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SUN LAKES SECTIONS 29 AND 30
MASTER DRAINAGE PLAN
MAY, 1996
AUGUST, 1996 Revisions

B & R Engineering, Inc.

PLANNING - CIVIL ENGINEERING - LAND DEVELOPMENT

9666 E. Riggs Road, Suite 502, Sun Lakes, Arizona 85248

SUN LAKES SECTIONS 29 AND 30
MASTER DRAINAGE PLAN
MAY, 1996
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PREPARED BY:

B&R ENGINEERING, INC.
9666 EAST RIGGS ROAD, SUITE 502
SUN LAKES, ARIZONA 85248
(602) 895-0799

Jason M. Burgess

Registered Professional Engineer (Civil)
CERTIFICATE NO.
8071
JASON M.
BURGESS
Date Signed 8/14/96
ARIZONA, U.S.A.

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CERTIFICATE NO.
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ARIZONA, U.S.A.

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B. Soil Drainage

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C. ONSITE IMPROVEMENTS

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Figure 5 - Lake Level Control Structure

Figure 6a - Typical Cross-Section Across Concrete Rectangular Drainageway

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D. RAMSS Inc. "Hydraulic Model" Files

MDP10A.S10	Summary Output for all lakes; 10-yr., 2-hr. storm; 6 minute increment.
MDP10A.RSC	Lake routing input data; 10-yr., 2-hr. storm; 6 minute increment.
MDP10A.QIN	Input hydrograph file for all lakes; 10-yr., 2-hr. storm; 6 minute increment.
MDP100A.S99	Same as MDP10A.S10 except 100-yr., 2-hr. storm.
MDP100A.RSC	Same as MDP10A.RSC except 100-yr., 2-hr. storm.
MDP100A.QIN	Same as MDP10A.QIN except 100-yr., 2-hr. storm.

HEC-1 INPUT FILES - (3-1/2" Floppy Diskette)

MDP10B.1	Northeast Corner; 10-yr, 2-hr storm.
MDP10A.1	All areas except Northeast Corner; same storm.
MDP100B.1	Same area as MDP10B.1; 100-yr., 2-hr. storm.
MDP100A.1	Same area as MDP10A.1; 100-yr., 2-hr. storm.

PURPOSE

The purpose of this "Master Drainage Plan" is to show the existing conditions, proposed development and the analysis of the drainage characteristics for a portion of Sun Lakes. The drainage and hydrologic modeling standards established by the Flood Control District of Maricopa County (FCDMC) are used in this analysis. This report is a revision of the approved April, 1993 Sun Lakes Master Drainage Plan for Sections 29 and 30.

EXISTING LAND USE

The Sun Lakes community is located along Riggs Road east of I-10 (Figure 1, Page 2). The study area contains approximately 1280 acres of land in Section 29 and 30, Township 2 South, Range 5 East, Gila and Salt River Base and Meridian in Maricopa County, Arizona (Figure 2, Page 5). Presently, the Project Site has seven approved subdivisions, four of which have completed the construction phase and three that are currently being constructed. These subdivisions are denoted as Units 31, 32, 32A, 34, 35, 37 and 40. In addition, three more units are anticipated to be approved for construction by the end of 1996 and will be directly analyzed within the context of this report. These subdivisions include Units 36, 36A, and 36B. Figure 3 (in the back of this report) identifies the location of the approved and future units. All other areas analyzed in this report will be denoted as future and existing development which will include residential subdivisions, commercial areas, and existing (Oakwood Golf Course) and future proposed golf course areas (refer to Figure 3, insert). Other uses include two churches, a fire station, a construction yard, a wastewater treatment facility, RV storage and mini-warehouses, and a shopping center. The Project Site is owned by the Sun Lakes Development Company.

SCOPE

This analysis is used to develop a Master Drainage Plan consisting of existing and proposed roadways, channels, pipes, and other drainage structures designed to carry storm runoff away from the development and into a network of retention facilities within the golf course and designated areas. The retention basin system shall meet or exceed the 100-year design storm criterion used by FCDMC. Streets will meet the 10-year design storm criterion. The Master Drainage Plan (MDP) utilizes the interconnected lake system within the existing Oakwood golf course as the principle means of retaining storm runoff. The future proposed golf course located in the northeast portion of Section 29 will also be designed to retain storm runoff in a series of retention basins and lakes. Once implemented, this MDP will ensure that housing and commercial structures are above 100 year design storm flood levels.

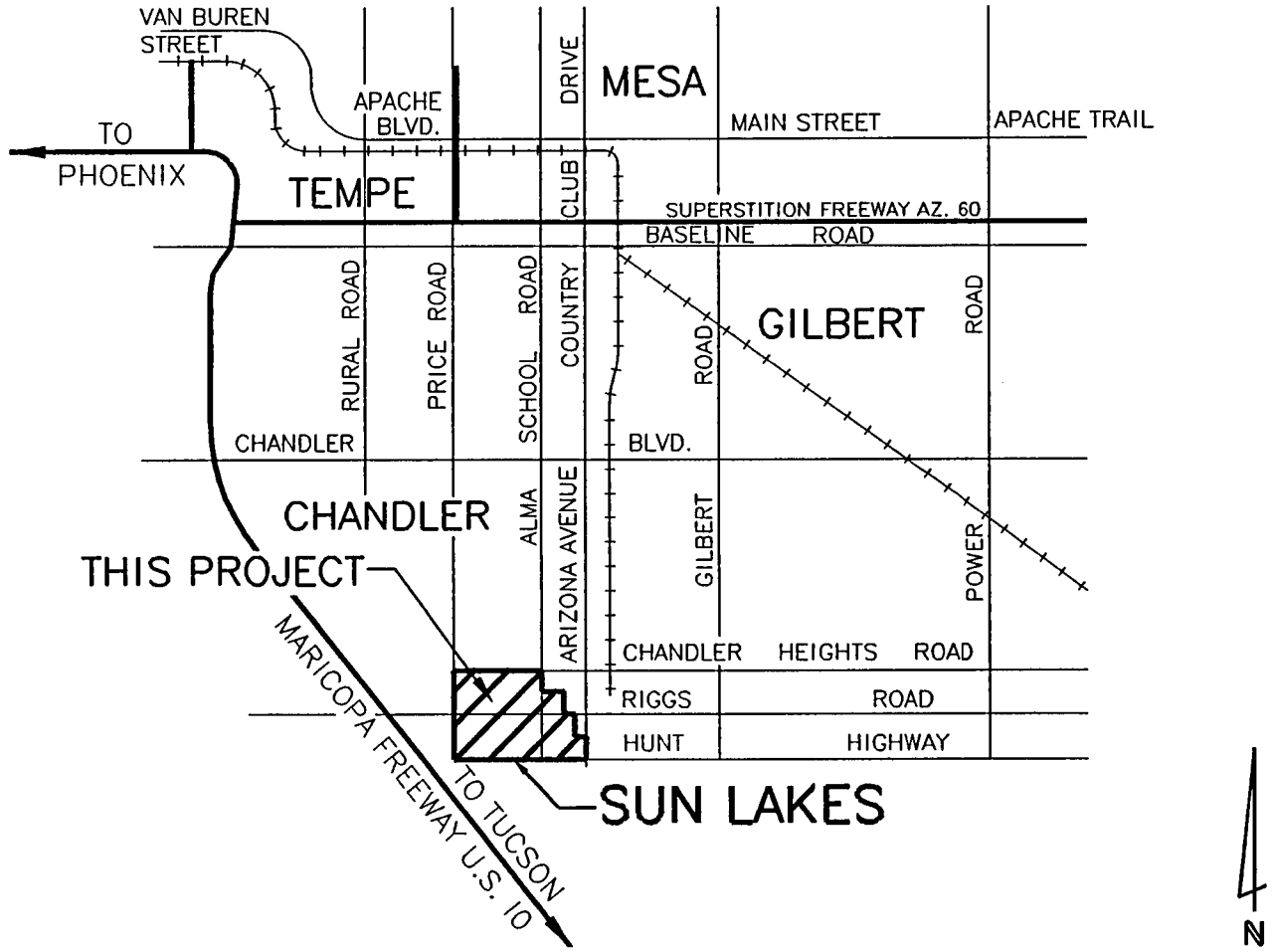


FIGURE 1
VICINITY MAP

N.T.S.

CLIMATE

The study area lies within the portion of Arizona designated as the Upper Sonoran Desert. The climate of the Project Site is typical of the arid region where temperatures range from 20 degrees F in winter to 122 degrees F in summer.

An average annual rainfall of approximately 8 inches occurs primarily during two periods throughout the year. Winter storms (December - March) are characterized by less intense, spacially large storms that have six hours to multi-day durations. These storms typically influence the higher elevations more than the desert plains.

The more intense thunderstorms that occur during the summer months (July - September) are considered to have a greater impact on areas the size of the Project Site. Therefore, the Design Storm for runoff retention is the 100-year frequency, 2-hour duration storm (as required by FCDMC).

SOIL, TOPOGRAPHY AND EXISTING VEGETATION

Overall, the soil is a blend of the indigenous soil types on the Project Site and a detailed discussion is in the Sun Lakes Development Master Plan. The antecedent moisture conditions are assumed to be "Normal" where the soil is above the "wilting point moisture" but below saturation. Due to farming and recreational usage, most if not all of the indigenous desert vegetation has been removed, resulting in no appreciable plant interception or evaporation losses. All rainfall losses are therefore assumed to be due to infiltration into the soil. The exception to this would be golf course areas, which have aproximately 95% turf or vegetative cover.

Drainage is improved on golf courses by regular aeration and "plugging" (for fertilization purposes). Golf courses also lose a significant amount due to evapo-transpiration losses.

In addition, a series of drywells constructed around the perimeter of designated lakes, will greatly improve rates of percolation and will aid in evacuating retained stormwater within the project site. However, infiltration by use of drywells will not be analyzed within the context of this report since these rates cannot be used in determining outflow rates in flood-routing according to FCDMC. The retention facilities which rely on infiltration by drywells will be sized to contain the maximum storage volume as specified by FCDMC.

The topography consists of flat desert plain with an overall slope of 0.17% to the west from the San Tan mountains.

REGIONAL OFFSITE DRAINAGE

The project region is protected by the Roosevelt Irrigation District floodway, which diverts sheet flows south to the Gila River. The banks of the Gila River are fairly well defined as a water course. The river is dry, has no permanent flow and has historically carried sizeable flows in this area.

The area immediately south of Hunt Highway (Southern Sun Lakes Border) and north of the Gila River is characterized by dense vegetation resulting from frequent storm flows through the area from Canal levee diversions located east of the Project Site (see Figure 2, Page 5).

LOCAL OFFSITE DRAINAGE

Locally, the project is protected by a grade break (ridge) located along the Chandler Heights Road alignment to the north. Generally, runoff east of Alma School Road flows southward. Runoff from a section of Alma School Road (approximately 1200' long; Figure 2a, Page 6) will drain onto the Project. Other offsite flows entering the Project Site are due to runoff from the Ironwood Development Units 27, 27a and 28, which are located in the southwest quarter of Section 28. All other 100-year, 2-hour runoff within Section 28 is retained onsite.

The 100 year - 2-hour offsite flows from Ironwood are intercepted by two lakes (Lakes 50 and 51) and retained by these lakes with emergency overflow from Lake 50 directed into inlets on Alma School Road that drain into a 15" pipe and are routed to Lake 34 (onsite - refer to Figure 2a, pg. 6). Along that pipe reach, storm drain inlets intercept some additional runoff from two areas in Ironwood and two on Alma School Road. Flows not intercepted by drains will enter the site on Champagne Drive (proposed), at the east boundary of the site.

A more detailed description of the offsite routing will be covered in the Hydrologic Modeling section of this report.

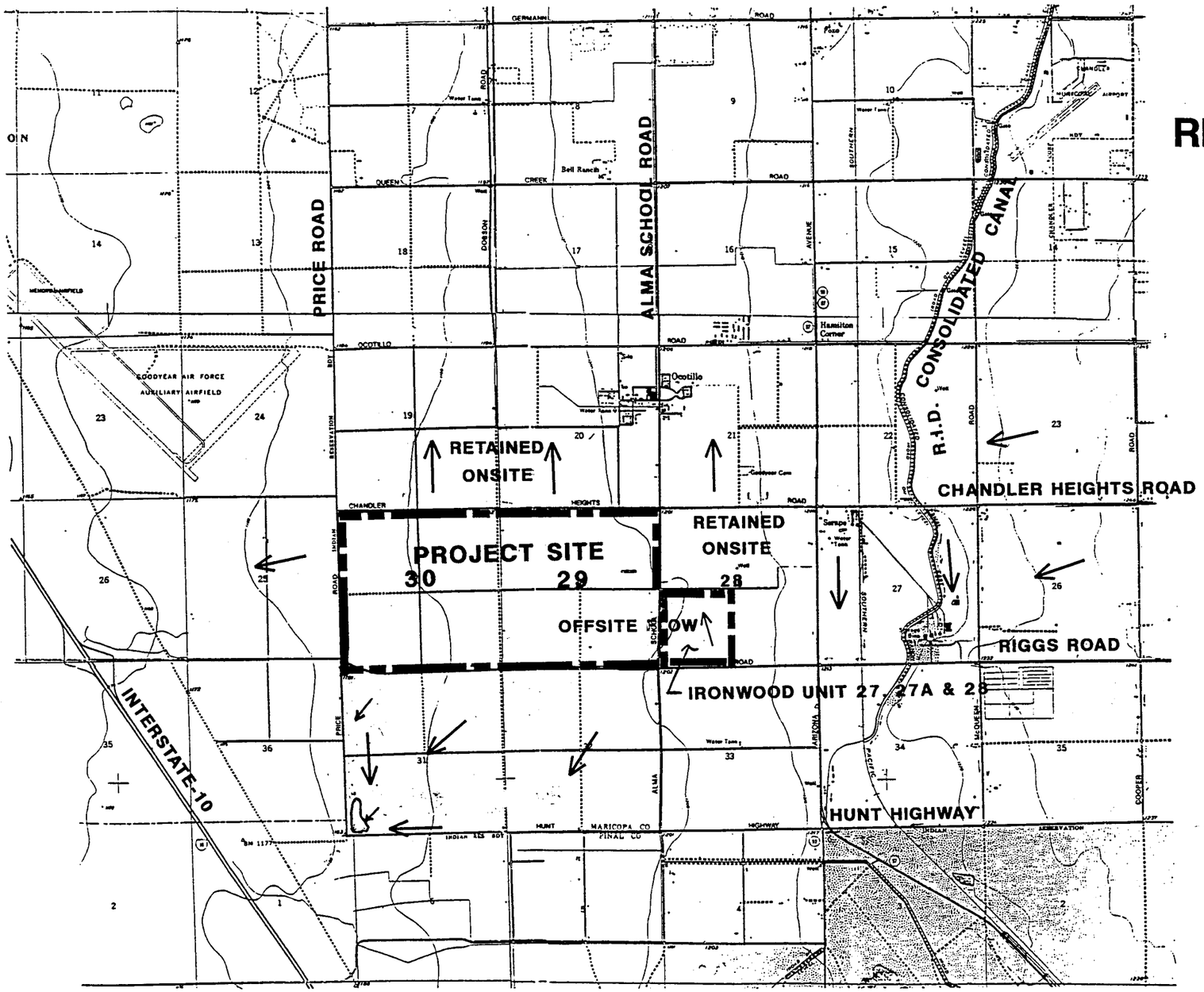
1992 ADDENDUM

Sun Lakes

DEVELOPMENT MASTER PLAN

REGIONAL OFFSITE DRAINAGE

FIGURE 2



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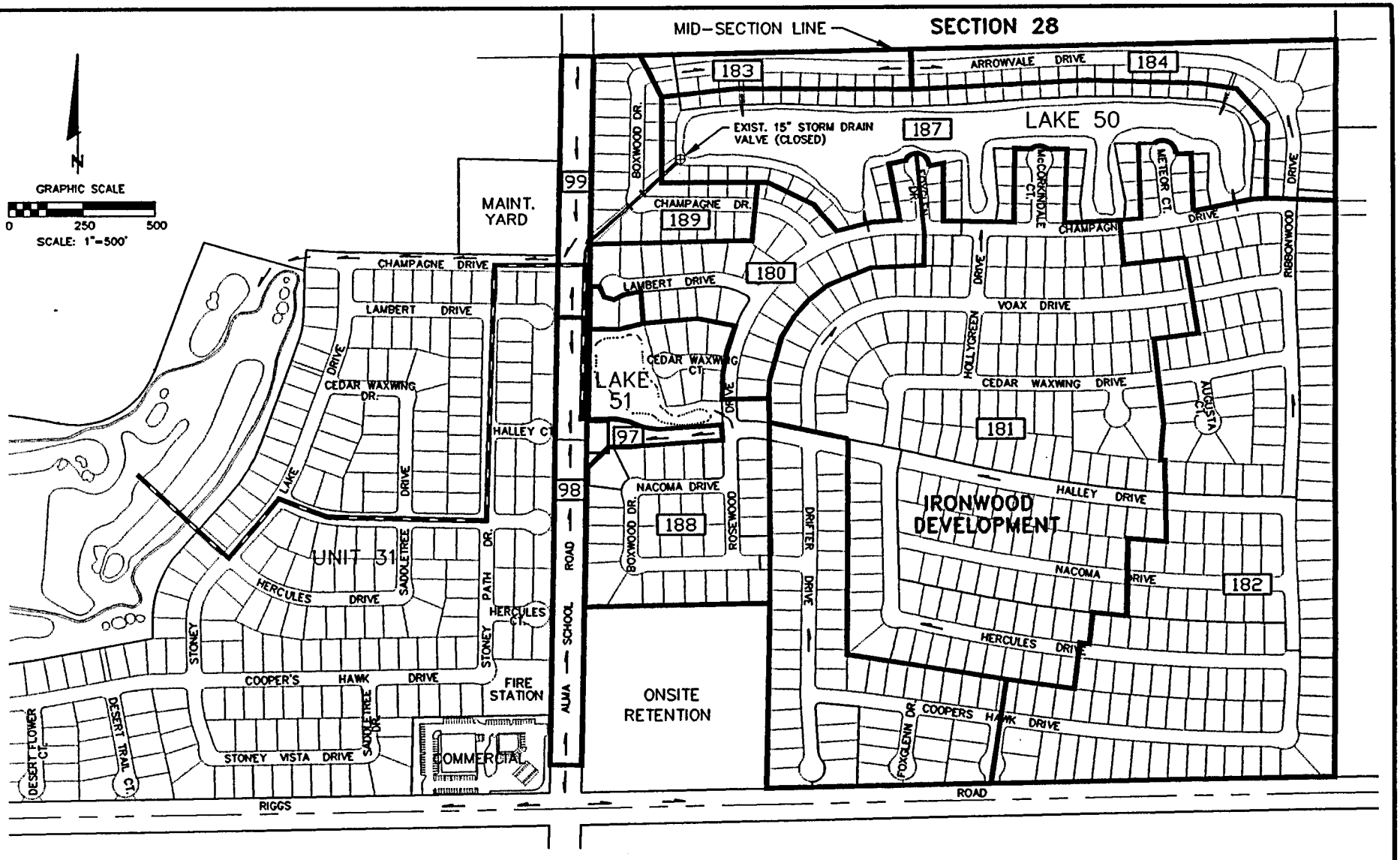
D&D B&R ENGINEERING, INC.
9666 E. RIGGS ROAD SUITE 502
SUN LAKES, ARIZONA 85248
(602) 895-0799

REVISED 3-17-93



LEGEND

- SUB-BASIN BOUNDARY
- 180 OFFSITE SUB-BASIN
- DIRECTION OF FLOW
- EXIST. INLETS
- EXIST. STORM DRAIN

FIGURE 2A

LOCAL OFFSITE DRAINAGE MAP

DBR ENGINEERING INC.
9666 E. RIGGS RD. SUITE 502
SUN LAKES, ARIZONA 85248
PHONE: (602) 895-0799

MAY 16, 1996

2930DRN.DWG

DESIGN STORM DEPTH

The runoff retention facilities are designed to contain the runoff from a 100-year frequency, 2-hour duration storm (design storm). The depths for the design storm and for the 2, 5, 10, 25, 50 and 100 year frequency storms are calculated using the rainfall maps and formulas outlined in the Drainage Design Manual, Hydrology Vol. I (Flood Control District of Maricopa County, 1992 and 1995 revisions). The Precipitation Depth Summary Table for these storm frequencies (durations of 5 minutes through 24 hours) and the FCDMC precipitation maps for Maricopa County are shown in the Calculations, Appendix A.

The 100-year, 2-hour design storm depth is 2.60 inches. Due to the relatively small drainage area of 2.25 square miles, the areal adjustment factor used is 1.00 (which is conservative). The FCDMC 2-hour storm distribution is used in the HEC-1 storm runoff model.

OVERALL SOIL CHARACTERISTICS

Drainage sub-basins are delineated using the grading plan for approved units and a preliminary street layout and grading plan for future development areas of Phase III (May, 1996). The Green and Ampt method for estimating rainfall losses is used in the HEC-1 model. Typical Green & Ampt parameters were developed for each land use. The soil type is a blend of Es, Mo, Mv, Tx and Vf soils according to the Soil Conservation Service - Eastern Maricopa and Northern Pinal Counties Area, Arizona - Soil Survey (et al) 1974.

The Green and Ampt parameters are based on Appendix C, Table 4.2 (FCDMC Hydrology, Vol. 1). Upon completion, the native soils will have been scraped, stockpiled and then redistributed over the project area. Therefore a uniform soil type is assumed. The Green and Ampt soil loss parameters are used to describe the entire project area (Calculations, Appendix B).

LAND USE SOIL LOSS PARAMETERS

The Initial Abstracts are determined by land use (Table 4.1, FCDMC). The Initial Abstract for golf courses is increased due to the 95% vegetative cover (existing trees, shrubs and turf). The bare-ground hydraulic conductivity (XKSAT) values for each soil type are taken from Appendix C-Table 4.2 (FCDMC Hydrology, Vol. 1) and then averaged using equation 4.4. That bare-ground XKSAT value is multiplied by a vegetation cover adjustment factor (C_k). The factor is: C_k= 2.00 for golf courses and C_k= 1.12 for the residential and commercial areas (see Figure 4.4, Appendix B, this report). The adjusted XKSAT value for each land use is shown at the top of Table 1 (pgs 9 - 20). Values for capillary suction (PSIF) and soil moisture deficit (DTHETA) are determined using the adjusted XKSAT value for a given land use and Figure 4.3 (Appendix B). See Appendix B of this report for the FCDMC tables, figures and the calculations. The values for all of the Land Use Soil Loss Parameters are shown at the top of Table 1 in this report.

The percent impervious (RTIMP) values for Single Family Residences use typical lot coverages for UR\L & UR\M zoning (see Sun Lakes Development Master Plan and Appendix B). The RTIMP for commercial (GRC), resort (MUC), Light industrial (LIC) and high density residential (UR\H) are assumed to be similar. See the upper portion of Table 1 (pg. 9) of this report for estimated loss parameters for each land use. It should be noted that HEC-1 does not consider any infiltration for areas with RTIMP = 100%. *Therefore, any reasonable Green and Ampt parameters may be input for lake areas.*

LAND USES

Land uses are grouped by drainage characteristics as follows:

Single Family Residences (UR\L & UR\M)
Commercial (GRC, MUC, LIC, UR\H & Alma School Road)
Golf Course (OS)
Lakes (no zone designation)
Drainageway (defined channelized drainage network)

Since many of the sub-basins have more than one land-use, the individual loss parameters are an area weighted average of the Land-use Soil Loss Parameters and are shown in Table 1. The watershed resistance coefficient is:

$$K_b = m * \log(A) + b \qquad \text{(Equation on Table 5.1, FCDMC)}$$

The value for K_b is also area weighted and shown on Table 1 of the report. The physical characteristics (A, L, & S) of each sub-basin are shown in Table 1. Area (A) is in square miles, flowpath length (L) is in miles and slope (S) is in feet per mile. The values used for "m" and "b" are: **m = -0.00625 and b = 0.04**. Exceptions to the k_b equation for establishing a watershed resistance value may apply to sub-basins that are predominantly channelized or have a more defined drainage network.

TABLE 1

5-6-96

(SLGRAMP1.WQ2)

SUB-BASIN RAINFALL LOSS PARAMETERS

RESIST. COEFF. PARAMETERS	
m(res, comm) =	-0.006
m(lake) =	-0.006
m(golf, o.s.) =	-0.006
b(res, comm) =	0.040
b(lake) =	0.040
b(golf, o.s.) =	0.040

LAND USE	IA	DTHETA	PSIF	XKSAT	RTIMP
Res SF	0.100	0.250	4.800	0.260	30.000
Res CAS	0.100	0.250	4.800	0.260	40.000
Golf/O.S.	0.500	0.255	3.750	0.460	1.000
Comm	0.050	0.250	5.000	0.230	80.000
Lake	0.000	0.250	5.000	0.230	100.000

SPECIFIC SUB-BASIN DATA					WEIGHTED GREEN / AMPT PARAMETERS								
Sub-Basin #	Area (mi^2)	Length (mi)	Resist. Coeff. Kb	Slope (ft/mi)	IA	DTHETA	PSIF	XKSAT	RTIMP (%)	100-yr, 2-hr Tc(hr)	R(hr)	10-yr, 2-hr Tc(hr)	R(hr)
OFFSITE *													
97.000	0.0013	0.080	0.041	62.857	0.050	0.250	5.000	0.230	80.000	0.083	0.160	0.092	0.177
98.000	0.0056	0.205	0.037	12.711	0.050	0.250	5.000	0.230	80.000	0.217	0.352	0.271	0.451
99.000	0.0030	0.110	0.038	22.759	0.050	0.250	5.000	0.230	80.000	0.121	0.166	0.154	0.218
180.000	0.0119	0.189	0.034	4.066	0.100	0.250	4.800	0.260	30.000	0.313	0.334	0.429	0.475
181.000	0.0601	0.402	0.030	26.674	0.100	0.250	4.800	0.260	30.000	0.225	0.169	0.292	0.226
182.000	0.0574	0.591	0.030	10.543	0.100	0.250	4.800	0.260	30.000	0.417	0.471	0.583	0.684
183.000	0.0056	0.121	0.037	18.975	0.100	0.250	4.800	0.260	30.000	0.142	0.144	0.179	0.187
184.000	0.0089	0.220	0.035	13.883	0.100	0.250	4.800	0.260	30.000	0.217	0.296	0.283	0.398
187.000	0.0257	0.009	0.032	260.000	0.070	0.251	4.835	0.259	76.100	0.083	0.004	0.083	0.004
188.000	0.0422	0.379	0.031	13.094	0.110	0.250	4.768	0.267	35.550	0.287	0.260	0.387	0.362
189.000	0.0094	0.129	0.035	33.000	0.100	0.250	4.800	0.260	30.000	0.112	0.093	0.146	0.124

* See also Figure 2a

TABLE 1

5-6-96

(SLGRAMP1.WQ2)

SUB-BASIN RAINFALL LOSS PARAMETERS

RESIST. COEFF. PARAMETERS	
m(res, comm) =	-0.006
m(lake) =	-0.006
m(golf, o.s.) =	-0.006
b(res, comm) =	0.040
b(lake) =	0.040
b(golf, o.s.) =	0.040

LAND USE	IA	DTHETA	PSIF	XKSAT	RTIMP
Res SF	0.100	0.250	4.800	0.260	30.000
Res CAS	0.100	0.250	4.800	0.260	40.000
Golf/O.S.	0.500	0.255	3.750	0.460	1.000
Comm	0.050	0.250	5.000	0.230	80.000
Lake	0.000	0.250	5.000	0.230	100.000

SPECIFIC SUB-BASIN DATA					WEIGHTED GREEN / AMPT PARAMETERS								
Sub-Basin #	Area (mi^2)	Length (mi)	Resist. Coeff. Kb	Slope (ft/mi)	IA	DTHETA	PSIF	XKSAT	RTIMP (%)	100-yr, 2-hr Tc(hr)	R(hr)	10-yr, 2-hr Tc(hr)	R(hr)
ONSITE *													
10	0.0077	0.136	0.036	20.533	0.100	0.250	4.800	0.260	30.000	0.146	0.142	0.183	0.183
14	0.0080	0.148	0.036	20.308	0.100	0.250	4.800	0.260	30.000	0.154	0.158	0.196	0.206
16	0.0081	0.148	0.036	18.277	0.100	0.250	4.800	0.260	30.000	0.158	0.161	0.204	0.214
20	0.0184	0.184	0.033	21.773	0.440	0.254	3.908	0.430	5.350	0.171	0.131	0.258	0.207
24	0.0091	0.130	0.035	24.666	0.100	0.250	4.800	0.260	30.000	0.129	0.109	0.167	0.144
28	0.0071	0.112	0.036	19.688	0.100	0.250	4.800	0.260	30.000	0.129	0.111	0.167	0.147
30	0.0201	0.169	0.033	17.798	0.440	0.254	3.908	0.430	5.350	0.175	0.120	0.267	0.191
40	0.0111	0.148	0.035	20.985	0.100	0.250	4.800	0.260	30.000	0.146	0.123	0.192	0.167
44	0.0073	0.169	0.036	23.137	0.100	0.250	4.800	0.260	30.000	0.158	0.191	0.200	0.247
50	0.0124	0.116	0.034	17.171	0.440	0.254	3.908	0.430	5.350	0.142	0.092	0.217	0.148
76**	0.0045	0.287	0.025	23.350	0.050	0.250	5.000	0.230	80.000	0.167	0.406	0.204	0.508
78**	0.0034	0.222	0.025	12.185	0.050	0.250	5.000	0.230	80.000	0.183	0.431	0.225	0.541
84	0.0046	0.102	0.037	17.600	0.100	0.250	4.800	0.260	30.000	0.129	0.132	0.167	0.175
98	0.0134	0.222	0.034	29.333	0.100	0.250	4.800	0.260	30.000	0.167	0.177	0.208	0.227
110	0.0072	0.098	0.036	40.615	0.440	0.254	3.908	0.430	5.350	0.096	0.071	0.146	0.113
80	0.0086	0.142	0.035	35.904	0.100	0.250	4.800	0.260	30.000	0.117	0.108	0.150	0.142
82	0.0044	0.076	0.037	23.760	0.100	0.250	4.800	0.260	30.000	0.100	0.081	0.125	0.103
90	0.0173	0.222	0.033	22.564	0.100	0.250	4.800	0.260	30.000	0.179	0.166	0.225	0.214
94	0.0122	0.148	0.034	21.662	0.100	0.250	4.800	0.260	30.000	0.142	0.113	0.183	0.150

* See also Figure 3

** Kb factor is less due to a defined drainage network identified by Sun Lakes Blvd. and L > 1000 ft (ADOT Table 2-1, Pg. 2-8).

TABLE 1

5-31-96

(SLGRAMP1.WQ2)

SUB-BASIN RAINFALL LOSS PARAMETERS

RESIST. COEFF. PARAMETERS	
m(res, comm) =	-0.006
m(lake) =	-0.006
m(golf, o.s.) =	-0.006
b(res, comm) =	0.040
b(lake) =	0.040
b(golf, o.s.) =	0.040

LAND USE	IA	DTHETA	PSIF	XKSAT	RTIMP
Res SF	0.100	0.250	4.800	0.260	30.000
Res CAS	0.100	0.250	4.800	0.260	40.000
Golf/O.S.	0.500	0.255	3.750	0.460	1.000
Comm	0.050	0.250	5.000	0.230	80.000
Lake	0.000	0.250	5.000	0.230	100.000

SPECIFIC SUB-BASIN DATA					WEIGHTED GREEN / AMPT PARAMETERS								
Sub-Basin #	Area (mi^2)	Length (mi)	Resist. Coeff. Kb	Slope (ft/mi)	IA	DTHETA	PSIF	XKSAT	RTIMP (%)	100-yr, 2-hr Tc(hr)	R(hr)	10-yr, 2-hr Tc(hr)	R(hr)
ONSITE *													
112	0.0129	0.112	0.034	13.424	0.420	0.254	3.960	0.420	6.800	0.154	0.096	0.225	0.146
120	0.0099	0.153	0.035	18.252	0.100	0.250	4.800	0.260	30.000	0.158	0.148	0.204	0.196
124	0.0120	0.161	0.034	16.772	0.100	0.250	4.800	0.260	30.000	0.167	0.146	0.213	0.191
130	0.0219	0.195	0.033	20.505	0.440	0.254	3.908	0.430	5.350	0.183	0.134	0.279	0.214
140	0.0075	0.127	0.036	19.701	0.100	0.250	4.800	0.260	30.000	0.142	0.132	0.179	0.171
142	0.0059	0.102	0.036	27.378	0.100	0.250	4.800	0.260	30.000	0.108	0.094	0.138	0.123
144	0.0162	0.214	0.034	17.288	0.100	0.250	4.800	0.260	30.000	0.196	0.185	0.250	0.243
146	0.0079	0.182	0.036	19.800	0.100	0.250	4.800	0.260	30.000	0.175	0.216	0.225	0.285
148	0.0102	0.159	0.035	18.857	0.100	0.250	4.800	0.260	30.000	0.162	0.154	0.204	0.199
150	0.0222	0.095	0.033	52.800	0.307	0.253	4.239	0.369	34.042	0.083	0.031	0.104	0.040
156	0.0051	0.102	0.037	34.222	0.100	0.250	4.800	0.260	30.000	0.100	0.094	0.129	0.124
158	0.0103	0.131	0.035	17.600	0.100	0.250	4.800	0.260	30.000	0.146	0.117	0.188	0.154
160	0.0090	0.064	0.035	31.059	0.420	0.254	3.960	0.420	6.800	0.083	0.038	0.121	0.058
168	0.0059	0.116	0.036	25.967	0.100	0.250	4.800	0.260	30.000	0.121	0.118	0.154	0.155
170	0.0125	0.127	0.034	15.761	0.420	0.254	3.960	0.420	6.800	0.158	0.112	0.229	0.168
174	0.0099	0.176	0.035	21.006	0.100	0.250	4.800	0.260	30.000	0.167	0.175	0.208	0.224
176	0.0078	0.148	0.036	28.431	0.100	0.250	4.800	0.260	30.000	0.133	0.136	0.175	0.184
178	0.0144	0.188	0.034	17.600	0.100	0.250	4.800	0.260	30.000	0.179	0.162	0.229	0.212
180	0.0028	0.116	0.038	25.967	0.420	0.254	3.960	0.420	6.800	0.129	0.194	0.196	0.308

* See also Figure 3

TABLE 1

SUB-BASIN RAINFALL LOSS PARAMETERS

5-6-96

(SLGRAMP1.WQ2)

RESIST. COEFF. PARAMETERS	
m(res, comm) =	-0.006
m(lake) =	-0.006
m(golf, o.s.) =	-0.006
b(res, comm) =	0.040
b(lake) =	0.040
b(golf, o.s.) =	0.040

LAND USE	IA	DTHETA	PSIF	XKSAT	RTIMP
Res SF	0.100	0.250	4.800	0.260	30.000
Res CAS	0.100	0.250	4.800	0.260	40.000
Golf/O.S.	0.500	0.255	3.750	0.460	1.000
Comm	0.050	0.250	5.000	0.230	80.000
Lake	0.000	0.250	5.000	0.230	100.000

SPECIFIC SUB-BASIN DATA					WEIGHTED GREEN / AMPT PARAMETERS								
Sub-Basin #	Area (mi^2)	Length (mi)	Resist. Coeff. Kb	Slope (ft/mi)	IA	DTHETA	PSIF	XKSAT	RTIMP (%)	100-yr, 2-hr Tc(hr)	R(hr)	10-yr, 2-hr Tc(hr)	R(hr)
ONSITE *													
200.000	0.0062	0.076	0.036	33.000	0.050	0.250	5.000	0.230	80.000	0.083	0.054	0.104	0.069
210.000	0.0334	0.350	0.032	15.811	0.100	0.250	4.800	0.260	30.000	0.262	0.251	0.346	0.341
218.000	0.0224	0.255	0.033	21.866	0.100	0.250	4.800	0.260	30.000	0.196	0.177	0.250	0.232
220.000	0.0111	0.229	0.035	17.891	0.100	0.250	4.800	0.260	30.000	0.204	0.254	0.262	0.335
221.000	0.0211	0.280	0.033	18.444	0.100	0.250	4.800	0.260	30.000	0.221	0.225	0.283	0.297
223.000	0.0057	0.128	0.037	21.120	0.100	0.250	4.800	0.260	30.000	0.138	0.150	0.179	0.201
225.000	0.0038	0.116	0.038	17.311	0.100	0.250	4.800	0.260	30.000	0.146	0.187	0.188	0.247
227.000	0.0525	0.223	0.030	30.875	0.400	0.254	4.010	0.411	12.365	0.158	0.077	0.225	0.114
230.000	0.0267	0.252	0.032	15.880	0.050	0.250	5.000	0.230	80.000	0.208	0.170	0.258	0.216
232.000	0.0113	0.195	0.035	14.815	0.100	0.250	4.800	0.260	30.000	0.200	0.216	0.254	0.282
234.000	0.0113	0.206	0.035	12.788	0.100	0.250	4.800	0.260	40.000	0.217	0.246	0.275	0.321
240.000	0.0321	0.201	0.032	25.902	0.358	0.253	4.110	0.393	23.845	0.162	0.097	0.221	0.136
250.000	0.0233	0.186	0.033	23.167	0.100	0.250	4.800	0.260	40.000	0.158	0.106	0.200	0.138
252.000	0.0079	0.116	0.036	23.370	0.100	0.250	4.800	0.260	30.000	0.125	0.104	0.162	0.139
260.000	0.0332	0.180	0.032	38.349	0.460	0.255	3.855	0.440	3.900	0.133	0.070	0.208	0.115
262.000	0.0038	0.163	0.038	11.665	0.100	0.250	4.800	0.260	30.000	0.204	0.356	0.267	0.479
264.000	0.0048	0.134	0.037	18.723	0.100	0.250	4.800	0.260	30.000	0.150	0.189	0.192	0.248
266.000	0.0060	0.100	0.036	26.898	0.100	0.250	4.800	0.260	30.000	0.108	0.092	0.138	0.120
268.000	0.0044	0.086	0.037	23.209	0.100	0.250	4.800	0.260	30.000	0.104	0.093	0.133	0.122
270.000	0.0114	0.106	0.035	23.571	0.390	0.254	4.039	0.405	8.975	0.121	0.075	0.175	0.114
280.000	0.0045	0.160	0.037	15.621	0.100	0.250	4.800	0.260	30.000	0.179	0.276	0.229	0.362
282.000	0.0080	0.144	0.036	20.842	0.100	0.250	4.800	0.260	30.000	0.150	0.150	0.192	0.197
284.000	0.0055	0.126	0.037	19.850	0.100	0.250	4.800	0.260	30.000	0.142	0.156	0.183	0.208
286.000	0.0146	0.162	0.034	24.702	0.388	0.254	4.043	0.404	9.091	0.150	0.117	0.217	0.176

* See also Figure 3

TABLE 1

SUB-BASIN RAINFALL LOSS PARAMETERS

5-6-96

(SLGRAMP1.WQ2)

RESIST. COEFF. PARAMETERS	
m(res, comm) =	-0.006
m(lake) =	-0.006
m(golf, o.s.) =	-0.006
b(res, comm) =	0.040
b(lake) =	0.040
b(golf, o.s.) =	0.040

LAND USE	IA	DTHETA	PSIF	XKSAT	RTIMP
Res SF	0.100	0.250	4.800	0.260	30.000
Res CAS	0.100	0.250	4.800	0.260	40.000
Golf/O.S.	0.500	0.255	3.750	0.460	1.000
Comm	0.050	0.250	5.000	0.230	80.000
Lake	0.000	0.250	5.000	0.230	100.000

SPECIFIC SUB-BASIN DATA					WEIGHTED GREEN / AMPT PARAMETERS								
Sub-Basin #	Area (mi^2)	Length (mi)	Resist. Coeff. Kb	Slope (ft/mi)	IA	DTHETA	PSIF	XKSAT	RTIMP (%)	100-yr, 2-hr Tc(hr)	R(hr)	10-yr, 2-hr Tc(hr)	R(hr)
ONSITE *													
289.000	0.0115	0.178	0.035	28.085	0.500	0.255	3.750	0.460	1.000	0.162	0.158	0.262	0.269
290.000	0.0148	0.164	0.034	42.728	0.442	0.254	3.897	0.433	9.513	0.125	0.096	0.188	0.150
292.000	0.0388	0.350	0.031	14.270	0.050	0.250	5.000	0.230	80.000	0.258	0.227	0.321	0.288
294.000	0.0175	0.250	0.033	16.000	0.100	0.250	4.800	0.260	40.000	0.213	0.219	0.275	0.292
300.000	0.0249	0.233	0.032	15.883	0.050	0.250	5.000	0.230	80.000	0.196	0.155	0.246	0.199
310.000	0.0260	0.250	0.032	8.000	0.140	0.251	4.750	0.276	64.200	0.267	0.225	0.342	0.297
320.000	0.0186	0.142	0.033	28.160	0.333	0.253	4.173	0.382	29.828	0.125	0.075	0.171	0.106
334.000	0.0087	0.134	0.035	20.079	0.100	0.250	4.800	0.260	30.000	0.142	0.127	0.183	0.168
336.000	0.0058	0.114	0.036	19.360	0.100	0.250	4.800	0.260	30.000	0.133	0.131	0.171	0.172
340.000	0.0339	0.205	0.032	42.824	0.370	0.254	4.084	0.397	18.667	0.133	0.077	0.188	0.112
366.000	0.0012	0.152	0.041	16.398	0.100	0.250	4.800	0.260	30.000	0.183	0.576	0.233	0.753
368.000	0.0080	0.161	0.036	18.635	0.100	0.250	4.800	0.260	30.000	0.167	0.184	0.213	0.241
370.000	0.0127	0.098	0.034	55.846	0.450	0.254	3.881	0.435	4.625	0.083	0.044	0.125	0.069
386.000	0.0221	0.288	0.033	14.589	0.100	0.250	4.800	0.260	30.000	0.242	0.248	0.321	0.340
390.000	0.0268	0.153	0.032	39.111	0.346	0.253	4.149	0.385	19.292	0.117	0.060	0.162	0.086
400.000	0.0082	0.153	0.035	19.556	0.100	0.250	4.800	0.260	30.000	0.154	0.160	0.200	0.213
404.000	0.0056	0.119	0.037	18.438	0.100	0.250	4.800	0.260	30.000	0.142	0.148	0.179	0.192
406.000	0.0086	0.165	0.035	19.421	0.100	0.250	4.800	0.260	30.000	0.162	0.175	0.208	0.231

* See also Figure 3

TABLE 1

5-31-96

(SLGRAMP1.WQ2)

SUB-BASIN RAINFALL LOSS PARAMETERS

RESIST. COEFF. PARAMETERS	
m(res, comm) =	-0.006
m(lake) =	-0.006
m(golf, o.s.) =	-0.006
b(res, comm) =	0.040
b(lake) =	0.040
b(golf, o.s.) =	0.040

LAND USE	IA	DTHETA	PSIF	XKSAT	RTIMP
Res SF	0.100	0.250	4.800	0.260	30.000
Res CAS	0.100	0.250	4.800	0.260	40.000
Golf/O.S.	0.500	0.255	3.750	0.460	1.000
Comm	0.050	0.250	5.000	0.230	80.000
Lake	0.000	0.250	5.000	0.230	100.000

SPECIFIC SUB-BASIN DATA					WEIGHTED GREEN / AMPT PARAMETERS								
Sub-Basin #	Area (mi^2)	Length (mi)	Resist. Coeff. Kb	Slope (ft/mi)	IA	DTHETA	PSIF	XKSAT	RTIMP (%)	100-yr, 2-hr Tc(hr)	100-yr, 2-hr R(hr)	10-yr, 2-hr Tc(hr)	10-yr, 2-hr R(hr)
ONSITE *													
420.000	0.0432	0.189	0.031	13.200	0.050	0.250	5.000	0.230	80.000	0.183	0.089	0.225	0.112
470.000	0.0306	0.203	0.032	26.153	0.316	0.253	4.224	0.371	24.269	0.162	0.100	0.217	0.138
495.000	0.0230	0.275	0.033	15.294	0.100	0.250	4.800	0.260	30.000	0.233	0.225	0.304	0.302
500.000	0.0115	0.106	0.035	39.600	0.400	0.254	4.013	0.410	8.250	0.100	0.061	0.146	0.092
530.000	0.0156	0.201	0.034	16.936	0.100	0.250	4.800	0.260	30.000	0.188	0.171	0.242	0.227
535.000	0.0122	0.208	0.034	17.760	0.100	0.250	4.800	0.260	30.000	0.192	0.208	0.246	0.274
540.000	0.0166	0.229	0.034	19.200	0.100	0.250	4.800	0.260	30.000	0.196	0.193	0.250	0.253
545.000	0.0108	0.232	0.035	12.705	0.100	0.250	4.800	0.260	30.000	0.233	0.302	0.304	0.405
550.000	0.0385	0.295	0.031	20.985	0.340	0.253	4.160	0.383	21.356	0.213	0.160	0.300	0.234
560.000	0.0475	0.455	0.031	9.900	0.050	0.250	5.000	0.230	80.000	0.346	0.344	0.442	0.452
570.000	0.0193	0.197	0.033	43.154	0.275	0.253	4.313	0.357	45.550	0.129	0.099	0.171	0.135
575.000	0.0259	0.235	0.032	13.200	0.168	0.251	4.613	0.297	40.003	0.221	0.174	0.283	0.230
580.000	0.0116	0.161	0.035	13.200	0.050	0.250	5.000	0.230	80.000	0.179	0.161	0.221	0.204
590.000	0.0052	0.136	0.037	13.200	0.050	0.250	5.000	0.230	80.000	0.171	0.211	0.208	0.263
630.000	0.0289	0.275	0.032	18.207	0.050	0.250	5.000	0.230	80.000	0.208	0.174	0.258	0.221

* See also Figure 3

TOTAL 1.3881 SQ.MI.

ONSITE

AREA

TABLE 1

SUB-BASIN RAINFALL LOSS PARAMETERS

5-7-96

(EXUNGAMP.WQ2)

RESIST. COEFF. PARAMETERS		LAND USE	IA	DTHETA	PSIF	XKSAT	RTIMP
m(res, comm) =	-0.006	Res SF	0.100	0.250	4.800	0.260	30
m(lake) =	-0.006	Res CAS	0.100	0.250	4.800	0.260	40
m(golf, o.s.) =	-0.006	Golf/O.S.	0.500	0.255	3.750	0.460	1
b(res, comm) =	0.040	Comm	0.050	0.250	5.000	0.230	80
b(lake) =	0.040	Lake	0.000	0.250	5.000	0.230	100
b(golf, o.s.) =	0.040						

UNIT 32 & 32A SUB-BASIN DATA

SPECIFIC SUB-BASIN DATA					WEIGHTED GREEN / AMPT PARAMETERS								
Sub-Basin #	Area (mi^2)	Length (mi)	Resist. Coeff, Kb	Slope (ft/mi)	IA	DTHETA	PSIF	XKSAT	RTIMP (%)	100-yr, 2-hr Tc(hr)	R(hr)	10-yr, 2-hr Tc(hr)	R(hr)
32-1	0.007	0.174	0.036	17.217	0.100	0.250	4.800	0.260	30.000	0.179	0.229	0.229	0.301
32-2A	0.010	0.239	0.035	20.952	0.100	0.250	4.800	0.260	30.000	0.196	0.266	0.254	0.355
32-2B	0.010	0.246	0.035	20.930	0.100	0.250	4.800	0.260	30.000	0.200	0.279	0.258	0.370
32-2C	0.008	0.180	0.036	18.900	0.100	0.250	4.800	0.260	30.000	0.175	0.213	0.225	0.281
32-3A	0.008	0.208	0.036	18.270	0.100	0.250	4.800	0.260	30.000	0.196	0.270	0.250	0.354
32-3B	0.009	0.189	0.035	20.060	0.100	0.250	4.800	0.260	30.000	0.175	0.207	0.225	0.273
32-3C	0.006	0.098	0.036	20.308	0.100	0.250	4.800	0.260	30.000	0.117	0.098	0.150	0.130
32-4A	0.011	0.227	0.035	15.400	0.100	0.250	4.800	0.260	30.000	0.213	0.265	0.279	0.358
32-4B	0.017	0.198	0.034	19.200	0.100	0.250	4.800	0.260	30.000	0.179	0.153	0.229	0.201
32-5A	0.008	0.170	0.036	8.213	0.050	0.250	5.000	0.230	80.000	0.225	0.268	0.279	0.341
32-5B	0.022	0.322	0.033	18.320	0.100	0.250	4.800	0.260	30.000	0.237	0.267	0.313	0.362
32-6B	0.012	0.184	0.034	19.600	0.100	0.250	4.800	0.260	30.000	0.171	0.167	0.217	0.218
32-6C*	0.004	0.284	0.025	11.110	0.050	0.250	5.000	0.230	80.000	0.217	0.576	0.271	0.738
32A-6A	0.006	0.129	0.036	13.200	0.100	0.250	4.800	0.260	30.000	0.167	0.182	0.213	0.238

* Kb factor for SUB 6C has been modified to represent a defined drainage network with flow transmitted through the street. SUB 6A will be reached through this network in the HEC-1 model. SUB 6C will be designated as commercial due to the extent of pavement.

TOTAL AREA 0.139 SQ.MI.

ONSITE

TABLE 1

5-7-96

(EXUNGAMP.WQ2)

SUB-BASIN RAINFALL LOSS PARAMETERS

RESIST. COEFF. PARAMETERS		LAND USE	IA	DTHETA	PSIF	XKSAT	RTIMP
m(res, comm) =	-0.006	Res SF	0.100	0.250	4.800	0.260	30
m(lake) =	-0.006	Res CAS	0.100	0.250	4.800	0.260	40
m(golf, o.s.) =	-0.006	Golf/O.S.	0.500	0.255	3.750	0.460	1
b(res, comm) =	0.040	Comm	0.050	0.250	5.000	0.230	80
b(lake) =	0.040	Lake	0.000	0.250	5.000	0.230	100
b(golf, o.s.) =	0.040						

UNIT 34 SUB-BASIN DATA

SPECIFIC SUB-BASIN DATA					WEIGHTED GREEN / AMPT PARAMETERS								
Sub-Basin #	Area (mi^2)	Length (mi)	Resist. Coeff. Kb	Slope (ft/mi)	IA	DTHETA	PSIF	XKSAT	RTIMP (%)	100-yr, 2-hr Tc(hr)	R(hr)	10-yr, 2-hr Tc(hr)	R(hr)
34-1	0.009	0.131	0.035	13.697	0.100	0.250	4.800	0.260	30.000	0.167	0.167	0.213	0.219
34-2	0.014	0.227	0.034	14.740	0.100	0.250	4.800	0.260	30.000	0.213	0.231	0.275	0.307
34-3A	0.014	0.208	0.034	13.872	0.100	0.250	4.800	0.260	30.000	0.208	0.210	0.267	0.277
34-3B	0.009	0.227	0.035	17.028	0.100	0.250	4.800	0.260	30.000	0.208	0.290	0.267	0.382
34-3C	0.002	0.059	0.039	20.439	0.100	0.250	4.800	0.260	30.000	0.092	0.094	0.117	0.122
34-4A	0.010	0.163	0.035	17.743	0.100	0.250	4.800	0.260	30.000	0.167	0.164	0.213	0.214
34-4B	0.003	0.081	0.038	19.647	0.100	0.250	4.800	0.260	30.000	0.112	0.120	0.142	0.155
34-5A	0.014	0.225	0.034	14.642	0.100	0.250	4.800	0.260	30.000	0.213	0.229	0.275	0.305
34-5B	0.009	0.142	0.035	13.235	0.100	0.250	4.800	0.260	30.000	0.171	0.160	0.221	0.213
34-5C	0.006	0.107	0.037	19.905	0.100	0.250	4.800	0.260	30.000	0.129	0.118	0.167	0.156
34-6A	0.015	0.239	0.034	14.918	0.100	0.250	4.800	0.260	30.000	0.221	0.241	0.283	0.318
34-6B	0.004	0.106	0.038	14.331	0.100	0.250	4.800	0.260	30.000	0.146	0.169	0.188	0.223
34-7	0.003	0.284	0.038	10.560	0.230	0.252	4.500	0.322	48.400	0.321	1.167	0.438	1.646
34-8	0.002	0.284	0.039	10.560	0.050	0.250	5.000	0.230	80.000	0.313	1.335	0.400	1.756

TOTAL ONSITE AREA 0.115 SQ.MI.

TABLE 1

5-7-96

(B:EXUNGAMP.WQ2)

SUB-BASIN RAINFALL LOSS PARAMETERS

RESIST. COEFF. PARAMETERS		LAND USE	IA	DTHETA	PSIF	XKSAT	RTIMP
m(res, comm) =	-0.006	Res SF	0.100	0.250	4.800	0.260	30
m(lake) =	-0.006	Res CAS	0.100	0.250	4.800	0.260	40
m(golf, o.s.) =	-0.006	Golf/O.S.	0.500	0.255	3.750	0.460	1
b(res, comm) =	0.040	Comm	0.050	0.250	5.000	0.230	80
b(lake) =	0.040	Lake	0.000	0.250	5.000	0.230	100
b(golf, o.s.) =	0.040	D-WAY	0.050	0.250	5.000	0.230	90

UNIT 36, FUTURE UNITS 36A AND 36B SUB-BASIN DATA

	SPECIFIC SUB-BASIN DATA				WEIGHTED GREEN / AMPT PARAMETERS								
Sub-Basin #	Area (mi^2)	Length (mi)	Resist Coeff. Kb	Slope (ft/mi)	IA	DTHETA	PSIF	XKSAT	RTIMP (%)	100-yr, 2-hr Tc(hr)	100-yr, 2-hr R(hr)	10-yr, 2-hr Tc(hr)	10-yr, 2-hr R(hr)
OFFSITE													
35-10	0.0031	0.104	0.038	13.224	0.100	0.250	5.000	0.230	80.000	0.146	0.192	0.179	0.241
ONSITE													
36A-1A	0.0081	0.142	0.036	13.200	0.100	0.250	4.800	0.260	30.000	0.171	0.170	0.221	0.226
36A-1B	0.0057	0.142	0.036	13.200	0.100	0.250	4.800	0.260	30.000	0.175	0.213	0.225	0.282
36A-2A	0.0052	0.154	0.037	16.256	0.100	0.250	4.800	0.260	30.000	0.175	0.240	0.221	0.310
36A-2B	0.0048	0.131	0.037	13.009	0.100	0.250	4.800	0.260	30.000	0.171	0.215	0.217	0.280
35-3	0.0065	0.116	0.036	19.908	0.100	0.250	4.800	0.260	30.000	0.133	0.124	0.171	0.164
36B-4	0.0094	0.208	0.035	13.920	0.100	0.250	4.800	0.260	30.000	0.213	0.270	0.271	0.353
36A-5A	0.0036	0.189	0.038	17.424	0.280	0.252	4.328	0.350	16.950	0.200	0.404	0.271	0.566
36A-5B	0.0044	0.216	0.037	16.196	0.261	0.252	4.377	0.341	18.313	0.217	0.438	0.300	0.629
36A-5C	0.0060	0.161	0.036	18.635	0.100	0.250	4.800	0.260	30.000	0.167	0.217	0.213	0.284
35-6A	0.0085	0.219	0.035	15.529	0.100	0.250	4.800	0.260	30.000	0.208	0.291	0.271	0.390
35-6B	0.0082	0.183	0.035	20.792	0.100	0.250	4.800	0.260	30.000	0.171	0.207	0.217	0.269
35-6C	0.0041	0.179	0.037	22.302	0.206	0.251	4.522	0.313	22.315	0.171	0.302	0.225	0.409
35-6D	0.0022	0.073	0.039	28.800	0.100	0.250	4.800	0.260	30.000	0.092	0.105	0.117	0.137
35-6E	0.0067	0.131	0.036	16.428	0.100	0.250	4.800	0.260	30.000	0.154	0.158	0.196	0.207
36B-6F	0.0047	0.093	0.037	18.000	0.100	0.250	4.800	0.260	30.000	0.112	0.095	0.146	0.127
36B-6G	0.0015	0.193	N/A**	15.529	0.050	0.250	5.000	0.230	90.000	0.083	0.257	0.100	0.316
36B-7A	0.0054	0.125	0.037	14.400	0.100	0.250	4.800	0.260	30.000	0.158	0.178	0.204	0.236
36B-7B	0.0037	0.114	0.038	27.280	0.100	0.250	4.800	0.260	30.000	0.129	0.163	0.167	0.217
36B-7C	0.0050	0.104	0.037	22.080	0.100	0.250	4.800	0.260	30.000	0.121	0.119	0.154	0.156
36B-8	0.0066	0.098	0.036	21.323	0.100	0.250	4.800	0.260	30.000	0.117	0.093	0.150	0.123
36B-9A	0.0051	0.129	0.037	23.294	0.100	0.250	4.800	0.260	30.000	0.133	0.156	0.175	0.210
36B-9B	0.0066	0.161	0.036	27.332	0.100	0.250	4.800	0.260	30.000	0.142	0.172	0.183	0.228
TOTAL ONSITE AREA	0.125												

** Sub-Area 6G Kb factor is not applicable since flows from this region are channelized. Time of concentration has been determined by dividing channel length by average flow velocity for each storm event.
The storage coefficient is determined using equation 5.6 of the Maricopa County Drainage Design Manual, Volume I - Hydrology.

TABLE 1

5-7-96

(B:EXUNGAMP.WQ2)

SUB-BASIN RAINFALL LOSS PARAMETERS

RESIST. COEFF. PARAMETERS		LAND USE	IA	DTHETA	PSIF	XKSAT	RTIMP
m(res, comm) =	-0.006	Res SF	0.100	0.250	4.800	0.260	30
m(lake) =	-0.006	Res CAS	0.100	0.250	4.800	0.260	40
m(golf, o.s.) =	-0.006	Golf/O.S.	0.500	0.255	3.750	0.460	1
b(res, comm) =	0.040	Comm	0.050	0.250	5.000	0.230	80
b(lake) =	0.040	Lake	0.000	0.250	5.000	0.230	100
b(golf, o.s.) =	0.040	D-WAY	0.050	0.250	5.000	0.230	90

FUTURE UNIT 36 SUB-BASIN DATA

SPECIFIC SUB-BASIN DATA					WEIGHTED GREEN / AMPT PARAMETERS								
Sub-Basin #	Area (mi^2)	Length (mi)	Resist. Coeff. Kb	Slope (ft/mi)	IA	DTHETA	PSIF	XKSAT	RTIMP (%)	100-yr, 2-hr Tc(hr)	100-yr, 2-hr R(hr)	10-yr, 2-hr Tc(hr)	10-yr, 2-hr R(hr)
ONSITE													
36-2A	0.0105	0.189	0.035	16.421	0.100	0.250	4.800	0.260	30.000	0.188	0.204	0.242	0.271
36-2B	0.0064	0.133	0.036	19.166	0.100	0.250	4.800	0.260	30.000	0.150	0.107	0.192	0.210
36-3A	0.0122	0.128	0.034	13.200	0.100	0.250	4.800	0.260	30.000	0.154	0.189	0.200	0.143
36-3B	0.0039	0.081	0.038	13.200	0.100	0.250	4.800	0.260	30.000	0.129	0.121	0.167	0.160
36-4A	0.0092	0.108	0.035	13.200	0.100	0.250	4.800	0.260	30.000	0.142	0.103	0.183	0.137
36-4B	0.0041	0.098	0.037	14.256	0.100	0.250	4.800	0.260	30.000	0.138	0.180	0.179	0.197
36-5A	0.0049	0.087	0.037	15.840	0.100	0.250	4.800	0.260	30.000	0.121	0.168	0.158	0.170
36-5B	0.0046	0.066	0.037	15.840	0.100	0.250	4.800	0.260	30.000	0.104	0.143	0.133	0.097
36-5C	0.0028	0.066	0.038	15.840	0.100	0.250	4.800	0.260	30.000	0.108	0.175	0.138	0.134
36-6A	0.0122	0.174	0.034	18.374	0.100	0.250	4.800	0.260	30.000	0.171	0.180	0.221	0.195
36-6B	0.0110	0.180	0.035	16.685	0.100	0.250	4.800	0.260	30.000	0.183	0.226	0.233	0.244

TOTAL ONSITE AREA 0.082

TABLE 1

SUB-BASIN RAINFALL LOSS PARAMETERS

5-7-96

(EXUNGAMP.WQ2)

RESIST. COEFF. PARAMETERS		LAND USE	IA	DTHETA	PSIF	XKSAT	RTIMP
m(res, comm) =	-0.006	Res SF	0.100	0.250	4.800	0.260	30
m(lake) =	-0.006	Res CAS	0.100	0.250	4.800	0.260	40
m(golf, o.s.) =	-0.006	Golf/O.S.	0.500	0.255	3.750	0.460	1
b(res, comm) =	0.040	Comm	0.050	0.250	5.000	0.230	80
b(lake) =	0.040	Lake	0.000	0.250	5.000	0.230	100
b(golf, o.s.) =	0.040						

UNIT 37 & WP3 SUB-BASIN DATA

SPECIFIC SUB-BASIN DATA					WEIGHTED GREEN / AMPT PARAMETERS								
Sub-Basin #	Area (mi^2)	Length (mi)	Resist. Coeff, Kb	Slope (ft/mi)	IA	DTHETA	PSIF	XKSAT	RTIMP (%)	100-yr, 2-hr Tc(hr)	100-yr, 2-hr R(hr)	10-yr, 2-hr Tc(hr)	10-yr, 2-hr R(hr)
ONSITE													
37-1*	0.0058	0.239	0.036	12.672	0.100	0.250	4.800	0.260	40.000	0.242	0.458	0.313	0.610
37-2a	0.0035	0.167	0.038	14.784	0.100	0.250	4.800	0.260	40.000	0.192	0.355	0.242	0.459
37-2b	0.0054	0.152	0.037	28.512	0.100	0.250	4.800	0.260	40.000	0.138	0.178	0.175	0.232
WP3-3	0.0013	0.121	0.040	13.200	0.289	0.253	4.338	0.352	38.130	0.171	0.424	0.225	0.576
WP3	0.0021	0.128	0.039	41.184	0.050	0.250	5.000	0.230	80.000	0.108	0.204	0.133	0.256
37-100	0.0077	0.193	0.036	20.592	0.100	0.250	4.800	0.260	40.000	0.179	0.236	0.225	0.304
37-102	0.0033	0.114	0.038	19.536	0.100	0.250	4.800	0.260	40.000	0.133	0.181	0.175	0.244
37-104	0.0093	0.189	0.035	22.704	0.100	0.250	4.800	0.260	40.000	0.167	0.192	0.208	0.246
37-104B	0.0010	0.045	0.041	48.576	0.100	0.250	4.800	0.260	40.000	0.083	0.101	0.083	0.101
37-106	0.0067	0.123	0.036	21.912	0.100	0.250	4.800	0.260	40.000	0.129	0.124	0.171	0.169
37-108	0.0037	0.108	0.038	17.424	0.100	0.250	4.800	0.260	40.000	0.138	0.168	0.175	0.219
TOTAL ONSITE AREA	0.050												

* A portion of D.A. 1 is offsite. This portion consists of the east half of the Dobson Road Right-of-Way or approximately 0.60 acres of the total drainage area.

TABLE 1

SUB-BASIN RAINFALL LOSS PARAMETERS

RESIST. COEFF. PARAMETERS		LAND USE	IA	DTHETA	PSIF	XKSAT	RTIMP
m(res, comm) =	-0.006	Res SF	0.100	0.250	4.800	0.260	30
m(lake) =	-0.006	Res CAS	0.100	0.250	4.800	0.260	40
m(golf, o.s.) =	-0.006	Golf/O.S.	0.500	0.255	3.750	0.460	1
b(res, comm) =	0.040	Comm	0.050	0.250	5.000	0.230	80
b(lake) =	0.040	Lake	0.000	0.250	5.000	0.230	100
b(golf, o.s.) =	0.040	D-WAY	0.050	0.250	5.000	0.230	90

UNIT 40 SUB-BASIN DATA

SPECIFIC SUB-BASIN DATA					WEIGHTED GREEN / AMPT PARAMETERS								
Sub-Basin #	Area (mi^2)	Length (mi)	Resist. Coeff. Kb	Slope (ft/mi)	IA	DTHETA	PSIF	XKSAT	RTIMP (%)	100-yr, 2-hr Tc(hr)	100-yr, 2-hr R(hr)	10-yr, 2-hr Tc(hr)	10-yr, 2-hr R(hr)
ONSITE													
40-1	0.0167	0.254	0.034	18.913	0.100	0.250	4.800	0.260	30.000	0.213	0.228	0.275	0.304
40-2A	0.0084	0.138	0.035	23.145	0.100	0.250	4.800	0.260	30.000	0.138	0.128	0.175	0.167
40-2B	0.0063	0.142	0.036	21.824	0.100	0.250	4.800	0.260	30.000	0.146	0.165	0.188	0.217
40-3	0.0138	0.288	0.034	13.200	0.100	0.250	4.800	0.260	30.000	0.258	0.350	0.342	0.477
40-4B	0.0068	0.125	0.036	15.840	0.100	0.250	4.800	0.260	30.000	0.150	0.147	0.196	0.197
40-4C	0.0129	0.227	0.034	15.400	0.100	0.250	4.800	0.260	30.000	0.213	0.242	0.271	0.316

TOTAL ONSITE AREA 0.065 SQ.MI.

CLARK UNIT HYDROGRAPH

The Clark unit hydrograph method is used to estimate the runoff. The time of concentration is determined using equation 5.5 (FCDMC - Vol.1, Hydrology). Sub-basin data including flow path length in miles (L), watercourse slope in feet per mile (S) and resistance coefficient (Kb) is used in the equation for Tc:

$$T_c = 11.4 * L^{(.5)} * Kb^{(.52)} * S^{(-.31)} * i^{(-.38)} \qquad \text{(Equation 5.5, FCDMC)}$$

The variable "i" is the rainfall excess intensity (inches/hour). Since the intensity is codependent on T_c, the necessary iterations are carried out using the program MCUHP1. The Storage Coefficient is given by the formula:

$$R = 0.37 * T_c^{(1.11)} * A^{(-.57)} * L^{(.80)} \qquad \text{(Equation 5.6, FCDMC)}$$

The resulting values for T_c and storage coefficient (R) for the 100-yr, 2-hr storm are shown on the right side of Table 1.

TIME AREA RELATION

The time versus drainage area relations for the Clark Unit Hydrograph are taken from Table 5.2, under "urban watersheds" (FCDMC - Vol. 1, Hydrology). All of the sub-basins are assumed to drain in this manner.

The areas of sub-basins were measured from a 1:300 scale Watershed Delineation Map. A representation of the Watershed Delineation Map is shown on Figure 3 (Insert).

OFFSITE FLOWS

The source of the offsite flows in excess of the 100 year, 2 hour runoff are Ironwood-Units 27, 27A and 28 in the southwest corner of Section 28 (Figure 2 and 2a). Existing drainage for the area is primarily toward the west. The flows that enter the Onsite area are:

1) Overflow from Lake 50 in Sun Lakes Unit 27 in excess of the 100 year, 2 hour storm (then routed via inlets and pipe to Lake 34).
2) Street flow from Alma School Road (not intercepted by storm drain inlets).

The offsite area is comprised of the following drainage areas (see Figure 2a - page 6 and 2b - page 23):

- Sub-basin 188 drains to Lake 51, which bleeds off to Lake 50
- Sub-basins 180-184 and 187 drain into Lake 50. Overflow (if any) drains to Lake 34 via existing inlets and a 15 inch storm drain.
- Sub-basin 189 is partially intercepted by a storm drain, the remainder flows down Tract "F" drainageway as channel flow to Alma School Road.
- Sub-basins 97 and 98 drain onto Alma School and collect in a sag curve. The concentrated flow bleeds into a pair of storm inlets that flow into a 12" diameter pipe. The inlet capacity is limited by downstream conditions. The stormwater in the pipe flows north to the Lake 34 pipe. Flow not entering the inlets, backs onto Alma School Road, which acts like a detention area (modeled as DET98).
- Sub-basin 99 is Alma School runoff that collects with the other flows reaching Alma School. These combined flows are partially intercepted by three storm drain inlets, all of which drain into the 15" Lake 34 pipe. The lake interconnect pipe is assumed to be flowing near capacity (during the 100 year storm) just upstream from the Alma School storm inlets. The inflow (from each Alma School storm drain inlet) is assumed to be reduced because of the overloaded interconnect pipe. Therefore, a large portion of the runoff flows past the inlets and enters the project on Champagne Drive.

To compensate for the flow entering Champagne Drive (60-foot right-of-way local street), 6-inch vertical curb has been used in lieu of standard roll curb. This will contain the streetflow within the curbs.

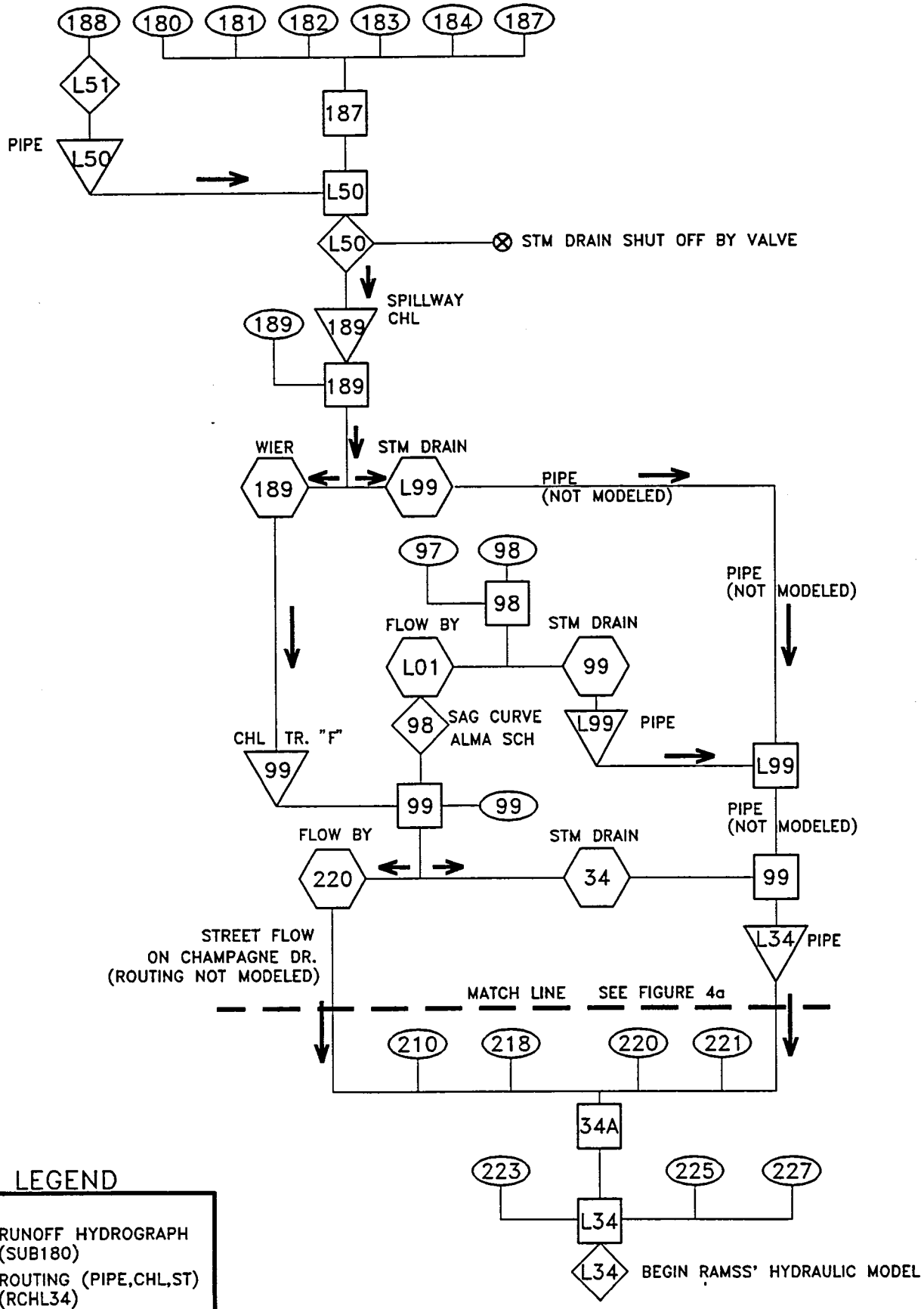


FIGURE 2b
OFFSITE ROUTING SCHEMATIC
FOR MODELS MDP10A.1 AND MDP100A.1

OVERALL ROUTING OF ONSITE STORM RUNOFF

The Project Site is comprised of the following drainage areas (Figure 3, Insert):

HEC-1 Models MDP10B.1 and MDP100B.1 (NE portion of Section 29; this will be self- retained)

- Sub-Basins 10-180 drain into Retention Basins 20, 30, 50, 110, 112, 130, 160, 170, 180 and the existing Lake 31, where all of the 100-year design storm will be retained. For the sake of clarity on Figure 3, the retention basins are not shown. The basins are located at the lowest portion of the Sub-basin having the same number (DET30 is in SUB30). The Sub-basin number "60" is not used in this model. Sub-basins have been broken down into more detailed drainage areas as compared to the previous Master Drainage Model (April, 1993) since these areas have become more clearly defined with a newer, preliminary layout and general grading plan. See Figure 4b on page 27 for a routing schematic of drainage areas used in the HEC-1 models.

HEC-1 Models MDP10A.1 and MDP100A.1

- Sub-Basins 210-550, 570 and 575 drain into Lakes 33-43, Lakes 370 and 500 and Detention Basins 270 and 289, where all of the 100-year design storm will be retained. Refer to Figure 4a on pages 25 and 26 for a routing schematic of drainage areas used in the HEC-1 models.

- As mentioned within the section entitled "Introduction", certain Units will be directly analyzed within the context of this report. These Units are approved or are anticipated to be approved for construction by the end of 1996. Therefore, drainage sub-basins of these Units will be modelled within the HEC-1 files. The denotation of these sub-basins will include the Unit number followed by a hyphen and the corresponding drainage area designation (1, 2A, 2B, etc...). The Sub-Basin Rainfall Loss Parameters of these Units will also be included in Table 1 (pgs. 9-20) of this report.

- Sub-Basins 200, 420, 560, 580, 590, 630 and 6A and 6B of future Unit 36 each drain into Retention Basins 200, 420, 560, and 45, respectively (Sub-Basins 6A and 6B of future Unit 36 drain into retention basin 45). Each retention basin is located within the Subbasin. Preliminary retention basins are not shown on Figure 3 for clarity. Basin 45 is shown since this basin is existing.

SUB-BASINS AND LOCAL STREETS

Individual sub-basins either drain directly into a lake or retention basin or they will be routed through a drainageway or street to the lake system. Refer to the HEC-1 Routing Schematic (Figures 4a and 4b).

In most cases, all runoff from a residential or commercial lot is assumed to sheet flow to the nearest street. Residential lots adjacent golf course areas are assumed to sheet drain the back half of the lot directly into the golf course. Flows along most local streets are considered to be a part of the sheet flow and are not specifically routed, with a few exceptions. Those reaches are modeled using Kinematic Wave routing in a "trapezoidal channel" with steep sides.

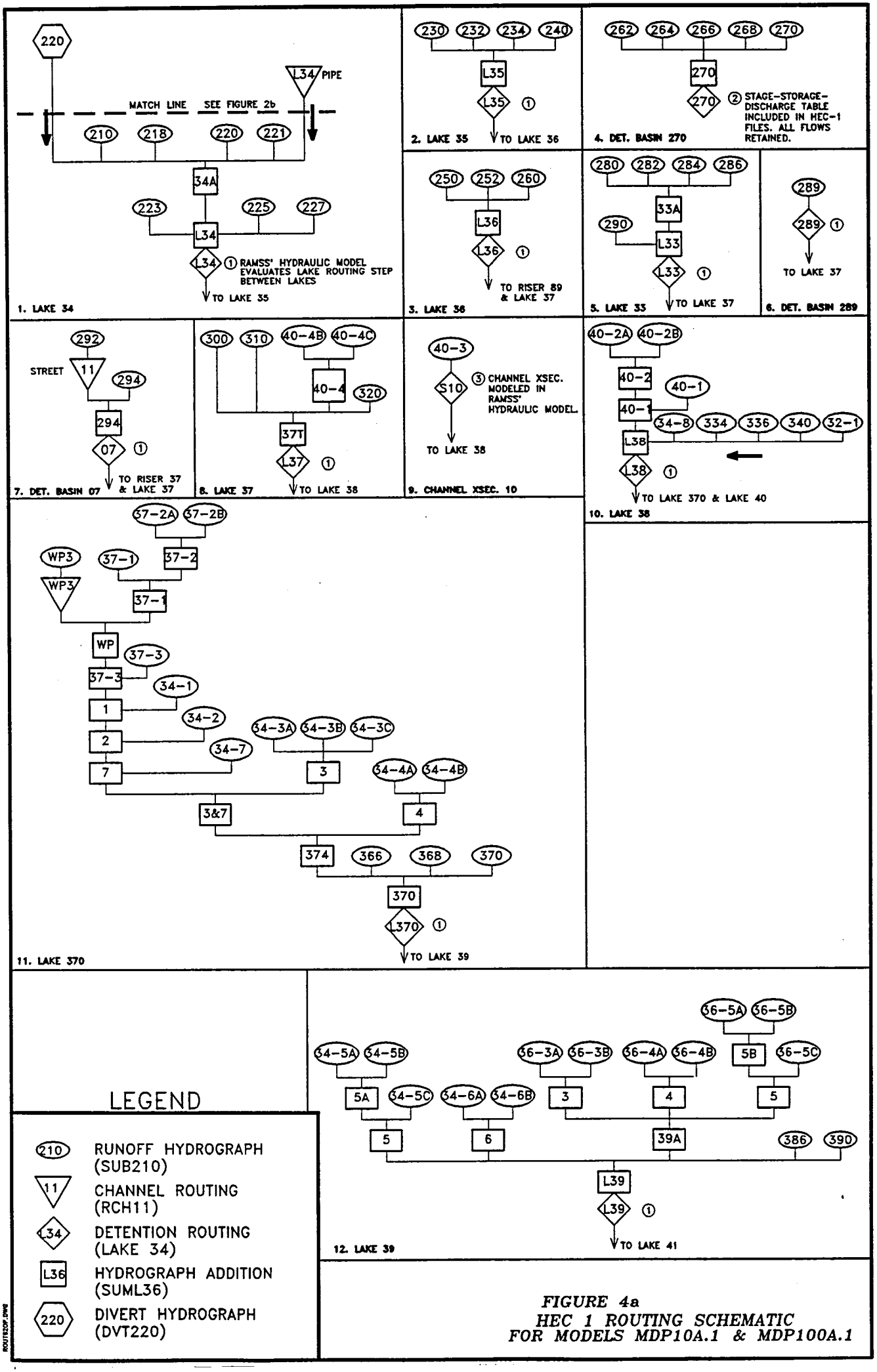


FIGURE 4a
HEC 1 ROUTING SCHEMATIC
FOR MODELS MDP10A.1 & MDP100A.1

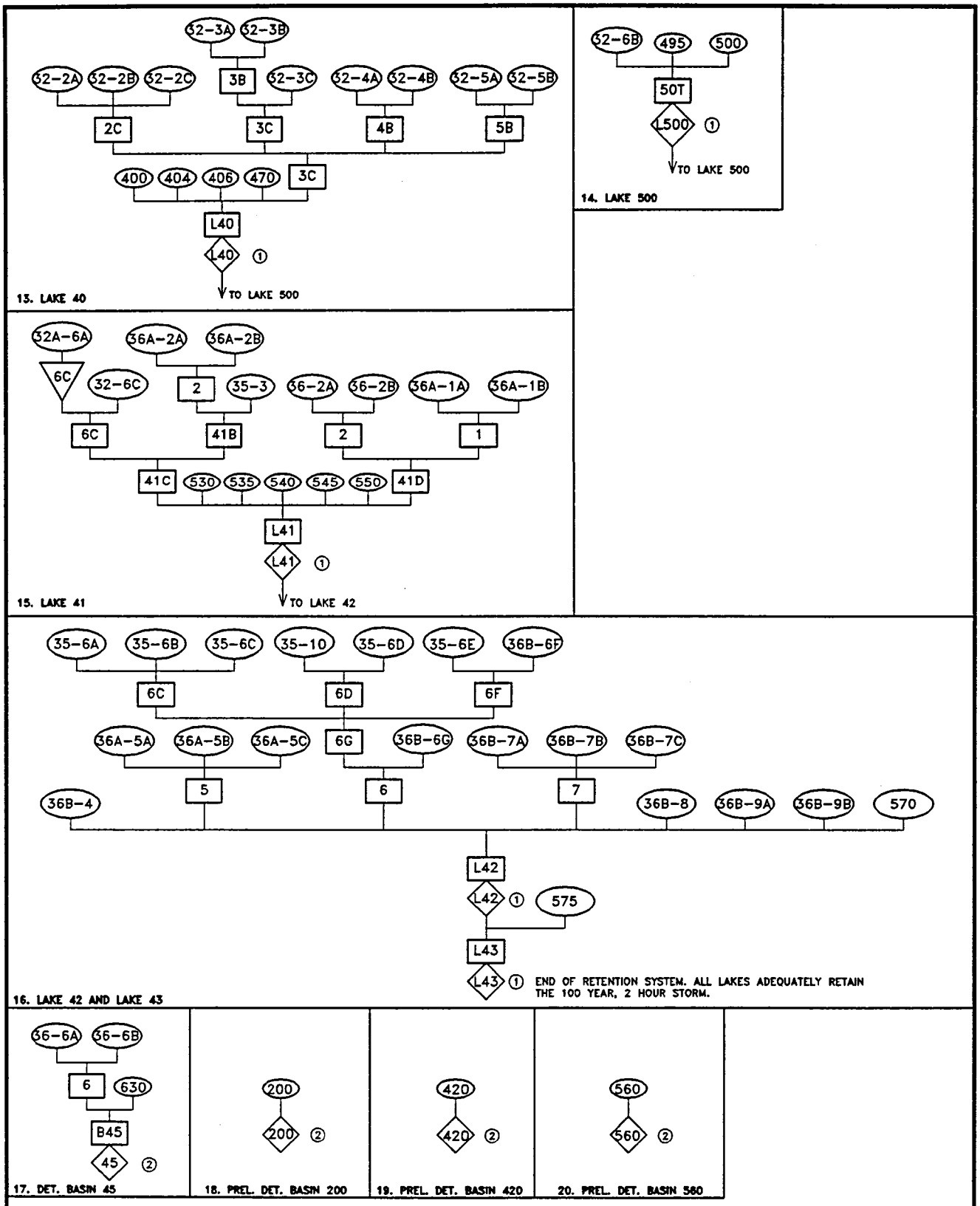


FIGURE 4a (cont.)
HEC 1 ROUTING SCHEMATIC
FOR MODELS MDP10A.1 & MDP100A.1

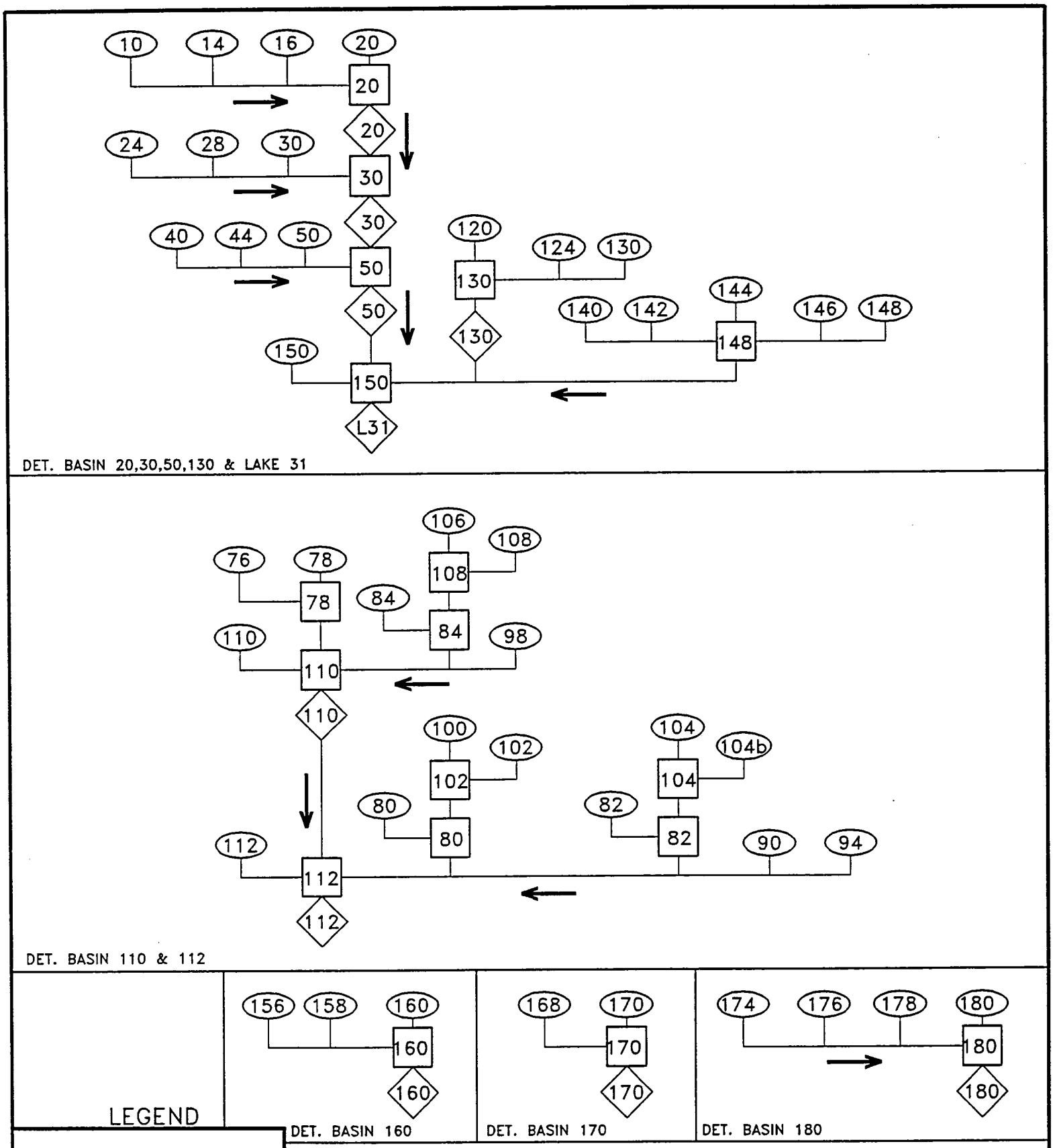


FIGURE 4b
ROUTING SCHEMATICS FOR MODEL MDP10B.1 & MDP100B.1

ROI IP.DV

ROUTING THROUGH STREETS

The Street Runoff Capacity tables show flow depths in streets where large flows are concentrated (Manning's equation). Typical cross-sections for 50', 60', 80' and 110' right-of-way streets (normal crowns) are shown with flow capacity tables (Figures 1-4, Appendix C). Design of drainage structures on collector or arterial streets is beyond the scope of this report. Drainage tract locations are provided to reduce flows on certain streets. These tracts take flows off of the streets and into drainageways that empty into the golf course. All streets meet or exceed the FCDMC 100-year criteria for street flow. Flows on streets meet the FCDMC street flow criteria for the 10-year, 2-hour storm.

ROUTING THROUGH DRAINAGEWAYS

A rectangular or trapezoidal concrete-lined drainageway is typically used to convey flow from a subdivision unit to the nearest golf course or lake (Figure 6a and 6b, Appendix C). Mannings formula was run on each cross-section to check the normal depth at the 100-year peak flow. Each channel will contain the 100-yr flow within its banks. The Manning's roughness coefficient (n) value for these concrete drainageways will be n=0.012.

RETENTION BASIN /LAKE ROUTING

Retention Basins retain all water flowing into them or have outlet pipes that drain to the next downstream basin or lake. Retained runoff infiltrates into the ground. It is also anticipated that drywells shall be used to enhance infiltration rates for some of the future proposed retention basins. As mentioned earlier, infiltration rate is not considered in the flood routing analysis.

Drainage improvements for this report include the following (refer to Fig. 5, insert):

- A 42-inch storm drain to connect Lake 41 to Lake 42.
- A 30-inch storm drain to connect Lake 42 to Lake 43.
- A submersible storm pump to evacuate stormwater from Lake 41 to Lake 42. This pump will operate at a rate of 2000gpm (4.5 cfs) and will act independently of tailwater conditions at downstream Lake 42 since pump head controls flow. There will be adequate pressure to transmit pumped stormwater to Lake 42.

HYDRAULIC MODELING

Routing through all lakes is modeled using the RAMSS Inc. "Hydraulic Model" which performs structure and channel routings between reservoirs that is not possible using the static routing table in HEC-1. In this hydraulic model, the lake routing system can be analyzed under varying tailwater control conditions. Therefore, outlet control is considered using this software. The HEC-1 models are developed to determine peak runoff rates for each sub-basin affecting the routing of stormwater within the lake circulation system (see Figure 5, insert - back cover). Localized sub-basins flowing into each lake are summated and an inflow hydrograph representing this summation is created for each lake using HEC-1. These hydrographs are imported into an input file and edited to meet RAMSS Inc. "Hydraulic Model" format requirements, denoted with a .QIN file extension. A "Hydraulic Model" file is created (file extension .RSC) detailing the routing between lakes and basins. Input includes storage volume of each lake, reference name of the inflow hydrograph to be read from the .QIN file, and physical dimensions of outlet structures that interconnect the lakes as illustrated by Figure 5 (insert) of this report. These structures include horizontal orifice structures (riser pipes), pipes, a pump at Lake 41, channels and overflow weirs. The Manning "n-value" used for PVC pipe routing reaches is n= 0.012. The routing step method used in this model analyzes each structure independently and varies outlet discharge based on downstream tailwater conditions. Figure 5 of Appendix C illustrates a typical lake level control structure or horizontal orifice used within the lakes of existing Oakwood Golf Course.

The RAMSS' Inc. "Hydraulic Model" is a user friendly, menu intensive-type program that allows for input of all essential characteristics describing the storage facility and all outlet structures that aid in discharging stormwater from the storage facility. It is accurate in analyzing applicable losses in pipes and channels that interconnect the various storage reservoirs while taking into account local inflows into each reservoir represented by hydrographs that are read from .QIN files. As previously mentioned, these hydrographs are generated by the HEC-1 file and then edited and saved as .QIN files to meet the format requirements of the RAMSS' "Hydraulic Model".

GRADING

The finished floors on the project site have been and will be designed so that they are above the anticipated controlled discharge of stormwater (100-year design storm) in the streets or the maximum water surface elevation in adjacent lakes.

RETENTION / DETENTION

Runoff (due to the 100-year, 2-hour storm) occurring within the Northeast corner of the Project Site will be retained entirely within the proposed golf course. This comprises the HEC-1 models MDP10B.1 and MDP100B.1. Four minor areas will retain their 100-yr runoff onsite (200, 420, 560, 580, 590 and 630). The rest of the Project will be retained within the boundaries of the site by roadways, channels, golf course retention basins, and lakes (HEC-1 models MDP10A.1, MDP100A.1).

The peak flows (100-yr 2-hr and 10-yr. 2-hr. storms, cfs) and the rainfall excess volume (100-yr. 2-hr. retention requirement) from each sub-basin are itemized in Tables 2a and 2b (pgs. 31-37). The estimated peak runoff volumes detained by each lake (required capacity), maximum water surface elevations (WSEL) and maximum lake depths are tallied on Table 3a (pg. 38). Similarly, Table 3b (pg. 38) summarizes Preliminary Retention Basins in the northeast portion of Section 29.

The HEC-1 rainfall runoff models are (Appendix D):

MDP10B.1	Northeast Corner; 10-yr, 2-hr Storm
MDP10A.1	All areas except Northeast Corner; 10-yr., 2-hr. Storm
MDP100B.1	Same area as MDP10B.1; 100-yr, 2-hr Storm
MDP100A.1	Same area as MDP10A.1; 100-yr, 2-hr Storm

The RAMSS Inc. "Hydraulic Model" files are (Appendix D):

MDP10A.S10	Summary output with maximum flows and peak and final volumes of each lake and corresponding outlet structures; 10-yr., 2-hr. storm.
MDP10A.RSC	Lake routing of existing Oakwood G.C.; 10-yr., 2-hr. storm.
MDP10A.QIN	Lake input hydrographs obtained from corresponding HEC-1 model; 10-yr., 2-hr. storm.
MDP100A.S99	Same as MDP10A.S10 except 100-yr., 2-hr. storm.
MDP100A.RSC	Same as MDP10A.RSC except 100-yr., 2-hr. storm.
MDP100A.QIN	Same as MDP10A.QIN except 100-yr., 2-hr. storm.

Peak inflows are taken from the SUM of flows just prior to the particular lake or retention basin. Peak lake water-surface elevations (WSEL) are taken from model MDP10A.S10 and MDP100A.S99. Likewise for the peak storage and peak outflow.

TABLE 2a
FUTURE AND EXISTING (OAKWOOD G.C. & UNIT 31) DEVELOPMENT
SUB-BASIN RUNOFF SUMMARY (SLQDATA.WQ2)
(ONSITE ONLY, 100-YR AND 10-YR FLOWS) 5-16-96

Sub-Basin #	100-YR RAINFALL EXCESS(in)	SUB-BASIN AREA(ac)	RUNOFF VOLUME (ac-ft)	100-YR FLOW (cfs)	10-YR FLOW (cfs)
10	1.83	4.91	0.75	21	11
14	1.83	5.13	0.78	20	10
16	1.83	5.17	0.79	20	10
20	1.23	11.78	1.21	39	12
24	1.83	5.84	0.89	27	13
28	1.83	4.55	0.69	21	10
30	1.23	12.86	1.32	44	14
40	1.83	7.13	1.09	31	15
44	1.83	4.67	0.71	16	8
50	1.23	7.92	0.81	31	10
76	2.39	2.87	0.57	7	4
78	2.39	2.15	0.43	5	3
84	1.83	2.97	0.45	14	7
98	1.83	8.59	1.31	31	15
110	1.23	4.60	0.47	21	7
80	1.83	5.50	0.84	27	13
82	1.83	2.80	0.43	13	7
90	1.83	11.10	1.69	42	21
94	1.83	7.78	1.19	35	17
112	1.27	8.28	0.88	33	11
120	1.83	6.34	0.97	26	13
124	1.83	7.65	1.17	31	15
130	1.23	14.03	1.44	47	15
140	1.83	4.80	0.73	19	10
142	1.83	3.75	0.57	19	9
144	1.83	10.35	1.58	38	18
146	1.83	5.07	0.77	18	8
148	1.83	6.50	0.99	25	13
150	1.72	14.21	2.04	81	44
156	1.83	3.27	0.50	16	8
158	1.83	6.56	1.00	29	15

SHEET 1 OF 3

TABLE 2a
FUTURE AND EXISTING (OAKWOOD G.C. & UNIT 31) DEVELOPMENT
SUB-BASIN RUNOFF SUMMARY

(SLQDATA.WQ2)

(ONSITE ONLY, 100-YR AND 10-YR FLOWS)

5-16-96

Sub-Basin #	100-YR RAINFALL EXCESS(in)	SUB-BASIN AREA(ac)	RUNOFF VOLUME (ac-ft)	100-YR FLOW (cfs)	10-YR FLOW (cfs)
160	1.27	5.76	0.61	30	12
168	1.83	3.79	0.58	17	9
170	1.27	8.01	0.85	30	11
174	1.83	6.31	0.96	24	12
176	1.83	4.99	0.76	21	11
178	1.83	9.22	1.41	35	17
180	1.27	1.80	0.19	6	2
200	2.38	3.98	0.79	21	13
210*	1.78	21.40	3.17	60	28
218*	1.78	14.35	2.13	47	23
220	1.78	7.11	1.05	20	9
221*	1.78	13.51	2.00	40	19
223	1.78	3.63	0.54	13	6
225	1.78	2.41	0.36	8	4
227	1.30	33.57	3.64	130	44
230	2.38	17.08	3.39	64	36
232	1.78	7.23	1.07	22	11
234	1.90	7.24	1.15	21	10
240	1.50	20.54	2.57	78	31
250	1.90	14.91	2.36	61	31
252	1.78	5.04	0.75	21	10
260	1.12	21.26	1.98	80	22
262	1.78	2.42	0.36	6	3
264	1.78	3.04	0.45	10	5
266	1.78	3.87	0.57	17	9
268	1.78	2.82	0.42	12	6
270	1.25	7.32	0.76	29	10
280	1.78	2.86	0.42	7	3
282	1.78	5.14	0.76	18	9
284	1.78	3.51	0.52	11	5
286	1.26	9.35	0.98	31	11

* EXISTING UNIT 31 DEVELOPMENT

SHEET 2 OF 3

TABLE 2a
FUTURE AND EXISTING (OAKWOOD G.C. & UNIT 31) DEVELOPMENT
SUB-BASIN RUNOFF SUMMARY (SLQDATA.WQ2)
(ONSITE ONLY, 100-YR AND 10-YR FLOWS) 5-16-96

Sub-Basin #	100-YR RAINFALL EXCESS(in)	SUB-BASIN AREA(ac)	RUNOFF VOLUME (ac-ft)	100-YR FLOW (cfs)	10-YR FLOW (cfs)
289	1.04	7.39	0.64	18	4
290	1.22	9.47	0.96	34	10
292	2.38	24.81	4.92	83	46
294	1.90	11.21	1.77	35	17
300	2.38	15.91	3.16	61	35
310	2.16	16.63	2.99	53	27
320	1.60	11.91	1.59	51	22
334	1.78	5.59	0.83	22	10
336	1.78	3.73	0.55	14	7
340	1.41	21.72	2.55	88	34
366	1.78	0.78	0.12	1	1
368	1.78	5.13	0.76	17	8
370	1.14	8.14	0.77	34	12
386	1.78	14.13	2.10	40	19
390	1.44	17.14	2.06	75	32
400	1.78	5.27	0.78	18	9
404	1.78	3.56	0.53	13	6
406	1.78	5.50	0.82	18	9
420	2.38	27.63	5.48	129	72
470	1.53	19.57	2.50	75	31
495	1.78	14.72	2.18	44	20
500	1.24	7.33	0.76	31	11
530	1.78	9.97	1.48	33	16
535	1.78	7.79	1.16	24	12
540	1.78	10.60	1.57	34	16
545	1.78	6.94	1.03	18	8
550	1.47	24.65	3.02	74	29
560	2.38	30.41	6.03	84	44
570	1.85	12.34	1.90	52	25
575	1.84	16.58	2.54	55	27
580	2.38	7.44	1.48	28	16
590	2.38	3.31	0.66	12	7
630	2.38	18.47	3.66	68	39

TOTAL RUNOFF VOLUME: 129.95 ac-ft
(FUTURE ONSITE DEVELOPMENT & EXISTING UNIT 31)

SHEET 3 OF 3

TABLE 2b
EXISTING & FUTURE UNITS
SUB-BASIN RUNOFF SUMMARY (EXUNQDAT.WQ2)
(ONSITE ONLY, 100-YR AND 10-YR FLOWS) 5-16-96

Sub-Basin #	100-YR RAINFALL EXCESS(in)	SUB-BASIN AREA(ac)	RUNOFF VOLUME (ac-ft)	100-YR FLOW (cfs)	10-YR FLOW (cfs)
UNIT32/32A:					
32-1	1.78	4.58	0.68	13	6
32-2A	1.78	6.37	0.94	18	8
32-2B	1.78	6.54	0.97	18	8
32-2C	1.78	4.91	0.73	16	8
32-3A	1.78	5.11	0.76	14	7
32-3B	1.78	5.93	0.88	18	9
32-3C	1.78	3.69	0.55	17	8
32-4A	1.78	7.04	1.04	20	9
32-4B	1.78	10.63	1.58	38	19
32-5A	2.38	5.12	1.02	16	9
32-5B	1.78	14.08	2.09	39	18
32-6B	1.78	7.68	1.14	26	13
32-6C	2.38	2.87	0.57	6	3
32A-6A	1.78	4.10	0.61	12	9
UNIT 34:					
34-1	1.78	6.02	0.89	19	10
34-2	1.78	9.09	1.35	27	12
34-3A	1.78	9.15	1.36	28	13
34-3B	1.78	5.57	0.83	15	7
34-3C	1.78	1.34	0.20	6	3
34-4A	1.78	6.53	0.97	22	11
34-4B	1.78	1.86	0.28	8	4
34-5A	1.78	9.15	1.36	27	12
34-5B	1.78	5.63	0.84	20	10
34-5C	1.78	3.58	0.53	15	7
34-6A	1.78	9.54	1.42	28	13
34-6B	1.78	2.43	0.36	9	4
34-7	1.92	1.98	0.32	2	1
34-8	2.38	1.47	0.29	2	1

SHEET 1 OF 4

TABLE 2b
EXISTING & FUTURE UNITS
SUB-BASIN RUNOFF SUMMARY (EXUNQDAT.WQ2)
(ONSITE ONLY, 100-YR AND 10-YR FLOWS) 5-16-96

Sub-Basin #	100-YR RAINFALL EXCESS(in)	SUB-BASIN AREA(ac)	RUNOFF VOLUME (ac-ft)	100-YR FLOW (cfs)	10-YR FLOW (cfs)
UNIT 35 & FUT. UNITS 36A & 36B:					
36A-1A	1.78	5.18	0.77	17	9
36A-1B	1.78	3.65	0.54	11	5
36A-2A	1.78	3.33	0.49	10	5
36A-2B	1.78	3.08	0.46	9	5
35-3	1.78	4.19	0.62	16	8
36B-4	1.78	6.00	0.89	17	9
36A-5A	1.46	2.29	0.28	5	2
36A-5B	1.49	2.83	0.35	5	2
36A-5C	1.78	3.86	0.57	12	6
35-6A	1.78	5.47	0.81	15	7
35-6B	1.78	5.26	0.78	16	8
35-6C	1.59	2.60	0.34	6	3
35-6D	1.78	1.41	0.21	6	3
35-6E	1.78	4.31	0.64	15	7
36B-6F	1.78	3.00	0.45	13	6
36B-6G	2.49	0.95	0.20	3	2
36B-7A	1.78	3.46	0.51	11	6
36B-7B	1.78	2.36	0.35	8	4
36B-7C	1.78	3.22	0.48	13	6
36B-8	1.78	4.23	0.63	18	9
36B-9A	1.78	3.26	0.48	12	6
36B-9B	1.78	4.25	0.63	14	7
35-10	2.37	1.98	0.39	7	4

SHEET 2 OF 4

TABLE 2b
EXISTING & FUTURE UNITS
SUB-BASIN RUNOFF SUMMARY (EXUNQDAT.WQ2)
(ONSITE ONLY, 100-YR AND 10-YR FLOWS) 5-16-96

Sub-Basin #	100-YR RAINFALL EXCESS(in)	SUB-BASIN AREA(ac)	RUNOFF VOLUME (ac-ft)	100-YR FLOW (cfs)	10-YR FLOW (cfs)
FUT. UNIT 36					
36-2A	1.78	6.72	1.00	21	10
36-2B	1.78	4.10	0.61	17	7
36-3A	1.78	7.81	1.16	25	15
36-3B	1.78	2.50	0.37	10	5
36-4A	1.78	5.90	0.88	25	12
36-4B	1.78	2.62	0.39	9	5
36-5A	1.78	3.14	0.47	11	6
36-5B	1.78	2.94	0.44	11	7
36-5C	1.78	1.79	0.27	6	4
36-6A	1.78	7.81	1.16	25	14
36-6B	1.78	7.04	1.04	21	11
UNIT 37 & WTR PLNT 3:					
37-1	1.90	3.71	0.59	8	4
37-2a	1.90	2.24	0.35	6	3
37-2b	1.90	3.46	0.55	12	6
37-3	1.75	0.83	0.12	2	1
WP3	2.38	1.34	0.27	5	3
37-100	1.94	4.92	0.80	17	8
37-102	1.94	2.08	0.34	8	4
37-104	1.94	5.95	0.96	22	11
37-104B	1.94	0.64	0.10	3	2
37-106	1.94	4.29	0.69	19	10
37-108	1.94	2.37	0.38	9	5

SHEET 3 OF 4

TABLE 2b
EXISTING & FUTURE UNITS
SUB-BASIN RUNOFF SUMMARY (EXUNQDAT.WQ2)
(ONSITE ONLY, 100-YR AND 10-YR FLOWS) 5-16-96

Sub-Basin #	100-YR RAINFALL EXCESS(in)	SUB-BASIN AREA(ac)	RUNOFF VOLUME (ac-ft)	100-YR FLOW (cfs)	10-YR FLOW (cfs)
UNIT 40:					
40-1	1.78	10.71	1.59	32	15
40-2A	1.78	5.40	0.80	21	10
40-2B	1.78	4.02	0.60	14	7
40-3	1.78	8.85	1.31	21	10
40-4B	1.78	4.35	0.65	16	8
40-4C	1.78	8.26	1.22	24	11

TOTAL RUNOFF VOLUME: 55.49 ac-ft
(EXISTING & FUTURE UNITS)

TOTAL RUNOFF VOLUME: 185.44 ac-ft
(FUTURE ONSITE DEVELOPMENT, ALL EXIST. UNITS, & FUTURE UNITS)

SHEET 4 OF 4

TABLE 3A

5-31-96

SECTION 29 & 30 LAKE/ RETENTION BASIN SUMMARY 100-YR 2-HR STORM

(LAKEDAT1.WQ2)

Lake Num	Down-stream Lake	Normal Pool/ Basin Bottom Elev	Peak WS Elev	Depth at Peak (ft)	Peak Inflow (cfs)	Peak Outflow (cfs)	Peak Storage (ac-ft)	RAMSS' HYD. Model Output Filename
7	38	1183.50	1187.16	3.66	114	107	2.0	MDP100A.S99
33	37	1187.00	1188.71	1.71	101	9	2.9	MDP100A.S99
34	35	1190.10	1193.64	3.54	336	5	13.5	MDP100A.S99
35	36	1188.78	1190.94	2.16	183	9	7.6	MDP100A.S99
36	37	1187.88	1190.32	2.44	172	7	5.6	MDP100A.S99
37	38	1184.00	1186.94	2.94	282	83	11.5	MDP100A.S99
38	370 & 40	1181.21	1184.23	3.02	221	38	14.4	MDP100A.S99
39	41	1178.52	1182.55	4.03	306	6	13.2	MDP100A.S99
40	500	1177.92	1181.99	4.07	332	14	21.6	MDP100A.S99
41	42	1177.00	1180.90	3.90	317	29	22.8	MDP100A.S99
42	43	1172.50	1180.90	8.40	259	29	46.1	MDP100A.S99
43	none	1172.50	1180.90	8.40	76	0	28.2	MDP100A.S99
45	none	1180.00	1183.37	3.37	115	0	5.8	MDP100A.OH1*
289	37	1188.00	1189.16	1.16	18	2	0.5	MDP100A.S99
370	39	1180.50	1184.30	3.80	203	16	8.0	MDP100A.S99
500	41	1177.50	1180.90	3.40	102	18	6.4	MDP100A.S99
			TOTAL ONSITE RETENTION				210.1	Ac-Ft

TABLE 3B

PRELIMINARY LAKE/RETENTION BASIN SUMMARY 100-YR 2-HR STORM

Lake/Reten. Basin Num	Lake/Bas Bottom Elev**	Peak WS Elev	Depth at Peak (ft)	Peak Inflow (cfs)	Peak Outflow (cfs)	Peak Storage (ac-ft)	HEC-1 Input Filename
20	100.0	103.51	3.51	100	0	3.5	MDP100B.1
30	100.0	102.87	2.87	90	0	2.9	MDP100B.1
31	1188.5	1189.77	1.27	194	0	6.6	MDP100B.1
50	100.0	102.54	2.54	77	0	2.5	MDP100B.1
110	100.0	102.09	2.09	103	0	4.2	MDP100B.1
112	100.0	102.39	2.39	194	0	7.2	MDP100B.1
130	100.0	103.58	3.58	104	0	3.6	MDP100B.1
160	100.0	102.10	2.10	76	0	2.1	MDP100B.1
170	100.0	101.46	1.46	48	0	1.5	MDP100B.1
180	100.0	101.66	1.66	86	0	3.3	MDP100B.1
200	100.0	100.79	0.79	21	0	0.8	MDP100A.1
270	100.0	102.56	2.56	73	0	2.6	MDP100A.1
420	100.0	102.74	2.74	129	0	5.5	MDP100A.1
560	100.0	103.00	3.00	84	0	6.0	MDP100A.1
580	100.0	100.73	0.73	28	0	1.5	MDP100A.1
590	100.0	100.33	0.33	12	0	0.7	MDP100A.1
			TOTAL ONSITE RETENTION			54.5	Ac-Ft

* Stage-storage-discharge results are in the HEC-1 output file.

** All preliminary retention basin elevations are based on assumed 100 Ft datum.

Lakes have 6:1 sideslopes (or gentler) except in areas where lake walls are used.

Retention basin sideslopes vary from 4:1 to 10:1. All retention basins will be designed to have at least one slope less than 6:1

EXISTING LAKES - COMPLIANCE W/ NEW DESIGN REQUIREMENTS

The lakes 33 through 41 and the golf course surrounding them are already constructed as per the approved 1985 Master Drainage Plan (MDP) for Sun Lakes. See Table 3a for lake depths, peak water surface elevations, peak storage and peak 100-yr storm inflows.

Lakes 42 and 43 will be constructed with storage volumes as indicated in the "Hydraulic Model" files (MDP10A.S10, MDP100A.S99) of Appendix D. Outlet control structures proposed for these lakes and at Lake 41 are as indicated within the Retention Basin/Lake Routing section of this report (pg. 30). Lake 43 shall be designed with an emergency overflow weir that directs flows south down a channel adjacent to Price Road leading to an additional retention basin in the southwest corner of Section 31 (not this report). Lake 42 will also have an emergency overflow weir at Price Road to direct flows west off the project site. This will provide emergency protection for lots within the Project Site in the unlikely event that runoff volume occurs from large event storms.

Lake 31 and retention basins 20, 30, 50, 110, 112, 130, 160, 170, and 180 in the northeast corner are preliminary basins and peak storage volume is the only relevant number for this MDP. This volume will be used in the preliminary golf course design. Once better golf course topographic maps are made available, a more accurate stage/storage relationship can be modeled. The golf course design will be coordinated to provide the required storage volume and keep sideslopes gentler than 6:1. See Table 3b for retention basin depths, relative water surface elevations, depth at peak storage and peak 100-yr storm inflows.

CONCLUSION

The Project Site adheres to the drainage criteria as set forth by the Flood Control District of Maricopa County. Streets meet the design constraints of the 10 year and 100 year storm events. Results indicate that the total volume of onsite runoff is 185.44 acre-feet (Table 2b, pg. 37). Available storage volume at peak for all storage facilities is 264.6 acre-feet (Tables 3a, 3b, pg. 38). The lake circulation system as shown on Figure 5 (insert - back cover) and Retention Basin 45 contain an available storage capacity of 210.1 acre-feet (Table 3A, page 38). 100 year-2 hour runoff volume for all areas affecting this proposed system is approximately 130.94 acre-feet. Therefore, adequate retention is provided for the 100-year, 2-hour event storm. The preliminary storage facilities (Table 3B, page 38) will be sized to adequately retain 54.5 acre-feet which is the 100 year-2 hour runoff volume generated by the areas affecting these basins.

REFERENCES

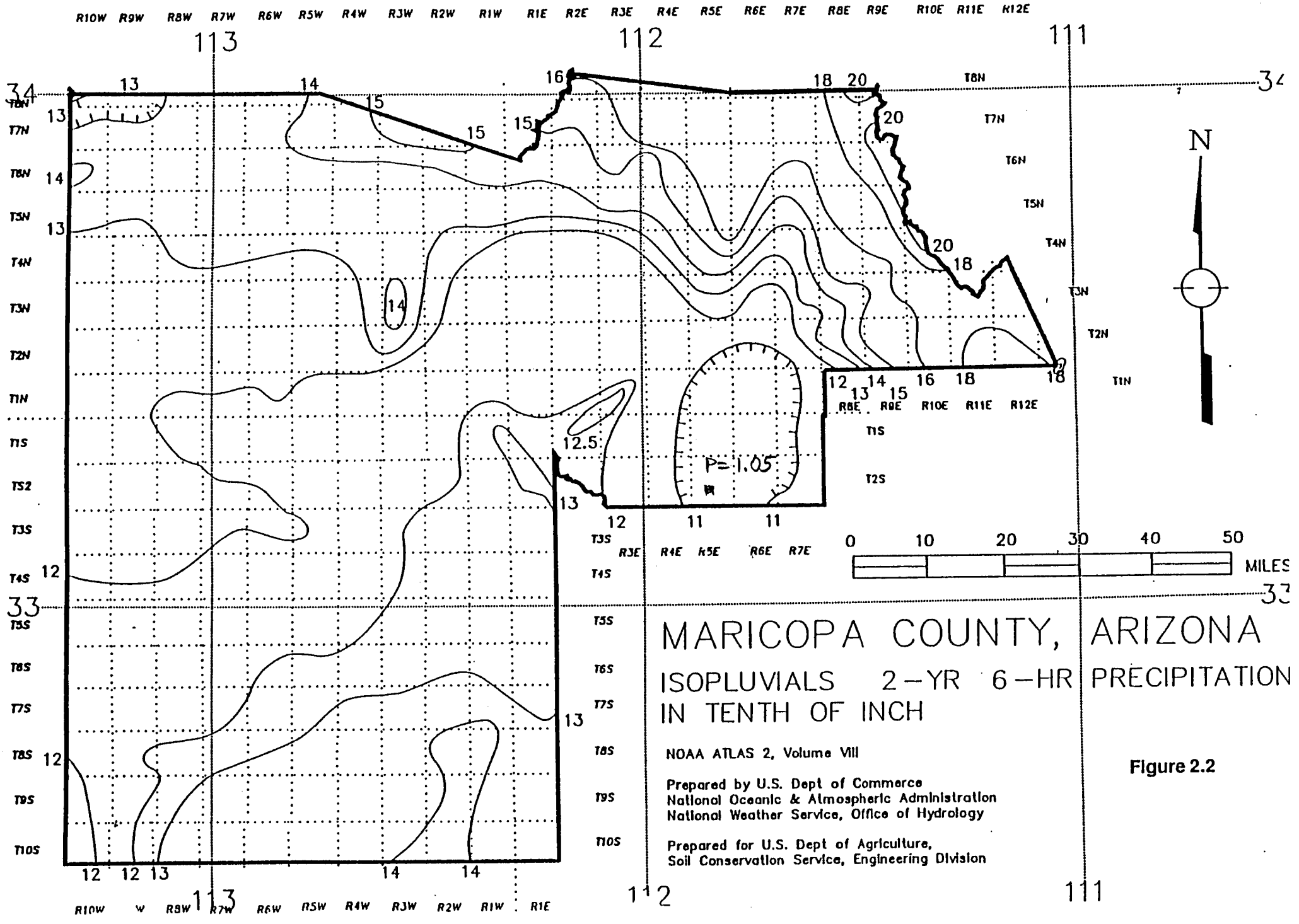
MARICOPA County, Flood Control District: Drainage Design Manual; Volume 1 Hydrology; Flood Control District of Maricopa County; 1992 Ed.

MARICOPA County, Flood Control District; Drainage Design Manual; Volume 2 Hydraulics; Flood Control District of Maricopa County; 1992 Ed.

MARICOPA County, Flood Control District; Hydraulic Design Manual; Flood Control District of Maricopa County

B&R Engineering, Inc.; Sun Lakes - Development Master Plan; 1985

B&R Engineering, Inc.; Sun Lakes - Development Master Plan; 1992 Addendum


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
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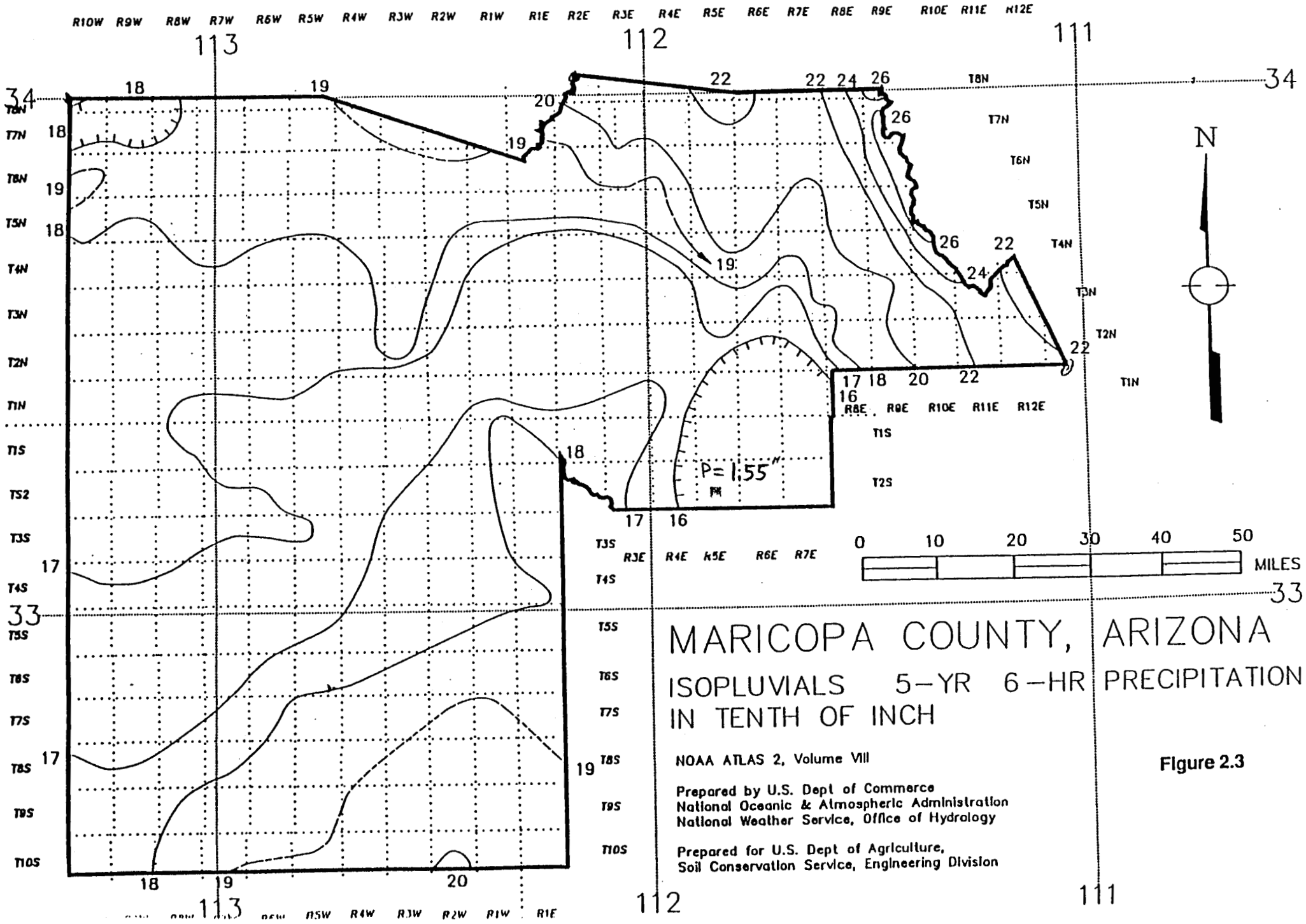
T8N T7N T6N T5N T4N T3N T2N T1N T1S T2S T3S T4S T5S T6S T7S T8S T9S T10S
113 112 111
34 33

Figure 2.2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0 10 20 30 40 50
MILES
R10W R9W R8W R7W R6W R5W R4W R3W R2W R1W R1E R2E R3E R4E R5E R6E R7E R8E R9E R10E R11E R12E
T8N T7N T6N T5N T4N T3N T2N T1N T1S T2S T3S T4S T5S T6S T7S T8S T9S T10S
113 112 111
34 33

Figure 2.3

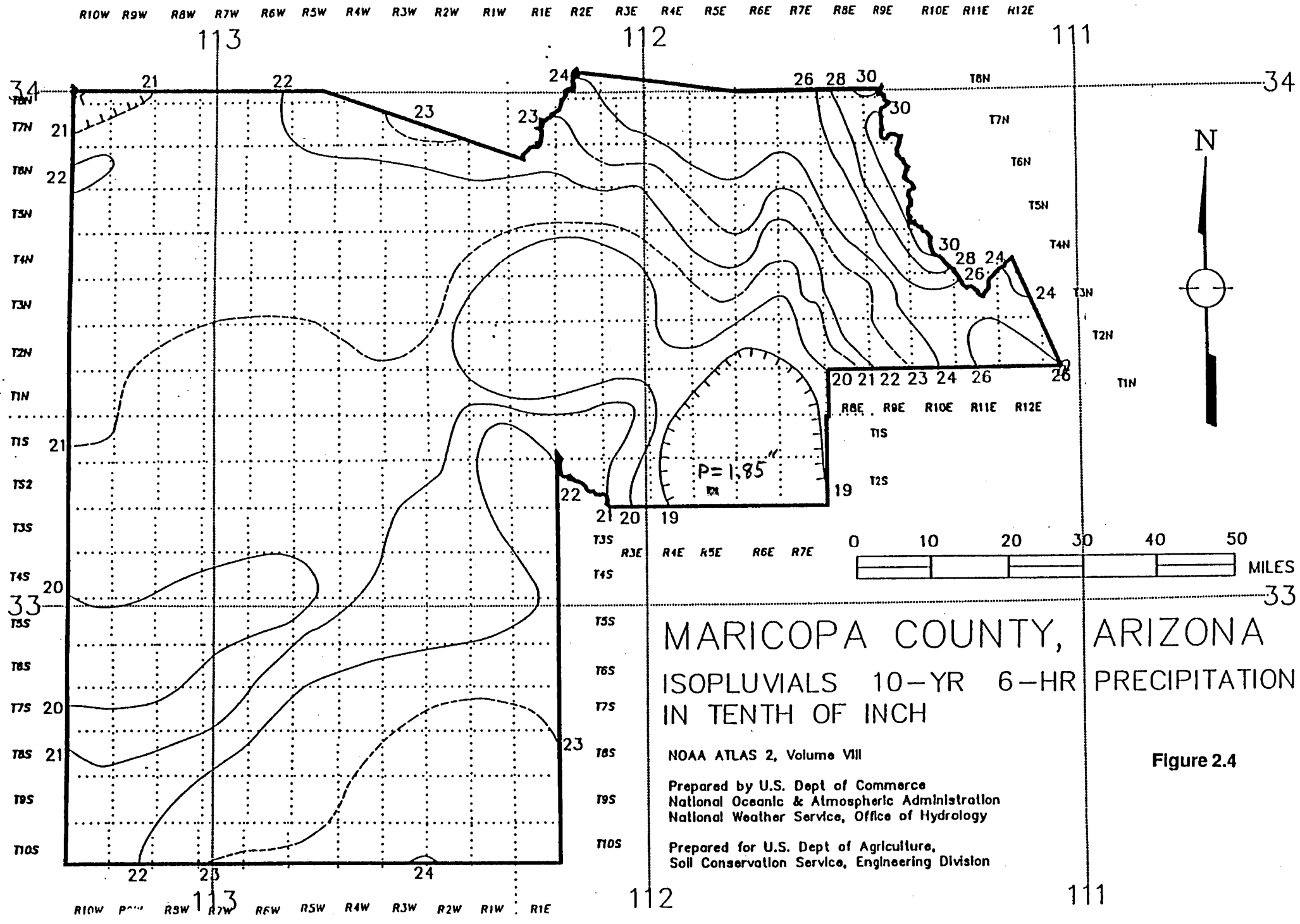

MARICOPA COUNTY, ARIZONA
ISOPLUVIALS 10-YR 6-HR PRECIPITATION
IN TENTH OF INCH
NOAA ATLAS 2, Volume VIII
Prepared by U.S. Dept of Commerce
National Oceanic & Atmospheric Administration
National Weather Service, Office of Hydrology
Prepared for U.S. Dept of Agriculture,
Soil Conservation Service, Engineering Division
N
0 10 20 30 40 50
MILES
P=1.85"
R10W R9W R8W R7W R6W R5W R4W R3W R2W R1W R1E R2E R3E R4E R5E R6E R7E R8E R9E R10E R11E R12E
T8N T7N T6N T5N T4N T3N T2N T1N T1S T2S T3S T4S T5S T6S T7S T8S T9S T10S
113 112 111
34 33

Figure 2.4

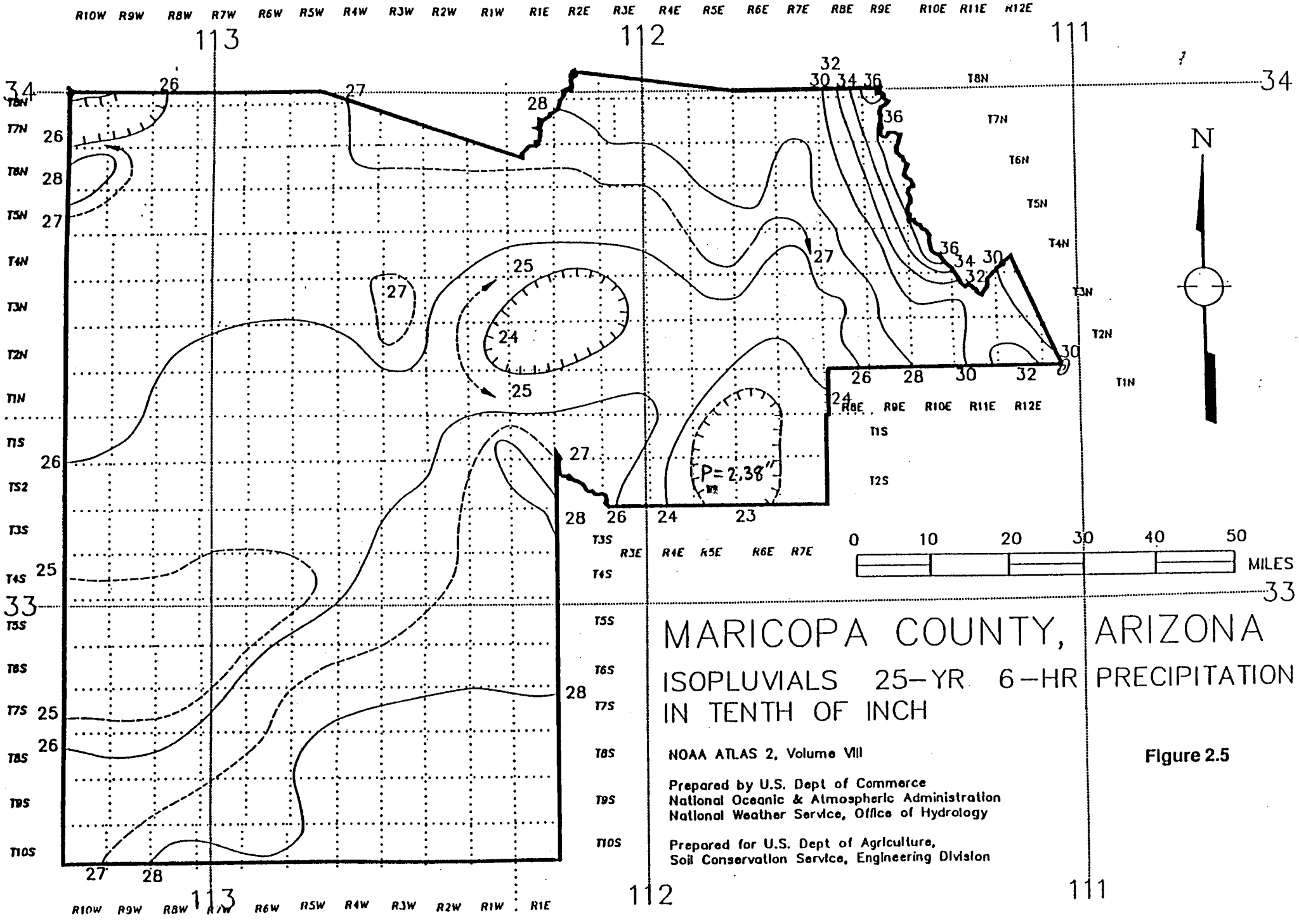
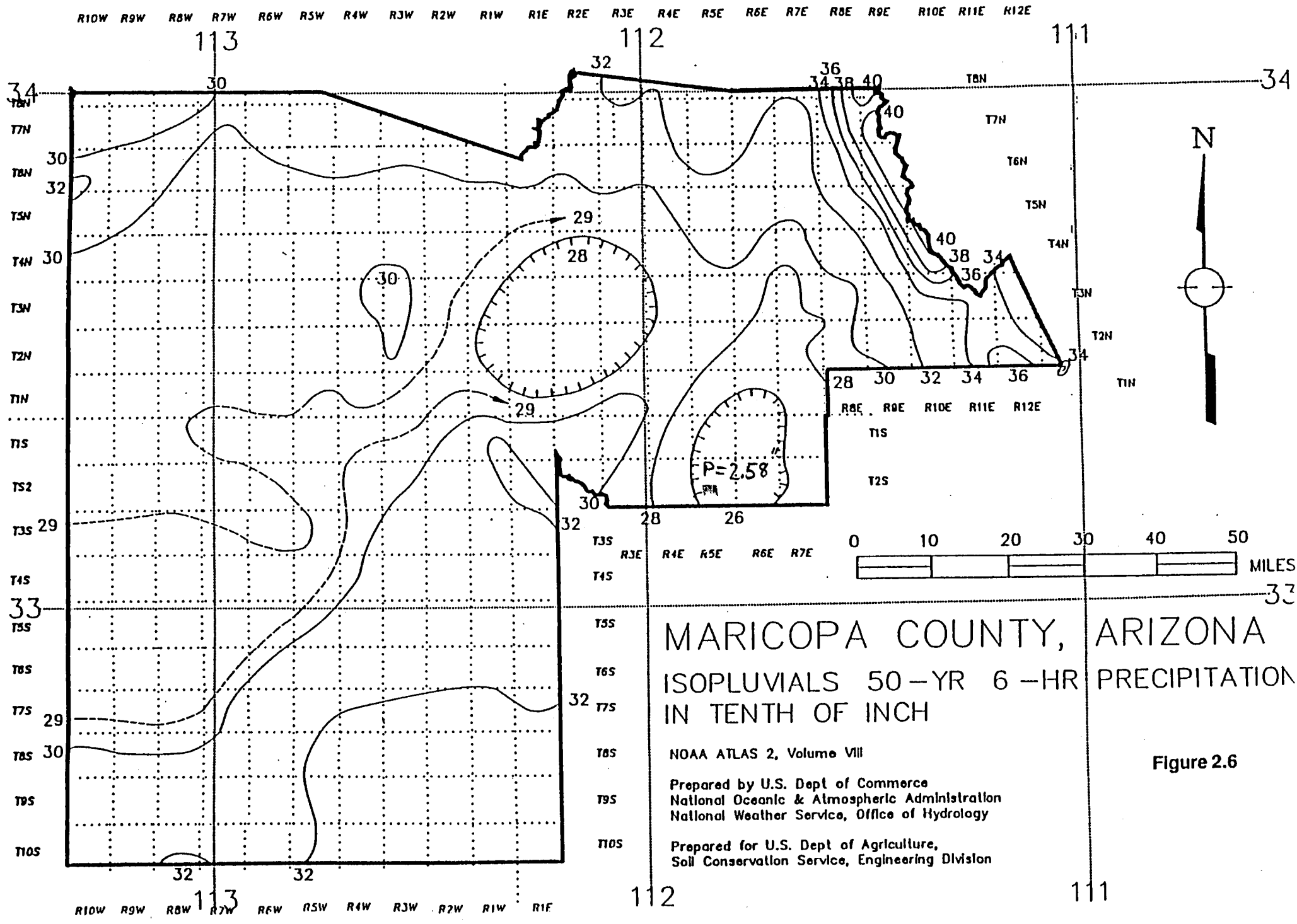

MARICOPA COUNTY, ARIZONA
ISOPLUVIALS 25-YR 6-HR PRECIPITATION
IN TENTH OF INCH
NOAA ATLAS 2, Volume VIII
Prepared by U.S. Dept of Commerce
National Oceanic & Atmospheric Administration
National Weather Service, Office of Hydrology
Prepared for U.S. Dept of Agriculture,
Soil Conservation Service, Engineering Division
N
MILES
0 10 20 30 40 50
P=2.38"
R10W R9W R8W R7W R6W R5W R4W R3W R2W R1W R1E R2E R3E R4E R5E R6E R7E R8E R9E R10E R11E R12E
T8N T7N T6N T5N T4N T3N T2N T1N T1S T2S T3S T4S T5S T6S T7S T8S T9S T10S
113 112 111
34 33

Figure 2.5


MARICOPA COUNTY, ARIZONA
ISOPLUVIALS 50-YR 6-HR PRECIPITATION
IN TENTH OF INCH
NOAA ATLAS 2, Volume VIII
Prepared by U.S. Dept of Commerce
National Oceanic & Atmospheric Administration
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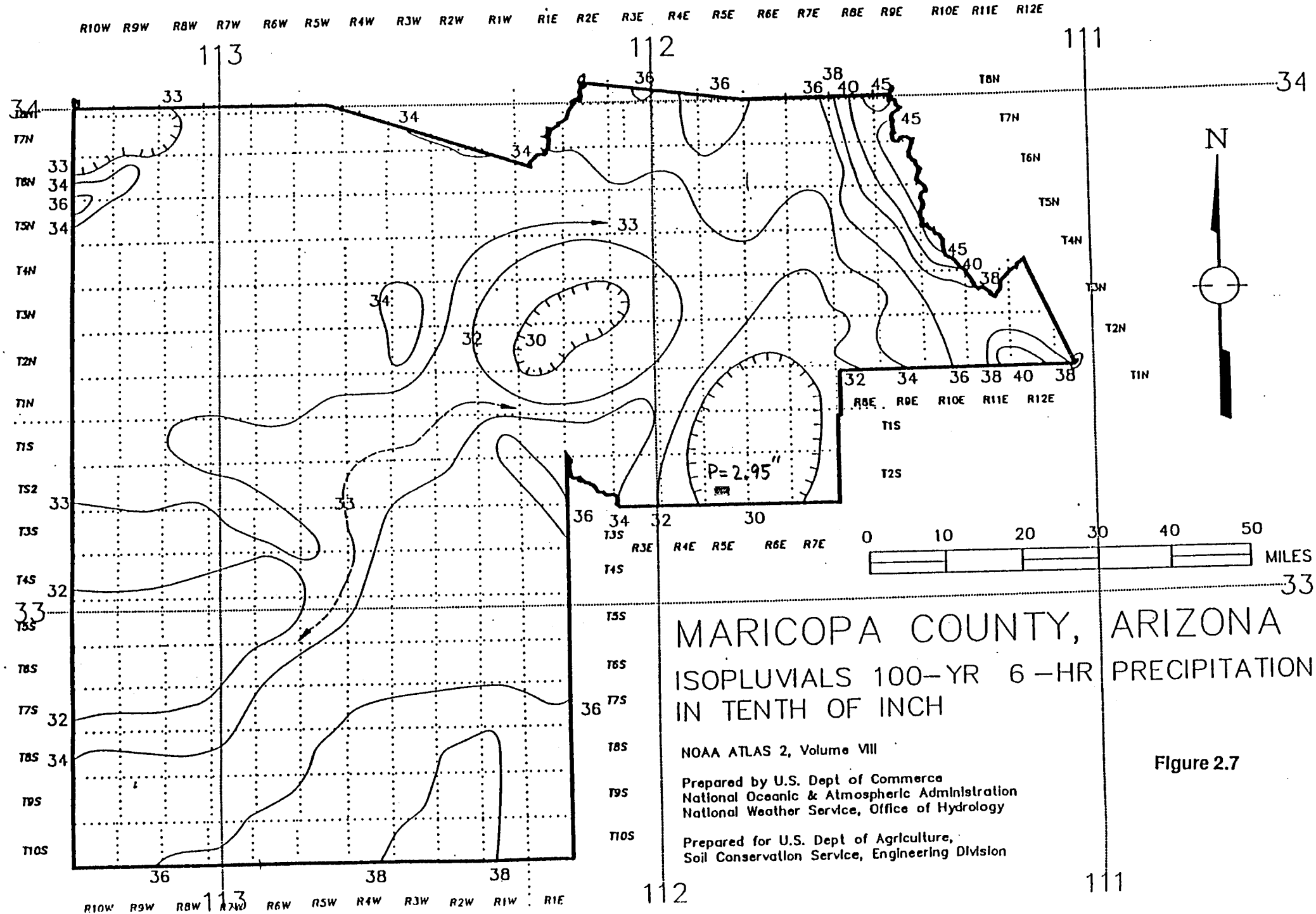
Prepared for U.S. Dept of Agriculture,
Soil Conservation Service, Engineering Division
N
MILES
P=2.58"

Figure 2.6


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
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National Weather Service, Office of Hydrology
Prepared for U.S. Dept of Agriculture,
Soil Conservation Service, Engineering Division
N
MILES
P=2.95"

Figure 2.7

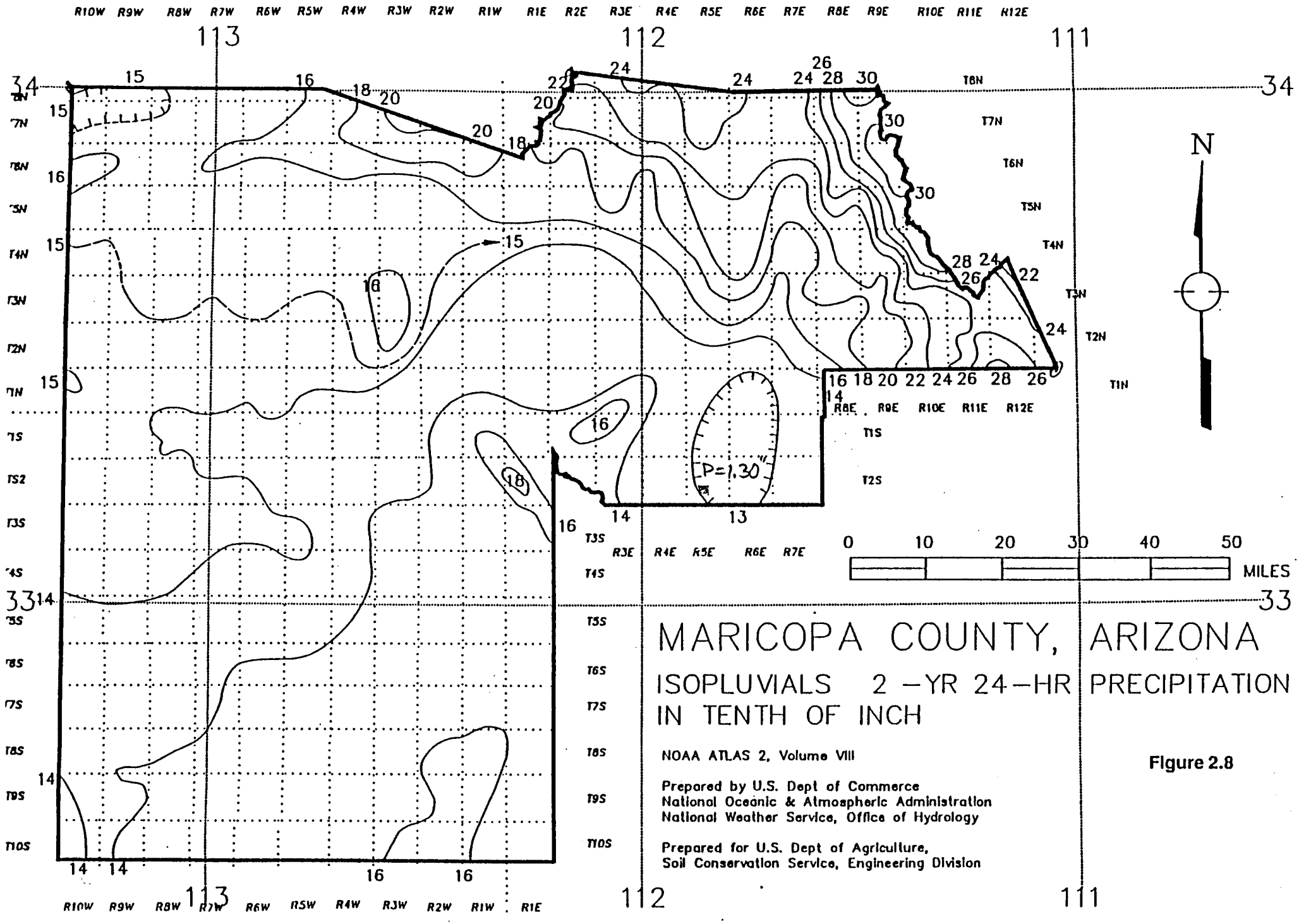

MARICOPA COUNTY, ARIZONA
ISOPLUVIALS 2 -YR 24-HR PRECIPITATION
IN TENTH OF INCH
NOAA ATLAS 2, Volume VIII
Prepared by U.S. Dept of Commerce
National Oceanic & Atmospheric Administration
National Weather Service, Office of Hydrology
Prepared for U.S. Dept of Agriculture,
Soil Conservation Service, Engineering Division
N
0 10 20 30 40 50
MILES
P=1.30"
R10W R9W R8W R7W R6W R5W R4W R3W R2W R1W R1E R2E R3E R4E R5E R6E R7E R8E R9E R10E R11E R12E
T8N T7N T6N T5N T4N T3N T2N T1N T1S T2S T3S T4S T5S T6S T7S T8S T9S T10S
113 112 111
34 33

Figure 2.8

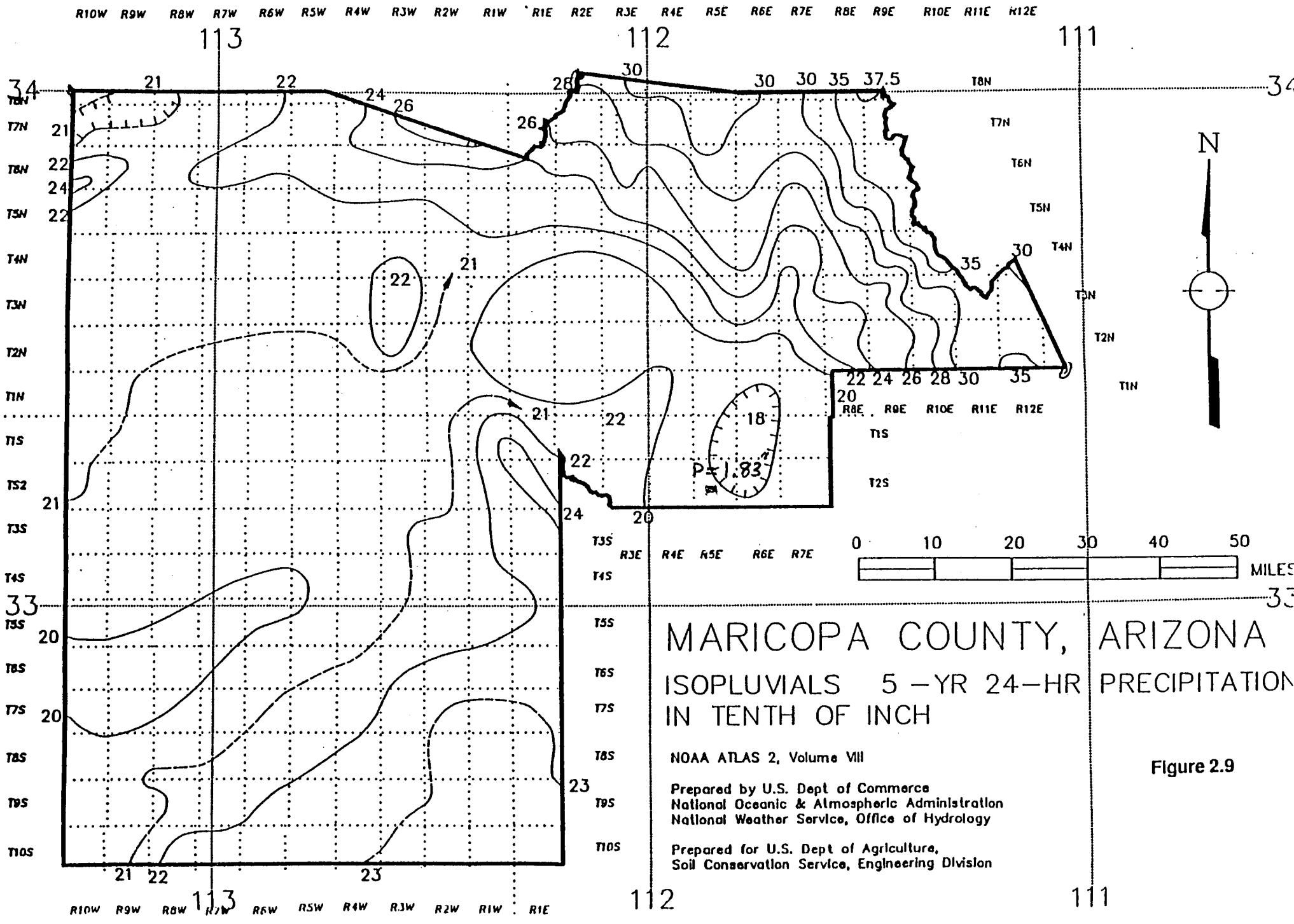
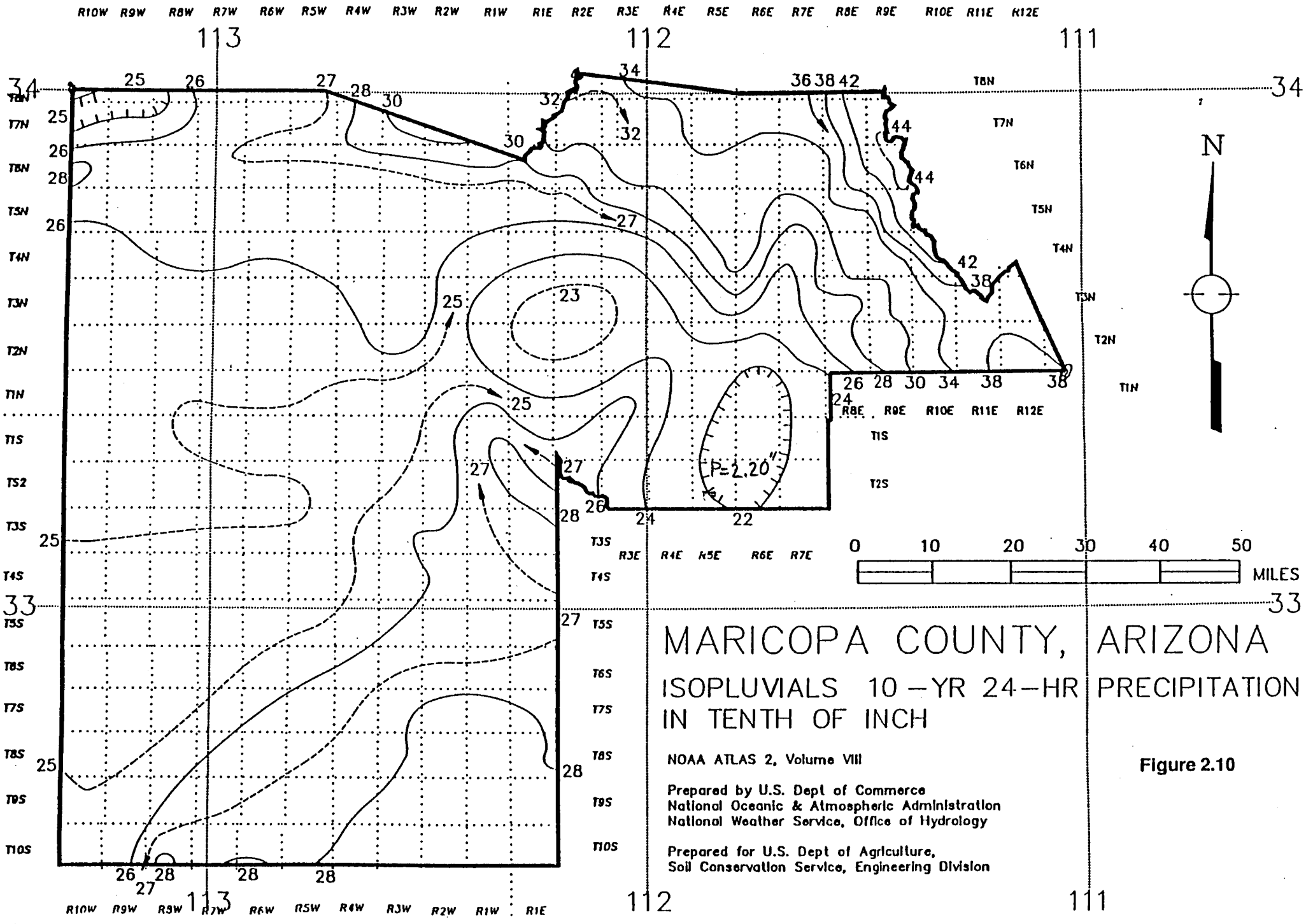

MARICOPA COUNTY, ARIZONA
ISOPLUVIALS 5 –YR 24–HR PRECIPITATION
IN TENTH OF INCH
NOAA ATLAS 2, Volume VIII
Prepared by U.S. Dept of Commerce
National Oceanic & Atmospheric Administration
National Weather Service, Office of Hydrology
Prepared for U.S. Dept of Agriculture,
Soil Conservation Service, Engineering Division
N
0 10 20 30 40 50
MILES
P=1.83
113
112
111
34
33

Figure 2.9


MARICOPA COUNTY, ARIZONA
ISOPLUVIALS 10 – YR 24 – HR PRECIPITATION
IN TENTH OF INCH
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N
0 10 20 30 40 50
MILES
P=2.20"
113
112
111
34
33

Figure 2.10

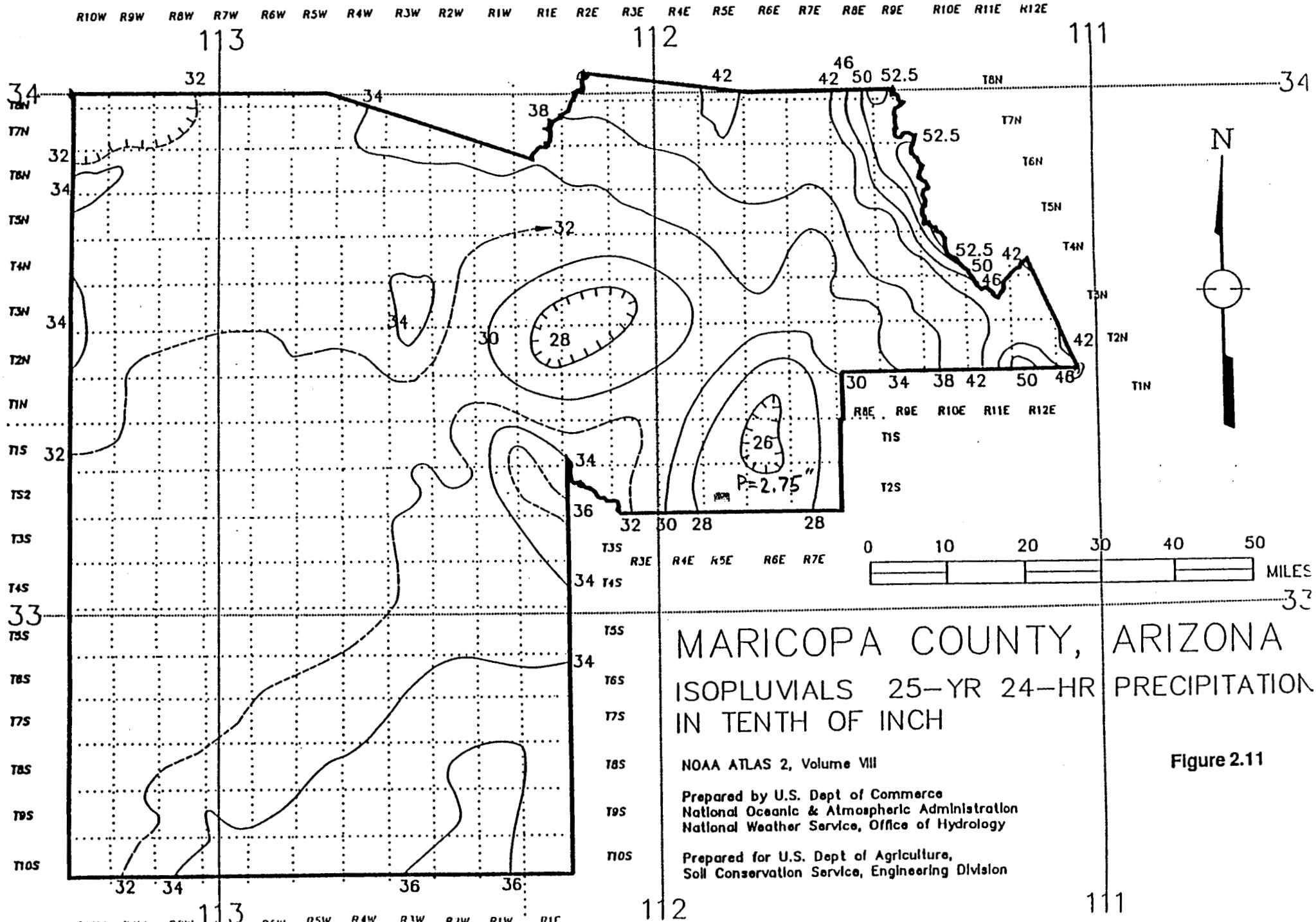
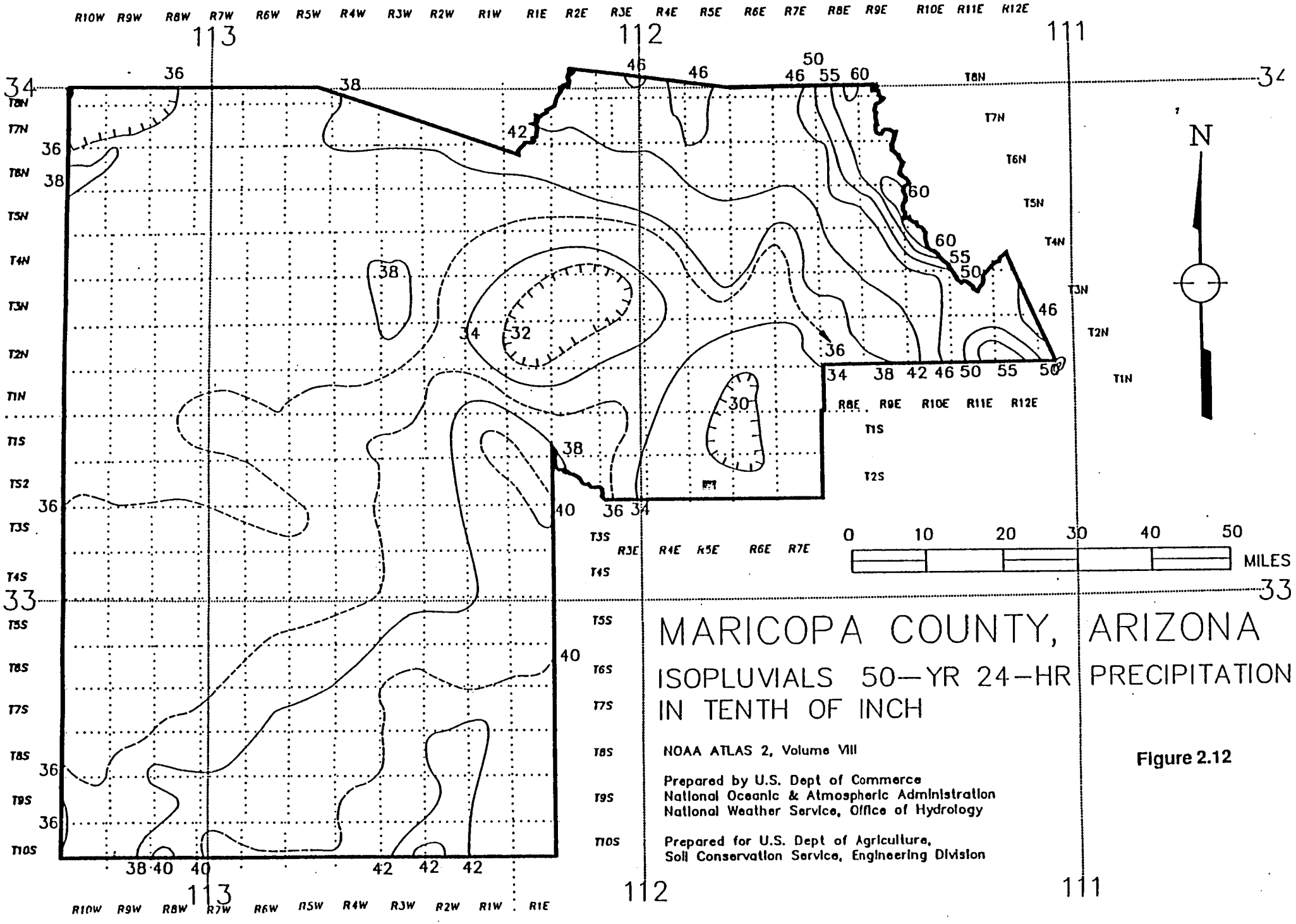

MARICOPA COUNTY, ARIZONA
ISOPLUVIALS 25-YR 24-HR PRECIPITATION
IN TENTH OF INCH
NOAA ATLAS 2, Volume VIII
Prepared by U.S. Dept of Commerce
National Oceanic & Atmospheric Administration
National Weather Service, Office of Hydrology
Prepared for U.S. Dept of Agriculture,
Soil Conservation Service, Engineering Division
N
MILES
P=2.75"

Figure 2.11


MARICOPA COUNTY, ARIZONA
ISOPLUVIALS 50—YR 24—HR PRECIPITATION
IN TENTH OF INCH
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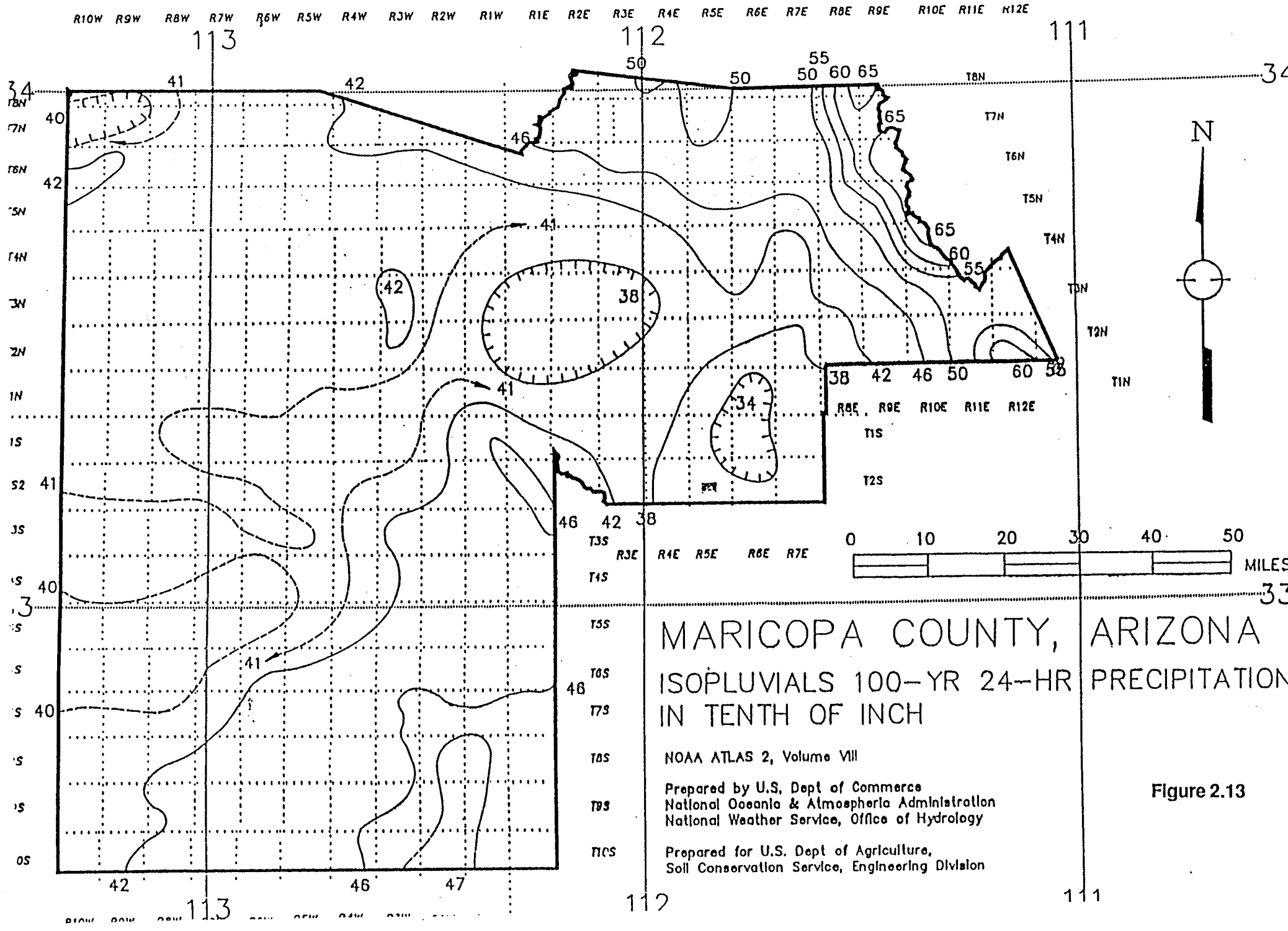
N
0 10 20 30 40 50
MILES
R10W R9W R8W R7W R6W R5W R4W R3W R2W R1W R1E R2E R3E R4E R5E R6E R7E R8E R9E R10E R11E R12E
T8N T7N T6N T5N T4N T3N T2N T1N T1S T2S T3S T4S T5S T6S T7S T8S T9S T10S
113 112 111
34 33

Figure 2.12


MARICOPA COUNTY, ARIZONA
ISOPLUVIALS 100-YR 24-HR PRECIPITATION
IN TENTH OF INCH
NOAA ATLAS 2, Volume VIII
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Soil Conservation Service, Engineering Division
N
0 10 20 30 40 50
MILES
R10W R9W R8W R7W R6W R5W R4W R3W R2W R1W R1E R2E R3E R4E R5E R6E R7E R8E R9E R10E R11E R12E
T8N T7N T6N T5N T4N T3N T2N T1N T1S T2S T3S T4S T5S T6S T7S T8S T9S T10S
113 112 111
34 33

Figure 2.13

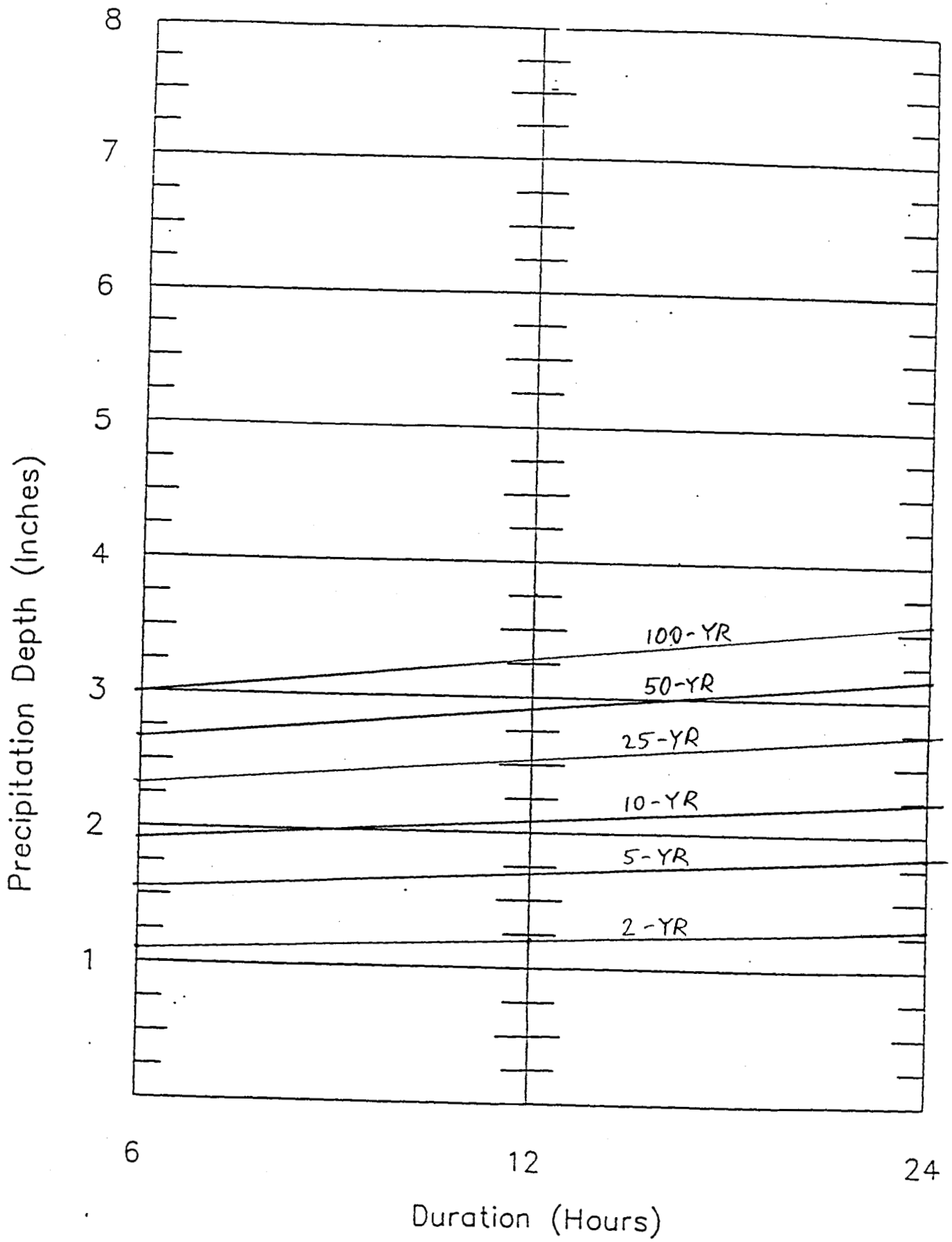


FIG 2.15

Precipitation depth—duration diagram (6 to 24 hr).

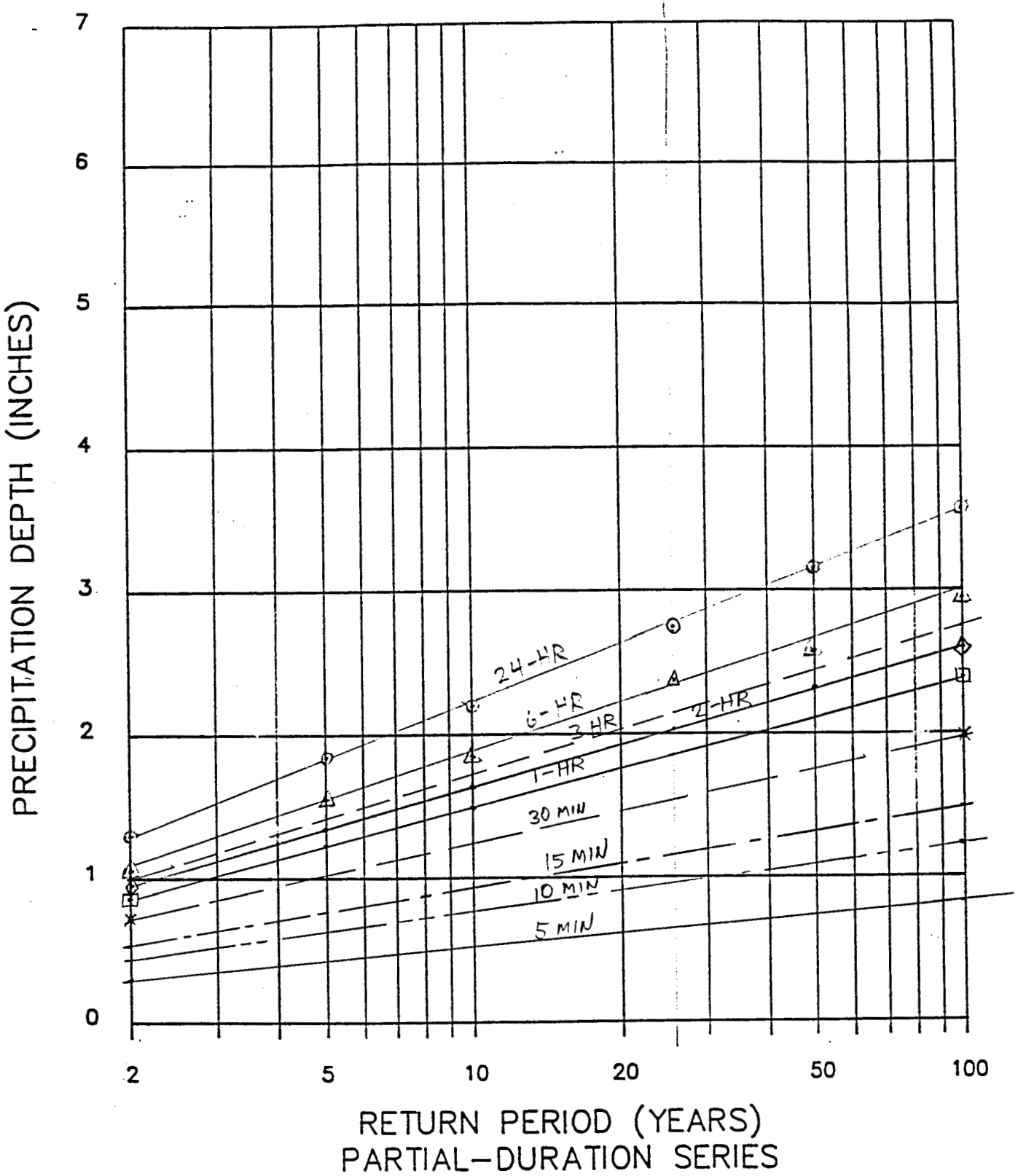


Figure 2.14
Precipitation Depth versus Return Period for Partial-Duration Series

DEVELOPMENT OF DEPTH-DURATION TABLE
USING FCDMC PROGRAM PREFRE.EXE
LOCATION: SUN LAKES AT T2S, R5E SEC 29 & 30

SITE NAME: SUN LAKES SEC. 29 & 30 1992
PRIMARY ZONE #: 7 (APP. A, PREFRE)
SHORT DURA. ZONE #: 8 (APP B, ")
LAT. & LONG.: NOT INCLUDED
SITE ELEV.: " "

INPUT FILE WAS CREATED: PREFRE.DAT

SUN LAKES SEC. 29 & 30 1992
7, 8, , , , 0
1.05, 1.55, 1.85, 2.38, 2.58, 2.95, 1.30, 1.83, 2.20, 2.75, 3.15, 3.57
ENDRUN
NOTE: NUMEROUS ATTEMPTS AT "PREFRE.EXE" YIELDED NOTHING.

RETURN FREQ	RAW MAP VALUES		ADJUSTED FROM FIG 2.14	
	6-HR	24-HR	6-HR	24-HR
2 YR	1.05	1.30	1.10	1.30
5 YR	1.55	1.83	1.55	1.83
10 YR	1.85	2.20	1.91	2.25
25 YR	2.38	2.75	2.31	2.75
50 YR	2.58	3.15	2.67	3.15
100 YR	2.95	3.57	3.00	3.57

FOR P(2YR, 1hr) & P(100 YR, 1hr) AND 1hr DEPTHS FOR 5, 10, 25 & 50 YR:

$P_2^1 = -.011 + .942(1.10)(1.10/1.30) \longrightarrow P_2^1 = 0.87''$

$P_{100}^1 = .494 + .755(3.00)(3.00/3.57) \longrightarrow P_{100}^1 = 2.40''$

$P_2^1 = 0.87''$ AND $P_{100}^1 = 2.40''$ ARE PLOTTED ON FIG. 2.14

SO $P_5^1 = 1.23''$, $P_{10}^1 = 1.50''$, $P_{25}^1 = 1.82''$ $P_{50}^1 = 2.10''$

FOR 2-HR DEPTHS P_2^2 & P_{100}^2 AND 2HR DEPTHS FOR 5, 10, 25 & 50 YR:

$P_2^2 = .341(1.10) + .659(0.87) \longrightarrow P_2^2 = 0.95''$

$P_{100}^2 = .341(3.00) + .659(2.40) \longrightarrow P_{100}^2 = 2.60''$

PLOT P_2^2 & P_{100}^2 ON FIG. 2.14 AND READ:

$P_5^2 = 1.35''$, $P_{10}^2 = 1.65''$, $P_{25}^2 = 2.03''$, $P_{50}^2 = 2.31''$

SIMILARLY FOR 3 hr DURATION

$P_2^3 = .569(1.10) + .431(0.87) =$ $P_2^3 = 1.00''$

$P_{100}^3 = .569(3.00) + .431(2.40) =$ $P_{100}^3 = 2.74''$

$P_5^3 = 1.41''$, $P_{10}^3 = 1.72''$, $P_{25}^3 = 2.15''$, $P_{50}^3 = 2.45''$

PLOT 6 & 24 HR STORMS (ALL FREQ) ON FIG 2.15 READ 12 HR DEPTHS

$P_2^{12} = 1.20''$, $P_5^{12} = 1.70''$, $P_{10}^{12} = 2.09''$, $P_{25}^{12} = 2.54''$, $P_{50}^{12} = 2.90''$, $P_{100}^{12} = 3.30''$

---

30 MIN DEPTHS FOR P_2^{30M} & P_{100}^{30M} ARE PLOTTED ON FIG 2.14, READ OTHERS

$P_2^{30M} = .82(P_2^1) = .82(0.87'') \longrightarrow P_2^{30M} = 0.71''$

$P_{100}^{30M} = .82(P_{100}^1) = .82(2.40'') \longrightarrow P_{100}^{30M} = 1.97''$

$P_5^{30M} = 1.02''$, $P_{10}^{30M} = 1.25''$, $P_{25}^{30M} = 1.55''$, $P_{50}^{30M} = 1.76''$

15 MIN DEPTHS:

$P_2^{15M} = .62(P_2^1) = .62(.87) \longrightarrow P_2^{15M} = 0.54''$

$P_{100}^{15M} = .62(P_{100}^1) = .62(2.40) \longrightarrow P_{100}^{15M} = 1.49''$

$P_5^{15M} = .77''$, $P_{10}^{15M} = .92''$, $P_{25}^{15M} = 1.15''$, $P_{50}^{15M} = 1.31''$

SIMILARLY FOR 10-MIN DEPTHS

$P_2^{10M} = 0.51\,(P_2^1) = 0.51\,(0.87'')$ $\qquad P_2^{10M} = 0.44''$

$P_{100}^{10M} = 0.51\,(P_{100}^1) = 0.51\,(2.40'')$ $\qquad P_{100}^{10M} = 1.22''$

$P_5^{10M} = 0.63''$, $P_{10}^{10M} = 0.78''$, $P_{25}^{10M} = 0.95''$, $P_{50}^{10M} = 1.09''$

SIMILARLY FOR 5-MIN DEPTHS

$P_2^{5M} = .34\,(P_2^1) = .34\,(.87'')$ $\qquad P_2^{5M} = 0.30''$

$P_{100}^{5M} = .34\,(P_{100}^1) = .34\,(2.40'')$ $\qquad P_{100}^{5M} = 0.82''$

$P_5^{5M} = 0.43''$, $P_{10}^{5M} = 0.52''$, $P_{25}^{5M} = 0.66''$, $P_{50}^{5M} = 0.74''$

DURATION	2 YR	5 YR	10 YR	25 YR	50 YR	100 YR
5 MIN	0.30	0.43	0.52	0.66	0.74	0.82
10 MIN	0.44	0.63	0.78	0.95	1.09	1.22
15 MIN	0.54	0.77	0.92	1.15	1.31	1.49
30 MIN	0.71	1.02	1.25	1.55	1.76	1.97
1 HR	0.87	1.23	1.50	1.82	2.10	2.40
2 HR	0.95	1.35	1.65	2.03	2.31	2.60
3 HR	1.00	1.41	1.72	2.15	2.45	2.74
6 HR	1.10	1.55	1.91	2.31	2.67	3.00
12 HR	1.20	1.70	2.09	2.54	2.90	3.30
24 HR	1.30	1.83	2.25	2.75	3.15	3.57

THE FORTRAN PROGRAM MCUHP1 (FCDMC) WILL BE USED TO DETERMINE TIME OF CONCENTRATION (T_c)

Eastern Soil Survey

Map Unit No.	Soil Name	USDA Soil Texture	Control Horizon Depth, in	Table 4.2 Textural Class	XKSAT, in/hr
Af	Agualt	Fine Sandy Loam	0-17	Loam	0.25
Ag	Agualt	Loam	0-17	Loam	0.25
Am	Alluvial Land	Sand	0-60	Loamy Sand	1.20
AnA	Antho	Sandy Loam	0-17	Sandy Loam	0.40
AnB	Antho	Sandy Loam	0-17	Sandy Loam	0.40
AoB	Antho	Gravelly Sandy Loam	0-17	Sandy Loam	0.40
Av	Avondale	Clay Loam	0-13	Clay Loam	0.04
Ca	Carrizo	Gravelly Loamy Sand	0-15	Loamy Sand	1.20
Cb	Carrizo	Fine Sandy Loam	0-15	Loam	0.25
Cc	Cashion	Clay	0-12	Clay	0.01
CeC	Cavelt	Gravelly Loam	2-8	Sandy Loam	0.40
Co	Contine	Clay Loam	0-12	Clay Loam	0.04
★ Es	Estrella	Loam	0-15	Loam	0.25
Gf	Gilman	Fine Sandy Loam	0-13	Loam	0.25
Gm	Gilman	Loam	0-13	Loam	0.25
Gn	Glenbar	Clay Loam	0-14	Clay Loam	0.04
Gr	Gravelly Alluvial Land	Very Gravelly Sandy Loam, Loamy Sand	0-60	Loamy Sand	1.20
LaA	Laveen	Loam	0-14	Loam	0.25
LaB	Laveen	Loam	0-14	Loam	0.25
LeA	Laveen	Clay Loam	0-14	Clay Loam	0.04
★ Mo	Mohall	Sandy Loam	0-16	Sandy Loam	0.40
★ Mv	Mohall	Loam	0-15	Loam	0.25
Pm	Pimer	Clay Loam	0-15	Clay Loam	0.04
PnA	Pinal	Gravelly Loam	0-18	Sandy Loam	0.40
PnC	Pinal	Gravelly Loam	0-18	Sandy Loam	0.40
Po	Pinal Variant	Loam	0-13	Loam	0.25
PvA	Pinamt	Very Gravelly Loam	0-3	Sandy Loam	0.40
PvC	Pinamt	Very Gravelly Loam	0-3	Sandy Loam	0.40
RlA	Rillito	Gravelly Loam	0-13	Sandy Loam	0.40
RlB	Rillito	Gravelly Loam	0-13	Sandy Loam	0.40
Ro	Rock Land	Gravelly Loam - Clay Loam	—	Loam	0.25
Ru	Rough Broken Land	Varies	—	Sandy Loam	0.40
TrB	Tremant	Gravelly Sandy Clay Loam	1-5	Silt	0.10
★ Tx	Trix	Clay Loam	0-14	Clay Loam	0.04
Va	Valencia	Sandy Loam	0-13	Sandy Loam	0.40
Ve	Vecont	Clay	0-14	Clay	0.01
★ Vf	Vint	Loamy Fine Sand	0-12	Loamy Sand	1.20

REVISED 4-4-93
DES

CALCULATIONS- PROJECT GREEN & AMPT SOIL PARAMETERS

SOIL	AREA (MAP UNITS)	FRACTION OF WHOLE	
E_s	6.12	.10	
M_o	13.09	.22	
M_v	29.88	.49	
T_x	8.27	.14	
V_f	2.98	.05	(VERY SMALL PERCENTAGE)
TOTAL AREA	60.34	1.00	

$$XKSAT = ALOG[.10 \log(.25)_{E_s} + .22 \log(.40)_{M_o} + .49 \log(.25)_{M_v} + .14 \log(.04)_{T_x} + .05 \log(1.20)_{V_f}]$$

$XKSAT_{WTD} = 0.232$ (BARE GROUND)

$XKSAT = C_K \cdot XKSAT_{WTD}$

$C_K = 1.12$ RES, COMM $C_K = 2.0$ GOLF COURSE

$$PSIF = ALOG[.10 \log(3.5) + .22 \log(4.3) + .49 \log(3.5) + .14 \log(8.2) + .05 \log(35)]$$

$PSIF_{WTD} = 4.13$ (FIG. 4.3 SHALL BE USED TO SELECT PSIF)

$$D\theta = ALOG[(.10 + .22 + .49) \log(.25) + (.14) \log(.15) + .05 \log(.30)]$$

$D\theta_{WTD} = .235$ (FIG 4.3 SHALL BE USED TO SELECT $D\theta$)

GREEN & AMPT LOSS PARAMETERS

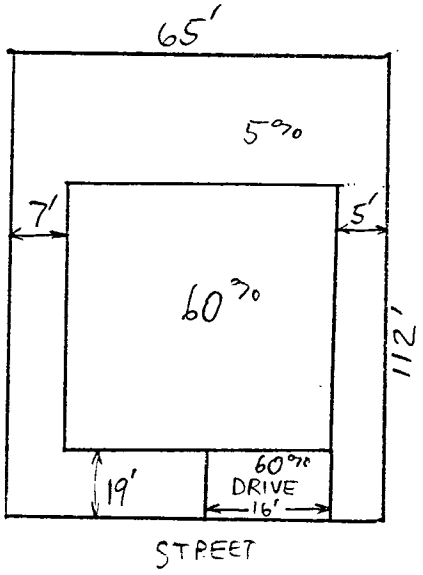
INITIAL: SO FOR ALL SOILS WITHIN SEC 29-30

	XKSAT	PSIF	DΘ	INIT. IA LOSS (IN)	FOR RESISTIVITY m	b	
GOLF COURSE	0.46	3.75	.255	.50	-.00625	0.04	chgd
RESID. UH/L, UH/M	0.26	4.8	0.25	.10	-.00625	0.04	
COMM. UH/H	0.23	5.0	0.25	.05	-.00625	0.04	
LAKE	0.23	5.0	0.25	.00	-.00625	0.04	chgd

CALCULATIONS (CNTD.)

TYPICAL PERCENT IMPERVIOUS BY LAND USE

UR/L REGULAR



SMALL 51' x 41' DEEP

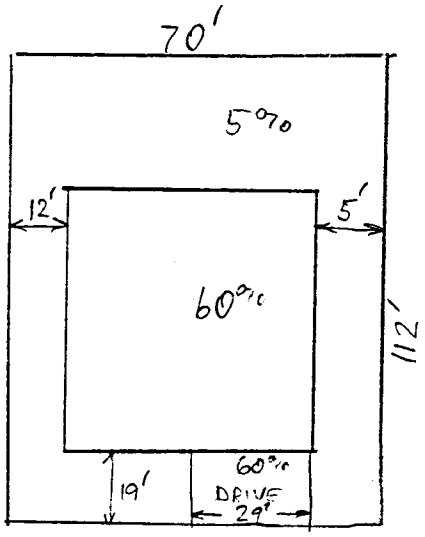
DBL DRVWY

LARGE 53' x 66' DEEP

$$RTIMP_{MIN} = \frac{2395(.60) + 4885(.05)}{7280} = .23$$

$$RTIMP_{MAX} = \frac{3802(.60) + 3478(.05)}{7280} = .33$$

UR/L LUXURY



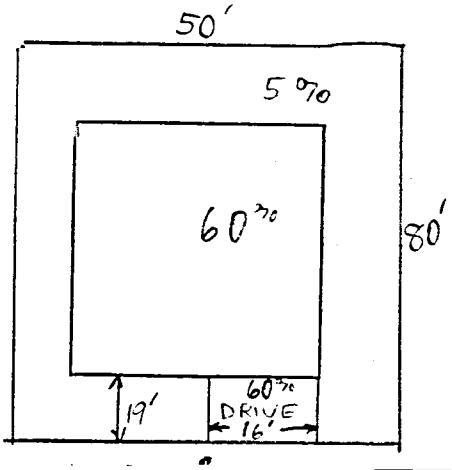
SMALL 43' x 76' DEEP

LARGE 53' x 87' DEEP

$$RTIMP_{MIN} = \frac{3570(.60) + 4270(.05)}{7840} = .30$$

$$RTIMP_{MAX} = \frac{5162(.60) + 2678(.05)}{7840} = .41$$

UR/M CASITAS



SMALL 45' x 54' DEEP

LARGE 45' x 60' DEEP

$$RTIMP_{MIN} = \frac{2730(.60) + 1270(.05)}{4000} = .42$$

$$RTIMP_{MAX} = \frac{3004(.60) + 996(.05)}{4000} = .46$$

CALCULATIONS (CNTD.)

PERCENT IMPERVIOUS USED

UR/L (ALL)	RTIMP =	30 %
UR/M	RTIMP =	40 %
UR/H & COMMERCIAL	RTIMP =	80 %
O.S./(GOLF COURSE)	RTIMP =	1 %
LAKE		100 %

4.2 Surface Retention Loss

Surface retention loss, as used herein, is the summation of all rainfall losses other than infiltration. The major component of surface retention loss is depression storage; relatively minor components of surface retention loss are due to interception and evaporation, as previously discussed. Depression storage is considered to occur in two forms. First, in-place depression storage occurs at, and in the near vicinity of, the raindrop impact. The mechanism for this depression storage is the microrelief of the soil and soil cover. The second form of depression storage is the retention of surface runoff that occurs away from the point of raindrop impact in surface depressions such as puddles, roadway gutters and swales, roofs, irrigation bordered fields and lawns, and so forth.

A relatively minor contribution by interception is also considered as a part of the total surface retention loss. Estimates of surface retention loss are difficult to obtain and are a function of the physiography and land-use of the area.

The surface retention loss on impervious surfaces has been estimated to be in the range 0.0625 inch to 0.125 inch by Tholin and Keefer (1960), 0.11 inch for 1 percent slope to 0.06 inch for 2.5 percent slopes by Viessman (1967), and 0.04 inch based on rainfall-runoff data for an urban watershed in Albuquerque by Sabol (1983). Hicks (1944) provides estimates of surface retention losses during intense storms as 0.20 inch for sand, 0.15 inch for loam, and 0.10 inch for clay. Tholin and Keefer (1960) estimated the surface retention loss for turf to be between 0.25 to 0.50 inch. Based on rainfall simulator studies on undeveloped alluvial plains in the Albuquerque area, the surface retention loss was estimated as 0.1 to 0.2 inch (Sabol and others, 1982a). Rainfall simulator studies in New Mexico result in estimates of 0.39 inch for eastern plains rangelands and 0.09 inch for pinon-juniper hillslopes (Sabol and others, 1982b). Surface retention losses for various land-uses and surface cover conditions in Maricopa County have been extrapolated from these reported estimates and these are shown in Table 4.1.

Table 4.1
Surface Retention Loss for Various Land Surfaces in Maricopa County

Land-use and/or Surface Cover (1)	Surface Retention Loss IA, Inches (2)
Natural	
Desert and rangeland, flat slope	0.35
Hillslopes, Sonoran Desert	0.15
Mountain, with vegetated surface	0.25
Developed (Residential and Commercial)	
Lawn and turf	0.20
Desert landscape	0.10
Pavement	0.05
Agricultural	
Tilled fields and irrigated pasture	0.50
GOLF COURSE AREA (90-100 TURF)	0.50

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The three infiltration parameters are functions of soil characteristics, ground surface characteristics, and land management practices. The soil characteristics of interest are particle size distribution (soil texture), organic matter, and bulk density. The primary soil surface characteristics are vegetation canopy cover, ground cover, and soil crusting. The land management practices are identified as various tillages as they result in changes to soil porosity.

Values of Green and Ampt equation parameters as a function of soil characteristics alone (bare ground condition) have been obtained from published reports (Rawls and others, 1983; Rawls and Brakensiek, 1983), and average values of XKSAT and PSIF for each of the soil texture classes are shown in Columns (2) and (3) of Table 4.2. The values of XKSAT and PSIF from Table 4.2 or Figure 4.3 should be used if general soil texture classification of the drainage area is available. References used to create Table 4.2 can be found in the Documentation Manual.

In Table 4.2, loamy sand and sand are combined. The parameter values that are shown in the table are for loamy sand. The hydraulic conductivity (XKSAT) for sand is often used as 4.6 inches/hour, and the capillary suction (PSIF) is often used as 1.9 inches. Using those parameter values for drainage areas can result in the generation of no rainfall excess—which may or may not be correct. Incorrect results could cause serious consequences for flood control planning and design. Therefore, it is recommended that—for watersheds consisting of relatively small subareas of sand—the Green and Ampt parameter values for loamy sand be used for the sand portion of the watershed. If the area contains a large portion of sand, then either the Green and

XKSAT VALUES ARE TAKEN FROM APPENDIX C ; FCDMC-VOLUME 1, HYDROLOGY

Table 4.2
Green and Ampt Loss Rate Parameter Values for Bare Ground

Soil Texture Classification (1)	XKSAT inches/hour (2)	PSIF inches (3)	DTHETA[1]		
			Dry (4)	Normal (5)	Saturated (6)
loamy sand & sand		2.4	0.35	0.30	0
sandy loam		4.3	0.35	0.25	0
loam		3.5	0.35	0.25	0
silty loam		6.6	0.40	0.25	0
silt		7.5	0.35	0.15	0
sandy clay loam		8.6	0.25	0.15	0
clay loam		8.2	0.25	0.15	0
silty clay loam		10.8	0.30	0.15	0
sandy clay		9.4	0.20	0.10	0
silty clay		11.5	0.20	0.10	0
clay		12.4	0.15	0.05	0

[1] Selection of DTHETA:
Dry = Nonirrigated lands, such as desert and rangeland;
Normal = Irrigated lawn, turf, and permanent pasture;
Saturated = Irrigated agricultural land.

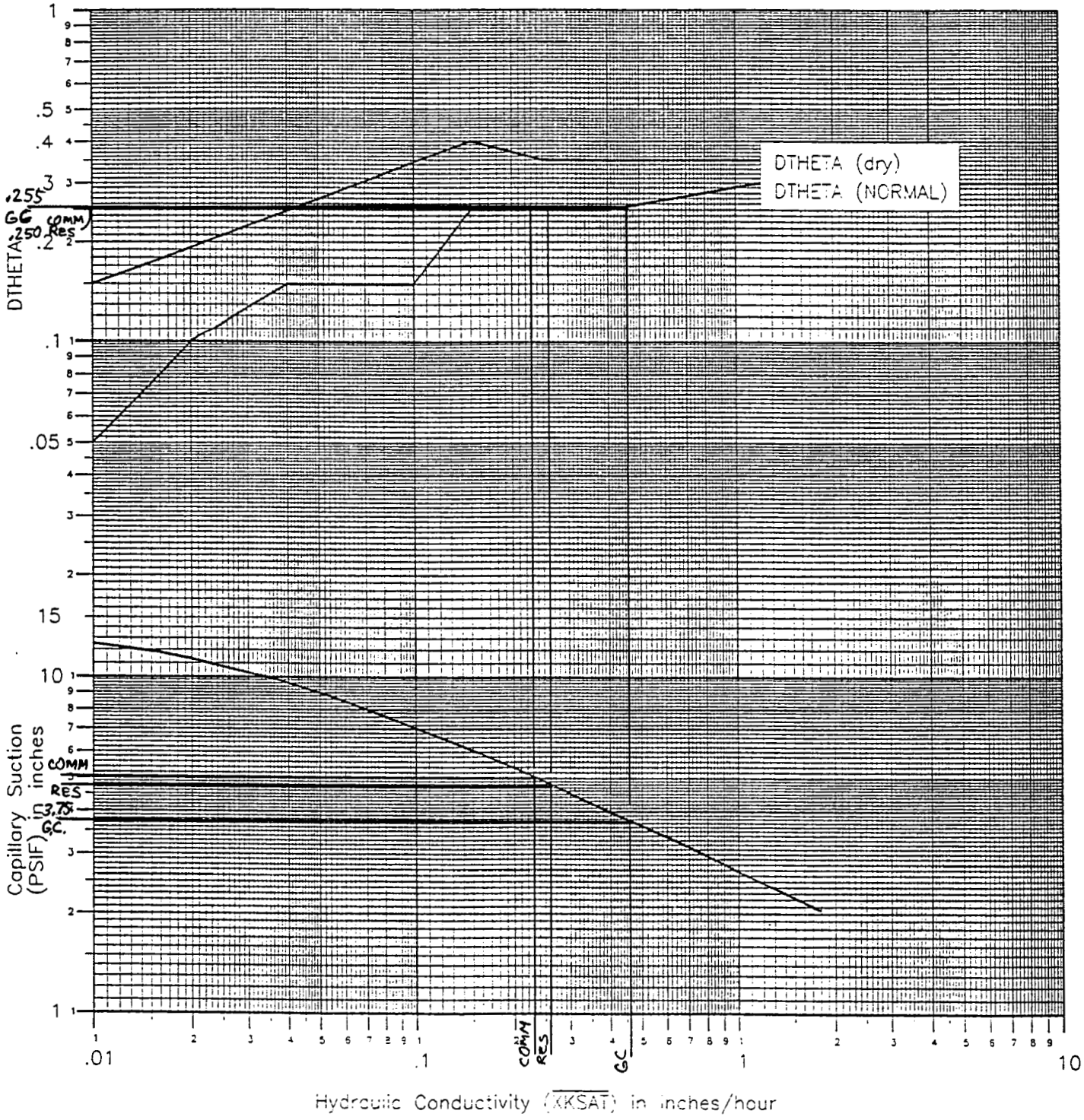

Figure 4.3
Composite Values of PSIF and DTHETA as a function of XKSAT
(To be used for area-weighted averaging of Green and Ampt parameters.)

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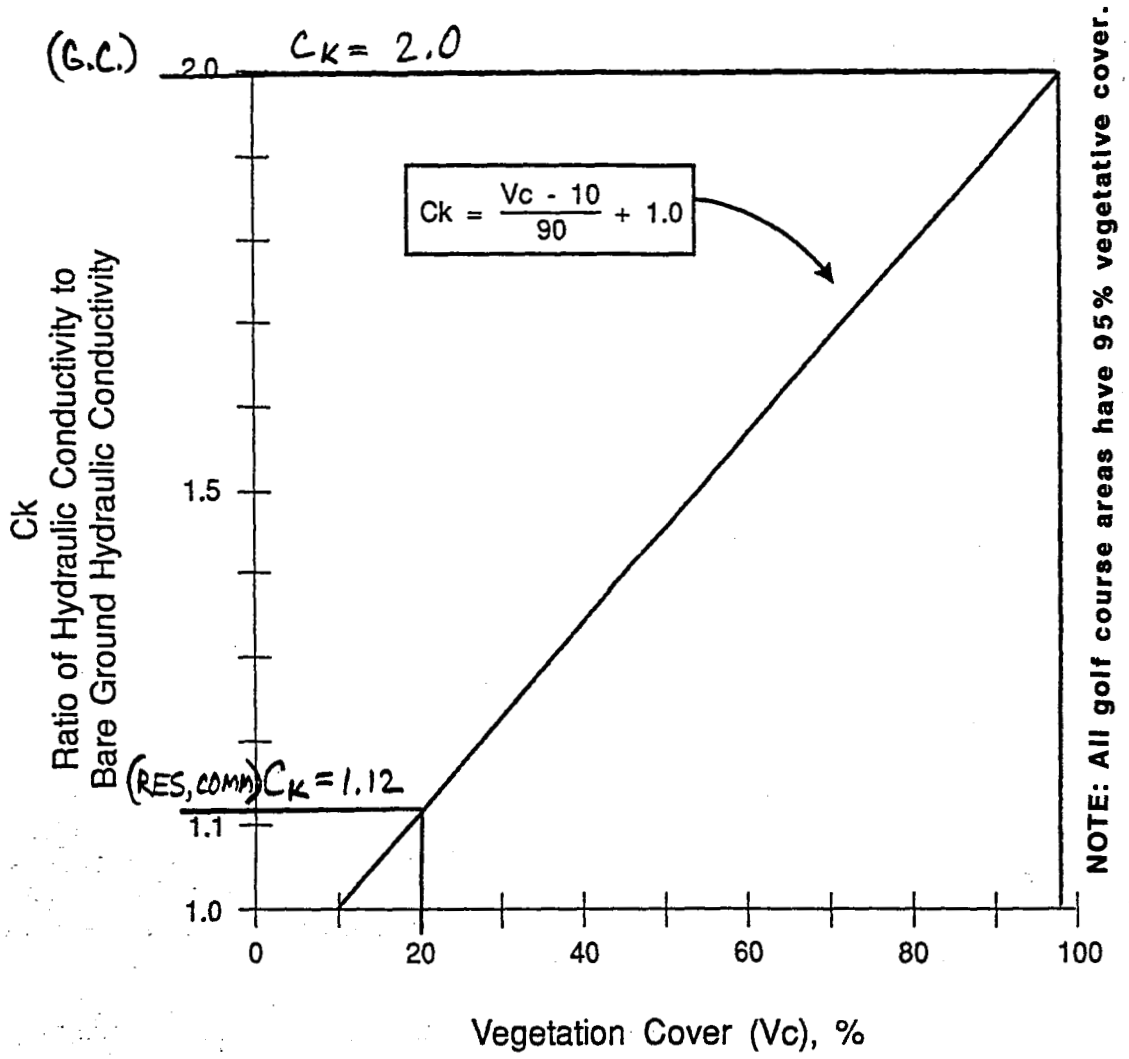

Figure 4.4
Effect of Vegetation Cover on Hydraulic Conductivity
For Hydraulic Soil Groups B, C, and D, and for all Soil Textures
***other than* Sand and Loamy Sand**

on canopy cover for trees and shrubs. Note that this correction can be applied only to soils other than sand and loamy sand.

The influence of tillage results in a change in total porosity and therefore a need to modify the three Green and Ampt equation infiltration parameters. The effect of tillage systems on soil porosity and the corresponding changes to hydraulic conductivity, wetting front capillary suction, and water retention is available (Rawls and Brakensiek, 1983). Although this information is available, it is not presented in this manual, nor is it recommended that these adjustments be made to the infiltration parameters for design purpose use in Maricopa County, because for most flood estimation purposes it cannot be assumed that the soil will be in any particular state of tillage at the time of storm occurrence and therefore the base condition infiltration parameters, as presented, should be used for flood estimation purposes. However,

No adjustment will be made to XKSAT (for compaction considerations), in keeping with this paragraph.

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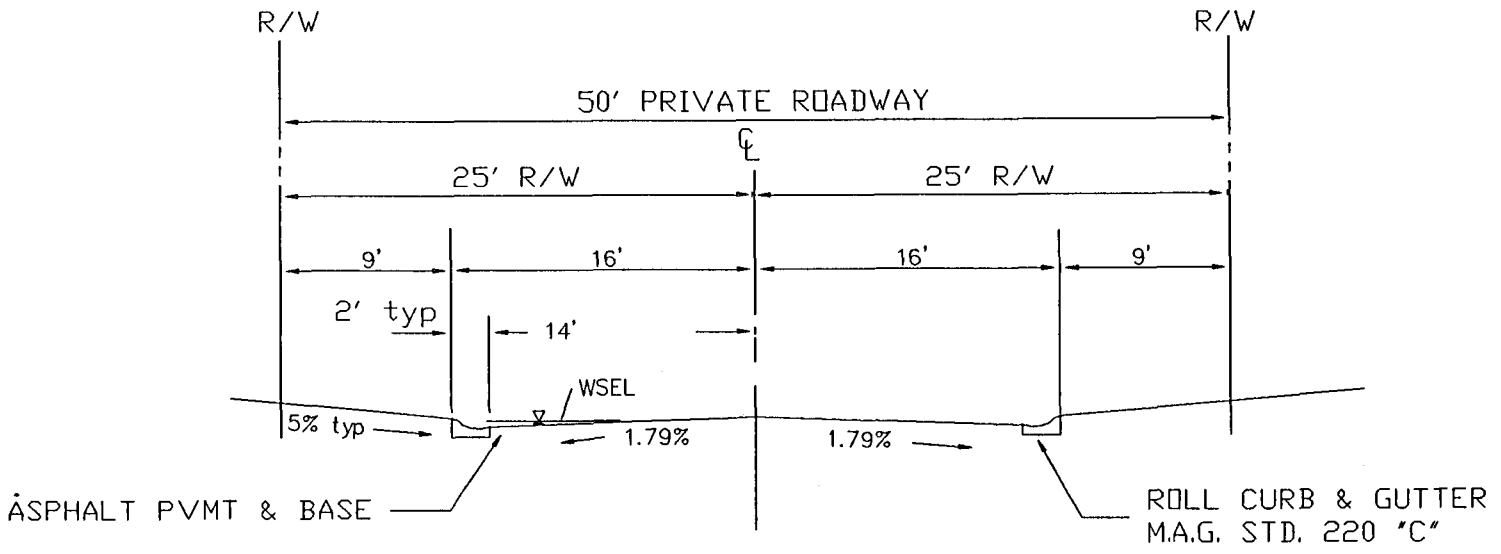

FIGURE 1/TABLE 1

TYPICAL PRIVATE ROADWAY

50'LOCAL STREET

FULL STREET RUNOFF CAPACITY

width	
lip to cl	14.00 ft
backslope	0.05 '/ft
mannings n	0.015

CROSS SLOPE =	0.0179 '/ft
crown height =	0.25 ft

	1.79% xs		longtitudinal slope					longtitudinal slope		
d	ATOT	WP	0.20	0.25	0.30	0.35	0.40	0.50	0.60	0.80
0.33	6.39	32.00	9.68	10.82	11.85	12.80	13.68	15.30	16.76	19.35
0.43	9.79	36.00	18.21	20.36	22.30	24.09	25.75	28.79	31.54	36.42
0.53	13.59	40.00	29.32	32.78	35.91	38.79	41.47	46.36	50.79	58.64
0.63	17.79	44.00	43.10	48.19	52.79	57.02	60.96	68.15	74.66	86.20

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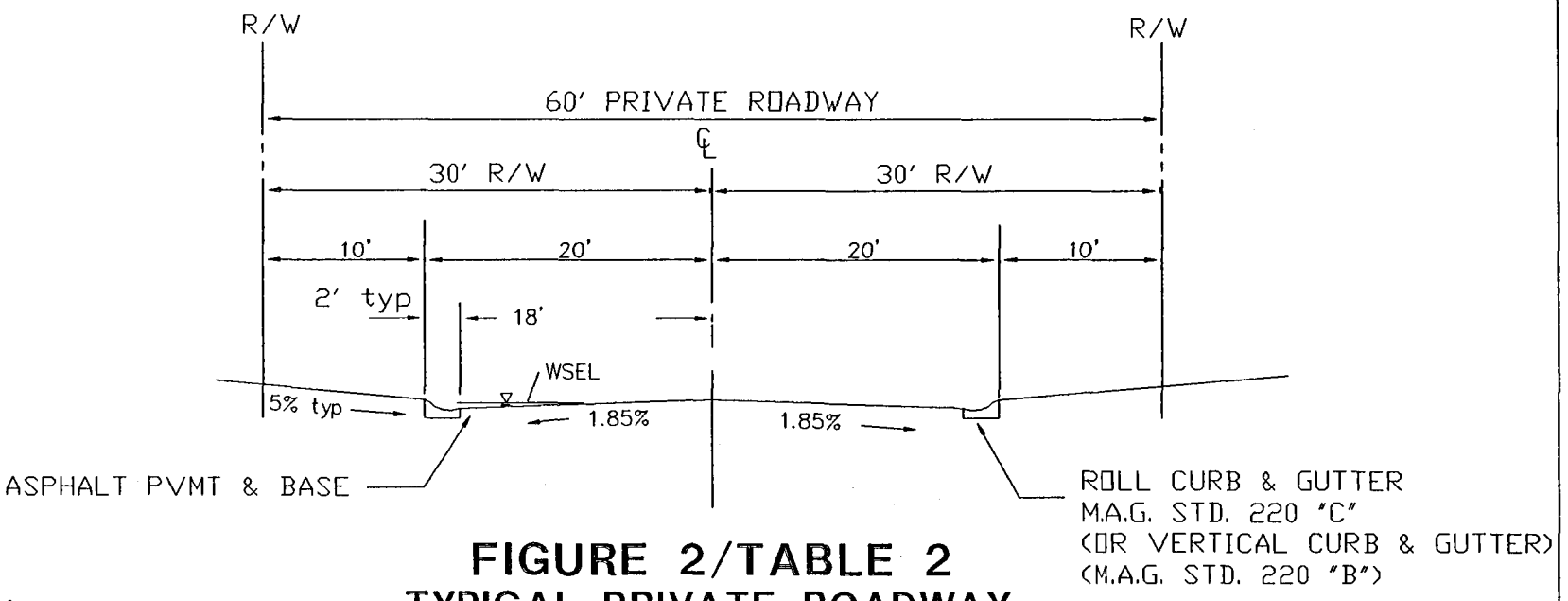

FIGURE 2/TABLE 2

TYPICAL PRIVATE ROADWAY

60'LOCAL STREET

FULL STREET RUNOFF CAPACITY

width	
lip to cl	18.00 ft
backslope	0.05 '/ft
mannings n	0.015

CROSS SLOPE =	0.0185 '/ft
crown height =	0.33 ft

			longtitudinal slope				longtitudinal slope			
d	ATOT	WP	0.20	0.25	0.30	0.35	0.40	0.50	0.60	0.80
0.33	6.55	40.00	8.68	9.70	10.63	11.48	12.27	13.72	15.03	17.35
0.43	10.75	44.00	18.60	20.80	22.78	24.61	26.31	29.41	32.22	37.20
0.53	15.35	48.00	31.79	35.54	38.93	42.05	44.96	50.26	55.06	63.58
0.63	20.35	52.00	48.22	53.91	59.06	63.79	68.20	76.24	83.52	96.44

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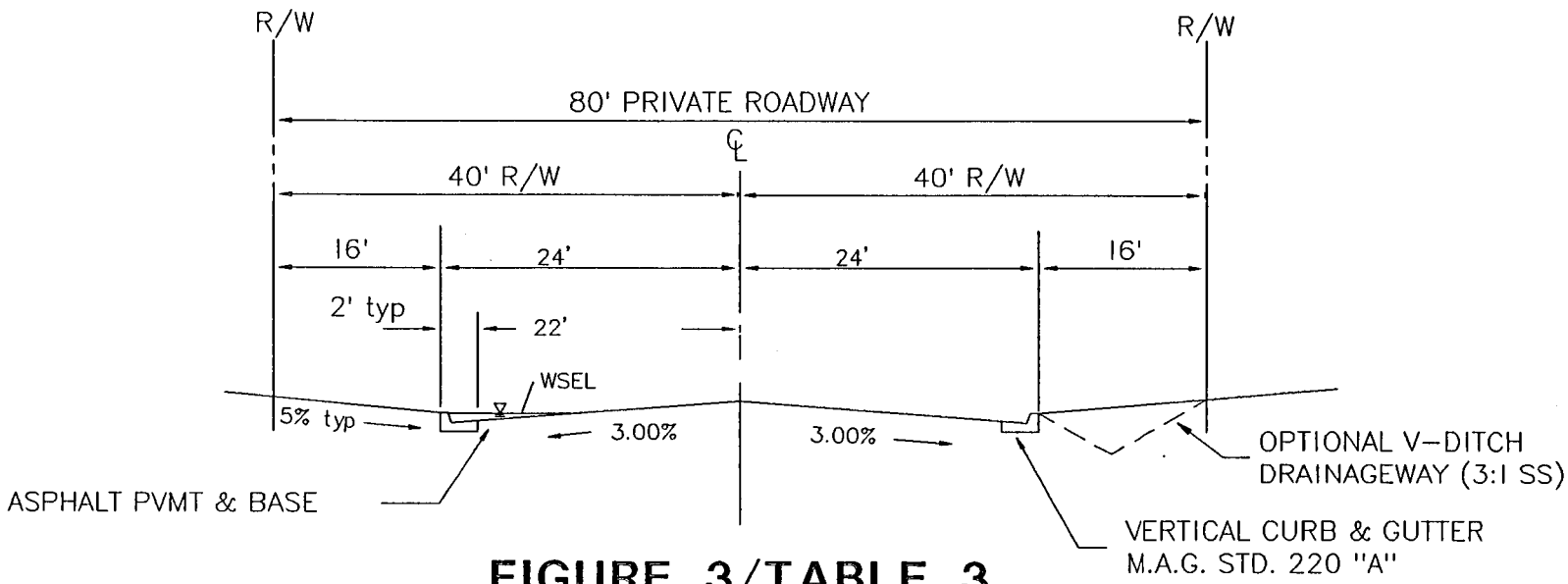

FIGURE 3/TABLE 3

TYPICAL PRIVATE ROADWAY

80'COLLECTOR STREET

FULL STREET RUNOFF CAPACITY

width		
Fl to Cl	23.50	ft
backslope	0.05	'/ft
mannings n	0.015	

CROSS SLOPE =	0.03	'/ft
crown height =	0.72	ft

	3% xs		longtitudinal slope				longtitudinal slope			
d	ATOT	WP	0.20	0.25	0.30	0.35	0.40	0.50	0.60	0.80
0.34	3.78	22.90	5.03	5.63	6.17	6.66	7.12	7.96	8.72	10.07
0.46	6.92	46.40	8.61	9.63	10.55	11.39	12.18	13.62	14.92	17.22
0.50	8.17	49.00	10.97	12.26	13.43	14.51	15.51	17.34	18.99	21.93
0.70	16.80	57.00	32.97	36.86	40.38	43.61	46.62	52.13	57.10	65.94

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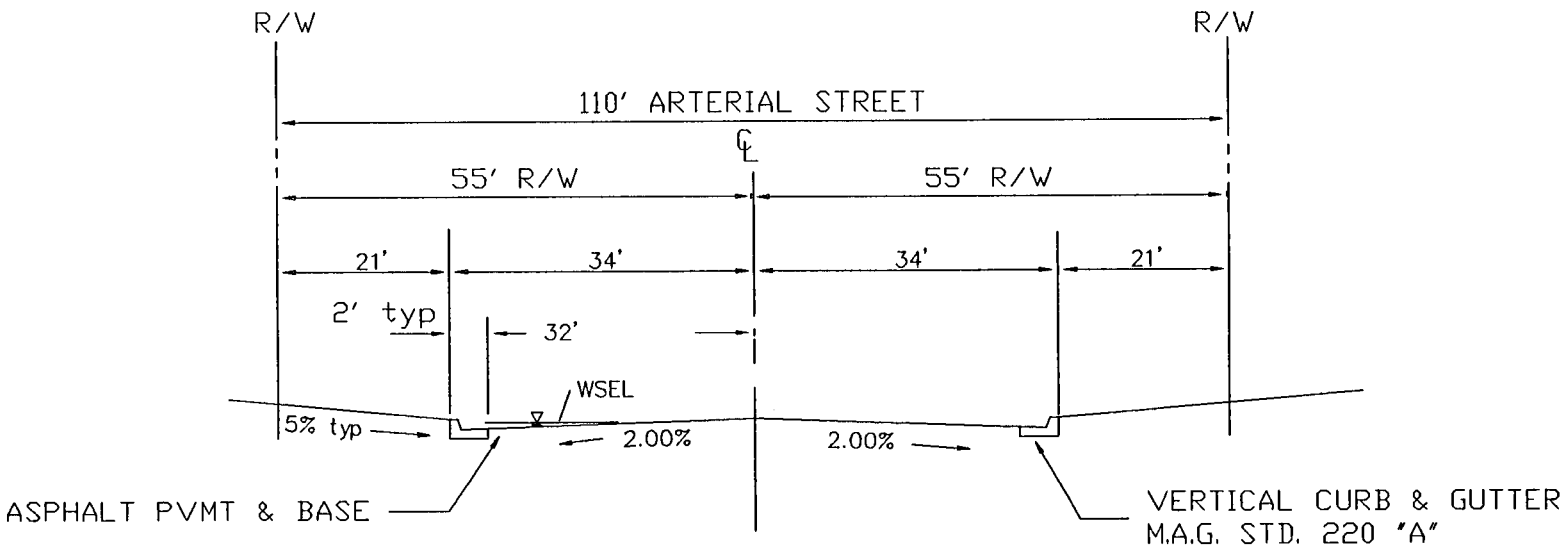

FIGURE 4/TABLE 4

PRICE ROAD

110'ARTERIAL STREET

FULL STREET RUNOFF CAPACITY

width		
lip to cl	33.50	ft
backslope	0.05	'/ft
mannings n =	0.015	

CROSS SLOPE =	0.02	'/ft
crown height =	0.67	ft

	2% xs		longtitudinal slope (%)							
d	ATOT	WP	0.20	0.25	0.30	0.35	0.40	0.50	0.60	0.80
0.43	9.25	43.86	14.51	16.22	17.77	19.19	20.52	22.94	25.13	29.01
0.50	12.50	51.00	21.69	24.25	26.56	28.69	30.67	34.29	37.57	43.38
0.60	17.95	75.00	30.67	34.29	37.56	40.57	43.37	48.49	53.12	61.34
0.70	25.26	79.00	52.31	58.49	64.07	69.20	73.98	82.71	90.61	104.62

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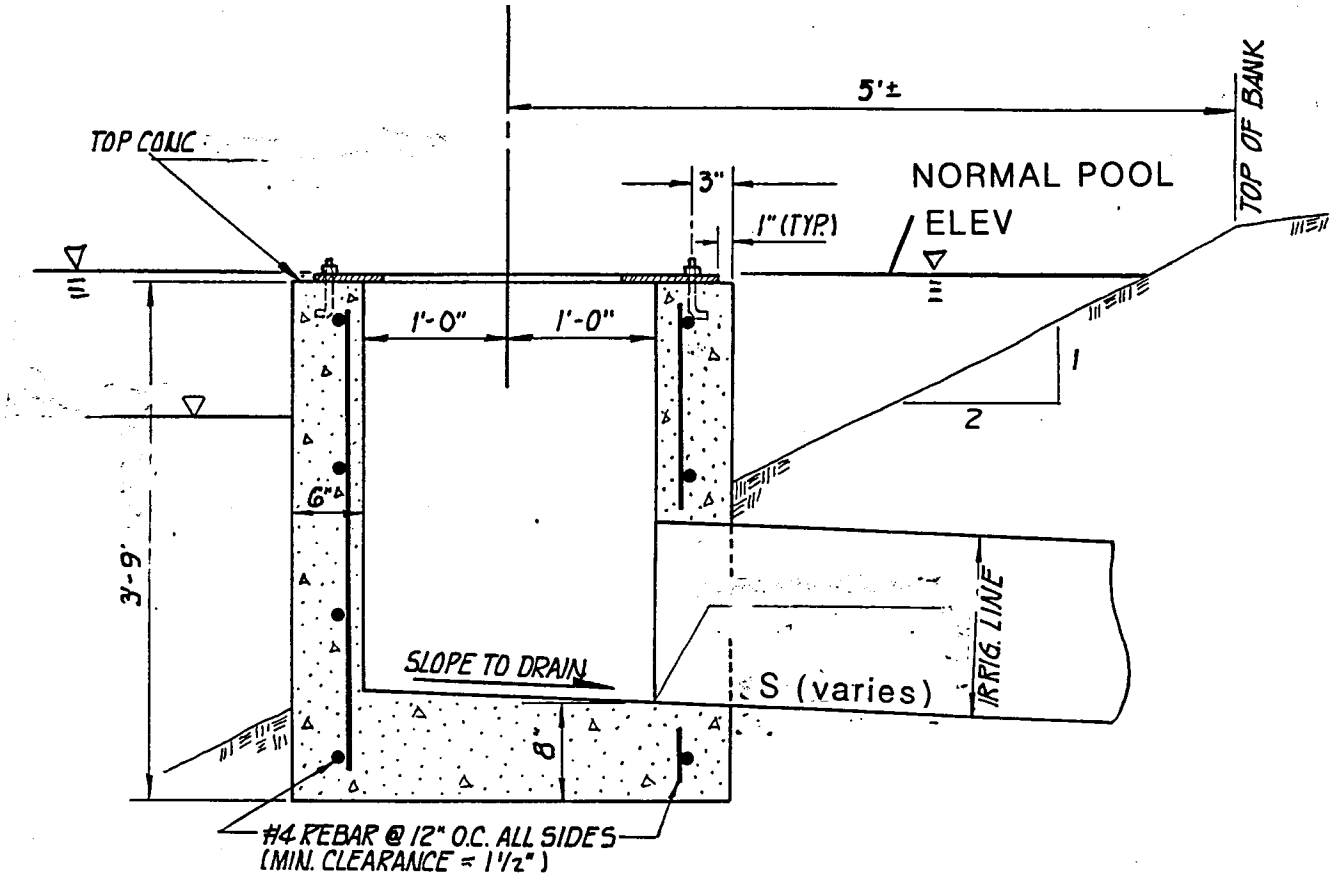
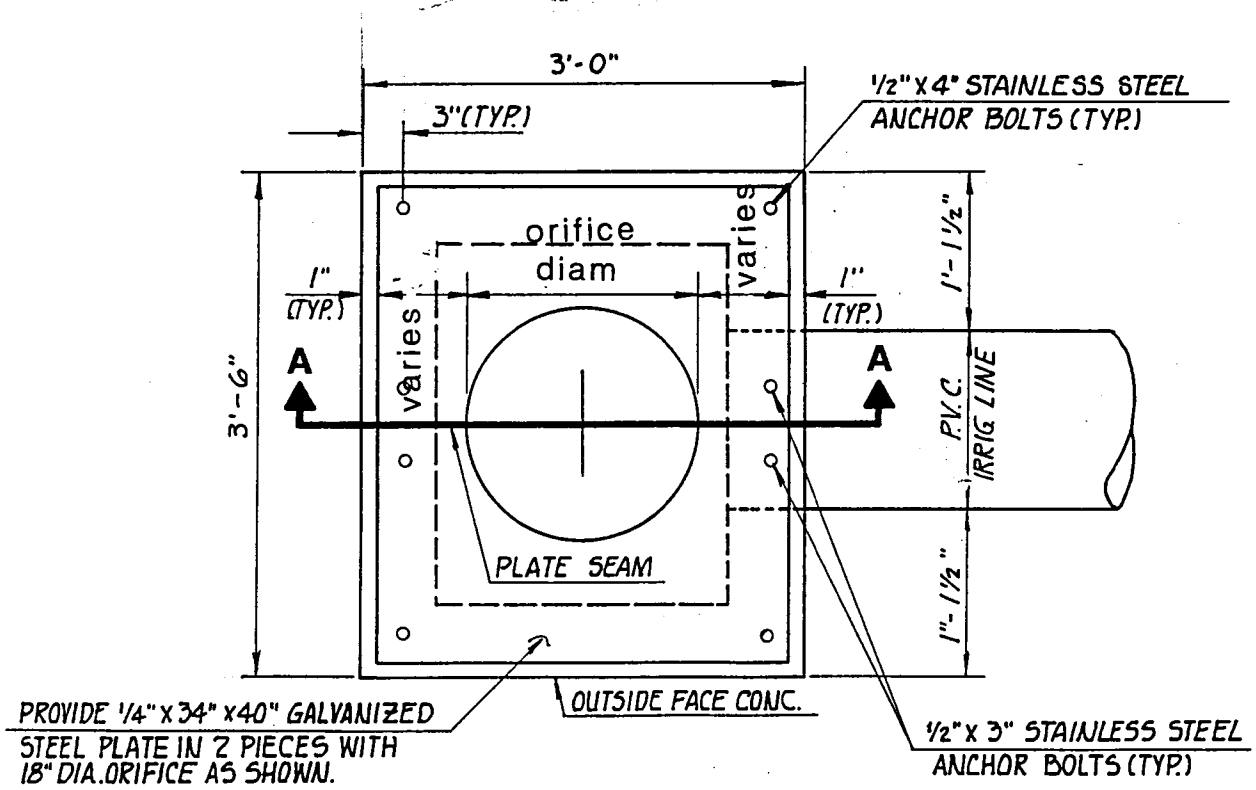
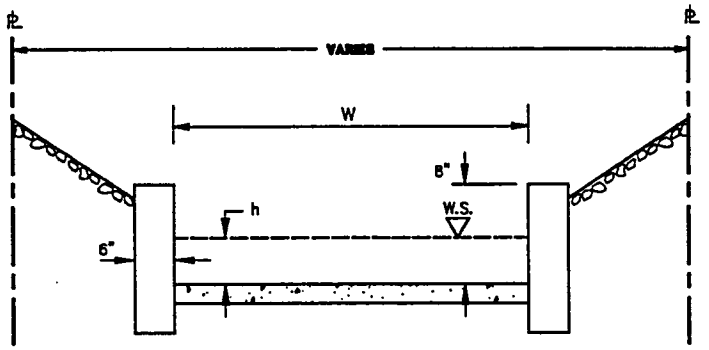


SECTION A-A



LAKE LEVEL CONTROL STRUCTURE

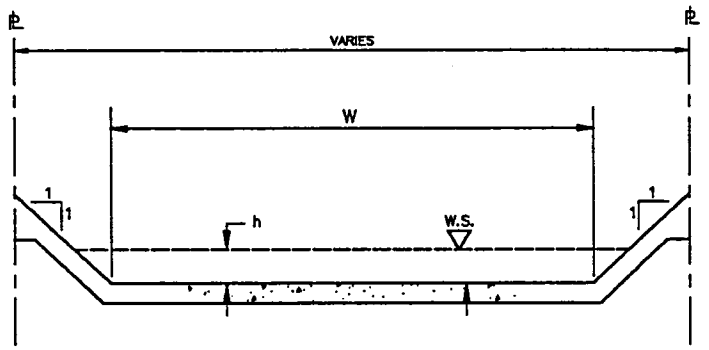
FIGURE 5



$$Q = \frac{1.49}{n} A R^{2/3} S^{1/2}$$

n = 0.012
S = 0.0025 (minimum)

FIGURE 6A
TYPICAL CROSS-SECTION ACROSS
CONCRETE RECTANGULAR DRAINAGEWAY



$$Q = \frac{1.49}{n} A R^{2/3} S^{1/2}$$

n = 0.012
S = 0.0025 (minimum)

FIGURE 6B
TYPICAL CROSS-SECTION ACROSS
CONCRETE TRAPEZOIDAL DRAINAGEWAY

FILE: CHANXSEC.DWG

OAKWOOD GOLF COURSE STORAGE ROUTING

Condition: Developed

10 Year Storm

Run Fri 05-31-1996 4:08 PM

Hydraulic Model

Version 3.17

Copyright 1991, 1993 By RAMSS Inc.

File: C:\MODEL\DATA\SL-OAK\MDP10A

Saved: _____

Project: OAKWOOD GOLF COURSE STORAGE ROUTING

File: C:\MODEL\DATA\SL-OAK\MDP10A
Condition: Developed Page: 1
Event: 10 Year Run: Fri 05-31-1996 4:08 PM

Hydraulic Model Version 3.17 Copyright 1991, 1993 By RAMSS Inc.

Start Time: 0.00 hours
End Time: 100.00 hours
Time increment: 0.10 hours

Volume Conversion: 40/60
Channel Storage: Yes
Diversion Storage: Yes
Structure Storage: Yes
Pipe Storage: Yes
Channel Backwater: Yes

All dimensions in feet unless specified otherwise

Volume Originally In System: 0.00 cf
Total Runoff Volume In: 2934129.60 cf
Total Baseflow In: 0.00 cf
Volume Remaining In System: 2872310.74 cf
Volume Discharged: 55903.60 cf
Volumes Check To: 5915.26 cf
Error: 0.20 %

Footnotes For Tabular Output

1 - LAKE42 0.00 hours Conveyance to LAKE43 connects outside limits

2 - RISER34 0.00 hours Conveyance connects to LAKE35 outside limits

3 - RISER35 0.00 hours Conveyance connects to LAKE36 outside limits

4 - RISER89 0.00 hours Conveyance connects to LAKE37 outside limits

5 - RISER33 0.00 hours Conveyance connects to LAKE37 outside limits

6 - RISER37 0.00 hours Conveyance connects to LAKE38 outside limits

7 - RISER38A 0.00 hours Conveyance connects to DET370 outside limits

8 - RISER38B 0.00 hours Conveyance connects to LAKE40 outside limits

9 - RISER70 0.00 hours Conveyance connects to LAKE39 outside limits

10 - RISER39 0.00 hours Conveyance connects to LAKE41 outside limits

11 - RISER49 0.00 hours Conveyance connects to DET500 outside limits

12 - RISER50 0.00 hours Conveyance connects to LAKE41 outside limits

13 - RISER42 0.00 hours Conveyance connects to LAKE42 outside limits

14 - LAKE42 0.00 hours Conveyance connects to LAKE43 outside limits

15 - RISER39 1.30 hours Level of 1179.05 exceeded top elevation

16 - RISER49 1.30 hours Level of 1177.98 exceeded top elevation

17 - RISER35 1.40 hours Level of 1189.16 exceeded top elevation

18 - RISER37 1.40 hours Level of 1184.88 exceeded top elevation

19 - RISER38A 1.40 hours Level of 1181.52 exceeded top elevation

20 - RISER70 1.40 hours Level of 1181.20 exceeded top elevation

21 - RISER36 1.50 hours Level of 1188.91 exceeded top elevation

22 - RISER38B 1.50 hours Level of 1181.45 exceeded top elevation

23 - RISER50 1.50 hours Level of 1177.56 exceeded top elevation

24 - RISER34 1.60 hours Level of 1190.10 exceeded top elevation

25 - RISER33 1.60 hours Level of 1187.15 exceeded top elevation

Project: OAKWOOD GOLF COURSE STORAGE ROUTING

File: C:\MODEL\DATA\SL-OAK\MDP10A
Condition: Developed Page: 2
Event: 10 Year Run: Fri 05-31-1996 4:08 PM

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Basin LAKE34

Elevation (ft)	Area (sf)	Volume (cf)
1190.10	103456.00	0.00
1190.22	106184.00	12578.40
1190.32	108458.00	23310.50
1190.50	112550.00	43201.22
1190.60	114823.00	54569.87
1191.00	123197.00	102173.87
1192.00	157679.00	242611.87
1193.00	213526.00	428214.37
1194.00	290918.00	680436.37

Runoff volume of 320209.20 cf with multiplier of 1.00 from area: LAKE34

No Inflows Connected

Riser to RISER34
Perimeter: 2.62 Crest Elev: 1190.10 Coefficient: 3.00
H.Or. Area: 0.55
PeakQ: 3.92 Volume: 319380.44 Centroid: 15.90

Peak WS Level: 1192.29 ft Peak Volume: 297246.20 cf
Final WS Level: 1190.11 ft Final Volume: 817.82 cf

Structure RISER34
Base Elevation: 1187.00 Base Area: 0.55
Bench Elevation: 1187.00 Bench Area: 0.55
Top Elevation: 1190.10

Inflows Connected From:
LAKE34

Circular Conduit to LAKE35
Diam: 21.00" Orif.Diam: 21.00" Length: 1100.00
InvIn: 1187.00 InvOut: 1185.00 Slope: 0.0018
n: 0.0120 Km: 0.5000 Kp: 0.0126
PeakQ: 3.92

Peak WS Level: 1190.86 ft

Project: OAKWOOD GOLF COURSE STORAGE ROUTING

File: C:\MODEL\DATA\SL-OAK\MDP10A
Condition: Developed Page: 3
Event: 10 Year Run: Fri 05-31-1996 4:08 PM

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Basin LAKE35

Elevation (ft)	Area (sf)	Volume (cf)
1188.78	18000.00	0.00
1188.90	19499.00	2249.94
1189.00	35748.00	5012.29
1189.20	68247.00	15411.79
1189.30	84496.00	23048.94
1190.00	198240.00	122006.54
1191.00	248976.00	345614.54
1192.00	311761.00	625983.04
1193.00	435202.00	999464.54

Runoff volume of 197773.20 cf with multiplier of 1.00 from area: LAKE35

Inflows Connected From:
RISER34

Riser to RISER35
Perimeter: 4.71 Crest Elev: 1188.78 Coefficient: 3.00
H.Or. Area: 1.77
PeakQ: 8.16 Volume: 517047.85 Centroid: 14.99

Peak WS Level: 1190.22 ft Peak Volume: 171144.69 cf
Final WS Level: 1188.79 ft Final Volume: 108.31 cf

Structure RISER35
Base Elevation: 1185.00 Base Area: 3.14
Bench Elevation: 1185.00 Bench Area: 3.14
Top Elevation: 1188.78

Inflows Connected From:
LAKE35

Circular Conduit to LAKE36
Diam: 24.00" Orif.Diam: 24.00" Length: 840.00
InvIn: 1185.00 InvOut: 1184.00 Slope: 0.0012
n: 0.0120 Km: 0.5000 Kp: 0.0106
PeakQ: 8.15

Peak WS Level: 1190.22 ft

Project: OAKWOOD GOLF COURSE STORAGE ROUTING

File: C:\MODEL\DATA\SL-OAK\MDP10A
Condition: Developed Page: 4
Event: 10 Year Run: Fri 05-31-1996 4:08 PM

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Basin LAKE36

Elevation (ft)	Area (sf)	Volume (cf)
1187.88	30000.00	0.00
1188.00	34435.00	3866.10
1188.10	41232.00	7649.45
1189.00	102401.00	72284.30
1190.00	130015.00	188492.30
1191.00	209942.00	358470.80
1191.50	270469.00	478573.55
1191.80	306785.00	565161.65
1192.00	330996.00	628939.75

Runoff volume of 105022.80 cf with multiplier of 1.00 from area: LAKE36

Inflows Connected From:
RISER35

Riser to RISER36
Perimeter: 4.19 Crest Elev: 1187.88 Coefficient: 3.00
H.Or. Area: 1.40
PeakQ: 6.55 Volume: 621831.69 Centroid: 17.68

Peak WS Level: 1189.54 ft Peak Volume: 134473.02 cf
Final WS Level: 1187.89 ft Final Volume: 232.78 cf

Structure RISER36
Base Elevation: 1183.50 Base Area: 1.77
Bench Elevation: 1183.50 Bench Area: 1.77
Top Elevation: 1187.88

Inflows Connected From:
LAKE36

Circular Conduit to RISER89
Diam: 18.00" Orif.Diam: 18.00" Length: 900.00
InvIn: 1183.50 InvOut: 1182.00 Slope: 0.0017
n: 0.0120 Km: 0.5000 Kp: 0.0155
PeakQ: 6.55

Peak WS Level: 1189.54 ft

Project: OAKWOOD GOLF COURSE STORAGE ROUTING

File: C:\MODEL\DATA\SL-OAK\MDP10A
Condition: Developed Page: 5
Event: 10 Year Run: Fri 05-31-1996 4:08 PM

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Basin LAKE289

Elevation (ft)	Area (sf)	Volume (cf)
1188.00	6534.00	0.00
1189.00	25264.80	15899.40
1190.00	60984.00	59023.80

Runoff volume of 8816.40 cf with multiplier of 1.00 from area: LAK289

No Inflows Connected

Riser to RISER89
Perimeter: 2.62 Crest Elev: 1188.40 Coefficient: 3.00
H.Or. Area: 0.55
PeakQ: 0.29 Volume: 2456.89 Centroid: 5.01

Peak WS Level: 1188.51 ft Peak Volume: 8133.42 cf
Final WS Level: 1188.40 ft Final Volume: 6366.53 cf

Structure RISER89
Base Elevation: 1182.00 Base Area: 1.77
Bench Elevation: 1182.00 Bench Area: 1.77
Top Elevation: 1188.40

Inflows Connected From:
LAKE289 RISER36

Circular Conduit to LAKE37
Diam: 18.00" Orif.Diam: 18.00" Length: 440.00
InvIn: 1182.00 InvOut: 1181.50 Slope: 0.0011
n: 0.0120 Km: 0.5000 Kp: 0.0155
PeakQ: 6.80

Peak WS Level: 1187.41 ft

Basin LAKE33

Elevation (ft)	Area (sf)	Volume (cf)
1187.00	66713.00	0.00
1188.00	73446.00	70079.50
1189.00	87687.00	150646.00
1190.00	115842.00	252410.50
1190.30	131996.00	289586.20
1190.50	142766.00	317062.40
1191.00	169690.00	395176.40

Runoff volume of 72946.80 cf with multiplier of 1.00 from area: LAKE33

No Inflows Connected

Riser to RISER33
Perimeter: 6.00 Crest Elev: 1187.00 Coefficient: 3.00
H.Or. Area: 3.17
PeakQ: 8.58 Volume: 72905.87 Centroid: 3.91

Weir to LAKE37
Crest: 1190.30 Length: 100.00 S.Slope: 0.00:1
Coeff: 3.00
PeakQ: 0.00 Volume: 0.00 Centroid: 0.00

Peak WS Level: 1187.73 ft Peak Volume: 51150.65 cf
Final WS Level: 1187.00 ft Final Volume: 33.95 cf

Project: OAKWOOD GOLF COURSE STORAGE ROUTING

File: C:\MODEL\DATA\SL-OAK\MDP10A
Condition: Developed Page: 6
Event: 10 Year Run: Fri 05-31-1996 4:08 PM

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Structure RISER33
Base Elevation: 1183.00 Base Area: 1.77
Bench Elevation: 1183.00 Bench Area: 1.77
Top Elevation: 1187.00

Inflows Connected From:
LAKE33

Circular Conduit to LAKE37

Diam:	21.00"	Orif.Diam:	21.00"	Length:	950.00
InvIn:	1184.63	InvOut:	1181.50	Slope:	0.0033
n:	0.0120	Km:	0.5000	Kp:	0.0126
PeakQ:	8.58	Volume:	72915.51	Centroid:	3.93

Peak WS Level: 1187.73 ft

Basin LAKE07

Elevation (ft)	Area (sf)	Volume (cf)
1183.50	0.00	0.00
1184.00	7405.20	1851.30
1185.00	20473.20	15790.50
1186.00	35719.20	43886.70
1186.40	37026.00	58435.74
1186.70	37897.20	69674.22
1187.00	38768.40	81174.06
1187.50	40510.80	100993.86
1188.00	42253.20	121684.86

Runoff volume of 174236.40 cf with multiplier of 1.00 from area: LAKE07

No Inflows Connected

Circular Conduit to RISER37

Diam:	15.00"	Orif.Diam:	15.00"	Length:	500.00
InvIn:	1183.50	InvOut:	1181.00	Slope:	0.0050
n:	0.0120	Km:	0.5000	Kp:	0.0198
PeakQ:	4.32	Volume:	29550.43	Centroid:	7.92

Weir to SEC07

Crest:	1186.40	Length:	50.00	S.Slope:	5.00:1
Coeff:	3.00				
PeakQ:	43.50	Volume:	88759.57	Centroid:	2.09

Exfiltration to FREE

InvIn:	1184.00	InvOut:	1182.00	Area:	100.00
in/hr:	172.80	Hours:	0.00		
PeakQ:	0.40	Volume:	55903.60	Centroid:	20.10

Peak WS Level: 1186.83 ft Peak Volume: 74739.68 cf
Final WS Level: 1183.50 ft Final Volume: 16.80 cf

Project: OAKWOOD GOLF COURSE STORAGE ROUTING

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Channel Section SEC07
Connects to: SEC08
Distance to next section: 65.00 ft
Overbank distance: 0.00 ft
Slope at cross section: 0.0331 ft/ft
Additional Baseflow: 0.00 cfs

Elevation (ft)	Width (ft)	Area (sf)	Perim (ft)	Weighted n
1186.35	0.10	0.00	0.10	0.0250
1186.36	50.00	0.25	50.00	0.0250
1186.55	52.00	9.94	52.04	0.0250
1186.75	54.00	20.54	54.08	0.0250
1187.50	61.40	63.82	61.63	0.0250

Inflows Connected From:
LAKE07

Total Volume Discharged: 88759.48

PeakWS (ft)	PeakQ (cfs)	PeakV (fps)	PeakSpread (ft)
1186.60	43.50	3.54	52.45

Channel Section SEC08
Connects to: LAKE37
Distance to next section: 10.00 ft
Overbank distance: 0.00 ft
Slope at cross section: 0.0331 ft/ft
Additional Baseflow: 0.00 cfs

Elevation (ft)	Width (ft)	Area (sf)	Perim (ft)	Weighted n
1184.20	0.10	0.00	0.10	0.0250
1184.21	50.00	0.25	50.00	0.0250
1184.40	52.00	9.94	52.04	0.0250
1184.60	54.00	20.54	54.08	0.0250
1185.35	61.40	63.82	61.63	0.0250
1186.00	68.00	105.87	68.35	0.0250
1186.50	73.00	141.12	73.45	0.0250
1186.60	74.00	148.47	74.47	0.0250
1187.00	78.00	178.87	78.55	0.0250
1187.50	83.00	219.12	83.65	0.0250

No Inflows Connected

Total Volume Discharged: 88759.48

PeakWS (ft)	PeakQ (cfs)	PeakV (fps)	PeakSpread (ft)
1186.24	43.50	0.00	70.42

Project: OAKWOOD GOLF COURSE STORAGE ROUTING

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Basin LAKE37

Elevation (ft)	Area (sf)	Volume (cf)
1184.00	128066.00	0.00
1185.00	156816.00	142441.00
1186.00	182516.00	312107.00
1186.60	204296.00	428150.60
1187.00	219107.00	512831.20

Runoff volume of 240966.00 cf with multiplier of 1.00 from area: LAKE37

Inflows Connected From:
SEC08 RISER33 LAKE33 RISER89

Riser to RISER37
Perimeter: 6.28 Crest Elev: 1184.00 Coefficient: 3.00
H.Or. Area: 3.14
PeakQ: 7.36 Volume: 956407.75 Centroid: 21.46

Weir to SEC09
Crest: 1186.00 Length: 70.00 S.Slope: 5.00:1
Coeff: 3.00
PeakQ: 7.64 Volume: 66610.98 Centroid: 4.09

Peak WS Level: 1186.24 ft Peak Volume: 359007.85 cf
Final WS Level: 1184.01 ft Final Volume: 1322.61 cf

Channel Section SEC09
Connects to: SEC10
Distance to next section: 200.00 ft
Overbank distance: 0.00 ft
Slope at cross section: 0.0050 ft/ft
Additional Baseflow: 0.00 cfs

Elevation (ft)	Width (ft)	Area (sf)	Perim (ft)	Weighted n
1186.00	0.10	0.00	0.10	0.0300
1186.01	26.00	0.13	26.00	0.0300
1187.00	32.00	28.84	32.32	0.0300
1188.00	38.00	63.84	38.64	0.0300

Inflows Connected From:
LAKE37

Total Volume Discharged: 66636.57

PeakWS (ft)	PeakQ (cfs)	PeakV (fps)	PeakSpread (ft)
1186.23	7.64	1.26	27.34

Project: OAKWOOD GOLF COURSE STORAGE ROUTING

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Channel Section SEC10
Connects to: SEC11
Distance to next section: 200.00 ft
Overbank distance: 0.00 ft
Slope at cross section: 0.0050 ft/ft
Additional Baseflow: 0.00 cfs

Elevation (ft)	Width (ft)	Area (sf)	Perim (ft)	Weighted n
1185.00	0.10	0.00	0.10	0.0300
1185.01	26.00	0.13	26.00	0.0300
1186.00	32.00	28.84	32.32	0.0300
1187.00	38.00	63.84	38.64	0.0300
1188.00	44.00	104.84	44.97	0.0300

Runoff volume of 30693.60 cf with multiplier of 1.00 from area: SEC010

No Inflows Connected

Total Volume Discharged: 97393.05

PeakWS (ft)	PeakQ (cfs)	PeakV (fps)	PeakSpread (ft)
1185.26	9.51	1.39	27.52

Channel Section SEC11
Connects to: SEC12
Distance to next section: 200.00 ft
Overbank distance: 0.00 ft
Slope at cross section: 0.0050 ft/ft
Additional Baseflow: 0.00 cfs

Elevation (ft)	Width (ft)	Area (sf)	Perim (ft)	Weighted n
1184.00	0.10	0.00	0.10	0.0300
1184.01	26.00	0.13	26.00	0.0300
1185.00	32.00	28.84	32.32	0.0300
1186.00	38.00	63.84	38.64	0.0300
1187.00	44.00	104.84	44.97	0.0300

No Inflows Connected

Total Volume Discharged: 97697.61

PeakWS (ft)	PeakQ (cfs)	PeakV (fps)	PeakSpread (ft)
1184.26	9.37	1.38	27.50

Project: OAKWOOD GOLF COURSE STORAGE ROUTING

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Channel Section SEC12
Connects to: LAKE38
Distance to next section: 300.00 ft
Overbank distance: 0.00 ft
Slope at cross section: 0.0050 ft/ft
Additional Baseflow: 0.00 cfs

Elevation (ft)	Width (ft)	Area (sf)	Perim (ft)	Weighted n
1183.00	0.10	0.00	0.10	0.0300
1183.01	26.00	0.13	26.00	0.0300
1184.00	32.00	28.84	32.32	0.0300
1185.00	38.00	63.84	38.64	0.0300
1186.00	44.00	104.84	44.97	0.0300

No Inflows Connected

Total Volume Discharged: 97912.59

PeakWS (ft)	PeakQ (cfs)	PeakV (fps)	PeakSpread (ft)
1183.25	9.47	1.46	27.44

Structure RISER37
Base Elevation: 1181.00 Base Area: 1.77
Bench Elevation: 1181.00 Bench Area: 1.77
Top Elevation: 1184.00

Inflows Connected From:
LAKE37 LAKE07

Circular Conduit to LAKE38

Diam:	18.00"	Orif.Diam:	18.00"	Length:	848.00
InvIn:	1181.00	InvOut:	1178.88	Slope:	0.0025
n:	0.0120	Km:	0.5000	Kp:	0.0155
PeakQ:	7.67				

Peak WS Level: 1186.24 ft

Project: OAKWOOD GOLF COURSE STORAGE ROUTING

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Basin LAKE38

Elevation (ft)	Area (sf)	Volume (cf)
1181.21	128908.00	0.00
1182.00	164657.00	115958.17
1182.50	191228.00	204929.42
1183.00	217800.00	307186.42
1183.30	237402.00	375466.73
1184.00	283576.00	557809.02
1184.50	335412.00	712556.02
1185.00	387248.00	893221.02

Runoff volume of 176817.60 cf with multiplier of 1.00 from area: LAKE38

Inflows Connected From:
RISER37 SEC12

Riser to RISER38A
Perimeter: 6.28 Crest Elev: 1181.21 Coefficient: 3.00
H.Or. Area: 3.14
PeakQ: 4.59 Volume: 394256.59 Centroid: 25.30

Riser to RISER38B
Perimeter: 6.28 Crest Elev: 1181.21 Coefficient: 3.00
H.Or. Area: 3.14
PeakQ: 9.06 Volume: 865702.75 Centroid: 18.52

Weir to LAKE40
Crest: 1183.30 Length: 4.50 S.Slope: 7.00:1
Coeff: 3.00
PeakQ: 0.00 Volume: 0.00 Centroid: 0.00

Peak WS Level: 1182.70 ft Peak Volume: 244840.51 cf
Final WS Level: 1181.22 ft Final Volume: 1126.97 cf

Structure RISER38A
Base Elevation: 1178.21 Base Area: 1.77
Bench Elevation: 1178.21 Bench Area: 1.77
Top Elevation: 1181.21

Inflows Connected From:
LAKE38

Circular Conduit to DET370
Diam: 18.00" Orif.Diam: 18.00" Length: 300.00
InvIn: 1178.21 InvOut: 1177.00 Slope: 0.0040
n: 0.0120 Km: 0.5000 Kp: 0.0155
PeakQ: 4.58

Peak WS Level: 1182.70 ft

Project: OAKWOOD GOLF COURSE STORAGE ROUTING

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Structure RISER38B
Base Elevation: 1178.21 Base Area: 1.77
Bench Elevation: 1178.21 Bench Area: 1.77
Top Elevation: 1181.21

Inflows Connected From:
LAKE38

Circular Conduit to LAKE40
Diam: 18.00" Orif.Diam: 18.00" Length: 400.00
InvIn: 1178.21 InvOut: 1174.92 Slope: 0.0082
n: 0.0120 Km: 0.5000 Kp: 0.0155
PeakQ: 9.07

Peak WS Level: 1182.70 ft

Basin DET370

Elevation (ft)	Area (sf)	Volume (cf)
1180.50	68389.20	0.00
1181.00	73180.80	35392.50
1182.00	80150.40	112058.10
1183.00	98445.60	201356.10
1184.00	121532.00	311344.90
1184.20	128502.00	336348.30
1184.40	135907.00	362789.20
1185.00	157252.00	450736.90

Runoff volume of 222292.80 cf with multiplier of 1.00 from area: DET370

Inflows Connected From:
RISER38A

Riser to RISER70
Perimeter: 6.28 Crest Elev: 1180.50 Coefficient: 3.00
H.Or. Area: 3.14
PeakQ: 6.05 Volume: 615886.48 Centroid: 22.73

Weir to LAKE39
Crest: 1184.20 Length: 100.00 S.Slope: 5.00:1
Coeff: 3.00
PeakQ: 0.00 Volume: 0.00 Centroid: 0.00

Peak WS Level: 1182.75 ft Peak Volume: 178760.63 cf
Final WS Level: 1180.51 ft Final Volume: 662.50 cf

Project: OAKWOOD GOLF COURSE STORAGE ROUTING

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Structure RISER70
Base Elevation: 1177.50 Base Area: 1.77
Bench Elevation: 1177.50 Bench Area: 1.77
Top Elevation: 1180.50

Inflows Connected From:
DET370

Circular Conduit to LAKE39
Diam: 18.00" Orif.Diam: 18.00" Length: 670.00
InvIn: 1177.50 InvOut: 1176.00 Slope: 0.0022
n: 0.0120 Km: 0.5000 Kp: 0.0155
PeakQ: 6.04

Peak WS Level: 1182.75 ft

Basin LAKE39

Elevation (ft)	Area (sf)	Volume (cf)
1178.52	80883.00	0.00
1179.00	86573.00	40189.44
1179.10	88631.00	48949.64
1180.00	107154.00	137052.89
1181.00	149963.00	265611.39
1182.00	203652.00	442418.89
1183.00	270310.00	679399.89
1183.20	296984.00	736129.29
1183.70	363669.00	901292.54
1184.00	403680.00	1016394.89

Runoff volume of 291783.60 cf with multiplier of 1.00 from area: LAKE39

Inflows Connected From:
RISER70 DET370

Riser to RISER39
Perimeter: 6.28 Crest Elev: 1178.52 Coefficient: 3.00
H.Or. Area: 3.14
PeakQ: 5.14 Volume: 874376.15 Centroid: 27.76

Weir to LAKE41
Crest: 1183.20 Length: 20.00 S.Slope: 5.00:1
Coeff: 3.00
PeakQ: 0.00 Volume: 0.00 Centroid: 0.00

Peak WS Level: 1181.18 ft Peak Volume: 297970.32 cf
Final WS Level: 1178.91 ft Final Volume: 32975.42 cf

Project: OAKWOOD GOLF COURSE STORAGE ROUTING

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Structure RISER39
Base Elevation: 1175.52 Base Area: 1.77
Bench Elevation: 1175.52 Bench Area: 1.77
Top Elevation: 1178.52

Inflows Connected From:
LAKE39

Circular Conduit to LAKE41
Diam: 18.00" Orif.Diam: 18.00" Length: 1587.00
InvIn: 1175.52 InvOut: 1174.00 Slope: 0.0010
n: 0.0120 Km: 0.5000 Kp: 0.0155
PeakQ: 5.14

Peak WS Level: 1181.18 ft

Basin LAKE40

Elevation (ft)	Area (sf)	Volume (cf)
1177.92	138046.00	0.00
1178.00	138047.00	11043.72
1178.10	140661.00	24979.12
1178.90	161577.00	145874.32
1179.00	164191.00	162162.72
1180.00	219120.00	353818.22
1181.00	294174.00	610465.22
1182.00	374995.00	945049.72
1182.20	391200.00	1021669.22
1182.50	415559.00	1142683.07
1183.00	456122.00	1360603.32

Runoff volume of 356115.60 cf with multiplier of 1.00 from area: LAKE40

Inflows Connected From:
RISER38B LAKE38

Riser to RISER49
Perimeter: 6.28 Crest Elev: 1177.92 Coefficient: 3.00
H.Or. Area: 3.14
PeakQ: 8.10 Volume: 1073421.52 Centroid: 21.23

Weir to DET500
Crest: 1181.80 Length: 10.00 S.Slope: 55.00:1
Coeff: 3.00
PeakQ: 0.00 Volume: 0.00 Centroid: 0.00

Peak WS Level: 1180.09 ft Peak Volume: 377354.86 cf
Final WS Level: 1178.91 ft Final Volume: 148122.70 cf

Project: OAKWOOD GOLF COURSE STORAGE ROUTING

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Structure RISER49
Base Elevation: 1174.92 Base Area: 1.77
Bench Elevation: 1174.92 Bench Area: 1.77
Top Elevation: 1177.92

Inflows Connected From:
LAKE40

Circular Conduit to DET500

Diam:	18.00"	Orif.Diam:	18.00"	Length:	300.00
InvIn:	1174.92	InvOut:	1174.17	Slope:	0.0025
n:	0.0120	Km:	0.5000	Kp:	0.0155
PeakQ:	8.10				

Peak WS Level: 1180.09 ft

Basin DET500

Elevation (ft)	Area (sf)	Volume (cf)
1177.50	70567.20	0.00
1178.00	70567.20	35283.60
1179.00	78408.00	109771.20
1180.00	89733.60	193842.00
1181.00	101059.00	289238.30
1182.00	115434.00	397484.80
1183.00	135036.00	522719.80

Runoff volume of 91713.60 cf with multiplier of 1.00 from area: DET500

Inflows Connected From:
RISER49 LAKE40

Riser to RISER50

Perimeter:	6.28	Crest Elev:	1177.50	Coefficient:	3.00
H.Or. Area:	3.14				
PeakQ:	13.81	Volume:	1061786.39	Centroid:	19.31

Peak WS Level: 1178.91 ft Peak Volume: 103351.22 cf
Final WS Level: 1178.91 ft Final Volume: 103351.22 cf

Project: OAKWOOD GOLF COURSE STORAGE ROUTING

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Structure RISER50
Base Elevation: 1173.50 Base Area: 3.14
Bench Elevation: 1173.50 Bench Area: 3.14
Top Elevation: 1177.50

Inflows Connected From:
DET500

Circular Conduit to LAKE41

Diam:	36.00"	Orif.Diam:	36.00"	Length:	440.00
InvIn:	1173.50	InvOut:	1172.50	Slope:	0.0023
n:	0.0120	Km:	0.5000	Kp:	0.0062
PeakQ:	13.80				

Peak WS Level: 1178.91 ft

Basin LAKE41

Elevation (ft)	Area (sf)	Volume (cf)
1177.00	148834.00	0.00
1177.40	160234.00	61813.60
1177.50	163085.00	77979.55
1178.00	177335.00	163084.55
1178.50	216727.00	261600.05
1179.00	256118.00	379811.30
1179.50	292039.00	516850.55
1179.70	306407.00	576695.15
1180.00	327960.00	671850.20
1181.00	385520.00	1028590.20

Runoff volume of 325573.20 cf with multiplier of 1.00 from area: LAKE41

Inflows Connected From:
RISER50 RISER39 LAKE39

Riser to RISER42

Perimeter:	6.28	Crest Elev:	1177.00	Coefficient:	3.00
H.Or. Area:	3.14				
PeakQ:	19.04	Volume:	303991.80	Centroid:	-146.70

Exfiltration to LAKE42

InvIn:	1177.40	InvOut:	1180.00	Area:	100.00
in/hr:	1944.00	Hours:	0.00		
PeakQ:	4.50	Volume:	1598292.00	Centroid:	50.72

Peak WS Level: 1178.91 ft Peak Volume: 359436.86 cf
Final WS Level: 1178.91 ft Final Volume: 359436.86 cf

Project: OAKWOOD GOLF COURSE STORAGE ROUTING

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Structure RISER42
Base Elevation: 1173.00 Base Area: 9.62
Bench Elevation: 1173.00 Bench Area: 9.62
Top Elevation: 1177.00

Inflows Connected From:
LAKE41

Circular Conduit to LAKE42

Diam:	42.00"	Orif.Diam:	42.00"	Length:	1300.00
InvIn:	1173.00	InvOut:	1166.50	Slope:	0.0050
n:	0.0120	Km:	0.5000	Kp:	0.0050
PeakQ:	19.04				

Peak WS Level: 1178.91 ft

Basin LAKE42

Elevation (ft)	Area (sf)	Volume (cf)
1172.50	136000.00	0.00
1173.00	136000.00	68000.00
1174.00	149920.00	210960.00
1175.00	163200.00	367520.00
1176.00	176480.00	537360.00
1177.00	275840.00	763520.00
1178.00	300320.00	1051600.00
1179.00	320320.00	1361920.00
1180.00	340000.00	1692080.00
1181.00	361280.00	2042720.00
1182.00	406240.00	2426480.00

Runoff volume of 257954.40 cf with multiplier of 1.00 from area: LAKE42

Inflows Connected From:
RISER42 LAKE41

Circular Conduit to LAKE43

Diam:	30.00"	Orif.Diam:	30.00"	Length:	300.00
InvIn:	1161.00	InvOut:	1160.40	Slope:	0.0020
n:	0.0120	Km:	0.5000	Kp:	0.0079
PeakQ:	16.98				

Peak WS Level: 1178.94 ft Peak Volume: 1343585.24 cf
Final WS Level: 1178.94 ft Final Volume: 1343585.24 cf

Project: OAKWOOD GOLF COURSE STORAGE ROUTING

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Basin LAKE43

Elevation (ft)	Area (sf)	Volume (cf)
1172.50	97280.00	0.00
1173.00	97280.00	48640.00
1174.00	116480.00	155520.00
1175.00	130880.00	279200.00
1176.00	141920.00	415600.00
1177.00	150720.00	561920.00
1178.00	161120.00	717840.00
1179.00	170880.00	883840.00
1180.00	182560.00	1060560.00
1181.00	196160.00	1249920.00
1182.00	209600.00	1452800.00

Runoff volume of 61214.40 cf with multiplier of 1.00 from area: LAKE43

Inflows Connected From:
LAKE42

Peak WS Level: 1178.94 ft Peak Volume: 874032.94 cf
Final WS Level: 1178.94 ft Final Volume: 874032.94 cf

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      VERS =3.17
SSTOR= C D M P
SBACK= B
STINC=            0.10
OWNER=RJH
TITLE= D      OAKWOOD GOLF COURSE STORAGE ROUTING
BASIN=          LAKE34    0.00
HYDGR=                                      LAKE34 1.00000
AREA =        1190.10  103456 1190.22  106184 1190.32  108458 1190.50  112550
AREA =        1190.60  114823 1191.00  123197 1192.00  157679 1193.00  213526
AREA =        1194.00  290918
DISCH= R      RISER34    2.62 1190.10    3.00    0.55    0.00
ENDSTR
MHOLE=        RISER34 1187.00    0.55 1187.00    0.55 1190.10    0.00
DISCH= C       LAKE35 1.75000 1.75000 1100.00 1187.00 1185.00  0.0120  0.5000
ENDSTR
BASIN=          LAKE35    0.00
HYDGR=                                      LAKE35 1.00000
AREA =        1188.78 18000.0 1188.90 19499.0 1189.00 35748.0 1189.20 68247.0
AREA =        1189.30 84496.0 1190.00  198240 1191.00  248976 1192.00  311761
AREA =        1193.00  435202
DISCH= R      RISER35    4.71 1188.78    3.00    1.77    0.00
ENDSTR
MHOLE=        RISER35 1185.00    3.14 1185.00    3.14 1188.78    0.00
DISCH= C       LAKE36 2.00000 2.00000  840.00 1185.00 1184.00  0.0120  0.5000
ENDSTR
BASIN=          LAKE36    0.00
HYDGR=                                      LAKE36 1.00000
AREA =        1187.88 30000.0 1188.00 34435.0 1188.10 41232.0 1189.00  102401
AREA =        1190.00  130015 1191.00  209942 1191.50  270469 1191.80  306785
AREA =        1192.00  330996
DISCH= R      RISER36    4.19 1187.88    3.00    1.40    0.00
ENDSTR
MHOLE=        RISER36 1183.50    1.77 1183.50    1.77 1187.88    0.00
DISCH= C      RISER89 1.50000 1.50000  900.00 1183.50 1182.00  0.0120  0.5000
ENDSTR
BASIN=        LAKE289    0.00
HYDGR=                                      LAK289 1.00000
AREA =        1188.00 6534.00 1189.00 25264.8 1190.00 60984.0
DISCH= R      RISER89    2.62 1188.40    3.00    0.55    0.00
ENDSTR
MHOLE=        RISER89 1182.00    1.77 1182.00    1.77 1188.40    0.00
DISCH= C       LAKE37 1.50000 1.50000  440.00 1182.00 1181.50  0.0120  0.5000
ENDSTR
BASIN=          LAKE33    0.00
HYDGR=                                      LAKE33 1.00000
AREA =        1187.00 66713.0 1188.00 73446.0 1189.00 87687.0 1190.00  115842
AREA =        1190.30  131996 1190.50  142766 1191.00  169690
DISCH= R      RISER33    6.00 1187.00    3.00    3.17    0.00
DISCH= W       LAKE37  100.00 1190.30    3.00    0.00
ENDSTR
MHOLE=        RISER33 1183.00    1.77 1183.00    1.77 1187.00    0.00
DISCH= C       LAKE37 1.75000 1.75000  950.00 1184.63 1181.50  0.0120  0.5000
ENDSTR
BASIN=          LAKE07    0.00
HYDGR=                                      LAKE07 1.00000
AREA =        1183.50       0 1184.00 7405.20 1185.00 20473.2 1186.00 35719.2
AREA =        1186.40 37026.0 1186.70 37897.2 1187.00 38768.4 1187.50 40510.8
AREA =        1188.00 42253.2
DISCH= C      RISER37 1.25000 1.25000  500.00 1183.50 1181.00  0.0120  0.5000
DISCH= W        SEC07   50.00 1186.40    3.00    5.00
DISCH= X         FREE 1184.00 1182.00  100.00  172.80    0.00
ENDSTR
CHAN =          SEC07   SEC08   65.00    0.00    0.00    0.00
XSECT=        1186.35   -0.05    0.05  0.0250 1186.36  -25.00   25.00  0.0250
XSECT=        1186.55  -26.00   26.00  0.0250 1186.75  -27.00   27.00  0.0250
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MDP10A.RSC
LAKE ROUTING

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XSECT=          1187.50  -30.70   30.70  0.0250
ENDSTR
CHAN =            SEC08  LAKE37   10.00    0.00    0.00    0.00
XSECT=          1184.20   -0.05    0.05  0.0250 1184.21  -25.00   25.00  0.0250
XSECT=          1184.40  -26.00   26.00  0.0250 1184.60  -27.00   27.00  0.0250
XSECT=          1185.35  -30.70   30.70  0.0250 1186.00  -34.00   34.00  0.0250
XSECT=          1186.50  -36.50   36.50  0.0250 1186.60  -37.00   37.00  0.0250
XSECT=          1187.00  -39.00   39.00  0.0250 1187.50  -41.50   41.50  0.0250
ENDSTR
BASIN=           LAKE37    0.00
HYDGR=                                         LAKE37 1.00000
AREA =          1184.00  128066 1185.00  156816 1186.00  182516 1186.60  204296
AREA =          1187.00  219107
DISCH= R        RISER37    6.28 1184.00    3.00    3.14    0.00
DISCH= W          SEC09   70.00 1186.00    3.00    5.00
ENDSTR
CHAN =            SEC09   SEC10  200.00    0.00    0.00    0.00
XSECT=          1186.00   -0.05    0.05  0.0300 1186.01  -13.00   13.00  0.0300
XSECT=          1187.00  -16.00   16.00  0.0300 1188.00  -19.00   19.00  0.0300
ENDSTR
CHAN =            SEC10   SEC11  200.00    0.00    0.00    0.00
HYDGR=                                        SEC010 1.00000
XSECT=          1185.00   -0.05    0.05  0.0300 1185.01  -13.00   13.00  0.0300
XSECT=          1186.00  -16.00   16.00  0.0300 1187.00  -19.00   19.00  0.0300
XSECT=          1188.00  -22.00   22.00  0.0300
ENDSTR
CHAN =            SEC11   SEC12  200.00    0.00    0.00    0.00
XSECT=          1184.00   -0.05    0.05  0.0300 1184.01  -13.00   13.00  0.0300
XSECT=          1185.00  -16.00   16.00  0.0300 1186.00  -19.00   19.00  0.0300
XSECT=          1187.00  -22.00   22.00  0.0300
ENDSTR
CHAN =            SEC12  LAKE38  300.00    0.00    0.00    0.00
XSECT=          1183.00   -0.05    0.05  0.0300 1183.01  -13.00   13.00  0.0300
XSECT=          1184.00  -16.00   16.00  0.0300 1185.00  -19.00   19.00  0.0300
XSECT=          1186.00  -22.00   22.00  0.0300
ENDSTR
MHOLE=          RISER37 1181.00    1.77 1181.00    1.77 1184.00    0.00
DISCH= C         LAKE38 1.50000 1.50000  848.00 1181.00 1178.88  0.0120  0.5000
ENDSTR
BASIN=           LAKE38    0.00
HYDGR=                                         LAKE38 1.00000
AREA =          1181.21  128908 1182.00  164657 1182.50  191228 1183.00  217800
AREA =          1183.30  237402 1184.00  283576 1184.50  335412 1185.00  387248
DISCH= R       RISER38A    6.28 1181.21    3.00    3.14    0.00
DISCH= R       RISER38B    6.28 1181.21    3.00    3.14    0.00
DISCH= W         LAKE40    4.50 1183.30    3.00    7.00
ENDSTR
MHOLE=         RISER38A 1178.21    1.77 1178.21    1.77 1181.21    0.00
DISCH= C         DET370 1.50000 1.50000  300.00 1178.21 1177.00  0.0120  0.5000
ENDSTR
MHOLE=         RISER38B 1178.21    1.77 1178.21    1.77 1181.21    0.00
DISCH= C         LAKE40 1.50000 1.50000  400.00 1178.21 1174.92  0.0120  0.5000
ENDSTR
BASIN=           DET370    0.00
HYDGR=                                        DET370 1.00000
AREA =          1180.50 68389.2 1181.00 73180.8 1182.00 80150.4 1183.00 98445.6
AREA =          1184.00  121532 1184.20  128502 1184.40  135907 1185.00  157252
DISCH= R        RISER70    6.28 1180.50    3.00    3.14    0.00
DISCH= W         LAKE39  100.00 1184.20    3.00    5.00
ENDSTR
MHOLE=          RISER70 1177.50    1.77 1177.50    1.77 1180.50    0.00
DISCH= C         LAKE39 1.50000 1.50000  670.00 1177.50 1176.00  0.0120  0.5000
ENDSTR
BASIN=           LAKE39    0.00
HYDGR=                                         LAKE39 1.00000
AREA =          1178.52 80883.0 1179.00 86573.0 1179.10 88631.0 1180.00  107154
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AREA =          1181.00  149963 1182.00  203652 1183.00  270310 1183.20  296984
AREA =          1183.70  363669 1184.00  403680
DISCH= R        RISER39    6.28 1178.52    3.00    3.14    0.00
DISCH= W         LAKE41   20.00 1183.20    3.00    5.00
ENDSTR
MHOLE=          RISER39 1175.52    1.77 1175.52    1.77 1178.52    0.00
DISCH= C         LAKE41 1.50000 1.50000 1587.00 1175.52 1174.00  0.0120  0.5000
ENDSTR
BASIN=           LAKE40    0.00
HYDGR=                                        LAKE40 1.00000
AREA =          1177.92  138046 1178.00  138047 1178.10  140661 1178.90  161577
AREA =          1179.00  164191 1180.00  219120 1181.00  294174 1182.00  374995
AREA =          1182.20  391200 1182.50  415559 1183.00  456122
DISCH= R        RISER49    6.28 1177.92    3.00    3.14    0.00
DISCH= W         DET500   10.00 1181.80    3.00   55.00
ENDSTR
MHOLE=          RISER49 1174.92    1.77 1174.92    1.77 1177.92    0.00
DISCH= C         DET500 1.50000 1.50000  300.00 1174.92 1174.17  0.0120  0.5000
ENDSTR
BASIN=           DET500    0.00
HYDGR=                                        DET500 1.00000
AREA =          1177.50 70567.2 1178.00 70567.2 1179.00 78408.0 1180.00 89733.6
AREA =          1181.00  101059 1182.00  115434 1183.00  135036
DISCH= R        RISER50    6.28 1177.50    3.00    3.14    0.00
ENDSTR
MHOLE=          RISER50 1173.50    3.14 1173.50    3.14 1177.50    0.00
DISCH= C         LAKE41 3.00000 3.00000  440.00 1173.50 1172.50  0.0120  0.5000
ENDSTR
BASIN=           LAKE41    0.00
HYDGR=                                        LAKE41 1.00000
AREA =          1177.00  148834 1177.40  160234 1177.50  163085 1178.00  177335
AREA =          1178.50  216727 1179.00  256118 1179.50  292039 1179.70  306407
AREA =          1180.00  327960 1181.00  385520
DISCH= R        RISER42    6.28 1177.00    3.00    3.14    0.00
DISCH= X         LAKE42 1177.40 1180.00  100.00 1944.00    0.00
ENDSTR
MHOLE=          RISER42 1173.00    9.62 1173.00    9.62 1177.00    0.00
DISCH= C         LAKE42 3.50000 3.50000 1300.00 1173.00 1166.50  0.0120  0.5000
ENDSTR
BASIN=           LAKE42    0.00
HYDGR=                                        LAKE42 1.00000
AREA =          1172.50  136000 1173.00  136000 1174.00  149920 1175.00  163200
AREA =          1176.00  176480 1177.00  275840 1178.00  300320 1179.00  320320
AREA =          1180.00  340000 1181.00  361280 1182.00  406240
DISCH= C         LAKE43 2.50000 2.50000  300.00 1161.00 1160.40  0.0120  0.5000
ENDSTR
BASIN=           LAKE43    0.00
HYDGR=                                        LAKE43 1.00000
AREA =          1172.50 97280.0 1173.00 97280.0 1174.00  116480 1175.00  130880
AREA =          1176.00  141920 1177.00  150720 1178.00  161120 1179.00  170880
AREA =          1180.00  182560 1181.00  196160 1182.00  209600
ENDSTR
```

```
 0.00    0.10     10   1.65 LAKE34
 0.00    0.43   1.21    1.72    2.08    2.09    2.41    3.66    5.67    8.09
10.56   13.29  19.25   65.67  129.66  147.87  129.55   96.29   67.34   48.46
34.98   25.50  18.71   14.10   11.09    8.68    6.45    4.55    3.21    2.26
 1.56    1.10   0.73    0.43    0.26    0.16    0.12    0.08    0.06    0.04
 0.03    0.02   0.02    0.01    0.01    0.01    0.00    0.00    0.00    0.00
 0.00    0.00   0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00
 0.00    0.00   0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00
 0.00    0.00   0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00
 0.00    0.00   0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00
END 99
 0.00    0.10     10   1.65 LAKE35
 0.00    0.53   1.44    1.91    1.99    1.93    2.30    3.74    5.85    8.14
10.36   12.91  18.20   45.85   79.00   87.38   76.34   56.25   39.49   27.63
19.15   13.39   9.60    7.14    5.85    4.60    3.11    2.00    1.26    0.79
 0.50    0.31   0.18    0.11    0.06    0.04    0.02    0.01    0.01    0.00
 0.00    0.00   0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00
 0.00    0.00   0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00
 0.00    0.00   0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00
 0.00    0.00   0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00
 0.00    0.00   0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00
END 99
 0.00    0.10     10   1.65 LAKE36
 0.00    0.32   0.75    0.84    0.77    0.70    0.91    1.69    2.65    3.55
 4.36    5.36   8.62   35.59   62.82   61.04   44.77   25.10   13.31    7.32
 3.90    2.18   1.36    1.03    1.09    0.87    0.46    0.21    0.09    0.04
 0.02    0.01   0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00
 0.00    0.00   0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00
 0.00    0.00   0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00
 0.00    0.00   0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00
 0.00    0.00   0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00
 0.00    0.00   0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00
END 99
 0.00    0.10     10   1.65 LAK289
 0.00    0.00   0.00    0.01    0.01    0.01    0.01    0.01    0.02    0.02
 0.03    0.04   0.05    1.22    3.24    4.40    4.33    3.40    2.41    1.66
 1.15    0.79   0.54    0.38    0.26    0.18    0.13    0.09    0.06    0.03
 0.01    0.00   0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00
 0.00    0.00   0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00
 0.00    0.00   0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00
 0.00    0.00   0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00
 0.00    0.00   0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00
 0.00    0.00   0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00
END 99
 0.00    0.10     10   1.65 LAKE33
 0.00    0.14   0.35    0.43    0.43    0.41    0.51    0.87    1.36    1.85
 2.32    2.89   4.43   19.30   36.40   38.66   31.67   21.06   13.37    8.59
 5.53    3.67   2.47    1.76    1.35    0.98    0.64    0.40    0.27    0.18
 0.13    0.09   0.06    0.03    0.02    0.01    0.00    0.00    0.00    0.00
 0.00    0.00   0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00
 0.00    0.00   0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00
 0.00    0.00   0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00
 0.00    0.00   0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00
 0.00    0.00   0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00
END 99
 0.00    0.10     10   1.65 LAKE07
 0.00    0.09   0.35    0.77    1.24    1.54    1.79    2.33    3.40    5.02
 7.03    9.33  12.56   21.85   38.60   54.34   61.07   56.48   47.01   37.52
29.07   22.14  16.79   12.85   10.04    7.97    6.28    4.79    3.53    2.58
 1.75    1.21   0.80    0.53    0.39    0.27    0.19    0.13    0.09    0.07
 0.05    0.04   0.03    0.02    0.02    0.01    0.01    0.01    0.01    0.00
 0.00    0.00   0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00
 0.00    0.00   0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00
 0.00    0.00   0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00
 0.00    0.00   0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00
END 99
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MDP10A.QIN
10 YR INPUT
HYDROGRAPH FILE

```
  0.00     0.10      10    1.65 LAKE37
  0.00     0.63    1.74     2.35    2.49     2.45     2.91     4.66     7.26    10.12
 12.94    16.18   22.73    53.38   89.59    99.33    88.64    67.85    49.74    36.24
 25.97    18.88   13.88    10.50    8.50     6.61     4.69     3.16     2.14     1.45
  0.97     0.56    0.33     0.18    0.12     0.07     0.04     0.03     0.02     0.01
  0.01     0.00    0.00     0.00    0.00     0.00     0.00     0.00     0.00     0.00
  0.00     0.00    0.00     0.00    0.00     0.00     0.00     0.00     0.00     0.00
  0.00     0.00    0.00     0.00    0.00     0.00     0.00     0.00     0.00     0.00
  0.00     0.00    0.00     0.00    0.00     0.00     0.00     0.00     0.00     0.00
  0.00     0.00    0.00     0.00    0.00     0.00     0.00     0.00     0.00     0.00
END 99
  0.00     0.10      10    1.65 SEC010
  0.00     0.01    0.06     0.11    0.14     0.16     0.18     0.24     0.36     0.52
  0.69     0.89    1.24     2.66    5.75     8.55     9.57     9.11     7.88     6.63
  5.51     4.54    3.75     3.09    2.57     2.14     1.76     1.44     1.16     0.94
  0.76     0.62    0.50     0.41    0.33     0.26     0.21     0.17     0.14     0.10
  0.05     0.03    0.01     0.01    0.01     0.00     0.00     0.00     0.00     0.00
  0.00     0.00    0.00     0.00    0.00     0.00     0.00     0.00     0.00     0.00
  0.00     0.00    0.00     0.00    0.00     0.00     0.00     0.00     0.00     0.00
  0.00     0.00    0.00     0.00    0.00     0.00     0.00     0.00     0.00     0.00
  0.00     0.00    0.00     0.00    0.00     0.00     0.00     0.00     0.00     0.00
END 99
  0.00     0.10      10    1.65 LAKE38
  0.00     0.43    1.06     1.26    1.23     1.17     1.48     2.58     4.01     5.45
  6.80     8.44   13.05    47.98   84.98    86.75    69.55    46.04    30.00    20.17
 13.60     9.66    7.03     5.32    4.45     3.51     2.49     1.78     1.32     1.02
  0.79     0.61    0.50     0.43    0.39     0.35     0.33     0.31     0.29     0.27
  0.25     0.24    0.22     0.21    0.20     0.19     0.18     0.17     0.16     0.15
  0.14     0.13    0.13     0.12    0.11     0.11     0.10     0.10     0.09     0.08
  0.08     0.08    0.07     0.07    0.06     0.06     0.06     0.05     0.05     0.05
  0.05     0.04    0.04     0.04    0.04     0.03     0.03     0.03     0.03     0.03
  0.03     0.02    0.02     0.02    0.02     0.02     0.02     0.02     0.02     0.02
END 99
  0.00     0.10      10    1.65 DET370
  0.00     0.36    0.95     1.26    1.36     1.37     1.66     2.65     4.06     5.63
  7.22     9.23   14.27    46.72   83.01    91.19    81.31    61.85    46.24    34.61
 25.85    19.57   14.97    11.69    9.50     7.64     5.84     4.46     3.44     2.69
  2.17     1.75    1.46     1.23    1.05     0.90     0.78     0.68     0.60     0.53
  0.48     0.43    0.39     0.35    0.32     0.29     0.27     0.23     0.21     0.19
  0.18     0.17    0.16     0.14    0.13     0.12     0.12     0.11     0.10     0.10
  0.09     0.08    0.08     0.07    0.07     0.07     0.06     0.06     0.05     0.05
  0.05     0.04    0.04     0.04    0.04     0.03     0.03     0.03     0.03     0.03
  0.03     0.02    0.02     0.02    0.02     0.02     0.02     0.02     0.02     0.01
END 99
  0.00     0.10      10    1.65 LAKE39
  0.00     0.71    1.74     2.06    2.04     1.95     2.48     4.29     6.62     9.00
 11.24    13.98   22.19    78.81  136.91   139.76   114.05    77.82    52.66    36.59
 25.52    18.39   13.39    10.11    8.25     6.35     4.38     3.00     2.08     1.47
  1.04     0.66    0.43     0.22    0.13     0.07     0.05     0.03     0.02     0.01
  0.01     0.00    0.00     0.00    0.00     0.00     0.00     0.00     0.00     0.00
  0.00     0.00    0.00     0.00    0.00     0.00     0.00     0.00     0.00     0.00
  0.00     0.00    0.00     0.00    0.00     0.00     0.00     0.00     0.00     0.00
  0.00     0.00    0.00     0.00    0.00     0.00     0.00     0.00     0.00     0.00
  0.00     0.00    0.00     0.00    0.00     0.00     0.00     0.00     0.00     0.00
END 99
  0.00     0.10      10    1.65 LAKE40
  0.00     0.66    1.78     2.36    2.51     2.48     2.99     4.81     7.45    10.34
 13.20    16.53   24.92    74.98  136.43   154.51   138.17   104.77    76.10    55.35
 40.22    29.53   22.04    16.80   13.44    10.47     7.67     5.50     3.98     2.86
  2.08     1.51    1.10     0.72    0.40     0.22     0.12     0.08     0.05     0.03
  0.02     0.01    0.01     0.01    0.00     0.00     0.00     0.00     0.00     0.00
  0.00     0.00    0.00     0.00    0.00     0.00     0.00     0.00     0.00     0.00
  0.00     0.00    0.00     0.00    0.00     0.00     0.00     0.00     0.00     0.00
  0.00     0.00    0.00     0.00    0.00     0.00     0.00     0.00     0.00     0.00
  0.00     0.00    0.00     0.00    0.00     0.00     0.00     0.00     0.00     0.00
END 99
```

```
  0.00     0.10      10   1.65 DET500
  0.00     0.14    0.38     0.53    0.57     0.57     0.67     1.06     1.64     2.30
  2.95     3.70    5.55    20.08   37.43    41.72    36.89    27.46    19.71    14.14
 10.15     7.35    5.36     3.98    3.08     2.35     1.66     1.15     0.79     0.55
  0.38     0.20    0.12     0.06    0.04     0.02     0.01     0.01     0.01     0.00
  0.00     0.00    0.00     0.00    0.00     0.00     0.00     0.00     0.00     0.00
  0.00     0.00    0.00     0.00    0.00     0.00     0.00     0.00     0.00     0.00
  0.00     0.00    0.00     0.00    0.00     0.00     0.00     0.00     0.00     0.00
  0.00     0.00    0.00     0.00    0.00     0.00     0.00     0.00     0.00     0.00
  0.00     0.00    0.00     0.00    0.00     0.00     0.00     0.00     0.00     0.00
END 99
  0.00     0.10      10   1.65 LAKE41
  0.00     0.49    1.37     1.92    2.10     2.12     2.50     3.91     6.06     8.51
 10.98    13.82   20.85    60.26  114.34   138.20   129.88   102.66    75.79    55.02
 39.67    28.77   21.11    15.74   12.29     9.54     6.99     4.92     3.47     2.44
  1.79     1.33    1.04     0.81    0.65     0.53     0.41     0.33     0.27     0.23
  0.19     0.17    0.14     0.12    0.11     0.09     0.08     0.07     0.06     0.05
  0.04     0.04    0.03     0.03    0.02     0.01     0.01     0.00     0.00     0.00
  0.00     0.00    0.00     0.00    0.00     0.00     0.00     0.00     0.00     0.00
  0.00     0.00    0.00     0.00    0.00     0.00     0.00     0.00     0.00     0.00
  0.00     0.00    0.00     0.00    0.00     0.00     0.00     0.00     0.00     0.00
END 99
  0.00     0.10      10   1.65 LAKE42
  0.00     0.73    1.76     2.07    2.05     1.96     2.50     4.33     6.67     9.06
 11.32    14.07   21.79    66.62  112.89   117.03    97.69    68.83    47.93    33.76
 23.66    17.10   12.61     9.68    8.07     6.28     4.39     3.05     2.16     1.53
  1.13     0.85    0.66     0.52    0.41     0.30     0.23     0.17     0.14     0.11
  0.09     0.08    0.07     0.05    0.05     0.03     0.02     0.02     0.01     0.01
  0.00     0.00    0.00     0.00    0.00     0.00     0.00     0.00     0.00     0.00
  0.00     0.00    0.00     0.00    0.00     0.00     0.00     0.00     0.00     0.00
  0.00     0.00    0.00     0.00    0.00     0.00     0.00     0.00     0.00     0.00
  0.00     0.00    0.00     0.00    0.00     0.00     0.00     0.00     0.00     0.00
END 99
  0.00     0.10      10   1.65 LAKE43
  0.00     0.11    0.33     0.50    0.55     0.54     0.61     0.93     1.47     2.10
  2.72     3.41    4.66    11.10   21.24    26.64    25.26    19.95    14.38    10.11
  7.02     4.86    3.41     2.44    1.87     1.44     1.01     0.58     0.34     0.18
  0.11     0.07    0.04     0.03    0.02     0.01     0.00     0.00     0.00     0.00
  0.00     0.00    0.00     0.00    0.00     0.00     0.00     0.00     0.00     0.00
  0.00     0.00    0.00     0.00    0.00     0.00     0.00     0.00     0.00     0.00
  0.00     0.00    0.00     0.00    0.00     0.00     0.00     0.00     0.00     0.00
  0.00     0.00    0.00     0.00    0.00     0.00     0.00     0.00     0.00     0.00
  0.00     0.00    0.00     0.00    0.00     0.00     0.00     0.00     0.00     0.00
END 99
```

OAKWOOD GOLF COURSE STORAGE ROUTING

Condition: Developed

99 Year Storm

Run Fri 05-31-1996 3:19 PM

Hydraulic Model

Version 3.17

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File: C:\MODEL\DATA\SL-OAK\MDP100A

Saved: _____

MDP100A.S99
SUMMARY OUTPUT

Project: OAKWOOD GOLF COURSE STORAGE ROUTING

File: C:\MODEL\DATA\SL-OAK\MDP100A
Condition: Developed Page: 1
Event: 99 Year Run: Fri 05-31-1996 3:19 PM

Hydraulic Model Version 3.17 Copyright 1991, 1993 By RAMSS Inc.

Start Time: 0.00 hours
End Time: 100.00 hours
Time increment: 0.10 hours

Volume Conversion: 40/60
Channel Storage: Yes
Diversion Storage: Yes
Structure Storage: Yes
Pipe Storage: Yes
Channel Backwater: Yes

All dimensions in feet unless specified otherwise

Volume Originally In System: 0.00 cf
Total Runoff Volume In: 5462424.00 cf
Total Baseflow In: 0.00 cf
Volume Remaining In System: 5388215.84 cf
Volume Discharged: 94535.67 cf
Volumes Check To: 20327.51 cf
Error: 0.37 %

Footnotes For Tabular Output

1 - LAKE42 0.00 hours Conveyance to LAKE43 connects outside limits

2 - RISER34 0.00 hours Conveyance connects to LAKE35 outside limits

3 - RISER35 0.00 hours Conveyance connects to LAKE36 outside limits

4 - RISER89 0.00 hours Conveyance connects to LAKE37 outside limits

5 - RISER33 0.00 hours Conveyance connects to LAKE37 outside limits

6 - RISER37 0.00 hours Conveyance connects to LAKE38 outside limits

7 - RISER38A 0.00 hours Conveyance connects to DET370 outside limits

8 - RISER38B 0.00 hours Conveyance connects to LAKE40 outside limits

9 - RISER70 0.00 hours Conveyance connects to LAKE39 outside limits

10 - RISER39 0.00 hours Conveyance connects to LAKE41 outside limits

11 - RISER49 0.00 hours Conveyance connects to DET500 outside limits

12 - RISER50 0.00 hours Conveyance connects to LAKE41 outside limits

13 - RISER42 0.00 hours Conveyance connects to LAKE42 outside limits

14 - LAKE42 0.00 hours Conveyance connects to LAKE43 outside limits

15 - RISER39 1.10 hours Level of 1178.90 exceeded top elevation

16 - RISER35 1.20 hours Level of 1188.94 exceeded top elevation

17 - RISER37 1.20 hours Level of 1184.70 exceeded top elevation

18 - RISER70 1.20 hours Level of 1180.70 exceeded top elevation

19 - RISER49 1.20 hours Level of 1178.31 exceeded top elevation

20 - RISER38A 1.30 hours Level of 1181.70 exceeded top elevation

21 - RISER36 1.40 hours Level of 1189.29 exceeded top elevation

22 - RISER33 1.40 hours Level of 1187.76 exceeded top elevation

23 - RISER38B 1.40 hours Level of 1182.11 exceeded top elevation

24 - RISER50 1.40 hours Level of 1177.87 exceeded top elevation

25 - RISER34 1.50 hours Level of 1190.63 exceeded top elevation

Project: OAKWOOD GOLF COURSE STORAGE ROUTING

File: C:\MODEL\DATA\SL-OAK\MDP100A
Condition: Developed Page: 2
Event: 99 Year Run: Fri 05-31-1996 3:19 PM

Hydraulic Model Version 3.17 Copyright 1991, 1993 By RAMSS Inc.

Basin LAKE34

Elevation (ft)	Area (sf)	Volume (cf)
1190.10	103456.00	0.00
1190.22	106184.00	12578.40
1190.32	108458.00	23310.50
1190.50	112550.00	43201.22
1190.60	114823.00	54569.87
1191.00	123197.00	102173.87
1192.00	157679.00	242611.87
1193.00	213526.00	428214.37
1194.00	290918.00	680436.37

Runoff volume of 619563.60 cf with multiplier of 1.00 from area: LAKE34

No Inflows Connected

Riser to RISER34
Perimeter: 2.62 Crest Elev: 1190.10 Coefficient: 3.00
H.Or. Area: 0.55
PeakQ: 4.98 Volume: 618224.76 Centroid: 22.31

Peak WS Level: 1193.64 ft Peak Volume: 589867.06 cf
Final WS Level: 1190.11 ft Final Volume: 1330.14 cf

Structure RISER34
Base Elevation: 1187.00 Base Area: 0.55
Bench Elevation: 1187.00 Bench Area: 0.55
Top Elevation: 1190.10

Inflows Connected From:
LAKE34

Circular Conduit to LAKE35
Diam: 21.00" Orif.Diam: 21.00" Length: 1100.00
InvIn: 1187.00 InvOut: 1185.00 Slope: 0.0018
n: 0.0120 Km: 0.5000 Kp: 0.0126
PeakQ: 4.98

Peak WS Level: 1191.97 ft

Project: OAKWOOD GOLF COURSE STORAGE ROUTING

File: C:\MODEL\DATA\SL-OAK\MDP100A
Condition: Developed Page: 3
Event: 99 Year Run: Fri 05-31-1996 3:19 PM

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Basin LAKE35

Elevation (ft)	Area (sf)	Volume (cf)
1188.78	18000.00	0.00
1188.90	19499.00	2249.94
1189.00	35748.00	5012.29
1189.20	68247.00	15411.79
1189.30	84496.00	23048.94
1190.00	198240.00	122006.54
1191.00	248976.00	345614.54
1192.00	311761.00	625983.04
1193.00	435202.00	999464.54

Runoff volume of 353898.00 cf with multiplier of 1.00 from area: LAKE35

Inflows Connected From:
RISER34

Riser to RISER35
Perimeter: 4.71 Crest Elev: 1188.78 Coefficient: 3.00
H.Or. Area: 1.77
PeakQ: 8.75 Volume: 971945.54 Centroid: 25.85

Peak WS Level: 1190.94 ft Peak Volume: 332987.56 cf
Final WS Level: 1188.79 ft Final Volume: 175.01 cf

Structure RISER35
Base Elevation: 1185.00 Base Area: 3.14
Bench Elevation: 1185.00 Bench Area: 3.14
Top Elevation: 1188.78

Inflows Connected From:
LAKE35

Circular Conduit to LAKE36
Diam: 24.00" Orif.Diam: 24.00" Length: 840.00
InvIn: 1185.00 InvOut: 1184.00 Slope: 0.0012
n: 0.0120 Km: 0.5000 Kp: 0.0106
PeakQ: 8.74

Peak WS Level: 1190.94 ft

Project: OAKWOOD GOLF COURSE STORAGE ROUTING

File: C:\MODEL\DATA\SL-OAK\MDP100A
Condition: Developed Page: 4
Event: 99 Year Run: Fri 05-31-1996 3:19 PM

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Basin LAKE36

Elevation (ft)	Area (sf)	Volume (cf)
1187.88	30000.00	0.00
1188.00	34435.00	3866.10
1188.10	41232.00	7649.45
1189.00	102401.00	72284.30
1190.00	130015.00	188492.30
1191.00	209942.00	358470.80
1191.50	270469.00	478573.55
1191.80	306785.00	565161.65
1192.00	330996.00	628939.75

Runoff volume of 218739.60 cf with multiplier of 1.00 from area: LAKE36

Inflows Connected From:
RISER35

Riser to RISER36
Perimeter: 4.19 Crest Elev: 1187.88 Coefficient: 3.00
H.Or. Area: 1.40
PeakQ: 6.63 Volume: 1190305.12 Centroid: 29.71

Peak WS Level: 1190.32 ft Peak Volume: 242371.49 cf
Final WS Level: 1187.89 ft Final Volume: 377.11 cf

Structure RISER36
Base Elevation: 1183.50 Base Area: 1.77
Bench Elevation: 1183.50 Bench Area: 1.77
Top Elevation: 1187.88

Inflows Connected From:
LAKE36

Circular Conduit to RISER89
Diam: 18.00" Orif.Diam: 18.00" Length: 900.00
InvIn: 1183.50 InvOut: 1182.00 Slope: 0.0017
n: 0.0120 Km: 0.5000 Kp: 0.0155
PeakQ: 6.63

Peak WS Level: 1190.32 ft

Project: OAKWOOD GOLF COURSE STORAGE ROUTING

File: C:\MODEL\DATA\SL-OAK\MDP100A
Condition: Developed Page: 5
Event: 99 Year Run: Fri 05-31-1996 3:19 PM

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Basin LAKE289

Elevation (ft)	Area (sf)	Volume (cf)
1188.00	6534.00	0.00
1189.00	25264.80	15899.40
1190.00	60984.00	59023.80

Runoff volume of 27583.20 cf with multiplier of 1.00 from area: LAK289

No Inflows Connected

Riser to RISER89
Perimeter: 2.62 Crest Elev: 1188.40 Coefficient: 3.00
H.Or. Area: 0.55
PeakQ: 2.31 Volume: 21222.44 Centroid: 3.27

Peak WS Level: 1189.16 ft Peak Volume: 22921.16 cf
Final WS Level: 1188.40 ft Final Volume: 6366.55 cf

Structure RISER89
Base Elevation: 1182.00 Base Area: 1.77
Bench Elevation: 1182.00 Bench Area: 1.77
Top Elevation: 1188.40

Inflows Connected From:
LAKE289 RISER36

Circular Conduit to LAKE37
Diam: 18.00" Orif.Diam: 18.00" Length: 440.00
InvIn: 1182.00 InvOut: 1181.50 Slope: 0.0011
n: 0.0120 Km: 0.5000 Kp: 0.0155
PeakQ: 8.54

Peak WS Level: 1188.95 ft

Basin LAKE33

Elevation (ft)	Area (sf)	Volume (cf)
1187.00	66713.00	0.00
1188.00	73446.00	70079.50
1189.00	87687.00	150646.00
1190.00	115842.00	252410.50
1190.30	131996.00	289586.20
1190.50	142766.00	317062.40
1191.00	169690.00	395176.40

Runoff volume of 154166.40 cf with multiplier of 1.00 from area: LAKE33

No Inflows Connected

Riser to RISER33
Perimeter: 6.00 Crest Elev: 1187.00 Coefficient: 3.00
H.Or. Area: 3.17
PeakQ: 9.29 Volume: 154124.24 Centroid: 4.79

Weir to LAKE37
Crest: 1190.30 Length: 100.00 S.Slope: 0.00:1
Coeff: 3.00
PeakQ: 0.00 Volume: 0.00 Centroid: 0.00

Peak WS Level: 1188.71 ft Peak Volume: 127380.01 cf
Final WS Level: 1187.00 ft Final Volume: 36.02 cf

Project: OAKWOOD GOLF COURSE STORAGE ROUTING

File: C:\MODEL\DATA\SL-OAK\MDP100A
Condition: Developed Page: 6
Event: 99 Year Run: Fri 05-31-1996 3:19 PM

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Structure RISER33
Base Elevation: 1183.00 Base Area: 1.77
Bench Elevation: 1183.00 Bench Area: 1.77
Top Elevation: 1187.00

Inflows Connected From:
LAKE33

Circular Conduit to LAKE37

Diam:	21.00"	Orif.Diam:	21.00"	Length:	950.00
InvIn:	1184.63	InvOut:	1181.50	Slope:	0.0033
n:	0.0120	Km:	0.5000	Kp:	0.0126
PeakQ:	9.28	Volume:	154129.39	Centroid:	4.79

Peak WS Level: 1188.71 ft

Basin LAKE07

Elevation (ft)	Area (sf)	Volume (cf)
1183.50	0.00	0.00
1184.00	7405.20	1851.30
1185.00	20473.20	15790.50
1186.00	35719.20	43886.70
1186.40	37026.00	58435.74
1186.70	37897.20	69674.22
1187.00	38768.40	81174.06
1187.50	40510.80	100993.86
1188.00	42253.20	121684.86

Runoff volume of 290095.20 cf with multiplier of 1.00 from area: LAKE07

No Inflows Connected

Circular Conduit to RISER37

Diam:	15.00"	Orif.Diam:	15.00"	Length:	500.00
InvIn:	1183.50	InvOut:	1181.00	Slope:	0.0050
n:	0.0120	Km:	0.5000	Kp:	0.0198
PeakQ:	4.22	Volume:	-20718.62	Centroid:	35.92

Weir to SEC07

Crest:	1186.40	Length:	50.00	S.Slope:	5.00:1
Coeff:	3.00				
PeakQ:	103.18	Volume:	216244.49	Centroid:	1.95

Exfiltration to FREE

InvIn:	1184.00	InvOut:	1182.00	Area:	100.00
in/hr:	172.80	Hours:	0.00		
PeakQ:	0.40	Volume:	94535.67	Centroid:	33.31

Peak WS Level: 1187.16 ft Peak Volume: 87513.98 cf
Final WS Level: 1183.51 ft Final Volume: 26.97 cf

Project: OAKWOOD GOLF COURSE STORAGE ROUTING

File: C:\MODEL\DATA\SL-OAK\MDP100A
Condition: Developed Page: 7
Event: 99 Year Run: Fri 05-31-1996 3:19 PM

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Channel Section SEC07
Connects to: SEC08
Distance to next section: 65.00 ft
Overbank distance: 0.00 ft
Slope at cross section: 0.0331 ft/ft
Additional Baseflow: 0.00 cfs

Elevation (ft)	Width (ft)	Area (sf)	Perim (ft)	Weighted n
1186.35	0.10	0.00	0.10	0.0250
1186.36	50.00	0.25	50.00	0.0250
1186.55	52.00	9.94	52.04	0.0250
1186.75	54.00	20.54	54.08	0.0250
1187.50	61.40	63.82	61.63	0.0250

Inflows Connected From:
LAKE07

Total Volume Discharged: 249872.79

PeakWS (ft)	PeakQ (cfs)	PeakV (fps)	PeakSpread (ft)
1186.95	103.18	4.91	55.95

Channel Section SEC08
Connects to: LAKE37
Distance to next section: 10.00 ft
Overbank distance: 0.00 ft
Slope at cross section: 0.0331 ft/ft
Additional Baseflow: 0.00 cfs

Elevation (ft)	Width (ft)	Area (sf)	Perim (ft)	Weighted n
1184.20	0.10	0.00	0.10	0.0250
1184.21	50.00	0.25	50.00	0.0250
1184.40	52.00	9.94	52.04	0.0250
1184.60	54.00	20.54	54.08	0.0250
1185.35	61.40	63.82	61.63	0.0250
1186.00	68.00	105.87	68.35	0.0250
1186.50	73.00	141.12	73.45	0.0250
1186.60	74.00	148.47	74.47	0.0250
1187.00	78.00	178.87	78.55	0.0250
1187.50	83.00	219.12	83.65	0.0250

No Inflows Connected

Total Volume Discharged: 249872.79

PeakWS (ft)	PeakQ (cfs)	PeakV (fps)	PeakSpread (ft)
1186.94	103.18	0.00	77.40

Project: OAKWOOD GOLF COURSE STORAGE ROUTING

File: C:\MODEL\DATA\SL-OAK\MDP100A
Condition: Developed Page: 8
Event: 99 Year Run: Fri 05-31-1996 3:19 PM

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Basin LAKE37

Elevation (ft)	Area (sf)	Volume (cf)
1184.00	128066.00	0.00
1185.00	156816.00	142441.00
1186.00	182516.00	312107.00
1186.60	204296.00	428150.60
1187.00	219107.00	512831.20

Runoff volume of 417031.20 cf with multiplier of 1.00 from area: LAKE37

Inflows Connected From:
SEC08 RISER33 LAKE33 RISER89

Riser to RISER37
Perimeter: 6.28 Crest Elev: 1184.00 Coefficient: 3.00
H.Or. Area: 3.14
PeakQ: 8.80 Volume: 1513218.89 Centroid: 34.51

Weir to SEC09
Crest: 1186.00 Length: 70.00 S.Slope: 5.00:1
Coeff: 3.00
PeakQ: 73.87 Volume: 514025.08 Centroid: 3.83

Peak WS Level: 1186.94 ft Peak Volume: 500041.00 cf
Final WS Level: 1184.02 ft Final Volume: 2324.11 cf

Channel Section SEC09
Connects to: SEC10
Distance to next section: 200.00 ft
Overbank distance: 0.00 ft
Slope at cross section: 0.0050 ft/ft
Additional Baseflow: 0.00 cfs

Elevation (ft)	Width (ft)	Area (sf)	Perim (ft)	Weighted n
1186.00	0.10	0.00	0.10	0.0300
1186.01	26.00	0.13	26.00	0.0300
1187.00	32.00	28.84	32.32	0.0300
1188.00	38.00	63.84	38.64	0.0300

Inflows Connected From:
LAKE37

Total Volume Discharged: 515554.33

PeakWS (ft)	PeakQ (cfs)	PeakV (fps)	PeakSpread (ft)
1186.89	73.87	2.93	31.31

Project: OAKWOOD GOLF COURSE STORAGE ROUTING

File: C:\MODEL\DATA\SL-OAK\MDP100A
Condition: Developed Page: 9
Event: 99 Year Run: Fri 05-31-1996 3:19 PM

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Channel Section SEC10
Connects to: SEC11
Distance to next section: 200.00 ft
Overbank distance: 0.00 ft
Slope at cross section: 0.0050 ft/ft
Additional Baseflow: 0.00 cfs

Elevation (ft)	Width (ft)	Area (sf)	Perim (ft)	Weighted n
1185.00	0.10	0.00	0.10	0.0300
1185.01	26.00	0.13	26.00	0.0300
1186.00	32.00	28.84	32.32	0.0300
1187.00	38.00	63.84	38.64	0.0300
1188.00	44.00	104.84	44.97	0.0300

Runoff volume of 56736.00 cf with multiplier of 1.00 from area: SEC010

No Inflows Connected

Total Volume Discharged: 572369.74

PeakWS (ft)	PeakQ (cfs)	PeakV (fps)	PeakSpread (ft)
1185.92	82.63	3.13	31.54

Channel Section SEC11
Connects to: SEC12
Distance to next section: 200.00 ft
Overbank distance: 0.00 ft
Slope at cross section: 0.0050 ft/ft
Additional Baseflow: 0.00 cfs

Elevation (ft)	Width (ft)	Area (sf)	Perim (ft)	Weighted n
1184.00	0.10	0.00	0.10	0.0300
1184.01	26.00	0.13	26.00	0.0300
1185.00	32.00	28.84	32.32	0.0300
1186.00	38.00	63.84	38.64	0.0300
1187.00	44.00	104.84	44.97	0.0300

No Inflows Connected

Total Volume Discharged: 572577.95

PeakWS (ft)	PeakQ (cfs)	PeakV (fps)	PeakSpread (ft)
1184.92	82.24	3.14	31.50

Project: OAKWOOD GOLF COURSE STORAGE ROUTING

File: C:\MODEL\DATA\SL-OAK\MDP100A
Condition: Developed Page: 10
Event: 99 Year Run: Fri 05-31-1996 3:19 PM

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Channel Section SEC12
Connects to: LAKE38
Distance to next section: 300.00 ft
Overbank distance: 0.00 ft
Slope at cross section: 0.0050 ft/ft
Additional Baseflow: 0.00 cfs

Elevation (ft)	Width (ft)	Area (sf)	Perim (ft)	Weighted n
1183.00	0.10	0.00	0.10	0.0300
1183.01	26.00	0.13	26.00	0.0300
1184.00	32.00	28.84	32.32	0.0300
1185.00	38.00	63.84	38.64	0.0300
1186.00	44.00	104.84	44.97	0.0300

No Inflows Connected

Total Volume Discharged: 568309.70

PeakWS (ft)	PeakQ (cfs)	PeakV (fps)	PeakSpread (ft)
1184.23	81.74	3.27	33.36

Structure RISER37
Base Elevation: 1181.00 Base Area: 1.77
Bench Elevation: 1181.00 Bench Area: 1.77
Top Elevation: 1184.00

Inflows Connected From:
LAKE37 LAKE07

Circular Conduit to LAKE38

Diam:	18.00"	Orif.Diam:	18.00"	Length:	848.00
InvIn:	1181.00	InvOut:	1178.88	Slope:	0.0025
n:	0.0120	Km:	0.5000	Kp:	0.0155
PeakQ:	7.23				

Peak WS Level: 1186.95 ft

Project: OAKWOOD GOLF COURSE STORAGE ROUTING

File: C:\MODEL\DATA\SL-OAK\MDP100A
Condition: Developed Page: 11
Event: 99 Year Run: Fri 05-31-1996 3:19 PM

Hydraulic Model Version 3.17 Copyright 1991, 1993 By RAMSS Inc.

Basin LAKE38

Elevation (ft)	Area (sf)	Volume (cf)
1181.21	128908.00	0.00
1182.00	164657.00	115958.17
1182.50	191228.00	204929.42
1183.00	217800.00	307186.42
1183.30	237402.00	375466.73
1184.00	283576.00	557809.02
1184.50	335412.00	712556.02
1185.00	387248.00	893221.02

Runoff volume of 339764.40 cf with multiplier of 1.00 from area: LAKE38

Inflows Connected From:
RISER37 SEC12

Riser to RISER38A
Perimeter: 6.28 Crest Elev: 1181.21 Coefficient: 3.00
H.Or. Area: 3.14
PeakQ: 4.98 Volume: 501539.69 Centroid: 38.33

Riser to RISER38B
Perimeter: 6.28 Crest Elev: 1181.21 Coefficient: 3.00
H.Or. Area: 3.14
PeakQ: 9.50 Volume: 1510168.79 Centroid: 33.73

Weir to LAKE40
Crest: 1183.30 Length: 4.50 S.Slope: 7.00:1
Coeff: 3.00
PeakQ: 23.28 Volume: 386435.35 Centroid: 5.71

Peak WS Level: 1184.23 ft Peak Volume: 627722.63 cf
Final WS Level: 1181.22 ft Final Volume: 2066.81 cf

Structure RISER38A
Base Elevation: 1178.21 Base Area: 1.77
Bench Elevation: 1178.21 Bench Area: 1.77
Top Elevation: 1181.21

Inflows Connected From:
LAKE38

Circular Conduit to DET370
Diam: 18.00" Orif.Diam: 18.00" Length: 300.00
InvIn: 1178.21 InvOut: 1177.00 Slope: 0.0040
n: 0.0120 Km: 0.5000 Kp: 0.0155
PeakQ: 4.97

Peak WS Level: 1184.23 ft

Project: OAKWOOD GOLF COURSE STORAGE ROUTING

File: C:\MODEL\DATA\SL-OAK\MDP100A
Condition: Developed Page: 12
Event: 99 Year Run: Fri 05-31-1996 3:19 PM

Hydraulic Model Version 3.17 Copyright 1991, 1993 By RAMSS Inc.

Structure RISER38B
Base Elevation: 1178.21 Base Area: 1.77
Bench Elevation: 1178.21 Bench Area: 1.77
Top Elevation: 1181.21

Inflows Connected From:
LAKE38

Circular Conduit to LAKE40
Diam: 18.00" Orif.Diam: 18.00" Length: 400.00
InvIn: 1178.21 InvOut: 1174.92 Slope: 0.0082
n: 0.0120 Km: 0.5000 Kp: 0.0155
PeakQ: 9.49

Peak WS Level: 1184.23 ft

Basin DET370

Elevation (ft)	Area (sf)	Volume (cf)
1180.50	68389.20	0.00
1181.00	73180.80	35392.50
1182.00	80150.40	112058.10
1183.00	98445.60	201356.10
1184.00	121532.00	311344.90
1184.20	128502.00	336348.30
1184.40	135907.00	362789.20
1185.00	157252.00	450736.90

Runoff volume of 416808.00 cf with multiplier of 1.00 from area: DET370

Inflows Connected From:
RISER38A

Riser to RISER70
Perimeter: 6.28 Crest Elev: 1180.50 Coefficient: 3.00
H.Or. Area: 3.14
PeakQ: 6.51 Volume: 872315.67 Centroid: 34.31

Weir to LAKE39
Crest: 1184.20 Length: 100.00 S.Slope: 5.00:1
Coeff: 3.00
PeakQ: 9.18 Volume: 16974.23 Centroid: 2.31

Peak WS Level: 1184.30 ft Peak Volume: 349262.62 cf
Final WS Level: 1180.91 ft Final Volume: 29056.50 cf

Project: OAKWOOD GOLF COURSE STORAGE ROUTING

File: C:\MODEL\DATA\SL-OAK\MDP100A
Condition: Developed Page: 13
Event: 99 Year Run: Fri 05-31-1996 3:19 PM

Hydraulic Model Version 3.17 Copyright 1991, 1993 By RAMSS Inc.

Structure RISER70
Base Elevation: 1177.50 Base Area: 1.77
Bench Elevation: 1177.50 Bench Area: 1.77
Top Elevation: 1180.50

Inflows Connected From:
DET370

Circular Conduit to LAKE39
Diam: 18.00" Orif.Diam: 18.00" Length: 670.00
InvIn: 1177.50 InvOut: 1176.00 Slope: 0.0022
n: 0.0120 Km: 0.5000 Kp: 0.0155
PeakQ: 6.51

Peak WS Level: 1184.30 ft

Basin LAKE39

Elevation (ft)	Area (sf)	Volume (cf)
1178.52	80883.00	0.00
1179.00	86573.00	40189.44
1179.10	88631.00	48949.64
1180.00	107154.00	137052.89
1181.00	149963.00	265611.39
1182.00	203652.00	442418.89
1183.00	270310.00	679399.89
1183.20	296984.00	736129.29
1183.70	363669.00	901292.54
1184.00	403680.00	1016394.89

Runoff volume of 549345.60 cf with multiplier of 1.00 from area: LAKE39

Inflows Connected From:
RISER70 DET370

Riser to RISER39
Perimeter: 6.28 Crest Elev: 1178.52 Coefficient: 3.00
H.Or. Area: 3.14
PeakQ: 5.54 Volume: 1184403.45 Centroid: 37.22

Weir to LAKE41
Crest: 1183.20 Length: 20.00 S.Slope: 5.00:1
Coeff: 3.00
PeakQ: 0.00 Volume: 0.00 Centroid: 0.00

Peak WS Level: 1182.55 ft Peak Volume: 573596.83 cf
Final WS Level: 1180.91 ft Final Volume: 253903.68 cf

Project: OAKWOOD GOLF COURSE STORAGE ROUTING

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Condition: Developed Page: 14
Event: 99 Year Run: Fri 05-31-1996 3:19 PM

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Structure RISER39
Base Elevation: 1175.52 Base Area: 1.77
Bench Elevation: 1175.52 Bench Area: 1.77
Top Elevation: 1178.52

Inflows Connected From:
LAKE39

Circular Conduit to LAKE41
Diam: 18.00" Orif.Diam: 18.00" Length: 1587.00
InvIn: 1175.52 InvOut: 1174.00 Slope: 0.0010
n: 0.0120 Km: 0.5000 Kp: 0.0155
PeakQ: 5.54

Peak WS Level: 1182.55 ft

Basin LAKE40

Elevation (ft)	Area (sf)	Volume (cf)
1177.92	138046.00	0.00
1178.00	138047.00	11043.72
1178.10	140661.00	24979.12
1178.90	161577.00	145874.32
1179.00	164191.00	162162.72
1180.00	219120.00	353818.22
1181.00	294174.00	610465.22
1182.00	374995.00	945049.72
1182.20	391200.00	1021669.22
1182.50	415559.00	1142683.07
1183.00	456122.00	1360603.32

Runoff volume of 659955.60 cf with multiplier of 1.00 from area: LAKE40

Inflows Connected From:
RISER38B LAKE38

Riser to RISER49
Perimeter: 6.28 Crest Elev: 1177.92 Coefficient: 3.00
H.Or. Area: 3.14
PeakQ: 10.28 Volume: 1903740.41 Centroid: 32.99

Weir to DET500
Crest: 1181.80 Length: 10.00 S.Slope: 55.00:1
Coeff: 3.00
PeakQ: 3.94 Volume: 68326.38 Centroid: 9.10

Peak WS Level: 1181.99 ft Peak Volume: 940141.38 cf
Final WS Level: 1180.90 ft Final Volume: 583993.80 cf

Project: OAKWOOD GOLF COURSE STORAGE ROUTING

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Condition: Developed Page: 15
Event: 99 Year Run: Fri 05-31-1996 3:19 PM

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Structure RISER49
Base Elevation: 1174.92 Base Area: 1.77
Bench Elevation: 1174.92 Bench Area: 1.77
Top Elevation: 1177.92

Inflows Connected From:
LAKE40

Circular Conduit to DET500

Diam:	18.00"	Orif.Diam:	18.00"	Length:	300.00
InvIn:	1174.92	InvOut:	1174.17	Slope:	0.0025
n:	0.0120	Km:	0.5000	Kp:	0.0155
PeakQ:	10.28				

Peak WS Level: 1181.99 ft

Basin DET500

Elevation (ft)	Area (sf)	Volume (cf)
1177.50	70567.20	0.00
1178.00	70567.20	35283.60
1179.00	78408.00	109771.20
1180.00	89733.60	193842.00
1181.00	101059.00	289238.30
1182.00	115434.00	397484.80
1183.00	135036.00	522719.80

Runoff volume of 176925.60 cf with multiplier of 1.00 from area: DET500

Inflows Connected From:
RISER49 LAKE40

Riser to RISER50

Perimeter:	6.28	Crest Elev:	1177.50	Coefficient:	3.00
H.Or. Area:	3.14				
PeakQ:	18.30	Volume:	1869573.94	Centroid:	29.52

Peak WS Level: 1180.90 ft Peak Volume: 279410.46 cf
Final WS Level: 1180.90 ft Final Volume: 279410.46 cf

Project: OAKWOOD GOLF COURSE STORAGE ROUTING

File: C:\MODEL\DATA\SL-OAK\MDP100A
Condition: Developed Page: 16
Event: 99 Year Run: Fri 05-31-1996 3:19 PM

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Structure RISER50
Base Elevation: 1173.50 Base Area: 3.14
Bench Elevation: 1173.50 Bench Area: 3.14
Top Elevation: 1177.50

Inflows Connected From:
DET500

Circular Conduit to LAKE41
Diam: 36.00" Orif.Diam: 36.00" Length: 440.00
InvIn: 1173.50 InvOut: 1172.50 Slope: 0.0023
n: 0.0120 Km: 0.5000 Kp: 0.0062
PeakQ: 18.29

Peak WS Level: 1180.90 ft

Basin LAKE41

Elevation (ft)	Area (sf)	Volume (cf)
1177.00	148834.00	0.00
1177.40	160234.00	61813.60
1177.50	163085.00	77979.55
1178.00	177335.00	163084.55
1178.50	216727.00	261600.05
1179.00	256118.00	379811.30
1179.50	292039.00	516850.55
1179.70	306407.00	576695.15
1180.00	327960.00	671850.20
1181.00	385520.00	1028590.20

Runoff volume of 599302.80 cf with multiplier of 1.00 from area: LAKE41

Inflows Connected From:
RISER50 RISER39 LAKE39

Riser to RISER42
Perimeter: 6.28 Crest Elev: 1177.00 Coefficient: 3.00
H.Or. Area: 3.14
PeakQ: 24.33 Volume: 1911321.04 Centroid: 25.83

Exfiltration to LAKE42
InvIn: 1177.40 InvOut: 1180.00 Area: 100.00
in/hr: 1944.00 Hours: 0.00
PeakQ: 4.50 Volume: 750060.00 Centroid: 24.44

Peak WS Level: 1180.90 ft Peak Volume: 991874.27 cf
Final WS Level: 1180.90 ft Final Volume: 991874.27 cf

1. On sht 6/9 the indicated water sfce level is at Elev. 1177.05 after breakout of Sinkhole of Elev. 1174.0 prior to Lab 42 Construction.

why is the "after" condition elevation greater than the "prior" condition?

2

Elev 1181.0 overflow weir

Lake 43

100 yr-2 hr Volume

$V = c\frac{P}{12}A = .38\left(\frac{2.6}{12}\right)(16.58)$

C est. .30 (14.38) = 4.31
.95 (2.2) 2.09
6.40

$C_{ave} = \frac{6.40}{16.58} = 0.38$

Onsite $V_{roll} = 1.365$ Ac-ft.

At elev. 1177 : Area = 150720 ft² 3.4601 Acre surface area
Vol = 561920.0 ft³ 12.9 Acre-ft

At peak stage:
1180.90 Area =
→ 1181
4.50 Acre
78.7 Acre-ft ≈ 28.2

Lake 43 - w/ emergency overflow needs
→ a channel adjacent to Price Road.

1992 HEC-1 Model
Peak Q @ C.P. Lake 43 — 366 cfs
6hr vol = 33
24hr " = 51 Ac-ft

MESSAGE DISPLAY FOR MAXIMO DE VERA

To: EAR
Cc: SLT
MRJ
AMM
MRD

From: Maximo De Vera:TALOS
Postmark: 12/19/96 09:05AM
Status: Previously read

Host: TALOS
Delivered: 12/19/96 09:05AM

Subject: Sunlake Lake43

Message:
B & R Engineering Report dated Aug 1996 was reviewed together with the approved lake improvement design plans. Following are my comments:

1. Overall project area is 1280 acres. Estimated retention vol. reqt using FCD criteria is 194.13 ac-ft assuming C=0.7 The report showed 185.4 ac-ft which probably used a lower C factor but is quite close.

2. Inflow from Lake 42 is 29 cfs based on the report. The inflow vol for 2-hr duration amounts to 4.8 ca-ft. Onsite reqt. is 2.5 or a total of 7.3 ac-ft. Based on the stage-volume table generated by their RAMSS hydraulic model (FCD has no copy it) the storage volume corresponding to 1177.05 (elev indicated on design plan for 100yr storm) is 12.9 ac-ft. Thus, sufficient storage volume is provided.

3. Overflow weir into Price Rd is at elev. 1181. This would have a storage volume of 28.69 ac-ft(per RAMSS hydraulic model results) which is very much greater than that required for the 100yr storm. Thus, it is unlikely that overflow will occur.

Project: OAKWOOD GOLF COURSE STORAGE ROUTING

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Structure RISER42
Base Elevation: 1173.00 Base Area: 9.62
Bench Elevation: 1173.00 Bench Area: 9.62
Top Elevation: 1177.00

Inflows Connected From:
LAKE41

Circular Conduit to LAKE42

Diam:	42.00"	Orif.Diam:	42.00"	Length:	1300.00
InvIn:	1173.00	InvOut:	1166.50	Slope:	0.0050
n:	0.0120	Km:	0.5000	Kp:	0.0050
PeakQ:	24.33				

Peak WS Level: 1180.90 ft

Basin LAKE42

Elevation (ft)	Area (sf)	Volume (cf)
1172.50	136000.00	0.00
1173.00	136000.00	68000.00
1174.00	149920.00	210960.00
1175.00	163200.00	367520.00
1176.00	176480.00	537360.00
1177.00	275840.00	763520.00
1178.00	300320.00	1051600.00
1179.00	320320.00	1361920.00
1180.00	340000.00	1692080.00
1181.00	361280.00	2042720.00
1182.00	406240.00	2426480.00

Runoff volume of 472136.40 cf with multiplier of 1.00 from area: LAKE42

Inflows Connected From:
RISER42 LAKE41

Circular Conduit to LAKE43

Diam:	30.00"	Orif.Diam:	30.00"	Length:	300.00
InvIn:	1161.00	InvOut:	1160.40	Slope:	0.0020
n:	0.0120	Km:	0.5000	Kp:	0.0079
PeakQ:	23.84				

Peak WS Level: 1180.90 ft Peak Volume: 2006655.94 cf
Final WS Level: 1180.90 ft Final Volume: 2006655.94 cf

Project: OAKWOOD GOLF COURSE STORAGE ROUTING

File: C:\MODEL\DATA\SL-OAK\MDP100A
Condition: Developed Page: 18
Event: 99 Year Run: Fri 05-31-1996 3:19 PM

Hydraulic Model Version 3.17 Copyright 1991, 1993 By RAMSS Inc.

Basin LAKE43

Elevation (ft)	Area (sf)	Volume (cf)
1172.50	97280.00	0.00
1173.00	97280.00	48640.00
1174.00	116480.00	155520.00
1175.00	130880.00	279200.00
1176.00	141920.00	415600.00
1177.00	150720.00	561920.00 — 12.90 ac ft
1178.00	161120.00	717840.00
1179.00	170880.00	883840.00
1180.00	182560.00	1060560.00
1181.00	196160.00	1249920.00 — 28.69 vol. at overflow weir elev.
1182.00	209600.00	1452800.00

Runoff volume of 110372.40 cf with multiplier of 1.00 from area: LAKE43

Inflows Connected From:
LAKE42

Peak WS Level: 1180.90 ft Peak Volume: 1230460.61 cf
Final WS Level: 1180.90 ft Final Volume: 1230460.61 cf

```
      VERS =3.17
SSTOR= C D M P
3BACK= B
3TINC=            0.10
OWNER=RJH
TITLE= D      OAKWOOD GOLF COURSE STORAGE ROUTING
BASIN=          LAKE34    0.00
HYDGR=                                      LAKE34 1.00000
AREA =         1190.10  103456 1190.22  106184 1190.32  108458 1190.50  112550
AREA =         1190.60  114823 1191.00  123197 1192.00  157679 1193.00  213526
AREA =         1194.00  290918
DISCH= R       RISER34    2.62 1190.10    3.00    0.55    0.00
ENDSTR
MHOLE=         RISER34 1187.00    0.55 1187.00    0.55 1190.10    0.00
DISCH= C        LAKE35 1.75000 1.75000 1100.00 1187.00 1185.00  0.0120  0.5000
ENDSTR
BASIN=          LAKE35    0.00
HYDGR=                                      LAKE35 1.00000
AREA =         1188.78 18000.0 1188.90 19499.0 1189.00 35748.0 1189.20 68247.0
AREA =         1189.30 84496.0 1190.00  198240 1191.00  248976 1192.00  311761
AREA =         1193.00  435202
DISCH= R       RISER35    4.71 1188.78    3.00    1.77    0.00
ENDSTR
MHOLE=         RISER35 1185.00    3.14 1185.00    3.14 1188.78    0.00
DISCH= C        LAKE36 2.00000 2.00000  840.00 1185.00 1184.00  0.0120  0.5000
ENDSTR
BASIN=          LAKE36    0.00
HYDGR=                                      LAKE36 1.00000
AREA =         1187.88 30000.0 1188.00 34435.0 1188.10 41232.0 1189.00  102401
AREA =         1190.00  130015 1191.00  209942 1191.50  270469 1191.80  306785
AREA =         1192.00  330996
DISCH= R       RISER36    4.19 1187.88    3.00    1.40    0.00
ENDSTR
MHOLE=         RISER36 1183.50    1.77 1183.50    1.77 1187.88    0.00
DISCH= C       RISER89 1.50000 1.50000  900.00 1183.50 1182.00  0.0120  0.5000
ENDSTR
BASIN=         LAKE289    0.00
HYDGR=                                      LAK289 1.00000
AREA =         1188.00 6534.00 1189.00 25264.8 1190.00 60984.0
DISCH= R       RISER89    2.62 1188.40    3.00    0.55    0.00
ENDSTR
MHOLE=         RISER89 1182.00    1.77 1182.00    1.77 1188.40    0.00
DISCH= C        LAKE37 1.50000 1.50000  440.00 1182.00 1181.50  0.0120  0.5000
ENDSTR
BASIN=          LAKE33    0.00
HYDGR=                                      LAKE33 1.00000
AREA =         1187.00 66713.0 1188.00 73446.0 1189.00 87687.0 1190.00  115842
AREA =         1190.30  131996 1190.50  142766 1191.00  169690
DISCH= R       RISER33    6.00 1187.00    3.00    3.17    0.00
DISCH= W        LAKE37  100.00 1190.30    3.00    0.00
ENDSTR
MHOLE=         RISER33 1183.00    1.77 1183.00    1.77 1187.00    0.00
DISCH= C        LAKE37 1.75000 1.75000  950.00 1184.63 1181.50  0.0120  0.5000
ENDSTR
BASIN=          LAKE07    0.00
HYDGR=                                      LAKE07 1.00000
AREA =         1183.50       0 1184.00 7405.20 1185.00 20473.2 1186.00 35719.2
AREA =         1186.40 37026.0 1186.70 37897.2 1187.00 38768.4 1187.50 40510.8
AREA =         1188.00 42253.2
DISCH= C       RISER37 1.25000 1.25000  500.00 1183.50 1181.00  0.0120  0.5000
DISCH= W          SEC07   50.00 1186.40    3.00    5.00
DISCH= X           FREE 1184.00 1182.00  100.00  172.80    0.00
ENDSTR
CHAN =            SEC07   SEC08   65.00    0.00    0.00    0.00
XSECT=         1186.35   -0.05    0.05  0.0250 1186.36  -25.00   25.00  0.0250
XSECT=         1186.55  -26.00   26.00  0.0250 1186.75  -27.00   27.00  0.0250
```

MDP100A.RSC
LAKE ROUTING

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XSECT=          1187.50  -30.70   30.70  0.0250
ENDSTR
CHAN =            SEC08  LAKE37   10.00    0.00    0.00    0.00
XSECT=          1184.20   -0.05    0.05  0.0250 1184.21  -25.00   25.00  0.0250
XSECT=          1184.40  -26.00   26.00  0.0250 1184.60  -27.00   27.00  0.0250
XSECT=          1185.35  -30.70   30.70  0.0250 1186.00  -34.00   34.00  0.0250
XSECT=          1186.50  -36.50   36.50  0.0250 1186.60  -37.00   37.00  0.0250
XSECT=          1187.00  -39.00   39.00  0.0250 1187.50  -41.50   41.50  0.0250
ENDSTR
BASIN=           LAKE37    0.00
HYDGR=                                          LAKE37 1.00000
AREA =          1184.00  128066 1185.00  156816 1186.00  182516 1186.60  204296
AREA =          1187.00  219107
DISCH= R        RISER37    6.28 1184.00    3.00    3.14    0.00
DISCH= W          SEC09   70.00 1186.00    3.00    5.00
ENDSTR
CHAN =            SEC09   SEC10  200.00    0.00    0.00    0.00
XSECT=          1186.00   -0.05    0.05  0.0300 1186.01  -13.00   13.00  0.0300
XSECT=          1187.00  -16.00   16.00  0.0300 1188.00  -19.00   19.00  0.0300
ENDSTR
CHAN =            SEC10   SEC11  200.00    0.00    0.00    0.00
HYDGR=                                          SEC010 1.00000
XSECT=          1185.00   -0.05    0.05  0.0300 1185.01  -13.00   13.00  0.0300
XSECT=          1186.00  -16.00   16.00  0.0300 1187.00  -19.00   19.00  0.0300
XSECT=          1188.00  -22.00   22.00  0.0300
ENDSTR
CHAN =            SEC11   SEC12  200.00    0.00    0.00    0.00
XSECT=          1184.00   -0.05    0.05  0.0300 1184.01  -13.00   13.00  0.0300
XSECT=          1185.00  -16.00   16.00  0.0300 1186.00  -19.00   19.00  0.0300
XSECT=          1187.00  -22.00   22.00  0.0300
ENDSTR
CHAN =            SEC12  LAKE38  300.00    0.00    0.00    0.00
XSECT=          1183.00   -0.05    0.05  0.0300 1183.01  -13.00   13.00  0.0300
XSECT=          1184.00  -16.00   16.00  0.0300 1185.00  -19.00   19.00  0.0300
XSECT=          1186.00  -22.00   22.00  0.0300
ENDSTR
MHOLE=          RISER37 1181.00    1.77 1181.00    1.77 1184.00    0.00
DISCH= C         LAKE38 1.50000 1.50000  848.00 1181.00 1178.88  0.0120  0.5000
ENDSTR
BASIN=           LAKE38    0.00
HYDGR=                                          LAKE38 1.00000
AREA =          1181.21  128908 1182.00  164657 1182.50  191228 1183.00  217800
AREA =          1183.30  237402 1184.00  283576 1184.50  335412 1185.00  387248
DISCH= R       RISER38A    6.28 1181.21    3.00    3.14    0.00
DISCH= R       RISER38B    6.28 1181.21    3.00    3.14    0.00
DISCH= W         LAKE40    4.50 1183.30    3.00    7.00
ENDSTR
MHOLE=         RISER38A 1178.21    1.77 1178.21    1.77 1181.21    0.00
DISCH= C         DET370 1.50000 1.50000  300.00 1178.21 1177.00  0.0120  0.5000
ENDSTR
MHOLE=         RISER38B 1178.21    1.77 1178.21    1.77 1181.21    0.00
DISCH= C         LAKE40 1.50000 1.50000  400.00 1178.21 1174.92  0.0120  0.5000
ENDSTR
BASIN=           DET370    0.00
HYDGR=                                          DET370 1.00000
AREA =          1180.50 68389.2 1181.00 73180.8 1182.00 80150.4 1183.00 98445.6
AREA =          1184.00  121532 1184.20  128502 1184.40  135907 1185.00  157252
DISCH= R        RISER70    6.28 1180.50    3.00    3.14    0.00
DISCH= W         LAKE39  100.00 1184.20    3.00    5.00
ENDSTR
MHOLE=          RISER70 1177.50    1.77 1177.50    1.77 1180.50    0.00
DISCH= C         LAKE39 1.50000 1.50000  670.00 1177.50 1176.00  0.0120  0.5000
ENDSTR
BASIN=           LAKE39    0.00
HYDGR=                                          LAKE39 1.00000
AREA =          1178.52 80883.0 1179.00 86573.0 1179.10 88631.0 1180.00  107154
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AREA =          1181.00  149963 1182.00  203652 1183.00  270310 1183.20  296984
AREA =          1183.70  363669 1184.00  403680
DISCH= R        RISER39    6.28 1178.52    3.00    3.14    0.00
DISCH= W         LAKE41   20.00 1183.20    3.00    5.00
ENDSTR
MHOLE=          RISER39 1175.52    1.77 1175.52    1.77 1178.52    0.00
DISCH= C         LAKE41 1.50000 1.50000 1587.00 1175.52 1174.00  0.0120  0.5000
ENDSTR
BASIN=           LAKE40    0.00
HYDGR=                                        LAKE40 1.00000
AREA =          1177.92  138046 1178.00  138047 1178.10  140661 1178.90  161577
AREA =          1179.00  164191 1180.00  219120 1181.00  294174 1182.00  374995
AREA =          1182.20  391200 1182.50  415559 1183.00  456122
DISCH= R        RISER49    6.28 1177.92    3.00    3.14    0.00
DISCH= W         DET500   10.00 1181.80    3.00   55.00
ENDSTR
MHOLE=          RISER49 1174.92    1.77 1174.92    1.77 1177.92    0.00
DISCH= C         DET500 1.50000 1.50000  300.00 1174.92 1174.17  0.0120  0.5000
ENDSTR
BASIN=           DET500    0.00
HYDGR=                                        DET500 1.00000
AREA =          1177.50 70567.2 1178.00 70567.2 1179.00 78408.0 1180.00 89733.6
AREA =          1181.00  101059 1182.00  115434 1183.00  135036
DISCH= R        RISER50    6.28 1177.50    3.00    3.14    0.00
ENDSTR
MHOLE=          RISER50 1173.50    3.14 1173.50    3.14 1177.50    0.00
DISCH= C         LAKE41 3.00000 3.00000  440.00 1173.50 1172.50  0.0120  0.5000
ENDSTR
BASIN=           LAKE41    0.00
HYDGR=                                        LAKE41 1.00000
AREA =          1177.00  148834 1177.40  160234 1177.50  163085 1178.00  177335
AREA =          1178.50  216727 1179.00  256118 1179.50  292039 1179.70  306407
AREA =          1180.00  327960 1181.00  385520
DISCH= R        RISER42    6.28 1177.00    3.00    3.14    0.00
DISCH= X         LAKE42 1177.40 1180.00  100.00 1944.00    0.00
ENDSTR
MHOLE=          RISER42 1173.00    9.62 1173.00    9.62 1177.00    0.00
DISCH= C         LAKE42 3.50000 3.50000 1300.00 1173.00 1166.50  0.0120  0.5000
ENDSTR
BASIN=           LAKE42    0.00
HYDGR=                                        LAKE42 1.00000
AREA =          1172.50  136000 1173.00  136000 1174.00  149920 1175.00  163200
AREA =          1176.00  176480 1177.00  275840 1178.00  300320 1179.00  320320
AREA =          1180.00  340000 1181.00  361280 1182.00  406240
DISCH= C         LAKE43 2.50000 2.50000  300.00 1161.00 1160.40  0.0120  0.5000
ENDSTR
BASIN=           LAKE43    0.00
HYDGR=                                        LAKE43 1.00000
AREA =          1172.50 97280.0 1173.00 97280.0 1174.00  116480 1175.00  130880
AREA =          1176.00  141920 1177.00  150720 1178.00  161120 1179.00  170880
AREA =          1180.00  182560 1181.00  196160 1182.00  209600
ENDSTR
```

```
  0.00     0.10      99    2.60 LAKE34
  0.00     1.15    2.76     3.43     3.64     3.48     4.29     7.19    11.20    15.53
 19.52    27.17   57.27   205.74   335.68   317.22   242.56   153.17    97.26    64.90
 43.30    29.89   20.56    14.54    11.40     8.51     5.61     3.59     2.13     1.39
  0.93     0.71    0.57     0.48     0.41     0.36     0.31     0.28     0.25     0.22
  0.21     0.19    0.17     0.16     0.14     0.13     0.12     0.11     0.10     0.09
  0.08     0.08    0.07     0.07     0.06     0.05     0.05     0.05     0.04     0.04
  0.04     0.03    0.03     0.03     0.03     0.02     0.02     0.02     0.02     0.02
  0.02     0.01    0.01     0.01     0.01     0.01     0.01     0.01     0.01     0.01
  0.01     0.01    0.01     0.00     0.00     0.00     0.00     0.00     0.00     0.00
END 99
  0.00     0.10      99    2.60 LAKE35
  0.00     1.27    3.05     3.49     3.34     3.10     3.99     7.13    11.09    14.99
 18.56    23.84   40.75   115.17   180.01   172.77   133.36    84.87    53.96    34.90
 22.35    15.07   10.45     7.61     6.66     5.04     2.94     1.54     0.81     0.43
  0.24     0.13    0.07     0.04     0.02     0.01     0.00     0.00     0.00     0.00
  0.00     0.00    0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00
  0.00     0.00    0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00
  0.00     0.00    0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00
  0.00     0.00    0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00
  0.00     0.00    0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00
END 99
  0.00     0.10      99    2.60 LAKE36
  0.00     0.69    1.46     1.39     1.20     1.06     1.57     3.13     4.77     6.21
  7.43    10.65   24.10   108.86   163.05   127.37    78.23    31.75    14.54     7.29
  3.66     2.38    1.66     1.47     1.73     1.23     0.48     0.17     0.06     0.02
  0.00     0.00    0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00
  0.00     0.00    0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00
  0.00     0.00    0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00
  0.00     0.00    0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00
  0.00     0.00    0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00
  0.00     0.00    0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00
END 99
  0.00     0.10      99    2.60 LAK289
  0.00     0.00    0.01     0.01     0.01     0.01     0.01     0.02     0.04     0.05
  0.06     0.07    0.42     9.13    18.48    18.49    13.85     7.76     4.05     2.12
  1.11     0.58    0.22     0.08     0.02     0.01     0.01     0.00     0.00     0.00
  0.00     0.00    0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00
  0.00     0.00    0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00
  0.00     0.00    0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00
  0.00     0.00    0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00
  0.00     0.00    0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00
  0.00     0.00    0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00
END 99
  0.00     0.10      99    2.60 LAKE33
  0.00     0.33    0.74     0.77     0.71     0.65     0.89     1.67     2.56     3.40
  4.14     5.77   13.61    62.55   101.06    89.54    62.57    32.87    17.66     9.89
  5.58     3.49    2.23     1.65     1.47     1.09     0.61     0.34     0.20     0.10
  0.05     0.03    0.01     0.01     0.00     0.00     0.00     0.00     0.00     0.00
  0.00     0.00    0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00
  0.00     0.00    0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00
  0.00     0.00    0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00
  0.00     0.00    0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00
  0.00     0.00    0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00
END 99
  0.00     0.10      99    2.60 LAKE07
  0.00     0.25    0.98     1.92     2.62     2.94     3.32     4.56     7.03    10.38
 14.08    18.63   27.27    52.83    91.33   114.48   110.58    90.66    68.47    50.69
 36.90    26.39   18.85    13.76    10.56     8.28     6.03     4.09     2.68     1.72
  1.16     0.76    0.50     0.35     0.24     0.16     0.10     0.07     0.05     0.04
  0.03     0.02    0.02     0.01     0.01     0.01     0.01     0.00     0.00     0.00
  0.00     0.00    0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00
  0.00     0.00    0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00
  0.00     0.00    0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00
  0.00     0.00    0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00
END 99
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MDP100A.QIN
100 YR INPUT
HYDROGRAPH FILE

```
  0.00     0.10      99    2.60 LAKE37
  0.00     1.57     3.77     4.37     4.27     4.01     5.12     9.01    13.96    18.93
 23.54    30.33    50.25   129.20   195.80   189.88   152.20   102.67    69.40    46.93
 30.94    21.23    14.60    10.82     9.28     7.07     4.18     2.29     1.24     0.69
  0.39     0.22     0.12     0.07     0.04     0.02     0.01     0.00     0.00     0.00
  0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00
  0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00
  0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00
  0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00
  0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00
END 99
  0.00     0.10      99    2.60 SEC010
  0.00     0.06     0.17     0.25     0.28     0.29     0.35     0.52     0.80     1.12
  1.46     2.05     3.71     9.49    16.94    20.80    20.60    17.62    14.12    11.03
  8.49     6.53     5.01     3.87     3.04     2.38     1.82     1.37     1.02     0.76
  0.57     0.42     0.30     0.16     0.09     0.04     0.03     0.02     0.01     0.01
  0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00
  0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00
  0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00
  0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00
  0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00
END 99
  0.00     0.10      99    2.60 LAKE38
  0.00     1.00     2.16     2.20     2.03     1.86     2.61     4.93     7.49     9.88
 12.02    16.89    37.29   133.25   201.44   175.77   125.49    70.64    42.24    26.51
 16.69    11.40     8.04     6.14     5.52     4.14     2.48     1.64     1.19     0.96
  0.82     0.72     0.64     0.58     0.53     0.49     0.45     0.42     0.39     0.36
  0.33     0.31     0.29     0.27     0.25     0.23     0.21     0.20     0.18     0.17
  0.16     0.15     0.14     0.13     0.12     0.11     0.10     0.09     0.09     0.08
  0.07     0.07     0.06     0.06     0.06     0.05     0.05     0.04     0.04     0.04
  0.04     0.03     0.03     0.03     0.03     0.02     0.02     0.02     0.02     0.02
  0.02     0.01     0.01     0.01     0.01     0.01     0.01     0.00     0.00     0.00
END 99
  0.00     0.10      99    2.60 DET370
  0.00     0.84     2.02     2.38     2.39     2.32     2.96     5.07     7.78    10.71
 13.54    19.51    39.42   127.90   198.45   190.01   154.11   105.60    74.23    51.70
 35.83    25.63    18.66    13.99    11.32     8.71     6.24     4.56     3.43     2.67
  2.13     1.74     1.44     1.21     1.03     0.89     0.78     0.68     0.60     0.51
  0.45     0.40     0.36     0.33     0.30     0.27     0.24     0.22     0.20     0.18
  0.17     0.15     0.14     0.13     0.12     0.11     0.10     0.09     0.08     0.08
  0.07     0.07     0.06     0.06     0.05     0.05     0.04     0.04     0.04     0.03
  0.03     0.03     0.02     0.02     0.02     0.02     0.02     0.01     0.01     0.00
  0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00
END 99
  0.00     0.10      99    2.60 LAKE39
  0.00     1.53     3.35     3.54     3.38     3.16     4.30     7.86    11.93    15.88
 19.51    28.12    61.13   199.26   299.75   273.11   208.80   130.73    84.91    55.16
 35.32    23.71    16.00    11.43     9.31     6.60     3.77     2.01     1.08     0.56
  0.33     0.19     0.11     0.06     0.04     0.02     0.01     0.00     0.00     0.00
  0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00
  0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00
  0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00
  0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00
  0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00
END 99
  0.00     0.10      99    2.60 LAKE40
  0.00     1.61     3.84     4.43     4.35     4.13     5.31     9.29    14.32    19.39
 24.13    33.86    67.63   201.73   321.48   319.60   258.37   174.62   116.06    77.49
 51.63    35.56    24.74    17.97    14.38    10.64     6.88     4.28     2.40     1.35
  0.71     0.42     0.25     0.15     0.09     0.06     0.03     0.02     0.01     0.00
  0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00
  0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00
  0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00
  0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00
  0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00
END 99
```

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  0.00     0.10      99    2.60 DET500
  0.00     0.36    0.86     1.00    0.99    0.95    1.21    2.11    3.24    4.39
  5.47     7.81   17.12    61.89   95.73   88.49   68.95   44.15   29.35   19.36
 12.56     8.34    5.58     3.84    2.98    2.11    1.18    0.65    0.34    0.20
  0.11     0.06    0.04     0.02    0.01    0.01    0.00    0.00    0.00    0.00
  0.00     0.00    0.00     0.00    0.00    0.00    0.00    0.00    0.00    0.00
  0.00     0.00    0.00     0.00    0.00    0.00    0.00    0.00    0.00    0.00
  0.00     0.00    0.00     0.00    0.00    0.00    0.00    0.00    0.00    0.00
  0.00     0.00    0.00     0.00    0.00    0.00    0.00    0.00    0.00    0.00
  0.00     0.00    0.00     0.00    0.00    0.00    0.00    0.00    0.00    0.00
END 99
  0.00     0.10      99    2.60 LAKE41
  0.00     1.27    3.12     3.71    3.67    3.50    4.43    7.66   11.89   16.20
 20.27    28.67   57.23   172.02  284.73  295.11  244.47  168.16  110.42   72.13
 46.81    31.41   21.57    15.21   12.00    8.83    5.87    3.84    2.65    1.88
  1.33     0.97    0.73     0.57    0.45    0.37    0.30    0.25    0.21    0.17
  0.15     0.12    0.10     0.08    0.06    0.04    0.03    0.02    0.01    0.01
  0.01     0.01    0.01     0.00    0.00    0.00    0.00    0.00    0.00    0.00
  0.00     0.00    0.00     0.00    0.00    0.00    0.00    0.00    0.00    0.00
  0.00     0.00    0.00     0.00    0.00    0.00    0.00    0.00    0.00    0.00
  0.00     0.00    0.00     0.00    0.00    0.00    0.00    0.00    0.00    0.00
END 99
  0.00     0.10      99    2.60 LAKE42
  0.00     1.55    3.42     3.58    3.35    3.11    4.27    7.89   12.02   15.96
 19.53    27.35   54.48   160.11  242.26  227.07  176.40  113.47   74.14   48.77
 32.02    22.36   15.81    11.83   10.04    7.38    4.58    2.92    1.94    1.29
  0.83     0.56    0.38     0.28    0.20    0.15    0.10    0.05    0.02    0.01
  0.01     0.00    0.00     0.00    0.00    0.00    0.00    0.00    0.00    0.00
  0.00     0.00    0.00     0.00    0.00    0.00    0.00    0.00    0.00    0.00
  0.00     0.00    0.00     0.00    0.00    0.00    0.00    0.00    0.00    0.00
  0.00     0.00    0.00     0.00    0.00    0.00    0.00    0.00    0.00    0.00
  0.00     0.00    0.00     0.00    0.00    0.00    0.00    0.00    0.00    0.00
END 99
  0.00     0.10      99    2.60 LAKE43
  0.00     0.30    0.78     0.95    0.95    0.89    1.09    1.87    2.94    4.04
  5.06     6.55   11.53    31.38   51.78   54.57   45.44   31.24   20.06   12.64
  7.81     4.96    3.20     2.03    1.65    1.24    0.76    0.42    0.22    0.12
  0.06     0.03    0.02     0.01    0.00    0.00    0.00    0.00    0.00    0.00
  0.00     0.00    0.00     0.00    0.00    0.00    0.00    0.00    0.00    0.00
  0.00     0.00    0.00     0.00    0.00    0.00    0.00    0.00    0.00    0.00
  0.00     0.00    0.00     0.00    0.00    0.00    0.00    0.00    0.00    0.00
  0.00     0.00    0.00     0.00    0.00    0.00    0.00    0.00    0.00    0.00
  0.00     0.00    0.00     0.00    0.00    0.00    0.00    0.00    0.00    0.00
END 99
```

APPENDIX D

HEC-1 INPUT FILES

(Paper files are available upon request. Disk with files is provided)

B&D ENGINEERING, INC.
CIVIL ENGINEERING • LAND DEVELOPMENT
9666 E. Riggs Road, Suite 502, Sun Lakes, AZ 85248-7404 • (602) 895-0799 • FAX (602) 895-5557

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PLAN
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MGT
FILE
MRT

August 16, 1996

Magnus Jolayemi
Maricopa County Flood Control District
2801 West Durango Street
Phoenix, Arizona 85008

Re: Sun Lakes Sections 29 and 30 Master Drainage Plan - response to review comments per meeting held Thursday July 11, 1996.

Dear Magnus:

Enclosed please find two (2) copies of the revised drainage report titled "Sun Lakes Sections 29 And 30 Master Drainage Plan" based on review comments by the Flood Control District of Maricopa County discussed on Thursday July 11, 1996. The comments were in reference to the report dated May, 1996. The following is a written response to each comment:

1. *On page 7 the log area weighting method was applied to all soil loss parameters. FCD requires log area weighted average for Xksat value. The Dtheta and PSIF should be taken from graphs or tables.*

   A log area weighted average value was determined for the Xksat value. The value for Dtheta and PSIF was determined from Figure 4.3 on page 4-11 of the Drainage Design Manual for Maricopa County, Arizona (Volume I, Hydrology). A copy of this figure is included in Appendix B of this revised drainage report. The section entitled **Land Use Soil Loss Parameters** (page 8) describes, in greater detail, the determination of these soil loss parameters.

2. *OnTable 1 the RTIMP for Golf Course is set equal to 1. The presence of golf course facilities would bring the RTIMP to about 5%.*

Table 4.2a in the Drainage Design Manual for Maricopa County, Arizona (Volume 1, Hydrology) lists typical RTIMP values for different land use categories. An RTIMP value of 5% is more indicative for very low density residential areas. The golf course has very little if any impervious areas and is more representative of agricultural areas with a 0% impervious value. To account for a minute degree of imperviousness within the golf course, an RTIMP factor of 1% has been used and is justified.

3. *A Section on Hydraulic Modeling should be included in the report to be able to justify use of the model in the project area using the lake system. A summary table showing important results may be included. Per phone discussions with Robert Hedrick of B&R Engineering the model has been used in the Midwest since 1991 and has been successful in analyzing hydraulic network systems. He said the inflow generated by HEC-1 is reformatted for the RAMSS model to account for time of peak occurence.*

   A separate section entitled "Hydraulic Modeling" has been added to this revised report. This section describes, in greater detail, the use of the RAMSS' Hydraulic Model for the lake routing system within the project area. Table 3A of this report is a summary table detailing essential results produced by the model. Figure 5 of this report contains a table detailing the pipe parameters that make up the lake interconnect system. In addition, Appendix D of this report contains summary output detailing all essential input and output information describing the model for the 10 and 100 year, 2 hour event storms.

4. *Subbasin 34-8 and Sub 34-7 have very small drainage areas but have extremely high Tc and Stor. K values of 1.756 and 1.646, respectively. These may have to be re-checked by the consultant.*

   These sub-areas have high values because they are indicative of runoff generated by long right-of-way areas as shown on Figure 3 of this report. The long flow path relative to the small, narrow drainage areas gives a high value for time-of-concentration and storage coefficient, R. As per our discussion on July 11, 1996, it was recommended that these street areas not be treated as drainage areas, but as channel reaches for other subbasins flowing into them. Therefore, our approach is conservative in that the HEC-1 model reaches all subbasins through these areas while still treating these areas as separate subbasins generating runoff. As a result, we have decided to keep these drainage areas in the model.

5. *The unit peak Q of Sub 187, Sub 300 and Sub 420 are than 88% of the whole area mean of 928 cfs/sq. mi.. These sub-basins should be reviewed for the basic data used.*

These areas generate flows that are higher than the mean due to the runoff characteristics of these sub-basins. Such characteristics are steeper than normal slopes and high density areas (commercial and multi-family) that have a high impervious factor compared to the normal. Such characteristics produce a low time-of-concentration for relatively large drainage areas.

6. *In Figure 1 there is an inflow to Lake 34, however in the RAMSS model it indicates no inflow connected.*

   I believe reference to Figure 1 is incorrect. The reference should be made to Figure 2a on page 6 or Figure 5 in the back of the report. There is inflow into Lake 34. The inflow hydrograph of all flows into Lake 34 is created by the HEC-1 files (MDP10A.1 and MDP100A.1). These hydrographs are then formatted for the RAMSS' Hydraulic Model and Lake 34 reads each hydrograph as inflow. These hydrographs are labeled as LAKE34 in each of the .QIN files (MDP10A.QIN and MDP100A.QIN) The statement in the RAMSS' model indicating that no inflows are connected means that there are no upstream lakes connected to Lake 34 that are discharging to Lake 34. As indicated by Figure 2a and Figure 2b upstream Lake 50 is valved off such that pipeflow is not transmitted to Lake 34. Therefore, Lake 50 is not modeled in the RAMSS' files. Overflow (if any) from this lake is routed using the HEC-1 files and summated as part of the total flows into Lake 34.

7. *The peak WSL in Lakes 34,35,37,38,41, and 43 have been compared using the 10yr and 99yr events run of the RAMSS' model. There is about 2.0 ft difference between the 10yr and 99yr events in Lake 43 which is the most downstream lake. The results seem reasonable for the conditions imposed in the model.*

   The statement is noted and concurrence is established with respect to the 10 year and 99 year event storms and the water surface elevations generated by each lake as calculated in the RAMSS' Hydraulic Model.

If there are any additional comments or concerns, please feel free to call me or Tom Hickey at 895-0799. If report has been approved, please call or write to verify approval.

Sincerely,

Robert Hedrick
Associate Engineer

cc: Jason Burgess
Tom Hickey
File/Chrono

DATA\SL\MDP\fcdrev1.wps RJH

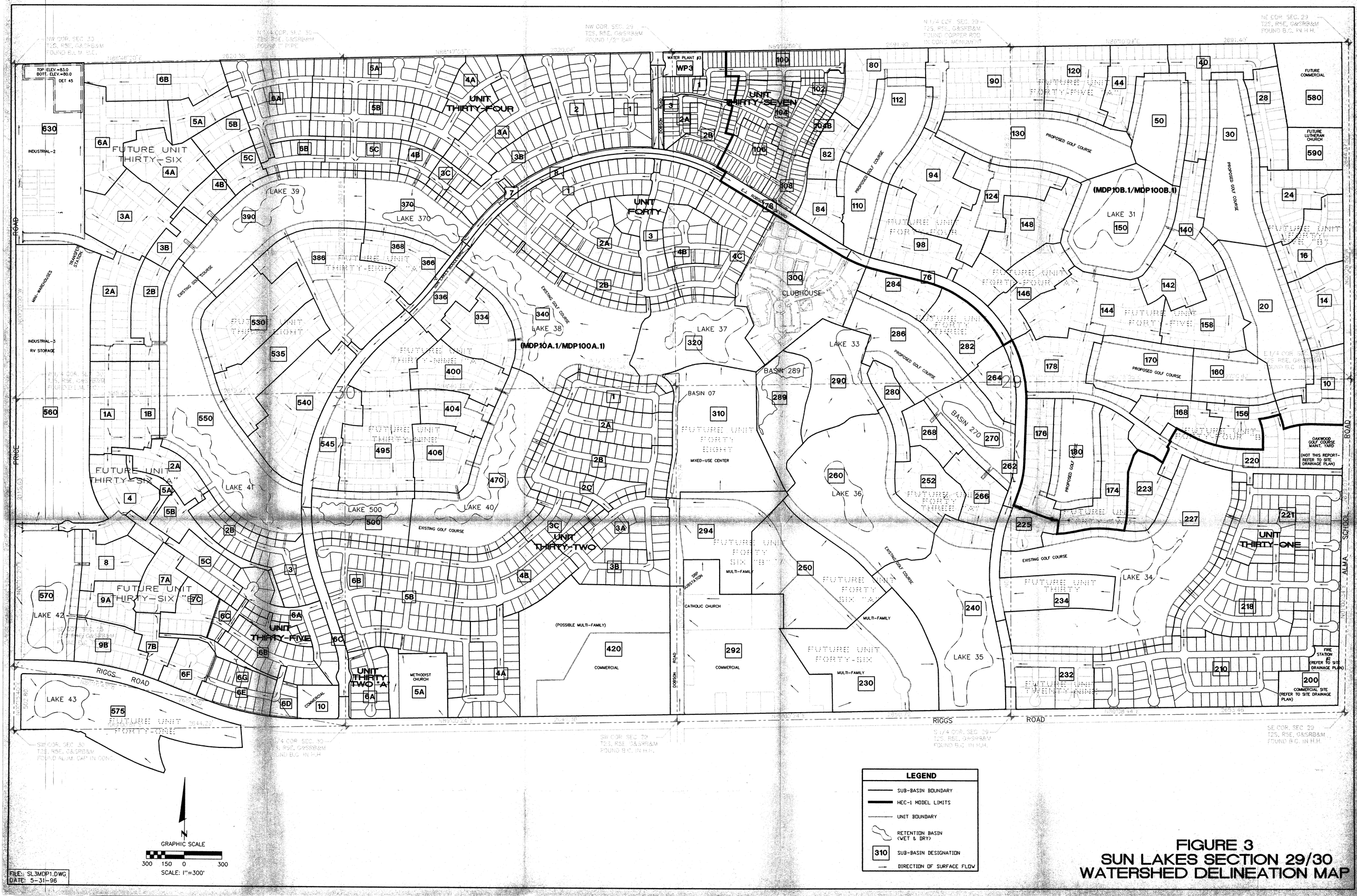
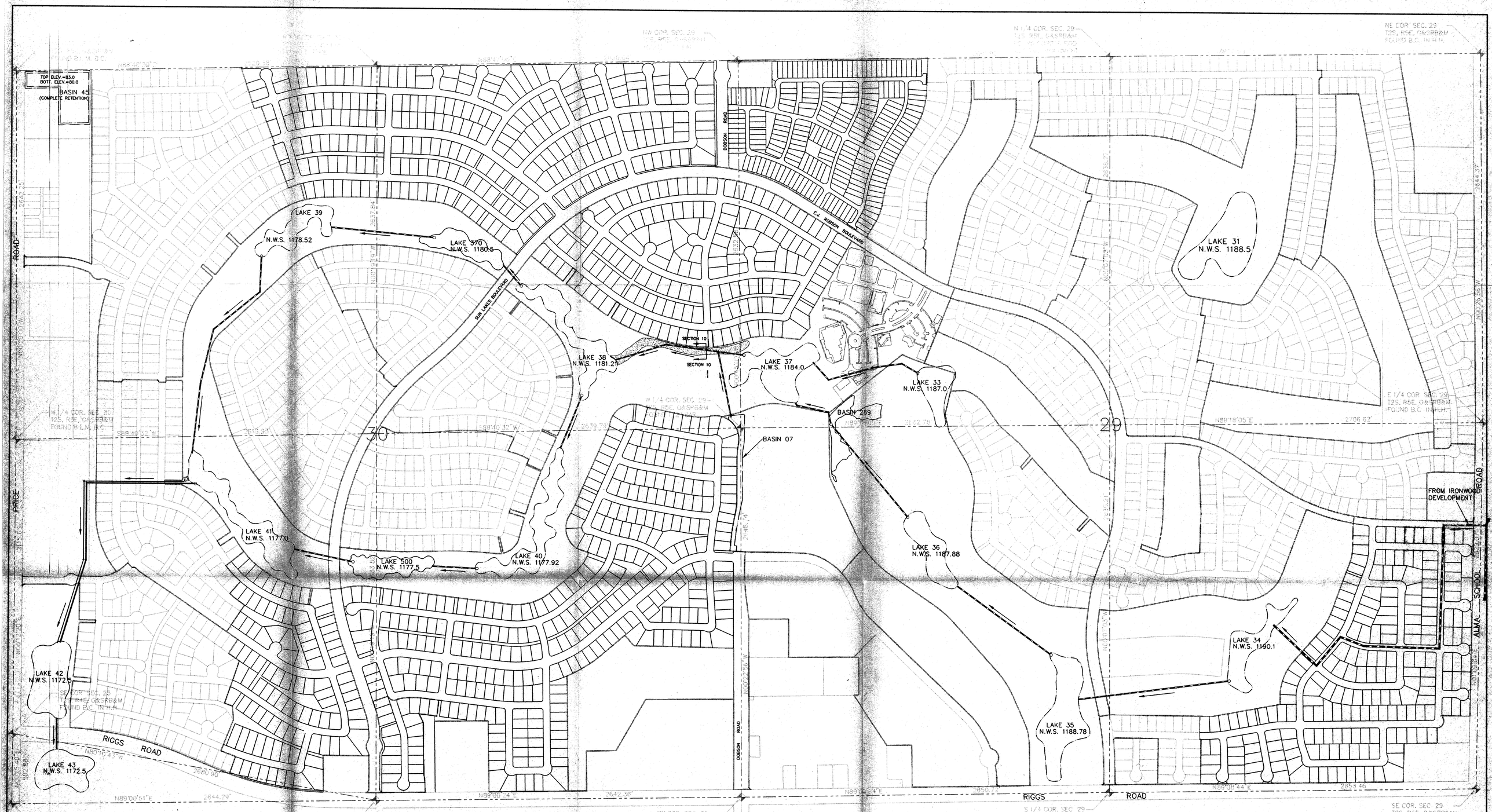


FIGURE 3
SUN LAKES SECTION 29/30
WATERSHED DELINEATION MAP



LAKE NUMBER	PIPE DIAM. (in.)	RISER DIAM.* (in.)	PIPE LENGTH (ft)	SLOPE (′/ft)	DOWNSTRM LAKE
7	15	none	500	0.0050	38
31	No pipe outlet for this lake				
33	21	catch basin	500	0.0033	37
34	21	10	1100	0.0018	35
35	24	18	840	0.0012	36
36	18	16	900	0.0017	37
37	18	24	848	0.0025	38
38	18	24	300	0.0040	370
39	18	24	400	0.0062	40
39	18	24	1987	0.0010	41
40	18	24	300	0.0025	500
41	42	24	1300	0.0050	42
42	30	none	300	0.0030	43
43	No pipe outlet for this lake				
45	No pipe outlet for this lake				
289	18	18	440	0.0015	37
370	18	24	670	0.0022	37
500	36	24	140	0.0023	41

* TOP OF RISER IS AT WATER SURFACE ELEVATION OF LAKE

LEGEND

- EXISTING STORM DRAIN SYSTEM
- PROPOSED STORM DRAIN SYSTEM
- RISER PIPE
- CATCH BASIN (LAKE 33)
- PROPOSED PUMP FACILITY AND OUTFLOW PIPE
- OVERFLOW CHANNEL
- RETENTION BASIN (LAKE-WET & BASIN-DRY)

FIGURE 5
EXISTING AND PROPOSED LAKE CIRCULATION SYSTEM RAMSS' HYDRAULIC MODEL

FILE: LAKECIRC.DWG
DATE: 5-15-96