available and partly upon judicious placement along section and half-section lines. Subbasin parameters for the HEC-1 model such as area, curve number, routing length and travel time were then determined from the assumed channelization in the watershed and fully developed land use. At that time the 100-year 6-hour design storm from the District's *Hydrologic Design Manual* (1995) was used to design the detention basin. HDR recommends that this storm continue to be utilized as the design storm.

Model Criteria

HDR evaluated four hydrologic design models for this project:

1. **100-year 6-hour Model (F1006cl.DAT).** This is the basic design model used to evaluate peak flows in the approach channels and to size the detention basin. The 10-year 6-hour (F10_6cl.DAT) and 2-year 6-hour (F2__cl.DAT) models were also evaluated. The output of these HEC-1 models is included in Appendix C and on diskette. The "cl" in the run file name refers to the detention basin outlet gate which is closed for these runs and the basin retains the entire runoff volume for the 100-year 6-hour event. Several minor revisions to the model were made in February 1999 to respond to District review comments of the initial draft issued in December 1998. These minor corrections did not significantly change model results or the basic design of the 48th Street Basin. Response to review comments is included in Appendix A.

2. **100-year 24-hour Model (F10024cl.DAT).** This model uses the SCS Type 2 24-hour storm distribution as recommended in Ref. 4. The model was run at the District's request to compare to the ADOT 24-hour model in Item 3 and to evaluate the additional volume produced by the 24-hour storm as compared to the 6-hour storm.

3. **ADOT 100-year 24-hour Model (A10024cE.DAT).** This model refers to storm criteria recommended in the ADOT *Drainage Design Manual: Hydrology* (Ref. 6). In particular, the "Balanced Storm" approach was used as programmed into the HEC-1 package (PH Card). The model produces significantly higher peak flows than the SCS Type 2 storm model. However, the runoff volumes using the two different storm distributions is very similar.

4. **ADOT SEVRDS Model (SVRD48TH.DAT).** This is a modified version of the Southeast Valley Regional Drainage System model to determine the impact of discharge from the 48th Street basin on peak flow in the Santan Outfall Channel. It was determined that retained volumes in the detention basin can be discharged to the channel after the basin reaches a level of 1158. By providing a small overflow weir at this level or higher, the peak design flow of 800 cfs to the Gila Drain Floodway will not be exceeded. This would be a simple and relatively inexpensive way to provide overflow protection for the basin without requiring additional storage volume for the 24-hour event. The correspondence regarding this issue is in Appendix B.

Details of the model criteria are as follows:

Rainfall Duration and Distribution

Rainfall duration and distribution is in accordance with District's 100-year 6-hour storm (Ref. 4). A spreadsheet with the rainfall data is attached to the HEC-1 run in Appendix C. The 24-hour model uses the SCS Type 2 Storm as tabulated in Ref. 8.

Since the proposed South Mountain Freeway/I-10 Interchange will be constructed upstream of the basin, a 100-year model was prepared for this project using ADOT's recommended 24-hour storm and the balanced storm distribution option (PH Card) in HEC-1 (Ref. 6, p. 1.2). The 24-hour duration generates greatly increased runoff volume compared to the 6-hour model, but similar runoff volume to the SCS Type 2 model.

Loss Rate and Unit Hydrograph Methodology

Previous models of the 48th Street drainage basin have used the Soil Conservation Service (SCS) methods to calculate loss rates and to generate hydrographs. These methods were in common use until 1992 when the District issued a new drainage manual (Ref. 4) and 1993 when ADOT issued a new hydrology manual (Ref. 6). HDR recommends that the City of Phoenix retain the use of the SCS methods for the 48th Street project because of the historical use of this model by various agencies and developers.

Time of Concentration Methodology

Two methodologies have been used for Time-of-Concentration (T_c). The model in Reference 3 used the SCS "upland" method in the City of Phoenix storm drain manual to calculate T_c. When HDR added subbasins to this model, the District manual (Ref. 4, Eqn. 3.2) was used. Lag time for the SCS Unit Hydrograph is assumed to be 0.6 x T_c.

Flow Routing

Channel routings are based upon Normal Depth routing methods and basins are routed using the Modified-Puls option in HEC-1.

Existing vs. Future Land Use

The current model assumes fully developed conditions in the watershed. It was assumed that all areas that are presently undeveloped will ultimately be commercial or higher density residential development with a curve number of 85. No reductions were made for on-site retention. At the 100-year level, on-site retention has been found to have little impact on storm peaks and volumes.

Results

The drainage basin HEC-1 model schematic is included in Appendix C as Exhibit A. The map shows all subbasins, routing reaches and hydrograph combining points, except for the South Mountain Freeway/I-10 interchange onsite drainage system. The subbasins for this system are shown on the Sheet 5 of 5 from the South Mountain Freeway report (Ref. 2).

The 100-year 6-hour HEC-1 model run output included in Appendix C. The primary purpose of the run is to determine the required volume of the 48th Street detention basin (formerly Basin 15 in the model). The basin complex, as shown in the site plan, has an equalization basin that has a design storage capacity of 43.6 ac-ft (38 ac-ft inflow volume in the model), and a primary basin that has a design storage capacity of 276.1 ac-ft (266 ac-ft inflow volume in the model). The vegetated treatment cells are not included in the HEC-1 routing, as these basins will treat storm water retained in the equalization basin post-event.

The 48th Street basin has been designed as a retention basin for the 100-year 6-hour storm event. The gate on the 42-inch outfall pipe would normally be closed until after the event. The gate would be manually opened to dewater the basin when there is capacity available in the Santan Outfall Channel.

The 10-year and 2-year 6-hour HEC-1 models are also included in Appendix C. This is for the purpose of evaluating the frequency that the lower basin capacity will be exceeded, as the upper basin may be used for recreation. The results indicate that the lower basin capacity may be exceeded for storms in excess of the 2-year event. In other words, the upper basin may be flooded once every year or two.

The 100-year 24-hour ADOT HEC-1 run is included in Appendix C. After deducting the 38 ac-ft retained in the equalization basin, the volume flowing into the primary basin is approximately 427 ac-ft compared to 266 ac-ft for 6-hour model. This run was configured with the 42-inch outflow closed to the Santan Outfall Channel. The results show that although the 100-year 24-hour storm volume exceeds the basin capacity by more than 100 ac-ft. If the basin side slopes are extended, the basin would rise to El.

1162.2, or more than two feet above the overflow level of 1160. The SCS Type 2 24-hour model produced the approximately the same results.

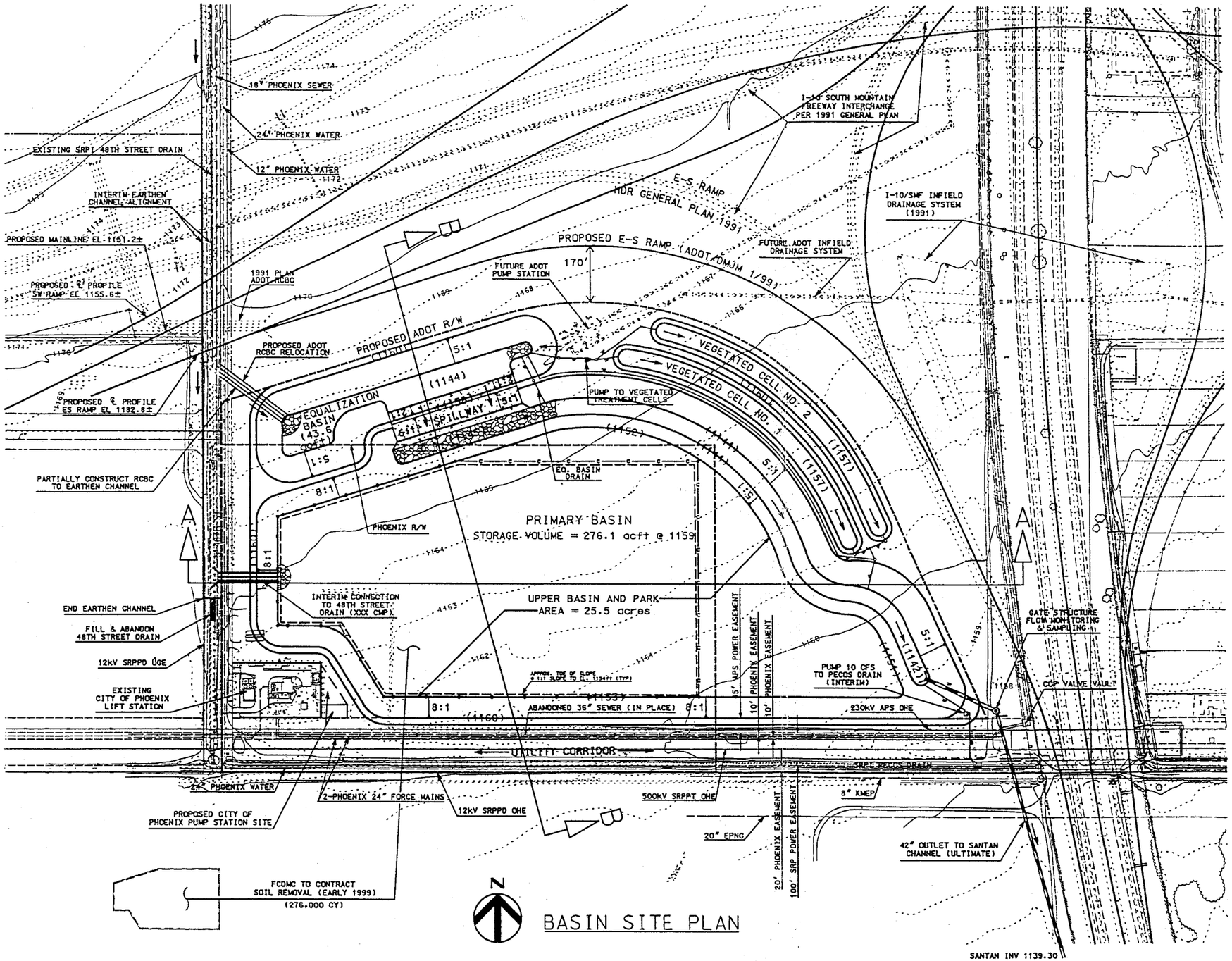
ADOT requested that HDR evaluate the impact of allowing the basin to discharge to the Santan Outfall Channel during the storm event. The maximum allowable 100-year discharge in to the Gila Drain Floodway is restricted to 800 cfs by agreement of the stakeholders in the SEVRDS project. The SEVRDS HEC-1 model was modified by adding the revised 48th Street model as described in the run print-out. It was found that discharge from the basin will not increase the Santan Outfall Channel peak flow of 816 cfs at the confluence, if the outflows are delayed until the 48th Street basin reaches El. 1158.[3] A small overflow weir 10 feet in length was provided at this level to demonstrate that a small weir placed at this elevation would not increase the discharge to the Gila Drain Floodway and would prevent the basin from overtopping for the 24-hour event. A summary of this investigation is provided in Appendix B.

Recommendations:

1. Use 100-year 6-hour HEC-1 model to design the basin complex and the temporary approach channel to the basin complex.[4]

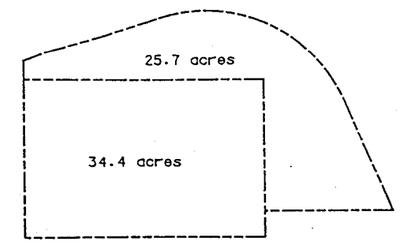
2. Use the ADOT SEVRDS (SVRD48TH.DAT) 24-hour HEC-1 model to determine a optimal overflow structure to discharge volumes exceeding the 6-hour model. Consider providing a small overflow weir at the basin outlet to provide increased protection from overtopping of the 24-hour event.

[3] When routed to the Gila Drain Floodway, the outflow to the floodway reduces to below 800 cfs.
[4] The City of Phoenix may construct a temporary channel along 48th Street to convey runoff to the basin in the interim until the South Mountain/I-10 Interchange is constructed.



BASIN SITE PLAN

BASIN COMPLEX SUMMARY					
BASIN	SIDE SLOPE	DEPTH (FT)	TOP EL (AC)	H2O SURF EL (AC FT)	BOT EL (AC)
PRIMARY BASIN	8:1 5:1	8 16	1160 38.0	1159 276.1	– –
UPPER BASIN	8:1	8	1160 –	1159 –	1152 25.5
LOWER BASIN	5:1	16	1160 –	1152 35.0	1144 2.5
EQUALIZATION BASIN	5:1	16	1160 4.7	1159 43.6	1144 1.4
VEGETATED CELL NO. 1	5:1	3	1160 1.8	1159.5 3.5	1157 1.1
VEGETATED CELL NO. 2	5:1	3	1160 1.8	1159.5 3.5	1157 1.1



NOTES:

1. PERIMETER LIGHTING TO BE PROVIDED.
2. CHAIN LINK FENCE TO BE PROVIDED AROUND EQUALIZATION BASIN.
3. MAINTENANCE ROAD SURFACE TREATMENT UNDECIDED (MAY BE 8' SIDEWALK).
4. PRIMARY BASIN TO BE TURFED W/ IRRIGATION SYSTEM (BOTTOM & SS).
5. EQUALIZATION TURFED W/ IRIGATION AS SHOWN IN SHEET 6.
6. LANDSCAPE TREATMENT AROUND PERIMETER NOT INCLUDED. (MAY BE ADDED LATER).
7. CONSTRUCTION OF 42" OUTLET TO SANTAN CHANNEL TO BE DEFERRED.

ABBREVIATIONS:

APS – ARIZONA PUBLIC SERVICE
EL – ELEVATION
EPNG – EL PASO NATURAL GAS
FCDMC – FLOOD CONTROL DISTRICT OF MARICOPA COUNTY
KMEP – KINDER MORGAN ENERGY PARTNERS
OHE – OVERHEAD ELECTRIC
PHOENIX – CITY OF PHOENIX
RCBC – REINFORCED CONCRETE BOX CULVERT
SRPI – SALT RIVER PROJECT IRRIGATION
SRPPD – SALT RIVER PROJECT POWER DISTRIBUTION
SRPPT – SALT RIVER PROJECT POWER TRANSMISSION
UGE – UNDERGROUND ELECTRIC

REVISIONS TO DRAWINGS				
NO.	DESCRIPTION	REV. BY	CKD. BY	DATE

HDR ENGINEERING, INC.
2141 E. HIGHLAND AVE. SUITE 250
PHOENIX, ARIZONA 85016-4736

PROJECT NO.	00167-346-044
FILE NAME:	48BASN3D.DGN
PLOT DATE:	MARCH 4, 1999
DRAWN BY:	LJ
DESIGNED BY:	JZ
CHECKED BY:	JZ

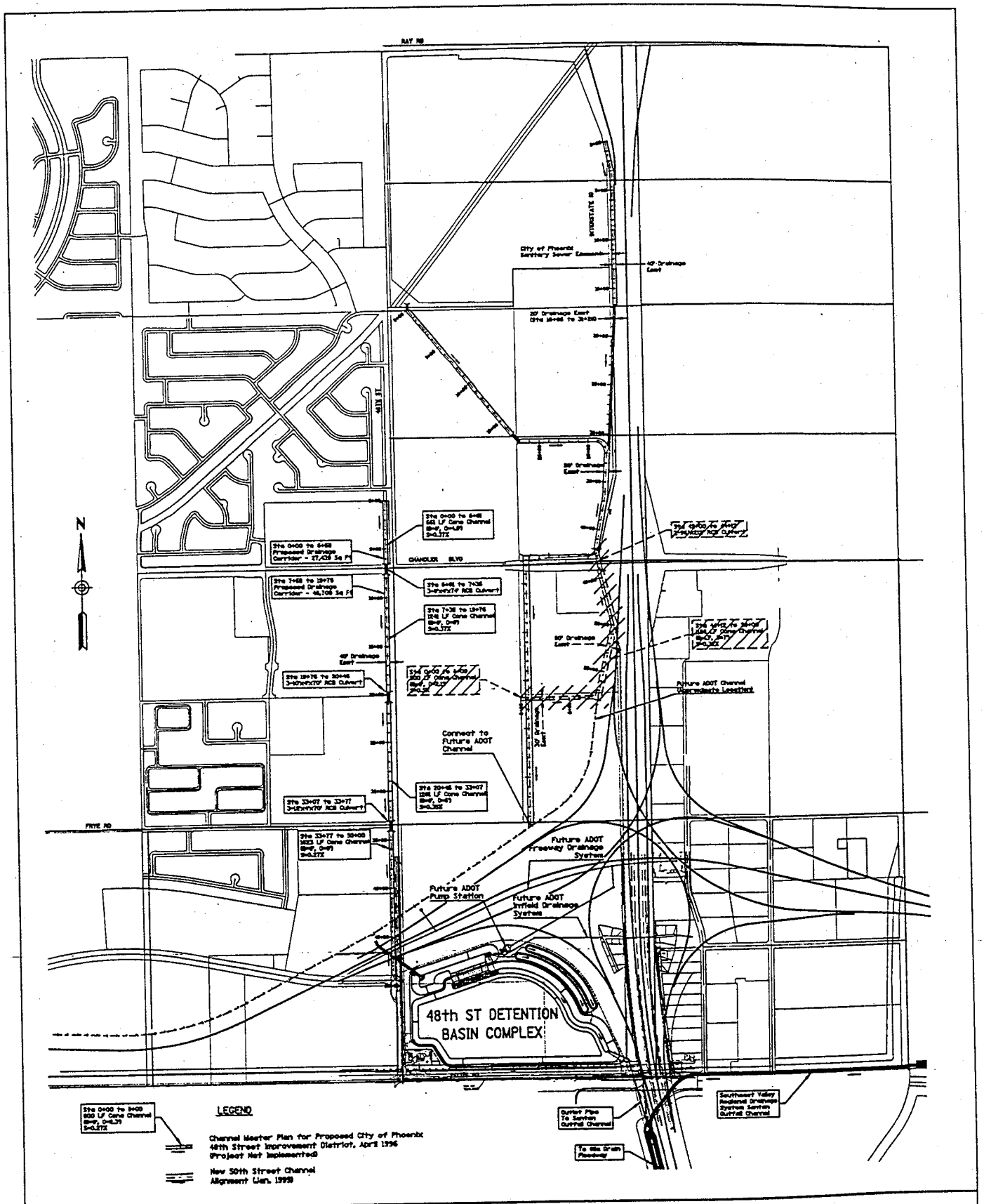
CITY OF PHOENIX, ARIZONA

CIVIL
48TH STREET DETENTION BASIN SITE PLAN

CITY PROJECT NO. ST-83120008 | DATE: MARCH 1999

SHEET NO. 1 OF 6

REV. NO.



CITY OF PHOENIX
48TH STREET DETENTION BASIN PROJECT

January 1999

HDR Engineering, Inc.

References

1. Coe & Van Loo Consultants, *48th Street and Chandler Boulevard Master Drainage Report*, July 1991.
2. HDR Engineering, Inc., *Final Concept Drainage Report, South Mountain Freeway, I-10 Papago to I-10 Maricopa*, Vols. I, II and III for Arizona Department of Transportation, February 1993.
3. Kimley-Horn and Associates, Inc., *Master Watershed Study for 48th Street and Ray Road*, for M&B Capital Group, LLC. September 26, 1995.
4. Flood Control District of Maricopa County, *Drainage Design Manual for Maricopa County, Arizona Volume I Hydrology*, June 1, 1992 (Rev. January 1, 1995).
5. Arizona Department of Transportation, *Roadway Design Guidelines*, Doc 31-089, May 1996.
6. Arizona Department of Transportation, *Highway Drainage Design Manual, Hydrology*, Report No. FHWA-AZ93-281, March 1993.
7. HDR Engineering, Inc., *Final Drainage Report, Santan Channel Project, Phase 1 and Phase 2*, for Arizona Department of Transportation and Flood Control District of Maricopa County, May 30, 1998.
8. Hjelmfeldt, A.T. and J. J. Cassidy, *Hydrology for Engineers and Planners* Iowa State University Press, Ames, Iowa 1975 (p. 76)

Figures

48th Street Detention Basin Site Plan, March 1999

48TH Street Detention Basin Project, January 1999

APPENDIX A

HEC-1 Model Revisions in Response to Flood Control District Comments Dated January 21, 1999

APPENDIX B

Memo and Correspondence Related to ADOT Letter Dated February 11, 1999

APPENDIX C

Diskette w/ HEC-1 Input Files
EXHIBIT A-HEC-1 Model Schematic
SEGMENT V Drainage Area Map, Sheet 5 of 5, South Mountain Freeway (6/92)
FCDMC 6-HOUR Rainfall Distribution

HEC-1 Output File F1006cl.OUT (100 yr-6 hr Run)
HEC-1 Output File F10_6cl.OUT (10 yr-6 hr Run)
HEC-1 Output File F2__6cl.OUT (2 yr-6 hr Run)

HEC-1 Output File F10024cl.OUT (100 yr-24 hr SCS Type 2 Run)
HEC-1 Output File A10024cE.OUT (100 yr-24 hr ADOT Run)
HEC-1 Output File SVRD48-P.OUT (100 yr-24 hr ADOT SEVRDS Run)

APPENDIX A

HEC-1 Model Revisions in Response to Flood Control District Comments Dated January 21, 1999

Flood Control District of Maricopa County
2801 West Durango Street
Phoenix, Arizona 85009-6399
(602) 506-1501
FAX: (602) 506-4601
TT: (602) 506-5897

01-21-99

MEMO TO: Don Rerick

FROM: Afshin Ahouraiyan

SUBJECT: Basin 15 project- Hydrology Report

The subject study has been reviewed and the following comments and questions are raised. The consultant may address the comments either by correspondence or a meeting with the District reviewers.

1- The design of ADOT's system is not included in the report as indicated on page 4. Appendix C where the ADOT's HEC-1 was to be included is missing from the report and needs to be included for comparison purposes.

HDR Response: Two ADOT Files are included in Appendix C (SVRD48-P.OUT and A10024ce.OUT).

2- In the HEC-1 model, an IN card is used right before the Diagram card. What is the purpose of the IN card and what is the basis for the parameters used for this card?

HDR Response: No function. Card removed.

3- Why are initial abstraction values used for some of the LS cards and not all?

HDR Response: Used only on the mountain subbasins M1,M2,M3,M4 to prescribe the intial abstraction.

4- The KK block "21-sth" indicates that the diversion cards are used to simulate detention area for development 21. However the DI, DQ cards seems to be used for a split flow analysis. Is this KK block representing the split flow to the channel behind Kmart or to or to simulate a detention basin area? There needs to be another KK block to either show the split flow or to simulate the detention area.

HDR Response: There is no detention. KM has been revised to "..simulate *Diversion* down 48th Street...".

5- The Curve Number used for A24 is based on plans for a future City park. How far along are these plans and what is the guarantee that this park would be placed there? The CN for this basin needs to be adjusted according to the answer for the above question.

HDR Response: The park was constructed last year. CN not changed.

6- The KK block DA522 needs to be corrected. The Drainage area DA card is not used properly.

HDR Response: DA522 corrected.

7- It is suggested that the location of the KK block A6A, Rtc8, and A7 be changed to right after the splt12.

HDR Response: A6A and Rtc8 moved. A7 not moved.

8- It is suggested that the location of KK block R5 be changed to right after RtC14. Also add Road12 before diversion at 48th Street.

HDR Response: R5 not relocated. R12b moved to after RtR6. R12a OK.

9- Why is there no routing of flows from areas 513 and 514 before the combination of flows at 515?

HDR Response: Carry -over from CVL model that did not route . Because this is a short routing reach, HDR did not modify.

The results of the HEC-1 are reasonable, however the changes are required to have the HEC-1 model represent the flow conditions.

If there are any questions on these comments please contact me at ext. 64519.

Flood Control District of Maricopa County
2801 West Durango Street
Phoenix, Arizona 85009-6399
(602) 506-1501
FAX: (602) 506-4601
TT: (602) 506-5897

01-22-99

MEMO TO: Don Rerick

FROM: Afshin Ahouraiyan

SUBJECT: Supplement Comments to Basin 15 project- Hydrology Report

Appendix A of the report contains a memo written from HDR consultant to the City of Phoenix comparing the District and ADOT's hydrology methodologies.

Under the section called Rainfall Duration and Distributions, it is mentioned that the Districts' methodology for design of regional drainage facilities should be based on the 100-year 6-hour storm.

The District's methodologies do not recommend a specific rainfall duration or frequency for the design of regional drainage facilities. The manual recommendations outlined in Table 2.1 are for on-site retention/detention facilities for new developments within the County.

Therefore it is recommended that the consultant analyze the hydrology for this project for the100-year 24-hour storm and make recommendation as to which result should be used for the design of this regional detention basin.

If you have any questions on this matter, please call me at ext. 64519.

<u>HDR Response 3/10/99</u>

We have removed the Memo to the City of Phoenix so as not to suggest that HDR's earlier model approach was actually approved by the District. The District was not involved in the project at that time. We have included the 24-hour model with the SCS Type 2 Storm in this report.

It appears at this time that the project partners, including ADOT prefer to use the SEVRDS 100-year 24-hour model to evaluate operation of an overflow structure to the Santan Channel. Since the SCS Type 2 and ADOT/SEVRDS versions of the 48th Street basin produce the same runoff volume, there is no conflict when dealing with the 48th Street Detention Basin sizing. When doing that the DA increases significantly and the 24-hour event is applicable.

APPENDIX B

Memo and Correspondence Related to ADOT Letter Dated February 11, 1999

Vfyovne

HDR

Memorandum

To Art Glover, City of Phoenix Fax 534-1961
Don Rerick, Flood Control District Fax 234-1322

From Jerry Zovne

Date Monday, March 08, 1999

Subject Response to ADOT Letter February 11, 1999 and Equalization Basin invert.

The letter, which is attached for reference, basically asks two questions, as follows:

1. How does the additional volume of the 100-year 24-hr storm impact design of the basin that is currently designed for the 100-year 6-hour storm?
2. If the additional volume was to be managed by discharging to the Santan Outfall Channel during the event, can this be accomplished without increasing the design outflow to the Gila Drain Floodway? The maximum 100-yr 24-hr discharge to the Floodway is assumed to be limited to 800 cfs.

Following is HDR's response:

1. Three HEC-1 models were compared to answer Question 1. These were:
   - 100yr-6hr model that was used to design the basin
   - 100yr-24hr model using Flood Control District 24-hour storm
   - 100yr-24hr model using the ADOT 24-hour storm.

   The 100yr-6hr model with no outflow during the storm produces a volume of 266 acre-feet that rises to a high water level of 1158.8 in the primary basin. The design high water level is 1159 and the top of basin is 1160.

   Both the ADOT and Flood Control versions of the 24-hour model produce a volume of approximately 425 acre-feet that would rise to about 1162.2 if the basin side slopes were extended above the current top of basin. The 24-hr models produce about 160 acre-ft (or about 60%) more runoff than the 6-hr model. To accommodate the additional volume, the basin could be raised a maximum of two feet and the primary basin lowered by about one foot. The cost impact would be the additional excavation of one foot (about 40,000 CY) in the basin. The fill of two feet along the south and southeast edges to 1162 would double the width of the perimeter road from 20 to 40 feet to accommodate the side slopes, but the cost impact would be nominal as it would reduce the amount of waste.

2. The current 48th Street HEC-1 model was inserted into the ADOT/SEVRDS model to determine the impact on the peak flow in the Santan Channel at the confluence of the 42-in outfall pipe and the Santan Outfall Channel. A number of alternatives were investigated for discharging to the Santan Outfall Channel during the storm. It was found that the 42-inch outfall pipe to the Santan Channel could not be opened until the 48th Street basin is nearly full. However, this led to an evaluation of option of

providing an emergency overflow structure instead of a level actuated emergency control gate as was previously suggested. It was found that a 10-foot long weir placed at elevation 1158 would provide sufficient capacity to prevent the basin from overflowing without requiring any other modifications. This is a relatively inexpensive structure similar to an ADOT Standard Catch Basin, Drop Inlet C-15.75 (42 "). With pipe and manhole to the 42- inch outfall pipe, this structure would not likely exceed $10,000. It would protect the basin as presently configured from overflow for the 24hr event.

In conclusion, HDR recommends that the 100yr-6hr storm HEC-1 model [1]continue to be used as the design event for the 48th Street Basin and that the ADOT/SEVRDS 100yr-24hr storm HEC-1 model[2] be used to design the basin overflow weir, should Phoenix and the Flood Control District decide to provide protection for this event.
****

Another coordination issue with ADOT is the Equalization Basin invert as described in the attached e-mail from Don Rerick, March 2, 1999. Our analysis indicates that we need to drop the EQ Basin invert from 1144 to 1140. That should be confirmed by ADOT before we proceed. Our assumed elevations of the South Mountain Freeway and ramps at the "assumed" location of RCBC undercrossing are shown on the attached basin master plan.

---

[1] The 100-yr 6-hr model has been revised to respond to Flood Control District comments. The revisions are minor and do not affect the detention basin design. The revised model and Hydrology Report is in preparation at this time. The conclusions herein are based upon the revised model.

[2] The ADOT 100yr-24hr SEVRDS model is a modified version of SVRD05~2 model in the ADOT ***Santan Channel Project Final Drainage Report, Phase 1 and Phase2***, HDR, May 30, 1998. Only the 48th Street portion of this model was revised to reflect the current HEC-1 model and basin design. The revised version of the model will be included in the 48th Street Hydrology Report.

Arizona Department of Transportation

Intermodal Transportation Division
Bridge Group
205 South Seventeenth Avenue, MD261E • Phoenix, Arizona 85007-3213

Jane Dee Hull
Governor

Mary E. Peters
Director

Thomas G. Schmitt
State Engineer

F. Daniel Davis
State Bridge Engineer

February 11, 1999

Post-it™ Fax Note 7671	Date 2-12-99 # of pages ▶ 2
To Jerry ZOVNE	From ART GLOVER
Co./Dept.	Co.
Phone #	Phone #
Fax #	Fax #

Mr. Art Glover
City of Phoenix
200 West Washington, 5th Floor
Phoenix, AZ 85003

Mr. Don Berick
Flood Control District of Maricopa County
Planning and Project Management Division
2801 West Durango Street
Phoenix, AZ 85009

Gentlemen:

As you know, ADOT is currently proceeding with the design of the Santan/I-10 Traffic Interchange. Part of this project, of course, includes the design of offsite drainage collector channels that will discharge into the proposed FCDMC/City of Phoenix 48th Street Detention Basin. Following recent discussions with our consultant, DMJM, and the FCDMC/City of Phoenix consultant, HDR, ADOT has several concerns regarding the compatibility of hydrologic design methodologies being used for the TI project and the 48th Street Detention Basin project.

In the interest of maintaining consistency with the methodology used to design the Santan Freeway Collector Channel and Basin B complex east of I-10, ADOT intends to design the west half of the Santan/I-10 TI offsite collector channels utilizing the ADOT 100-year, 24-hour storm, which produces a greater runoff volume than the FCDMC 100-year 6-hour storm. Note that the ADOT 100-year 24-hour storm is the methodology that has also been used for the design of the Santan Collector Channel and Basin B complex on the east side of I-10, which the FCDMC has approved and is participating in funding.

Since the 48th Street Detention Basin is designed for a smaller volume storm event than the ADOT storm, the basin will reach capacity before the entire ADOT storm runoff has occurred. As a result, during the ADOT storm event, the basin may overtop (after using up available freeboard), and/or the ADOT collector channels may not have sufficient capacity for the remaining storm flows due to backwater from the basin.

In either case, flooding of adjacent property could occur during the ADOT storm event.

In order to avoid these potential problems, ADOT is requesting that the FCDMC and City of Phoenix increase the design volume of the 48th Street Detention Basin to accommodate the ADOT 100-year 24-hour runoff volume. This will allow the entire Santan/I-10 TI and 48th Street

Detention Basin system to function properly even during the greater-volume ADOT storm event. It would also be consistent with the hydrologic design methodology used on the Santan Freeway/Basin B complex on the east side of I-10.

Alternatively, an outfall pipeline from the 48th Street Detention Basin to the Santan Outfall Channel could be utilized to reduce the basin storage requirement during the ADOT storm event. In this scenario, the effect of combining the 48th Street Basin outflow with the Santan Outfall Channel flows would have to be evaluated to ensure that the combined flow in the Santan Outfall Channel would not exceed its design capacity.

After you have had the opportunity to review this request, we would like to meet with you to discuss coordination issues. If you have any questions, plase contact Tony Ragle at 712-8611 or Javier Guana at 712-8545.

Very truly yours,

Joseph W. Warren

Joseph W. Warren, PE
Bridge Drainage Section Leader

c: Javier O. Guana, ADOT Valley Project Management
Thomas M. Monchak, DMJM

Zovne, Jerry

From: Don Rerick - FCDX [djr@mail.maricopa.gov]
Sent: Thursday, February 25, 1999 4:13 PM
To: 'aglover@ci.phoenix.az.us'; 'jzovne@hdrinc.com'
Cc: Don Rerick - FCDX
Subject: Basin 15 - Basin Invert Elevation

In the SEVRDS Phase 3 meeting on Wednesday, a question came up about the invert elevation of the basin versus the "lowest" ADOT drainage feature that is to directly drain into the basin. There appeared to be some concern that the invert may be high.

So, Jerry, would you please check on this and let me and Art know what the situation is. If there is some need to lower the present elevation, then there could be some negative impacts from the Parks Dept. perspective and we need to identify those ASAP and then get with ADOT.

Thanks.

Zovne, Jerry

From: Zovne, Jerry
Sent: Tuesday, March 02, 1999 11:00 AM
To: 'Don Rerick - FCDX'; 'Art Glover'
Subject: RE: Basin 15 - Basin Invert Elevation

The invert elevation in the Eq. Basin of 1144 was based upon the the (3)10x6 RCBC undercrossing just west of 48th Street, as the "lowest" feature per HDR's SMF/I-10 TI Drainage Concept in 1991. DMJM had not yet developed profiles when the 48th Street plan was finalized. However, per DMJM revised SMF/I-10 profiles received 1/8/99 the mainline profile at the location of the RCBC undercrossing shown on the 48th Street plan is at approximately 1151. This is 5 or 6 feet lower than the original HDR plan. This will likely require us to lower the Equalization Basin invert from 1144 to 1140. This is not difficult to do, however, here are some options:

1. Leave the lower half of the basin unlined with a side slope of 3:1. The bottom of the basin will collect debris and sediment that will have to be periodically removed anyway. The lower portion will be inundated frequently and long enough to cause some problems for the turf. Turf the upper portion at 5:1 slope. No change in EQ Basin footprint.

2. Reduce the side slope from 5:1 to 4:1 and the footprint of the EQ Basin does not change.

3. Maintain 5:1 except at the west end of the spillway where it tapers to 4:1. Top of EQ Basin footprint remains the same. Bottom footprint slightly modified.

4. Maintain 5:1 for entire basin. This requires widening the EQ Basin at least 20 feet that in turn requires modification of the primary basin and low flow channel, with some storage impact that would have to be evaluated.

Note: we recommend the lower half of the Eq. Basin be unlined in any case.

-----Original Message-----
From: Don Rerick - FCDX [mailto:djr@mail.maricopa.gov]

In the SEVRDS Phase 3 meeting on Wednesday, a question came up about the invert elevation of the basin versus the "lowest" ADOT drainage feature that is to directly drain into the basin. There appeared to be some concern that the invert may be high.

So, Jerry, would you please check on this and let me and Art know what the situation is. If there is some need to lower the present elevation, then there could be some negative impacts from the Parks Dept. perspective and we need to identify those ASAP and then get with ADOT.

Thanks.

Zovne, Jerry

From: Don Rerick - FCDX [djr@mail.maricopa.gov]
Sent: Tuesday, March 02, 1999 2:30 PM
To: 'Zovne, Jerry'; 'Don Rerick - FCDX'; 'Art Glover'
Subject: RE: Basin 15 - Basin Invert Elevation

In talking with Jerry regarding the message below, I have the following comments:

1. It appears either suggestion 2 or 3 works best. Probably need parks input on which to select.

2. Any associated costs such as required for this effort, that is for the benefit of ADOT must be paid for by ADOT. This would include the additional 4' of excavation in the equalization basin, and the partial construction of a stubout box culvert into the basin for ADOT's future use.

3. This cost responsibility should be spelled out in the IGA between the City and ADOT.

4. The cost estimate, and eventual actual cost of these items would be deducted from the total construction cost to be shared 50/50 between the City and the FCD. The City would then be reimbursed for their additional cost from ADOT per the IGA.

Lets be sure and discuss this issue at the March 9 meeting.

Thanks.

> ----Original Message----
> From: Zovne, Jerry [SMTP:JZOVNE@hdrinc.com]
> Sent: Tuesday, March 02, 1999 11:00 AM
> To: 'Don Rerick - FCDX'; 'Art Glover'
> Subject: RE: Basin 15 - Basin Invert Elevation
>
> The invert elevation in the Eq. Basin of 1144 was based upon the the
> (3)10x6
> RCBC undercrossing just west of 48th Street, as the "lowest" feature per
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> profiles when the 48th Street plan was finalized. However, per DMJM
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>
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Note: we recommend the lower half of the Eq. Basin be unlined in any
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> -----Original Message-----
> From: Don Rerick - FCDX [mailto:djr@mail.maricopa.gov]
>
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> situation is. If there is some need to lower the present elevation, then
> there could be some negative impacts from the Parks Dept. perspective and
> we
> need to identify those ASAP and then get with ADOT.
>
> Thanks.

APPENDIX C

Diskette w/ HEC-1 Input Files

EXHIBIT A-HEC-1 Model Schematic

SEGMENT V Drainage Area Map, Sheet 5 of 5, South Mountain Freeway (6/92)

FCDMC 6-HOUR Rainfall Distribution

HEC-1 Output File F1006cl.OUT (100 yr-6 hr Run)

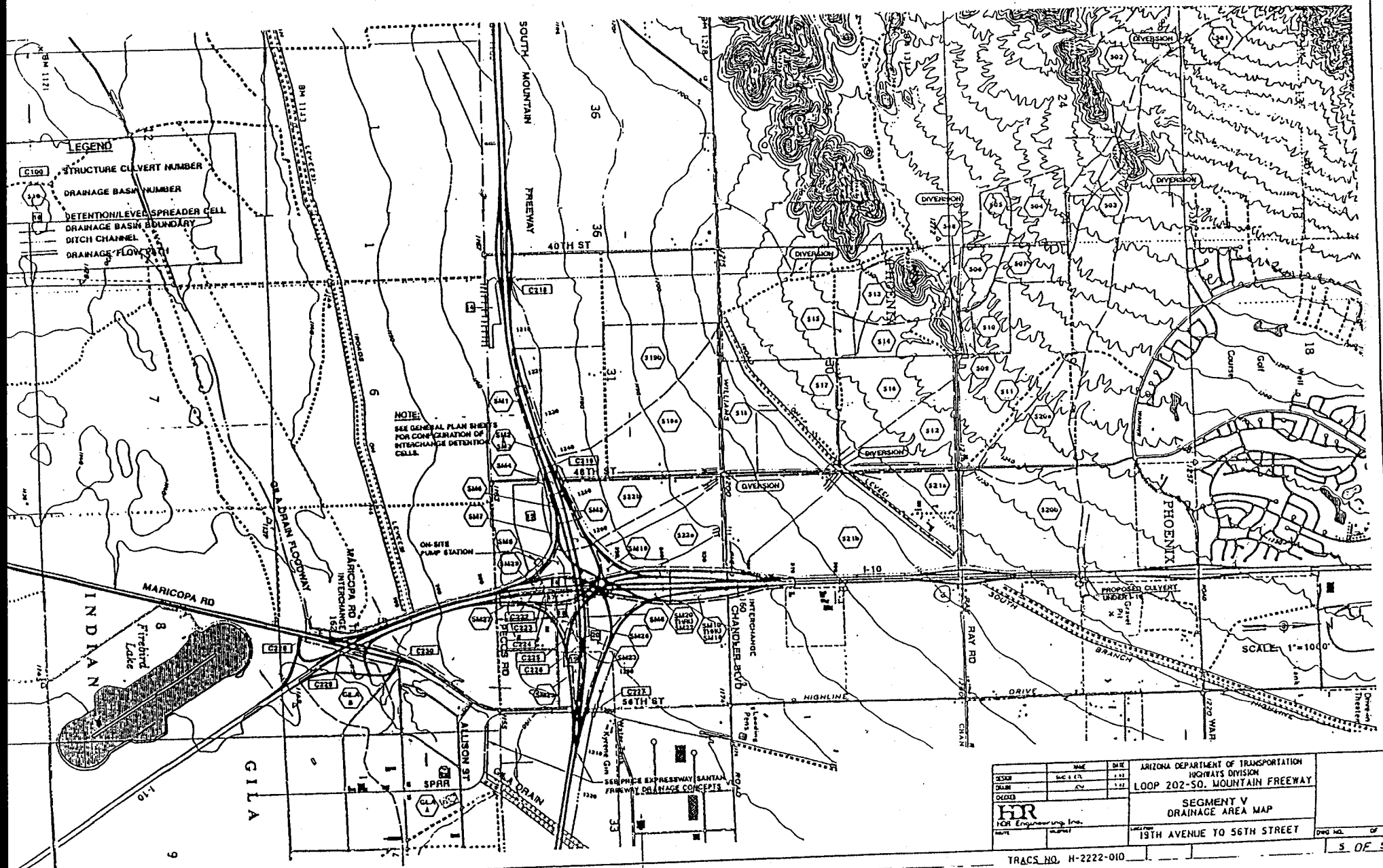
HEC-1 Output File F10_6cl.OUT (10 yr-6 hr Run)

HEC-1 Output File F2__6cl.OUT (2 yr-6 hr Run)

HEC-1 Output File F10024cl.OUT (100 yr-24 hr SCS Type 2 Run)

HEC-1 Output File A10024cE.OUT (100 yr-24 hr ADOT Run)

HEC-1 Output File SVRD48-P.OUT (100 yr-24 hr ADOT SEVRDS Run)



FAP & A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	IN THIS
9	ARIZ.				

ARIZONA DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION
LOOP 202-SO. MOUNTAIN FREEWAY

SEGMENT V
DRAINAGE AREA MAP

19TH AVENUE TO 56TH STREET

HDR Engineering Inc.

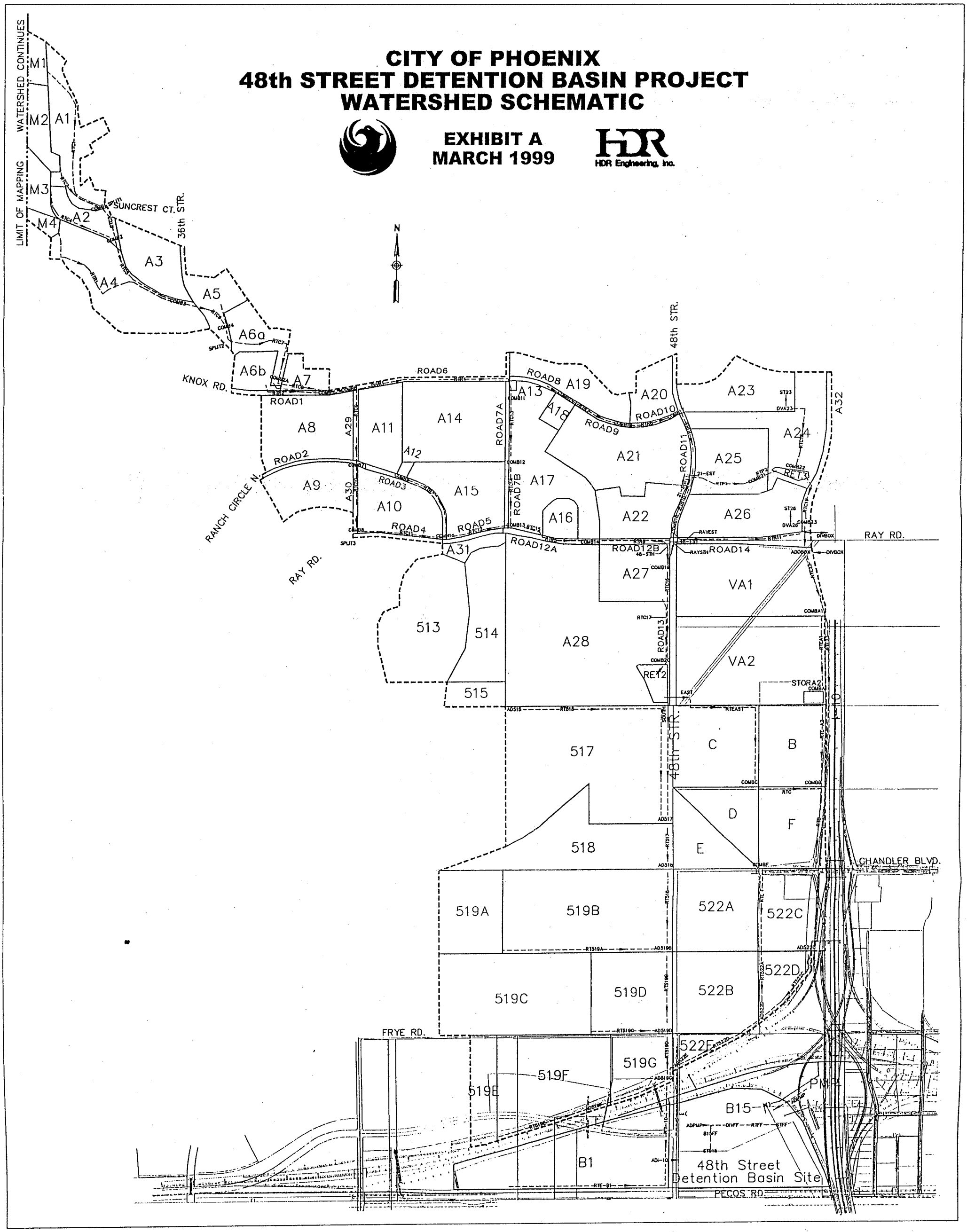
TRACS NO. H-2222-010

5 OF 5

CITY OF PHOENIX
48th STREET DETENTION BASIN PROJECT
WATERSHED SCHEMATIC

EXHIBIT A
MARCH 1999

HDR Engineering, Inc.



HDR Engineering, Inc. | Job No. 00167-293-044 | No.

Computation

Project	48th Drainage Improvements	Computed	RDT	7/9/97
Subject	Hydrologic Modeling	Checked	JJZ	7/10/97
Task	FCDMC 6-HOUR RAINFALL DIST.	Sheet 1 of 1		

Reference FCDMC Drainage Design Manual

RAINFALL DEPTHS Approx. Drainage area for 48th Street Watershed = 5 sq. miles
Depth-Area Reduction Factor (Table 2.2) = 0.96

2-yr 6-hr Precip (Fig. 2.2) = 1.1 inches
10-yr 6-hr Precip (Fig. 2.4) = 1.9 inches
100-yr 6-hr Precip (Fig. 2.7) = 3.2 inches

Reduced 2-yr 6-hr Precip = 1.1 inches
Reduced 10-yr 6-hr Precip = 1.8 inches
Reduced 100-yr 6-hr Precip = 3.1 inches

RAINFALL DISTRIBUTION FOR 6-HOUR STORM
From Fig. 2.17, use pattern 2.3 for drainage area of 5 sq. miles

Time (hrs)	Patter 2 (from Tab. 2.4)	Patter 2.3 (interpolated)	Patter 3 (from Tab. 2.4)
0	0	0.0	0
0:15	0.9	1.1	1.5
0:30	1.6	1.7	2
0:45	2.5	2.7	3
1:00	3.4	3.8	4.8
1:15	4.2	4.8	6.3
1:30	5.1	5.9	7.6
1:45	5.9	6.8	9
2:00	6.7	7.8	10.5
2:15	7.6	8.9	11.9
2:30	8.7	10.1	13.5
2:45	10	11.6	15.2
3:00	12	13.7	17.5
3:15	16.3	18.1	22.2
3:30	25.2	26.8	30.4
3:45	45.1	45.7	47.2
4:00	69.4	68.7	67
4:15	83.7	82.5	79.6
4:30	90	89.0	86.8
4:45	93.8	93.0	91.2
5:00	95	94.9	94.6
5:15	96.3	96.2	96
5:30	97.5	97.4	97.3
5:45	98.8	98.8	98.7
6:00	100	100.0	100

Pattern represents percent of rainfall depth