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ENGINEERING

SUPPLEMENT TO Laveen Area Conveyance Channel Drainage Report

FINAL

PREPARED FOR:
Flood Control District of Maricopa County

PREPARED BY:
AZTEC ENGINEERING

January 2002

FINAL

SUPPLEMENT TO
Laveen Area Conveyance Channel Drainage Report

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Registered Professional Engineer (Civil) CERTIFICATE NO. 35542 JEFFREY C. FORD Date Signed 01-14-02 ARIZONA U.S.A.

Registered Professional Engineer (Civil) CERTIFICATE NO. 27556 RAJU C. SHAH Date Signed 01/14/02 ARIZONA U.S.A.

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1.0 PROJECT DESCRIPTION

1.1 Location

The project is located in Maricopa County in Southwest Phoenix, and is located in Township 1 North, Range 2 East, Section 31 & Township 1 South, Range 2 East, Section 4. See Figure 1 for Vicinity Map.

1.2 Brief History

The Flood Control District of Maricopa County (FCDMC) is currently designing The Laveen Area Conveyance Channel (LACC), a new regional flood control facility. The horizontal alignment of the new channel generally follows the location of the existing Maricopa Drain, an SRP tailwater ditch that also conveys storm water to the Salt River during rainfall events. However, because of landowner and developer requests, the proposed channel deviates from the existing Maricopa Drain at some locations. These landowners and developers are also requesting that the Maricopa Drain be filled at these locations.

1.3 Purpose

This report addresses drainage issues identified by the FCDMC that result from filling sections of the existing Maricopa Drain as shown in Figure 2. This project evaluates the following items.

- Perform a drainage study for the north side of Baseline Road from 59th Avenue to 67th Avenue. Route the 100-year flood through the existing inlets at Baseline and 65th, Baseline and 63rd, and Baseline east of 63rd, to the existing Maricopa Drain, and across Baseline Road from the north side to the existing Maricopa Drain, to determine what flow rate is currently drained from north of Baseline Road to the existing Maricopa Drain during the 100-year event. Provide the size of pipe required to carry this flow from the existing inlets at Baseline and 65th, Baseline and 63rd, and Baseline east of 63rd, into a pipe on the south side of Baseline, to a pipe east of 63rd Avenue, into the LACC Project. Insure the pipe is

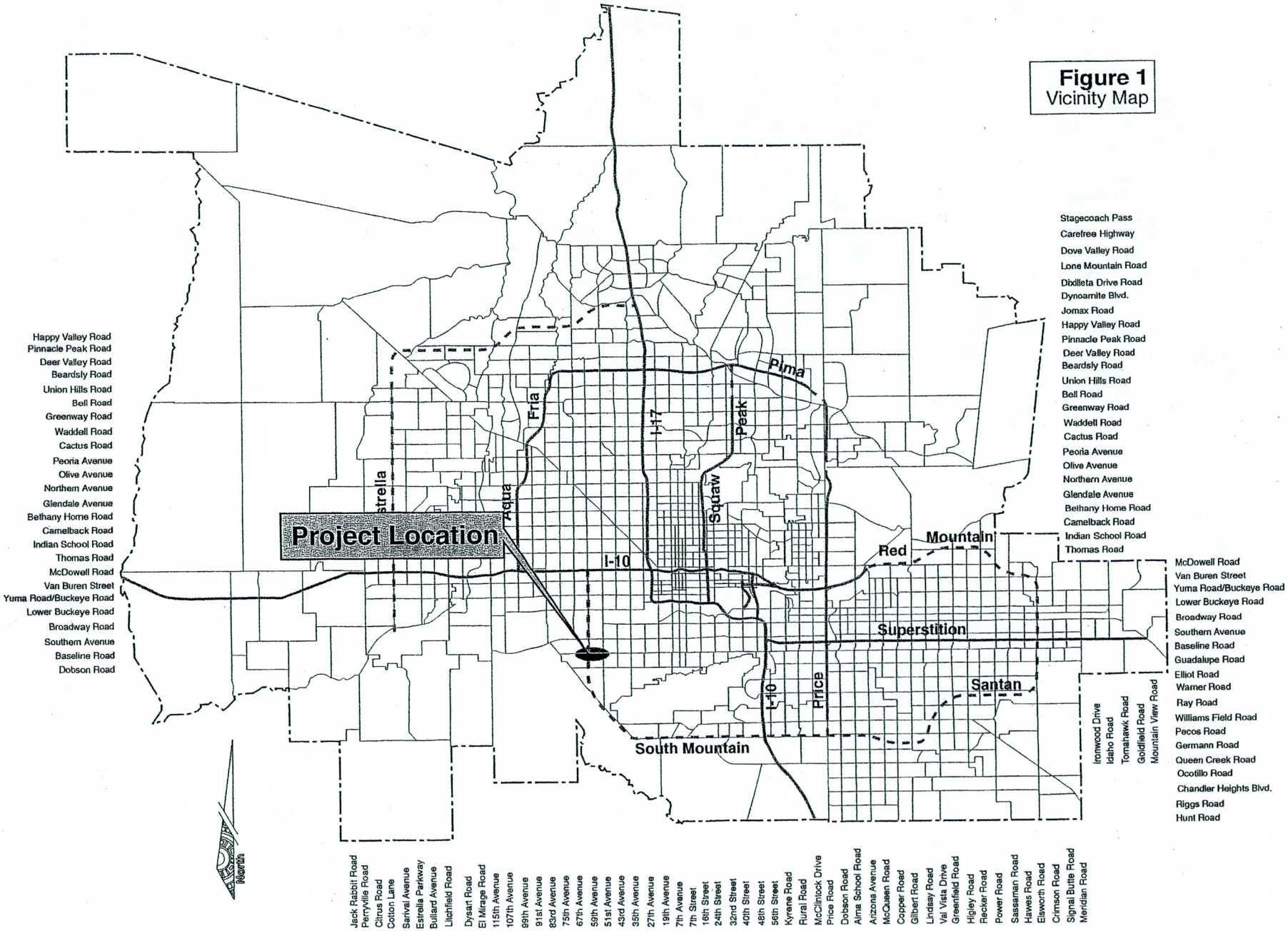


Figure 1
Vicinity Map

AZTEC ENGINEERING

Supplement to LACC

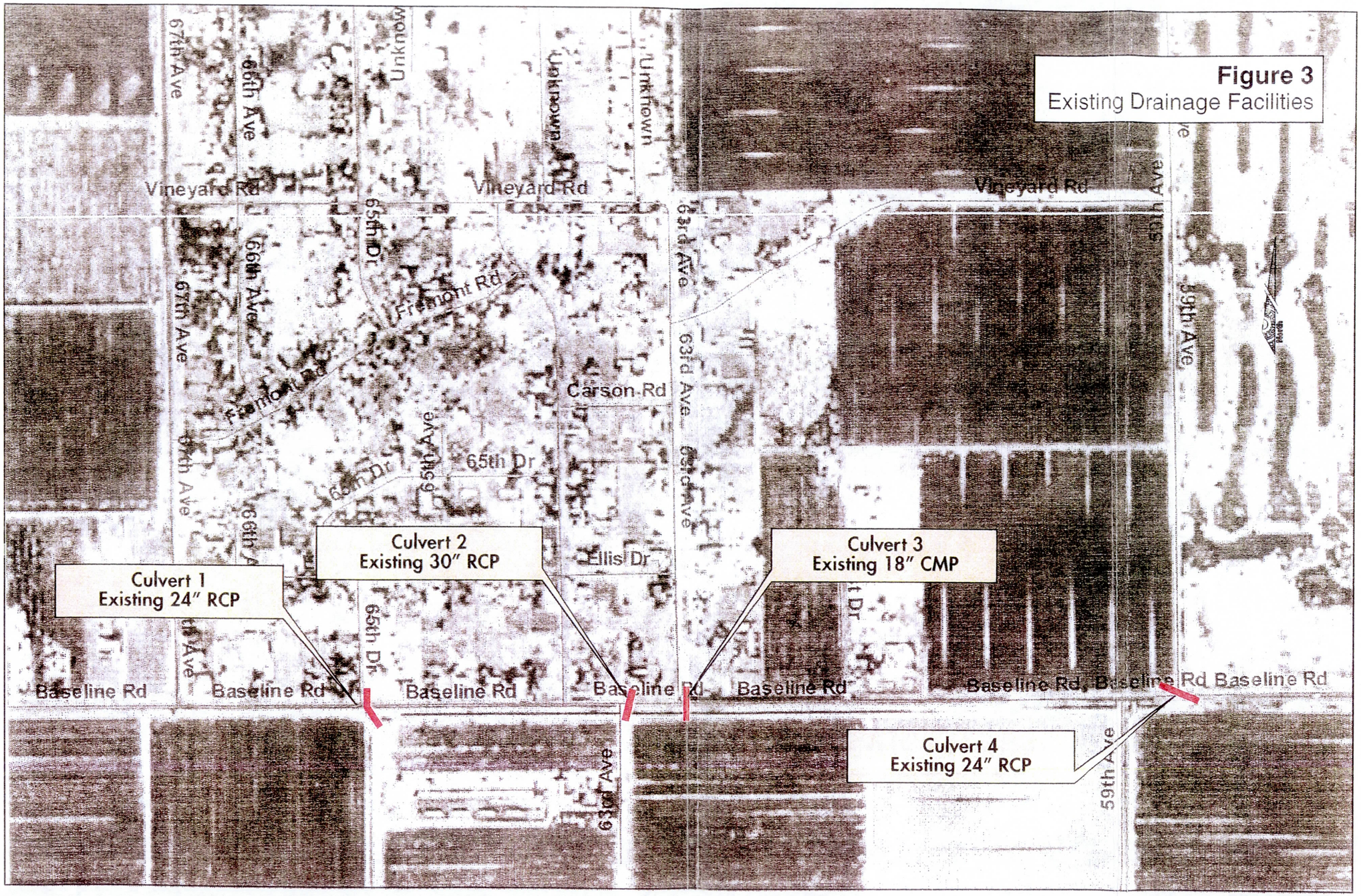


Figure 3
Existing Drainage Facilities

sized so that flood conditions up to the 100-year flood are not made worse than under existing conditions.

- Determine if the existing Maricopa Drain between 59th Avenue and the LACC can be drained east to the LACC. If feasible, size the dirt ditch required and prepare a conceptual design for this portion of the drain. If this is not feasible, determine if the existing Maricopa Drain can be tiled to drain to the east. Size the pipe required and prepare a conceptual design for this portion of the drain.
- Determine if the existing Maricopa Drain between 59th Avenue and 65th Avenue can be tiled and constructed in the south half of the existing Baseline Road right-of-way. Size the pipe required and prepare a conceptual design for this portion of the drain. Locate and size inlets and pipes to capture and convey water from the north side of Baseline Road to the pipe to be constructed in the south side of Baseline Road.
- Determine if the pipe sized above for the existing Maricopa Drain between 59th Avenue and 65th Avenue (or between 62nd Avenue and 65th Avenue) can drain to a pipe in the east side of 63rd Avenue and then south to the LACC. Size the pipe required and prepare a conceptual design for this portion of the drain.
- Perform drainage area calculations and calculate flows for the drainage area contributing to existing Maricopa Drain at 51st Avenue and Baseline Road for the 100-yr flood frequency. Also, evaluate capacity of the existing Maricopa Drain at this location and compare that with the pre LACC and post LACC design flows.

1.4 Existing Field Conditions

- Baseline is currently constructed as a rural section, and is therefore raised in relation to the surrounding topography. North of Baseline the general topography between 59th Avenue and 67th Avenue slopes from the north to the south. Baseline road cuts off this sheet flow. There are four existing culverts that convey storm water runoff from the north side of Baseline to the Maricopa Drain just south of Baseline (See Figure 3 Table 1, and Photo's 1 through 8)

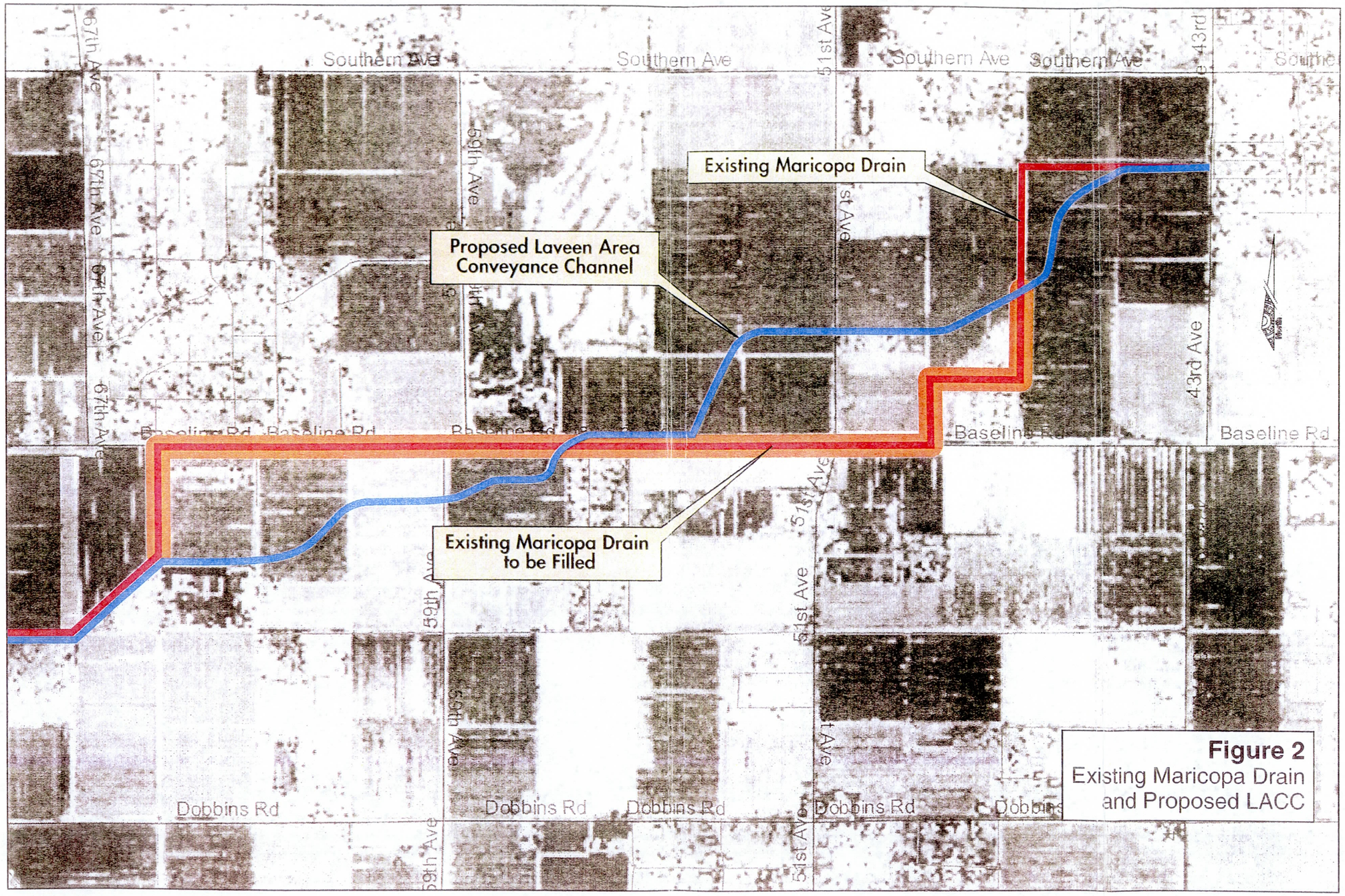


Figure 2
Existing Maricopa Drain and Proposed LACC

Table 1. Inlet Pipes

Inlet No.	Size/Type	Inlet Invert Elev.	Station
1	24" RCP	990.62	109+88
2	30" RCP	993.57	123+30
3	18" CMP	993.30	126+73
4	24" RCP	996.99	152+20

2.0 HYDROLOGY

2.1 Methodology

Three drainage areas were delineated and analyzed as follows;

- Area 1 – From 67th Avenue east to 63rd Avenue north of Baseline.
- Area 2 – From 63rd Avenue to 59th Avenue north of Baseline.
- Area 3 – From 51st Avenue to 47th Avenue, south of Baseline, and north of Baseline.

The Rational Method per the "Drainage Design Manual for Maricopa County Volume I, Hydrology" was used to determine runoff for Areas 1 and 2 (See Figure 4).

The existing HEC-1 model developed by FCDMC as a part of the LACC was obtained by AZTEC ENGINEERING and has been run using 10-year and 2-year rainfall events. This model uses existing conditions, and the existing area contributing to the corner of Baseline and 51st Avenue is approximately 0.70 sq. mile. The proposed LACC channel will intercept the flow from approximately 0.20 sq. mile. Therefore, per conversations with FCDMC, the peak flow from the HEC-1 model for this basin was reduced by a factor of 0.71 (0.5/0.7).

See Photo's 9 through 11 for existing conditions of these three areas.

See Appendix A for hydrology calculations.

Unit Serial No: 831613 Version: 05.70

Network Address: 00:40:af:65:83:e8

Novell Network Information disabled

Network Topology: Ethernet Connector: RJ45

Network Speed: 100 Megabits

TCP/IP Network Information enabled
Frame Type: Ethernet II Protocol Address: 156.42.97.235
Subnet Mask: 255.255.254.0 Default Gateway: 156.42.97.252
DNS Address: 0.0.0.0

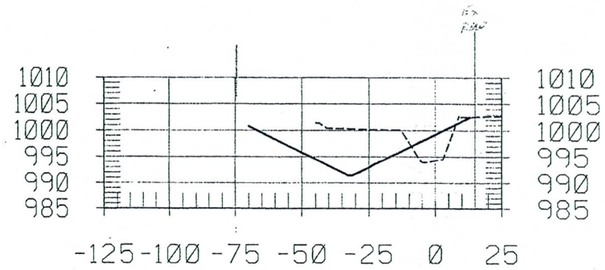
AppleTalk Network Information disabled

Novell inactive

Peer-to-Peer Connection Information
Printer Name: KON_831613

AppleTalk Inactive

TCP/IP Connection Information
Port Number : 10001



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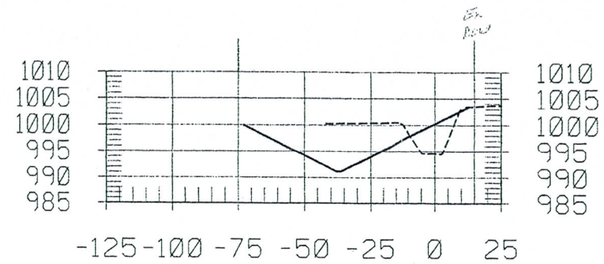

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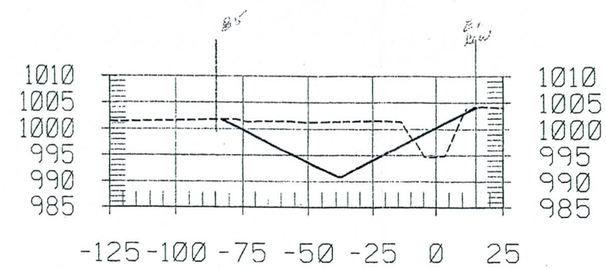

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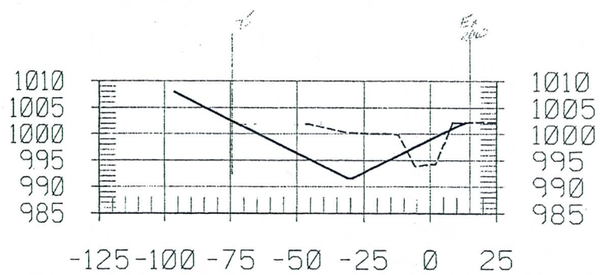

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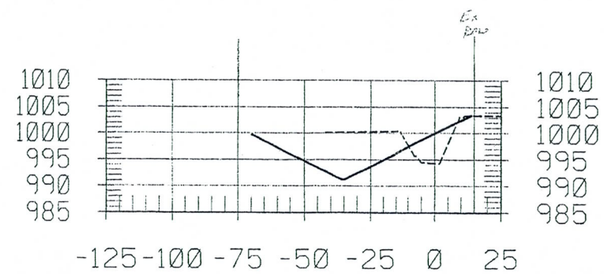

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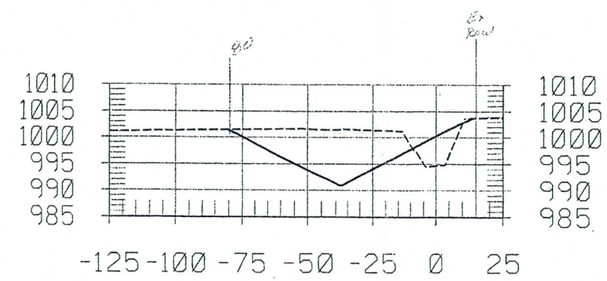

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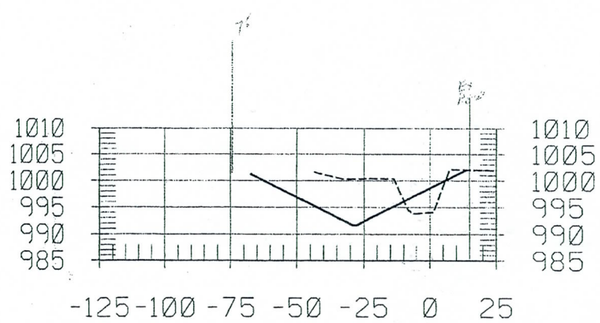

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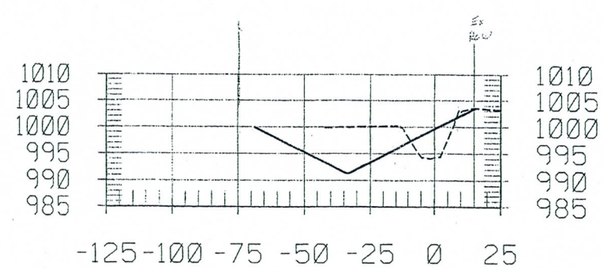

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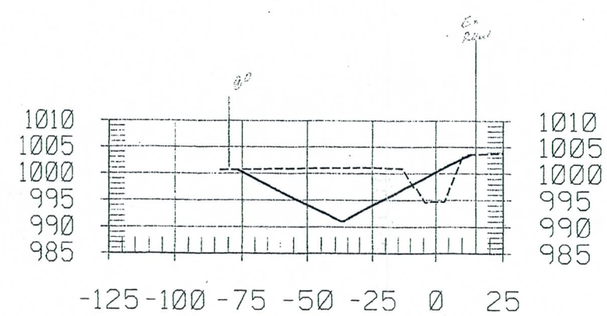

8+00.000

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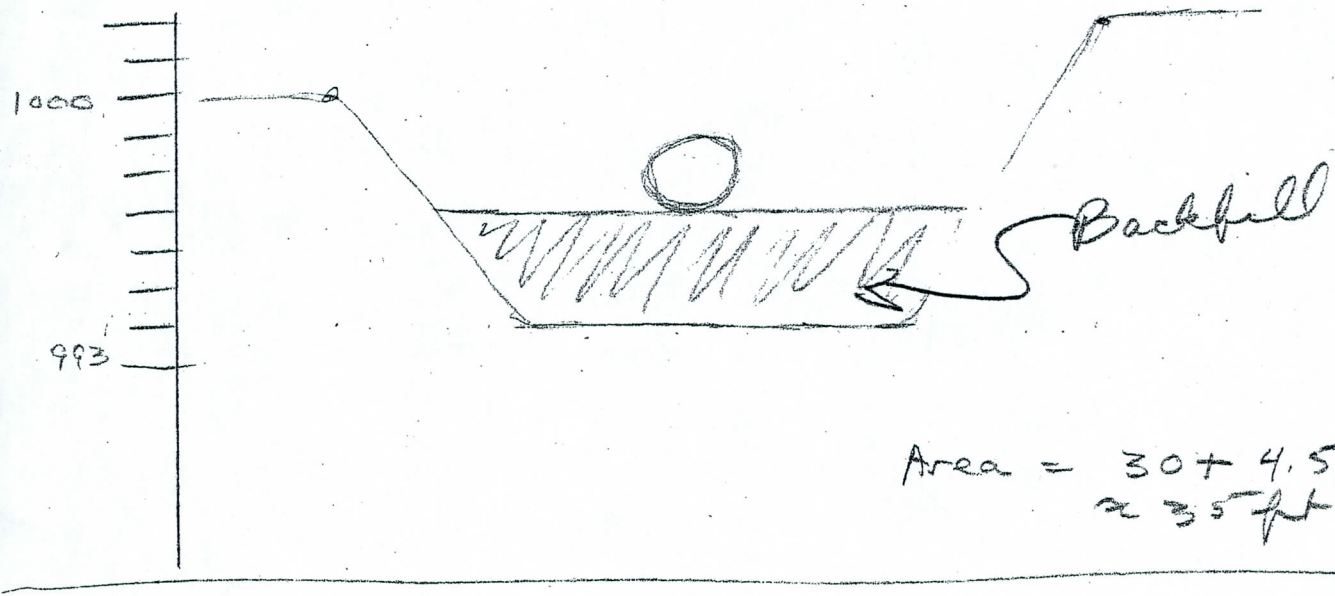
PROJECT TITLE

CROSS SECTIONS
SHEET

SHEET OF
XX XX

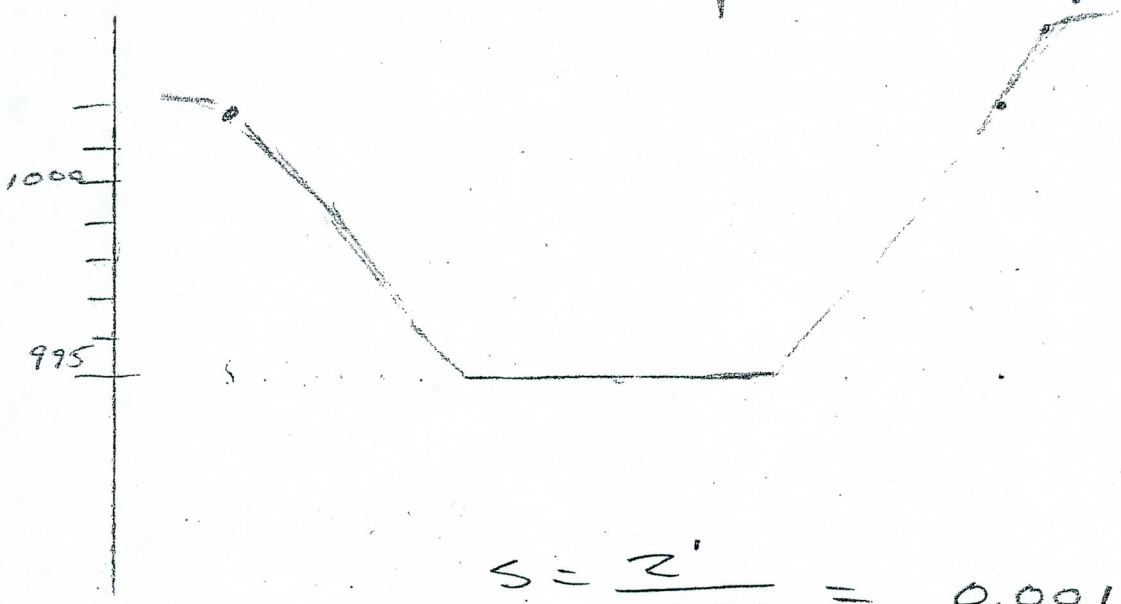
DATE XX/XX

Pipe - 24"
Invert el. = 996.99, upstream end



Area = 30 + 4.5
≈ 35 ft²

Downstream end (no fill or cut)



$$S = \frac{2'}{1320} = 0.0015$$

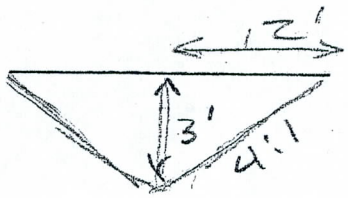
$$\frac{35\ ft^2 + 0}{2} \times 1320' = 860\ CY.\ \text{backfill}$$

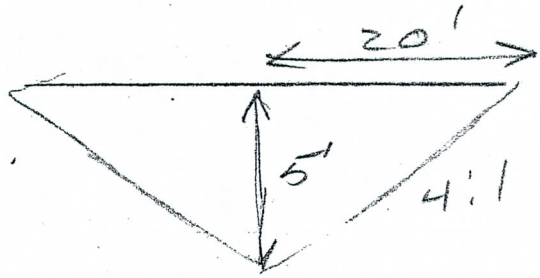
$6/CY → ≈ $5000

New channel

U.S. end – invert = 997
Existing ground = 1000

D.S. end – invert = 995
Existing ground = 1000





Area u.s. = 36 ft²

Area d.s. = 100 ft²

$$\frac{36 + 100}{2} \times 1320 = 3300 \text{ CY}$$

$$3300 \text{ CY} * \$3/\text{CY} \approx \$10{,}000$$

Other costs – Relocating irrigation system
– Planting turf
– Connection to U.S. + d.s. pipes

4000 SY, 0.83 acres

Pipe Alternative

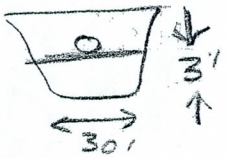
30"	$60/LF	→	$80,000
42"	$80/LF	→	$106,000

Other costs — Planting turf (assume can avoid irrigation system)
— Connection to U.S. + d.s. pipes

0.63 acres
3000 SY

Alt. 1 Regrade

Quantity



$\frac{3 \times 30}{2} \times 1320$

$= 2200$ CY

Backfill \$2/CY → \$4400

Alt 2 2:1 Slope ditch

Assume 3 ft deep at u.s. end, 5 ft deep at d.s. end, $s = 0.0015$, V-ditch

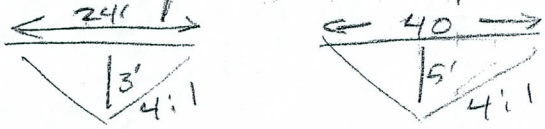
Quantity –

$\frac{18 + 50}{2} \times 1320 =$

1660 CY

3.00/CY → \$5000

Alt 3 4:1 Slope Ditch



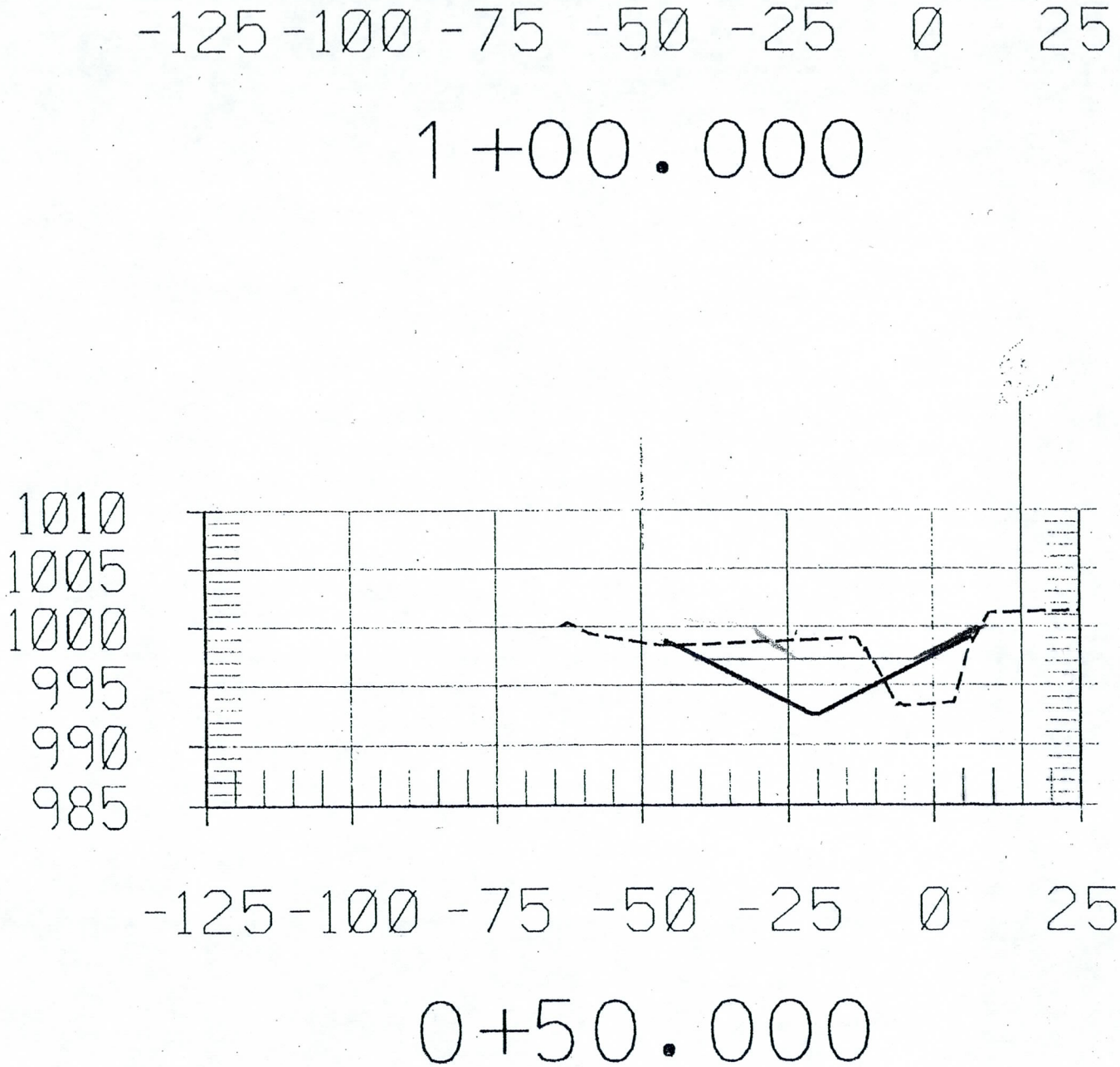
$\frac{36 + 100}{2} \times 1320 =$

3325 CY

3.00/CY → \$10,000

Alt. 4 30" RGRCP

\$60/LF × 1320 = \$79,200



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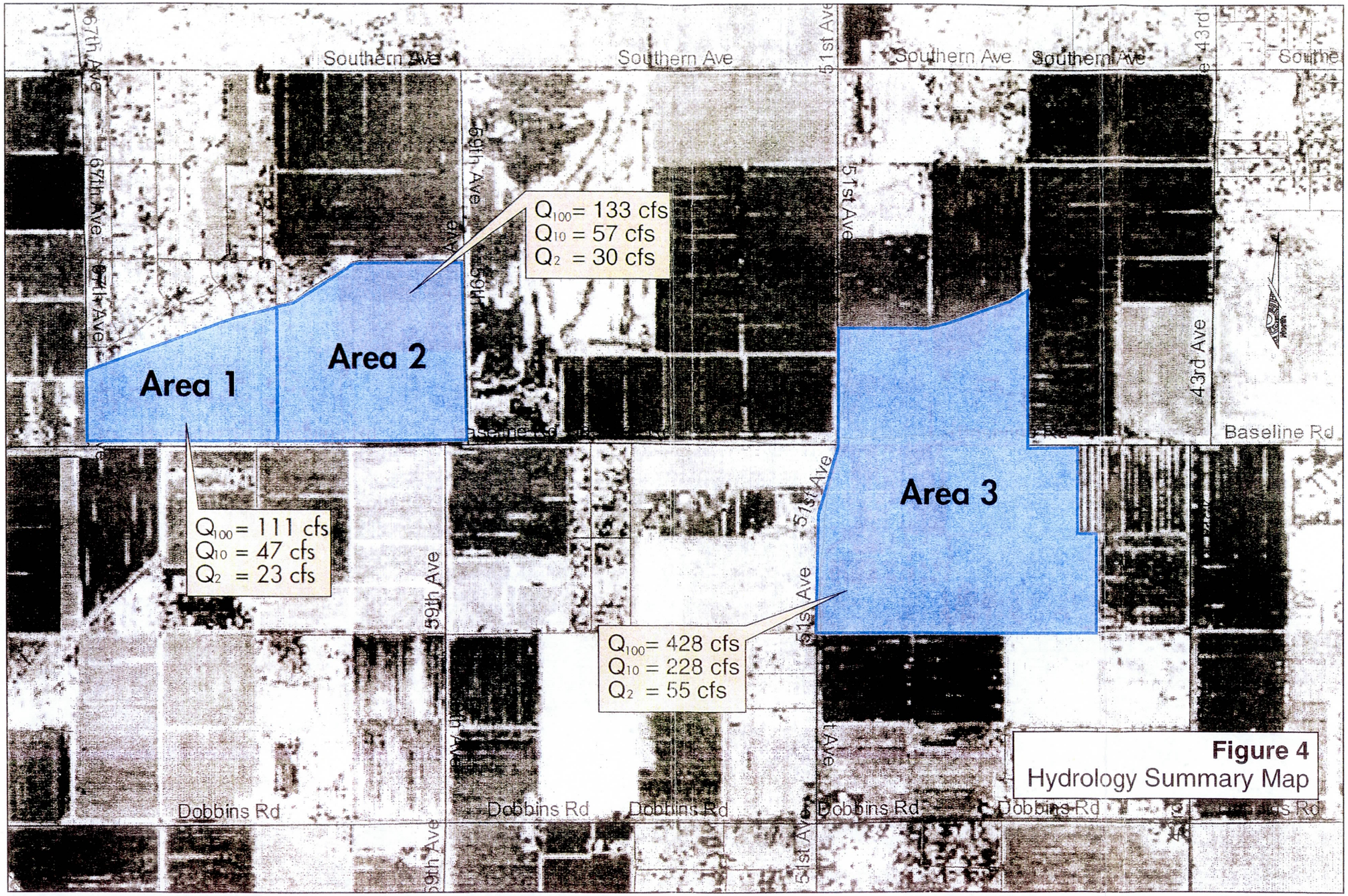

Figure 4
Hydrology Summary Map

2.2 Findings

The following runoffs where obtained:

Table 2. Flows for the 2-yr event

Area	C	i (in/hr)	A (acres)	Q (cfs)
1	0.25	0.97	94	23
2	0.20	0.95	157	30
3	-	-	-	55

Table 3. Flows for the 10-yr event

Area	C	i (in/hr)	A (acres)	Q (cfs)
1	0.25	2	94	47
2	0.20	1.8	157	57
3	-	-	-	228

Table 4. Flows for the 100-yr event

Area	C	i (in/hr)	A (acres)	Q (cfs)
1	0.31	3.8	94	111
2	0.25	3.4	157	133
3	-	-	-	428

3.0 HYDRAULIC ANALYSIS

3.1 Inlet locations

The four existing culverts that convey flow from the north side of Baseline to the south side of Baseline were briefly discussed in Section 1.4. These four structures provide the only conveyance of water from the north side of Baseline to the south side of Baseline until overtopping occurs. Stage-discharge tables were developed for each of the four inlets (See Tables 5 through 8).

The following assumptions where used to develop these tables:

- Zero percent clogging factor for existing conditions. These pipes are open and this assumption will result in the maximum flow that must be conveyed downstream.
- Inlet controlled.

The existing draft hydrology report for the LACC by FCDMC shows the unofficial floodplain around Baseline between 67th Avenue and 51st Avenue. The high-water elevation for the 100-year flood was used for each inlets to determine a design Q.

Table 5. Culvert 1

Elevation	Head Water	Head Water/Discharge	Q (from graph) cfs
991	0.38	0.19	-
992	1.38	0.69	8
993	2.38	1.19	16
994	3.38	1.69	22
995	4.38	2.19	27
996	**5.38**	**2.69**	**32**
997	6.38	3.19	36
998	7.38	3.69	39

Table 6. Culvert 2

Elevation	Head Water	Head Water/Discharge	Q (from graph) cfs
994	0.43	0.17	-
995	1.43	0.57	9
996	2.43	0.97	21
997	3.43	1.37	32
997.5	**3.93**	**1.57**	**37**
998	4.43	1.77	40

Table 7. Culvert 3

Elevation	Head Water	Head Water/Discharge	Q (from graph) cfs
994	0.70	0.46	-
995	1.70	1.13	7
996	2.70	1.80	11
997	3.70	2.47	13
998	**4.70**	**3.13**	**15**

Table 8. Culvert 4

Elevation	Head Water	Head Water/Discharge	Q (from graph) cfs
998	1.01	0.51	5
999	2.01	1.01	13
1000	3.01	1.51	20
1001	4.01	2.01	26
1001.5	**4.50**	**2.25**	**28**
1002	5.01	2.51	30

The total flow from Inlets 1,2 and 3 is 84 cfs.

The flow from Inlet 4 is 28 cfs.

3.2 Drain to LACC

The existing inlets 1, 2 & 3 will be tied into a proposed storm drain system that will convey the flow along the south side of Baseline Road to 63rd Avenue. A 54-inch diameter pipe will then convey the flow south to the proposed LACC along the east side of 63rd Avenue.

Aztec ENGINEERING has assumed that under proposed conditions, if flow in the LACC creates tailwater problems and limits the flow out of the proposed storm drains, than the same would have been true under existing conditions. Any flow in the proposed LACC would contribute to the Maricopa Drain under existing conditions.

Culvert number 4 will drain to the east in a 2-foot deep earthen channel with 4:1 side slopes. This channel is to be located north of Baseline Road and south of the golf course,

just to the west of 59th Avenue. This channel flows against the general topography of the surrounding land.

Four to one side slopes as recommended for earthen channels in the Flood Control District design manual will result in a channel well outside of the existing channel footprint. Steeper slopes or hard lining this drainage feature is therefore recommended. To cover this channel would require a 36-inch diameter pipe. The discharge for this proposed channel is approximately 135 degrees from flow in the LACC. Therefore it is recommended that this channel be tiled under Baseline Road and tied into the LACC on the south side of Baseline Road.

However, based upon modeling performed by the FCDMC, the existing 58" H X 81" W culvert at 59th Avenue appears to be the controlling point for the Maricopa Drain for this section. The modeling performed by FCDMC indicates that the capacity at this culvert is 212 cfs. Calculations are included in Appendix B. The existing HEC-1 model performed by the FCDMC indicates that 600 cfs will be added to the Maricopa Drain at the corner of 51st Avenue and Baseline under existing conditions. The existing Maricopa Drain at 51st Avenue has a capacity of approximately 600 cfs. Under proposed conditions, the flow to this area would be approximately 430 cfs because a portion of the contributing area will be cut off by the proposed LACC.

See Appendix B for conceptual plans for these proposed improvements.

4.0 CONSTRUCTION COST ESTIMATE

The total estimate for construction costs associated with this report is $791,505. This work includes:

- 336 feet of 18-inch diameter storm drain.
- 1,349 feet of 42-inch diameter storm drain.
- 1,596 feet of 54-inch diameter storm drain.
- 10 Storm Drain Manholes
- 970 cu. yards of channel excavation.
- 1 discharge headwall into the LACC for the 54-inch diameter storm drain.

The cost estimate is shown in Appendix D.

5.0 EXISTING UTILITIES

The existing utilities around Baseline Road include several buried telephone lines and a recently installed City of Phoenix 54-inch waterline on the north side of the monument line. Additionally, just north edge of pavement an SRP tailwater ditch generally runs east to west. There are existing 12 KV SRP overhead electric lines along the north and south side of Baseline Road.

See Figure 5 for a summary of the proposed improvements.

6.0 CONCLUSIONS

The existing storm drain system on the north side of Baseline Road currently has capacity for the 2-yr event. Events greater than this result in ponding on the north side of Baseline Road. Under existing conditions, the Maricopa Drain will overtop during major events, and high tailwater will result in minimal drainage protection north of Baseline Road. After the proposed improvements, drainage from the north side of Baseline will be governed by the hydraulic grade line in the LACC. Aztec ENGINEERING recommends that the existing inlets and headwalls remain, and that the proposed storm drain system shown in Appendix B tie into these existing lines on the south side of Baseline Road.

A new drainage facility from 59th Avenue to the proposed LACC can be constructed. This new facility will be flowing against the general topography of the surrounding area. Therefore, at 6.3-feet deep at the discharge into the LACC and 4:1 side slopes (as recommended in FCDMC Hydraulics Manual for earthen channels),the top of this channel would be outside of the existing channel footprint. Therefore, steeper side slopes or tiling is recommended.

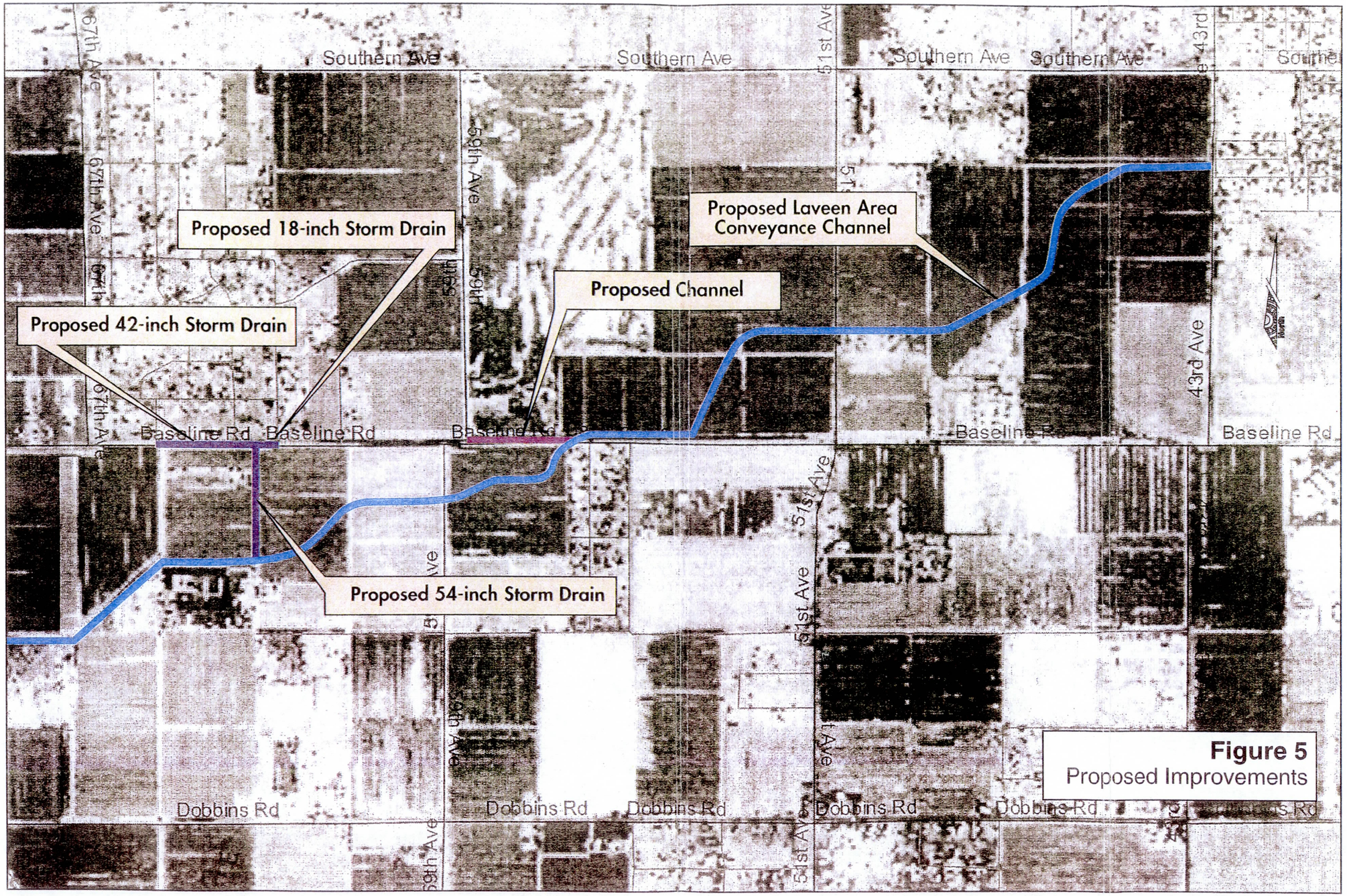

Figure 5
Proposed Improvements

References

- Drainage Design Manual for Maricopa County, Arizona, Volume I, Hydrology
- Drainage Design Manual for Maricopa County, Arizona, Volume II, Hydraulics, Flood Control District of Maricopa County Laveen Area Conveyance Channel Improvements 60% Design Report, June 2001
- Final Drainage Report for Cottonfields Phoenix, Arizona CMX, Group Inc., June 1, 2001
- Draft Hydrology Report – LACC, July 25, 2001

SITE PHOTOS

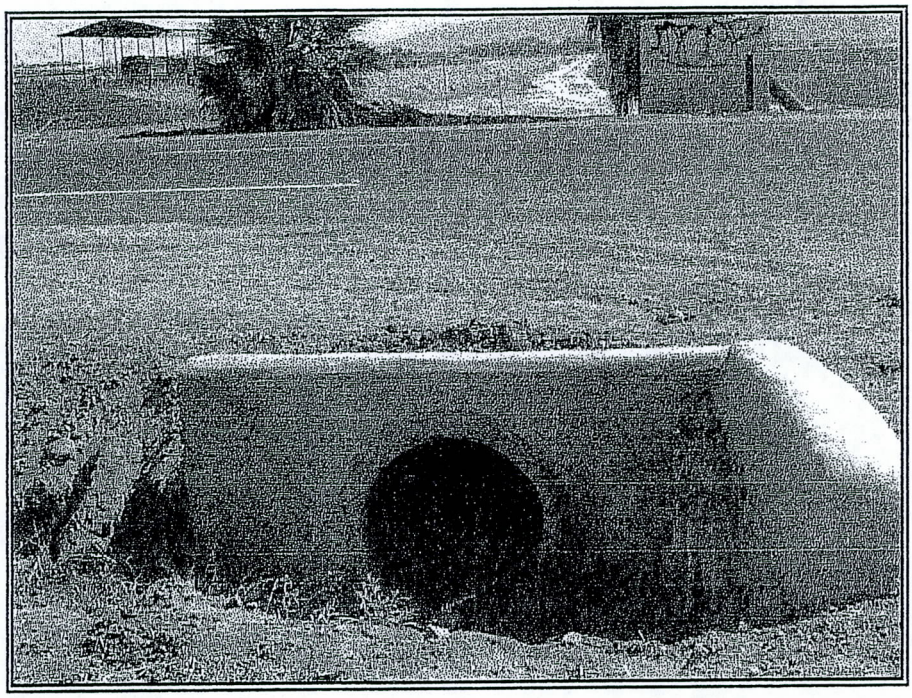

Photo 1 – Culvert 1 Inlet

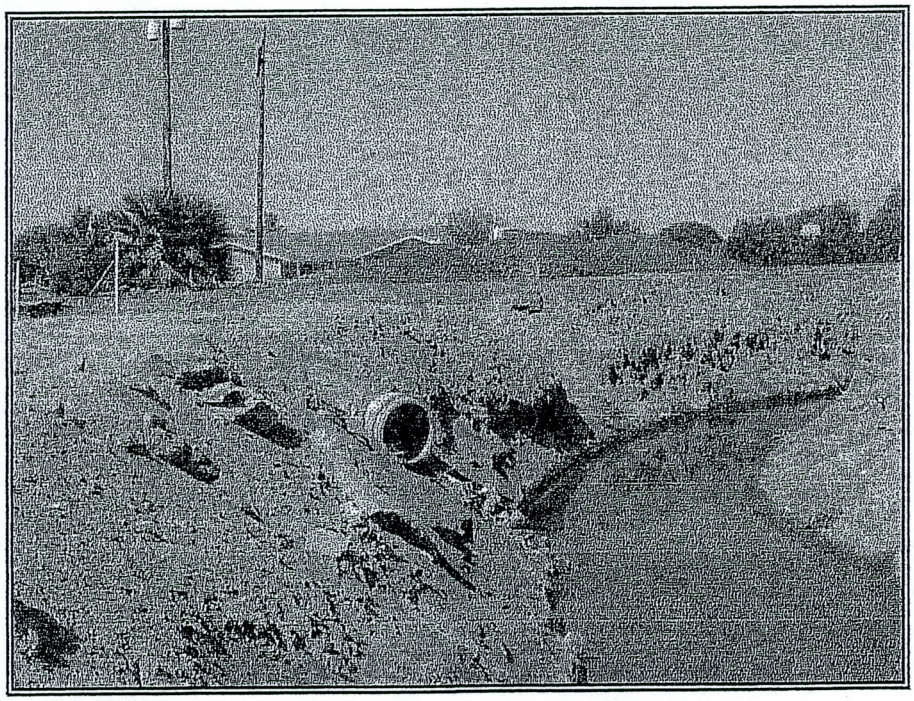

Photo 2 – Culvert 1 Outlet

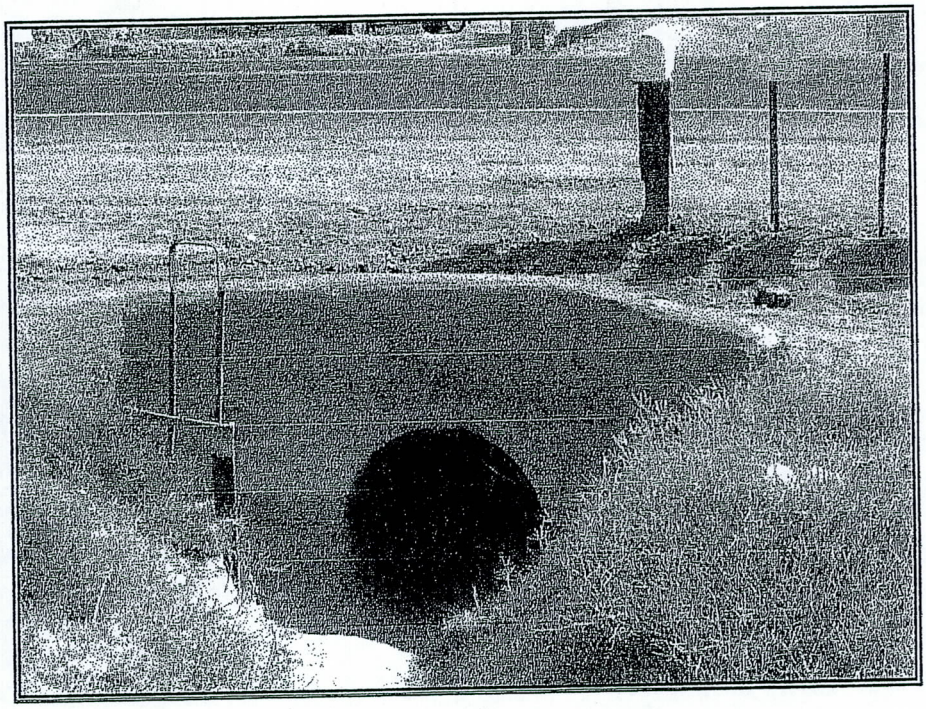

Photo 3 – Culvert 2 Inlet

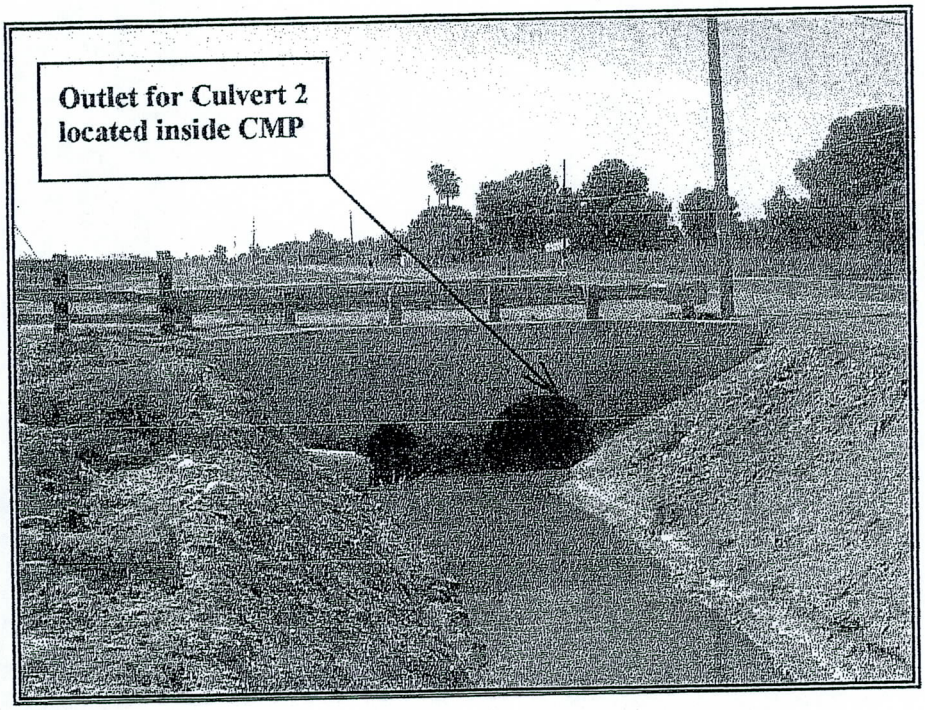

Photo 4 – Culvert 2 Outlet

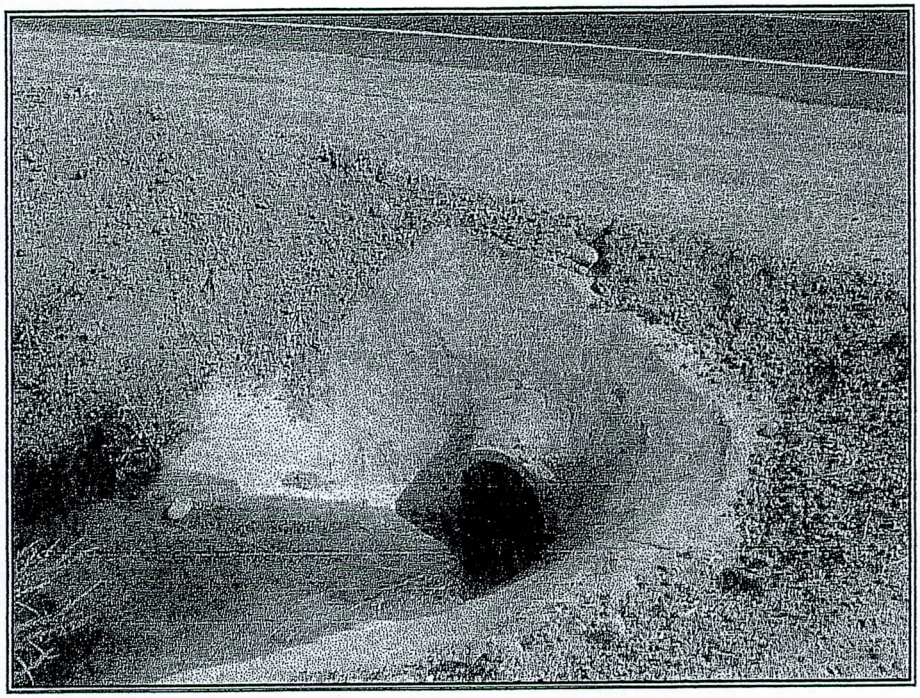

Photo 5 – Culvert 3 Inlet

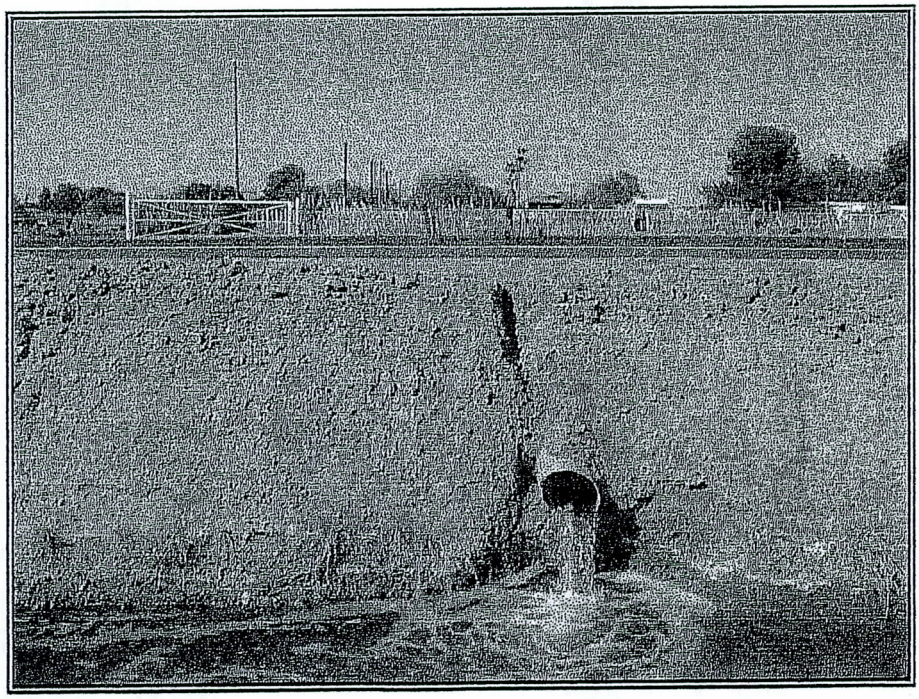

Photo 6 – Culvert 3 Outlet

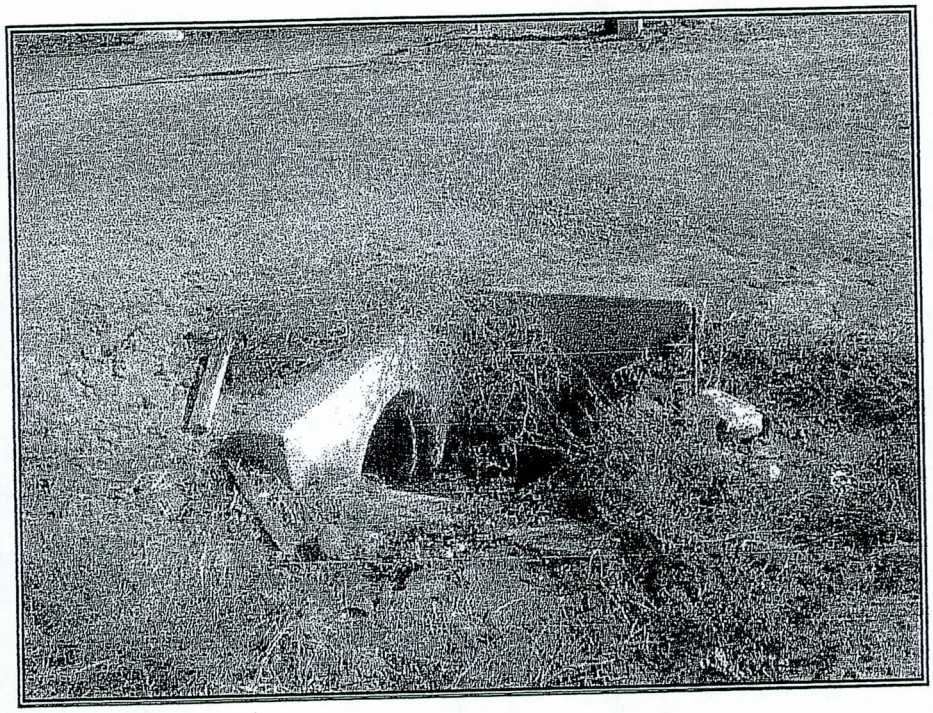

Photo 7 – Culvert 4 Inlet

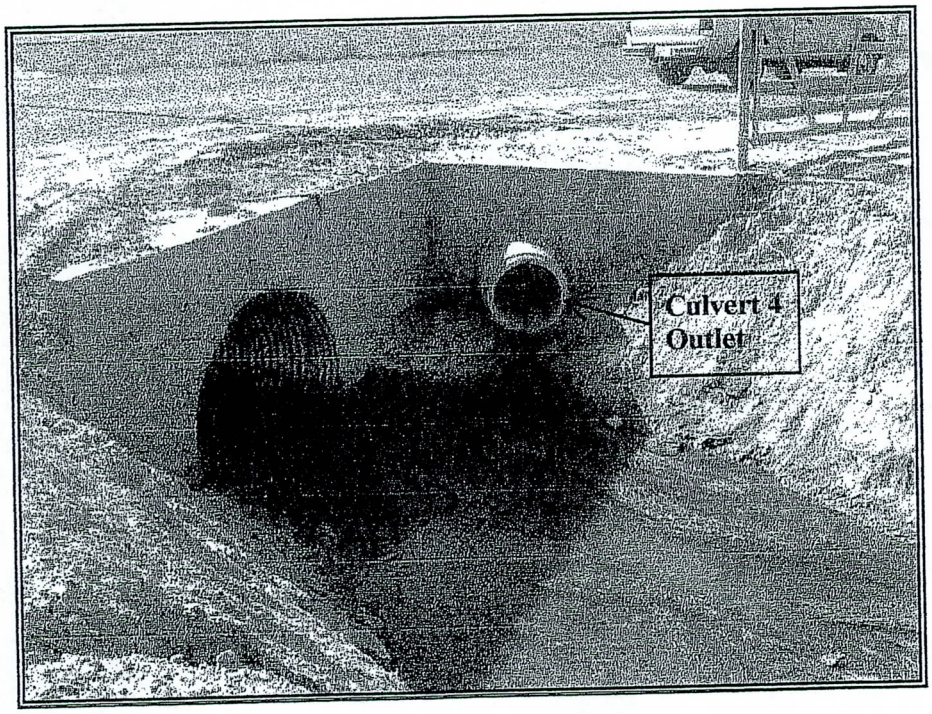

Photo 8 – Culvert 4 Outlet

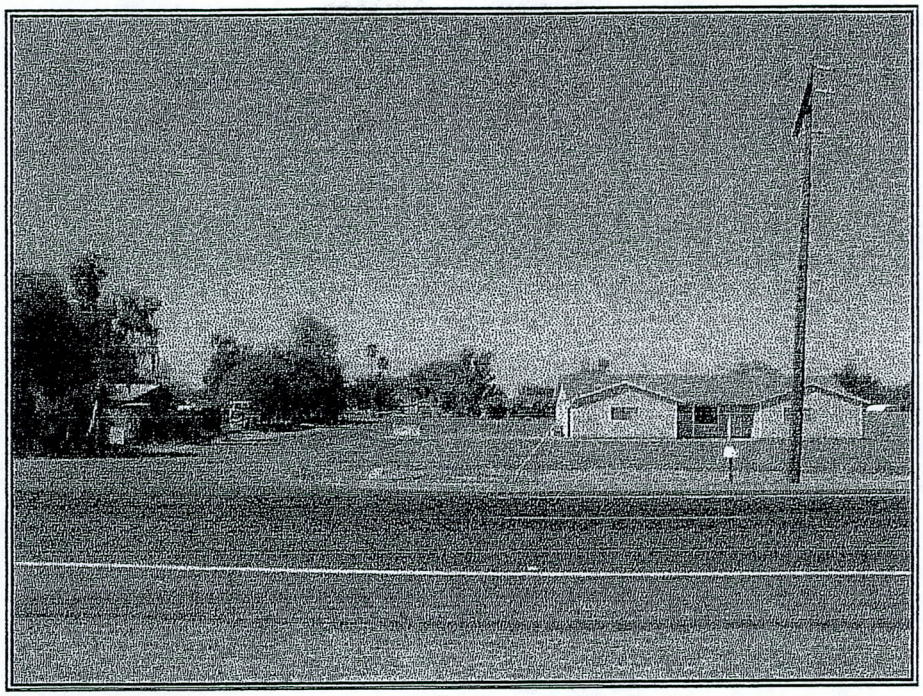

Photo 9 – Existing conditions Area 1 (C = Lawns-Flat)

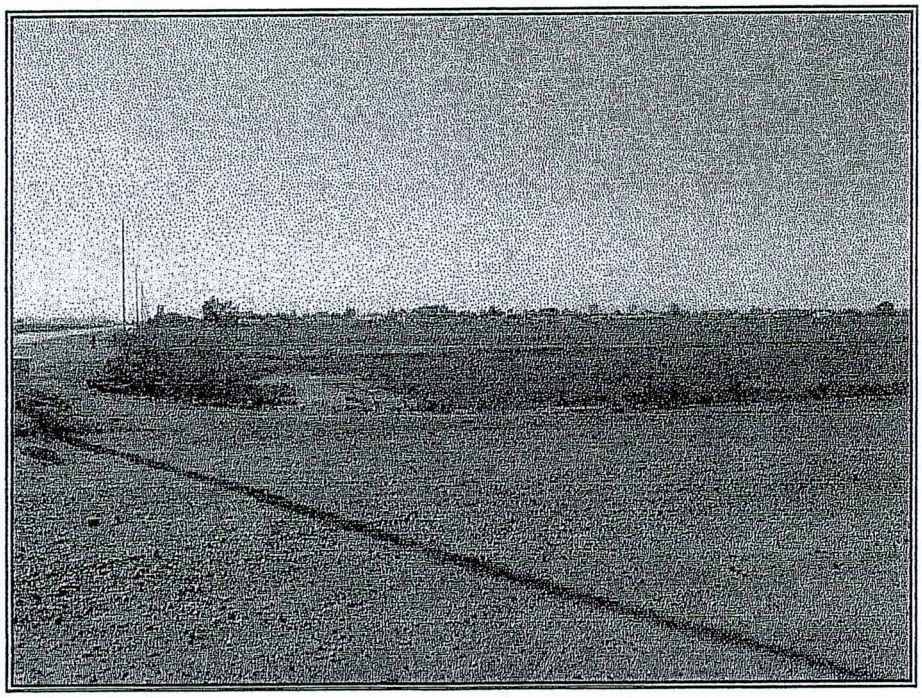

Photo 10 – Existing conditions Area 2 (C = Agricultural)

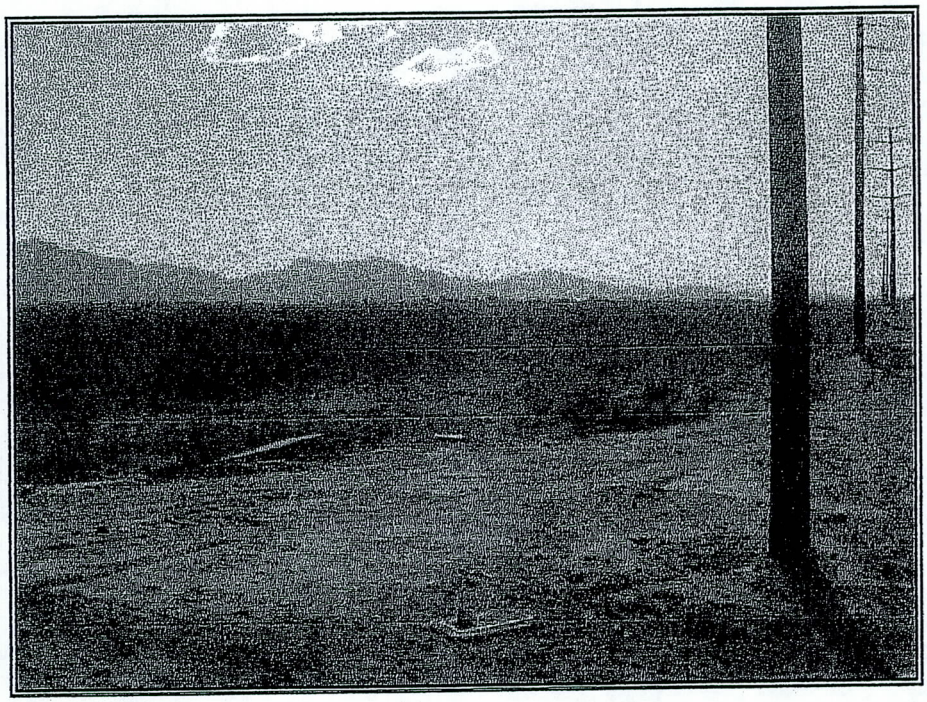

Photo 11 – Existing conditions Area 3 (C = Agricultural)

APPENDIX A

AZTEC ENGINEERING
3747 East Grove Street
Phoenix, AZ 85040-3982
Phone (602) 454-0402
Fax (602) 454-0403

Project: LACC
Project No: A200112-05
Computed by: I. David Lopez
Date: 8-28-2001
Checked By: J. [illegible]
Date: 9-7-01
Sheet Name: Rational Method Area 2
Sheet: 1 Of: 2

Peak Discharge using Rational Method for 2-yr. Event

$Q = CiA$

$A_2 = 157$ acres.

From Table 3.2 C Coefficients

$C = .20$ (Agricultural Areas for the 2-yr event)

Calculate i using T_c

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

$L = 0.724$ miles

$S = 7.7/0.724 = 10.64$ feet/mile

$K_b = m \log A + b$ Type "B"

$K_b = -0.01375 \log 157 + 0.08 = 0.050$

$K_b = 0.050$

Substitute Values

$T_c = 11.4\,(.724)^{0.5}\,(0.050)^{0.52}\,(10.64)^{-0.31}\, i^{-0.38}$

$T_c = .981\, i^{-0.38}$

First Iteration = Estimated guess.

$T_c = 1$ hr.

From Fig 3.2 $i = .95$

$T_c = .981\,(.95)^{0.38}$

$T_c = 1$ hr.

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Phoenix, AZ 85040-3982
Phone (602) 454-0402
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Project: LACC
Project No: A700112-05
Computed by: J. David Lopez
Date: 8-28-2001
Checked By: J. FORD
Date: 9-7-01
Sheet Name: Rational Method Area 2
Sheet: 2 Of: 2

Substitute back into $Q = CiA$

$Q = (.20)(.95)(157)$

$Q = 30$ cfs

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Project: LACC
Project No: AZ00112-05
Computed by: I. David Lopez
Date: 8-28-2001
Checked By: J. Sorg
Date: 9-7-01
Sheet Name: Rational Method Area 2
Sheet: 1 Of: 2

Peak Discharge using Rational Method for 10 Yr-Event.

$Q = CiA$

$A_2 = 157$ acres

From Table 3.2 C coeficients.

$C = .20$ (Agricultural Areas for the 10 Yr event)

Calculate i using T_c.

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

$L = 0.724$ miles

$S = 7.7/0.724 = 10.64$ feet/mile

$K_b = m \log A + b$ Type "B"

$K_b = -0.01373 \log 157 + 0.08 = 0.050$

$K_b = 0.050$

Substitute Values.

$T_c = 11.4\,(.724)^{0.5}\,(.050)^{0.52}\,(10.64)^{-0.31}\, i^{-0.38}$

$T_c = .981\, i^{-0.38}$

First Iteration = Estimated guess

$T_c = .83$ hr $= 50$ min

From Fig 3.2 $i = 1.7$ in/hr.

$T_c = .981\,(1.7)^{-0.38}$

$T_c = .80$ hr

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Project No: A700112 - 05
Computed by: I. David Lopez
Date: 8-28-2001
Checked By: J. FORD
Date: 9-7-01
Sheet Name: Rational Method Area 2
Sheet: 2 Of: 2

Second Iteration.

$T_c = .80$ hr.

From Fig 3.2 $i = 1.8$ in/hr

$T_c = .981 (1.8)^{-0.38}$

$T_c = .78$ hr.

Third Iteration.

$T_c = .78$ hr.

From Fig 3.2 $i = 1.8$ in/hr.

$T_c = .78$ hr. OK.

Substitute back into $Q = CiA$

$Q = (.20)(1.8)(157)$

$Q = 57$ cfs.

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Project: LACC
Project No: A700112-05
Computed by: I. David lopez
Date: 8-17-2001
Checked By: J. FORD
Date: 8-20-2001
Sheet Name: RAT. METHOD Q, AREA 2
Sheet: 1 Of: 2

Peak Discharge using Rational Method. for 100 Yr Event.

$Q = CiA$ ✓

$A_2 = 157$ Acres ✓

From Table 3.2 C coeficients

$C = 0.25$ (Agricultural Areas for the 100 Year event) ✓

Calculate i using T_c

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

$L = 0.724$ miles ✓

$S = 7.7/0.724 = 10.64$ feet/mile ✓

$Kb = m \log A + b$ Type "B" ✓

$Kb = -0.01375 \log 157 + 0.08 = 0.050$ ✓

$Kb = 0.050$ ✓

Substitute Values

$T_c = 11.4 \cdot (.724)^{0.5} \cdot (.050)^{0.52} \cdot (10.64)^{-0.31} \cdot i^{-0.38}$ ✓

$T_c = .981\, i^{-0.38}$ ✓

First Iteration = Estimated Guess

$T_c = 40$ min $= .67$ hr. ✓

From Fig 3.2 $i = 3.4$ in/hr. ✓

$T_c = .981\,(3.\cancel{3}4)^{-0.38}$ ✓ DL

$T_c = .62$ ✓

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Project: LACC
Project No: A700112-05
Computed by: I. David Lopez
Date: 8-17-2001
Checked By: J. FORD
Date: 8-20-2001
Sheet Name: RAT. METHOD Q, AREA 2
Sheet: 2 Of: 2

Second Iteration.

$T_c = .62$ ✓

From Fig 3.2 $i = 3.4$ in/hr. ✓

$T_c = 0.981 (3.4)^{-0.38}$

$T_c = .62$ OK. ✓ $i_{100YR-37min} = 3.4$ in/hr

Substitute back into $Q = CiA$

$Q = (0.25)(3.4)(157)$ ✓

$Q = 133$ cfs ✓

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3747 East Grove Street
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Phone (602) 454-0402
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Project: LACC
Project No: A200112-05
Computed by: I. David Lopez I.
Date: 8-28-2001
Checked By: J. FORD
Date:
Sheet Name: Rational Method Area 1
Sheet: 1 Of: 2

Peak Discharge using Rational Method for 2 yr-Event.

$Q = CiA$

$A_1 = 94$ acres

From table 3.2 C coefficients.

$C = 0.25$ (lawns - Flat for the 2 Year event).

Calculate i using T_c

$T_c = 11.4\, l^{0.5}\, k_b^{0.52}\, S^{-0.31}\, i^{-0.38}$

$l = .632$ miles

$S = 6.5/.632 = 10.28$ feet/mile

$k_b = m \log A + b$ Type "B" Suburban.

$k_b = -0.01375 \log 94 + 0.08 = 0.053$

$k_b = 0.053$

Substitute Values.

$T_c = 11.4\,(0.632)^{0.5} \cdot (0.053)^{0.52} \cdot (10.28)^{-0.31} \cdot i^{-0.38}$

$T_c = 0.9554\, i^{-0.38}$

First Iteration = Estimated guess

$T_c = .67$ hr.

From Fig. 3.2 $i = 1.2$ in/hr

$T_c = 0.9554\,(1.2)^{-0.38}$

$T_c = .89$ hr.

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Project: LACC
Project No: A700112-05
Computed by: L. David Lopez
Date: 8-28-2001
Checked By: J. Ford
Date: 9-7-01
Sheet Name: Rational Method Area 1
Sheet: 2 Of: 2

Second Iteration.

$T_c = .89$ hr.

From Fig 3.2 $i = 1.1$ in/hr.

$T_c = 0.9554(1.1)^{-0.38}$

$T_c = .92$

Third Iteration.

$T_c = .92$

From Fig 3.2 $i = 1$ in/hr.

$T_c = 0.9554(1)^{-0.38}$

$T_c = .96$

Fourth Iteration

$T_c = 96$

From Fig 3.2 $i = .95$ in/hr.

$T_c = .9554(.96)^{-0.38}$

$T_c = .97$ ok.

Substitute back into $Q = CiA$

$Q = (.25)(.97)(94)$

$Q = 23$ cfs

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Project: LACC
Project No: A200112-05
Computed by: J. David Lopez I.
Date: 8-28-2001
Checked By: J. FORD
Date: 9-7-01
Sheet Name: Rational Method Area 1
Sheet: 1 Of: 2

Peak Discharge using Rational Method for 10 Yr-Event.

$Q = CiA$

$A_1 = 94$ acres

From table 3.2 C coefficients

$C = 0.25$ (lawns - Flat for the 10 Year event)

Calculate i using T_c

$T_c = 11.4 L^{0.5} K_b^{0.52} S^{-0.31} i^{-0.38}$

$L = .632$ miles

$S = 6.5/.632 = 10.28$ feet/mile

$K_b = m \log A + b$ Type "B" Suburban

$K_b = -0.01375 \log 94 + 0.08 = 0.053$

$K_b = 0.053$

Substitute Values.

$T_c = 11.4 (0.637)^{0.5} \cdot (0.053)^{0.52} \cdot (10.28)^{-0.31} \cdot i^{-0.38}$

$T_c = 0.9554\, i^{-0.38}$

First Iteration = Estimated guess.

$T_c = .6$ hr.

From Fig 3.2 $i = 2.2$ in/hr.

$T_c = 0.9554 (2.2)^{-0.38}$

$T_c = .71$ hr.

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Project: LACC Project No: A700112-05
Computed by: I. David Lopez I. Date: 8-28-2001
Checked By: J. FURD Date: 9-7-01
Sheet Name Rational Method Area 1 Sheet: 2 Of: 2

Second Iteration

$T_c = .71$ hr.

From Fig 3.2 $i = 2$ in/hr.

$T_c = 0.9554\,(.2)^{-0.38}$

$T_c = .73$ hr. ok

Substitute back into $Q = CiA$

$Q = (0.25)(2)(94)$

$Q = 47$ cfs

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Project: LACC
Project No: A200112-05
Computed by: I. David Lopez
Date: 8-17-2001
Checked By: J. FORD
Date: 8-20-2001
Sheet Name: RAT. METHOD Q, AREA 1
Sheet: 1 Of: 2

Peak Discharge using Rational Method for 100 yr-Event.

$Q = CiA$ ✓

$A_1 = 94$ Acres ✓

From table 3.2 C coeficients

$C = 0.31$ (lawns-Flat for the 100 Year event) ✓

Calculate i using T_c ✓

$T_c = 11.4\, L^{0.5}\, K_b^{0.52}\, S^{-0.31}\, i^{-0.38}$ ✓

$L = .632$ miles ✓

$S = 6.5/.632 = 10.28$ feet/mile ✓

$K_b = m \log A + b$ Type "B" Suburban ✓

$K_b = -0.01375 \log 94 + 0.08 = 0.053$ ✓

$K_b = 0.053$ ✓

Substitute Values

$T_c = 11.4 \cdot (0.632)^{0.5} \cdot (0.053)^{0.52} \cdot (10.28)^{-0.31} \cdot i^{-0.38}$

$T_c = 0.9554\, i^{-0.38}$ ✓

First Iteration = Estimated Guess

$T_c = 30$ min $= .5$ hr.

From Fig. 3.2 $i = \cancel{4.5}$ 4.0 ✓ DL. in/hr.

$T_c = 0.9554\,(\cancel{4.5}\ 4.0)^{-0.38}$ ✓

$T_c = \cancel{.54}$ .56 ✓ DL. hr.

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3747 East Grove Street
Phoenix, AZ 85040-3982
Phone (602) 454-0402
Fax (602) 454-0403

Project: LACC
Project No: A700117-05
Computed by: I. David lopez
Date: 8-17-2001
Checked By: J. FORD
Date: 8-20-2001
Sheet Name: RAT. METHOD Q, AREA 1
Sheet: 2 Of: 2

Second Iteration.

$T_c = \cancel{.54}\ .56$ hr. ✓DL

From Fig 3.2 $i = \cancel{3.7}\ 3.8$ in/hr. ✓DL

$T_c = 0.9554\,(3.\cancel{7}\ 8)^{-0.38}$

$T_c = .58$ hr. ✓ OK

$i_{100YR,\,35min} = 3.8$ in/hr

~~third Iteration.~~

~~$T_c = .58$ hr.~~

~~From Fig 3.2 $i = 3.6$ in/hr.~~

~~$T_c = 0.9554\,(3.6)^{-0.38}$~~

~~$T_c = .587$ hr = 35 min. OK.~~

Substitute back into $Q = CiA$

$Q = 0.31\,(3.\cancel{6}\ 8)\,(94)$ ✓DL

$Q = \cancel{105\ cfs}$

111 cfs ✓D.L.

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT _____ PAGE ____ OF ____

DETAIL _____ COMPUTED _____ DATE ____

_____ CHECKED BY _____ DATE ____

SUMMARY OF RAINFALL STATISTICS

DURATION	RETURN PERIOD	VALUES READ FROM MAPS	VALUES GRAPHED BY HAND	PREFRE 4 INPUTS	PREFRE 12 INPUTS
6-hr	2 yr	1.20	1.20	1.20	1.20
	5	1.75	1.74	1.76	1.76
	10	2.14	2.12	2.13	2.14
	25	2.66	2.68	2.64	2.65
	50	3.05	3.08	3.03	3.04
	100	3.42	3.47	3.42	3.43
	500	—	—	4.32	4.34
24-hr	2 yr	1.40	1.40	1.40	1.39
	5	2.07	2.07	2.10	2.09
	10	2.55	2.57	2.56	2.56
	25	3.20	3.20	3.19	3.19
	50	3.68	3.71	3.67	3.67
	100	4.15	4.20	4.15	4.16
	500	—	—	5.26	5.27

10-YR FLOW

```
              **************
              *            *
 1 KK         *   BR51C    *
              *            *
              **************
```

SUB-BASIN BR51C-LAND USE - AGRICULTURE;MINOR DEVELOPMENT
24-HOUR TYPE II RAINFALL WAS USED TO FIND TC & R FOR THIS BASIN
THIS BASIN USED RAINFALL REDUCTION FACTOR OF .90

SUBBASIN RUNOFF DATA

5 BA SUBBASIN CHARACTERISTICS
TAREA .70 SUBBASIN AREA

PRECIPITATION DATA

416 PB STORM 2.30 BASIN TOTAL PRECIPITATION

PI INCREMENTAL PRECIPITATION PATTERN

.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.01	.01	.01	.01
.01	.01	.01	.01	.01	.01	.01	.01	.06	.06
.06	.06	.06	.06	.01	.01	.01	.01	.01	.01
.01	.01	.01	.01	.01	.01	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00		

LG GREEN AND AMPT LOSS RATE

STRTL	.50	STARTING LOSS
DTH	.00	MOISTURE DEFICIT
PSIF	3.65	WETTING FRONT SUCTION
XKSAT	.46	HYDRAULIC CONDUCTIVITY
RTIMP	.00	PERCENT IMPERVIOUS AREA

UC CLARK UNITGRAPH

TC	.90	TIME OF CONCENTRATION
R	.32	STORAGE COEFFICIENT

UA ACCUMULATED-AREA VS. TIME, 11 ORDINATES

.0	3.0	9.0	18.0	28.0	42.0	59.0	73.0	87.0	92.0
100.0									

***

UNIT HYDROGRAPH PARAMETERS
CLARK TC= .90 HR, R= .32 HR
SNYDER TP= .70 HR, CP= .85

UNIT HYDROGRAPH
28 END-OF-PERIOD ORDINATES

17.	63.	131.	205.	287.	385.	476.	536.	555.	524.
474.	403.	311.	240.	185.	143.	111.	85.	66.	51.
39.	30.	23.	18.	14.	11.	8.	6.		

HYDROGRAPH AT STATION BR51C

DA	MON	HRMN	ORD	RAIN	LOSS	EXCESS	COMP Q	*	DA	MON	HRMN	ORD	RAIN	LOSS	EXCESS	COMP Q
1		0000	1	.00	.00	.00	0.	*	1		2050	251	.00	.00	.00	0.
1		0005	2	.00	.00	.00	0.	*	1		2055	252	.00	.00	.00	0.
1		0010	3	.00	.00	.00	0.	*	1		2100	253	.00	.00	.00	0.
1		0015	4	.00	.00	.00	0.	*	1		2105	254	.00	.00	.00	0.
1		0020	5	.00	.00	.00	0.	*	1		2110	255	.00	.00	.00	0.
1		0025	6	.00	.00	.00	0.	*	1		2115	256	.00	.00	.00	0.
1		0030	7	.00	.00	.00	0.	*	1		2120	257	.00	.00	.00	0.
1		0035	8	.00	.00	.00	0.	*	1		2125	258	.00	.00	.00	0.
1		0040	9	.00	.00	.00	0.	*	1		2130	259	.00	.00	.00	0.
1		0045	10	.00	.00	.00	0.	*	1		2135	260	.00	.00	.00	0.
1		0050	11	.00	.00	.00	0.	*	1		2140	261	.00	.00	.00	0.

1	0055	12	.00	.00	.00	0.	*	1	2145	262	.00	.00	.00	0.
1	0100	13	.00	.00	.00	0.	*	1	2150	263	.00	.00	.00	0.
1	0105	14	.00	.00	.00	0.	*	1	2155	264	.00	.00	.00	0.
1	0110	15	.00	.00	.00	0.	*	1	2200	265	.00	.00	.00	0.
1	0115	16	.00	.00	.00	0.	*	1	2205	266	.00	.00	.00	0.
1	0120	17	.00	.00	.00	0.	*	1	2210	267	.00	.00	.00	0.
1	0125	18	.00	.00	.00	0.	*	1	2215	268	.00	.00	.00	0.
1	0130	19	.00	.00	.00	0.	*	1	2220	269	.00	.00	.00	0.
1	0135	20	.00	.00	.00	0.	*	1	2225	270	.00	.00	.00	0.
1	0140	21	.00	.00	.00	0.	*	1	2230	271	.00	.00	.00	0.
1	0145	22	.00	.00	.00	0.	*	1	2235	272	.00	.00	.00	0.
1	0150	23	.00	.00	.00	0.	*	1	2240	273	.00	.00	.00	0.
1	0155	24	.00	.00	.00	0.	*	1	2245	274	.00	.00	.00	0.
1	0200	25	.00	.00	.00	0.	*	1	2250	275	.00	.00	.00	0.
1	0205	26	.00	.00	.00	0.	*	1	2255	276	.00	.00	.00	0.
1	0210	27	.00	.00	.00	0.	*	1	2300	277	.00	.00	.00	0.
1	0215	28	.00	.00	.00	0.	*	1	2305	278	.00	.00	.00	0.
1	0220	29	.00	.00	.00	0.	*	1	2310	279	.00	.00	.00	0.
1	0225	30	.00	.00	.00	0.	*	1	2315	280	.00	.00	.00	0.
1	0230	31	.00	.00	.00	0.	*	1	2320	281	.00	.00	.00	0.
1	0235	32	.00	.00	.00	0.	*	1	2325	282	.00	.00	.00	0.
1	0240	33	.00	.00	.00	0.	*	1	2330	283	.00	.00	.00	0.
1	0245	34	.00	.00	.00	0.	*	1	2335	284	.00	.00	.00	0.
1	0250	35	.00	.00	.00	0.	*	1	2340	285	.00	.00	.00	0.
1	0255	36	.00	.00	.00	0.	*	1	2345	286	.00	.00	.00	0.
1	0300	37	.00	.00	.00	0.	*	1	2350	287	.00	.00	.00	0.
1	0305	38	.00	.00	.00	0.	*	1	2355	288	.00	.00	.00	0.
1	0310	39	.00	.00	.00	0.	*	2	0000	289	.00	.00	.00	0.
1	0315	40	.00	.00	.00	0.	*	2	0005	290	.00	.00	.00	0.
1	0320	41	.00	.00	.00	0.	*	2	0010	291	.00	.00	.00	0.
1	0325	42	.00	.00	.00	0.	*	2	0015	292	.00	.00	.00	0.
1	0330	43	.00	.00	.00	0.	*	2	0020	293	.00	.00	.00	0.
1	0335	44	.00	.00	.00	0.	*	2	0025	294	.00	.00	.00	0.
1	0340	45	.00	.00	.00	0.	*	2	0030	295	.00	.00	.00	0.
1	0345	46	.00	.00	.00	0.	*	2	0035	296	.00	.00	.00	0.
1	0350	47	.00	.00	.00	0.	*	2	0040	297	.00	.00	.00	0.
1	0355	48	.00	.00	.00	0.	*	2	0045	298	.00	.00	.00	0.
1	0400	49	.00	.00	.00	0.	*	2	0050	299	.00	.00	.00	0.
1	0405	50	.00	.00	.00	0.	*	2	0055	300	.00	.00	.00	0.
1	0410	51	.00	.00	.00	0.	*	2	0100	301	.00	.00	.00	0.
1	0415	52	.00	.00	.00	0.	*	2	0105	302	.00	.00	.00	0.
1	0420	53	.00	.00	.00	0.	*	2	0110	303	.00	.00	.00	0.
1	0425	54	.00	.00	.00	0.	*	2	0115	304	.00	.00	.00	0.
1	0430	55	.00	.00	.00	0.	*	2	0120	305	.00	.00	.00	0.
1	0435	56	.00	.00	.00	0.	*	2	0125	306	.00	.00	.00	0.
1	0440	57	.00	.00	.00	0.	*	2	0130	307	.00	.00	.00	0.
1	0445	58	.00	.00	.00	0.	*	2	0135	308	.00	.00	.00	0.
1	0450	59	.00	.00	.00	0.	*	2	0140	309	.00	.00	.00	0.
1	0455	60	.00	.00	.00	0.	*	2	0145	310	.00	.00	.00	0.
1	0500	61	.00	.00	.00	0.	*	2	0150	311	.00	.00	.00	0.
1	0505	62	.00	.00	.00	0.	*	2	0155	312	.00	.00	.00	0.
1	0510	63	.00	.00	.00	0.	*	2	0200	313	.00	.00	.00	0.
1	0515	64	.00	.00	.00	0.	*	2	0205	314	.00	.00	.00	0.
1	0520	65	.00	.00	.00	0.	*	2	0210	315	.00	.00	.00	0.
1	0525	66	.00	.00	.00	0.	*	2	0215	316	.00	.00	.00	0.
1	0530	67	.00	.00	.00	0.	*	2	0220	317	.00	.00	.00	0.
1	0535	68	.00	.00	.00	0.	*	2	0225	318	.00	.00	.00	0.
1	0540	69	.00	.00	.00	0.	*	2	0230	319	.00	.00	.00	0.
1	0545	70	.00	.00	.00	0.	*	2	0235	320	.00	.00	.00	0.
1	0550	71	.00	.00	.00	0.	*	2	0240	321	.00	.00	.00	0.
1	0555	72	.00	.00	.00	0.	*	2	0245	322	.00	.00	.00	0.
1	0600	73	.00	.00	.00	0.	*	2	0250	323	.00	.00	.00	0.
1	0605	74	.00	.00	.00	0.	*	2	0255	324	.00	.00	.00	0.
1	0610	75	.00	.00	.00	0.	*	2	0300	325	.00	.00	.00	0.
1	0615	76	.00	.00	.00	0.	*	2	0305	326	.00	.00	.00	0.
1	0620	77	.00	.00	.00	0.	*	2	0310	327	.00	.00	.00	0.
1	0625	78	.00	.00	.00	0.	*	2	0315	328	.00	.00	.00	0.
1	0630	79	.00	.00	.00	0.	*	2	0320	329	.00	.00	.00	0.
1	0635	80	.00	.00	.00	0.	*	2	0325	330	.00	.00	.00	0.
1	0640	81	.00	.00	.00	0.	*	2	0330	331	.00	.00	.00	0.
1	0645	82	.00	.00	.00	0.	*	2	0335	332	.00	.00	.00	0.
1	0650	83	.00	.00	.00	0.	*	2	0340	333	.00	.00	.00	0.
1	0655	84	.00	.00	.00	0.	*	2	0345	334	.00	.00	.00	0.
1	0700	85	.00	.00	.00	0.	*	2	0350	335	.00	.00	.00	0.
1	0705	86	.00	.00	.00	0.	*	2	0355	336	.00	.00	.00	0.
1	0710	87	.00	.00	.00	0.	*	2	0400	337	.00	.00	.00	0.
1	0715	88	.00	.00	.00	0.	*	2	0405	338	.00	.00	.00	0.
1	0720	89	.00	.00	.00	0.	*	2	0410	339	.00	.00	.00	0.
1	0725	90	.00	.00	.00	0.	*	2	0415	340	.00	.00	.00	0.
1	0730	91	.00	.00	.00	0.	*	2	0420	341	.00	.00	.00	0.
1	0735	92	.00	.00	.00	0.	*	2	0425	342	.00	.00	.00	0.
1	0740	93	.00	.00	.00	0.	*	2	0430	343	.00	.00	.00	0.
1	0745	94	.00	.00	.00	0.	*	2	0435	344	.00	.00	.00	0.
1	0750	95	.00	.00	.00	0.	*	2	0440	345	.00	.00	.00	0.
1	0755	96	.00	.00	.00	0.	*	2	0445	346	.00	.00	.00	0.
1	0800	97	.00	.00	.00	0.	*	2	0450	347	.00	.00	.00	0.
1	0805	98	.00	.00	.00	0.	*	2	0455	348	.00	.00	.00	0.
1	0810	99	.00	.00	.00	0.	*	2	0500	349	.00	.00	.00	0.
1	0815	100	.00	.00	.00	0.	*	2	0505	350	.00	.00	.00	0.
1	0820	101	.00	.00	.00	0.	*	2	0510	351	.00	.00	.00	0.
1	0825	102	.00	.00	.00	0.	*	2	0515	352	.00	.00	.00	0.
1	0830	103	.00	.00	.00	0.	*	2	0520	353	.00	.00	.00	0.
1	0835	104	.01	.01	.00	0.	*	2	0525	354	.00	.00	.00	0.
1	0840	105	.01	.01	.00	0.	*	2	0530	355	.00	.00	.00	0.
1	0845	106	.01	.01	.00	0.	*	2	0535	356	.00	.00	.00	0.

1	0850	107	.01	.01	.00	0.	*	2	0540	357	.00	.00	.00	0.
1	0855	108	.01	.01	.00	0.	*	2	0545	358	.00	.00	.00	0.
1	0900	109	.01	.01	.00	0.	*	2	0550	359	.00	.00	.00	0.
1	0905	110	.01	.01	.00	0.	*	2	0555	360	.00	.00	.00	0.
1	0910	111	.01	.01	.00	0.	*	2	0600	361	.00	.00	.00	0.
1	0915	112	.01	.01	.00	0.	*	2	0605	362	.00	.00	.00	0.
1	0920	113	.01	.01	.00	0.	*	2	0610	363	.00	.00	.00	0.
1	0925	114	.01	.01	.00	0.	*	2	0615	364	.00	.00	.00	0.
1	0930	115	.01	.01	.00	0.	*	2	0620	365	.00	.00	.00	0.
1	0935	116	.01	.01	.00	0.	*	2	0625	366	.00	.00	.00	0.
1	0940	117	.01	.01	.00	0.	*	2	0630	367	.00	.00	.00	0.
1	0945	118	.01	.01	.00	0.	*	2	0635	368	.00	.00	.00	0.
1	0950	119	.01	.01	.00	0.	*	2	0640	369	.00	.00	.00	0.
1	0955	120	.01	.01	.00	0.	*	2	0645	370	.00	.00	.00	0.
1	1000	121	.01	.01	.00	0.	*	2	0650	371	.00	.00	.00	0.
1	1005	122	.01	.01	.00	0.	*	2	0655	372	.00	.00	.00	0.
1	1010	123	.01	.01	.00	0.	*	2	0700	373	.00	.00	.00	0.
1	1015	124	.01	.01	.00	0.	*	2	0705	374	.00	.00	.00	0.
1	1020	125	.01	.01	.00	0.	*	2	0710	375	.00	.00	.00	0.
1	1025	126	.01	.01	.00	0.	*	2	0715	376	.00	.00	.00	0.
1	1030	127	.01	.01	.00	0.	*	2	0720	377	.00	.00	.00	0.
1	1035	128	.01	.01	.00	0.	*	2	0725	378	.00	.00	.00	0.
1	1040	129	.01	.01	.00	0.	*	2	0730	379	.00	.00	.00	0.
1	1045	130	.01	.01	.00	0.	*	2	0735	380	.00	.00	.00	0.
1	1050	131	.01	.01	.00	0.	*	2	0740	381	.00	.00	.00	0.
1	1055	132	.01	.01	.00	0.	*	2	0745	382	.00	.00	.00	0.
1	1100	133	.01	.01	.00	0.	*	2	0750	383	.00	.00	.00	0.
1	1105	134	.02	.02	.00	0.	*	2	0755	384	.00	.00	.00	0.
1	1110	135	.02	.02	.00	0.	*	2	0800	385	.00	.00	.00	0.
1	1115	136	.02	.02	.00	0.	*	2	0805	386	.00	.00	.00	0.
1	1120	137	.02	.02	.00	0.	*	2	0810	387	.00	.00	.00	0.
1	1125	138	.02	.02	.00	0.	*	2	0815	388	.00	.00	.00	0.
1	1130	139	.02	.02	.00	0.	*	2	0820	389	.00	.00	.00	0.
1	1135	140	.15	.04	.11	2.	*	2	0825	390	.00	.00	.00	0.
1	1140	141	.15	.04	.11	9.	*	2	0830	391	.00	.00	.00	0.
1	1145	142	.15	.04	.11	23.	*	2	0835	392	.00	.00	.00	0.
1	1150	143	.15	.04	.11	45.	*	2	0840	393	.00	.00	.00	0.
1	1155	144	.15	.04	.11	76.	*	2	0845	394	.00	.00	.00	0.
1	1200	145	.15	.04	.11	117.	*	2	0850	395	.00	.00	.00	0.
1	1205	146	.03	.03	.00	166.	*	2	0855	396	.00	.00	.00	0.
1	1210	147	.03	.03	.00	217.	*	2	0900	397	.00	.00	.00	0.
1	1215	148	.03	.03	.00	263.	*	2	0905	398	.00	.00	.00	0.
1	1220	149	.03	.03	.00	297.	*	2	0910	399	.00	.00	.00	0.
1	1225	150	.03	.03	.00	317.	*	2	0915	400	.00	.00	.00	0.
1	1230	151	.03	.03	.00	319.	*	2	0920	401	.00	.00	.00	0.
1	1235	152	.01	.01	.00	301.	*	2	0925	402	.00	.00	.00	0.
1	1240	153	.01	.01	.00	269.	*	2	0930	403	.00	.00	.00	0.
1	1245	154	.01	.01	.00	230.	*	2	0935	404	.00	.00	.00	0.
1	1250	155	.01	.01	.00	189.	*	2	0940	405	.00	.00	.00	0.
1	1255	156	.01	.01	.00	150.	*	2	0945	406	.00	.00	.00	0.
1	1300	157	.01	.01	.00	116.	*	2	0950	407	.00	.00	.00	0.
1	1305	158	.01	.01	.00	89.	*	2	0955	408	.00	.00	.00	0.
1	1310	159	.01	.01	.00	69.	*	2	1000	409	.00	.00	.00	0.
1	1315	160	.01	.01	.00	53.	*	2	1005	410	.00	.00	.00	0.
1	1320	161	.01	.01	.00	41.	*	2	1010	411	.00	.00	.00	0.
1	1325	162	.01	.01	.00	32.	*	2	1015	412	.00	.00	.00	0.
1	1330	163	.01	.01	.00	24.	*	2	1020	413	.00	.00	.00	0.
1	1335	164	.01	.01	.00	19.	*	2	1025	414	.00	.00	.00	0.
1	1340	165	.01	.01	.00	15.	*	2	1030	415	.00	.00	.00	0.
1	1345	166	.01	.01	.00	11.	*	2	1035	416	.00	.00	.00	0.
1	1350	167	.01	.01	.00	9.	*	2	1040	417	.00	.00	.00	0.
1	1355	168	.01	.01	.00	6.	*	2	1045	418	.00	.00	.00	0.
1	1400	169	.01	.01	.00	4.	*	2	1050	419	.00	.00	.00	0.
1	1405	170	.01	.01	.00	3.	*	2	1055	420	.00	.00	.00	0.
1	1410	171	.01	.01	.00	2.	*	2	1100	421	.00	.00	.00	0.
1	1415	172	.01	.01	.00	1.	*	2	1105	422	.00	.00	.00	0.
1	1420	173	.01	.01	.00	0.	*	2	1110	423	.00	.00	.00	0.
1	1425	174	.01	.01	.00	0.	*	2	1115	424	.00	.00	.00	0.
1	1430	175	.01	.01	.00	0.	*	2	1120	425	.00	.00	.00	0.
1	1435	176	.01	.01	.00	0.	*	2	1125	426	.00	.00	.00	0.
1	1440	177	.01	.01	.00	0.	*	2	1130	427	.00	.00	.00	0.
1	1445	178	.01	.01	.00	0.	*	2	1135	428	.00	.00	.00	0.
1	1450	179	.01	.01	.00	0.	*	2	1140	429	.00	.00	.00	0.
1	1455	180	.01	.01	.00	0.	*	2	1145	430	.00	.00	.00	0.
1	1500	181	.01	.01	.00	0.	*	2	1150	431	.00	.00	.00	0.
1	1505	182	.01	.01	.00	0.	*	2	1155	432	.00	.00	.00	0.
1	1510	183	.01	.01	.00	0.	*	2	1200	433	.00	.00	.00	0.
1	1515	184	.01	.01	.00	0.	*	2	1205	434	.00	.00	.00	0.
1	1520	185	.01	.01	.00	0.	*	2	1210	435	.00	.00	.00	0.
1	1525	186	.01	.01	.00	0.	*	2	1215	436	.00	.00	.00	0.
1	1530	187	.01	.01	.00	0.	*	2	1220	437	.00	.00	.00	0.
1	1535	188	.00	.00	.00	0.	*	2	1225	438	.00	.00	.00	0.
1	1540	189	.00	.00	.00	0.	*	2	1230	439	.00	.00	.00	0.
1	1545	190	.00	.00	.00	0.	*	2	1235	440	.00	.00	.00	0.
1	1550	191	.00	.00	.00	0.	*	2	1240	441	.00	.00	.00	0.
1	1555	192	.00	.00	.00	0.	*	2	1245	442	.00	.00	.00	0.
1	1600	193	.00	.00	.00	0.	*	2	1250	443	.00	.00	.00	0.
1	1605	194	.00	.00	.00	0.	*	2	1255	444	.00	.00	.00	0.
1	1610	195	.00	.00	.00	0.	*	2	1300	445	.00	.00	.00	0.
1	1615	196	.00	.00	.00	0.	*	2	1305	446	.00	.00	.00	0.
1	1620	197	.00	.00	.00	0.	*	2	1310	447	.00	.00	.00	0.
1	1625	198	.00	.00	.00	0.	*	2	1315	448	.00	.00	.00	0.
1	1630	199	.00	.00	.00	0.	*	2	1320	449	.00	.00	.00	0.
1	1635	200	.00	.00	.00	0.	*	2	1325	450	.00	.00	.00	0.
1	1640	201	.00	.00	.00	0.	*	2	1330	451	.00	.00	.00	0.

1	1645	202	.00	.00	.00	0.	*	2	1335	452	.00	.00	.00	0.
1	1650	203	.00	.00	.00	0.	*	2	1340	453	.00	.00	.00	0.
1	1655	204	.00	.00	.00	0.	*	2	1345	454	.00	.00	.00	0.
1	1700	205	.00	.00	.00	0.	*	2	1350	455	.00	.00	.00	0.
1	1705	206	.00	.00	.00	0.	*	2	1355	456	.00	.00	.00	0.
1	1710	207	.00	.00	.00	0.	*	2	1400	457	.00	.00	.00	0.
1	1715	208	.00	.00	.00	0.	*	2	1405	458	.00	.00	.00	0.
1	1720	209	.00	.00	.00	0.	*	2	1410	459	.00	.00	.00	0.
1	1725	210	.00	.00	.00	0.	*	2	1415	460	.00	.00	.00	0.
1	1730	211	.00	.00	.00	0.	*	2	1420	461	.00	.00	.00	0.
1	1735	212	.00	.00	.00	0.	*	2	1425	462	.00	.00	.00	0.
1	1740	213	.00	.00	.00	0.	*	2	1430	463	.00	.00	.00	0.
1	1745	214	.00	.00	.00	0.	*	2	1435	464	.00	.00	.00	0.
1	1750	215	.00	.00	.00	0.	*	2	1440	465	.00	.00	.00	0.
1	1755	216	.00	.00	.00	0.	*	2	1445	466	.00	.00	.00	0.
1	1800	217	.00	.00	.00	0.	*	2	1450	467	.00	.00	.00	0.
1	1805	218	.00	.00	.00	0.	*	2	1455	468	.00	.00	.00	0.
1	1810	219	.00	.00	.00	0.	*	2	1500	469	.00	.00	.00	0.
1	1815	220	.00	.00	.00	0.	*	2	1505	470	.00	.00	.00	0.
1	1820	221	.00	.00	.00	0.	*	2	1510	471	.00	.00	.00	0.
1	1825	222	.00	.00	.00	0.	*	2	1515	472	.00	.00	.00	0.
1	1830	223	.00	.00	.00	0.	*	2	1520	473	.00	.00	.00	0.
1	1835	224	.00	.00	.00	0.	*	2	1525	474	.00	.00	.00	0.
1	1840	225	.00	.00	.00	0.	*	2	1530	475	.00	.00	.00	0.
1	1845	226	.00	.00	.00	0.	*	2	1535	476	.00	.00	.00	0.
1	1850	227	.00	.00	.00	0.	*	2	1540	477	.00	.00	.00	0.
1	1855	228	.00	.00	.00	0.	*	2	1545	478	.00	.00	.00	0.
1	1900	229	.00	.00	.00	0.	*	2	1550	479	.00	.00	.00	0.
1	1905	230	.00	.00	.00	0.	*	2	1555	480	.00	.00	.00	0.
1	1910	231	.00	.00	.00	0.	*	2	1600	481	.00	.00	.00	0.
1	1915	232	.00	.00	.00	0.	*	2	1605	482	.00	.00	.00	0.
1	1920	233	.00	.00	.00	0.	*	2	1610	483	.00	.00	.00	0.
1	1925	234	.00	.00	.00	0.	*	2	1615	484	.00	.00	.00	0.
1	1930	235	.00	.00	.00	0.	*	2	1620	485	.00	.00	.00	0.
1	1935	236	.00	.00	.00	0.	*	2	1625	486	.00	.00	.00	0.
1	1940	237	.00	.00	.00	0.	*	2	1630	487	.00	.00	.00	0.
1	1945	238	.00	.00	.00	0.	*	2	1635	488	.00	.00	.00	0.
1	1950	239	.00	.00	.00	0.	*	2	1640	489	.00	.00	.00	0.
1	1955	240	.00	.00	.00	0.	*	2	1645	490	.00	.00	.00	0.
1	2000	241	.00	.00	.00	0.	*	2	1650	491	.00	.00	.00	0.
1	2005	242	.00	.00	.00	0.	*	2	1655	492	.00	.00	.00	0.
1	2010	243	.00	.00	.00	0.	*	2	1700	493	.00	.00	.00	0.
1	2015	244	.00	.00	.00	0.	*	2	1705	494	.00	.00	.00	0.
1	2020	245	.00	.00	.00	0.	*	2	1710	495	.00	.00	.00	0.
1	2025	246	.00	.00	.00	0.	*	2	1715	496	.00	.00	.00	0.
1	2030	247	.00	.00	.00	0.	*	2	1720	497	.00	.00	.00	0.
1	2035	248	.00	.00	.00	0.	*	2	1725	498	.00	.00	.00	0.
1	2040	249	.00	.00	.00	0.	*	2	1730	499	.00	.00	.00	0.
1	2045	250	.00	.00	.00	0.	*	2	1735	500	.00	.00	.00	0.
							*							

****

TOTAL RAINFALL = 2.30, TOTAL LOSS = 1.66, TOTAL EXCESS = .64

PEAK FLOW	TIME		MAXIMUM AVERAGE FLOW			
			6-HR	24-HR	72-HR	41.58-HR
+ (CFS)	(HR)					
		(CFS)				
+ 319.	12.50		48.	12.	7.	7.
		(INCHES)	.642	.642	.642	.642
		(AC-FT)	24.	24.	24.	24.

CUMULATIVE AREA = .70 SQ MI

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2-YR FLOW

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

              **************
              *            *
1411 KK       *    BR51C   *
              *            *
              **************
                            SUB-BASIN BR51C-LAND USE - AGRICULTURE;MINOR DEVELOPMENT
                            24-HOUR TYPE II RAINFALL WAS USED TO FIND TC & R FOR THIS BASIN
                            THIS BASIN USED RAINFALL REDUCTION FACTOR OF .90

                SUBBASIN RUNOFF DATA

1415 BA           SUBBASIN CHARACTERISTICS
                       TAREA          .70  SUBBASIN AREA

                  PRECIPITATION DATA

1416 PB                STORM        1.20  BASIN TOTAL PRECIPITATION

 191 PI             INCREMENTAL PRECIPITATION PATTERN
                       .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                       .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                       .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                       .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                       .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                       .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                       .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                       .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                       .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                       .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                       .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                       .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                       .00       .00       .00       .00       .00       .00       .01       .01       .01       .01
                       .01       .01       .01       .01       .01       .01       .01       .01       .06       .06
                       .06       .06       .06       .06       .01       .01       .01       .01       .01       .01
                       .01       .01       .01       .01       .01       .01       .00       .00       .00       .00
                       .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                       .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                       .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                       .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                       .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                       .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                       .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                       .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                       .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                       .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                       .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                       .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                       .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                       .00       .00       .00       .00       .00       .00       .00       .00

1417 LG           GREEN AND AMPT LOSS RATE
                       STRTL        .50  STARTING LOSS
                         DTH        .00  MOISTURE DEFICIT
                        PSIF       3.65  WETTING FRONT SUCTION
                       XKSAT        .46  HYDRAULIC CONDUCTIVITY
                       RTIMP        .00  PERCENT IMPERVIOUS AREA

1418 UC           CLARK UNITGRAPH
                          TC        .90  TIME OF CONCENTRATION
                           R        .32  STORAGE COEFFICIENT

1419 UA           ACCUMULATED-AREA VS. TIME,  11 ORDINATES
                        .0       3.0       9.0      18.0      28.0      42.0      59.0      73.0      87.0      92.0
                     100.0

                                                    ***

                                                UNIT HYDROGRAPH PARAMETERS
                                          CLARK   TC=   .90 HR,       R=   .32 HR
                                         SNYDER   TP=   .70 HR,      CP=   .85

                                                UNIT HYDROGRAPH
                                           28 END-OF-PERIOD ORDINATES
                 17.       63.      131.      205.      287.      385.      476.      536.      555.      524.
                474.      403.      311.      240.      185.      143.      111.       85.       66.       51.
                 39.       30.       23.       18.       14.       11.        8.        6.

*****************************************************************************************************************
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                                                HYDROGRAPH AT STATION     BR51C

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************
                                                                  *
       DA MON HRMN  ORD    RAIN    LOSS  EXCESS     COMP Q        *       DA MON HRMN  ORD    RAIN    LOSS  EXCESS
COMP Q
                                                                  *
```

A-18

	1	0000	1	.00	.00	.00	0.	*	1	2050	251	.00	.00	.00
0.														
	1	0005	2	.00	.00	.00	0.	*	1	2055	252	.00	.00	.00
0.														
	1	0010	3	.00	.00	.00	0.	*	1	2100	253	.00	.00	.00
0.														
	1	0015	4	.00	.00	.00	0.	*	1	2105	254	.00	.00	.00
0.														
	1	0020	5	.00	.00	.00	0.	*	1	2110	255	.00	.00	.00
0.														
	1	0025	6	.00	.00	.00	0.	*	1	2115	256	.00	.00	.00
0.														
	1	0030	7	.00	.00	.00	0.	*	1	2120	257	.00	.00	.00
0.														
	1	0035	8	.00	.00	.00	0.	*	1	2125	258	.00	.00	.00
0.														
	1	0040	9	.00	.00	.00	0.	*	1	2130	259	.00	.00	.00
0.														
	1	0045	10	.00	.00	.00	0.	*	1	2135	260	.00	.00	.00
0.														
	1	0050	11	.00	.00	.00	0.	*	1	2140	261	.00	.00	.00
0.														
	1	0055	12	.00	.00	.00	0.	*	1	2145	262	.00	.00	.00
0.														
	1	0100	13	.00	.00	.00	0.	*	1	2150	263	.00	.00	.00
0.														
	1	0105	14	.00	.00	.00	0.	*	1	2155	264	.00	.00	.00
0.														
	1	0110	15	.00	.00	.00	0.	*	1	2200	265	.00	.00	.00
0.														
	1	0115	16	.00	.00	.00	0.	*	1	2205	266	.00	.00	.00
0.														
	1	0120	17	.00	.00	.00	0.	*	1	2210	267	.00	.00	.00
0.														
	1	0125	18	.00	.00	.00	0.	*	1	2215	268	.00	.00	.00
0.														
	1	0130	19	.00	.00	.00	0.	*	1	2220	269	.00	.00	.00
0.														
	1	0135	20	.00	.00	.00	0.	*	1	2225	270	.00	.00	.00
0.														
	1	0140	21	.00	.00	.00	0.	*	1	2230	271	.00	.00	.00
0.														
	1	0145	22	.00	.00	.00	0.	*	1	2235	272	.00	.00	.00
0.														
	1	0150	23	.00	.00	.00	0.	*	1	2240	273	.00	.00	.00
0.														
	1	0155	24	.00	.00	.00	0.	*	1	2245	274	.00	.00	.00
0.														
	1	0200	25	.00	.00	.00	0.	*	1	2250	275	.00	.00	.00
0.														
	1	0205	26	.00	.00	.00	0.	*	1	2255	276	.00	.00	.00
0.														
	1	0210	27	.00	.00	.00	0.	*	1	2300	277	.00	.00	.00
0.														
	1	0215	28	.00	.00	.00	0.	*	1	2305	278	.00	.00	.00
0.														
	1	0220	29	.00	.00	.00	0.	*	1	2310	279	.00	.00	.00
0.														
	1	0225	30	.00	.00	.00	0.	*	1	2315	280	.00	.00	.00
0.														
	1	0230	31	.00	.00	.00	0.	*	1	2320	281	.00	.00	.00
0.														
	1	0235	32	.00	.00	.00	0.	*	1	2325	282	.00	.00	.00
0.														
	1	0240	33	.00	.00	.00	0.	*	1	2330	283	.00	.00	.00
0.														
	1	0245	34	.00	.00	.00	0.	*	1	2335	284	.00	.00	.00
0.														
	1	0250	35	.00	.00	.00	0.	*	1	2340	285	.00	.00	.00
0.														
	1	0255	36	.00	.00	.00	0.	*	1	2345	286	.00	.00	.00
0.														
	1	0300	37	.00	.00	.00	0.	*	1	2350	287	.00	.00	.00
0.														
	1	0305	38	.00	.00	.00	0.	*	1	2355	288	.00	.00	.00
0.														
	1	0310	39	.00	.00	.00	0.	*	2	0000	289	.00	.00	.00
0.														
	1	0315	40	.00	.00	.00	0.	*	2	0005	290	.00	.00	.00
0.														
	1	0320	41	.00	.00	.00	0.	*	2	0010	291	.00	.00	.00
0.														
	1	0325	42	.00	.00	.00	0.	*	2	0015	292	.00	.00	.00
0.														
	1	0330	43	.00	.00	.00	0.	*	2	0020	293	.00	.00	.00
0.														
	1	0335	44	.00	.00	.00	0.	*	2	0025	294	.00	.00	.00
0.														
	1	0340	45	.00	.00	.00	0.	*	2	0030	295	.00	.00	.00
0.														
	1	0345	46	.00	.00	.00	0.	*	2	0035	296	.00	.00	.00
0.														
	1	0350	47	.00	.00	.00	0.	*	2	0040	297	.00	.00	.00
0.														

	1	0355	48	.00	.00	.00	0.	*	2	0045	298	.00	.00	.00
0.														
	1	0400	49	.00	.00	.00	0.	*	2	0050	299	.00	.00	.00
0.														
	1	0405	50	.00	.00	.00	0.	*	2	0055	300	.00	.00	.00
0.														
	1	0410	51	.00	.00	.00	0.	*	2	0100	301	.00	.00	.00
0.														
	1	0415	52	.00	.00	.00	0.	*	2	0105	302	.00	.00	.00
0.														
	1	0420	53	.00	.00	.00	0.	*	2	0110	303	.00	.00	.00
0.														
	1	0425	54	.00	.00	.00	0.	*	2	0115	304	.00	.00	.00
0.														
	1	0430	55	.00	.00	.00	0.	*	2	0120	305	.00	.00	.00
0.														
	1	0435	56	.00	.00	.00	0.	*	2	0125	306	.00	.00	.00
0.														
	1	0440	57	.00	.00	.00	0.	*	2	0130	307	.00	.00	.00
0.														
	1	0445	58	.00	.00	.00	0.	*	2	0135	308	.00	.00	.00
0.														
	1	0450	59	.00	.00	.00	0.	*	2	0140	309	.00	.00	.00
0.														
	1	0455	60	.00	.00	.00	0.	*	2	0145	310	.00	.00	.00
0.														
	1	0500	61	.00	.00	.00	0.	*	2	0150	311	.00	.00	.00
0.														
	1	0505	62	.00	.00	.00	0.	*	2	0155	312	.00	.00	.00
0.														
	1	0510	63	.00	.00	.00	0.	*	2	0200	313	.00	.00	.00
0.														
	1	0515	64	.00	.00	.00	0.	*	2	0205	314	.00	.00	.00
0.														
	1	0520	65	.00	.00	.00	0.	*	2	0210	315	.00	.00	.00
0.														
	1	0525	66	.00	.00	.00	0.	*	2	0215	316	.00	.00	.00
0.														
	1	0530	67	.00	.00	.00	0.	*	2	0220	317	.00	.00	.00
0.														
	1	0535	68	.00	.00	.00	0.	*	2	0225	318	.00	.00	.00
0.														
	1	0540	69	.00	.00	.00	0.	*	2	0230	319	.00	.00	.00
0.														
	1	0545	70	.00	.00	.00	0.	*	2	0235	320	.00	.00	.00
0.														
	1	0550	71	.00	.00	.00	0.	*	2	0240	321	.00	.00	.00
0.														
	1	0555	72	.00	.00	.00	0.	*	2	0245	322	.00	.00	.00
0.														
	1	0600	73	.00	.00	.00	0.	*	2	0250	323	.00	.00	.00
0.														
	1	0605	74	.00	.00	.00	0.	*	2	0255	324	.00	.00	.00
0.														
	1	0610	75	.00	.00	.00	0.	*	2	0300	325	.00	.00	.00
0.														
	1	0615	76	.00	.00	.00	0.	*	2	0305	326	.00	.00	.00
0.														
	1	0620	77	.00	.00	.00	0.	*	2	0310	327	.00	.00	.00
0.														
	1	0625	78	.00	.00	.00	0.	*	2	0315	328	.00	.00	.00
0.														
	1	0630	79	.00	.00	.00	0.	*	2	0320	329	.00	.00	.00
0.														
	1	0635	80	.00	.00	.00	0.	*	2	0325	330	.00	.00	.00
0.														
	1	0640	81	.00	.00	.00	0.	*	2	0330	331	.00	.00	.00
0.														
	1	0645	82	.00	.00	.00	0.	*	2	0335	332	.00	.00	.00
0.														
	1	0650	83	.00	.00	.00	0.	*	2	0340	333	.00	.00	.00
0.														
	1	0655	84	.00	.00	.00	0.	*	2	0345	334	.00	.00	.00
0.														
	1	0700	85	.00	.00	.00	0.	*	2	0350	335	.00	.00	.00
0.														
	1	0705	86	.00	.00	.00	0.	*	2	0355	336	.00	.00	.00
0.														
	1	0710	87	.00	.00	.00	0.	*	2	0400	337	.00	.00	.00
0.														
	1	0715	88	.00	.00	.00	0.	*	2	0405	338	.00	.00	.00
0.														
	1	0720	89	.00	.00	.00	0.	*	2	0410	339	.00	.00	.00
0.														
	1	0725	90	.00	.00	.00	0.	*	2	0415	340	.00	.00	.00
0.														
	1	0730	91	.00	.00	.00	0.	*	2	0420	341	.00	.00	.00
0.														
	1	0735	92	.00	.00	.00	0.	*	2	0425	342	.00	.00	.00
0.														
	1	0740	93	.00	.00	.00	0.	*	2	0430	343	.00	.00	.00
0.														
	1	0745	94	.00	.00	.00	0.	*	2	0435	344	.00	.00	.00
0.														

	1	0750	95	.00	.00	.00	0.	*	2	0440	345	.00	.00	.00
0.														
	1	0755	96	.00	.00	.00	0.	*	2	0445	346	.00	.00	.00
0.														
	1	0800	97	.00	.00	.00	0.	*	2	0450	347	.00	.00	.00
0.														
	1	0805	98	.00	.00	.00	0.	*	2	0455	348	.00	.00	.00
0.														
	1	0810	99	.00	.00	.00	0.	*	2	0500	349	.00	.00	.00
0.														
	1	0815	100	.00	.00	.00	0.	*	2	0505	350	.00	.00	.00
0.														
	1	0820	101	.00	.00	.00	0.	*	2	0510	351	.00	.00	.00
0.														
	1	0825	102	.00	.00	.00	0.	*	2	0515	352	.00	.00	.00
0.														
	1	0830	103	.00	.00	.00	0.	*	2	0520	353	.00	.00	.00
0.														
	1	0835	104	.00	.00	.00	0.	*	2	0525	354	.00	.00	.00
0.														
	1	0840	105	.00	.00	.00	0.	*	2	0530	355	.00	.00	.00
0.														
	1	0845	106	.00	.00	.00	0.	*	2	0535	356	.00	.00	.00
0.														
	1	0850	107	.00	.00	.00	0.	*	2	0540	357	.00	.00	.00
0.														
	1	0855	108	.00	.00	.00	0.	*	2	0545	358	.00	.00	.00
0.														
	1	0900	109	.00	.00	.00	0.	*	2	0550	359	.00	.00	.00
0.														
	1	0905	110	.00	.00	.00	0.	*	2	0555	360	.00	.00	.00
0.														
	1	0910	111	.00	.00	.00	0.	*	2	0600	361	.00	.00	.00
0.														
	1	0915	112	.00	.00	.00	0.	*	2	0605	362	.00	.00	.00
0.														
	1	0920	113	.00	.00	.00	0.	*	2	0610	363	.00	.00	.00
0.														
	1	0925	114	.00	.00	.00	0.	*	2	0615	364	.00	.00	.00
0.														
	1	0930	115	.00	.00	.00	0.	*	2	0620	365	.00	.00	.00
0.														
	1	0935	116	.00	.00	.00	0.	*	2	0625	366	.00	.00	.00
0.														
	1	0940	117	.00	.00	.00	0.	*	2	0630	367	.00	.00	.00
0.														
	1	0945	118	.00	.00	.00	0.	*	2	0635	368	.00	.00	.00
0.														
	1	0950	119	.00	.00	.00	0.	*	2	0640	369	.00	.00	.00
0.														
	1	0955	120	.00	.00	.00	0.	*	2	0645	370	.00	.00	.00
0.														
	1	1000	121	.00	.00	.00	0.	*	2	0650	371	.00	.00	.00
0.														
	1	1005	122	.00	.00	.00	0.	*	2	0655	372	.00	.00	.00
0.														
	1	1010	123	.00	.00	.00	0.	*	2	0700	373	.00	.00	.00
0.														
	1	1015	124	.00	.00	.00	0.	*	2	0705	374	.00	.00	.00
0.														
	1	1020	125	.00	.00	.00	0.	*	2	0710	375	.00	.00	.00
0.														
	1	1025	126	.00	.00	.00	0.	*	2	0715	376	.00	.00	.00
0.														
	1	1030	127	.00	.00	.00	0.	*	2	0720	377	.00	.00	.00
0.														
	1	1035	128	.01	.01	.00	0.	*	2	0725	378	.00	.00	.00
0.														
	1	1040	129	.01	.01	.00	0.	*	2	0730	379	.00	.00	.00
0.														
	1	1045	130	.01	.01	.00	0.	*	2	0735	380	.00	.00	.00
0.														
	1	1050	131	.01	.01	.00	0.	*	2	0740	381	.00	.00	.00
0.														
	1	1055	132	.01	.01	.00	0.	*	2	0745	382	.00	.00	.00
0.														
	1	1100	133	.01	.01	.00	0.	*	2	0750	383	.00	.00	.00
0.														
	1	1105	134	.01	.01	.00	0.	*	2	0755	384	.00	.00	.00
0.														
	1	1110	135	.01	.01	.00	0.	*	2	0800	385	.00	.00	.00
0.														
	1	1115	136	.01	.01	.00	0.	*	2	0805	386	.00	.00	.00
0.														
	1	1120	137	.01	.01	.00	0.	*	2	0810	387	.00	.00	.00
0.														
	1	1125	138	.01	.01	.00	0.	*	2	0815	388	.00	.00	.00
0.														
	1	1130	139	.01	.01	.00	0.	*	2	0820	389	.00	.00	.00
0.														
	1	1135	140	.08	.08	.00	0.	*	2	0825	390	.00	.00	.00
0.														
	1	1140	141	.08	.08	.00	0.	*	2	0830	391	.00	.00	.00
0.														

	1	1145	142	.08	.04	.03	1.	*	2	0835	392	.00	.00	.00
0.														
	1	1150	143	.08	.04	.04	3.	*	2	0840	393	.00	.00	.00
0.														
	1	1155	144	.08	.04	.04	7.	*	2	0845	394	.00	.00	.00
0.														
	1	1200	145	.08	.04	.04	15.	*	2	0850	395	.00	.00	.00
0.														
	1	1205	146	.01	.01	.00	25.	*	2	0855	396	.00	.00	.00
0.														
	1	1210	147	.01	.01	.00	36.	*	2	0900	397	.00	.00	.00
0.														
	1	1215	148	.01	.01	.00	49.	*	2	0905	398	.00	.00	.00
0.														
	1	1220	149	.01	.01	.00	61.	*	2	0910	399	.00	.00	.00
0.														
	1	1225	150	.01	.01	.00	71.	*	2	0915	400	.00	.00	.00
0.														
	1	1230	151	.01	.01	.00	77.	*	2	0920	401	.00	.00	.00
0.														
	1	1235	152	.01	.01	.00	77.	*	2	0925	402	.00	.00	.00
0.														
	1	1240	153	.01	.01	.00	72.	*	2	0930	403	.00	.00	.00
0.														
	1	1245	154	.01	.01	.00	63.	*	2	0935	404	.00	.00	.00
0.														
	1	1250	155	.01	.01	.00	53.	*	2	0940	405	.00	.00	.00
0.														
	1	1255	156	.01	.01	.00	42.	*	2	0945	406	.00	.00	.00
0.														
	1	1300	157	.01	.01	.00	33.	*	2	0950	407	.00	.00	.00
0.														
	1	1305	158	.01	.01	.00	25.	*	2	0955	408	.00	.00	.00
0.														
	1	1310	159	.01	.01	.00	19.	*	2	1000	409	.00	.00	.00
0.														
	1	1315	160	.01	.01	.00	15.	*	2	1005	410	.00	.00	.00
0.														
	1	1320	161	.01	.01	.00	12.	*	2	1010	411	.00	.00	.00
0.														
	1	1325	162	.01	.01	.00	9.	*	2	1015	412	.00	.00	.00
0.														
	1	1330	163	.01	.01	.00	7.	*	2	1020	413	.00	.00	.00
0.														
	1	1335	164	.00	.00	.00	5.	*	2	1025	414	.00	.00	.00
0.														
	1	1340	165	.00	.00	.00	4.	*	2	1030	415	.00	.00	.00
0.														
	1	1345	166	.00	.00	.00	3.	*	2	1035	416	.00	.00	.00
0.														
	1	1350	167	.00	.00	.00	2.	*	2	1040	417	.00	.00	.00
0.														
	1	1355	168	.00	.00	.00	2.	*	2	1045	418	.00	.00	.00
0.														
	1	1400	169	.00	.00	.00	1.	*	2	1050	419	.00	.00	.00
0.														
	1	1405	170	.00	.00	.00	1.	*	2	1055	420	.00	.00	.00
0.														
	1	1410	171	.00	.00	.00	1.	*	2	1100	421	.00	.00	.00
0.														
	1	1415	172	.00	.00	.00	0.	*	2	1105	422	.00	.00	.00
0.														
	1	1420	173	.00	.00	.00	0.	*	2	1110	423	.00	.00	.00
0.														
	1	1425	174	.00	.00	.00	0.	*	2	1115	424	.00	.00	.00
0.														
	1	1430	175	.00	.00	.00	0.	*	2	1120	425	.00	.00	.00
0.														
	1	1435	176	.00	.00	.00	0.	*	2	1125	426	.00	.00	.00
0.														
	1	1440	177	.00	.00	.00	0.	*	2	1130	427	.00	.00	.00
0.														
	1	1445	178	.00	.00	.00	0.	*	2	1135	428	.00	.00	.00
0.														
	1	1450	179	.00	.00	.00	0.	*	2	1140	429	.00	.00	.00
0.														
	1	1455	180	.00	.00	.00	0.	*	2	1145	430	.00	.00	.00
0.														
	1	1500	181	.00	.00	.00	0.	*	2	1150	431	.00	.00	.00
0.														
	1	1505	182	.00	.00	.00	0.	*	2	1155	432	.00	.00	.00
0.														
	1	1510	183	.00	.00	.00	0.	*	2	1200	433	.00	.00	.00
0.														
	1	1515	184	.00	.00	.00	0.	*	2	1205	434	.00	.00	.00
0.														
	1	1520	185	.00	.00	.00	0.	*	2	1210	435	.00	.00	.00
0.														
	1	1525	186	.00	.00	.00	0.	*	2	1215	436	.00	.00	.00
0.														
	1	1530	187	.00	.00	.00	0.	*	2	1220	437	.00	.00	.00
0.														
	1	1535	188	.00	.00	.00	0.	*	2	1225	438	.00	.00	.00
0.														

	1	1540	189	.00	.00	.00	0.	*	2	1230	439	.00	.00	.00
0.														
	1	1545	190	.00	.00	.00	0.	*	2	1235	440	.00	.00	.00
0.														
	1	1550	191	.00	.00	.00	0.	*	2	1240	441	.00	.00	.00
0.														
	1	1555	192	.00	.00	.00	0.	*	2	1245	442	.00	.00	.00
0.														
	1	1600	193	.00	.00	.00	0.	*	2	1250	443	.00	.00	.00
0.														
	1	1605	194	.00	.00	.00	0.	*	2	1255	444	.00	.00	.00
0.														
	1	1610	195	.00	.00	.00	0.	*	2	1300	445	.00	.00	.00
0.														
	1	1615	196	.00	.00	.00	0.	*	2	1305	446	.00	.00	.00
0.														
	1	1620	197	.00	.00	.00	0.	*	2	1310	447	.00	.00	.00
0.														
	1	1625	198	.00	.00	.00	0.	*	2	1315	448	.00	.00	.00
0.														
	1	1630	199	.00	.00	.00	0.	*	2	1320	449	.00	.00	.00
0.														
	1	1635	200	.00	.00	.00	0.	*	2	1325	450	.00	.00	.00
0.														
	1	1640	201	.00	.00	.00	0.	*	2	1330	451	.00	.00	.00
0.														
	1	1645	202	.00	.00	.00	0.	*	2	1335	452	.00	.00	.00
0.														
	1	1650	203	.00	.00	.00	0.	*	2	1340	453	.00	.00	.00
0.														
	1	1655	204	.00	.00	.00	0.	*	2	1345	454	.00	.00	.00
0.														
	1	1700	205	.00	.00	.00	0.	*	2	1350	455	.00	.00	.00
0.														
	1	1705	206	.00	.00	.00	0.	*	2	1355	456	.00	.00	.00
0.														
	1	1710	207	.00	.00	.00	0.	*	2	1400	457	.00	.00	.00
0.														
	1	1715	208	.00	.00	.00	0.	*	2	1405	458	.00	.00	.00
0.														
	1	1720	209	.00	.00	.00	0.	*	2	1410	459	.00	.00	.00
0.														
	1	1725	210	.00	.00	.00	0.	*	2	1415	460	.00	.00	.00
0.														
	1	1730	211	.00	.00	.00	0.	*	2	1420	461	.00	.00	.00
0.														
	1	1735	212	.00	.00	.00	0.	*	2	1425	462	.00	.00	.00
0.														
	1	1740	213	.00	.00	.00	0.	*	2	1430	463	.00	.00	.00
0.														
	1	1745	214	.00	.00	.00	0.	*	2	1435	464	.00	.00	.00
0.														
	1	1750	215	.00	.00	.00	0.	*	2	1440	465	.00	.00	.00
0.														
	1	1755	216	.00	.00	.00	0.	*	2	1445	466	.00	.00	.00
0.														
	1	1800	217	.00	.00	.00	0.	*	2	1450	467	.00	.00	.00
0.														
	1	1805	218	.00	.00	.00	0.	*	2	1455	468	.00	.00	.00
0.														
	1	1810	219	.00	.00	.00	0.	*	2	1500	469	.00	.00	.00
0.														
	1	1815	220	.00	.00	.00	0.	*	2	1505	470	.00	.00	.00
0.														
	1	1820	221	.00	.00	.00	0.	*	2	1510	471	.00	.00	.00
0.														
	1	1825	222	.00	.00	.00	0.	*	2	1515	472	.00	.00	.00
0.														
	1	1830	223	.00	.00	.00	0.	*	2	1520	473	.00	.00	.00
0.														
	1	1835	224	.00	.00	.00	0.	*	2	1525	474	.00	.00	.00
0.														
	1	1840	225	.00	.00	.00	0.	*	2	1530	475	.00	.00	.00
0.														
	1	1845	226	.00	.00	.00	0.	*	2	1535	476	.00	.00	.00
0.														
	1	1850	227	.00	.00	.00	0.	*	2	1540	477	.00	.00	.00
0.														
	1	1855	228	.00	.00	.00	0.	*	2	1545	478	.00	.00	.00
0.														
	1	1900	229	.00	.00	.00	0.	*	2	1550	479	.00	.00	.00
0.														
	1	1905	230	.00	.00	.00	0.	*	2	1555	480	.00	.00	.00
0.														
	1	1910	231	.00	.00	.00	0.	*	2	1600	481	.00	.00	.00
0.														
	1	1915	232	.00	.00	.00	0.	*	2	1605	482	.00	.00	.00
0.														
	1	1920	233	.00	.00	.00	0.	*	2	1610	483	.00	.00	.00
0.														
	1	1925	234	.00	.00	.00	0.	*	2	1615	484	.00	.00	.00
0.														
	1	1930	235	.00	.00	.00	0.	*	2	1620	485	.00	.00	.00
0.														

	1	1935	236	.00	.00	.00	0.	*	2	1625	486	.00	.00	.00
0.														
	1	1940	237	.00	.00	.00	0.	*	2	1630	487	.00	.00	.00
0.														
	1	1945	238	.00	.00	.00	0.	*	2	1635	488	.00	.00	.00
0.														
	1	1950	239	.00	.00	.00	0.	*	2	1640	489	.00	.00	.00
0.														
	1	1955	240	.00	.00	.00	0.	*	2	1645	490	.00	.00	.00
0.														
	1	2000	241	.00	.00	.00	0.	*	2	1650	491	.00	.00	.00
0.														
	1	2005	242	.00	.00	.00	0.	*	2	1655	492	.00	.00	.00
0.														
	1	2010	243	.00	.00	.00	0.	*	2	1700	493	.00	.00	.00
0.														
	1	2015	244	.00	.00	.00	0.	*	2	1705	494	.00	.00	.00
0.														
	1	2020	245	.00	.00	.00	0.	*	2	1710	495	.00	.00	.00
0.														
	1	2025	246	.00	.00	.00	0.	*	2	1715	496	.00	.00	.00
0.														
	1	2030	247	.00	.00	.00	0.	*	2	1720	497	.00	.00	.00
0.														
	1	2035	248	.00	.00	.00	0.	*	2	1725	498	.00	.00	.00
0.														
	1	2040	249	.00	.00	.00	0.	*	2	1730	499	.00	.00	.00
0.														
	1	2045	250	.00	.00	.00	0.	*	2	1735	500	.00	.00	.00
0.														
								*						

****
****

TOTAL RAINFALL = 1.20, TOTAL LOSS = 1.05, TOTAL EXCESS = .15

	PEAK FLOW (CFS)	TIME (HR)		MAXIMUM AVERAGE FLOW 6-HR	24-HR	72-HR	41.58-HR
+			(CFS)				
+	77.	12.58		11.	3.	2.	2.
			(INCHES)	.146	.146	.146	.146
			(AC-FT)	5.	5.	5.	5.

CUMULATIVE AREA = .70 SQ MI

AZTEC ENGINEERING
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Phoenix, AZ 85040-3982
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Project: MLFCD ASS #5 Project No: AZ00112/05
Computed by: JCF Date: 9/3/01
Checked By: RCS Date: 9/10/01
Sheet Name HW/DISCHARGE Sheet: 1 Of:

- THESE CALC'S ARE TO DEVELOPE AN ELEVATION/DISCHARGE CURVE FOR EXISTING CONDITIONS FROM THE NORTH OF BASELINE TO THE SOUTH ACROSS BASELINE ROAD FROM 67TH AVE TO 59TH AVE.

ASSUMPTIONS

- USE 0% CLOGGING FACTOR FOR EXISTING CONDITIONS BECAUSE ① THESE ARE OPEN PIPES ② TO BE CONSERVATIVE.
- USE INLET INVERT AS THE CULVERT INLET SHOWN ON COP PROJ WS85500143. THESE INVERTS WILL BE SLIGHTLY LOWER THAN ACTUAL BUT WILL BE CLOSE, AND WILL BE MORE CONSERVATIVE.
- INLET CONTROLLED
- OVERTOPPING BEGINS @ 998.00

EXISTING PIPE SUMMARY (STATIONING FROM COP PROJ# WS85500143).

PIPE I.D.#	SIZE/TYPE	INLET INVERT	STATION
1	24" RCP	990.62	109+88
2	30" RCP	993.57	123+30
3	18" CMP	993.30	126+73

PIPE #1

ELEV	HW	HW/D	Q (FROM GRAPH) (CFS)
991	0.38	0.19 ✓	—
992	1.38	0.69	8
993	2.38	1.19	16
994	3.38	1.69	22
995	4.38	2.19	27
996	5.38	2.69	32
997	6.38	3.19	36
998	7.38	3.69	39

AZTEC ENGINEERING
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Project: MCFLD ASS # 5 Project No: AZ00112/05
Computed by: JCF Date: 9/3/01
Checked By: PCS Date: 9/10/01
Sheet Name HW/DISCHARGE Sheet: 2 Of:

PIPE #2

ELEV	HW	HW/D	Q (FROM GRAPH) (CFS)
994	0.43	0.17 ✓	—
995	1.43	0.57	9
996	2.43	0.97	21
997	3.43	1.37	32
998	4.43	1.77	40
(997.50)	3.93	1.57	37

PIPE #3

ELEV	HW	HW/D	Q (FROM GRAPH) (CFS)
994	0.70	0.46 ✓	—
995	1.70	1.13	7
996	2.70	1.80	11
997	3.70	2.47	13
998	4.70	3.13	15

PIPE #4 24" RCP INLET INV = 996.99 STATION 152+20

ELEV	HW	HW/D	Q (FROM GRAPH) (CFS)
998	1.01	0.51 ✓	5
999	2.01	1.01	13
1000	3.01	1.51	20
1001	4.01	2.01	26
1002	5.01	2.51	30
(1001.50)	4.50	2.25	28

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Project: MCFCD ASS #5 Project No: AZ00112/05
Computed by: JCF Date: 09/04/01
Checked By: RLS Date: 09/10/01
Sheet Name HW AT PIPES Sheet: 3 Of:

- THE NEW SYSTEM WILL BE DESIGNED TO CONVEY THE AMOUNT OF STORMWATER THAT CAN FLOW INTO THE EXISTING INLETS UNDER INLET CONTROL FOR THE EXISTING 100-YR HIGHWATER AS WAS DETERMINED IN THE UNOFFICIAL FLOODPLAIN DELINEATION, LAVEEN AREA. PIPES 1, 2 & 3 ONLY

PIPE I.D.#	STATION	HW
1	109+88	996.00
2	123+30	997.50
3	126+73	998.00
4	152+20	1001.50

PIPE #1 @ HW=996.00; Q= 32cfs
PIPE #2 @ HW=997.50; Q= 37cfs
PIPE #3 @ HW=998.00; Q= 15cfs
PIPE #4 @ HW=1001.50; Q= 28cfs

TOTAL FLOW ON 63RD AVE = 32cfs + 37cfs + 15cfs
= 84cfs

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Project: _____ Project No: A200112/05
Computed by: _____ Date: _____
Checked By: RCS Date: 09/10/01
Sheet Name _____ Sheet: 4 Of: _____

• ANALYZE TAKING THE FLOW IN PIPE #4 EAST TO THE LAVEEN CHANNEL

INVERT IN 996.99

INVERT @ LACC 991.50

$\Delta Y = 996.99 - 991.50 = 5.49$

$\Delta X = 1210'$

$S_{MAX} = \frac{5.49'}{1210'} = 0.0045'/ft$

WHEN HW = 1001.50 ; Q = 28 cfs

THE EXISTING CHANNEL IS ≈ 22± FEET WIDE. USE 20-FEET EARTHEN CHANNEL

$n = 0.022$
$S = 0.002'/ft$
$D = 1.5'$
$H:V = 4:1$
BOTTOM WIDTH = 1.2'
$Q = 28$ cfs
$V = 2.59$ fps
CHANNEL WIDTH WITH 0.5' FREEBOARD = 17.2'

$INV_{IN} = 996.99$

$(0.002'/ft)(1210') = 2.42'$

$INV_{OUT} = 996.99' - 2.42'$

$INV_{OUT} = 994.57'$ OK ✓

PIPE #1

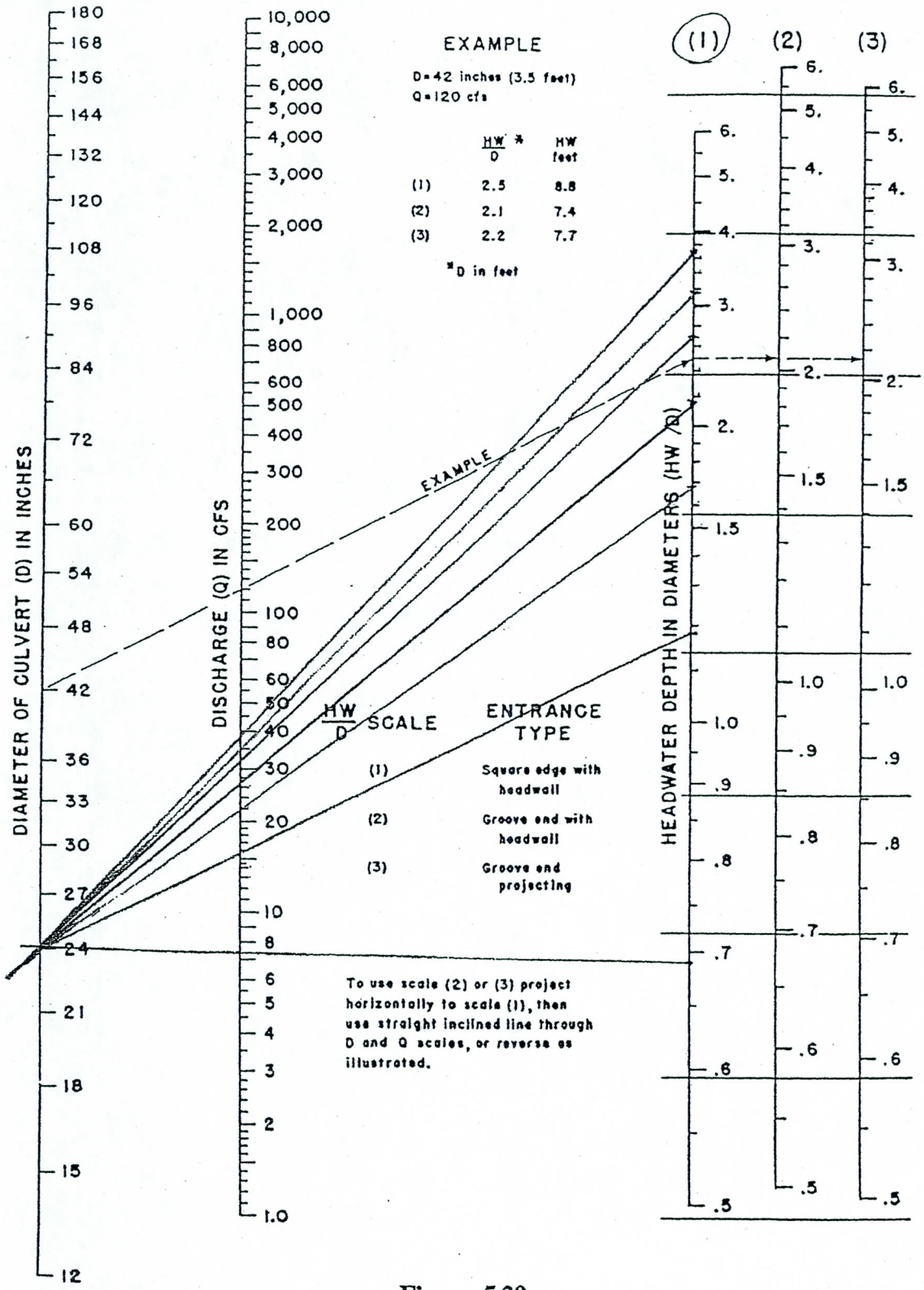

Figure 5.20
Headwater Depth for Concrete Pipe Culverts with Inlet Control
(USDOT, FHWA, HDS-5, 1985)

PIPE # 2

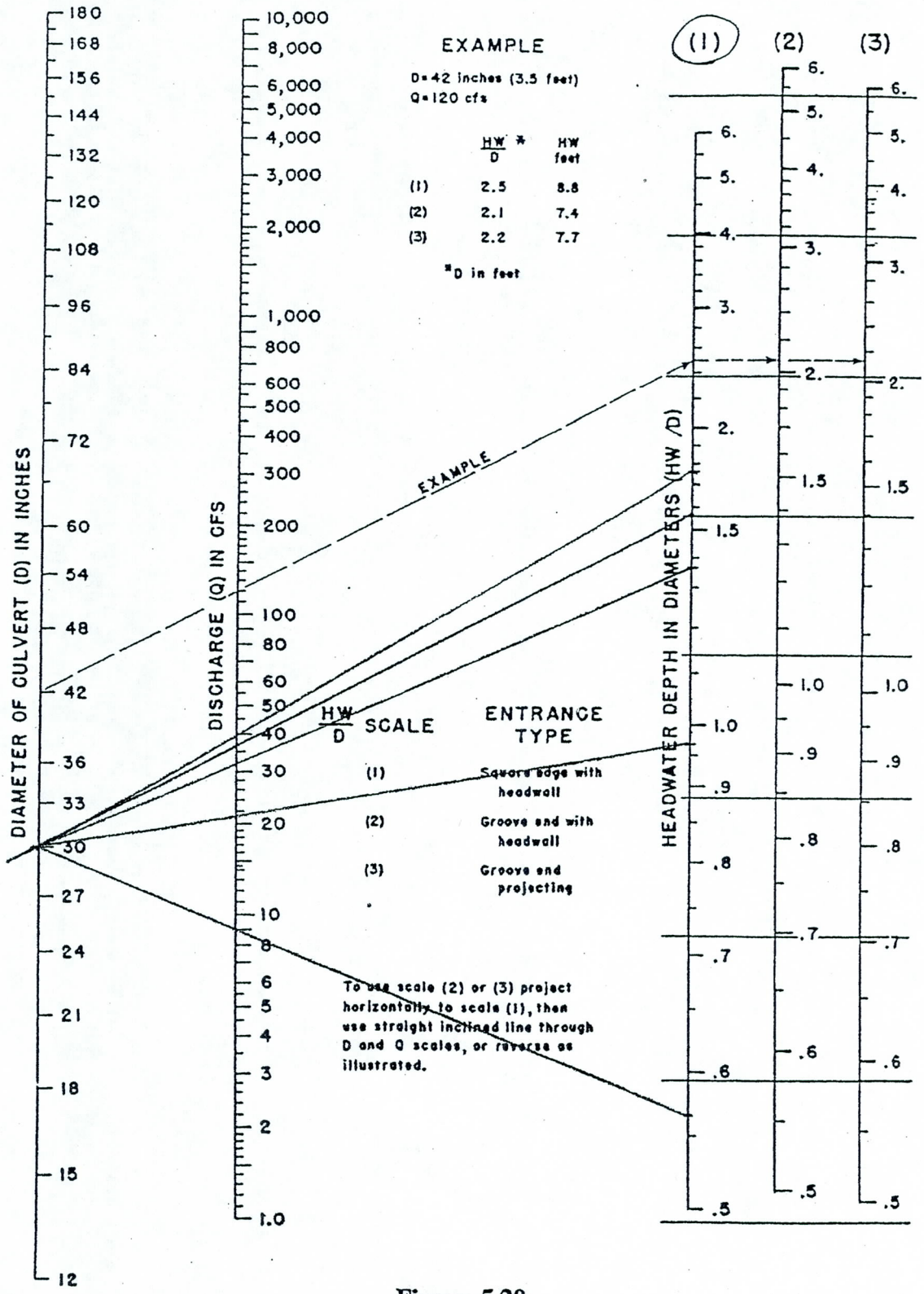

Figure 5.20
Headwater Depth for Concrete Pipe Culverts with Inlet Control
(USDOT, FHWA, HDS-5, 1985)

PIPE #3

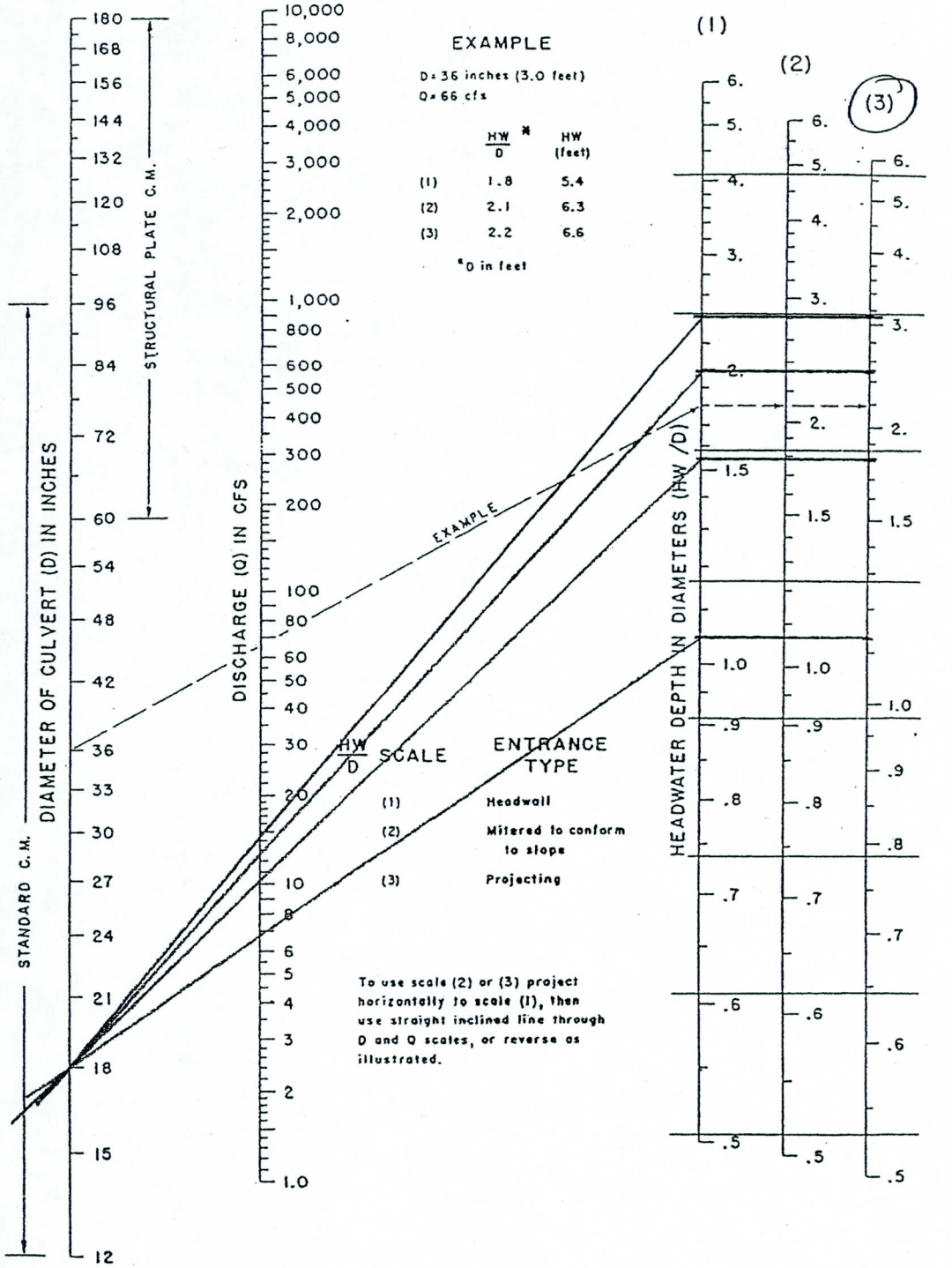

Figure 5.21
Headwater Depth for C.M. Pipe with Inlet Control
(USDOT, FHWA, HDS-5, 1985)

 PIPE # 4

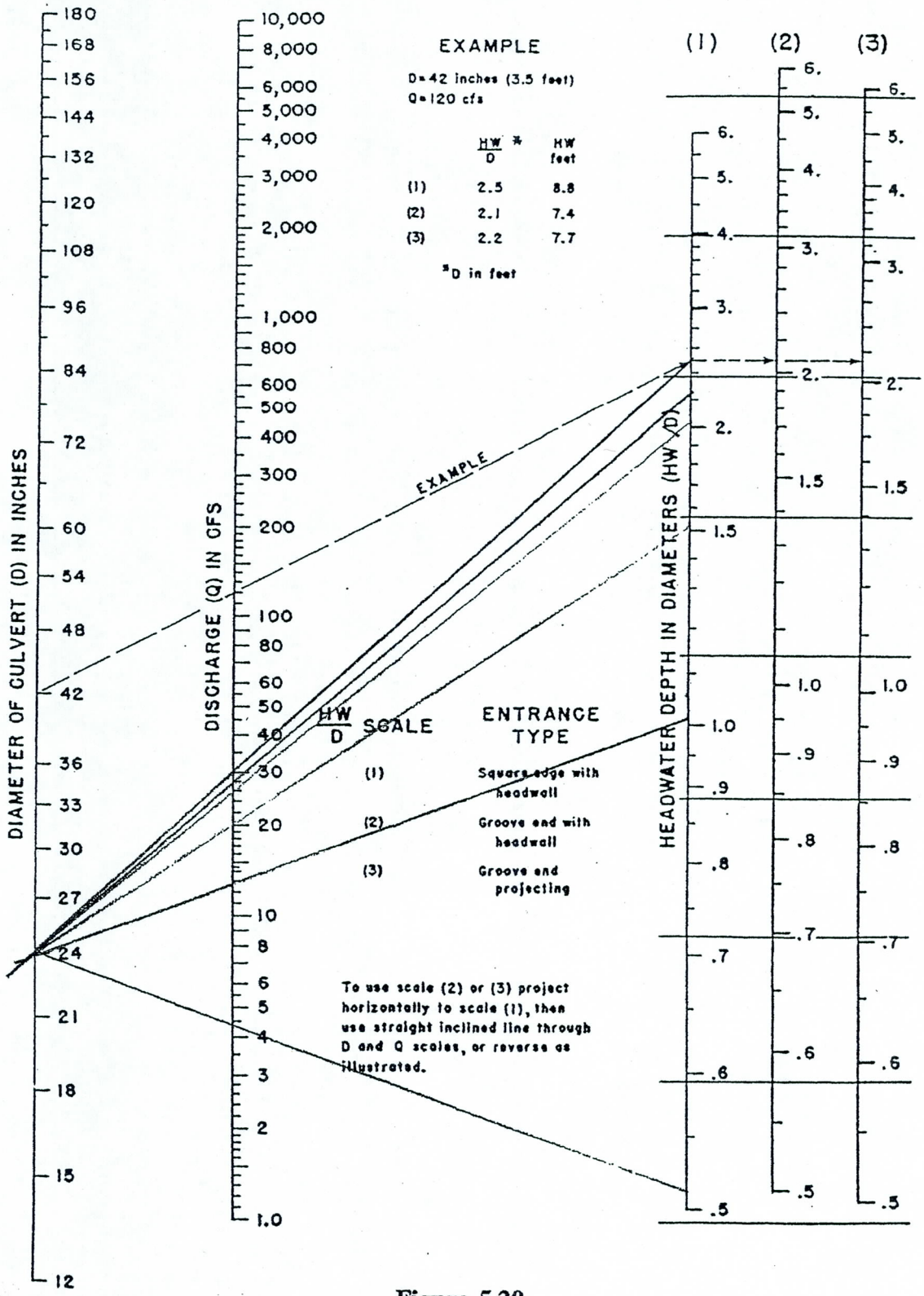

Figure 5.20
Headwater Depth for Concrete Pipe Culverts with Inlet Control
(USDOT, FHWA, HDS-5, 1985)

Worksheet
Worksheet for Pressure Pipe

PIPE ID # 100

Project Description	
Worksheet	Pressure Pipe - 1
Flow Element	Pressure Pipe
Method	Hazen-Williams Formula
Solve For	Pressure at 1

Input Data		
Pressure at 2	991.9	feet H20
Elevation at 1	988.10	ft
Elevation at 2	987.40	ft
Length	1,600.00	ft
C Coefficient	130.0	
Diameter	54	in
Discharge	84.00	cfs

Results		
Pressure at 1	993.4	feet H20
Headloss	2.22	ft
Energy Grade at 1	1,981.90	ft
Energy Grade at 2	1,979.68	ft
Hydraulic Grade at 1	1,981.47	ft
Hydraulic Grade at 2	1,979.25	ft
Flow Area	15.9	ft^2
Wetted Perimeter	14.14	ft
Velocity	5.28	ft/s
Velocity Head	0.43	ft
Friction Slope	0.001387	ft/ft

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Worksheet
Worksheet for Circular Channel

PIPE ID # 100

Project Description	
Worksheet	Circular Channel - 1
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Discharge

Input Data		
Mannings Coefficient	0.013	
Slope	0.000440	ft/ft
Depth	4.50	ft
Diameter	54	in

Results		
Discharge	41.25	cfs
Flow Area	15.9	ft²
Wetted Perimeter	14.14	ft
Top Width	1.26e-7	ft
Critical Depth	1.85	ft
Percent Full	100.0	%
Critical Slope	0.003503	ft/ft
Velocity	2.59	ft/s
Velocity Head	0.10	ft
Specific Energy	4.60	ft
Froude Number	4.08e-5	
Maximum Discharg	44.37	cfs
Discharge Full	41.25	cfs
Slope Full	0.000440	ft/ft
Flow Type	Subcritical	

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Worksheet
Worksheet for Pressure Pipe

PIPE ID# 101

Project Description	
Worksheet	Pressure Pipe - 1
Flow Element	Pressure Pipe
Method	Hazen-Williams Formula
Solve For	Pressure at 1

Input Data		
Pressure at 2	993.9	feet H20
Elevation at 1	989.00	ft
Elevation at 2	988.25	ft
Length	1,600.00	ft
C Coefficient	130.0	
Diameter	42	in
Discharge	32.00	cfs

Results		
Pressure at 1	994.4	feet H20
Headloss	1.26	ft
Energy Grade at 1	1,983.53	ft
Energy Grade at 2	1,982.27	ft
Hydraulic Grade at 1	1,983.36	ft
Hydraulic Grade at 2	1,982.10	ft
Flow Area	9.6	ft^2
Wetted Perimeter	11.00	ft
Velocity	3.33	ft/s
Velocity Head	0.17	ft
Friction Slope	0.000790	ft/ft

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Worksheet
Worksheet for Pressure Pipe

PIPE ID# 101

Project Description	
Worksheet	Pressure Pipe - 1
Flow Element	Pressure Pipe
Method	Hazen-Williams Formula
Solve For	Pressure at 1

Input Data		
Pressure at 2	993.9	feet H20
Elevation at 1	989.00	ft
Elevation at 2	988.25	ft
Length	1,600.00	ft
C Coefficient	130.0	
Diameter	36	in
Discharge	32.00	cfs

Results		
Pressure at 1	995.8	feet H20
Headloss	2.68	ft
Energy Grade at 1	1,985.09	ft
Energy Grade at 2	1,982.41	ft
Hydraulic Grade at 1	1,984.77	ft
Hydraulic Grade at 2	1,982.10	ft
Flow Area	7.1	ft^2
Wetted Perimeter	9.42	ft
Velocity	4.53	ft/s
Velocity Head	0.32	ft
Friction Slope	0.001673	ft/ft

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Worksheet
Worksheet for Circular Channel

PIPE ID# 101

Project Description	
Worksheet	Circular Channel - 1
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Discharge

Input Data		
Mannings Coefficient	0.013	
Slope	0.000560	ft/ft
Depth	3.50	ft
Diameter	42	in

Results		
Discharge	23.81	cfs
Flow Area	9.6	ft²
Wetted Perimeter	11.00	ft
Top Width	1.12e-7	ft
Critical Depth	1.50	ft
Percent Full	100.0	%
Critical Slope	0.003844	ft/ft
Velocity	2.47	ft/s
Velocity Head	0.10	ft
Specific Energy	3.60	ft
Froude Number	4.7e-5	
Maximum Discharg	25.61	cfs
Discharge Full	23.81	cfs
Slope Full	0.000560	ft/ft
Flow Type	Subcritical	

Worksheet
Worksheet for Circular Channel

PIPE ID# 102

Project Description	
Worksheet	Circular Channel - 1
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Discharge

Input Data		
Mannings Coefficient	0.013	
Slope	0.005100	ft/ft
Depth	1.50	ft
Diameter	18	in

Results		
Discharge	7.50	cfs
Flow Area	1.8	ft^2
Wetted Perimeter	4.71	ft
Top Width	3.65e-8	ft
Critical Depth	1.06	ft
Percent Full	100.0	%
Critical Slope	0.007080	ft/ft
Velocity	4.24	ft/s
Velocity Head	0.28	ft
Specific Energy	1.78	ft
Froude Number	1.08e-4	
Maximum Discharg	8.07	cfs
Discharge Full	7.50	cfs
Slope Full	0.005100	ft/ft
Flow Type	Subcritical	

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Worksheet
Worksheet for Pressure Pipe

PIPE ID# 102

Project Description	
Worksheet	Pressure Pipe - 1
Flow Element	Pressure Pipe
Method	Hazen-Williams Formula
Solve For	Pressure at 1

Input Data		
Pressure at 2	993.9	feet H20
Elevation at 1	990.00	ft
Elevation at 2	988.25	ft
Length	335.00	ft
C Coefficient	130.0	
Diameter	18	in
Discharge	15.00	cfs

Results		
Pressure at 1	996.2	feet H20
Headloss	4.03	ft
Energy Grade at 1	1,987.25	ft
Energy Grade at 2	1,983.22	ft
Hydraulic Grade at 1	1,986.13	ft
Hydraulic Grade at 2	1,982.10	ft
Flow Area	1.8	ft^2
Wetted Perimeter	4.71	ft
Velocity	8.49	ft/s
Velocity Head	1.12	ft
Friction Slope	0.012029	ft/ft

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Worksheet
Worksheet for Trapezoidal Channel

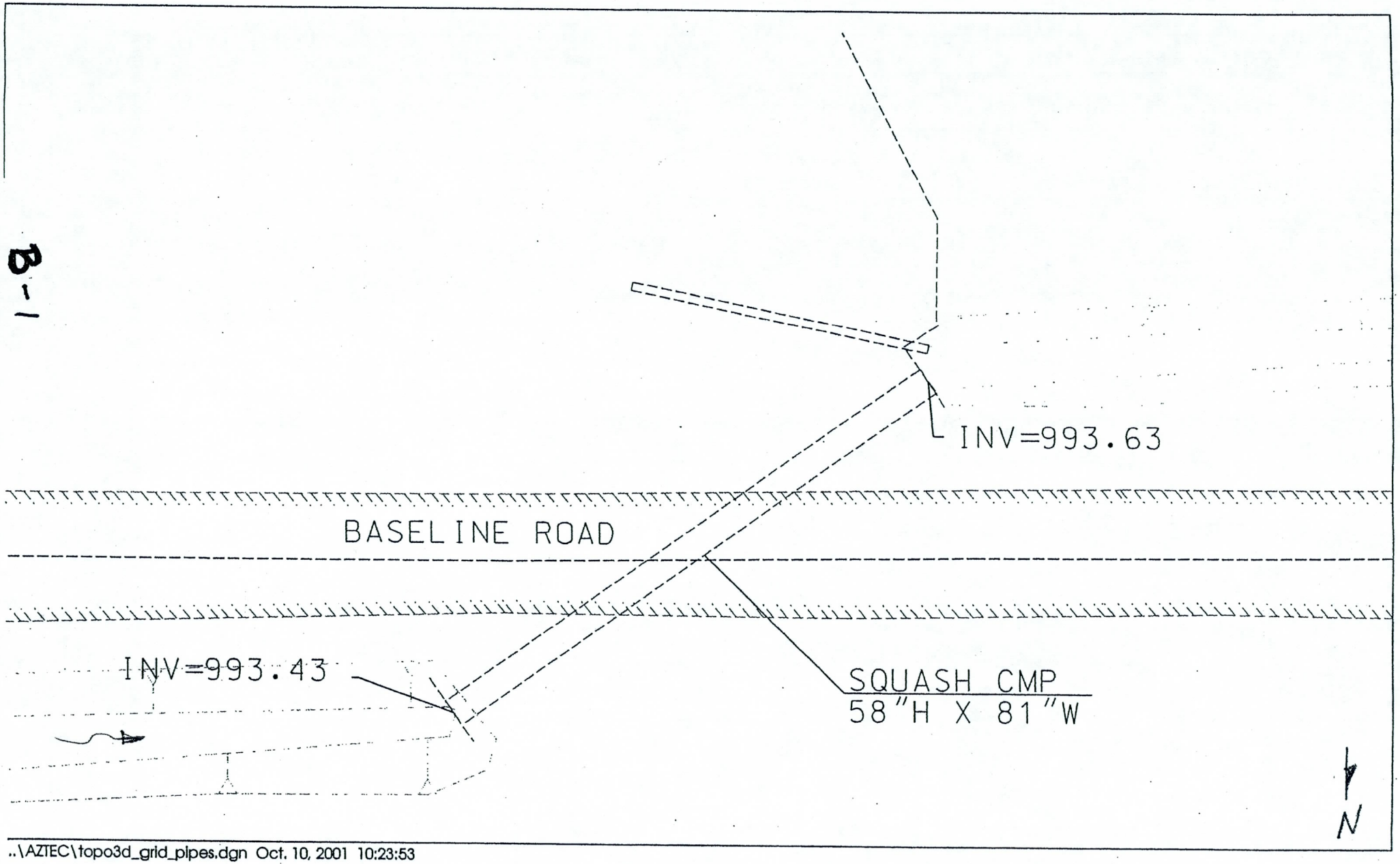
Project Description	
Worksheet	Trapezoidal Channe
Flow Element	Trapezoidal Channe
Method	Manning's Formula
Solve For	Discharge

Input Data		
Mannings Coeffic	0.022	
Slope	001200	ft/ft
Depth	8.00	ft
Left Side Slope	1.00	H : V
Right Side Slope	1.00	H : V
Bottom Width	5.00	ft

Results		
Discharge	588.83	cfs
Flow Area	104.0	ft²
Wetted Perime	27.63	ft
Top Width	21.00	ft
Critical Depth	5.35	ft
Critical Slope	0.006456	ft/ft
Velocity	5.66	ft/s
Velocity Head	0.50	ft
Specific Energ	8.50	ft
Froude Numbe	0.45	
Flow Type	ubcritical	

APPENDIX B

B-1



..\AZTEC\topo3d_grid_pipes.dgn Oct. 10, 2001 10:23:53

Culvert Calculator Report
Baseline Culvert

Solve For: Discharge

Culvert Summary					
Allowable HW Elevation	1,000.63	ft	Headwater Depth/Height	1.42	
Computed Headwater Elev	1,000.63	ft	Discharge	212.19	cfs
Inlet Control HW Elev.	999.36	ft	Tailwater Elevation	993.43	ft
Outlet Control HW Elev.	1,000.63	ft	Control Type	Outlet Control	

Grades					
Upstream Invert	993.63	ft	Downstream Invert	993.43	ft
Length	140.00	ft	Constructed Slope	0.001429	ft/ft

Hydraulic Profile					
Profile	CompositeM2PressureProfile		Depth, Downstream	3.36	ft
Slope Type	Mild		Normal Depth	N/A	ft
Flow Regime	Subcritical		Critical Depth	3.36	ft
Velocity Downstream	10.61	ft/s	Critical Slope	0.015930	ft/ft

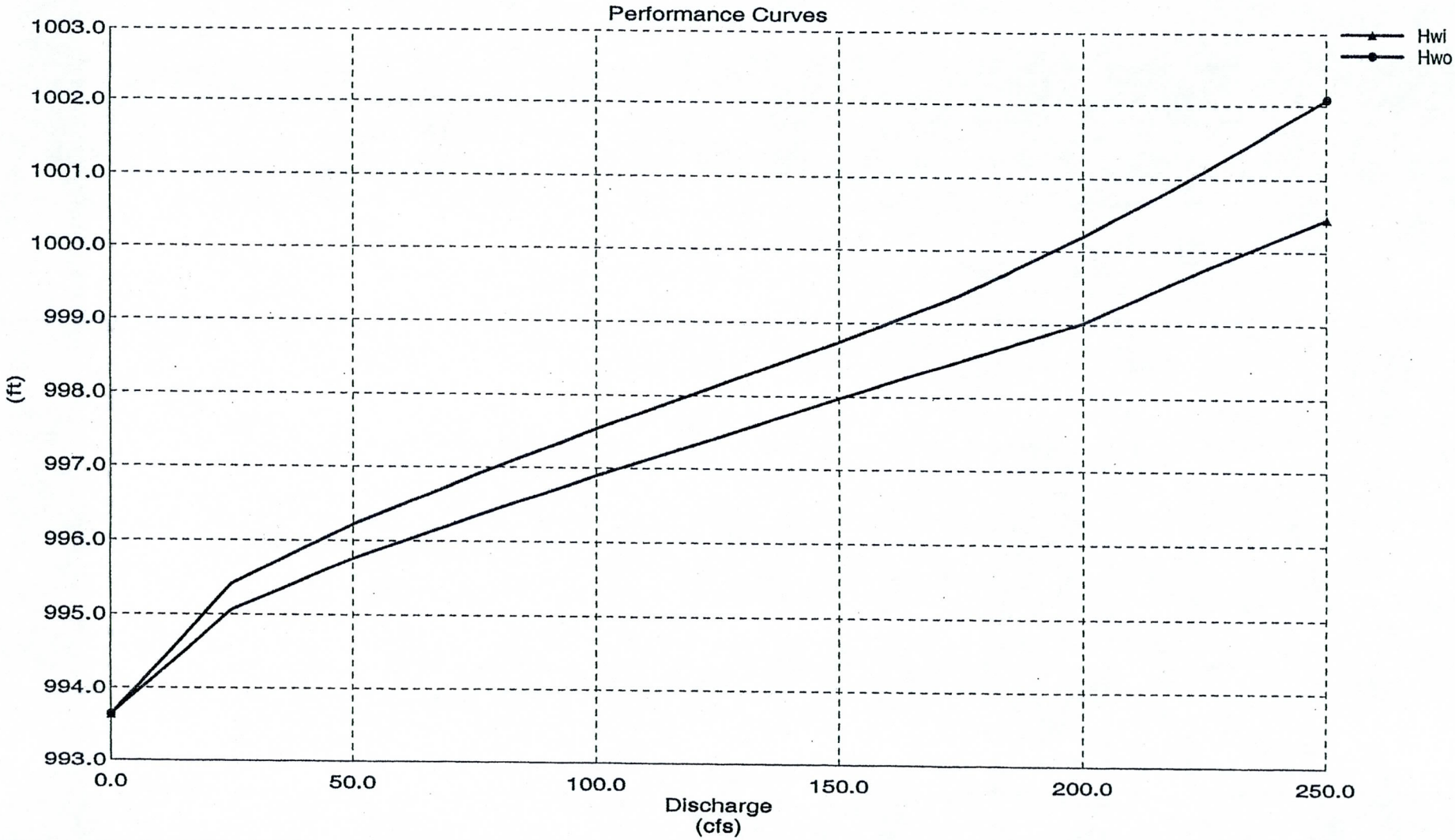
Section					
Section Shape	Arch		Mannings Coefficient	0.025	
Section Material	Aluminum Var CR Historic		Span	6.75	ft
Section Size	81 x 59 inch		Rise	4.92	ft
Number Sections	1				

Outlet Control Properties					
Outlet Control HW Elev.	1,000.63	ft	Upstream Velocity Head	1.01	ft
Ke	0.50		Entrance Loss	0.51	ft

Inlet Control Properties					
Inlet Control HW Elev.	999.36	ft	Flow Control	Transition	
Inlet Type	90° headwall		Area Full	26.3	ft^2
K	0.00830		HDS 5 Chart	34	
M	2.00000		HDS 5 Scale	1	
C	0.03790		Equation Form	1	
Y	0.69000				

Performance Curves Report
Baseline Culvert

Range Data:				
	Minimum	Maximum	Increment	
Discharge	0.00	250.00	25.00	cfs



B-3

Title: Laveen Area Conveyance Channel
s:\...\hydraulics\culvsystem1\baseline_culv.cvm
10/10/01 10:30:32 AM

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Project Engineer: Michael Lopez
CulvertMaster v2.0 [2.005]

pe No. 3

Q_3

lo. 2

fect.

f the incoming flow as well as the coming pipes. To illustrate this effect, two cases to determine the correction s, the angle between the inflow pipe

$^{0.75} + 1$

ation 7-16. This correction factor e, has on the inflow pipe for which s calculated for pipe #1 when pipe #2 h > d_{aho}. Additionally, the correction ole that has both an inflow line and qual to 1.0.

Table 7-6. Correction for benching.

Bench Type	Correction Factors, C_B	
	Submerged *	Unsubmerged **
Flat or Depressed Floor	1.00	1.00
Half Bench	0.95	0.15
Full Bench	0.75	0.07

* pressure flow, $d_{aho}/D_o > 3.2$
** free surface flow, $d_{aho}/D_o < 1.0$

$$C_p = 1 + 0.2\left(\frac{h}{D_o}\right)\left(\frac{h - d_{aho}}{D_o}\right) \tag{7-16}$$

where: C_p = correction for plunging flow
h = vertical distance of plunging flow from the flow line of the higher elevation inlet pipe to the center of the outflow pipe.
D_o = outlet pipe diameter
d_{aho} = water depth in access hole relative to the outlet pipe invert

The correction for **benching** in the access hole, C_B, is obtained from table 7-6. Figure 7-6 illustrates benching methods listed in table 7-6. Benching tends to direct flow through the access hole, resulting in a reduction in head loss. For flow depths between the submerged and unsubmerged conditions, a linear interpolation is performed.

In summary, to estimate the head loss through an access hole from the outflow pipe to a particular inflow pipe using the energy-loss method, multiply the above correction factors together to get the head loss coefficient, K. This coefficient is then multiplied by the velocity head in the outflow pipe to estimate the minor loss for the connection.

7.1.6.8 Inlet and Access Hole Losses - Power-Loss Methodology

The power-loss methodology was developed in response to the need for an energy loss relationship which would cover the wide range of flow conditions which occur in access holes [42]. This procedure estimates energy losses at access holes for free-surface, transitional, and pressure flows. Two-pipe, three-pipe, and four-pipe configurations were evaluated during development of the methodology.

The power-loss methodology is based on the premise that minor energy losses through an access hole can be determined using a conservation of power concept. The power entering the access hole can be equated to the sum of the outflow power and the power lost. The solution of the equation involves selection of an initial value of the depth of flow in the access hole, d_{aho}, and computation of the inflow power, outflow power, and the power loss in the access hole until the equality is achieved. Computation of losses are dependent on the initial value of d_{aho} selected and the adjusted d_{aho} values determined during the iterative processes.

$D_o = 5'$

$d_{aho} = 7'-9'$ $\quad 9/5 = 1.8$

B-4

==========
Scenario: Base

>>>> Info: Subsurface Analysis iterations: 1
>>>> Info: Convergence was achieved.

==========
Gravity subnetwork discharging at: OUTLET

>>>> Info: Loading and hydraulic computations completed successfully.
>>>> Warning: P-1 Pipe discharge is above full flow capacity.
>>>> Warning: P-2 Pipe discharge is above full flow capacity.
>>>> Warning: P-4 Pipe discharge is above full flow capacity.
>>>> Warning: P-3 Pipe discharge is above full flow capacity.

CALCULATION SUMMARY FOR SURFACE NETWORKS

Label	Inlet Type	Inlet	Total Intercepted Flow (cfs)	Total Bypassed Flow (cfs)	Capture Efficiency (%)	Gutter Spread (ft)	Gutter Depth (ft)
I-1	Generic Inlet	Generic Default 100%	0.00	0.00	100.0	0.00	0.00

CALCULATION SUMMARY FOR SUBSURFACE NETWORK WITH ROOT: OUTLET

Label	Number of Sections	Section Size	Section Shape	Length (ft)	Total System Flow (cfs)	Average Velocity (ft/s)	Hydraulic Grade Upstream (ft)	Hydraulic Grade Downstream (ft)
P-1	2	60 inch	Circular	82.00	225.00	5.73	1,002.32	1,002.17
P-2	2	60 inch	Circular	660.00	225.00	5.73	1,003.86	1,002.63
P-3	2	60 inch	Circular	660.00	225.00	5.73	1,005.17	1,003.94
P-4	2	60 inch	Circular	660.00	225.00	5.73	1,006.48	1,005.25

Label	Total System Flow (cfs)	Ground Elevation (ft)	Hydraulic Grade Line In (ft)	Hydraulic Grade Line Out (ft)
OUTLET	225.00	1,004.00	1,002.17	1,002.17
MH-15	225.00	1,005.40	1,002.63	1,002.32
MH-16	225.00	1,006.50	1,003.94	1,003.86
MH-17	225.00	1,007.40	1,005.25	1,005.17
I-1	225.00	1,010.50	1,006.89	1,006.48

==========
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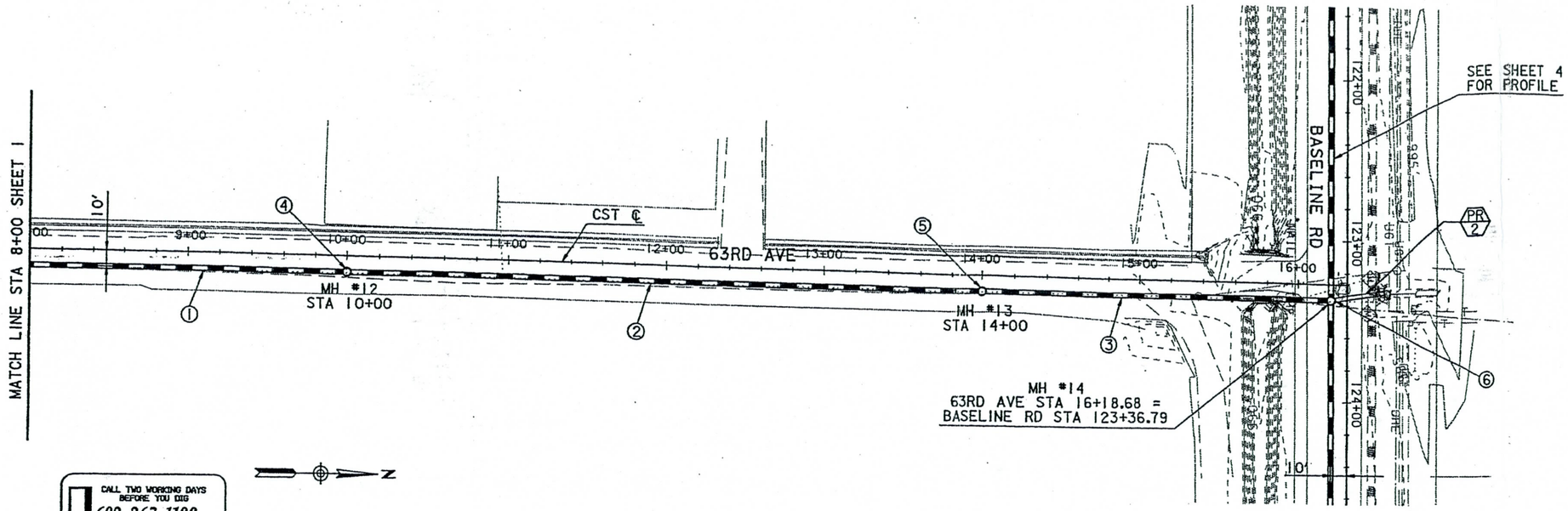
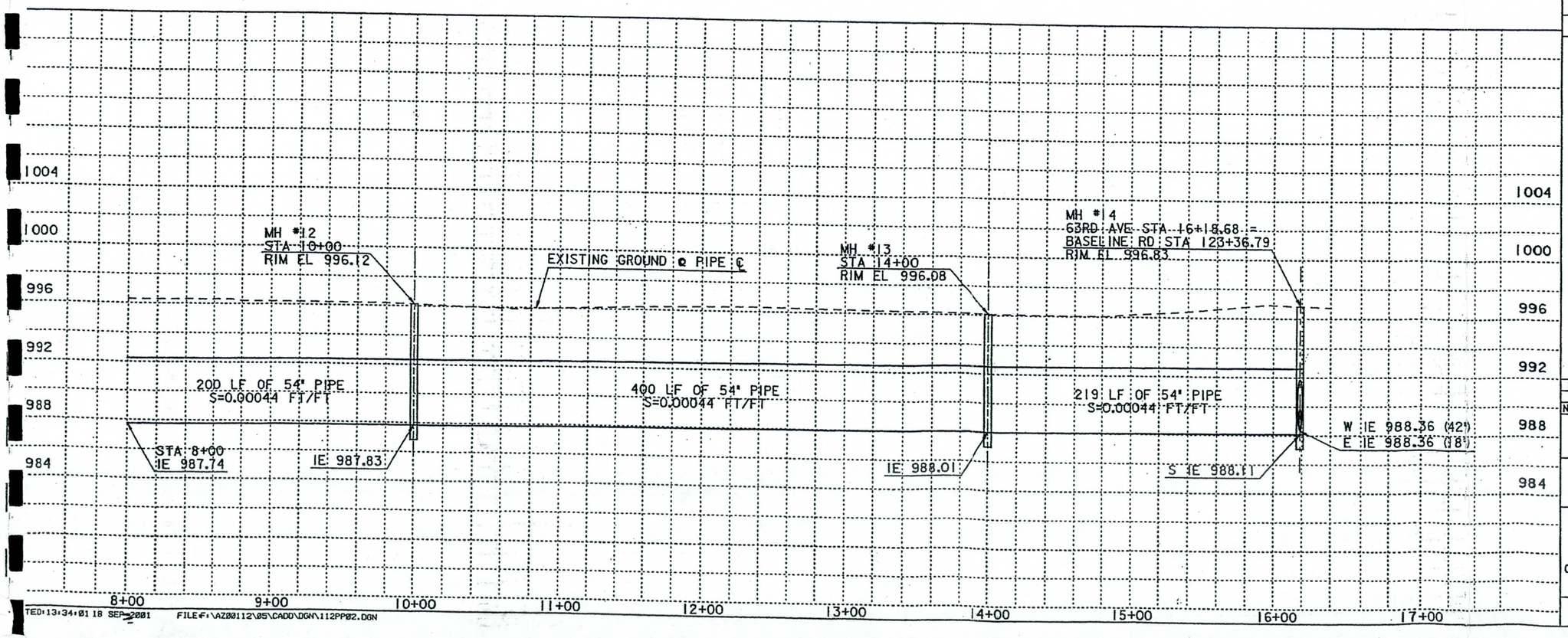
APPENDIX C



CALL TWO WORKING DAYS BEFORE YOU DIG
602-263-1100
1-800-STAKE-IT
OUTSIDE MARICOPA COUNTY

20 0 20 40
Scale In Feet



☐ REMOVE ☐

○ CONSTRUCT ○

INSTALL NEW STORM DRAIN PIPE

NO.	STA TO STA	DIA. (IN)	LENGTH (FT)
①	8+00 TO 10+00	54"	200
②	10+00 TO 14+00	54"	400
③	14+00 TO 16+18.68	54"	219

INSTALL NEW STORM DRAIN MANHOLE

NO.	STATION	BASE DETAIL	SHAFT DETAIL	COVER DETAIL
④	10+00			
⑤	14+00			
⑥	16+18.68			

NO.	REVISION	BY	DATE
2			
1			

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY
ENGINEERING DIVISION

LAVEEN AREA CONVEYANCE CHANNEL
FCD PROJECT NO. 1170831
FCD CONTRACT NO.

PRELIMINARY NOT FOR CONSTRUCTION

	BY	DATE
DESIGNED	DVD	9/01
DRAWN	DVD	9/01
CHECKED	JCF	9/01

DRAWING NO. PLAN AND PROFILE STA 8+00 TO 16+18.68

SHEET 2 OF 7

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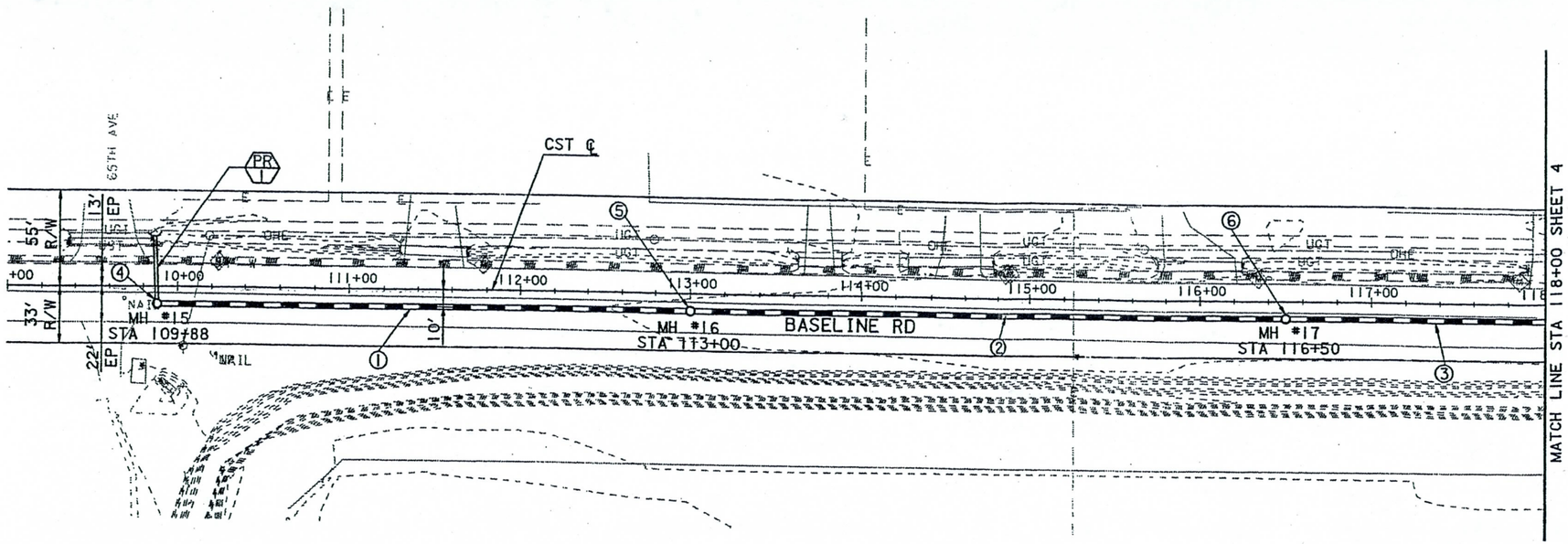
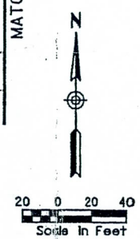
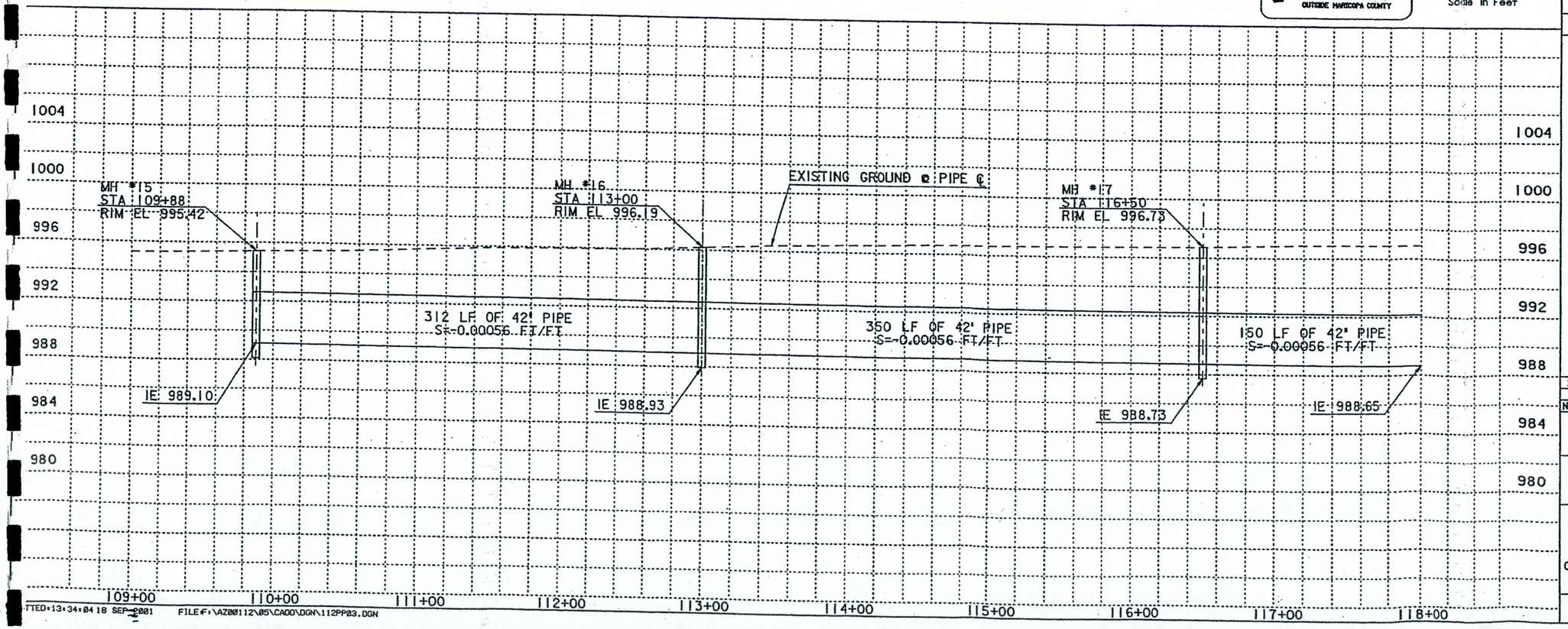




CALL TWO WORKING DAYS BEFORE YOU DIG
602-263-1100
1-800-STAKE-IT
OUTSIDE MARICOPA COUNTY



☐ REMOVE ☐

○ CONSTRUCT ○

INSTALL NEW STORM DRAIN PIPE

NO.	STA TO STA	DIA. (IN)	LENGTH (FT)
①	109+88 TO 113+00	42"	312
②	113+00 TO 116+50	42"	350
③	116+50 TO 118+00	42"	150

INSTALL NEW STORM DRAIN MANHOLE

NO.	STATION	BASE DETAIL	SHAFT DETAIL	COVER DETAIL
④	109+88			
⑤	113+00			
⑥	116+50			

NO.	REVISION	BY	DATE
2			
1			

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY
ENGINEERING DIVISION

LAVEEN AREA CONVEYANCE CHANNEL
FCD PROJECT NO. 1170831
FCD CONTRACT NO.

PRELIMINARY NOT FOR CONSTRUCTION

	BY	DATE
DESIGNED	DVD	9/01
DRAWN	DVD	9/01
CHECKED	JCF	9/01

DRAWING NO. PLAN AND PROFILE STA 109+88 TO 118+00 SHEET 3 OF 7

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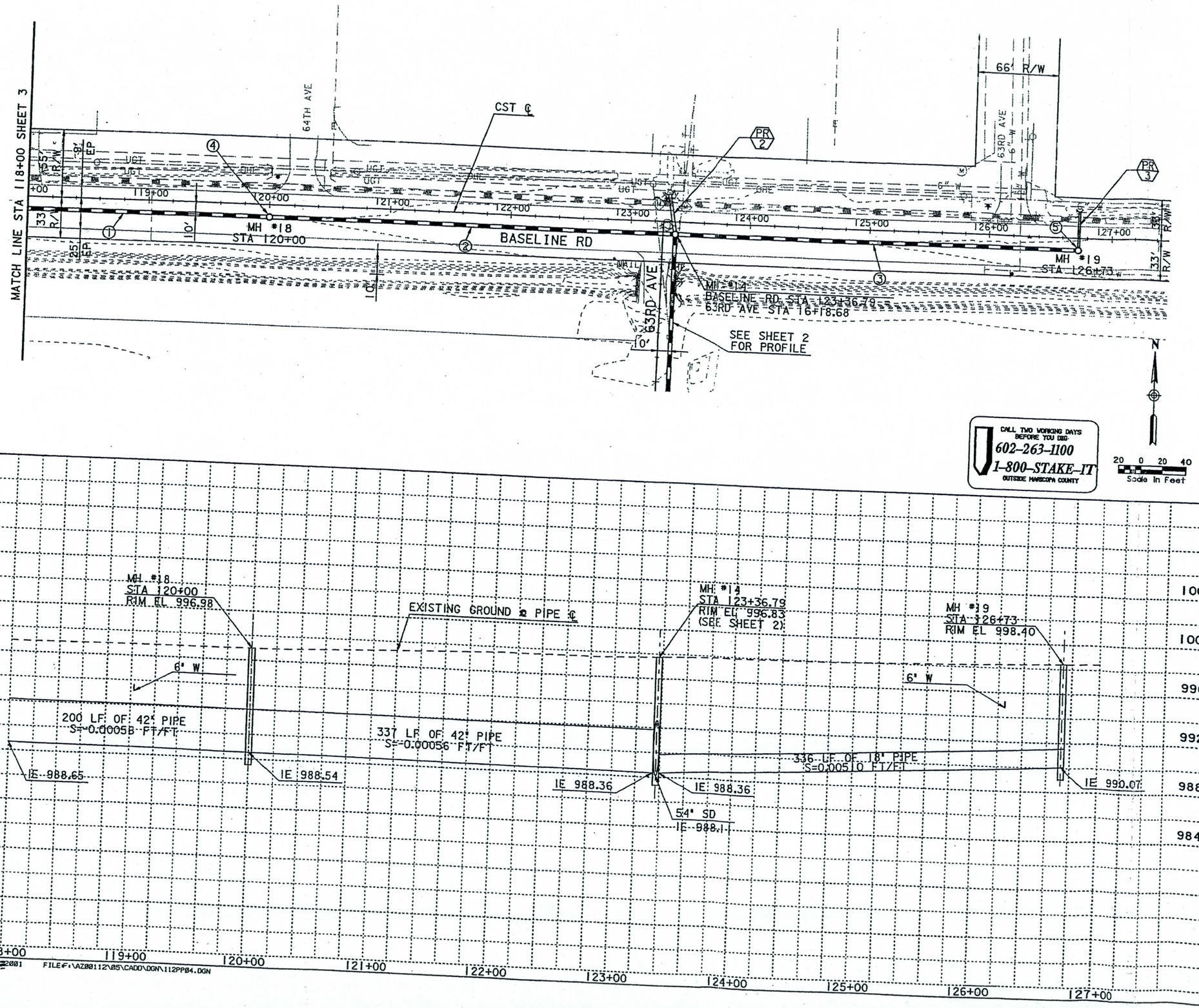

☐ REMOVE ☐

○ CONSTRUCT ○

INSTALL NEW STORM DRAIN PIPE

NO.	STA TO STA	DIA. (IN)	LENGTH (FT)
①	118+00 TO 120+00	42"	200
②	120+00 TO 123+36.79	42"	337
③	123+36.79 TO 126+73	18"	336

INSTALL NEW STORM DRAIN MANHOLE

NO.	STATION	BASE DETAIL	SHAFT DETAIL	COVER DETAIL
④	120+00			
⑤	126+73			

NO.	REVISION	BY	DATE
2			
1			

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY
ENGINEERING DIVISION

LAVEEN AREA CONVEYANCE CHANNEL
FCD PROJECT NO. 1170831
FCD CONTRACT NO.

PRELIMINARY NOT FOR CONSTRUCTION

	BY	DATE
DESIGNED	DVD	9/01
DRAWN	DVD	9/01
CHECKED	JCF	9/01

DRAWING NO. PLAN AND PROFILE STA 118+00 TO 126+73 SHEET 4 OF 7

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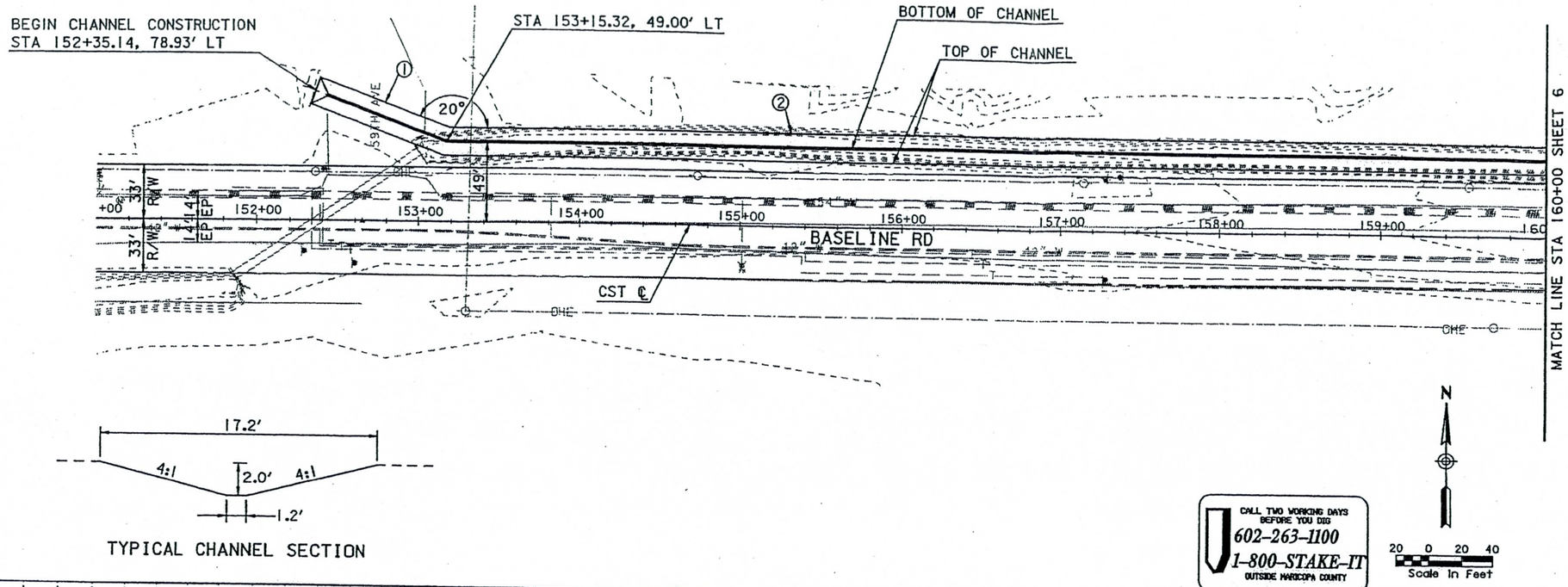
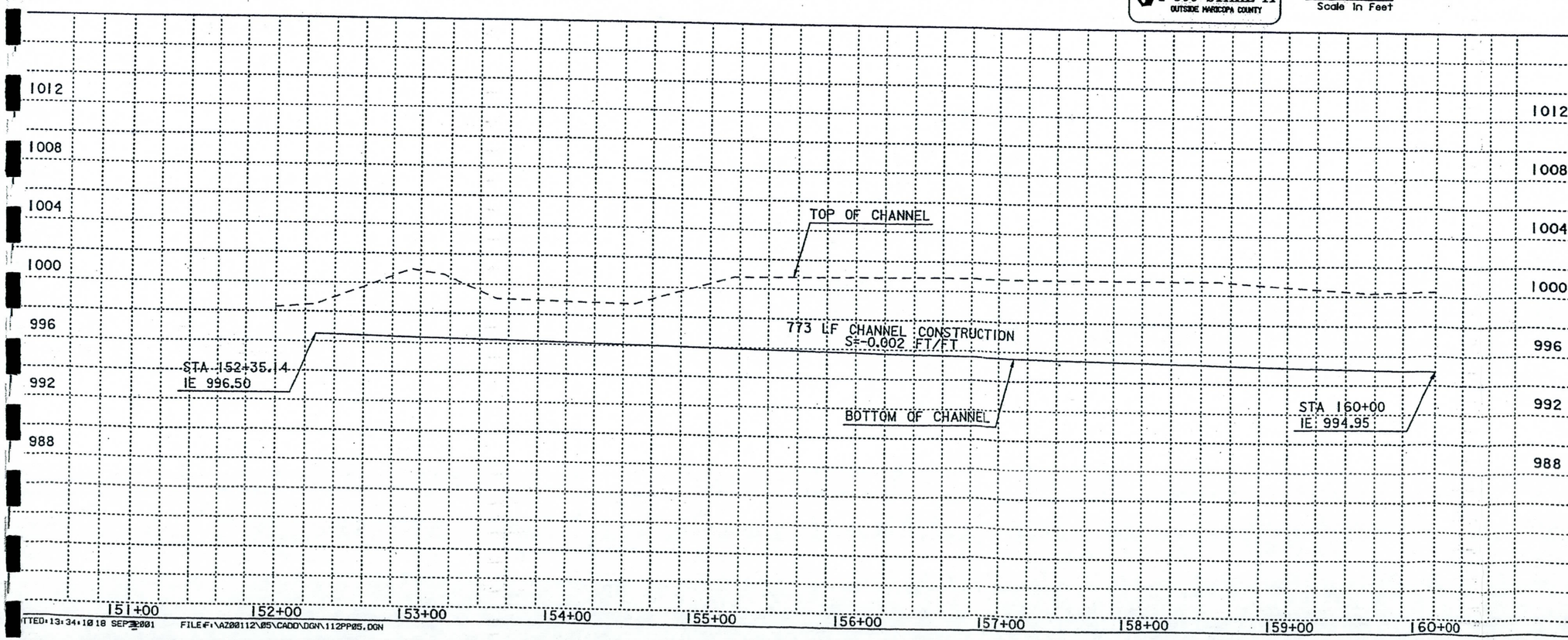




☐ REMOVE ☐

○ CONSTRUCT ○

CONSTRUCT NEW CHANNEL

NO.	STA TO STA	CHANNEL EXCAVATION (CU YD)
①	152+35.14 TO 153+15.32	60.2
②	153+15.32 TO 160+00	466.6

NO.	REVISION	BY	DATE
2			
1			

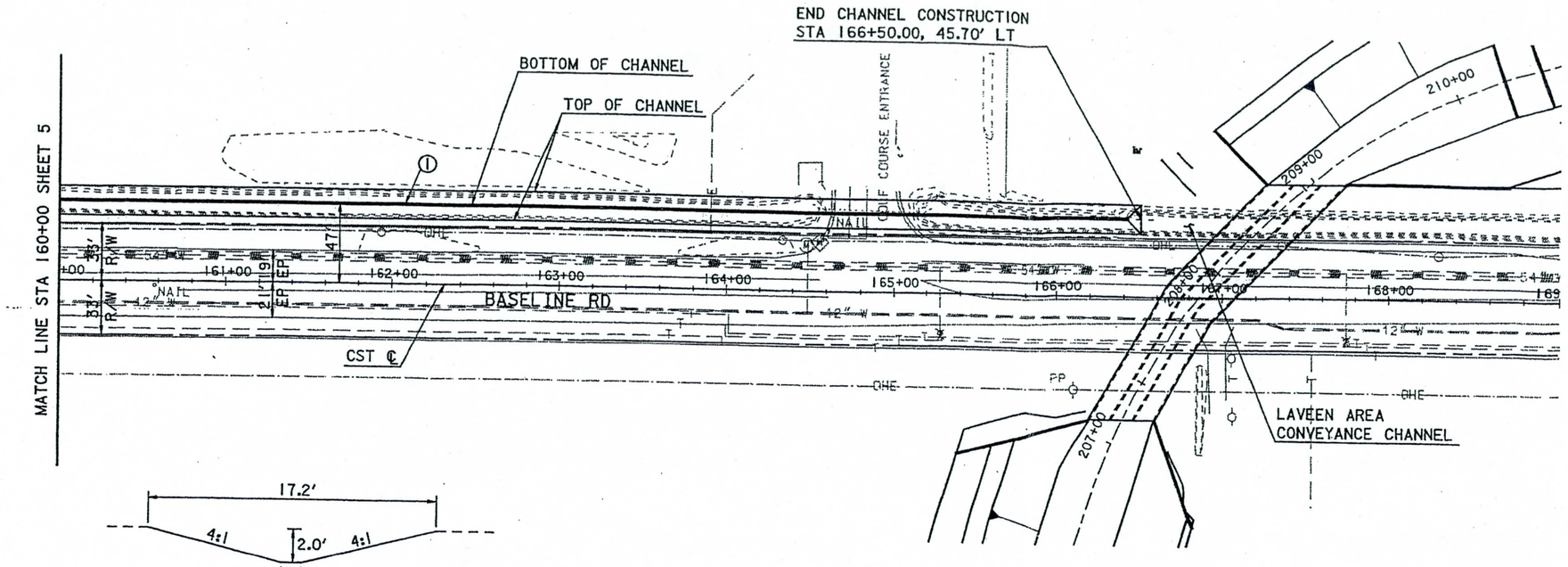
FLOOD CONTROL DISTRICT OF MARICOPA COUNTY
ENGINEERING DIVISION

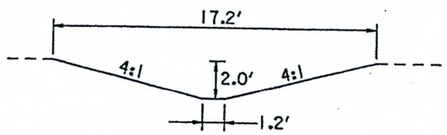
LAVEEN AREA CONVEYANCE CHANNEL
FCD PROJECT NO. 1170831
FCD CONTRACT NO.

PRELIMINARY NOT FOR CONSTRUCTION

	BY	DATE
DESIGNED	DVD	9/01
DRAWN	DVD	9/01
CHECKED	JCF	9/01

DRAWING NO. — CHANNEL PLAN AND PROFILE — SHEET 5 OF 7

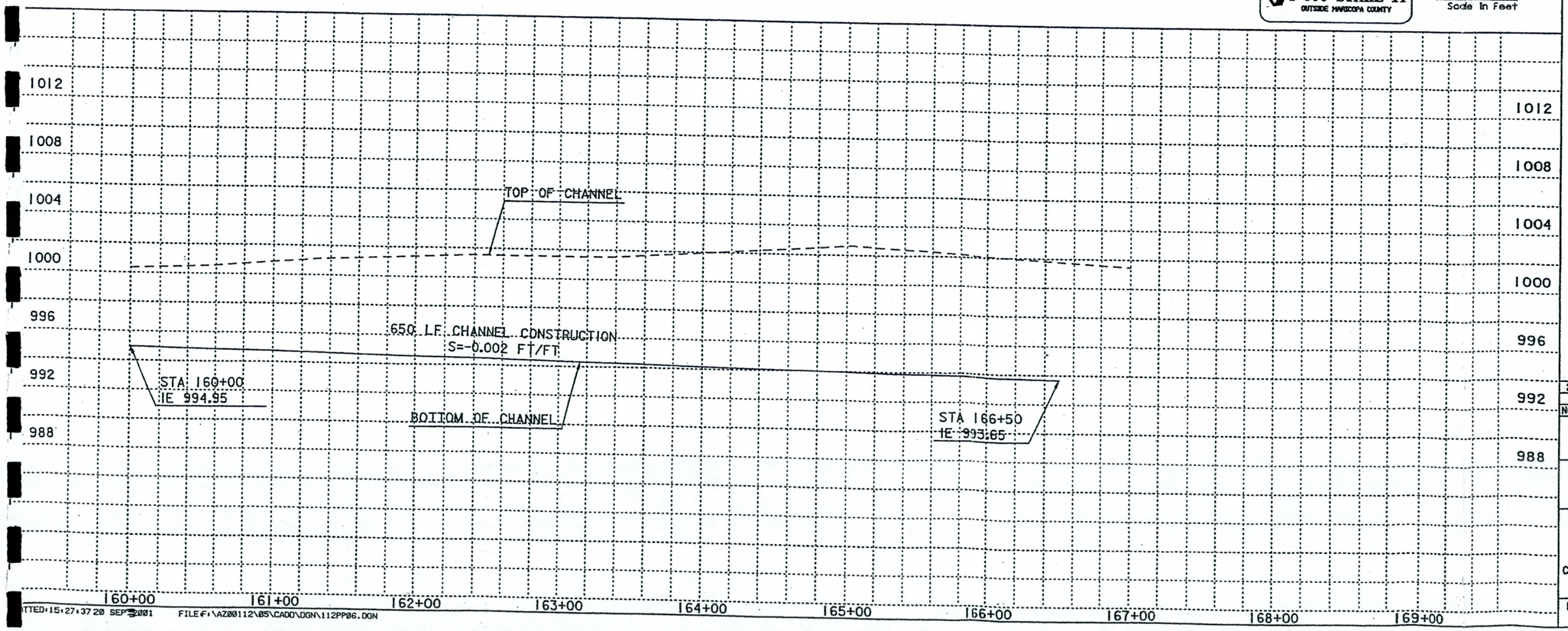




TYPICAL CHANNEL SECTION

N

20 0 20 40
Scale In Feet



☐ REMOVE ☐

○ CONSTRUCT ○

CONSTRUCT NEW CHANNEL

NO.	STA TO STA	CHANNEL EXCAVATION (CU YD)
1	160+00 TO 166+50	443.0

NO.	REVISION	BY	DATE
2			
1			

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY
ENGINEERING DIVISION

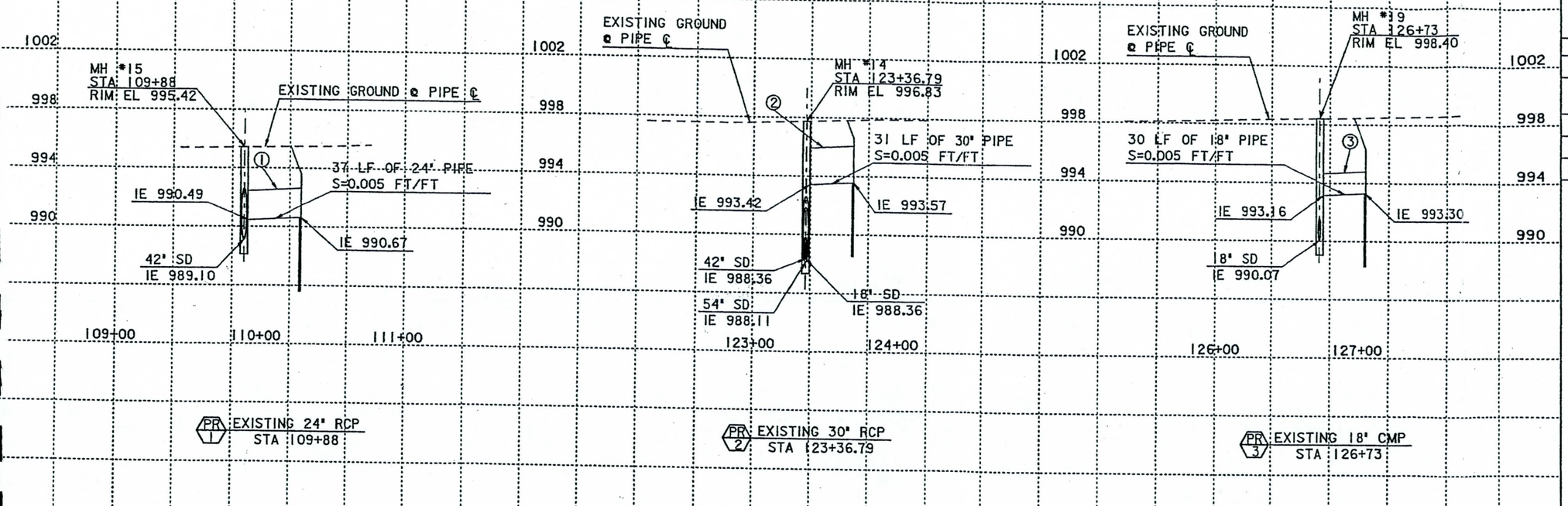
LAVEEN AREA CONVEYANCE CHANNEL
FCD PROJECT NO. 1170831
FCD CONTRACT NO.

PRELIMINARY NOT FOR CONSTRUCTION

	BY	DATE
DESIGNED	DVD	9/01
DRAWN	DVD	9/01
CHECKED	JCF	9/01

DRAWING NO. CHANNEL PLAN AND PROFILE — SHEET 6 OF 7

PLOTTED: 15:27:37 20 SEP 2001 FILE: F:\AZ00112\05\CADD\DGN\112PP06.DGN



☐ REMOVE ☐

○ CONSTRUCT ○

RECONSTRUCT EXISTING STORM DRAIN

NO.	STATION	DIA. (IN)	LENGTH (FT)
①	109+88	24"	37
②	123+36.79	30"	31
③	126+73	18"	29

NO.	REVISION	BY	DATE
2			
1			

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY
ENGINEERING DIVISION

LAVEEN AREA CONVEYANCE CHANNEL
FCD PROJECT NO. 1170831
FCD CONTRACT NO.

PRELIMINARY NOT FOR CONSTRUCTION

	BY	DATE
DESIGNED	DVD	9/01
DRAWN	DVD	9/01
CHECKED	JCF	9/01

DRAWING NO. PIPE RECONSTRUCTION PROFILES

SHEET 7 OF 7

APPENDIX D

APPENDIX C

COST ESTIMATE
SUPPLIMENT TO LACC

ITEM NO.	DESCRIPTION	UNIT	QUANTITY	UNIT PRICE	TOTAL
1	18-Inch Storm Drain Pipe	L. Ft.	336	$100.00	$33,600.00
2	42-Inch Storm Drain Pipe	L. Ft.	1,349	$150.00	$202,350.00
3	54-Inch Storm Drain Pipe	L. Ft.	1,596	$200.00	$319,200.00
4	Storm Drain Manhole	Each	10	$4,000.00	$40,000.00
5	Channel Excavation	Cu. Yd	970	$10.00	$9,700.00
6	Discharge Headwall (54")	Each	1	$4,000.00	$4,000.00
	Total item 1 through 6				$608,850.00
	Contingency (30%)				$182,655.00
	TOTAL				$791,505.00