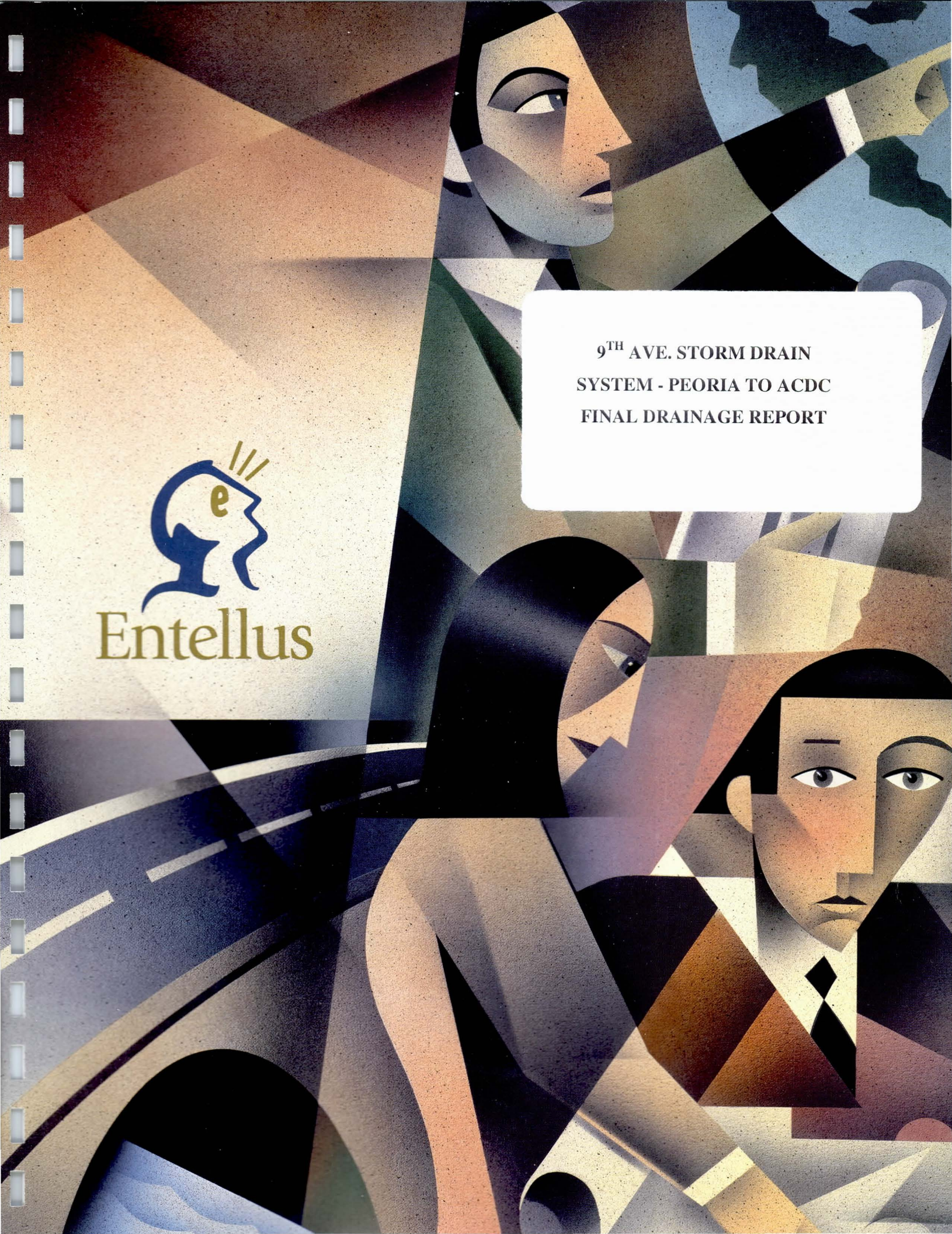

9TH AVE. STORM DRAIN
SYSTEM - PEORIA TO ACDC
FINAL DRAINAGE REPORT
Entellus

9TH AVE. STORM DRAIN SYSTEM - PEORIA TO ACDC FINAL DRAINAGE REPORT

City of Phoenix No. ST83130249

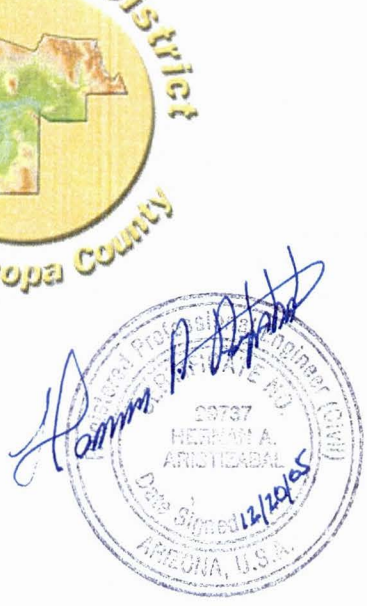
Entellus Project No. 115.076F

December 2005

Prepared by:

Intelligent Engineering

Environmental *Solutions*



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TO:	Laura Fritschi
FROM:	Jacob Sweeting
JOB NO:	115.076F (ST83130249)
DATE:	12/21/2005
CC:	File

PROJECT NAME: 9th Avenue Storm Drain: ACDC - Peoria

Final Drainage Report

RE: Drainage Analysis

1. *Project Description*

This technical memorandum summarizes the hydrologic analysis and hydraulic design performed for the design of the 9th Avenue Storm Drain System, from Peoria Avenue to the ACDC. This project is a cooperative effort between the Flood Control District of Maricopa County (*District*) and the City of Phoenix (*City*).

The *Sunnyslope Candidate Assessment Report* (hereinafter referred to as the *CAR*) **(Ref 1)**, was prepared by the *District* and includes conceptual solutions for drainage problems identified throughout the study area. The 9th Avenue storm drain system was one of the conceptual solutions proposed in the *CAR*. **Attachment A** is an exhibit showing the project vicinity.

2. *Existing Conditions*

The total contributing drainage area to the proposed storm drain system is approximately one square mile. The watershed includes a significant amount of mountain runoff, as well as the outflows from two upstream flood control dams.

A detailed summary of the existing drainage conditions in the vicinity of this project was included in the *CAR*. The *CAR* also summarized several existing drainage problems or undesirable conditions as shown below:

1. Runoff ponds along the inside edge of the curve in 7th Avenue at the southwest corner of Mountain View Park (7th Avenue about ½ mile south of Peoria Avenue), causing long standing nuisance and maintenance problems. The watershed contributing to this runoff extends up into the North Mountain Preserve, and includes the discharge from the upstream East Park Flood Control Dam.

2. The discharge from the northwest flood control dam at Peoria and 7th Avenues is conveyed through private property in a series of culverts and short channel drains into 11th Avenue and is collected in the existing 11th Avenue storm drain. This channel also creates undesirable dip sections in the street crossings at North Lane and at Cochise Drive.

3. Overflow from the detention basin at the middle school at 9th Avenue and Cheryl Avenue discharges across private property, through a 60-inch culvert, then into a channel that eventually discharges downstream into Cinnabar Avenue.

4. The 7th Avenue storm drain, upstream of Cheryl Avenue, discharges across private property through a series of culverts and short channel sections, eventually spilling out into 9th Avenue.

5. The discharge from the southeast flood control dam (combined with substantial downstream local runoff) discharges through Mountain View Park, across private property and down 9th Avenue to the ACDC, creating a significant flooding potential.

Attachment B includes a map from the *CAR* that has been reproduced and labeled with the various conditions listed above.

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3. *Proposed Conditions*

A Memorandum of Understanding (MOU) between the District and the City summarized the proposed storm drain system as follows:

The 9th Avenue storm drain would collect and convey the 10-year flood from Peoria Avenue downstream to the ACDC.

The new 9th Avenue storm drain will include four laterals. The first is a short run in North Lane, west of 9th Avenue, which will collect the flow that currently flows through private property in an undersized culvert. The North Lane lateral will allow the downstream privately owned culvert to be abandoned. The second is in Cheryl Drive from 9th Avenue to 7th Avenue; collecting flow from the existing channel outfall at 7th Avenue and Cheryl Avenue. The Cheryl Avenue lateral would also collect flows from the intersection at 8th Avenue, allowing the downstream private culvert to be abandoned. The third lateral is in Cinnabar Avenue from 9th Avenue to 7th Avenue. This lateral will collect a significant concentration of runoff at the southwest corner of Mountain View Park, which includes the discharge from the upstream flood control dam. This lateral will also collect the discharge from the middle school detention basin at 9th Avenue, allowing the downstream, privately owned 60-inch culvert to be abandoned. The fourth lateral, in Cochise Street, will connect to the existing 11th Avenue storm drain. It will drain the low spot in Cochise Street and allow the downstream, privately owned culvert to be abandoned.

Attachment B includes an exhibit showing the proposed layout of the storm drain and laterals.

4. *Off Site Flows - Hydrology Modeling*

The *CAR* presented peak flows for the proposed storm drain system estimated using a flow versus area relationship based on the *1994 ACDC ADMS Hydrology Report* (**Ref 2**). These approximate flows were adequate for developing a conceptual layout of the storm drain system. However, a more detailed estimate of the peak flows was needed to design the system of inlets and pipes.

The U.S. Army Corp of Engineers' computer program HEC-1 (**Ref 3**), was used to develop the rainfall-runoff hydrology models for this project. The procedures and modeling parameters were based on the *Draft Drainage Design Manual for Maricopa County – Volume 1 – Hydrology* (hereinafter referred to as the *Hydrology Manual*) (**Ref 4**).

The hydrology models were created in order to model offsite flows entering the storm drain system. However, local drainage areas were also included in the hydrology models in order to develop design flows used for preliminary sizing of the pipe. The local drainage areas will be revisited later using the rational method when designing the inlets.

Two models were created to estimate off-site flows for this project: 10-year 6-hour and 100-year 6-hour. The storm drain system was sized in order to convey the peak flows estimated using the 10-year model. The 100-year model was used to verify that the City's dry lane requirements were met. The 6-hour duration storm controls in this watershed and was used for both models. Areal reduction was not used in the models because the watershed area is relatively small (less than 1 square mile). Maps showing delineated watershed are included in **Attachment C**.

4.1. *Precipitation*

Precipitation data was obtained from the *NOAA Atlas 2, Volume VIII Arizona* (**Ref 5**), and selected isopluvial maps for Maricopa County, which are located in *The Hydrology Manual*. This information was used in the Precipitation Frequency (PreFre) module of the *DDMS* program (**Ref 6**). Copies of the isopluvial maps, as well as the PreFre output are included in **Attachment D**.

4.2. *Subbasin Delineation*

In order to determine peak flows at key locations, the 0.91 square mile watershed was delineated into twenty-two subbasins. The subbasin boundaries and lengths were delineated in *ArcMap* (**Ref 7**) using *2004 Color Aerial Photography* (**Ref 8**), *and 2 foot Contours* (**Ref 9**), provided by the District. The subbasin boundaries and lengths were imported into *WMS 7.1* (**Ref 10**) and the subbasin parameters were

extracted. A map showing the delineated subbasins is included in **Attachment C**.

4.3. Rainfall Losses

The Green-Ampt method was used to determine rainfall losses throughout the project watershed. The digital GIS formats of the *MAG General Plan* (**Ref 11**), and the *Soil Conservation Service Soil Survey for Maricopa County* (**Ref 12**), were obtained from the District and imported into WMS. Because the area is completely developed, there were no significant differences between the landuse information included in the *General Plan* and the existing landuse in the area. The Green-Ampt parameters for each subbasin were generated in WMS using District parameter tables along with the land use and soil information. Maps showing the landuse and soils data are included in the **Attachment E**.

4.4. Unit Hydrograph

The excess runoff in each subbasin was routed to the subbasin concentration point using the Clark Unit Hydrograph. WMS was used to estimate the Clark Unit Hydrograph time of concentration and storage coefficient for each subbasin. In order to estimate these parameters, WMS required the adjusted slope, length and resistance coefficient for each subbasin. The length and slope of each subbasin were estimated using ArcMap. The slopes were adjusted using Table 5.2 from *The Hydrology Manual*. The resistance coefficient (Kb) for each subbasin was estimated using the criteria shown in Table 5.3 of *The Hydrology Manual*. The parameters used to estimate the Clark Unit Hydrograph have been summarized on a table included in **Attachment F**.

4.5. Routing Parameters

Normal depth routing was used to route the discharges from the dam outlets, through downstream subbasins via natural washes. The geometries of these washes were modeled using eight point cross sections developed from the project topography. The route slopes were estimated using the project topography as well. The Manning's roughness coefficients and route lengths were estimated using the aerial photography provided by the District.

Kinematic wave routing was used to route flows through the proposed storm drain system. The slopes used for each route were estimated using the project topography and represent an estimate of the existing ground slope. It is likely that the proposed slope will be different than the routing slopes used in the hydrologic model which is acceptable because the peak flows are virtually unaffected by the pipe slopes. Furthermore, the pipe sizes used in the routing parameters were initial estimates based on the *CAR*, and will be different than those used in

the final design. Data used for the routing has been included in **Attachment G**.

4.6. Storage

Discharges from the two flood control dams upstream from the storm drain system were estimated using relevant portions of the *East and West Park Dam Safety Analysis Models* (**Ref 13**). The upstream subbasin boundaries and storage routing routines for each dam were extracted from the models and inserted into the model developed for this project.

4.7. Results

The design flows obtained from the 10-year hydrology models were used to estimate the required pipe sizes throughout the system. The HEC-1 input and output have been included as **Attachment H**. *StormCAD Version 5.5* (**Ref 14**) was used to determine the required pipe sizes based on the City's design criteria. Output from the software showing calculations for the size selection is included in **Attachment I**.

5. On-Site Hydrology / Drainage

The peak 10-year flows from the local drainage areas were determined by delineating subbasins within the project area along 9th Ave. The Rational Method was used determine the 10-year peak flows from each of the local subbasins. Off-site sub-basin flows that contributed to the 9th Ave. storm drain were determined using HEC-1. The Local Hydrology and Catch Basins exhibit in **Attachment C** shows the location of each catch basin and the local and off-site subbasins that contribute flow to them. **Attachment J** includes a spreadsheet that shows hydrologic and hydraulic results for the local peak flows and catch basins. The table includes estimates of catch basin interception and flow by.

6. Hydraulics

6.1. Main Storm Drain Sizing

The main storm drain pipe was sized using results from the off-site and local hydrology estimates and hydraulic modeling software (**see section 4.7**). The hydraulic grade line for the 10-year event is shown on the plans and is summarized in **Attachment I**. It should be noted that all pipes were sized using the 10-year peak flows, except the lateral on Cochise Drive. This lateral connects to the existing 11th Avenue storm drain system. The capacity of the existing storm drain limited the size of the proposed lateral on Cochise Drive to 18", whereas a 24" pipe would more effectively convey the 10-year peak flow.

Design constraints for sizing the pipes were:

- 10-year peak flows
- Existing storm drains
- Hydraulic grade line at 1ft. or more below proposed grade
- Maximum 10-year velocity of 20 fps.

The StormCAD output included in **Attachment I** shows the average velocity in all pipes to be less than 20 fps. Some of this flow is in the supercritical flow range and has the potential to create a hydraulic jump within the storm drain. Effects of possible hydraulic jumps occurring on the pipe were considered when placing manholes and catch basins.

6.2. Catch Basin / Inlet Design

The amount of flow that was intercepted by each catch basin was determined using *Flow Master 2005* **(Ref 15)** and the results are summarized in **Attachment J**. The catch basins were designed using guidelines from the City of Phoenix's *Strom Water Policies*. Catch basins were generally placed as follows:

- At existing sumps or low points
- Where the 2-year or 100-year flows were expected to exceed the City's dry lane / flow depth requirements
- Curb returns (where applicable)

The typical catch basin used was the type "M" (curb openings) from the City of Phoenix supplement. Catch basins type "N" (City of Phoenix), or the type "G" (MAG) were used where grated inlets were more applicable than curb openings.

The table below lists design flows at key locations throughout the storm drain system. The "Map ID" column refers to the "Proposed Storm Drain System Layout" map which is included with **Attachment A**.

Design Peak Flows and Pipe Sizes

Map ID	Location	Design Description	ID	Design Flow (cfs)	Pipe Size (in)
1	Cochise Dr., Dip at 10th Ave. Align. to 11th Ave.	Headwall-Inlet	S7	10	18
2	Peoria Ave. and 9th Ave.	Join to Existing Culvert	C2	70	N/A
3	9th Ave., Peoria Ave. - North Ln.	Main Pipe	CSD1	90	36
4	Wash Crossing at North Ln., Just West of 9th Ave.	Headwall-Inlet/Lateral	S4	5	24
5	9th Ave. and North Ln. at School Entrance	Catch Basin	S6	See **Attachment J**	
6	9th Ave., North Ln. - Cheryl Dr.	Main Pipe	CSD2	90	42
7	7th Ave. and Cheryl Dr.	Join to Existing Culvert	S3	100	24 x 36
8	Cheryl Dr., 7th Ave. - Dip at 8th Ave. Align.	Lateral Pipe	C10	130	48
9	9th Ave. and Cheryl Dr. from School Basin	Join to Existing Culvert	S9	30	60 (Existing)
10	Cheryl Dr., Dip at 8th Ave. Align. - 9th Ave.	Lateral Pipe	C9*	130	48
11	9th Ave., Cheryl Dr. - Cinnabar Ave.	Main Pipe	CSD3	220	54
12	Bend in 7th Ave. at SW Corner of Mtn. View Park	Catch Basin	S17	See **Attachment J**	
13	7th Ave., Bend to Cinnabar	Lateral Pipe	S17	120	48
14	7th Ave. and Cinnabar Ave.	Headwall/Inlet	C14b	See **Attachment J**	
15	Cinnabar Ave., 7th Ave. - Dip 8th Ave. Align.	Lateral Pipe	C13	120	54
16	Cinnabar Ave., Dip at 8th Ave. Align. - 9th Ave.	Lateral Pipe	C12*	120	54
17	9th Ave., Cinnabar Ave. - Mountain View Rd.	Main Pipe	CSD4	340	66
18	9th Ave., Mtn. View Rd. - Purdue Ave. Align.	Main Pipe	CSD5	380	66
19	9th Ave. and Vogel Ave.	Catch Basin	S19	See **Attachment J**	
20	9th Ave., Purdue Ave. Align. - Vogel Ave.	Main Pipe	CSD6	380	66
21	9th Ave., Vogel Ave. - Hatcher Rd.	Main Pipe	S20	380	66
22	9th Ave., Vogel Ave. - Hatcher Rd.	Main Pipe	CSD7	380	66
23	9th Ave., Hatcher Rd. - ACDC	Main Pipe	CSD8	380	72

Note: All flows were rounded to the nearest 5 cfs. Local flows were included in hydrology models but are not shown on this table.

List of References

1 Flood Control District of Maricopa County and Engineering and Environmental Consultants Inc., *Sunnyslope Candidate Assessment Report FCD 2003C052*, October 2004.

2 Flood Control District of Maricopa County and Kaminski Hubbard Engineering, Inc, *Arizona Canal Diversion Channel, Area Drainage Master Study - 10th Street to Cave Creek Watershed, Volume 1.6*, November 1994

3 United States Department of Army, Corps of Engineers, Hydrologic Engineering Center, Generalized Computer Program 723-X6-L2010, *HEC-1 Flood Hydrograph Package*, California, February 1981, Revised May 1991.

4 Flood Control District of Maricopa County, *Draft Drainage Design Manual for Maricopa County, Volume-1 Hydrology*, November 2003.

5 National Oceanic and Atmospheric Administration, *NOAA Atlas 2, Precipitation-Frequency Atlas of the Western United States, Volume VIII-Arizona*, 1973.

6 Flood Control District of Maricopa County and KVL Consultants, Inc., *Drainage Design Management System (DDMS), Version 1.8 Software,* October 2002.

7 ESRI, *ArcMap 9.0*, 2004.

8 Flood Control District of Maricopa County, *2004 Color Aerial Photography*, 2004.

9 Flood Control District of Maricopa County, *2004 2' Contour Mapping*, 2004.

10 Brigham Young University, *Watershed Modeling System Version 7.1*, 2004.

11 Maricopa Association of Governments, *MAG General Plan*, (Electronic Format from the Flood Control District of Maricopa County)

12 U.S. Department of Agriculture, *Soil Survey of Maricopa County, Arizona-Central Part*, April 1986. (Electronic Format from the Flood Control District of Maricopa County)

13 City of Phoenix and PrimaTech LLC, *Engineers and Consultants, East and West Park Dam Safety Analysis Models*, 2004

14 Haestad Methods, *StormCAD for Windows Version 5.5*, 2004

15 Haestad Methods, *Flow Master for Windows*, 2005

16 City of Phoenix, *Storm Water Policies and Standards,* March 2004.

ATTACHMENTS

A. Vicinity Map
B. Proposed Storm Drain Layout/ Map from *CAR*
C. Hydrology Maps
D. Precipitation Data
E. Soil and Landuse Data
F. Clark Unit Hydrograph Data
G. Hydraulic Routing Data
H. HEC-1 Input/Output
I. StormCAD Output
J. Hydrology / Hydraulics Supporting Data
K. Electronic Files

9th Avenue Storm Drain - Peoria to ACDC
Drainage Technical Memordandum
Vicinity Map

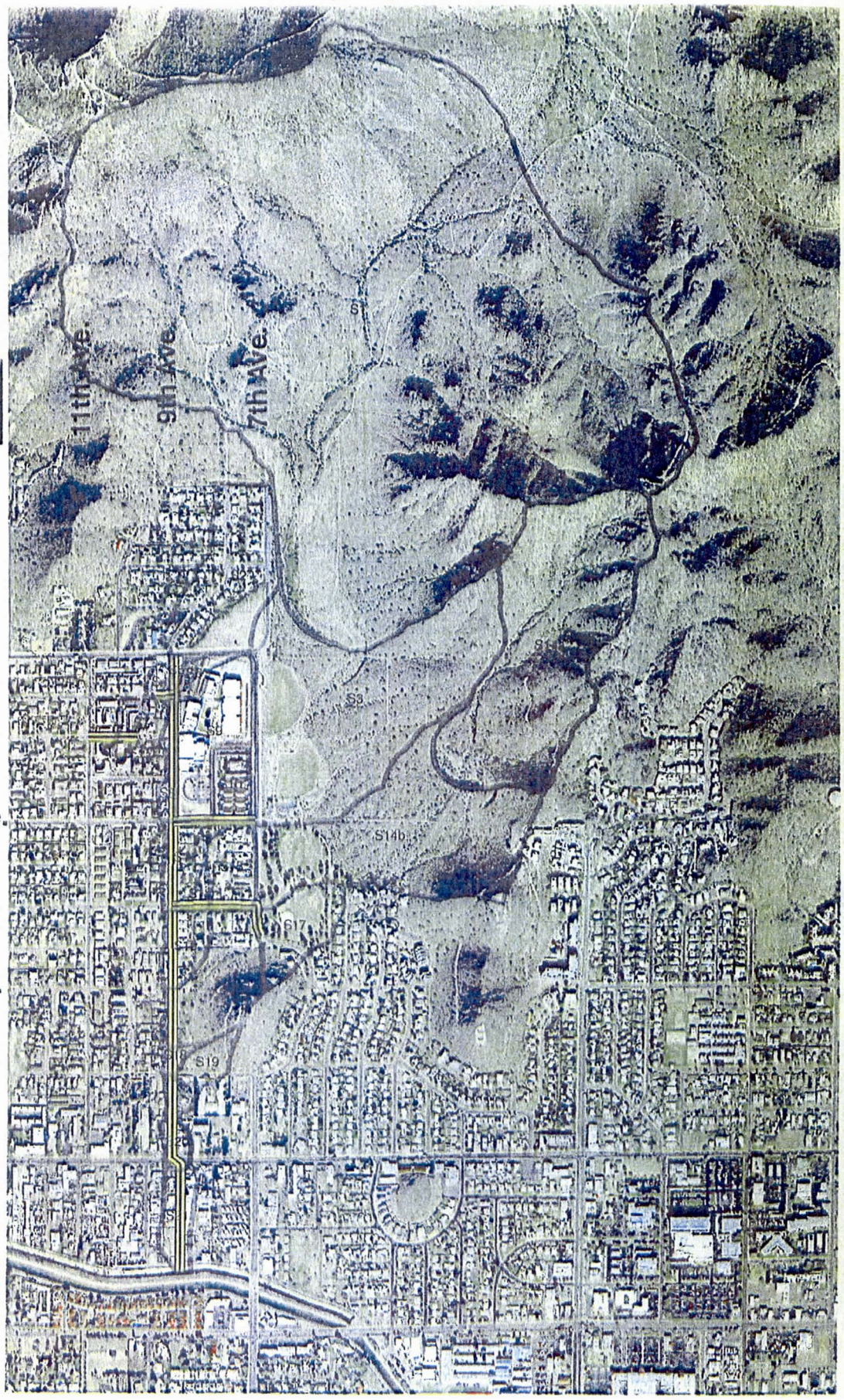
Entellus

N

Not To Scale

Legend

Proposed Storm Drain



Peoria Ave.

North Ln.

Cochise Dr.

Cheryl Ave.

Cinnabar Ave.

Mountain View Rd.

Purdue Ave.

Vogel Ave.

Hatcher Dr.

ACDC

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9th Avenue Storm Drain - Peoria to ACDC
Drainage Technical Memordandum
Proposed Storm Drain System Layout

Entellus

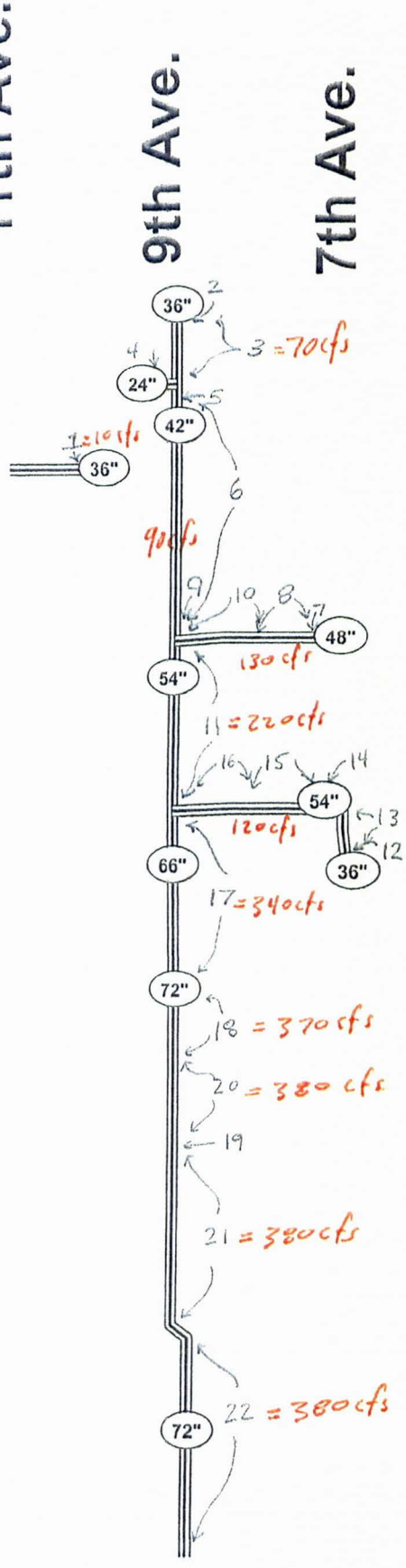
N

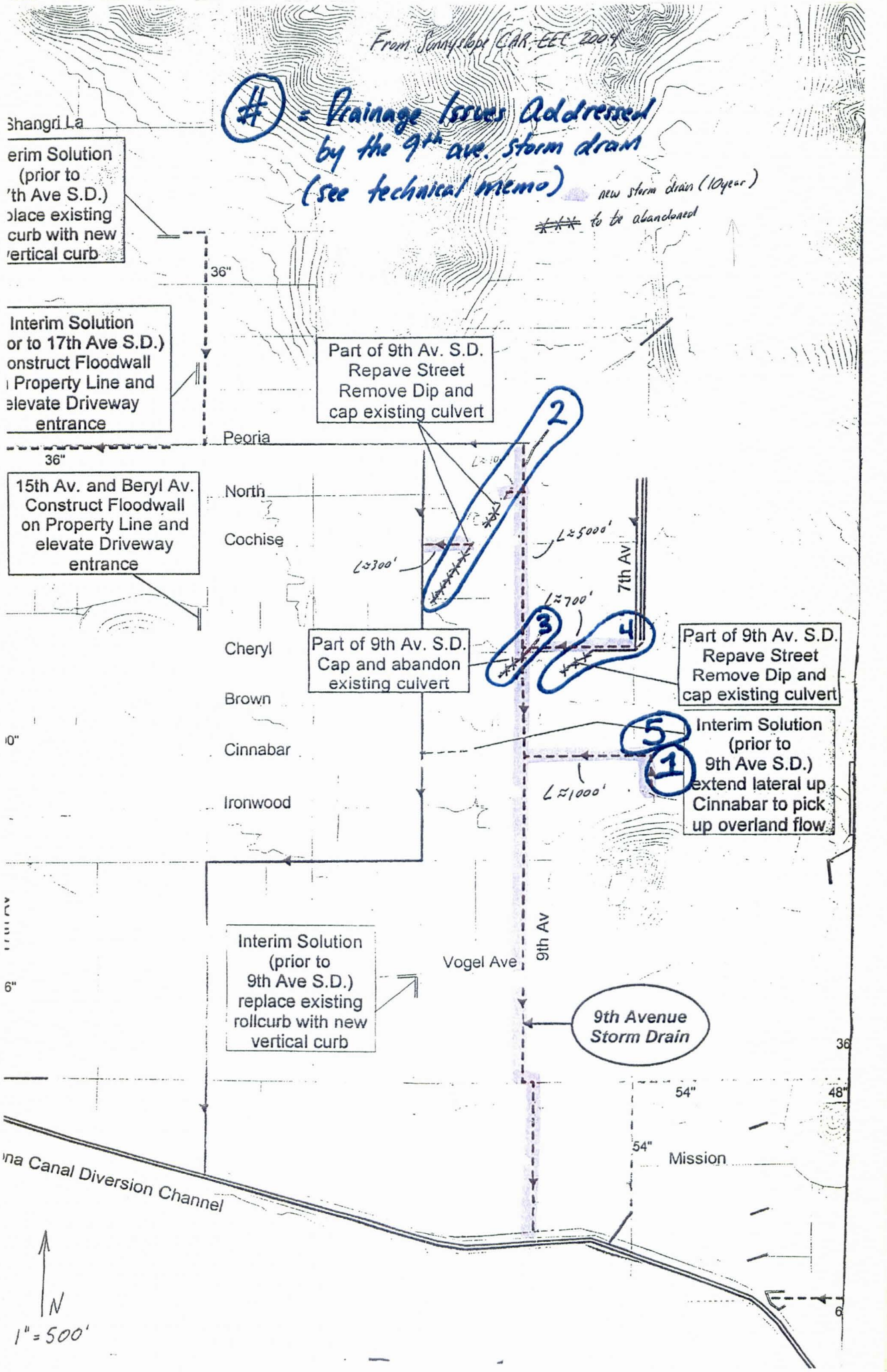
Not To Scale

Legend

Proposed Storm Drain

1 → Map 10 (See Flow Summary Table)




From Sunnyslope CAR, EEC 2004
(#) = Drainage Issues Addressed by the 9th ave. storm drain (see technical memo)
new storm drain (10year)
to be abandoned
Shangri La
erim Solution (prior to 'th Ave S.D.) place existing curb with new 'ertical curb
36"
Interim Solution or to 17th Ave S.D.) onstruct Floodwall Property Line and elevate Driveway entrance
Part of 9th Av. S.D. Repave Street Remove Dip and cap existing culvert
Peoria
36"
15th Av. and Beryl Av. Construct Floodwall on Property Line and elevate Driveway entrance
North
Cochise
L≈300'
L≈5000'
7th Av
L≈700'
Cheryl
Part of 9th Av. S.D. Cap and abandon existing culvert
Part of 9th Av. S.D. Repave Street Remove Dip and cap existing culvert
Brown
Cinnabar
Interim Solution (prior to 9th Ave S.D.) extend lateral up Cinnabar to pick up overland flow
L≈1000'
Ironwood
Interim Solution (prior to 9th Ave S.D.) replace existing rollcurb with new vertical curb
Vogel Ave
9th Av
9th Avenue Storm Drain
54"
48"
54"
Mission
na Canal Diversion Channel
N
1" = 500'

ATTACHMENTS

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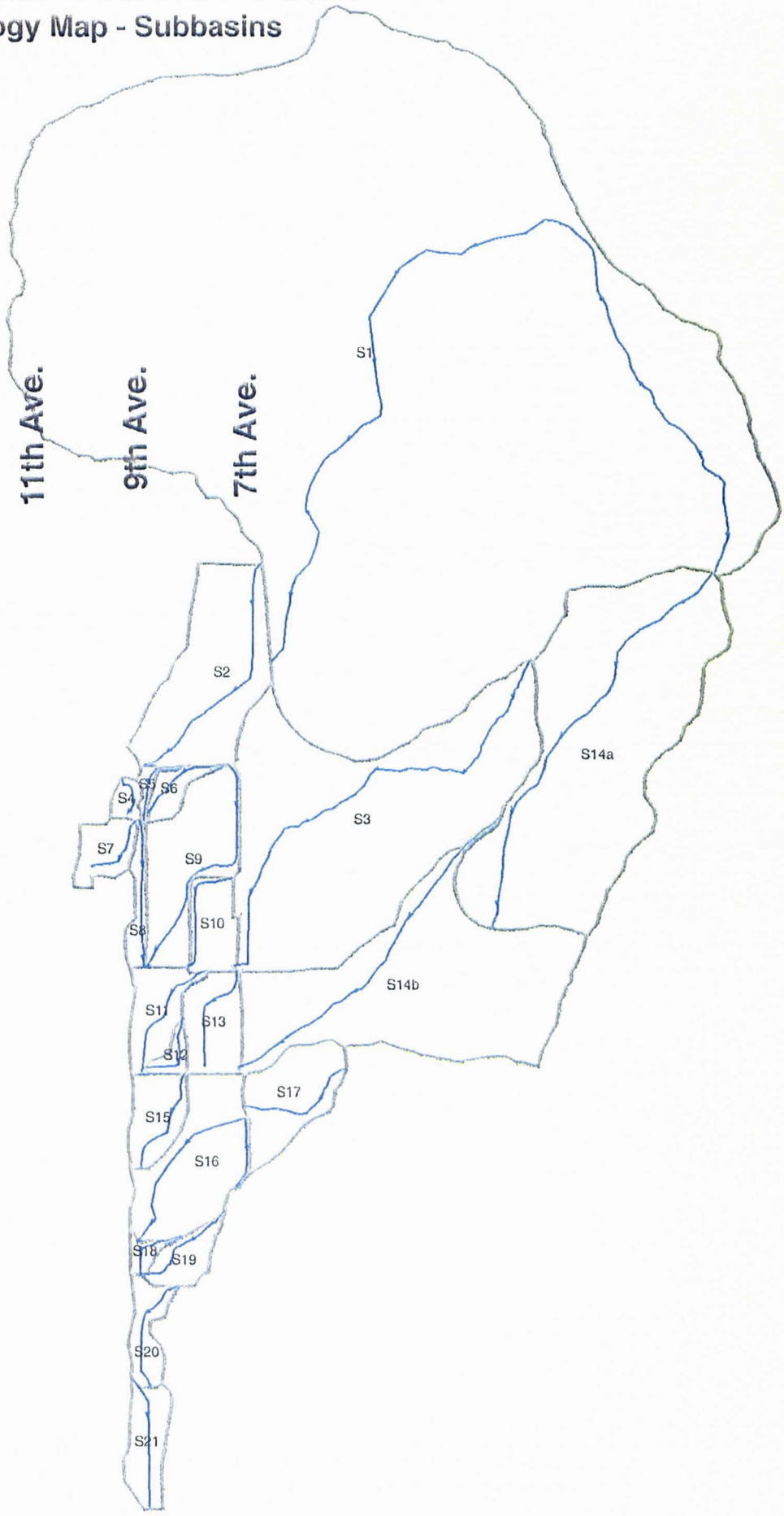
9th Avenue Storm Drain - Peoria to ACDC
Hydrology Map - Subbasins

Entellus

N

1 inch equals 1,000 feet

Legend
- Subbasin Boundaries
- Hydrologic Routing



9th Avenue Storm Drain - Peoria to ACDC
Hydrology Map - Routes and CP's

Entellus

N

1 inch equals 1,000 feet

Legend

- Subbasin Boundaries
- Hydraulic Routing
- Concentration Points

11th Ave.

9th Ave.

7th Ave.

Peoria Ave.

North Ln.

Cochise Dr.

Cheryl Ave.

Cinnabar Ave.

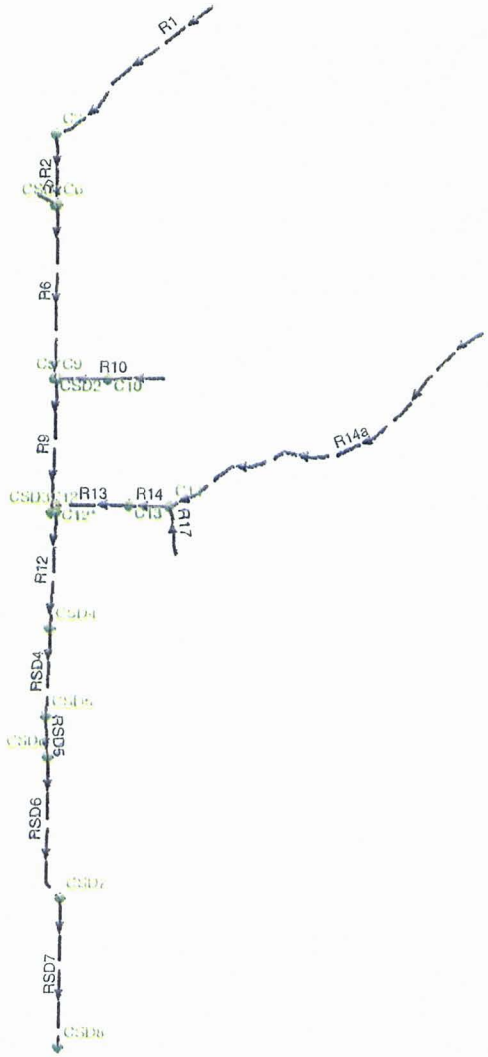
Mountain View Rd.

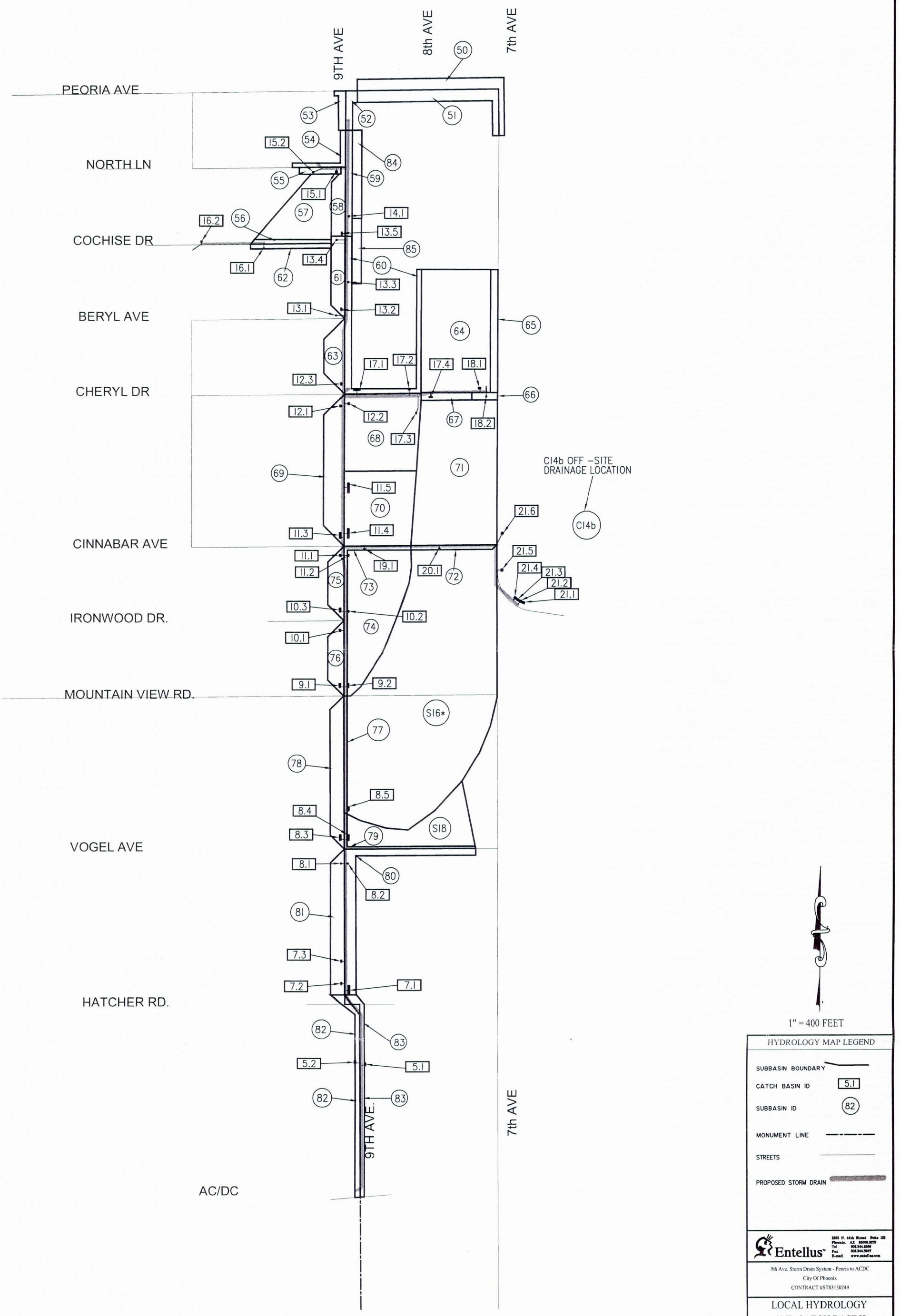
Purdue Ave.

Vogel Ave.

Hatcher Dr.

ACDC




9TH AVE
8th AVE
7th AVE
PEORIA AVE
NORTH LN
COCHISE DR
BERYL AVE
CHERYL DR
CINNABAR AVE
IRONWOOD DR.
MOUNTAIN VIEW RD.
VOGEL AVE
HATCHER RD.
AC/DC
9TH AVE.
7th AVE
C14b OFF -SITE DRAINAGE LOCATION
C14b
S16*
S18
1" = 400 FEET
HYDROLOGY MAP LEGEND
SUBBASIN BOUNDARY
CATCH BASIN ID
SUBBASIN ID
MONUMENT LINE
STREETS
PROPOSED STORM DRAIN
Entellus
9th Ave. Storm Drain System - Peoria to ACDC
City Of Phoenix
CONTRACT #ST83130249
LOCAL HYDROLOGY AND CATCH BASINS
DATE: 12/13/05

ATTACHMENTS

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J. Hydrology / Hydraulics Supporting Data
K. Electronic Files

— Output from PreFre module in DDMSW —

Prefre input data obtained using ...

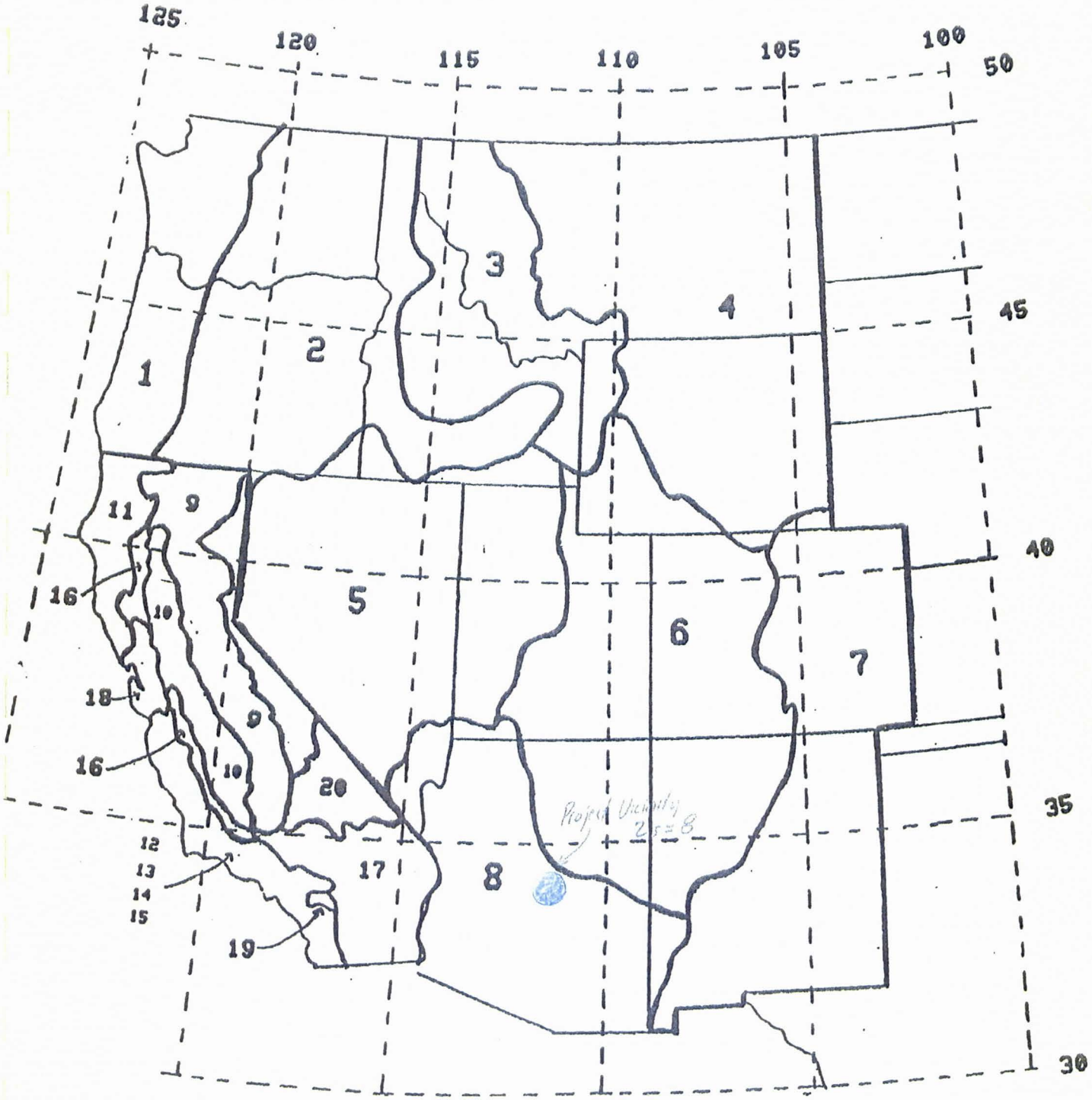
Flood Control District of Maricopa County
SUNNYSD - 9th Avenue Storm Drain from Peoria Avenue to ACDC

Rainfall Data

Primary Zone Number:	7	Latitude:	0.0	Elevation:	0
Short Duration Zone Number:	8	Longitude:	0.0		

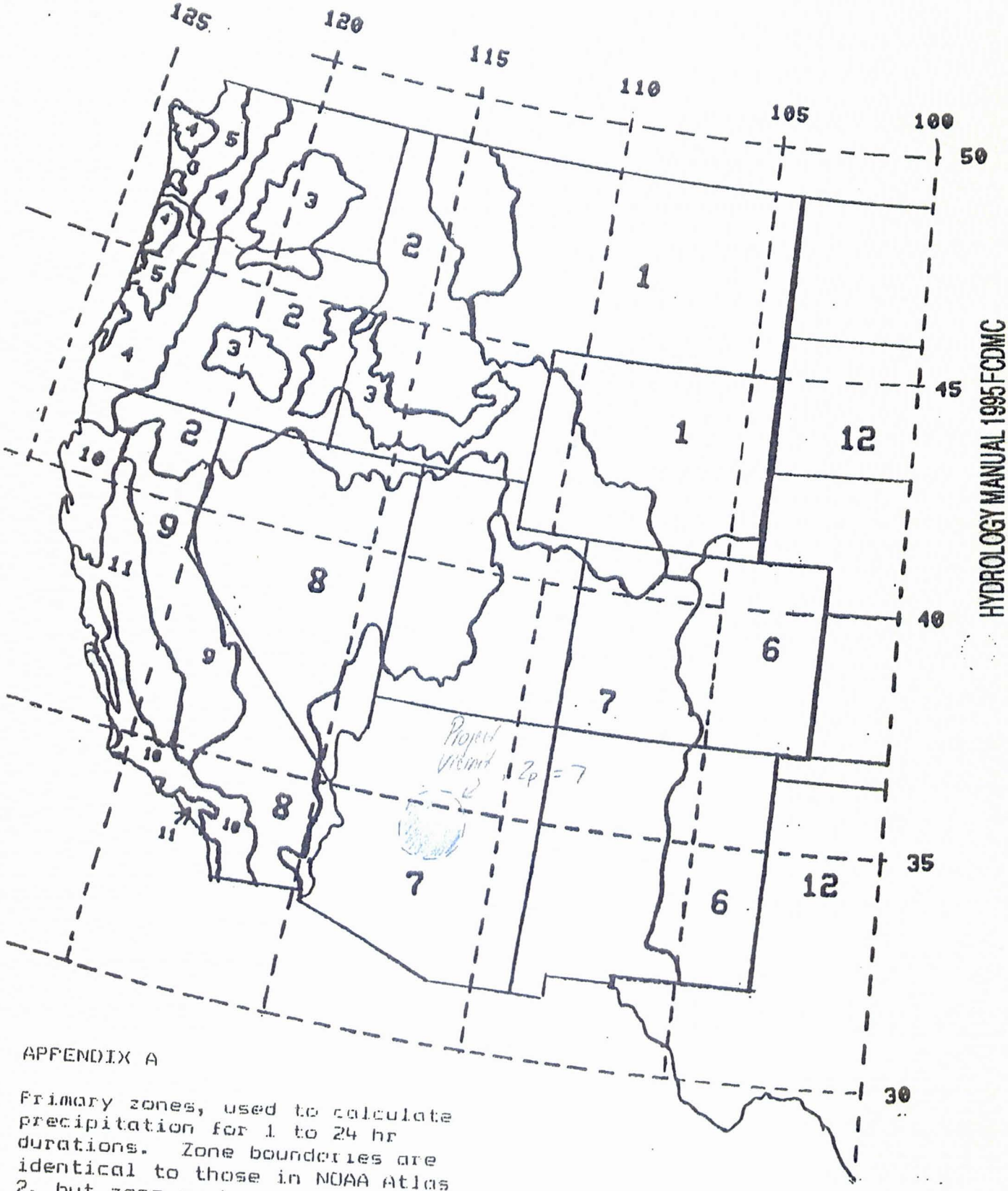
	2-year	100-year
6-hour	1.2	3.1
24-hour	1.4	3.8

	Point Values (in)					
Duration	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
5 MIN	0.33	0.42	0.49	0.58	0.65	0.72
10 MIN	0.49	0.64	0.74	0.88	0.99	1.11
15 MIN	0.59	0.80	0.93	1.12	1.27	1.42
30 MIN	0.79	1.06	1.25	1.52	1.72	1.92
1 HOUR	0.96	1.31	1.56	1.89	2.15	2.40
2 HOUR	1.04	1.44	1.70	2.07	2.36	2.64
3 HOUR	1.10	1.52	1.80	2.19	2.50	2.80
6 HOUR	1.20	1.67	1.99	2.43	2.76	3.10
12 HOUR	1.30	1.84	2.20	2.69	3.07	3.45
24 HOUR	1.40	2.00	2.40	2.95	3.38	3.80



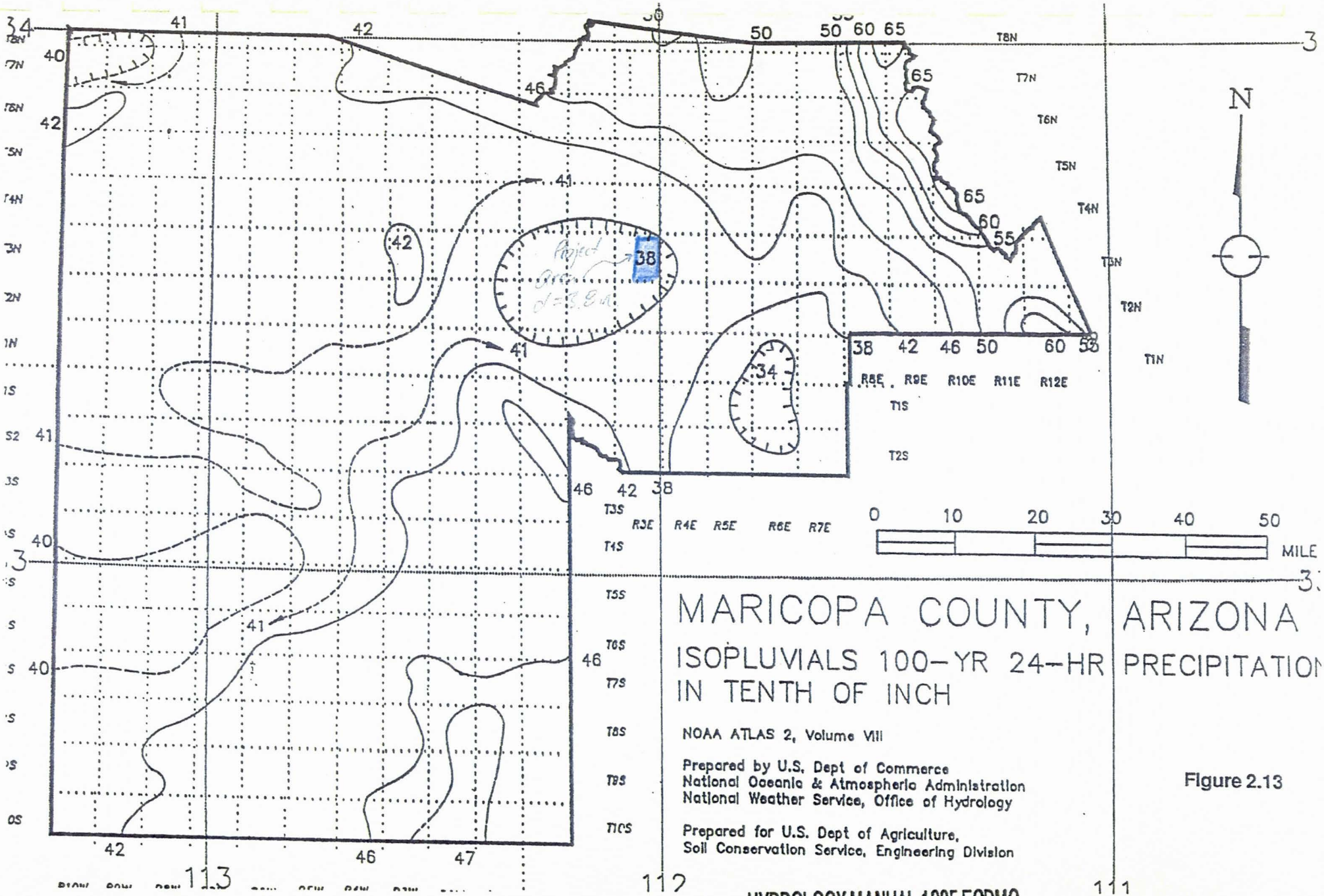
APPENDIX B

Short-duration zones, used to calculate 5 to 30 min durations.



APPENDIX A

Primary zones, used to calculate precipitation for 1 to 24 hr durations. Zone boundaries are identical to those in NOAA Atlas 2, but zone numbers may differ.



MARICOPA COUNTY, ARIZONA

ISOPLUVIALS 100-YR 24-HR PRECIPITATION IN TENTH OF INCH

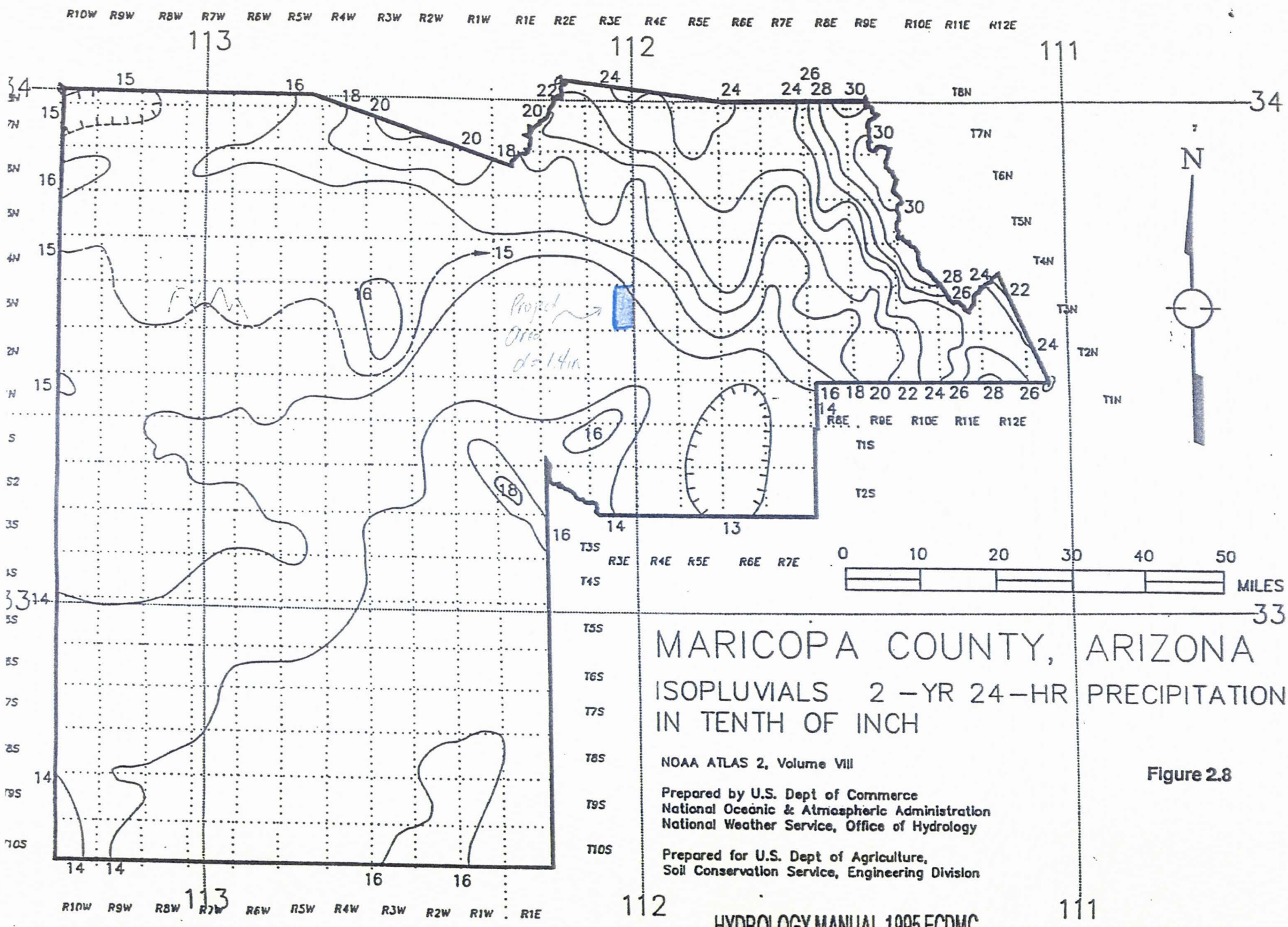
NOAA ATLAS 2, Volume VIII

Prepared by U.S. Dept of Commerce
National Oceanic & Atmospheric Administration
National Weather Service, Office of Hydrology

Prepared for U.S. Dept of Agriculture,
Soil Conservation Service, Engineering Division

Figure 2.13

HYDROLOGY MANUAL 1995 FCDMC



MARICOPA COUNTY, ARIZONA

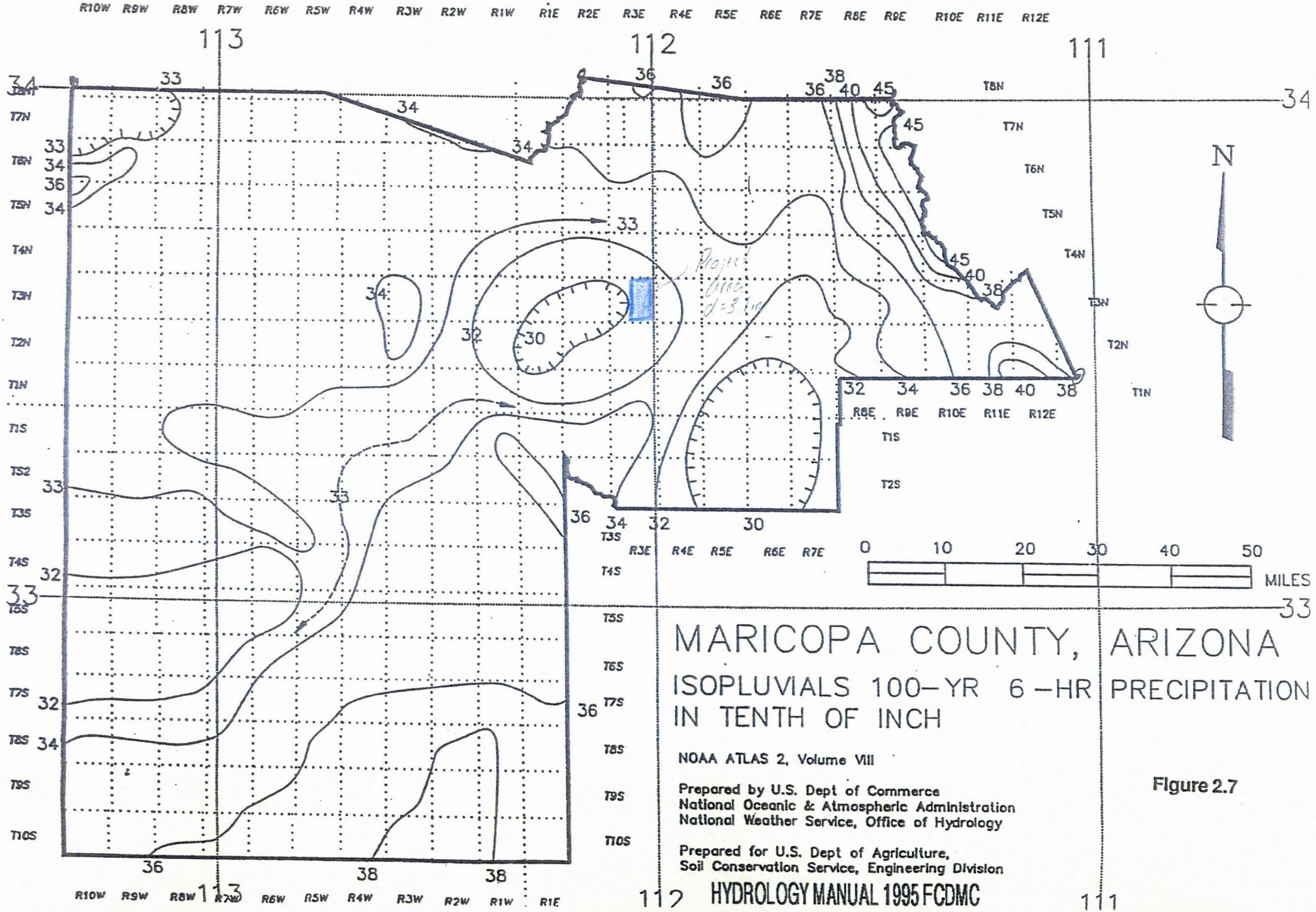
ISOPLUVIALS 2 – YR 24 – HR PRECIPITATION IN TENTH OF INCH

NOAA ATLAS 2, Volume VIII

Prepared by U.S. Dept of Commerce
National Oceanic & Atmospheric Administration
National Weather Service, Office of Hydrology

Prepared for U.S. Dept of Agriculture,
Soil Conservation Service, Engineering Division

Figure 2.8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113
112
111
T7N
T6N
T5N
T4N
T3N
T2N
T1N
T1S
T2S
T3S
T4S
T5S
T6S
T7S
T8S
T9S
T10S
N
0 10 20 30 40 50
MILES
MARICOPA COUNTY, ARIZONA
ISOPLUVIALS 100-YR 6-HR PRECIPITATION
IN TENTH OF INCH
NOAA ATLAS 2, Volume VIII
Prepared by U.S. Dept of Commerce
National Oceanic & Atmospheric Administration
National Weather Service, Office of Hydrology
Prepared for U.S. Dept of Agriculture,
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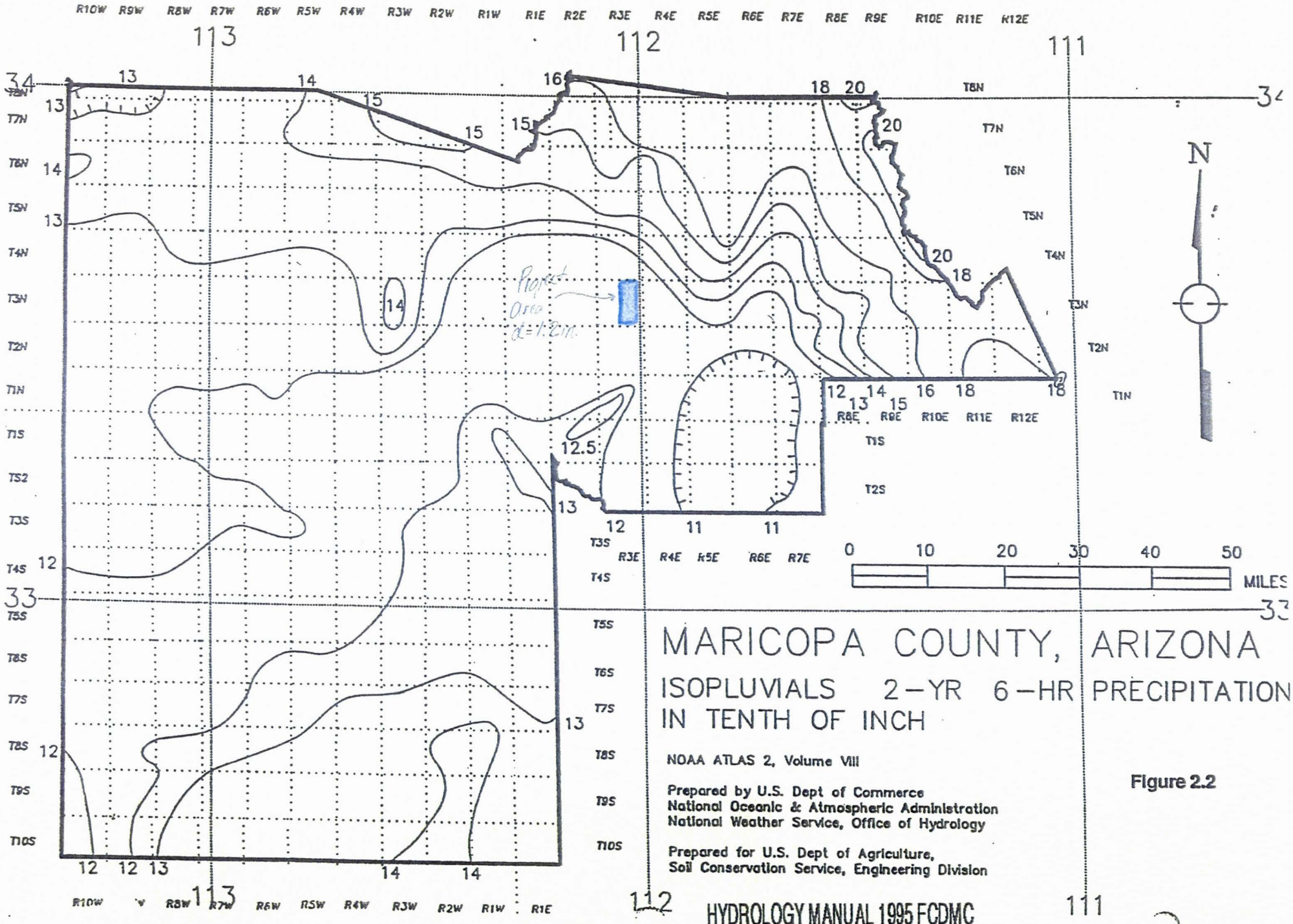
Figure 2.7



MARICOPA COUNTY, ARIZONA

ISOPLUVIALS 2-YR 6-HR PRECIPITATION IN TENTH OF INCH

NOAA ATLAS 2, Volume VIII

Prepared by U.S. Dept of Commerce
National Oceanic & Atmospheric Administration
National Weather Service, Office of Hydrology

Prepared for U.S. Dept of Agriculture,
Soil Conservation Service, Engineering Division

Figure 2.2

ATTACHMENTS

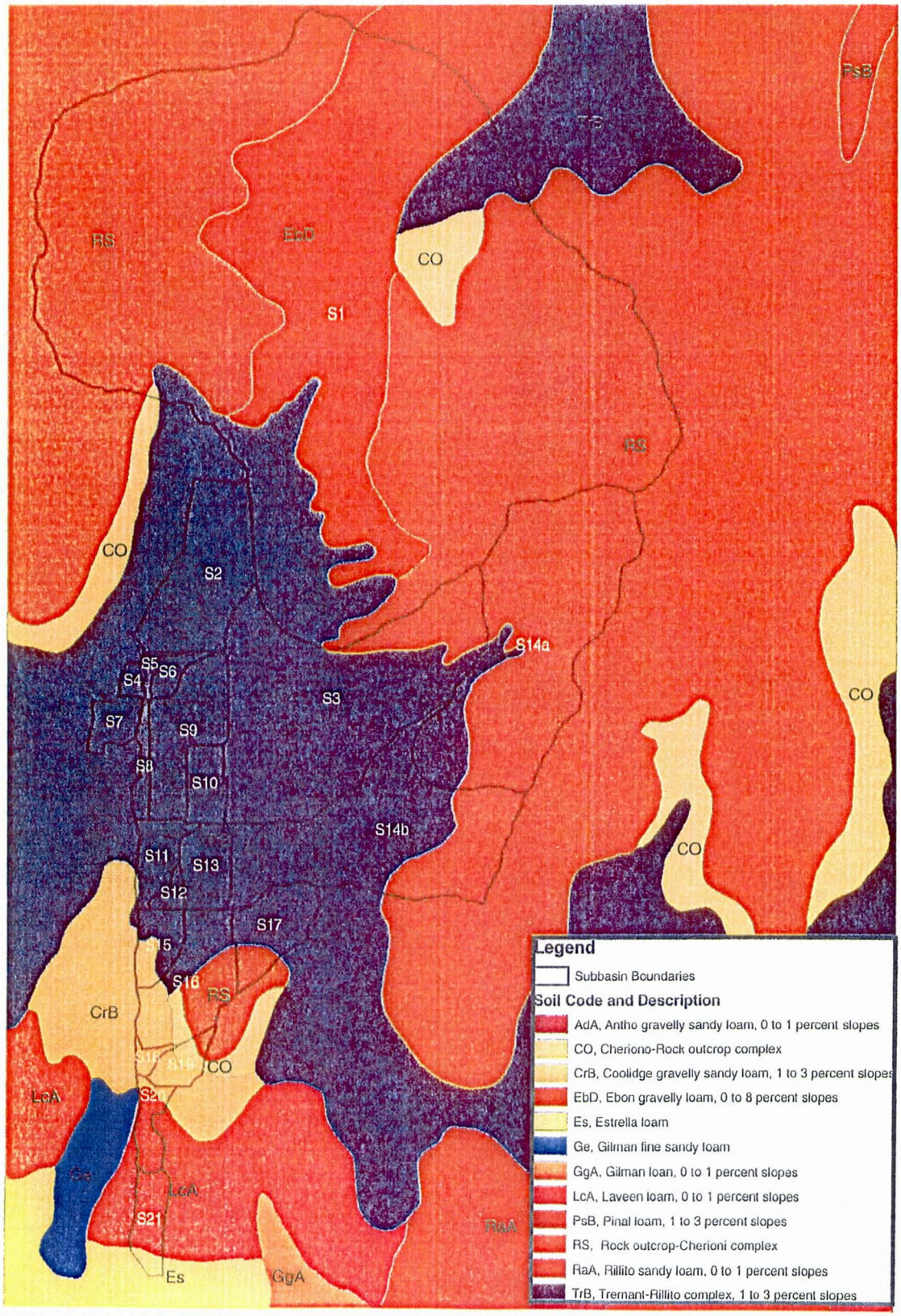
A. Vicinity Map
B. Proposed Storm Drain Layout/ Map from *CAR*
C. Hydrology Maps
D. Precipitation Data
E. Soil and Landuse Data
F. Clark Unit Hydrograph Data
G. Hydraulic Routing Data
H. HEC-1 Input/Output
I. StormCAD Output
J. Hydrology / Hydraulics Supporting Data
K. Electronic Files

Drainage Technical Memordandum
Soil Data (SCS Soil Survey)
9th Avenue Storm Drain - Peoria to ACDC

Entellus

N

Not To Scale

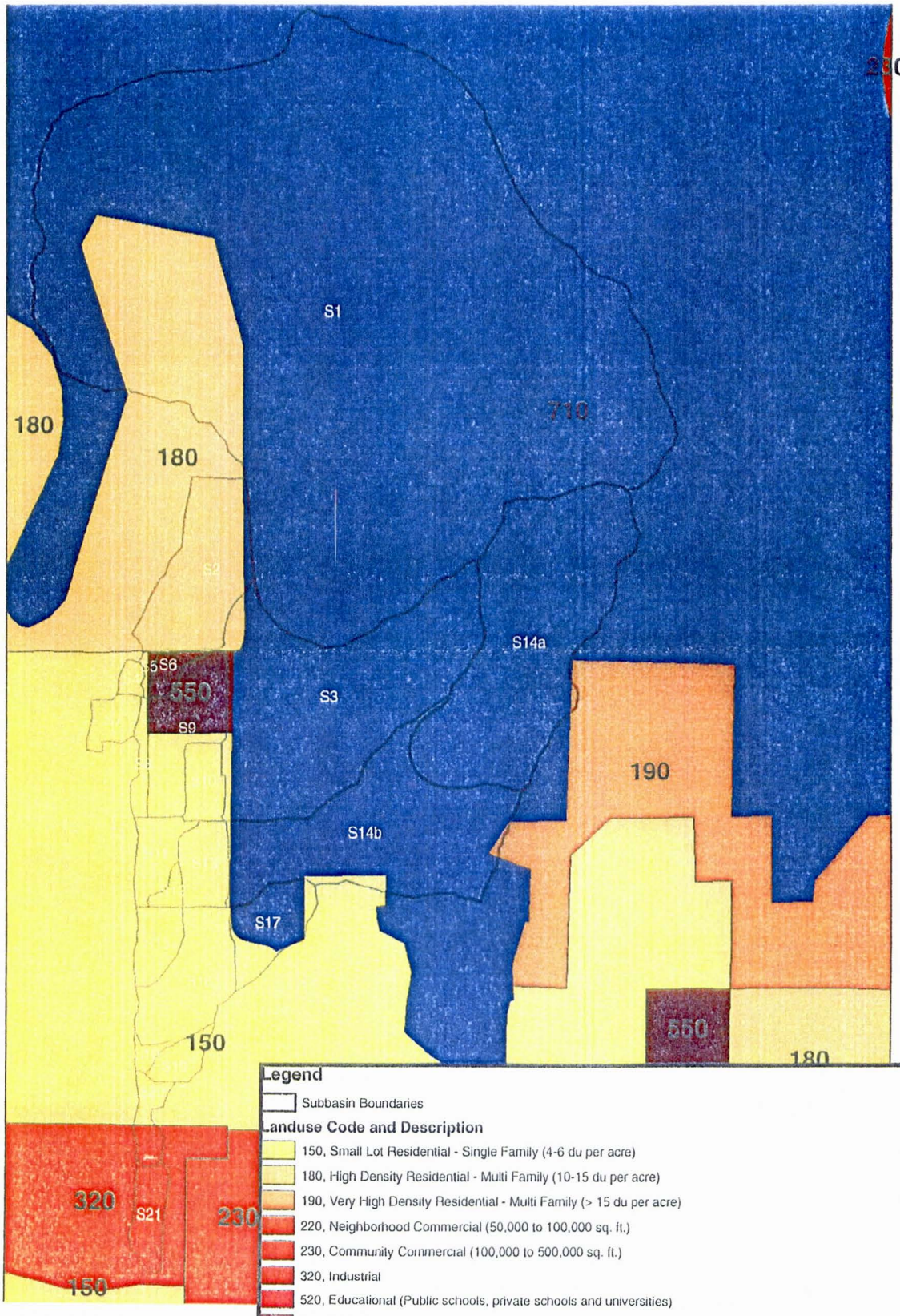


Drainage Technical Memordandum
Landuse Data (MAG General Plan)
9th Avenue Storm Drain - Peoria to ACDC

Entellus

N

Not To Scale



Legend

Subbasin Boundaries

Landuse Code and Description

- 150, Small Lot Residential - Single Family (4-6 du per acre)
- 180, High Density Residential - Multi Family (10-15 du per acre)
- 190, Very High Density Residential - Multi Family (> 15 du per acre)
- 220, Neighborhood Commercial (50,000 to 100,000 sq. ft.)
- 230, Community Commercial (100,000 to 500,000 sq. ft.)
- 320, Industrial
- 520, Educational (Public schools, private schools and universities)
- 550, Public Facilities (Includes community centers, power sub-stations, libraries, city halls, police / fire stations and other government facilities
- 710, Active Open Space (Includes parks)

Entellus Inc. BY JCS DATE 6/30/2004

CLIENT COP and FCD

JOB 9th Avenue Storm Drain **JOB No.** 115076F

Landuse and Soil Parameters

This information was obtained from the District and imported into WMS in order to generate the Green and Ampt Parameters.
The District Tables were clipped to only show the landuse and soil types present in the study area.

Soil Code	Description	Soil Name	XKSAT	RTIMP	% Effective
651202720	Antho gravelly sandy loam, 0 to 1 percent slopes	AdA	0.4	0	100
6512448	Cheriono-Rock outcrop complex	CO	0.29	20	100
651245522	Coolidge gravelly sandy loam, 1 to 3 percent slopes	CrB	0.4	0	100
651282326	Ebon gravelly loam, 0 to 8 percent slopes	EbD	0.1	0	100
6512857	Estrella loam	Es	0.25	0	100
6513229	Gilman fine sandy loam	Ge	0.26	0	100
651323320	Gilman loan, 0 to 1 percent slopes	GgA	0.25	0	100
651422520	Laveen loam, 0 to 1 percent slopes	LcA	0.25	0	100
651505722	Pinal loam, 1 to 3 percent slopes	PsB	0.26	0	100
651542120	Rillito sandy loam, 0 to 1 percent slopes	RaA	0.39	0	100
6515456	Rock outcrop-Cherioni complex	RS	0.4	65	100
651585522	Tremant-Rillito complex, 1 to 3 percent slopes	TrB	0.13	0	100

Landuse Code	Description	IA	RTIMP	Percent Veg	Saturation
150	Small Lot Residential - Single Family (4-6 du per acre)	0.25	35	50	normal
180	High Density Residential - Multi Family (10-15 du per acre)	0.25	65	50	normal
190	Very High Density Residential - Multi Family (> 15 du per acre)	0.25	85	50	normal
220	Neighborhood Commercial (50,000 to 100,000 sq. ft.)	0.1	80	65	normal
230	Community Commercial (100,000 to 500,000 sq. ft.)	0.1	80	75	normal
320	Industrial	0.15	55	60	normal
520	Educational (Public schools, private schools and universities)	0.29	45	80	normal
550	blic Facilities (Includes community centers, power sub-stations, libraries	0.1	80	75	normal
710	Active Open Space (Includes parks)	0.1	5	50	normal

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Entellus Inc.

CLIENT COP and FCD

JOB 9th Avenue Storm Drain

BY JCS **DATE** 6/30/2004

JOB No. 115076F

Clark Unit Hydrograph Parameters

The information shown on the table below was inputted into WMS in order to generate the Clark Unit Hydrograph Parameters.

Subbasin ID	Length (Miles)	Upstream Elevation (Feet)	Downstream Elevation (Feet)	Slope (Feet/Mile)	Adjusted Slope[1] (Feet/Mile)	Roughness "Kb"	Subbasin Area (Sq.Miles)	100-Year Precipitation Tc Hours	100-Year Precipitation Rs	10-Year Precipitation Tc Hours	10-Year Precipitation Rs
S1	1.3	2100	1316	603	313	D	0.5385			0.542	0.329
S2	0.32	1342	1303	122	122	A	0.0283			0.15	0.138
S3	0.624	1760	1286	718	313	C	0.0861			0.3	0.27
S4	0.056	1302	1296	107	107	A	0.0017			0.083	0.088
S5	0.104	1306	1296	96	96	A	0.0012			0.104	0.224
S6	0.123	1310	1296	114	114	A	0.003			0.104	0.153
S7	0.094	1295	1284	117	117	A	0.0049			0.088	0.077
S8	0.18	1310	1281	161	161	A	0.0032			0.113	0.216
S9	0.31	1310	1280	97	97	A	0.0183			0.163	0.188
S10	0.152	1297	1284	86	86	A	0.0065			0.121	0.137
S11	0.165	1283	1268	91	91	A	0.0073			0.125	0.143
S12	0.101	1280	1268	119	119	A	0.0018			0.096	0.16
S13	0.141	1284	1272	85	85	A	0.0085			0.117	0.107
S14a	0.538	2100	1348	1398	313	D	0.082			0.329	0.242
S14b	0.464	1420	1274	315	268	C	0.0624			0.271	0.228
S15	0.138	1272	1258	101	101	A	0.0068			0.108	0.11
S16	0.313	1418	1254	524	305	C	0.0197			0.221	0.256
S17	0.16	1288	1270	113	113	B	0.0126			0.158	0.113
S18	0.083	1270	1250	241	233	A	0.0015			0.083	0.128
S19	0.141	1418	1250	1191	313	D	0.0046			0.183	0.252
S20	1.51	1248	1242	40	40	A	0.005			0.154	0.209
S21	0.168	1242	1234	48	48	A	0.0067			0.154	0.192

[1] The Slope were adjusted using Table 5.2 from the District Hydrology Manual

[2] Kb values were estimated using the criteria in Table 5.3 from the District Hydrology Manual

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Entellus™

SHEET _____ OF _____

BY LL DATE 5/5/15

CHECK _____ DATE _____

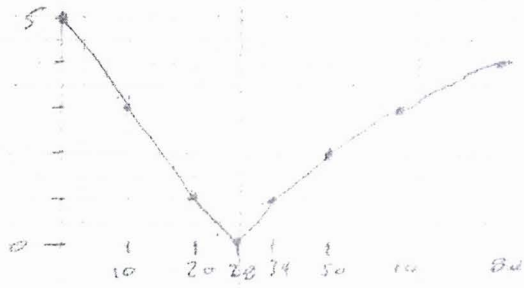
CLIENT COP-FCD

JOB NAME 9th Ave SD - Rock Model JOB NO. 115076F

Rock Notes

ID	Length (ft)	Upstream El	Downstream El	Slope	Other
R1	1086	1316	1303	.0120	Manning (.04, .035, .04)
R2	375	1303	1296	.0187	Pipe ϕ = 60", Manning = .013
R4	128	1296.5	1296	.0039	Pipe ϕ = 36", Manning = .013
R6	935	1296	1280	.0171	Pipe ϕ = 60", Manning = .013
R3	310	1286	1284	.0065	Pipe ϕ = 48", Manning = .013
R10	262	1284	1280	.0153	Pipe ϕ = 48", Manning = .013
R9	695	1280	1268	.0173	Pipe ϕ = 72", Manning = .013
R17	257	1270	1269.5	.0019	Pipe ϕ = 36", Manning = .013
R14a	2034	1350	1272	.0383	Manning (.04, .035, .04)
R14	219	1274	1272	.0091	Pipe ϕ = 36", Manning = .013
R13	390	1272	1268	.0103	Pipe ϕ = 48", Manning = .013
R12	613	1268	1258	.0163	Pipe ϕ = 84", Manning = .013
RSD4	478	1258	1254	.0084	Pipe ϕ = 84", Manning = .013
RSD5	213	1254	1250	.0188	" "
RSD6	764	1250	1242	.0105	" "
RSD7	788	1242	1234	.0102	" "

R14a - Geometry approximated using contours



R1 - Geometry Approximated using contours

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```
1*****************************************
*                                       *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *
*             JUN  1998                 *
*           VERSION 4.1                 *
*                                       *
*  RUN DATE   18MAY05  TIME  09:44:09   *
*                                       *
*****************************************
```

```
*****************************************
*                                       *
*    U.S. ARMY CORPS OF ENGINEERS       *
*    HYDROLOGIC ENGINEERING CENTER      *
*          609 SECOND STREET            *
*       DAVIS, CALIFORNIA 95616         *
*           (916) 756-1104              *
*                                       *
*****************************************
```

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

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

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


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

   1          ID        City of Phoenix and the Flood Control District of Maricopa County
   2          ID        COP# ST83130249, FCD#580.02.20
   3          ID        9th Avenue Storm Drain from Peoria Avenue to ACDC (Sunnyslope Storm Drai
   4          ID
   5          ID        EVENT:                    10 Year - 6 hour
   6          ID        RAINFALL DISTRIBUTION:    Per Flood Control District of Maricopa County H
   7          ID        TIME OF CONCENTRATION:    Per Arizona Department of Transportation Hydrol
   8          ID        INPUT FILE NAME:          10ySunnySD.hc1
   9          ID        DATE:                     May 2005
  10          ID
  11          ID        PREPARED BY: Entellus Inc.
  12          ID        ADDRESS: 2255 N. 44th Street
  13          ID                 Phoenix, ARIZONA 85008
  14          ID        TEL:     (602)244-2566
  15          ID        FAX:     (602)244-8947
  16          ID
  17          ID
  18          ID        NOTES BY ENTELLUS:
  19          ID        Regarding runoff routing through the proposed storm drain system, all pi
  20          ID        based on a preliminary estimate of the required pipe size. The pipe size
  21          ID        not necessarily the pipe size proposed for the system. The pipe slope wa
  22          ID        using the existing grade determined using the District provided 2' conto
  23          ID        shown in the model are not necessarily the proposed slopes.
  24          ID
  25          ID        Green and Ampt parameters were estimated using WMS 7.1, with the SCS Soi
  26          ID        the MAG General Plan.
  27          ID
  28          ID        Clark Unit Hydrograph parameters were estimated using WMS 7.1.
  29          ID
              *
              *
              *DIAGRAM
              *
              *
  30          IT       1                    600
  31          IO       5
              *
              *
              *
              *
              *
              * The peak flow in S7 is the design flow for the inlets and pipe along
              * Cochise Drive.

  32          KK       S7
  33          KO        0       0     0.0        0       22
  34          BA   0.0049
  35          PH                       .49      .93     1.56     1.70     1.80     1.99
  36          LG     0.25     0.21     6.4    0.188     35.0
              * 10 Year Clark Unit Hydrograph Parameters
  37          UC      .088     .077
              *
              *
```



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

```
38          KK       S1
39          KO        0        0      0.0        0       22
40          BA   0.5385
41          LG    0.115     0.25    4.915    0.282   46.991
            * 10 Year Clark Unit Hydrograph Parameters
42          UC     .542     .329
            *
            *
            * The stage, storage, discharge operation below was obtained from the West Park
            * Dam Safety Analysis Model created by PrimaTech. The rating curve represents
            * the outflow from the principal outlet pipe.

43          KK      WPD
44          KM    Runoff is stored behind West Park Dam.
45          RS        1     STOR        0       -1
46          SV      0.0     1.50     6.20    28.05    53.80   109.10   109.10   131.90   157.65   186.85
47          SE   1313.4  1317.00  1320.00  1326.00  1330.00  1336.00  1336.10  1338.00  1340.00  1342.00
48          SQ      0.0    14.31    19.36    26.73    30.67    35.78    45.42   892.79  2458.42  4485.34
            *
            *
            * R1 routes runoff from the West Park Dam principal outlet through a wash
            * to the intersection of Peoria and 9th Avenues.
            * The route parameters were extraced using the 2' contours supplied by the
            * District. The normal depth routing methodology was used.

49          KK       R1
50          RS        1     FLOW       -1
51          RC      .04     .035      .04     1086    .0120
52          RX        0       13       17       23       27       30       34       43
53          RY        7        3        1        0        1        3        5        7
            *
            *

54          KK       S2
55          KO        0        0      0.0        0       22
56          BA   0.0283
57          LG     0.25     0.21      6.4    0.188     65.0
            * 10 Year Clark Unit Hydrograph Parameters
58          UC     .150     .138
            *
            *
            * C2 combines runoff from subbasin S2 and route R1
            * The peak flow from this concentration point is the design flow for the inlet
            * into the storm drain system at the intersection of Peoria Avenue and 9th Avenu

59          KK       C2
60          HC        2
            *
            *
            * Route R2
            * The route is through the proposed 9th Avenue storm drain between
            * Peoria Avenue and North Lane.
1                                        HEC-1 INPUT                                        PAGE   3

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

61          KK       R2
62          RS        1     FLOW       -1
63          RK      375    .0187     .013             CIRC        5
            *
            *
            * The peak flow from S5 is the design flow for inlets into
            * the 9th Avenue storm drain between Peoria Avenue and North Lane.

64          KK       S5
65          KO        0        0      0.0        0       22
66          BA   0.0012
67          LG      0.2     0.21      6.4      0.2     50.0
            * 10 Year Clark Unit Hydrograph Parameters
68          UC     .104     .224
            *
            *
            * CSD1 (Storm Drain Reach 1) combines runoff from S5 and R1
            * The peak flow at CSD1 is the design flow for the 9th Avenue
            * storm drain pipe between Peoria Avenue and the North Lane, and is the

69          KK     CSD1
70          HC        2
            *
            *
            * The peak flow from S4 is the design flow for inlets into the
            * lateral pipe along North Lane, and the design flow for the
            * lateral pipe along North Lane.

71          KK       S4
72          KO        0        0      0.0        0       22
73          BA   0.0017
74          LG     0.25     0.21      6.4    0.188     35.0
            * 10 Year Clark Unit Hydrograph Parameters
75          UC    0.083    0.088
            *
            *
            * Route R4
```

```
                * The route is through the proposed lateral along North Lane

     76         KK       R4
     77         RS        1    FLOW       -1
     78         RK      128   .0039     .013            CIRC        3
                *
                *
                * The peak flow from subbasin S6 is the design flow for the inlets at the
                * intersection of 9th Avenue and North Lane. The inlet will catch runoff
                * leaving the school parking lot.

     79         KK       S6
     80         KO        0        0      0.0        0       22
     81         BA   0.0030
     82         LG      0.1     0.21      6.4    0.224     80.0
                * 10 Year Clark Unit Hydrograph Parameters
     83         UC    0.104    0.153
                *
                *
                * C6 combines runoff from subbain S6, Route R4 and C5
1                                          HEC-1 INPUT                                          PAGE  4

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

     84         KK       C6
     85         HC        3
                *
                *
                * Route R6 routes runoff concentrating near the intersection of North Lane
                * and 9th Avenue to the intersection of Cheryl Drive and 9th Avenue,
                * along 9th Avenue. The route is through the proposed 9th Avenue storm drain.

     86         KK       R6
     87         RS        1    FLOW       -1
     88         RK      935   .0171     .013            CIRC        5
                *
                *
                * The peak flow from S8 is the design flow for inlets into
                * the 9th Avenue storm drain between North Lane and Cheryl Drive.

     89         KK       S8
     90         KO        0        0      0.0        0       22
     91         BA   0.0032
     92         LG     0.25     0.21      6.4    0.188     35.0
                * 10 Year Clark Unit Hydrograph Parameters
     93         UC     .113     .216
                *
                *
                * CSD2 (Storm Drain Reach 2) combines runoff from subbasin S8 and Route R6.
                * The peak flow will be the design flow for the 9th Avenue storm drain
                * between North Lane and Cheryl Drive.

     94         KK     CSD2
     95         HC        2
                *
                *
                * The peak flow from S3 is the design flow for inlets into
                * the lateral along Cheryl Drive Drive at 7th Avenue.

     96         KK       S3
     97         KO        0        0      0.0        0       22
     98         BA   0.0861
     99         LG    0.106     0.25    5.879    0.215   18.356
                * 10 Year Clark Unit Hydrograph Parameters
    100         UC     .300     .270
                *
                *
                * Route R3 routes runoff concentrating near the intersection of 7th
                * Avenue and Cheryl Druve to the dip section on Cheryl Druve
                * at approximately the 8th Avenue Alignment.
                * The route is through the proposed lateral along Cheryl Drive.

    101         KK       R3
    102         RS        1    FLOW       -1
    103         RK      310   .0065     .013            CIRC        4
                *
                *
                * The peak flow at S10 will be the design flow at the inlets at the dip
                * section on Cheryl Drive at approximately the 8th Avenue alignment.
1                                          HEC-1 INPUT                                          PAGE  5

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

    104         KK      S10
    105         KO        0        0      0.0        0       22
    106         BA   0.0065
    107         LG     0.25     0.21      6.4    0.188     35.0
                * 10 Year Clark Unit Hydrograph Parameters
    108         UC     .121     .137
                *
                *
                * C10 combines runoff from subbasin S10 and Route R3.
                * The peak flow at C10 will be the design flow for the lateral along Cheryl
```

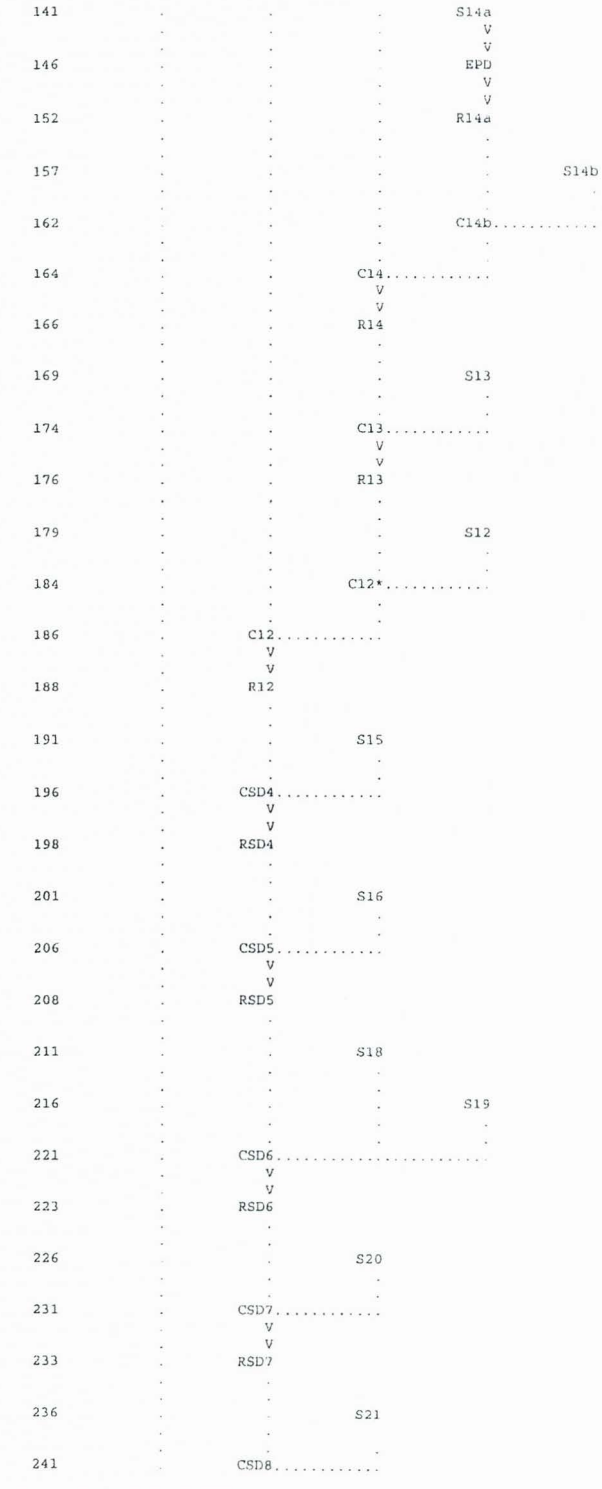
```
                * drive between 7th Avenue and the dip section on Cheryl drive
109             KK      C10
110             HC        2
                *
                *
                * Route R10 routes runoff concentrating at the dip section on Cheryl Drive
                * to 9th Avenue.
                * The route is through the proposed lateral along Cheryl Drive.
111             KK      R10
112             RS        1    FLOW       -1
113             RK      262   .0153     .013             CIRC        4
                *
                *
                * The peak flow from subbasin S9 is the design flow for the inlets at the
                * intersection of 9th Avenue and Cheryl Drive. The inlet will catch runoff
                * leaving the school site.
114             KK       S9
115             KO        0        0      0.0        0       32
116             BA   0.0183
117             LG    0.158     0.21      6.4     0.21   62.572
                * 10 Year Clark Unit Hydrograph Parameters
118             UC     .163     .188
                *
                *
                * C9* combines runoff from subbasin S9, Route R10 and C8.
119             KK      C9*
120             HC        2
                *
                *
                * C9 combines runoff from subbasin CSD2 and C9*
121             KK       C9
122             HC        2
                *
                * Route R9 routes runoff concentrating near the intersection of Cheryl Drive
                * and 9th Avenue to the intersection of Cinnabar Avenue and 9th Avenue,
                * along 9th Avenue. The route is through the proposed 9th Avenue storm drain.
1                                       HEC-1 INPUT                                        PAGE  6

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

123             KK       R9
124             RS        1    FLOW       -1
125             RK      695   .0173     .013             CIRC        6
                *
                *
                * The peak flow from S11 will be the design flow for inlets along 9th Avenue
                * between Cheryl Drive and Cinnabar Avenue.
126             KK      S11
127             KO        0        0      0.0        0       22
128             BA   0.0073
129             LG     0.25     0.21      6.4    0.188     35.0
                * 10 Year Clark Unit Hydrograph Parameters
130             UC     .125     .143
                *
                *
                * CSD3 (Storm Drain Reach 3) combines runoff from subbasin S11 and Route R9.
                * The flow will be the design flow for the 9th Avenue Storm drain
                * pipe between Cheryl Drive and Cinnabar Avenue.
131             KK     CSD3
132             HC        2
                *
                *
                * The peak flow from S17 will be the design flow for inlets at the bend
                * along 7th Avenue near the southwest corner of Mountain View Park
133             KK      S17
134             KO        0        0      0.0        0       22
135             BA   0.0126
136             LG    0.147     0.25    5.671     0.23   30.962
                * 10 Year Clark Unit Hydrograph Parameters
137             UC     .158     .133
                *
                *
                * Route R17 routes runoff from the bend at 7th Avenue, north to the lateral
                * along Cinnabar Avenue through a proposed lateral pipe section.
138             KK      R17
139             RS        1    FLOW       -1
140             RK      257   .0019     .013             CIRC        3
                *
                *
141             KK     S14a
142             KO        3
143             BA    0.082
144             LG    0.101     0.25    4.293    0.363   69.989
                * 10 Year Clark Unit Hydrograph Parameters by Entellus
```

```
 145          UC   0.329   0.242
              *
              *
              * The stage, storage, discharge operation below was obtained from the East Park
              * Dam Safety Analysis Model created by PrimaTech. The rating curve represents
              * the outflow from the principal outlet pipe.
1                                        HEC-1 INPUT                                        PAGE  7

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


 146          KK     EPD
 147          KM   Runoff is stored behind West Park Dam.
 148          RS       1    STOR        0       -1
 149          SV    0.00    0.10    0.45    1.30    2.40    6.75   14.50   21.00   26.25   34.00
 150          SE   1345. 1348.20 1350.00 1352.50 1355.00 1360.00 1365.00 1368.00 1370.00 1372.70
 151          SQ    0.00    0.00    5.00    9.12   11.64   15.00   17.05   18.18  390.81 1359.72
              *
              *
              * R14a routes runoff from the East Park Dam principal outlet through a wash
              * to the intersection of 7th Avenue and Cinnabar Avenue.
              * The route parameters were extraced using the 2' contours supplied by the
              * District. The normal depth routing methodology was used.

 152          KK    R14a
 153          RS       1    FLOW       -1
 154          RC     .04    .035      .04    2034    .0383
 155          RX       0      10       20      28      34      50      70      80
 156          RY       5       3        1       0       1       2       3       4
              *
              *


 157          KK    S14b
 158          KO       0       0     0.0       0      22
 159          BA  0.0624
 160          LG   0.105    0.25   5.556   0.239   25.56
              * 10 Year Clark Unit Hydrograph Parameters
 161          UC    .271    .228
              *
              *
              * The flow at C14b will be the design flow for the inlets at 7th Avenue and
              * Cinnabar Avenue.
              * C14 combines runoff from subbasin S14b and Route R14a.

 162          KK    C14b
 163          HC       2
              *
              *
              * C14 combines runoff from subbasin C14b and Route R17.

 164          KK     C14
 165          HC       2
              *
              *
              * Route R14 routes runoff from the intersection of 7th Avenue and Cinnabar
              * Avenue along 7th Avenue to the dip section through the proposed lateral.

 166          KK     R14
 167          RS       1    FLOW       -1
 168          RK     219   .0091     .013             CIRC        3
              *
              *
              * The peak flow from S13 will be the design flow for the inlets into the
              * Cinnabar Avenue lateral at the dip section.
1                                        HEC-1 INPUT                                        PAGE  8

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


 169          KK     S13
 170          KO       0       0     0.0       0      22
 171          BA  0.0085
 172          LG    0.25    0.21     6.4   0.188    35.0
              * 10 Year Clark Unit Hydrograph Parameters
 173          UC    .117    .107
              *
              *
              * C13 combines runoff from subbasin S13 and Route R14. The flow at
              * C13 will be the design flow for the lateral pipe along Cinnabar
              * between the 7th Avenue and the dip section at approximately the
              * 8th Avenue alignment.

 174          KK     C13
 175          HC       2
              *
              *
              * Route R13 routes runoff from the dip section on  Cinnabar
              * Avenue along Cinnabar Avenue through the proposed lateral to 9th Avenue.

 176          KK     R13
 177          RS       1    FLOW       -1
 178          RK     390   .0103    0.013             CIRC        4
              *
              *
              * The flow at S12 will be the design flow for the inlets along
```

```
                * Cinnabar Avenue between the dip section and 9th Avenue
  179           KK     S12
  180           KO       0       0     0.0       0      22
  181           BA  0.0018
  182           LG    0.25    0.21     6.4   0.188    35.0
                * 10 Year Clark Unit Hydrograph Parameters
  183           UC    .0096     .160
                *
                *
                * C12* combines runoff from subbasin S14 and Route R17. The flow at
                * C12* will be the design flow for the lateral pipe along Cinnabar
                * Avenue between the dip section and 9th Avenue.

  184           KK    C12*
  185           HC       2
                *
                *
                * C12 combines runoff from C12* and R11

  186           KK     C12
  187           HC       2
                *
                *
                * Route R12 routes runoff from the the intersection of Cinnabar and
                * 9th Avenues along 9th Avenue to Mountain View.
                * The route is through the proposed 9th Avenue storm drain.
1                                       HEC-1 INPUT                                    PAGE  9

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

  188           KK     R12
  189           RS       1    FLOW      -1
  190           RK     613   .0163    .013            CIRC       7
                *
                *
                * The flow at S15 will be the design flow for inlets along 9th
                * Avenue between Cinnabar Avenue and Mountain View Road.

  191           KK     S15
  192           KO       0       0     0.0       0      22
  193           BA  0.0068
  194           LG    0.25    0.25   5.305   0.254    35.0
                * 10 Year Clark Unit Hydrograph Parameters
  195           UC    .108     .110
                *
                *
                * CSD4 combines runoff from S15 and R12
                * The flow will be the design flow for the 9th Avenue Storm
                * drain between Cinnabar Avenue and Mountain View Road.

  196           KK    CSD4
  197           HC       2
                *
                *
                * Route RSD4
                * The route is through the proposed 9th Avenue storm drain between
                * the Mountain View Road and the Purdue Avenue alignment.

  198           KK    RSD4
  199           RS       1    FLOW      -1
  200           RK     478   .0084    .013            CIRC       7
                *
                *
                * The flow at S16 will be the design flows for inlets along
                * 9th Avenue between Mountain view Road and the Purdue Avenue alignment.

  201           KK     S16
  202           KO       0       0     0.0       0      22
  203           BA  0.0197
  204           LG    0.25    0.25   4.676   0.316  58.634
                * 10 Year Clark Unit Hydrograph Parameters
  205           UC    .221     .256
                *
                *
                * CSD5 (Storm Drain Reach 5) combines runoff from S16 and R15
                * The peak flow at CSD6 is the design flow for the 9th Avenue
                * storm drain pipe between Mountain View Road and the Purdue Avenue alignment.

  206           KK    CSD5
  207           HC       2
                *
                *
                * Route RSD5
                * The route is through the proposed 9th Avenue storm drain between
                * the Purdue Avenue alignment and Vogel Avenue.
1                                       HEC-1 INPUT                                    PAGE 10

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

  208           KK    RSD5
  209           RS       1    FLOW      -1
  210           RK     213   .0188    .013            CIRC       7
```

```
                *
                *
                * The peak flow from S18 is the design flow for inlets into
                * the 9th Avenue storm drain between the Purude Avenue alignment and Vogel Avenu

  211           KK     S18
  212           KO       0       0     0.0       0      22
  213           BA  0.0015
  214           LG    0.25    0.25    3.95     0.4    35.0
                * 10 Year Clark Unit Hydrograph Parameters
  215           UC   0.083   0.128
                *
                *
                * The peak flow from S19 is the design flow for inlets into
                * the 9th Avenue storm drain at Vogel Avenue.

  216           KK     S19
  217           KO       0       0     0.0       0      22
  218           BA  0.0046
  219           LG    0.25    0.25   4.207   0.413  50.106
                * 10 Year Clark Unit Hydrograph Parameters
  220           UC    .183    .252
                *
                *
                * CSD6 (Storm Drain Reach 6) combines runoff from S18, S19 and RSD5
                * The peak flow at CSD6 is the design flow for the 9th Avenue
                * storm drain pipe between Mountain View Road and Vogel Avenue.

  221           KK    CSD6
  222           HC       3
                *
                *
                * Route RSD6
                * The route is through the proposed 9th Avenue storm drain between
                * Vogel Avenue and Hatcher Road.

  223           KK    RSD6
  224           RS       1    FLOW      -1
  225           RK     764   .0105    .013            CIRC       7
                *
                *
                * The peak flow from S20 is the design flow for inlets into
                * the 9th Avenue storm drain between Vogel Avenue and Hatcher Road.

  226           KK     S20
  227           KO       0       0     0.0       0      22
  228           BA  0.0050
  229           LG   0.202    0.25   4.674   0.382  44.583
                * 10 Year Clark Unit Hydrograph Parameters
  230           UC    .154    .209
                *
                *
                *
                * CSD7 (Storm Drain Reach 7) combines runoff from S20 and RSD6
                * The peak flow at CSD7 is the design flow for the 9th Avenue
                * storm drain pipe between Vogel Avenue and Hatcher Road.
1                                       HEC-1 INPUT                                        PAGE 11

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


  231           KK    CSD7
  232           HC       2
                *
                *
                * Route RSD7
                * The route is through the proposed 9th Avenue storm drain between
                * Hatcher Road and the ACDC.

  233           KK    RSD7
  234           RS       1    FLOW      -1
  235           RK     788   .0102    .013            CIRC       7
                *
                *
                *
                * The peak flow from S21 is the design flow for inlets into
                * the 9th Avenue storm drain between Hatcher Road and the ACDC.

  236           KK     S21
  237           KO       0       0     0.0       0      22
  238           BA  0.0067
  239           LG    0.15    0.25     4.8   0.389    55.0
                * 10 Year Clark Unit Hydrograph Parameters
  240           UC    .154    .192
                *
                *
                * CSD8 (Storm Drain Reach 8) combines runoff from S21 and RSD7
                * The peak flow at CSD8 is the design flow for the 9th Avenue
                * storm drain pipe between Hatcher and the ACDC, and is the
                * outflow into the ACDC.

  241           KK    CSD8
  242           HC       2
                *
                *
```

```
          243          ZZ
1
                SCHEMATIC DIAGRAM OF STREAM NETWORK
 INPUT
 LINE      (V) ROUTING           (--->) DIVERSION OR PUMP FLOW
  NO.      (.) CONNECTOR         (<---) RETURN OF DIVERTED OR PUMPED FLOW

   32          S7
               .
               .
   38          .          S1
               .          V
               .          V
   43          .         WPD
               .          V
               .          V
   49          .          R1
               .          .
               .          .
   54          .          .          S2
               .          .          .
               .          .          .
   59          .         C2..........
               .          V
               .          V
   61          .          R2
               .          .
               .          .
   64          .          .          S5
               .          .          .
               .          .          .
   69          .        CSD1.........
               .          .
               .          .
   71          .          .          S4
               .          .          V
               .          .          V
   76          .          .          R4
               .          .          .
               .          .          .
   79          .          .          .          S6
               .          .          .          .
               .          .          .          .
   84          .         C6..........................
               .          V
               .          V
   86          .          R6
               .          .
               .          .
   89          .          .          S8
               .          .          .
               .          .          .
   94          .        CSD2.........
               .          .
               .          .
   96          .          .          S3
               .          .          V
               .          .          V
  101          .          .          R3
               .          .          .
               .          .          .
  104          .          .          .          S10
               .          .          .          .
               .          .          .          .
  109          .          .         C10.........
               .          .          V
               .          .          V
  111          .          .         R10
               .          .          .
               .          .          .
  114          .          .          .          S9
               .          .          .          .
               .          .          .          .
  119          .          .         C9*.........
               .          .          .
               .          .          .
  121          .         C9..........
               .          V
               .          V
  123          .         R9
               .          .
               .          .
  126          .          .         S11
               .          .          .
               .          .          .
  131          .        CSD3.........
               .          .
               .          .
  133          .          .         S17
               .          .          V
               .          .          V
  138          .          .         R17
               .          .          .
               .          .          .
```



(***) RUNOFF ALSO COMPUTED AT THIS LOCATION

1

RUNOFF SUMMARY
FLOW IN CUBIC FEET PER SECOND
TIME IN HOURS, AREA IN SQUARE MILES

OPERATION	STATION	PEAK FLOW	TIME OF PEAK	AVERAGE FLOW FOR MAXIMUM PERIOD 6-HOUR	24-HOUR	72-HOUR	BASIN AREA	MAXIMUM STAGE	TIME OF MAX STAGE
HYDROGRAPH AT	S7	12.	3.10	1.	0.	0.	.00		
HYDROGRAPH AT	S1	520.	3.47	77.	46.	46.	.54		
ROUTED TO	WPD	23.	4.95	22.	16.	16.	.54	1322.75	4.97
ROUTED TO	R1	23.	4.98	22.	16.	16.	.54	1.15	5.02
HYDROGRAPH AT	S2	57.	3.15	5.	3.	3.	.03		
2 COMBINED AT	C2	70.	3.15	26.	19.	19.	.57		
ROUTED TO	R2	70.	3.17	26.	19.	19.	.57		
HYDROGRAPH AT	S5	2.	3.13	0.	0.	0.	.00		
2 COMBINED AT	CSD1	72.	3.17	26.	19.	19.	.57		
HYDROGRAPH AT	S4	4.	3.10	0.	0.	0.	.00		
ROUTED TO	R4	4.	3.10	0.	0.	0.	.00		
HYDROGRAPH AT	S6	6.	3.13	1.	0.	0.	.00		
3 COMBINED AT	C6	81.	3.15	26.	19.	19.	.57		
ROUTED TO	R6	81.	3.17	26.	19.	19.	.57		
HYDROGRAPH AT	S8	5.	3.15	0.	0.	0.	.00		
2 COMBINED AT	CSD2	86.	3.17	27.	20.	20.	.58		
HYDROGRAPH AT	S3	96.	3.28	9.	6.	6.	.09		
ROUTED TO	R3	96.	3.28	9.	6.	6.	.09		
HYDROGRAPH AT	S10	12.	3.13	1.	1.	1.	.01		
2 COMBINED AT	C10	104.	3.28	10.	6.	6.	.09		
ROUTED TO	R10	104.	3.28	10.	6.	6.	.09		
HYDROGRAPH AT	S9	32.	3.17	3.	2.	2.	.02		
2 COMBINED AT	C9*	130.	3.27	13.	8.	8.	.11		
2 COMBINED AT	C9	205.	3.22	39.	28.	28.	.69		
ROUTED TO	R9	205.	3.22	39.	28.	28.	.69		
HYDROGRAPH AT	S11	13.	3.13	1.	1.	1.	.01		
2 COMBINED AT	CSD3	216.	3.22	40.	28.	28.	.69		
HYDROGRAPH AT	S17	23.	3.15	2.	1.	1.	.01		

	ROUTED TO								
+		R17	23.	3.17	2.	1.	1.	.01	
	HYDROGRAPH AT								
+		S14a	109.	3.30	13.	8.	8.	.08	
	ROUTED TO								
+		EPD	12.	4.08	10.	7.	7.	.08	
+								1355.04	4.08
	ROUTED TO								
+		R14a	12.	4.23	10.	6.	6.	.08	
+								.63	4.27
	HYDROGRAPH AT								
+		S14b	79	3.25	7.	4.	4.	.06	
	2 COMBINED AT								
+		C14b	85.	3.27	16.	11.	11.	.14	
	2 COMBINED AT								
+		C14	103.	3.23	18.	12.	12.	.16	
	ROUTED TO								
+		R14	103.	3.25	18.	12.	12.	.16	
	HYDROGRAPH AT								
+		S13	18.	3.12	1.	1.	1.	.01	
	2 COMBINED AT								
+		C13	114.	3.22	19.	12.	12.	.17	
	ROUTED TO								
+		R13	114.	3.23	19.	12.	12.	.17	
	HYDROGRAPH AT								
+		S12	3.	3.07	0.	0.	0.	.00	
	2 COMBINED AT								
+		C12*	117.	3.23	19.	13.	13.	.17	
	2 COMBINED AT								
+		C12	332.	3.22	59.	41.	41.	.86	
	ROUTED TO								
+		R12	332.	3.22	59.	41.	41.	.86	
	HYDROGRAPH AT								
+		S15	14.	3.12	1.	1.	1.	.01	
	2 COMBINED AT								
+		CSD4	342.	3.22	60.	41.	41.	.87	
	ROUTED TO								
+		RSD4	341.	3.22	60.	41.	41.	.87	
	HYDROGRAPH AT								
+		S16	27.	3.23	3.	2.	2.	.02	
	2 COMBINED AT								
+		CSD5	368.	3.22	63.	43.	43.	.89	
	ROUTED TO								
+		RSD5	368.	3.22	63.	43.	43.	.89	
	HYDROGRAPH AT								
+		S18	3.	3.10	0.	0.	0.	.00	
	HYDROGRAPH AT								
+		S19	6.	3.20	1.	0.	0.	.00	
	3 COMBINED AT								
+		CSD6	375.	3.22	64.	44.	44.	.89	
	ROUTED TO								
+		RSD6	375.	3.23	64.	44.	44.	.89	
	HYDROGRAPH AT								
+		S20	7.	3.17	1.	0.	0.	.00	
	2 COMBINED AT								
+		CSD7	382.	3.23	64.	44.	44.	.90	
	ROUTED TO								
+		RSD7	381.	3.23	64.	44.	44.	.90	
	HYDROGRAPH AT								
+		S21	11.	3.17	1.	1.	1.	.01	
	2 COMBINED AT								
+		CSD8	391.	3.23	65.	45.	45.	.91	

1

ATTACHMENTS

A. Vicinity Map
B. Proposed Storm Drain Layout/ Map from *CAR*
C. Hydrology Maps
D. Precipitation Data
E. Soil and Landuse Data
F. Clark Unit Hydrograph Data
G. Hydraulic Routing Data
H. HEC-1 Input/Output
I. StormCAD Output
J. Hydrology / Hydraulics Supporting Data
K. Electronic Files

Calculation Results Summary

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

>>>> Info: Subsurface Network Rooted by: ACDC Outlet
>>>> Info: Subsurface Analysis iterations: 1
>>>> Info: Convergence was achieved.

>>>> Info: Subsurface Network Rooted by: Manhole 21
>>>> Info: Subsurface Analysis iterations: 1
>>>> Info: Convergence was achieved.

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)
Manhole 7: Q=380 cfs	Generic Inlet	Generic Default 100%	0.00	0.00	100.0	0.00	0.00
Manhole 11: Q=340 cfs	Generic Inlet	Generic Default 100%	0.00	0.00	100.0	0.00	0.00
Manhole 13: Q=220 cfs	Generic Inlet	Generic Default 100%	0.00	0.00	100.0	0.00	0.00
Manhole 23: Q=130 cfs	Generic Inlet	Generic Default 100%	0.00	0.00	100.0	0.00	0.00
Manhole 26A: Q=120 cfs	Generic Inlet	Generic Default 100%	0.00	0.00	100.0	0.00	0.00
Manhole 18: Q=90 cfs	Generic Inlet	Generic Default 100%	0.00	0.00	100.0	0.00	0.00
Manhole 19A: Q=5 cfs	Generic Inlet	Generic Default 100%	0.00	0.00	100.0	0.00	0.00
Manhole 20: Q=10 cfs	Generic Inlet	Generic Default 100%	0.00	0.00	100.0	0.00	0.00

CALCULATION SUMMARY FOR SUBSURFACE NETWORK WITH ROOT: ACDC 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)
9th-1	1	72 inch	Circular	22.00	380.00	19.02	1,222.40	1,221.66
9th-2	1	72 inch	Circular	327.00	380.00	19.11	1,226.76	1,223.97
9th-3	1	66 inch	Circular	435.00	380.00	18.33	1,232.78	1,226.54
9th-4	1	66 inch	Circular	86.00	380.00	15.99	1,235.07	1,233.96
9th-5	1	66 inch	Circular	579.00	380.00	15.99	1,243.59	1,236.18
9th-6	1	66 inch	Circular	105.00	380.00	15.99	1,245.14	1,243.79
9th-7	1	66 inch	Circular	411.00	380.00	15.99	1,250.60	1,245.34

Calculation Results Summary

9th-8	1	66 inch	Circular	261.00	340.00	14.31	1,253.47	1,250.80
9th-8b	1	66 inch	Circular	329.00	340.00	14.31	1,256.90	1,253.52
9th-9	1	66 inch	Circular	173.00	340.00	14.31	1,258.67	1,256.90
9th-9A	1	66 inch	Circular	74.00	340.00	14.31	1,259.59	1,258.83
9th-10	1	66 inch	Circular	37.00	340.00	14.31	1,259.97	1,259.59
9th-11	1	54 inch	Circular	254.00	220.00	13.83	1,266.01	1,262.83
Cinnabar-1	1	54 inch	Circular	418.00	120.00	7.55	1,264.39	1,262.83
9th-12	1	54 inch	Circular	397.00	220.00	19.07	1,271.77	1,266.16
Cinnabar-2	1	54 inch	Circular	246.00	120.00	7.55	1,265.35	1,264.43
Cheryl-1	1	48 inch	Circular	325.00	130.00	10.35	1,277.31	1,274.65
9th-13	1	42 inch	Circular	19.00	95.00	9.87	1,274.82	1,274.65
7th-1	1	48 inch	Circular	176.00	120.00	9.55	1,266.62	1,265.39
Cheryl-2	1	48 inch	Circular	55.00	130.00	10.35	1,277.76	1,277.31
9th-14	1	42 inch	Circular	269.00	95.00	15.32	1,276.99	1,274.90
7th-2	1	48 inch	Circular	123.00	120.00	9.55	1,267.88	1,267.02
Cheryl-3	1	48 inch	Circular	242.00	130.00	19.33	1,280.34	1,277.81
9th-15A	1	42 inch	Circular	52.00	95.00	15.09	1,277.91	1,277.08
9th-15	1	36 inch	Circular	330.00	95.00	14.63	1,284.43	1,278.00
9th-16	1	36 inch	Circular	325.00	95.00	13.44	1,291.10	1,284.43
9th-18	1	36 inch	Circular	113.00	5.00	0.71	1,292.79	1,292.79
9th-17	1	36 inch	Circular	205.00	90.00	12.73	1,296.52	1,292.79
9th-19	1	36 inch	Circular	24.00	5.00	0.71	1,292.79	1,292.79

Label	Total System Flow (cfs)	Ground Elevation (ft)	Hydraulic Grade Line In (ft)	Hydraulic Grade Line Out (ft)
ACDC Outlet	380.00	1,229.00	1,216.87	1,216.87
Manhole 1	380.00	1,230.31	1,223.97	1,222.40
Manhole 2	380.00	1,236.30	1,226.92	1,226.76
Manhole 3	380.00	1,241.21	1,233.96	1,232.78
Manhole 4	380.00	1,242.39	1,236.18	1,235.07
Manhole 5	380.00	1,249.60	1,243.79	1,243.59
Manhole 6	380.00	1,250.56	1,245.34	1,245.14
Manhole 7: Q=380 cfs	380.00	1,256.20	1,250.80	1,250.60
Manhole 8	340.00	1,258.87	1,253.52	1,253.47
Manhole 9	340.00	1,263.46	1,256.90	1,256.90
Manhole 9A	340.00	1,267.16	1,258.83	1,258.67
Manhole 10	340.00	1,266.95	1,259.59	1,259.59
Manhole 11: Q=340 cfs	340.00	1,267.49	1,262.83	1,259.97
Manhole 12	220.00	1,273.01	1,266.16	1,266.01
Manhole 24	120.00	1,270.38	1,264.43	1,264.39
Manhole 13: Q=220 cfs	220.00	1,280.35	1,274.65	1,271.77
Manhole 25	120.00	1,274.00	1,265.39	1,265.35
Manhole 21A	130.00	1,282.93	1,277.31	1,277.31

Manhole 14	95.00	1,280.76	1,274.90	1,274.82
Manhole 26	120.00	1,270.79	1,267.02	1,266.62
Manhole 22	130.00	1,281.67	1,277.81	1,277.76
Manhole 15A	95.00	1,286.16	1,277.08	1,276.99
Manhole 26A: Q=120 cfs	120.00	1,269.97	1,267.95	1,267.88
Manhole 23: Q=130 cfs	130.00	1,286.00	1,280.44	1,280.34
Manhole 15	95.00	1,286.81	1,278.00	1,277.91
Manhole 16	95.00	1,291.88	1,284.43	1,284.43
Manhole 17	95.00	1,296.16	1,292.79	1,291.10
Manhole 19	5.00	1,293.96	1,292.79	1,292.79
Manhole 18: Q=90 cfs	90.00	1,299.30	1,296.64	1,296.52
Manhole 19A: Q=5 cfs	5.00	1,293.27	1,292.79	1,292.79

CALCULATION SUMMARY FOR SUBSURFACE NETWORK WITH ROOT: Manhole 21

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)
Cochise 1	1	18 inch	Circular	271.00	10.00	5.66	1,279.14	1,276.68

Label	Total System Flow (cfs)	Ground Elevation (ft)	Hydraulic Grade Line In (ft)	Hydraulic Grade Line Out (ft)
Manhole 21	10.00	1,284.65	1,275.18	1,275.18
Manhole 20: Q=10 cfs	10.00	1,283.70	1,279.16	1,279.14

Completed: 12/16/2005 03:54:48 PM

ATTACHMENTS

A. Vicinity Map
B. Proposed Storm Drain Layout/ Map from *CAR*
C. Hydrology Maps
D. Precipitation Data
E. Soil and Landuse Data
F. Clark Unit Hydrograph Data
G. Hydraulic Routing Data
H. HEC-1 Input/Output
I. StormCAD Output
J. Hydrology / Hydraulics Supporting Data
K. Electronic Files

Entellus Inc.
CLIENT COP and FCD
JOB 9th Avenue Storm Drain

BY: GA
CHECKED: JS
JOB No. 115076F

DATE 12/14/2005
DATE 12/14/2005

HYDROLOGY										
Subbasin ID	Area (Ac)	100-Year Runoff Coefficient	10-Year Runoff Coefficient	Upstream Elevation (ft)	Downstream Elevation (ft)	Flow Length (ft)	Slope %	Surface Type	10-Year Peak Flow (cfs)	Street
50	0.75	0.95	0.85	1320.00	1303.19	780.00		Paved Street	**4**	**9th Rt.**
51	0.75	0.95	0.85	1320.00	1303.22	780.00		Paved Street	**3**	**9th Rt.**
52	0.30	0.95	0.85	1303.22	1298.07	250.00	0.02	Paved Street	**2**	**9th Rt.**
										9th Rt.
84	0.52			1298.07	1293.67	351.00	0.01	Paved Street - School Site	**3**	**9th Rt.**
59	0.12	0.95	0.85	1298.07	1293.67	351.00	0.01	Paved Street	**0.6**	**9th Rt.**
										9th Rt.
85	0.44			1293.67	1289.37	287.00	0.01	School Site	**2**	**9th Rt.**
60	1.30	0.92	0.85	1298.50	1280.56	1190.00	0.02	Paved Street	**4.2**	**9th Rt.**
										9th Rt.
										9th Rt.
68	2.70	0.70	0.56	1282.72	1274.50	530.00	0.02	Single -family & Multi-family	**9.0**	**9th Rt.**
From Cheryl									**0.0**	**9th Rt.**
70	1.20	0.95	0.85	1277.00	1267.79	420.00	0.02	Single -family & Multi-family	**6**	**9th Rt.**
										9th Rt.
										9th Rt.
73	0.54	0.95	0.85	1272.00	1258.48	890.00	0.02	Paved Street	**2**	**9th Rt.**
From Cinnabar									**7**	**9th Rt.**
74	3.26	0.75	0.60	1272.45	1258.48	680.00	0.02	Single -family & Multi-family	**11**	**9th Rt.**
										9th Rt.
										9th Rt.
S16 (Partial)	11.70	n/a	n/a	n/a	n/a	n/a	n/a	n/a	**25**	**9th Rt.**
77	0.30	0.95	0.85	1258.83	1251.87	510.00	0.01	Paved Street	**1**	**9th Rt.**
										9th Rt.
79	0.32	0.95	0.85	1260.00	1250.03	560.00	0.02	Pavement, Driveways, Rock Yards	**1**	**9th Rt.**
S18	3.10	n/a	n/a	n/a	n/a	n/a	n/a	n/a	**3**	**9th Rt.**
										9th Rt.
80	2.20	0.95	0.85	1260.00	1242.61	1160.00	0.01	Paved Street	**9**	**9th Rt.**
										9th Rt.
										9th Rt.
83	0.71	0.95	0.85	1241.35	1238.31	260.00	0.01	Paved Street	**4**	**9th Rt.**
										9th Rt.

HYDRAULICS						
CB#	Station of Structure	Proposed Structure Type	Modeled	Cummualitive Flow (cfs)	Catch Basin Interception (cfs)	Flow By (cfs)
				4		4.00
				7.00		7.00
				9.00		9.00
EXIST 1	STA. 62+19	Concrete Catch Basin, Type "M-1, L=6-Ft", Phx. Supp. Detail P-1569-1	Grade	9.00	3.29	5.71
				8.31		8.31
				8.91		8.91
CB14.1	STA.58+45.00 15.5' RT.	Concrete Catch Basin, Type "G", M.A.G. Detail 537 - Double	Grade	8.91	4.44	4.47
				6.67		6.67
				10.87		10.87
CB13.3	STA.55+63.00 15' RT	Concrete Catch Basin, Type "G", M.A.G. Detail 537 - Double	Grade	10.87	4.04	6.83
CB12.2	STA.50+31.60 16.4' RT. B/C	Concrete Catch Basin, Type "M", Phx. Supp. Detail P-1569-1	Grade	6.83	1.03	5.80
				14.80		14.80
CB11.5	STA.46+65.00 16.2' RT. B/C	Concrete Catch Basin, Type "M-2, L=17-Ft", Phx. Supp. Detail P-1569-1	Grade	14.80	13.06	1.74
				7.74		7.74
CB11.4	STA.44+71.40 16.2' RT. B/C	Concrete Catch Basin, Type "M-2, L=17-Ft", Phx. Supp. Detail P-1569-1	Grade	7.74	7.74	0.00
CB11.2	STA.43+75.25 16.2' RT. B/C	Concrete Catch Basin, Type "M", Phx. Supp. Detail P-1569-1	Grade	0.00	0	0.00
				2.00		2.00
				9.30		9.30
				20.30		20.30
CB10.2	STA.41+27.00 16.3' RT. B/C	Concrete Catch Basin, Type "M", Phx. Supp. Detail P-1569-1	Grade	20.30	1.7	18.60
CB9.2	STA.37+98.00 16.3' RT. B/C	Concrete Catch Basin, Type "M-1, L=10-Ft", Phx. Supp. Detail P-1569-1	Grade	18.60	6.58	12.02
				37.02		37.02
				38.02		38.02
CB8.5	STA.32+54.03 16.1' RT. B/C	Concrete Catch Basin, Type "M-1, L=10-Ft", Phx. Supp. Detail P-1569-1	Grade	38.02	10.99	27.03
				28.03		28.03
				31.03		31.03
CB8.4	STA.31+25.43 16.1' RT. B/C	Concrete Catch Basin, Type "M-1, L=17-Ft", Phx. Supp. Detail P-1569-1	Grade	31.03	12.56	18.47
				27.47		27.47
CB8.2	STA.30+21.00 16.1' RT. B/C	Concrete Catch Basin, Type "N, Single", Phx. Supp. Detail P-1570	Grade	27.47	8.20	19.27
CB7.1	STA.24+70.88 16.3' RT. B/C	Concrete Catch Basin, Type "M-2, L=17-Ft", Phx. Supp. Detail P-1569-1	Grade	19.27	17.17	2.10
				6.10		6.10
CB5.1	STA.21+36.28 19.7' RT. B/C	Concrete Catch Basin, Type "M-1, L=6-Ft", Phx. Supp. Detail P-1569-1	Grade	6.10	3.10	3.00

65	1.10	0.95	0.85	1296.20	1285.70	550.00	0.02	Pavement, Driveways, Rock Yards	**5**	**Cheryl**
66	0.10	0.95	0.85	1286.68	1285.12	75.00	0.02	Paved Street	**1**	**Cheryl**
										Cheryl
										Cheryl
64	4.16	0.75	0.60	1296.50	1281.42	216.00	0.07	Pavement, Driveways, Rock Yards	**15**	**Cheryl**
										Cheryl
										Cheryl
										Cheryl
67	0.25	0.95	0.85	1285.94	1280.70	160.00	0.03	Paved Street	**2**	**Cheryl**
										Cheryl

				5.00	5.00
				6.00	6.00
CB18.2	STA.22+77.00 18.4' RT. B/C	Concrete Catch Basin, Type "N, Single", Phx. Supp. Detail P-1570	Grade	6.00	3.32	2.68
CB18.1	STA.22+50.00 18.5' LT. B/C	Concrete Catch Basin, Type "M-1, L=3-Ft", Phx. Supp. Detail P-1569-1	Grade	2.68	1.21	1.47
				16.47		16.47
CB17.4	STA.20+35.00 17.7' RT.	ABT Inc. TF-14 Heavy Duty Grated Trench Drain w/1901 Catch Basin, Per Special Provisions (Or Approved Equivalent)	Grade	16.47	9.35	7.12
CB17.2	STA.19+43.90 18.5' LT. B/C	Concrete Catch Basin, Type "M", Phx. Supp. Detail P-1569-1	Grade	7.12	0.96	6.16
CB17.3	STA.19+77.82 86.3' RT.	Concrete Catch Basin, Type "G", M.A.G. Detail 537 - Double	Sag / Sump	6.16	6.16	0.00
				2.00		2.00
CB17.1	STA.17+16.90 18.5' LT. B/C	Concrete Catch Basin, Type "M-2, L=10-Ft", Phx. Supp. Detail P-1569-1	Grade	2.00	2.00	0.00

C14b	92.48	n/a	n/a	n/a	n/a	n/a	n/a	n/a	**85**	**7th**
										7th
										7th
										7th
										7th
										7th
										7th

				85.00		85.00
CB21.6	STA.105+62.40 23.2' RT.	Concrete Catch Basin, Type "G", M.A.G. Detail 537 - Double	Ditch	85.00	25.07	59.93
CB21.5	STA.104+00.00 21.9' RT.	Concrete Catch Basin, Type "G", M.A.G. Detail 537 - Double	Grade	59.93	11.64	48.29
CB21.4	STA.102+77.09 80.3' RT.	Concrete Catch Basin, Type "G", M.A.G. Detail 537 - Double	Sag / Sump	48.29	12.00	36.29
CB21.3	STA.102+68.68 91.5' RT.	Concrete Catch Basin, Type "G", M.A.G. Detail 537 - Double	Sag / Sump	36.29	12.00	24.29
CB21.2	STA.102+61.91 103.8' RT.	Concrete Catch Basin, Type "G", M.A.G. Detail 537 - Double	Sag / Sump	24.29	12.00	12.29
CB21.1	STA.102+55.85 116.4' RT.	Concrete Catch Basin, Type "G", M.A.G. Detail 537 - Double	Sag / Sump	12.29	12.29	0.00

71	5.50	0.75	0.60	1285.25	1270.65	710.00	0.02	Single -family & Multi-family	**19**	**Cinnabar**
72	0.25	0.95	0.85	1273.75	1270.00	250.00	0.02	Paved Street	**2**	**Cinnabar**
										Cinnabar
										Cinnabar

				19.00		19.00
				21.00		21.00
CB20.1	STA.20+74.00 16.4' RT. B/C	Concrete Catch Basin, Type "G", M.A.G. Detail 537 - Double	Grade	21.00	6.17	14.83
CB19.1	STA.17+50.00 18.3' RT. B/C	Concrete Catch Basin, Type "N, Triple", Phx. Supp. Detail P-1570	Grade	14.83	7.53	7.30

53	0.33	0.95	0.85	1302.77	1298.10	170.00	0.03	Paved Street	**2**	**9th Lt.**
										9th Lt.
54	0.11	0.95	0.85	1298.10	1293.71	230.00	0.02	Pavement	**1**	**9th Lt.**
55	0.10	0.95	0.85	1296.46	1292.36	142.00	0.03	Paved Street	**1**	**North**
										North
										North

				2.00		2.00
EXIST 2	STA. 62+19	Concrete Catch Basin, Type "N, Triple", Phx. Supp. Detail P-1570	Grade	2.00	1.72	0.28
				1.28		1.28
				2.28		2.28
CB15.1	STA.16+26.25 18.5' RT. B/C	Concrete Catch Basin, Type "M", Phx. Supp. Detail P-1569-1	Grade	2.28	0.58	1.70
CB15.2	STA.15+25.92 20.3' RT.	Concrete Catch Basin, Type "G", M.A.G. Detail 537 - Double	Sag / Sump	1.70	1.7	0.00

58	0.34	0.95	0.85	1295.34	1291.65	266.00	0.01	Pavement, Driveways, Rock Yards	2	9th Lt.
										9th Lt,
										9th Lt.
57	2.40	0.75	0.60	1292.36	1283.44	360.00	0.02	Single -family & Multi-family	8	Cochise
56	0.20	0.95	0.95	1291.65	1283.44	332.00	0.02	Paved Street	1	Cochise
62	0.20	0.95	0.95	1291.22	1283.22	352.00	0.02	Paved Street	1	Cochise
										Cochise
										Cochise

				2.00		2.00
CB13.5	STA.57+73.00 16.4' LT. B/C	Concrete Catch Basin, Type "N, Triple", Phx. Supp. Detail P-1570	Grade	2.00	1.66	0.34
CB13.4	STA.57+47.10 37.5' LT. B/C	Concrete Catch Basin, Type "N, Single", Phx. Supp. Detail P-1570	Grade	0.34	0.34	0.00
				8.00		8.00
				9.00		9.00
				10.00		10.00
CB16.1	STA.13+12.00 18' RT.	Concrete Catch Basin, Type "G", M.A.G. Detail 537 - Double	Grade	10.00	3.83	6.17
CB16.2	STA.10+40.80 15.2' LT. B/C	Concrete Catch Basin, Type "N, Single", Phx. Supp. Detail P-1570	Grade	6.17	3.37	2.80

61	0.50	0.95	0.85	1291.22	1287.11	270.00	0.02	Pavement, Driveways, Rock Yards	3	9th Lt.
										9th Lt.
										9th Lt.
63	0.60	0.95	0.85	1286.23	1280.50	270.00	0.02	Pavement, Driveways, Rock Yards	3	9th Lt.
										9th Lt.
										9th Lt.
69	1.10	0.95	0.85	1279.58	1267.50	630.00	0.02	Pavement, Driveways, Rock Yards	5	9th Lt.
										9th Lt.
										9th Lt.
75	0.37	0.95	0.85	1267.03	1263.40	300.00	0.01	Pavement, Driveways, Rock Yards	2	9th Lt.
										9th Lt.
										9th Lt.
76	0.23	0.95	0.85	1263.12	1258.06	300.00	0.02	Pavement, Driveways, Rock Yards	1	9th Lt.
										9th Lt.
78	1.00	0.95	0.85	1258.13	1250.11	660.00	0.01	Pavement, Driveways, Rock Yards	4	9th Lt.
										9th Lt.
										9th Lt.
81	1.00	0.95	0.85	1249.58	1242.80	580.00	0.01	Pavement, Driveways, Rock Yards	5	9th Lt.
										9th Lt.
										9th Lt.
82	0.71	0.95	0.85	1241.36	1238.31	250.00	0.01	Paved Street	4	9th Lt.
										9th Lt.

				3.00		3.00
CB13.2	STA.54+43.00 16.4' LT. B/C	Concrete Catch Basin, Type "N, Triple", Phx. Supp. Detail P-1570	Grade	3.00	2.32	0.68
CB13.1	STA.54+15.94 37.5' LT. B/C	Concrete Catch Basin, Type "N, Single", Phx. Supp. Detail P-1570	Grade	0.68	0.66	0.02
				3.02		3.02
CB12.3	STA.51+19.00 16.5' LT. B/C	Concrete Catch Basin, Type "N, Triple", Phx. Supp. Detail P-1570	Grade	3.02	2.34	0.68
CB12.1	STA.50+21.60 16.3' LT. B/C	Concrete Catch Basin, Type "M", Phx. Supp. Detail P-1569-1	Grade	0.68	0.35	0.33
				5.33		5.33
CB11.3	STA.44+54.10 16.3' LT. B/C	Concrete Catch Basin, Type "M-1, L=17-Ft", Phx. Supp. Detail P-1569-1	Grade	5.33	4.6	0.73
CB11.1	STA.43+75.25 16.3' LT. B/C	Concrete Catch Basin, Type "M", Phx. Supp. Detail P-1569-1	Grade	0.73	0.36	0.37
				2.37		2.37
CB10.3	STA.41+27.00 16.9' LT. B/C	Concrete Catch Basin, Type "M-1, L=10-Ft", Phx. Supp. Detail P-1569-1	Grade	2.37	2.24	0.13
CB10.1	STA.40+43.80 16.9' LT. B/C	Concrete Catch Basin, Type "M", Phx. Supp. Detail P-1569-1	Grade	0.13	0.13	0.00
				1.00		1.00
CB9.1	STA.37+98.00 16.5' LT. B/C	Concrete Catch Basin, Type "M-1, L=10-Ft", Phx. Supp. Detail P-1569-1	Grade	1.00	1	0.00
				4.00		4.00
CB8.3	STA.31+25.43 16.6' LT. B/C	Concrete Catch Basin, Type "M-1, L=17-Ft", Phx. Supp. Detail P-1569-1	Grade	4.00	3.96	0.04
CB8.1	STA.30+21.00 16.6' LT. B/C	Concrete Catch Basin, Type "N, Single", Phx. Supp. Detail P-1570	Grade	0.04	0.04	0.00
				5.00		5.00
CB7.3	STA.26+00.00 17.2' LT. B/C	Concrete Catch Basin, Type "N, Triple", Phx. Supp. Detail P-1570	Grade	5.00	3.45	1.55
CB7.2	STA.25+00.00 16.4' LT. B/C	Concrete Catch Basin, Type "N, Triple", Phx. Supp. Detail P-1570	Grade	1.55	1.34	0.21
				4.21		4.21
CB5.2	STA.21+46.36 20.1' LT. B/C	Concrete Catch Basin, Type "M-1, L=6-Ft", Phx. Supp. Detail P-1569-1	Grade	4.21	2.54	1.67

Worksheet for EXIST 1

Project Description		
Flow Element:	Curb Inlet On Grade	
Solve For:	Efficiency	
Input Data		
Discharge:	9.00	ft^3/s
Slope:	0.02000	ft/ft
Gutter Width:	1.50	ft
Gutter Cross Slope:	0.04	ft/ft
Road Cross Slope:	0.02	ft/ft
Manning Coefficient:	0.015	
Curb Opening Length:	7.20	ft
Local Depression:	2.00	in
Local Depression Width:	1.50	ft
Results		
Efficiency:	36.54	%
Intercepted Flow:	3.29	ft^3/s
Bypass Flow:	5.71	ft^3/s
Spread:	13.96	ft
Depth:	0.31	ft
Flow Area:	1.97	ft^2
Gutter Depression:	0.03	ft
Total Depression:	0.20	ft
Velocity:	4.56	ft/s
Equivalent Cross Slope:	0.05735	ft/ft
Length Factor:	0.22	
Total Interception Length:	32.25	ft

Worksheet for CB14.1

Project Description		
Flow Element:	Grate Inlet On Grade	
Solve For:	Efficiency	
Input Data		
Discharge:	8.91	ft^3/s
Slope:	0.01000	ft/ft
Gutter Width:	2.00	ft
Gutter Cross Slope:	0.04	ft/ft
Road Cross Slope:	0.02	ft/ft
Manning Coefficient:	0.015	
Grate Width:	2.00	ft
Grate Length:	4.00	ft
Grate Type:	P-50 mm (P-1-7/8")	
Clogging:	50.00	%
Options		
Grate Flow Option:	ExcludeNone	
Results		
Efficiency:	37.21	%
Intercepted Flow:	3.32	ft^3/s
Bypass Flow:	5.59	ft^3/s
Spread:	15.77	ft
Depth:	0.36	ft
Flow Area:	2.53	ft^2
Gutter Depression:	0.04	ft
Total Depression:	0.04	ft
Velocity:	3.52	ft/s
Splash Over Velocity:	8.13	ft/s
Frontal Flow Factor:	1.00	
Side Flow Factor:	0.06	
Grate Flow Ratio:	0.33	
Active Grate Length:	2.00	ft

Worksheet for CB13.3

Project Description		
Flow Element:	Grate Inlet On Grade	
Solve For:	Efficiency	
Input Data		
Discharge:	10.87	ft^3/s
Slope:	0.02000	ft/ft
Gutter Width:	2.00	ft
Gutter Cross Slope:	0.04	ft/ft
Road Cross Slope:	0.02	ft/ft
Manning Coefficient:	0.015	
Grate Width:	2.00	ft
Grate Length:	4.00	ft
Grate Type:	P-50 mm (P-1-7/8")	
Clogging:	50.00	%
Options		
Grate Flow Option:	ExcludeNone	
Results		
Efficiency:	37.19	%
Intercepted Flow:	4.04	ft^3/s
Bypass Flow:	6.83	ft^3/s
Spread:	14.90	ft
Depth:	0.34	ft
Flow Area:	2.26	ft^2
Gutter Depression:	0.04	ft
Total Depression:	0.04	ft
Velocity:	4.80	ft/s
Splash Over Velocity:	8.13	ft/s
Frontal Flow Factor:	1.00	
Side Flow Factor:	0.04	
Grate Flow Ratio:	0.35	
Active Grate Length:	2.00	ft

Worksheet for CB12.2

Project Description		
Flow Element:	Curb Inlet On Grade	
Solve For:	Efficiency	
Input Data		
Discharge:	6.83	ft^3/s
Slope:	0.02000	ft/ft
Gutter Width:	1.50	ft
Gutter Cross Slope:	0.04	ft/ft
Road Cross Slope:	0.02	ft/ft
Manning Coefficient:	0.015	
Curb Opening Length:	2.40	ft
Local Depression:	2.00	in
Local Depression Width:	1.50	ft
Results		
Efficiency:	15.11	%
Intercepted Flow:	1.03	ft^3/s
Bypass Flow:	5.80	ft^3/s
Spread:	12.56	ft
Depth:	0.28	ft
Flow Area:	1.60	ft^2
Gutter Depression:	0.03	ft
Total Depression:	0.20	ft
Velocity:	4.26	ft/s
Equivalent Cross Slope:	0.06130	ft/ft
Length Factor:	0.09	
Total Interception Length:	27.59	ft

Worksheet for CB11.5

Project Description		
Flow Element:	Curb Inlet On Grade	
Solve For:	Efficiency	
Input Data		
Discharge:	14.80	ft^3/s
Slope:	0.02000	ft/ft
Gutter Width:	1.50	ft
Gutter Cross Slope:	0.04	ft/ft
Road Cross Slope:	0.02	ft/ft
Manning Coefficient:	0.015	
Curb Opening Length:	29.60	ft
Local Depression:	2.00	in
Local Depression Width:	1.50	ft
Results		
Efficiency:	88.21	%
Intercepted Flow:	13.06	ft^3/s
Bypass Flow:	1.74	ft^3/s
Spread:	16.87	ft
Depth:	0.37	ft
Flow Area:	2.87	ft^2
Gutter Depression:	0.03	ft
Total Depression:	0.20	ft
Velocity:	5.15	ft/s
Equivalent Cross Slope:	0.05110	ft/ft
Length Factor:	0.70	
Total Interception Length:	42.58	ft

Worksheet for CB11.4

Project Description		
Flow Element:	Curb Inlet On Grade	
Solve For:	Efficiency	
Input Data		
Discharge:	7.74	ft^3/s
Slope:	0.02000	ft/ft
Gutter Width:	1.50	ft
Gutter Cross Slope:	0.04	ft/ft
Road Cross Slope:	0.02	ft/ft
Manning Coefficient:	0.015	
Curb Opening Length:	29.60	ft
Local Depression:	2.00	in
Local Depression Width:	1.50	ft
Results		
Efficiency:	99.98	%
Intercepted Flow:	7.74	ft^3/s
Bypass Flow:	0.00	ft^3/s
Spread:	13.19	ft
Depth:	0.29	ft
Flow Area:	1.76	ft^2
Gutter Depression:	0.03	ft
Total Depression:	0.20	ft
Velocity:	4.39	ft/s
Equivalent Cross Slope:	0.05874	ft/ft
Length Factor:	0.99	
Total Interception Length:	29.83	ft

Worksheet for CB11.2

Project Description		
Flow Element:	Curb Inlet On Grade	
Solve For:	Efficiency	
Input Data		
Discharge:	0.01	ft^3/s
Slope:	0.02000	ft/ft
Gutter Width:	1.50	ft
Gutter Cross Slope:	0.04	ft/ft
Road Cross Slope:	0.02	ft/ft
Manning Coefficient:	0.015	
Curb Opening Length:	2.40	ft
Local Depression:	2.00	in
Local Depression Width:	1.50	ft
Results		
Efficiency:	100.00	%
Intercepted Flow:	0.01	ft^3/s
Bypass Flow:	0.00	ft^3/s
Spread:	0.70	ft
Depth:	0.03	ft
Flow Area:	0.01	ft^2
Gutter Depression:	0.03	ft
Total Depression:	0.20	ft
Velocity:	0.99	ft/s
Equivalent Cross Slope:	0.15271	ft/ft
Length Factor:	2.33	
Total Interception Length:	1.03	ft

Worksheet for CB10.2

Project Description		
Flow Element:	Curb Inlet On Grade	
Solve For:	Efficiency	
Input Data		
Discharge:	20.30	ft^3/s
Slope:	0.02000	ft/ft
Gutter Width:	1.50	ft
Gutter Cross Slope:	0.04	ft/ft
Road Cross Slope:	0.02	ft/ft
Manning Coefficient:	0.015	
Curb Opening Length:	2.40	ft
Local Depression:	2.00	in
Local Depression Width:	1.50	ft
Results		
Efficiency:	8.36	%
Intercepted Flow:	1.70	ft^3/s
Bypass Flow:	18.60	ft^3/s
Spread:	19.02	ft
Depth:	0.41	ft
Flow Area:	3.64	ft^2
Gutter Depression:	0.03	ft
Total Depression:	0.20	ft
Velocity:	5.57	ft/s
Equivalent Cross Slope:	0.04767	ft/ft
Length Factor:	0.05	
Total Interception Length:	50.70	ft

Worksheet for CB9.2

Project Description		
Flow Element:	Curb Inlet On Grade	
Solve For:	Efficiency	
Input Data		
Discharge:	18.60	ft^3/s
Slope:	0.02000	ft/ft
Gutter Width:	1.50	ft
Gutter Cross Slope:	0.04	ft/ft
Road Cross Slope:	0.02	ft/ft
Manning Coefficient:	0.015	
Curb Opening Length:	10.40	ft
Local Depression:	2.00	in
Local Depression Width:	1.50	ft
Results		
Efficiency:	35.36	%
Intercepted Flow:	6.58	ft^3/s
Bypass Flow:	12.02	ft^3/s
Spread:	18.40	ft
Depth:	0.40	ft
Flow Area:	3.41	ft^2
Gutter Depression:	0.03	ft
Total Depression:	0.20	ft
Velocity:	5.45	ft/s
Equivalent Cross Slope:	0.04858	ft/ft
Length Factor:	0.22	
Total Interception Length:	48.32	ft

Worksheet for CB8.5

Project Description		
Flow Element:	Curb Inlet On Grade	
Solve For:	Efficiency	
Input Data		
Discharge:	38.02	ft^3/s
Slope:	0.01000	ft/ft
Gutter Width:	1.50	ft
Gutter Cross Slope:	0.04	ft/ft
Road Cross Slope:	0.02	ft/ft
Manning Coefficient:	0.015	
Curb Opening Length:	10.40	ft
Local Depression:	2.00	in
Local Depression Width:	1.50	ft
Results		
Efficiency:	28.91	%
Intercepted Flow:	10.99	ft^3/s
Bypass Flow:	27.03	ft^3/s
Spread:	27.48	ft
Depth:	0.58	ft
Flow Area:	7.57	ft^2
Gutter Depression:	0.03	ft
Total Depression:	0.20	ft
Velocity:	5.02	ft/s
Equivalent Cross Slope:	0.03926	ft/ft
Length Factor:	0.17	
Total Interception Length:	60.22	ft

Worksheet for CB8.4

Project Description		
Flow Element:	Curb Inlet On Grade	
Solve For:	Efficiency	
Input Data		
Discharge:	31.03	ft^3/s
Slope:	0.02000	ft/ft
Gutter Width:	1.50	ft
Gutter Cross Slope:	0.04	ft/ft
Road Cross Slope:	0.02	ft/ft
Manning Coefficient:	0.015	
Curb Opening Length:	16.00	ft
Local Depression:	2.00	in
Local Depression Width:	1.50	ft
Results		
Efficiency:	40.48	%
Intercepted Flow:	12.56	ft^3/s
Bypass Flow:	18.47	ft^3/s
Spread:	22.33	ft
Depth:	0.48	ft
Flow Area:	5.01	ft^2
Gutter Depression:	0.03	ft
Total Depression:	0.20	ft
Velocity:	6.19	ft/s
Equivalent Cross Slope:	0.04364	ft/ft
Length Factor:	0.25	
Total Interception Length:	63.89	ft

Worksheet for CB8.2

Project Description		
Flow Element:	Grate Inlet On Grade	
Solve For:	Efficiency	
Input Data		
Discharge:	27.47	ft^3/s
Slope:	0.01000	ft/ft
Gutter Width:	1.50	ft
Gutter Cross Slope:	0.04	ft/ft
Road Cross Slope:	0.02	ft/ft
Manning Coefficient:	0.015	
Grate Width:	2.00	ft
Grate Length:	3.00	ft
Grate Type:	P-50 mm (P-1-7/8")	
Clogging:	50.00	%
Options		
Grate Flow Option:	ExcludeNone	
Results		
Efficiency:	29.87	%
Intercepted Flow:	8.20	ft^3/s
Bypass Flow:	19.27	ft^3/s
Spread:	24.31	ft
Depth:	0.52	ft
Flow Area:	5.93	ft^2
Gutter Depression:	0.03	ft
Total Depression:	0.03	ft
Velocity:	4.63	ft/s
Splash Over Velocity:	6.99	ft/s
Frontal Flow Factor:	1.00	
Side Flow Factor:	0.02	
Grate Flow Ratio:	0.28	
Active Grate Length:	1.50	ft

Worksheet for CB7.1

Project Description		
Flow Element:	Curb Inlet On Grade	
Solve For:	Efficiency	
Input Data		
Discharge:	19.27	ft^3/s
Slope:	0.01000	ft/ft
Gutter Width:	1.50	ft
Gutter Cross Slope:	0.04	ft/ft
Road Cross Slope:	0.02	ft/ft
Manning Coefficient:	0.015	
Curb Opening Length:	29.60	ft
Local Depression:	2.00	in
Local Depression Width:	1.50	ft
Results		
Efficiency:	89.09	%
Intercepted Flow:	17.17	ft^3/s
Bypass Flow:	2.10	ft^3/s
Spread:	21.27	ft
Depth:	0.46	ft
Flow Area:	4.55	ft^2
Gutter Depression:	0.03	ft
Total Depression:	0.20	ft
Velocity:	4.24	ft/s
Equivalent Cross Slope:	0.04481	ft/ft
Length Factor:	0.71	
Total Interception Length:	41.81	ft

Worksheet for CB5.1

Project Description		
Flow Element:	Curb Inlet On Grade	
Solve For:	Efficiency	
Input Data		
Discharge:	6.10	ft^3/s
Slope:	0.01000	ft/ft
Gutter Width:	1.50	ft
Gutter Cross Slope:	0.04	ft/ft
Road Cross Slope:	0.02	ft/ft
Manning Coefficient:	0.015	
Curb Opening Length:	7.20	ft
Local Depression:	2.00	in
Local Depression Width:	1.50	ft
Results		
Efficiency:	50.80	%
Intercepted Flow:	3.10	ft^3/s
Bypass Flow:	3.00	ft^3/s
Spread:	13.74	ft
Depth:	0.31	ft
Flow Area:	1.91	ft^2
Gutter Depression:	0.03	ft
Total Depression:	0.20	ft
Velocity:	3.19	ft/s
Equivalent Cross Slope:	0.05793	ft/ft
Length Factor:	0.33	
Total Interception Length:	22.11	ft

Worksheet for CB18.2

Project Description		
Flow Element:	Grate Inlet On Grade	
Solve For:	Efficiency	
Input Data		
Discharge:	6.00	ft^3/s
Slope:	0.02000	ft/ft
Gutter Width:	1.50	ft
Gutter Cross Slope:	0.04	ft/ft
Road Cross Slope:	0.02	ft/ft
Manning Coefficient:	0.015	
Grate Width:	2.00	ft
Grate Length:	3.00	ft
Grate Type:	P-50 mm (P-1-7/8")	
Clogging:	50.00	%
Options		
Grate Flow Option:	ExcludeNone	
Results		
Efficiency:	55.41	%
Intercepted Flow:	3.32	ft^3/s
Bypass Flow:	2.68	ft^3/s
Spread:	11.95	ft
Depth:	0.27	ft
Flow Area:	1.45	ft^2
Gutter Depression:	0.03	ft
Total Depression:	0.03	ft
Velocity:	4.13	ft/s
Splash Over Velocity:	6.99	ft/s
Frontal Flow Factor:	1.00	
Side Flow Factor:	0.03	
Grate Flow Ratio:	0.54	
Active Grate Length:	1.50	ft

Worksheet for CB18.1

Project Description		
Flow Element:	Curb Inlet On Grade	
Solve For:	Efficiency	
Input Data		
Discharge:	2.68	ft^3/s
Slope:	0.02000	ft/ft
Gutter Width:	1.50	ft
Gutter Cross Slope:	0.04	ft/ft
Road Cross Slope:	0.02	ft/ft
Manning Coefficient:	0.015	
Curb Opening Length:	4.60	ft
Local Depression:	2.00	in
Local Depression Width:	1.50	ft
Results		
Efficiency:	45.30	%
Intercepted Flow:	1.21	ft^3/s
Bypass Flow:	1.47	ft^3/s
Spread:	8.73	ft
Depth:	0.21	ft
Flow Area:	0.79	ft^2
Gutter Depression:	0.03	ft
Total Depression:	0.20	ft
Velocity:	3.41	ft/s
Equivalent Cross Slope:	0.07774	ft/ft
Length Factor:	0.28	
Total Interception Length:	16.15	ft

Worksheet for CB17.4

Project Description		
Flow Element:	Grate Inlet On Grade	
Solve For:	Efficiency	
Input Data		
Discharge:	16.47	ft^3/s
Slope:	0.05000	ft/ft
Gutter Width:	1.50	ft
Gutter Cross Slope:	0.04	ft/ft
Road Cross Slope:	0.02	ft/ft
Manning Coefficient:	0.015	
Grate Width:	1.00	ft
Grate Length:	16.00	ft
Grate Type:	P-50 mm (P-1-7/8")	
Clogging:	50.00	%
Options		
Grate Flow Option:	ExcludeNone	
Results		
Efficiency:	56.75	%
Intercepted Flow:	9.35	ft^3/s
Bypass Flow:	7.12	ft^3/s
Spread:	14.76	ft
Depth:	0.33	ft
Flow Area:	2.20	ft^2
Gutter Depression:	0.03	ft
Total Depression:	0.03	ft
Velocity:	7.47	ft/s
Splash Over Velocity:	21.38	ft/s
Frontal Flow Factor:	1.00	
Side Flow Factor:	0.47	
Grate Flow Ratio:	0.18	
Active Grate Length:	8.00	ft

Worksheet for CB17.2

Project Description		
Flow Element:	Curb Inlet On Grade	
Solve For:	Efficiency	
Input Data		
Discharge:	7.12	ft^3/s
Slope:	0.03000	ft/ft
Gutter Width:	1.50	ft
Gutter Cross Slope:	0.04	ft/ft
Road Cross Slope:	0.02	ft/ft
Manning Coefficient:	0.015	
Curb Opening Length:	2.40	ft
Local Depression:	2.00	in
Local Depression Width:	1.50	ft
Results		
Efficiency:	13.52	%
Intercepted Flow:	0.96	ft^3/s
Bypass Flow:	6.16	ft^3/s
Spread:	11.81	ft
Depth:	0.27	ft
Flow Area:	1.42	ft^2
Gutter Depression:	0.03	ft
Total Depression:	0.20	ft
Velocity:	5.02	ft/s
Equivalent Cross Slope:	0.06379	ft/ft
Length Factor:	0.08	
Total Interception Length:	30.96	ft

Worksheet for CB17.3

Project Description		
Flow Element:	Grate Inlet In Sag	
Solve For:	Spread	
Input Data		
Discharge:	6.16	ft^3/s
Gutter Width:	2.00	ft
Gutter Cross Slope:	0.04	ft/ft
Road Cross Slope:	0.02	ft/ft
Grate Width:	2.00	ft
Grate Length:	4.00	ft
Local Depression:	6.00	in
Local Depression Width:	10.00	ft
Grate Type:	P-50 mm (P-1-7/8")	
Clogging:	50.00	%
Results		
Spread:	6.69	ft
Depth:	0.11	ft
Gutter Depression:	0.04	ft
Total Depression:	0.54	ft
Open Grate Area:	3.60	ft^2
Active Grate Weir Length:	6.00	ft

Worksheet for CB17.1

Project Description		
Flow Element:	Curb Inlet On Grade	
Solve For:	Efficiency	
Input Data		
Discharge:	2.00	ft^3/s
Slope:	0.03000	ft/ft
Gutter Width:	1.50	ft
Gutter Cross Slope:	0.04	ft/ft
Road Cross Slope:	0.02	ft/ft
Manning Coefficient:	0.015	
Curb Opening Length:	18.40	ft
Local Depression:	2.00	in
Local Depression Width:	1.50	ft
Results		
Efficiency:	100.00	%
Intercepted Flow:	2.00	ft^3/s
Bypass Flow:	0.00	ft^3/s
Spread:	7.17	ft
Depth:	0.18	ft
Flow Area:	0.54	ft^2
Gutter Depression:	0.03	ft
Total Depression:	0.20	ft
Velocity:	3.72	ft/s
Equivalent Cross Slope:	0.08852	ft/ft
Length Factor:	1.23	
Total Interception Length:	14.92	ft

Worksheet for CB21.6

Project Description		
Flow Element:	Ditch Inlet On Grade	
Solve For:	Efficiency	
Input Data		
Manning Coefficient:	0.025	
Slope:	0.04000	ft/ft
Left Side Slope:	6.00	ft/ft (H:V)
Right Side Slope:	6.00	ft/ft (H:V)
Bottom Width:	2.00	ft
Discharge:	85.00	ft^3/s
Grate Width:	2.00	ft
Grate Length:	4.00	ft
Grate Type:	P-50 mm (P-1-7/8")	
Clogging:	50.00	%
Results		
Efficiency:	29.50	%
Intercepted Flow:	25.07	ft^3/s
Bypass Flow:	59.93	ft^3/s
Flow Area:	9.78	ft^2
Wetted Perimeter:	15.63	ft
Top Width:	15.45	ft
Velocity:	8.69	ft/s
Splash Over Velocity:	8.13	ft/s
Frontal Flow Factor:	0.95	
Side Flow Factor:	0.10	
Grate Flow Ratio:	0.23	
Active Grate Length:	2.00	ft
Critical Depth:	1.50	ft
Critical Slope:	0.00987	ft/ft
Froude Number:	1.93	
Flow Type:	Supercritical	
Specific Energy:	2.30	ft
Velocity Head:	1.17	ft
Depth:	1.12	ft

Worksheet for CB21.5

Project Description		
Flow Element:	Grate Inlet On Grade	
Solve For:	Efficiency	
Input Data		
Discharge:	59.93	ft^3/s
Slope:	0.04000	ft/ft
Gutter Width:	2.00	ft
Gutter Cross Slope:	0.04	ft/ft
Road Cross Slope:	0.02	ft/ft
Manning Coefficient:	0.015	
Grate Width:	2.00	ft
Grate Length:	4.00	ft
Grate Type:	P-50 mm (P-1-7/8")	
Clogging:	50.00	%
Options		
Grate Flow Option:	ExcludeNone	
Results		
Efficiency:	19.43	%
Intercepted Flow:	11.64	ft^3/s
Bypass Flow:	48.29	ft^3/s
Spread:	25.06	ft
Depth:	0.54	ft
Flow Area:	6.32	ft^2
Gutter Depression:	0.04	ft
Total Depression:	0.04	ft
Velocity:	9.48	ft/s
Splash Over Velocity:	8.13	ft/s
Frontal Flow Factor:	0.88	
Side Flow Factor:	0.01	
Grate Flow Ratio:	0.21	
Active Grate Length:	2.00	ft

Worksheet for CB21.4 - 21.1

Project Description		
Flow Element:	Grate Inlet In Sag	
Solve For:	Spread	
Input Data		
Discharge:	48.29	ft^3/s
Gutter Width:	2.00	ft
Gutter Cross Slope:	0.04	ft/ft
Road Cross Slope:	0.02	ft/ft
Grate Width:	2.00	ft
Grate Length:	16.00	ft
Local Depression:	18.00	in
Local Depression Width:	10.00	ft
Grate Type:	P-50 mm (P-1-7/8")	
Clogging:	50.00	%
Results		
Spread:	7.83	ft
Depth:	0.00	ft
Gutter Depression:	0.04	ft
Total Depression:	1.54	ft
Open Grate Area:	14.40	ft^2
Active Grate Weir Length:	18.00	ft

Worksheet for CB20.1

Project Description		
Flow Element:	Grate Inlet On Grade	
Solve For:	Efficiency	
Input Data		
Discharge:	21.00	ft^3/s
Slope:	0.02000	ft/ft
Gutter Width:	2.00	ft
Gutter Cross Slope:	0.04	ft/ft
Road Cross Slope:	0.02	ft/ft
Manning Coefficient:	0.015	
Grate Width:	2.00	ft
Grate Length:	4.00	ft
Grate Type:	P-50 mm (P-1-7/8")	
Clogging:	50.00	%
Options		
Grate Flow Option:	ExcludeNone	
Results		
Efficiency:	29.40	%
Intercepted Flow:	6.17	ft^3/s
Bypass Flow:	14.83	ft^3/s
Spread:	19.19	ft
Depth:	0.43	ft
Flow Area:	3.72	ft^2
Gutter Depression:	0.04	ft
Total Depression:	0.04	ft
Velocity:	5.64	ft/s
Splash Over Velocity:	8.13	ft/s
Frontal Flow Factor:	1.00	
Side Flow Factor:	0.03	
Grate Flow Ratio:	0.27	
Active Grate Length:	2.00	ft

Worksheet for CB19.1

Project Description		
Flow Element:	Grate Inlet On Grade	
Solve For:	Efficiency	
Input Data		
Discharge:	14.83	ft^3/s
Slope:	0.02000	ft/ft
Gutter Width:	1.50	ft
Gutter Cross Slope:	0.04	ft/ft
Road Cross Slope:	0.02	ft/ft
Manning Coefficient:	0.015	
Grate Width:	2.00	ft
Grate Length:	9.00	ft
Grate Type:	P-50 mm (P-1-7/8")	
Clogging:	50.00	%
Options		
Grate Flow Option:	ExcludeNone	
Results		
Efficiency:	50.80	%
Intercepted Flow:	7.53	ft^3/s
Bypass Flow:	7.30	ft^3/s
Spread:	16.89	ft
Depth:	0.37	ft
Flow Area:	2.88	ft^2
Gutter Depression:	0.03	ft
Total Depression:	0.03	ft
Velocity:	5.16	ft/s
Splash Over Velocity:	12.28	ft/s
Frontal Flow Factor:	1.00	
Side Flow Factor:	0.18	
Grate Flow Ratio:	0.40	
Active Grate Length:	4.50	ft

Worksheet for EXIST 2

Project Description		
Flow Element:	Grate Inlet On Grade	
Solve For:	Efficiency	
Input Data		
Discharge:	2.00	ft^3/s
Slope:	0.03000	ft/ft
Gutter Width:	1.50	ft
Gutter Cross Slope:	0.04	ft/ft
Road Cross Slope:	0.02	ft/ft
Manning Coefficient:	0.015	
Grate Width:	2.00	ft
Grate Length:	9.00	ft
Grate Type:	P-50 mm (P-1-7/8")	
Clogging:	50.00	%
Options		
Grate Flow Option:	ExcludeNone	
Results		
Efficiency:	85.84	%
Intercepted Flow:	1.72	ft^3/s
Bypass Flow:	0.28	ft^3/s
Spread:	7.17	ft
Depth:	0.18	ft
Flow Area:	0.54	ft^2
Gutter Depression:	0.03	ft
Total Depression:	0.03	ft
Velocity:	3.72	ft/s
Splash Over Velocity:	12.28	ft/s
Frontal Flow Factor:	1.00	
Side Flow Factor:	0.29	
Grate Flow Ratio:	0.80	
Active Grate Length:	4.50	ft

Worksheet for CB15.1

Project Description		
Flow Element:	Curb Inlet On Grade	
Solve For:	Efficiency	
Input Data		
Discharge:	2.28	ft^3/s
Slope:	0.03000	ft/ft
Gutter Width:	1.50	ft
Gutter Cross Slope:	0.04	ft/ft
Road Cross Slope:	0.02	ft/ft
Manning Coefficient:	0.015	
Curb Opening Length:	2.40	ft
Local Depression:	2.00	in
Local Depression Width:	1.50	ft
Results		
Efficiency:	25.22	%
Intercepted Flow:	0.58	ft^3/s
Bypass Flow:	1.70	ft^3/s
Spread:	7.56	ft
Depth:	0.18	ft
Flow Area:	0.60	ft^2
Gutter Depression:	0.03	ft
Total Depression:	0.20	ft
Velocity:	3.83	ft/s
Equivalent Cross Slope:	0.08552	ft/ft
Length Factor:	0.15	
Total Interception Length:	16.10	ft

Worksheet for CB15.2

Project Description		
Flow Element:	Grate Inlet In Sag	
Solve For:	Spread	
Input Data		
Discharge:	1.70	ft^3/s
Gutter Width:	2.00	ft
Gutter Cross Slope:	0.04	ft/ft
Road Cross Slope:	0.02	ft/ft
Grate Width:	2.00	ft
Grate Length:	4.00	ft
Local Depression:	6.00	in
Local Depression Width:	10.00	ft
Grate Type:	P-50 mm (P-1-7/8")	
Clogging:	50.00	%
Results		
Spread:	5.46	ft
Depth:	0.00	ft
Gutter Depression:	0.04	ft
Total Depression:	0.54	ft
Open Grate Area:	3.60	ft^2
Active Grate Weir Length:	6.00	ft

Worksheet for CB13.5

Project Description		
Flow Element:	Grate Inlet On Grade	
Solve For:	Efficiency	
Input Data		
Discharge:	2.00	ft^3/s
Slope:	0.01000	ft/ft
Gutter Width:	1.50	ft
Gutter Cross Slope:	0.04	ft/ft
Road Cross Slope:	0.02	ft/ft
Manning Coefficient:	0.015	
Grate Width:	2.00	ft
Grate Length:	9.00	ft
Grate Type:	P-50 mm (P-1-7/8")	
Clogging:	50.00	%
Options		
Grate Flow Option:	ExcludeNone	
Results		
Efficiency:	83.08	%
Intercepted Flow:	1.66	ft^3/s
Bypass Flow:	0.34	ft^3/s
Spread:	8.92	ft
Depth:	0.21	ft
Flow Area:	0.82	ft^2
Gutter Depression:	0.03	ft
Total Depression:	0.03	ft
Velocity:	2.44	ft/s
Splash Over Velocity:	12.28	ft/s
Frontal Flow Factor:	1.00	
Side Flow Factor:	0.46	
Grate Flow Ratio:	0.69	
Active Grate Length:	4.50	ft

Worksheet for CB13.4

Project Description		
Flow Element:	Grate Inlet On Grade	
Solve For:	Efficiency	
Input Data		
Discharge:	0.34	ft^3/s
Slope:	0.01000	ft/ft
Gutter Width:	1.50	ft
Gutter Cross Slope:	0.04	ft/ft
Road Cross Slope:	0.02	ft/ft
Manning Coefficient:	0.015	
Grate Width:	2.00	ft
Grate Length:	3.00	ft
Grate Type:	P-50 mm (P-1-7/8")	
Clogging:	50.00	%
Options		
Grate Flow Option:	ExcludeNone	
Results		
Efficiency:	102.71	%
Intercepted Flow:	0.35	ft^3/s
Bypass Flow:	-0.01	ft^3/s
Spread:	4.27	ft
Depth:	0.12	ft
Flow Area:	0.21	ft^2
Gutter Depression:	0.03	ft
Total Depression:	0.03	ft
Velocity:	1.65	ft/s
Splash Over Velocity:	6.99	ft/s
Frontal Flow Factor:	1.00	
Side Flow Factor:	0.12	
Grate Flow Ratio:	1.03	
Active Grate Length:	1.50	ft

Worksheet for CB16.1

Project Description		
Flow Element:	Grate Inlet On Grade	
Solve For:	Efficiency	
Input Data		
Discharge:	10.00	ft^3/s
Slope:	0.02000	ft/ft
Gutter Width:	2.00	ft
Gutter Cross Slope:	0.04	ft/ft
Road Cross Slope:	0.02	ft/ft
Manning Coefficient:	0.015	
Grate Width:	2.00	ft
Grate Length:	4.00	ft
Grate Type:	P-50 mm (P-1-7/8")	
Clogging:	50.00	%
Options		
Grate Flow Option:	ExcludeNone	
Results		
Efficiency:	38.29	%
Intercepted Flow:	3.83	ft^3/s
Bypass Flow:	6.17	ft^3/s
Spread:	14.43	ft
Depth:	0.33	ft
Flow Area:	2.12	ft^2
Gutter Depression:	0.04	ft
Total Depression:	0.04	ft
Velocity:	4.71	ft/s
Splash Over Velocity:	8.13	ft/s
Frontal Flow Factor:	1.00	
Side Flow Factor:	0.04	
Grate Flow Ratio:	0.36	
Active Grate Length:	2.00	ft

Worksheet for CB16.2

Project Description		
Flow Element:	Grate Inlet On Grade	
Solve For:	Efficiency	
Input Data		
Discharge:	6.17	ft^3/s
Slope:	0.02000	ft/ft
Gutter Width:	1.50	ft
Gutter Cross Slope:	0.04	ft/ft
Road Cross Slope:	0.02	ft/ft
Manning Coefficient:	0.015	
Grate Width:	2.00	ft
Grate Length:	3.00	ft
Grate Type:	P-50 mm (P-1-7/8")	
Clogging:	50.00	%
Options		
Grate Flow Option:	ExcludeNone	
Results		
Efficiency:	54.60	%
Intercepted Flow:	3.37	ft^3/s
Bypass Flow:	2.80	ft^3/s
Spread:	12.09	ft
Depth:	0.27	ft
Flow Area:	1.48	ft^2
Gutter Depression:	0.03	ft
Total Depression:	0.03	ft
Velocity:	4.16	ft/s
Splash Over Velocity:	6.99	ft/s
Frontal Flow Factor:	1.00	
Side Flow Factor:	0.03	
Grate Flow Ratio:	0.53	
Active Grate Length:	1.50	ft

Worksheet for CB13.2

Project Description		
Flow Element:	Grate Inlet On Grade	
Solve For:	Efficiency	
Input Data		
Discharge:	3.00	ft^3/s
Slope:	0.02000	ft/ft
Gutter Width:	1.50	ft
Gutter Cross Slope:	0.04	ft/ft
Road Cross Slope:	0.02	ft/ft
Manning Coefficient:	0.015	
Grate Width:	2.00	ft
Grate Length:	9.00	ft
Grate Type:	P-50 mm (P-1-7/8")	
Clogging:	50.00	%
Options		
Grate Flow Option:	ExcludeNone	
Results		
Efficiency:	77.49	%
Intercepted Flow:	2.32	ft^3/s
Bypass Flow:	0.68	ft^3/s
Spread:	9.13	ft
Depth:	0.21	ft
Flow Area:	0.86	ft^2
Gutter Depression:	0.03	ft
Total Depression:	0.03	ft
Velocity:	3.50	ft/s
Splash Over Velocity:	12.28	ft/s
Frontal Flow Factor:	1.00	
Side Flow Factor:	0.31	
Grate Flow Ratio:	0.67	
Active Grate Length:	4.50	ft

Worksheet for CB13.1

Project Description		
Flow Element:	Grate Inlet On Grade	
Solve For:	Efficiency	
Input Data		
Discharge:	0.68	ft^3/s
Slope:	0.02000	ft/ft
Gutter Width:	1.50	ft
Gutter Cross Slope:	0.04	ft/ft
Road Cross Slope:	0.02	ft/ft
Manning Coefficient:	0.015	
Grate Width:	2.00	ft
Grate Length:	3.00	ft
Grate Type:	P-50 mm (P-1-7/8")	
Clogging:	50.00	%
Options		
Grate Flow Option:	ExcludeNone	
Results		
Efficiency:	97.42	%
Intercepted Flow:	0.66	ft^3/s
Bypass Flow:	0.02	ft^3/s
Spread:	5.01	ft
Depth:	0.13	ft
Flow Area:	0.27	ft^2
Gutter Depression:	0.03	ft
Total Depression:	0.03	ft
Velocity:	2.49	ft/s
Splash Over Velocity:	6.99	ft/s
Frontal Flow Factor:	1.00	
Side Flow Factor:	0.06	
Grate Flow Ratio:	0.97	
Active Grate Length:	1.50	ft

Worksheet for CB12.3

Project Description		
Flow Element:	Grate Inlet On Grade	
Solve For:	Efficiency	
Input Data		
Discharge:	3.02	ft^3/s
Slope:	0.02000	ft/ft
Gutter Width:	1.50	ft
Gutter Cross Slope:	0.04	ft/ft
Road Cross Slope:	0.02	ft/ft
Manning Coefficient:	0.015	
Grate Width:	2.00	ft
Grate Length:	9.00	ft
Grate Type:	P-50 mm (P-1-7/8")	
Clogging:	50.00	%
Options		
Grate Flow Option:	ExcludeNone	
Results		
Efficiency:	77.38	%
Intercepted Flow:	2.34	ft^3/s
Bypass Flow:	0.68	ft^3/s
Spread:	9.15	ft
Depth:	0.22	ft
Flow Area:	0.86	ft^2
Gutter Depression:	0.03	ft
Total Depression:	0.03	ft
Velocity:	3.50	ft/s
Splash Over Velocity:	12.28	ft/s
Frontal Flow Factor:	1.00	
Side Flow Factor:	0.31	
Grate Flow Ratio:	0.67	
Active Grate Length:	4.50	ft

Worksheet for CB12.1

Project Description		
Flow Element:	Curb Inlet On Grade	
Solve For:	Efficiency	
Input Data		
Discharge:	0.68	ft^3/s
Slope:	0.02000	ft/ft
Gutter Width:	1.50	ft
Gutter Cross Slope:	0.04	ft/ft
Road Cross Slope:	0.02	ft/ft
Manning Coefficient:	0.015	
Curb Opening Length:	2.40	ft
Local Depression:	2.00	in
Local Depression Width:	1.50	ft
Results		
Efficiency:	50.98	%
Intercepted Flow:	0.35	ft^3/s
Bypass Flow:	0.33	ft^3/s
Spread:	4.98	ft
Depth:	0.13	ft
Flow Area:	0.27	ft^2
Gutter Depression:	0.03	ft
Total Depression:	0.20	ft
Velocity:	2.50	ft/s
Equivalent Cross Slope:	0.11086	ft/ft
Length Factor:	0.33	
Total Interception Length:	7.34	ft

Worksheet for CB11.3

Project Description		
Flow Element:	Curb Inlet On Grade	
Solve For:	Efficiency	
Input Data		
Discharge:	5.33	ft^3/s
Slope:	0.02000	ft/ft
Gutter Width:	1.50	ft
Gutter Cross Slope:	0.04	ft/ft
Road Cross Slope:	0.02	ft/ft
Manning Coefficient:	0.015	
Curb Opening Length:	16.00	ft
Local Depression:	2.00	in
Local Depression Width:	1.50	ft
Results		
Efficiency:	86.24	%
Intercepted Flow:	4.60	ft^3/s
Bypass Flow:	0.73	ft^3/s
Spread:	11.42	ft
Depth:	0.26	ft
Flow Area:	1.33	ft^2
Gutter Depression:	0.03	ft
Total Depression:	0.20	ft
Velocity:	4.01	ft/s
Equivalent Cross Slope:	0.06519	ft/ft
Length Factor:	0.67	
Total Interception Length:	23.96	ft

Worksheet for CB11.1

Project Description		
Flow Element:	Curb Inlet On Grade	
Solve For:	Efficiency	
Input Data		
Discharge:	0.73	ft^3/s
Slope:	0.02000	ft/ft
Gutter Width:	1.50	ft
Gutter Cross Slope:	0.04	ft/ft
Road Cross Slope:	0.02	ft/ft
Manning Coefficient:	0.015	
Curb Opening Length:	2.40	ft
Local Depression:	2.00	in
Local Depression Width:	1.50	ft
Results		
Efficiency:	49.27	%
Intercepted Flow:	0.36	ft^3/s
Bypass Flow:	0.37	ft^3/s
Spread:	5.13	ft
Depth:	0.14	ft
Flow Area:	0.29	ft^2
Gutter Depression:	0.03	ft
Total Depression:	0.20	ft
Velocity:	2.54	ft/s
Equivalent Cross Slope:	0.10893	ft/ft
Length Factor:	0.31	
Total Interception Length:	7.64	ft

Worksheet for CB10.3

Project Description		
Flow Element:	Curb Inlet On Grade	
Solve For:	Efficiency	
Input Data		
Discharge:	2.37	ft^3/s
Slope:	0.01000	ft/ft
Gutter Width:	1.50	ft
Gutter Cross Slope:	0.04	ft/ft
Road Cross Slope:	0.02	ft/ft
Manning Coefficient:	0.015	
Curb Opening Length:	10.40	ft
Local Depression:	2.00	in
Local Depression Width:	1.50	ft
Results		
Efficiency:	94.44	%
Intercepted Flow:	2.24	ft^3/s
Bypass Flow:	0.13	ft^3/s
Spread:	9.55	ft
Depth:	0.22	ft
Flow Area:	0.93	ft^2
Gutter Depression:	0.03	ft
Total Depression:	0.20	ft
Velocity:	2.54	ft/s
Equivalent Cross Slope:	0.07230	ft/ft
Length Factor:	0.80	
Total Interception Length:	13.01	ft

Worksheet for CB10.1

Project Description		
Flow Element:	Curb Inlet On Grade	
Solve For:	Efficiency	
Input Data		
Discharge:	0.13	ft^3/s
Slope:	0.01000	ft/ft
Gutter Width:	1.50	ft
Gutter Cross Slope:	0.04	ft/ft
Road Cross Slope:	0.02	ft/ft
Manning Coefficient:	0.015	
Curb Opening Length:	2.40	ft
Local Depression:	2.00	in
Local Depression Width:	1.50	ft
Results		
Efficiency:	99.30	%
Intercepted Flow:	0.13	ft^3/s
Bypass Flow:	0.00	ft^3/s
Spread:	2.70	ft
Depth:	0.08	ft
Flow Area:	0.10	ft^2
Gutter Depression:	0.03	ft
Total Depression:	0.20	ft
Velocity:	1.36	ft/s
Equivalent Cross Slope:	0.14210	ft/ft
Length Factor:	0.94	
Total Interception Length:	2.56	ft

Worksheet for CB9.1

Project Description		
Flow Element:	Curb Inlet On Grade	
Solve For:	Efficiency	
Input Data		
Discharge:	1.00	ft^3/s
Slope:	0.02000	ft/ft
Gutter Width:	1.50	ft
Gutter Cross Slope:	0.04	ft/ft
Road Cross Slope:	0.02	ft/ft
Manning Coefficient:	0.015	
Curb Opening Length:	10.40	ft
Local Depression:	2.00	in
Local Depression Width:	1.50	ft
Results		
Efficiency:	100.00	%
Intercepted Flow:	1.00	ft^3/s
Bypass Flow:	0.00	ft^3/s
Spread:	5.86	ft
Depth:	0.15	ft
Flow Area:	0.37	ft^2
Gutter Depression:	0.03	ft
Total Depression:	0.20	ft
Velocity:	2.72	ft/s
Equivalent Cross Slope:	0.10058	ft/ft
Length Factor:	1.14	
Total Interception Length:	9.15	ft

Worksheet for CB8.3

Project Description		
Flow Element:	Curb Inlet On Grade	
Solve For:	Efficiency	
Input Data		
Discharge:	4.00	ft^3/s
Slope:	0.01000	ft/ft
Gutter Width:	1.50	ft
Gutter Cross Slope:	0.04	ft/ft
Road Cross Slope:	0.02	ft/ft
Manning Coefficient:	0.015	
Curb Opening Length:	16.00	ft
Local Depression:	2.00	in
Local Depression Width:	1.50	ft
Results		
Efficiency:	98.92	%
Intercepted Flow:	3.96	ft^3/s
Bypass Flow:	0.04	ft^3/s
Spread:	11.68	ft
Depth:	0.27	ft
Flow Area:	1.39	ft^2
Gutter Depression:	0.03	ft
Total Depression:	0.20	ft
Velocity:	2.88	ft/s
Equivalent Cross Slope:	0.06423	ft/ft
Length Factor:	0.92	
Total Interception Length:	17.41	ft

Worksheet for CB8.1

Project Description		
Flow Element:	Grate Inlet On Grade	
Solve For:	Efficiency	
Input Data		
Discharge:	0.04	ft^3/s
Slope:	0.01000	ft/ft
Gutter Width:	1.50	ft
Gutter Cross Slope:	0.04	ft/ft
Road Cross Slope:	0.02	ft/ft
Manning Coefficient:	0.015	
Grate Width:	2.00	ft
Grate Length:	3.00	ft
Grate Type:	P-50 mm (P-1-7/8")	
Clogging:	50.00	%
Options		
Grate Flow Option:	ExcludeNone	
Results		
Efficiency:	100.00	%
Intercepted Flow:	0.04	ft^3/s
Bypass Flow:	0.00	ft^3/s
Spread:	1.34	ft
Depth:	0.06	ft
Flow Area:	0.04	ft^2
Gutter Depression:	0.03	ft
Total Depression:	0.03	ft
Velocity:	1.08	ft/s
Splash Over Velocity:	6.99	ft/s
Frontal Flow Factor:	1.00	
Side Flow Factor:	0.23	
Grate Flow Ratio:	1.00	
Active Grate Length:	1.50	ft

Worksheet for CB7.3

Project Description		
Flow Element:	Grate Inlet On Grade	
Solve For:	Efficiency	
Input Data		
Discharge:	5.00	ft^3/s
Slope:	0.01000	ft/ft
Gutter Width:	1.50	ft
Gutter Cross Slope:	0.04	ft/ft
Road Cross Slope:	0.02	ft/ft
Manning Coefficient:	0.015	
Grate Width:	2.00	ft
Grate Length:	9.00	ft
Grate Type:	P-50 mm (P-1-7/8")	
Clogging:	50.00	%
Options		
Grate Flow Option:	ExcludeNone	
Results		
Efficiency:	69.08	%
Intercepted Flow:	3.45	ft^3/s
Bypass Flow:	1.55	ft^3/s
Spread:	12.73	ft
Depth:	0.29	ft
Flow Area:	1.64	ft^2
Gutter Depression:	0.03	ft
Total Depression:	0.03	ft
Velocity:	3.04	ft/s
Splash Over Velocity:	12.28	ft/s
Frontal Flow Factor:	1.00	
Side Flow Factor:	0.36	
Grate Flow Ratio:	0.51	
Active Grate Length:	4.50	ft

Worksheet for CB7.2

Project Description		
Flow Element:	Grate Inlet On Grade	
Solve For:	Efficiency	
Input Data		
Discharge:	1.55	ft^3/s
Slope:	0.01000	ft/ft
Gutter Width:	1.50	ft
Gutter Cross Slope:	0.04	ft/ft
Road Cross Slope:	0.02	ft/ft
Manning Coefficient:	0.015	
Grate Width:	2.00	ft
Grate Length:	9.00	ft
Grate Type:	P-50 mm (P-1-7/8")	
Clogging:	50.00	%
Options		
Grate Flow Option:	ExcludeNone	
Results		
Efficiency:	86.64	%
Intercepted Flow:	1.34	ft^3/s
Bypass Flow:	0.21	ft^3/s
Spread:	8.07	ft
Depth:	0.19	ft
Flow Area:	0.67	ft^2
Gutter Depression:	0.03	ft
Total Depression:	0.03	ft
Velocity:	2.30	ft/s
Splash Over Velocity:	12.28	ft/s
Frontal Flow Factor:	1.00	
Side Flow Factor:	0.49	
Grate Flow Ratio:	0.74	
Active Grate Length:	4.50	ft

Worksheet for CB5.2

Project Description		
Flow Element:	Curb Inlet On Grade	
Solve For:	Efficiency	
Input Data		
Discharge:	4.21	ft^3/s
Slope:	0.01000	ft/ft
Gutter Width:	1.50	ft
Gutter Cross Slope:	0.04	ft/ft
Road Cross Slope:	0.02	ft/ft
Manning Coefficient:	0.015	
Curb Opening Length:	7.20	ft
Local Depression:	2.00	in
Local Depression Width:	1.50	ft
Results		
Efficiency:	60.34	%
Intercepted Flow:	2.54	ft^3/s
Bypass Flow:	1.67	ft^3/s
Spread:	11.91	ft
Depth:	0.27	ft
Flow Area:	1.44	ft^2
Gutter Depression:	0.03	ft
Total Depression:	0.20	ft
Velocity:	2.92	ft/s
Equivalent Cross Slope:	0.06341	ft/ft
Length Factor:	0.40	
Total Interception Length:	17.92	ft

ATTACHMENTS

A. Vicinity Map
B. Proposed Storm Drain Layout/ Map from *CAR*
C. Hydrology Maps
D. Precipitation Data
E. Soil and Landuse Data
F. Clark Unit Hydrograph Data
G. Hydraulic Routing Data
H. HEC-1 Input/Output
I. StormCAD Output
J. Hydrology / Hydraulics Supporting Data
K. Electronic Files