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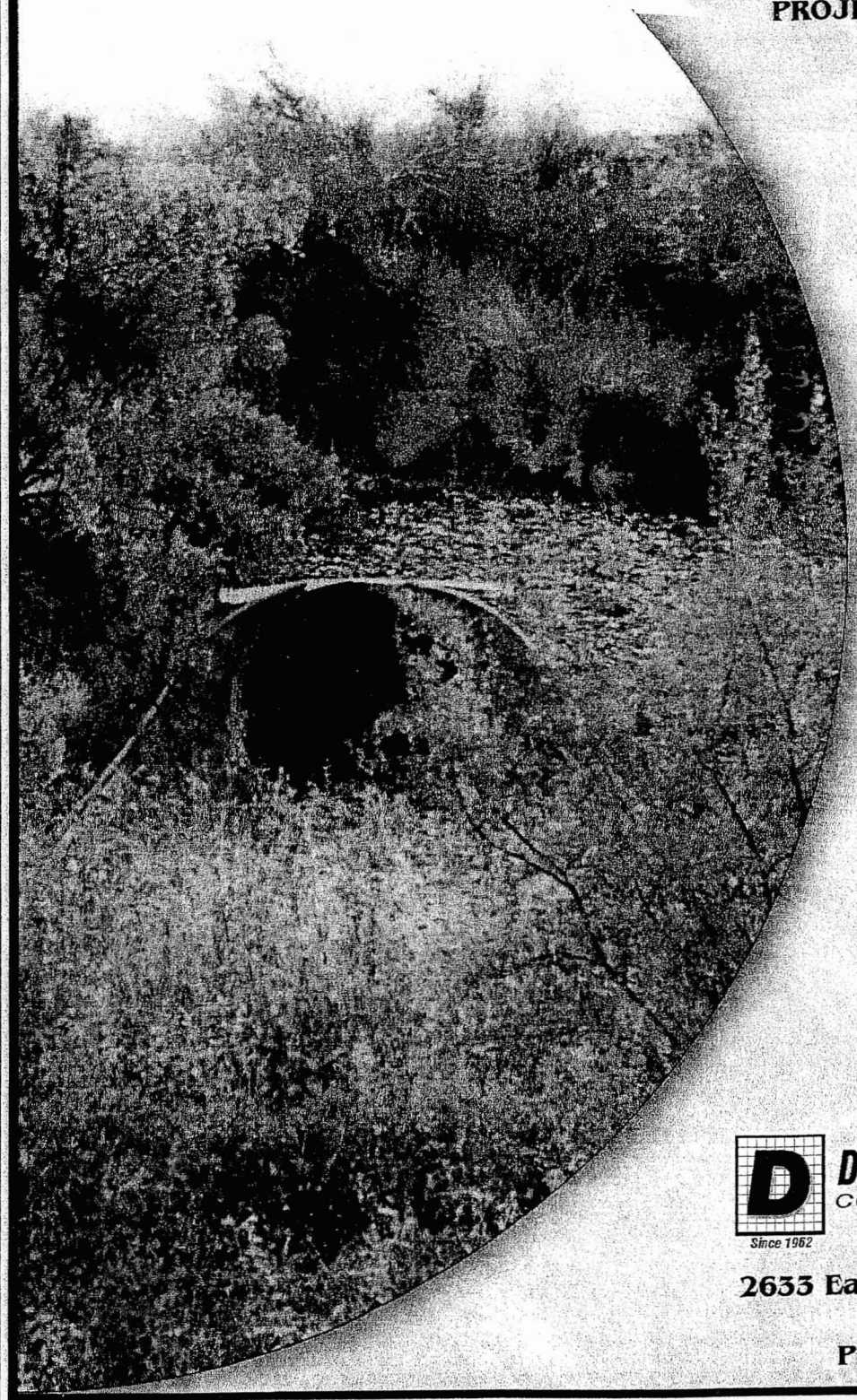
US 60

203rd Avenue (West) to Dear Valley Road

TRACS NO. 060 MA 131 H4573 02C
PROJECT NO. STP-022-2(57)

Final Drainage Report

March, 2001



ADOT

Prepared for
ARIZONA DEPARTMENT OF TRANSPORTATION

Prepared by

DIBBLE & ASSOCIATES
CONSULTING ENGINEERS
Since 1962

2633 East Indian School Road
Suite 401
Phoenix, Arizona 85016

FINAL DRAINAGE REPORT

US 60: 203rd Ave. (West) - Deer Valley Rd.

PROJECT NO. STP-022-2-(57)

TRACS NO. 060 MA 131 H4573 02C

CONTRACT NO. 97-81

March, 2001

Registered Professional Engineer (Civil)
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ARIZONA U.S.A.

Prepared for:

ARIZONA DEPARTMENT OF TRANSPORTATION

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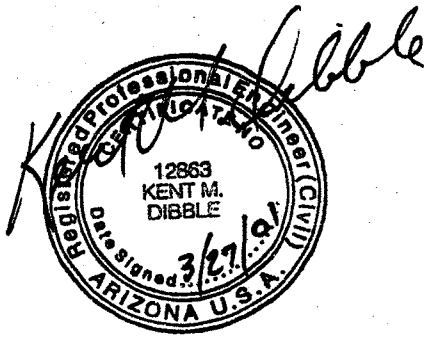

March, 2001

FINAL DRAINAGE REPORT

US60: 203rd Ave. (West) - Deer Valley Rd.

I. INTRODUCTION

General

This drainage report is part of Federal Project No. STP-022-2(57), TRACS NO. 060 MA 131 H4573 02C for US 60, Morristown Railroad Overpass (RROP) to Beardsley Road in Maricopa County and located within the ADOT Prescott District. The limits of the study are milepost (MP) 123.44 near the Morristown Railroad Overpass and extending southeasterly approximately 15.4 miles to MP 138.83 just east of the connection to Loop 303 with US 60. The said US 60 project is divided into three areas, known as *Project 1, Project 2, and Project 3*. **Figure 1** illustrates the study area.

This report will be limited to approximately a six mile stretch between Station 474+00, approximately MP130.66, to Station 796+00, approximately MP 136.76, along said US 60 roadway known as *Project 2*. These limits are approximately 203rd Avenue to the west and Deer Valley Road to the East.

Three previous reports on the hydrology of the project area have been completed. In 1989, the Flood Control District of Maricopa County (FCDMC) prepared the *Wittmann Area Drainage Master Study (ADMS)* that encompassed the entire study area. ADOT prepared a drainage report that covered a portion of this study area from MP 129.57 to MP 137.50. The report is entitled *Wittmann-Beardsley US 60 Bridge Replacement*, TRACS No. H 2725 01 C, Project No. BRF-022-2(35), May 1993. The ADOT drainage report entailed all of the culverts on US 60 located south of the Central Arizona Project (CAP) Canal or Hayden-Rhodes Aqueduct. Dibble and Associates reviewed the report by the FCDMC and modified the drainage delineation and peak runoff values. These flows are acceptable to ADOT and are documented in the Dibble & Associates report: *US 60 Morristown RROP to Beardsley Road, Final Revised Hydrology Report,* September, 1998. Excerpts from this report are located in **Appendix O**. The Wittmann-Beardsley US 60 Bridge Report has been requested but cannot be located, and Dibble & Associates has received only a copy of the peak runoff values from this report. These peak runoff values are used to design the culverts for this section of US60.

Scope of Work

Dibble will perform updates to the hydrologic analysis performed during the study phase of this project. The update will confirm or revise the parameters and variables used in the analysis, and will revise the HEC-1 and Rational Method calculations performed.

Dibble will utilize the revised hydrologic information developed in the Stage I Hydrology reports to perform complete hydraulic analysis and design for Project 2, consisting of five existing concrete box culverts, five new concrete box culverts, and 28 concrete or corrugated steel pipe culverts located beneath US 60 mainline and frontage roads as well as 23 median drainage catch basins. This drainage report will cover the corridor encompassed by US 60 mainline Station 474+00 to Station 796+00.

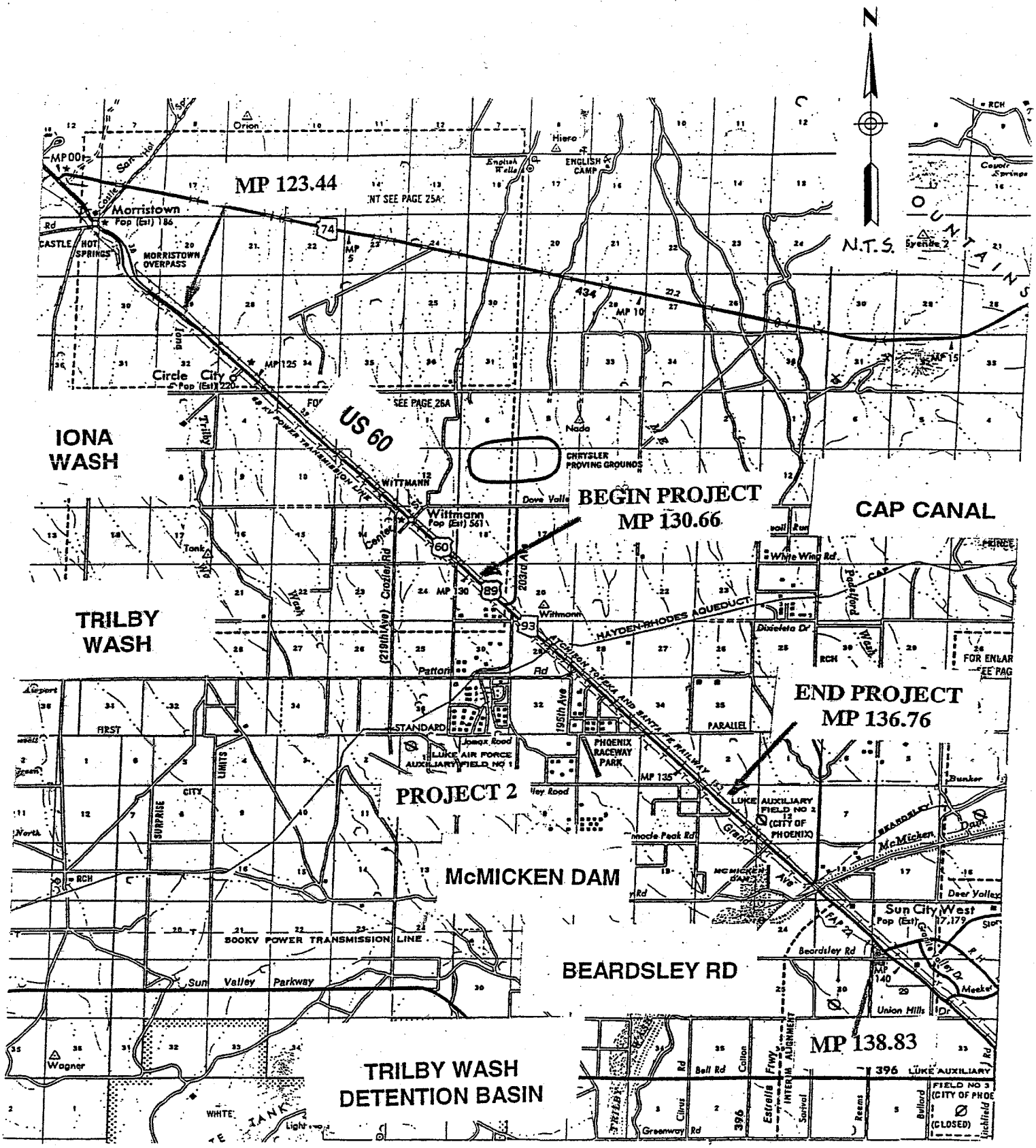

Figure 1. Vicinity Map

Existing Conditions

The following is a detailed report of the existing conditions completed by Sverdrup for the *Final Design Concept Report, US 60 Morristown RROP to Beardsley Road*, June 1996, Federal Project No. STP-022-2-955, TRACS No. 060 MA 121H 3623 01 L.

Storm runoff crossing US 60 between the Morristown RROP (MP 121.90) and McMicken Floodway (MP 138.09) generally flows from north to south. The total drainage basin area north of US 60 along this segment is approximately 115 square miles. The major drainage basins located within this region are Iona Wash (8 square miles), Trilby Wash (16 square miles), and Wittmann Wash (9 square miles). Ground elevations vary from 4,300 feet in the Wickenburg and Hieroglyphic Mountains to 1,325 feet at the McMicken Floodway. The drainage area covers a wide range of slopes from mountainous areas with slopes greater than 10 percent to alluvial fans with slopes of 1.5 to 10 percent to flat desert regions with slopes ranging from 1.5 to 0.6 percent. Peak flows reaching US 60 are controlled by the AT&SF railroad embankment, located approximately 100 feet north of the US 60 R/W. The railroad embankment acts as a barrier or dam to the runoff. Runoff is released through culverts and timber pile bridges. Runoff passing under the railroad flows through culverts and bridges under US 60 and into the McMicken Dam. At the south end of the project, the McMicken Dam outlet channel provides for the passage of flood water out of the dam and discharge into the Agua Fria River.

This region is located in the upper Sonoran desert zone. The primary foliage found in the drainage sub-basins located in the foothills and mountainous areas are: desert holly, catclaw, mountain palo verde, ocotillo, saguaro, and prickly pear cactus. The vegetative cover density ranged from 20 to 34 percent.

Common plants found in the lower desert sub-basins areas are: mesquite, ironwood, palo verde, creosote, catclaw, and numerous varieties of cacti species. The vegetative cover density ranged from 20 to 40 percent. Mesquite, palo verde, desert broom, and acacia heavily vegetate the banks of washes.

The natural ground surface along the alignment slopes gently downward to the south and southeast with numerous small drainages crossing the alignment. Vegetation in the area consists of sparse to moderate growth of trees, small shrubs, and native grasses.

The geologic units exposed along the US 60 alignment include Tertiary to Quaternary age alluvial plain and alluvial fan deposits which are dissected and overlain by recent narrow stream channel deposits. The discussions presented herein are based on observed surface exposures. Due to the intertonguing nature and gradational contacts of the unconsolidated deposits, future subsurface exploration, excavations and site grading may reveal local variations to the conditions described herein.

Alluvial Plain Deposits

The alluvial plain deposits are exposed over a limited area along the eastern end of the alignment from Beardsley Road to just south of the McMicken Dam outlet crossing. The alluvial plain material consists of a lenticular deposit of silty sand, sandy clay, and clayey sand. The silty sand unit is comprised primarily of fine-grained sand with some gravel. The unit is considered weakly lime

cemented, low in plasticity, and brown. The moisture content of this unit is estimated to be low. The soil density is estimated to range from loose to medium dense at the surface and probably increases to medium dense to dense with depth.

The sandy clay and clayey sand units include fine- to medium-grained sand. The deposits are weakly lime cemented, moderately firm to very firm, medium in plasticity, and brown. The clayey sand unit contains some gravel and considerable amounts of silt.

Alluvial Fan Deposits

The alluvial fan deposit is extensively exposed along the alignment north of McMicken Dam Outlet Channel (MCDOC). The deposit intertongues with the alluvial plain deposit near MCDOC and is dissected and overlain with localized coarse-grained stream channel material in the drainage bottoms. The alluvial units contain variable amounts of fine-grained material. The lithology of the alluvial fan deposit generally is more coarse-grained in the upgradient direction to the northwest.

The sand unit generally is exposed southeast of Wittmann and is comprised primarily of fine-grained silty to clayey and some gravelly lenses with occasional small cobbles. The unit is medium dense to dense, typically slightly moist, weakly lime cemented, low to medium in plasticity, and light brown to brown.

The gravel unit is exposed northwest of Wittmann to the Morristown RROP area and consists primarily of silty gravel, with some to considerable silty sand lenses and occasional small cobbles. Exposures of this unit generally are dense to very dense, slightly moist, low in plasticity and brown. The particles are poorly graded and subangular to subrounded in shape. The deposit contains some clay lenses and the cementation varies from weakly to strongly lime cemented. The degree of cementation exposed at the surface generally increases to the northwest. Some local strongly lime cemented lenses were exposed as discontinuous and irregularly shaped ridge camps between drainages.

Stream Channel Deposits

The stream channel deposits primarily occur in the drainage channels that traverse and overlie the alluvial fan deposit. These deposits are comprised of sandy gravel interbedded with some sand lenses and occasional small cobbles. The deposits generally are loose and slightly moist with the moisture content possibly increasing with depth. Exposures of the sandy gravel unit indicate poorly graded subrounded gravel and medium to coarse-grained, non-plastic, light-gray sand. The sand lenses are predominantly fine-grained, non-plastic, and light brown.

Existing cross drainage structures in Project 2 of US 60 include corrugated metal pipes (7), reinforced concrete box culverts (6), and small short span bridges (1). Many of the existing cross drainage structures were constructed in a manner to minimize the length of the culvert. Rechannelization of washes was needed to direct flows under the roadway. Most of the culverts and bridges were placed during the roadway construction in the early 1940s. The McMicken outlet channel bridge was built in 1956 and the Central Arizona Project canal bridge was built in 1978. Within *Projects 1, 2, & 3*, 15 of the box and pipe culverts were recently reconstructed (1994). The

construction work replaced 13 timber top box culverts and extended two concrete box culverts, between MP 129.57 to MP 137.50. ADOT requested that all pipe culverts constructed in the early 1940's be replaced during the roadway widening.

Environmental Considerations

As reported in Sverdrup's *Final Design Concept Report*, The Environmental Assessment (EA) has been approved by ADOT and FHWA, and a Finding of No Significant Impact has been signed by FHWA.

An Erosion Control Plan and Storm Water Pollutant Prevention Plan are being prepared to reduce erosion and prevent other pollutants from entering any streams within the project limits. This plan is submitted in the construction plans.

II DESIGN CRITERIA

Hydrology

US 60 is considered a "Drainage Class 1" highway for ADOT drainage design elements. Therefore, the following design frequencies will be used per ADOT *Roadway Design Guidelines Manual*, Section 600, Table 603.2A:

New Construction	50 Years
Reconstruction	50 Years
Structure affected by major project	50 Years

The design frequency for pavement drainage and median ditches of US 60 is 50 years as a Non-Depressed Roadway per ADOT *Roadway Design Guidelines Manual,* Section 600, Table 603.2A and Table 603.2B. The hydraulic grade line must not be higher than 3" below the top of pavement.

The drainage channels paralleling US60 are designed for a 50-year storm frequency. These channels will intercept cross-flows and redirect them to discharge points. These channels are required to maintain one foot of freeboard if there is the possibility the channel could overflow and flood outside of ADOT right-of-way.

Hydraulics

Culverts - Box culverts are concrete with Manning's n of 0.012, determined using Table 607.10 - Pipe Roughness, ADOT *Roadway Design Guidelines Manual,* May 1996, Section 607.10.

Pipe culverts on the project are either concrete or corrugated steel. Concrete pipe culverts have a Manning's n of 0.012 and Corrugated metal culverts have a Manning's n of 0.024. These Manning n values have been determined using Table 607.10-Pipe Roughness, ADOT *Roadway Guidelines Manual,* Section 607.10. **Table 1** lists the cross culverts by station location and includes other culvert-specific information (**Table 1** does not include median drainage pipes. These can be found in **Table 2**).

The 50-yr and 100-year flood discharges are determined in Section III for each culvert location. Per the ADOT *Roadway Design Guidelines Manual,* May 1996, Section 611.3, the 50-year headwater level should be no higher than 3-inches below the edge of pavement. The backwater created by a 100-year event should not increase flooding of farm land, developable lands or buildings.

The following limitations on flow characteristics are maintained:

Allowable headwater:	generally 1.5 times the culvert height or 0.25 feet (3") below the edge of pavement
Maximum velocity:	limited by the downstream channel material unless an energy dissipator is provided.

Pavement Drainage - The pavement will drain into the median drainage catch basins and will drain into the swales parallel to the highway until it is diverted into natural channels, or drains directly into box or pipe culverts.

Median Drainage & Catch Basins

Catch Basin design criteria is taken from the ADOT Highways Division, Structures Section, *Drainage Manual Volume 1*, August 1987, Section G, Pavement and Median drainage.

Inlets are designed with a 50% clogging factor, and this is accounted for by reducing the grate area by 50% and reducing the grate perimeter by 50% as described in Hydraulic Engineering Circular No. 12, Section 8, Interception Capacity of Inlets in Sag Locations.

The median dikes will be 1 foot minimum lower than the adjacent edge of traveled way.

The median drainage will collect and flow in swales between the divided US 60 highway. These median swales are to convey pavement runoff to the median catch basins and are not intended or designed to retain or pond water. The 50-year flood discharges are determined in Section III for the median and roadway drainage catch basin locations. Median drains are placed as needed along the length of the project. **Appendix C** displays the drainage area calculations and the roadway drainage area sub-basins are located in **Appendix B**. **Table 2** lists the Median Drain Catch Basin Summary by station location and shows catch basin details as well as other pertinent information. See **Appendix N** for the ADOT catch basin details used, Drawing Numbers C-15.80 and C-15.90.

Erosion Control - Existing erosion problems were noted at the outlet of several of the existing culverts. Outlet protection for culverts is provided according to requirements set forth in ADOT *Roadway Design Guidelines*, May 1996, Section 612.2 - Erosion Control:

Ratio of outlet velocity to Natural stream velocity:	Required Protection
less than 1.5	No protection required
1.5 to 2.0 with outlet velocity less than 10 fps	Dumped rock riprap apron
1.5 to 2.5 with outlet velocity between 10 and 15 fps	Wire-tied riprap apron
Greater than 2.5 or outlet velocity greater than 15 fps	Energy Dissipator

Due to the possible erosive nature of the existing non-cohesive soil, all culverts which do not require protection per the above criteria will have a minimum outlet protection of dumped rock riprap apron. All boxes that have a roadside ditch contributing flow, will have a riprap settling basin for outlet protection. Roadside ditch ends will have wire-tied riprap for added protection (see Details N, O, and R in the project plans).

FEMA Considerations - A detailed floodplain analysis has been prepared by the Federal Emergency Management Agency (FEMA) for the length of the project. The Flood Insurance Rate Maps prepared by FEMA are shown in **Appendix P**. Three zones have been designated on the mapping. They are: Zone A which is defined as areas of 100-year flooding with no base flood elevations determined; Zone AE which is defined as areas of 100-year flooding with base flood elevations determined; and Zone X which is defined as areas determined to be outside the 100-year floodplain.

III. STUDY APPROACH

Methodology

Rainfall and Runoff - For drainage basins larger than 160 acres, the 50-year and 100-year rainfall frequencies were modeled in HEC-1 to determine the peak runoff at desired concentration points (culverts and bridges). For drainage basins smaller than 160 acres, the Rational Method was used to determine the runoff for the 50-year and 100-year storm. The peak discharges for the 50-year and 100-year floods are listed in **Table 1.** The area north of the CAP canal was analyzed by Sverdrup and reported in the *Final Design Concept Report, US 60, Morristown RROP to Beardsley Road,* June 1996. This information was analyzed and has been adjusted by Dibble & Associates, in a report titled *Final Revised Hydrology Report, US 60, Morristown RROP to Beardsley Road*, TRACS NO. 060 MA 121 H4573 01D, Project No. STP-022-2(55) dated September, 1998. Dibble & Associates used the HEC-1 computer files from Sverdrup as a basis for design and modified only the basin delineation and rainfall intensity acquired from the appropriate isopluvial maps from the *Drainage Design Manual for Maricopa County, Arizona, Volume I, Hydrology*. These updates changed the peak runoff values and are used for design. This data is the basis for drainage design north of the CAP canal. As stated earlier, the ADOT drainage report, Project No. BRF-022-2(35) is used for drainage data south of the CAP Canal. The small 100 year flows are due to the railroad constricting the flow to US 60. Median drainage was calculated using the Rational Method and mathematically

added to the 50 year design flow. Since the time of peak flow information was not available, the hydrological flows where not calculated. The 100 year median flows were conservatively calculated by multiplying the 50 year flows by a factor of 1.1.

TABLE 1
CROSS CULVERT SUMMARY TABLE

STA (+/-)	Q50 (cfs)	Q100 (cfs)	Culvert Dim./ Dia.	Barrel Material	Length (ft)	Outlet Velocity (fps)	Natural Channel Velocity (fps)	Outlet Prot.	Velocity Ratio
203rd Ave	124	136	2-36"	RCP	112	9.82	4.43	WTR	2.22
496+76	22	24	2-24"/2-30"	CMP	90/94	2.24	-	DR	-
516+54	27	29	2-30"	CMP	178	2.85	-	DR	-
549+15	8	9	24"	CMP	181	2.55	-	DR	-
556+75	89	98	2-48"	CMP	202	3.5	-	DR	-
563+87	54*	-	36"	CMP	196	7.6	-	WTR	-
576+95.94	515	518	3-10'x3'	CBC	178	12.38	6.86	WTR	1.88
Conn 605	35	39	2-24"	CMP	100	5.57	3.01	DR	1.85
622+37.74	513	518	2-10'x5'	CBC	180	9.57	5.64	RSB	1.70
Jomax	38	42	2-30"	CMP	107	6.30	2.61	WTR	2.41
647+98.47	312	376	5-8'x3'	CBC	220	12.21	4.11	RSB	2.97
662+37	136	150	3-36"	CMP	177	6.5	-	WTR	-
685+42	21	23	36"	CMP	182	3.1	-	DR	-
Happy Valley	96	106	2-36"	RCP	118	7.04	3.51	WTR	2.01
720+72.94	1032	1069	4-10'x4'	CBC	221	6.45	7.93	CONC	0.81
Norwich	55	61	2-30"	RCP	122	5.60	8.50	CONC	0.66
782+07.54	622	744	3-8'x3'	CBC	219	10.96	6.44	RSB	1.70
Frontage Rd. D	616	678	3-10'x3'	CBC	108	6.84	6.00	WTR	1.14
Jomax 6+81.50	778	856	3-10'x4'	CBC	58	9.40	2.94	WTR	3.20
Hap. Val. 8+00	27**	-	35"x24"	CMPA	81	6.73	3.13	DR	2.15
Hap. Val. 14+75	129**	-	6'x3'	CBC	70	7.10	2.13	WTR	3.33
Citrus/Hap. Val.	202**	-	6'x4'	CBC	63	10.22	7.15	CONC	1.43
Citrus 29+85.50	253**	-	6'x4'	CBC	60	11.05	3.72	WTR	2.97

CBC - Concrete Box Culvert
CMP - Corrugated Metal Pipe
RCP - Reinforced Concrete Pipe
* - Offsite Flow Not Available
DR - Dumped Riprap
WTR - Wire-Tied Riprap
RSB - Riprap Settling Basin / Energy Dissipator
CONC - Concrete Lined
** - Hydrology not known for offsite areas, Q based on culvert maximum allowable capacity

Note: The outlet velocity numbers and the natural channel velocity were calculated using HY-8 (see **Appendices A** and **H**)

Box and Pipe Culvert Analysis - Culverts are analyzed using procedures contained in the FHWA publication *Hydraulic Design of Highway Culverts, HDS -5.* The results are modeled on the computer software *HY8-Culvert Analysis,* Version 6.1. Cross sections of each channel crossing US 60 were taken so that the natural channel could be better modeled in order to determine the natural channel velocity. The computer models for these boxes and pipes were analyzed by Dibble & Associates and can be found in **Appendices A** and **H**.

Pipe Culvert Analysis - The computer software *FlowMaster*, Version 5.13 is used by Collins/Pina to analyze the existing channels based on Manning's normal depth. Utilizing the natural channel water elevation in conjunction with *HYDROCALC Hydraulics for Windows*, Version 1.1, the culvert size is determined. The initial design of the pipe culverts is based upon the Federal Highway Administration, HDS No. 5. The output for the pipe culverts crossing US 60 can be found in **Appendix I**.

Median and Pavement Drainage - The Rational Method is used to determine the runoff collected in the median drainage area. A flow for the 50-year event is determined by adding the contribution from the pavement and the median, with "C" factors of 0.95 and 0.70, respectively. The US60 roadway median along *Project 2* is divided into individual segments by connector roads or new dikes between east and west bound US60. For each of these segments, individual intensities are calculated to better determine the flow to each of the median catch basins. The depth of flow is determined in each of the median swales, as calculated in **Appendix D.** The catch basins are analyzed as weir and orifice conditions to determine the controlling depth as outlined in ADOT Structures Section, *Drainage Manual, Volume 1*, Policy, Bridge Drainage Services, August 1987. See **Appendix E** for Orifice and Weir calculations. See **Appendix C** for the Roadway Drainage Area Flow Summary Table and **Appendix B** for the Roadway Drainage Area Sub-basins. **Table 2** displays the median drainage catch basin pertinent information. The headwater depth inside the catch basin is determined using HY8 and illustrated in **Appendix G.**

TABLE 2

MEDIAN DRAINAGE CATCH BASIN SUMMARY TABLE

STA (+/-)	Q50 (cfs)	Depth of flow d - Weir Condition	Depth of flow d - Orifice Condition	Controlling Depth	Hydraulic Grate Control	ADOT Catch Basin	Outlet Velocity (ftps)	Natural Velocity (fps)	Outlet Protec-tion	Velocity Ratio
480+00	12	0.9	0.8	0.9	Weir	C-15.80	5.9	2.4	WTR	2.5
496+76	13	1.0	1.0	1.0	Orifice	Junc. Box	-	-	-	-
516+54	12	0.9	0.8	0.9	Weir	Junc. Box	-	-	-	-
547+51	4	0.4	0.1	0.4	Weir	C-15.80	-	-	-	-
549+15	5	0.5	0.1	0.5	Weir	C-15.80				
556+75	7	0.6	0.3	0.6	Weir	Junc. Box	-	-	-	-
563+87	6	0.6	0.2	0.6	Weir	Junc. Box	-	-	-	-
576+65	8	0.6	0.1	0.6	Weir	C-15.90	-	-	-	-
577+29	5	0.4	0.0	0.4	Weir	C-15.90	-	-	-	-
601+00	13	1.0	1.0	1.0	Orifice	C-15.80	6.1	2.9	WTR	2.1
622+07	13	0.8	0.3	0.8	Weir	C-15.90	-	-	-	-
640+00	14	1.0	1.1	1.1	Orifice	C-15.80	6.2	2.4	WTR	2.6
662+37	14	1.0	1.1	1.1	Orifice	Junc. Box	-	-	-	-
674+00	8	0.7	0.4	0.7	Weir	C-15.80	5.1	1.8	WTR	2.8
685+42	8	0.7	0.4	0.7	Weir	Junc. Box	-	-	-	-
698+00	8	0.7	0.4	0.7	Weir	C-15.80	3.7	0	DR	0
708+00	10	0.8	0.6	0.8	Weir	C-15.80	4.1	0	DR	0
719+91	8	0.6	0.1	0.6	Weir	C-15.90	-	-	-	-
733+00	9	0.7	0.5	0.7	Weir	C-15.80	6.0	2.6	CONC	2.3
745+00	8	0.7	0.4	0.7	Weir	C-15.80	2.5	0	CONC	0
755+00	8	0.7	0.4	0.7	Weir	C-15.80	2.5	0	CONC	0
770+00	11	0.9	0.7	0.9	Weir	C-15.80	3.5	0	CONC	0
781+35	8	0.6	0.1	0.6	Weir	C-15.90	-	-	-	-

DR - Dumped Riprap
WTR - Wire Tied Riprap
CONC - Concrete Lined
Junc. Box - Junction structure (Detail K in Construction Plans)

The median drainage flow is determined using the rational method, as follows:

$$Q = C\,i\,A$$

Q	=	the peak discharge, cfs
C	=	the runoff coefficient
i	=	the average rainfall intensity, inches/hr
A	=	the contributing drainage area, acres

The intensity is determined by an iterative process outlined in the ADOT *Highway Drainage Design Manual*, Section 2.2.5 Estimation of Time of Concentration. Sample calculations are located in **Appendix C.** The equation is as follows:

$$Tc = 11.4\,L^{0.5}\,Kb^{0.52}\,S^{-0.31}\,i^{-0.38}$$

Where	Tc	=	the time of concentration, hours
	L	=	the length of the longest flow path, miles
	Kb	=	the water shed resistance coefficient
	S	=	the slope of the longest flow path, ft/mi
	I	=	the average intensity, in/hr, for a duration of rainfall equal to Tc unless Tc is less than 10 minutes, in which case the i is for a 10-minute duration.

The depth of flow must be determined in the median channels, using Manning's Open Channel Flow, as follows:

$$Q = \frac{1.486}{n} A * R^{2/3} * S^{1/2}$$

Where	Q	=	discharge, cfs
	n	=	roughness coefficient
	A	=	cross-sectional area of flow (ft^2)
	R	=	Hydraulic radius, ft
	S	=	longitudinal slope of water surface (ft/ft), assume uniform flow, therefore, use channel slope.

This depth of flow must be compared to the depth created at the catch basin at the inlet due to the weir or orifice conditions to determine the governing depth. The depth is determined using the following equations from Hydraulic Engineering Circular No. 12.

Weir:

$Qi = Cw*P*d^{1.5}$

Where	Qi	=	Flow at the inlet, cfs
	Cw	=	Weir coefficient (3.0)
	P	=	Perimeter of the grate, ft, disregarding bars
	d	=	depth of flow at grate due to Weir condition

Orifice:

$Qi = Co*A(2g*d)^{0.5}$

Where	Qi	=	Flow at the inlet, cfs
	Co	=	Orifice Coefficient
	A	=	Clear opening area of the grate, ft^2
	g	=	gravity, 32.16 ft/s^2
	d	=	depth of flow at grate due to Orifice condition

The flow will drain into the catch basins and will drain via a 24" corrugated metal pipe (CMP) for C-15.80 catch basins and via a 28"x20" CMPA for C-15.90 catch basins. Using HY8, the headwater depth inside the catch basin is determined and shown in **Appendix G**.

Median drainage pipes connecting with other catch basins which contribute flow are considered as storm drains, and the median drainage at Station 547+51 is an example of this situation. The following design equations are taken from the *Arapahoe County Storm Drainage Design and Technical Criteria*. For storm drain / median drainage pipes connecting with a catch basin inlet at the junction, Equation 805 is used to determine the head loss due to this situation. Adding this head loss depth to the headwater elevation in the catch basin calculation by HY8, provides a new constant tailwater elevation for the culvert draining from the median. Equation 801 is used to determine the head loss due to an inlet at the beginning of the storm drain system. This head loss depth is added to the headwater depth inside the catch basin. See **Appendix J** for calculations.

Following are Equation 805 and 801 as discussed above.

Equation 805

$H_L = V_2^2 / 2g - Kj*V_1^2 / 2G$

V_1	=	Velocity Upstream of Junction
V_2	=	Velocity Downstream of Junction
Kj	=	0.25, Table 803

Equation 801

$$H_L = K V^2 / 2g$$

V_1 = Velocity Downstream of Catch Basin

K = 1.25, Table 803

Erosion Control - Erosion control for culvert outlets is provided with dumped rock riprap, wire-tied riprap or riprap settling basin type energy dissipators.

Dumped riprap is sized based on the culvert's outlet velocity and **Figure 2**, from Federal Highway Administration Hydraulic Engineering Circular No. 14, *Hydraulic Design of Energy Dissipators for Culverts and Channels,* with a minimum equivalent spherical stone diameter (D_{50}) of 0.5 foot. See **Appendix M** for riprap sizing calculations at culvert outlets. **Table 3** lists the recommended riprap gradation according to the specified D_{50} class. The Pima County Department of Transportation and Flood Control District, *Drainage and Channel Design Standards for Local Drainage*, procedures are used to design the length of the dumped riprap aprons for the box culverts. The length of the riprap apron is computed according to the following equations:

For F < or = 1:

$$L = 8 * D$$

For F > 1:

$$L = D (8 + 17 \log F), \text{ for minimum tailwater}$$

and $$L = D (8 + 55 \log F), \text{ for maximum tailwater}$$

where, L = Length of riprap apron (feet)

D = Culvert diameter or height (feet)

F = Froude number for the culvert flow

Minimum tailwater is assumed when the tailwater depth is less than half of the culvert height. Maximum tailwater is assumed when the tailwater is greater than half the culvert height. See **Appendix L** for apron length calculations.

TABLE 3

RIPRAP CLASSIFICATION

% Passing	D50 Class				
	Size	6"	12"	24"	30"
100-90	2 x D50	12	24	48	60
85-70	1.5 x D50	9	18	36	45
50-30	1 x D50	6	12	24	30
15-5	.67 x D50	4	8	16	20
5-0	.33 x D50	2	4	8	10

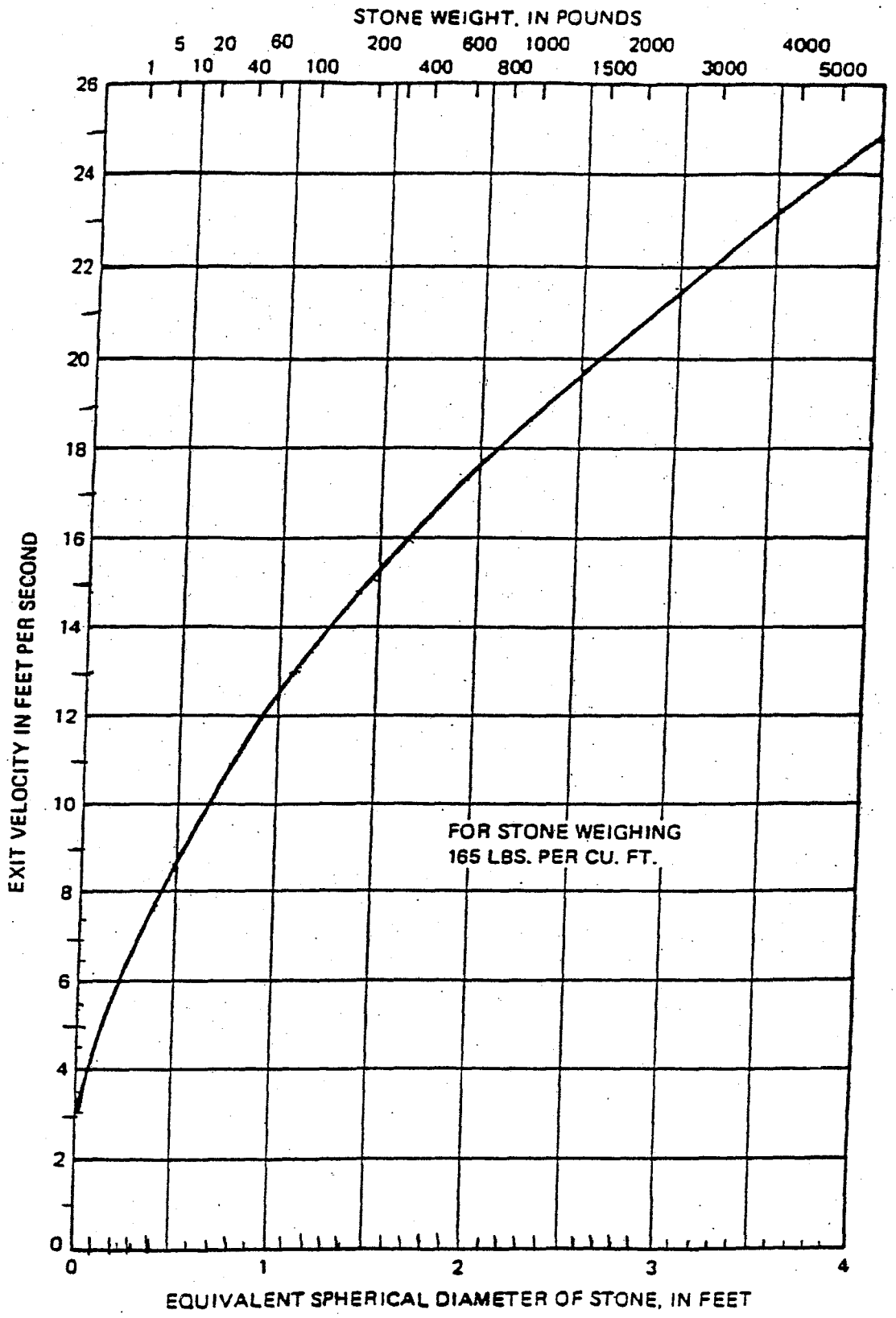

Figure 2. Riprap Size for Culvert Outlets
(From Hydraulic Design of Energy Dissipators for Culverts and Channels)

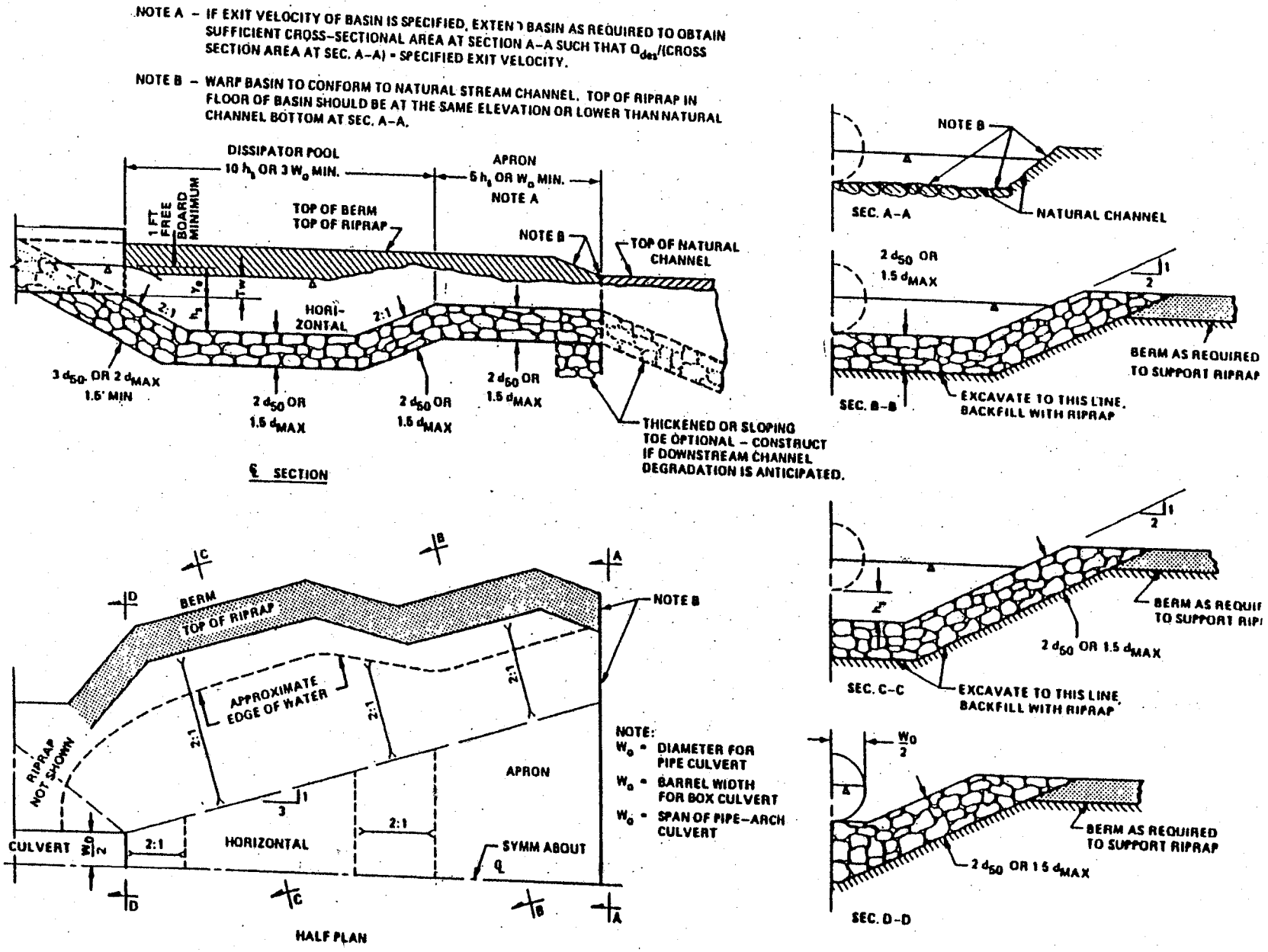

Figure 3. Riprap Settling Basin
(From HEC-14)

IV. RESULTS AND RECOMMENDATIONS

Hydrology

The rainfall data for the area north of the CAP Canal was completed by the FCDMC and summarized in the report *Wittmann Area Drainage Master Study* and revised by Dibble & Associates and reported in *US60 Morristown RROP to Beardsley Road, Final Revised Hydrology Report,* September 1998. Pertinent information from this report is located in **Appendix O.** The rainfall data for the area south of the CAP Canal was completed by ADOT and is summarized in their drainage report, *Wittmann-Beardsley US 60 Bridge Replacement.*

Table 1 summarizes the peak flows for the proposed channels and culverts as well as the culvert sizes. The following is a brief discussion of each of the culverts. See **Appendix B** for drainage area plans and the construction drawings for profiles and drainage details.

Box Culvert Analysis

The analysis of each box can be found in **Appendix A**.

Sta. 576+95.94 - The existing 3-10'x3' box culvert will remain and will be extended beyond the new eastbound US60. The outlet will be protected with wire-tied riprap due to the non-cohesive sandy nature of the soil. This box culvert will collect median drainage from two catch basins, located east and west of the culvert.

Sta. 622+37.74 - The existing 2-10'x5' box culvert will remain and will be extended beyond the new eastbound US60. The outlet will be protected with a riprap settling basin. The settling basin will accept flow from a roadside ditch as well as from the culvert. This box culvert will collect median drainage from one catch basin, located west of the culvert.

Sta. 647+98.47 - The existing 5-8'x3' box culvert will remain and will be extended beyond the new eastbound US60. The outlet will be protected with a riprap settling basin. The settling basin will accept flow from a roadside ditch as well as from the culvert.

Sta. 720+72.94 - The existing 4-10'x4' box culvert will remain and will be extended beyond the new eastbound US60. The outlet will be protected with concrete lining. This concrete lined channel will accept flow from a roadside ditch as well as from the culvert. Both the flow from the culvert and the roadside ditch have been analyzed for this system. This box culvert will collect median drainage from one catch basin, located west of the culvert. See **Appendix Q** for system calculations.

Sta. 782+07.54- The existing 3-8'x3' box culvert will remain and will be extended beyond the new eastbound US60. The outlet will be protected with a riprap settling basin. This settling basin will accept flow from a concrete lined roadside ditch as well as from the culvert. This box culvert will collect median drainage from one catch basin, located west of the culvert.

Frontage Road 'D' Sta. 1627+05- This is a new culvert location consisting of a 3-10'x3' box culvert. This box will convey flow from an existing wash underneath the new Frontage Road 'D'.

The outlet will be protected with wire-tied riprap.

Jomax Sta. 6+81.50- This is a new culvert location consisting of a 3-10'x4' box culvert. This box will convey flow from an existing wash north of Jomax Road to the south. Currently there is a dip crossing on existing Jomax Road for this wash. The outlet will be protected with wire-tied riprap.

Happy Valley Road Sta. 14+75- This is a new culvert location consisting of a 6'x3' box culvert. This box will convey flow from the new roadside swale, north of Happy Valley, under the new Happy Valley to the new swale south of Happy Valley. The outlet will be protected by wire-tied riprap.

Citrus Road/Old Happy Valley Road Intersection- This is a new culvert location consisting of a 6'x4' box culvert. This box will convey flow from the new Citrus Road swale underneath the old Happy Valley Road. This will outlet into a concrete lined channel and is considered part of the Box Sta. 720+72.94 channel system. See **Appendix Q** for calculations.

Citrus Road Sta. 29+85.50- This is a new culvert location consisting of a 6'x4' box culvert. This box will convey flow from the existing swale underneath and north of Citrus Road. The outlet will be protected by wire-tied riprap. This flow will be contributing to the flow from Box Sta. 720+72.94. See **Appendix Q** for calculations.

Pipe Culvert Analysis

The analysis for each pipe culvert can be found in **Appendix A** unless otherwise noted.

203rd Ave. at US60 - This is a new culvert location consisting of two 36" reinforced concrete pipes. These pipes will convey runoff from the roadside ditch under the 203rd Avenue intersection. The outlet will require wire-tied riprap and dumped riprap at the inlet due to the possible erosive nature of the soil.

Sta. 496+76 - This culvert will replace the existing two 18" corrugated metal pipes currently in service. The replacement will consist of two 24" corrugated metal pipes under the existing US60 and two 30" corrugated metal pipes under the new eastbound US60, connected by a junction box in the median. These pipes will direct flow from north of US60 to the south side of the highway. The culverts will also collect flow from the median via junction box. The outlet will require dumped riprap due to the possible erosive nature of the soil and will be outletting into a roadside ditch. (See **Appendix I** for output).

Sta. 516+54 - This culvert will replace the existing 24" corrugated metal pipe currently in service. The replacement will consist of two 30" corrugated metal pipes. These pipes will direct flow from north of US60 to the south side of the highway. The culvert will also collect flow from the median via a junction box. The outlet will require dumped riprap due to the possible erosive nature of the soil and will be outletting into a roadside ditch. (See **Appendix I** for output).

Sta. 549+15 - This culvert will be an extension of the existing 24" corrugated metal pipe. This pipe

will direct flow from north of US60 to the south side of the highway. The culvert will also collect flow from the median via a catch basin as well as an intercepting median drainage culvert. The outlet will require dumped riprap due to the possible erosive nature of the soil. (See **Appendix I** for output).

Sta. 556+75 - This culvert will be an extension of the existing 48"x54" oval, corrugated metal pipe. The extension will consist of a junction box and two 48" corrugated metal pipes. These pipes will direct flow from north of US60 to the south side of the highway. The culvert will also collect flow from the median via the junction box. The outlet will require dumped riprap due to the possible erosive nature of the soil. (See **Appendix I** for output).

Sta. 563+87 - This culvert will replace the existing 36" corrugated metal pipe currently in service. The replacement will consist of a 42" corrugated metal pipe. The pipe will direct flow from north of US60 to the south side of the highway. The culvert will also collect flow from the median via a junction box. (See Appendix I for output).

Conn 605 at US60 - This is a new culvert location consisting of two 24" corrugated metal pipes. These pipes will convey runoff from the roadside ditch under the Connector 605 intersection. The outlet will require wire-tied riprap due to the possible erosive nature of the soil.

Jomax at US60 - This is a new culvert location consisting of two 30" corrugated metal pipes. These pipes will convey runoff from the roadside ditch under the Jomax Road intersection. The outlet will require wire-tied riprap due to the possible erosive nature of the soil.

Sta. 662+37 - This culvert will be an extension of the existing three 36" corrugated metal pipes. These pipes will direct flow from north of US60 to the south side of the highway. The culvert will also collect flow from the median via a junction box. The outlet will require wire-tied riprap due to the possible erosive nature of the soil. (See **Appendix I** for output).

Sta. 685+42 - This culvert will be an extension of the existing 24" corrugated metal pipe. The extension will consist of a 36" corrugated metal pipe connected by a junction box. This pipe will direct flow from north of US60 to the south side of the highway. The culvert will also collect flow from the median via the junction box. The outlet will require dumped riprap due to the possible erosive nature of the soil and will be outletting into a roadside ditch. (See **Appendix I** for output).

Happy Valley at US60 - This is a new culvert location consisting of two 36" reinforced concrete pipes. These pipes will convey runoff from the roadside ditch under the Happy Valley Road intersection. The outlet will require wire-tied riprap due to the possible erosive nature of the soil.

Norwich at US60 - This is a new culvert location consisting of two 30" reinforced concrete pipes. These pipes will convey runoff from the roadside ditch under the Norwich Road intersection. The outlet will require no protection due to the concrete lined channel at which the culvert outlets.

Bradley Road Sta. 19+60 - This is a new culvert location consisting of a 24" corrugated metal pipe. This pipe is for nuisance flow and no erosion protection is required. A drop inlet is required to move

the flow underneath Bradley Road.

Happy Valley Road Sta. 8+00 - This is a new culvert location consisting of a 35"x24" corrugated metal pipe arch. This pipe will convey flow from the existing roadside ditch under the new Happy Valley Road, back into the existing roadside ditch, near 181st Drive. Dumped riprap will protect the outlet.

Median Drainage Catch Basin Analysis

Detailed information about the median drainage catch basins is listed in **Table 2**. The following is a brief discussion of each location. The analysis for each median culvert can be found in **Appendices H** and **I**.

Sta. 480+00 - This location will utilize an ADOT Std. C-15.80 catch basin with a 2.5' drop which will drain via a 24" corrugated metal pipe to the south side of eastbound US60 into a new roadside ditch. This ditch will collect the flow and carry it downstream to an existing wash at approximate Station 532+50. The pipe outlet will have wire-tied riprap for erosion protection.

Sta. 496+76 - This location will utilize a junction box with catch basin grates with a 3.5' drop which will drain directly into the new two 30" corrugated metal pipes at this Station. The contributing flow from the junction box has been considered in the design of these pipes.

Sta. 516+54 - This location will utilize a junction box with catch basin grates with a 3.5' drop which will drain directly into the new two 30" corrugated metal pipes at this Station. The contributing flow from the junction box has been considered in the design of these pipes.

Sta. 547+51 / 549+15 - This location will utilize an ADOT Std. C-15.80 catch basin with a 3.5' drop which will drain via a 24" reinforced concrete pipe into the 24" corrugated metal pipe. The contributing flow from the two catch basins has been considered in the design of these pipes. Included in this report are hand calculations which analyze this culvert as a storm drain (See **Appendix J**).

Sta. 556+75 - This location will utilize a junction box with catch basin grates with a 5.8' drop which will drain directly into the new two 48" corrugated metal pipes. The contributing flow from the junction box has been considered in the design of these pipes.

Sta. 563+87 - This location will utilize a junction box with catch basin grates with a 4.5' drop which will drain directly into the new 42" corrugated metal pipe. The contributing flow from the catch basin has been considered in the design of the this pipe.

Sta. 576+65 - This location will utilize an ADOT Std. C-15.90 catch basin with a 28" x 20" corrugated metal pipe arch which will drain directly into the new 3-10'x3' concrete box culvert at this Station. The contributing flow from the catch basin has been considered in the design of the box culvert.

Sta. 577+29 - This location will utilize an ADOT Std. C-15.90 catch basin which will drain directly into the new 3-10'x3' concrete box culvert at this Station. The contributing flow from the catch basin has been considered in the design of the this box culvert.

Sta. 601+00 - This location will utilize an ADOT Std. C-15.80 catch basin with a 3.0' drop which will drain via a 24" reinforced concrete pipe to the south side of eastbound US60 into a new roadside ditch. This ditch will collect the flow and carry it downstream to an existing wash at approximate Station 623+00. The pipe outlet requires wire-tied riprap for erosion protection.

Sta. 622+07 - This location will utilize an ADOT Std. C-15.90 catch basin which will drain directly into the new 2-10'x5' concrete box culvert at this Station. The contributing flow from the catch basin has been considered in the design of the this box culvert.

Sta. 640+00 - This location will utilize an ADOT Std. C-15.80 catch basin with a 3.0' drop which will drain via a 24" reinforced concrete pipe to the south side of eastbound US60 into a new roadside ditch. This ditch will collect the flow and carry it downstream to an existing wash at approximate Station 648+00. The pipe outlet requires wire-tied riprap for erosion protection.

Sta. 662+37 - This location will utilize a junction box with catch basin grates with a 4.0' drop which will drain directly into the new three 36" corrugated metal pipes. The contributing flow from the catch basin has been considered in the design of these pipes.

Sta. 674+00 - This location will utilize an ADOT Std. C-15.80 catch basin with a 2.5' drop which will drain via a 24"corrugated metal pipe to the south side of eastbound US60 into a new roadside ditch. This ditch will collect the flow and carry it downstream to an existing wash at approximate Station 721+00. The pipe outlet requires wire-tied riprap for erosion protection.

Sta. 685+42 - This location will utilize a junction box with catch basin grates with a 4.0' drop which will drain directly into a new 36" corrugated metal pipe. The contributing flow from the catch basin has been considered in the design of the this pipe.

Sta. 698+00 - This location will utilize an ADOT Std. C-15.80 catch basin with a 2.5' drop which will drain via a 24" corrugated metal pipe to the south side of eastbound US60 into a new roadside ditch. This ditch will collect the flow and carry it downstream to an existing wash at approximate Station 721+00. The pipe outlet requires dumped riprap for erosion protection.

Sta. 708+00 - This location will utilize an ADOT Std. C-15.80 catch basin with a 2.5' drop which will drain via a 24" corrugated metal pipe to the south side of eastbound US60 into a new roadside ditch. This ditch will collect the flow and carry it downstream to an existing wash at approximate Station 721+00. The pipe outlet requires dumped riprap for erosion protection.

Sta. 719+91 - This location will utilize an ADOT Std. C-15.90 catch basin which will drain directly into the new 4-10'x4' concrete box culvert at this Station. The contributing flow from the catch basin has been considered in the design of the this box culvert.

Sta. 733+00 - This location will utilize an ADOT Std. C-15.80 catch basin with a 2.5' drop which will drain via a 24" reinforced concrete pipe to the south side of eastbound US60 into a new roadside ditch. This ditch will collect the flow and carry it downstream to an existing wash at approximate Station 783+00.

Sta. 745+00 - This location will utilize an ADOT Std. C-15.80 catch basin with a 2.5' drop which will drain via a 24" reinforced concrete pipe to the south side of eastbound US60 into a new roadside ditch. This ditch will collect the flow and carry it downstream to an existing wash at approximate Station 783+00.

Sta. 755+00 - This location will utilize an ADOT Std. C-15.80 catch basin with a 2.5' drop which will drain via a 24" corrugated metal pipe to the south side of eastbound US60 into a new roadside ditch. This ditch will collect the flow and carry it downstream to an existing wash at approximate Station 783+00.

Sta. 770+00 - This location will utilize an ADOT Std. C-15.80 catch basin with a 2.5' drop which will drain via a 24"corrugated metal pipe to the south side of eastbound US60 into a new roadside ditch. This ditch will collect the flow and carry it downstream to an existing wash at approximate Station 783+00.

Sta. 781+35 - This location will utilize an ADOT Std. C-15.90 catch basin which will drain directly into the new 3- 8'x3' concrete box culvert at this Station. The contributing flow from the catch basin has been considered in the design of the this box culvert.

Outlet Protection

The outlet protection type for box and pipe culverts are listed in **Table 4** and **Table 5**, along with some pertinent dimensions.

Table 6 presents the Pipe and Box Culvert Summary.

Table 4
Box and Pipe Culvert Outlet Protection Summary

STA (+/-)	Outlet Prot.	Required Length of Lining (ft)	Length of Basin (ft) (Pool + Apron)	Length of Pool (ft)	D50(ft)
203rd Ave	WTR	20	-	-	1
496+76	DR	-	-	-	-
516+54	DR	-	-	-	-
549+15	DR	6	-	-	0.5
556+75	DR	10	-	-	0.5
563+87	WTR	11	-	-	0.5
576+95.94	WTR	24	-	-	1
Conn 605	WTR	16	-	-	0.5
622+37.74	RSB	-	50	40	1
Jomax	WTR	20	-	-	0.5
647+98.47	RSB	-	40	32	1
662+37	DR	14	-	-	0.5
685+42	DR	-	-	-	-
Happy Valley	WTR	20	-	-	0.5
720+72.94	CONC	-	-	-	-
Norwich	CONC	-	-	-	-
782+07.54	RSB	-	40	32	1
Frontage Rd D	WTR	24	-	-	1
Hap Val 8+00	DR	16	-	-	0.5
Hap Val 14+75	WTR	24	-	-	1
Jomax 6+81.50	WTR	32	-	-	1
Citrus/Hap Val	CONC	-	-	-	-
Citrus 29+85.50	WTR	32	-	-	1

DR - Dumped Riprap
WTR - Wire Tied Riprap
RSB - Riprap Settling Basin / Energy Dissipator
CONC - Concrete Lining

NOTE: All Stationing from eastbound US 60 unless otherwise noted.
See Details O, Q, and R in Project Plans for riprap dimensions.

The outlet protection type for median drainage Catch Basins are listed in **Table 5**, along with some pertinent dimensions.

Table 5
Median Drainage Catch Basin Outlet Protection Summary

STA (+/-)	Outlet Prot.	Length of Lining (ft)	Length of Basin (ft) (Pool + Apron)	Length of Pool (ft)	D50(ft)
480+00	WTR		-	-	0.5
601+00	WTR		-	-	0.5
640+00	WTR		-	-	0.5
674+00	WTR		-	-	0.5
698+00	DR		-	-	0.5
708+00	DR		-	-	0.5
733+00	CONC	-	-	-	-
745+00	CONC	-	-	-	-
755+00	CONC	-	-	-	-
770+00	CONC	-	-	-	-

DR - Dumped Riprap
WTR - Wire Tied Riprap
CONC - Concrete Lined

NOTE: All Stationing from eastbound US 60 unless otherwise noted.
See Detail O in the Project Plans for riprap dimensions and layouts.

Recommendation

This drainage report covers the box culvert and pipe culvert design on US 60 from Station 474+00 to Station 796+00. All design work has been completed, to the best of knowledge, in compliance with ADOT design standards. It is recommended that these culvert sizes, median catch basins, outlet protection, and other appurtenances be installed for this section of US60.

Table 6

Box and Pipe Culvert Summary

US60: 203rd Ave (West) - Deer Valley Rd

Station	50 yr Flow (cfs)	100 yr Flow (cfs)	Exist Cond.	Proposed Cond.	Culvert Slope (ft/ft)	Exension or New	Removal	Outlet Protection	Catch Basin Type	Contributing Drainage Areas	Comments
480+00.	12	13	-	24" CMP	0.0051	New	-	Wire-tied Riprap	C-15.80	38B	outlets into roadside ditch
496+76	22	24	2-18" CMP	2-24" CMP / 2-30" CMP	0.0223 / 0.0053	New	2-18" CMP	Dumped Riprap	Junction Box	39,40	outlets into roadside ditch, 9 cfs off.
203rd Ave	124	136	-	2-36" RCP	0.0084	New	-	Wire-tied Riprap	-	AKa, AJa-d, 34, 38a-c, 39, 4C	offsite of 9 cfs (34 & Aka from Proj 3)
516+54	27	29	24" CMP	2-30" CMP	0.0170 / 0.0053	New	24" CMP	Dumped Riprap	Junction Box	41	outlets into roadside ditch, 14 cfs off.
547+51	4	5	-	24" RCP	0.0037	New	-	-	C-15.80	45	storm drain design, Appendix J
549+15	8	9	24" CMP	24" CMP	0.0033	Extension	-	Dumped Riprap	C-15.80	45	offsite of 13 cfs
556+75	89	98	48"x54" Oval CMP	2-48" CMP	0.0143	Extension	-	Dumped Riprap	Junction Box	46	offsite of 82 cfs
563+87	54	-	36" CMP	36" CMP	0.0128	New	36" CMP	Wire-tied Riprap	Junction Box	47	offsite flow not available
576+65	8	9	-	28"x20" CMPA	0.0070	New	-	-	C-15.90	49	-
576+95.94	515	518	3-10'x3' CBC	3-10'x3' CBC	0.0168	Extension	-	Wire-tied Riprap	-	49,50	offsite of 500 cfs
577+29	5	6	-	28"x20" CMPA	0.0050	New	-	-	C-15.90	50	-
601+00	13	14	-	24" RCP	0.0026	New	-	Wire-tied Riprap	C-15.80	51	outlets into roadside ditch
Conn 605	35	39	-	2-24" CMP	0.0050	New	-	Dumped Riprap	-	AW,51	-
622+07	13	14	-	28"x20" CMPA	0.015	New	-	-	C-15.90	52	-
622+37.74	513	518	2-10'x5' CBC	2-10'x5' CBC	0.005	Extension	-	Riprap Basin	-	53	outlets into roadside ditch
640+00	14	15	-	24" RCP	0.0053	New	-	Wire-tied Riprap	C-15.80	52	offsite of 500 cfs
Jomax Rd	38	42	-	2-30" CMP	0.005	New	-	Wire-tied Riprap	-	BA,53	-
647+98.47	312	376	5-8'x3' CBC	5-8'x3' CBC	0.0343	Extension	-	Riprap Basin	-	-	
662+37	136	150	3-36" CMP	3-36" CMP	0.0154	Extension	-	Dumped Riprap	Junction Box	54,55	offsite of 122 cfs
674+00	8	9	-	24" CMP	0.005	New	-	Wire-tied Riprap	C-15.80	56A	outlets into roadside ditch
685+42	21	23	24" CMP	36" CMP	0.0079	Extension	-	Dumped Riprap	Junction Box	56B	offsite of 13 cfs
698+00	8	9	-	24" CMP	0.0049	New	-	Dumped Riprap	C-15.80	57A	outlets into roadside ditch

Table 6

Box and Pipe Culvert Summary

US60: 203rd Ave (West) - Deer Valley Rd

Station	50 yr Flow (cfs)	100 yr Flow (cfs)	Exist Cond.	Proposed Cond.	Culvert Slope (ft/ft)	Exension or New	Removal	Outlet Protection	Catch Basin Type	Contributing Drainage Areas	Comments
708+00	10	11	-	24" CMP	0.0077	New	-	Dumped Riprap	C-15.80	57B	outlets into roadside ditch
Happy Valley	96	106	-	2-36" RCP	0.005	New	-	Wire-tied Riprap	-	BF,BG,56A,56B,57A,57B	offsite of 13 cfs
719+91	8	9	-	28"x20" CMPA	0.045	New	-	-	C-15.90	58	-
720+72.94	1032	1069	4-10'x4' CBC	4-10'x4' CBC	0.005	Extension	-	Concrete Lined	-	58	offsite of 1023 cfs
733+00	9	10	-	24" RCP	0.0051	New	-	Concrete Lined	C-15.80	59A	outlets into roadside ditch
745+00	8	9	-	24" RCP	0.005	New	-	Concrete Lined	C-15.80	59B	outlets into roadside ditch
755+00	8	9	-	24" CMP	0.005	New	-	Concrete Lined	C-15.80	59C	outlets into roadside ditch
Norwich	55	61	-	2-30" RCP	0.005	New	-	Concrete Lined	-	BK,59A,59B,59C	-
770+00	11	12	-	24" CMP	0.0074	New	-	Concrete Lined	C-15.80	60A	outlets into roadside ditch
781+35	8	9	-	28"x20" CMPA	0.0743	New	-	-	C-15.90	60B	-
782+07.54	622	744	3-8'x3' CBC	3-8'x3' CBC	0.0059	Extension	-	Riprap Basin	-	60B	offsite of 612 cfs
Bradley 19+60	-	-	-	24" CMP	0.0008	New	-	-	C-15.75	-	-
Frtg D 1627+05	616	678	-	3-10'x3' CBC	0.0086	New	-	Wire-tied Riprap	-	AW,AY,51,52,Fra	offsite of 500 cfs
Jomax 6+81.50	778	856	-	3-10'x4' CBC	0.0026	New	-	Wire-tied Riprap	-	AW,AY,51,52,Fra,Frb,JX	offsite of 500 cfs
Hap. Val. 8+00	27	-	-	35"x24" CMPA	0.0021	New	-	Dumped Riprap	-	-	Q based on culvert capacity
Hap. Val. 14+75	129	-	-	6'x3' CBC	0.01	New	-	Wire-tied Riprap	-	-	Q based on culvert capacity
Citrus/Happy	202	-	2-48" CMP	6'x4' CBC	0.003	New	2-48" CMP	Concrete Lined	-	-	Q based on culvert capacity
Citrus 29+85.50	253	-	2-54"x38" CMPA	6'x4' CBC	0.004	New	2-54"x38" CMPA	Wire-tied Riprap	-	-	Q based on culvert capacity

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4. Arizona Department Of Transportation, Wittmann - Beardsley US 60 Bridge Replacement, TRACS No. H2725 01 C, Project No. BRF-022-2(35), May 1993.

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6. Federal Highway Administration, HY-8, Culvert Analysis, Version 6.1.

7. Federal Highway Administration, Hydraulic Design of Energy Dissipators for Culverts and Channels, Hydraulic Engineering Circular No. 14, September 1983.

8. Federal Highway Administration, Hydraulic Design of Highway Culverts, Report No. FHWA-IP-85-15, HDS-5, September 1985.

9. Flood Control District of Maricopa County Drainage Design Manual for Maricopa County, Arizona, Volume 1 Hydrology, January 1, 1995.

10. Flood Control District of Maricopa County, Drainage Design Manual for Maricopa County, AZ, Volume II Hydraulics, January 28, 1996.

11. Flood Control District of Maricopa County, Wittmann Area Drainage Master Study (ADMS), 1989.

12. Drainage of Highway Pavements, Hydraulic Engineering Circular No. 12, March 1984.

13. Pima County Department of Transportation and Flood Control District, Drainage and Channel Design Standards for Local Drainage.

14. State of Arizona Department of Transportation, Highways Division, Structures Section, Drainage Manual, Volume 1, August 1987.

15. Sverdrup Civil, Final Design Concept Report, US 60 Morristown RROP to Beardsley Road, Federal Project No. STP-022-2-955 TRACS No. 060 MA 121H 3623 01 L, June 1996.

Appendices

Appendix A

HYS

Culvert Design

Backward Flow Analysis

BOX 576+95.94

CURRENT DATE: 06-22-2000 FILE DATE: 06-22-2000
CURRENT TIME: 10:19:51 FILE NAME: BOX577

****
********** FHWA CULVERT ANALYSIS **********
********** HY-8, VERSION 6.1 **********
****

CULV NO.	SITE DATA: INLET ELEV. (ft)	OUTLET ELEV. (ft)	CULVERT LENGTH (ft)	CULVERT SHAPE, MATERIAL, INLET: BARRELS SHAPE MATERIAL	SPAN (ft)	RISE (ft)	MANNING n	INLET TYPE
1	1520.85	1518.75	178.01	3 RCB	10.00	3.00	.013	CONVENTIONAL
2								
3								
4								
5								
6								

****

SUMMARY OF CULVERT FLOWS (cfs) FILE: BOX577 DATE: 06-22-2000

ELEV (ft)	TOTAL	1	2	3	4	5	6	ROADWAY	ITR	
1520.85	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	1	
1521.52	51.8	51.8	0.0	0.0	0.0	0.0	0.0	0.00	1	
1521.91	103.6	103.6	0.0	0.0	0.0	0.0	0.0	0.00	1	
1522.24	155.4	155.4	0.0	0.0	0.0	0.0	0.0	0.00	1	
1522.55	207.2	207.2	0.0	0.0	0.0	0.0	0.0	0.00	1	
1522.84	259.0	259.0	0.0	0.0	0.0	0.0	0.0	0.00	1	
1523.12	310.8	310.8	0.0	0.0	0.0	0.0	0.0	0.00	1	
1523.39	362.6	362.6	0.0	0.0	0.0	0.0	0.0	0.00	1	
1523.66	414.4	414.4	0.0	0.0	0.0	0.0	0.0	0.00	1	
1523.92	466.2	466.2	0.0	0.0	0.0	0.0	0.0	0.00	1	
1524.17	***515.0***	***515.0***	***0.0***	***0.0***	***0.0***	***0.0***	***0.0***	***0.00***	***1***	***Q50***
1526.19	859.3	859.3	0.0	0.0	0.0	0.0	0.0	OVERTOPPING		

****

1524.18 518.0 Q100

****

SUMMARY OF ITERATIVE SOLUTION ERRORS FILE: BOX577 DATE: 06-22-2000

HEAD ELEV (ft)	HEAD ERROR (ft)	TOTAL FLOW (cfs)	FLOW ERROR (cfs)	% FLOW ERROR
1520.85	0.000	0.00	0.00	0.00
1521.52	0.000	51.80	0.00	0.00
1521.91	0.000	103.60	0.00	0.00
1522.24	0.000	155.40	0.00	0.00
1522.55	0.000	207.20	0.00	0.00
1522.84	0.000	259.00	0.00	0.00
1523.12	0.000	310.80	0.00	0.00
1523.39	0.000	362.60	0.00	0.00
1523.66	0.000	414.40	0.00	0.00
1523.92	0.000	466.20	0.00	0.00
1524.17	0.000	515.00	0.00	0.00

****

<1> TOLERANCE (ft) = 0.010 <2> TOLERANCE (%) = 1.000

****

CURRENT DATE: 06-22-2000 FILE DATE: 06-22-2000
CURRENT TIME: 10:19:51 FILE NAME: BOX577

PERFORMANCE CURVE FOR CULVERT 1 - 3(10.00 (ft) BY 3.00 (ft)) RCB

DIS-CHARGE FLOW (cfs)	HEAD-WATER ELEV. (ft)	INLET CONTROL DEPTH (ft)	OUTLET CONTROL DEPTH (ft)	FLOW TYPE <F4>	NORMAL DEPTH (ft)	CRIT. DEPTH (ft)	OUTLET DEPTH (ft)	TW DEPTH (ft)	OUTLET VEL. (fps)	TW VEL. (fps)
0.00	1520.85	0.00	0.00	0-NF	0.00	0.00	0.00	0.00	0.00	0.00
51.80	1521.52	0.67	0.67	1-S2n	0.31	0.45	0.25	0.51	6.81	3.00
103.60	1521.91	1.06	1.06	1-S2n	0.47	0.72	0.42	0.78	8.23	3.89
155.40	1522.24	1.39	1.39	1-S2n	0.62	0.94	0.54	0.98	9.54	4.51
207.20	1522.55	1.70	1.70	1-S2n	0.73	1.14	0.64	1.17	10.75	5.00
259.00	1522.84	1.99	1.99	1-S2n	0.85	1.33	0.87	1.33	9.97	5.41
310.80	1523.12	2.27	2.27	1-S2n	0.96	1.50	0.90	1.48	11.55	5.77
362.60	1523.39	2.54	2.54	1-S2n	1.06	1.66	1.09	1.62	11.11	6.09
414.40	1523.65	2.80	2.80	1-S2n	1.15	1.81	1.19	1.75	11.60	6.37
466.20	1523.92	3.07	3.07	5-S2n	1.25	1.96	1.29	1.87	12.03	6.63
515.00	1524.17	3.32	3.32	5-S2n	1.33	2.10	1.39	1.98	12.38	6.86

El. inlet face invert 1520.85 ft El. outlet invert 1518.75 ft
El. inlet throat invert 0.00 ft El. inlet crest 0.00 ft

***** SITE DATA ***** CULVERT INVERT **********

INLET STATION	1866.00 ft
INLET ELEVATION	1520.85 ft
OUTLET STATION	2044.00 ft
OUTLET ELEVATION	1518.75 ft
NUMBER OF BARRELS	3
SLOPE (V/H)	0.0118
CULVERT LENGTH ALONG SLOPE	178.01 ft

***** CULVERT DATA SUMMARY **********

BARREL SHAPE	BOX
BARREL SPAN	10.00 ft
BARREL RISE	3.00 ft
BARREL MATERIAL	CONCRETE
BARREL MANNING'S n	0.013
INLET TYPE	CONVENTIONAL
INLET EDGE AND WALL	1:1 BEVEL (45 DEG. FLARE)
INLET DEPRESSION	NONE

CURRENT DATE: 06-22-2000 FILE DATE: 06-22-2000
CURRENT TIME: 10:19:51 FILE NAME: BOX577

****
********** TAILWATER **********
****

******* REGULAR CHANNEL CROSS SECTION **********

BOTTOM WIDTH	32.00 ft
SIDE SLOPE H/V (X:1)	3.0
CHANNEL SLOPE V/H (ft/ft)	0.013
MANNING'S n (.01-0.1)	0.035
CHANNEL INVERT ELEVATION	1518.75 ft
CULVERT NO.1 OUTLET INVERT ELEVATION	1518.75 ft

******* UNIFORM FLOW RATING CURVE FOR DOWNSTREAM CHANNEL

FLOW (cfs)	W.S.E. (ft)	FROUDE NUMBER	DEPTH (ft)	VEL. (f/s)	SHEAR (psf)
0.00	1518.75	0.000	0.00	0.00	0.00
51.80	1519.26	0.738	0.51	3.00	0.42
103.60	1519.53	0.779	0.78	3.89	0.63
155.40	1519.73	0.801	0.98	4.51	0.80
207.20	1519.92	0.817	1.17	5.00	0.95
259.00	1520.08	0.828	1.33	5.41	1.08
310.80	1520.23	0.837	1.48	5.77	1.20
362.60	1520.37	0.844	1.62	6.09	1.31
414.40	1520.50	0.850	1.75	6.37	1.42
466.20	1520.62	0.855	1.87	6.63	1.52
515.00	1520.73	0.859	1.98	6.86	1.61

****
********** ROADWAY OVERTOPPING DATA **********
****

WEIR COEFFICIENT	2.50
EMBANKMENT TOP WIDTH	48.00 ft
CREST LENGTH	100.00 ft
OVERTOPPING CREST ELEVATION	1526.19 ft

****

BOX 622+37.74

CURRENT DATE: 06-22-2000 FILE DATE: 06-22-2000
CURRENT TIME: 10:23:12 FILE NAME: BOX622

****
********** FHWA CULVERT ANALYSIS **********
********** HY-8, VERSION 6.1 **********
****

CULV NO.	SITE DATA: INLET ELEV. (ft)	OUTLET ELEV. (ft)	CULVERT LENGTH (ft)	CULVERT SHAPE, MATERIAL, INLET: BARRELS SHAPE MATERIAL	SPAN (ft)	RISE (ft)	MANNING n	INLET TYPE
1	1485.48	1484.89	180.00	2 RCB	10.00	5.00	.013	CONVENTIONAL
2								
3								
4								
5								
6								

****

SUMMARY OF CULVERT FLOWS (cfs) FILE: BOX622 DATE: 06-22-2000

ELEV (ft)	TOTAL	1	2	3	4	5	6	ROADWAY	ITR	
1485.48	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	1	
1486.36	51.8	51.8	0.0	0.0	0.0	0.0	0.0	0.00	1	
1486.88	103.6	103.6	0.0	0.0	0.0	0.0	0.0	0.00	1	
1487.32	155.4	155.4	0.0	0.0	0.0	0.0	0.0	0.00	1	
1487.71	207.2	207.2	0.0	0.0	0.0	0.0	0.0	0.00	1	
1488.07	259.0	259.0	0.0	0.0	0.0	0.0	0.0	0.00	1	
1488.43	310.8	310.8	0.0	0.0	0.0	0.0	0.0	0.00	1	
1488.77	362.6	362.6	0.0	0.0	0.0	0.0	0.0	0.00	1	
1489.09	414.4	414.4	0.0	0.0	0.0	0.0	0.0	0.00	1	
1489.41	466.2	466.2	0.0	0.0	0.0	0.0	0.0	0.00	1	
1489.69	***513.0***	***513.0***	***0.0***	***0.0***	***0.0***	***0.0***	***0.0***	***0.00***	***1***	***Q50***
1492.90	1030.9	1030.9	0.0	0.0	0.0	0.0	0.0	OVERTOPPING		

****

1489.72 518.0 Q100

****

SUMMARY OF ITERATIVE SOLUTION ERRORS FILE: BOX622 DATE: 06-22-2000

HEAD ELEV (ft)	HEAD ERROR (ft)	TOTAL FLOW (cfs)	FLOW ERROR (cfs)	% FLOW ERROR
1485.48	0.000	0.00	0.00	0.00
1486.36	0.000	51.80	0.00	0.00
1486.88	0.000	103.60	0.00	0.00
1487.32	0.000	155.40	0.00	0.00
1487.71	0.000	207.20	0.00	0.00
1488.07	0.000	259.00	0.00	0.00
1488.43	0.000	310.80	0.00	0.00
1488.77	0.000	362.60	0.00	0.00
1489.09	0.000	414.40	0.00	0.00
1489.41	0.000	466.20	0.00	0.00
1489.69	0.000	513.00	0.00	0.00

****

<1> TOLERANCE (ft) = 0.010 <2> TOLERANCE (%) = 1.000

****

CURRENT DATE: 06-22-2000 FILE DATE: 06-22-2000
CURRENT TIME: 10:23:12 FILE NAME: BOX622

PERFORMANCE CURVE FOR CULVERT 1 - 2(10.00 (ft) BY 5.00 (ft)) RCB

DIS-CHARGE FLOW (cfs)	HEAD-WATER ELEV. (ft)	INLET CONTROL DEPTH (ft)	OUTLET CONTROL DEPTH (ft)	FLOW TYPE <F4>	NORMAL DEPTH (ft)	CRIT. DEPTH (ft)	OUTLET DEPTH (ft)	TW DEPTH (ft)	OUTLET VEL. (fps)	TW VEL. (fps)
0.00	1485.48	0.00	0.00	0-NF	0.00	0.00	0.00	0.00	0.00	0.00
51.80	1486.36	0.88	0.88	1-S2n	0.58	0.59	0.49	0.61	5.24	2.54
103.60	1486.88	1.40	1.40	1-S2n	0.92	0.94	0.84	0.91	6.14	3.25
155.40	1487.32	1.84	1.84	1-S2n	1.19	1.24	1.14	1.16	6.84	3.75
207.20	1487.71	2.23	2.23	1-S2n	1.45	1.50	1.40	1.37	7.42	4.15
259.00	1488.07	2.59	2.59	1-S2n	1.68	1.74	1.68	1.55	7.72	4.47
310.80	1488.43	2.95	2.95	1-S2n	1.90	1.96	1.90	1.73	8.17	4.76
362.60	1488.77	3.29	3.29	1-S2n	2.11	2.17	2.10	1.89	8.62	5.01
414.40	1489.09	3.61	3.61	1-S2n	2.31	2.38	2.32	2.04	8.95	5.24
466.20	1489.41	3.93	3.93	1-S2n	2.51	2.57	2.51	2.17	9.29	5.45
513.00	1489.69	4.21	4.21	1-S2n	2.68	2.74	2.68	2.29	9.57	5.64

El. inlet face invert 1485.48 ft El. outlet invert 1484.89 ft
El. inlet throat invert 0.00 ft El. inlet crest 0.00 ft

***** SITE DATA ***** CULVERT INVERT **********

INLET STATION	1863.00 ft
INLET ELEVATION	1485.48 ft
OUTLET STATION	2043.00 ft
OUTLET ELEVATION	1484.89 ft
NUMBER OF BARRELS	2
SLOPE (V/H)	0.0033
CULVERT LENGTH ALONG SLOPE	180.00 ft

***** CULVERT DATA SUMMARY **********

BARREL SHAPE	BOX
BARREL SPAN	10.00 ft
BARREL RISE	5.00 ft
BARREL MATERIAL	CONCRETE
BARREL MANNING'S n	0.013
INLET TYPE	CONVENTIONAL
INLET EDGE AND WALL	1:1 BEVEL (45 DEG. FLARE)
INLET DEPRESSION	NONE

CURRENT DATE: 06-22-2000 FILE DATE: 06-22-2000
CURRENT TIME: 10:23:12 FILE NAME: BOX622

****
********** TAILWATER **********
****

***** USER DEFINED CHANNEL CROSS-SECTION FILE NAME: BOX622
MAIN CHANNEL ONLY FILE DATE: 04-20-2000

LEFT CHANNEL BOUNDARY	0
RIGHT CHANNEL BOUNDARY	0
MANNING n LEFT OVER BANK	0.000
MANNING n MAIN CHANNEL	0.035
MANNING n RIGHT OVER BANK	0.000
SLOPE OF CHANNEL	0.0075 ft/ft

CROSS-SECTION COORD. NO.	X (ft)	Y (ft)
1	100.00	1489.00
2	109.00	1484.89
3	141.00	1484.89
4	151.00	1487.00

******* UNIFORM FLOW RATING CURVE FOR DOWNSTREAM CHANNEL

FLOW (cfs)	W.S.E. (ft)	FROUDE NUMBER	DEPTH (ft)	VEL. (f/s)	SHEAR (psf)
0.00	1484.89	0.000	0.00	0.00	0.00
51.80	1485.50	0.589	0.61	2.54	0.27
103.60	1485.80	0.626	0.91	3.25	0.39
155.40	1486.05	0.648	1.16	3.75	0.48
207.20	1486.26	0.664	1.37	4.15	0.56
259.00	1486.44	0.677	1.55	4.47	0.63
310.80	1486.62	0.687	1.73	4.76	0.69
362.60	1486.78	0.695	1.89	5.01	0.74
414.40	1486.93	0.703	2.04	5.24	0.80
466.20	1487.06	0.709	2.17	5.45	0.85
513.00	1487.18	0.715	2.29	5.64	0.89

Note: Shear stress was calculated using R.

****
********** ROADWAY OVERTOPPING DATA **********
****

WEIR COEFFICIENT	2.50
EMBANKMENT TOP WIDTH	38.00 ft
CREST LENGTH	100.00 ft
OVERTOPPING CREST ELEVATION	1492.90 ft

****

BOX 647+98.47

CURRENT DATE: 06-22-2000 FILE DATE: 06-22-2000
CURRENT TIME: 10:26:26 FILE NAME: BOX648

****
********** FHWA CULVERT ANALYSIS **********
********** HY-8, VERSION 6.1 **********
****

CULV NO.	SITE DATA: INLET ELEV. (ft)	OUTLET ELEV. (ft)	CULVERT LENGTH (ft)	CULVERT SHAPE, MATERIAL, INLET: BARRELS SHAPE MATERIAL	SPAN (ft)	RISE (ft)	MANNING n	INLET TYPE
1	1467.72	1463.50	220.04	5 RCB	8.00	3.00	.013	CONVENTIONAL
2								
3								
4								
5								
6								

****

SUMMARY OF CULVERT FLOWS (cfs) FILE: BOX648 DATE: 06-22-2000

ELEV (ft)	TOTAL	1	2	3	4	5	6	ROADWAY	ITR	
1467.72	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	1	
1468.16	37.6	37.6	0.0	0.0	0.0	0.0	0.0	0.00	1	
1468.42	75.2	75.2	0.0	0.0	0.0	0.0	0.0	0.00	1	
1468.64	112.8	112.8	0.0	0.0	0.0	0.0	0.0	0.00	1	
1468.83	150.4	150.4	0.0	0.0	0.0	0.0	0.0	0.00	1	
1469.02	188.0	188.0	0.0	0.0	0.0	0.0	0.0	0.00	1	
1469.18	225.6	225.6	0.0	0.0	0.0	0.0	0.0	0.00	1	
1469.35	263.2	263.2	0.0	0.0	0.0	0.0	0.0	0.00	1	
1469.52	300.8	300.8	0.0	0.0	0.0	0.0	0.0	0.00	1	
1469.56	***312.0***	***312.0***	***0.0***	***0.0***	***0.0***	***0.0***	***0.0***	***0.00***	***1***	***Q50***
1469.83	**376.0**	**376.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.00**	**1**	
1472.43	1019.7	1019.7	0.0	0.0	0.0	0.0	0.0	OVERTOPPING		

****

SUMMARY OF ITERATIVE SOLUTION ERRORS FILE: BOX648 DATE: 06-22-2000

HEAD ELEV (ft)	HEAD ERROR (ft)	TOTAL FLOW (cfs)	FLOW ERROR (cfs)	% FLOW ERROR
1467.72	0.000	0.00	0.00	0.00
1468.16	0.000	37.60	0.00	0.00
1468.42	0.000	75.20	0.00	0.00
1468.64	0.000	112.80	0.00	0.00
1468.83	0.000	150.40	0.00	0.00
1469.02	0.000	188.00	0.00	0.00
1469.18	0.000	225.60	0.00	0.00
1469.35	0.000	263.20	0.00	0.00
1469.52	0.000	300.80	0.00	0.00
1469.56	0.000	312.00	0.00	0.00
1469.83	0.000	376.00	0.00	0.00

****

<1> TOLERANCE (ft) = 0.010 <2> TOLERANCE (%) = 1.000

****

CURRENT DATE: 06-22-2000 FILE DATE: 06-22-2000
CURRENT TIME: 10:26:26 FILE NAME: BOX648

PERFORMANCE CURVE FOR CULVERT 1 - 5(8.00 (ft) BY 3.00 (ft)) RCB

DIS-CHARGE FLOW (cfs)	HEAD-WATER ELEV. (ft)	INLET CONTROL DEPTH (ft)	OUTLET CONTROL DEPTH (ft)	FLOW TYPE <F4>	NORMAL DEPTH (ft)	CRIT. DEPTH (ft)	OUTLET DEPTH (ft)	TW DEPTH (ft)	OUTLET VEL. (fps)	TW VEL. (fps)
0.00	1467.72	0.00	0.00	0-NF	0.00	0.00	0.00	0.00	0.00	0.00
37.60	1468.16	0.44	0.44	1-S2n	0.14	0.30	0.10	0.35	9.19	1.80
75.20	1468.42	0.70	0.70	1-S2n	0.28	0.48	0.18	0.52	10.45	2.36
112.80	1468.64	0.92	0.92	1-S2n	0.36	0.63	0.23	0.67	12.33	2.77
150.40	1468.84	1.12	1.12	1-S2n	0.43	0.76	0.36	0.80	10.40	3.10
188.00	1469.01	1.29	1.29	1-S2n	0.49	0.88	0.38	0.91	12.24	3.38
225.60	1469.18	1.46	1.46	1-S2n	0.56	1.00	0.50	1.01	11.32	3.63
263.20	1469.35	1.63	1.63	1-S2n	0.62	1.11	0.51	1.11	13.00	3.85
300.80	1469.51	1.79	1.79	1-S2n	0.67	1.21	0.61	1.20	12.35	4.06
312.00	1469.56	1.84	1.84	1-S2n	0.69	1.24	0.64	1.23	12.21	4.11
376.00	1469.83	2.11	2.11	1-S2n	0.78	1.40	0.70	1.38	13.37	4.42

El. inlet face invert 1467.72 ft El. outlet invert 1463.50 ft
El. inlet throat invert 0.00 ft El. inlet crest 0.00 ft

***** SITE DATA ***** CULVERT INVERT **********

INLET STATION	1838.50 ft
INLET ELEVATION	1467.72 ft
OUTLET STATION	2058.50 ft
OUTLET ELEVATION	1463.50 ft
NUMBER OF BARRELS	5
SLOPE (V/H)	0.0192
CULVERT LENGTH ALONG SLOPE	220.04 ft

***** CULVERT DATA SUMMARY **********

BARREL SHAPE	BOX
BARREL SPAN	8.00 ft
BARREL RISE	3.00 ft
BARREL MATERIAL	CONCRETE
BARREL MANNING'S n	0.013
INLET TYPE	CONVENTIONAL
INLET EDGE AND WALL	1:1 BEVEL (45 DEG. FLARE)
INLET DEPRESSION	NONE

CURRENT DATE: 06-22-2000 FILE DATE: 06-22-2000
CURRENT TIME: 10:26:26 FILE NAME: BOX648

****
********** TAILWATER **********
****

******* REGULAR CHANNEL CROSS SECTION **********

BOTTOM WIDTH	60.00 ft
SIDE SLOPE H/V (X:1)	1.3
CHANNEL SLOPE V/H (ft/ft)	0.007
MANNING'S n (.01-0.1)	0.035
CHANNEL INVERT ELEVATION	1463.50 ft
CULVERT NO.1 OUTLET INVERT ELEVATION	1463.50 ft

******* UNIFORM FLOW RATING CURVE FOR DOWNSTREAM CHANNEL

FLOW (cfs)	W.S.E. (ft)	FROUDE NUMBER	DEPTH (ft)	VEL. (f/s)	SHEAR (psf)
0.00	1463.50	0.000	0.00	0.00	0.00
37.60	1463.85	0.539	0.35	1.80	0.16
75.20	1464.02	0.575	0.52	2.36	0.25
112.80	1464.17	0.597	0.67	2.77	0.31
150.40	1464.30	0.613	0.80	3.10	0.37
188.00	1464.41	0.625	0.91	3.38	0.43
225.60	1464.51	0.635	1.01	3.63	0.47
263.20	1464.61	0.644	1.11	3.85	0.52
300.80	1464.70	0.651	1.20	4.06	0.56
312.00	1464.73	0.654	1.23	4.11	0.58
376.00	1464.88	0.664	1.38	4.42	0.64

****
********** ROADWAY OVERTOPPING DATA **********
****

WEIR COEFFICIENT	2.50
EMBANKMENT TOP WIDTH	38.00 ft
CREST LENGTH	100.00 ft
OVERTOPPING CREST ELEVATION	1472.43 ft

****

BOX 720+72.94

CURRENT DATE: 06-22-2000 FILE DATE: 06-22-2000
CURRENT TIME: 10:27:52 FILE NAME: BOX720

****
********** FHWA CULVERT ANALYSIS **********
********** HY-8, VERSION 6.1 **********
****

CULV NO.	SITE DATA: INLET ELEV. (ft)	OUTLET ELEV. (ft)	CULVERT LENGTH (ft)	CULVERT SHAPE, MATERIAL, INLET: BARRELS SHAPE MATERIAL	SPAN (ft)	RISE (ft)	MANNING n	INLET TYPE
1	1416.09	1415.25	221.00	4 RCB	10.00	4.00	.013	CONVENTIONAL
2								
3								
4								
5								
6								

****

SUMMARY OF CULVERT FLOWS (cfs) FILE: BOX720 DATE: 06-22-2000

ELEV (ft)	TOTAL	1	2	3	4	5	6	ROADWAY	ITR	
1416.09	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	1	
1416.99	106.9	106.9	0.0	0.0	0.0	0.0	0.0	0.00	1	
1417.52	213.8	213.8	0.0	0.0	0.0	0.0	0.0	0.00	1	
1417.96	320.7	320.7	0.0	0.0	0.0	0.0	0.0	0.00	1	
1418.38	427.6	427.6	0.0	0.0	0.0	0.0	0.0	0.00	1	
1418.77	534.5	534.5	0.0	0.0	0.0	0.0	0.0	0.00	1	
1419.15	641.4	641.4	0.0	0.0	0.0	0.0	0.0	0.00	1	
1419.51	748.3	748.3	0.0	0.0	0.0	0.0	0.0	0.00	1	
1420.14	855.2	855.2	0.0	0.0	0.0	0.0	0.0	0.00	1	
1420.63	962.1	962.1	0.0	0.0	0.0	0.0	0.0	0.00	1	
1420.95	***1032.0***	***1032.0***	***0.0***	***0.0***	***0.0***	***0.0***	***0.0***	***0.00***	***1***	***Q50***
1422.06	1228.3	1228.3	0.0	0.0	0.0	0.0	0.0	OVERTOPPING		

****

1421.13 1069.0 Q100

****

SUMMARY OF ITERATIVE SOLUTION ERRORS FILE: BOX720 DATE: 06-22-2000

HEAD ELEV (ft)	HEAD ERROR (ft)	TOTAL FLOW (cfs)	FLOW ERROR (cfs)	% FLOW ERROR
1416.09	0.000	0.00	0.00	0.00
1416.99	0.000	106.90	0.00	0.00
1417.52	0.000	213.80	0.00	0.00
1417.96	0.000	320.70	0.00	0.00
1418.38	0.000	427.60	0.00	0.00
1418.77	0.000	534.50	0.00	0.00
1419.15	0.000	641.40	0.00	0.00
1419.51	0.000	748.30	0.00	0.00
1420.14	0.000	855.20	0.00	0.00
1420.63	0.000	962.10	0.00	0.00
1420.95	0.000	1032.00	0.00	0.00

****

<1> TOLERANCE (ft) = 0.010 <2> TOLERANCE (%) = 1.000

****

CURRENT DATE: 06-22-2000 FILE DATE: 06-22-2000
CURRENT TIME: 10:27:52 FILE NAME: BOX720

PERFORMANCE CURVE FOR CULVERT 1 - 4(10.00 (ft) BY 4.00 (ft)) RCB

DIS-CHARGE FLOW (cfs)	HEAD-WATER ELEV. (ft)	INLET CONTROL DEPTH (ft)	OUTLET CONTROL DEPTH (ft)	FLOW TYPE <F4>	NORMAL DEPTH (ft)	CRIT. DEPTH (ft)	OUTLET DEPTH (ft)	TW DEPTH (ft)	OUTLET VEL. (fps)	TW VEL. (fps)
0.00	1416.09	0.00	0.00	0-NF	0.00	0.00	0.00	0.00	0.00	0.00
106.90	1416.99	0.90	0.90	1-S2n	0.56	0.61	0.51	1.24	5.28	3.83
213.80	1417.52	1.43	1.43	1-S2n	0.90	0.96	0.76	1.86	7.01	4.85
320.70	1417.97	1.88	1.88	1-S2n	1.17	1.26	1.06	2.34	7.55	5.54
427.60	1418.38	2.29	2.29	1-S2n	1.41	1.53	1.33	2.76	8.05	6.07
534.50	1418.77	2.68	2.68	1-S2n	1.64	1.77	1.57	3.13	8.49	6.51
641.40	1419.15	3.06	3.06	1-S2n	1.85	2.00	1.80	3.46	8.89	6.88
748.30	1419.51	3.42	3.42	1-S2n	2.06	2.22	2.06	3.77	9.07	7.21
855.20	1420.14	3.77	4.05	4-FFt	2.25	2.43	4.00	4.06	5.35	7.50
962.10	1420.62	4.12	4.53	4-FFt	2.45	2.62	4.00	4.32	6.01	7.77
1032.00	1420.95	4.35	4.86	4-FFt	2.57	2.75	4.00	4.49	6.45	7.93

El. inlet face invert 1416.09 ft El. outlet invert 1415.25 ft
El. inlet throat invert 0.00 ft El. inlet crest 0.00 ft

***** SITE DATA ***** CULVERT INVERT **********

INLET STATION	1838.00 ft
INLET ELEVATION	1416.09 ft
OUTLET STATION	2059.00 ft
OUTLET ELEVATION	1415.25 ft
NUMBER OF BARRELS	4
SLOPE (V/H)	0.0038
CULVERT LENGTH ALONG SLOPE	221.00 ft

***** CULVERT DATA SUMMARY **********

BARREL SHAPE	BOX
BARREL SPAN	10.00 ft
BARREL RISE	4.00 ft
BARREL MATERIAL	CONCRETE
BARREL MANNING'S n	0.013
INLET TYPE	CONVENTIONAL
INLET EDGE AND WALL	1:1 BEVEL (45 DEG. FLARE)
INLET DEPRESSION	NONE

CURRENT DATE: 06-22-2000 FILE DATE: 06-22-2000
CURRENT TIME: 10:27:52 FILE NAME: BOX720

****
********** TAILWATER **********
****

******* REGULAR CHANNEL CROSS SECTION **********

BOTTOM WIDTH	20.00 ft
SIDE SLOPE H/V (X:1)	2.0
CHANNEL SLOPE V/H (ft/ft)	0.001
MANNING'S n (.01-0.1)	0.013
CHANNEL INVERT ELEVATION	1415.25 ft
CULVERT NO.1 OUTLET INVERT ELEVATION	1415.25 ft

******* UNIFORM FLOW RATING CURVE FOR DOWNSTREAM CHANNEL

FLOW (cfs)	W.S.E. (ft)	FROUDE NUMBER	DEPTH (ft)	VEL. (f/s)	SHEAR (psf)
0.00	1415.25	0.000	0.00	0.00	0.00
106.90	1416.49	0.606	1.24	3.83	0.08
213.80	1417.11	0.627	1.86	4.85	0.12
320.70	1417.59	0.638	2.34	5.54	0.15
427.60	1418.01	0.644	2.76	6.07	0.17
534.50	1418.38	0.649	3.13	6.51	0.19
641.40	1418.71	0.652	3.46	6.88	0.22
748.30	1419.02	0.655	3.77	7.21	0.23
855.20	1419.31	0.657	4.06	7.50	0.25
962.10	1419.57	0.658	4.32	7.77	0.27
1032.00	1419.74	0.659	4.49	7.93	0.28

****
********** ROADWAY OVERTOPPING DATA **********
****

WEIR COEFFICIENT	2.50
EMBANKMENT TOP WIDTH	38.00 ft
CREST LENGTH	100.00 ft
OVERTOPPING CREST ELEVATION	1422.06 ft

****

BOX 782+07.54

CURRENT DATE: 06-22-2000 FILE DATE: 06-22-2000
CURRENT TIME: 10:29:57 FILE NAME: BOX782

****
********** FHWA CULVERT ANALYSIS **********
********** HY-8, VERSION 6.1 **********
****

CULV NO.	SITE DATA: INLET ELEV. (ft)	OUTLET ELEV. (ft)	CULVERT LENGTH (ft)	CULVERT SHAPE, MATERIAL, INLET: BARRELS SHAPE MATERIAL	SPAN (ft)	RISE (ft)	MANNING n	INLET TYPE
1	1375.18	1374.00	219.00	3 RCB	8.00	3.00	.013	CONVENTIONAL
2								
3								
4								
5								
6								

****

SUMMARY OF CULVERT FLOWS (cfs) FILE: BOX782 DATE: 06-22-2000

ELEV (ft)	TOTAL	1	2	3	4	5	6	ROADWAY	ITR	
1375.18	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	1	
1376.17	74.4	74.4	0.0	0.0	0.0	0.0	0.0	0.00	1	
1376.76	148.8	148.8	0.0	0.0	0.0	0.0	0.0	0.00	1	
1377.29	223.2	223.2	0.0	0.0	0.0	0.0	0.0	0.00	1	
1377.78	297.6	297.6	0.0	0.0	0.0	0.0	0.0	0.00	1	
1378.25	372.0	372.0	0.0	0.0	0.0	0.0	0.0	0.00	1	
1378.73	446.4	446.4	0.0	0.0	0.0	0.0	0.0	0.00	1	
1379.24	520.8	520.8	0.0	0.0	0.0	0.0	0.0	0.00	1	
1379.78	595.2	595.2	0.0	0.0	0.0	0.0	0.0	0.00	1	
1379.99	***622.0***	***622.0***	***0.0***	***0.0***	***0.0***	***0.0***	***0.0***	***0.00***	***1***	***Q50***
1380.94	**744.0**	**730.4**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**13.10**	**3**	**Q100**
1380.80	718.0	718.0	0.0	0.0	0.0	0.0	0.0	OVERTOPPING		

****

SUMMARY OF ITERATIVE SOLUTION ERRORS FILE: BOX782 DATE: 06-22-2000

HEAD ELEV (ft)	HEAD ERROR (ft)	TOTAL FLOW (cfs)	FLOW ERROR (cfs)	% FLOW ERROR
1375.18	0.000	0.00	0.00	0.00
1376.17	0.000	74.40	0.00	0.00
1376.76	0.000	148.80	0.00	0.00
1377.29	0.000	223.20	0.00	0.00
1377.78	0.000	297.60	0.00	0.00
1378.25	0.000	372.00	0.00	0.00
1378.73	0.000	446.40	0.00	0.00
1379.24	0.000	520.80	0.00	0.00
1379.78	0.000	595.20	0.00	0.00
1379.99	0.000	622.00	0.00	0.00
1380.94	-0.002	744.00	0.48	0.06

****

<1> TOLERANCE (ft) = 0.010 <2> TOLERANCE (%) = 1.000

****

CURRENT DATE: 06-22-2000 FILE DATE: 06-22-2000
CURRENT TIME: 10:29:57 FILE NAME: BOX782

PERFORMANCE CURVE FOR CULVERT 1 - 3(8.00 (ft) BY 3.00 (ft)) RCB

DIS-CHARGE FLOW (cfs)	HEAD-WATER ELEV. (ft)	INLET CONTROL DEPTH (ft)	OUTLET CONTROL DEPTH (ft)	FLOW TYPE <F4>	NORMAL DEPTH (ft)	CRIT. DEPTH (ft)	OUTLET DEPTH (ft).	TW DEPTH (ft)	OUTLET VEL. (fps)	TW VEL. (fps)
0.00	1375.18	0.00	0.00	0-NF	0.00	0.00	0.00	0.00	0.00	0.00
74.40	1376.17	0.99	0.99	1-S2n	0.58	0.67	0.47	0.97	6.60	3.29
148.80	1376.76	1.58	1.58	1-S2n	0.90	1.06	0.89	1.45	6.94	4.15
223.20	1377.29	2.11	2.11	1-S2n	1.18	1.39	1.09	1.82	8.51	4.73
297.60	1377.78	2.60	2.60	1-S2n	1.42	1.69	1.43	2.14	8.69	5.17
372.00	1378.25	3.07	3.07	5-S2n	1.65	1.96	1.56	2.41	9.95	5.53
446.40	1378.73	3.55	3.55	5-S2n	1.88	2.21	1.81	2.67	10.27	5.84
520.80	1379.24	4.06	4.06	5-S2n	2.09	2.45	2.10	2.90	10.34	6.12
595.20	1379.78	4.60	4.21	4-FFt	2.29	2.68	2.29	3.11	10.83	6.36
622.00	1379.99	4.81	4.50	4-FFt	2.36	2.76	2.36	3.18	10.96	6.44
730.42	1380.94	5.72	5.76	4-FFt	2.65	3.00	3.00	3.50	10.14	6.78

El. inlet face invert 1375.18 ft El. outlet invert 1374.00 ft
El. inlet throat invert 0.00 ft El. inlet crest 0.00 ft

***** SITE DATA ***** CULVERT INVERT **********

INLET STATION	1839.00 ft
INLET ELEVATION	1375.18 ft
OUTLET STATION	2058.00 ft
OUTLET ELEVATION	1374.00 ft
NUMBER OF BARRELS	3
SLOPE (V/H)	0.0054
CULVERT LENGTH ALONG SLOPE	219.00 ft

***** CULVERT DATA SUMMARY **********

BARREL SHAPE	BOX
BARREL SPAN	8.00 ft
BARREL RISE	3.00 ft
BARREL MATERIAL	CONCRETE
BARREL MANNING'S n	0.013
INLET TYPE	CONVENTIONAL
INLET EDGE AND WALL	1:1 BEVEL (45 DEG. FLARE)
INLET DEPRESSION	NONE

CURRENT DATE: 06-22-2000 FILE DATE: 06-22-2000
CURRENT TIME: 10:29:57 FILE NAME: BOX782

****
********** TAILWATER **********
****

******* REGULAR CHANNEL CROSS SECTION **********

BOTTOM WIDTH	20.00 ft
SIDE SLOPE H/V (X:1)	3.3
CHANNEL SLOPE V/H (ft/ft)	0.007
MANNING'S n (.01-0.1)	0.035
CHANNEL INVERT ELEVATION	1374.00 ft
CULVERT NO.1 OUTLET INVERT ELEVATION	1374.00 ft

******* UNIFORM FLOW RATING CURVE FOR DOWNSTREAM CHANNEL

FLOW (cfs)	W.S.E. (ft)	FROUDE NUMBER	DEPTH (ft)	VEL. (f/s)	SHEAR (psf)
0.00	1374.00	0.000	0.00	0.00	0.00
74.40	1374.97	0.588	0.97	3.29	0.46
148.80	1375.45	0.608	1.45	4.15	0.68
223.20	1375.82	0.617	1.82	4.73	0.85
297.60	1376.14	0.623	2.14	5.17	1.00
372.00	1376.41	0.628	2.41	5.53	1.13
446.40	1376.67	0.631	2.67	5.84	1.25
520.80	1376.90	0.634	2.90	6.12	1.36
595.20	1377.11	0.636	3.11	6.36	1.46
622.00	1377.18	0.636	3.18	6.44	1.49
744.00	1377.50	0.639	3.50	6.78	1.64

****
********** ROADWAY OVERTOPPING DATA **********
****

WEIR COEFFICIENT	2.50
EMBANKMENT TOP WIDTH	38.00 ft
CREST LENGTH	100.00 ft
OVERTOPPING CREST ELEVATION	1380.80 ft

****

Box Frontage Road D Station 1627+05

CURRENT DATE: 02-15-2001 FILE DATE: 02-15-2001
CURRENT TIME: 10:40:02 FILE NAME: BOXFRD

****
********** FHWA CULVERT ANALYSIS **********
********** HY-8, VERSION 6.1 **********
****

CULV NO.	SITE DATA: INLET ELEV. (ft)	OUTLET ELEV. (ft)	CULVERT LENGTH (ft)	CULVERT SHAPE, MATERIAL, INLET: BARRELS SHAPE MATERIAL	SPAN (ft)	RISE (ft)	MANNING n	INLET TYPE
1	1480.63	1479.70	108.00	3 RCB	10.00	3.00	.013	CONVENTIONAL
2								
3								
4								
5								
6								

****

SUMMARY OF CULVERT FLOWS (cfs) FILE: BOXFRD DATE: 02-15-2001

ELEV (ft)	TOTAL	1	2	3	4	5	6	ROADWAY	ITR	
1480.63	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	1	
1481.43	67.8	67.8	0.0	0.0	0.0	0.0	0.0	0.00	1	
1481.90	135.6	135.6	0.0	0.0	0.0	0.0	0.0	0.00	1	
1482.31	203.4	203.4	0.0	0.0	0.0	0.0	0.0	0.00	1	
1482.69	271.2	271.2	0.0	0.0	0.0	0.0	0.0	0.00	1	
1483.05	339.0	339.0	0.0	0.0	0.0	0.0	0.0	0.00	1	
1483.40	406.8	406.8	0.0	0.0	0.0	0.0	0.0	0.00	1	
1483.74	474.6	474.6	0.0	0.0	0.0	0.0	0.0	0.00	1	
1484.16	542.4	542.4	0.0	0.0	0.0	0.0	0.0	0.00	1	
1484.61	610.2	610.2	0.0	0.0	0.0	0.0	0.0	0.00	1	
1484.65	***616.0***	***616.0***	***0.0***	***0.0***	***0.0***	***0.0***	***0.0***	***0.00***	***1***	***Q50***
1485.48	731.0	731.0	0.0	0.0	0.0	0.0	0.0	OVERTOPPING		

****

1485.08 678.0 Q100

****

SUMMARY OF ITERATIVE SOLUTION ERRORS FILE: BOXFRD DATE: 02-15-2001

HEAD ELEV (ft)	HEAD ERROR (ft)	TOTAL FLOW (cfs)	FLOW ERROR (cfs)	% FLOW ERROR
1480.63	0.000	0.00	0.00	0.00
1481.43	0.000	67.80	0.00	0.00
1481.90	0.000	135.60	0.00	0.00
1482.31	0.000	203.40	0.00	0.00
1482.69	0.000	271.20	0.00	0.00
1483.05	0.000	339.00	0.00	0.00
1483.40	0.000	406.80	0.00	0.00
1483.74	0.000	474.60	0.00	0.00
1484.16	0.000	542.40	0.00	0.00
1484.61	0.000	610.20	0.00	0.00
1484.65	0.000	616.00	0.00	0.00

****

<1> TOLERANCE (ft) = 0.010 <2> TOLERANCE (%) = 1.000

****

CURRENT DATE: 02-15-2001 FILE DATE: 02-15-2001
CURRENT TIME: 10:40:02 FILE NAME: BOXFRD

PERFORMANCE CURVE FOR CULVERT 1 - 3(10.00 (ft) BY 3.00 (ft)) RCB

DIS-CHARGE FLOW (cfs)	HEAD-WATER ELEV. (ft)	INLET CONTROL DEPTH (ft)	OUTLET CONTROL DEPTH (ft)	FLOW TYPE <F4>	NORMAL DEPTH (ft)	CRIT. DEPTH (ft)	OUTLET DEPTH (ft)	TW DEPTH (ft)	OUTLET VEL. (fps)	TW VEL. (fps)
0.00	1480.63	0.00	0.00	0-NF	0.00	0.00	0.00	0.50	0.00	0.00
67.80	1481.43	0.80	0.80	1-S2n	0.39	0.54	0.34	1.40	6.60	2.81
135.60	1481.90	1.27	1.27	1-S2n	0.63	0.86	0.56	1.86	8.06	3.61
203.40	1482.31	1.68	1.68	1-S2n	0.80	1.13	0.73	2.22	9.31	4.16
271.20	1482.69	2.06	2.06	1-S2n	0.97	1.37	1.00	2.53	9.00	4.59
339.00	1483.05	2.42	2.42	1-S2n	1.12	1.59	1.17	2.82	9.69	4.94
406.80	1483.40	2.77	2.77	1-S1f	1.26	1.79	1.90	3.07	7.14	5.25
474.60	1483.74	3.11	3.09	4-FFt	1.40	1.99	1.40	3.31	11.31	5.52
542.40	1484.15	3.46	3.52	4-FFt	1.53	2.17	3.00	3.53	6.03	5.76
610.20	1484.61	3.83	3.98	4-FFt	1.65	2.35	3.00	3.74	6.78	5.98
616.00	1484.65	3.86	4.02	4-FFt	1.66	2.36	3.00	3.76	6.84	6.00

El. inlet face invert 1480.63 ft El. outlet invert 1479.70 ft
El. inlet throat invert 0.00 ft El. inlet crest 0.00 ft

***** SITE DATA ***** CULVERT INVERT **********

INLET STATION	1946.00 ft
INLET ELEVATION	1480.63 ft
OUTLET STATION	2054.00 ft
OUTLET ELEVATION	1479.70 ft
NUMBER OF BARRELS	3
SLOPE (V/H)	0.0086
CULVERT LENGTH ALONG SLOPE	108.00 ft

***** CULVERT DATA SUMMARY **********

BARREL SHAPE	BOX
BARREL SPAN	10.00 ft
BARREL RISE	3.00 ft
BARREL MATERIAL	CONCRETE
BARREL MANNING'S n	0.013
INLET TYPE	CONVENTIONAL
INLET EDGE AND WALL	1:1 BEVEL (45 DEG. FLARE)
INLET DEPRESSION	NONE

CURRENT DATE: 02-15-2001 FILE DATE: 02-15-2001
CURRENT TIME: 10:40:02 FILE NAME: BOXFRD

****
********** TAILWATER **********
****

******* REGULAR CHANNEL CROSS SECTION **********

BOTTOM WIDTH	25.00 ft
SIDE SLOPE H/V (X:1)	2.0
CHANNEL SLOPE V/H (ft/ft)	0.006
MANNING'S n (.01-0.1)	0.035
CHANNEL INVERT ELEVATION	1480.20 ft
CULVERT NO.1 OUTLET INVERT ELEVATION	1479.70 ft

******* UNIFORM FLOW RATING CURVE FOR DOWNSTREAM CHANNEL

FLOW (cfs)	W.S.E. (ft)	FROUDE NUMBER	DEPTH (ft)	VEL. (f/s)	SHEAR (psf)
0.00	1480.20	0.000	0.00	0.00	0.00
67.80	1481.10	0.522	0.90	2.81	0.31
135.60	1481.56	0.546	1.36	3.61	0.47
203.40	1481.92	0.558	1.72	4.16	0.60
271.20	1482.23	0.567	2.03	4.59	0.71
339.00	1482.52	0.572	2.32	4.94	0.81
406.80	1482.77	0.577	2.57	5.25	0.90
474.60	1483.01	0.581	2.81	5.52	0.98
542.40	1483.23	0.583	3.03	5.76	1.06
610.20	1483.44	0.586	3.24	5.98	1.13
616.00	1483.46	0.586	3.26	6.00	1.14

****
********** ROADWAY OVERTOPPING DATA **********
****

WEIR COEFFICIENT	2.50
EMBANKMENT TOP WIDTH	28.00 ft
CREST LENGTH	100.00 ft
OVERTOPPING CREST ELEVATION	1485.48 ft

****

BOX Jomax 6+81.50

CURRENT DATE: 06-22-2000 FILE DATE: 06-22-2000
CURRENT TIME: 10:54:59 FILE NAME: JMXXING

****
********** FHWA CULVERT ANALYSIS **********
********** HY-8, VERSION 6.1 **********
****

CULV NO.	SITE DATA: INLET ELEV. (ft)	OUTLET ELEV. (ft)	CULVERT LENGTH (ft)	CULVERT SHAPE, MATERIAL, INLET: BARRELS SHAPE MATERIAL	SPAN (ft)	RISE (ft)	MANNING n	INLET TYPE
1	1468.87	1468.72	58.00	3 RCB	10.00	4.00	.012	CONVENTIONAL
2								
3								
4								
5								
6								

****

SUMMARY OF CULVERT FLOWS (cfs) FILE: JMXXING DATE: 06-22-2000

ELEV (ft)	TOTAL	1	2	3	4	5	6	ROADWAY	ITR	
1469.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	1	
1469.97	85.6	85.6	0.0	0.0	0.0	0.0	0.0	0.00	1	
1470.47	171.2	171.2	0.0	0.0	0.0	0.0	0.0	0.00	1	
1470.96	256.8	256.8	0.0	0.0	0.0	0.0	0.0	0.00	1	
1471.37	342.4	342.4	0.0	0.0	0.0	0.0	0.0	0.00	1	
1471.75	428.0	428.0	0.0	0.0	0.0	0.0	0.0	0.00	1	
1472.12	513.6	513.6	0.0	0.0	0.0	0.0	0.0	0.00	1	
1472.57	599.2	599.2	0.0	0.0	0.0	0.0	0.0	0.00	1	
1472.92	684.8	684.8	0.0	0.0	0.0	0.0	0.0	0.00	1	
1473.25	770.4	770.4	0.0	0.0	0.0	0.0	0.0	0.00	1	
1473.28	***778.0***	***778.0***	***0.0***	***0.0***	***0.0***	***0.0***	***0.0***	***0.00***	***1***	***Q50***
1476.10	1352.1	1352.1	0.0	0.0	0.0	0.0	0.0	OVERTOPPING		

****

1473.57 856.0 Q100

****

SUMMARY OF ITERATIVE SOLUTION ERRORS FILE: JMXXING DATE: 06-22-2000

HEAD ELEV (ft)	HEAD ERROR (ft)	TOTAL FLOW (cfs)	FLOW ERROR (cfs)	% FLOW ERROR
1469.00	0.000	0.00	0.00	0.00
1469.97	0.000	85.60	0.00	0.00
1470.47	0.000	171.20	0.00	0.00
1470.96	0.000	256.80	0.00	0.00
1471.37	0.000	342.40	0.00	0.00
1471.75	0.000	428.00	0.00	0.00
1472.12	0.000	513.60	0.00	0.00
1472.57	0.000	599.20	0.00	0.00
1472.92	0.000	684.80	0.00	0.00
1473.25	0.000	770.40	0.00	0.00
1473.28	0.000	778.00	0.00	0.00

****

<1> TOLERANCE (ft) = 0.010 <2> TOLERANCE (%) = 1.000

****

CURRENT DATE: 06-22-2000 FILE DATE: 06-22-2000
CURRENT TIME: 10:54:59 FILE NAME: JMXXING

PERFORMANCE CURVE FOR CULVERT 1 - 3(10.00 (ft) BY 4.00 (ft)) RCB

DIS-CHARGE FLOW (cfs)	HEAD-WATER ELEV. (ft)	INLET CONTROL DEPTH (ft)	OUTLET CONTROL DEPTH (ft)	FLOW TYPE <F4>	NORMAL DEPTH (ft)	CRIT. DEPTH (ft)	OUTLET DEPTH (ft)	TW DEPTH (ft)	OUTLET VEL. (fps)	TW VEL. (fps)
0.00	1469.00	0.00	0.13	0-NF	0.00	0.00	0.00	0.28	0.00	0.00
85.60	1469.97	1.01	1.10	3-M1t	0.63	0.63	1.07	1.07	2.68	2.56
171.20	1470.47	1.60	1.60	1-S2n	1.00	1.01	0.91	1.28	6.30	2.94
256.80	1470.96	2.09	2.09	1-S2n	1.31	1.32	1.22	1.28	7.03	2.94
342.40	1471.37	2.50	2.50	1-S2n	1.59	1.60	1.50	1.28	7.63	2.94
428.00	1471.75	2.88	2.88	1-S2n	1.84	1.85	1.75	1.28	8.14	2.94
513.60	1472.12	3.25	3.25	1-S2n	2.09	2.09	1.99	1.28	8.59	2.94
599.20	1472.57	3.61	3.70	2-M2c	2.32	2.32	2.32	1.28	8.61	2.94
684.80	1472.92	3.97	4.05	2-M2c	2.54	2.53	2.53	1.28	9.01	2.94
770.40	1473.25	4.33	4.38	2-M2c	2.76	2.74	2.74	1.28	9.37	2.94
778.00	1473.28	4.36	4.41	2-M2c	2.78	2.76	2.76	1.28	9.40	2.94

El. inlet face invert 1468.87 ft El. outlet invert 1468.72 ft
El. inlet throat invert 0.00 ft El. inlet crest 0.00 ft

***** SITE DATA ***** CULVERT INVERT **********

INLET STATION	1971.00 ft
INLET ELEVATION	1468.87 ft
OUTLET STATION	2029.00 ft
OUTLET ELEVATION	1468.72 ft
NUMBER OF BARRELS	3
SLOPE (V/H)	0.0026
CULVERT LENGTH ALONG SLOPE	58.00 ft

***** CULVERT DATA SUMMARY **********

BARREL SHAPE	BOX
BARREL SPAN	10.00 ft
BARREL RISE	4.00 ft
BARREL MATERIAL	CONCRETE
BARREL MANNING'S n	0.012
INLET TYPE	CONVENTIONAL
INLET EDGE AND WALL	1:1 BEVEL
INLET DEPRESSION	NONE

CURRENT DATE: 06-22-2000 FILE DATE: 06-22-2000
CURRENT TIME: 10:54:59 FILE NAME: JMXXING

****
********** TAILWATER **********
****

***** USER DEFINED CHANNEL CROSS-SECTION FILE NAME: JMXXING
MAIN CHANNEL ONLY FILE DATE: 04-10-2000

LEFT CHANNEL BOUNDARY	0
RIGHT CHANNEL BOUNDARY	0
MANNING n LEFT OVER BANK	0.000
MANNING n MAIN CHANNEL	0.035
MANNING n RIGHT OVER BANK	0.000
SLOPE OF CHANNEL	0.0065 ft/ft

CROSS-SECTION COORD. NO.	X (ft)	Y (ft)
1	70.00	1470.00
2	77.00	1469.00
3	111.00	1469.00
4	127.00	1470.00

******* UNIFORM FLOW RATING CURVE FOR DOWNSTREAM CHANNEL

FLOW (cfs)	W.S.E. (ft)	FROUDE NUMBER	DEPTH (ft)	VEL. (f/s)	SHEAR (psf)
0.00	1469.00	0.000	0.28	0.00	0.00
85.60	1469.79	0.561	1.07	2.56	0.26
171.20	1470.00	0.580	1.28	2.94	0.32
256.80	1470.00	0.580	1.28	2.94	0.32
342.40	1470.00	0.580	1.28	2.94	0.32
428.00	1470.00	0.580	1.28	2.94	0.32
513.60	1470.00	0.580	1.28	2.94	0.32
599.20	1470.00	0.580	1.28	2.94	0.32
684.80	1470.00	0.580	1.28	2.94	0.32
770.40	1470.00	0.580	1.28	2.94	0.32
778.00	1470.00	0.580	1.28	2.94	0.32

Note: Shear stress was calculated using R.

****
********** ROADWAY OVERTOPPING DATA **********
****

WEIR COEFFICIENT	2.50
EMBANKMENT TOP WIDTH	24.00 ft
CREST LENGTH	100.00 ft
OVERTOPPING CREST ELEVATION	1476.10 ft

****

Box at Happy Valley Sta 14+75

CURRENT DATE: 07-05-2000 FILE DATE: 07-05-2000
CURRENT TIME: 09:55:45 FILE NAME: BOXHAPPY

****
********** FHWA CULVERT ANALYSIS **********
********** HY-8, VERSION 6.1 **********
****

CULV NO.	SITE DATA: INLET ELEV. (ft)	OUTLET ELEV. (ft)	CULVERT LENGTH (ft)	CULVERT SHAPE, MATERIAL, INLET: BARRELS SHAPE MATERIAL	SPAN (ft)	RISE (ft)	MANNING n	INLET TYPE
1	1419.45	1418.75	70.00	1 RCB	6.00	3.00	.013	CONVENTIONAL
2								
3								
4								
5								
6								

****

SUMMARY OF CULVERT FLOWS (cfs) FILE: BOXHAPPY DATE: 07-05-2000

ELEV (ft)	TOTAL	1	2	3	4	5	6	ROADWAY	ITR
1419.45	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	1
1420.73	14.0	14.0	0.0	0.0	0.0	0.0	0.0	0.00	1
1421.24	28.0	28.0	0.0	0.0	0.0	0.0	0.0	0.00	1
1421.70	42.0	42.0	0.0	0.0	0.0	0.0	0.0	0.00	1
1422.02	56.0	56.0	0.0	0.0	0.0	0.0	0.0	0.00	1
1422.42	70.0	70.0	0.0	0.0	0.0	0.0	0.0	0.00	1
1422.81	84.0	84.0	0.0	0.0	0.0	0.0	0.0	0.00	1
1423.21	98.0	98.0	0.0	0.0	0.0	0.0	0.0	0.00	1
1423.62	112.0	112.0	0.0	0.0	0.0	0.0	0.0	0.00	1
1424.05	126.0	126.0	0.0	0.0	0.0	0.0	0.0	0.00	1
1424.12	129.0	127.8	0.0	0.0	0.0	0.0	0.0	0.00	7
1424.13	***128.7***	***128.7***	***0.0***	***0.0***	***0.0***	***0.0***	***0.0***	***OVERTOPPING***	***Qcap***

****

SUMMARY OF ITERATIVE SOLUTION ERRORS FILE: BOXHAPPY DATE: 07-05-2000

HEAD ELEV (ft)	HEAD ERROR (ft)	TOTAL FLOW (cfs)	FLOW ERROR (cfs)	% FLOW ERROR
1419.45	0.000	0.00	0.00	0.00
1420.73	0.000	14.00	0.00	0.00
1421.24	0.000	28.00	0.00	0.00
1421.70	0.000	42.00	0.00	0.00
1422.02	0.000	56.00	0.00	0.00
1422.42	0.000	70.00	0.00	0.00
1422.81	0.000	84.00	0.00	0.00
1423.21	0.000	98.00	0.00	0.00
1423.62	0.000	112.00	0.00	0.00
1424.05	0.000	126.00	0.00	0.00
1424.12	-0.006	129.00	1.15	0.89

****

<1> TOLERANCE (ft) = 0.010 <2> TOLERANCE (%) = 1.000

****

CURRENT DATE: 07-05-2000 FILE DATE: 07-05-2000
CURRENT TIME: 09:55:45 FILE NAME: BOXHAPPY

****

PERFORMANCE CURVE FOR CULVERT 1 - 1(6.00 (ft) BY 3.00 (ft)) RCB

****

DIS-CHARGE FLOW (cfs)	HEAD-WATER ELEV. (ft)	INLET CONTROL DEPTH (ft)	OUTLET CONTROL DEPTH (ft)	FLOW TYPE <F4>	NORMAL DEPTH (ft)	CRIT. DEPTH (ft)	OUTLET DEPTH (ft)	TW DEPTH (ft)	OUTLET VEL. (fps)	TW VEL. (fps)
0.00	1419.45	0.00	0.00	0-NF	0.00	0.00	0.00	0.00	0.00	0.00
14.00	1420.73	0.82	1.28	3-M1t	0.39	0.55	1.81	1.81	1.29	1.22
28.00	1421.24	1.30	1.79	3-M1t	0.63	0.88	2.34	2.34	1.99	1.45
42.00	1421.70	1.72	2.25	3-M1t	0.81	1.15	2.73	2.73	2.56	1.61
56.00	1422.02	2.11	2.57	1-S1f	0.99	1.40	3.00	3.04	3.11	1.73
70.00	1422.42	2.48	2.97	1-S1f	1.15	1.62	3.00	3.31	3.89	1.83
84.00	1422.81	2.84	3.36	4-FFt	1.30	1.83	3.00	3.54	4.67	1.91
98.00	1423.21	3.19	3.76	4-FFt	1.45	2.03	3.00	3.75	5.44	1.99
112.00	1423.62	3.55	4.17	4-FFt	1.59	2.22	3.00	3.94	6.22	2.06
126.00	1424.05	3.93	4.60	4-FFt	1.72	2.40	3.00	4.12	7.00	2.12
127.85	1424.12	3.98	4.67	4-FFt	1.74	2.42	3.00	4.16	7.10	2.13

****

El. inlet face invert 1419.45 ft El. outlet invert 1418.75 ft
El. inlet throat invert 0.00 ft El. inlet crest 0.00 ft

****

***** SITE DATA ***** CULVERT INVERT **********

INLET STATION	1965.50 ft
INLET ELEVATION	1419.45 ft
OUTLET STATION	2035.50 ft
OUTLET ELEVATION	1418.75 ft
NUMBER OF BARRELS	1
SLOPE (V/H)	0.0100
CULVERT LENGTH ALONG SLOPE	70.00 ft

***** CULVERT DATA SUMMARY **********

BARREL SHAPE	BOX
BARREL SPAN	6.00 ft
BARREL RISE	3.00 ft
BARREL MATERIAL	CONCRETE
BARREL MANNING'S n	0.013
INLET TYPE	CONVENTIONAL
INLET EDGE AND WALL	1:1 BEVEL (45 DEG. FLARE)
INLET DEPRESSION	NONE

****

CURRENT DATE: 07-05-2000
CURRENT TIME: 09:55:45

FILE DATE: 07-05-2000
FILE NAME: BOXHAPPY

****
********** TAILWATER **********
****

******* REGULAR CHANNEL CROSS SECTION **********

SIDE SLOPE H/V (X:1)	3.5
CHANNEL SLOPE V/H (ft/ft)	0.001
MANNING'S n (.01-0.1)	0.035
CHANNEL INVERT ELEVATION	1418.75 ft
CULVERT NO.1 OUTLET INVERT ELEVATION	1418.75 ft

******* UNIFORM FLOW RATING CURVE FOR DOWNSTREAM CHANNEL

FLOW (cfs)	W.S.E. (ft)	FROUDE NUMBER	DEPTH (ft)	VEL. (f/s)	SHEAR (psf)
0.00	1418.75	0.000	0.00	0.00	0.00
14.00	1420.56	0.160	1.81	1.22	0.11
28.00	1421.09	0.167	2.34	1.45	0.15
42.00	1421.48	0.172	2.73	1.61	0.17
56.00	1421.79	0.175	3.04	1.73	0.19
70.00	1422.06	0.177	3.31	1.83	0.21
84.00	1422.29	0.179	3.54	1.91	0.22
98.00	1422.50	0.181	3.75	1.99	0.23
112.00	1422.69	0.183	3.94	2.06	0.25
126.00	1422.87	0.184	4.12	2.12	0.26
129.00	1422.91	0.184	4.16	2.13	0.26

****
********** ROADWAY OVERTOPPING DATA **********
****

WEIR COEFFICIENT	2.50
EMBANKMENT TOP WIDTH	50.00 ft
CREST LENGTH	100.00 ft
OVERTOPPING CREST ELEVATION	1424.13 ft

****

Box at Citrus and old Happy Valley

CURRENT DATE: 07-05-2000 FILE DATE: 07-05-2000
CURRENT TIME: 10:02:14 FILE NAME: BOXTO

****
********** FHWA CULVERT ANALYSIS **********
********** HY-8, VERSION 6.1 **********
****

CULV NO.	SITE DATA: INLET ELEV. (ft)	OUTLET ELEV. (ft)	CULVERT LENGTH (ft)	CULVERT SHAPE, MATERIAL, INLET: BARRELS SHAPE MATERIAL	SPAN (ft)	RISE (ft)	MANNING n	INLET TYPE
1	1415.13	1414.94	63.00	1 RCB	6.00	4.00	.013	CONVENTIONAL
2								
3								
4								
5								
6								

****

SUMMARY OF CULVERT FLOWS (cfs) FILE: BOXTO DATE: 07-05-2000

ELEV (ft)	TOTAL	1	2	3	4	5	6	ROADWAY	ITR
1415.13	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	1
1416.29	21.0	21.0	0.0	0.0	0.0	0.0	0.0	0.00	1
1416.96	42.0	42.0	0.0	0.0	0.0	0.0	0.0	0.00	1
1417.53	63.0	63.0	0.0	0.0	0.0	0.0	0.0	0.00	1
1418.04	84.0	84.0	0.0	0.0	0.0	0.0	0.0	0.00	1
1418.51	105.0	105.0	0.0	0.0	0.0	0.0	0.0	0.00	1
1418.94	126.0	126.0	0.0	0.0	0.0	0.0	0.0	0.00	1
1419.36	147.0	147.0	0.0	0.0	0.0	0.0	0.0	0.00	1
1419.78	168.0	168.0	0.0	0.0	0.0	0.0	0.0	0.00	1
1420.27	189.0	189.0	0.0	0.0	0.0	0.0	0.0	0.00	1
1420.54	202.0	200.2	0.0	0.0	0.0	0.0	0.0	0.00	10
1420.58	***202.0***	***202.0***	***0.0***	***0.0***	***0.0***	***0.0***	***0.0***	***OVERTOPPING***	***Qcap***

****

SUMMARY OF ITERATIVE SOLUTION ERRORS FILE: BOXTO DATE: 07-05-2000

HEAD ELEV (ft)	HEAD ERROR (ft)	TOTAL FLOW (cfs)	FLOW ERROR (cfs)	% FLOW ERROR
1415.13	0.000	0.00	0.00	0.00
1416.29	0.000	21.00	0.00	0.00
1416.96	0.000	42.00	0.00	0.00
1417.53	0.000	63.00	0.00	0.00
1418.04	0.000	84.00	0.00	0.00
1418.51	0.000	105.00	0.00	0.00
1418.94	0.000	126.00	0.00	0.00
1419.36	0.000	147.00	0.00	0.00
1419.78	0.000	168.00	0.00	0.00
1420.27	0.000	189.00	0.00	0.00
1420.54	-0.010	202.00	1.80	0.89

****

<1> TOLERANCE (ft) = 0.010 <2> TOLERANCE (%) = 1.000

****

CURRENT DATE: 07-05-2000 FILE DATE: 07-05-2000
CURRENT TIME: 10:02:14 FILE NAME: BOXTO

****

PERFORMANCE CURVE FOR CULVERT 1 - 1(6.00 (ft) BY 4.00 (ft)) RCB

****

DIS-CHARGE FLOW (cfs)	HEAD-WATER ELEV. (ft)	INLET CONTROL DEPTH (ft)	OUTLET CONTROL DEPTH (ft)	FLOW TYPE <F4>	NORMAL DEPTH (ft)	CRIT. DEPTH (ft)	OUTLET DEPTH (ft)	TW DEPTH (ft)	OUTLET VEL. (fps)	TW VEL. (fps)
0.00	1415.13	0.00	0.00	0-NF	0.00	0.00	0.00	0.00	0.00	0.00
21.00	1416.29	1.08	1.16	2-M2c	0.77	0.73	0.73	0.64	4.82	3.81
42.00	1416.96	1.71	1.83	2-M2c	1.22	1.15	1.15	0.93	6.07	4.66
63.00	1417.53	2.26	2.40	2-M2c	1.62	1.51	1.51	1.14	6.95	5.22
84.00	1418.04	2.78	2.91	2-M2c	1.98	1.83	1.83	1.32	7.65	5.65
105.00	1418.51	3.26	3.38	2-M2c	2.33	2.12	2.12	1.47	8.24	6.01
126.00	1418.95	3.72	3.82	2-M2c	2.66	2.40	2.40	1.61	8.76	6.31
147.00	1419.36	4.18	4.23	2-M2c	2.98	2.66	2.66	1.73	9.22	6.57
168.00	1419.78	4.65	4.62	2-M2c	3.30	2.90	2.90	1.84	9.64	6.81
189.00	1420.27	5.14	5.00	2-M2c	4.00	3.14	3.14	1.95	10.03	7.02
200.20	1420.54	5.41	5.20	2-M2c	4.00	3.26	3.26	2.01	10.22	7.15

****

El. inlet face invert 1415.13 ft El. outlet invert 1414.94 ft
El. inlet throat invert 0.00 ft El. inlet crest 0.00 ft

****

***** SITE DATA ***** CULVERT INVERT **********

INLET STATION	1968.50 ft
INLET ELEVATION	1415.13 ft
OUTLET STATION	2031.50 ft
OUTLET ELEVATION	1414.94 ft
NUMBER OF BARRELS	1
SLOPE (V/H)	0.0030
CULVERT LENGTH ALONG SLOPE	63.00 ft

***** CULVERT DATA SUMMARY **********

BARREL SHAPE	BOX
BARREL SPAN	6.00 ft
BARREL RISE	4.00 ft
BARREL MATERIAL	CONCRETE
BARREL MANNING'S n	0.013
INLET TYPE	CONVENTIONAL
INLET EDGE AND WALL	1:1 BEVEL (45 DEG. FLARE)
INLET DEPRESSION	NONE

****

CURRENT DATE: 07-05-2000 FILE DATE: 07-05-2000
CURRENT TIME: 10:02:14 FILE NAME: BOXTO

****
********** TAILWATER **********
****

******* REGULAR CHANNEL CROSS SECTION **********

BOTTOM WIDTH	6.00 ft
SIDE SLOPE H/V (X:1)	4.0
CHANNEL SLOPE V/H (ft/ft)	0.003
MANNING'S n (.01-0.1)	0.013
CHANNEL INVERT ELEVATION	1414.94 ft
CULVERT NO.1 OUTLET INVERT ELEVATION	1414.94 ft

******* UNIFORM FLOW RATING CURVE FOR DOWNSTREAM CHANNEL

FLOW (cfs)	W.S.E. (ft)	FROUDE NUMBER	DEPTH (ft)	VEL. (f/s)	SHEAR (psf)
0.00	1414.94	0.000	0.00	0.00	0.00
21.00	1415.58	0.838	0.64	3.81	0.12
42.00	1415.87	0.853	0.93	4.66	0.17
63.00	1416.08	0.862	1.14	5.22	0.21
84.00	1416.26	0.867	1.32	5.65	0.24
105.00	1416.41	0.873	1.47	6.01	0.27
126.00	1416.55	0.877	1.61	6.31	0.29
147.00	1416.67	0.880	1.73	6.57	0.31
168.00	1416.78	0.884	1.84	6.81	0.33
189.00	1416.89	0.886	1.95	7.02	0.35
202.00	1416.95	0.888	2.01	7.15	0.36

****
********** ROADWAY OVERTOPPING DATA **********
****

WEIR COEFFICIENT	2.50
EMBANKMENT TOP WIDTH	50.00 ft
CREST LENGTH	100.00 ft
OVERTOPPING CREST ELEVATION	1420.58 ft

****

CURRENT DATE: 07-05-2000 FILE DATE: 07-05-2000
CURRENT TIME: 10:05:14 FILE NAME: BOXCITR

PERFORMANCE CURVE FOR CULVERT 1 - 1(6.00 (ft) BY 4.00 (ft)) RCB

DIS-CHARGE FLOW (cfs)	HEAD-WATER ELEV. (ft)	INLET CONTROL DEPTH (ft)	OUTLET CONTROL DEPTH (ft)	FLOW TYPE <F4>	NORMAL DEPTH (ft)	CRIT. DEPTH (ft)	OUTLET DEPTH (ft)	TW DEPTH (ft)	OUTLET VEL. (fps)	TW VEL. (fps)
0.00	1414.73	0.00	0.00	0-NF	0.00	0.00	0.00	0.00	0.00	0.00
26.00	1415.97	1.24	1.24	1-S2n	0.81	0.84	0.74	1.18	5.88	2.05
52.00	1416.71	1.98	1.98	1-S2n	1.28	1.33	1.23	1.66	7.05	2.47
78.00	1417.36	2.63	2.63	1-S2n	1.70	1.74	1.64	2.02	7.92	2.75
104.00	1417.96	3.23	3.23	1-S2n	2.08	2.11	2.01	2.31	8.62	2.96
130.00	1418.64	3.81	3.91	3-M1t	2.45	2.45	2.55	2.55	8.48	3.14
156.00	1419.14	4.38	4.41	3-M2t	2.80	2.76	2.77	2.77	9.38	3.29
182.00	1419.70	4.97	4.88	2-M2c	3.15	3.06	3.06	2.97	9.90	3.42
208.00	1420.33	5.60	5.33	2-M2c	3.48	3.35	3.35	3.15	10.35	3.54
234.00	1421.00	6.27	5.76	2-M2c	4.00	3.62	3.62	3.32	10.77	3.65
253.00	1421.52	6.79	6.17	2-M2c	4.00	3.82	3.82	3.44	11.05	3.72

El. inlet face invert 1414.73 ft El. outlet invert 1414.49 ft
El. inlet throat invert 0.00 ft El. inlet crest 0.00 ft

***** SITE DATA ***** CULVERT INVERT **********

INLET STATION	1970.00 ft
INLET ELEVATION	1414.73 ft
OUTLET STATION	2030.00 ft
OUTLET ELEVATION	1414.49 ft
NUMBER OF BARRELS	1
SLOPE (V/H)	0.0040
CULVERT LENGTH ALONG SLOPE	60.00 ft

***** CULVERT DATA SUMMARY **********

BARREL SHAPE	BOX
BARREL SPAN	6.00 ft
BARREL RISE	4.00 ft
BARREL MATERIAL	CONCRETE
BARREL MANNING'S n	0.013
INLET TYPE	CONVENTIONAL
INLET EDGE AND WALL	1:1 BEVEL (45 DEG. FLARE)
INLET DEPRESSION	NONE

CURRENT DATE: 07-05-2000 FILE DATE: 07-05-2000
CURRENT TIME: 10:05:14 FILE NAME: BOXCITR

****
********** TAILWATER **********
****

******* REGULAR CHANNEL CROSS SECTION **********

BOTTOM WIDTH	6.00 ft
SIDE SLOPE H/V (X:1)	4.0
CHANNEL SLOPE V/H (ft/ft)	0.003
MANNING'S n (.01-0.1)	0.035
CHANNEL INVERT ELEVATION	1414.49 ft
CULVERT NO.1 OUTLET INVERT ELEVATION	1414.49 ft

******* UNIFORM FLOW RATING CURVE FOR DOWNSTREAM CHANNEL

FLOW (cfs)	W.S.E. (ft)	FROUDE NUMBER	DEPTH (ft)	VEL. (f/s)	SHEAR (psf)
0.00	1414.49	0.000	0.00	0.00	0.00
26.00	1415.67	0.331	1.18	2.05	0.23
52.00	1416.15	0.337	1.66	2.47	0.32
78.00	1416.51	0.341	2.02	2.75	0.39
104.00	1416.80	0.344	2.31	2.96	0.45
130.00	1417.04	0.346	2.55	3.14	0.49
156.00	1417.26	0.348	2.77	3.29	0.54
182.00	1417.46	0.350	2.97	3.42	0.57
208.00	1417.64	0.351	3.15	3.54	0.61
234.00	1417.81	0.353	3.32	3.65	0.64
253.00	1417.93	0.354	3.44	3.72	0.67

****
********** ROADWAY OVERTOPPING DATA **********
****

WEIR COEFFICIENT	2.50
EMBANKMENT TOP WIDTH	50.00 ft
CREST LENGTH	100.00 ft
OVERTOPPING CREST ELEVATION	1421.54 ft

****

Culvert at 203rd Avenue & US60

CURRENT DATE: 01-03-2001 FILE DATE: 01-03-2001
CURRENT TIME: 07:56:58 FILE NAME: 203RDML

****
********** FHWA CULVERT ANALYSIS **********
********** HY-8, VERSION 6.1 **********
****

CULV NO.	SITE DATA: INLET ELEV. (ft)	OUTLET ELEV. (ft)	CULVERT LENGTH (ft)	CULVERT SHAPE, MATERIAL, INLET: BARRELS SHAPE MATERIAL	SPAN (ft)	RISE (ft)	MANNING n	INLET TYPE
1	1583.18	1582.24	112.00	2 RCP	3.00	3.00	.013	CONVENTIONAL
2								
3								
4								
5								
6								

****

SUMMARY OF CULVERT FLOWS (cfs) FILE: 203RDML DATE: 01-03-2001

ELEV (ft)	TOTAL	1	2	3	4	5	6	ROADWAY	ITR	
1583.18	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	1	
1584.24	13.6	13.6	0.0	0.0	0.0	0.0	0.0	0.00	1	
1584.80	27.2	27.2	0.0	0.0	0.0	0.0	0.0	0.00	1	
1585.24	40.8	40.8	0.0	0.0	0.0	0.0	0.0	0.00	1	
1585.60	54.4	54.4	0.0	0.0	0.0	0.0	0.0	0.00	1	
1585.95	68.0	68.0	0.0	0.0	0.0	0.0	0.0	0.00	1	
1586.30	81.6	81.6	0.0	0.0	0.0	0.0	0.0	0.00	1	
1586.68	95.2	95.2	0.0	0.0	0.0	0.0	0.0	0.00	1	
1587.11	108.8	108.8	0.0	0.0	0.0	0.0	0.0	0.00	1	
1587.60	122.4	122.4	0.0	0.0	0.0	0.0	0.0	0.00	1	
1587.67	***124.0***	***124.0***	***0.0***	***0.0***	***0.0***	***0.0***	***0.0***	***0.00***	***1***	***Q50***
1588.80	149.8	149.8	0.0	0.0	0.0	0.0	0.0	OVERTOPPING		

****

1588.16 136.0 Q100

****

SUMMARY OF ITERATIVE SOLUTION ERRORS FILE: 203RDML DATE: 01-03-2001

HEAD ELEV (ft)	HEAD ERROR (ft)	TOTAL FLOW (cfs)	FLOW ERROR (cfs)	% FLOW ERROR
1583.18	0.000	0.00	0.00	0.00
1584.24	0.000	13.60	0.00	0.00
1584.80	0.000	27.20	0.00	0.00
1585.24	0.000	40.80	0.00	0.00
1585.60	0.000	54.40	0.00	0.00
1585.95	0.000	68.00	0.00	0.00
1586.30	0.000	81.60	0.00	0.00
1586.68	0.000	95.20	0.00	0.00
1587.11	0.000	108.80	0.00	0.00
1587.60	0.000	122.40	0.00	0.00
1587.67	0.000	124.00	0.00	0.00

****

<1> TOLERANCE (ft) = 0.010 <2> TOLERANCE (%) = 1.000

****

CURRENT DATE: 01-03-2001 FILE DATE: 01-03-2001
CURRENT TIME: 07:56:58 FILE NAME: 203RDML

PERFORMANCE CURVE FOR CULVERT 1 - 2(3.00 (ft) BY 3.00 (ft)) RCP

DIS-CHARGE FLOW (cfs)	HEAD-WATER ELEV. (ft)	INLET CONTROL DEPTH (ft)	OUTLET CONTROL DEPTH (ft)	FLOW TYPE <F4>	NORMAL DEPTH (ft)	CRIT. DEPTH (ft)	OUTLET DEPTH (ft)	TW DEPTH (ft)	OUTLET VEL. (fps)	TW VEL. (fps)
0.00	1583.18	0.00	0.00	0-NF	0.00	0.00	0.00	0.00	0.00	0.00
13.60	1584.24	1.06	1.06	1-S2n	0.66	0.81	0.61	0.57	6.63	2.32
27.20	1584.80	1.62	1.62	1-S2n	0.96	1.17	0.87	0.83	7.97	2.88
40.80	1585.24	2.06	2.06	1-S2n	1.19	1.45	1.20	1.04	7.73	3.24
54.40	1585.60	2.42	2.42	1-S2n	1.40	1.68	1.41	1.20	8.31	3.52
68.00	1585.95	2.77	2.77	1-S2n	1.60	1.89	1.61	1.35	8.77	3.75
81.60	1586.30	3.12	3.12	5-S2n	1.79	2.08	1.81	1.48	9.18	3.95
95.20	1586.68	3.50	3.50	5-S2n	1.99	2.24	1.94	1.60	9.87	4.12
108.80	1587.11	3.93	3.93	5-S2n	2.21	2.39	2.22	1.71	9.73	4.27
122.40	1587.60	4.42	4.42	5-S2n	2.47	2.50	2.40	1.82	10.07	4.41
124.00	1587.67	4.49	4.32	2-M2c	2.52	2.52	2.52	1.83	9.82	4.43

El. inlet face invert 1583.18 ft El. outlet invert 1582.24 ft
El. inlet throat invert 0.00 ft El. inlet crest 0.00 ft

***** SITE DATA ***** CULVERT INVERT **********

INLET STATION	1940.50 ft
INLET ELEVATION	1583.18 ft
OUTLET STATION	2052.50 ft
OUTLET ELEVATION	1582.24 ft
NUMBER OF BARRELS	2
SLOPE (V/H)	0.0084
CULVERT LENGTH ALONG SLOPE	112.00 ft

***** CULVERT DATA SUMMARY **********

BARREL SHAPE	CIRCULAR
BARREL DIAMETER	3.00 ft
BARREL MATERIAL	CONCRETE
BARREL MANNING'S n	0.013
INLET TYPE	CONVENTIONAL
INLET EDGE AND WALL	GROOVED END PROJECTION
INLET DEPRESSION	NONE

CURRENT DATE: 01-03-2001 FILE DATE: 01-03-2001
CURRENT TIME: 07:56:58 FILE NAME: 203RDML

****
********** TAILWATER **********
****

******* REGULAR CHANNEL CROSS SECTION **********

BOTTOM WIDTH	8.00 ft
SIDE SLOPE H/V (X:1)	4.0
CHANNEL SLOPE V/H (ft/ft)	0.008
MANNING'S n (.01-0.1)	0.035
CHANNEL INVERT ELEVATION	1582.24 ft
CULVERT NO.1 OUTLET INVERT ELEVATION	1582.24 ft

******* UNIFORM FLOW RATING CURVE FOR DOWNSTREAM CHANNEL

FLOW (cfs)	W.S.E. (ft)	FROUDE NUMBER	DEPTH (ft)	VEL. (f/s)	SHEAR (psf)
0.00	1582.24	0.000	0.00	0.00	0.00
13.60	1582.81	0.542	0.57	2.32	0.30
27.20	1583.07	0.555	0.83	2.88	0.44
40.80	1583.28	0.561	1.04	3.24	0.54
54.40	1583.44	0.565	1.20	3.52	0.63
68.00	1583.59	0.568	1.35	3.75	0.71
81.60	1583.72	0.571	1.48	3.95	0.78
95.20	1583.84	0.573	1.60	4.12	0.84
108.80	1583.95	0.575	1.71	4.27	0.90
122.40	1584.06	0.576	1.82	4.41	0.95
124.00	1584.07	0.577	1.83	4.43	0.96

****
********** ROADWAY OVERTOPPING DATA **********
****

WEIR COEFFICIENT	2.50
EMBANKMENT TOP WIDTH	100.00 ft
CREST LENGTH	100.00 ft
OVERTOPPING CREST ELEVATION	1588.80 ft

****

Culverts at CONN605 & US60

CURRENT DATE: 06-22-2000 FILE DATE: 06-22-2000
CURRENT TIME: 11:15:47 FILE NAME: CONN605

****
********** FHWA CULVERT ANALYSIS **********
********** HY-8, VERSION 6.1 **********
****

CULV NO.	SITE DATA: INLET ELEV. (ft)	OUTLET ELEV. (ft)	CULVERT LENGTH (ft)	CULVERT SHAPE, MATERIAL, INLET: BARRELS SHAPE MATERIAL	SPAN (ft)	RISE (ft)	MANNING n	INLET TYPE
1	1497.06	1496.56	100.00	2 CSP	2.00	2.00	.024	CONVENTIONAL
2								
3								
4								
5								
6								

****

SUMMARY OF CULVERT FLOWS (cfs) FILE: CONN605 DATE: 06-22-2000

ELEV (ft)	TOTAL	1	2	3	4	5	6	ROADWAY	ITR	
1497.06	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	1	
1497.95	3.9	3.9	0.0	0.0	0.0	0.0	0.0	0.00	1	
1498.31	7.8	7.8	0.0	0.0	0.0	0.0	0.0	0.00	1	
1498.52	11.7	11.7	0.0	0.0	0.0	0.0	0.0	0.00	1	
1498.80	15.6	15.6	0.0	0.0	0.0	0.0	0.0	0.00	1	
1499.08	19.5	19.5	0.0	0.0	0.0	0.0	0.0	0.00	1	
1499.50	23.4	23.4	0.0	0.0	0.0	0.0	0.0	0.00	1	
1500.15	27.3	27.3	0.0	0.0	0.0	0.0	0.0	0.00	1	
1499.52	31.2	31.2	0.0	0.0	0.0	0.0	0.0	0.00	1	
1499.64	***35.0***	***35.0***	***0.0***	***0.0***	***0.0***	***0.0***	***0.0***	***0.00***	***1***	***Q50***
1499.78	**39.0**	**39.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.00**	**1**	**Q100**
1502.67	58.5	58.5	0.0	0.0	0.0	0.0	0.0	OVERTOPPING		

****

SUMMARY OF ITERATIVE SOLUTION ERRORS FILE: CONN605 DATE: 06-22-2000

HEAD ELEV (ft)	HEAD ERROR (ft)	TOTAL FLOW (cfs)	FLOW ERROR (cfs)	% FLOW ERROR
1497.06	0.000	0.00	0.00	0.00
1497.95	0.000	3.90	0.00	0.00
1498.31	0.000	7.80	0.00	0.00
1498.52	0.000	11.70	0.00	0.00
1498.80	0.000	15.60	0.00	0.00
1499.08	0.000	19.50	0.00	0.00
1499.50	0.000	23.40	0.00	0.00
1500.15	0.000	27.30	0.00	0.00
1499.52	0.000	31.20	0.00	0.00
1499.64	0.000	35.00	0.00	0.00
1499.78	0.000	39.00	0.00	0.00

****

<1> TOLERANCE (ft) = 0.010 <2> TOLERANCE (%) = 1.000

****

CURRENT DATE: 06-22-2000 FILE DATE: 06-22-2000
CURRENT TIME: 11:15:47 FILE NAME: CONN605

PERFORMANCE CURVE FOR CULVERT 1 - 2(2.00 (ft) BY 2.00 (ft)) CSP

DIS-CHARGE FLOW (cfs)	HEAD-WATER ELEV. (ft)	INLET CONTROL DEPTH (ft)	OUTLET CONTROL DEPTH (ft)	FLOW TYPE <F4>	NORMAL DEPTH (ft)	CRIT. DEPTH (ft)	OUTLET DEPTH (ft)	TW DEPTH (ft)	OUTLET VEL. (fps)	TW VEL. (fps)
0.00	1497.06	0.00	0.00	0-NF	0.00	0.00	0.00	0.40	0.00	0.00
3.90	1497.95	0.62	0.89	3-M1t	0.64	0.48	1.15	1.15	1.05	1.74
7.80	1498.31	0.94	1.25	3-M1t	0.94	0.69	1.37	1.37	1.70	2.07
11.70	1498.52	1.20	1.46	3-M1t	1.20	0.85	1.53	1.53	2.27	2.29
15.60	1498.80	1.42	1.74	3-M1t	1.49	0.99	1.66	1.66	2.81	2.46
19.50	1499.08	1.61	2.02	3-M2t	2.00	1.11	1.77	1.77	3.32	2.60
23.40	1499.50	1.79	2.44	3-M2t	2.00	1.23	1.87	1.87	3.86	2.72
27.30	1500.15	1.97	3.09	3-M2t	2.00	1.33	1.95	1.95	4.40	2.83
31.20	1499.52	2.16	2.46	3-M1f	2.00	1.42	2.00	2.03	4.97	2.93
35.00	1499.64	2.36	2.58	3-M1f	2.00	1.50	2.00	2.10	5.57	3.01
39.00	1499.78	2.60	2.72	3-M1f	2.00	1.59	2.00	2.17	6.21	3.10

El. inlet face invert 1497.06 ft El. outlet invert 1496.56 ft
El. inlet throat invert 0.00 ft El. inlet crest 0.00 ft

***** SITE DATA ***** CULVERT INVERT **********

INLET STATION	1950.00 ft
INLET ELEVATION	1497.06 ft
OUTLET STATION	2050.00 ft
OUTLET ELEVATION	1496.56 ft
NUMBER OF BARRELS	2
SLOPE (V/H)	0.0050
CULVERT LENGTH ALONG SLOPE	100.00 ft

***** CULVERT DATA SUMMARY **********

BARREL SHAPE	CIRCULAR
BARREL DIAMETER	2.00 ft
BARREL MATERIAL	CORRUGATED STEEL
BARREL MANNING'S n	0.024
INLET TYPE	CONVENTIONAL
INLET EDGE AND WALL	GROOVED END PROJECTION
INLET DEPRESSION	NONE

CURRENT DATE: 06-22-2000
CURRENT TIME: 11:15:47

FILE DATE: 06-22-2000
FILE NAME: CONN605

****
********** TAILWATER **********
****

******* REGULAR CHANNEL CROSS SECTION **********

SIDE SLOPE H/V (X:1)	4.0
CHANNEL SLOPE V/H (ft/ft)	0.006
MANNING'S n (.01-0.1)	0.035
CHANNEL INVERT ELEVATION	1496.96 ft
CULVERT NO.1 OUTLET INVERT ELEVATION	1496.56 ft

******* UNIFORM FLOW RATING CURVE FOR DOWNSTREAM CHANNEL

FLOW (cfs)	W.S.E. (ft)	FROUDE NUMBER	DEPTH (ft)	VEL. (f/s)	SHEAR (psf)
0.00	1496.96	0.000	0.00	0.00	0.00
3.90	1497.71	0.355	0.75	1.74	0.30
7.80	1497.93	0.370	0.97	2.07	0.39
11.70	1498.09	0.380	1.13	2.29	0.46
15.60	1498.22	0.387	1.26	2.46	0.51
19.50	1498.33	0.392	1.37	2.60	0.56
23.40	1498.43	0.396	1.47	2.72	0.59
27.30	1498.51	0.400	1.55	2.83	0.63
31.20	1498.59	0.404	1.63	2.93	0.66
35.00	1498.66	0.407	1.70	3.01	0.69
39.00	1498.73	0.410	1.77	3.10	0.72

****
********** ROADWAY OVERTOPPING DATA **********
****

WEIR COEFFICIENT	2.50
EMBANKMENT TOP WIDTH	48.00 ft
CREST LENGTH	100.00 ft
OVERTOPPING CREST ELEVATION	1502.67 ft

****

Culverts at Jomax & US60

CURRENT DATE: 06-22-2000 FILE DATE: 06-22-2000
CURRENT TIME: 11:18:47 FILE NAME: JOMAXML

****
********** FHWA CULVERT ANALYSIS **********
********** HY-8, VERSION 6.1 **********
****

CULV NO.	SITE DATA: INLET ELEV. (ft)	OUTLET ELEV. (ft)	CULVERT LENGTH (ft)	CULVERT SHAPE, MATERIAL, INLET: BARRELS SHAPE MATERIAL	SPAN (ft)	RISE (ft)	MANNING n	INLET TYPE
1	1466.21	1465.68	107.00	2 CSP	2.50	2.50	.024	CONVENTIONAL
2								
3								
4								
5								
6								

****

SUMMARY OF CULVERT FLOWS (cfs) FILE: JOMAXML DATE: 06-22-2000

ELEV (ft)	TOTAL	1	2	3	4	5	6	ROADWAY	ITR	
1466.21	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	1	
1466.99	4.8	4.8	0.0	0.0	0.0	0.0	0.0	0.00	1	
1467.35	9.6	9.6	0.0	0.0	0.0	0.0	0.0	0.00	1	
1467.65	14.4	14.4	0.0	0.0	0.0	0.0	0.0	0.00	1	
1467.91	19.2	19.2	0.0	0.0	0.0	0.0	0.0	0.00	1	
1468.15	24.0	24.0	0.0	0.0	0.0	0.0	0.0	0.00	1	
1468.38	28.8	28.8	0.0	0.0	0.0	0.0	0.0	0.00	1	
1468.57	33.6	33.6	0.0	0.0	0.0	0.0	0.0	0.00	1	
1468.83	***38.0***	***38.0***	***0.0***	***0.0***	***0.0***	***0.0***	***0.0***	***0.00***	***1***	***Q50***
1469.13	43.2	43.2	0.0	0.0	0.0	0.0	0.0	0.00	1	
1469.27	48.0	48.0	0.0	0.0	0.0	0.0	0.0	0.00	1	
1471.72	68.7	68.7	0.0	0.0	0.0	0.0	0.0	OVERTOPPING		

****

1469.00 42.0 Q100

****

SUMMARY OF ITERATIVE SOLUTION ERRORS FILE: JOMAXML DATE: 06-22-2000

HEAD ELEV (ft)	HEAD ERROR (ft)	TOTAL FLOW (cfs)	FLOW ERROR (cfs)	% FLOW ERROR
1466.21	0.000	0.00	0.00	0.00
1466.99	0.000	4.80	0.00	0.00
1467.35	0.000	9.60	0.00	0.00
1467.65	0.000	14.40	0.00	0.00
1467.91	0.000	19.20	0.00	0.00
1468.15	0.000	24.00	0.00	0.00
1468.38	0.000	28.80	0.00	0.00
1468.57	0.000	33.60	0.00	0.00
1468.79	0.000	38.00	0.00	0.00
1469.13	0.000	43.20	0.00	0.00
1469.27	0.000	48.00	0.00	0.00

****

<1> TOLERANCE (ft) = 0.010 <2> TOLERANCE (%) = 1.000

****

CURRENT DATE: 06-22-2000 FILE DATE: 06-22-2000
CURRENT TIME: 11:18:47 FILE NAME: JOMAXML

PERFORMANCE CURVE FOR CULVERT 1 - 2(2.50 (ft) BY 2.50 (ft)) CSP

DIS-CHARGE FLOW (cfs)	HEAD-WATER ELEV. (ft)	INLET CONTROL DEPTH (ft)	OUTLET CONTROL DEPTH (ft)	FLOW TYPE <F4>	NORMAL DEPTH (ft)	CRIT. DEPTH (ft)	OUTLET DEPTH (ft)	TW DEPTH (ft)	OUTLET VEL. (fps)	TW VEL. (fps)
0.00	1466.21	0.00	0.00	0-NF	0.00	0.00	0.00	0.00	0.00	0.00
4.80	1466.99	0.68	0.78	2-M2c	0.65	0.50	0.50	0.37	3.39	1.37
9.60	1467.35	1.01	1.14	2-M2c	0.94	0.72	0.72	0.55	4.11	1.72
14.40	1467.65	1.28	1.44	2-M2c	1.18	0.88	0.88	0.68	4.63	1.96
19.20	1467.91	1.50	1.70	2-M2c	1.41	1.03	1.03	0.80	5.03	2.13
24.00	1468.14	1.71	1.93	2-M2c	1.64	1.16	1.16	0.90	5.40	2.28
28.80	1468.38	1.90	2.17	2-M2c	1.89	1.28	1.28	1.00	5.72	2.41
33.60	1468.57	2.08	2.36	2-M2c	2.50	1.38	1.38	1.08	6.05	2.52
38.00	1468.79	2.26	2.58	2-M2c	2.50	1.48	1.48	1.15	6.30	2.61
43.20	1469.13	2.49	2.92	2-M2c	2.50	1.58	1.58	1.23	6.64	2.71
48.00	1469.27	2.72	3.06	2-M2c	2.50	1.66	1.66	1.30	6.93	2.79

El. inlet face invert 1466.21 ft El. outlet invert 1465.68 ft
El. inlet throat invert 0.00 ft El. inlet crest 0.00 ft

***** SITE DATA ***** CULVERT INVERT **********

INLET STATION	1946.00 ft
INLET ELEVATION	1466.21 ft
OUTLET STATION	2053.00 ft
OUTLET ELEVATION	1465.68 ft
NUMBER OF BARRELS	2
SLOPE (V/H)	0.0050
CULVERT LENGTH ALONG SLOPE	107.00 ft

***** CULVERT DATA SUMMARY **********

BARREL SHAPE	CIRCULAR
BARREL DIAMETER	2.50 ft
BARREL MATERIAL	CORRUGATED STEEL
BARREL MANNING'S n	0.024
INLET TYPE	CONVENTIONAL
INLET EDGE AND WALL	MITERED TO CONFORM TO SLOPE
INLET DEPRESSION	NONE

CURRENT DATE: 06-22-2000 FILE DATE: 06-22-2000
CURRENT TIME: 11:18:47 FILE NAME: JOMAXML

****
********** TAILWATER **********
****

******* REGULAR CHANNEL CROSS SECTION **********

BOTTOM WIDTH	8.00 ft
SIDE SLOPE H/V (X:1)	4.0
CHANNEL SLOPE V/H (ft/ft)	0.005
MANNING'S n (.01-0.1)	0.035
CHANNEL INVERT ELEVATION	1465.68 ft
CULVERT NO.1 OUTLET INVERT ELEVATION	1465.68 ft

******* UNIFORM FLOW RATING CURVE FOR DOWNSTREAM CHANNEL

FLOW (cfs)	W.S.E. (ft)	FROUDE NUMBER	DEPTH (ft)	VEL. (f/s)	SHEAR (psf)
0.00	1465.68	0.000	0.00	0.00	0.00
4.80	1466.05	0.398	0.37	1.37	0.11
9.60	1466.23	0.410	0.55	1.72	0.17
14.40	1466.36	0.416	0.68	1.96	0.21
19.20	1466.48	0.420	0.80	2.13	0.24
24.00	1466.58	0.423	0.90	2.28	0.27
28.80	1466.68	0.425	1.00	2.41	0.30
33.60	1466.76	0.427	1.08	2.52	0.33
38.00	1466.83	0.428	1.15	2.61	0.35
43.20	1466.91	0.429	1.23	2.71	0.37
48.00	1466.98	0.431	1.30	2.79	0.39

****
********** ROADWAY OVERTOPPING DATA **********
****

WEIR COEFFICIENT	2.50
EMBANKMENT TOP WIDTH	50.00 ft
CREST LENGTH	100.00 ft
OVERTOPPING CREST ELEVATION	1471.72 ft

****

Culverts at Happy Valley & US60

CURRENT DATE: 06-22-2000 FILE DATE: 06-22-2000
CURRENT TIME: 11:35:37 FILE NAME: HAPVALML

****
********** FHWA CULVERT ANALYSIS **********
********** HY-8, VERSION 6.1 **********
****

CULV NO.	SITE DATA: INLET ELEV. (ft)	OUTLET ELEV. (ft)	CULVERT LENGTH (ft)	CULVERT SHAPE, MATERIAL, INLET: BARRELS SHAPE MATERIAL	SPAN (ft)	RISE (ft)	MANNING n	INLET TYPE
1	1419.58	1418.99	118.00	2 RCP	3.00	3.00	.013	CONVENTIONAL
2								
3								
4								
5								
6								

****

SUMMARY OF CULVERT FLOWS (cfs) FILE: HAPVALML DATE: 06-22-2000

ELEV (ft)	TOTAL	1	2	3	4	5	6	ROADWAY	ITR	
1419.99	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	1	
1420.74	10.6	10.6	0.0	0.0	0.0	0.0	0.0	0.00	1	
1420.98	21.2	21.2	0.0	0.0	0.0	0.0	0.0	0.00	1	
1421.36	31.8	31.8	0.0	0.0	0.0	0.0	0.0	0.00	1	
1421.69	42.4	42.4	0.0	0.0	0.0	0.0	0.0	0.00	1	
1421.97	53.0	53.0	0.0	0.0	0.0	0.0	0.0	0.00	1	
1422.24	63.6	63.6	0.0	0.0	0.0	0.0	0.0	0.00	1	
1422.62	74.2	74.2	0.0	0.0	0.0	0.0	0.0	0.00	1	
1422.92	84.8	84.8	0.0	0.0	0.0	0.0	0.0	0.00	1	
1423.24	95.4	95.4	0.0	0.0	0.0	0.0	0.0	0.00	1	
1423.27	***96.0***	***96.0***	***0.0***	***0.0***	***0.0***	***0.0***	***0.0***	***0.00***	***1***	***Q50***
1425.64	158.7	158.7	0.0	0.0	0.0	0.0	0.0	OVERTOPPING		

****

1423.42 106.0 Q100

****

SUMMARY OF ITERATIVE SOLUTION ERRORS FILE: HAPVALML DATE: 06-22-2000

HEAD ELEV (ft)	HEAD ERROR (ft)	TOTAL FLOW (cfs)	FLOW ERROR (cfs)	% FLOW ERROR
1419.99	0.000	0.00	0.00	0.00
1420.74	0.000	10.60	0.00	0.00
1420.98	0.000	21.20	0.00	0.00
1421.36	0.000	31.80	0.00	0.00
1421.69	0.000	42.40	0.00	0.00
1421.97	0.000	53.00	0.00	0.00
1422.24	0.000	63.60	0.00	0.00
1422.62	0.000	74.20	0.00	0.00
1422.92	0.000	84.80	0.00	0.00
1423.24	0.000	95.40	0.00	0.00
1423.27	0.000	96.00	0.00	0.00

****

<1> TOLERANCE (ft) = 0.010 <2> TOLERANCE (%) = 1.000

****

CURRENT DATE: 06-22-2000 FILE DATE: 06-22-2000
CURRENT TIME: 11:35:37 FILE NAME: HAPVALML

PERFORMANCE CURVE FOR CULVERT 1 - 2(3.00 (ft) BY 3.00 (ft)) RCP

DIS-CHARGE FLOW (cfs)	HEAD-WATER ELEV. (ft)	INLET CONTROL DEPTH (ft)	OUTLET CONTROL DEPTH (ft)	FLOW TYPE <F4>	NORMAL DEPTH (ft)	CRIT. DEPTH (ft)	OUTLET DEPTH (ft).	TW DEPTH (ft)	OUTLET VEL. (fps)	TW VEL. (fps)
0.00	1419.99	0.00	0.41	0-NF	0.00	0.00	0.00	1.00	0.00	0.00
10.60	1420.74	0.92	1.17	3-M1t	0.67	0.71	1.56	1.56	1.43	1.85
21.20	1420.98	1.40	1.40	1-S2n	0.96	1.02	0.97	1.82	5.38	2.29
31.80	1421.36	1.78	1.78	1-S2n	1.20	1.27	1.07	2.02	7.03	2.58
42.40	1421.69	2.11	2.11	1-S2n	1.41	1.48	1.28	2.19	7.38	2.80
53.00	1421.97	2.39	2.39	1-S2n	1.61	1.66	1.56	2.33	7.16	2.98
63.60	1422.24	2.66	2.66	1-S2n	1.80	1.83	1.73	2.46	7.55	3.14
74.20	1422.62	2.93	3.04	3-M1t	2.01	1.97	2.58	2.58	5.75	3.28
84.80	1422.91	3.21	3.33	3-M1t	2.23	2.12	2.69	2.69	6.35	3.40
95.40	1423.24	3.51	3.66	3-M1t	2.51	2.24	2.79	2.79	7.00	3.51
96.00	1423.27	3.53	3.69	3-M1t	2.53	2.25	2.80	2.80	7.04	3.51

El. inlet face invert 1419.58 ft El. outlet invert 1418.99 ft
El. inlet throat invert 0.00 ft El. inlet crest 0.00 ft

***** SITE DATA ***** CULVERT INVERT **********

INLET STATION	1937.00 ft
INLET ELEVATION	1419.58 ft
OUTLET STATION	2055.00 ft
OUTLET ELEVATION	1418.99 ft
NUMBER OF BARRELS	2
SLOPE (V/H)	0.0050
CULVERT LENGTH ALONG SLOPE	118.00 ft

***** CULVERT DATA SUMMARY **********

BARREL SHAPE	CIRCULAR
BARREL DIAMETER	3.00 ft
BARREL MATERIAL	CONCRETE
BARREL MANNING'S n	0.013
INLET TYPE	CONVENTIONAL
INLET EDGE AND WALL	GROOVED END PROJECTION
INLET DEPRESSION	NONE

CURRENT DATE: 06-22-2000
CURRENT TIME: 11:35:37

FILE DATE: 06-22-2000
FILE NAME: HAPVALML

****
********** TAILWATER **********
****

******* REGULAR CHANNEL CROSS SECTION **********

BOTTOM WIDTH	8.00 ft
SIDE SLOPE H/V (X:1)	4.0
CHANNEL SLOPE V/H (ft/ft)	0.005
MANNING'S n (.01-0.1)	0.035
CHANNEL INVERT ELEVATION	1419.99 ft
CULVERT NO.1 OUTLET INVERT ELEVATION	1418.99 ft

******* UNIFORM FLOW RATING CURVE FOR DOWNSTREAM CHANNEL

FLOW (cfs)	W.S.E. (ft)	FROUDE NUMBER	DEPTH (ft)	VEL. (f/s)	SHEAR (psf)
0.00	1419.99	0.000	0.00	0.00	0.00
10.60	1420.55	0.434	0.56	1.85	0.19
21.20	1420.81	0.445	0.82	2.29	0.28
31.80	1421.01	0.450	1.02	2.58	0.34
42.40	1421.18	0.453	1.19	2.80	0.40
53.00	1421.32	0.455	1.33	2.98	0.45
63.60	1421.45	0.457	1.46	3.14	0.49
74.20	1421.57	0.459	1.58	3.28	0.53
84.80	1421.68	0.460	1.69	3.40	0.57
95.40	1421.78	0.462	1.79	3.51	0.60
96.00	1421.79	0.462	1.80	3.51	0.61

****
********** ROADWAY OVERTOPPING DATA **********
****

WEIR COEFFICIENT	2.50
EMBANKMENT TOP WIDTH	52.00 ft
CREST LENGTH	100.00 ft
OVERTOPPING CREST ELEVATION	1425.64 ft

****

Culverts at Norwich & US60

CURRENT DATE: 06-22-2000 FILE DATE: 06-22-2000
CURRENT TIME: 11:36:43 FILE NAME: NORWICH

****
********** FHWA CULVERT ANALYSIS **********
********** HY-8, VERSION 6.1 **********
****

CULV NO.	SITE DATA: INLET ELEV. (ft)	OUTLET ELEV. (ft)	CULVERT LENGTH (ft)	CULVERT SHAPE, MATERIAL, INLET: BARRELS SHAPE MATERIAL	SPAN (ft)	RISE (ft)	MANNING n	INLET TYPE
1	1388.43	1387.82	122.00	2 RCP	2.50	2.50	.013	CONVENTIONAL
2								
3								
4								
5								
6								

****

SUMMARY OF CULVERT FLOWS (cfs) FILE: NORWICH DATE: 06-22-2000

ELEV (ft)	TOTAL	1	2	3	4	5	6	ROADWAY	ITR	
1388.43	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	1	
1389.16	6.1	6.1	0.0	0.0	0.0	0.0	0.0	0.00	1	
1389.53	12.2	12.2	0.0	0.0	0.0	0.0	0.0	0.00	1	
1389.83	18.3	18.3	0.0	0.0	0.0	0.0	0.0	0.00	1	
1390.09	24.4	24.4	0.0	0.0	0.0	0.0	0.0	0.00	1	
1390.32	30.5	30.5	0.0	0.0	0.0	0.0	0.0	0.00	1	
1390.53	36.6	36.6	0.0	0.0	0.0	0.0	0.0	0.00	1	
1390.92	42.7	42.7	0.0	0.0	0.0	0.0	0.0	0.00	1	
1391.15	48.8	48.8	0.0	0.0	0.0	0.0	0.0	0.00	1	
1391.51	54.9	54.9	0.0	0.0	0.0	0.0	0.0	0.00	1	
1391.52	***55.0***	***55.0***	***0.0***	***0.0***	***0.0***	***0.0***	***0.0***	***0.00***	***1***	***Q50***
1394.16	91.0	91.0	0.0	0.0	0.0	0.0	0.0	OVERTOPPING		

****

1391.65 61.0 Q100

****

SUMMARY OF ITERATIVE SOLUTION ERRORS FILE: NORWICH DATE: 06-22-2000

HEAD ELEV (ft)	HEAD ERROR (ft)	TOTAL FLOW (cfs)	FLOW ERROR (cfs)	% FLOW ERROR
1388.43	0.000	0.00	0.00	0.00
1389.16	0.000	6.10	0.00	0.00
1389.53	0.000	12.20	0.00	0.00
1389.83	0.000	18.30	0.00	0.00
1390.09	0.000	24.40	0.00	0.00
1390.32	0.000	30.50	0.00	0.00
1390.53	0.000	36.60	0.00	0.00
1390.92	0.000	42.70	0.00	0.00
1391.15	0.000	48.80	0.00	0.00
1391.51	0.000	54.90	0.00	0.00
1391.52	0.000	55.00	0.00	0.00

****

<1> TOLERANCE (ft) = 0.010 <2> TOLERANCE (%) = 1.000

****

CURRENT DATE: 06-22-2000 FILE DATE: 06-22-2000
CURRENT TIME: 11:36:43 FILE NAME: NORWICH

PERFORMANCE CURVE FOR CULVERT 1 - 2(2.50 (ft) BY 2.50 (ft)) RCP

DIS-CHARGE FLOW (cfs)	HEAD-WATER ELEV. (ft)	INLET CONTROL DEPTH (ft)	OUTLET CONTROL DEPTH (ft)	FLOW TYPE <F4>	NORMAL DEPTH (ft)	CRIT. DEPTH (ft)	OUTLET DEPTH (ft)	TW DEPTH (ft)	OUTLET VEL. (fps)	TW VEL. (fps)
0.00	1388.43	0.00	0.00	0-NF	0.00	0.00	0.00	0.00	0.00	0.00
6.10	1389.16	0.73	0.73	1-S2n	0.54	0.56	0.46	1.12	4.82	4.91
12.20	1389.53	1.10	1.10	1-S2n	0.77	0.81	0.71	1.45	5.29	5.83
18.30	1389.83	1.40	1.40	1-S2n	0.96	1.01	0.91	1.68	5.67	6.46
24.40	1390.09	1.66	1.66	1-S2n	1.13	1.17	1.07	1.88	6.10	6.94
30.50	1390.32	1.89	1.89	1-S2n	1.29	1.31	1.21	2.04	6.45	7.33
36.60	1390.53	2.10	2.10	1-S2n	1.44	1.45	1.35	2.18	6.80	7.68
42.70	1390.92	2.30	2.49	3-M1t	1.59	1.57	2.31	2.31	4.53	7.98
48.80	1391.15	2.50	2.72	3-M1t	1.75	1.68	2.43	2.43	5.04	8.25
54.90	1391.51	2.72	3.08	3-M1f	1.94	1.78	2.50	2.54	5.59	8.50
55.00	1391.51	2.72	3.08	3-M1f	1.94	1.78	2.50	2.54	5.60	8.50

El. inlet face invert 1388.43 ft El. outlet invert 1387.82 ft
El. inlet throat invert 0.00 ft El. inlet crest 0.00 ft

***** SITE DATA ***** CULVERT INVERT **********

INLET STATION	1939.00 ft
INLET ELEVATION	1388.43 ft
OUTLET STATION	2061.00 ft
OUTLET ELEVATION	1387.82 ft
NUMBER OF BARRELS	2
SLOPE (V/H)	0.0050
CULVERT LENGTH ALONG SLOPE	122.00 ft

***** CULVERT DATA SUMMARY **********

BARREL SHAPE	CIRCULAR
BARREL DIAMETER	2.50 ft
BARREL MATERIAL	CONCRETE
BARREL MANNING'S n	0.013
INLET TYPE	CONVENTIONAL
INLET EDGE AND WALL	GROOVED END PROJECTION
INLET DEPRESSION	NONE

CURRENT DATE: 06-22-2000 FILE DATE: 06-22-2000
CURRENT TIME: 11:36:43 FILE NAME: NORWICH

****
********** TAILWATER **********
****

******* REGULAR CHANNEL CROSS SECTION **********

SIDE SLOPE H/V (X:1)	1.0
CHANNEL SLOPE V/H (ft/ft)	0.006
MANNING'S n (.01-0.1)	0.013
CHANNEL INVERT ELEVATION	1387.82 ft
CULVERT NO.1 OUTLET INVERT ELEVATION	1387.82 ft

******* UNIFORM FLOW RATING CURVE FOR DOWNSTREAM CHANNEL

FLOW (cfs)	W.S.E. (ft)	FROUDE NUMBER	DEPTH (ft)	VEL. (f/s)	SHEAR (psf)
0.00	1387.82	0.000	0.00	0.00	0.00
6.10	1388.94	0.818	1.12	4.91	0.44
12.20	1389.27	0.855	1.45	5.83	0.57
18.30	1389.50	0.877	1.68	6.46	0.67
24.40	1389.69	0.893	1.88	6.94	0.75
30.50	1389.86	0.904	2.04	7.33	0.81
36.60	1390.00	0.915	2.18	7.68	0.87
42.70	1390.13	0.924	2.31	7.98	0.92
48.80	1390.25	0.932	2.43	8.25	0.97
54.90	1390.36	0.939	2.54	8.50	1.01
55.00	1390.36	0.939	2.54	8.50	1.01

****
********** ROADWAY OVERTOPPING DATA **********
****

WEIR COEFFICIENT	2.50
EMBANKMENT TOP WIDTH	52.00 ft
CREST LENGTH	100.00 ft
OVERTOPPING CREST ELEVATION	1394.16 ft

****

Culvert at Bradley Sta 19+60

CURRENT DATE: 06-10-2000 FILE DATE: 06-10-2000
CURRENT TIME: 13:15:38 FILE NAME: CMPBRAD

****
********** FHWA CULVERT ANALYSIS **********
********** HY-8, VERSION 6.1 **********
****

CULV NO.	SITE DATA: INLET ELEV. (ft)	SITE DATA: OUTLET ELEV. (ft)	SITE DATA: CULVERT LENGTH (ft)	CULVERT SHAPE, MATERIAL, INLET: BARRELS SHAPE MATERIAL	SPAN (ft)	RISE (ft)	MANNING n	INLET TYPE
1	1580.00	1579.91	119.00	1 CSP	2.00	2.00	.024	CONVENTIONAL
2								
3								
4								
5								
6								

****

SUMMARY OF CULVERT FLOWS (cfs) FILE: CMPBRAD DATE: 06-10-2000

ELEV (ft)	TOTAL	1	2	3	4	5	6	ROADWAY	ITR
1580.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	1
1581.83	4.5	4.5	0.0	0.0	0.0	0.0	0.0	0.00	1
1582.15	9.0	9.0	0.0	0.0	0.0	0.0	0.0	0.00	1
1582.52	13.5	13.5	0.0	0.0	0.0	0.0	0.0	0.00	1
1582.81	18.0	18.0	0.0	0.0	0.0	0.0	0.0	0.00	1
1583.33	22.5	22.5	0.0	0.0	0.0	0.0	0.0	0.00	1
1584.19	27.0	27.0	0.0	0.0	0.0	0.0	0.0	0.00	1
1585.22	31.5	31.5	0.0	0.0	0.0	0.0	0.0	0.00	1
1586.32	35.0	31.5	0.0	0.0	0.0	0.0	0.0	3.19	13
1586.38	40.5	31.5	0.0	0.0	0.0	0.0	0.0	8.77	7
1586.41	45.0	31.5	0.0	0.0	0.0	0.0	0.0	13.11	5
1586.27	31.5	31.5	0.0	0.0	0.0	0.0	0.0	OVERTOPPING	

****

SUMMARY OF ITERATIVE SOLUTION ERRORS FILE: CMPBRAD DATE: 06-10-2000

HEAD ELEV (ft)	HEAD ERROR (ft)	TOTAL FLOW (cfs)	FLOW ERROR (cfs)	% FLOW ERROR
1580.00	0.000	0.00	0.00	0.00
1581.83	0.000	4.50	0.00	0.00
1582.15	0.000	9.00	0.00	0.00
1582.52	0.000	13.50	0.00	0.00
1582.81	0.000	18.00	0.00	0.00
1583.33	0.000	22.50	0.00	0.00
1584.19	0.000	27.00	0.00	0.00
1585.22	0.000	31.50	0.00	0.00
1586.32	-0.002	35.00	0.31	0.89
1586.38	-0.002	40.50	0.23	0.57
1586.41	-0.003	45.00	0.39	0.87

****

<1> TOLERANCE (ft) = 0.010 <2> TOLERANCE (%) = 1.000

****

CURRENT DATE: 06-10-2000 FILE DATE: 06-10-2000
CURRENT TIME: 13:15:38 FILE NAME: CMPBRAD

PERFORMANCE CURVE FOR CULVERT 1 - 1(2.00 (ft) BY 2.00 (ft)) CSP

DIS-CHARGE FLOW (cfs)	HEAD-WATER ELEV. (ft)	INLET CONTROL DEPTH (ft)	OUTLET CONTROL DEPTH (ft)	FLOW TYPE <F4>	NORMAL DEPTH (ft)	CRIT. DEPTH (ft)	OUTLET DEPTH (ft)	TW DEPTH (ft)	OUTLET VEL. (fps)	TW VEL. (fps)
0.00	1580.00	0.00	0.00	0-NF	0.00	0.00	0.00	0.00	0.00	0.00
4.50	1581.83	1.04	1.83	3-M2t	2.00	0.74	1.73	1.73	1.57	0.38
9.00	1582.15	1.57	2.15	3-M2t	2.00	1.07	1.73	2.24	1.57	0.45
13.50	1582.52	2.06	2.52	3-M2t	2.00	1.32	1.73	2.61	1.57	0.50
18.00	1582.81	2.63	2.81	3-M2t	2.00	1.52	1.73	2.90	1.57	0.53
22.50	1583.33	3.33	3.07	3-M2t	2.00	1.68	1.73	3.16	7.83	0.56
27.00	1584.19	4.19	3.29	3-M2t	2.00	1.81	1.73	3.38	9.39	0.59
31.50	1585.22	5.22	3.49	3-M2t	2.00	1.94	1.73	3.58	10.96	0.61
31.50	1585.22	5.22	3.64	3-M2t	2.00	1.94	1.73	3.73	10.96	0.63
31.50	1585.22	5.22	3.85	3-M2t	2.00	1.94	1.73	3.94	10.96	0.65
31.50	1585.22	5.22	4.01	3-M2t	2.00	1.94	1.73	4.09	10.96	0.67

El. inlet face invert 1580.00 ft El. outlet invert 1579.91 ft
El. inlet throat invert 0.00 ft El. inlet crest 0.00 ft

***** SITE DATA ***** CULVERT INVERT **********

INLET STATION	1941.00 ft
INLET ELEVATION	1580.00 ft
OUTLET STATION	2060.00 ft
OUTLET ELEVATION	1579.91 ft
NUMBER OF BARRELS	1
SLOPE (V/H)	0.0008
CULVERT LENGTH ALONG SLOPE	119.00 ft

***** CULVERT DATA SUMMARY **********

BARREL SHAPE	CIRCULAR
BARREL DIAMETER	2.00 ft
BARREL MATERIAL	CORRUGATED STEEL
BARREL MANNING'S n	0.024
INLET TYPE	CONVENTIONAL
INLET EDGE AND WALL	SQUARE EDGE WITH HEADWALL
INLET DEPRESSION	NONE

CURRENT DATE: 06-10-2000
CURRENT TIME: 13:15:38

FILE DATE: 06-10-2000
FILE NAME: CMPBRAD

****
********** TAILWATER **********
****

******* REGULAR CHANNEL CROSS SECTION **********

SIDE SLOPE H/V (X:1)	4.0
CHANNEL SLOPE V/H (ft/ft)	0.000
MANNING'S n (.01-0.1)	0.035
CHANNEL INVERT ELEVATION	1579.91 ft
CULVERT NO.1 OUTLET INVERT ELEVATION	1579.91 ft

******* UNIFORM FLOW RATING CURVE FOR DOWNSTREAM CHANNEL

FLOW (cfs)	W.S.E. (ft)	FROUDE NUMBER	DEPTH (ft)	VEL. (f/s)	SHEAR (psf)
0.00	1579.91	0.000	0.00	0.00	0.00
4.50	1581.64	0.051	1.73	0.38	0.01
9.00	1582.15	0.053	2.24	0.45	0.01
13.50	1582.52	0.054	2.61	0.50	0.02
18.00	1582.81	0.055	2.90	0.53	0.02
22.50	1583.07	0.056	3.16	0.56	0.02
27.00	1583.29	0.057	3.38	0.59	0.02
31.50	1583.49	0.057	3.58	0.61	0.02
35.00	1583.64	0.058	3.73	0.63	0.02
40.50	1583.85	0.058	3.94	0.65	0.03
45.00	1584.01	0.058	4.09	0.67	0.03

****
********** ROADWAY OVERTOPPING DATA **********
****

WEIR COEFFICIENT	2.50
EMBANKMENT TOP WIDTH	100.00 ft
CREST LENGTH	100.00 ft
OVERTOPPING CREST ELEVATION	1586.27 ft

****

Culvert at Happy Valley Sta 8+00

CURRENT DATE: 07-05-2000 FILE DATE: 07-05-2000
CURRENT TIME: 09:50:39 FILE NAME: CMPHAPVL

****
********** FHWA CULVERT ANALYSIS **********
********** HY-8, VERSION 6.1 **********
****

CULV NO.	SITE DATA: INLET ELEV. (ft)	OUTLET ELEV. (ft)	CULVERT LENGTH (ft)	CULVERT SHAPE, MATERIAL, INLET: BARRELS SHAPE MATERIAL	SPAN (ft)	RISE (ft)	MANNING n	INLET TYPE
1	1421.75	1421.58	81.00	1 CMPA	2.92	2.00	.025	CONVENTIONAL
2								
3								
4								
5								
6								

****

SUMMARY OF CULVERT FLOWS (cfs) FILE: CMPHAPVL DATE: 07-05-2000

ELEV (ft)	TOTAL	1	2	3	4	5	6	ROADWAY	ITR
1421.75	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	1
1422.53	3.0	3.0	0.0	0.0	0.0	0.0	0.0	0.00	1
1422.89	6.0	6.0	0.0	0.0	0.0	0.0	0.0	0.00	1
1423.19	9.0	9.0	0.0	0.0	0.0	0.0	0.0	0.00	1
1423.43	12.0	12.0	0.0	0.0	0.0	0.0	0.0	0.00	1
1423.79	15.0	15.0	0.0	0.0	0.0	0.0	0.0	0.00	1
1424.06	18.0	18.0	0.0	0.0	0.0	0.0	0.0	0.00	1
1424.49	20.0	20.0	0.0	0.0	0.0	0.0	0.0	0.00	1
1425.28	24.0	24.0	0.0	0.0	0.0	0.0	0.0	0.00	1
1425.68	27.0	26.1	0.0	0.0	0.0	0.0	0.0	0.00	30
1425.85	30.0	26.7	0.0	0.0	0.0	0.0	0.0	2.98	15
1425.80	***26.7***	***26.7***	***0.0***	***0.0***	***0.0***	***0.0***	***0.0***	***OVERTOPPING***	***Qcap***

****

SUMMARY OF ITERATIVE SOLUTION ERRORS FILE: CMPHAPVL DATE: 07-05-2000

HEAD ELEV (ft)	HEAD ERROR (ft)	TOTAL FLOW (cfs)	FLOW ERROR (cfs)	% FLOW ERROR
1421.75	0.000	0.00	0.00	0.00
1422.53	0.000	3.00	0.00	0.00
1422.89	0.000	6.00	0.00	0.00
1423.19	0.000	9.00	0.00	0.00
1423.43	0.000	12.00	0.00	0.00
1423.79	0.000	15.00	0.00	0.00
1424.06	0.000	18.00	0.00	0.00
1424.49	0.000	20.00	0.00	0.00
1425.28	0.000	24.00	0.00	0.00
1425.68	-0.006	27.00	0.85	3.15
1425.85	-0.002	30.00	0.28	0.93

****

<1> TOLERANCE (ft) = 0.010 <2> TOLERANCE (%) = 1.000

****

CURRENT DATE: 07-05-2000 FILE DATE: 07-05-2000
CURRENT TIME: 09:50:39 FILE NAME: CMPHAPVL

****

PERFORMANCE CURVE FOR CULVERT 1 - 1(2.92 (ft) BY 2.00 (ft)) CMPA

****

DIS-CHARGE FLOW (cfs)	HEAD-WATER ELEV. (ft)	INLET CONTROL DEPTH (ft)	OUTLET CONTROL DEPTH (ft)	FLOW TYPE <F4>	NORMAL DEPTH (ft)	CRIT. DEPTH (ft)	OUTLET DEPTH (ft)	TW DEPTH (ft)	OUTLET VEL. (fps)	TW VEL. (fps)
0.00	1421.75	0.00	0.00	0-NF	0.00	0.00	0.00	0.00	0.00	0.00
3.00	1422.53	0.65	0.78	3-M2t	0.71	0.42	0.65	0.65	1.88	1.76
6.00	1422.89	0.97	1.14	3-M2t	1.12	0.61	0.85	0.85	2.78	2.10
9.00	1423.20	1.23	1.45	3-M2t	1.61	0.77	0.98	0.98	3.52	2.32
12.00	1423.43	1.44	1.68	3-M2t	2.00	0.91	1.10	1.10	4.19	2.49
15.00	1423.79	1.67	2.04	3-M2t	2.00	1.03	1.19	1.19	4.80	2.64
18.00	1424.06	1.91	2.31	3-M2t	2.00	1.15	1.28	1.28	5.39	2.76
20.00	1424.49	2.10	2.74	3-M2t	2.00	1.22	1.33	1.33	5.77	2.83
24.00	1425.28	2.53	3.53	3-M2t	2.00	1.35	1.42	1.42	6.48	2.96
26.15	1425.68	2.79	3.93	3-M2t	2.00	1.42	1.49	1.49	6.81	3.05
26.74	1425.85	2.86	4.10	3-M2t	2.00	1.43	1.55	1.55	6.73	3.13

****

El. inlet face invert 1421.75 ft El. outlet invert 1421.58 ft
El. inlet throat invert 0.00 ft El. inlet crest 0.00 ft

****

***** SITE DATA ***** CULVERT INVERT **********

INLET STATION	1959.00 ft
INLET ELEVATION	1421.75 ft
OUTLET STATION	2040.00 ft
OUTLET ELEVATION	1421.58 ft
NUMBER OF BARRELS	1
SLOPE (V/H)	0.0021
CULVERT LENGTH ALONG SLOPE	81.00 ft

***** CULVERT DATA SUMMARY **********

BARREL SHAPE	PIPE ARCH
BARREL SPAN	2.92 ft
BARREL RISE	2.00 ft
BARREL MATERIAL	STEEL OR ALUMINUM
BARREL MANNING'S n	0.025
INLET TYPE	CONVENTIONAL
INLET EDGE AND WALL	MITERED
INLET DEPRESSION	NONE

****

CURRENT DATE: 07-05-2000 FILE DATE: 07-05-2000
CURRENT TIME: 09:50:39 FILE NAME: CMPHAPVL

****
********** TAILWATER **********
****

******* REGULAR CHANNEL CROSS SECTION **********

SIDE SLOPE H/V (X:1)	4.0
CHANNEL SLOPE V/H (ft/ft)	0.008
MANNING'S n (.01-0.1)	0.035
CHANNEL INVERT ELEVATION	1421.58 ft
CULVERT NO.1 OUTLET INVERT ELEVATION	1421.58 ft

******* UNIFORM FLOW RATING CURVE FOR DOWNSTREAM CHANNEL

FLOW (cfs)	W.S.E. (ft)	FROUDE NUMBER	DEPTH (ft)	VEL. (f/s)	SHEAR (psf)
0.00	1421.58	0.000	0.00	0.00	0.00
3.00	1422.23	0.385	0.65	1.76	0.33
6.00	1422.43	0.402	0.85	2.10	0.42
9.00	1422.56	0.412	0.98	2.32	0.49
12.00	1422.68	0.419	1.10	2.49	0.55
15.00	1422.77	0.425	1.19	2.64	0.60
18.00	1422.86	0.430	1.28	2.76	0.64
20.00	1422.91	0.433	1.33	2.83	0.66
24.00	1423.00	0.438	1.42	2.96	0.71
27.00	1423.07	0.441	1.49	3.05	0.74
30.00	1423.13	0.444	1.55	3.13	0.77

****
********** ROADWAY OVERTOPPING DATA **********
****

WEIR COEFFICIENT	2.50
EMBANKMENT TOP WIDTH	50.00 ft
CREST LENGTH	100.00 ft
OVERTOPPING CREST ELEVATION	1425.80 ft

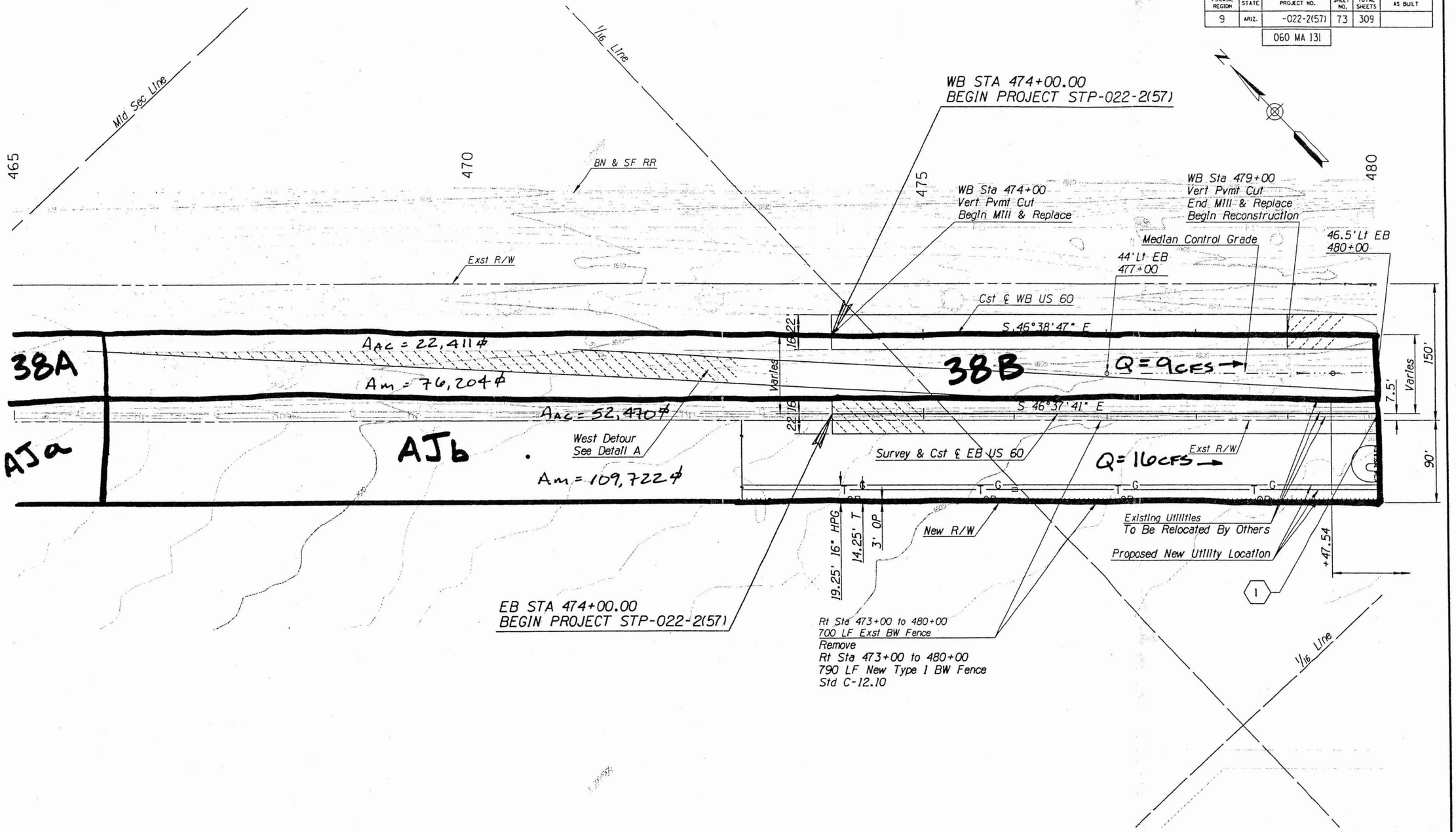
****

Appendix B

Roadway Drainage Area Sub-basins

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	ARIZ.	-022-2(57)	73	309	

060 MA 131



	NAME	DATE
DESIGN	MGJ	2-01
DRAWN	RLG, BLJ	2-01
CHECKED	KMD	2-01

DIBBLE & ASSOCIATES
CONSULTING ENGINEERS

ARIZONA DEPARTMENT OF TRANSPORTATION
INTERMODAL TRANSPORTATION DIVISION

PLAN SHEET
STA 465+00 TO 480+00

Registered Professional Engineer (Civil) CERTIFICATE NO. 12863 KENT M. DIBBLE Date Signed ARIZONA, U.S.A.

ROUTE: US 60
LOCATION: 203RD AVE (WEST) - DEER VALLEY RD

SHEET 1 OF 63

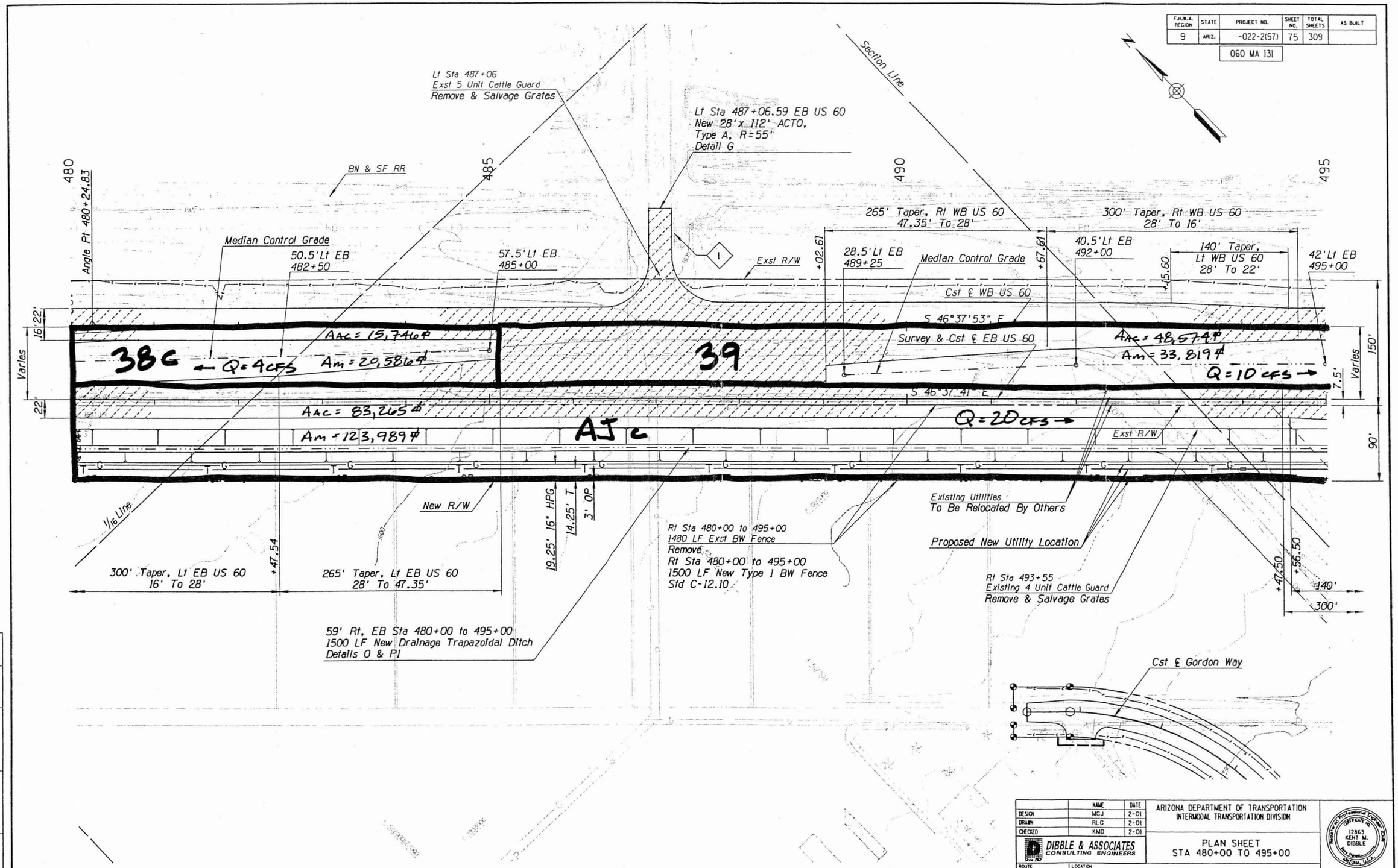
TRACS NO. H4573 02C | -022-2(57) | ___ OF ___

CONSTRUCTION DISPLAY ON

:/9727/ustn/mlpl26p2.dgn Mar. 08, 2001 09:30:36

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	ARIZ.	-022-2(57)	75	309	

060 MA 131



	NAME	DATE
DESIGN	MGJ	2-01
DRAWN	RLG	2-01
CHECKED	KMD	2-01

DIBBLE & ASSOCIATES
CONSULTING ENGINEERS

ARIZONA DEPARTMENT OF TRANSPORTATION
INTERMODAL TRANSPORTATION DIVISION

PLAN SHEET
STA 480+00 TO 495+00

Registered Professional Engineer (Civil)
CERTIFICATE NO. 12863
KENT M. DIBBLE
Date Signed
ARIZONA, U.S.A.

ROUTE: US 60
LOCATION: 203RD AVE (WEST) - DEER VALLEY RD

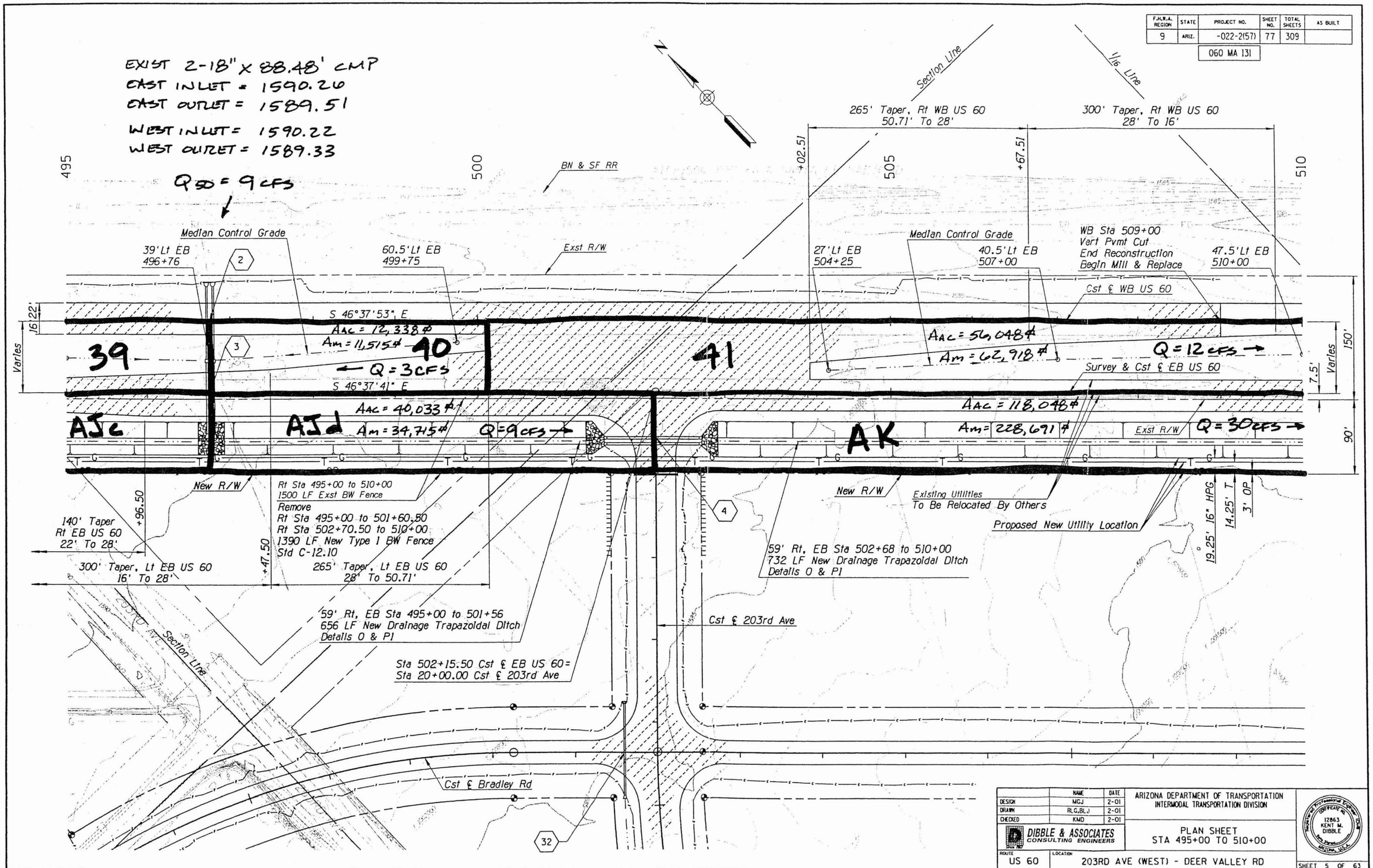
SHEET 3 OF 63

TRACS NO. H4573 02C | -022-2(57) | ___ OF ___

CONSTRUCTION DISPLAY ON

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	ARIZ.	-022-2(57)	77	309	

060 MA 131



	NAME	DATE
DESIGN	MGJ	2-01
DRAWN	RLG,BLJ	2-01
CHECKED	KMD	2-01

DIBBLE & ASSOCIATES
CONSULTING ENGINEERS

ARIZONA DEPARTMENT OF TRANSPORTATION
INTERMODAL TRANSPORTATION DIVISION

PLAN SHEET
STA 495+00 TO 510+00

ROUTE: US 60
LOCATION: 203RD AVE (WEST) - DEER VALLEY RD

OFFICIAL SEAL 12863 KENT M. DIBBLE ARIZONA, U.S.A.

SHEET 5 OF 63

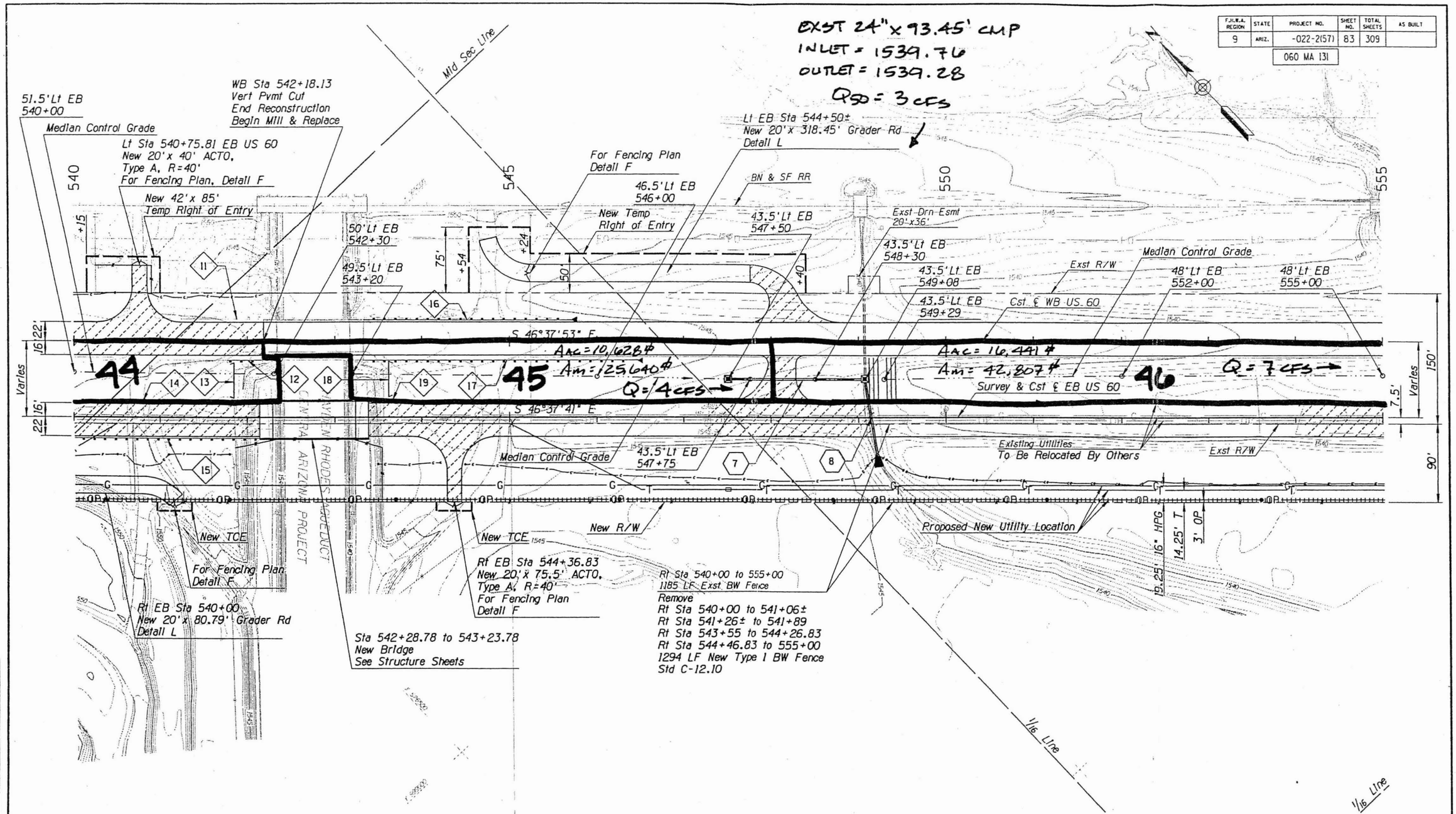
TRACS NO. H4573 02C | -022-2(57) | ___ OF ___

CONSTRUCTION DISPLAY ON

:/s727/dstn/mlpl28.dgn Mar. 08, 2001 09:30:43

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	ARIZ.	-022-2(57)	83	309	

060 MA 131



	NAME	DATE
DESIGN	MGJ	2-01
DRAWN	RLG	2-01
CHECKED	KMD	2-01

DIBBLE & ASSOCIATES CONSULTING ENGINEERS

ARIZONA DEPARTMENT OF TRANSPORTATION
INTERMODAL TRANSPORTATION DIVISION

PLAN SHEET
STA 540+00 TO 555+00

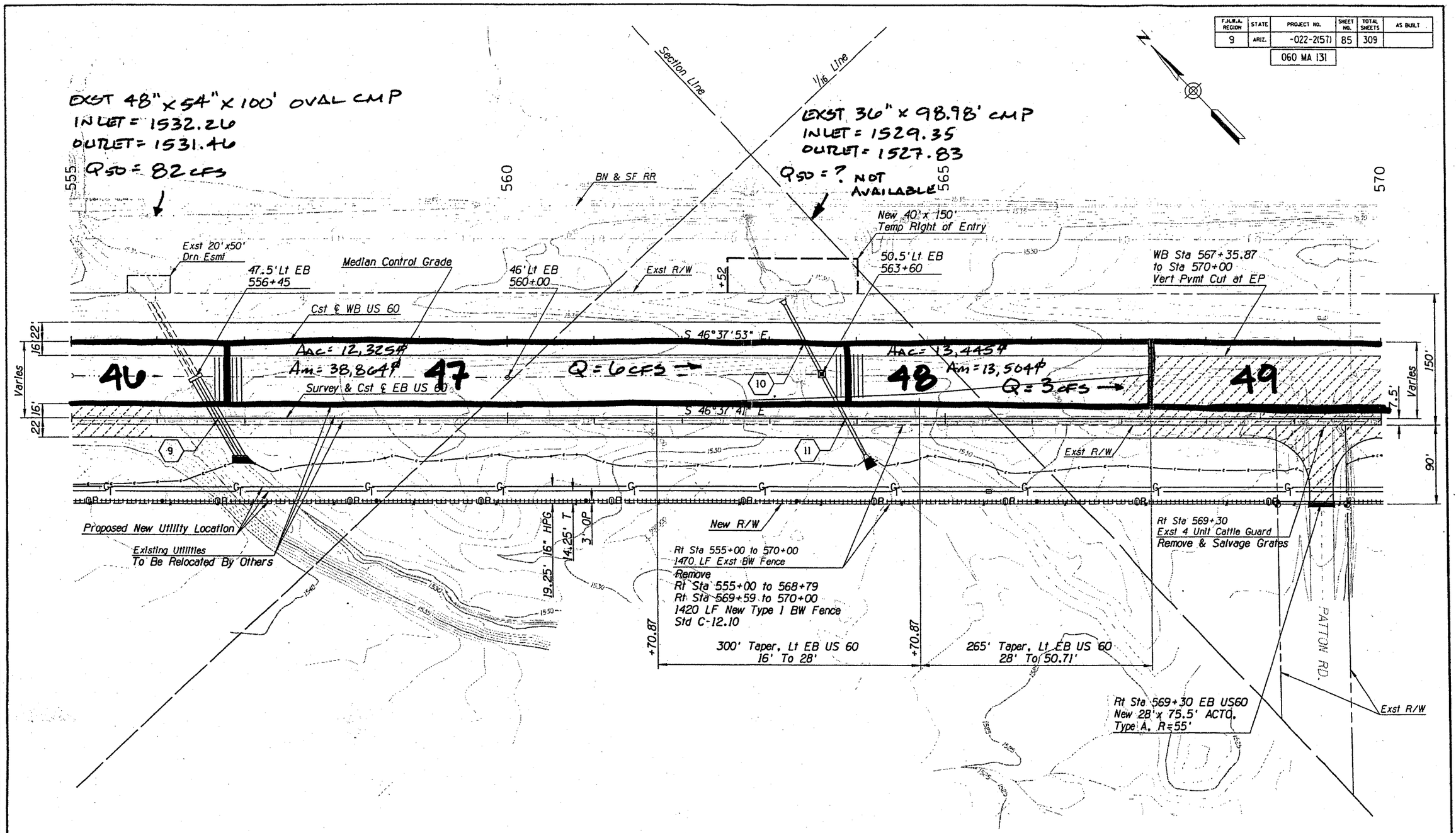
ROUTE: US 60
LOCATION: 203RD AVE (WEST) - DEER VALLEY RD

SHEET 11 OF 63

TRACS NO. H4573 02C | -022-2(57) | ___ OF ___

5/27/ustn/mlpl31.dgn Mar. 08, 2001 09:31:05

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	ARIZ.	-022-2(57)	85	309	
060 MA 131					



	NAME	DATE
DESIGN	MGJ	2-01
DRAWN	RLG, BLJ	2-01
CHECKED	KMD	2-01

DIBBLE & ASSOCIATES
CONSULTING ENGINEERS

ARIZONA DEPARTMENT OF TRANSPORTATION
INTERMODAL TRANSPORTATION DIVISION

PLAN SHEET
STA 555+00 TO 570+00

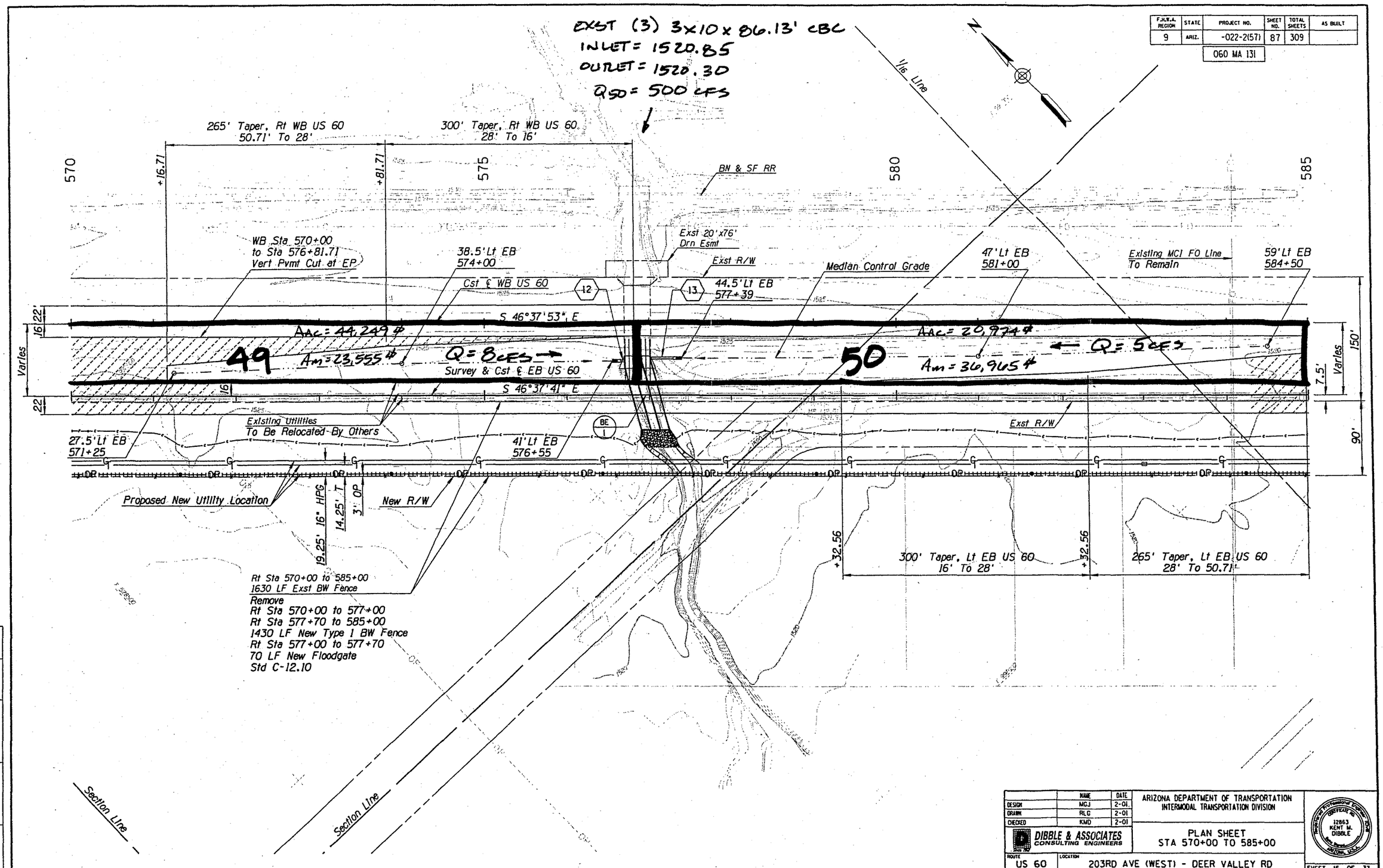
ROUTE: US 60
LOCATION: 203RD AVE (WEST) - DEER VALLEY RD

SHEET 13 OF 63

TRACS NO. H4573 02C | -022-2(57) | ___ OF ___

CONSTRUCTION DISPLAY ON

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	ARIZ.	-022-2(57)	87	309	
		060 MA 131			



	NAME	DATE
DESIGN	MGJ	2-01
DRAWN	RLG	2-01
CHECKED	KMD	2-01

DIBBLE & ASSOCIATES
CONSULTING ENGINEERS

ARIZONA DEPARTMENT OF TRANSPORTATION
INTERMODAL TRANSPORTATION DIVISION

PLAN SHEET
STA 570+00 TO 585+00

Registered Professional Engineer (Civil)
CERTIFICATE NO. 12863
KENT M. DIBBLE
ARIZONA, U.S.A.

ROUTE: US 60
LOCATION: 203RD AVE (WEST) - DEER VALLEY RD

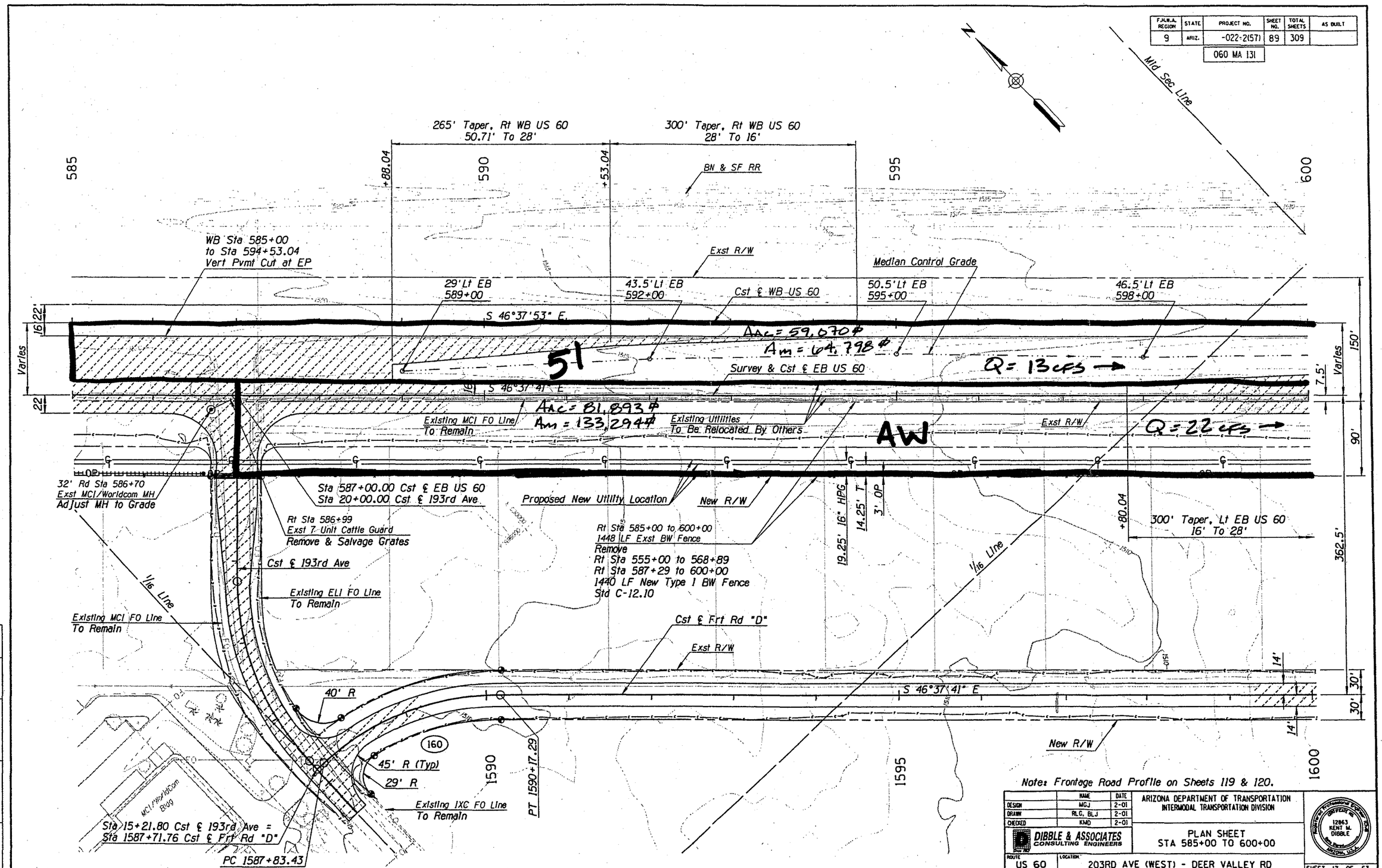
SHEET 15 OF 33

TRACS NO. H4573 02C | -022-2(57) | ___ OF ___

CONSTRUCTION DISPLAY ON

:/9727/ustn/mlpl33.dgn Mar. 08, 2001 09:31:12

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	ARIZ.	-022-2(57)	89	309	
		060 MA 131			



Note: Frontage Road Profile on Sheets 119 & 120.

	NAME	DATE
DESIGN	MGJ	2-01
DRAWN	RLG, BLJ	2-01
CHECKED	KMD	2-01

DIBBLE & ASSOCIATES CONSULTING ENGINEERS

ARIZONA DEPARTMENT OF TRANSPORTATION
INTERMODAL TRANSPORTATION DIVISION

PLAN SHEET
STA 585+00 TO 600+00

ROUTE: US 60
LOCATION: 203RD AVE (WEST) - DEER VALLEY RD

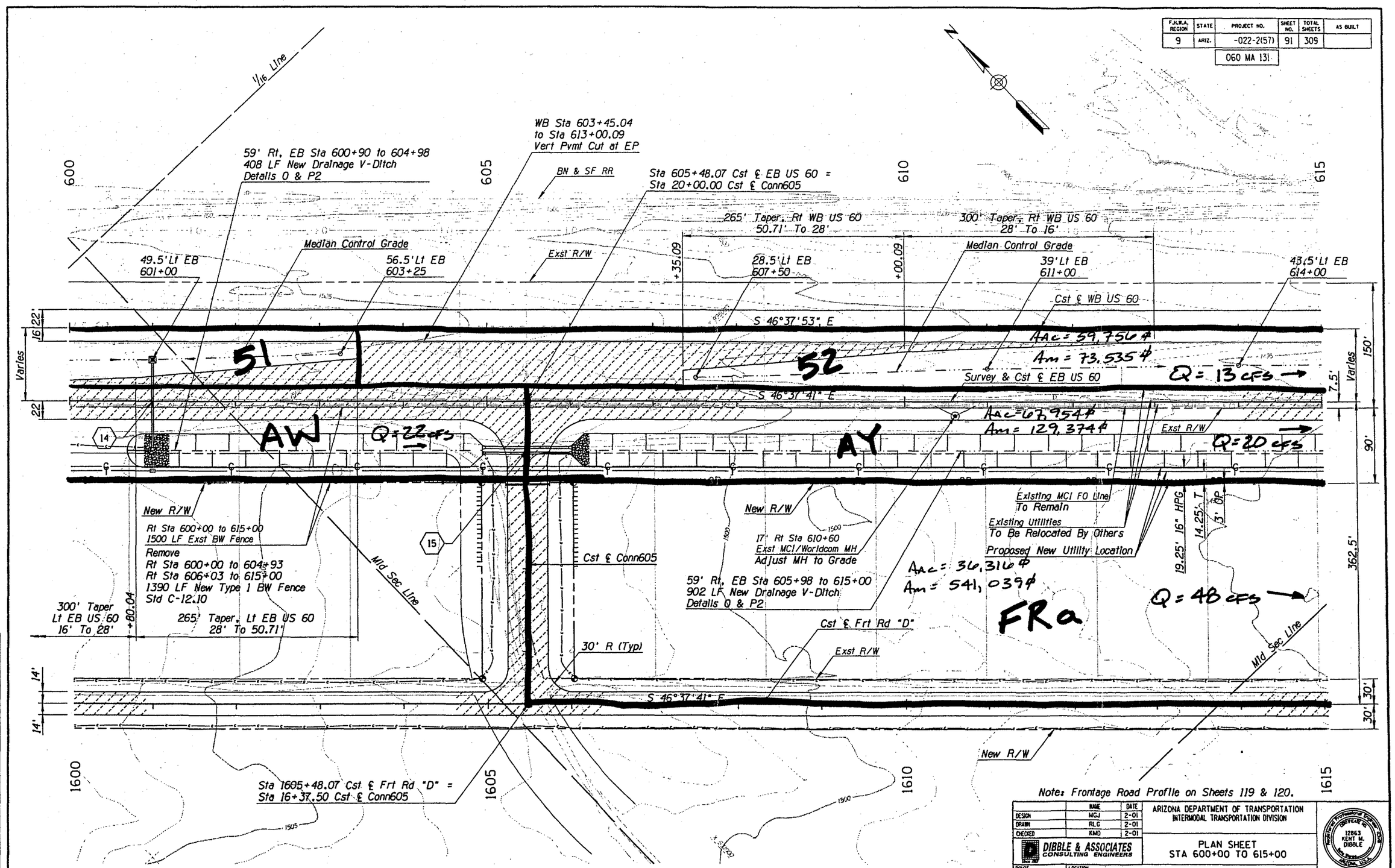
12863 KENT M. DIBBLE

SHEET 17 OF 63

TRACS NO. H4573 02C | -022-2(57) | ___ OF ___

CONSTRUCTION DISPLAY ON

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	ARIZ.	-022-2(57)	91	309	
		060 MA 131			



Note: Frontage Road Profile on Sheets 119 & 120.

	NAME	DATE
DESIGN	MGJ	2-01
DRAWN	RLG	2-01
CHECKED	KMD	2-01

DIBBLE & ASSOCIATES CONSULTING ENGINEERS

ARIZONA DEPARTMENT OF TRANSPORTATION
INTERMODAL TRANSPORTATION DIVISION

PLAN SHEET
STA 600+00 TO 615+00

CERTIFICATE OF 12863 KENT M. DIBBLE ARIZONA, U.S.A.

ROUTE: US 60
LOCATION: 203RD AVE (WEST) - DEER VALLEY RD

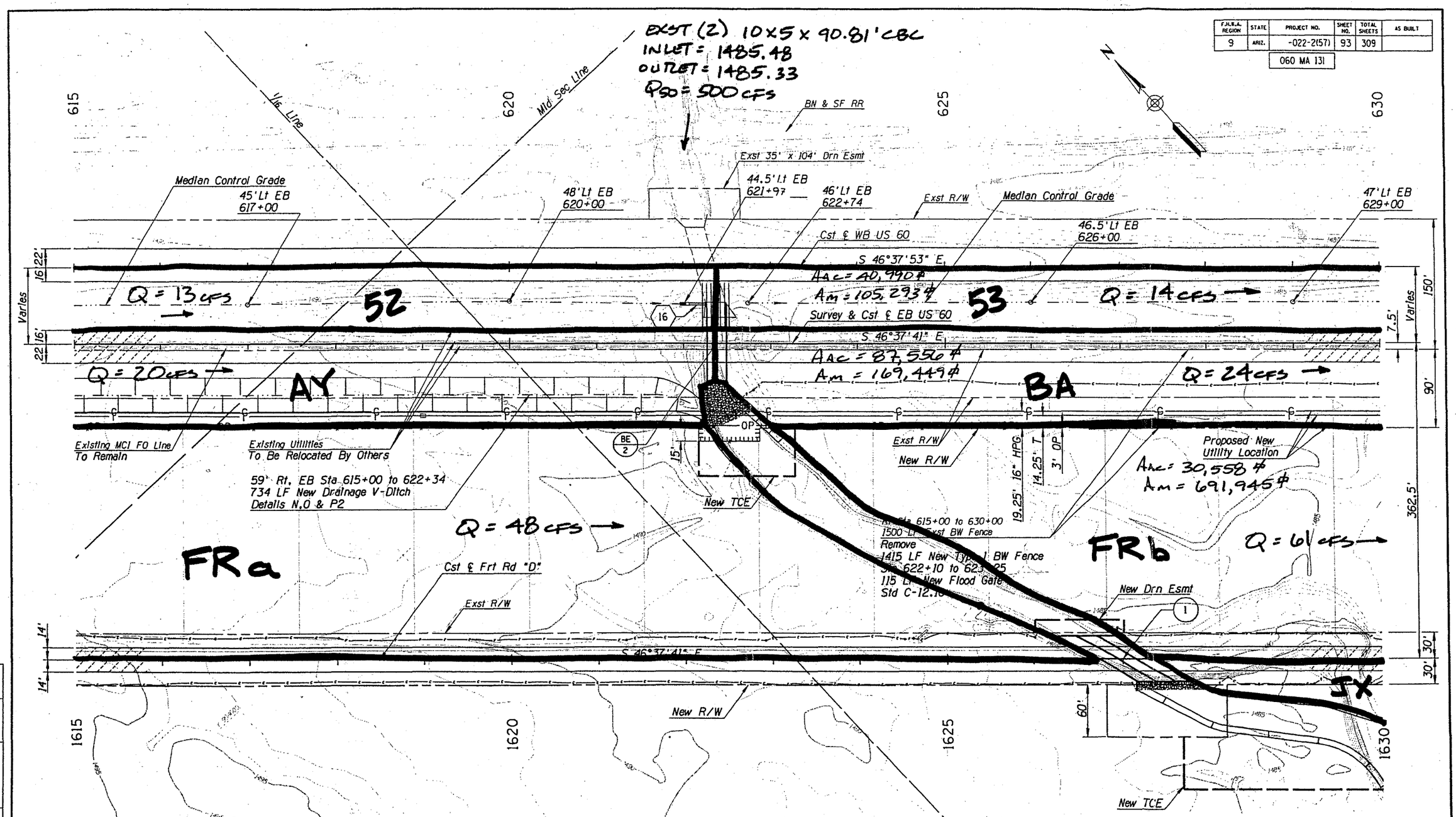
SHEET 19 OF 63

TRACS NO. H4573 02C | -022-2(57) | ___ OF ___

CONSTRUCTION DISPLAY ON

:/9727/ustn/mlpl35.dgn Mar. 08, 2001 09:31:19

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	ARIZ.	-022-2(57)	93	309	
		060 MA 131			



Note: Frontage Road Profile on Sheets 119 & 120.

	NAME	DATE
DESIGN	MGJ	2-01
DRAWN	RLG/BLJ	2-01
CHECKED	KMD	2-01

DIBBLE & ASSOCIATES CONSULTING ENGINEERS

ARIZONA DEPARTMENT OF TRANSPORTATION
INTERMODAL TRANSPORTATION DIVISION

PLAN SHEET
STA 615+00 TO 630+00

ROUTE: US 60
LOCATION: 203RD AVE (WEST) - DEER VALLEY RD

CERTIFICATE NO. 12663 KENT M. DIBBLE

SHEET 21 OF 63

TRACS NO. H4573 02C | -022-2(57) | ___ OF ___

CONSTRUCTION DISPLAY ON

:/9727/ustn/mlpl36.dgn Mar. 08, 2001 09:31:23

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	ARIZ.	-022-2(57)	95	309	

060 MA 131

630 635 640 645

BN & SF RR

WB Sta 642+89.84
to Sta 645+00
Vert Pvmt Cut at EP

Sta 644+92.84 Cst ℄ EB US 60 =
Sta 20+00.00 Cst ℄ Jomax Rd

Median Control Grade

48' Lt EB
632+00

Exst R/W

47.5' Lt EB
635+00

46.5' Lt EB
638+00

48.5' Lt EB
640+00

57' Lt EB
642+50

Cst ℄ WB US 60

S 46°37'53" E

Acc = 30,209#

Q = 14cfs →

53

54

Acq = 1,555#

Survey & Cst ℄ EB US 60

S 46°37'41" E

Varies

22' 16'

7.5'

150'

90'

362.5'

Existing MCI FO Line
To Remain

Existing Utilities
To Be Relocated By Others

BA

Q = 24 cfs

Exst R/W

17

18

Proposed New Utility Location

17' Rt Sta 635+49
Existing MCI/Worldcom MH
Adjust MH to Grade

19.25'
16" HPG

14.25' T
3' OP

New R/W

Section Line

+24.84

+24.84

55' Rt, EB Sta 639+90 to 644+39
449 LF New Trapazoidal Ditch
Details O & P3

300' Taper, Lt EB US 60
16' To 28'

265' Taper, Lt EB US 60
28' To 50.71'

Q = 61 cfs

FRb

Rt Sta 630+00 to 645+00
1500 LF Exst BW Fence
Remove
Rt Sta 630+00 to 644+37.84
1438 LF New Type 1 BW Fence
Std C-12.10

1/16 Line

Cst ℄ Jomax Rd

Cst ℄ Frt Rd "D"

Exst R/W

55' R (Typ)

14' 14'

S 46°37'41" E

30' 30'

New R/W

Sta 1644+92.84 Cst ℄ Frt Rd "D" =
Sta 16+37.50 Cst ℄ Jomax Rd

Rt Sta 1641+54.29 Frt Rd "D"
New 28' x 57' ACTO,
Type A, R=15'

JX

1635

1640

Note: Frontage Road Profile on Sheets 119 & 120.

	NAME	DATE
DESIGN	MGJ	2-01
DRAWN	RLG, BLJ	2-01
CHECKED	KMD	2-01

DIBBLE & ASSOCIATES
CONSULTING ENGINEERS

ARIZONA DEPARTMENT OF TRANSPORTATION
INTERMODAL TRANSPORTATION DIVISION

PLAN SHEET
STA 630+00 TO 645+00

ROUTE: US 60
LOCATION: 203RD AVE (WEST) - DEER VALLEY RD

SHEET 23 OF 63

TRACS NO. H4573 02C | -022-2(57) | ___ OF ___

CONSTRUCTION DISPLAY ON

:/5727/ustn/mlpl37.dgn Mar. 08, 2001 09:31:28

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	ARIZ.	-022-2(57)	97	309	
		060 MA 131			

EXST (5) 8X3 X 100.10' CBC
INLET = 1467.72
OUTLET = 1467.62
Q50 = 308 CFS

265' Taper, Rt WB US 60
50.71' To 28'

300' Taper, Rt WB US 60
28' To 16'

1/16 Line

645 +79.86 +44.86 650 655 660

BN & SF RR

Exst 20'x 92' Drn Esmt

32.5' Lt EB
648+27

Exst R/W

42' Lt EB
651+00

47' Lt EB
654+00

Median Control Grade

Existing IXC FO Line
To Remain

46.5' Lt EB
657+00

Angle Pt 658+28.23

44.5' Lt EB
660+00

Cst ℄ WB US 60

S 46°37'53" E

S 46°37'40" E

16 22' Varies

54 Q = 4 CFS

55

AAC = 30,604 ft²
Am = 77,299 ft²

Q = 10 CFS

Survey & Cst ℄ EB US 60

S 46°37'41" E

7.5' Varies 150'

22

AAC = 14,375 ft²
Am = 24,829 ft²

BC Q = 4 CFS

Existing Utilities
To Be Relocated By Others

Existing MCI FO Line
To Remain

Exst R/W

90'

BE 3

WB Sta 645+00
to Sta 652+44.86
Vert Pvmt Cut at EP

New R/W

5' (Typ)

45' R

45' R

Rt Sta 654+30
Exst 5 Unit Cattle Guard
Remove & Salvage Grates

Proposed New Utility Location

19.25' 16" HPG

14.25' T

3' OP

New TCE

Rt Sta 653+11.43
New Cul-de-Sac

Rt Sta 645+00 to 660+00
1577 LF Exst BW Fence
Remove
1345 LF New Type 1 BW Fence
Sta 648+58 to 649+58
100 LF New Floodgate
Std C-12.10

55' Rt, EB Sta 645+46 to 648+25
279 LF New Trapazoidal Ditch
Details N, O & P3

Existing IXC FO Line
To Remain

653+11.43
143.17' Rt

T5N R2W
T4N R2W

FD Township Line

Section Line

	NAME	DATE
DESIGN	MGJ	2-01
DRAWN	RLG/BLJ	2-01
CHECKED	KMD	2-01

DIBBLE & ASSOCIATES CONSULTING ENGINEERS

ARIZONA DEPARTMENT OF TRANSPORTATION
INTERMODAL TRANSPORTATION DIVISION

PLAN SHEET
STA 645+00 TO 660+00

ROUTE: US 60
LOCATION: 203RD AVE (WEST) - DEER VALLEY RD

CERTIFICATE OF AUTHORITY 12863 KENT M. DIBBLE ARIZONA, U.S.A.

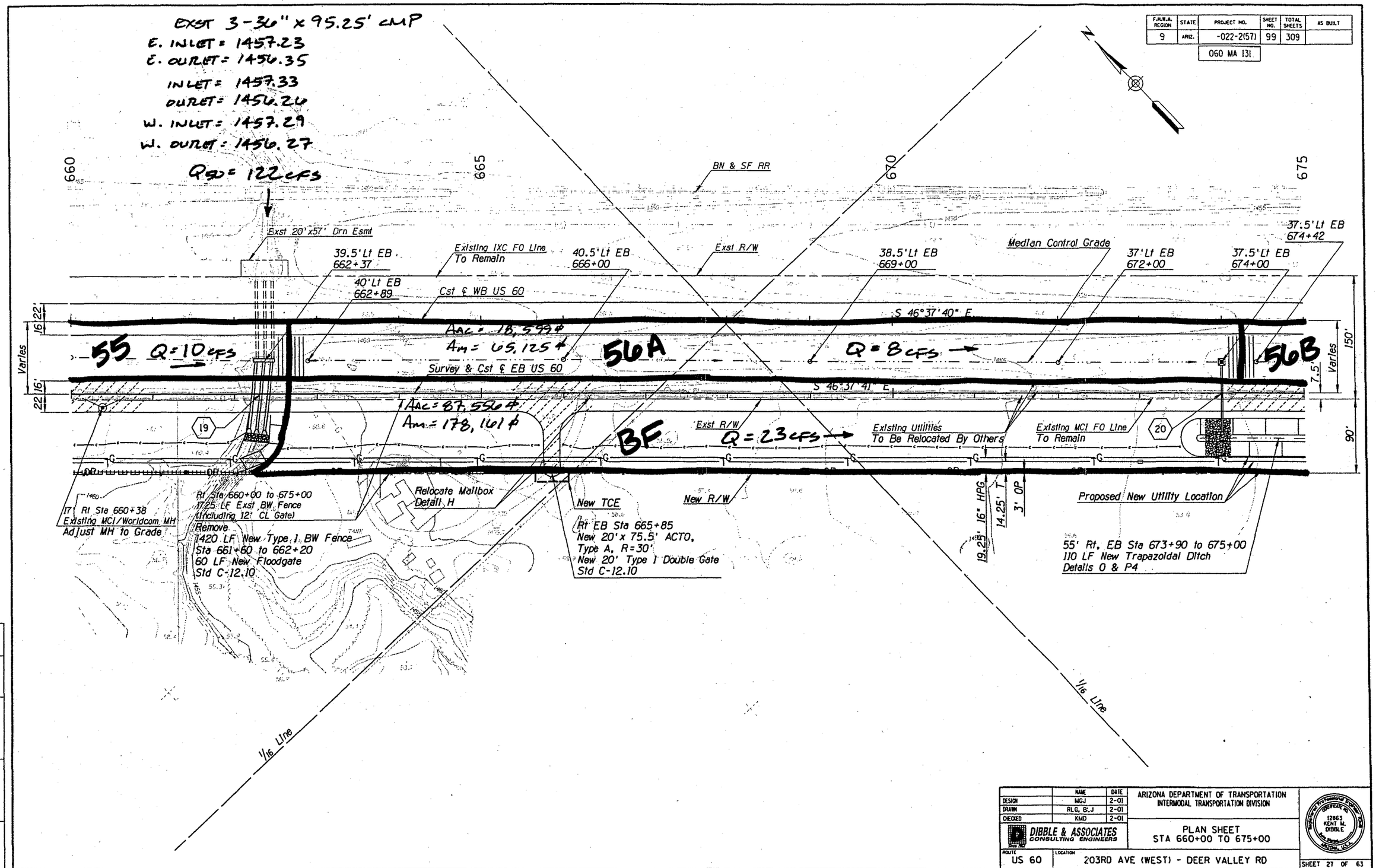
SHEET 25 OF 63

TRACS NO. H4573 02C | -022-2(57) | ___ OF ___

CONSTRUCTION DISPLAY ON

:/9727/ustn/mlpl38.dgn Mar. 08, 2001 09:31:32

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	ARIZ.	-022-2(57)	99	309	
		060 MA 131			



	NAME	DATE
DESIGN	MCJ	2-01
DRAWN	RLG, BJ	2-01
CHECKED	KMD	2-01

DIBBLE & ASSOCIATES CONSULTING ENGINEERS

ARIZONA DEPARTMENT OF TRANSPORTATION
INTERMODAL TRANSPORTATION DIVISION

PLAN SHEET
STA 660+00 TO 675+00

ROUTE: US 60
LOCATION: 203RD AVE (WEST) - DEER VALLEY RD

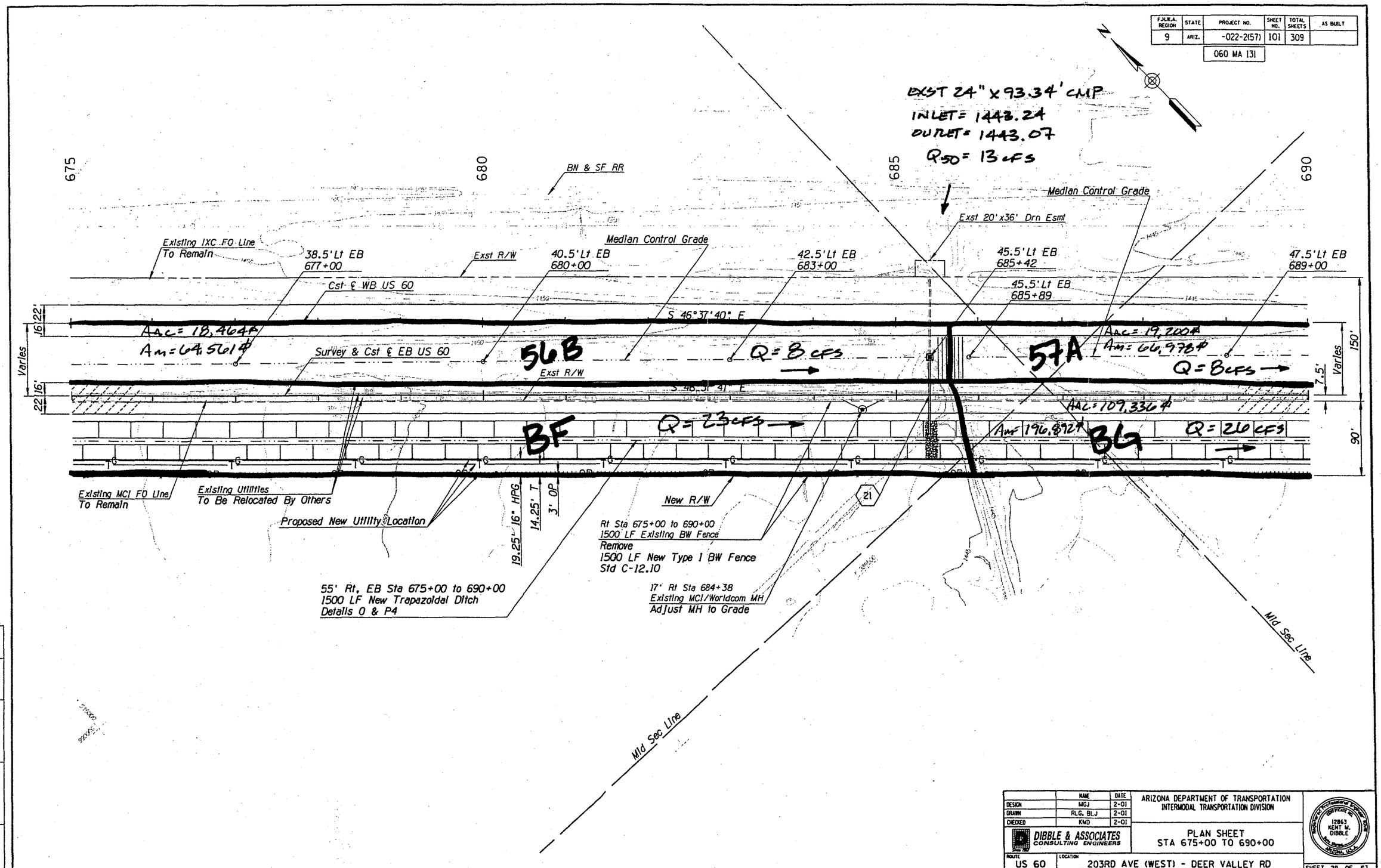
SHEET 27 OF 63

TRACS NO. H4573 02C | -022-2(57) | ___ OF ___

:/9727/ustn/mlp139.dgn Mar. 08, 2001 09:31:36

CONSTRUCTION DISPLAY ON

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	ARIZ.	-022-2(57)	101	309	
		060 MA 131			



	NAME	DATE
DESIGN	MCJ	2-01
DRAWN	RLG, BLJ	2-01
CHECKED	KMD	2-01

DIBBLE & ASSOCIATES CONSULTING ENGINEERS

ARIZONA DEPARTMENT OF TRANSPORTATION
INTERMODAL TRANSPORTATION DIVISION

PLAN SHEET
STA 675+00 TO 690+00

ROUTE: US 60
LOCATION: 203RD AVE (WEST) - DEER VALLEY RD

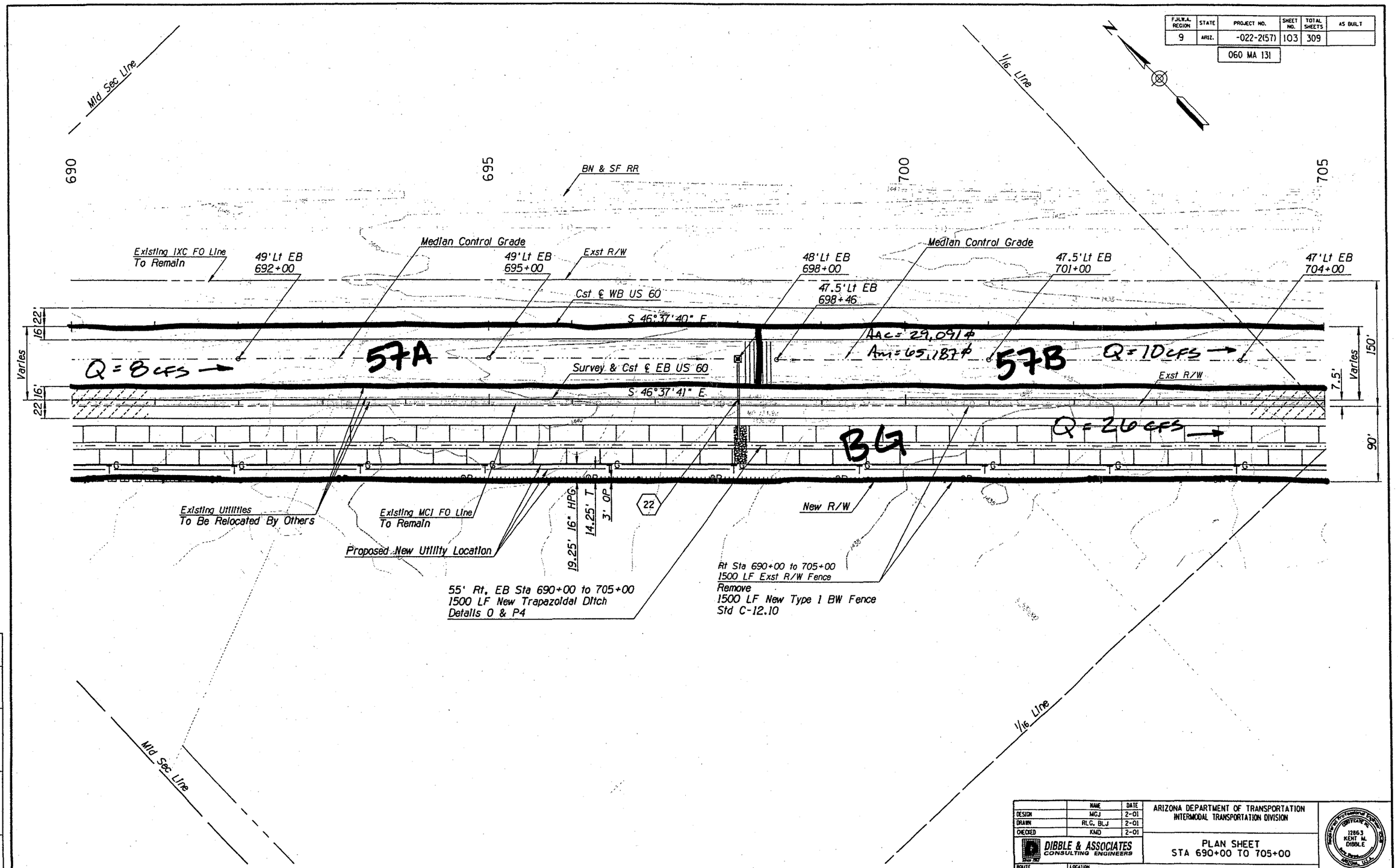
SHEET 29 OF 63

TRACS NO. H4573 02C | -022-2(57) | ___ OF ___

CONSTRUCTION DISPLAY ON

:/9727/ustn/mlpl40.dgn Mar. 08, 2001 09:31:40

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	ARIZ.	-022-2(57)	103	309	
		060 MA 131			



	NAME	DATE
DESIGN	MCJ	2-01
DRAWN	RLG, BLJ	2-01
CHECKED	KMD	2-01

DIBBLE & ASSOCIATES CONSULTING ENGINEERS

ARIZONA DEPARTMENT OF TRANSPORTATION
INTERMODAL TRANSPORTATION DIVISION

PLAN SHEET
STA 690+00 TO 705+00

ROUTE: US 60
LOCATION: 203RD AVE (WEST) - DEER VALLEY RD

Registered Professional Engineer (Civil) CERTIFICATE NO. 12863 KENT M. DIBBLE Arizona, U.S.A.

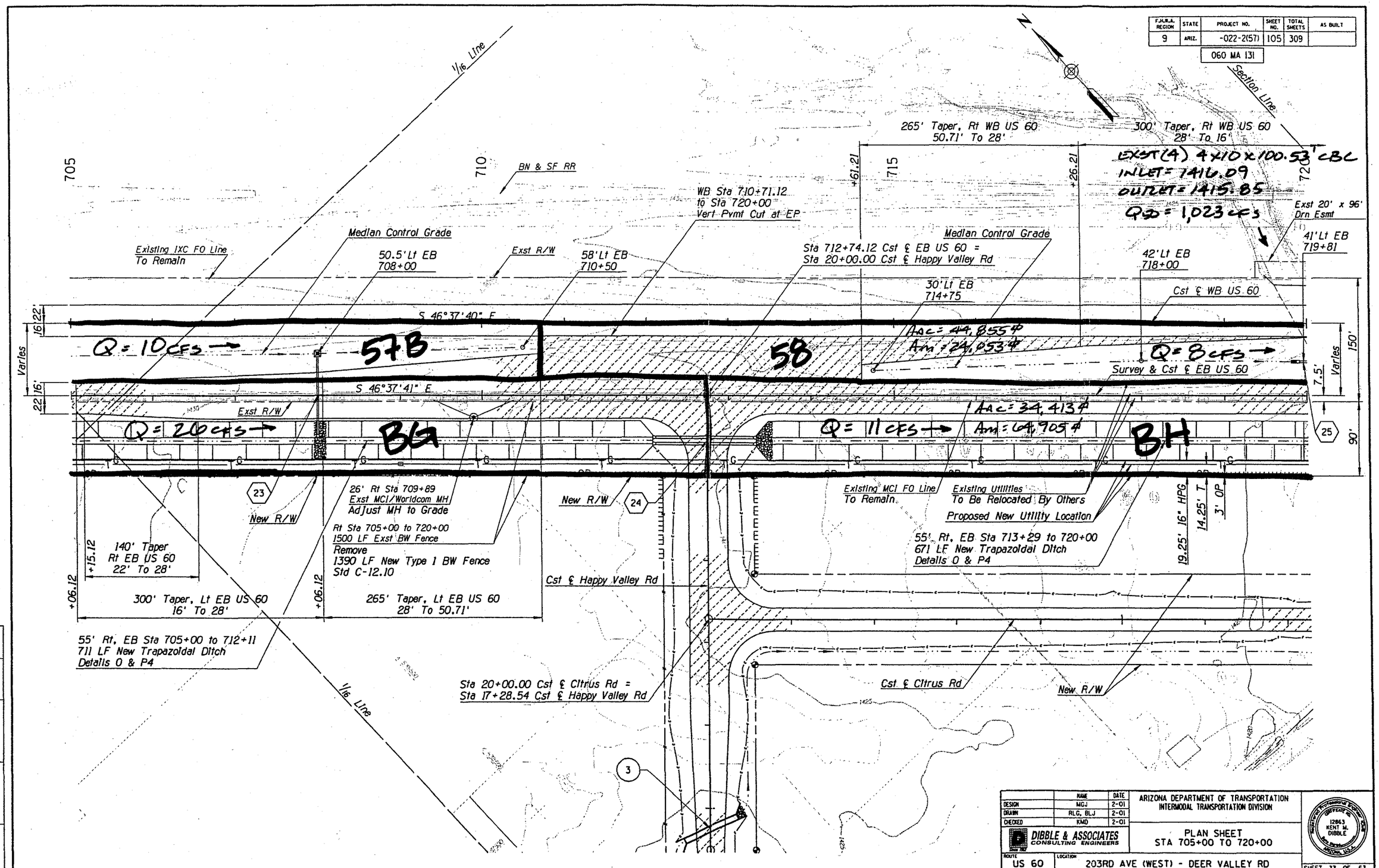
SHEET 31 OF 63

TRACS NO. H4573 02C | -022-2(57) | ___ OF ___

CONSTRUCTION DISPLAY ON

/9727/ustn/mlp141.dgn Mar 08 2001 09:31:44

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	ARIZ.	-022-2(57)	105	309	
		060 MA 131			



	NAME	DATE
DESIGN	MGJ	2-01
DRAWN	RLG, BLJ	2-01
CHECKED	KMD	2-01

DIBBLE & ASSOCIATES CONSULTING ENGINEERS

ARIZONA DEPARTMENT OF TRANSPORTATION
INTERMODAL TRANSPORTATION DIVISION

PLAN SHEET
STA 705+00 TO 720+00

ROUTE: US 60
LOCATION: 203RD AVE (WEST) - DEER VALLEY RD

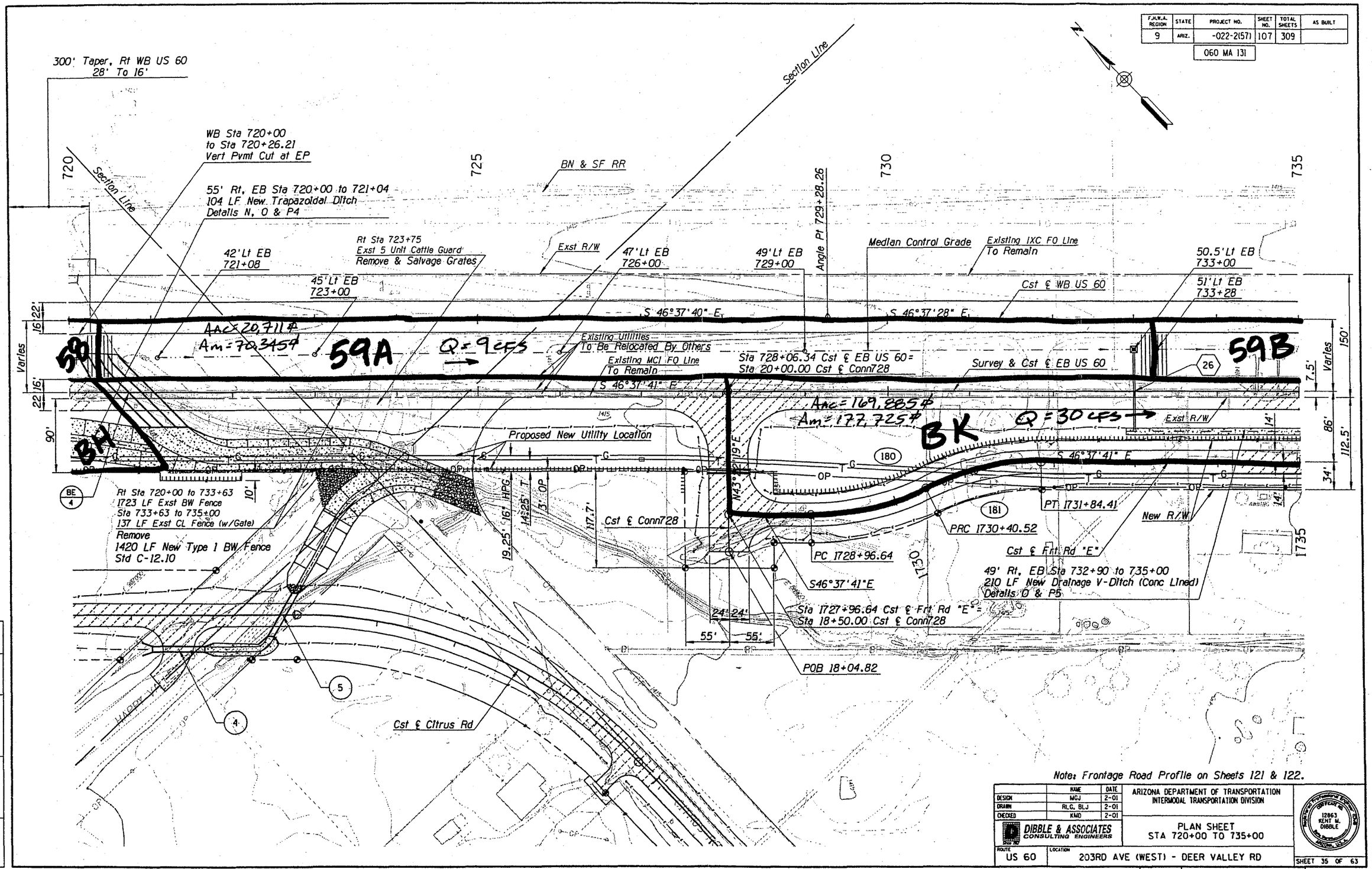
SHEET 33 OF 63

TRACS NO. H4573 02C | -022-2(57) | ___ OF ___

:/9727/ustn/mlpl42.dgn Mar. 08, 2001 09:31:49

CONSTRUCTION DISPLAY ON

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	ARIZ.	-022-2(57)	107	309	
		060 MA 131			



Note: Frontage Road Profile on Sheets 121 & 122.

	NAME	DATE
DESIGN	MGJ	2-01
DRAWN	RLG, BLJ	2-01
CHECKED	KMD	2-01

DIBBLE & ASSOCIATES CONSULTING ENGINEERS

ARIZONA DEPARTMENT OF TRANSPORTATION
INTERMODAL TRANSPORTATION DIVISION

PLAN SHEET
STA 720+00 TO 735+00

ROUTE: US 60
LOCATION: 203RD AVE (WEST) - DEER VALLEY RD

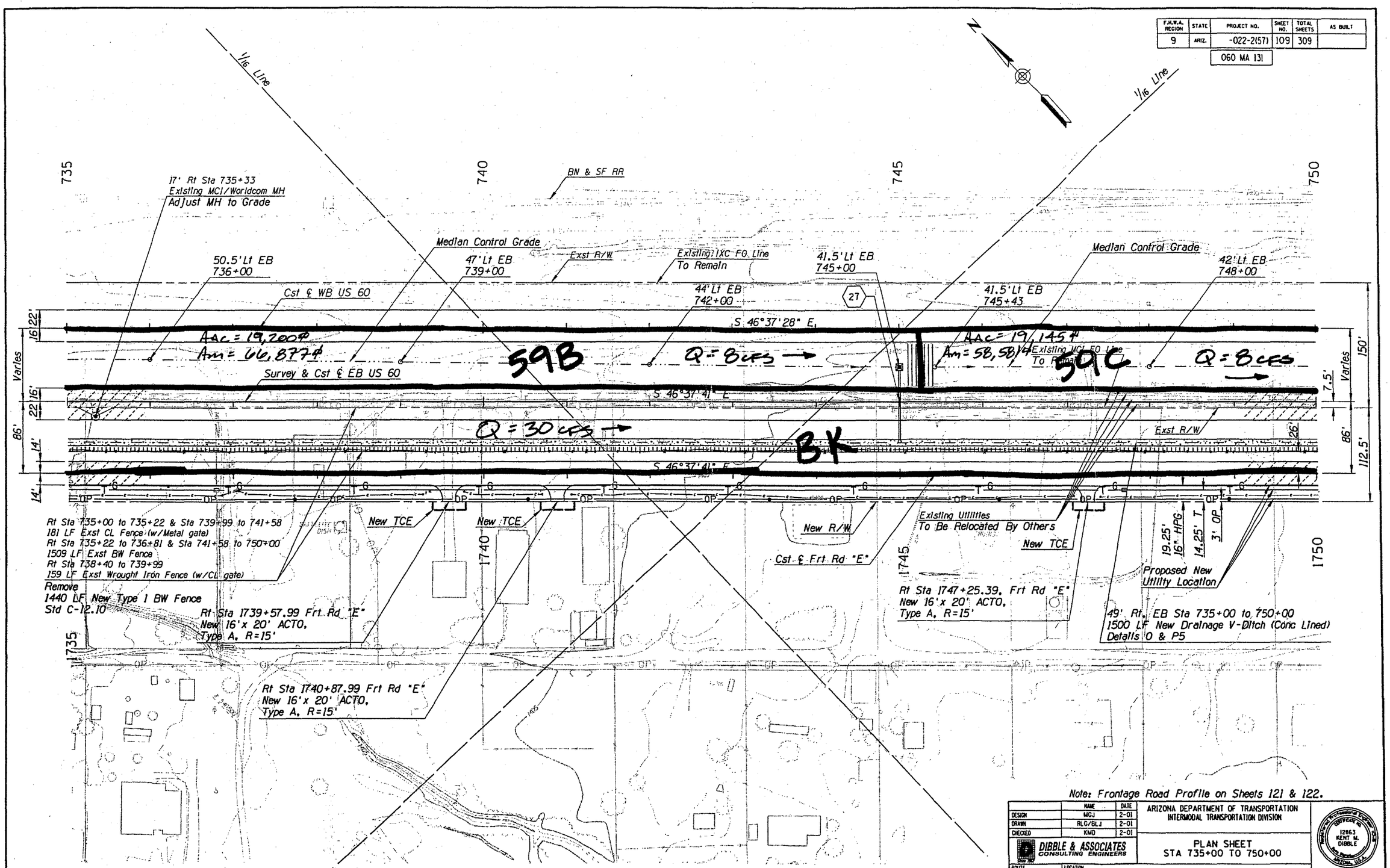
SHEET 35 OF 63

TRACS NO. H4573 02C | -022-2(57) | ___ OF ___

CONSTRUCTION DISPLAY ON

:/9727/ustn/mlpl43.dgn Mar. 08, 2001 09:31:53

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	ARIZ.	-022-2(57)	109	309	
		060 MA 131			



Note: Frontage Road Profile on Sheets 121 & 122.

	NAME	DATE
DESIGN	MGJ	2-01
DRAWN	RLG/BLJ	2-01
CHECKED	KMD	2-01

DIBBLE & ASSOCIATES CONSULTING ENGINEERS

ARIZONA DEPARTMENT OF TRANSPORTATION
INTERMODAL TRANSPORTATION DIVISION

PLAN SHEET
STA 735+00 TO 750+00

Registered Professional Engineer (Civil) CERTIFICATE NO. 12863 KENT M. DIBBLE Date Signed ARIZONA, U.S.A.

ROUTE: US 60
LOCATION: 203RD AVE (WEST) - DEER VALLEY RD

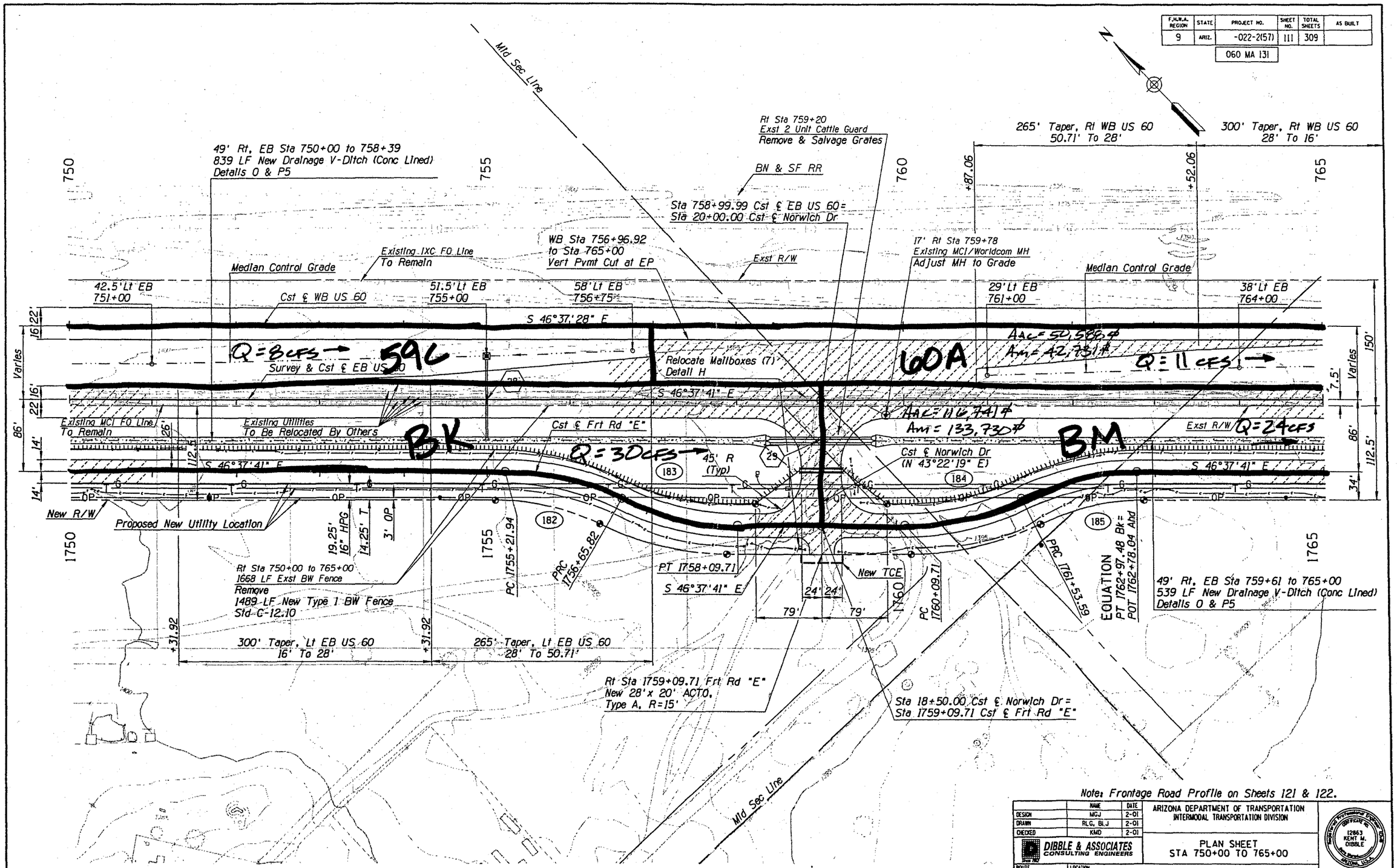
SHEET 37 OF 63

TRACS NO. H4573 02C | -022-2(57) | ___ OF ___

CONSTRUCTION DISPLAY ON

:/972//ustn/mlp144.dgn Mar 08, 2001 09:31:58

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	ARIZ.	-022-2(57)	111	309	
		060 MA 131			



Note: Frontage Road Profile on Sheets 121 & 122.

	NAME	DATE
DESIGN	MGJ	2-01
DRAWN	RLG, BLJ	2-01
CHECKED	KMD	2-01

DIBBLE & ASSOCIATES CONSULTING ENGINEERS

ARIZONA DEPARTMENT OF TRANSPORTATION
INTERMODAL TRANSPORTATION DIVISION

PLAN SHEET
STA 750+00 TO 765+00

ROUTE: US 60
LOCATION: 203RD AVE (WEST) - DEER VALLEY RD

12863 KENT M. DIBBLE ARIZONA, U.S.A.

SHEET 39 OF 63

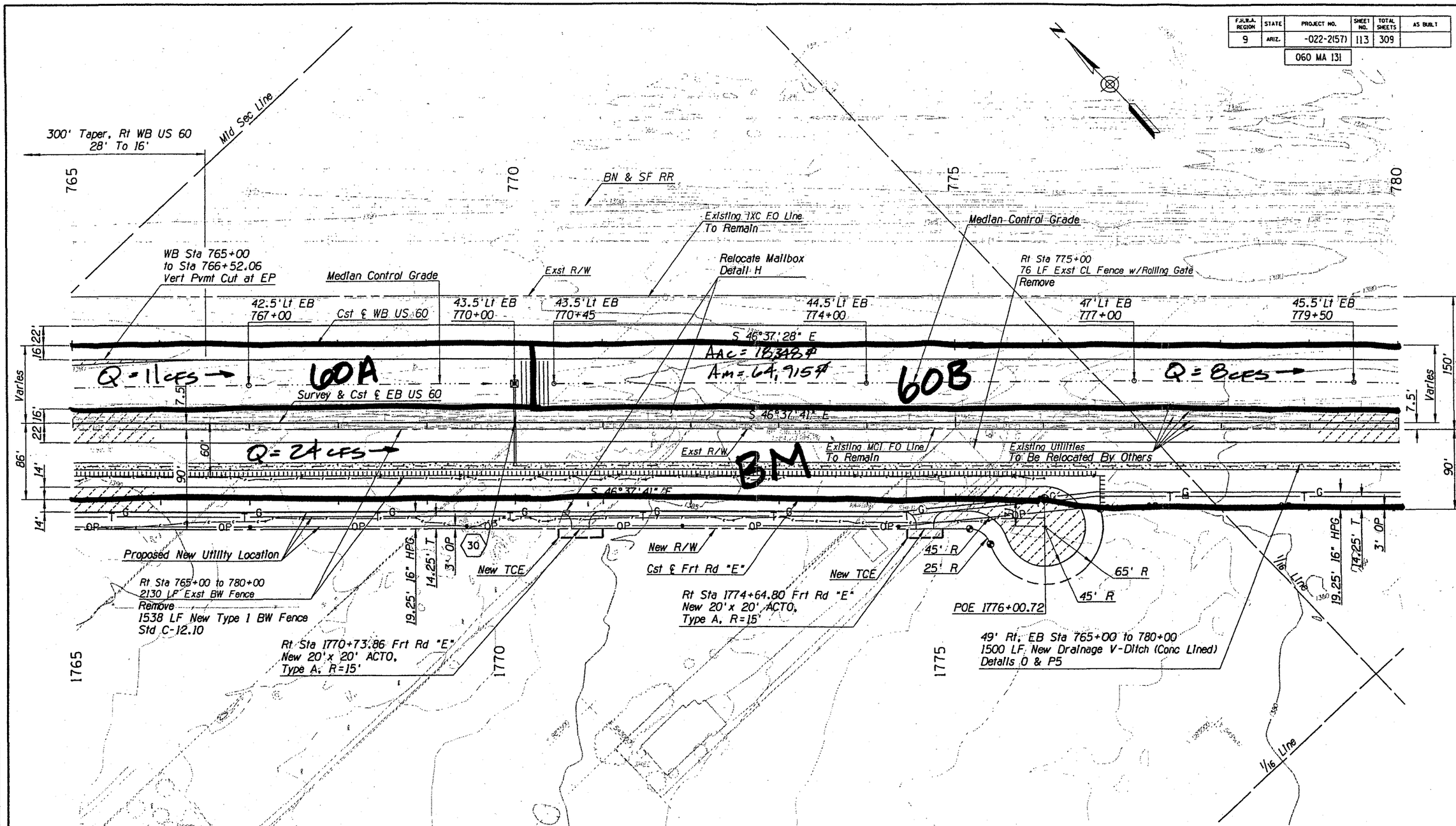
TRACS NO. H4573 02C | -022-2(57) | ___ OF ___

CONSTRUCTION DISPLAY ON

-/8727/ustn/mlpl45.dgn Mar 08 2001 09:32:03

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	ARIZ.	-022-2(57)	113	309	

060 MA 131



Note: Frontage Road Profile on Sheets 121 & 122.

	NAME	DATE
DESIGN	MGJ	2-01
DRAWN	RLG, BLJ	2-01
CHECKED	KMD	2-01

DIBBLE & ASSOCIATES CONSULTING ENGINEERS

ARIZONA DEPARTMENT OF TRANSPORTATION
INTERMODAL TRANSPORTATION DIVISION

PLAN SHEET
STA 765+00 TO 780+00

Registered Professional Engineer (Civil) CERTIFICATE NO. 12863 KENT M. DIBBLE ARIZONA, U.S.A.

ROUTE: US 60
LOCATION: 203RD AVE (WEST) - DEER VALLEY RD

SHEET 41 OF 63

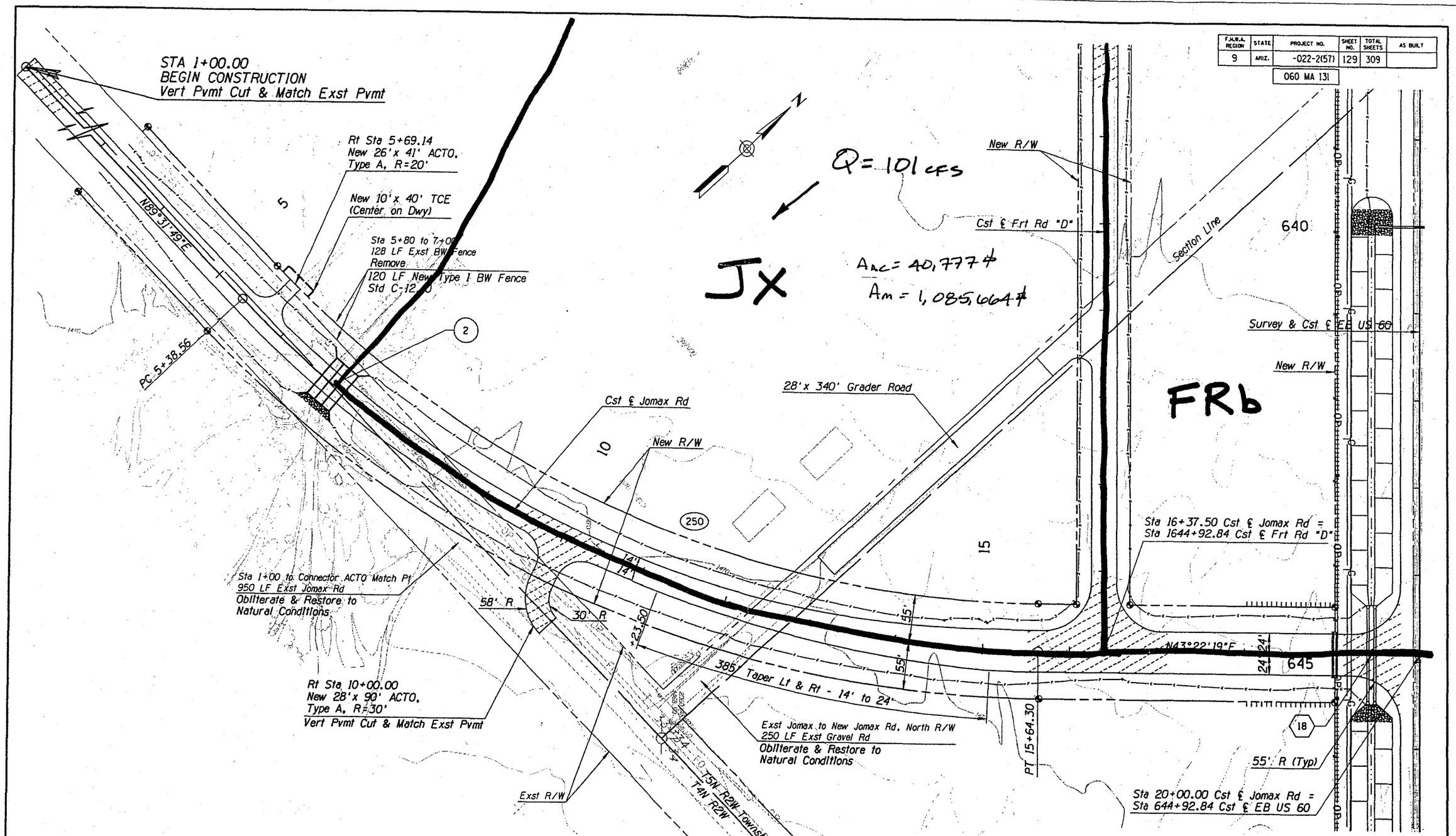
TRACS NO. H4573 02C | -022-2(57) | ___ OF ___

CONSTRUCTION DISPLAY ON

297277/ustn/mlp146.dgn Mar 08 2001 09:32:08

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	ARIZ.	-022-2(57)	129	309	

060 MA 131



	NAME	DATE
DESIGN	JMB	2-01
DRAWN	RLG	2-01
CHECKED	KMD	2-01

DIBBLE & ASSOCIATES CONSULTING ENGINEERS

ARIZONA DEPARTMENT OF TRANSPORTATION
INTERMODAL TRANSPORTATION DIVISION

PLAN SHEET
JOMAX RD

ROUTE: US 60
LOCATION: 203RD AVE (WEST) - DEER VALLEY RD

REGISTERED PROFESSIONAL ENGINEER (CIVIL) CERTIFICATE NO. 12863 KENT M. DIBBLE ARIZONA, U.S.A.

SHEET 57 OF 63

TRACS NO. H4573 02C | -022-2(57) | ___ OF ___

CONSTRUCTION DISPLAY ON

...7277/ustn/xrpljomx.dgn Mar. 09, 2001 10:18:32

Appendix C

Roadway Drainage Area Flow Calculations

9727 PROJECT 2 - Rational Method Summary of Drainage Areas for 50 year Flow

Area	c	A (square ft)	A (acres)	AC	Composite C	L (feet)	L (miles)	Kb	S (ft/ft)	S (ft/mile)	Tc (hours)	Tc (minutes)	i (in/hour)	Q (cfs)
38A(ac)	0.95	49,449	1.14	1.08										
38A(med)	0.70	39,977	0.92	0.64										
38A			2.05	1.72	0.84	900	0.17	0.04	0.0081	42.77	0.17	10	6.22	**11**
38B(ac)	0.95	22,411	0.51	0.49										
38B(med)	0.70	76,204	1.75	1.22										
38B			2.26	1.71	0.76	1400	0.27	0.04	0.0049	25.87	0.26	15.62	5.18	**9**
38C(ac)	0.95	15,746	0.36	0.34										
38C(med)	0.70	20,586	0.47	0.33										
38C			0.83	0.67	0.81	500	0.09	0.04	0.0012	6.34	0.24	14.18	5.43	**4**
39(ac)	0.95	48,574	1.12	1.06										
39(med)	0.70	33,819	0.78	0.54										
39			1.89	1.60	0.85	1175	0.22	0.04	0.01302	68.75	0.17	10	6.22	**10**
40(ac)	0.95	12,338	0.28	0.27										
40(med)	0.70	11,515	0.26	0.19										
40			0.55	0.45	0.83	350	0.07	0.04	0.00264	13.95	0.17	10	6.22	**3**
41(ac)	0.95	56,048	1.29	1.22										
41(med)	0.70	62,918	1.44	1.01										
41			2.73	2.23	0.82	1640	0.31	0.04	0.01011	53.38	0.22	13.13	5.58	**12**
42(ac)	0.95	21,852	0.50	0.48										
42(med)	0.70	76,274	1.75	1.23										
42			2.25	1.70	0.76	1430	0.27	0.04	0.00757	39.97	0.22	13.45	5.53	**9**
43(ac)	0.95	8,646	0.20	0.19										
43(med)	0.70	22,207	0.51	0.36										
43			0.71	0.55	0.77	485	0.09	0.04	0.00163	8.61	0.21	12.48	5.69	**3**
44(ac)	0.95	12,178	0.28	0.27										
44(med)	0.70	27,187	0.62	0.44										
44			0.90	0.70	0.78	530	0.10	0.04	0.02083	109.98	0.17	10	6.22	**4**
45(ac)	0.95	10,628	0.24	0.23										
45(med)	0.70	25,640	0.59	0.41										
45			0.83	0.64	0.77	420	0.08	0.04	0.008	42.24	0.17	10	6.22	**4**
46(ac)	0.95	16,441	0.38	0.36										
46(med)	0.70	42,807	0.98	0.69										
46			1.36	1.05	0.77	715	0.14	0.04	0.00683	36.04	0.17	10	6.22	**7**
47(ac)	0.95	12,325	0.28	0.27										
47(med)	0.70	38,864	0.89	0.62										
47			1.18	0.89	0.76	660	0.13	0.04	0.0072	38.02	0.17	10	6.22	**6**
48(ac)	0.95	13,445	0.31	0.29										
48(med)	0.70	13,504	0.31	0.22										
48			0.62	0.51	0.82	370	0.07	0.04	0.005	26.40	0.17	10	6.22	**3**
49(ac)	0.95	44,249	1.02	0.97										
49(med)	0.70	23,555	0.54	0.38										
49			1.56	1.34	0.86	925	0.18	0.04	0.00658	34.75	0.18	10.96	5.99	**8**
50(ac)	0.95	20,974	0.48	0.46										
50(med)	0.70	36,965	0.85	0.59										
50			1.33	1.05	0.79	739	0.14	0.04	0.00106	5.57	0.32	19.08	4.62	**5**
51(ac)	0.95	59,070	1.36	1.29										
51(med)	0.70	64,798	1.49	1.04										
51			2.84	2.33	0.82	1600	0.30	0.04	0.01143	60.35	0.21	12.37	5.71	**13**
52(ac)	0.95	59,756	1.37	1.30										
52(med)	0.70	73,535	1.69	1.18										
52			3.06	2.48	0.81	1850	0.35	0.04	0.0085	44.86	0.25	15.02	5.29	**13**
53(ac)	0.95	40,990	0.94	0.89										
53(med)	0.70	105,293	2.42	1.69										
53			3.36	2.59	0.77	1725	0.33	0.04	0.0096	50.69	0.23	13.79	5.47	**14**
54(ac)	0.95	30,209	0.69	0.66										
54(med)	0.70	1,555	0.04	0.02										
54			0.73	0.68	0.94	530	0.10	0.04	0.00475	25.08	0.17	10	6.22	**4**
55(ac)	0.95	30,662	0.70	0.67										
55(med)	0.70	77,299	1.77	1.24										
55			2.48	1.91	0.77	1410	0.27	0.04	0.00644	34.00	0.24	14.15	5.42	**10**
56A(ac)	0.95	18,599	0.43	0.41										
56A(med)	0.70	65,125	1.50	1.05										
56A			1.92	1.45	0.76	1110	0.21	0.04	0.00649	34.27	0.20	12.27	5.73	**8**
56B(ac)	0.95	18,464	0.42	0.40										
56B(med)	0.70	64,561	1.48	1.04										
56B			1.91	1.44	0.76	1100	0.21	0.04	0.00465	24.57	0.23	13.77	5.48	**8**
57A(ac)	0.95	19,200	0.44	0.42										
57B(med)	0.70	66,978	1.54	1.08										
57A			1.98	1.50	0.76	1210	0.23	0.04	0.00649	34.27	0.22	12.90	5.62	**8**

9727 PROJECT 2 - Rational Method Summary of Drainage Areas for 50 year Flow

Area	c	A (square ft)	A (acres)	AC	Composite C	L (feet)	L (miles)	Kb	S (ft/ft)	S (ft/mile)	Tc (hours)	Tc (minutes)	i (in/hour)	Q (cfs)
57B(ac)	0.95	29,091	0.67	0.63										
57B(med)	0.70	65,187	1.50	1.05										
57B			2.16	1.68	0.78	950	0.18	0.04	0.00096	5.09	0.33	19.86	6.22	**10**
58(ac)	0.95	44,855	1.03	0.98										
58(med)	0.70	24,053	0.55	0.39										
58			1.58	1.36	0.86	930	0.18	0.04	0.01097	57.92	0.17	10	6.22	**8**
59A(ac)	0.95	20,711	0.48	0.45										
59A(med)	0.70	70,345	1.61	1.13										
59A			2.09	1.58	0.76	1200	0.23	0.04	0.0068	35.93	0.21	12.62	5.67	**9**
59B(ac)	0.95	19,200	0.44	0.42										
59B(med)	0.70	66,877	1.54	1.07										
59B			1.98	1.49	0.76	1170	0.22	0.04	0.0065	34.33	0.21	12.65	5.66	**8**
59C(ac)	0.95	19,145	0.44	0.42										
59C(med)	0.70	58,581	1.34	0.94										
59C			1.78	1.36	0.76	960	0.18	0.04	0.00779	41.10	0.18	10.54	6.09	**8**
60A(ac)	0.95	50,588	1.16	1.10										
60A(med)	0.70	42,731	0.98	0.69										
60A			2.14	1.79	0.84	1300	0.25	0.04	0.01	52.80	0.19	11.50	5.88	**11**
60B(ac)	0.95	18,348	0.42	0.40										
60B(med)	0.70	64,915	1.49	1.04										
60B			1.91	1.44	0.76	1080	0.20	0.04	0.00559	29.53	0.21	12.74	5.65	**8**
61(ac)	0.95	25,581	0.59	0.56										
61(med)	0.70	87,502	2.01	1.41										
61			2.60	1.96	0.76	1485	0.28	0.04	0.00455	24.03	0.28	16.70	4.98	**10**
62(ac)	0.95	22,145	0.51	0.48										
62(med)	0.70	40,963	0.94	0.66										
62			1.45	1.14	0.79	830	0.16	0.04	0.00067	3.55	0.39	23.69	4.40	**5**
AJ(ac)	0.95	191,229	4.39	4.17										
AJ(med)	0.70	343,690	7.89	5.52										
AJ			12.28	9.69	0.79	46290	8.77	0.04	0.0085	44.88	1.36	81.69	4.24	**41**
AK(ac)	0.95	118,048	2.71	2.57										
AK(med)	0.70	228,691	5.25	3.68										
AK			7.96	6.25	0.79	3035	0.57	0.04	0.0101	53.33	0.31	18.87	4.83	**30**
AW(ac)	0.95	81,893	1.88	1.79										
AW(med)	0.70	133,294	3.06	2.14										
AW			4.94	3.93	0.80	1800	0.34	0.04	0.012	63.36	0.22	13.01	5.61	**22**
AY(ac)	0.95	67,954	1.56	1.48										
AY(med)	0.70	129,374	2.97	2.08										
AY			4.53	3.56	0.79	1700	0.32	0.04	0.012	63.36	0.21	12.58	5.69	**20**
BA(ac)	0.95	87,556	2.01	1.91										
BA(med)	0.70	169,449	3.89	2.72										
BA			5.90	4.63	0.79	2250	0.43	0.04	0.01	52.80	0.26	15.86	5.19	**24**
BC(ac)	0.95	14,375	0.33	0.31										
BC(med)	0.70	24,829	0.57	0.40										
BC			0.90	0.71	0.79	300	0.06	0.04	0.01	52.80	0.17	10	6.22	**4**
BF(ac)	0.95	87,556	2.01	1.91										
BF(med)	0.70	178,161	4.09	2.86										
BF			6.10	4.77	0.78	2300	0.44	0.04	0.0063	33.26	0.32	19.05	4.81	**23**
BG(ac)	0.95	109,336	2.51	2.38										
BG(med)	0.70	196,892	4.52	3.16										
BG			7.03	5.55	0.79	2750	0.52	0.04	0.0075	39.60	0.33	19.86	4.73	**26**
BH(ac)	0.95	34,413	0.79	0.75										
BH(med)	0.70	64,905	1.49	1.04										
BH			2.28	1.79	0.79	800	0.15	0.04	0.0065	34.32	0.17	10.11	6.19	**11**
BK(ac)	0.95	169,885	3.90	3.71										
BK(med)	0.70	177,725	4.08	2.86										
BK			7.98	6.56	0.82	3100	0.59	0.04	0.0075	39.60	0.36	21.31	4.60	**30**
BM(ac)	0.95	116,741	2.68	2.55										
BM(med)	0.70	133,730	3.07	2.15										
BM			5.75	4.70	0.82	2400	0.45	0.04	0.01	52.80	0.27	16.48	5.11	**24**
FRa(ac)	0.95	36,316	0.83	0.79										
FRa(med)	0.70	541,039	12.42	8.69										
FRa			13.25	9.49	0.72	2000	0.38	0.04	0.0065	34.32	0.29	17.32	5.01	**48**
FRb(ac)	0.95	30,558	0.70	0.67										
FRb(med)	0.70	691,945	15.88	11.12										
FRb			16.59	11.79	0.71	2000	0.38	0.04	0.008	42.24	0.27	16.05	5.17	**61**
JX(ac)	0.95	40,777	0.94	0.89										
JX(med)	0.70	1,085,664	24.92	17.45										
JX			25.86	18.34	0.71	1700	0.32	0.04	0.01	52.80	0.22	13.48	5.50	**101**

Appendix D

Median Flow Depth Calculations

MEDIAN CHANNEL CALCULATIONS

Concrete	Mannings n =	0.015	* C	0.015
Earth	Mannings n =	0.025	* E	0.025
Grass	Mannings n =	0.035	D G	0.035
Riprap	Mannings n =	0.040	* R	0.04

Subarea-Reach	US Invert	DS Invert	Length	Slope [ft/ft]	Qt [cfs]	Matl	SS [H:V] Lt	SS [H:V] Rt	B [ft]	Depth [ft]	0 Mann n	Area [ft^2]	Perimeter [ft]	Qcalc [cfs]	Vel. [fps]	Froude #	Tractive Shear Avg [psf]	Tractive Shear Max [psf]
47700 to 48000	1604.96	1602.90	300	0.0069	8.0	E	10.9	16.8	0	0.62	0.025	5.31	17.18	12.0	2.25	0.50	0.132	0.266
48500 to 48000	1603.50	1602.90	500	0.0012	4.0	E	10.9	16.8	0	0.62	0.025	5.31	17.18	5.0	0.94	0.21	0.023	0.046
48925 to 49676	1600.99	1591.21	751	0.0130	10.0	E	6.1	12.3	0	0.67	0.025	4.12	12.38	13.4	3.26	0.70	0.270	0.544
49975 to 49676	1592.00	1591.21	299	0.0026	3.0	E	6.1	12.3	0	0.67	0.025	4.12	12.38	6.0	1.47	0.32	0.055	0.110
50425 to 51654	1586.92	1574.50	1229	0.0101	12.0	E	7.2	18.9	0	0.60	0.025	4.70	15.71	12.5	2.67	0.61	0.188	0.378
51685 to 53079	1574.57	1559.30	1394	0.0110	9.0	E	4.5	6.5	0	0.70	0.025	2.69	7.81	8.2	3.06	0.64	0.235	0.478
53675 to 53239	1555.50	1554.75	436	0.0017	3.0	E	3.3	4.9	0	0.77	0.025	2.43	6.52	3.1	1.28	0.26	0.040	0.083
53750 to 54230	1554.00	1544.00	480	0.0208	4.0	E	4.9	6.5	0	0.46	0.025	1.20	5.32	3.8	3.19	0.83	0.294	0.598
54320 to 54750	1546.79	1543.35	430	0.0080	4.0	E	7.5	25.8	0	0.37	0.025	2.28	12.37	3.9	1.72	0.50	0.092	0.185
54830 to 54908	1543.76	1542.28	78	0.0190	1.0	E	11.9	28.0	0	0.20	0.025	0.80	7.99	1.4	1.76	0.69	0.118	0.237
54929 to 55645	1542.27	1537.25	716	0.0070	7.0	E	16.8	36.3	0	0.40	0.025	4.24	21.24	7.2	1.70	0.47	0.087	0.175
55645 to 56360	1537.25	1532.34	715	0.0069	6.0	E	20.2	30.5	0	0.38	0.025	3.66	19.28	6.0	1.63	0.47	0.081	0.163
57125 to 57655	1526.50	1523.04	530	0.0065	8.0	E	9.9	15.4	0	0.56	0.025	3.97	14.24	8.2	2.05	0.48	0.114	0.228
58450 to 57739	1522.25	1521.50	711	0.0011	5.0	E	7.3	9.2	0	0.78	0.025	5.04	13.01	5.2	1.03	0.20	0.025	0.051
58900 to 60100	1518.47	1504.75	1200	0.0114	10.0	E	10.2	11.2	0	0.65	0.025	4.51	13.95	13.5	3.00	0.65	0.231	0.464
60325 to 60100	1505.50	1504.75	225	0.0033	3.0	E	10.2	11.2	0	0.65	0.025	4.51	13.95	7.3	1.62	0.35	0.067	0.135
60750 to 62187	1501.06	1488.85	1437	0.0085	13.0	E	6.0	10.2	0	0.76	0.025	4.69	12.44	13.4	2.86	0.58	0.200	0.403
62274 to 64000	1490.17	1473.60	1726	0.0096	11.0	E	9.4	10.4	0	0.72	0.025	5.13	14.31	15.1	2.94	0.61	0.215	0.431
64250 to 64000	1474.25	1473.60	250	0.0026	3.0	E	9.5	10.4	0	0.72	0.025	5.15	14.37	7.9	1.53	0.32	0.058	0.117
64827 to 66237	1469.43	1460.26	1410	0.0065	14.0	E	16.1	20.9	0	0.60	0.025	6.66	22.25	14.3	2.15	0.49	0.122	0.243
66289 to 67400	1458.94	1451.73	1111	0.0065	8.0	E	10.4	14.6	0	0.56	0.025	3.93	14.07	8.0	2.04	0.48	0.113	0.227
67442 to 68542	1451.42	1446.30	1100	0.0047	8.0	E	14.5	24.0	0	0.51	0.025	5.00	19.62	8.1	1.63	0.40	0.074	0.148
68589 to 69800	1445.19	1437.45	1211	0.0064	8.0	E	10.7	17.9	0	0.53	0.025	4.02	15.21	7.9	1.96	0.47	0.105	0.211
69846 to 70800	1436.95	1427.75	954	0.0096	7.0	E	9.3	10.3	0	0.63	0.025	3.89	12.40	10.5	2.69	0.60	0.189	0.379
71050 to 70800	1428.25	1427.75	250	0.0020	3.0	E	9.3	10.3	0	0.63	0.025	3.89	12.40	4.8	1.23	0.27	0.039	0.079
71475 to 71981	1425.11	1419.56	506	0.0110	8.0	E	6.1	16.6	0	0.53	0.025	3.19	12.09	8.2	2.56	0.62	0.180	0.363
72108 to 73300	1419.14	1411.03	1192	0.0068	9.0	E	8.8	21.5	0	0.54	0.025	4.42	16.40	9.0	2.04	0.49	0.114	0.229
73328 to 74500	1410.81	1403.19	1172	0.0065	8.0	E	9.4	15.5	0	0.56	0.025	3.91	14.01	8.0	2.05	0.48	0.113	0.227
74543 to 75500	1402.80	1395.35	957	0.0078	6.0	E	11.8	11.2	0	0.56	0.025	3.60	12.92	8.1	2.24	0.53	0.136	0.272
75675 to 75500	1396.50	1395.35	175	0.0066	2.0	E	11.8	11.2	0	0.56	0.025	3.60	12.92	7.4	2.06	0.48	0.114	0.230
76100 to 77000	1393.35	1384.35	900	0.0100	11.0	E	10.1	15.7	0	0.58	0.025	4.33	14.99	11.3	2.60	0.60	0.180	0.362
77045 to 78125	1383.98	1377.94	1080	0.0056	8.0	E	10.1	15.3	0	0.58	0.025	4.26	14.75	8.3	1.94	0.45	0.101	0.202
78229 to 79600	1377.60	1371.36	1371	0.0046	10.0	E	7.3	16.6	0	0.66	0.025	5.21	15.85	9.9	1.91	0.41	0.093	0.187

Downstream Median Channel Sta.	EB crwn. elev.	WB crwn. elev.	EB dist from CL to eop.	EB slope to eop (ft/ft)	WB dist from CL to eop.	WB slope to eop (ft/ft)	EB eop. elev.	WB eop. elev.	Governing EB or WB Elev 3" below E.O.P.	W.S.E.	F.B. (ft.)
48000	1605.39	1605.66	16.00	0.0200	16.00	-0.0200	1605.71	1605.34	1605.09	1603.52	1.57
48000	1605.39	1605.66	16.00	0.0200	16.00	-0.0200	1605.71	1605.34	1605.09	1603.52	1.57
49676	1594.68	1595.47	16.00	0.0200	16.00	-0.0200	1595.00	1595.15	1594.75	1591.88	2.87
49676	1594.68	1595.47	16.00	0.0200	16.00	-0.0200	1595.00	1595.15	1594.75	1591.88	2.87
51654	1578.36	1587.49	16.00	0.0200	16.00	-0.0150	1578.68	1576.69	1576.44	1575.10	1.34
53079	1566.49	1565.45	16.00	0.0200	16.00	-0.0200	1566.81	1565.13	1564.88	1560.00	4.88
53239	1564.21	1563.05	16.00	0.0200	16.00	-0.0200	1564.53	1562.73	1562.48	1555.52	6.96
54230	1550.66	1549.99	16.00	0.0200	16.00	-0.0150	1550.98	1549.75	1549.50	1544.46	5.04
54750	1546.70	1545.29	16.00	0.0200	16.00	-0.0150	1547.02	1545.05	1544.80	1543.72	1.08
54908	1544.27	1544.09	16.00	0.0200	16.00	-0.0150	1544.59	1543.85	1543.60	1542.48	1.12
55645	1538.81	1538.59	16.00	0.0200	16.00	-0.0150	1539.13	1538.35	1538.10	1537.65	0.45
56360	1533.73	1533.79	16.00	0.0200	16.00	-0.0150	1534.05	1533.55	1533.30	1532.72	0.58
57655	1525.24	1526.29	16.00	0.0200	16.00	-0.0150	1525.56	1526.05	1525.31	1523.60	1.71
57739	1525.07	1526.39	16.00	0.0200	16.00	-0.0150	1525.39	1526.15	1525.14	1522.28	2.86
60100	1507.71	1508.39	16.00	0.0200	16.00	-0.0150	1508.03	1508.15	1507.78	1505.40	2.38
60100	1507.71	1508.39	16.00	0.0200	16.00	-0.0150	1508.03	1508.15	1507.78	1505.40	2.38
62187	1493.27	1493.29	16.00	0.0200	16.00	-0.0150	1493.59	1493.05	1492.80	1489.61	3.19
64000	1476.74	1477.59	16.00	0.0200	16.00	-0.0150	1477.06	1477.35	1476.81	1474.32	2.49
64000	1476.71	1477.59	16.00	0.0200	16.00	-0.0150	1477.03	1477.35	1476.78	1474.32	2.46
66237	1461.40	1462.79	16.00	0.0200	16.00	-0.0150	1461.72	1462.55	1461.47	1460.86	0.61
67400	1453.47	1455.39	16.00	0.0200	16.00	-0.0150	1453.79	1455.15	1453.54	1452.29	1.25
68542	1448.02	1448.29	16.00	0.0200	16.00	-0.0150	1448.34	1448.05	1447.80	1446.81	0.99
69800	1440.12	1439.89	16.00	0.0200	16.00	-0.0150	1440.44	1439.65	1439.40	1437.98	1.42
70800	1431.13	1431.59	16.00	0.0200	16.00	-0.0150	1431.45	1431.35	1431.10	1428.38	2.72
70800	1431.13	1431.59	16.00	0.0200	16.00	-0.0150	1431.45	1431.35	1431.10	1428.38	2.72
71981	1423.37	1422.59	16.00	0.0200	16.00	-0.0150	1423.69	1422.35	1422.10	1420.09	2.01
73300	1414.62	1412.99	16.00	0.0200	16.00	-0.0150	1414.94	1412.75	1412.50	1411.57	0.93
74500	1405.58	1406.39	16.00	0.0200	16.00	-0.0150	1405.90	1406.15	1405.65	1403.75	1.90
75500	1398.05	1398.79	16.00	0.0200	16.00	-0.0150	1398.37	1398.55	1398.12	1395.91	2.21
75500	1398.05	1398.79	16.00	0.0200	16.00	-0.0150	1398.37	1398.55	1398.12	1395.91	2.21
77000	1386.76	1387.39	16.00	0.0200	16.00	-0.0150	1387.08	1387.15	1386.83	1384.93	1.90
78125	1380.30	1381.09	16.00	0.0200	16.00	-0.0150	1380.62	1380.85	1380.37	1378.52	1.85
79600	1375.16	1374.09	16.00	0.0200	16.00	-0.0150	1375.48	1373.85	1373.60	1372.02	1.58

DIBBLE & ASSOCIATES
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Project: US 60 - Project 2
Job No. CB Sta. 480+00

Project No. 9727
By: JMB

```
**                T                 **
 **-------------- ----------------------**
  **                0.62          **
Za **             FT DEEP        ** Zb
    **                            **
     **********   *********    ****
                   B
```

Q =	**12.0**	cfs
So =	**0.0069**	ft/ft
n =	**0.025**	
B =	**0**	ft
Za =	**11**	: 1
Zb =	**17**	: 1
Zave =	14.00	: 1
TRIAL DEPTH =	**0.62**	ft

NORMAL FLOW CALCULATIONS

flow (Qn) =	12.1	cfs
depth (dn) =	0.62	ft
velocity (Vn) =	2.26	fps
Froude Number	0.71	

CRITICAL FLOW CALCULATIONS

depth (dc) =	**3.720**	FT
velocity (Vc) =	0.06	FPS
slope (Sc) =	0.0000	FT/FT

DIBBLE & ASSOCIATES
CHANNEL HYDRAULICS CHARACTERISTICS

Project:	US 60 - Project 2	Project No.	9727
Job No.	CB Sta. 496+76	By:	JMB

```
**              T              **
**-------------- -------------- ----------**
**                0.67          **
Za **           FT DEEP       ** Zb
   **                          **
   **********   *********   ****
                B
```

Q =	**13.0**	cfs
So =	**0.013**	ft/ft
n =	**0.025**	
B =	**0**	ft
Za =	**6**	: 1
Zb =	**12**	: 1
Zave =	9.00	: 1
TRIAL DEPTH =	**0.67**	ft

NORMAL FLOW CALCULATIONS

flow (Qn) =	13.1	cfs
depth (dn) =	0.67	ft
velocity (Vn) =	3.25	fps
Froude Number	0.99	

CRITICAL FLOW CALCULATIONS

depth (dc) =	**3.720**	FT
velocity (Vc) =	0.10	FPS
slope (Sc) =	0.0000	FT/FT

DIBBLE & ASSOCIATES
CHANNEL HYDRAULICS CHARACTERISTICS

Project: US 60 - Project 2
Job No. CB Sta. 516+54

Project No. 9727
By: JMB

```
**              T              **
 **------------ ------------ ----------**
  **              0.60          **
Za **            FT DEEP       ** Zb
   **                           **
    **********   *********   ****
                 B
```

Q =	**12.0**	cfs
So =	**0.0101**	ft/ft
n =	**0.025**	
B =	**0**	ft
Za =	**7**	: 1
Zb =	**19**	: 1
Zave =	13.00	: 1
TRIAL DEPTH =	**0.6**	ft

NORMAL FLOW CALCULATIONS

flow (Qn) =	12.5	cfs
depth (dn) =	0.60	ft
velocity (Vn) =	2.67	fps
Froude Number	0.86	

CRITICAL FLOW CALCULATIONS

depth (dc) =	**3.720**	FT
velocity (Vc) =	0.07	FPS
slope (Sc) =	0.0000	FT/FT

DIBBLE & ASSOCIATES
CHANNEL HYDRAULICS CHARACTERISTICS

Project:	US 60 - Project 2	Project No.	9727
Job No.	Sta. 530+79	By:	JMB

```
 **              T              **
 **-------------- -------------- ----------**
 **                0.70          **
Za **            FT DEEP       ** Zb
   **                           **
    **********   *********   ****
                 B
```

Q =	**9.0**	cfs
So =	**0.011**	ft/ft
n =	**0.025**	
B =	**0**	ft
Za =	**5**	: 1
Zb =	**7**	: 1
Zave =	6.00	: 1
TRIAL DEPTH =	**0.7**	ft

NORMAL FLOW CALCULATIONS

flow (Qn) =	9.0	cfs
depth (dn) =	0.70	ft
velocity (Vn) =	3.07	fps
Froude Number	0.91	

CRITICAL FLOW CALCULATIONS

depth (dc) =	**3.720**	FT
velocity (Vc) =	0.11	FPS
slope (Sc) =	0.0000	FT/FT

DIBBLE & ASSOCIATES
CHANNEL HYDRAULICS CHARACTERISTICS

Project: US 60 - Project 2
Job No. Sta. 532+39

Project No. 9727
By: JMB

```
**                T                 **
 **-------------- ------------------**
  **                0.77          **
Za **             FT DEEP        ** Zb
    **                            **
     **********   *********   ****
                    B
```

Q =	**3.0**	cfs
So =	**0.0017**	ft/ft
n =	**0.025**	
B =	**0**	ft
Za =	**3**	: 1
Zb =	**5**	: 1
Zave =	4.00	: 1
TRIAL DEPTH =	**0.77**	ft

NORMAL FLOW CALCULATIONS

flow (Qn) =	3.0	cfs
depth (dn) =	0.77	ft
velocity (Vn) =	1.27	fps
Froude Number	0.36	

CRITICAL FLOW CALCULATIONS

depth (dc) =	**3.720**	FT
velocity (Vc) =	0.05	FPS
slope (Sc) =	0.0000	FT/FT

DIBBLE & ASSOCIATES
CHANNEL HYDRAULICS CHARACTERISTICS

Project:	US 60 - Project 2	Project No.	9727
Job No.	Sta. 542+30	By:	JMB

```
 **              T              **
  **------------- -------------**
  **              0.46          **
Za **            FT DEEP      ** Zb
   **                         **
    **********   *********   ****
                 B
```

Q =	**4.0**	cfs
So =	**0.0208**	ft/ft
n =	**0.025**	
B =	**0**	ft
Za =	**5**	: 1
Zb =	**7**	: 1
Zave =	6.00	: 1
TRIAL DEPTH =	**0.46**	ft

NORMAL FLOW CALCULATIONS

flow (Qn) =	4.0	cfs
depth (dn) =	0.46	ft
velocity (Vn) =	3.19	fps
Froude Number	1.17	

CRITICAL FLOW CALCULATIONS

depth (dc) =	**3.720**	FT
velocity (Vc) =	0.05	FPS
slope (Sc) =	0.0000	FT/FT

DIBBLE & ASSOCIATES
CHANNEL HYDRAULICS CHARACTERISTICS

Project: US 60 - Project 2
Job No. CB Sta. 547+51

Project No. 9727
By: JMB

```
**                T                 **
 **-------------- ---------------------**
  **                0.37          **
Za **               FT DEEP       ** Zb
   **                              **
    ***********   *********    ****
                     B
```

Q =	**4.0**	cfs
So =	**0.008**	ft/ft
n =	**0.025**	
B =	**0**	ft
Za =	**8**	: 1
Zb =	**26**	: 1
Zave =	17.00	: 1
TRIAL DEPTH =	**0.37**	ft

NORMAL FLOW CALCULATIONS

flow (Qn) =	4.0	cfs
depth (dn) =	0.37	ft
velocity (Vn) =	1.72	fps
Froude Number	0.71	

CRITICAL FLOW CALCULATIONS

depth (dc) =	**3.720**	FT
velocity (Vc) =	0.02	FPS
slope (Sc) =	0.0000	FT/FT

DIBBLE & ASSOCIATES
CHANNEL HYDRAULICS CHARACTERISTICS

Project:	US 60 - Project 2	Project No.	9727
Job No.	CB Sta. 549+15	By:	JMB

```
 **              T              **
  **------------- -------------- ----------**
  **                0.20        **
Za **             FT DEEP      ** Zb
    **                          **
     **********   *********   ****
                   B
```

Q =	**1.0**	cfs
So =	**0.019**	ft/ft
n =	**0.025**	
B =	**0**	ft
Za =	**12**	: 1
Zb =	**28**	: 1
Zave =	20.00	: 1
TRIAL DEPTH =	**0.2**	ft

NORMAL FLOW CALCULATIONS

flow (Qn) =	1.4	cfs
depth (dn) =	0.20	ft
velocity (Vn) =	1.76	fps
Froude Number	0.98	

CRITICAL FLOW CALCULATIONS

depth (dc) =	**3.720**	FT
velocity (Vc) =	0.00	FPS
slope (Sc) =	0.0000	FT/FT

DIBBLE & ASSOCIATES
CHANNEL HYDRAULICS CHARACTERISTICS

Project: US 60 - Project 2
Job No. CB Sta. 556+75
Project No. 9727
By: JMB

```
**              T              **
 **------------ ------------------**
  **              0.40          **
Za **            FT DEEP       ** Zb
   **                          **
    **********   *********   ****
                 B
```

Q =	**7.0**	cfs
So =	**0.007**	ft/ft
n =	**0.025**	
B =	**0**	ft
Za =	**17**	: 1
Zb =	**36**	: 1
Zave =	26.50	: 1
TRIAL DEPTH =	**0.4**	ft

NORMAL FLOW CALCULATIONS

flow (Qn) =	7.2	cfs
depth (dn) =	0.40	ft
velocity (Vn) =	1.70	fps
Froude Number	0.67	

CRITICAL FLOW CALCULATIONS

depth (dc) =	**3.720**	FT
velocity (Vc) =	0.02	FPS
slope (Sc) =	0.0000	FT/FT

DIBBLE & ASSOCIATES
CHANNEL HYDRAULICS CHARACTERISTICS

Project:	US 60 - Project 2	Project No.	9727
Job No.	CB Sta. 563+87	By:	JMB

```
 **              T              **
  **------------- -------------*-----**
  **                0.38        **
Za **            FT DEEP      ** Zb
    **                         **
     **********   *********   ****
                   B
```

Q =	**6.0**	cfs
So =	**0.0069**	ft/ft
n =	**0.025**	
B =	**0**	ft
Za =	**20**	: 1
Zb =	**30**	: 1
Zave =	25.00	: 1
TRIAL DEPTH =	**0.38**	ft

NORMAL FLOW CALCULATIONS

flow (Qn) =	5.9	cfs
depth (dn) =	0.38	ft
velocity (Vn) =	1.63	fps
Froude Number	0.66	

CRITICAL FLOW CALCULATIONS

depth (dc) =	**3.720**	FT
velocity (Vc) =	0.02	FPS
slope (Sc) =	0.0000	FT/FT

DIBBLE & ASSOCIATES
CHANNEL HYDRAULICS CHARACTERISTICS

Project: US 60 - Project 2
Job No. CB Sta. 576+65
Project No. 9727
By: JMB

```
**                T                 **
 **-------------- ------------------**
  **                0.56          **
Za **             FT DEEP       ** Zb
    **                          **
     **********  *********   ****
                  B
```

Q =	**8.0**	cfs
So =	**0.0065**	ft/ft
n =	**0.025**	
B =	**0**	ft
Za =	**10**	: 1
Zb =	**15**	: 1
Zave =	12.50	: 1
TRIAL DEPTH =	**0.56**	ft

NORMAL FLOW CALCULATIONS

flow (Qn) =	8.0	cfs
depth (dn) =	0.56	ft
velocity (Vn) =	2.05	fps
Froude Number	0.68	

CRITICAL FLOW CALCULATIONS

depth (dc) =	**3.720**	FT
velocity (Vc) =	0.05	FPS
slope (Sc) =	0.0000	FT/FT

DIBBLE & ASSOCIATES
CHANNEL HYDRAULICS CHARACTERISTICS

Project:	US 60 - Project 2	Project No.	9727
Job No.	CB Sta. 577+39	By:	JMB

```
 **              T              **
 **-------------- -------------- ----------**
 **                0.78          **
Za **            FT DEEP       ** Zb
   **                           **
    **********   *********   ****
                 B
```

Q =	**5.0**	cfs
So =	**0.0011**	ft/ft
n =	**0.025**	
B =	**0**	ft
Za =	**7**	: 1
Zb =	**9**	: 1
Zave =	8.00	: 1
TRIAL DEPTH =	**0.78**	ft

NORMAL FLOW CALCULATIONS

flow (Qn) =	5.1	cfs
depth (dn) =	0.78	ft
velocity (Vn) =	1.05	fps
Froude Number	0.30	

CRITICAL FLOW CALCULATIONS

depth (dc) =	**3.720**	FT
velocity (Vc) =	0.05	FPS
slope (Sc) =	0.0000	FT/FT

DIBBLE & ASSOCIATES
CHANNEL HYDRAULICS CHARACTERISTICS

Project: US 60 - Project 2
Job No. CB Sta. 601+00
Project No. 9727
By: JMB

```
**              T              **
 **------------ ------------ ----------**
  **              0.65          **
Za **            FT DEEP       ** Zb
   **                           **
    **********  *********   ****
                 B
```

Q =	**13.0**	cfs
So =	**0.0114**	ft/ft
n =	**0.025**	
B =	**0**	ft
Za =	**10**	: 1
Zb =	**11**	: 1
Zave =	10.50	: 1
TRIAL DEPTH =	**0.65**	ft

NORMAL FLOW CALCULATIONS

flow (Qn) =	13.3	cfs
depth (dn) =	0.65	ft
velocity (Vn) =	2.99	fps
Froude Number	0.92	

CRITICAL FLOW CALCULATIONS

depth (dc) =	**3.720**	FT
velocity (Vc) =	0.09	FPS
slope (Sc) =	0.0000	FT/FT

DIBBLE & ASSOCIATES
CHANNEL HYDRAULICS CHARACTERISTICS

Project:	US 60 - Project 2	Project No.	9727
Job No.	CB Sta. 622+07	By:	JMB

```
 **              T              **
  **------------- -------------- ----------**
  **                0.76        **
Za **             FT DEEP      ** Zb
   **                          **
    **********   *********   ****
                 B
```

Q =	**13.0**	cfs
So =	**0.0085**	ft/ft
n =	**0.025**	
B =	**0**	ft
Za =	**6**	: 1
Zb =	**10**	: 1
Zave =	8.00	: 1
TRIAL DEPTH =	**0.76**	ft

NORMAL FLOW CALCULATIONS

flow (Qn) =	13.2	cfs
depth (dn) =	0.76	ft
velocity (Vn) =	2.86	fps
Froude Number	0.82	

CRITICAL FLOW CALCULATIONS

depth (dc) =	**3.720**	FT
velocity (Vc) =	0.12	FPS
slope (Sc) =	0.0000	FT/FT

DIBBLE & ASSOCIATES
CHANNEL HYDRAULICS CHARACTERISTICS

Project: US 60 - Project 2
Job No. CB Sta. 640+00

Project No. 9727
By: JMB

```
**                T                 **
**-------------- --------------- ----------**
 **                0.72            **
Za **             FT DEEP         ** Zb
   **                              **
   **********    *********    ****
                  B
```

Q =	**14.0**	cfs
So =	**0.0096**	ft/ft
n =	**0.025**	
B =	**0**	ft
Za =	**9**	: 1
Zb =	**10**	: 1
Zave =	9.50	: 1
TRIAL DEPTH =	**0.72**	ft

NORMAL FLOW CALCULATIONS

flow (Qn) =	14.5	cfs
depth (dn) =	0.72	ft
velocity (Vn) =	2.94	fps
Froude Number	0.86	

CRITICAL FLOW CALCULATIONS

depth (dc) =	**3.720**	FT
velocity (Vc) =	0.11	FPS
slope (Sc) =	0.0000	FT/FT

DIBBLE & ASSOCIATES
CHANNEL HYDRAULICS CHARACTERISTICS

Project:	US 60 - Project 2	Project No.	9727
Job No.	CB Sta. 662+37	By:	JMB

```
 **              T              **
  **-------------- -------------- ----------**
  **                0.60        **
Za **             FT DEEP      ** Zb
    **                          **
     **********   *********   ****
                   B
```

Q =	**14.0**	cfs
So =	**0.0065**	ft/ft
n =	**0.025**	
B =	**0**	ft
Za =	**16**	: 1
Zb =	**21**	: 1
Zave =	18.50	: 1
TRIAL DEPTH =	**0.6**	ft

NORMAL FLOW CALCULATIONS

flow (Qn) =	14.3	cfs
depth (dn) =	0.60	ft
velocity (Vn) =	2.15	fps
Froude Number	0.69	

CRITICAL FLOW CALCULATIONS

depth (dc) =	**3.720**	FT
velocity (Vc) =	0.05	FPS
slope (Sc) =	0.0000	FT/FT

DIBBLE & ASSOCIATES
CHANNEL HYDRAULICS CHARACTERISTICS

Project: US 60 - Project 2
Job No. CB Sta. 674+00

Project No. 9727
By: JMB

```
**              T              **
 **------------ ------------ ----------**
  **                0.56        **
Za **             FT DEEP      ** Zb
   **                            **
    **********   *********   ****
                   B
```

Q =	**8.0**	cfs
So =	**0.0065**	ft/ft
n =	**0.025**	
B =	**0**	ft
Za =	**10**	: 1
Zb =	**15**	: 1
Zave =	12.50	: 1
TRIAL DEPTH =	**0.56**	ft

NORMAL FLOW CALCULATIONS

flow (Qn) =	8.0	cfs
depth (dn) =	0.56	ft
velocity (Vn) =	2.05	fps
Froude Number	0.68	

CRITICAL FLOW CALCULATIONS

depth (dc) =	**3.720**	FT
velocity (Vc) =	0.05	FPS
slope (Sc) =	0.0000	FT/FT

DIBBLE & ASSOCIATES
CHANNEL HYDRAULICS CHARACTERISTICS

Project:	US 60 - Project 2	Project No.	9727
Job No.	CB Sta. 685+42	By:	JMB

```
 **              T              **
 **-------------- -------------- ----------**
 **              0.51           **
Za **           FT DEEP        ** Zb
   **                          **
    **********   *********   ****
                 B
```

Q =	**8.0**	cfs
So =	**0.0047**	ft/ft
n =	**0.025**	
B =	**0**	ft
Za =	**15**	: 1
Zb =	**24**	: 1
Zave =	19.50	: 1
TRIAL DEPTH =	**0.51**	ft

NORMAL FLOW CALCULATIONS

flow (Qn) =	8.3	cfs
depth (dn) =	0.51	ft
velocity (Vn) =	1.64	fps
Froude Number	0.57	

CRITICAL FLOW CALCULATIONS

depth (dc) =	**3.720**	FT
velocity (Vc) =	0.03	FPS
slope (Sc) =	0.0000	FT/FT

DIBBLE & ASSOCIATES
CHANNEL HYDRAULICS CHARACTERISTICS

Project: US 60 - Project 2
Job No. CB Sta. 698+00

Project No. 9727
By: JMB

```
**              T              **
**------------ ------------ ----------**
**                0.53          **
Za **           FT DEEP        ** Zb
   **                            **
   **********   *********    ****
                  B
```

Q =	**8.0**	cfs
So =	**0.0064**	ft/ft
n =	**0.025**	
B =	**0**	ft
Za =	**11**	: 1
Zb =	**18**	: 1
Zave =	14.50	: 1
TRIAL DEPTH =	**0.53**	ft

NORMAL FLOW CALCULATIONS

flow (Qn) =	8.0	cfs
depth (dn) =	0.53	ft
velocity (Vn) =	1.96	fps
Froude Number	0.67	

CRITICAL FLOW CALCULATIONS

depth (dc) =	**3.720**	FT
velocity (Vc) =	0.04	FPS
slope (Sc) =	0.0000	FT/FT

DIBBLE & ASSOCIATES
CHANNEL HYDRAULICS CHARACTERISTICS

Project:	US 60 - Project 2	Project No.	9727
Job No.	CB Sta. 708+00	By:	JMB

```
 **              T              **
  **------------- -------------- ----------**
   **                0.63        **
Za **             FT DEEP      ** Zb
    **                          **
     **********   *********    ****
                   B
```

Q =	**10.0**	cfs
So =	**0.0096**	ft/ft
n =	**0.025**	
B =	**0**	ft
Za =	**9**	: 1
Zb =	**10**	: 1
Zave =	9.50	: 1
TRIAL DEPTH =	**0.63**	ft

NORMAL FLOW CALCULATIONS

flow (Qn) =	10.1	cfs
depth (dn) =	0.63	ft
velocity (Vn) =	2.69	fps
Froude Number	0.84	

CRITICAL FLOW CALCULATIONS

depth (dc) =	**3.720**	FT
velocity (Vc) =	0.08	FPS
slope (Sc) =	0.0000	FT/FT

DIBBLE & ASSOCIATES
CHANNEL HYDRAULICS CHARACTERISTICS

Project: US 60 - Project 2
Job No. CB Sta. 719+91

Project No. 9727
By: JMB

```
**                T                 **
 **-------------- -------------- ----------**
  **                0.53            **
Za **             FT DEEP          ** Zb
   **                                **
    **********   *********    ****
                   B
```

Q =	**8.0**	cfs
So =	**0.011**	ft/ft
n =	**0.025**	
B =	**0**	ft
Za =	**6**	: 1
Zb =	**17**	: 1
Zave =	11.50	: 1
TRIAL DEPTH =	**0.53**	ft

NORMAL FLOW CALCULATIONS

flow (Qn) =	8.3	cfs
depth (dn) =	0.53	ft
velocity (Vn) =	2.56	fps
Froude Number	0.88	

CRITICAL FLOW CALCULATIONS

depth (dc) =	**3.720**	FT
velocity (Vc) =	0.05	FPS
slope (Sc) =	0.0000	FT/FT

DIBBLE & ASSOCIATES
CHANNEL HYDRAULICS CHARACTERISTICS

Project:	US 60 - Project 2	Project No.	9727
Job No.	CB Sta. 733+00	By:	JMB

```
 **              T              **
 **-------------- -------------- ----------**
 **                0.54          **
Za **            FT DEEP       ** Zb
   **                           **
   **********   *********   ****
                B
```

Q =	**9.0**	cfs
So =	**0.0068**	ft/ft
n =	**0.025**	
B =	**0**	ft
Za =	**9**	: 1
Zb =	**22**	: 1
Zave =	15.50	: 1
TRIAL DEPTH =	**0.54**	ft

NORMAL FLOW CALCULATIONS

flow (Qn) =	9.2	cfs
depth (dn) =	0.54	ft
velocity (Vn) =	2.04	fps
Froude Number	0.69	

CRITICAL FLOW CALCULATIONS

depth (dc) =	**3.720**	FT
velocity (Vc) =	0.04	FPS
slope (Sc) =	0.0000	FT/FT

DIBBLE & ASSOCIATES
CHANNEL HYDRAULICS CHARACTERISTICS

Project: US 60 - Project 2
Job No. CB Sta. 745+00

Project No. 9727
By: JMB

```
**                T                 **
 **-------------- ----------------------**
  **                0.56          **
Za **             FT DEEP        ** Zb
   **                             **
    **********   *********    ****
                   B
```

Q =	**8.0**	cfs
So =	**0.0065**	ft/ft
n =	**0.025**	
B =	**0**	ft
Za =	**9**	: 1
Zb =	**16**	: 1
Zave =	12.50	: 1
TRIAL DEPTH =	**0.56**	ft

NORMAL FLOW CALCULATIONS

flow (Qn) =	8.0	cfs
depth (dn) =	0.56	ft
velocity (Vn) =	2.05	fps
Froude Number	0.68	

CRITICAL FLOW CALCULATIONS

depth (dc) =	**3.720**	FT
velocity (Vc) =	0.05	FPS
slope (Sc) =	0.0000	FT/FT

DIBBLE & ASSOCIATES
CHANNEL HYDRAULICS CHARACTERISTICS

Project:	US 60 - Project 2	Project No.	9727
Job No.	CB Sta. 755+00	By:	JMB

```
 **              T              **
 **-------------- -------------- ----------**
 **                0.56          **
Za **            FT DEEP       ** Zb
   **                           **
    **********   *********   ****
                 B
```

Q =	**8.0**	cfs
So =	**0.0078**	ft/ft
n =	**0.025**	
B =	**0**	ft
Za =	**12**	: 1
Zb =	**11**	: 1
Zave =	11.50	: 1
TRIAL DEPTH =	**0.56**	ft

NORMAL FLOW CALCULATIONS

flow (Qn) =	8.1	cfs
depth (dn) =	0.56	ft
velocity (Vn) =	2.24	fps
Froude Number	0.75	

CRITICAL FLOW CALCULATIONS

depth (dc) =	**3.720**	FT
velocity (Vc) =	0.05	FPS
slope (Sc) =	0.0000	FT/FT

DIBBLE & ASSOCIATES
CHANNEL HYDRAULICS CHARACTERISTICS

Project:	US 60 - Project 2	Project No.	9727
Job No.	CB Sta. 770+00	By:	JMB

```
**              T              **
**------------- -------------- ----------**
**                0.58          **
Za **           FT DEEP        ** Zb
**                              **
**********     *********     ****
                B
```

Q =	**11.0**	cfs
So =	**0.01**	ft/ft
n =	**0.025**	
B =	**0**	ft
Za =	**10**	: 1
Zb =	**16**	: 1
Zave =	13.00	: 1
TRIAL DEPTH =	**0.58**	ft

NORMAL FLOW CALCULATIONS

flow (Qn) =	11.4	cfs
depth (dn) =	0.58	ft
velocity (Vn) =	2.60	fps
Froude Number	0.85	

CRITICAL FLOW CALCULATIONS

depth (dc) =	**3.720**	FT
velocity (Vc) =	0.06	FPS
slope (Sc) =	0.0000	FT/FT

DIBBLE & ASSOCIATES
CHANNEL HYDRAULICS CHARACTERISTICS

Project:	US 60 - Project 2	Project No.	9727
Job No.	CB Sta. 781+35	By:	JMB

```
**              T              **
 **-------------- -------------- ----------**
 **                0.58        **
Za **            FT DEEP      ** Zb
   **                          **
    **********   *********   ****
                 B
```

Q =	**8.0**	cfs
So =	**0.0056**	ft/ft
n =	**0.025**	
B =	**0**	ft
Za =	**10**	: 1
Zb =	**15**	: 1
Zave =	12.50	: 1
TRIAL DEPTH =	**0.58**	ft

NORMAL FLOW CALCULATIONS

flow (Qn) =	8.2	cfs
depth (dn) =	0.58	ft
velocity (Vn) =	1.94	fps
Froude Number	0.64	

CRITICAL FLOW CALCULATIONS

depth (dc) =	**3.720**	FT
velocity (Vc) =	0.05	FPS
slope (Sc) =	0.0000	FT/FT

DIBBLE & ASSOCIATES
CHANNEL HYDRAULICS CHARACTERISTICS

Project: US 60 - Project 2
Job No. Sta. 796+00

Project No. 9727
By: JMB

```
**                T                 **
 **-------------- ------------------**
  **                0.66          **
Za **             FT DEEP        ** Zb
   **                              **
    **********   *********    ****
                   B
```

Q =	**10.0**	cfs
So =	**0.0046**	ft/ft
n =	**0.025**	
B =	**0**	ft
Za =	**7**	: 1
Zb =	**17**	: 1
Zave =	12.00	: 1
TRIAL DEPTH =	**0.66**	ft

NORMAL FLOW CALCULATIONS

flow (Qn) =	10.0	cfs
depth (dn) =	0.66	ft
velocity (Vn) =	1.92	fps

CRITICAL FLOW CALCULATIONS

depth (dc) =	**3.720**	FT
velocity (Vc) =	0.06	FPS
slope (Sc) =	0.0000	FT/FT

Appendix E

Median Weir/Orifice Calculations

Station	Q (cfs)	Weir Qi=Cw*P*d^1.5 Solve for d					Orifice Qi=Co*A(2g*d)^0.5 Solve for d						Controlling Depth (ft)	Controlling Inlet Condition
		Qi (cfs)	Cw	P (grate ft)	P (assume 50% blockage - 50% Reduction of P)	d	Qi	Co	A (grate ft^2)	A (assume 50% blockage - 50% Reduction of A)	g (ft/s^2)	d		
Sump Condition - ADOT C-15.80														
480+00	12	12	3.0	9.27	4.64	**0.91**	12	0.67	4.91	2.46	32.16	**0.83**	**0.91**	**Weir**
496+76	13	13	3.0	9.27	4.64	**0.96**	13	0.67	4.91	2.46	32.16	**0.97**	**0.97**	**Orifice**
516+54	12	12	3.0	9.27	4.64	**0.91**	12	0.67	4.91	2.46	32.16	**0.83**	**0.91**	**Weir**
547+51	4	4	3.0	9.27	4.64	**0.43**	4	0.67	4.91	2.46	32.16	**0.09**	**0.43**	**Weir**
549+15	5	5	3.0	9.27	4.64	**0.50**	5	0.67	4.91	2.46	32.16	**0.14**	**0.50**	**Weir**
556+75	7	7	3.0	9.27	4.64	**0.63**	7	0.67	4.91	2.46	32.16	**0.28**	**0.63**	**Weir**
563+87	6	6	3.0	9.27	4.64	**0.57**	6	0.67	4.91	2.46	32.16	**0.21**	**0.57**	**Weir**
601+00	13	13	3.0	9.27	4.64	**0.96**	13	0.67	4.91	2.46	32.16	**0.97**	**0.97**	**Orifice**
640+00	14	14	3.0	9.27	4.64	**1.00**	14	0.67	4.91	2.46	32.16	**1.13**	**1.13**	**Orifice**
662+37	14	14	3.0	9.27	4.64	**1.00**	14	0.67	4.91	2.46	32.16	**1.13**	**1.13**	**Orifice**
674+00	8	8	3.0	9.27	4.64	**0.69**	8	0.67	4.91	2.46	32.16	**0.37**	**0.69**	**Weir**
685+42	8	8	3.0	9.27	4.64	**0.69**	8	0.67	4.91	2.46	32.16	**0.37**	**0.69**	**Weir**
698+00	8	8	3.0	9.27	4.64	**0.69**	8	0.67	4.91	2.46	32.16	**0.37**	**0.69**	**Weir**
708+00	10	10	3.0	9.27	4.64	**0.80**	10	0.67	4.91	2.46	32.16	**0.57**	**0.80**	**Weir**
733+00	9	9	3.0	9.27	4.64	**0.75**	9	0.67	4.91	2.46	32.16	**0.47**	**0.75**	**Weir**
745+00	8	8	3.0	9.27	4.64	**0.69**	8	0.67	4.91	2.46	32.16	**0.37**	**0.69**	**Weir**
755+00	8	8	3.0	9.27	4.64	**0.69**	8	0.67	4.91	2.46	32.16	**0.37**	**0.69**	**Weir**
770+00	11	11	3.0	9.27	4.64	**0.85**	11	0.67	4.91	2.46	32.16	**0.70**	**0.85**	**Weir**
Sump Condition - ADOT C-15.90														
576+65	8	8	3.0	12.41	6.21	**0.57**	8	0.67	9.44	4.72	32.16	**0.10**	**0.57**	**Weir**
577+29	5	5	3.0	12.41	6.21	**0.41**	5	0.67	9.44	4.72	32.16	**0.04**	**0.41**	**Weir**
622+07	13	13	3.0	12.41	6.21	**0.79**	13	0.67	9.44	4.72	32.16	**0.26**	**0.79**	**Weir**
719+91	8	8	3.0	12.41	6.21	**0.57**	8	0.67	9.44	4.72	32.16	**0.10**	**0.57**	**Weir**
781+35	8	8	3.0	12.41	6.21	**0.57**	8	0.67	9.44	4.72	32.16	**0.10**	**0.57**	**Weir**

Appendix F

Controlling Depth Calculations

Controlling Depth for Median Flow					
Culvert Sta.	Orifice / Weir Controlling Depth (ft)	Orifice / Weir Condition	Median Flow Depth	Overall Controlling Depth (ft)	Condition
480+00	0.91	Weir	0.62	**0.91**	**Orifice/Weir**
496+76	0.97	Orifice	0.67	**0.97**	**Orifice/Weir**
516+54	0.91	Weir	0.60	**0.91**	**Orifice/Weir**
547+51	0.43	Weir	0.37	**0.43**	**Orifice/Weir**
549+15	0.50	Weir	0.20	**0.50**	**Orifice/Weir**
556+75	0.63	Weir	0.40	**0.63**	**Orifice/Weir**
563+87	0.57	Weir	0.38	**0.57**	**Orifice/Weir**
576+65	0.57	Weir	0.56	**0.57**	**Orifice/Weir**
577+29	0.41	Weir	0.78	**0.78**	**Flow Depth**
601+00	0.97	Orifice	0.65	**0.97**	**Orifice/Weir**
622+07	0.79	Weir	0.76	**0.79**	**Orifice/Weir**
640+00	1.13	Orifice	0.72	**1.13**	**Orifice/Weir**
662+37	1.13	Orifice	0.60	**1.13**	**Orifice/Weir**
674+00	0.69	Weir	0.56	**0.69**	**Orifice/Weir**
685+42	0.69	Weir	0.51	**0.69**	**Orifice/Weir**
698+00	0.69	Weir	0.53	**0.69**	**Orifice/Weir**
708+00	0.80	Weir	0.63	**0.80**	**Orifice/Weir**
719+91	0.57	Weir	0.53	**0.57**	**Orifice/Weir**
733+00	0.75	Weir	0.54	**0.75**	**Orifice/Weir**
745+00	0.69	Weir	0.56	**0.69**	**Orifice/Weir**
755+00	0.69	Weir	0.56	**0.69**	**Orifice/Weir**
770+00	0.85	Weir	0.58	**0.85**	**Orifice/Weir**
781+35	0.57	Weir	0.58	**0.58**	**Flow Depth**
	(From App. E)		(From App. D)		

Appendix G

Median Freeboard Calculations

Freeboard in Median Swale							
Median Culvert Sta.	EOP Elevation	Elevation 3" below EOP	Channel Invert / Grate Elevation	Headwater Elevation (50 year Flow)	Total Channel Depth (ft)	Controlling Depth (ft) *	Freeboard
480+00	1605.34	1605.09	1602.90	1602.61	2.19	0.91	1.28
496+76	1595.00	1594.75	1591.21	1591.45	3.54	0.97	2.57
516+54	1576.69	1576.44	1574.50	1574.59	1.94	0.91	1.03
547+51	1545.05	1544.80	1543.35	-	1.45	0.43	1.02
549+15	1543.85	1543.60	1542.28	1541.67	1.32	0.50	0.82
556+75	1538.35	1538.10	1537.25	1535.36	0.85	0.63	0.22
563+87	1533.55	1533.30	1532.34	1532.98	0.96	0.57	0.39
576+65	1525.56	1525.31	1523.04	1523.31	2.27	0.57	1.70
577+29	1525.39	1525.14	1521.50	1521.73	3.64	0.78	2.86
601+00	1508.03	1507.78	1504.75	1503.80	3.03	0.97	2.06
622+07	1493.05	1492.80	1488.85	1489.63	3.95	0.79	3.16
640+00	1477.03	1476.78	1473.60	1472.66	3.18	1.13	2.05
662+37	1461.72	1461.47	1460.26	1460.92	1.21	1.13	0.08
674+00	1453.79	1453.54	1451.73	1450.91	1.81	0.69	1.12
685+42	1448.05	1447.80	1446.30	1445.76	1.50	0.69	0.81
698+00	1439.65	1439.40	1437.45	1436.66	1.95	0.69	1.26
708+00	1431.35	1431.10	1427.75	1427.12	3.35	0.80	2.55
719+91	1422.35	1422.10	1419.56	1419.73	2.54	0.57	1.97
733+00	1412.75	1412.50	1411.03	1410.06	1.47	0.75	0.72
745+00	1405.90	1405.65	1403.19	1402.90	2.46	0.69	1.77
755+00	1398.37	1398.12	1395.35	1395.42	2.77	0.69	2.08
770+00	1387.08	1386.83	1384.35	1385.34	2.48	0.85	1.63
781+35	1380.62	1380.37	1377.94	1378.11	2.43	0.58	1.85

* From **Appendix F**

Conclusion: There will be freeboard available for the design storm.

Appendix H

HY8
Culvert Design
Median Drainage Pipe Culverts

Dibble & Associates
March 2001

Project [illegible]
[illegible] SC01 203rd AVE [illegible]

Culvert Sta. 480+00

CURRENT DATE: 02-15-2001
CURRENT TIME: 13:17:05

FILE DATE: 02-15-2001
FILE NAME: CB480

****
********** FHWA CULVERT ANALYSIS **********
********** HY-8, VERSION 6.1 **********
****

CULV NO.	SITE DATA: INLET ELEV. (ft)	OUTLET ELEV. (ft)	CULVERT LENGTH (ft)	CULVERT SHAPE, MATERIAL, INLET: BARRELS SHAPE MATERIAL	SPAN (ft)	RISE (ft)	MANNING n	INLET TYPE
1	1600.40	1599.90	97.00	1 CSP	2.00	2.00	.024	CONVENTIONAL
2								
3								
4								
5								
6								

****

SUMMARY OF CULVERT FLOWS (cfs) FILE: CB480 DATE: 02-15-2001

ELEV (ft)	TOTAL	1	2	3	4	5	6	ROADWAY	ITR	
1600.40	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	1	
1601.06	1.6	1.6	0.0	0.0	0.0	0.0	0.0	0.00	1	
1601.39	3.2	3.2	0.0	0.0	0.0	0.0	0.0	0.00	1	
1601.64	4.8	4.8	0.0	0.0	0.0	0.0	0.0	0.00	1	
1601.86	6.4	6.4	0.0	0.0	0.0	0.0	0.0	0.00	1	
1602.08	8.0	8.0	0.0	0.0	0.0	0.0	0.0	0.00	1	
1602.30	9.6	9.6	0.0	0.0	0.0	0.0	0.0	0.00	1	
1602.54	11.2	11.2	0.0	0.0	0.0	0.0	0.0	0.00	1	
1602.61	***12.0***	***12.0***	***0.0***	***0.0***	***0.0***	***0.0***	***0.0***	***0.00***	***1***	***Q50***
1603.20	14.4	14.4	0.0	0.0	0.0	0.0	0.0	0.00	1	
1603.78	16.0	16.0	0.0	0.0	0.0	0.0	0.0	0.00	1	
1605.71	21.3	21.3	0.0	0.0	0.0	0.0	0.0	OVERTOPPING		

****

1602.64 13.0 Q100

****

SUMMARY OF ITERATIVE SOLUTION ERRORS FILE: CB480 DATE: 02-15-2001

HEAD ELEV (ft)	HEAD ERROR (ft)	TOTAL FLOW (cfs)	FLOW ERROR (cfs)	% FLOW ERROR
1600.40	0.000	0.00	0.00	0.00
1601.06	0.000	1.60	0.00	0.00
1601.39	0.000	3.20	0.00	0.00
1601.64	0.000	4.80	0.00	0.00
1601.86	0.000	6.40	0.00	0.00
1602.08	0.000	8.00	0.00	0.00
1602.30	0.000	9.60	0.00	0.00
1602.54	0.000	11.20	0.00	0.00
1602.60	0.000	12.00	0.00	0.00
1603.20	0.000	14.40	0.00	0.00
1603.78	0.000	16.00	0.00	0.00

****

<1> TOLERANCE (ft) = 0.010 <2> TOLERANCE (%) = 1.000

****

CURRENT DATE: 02-15-2001 FILE DATE: 02-15-2001
CURRENT TIME: 13:17:05 FILE NAME: CB480

PERFORMANCE CURVE FOR CULVERT 1 - 1(2.00 (ft) BY 2.00 (ft)) CSP

DIS-CHARGE FLOW (cfs)	HEAD-WATER ELEV. (ft)	INLET CONTROL DEPTH (ft)	OUTLET CONTROL DEPTH (ft)	FLOW TYPE <F4>	NORMAL DEPTH (ft)	CRIT. DEPTH (ft)	OUTLET DEPTH (ft)	TW DEPTH (ft)	OUTLET VEL. (fps)	TW VEL. (fps)
0.00	1600.40	0.00	0.00	0-NF	0.00	0.00	0.00	0.00	0.00	0.00
1.60	1601.06	0.61	0.66	3-M2t	0.57	0.43	0.52	0.52	2.44	1.48
3.20	1601.39	0.86	0.99	3-M2t	0.83	0.62	0.67	0.67	3.42	1.75
4.80	1601.64	1.07	1.24	3-M2t	1.05	0.77	0.79	0.79	4.19	1.94
6.40	1601.86	1.27	1.46	2-M2c	1.26	0.89	0.89	0.88	4.73	2.09
8.00	1602.08	1.45	1.68	2-M2c	1.49	1.01	1.01	0.95	5.05	2.21
9.60	1602.30	1.63	1.90	2-M2c	2.00	1.10	1.10	1.02	5.41	2.31
11.20	1602.54	1.80	2.14	2-M2c	2.00	1.20	1.20	1.08	5.69	2.40
12.00	1602.61	1.89	2.21	2-M2c	2.00	1.24	1.24	1.11	5.85	2.44
14.40	1603.20	2.16	2.80	2-M2c	2.00	1.36	1.36	1.19	6.31	2.56
16.00	1603.78	2.36	3.38	2-M2c	2.00	1.44	1.44	1.23	6.61	2.62

El. inlet face invert 1600.40 ft El. outlet invert 1599.90 ft
El. inlet throat invert 0.00 ft El. inlet crest 0.00 ft

***** SITE DATA ***** CULVERT INVERT **********

INLET STATION	1954.50 ft
INLET ELEVATION	1600.40 ft
OUTLET STATION	2051.50 ft
OUTLET ELEVATION	1599.90 ft
NUMBER OF BARRELS	1
SLOPE (V/H)	0.0052
CULVERT LENGTH ALONG SLOPE	97.00 ft

***** CULVERT DATA SUMMARY **********

BARREL SHAPE	CIRCULAR
BARREL DIAMETER	2.00 ft
BARREL MATERIAL	CORRUGATED STEEL
BARREL MANNING'S n	0.024
INLET TYPE	CONVENTIONAL
INLET EDGE AND WALL	SQUARE EDGE WITH HEADWALL
INLET DEPRESSION	NONE

CURRENT DATE: 02-15-2001
CURRENT TIME: 13:17:05

FILE DATE: 02-15-2001
FILE NAME: CB480

****
********** TAILWATER **********
****

******* REGULAR CHANNEL CROSS SECTION **********

SIDE SLOPE H/V (X:1)	4.0
CHANNEL SLOPE V/H (ft/ft)	0.008
MANNING'S n (.01-0.1)	0.035
CHANNEL INVERT ELEVATION	1599.90 ft
CULVERT NO.1 OUTLET INVERT ELEVATION	1599.90 ft

******* UNIFORM FLOW RATING CURVE FOR DOWNSTREAM CHANNEL

FLOW (cfs)	W.S.E. (ft)	FROUDE NUMBER	DEPTH (ft)	VEL. (f/s)	SHEAR (psf)
0.00	1599.90	0.000	0.00	0.00	0.00
1.60	1600.42	0.360	0.52	1.48	0.25
3.20	1600.57	0.376	0.67	1.75	0.32
4.80	1600.69	0.386	0.79	1.94	0.37
6.40	1600.78	0.393	0.88	2.09	0.41
8.00	1600.85	0.398	0.95	2.21	0.45
9.60	1600.92	0.403	1.02	2.31	0.48
11.20	1600.98	0.407	1.08	2.40	0.51
12.00	1601.01	0.409	1.11	2.44	0.52
14.40	1601.09	0.413	1.19	2.56	0.56
16.00	1601.14	0.416	1.23	2.62	0.58

****
********** ROADWAY OVERTOPPING DATA **********
****

WEIR COEFFICIENT	2.50
EMBANKMENT TOP WIDTH	38.00 ft
CREST LENGTH	100.00 ft
OVERTOPPING CREST ELEVATION	1605.71 ft

****

Culvert Sta. 576+65

CURRENT DATE: 06-22-2000 FILE DATE: 06-22-2000
CURRENT TIME: 13:11:49 FILE NAME: CB576

****
********** FHWA CULVERT ANALYSIS **********
********** HY-8, VERSION 6.1 **********
****

CULV NO.	SITE DATA: INLET ELEV. (ft)	OUTLET ELEV. (ft)	CULVERT LENGTH (ft)	CULVERT SHAPE, MATERIAL, INLET: BARRELS SHAPE MATERIAL	SPAN (ft)	RISE (ft)	MANNING n	INLET TYPE
1	1521.99	1521.95	6.00	1 CMPA	2.33	1.67	.025	CONVENTIONAL
2								
3								
4								
5								
6								

****

SUMMARY OF CULVERT FLOWS (cfs) FILE: CB576 DATE: 06-22-2000

ELEV (ft)	TOTAL	1	2	3	4	5	6	ROADWAY	ITR	
1521.99	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	1	
1522.38	1.0	1.0	0.0	0.0	0.0	0.0	0.0	0.00	1	
1522.56	2.0	2.0	0.0	0.0	0.0	0.0	0.0	0.00	1	
1522.72	3.0	3.0	0.0	0.0	0.0	0.0	0.0	0.00	1	
1522.85	4.0	4.0	0.0	0.0	0.0	0.0	0.0	0.00	1	
1522.98	5.0	5.0	0.0	0.0	0.0	0.0	0.0	0.00	1	
1523.09	6.0	6.0	0.0	0.0	0.0	0.0	0.0	0.00	1	
1523.20	7.0	7.0	0.0	0.0	0.0	0.0	0.0	0.00	1	
1523.31	***8.0***	***8.0***	***0.0***	***0.0***	***0.0***	***0.0***	***0.0***	***0.00***	***1***	***Q50***
1523.42	**9.0**	**9.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.00**	**1**	**Q100**
1523.52	10.0	10.0	0.0	0.0	0.0	0.0	0.0	0.00	1	
1525.49	24.1	24.1	0.0	0.0	0.0	0.0	0.0	OVERTOPPING		

****

SUMMARY OF ITERATIVE SOLUTION ERRORS FILE: CB576 DATE: 06-22-2000

HEAD ELEV (ft)	HEAD ERROR (ft)	TOTAL FLOW (cfs)	FLOW ERROR (cfs)	% FLOW ERROR
1521.99	0.000	0.00	0.00	0.00
1522.38	0.000	1.00	0.00	0.00
1522.56	0.000	2.00	0.00	0.00
1522.72	0.000	3.00	0.00	0.00
1522.85	0.000	4.00	0.00	0.00
1522.98	0.000	5.00	0.00	0.00
1523.09	0.000	6.00	0.00	0.00
1523.20	0.000	7.00	0.00	0.00
1523.31	0.000	8.00	0.00	0.00
1523.42	0.000	9.00	0.00	0.00
1523.52	0.000	10.00	0.00	0.00

****

<1> TOLERANCE (ft) = 0.010 <2> TOLERANCE (%) = 1.000

****

CURRENT DATE: 06-22-2000 FILE DATE: 06-22-2000
CURRENT TIME: 13:11:49 FILE NAME: CB576

PERFORMANCE CURVE FOR CULVERT 1 - 1(2.33 (ft) BY 1.67 (ft)) CMPA

DIS-CHARGE FLOW (cfs)	HEAD-WATER ELEV. (ft)	INLET CONTROL DEPTH (ft)	OUTLET CONTROL DEPTH (ft)	FLOW TYPE <F4>	NORMAL DEPTH (ft)	CRIT. DEPTH (ft)	OUTLET DEPTH (ft)	TW DEPTH (ft)	OUTLET VEL. (fps)	TW VEL. (fps)
0.00	1521.99	0.00	0.00	0-NF	0.00	0.00	0.00	-0.44	0.00	0.00
1.00	1522.38	0.37	0.39	2-M2c	0.31	0.24	0.24	-0.44	2.59	0.00
2.00	1522.56	0.55	0.57	2-M2c	0.46	0.36	0.36	-0.44	3.11	0.00
3.00	1522.72	0.70	0.73	2-M2c	0.58	0.45	0.45	-0.44	3.51	0.00
4.00	1522.85	0.82	0.86	2-M2c	0.69	0.53	0.53	-0.44	3.84	0.00
5.00	1522.98	0.95	0.99	2-M2c	0.80	0.60	0.60	-0.44	4.14	0.00
6.00	1523.09	1.06	1.10	2-M2c	0.91	0.67	0.67	-0.44	4.38	0.00
7.00	1523.21	1.17	1.22	2-M2c	1.02	0.73	0.73	-0.44	4.65	0.00
8.00	1523.31	1.27	1.32	2-M2c	1.14	0.79	0.79	-0.44	4.87	0.00
9.00	1523.42	1.37	1.43	2-M2c	1.28	0.85	0.85	-0.44	5.07	0.00
10.00	1523.52	1.48	1.53	2-M2c	1.67	0.90	0.90	-0.44	5.30	0.00

El. inlet face invert 1521.99 ft El. outlet invert 1521.95 ft
El. inlet throat invert 0.00 ft El. inlet crest 0.00 ft

***** SITE DATA ***** CULVERT INVERT **********

INLET STATION	1994.00 ft
INLET ELEVATION	1521.99 ft
OUTLET STATION	2000.00 ft
OUTLET ELEVATION	1521.95 ft
NUMBER OF BARRELS	1
SLOPE (V/H)	0.0067
CULVERT LENGTH ALONG SLOPE	6.00 ft

***** CULVERT DATA SUMMARY **********

BARREL SHAPE	PIPE ARCH
BARREL SPAN	2.33 ft
BARREL RISE	1.67 ft
BARREL MATERIAL	STEEL OR ALUMINUM
BARREL MANNING'S n	0.025
INLET TYPE	CONVENTIONAL
INLET EDGE AND WALL	HEADWALL
INLET DEPRESSION	NONE

CURRENT DATE: 06-22-2000
CURRENT TIME: 13:11:49

FILE DATE: 06-22-2000
FILE NAME: CB576

****
********** TAILWATER **********
****
****

CONSTANT WATER SURFACE ELEVATION
1521.51

****
********** ROADWAY OVERTOPPING DATA **********
****

WEIR COEFFICIENT	2.50
EMBANKMENT TOP WIDTH	5.00 ft
CREST LENGTH	100.00 ft
OVERTOPPING CREST ELEVATION	1525.49 ft

****

Culvert Sta. 577+29

CURRENT DATE: 06-22-2000 FILE DATE: 06-22-2000
CURRENT TIME: 13:13:01 FILE NAME: CB577

****
********** FHWA CULVERT ANALYSIS **********
********** HY-8, VERSION 6.1 **********
****

CULV NO.	SITE DATA: INLET ELEV. (ft)	OUTLET ELEV. (ft)	CULVERT LENGTH (ft)	CULVERT SHAPE, MATERIAL, INLET: BARRELS SHAPE MATERIAL	SPAN (ft)	RISE (ft)	MANNING n	INLET TYPE
1	1520.45	1520.31	28.00	1 CMPA	2.33	1.67	.025	CONVENTIONAL
2								
3								
4								
5								
6								

****

SUMMARY OF CULVERT FLOWS (cfs) FILE: CB577 DATE: 06-22-2000

ELEV (ft)	TOTAL	1	2	3	4	5	6	ROADWAY	ITR	
1521.57	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	1	
1521.58	0.7	0.7	0.0	0.0	0.0	0.0	0.0	0.00	1	
1521.60	1.4	1.4	0.0	0.0	0.0	0.0	0.0	0.00	1	
1521.61	2.1	2.1	0.0	0.0	0.0	0.0	0.0	0.00	1	
1521.63	2.8	2.8	0.0	0.0	0.0	0.0	0.0	0.00	1	
1521.66	3.5	3.5	0.0	0.0	0.0	0.0	0.0	0.00	1	
1521.77	4.2	4.2	0.0	0.0	0.0	0.0	0.0	0.00	1	
1521.72	4.9	4.9	0.0	0.0	0.0	0.0	0.0	0.00	1	
1521.73	**5.0**	**5.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.00**	**1**	**Q50**
1521.81	6.3	6.3	0.0	0.0	0.0	0.0	0.0	0.00	1	
1521.86	7.0	7.0	0.0	0.0	0.0	0.0	0.0	0.00	1	
1525.49	26.0	26.0	0.0	0.0	0.0	0.0	0.0	OVERTOPPING		

****

1521.79 6.0 Q100

****

SUMMARY OF ITERATIVE SOLUTION ERRORS FILE: CB577 DATE: 06-22-2000

HEAD ELEV (ft)	HEAD ERROR (ft)	TOTAL FLOW (cfs)	FLOW ERROR (cfs)	% FLOW ERROR
1521.57	0.000	0.00	0.00	0.00
1521.58	0.000	0.70	0.00	0.00
1521.60	0.000	1.40	0.00	0.00
1521.61	0.000	2.10	0.00	0.00
1521.63	0.000	2.80	0.00	0.00
1521.66	0.000	3.50	0.00	0.00
1521.77	0.000	4.20	0.00	0.00
1521.72	0.000	4.90	0.00	0.00
1521.73	0.000	5.00	0.00	0.00
1521.81	0.000	6.30	0.00	0.00
1521.86	0.000	7.00	0.00	0.00

****

<1> TOLERANCE (ft) = 0.010 <2> TOLERANCE (%) = 1.000

****

CURRENT DATE: 06-22-2000 FILE DATE: 06-22-2000
CURRENT TIME: 13:13:01 FILE NAME: CB577

PERFORMANCE CURVE FOR CULVERT 1 - 1(2.33 (ft) BY 1.67 (ft)) CMPA

DIS-CHARGE FLOW (cfs)	HEAD-WATER ELEV. (ft)	INLET CONTROL DEPTH (ft)	OUTLET CONTROL DEPTH (ft)	FLOW TYPE <F4>	NORMAL DEPTH (ft)	CRIT. DEPTH (ft)	OUTLET DEPTH (ft)	TW DEPTH (ft)	OUTLET VEL. (fps)	TW VEL. (fps)
0.00	1521.57	0.00	1.12	0-NF	0.00	0.00	0.00	1.26	0.00	0.00
0.70	1521.58	0.39	1.13	3-M1t	0.27	0.20	1.26	1.26	0.27	0.00
1.40	1521.60	0.45	1.15	3-M1t	0.40	0.29	1.26	1.26	0.54	0.00
2.10	1521.61	0.57	1.16	3-M1t	0.51	0.37	1.26	1.26	0.81	0.00
2.80	1521.63	0.67	1.18	3-M1t	0.60	0.43	1.26	1.26	1.08	0.00
3.50	1521.66	0.76	1.21	3-M1t	0.70	0.50	1.26	1.26	1.35	0.00
4.20	1521.77	0.85	1.32	3-M1t	0.78	0.55	1.26	1.26	1.62	0.00
4.90	1521.72	0.94	1.27	3-M1t	0.87	0.60	1.26	1.26	1.89	0.00
5.00	1521.73	0.95	1.28	3-M1t	0.88	0.60	1.26	1.26	1.92	0.00
6.30	1521.81	1.10	1.36	3-M1t	1.05	0.69	1.26	1.26	2.42	0.00
7.00	1521.86	1.17	1.41	3-M1t	1.15	0.73	1.26	1.26	2.69	0.00

El. inlet face invert 1520.45 ft El. outlet invert 1520.31 ft
El. inlet throat invert 0.00 ft El. inlet crest 0.00 ft

***** SITE DATA ***** CULVERT INVERT **********

INLET STATION	2000.00 ft
INLET ELEVATION	1520.45 ft
OUTLET STATION	2028.00 ft
OUTLET ELEVATION	1520.31 ft
NUMBER OF BARRELS	1
SLOPE (V/H)	0.0050
CULVERT LENGTH ALONG SLOPE	28.00 ft

***** CULVERT DATA SUMMARY **********

BARREL SHAPE	PIPE ARCH
BARREL SPAN	2.33 ft
BARREL RISE	1.67 ft
BARREL MATERIAL	STEEL OR ALUMINUM
BARREL MANNING'S n	0.025
INLET TYPE	CONVENTIONAL
INLET EDGE AND WALL	HEADWALL
INLET DEPRESSION	NONE

CURRENT DATE: 06-22-2000
CURRENT TIME: 13:13:01

FILE DATE: 06-22-2000
FILE NAME: CB577

****
********** TAILWATER **********
****
****

CONSTANT WATER SURFACE ELEVATION
1521.57

****
********** ROADWAY OVERTOPPING DATA **********
****

WEIR COEFFICIENT	2.50
EMBANKMENT TOP WIDTH	20.00 ft
CREST LENGTH	100.00 ft
OVERTOPPING CREST ELEVATION	1525.49 ft

****

Culvert Sta. 601+00

CURRENT DATE: 06-22-2000 FILE DATE: 06-22-2000
CURRENT TIME: 13:14:15 FILE NAME: CB601

****
********** FHWA CULVERT ANALYSIS **********
********** HY-8, VERSION 6.1 **********
****

CULV NO.	SITE DATA: INLET ELEV. (ft)	OUTLET ELEV. (ft)	CULVERT LENGTH (ft)	CULVERT SHAPE, MATERIAL, INLET: BARRELS SHAPE MATERIAL	SPAN (ft)	RISE (ft)	MANNING n	INLET TYPE
1	1501.75	1501.48	104.00	1 RCP	2.00	2.00	.013	CONVENTIONAL
2								
3								
4								
5								
6								

****

SUMMARY OF CULVERT FLOWS (cfs) FILE: CB601 DATE: 06-22-2000

ELEV (ft)	TOTAL	1	2	3	4	5	6	ROADWAY	ITR	
1501.75	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	1	
1502.35	1.5	1.5	0.0	0.0	0.0	0.0	0.0	0.00	1	
1502.63	3.0	3.0	0.0	0.0	0.0	0.0	0.0	0.00	1	
1502.83	4.5	4.5	0.0	0.0	0.0	0.0	0.0	0.00	1	
1503.03	6.0	6.0	0.0	0.0	0.0	0.0	0.0	0.00	1	
1503.20	7.5	7.5	0.0	0.0	0.0	0.0	0.0	0.00	1	
1503.37	9.0	9.0	0.0	0.0	0.0	0.0	0.0	0.00	1	
1503.53	10.5	10.5	0.0	0.0	0.0	0.0	0.0	0.00	1	
1503.69	12.0	12.0	0.0	0.0	0.0	0.0	0.0	0.00	1	
1503.80	***13.0***	***13.0***	***0.0***	***0.0***	***0.0***	***0.0***	***0.0***	***0.00***	***1***	***Q50***
1504.03	15.0	15.0	0.0	0.0	0.0	0.0	0.0	0.00	1	
1508.03	34.1	34.1	0.0	0.0	0.0	0.0	0.0	OVERTOPPING		

****

1503.85 14.0 Q100

****

SUMMARY OF ITERATIVE SOLUTION ERRORS FILE: CB601 DATE: 06-22-2000

HEAD ELEV (ft)	HEAD ERROR (ft)	TOTAL FLOW (cfs)	FLOW ERROR (cfs)	% FLOW ERROR
1501.75	0.000	0.00	0.00	0.00
1502.35	0.000	1.50	0.00	0.00
1502.63	0.000	3.00	0.00	0.00
1502.83	0.000	4.50	0.00	0.00
1503.03	0.000	6.00	0.00	0.00
1503.20	0.000	7.50	0.00	0.00
1503.37	0.000	9.00	0.00	0.00
1503.53	0.000	10.50	0.00	0.00
1503.69	0.000	12.00	0.00	0.00
1503.80	0.000	13.00	0.00	0.00
1504.03	0.000	15.00	0.00	0.00

****

<1> TOLERANCE (ft) = 0.010 <2> TOLERANCE (%) = 1.000

****

CURRENT DATE: 06-22-2000 FILE DATE: 06-22-2000
CURRENT TIME: 13:14:15 FILE NAME: CB601

PERFORMANCE CURVE FOR CULVERT 1 - 1(2.00 (ft) BY 2.00 (ft)) RCP

DIS-CHARGE FLOW (cfs)	HEAD-WATER ELEV. (ft)	INLET CONTROL DEPTH (ft)	OUTLET CONTROL DEPTH (ft)	FLOW TYPE <F4>	NORMAL DEPTH (ft)	CRIT. DEPTH (ft)	OUTLET DEPTH (ft).	TW DEPTH (ft)	OUTLET VEL. (fps)	TW VEL. (fps)
0.00	1501.75	0.00	0.00	0-NF	0.00	0.00	0.00	0.00	0.00	0.00
1.50	1502.35	0.54	0.60	3-M2t	0.48	0.42	0.47	0.47	2.62	1.68
3.00	1502.63	0.80	0.88	3-M2t	0.69	0.60	0.61	0.61	3.68	1.99
4.50	1502.83	1.03	1.08	2-M2c	0.86	0.74	0.74	0.71	4.24	2.21
6.00	1503.03	1.21	1.28	2-M2c	1.02	0.86	0.86	0.80	4.63	2.37
7.50	1503.20	1.38	1.45	2-M2c	1.17	0.97	0.97	0.86	4.96	2.51
9.00	1503.37	1.53	1.62	2-M2c	1.33	1.07	1.07	0.93	5.28	2.62
10.50	1503.53	1.67	1.78	2-M2c	1.50	1.16	1.16	0.98	5.57	2.73
12.00	1503.69	1.81	1.94	2-M2c	1.74	1.24	1.24	1.03	5.85	2.82
13.00	1503.80	1.90	2.05	2-M2c	2.00	1.29	1.29	1.06	6.06	2.88
15.00	1504.03	2.09	2.28	2-M2c	2.00	1.40	1.40	1.12	6.41	2.98

El. inlet face invert 1501.75 ft El. outlet invert 1501.48 ft
El. inlet throat invert 0.00 ft El. inlet crest 0.00 ft

***** SITE DATA ***** CULVERT INVERT **********

INLET STATION	1951.50 ft
INLET ELEVATION	1501.75 ft
OUTLET STATION	2055.50 ft
OUTLET ELEVATION	1501.48 ft
NUMBER OF BARRELS	1
SLOPE (V/H)	0.0026
CULVERT LENGTH ALONG SLOPE	104.00 ft

***** CULVERT DATA SUMMARY **********

BARREL SHAPE	CIRCULAR
BARREL DIAMETER	2.00 ft
BARREL MATERIAL	CONCRETE
BARREL MANNING'S n	0.013
INLET TYPE	CONVENTIONAL
INLET EDGE AND WALL	GROOVED END IN HEADWALL
INLET DEPRESSION	NONE

CURRENT DATE: 06-22-2000
CURRENT TIME: 13:14:15

FILE DATE: 06-22-2000
FILE NAME: CB601

****
********** TAILWATER **********
****

******* REGULAR CHANNEL CROSS SECTION **********

SIDE SLOPE H/V (X:1)	4.0
CHANNEL SLOPE V/H (ft/ft)	0.011
MANNING'S n (.01-0.1)	0.035
CHANNEL INVERT ELEVATION	1501.48 ft
CULVERT NO.1 OUTLET INVERT ELEVATION	1501.48 ft

******* UNIFORM FLOW RATING CURVE FOR DOWNSTREAM CHANNEL

FLOW (cfs)	W.S.E. (ft)	FROUDE NUMBER	DEPTH (ft)	VEL. (f/s)	SHEAR (psf)
0.00	1501.48	0.000	0.00	0.00	0.00
1.50	1501.95	0.429	0.47	1.68	0.33
3.00	1502.09	0.448	0.61	1.99	0.43
4.50	1502.19	0.460	0.71	2.21	0.50
6.00	1502.28	0.468	0.80	2.37	0.55
7.50	1502.34	0.475	0.86	2.51	0.60
9.00	1502.41	0.480	0.93	2.62	0.64
10.50	1502.46	0.485	0.98	2.73	0.68
12.00	1502.51	0.489	1.03	2.82	0.71
13.00	1502.54	0.492	1.06	2.88	0.74
15.00	1502.60	0.496	1.12	2.98	0.78

****
********** ROADWAY OVERTOPPING DATA **********
****

WEIR COEFFICIENT	2.50
EMBANKMENT TOP WIDTH	48.00 ft
CREST LENGTH	100.00 ft
OVERTOPPING CREST ELEVATION	1508.03 ft

****

Culvert Sta. 622+07

CURRENT DATE: 06-22-2000 FILE DATE: 06-22-2000
CURRENT TIME: 13:15:27 FILE NAME: CB622

****
********** FHWA CULVERT ANALYSIS **********
********** HY-8, VERSION 6.1 **********
****

CULV NO.	SITE DATA: INLET ELEV. (ft)	OUTLET ELEV. (ft)	CULVERT LENGTH (ft)	CULVERT SHAPE, MATERIAL, INLET: BARRELS SHAPE MATERIAL	SPAN (ft)	RISE (ft)	MANNING n	INLET TYPE
1	1487.80	1487.50	20.00	1 CMPA	2.33	1.67	.025	CONVENTIONAL
2								
3								
4								
5								
6								

****

SUMMARY OF CULVERT FLOWS (cfs) FILE: CB622 DATE: 06-22-2000

ELEV (ft)	TOTAL	1	2	3	4	5	6	ROADWAY	ITR	
1487.98	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	1	
1488.29	1.5	1.5	0.0	0.0	0.0	0.0	0.0	0.00	1	
1488.53	3.0	3.0	0.0	0.0	0.0	0.0	0.0	0.00	1	
1488.74	4.5	4.5	0.0	0.0	0.0	0.0	0.0	0.00	1	
1488.92	6.0	6.0	0.0	0.0	0.0	0.0	0.0	0.00	1	
1489.09	7.5	7.5	0.0	0.0	0.0	0.0	0.0	0.00	1	
1489.23	9.0	9.0	0.0	0.0	0.0	0.0	0.0	0.00	1	
1489.38	10.5	10.5	0.0	0.0	0.0	0.0	0.0	0.00	1	
1489.53	12.0	12.0	0.0	0.0	0.0	0.0	0.0	0.00	1	
1489.63	***13.0***	***13.0***	***0.0***	***0.0***	***0.0***	***0.0***	***0.0***	***0.00***	***1***	***Q50***
1489.84	15.0	15.0	0.0	0.0	0.0	0.0	0.0	0.00	1	
1492.77	28.4	28.4	0.0	0.0	0.0	0.0	0.0	OVERTOPPING		

****

1489.74 14.0 Q100

****

SUMMARY OF ITERATIVE SOLUTION ERRORS FILE: CB622 DATE: 06-22-2000

HEAD ELEV (ft)	HEAD ERROR (ft)	TOTAL FLOW (cfs)	FLOW ERROR (cfs)	% FLOW ERROR
1487.98	0.000	0.00	0.00	0.00
1488.29	0.000	1.50	0.00	0.00
1488.53	0.000	3.00	0.00	0.00
1488.74	0.000	4.50	0.00	0.00
1488.92	0.000	6.00	0.00	0.00
1489.09	0.000	7.50	0.00	0.00
1489.23	0.000	9.00	0.00	0.00
1489.38	0.000	10.50	0.00	0.00
1489.53	0.000	12.00	0.00	0.00
1489.63	0.000	13.00	0.00	0.00
1489.84	0.000	15.00	0.00	0.00

****

<1> TOLERANCE (ft) = 0.010 <2> TOLERANCE (%) = 1.000

****

CURRENT DATE: 06-22-2000 FILE DATE: 06-22-2000
CURRENT TIME: 13:15:27 FILE NAME: CB622

PERFORMANCE CURVE FOR CULVERT 1 - 1(2.33 (ft) BY 1.67 (ft)) CMPA

DIS-CHARGE FLOW (cfs)	HEAD-WATER ELEV. (ft)	INLET CONTROL DEPTH (ft)	OUTLET CONTROL DEPTH (ft)	FLOW TYPE <F4>	NORMAL DEPTH (ft)	CRIT. DEPTH (ft)	OUTLET DEPTH (ft)	TW DEPTH (ft)	OUTLET VEL. (fps)	TW VEL. (fps)
0.00	1487.98	0.00	0.18	0-NF	0.00	0.00	0.00	0.48	0.00	0.00
1.50	1488.29	0.46	0.49	3-M1t	0.31	0.31	0.48	0.48	1.63	0.00
3.00	1488.53	0.69	0.73	3-M1t	0.46	0.45	0.48	0.48	3.26	0.00
4.50	1488.74	0.88	0.94	2-M2c	0.58	0.57	0.57	0.48	4.00	0.00
6.00	1488.92	1.06	1.12	2-M2c	0.69	0.67	0.67	0.48	4.38	0.00
7.50	1489.09	1.22	1.29	2-M2c	0.80	0.76	0.76	0.48	4.76	0.00
9.00	1489.23	1.37	1.43	2-M2c	0.91	0.85	0.85	0.48	5.07	0.00
10.50	1489.38	1.52	1.58	2-M2c	1.02	0.93	0.93	0.48	5.41	0.00
12.00	1489.53	1.68	1.73	2-M2c	1.14	1.01	1.01	0.48	5.69	0.00
13.00	1489.63	1.79	1.83	2-M2c	1.23	1.05	1.05	0.48	5.91	0.00
15.00	1489.84	2.02	2.04	2-M2c	1.67	1.14	1.14	0.48	6.30	0.00

El. inlet face invert 1487.80 ft El. outlet invert 1487.50 ft
El. inlet throat invert 0.00 ft El. inlet crest 0.00 ft

***** SITE DATA ***** CULVERT INVERT **********

INLET STATION	62207.00 ft
INLET ELEVATION	1487.80 ft
OUTLET STATION	62227.00 ft
OUTLET ELEVATION	1487.50 ft
NUMBER OF BARRELS	1
SLOPE (V/H)	0.0150
CULVERT LENGTH ALONG SLOPE	20.00 ft

***** CULVERT DATA SUMMARY **********

BARREL SHAPE	PIPE ARCH
BARREL SPAN	2.33 ft
BARREL RISE	1.67 ft
BARREL MATERIAL	STEEL OR ALUMINUM
BARREL MANNING'S n	0.025
INLET TYPE	CONVENTIONAL
INLET EDGE AND WALL	HEADWALL
INLET DEPRESSION	NONE

CURRENT DATE: 06-22-2000
CURRENT TIME: 13:15:27

FILE DATE: 06-22-2000
FILE NAME: CB622

****
********** TAILWATER **********
****
****

CONSTANT WATER SURFACE ELEVATION
1487.98

****
********** ROADWAY OVERTOPPING DATA **********
****

WEIR COEFFICIENT	2.50
EMBANKMENT TOP WIDTH	30.00 ft
CREST LENGTH	100.00 ft
OVERTOPPING CREST ELEVATION	1492.77 ft

****

Culvert Sta. 640+00

CURRENT DATE: 05-09-2000 FILE DATE: 05-09-2000
CURRENT TIME: 14:31:44 FILE NAME: CB640

****
********** FHWA CULVERT ANALYSIS **********
********** HY-8, VERSION 6.1 **********
****

CULV NO.	SITE DATA: INLET ELEV. (ft)	OUTLET ELEV. (ft)	CULVERT LENGTH (ft)	CULVERT SHAPE, MATERIAL, INLET: BARRELS SHAPE MATERIAL	SPAN (ft)	RISE (ft)	MANNING n	INLET TYPE
1	1470.60	1470.10	95.00	1 RCP	2.00	2.00	.013	CONVENTIONAL
2								
3								
4								
5								
6								

****

SUMMARY OF CULVERT FLOWS (cfs) FILE: CB640 DATE: 05-09-2000

ELEV (ft)	TOTAL	1	2	3	4	5	6	ROADWAY	ITR	
1470.60	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	1	
1471.16	1.6	1.6	0.0	0.0	0.0	0.0	0.0	0.00	1	
1471.43	3.2	3.2	0.0	0.0	0.0	0.0	0.0	0.00	1	
1471.66	4.8	4.8	0.0	0.0	0.0	0.0	0.0	0.00	1	
1471.86	6.4	6.4	0.0	0.0	0.0	0.0	0.0	0.00	1	
1472.03	8.0	8.0	0.0	0.0	0.0	0.0	0.0	0.00	1	
1472.18	9.6	9.6	0.0	0.0	0.0	0.0	0.0	0.00	1	
1472.40	11.2	11.2	0.0	0.0	0.0	0.0	0.0	0.00	1	
1472.56	12.8	12.8	0.0	0.0	0.0	0.0	0.0	0.00	1	
1472.66	***14.0***	***14.0***	***0.0***	***0.0***	***0.0***	***0.0***	***0.0***	***0.00***	***1***	***Q50***
1472.85	16.0	16.0	0.0	0.0	0.0	0.0	0.0	0.00	1	
1476.87	35.7	35.7	0.0	0.0	0.0	0.0	0.0	OVERTOPPING		

****

1472.76 15.0 Q100

****

SUMMARY OF ITERATIVE SOLUTION ERRORS FILE: CB640 DATE: 05-09-2000

HEAD ELEV (ft)	HEAD ERROR (ft)	TOTAL FLOW (cfs)	FLOW ERROR (cfs)	% FLOW ERROR
1470.60	0.000	0.00	0.00	0.00
1471.16	0.000	1.60	0.00	0.00
1471.43	0.000	3.20	0.00	0.00
1471.66	0.000	4.80	0.00	0.00
1471.86	0.000	6.40	0.00	0.00
1472.03	0.000	8.00	0.00	0.00
1472.18	0.000	9.60	0.00	0.00
1472.40	0.000	11.20	0.00	0.00
1472.56	0.000	12.80	0.00	0.00
1472.66	0.000	14.00	0.00	0.00
1472.85	0.000	16.00	0.00	0.00

****

<1> TOLERANCE (ft) = 0.010 <2> TOLERANCE (%) = 1.000

****

CURRENT DATE: 05-09-2000 FILE DATE: 05-09-2000
CURRENT TIME: 14:31:44 FILE NAME: CB640

PERFORMANCE CURVE FOR CULVERT 1 - 1(2.00 (ft) BY 2.00 (ft)) RCP

DIS-CHARGE FLOW (cfs)	HEAD-WATER ELEV. (ft)	INLET CONTROL DEPTH (ft)	OUTLET CONTROL DEPTH (ft)	FLOW TYPE <F4>	NORMAL DEPTH (ft)	CRIT. DEPTH (ft)	OUTLET DEPTH (ft)	TW DEPTH (ft)	OUTLET VEL. (fps)	TW VEL. (fps)
0.00	1470.60	0.00	0.00	0-NF	0.00	0.00	0.00	0.00	0.00	0.00
1.60	1471.16	0.56	0.56	1-S2n	0.42	0.43	0.33	0.16	4.56	1.13
3.20	1471.43	0.83	0.83	1-S2n	0.60	0.62	0.52	0.24	4.86	1.45
4.80	1471.66	1.06	1.06	1-S2n	0.73	0.77	0.67	0.31	5.21	1.67
6.40	1471.86	1.26	1.26	1-S2n	0.86	0.89	0.79	0.37	5.54	1.85
8.00	1472.03	1.43	1.43	1-S2n	0.98	1.01	0.91	0.42	5.78	1.99
9.60	1472.18	1.58	1.58	1-S2n	1.10	1.10	1.00	0.46	6.09	2.11
11.20	1472.40	1.73	1.80	2-M2c	1.21	1.20	1.20	0.50	5.69	2.22
12.80	1472.56	1.88	1.96	2-M2c	1.33	1.28	1.28	0.54	6.02	2.32
14.00	1472.66	1.99	2.06	2-M2c	1.42	1.34	1.34	0.57	6.24	2.39
16.00	1472.85	2.19	2.25	2-M2c	1.59	1.44	1.44	0.61	6.61	2.49

El. inlet face invert 1470.60 ft El. outlet invert 1470.10 ft
El. inlet throat invert 0.00 ft El. inlet crest 0.00 ft

***** SITE DATA ***** CULVERT INVERT **********

INLET STATION	1952.50 ft
INLET ELEVATION	1470.60 ft
OUTLET STATION	2047.50 ft
OUTLET ELEVATION	1470.10 ft
NUMBER OF BARRELS	1
SLOPE (V/H)	0.0053
CULVERT LENGTH ALONG SLOPE	95.00 ft

***** CULVERT DATA SUMMARY **********

BARREL SHAPE	CIRCULAR
BARREL DIAMETER	2.00 ft
BARREL MATERIAL	CONCRETE
BARREL MANNING'S n	0.013
INLET TYPE	CONVENTIONAL
INLET EDGE AND WALL	GROOVED END IN HEADWALL
INLET DEPRESSION	NONE

CURRENT DATE: 05-09-2000
CURRENT TIME: 14:31:44

FILE DATE: 05-09-2000
FILE NAME: CB640

****
********** TAILWATER **********
****

******* REGULAR CHANNEL CROSS SECTION **********

BOTTOM WIDTH	8.00 ft
SIDE SLOPE H/V (X:1)	4.0
CHANNEL SLOPE V/H (ft/ft)	0.009
MANNING'S n (.01-0.1)	0.035
CHANNEL INVERT ELEVATION	1470.10 ft
CULVERT NO.1 OUTLET INVERT ELEVATION	1470.10 ft

******* UNIFORM FLOW RATING CURVE FOR DOWNSTREAM CHANNEL

FLOW (cfs)	W.S.E. (ft)	FROUDE NUMBER	DEPTH (ft)	VEL. (f/s)	SHEAR (psf)
0.00	1470.10	0.000	0.00	0.00	0.00
1.60	1470.26	0.494	0.16	1.13	0.09
3.20	1470.34	0.517	0.24	1.45	0.14
4.80	1470.41	0.530	0.31	1.67	0.17
6.40	1470.47	0.538	0.37	1.85	0.20
8.00	1470.52	0.544	0.42	1.99	0.23
9.60	1470.56	0.548	0.46	2.11	0.25
11.20	1470.60	0.552	0.50	2.22	0.28
12.80	1470.64	0.555	0.54	2.32	0.30
14.00	1470.67	0.557	0.57	2.39	0.31
16.00	1470.71	0.560	0.61	2.49	0.34

****
********** ROADWAY OVERTOPPING DATA **********
****

WEIR COEFFICIENT	2.50
EMBANKMENT TOP WIDTH	38.00 ft
CREST LENGTH	100.00 ft
OVERTOPPING CREST ELEVATION	1476.87 ft

****

Culvert Sta. 674+00

CURRENT DATE: 02-15-2001 FILE DATE: 02-15-2001
CURRENT TIME: 13:25:49 FILE NAME: CB674

****
********** FHWA CULVERT ANALYSIS **********
********** HY-8, VERSION 6.1 **********
****

CULV NO.	SITE DATA: INLET ELEV. (ft)	OUTLET ELEV. (ft)	CULVERT LENGTH (ft)	CULVERT SHAPE, MATERIAL, INLET: BARRELS SHAPE MATERIAL	SPAN (ft)	RISE (ft)	MANNING n	INLET TYPE
1	1449.23	1448.81	84.00	1 CSP	2.00	2.00	.024	CONVENTIONAL
2								
3								
4								
5								
6								

****

SUMMARY OF CULVERT FLOWS (cfs) FILE: CB674 DATE: 02-15-2001

ELEV (ft)	TOTAL	1	2	3	4	5	6	ROADWAY	ITR	
1449.23	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	1	
1449.73	0.9	0.9	0.0	0.0	0.0	0.0	0.0	0.00	1	
1449.96	1.8	1.8	0.0	0.0	0.0	0.0	0.0	0.00	1	
1450.14	2.7	2.7	0.0	0.0	0.0	0.0	0.0	0.00	1	
1450.27	3.6	3.6	0.0	0.0	0.0	0.0	0.0	0.00	1	
1450.43	4.5	4.5	0.0	0.0	0.0	0.0	0.0	0.00	1	
1450.56	5.4	5.4	0.0	0.0	0.0	0.0	0.0	0.00	1	
1450.68	6.3	6.3	0.0	0.0	0.0	0.0	0.0	0.00	1	
1450.80	7.2	7.2	0.0	0.0	0.0	0.0	0.0	0.00	1	
1450.91	***8.0***	***8.0***	***0.0***	***0.0***	***0.0***	***0.0***	***0.0***	***0.00***	***1***	***Q50***
1451.04	**9.0**	**9.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.00**	**1**	**Q100**
1453.79	19.9	19.9	0.0	0.0	0.0	0.0	0.0	OVERTOPPING		

****

SUMMARY OF ITERATIVE SOLUTION ERRORS FILE: CB674 DATE: 02-15-2001

HEAD ELEV (ft)	HEAD ERROR (ft)	TOTAL FLOW (cfs)	FLOW ERROR (cfs)	% FLOW ERROR
1449.23	0.000	0.00	0.00	0.00
1449.73	0.000	0.90	0.00	0.00
1449.96	0.000	1.80	0.00	0.00
1450.14	0.000	2.70	0.00	0.00
1450.27	0.000	3.60	0.00	0.00
1450.43	0.000	4.50	0.00	0.00
1450.56	0.000	5.40	0.00	0.00
1450.68	0.000	6.30	0.00	0.00
1450.80	0.000	7.20	0.00	0.00
1450.91	0.000	8.00	0.00	0.00
1451.04	0.000	9.00	0.00	0.00

****

<1> TOLERANCE (ft) = 0.010 <2> TOLERANCE (%) = 1.000

****

CURRENT DATE: 02-15-2001 FILE DATE: 02-15-2001
CURRENT TIME: 13:25:49 FILE NAME: CB674

PERFORMANCE CURVE FOR CULVERT 1 - 1(2.00 (ft) BY 2.00 (ft)) CSP

DIS-CHARGE FLOW (cfs)	HEAD-WATER ELEV. (ft)	INLET CONTROL DEPTH (ft)	OUTLET CONTROL DEPTH (ft)	FLOW TYPE <F4>	NORMAL DEPTH (ft)	CRIT. DEPTH (ft)	OUTLET DEPTH (ft)	TW DEPTH (ft)	OUTLET VEL. (fps)	TW VEL. (fps)
0.00	1449.23	0.00	0.00	0-NF	0.00	0.00	0.00	0.19	0.00	0.00
0.90	1449.73	0.49	0.50	3-M2t	0.43	0.31	0.32	0.32	2.73	0.83
1.80	1449.96	0.64	0.73	2-M2c	0.62	0.46	0.46	0.38	3.30	1.07
2.70	1450.14	0.78	0.91	2-M2c	0.76	0.57	0.57	0.43	3.66	1.24
3.60	1450.27	0.91	1.04	2-M2c	0.90	0.66	0.66	0.48	3.98	1.37
4.50	1450.42	1.03	1.19	2-M2c	1.02	0.74	0.74	0.52	4.24	1.48
5.40	1450.56	1.15	1.33	2-M2c	1.14	0.82	0.82	0.55	4.47	1.57
6.30	1450.68	1.26	1.45	2-M2c	1.27	0.88	0.88	0.59	4.70	1.66
7.20	1450.80	1.36	1.57	2-M2c	1.39	0.95	0.95	0.62	4.90	1.73
8.00	1450.91	1.45	1.68	2-M2c	1.52	1.01	1.01	0.64	5.05	1.79
9.00	1451.04	1.56	1.81	2-M2c	1.73	1.07	1.07	0.68	5.28	1.86

El. inlet face invert 1449.23 ft El. outlet invert 1448.81 ft
El. inlet throat invert 0.00 ft El. inlet crest 0.00 ft

***** SITE DATA ***** CULVERT INVERT **********

INLET STATION	1963.50 ft
INLET ELEVATION	1449.23 ft
OUTLET STATION	2047.50 ft
OUTLET ELEVATION	1448.81 ft
NUMBER OF BARRELS	1
SLOPE (V/H)	0.0050
CULVERT LENGTH ALONG SLOPE	84.00 ft

***** CULVERT DATA SUMMARY **********

BARREL SHAPE	CIRCULAR
BARREL DIAMETER	2.00 ft
BARREL MATERIAL	CORRUGATED STEEL
BARREL MANNING'S n	0.024
INLET TYPE	CONVENTIONAL
INLET EDGE AND WALL	SQUARE EDGE WITH HEADWALL
INLET DEPRESSION	NONE

CURRENT DATE: 02-15-2001
CURRENT TIME: 13:25:49

FILE DATE: 02-15-2001
FILE NAME: CB674

****
********** TAILWATER **********
****

******* REGULAR CHANNEL CROSS SECTION **********

BOTTOM WIDTH	8.00 ft
SIDE SLOPE H/V (X:1)	4.0
CHANNEL SLOPE V/H (ft/ft)	0.007
MANNING'S n (.01-0.1)	0.035
CHANNEL INVERT ELEVATION	1449.00 ft
CULVERT NO.1 OUTLET INVERT ELEVATION	1448.81 ft

******* UNIFORM FLOW RATING CURVE FOR DOWNSTREAM CHANNEL

FLOW (cfs)	W.S.E. (ft)	FROUDE NUMBER	DEPTH (ft)	VEL. (f/s)	SHEAR (psf)
0.00	1449.00	0.000	0.00	0.00	0.00
0.90	1449.13	0.410	0.13	0.83	0.05
1.80	1449.19	0.431	0.19	1.07	0.08
2.70	1449.24	0.443	0.24	1.24	0.10
3.60	1449.29	0.450	0.29	1.37	0.12
4.50	1449.33	0.456	0.33	1.48	0.13
5.40	1449.36	0.460	0.36	1.57	0.15
6.30	1449.40	0.464	0.40	1.66	0.16
7.20	1449.43	0.467	0.43	1.73	0.17
8.00	1449.45	0.469	0.45	1.79	0.18
9.00	1449.49	0.472	0.49	1.86	0.20

****
********** ROADWAY OVERTOPPING DATA **********
****

WEIR COEFFICIENT	2.50
EMBANKMENT TOP WIDTH	38.00 ft
CREST LENGTH	100.00 ft
OVERTOPPING CREST ELEVATION	1453.79 ft

****

Culvert Sta. 698+00

CURRENT DATE: 06-22-2000 FILE DATE: 06-22-2000
CURRENT TIME: 13:19:03 FILE NAME: CB698

****
********** FHWA CULVERT ANALYSIS **********
********** HY-8, VERSION 6.1 **********
****

CULV NO.	SITE DATA: INLET ELEV. (ft)	OUTLET ELEV. (ft)	CULVERT LENGTH (ft)	CULVERT SHAPE, MATERIAL, INLET: BARRELS SHAPE MATERIAL	SPAN (ft)	RISE (ft)	MANNING n	INLET TYPE
1	1434.95	1434.48	95.00	1 CSP	2.00	2.00	.024	CONVENTIONAL
2								
3								
4								
5								
6								

****

SUMMARY OF CULVERT FLOWS (cfs) FILE: CB698 DATE: 06-22-2000

ELEV (ft)	TOTAL	1	2	3	4	5	6	ROADWAY	ITR	
1435.79	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	1	
1435.84	0.9	0.9	0.0	0.0	0.0	0.0	0.0	0.00	1	
1435.99	1.8	1.8	0.0	0.0	0.0	0.0	0.0	0.00	1	
1435.99	2.7	2.7	0.0	0.0	0.0	0.0	0.0	0.00	1	
1436.10	3.6	3.6	0.0	0.0	0.0	0.0	0.0	0.00	1	
1436.28	4.5	4.5	0.0	0.0	0.0	0.0	0.0	0.00	1	
1436.32	5.4	5.4	0.0	0.0	0.0	0.0	0.0	0.00	1	
1436.45	6.3	6.3	0.0	0.0	0.0	0.0	0.0	0.00	1	
1436.55	7.2	7.2	0.0	0.0	0.0	0.0	0.0	0.00	1	
1436.66	***8.0***	***8.0***	***0.0***	***0.0***	***0.0***	***0.0***	***0.0***	***0.00***	***1***	***Q50***
1436.79	**9.0**	**9.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.00**	**1**	**Q100**
1440.44	21.8	21.8	0.0	0.0	0.0	0.0	0.0	OVERTOPPING		

****

SUMMARY OF ITERATIVE SOLUTION ERRORS FILE: CB698 DATE: 06-22-2000

HEAD ELEV (ft)	HEAD ERROR (ft)	TOTAL FLOW (cfs)	FLOW ERROR (cfs)	% FLOW ERROR
1435.79	0.000	0.00	0.00	0.00
1435.84	0.000	0.90	0.00	0.00
1435.99	0.000	1.80	0.00	0.00
1435.99	0.000	2.70	0.00	0.00
1436.10	0.000	3.60	0.00	0.00
1436.28	0.000	4.50	0.00	0.00
1436.32	0.000	5.40	0.00	0.00
1436.45	0.000	6.30	0.00	0.00
1436.55	0.000	7.20	0.00	0.00
1436.66	0.000	8.00	0.00	0.00
1436.79	0.000	9.00	0.00	0.00

****

<1> TOLERANCE (ft) = 0.010 <2> TOLERANCE (%) = 1.000

****

CURRENT DATE: 06-22-2000 FILE DATE: 06-22-2000
CURRENT TIME: 13:20:22 FILE NAME: CB708

PERFORMANCE CURVE FOR CULVERT 1 - 1(2.00 (ft) BY 2.00 (ft)) CSP

DIS-CHARGE FLOW (cfs)	HEAD-WATER ELEV. (ft)	INLET CONTROL DEPTH (ft)	OUTLET CONTROL DEPTH (ft)	FLOW TYPE <F4>	NORMAL DEPTH (ft)	CRIT. DEPTH (ft)	OUTLET DEPTH (ft)	TW DEPTH (ft)	OUTLET VEL. (fps)	TW VEL. (fps)
0.00	1425.96	0.00	0.71	0-NF	0.00	0.00	0.00	1.46	0.00	0.00
1.10	1426.13	0.53	0.88	3-M1t	0.43	0.35	1.46	1.46	0.45	0.00
2.20	1426.18	0.71	0.93	3-M1t	0.61	0.51	1.46	1.46	0.90	0.00
3.30	1426.32	0.87	1.07	3-M1t	0.76	0.63	1.46	1.46	1.35	0.00
4.40	1426.47	1.02	1.22	3-M1t	0.89	0.73	1.46	1.46	1.79	0.00
5.50	1426.61	1.16	1.36	3-M1t	1.01	0.83	1.46	1.46	2.24	0.00
6.60	1426.74	1.29	1.49	3-M1t	1.13	0.91	1.46	1.46	2.69	0.00
7.70	1426.84	1.41	1.59	3-M1t	1.25	0.99	1.46	1.46	3.14	0.00
8.80	1426.97	1.54	1.72	3-M1t	1.38	1.05	1.46	1.46	3.59	0.00
9.90	1427.11	1.66	1.86	3-M2t	1.52	1.12	1.46	1.46	4.04	0.00
10.00	1427.12	1.67	1.87	3-M2t	1.53	1.13	1.46	1.46	4.08	0.00

El. inlet face invert 1425.25 ft El. outlet invert 1424.50 ft
El. inlet throat invert 0.00 ft El. inlet crest 0.00 ft

***** SITE DATA ***** CULVERT INVERT **********

INLET STATION	1950.50 ft
INLET ELEVATION	1425.25 ft
OUTLET STATION	2047.50 ft
OUTLET ELEVATION	1424.50 ft
NUMBER OF BARRELS	1
SLOPE (V/H)	0.0077
CULVERT LENGTH ALONG SLOPE	97.00 ft

***** CULVERT DATA SUMMARY **********

BARREL SHAPE	CIRCULAR
BARREL DIAMETER	2.00 ft
BARREL MATERIAL	CORRUGATED STEEL
BARREL MANNING'S n	0.024
INLET TYPE	CONVENTIONAL
INLET EDGE AND WALL	SQUARE EDGE WITH HEADWALL
INLET DEPRESSION	NONE

CURRENT DATE: 06-22-2000
CURRENT TIME: 13:20:22

FILE DATE: 06-22-2000
FILE NAME: CB708

****
********** TAILWATER **********
****
****

CONSTANT WATER SURFACE ELEVATION
1425.96

****
********** ROADWAY OVERTOPPING DATA **********
****

WEIR COEFFICIENT	2.50
EMBANKMENT TOP WIDTH	38.00 ft
CREST LENGTH	100.00 ft
OVERTOPPING CREST ELEVATION	1431.45 ft

****

Culvert Sta. 719+91

CURRENT DATE: 06-22-2000 FILE DATE: 06-22-2000
CURRENT TIME: 13:21:52 FILE NAME: CB720

****
********** FHWA CULVERT ANALYSIS **********
********** HY-8, VERSION 6.1 **********
****

CULV NO.	SITE DATA: INLET ELEV. (ft)	OUTLET ELEV. (ft)	CULVERT LENGTH (ft)	CULVERT SHAPE, MATERIAL, INLET: BARRELS SHAPE MATERIAL	SPAN (ft)	RISE (ft)	MANNING n	INLET TYPE
1	1418.49	1417.50	22.02	1 CMPA	2.33	1.67	.025	CONVENTIONAL
2								
3								
4								
5								
6								

****

SUMMARY OF CULVERT FLOWS (cfs) FILE: CB720 DATE: 06-22-2000

ELEV (ft)	TOTAL	1	2	3	4	5	6	ROADWAY	ITR	
1418.49	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	1	
1418.83	0.9	0.9	0.0	0.0	0.0	0.0	0.0	0.00	1	
1418.99	1.8	1.8	0.0	0.0	0.0	0.0	0.0	0.00	1	
1419.12	2.7	2.7	0.0	0.0	0.0	0.0	0.0	0.00	1	
1419.24	3.6	3.6	0.0	0.0	0.0	0.0	0.0	0.00	1	
1419.35	4.5	4.5	0.0	0.0	0.0	0.0	0.0	0.00	1	
1419.45	5.4	5.4	0.0	0.0	0.0	0.0	0.0	0.00	1	
1419.55	6.3	6.3	0.0	0.0	0.0	0.0	0.0	0.00	1	
1419.65	7.2	7.2	0.0	0.0	0.0	0.0	0.0	0.00	1	
1419.73	***8.0***	***8.0***	***0.0***	***0.0***	***0.0***	***0.0***	***0.0***	***0.00***	***1***	***Q50***
1419.83	**9.0**	**9.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.00**	**1**	**Q100**
1421.89	23.8	23.8	0.0	0.0	0.0	0.0	0.0	OVERTOPPING		

****

SUMMARY OF ITERATIVE SOLUTION ERRORS FILE: CB720 DATE: 06-22-2000

HEAD ELEV (ft)	HEAD ERROR (ft)	TOTAL FLOW (cfs)	FLOW ERROR (cfs)	% FLOW ERROR
1418.49	0.000	0.00	0.00	0.00
1418.83	0.000	0.90	0.00	0.00
1418.99	0.000	1.80	0.00	0.00
1419.12	0.000	2.70	0.00	0.00
1419.24	0.000	3.60	0.00	0.00
1419.35	0.000	4.50	0.00	0.00
1419.45	0.000	5.40	0.00	0.00
1419.55	0.000	6.30	0.00	0.00
1419.65	0.000	7.20	0.00	0.00
1419.73	0.000	8.00	0.00	0.00
1419.83	0.000	9.00	0.00	0.00

****

<1> TOLERANCE (ft) = 0.010 <2> TOLERANCE (%) = 1.000

****

CURRENT DATE: 06-22-2000 FILE DATE: 06-22-2000
CURRENT TIME: 13:21:52 FILE NAME: CB720

PERFORMANCE CURVE FOR CULVERT 1 - 1(2.33 (ft) BY 1.67 (ft)) CMPA

DIS-CHARGE FLOW (cfs)	HEAD-WATER ELEV. (ft)	INLET CONTROL DEPTH (ft)	OUTLET CONTROL DEPTH (ft)	FLOW TYPE <F4>	NORMAL DEPTH (ft)	CRIT. DEPTH (ft)	OUTLET DEPTH (ft)	TW DEPTH (ft)	OUTLET VEL. (fps)	TW VEL. (fps)
0.00	1418.49	0.00	0.00	0-NF	0.00	0.00	0.00	0.88	0.00	0.00
0.90	1418.83	0.34	0.34	1-S2n	0.18	0.23	0.03	0.88	13.40	0.00
1.80	1418.99	0.50	0.50	1-S2n	0.25	0.34	0.14	0.88	7.89	0.00
2.70	1419.12	0.63	0.63	1-S2n	0.32	0.42	0.22	0.88	7.62	0.00
3.60	1419.24	0.75	0.75	1-S2n	0.37	0.50	0.30	0.88	6.87	0.00
4.50	1419.35	0.86	0.86	1-S2n	0.42	0.57	0.37	0.88	6.83	0.00
5.40	1419.45	0.96	0.96	1-S2n	0.47	0.63	0.46	0.88	6.13	0.00
6.30	1419.55	1.06	1.06	1-S2n	0.51	0.69	0.39	0.88	8.77	0.00
7.20	1419.65	1.16	1.16	1-S2n	0.55	0.75	0.45	0.88	8.55	0.00
8.00	1419.73	1.24	1.24	1-S2n	0.59	0.79	0.49	0.88	8.40	0.00
9.00	1419.83	1.34	1.34	1-S2n	0.63	0.85	0.55	0.88	8.29	0.00

El. inlet face invert 1418.49 ft El. outlet invert 1417.50 ft
El. inlet throat invert 0.00 ft El. inlet crest 0.00 ft

***** SITE DATA ***** CULVERT INVERT **********

INLET STATION	1978.00 ft
INLET ELEVATION	1418.49 ft
OUTLET STATION	2000.00 ft
OUTLET ELEVATION	1417.50 ft
NUMBER OF BARRELS	1
SLOPE (V/H)	0.0450
CULVERT LENGTH ALONG SLOPE	22.02 ft

***** CULVERT DATA SUMMARY **********

BARREL SHAPE	PIPE ARCH
BARREL SPAN	2.33 ft
BARREL RISE	1.67 ft
BARREL MATERIAL	STEEL OR ALUMINUM
BARREL MANNING'S n	0.025
INLET TYPE	CONVENTIONAL
INLET EDGE AND WALL	HEADWALL
INLET DEPRESSION	NONE

CURRENT DATE: 06-22-2000
CURRENT TIME: 13:21:52

FILE DATE: 06-22-2000
FILE NAME: CB720

****
********** TAILWATER **********
****
****

CONSTANT WATER SURFACE ELEVATION
1418.38

****
********** ROADWAY OVERTOPPING DATA **********
****

WEIR COEFFICIENT	2.50
EMBANKMENT TOP WIDTH	20.00 ft
CREST LENGTH	100.00 ft
OVERTOPPING CREST ELEVATION	1421.89 ft

****

Culvert Sta. 733+00

CURRENT DATE: 06-22-2000 FILE DATE: 06-22-2000
CURRENT TIME: 13:30:19 FILE NAME: CB733

****
********** FHWA CULVERT ANALYSIS **********
********** HY-8, VERSION 6.1 **********
****

CULV NO.	SITE DATA: INLET ELEV. (ft)	OUTLET ELEV. (ft)	CULVERT LENGTH (ft)	CULVERT SHAPE, MATERIAL, INLET: BARRELS SHAPE MATERIAL	SPAN (ft)	RISE (ft)	MANNING n	INLET TYPE
1	1408.53	1408.05	95.00	1 RCP	2.00	2.00	.013	CONVENTIONAL
2								
3								
4								
5								
6								

****

SUMMARY OF CULVERT FLOWS (cfs) FILE: CB733 DATE: 06-22-2000

ELEV (ft)	TOTAL	1	2	3	4	5	6	ROADWAY	ITR	
1408.53	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	1	
1408.97	1.0	1.0	0.0	0.0	0.0	0.0	0.0	0.00	1	
1409.16	2.0	2.0	0.0	0.0	0.0	0.0	0.0	0.00	1	
1409.33	3.0	3.0	0.0	0.0	0.0	0.0	0.0	0.00	1	
1409.48	4.0	4.0	0.0	0.0	0.0	0.0	0.0	0.00	1	
1409.62	5.0	5.0	0.0	0.0	0.0	0.0	0.0	0.00	1	
1409.74	6.0	6.0	0.0	0.0	0.0	0.0	0.0	0.00	1	
1409.85	7.0	7.0	0.0	0.0	0.0	0.0	0.0	0.00	1	
1409.96	8.0	8.0	0.0	0.0	0.0	0.0	0.0	0.00	1	
1410.06	***9.0***	***9.0***	***0.0***	***0.0***	***0.0***	***0.0***	***0.0***	***0.00***	***1***	***Q50***
1410.38	**10.0**	**10.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.00**	**1**	**Q100**
1414.94	31.0	31.0	0.0	0.0	0.0	0.0	0.0	OVERTOPPING		

****

SUMMARY OF ITERATIVE SOLUTION ERRORS FILE: CB733 DATE: 06-22-2000

HEAD ELEV (ft)	HEAD ERROR (ft)	TOTAL FLOW (cfs)	FLOW ERROR (cfs)	% FLOW ERROR
1408.53	0.000	0.00	0.00	0.00
1408.97	0.000	1.00	0.00	0.00
1409.16	0.000	2.00	0.00	0.00
1409.33	0.000	3.00	0.00	0.00
1409.48	0.000	4.00	0.00	0.00
1409.62	0.000	5.00	0.00	0.00
1409.74	0.000	6.00	0.00	0.00
1409.85	0.000	7.00	0.00	0.00
1409.96	0.000	8.00	0.00	0.00
1410.06	0.000	9.00	0.00	0.00
1410.38	0.000	10.00	0.00	0.00

****

<1> TOLERANCE (ft) = 0.010 <2> TOLERANCE (%) = 1.000

****

CURRENT DATE: 06-22-2000 FILE DATE: 06-22-2000
CURRENT TIME: 13:30:19 FILE NAME: CB733

PERFORMANCE CURVE FOR CULVERT 1 - 1(2.00 (ft) BY 2.00 (ft)) RCP

DIS-CHARGE FLOW (cfs)	HEAD-WATER ELEV. (ft)	INLET CONTROL DEPTH (ft)	OUTLET CONTROL DEPTH (ft)	FLOW TYPE <F4>	NORMAL DEPTH (ft)	CRIT. DEPTH (ft)	OUTLET DEPTH (ft)	TW DEPTH (ft)	OUTLET VEL. (fps)	TW VEL. (fps)
0.00	1408.53	0.00	0.00	0-NF	0.00	0.00	0.00	0.00	0.00	0.00
1.00	1408.97	0.44	0.44	1-S2n	0.32	0.33	0.23	0.82	6.27	1.50
2.00	1409.16	0.63	0.63	1-S2n	0.47	0.48	0.38	1.06	4.75	1.78
3.00	1409.33	0.80	0.80	1-S2n	0.58	0.60	0.50	1.23	4.79	1.97
4.00	1409.48	0.95	0.95	1-S2n	0.67	0.69	0.59	1.38	5.10	2.11
5.00	1409.62	1.09	1.09	1-S2n	0.76	0.79	0.69	1.49	5.23	2.24
6.00	1409.74	1.21	1.21	1-S2n	0.84	0.86	0.76	1.60	5.45	2.34
7.00	1409.85	1.32	1.32	1-S2n	0.92	0.93	0.83	1.70	5.65	2.43
8.00	1409.96	1.43	1.43	1-S2n	0.99	1.01	0.91	1.78	5.78	2.52
9.00	1410.06	1.53	1.53	1-S2n	1.07	1.07	0.97	1.86	5.98	2.59
10.00	1410.38	1.62	1.85	3-M1t	1.14	1.13	1.94	1.94	3.23	2.66

El. inlet face invert 1408.53 ft El. outlet invert 1408.05 ft
El. inlet throat invert 0.00 ft El. inlet crest 0.00 ft

***** SITE DATA ***** CULVERT INVERT **********

INLET STATION	1950.50 ft
INLET ELEVATION	1408.53 ft
OUTLET STATION	2045.50 ft
OUTLET ELEVATION	1408.05 ft
NUMBER OF BARRELS	1
SLOPE (V/H)	0.0051
CULVERT LENGTH ALONG SLOPE	95.00 ft

***** CULVERT DATA SUMMARY **********

BARREL SHAPE	CIRCULAR
BARREL DIAMETER	2.00 ft
BARREL MATERIAL	CONCRETE
BARREL MANNING'S n	0.013
INLET TYPE	CONVENTIONAL
INLET EDGE AND WALL	GROOVED END IN HEADWALL
INLET DEPRESSION	NONE

CURRENT DATE: 06-22-2000
CURRENT TIME: 13:30:19

FILE DATE: 06-22-2000
FILE NAME: CB733

****
********** TAILWATER **********
****

******* REGULAR CHANNEL CROSS SECTION **********

SIDE SLOPE H/V (X:1)	1.0
CHANNEL SLOPE V/H (ft/ft)	0.006
MANNING'S n (.01-0.1)	0.035
CHANNEL INVERT ELEVATION	1408.05 ft
CULVERT NO.1 OUTLET INVERT ELEVATION	1408.05 ft

******* UNIFORM FLOW RATING CURVE FOR DOWNSTREAM CHANNEL

FLOW (cfs)	W.S.E. (ft)	FROUDE NUMBER	DEPTH (ft)	VEL. (f/s)	SHEAR (psf)
0.00	1408.05	0.000	0.00	0.00	0.00
1.00	1408.87	0.291	0.82	1.50	0.33
2.00	1409.11	0.304	1.06	1.78	0.43
3.00	1409.29	0.312	1.23	1.97	0.50
4.00	1409.43	0.318	1.38	2.11	0.56
5.00	1409.55	0.322	1.49	2.24	0.61
6.00	1409.65	0.326	1.60	2.34	0.65
7.00	1409.75	0.329	1.70	2.43	0.69
8.00	1409.83	0.332	1.78	2.52	0.72
9.00	1409.91	0.334	1.86	2.59	0.75
10.00	1409.99	0.337	1.94	2.66	0.79

****
********** ROADWAY OVERTOPPING DATA **********
****

WEIR COEFFICIENT	2.50
EMBANKMENT TOP WIDTH	38.00 ft
CREST LENGTH	100.00 ft
OVERTOPPING CREST ELEVATION	1414.94 ft

****

Culvert Sta. 745+00

CURRENT DATE: 06-22-2000 FILE DATE: 06-22-2000
CURRENT TIME: 13:34:18 FILE NAME: CB745

****
********** FHWA CULVERT ANALYSIS **********
********** HY-8, VERSION 6.1 **********
****

CULV NO.	SITE DATA: INLET ELEV. (ft)	OUTLET ELEV. (ft)	CULVERT LENGTH (ft)	CULVERT SHAPE, MATERIAL, INLET: BARRELS SHAPE MATERIAL	SPAN (ft)	RISE (ft)	MANNING n	INLET TYPE
1	1400.69	1400.26	86.00	1 RCP	2.00	2.00	.013	CONVENTIONAL
2								
3								
4								
5								
6								

****

SUMMARY OF CULVERT FLOWS (cfs) FILE: CB745 DATE: 06-22-2000

ELEV (ft)	TOTAL	1	2	3	4	5	6	ROADWAY	ITR	
1402.67	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	1	
1402.67	0.9	0.9	0.0	0.0	0.0	0.0	0.0	0.00	1	
1402.68	1.8	1.8	0.0	0.0	0.0	0.0	0.0	0.00	1	
1402.70	2.7	2.7	0.0	0.0	0.0	0.0	0.0	0.00	1	
1402.72	3.6	3.6	0.0	0.0	0.0	0.0	0.0	0.00	1	
1402.74	4.5	4.5	0.0	0.0	0.0	0.0	0.0	0.00	1	
1402.77	5.4	5.4	0.0	0.0	0.0	0.0	0.0	0.00	1	
1402.81	6.3	6.3	0.0	0.0	0.0	0.0	0.0	0.00	1	
1402.85	7.2	7.2	0.0	0.0	0.0	0.0	0.0	0.00	1	
1402.90	***8.0***	***8.0***	***0.0***	***0.0***	***0.0***	***0.0***	***0.0***	***0.00***	***1***	***Q50***
1402.84	**9.0**	**9.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.00**	**1**	**Q100**
1405.90	33.4	33.4	0.0	0.0	0.0	0.0	0.0	OVERTOPPING		

****

SUMMARY OF ITERATIVE SOLUTION ERRORS FILE: CB745 DATE: 06-22-2000

HEAD ELEV (ft)	HEAD ERROR (ft)	TOTAL FLOW (cfs)	FLOW ERROR (cfs)	% FLOW ERROR
1402.67	0.000	0.00	0.00	0.00
1402.67	0.000	0.90	0.00	0.00
1402.68	0.000	1.80	0.00	0.00
1402.70	0.000	2.70	0.00	0.00
1402.72	0.000	3.60	0.00	0.00
1402.74	0.000	4.50	0.00	0.00
1402.77	0.000	5.40	0.00	0.00
1402.81	0.000	6.30	0.00	0.00
1402.85	0.000	7.20	0.00	0.00
1402.90	0.000	8.00	0.00	0.00
1402.84	0.000	9.00	0.00	0.00

****

<1> TOLERANCE (ft) = 0.010 <2> TOLERANCE (%) = 1.000

****

CURRENT DATE: 06-22-2000 FILE DATE: 06-22-2000
CURRENT TIME: 13:34:18 FILE NAME: CB745

PERFORMANCE CURVE FOR CULVERT 1 - 1(2.00 (ft) BY 2.00 (ft)) RCP

DIS-CHARGE FLOW (cfs)	HEAD-WATER ELEV. (ft)	INLET CONTROL DEPTH (ft)	OUTLET CONTROL DEPTH (ft)	FLOW TYPE <F4>	NORMAL DEPTH (ft)	CRIT. DEPTH (ft)	OUTLET DEPTH (ft)	TW DEPTH (ft)	OUTLET VEL. (fps)	TW VEL. (fps)
0.00	1402.67	0.00	1.98	0-NF	0.00	0.00	0.00	2.41	0.00	0.00
0.90	1402.67	0.42	1.98	1-S1f	0.31	0.31	2.00	2.41	0.29	0.00
1.80	1402.68	0.60	1.99	1-S1f	0.45	0.46	2.00	2.41	0.57	0.00
2.70	1402.70	0.75	2.01	4-FFt	0.55	0.57	2.00	2.41	0.86	0.00
3.60	1402.72	0.89	2.03	4-FFt	0.64	0.66	2.00	2.41	1.15	0.00
4.50	1402.74	1.02	2.05	4-FFt	0.72	0.74	2.00	2.41	1.43	0.00
5.40	1402.77	1.14	2.08	4-FFt	0.80	0.82	2.00	2.41	1.72	0.00
6.30	1402.81	1.25	2.12	4-FFt	0.87	0.88	2.00	2.41	2.01	0.00
7.20	1402.85	1.35	2.16	4-FFt	0.94	0.95	2.00	2.41	2.29	0.00
8.00	1402.90	1.43	2.21	4-FFt	1.00	1.01	2.00	2.41	2.55	0.00
9.00	1402.84	1.53	2.15	3-M1f	1.07	1.07	2.00	2.41	2.86	0.00

El. inlet face invert 1400.69 ft El. outlet invert 1400.26 ft
El. inlet throat invert 0.00 ft El. inlet crest 0.00 ft

***** SITE DATA ***** CULVERT INVERT **********

INLET STATION	1959.50 ft
INLET ELEVATION	1400.69 ft
OUTLET STATION	2045.50 ft
OUTLET ELEVATION	1400.26 ft
NUMBER OF BARRELS	1
SLOPE (V/H)	0.0050
CULVERT LENGTH ALONG SLOPE	86.00 ft

***** CULVERT DATA SUMMARY **********

BARREL SHAPE	CIRCULAR
BARREL DIAMETER	2.00 ft
BARREL MATERIAL	CONCRETE
BARREL MANNING'S n	0.013
INLET TYPE	CONVENTIONAL
INLET EDGE AND WALL	GROOVED END IN HEADWALL
INLET DEPRESSION	NONE

CURRENT DATE: 06-22-2000
CURRENT TIME: 13:34:18

FILE DATE: 06-22-2000
FILE NAME: CB745

****
********** TAILWATER **********
****
****

CONSTANT WATER SURFACE ELEVATION
1402.67

****
********** ROADWAY OVERTOPPING DATA **********
****

WEIR COEFFICIENT	2.50
EMBANKMENT TOP WIDTH	38.00 ft
CREST LENGTH	100.00 ft
OVERTOPPING CREST ELEVATION	1405.90 ft

****

Culvert Sta. 755+00

CURRENT DATE: 06-22-2000 FILE DATE: 06-22-2000
CURRENT TIME: 13:35:30 FILE NAME: CB755

****
********** FHWA CULVERT ANALYSIS **********
********** HY-8, VERSION 6.1 **********
****

CULV NO.	SITE DATA: INLET ELEV. (ft)	OUTLET ELEV. (ft)	CULVERT LENGTH (ft)	CULVERT SHAPE, MATERIAL, INLET: BARRELS SHAPE MATERIAL	SPAN (ft)	RISE (ft)	MANNING n	INLET TYPE
1	1392.85	1392.37	96.00	1 CSP	2.00	2.00	.024	CONVENTIONAL
2								
3								
4								
5								
6								

****

SUMMARY OF CULVERT FLOWS (cfs) FILE: CB755 DATE: 06-22-2000

ELEV (ft)	TOTAL	1	2	3	4	5	6	ROADWAY	ITR	
1394.86	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	1	
1394.87	0.9	0.9	0.0	0.0	0.0	0.0	0.0	0.00	1	
1394.89	1.8	1.8	0.0	0.0	0.0	0.0	0.0	0.00	1	
1394.92	2.7	2.7	0.0	0.0	0.0	0.0	0.0	0.00	1	
1394.97	3.6	3.6	0.0	0.0	0.0	0.0	0.0	0.00	1	
1395.04	4.5	4.5	0.0	0.0	0.0	0.0	0.0	0.00	1	
1395.11	5.4	5.4	0.0	0.0	0.0	0.0	0.0	0.00	1	
1395.21	6.3	6.3	0.0	0.0	0.0	0.0	0.0	0.00	1	
1395.31	7.2	7.2	0.0	0.0	0.0	0.0	0.0	0.00	1	
1395.42	***8.0***	***8.0***	***0.0***	***0.0***	***0.0***	***0.0***	***0.0***	***0.00***	***1***	***Q50***
1395.57	**9.0**	**9.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.00**	**1**	**Q100**
1398.37	20.1	20.1	0.0	0.0	0.0	0.0	0.0	OVERTOPPING		

****

SUMMARY OF ITERATIVE SOLUTION ERRORS FILE: CB755 DATE: 06-22-2000

HEAD ELEV (ft)	HEAD ERROR (ft)	TOTAL FLOW (cfs)	FLOW ERROR (cfs)	% FLOW ERROR
1394.86	0.000	0.00	0.00	0.00
1394.87	0.000	0.90	0.00	0.00
1394.89	0.000	1.80	0.00	0.00
1394.92	0.000	2.70	0.00	0.00
1394.97	0.000	3.60	0.00	0.00
1395.04	0.000	4.50	0.00	0.00
1395.11	0.000	5.40	0.00	0.00
1395.21	0.000	6.30	0.00	0.00
1395.31	0.000	7.20	0.00	0.00
1395.42	0.000	8.00	0.00	0.00
1395.57	0.000	9.00	0.00	0.00

****

<1> TOLERANCE (ft) = 0.010 <2> TOLERANCE (%) = 1.000

****

CURRENT DATE: 06-22-2000 FILE DATE: 06-22-2000
CURRENT TIME: 13:35:30 FILE NAME: CB755

PERFORMANCE CURVE FOR CULVERT 1 - 1(2.00 (ft) BY 2.00 (ft)) CSP

DIS-CHARGE FLOW (cfs)	HEAD-WATER ELEV. (ft)	INLET CONTROL DEPTH (ft)	OUTLET CONTROL DEPTH (ft)	FLOW TYPE <F4>	NORMAL DEPTH (ft)	CRIT. DEPTH (ft)	OUTLET DEPTH (ft)	TW DEPTH (ft)	OUTLET VEL. (fps)	TW VEL. (fps)
0.00	1394.86	0.00	2.01	0-NF	0.00	0.00	0.00	2.49	0.00	0.00
0.90	1394.87	0.49	2.02	4-FFt	0.43	0.31	2.00	2.49	0.29	0.00
1.80	1394.89	0.64	2.04	4-FFt	0.62	0.46	2.00	2.49	0.57	0.00
2.70	1394.92	0.78	2.07	4-FFt	0.76	0.57	2.00	2.49	0.86	0.00
3.60	1394.97	0.91	2.12	4-FFt	0.90	0.66	2.00	2.49	1.15	0.00
4.50	1395.04	1.03	2.19	4-FFt	1.02	0.74	2.00	2.49	1.43	0.00
5.40	1395.11	1.15	2.26	4-FFt	1.14	0.82	2.00	2.49	1.72	0.00
6.30	1395.21	1.26	2.36	4-FFt	1.27	0.88	2.00	2.49	2.01	0.00
7.20	1395.31	1.36	2.46	4-FFt	1.39	0.95	2.00	2.49	2.29	0.00
8.00	1395.42	1.45	2.57	4-FFt	1.52	1.01	2.00	2.49	2.55	0.00
9.00	1395.57	1.56	2.72	4-FFt	1.73	1.07	2.00	2.49	2.86	0.00

El. inlet face invert 1392.85 ft El. outlet invert 1392.37 ft
El. inlet throat invert 0.00 ft El. inlet crest 0.00 ft

***** SITE DATA ***** CULVERT INVERT **********

INLET STATION	1949.50 ft
INLET ELEVATION	1392.85 ft
OUTLET STATION	2045.50 ft
OUTLET ELEVATION	1392.37 ft
NUMBER OF BARRELS	1
SLOPE (V/H)	0.0050
CULVERT LENGTH ALONG SLOPE	96.00 ft

***** CULVERT DATA SUMMARY **********

BARREL SHAPE	CIRCULAR
BARREL DIAMETER	2.00 ft
BARREL MATERIAL	CORRUGATED STEEL
BARREL MANNING'S n	0.024
INLET TYPE	CONVENTIONAL
INLET EDGE AND WALL	SQUARE EDGE WITH HEADWALL
INLET DEPRESSION	NONE

CURRENT DATE: 06-22-2000
CURRENT TIME: 13:35:30

FILE DATE: 06-22-2000
FILE NAME: CB755

****
********** TAILWATER **********
****
****

CONSTANT WATER SURFACE ELEVATION
1394.86

****
********** ROADWAY OVERTOPPING DATA **********
****

WEIR COEFFICIENT	2.50
EMBANKMENT TOP WIDTH	38.00 ft
CREST LENGTH	100.00 ft
OVERTOPPING CREST ELEVATION	1398.37 ft

****

Culvert Sta. 770+00

CURRENT DATE: 06-22-2000
CURRENT TIME: 13:36:38

FILE DATE: 06-22-2000
FILE NAME: CB770

****
********** FHWA CULVERT ANALYSIS **********
********** HY-8, VERSION 6.1 **********
****

CULV NO.	SITE DATA: INLET ELEV. (ft)	OUTLET ELEV. (ft)	CULVERT LENGTH (ft)	CULVERT SHAPE, MATERIAL, INLET: BARRELS SHAPE MATERIAL	SPAN (ft)	RISE (ft)	MANNING n	INLET TYPE
1	1381.85	1381.20	88.00	1 CSP	2.00	2.00	.024	CONVENTIONAL
2								
3								
4								
5								
6								

****

SUMMARY OF CULVERT FLOWS (cfs) FILE: CB770 DATE: 06-22-2000

ELEV (ft)	TOTAL	1	2	3	4	5	6	ROADWAY	ITR	
1384.35	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	1	
1384.36	1.2	1.2	0.0	0.0	0.0	0.0	0.0	0.00	1	
1384.40	2.4	2.4	0.0	0.0	0.0	0.0	0.0	0.00	1	
1384.45	3.6	3.6	0.0	0.0	0.0	0.0	0.0	0.00	1	
1384.54	4.8	4.8	0.0	0.0	0.0	0.0	0.0	0.00	1	
1384.64	6.0	6.0	0.0	0.0	0.0	0.0	0.0	0.00	1	
1384.77	7.2	7.2	0.0	0.0	0.0	0.0	0.0	0.00	1	
1384.93	8.4	8.4	0.0	0.0	0.0	0.0	0.0	0.00	1	
1385.10	9.6	9.6	0.0	0.0	0.0	0.0	0.0	0.00	1	
1385.30	10.8	10.8	0.0	0.0	0.0	0.0	0.0	0.00	1	
1385.34	***11.0***	***11.0***	***0.0***	***0.0***	***0.0***	***0.0***	***0.0***	***0.00***	***1***	***Q50***
1387.08	18.3	18.3	0.0	0.0	0.0	0.0	0.0	OVERTOPPING		

****

1385.53 12.0 Q100

****

SUMMARY OF ITERATIVE SOLUTION ERRORS FILE: CB770 DATE: 06-22-2000

HEAD ELEV (ft)	HEAD ERROR (ft)	TOTAL FLOW (cfs)	FLOW ERROR (cfs)	% FLOW ERROR
1384.35	0.000	0.00	0.00	0.00
1384.36	0.000	1.20	0.00	0.00
1384.40	0.000	2.40	0.00	0.00
1384.45	0.000	3.60	0.00	0.00
1384.54	0.000	4.80	0.00	0.00
1384.64	0.000	6.00	0.00	0.00
1384.77	0.000	7.20	0.00	0.00
1384.93	0.000	8.40	0.00	0.00
1385.10	0.000	9.60	0.00	0.00
1385.30	0.000	10.80	0.00	0.00
1385.34	0.000	11.00	0.00	0.00

****

<1> TOLERANCE (ft) = 0.010 <2> TOLERANCE (%) = 1.000

****

CURRENT DATE: 06-22-2000 FILE DATE: 06-22-2000
CURRENT TIME: 13:36:38 FILE NAME: CB770

PERFORMANCE CURVE FOR CULVERT 1 - 1(2.00 (ft) BY 2.00 (ft)) CSP

DIS-CHARGE FLOW (cfs)	HEAD-WATER ELEV. (ft)	INLET CONTROL DEPTH (ft)	OUTLET CONTROL DEPTH (ft)	FLOW TYPE <F4>	NORMAL DEPTH (ft)	CRIT. DEPTH (ft)	OUTLET DEPTH (ft)	TW DEPTH (ft)	OUTLET VEL. (fps)	TW VEL. (fps)
0.00	1384.35	0.00	2.50	0-NF	0.00	0.00	0.00	3.15	0.00	0.00
1.20	1384.36	0.54	2.51	4-FFt	0.45	0.37	2.00	3.15	0.38	0.00
2.40	1384.40	0.74	2.55	4-FFt	0.64	0.53	2.00	3.15	0.76	0.00
3.60	1384.45	0.91	2.60	4-FFt	0.80	0.66	2.00	3.15	1.15	0.00
4.80	1384.54	1.07	2.69	4-FFt	0.94	0.77	2.00	3.15	1.53	0.00
6.00	1384.64	1.22	2.79	4-FFt	1.08	0.86	2.00	3.15	1.91	0.00
7.20	1384.77	1.36	2.92	4-FFt	1.21	0.95	2.00	3.15	2.29	0.00
8.40	1384.93	1.49	3.08	4-FFt	1.35	1.03	2.00	3.15	2.67	0.00
9.60	1385.10	1.62	3.25	4-FFt	1.50	1.10	2.00	3.15	3.06	0.00
10.80	1385.30	1.75	3.45	4-FFt	1.70	1.18	2.00	3.15	3.44	0.00
11.00	1385.34	1.78	3.49	4-FFt	1.74	1.19	2.00	3.15	3.50	0.00

El. inlet face invert 1381.85 ft El. outlet invert 1381.20 ft
El. inlet throat invert 0.00 ft El. inlet crest 0.00 ft

***** SITE DATA ***** CULVERT INVERT **********

INLET STATION	1957.50 ft
INLET ELEVATION	1381.85 ft
OUTLET STATION	2045.50 ft
OUTLET ELEVATION	1381.20 ft
NUMBER OF BARRELS	1
SLOPE (V/H)	0.0074
CULVERT LENGTH ALONG SLOPE	88.00 ft

***** CULVERT DATA SUMMARY **********

BARREL SHAPE	CIRCULAR
BARREL DIAMETER	2.00 ft
BARREL MATERIAL	CORRUGATED STEEL
BARREL MANNING'S n	0.024
INLET TYPE	CONVENTIONAL
INLET EDGE AND WALL	SQUARE EDGE WITH HEADWALL
INLET DEPRESSION	NONE

CURRENT DATE: 06-22-2000
CURRENT TIME: 13:36:38

FILE DATE: 06-22-2000
FILE NAME: CB770

****
********** TAILWATER **********
****
****

CONSTANT WATER SURFACE ELEVATION
1384.35

****
********** ROADWAY OVERTOPPING DATA **********
****

WEIR COEFFICIENT	2.50
EMBANKMENT TOP WIDTH	38.00 ft
CREST LENGTH	100.00 ft
OVERTOPPING CREST ELEVATION	1387.08 ft

****

Culvert Sta. 781+35

CURRENT DATE: 06-22-2000 FILE DATE: 06-22-2000
CURRENT TIME: 13:38:15 FILE NAME: CB781

****
********** FHWA CULVERT ANALYSIS **********
********** HY-8, VERSION 6.1 **********
****

CULV NO.	SITE DATA: INLET ELEV. (ft)	OUTLET ELEV. (ft)	CULVERT LENGTH (ft)	CULVERT SHAPE, MATERIAL, INLET: BARRELS SHAPE MATERIAL	SPAN (ft)	RISE (ft)	MANNING n	INLET TYPE
1	1376.89	1375.33	21.06	1 CMPA	2.33	1.67	.025	CONVENTIONAL
2								
3								
4								
5								
6								

****

SUMMARY OF CULVERT FLOWS (cfs) FILE: CB781 DATE: 06-22-2000

ELEV (ft)	TOTAL	1	2	3	4	5	6	ROADWAY	ITR	
1377.04	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	1	
1377.22	0.9	0.9	0.0	0.0	0.0	0.0	0.0	0.00	1	
1377.38	1.8	1.8	0.0	0.0	0.0	0.0	0.0	0.00	1	
1377.51	2.7	2.7	0.0	0.0	0.0	0.0	0.0	0.00	1	
1377.62	3.6	3.6	0.0	0.0	0.0	0.0	0.0	0.00	1	
1377.72	4.5	4.5	0.0	0.0	0.0	0.0	0.0	0.00	1	
1377.83	5.4	5.4	0.0	0.0	0.0	0.0	0.0	0.00	1	
1377.93	6.3	6.3	0.0	0.0	0.0	0.0	0.0	0.00	1	
1378.03	7.2	7.2	0.0	0.0	0.0	0.0	0.0	0.00	1	
1378.11	***8.0***	***8.0***	***0.0***	***0.0***	***0.0***	***0.0***	***0.0***	***0.00***	***1***	***Q50***
1378.21	**9.0**	**9.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.00**	**1**	**Q100**
1380.21	23.5	23.5	0.0	0.0	0.0	0.0	0.0	OVERTOPPING		

****

SUMMARY OF ITERATIVE SOLUTION ERRORS FILE: CB781 DATE: 06-22-2000

HEAD ELEV (ft)	HEAD ERROR (ft)	TOTAL FLOW (cfs)	FLOW ERROR (cfs)	% FLOW ERROR
1377.04	0.000	0.00	0.00	0.00
1377.22	0.000	0.90	0.00	0.00
1377.38	0.000	1.80	0.00	0.00
1377.51	0.000	2.70	0.00	0.00
1377.62	0.000	3.60	0.00	0.00
1377.72	0.000	4.50	0.00	0.00
1377.83	0.000	5.40	0.00	0.00
1377.93	0.000	6.30	0.00	0.00
1378.03	0.000	7.20	0.00	0.00
1378.11	0.000	8.00	0.00	0.00
1378.21	0.000	9.00	0.00	0.00

****

<1> TOLERANCE (ft) = 0.010 <2> TOLERANCE (%) = 1.000

****

CURRENT DATE: 06-22-2000 FILE DATE: 06-22-2000
CURRENT TIME: 13:38:15 FILE NAME: CB781

PERFORMANCE CURVE FOR CULVERT 1 - 1(2.33 (ft) BY 1.67 (ft)) CMPA

DIS-CHARGE FLOW (cfs)	HEAD-WATER ELEV. (ft)	INLET CONTROL DEPTH (ft)	OUTLET CONTROL DEPTH (ft)	FLOW TYPE <F4>	NORMAL DEPTH (ft)	CRIT. DEPTH (ft)	OUTLET DEPTH (ft)	TW DEPTH (ft)	OUTLET VEL. (fps)	TW VEL. (fps)
0.00	1377.04	0.00	0.15	0-NF	0.00	0.00	0.00	1.71	0.00	0.00
0.90	1377.22	0.33	0.33	1-S1f	0.17	0.23	0.37	1.71	1.37	0.00
1.80	1377.38	0.49	0.49	1-S1f	0.22	0.34	0.47	1.71	2.02	0.00
2.70	1377.50	0.61	0.61	1-S1f	0.27	0.42	0.57	1.71	2.41	0.00
3.60	1377.62	0.73	0.73	1-S1f	0.33	0.50	0.67	1.71	2.66	0.00
4.50	1377.72	0.83	0.83	1-S1f	0.37	0.57	0.77	1.71	2.84	0.00
5.40	1377.83	0.94	0.94	1-S1f	0.40	0.63	0.77	1.71	3.41	0.00
6.30	1377.93	1.04	1.04	1-S1f	0.44	0.69	0.87	1.71	3.48	0.00
7.20	1378.02	1.13	1.13	1-S1f	0.48	0.75	0.87	1.71	3.98	0.00
8.00	1378.11	1.22	1.22	1-S1f	0.51	0.79	0.97	1.71	3.95	0.00
9.00	1378.21	1.32	1.32	1-S1f	0.54	0.85	0.97	1.71	4.45	0.00

El. inlet face invert 1376.89 ft El. outlet invert 1375.33 ft
El. inlet throat invert 0.00 ft El. inlet crest 0.00 ft

***** SITE DATA ***** CULVERT INVERT **********

INLET STATION	1979.00 ft
INLET ELEVATION	1376.89 ft
OUTLET STATION	2000.00 ft
OUTLET ELEVATION	1375.33 ft
NUMBER OF BARRELS	1
SLOPE (V/H)	0.0743
CULVERT LENGTH ALONG SLOPE	21.06 ft

***** CULVERT DATA SUMMARY **********

BARREL SHAPE	PIPE ARCH
BARREL SPAN	2.33 ft
BARREL RISE	1.67 ft
BARREL MATERIAL	STEEL OR ALUMINUM
BARREL MANNING'S n	0.025
INLET TYPE	CONVENTIONAL
INLET EDGE AND WALL	HEADWALL
INLET DEPRESSION	NONE

CURRENT DATE: 06-22-2000
CURRENT TIME: 13:38:15

FILE DATE: 06-22-2000
FILE NAME: CB781

****
********** TAILWATER **********
****
****

CONSTANT WATER SURFACE ELEVATION
1377.04

****
********** ROADWAY OVERTOPPING DATA **********
****

WEIR COEFFICIENT	2.50
EMBANKMENT TOP WIDTH	20.00 ft
CREST LENGTH	100.00 ft
OVERTOPPING CREST ELEVATION	1380.21 ft

****

Appendix I

HydroCalc
Culvert Design
Mainline Pipe Culverts

Dibble & Associates
March 2001

Project 2 Drainage Report
US60/ 20th Ave (West) / Deer Valley Rd

$Q_{50} = \frac{9}{2} = 4.5 \pm cfs$

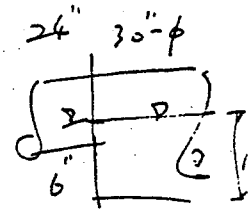
$Q_{100} = \frac{10}{2} \pm = 5 \pm cfs$

PIPE CULVERT ANALYSIS
COMPUTATION OF CULVERT PERFORMANCE CURVE

January 10, 2001

PROGRAM INPUT DATA

DESCRIPTION	VALUE
Culvert Diameter (ft)	2.0
FHWA Chart Number	2
FHWA Scale Number (Type of Culvert Entrance)	1
Manning's Roughness Coefficient (n-value)	0.024
Entrance Loss Coefficient of Culvert Opening	0.5
Culvert Length (ft)	100.0
Invert Elevation at Downstream end of Culvert (ft)	90.0
Invert Elevation at Upstream end of Culvert (ft)	90.5
Culvert Slope (ft/ft)	0.005
Starting Flow Rate (cfs)	1.0
Incremental Flow Rate (cfs)	0.5
Ending Flow Rate (cfs)	11.0
Starting Tailwater Depth (ft)	0.0
Incremental Tailwater Depth (ft)	0.18
Ending Tailwater Depth (ft)	3.6



1.86
- .5
TW = 1.36' ±

COMPUTATION RESULTS

Flow Rate (cfs)	Tailwater Depth (ft)	Headwater (ft) Inlet Control	Headwater (ft) Outlet Control	Normal Depth (ft)	Critical Depth (ft)	Depth at Outlet (ft)	Outlet Velocity (fps)
1.0	0.0	0.46	0.54	0.46	0.34	0.34	2.77
1.5	0.18	0.57	0.66	0.56	0.42	0.42	3.09
2.0	0.36	0.66	0.77	0.65	0.49	0.49	3.34
2.5	0.54	0.75	0.87	0.74	0.55	0.55	3.56
3.0	0.72	0.82	0.96	0.81	0.6	0.72	2.95
3.5	0.9	0.9	1.04	0.88	0.65	0.9	2.55
4.0	1.08	0.97	1.13 HW50	0.96	0.7	1.08	2.31
4.5	1.26	1.03	1.23	1.02	0.75	1.26	2.16
5.0	1.44	1.1	1.35	1.09	0.79	1.44	2.06
5.5	1.62	1.16	1.49	1.16	0.83	1.62	2.02
6.0	1.8	1.22	1.65 HW100	1.22	0.87	1.8	2.01
6.5	1.98	1.28	1.84	1.29	0.9	1.98	2.07
7.0	2.16	1.34	2.1	1.36	0.94	2.0	2.23
7.5	2.34	1.39	2.35	1.44	0.97	2.0	2.39
8.0	2.52	1.45	2.6	1.52	1.01	2.0	2.55
8.5	2.7	1.5	2.85	1.61	1.04	2.0	2.71
9.0	2.88	1.56	3.11	1.72	1.07	2.0	2.86
9.5	3.06	1.61	3.37	2.0	1.1	2.0	3.02
10.0	3.24	1.67	3.64	2.0	1.13	2.0	3.18
10.5	3.42	1.72	3.91	2.0	1.16	2.0	3.34
11.0	3.6	1.78	4.19	2.0	1.19	2.0	3.5

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STA 496+76 2 x 30" ϕ (2/2) $Q_{50} = \frac{22}{2} = 11$ cfs

$Q_{100} = \frac{24}{2} = 12$ cfs

PIPE CULVERT ANALYSIS
COMPUTATION OF CULVERT PERFORMANCE CURVE

January 10, 2001

PROGRAM INPUT DATA

DESCRIPTION	VALUE
Culvert Diameter (ft)	2.5
FHWA Chart Number	2
FHWA Scale Number (Type of Culvert Entrance)	1
Manning's Roughness Coefficient (n-value)	0.024
Entrance Loss Coefficient of Culvert Opening	0.5
Culvert Length (ft)	94.0
Invert Elevation at Downstream end of Culvert (ft)	87.25
Invert Elevation at Upstream end of Culvert (ft)	87.71
Culvert Slope (ft/ft)	0.0049
Starting Flow Rate (cfs)	5.0
Incremental Flow Rate (cfs)	0.5
Ending Flow Rate (cfs)	15.0
Starting Tailwater Depth (ft)	0.0
Incremental Tailwater Depth (ft)	0.01
Ending Tailwater Depth (ft)	0.2

COMPUTATION RESULTS

Flow Rate (cfs)	Tailwater Depth (ft)	Headwater (ft) Inlet Control	Headwater (ft) Outlet Control	Normal Depth (ft)	Critical Depth (ft)	Depth at Outlet (ft)	Outlet Velocity (fps)
5.0	0.0	1.0	1.16	0.97	0.74	0.74	4.13
5.5	0.01	1.06	1.22	1.03	0.77	0.77	4.25
6.0	0.02	1.11	1.28	1.08	0.81	0.81	4.35
6.5	0.03	1.16	1.33	1.13	0.84	0.84	4.46
7.0	0.04	1.21	1.39	1.18	0.88	0.88	4.55
7.5	0.05	1.26	1.44	1.22	0.91	0.91	4.65
8.0	0.06	1.3	1.5	1.27	0.94	0.94	4.74
8.5	0.07	1.35	1.55	1.32	0.97	0.97	4.82
9.0	0.08	1.39	1.6	1.37	1.0	1.0	4.91
9.5	0.09	1.44	1.65	1.41	1.03	1.03	4.99
10.0	0.1	1.48	1.7	1.46	1.06	1.06	5.07
10.5	0.11	1.53	1.75	1.51	1.08	1.08	5.15
11.0	0.12	1.57	1.8	1.55	1.11	1.11	5.22
11.5	0.13	1.61	1.85	1.6	1.14	1.14	5.3
12.0	0.14	1.65	1.89	1.65	1.16	1.16	5.37
12.5	0.15	1.69	1.94	1.7	1.19	1.19	5.44
13.0	0.16	1.73	1.99	1.75	1.21	1.21	5.51
13.5	0.17	1.77	2.04	1.8	1.24	1.24	5.58
14.0	0.18	1.81	2.08	1.86	1.26	1.26	5.65
14.5	0.19	1.85	2.13	1.91	1.28	1.28	5.72
15.0	0.2	1.89	2.18	1.97	1.31	1.31	5.78

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STA 01-20-4 $Q_{50} = \frac{27}{2} = 13.5$ cfs

ST 516+54 $Q_{100} = \frac{29}{2} = 14.5$ cfs

PIPE CULVERT ANALYSIS
COMPUTATION OF CULVERT PERFORMANCE CURVE

January 10, 2001

PROGRAM INPUT DATA

DESCRIPTION	VALUE
Culvert Diameter (ft)	2.5
FHWA Chart Number	2
FHWA Scale Number (Type of Culvert Entrance)	1
Manning's Roughness Coefficient (n-value)	0.024
Entrance Loss Coefficient of Culvert Opening	0.5
Culvert Length (ft)	210.0
Invert Elevation at Downstream end of Culvert (ft)	71.7
Invert Elevation at Upstream end of Culvert (ft)	72.5
Culvert Slope (ft/ft)	0.0038
Starting Flow Rate (cfs)	10.0
Incremental Flow Rate (cfs)	0.5
Ending Flow Rate (cfs)	20.0
Starting Tailwater Depth (ft)	0.0
Incremental Tailwater Depth (ft)	0.1
Ending Tailwater Depth (ft)	2.0

COMPUTATION RESULTS

Flow Rate (cfs)	Tailwater Depth (ft)	Headwater (ft) Inlet Control	Headwater (ft) Outlet Control	Normal Depth (ft)	Critical Depth (ft)	Depth at Outlet (ft)	Outlet Velocity (fps)
10.0	0.0	1.48	1.78	1.58	1.06	1.06	5.07
10.5	0.1	1.53	1.84	1.64	1.08	1.08	5.15
11.0	0.2	1.57	1.89	1.7	1.11	1.11	5.22
11.5	0.3	1.61	1.94	1.75	1.14	1.14	5.3
12.0	0.4	1.65	2.0	1.81	1.16	1.16	5.37
12.5	0.5	1.69	2.05	1.87	1.19	1.19	5.44
13.0	0.6	1.73	2.11 HW50	1.94	1.21	1.21	5.51
13.5	0.7	1.77	2.16	2.01	1.24	1.24	5.58
14.0	0.8	1.81	2.22	2.1	1.26	1.26	5.65
14.5	0.9	1.85	2.27	2.21	1.28	1.28	5.72
15.0	1.0	1.89	2.33	2.5	1.31	1.31	5.78
15.5	1.1	1.93	2.39	2.5	1.33	1.33	5.85
16.0	1.2	1.97	2.45 HW100	2.5	1.35	1.35	5.91
16.5	1.3	2.01	2.51	2.5	1.37	1.37	5.98
17.0	1.4	2.05	2.58	2.5	1.39	1.4	6.01
17.5	1.5	2.09	2.65	2.5	1.42	1.5	5.69
18.0	1.6	2.13	2.73	2.5	1.44	1.6	5.43
18.5	1.7	2.17	2.62	2.5	1.46	1.7	5.2
19.0	1.8	2.2	2.74	2.5	1.48	1.8	5.02
19.5	1.9	2.24	2.88	2.5	1.5	1.9	4.87
20.0	2.0	2.28	3.04	2.5	1.52	2.0	4.75

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STA 549+15 LX 24-4 450 = 0.45 Q100 = 9 cfs

PIPE CULVERT ANALYSIS
COMPUTATION OF CULVERT PERFORMANCE CURVE

January 10, 2001

PROGRAM INPUT DATA

DESCRIPTION	VALUE
Culvert Diameter (ft)	2.0
FHWA Chart Number	2
FHWA Scale Number (Type of Culvert Entrance)	1
Manning's Roughness Coefficient (n-value)	0.024
Entrance Loss Coefficient of Culvert Opening	0.5
Culvert Length (ft)	98.0
Invert Elevation at Downstream end of Culvert (ft)	39.5
Invert Elevation at Upstream end of Culvert (ft)	39.6
Culvert Slope (ft/ft)	0.001
Starting Flow Rate (cfs)	5.0
Incremental Flow Rate (cfs)	1.0
Ending Flow Rate (cfs)	15.0
Starting Tailwater Depth (ft)	0.0
Incremental Tailwater Depth (ft)	0.2
Ending Tailwater Depth (ft)	2.0

COMPUTATION RESULTS

Flow Rate (cfs)	Tailwater Depth (ft)	Headwater (ft) Inlet Control	Headwater (ft) Outlet Control	Normal Depth (ft)	Critical Depth (ft)	Depth at Outlet (ft)	Outlet Velocity (fps)
5.0	0.0	1.1	1.45	2.0	0.79	0.79	4.35
6.0	0.2	1.22	1.6	2.0	0.87	0.87	4.6
7.0	0.4	1.34	1.75	2.0	0.94	0.94	4.83
8.0	0.6	1.45	1.91	2.0	1.01	1.01	5.05
9.0	0.8	1.56	2.07	2.0	1.07	1.07	5.26
10.0	1.0	1.67	2.09	2.0	1.13	1.13	5.45
11.0	1.2	1.78	2.29	2.0	1.19	1.2	5.59
12.0	1.4	1.89	2.53	2.0	1.24	1.4	5.11
13.0	1.6	1.99	2.81	2.0	1.3	1.6	4.83
14.0	1.8	2.1	3.15	2.0	1.35	1.8	4.7
15.0	2.0	2.21	3.9	2.0	1.4	2.0	4.77

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556+75

2x48-φ

$Q_{50} = \frac{88}{2} = 44$ cfs

$Q_{100} = \frac{98}{2} = 49$ cfs

PIPE CULVERT ANALYSIS
COMPUTATION OF CULVERT PERFORMANCE CURVE

January 10, 2001

PROGRAM INPUT DATA

DESCRIPTION	VALUE
Culvert Diameter (ft)	4.0
FHWA Chart Number	2
FHWA Scale Number (Type of Culvert Entrance)	1
Manning's Roughness Coefficient (n-value)	0.024
Entrance Loss Coefficient of Culvert Opening	0.5
Culvert Length (ft)	205.0
Invert Elevation at Downstream end of Culvert (ft)	30.5
Invert Elevation at Upstream end of Culvert (ft)	32.26
Culvert Slope (ft/ft)	0.0086
Starting Flow Rate (cfs)	40.0
Incremental Flow Rate (cfs)	2.0
Ending Flow Rate (cfs)	60.0
Starting Tailwater Depth (ft)	1.4
Incremental Tailwater Depth (ft)	0.1
Ending Tailwater Depth (ft)	2.4

COMPUTATION RESULTS

Flow Rate (cfs)	Tailwater Depth (ft)	Headwater (ft) Inlet Control	Headwater (ft) Outlet Control	Normal Depth (ft)	Critical Depth (ft)	Depth at Outlet (ft)	Outlet Velocity (fps)
40.0	1.4	2.68	2.94	2.13	1.89	1.89	6.86
42.0	1.5	2.76	3.02	2.19	1.94	1.94	6.97
44.0	1.6	2.84	3.1	2.26	1.98	1.98	7.07
46.0	1.7	2.92	3.18	2.32	2.03	2.03	7.18
48.0	1.8	3.0	3.26	2.39	2.08	2.08	7.28
50.0	1.9	3.08	3.35	2.45	2.12	2.12	7.39
52.0	2.0	3.15	3.43	2.52	2.17	2.17	7.49
54.0	2.1	3.23	3.51	2.58	2.21	2.21	7.59
56.0	2.2	3.31	3.59	2.65	2.25	2.25	7.69
58.0	2.3	3.38	3.67	2.72	2.29	2.3	7.76
60.0	2.4	3.46	3.75	2.79	2.33	2.4	7.62

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STA 563+87 1* 42-9 Q_{50} = 54 cfs

Q_{100} = 59 cfs

PIPE CULVERT ANALYSIS
COMPUTATION OF CULVERT PERFORMANCE CURVE

January 11, 2001

PROGRAM INPUT DATA

DESCRIPTION	VALUE
Culvert Diameter (ft)	3.5
FHWA Chart Number	2
FHWA Scale Number (Type of Culvert Entrance)	1
Manning's Roughness Coefficient (n-value)	0.024
Entrance Loss Coefficient of Culvert Opening	0.5
Culvert Length (ft)	196.0
Invert Elevation at Downstream end of Culvert (ft)	26.5
Invert Elevation at Upstream end of Culvert (ft)	29.0
Culvert Slope (ft/ft)	0.0128
Starting Flow Rate (cfs)	45.0
Incremental Flow Rate (cfs)	1.0
Ending Flow Rate (cfs)	60.0
Starting Tailwater Depth (ft)	0.7
Incremental Tailwater Depth (ft)	0.0
Ending Tailwater Depth (ft)	0.7

COMPUTATION RESULTS

Flow Rate (cfs)	Tailwater Depth (ft)	Headwater (ft) Inlet Control	Headwater (ft) Outlet Control	Normal Depth (ft)	Critical Depth (ft)	Depth at Outlet (ft)	Outlet Velocity (fps)
45.0	0.7	3.11	3.36	2.22	2.09	2.09	7.5
46.0	0.7	3.16	3.4	2.26	2.12	2.12	7.56
47.0	0.7	3.21	3.45	2.29	2.14	2.14	7.62
48.0	0.7	3.25	3.49	2.33	2.16	2.16	7.69
49.0	0.7	3.3	3.53	2.36	2.19	2.19	7.75
50.0	0.7	3.35	3.58	2.4	2.21	2.21	7.81
51.0	0.7	3.39	3.62	2.43	2.23	2.23	7.87
52.0	0.7	3.44	3.67	2.47	2.26	2.26	7.93
53.0	0.7	3.49	3.71 Hw50	2.5	2.28	2.28	7.99
54.0	0.7	3.53	3.76	2.54	2.3	2.3	8.06
55.0	0.7	3.58	3.8	2.58	2.32	2.32	8.12
56.0	0.7	3.62	3.84	2.62	2.34	2.34	8.18
57.0	0.7	3.67	3.89	2.66	2.36	2.36	8.24
58.0	0.7	3.72	3.94 Hw100	2.7	2.39	2.39	8.3
59.0	0.7	3.76	3.98	2.75	2.41	2.41	8.36
60.0	0.7	3.81	4.03	2.79	2.43	2.43	8.43

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STA 662+37

$Q_{50} = \frac{150}{3} = 45$ cfs

$Q_{100} = \frac{150}{3} = 50$ cfs

PIPE CULVERT ANALYSIS
COMPUTATION OF CULVERT PERFORMANCE CURVE

January 10, 2001

PROGRAM INPUT DATA

DESCRIPTION	VALUE
Culvert Diameter (ft)	3.0
FHWA Chart Number	2
FHWA Scale Number (Type of Culvert Entrance)	1
Manning's Roughness Coefficient (n-value)	0.024
Entrance Loss Coefficient of Culvert Opening	0.5
Culvert Length (ft)	82.0
Invert Elevation at Downstream end of Culvert (ft)	55.0
Invert Elevation at Upstream end of Culvert (ft)	56.26
Culvert Slope (ft/ft)	0.0154
Starting Flow Rate (cfs)	40.0
Incremental Flow Rate (cfs)	1.0
Ending Flow Rate (cfs)	50.0
Starting Tailwater Depth (ft)	0.0
Incremental Tailwater Depth (ft)	0.1
Ending Tailwater Depth (ft)	1.0

COMPUTATION RESULTS

Flow Rate (cfs)	Tailwater Depth (ft)	Headwater (ft) Inlet Control	Headwater (ft) Outlet Control	Normal Depth (ft)	Critical Depth (ft)	Depth at Outlet (ft)	Outlet Velocity (fps)
40.0	0.0	3.22	3.41	2.21	2.06	2.06	7.73
41.0	0.1	3.27	3.46	2.26	2.09	2.09	7.82
42.0	0.2	3.33	3.52	2.31	2.11	2.11	7.9
43.0	0.3	3.4	3.57	2.36	2.14	2.14	7.99
44.0	0.4	3.52	3.63	2.41	2.16	2.16	8.07
45.0	0.5	3.62	3.69	2.47	2.19	2.19	8.16
46.0	0.6	3.7	3.75	2.54	2.21	2.21	8.24
47.0	0.7	3.77	3.81	2.62	2.23	2.23	8.33
48.0	0.8	3.83	3.88	2.74	2.26	2.26	8.42
49.0	0.9	3.87	3.95	3.0	2.28	2.28	8.5
50.0	1.0	3.94	4.03	3.0	2.3	2.3	8.59

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SCH 685+42 1x36-p Q_{50} = 21 cfs Q_{100} = 23 cfs

PIPE CULVERT ANALYSIS
COMPUTATION OF CULVERT PERFORMANCE CURVE

January 10, 2001

PROGRAM INPUT DATA

DESCRIPTION	VALUE
Culvert Diameter (ft)	3.0
FHWA Chart Number	2
FHWA Scale Number (Type of Culvert Entrance)	1
Manning's Roughness Coefficient (n-value)	0.024
Entrance Loss Coefficient of Culvert Opening	0.5
Culvert Length (ft)	108.0
Invert Elevation at Downstream end of Culvert (ft)	43.0
Invert Elevation at Upstream end of Culvert (ft)	43.3
Culvert Slope (ft/ft)	0.0028
Starting Flow Rate (cfs)	20.0
Incremental Flow Rate (cfs)	1.0
Ending Flow Rate (cfs)	25.0
Starting Tailwater Depth (ft)	1.6
Incremental Tailwater Depth (ft)	0.1
Ending Tailwater Depth (ft)	2.1

COMPUTATION RESULTS

Flow Rate (cfs)	Tailwater Depth (ft)	Headwater (ft) Inlet Control	Headwater (ft) Outlet Control	Normal Depth (ft)	Critical Depth (ft)	Depth at Outlet (ft)	Outlet Velocity (fps)
20.0	1.6	2.05	2.44	2.62	1.44	1.6	5.22
21.0	1.7	2.11	2.52	3.0	1.47	1.7	5.08
22.0	1.8	2.17	2.6	3.0	1.51	1.8	4.97
23.0	1.9	2.23	2.68	3.0	1.54	1.9	4.87
24.0	2.0	2.29	2.77	3.0	1.58	2.0	4.79
25.0	2.1	2.35	2.86	3.0	1.61	2.1	4.73

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3977 US 60 Headwater at 50 year and 100 year flood

Station	Proposed CMP		Pipe Inv.	Q-50	HW-50		Q-100	HW-100	
	No. of barrel	size (in)	ft (upstream)	cfs	ft	ft (Ele.)	cfs	ft	ft (Ele.)
496+76	2	24	1590.22	22	1.23	1591.45	24	1.35	1591.57
	2	30							
516+54	2	30	1572.43	27	2.16	1574.59	29	2.27	1574.70
549+15	1	24	1539.76	8	1.91	1541.67	9	2.07	1541.83
556+75	2	48	1532.26	89	3.1	1535.36	98	3.35	1535.61
563+87	1	42	**1529.00**	54	3.98	1532.98	59	3.76	1532.76
662+37	3	36	1457.23	136	3.69	1460.92	150	4.03	1461.26
685+42	1	36	1443.24	21	2.52	1445.76	23	2.68	1445.92

Title: Sizing of rip-raps

Calc: Tilghman/KFL Chk: KFL
Date: 11/29/99 Date: 11/29/99

Ref:1 ADOT Road Design Guideline, p. 600-29 to find the D50

D50 = (10*(C*D*SN)^1.5*V^3) / ((K*(GS-1))^1.5*R^0.5)

Where
- C — ratio of max. to average boundary shear, max. value is 2
- D — ratio of max. to average boundary shear in a bend, = 1 when r/w > 7.0
- SN — stability number, = 1.25 for culvert outlets
- V — average channel velocity, m/s
- Gs — specific gravity of rock, = 2.4
- R — hydraulic radius of channel, m

V(p)/V =	
< 1.5	no channel protection
1.5-2.0	dumped rip rap, V(p) < 10 f/s
1.5-2.5	wire rip rap, when V(p) = 10 - 15 f/s
>2.5	energy dissipater

Ref: 2 Pima county equation, to find the length of rip rap

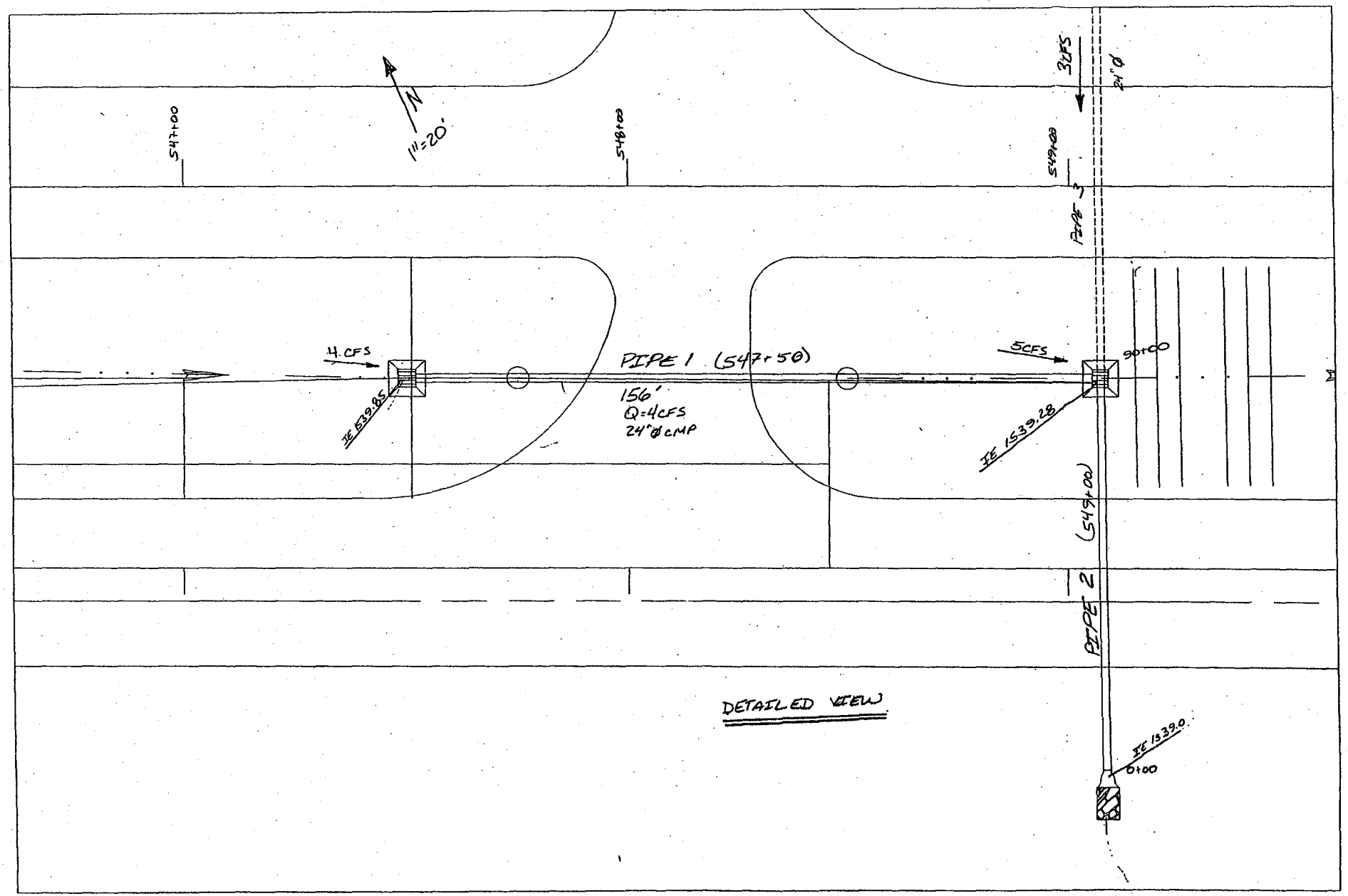
L(sb)=Dc*(8+17log(F))

Where
- L(sb) — length of rip rap, ft
- D50 — D50 of rip rap, min. 6"
- t — thickness of rip rap = 2* D50
- Dc — diameter of culvert, ft
- F — Froude number of channel

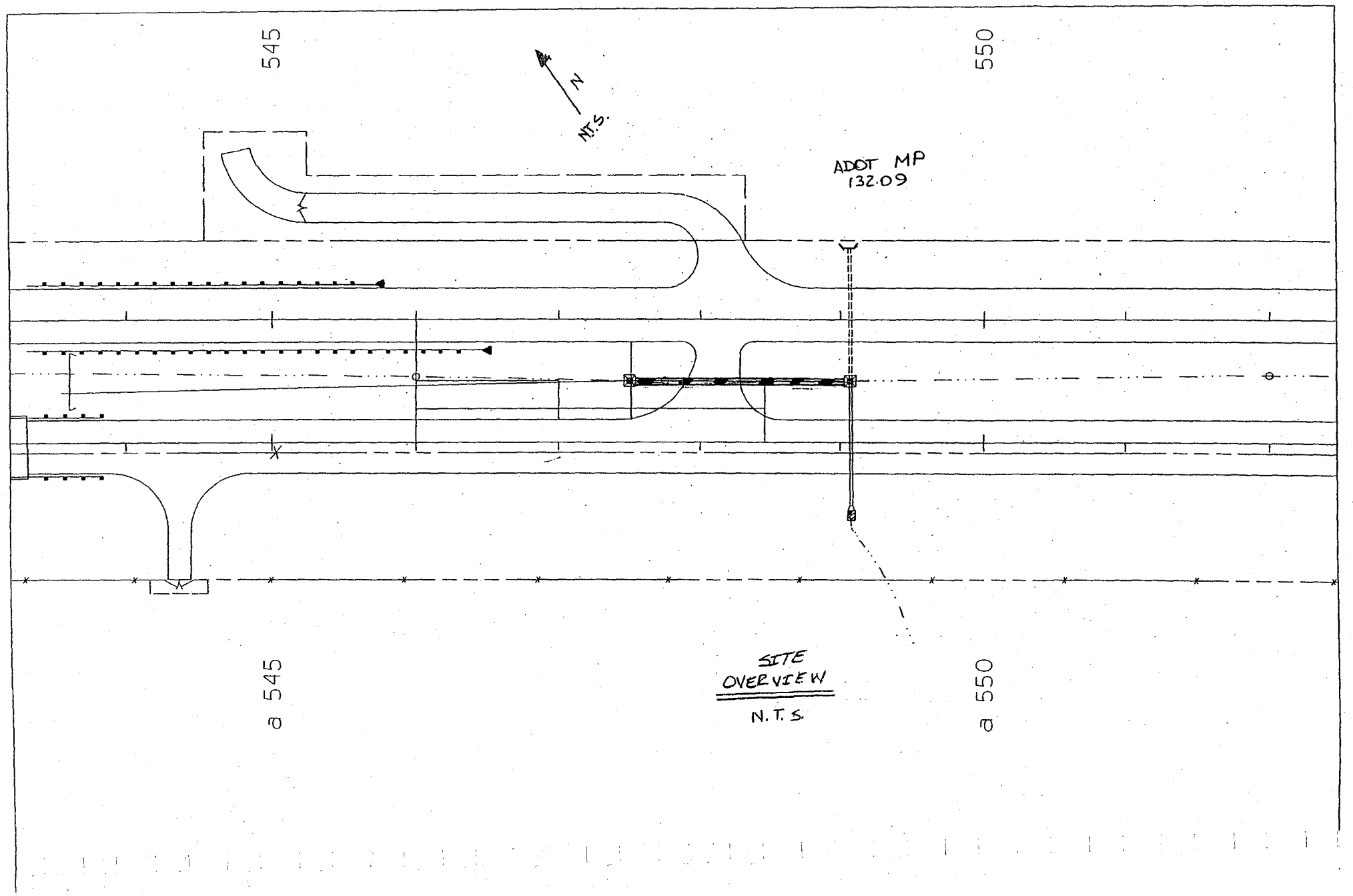
STATION	C	D	K	SN	V f/s	V m/s	R ft	R m	Gs	D50 mm	D50 in	D50 Pro'd	t in	F	Dc ft	L(sb) ft	L(sb) ft	V(p) f/s	V(p)/V	Rip Rap type	W (ft)	Vol of rip rap cy	cy	STATION
496+95	2	1	1	1.25	1.1	0.34	0.13	0.04	2.4	5	0.2	6	12	n/a, trapezoidal channel						Dump rr			14	496+95
516+54	2	1	1	1.25	1.22	0.37	0.17	0.05	2.4	5	0.2	6	12	n/a, trapezoidal channel						Dump rr			14	516+54
549+30	2	1	1	1.25	2.2	0.67	0.33	0.10	2.4	23	0.9	6	12	0.61	2	8.7	9	5.05	2.30	Dump rr	5.67	1.89	2	549+30
556+21	2	1	1	1.25	3.23	0.98	0.70	0.21	2.4	49	1.9	6	12	0.68	2	10.3	11	7.07	2.19	Dump rr	11.34	4.62	5	556+21
563+41	2	1	1	1.25	1.47	0.45	1.00	0.30	2.4	4	0.2	6	12	0.54	3.5	12.1	13	8.06	5.48	Wire rr	9.8	4.72	5	563+41
662+37	2	1	1	1.25	1.84	0.56	0.93	0.28	2.4	8	0.3	6	12	0.57	3	11.5	12	8.16	4.43	Wire rr	25.2	11.20	12	662+37
685+60	2	1	1	1.25	2.69	0.82	0.72	0.22	2.4	28	1.1	6	12	n/a, trapezoidal channel						Dump rr			28	685+60

Appendix J

Culvert Design
Median
Storm Drain Scenario



j:/9727/ustn/mcbwork.dgn Oct. 29, 1999 09:27:46



SITE OVERVIEW

N.T.S.

DIBBLE & ASSOCIATES
CONSULTING ENGINEERS
Since 1962

CALC JLMC DATE 11/01/99 JOB 9727.3
CHKD GB DATE 3 Nov 99 SHT 1 OF 4

TITLE M547 & M549 STORM DRAIN ANALYSIS - RCP

Reference:
ARAPAHOE COUNTY STORM DRAINAGE DESIGN AND TECHNICAL CRITERIA. 09/15/99

STA 0+00 (OUTFALL) DATA AS FOLLOWS

DESIGN DISCHARGE	Q = 12CFS	(3 + 4 + 5)
INVERT OF PIPE	IE = 1539.00	
DIAMETER	D = 24"	
STARTING WATER SURFACE	WS = 1540.62	1539 + dc 1.62

TW = 0

$$\frac{dc^* + d}{2} = \frac{1.23 + 2}{2} = 1.62$$

dc TAKEN FROM QUICK 2 COMPUTER SOFTWARE

AREA OF PIPE	A = 3.14 SF
V = Q2 SOFTWARE	V = 5.0 FPS ✓

STEP 1 : C VALUE

$$K = \frac{2gn^2}{2.21} = \frac{2(32.2)(0.012)^2}{2.21} = 0.0042 \checkmark$$

STEP 2 : VELOCITY HEAD, Hv

$$Hv = \frac{V^2}{2g} = \frac{5.0^2}{64.4} = 0.39$$

STEP 3 : ENERGY GRADE POINT, EG

$$E.G. = W.S. + Hv = 1540.62 + 0.39 = 1541.01$$

NOTE : IT IS KNOWN THAT THE ARAPAHOE COUNTY ASSUME 80% FULL PIPE FLOW. ALL PIPE FLOW LOCATIONS MAY NOT CONFORM TO THIS BUT THE ARAPAHOE METHOD WILL STILL BE USED

STEP 4: S_f VALUE

$$S_f = \alpha \cdot H_v / R^{4/3} = (0.0042)(0.39)/(0.5)^{4/3} = 0.0041 \checkmark$$

STEP 5: Avg S_f

FIRST STA: ∴ Avg S_f = S_f = 0.0041

STEP 6: L

$L = 90'$

STEP 7: FRICTION LOSS, H_f

$$H_f = (\text{Avg } S_f)(L)$$
$$= (0.0041)(90')$$
$$= 0.37 \checkmark$$

STEP 8: FORM LOSSES

CASE II: INLET ON MAIN LINE WITH BRANCH LATERAL

$$H_L = \frac{V_2^2}{2g} - K_j \cdot \frac{V_3^2}{2g}$$

$$= \frac{5^2}{64.4} - 0.25 \cdot \frac{4.2^2}{64.4} = 0.32 \checkmark$$

STEP 9: SUM ALL FORM LOSSES

$0.37 + 0.32 = 0.69$

STEP 10: ADD TOTAL LOSS TO E.G. AT DOWNSTREAM END TO COMPUTE E.G. AT UPSTREAM END

E.G. (U/S) = E.G. (D/S) + TOTAL LOSS
= 1541.01 + 0.69
= 1541.70 ✓

STEP 11: INPUT NEW DATA FOR PIPE 1

DESIGN DISCHARGE	Q = 4 CFS
INVERT OF PIPE	IE = 1539.28
DIAMETER	D = 2'
AREA OF PIPE	A = 3.14 SF
V = FROM Q2	V = 4 FPS
K = SAME AS PIPE 2	K = 0.0168
Hv = $V^2/2g$ = $4^2/64.4$	Hv = 0.25

STEP 12: COMPUTE NEW WATER SURFACE

W.S. = EG − Hv
= 1541.70 − 0.39
= 1541.31 GRATE 1542.28
Δ = 0.97 ∴ OK!

STEP 3 (2): ENERGY GRADE POINT, EG

EG = W.S. + Hv = 1541.31 + 0.25
= 1541.56

STEP 4(2): Sf VALUE

$S_f = K\,Hv/R^{4/3} = 0.0042 \cdot 0.25 / 0.5^{4/3} = 0.0027$ ✓

STEP 5(2): AVG Sf = (0.0027 + 0.0041)/2 = 0.0034 ✓

NOTE: PIPE 3 HYDRAULICS ARE ANALYZED SEPARATELY

STEP 6(2): L

$L = 156$ LF

STEP 7(2): FRICTION LOSS, H_f

$$H_f = (\text{AVG } S_f)(L)$$
$$= (0.0034)(156)$$
$$= 0.53 \checkmark$$

STEP 8(2): FORM LOSSES

CASE III: INLET AT BEGINNING OF LINE

$$H_L = K \cdot \frac{V^2}{2g} = 1.25 \cdot \frac{4^2}{64.4} = 0.31$$

STEP 9(2): SUM ALL LOSSES

$$0.53 + 0.31 = 0.84$$

STEP 10(2) E.G. AT U/S END

$$\text{E.G. (U/S)} = \text{E.G. (D/S)} + \text{TOTAL LOSS}$$
$$= 1541.56 + 0.84$$
$$= 1542.40$$

$$\text{W.S.} = \text{E.G. (U/S)} - H_v$$
$$= 1542.40 - 0.25$$
$$= 1542.15$$

GRATE: 1543.35 $\Delta = 1.2$ ∴ OK!

CONCLUSION:

ADOT CRITERIA IS TO MAINTAIN A H.W. ELEVATION 0.5 FT BELOW THE TOP OF GRATE FOR THE DESIGN 50 YEAR EVENT. WE HAVE MET THIS REQUIREMENT FOR BOTH CATCH BASINS, STA. 547+50 AND STA. 549+15. THIS IS BASED ON A CONSERVATIVE ASSUMPTION THAT THE PEAK FLOW FOR ALL CONTRIBUTING SUB-BASINS OCCUR SIMULTANEOUSLY. THE S.D. SYSTEM WILL INCLUDE 2 ADOT C-15RD CATCH BASINS IN CONJUNCTION WITH 24" RCP

Untitled QUICK 2
NORMAL DEPTH
PIPE 2

```
+-------------------------------------------------------+
|                  NORMAL  DEPTH                        |
|                CIRCULAR  CHANNEL                      |
|                                                       |
|                INPUT VARIABLES                        |
|                                                       |
| Diameter (in)        24.0   Manning's n       0.0240 |
| Discharge (cfs)        12   Depth (ft)          2.00 |
| Slope (ft/ft)      0.0033                             |
|-------------------------------------------------------|
|                OUTPUT VARIABLES                       |
|                                                       |
| Area (sq ft)          2.4   Wet Perimeter (ft)    4.0 |
| Velocity (ft/s)       5.0   Hyd Radius (ft)       0.6 |
| Top Width (ft)        1.8   Froude #              0.8 |
| Max Discharge(cfs)     15   Flow Type  SUBCRITICAL    |
|-------------------------------------------------------|
| DEPTH is Greater than the DIAMETER                    |
| Print                <F5>          New Shape   <F9>   |
| <- Back Tab          <F2>          Main Menu   <F7>   |
+-------------------------------------------------------+
```

TRY CMP,
WILL NOT WORK

```
+-------------------------------------------------------+
|                  NORMAL  DEPTH                        |
|                CIRCULAR  CHANNEL                      |
|                                                       |
|                INPUT VARIABLES                        |
|                                                       |
| Diameter (in)        24.0   Manning's n       0.0120 |
| Discharge (cfs)        12   Depth (ft)          1.42 |
| Slope (ft/ft)      0.0033                             |
|-------------------------------------------------------|
|                OUTPUT VARIABLES                       |
|                                                       |
| Area (sq ft)          2.4   Wet Perimeter (ft)    4.0 |
| Velocity (ft/s)       5.0   Hyd Radius (ft)       0.6 |
| Top Width (ft)        1.8   Froude #              0.8 |
| Max Discharge(cfs)     15   Flow Type  SUBCRITICAL    |
|-------------------------------------------------------|
| Begin Calculations   <Enter>                          |
| Print                <F5>          New Shape   <F9>   |
| <- Back Tab          <F2>          Main Menu   <F7>   |
+-------------------------------------------------------+
```

TRY RCP
OK, USE RCP

CRITICAL DEPTH

PIPE 2

```
+-------------------------------------------------+
|          CRITICAL  DEPTH                        |
|          CIRCULAR  CHANNEL                      |
|                                                 |
|          INPUT VARIABLES                        |
|                                                 |
|                                                 |
| Diameter (in)      24.0  Manning's n      0.0240 |
| Discharge (cfs)     12   Depth (ft)       1.23   |
| Slope (ft/ft)    0.0033  Critical Slope   0.0192 |
|-------------------------------------------------|
|          OUTPUT VARIABLES                       |
|                                                 |
| Area (sq ft)        2.0  Wet Perimeter (ft)  3.6 |
| Velocity (ft/s)     5.9  Hyd Radius (ft)     0.6 |
| Top Width (ft)      1.9  Froude #            1.0 |
| Max Discharge(cfs)   18  Flow Type  CRITICAL    |
|-------------------------------------------------|
| Begin Calculations  <Enter>                     |
| Print          <F5>        New Shape  <F9>      |
| <- Back Tab      <F2>        Main Menu  <F7>     |
+-------------------------------------------------+
```

TRY CMP
WILL NOT WORK

```
+-------------------------------------------------+
|          CRITICAL  DEPTH                        |
|          CIRCULAR  CHANNEL                      |
|                                                 |
|          INPUT VARIABLES                        |
|                                                 |
|                                                 |
| Diameter (in)      24.0  Manning's n      0.0120 |
| Discharge (cfs)     12   Depth (ft)       1.23   |
| Slope (ft/ft)    0.0033  Critical Slope   0.0048 |
|-------------------------------------------------|
|          OUTPUT VARIABLES                       |
|                                                 |
| Area (sq ft)        2.0  Wet Perimeter (ft)  3.6 |
| Velocity (ft/s)     5.9  Hyd Radius (ft)     0.6 |
| Top Width (ft)      1.9  Froude #            1.0 |
| Max Discharge(cfs)   18  Flow Type  CRITICAL    |
|-------------------------------------------------|
| Begin Calculations  <Enter>                     |
| Print          <F5>        New Shape  <F9>      |
| <- Back Tab      <F2>        Main Menu  <F7>     |
+-------------------------------------------------+
```

TRY RCP
OK, USE RCP

QUICK 2

Pipe 3 Normal Depth

```
+-----------------------------------------+
|          NORMAL  DEPTH                  |
|        CIRCULAR  CHANNEL                |
|                                         |
|          INPUT VARIABLES                |
|                                         |
|                                         |
| Diameter (in)     24.0  Manning's n     0.0240 |
| Discharge (cfs)     3   Depth (ft)      0.80   |
| Slope (ft/ft)   0.0052                  |
|-----------------------------------------|
|          OUTPUT VARIABLES               |
|                                         |
| Area (sq ft)      1.2  Wet Perimeter (ft)  2.7  |
| Velocity (ft/s)   2.6  Hyd Radius (ft)     0.4  |
| Top Width (ft)    2.0  Froude #            0.6  |
| Max Discharge(cfs)  10  Flow Type  SUBCRITICAL  |
|-----------------------------------------|
| Begin Calculations  <Enter>             |
| Print          <F5>      New Shape  <F9>  |
| <- Back Tab      <F2>      Main Menu  <F7>  |
+-----------------------------------------+
```

TRY CMP
WILL NOT WORK

```
+-----------------------------------------+
|          NORMAL  DEPTH                  |
|        CIRCULAR  CHANNEL                |
|                                         |
|          INPUT VARIABLES                |
|                                         |
|                                         |
| Diameter (in)     24.0  Manning's n     0.0120 |
| Discharge (cfs)     3   Depth (ft)      0.56   |
| Slope (ft/ft)   0.0052                  |
|-----------------------------------------|
|          OUTPUT VARIABLES               |
|                                         |
| Area (sq ft)      0.7  Wet Perimeter (ft)  2.2  |
| Velocity (ft/s)   4.2  Hyd Radius (ft)     0.3  |
| Top Width (ft)    1.8  Froude #            1.2  |
| Max Discharge(cfs)  19  Flow Type  SUPERCRITICAL |
|-----------------------------------------|
| Begin Calculations  <Enter>             |
| Print          <F5>      New Shape  <F9>  |
| <- Back Tab      <F2>      Main Menu  <F7>  |
+-----------------------------------------+
```

TRY RCP,
OK, USE RCP

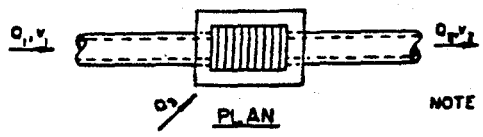
ARAPAHOE COUNTY

STORM DRAINAGE DESIGN AND TECHNICAL CRITERIA

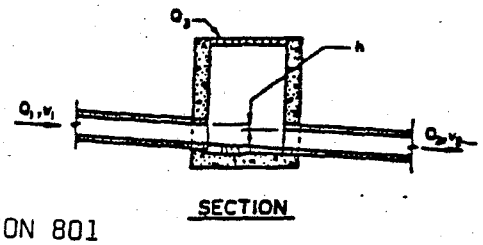
PREPARED IN COOPERATION WITH
URBAN DRAINAGE AND FLOOD CONTROL DISTRICT
AND WRC ENGINEERING, INC.

Arapahoe County Colorado

MANHOLE AND JUNCTION LOSSES



NOTE For Any Type of Inlet.

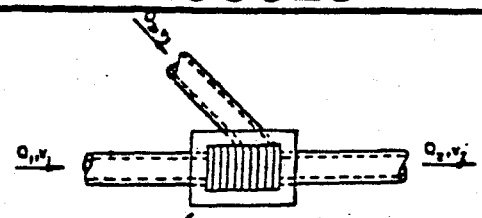


USE EQUATION 801

$$H_L = K\frac{V^2}{2g}$$

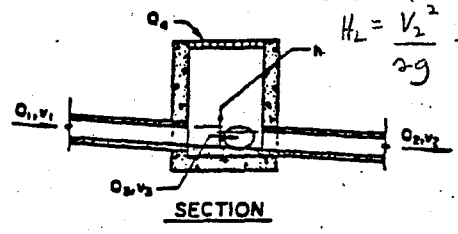
CASE I

INLET ON MAIN LINE



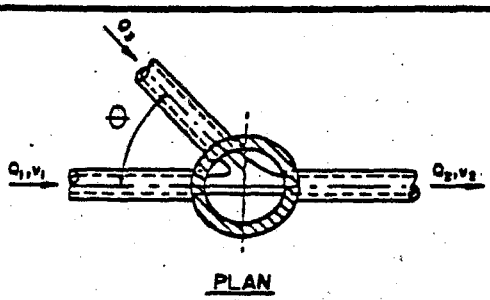
USE EQUATION 805

$$H_L = \frac{V_2^2}{2g} - K_j\frac{V_1^2}{2g}$$

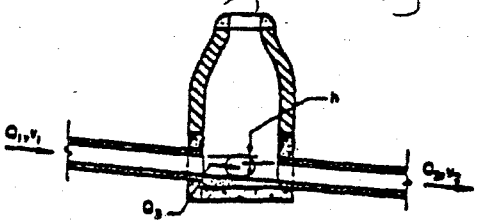


CASE II

INLET ON MAIN LINE WITH BRANCH LATERAL

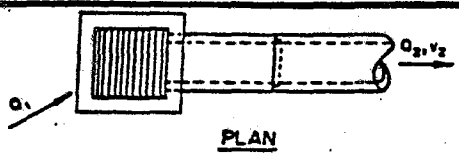


USE EQUATION 805 $H_L = \frac{V_2^2}{2g} - K_j\frac{V_1^2}{2g}$



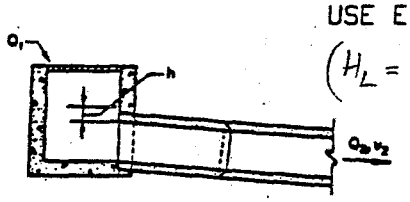
CASE III

MANHOLE ON MAIN LINE WITH Θ° BRANCH LATERAL



USE EQUATION 801

$$\left(H_L = K\frac{V^2}{2g}\right)$$



CASE IV

INLET OR MANHOLE AT BEGINNING OF LINE

CASE NO.	K_j
I	0.05
II	0.25
IV	1.25

CASE III

θ°	K_j
22-1/2	0.75
45	0.50
60	0.35
90	0.25
No Lateral	See Case I

REFERENCE: APWA Special Report No. 49, 1981

QUICK 2

Pipe 1

```
+-----------------------------------------+
|          NORMAL DEPTH                   |
|        CIRCULAR CHANNEL                 |
|                                         |
|        INPUT VARIABLES                  |
|                                         |
|                                         |
| Diameter (in)     24.0  Manning's n     0.0240 |
| Discharge (cfs)     4   Depth (ft)      1.05   |
| Slope (ft/ft)   0.0036                  |
|-----------------------------------------|
|        OUTPUT VARIABLES                 |
|                                         |
| Area (sq ft)      1.7  Wet Perimeter (ft)  3.2 |
| Velocity (ft/s)   2.4  Hyd Radius (ft)     0.5 |
| Top Width (ft)    2.0  Froude #            0.5 |
| Max Discharge(cfs)   8  Flow Type  SUBCRITICAL |
|-----------------------------------------|
| Begin Calculations  <Enter>             |
| Print          <F5>      New Shape  <F9> |
| <- Back Tab      <F2>      Main Menu  <F7> |
+-----------------------------------------+
```

TRY CMP,

WILL NOT WORK

```
+-----------------------------------------+
|          NORMAL DEPTH                   |
|        CIRCULAR CHANNEL                 |
|                                         |
|        INPUT VARIABLES                  |
|                                         |
|                                         |
| Diameter (in)     24.0  Manning's n     0.0120 |
| Discharge (cfs)     4   Depth (ft)      0.71   |
| Slope (ft/ft)   0.0036                  |
|-----------------------------------------|
|        OUTPUT VARIABLES                 |
|                                         |
| Area (sq ft)      1.0  Wet Perimeter (ft)  2.6 |
| Velocity (ft/s)   4.0  Hyd Radius (ft)     0.4 |
| Top Width (ft)    1.9  Froude #            1.0 |
| Max Discharge(cfs)  16  Flow Type  CRITICAL    |
|-----------------------------------------|
| Begin Calculations  <Enter>             |
| Print          <F5>      New Shape  <F9> |
| <- Back Tab      <F2>      Main Menu  <F7> |
+-----------------------------------------+
```

TRY RCP

OK, USE RCP

Appendix K

Rip Rap Settling Basin Design

FHWA CULVERT ANALYSIS, HY-8, VERSION 6.0

Box 648+98.47 Riprap Basin Design

CURRENT DATE	CURRENT TIME	FILE NAME	FILE DATE
06-09-2000	13:31:16	BOX648	05-09-2000

****
CULVERT AND CHANNEL DATA
****

CULVERT NO. 1		DOWNSTREAM CHANNEL	
CULVERT TYPE: 8.000 X 3.000 BOX		CHANNEL TYPE : TRAPEZOIDAL	
CULVERT LENGTH	= 220.040 ft	BOTTOM WIDTH	= 60.000 ft
NO. OF BARRELS	= 5.0	TAILWATER DEPTH	= 1.221 ft
FLOW PER BARREL	= 61.600 cfs	TOTAL DESIGN FLOW	= 308.000 cfs
INVERT ELEVATION	= 1463.500 ft	BOTTOM ELEVATION	= 1463.500 ft
OUTLET VELOCITY	= 12.260 fps	NORMAL VELOCITY	= 4.093 fps
OUTLET DEPTH	= 0.630 ft		

****

****
RIPRAP STILLING BASIN -- FINAL DESIGN
****

THE LENGTH OF THE BASIN	=	32.000 ft
THE LENGTH OF THE POOL	=	24.000 ft
THE LENGTH OF THE APRON	=	8.000 ft
THE WIDTH OF THE BASIN AT THE OUTLET	=	29.333 ft
THE DEPTH OF POOL BELOW CULVERT INVERT	=	1.050 ft
THE THICKNESS OF THE RIPRAP ON THE APRON	=	2.000 ft
THE THICKNESS OF THE RIPRAP ON THE REST OF THE BASIN	=	1.500 ft
THE BASIN OUTLET VELOCITY	=	1.720 fps
THE DEPTH OF FLOW AT BASIN OUTLET	=	1.221 ft

****

FHWA CULVERT ANALYSIS, HY-8, VERSION 6.0

Box 622+37.74 Riprap Basin Design

CURRENT DATE	CURRENT TIME	FILE NAME	FILE DATE
06-09-2000	13:32:59	BOX622	05-09-2000

****

CULVERT AND CHANNEL DATA

****

CULVERT NO. 1		DOWNSTREAM CHANNEL	
CULVERT TYPE: 10.000 X 5.000 BOX		CHANNEL TYPE : IRREGULAR	
CULVERT LENGTH	= 180.001 ft	BOTTOM WIDTH	= 32.000 ft
NO. OF BARRELS	= 2.0	TAILWATER DEPTH	= 2.285 ft
FLOW PER BARREL	= 256.500 cfs	TOTAL DESIGN FLOW	= 513.000 cfs
INVERT ELEVATION	= 1484.890 ft	BOTTOM ELEVATION	= 1484.890 ft
OUTLET VELOCITY	= 9.570 fps	NORMAL VELOCITY	= 5.645 fps
OUTLET DEPTH	= 2.680 ft		

****

****

RIPRAP STILLING BASIN -- FINAL DESIGN

****

THE LENGTH OF THE BASIN	=	40.000 ft
THE LENGTH OF THE POOL	=	30.000 ft
THE LENGTH OF THE APRON	=	10.000 ft
THE WIDTH OF THE BASIN AT THE OUTLET	=	32.000 ft
THE DEPTH OF POOL BELOW CULVERT INVERT	=	0.474 ft
THE THICKNESS OF THE RIPRAP ON THE APRON	=	3.000 ft
THE THICKNESS OF THE RIPRAP ON THE REST OF THE BASIN	=	2.000 ft
THE BASIN OUTLET VELOCITY	=	3.508 fps
THE DEPTH OF FLOW AT BASIN OUTLET	=	2.285 ft

****

FHWA CULVERT ANALYSIS, HY-8, VERSION 6.0

Box 782+07.54 Riprap Basin Design

CURRENT DATE	CURRENT TIME	FILE NAME	FILE DATE
06-09-2000	13:33:48	BOX782	05-11-2000

****
CULVERT AND CHANNEL DATA
****

CULVERT NO. 1		DOWNSTREAM CHANNEL	
CULVERT TYPE:	8.000 X 3.000 BOX	CHANNEL TYPE :	TRAPEZOIDAL
CULVERT LENGTH =	219.003 ft	BOTTOM WIDTH =	20.000 ft
NO. OF BARRELS =	3.0	TAILWATER DEPTH =	3.177 ft
FLOW PER BARREL =	206.667 cfs	TOTAL DESIGN FLOW =	620.000 cfs
INVERT ELEVATION =	1374.000 ft	BOTTOM ELEVATION =	1374.000 ft
OUTLET VELOCITY =	10.950 fps	NORMAL VELOCITY =	6.437 fps
OUTLET DEPTH =	2.360 ft		

****

****
RIPRAP STILLING BASIN -- FINAL DESIGN
****

THE LENGTH OF THE BASIN	=	32.000 ft
THE LENGTH OF THE POOL	=	24.000 ft
THE LENGTH OF THE APRON	=	8.000 ft
THE WIDTH OF THE BASIN AT THE OUTLET	=	20.000 ft
THE DEPTH OF POOL BELOW CULVERT INVERT	=	0.633 ft
THE THICKNESS OF THE RIPRAP ON THE APRON	=	3.000 ft
THE THICKNESS OF THE RIPRAP ON THE REST OF THE BASIN	=	2.000 ft
THE BASIN OUTLET VELOCITY	=	3.253 fps
THE DEPTH OF FLOW AT BASIN OUTLET	=	3.177 ft

****

Appendix L

Riprap Lining Length Calculations

Minimum Length of Outlet Protection

These calculations represent the minimum length of outlet protection required. Actual outlet protection length may be greater depending on the outlet conditions. Actual outlet protection dimensions are listed in Tables 4 and 5 of this report.

Project 2 : US60 - 203rd Ave (West) - Deer Valley Rd

L = D (8 + 17 log F), for Froude Number > 1
L = 8D, for Froude Number < 1

where, L = Length of riprap
D = Culvert Diameter or heigth (feet)
F = Froude number for the culvert flow

BOX AND PIPE CULVERTS

Station: 203rd Ave. 502+00

Culvert Height/ Dia:	3	ft.
Tailwater Depth:	1.83	ft.
Froude Number:	0.577	

L = 8D
L= 24.0 ft. See Detail O in Constr. Plans

Station: 576+95.94

Culvert Height/ Dia:	3	ft.
Tailwater Depth:	1.98	ft.
Froude Number:	0.859	

L = 8D
L= 24.0 ft. See Detail Q in Constr. Plans

Station: Conn 605 **605+00**

Culvert Height/ Dia:	2	ft.
Tailwater Depth:	2.1	ft.
Froude Number:	0.407	

L = 8D

L= 16.0 ft. See Detail O in Constr. Plans

Station: 622+37.74

Culvert Height/ Dia:	5	ft.
Tailwater Depth:	2.29	ft.
Froude Number:	0.715	

L = 8D

L= 40.0 ft. See Detail R in Constr. Plans

Station: Jomax **645+00**

Culvert Height/ Dia:	2.5	ft.
Tailwater Depth:	1.15	ft.
Froude Number:	0.428	

L = 8D

L= 20.0 ft. See Detail O in Constr. Plans

Station: 647+98.47

Culvert Height/ Dia:	3	ft.
Tailwater Depth:	1.23	ft.
Froude Number:	0.654	

L = 8D

L= 24.0 ft. See Detail R in Constr. Plans

Station: Happy Valley 712+50

Culvert Height/ Dia:	3	ft.
Tailwater Depth:	2.8	ft.
Froude Number:	0.462	

L = 8D

L= 24.0 ft. See Detail O in Constr. Plans

Station: 782+07.54

Culvert Height/ Dia:	3	ft.
Tailwater Depth:	3.18	ft.
Froude Number:	0.636	

L = 8D

L= 24.0 ft. See Detail R in Constr. Plans

Station: Frtg D 1627+05

Culvert Height/ Dia:	3	ft.
Tailwater Depth:	3.76	ft.
Froude Number:	0.586	

L = 8D

L= 24.0 ft. See Detail Q in Constr. Plans

Station: Jomax 6+81.50

Culvert Height/ Dia:	4	ft.
Tailwater Depth:	1.28	ft.
Froude Number:	0.58	

L = 8D

L= 32.0 ft. See Detail Q in Constr. Plans

Station:	**Happy Valley**		**8+00**
Culvert Height/ Dia:	2	ft.	
Tailwater Depth:	1.55	ft.	
Froude Number:	0.441		
L = 8D			
L=	16.0	ft.	See Detail Q in Constr. Plans
Station:	**Happy Valley**		**14+75**
Culvert Height/ Dia:	3	ft.	
Tailwater Depth:	4.16	ft.	
Froude Number:	0.184		
L = 8D			
L=	24.0	ft.	See Detail Q in Constr. Plans
Station:	**Citrus**		**29+85.50**
Culvert Height/ Dia:	4	ft.	
Tailwater Depth:	3.44	ft.	
Froude Number:	0.354		
L = 8D			
L=	32.0	ft.	See Detail Q in Constr. Plans

Appendix M

Riprap D_{50} Sizing

D50 Calculations

These calculations represent the minimum riprap classification. (See Figure 2 in this report).

Project 2 : US60 - 203rd Ave (West) - Deer Valley Rd

BOX AND PIPE CULVERTS

Station: 203rd Ave. 502+00

Exit Velocity (fps) : 9.8
Equivalent Spherical of stone (ft) : 1.0

Station: 576+95.94

Exit Velocity (fps) : 12.4
Equivalent Spherical of stone (ft) : 1.0

Station: Conn 605 605+00

Exit Velocity (fps) : 5.6
Equivalent Spherical of stone (ft) : 0.5

Station: 622+37.74

Exit Velocity (fps) : 9.6
Equivalent Spherical of stone (ft) : 1.0

Station: Jomax 645+00

Exit Velocity (fps) : 6.3
Equivalent Spherical of stone (ft) : 0.5

Station: 647+98.47

Exit Velocity (fps) : 12.2
Equivalent Spherical of stone (ft) : 1.0

D50 Calculations

These calculations represent the minimum riprap classification. (See Figure 2 in this report).

Project 2 : US60 - 203rd Ave (West) - Deer Valley Rd

Station: Happy Valley 712+50

Exit Velocity (fps) :	7.0
Equivalent Spherical of stone (ft) :	0.5

Station: 782+07.54

Exit Velocity (fps) :	11.0
Equivalent Spherical of stone (ft) :	1.0

Station: Frtg D 1627+05

Exit Velocity (fps) :	6.8
Equivalent Spherical of stone (ft) :	1.0

Station: Jomax 6+81.50

Exit Velocity (fps) :	9.4
Equivalent Spherical of stone (ft) :	1.0

Station: Happy Valley 14+75

Exit Velocity (fps) :	7.1
Equivalent Spherical of stone (ft) :	1.0

Station: Citrus 29+85.50

Exit Velocity (fps) :	11.1
Equivalent Spherical of stone (ft) :	1.0

D50 Calculations

These calculations represent the minimum riprap classification. (See Figure 2 in this report).

Project 2 : US60 - 203rd Ave (West) - Deer Valley Rd

MEDIAN DRAINAGE

Station: 480+00

Exit Velocity (fps) :	5.9
Equivalent Spherical of stone (ft) :	0.5

Station: 601+00

Exit Velocity (fps) :	6.1
Equivalent Spherical of stone (ft) :	0.5

Station: 640+00

Exit Velocity (fps) :	6.2
Equivalent Spherical of stone (ft) :	0.5

Station: 674+00

Exit Velocity (fps) :	5.1
Equivalent Spherical of stone (ft) :	0.5

Station: 698+00

Exit Velocity (fps) :	3.7
Equivalent Spherical of stone (ft) :	0.5

Station: 708+00

Exit Velocity (fps) :	4.1
Equivalent Spherical of stone (ft) :	0.5

Appendix N

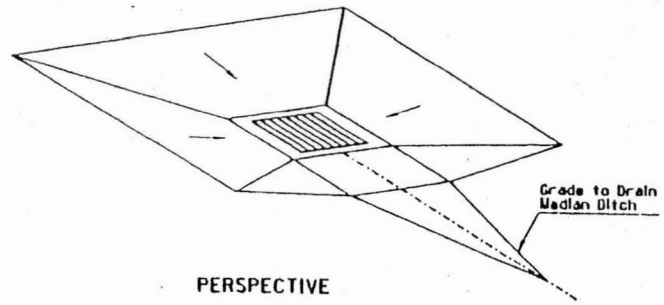
ADOT Catch Basin Details

REVISIONS		
Changed grates to match new curbed concrete bolt	PHB	1/11
Revised & add	PHB	1/11

GENERAL NOTES

① 1. Apron shall be portland cement concrete.
2. All concrete shall be Class B.
3. Grating shall be fabricated of structural steel.
4. Structural steel shall be in accordance with ASTM A36.
5. Welding shall be in accordance with Standard Welding Specifications.
6. Grating assembly shall be given one shop coat of No. 1 paint.
7. 'H' indicated on plans.

* 8" When Wall Height Exceeds 8'



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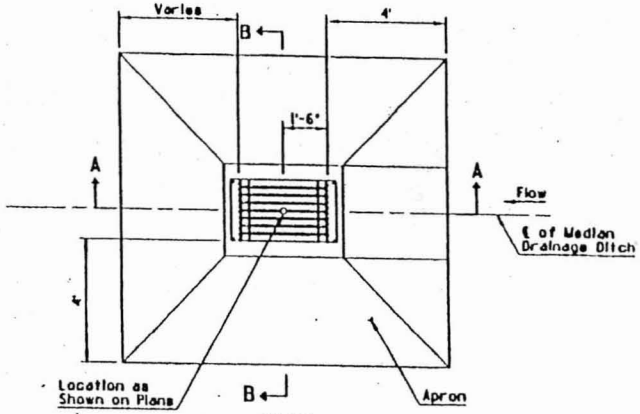
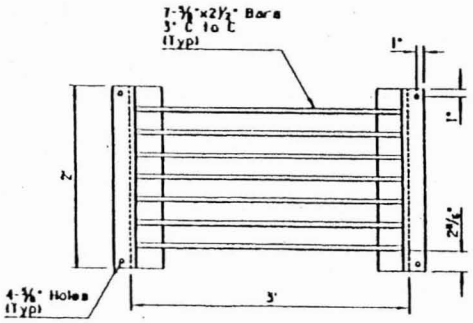
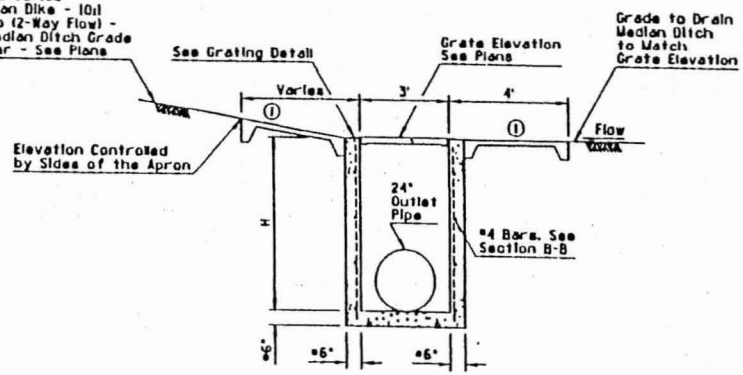


PLAN

② Slope Varies
Median Dike - (Oil)
Sump (2-Way Flow) -
Median Ditch Grade
Other - See Plans





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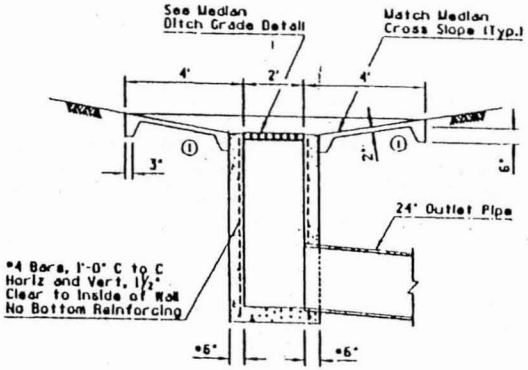

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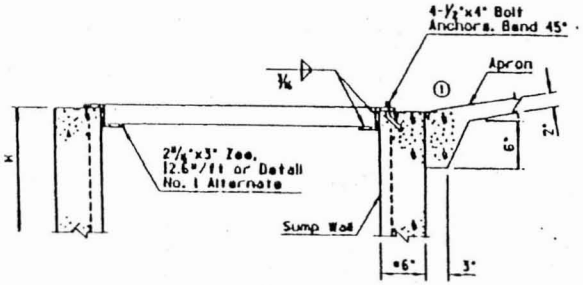
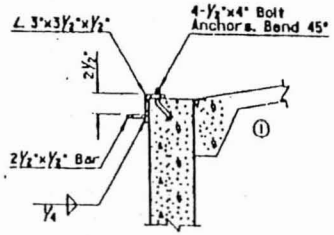
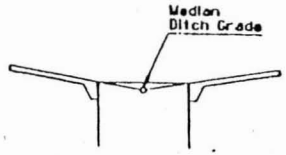


GRATING DETAIL

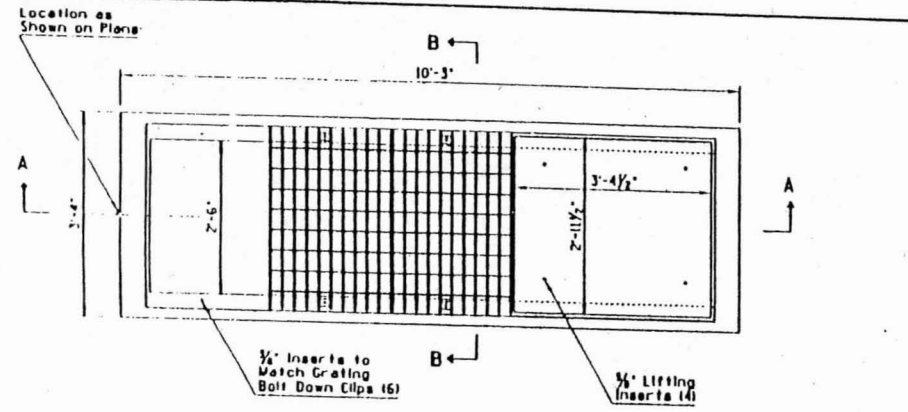


DETAIL NO. 1

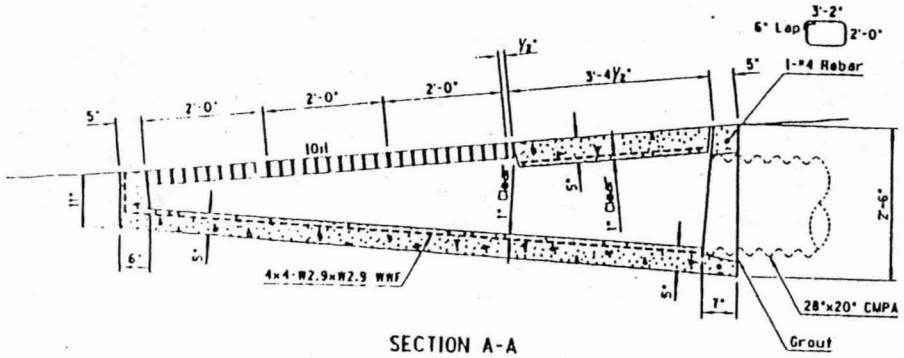


MEDIAN DITCH GRADE DETAIL

Terry H. Otterness	STATE OF ARIZONA DEPARTMENT OF TRANSPORTATION DIVISION OF HIGHWAYS STANDARD DRAWINGS	REV. 5/97
Approved for Distribution	CATCH BASIN, MEDIAN FLUSH	DRAWING NO. C-15.80



PLAN



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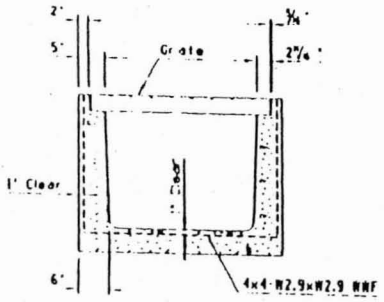

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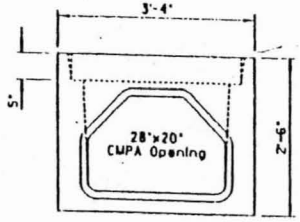
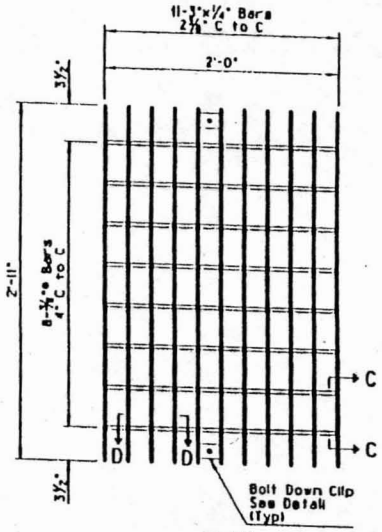


END VIEW



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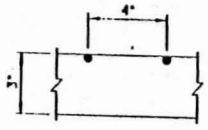

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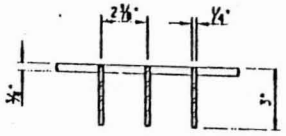
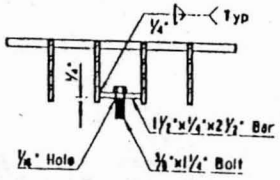


SECTION D-D



BOLT DOWN CLIP DETAIL

GENERAL NOTES

1. Concrete shall conform to the requirements for Class S Concrete. The minimum strength shall be 4000 psi.
2. Grout shall be in accordance with Standard Specifications except water content shall be such that the consistency is proper for smooth troweling.
3. Grate cross rods shall be resistance welded, fillet welded or electro-forged to bearing bars.
4. The completed grate shall be given one shop coat of No. 1 paint.
5. ① Foundation soil and backfill shall be in accordance with Section 203-5 of the Standard Specifications.

Terry H. Ottman	STATE OF ARIZONA DEPARTMENT OF TRANSPORTATION DIVISION OF HIGHWAYS STANDARD DRAWINGS	10/95
Ronald W. Kline	CATCH BASIN, MEDIAN DIKE PRECAST	C-15.90

Appendix O

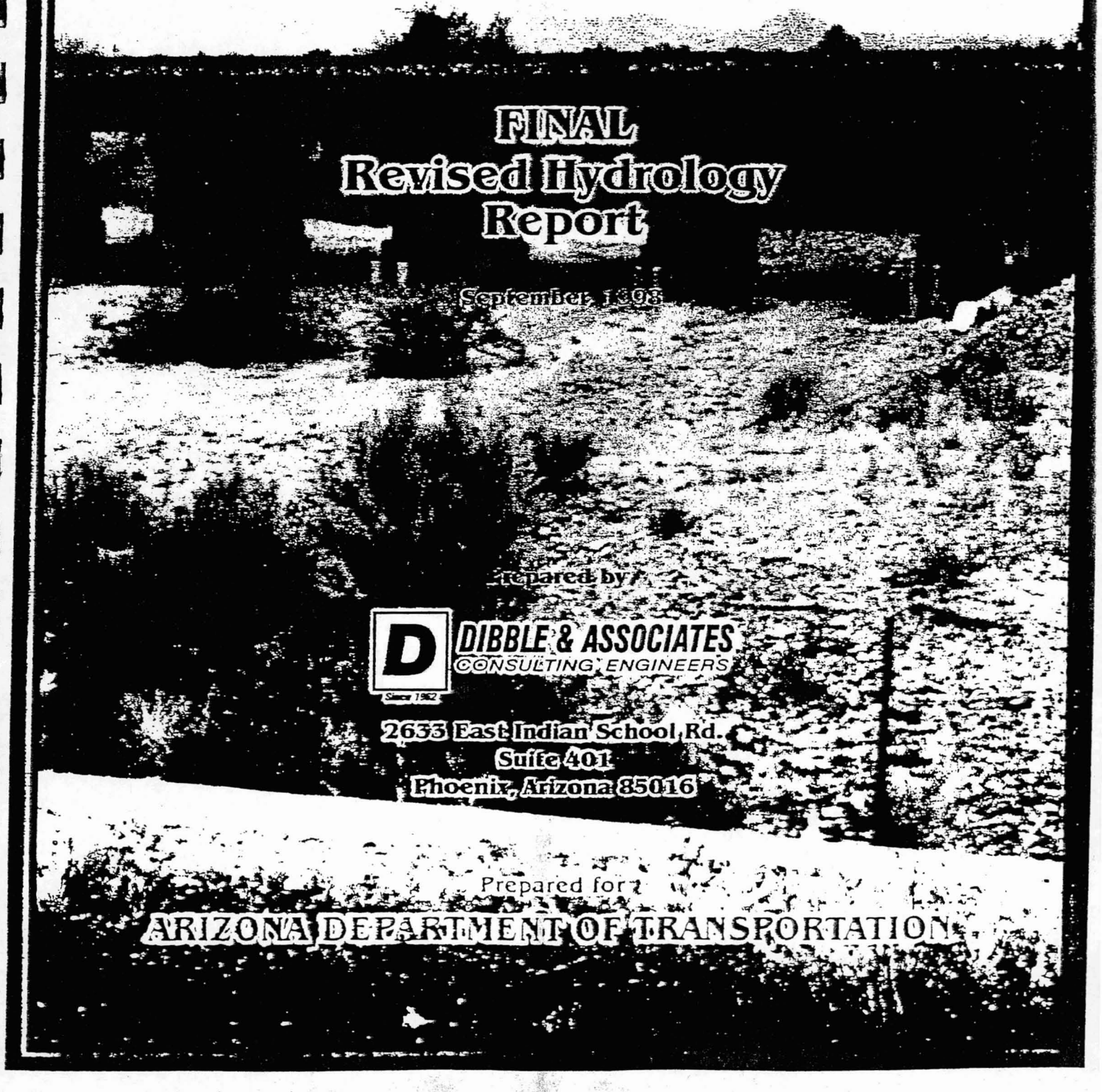
US60 Hydrology Report Excerpts

EXCEIPTS FROM

US 60

MORRISTOWN RROP to BEARDSLEY ROAD

TRACS NO. 060 MA 121 H4573 01D
PROJECT NO. STP-022-2(55)



FINAL Revised Hydrology Report

September 1993

Prepared by:

DIBBLE & ASSOCIATES
CONSULTING ENGINEERS
Since 1952

2633 East Indian School Rd.
Suite 401
Phoenix, Arizona 85016

Prepared for:

ARIZONA DEPARTMENT OF TRANSPORTATION

US 60
MORRISTOWN RROP to BEARDSLEY ROAD

TRACS NO. 060 MA 121 H4573 01D
PROJECT NO. STP-022-2(55)

REVISED HYDROLOGY

September 1998

Registered Professional Engineer (Civil)
CERTIFICATE NO.
21684
BRIAN J.
FRY
Date Signed 9.15.98
ARIZONA, U.S.A.

Prepared by

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2633 E. Indian School Rd.
Suite 401
Phoenix, Arizona 85016

Prepared for

ARIZONA DEPARTMENT OF TRANSPORTATION

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3. FIGURE TWO: Revised Delineation of Sub-Basins

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   B. Fifty-Year HEC-1 Output
   C. One Hundred Year HEC-1 Output

Registered Professional Engineer (Civil)
CERTIFICATE NO.
21684
BRIAN J.
FRY
Date Signed 9-15-98
ARIZONA, U.S.A.

REVISED HYDROLOGY: US60 Morristown RROP to Beardsley Rd. STP-022-2(55)

BACKGROUND:

In December of 1994, a hydrology report entitled "US 60 MORRISTOWN RROP TO BEARDSLEY ROAD - HYDROLOGY REPORT" (project no. 060 MA 121.9 H 3623 01 L) was prepared for the Arizona Department of Transportation (ADOT) by Sverdrup Civil, Inc. which attempted to quantify runoff reaching US 60 between the Morristown Railroad Overpass and Beardsley Road. The methodology used to determine how much runoff reaches US 60 included a HEC-1 computer model. The drainage basin generating runoff was subdivided using a USGS 7.5 minute topography map, and the characteristics of those sub-basins were input into the HEC-1 model. The existing railroad north and east of the road plays a big role in determining the quantity of runoff reaching the road. Hence, existing pipe culverts, box culverts and bridges under the railroad were included in the HEC-1 model.

An addendum to that report was issued in February of 1995 in response to ADOT comments on the original report. The addendum included HEC-1 runs which did not model transmission losses (infiltration values shown on RL records set to 0). This model also included a few minor routing modifications.

METHODOLOGY:

The HEC-1 model included in the addendum was used as a starting point for this study. For a detailed discussion on modeling methodology, the original Sverdrup report should be consulted. The following discussion pertains only to revisions to the Sverdrup model made by Dibble.

An independent subbasin delineation was performed by Dibble in an attempt to confirm the work previously done by Sverdrup. When the Dibble delineation was compared to the Sverdrup delineation, 3 Sverdrup sub-basins (120A, 120G, & 130A), as well as one routing path which carries significant flow appeared to be suspect. These sub-basins are in the immediate vicinity of Wittmann Wash. It is critical that these sub-basins and the runoff routing paths are modeled correctly in order for HEC-1 to accurately determine how much runoff reaches the road at these locations. The differences between the Sverdrup and the Dibble delineations are shown on Figures 1 and 2. The Dibble Delineation was also compared to the Wittmann Area Drainage Master Study delineation. Although the Wittmann ADMS seemed to confirm the Dibble delineation, a field trip was made to the area to visually survey the drainage patterns of the suspect area. The field investigation confirmed the Dibble delineation and routing of the sub-basins in question.

The Sverdrup HEC-1 model was then edited to reflect the Dibble sub-basin delineation and routing. Sub-basin 120A was renamed, R120A, sub-basin 120G was renamed R120G and sub-basin 130A was renamed R130A. A comparison of the HEC-1 parameters for these basins used by Sverdrup, and those used by Dibble is shown in Table 1.

TABLE 1

HEC-1 PARAMETERS

	"BA" Card		"LG" Card					"UC" Card	
	Basin	Area (mi^2)	IA (in)	DTHETA	PSIF (in)	XKSAT (in/hr)	RTIMP (%)	Tc (hrs)	R (hrs)
Sverdrup (Original)	**120A**	3.923	0.300	0.111	11.010	0.032	0.000	2.547	2.610
	120G	2.698	0.350	0.250	5.800	0.212	0.000	2.148	1.811
	130A	0.945	0.350	0.250	5.100	0.292	0.000	1.305	1.066
Dibble (Revised)	**R120A**	3.803	0.300	0.111	11.010	0.029	0.000	2.596	2.714
	R120G	2.275	0.350	0.250	5.800	0.222	0.000	2.112	1.958
	R130A	1.488	0.350	0.250	5.100	0.259	0.000	1.874	2.054

HEC-1 was run using the revised parameters for these basins for both the 50-year and 100-year storms. A comparison of the reported runoff values passing each existing railroad culvert, (and therefore reaching the roadway), is shown in Table 2.

TABLE 2

Railroad Culvert (mp)	Contributing Sub Basin	HEC-1 Model Designation	Sverdrup Model Q50 (cfs)	Sverdrup Model Q100 (cfs)	Dibble Revision Q50 (cfs)	Dibble Revision Q100 (cfs)	Difference Q50 (cfs)	Difference Q100 (cfs)
123.70	30A	C12370	244	265	244	265	0	0
123.78	40A	C12378	196	200	196	200	0	0
123.80	40A	C12380	67	98	67	98	0	0
124.03	50A	C12403	137	137	137	137	0	0
124.30	50A	C12430	220	224	220	224	0	0
124.40	50A	C12440	15	17	15	17	0	0
124.65	50B	C12465	153	155	153	155	0	0
124.80	50B	C12480	228	321	228	321	0	0
124.90	60I	C12490	30	30	30	30	0	0
125.05	60I	C12505	83	88	83	88	0	0
125.20	60I	C12520	9790	10778	9790	10778	0	0
125.35	70A	C12535	66	68	66	68	0	0
125.45	70A	C12545	76	79	76	79	0	0
125.80	70A	C12580	177	185	177	185	0	0
125.90	70A	C12590	120	135	120	135	0	0
126.00	70C	C12600	243	273	243	273	0	0
126.10	70C	C12610	324	331	324	331	0	0
126.35	80A	C12635	115	117	115	117	0	0
126.55	80A	C12655	69	70	69	70	0	0
126.60	80A	C12660	194	197	194	197	0	0
126.95	90A	C12695	672	711	672	710	0	-1
127.50	100B	C12750	2788	3525	2788	3526	0	1
127.90	110B	C12790	1049	1212	1049	1212	0	0
128.55	114	C12855	137	158	137	158	0	0
129.00	120G	C12900	3695	4047	2398	2643	-1297	-1404
129.55	130A	C12955	1181	1498	1920	2128	739	630
130.00	140A	C13000	124	127	150	165	26	38
131.70	150J	C13170	3077	3253	3149	3381	72	128

RESULTS:

The most significant difference in the models is the runoff carried by Wittmann wash at US 60. The Sverdrup model from the addendum reports a 50-year flow of 3695 cfs and a 100-year flow of 4047 cfs. (It should be noted, however, that the recommendations for proposed structures under US60 made by the original report were based on the flow values from the original model-although the HEC-1 model was revised, the recommendations were not). The Dibble model reports a 50-year flow of 2398 cfs and a 100-year flow of 2643, a difference of -1297 cfs and -1404 cfs, respectively. The wash immediately south and east of Wittmann Wash is reported to carry a 50-year flow of 1181 cfs and a 100-year flow of 1498 cfs at US 60 by the Sverdrup model. The Dibble model reports a 50-year flow of 1920 cfs and a 100-year flow of 2128 cfs for the same location, a difference of 739 cfs and 630 cfs, respectively. Because the proposed improvements for the drainage structures were not updated when the HEC-1 model was, all recommendations should be revisited and revised, if necessary, based on the flow values reported by the Dibble model. Table 3 shows 50-year and 100-year flows at each of the existing roadway structures reported by the Dibble model.

Complete HEC-1 input and output files for the 50-year and 100-year storms are included in the appendix. Also included are calculations sheets for basin parameters for the revised HEC-1 sub-basins.

Railroad Culvert MP#	Exist Roadway Culvert Station (ft)	Existing Roadway Culvert Data				
		Qty./Size & Type	Inlet Type notes: (1)	Length (ft)	50-YR Inflow (cfs) notes: (2)	100-YR (cfs) notes: (2)
123.70	**1526+16**	6x5 CBC	45 HW	102	244	265
123.75	**1535+35**	24" CMP	PR	98	22*	24*
123.78	**1537+78**	6x6 CBC	45 HW	114	174*	176*
123.80	**1541+08**	36" CMP	90 HW	98	67	98
124.00	**1243+12**	30" CMP	NOT FND	140	37*	37*
124.03	**1236+15**	36" CMP	ES	98	100*	100*
124.30	**1232+67**	6x5 CBC	45 HW	140	220	224
124.40	**1221+20**	24" CMP	NOT FND	98	15	17
124.65	**1213+28**	6x6 CBC	45 HW	140	153	155
124.80	**1210+50**	36" CMP	ES	98	228	321
124.90	**1200+94**	24" CMP	NOT FND	98	30	30
125.05	**1196+73**	36" CMP	ES	114	83	88
125.20	**1187+50**	(7) 25' RCBR	45 HW	50	9,790	10,778
125.35	**1181+43**	36" CMP	ES	98	66	68
125.45	**1174+93**	36" CMP	ES	98	76	79
	1170+93	24" CMP	PR	98	4	4
125.80	**1154+85**	6x5 CBC	45 HW	98	174	182
125.90		**FLOWS TO RDWY CULVERT @ 1146+27**			120	135
126.00	**1146+27**	6x3 CBC	45 HW	140	243	273
126.10	**1138+49**	10x6 CBC	45 HW	114	324	331
126.35	**1125+93**	36" CMP	ES	140	115	117
126.55	**1116+30**	36" CMP	ES	98	69	70
126.60	**1110+76**	6x5 CBC	45 HW	114	194	197
126.95	**1094+85**	(2)10x6 CBC	45 HW	140	672	710
127.10	**1084+18**	24" CMP	NOT FND	140	26	28
127.50	**1066+18**	(8)10x6 CBC	45 HW	85	2,788	3,526
127.90	**1046+57**	(6)10x5 CBC	45 HW	98	1,049	1,212
127.93		**FLOWS INTO US60/RR MEDIAN**			**culvert flow**	**culvert flow**
128.05		**FLOWS INTO US60/RR MEDIAN**			**included**	**included**
128.20		**FLOWS INTO US60/RR MEDIAN**			**below**	**below**
128.55		**FLOWS UNDER CENTER STREET**			137	158
129.00		(3) 35' RCBR	45 HW	55	2,398	2,643
129.55	**1301+52**	8x5 CBC	45 HW	86	1,920	2,128
130.00	**1277+40**	(2)20"x28" CMP	ES	102	150	165
	1221+50	(2)18" CPC	90 HW	98	9	11
	1201+72	24" CMP	ES	94	14	17
131.70	**1187+05**	(6)10x4 CBC	45 HW	122	3,149	3,381

NOTES:

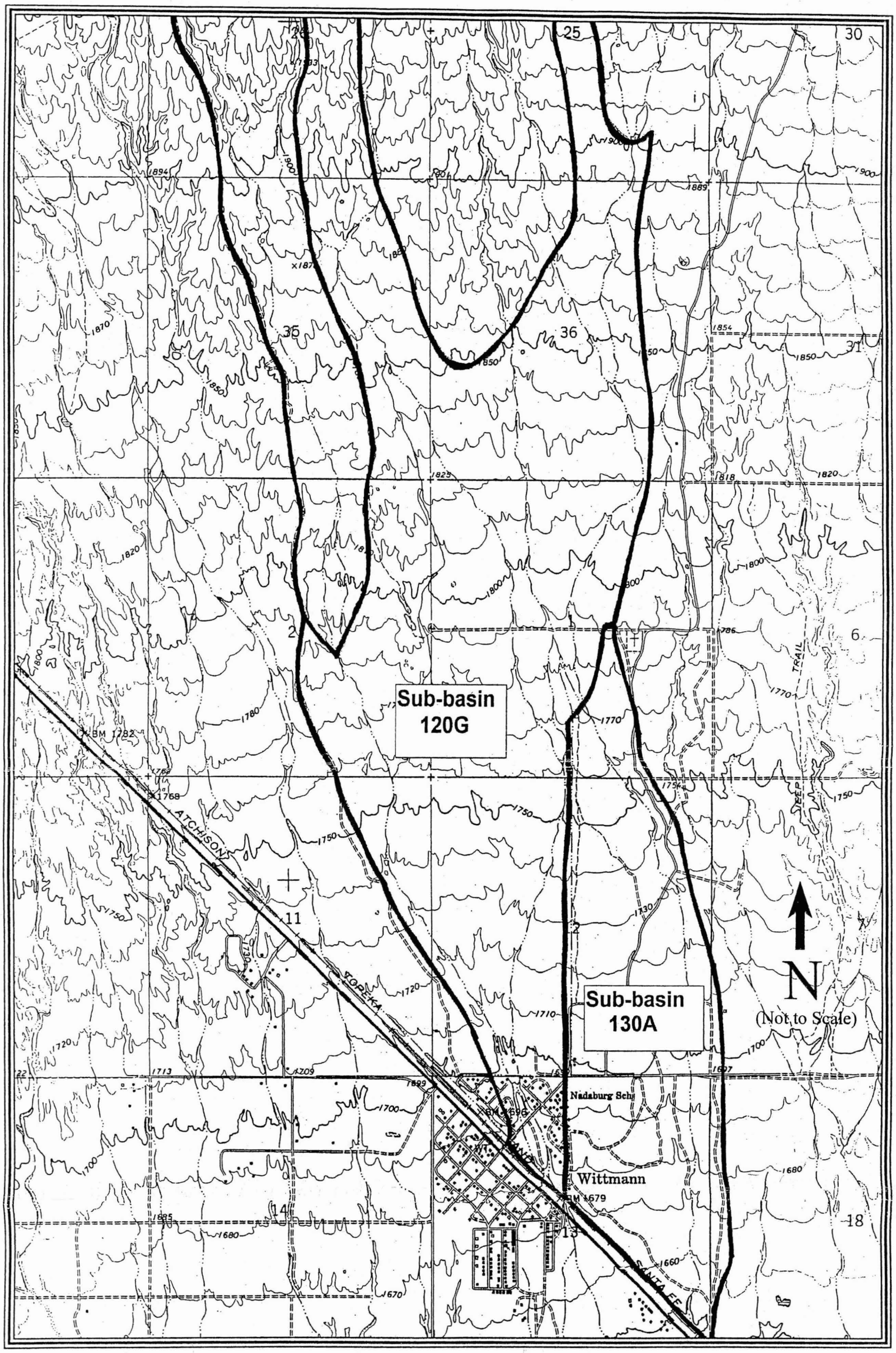
1) CMP = CORRUGATED METAL PIPE: CBC = CONCRETE BOX CULVERT; RCBR = REINFORCED CONCRETE BRIDGE
PR = PROJECTING END: 90HW = CONCRETE HEADWALL (90 deg. wings)
45HW = CONCRETE HEADWALL (45 deg. wings): ES = CORRUGATED METAL END SECTION

2) "*" OUTFLOW FROM ONE OF TWO OR MORE RR CULVERTS THAT SHARE COMMON HEADWATER & WIER

TABLE 3

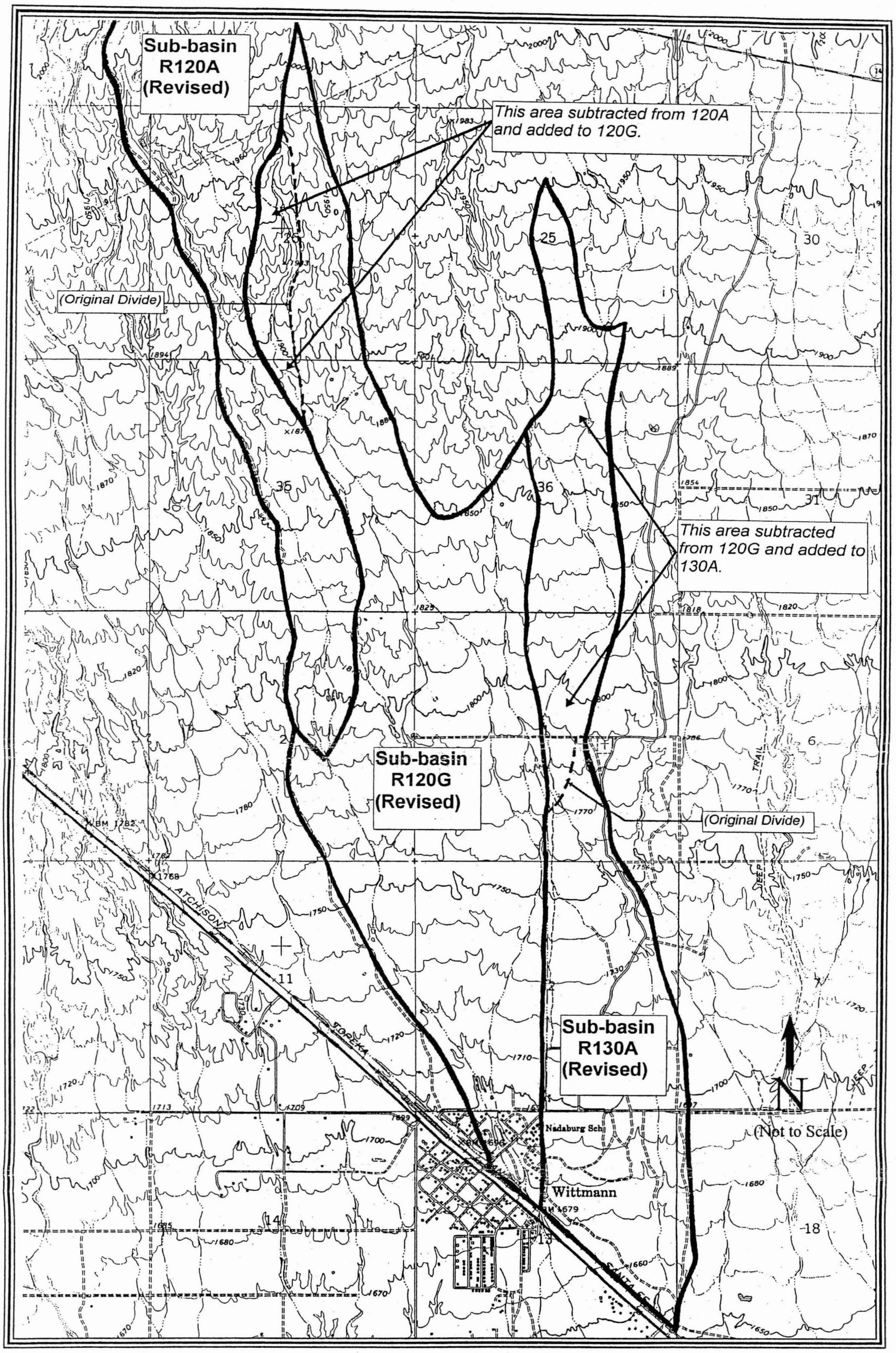
Appendix P

Flood Insurance Rate Maps
US 60 Morristown RROP to Beardsley Road



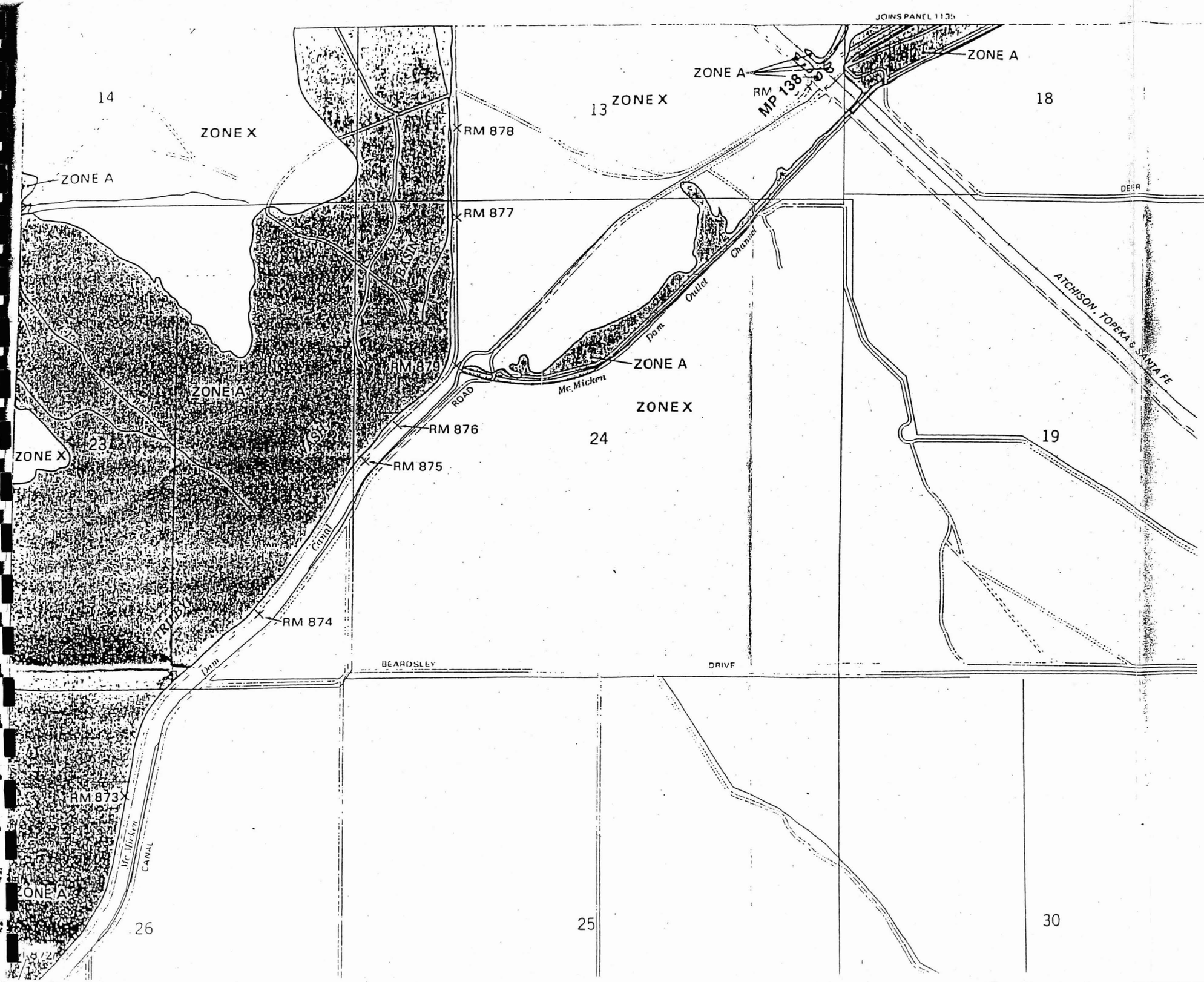
SUB-BASINS AS ORIGINALLY DELINEATED IN SVERDRUP REPORT

Figure 1



REVISED DELINEATION OF SUB-BASINS

Figure 2



NATIONAL FLOOD INSURANCE PROGRAM

FIRM
FLOOD INSURANCE RATE MAP

MARICOPA COUNTY, ARIZONA AND INCORPORATED AREAS

PANEL 1145 OF 4350

CONTAINS

COMMUNITY	NUMBER	PANEL	SUFFIX
MARICOPA COUNTY UNINCORPORATED AREAS	040037	1145	E
GUADALUPE, TOWN OF	040053	1145	E

Scale: 1"=1000'

MAP NUMBER
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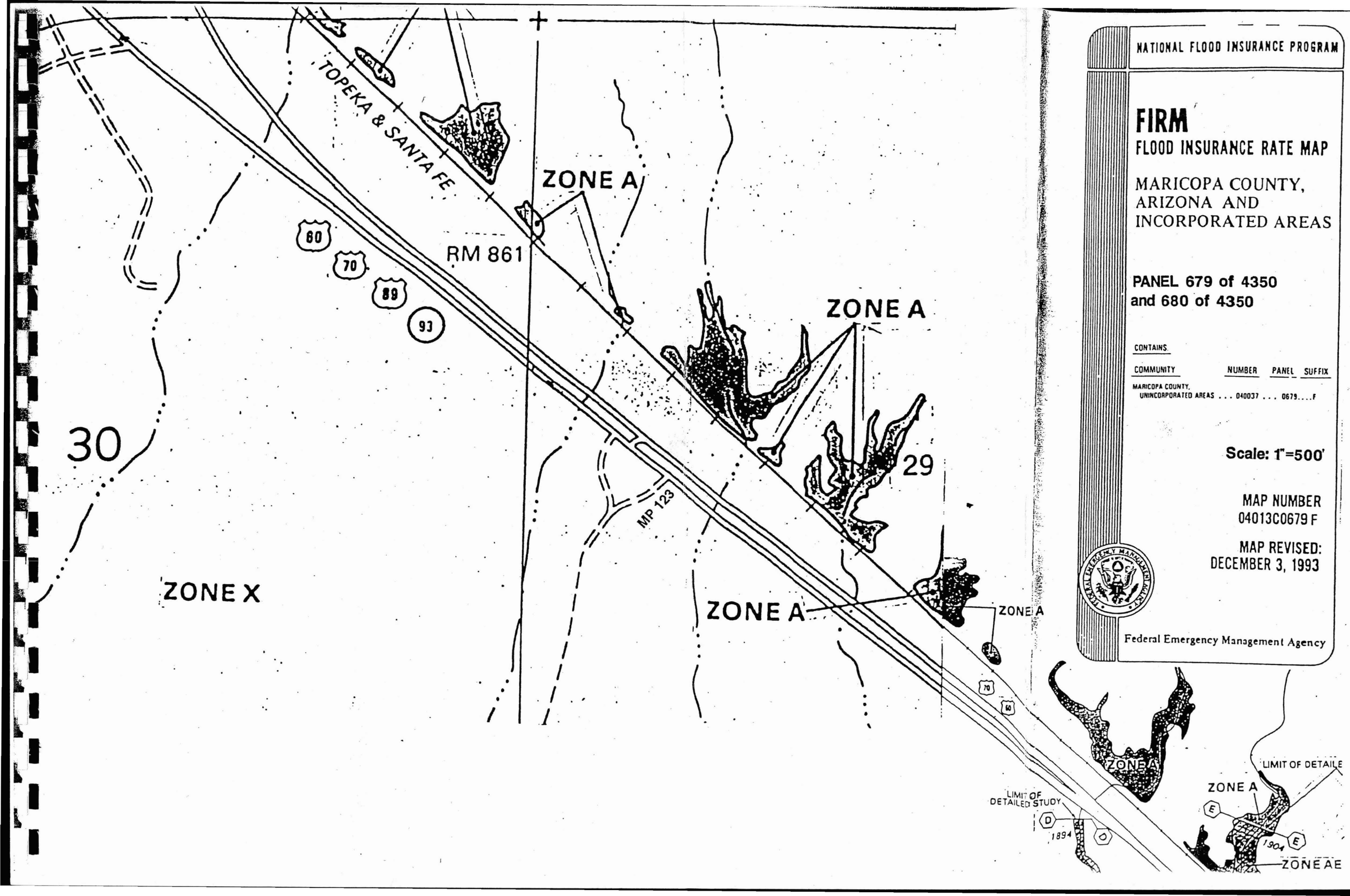
MAP REVISED:
SEPTEMBER 4, 1991

Federal Emergency Management Agency



NATIONAL FLOOD INSURANCE PROGRAM

FIRM

FLOOD INSURANCE RATE MAP

MARICOPA COUNTY, ARIZONA AND INCORPORATED AREAS

PANEL 679 of 4350 and 680 of 4350

CONTAINS:

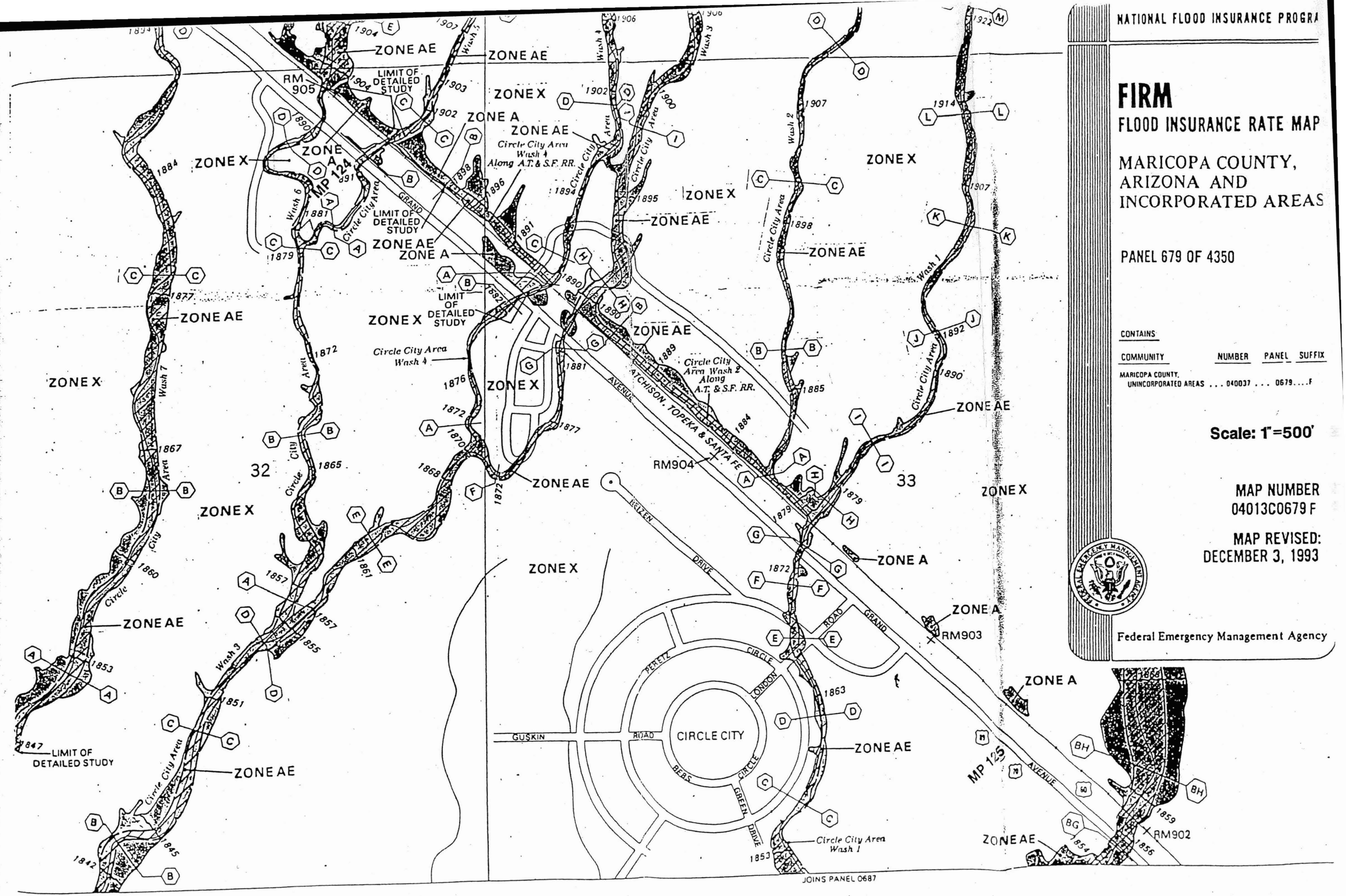
COMMUNITY	NUMBER	PANEL	SUFFIX
MARICOPA COUNTY, UNINCORPORATED AREAS	040037	0679	F

Scale: 1"=500'

MAP NUMBER 04013C0679 F

MAP REVISED: DECEMBER 3, 1993

Federal Emergency Management Agency



NATIONAL FLOOD INSURANCE PROGRA

FIRM
FLOOD INSURANCE RATE MAP

MARICOPA COUNTY, ARIZONA AND INCORPORATED AREAS

PANEL 679 OF 4350

CONTAINS

COMMUNITY	NUMBER	PANEL	SUFFIX
MARICOPA COUNTY, UNINCORPORATED AREAS	040037	0679	F

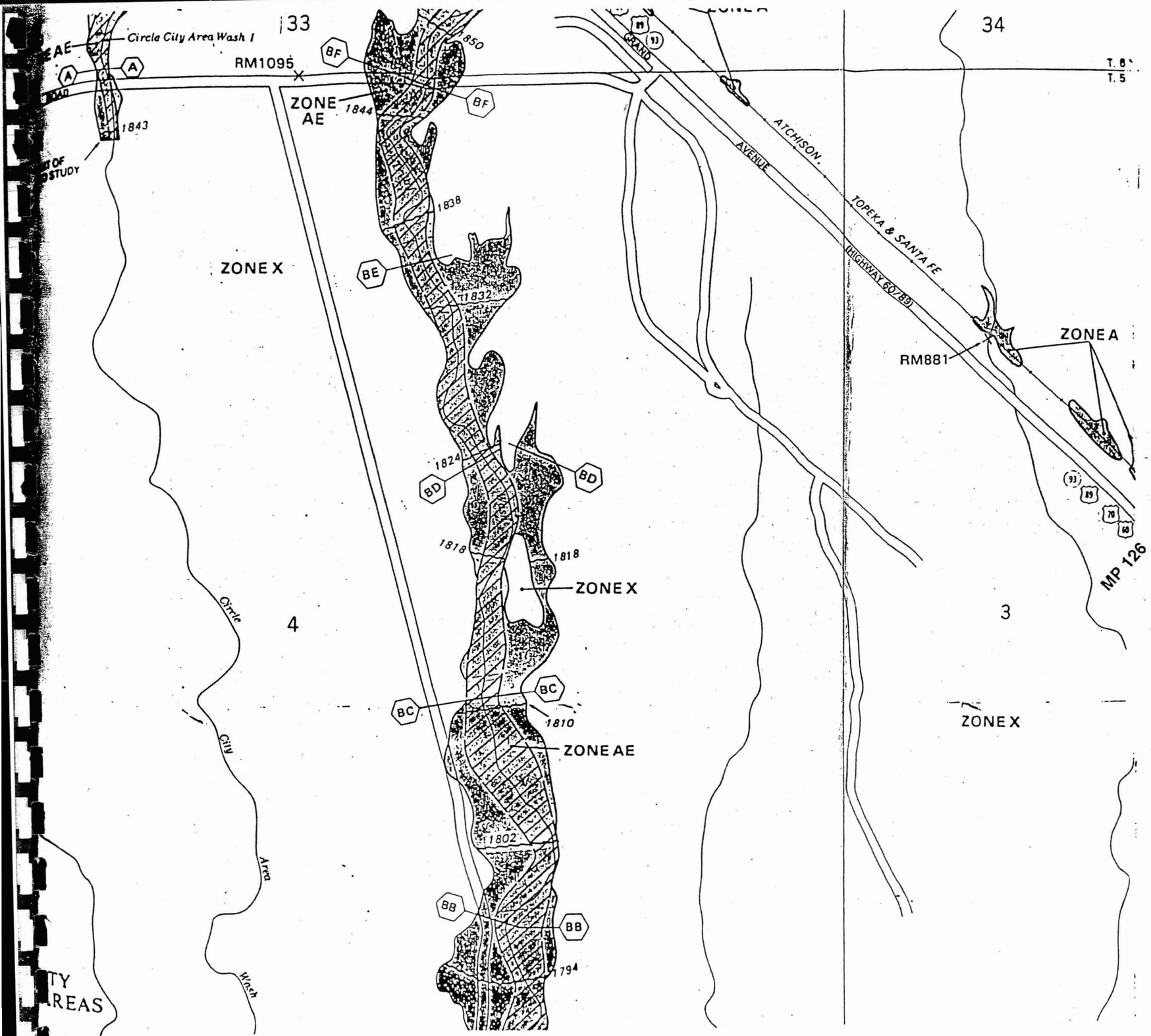
Scale: 1"=500'

MAP NUMBER
04013C0679 F

MAP REVISED:
DECEMBER 3, 1993

Federal Emergency Management Agency

NOTE: MAP AREA SHOWN ON THIS PANEL IS LOCATED WITHIN



NATIONAL FLOOD INSURANCE PROGRAM

FIRM
FLOOD INSURANCE RATE MAP

MARICOPA COUNTY, ARIZONA AND INCORPORATED AREAS

PANEL 687 OF 4350

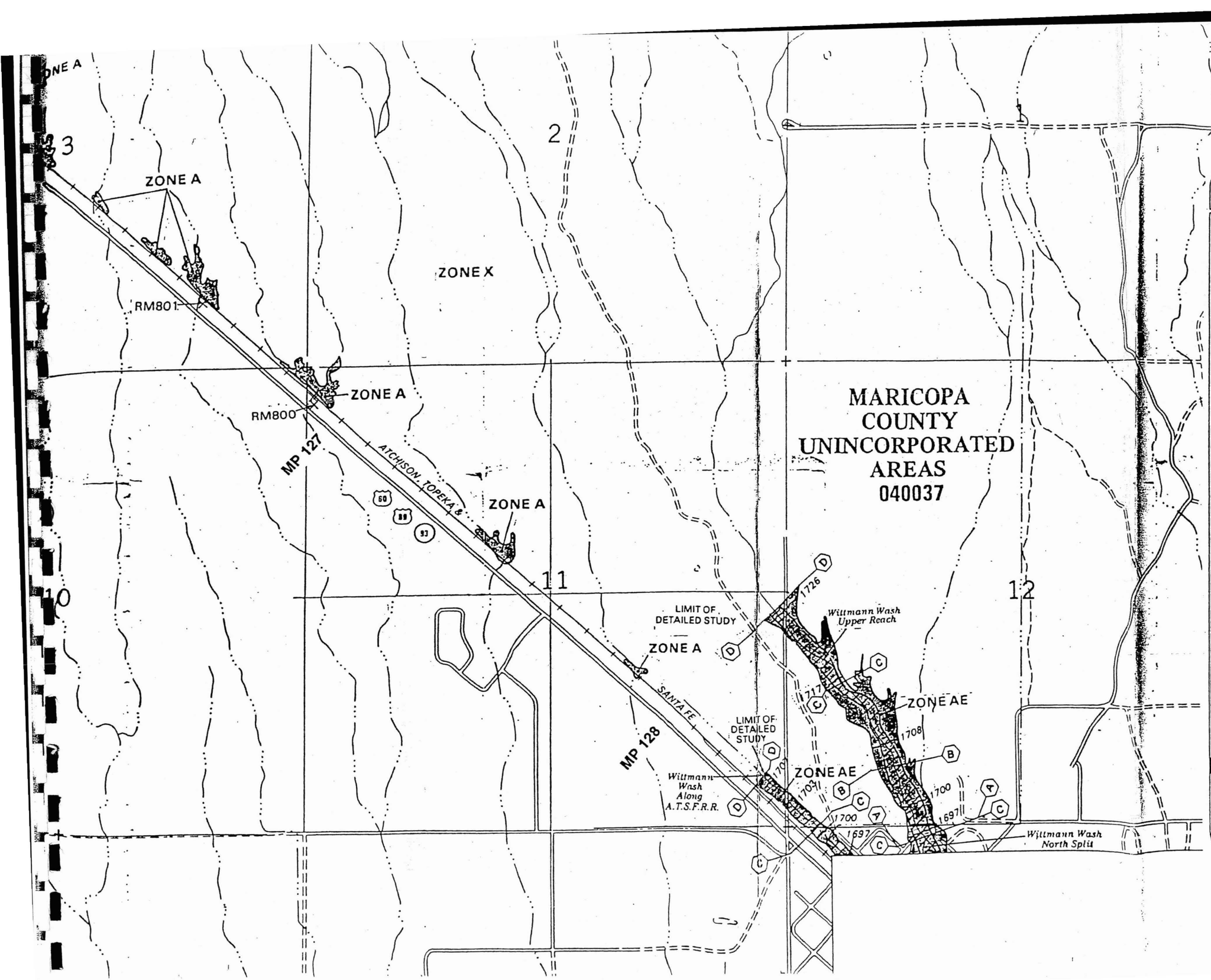
CONTAINS

COMMUNITY	NUMBER	PANEL	SUFFIX
MARICOPA COUNTY, UNINCORPORATED AREAS	040037	0687	F

Scale: 1"=500'

MAP NUMBER
04013C0687F
MAP REVISED:
DECEMBER 3, 1993

Federal Emergency Management Agency



NATIONAL FLOOD INSURANCE PROGRAM

FIRM

FLOOD INSURANCE RATE MAP

MARICOPA COUNTY,
ARIZONA AND
INCORPORATED AREAS

PANEL 695 OF 4350

CONTAINS

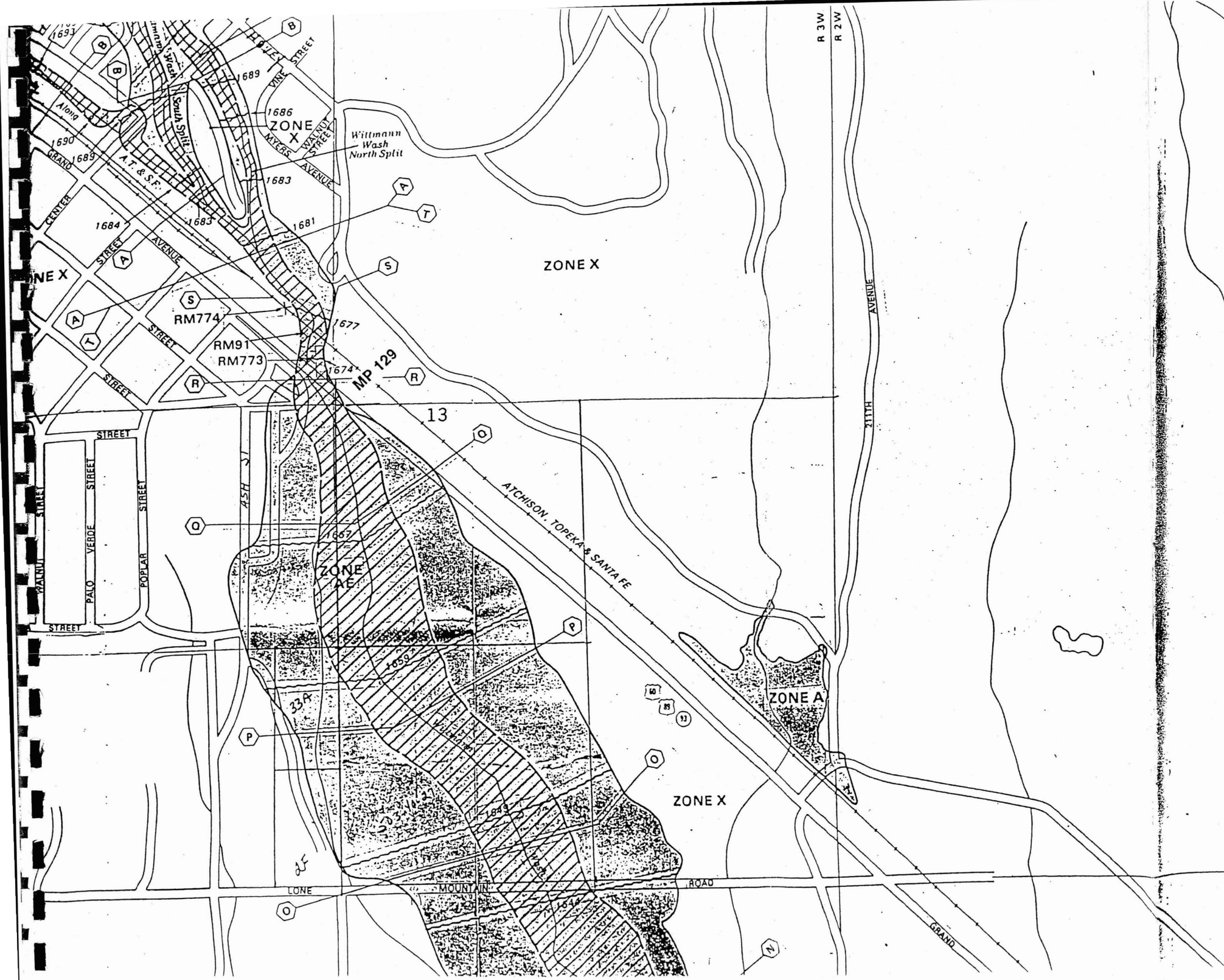
COMMUNITY	NUMBER	PANEL	SUFFIX
MARICOPA COUNTY, UNINCORPORATED AREAS	040037	0695	E

Scale: 1"=1000'

MAP NUMBER
04013C0695 E

MAP REVISED:
SEPTEMBER 4, 1991

Federal Emergency Management Agency



NATIONAL FLOOD INSURANCE PROGRAM

FIRM
FLOOD INSURANCE RATE MAP

MARICOPA COUNTY, ARIZONA AND INCORPORATED AREAS

PANEL 694 OF 4350

CONTAINS

COMMUNITY	NUMBER	PANEL	SUFFIX
MARICOPA COUNTY, UNINCORPORATED AREAS	040037	0694	E

Scale: 1"=500'

MAP NUMBER
04013C0694 E

MAP REVISED:
SEPTEMBER 4, 1991

Federal Emergency Management Agency

NATIONAL FLOOD INSURANCE PROGRAM

FIRM
FLOOD INSURANCE RATE MAP

MARICOPA COUNTY,
ARIZONA AND
INCORPORATED AREAS

PANEL 715 OF 4350

CONTAINS

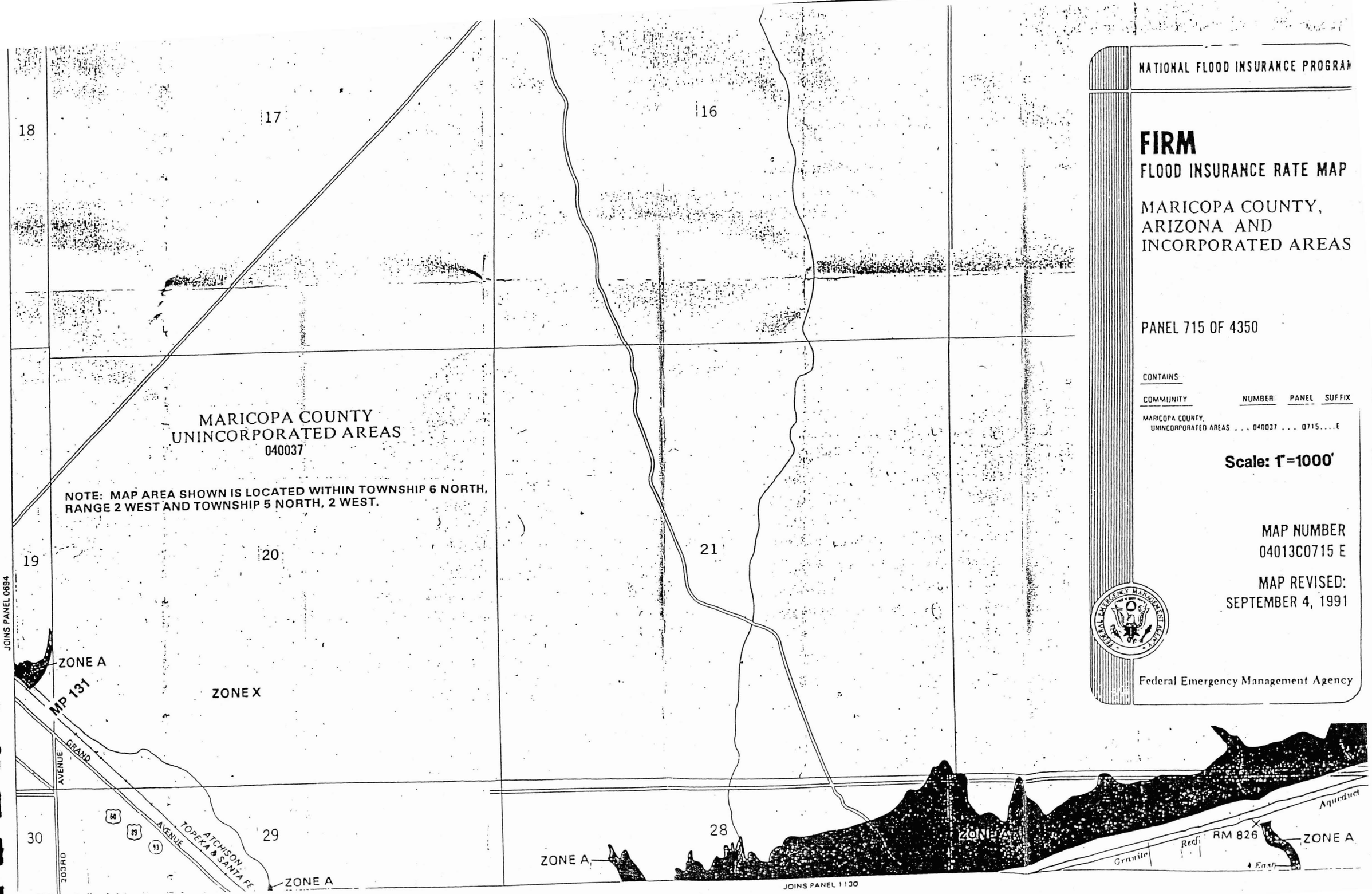
COMMUNITY	NUMBER	PANEL	SUFFIX
MARICOPA COUNTY, UNINCORPORATED AREAS	040037	0715	E

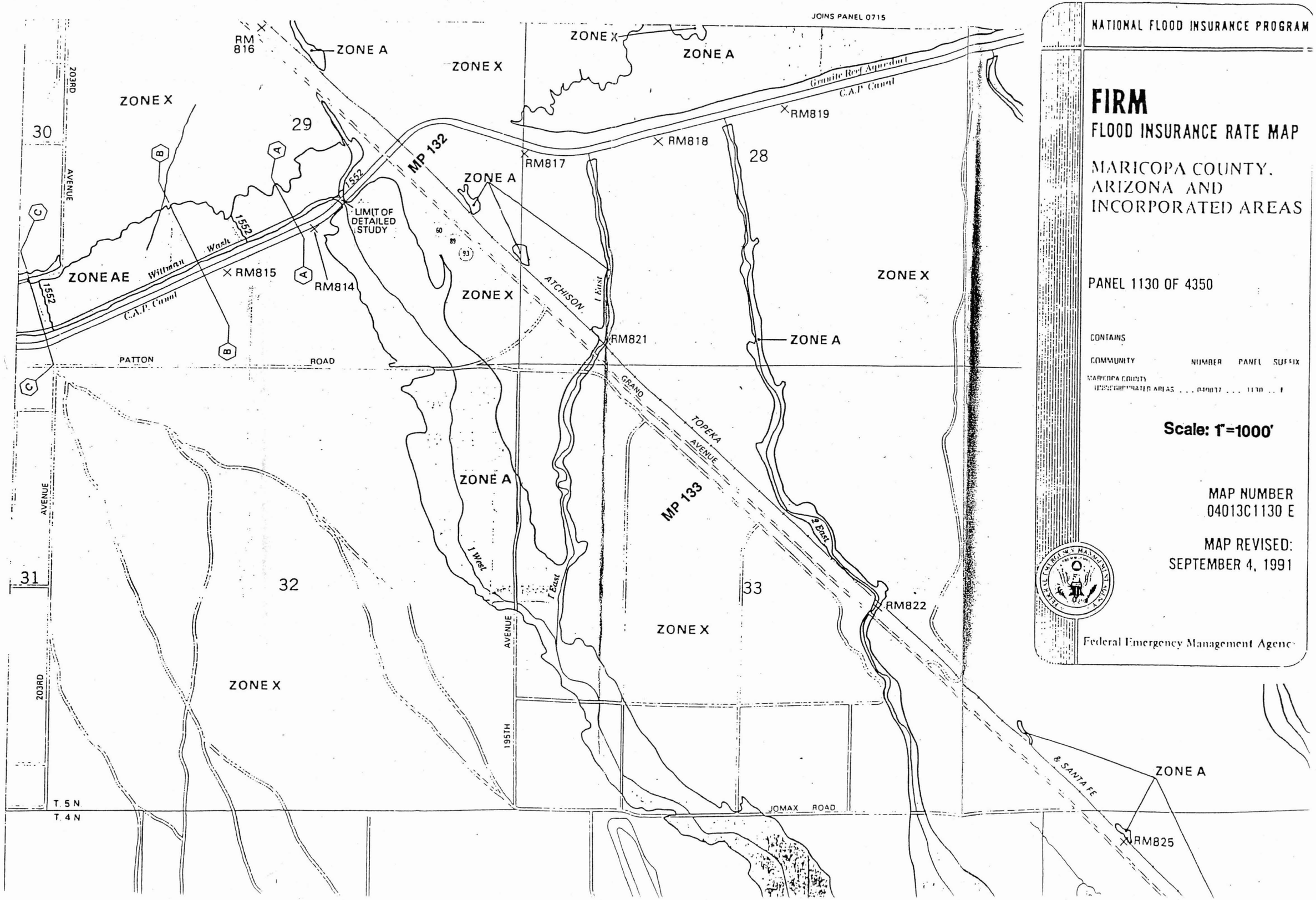
Scale: 1"=1000'

MAP NUMBER
04013C0715 E

MAP REVISED:
SEPTEMBER 4, 1991

Federal Emergency Management Agency





NATIONAL FLOOD INSURANCE PROGRAM

FIRM
FLOOD INSURANCE RATE MAP

MARICOPA COUNTY, ARIZONA AND INCORPORATED AREAS

PANEL 1130 OF 4350

CONTAINS

COMMUNITY	NUMBER	PANEL	SUFFIX
MARICOPA COUNTY UNINCORPORATED AREAS	040037	1130	E

Scale: 1"=1000'

MAP NUMBER
04013C1130 E

MAP REVISED:
SEPTEMBER 4, 1991

Federal Emergency Management Agency

NATIONAL FLOOD INSURANCE PROGRAM

FIRM
FLOOD INSURANCE RATE MAP

MARICOPA COUNTY, ARIZONA AND INCORPORATED AREAS

PANEL 1130 OF 4350

CONTAINS

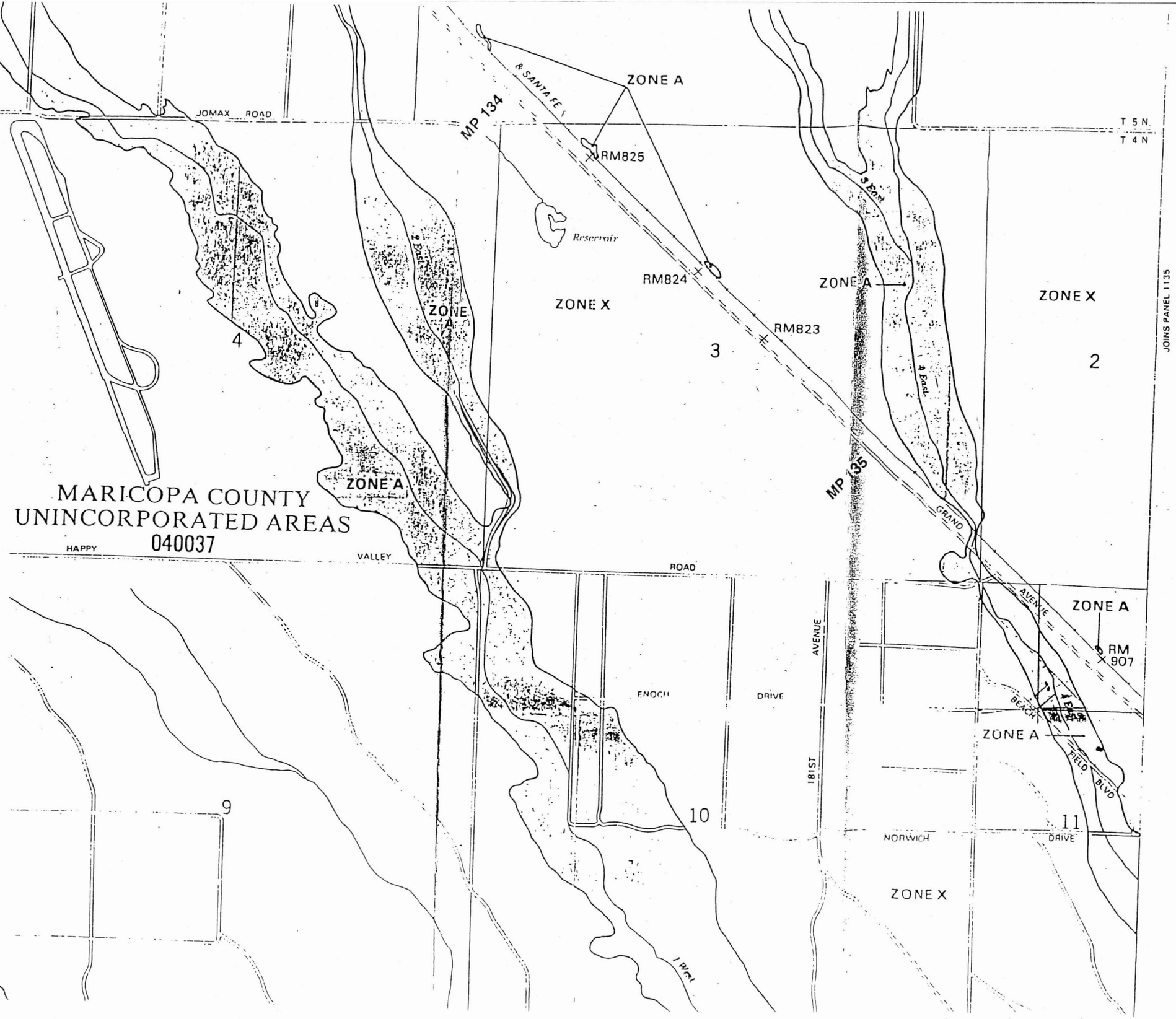
COMMUNITY	NUMBER	PANEL	SUFFIX
MARICOPA COUNTY, UNINCORPORATED AREAS	040037	1130	E

Scale: 1"=1000'

MAP NUMBER
04013C1130 E

MAP REVISED:
SEPTEMBER 4, 1991

Federal Emergency Management Agenc



NATIONAL FLOOD INSURANCE PROGRAM

FIRM
FLOOD INSURANCE RATE MAP

MARICOPA COUNTY,
ARIZONA AND
INCORPORATED AREAS

PANEL 694 OF 4350

CONTAINS:

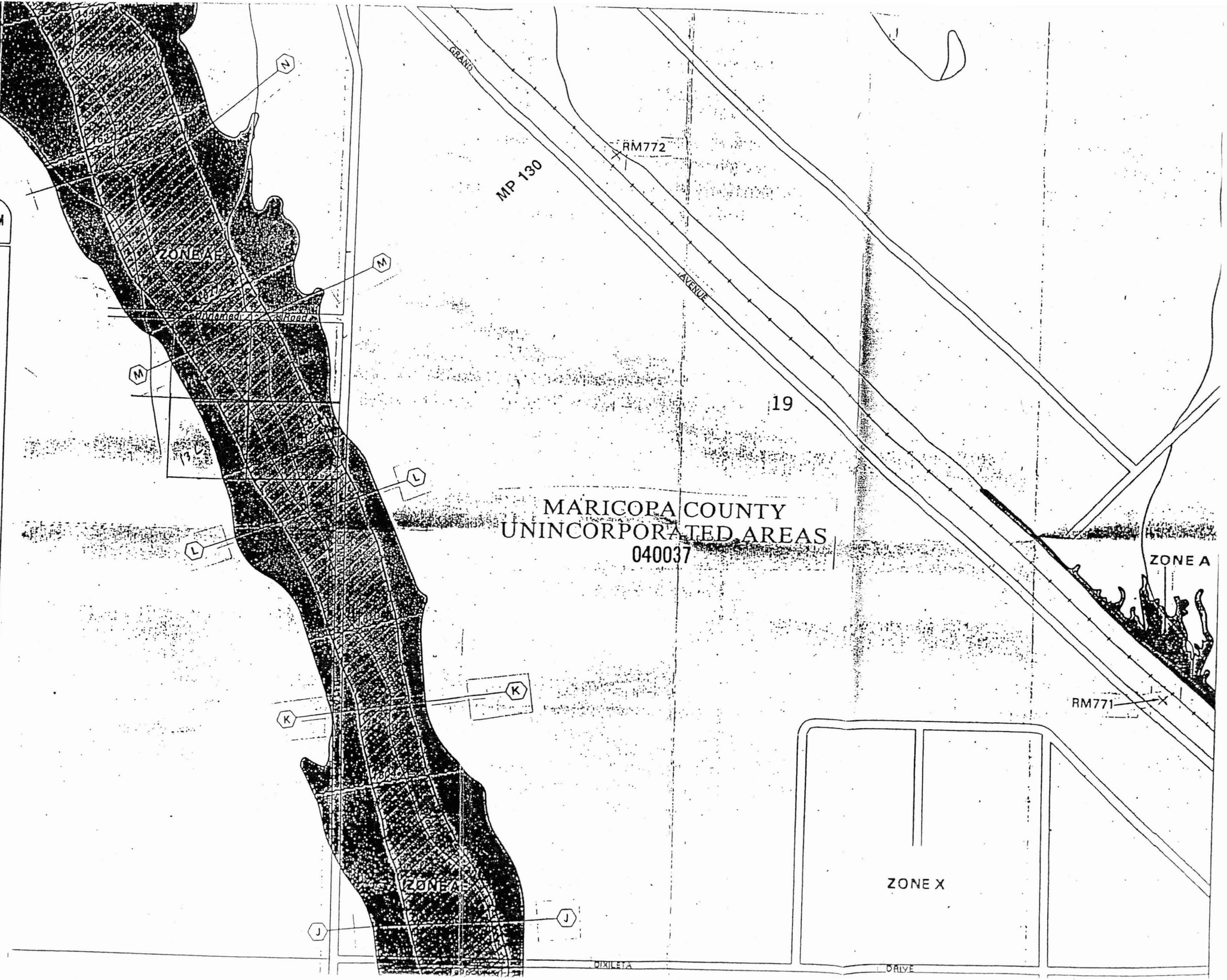
COMMUNITY	NUMBER	PANEL	SUFFIX
MARICOPA COUNTY, UNINCORPORATED AREAS	040037	0694	E

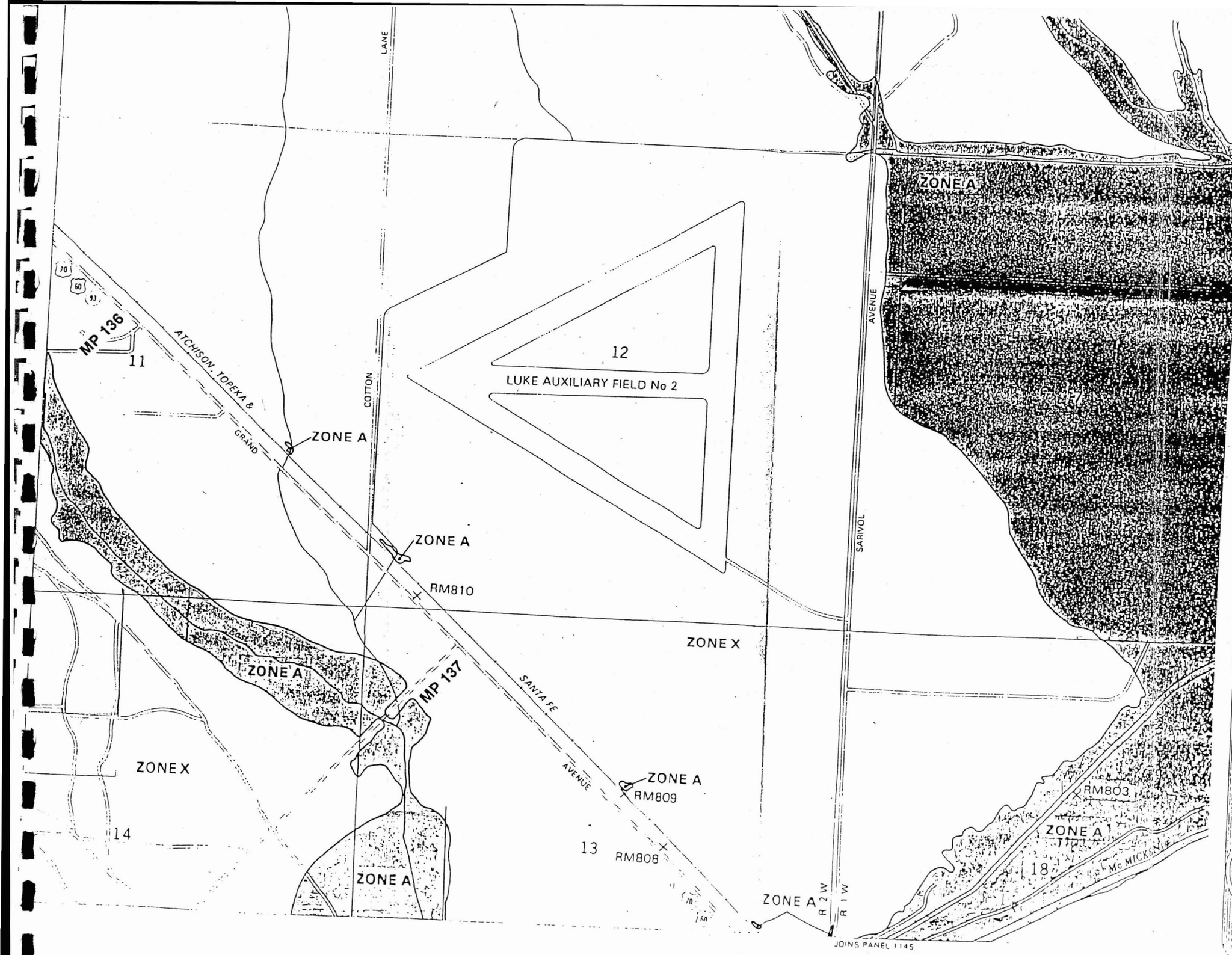
Scale: 1"=500'

MAP NUMBER
04013C0694 E

MAP REVISED:
SEPTEMBER 4, 1991

Federal Emergency Management A





NATIONAL FLOOD INSURANCE PROGRA

FIRM
FLOOD INSURANCE RATE MAP

MARICOPA COUNTY, ARIZONA AND INCORPORATED AREAS

PANEL 1135 OF 4350

CONTAINS

COMMUNITY	NUMBER	PANEL	SUFFIX
MARICOPA COUNTY UNINCORPORATED AREAS	040037	1135	E

Scale: 1"=1000'

MAP NUMBER
04013C1135 E

MAP REVISED:
SEPTEMBER 4, 1991

Federal Emergency Management Agency

Appendix Q

Channel Calculations and Exhibits

DIBBLE & ASSOCIATES
Consulting Engineers

CHANNEL DESIGN SPREADSHEET

Date: 12-Mar-01
Job No.: 9727
Filepath: J:\9727\qp\drainage\pr2chann.wb3

Client Agency: **ADOT**
Job Name: US 60 Project 2

Channel Roughness Factors:

Concrete	Mannings n =	0.013	C
Earth	Mannings n =	0.035	E
Grass	Ret. Class =	D	G
Riprap	Mannings n =	0.040	R

Design Criteria:

Qdes Return Period: 50 yrs
Max Froude No.: 0.86

Subarea-Reach	Length [ft]	Slope [ft/ft]	Qdes [cfs]	Matl	SS (H:V) Left	SS (H:V) Right	B [ft]	Flow Depth [ft]	Qcalc [cfs] (1)	Vel. [fps] (2)	Froude # (3)	Tractive Shear Avg [psf] (4)	Tractive Shear Max [psf] (5)	FB [ft] (6)	Minimum Channel Section Depth [ft]	Topwidth [ft] (7)	Bend R [ft] (8)
	Site Input Data			Design Input Data													
Ditch 640																	
1	439	0.0089	38	E	4	4	8	1.0	39	3.27	0.67	0.410	0.555	1.00	2.00	24.0	48.0
2	279.2	0.0048	42	E	4	4	8	1.3	44	2.72	0.50	0.266	0.374	1.00	2.25	26.0	54.0
Ditch 601																	
1	398	0.0111	35	E	4	4	1	2.3	117	4.98	0.80	0.814	1.593	1.00	3.30	27.4	58.2
2	1636	0.0065	55	E	4	4	1	4.0	370	5.44	0.67	0.812	1.622	1.00	5.00	41.0	99.0
Ditch 674																	
1	1142	0.0063	31	E	4	4	8	1.9	116	3.92	0.61	0.492	0.747	1.00	2.90	31.2	69.6
2	1258	0.0057	52	E	4	4	8	2.1	136	3.94	0.59	0.484	0.747	1.00	3.10	32.8	74.4
3	1000	0.0100	86	E	4	4	8	2.2	198	5.35	0.78	0.882	1.373	1.00	3.20	33.6	76.8
4	411	0.0120	96	E	4	4	8	2.6	307	6.42	0.88 *	1.214	1.942	1.00	3.60	36.8	86.4
5	779	0.0041	107	E	4	4	8	4.8	696	5.33	0.56	0.702	1.228	1.31	6.11	56.9	139.2
Ditch 733																	
1	1200	0.0065	39	C	1	1	0	2.0	29	7.31	1.29 *	0.287	0.811	1.00	3.00	6.0	12.0
2	1000	0.0079	47	C	1	1	0	2.6	65	9.61	1.48 *	0.453	1.282	1.00	3.60	7.2	15.6
3	339	0.0162	55	C	1	1	0	3.1	149	15.47	2.19 *	1.108	3.134	1.70	4.80	9.6	18.6
4	1039	0.0064	79	C	1	1	0	6.1	568	15.26	1.54 *	0.861	2.436	2.43	8.53	17.1	36.6
5	1245	0.0058	90	C	1	1	0	4.1	187	11.15	1.37 *	0.525	1.484	1.51	5.61	11.2	24.6

(1) Qcalc = 1.486/n*A*R^(2/3)*S^(1/2) ; R=A/P
(2) Vel. = Q/A
(3) Froude # = Vel./(g*HDepth)^(1/2) ; HDepth = A/Flow topwidth
(4) TSAvg = G*R*S ; G=gamma, R=A/P
(5) TSMax = G*Depth*S
(6) Freeboard = 0.20*(Depth + (V^2/2g) ; Min FB =1 foot
(7) Channel Topwidth = topwidth at flow depth plus FB
(8) Minimum bend radius = 3*flow topwidth

Culvert & Channel System
(Station 720+72.94)

The culvert and channel system located at Station 720+72.94 consists of a 101-foot extension of a 4-10'x4' CBC and approximately 425-feet of concrete lined channel. In addition to flows through the culvert of 1023 cfs, the system receives flows of 107 cfs and 225 cfs from a roadside channel and a downstream collector channel respectively. The culvert also serves to drain a section of median but due to the small flow and relatively short time of concentration for the median, compared to the main channel, this flow is ignored.

The objective of this design is to convey the 50-year flow from the upstream side of US60 to the downstream side without increasing the downstream flooding potential. To accomplish this, it was deemed best to return the flow to it's historic flow condition as soon as possible after leaving the culvert. The proposed concrete channel accomplishes this by routing flow from the culvert to the existing natural wash.

The entire system from about 50-feet upstream to about 900-feet downstream of US60 was analyzed for both existing and proposed conditions using the Hydrologic Engineering Center's River Analysis System (HEC-RAS). According to the model, the existing natural wash lacks capacity for the 50-year event. Therefore, in keeping with the policy of returning flow to the existing condition by the right-of-way boundary, the proposed channel was designed to allow overtopping matching the existing conditions. Riprap is to be placed 5-feet wide along the right (west) channel edge to aid in the prevention of erosion. For additional erosion protection, all channels are designed with a 2-feet turn-down.

The system was also analyzed for main channel velocity differences at the point of discharge. forty lineal feet of riprap is proposed at the point of discharge in order to slow the flow in the main channel to within an acceptable ratio of the existing velocity. As indicated in **Table 1**, the main channel velocities downstream from the channel (R.S. 447) have not been increased over historic conditions.

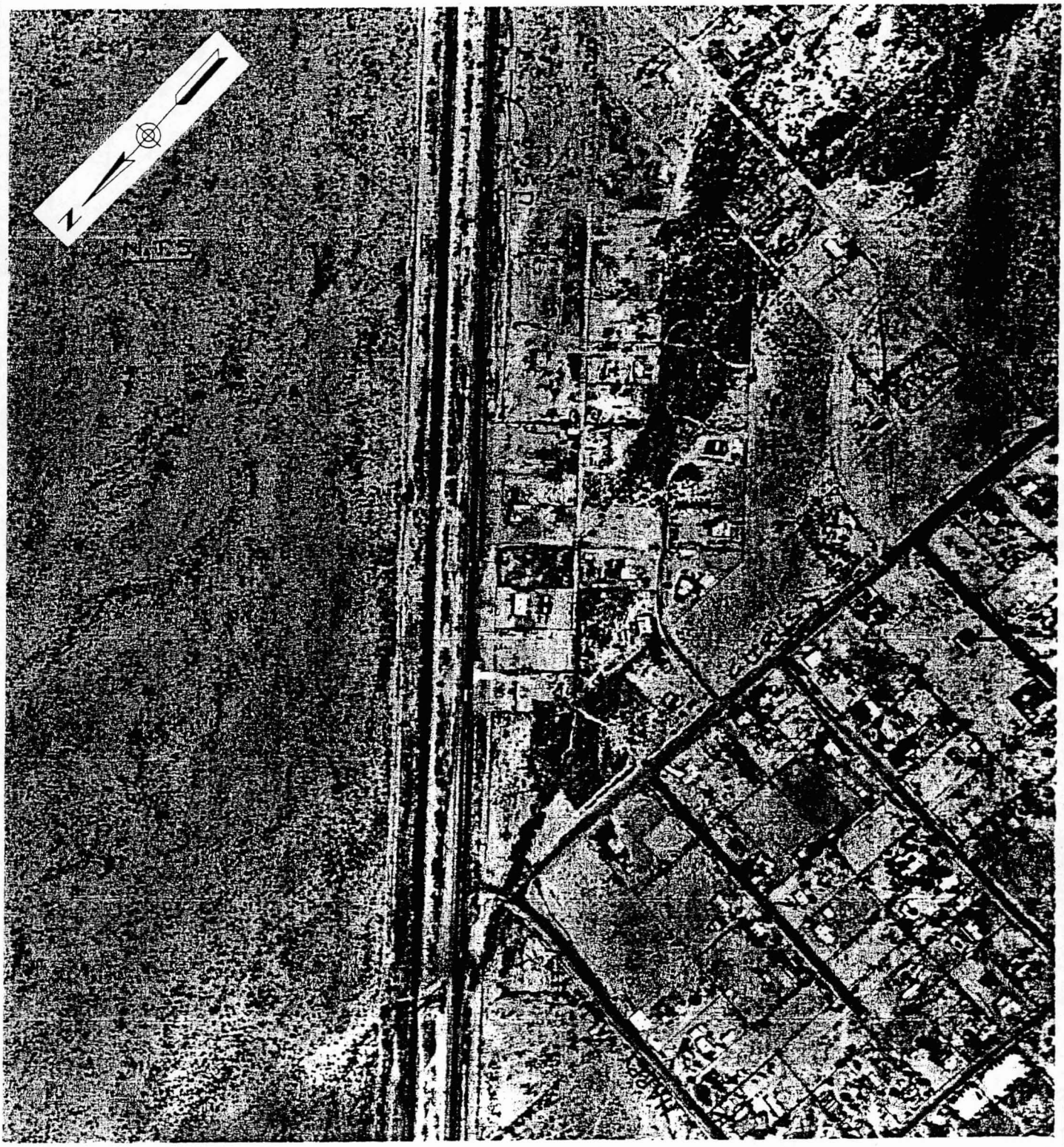
Table 1

River	Water Surface Elevation			Velocity (fps)			Ratio
Station	Improved	Existing	Compare	Improved	Existing	Compare	Imp./Exst.
1247	1424.67	1424.31	0.36	1.0	1.1	0.1	0.9
1204	1423.83	1423.49	0.34	6.5	6.4	-0.1	1.0
1188	1422.33	1422.27	0.06	9.9	9.2	-0.8	1.1
1147	1422.30	1422.78	-0.48	4.2	2.8	-1.4	1.5
1078	1422.06	1422.55	-0.49	4.2	3.4	-0.9	1.3
747	1420.56	1420.35	0.21	4.1	3.1	-1.0	1.3
647	1420.01	1420.21	-0.20	6.5	4.1	-2.4	1.6
600	1419.15	1420.11	-0.96	8.8	6.4	-2.4	1.4
547	1418.89	1419.72	-0.83	7.9	3.7	-4.3	2.2
447	1418.79	1418.47	0.32	3.3	4.0	0.7	0.8
347	1417.09	1417.09	0.00	3.7	3.7	0.0	1.0
247	1416.54	1416.54	0.00	4.1	4.1	0.0	1.0
147	1415.95	1415.95	0.00	2.6	2.6	0.0	1.0
47	1414.79	1414.79	0.00	3.6	3.6	0.0	1.0
1	1414.39	1414.39	0.00	2.4	2.4	0.0	1.0

To further show the effects of the proposed channel verses the existing condition, an exhibit showing the floodplain of the two cases is shown in **Exhibit 2**. As can be seen from the exhibit, the two floodplains are nearly identical. In some locations, the improved floodplain is smaller than the existing. However, there is one location where the floodplain is larger than existing. This can be explained by the slowing effects of the riprap lined section of channel which serves to slow the flow and thus increase the water surface elevation by 0.32 feet. The results of this are short-lived as the floodplain returns to its historic path a short distance downstream of this point. Not increasing the velocity in the downstream natural channel is more important that this short-lived increase in the floodplain width since the downstream environment is already stable under the existing conditions.

ARIZONA DEPARTMENT
OF TRANSPORTATION

US 60
HAPPY VALLEY/CITRUS AREA

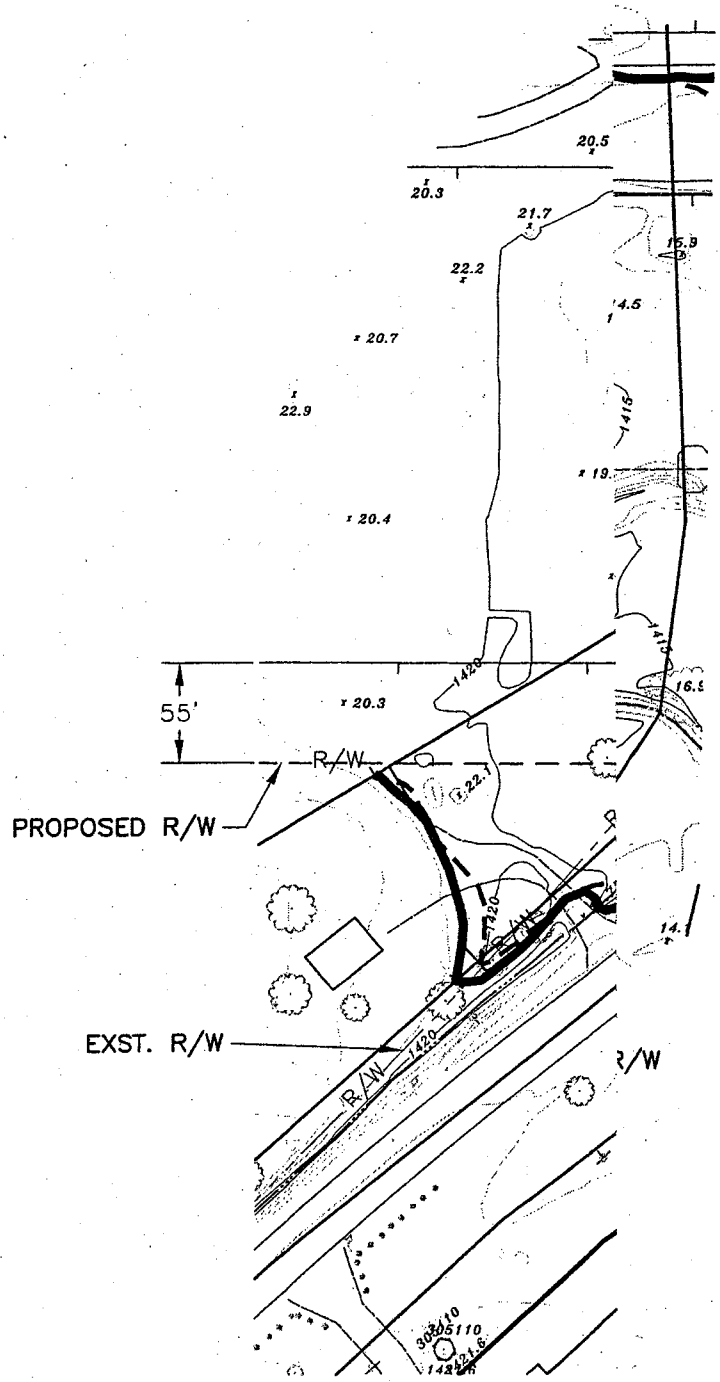


APPENDIX Q – EXHIBIT 1
EXISTING AERIAL

DIBBLE & ASSOCIATES
CONSULTING ENGINEERS

ARIZONA DEPARTMENT OF TRANSPORTATION

US 60
HAPPY VALLEY/CITRUS AREA



GRAPHIC SCALE

100 0 100 150

(IN FEET)
1 inch = 100 ft.

LEGEND

EXIST. FLOODPLAIN

PROPOSED FLOODPLAIN

PROJECT DESCRIPTION:
APPENDIX Q – EXHIBIT 2
EXISTING & PROPOSED FLOODPLAIN

CONSULTANT:
DIBBLE & ASSOCIATES
CONSULTING ENGINEERS
Since 1962

Filename: exh01-fplan.dwg Last Revised: 06/29/2000, 17:05:33 Plotted: 06/30/2
Cross References: XPLSH=J:\9727\ACAD\9727plsh.dwg, XPLAN=J:\9727\ACAD\HEC-RAS-SECTjij.dw

HEC-RAS September 1998 Version 2.2
U.S. Army Corp of Engineers
Hydrologic Engineering Center
609 Second Street, Suite D
Davis, California 95616-4687
(916) 756-1104

```
X     X  XXXXXX    XXXX        XXXX       XX      XXXX
X     X  X        X    X      X   X     X  X    X
X     X  X        X           X   X    X    X   X
XXXXXXX  XXXX     X       XXX XXXX     XXXXXX    XXXX
X     X  X        X           X  X     X    X        X
X     X  X        X    X      X   X    X    X        X
X     X  XXXXXX    XXXX       X    X   X    X   XXXXX
```

PROJECT DATA
Project Title: Station 720 Wash
Project File : Dan.prj
Run Date and Time: 7/5/00 1:36:08 PM

Project in English units

Project Description:
TEMP HEC2 HEADER

PLAN DATA

Plan Title: Plan 01
Plan File : j:\9727\HEC-RAS\Dan.p01

Geometry Title: Exist Conditions
Geometry File : j:\9727\HEC-RAS\Dan.g01

Flow Title : 50-yr flow
Flow File : j:\9727\HEC-RAS\Dan.f01

Plan Summary Information:

Number of:	Cross Sections	= 18	Mulitple Openings	=	0
	Culverts	= 2	Inline Weirs	=	0
	Bridges	= 1			

Computational Information

Water surface calculation tolerance	= 0.01
Critical depth calculaton tolerance	= 0.01
Maximum number of interations	= 20
Maximum difference tolerance	= 0.3
Flow tolerance factor	= 0.001

Computation Options

Critical depth computed only where necessary	
Conveyance Calculation Method:	At breaks in n values only
Friction Slope Method:	Average Conveyance
Computational Flow Regime:	Subcritical Flow

FLOW DATA

Flow Title: 100-yr flow
Flow File : j:\9727\HEC-RAS\Dan.f01

Flow Data (cfs)

River	Reach	RS	PF 1
RIVER-1	Reach-1	1247	1023
RIVER-1	Reach-1	947	1130
RIVER-1	Reach-1	547	1355

Boundary Conditions

River	Reach	Profile	Upstream	Downstream
RIVER-1	Reach-1	PF 1		Normal S = .005

GEOMETRY DATA

Geometry Title: Exist Conditions
Geometry File : j:\9727\HEC-RAS\Dan.g01

CROSS SECTION RIVER: RIVER-1
REACH: Reach-1 RS: 1247

INPUT
Description: Cross section has vertical extension on left end due to lack of topo data
Station Elevation Data num= 83

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
827	1420.2	834.25	1420.66	839.59	1421.02	847.41	1420.49	852.68	1420.06
855.53	1419.8	864.07	1420.07	868.03	1420.12	888.33	1420.08	889.13	1420.09
913.59	1420.5	929.67	1420.49	940.98	1420.56	945.56	1420.54	952.83	1420.43
955.47	1420.4	964.22	1422.98	966.66	1423.54	969.41	1422.6	976.05	1420.21
981.57	1420	981.8	1419.98	989.52	1418.41	991.46	1418.34	1000.41	1418.65
1002.18	1418.9	1009.17	1417.72	1012.65	1417.73	1016.93	1417.77	1020.38	1417.98
1021.64	1418	1033.23	1418.38	1036.82	1418.42	1042.21	1418.54	1048.85	1418.7
1055.39	1419	1065	1418.92	1068.62	1419	1070.91	1419.03	1074.14	1419.45
1082.8	1419.2	1085.08	1419.24	1086.42	1419.24	1097.01	1419.28	1110.01	1419.49
1126.39	1419.9	1128.23	1419.89	1133.06	1419.89	1145.5	1420.13	1147.39	1420.16
1172.39	1420.5	1177.33	1420.57	1183.48	1420.63	1206.01	1421.03	1212.55	1421.11
1234.42	1421.4	1244.02	1421.42	1256.16	1421.63	1265.33	1421.82	1280.89	1422.1
1296.42	1422.2	1300.56	1422.25	1306.34	1422.19	1317.47	1422.36	1322.89	1422.28
1333.03	1422.6	1339.77	1422.62	1360.42	1422.77	1362.45	1422.77	1404.63	1423
1406.67	1423	1410.39	1423.04	1446.02	1423.45	1454.32	1423.54	1509.78	1423.95
1513.95	1424	1519.14	1424.03	1565.1	1424.43	1572.56	1424.47	1606.06	1424.63
1618.43	1424.8	1628.26	1424.89	1670.54	1425.06				

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
827	.06	1002.18	.035	1048.85	.06

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
1002.18	1048.85	42.77	42.77	42.77	.3	.5

Left Levee Station= 966.66 Elevation= 1423.54

CROSS SECTION OUTPUT Profile #PF 1

			Left OB	Channel	Right OB
E.G. Elev (ft)	1424.32	Element			
Vel Head (ft)	0.01	Wt. n-Val.	0.060	0.035	0.060
W.S. Elev (ft)	1424.31	Reach Len. (ft)	42.77	42.77	42.77
Crit W.S. (ft)	1420.29	Flow Area (sq ft)	694.77	284.65	1217.61
E.G. Slope (ft/ft)	0.000056	Area (sq ft)	694.77	284.65	1217.61
Q Total (cfs)	1023.00	Flow (cfs)	315.74	301.00	406.27
Top Width (ft)	724.80	Top Width (ft)	175.18	46.67	502.95
Vel Total (ft/s)	0.47	Avg. Vel. (ft/s)	0.45	1.06	0.33

Max Chl Dpth (ft)	6.59	Hydr. Depth (ft)	3.97	6.10	2.42
Conv. Total (cfs)	136885.2	Conv. (cfs)	42248.2	40275.7	54361.4
Length Wtd. (ft)	42.77	Wetted Per. (ft)	180.57	46.79	503.03
Min Ch El (ft)	1417.72	Shear (lb/sq ft)	0.01	0.02	0.01
Alpha	2.02	Stream Power (lb/ft s)	0.01	0.02	0.00
Frctn Loss (ft)	0.01	Cum Volume (acre-ft)	4.87	6.24	6.50
C & E Loss (ft)	0.19	Cum SA (acres)	3.43	3.70	6.78

Warning: The cross-section end points had to be extended vertically for the computed water surface.
Warning: The velocity head has changed by more than 0.5 ft (0.15 m). This may indicate the need for
additional cross sections.
Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.

CROSS SECTION RIVER: RIVER-1
REACH: Reach-1 RS: 1204

INPUT
Description: us side of rr bridge
Station Elevation Data num= 35

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
248	1419.9	289.65	1420.21	294.19	1420.26	298.26	1420.28	504.97	1421.69
510.81	1421.7	519.85	1421.79	525.78	1421.84	710.55	1423.39	713.25	1423.41
717.06	1423.5	720.35	1423.49	808.12	1424.26	890.19	1425.02	895.01	1425.06
898.04	1425.1	900.85	1425.03	903.31	1424.64	973.16	1425.58	975.92	1425.83
1002.18	1418.9	1009.17	1417.72	1012.65	1417.73	1016.93	1417.77	1020.38	1417.98
1031.29	1426.3	1074.66	1426.68	1109.34	1426.97	1227.97	1427.58	1269.53	1427.74
1433.38	1429.1	1638.62	1430.15	1639.19	1430.16	1671.41	1430.43	1685.36	1430.54

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
248	.06	975.92	.035	1031.29	.06

Bank Sta: Left Right Lengths: Left Channel Right Coeff Contr. Expan.
975.92 1031.29 56.52 56.52 56.52 .3 .5
Left Levee Station= 975.92 Elevation= 1425.83

CROSS SECTION OUTPUT Profile #PF 1

			Left OB	Channel	Right OB
E.G. Elev (ft)	1424.13	Element			
Vel Head (ft)	0.63	Wt. n-Val.		0.035	
W.S. Elev (ft)	1423.49	Reach Len. (ft)	1.00	1.00	1.00
Crit W.S. (ft)	1422.07	Flow Area (sq ft)		160.07	
E.G. Slope (ft/ft)	0.004221	Area (sq ft)		160.07	
Q Total (cfs)	1023.00	Flow (cfs)		1023.00	
Top Width (ft)	42.82	Top Width (ft)		42.82	
Vel Total (ft/s)	6.39	Avg. Vel. (ft/s)		6.39	
Max Chl Dpth (ft)	5.77	Hydr. Depth (ft)		3.74	
Conv. Total (cfs)	15746.3	Conv. (cfs)		15746.3	
Length Wtd. (ft)	1.00	Wetted Per. (ft)		45.39	
Min Ch El (ft)	1417.72	Shear (lb/sq ft)		0.93	
Alpha	1.00	Stream Power (lb/ft s)		5.94	
Frctn Loss (ft)	0.00	Cum Volume (acre-ft)	4.53	6.02	5.90
C & E Loss (ft)	0.00	Cum SA (acres)	3.35	3.65	6.54

BRIDGE RIVER: RIVER-1
REACH: Reach-1 RS: 1203.9

INPUT
Description:
Distance from Upstream XS = 1
Deck/Roadway Width = 15
Weir Coefficient = 2.6
Bridge Deck/Roadway Skew =
Upstream Deck/Roadway Coordinates
num= 4

Sta	Hi Cord	Lo Cord	Sta	Hi Cord	Lo Cord	Sta	Hi Cord	Lo Cord
872	1425.5		970	1426.1	1424.1	1030	1426.4	1424.4
1075	1426.7							

Upstream Bridge Cross Section Data
Station Elevation Data num= 35

1160 1423.5

Downstream Bridge Cross Section Data
Station Elevation Data num= 57

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
449	1417.3	499.86	1417.73	538.24	1418.02	596.88	1418.65	631.81	1418.99
682.41	1419.2	690.22	1419.25	697.08	1419.3	704.8	1419.33	715.39	1419.37
823.34	1420.5	825.65	1420.52	854.81	1420.84	907.66	1421.38	911.55	1421.42
913.78	1421.5	951.46	1421.73	965.61	1421.83	976.49	1421.92	980	1416.7
1000	1416.7	1020	1416.7	1025.99	1421.92	1048	1422.3	1066.02	1422.57
1100.63	1422.77	1113.14	1422.8	1155.75	1422.99	1195.62	1423.31	1223.6	1423.5
1264.85	1423.81	1303.89	1424	1345.19	1424.29	1372	1424.45	1397.67	1424.57
1412.34	1424.65	1454.44	1425	1460.85	1425	1461.93	1425.01	1486.02	1425.11
1512.93	1425.23	1544.89	1425.5	1561.53	1425.57	1562.46	1425.59	1605.2	1425.87
1656.83	1426.15	1675.75	1426.3	1712.27	1426.47	1745.43	1426.73	1772.62	1426.95
1799.35	1427.18	1842.26	1427.6	1859.84	1427.73	1875.41	1427.86	1922.97	1428.18
1980.06	1428.57	1992.54	1428.6						

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
449	.06	449	.035	1992.54	.06

Bank Sta: Left Right Coeff Contr. Expan.
449 1992.54 .3 .5
Left Levee Station= 976.49 Elevation= 1422.5

Upstream Embankment side slope = 0 horiz. to 1.0 vertical
Downstream Embankment side slope = 0 horiz. to 1.0 vertical
Maximum allowable submergence for weir flow = .95
Elevation at which weir flow begins =
Energy head used in spillway design =
Spillway height used in design =
Weir crest shape = Broad Crested

Number of Culverts = 1

Culvert Name	Shape	Rise	Span
Culvert #1	Box	4	40

FHWA Chart # 8 - flared wingwalls
FHWA Scale # 1 - Wingwall flared 30 to 75 deg.
Solution Criteria = Highest U.S. EG

Culvert	Upstrm Dist	Length	n Value	Entrance Loss Coef	Exit Loss Coef
	65	100	.013	.62	1

Upstream Elevation = 1417.2
Centerline Station = 1000
Downstream Elevation = 1416.7
Centerline Station = 1000

CULVERT OUTPUT Profile #PF 1
Culvert ID : Culvert #1

Culv Q (cfs)	1007.43	Culv Vel In (ft/s)	6.30
# Barrels	1	Culv Vel Out (ft/s)	6.30
Q Barrel (cfs)	1007.43	Culv Inv El Up (ft)	1417.20
E.G. US. (ft)	1422.73	Culv Inv El Dn (ft)	1416.70
W.S. US. (ft)	1422.55	Culv Frctn Ls (ft)	0.14
Delta EG (ft)	0.79	Culv Ext Lss (ft)	0.27
Delta WS (ft)	0.95	Culv Ent Lss (ft)	0.38
E.G. IC (ft)	1421.62	Q Weir (cfs)	15.57
E.G. OC (ft)	1422.73	Weir Sta Lft (ft)	976.49
Culvert Control	Outlet	Weir Sta Rgt (ft)	1051.86
Culv WS In (ft)	1421.20	Weir Submerg	0.00
Culv WS Out (ft)	1420.70	Weir Max Depth (ft)	0.26
Culv Nml Depth (ft)		Weir Avg Depth (ft)	0.18
Culv Crt Depth (ft)	2.70	Wr Flw Area (sq ft)	13.59
Culv Ful Lngh (ft)	100.00	Min Top Rd (ft)	1422.46

CROSS SECTION RIVER: RIVER-1
REACH: Reach-1 RS: 977

INPUT
Description: ds face of exist. us60 bridge
Station Elevation Data num= 57

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
449	1417.3	499.86	1417.73	538.24	1418.02	596.88	1418.65	631.81	1418.99

682.41	1419.2	690.22	1419.25	697.08	1419.3	704.8	1419.33	715.39	1419.37
823.34	1420.5	825.65	1420.52	854.81	1420.84	907.66	1421.38	911.55	1421.42
913.78	1421.5	951.46	1421.73	965.61	1421.83	976.49	1421.92	980	1416.7
1000	1416.7	1020	1416.7	1025.99	1421.92	1048	1422.3	1066.02	1422.57
1100.63	1422.77	1113.14	1422.8	1155.75	1422.99	1195.62	1423.31	1223.6	1423.5
1264.85	1423.81	1303.89	1424	1345.19	1424.29	1372	1424.45	1397.67	1424.57
1412.34	1424.65	1454.44	1425	1460.85	1425	1461.93	1425.01	1486.02	1425.11
1512.93	1425.23	1544.89	1425.5	1561.53	1425.57	1562.46	1425.59	1605.2	1425.87
1656.83	1426.15	1675.75	1426.3	1712.27	1426.47	1745.43	1426.73	1772.62	1426.95
1799.35	1427.18	1842.26	1427.6	1859.84	1427.73	1875.41	1427.86	1922.97	1428.18
1980.06	1428.57	1992.54	1428.6						

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
449	.06	449	.035	1992.54	.06

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
449	1992.54	99.96	99.96	99.96	.3	.5

Left Levee Station= 976.49 Elevation= 1422.5

CROSS SECTION OUTPUT Profile #PF 1

E.G. Elev (ft)	1421.94	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.34	Wt. n-Val.		0.035	
W.S. Elev (ft)	1421.60	Reach Len. (ft)	99.96	99.96	99.96
Crit W.S. (ft)	1419.36	Flow Area (sq ft)		217.71	
E.G. Slope (ft/ft)	0.001879	Area (sq ft)		217.71	
Q Total (cfs)	1023.00	Flow (cfs)		1023.00	
Top Width (ft)	48.91	Top Width (ft)		48.91	
Vel Total (ft/s)	4.70	Avg. Vel. (ft/s)		4.70	
Max Chl Dpth (ft)	4.90	Hydr. Depth (ft)		4.45	
Conv. Total (cfs)	23600.8	Conv. (cfs)		23600.8	
Length Wtd. (ft)	99.96	Wetted Per. (ft)		53.36	
Min Ch El (ft)	1416.70	Shear (lb/sq ft)		0.48	
Alpha	1.00	Stream Power (lb/ft s)		2.25	
Frctn Loss (ft)	0.40	Cum Volume (acre-ft)	4.53	3.83	4.87
C & E Loss (ft)	0.19	Cum SA (acres)	3.35	3.06	5.63

Warning: The velocity head has changed by more than 0.5 ft (0.15 m). This may indicate the need for additional cross sections.

Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.

CROSS SECTION RIVER: RIVER-1
REACH: Reach-1 RS: 947

INPUT
Description:
Station Elevation Data num= 119

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
900	1421.2	903.82	1421.24	918.5	1421.47	920.41	1421.53	921.42	1421.57
932.3	1421.5	943.3	1421.21	944.86	1421.19	946.8	1421.14	958.6	1420.92
968.95	1420.5	970.74	1420.43	978.77	1419.86	983.09	1419.62	984.16	1419.69
984.38	1418.5	985.77	1417.85	990.8	1417.3	994.82	1416.53	1004.02	1416.62
1007.01	1416.6	1016.39	1417.32	1016.63	1417.35	1028.32	1419.29	1038.22	1421.03
1039.13	1421	1041.48	1420.73	1045.91	1420.23	1050.3	1419.7	1061.19	1419.58
1062.2	1419.6	1064.74	1419.56	1090.08	1419.5	1093.08	1419.5	1102.57	1419.17
1106.23	1419	1116.78	1418.95	1135.5	1418.74	1137.41	1418.72	1139.55	1418.77
1148.05	1419	1153.76	1419.09	1167.02	1419.2	1184.42	1419.53	1185.42	1419.55
1190.42	1419.6	1216.02	1420.02	1221.28	1420.08	1247.67	1420.21	1254.5	1420.23
1263.24	1420.2	1279.34	1420.19	1289.58	1420.24	1303.82	1420.23	1308.6	1420.25
1312.22	1420.3	1325.72	1420.31	1343.68	1420.37	1353.99	1420.42	1364.71	1420.52
1373.76	1420.6	1389.43	1420.68	1397.61	1420.78	1406.28	1420.9	1424.42	1421.21
1428.22	1421.2	1433.79	1421.22	1439.08	1421.22	1447.37	1421.2	1454.83	1421.32
1471.29	1421.5	1487.94	1421.62	1496.96	1421.65	1506.22	1421.77	1520.79	1422.04
1536.33	1422	1545.68	1422.19	1555.12	1422.23	1570.1	1422.4	1585.89	1422.42
1595.53	1422.4	1605.34	1422.51	1621.54	1422.69	1634.41	1422.69	1644.66	1422.74
1658.49	1422.9	1669.22	1422.97	1694.97	1423.19	1708.49	1423.33	1718.82	1423.37
1733.33	1423.4	1744.32	1423.54	1755.53	1423.74	1775.38	1423.8	1786.94	1423.95
1807.15	1424.1	1823.25	1424.13	1844.7	1424.3	1857.91	1424.51	1870.96	1424.74
1883.26	1424.7	1895.54	1424.72	1908.39	1424.82	1921.37	1424.92	1932.59	1424.98
1961.38	1425.2	1967.63	1425.28	2005.48	1425.58	2020.8	1425.61	2037.44	1425.75
2039.58	1425.8	2041.36	1425.79	2058.87	1425.99	2076.71	1425.96	2076.79	1425.96
2095.66	1426.3	2114.64	1426.42	2133.1	1426.45	2138.76	1426.47		

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
900	.06	958.6	.035	1038.22	.06

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
958.6	1038.22	110.92	110.92	110.92	.3	.5

Left Levee Station= 921.42 Elevation= 1421.57
Right Levee Station= 1038.22 Elevation= 1421.03

CROSS SECTION OUTPUT Profile #PF 1

E.G. Elev (ft)	1421.34	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.99	Wt. n-Val.		0.035	
W.S. Elev (ft)	1420.35	Reach Len. (ft)	110.92	110.92	110.92
Crit W.S. (ft)	1420.21	Flow Area (sq ft)		141.60	
E.G. Slope (ft/ft)	0.012271	Area (sq ft)		141.60	
Q Total (cfs)	1130.00	Flow (cfs)		1130.00	
Top Width (ft)	62.52	Top Width (ft)		62.52	
Vel Total (ft/s)	7.98	Avg. Vel. (ft/s)		7.98	
Max Chl Dpth (ft)	3.82	Hydr. Depth (ft)		2.27	
Conv. Total (cfs)	10201.0	Conv. (cfs)		10201.0	
Length Wtd. (ft)	110.92	Wetted Per. (ft)		64.06	
Min Ch El (ft)	1416.53	Shear (lb/sq ft)		1.69	
Alpha	1.00	Stream Power (lb/ft s)		13.51	
Frctn Loss (ft)	0.56	Cum Volume (acre-ft)	4.53	3.42	4.87
C & E Loss (ft)	0.42	Cum SA (acres)	3.35	2.93	5.63

Warning: The velocity head has changed by more than 0.5 ft (0.15 m). This may indicate the need for additional cross sections.
Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.

CROSS SECTION RIVER: RIVER-1
REACH: Reach-1 RS: 847

INPUT
Description:
Station Elevation Data num= 157

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
879	1420.7	883.19	1420.82	886.26	1420.88	888.19	1420.96	900.58	1420.65
906.14	1420.5	910.38	1420.36	913.47	1420.11	920.17	1419.6	927.8	1419.57
934.73	1419.6	939.8	1419.55	957.01	1419.94	959.23	1420.04	962.88	1420.34
969.02	1421	972.92	1421.14	973.03	1420.95	989.72	1418.88	997.6	1418.19
1000.31	1416	1000.86	1415.8	1003.1	1414.94	1004.22	1414.95	1009.17	1415
1013.22	1416.7	1015.46	1417.65	1018.9	1417.9	1027.3	1418.7	1038.4	1418.93
1041.15	1418.9	1043.35	1418.94	1048.75	1418.93	1059.87	1419	1065.82	1418.79
1077.8	1418.5	1084.09	1418.36	1086.46	1418.34	1091.31	1418.39	1105.01	1418.51
1111.19	1418.6	1133.68	1418.62	1139.88	1418.63	1144.93	1418.68	1167.35	1418.88
1194.61	1418.7	1196.51	1418.72	1215.09	1418.81	1223.94	1418.87	1233.71	1418.9
1244.14	1419	1266.29	1419.02	1271.23	1419.04	1287.9	1419.33	1300.98	1419.38
1303.81	1419.3	1308.27	1419.26	1323.25	1419.37	1331.84	1419.43	1342.78	1419.59
1359.26	1419.9	1360.64	1419.95	1361.18	1419.95	1382.28	1419.87	1386.88	1420.03
1407.4	1420.1	1415.24	1420.1	1417.12	1420.12	1421.08	1419.93	1421.9	1419.99
1424.17	1420	1432.44	1420.14	1436.69	1420.25	1437.56	1420.26	1438.23	1420.31
1467.47	1421.7	1474.97	1422.04	1486.47	1422.29	1494.01	1422.39	1498.53	1422.49
1517	1422.8	1528.91	1423.01	1532.57	1422.99	1545.21	1422.89	1558.83	1423.28
1564.79	1423.5	1577.85	1423.7	1581.94	1423.72	1590.73	1423.81	1606.58	1423.85
1615.23	1424	1623.87	1424.04	1641.39	1424.22	1648.18	1424.38	1664.42	1424.87
1670.83	1424.9	1689.18	1424.79	1697.81	1425.13	1711.27	1425.29	1713.04	1425.31
1730.65	1425.2	1738.4	1424.96	1763.75	1425.24	1764.75	1425.23	1765.52	1425.25
1784.22	1425.2	1789.43	1425.16	1789.64	1425.17	1813.86	1425.68	1837.15	1425.68
1839.58	1425.7	1842.04	1425.77	1862.92	1426.11	1882.33	1426.15	1882.49	1426.15
1888.82	1426.2	1900	1426.28	1909.68	1426.41	1913.89	1426.36	1914.7	1426.35
1916.69	1426.3	1923.36	1426.2	1928.36	1426.1	1951.61	1426.22	1962.47	1426.25
1965.38	1426.3	1993.82	1426.56	2000.18	1426.57	2010.17	1426.73	2019.67	1426.75
2025.9	1426.9	2053.09	1427.14	2058.07	1427.15	2062.06	1427.21	2076.33	1427.2
2092.8	1427.3	2093.99	1427.24	2095.45	1427.25	2125.77	1427.42	2132.37	1427.47
2141.44	1427.7	2151.52	1427.66	2152.22	1427.67	2158.99	1427.75	2185.89	1427.7
2189.7	1427.7	2199.34	1427.4	2224.56	1426.75	2228.46	1426.52	2235.53	1426.53
2247.26	1426.5	2254.36	1426.56	2265.2	1427.25	2273.49	1427.56	2280.89	1427.67
2287.23	1427.6	2289.57	1427.65						

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val

879 .06 989.72 .035 1038.4 .06

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
989.72	1038.4	88.53	88.53	88.53	.3	.5

Left Levee Station= 972.92 Elevation= 1421.14

CROSS SECTION OUTPUT Profile #PF 1

			Left OB	Channel	Right OB
E.G. Elev (ft)	1420.36	Element			
Vel Head (ft)	0.15	Wt. n-Val.	0.060	0.035	0.060
W.S. Elev (ft)	1420.21	Reach Len. (ft)	88.53	88.53	88.53
Crit W.S. (ft)	1419.65	Flow Area (sq ft)	7.10	130.86	421.35
E.G. Slope (ft/ft)	0.002760	Area (sq ft)	7.10	130.86	421.35
Q Total (cfs)	1130.00	Flow (cfs)	6.99	552.33	570.69
Top Width (ft)	455.99	Top Width (ft)	10.70	48.68	396.62
Vel Total (ft/s)	2.02	Avg. Vel. (ft/s)	0.98	4.22	1.35
Max Chl Dpth (ft)	5.27	Hydr. Depth (ft)	0.66	2.69	1.06
Conv. Total (cfs)	21511.0	Conv. (cfs)	133.0	10514.3	10863.8
Length Wtd. (ft)	88.53	Wetted Per. (ft)	10.78	50.26	396.65
Min Ch El (ft)	1414.94	Shear (lb/sq ft)	0.11	0.45	0.18
Alpha	2.36	Stream Power (lb/ft s)	0.11	1.89	0.25
Frctn Loss (ft)	0.14	Cum Volume (acre-ft)	4.52	3.07	4.33
C & E Loss (ft)	0.05	Cum SA (acres)	3.33	2.79	5.13

Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.

CROSS SECTION RIVER: RIVER-1
REACH: Reach-1 RS: 747

INPUT
Description:
Station Elevation Data num= 191

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
857	1420.4	857.94	1420.42	864.05	1420.47	871.13	1420.28	880.87	1419.88
883.08	1419.6	889.53	1419.07	893.74	1418.69	902.65	1418.64	908.91	1418.6
929.79	1418	934.06	1417.89	943.13	1418.51	946.01	1418.71	957.44	1419.72
965.66	1419.8	966.75	1419.86	970.93	1419.29	976.39	1418.48	978.53	1418.45
989.27	1418.2	996.11	1415.45	997.64	1414.88	998.22	1414.91	1002.5	1414.99
1003.88	1415.4	1011.23	1417.67	1021.05	1417.99	1023.22	1418.04	1026.3	1418.04
1049.38	1418.2	1057.56	1418.23	1072.73	1418.16	1082.62	1418.13	1093.15	1418.18
1102.57	1418.1	1107.9	1418.1	1117.4	1418.17	1123.62	1418.21	1129.62	1418.21
1140.85	1418.3	1153.9	1418.28	1160.21	1418.33	1168.35	1418.3	1174.04	1418.35
1184.71	1418.3	1205.33	1418.39	1209.64	1418.44	1214.61	1418.39	1216.7	1418.4
1243.21	1418.5	1249.55	1418.49	1254.24	1418.51	1270.28	1418.57	1282.19	1418.63
1284.26	1418.6	1286.69	1418.64	1316.17	1418.77	1318.4	1418.78	1326.36	1418.73
1341.2	1418.6	1348.51	1418.79	1356.43	1419.14	1360.74	1419.17	1368.31	1419.24
1383.64	1419.4	1397.63	1419.57	1418.57	1419.81	1428.85	1419.87	1448.05	1419.98
1451.53	1420.1	1453.23	1420.08	1459.36	1420.13	1464.7	1420.08	1468.98	1420.05
1477.44	1419.7	1477.81	1419.69	1491.3	1420.04	1498.18	1419.81	1501.24	1419.79
1508.83	1419.7	1518.29	1420.08	1531.34	1420.41	1541.24	1420.67	1548.54	1420.83
1552.64	1420.9	1565.32	1421.33	1574	1421.41	1582.48	1421.56	1594.99	1421.74
1604.76	1421.8	1610.85	1421.9	1613.7	1421.85	1625.15	1421.87	1629.69	1422.39
1642.82	1422.7	1644.61	1422.81	1647.2	1422.92	1649.92	1423.08	1663.53	1423.9
1668.25	1423.4	1683.59	1423.47	1685.37	1423.46	1705.67	1423.55	1714.58	1423.42
1723.24	1423.2	1726.14	1423.12	1729.99	1422.94	1730.23	1422.93	1758.3	1422.13
1760.31	1422.1	1762.72	1422.03	1774.14	1422.08	1794.53	1421.6	1795.95	1421.57
1797.76	1421.6	1828.71	1421.5	1840.85	1421.59	1866.63	1421.61	1866.82	1421.61
1893.46	1421.8	1897.27	1421.75	1901.77	1421.56	1905.12	1421.37	1911.15	1421.87
1912.54	1422	1914.45	1422.02	1932.53	1422.15	1935.53	1422.15	1950.29	1422.16
1960.86	1422.2	1970.27	1422.24	1984.16	1422.3	1998.58	1422.42	2010.66	1422.46
2021.24	1422.5	2036.35	1422.68	2038.31	1422.69	2041.85	1422.69	2058.68	1422.73
2074.46	1422.7	2077.89	1422.71	2082.02	1422.73	2096.9	1423.03	2106.6	1423.11
2113.14	1423.1	2117.3	1423.23	2124.73	1423.37	2125.03	1423.37	2130.06	1423.35
2137.19	1423.4	2148.11	1423.85	2148.83	1423.88	2161.85	1423.96	2163.24	1423.95
2177.73	1424.1	2178.42	1423.93	2178.94	1424.11	2183.18	1424.4	2187.32	1424.11
2190.58	1424.2	2199.34	1424.55	2216.04	1424.73	2224.97	1424.79	2231.03	1424.81
2249.58	1425.1	2256.97	1425.17	2276.09	1425.07	2283.91	1425	2296.75	1424.91
2313.26	1424.7	2321.22	1424.68	2336.76	1424.85	2342.41	1424.82	2363.41	1424.82
2368.41	1424.8	2382.58	1424.66	2394.11	1424.5	2399.77	1424.36	2405.96	1424.23
2422.34	1424.2	2431.15	1424.18	2438.15	1424.3	2439.22	1424.33	2440.05	1424.34
2448.78	1424.5	2450.25	1424.43	2454.93	1424.15	2460.74	1424.74	2461.1	1424.77
2463.58	1424.3								

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
857	.06	989.27	.035	1023.22	.06

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
989.27	1023.22	100.59	100.59	100.59	.3	.5

Left Levee Station= 965.66 Elevation= 1419.8

CROSS SECTION OUTPUT Profile #PF 1

E.G. Elev (ft)	1420.17	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.06	Wt. n-Val.	0.060	0.035	0.060
W.S. Elev (ft)	1420.11	Reach Len. (ft)	100.59	100.59	100.59
Crit W.S. (ft)	1419.19	Flow Area (sq ft)	147.61	115.16	631.75
E.G. Slope (ft/ft)	0.001061	Area (sq ft)	147.61	115.16	631.75
Q Total (cfs)	1130.00	Flow (cfs)	141.22	352.27	636.51
Top Width (ft)	639.76	Top Width (ft)	114.01	33.95	491.80
Vel Total (ft/s)	1.26	Avg. Vel. (ft/s)	0.96	3.06	1.01
Max Chl Dpth (ft)	5.23	Hydr. Depth (ft)	1.29	3.39	1.28
Conv. Total (cfs)	34695.6	Conv. (cfs)	4336.0	10816.0	19543.5
Length Wtd. (ft)	100.59	Wetted Per. (ft)	114.26	34.99	491.85
Min Ch El (ft)	1414.88	Shear (lb/sq ft)	0.09	0.22	0.09
Alpha	2.26	Stream Power (lb/ft s)	0.08	0.67	0.09
Frctn Loss (ft)	0.18	Cum Volume (acre-ft)	4.37	2.82	3.26
C & E Loss (ft)	0.05	Cum SA (acres)	3.21	2.71	4.23

Warning: Divided flow computed for this cross-section.
Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.

CROSS SECTION RIVER: RIVER-1
REACH: Reach-1 RS: 647

INPUT
Description: us face of hv road
Station Elevation Data num= 87

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
836	1419.3	844.71	1419.48	866.55	1419.23	880.09	1418.98	885.55	1419.02
894.52	1418.9	895.77	1418.87	902.93	1418.85	906.14	1418.83	912.98	1418.87
917.81	1418.7	922.74	1418.74	928.18	1418.81	938.49	1419.23	941.86	1419.35
950.78	1419.3	953.15	1419.41	964.18	1419.07	965.56	1418.97	967.87	1418.91
982.53	1418.4	991	1418.05	1000	1414.2	1022.53	1417.9	1028.55	1417.9
1030.35	1417.92	1048.9	1418.05	1055.42	1418.17	1066.3	1418.3	1081.64	1418.64
1085.3	1418.7	1090.51	1418.75	1108.3	1418.81	1109.47	1418.8	1136.29	1418.96
1171.11	1419.28	1175.23	1419.3	1180.28	1419.37	1216.32	1419.9	1224.62	1420
1225.86	1420.01	1234.52	1420.11	1265.13	1420.4	1273.96	1420.5	1317.42	1420.6
1319.79	1420.63	1321.36	1420.63	1358.62	1421.05	1366.67	1421.1	1451.52	1421.42
1457.99	1421.43	1483.09	1421.53	1508.59	1421.6	1560.14	1421.8	1570.4	1421.8
1655.34	1422.1	1663.11	1422.13	1700.82	1422.14	1751.77	1422.1	1763.41	1422.05
1766.11	1422.04	1842.48	1421.67	1845.6	1421.67	1865.84	1421.7	1871.75	1421.65
1913.1	1421.62	1917.86	1421.61	1918.65	1421.6	1965.77	1421.7	1966.21	1421.7
1970.9	1421.71	2014.45	1421.87	2017.28	1421.88	2050.95	1422.2	2054.65	1422.25
2087.93	1422.36	2090.76	1422.38	2137.64	1422.88	2140.33	1422.9	2191.77	1423.41
2198.97	1423.47	2283.77	1424.22	2367.87	1424.04	2369.3	1424	2460.98	1424.04
2462.63	1424.06	2492.94	1424.16						

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
836	.06	967.87	.035	1081.64	.06

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
967.87	1081.64	100	100	100	.3	.5

Left Levee Station= 953.15 Elevation= 1419.41

CROSS SECTION OUTPUT Profile #PF 1

E.G. Elev (ft)	1419.94	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.22	Wt. n-Val.	0.060	0.035	0.060
W.S. Elev (ft)	1419.72	Reach Len. (ft)	100.00	100.00	100.00
Crit W.S. (ft)	1419.16	Flow Area (sq ft)	81.18	235.18	77.73
E.G. Slope (ft/ft)	0.003548	Area (sq ft)	81.18	235.18	77.73
Q Total (cfs)	1130.00	Flow (cfs)	86.46	958.75	84.79
Top Width (ft)	367.86	Top Width (ft)	131.87	113.77	122.22
Vel Total (ft/s)	2.87	Avg. Vel. (ft/s)	1.07	4.08	1.09
Max Chl Dpth (ft)	5.52	Hydr. Depth (ft)	0.62	2.07	0.64
Conv. Total (cfs)	18972.1	Conv. (cfs)	1451.6	16097.0	1423.5

Length Wtd. (ft)	100.00	Wetted Per. (ft)	132.32	114.88	122.23
Min Ch El (ft)	1414.20	Shear (lb/sq ft)	0.14	0.45	0.14
Alpha	1.74	Stream Power (lb/ft s)	0.14	1.85	0.15
Frctn Loss (ft)		Cum Volume (acre-ft)	4.10	2.42	2.44
C & E Loss (ft)		Cum SA (acres)	2.92	2.54	3.52

Warning: The parabolic search method failed to converge on critical depth. The program will try the
cross section slice/secant method to find critical depth.
Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid,
energy was used.

CULVERT RIVER: RIVER-1
REACH: Reach-1 RS: 646.9

INPUT
Description:
Distance from Upstream XS = .1
Deck/Roadway Width = 40
Weir Coefficient = 2.6
Bridge Deck/Roadway Skew =
Upstream Deck/Roadway Coordinates
num= 4

Sta	Hi Cord	Lo Cord	Sta	Hi Cord	Lo Cord	Sta	Hi Cord	Lo Cord
960	1418.7		980	1418.7	1417.2	1020	1418.5	1417
1060	1418.5							

Upstream Bridge Cross Section Data
Station Elevation Data num= 87

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
836	1419.3	844.71	1419.48	866.55	1419.23	880.09	1418.98	885.55	1419.02
894.52	1418.9	895.77	1418.87	902.93	1418.85	906.14	1418.83	912.98	1418.87
917.81	1418.7	922.74	1418.74	928.18	1418.81	938.49	1419.23	941.86	1419.35
950.78	1419.3	953.15	1419.41	964.18	1419.07	965.56	1418.97	967.87	1418.91
982.53	1418.4	991	1418.05	1000	1414.2	1022.53	1417.9	1028.55	1417.9
1030.35	1417.92	1048.9	1418.05	1055.42	1418.17	1066.3	1418.3	1081.64	1418.64
1085.3	1418.7	1090.51	1418.75	1108.3	1418.81	1109.47	1418.8	1136.29	1418.96
1171.11	1419.28	1175.23	1419.3	1180.28	1419.37	1216.32	1419.9	1224.62	1420
1225.86	1420.01	1234.52	1420.11	1265.13	1420.4	1273.96	1420.5	1317.42	1420.6
1319.79	1420.63	1321.36	1420.63	1358.62	1421.05	1366.67	1421.1	1451.52	1421.42
1457.99	1421.43	1483.09	1421.53	1508.59	1421.6	1560.14	1421.8	1570.4	1421.8
1655.34	1422.1	1663.11	1422.13	1700.82	1422.14	1751.77	1422.1	1763.41	1422.05
1766.11	1422.04	1842.48	1421.67	1845.6	1421.67	1865.84	1421.7	1871.75	1421.65
1913.1	1421.62	1917.86	1421.61	1918.65	1421.6	1965.77	1421.7	1966.21	1421.7
1970.9	1421.71	2014.45	1421.87	2017.28	1421.88	2050.95	1422.2	2054.65	1422.25
2087.93	1422.36	2090.76	1422.38	2137.64	1422.88	2140.33	1422.9	2191.77	1423.41
2198.97	1423.47	2283.77	1424.22	2367.87	1424.04	2369.3	1424	2460.98	1424.04
2462.63	1424.06	2492.94	1424.16						

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
836	.06	967.87	.035	1081.64	.06

Bank Sta: Left Right Coeff Contr. Expan.
967.87 1081.64 .3 .5
Left Levee Station= 953.15 Elevation= 1419.41

Downstream Deck/Roadway Coordinates
num= 4

Sta	Hi Cord	Lo Cord	Sta	Hi Cord	Lo Cord	Sta	Hi Cord	Lo Cord
960	1418.7		980	1418.7	1417.2	1020	1418.5	1417
1060	1418.5							

Downstream Bridge Cross Section Data
Station Elevation Data num= 87

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
836	1419.3	844.71	1419.48	866.55	1419.23	880.09	1418.98	885.55	1419.02
894.52	1418.9	895.77	1418.87	902.93	1418.85	906.14	1418.83	912.98	1418.87
917.81	1418.7	922.74	1418.74	928.18	1418.81	938.49	1419.23	941.86	1419.35
950.78	1419.3	953.15	1419.41	964.18	1419.07	965.56	1418.97	967.87	1418.91
982.53	1418.4	991	1418.05	1000	1414.2	1022.53	1417.9	1028.55	1417.9
1030.35	1417.92	1048.9	1418.05	1055.42	1418.17	1066.3	1418.3	1081.64	1418.64
1085.3	1418.7	1090.51	1418.75	1108.3	1418.81	1109.47	1418.8	1136.29	1418.96
1171.11	1419.28	1175.23	1419.3	1180.28	1419.37	1216.32	1419.9	1224.62	1420

```
 1225.86 1420.01 1234.52 1420.11 1265.13  1420.4 1273.96  1420.5 1317.42  1420.6
 1319.79 1420.63 1321.36 1420.63 1358.62 1421.05 1366.67  1421.1 1451.52 1421.42
 1457.99 1421.43 1483.09 1421.53 1508.59  1421.6 1560.14  1421.8  1570.4  1421.8
 1655.34  1422.1 1663.11 1422.13 1700.82 1422.14 1751.77  1422.1 1763.41 1422.05
 1766.11 1422.04 1842.48 1421.67  1845.6 1421.67 1865.84  1421.7 1871.75 1421.65
  1913.1 1421.62 1917.86 1421.61 1918.65  1421.6 1965.77  1421.7 1966.21  1421.7
  1970.9 1421.71 2014.45 1421.87 2017.28 1421.88 2050.95  1422.2 2054.65 1422.25
 2087.93 1422.36 2090.76 1422.38 2137.64 1422.88 2140.33  1422.9 2191.77 1423.41
 2198.97 1423.47 2283.77 1424.22 2367.87 1424.04  2369.3    1424 2460.98 1424.04
 2462.63 1424.06 2492.94 1424.16

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
     836     .06  967.87    .035 1081.64     .06

Bank Sta: Left   Right    Coeff Contr.   Expan.
        967.87 1081.64              .3       .5
Left Levee       Station=  953.15      Elevation= 1419.41

Upstream Embankment side slope              =       0 horiz. to 1.0 vertical
Downstream Embankment side slope            =       0 horiz. to 1.0 vertical
Maximum allowable submergence for weir flow =     .95
Elevation at which weir flow begins         =
Energy head used in spillway design         =
Spillway height used in design              =
Weir crest shape                            = Broad Crested

Number of Culverts =  1

Culvert Name      Shape      Rise    Span
Culvert #1            Box       4      10
FHWA Chart # 8 - flared wingwalls
FHWA Scale # 1 - Wingwall flared 30 to 75 deg.
Solution Criteria = Highest U.S. EG
Culvert Upstrm Dist  Length    n Value   Entrance Loss Coef   Exit Loss Coef
               100      60       .013                 .62                1
Upstream   Elevation =  1416.3
           Centerline Station =  1300
Downstream Elevation =  1416.1
           Centerline Station =  1300

CULVERT OUTPUT    Profile #PF 1
Culvert ID : Culvert #1

  Culv Q (cfs)            121.46   Culv Vel In (ft/s)        3.68
  # Barrels                    1   Culv Vel Out (ft/s)       3.47
  Q Barrel (cfs)          121.46   Culv Inv El Up (ft)    1416.30
  E.G. US. (ft)          1419.94   Culv Inv El Dn (ft)    1416.10
  W.S. US. (ft)          1419.72   Culv Frctn Ls (ft)        0.02
  Delta EG (ft)             0.15   Culv Ext Lss (ft)
  Delta WS (ft)             0.56   Culv Ent Lss (ft)         0.13
  E.G. IC (ft)           1419.88   Q Weir (cfs)           1008.54
  E.G. OC (ft)           1419.94   Weir Sta Lft (ft)       836.00
  Culvert Control         Outlet   Weir Sta Rgt (ft)      1218.81
  Culv WS In (ft)        1419.60   Weir Submerg              0.31
  Culv WS Out (ft)       1419.60   Weir Max Depth (ft)       1.71
  Culv Nml Depth (ft)       1.61   Weir Avg Depth (ft)       0.97
  Culv Crt Depth (ft)       1.66   Wr Flw Area (sq ft)     372.25
  Culv Ful Lngh (ft)               Min Top Rd (ft)        1418.22


Warning: During subcritical analysis, with the exit loss set =1.0, the projected WSEL in culvert
has a
         lower energy than the downstream energy.  Most likely, the downstream cross section
         blocks part of the culvert or the ineffective area is set too far in.  Instead of
projecting the
         WSEL, the program did an energy balance to get the WSEL inside the culvert at the
         downstream end.

CROSS SECTION          RIVER: RIVER-1
REACH: Reach-1            RS: 600

INPUT
Description: ds face of hv road
Station Elevation Data    num=      87
     Sta     Elev     Sta     Elev     Sta     Elev     Sta     Elev     Sta     Elev
```

836	1419.3	844.71	1419.48	866.55	1419.23	880.09	1418.98	885.55	1419.02
894.52	1418.9	895.77	1418.87	902.93	1418.85	906.14	1418.83	912.98	1418.87
917.81	1418.7	922.74	1418.74	928.18	1418.81	938.49	1419.23	941.86	1419.35
950.78	1419.3	953.15	1419.41	964.18	1419.07	965.56	1418.97	967.87	1418.91
982.53	1418.4	991	1418.05	1000	1414.2	1022.53	1417.9	1028.55	1417.9
1030.35	1417.92	1048.9	1418.05	1055.42	1418.17	1066.3	1418.3	1081.64	1418.64
1085.3	1418.7	1090.51	1418.75	1108.3	1418.81	1109.47	1418.8	1136.29	1418.96
1171.11	1419.28	1175.23	1419.3	1180.28	1419.37	1216.32	1419.9	1224.62	1420
1225.86	1420.01	1234.52	1420.11	1265.13	1420.4	1273.96	1420.5	1317.42	1420.6
1319.79	1420.63	1321.36	1420.63	1358.62	1421.05	1366.67	1421.1	1451.52	1421.42
1457.99	1421.43	1483.09	1421.53	1508.59	1421.6	1560.14	1421.8	1570.4	1421.8
1655.34	1422.1	1663.11	1422.13	1700.82	1422.14	1751.77	1422.1	1763.41	1422.05
1766.11	1422.04	1842.48	1421.67	1845.6	1421.67	1865.84	1421.7	1871.75	1421.65
1913.1	1421.62	1917.86	1421.61	1918.65	1421.6	1965.77	1421.7	1966.21	1421.7
1970.9	1421.71	2014.45	1421.87	2017.28	1421.88	2050.95	1422.2	2054.65	1422.25
2087.93	1422.36	2090.76	1422.38	2137.64	1422.88	2140.33	1422.9	2191.77	1423.41
2198.97	1423.47	2283.77	1424.22	2367.87	1424.04	2369.3	1424	2460.98	1424.04
2462.63	1424.06	2492.94	1424.16						

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
836	.06	967.87	.035	1081.64	.06

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
967.87	1081.64	100	100	100	.3	.5

Left Levee Station= 953.15 Elevation= 1419.41

CROSS SECTION OUTPUT Profile #PF 1

E.G. Elev (ft)	1419.79	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.63	Wt. n-Val.	0.060	0.035	0.060
W.S. Elev (ft)	1419.16	Reach Len. (ft)	100.00	100.00	100.00
Crit W.S. (ft)	1419.16	Flow Area (sq ft)	0.82	171.60	20.77
E.G. Slope (ft/ft)	0.013458	Area (sq ft)	0.82	171.60	20.77
Q Total (cfs)	1130.00	Flow (cfs)	0.59	1104.33	25.08
Top Width (ft)	196.50	Top Width (ft)	6.54	113.77	76.19
Vel Total (ft/s)	5.85	Avg. Vel. (ft/s)	0.72	6.44	1.21
Max Chl Dpth (ft)	4.96	Hydr. Depth (ft)	0.13	1.51	0.27
Conv. Total (cfs)	9740.6	Conv. (cfs)	5.1	9519.3	216.2
Length Wtd. (ft)	100.00	Wetted Per. (ft)	6.55	114.88	76.19
Min Ch El (ft)	1414.20	Shear (lb/sq ft)	0.11	1.25	0.23
Alpha	1.18	Stream Power (lb/ft s)	0.08	8.08	0.28
Frctn Loss (ft)	0.62	Cum Volume (acre-ft)	4.01	1.95	2.33
C & E Loss (ft)	0.27	Cum SA (acres)	2.77	2.28	3.29

Warning: The energy equation could not be balanced within the specified number of iterations. The
program used critical depth for the water surface and continued on with the calculations.
Warning: The velocity head has changed by more than 0.5 ft (0.15 m). This may indicate the need for
additional cross sections.
Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.
Warning: The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate the need for additional cross sections.
Warning: During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated water surface came back below critical depth. This indicates
that there is not a valid subcritical answer. The program defaulted to critical depth.
Warning: The parabolic search method failed to converge on critical depth. The program will try the
cross section slice/secant method to find critical depth.
Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid,
energy was used.

CROSS SECTION RIVER: RIVER-1
REACH: Reach-1 RS: 547

INPUT
Description:
Station Elevation Data num= 211

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
799	1418.5	804.61	1418.65	815.35	1418.63	819.18	1418.59	820.57	1418.47

823.31	1418.1	824.04	1418.03	827.8	1417.54	835.34	1416.45	841.26	1416.15
847.85	1415.9	855.17	1416.32	866.74	1416.34	869.59	1416.19	874.75	1415.95
879.56	1415.9	880.75	1415.94	888.98	1416.06	895.67	1416.45	896.22	1416.46
901.09	1416.3	910.84	1416.25	914.7	1416.24	919.51	1416.22	936.25	1416.69
938.64	1416.8	951.59	1417.68	954.09	1417.92	960.19	1418.47	977.1	1418.42
983.95	1418.3	987.46	1416.99	999.45	1413.83	1001.07	1413.83	1002.01	1413.84
1012.87	1416.8	1015.87	1417.5	1022.75	1417.94	1028.45	1417.9	1030.7	1417.95
1034.87	1417.9	1039.67	1418.01	1050.83	1418.09	1051.68	1418.1	1054.76	1418.13
1057.09	1418.1	1067.88	1418.23	1067.96	1418.23	1076.57	1418.1	1089.95	1417.98
1100.37	1417.9	1109.01	1417.9	1115.36	1417.81	1115.67	1417.81	1122.15	1417.49
1131.14	1415.1	1133.53	1415.9	1139.39	1417.74	1148.53	1417.76	1157.6	1417.3
1159.2	1417.1	1160.93	1417.16	1162.67	1417.17	1177.09	1417.23	1186.52	1417.48
1189.38	1417.5	1201.82	1417.29	1217.6	1417.25	1225.11	1417.24	1233.43	1417.41
1254.54	1417.7	1261.45	1417.56	1269.86	1417.72	1278.94	1417.75	1286.2	1417.71
1291.79	1417.5	1308.65	1417.84	1312.29	1417.67	1314.62	1417.82	1323.79	1417.68
1344.89	1417.8	1352.7	1417.8	1365.21	1417.95	1372.41	1418	1377.66	1418
1390.86	1418	1406.16	1418.09	1412.11	1418.15	1438.02	1418.54	1446.64	1418.65
1449.3	1418.7	1460.55	1419.02	1471.03	1418.81	1478.26	1418.78	1490.64	1418.73
1513.92	1419	1532.16	1419.21	1540.52	1419.24	1546.66	1419.36	1577.82	1419.92
1579.79	1420	1590.18	1420.28	1613.45	1421	1615.83	1421.04	1618.71	1421.07
1636.76	1421.3	1651.02	1421.46	1657.74	1421.52	1665.13	1421.54	1672.12	1421.49
1688.06	1421.6	1695.35	1421.69	1711.32	1421.83	1712.12	1421.84	1713.55	1421.85
1716.19	1421.9	1720.89	1422.3	1723.05	1422.42	1725.34	1422.16	1742.55	1422.29
1748.55	1422.3	1755.15	1422.25	1767.8	1422.12	1782.28	1422.17	1788.33	1422.14
1798.16	1422	1809.13	1422	1815.73	1422.02	1828.17	1421.78	1828.85	1421.78
1856.39	1421.7	1859.04	1421.71	1863.93	1421.68	1871.97	1421.6	1884.9	1421.41
1885.62	1421.4	1891.63	1421.55	1895.04	1421.78	1908.81	1421.8	1929.08	1421.61
1932.72	1421.5	1938.49	1421.42	1944.58	1421.47	1950.33	1421.57	1954.94	1421.39
1958.55	1421.3	1965.08	1421.34	1970.69	1421.41	1972.61	1421.41	1976.58	1421.41
2010.74	1421.5	2014.92	1421.53	2016.56	1421.55	2026	1421.58	2033.75	1421.55
2036.96	1421.6	2043.75	1421.31	2044.9	1421.32	2049.11	1421.55	2052.66	1421.99
2053.99	1422.2	2055.53	1422.16	2065.1	1422.26	2067.67	1422.33	2073.19	1422.31
2076.58	1422.7	2125.74	1423.03	2149.39	1423.08	2160.44	1423.1	2167.38	1423.11
2172.93	1423.1	2178.1	1423.23	2182.76	1423.74	2183.13	1423.8	2184.83	1423.91
2185.59	1423.9	2187.18	1423.96	2226.35	1424.33	2227.49	1424.34	2232.51	1424.5
2234.52	1424.5	2247.6	1424.35	2261.58	1424.57	2268.15	1424.72	2279.64	1424.78
2315.49	1424.5	2323.42	1424.47	2328.63	1424.46	2339.01	1424.4	2350.01	1424.31
2359.86	1424.3	2371.9	1424.23	2374.21	1424.33	2377.07	1423.73	2378.79	1423.26
2393.4	1423	2403.11	1422.86	2420.87	1422.79	2430.91	1422.78	2440.79	1422.65
2456.59	1422.4	2471.38	1422.5	2482.3	1422.52	2492.21	1422.62	2496.46	1422.63
2499.17	1422.7	2508.93	1422.73	2509.9	1422.76	2535.14	1423.15	2546.42	1423.06
2550.19	1423.2								

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
799	.06	977.1	.035	1039.67	.06

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
977.1	1039.67	100	100	100	.3	.5

Left Levee Station= 960.19 Elevation= 1418.47

CROSS SECTION OUTPUT Profile #PF 1

E.G. Elev (ft)	1418.57	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.10	Wt. n-Val.	0.060	0.035	0.060
W.S. Elev (ft)	1418.47	Reach Len. (ft)	100.00	100.00	100.00
Crit W.S. (ft)	1418.47	Flow Area (sq ft)	264.25	104.67	305.00
E.G. Slope (ft/ft)	0.003857	Area (sq ft)	264.25	104.67	305.00
Q Total (cfs)	1355.00	Flow (cfs)	575.58	384.26	395.16
Top Width (ft)	612.82	Top Width (ft)	156.53	62.57	393.72
Vel Total (ft/s)	2.01	Avg. Vel. (ft/s)	2.18	3.67	1.30
Max Chl Dpth (ft)	4.64	Hydr. Depth (ft)	1.69	1.67	0.77
Conv. Total (cfs)	21817.0	Conv. (cfs)	9267.5	6187.0	6362.5
Length Wtd. (ft)	100.00	Wetted Per. (ft)	156.80	63.71	394.51
Min Ch El (ft)	1413.83	Shear (lb/sq ft)	0.41	0.40	0.19
Alpha	1.57	Stream Power (lb/ft s)	0.88	1.45	0.24
Frctn Loss (ft)	0.40	Cum Volume (acre-ft)	3.71	1.64	1.95
C & E Loss (ft)	0.01	Cum SA (acres)	2.58	2.07	2.75

Warning: The energy equation could not be balanced within the specified number of iterations. The
program used critical depth for the water surface and continued on with the calculations.
Warning: During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated water surface came back below critical depth. This

indicates
that there is not a valid subcritical answer. The program defaulted to critical depth.
Warning: The parabolic search method failed to converge on critical depth. The program will try the
cross section slice/secant method to find critical depth.

CROSS SECTION RIVER: RIVER-1
REACH: Reach-1 RS: 447

INPUT
Description:
Station Elevation Data num= 213

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
767	1417.8	768.79	1417.87	771.39	1417.94	772.62	1417.93	776.85	1417.86
788.19	1417.8	791.44	1417.47	801.9	1415.29	802.47	1415.2	803.52	1415.2
815.04	1415.2	822.91	1415.17	839.16	1415.18	845.66	1415.21	846.55	1415.22
857.2	1415.4	860.19	1415.47	865.4	1415.56	868.16	1415.56	870.23	1415.56
875.89	1415.6	889.22	1415.73	905.62	1415.63	916.32	1415.57	933.83	1415.58
938.7	1415.6	940.56	1415.58	944.44	1415.62	953.91	1415.82	969.11	1416.14
974.65	1417.1	977.25	1417.5	981.77	1416.4	990.44	1415.06	993.62	1414.84
999.31	1413.1	1012.86	1416.13	1014.33	1416.72	1015.56	1416.8	1022.7	1417.24
1027.47	1417.6	1030.12	1417.25	1033.02	1416.95	1052.08	1416.92	1053.4	1416.87
1053.6	1416.9	1054.68	1416.86	1064.49	1416.56	1073.57	1416.59	1078.65	1416.55
1087.71	1417	1088.74	1417.02	1090.89	1417	1100.73	1416.9	1106.56	1416.74
1114.6	1416.6	1120.38	1416.52	1129.19	1416.58	1143.09	1416.88	1145.13	1416.91
1149.25	1417	1154.35	1416.99	1173.06	1417	1183.06	1416.97	1189.21	1416.98
1215.62	1417.1	1220.89	1417.19	1227.92	1417.21	1237.56	1417.24	1244.44	1417.28
1255.39	1417.3	1269.2	1417.33	1273.43	1417.33	1276.55	1417.35	1292.81	1417.32
1308.77	1417.3	1314.95	1417.05	1322.44	1417.24	1325.87	1417.21	1328.77	1417.25
1349.9	1417.4	1360.9	1417.4	1365.78	1417.44	1372.41	1417.47	1387.76	1417.58
1392.63	1417.5	1415.8	1417.67	1426.43	1417.84	1440.51	1418.03	1458.56	1418.06
1460.56	1418.1	1490.63	1418.47	1496.67	1418.51	1505.06	1418.65	1516.62	1418.74
1524.26	1418.8	1551.53	1418.98	1554.94	1419.01	1573.56	1419.12	1590.3	1419.36
1596.35	1419.5	1620.8	1419.95	1627.98	1420.13	1637.28	1420.13	1640.02	1420.23
1648.28	1420.7	1655.38	1421.24	1668.32	1422.2	1685.34	1422.55	1686.54	1422.58
1707.22	1422.7	1714.51	1422.76	1723.34	1422.77	1727.44	1422.81	1752.17	1422.83
1755.38	1422.8	1755.99	1422.7	1758.75	1422.03	1768.75	1421.97	1781.45	1421.9
1794.61	1422.1	1804.64	1421.99	1806.23	1422.12	1819.73	1422.15	1830.62	1422.09
1837.19	1422	1841.42	1422.04	1854	1422.03	1857.38	1421.93	1866.22	1421.58
1871.82	1421.3	1884.49	1420.52	1887.69	1420.49	1905.37	1420.48	1915.17	1420.62
1919.76	1420.6	1921.75	1420.62	1940.87	1420.6	1946.55	1420.65	1952.46	1420.84
1956.71	1421.2	1960.29	1421.47	1961.27	1421.48	1976.48	1421.76	1979	1421.8
1980.18	1421.8	1985.57	1421.76	1996.69	1421.71	2006.81	1421.68	2029.92	1421.8
2051.26	1422	2061.14	1422.17	2075.02	1422.31	2081.68	1422.28	2083.05	1422.28
2087.5	1422.5	2096.5	1422.45	2098.12	1422.46	2108.42	1422.83	2113.26	1422.85
2121.11	1423	2142.52	1423.21	2153.17	1423.31	2175.7	1423.55	2192.35	1423.6
2196.09	1423.5	2204.35	1423.53	2208.63	1423.59	2211.57	1423.6	2214.71	1423.89
2216.75	1424	2219.36	1424.11	2238.01	1424.23	2256.08	1424.32	2263.54	1424.43
2266.32	1424.4	2274.08	1424.35	2280.86	1424.3	2287.68	1424.33	2302.38	1424.56
2311.84	1424.4	2318.14	1424.39	2352.72	1424.44	2357.34	1424.31	2358.23	1424.31
2369.65	1424.3	2371.3	1424.3	2374.55	1424.13	2383.79	1423.8	2391.48	1423.74
2400.43	1423.7	2402.85	1423.63	2406.96	1423.59	2409.74	1423.14	2411.73	1422.8
2434.1	1422.3	2436.74	1422.26	2465.45	1422.2	2468.03	1422.17	2490.66	1422.16
2514.69	1422.3	2516.22	1422.31	2518.97	1422.33	2534.97	1422.44	2542.68	1422.32
2556.17	1422.4	2556.68	1422.38	2567.65	1422.46	2568.91	1422.49	2569.45	1422.48
2569.94	1422.5	2572.59	1422.53	2585.65	1422.89				

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
767	.06	977.25	.035	1030.12	.06

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
977.25	1030.12	100	100	100	.3	.5

Left Levee Station= 977.25 Elevation= 1417.5

CROSS SECTION OUTPUT Profile #PF 1

E.G. Elev (ft)	1417.63	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.13	Wt. n-Val.	0.060	0.035	0.060
W.S. Elev (ft)	1417.50	Reach Len. (ft)	100.00	100.00	100.00
Crit W.S. (ft)	1417.50	Flow Area (sq ft)	348.96	91.73	151.16
E.G. Slope (ft/ft)	0.004172	Area (sq ft)	348.96	91.73	151.16
Q Total (cfs)	1355.00	Flow (cfs)	847.70	368.23	139.07
Top Width (ft)	583.42	Top Width (ft)	186.11	50.79	346.52
Vel Total (ft/s)	2.29	Avg. Vel. (ft/s)	2.43	4.01	0.92
Max Chl Dpth (ft)	4.40	Hydr. Depth (ft)	1.88	1.81	0.44

Conv. Total (cfs)	20978.5	Conv. (cfs)	13124.3	5701.0	2153.2
Length Wtd. (ft)	100.00	Wetted Per. (ft)	186.46	51.78	346.58
Min Ch El (ft)	1413.10	Shear (lb/sq ft)	0.49	0.46	0.11
Alpha	1.56	Stream Power (lb/ft s)	1.18	1.85	0.10
Frctn Loss (ft)	0.42	Cum Volume (acre-ft)	3.00	1.41	1.43
C & E Loss (ft)	0.03	Cum SA (acres)	2.18	1.94	1.90

Warning: The energy equation could not be balanced within the specified number of iterations. The
program selected the water surface that had the least amount of error between computed and assumed values.
Warning: Divided flow computed for this cross-section.
Warning: During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated water surface came back below critical depth. This indicates
that there is not a valid subcritical answer. The program defaulted to critical depth.
Warning: The parabolic search method failed to converge on critical depth. The program will try the
cross section slice/secant method to find critical depth.

CROSS SECTION RIVER: RIVER-1
REACH: Reach-1 RS: 347

INPUT
Description:
Station Elevation Data num= 206

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
738	1417.7	743.76	1417.67	757.6	1417.44	759.69	1417.4	761.53	1417.15
762.65	1417	771.32	1415.22	773.55	1414.79	775.76	1414.77	783.29	1414.72
796.24	1414.6	805.54	1414.65	815.03	1414.75	816.88	1414.74	825.07	1414.91
827.5	1415	829.33	1415.02	836.37	1415.35	837.63	1415.29	841.87	1415.29
855.18	1415.3	860.64	1415.28	881.23	1415.44	887.14	1415.46	906.34	1415.68
911.2	1415.7	916.54	1415.77	936.25	1415.9	956.91	1416.13	961.16	1416.21
965.8	1416.3	982.58	1416.7	985.92	1416.91	993.34	1415.51	1000.15	1414.09
1000.21	1414.1	1003.01	1414.9	1006.55	1415.72	1010.48	1416.92	1016.28	1416.89
1040.7	1416.8	1043.64	1416.73	1050.26	1416.54	1062.19	1416.19	1067.57	1416.22
1083.8	1416.1	1094.37	1416.05	1098.47	1415.98	1104.69	1415.69	1116.19	1414.8
1120.46	1414.5	1125.11	1414.73	1129.52	1414.98	1133.07	1415.17	1144.46	1415.45
1144.81	1415.5	1157.47	1415.5	1171.23	1416.03	1173.14	1416.06	1176.71	1416.1
1209.14	1416.5	1210.26	1416.49	1212.08	1416.45	1232.19	1416.22	1250.5	1416.11
1252.18	1416.4	1264.16	1416.19	1271.76	1416.34	1287.94	1416.2	1291.04	1416.27
1302.18	1416.8	1304.05	1416.78	1305.71	1416.81	1323.17	1416.93	1335.93	1417.08
1337.66	1417.1	1338.01	1417.08	1339.66	1417.08	1341.87	1417.07	1368.57	1416.95
1379.4	1417.1	1388.55	1417.13	1403.96	1417.24	1408.9	1417.27	1427.17	1417.43
1439.92	1417.5	1459.5	1417.67	1466.31	1417.72	1496.46	1417.94	1518.09	1417.97
1526.2	1418	1530.22	1418.04	1543.03	1418.11	1559.15	1418.27	1573.23	1418.44
1589.77	1418.7	1603.99	1418.83	1620.13	1418.76	1629.59	1418.88	1648.31	1419.16
1661.61	1419.4	1681.23	1419.32	1682.39	1419.33	1683.48	1419.36	1705.49	1420.06
1714.31	1420.9	1722.83	1421.6	1737.96	1422.09	1739.02	1422.13	1758.6	1422.51
1767.9	1422.7	1768.78	1422.7	1772.62	1422.73	1789.1	1422.79	1807.18	1422.42
1810.32	1422.3	1810.7	1422.24	1813.6	1421.65	1825.15	1421.65	1835.64	1421.76
1841.1	1422	1842.79	1422.06	1864.79	1422.36	1893.75	1422.39	1895.05	1422.39
1899.83	1422.4	1912.13	1422.2	1917.19	1422.04	1927.14	1421.78	1928.71	1421.52
1940.95	1420.6	1947.35	1420.19	1969.99	1420.34	1973	1420.38	1974.76	1420.39
1988.58	1420.6	1989.02	1420.66	1997.99	1421.68	2001.38	1421.87	2003.34	1422.04
2017.7	1422.1	2018.59	1422.04	2025.55	1422.1	2036.04	1422.25	2040.53	1422.33
2066.2	1422.2	2066.57	1422.2	2089.81	1422.46	2097.38	1422.25	2100.82	1422.24
2123.04	1422.3	2134.46	1422.33	2136.19	1422.33	2142.7	1422.31	2149.58	1422.41
2154.54	1422.5	2156.28	1422.47	2162.07	1422.54	2173.62	1422.56	2174.76	1422.59
2175.96	1422.6	2200.86	1422.81	2210.09	1422.92	2213.22	1422.95	2244.14	1423.34
2251.09	1423.4	2266.2	1423.73	2266.58	1423.74	2271.17	1424.11	2284.5	1424.17
2293.79	1424.2	2307.28	1424.31	2318.42	1424.32	2320.95	1424.36	2334.93	1424.31
2355.71	1424.4	2357.63	1424.45	2359.31	1424.43	2386.85	1424.45	2387.76	1424.45
2417.76	1424.1	2418.37	1424.11	2420.39	1424.11	2423.51	1424.09	2434.11	1423.97
2443.17	1423.9	2443.8	1423.77	2445.64	1423.33	2446.86	1423.3	2461.78	1423.16
2463.7	1422.8	2466.64	1422.41	2491.75	1422.05	2492.04	1422.05	2519.74	1422.16
2519.95	1422.2	2545.33	1421.81	2550.37	1421.88	2572.02	1422.16	2592.59	1422.15
2595.77	1422.1	2603.62	1422.11	2607.65	1422.14	2617.36	1422.27	2624.52	1422.34
2641.81	1422.8								

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
738	.06	985.92	.035	1010.48	.06

Bank Sta: Left Right Lengths: Left Channel Right Coeff Contr. Expan.

985.92 1010.48 97.93 97.93 97.93 .3 .5

Left Levee Station= 985.92 Elevation= 1416.91

CROSS SECTION OUTPUT Profile #PF 1

E.G. Elev (ft)	1417.16	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.08	Wt. n-Val.	0.060	0.035	0.060
W.S. Elev (ft)	1417.09	Reach Len. (ft)	97.93	97.93	97.93
Crit W.S. (ft)	1416.91	Flow Area (sq ft)	354.96	38.77	293.42
E.G. Slope (ft/ft)	0.004238	Area (sq ft)	354.96	38.77	293.42
Q Total (cfs)	1355.00	Flow (cfs)	777.42	142.70	434.88
Top Width (ft)	614.81	Top Width (ft)	223.91	24.56	366.34
Vel Total (ft/s)	1.97	Avg. Vel. (ft/s)	2.19	3.68	1.48
Max Chl Dpth (ft)	3.00	Hydr. Depth (ft)	1.59	1.58	0.80
Conv. Total (cfs)	20815.3	Conv. (cfs)	11942.6	2192.1	6680.6
Length Wtd. (ft)	97.93	Wetted Per. (ft)	224.17	25.22	366.49
Min Ch El (ft)	1414.09	Shear (lb/sq ft)	0.42	0.41	0.21
Alpha	1.26	Stream Power (lb/ft s)	0.92	1.50	0.31
Frctn Loss (ft)	0.53	Cum Volume (acre-ft)	2.19	1.26	0.92
C & E Loss (ft)	0.00	Cum SA (acres)	1.71	1.86	1.08

Warning: Divided flow computed for this cross-section.
Warning: The parabolic search method failed to converge on critical depth. The program will try the
cross section slice/secant method to find critical depth.

CROSS SECTION RIVER: RIVER-1
REACH: Reach-1 RS: 247

INPUT
Description:
Station Elevation Data num= 147

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
694	1417	697.33	1416.98	698.3	1416.98	699.13	1416.97	715.5	1416.62
716.57	1416.5	719.07	1416.13	721.38	1415.74	730.17	1414.11	735.45	1414.04
739.36	1414	742.96	1414.02	760.45	1414	767.87	1413.84	774.95	1413.71
775.82	1413.7	782.67	1414.11	789.57	1414.69	792.18	1414.93	797.73	1415.04
804.58	1415	816.03	1414.82	816.88	1414.8	839.19	1415.31	841.23	1415.34
862.46	1415.5	866.25	1415.55	886.26	1415.82	891.64	1415.93	898.62	1416.01
916.67	1416.2	927.42	1416.16	941.77	1416.29	952.81	1416.18	964.28	1416.23
968.57	1416.1	972.48	1416.18	977.79	1415.84	982.08	1417.38	987.57	1418.01
987.94	1418.1	989.25	1417.49	996.62	1414	997.17	1414.21	1000.02	1415.1
1004.75	1416.8	1016.92	1416.69	1022.63	1416.58	1037.83	1416.24	1055.86	1416
1058.04	1416	1075.9	1415.87	1092.75	1415.72	1096.05	1415.68	1112.04	1415.6
1125.73	1415.3	1132.33	1415.21	1144.72	1414.45	1149.39	1414.16	1159.01	1414.78
1160.8	1414.9	1164.47	1414.89	1172.36	1414.94	1179.87	1414.95	1185	1415.01
1193.98	1415.3	1205	1415.39	1213.35	1415.43	1227.94	1415.69	1231.23	1415.75
1233.1	1415.8	1246.31	1415.89	1268.67	1416.11	1272.59	1416.15	1276	1416.17
1290.15	1416.1	1298.8	1416.17	1303.67	1416.39	1319.08	1416.56	1330.48	1416.64
1331.58	1416.7	1350.41	1416.78	1363.07	1416.83	1371.29	1416.76	1375.54	1416.67
1394.25	1416.8	1398.7	1416.81	1416.51	1416.78	1428.22	1416.95	1450.16	1417.17
1458.6	1417.2	1466.32	1417.49	1485.07	1417.89	1491.07	1417.88	1509.53	1418.37
1510.63	1418.4	1511.39	1418.41	1529.27	1418.84	1540.83	1419.02	1551.18	1419.21
1568.14	1419.2	1571.33	1419.24	1588.41	1419.06	1610.14	1418.89	1611.52	1418.87
1633.2	1418.9	1643.8	1418.94	1645.48	1418.96	1669.6	1419.18	1670.99	1419.19
1674.2	1419.2	1701.13	1419.42	1710.31	1419.53	1730.03	1419.73	1750.18	1419.98
1761.29	1420.3	1770.32	1420.69	1786.57	1420.86	1788.99	1420.91	1807.97	1421.75
1818.68	1421.8	1835.7	1421.77	1842.8	1421.67	1844.26	1421.49	1845.3	1421.36
1846.17	1421.3	1851.66	1421.23	1874.1	1421.8	1879.8	1421.87	1925.67	1421.93
1928.27	1422	1928.57	1421.97	1934.63	1422.05	1935.09	1422.06	1935.89	1422.02
1945.1	1422	1945.58	1422.04	1946.31	1422.05	1955.79	1421.88	1960.71	1421.11
1968.75	1420	1974.19	1419.98	1987.62	1420.14	1996.63	1420.22	1999.41	1420.27
2006.1	1420.3	2015.91	1420.31						

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
694	.06	987.94	.035	1004.75	.06

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
987.94	1004.75	102.08	102.08	102.08	.3	.5

CROSS SECTION OUTPUT Profile #PF 1

E.G. Elev (ft)	1416.62	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.09	Wt. n-Val.	0.060	0.035	0.060

W.S. Elev (ft)	1416.54	Reach Len. (ft)	102.08	102.08	102.08
Crit W.S. (ft)		Flow Area (sq ft)	327.60	16.37	256.37
E.G. Slope (ft/ft)	0.007202	Area (sq ft)	327.60	16.37	256.37
Q Total (cfs)	1355.00	Flow (cfs)	795.29	66.25	493.46
Top Width (ft)	568.69	Top Width (ft)	263.49	12.76	292.44
Vel Total (ft/s)	2.26	Avg. Vel. (ft/s)	2.43	4.05	1.92
Max Chl Dpth (ft)	2.84	Hydr. Depth (ft)	1.24	1.28	0.88
Conv. Total (cfs)	15966.4	Conv. (cfs)	9371.2	780.6	5814.6
Length Wtd. (ft)	102.08	Wetted Per. (ft)	263.91	13.75	292.52
Min Ch El (ft)	1414.00	Shear (lb/sq ft)	0.56	0.54	0.39
Alpha	1.10	Stream Power (lb/ft s)	1.35	2.17	0.76
Frctn Loss (ft)	0.58	Cum Volume (acre-ft)	1.43	1.20	0.30
C & E Loss (ft)	0.00	Cum SA (acres)	1.17	1.81	0.34

Warning: Divided flow computed for this cross-section.

CROSS SECTION RIVER: RIVER-1
REACH: Reach-1 RS: 147

INPUT
Description:
Station Elevation Data num= 174

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
639	1416.5	642.07	1416.52	650.11	1416.34	660.1	1416.11	663.18	1415.71
664.09	1415.6	670.53	1414.29	674.55	1413.55	680.92	1413.43	685.39	1413.43
697.28	1413.5	703.62	1413.42	710.89	1413.38	719.52	1413.24	722.36	1413.4
726.95	1413.7	731.15	1413.99	736.36	1414.38	741.02	1414.46	743.72	1414.52
759.44	1414.4	762.69	1414.3	767.14	1414.43	789.77	1414.72	812.17	1414.93
813.87	1414.9	838.21	1415.19	861.42	1415.44	862.48	1415.44	887.14	1415.67
889.51	1415.7	899.75	1415.72	903.04	1415.04	906.51	1414.49	908.53	1414.91
912.63	1414.2	913.85	1413.39	917.18	1414.28	924.65	1415.44	925.46	1415.63
925.79	1415.6	926.56	1415.65	933.86	1415.84	935.78	1415.37	938.93	1414.96
944.88	1415.8	945.26	1415.84	958.69	1416.04	963.36	1416.09	979	1416.05
982.99	1416.1	990.23	1416.22	992.77	1416.28	993.71	1415.94	1000.27	1413.06
1003.15	1413.6	1004.97	1414.19	1010.11	1416.08	1025.32	1415.6	1028.03	1415.53
1054.23	1415.3	1061.56	1415.23	1070.13	1415.29	1079.93	1415.29	1088.17	1415.23
1098.34	1415.2	1109.1	1415.2	1116.74	1415.17	1131.58	1414.59	1135.46	1414.52
1135.58	1414.5	1138.84	1414.63	1148.23	1415.02	1149.52	1415.22	1153.08	1415.76
1164.8	1414.3	1169.7	1413.53	1178.51	1414.26	1182.71	1414.68	1188.47	1414.72
1194.71	1414.8	1199.99	1414.84	1206.8	1414.88	1207.72	1414.92	1224.29	1415.24
1226.29	1415.3	1228.56	1415.32	1243.98	1415.67	1244.91	1415.68	1257.61	1416.04
1277.63	1416.6	1279.9	1416.63	1284.61	1416.75	1290.92	1416.87	1291.69	1416.95
1296.76	1417.1	1297.6	1417.12	1305.53	1417.51	1338.6	1417.5	1351.3	1417.63
1364.21	1417.6	1367.56	1417.54	1369.94	1417.49	1375.85	1417.31	1376.1	1417.3
1381.95	1417	1383.9	1416.97	1396.06	1416.53	1401.56	1416.49	1408.27	1416.39
1410	1416.3	1431.29	1416.16	1446.62	1416.28	1453.14	1416.35	1456.35	1416.42
1459.54	1416.4	1470.06	1416.71	1488.49	1417.11	1497.87	1417.29	1504.08	1417.33
1506.17	1417.6	1508.28	1418.33	1514.61	1419.9	1515.52	1420	1517.31	1419.65
1525.7	1417.9	1526.74	1417.85	1533.78	1417.86	1540.2	1417.88	1549.11	1418.05
1556.15	1418.1	1562.03	1418.3	1576.01	1418.22	1578.14	1418.28	1597.9	1418.89
1604.47	1419	1616.62	1419.54	1626.84	1419.84	1629.96	1419.86	1632.21	1419.84
1648.93	1419.8	1658.86	1420	1660.97	1420.04	1664.97	1420.1	1690.69	1420.39
1700.09	1420.4	1716.22	1420.44	1718.32	1420.42	1720.23	1420.42	1723.38	1420.47
1738.95	1420.4	1741.46	1420.36	1751.9	1419.88	1756.42	1419.68	1761.98	1419.74
1786.76	1419.9	1793.59	1420.11	1802.61	1420.31	1817.98	1420.56	1846.83	1420.72
1851.37	1420.8	1867.75	1420.88	1869.57	1420.65	1870.9	1420.5	1881.95	1420.22
1890.46	1420	1907.15	1419.85	1912.87	1419.81	1914.57	1419.8	1917.46	1419.75
1940.12	1419.7	1953.58	1419.41	1968.61	1419.38	1975.13	1419.44		

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
639	.06	899.75	.035	1257.61	.06

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
899.75	1257.61	100	100	100	.3	.5

CROSS SECTION OUTPUT Profile #PF 1

E.G. Elev (ft)	1416.04	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.09	Wt. n-Val.	0.060	0.035	
W.S. Elev (ft)	1415.95	Reach Len. (ft)	100.00	100.00	100.00
Crit W.S. (ft)		Flow Area (sq ft)	321.29	268.22	
E.G. Slope (ft/ft)	0.004593	Area (sq ft)	321.29	268.22	
Q Total (cfs)	1355.00	Flow (cfs)	657.30	697.70	
Top Width (ft)	548.27	Top Width (ft)	238.45	309.82	

Vel Total (ft/s)	2.30	Avg. Vel. (ft/s)	2.05	2.60
Max Chl Dpth (ft)	2.89	Hydr. Depth (ft)	1.35	0.87
Conv. Total (cfs)	19993.9	Conv. (cfs)	9698.9	10295.0
Length Wtd. (ft)	100.00	Wetted Per. (ft)	238.73	312.03
Min Ch El (ft)	1413.06	Shear (lb/sq ft)	0.39	0.25
Alpha	1.04	Stream Power (lb/ft s)	0.79	0.64
Frctn Loss (ft)	0.91	Cum Volume (acre-ft)	0.67	0.86
C & E Loss (ft)	0.06	Cum SA (acres)	0.58	1.44

Warning: Divided flow computed for this cross-section.
Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.

CROSS SECTION RIVER: RIVER-1
REACH: Reach-1 RS: 47

INPUT
Description:
Station Elevation Data num= 153

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
626	1416	627.61	1416.04	628.72	1416.05	645.62	1415.67	647.35	1415.62
647.73	1415.6	652	1415.15	660.95	1413.08	661.51	1413.07	672.13	1412.92
681.59	1412.8	693.3	1412.62	707.61	1412.73	710.12	1412.76	716.62	1413.13
721.78	1413.7	724.6	1413.92	730.6	1413.99	740.5	1414.16	743.83	1414.17
745.39	1414.2	747.72	1414.8	750.04	1415.61	753.46	1414.61	755.8	1413.94
758.91	1414	778.41	1414.25	796.33	1414.37	802.13	1414.43	807.19	1414.51
826.5	1414.7	830.86	1414.71	850.08	1414.9	851.52	1414.88	863.34	1414.77
867.69	1413.4	873.32	1411.75	877.41	1413.34	880.37	1413.98	885.54	1413.22
887.11	1412.8	891.73	1414.49	891.84	1414.52	896.14	1414.62	900.28	1414.73
903.41	1414.8	927.79	1414.29	928.48	1414.29	947.51	1414.69	952.63	1414.81
971.33	1415	977.1	1415.06	985.48	1414.62	985.74	1414.61	987.45	1415.61
990.13	1417	996.75	1414	1000.79	1412.85	1000.93	1412.81	1003.85	1413.92
1007.45	1414.9	1033.24	1414.52	1034.24	1414.51	1052.97	1414.53	1065.31	1414.61
1072.46	1414.5	1081.46	1414.51	1091.65	1414.44	1098.76	1414.41	1110.71	1414.43
1128.13	1414.4	1129.94	1414.46	1157.69	1414.77	1166.86	1414.67	1182.26	1414.76
1188.2	1414.7	1201.36	1414.38	1204.85	1414.45	1207.79	1414.51	1222.52	1414.91
1239.1	1413.1	1240.5	1412.92	1242.96	1413.25	1252.27	1414.49	1265.26	1414.7
1268.98	1414.7	1279.02	1414.72	1280.2	1414.74	1297.44	1414.8	1298.71	1414.81
1303.16	1414.9	1311.61	1415.21	1319.46	1415.64	1342.23	1416.84	1362.04	1417.27
1368.69	1417.3	1374.77	1417.35	1386.81	1417.42	1399.92	1417.19	1421.92	1416.6
1426.22	1416.4	1428.41	1416.4	1448.6	1415.59	1454.84	1415.53	1463.26	1415.62
1469.5	1415.7	1483.1	1415.77	1490.6	1415.77	1505.67	1415.77	1509.34	1415.79
1513.77	1415.9	1533.87	1416.07	1546.53	1416.25	1548.58	1416.27	1551.4	1416.35
1566.42	1416.6	1571.2	1416.66	1588.12	1416.8	1600.27	1416.97	1603.44	1416.98
1608.98	1417	1623.92	1417.13	1632.63	1417.22	1643.41	1417.31	1661.12	1417.49
1662.95	1417.5	1681.39	1417.56	1693.46	1417.64	1700.15	1417.7	1710.66	1417.8
1719.05	1417.9	1723.96	1417.96	1738.87	1418.01	1743.54	1418.07	1758.71	1418.32
1759.27	1418.3	1792.65	1418.93	1800.24	1419.05	1815.3	1419.22	1828.99	1419.63
1835.03	1419.8	1841.94	1420	1863.94	1420.65	1879.26	1420.88	1889.95	1420.86
1898.69	1420.9	1916.73	1420.86	1926.3	1420.57	1928.29	1420.04	1929.55	1419.83
1932.39	1419.9	1935.84	1420.02	1938.01	1419.87				

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
626	.06	851.52	.035	1319.46	.06

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
851.52	1319.46	46.65	46.65	46.65	.3	.5

CROSS SECTION OUTPUT Profile #PF 1

E.G. Elev (ft)	1415.08	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.28	Wt. n-Val.	0.060	0.035	
W.S. Elev (ft)	1414.79	Reach Len. (ft)	46.65	46.65	46.65
Crit W.S. (ft)	1414.79	Flow Area (sq ft)	176.37	148.83	
E.G. Slope (ft/ft)	0.025771	Area (sq ft)	176.37	148.83	
Q Total (cfs)	1355.00	Flow (cfs)	816.66	538.34	
Top Width (ft)	563.51	Top Width (ft)	180.76	382.75	
Vel Total (ft/s)	4.17	Avg. Vel. (ft/s)	4.63	3.62	
Max Chl Dpth (ft)	3.04	Hydr. Depth (ft)	0.98	0.39	
Conv. Total (cfs)	8440.6	Conv. (cfs)	5087.2	3353.4	
Length Wtd. (ft)		Wetted Per. (ft)	181.21	384.93	
Min Ch El (ft)	1411.75	Shear (lb/sq ft)	1.57	0.62	
Alpha	1.04	Stream Power (lb/ft s)	7.25	2.25	
Frctn Loss (ft)		Cum Volume (acre-ft)	0.09	0.39	

C & E Loss (ft)	Cum SA (acres)	0.10	0.64

Warning: The energy equation could not be balanced within the specified number of iterations. The
program used critical depth for the water surface and continued on with the calculations.
Warning: Divided flow computed for this cross-section.
Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.

CROSS SECTION RIVER: RIVER-1
REACH: Reach-1 RS: 1

INPUT
Description:
Station Elevation Data num= 120

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
574.65	1415	576.18	1415.03	576.98	1415.03	592.03	1414.86	595.52	1414.79
596.78	1414.6	600.57	1414.22	600.99	1414.16	608.79	1412.52	610.53	1412.45
621.73	1412.2	625.88	1412.28	645.03	1412.16	648.17	1412.05	655.41	1412.12
665.75	1412.8	672.68	1413.14	680.87	1413.09	687.4	1413.12	697.51	1412.91
708.33	1412.6	718.61	1412.9	728.61	1413.24	741.94	1413.36	752.96	1413.5
765.48	1413.5	767.52	1413.45	778.48	1413.57	787.72	1413.62	804.68	1413.83
809.27	1413.8	828.08	1413.65	830.33	1413.62	834.1	1413.7	840.14	1413.03
840.93	1412.9	841.66	1413.04	842.24	1413.2	845.09	1414	855.26	1414.13
860.18	1414.1	863.58	1412.55	866.66	1411.45	869.09	1412.01	874.44	1413.58
889.25	1413.6	895.36	1413.7	913.83	1414.22	921.38	1414.32	941.44	1414.47
943.39	1414.5	944.75	1414.48	972.03	1414.65	982.15	1414.16	982.99	1414.11
984.31	1414.3	986.62	1414.75	994.74	1413.05	995.94	1412.71	996.03	1412.73
996.67	1412.8	1000.16	1414.23	1022.32	1414.14	1024.98	1414.12	1027.62	1414.02
1042.96	1413.5	1057.86	1413.52	1059.74	1413.55	1059.86	1413.52	1060.44	1413.5
1077.93	1413.1	1082.41	1413.35	1099.49	1413.86	1106.38	1413.69	1132.03	1413.99
1133.27	1414	1134.76	1414.03	1137.37	1414.08	1155	1414.4	1158.47	1414.38
1176.02	1414.2	1183.42	1414.13	1210.83	1413.98	1211.55	1413.97	1218.74	1413.61
1224.71	1414.1	1225.3	1414.11	1229.39	1414.08	1230.24	1414.06	1242.9	1414.41
1243.94	1414.4	1247.1	1414.32	1258.98	1414.1	1262.55	1414.13	1271.79	1413.22
1279.37	1412.5	1283.01	1413.01	1292.2	1414.3	1300.61	1414.46	1303.91	1414.49
1307.93	1414.5	1309.51	1414.42	1312.04	1414.4	1323.46	1414.23	1326.59	1414.24
1332.1	1414.1	1335.04	1414.11	1348.43	1414.16	1384.67	1414.08	1411.55	1414.14
1436.08	1414.2	1461.94	1414.14	1480.32	1414.11	1486.98	1414.4	1496.82	1414.46
1580.78	1414.5	1592.71	1414.54	1653.03	1414.69	1665.31	1414.69	1691.27	1414.72

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
574.65	.06	574.65	.035	1691.27	.06

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
574.65	1691.27	0	0	0	.3	.5

CROSS SECTION OUTPUT Profile #PF 1

			Left OB	Channel	Right OB
E.G. Elev (ft)	1414.47	Element			
Vel Head (ft)	0.09	Wt. n-Val.		0.035	
W.S. Elev (ft)	1414.39	Reach Len. (ft)			
Crit W.S. (ft)	1413.90	Flow Area (sq ft)		572.23	
E.G. Slope (ft/ft)	0.005002	Area (sq ft)		572.23	
Q Total (cfs)	1355.00	Flow (cfs)		1355.00	
Top Width (ft)	815.01	Top Width (ft)		815.01	
Vel Total (ft/s)	2.37	Avg. Vel. (ft/s)		2.37	
Max Chl Dpth (ft)	2.94	Hydr. Depth (ft)		0.70	
Conv. Total (cfs)	19158.8	Conv. (cfs)		19158.8	
Length Wtd. (ft)		Wetted Per. (ft)		817.07	
Min Ch El (ft)	1411.45	Shear (lb/sq ft)		0.22	
Alpha	1.00	Stream Power (lb/ft s)		0.52	
Frctn Loss (ft)		Cum Volume (acre-ft)			
C & E Loss (ft)		Cum SA (acres)			

Warning: Divided flow computed for this cross-section.

SUMMARY OF MANNING'S N VALUES

River:RIVER-1

Reach	River Sta.	n1	n2	n3
Reach-1	1247	.06	.035	.06
Reach-1	1204	.06	.035	.06
Reach-1	1203.9	Bridge		
Reach-1	1188	.06	.035	.06
Reach-1	1147	.06	.035	.06
Reach-1	1077	.06	.035	.06
Reach-1	1076.9	Culvert		
Reach-1	977	.06	.035	.06
Reach-1	947	.06	.035	.06
Reach-1	847	.06	.035	.06
Reach-1	747	.06	.035	.06
Reach-1	647	.06	.035	.06
Reach-1	646.9	Culvert		
Reach-1	600	.06	.035	.06
Reach-1	547	.06	.035	.06
Reach-1	447	.06	.035	.06
Reach-1	347	.06	.035	.06
Reach-1	247	.06	.035	.06
Reach-1	147	.06	.035	.06
Reach-1	47	.06	.035	.06
Reach-1	1	.06	.035	.06

SUMMARY OF REACH LENGTHS

River: RIVER-1

Reach	River Sta.	Left	Channel	Right
Reach-1	1247	42.77	42.77	42.77
Reach-1	1204	56.52	56.52	56.52
Reach-1	1203.9	Bridge		
Reach-1	1188	56.52	56.52	56.52
Reach-1	1147	100	100	100
Reach-1	1077	199.92	199.92	199.92
Reach-1	1076.9	Culvert		
Reach-1	977	99.96	99.96	99.96
Reach-1	947	110.92	110.92	110.92
Reach-1	847	88.53	88.53	88.53
Reach-1	747	100.59	100.59	100.59
Reach-1	647	100	100	100
Reach-1	646.9	Culvert		
Reach-1	600	100	100	100
Reach-1	547	100	100	100
Reach-1	447	100	100	100
Reach-1	347	97.93	97.93	97.93
Reach-1	247	102.08	102.08	102.08
Reach-1	147	100	100	100
Reach-1	47	46.65	46.65	46.65
Reach-1	1	0	0	0

SUMMARY OF CONTRACTION AND EXPANSION COEFFICIENTS
River: RIVER-1

Reach	River Sta.	Contr.	Expan.
Reach-1	1247	.3	.5
Reach-1	1204	.3	.5
Reach-1	1203.9	Bridge	
Reach-1	1188	.3	.5
Reach-1	1147	.3	.5
Reach-1	1077	.3	.5
Reach-1	1076.9	Culvert	
Reach-1	977	.3	.5
Reach-1	947	.3	.5
Reach-1	847	.3	.5
Reach-1	747	.3	.5

Reach-1	647		.3	.5
Reach-1	646.9	Culvert		
Reach-1	600		.3	.5
Reach-1	547		.3	.5
Reach-1	447		.3	.5
Reach-1	347		.3	.5
Reach-1	247		.3	.5
Reach-1	147		.3	.5
Reach-1	47		.3	.5
Reach-1	1		.3	.5

HEC-RAS September 1998 Version 2.2
U.S. Army Corp of Engineers
Hydrologic Engineering Center
609 Second Street, Suite D
Davis, California 95616-4687
(916) 756-1104

```
X     X  XXXXXX    XXXX        XXXX       XX      XXXX
X     X  X        X    X      X   X     X  X    X
X     X  X        X           X   X    X    X   X
XXXXXXX  XXXX     X       XXX XXXX     XXXXXX    XXXX
X     X  X        X           X  X     X    X        X
X     X  X        X    X      X   X    X    X        X
X     X  XXXXXX    XXXX       X    X   X    X   XXXXX
```

PROJECT DATA
Project Title: Station 720 Wash
Project File : Dan.prj
Run Date and Time: 6/28/00 12:51:58 PM

Project in English units

Project Description:
TEMP HEC2 HEADER

PLAN DATA

Plan Title: Plan 01
Plan File : j:\9727\HEC-RAS\Dan.p01

Geometry Title: Improved Channel
Geometry File : j:\9727\HEC-RAS\Dan.g04

Flow Title : 50-yr flow
Flow File : j:\9727\HEC-RAS\Dan.f01

Plan Summary Information:

Number of:	Cross Sections	= 19	Mulitple Openings	=	0
	Culverts	= 1	Inline Weirs	=	0
	Bridges	= 1			

Computational Information

Water surface calculation tolerance	=	0.01
Critical depth calculaton tolerance	=	0.01
Maximum number of interations	=	20
Maximum difference tolerance	=	0.3
Flow tolerance factor	=	0.001

Computation Options

Critical depth computed only where necessary	
Conveyance Calculation Method:	At breaks in n values only
Friction Slope Method:	Average Conveyance
Computational Flow Regime:	Subcritical Flow

FLOW DATA

Flow Title: 100-yr flow
Flow File : j:\9727\HEC-RAS\Dan.f01

Flow Data (cfs)

River	Reach	RS	PF 1
RIVER-1	Reach-1	1247	1023
RIVER-1	Reach-1	947	1130
RIVER-1	Reach-1	547	1355

Boundary Conditions

River	Reach	Profile	Upstream	Downstream
RIVER-1	Reach-1	PF 1		Normal S = .005

GEOMETRY DATA

Geometry Title: Improved Channel
Geometry File : j:\9727\HEC-RAS\Dan.g04

CROSS SECTION RIVER: RIVER-1
REACH: Reach-1 RS: 1247

INPUT
Description:
Station Elevation Data num= 83

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
827	1420.2	834.25	1420.66	839.59	1421.02	847.41	1420.49	852.68	1420.06
855.53	1419.8	864.07	1420.07	868.03	1420.12	888.33	1420.08	889.13	1420.09
913.59	1420.5	929.67	1420.49	940.98	1420.56	945.56	1420.54	952.83	1420.43
955.47	1420.4	964.22	1422.98	966.66	1423.54	969.41	1422.6	976.05	1420.21
981.57	1420	981.8	1419.98	989.52	1418.41	991.46	1418.34	1000.41	1418.65
1002.18	1418.9	1009.17	1417.72	1012.65	1417.73	1016.93	1417.77	1020.38	1417.98
1021.64	1418	1033.23	1418.38	1036.82	1418.42	1042.21	1418.54	1048.85	1418.7
1055.39	1419	1065	1418.92	1068.62	1419	1070.91	1419.03	1074.14	1419.45
1082.8	1419.2	1085.08	1419.24	1086.42	1419.24	1097.01	1419.28	1110.01	1419.49
1126.39	1419.9	1128.23	1419.89	1133.06	1419.89	1145.5	1420.13	1147.39	1420.16
1172.39	1420.5	1177.33	1420.57	1183.48	1420.63	1206.01	1421.03	1212.55	1421.11
1234.42	1421.4	1244.02	1421.42	1256.16	1421.63	1265.33	1421.82	1280.89	1422.1
1296.42	1422.2	1300.56	1422.25	1306.34	1422.19	1317.47	1422.36	1322.89	1422.28
1333.03	1422.6	1339.77	1422.62	1360.42	1422.77	1362.45	1422.77	1404.63	1423
1406.67	1423	1410.39	1423.04	1446.02	1423.45	1454.32	1423.54	1509.78	1423.95
1513.95	1424	1519.14	1424.03	1565.1	1424.43	1572.56	1424.47	1606.06	1424.63
1618.43	1424.8	1628.26	1424.89	1670.54	1425.06				

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
827	.06	1002.18	.035	1048.85	.06

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
1002.18	1048.85	42.77	42.77	42.77	.3	.5

Left Levee Station= 966.66 Elevation= 1423.54

CROSS SECTION OUTPUT Profile #PF 1

			Left OB	Channel	Right OB
E.G. Elev (ft)	1424.68	Element			
Vel Head (ft)	0.01	Wt. n-Val.	0.060	0.035	0.060
W.S. Elev (ft)	1424.67	Reach Len. (ft)	42.77	42.77	42.77
Crit W.S. (ft)	1420.29	Flow Area (sq ft)	757.17	301.28	1406.47
E.G. Slope (ft/ft)	0.000042	Area (sq ft)	757.17	301.28	1406.47
Q Total (cfs)	1023.00	Flow (cfs)	316.68	287.91	418.41
Top Width (ft)	782.01	Top Width (ft)	175.18	46.67	560.16
Vel Total (ft/s)	0.42	Avg. Vel. (ft/s)	0.42	0.96	0.30
Max Chl Dpth (ft)	6.95	Hydr. Depth (ft)	4.32	6.46	2.51

Conv. Total (cfs)	157307.0	Conv. (cfs)	48695.7	44271.7	64339.6
Length Wtd. (ft)	42.77	Wetted Per. (ft)	180.93	46.79	560.24
Min Ch El (ft)	1417.72	Shear (lb/sq ft)	0.01	0.02	0.01
Alpha	2.02	Stream Power (lb/ft s)	0.00	0.02	0.00
Frctn Loss (ft)	0.01	Cum Volume (acre-ft)	2.97	7.10	16.81
C & E Loss (ft)	0.19	Cum SA (acres)	2.06	3.50	13.44

Warning: The cross-section end points had to be extended vertically for the computed water surface.
Warning: The velocity head has changed by more than 0.5 ft (0.15 m). This may indicate the need for additional cross sections.
Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.

CROSS SECTION RIVER: RIVER-1
REACH: Reach-1 RS: 1204

INPUT
Description: us side of rr bridge
Station Elevation Data num= 35

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
248	1419.9	289.65	1420.21	294.19	1420.26	298.26	1420.28	504.97	1421.69
510.81	1421.7	519.85	1421.79	525.78	1421.84	710.55	1423.39	713.25	1423.41
717.06	1423.5	720.35	1423.49	808.12	1424.26	890.19	1425.02	895.01	1425.06
898.04	1425.1	900.85	1425.03	903.31	1424.64	973.16	1425.58	975.92	1425.83
1002.18	1418.9	1009.17	1417.72	1012.65	1417.73	1016.93	1417.77	1020.38	1417.98
1031.29	1426.3	1074.66	1426.68	1109.34	1426.97	1227.97	1427.58	1269.53	1427.74
1433.38	1429.1	1638.62	1430.15	1639.19	1430.16	1671.41	1430.43	1685.36	1430.54

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
248	.06	975.92	.035	1031.29	.06

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
975.92	1031.29	56.52	56.52	56.52	.3	.5

Left Levee Station= 975.92 Elevation= 1425.83

CROSS SECTION OUTPUT Profile #PF 1

			Left OB	Channel	Right OB
E.G. Elev (ft)	1424.48	Element			
Vel Head (ft)	0.65	Wt. n-Val.		0.035	
W.S. Elev (ft)	1423.83	Reach Len. (ft)	1.00	1.00	1.00
Crit W.S. (ft)	1422.31	Flow Area (sq ft)		174.76	
E.G. Slope (ft/ft)	0.004056	Area (sq ft)		174.76	
Q Total (cfs)	1130.00	Flow (cfs)		1130.00	
Top Width (ft)	44.54	Top Width (ft)		44.54	
Vel Total (ft/s)	6.47	Avg. Vel. (ft/s)		6.47	
Max Chl Dpth (ft)	6.11	Hydr. Depth (ft)		3.92	
Conv. Total (cfs)	17742.2	Conv. (cfs)		17742.2	
Length Wtd. (ft)	1.00	Wetted Per. (ft)		47.26	
Min Ch El (ft)	1417.72	Shear (lb/sq ft)		0.94	
Alpha	1.00	Stream Power (lb/ft s)		6.06	
Frctn Loss (ft)	0.00	Cum Volume (acre-ft)	2.60	6.87	16.12
C & E Loss (ft)	0.00	Cum SA (acres)	1.97	3.45	13.16

BRIDGE RIVER: RIVER-1
REACH: Reach-1 RS: 1203.9

INPUT
Description: Railroad bridge
Distance from Upstream XS = 1
Deck/Roadway Width = 15
Weir Coefficient = 2.6
Bridge Deck/Roadway Skew =
Upstream Deck/Roadway Coordinates
num= 4

Sta	Hi Cord	Lo Cord	Sta	Hi Cord	Lo Cord	Sta	Hi Cord	Lo Cord
872	1425.5		970	1426.1	1424.1	1030	1426.4	1424.4
1075	1426.7							

Upstream Bridge Cross Section Data
Station Elevation Data num= 35

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev

```
     248  1419.9  289.65 1420.21  294.19 1420.26  298.26 1420.28  504.97 1421.69
  510.81  1421.7  519.85 1421.79  525.78 1421.84  710.55 1423.39  713.25 1423.41
  717.06  1423.5  720.35 1423.49  808.12 1424.26  890.19 1425.02  895.01 1425.06
  898.04  1425.1  900.85 1425.03  903.31 1424.64  973.16 1425.58  975.92 1425.83
 1002.18  1418.9 1009.17 1417.72 1012.65 1417.73 1016.93 1417.77 1020.38 1417.98
 1031.29  1426.3 1074.66 1426.68 1109.34 1426.97 1227.97 1427.58 1269.53 1427.74
 1433.38  1429.1 1638.62 1430.15 1639.19 1430.16 1671.41 1430.43 1685.36 1430.54

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
     248     .06  975.92    .035 1031.29     .06

Bank Sta: Left   Right    Coeff Contr.   Expan.
        975.92 1031.29            .3        .5
Left Levee       Station=  975.92      Elevation= 1425.83

Downstream  Deck/Roadway Coordinates
    num=       4
     Sta Hi Cord Lo Cord     Sta Hi Cord Lo Cord     Sta Hi Cord Lo Cord
     872  1425.5             970  1426.1  1424.1    1030  1426.4  1424.4
    1075  1426.7

Downstream Bridge Cross Section Data
Station Elevation Data    num=      35
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
     248  1419.9  289.65 1420.21  294.19 1420.26  298.26 1420.28  504.97 1421.69
  510.81  1421.7  519.85 1421.79  525.78 1421.84  710.55 1423.39  713.25 1423.41
  717.06  1423.5  720.35 1423.49  808.12 1424.26  890.19 1425.02  895.01 1425.06
  898.04  1425.1  900.85 1425.03  903.31 1424.64  973.16 1425.58  975.92 1425.83
 1002.18  1418.9 1009.17 1417.72 1012.65 1417.73 1016.93 1417.77 1020.38 1417.98
 1031.29  1426.3 1074.66 1426.68 1109.34 1426.97 1227.97 1427.58 1269.53 1427.74
 1433.38  1429.1 1638.62 1430.15 1639.19 1430.16 1671.41 1430.43 1685.36 1430.54

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
     248     .06  975.92    .035 1031.29     .06

Bank Sta: Left   Right    Coeff Contr.   Expan.
        975.92 1031.29            .3        .5
Left Levee       Station=  975.92      Elevation= 1425.83

Upstream Embankment side slope              =       0 horiz. to 1.0 vertical
Downstream Embankment side slope            =       0 horiz. to 1.0 vertical
Maximum allowable submergence for weir flow =     .95
Elevation at which weir flow begins         =
Energy head used in spillway design         =
Spillway height used in design              =
Weir crest shape                            = Broad Crested

Number of Bridge Coefficient Sets =  1

Low Flow Methods and Data
       Energy
Selected Low Flow Methods = Energy

High Flow Method
       Energy Only

Additional Bridge Parameters
       Add Friction component to Momentum
       Do not add Weight component to Momentum
       Class B flow critical depth computations use critical depth
           inside the bridge at the upstream end
       Criteria to check for pressure flow = Upstream energy grade line

BRIDGE OUTPUT    Profile #PF 1
Opening : Bridge #1

  E.G. US. (ft)                1424.48   Element                 Inside BR US  Inside BR DS
  W.S. US. (ft)                1423.83   E.G. Elev (ft)               1424.47       1424.40
  Q Total (cfs)                1130.00   W.S. Elev (ft)               1423.82       1423.71
  Q Bridge (cfs)               1130.00   Crit W.S. (ft)               1422.31       1422.31
  Q Weir (cfs)                           Max Chl Dpth (ft)               6.10          5.99
  Weir Sta Lft (ft)                      Vel Total (ft/s)                6.47          6.67
  Weir Sta Rgt (ft)                      Flow Area (sq ft)             174.58        169.45
  Weir Submerg                           Froude # Chl                    0.58          0.60
```

Weir Max Depth (ft)		Specif Force (cu ft)	657.41	644.34
Min Top Rd (ft)	1425.83	Hydr Depth (ft)	3.92	3.86
Min El Prs (ft)	1424.39	W.P. Total (ft)	47.24	46.59
Delta EG (ft)	0.62	Conv. Total (cfs)	17717.6	17014.1
Delta WS (ft)	1.49	Top Width (ft)	44.52	43.93
BR Open Area (sq ft)	195.30	Frctn Loss (ft)	0.06	0.29
BR Open Vel (ft/s)	6.67	C & E Loss (ft)	0.01	0.25
Coef of Q		Shear Total (lb/sq ft)	0.94	1.00
Br Sel Method	Energy only	Power Total (lb/ft s)	6.07	6.68

Note: Momentum answer is not valid if the water surface is above the low chord or if there is weir flow. The momentum answer has been disregarded.
Warning: The velocity head has changed by more than 0.5 ft (0.15 m). This may indicate the need for additional cross sections.
Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.

CROSS SECTION RIVER: RIVER-1
REACH: Reach-1 RS: 1188

INPUT
Description: ds side of rr bridge
Station Elevation Data num= 35

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
248	1419.9	289.65	1420.21	294.19	1420.26	298.26	1420.28	504.97	1421.69
510.81	1421.7	519.85	1421.79	525.78	1421.84	710.55	1423.39	713.25	1423.41
717.06	1423.5	720.35	1423.49	808.12	1424.26	890.19	1425.02	895.01	1425.06
898.04	1425.1	900.85	1425.03	903.31	1424.64	973.16	1425.58	975.92	1425.83
1002.18	1418.9	1009.17	1417.72	1012.65	1417.73	1016.93	1417.77	1020.38	1417.98
1031.29	1426.3	1074.66	1426.68	1109.34	1426.97	1227.97	1427.58	1269.53	1427.74
1433.38	1429.1	1638.62	1430.15	1639.19	1430.16	1671.41	1430.43	1685.36	1430.54

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
248	.06	975.92	.035	1031.29	.06

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
975.92	1031.29	56.52	56.52	56.52	.3	.5

Left Levee Station= 975.92 Elevation= 1425.83

CROSS SECTION OUTPUT Profile #PF 1

E.G. Elev (ft)	1423.86	Element	Left OB	Channel	Right OB
Vel Head (ft)	1.53	Wt. n-Val.		0.035	
W.S. Elev (ft)	1422.33	Reach Len. (ft)	56.52	56.52	56.52
Crit W.S. (ft)	1422.33	Flow Area (sq ft)		113.93	
E.G. Slope (ft/ft)	0.013044	Area (sq ft)		113.93	
Q Total (cfs)	1130.00	Flow (cfs)		1130.00	
Top Width (ft)	36.92	Top Width (ft)		36.92	
Vel Total (ft/s)	9.92	Avg. Vel. (ft/s)		9.92	
Max Chl Dpth (ft)	4.61	Hydr. Depth (ft)		3.09	
Conv. Total (cfs)	9893.9	Conv. (cfs)		9893.9	
Length Wtd. (ft)	56.52	Wetted Per. (ft)		38.94	
Min Ch El (ft)	1417.72	Shear (lb/sq ft)		2.38	
Alpha	1.00	Stream Power (lb/ft s)		23.63	
Frctn Loss (ft)	0.23	Cum Volume (acre-ft)	2.60	6.67	16.12
C & E Loss (ft)	0.67	Cum SA (acres)	1.97	3.40	13.16

Warning: The energy equation could not be balanced within the specified number of iterations. The program used critical depth for the water surface and continued on with the calculations.
Warning: The velocity head has changed by more than 0.5 ft (0.15 m). This may indicate the need for additional cross sections.
Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.
Warning: The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate the need for additional cross sections.
Warning: During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated water surface came back below critical depth. This indicates

that there is not a valid subcritical answer. The program defaulted to critical depth.
Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid,
energy was used.

CROSS SECTION RIVER: RIVER-1
REACH: Reach-1 RS: 1147

INPUT
Description: swale between rr and esist us60
Station Elevation Data num= 156

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
194	1413.8	202.35	1413.8	210.23	1413.9	226.71	1414.02	234.03	1414.06
249.38	1414.1	270.04	1414.31	275.83	1414.37	296.52	1414.44	299.41	1414.44
308.89	1414.4	324.82	1414.48	332.24	1414.54	353.12	1414.77	363.83	1414.96
379.4	1415.1	390.96	1415.16	407.63	1415.16	417.34	1415.2	438.19	1415.32
447.97	1415.3	456.97	1415.47	479.96	1415.67	492.44	1415.78	504.28	1415.72
531.3	1415.9	545.17	1416.05	560.92	1416.15	574.25	1416.17	586.31	1416.24
598.49	1416.3	608.78	1416.46	619.54	1416.61	633.07	1416.7	648.43	1416.77
659.81	1416.9	667.91	1416.88	675.83	1416.9	688.24	1416.94	697.86	1416.96
710.7	1417	726.33	1417.04	729.98	1417.05	754.08	1417.21	755.71	1417.22
783.25	1417.6	786.14	1417.58	789.68	1417.61	813.76	1417.94	820.14	1418.01
837.19	1418.1	854.19	1418.32	860.19	1418.37	870.25	1418.4	882.11	1418.42
896.91	1418.2	904.19	1418.25	920.64	1418.57	925.88	1418.69	934.35	1418.89
934.49	1418.9	960.01	1422.31	961.12	1422.33	962.16	1422.38	970.5	1422.79
974.86	1422.9	988.59	1417.28	988.97	1417.12	998.75	1418.06	1000.7	1418.18
1009.29	1418.2	1017.48	1418.15	1022.37	1419.54	1030.42	1421.61	1047.97	1421.94
1050.49	1422	1054.25	1422.05	1057.48	1421.97	1080.66	1421.77	1084.57	1421.8
1100.5	1421.7	1109.53	1421.6	1113.56	1421.81	1113.64	1421.81	1126.67	1421.4
1133.2	1421.3	1140.9	1421.07	1148.76	1420.84	1158.91	1420.54	1159.89	1420.52
1162.08	1420.5	1169.63	1420.48	1184.69	1420.58	1189.19	1420.6	1199.78	1420.63
1208.82	1420.6	1221.62	1420.76	1230.54	1420.85	1247.49	1421.08	1260.66	1421.11
1273.59	1421.4	1277.91	1421.46	1299.18	1421.62	1320.05	1421.61	1326.49	1421.66
1346.11	1421.8	1349.39	1421.78	1373.67	1421.78	1374.72	1421.78	1381.13	1421.78
1397.63	1421.8	1400.37	1421.84	1417.46	1421.89	1422.04	1421.9	1444.08	1422.26
1449.55	1422.3	1470.53	1422.47	1493.35	1422.47	1497.02	1422.52	1516.92	1422.64
1520	1422.6	1538.54	1422.86	1546.49	1422.95	1549.73	1423.01	1573.95	1423.18
1577.24	1423.2	1584.3	1423.16	1605.81	1423.25	1612.04	1423.31	1645.61	1423.67
1652.01	1423.7	1672.57	1423.91	1677.56	1423.95	1679.08	1423.96	1689.29	1424.04
1706.24	1424.2	1708.87	1424.21	1733.87	1424.37	1754.32	1424.5	1761.78	1424.57
1786	1424.6	1791.55	1424.74	1795.07	1424.79	1811.27	1424.95	1830.61	1425.02
1839.54	1425	1858.96	1425.15	1861.16	1425.15	1878.13	1425.38	1891.14	1425.53
1899.24	1425.7	1905.64	1425.77	1918.64	1425.87	1932.45	1426	1935.97	1426.01
1944.64	1426.1								

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
194	.06	974.86	.035	1030.42	.06

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
974.86	1030.42	70	70	70	.3	.5

Left Levee Station= 974.86 Elevation= 1422.9
Right Levee Station= 1047.97 Elevation= 1421.94

CROSS SECTION OUTPUT Profile #PF 1

			Left OB	Channel	Right OB
E.G. Elev (ft)	1422.49	Element			
Vel Head (ft)	0.19	Wt. n-Val.		0.035	0.060
W.S. Elev (ft)	1422.30	Reach Len. (ft)	70.00	70.00	70.00
Crit W.S. (ft)	1421.12	Flow Area (sq ft)		186.74	356.00
E.G. Slope (ft/ft)	0.001935	Area (sq ft)		186.74	356.00
Q Total (cfs)	1130.00	Flow (cfs)		782.07	347.93
Top Width (ft)	473.05	Top Width (ft)		54.09	418.96
Vel Total (ft/s)	2.08	Avg. Vel. (ft/s)		4.19	0.98
Max Chl Dpth (ft)	8.50	Hydr. Depth (ft)		3.45	0.85
Conv. Total (cfs)	25686.2	Conv. (cfs)		17777.2	7908.9
Length Wtd. (ft)	70.00	Wetted Per. (ft)		55.62	419.01
Min Ch El (ft)	1417.12	Shear (lb/sq ft)		0.41	0.10
Alpha	2.87	Stream Power (lb/ft s)		1.70	0.10
Frctn Loss (ft)	0.13	Cum Volume (acre-ft)	2.60	6.48	15.89
C & E Loss (ft)	0.03	Cum SA (acres)	1.97	3.34	12.89

CROSS SECTION RIVER: RIVER-1
REACH: Reach-1 RS: 1078

INPUT
Description: us face of exist. us60 bridge
Station Elevation Data num= 56

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
449	1417.3	499.86	1417.73	538.24	1418.02	596.88	1418.65	631.81	1418.99
682.41	1419.2	690.22	1419.25	697.08	1419.3	704.8	1419.33	715.39	1419.37
823.34	1420.5	825.65	1420.52	854.81	1420.84	907.66	1421.38	911.55	1421.42
913.78	1421.5	951.46	1421.73	965.61	1421.83	976.49	1421.92	980	1417.2
1000	1417.2	1020	1417.2	1048	1422.3	1066.02	1422.57	1100.63	1422.77
1113.14	1422.8	1155.75	1422.99	1195.62	1423.31	1223.6	1423.5	1264.85	1423.81
1303.89	1424	1345.19	1424.29	1372	1424.45	1397.67	1424.57	1412.34	1424.65
1454.44	1425	1460.85	1425	1461.93	1425.01	1486.02	1425.11	1512.93	1425.23
1544.89	1425.5	1561.53	1425.57	1562.46	1425.59	1605.2	1425.87	1656.83	1426.15
1675.75	1426.3	1712.27	1426.47	1745.43	1426.73	1772.62	1426.95	1799.35	1427.18
1842.26	1427.6	1859.84	1427.73	1875.41	1427.86	1922.97	1428.18	1980.06	1428.57
1992.54	1428.6								

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
449	.06	449	.035	1992.54	.06

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
449	1992.54	399.84	399.84	399.84	.3	.5

Left Levee Station= 976.49 Elevation= 1422.95

CROSS SECTION OUTPUT Profile #PF 1

E.G. Elev (ft)	1422.34	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.28	Wt. n-Val.		0.035	
W.S. Elev (ft)	1422.06	Reach Len. (ft)	399.84	399.84	399.84
Crit W.S. (ft)	1419.90	Flow Area (sq ft)		268.04	
E.G. Slope (ft/ft)	0.001745	Area (sq ft)		268.04	
Q Total (cfs)	1130.00	Flow (cfs)		1130.00	
Top Width (ft)	70.19	Top Width (ft)		70.19	
Vel Total (ft/s)	4.22	Avg. Vel. (ft/s)		4.22	
Max Chl Dpth (ft)	4.86	Hydr. Depth (ft)		3.82	
Conv. Total (cfs)	27047.4	Conv. (cfs)		27047.4	
Length Wtd. (ft)	399.84	Wetted Per. (ft)		73.15	
Min Ch El (ft)	1417.20	Shear (lb/sq ft)		0.40	
Alpha	1.00	Stream Power (lb/ft s)		1.68	
Frctn Loss (ft)		Cum Volume (acre-ft)	2.60	6.11	15.60
C & E Loss (ft)		Cum SA (acres)	1.97	3.24	12.55

CULVERT RIVER: RIVER-1
REACH: Reach-1 RS: 1076.9

INPUT
Description:
Distance from Upstream XS = .1
Deck/Roadway Width = 220
Weir Coefficient = 2.6
Bridge Deck/Roadway Skew =
Upstream Deck/Roadway Coordinates
num= 4

Sta	Hi Cord	Lo Cord	Sta	Hi Cord	Lo Cord	Sta	Hi Cord	Lo Cord
880	1421.5		980	1422.5	1420.5	1020	1422.5	1420.5
1160	1423.5							

Upstream Bridge Cross Section Data
Station Elevation Data num= 56

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
449	1417.3	499.86	1417.73	538.24	1418.02	596.88	1418.65	631.81	1418.99
682.41	1419.2	690.22	1419.25	697.08	1419.3	704.8	1419.33	715.39	1419.37
823.34	1420.5	825.65	1420.52	854.81	1420.84	907.66	1421.38	911.55	1421.42
913.78	1421.5	951.46	1421.73	965.61	1421.83	976.49	1421.92	980	1417.2
1000	1417.2	1020	1417.2	1048	1422.3	1066.02	1422.57	1100.63	1422.77
1113.14	1422.8	1155.75	1422.99	1195.62	1423.31	1223.6	1423.5	1264.85	1423.81
1303.89	1424	1345.19	1424.29	1372	1424.45	1397.67	1424.57	1412.34	1424.65
1454.44	1425	1460.85	1425	1461.93	1425.01	1486.02	1425.11	1512.93	1425.23
1544.89	1425.5	1561.53	1425.57	1562.46	1425.59	1605.2	1425.87	1656.83	1426.15
1675.75	1426.3	1712.27	1426.47	1745.43	1426.73	1772.62	1426.95	1799.35	1427.18
1842.26	1427.6	1859.84	1427.73	1875.41	1427.86	1922.97	1428.18	1980.06	1428.57
1992.54	1428.6								

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
449	.06	449	.035	1992.54	.06

Bank Sta: Left Right Coeff Contr. Expan.
449 1992.54 .3 .5
Left Levee Station= 976.49 Elevation= 1422.95

Downstream Deck/Roadway Coordinates
num= 4

Sta	Hi Cord	Lo Cord	Sta	Hi Cord	Lo Cord	Sta	Hi Cord	Lo Cord
880	1421.5		980	1422.5	1420.5	1020	1422.5	1420.5
1160	1423.5							

Downstream Bridge Cross Section Data
Station Elevation Data num= 152

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
879	1420.7	883.19	1420.82	886.26	1420.88	888.19	1420.96	900.58	1420.65
906.14	1420.5	910.38	1420.36	913.47	1420.11	920.17	1419.6	927.8	1419.57
934.73	1419.6	939.8	1419.55	957.01	1419.94	959.23	1420.04	962.88	1420.34
969.02	1421	972.92	1421.14	973.03	1420.95	977.6	1421.35	978.5	1416.7
1000	1416.7	1021.5	1416.7	1022.5	1419.45	1027.3	1418.7	1038.4	1418.93
1041.15	1418.9	1043.35	1418.94	1048.75	1418.93	1059.87	1419	1065.82	1418.79
1077.8	1418.5	1084.09	1418.36	1086.46	1418.34	1091.31	1418.39	1105.01	1418.51
1111.19	1418.6	1133.68	1418.62	1139.88	1418.63	1144.93	1418.68	1167.35	1418.88
1194.61	1418.7	1196.51	1418.72	1215.09	1418.81	1223.94	1418.87	1233.71	1418.9
1244.14	1419	1266.29	1419.02	1271.23	1419.04	1287.9	1419.33	1300.98	1419.38
1303.81	1419.3	1308.27	1419.26	1323.25	1419.37	1331.84	1419.43	1342.78	1419.59
1359.26	1419.9	1360.64	1419.95	1361.18	1419.95	1382.28	1419.87	1386.88	1420.03
1407.4	1420.1	1415.24	1420.1	1417.12	1420.12	1421.08	1419.93	1421.9	1419.99
1424.17	1420	1432.44	1420.14	1436.69	1420.25	1437.56	1420.26	1438.23	1420.31
1467.47	1421.7	1474.97	1422.04	1486.47	1422.29	1494.01	1422.39	1498.53	1422.49
1517	1422.8	1528.91	1423.01	1532.57	1422.99	1545.21	1422.89	1558.83	1423.28
1564.79	1423.5	1577.85	1423.7	1581.94	1423.72	1590.73	1423.81	1606.58	1423.85
1615.23	1424	1623.87	1424.04	1641.39	1424.22	1648.18	1424.38	1664.42	1424.87
1670.83	1424.9	1689.18	1424.79	1697.81	1425.13	1711.27	1425.29	1713.04	1425.31
1730.65	1425.2	1738.4	1424.96	1763.75	1425.24	1764.75	1425.23	1765.52	1425.25
1784.22	1425.2	1789.43	1425.16	1789.64	1425.17	1813.86	1425.68	1837.15	1425.68
1839.58	1425.7	1842.04	1425.77	1862.92	1426.11	1882.33	1426.15	1882.49	1426.15
1888.82	1426.2	1900	1426.28	1909.68	1426.41	1913.89	1426.36	1914.7	1426.35
1916.69	1426.3	1923.36	1426.2	1928.36	1426.1	1951.61	1426.22	1962.47	1426.25
1965.38	1426.3	1993.82	1426.56	2000.18	1426.57	2010.17	1426.73	2019.67	1426.75
2025.9	1426.9	2053.09	1427.14	2058.07	1427.15	2062.06	1427.21	2076.33	1427.2
2092.8	1427.3	2093.99	1427.24	2095.45	1427.25	2125.77	1427.42	2132.37	1427.47
2141.44	1427.7	2151.52	1427.66	2152.22	1427.67	2158.99	1427.75	2185.89	1427.7
2189.7	1427.7	2199.34	1427.4	2224.56	1426.75	2228.46	1426.52	2235.53	1426.53
2247.26	1426.5	2254.36	1426.56	2265.2	1427.25	2273.49	1427.56	2280.89	1427.67
2287.23	1427.6	2289.57	1427.65						

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
879	.06	977.6	.013	1022.5	.06

Bank Sta: Left Right Coeff Contr. Expan.
977.6 1022.5 .3 .5
Ineffective Flow num= 1

Sta L	Sta R	Elev
1022.5	2289.57	1425

Left Levee Station= 977.6 Elevation= 1421.35

Upstream Embankment side slope = 0 horiz. to 1.0 vertical
Downstream Embankment side slope = 0 horiz. to 1.0 vertical
Maximum allowable submergence for weir flow = .95
Elevation at which weir flow begins =
Energy head used in spillway design =
Spillway height used in design =
Weir crest shape = Broad Crested

Number of Culverts = 1

Culvert Name	Shape	Rise	Span
Culvert #1	Box	4	10

FHWA Chart # 8 - flared wingwalls
FHWA Scale # 1 - Wingwall flared 30 to 75 deg.
Solution Criteria = Highest U.S. EG

Culvert	Upstrm Dist	Length	n Value	Entrance Loss Coef	Exit Loss Coef
	65	220	.013	.62	1

Number of Barrels = 4
Upstream Elevation = 1417.2
Centerline Stations

Sta.	Sta.	Sta.	Sta.
983.625	994.5421	005.4581	016.375

Downstream Elevation = 1416.7
Centerline Stations

Sta.	Sta.	Sta.	Sta.
983.625	994.5421	005.4581	016.375

CULVERT OUTPUT Profile #PF 1
Culvert ID : Culvert #1

Culv Q (cfs)	1130.00	Culv Vel In (ft/s)	8.25
# Barrels	4	Culv Vel Out (ft/s)	7.80
Q Barrel (cfs)	282.50	Culv Inv El Up (ft)	1417.20
E.G. US. (ft)	1422.34	Culv Inv El Dn (ft)	1416.70
W.S. US. (ft)	1422.06	Culv Frctn Ls (ft)	0.41
Delta EG (ft)	1.23	Culv Ext Lss (ft)	0.16
Delta WS (ft)	1.74	Culv Ent Lss (ft)	0.66
E.G. IC (ft)	1421.96	Q Weir (cfs)	
E.G. OC (ft)	1422.34	Weir Sta Lft (ft)	
Culvert Control	Outlet	Weir Sta Rgt (ft)	
Culv WS In (ft)	1420.62	Weir Submerg	
Culv WS Out (ft)	1420.32	Weir Max Depth (ft)	
Culv Nml Depth (ft)	3.28	Weir Avg Depth (ft)	
Culv Crt Depth (ft)	2.92	Wr Flw Area (sq ft)	
Culv Ful Lngh (ft)		Min Top Rd (ft)	1422.46

CROSS SECTION RIVER: RIVER-1
REACH: Reach-1 RS: 857

INPUT
Description:
Station Elevation Data num= 152

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
879	1420.7	883.19	1420.82	886.26	1420.88	888.19	1420.96	900.58	1420.65
906.14	1420.5	910.38	1420.36	913.47	1420.11	920.17	1419.6	927.8	1419.57
934.73	1419.6	939.8	1419.55	957.01	1419.94	959.23	1420.04	962.88	1420.34
969.02	1421	972.92	1421.14	973.03	1420.95	977.6	1421.35	978.5	1416.7
1000	1416.7	1021.5	1416.7	1022.5	1419.45	1027.3	1418.7	1038.4	1418.93
1041.15	1418.9	1043.35	1418.94	1048.75	1418.93	1059.87	1419	1065.82	1418.79
1077.8	1418.5	1084.09	1418.36	1086.46	1418.34	1091.31	1418.39	1105.01	1418.51
1111.19	1418.6	1133.68	1418.62	1139.88	1418.63	1144.93	1418.68	1167.35	1418.88
1194.61	1418.7	1196.51	1418.72	1215.09	1418.81	1223.94	1418.87	1233.71	1418.9
1244.14	1419	1266.29	1419.02	1271.23	1419.04	1287.9	1419.33	1300.98	1419.38
1303.81	1419.3	1308.27	1419.26	1323.25	1419.37	1331.84	1419.43	1342.78	1419.59
1359.26	1419.9	1360.64	1419.95	1361.18	1419.95	1382.28	1419.87	1386.88	1420.03
1407.4	1420.1	1415.24	1420.1	1417.12	1420.12	1421.08	1419.93	1421.9	1419.99
1424.17	1420	1432.44	1420.14	1436.69	1420.25	1437.56	1420.26	1438.23	1420.31
1467.47	1421.7	1474.97	1422.04	1486.47	1422.29	1494.01	1422.39	1498.53	1422.49
1517	1422.8	1528.91	1423.01	1532.57	1422.99	1545.21	1422.89	1558.83	1423.28
1564.79	1423.5	1577.85	1423.7	1581.94	1423.72	1590.73	1423.81	1606.58	1423.85
1615.23	1424	1623.87	1424.04	1641.39	1424.22	1648.18	1424.38	1664.42	1424.87
1670.83	1424.9	1689.18	1424.79	1697.81	1425.13	1711.27	1425.29	1713.04	1425.31
1730.65	1425.2	1738.4	1424.96	1763.75	1425.24	1764.75	1425.23	1765.52	1425.25
1784.22	1425.2	1789.43	1425.16	1789.64	1425.17	1813.86	1425.68	1837.15	1425.68
1839.58	1425.7	1842.04	1425.77	1862.92	1426.11	1882.33	1426.15	1882.49	1426.15
1888.82	1426.2	1900	1426.28	1909.68	1426.41	1913.89	1426.36	1914.7	1426.35
1916.69	1426.3	1923.36	1426.2	1928.36	1426.1	1951.61	1426.22	1962.47	1426.25
1965.38	1426.3	1993.82	1426.56	2000.18	1426.57	2010.17	1426.73	2019.67	1426.75
2025.9	1426.9	2053.09	1427.14	2058.07	1427.15	2062.06	1427.21	2076.33	1427.2
2092.8	1427.3	2093.99	1427.24	2095.45	1427.25	2125.77	1427.42	2132.37	1427.47
2141.44	1427.7	2151.52	1427.66	2152.22	1427.67	2158.99	1427.75	2185.89	1427.7
2189.7	1427.7	2199.34	1427.4	2224.56	1426.75	2228.46	1426.52	2235.53	1426.53
2247.26	1426.5	2254.36	1426.56	2265.2	1427.25	2273.49	1427.56	2280.89	1427.67
2287.23	1427.6	2289.57	1427.65						

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
879	.06	977.6	.013	1022.5	.06

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
977.6	1022.5	197.06	197.06	197.06	.3	.5

Ineffective Flow num= 1

Sta L	Sta R	Elev
1022.5	2289.57	1425

Left Levee Station= 977.6 Elevation= 1421.35

CROSS SECTION OUTPUT Profile #PF 1

E.G. Elev (ft)	1421.10	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.78	Wt. n-Val.		0.013	
W.S. Elev (ft)	1420.32	Reach Len. (ft)	197.06	197.06	197.06
Crit W.S. (ft)	1419.45	Flow Area (sq ft)		159.23	
E.G. Slope (ft/ft)	0.000814	Area (sq ft)		159.23	489.75
Q Total (cfs)	1130.00	Flow (cfs)		1130.00	
Top Width (ft)	460.67	Top Width (ft)		44.70	415.97
Vel Total (ft/s)	7.10	Avg. Vel. (ft/s)		7.10	
Max Chl Dpth (ft)	3.62	Hydr. Depth (ft)		3.56	
Conv. Total (cfs)	39600.4	Conv. (cfs)		39600.4	
Length Wtd. (ft)	197.06	Wetted Per. (ft)		49.61	
Min Ch El (ft)	1416.70	Shear (lb/sq ft)		0.16	
Alpha	1.00	Stream Power (lb/ft s)		1.16	
Frctn Loss (ft)	0.07	Cum Volume (acre-ft)	2.60	4.15	13.36
C & E Loss (ft)	0.31	Cum SA (acres)	1.97	2.71	10.64

Warning: The velocity head has changed by more than 0.5 ft (0.15 m). This may indicate the need for additional cross sections.

Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.

CROSS SECTION RIVER: RIVER-1
REACH: Reach-1 RS: 747

INPUT
Description:
Station Elevation Data num= 188

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
857	1420.4	857.94	1420.42	864.05	1420.47	871.13	1420.28	880.87	1419.88
883.08	1419.6	889.53	1419.07	893.74	1418.69	902.65	1418.64	908.91	1418.6
929.79	1418	934.06	1417.89	943.13	1418.51	946.01	1418.71	957.44	1419.72
965.66	1419.8	966.75	1419.86	970.93	1419.29	976.39	1418.48	977.6	1421.25
990	1415.05	1000	1415.05	1010	1415.05	1019	1419.35	1021.05	1417.99
1023.22	1418.04	1026.3	1418.04	1049.38	1418.2	1057.56	1418.23	1072.73	1418.16
1082.62	1418.13	1093.15	1418.18	1102.57	1418.1	1107.9	1418.1	1117.4	1418.17
1123.62	1418.21	1129.62	1418.21	1140.85	1418.3	1153.9	1418.28	1160.21	1418.33
1168.35	1418.3	1174.04	1418.35	1184.71	1418.3	1205.33	1418.39	1209.64	1418.44
1214.61	1418.39	1216.7	1418.4	1243.21	1418.5	1249.55	1418.49	1254.24	1418.51
1270.28	1418.57	1282.19	1418.63	1284.26	1418.6	1286.69	1418.64	1316.17	1418.77
1318.4	1418.78	1326.36	1418.73	1341.2	1418.6	1348.51	1418.79	1356.43	1419.14
1360.74	1419.17	1368.31	1419.24	1383.64	1419.4	1397.63	1419.57	1418.57	1419.81
1428.85	1419.87	1448.05	1419.98	1451.53	1420.1	1453.23	1420.08	1459.36	1420.13
1464.7	1420.08	1468.98	1420.05	1477.44	1419.7	1477.81	1419.69	1491.3	1420.04
1498.18	1419.81	1501.24	1419.79	1508.83	1419.7	1518.29	1420.08	1531.34	1420.41
1541.24	1420.67	1548.54	1420.83	1552.64	1420.9	1565.32	1421.33	1574	1421.41
1582.48	1421.56	1594.99	1421.74	1604.76	1421.8	1610.85	1421.9	1613.7	1421.85
1625.15	1421.87	1629.69	1422.39	1642.82	1422.7	1644.61	1422.81	1647.2	1422.92
1649.92	1423.08	1663.53	1423.9	1668.25	1423.4	1683.59	1423.47	1685.37	1423.46
1705.67	1423.55	1714.58	1423.42	1723.24	1423.2	1726.14	1423.12	1729.99	1422.94
1730.23	1422.93	1758.3	1422.13	1760.31	1422.1	1762.72	1422.03	1774.14	1422.08
1794.53	1421.6	1795.95	1421.57	1797.76	1421.6	1828.71	1421.5	1840.85	1421.59
1866.63	1421.61	1866.82	1421.61	1893.46	1421.8	1897.27	1421.75	1901.77	1421.56
1905.12	1421.37	1911.15	1421.87	1912.54	1422	1914.45	1422.02	1932.53	1422.15
1935.53	1422.15	1950.29	1422.16	1960.86	1422.2	1970.27	1422.24	1984.16	1422.3
1998.58	1422.42	2010.66	1422.46	2021.24	1422.5	2036.35	1422.68	2038.31	1422.69
2041.85	1422.69	2058.68	1422.73	2074.46	1422.7	2077.89	1422.71	2082.02	1422.73
2096.9	1423.03	2106.6	1423.11	2113.14	1423.1	2117.3	1423.23	2124.73	1423.37
2125.03	1423.37	2130.06	1423.35	2137.19	1423.4	2148.11	1423.85	2148.83	1423.88
2161.85	1423.96	2163.24	1423.95	2177.73	1424.1	2178.42	1423.93	2178.94	1424.11
2183.18	1424.4	2187.32	1424.11	2190.58	1424.2	2199.34	1424.55	2216.04	1424.73
2224.97	1424.79	2231.03	1424.81	2249.58	1425.1	2256.97	1425.17	2276.09	1425.07
2283.91	1425	2296.75	1424.91	2313.26	1424.7	2321.22	1424.68	2336.76	1424.85
2342.41	1424.82	2363.41	1424.82	2368.41	1424.8	2382.58	1424.66	2394.11	1424.5
2399.77	1424.36	2405.96	1424.23	2422.34	1424.2	2431.15	1424.18	2438.15	1424.3
2439.22	1424.33	2440.05	1424.34	2448.78	1424.5	2450.25	1424.43	2454.93	1424.15
2460.74	1424.74	2461.1	1424.77	2463.58	1424.3				

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
857	.06	977.6	.013	1019	.06

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
977.6	1019	100.59	100.59	100.59	.3	.5

Left Levee Station= 977.6 Elevation= 1421.25

CROSS SECTION OUTPUT Profile #PF 1

E.G. Elev (ft)	1420.72	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.16	Wt. n-Val.		0.013	0.060
W.S. Elev (ft)	1420.56	Reach Len. (ft)	100.59	100.59	100.59
Crit W.S. (ft)	1419.26	Flow Area (sq ft)		170.77	867.82
E.G. Slope (ft/ft)	0.000201	Area (sq ft)		170.77	867.82
Q Total (cfs)	1130.00	Flow (cfs)		700.94	429.06
Top Width (ft)	558.04	Top Width (ft)		40.02	518.02
Vel Total (ft/s)	1.09	Avg. Vel. (ft/s)		4.10	0.49
Max Chl Dpth (ft)	5.51	Hydr. Depth (ft)		4.27	1.68
Conv. Total (cfs)	79792.3	Conv. (cfs)		49495.1	30297.2
Length Wtd. (ft)	100.59	Wetted Per. (ft)		42.29	518.49
Min Ch El (ft)	1415.05	Shear (lb/sq ft)		0.05	0.02
Alpha	8.91	Stream Power (lb/ft s)		0.21	0.01
Frctn Loss (ft)	0.03	Cum Volume (acre-ft)	2.60	3.41	10.29
C & E Loss (ft)	0.12	Cum SA (acres)	1.97	2.52	8.53

Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.

CROSS SECTION RIVER: RIVER-1
REACH: Reach-1 RS: 647

INPUT
Description: us face of hv road
Station Elevation Data num= 89

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
836	1419.3	844.71	1419.48	866.55	1419.23	880.09	1418.98	885.55	1419.02
894.52	1418.9	895.77	1418.87	902.93	1418.85	906.14	1418.83	912.98	1418.87
917.81	1418.7	922.74	1418.74	928.18	1418.81	938.49	1419.23	941.86	1419.35
950.78	1419.3	953.15	1419.41	964.18	1419.07	965.56	1418.97	967.87	1418.91
977.6	1421.15	990	1414.95	1000	1414.95	1010	1414.95	1019	1419.25
1022.53	1417.9	1028.55	1417.9	1030.35	1417.92	1048.9	1418.05	1055.42	1418.17
1066.3	1418.3	1081.64	1418.64	1085.3	1418.7	1090.51	1418.75	1108.3	1418.81
1109.47	1418.8	1136.29	1418.96	1171.11	1419.28	1175.23	1419.3	1180.28	1419.37
1216.32	1419.9	1224.62	1420	1225.86	1420.01	1234.52	1420.11	1265.13	1420.4
1273.96	1420.5	1317.42	1420.6	1319.79	1420.63	1321.36	1420.63	1358.62	1421.05
1366.67	1421.1	1451.52	1421.42	1457.99	1421.43	1483.09	1421.53	1508.59	1421.6
1560.14	1421.8	1570.4	1421.8	1655.34	1422.1	1663.11	1422.13	1700.82	1422.14
1751.77	1422.1	1763.41	1422.05	1766.11	1422.04	1842.48	1421.67	1845.6	1421.67
1865.84	1421.7	1871.75	1421.65	1913.1	1421.62	1917.86	1421.61	1918.65	1421.6
1965.77	1421.7	1966.21	1421.7	1970.9	1421.71	2014.45	1421.87	2017.28	1421.88
2050.95	1422.2	2054.65	1422.25	2087.93	1422.36	2090.76	1422.38	2137.64	1422.88
2140.33	1422.9	2191.77	1423.41	2198.97	1423.47	2283.77	1424.22	2367.87	1424.04
2369.3	1424	2460.98	1424.04	2462.63	1424.06	2492.94	1424.16		

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
836	.06	977.6	.013	1019	.06

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
977.6	1019	100	100	100	.3	.5

Left Levee Station= 977.6 Elevation= 1421.15

CROSS SECTION OUTPUT Profile #PF 1

E.G. Elev (ft)	1420.57	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.56	Wt. n-Val.		0.013	0.060
W.S. Elev (ft)	1420.01	Reach Len. (ft)	100.00	100.00	100.00
Crit W.S. (ft)	1419.20	Flow Area (sq ft)		152.85	230.23
E.G. Slope (ft/ft)	0.000556	Area (sq ft)		152.85	230.23
Q Total (cfs)	1130.00	Flow (cfs)		985.57	144.43
Top Width (ft)	245.50	Top Width (ft)		39.11	206.39
Vel Total (ft/s)	2.95	Avg. Vel. (ft/s)		6.45	0.63
Max Chl Dpth (ft)	5.06	Hydr. Depth (ft)		3.91	1.12
Conv. Total (cfs)	47941.3	Conv. (cfs)		41813.6	6127.6
Length Wtd. (ft)	100.00	Wetted Per. (ft)		41.28	206.65

Min Ch El (ft)	1414.95	Shear (lb/sq ft)		0.13	0.04
Alpha	4.17	Stream Power (lb/ft s)		0.83	0.02
Frctn Loss (ft)	0.08	Cum Volume (acre-ft)	2.60	3.03	9.02
C & E Loss (ft)	0.18	Cum SA (acres)	1.97	2.43	7.69

Warning: The velocity head has changed by more than 0.5 ft (0.15 m). This may indicate the need for additional cross sections.
Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.

CROSS SECTION RIVER: RIVER-1
REACH: Reach-1 RS: 600

INPUT
Description: ds face of hv road
Station Elevation Data num= 89

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
836	1419.3	844.71	1419.48	866.55	1419.23	880.09	1418.98	885.55	1419.02
894.52	1418.9	895.77	1418.87	902.93	1418.85	906.14	1418.83	912.98	1418.87
917.81	1418.7	922.74	1418.74	928.18	1418.81	938.49	1419.23	941.86	1419.35
950.78	1419.3	953.15	1419.41	964.18	1419.07	965.56	1418.97	967.87	1418.91
977.6	1421.1	990	1414.9	1000	1414.9	1010	1414.9	1019	1419.2
1022.53	1417.9	1028.55	1417.9	1030.35	1417.92	1048.9	1418.05	1055.42	1418.17
1066.3	1418.3	1081.64	1418.64	1085.3	1418.7	1090.51	1418.75	1108.3	1418.81
1109.47	1418.8	1136.29	1418.96	1171.11	1419.28	1175.23	1419.3	1180.28	1419.37
1216.32	1419.9	1224.62	1420	1225.86	1420.01	1234.52	1420.11	1265.13	1420.4
1273.96	1420.5	1317.42	1420.6	1319.79	1420.63	1321.36	1420.63	1358.62	1421.05
1366.67	1421.1	1451.52	1421.42	1457.99	1421.43	1483.09	1421.53	1508.59	1421.6
1560.14	1421.8	1570.4	1421.8	1655.34	1422.1	1663.11	1422.13	1700.82	1422.14
1751.77	1422.1	1763.41	1422.05	1766.11	1422.04	1842.48	1421.67	1845.6	1421.67
1865.84	1421.7	1871.75	1421.65	1913.1	1421.62	1917.86	1421.61	1918.65	1421.6
1965.77	1421.7	1966.21	1421.7	1970.9	1421.71	2014.45	1421.87	2017.28	1421.88
2050.95	1422.2	2054.65	1422.25	2087.93	1422.36	2090.76	1422.38	2137.64	1422.88
2140.33	1422.9	2191.77	1423.41	2198.97	1423.47	2283.77	1424.22	2367.87	1424.04
2369.3	1424	2460.98	1424.04	2462.63	1424.06	2492.94	1424.16		

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
836	.06	977.6	.013	1019	.06

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
977.6	1019	100	100	100	.3	.5

Left Levee Station= 977.6 Elevation= 1421.1

CROSS SECTION OUTPUT Profile #PF 1

E.G. Elev (ft)	1420.31	Element	Left OB	Channel	Right OB
Vel Head (ft)	1.16	Wt. n-Val.		0.013	0.060
W.S. Elev (ft)	1419.15	Reach Len. (ft)	100.00	100.00	100.00
Crit W.S. (ft)	1419.15	Flow Area (sq ft)		122.09	81.29
E.G. Slope (ft/ft)	0.001321	Area (sq ft)		122.09	81.29
Q Total (cfs)	1130.00	Flow (cfs)		1078.68	51.32
Top Width (ft)	175.62	Top Width (ft)		37.41	138.21
Vel Total (ft/s)	5.56	Avg. Vel. (ft/s)		8.83	0.63
Max Chl Dpth (ft)	4.25	Hydr. Depth (ft)		3.26	0.59
Conv. Total (cfs)	31085.5	Conv. (cfs)		29673.8	1411.7
Length Wtd. (ft)	100.00	Wetted Per. (ft)		39.38	138.44
Min Ch El (ft)	1414.90	Shear (lb/sq ft)		0.26	0.05
Alpha	2.41	Stream Power (lb/ft s)		2.26	0.03
Frctn Loss (ft)	0.12	Cum Volume (acre-ft)	2.60	2.72	8.66
C & E Loss (ft)	0.25	Cum SA (acres)	1.97	2.34	7.30

Warning: The energy equation could not be balanced within the specified number of iterations. The program used critical depth for the water surface and continued on with the calculations.
Warning: Divided flow computed for this cross-section.
Warning: During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The program defaulted to critical depth.
Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid,

water surface was used.

CROSS SECTION RIVER: RIVER-1
REACH: Reach-1 RS: 547

INPUT
Description:
Station Elevation Data num= 209

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
799	1418.5	804.61	1418.65	815.35	1418.63	819.18	1418.59	820.57	1418.47
823.31	1418.1	824.04	1418.03	827.8	1417.54	835.34	1416.45	841.26	1416.15
847.85	1415.9	855.17	1416.32	866.74	1416.34	869.59	1416.19	874.75	1415.95
879.56	1415.9	880.75	1415.94	888.98	1416.06	895.67	1416.45	896.22	1416.46
901.09	1416.3	910.84	1416.25	914.7	1416.24	919.51	1416.22	936.25	1416.69
938.64	1416.8	951.59	1417.68	954.09	1417.92	960.19	1418.47	977.1	1418.42
977.6	1421.05	990	1414.85	1000	1414.85	1010	1414.85	1019	1419.15
1022.75	1417.94	1028.45	1417.9	1030.7	1417.95	1034.87	1417.9	1039.67	1418.01
1050.83	1418.09	1051.68	1418.1	1054.76	1418.13	1057.09	1418.1	1067.88	1418.23
1067.96	1418.23	1076.57	1418.1	1089.95	1417.98	1100.37	1417.9	1109.01	1417.9
1115.36	1417.81	1115.67	1417.81	1122.15	1417.49	1131.14	1415.1	1133.53	1415.9
1139.39	1417.74	1148.53	1417.76	1157.6	1417.3	1159.2	1417.1	1160.93	1417.16
1162.67	1417.17	1177.09	1417.23	1186.52	1417.48	1189.38	1417.5	1201.82	1417.29
1217.6	1417.25	1225.11	1417.24	1233.43	1417.41	1254.54	1417.7	1261.45	1417.56
1269.86	1417.72	1278.94	1417.75	1286.2	1417.71	1291.79	1417.5	1308.65	1417.84
1312.29	1417.67	1314.62	1417.82	1323.79	1417.68	1344.89	1417.8	1352.7	1417.8
1365.21	1417.95	1372.41	1418	1377.66	1418	1390.86	1418	1406.16	1418.09
1412.11	1418.15	1438.02	1418.54	1446.64	1418.65	1449.3	1418.7	1460.55	1419.02
1471.03	1418.81	1478.26	1418.78	1490.64	1418.73	1513.92	1419	1532.16	1419.21
1540.52	1419.24	1546.66	1419.36	1577.82	1419.92	1579.79	1420	1590.18	1420.28
1613.45	1421	1615.83	1421.04	1618.71	1421.07	1636.76	1421.3	1651.02	1421.46
1657.74	1421.52	1665.13	1421.54	1672.12	1421.49	1688.06	1421.6	1695.35	1421.69
1711.32	1421.83	1712.12	1421.84	1713.55	1421.85	1716.19	1421.9	1720.89	1422.3
1723.05	1422.42	1725.34	1422.16	1742.55	1422.29	1748.55	1422.3	1755.15	1422.25
1767.8	1422.12	1782.28	1422.17	1788.33	1422.14	1798.16	1422	1809.13	1422
1815.73	1422.02	1828.17	1421.78	1828.85	1421.78	1856.39	1421.7	1859.04	1421.71
1863.93	1421.68	1871.97	1421.6	1884.9	1421.41	1885.62	1421.4	1891.63	1421.55
1895.04	1421.78	1908.81	1421.8	1929.08	1421.61	1932.72	1421.5	1938.49	1421.42
1944.58	1421.47	1950.33	1421.57	1954.94	1421.39	1958.55	1421.3	1965.08	1421.34
1970.69	1421.41	1972.61	1421.41	1976.58	1421.41	2010.74	1421.5	2014.92	1421.53
2016.56	1421.55	2026	1421.58	2033.75	1421.55	2036.96	1421.6	2043.75	1421.31
2044.9	1421.32	2049.11	1421.55	2052.66	1421.99	2053.99	1422.2	2055.53	1422.16
2065.1	1422.26	2067.67	1422.33	2073.19	1422.31	2076.58	1422.7	2125.74	1423.03
2149.39	1423.08	2160.44	1423.1	2167.38	1423.11	2172.93	1423.1	2178.1	1423.23
2182.76	1423.74	2183.13	1423.8	2184.83	1423.91	2185.59	1423.9	2187.18	1423.96
2226.35	1424.33	2227.49	1424.34	2232.51	1424.5	2234.52	1424.5	2247.6	1424.35
2261.58	1424.57	2268.15	1424.72	2279.64	1424.78	2315.49	1424.5	2323.42	1424.47
2328.63	1424.46	2339.01	1424.4	2350.01	1424.31	2359.86	1424.3	2371.9	1424.23
2374.21	1424.33	2377.07	1423.73	2378.79	1423.26	2393.4	1423	2403.11	1422.86
2420.87	1422.79	2430.91	1422.78	2440.79	1422.65	2456.59	1422.4	2471.38	1422.5
2482.3	1422.52	2492.21	1422.62	2496.46	1422.63	2499.17	1422.7	2508.93	1422.73
2509.9	1422.76	2535.14	1423.15	2546.42	1423.06	2550.19	1423.2		

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
799	.06	977.6	.013	1019	.06

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
977.6	1019	100	100	100	.3	.5

Left Levee Station= 977.6 Elevation= 1421.05

CROSS SECTION OUTPUT Profile #PF 1

E.G. Elev (ft)	1419.55	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.66	Wt. n-Val.		0.013	0.060
W.S. Elev (ft)	1418.89	Reach Len. (ft)	100.00	100.00	100.00
Crit W.S. (ft)	1418.89	Flow Area (sq ft)		114.28	498.04
E.G. Slope (ft/ft)	0.001129	Area (sq ft)		114.28	498.04
Q Total (cfs)	1355.00	Flow (cfs)		907.90	447.10
Top Width (ft)	510.50	Top Width (ft)		36.54	473.96
Vel Total (ft/s)	2.21	Avg. Vel. (ft/s)		7.94	0.90
Max Chl Dpth (ft)	4.04	Hydr. Depth (ft)		3.13	1.05
Conv. Total (cfs)	40326.6	Conv. (cfs)		27020.4	13306.2
Length Wtd. (ft)		Wetted Per. (ft)		38.42	474.91
Min Ch El (ft)	1414.85	Shear (lb/sq ft)		0.21	0.07
Alpha	8.69	Stream Power (lb/ft s)		1.67	0.07
Frctn Loss (ft)		Cum Volume (acre-ft)	2.60	2.45	8.00

C & E Loss (ft) Cum SA (acres) 1.97 2.26 6.60

Warning: The energy equation could not be balanced within the specified number of iterations. The
program used critical depth for the water surface and continued on with the calculations.
Warning: Divided flow computed for this cross-section.

CROSS SECTION RIVER: RIVER-1
REACH: Reach-1 RS: 488

INPUT
Description: Dummy cross section which indicates the change in material for the n-value used.
Station Elevation Data num= 211

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
767	1417.8	768.79	1417.87	771.39	1417.94	772.62	1417.93	776.85	1417.86
788.19	1417.8	791.44	1417.47	801.9	1415.29	802.47	1415.2	803.52	1415.2
815.04	1415.2	822.91	1415.17	839.16	1415.18	845.66	1415.21	846.55	1415.22
857.2	1415.4	860.19	1415.47	865.4	1415.56	868.16	1415.56	870.23	1415.56
875.89	1415.6	889.22	1415.73	905.62	1415.63	916.32	1415.57	933.83	1415.58
938.7	1415.6	940.56	1415.58	944.44	1415.62	953.91	1415.82	969.11	1416.14
974.65	1417.1	977.25	1417.5	977.6	1420.99	990	1414.79	1000	1414.79
1010	1414.79	1019	1419.09	1022.7	1417.24	1027.47	1417.6	1030.12	1417.25
1033.02	1416.95	1052.08	1416.92	1053.4	1416.87	1053.6	1416.9	1054.68	1416.86
1064.49	1416.56	1073.57	1416.59	1078.65	1416.55	1087.71	1417	1088.74	1417.02
1090.89	1417	1100.73	1416.9	1106.56	1416.74	1114.6	1416.6	1120.38	1416.52
1129.19	1416.58	1143.09	1416.88	1145.13	1416.91	1149.25	1417	1154.35	1416.99
1173.06	1417	1183.06	1416.97	1189.21	1416.98	1215.62	1417.1	1220.89	1417.19
1227.92	1417.21	1237.56	1417.24	1244.44	1417.28	1255.39	1417.3	1269.2	1417.33
1273.43	1417.33	1276.55	1417.35	1292.81	1417.32	1308.77	1417.3	1314.95	1417.05
1322.44	1417.24	1325.87	1417.21	1328.77	1417.25	1349.9	1417.4	1360.9	1417.4
1365.78	1417.44	1372.41	1417.47	1387.76	1417.58	1392.63	1417.5	1415.8	1417.67
1426.43	1417.84	1440.51	1418.03	1458.56	1418.06	1460.56	1418.1	1490.63	1418.47
1496.67	1418.51	1505.06	1418.65	1516.62	1418.74	1524.26	1418.8	1551.53	1418.98
1554.94	1419.01	1573.56	1419.12	1590.3	1419.36	1596.35	1419.5	1620.8	1419.95
1627.98	1420.13	1637.28	1420.13	1640.02	1420.23	1648.28	1420.7	1655.38	1421.24
1668.32	1422.2	1685.34	1422.55	1686.54	1422.58	1707.22	1422.7	1714.51	1422.76
1723.34	1422.77	1727.44	1422.81	1752.17	1422.83	1755.38	1422.8	1755.99	1422.7
1758.75	1422.03	1768.75	1421.97	1781.45	1421.9	1794.61	1422.1	1804.64	1421.99
1806.23	1422.12	1819.73	1422.15	1830.62	1422.09	1837.19	1422	1841.42	1422.04
1854	1422.03	1857.38	1421.93	1866.22	1421.58	1871.82	1421.3	1884.49	1420.52
1887.69	1420.49	1905.37	1420.48	1915.17	1420.62	1919.76	1420.6	1921.75	1420.62
1940.87	1420.6	1946.55	1420.65	1952.46	1420.84	1956.71	1421.2	1960.29	1421.47
1961.27	1421.48	1976.48	1421.76	1979	1421.8	1980.18	1421.8	1985.57	1421.76
1996.69	1421.71	2006.81	1421.68	2029.92	1421.8	2051.26	1422	2061.14	1422.17
2075.02	1422.31	2081.68	1422.28	2083.05	1422.28	2087.5	1422.5	2096.5	1422.45
2098.12	1422.46	2108.42	1422.83	2113.26	1422.85	2121.11	1423	2142.52	1423.21
2153.17	1423.31	2175.7	1423.55	2192.35	1423.6	2196.09	1423.5	2204.35	1423.53
2208.63	1423.59	2211.57	1423.6	2214.71	1423.89	2216.75	1424	2219.36	1424.11
2238.01	1424.23	2256.08	1424.32	2263.54	1424.43	2266.32	1424.4	2274.08	1424.35
2280.86	1424.3	2287.68	1424.33	2302.38	1424.56	2311.84	1424.4	2318.14	1424.39
2352.72	1424.44	2357.34	1424.31	2358.23	1424.31	2369.65	1424.3	2371.3	1424.3
2374.55	1424.13	2383.79	1423.8	2391.48	1423.74	2400.43	1423.7	2402.85	1423.63
2406.96	1423.59	2409.74	1423.14	2411.73	1422.8	2434.1	1422.3	2436.74	1422.26
2465.45	1422.2	2468.03	1422.17	2490.66	1422.16	2514.69	1422.3	2516.22	1422.31
2518.97	1422.33	2534.97	1422.44	2542.68	1422.32	2556.17	1422.4	2556.68	1422.38
2567.65	1422.46	2568.91	1422.49	2569.45	1422.48	2569.94	1422.5	2572.59	1422.53
2585.65	1422.89								

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
767	.06	977.6	.013	1019	.06

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
977.6	1019	100	100	100	.3	.5

Left Levee Station= 977.6 Elevation= 1420.99

CROSS SECTION OUTPUT Profile #PF 1

E.G. Elev (ft)	1419.24	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.30	Wt. n-Val.		0.013	0.060
W.S. Elev (ft)	1418.94	Reach Len. (ft)	100.00	100.00	100.00
Crit W.S. (ft)	1418.43	Flow Area (sq ft)		118.36	795.42
E.G. Slope (ft/ft)	0.000622	Area (sq ft)		118.36	795.42

Q Total (cfs)	1355.00	Flow (cfs)		708.49	646.51
Top Width (ft)	563.67	Top Width (ft)		37.00	526.67
Vel Total (ft/s)	1.48	Avg. Vel. (ft/s)		5.99	0.81
Max Chl Dpth (ft)	4.15	Hydr. Depth (ft)		3.20	1.51
Conv. Total (cfs)	54313.0	Conv. (cfs)		28398.8	25914.2
Length Wtd. (ft)	100.00	Wetted Per. (ft)		38.92	527.17
Min Ch El (ft)	1414.79	Shear (lb/sq ft)		0.12	0.06
Alpha	8.66	Stream Power (lb/ft s)		0.71	0.05
Frctn Loss (ft)	0.09	Cum Volume (acre-ft)	2.60	2.18	6.51
C & E Loss (ft)	0.12	Cum SA (acres)	1.97	2.17	5.45

Warning: Divided flow computed for this cross-section.
Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.

CROSS SECTION RIVER: RIVER-1
REACH: Reach-1 RS: 487

INPUT
Description:
Station Elevation Data num= 211

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
767	1417.8	768.79	1417.87	771.39	1417.94	772.62	1417.93	776.85	1417.86
788.19	1417.8	791.44	1417.47	801.9	1415.29	802.47	1415.2	803.52	1415.2
815.04	1415.2	822.91	1415.17	839.16	1415.18	845.66	1415.21	846.55	1415.22
857.2	1415.4	860.19	1415.47	865.4	1415.56	868.16	1415.56	870.23	1415.56
875.89	1415.6	889.22	1415.73	905.62	1415.63	916.32	1415.57	933.83	1415.58
938.7	1415.6	940.56	1415.58	944.44	1415.62	953.91	1415.82	969.11	1416.14
974.65	1417.1	977.25	1417.5	977.6	1420.99	990	1414.79	1000	1414.79
1010	1414.79	1019	1419.09	1022.7	1417.24	1027.47	1417.6	1030.12	1417.25
1033.02	1416.95	1052.08	1416.92	1053.4	1416.87	1053.6	1416.9	1054.68	1416.86
1064.49	1416.56	1073.57	1416.59	1078.65	1416.55	1087.71	1417	1088.74	1417.02
1090.89	1417	1100.73	1416.9	1106.56	1416.74	1114.6	1416.6	1120.38	1416.52
1129.19	1416.58	1143.09	1416.88	1145.13	1416.91	1149.25	1417	1154.35	1416.99
1173.06	1417	1183.06	1416.97	1189.21	1416.98	1215.62	1417.1	1220.89	1417.19
1227.92	1417.21	1237.56	1417.24	1244.44	1417.28	1255.39	1417.3	1269.2	1417.33
1273.43	1417.33	1276.55	1417.35	1292.81	1417.32	1308.77	1417.3	1314.95	1417.05
1322.44	1417.24	1325.87	1417.21	1328.77	1417.25	1349.9	1417.4	1360.9	1417.4
1365.78	1417.44	1372.41	1417.47	1387.76	1417.58	1392.63	1417.5	1415.8	1417.67
1426.43	1417.84	1440.51	1418.03	1458.56	1418.06	1460.56	1418.1	1490.63	1418.47
1496.67	1418.51	1505.06	1418.65	1516.62	1418.74	1524.26	1418.8	1551.53	1418.98
1554.94	1419.01	1573.56	1419.12	1590.3	1419.36	1596.35	1419.5	1620.8	1419.95
1627.98	1420.13	1637.28	1420.13	1640.02	1420.23	1648.28	1420.7	1655.38	1421.24
1668.32	1422.2	1685.34	1422.55	1686.54	1422.58	1707.22	1422.7	1714.51	1422.76
1723.34	1422.77	1727.44	1422.81	1752.17	1422.83	1755.38	1422.8	1755.99	1422.7
1758.75	1422.03	1768.75	1421.97	1781.45	1421.9	1794.61	1422.1	1804.64	1421.99
1806.23	1422.12	1819.73	1422.15	1830.62	1422.09	1837.19	1422	1841.42	1422.04
1854	1422.03	1857.38	1421.93	1866.22	1421.58	1871.82	1421.3	1884.49	1420.52
1887.69	1420.49	1905.37	1420.48	1915.17	1420.62	1919.76	1420.6	1921.75	1420.62
1940.87	1420.6	1946.55	1420.65	1952.46	1420.84	1956.71	1421.2	1960.29	1421.47
1961.27	1421.48	1976.48	1421.76	1979	1421.8	1980.18	1421.8	1985.57	1421.76
1996.69	1421.71	2006.81	1421.68	2029.92	1421.8	2051.26	1422	2061.14	1422.17
2075.02	1422.31	2081.68	1422.28	2083.05	1422.28	2087.5	1422.5	2096.5	1422.45
2098.12	1422.46	2108.42	1422.83	2113.26	1422.85	2121.11	1423	2142.52	1423.21
2153.17	1423.31	2175.7	1423.55	2192.35	1423.6	2196.09	1423.5	2204.35	1423.53
2208.63	1423.59	2211.57	1423.6	2214.71	1423.89	2216.75	1424	2219.36	1424.11
2238.01	1424.23	2256.08	1424.32	2263.54	1424.43	2266.32	1424.4	2274.08	1424.35
2280.86	1424.3	2287.68	1424.33	2302.38	1424.56	2311.84	1424.4	2318.14	1424.39
2352.72	1424.44	2357.34	1424.31	2358.23	1424.31	2369.65	1424.3	2371.3	1424.3
2374.55	1424.13	2383.79	1423.8	2391.48	1423.74	2400.43	1423.7	2402.85	1423.63
2406.96	1423.59	2409.74	1423.14	2411.73	1422.8	2434.1	1422.3	2436.74	1422.26
2465.45	1422.2	2468.03	1422.17	2490.66	1422.16	2514.69	1422.3	2516.22	1422.31
2518.97	1422.33	2534.97	1422.44	2542.68	1422.32	2556.17	1422.4	2556.68	1422.38
2567.65	1422.46	2568.91	1422.49	2569.45	1422.48	2569.94	1422.5	2572.59	1422.53
2585.65	1422.89								

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
767	.06	977.6	.04	1019	.06

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
977.6	1019	100	100	100	.3	.5

Left Levee Station= 977.6 Elevation= 1420.99

CROSS SECTION OUTPUT Profile #PF 1

E.G. Elev (ft)	1419.03	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.05	Wt. n-Val.		0.040	0.060
W.S. Elev (ft)	1418.97	Reach Len. (ft)	100.00	100.00	100.00
Crit W.S. (ft)	1417.98	Flow Area (sq ft)		119.54	812.15
E.G. Slope (ft/ft)	0.001415	Area (sq ft)		119.54	812.15
Q Total (cfs)	1355.00	Flow (cfs)		352.04	1002.96
Top Width (ft)	568.65	Top Width (ft)		37.13	531.52
Vel Total (ft/s)	1.45	Avg. Vel. (ft/s)		2.95	1.23
Max Chl Dpth (ft)	4.18	Hydr. Depth (ft)		3.22	1.53
Conv. Total (cfs)	36024.4	Conv. (cfs)		9359.3	26665.1
Length Wtd. (ft)	100.00	Wetted Per. (ft)		39.06	532.03
Min Ch El (ft)	1414.79	Shear (lb/sq ft)		0.27	0.13
Alpha	1.60	Stream Power (lb/ft s)		0.80	0.17
Frctn Loss (ft)	0.16	Cum Volume (acre-ft)	2.60	1.91	4.67
C & E Loss (ft)	0.00	Cum SA (acres)	1.97	2.09	4.23

Warning: Divided flow computed for this cross-section.

CROSS SECTION RIVER: RIVER-1
REACH: Reach-1 RS: 447

INPUT
Description:
Station Elevation Data num= 211

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
767	1417.8	768.79	1417.87	771.39	1417.94	772.62	1417.93	776.85	1417.86
788.19	1417.8	791.44	1417.47	801.9	1415.29	802.47	1415.2	803.52	1415.2
815.04	1415.2	822.91	1415.17	839.16	1415.18	845.66	1415.21	846.55	1415.22
857.2	1415.4	860.19	1415.47	865.4	1415.56	868.16	1415.56	870.23	1415.56
875.89	1415.6	889.22	1415.73	905.62	1415.63	916.32	1415.57	933.83	1415.58
938.7	1415.6	940.56	1415.58	944.44	1415.62	953.91	1415.82	969.11	1416.14
974.65	1417.1	977.25	1417.5	977.6	1420.95	990	1414.75	1000	1414.75
1010	1414.75	1019	1419.05	1022.7	1417.24	1027.47	1417.6	1030.12	1417.25
1033.02	1416.95	1052.08	1416.92	1053.4	1416.87	1053.6	1416.9	1054.68	1416.86
1064.49	1416.56	1073.57	1416.59	1078.65	1416.55	1087.71	1417	1088.74	1417.02
1090.89	1417	1100.73	1416.9	1106.56	1416.74	1114.6	1416.6	1120.38	1416.52
1129.19	1416.58	1143.09	1416.88	1145.13	1416.91	1149.25	1417	1154.35	1416.99
1173.06	1417	1183.06	1416.97	1189.21	1416.98	1215.62	1417.1	1220.89	1417.19
1227.92	1417.21	1237.56	1417.24	1244.44	1417.28	1255.39	1417.3	1269.2	1417.33
1273.43	1417.33	1276.55	1417.35	1292.81	1417.32	1308.77	1417.3	1314.95	1417.05
1322.44	1417.24	1325.87	1417.21	1328.77	1417.25	1349.9	1417.4	1360.9	1417.4
1365.78	1417.44	1372.41	1417.47	1387.76	1417.58	1392.63	1417.5	1415.8	1417.67
1426.43	1417.84	1440.51	1418.03	1458.56	1418.06	1460.56	1418.1	1490.63	1418.47
1496.67	1418.51	1505.06	1418.65	1516.62	1418.74	1524.26	1418.8	1551.53	1418.98
1554.94	1419.01	1573.56	1419.12	1590.3	1419.36	1596.35	1419.5	1620.8	1419.95
1627.98	1420.13	1637.28	1420.13	1640.02	1420.23	1648.28	1420.7	1655.38	1421.24
1668.32	1422.2	1685.34	1422.55	1686.54	1422.58	1707.22	1422.7	1714.51	1422.76
1723.34	1422.77	1727.44	1422.81	1752.17	1422.83	1755.38	1422.8	1755.99	1422.7
1758.75	1422.03	1768.75	1421.97	1781.45	1421.9	1794.61	1422.1	1804.64	1421.99
1806.23	1422.12	1819.73	1422.15	1830.62	1422.09	1837.19	1422	1841.42	1422.04
1854	1422.03	1857.38	1421.93	1866.22	1421.58	1871.82	1421.3	1884.49	1420.52
1887.69	1420.49	1905.37	1420.48	1915.17	1420.62	1919.76	1420.6	1921.75	1420.62
1940.87	1420.6	1946.55	1420.65	1952.46	1420.84	1956.71	1421.2	1960.29	1421.47
1961.27	1421.48	1976.48	1421.76	1979	1421.8	1980.18	1421.8	1985.57	1421.76
1996.69	1421.71	2006.81	1421.68	2029.92	1421.8	2051.26	1422	2061.14	1422.17
2075.02	1422.31	2081.68	1422.28	2083.05	1422.28	2087.5	1422.5	2096.5	1422.45
2098.12	1422.46	2108.42	1422.83	2113.26	1422.85	2121.11	1423	2142.52	1423.21
2153.17	1423.31	2175.7	1423.55	2192.35	1423.6	2196.09	1423.5	2204.35	1423.53
2208.63	1423.59	2211.57	1423.6	2214.71	1423.89	2216.75	1424	2219.36	1424.11
2238.01	1424.23	2256.08	1424.32	2263.54	1424.43	2266.32	1424.4	2274.08	1424.35
2280.86	1424.3	2287.68	1424.33	2302.38	1424.56	2311.84	1424.4	2318.14	1424.39
2352.72	1424.44	2357.34	1424.31	2358.23	1424.31	2369.65	1424.3	2371.3	1424.3
2374.55	1424.13	2383.79	1423.8	2391.48	1423.74	2400.43	1423.7	2402.85	1423.63
2406.96	1423.59	2409.74	1423.14	2411.73	1422.8	2434.1	1422.3	2436.74	1422.26
2465.45	1422.2	2468.03	1422.17	2490.66	1422.16	2514.69	1422.3	2516.22	1422.31
2518.97	1422.33	2534.97	1422.44	2542.68	1422.32	2556.17	1422.4	2556.68	1422.38
2567.65	1422.46	2568.91	1422.49	2569.45	1422.48	2569.94	1422.5	2572.59	1422.53
2585.65	1422.89								

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
767	.06	977.6	.04	1019	.06

Bank Sta: Left Right Lengths: Left Channel Right Coeff Contr. Expan.

977.6 1019 100 100 100 .3 .5
Left Levee Station= 977.6 Elevation= 1420.95

CROSS SECTION OUTPUT Profile #PF 1

E.G. Elev (ft)	1418.86	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.07	Wt. n-Val.		0.040	0.060
W.S. Elev (ft)	1418.79	Reach Len. (ft)	100.00	100.00	100.00
Crit W.S. (ft)	1418.00	Flow Area (sq ft)		114.24	717.14
E.G. Slope (ft/ft)	0.001881	Area (sq ft)		114.24	717.14
Q Total (cfs)	1355.00	Flow (cfs)		380.66	974.34
Top Width (ft)	540.14	Top Width (ft)		36.54	503.60
Vel Total (ft/s)	1.63	Avg. Vel. (ft/s)		3.33	1.36
Max Chl Dpth (ft)	4.04	Hydr. Depth (ft)		3.13	1.42
Conv. Total (cfs)	31243.6	Conv. (cfs)		8777.2	22466.4
Length Wtd. (ft)	100.00	Wetted Per. (ft)		38.41	504.06
Min Ch El (ft)	1414.75	Shear (lb/sq ft)		0.35	0.17
Alpha	1.67	Stream Power (lb/ft s)		1.16	0.23
Frctn Loss (ft)	0.34	Cum Volume (acre-ft)	2.60	1.64	2.91
C & E Loss (ft)	0.10	Cum SA (acres)	1.97	2.00	3.04

Warning: Divided flow computed for this cross-section.
Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.

CROSS SECTION RIVER: RIVER-1
REACH: Reach-1 RS: 446

INPUT
Description: Dummy cross section added to indicate the change in the material and the n-value used for the model.
Station Elevation Data num= 211

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
767	1417.8	768.79	1417.87	771.39	1417.94	772.62	1417.93	776.85	1417.86
788.19	1417.8	791.44	1417.47	801.9	1415.29	802.47	1415.2	803.52	1415.2
815.04	1415.2	822.91	1415.17	839.16	1415.18	845.66	1415.21	846.55	1415.22
857.2	1415.4	860.19	1415.47	865.4	1415.56	868.16	1415.56	870.23	1415.56
875.89	1415.6	889.22	1415.73	905.62	1415.63	916.32	1415.57	933.83	1415.58
938.7	1415.6	940.56	1415.58	944.44	1415.62	953.91	1415.82	969.11	1416.14
974.65	1417.1	977.25	1417.5	977.6	1420.95	990	1414.75	1000	1414.75
1010	1414.75	1019	1419.05	1022.7	1417.24	1027.47	1417.6	1030.12	1417.25
1033.02	1416.95	1052.08	1416.92	1053.4	1416.87	1053.6	1416.9	1054.68	1416.86
1064.49	1416.56	1073.57	1416.59	1078.65	1416.55	1087.71	1417	1088.74	1417.02
1090.89	1417	1100.73	1416.9	1106.56	1416.74	1114.6	1416.6	1120.38	1416.52
1129.19	1416.58	1143.09	1416.88	1145.13	1416.91	1149.25	1417	1154.35	1416.99
1173.06	1417	1183.06	1416.97	1189.21	1416.98	1215.62	1417.1	1220.89	1417.19
1227.92	1417.21	1237.56	1417.24	1244.44	1417.28	1255.39	1417.3	1269.2	1417.33
1273.43	1417.33	1276.55	1417.35	1292.81	1417.32	1308.77	1417.3	1314.95	1417.05
1322.44	1417.24	1325.87	1417.21	1328.77	1417.25	1349.9	1417.4	1360.9	1417.4
1365.78	1417.44	1372.41	1417.47	1387.76	1417.58	1392.63	1417.5	1415.8	1417.67
1426.43	1417.84	1440.51	1418.03	1458.56	1418.06	1460.56	1418.1	1490.63	1418.47
1496.67	1418.51	1505.06	1418.65	1516.62	1418.74	1524.26	1418.8	1551.53	1418.98
1554.94	1419.01	1573.56	1419.12	1590.3	1419.36	1596.35	1419.5	1620.8	1419.95
1627.98	1420.13	1637.28	1420.13	1640.02	1420.23	1648.28	1420.7	1655.38	1421.24
1668.32	1422.2	1685.34	1422.55	1686.54	1422.58	1707.22	1422.7	1714.51	1422.76
1723.34	1422.77	1727.44	1422.81	1752.17	1422.83	1755.38	1422.8	1755.99	1422.7
1758.75	1422.03	1768.75	1421.97	1781.45	1421.9	1794.61	1422.1	1804.64	1421.99
1806.23	1422.12	1819.73	1422.15	1830.62	1422.09	1837.19	1422	1841.42	1422.04
1854	1422.03	1857.38	1421.93	1866.22	1421.58	1871.82	1421.3	1884.49	1420.52
1887.69	1420.49	1905.37	1420.48	1915.17	1420.62	1919.76	1420.6	1921.75	1420.62
1940.87	1420.6	1946.55	1420.65	1952.46	1420.84	1956.71	1421.2	1960.29	1421.47
1961.27	1421.48	1976.48	1421.76	1979	1421.8	1980.18	1421.8	1985.57	1421.76
1996.69	1421.71	2006.81	1421.68	2029.92	1421.8	2051.26	1422	2061.14	1422.17
2075.02	1422.31	2081.68	1422.28	2083.05	1422.28	2087.5	1422.5	2096.5	1422.45
2098.12	1422.46	2108.42	1422.83	2113.26	1422.85	2121.11	1423	2142.52	1423.21
2153.17	1423.31	2175.7	1423.55	2192.35	1423.6	2196.09	1423.5	2204.35	1423.53
2208.63	1423.59	2211.57	1423.6	2214.71	1423.89	2216.75	1424	2219.36	1424.11
2238.01	1424.23	2256.08	1424.32	2263.54	1424.43	2266.32	1424.4	2274.08	1424.35
2280.86	1424.3	2287.68	1424.33	2302.38	1424.56	2311.84	1424.4	2318.14	1424.39
2352.72	1424.44	2357.34	1424.31	2358.23	1424.31	2369.65	1424.3	2371.3	1424.3
2374.55	1424.13	2383.79	1423.8	2391.48	1423.74	2400.43	1423.7	2402.85	1423.63
2406.96	1423.59	2409.74	1423.14	2411.73	1422.8	2434.1	1422.3	2436.74	1422.26
2465.45	1422.2	2468.03	1422.17	2490.66	1422.16	2514.69	1422.3	2516.22	1422.31
2518.97	1422.33	2534.97	1422.44	2542.68	1422.32	2556.17	1422.4	2556.68	1422.38
2567.65	1422.46	2568.91	1422.49	2569.45	1422.48	2569.94	1422.5	2572.59	1422.53

2585.65 1422.89

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
767	.06	977.6	.035	1019	.06

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
977.6	1019	100	100	100	.3	.5

Left Levee Station= 977.6 Elevation= 1420.95

CROSS SECTION OUTPUT Profile #PF 1

E.G. Elev (ft)	1418.42	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.39	Wt. n-Val.		0.035	0.060
W.S. Elev (ft)	1418.03	Reach Len. (ft)	100.00	100.00	100.00
Crit W.S. (ft)	1418.03	Flow Area (sq ft)		87.61	362.29
E.G. Slope (ft/ft)	0.008161	Area (sq ft)		87.61	362.29
Q Total (cfs)	1355.00	Flow (cfs)		620.17	734.83
Top Width (ft)	452.84	Top Width (ft)		33.42	419.42
Vel Total (ft/s)	3.01	Avg. Vel. (ft/s)		7.08	2.03
Max Chl Dpth (ft)	3.28	Hydr. Depth (ft)		2.62	0.86
Conv. Total (cfs)	14999.5	Conv. (cfs)		6865.1	8134.3
Length Wtd. (ft)	100.00	Wetted Per. (ft)		34.94	419.69
Min Ch El (ft)	1414.75	Shear (lb/sq ft)		1.28	0.44
Alpha	2.77	Stream Power (lb/ft s)		9.04	0.89
Frctn Loss (ft)	0.57	Cum Volume (acre-ft)	2.60	1.41	1.67
C & E Loss (ft)	0.16	Cum SA (acres)	1.97	1.92	1.99

Warning: The energy equation could not be balanced within the specified number of iterations. The
program used critical depth for the water surface and continued on with the calculations.
Warning: Divided flow computed for this cross-section.
Warning: The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate the need for additional cross sections.
Warning: During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated water surface came back below critical depth. This indicates
that there is not a valid subcritical answer. The program defaulted to critical depth.
Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid,
water surface was used.

CROSS SECTION RIVER: RIVER-1
REACH: Reach-1 RS: 347

INPUT
Description:
Station Elevation Data num= 206

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
738	1417.7	743.76	1417.67	757.6	1417.44	759.69	1417.4	761.53	1417.15
762.65	1417	771.32	1415.22	773.55	1414.79	775.76	1414.77	783.29	1414.72
796.24	1414.6	805.54	1414.65	815.03	1414.75	816.88	1414.74	825.07	1414.91
827.5	1415	829.33	1415.02	836.37	1415.35	837.63	1415.29	841.87	1415.29
855.18	1415.3	860.64	1415.28	881.23	1415.44	887.14	1415.46	906.34	1415.68
911.2	1415.7	916.54	1415.77	936.25	1415.9	956.91	1416.13	961.16	1416.21
965.8	1416.3	982.58	1416.7	985.92	1416.91	993.34	1415.51	1000.15	1414.09
1000.21	1414.1	1003.01	1414.9	1006.55	1415.72	1010.48	1416.92	1016.28	1416.89
1040.7	1416.8	1043.64	1416.73	1050.26	1416.54	1062.19	1416.19	1067.57	1416.22
1083.8	1416.1	1094.37	1416.05	1098.47	1415.98	1104.69	1415.69	1116.19	1414.8
1120.46	1414.5	1125.11	1414.73	1129.52	1414.98	1133.07	1415.17	1144.46	1415.45
1144.81	1415.5	1157.47	1415.5	1171.23	1416.03	1173.14	1416.06	1176.71	1416.1
1209.14	1416.5	1210.26	1416.49	1212.08	1416.45	1232.19	1416.22	1250.5	1416.11
1252.18	1416.4	1264.16	1416.19	1271.76	1416.34	1287.94	1416.2	1291.04	1416.27
1302.18	1416.8	1304.05	1416.78	1305.71	1416.81	1323.17	1416.93	1335.93	1417.08
1337.66	1417.1	1338.01	1417.08	1339.66	1417.08	1341.87	1417.07	1368.57	1416.95
1379.4	1417.1	1388.55	1417.13	1403.96	1417.24	1408.9	1417.27	1427.17	1417.43
1439.92	1417.5	1459.5	1417.67	1466.31	1417.72	1496.46	1417.94	1518.09	1417.97
1526.2	1418	1530.22	1418.04	1543.03	1418.11	1559.15	1418.27	1573.23	1418.44
1589.77	1418.7	1603.99	1418.83	1620.13	1418.76	1629.59	1418.88	1648.31	1419.16
1661.61	1419.4	1681.23	1419.32	1682.39	1419.33	1683.48	1419.36	1705.49	1420.06
1714.31	1420.9	1722.83	1421.6	1737.96	1422.09	1739.02	1422.13	1758.6	1422.51
1767.9	1422.7	1768.78	1422.7	1772.62	1422.73	1789.1	1422.79	1807.18	1422.42
1810.32	1422.3	1810.7	1422.24	1813.6	1421.65	1825.15	1421.65	1835.64	1421.76
1841.1	1422	1842.79	1422.06	1864.79	1422.36	1893.75	1422.39	1895.05	1422.39

1899.83	1422.4	1912.13	1422.2	1917.19	1422.04	1927.14	1421.78	1928.71	1421.52
1940.95	1420.6	1947.35	1420.19	1969.99	1420.34	1973	1420.38	1974.76	1420.39
1988.58	1420.6	1989.02	1420.66	1997.99	1421.68	2001.38	1421.87	2003.34	1422.04
2017.7	1422.1	2018.59	1422.04	2025.55	1422.1	2036.04	1422.25	2040.53	1422.33
2066.2	1422.2	2066.57	1422.2	2089.81	1422.46	2097.38	1422.25	2100.82	1422.24
2123.04	1422.3	2134.46	1422.33	2136.19	1422.33	2142.7	1422.31	2149.58	1422.41
2154.54	1422.5	2156.28	1422.47	2162.07	1422.54	2173.62	1422.56	2174.76	1422.59
2175.96	1422.6	2200.86	1422.81	2210.09	1422.92	2213.22	1422.95	2244.14	1423.34
2251.09	1423.4	2266.2	1423.73	2266.58	1423.74	2271.17	1424.11	2284.5	1424.17
2293.79	1424.2	2307.28	1424.31	2318.42	1424.32	2320.95	1424.36	2334.93	1424.31
2355.71	1424.4	2357.63	1424.45	2359.31	1424.43	2386.85	1424.45	2387.76	1424.45
2417.76	1424.1	2418.37	1424.11	2420.39	1424.11	2423.51	1424.09	2434.11	1423.97
2443.17	1423.9	2443.8	1423.77	2445.64	1423.33	2446.86	1423.3	2461.78	1423.16
2463.7	1422.8	2466.64	1422.41	2491.75	1422.05	2492.04	1422.05	2519.74	1422.16
2519.95	1422.2	2545.33	1421.81	2550.37	1421.88	2572.02	1422.16	2592.59	1422.15
2595.77	1422.1	2603.62	1422.11	2607.65	1422.14	2617.36	1422.27	2624.52	1422.34
2641.81	1422.8								

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
738	.06	985.92	.035	1010.48	.06

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
985.92	1010.48	97.93	97.93	97.93	.3	.5

Left Levee Station= 985.92 Elevation= 1416.91

CROSS SECTION OUTPUT Profile #PF 1

			Left OB	Channel	Right OB
E.G. Elev (ft)	1417.16	Element			
Vel Head (ft)	0.08	Wt. n-Val.	0.060	0.035	0.060
W.S. Elev (ft)	1417.09	Reach Len. (ft)	97.93	97.93	97.93
Crit W.S. (ft)	1416.91	Flow Area (sq ft)	354.96	38.77	293.42
E.G. Slope (ft/ft)	0.004238	Area (sq ft)	354.96	38.77	293.42
Q Total (cfs)	1355.00	Flow (cfs)	777.42	142.70	434.88
Top Width (ft)	614.81	Top Width (ft)	223.91	24.56	366.34
Vel Total (ft/s)	1.97	Avg. Vel. (ft/s)	2.19	3.68	1.48
Max Chl Dpth (ft)	3.00	Hydr. Depth (ft)	1.59	1.58	0.80
Conv. Total (cfs)	20815.3	Conv. (cfs)	11942.6	2192.1	6680.6
Length Wtd. (ft)	97.93	Wetted Per. (ft)	224.17	25.22	366.49
Min Ch El (ft)	1414.09	Shear (lb/sq ft)	0.42	0.41	0.21
Alpha	1.26	Stream Power (lb/ft s)	0.92	1.50	0.31
Frctn Loss (ft)	0.53	Cum Volume (acre-ft)	2.19	1.26	0.92
C & E Loss (ft)	0.00	Cum SA (acres)	1.71	1.86	1.08

Warning: Divided flow computed for this cross-section.
Warning: The parabolic search method failed to converge on critical depth. The program will try the
cross section slice/secant method to find critical depth.

CROSS SECTION RIVER: RIVER-1
REACH: Reach-1 RS: 247

INPUT
Description:
Station Elevation Data num= 147

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
694	1417	697.33	1416.98	698.3	1416.98	699.13	1416.97	715.5	1416.62
716.57	1416.5	719.07	1416.13	721.38	1415.74	730.17	1414.11	735.45	1414.04
739.36	1414	742.96	1414.02	760.45	1414	767.87	1413.84	774.95	1413.71
775.82	1413.7	782.67	1414.11	789.57	1414.69	792.18	1414.93	797.73	1415.04
804.58	1415	816.03	1414.82	816.88	1414.8	839.19	1415.31	841.23	1415.34
862.46	1415.5	866.25	1415.55	886.26	1415.82	891.64	1415.93	898.62	1416.01
916.67	1416.2	927.42	1416.16	941.77	1416.29	952.81	1416.18	964.28	1416.23
968.57	1416.1	972.48	1416.18	977.79	1415.84	982.08	1417.38	987.57	1418.01
987.94	1418.1	989.25	1417.49	996.62	1414	997.17	1414.21	1000.02	1415.1
1004.75	1416.8	1016.92	1416.69	1022.63	1416.58	1037.83	1416.24	1055.86	1416
1058.04	1416	1075.9	1415.87	1092.75	1415.72	1096.05	1415.68	1112.04	1415.6
1125.73	1415.3	1132.33	1415.21	1144.72	1414.45	1149.39	1414.16	1159.01	1414.78
1160.8	1414.9	1164.47	1414.89	1172.36	1414.94	1179.87	1414.95	1185	1415.01
1193.98	1415.3	1205	1415.39	1213.35	1415.43	1227.94	1415.69	1231.23	1415.75
1233.1	1415.8	1246.31	1415.89	1268.67	1416.11	1272.59	1416.15	1276	1416.17
1290.15	1416.1	1298.8	1416.17	1303.67	1416.39	1319.08	1416.56	1330.48	1416.64
1331.58	1416.7	1350.41	1416.78	1363.07	1416.83	1371.29	1416.76	1375.54	1416.67
1394.25	1416.8	1398.7	1416.81	1416.51	1416.78	1428.22	1416.95	1450.16	1417.17
1458.6	1417.2	1466.32	1417.49	1485.07	1417.89	1491.07	1417.88	1509.53	1418.37

1510.63	1418.4	1511.39	1418.41	1529.27	1418.84	1540.83	1419.02	1551.18	1419.21
1568.14	1419.2	1571.33	1419.24	1588.41	1419.06	1610.14	1418.89	1611.52	1418.87
1633.2	1418.9	1643.8	1418.94	1645.48	1418.96	1669.6	1419.18	1670.99	1419.19
1674.2	1419.2	1701.13	1419.42	1710.31	1419.53	1730.03	1419.73	1750.18	1419.98
1761.29	1420.3	1770.32	1420.69	1786.57	1420.86	1788.99	1420.91	1807.97	1421.75
1818.68	1421.8	1835.7	1421.77	1842.8	1421.67	1844.26	1421.49	1845.3	1421.36
1846.17	1421.3	1851.66	1421.23	1874.1	1421.8	1879.8	1421.87	1925.67	1421.93
1928.27	1422	1928.57	1421.97	1934.63	1422.05	1935.09	1422.06	1935.89	1422.02
1945.1	1422	1945.58	1422.04	1946.31	1422.05	1955.79	1421.88	1960.71	1421.11
1968.75	1420	1974.19	1419.98	1987.62	1420.14	1996.63	1420.22	1999.41	1420.27
2006.1	1420.3	2015.91	1420.31						

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
694	.06	987.94	.035	1004.75	.06

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
987.94	1004.75	102.08	102.08	102.08	.3	.5

CROSS SECTION OUTPUT Profile #PF 1

			Left OB	Channel	Right OB
E.G. Elev (ft)	1416.62	Element			
Vel Head (ft)	0.09	Wt. n-Val.	0.060	0.035	0.060
W.S. Elev (ft)	1416.54	Reach Len. (ft)	102.08	102.08	102.08
Crit W.S. (ft)		Flow Area (sq ft)	327.60	16.37	256.37
E.G. Slope (ft/ft)	0.007202	Area (sq ft)	327.60	16.37	256.37
Q Total (cfs)	1355.00	Flow (cfs)	795.29	66.25	493.46
Top Width (ft)	568.69	Top Width (ft)	263.49	12.76	292.44
Vel Total (ft/s)	2.26	Avg. Vel. (ft/s)	2.43	4.05	1.92
Max Chl Dpth (ft)	2.84	Hydr. Depth (ft)	1.24	1.28	0.88
Conv. Total (cfs)	15966.4	Conv. (cfs)	9371.2	780.6	5814.6
Length Wtd. (ft)	102.08	Wetted Per. (ft)	263.91	13.75	292.52
Min Ch El (ft)	1414.00	Shear (lb/sq ft)	0.56	0.54	0.39
Alpha	1.10	Stream Power (lb/ft s)	1.35	2.17	0.76
Frctn Loss (ft)	0.58	Cum Volume (acre-ft)	1.43	1.20	0.30
C & E Loss (ft)	0.00	Cum SA (acres)	1.17	1.81	0.34

Warning: Divided flow computed for this cross-section.

CROSS SECTION RIVER: RIVER-1
REACH: Reach-1 RS: 147

INPUT
Description:
Station Elevation Data num= 174

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
639	1416.5	642.07	1416.52	650.11	1416.34	660.1	1416.11	663.18	1415.71
664.09	1415.6	670.53	1414.29	674.55	1413.55	680.92	1413.43	685.39	1413.43
697.28	1413.5	703.62	1413.42	710.89	1413.38	719.52	1413.24	722.36	1413.4
726.95	1413.7	731.15	1413.99	736.36	1414.38	741.02	1414.46	743.72	1414.52
759.44	1414.4	762.69	1414.3	767.14	1414.43	789.77	1414.72	812.17	1414.93
813.87	1414.9	838.21	1415.19	861.42	1415.44	862.48	1415.44	887.14	1415.67
889.51	1415.7	899.75	1415.72	903.04	1415.04	906.51	1414.49	908.53	1414.91
912.63	1414.2	913.85	1413.39	917.18	1414.28	924.65	1415.44	925.46	1415.63
925.79	1415.6	926.56	1415.65	933.86	1415.84	935.78	1415.37	938.93	1414.96
944.88	1415.8	945.26	1415.84	958.69	1416.04	963.36	1416.09	979	1416.05
982.99	1416.1	990.23	1416.22	992.77	1416.28	993.71	1415.94	1000.27	1413.06
1003.15	1413.6	1004.97	1414.19	1010.11	1416.08	1025.32	1415.6	1028.03	1415.53
1054.23	1415.3	1061.56	1415.23	1070.13	1415.29	1079.93	1415.29	1088.17	1415.23
1098.34	1415.2	1109.1	1415.2	1116.74	1415.17	1131.58	1414.59	1135.46	1414.52
1135.58	1414.5	1138.84	1414.63	1148.23	1415.02	1149.52	1415.22	1153.08	1415.76
1164.8	1414.3	1169.7	1413.53	1178.51	1414.26	1182.71	1414.68	1188.47	1414.72
1194.71	1414.8	1199.99	1414.84	1206.8	1414.88	1207.72	1414.92	1224.29	1415.24
1226.29	1415.3	1228.56	1415.32	1243.98	1415.67	1244.91	1415.68	1257.61	1416.04
1277.63	1416.6	1279.9	1416.63	1284.61	1416.75	1290.92	1416.87	1291.69	1416.95
1296.76	1417.1	1297.6	1417.12	1305.53	1417.51	1338.6	1417.5	1351.3	1417.63
1364.21	1417.6	1367.56	1417.54	1369.94	1417.49	1375.85	1417.31	1376.1	1417.3
1381.95	1417	1383.9	1416.97	1396.06	1416.53	1401.56	1416.49	1408.27	1416.39
1410	1416.3	1431.29	1416.16	1446.62	1416.28	1453.14	1416.35	1456.35	1416.42
1459.54	1416.4	1470.06	1416.71	1488.49	1417.11	1497.87	1417.29	1504.08	1417.33
1506.17	1417.6	1508.28	1418.33	1514.61	1419.9	1515.52	1420	1517.31	1419.65
1525.7	1417.9	1526.74	1417.85	1533.78	1417.86	1540.2	1417.88	1549.11	1418.05
1556.15	1418.1	1562.03	1418.3	1576.01	1418.22	1578.14	1418.28	1597.9	1418.89
1604.47	1419	1616.62	1419.54	1626.84	1419.84	1629.96	1419.86	1632.21	1419.84
1648.93	1419.8	1658.86	1420	1660.97	1420.04	1664.97	1420.1	1690.69	1420.39

1700.09	1420.4	1716.22	1420.44	1718.32	1420.42	1720.23	1420.42	1723.38	1420.47
1738.95	1420.4	1741.46	1420.36	1751.9	1419.88	1756.42	1419.68	1761.98	1419.74
1786.76	1419.9	1793.59	1420.11	1802.61	1420.31	1817.98	1420.56	1846.83	1420.72
1851.37	1420.8	1867.75	1420.88	1869.57	1420.65	1870.9	1420.5	1881.95	1420.22
1890.46	1420	1907.15	1419.85	1912.87	1419.81	1914.57	1419.8	1917.46	1419.75
1940.12	1419.7	1953.58	1419.41	1968.61	1419.38	1975.13	1419.44		

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
639	.06	899.75	.035	1257.61	.06

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
899.75	1257.61	100	100	100	.3	.5

CROSS SECTION OUTPUT Profile #PF 1

E.G. Elev (ft)	1416.04	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.09	Wt. n-Val.	0.060	0.035	
W.S. Elev (ft)	1415.95	Reach Len. (ft)	100.00	100.00	100.00
Crit W.S. (ft)		Flow Area (sq ft)	321.29	268.22	
E.G. Slope (ft/ft)	0.004593	Area (sq ft)	321.29	268.22	
Q Total (cfs)	1355.00	Flow (cfs)	657.30	697.70	
Top Width (ft)	548.27	Top Width (ft)	238.45	309.82	
Vel Total (ft/s)	2.30	Avg. Vel. (ft/s)	2.05	2.60	
Max Chl Dpth (ft)	2.89	Hydr. Depth (ft)	1.35	0.87	
Conv. Total (cfs)	19993.9	Conv. (cfs)	9698.9	10295.0	
Length Wtd. (ft)	100.00	Wetted Per. (ft)	238.73	312.03	
Min Ch El (ft)	1413.06	Shear (lb/sq ft)	0.39	0.25	
Alpha	1.04	Stream Power (lb/ft s)	0.79	0.64	
Frctn Loss (ft)	0.91	Cum Volume (acre-ft)	0.67	0.86	
C & E Loss (ft)	0.06	Cum SA (acres)	0.58	1.44	

Warning: Divided flow computed for this cross-section.
Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.

CROSS SECTION RIVER: RIVER-1
REACH: Reach-1 RS: 47

INPUT
Description:
Station Elevation Data num= 153

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
626	1416	627.61	1416.04	628.72	1416.05	645.62	1415.67	647.35	1415.62
647.73	1415.6	652	1415.15	660.95	1413.08	661.51	1413.07	672.13	1412.92
681.59	1412.8	693.3	1412.62	707.61	1412.73	710.12	1412.76	716.62	1413.13
721.78	1413.7	724.6	1413.92	730.6	1413.99	740.5	1414.16	743.83	1414.17
745.39	1414.2	747.72	1414.8	750.04	1415.61	753.46	1414.61	755.8	1413.94
758.91	1414	778.41	1414.25	796.33	1414.37	802.13	1414.43	807.19	1414.51
826.5	1414.7	830.86	1414.71	850.08	1414.9	851.52	1414.88	863.34	1414.77
867.69	1413.4	873.32	1411.75	877.41	1413.34	880.37	1413.98	885.54	1413.22
887.11	1412.8	891.73	1414.49	891.84	1414.52	896.14	1414.62	900.28	1414.73
903.41	1414.8	927.79	1414.29	928.48	1414.29	947.51	1414.69	952.63	1414.81
971.33	1415	977.1	1415.06	985.48	1414.62	985.74	1414.61	987.45	1415.61
990.13	1417	996.75	1414	1000.79	1412.85	1000.93	1412.81	1003.85	1413.92
1007.45	1414.9	1033.24	1414.52	1034.24	1414.51	1052.97	1414.53	1065.31	1414.61
1072.46	1414.5	1081.46	1414.51	1091.65	1414.44	1098.76	1414.41	1110.71	1414.43
1128.13	1414.4	1129.94	1414.46	1157.69	1414.77	1166.86	1414.67	1182.26	1414.76
1188.2	1414.7	1201.36	1414.38	1204.85	1414.45	1207.79	1414.51	1222.52	1414.91
1239.1	1413.1	1240.5	1412.92	1242.96	1413.25	1252.27	1414.49	1265.26	1414.7
1268.98	1414.7	1279.02	1414.72	1280.2	1414.74	1297.44	1414.8	1298.71	1414.81
1303.16	1414.9	1311.61	1415.21	1319.46	1415.64	1342.23	1416.84	1362.04	1417.27
1368.69	1417.3	1374.77	1417.35	1386.81	1417.42	1399.92	1417.19	1421.92	1416.6
1426.22	1416.4	1428.41	1416.4	1448.6	1415.59	1454.84	1415.53	1463.26	1415.62
1469.5	1415.7	1483.1	1415.77	1490.6	1415.77	1505.67	1415.77	1509.34	1415.79
1513.77	1415.9	1533.87	1416.07	1546.53	1416.25	1548.58	1416.27	1551.4	1416.35
1566.42	1416.6	1571.2	1416.66	1588.12	1416.8	1600.27	1416.97	1603.44	1416.98
1608.98	1417	1623.92	1417.13	1632.63	1417.22	1643.41	1417.31	1661.12	1417.49
1662.95	1417.5	1681.39	1417.56	1693.46	1417.64	1700.15	1417.7	1710.66	1417.8
1719.05	1417.9	1723.96	1417.96	1738.87	1418.01	1743.54	1418.07	1758.71	1418.32
1759.27	1418.3	1792.65	1418.93	1800.24	1419.05	1815.3	1419.22	1828.99	1419.63
1835.03	1419.8	1841.94	1420	1863.94	1420.65	1879.26	1420.88	1889.95	1420.86
1898.69	1420.9	1916.73	1420.86	1926.3	1420.57	1928.29	1420.04	1929.55	1419.83
1932.39	1419.9	1935.84	1420.02	1938.01	1419.87				

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
626	.06	851.52	.035	1319.46	.06

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
851.52	1319.46	46.65	46.65	46.65	.3	.5

CROSS SECTION OUTPUT Profile #PF 1

			Left OB	Channel	Right OB
E.G. Elev (ft)	1415.08	Element			
Vel Head (ft)	0.28	Wt. n-Val.	0.060	0.035	
W.S. Elev (ft)	1414.79	Reach Len. (ft)	46.65	46.65	46.65
Crit W.S. (ft)	1414.79	Flow Area (sq ft)	176.37	148.83	
E.G. Slope (ft/ft)	0.025771	Area (sq ft)	176.37	148.83	
Q Total (cfs)	1355.00	Flow (cfs)	816.66	538.34	
Top Width (ft)	563.51	Top Width (ft)	180.76	382.75	
Vel Total (ft/s)	4.17	Avg. Vel. (ft/s)	4.63	3.62	
Max Chl Dpth (ft)	3.04	Hydr. Depth (ft)	0.98	0.39	
Conv. Total (cfs)	8440.6	Conv. (cfs)	5087.2	3353.4	
Length Wtd. (ft)		Wetted Per. (ft)	181.21	384.93	
Min Ch El (ft)	1411.75	Shear (lb/sq ft)	1.57	0.62	
Alpha	1.04	Stream Power (lb/ft s)	7.25	2.25	
Frctn Loss (ft)		Cum Volume (acre-ft)	0.09	0.39	
C & E Loss (ft)		Cum SA (acres)	0.10	0.64	

Warning: The energy equation could not be balanced within the specified number of iterations. The
program used critical depth for the water surface and continued on with the calculations.
Warning: Divided flow computed for this cross-section.
Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.

CROSS SECTION RIVER: RIVER-1
REACH: Reach-1 RS: 1

INPUT
Description:
Station Elevation Data num= 120

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
574.65	1415	576.18	1415.03	576.98	1415.03	592.03	1414.86	595.52	1414.79
596.78	1414.6	600.57	1414.22	600.99	1414.16	608.79	1412.52	610.53	1412.45
621.73	1412.2	625.88	1412.28	645.03	1412.16	648.17	1412.05	655.41	1412.12
665.75	1412.8	672.68	1413.14	680.87	1413.09	687.4	1413.12	697.51	1412.91
708.33	1412.6	718.61	1412.9	728.61	1413.24	741.94	1413.36	752.96	1413.5
765.48	1413.5	767.52	1413.45	778.48	1413.57	787.72	1413.62	804.68	1413.83
809.27	1413.8	828.08	1413.65	830.33	1413.62	834.1	1413.7	840.14	1413.03
840.93	1412.9	841.66	1413.04	842.24	1413.2	845.09	1414	855.26	1414.13
860.18	1414.1	863.58	1412.55	866.66	1411.45	869.09	1412.01	874.44	1413.58
889.25	1413.6	895.36	1413.7	913.83	1414.22	921.38	1414.32	941.44	1414.47
943.39	1414.5	944.75	1414.48	972.03	1414.65	982.15	1414.16	982.99	1414.11
984.31	1414.3	986.62	1414.75	994.74	1413.05	995.94	1412.71	996.03	1412.73
996.67	1412.8	1000.16	1414.23	1022.32	1414.14	1024.98	1414.12	1027.62	1414.02
1042.96	1413.5	1057.86	1413.52	1059.74	1413.55	1059.86	1413.52	1060.44	1413.5
1077.93	1413.1	1082.41	1413.35	1099.49	1413.86	1106.38	1413.69	1132.03	1413.99
1133.27	1414	1134.76	1414.03	1137.37	1414.08	1155	1414.4	1158.47	1414.38
1176.02	1414.2	1183.42	1414.13	1210.83	1413.98	1211.55	1413.97	1218.74	1413.61
1224.71	1414.1	1225.3	1414.11	1229.39	1414.08	1230.24	1414.06	1242.9	1414.41
1243.94	1414.4	1247.1	1414.32	1258.98	1414.1	1262.55	1414.13	1271.79	1413.22
1279.37	1412.5	1283.01	1413.01	1292.2	1414.3	1300.61	1414.46	1303.91	1414.49
1307.93	1414.5	1309.51	1414.42	1312.04	1414.4	1323.46	1414.23	1326.59	1414.24
1332.1	1414.1	1335.04	1414.11	1348.43	1414.16	1384.67	1414.08	1411.55	1414.14
1436.08	1414.2	1461.94	1414.14	1480.32	1414.11	1486.98	1414.4	1496.82	1414.46
1580.78	1414.5	1592.71	1414.54	1653.03	1414.69	1665.31	1414.69	1691.27	1414.72

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
574.65	.06	574.65	.035	1691.27	.06

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
574.65	1691.27	0	0	0	.3	.5

CROSS SECTION OUTPUT Profile #PF 1

			Left OB	Channel	Right OB
E.G. Elev (ft)	1414.47	Element			

Vel Head (ft)	0.09	Wt. n-Val.	0.035
W.S. Elev (ft)	1414.39	Reach Len. (ft)	
Crit W.S. (ft)	1413.90	Flow Area (sq ft)	572.23
E.G. Slope (ft/ft)	0.005002	Area (sq ft)	572.23
Q Total (cfs)	1355.00	Flow (cfs)	1355.00
Top Width (ft)	815.01	Top Width (ft)	815.01
Vel Total (ft/s)	2.37	Avg. Vel. (ft/s)	2.37
Max Chl Dpth (ft)	2.94	Hydr. Depth (ft)	0.70
Conv. Total (cfs)	19158.8	Conv. (cfs)	19158.8
Length Wtd. (ft)		Wetted Per. (ft)	817.07
Min Ch El (ft)	1411.45	Shear (lb/sq ft)	0.22
Alpha	1.00	Stream Power (lb/ft s)	0.52
Frctn Loss (ft)		Cum Volume (acre-ft)	
C & E Loss (ft)		Cum SA (acres)	

Warning: Divided flow computed for this cross-section.

SUMMARY OF MANNING'S N VALUES

River:RIVER-1

Reach	River Sta.	n1	n2	n3
Reach-1	1247	.06	.035	.06
Reach-1	1204	.06	.035	.06
Reach-1	1203.9	Bridge		
Reach-1	1188	.06	.035	.06
Reach-1	1147	.06	.035	.06
Reach-1	1078	.06	.035	.06
Reach-1	1076.9	Culvert		
Reach-1	857	.06	.013	.06
Reach-1	747	.06	.013	.06
Reach-1	647	.06	.013	.06
Reach-1	600	.06	.013	.06
Reach-1	547	.06	.013	.06
Reach-1	488	.06	.013	.06
Reach-1	487	.06	.04	.06
Reach-1	447	.06	.04	.06
Reach-1	446	.06	.035	.06
Reach-1	347	.06	.035	.06
Reach-1	247	.06	.035	.06
Reach-1	147	.06	.035	.06
Reach-1	47	.06	.035	.06
Reach-1	1	.06	.035	.06

SUMMARY OF REACH LENGTHS

River: RIVER-1

Reach	River Sta.	Left	Channel	Right
Reach-1	1247	42.77	42.77	42.77
Reach-1	1204	56.52	56.52	56.52
Reach-1	1203.9	Bridge		
Reach-1	1188	56.52	56.52	56.52
Reach-1	1147	70	70	70
Reach-1	1078	399.84	399.84	399.84
Reach-1	1076.9	Culvert		
Reach-1	857	197.06	197.06	197.06
Reach-1	747	100.59	100.59	100.59
Reach-1	647	100	100	100
Reach-1	600	100	100	100
Reach-1	547	100	100	100
Reach-1	488	100	100	100
Reach-1	487	100	100	100
Reach-1	447	100	100	100
Reach-1	446	100	100	100
Reach-1	347	97.93	97.93	97.93
Reach-1	247	102.08	102.08	102.08
Reach-1	147	100	100	100

Reach-1	47	46.65	46.65	46.65
Reach-1	1	0	0	0

SUMMARY OF CONTRACTION AND EXPANSION COEFFICIENTS
River: RIVER-1

Reach	River Sta.		Contr.	Expan.
Reach-1	1247		.3	.5
Reach-1	1204		.3	.5
Reach-1	1203.9	Bridge		
Reach-1	1188		.3	.5
Reach-1	1147		.3	.5
Reach-1	1078		.3	.5
Reach-1	1076.9	Culvert		
Reach-1	857		.3	.5
Reach-1	747		.3	.5
Reach-1	647		.3	.5
Reach-1	600		.3	.5
Reach-1	547		.3	.5
Reach-1	488		.3	.5
Reach-1	487		.3	.5
Reach-1	447		.3	.5
Reach-1	446		.3	.5
Reach-1	347		.3	.5
Reach-1	247		.3	.5
Reach-1	147		.3	.5
Reach-1	47		.3	.5
Reach-1	1		.3	.5