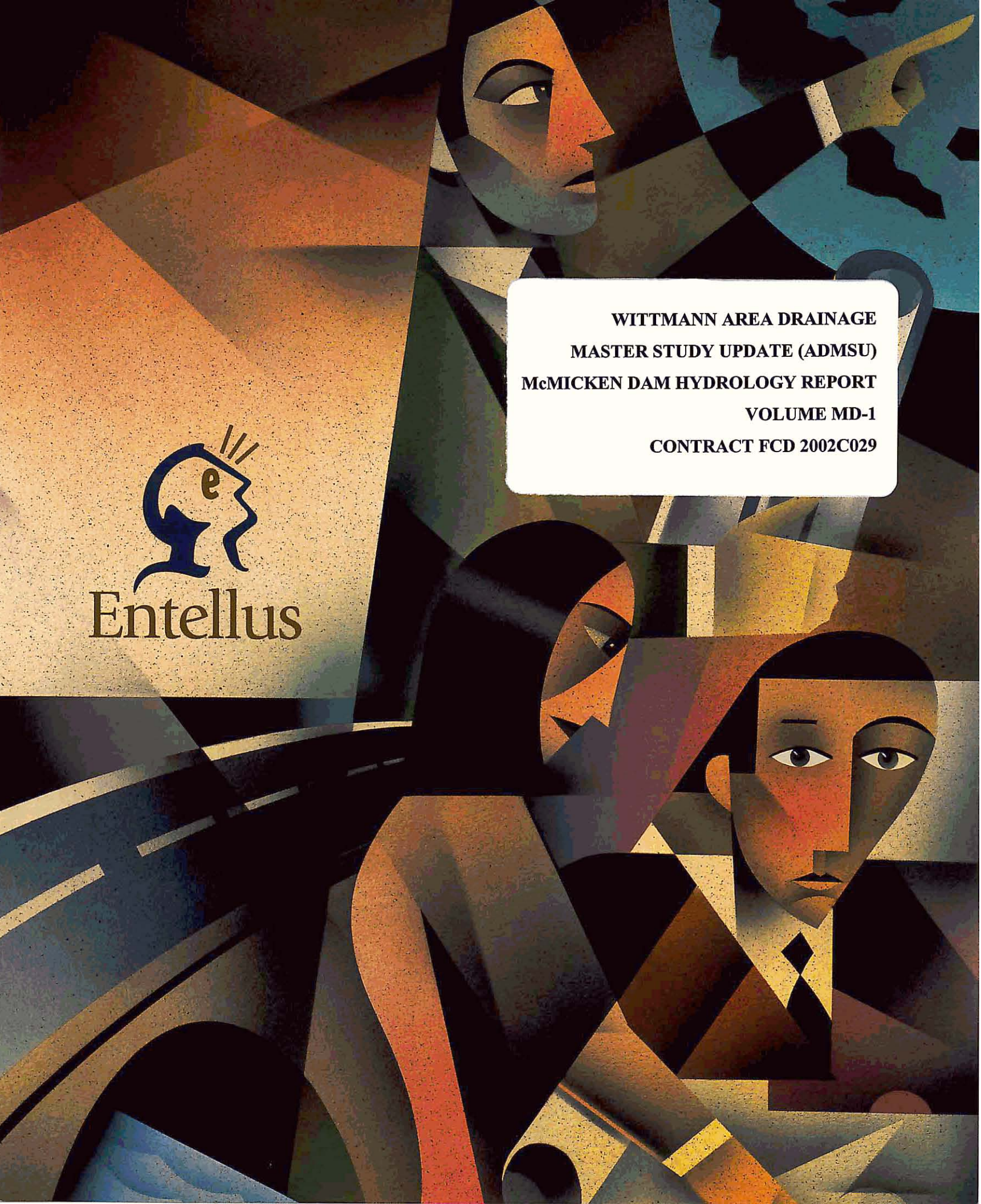

WITTMANN AREA DRAINAGE MASTER STUDY UPDATE (ADMSU)

McMICKEN DAM HYDROLOGY REPORT

VOLUME MD-1

CONTRACT FCD 2002C029

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WITTMANN AREA DRAINAGE MASTER STUDY UPDATE

McMICKEN DAM HYDROLOGY REPORT

VOLUME MD

Contract FCD 2002C029

December 12, 2003

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Includes July 2008 Addendum, Appendix B.1.2 and Appendix H

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WITTMANN AREA DRAINAGE MASTER STUDY UPDATE (ADMSU)

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VOLUME NAME	VOLUME ID
EXISTING CONDITIONS ANALYSIS (PART 1)	EC
ADMSU HYDROLOGY	HY
MCMICKEN DAM HYDROLOGY	MD
FLOODPLAIN DELINEATION	HD
ALTERNATIVES IDENTIFICATION	AI
ALTERNATIVE ANALYSIS MCMICKEN DAM	MA
RULES OF DEVELOPMENT	RD
REPORT OF SURVEY	SR
GEOMORPHOLOGY REPORT	GR
SUBSIDENCE REPORT	SU
ADMINISTRATIVE REPORT	AR

Note: Volume ID will be used for Section, Plate, Figure, and Table Identifiers.

WITTMANN AREA DRAINAGE MASTER STUDY UPDATE
FCD 2002C029

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WITTMANN AREA DRAINAGE MASTER STUDY UPDATE
FCD 2002C029
McMICKEN DAM HYDROLOGY REPORT
(VOLUME MD)

SECTION MD-1: INTRODUCTION

The information presented in this hydrology report are part of the scope of work performed by Entellus, Inc. for the Flood Control District of Maricopa County (District) under Contract FCD No. 2002C029. The purpose of this report is to present the results of the Hydrology Analysis specific to McMicken Dam. In addition, it documents the methodology, assumptions, problems and solutions encountered during the development of the hydrology models.

The hydrology presented in this report was specifically developed to analyze the effect of "significant" (100-year and larger) floods on McMicken Dam and its Outlet Channel.

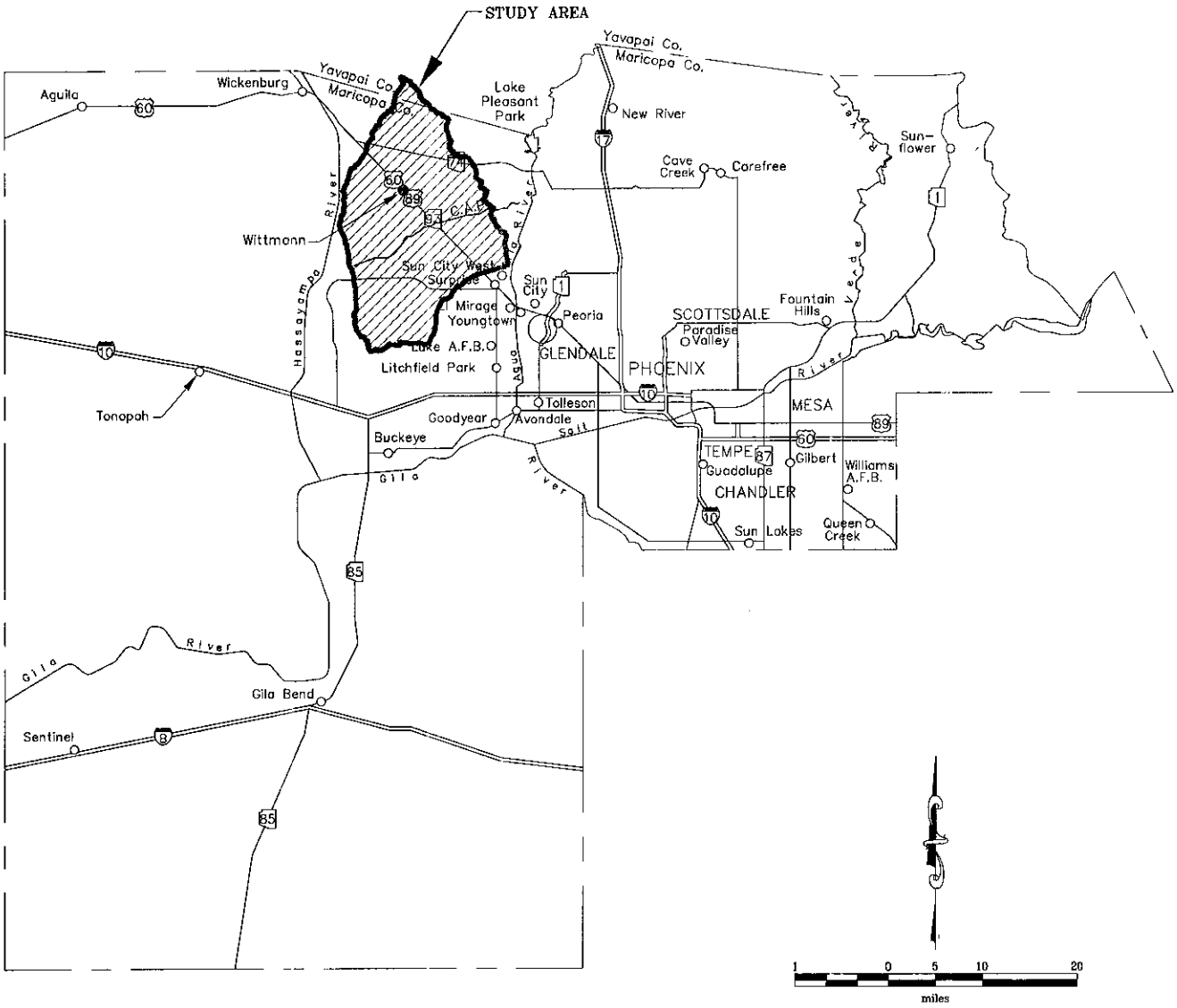
The watershed contains several major natural watercourses: Wittmann Wash, Trilby Wash, Iona Wash, Padelford Wash, and Picacho Wash. Additionally, several man-made features traverse the watershed and cross the natural channels including the Central Arizona Project (CAP) Canal, Sun Valley Parkway, US Highway 60 (US 60), State Route 74 (SR 74), and the Burlington Northern Santa Fe (BNSF) Railroad. Other significant structures include the McMicken Dam and Outlet Channel, Bonita Dam, and the Beardsley Canal.

The study area is bounded by the Hieroglyphic Mountains yto the north and northeast; the White Tank Mountains, McMicken Dam and its Outlet Channel to the south; the Agua Fria River to the east; and the Hassayampa River basin to the west. The total watershed area is approximately 300 square miles. The study area consists of mostly undeveloped land. However, several small communities exist, and several developments are either under construction or in the planning stage. The unincorporated areas of Wittmann, Morristown, and Circle City are located along US 60, in the center of the watershed area. The Cities of Surprise, Peoria, and Town of Buckeye have also annexed portions of the watershed, however most of the area remains undeveloped or low density scattered rural residential. **Figure MD-1.1** shows the study area.

Based on the topographic mapping information and watershed characteristics, the watershed was divided into seven major sub-areas as shown in **Figure MD-1.2**.

The hydrology models presented in this report do not include attenuation due to McMicken Dam storage. All the peak discharges are inflow hydrographs to McMicken Dam, or its Outlet Channel. The flow routing through McMicken Dam and the Outlet Channel is strictly channel routing. Routing through storage behind the dam is not part of this report and is being addressed in another phase of the project.

This report is separate from the hydrology report for the Wittmann Area Drainage Master Study Update because the events modeled and the model itself is different than the hydrology model that will be used for the Master Study Update. The purpose and intended use of the hydrologic models for McMicken Dam are different than the objectives for the Master Study Update. The hydrology model for McMicken Dam Analysis is only focused on flows entering the dam at key inflow points, therefore, the upstream watersheds were not broken down into the amount of detail needed to address localized flooding issues required in Drainage Master Planning. The storm and flooding events modeled in this report were also only the larger, more significant events of interest for dam safety analysis purposes. This report provides the hydrologic data required for the dam safety analysis and documents the various criteria and modeling assumptions used to develop the hydrology models. A separate hydrology report will document the criteria and results for the more detailed hydrologic model developed for the Master Study Update.



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VICINTY MAP
FIGURE MD-1.1

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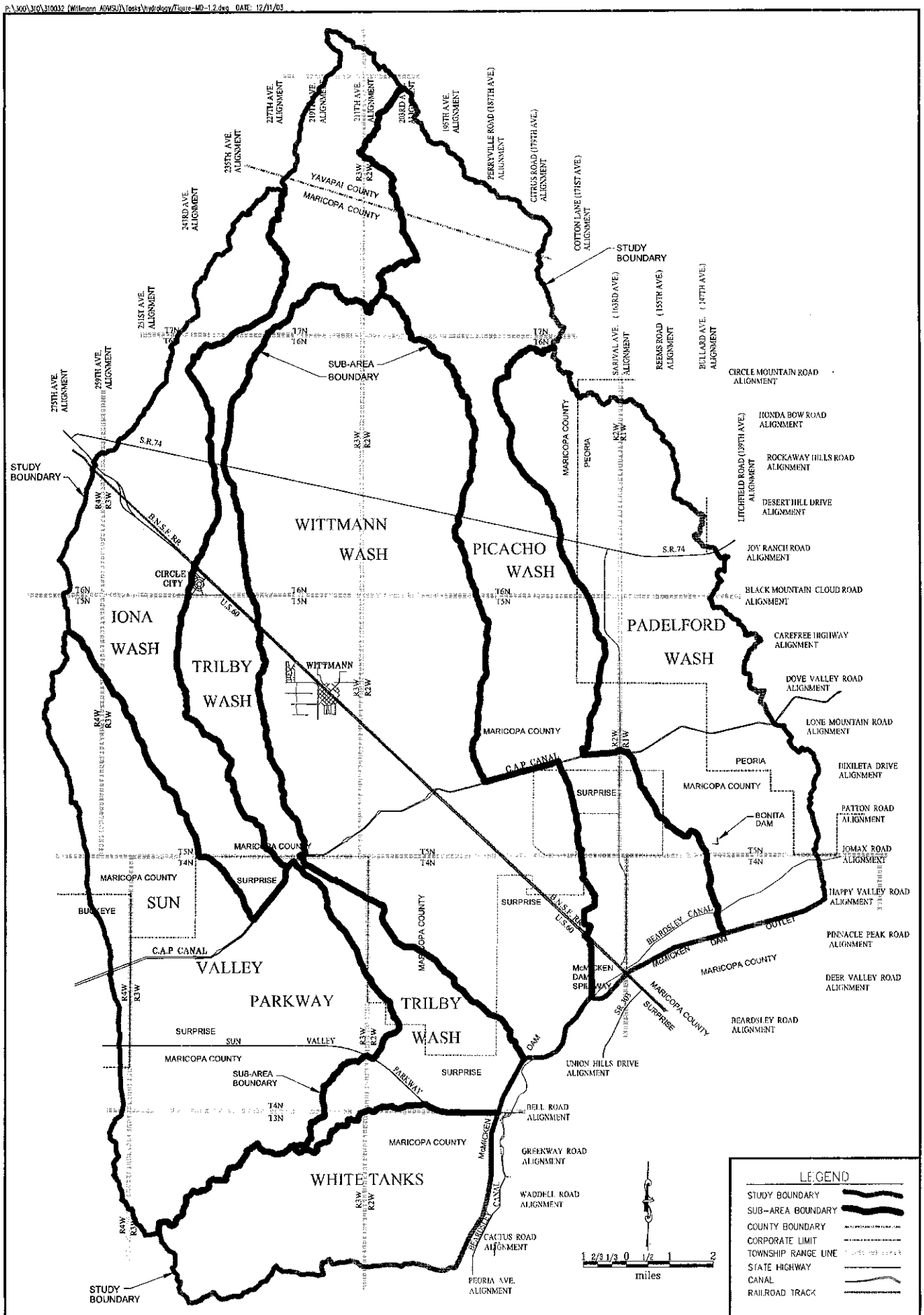

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SUB-AREA BOUNDARIES
FIGURE MD-1.2

SECTION MD-2: ADWR/FEMA FORMS (NOT INCLUDED)

This section does not apply to this report.

SECTION MD-3: MAPPING AND SURVEY INFORMATION

3.1 Mapping

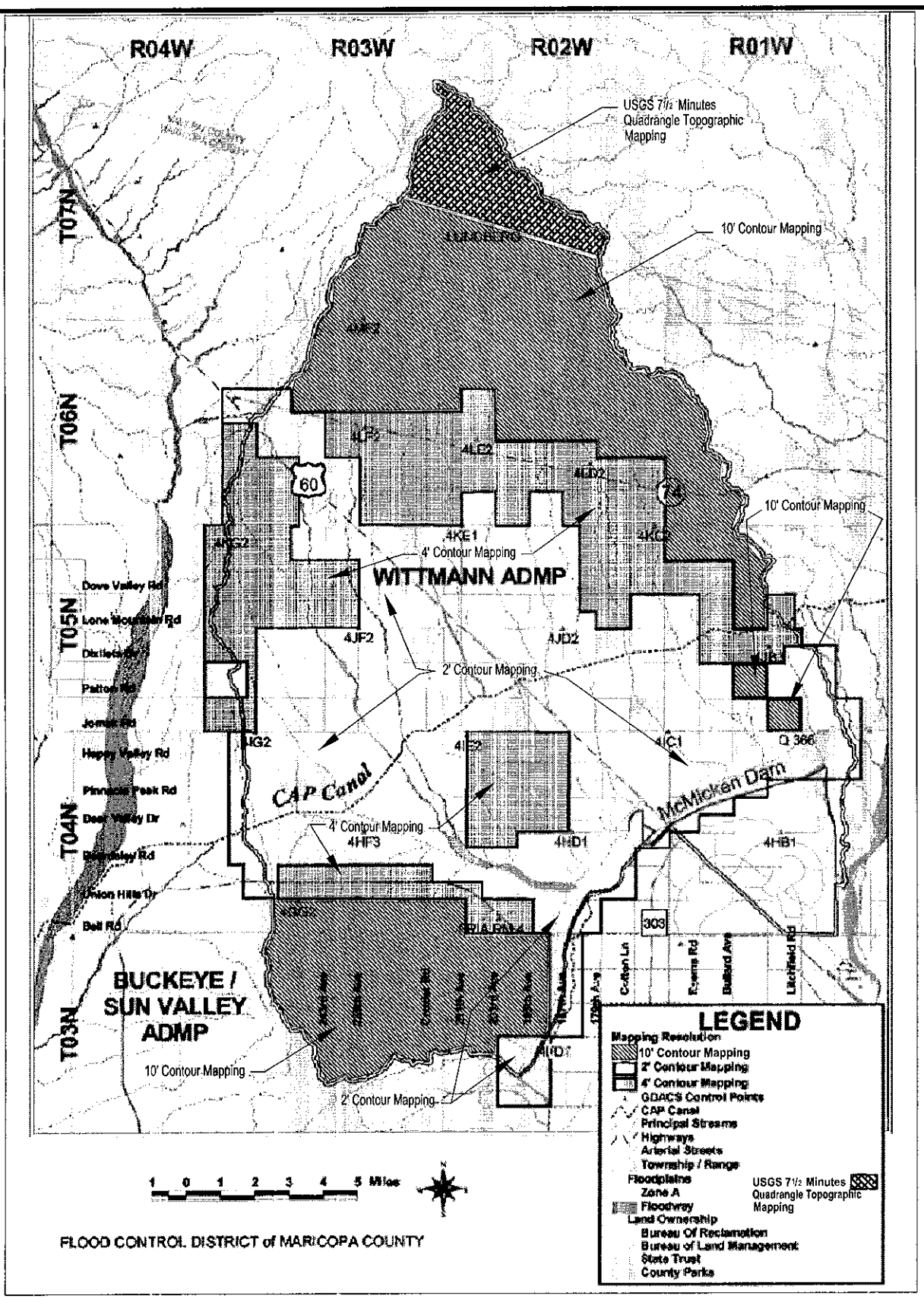
The base map used for this study was furnished by the District based on four different sources, including: USGS 7.5 minute quadrangle topographic mapping (**Ref 1**); 400-scale, 10-foot contour mapping (**Ref 2**); 200 scale, 4-foot contour mapping (**Ref 3**); and 100 scale, 2-foot contour mapping (**Ref 4**). **Figure MD-3.1** shows the location of each mapping level. Except for the USGS mapping, the mapping was prepared by Stewart Geo Technologies (Landata, Inc.) for the District. The District provided Entellus with a composite ASCII grid file developed from all four mapping levels.

3.1.1 Watershed Map

Watershed boundaries and hydrologic parameters were determined primarily from the topographic base map furnished by the District. Aerial photography and field observations were also used to determine basin boundaries. **Plate MD-6** contains a plot of the general topography of the area based on the topographic mapping provided by the District (**Refs 1-4**). For the areas where 2-foot and 4-foot contour mapping was available, only the index contours were plotted.

3.1.2 Soils Map

Electronic soil maps were furnished by the District for the portion of the watershed within Maricopa County. This mapping is a digital version of the Natural Resources Conservation Service (NRCS) *Soil Survey of Maricopa County, Arizona-Central Part* (**Ref 5**) and *Soil Survey of Aguila-Carefree Area* (**Ref 6**). For the area outside of Maricopa County, the soil information was digitized from the *Soil Survey of Yavapai County, Arizona, Western Part* (**Ref 7**). The combined soils mapping data is presented on **Plate MD-5**.



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MAPPING COVERAGES

FIGURE MD-3.1

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3.1.3 Land Use Map (Existing Conditions)

Existing land use information was created from the 2002 aerial photos provided by the District (**Ref 8**) and County assessor maps (**Ref 9**). The existing land use type boundaries are presented in **Plate MD-3.**

3.1.4 Land Use Map (Ultimate Development)

The ultimate land use protections were provided by the District and corresponds to the Maricopa Association of Governments (MAG) general plan. Entellus cross-referenced MAG's general plan with those of the Cities of Surprise and Peoria. Each plan has different nomenclature for land use types. For the most part, the plans are in close agreement. However, there are some small areas with differences in development density in the City of Surprise. Since the areas were small and the land use is similar for both plans, Entellus opted to use the more conservative (higher density) MAG general plan for the McMicken Dam analysis. Comparisons between the two plans are included in **Appendix B.2.2**. The differences in the City of Peoria were considered insignificant. There were three land uses that had ranges of dwelling units per acres that overlapped with MAG's ranges. The ultimate land use is presented in **Plate MD-4**.

A small portion of the western edge of the Sun Valley sub-area falls within the Town of Buckeye. The land use category in this small portion is Rural Residential with undefined density in terms of dwelling units per acre; therefore, MAG's designation was used.

3.2 Survey Information

Entellus did not perform field survey for the McMicken Dam hydrology. Survey reports of the relevant drainage structures (culverts, overchutes) were provided by the District. The survey data were obtained from the following reports:

Wittmann ADMP SR 74 Structure Surveys (**Ref 10**)

Wittmann ADMP US 60-Railroad Structure Surveys (**Ref 11**)

Wittmann ADMP Sun Valley Parkway Structure Surveys (**Ref 12**)

Wittmann ADMP CAP Canal Structure Surveys (**Ref 13**)

SECTION MD-4: HYDROLOGY

4.1 Method Description

Peak flows in this study area were estimated through precipitation/runoff modeling. The hydrologic modeling was performed using the 2003 version of the Watershed Modeling System (WMS) 7.0 software, developed by Brigham Young University (**Ref 14**). The models were developed using the Green and Ampt methodology to estimate the rainfall losses. Excess rainfall was then routed to the concentration points using the S-Graph methodology. The procedures and model parameters were based on the *Drainage Design Manual for Maricopa County – Volume 1 – Hydrology Revised 1995* (hereinafter referred to as the *Hydrology Manual*) (**Ref 15**). The following hydrologic models were prepared:

- 100-yr, 24-hr Existing
- 100-yr, 24-hr Future
- 200-yr, 24-hr Existing
- 200-yr, 24-hr Future
- 500-yr, 24-hr Existing
- 500-yr, 24-hr Future
- 6-hr Probable Maximum Flood (PMF) Future
- 72-hr Probable Maximum Flood (PMF) Future

The southern end of the McMicken Dam was removed from this study because the District is planning on constructing a dike to isolate this portion of the dam. This area is currently being studied in the *McMicken Dam Fissure Risk Zone Remediation Project* (**Ref 16**).

The flow routing schematic for runoff modeling is presented on **Plate MD-1**. The 24-hour storm duration was used as the base model for this study. For this size of watershed, the twenty-four hour duration storm produces higher peaks and volumes at the McMicken Dam spillway than lesser duration storms.

4.2 Parameter Estimation

4.2.1 Drainage Area Boundary

The total area contributing to McMicken Dam varies from approximately 230 to 245 square miles, depending on the magnitude of the storm event. This variation is due to the effect of the CAP at different flooding levels which is explained in more detail under Section 4.2.5.5 Storage Routing. The total watershed area upstream of the dam and the Outlet Channel just before it discharges into the Agua Fria River is approximately 312 square miles. Based on the topographic mapping information and watershed characteristics, the watershed was divided into seven major sub-areas as shown in **Figure MD-1.2**. These major sub-areas were delineated to provide inflow hydrographs to McMicken Dam at strategic points. The points facilitate the use of dynamic routing to model the water surface through the dam and Outlet Channel. The seven major sub-areas were abbreviated in the hydrology models as follows:

- White Tank Mountains Sub-Area (WT)
- Picacho Wash Sub-Area (PI)
- Padelford Wash Sub-Area (PD)
- Trilby Wash Sub-Area (TW)
- Iona Wash Sub-Area (IW)
- Wittmann Wash Sub-Area (WI)
- Sun Valley Parkway Sub-Area (SV)

Each of the major basins was subdivided further at strategic places where watershed characteristics or man-made facilities affected runoff characteristics.

The US 60 and SR 74 roadways; the Sun Valley Parkway, and the BNSF Railway affect the movement of runoff through the watershed. However, the effect of these structures is local and they have little effect on the flows reaching the McMicken Dam. Therefore, these features were ignored in the development of the hydrology model for McMicken Dam.

The most prominent man-made facility upstream of McMicken Dam is the CAP Canal. The CAP Canal in most locations has a high embankment on its north side that protects the canal from runoff. This embankment provides a large impoundment area upstream with the potential of storing a significant volume of flow. This structure was modeled as part of this analysis because it may have a significant effect on the flows reaching McMicken Dam and its Outlet Channel. Basin boundaries were placed along the canal alignment in order to allow storage modeling.

There are two other structures of some significance, Lake Bonita Dam and the Beardsley Canal. Neither structure affects McMicken Dam because both are upstream of, and impact the McMicken Outlet Channel. Lake Bonita Dam has been designated an unsafe dam by ADWR. It is generally felt that it could not withstand a significant runoff event without failing. Because ADWR is currently working on a plan to permanently breach the dam, and the work may be completed within the next year, Entellus was directed by the District to not include it in the modeling. The Beardsley Canal cross drainage and storm protection is not designed to handle significant runoff (25-year or larger), and most likely will be overtopped early during a severe runoff event (100-year or larger). Neither Lake Bonita Dam nor Beardsley Canal were modeled, and basin boundaries do not reflect the location of these structures.

There were other minor structures such as small diversion ditches or dikes at several locations throughout the watershed. Most of these structures were not adequately

engineered or were intended for minor storm events (10-year or less). When subjected to runoff from larger events, these structures have very little effect on the flows reaching the McMicken Dam or its Outlet Channel. Therefore, these small ditches and dikes were not modeled, and basin boundaries do not reflect their locations.

4.2.2 Gage Data

There are five stage gages in the study area. The first gage is located at the McMicken Dam Principal Spillway, near the US 60 and 163rd Avenue intersection. This gage has data from the last twenty years. The second gage location is on the right bank of the McMicken Outlet Channel, just downstream of the first gage. This gage has data from the last ten years. The third gage is located in the Ford Canyon Wash, in the White Tank Mountains Regional Park, one-quarter mile north of Ford Canyon Road. This gage has records for the last two years. The fourth gage is located on the east slope of the White Tank Mountains, and this gage has data for the previous fifteen years. The last gage location is in the Upper Trilby Wash, two miles upstream of Castle Hot Springs Road. This gage has records from the last three years. These gages were not used specifically in this project, but some of the gage data are incorporated in *Flood Frequency Analysis of Stream Flow Stations* (**Ref 17**). District hydrologists Steve Waters and Joe Rumann were contacted to explore the recommendation that Entellus model the 1993 floods in an effort to calibrate the HEC-1 model. Mr. Rumann thought it would probably be worthwhile as a check, if adequate data were available. Mr. Waters responded that there was not much inflow to the dam from the 1993 storms as compared to the 1991 storms. However, in both years, the amount of rainfall data available in the watershed area was very limited. Because of the uncertainty that would exist about the distribution of rainfall within the watershed that created these runoff events, any attempt at using them for calibration purposes would be inconclusive and not worth the effort.

Most of the precipitation gages do not have a long enough period of record to be useful for calibration. Because this model is also intended to only provide inflow hydrographs to the dam spillway and Outlet Channel, it does not account for storage provided by the dam. The two gages at the McMicken Dam spillway and the Outlet Channel cannot be used for calibration because they include the effect of storage attenuation.

Data and gage information for the McMicken Dam Outlet Gage ID 5448 obtained from the District's website is included in **Appendix B.8.**

There are thirteen precipitation gages scattered throughout the study area. However, the precipitation gage data cannot be used in this study due to the insufficient periods of record.

4.2.3 Statistical Parameters

Precipitation/runoff models were used for developing the hydrology for this area. New statistical data was not developed as part of this study. However, results of the runoff models were compared with gage data collected by the District for the entire County, which is located in *Flood Frequency Analysis of Stream Flow Stations* (**Ref 17**). The results appear to be within the range of expectation for this type of terrain. The comparison is presented in **Section MD-4.6**.

4.2.4 Precipitation

4.2.4.1 100-year, 200-year, and 500-year, 24-hour Rainfall Estimation

Precipitation data for the 100-year, 200-year, and 500-year, 24-hour events was obtained from the *NOAA Atlas 2, Volume VIII Arizona* (**Ref 18**), and selected isopluvial maps for Maricopa County, which are located in *The Hydrology Manual* (**Ref 15**). This information was used in the Precipitation Frequency (PreFre) module of the *DDMS* program (**Ref 19**).

Copies of the isopluvial maps, as well as the PreFre output are included in **Appendix B.1.1**.

PreFre does not directly compute precipitation depths for the 200-year storm. This value was obtained by plotting rainfall amounts for the known storm frequencies on a logarithmic scale and using a graph to interpolate the 200-year value. (**Appendix B.1.1**)

Areal reduction was accounted for using the curves provided in *The Hydrology Manual*. These curves were developed for a 100-year frequency and may not accurately reflect areal distribution patterns of the 200 and 500-year frequencies. However, using the 100-year areal reduction for the larger storms should be conservative because it is assumed that the areal reduction would be less for these larger event storms.

4.2.4.2 100-year, 10-day Rainfall Estimation

The 100-year, 10-day Principal Spillway Hydrograph (PSH) was developed based on the procedures outlined in the *NRCS's, National Engineering Handbook* (**Ref 20**). The details of the calculation along with the relevant copies of the references are included in **Appendix G**.

The total rainfall amount for the 100-year, 10-day rainfall, per NRCS guidelines, was obtained from the U.S. Weather Bureau's *Technical Paper No. 49* (**Ref 21**).

The PSH is tabulated in **Table MD-G.1**, and a graphical representation of the same information is shown in **Figure MD-G.1** both located in (**Appendix G**).

4.2.4.3 Probable Maximum Flood

The 72-hr PMF data was provided by the District and was based on the following previous reports: *Hydrologic Analysis of the McMicken Dam Watershed* (**Ref 22**), and the *Hydrologic Analysis of McMicken Dam* (**Ref 23**). For the 6-hour PMF, the rainfall data was developed using the average depth procedures as described in *HMR No. 49* (**Ref 36**). Copies of relevant pages from these reports and copies of the worksheet used are included in **Appendix B.1.2**.

Areal reduction is already included in the procedures used to develop the precipitation depths and distributions for the area contributing to the dam (approximately 240 square miles). Since the entire areal reduction is applied to each sub-basin, flows obtained from this model upstream of the dam would significantly underestimate potential runoff at that location, and should not be used.

4.2.5 Physical Parameters

4.2.5.1 Basin Parameters

Soils: Soil data within Maricopa County were provided in digital format by the District. The soils map is a digital version of the *Soil Survey of Aguila-Carefree Area* (**Ref 6**) and the *Soil Survey of Maricopa County, Arizona-Central Part* (**Ref 5**). Soil data within Yavapai County were obtained from the *Soil Survey of Yavapai County, Arizona, Western Part* (**Ref 7**).

The XKSAT values for the portion of the watershed within Maricopa County were provided by the District in the form of a GIS table. The table was modified to include XKSAT for the soils in Yavapai County. The XKSAT values for soils in Yavapai County were estimated based on the procedure outlined in *The Hydrology Manual* (**Ref 15**). Determination of

XKSAT values for soils in Yavapai County is documented in **Appendix B.2.1**.

Green and Ampt parameters were generated using WMS. Green and Ampt parameters were automatically estimated by WMS using the soil and land use data. In order to verify that WMS was calculating these parameters correctly, several basins were tested using DDMS. The Green and Ampt parameters generated using both programs were virtually identical. Details of these comparisons, and a summary table of the Green and Ampt parameters used for each basin are included in **Appendix B.2.5**.

Land Use: Existing land use was estimated based on aerial photography provided by the District (**Ref 8**), and the County Assessor's maps (**Ref 9**). Areas with similar types of development were identified, and a land use designation was assigned based on density and type of development.

Future land use was provided by the District in digital format and reflects the MAG general plan development. In general, the future land use conditions are much more developed than the existing land use conditions. Other differences include improvements that the general plan calls for to the White Tanks Regional Park. There are 38 different MAG land use categories. In contrast **Table 4.2** from *The Draft Hydrology Manual* (**Ref 37**) only lists 17. These tables were expanded to accommodate the various land-use categories found in the MAG land use plan for the Wittmann study area. **Appendix B.2.2** includes the original and modified tables that summarize the land use classifications and parameters used for this study.

The Hydrology Manual recommends adjusting the land use parameters in order to represent typical development within the study area. The parameters were adjusted in three different ways:

- Four categories were adjusted to reflect the difference in density based on dwelling units per acre. For example, there is only one LDR (low density residential) category in *Table 4.2* of the *Draft Hydrology Design Manual.* LDR-1 and LDR-2 were created in order to match the MAG land use plan. Because the MAG plan lists different dwelling units per acre, the percent impervious values were adjusted to reflect a value that fell between the next highest and lowest density category.
- Three of the four open space categories included some type of development in its description (parks, golf courses, and undetermined). Assuming these types of developments are mostly covered with grass or landscaped vegetation, a 5% impervious value was used. Assuming the grass requires some watering, normal saturation conditions were used.
- Adjustments to the percent ground cover were made in order to reflect conditions observed in the existing developments within the study area. The adjustments (seven in total) were made for specific use categories, primarily industrial and open space. The standard values found in Table 4.2 of *The Draft Hydrology Manual* and Table 4.2a of *The Hydrology Manual* seemed extremely high compared to what has been observed in the field. Most developments within the study area have maintained natural desert or bare ground for their landscaping. In order to reflect these conditions, the percent ground covers for the open space categories were adjusted downward. The ground covers for undefined and passive (natural desert) were both adjusted from 90% to 30%. The ground cover was changed from 90% to 50% for active parks, and to 75% for golf courses.

The Cities of Surprise and Peoria, and the Town of Buckeye all have developed their own general plans, which differ slightly from the MAG general plan. The areas affected by this variation are few, and the differences in land use slight. Where differences occurred, MAG land use densities were higher. In order to remain conservative, no adjustments to the model were made to account for the variations found in the general plans of various cities. A comparison between the MAG general plan and the City of Surprise general plan is shown in **Figure MD-B.1,** and graphics of various general plans are located in **Appendix B.2.2.**

4.2.5.2 S-Graphs

The standard District S-Graphs for mountain or valley regions were used for basins that include predominantly mountainous or valley terrain. The valley S-Graph was developed based on the Skunk Creek watershed near Phoenix. The mountain S-Graph was developed from the New River watershed near Rock Springs. The S-Graph data was collected from the District's 1987 S-Graph Report (**Ref 29**). Various basins include large portions of physiographic and hydrologic characteristics representative of both mountain and valley S-Graphs. In order to better represent the conditions of these basins, weighted S-Graphs were developed. These modified S-Graphs were used for basins WT100, WT130, and SV200. Excerpts from the S-Graph Report and weighted S-Graph developments are documented in **Appendix B.2.3**.

Appendix B.2.3 also includes a comparison of the flows reaching the McMicken Dam using a weighted S-Graph, a valley S-Graph, and a mountain S-Graph for all three basins. The comparison shows that the effect of using the different S-Graphs is minor, because the basins are all relatively small.

4.2.5.3 Lag Time

The slope and lag time for each basin were manually estimated based on the topographic mapping and following the procedures in *The Hydrology Manual* (**Ref 15**). The values recommended by the Corp of Engineers for the "C" and "m" parameters were used. The centroid of each basin was estimated using AutoCAD 2000 (**Ref 24**) software. The "Lca" value for each basin, which is the length along the watercourse to a point opposite of the centroid in miles, is shown in **Appendix B.2**. A summary of the lag time parameters used to estimate the lag time for the 100-year, 200-year, and 500-year rainfall events are included in **Table MD-4.1**. The Kn values were estimated using the values recommended in the *Hydrology Manual*. The Kn value, which is the hydraulic efficiency of the watershed, changes with higher rainfall depth. For extreme events (PMF) the depth of flow through the watershed would be significantly deeper than the flows of the 100-year event. Thus, minor obstructions would become less of an impediment to the flow. Therefore, the PMF model used a smoother Kn value (0.005 less than the 100-year) to estimate the lag time. The basin lag times for the PMF model is shown below in **Table MD-4.1.** For more detail, see **Appendix B.2**.

Table MD-4.1. Basin Lag Time

Basin ID	Hydraulic Path (miles)	Lca *(2) (miles)	Basin Area (square miles)	Basin Slope (ft/mile)	100, 200, & 500-yr Models		PMF Model	
					Kn	Basin t_{Lag} (hours)	Kn	Basin t_{Lag} (hours)
IW310	16.2	7.73	25.8	55.7	0.030	2.10	0.025	1.75
IW350	4.8	1.97	4.2	232.0	0.030	0.60	0.025	0.50
PD700	5.1	2.25	7.3	44.9	0.030	0.89	0.025	0.74
PD710	6.2	3.48	6.7	37.5	0.035	1.35	0.030	1.16
PD730	1.0	0.54	0.5	284.0	0.050	0.32	0.045	0.29
PD735	4.5	1.91	3.2	139.2	0.030	0.64	0.025	0.53
PD740	1.2	0.51	0.9	212.8	0.030	0.22	0.025	0.18

Basin ID	Hydraulic Path (miles)	Lca *(2) (miles)	Basin Area (square miles)	Basin Slope (ft/mile)	100, 200, & 500-yr Models		PMF Model	
					Kn	Basin t_{Lag} (hours)	Kn	Basin t_{Lag} (hours)
PD745	2.7	1.25	2.0	235.4	0.030	0.40	0.025	0.34
PD760	3.2	1.28	2.7	240.6	0.030	0.43	0.025	0.36
PD780	9.6	4.10	19.2	122.7	0.030	1.17	0.025	0.97
PI600	6.0	2.84	12.0	36.4	0.035	1.25	0.030	1.07
PI640	9.9	4.52	17.6	77.0	0.030	1.34	0.025	1.11
PI680	9.3	4.52	16.9	216.6	0.050	1.79	0.045	1.61
SV200M	3.3	1.10	9.3	315.4	0.050	0.66	0.045	0.59
SV200V	9.2	5.30	22.0	43.6	0.030	1.54	0.025	1.28
SV220	8.5	3.56	17.0	34.1	0.030	1.34	0.025	1.12
TW400	7.6	2.85	13.0	29.0	0.035	1.42	0.030	1.22
TW420	10.3	4.91	10.9	51.4	0.030	1.51	0.025	1.26
TW460	3.5	2.01	2.4	103.3	0.030	0.63	0.025	0.52
TW480	9.2	3.95	12.7	194.6	0.050	1.73	0.045	1.55
WI500	6.7	3.70	9.2	30.3	0.035	1.48	0.030	1.27
WI505	5.2	3.00	6.7	36.8	0.035	1.20	0.030	1.03
WI510	8.1	4.29	9.3	27.0	0.035	1.73	0.030	1.48
WI520	13.2	6.93	16.4	121.7	0.030	1.61	0.025	1.34
WI540	10.7	4.51	11.6	81.9	0.030	1.36	0.025	1.14
WI580	14.7	7.24	30.3	76.0	0.030	1.87	0.025	1.55
WT100M	2.0	0.69	1.3	744.8	0.050	0.39	0.0045	0.35
WT100V	2.4	1.02	2.6	61.5	0.030	0.47	0.025	0.39
WT110	4.0	1.73	2.9	276.2	0.030	0.52	0.025	0.43
WT120	3.6	1.47	2.8	189.6	0.030	0.50	0.025	0.42
WT130M	2.3	0.93	1.3	570.6	0.050	0.48	0.045	0.43
WT130V	2.3	1.27	1.3	92.2	0.030	0.46	0.025	0.38
WT140	5.5	3.04	3.8	393.5	0.050	1.12	0.045	1.01
WT150	7.0	3.55	5.8	321.7	0.050	1.36	0.045	1.22
WT160	2.7	1.35	0.8	515.4	0.050	0.60	0.045	0.54

Notes: (1) These basins were split to account for the Mountain and Valley areas.

(2) The Lca values for each basin are visually presented in Appendix B.2.3.

4.2.5.4 Reach Routing Parameters

The normal depth routing method was used to route flows from one concentration point to the next.

NSTEPS: The time steps NSTEPS used in the normal depth routing were estimated using an interactive process. The initial values for the NSTEPS were estimated using an assumed wave celerity of 3 to 10 fps depending on the slope of the reach and using the following equation.

$$NSTEPS = \frac{ReachLength}{Velocity * TimeStep * 60}$$

These original NSTEPS values were entered in the model and the model was run. Then a new set of NSTEPS was estimated based on the difference between the time-to-peak of the inflow and outflow hydrographs using the following equation.

$$NSTEPS = \frac{\Delta Time\,to\,peak}{TimeStep}$$

This process was repeated until the NSTEPS value did not change significantly. Finally, the wave celerity estimated from the HEC-1 output was compared to the normal depth calculation to make sure the values were reasonable.

Geometry: The channel cross-section geometry used for the routes were extracted from the work map and from field observations. Several of the routing reaches are very similar in geometry and hydrologic conditions. For this reason, it was determined that typical cross-sections were adequate to represent the channel characteristics of more that one routing

reach. A summary of the typical cross section development and descriptions are included in **Appendix B.3.**

Slopes and "n" Values: Slopes and "n" values for the routing reaches were estimated based on the topographic mapping, aerial photographs, and field observations. Many routing reaches within similar areas appear to have similar hydrologic conditions. Therefore, typical "n" values were developed that represent these similar areas. **Figure MD-B.2** located in **Appendix B.7** shows the typical "n" value areas used in the models. The "n" value for the routing reaches was not varied between the different frequency models. The cross-section sketches and tabulated reach routing parameters are included in **Appendix B.3**.

Transmission losses were not considered for this study. These losses are difficult to estimate. Therefore, a conservative approach was taken and potential transmission losses were ignored.

4.2.5.5 Storage Routing Parameters

This hydrologic analysis was intended to model conditions at McMicken Dam including floods ranging from the 100-yr frequency storm to the PMF. Under these conditions, the design capacity of the roadway crossings would normally be exceeded, and it was assumed they would not have a significant effect on the flows at the dam downstream. For this reason, roadway crossings were not modeled.

In contrast, the CAP Canal upstream embankment area appeared to have a significant storage area, which may have some affect on downstream flooding. Therefore, the CAP Canal structures were modeled using level pool routing. There are twenty-two structures along the CAP Canal: five open overchutes and seventeen pipe crossings. Stage/Discharge relationships for all pipe crossings were developed using the Federal

Highway Administration (FHA) nomographs for culverts with inlet control (**Ref 25**). The Stage/Discharge relationship for the overchutes were developed assuming critical flow conditions through the structure. The calculations are presented in **Appendix B.4**.

Several of the drainage structures crossing the CAP Canal are not independent, but actually work as a system under certain conditions. In this system, runoff from several sources contributes to a common ponding area. The runoff could move from one structure to another, depending on the relative capacity of the cross drainage structures within the system. The one large system is located east of US 60 and includes fourteen structures. These include structures from CAP 060 (Sta. 36+12) to CAP 190 (Sta. 315+00). A combined Stage/Discharge and Stage/Storage relationship was developed for this system. Detailed calculations, including exhibits showing the CAP Canal impoundment areas, are included in **Appendix B.4**.

For this project, the storm drain protection for the CAP was assumed to perform as intended. That is, all runoff crossing the canal would be through the cross drainage structures. The original design of the cross-drainage structures was a 50-year storm but the embankment and impoundment were design for a 100-year event. Once overtopping conditions occurred, flow was assumed to follow the same general path downstream as the non-overtopping flows and to cross the canal directly and not to be redirected or significantly affected by the presence of the canal itself.

It is difficult to predict how the canal cross-drainage system would perform if it were to overtop or fail. The exact location or mode of failure would be difficult to predict. However, from the contour information it

appears that top of bank elevations tend to be lower near the cross drainage structures. Therefore, these would most likely be the first places where the embankment would be overtopped and the place failure could be initiated.

During the summer of 2003 there were some significantly large local storms in the project area resulting in damage to the canal at two different locations. At both of these locations the protecting embankment did not fail but it was bypassed. The bypassed flow went over the canal bank damaging the bank, undermining and damaging the lining, and depositing sediment into the canal. It appears it was a result of modifications of the embankment related to roadway construction. The performance of the cross drainage system during this storm demonstrates that it is a fragile system with many unknowns and weakness that may not be evident. Damage occurred on the downstream canal bank in one instance. After flow crossed the canal via an overchute it split off, being diverted more than ninety degrees, where it found a low spot along the frontage maintenance road and flowed back into the canal over the south bank.

The canal itself can store and convey a significant amount of flow before completely filling and overtopping the downstream side of the canal. A failure of the cross-drainage system could result in a failure in the canal anywhere within the reach between CAP control gates. This failure may or may not be within the same watershed. The canal itself is mostly below grade but there is some compacted fill at the downstream bank of the canal. Most of this fill is associated with washes and cross drainage structures. The presence of obstructions along the canal (overchutes) and depression associated with washes at the downstream bank of the canal makes cross drainage structures a very likely place for flow to spill out of the canal.

For this project the 100-500 year storms assumed overtopping flow would occur at or near the existing cross drainage structures and follow the same path as the non-overtopping flows.

For the PMF models the embankments are overtopped and failure of the canal would be almost certain. For the 14 cross-drainage structure system east of Grand Avenue, it was assumed that the canal would not have any effect on the flows ones it started overflowing. The assumption is that the CAP would distribute flows evenly along the length of the embankment or southern canal bank.

4.2.5.6 Flow Splits and Diversions

Portions of the watershed are characterized by distributary and braided flow and contain multiple split flow locations. Because the purpose of this model is to develop a hydrograph at McMicken Dam, most of the split flows are irrelevant since the flow reaches the dam at approximately the same location.

There was one split flow that was included for the McMicken Dam hydrology models. This split flow occurs because the CAP Canal impoundment area east of US 60 acts as a system. As the runoff ponds behind the CAP Canal, the 14 cross-drainage structures direct the flow to four different downstream concentration points. The amount of flow that is directed to each concentration point was estimated using the capacities of the cross-draining structures. Details of these split flow calculation are included in **Appendix B.5**. Split flows will be discussed in more detail under the Special Problems and Solutions section of this report.

The rating curves used for the diversion at the CAP Canal were developed so they would reflect flow conditions for all of the return periods.

However, this analysis did not consider failure of the CAP Canal embankment because predicting the location of failure would be nearly impossible. Therefore, overtopping flows were distributed to the downstream basins based on the length of canal bordering the basin. The methodology used to track the contributing area at diversions used the percentage of flow proportional to the peak discharge at each overchute plus the weir flow within the sub basin for each downstream flow path. The contributing area to any particular downstream location can change as the water level changes behind the CAP that affects the amount of runoff flowing in anyone direction. This is evident at the primary spillway of the McMicken Dam (C.P. 500.3) where the contributing drainage area is 230 square miles for the 100-year storm; and the contributing area is 245 square miles for the PMF. The reason for this is that the CAP overchutes direct more flow away from the dam during the smaller flood events. The flow for the PMF assumes the entire flow is evenly distributed as it overtops the canal. The contributing area of 245 square miles for the 72-hr PMF is in close agreement with the 247 square miles used in most previous models. The original Corps of Engineers Design was prepared in 1954, well before the construction of the CAP Canal. Subsequent models, that did include the CAP canal, did not use the same contributing area tracking methodology used in this study.

4.3 Problems Encountered During the Study

4.3.1 Special Problems and Solutions

The problems and solutions encountered during the study are presented for each of the seven areas shown in **Figure MD-1.2.**

4.3.1.1 General Area

The general project area is characterized by steep mountain headwater areas draining onto alluvial fan surfaces with distributary flow systems,

which contain numerous split flow conditions in many locations. The hydrology models created for this report represent severe rainfall/runoff events. The model developed for these large events did not consider small drainage features/structures. These features/structures may have a significant effect during smaller events, however, will have little or no effect on larger flow events. Therefore, they were not modeled for the McMicken Dam Hydrology.

The only structure modeled was the CAP Canal embankment. This structure has a potential to store a significant amount of flow behind the upstream embankment. The model shows this structure being overtopped during the extreme (PMF) storm events. This analysis does not consider potential effects of the CAP Canal embankment failing, which may or may not have a significant effect on the performance of the McMicken Dam.

As expected in areas that are being developed, the runoff from most basins estimated by the existing conditions model (undeveloped) was less than the runoff estimated by the future conditions model (developed). However, for basins TW480 and TW460, the future conditions model estimates runoff that is less than the runoff estimated by the existing conditions model. This difference can be explained by looking at the existing and future land use parameters. The future land use for the two basins shows some area designated as OPEN-2. This classification includes parks which have more vegetation than the natural, or existing desert conditions. The increased vegetation causes more runoff attenuation, which results in the future conditions peak runoff to be lower than the existing conditions peak runoff.

In order to avoid instabilities in some route hydrographs, modifications were made to the typical cross section used for the particular route. These modifications are noted in each HEC-1 input model.

During the NSTEP check for the routes, as found in **Appendix B.3**, the wave velocity for each route was calculated based on the HEC-1 difference in time to peak between the input and output hydrographs. This velocity then was compared to normal depth estimates using Manning's equation. Typically, the wave velocity should be faster than the normal depth velocity by a factor of 1.2 to 1.6 depending on the cross section geometry.

Certain routes showed significant differences between the normal depth and wave velocities estimated from the HEC-1 output. These hydrographs were examined closely, and in most cases it was determined that the NSTEP used was adequate. Most of the larger differences are attributed to the time interval used in the HEC-1 model (15 minutes). Peaks can only be reported by HEC-1 at this interval, but most likely the peak actually occurs some time before or after the time reported by HEC-1. This introduces an error in estimating wave velocity from the output of the HEC-1 model that could be significant in particular for short reaches. For some of the most extreme cases the time to peak shown on **Appendix B.3** was modified from those reported by HEC-1. These modifications were based on plotted hydrographs as shown in **Appendix B.3**.

In other cases, there were hydrographs with more than one peak and the time to peak reported by HEC-1 for the outflow hydrograph does not correspond to the same peak in the inflow hydrograph. In these cases the reported time to peak for the inflow hydrograph was not used, but the

corresponding time to peak was obtained from the plotted hydrographs. Plots of the input and output hydrographs are found in **Appendix B.3**.

4.3.1.2 Picacho Wash Sub-Area

Runoff from this sub-area ponds upstream of the CAP Canal and combines with flow from the Padelford Wash and Wittmann sub-areas. According to the models, the CAP Canal would not be overtopped during a 100-year, 200-year, or 500-year storm. Therefore, this impoundment area acts as one storage system that distributes flow among the cross-drainage structures. The flow distribution was estimated based on the capacities of the fourteen different structures located in this impoundment area. The outflow estimate for the CAP overchutes contributing to the downstream concentration points is included in **Appendix B.5**.

The model results indicate that the CAP Canal would overtop during a PMF event. It was not a part of this study to analyze possible failure of the CAP Canal bank. However, Entellus reviewed crest elevations from survey and mapping information to see if there were low points along the embankment that would suggest potential for failure. The embankment crest appears to be level. Based on the mapping, it would appear that the low embankment locations are usually close to cross drainage structures. Based on this observation, overtopping flow was directed to the same concentration points as the cross drainage structures. Once an overtopping condition was reached, no additional storage was allowed behind the CAP Canal, and flow was allowed to pass over the canal. No attempt was made to try to model/predict any possible effects the canal itself might have on overtopping flows such as storage or diversion effects.

There were other natural split flow conditions that were identified in this sub-area, but they were not modeled. This was because in most cases, split flows reached the same concentration point along McMicken Dam,

In some cases, a conservative assumption was made to route all the flow at the split to the furthest upstream location along the dam or Outlet Channel. Bringing the flow further upstream away from the spillway would be a more conservative approach because it will likely result in these flows contributing to the McMicken pool for a longer period of time.

The split flows upstream of the CAP Canal were ignored because they all combine at the storage area behind the embankment.

The downstream portion of the Picacho Wash sub-area is bisected by the Beardsley Canal on the southern end. This canal was not designed to collect significant amounts of runoff from the upstream drainage areas. It was assumed that during large runoff events, the canal would overtop, and runoff would continue unobstructed to the McMicken Outlet Channel on the southern end of this sub-area. Therefore, the Beardsley Canal was not modeled.

4.3.1.3 Padelford Wash Sub-Area

A significant split flow area was identified and field checked north of the CAP Canal. This split was modeled in the Padelford Wash Floodplain Delineation Study (**Ref 26**). However, all the routes from this split flow area appear to combine at the CAP Canal impoundment area discussed in the previous section. Therefore, this split was not modeled in our study.

There were many other split flow conditions that were identified, but were not modeled for various reasons. Along the project boundary, there are splits that appear to be relatively minor and/or the worst-case scenario of the entire flow remaining within the study watershed was assumed. At other split flow locations it was assumed that all of the flow from the sub-watershed enters the dam or Outlet Channel at the furthest upstream location. This conservative approach was used because it results in flow

contributing to the McMicken Dam impoundment for a longer period of time.

4.3.1.4 Wittmann Wash, Trilby Wash, and Iona Wash Sub-Areas

There were many split flow conditions identified in these three sub-areas, but they were also not modeled because the splits enter the dam at approximately the same location. For example, a split occurs at the intersection of the US 60 and the Citrus Avenue Alignment. At this location, most of the flow appears to be conveyed through the railroad and highway. However, some of the flow continues southwest along the railroad tracks. These two flow paths intersect McMicken Dam at approximately the same location.

4.3.1.5 Sun Valley Parkway Sub-Area

This sub-area includes a portion of the White Tank Mountains. The mountainous area was not delineated as separate basins in order to avoid creating small basins. Instead, basin SV200 contains mountainous and valley terrain. For this basin, a composite weighted S-Graph was developed using a combination of mountain S-Graph for the White Tanks area and the valley S-Graph for the remaining area. The estimations for this modified S-Graph are presented in **Appendix B.2.3**.

The use of the combined S-Graph does not appear to have a significant effect on the flows reaching McMicken Dam. **Appendix B.2.3** includes a comparison of the peak flows reaching the dam obtained using the composite S-Graph versus using the mountain and the valley S-Graphs.

4.3.1.6 White Tanks Sub-Area

Basins WT100 and WT130 in the White Tanks sub-area required modified S-Graphs because they include a significant portion of both mountain and valley terrain (see **Section 4.2.6.2**). The estimates for the two modified S-

Graphs and a comparison using the mountain and valley S-Graphs are presented in **Appendix B.2.3**.

4.3.1.7 Central Arizona Project Canal

There are twenty-two drainage structures crossing the CAP Canal within the project area. There is considerable storage upstream of the CAP Canal created by embankments that were constructed to protect the canal and route flows to the cross-drainage structures. Typically one structure drains a single impoundment area. However, in one instance, fourteen structures drain a single impoundment area. In this area, stage/discharge relationships were estimated based on the combined effect of all the structures within this impoundment area. The outflow was divided between the different structures depending on their relative stage discharges. The parameters used in developing the stage-storage and stage/discharge data are included in **Appendix B.4**.

One of the difficulties in establishing the storage volumes of impoundment areas was that in certain areas 2-foot contours were provided by the District, and in other areas only 4-foot contours were available. In another area the only available topography was 10-foot mapping. In this area, Entellus developed 2-foot contours, by interpolation from the 10 footers, using the ASCII grid files provided by the District. This affected structures CAP 200 and CAP 210. For the large impoundment system behind structures CAP 060 to CAP 190, contours and spot elevations show that water would overtop the lateral embankment immediately east of structure CAP 190 prior to overtopping the CAP Canal embankment. This embankment elevation of 1556 feet was assumed as the berm overtopping elevation for the entire section. However, the water surface behind the lateral embankment would also be high and it was assumed that cross flow along this lateral embankment would be negligible. Therefore, all flows

were assumed to overtop the embankment and flow southerly in a similar path as the cross-drainage structures.

Another issue for consideration was how the calculated storage and flow values compared to those calculated by the Bureau of Reclamation (BOR) **(Ref 26)**. In general, flows and storage volumes for the cross-drainage structures west of US 60 matched the BOR design data quite well. In other areas, the data did not match very well. In the large impoundment area east of US 60, the calculated storage volume was roughly double that of the BOR for the same outflow discharge. For the three drainage structures farthest east in the study area, the calculated storage volumes were significantly less than those of the BOR. It is likely that these differences could be better explained if the stage data from the BOR was available. The only BOR data available were inflow and outflow discharge rates and total storage volumes. The differences could also be related to the difference in topographic mapping or the calculated flow rates for the structures.

Structure CAP 050 was a special case. At the time of the field survey by DTM Inc. (2002), this overchute was completely covered in sediment. Hence, there were no ground shots taken. The invert was estimated from the Bureau of Reclamation's structure height and topographic data received from the District.

No spot elevations were available from the District's mapping along the embankment area of structure CAP 030. Therefore, the highest contour elevation was used as the overtopping elevation.

The impoundment area for structure CAP 220 extends outside the project boundary and combines with a 30" RCP at station 459+30 before

overtopping the berm into the canal. CAP 220 is a 72" RCP, considerably larger than the 30" RCP. Additionally, the invert of the 72" RCP is lower than the estimated 30" RCP invert. Therefore, the discharge associated with the 30-inch culvert (outside the project area) has been ignored, but the impoundment storage volume outside of the project area has been considered.

4.3.2 Modeling Warning and Error Messages

4.3.2.1 100-year, 24-hour models

There were no error messages in this HEC-1 model. Warning messages generated by the HEC-1 were examined to ensure that the models were not adversely affected.

The warning messages encountered for the 100-year, 24-hour HEC-1 model for are as follows:

- WARNING --- MODIFIED PULS ROUTING MAY BE NUMERICALLY UNSTABLE FOR FLOWS BETWEEN (*Value*) TO (*Value*).

This warning specified a range of flows where routing might be numerically unstable. This warning occurred in twenty-one routing reaches for the existing model and twenty-three routing reaches for the future model. For thirteen of these warnings in the existing model, the routed flow was outside of the unstable range, and the warning was ignored. For seventeen of these warnings in the future model, the routed flow was outside of the unstable range, and the warning was ignored.

The hydrographs from the two models that were within the range of the specified flows were examined. The hydrographs of seven warnings in the

existing model and five warnings in the future models showed no signs of instability, and the warnings were ignored. The remaining hydrograph in the existing model was CAP210. This hydrograph showed noise in the recession end of the hydrograph. The remaining hydrograph in the existing model was CAP220. This hydrograph showed noise in the recession end of the hydrograph and was therefore ignored.

4.3.2.2 200-year, 24-hour models

There were no error messages in this HEC-1 model. Warning messages generated by the HEC-1 were examined to ensure that the models were not adversely affected.

The warning messages encountered for the 200-year, 24-hour HEC-1 model for are as follows:

- WARNING --- MODIFIED PULS ROUTING MAY BE NUMERICALLY UNSTABLE FOR FLOWS BETWEEN (*Value*) TO (*Value*).

This warning specified a range of flows where routing might be numerically unstable. This warning occurred in twenty-one routing reaches for the existing model and twenty-three routing reaches for the future model. For fifteen of these warnings in the existing model, the routed flow was outside of the unstable range, and the warning was ignored. For fifteen of these warnings in the future model, the routed flow was outside of the unstable range, and the warning was ignored.

The hydrographs of the other six warnings in the existing model and the other eight warnings in the future model were within the range of the specified flows and were examined. The hydrographs of five warnings in the existing model and seven warnings in the future models showed no

signs of instability, and the warnings were ignored. The remaining hydrograph, CAP210 for both the existing and future model, showed noise in the recession end of the hydrograph and was therefore ignored.

4.3.2.3 500-year, 24-hour model (Existing Conditions)

There were no error messages in the HEC-1 models. Warning messages generated by the HEC-1 were examined to ensure that the models were not adversely affected.

The warning messages encountered for the 500-year, 24-hour existing conditions HEC-1 model are as follows:

- WARNING --- MODIFIED PULS ROUTING MAY BE NUMERICALLY UNSTABLE FOR FLOWS BETWEEN (*Value*) TO (*Value*).
- WARNING --- EXCESS PONDING LESS THAN ZERO FOR PERIOD. EXCESS SET TO ZERO.

The first warning specified a range of flows where routing might be numerically unstable. This warning occurred in sixteen routing reaches. Eight of them became unstable at a range specified by the program that was higher than the flow being routed, and the warning was ignored. The hydrographs of the other eight that were within the range of the specified flows were examined. Seven of the hydrographs showed no signs of instability, and the warning was ignored. The remaining hydrograph, CAP210, showed noise in the recession portion of the hydrograph and was therefore ignored.

The second warning appears when a negative value for ponding occurs, which happens when the soil infiltration is greater than the runoff. The

model automatically corrects this by setting the negative value to zero, therefore the warning was ignored.

4.3.2.4 500-year, 24-hour model (Future Conditions)

There were no error messages in this HEC-1 model. Warning messages generated by the HEC-1 were examined to ensure that the models were not adversely affected.

The warning messages encountered for the 500-year, 24-hour future condition HEC-1 model for are as follows:

- WARNING --- MODIFIED PULS ROUTING MAY BE NUMERICALLY UNSTABLE FOR FLOWS BETWEEN (*Value*) TO (*Value*).

This warning specified a range of flows at which routing might be numerically unstable. This warning occurred in twenty-two routing reaches. Thirteen of them became unstable at a range specified by the program that was higher than the flow being routed, and the warning was ignored. The hydrographs of the other nine that were within the range of the specified flows were examined. The hydrographs of eight of the warnings showed no signs of instability, and the warning was ignored. The remaining hydrograph, CAP210, showed noise in the recession portion of the hydrograph and was therefore ignored.

4.3.2.5 6-hour PMF model

There were no error messages in this HEC-1 model. Warning messages generated by the HEC-1 were examined to ensure that the models were not adversely affected.

The warning messages encountered for the 6-hour PMF HEC-1 model for are as follows:

- WARNING --- MODIFIED PULS ROUTING MAY BE NUMERICALLY UNSTABLE FOR FLOWS BETWEEN (*Value*) TO (*Value*).

This warning specified a range of flows where routing might be numerically unstable. This warning occurred in eighteen routing reaches. For ten of these warnings the routed flow was outside of the unstable range, and the warning was ignored.

The hydrographs from the model that were within the range of the specified flows were examined. The hydrographs of six warnings in the model showed no signs of instability, and the warnings were ignored. The remaining two hydrographs, CAP210 and CAP220, showed noise in the recession portion of the hydrograph and was therefore ignored.

4.3.2.6 72-hour PMF model

There were no error messages in this HEC-1 model. Warning messages generated by the HEC-1 were examined to ensure that the models were not adversely affected.

The warning messages encountered for the 72-hour PMF HEC-1 model for are as follows:

- WARNING --- MODIFIED PULS ROUTING MAY BE NUMERICALLY UNSTABLE FOR FLOWS BETWEEN (*Value*) TO (*Value*).

This warning specified a range of flows where routing might be numerically unstable. This warning occurred in eighteen routing reaches. For nine of these warnings the routed flow was outside of the unstable range, and the warning was ignored.

The hydrographs from the model that were within the range of the specified flows were examined. The hydrographs of eight warnings in the model showed no signs of instability, and the warnings were ignored. The remaining hydrograph, CAP210, showed noise in the recession portion of the hydrograph and was therefore ignored.

4.4 Calibration

There is inadequate stream gage data to accurately calibrate the model. However, results were compared to previous studies. The results of the hydrologic models and results from previous related studies are summarized in **Table MD-4.2.** Indirect methods were also used to verify results. See section 4.6 for a detailed discussion of the various indirect methods used. The model results appear to compare well with the limits of these other methods.

The only gaging stations within the project area with enough periods of record to provide meaningful calibration data are located at the McMicken Dam Spillway, and downstream in the McMicken Outlet Channel. Both of these gages record flow after they are attenuated by the dam storage pool. For this analysis, a storage routing was not performed because the intent of this study is to provide input hydrographs to the dam and the Outlet Channel. Therefore, the gage data cannot be compared to the result of the models at this time.

Table MD-4.2 – Summary of Hydrologic Results

Inflow to McMicken Dam @ Spillway (C.P. 500.3)	U.S. Army C.O.E. Design 1954	SH&B 1983	FCDMC Existing Conditions 1987	Wittmann ADMS Existing Conditions 1989	Entellus Existing Conditions 2004	Entellus Future Conditions 2004
Drainage Area sq. mi.	247	236	247	258	230	230-245
Modeling Methods	Standard Project Storm 8/1951 Queen Creek Storm	HEC-1 Kinematic Wave; Uniform Loss Rate; Modified Puls;	HEC-1 Kinematic Wave and S-Graph; Uniform Loss Rate; Muskingum Routing	HEC-1 Kinematic Wave and S-Graph; Curve Numbers; Muskingum Routing;	WMS/HEC-1 S-Graphs; Green & Ampt; Normal Depth Routing	WMS/HEC-1 S-Graphs; Green & Ampt; Normal Depth Routing
Number of Sub basins	1	8	44	200	32	32
100-year Peak Inflow	*	*	*	20,431 cfs	25,608 cfs	29,492 cfs
200-year Peak Inflow	*	*	*	*	30,877 cfs	35,346 cfs
500-year Peak Inflow	*	*	*	*	37,639 cfs	42,934 cfs
Standard Project Storm	35,000 cfs	*	42,000 cfs	37,503 cfs	*	*
6-hr PMF Peak Flow	*	*	*	*	*	115,625 cfs
72-hr PMF Peak Inflow	120,000 cfs	155,800 cfs	114,850 cfs	110,374 cfs	*	127,499 cfs

4.5 Results of Hydrologic Analysis

Results of the hydrologic analysis including the HEC-1 input files are presented in **Appendices D, E, F, H, and I.** The peak inflow values to McMicken Dam at the principal spillway (Concentration Point 500.3) are listed in **Table MD-4.2.** The summary of flows for all basin and concentration points is shown in **Table MD-4.3.** The complete summary of flows is presented in **Table MD-B.6, Appendix B.6.** It should be noted that the total contributing area for the 72 hour PMF model varies

from the area of the other models. The 72-hour PMF contributing area is 245 square miles. The contributing area for the other models is 230 square miles. The difference is due to the variation in the amount of flow that the CAP diverts downstream of the dam during different size storm runoff events. The common storage area upstream of the CAP east of US 60 is drained by 14 different cross drainage structures whose outflow varies depending upon the depth of water in the impoundment area. This combined with the weir flow when the embankment is overtopped changes the percentage of flow that enters above the dam's spillway versus what is diverted below it into the Outlet Channel. The percentage of flow entering into the dam is larger during the 72 hour PMF; therefore, the amount of contributing watershed area was manually adjusted in the model accordingly. The percentage breakdown is shown in the comment cards of the HEC-1 model following concentration point WI505.

4.6 Verification of Results

The Draft Hydrology Manual (**Ref 37**) recommends using indirect methods for verifying flood discharges generated using analytical rainfall-runoff models. These methods compare the 100-year peak runoff values generated using the model, to peak discharges found using three different indirect methods. The three recommended sources for the 100-year peak discharges from indirect methods are: 1) Unit peak discharge curves versus drainage area; 2) USGS Data for Arizona, graphs of estimated 100 year discharges versus drainage area for gaged watersheds in Arizona: and 3) Regional regression equations for flood Region 12 in Maricopa County. Summaries of the results for each method are described below.

4.6.1 Verification with Unit Peak Discharge Curves

This method compares the 100-year peak discharge per area generated by the model (unit peak discharge) to seven different envelope curves provided in the *Draft Hydrology Manual.* In order to make the comparison, the 100-year unit peak discharges generated by the 100-year existing and future conditions models were plotted on the District figure showing the envelope curves.

Instead of showing a point for each basin, an area was plotted in which the future and existing 100-year HEC-1 output falls into. This plot is shown on **Figure MD-J.1** in **Appendix J**. The comparison shows that the discharges produced by the model are closest to the curves labeled C and D. Curve C represents peak stream flow data for Arizona, developed by Malvick (1980). Curve D represents peak stream flow data from the Little Colorado River Basin in Northern Arizona, developed by Crippen (1982). Most of the estimated 100-year discharges fall below the envelope curves that represent maximum observed flood discharges for the region.

4.6.2 *Verification with USGS Data for Arizona*

The second indirect method compares the 100-year peak discharges from the model to measured discharges from gaged watersheds with similar characteristics. Based on gage data, the District has established charts to describe the general relationship between peak discharges and watershed size for Maricopa County. In order to verify the model results, the 100-year existing and future peak discharges generated by the model were plotted on the District's charts. **Figure MD-J.2a** shows that the estimated values of peak discharges are in general agreement with the correlation curves developed by the District based on gage data. **Figure MD-J.2b** shows that the estimated values of peak discharges are all higher than the values estimated using the LP3 regression equation.

4.6.3 Verification with Regional Regression Equations

The third indirect method compares the 100-year peak discharges from the model to discharges found using regional regression equations and data graphs for flood regions in Maricopa County. The mean base elevation was estimated to be 2060 feet, and was estimated using the average elevation of the basin time of concentration flow paths. The cloud diagram provided in the *Draft Hydrology Manual* was used to determine if the regression equations would

be applicable for verifying output of the models. **Figure MD-J.3a** in **Appendix J** shows that the regression equations can be used to verify flow for basins ranging in size from 1 to 100 square miles for this particular mean elevation. In order to verify the model results, the 100-year existing and future peak discharges generated by the model were plotted with the discharges estimated using the regression equation for Region 12.

4.6.4 Verification Summary

Flows estimated by the HEC-1 models fall between the LP3 and the Region 12 regression lines. Therefore, the model appears to be generating flows that are reasonable. **Figure MD-J.2b** in **Appendix J** shows the plot with the model results and the LP3 line and the Region 12 Regression line.

Table MD-4.3: Summary of Concentration Point Peak Discharges

Basin or CP ID	100-yr 24-hr Storm		200-yr 24-hr Storm		500-yr 24-hr Storm		10-day 100-yr	6-hr PMF	72-hr PMF
	Exst. Cond. Q [cfs]	Fut. Cond. Q [cfs]	Exst. Cond. Q [cfs]	Fut. Cond. Q [cfs]	Exst. Cond. Q [cfs]	Fut. Cond. Q [cfs]	Fut. Cond. Q [cfs]	Fut. Cond. Q [cfs]	Fut. Cond. Q [cfs]
100	5462	5668	6257	6456	7996	7708	***	***	12482
110	4165	4417	4944	5146	5684	6344	***	***	10308
120	3511	3628	4047	4208	4815	4908	***	***	5287
130	2411	2557	2800	2935	3413	3558	***	***	3540
200	16943	19641	20046	22803	24258	26855	***	***	***
310	11821	12193	13475	13831	16125	16456	***	***	***
400	16144	18692	19247	22013	22659	25935	***	***	***
420	5868	6132	6723	6982	8128	8382	***	***	***
460	5458	5433	6240	6204	7084	7357	***	***	***
500.1	6415	6809	6837	7031	7297	8257	***	***	***
500.2	24831	28560	30094	34358	36706	42038	***	***	115437
500.3	25608	29492	30877	35346	37639	42934	7649	115625	127499
505	4053	4650	4683	5272	5672	6260	***	***	***
510	6482	7405	8061	9147	10461	11594	***	***	***
600	7289	7848	8438	8987	10013	10568	***	***	***
640	11653	11905	13201	13487	15641	15922	***	***	***
700	6366	6472	7303	7402	8588	8676	***	***	***
710	4102	4455	4755	5114	5731	6084	***	***	***
120*	4729	4862	5662	5548	6605	6892	***	***	8825
400*	19115	21956	22805	25862	26535	30577	***	***	73007
510*	23515	27205	28973	32646	34714	39503	***	***	97760
600*	25825	29887	31204	35359	37705	42525	***	***	136691
700*	28185	32368	33470	37795	40366	44870	***	***	147770
710*	28626	32785	34028	38280	40744	45588	***	***	146936
CAP	25606	26246	26147	26705	31526	32976	***	***	***
CAP010	7131	8559	9786	12435	13996	14321	***	***	***
CAP020	11559	11963	13508	13884	16072	16372	***	***	***
CAP030	5537	5769	6301	6555	7632	7881	***	***	***
CAP040	13327	13693	15675	15985	19516	19825	***	***	***
CAP050	13327	13693	15675	15985	19516	19825	***	***	***
CAP200	378	381	398	400	423	425	***	***	***
CAP210	2526	2581	2696	2747	2927	2975	***	***	***
CAP220	457	462	484	493	523	527	***	***	***
IW310	11939	12310	13584	13938	16248	16577	***	***	***
IW350	4129	4139	4697	4701	5448	5443	***	***	***
PD700	6281	6357	7218	7287	8462	8521	***	***	***
PD710	3617	3724	4227	4332	5010	5116	***	***	***
PD730	613	633	706	724	821	839	***	***	***
PD735	2721	2857	3131	3253	3678	3794	***	***	***
PD740	1457	1473	1673	1686	1943	1954	***	***	***
PD745	2473	2513	2846	2881	3318	3349	***	***	***
PD760	3484	3585	4052	4146	4789	4875	***	***	***
PD780	13677	13880	15461	15651	18363	18504	***	***	***
PI600	7289	7848	8438	8987	10013	10568	***	***	***
PI640	11751	12006	13297	13534	15709	15923	***	***	***
PI680	7704	7764	8716	8759	10298	10323	***	***	***

Table MD-4.3: Summary of Concentration Point Peak Discharges

Basin or CP ID	100-yr 24-hr Storm		200-yr 24-hr Storm		500-yr 24-hr Storm		10-day 100-yr	6-hr PMF	72-hr PMF
	Exst. Cond. Q [cfs]	Fut. Cond. Q [cfs]	Exst. Cond. Q [cfs]	Fut. Cond. Q [cfs]	Exst. Cond. Q [cfs]	Fut. Cond. Q [cfs]	Fut. Cond. Q [cfs]	Fut. Cond. Q [cfs]	Fut. Cond. Q [cfs]
SV200	10672	11930	12271	13548	14836	16107	***	***	***
SV220	11508	12073	13017	13551	15343	15837	***	***	***
TW400	7599	8875	8705	9983	10315	11577	***	***	***
TW420	6092	6353	7022	7277	8292	8542	***	***	***
TW460	2146	2124	2476	2450	2898	2867	***	***	***
TW480	6463	6439	7319	7286	8553	8510	***	***	***
WI500	5169	5927	5962	6727	7024	7778	***	***	***
WI505	4153	4717	4851	5409	5747	6304	***	***	***
WI510	5045	5897	5780	6631	6764	7605	***	***	***
WI520	8699	9032	9898	10218	11774	12076	***	***	***
WI540	7839	8161	8890	9205	10366	10669	***	***	***
WI580	14206	14456	16247	16483	19545	19757	***	***	***
WT100	2869	2991	3321	3438	3901	4012	***	***	***
WT110	3134	3195	3611	3667	4217	4267	***	***	***
WT120	3376	3418	3897	3931	4555	4583	***	***	***
WT130	1848	1889	2136	2173	2510	2542	***	***	***
WT140	2297	2394	2659	2751	3123	3210	***	***	***
WT150	3069	3203	3548	3678	4167	4291	***	***	***
WT160	751	772	868	887	1015	1031	***	***	***

SECTION MD-5: HYDRAULICS (NOT INCLUDED)

Hydraulic analysis is not part of this report.

SECTION MD-6: EROSION AND SEDIMENT TRANSPORT (NOT INCLUDED)

Erosion and sediment transport is not a part of the scope for this project.

HALF SIZE PLATES

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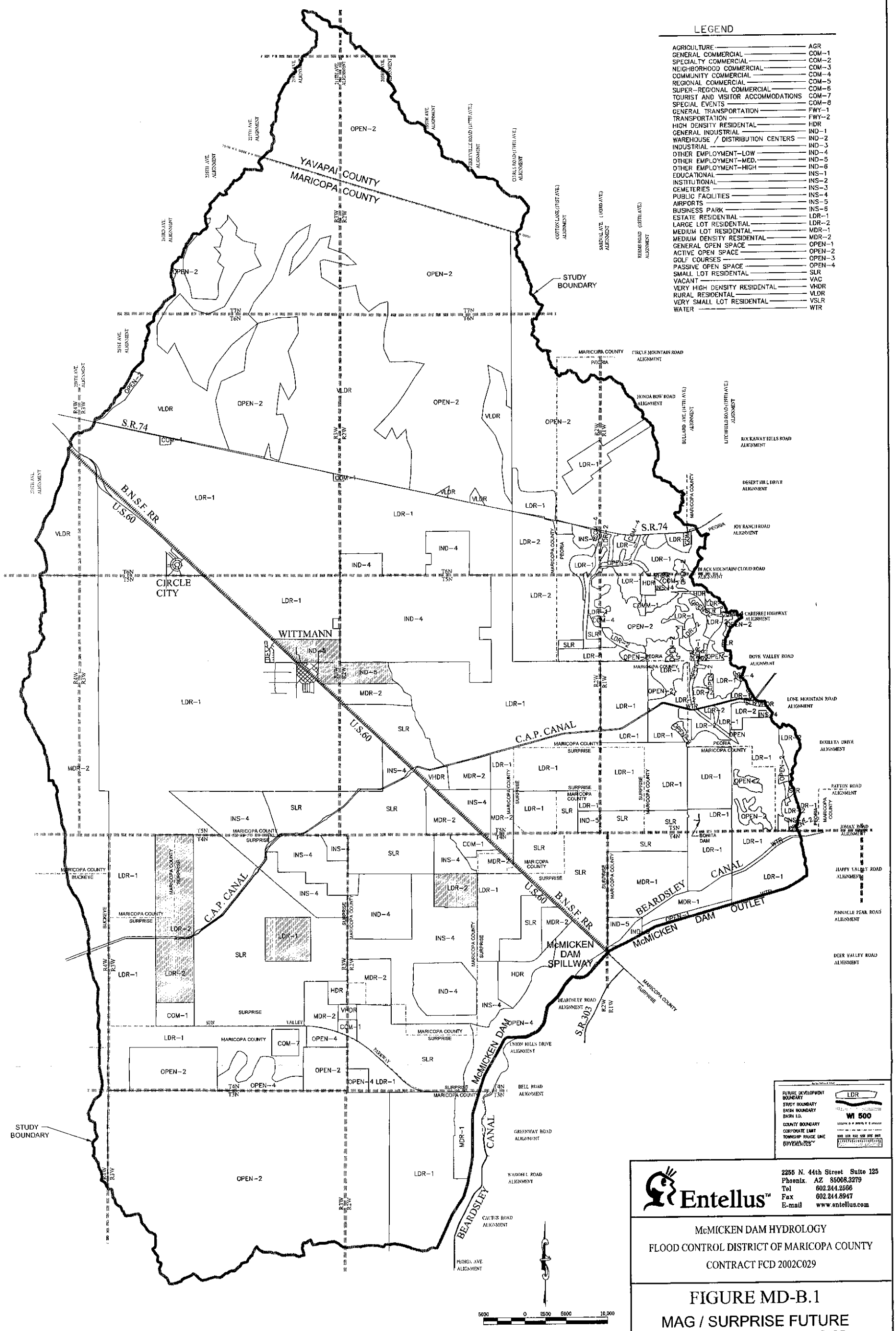

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FLOOD CONTROL DISTRICT OF MARICOPA COUNTY
CONTRACT FCD 2002C029

FIGURE MD-B.1

MAG / SURPRISE FUTURE LAND USE DIFFERENCES

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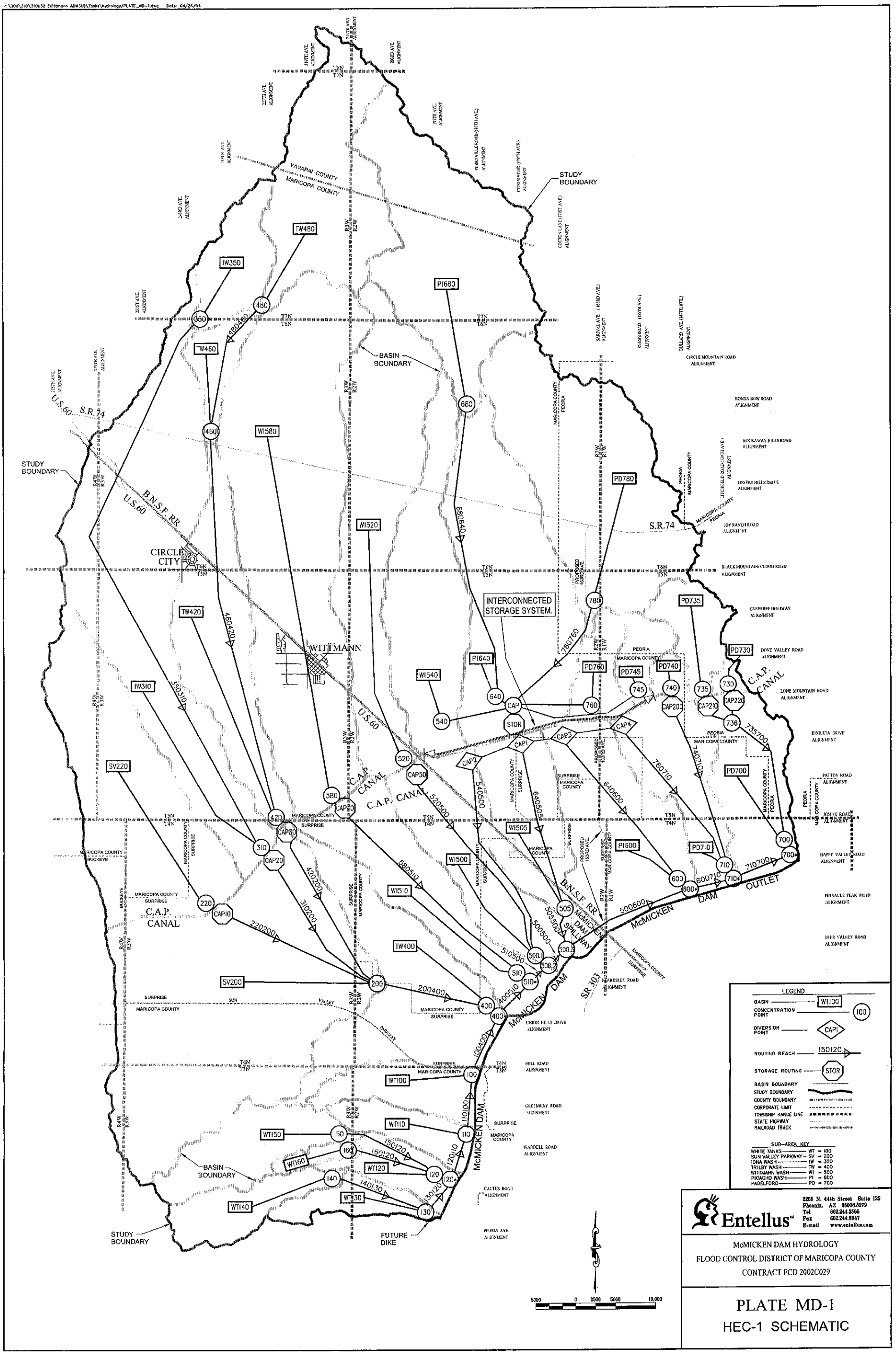

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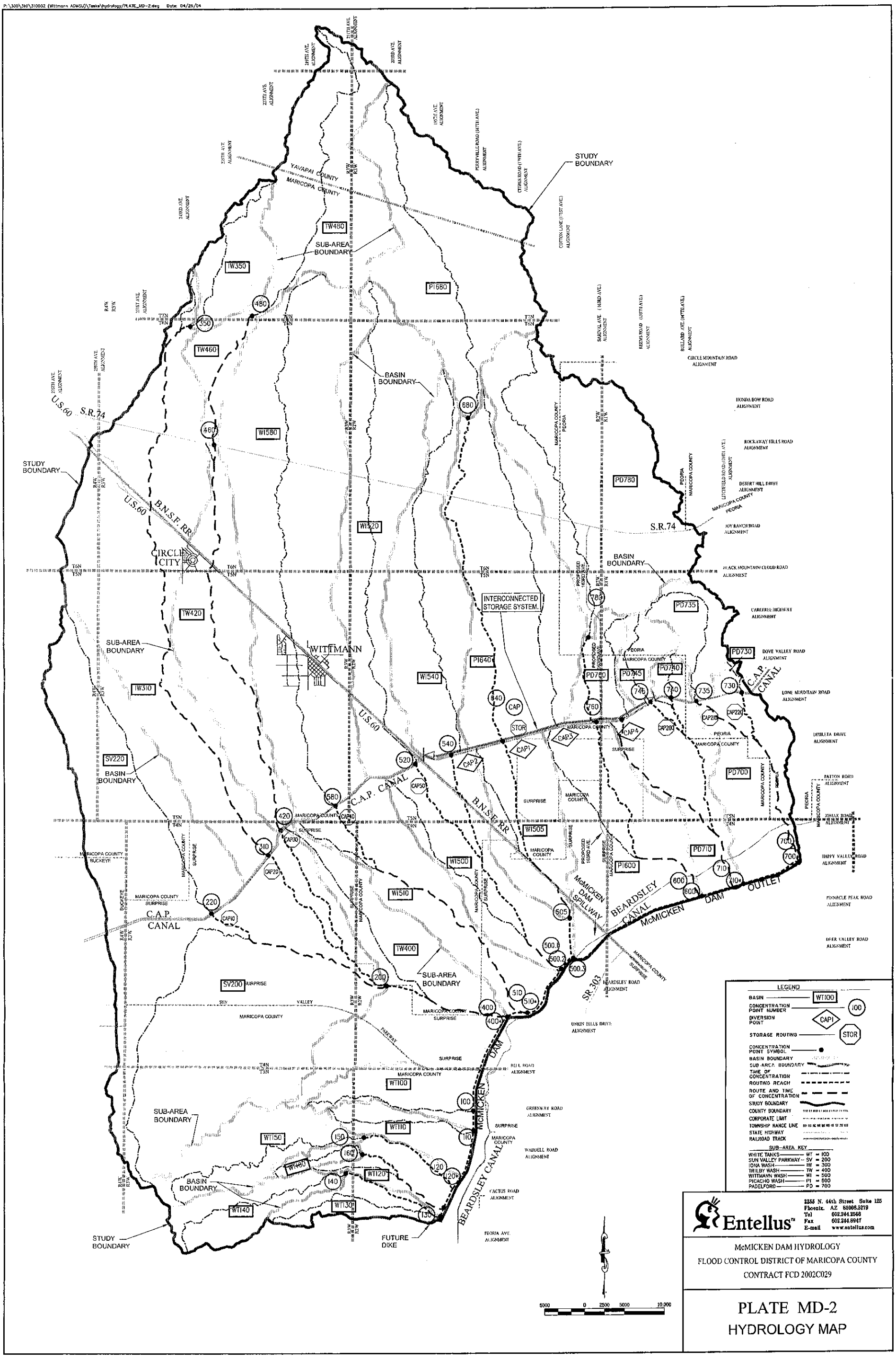

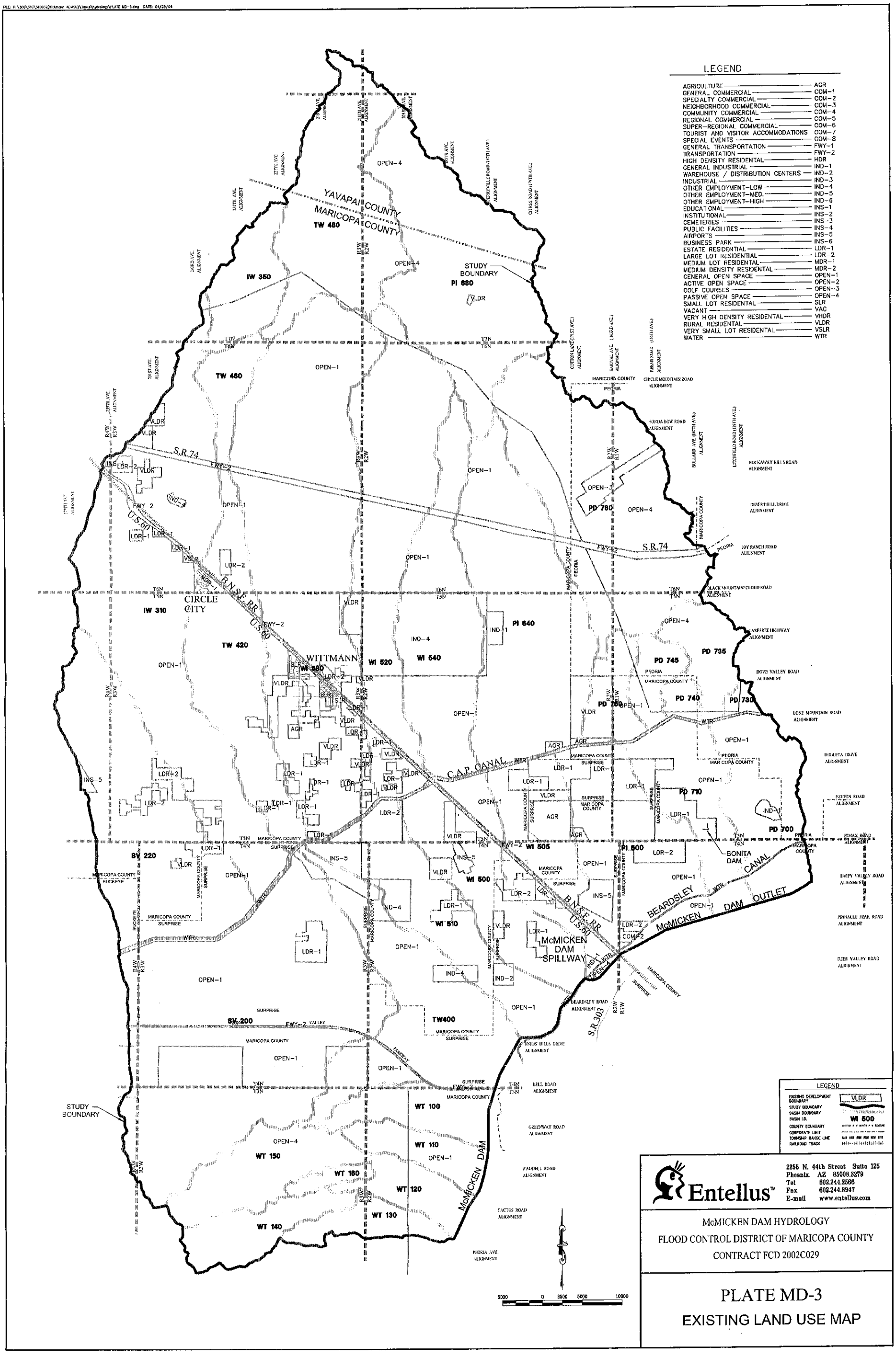
LEGEND
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SPECIALTY COMMERCIAL — COM-2
NEIGHBORHOOD COMMERCIAL — COM-3
COMMUNITY COMMERCIAL — COM-4
REGIONAL COMMERCIAL — COM-5
SUPER-REGIONAL COMMERCIAL — COM-6
TOURIST AND VISITOR ACCOMMODATIONS — COM-7
SPECIAL EVENTS — COM-8
GENERAL TRANSPORTATION — FWY-1
TRANSPORTATION — FWY-2
HIGH DENSITY RESIDENTAL — HDR
GENERAL INDUSTRIAL — IND-1
WAREHOUSE / DISTRIBUTION CENTERS — IND-2
INDUSTRIAL — IND-3
OTHER EMPLOYMENT-LOW — IND-4
OTHER EMPLOYMENT-MED. — IND-5
OTHER EMPLOYMENT-HIGH — IND-6
EDUCATIONAL — INS-1
INSTITUTIONAL — INS-2
CEMETERIES — INS-3
PUBLIC FACILITIES — INS-4
AIRPORTS — INS-5
BUSINESS PARK — INS-6
ESTATE RESIDENTIAL — LDR-1
LARGE LOT RESIDENTIAL — LDR-2
MEDIUM LOT RESIDENTAL — MDR-1
MEDIUM DENSITY RESIDENTAL — MDR-2
GENERAL OPEN SPACE — OPEN-1
ACTIVE OPEN SPACE — OPEN-2
GOLF COURSES — OPEN-3
PASSIVE OPEN SPACE — OPEN-4
SMALL LOT RESIDENTAL — SLR
VACANT — VAC
VERY HIGH DENSITY RESIDENTAL — VHDR
RURAL RESIDENTAL — VLDR
VERY SMALL LOT RESIDENTAL — VSLR
WATER — WTR
YAVAPAI COUNTY
MARICOPA COUNTY
STUDY BOUNDARY
S.R.74
U.S.60
B.N.S.F. RR
CIRCLE CITY
WITTMANN
C.A.P. CANAL
BEARDSLEY CANAL
McMICKEN DAM OUTLET
McMICKEN DAM SPILLWAY
BONITA DAM
S.R.303
PARKWAY
LEGEND
EXISTING DEVELOPMENT BOUNDARY
STUDY BOUNDARY
BASIN BOUNDARY
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PLATE MD-3
EXISTING LAND USE MAP

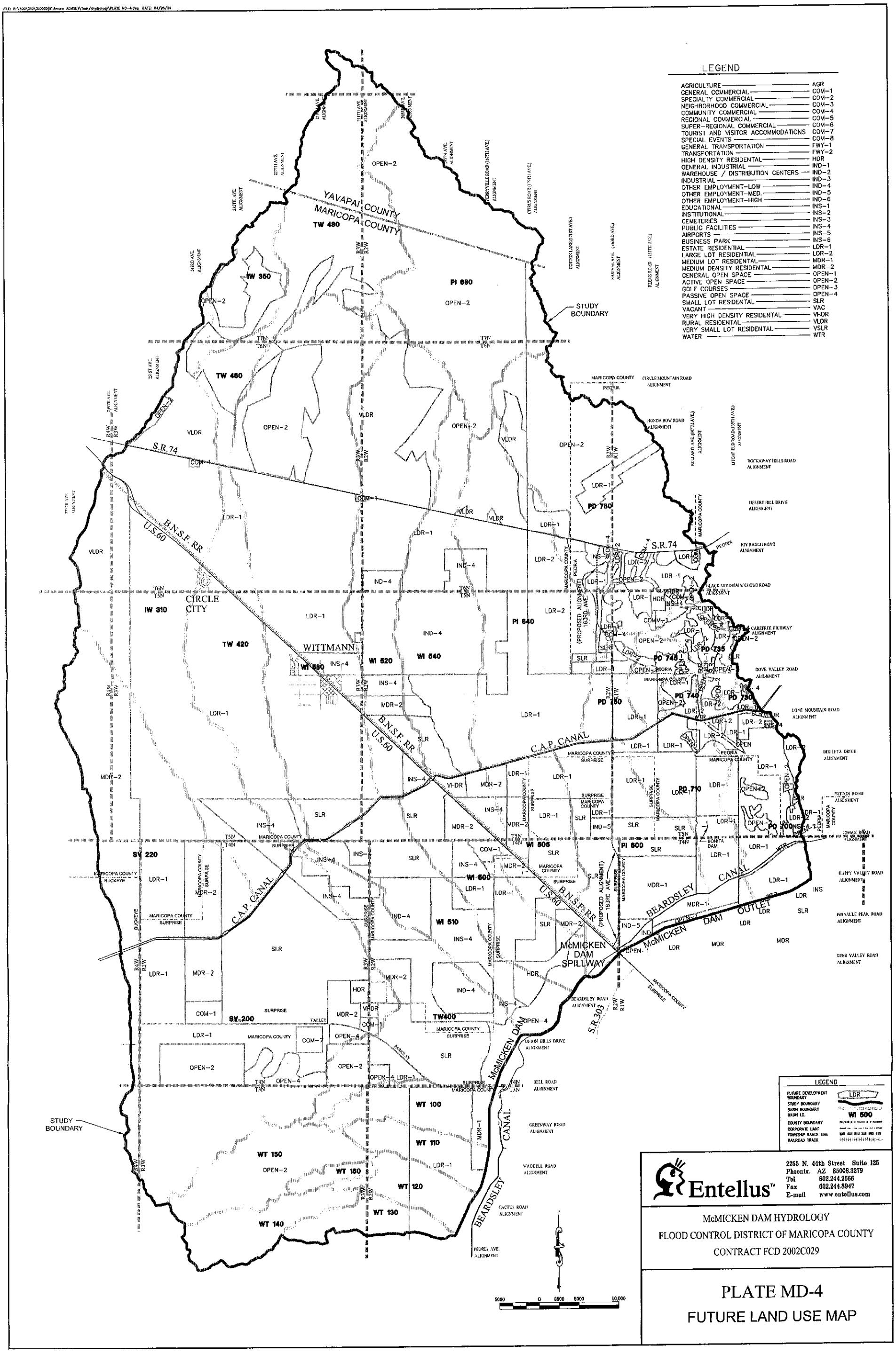

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PLATE MD-4
FUTURE LAND USE MAP

APPENDIX A. REFERENCES

A.1. Data Collection Summary

All the data collected to obtain the information in this report are identified in the Data Collection Report. This report includes complete bibliographic information of the documents and references used in this report.

A.2. Reference Documents

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35 Drainage Manual, by *Arizona Department of Transportation*, August 1987.

36 Hydrometeorological Report No.49, Probable Maximum Precipitation Estimates, Colorado River and Great Basin Drainage, US Corp of Engineers, 1977

37 Draft Hydrology Design Manual for Maricopa County, Arizona, Volume-1 Hydrology, by *Flood Control District of Maricopa County*, 2003.

38 Maricopa County Flood Control District Gage Information, www.fcd.maricopa.gov/services/ALERT, May 2003.

APPENDIX B. HYDROLOGIC ANALYSIS SUPPORTING DOCUMENTATION

B.1. Precipitation Data

B.1.1. 100-yr, 200-yr, and 500-yr, 24-hr storm events

B.1.2. 6-hr and 72-hr Probable Maximum Flood (PMF)

B.2. Physical Parameter Calculations

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B.2.2. Land Use

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B.2.4. Hydraulic Length and Slope

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B.3. Hydrograph Routing Data

B.4. Storage Routing Data

B.5. Flow Splits and Diversions Data

B.6. Summary of Peak Discharge

B.7. Manning's n Value Report

B.8. Gage Data

B.1. Precipitation Data

B.1.1. 100-yr, 200-yr, and 500-yr, 24-hr storm events

B.1.2. 6-hr and 72-hr Probable Maximum Flood (PMF)

B.1.1. 100-yr, 200-yr, and 500-yr, 24-hr storm events

APPENDIX B.1.1

Entellus

SHEET 1 OF 14

BY JS DATE 9-9-03

CHECK PW DATE 9-10-03

CLIENT FCDMC

JOB: Wittmann Area Drainage Master Study Update

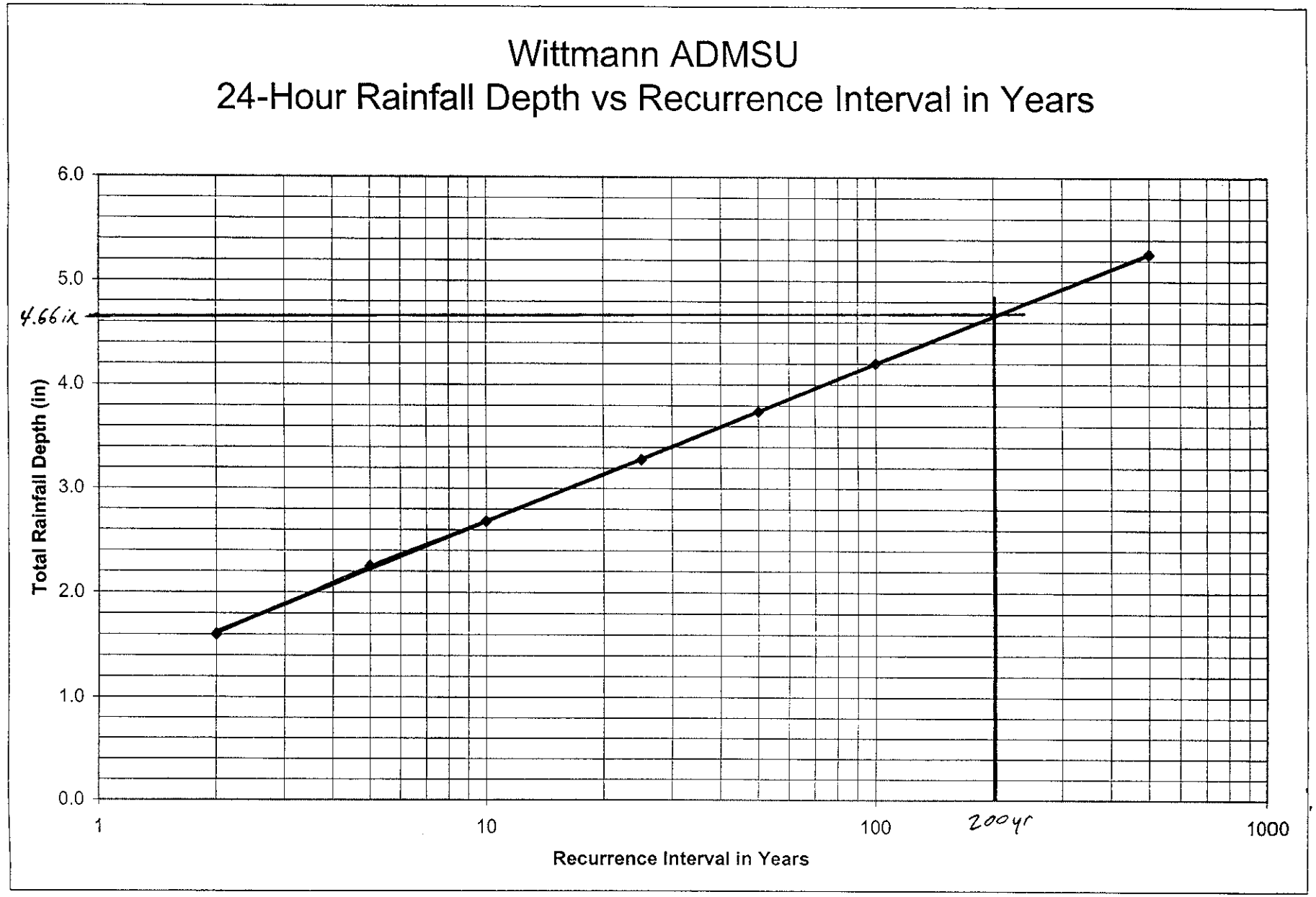
JOB NO. 310

200yr 24hr Precipitation Calculations
(Check of Log Log plot for 200yr Storm)

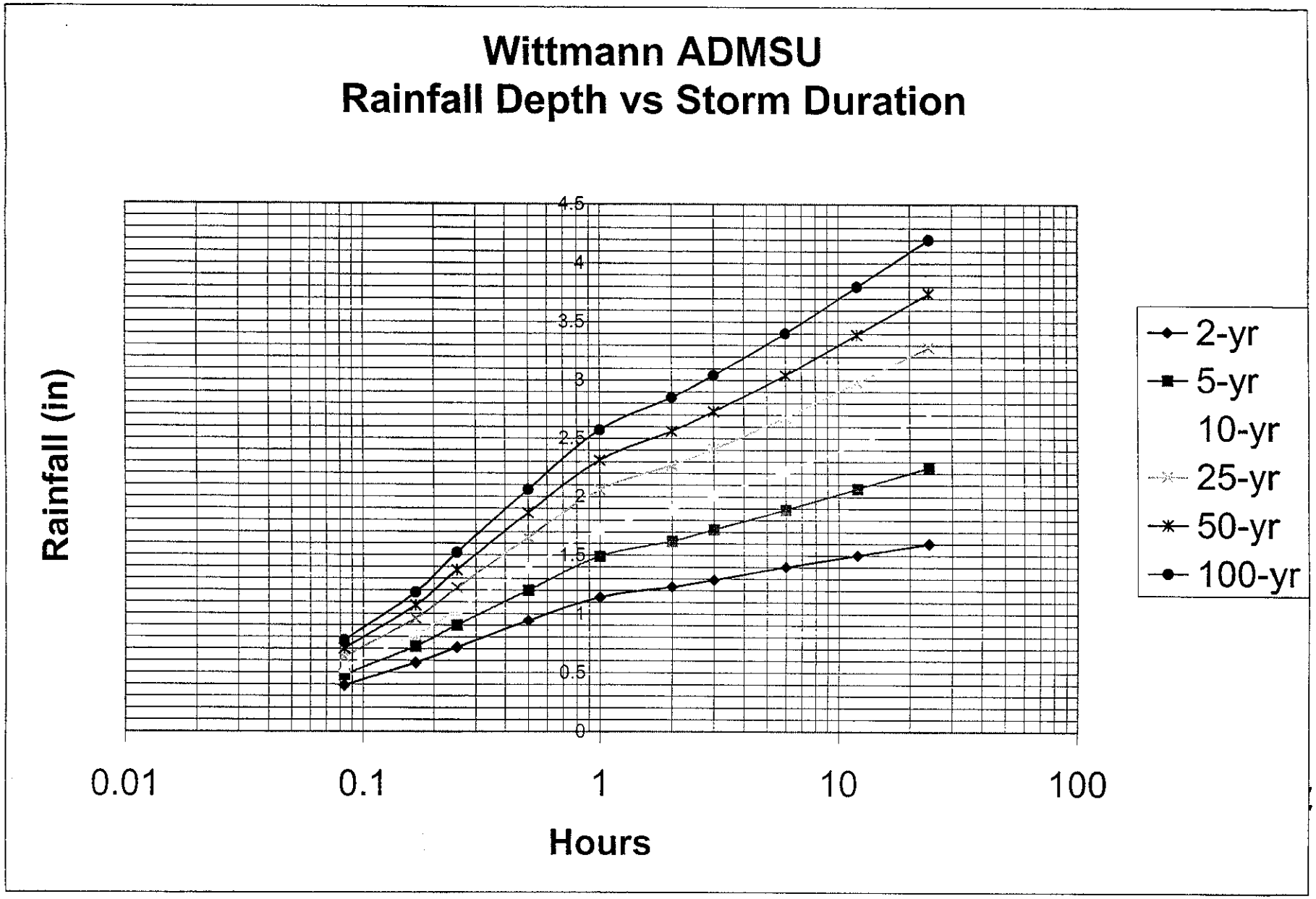
From Log Log plot of PreFre output for 24 hour storms the following equation was produced:
Rainfall Depth = .6597 Ln (# Year Storm) + 1.1613
(see attached charts)

# Year Storm	Rainfall Depth Using Equation Above (inches)	Rainfall Depth Using PreFre (inches)
10	2.68	2.7
100	4.2	4.2
200	4.66 x	
500	5.26	5.3

Therefore, using the equation developed from the Log Log plot attached, the 200yr 24hr rainfall depth is 4.66 inches.



APPENDIX B.1.1


Wittmann ADMSU
Rainfall Depth vs Storm Duration
Rainfall (in)
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
0.01
0.1
1
10
100
Hours
2-yr
5-yr
10-yr
25-yr
50-yr
100-yr

Flood Control District of Maricopa County
EXAMPLE2 - Single Storm, 24 Hr, Green Ampt, S-Graph, Normal Depth
Rainfall Data

Primary Zone Number: **7** Latitude: **0.0** Elevation: **0**

Short Duration Zone Number: **8** Longitude: **0.0**

	Point Values (in)						
Duration	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr	500-yr
5 MIN	0.39	0.48	0.54	0.63	0.70	0.77	0.93
10 MIN	0.58	0.72	0.82	0.96	1.07	1.18	1.44
15 MIN	0.71	0.90	1.03	1.22	1.37	1.52	1.86
30 MIN	0.94	1.20	1.39	1.65	1.86	2.06	2.53
1 HOUR	1.14	1.49	1.72	2.06	2.31	2.57	3.17
2 HOUR	1.23	1.62	1.89	2.27	2.56	2.85	3.53
3 HOUR	1.29	1.72	2.01	2.41	2.73	3.04	3.77
6 HOUR	1.40	1.89	2.22	2.68	3.04	3.40	4.22
12 HOUR	1.50	2.07	2.45	2.98	3.39	3.80	4.74
24 HOUR	1.60	2.25	2.68	3.28	3.74	4.20	5.26

APPENDIX B.1.1

Page 3 of 14

Wittmann ADMSU McMicken Dam Hydrology
HEC-1 Data for 500-yr 24-hour Distribution

JD	5.26	0.01								
PC	0	0.002	0.005	0.008	0.011	0.014	0.017	0.02	0.023	0.026
PC	0.029	0.032	0.035	0.038	0.041	0.044	0.048	0.052	0.056	0.06
PC	0.064	0.068	0.072	0.076	0.08	0.085	0.09	0.095	0.1	0.105
PC	0.11	0.115	0.12	0.126	0.133	0.14	0.147	0.155	0.163	0.172
PC	0.181	0.191	0.203	0.218	0.236	0.257	0.283	0.387	0.663	0.707
PC	0.735	0.758	0.776	0.791	0.804	0.815	0.825	0.834	0.842	0.849
PC	0.856	0.863	0.869	0.875	0.881	0.887	0.893	0.898	0.903	0.908
PC	0.913	0.918	0.922	0.926	0.93	0.934	0.938	0.942	0.946	0.95
PC	0.953	0.956	0.959	0.962	0.965	0.968	0.971	0.974	0.977	0.98
PC	0.983	0.986	0.989	0.992	0.995	0.998	1			
JD	4.9444	10								
JD	4.734	30								
JD	4.5236	60								
JD	4.4447	90								
JD	4.38684	120								
JD	4.3395	150								
JD	4.208	300								
JD	4.1028	500								

Note: This data was generated using DDMSW version 1.8.

Wittmann ADMSU McMicken Dam Hydrology
HEC-1 Data for 200-yr 24-hour Distribution

JD	4.66	0.01								
PC	0	0.002	0.005	0.008	0.011	0.014	0.017	0.02	0.023	0.026
PC	0.029	0.032	0.035	0.038	0.041	0.044	0.048	0.052	0.056	0.06
PC	0.064	0.068	0.072	0.076	0.08	0.085	0.09	0.095	0.1	0.105
PC	0.11	0.115	0.12	0.126	0.133	0.14	0.147	0.155	0.163	0.172
PC	0.181	0.191	0.203	0.218	0.236	0.257	0.283	0.387	0.663	0.707
PC	0.735	0.758	0.776	0.791	0.804	0.815	0.825	0.834	0.842	0.849
PC	0.856	0.863	0.869	0.875	0.881	0.887	0.893	0.898	0.903	0.908
PC	0.913	0.918	0.922	0.926	0.93	0.934	0.938	0.942	0.946	0.95
PC	0.953	0.956	0.959	0.962	0.965	0.968	0.971	0.974	0.977	0.98
PC	0.983	0.986	0.989	0.992	0.995	0.998	1			
JD	4.3804	10								
JD	4.194	30								
JD	4.0076	60								
JD	3.9377	90								
JD	3.88644	120								
JD	3.8445	150								
JD	3.728	300								
JD	3.6348	500								

Note: The total rainfall was obtained using the "24-Hour Rainfall Depth vs Recurrence Interval in Years" chart
The aerial reduction was estimated using the 100-yr 24-hour reduction amounts.

APPENDIX B.1.1

Wittmann ADMSU McMicken Dam Hydrology
HEC-1 Data for 100-yr 24-hour Distribution

JD	4.2	0.01								
PC	0	0.002	0.005	0.008	0.011	0.014	0.017	0.02	0.023	0.026
PC	0.029	0.032	0.035	0.038	0.041	0.044	0.048	0.052	0.056	0.06
PC	0.064	0.068	0.072	0.076	0.08	0.085	0.09	0.095	0.1	0.105
PC	0.11	0.115	0.12	0.126	0.133	0.14	0.147	0.155	0.163	0.172
PC	0.181	0.191	0.203	0.218	0.236	0.257	0.283	0.387	0.663	0.707
PC	0.735	0.758	0.776	0.791	0.804	0.815	0.825	0.834	0.842	0.849
PC	0.856	0.863	0.869	0.875	0.881	0.887	0.893	0.898	0.903	0.908
PC	0.913	0.918	0.922	0.926	0.93	0.934	0.938	0.942	0.946	0.95
PC	0.953	0.956	0.959	0.962	0.965	0.968	0.971	0.974	0.977	0.98
PC	0.983	0.986	0.989	0.992	0.995	0.998	1			
JD	3.948	10								
JD	3.78	30								
JD	3.612	60								
JD	3.553	90								
JD	3.503	120								
JD	3.465	150								
JD	3.36	300								
JD	3.276	500								

Note: This data was generated using DDMSW version 1.8.

Wittmann ADMSU McMicken Dam Hydrology
HEC-1 Data for 10-yr 24-hour Distribution

JD	2.68	0.01								
PC	0	0.002	0.005	0.008	0.011	0.014	0.017	0.02	0.023	0.026
PC	0.029	0.032	0.035	0.038	0.041	0.044	0.048	0.052	0.056	0.06
PC	0.064	0.068	0.072	0.076	0.08	0.085	0.09	0.095	0.1	0.105
PC	0.11	0.115	0.12	0.126	0.133	0.14	0.147	0.155	0.163	0.172
PC	0.181	0.191	0.203	0.218	0.236	0.257	0.283	0.387	0.663	0.707
PC	0.735	0.758	0.776	0.791	0.804	0.815	0.825	0.834	0.842	0.849
PC	0.856	0.863	0.869	0.875	0.881	0.887	0.893	0.898	0.903	0.908
PC	0.913	0.918	0.922	0.926	0.93	0.934	0.938	0.942	0.946	0.95
PC	0.953	0.956	0.959	0.962	0.965	0.968	0.971	0.974	0.977	0.98
PC	0.983	0.986	0.989	0.992	0.995	0.998	1			
JD	2.519	10								
JD	2.412	30								
JD	2.305	60								
JD	2.267	90								
JD	2.235	120								
JD	2.211	150								
JD	2.144	300								
JD	2.09	500								

Note: This data was generated using DDMSW version 1.8.

APPENDIX B.1.1

Wittmann ADMSU McMicken Dam Hydrology
HEC-1 Data for 100-yr 6-hour Distribution

JD	3.4	0.01								
PC	0	0.008	0.016	0.025	0.033	0.041	0.05	0.058	0.066	0.074
PC	0.087	0.099	0.118	0.138	0.216	0.377	0.834	0.911	0.931	0.95
PC	0.962	0.972	0.983	0.991	1					
JD	3.378	0.5								
JD	3.314	2.8								
PC	0	0.009	0.016	0.025	0.034	0.042	0.051	0.059	0.067	0.076
PC	0.087	0.1	0.12	0.163	0.252	0.451	0.694	0.837	0.9	0.938
PC	0.95	0.963	0.975	0.988	1					
JD	3.135	16								
PC	0	0.009	0.02	0.03	0.048	0.063	0.076	0.09	0.105	0.119
PC	0.135	0.152	0.175	0.222	0.304	0.472	0.67	0.796	0.868	0.912
PC	0.946	0.96	0.973	0.987	1					
JD	2.761	90								
PC	0	0.021	0.035	0.051	0.071	0.087	0.105	0.125	0.143	0.16
PC	0.179	0.201	0.232	0.281	0.364	0.5	0.658	0.773	0.841	0.888
PC	0.927	0.945	0.964	0.982	1					
JD	1.938	500								
PC	0	0.024	0.043	0.059	0.078	0.098	0.119	0.141	0.162	0.186
PC	0.212	0.239	0.271	0.321	0.408	0.515	0.627	0.735	0.814	0.864
PC	0.907	0.93	0.954	0.977	1					

Note: This data was generated using DDMSW version 1.8.

Wittmann ADMSU McMicken Dam Hydrology
HEC-1 Data for 10-yr 6-hour Distribution

JD	2.22	0.01								
PC	0	0.008	0.016	0.025	0.033	0.041	0.05	0.058	0.066	0.074
PC	0.087	0.099	0.118	0.138	0.216	0.377	0.834	0.911	0.931	0.95
PC	0.962	0.972	0.983	0.991	1					
JD	2.206	0.5								
JD	2.164	2.8								
PC	0	0.009	0.016	0.025	0.034	0.042	0.051	0.059	0.067	0.076
PC	0.087	0.1	0.12	0.163	0.252	0.451	0.694	0.837	0.9	0.938
PC	0.95	0.963	0.975	0.988	1					
JD	2.047	16								
PC	0	0.009	0.02	0.03	0.048	0.063	0.076	0.09	0.105	0.119
PC	0.135	0.152	0.175	0.222	0.304	0.472	0.67	0.796	0.868	0.912
PC	0.946	0.96	0.973	0.987	1					
JD	1.803	90								
PC	0	0.021	0.035	0.051	0.071	0.087	0.105	0.125	0.143	0.16
PC	0.179	0.201	0.232	0.281	0.364	0.5	0.658	0.773	0.841	0.888
PC	0.927	0.945	0.964	0.982	1					
JD	1.265	500								
PC	0	0.024	0.043	0.059	0.078	0.098	0.119	0.141	0.162	0.186
PC	0.212	0.239	0.271	0.321	0.408	0.515	0.627	0.735	0.814	0.864
PC	0.907	0.93	0.954	0.977	1					

Note: This data was generated using DDMSW version 1.8.

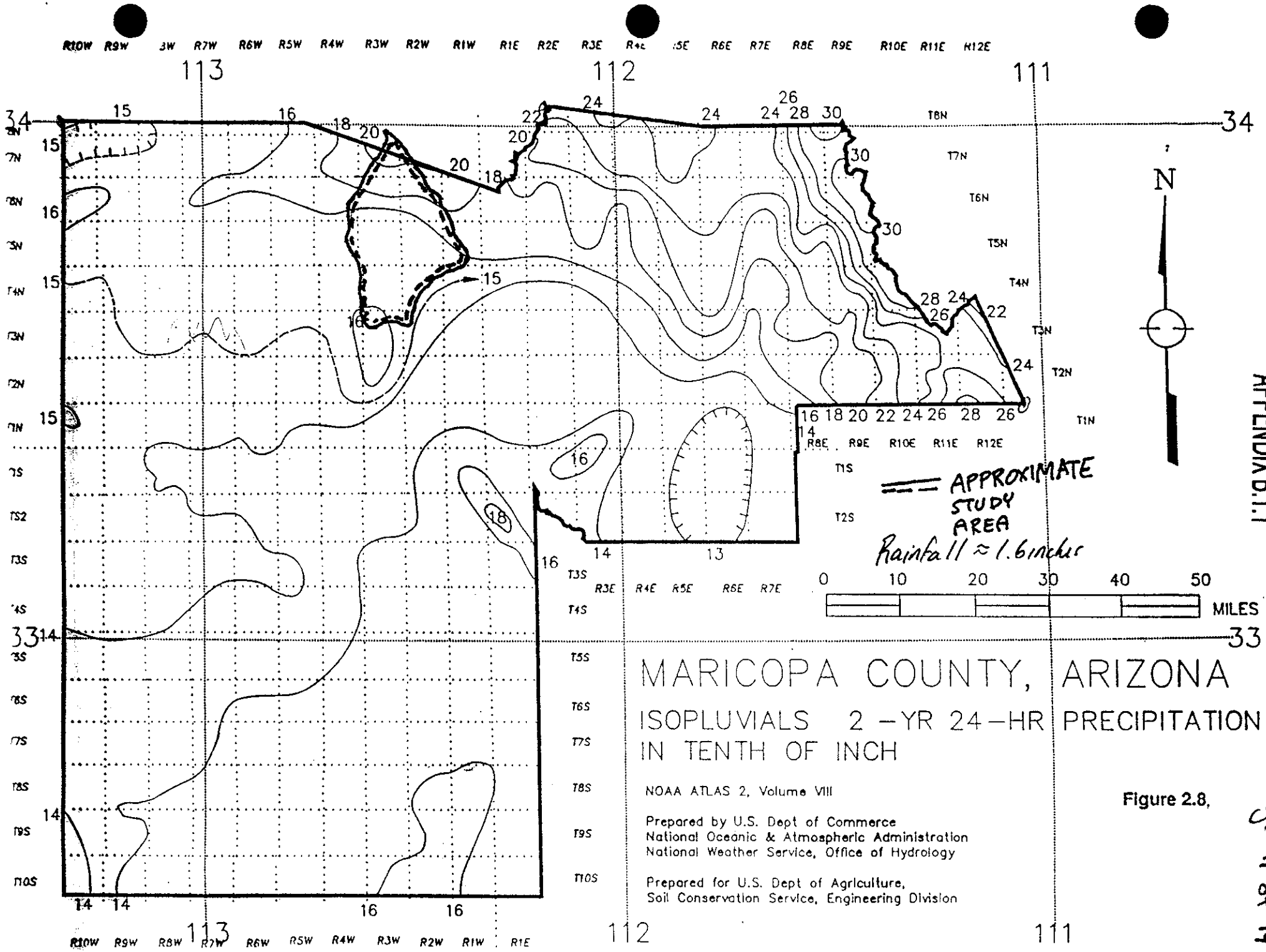


Figure 2.8.

APPENDIX B.1.1

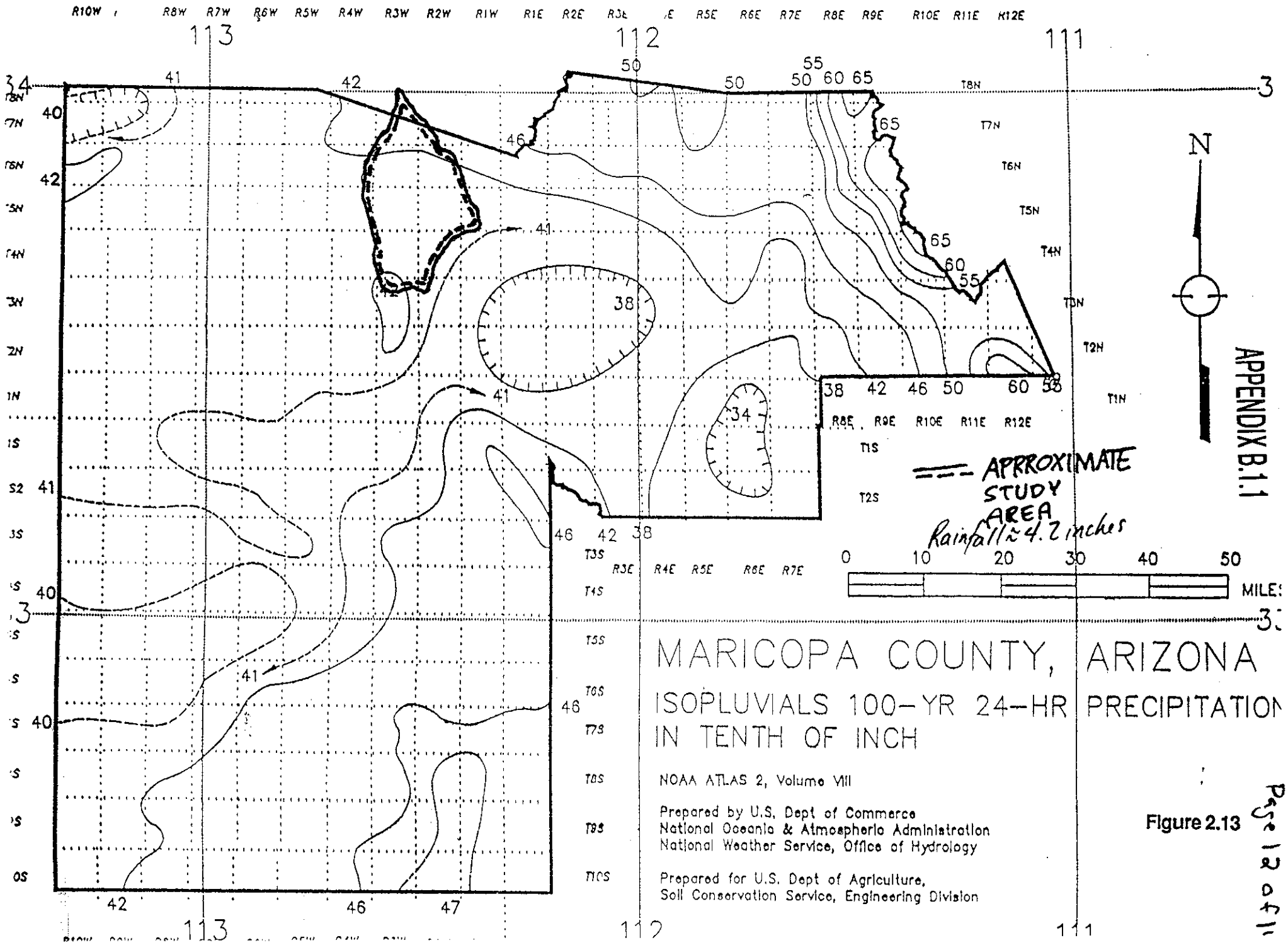


Figure 2.13

APPENDIX B.1.1

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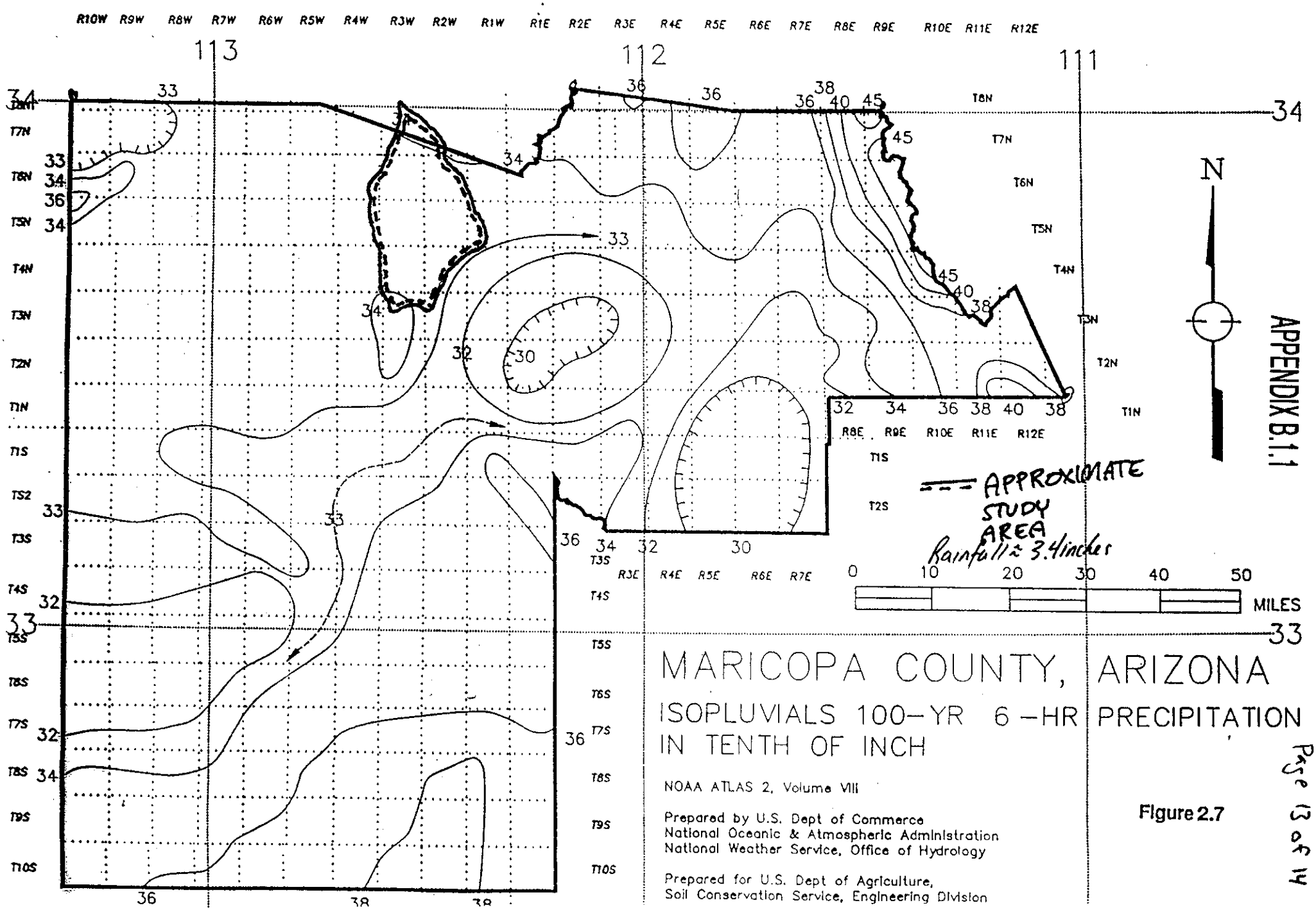

Figure 2.7

APPENDIX B.1.1

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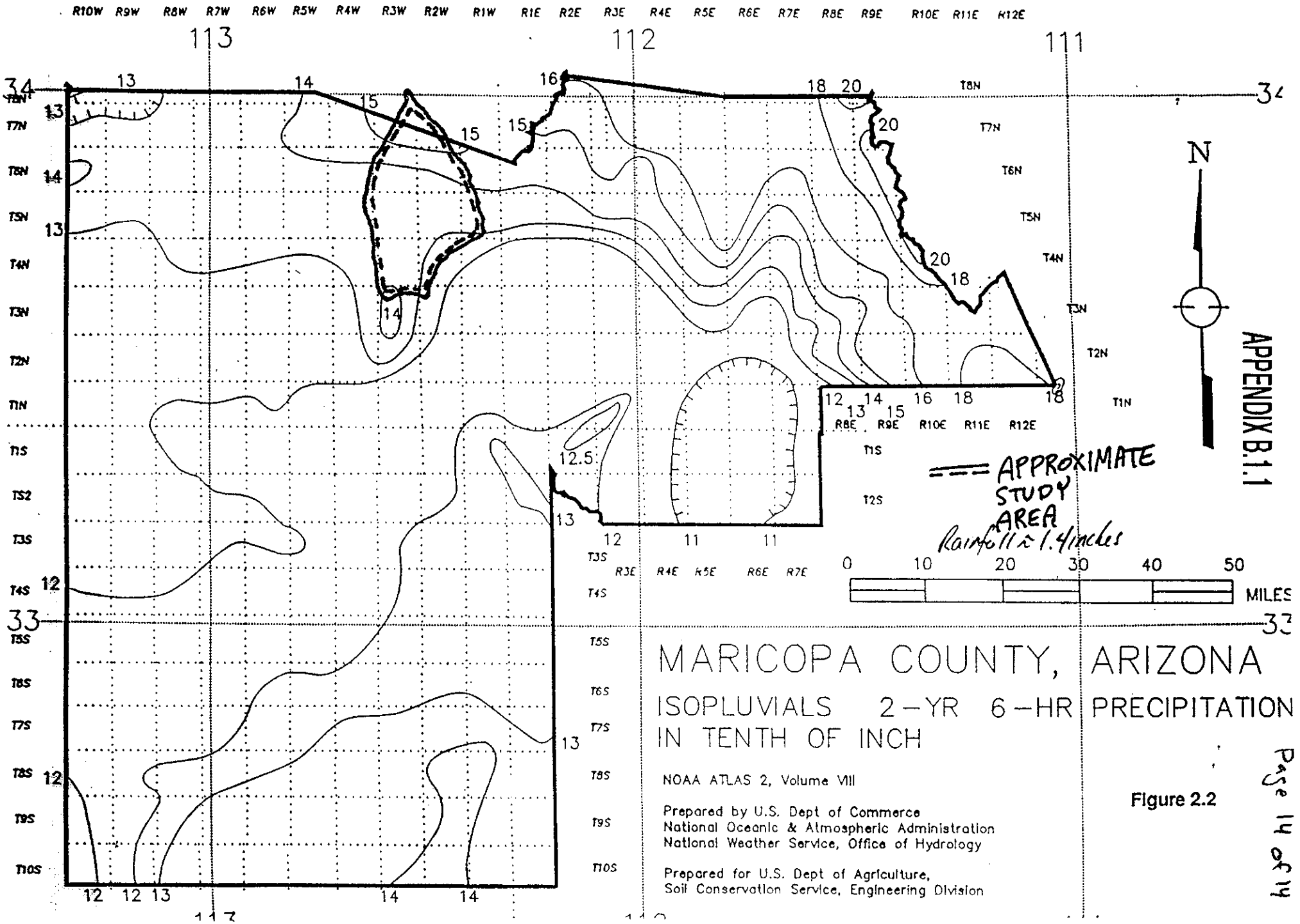


MARICOPA COUNTY, ARIZONA

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

NOAA ATLAS 2, Volume VIII

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

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

Figure 2.2

APPENDIX B.1.1

B.1.2. 6-hr and 72-hr Probable Maximum Flood (PMF)

6 Hour Local PMP

72 Hour General PMP

6 Hour Local PMP

Entellus™

SHEET 1 OF 3

BY JGA DATE 2-Jul-08

PROJECT: Wittman ADMSU

LOCATION: McMicken Dam **JOB NO.** 310.032

LOCAL PMP (Average Depth)

Area	239	mi^2
Latitude		
Longitude		
Elevation	1100	ft

1 Average 1-hr 1-mi2 PMP (Figure 4.5)	11.6 in.
2a Reduction for elevation. (No adjustment for elevations up to 5,000 feet: 5% decrease per 1,000 feet above 5,000 feet	100 %
2b Multiply step 1 by step 2a	11.6 in.
3 Average 6/1 ratio for drainage(figure 4.7)	1.32

	Duration (hr)								
	1/4	1/2	3/4	1	2	3	4	5	6
4 Duration variation for 6/1-hr ratio of step 3 (table 4.4)	71.8	87.8	94.6	100.0	114.8	122.0	126.4	129.8	132 %
5 1-mi^2 PMP for indicated duration (step 2b X step 4)	8.329	10.18	11.0	11.6	13.317	14.152	14.6624	15.0568	15.312 in.
6 Areal reduction (figure 4.9)	17	22	25.0	28	32	36	38	40	42 %
7 Areall reduction PMP (steps 5 X 6)	1.416	2.241	2.7	3.248	4.2614	5.0947	5.571712	6.02272	6.431 in.
8 Incremental PMP (successive Subtraction in step 7)				3.248	1.013	0.833	0.477	0.451	0.408 in.
	1.416	0.825	0.503	0.505 } 15-min. increments					
9 Time sequence of incr-mental PMP according to: (NOAA or COE)		coe EMR110-2-1411							
Hourly increment (table 4.7)				6	4	2	1	3	5
				0.40832	0.477	1.0134	3.248	0.83334	0.451 in.
Four largest 15-min. Increments (table 4.8)				1.4159	0.8248	0.5046	0.502744		in.

::

Entellus™

SHEET 2 OF 3

PROJECT: Wittman ADMSU

LOCATION: McMicken Dam JOB NO. 310.032

LOCAL PMP (Average Depth) - Continue

Cumulative Hourly and maximum 15-min PMP (COE

Time (Hour)	15-min PMP	Hourly PMP	Cumulative PMP
0			0.00
1.00		0.41	0.41
2.00		0.48	0.89
3.00		1.01	1.90
3.25	1.42		3.31
3.50	0.82		4.14
3.75	0.50		4.64
4.00	0.50	3.25	5.15
5.00		0.83	5.98
6.00		0.45	6.43

Cumulative Hourly and maximum 15-min PMP (NOAA

Time (Hour)	15-min PMP	Hourly PMP	Cumulative PMP
0			0.00
1.00		0.45	0.45
2.00		0.83	1.28
2.25	1.42		2.70
2.50	0.82		3.53
2.75	0.50		4.03
3.00	0.50	3.25	4.53
4.00		1.01	5.55
5.00		0.48	6.02
6.00		0.41	6.43

Cumulative PMP Distribution

Time (hours)	Cumulative Depth (in)	Unit Cumulative Depth
0.00	0.00	0.0000
0.25	0.10	0.0155
0.50	0.21	0.0327
0.75	0.31	0.0482
1.00	0.41	0.0635
1.25	0.53	0.0824
1.50	0.65	0.1011
1.75	0.77	0.1197
2.00	0.89	0.1377
2.25	1.14	0.1773
2.50	1.40	0.2177
2.75	1.65	0.2566
3.00	1.90	0.2952
3.25	3.31	0.5154
3.50	4.14	0.6437
3.75	4.64	0.7221
4.00	5.15	0.8003
4.25	5.36	0.8335
4.50	5.57	0.8661
4.75	5.77	0.8972
5.00	5.98	0.9299
5.25	6.09	0.9470
5.50	6.21	0.9656
5.75	6.32	0.9827
6.00	6.43	1.0000

Cumulative PMP Distribution

Time (hours)	Cumulative Depth (in)	Unit Cumulative Depth
0.00	0.00	0.0000
0.25	0.11	0.0171
0.50	0.23	0.0358
0.75	0.34	0.0529
1.00	0.45	0.0701
1.25	0.66	0.1026
1.50	0.87	0.1353
1.75	1.07	0.1664
2.00	1.28	0.1997
2.25	2.70	0.4199
2.50	3.53	0.5481
2.75	4.03	0.6266
3.00	4.53	0.7048
3.25	4.79	0.7448
3.50	5.04	0.7837
3.75	5.30	0.8241
4.00	5.55	0.8623
4.25	5.67	0.8817
4.50	5.79	0.9003
4.75	5.90	0.9174
5.00	6.02	0.9365
5.25	6.12	0.9516
5.50	6.23	0.9687
5.75	6.33	0.9843
6.00	6.43	1.0000

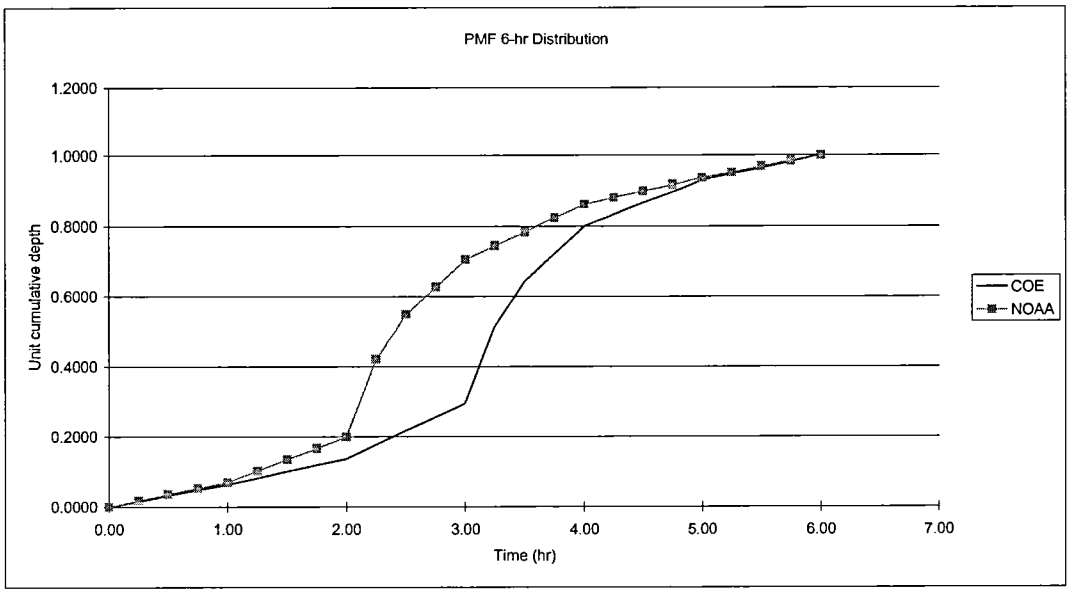
Entellus™

SHEET 3 OF 3

PROJECT: Wittman ADMSU

LOCATION: McMicken Dam JOB NO. 310.032

######



Louis Lovelg

U.S. DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

U.S. DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS

HYDROMETEOROLOGICAL REPORT NO. 49

Probable Maximum Precipitation Estimates, Colorado River and Great Basin Drainages

Prepared by
E. Marshall Hansen,
Francis K. Schwarz, and John T. Riedel
Hydrometeorological Branch
Office of Hydrology
National Weather Service

Silver Spring, Md.
September 1977

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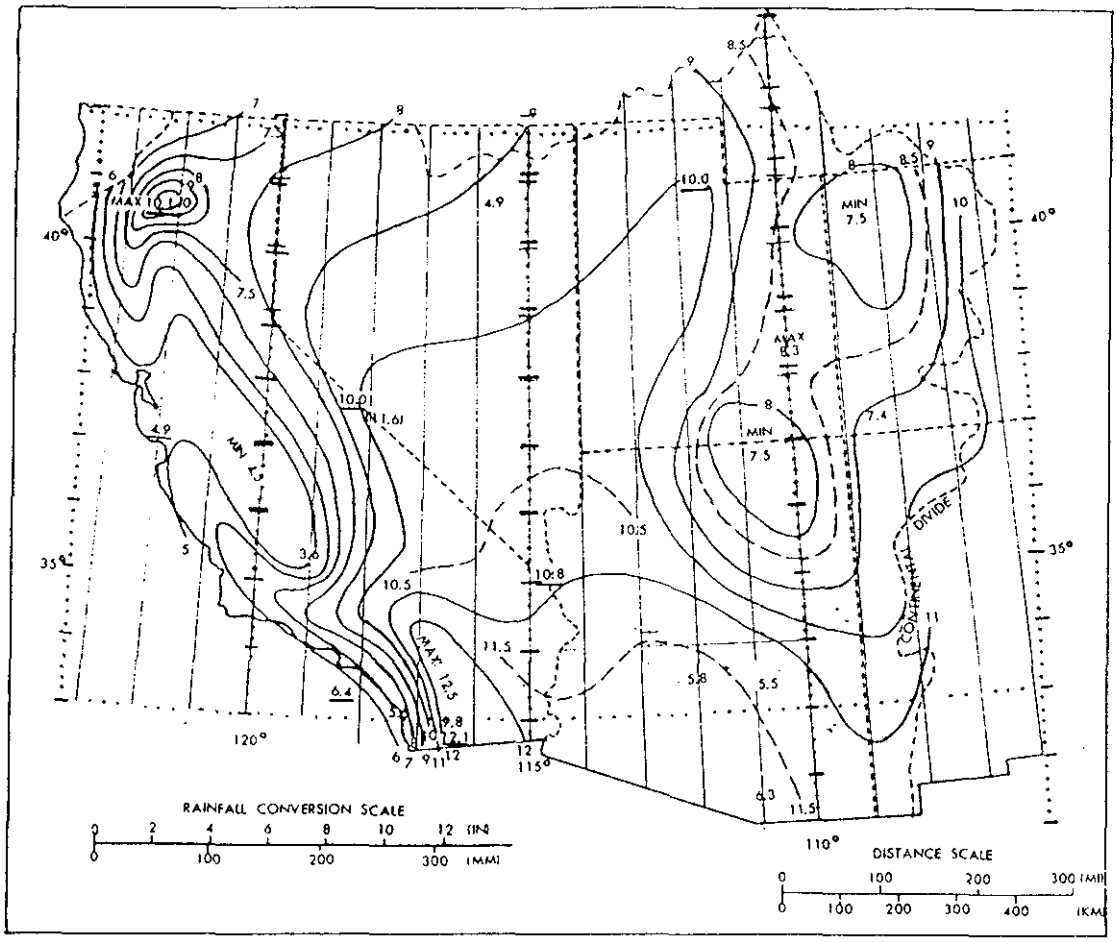


Figure 4.5--Local-storm PMP for 1 mi^2 (2.6 km^2) 1 hr. Directly applicable for locations between sea level and 5000 ft (1524 m). Elevation adjustment must be applied for locations above 5000 ft.

events. In contrast to figure 4.4, figure 4.5 maintains a maximum between these two locations. There is no known meteorological basis for a different solution. The analysis suggests that in the northern portion of the region maximum PMP occurs between the Sierra Nevada on the west and the Wasatch range on the east.

A discrete maximum (> 10 inches, 254 mm) occurs at the north end of the Sacramento Valley in northern California because the northward-flowing moist air is increasingly channeled and forced upslope. Support for this PMP center comes from the Newton, Kennett, and Red Bluff storms (fig. 4.1). Although the analysis in this region appears to be an extension of the broad maximum through the center of the Southwestern Region, it does not indicate the direction of moist inflow. The pattern has evolved primarily as a result of attempts to tie plotted maxima into a reasonable picture while considering inflow directions, terrain effects, and moisture potential.

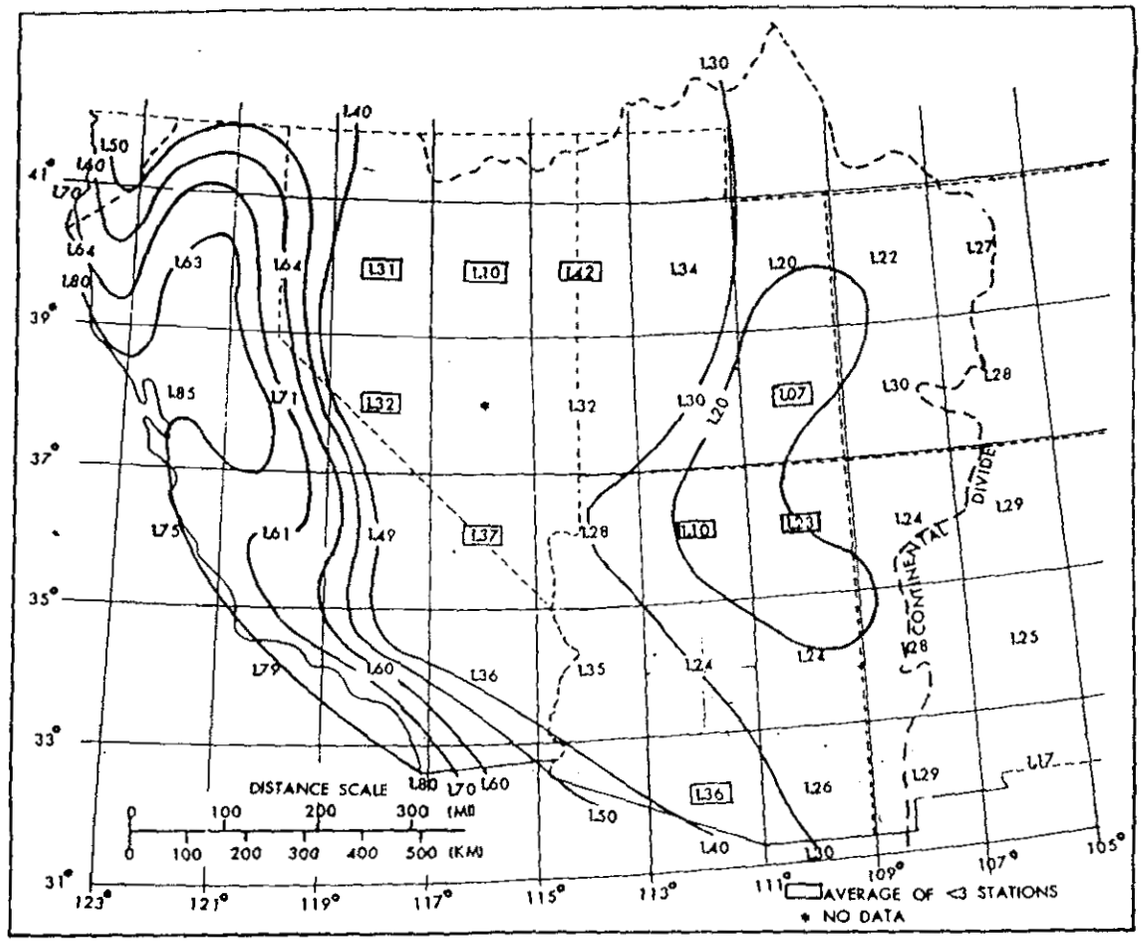


Figure 4.7.--Analysis of 6/1-hr ratios of averaged maximum station data (plotted at midpoints of a 2° latitude-longitude grid).

establish the basic depth-duration curve, then structure a variable set of depth-duration curves to cover the range of 6/1-hr ratios that are needed.

Three sets of data were considered for obtaining a base relation (see table 4.3 for depth-duration data):

a. An average of depth-duration relations from each of 17 greatest 3-hr rains from summer storms (1940-49) in Utah (U. S. Weather Bureau 1951b) and in unpublished tabulations for Nevada and Arizona (1940-63). The 3-hr amounts ranged from 1 to 3 inches (25 to 76 mm) in these events.

b. An average depth-duration relation from 14 of the most extreme short-duration storms listed in Storm Rainfall (U. S. Army, Corps of Engineers 1945-). These storms come from Eastern and Central States and have 3-hr amounts of 5 to 22 inches (127 to 559 mm).

ratios than storms with high 3/1-hr ratios. The geographical distribution of 15-min to 1-hr ratios also were inversely correlated with magnitudes of the 6/1-hr ratios of figure 4.7. For example, Los Angeles and San Diego (high 6/1-hr ratios) have low 15-min to 1-hr ratios (approximately 0.60) whereas the 15-min to 1-hr ratios in Arizona and Utah (low 6/1-hr ratios) were generally higher (approximately 0.75).

Depth-duration relations for durations less than 1 hour were then smoothed to provide a family of curves consistent with the relations determined for 1 to 6 hours, as shown in figure 4.3. Adjustment was necessary to some of the curves to provide smoother relations through the common point at 1 hour.

We believe we were justified in reducing the number of the curves shown in figure 4.3 for durations less than 1 hour, letting one curve apply to a range of 6/1-hr ratios. The corresponding curves have been indicated by letter designators, A-D, on figure 4.3. As an example, for any 6-hr amount between 115% and 135% of 1-hr, 1-mi^2 (2.6-km^2) PMP, the associated values for durations less than 1 hour are obtained from the curve designated as "B".

Table 4.4 lists durational variations in percent of 1-hr PMP for selected 6/1-hr rain ratios. These values were interpolated from figure 4.3.

To determine 6-hr PMP for a basin, use figure 4.3 (or table 4.4) and the geographical distribution of 6/1-hr ratios given in figure 4.7.

Table 4.4.--Durational variation of 1-mi^2 (2.6-km^2) local-storm PMP in percent of 1-hr PMP (see figure 4.3)

6/1-hr ratio	Duration (hr) 1/4	1/2	3/4	1	2	3	4	5	6
1.1	86	93	97	100	107	109	110	110	110
1.2	74	89	95	100	110	115	118	119	120
1.3	74	89	95	100	114	121	125	128	130
1.4	63	83	93	100	118	126	132	137	140
1.5	63	83	93	100	121	132	140	145	150
1.6	43	70	87	100	124	138	147	154	160
1.8	43	70	87	100	130	149	161	171	180
2.0	43	70	87	100	137	161	175	188	200

4.5 Depth-Area Relation

We have thus far developed local-storm PMP for an area of 1 mi^2 (2.6 km^2). To apply PMP to a basin, we need to determine how 1-mi^2 (2.6-km^2) PMP should decrease with increasing area. We have adopted depth-area relations based on rainfalls in the Southwest and from consideration of a model thunderstorm.

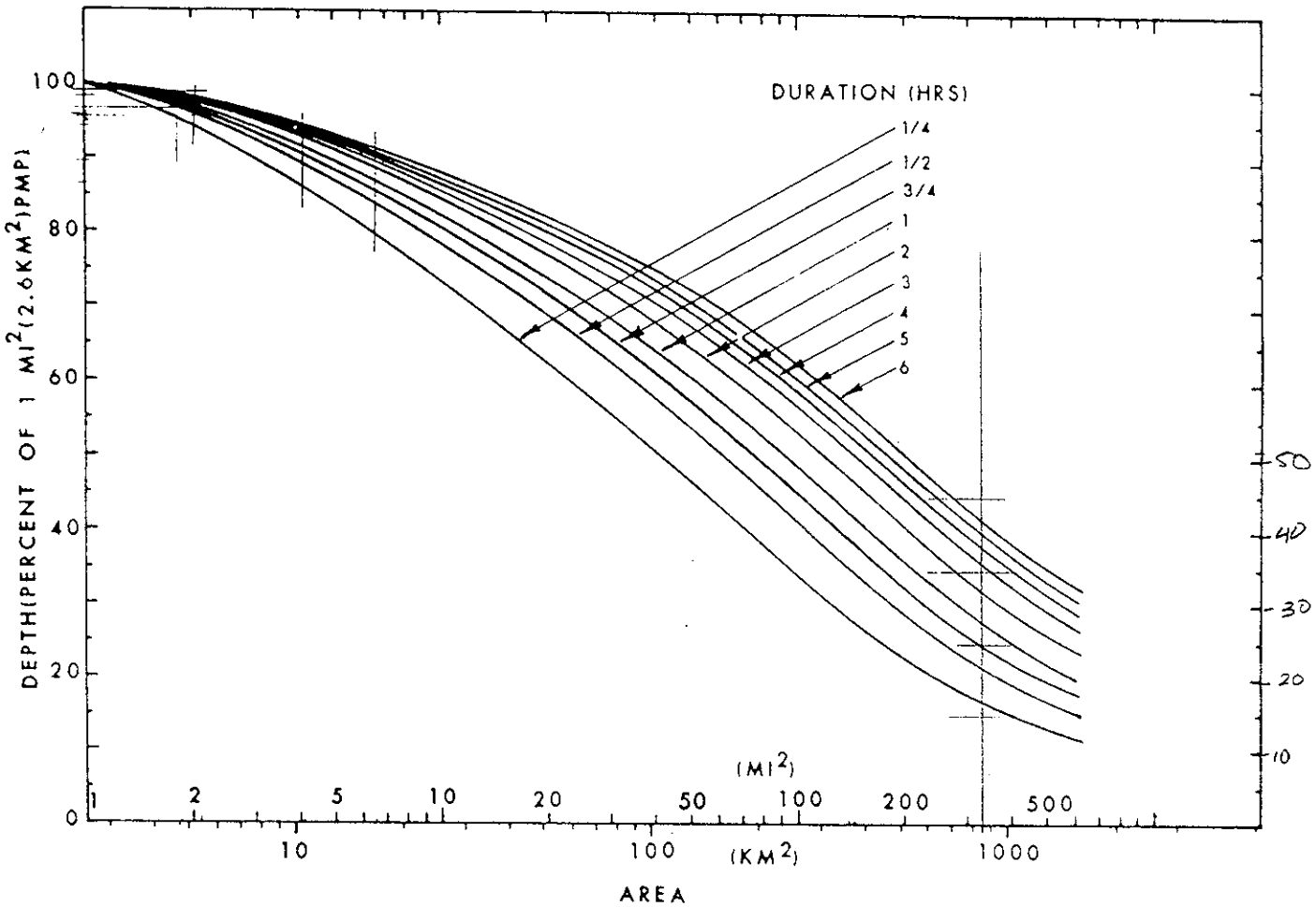
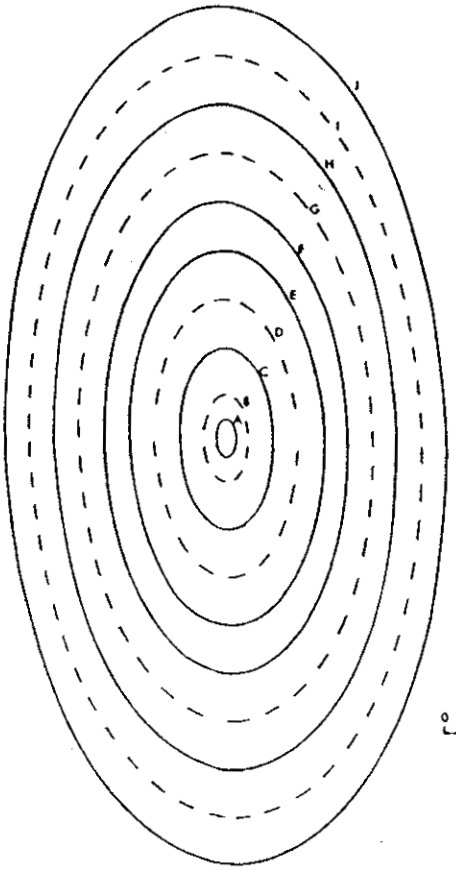


Figure 4.9.--Adopted depth-area relations for local-storm PMP.



ISOHYET	INCLOSED AREA (SQ.MI.)	(KM²)
A	1	2.6
B	5	13
C	25	65
D	55	142
E	95	246
F	150	388
G	220	570
H	300	777
I	385	997
J	500	1295

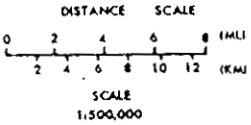


Figure 4.10.--Idealized local-storm isohyetal pattern.

storm period. The sequence of hourly incremental PMP for the Southwest 6-hr thunderstorm in accord with this study is presented in column 2 of table 4.7. A small variation from this sequence is given in Engineering Manual 1110-2-1411 (U. S. Army, Corps of Engineers 1965). The latter, listed in column 3 of table 4.7, places greater incremental amounts somewhat more toward the end of the 6-hr storm period. In application, the choice of either of these distributions is left to the user since one may prove to be more critical in a specific case than the other.

Table 4.7.--Time sequence for hourly incremental PMP in 6-hr storm

Increment	HMR No. 5[1]	EM1110-2-1411[2]
	Sequence Position	
Largest hourly amount	Third	Fourth
2nd largest	Fourth	Third
3rd largest	Second	Fifth
4th largest	Fifth	Second
5th largest	First	Last
least	Last	First

[1] U. S. Weather Bureau 1947.
[2] U. S. Corps of Engineers 1952.

Also of importance is the sequence of the four 15-min incremental PMP values. We recommend a time distribution, table 4.8, giving the greatest intensity in the first 15-min interval (U.S. Weather Bureau 1947). This is based on data from a broad geographical region. Additional support for this time distribution is found in the reports of specific storms by Keppell (1963) and Osborn and Renard (1969).

Table 4.8.--Time sequence for 15-min incremental PMP within 1 hr.

Increment	Sequence Position
Largest 15-min amount	First
2nd largest	Second
3rd largest	Third
least	Last

4.8 Seasonal Distribution

The time of the year when local-storm PMP is most likely is of interest. Guidance was obtained from analysis of the distribution of maximum 1-hr thunderstorm events through the warm season at the recording stations in Utah, Arizona, and in southern California (south of 37°N and east of the Sierra Nevada ridgeline). The period of record used was for 1940-72 with an average record length for the stations considered of 27 years. The month with the one greatest thunderstorm rainfall for the period of record at each station was noted. The totals of these events for each month, by States, are shown in table 4.9.

Table 4.9.--Seasonal distribution of thunderstorm rainfalls.

(The maximum event at each of 108 stations, period of record 1940-72.)

	Month						
	M	J	J	A	S	O	No. of Cases
Utah	1	5	9	14	5		34
Arizona		4	16	19	4		43
S. Calif.*		14	10	7			31
No. of cases/mo.	1	23	35	40	9	0	

*South of 37°N and east of Sierra Nevada ridgeline.

72 Hour General PMP

Report on

A HYDROLOGIC ANALYSIS OF THE MCMICKEN DAM WATERSHED

Prepared for

Maricopa County Flood Control District

by

J.M. Rumann, Hydrologist
Timothy E. Sutko, Hydrologist

March 1987

A HYDROLOGIC ANALYSIS
OF THE
MCMICKEN DAM WATERSHED

In order to create a spillway design hydrograph, the COE applied this same design storm to the watershed, but used a more conservative estimate of the loss rate function parameters. The COE did not judge the use of a Probable Maximum Flood estimate to be appropriate in the design of this structure, and so did not evaluate its potential impact on the dam or its appurtenances.

In order to comply with ADWR regulations, the Probable Maximum Precipitation was determined as per HMR 49. The SH&B analysis determined that the 72 hour general storm event would produce more severe flooding than the 6 hour general storm. However, a miscalculation in the computation of this storm produced an erroneous total rainfall depth. The actual rainfall amounts modeled for the SPS and the PMP in this study are 8.6 and 15.7 inches, respectively.

Parameter Value Selection

The COE uniform loss rate methodology was used to model the rainfall losses. An initial loss of 0.95 inches, and subsequent loss rate of 0.15 inches per hour were used as basin average values. These values are consistent with the results of COE studies in this area (COE, 1974).

Two routing methods were used in this study, the kinematic wave and Muskingum Routing. Muskingum routing was used whenever possible as it more accurately reflects flow attenuation due to channel storage. As used in HEC-1, the constant K in the Muskingum routing method is equal to the travel time through a reach. Due to a lack of better information, K was determined by conservatively assuming channel velocities of 4 feet per second. The constant x is the Muskingum weighting factor and expresses the relative importance of

General-storm PMP computations for the Colorado River and Great basin

Drainage Trilby Wash Area 247 mi^2

Latitude 33.8, Longitude 112.6 of basin center

Month September

Step	Duration (hrs) 6	12	18	24	48	72
A. Convergence PMP						
1. Drainage average value from one of figures 2.5 to 2.16	13.6 in.					
2. Reduction for barrier-elevation [fig. 2.18]	82%					
3. Barrier-elevation reduced PMP [step 1 X step 2]	11.2 in.					
4. Durational variation [figs. 2.25 to 2.27 and table 2.7]	74	89	95	100	112	117%
5. Convergence PMP for indicated durations [steps 3 X 4]	8.3	10.0	10.6	11.2	12.5	13.1 in.
6. Incremental 10 mi^2 (26 km^2) PMP [successive subtraction in step 5]	8.3	1.7	0.6	0.6	1.3	0.6 in.
7. Areal reduction [select from figs. 2.28 and 2.29]	73	90	94	98	100	100%
8. Arealy reduced PMP [step 6 X step 7]	6.1	1.5	0.6	0.6	1.3	0.6 in.
9. Drainage average PMP [accumulated values of step 8]	6.1	7.6	8.2	8.8	10.1	10.7 in.
B. Orographic PMP						
1. Drainage average orographic index from figure 3.11a to d.	3.4 in.					
2. Areal reduction [figure 3.20]	90%					
3. Adjustment for month [one of figs. 3.12 to 3.17]	100%					
4. Arealy and seasonally adjusted PMP [steps 1 X 2 X 3]	3.1 in.					
5. Durational variation [table 3.9]	35	62	83	100	142	161%
6. Orographic PMP for given durations [steps 4 X 5]	1.1	1.9	2.6	3.1	4.4	5.0 in.
C. Total PMP						
1. Add steps A9 and B6	7.2	9.5	10.8	11.9	14.5	15.7 in.

2. PMP for other durations from smooth curve fitted to plot of computed data.

3. Comparison with local-storm PMP (see sec. 6.3).

NATURE SAVER™ FAX MEMO 01616	Date 3-Feb-03	# of pages ▶ 2
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Co./Dept. Entellus	Co. FCDMC	
Phone #	Phone # 506-5472	
Fax # 602-244-8940	Fax #	

Louis Lovely

U.S. DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

U.S. DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS

HYDROMETEOROLOGICAL REPORT NO. 49

Probable Maximum Precipitation Estimates, Colorado River and Great Basin Drainages

Prepared by
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Hydrometeorological Branch
Office of Hydrology
National Weather Service

Silver Spring, Md.
September 1977

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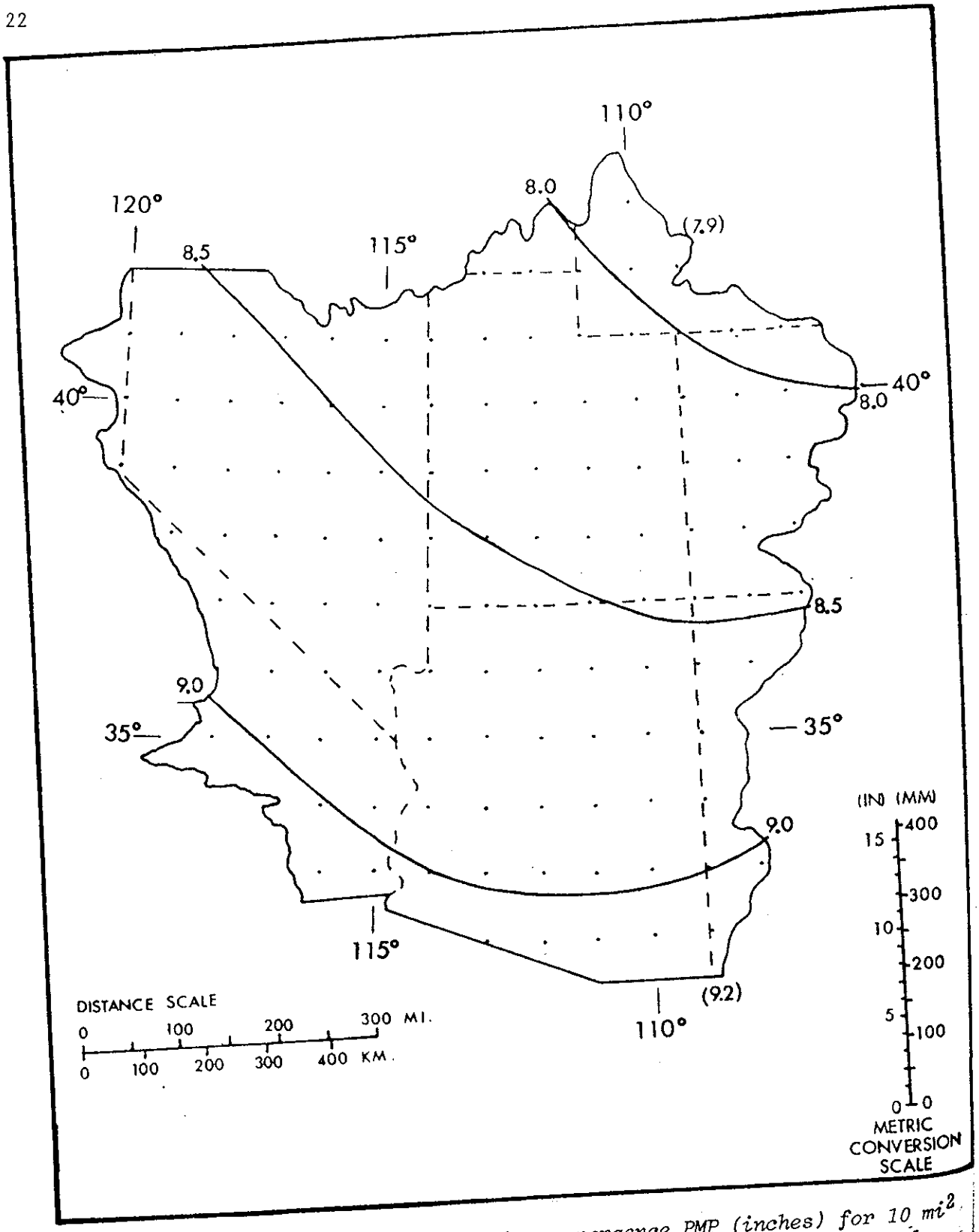


Figure 2.5.--1000-mb (100-kPa) 24-hr convergence PMP (inches) for 10 mi^2 (26 km^2) for January. Values in parentheses are limiting values and are to facilitate extrapolation beyond the indicated gradient.

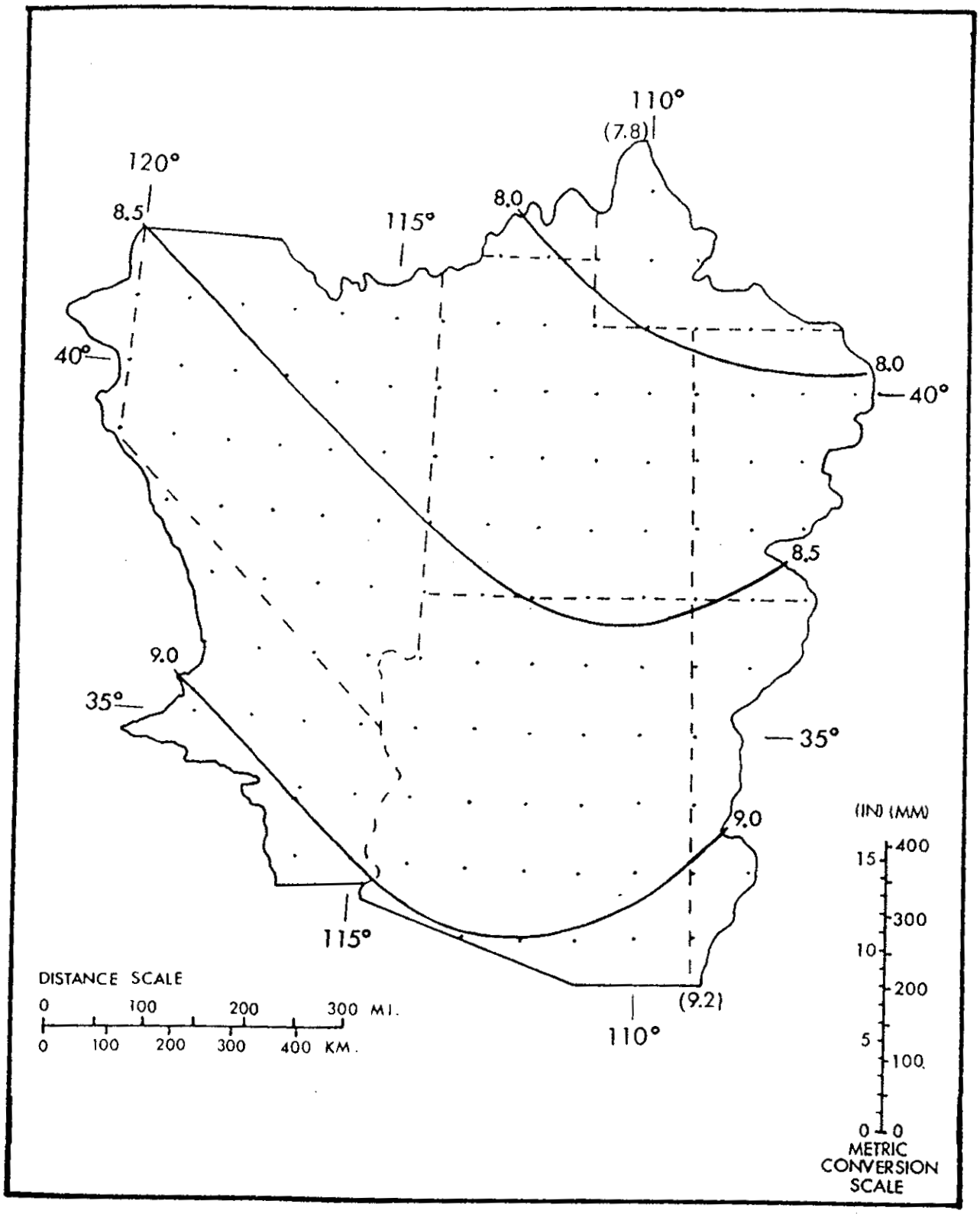


Figure 2.6.--1000-mb (100-kPa) 24-hr convergence PMP (inches) for 10 mi^2 (26 km^2) for February. Values in parentheses are limiting values and are to facilitate extrapolation beyond the indicated gradient.

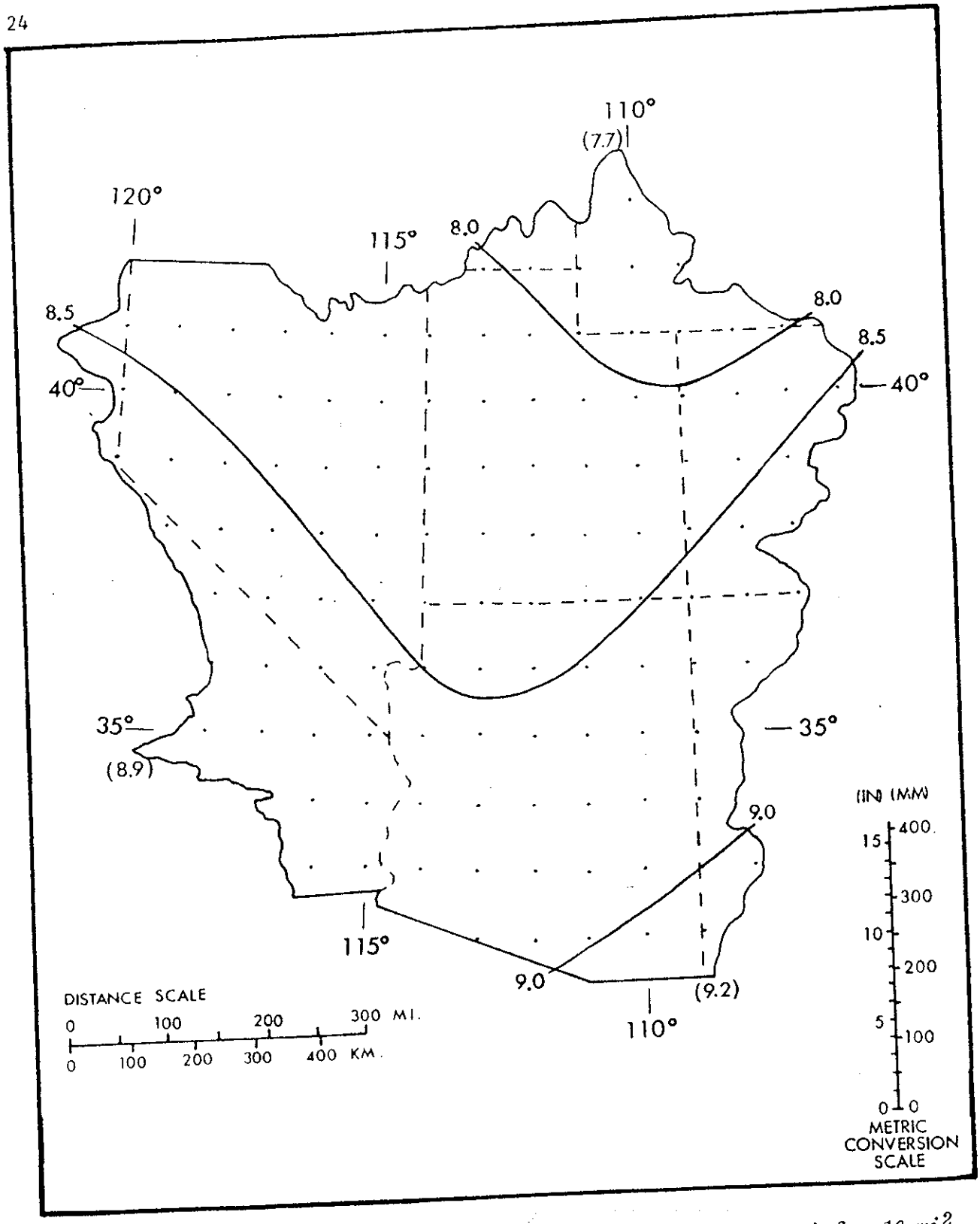


Figure 2.7.--1000-mb (100-kPa) 24-hr convergence PMP (inches) for 10 mi^2 (26 km^2) for March. Values in parentheses are limiting values and are to facilitate extrapolation beyond the indicated gradient.

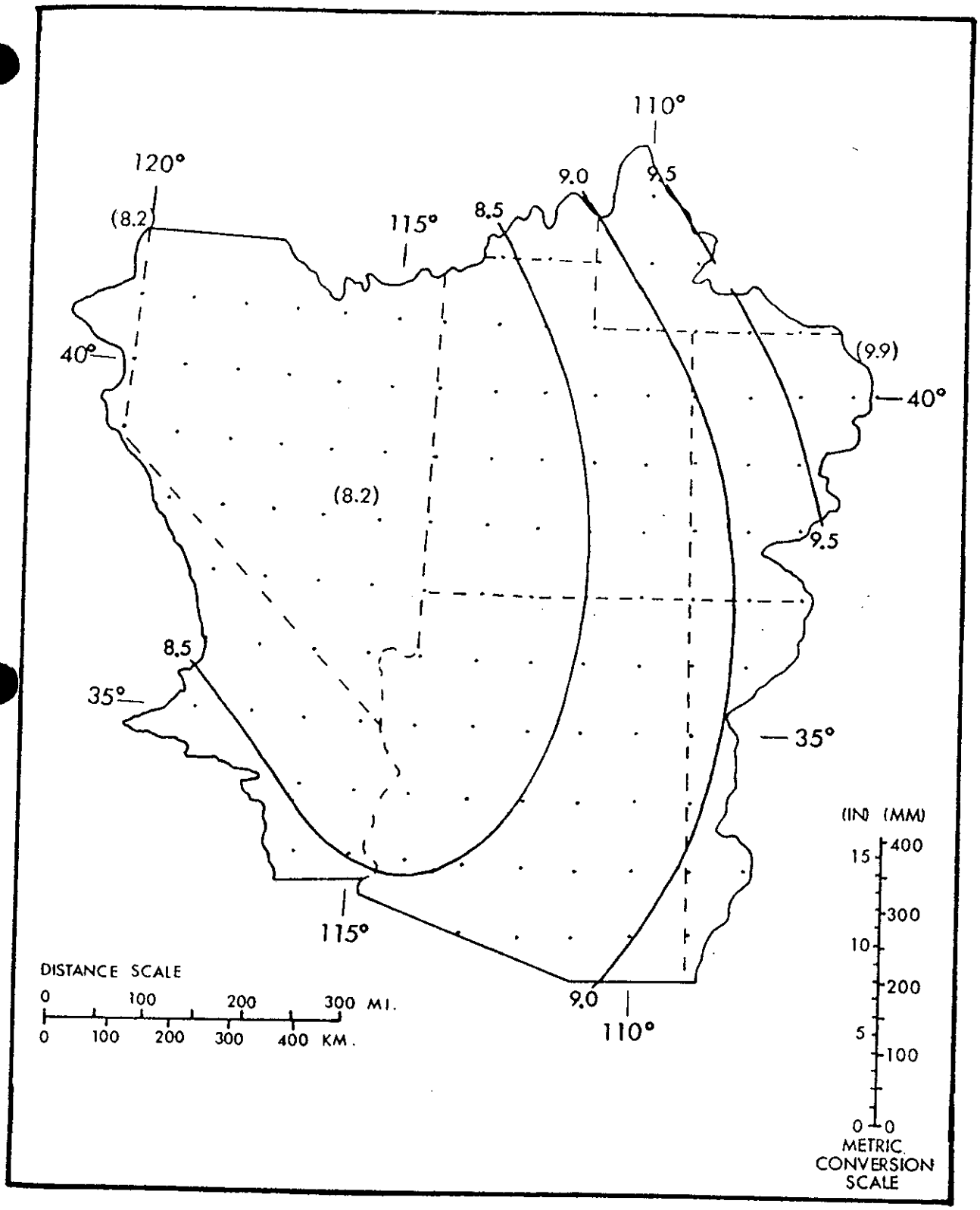


Figure 2.8.--1000-mb (100-kPa) 24-hr convergence PMP (inches) for 10 mi^2 (26 km^2) for April. Values in parentheses are limiting values and are to facilitate extrapolation beyond the indicated gradient.

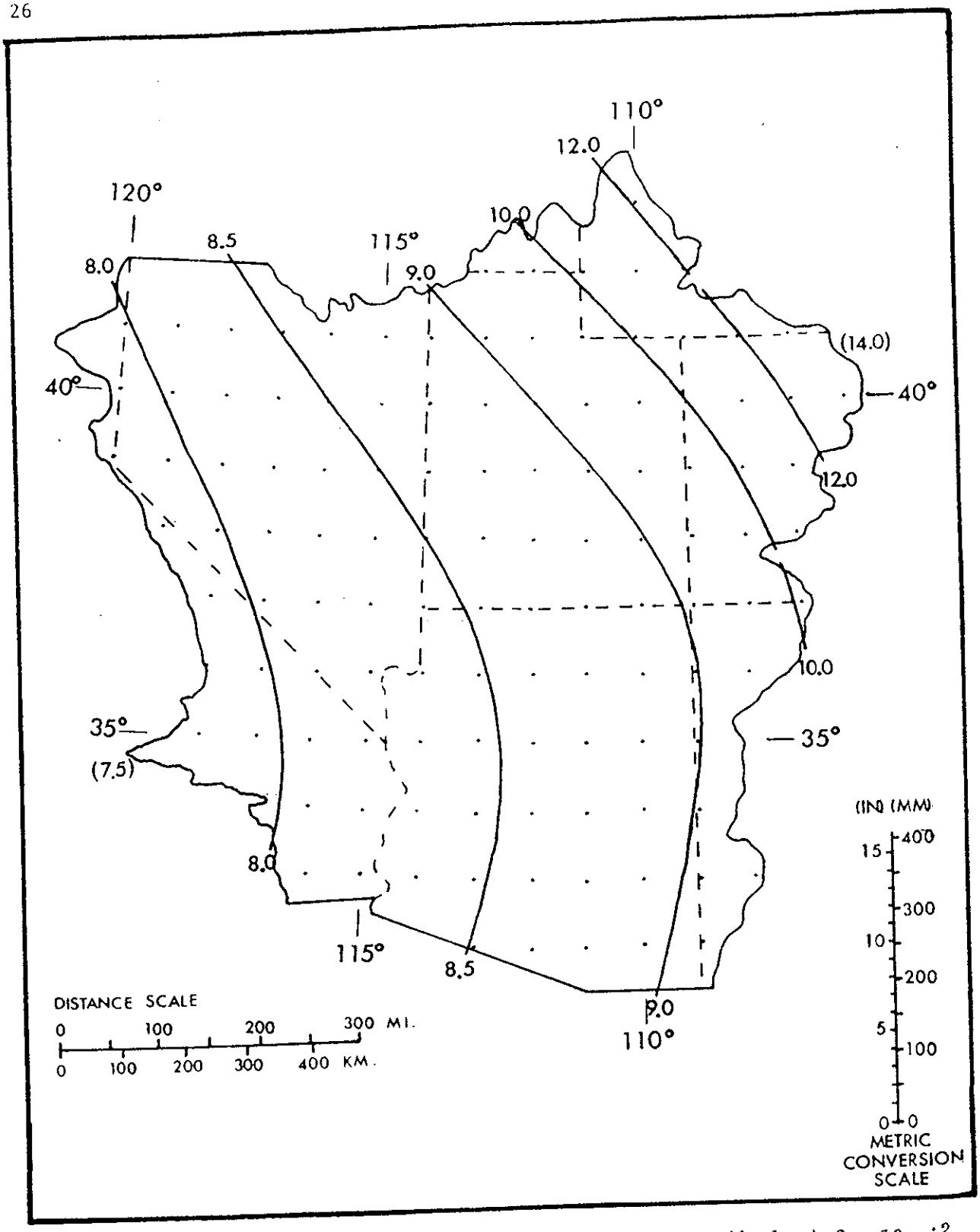


Figure 2.9.--1000-mb (100-kPa) 24-hr convergence PMP (inches) for 10 mi^2 (26 km^2) for May. Values in parentheses are limiting values and are to facilitate extrapolation beyond the indicated gradient.

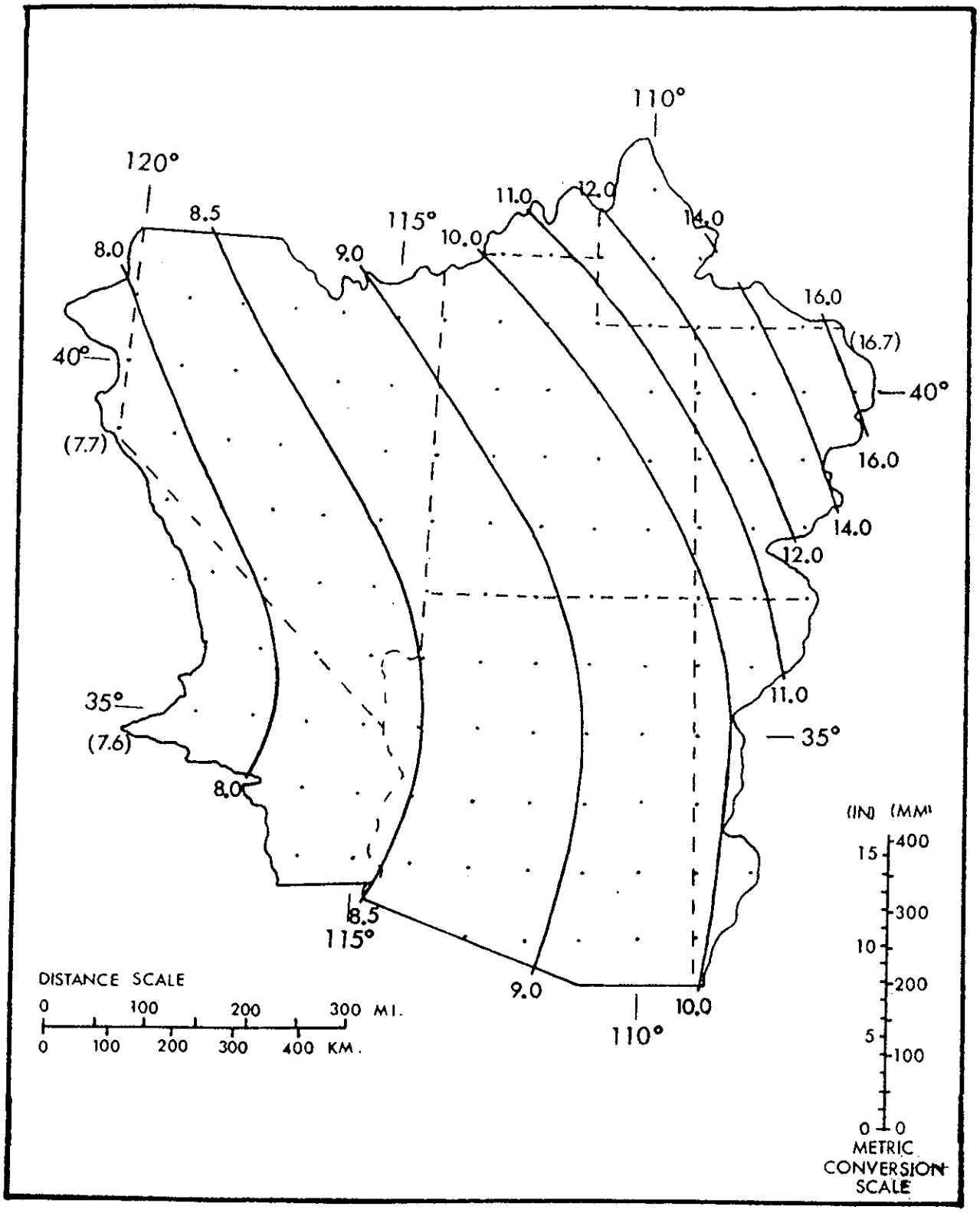


Figure 2.10.--1000-mb (100-kPa) 24-hr convergence PMP (inches) for 10 mi^2 (26 km^2) for June. Values in parentheses are limiting values and are to facilitate extrapolation beyond the indicated gradient.

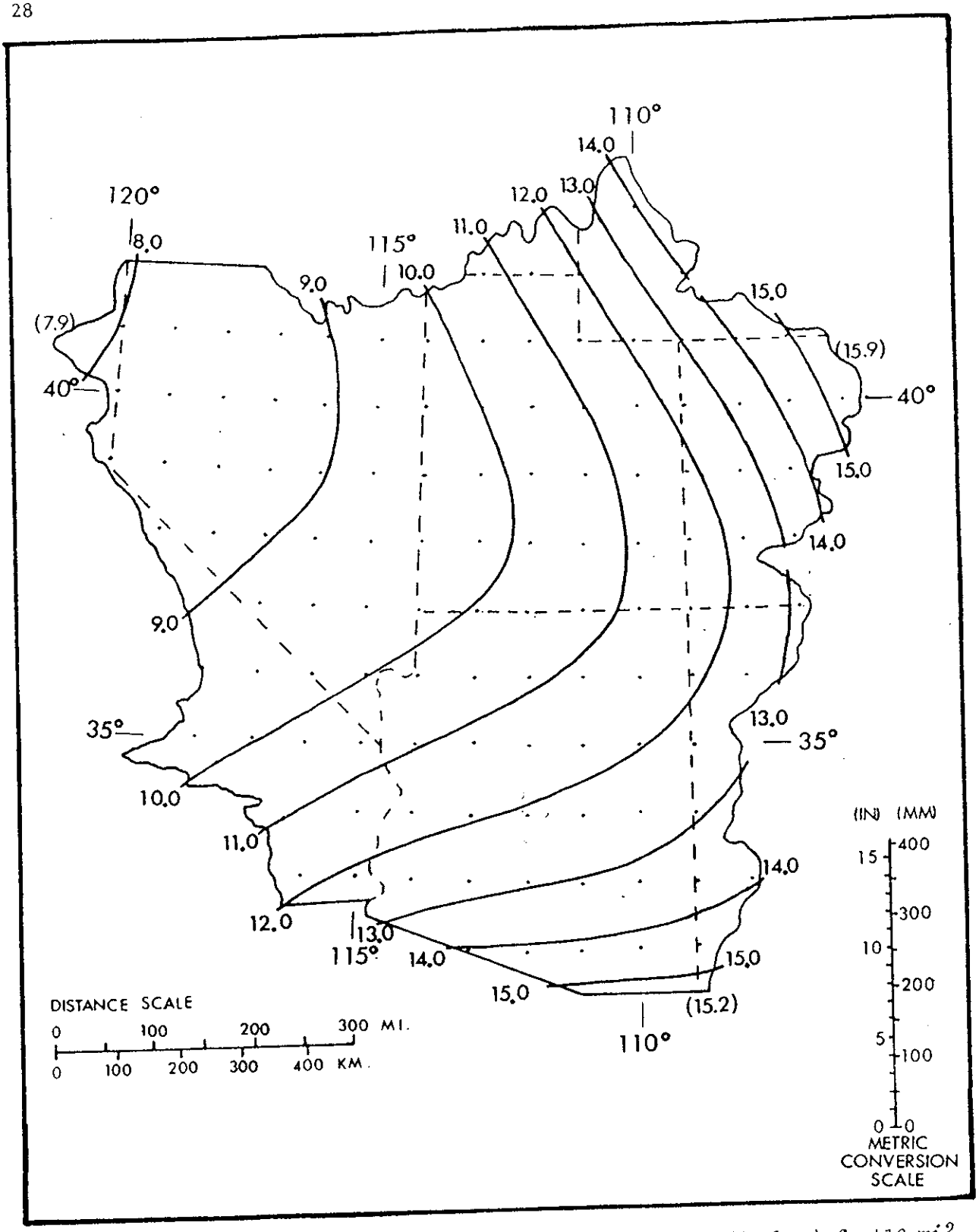


Figure 2.11.--1000-mb (100-kPa) 24-hr convergence PMP (inches) for 10 mi² (26 km²) for July. Values in parentheses are limiting values and are to facilitate extrapolation beyond the indicated gradient.

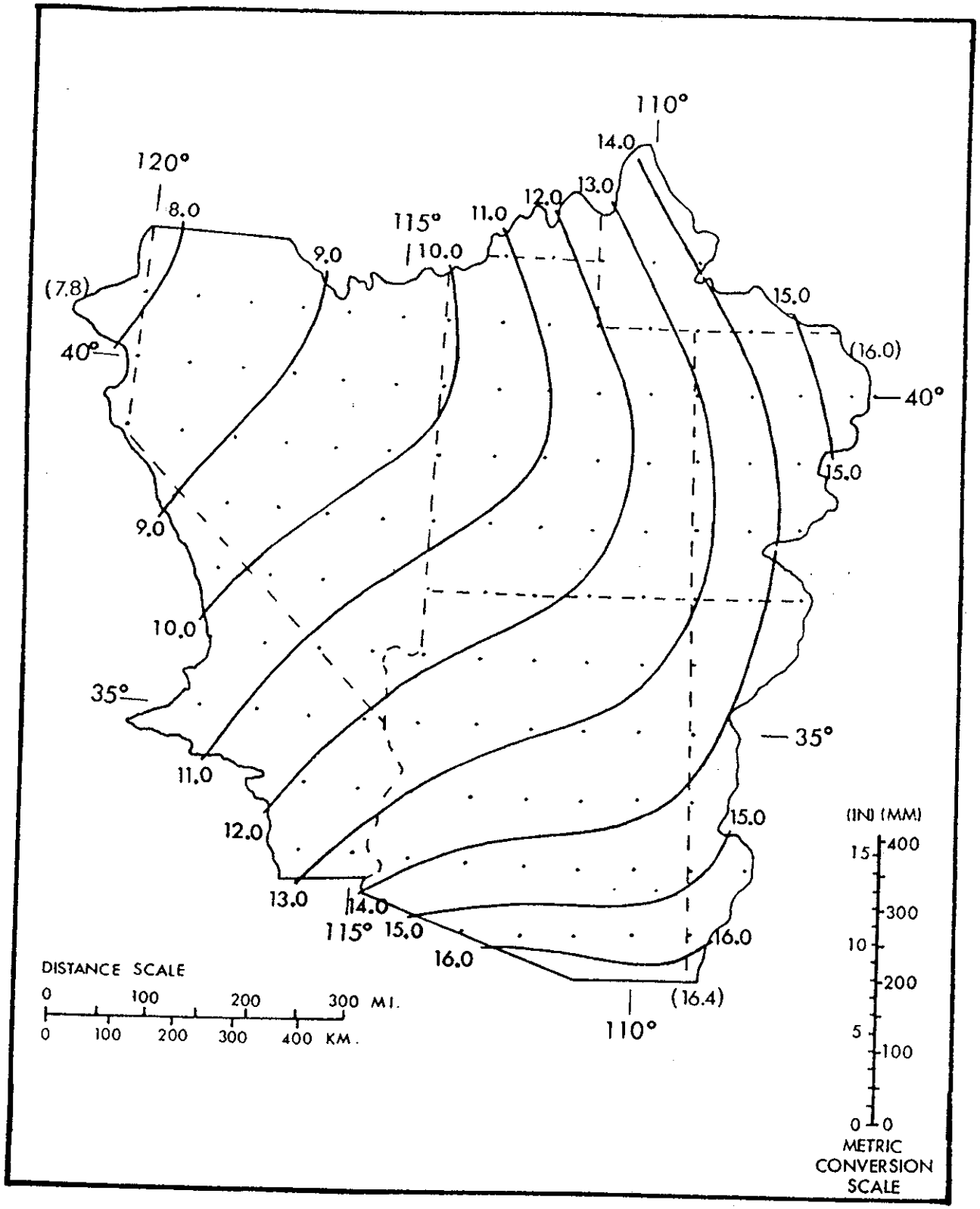


Figure 2.12.--1000-mb (100-kPa) 24-hr convergence PMP (inches) for 10 mi^2 (26 km^2) for August. Values in parentheses are limiting values and are to facilitate extrapolation beyond the indicated gradient.

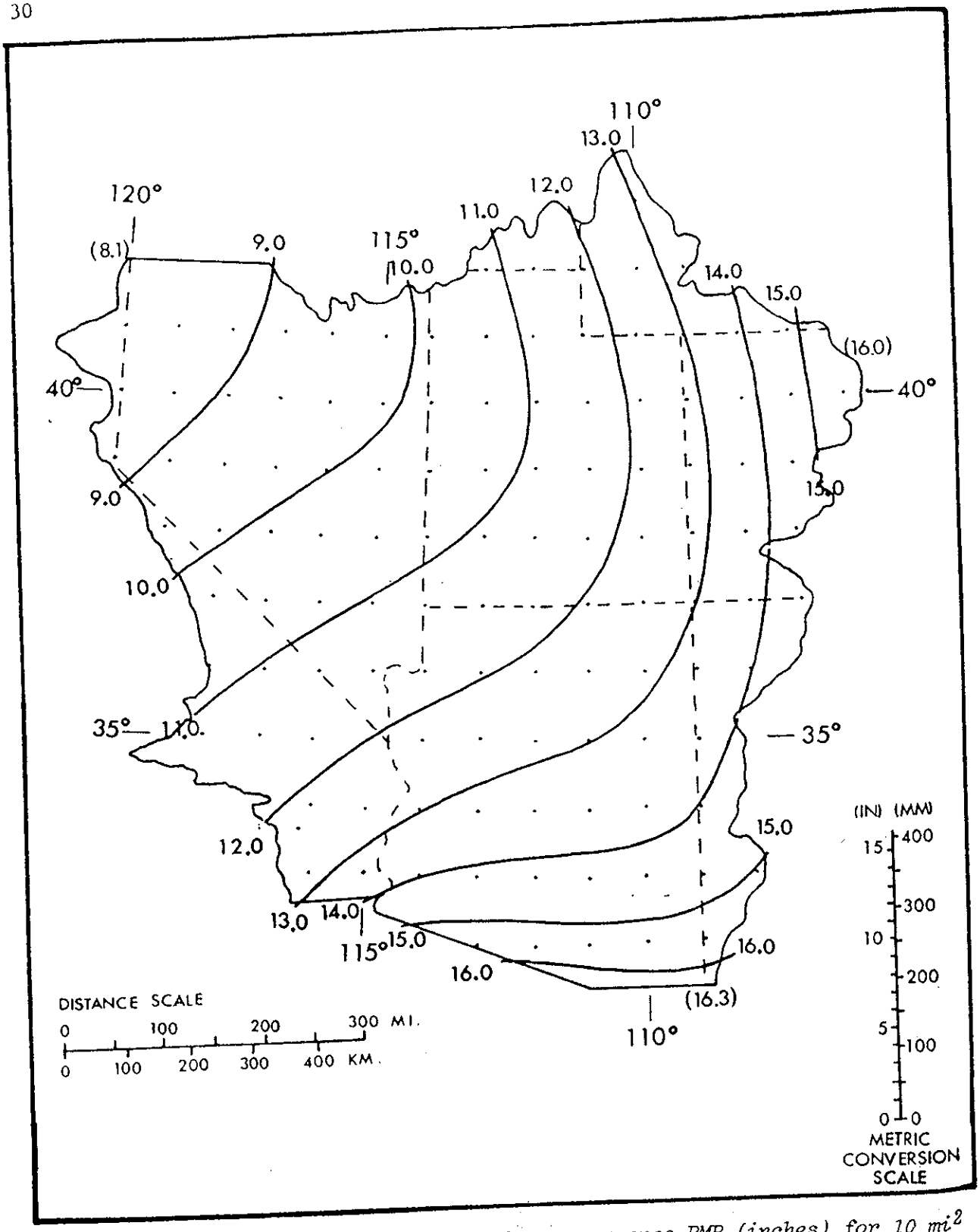


Figure 2.13.--1000-mb (100-kPa) 24-hr convergence PMP (inches) for 10 mi^2 (26 km^2) for September. Values in parentheses are limiting values and are to facilitate extrapolation beyond the indicated gradient.

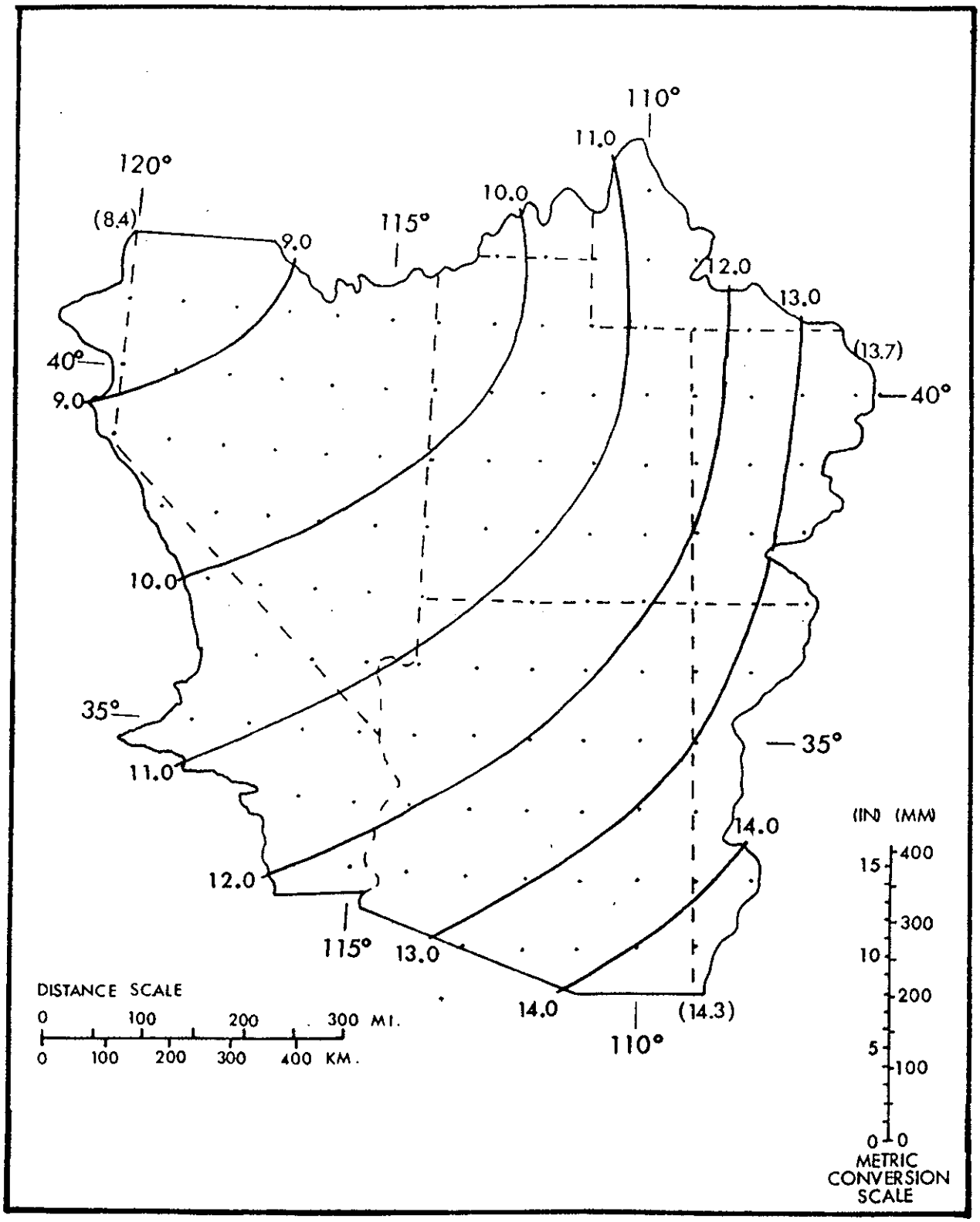


Figure 2.14.--1000-mb (100-kPa) 24-hr convergence PMP (inches) for 10 mi^2 (26 km^2) for October. Values in parentheses are limiting values and are to facilitate extrapolation beyond the indicated gradient.

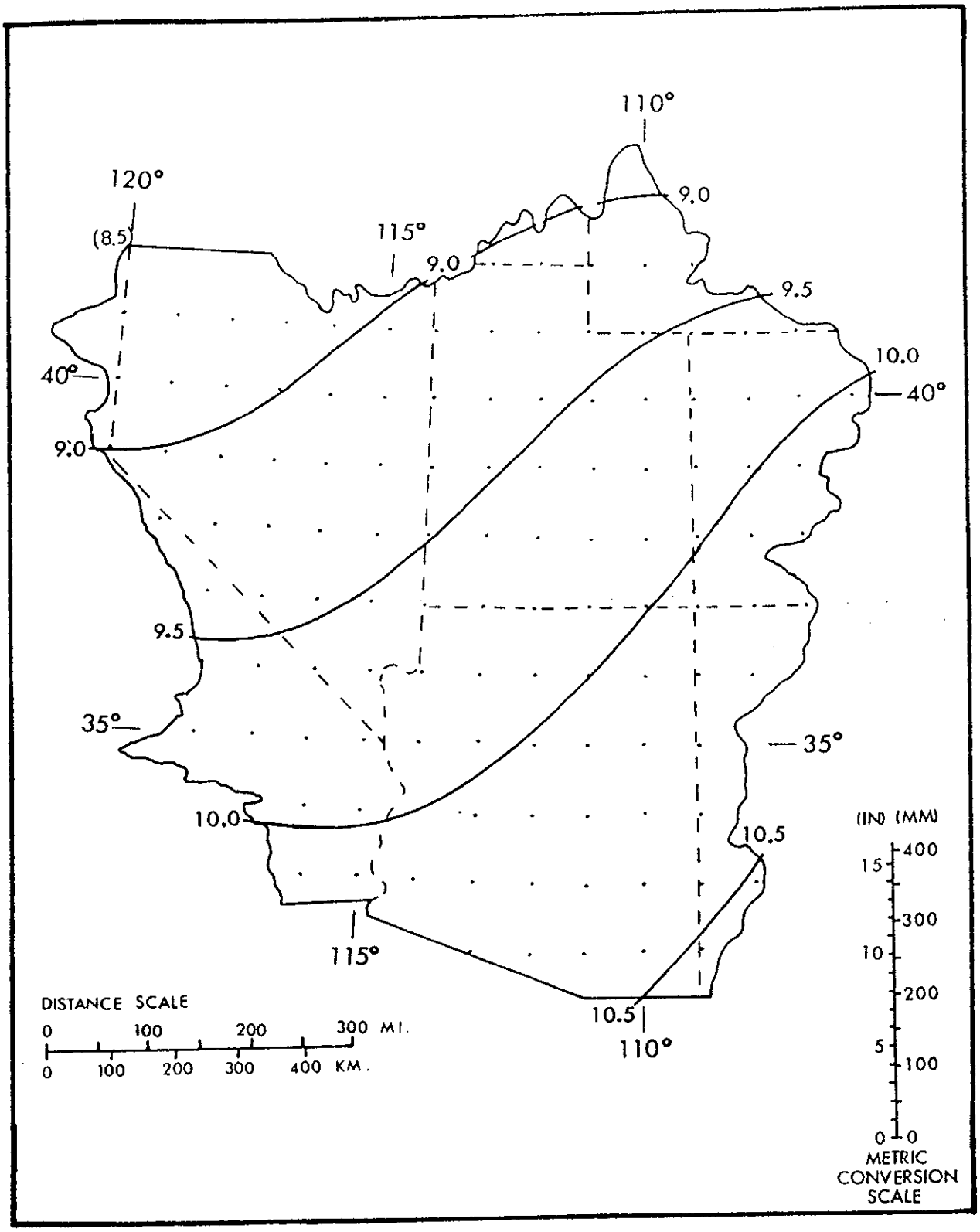


Figure 2.15.--1000-mb (100-kPa) 24-hr convergence PMP (inches) for 10 mi^2 (26 km^2) for November. Values in parentheses are limiting values and are to facilitate extrapolation beyond the indicated gradient.

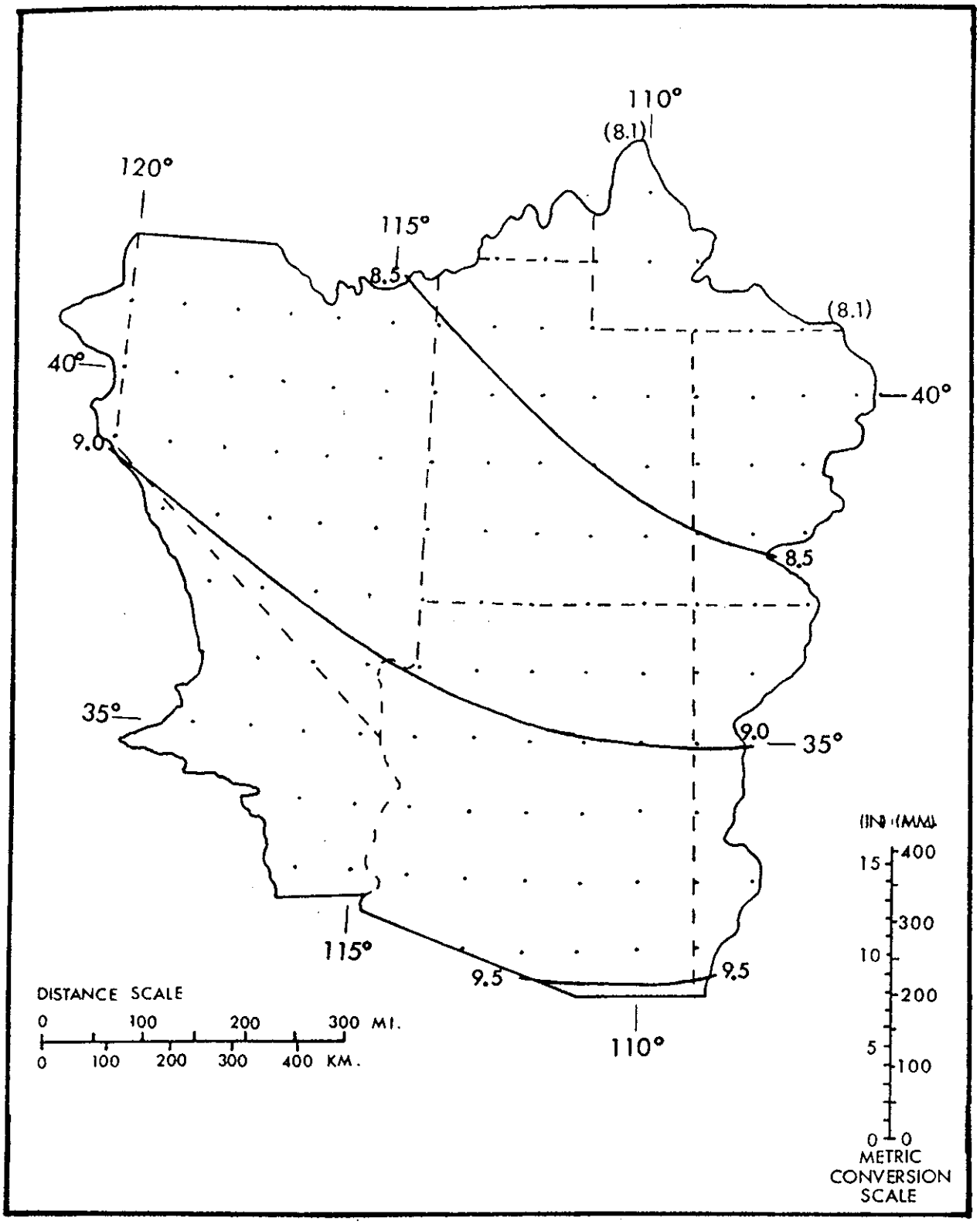


Figure 2.16.--1000-mb (100-kPa) 24-hr convergence PMP (inches) for 10 mi^2 (26 km^2) for December. Values in parentheses are limiting values and are to facilitate extrapolation beyond the indicated gradient.

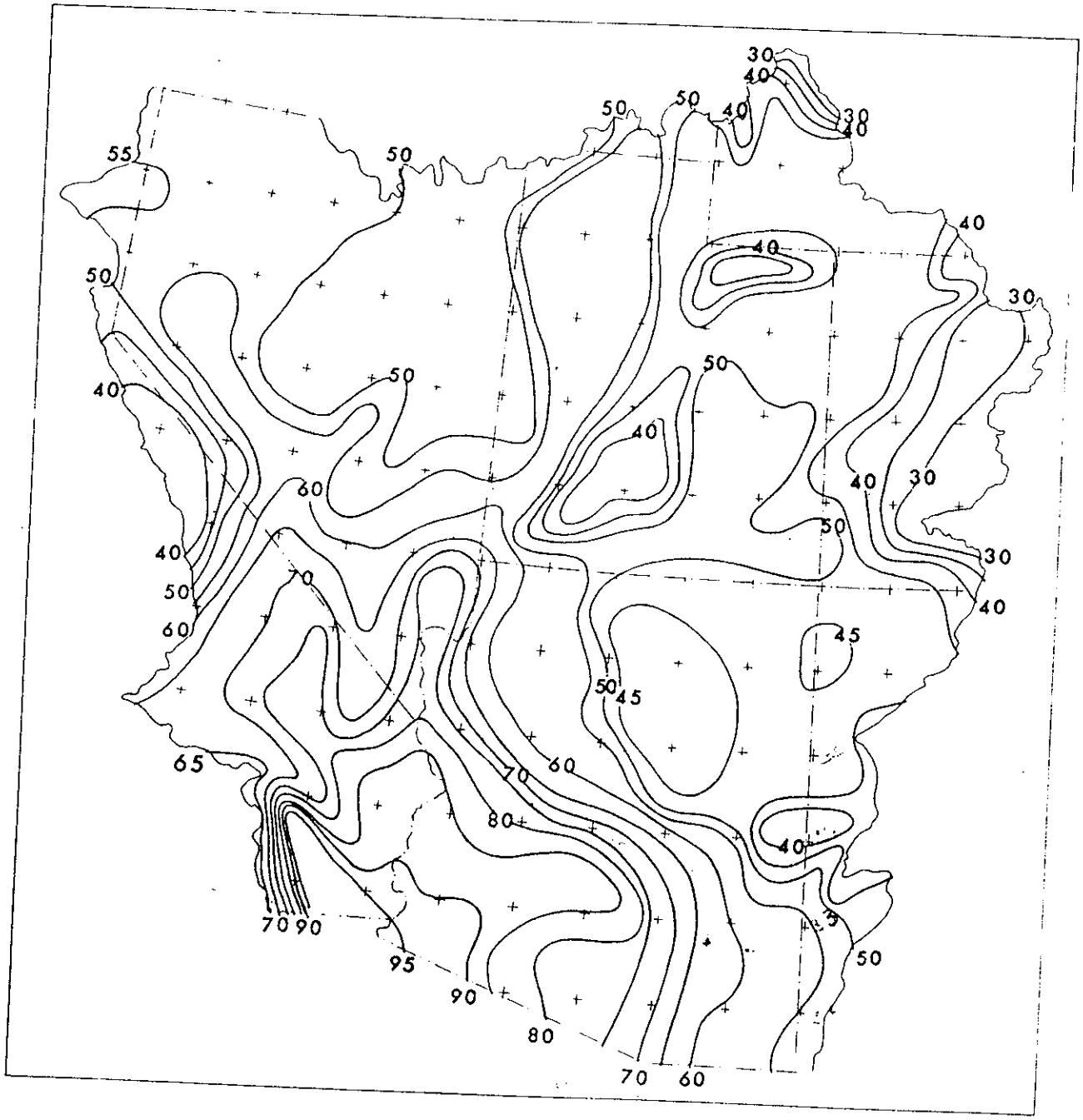
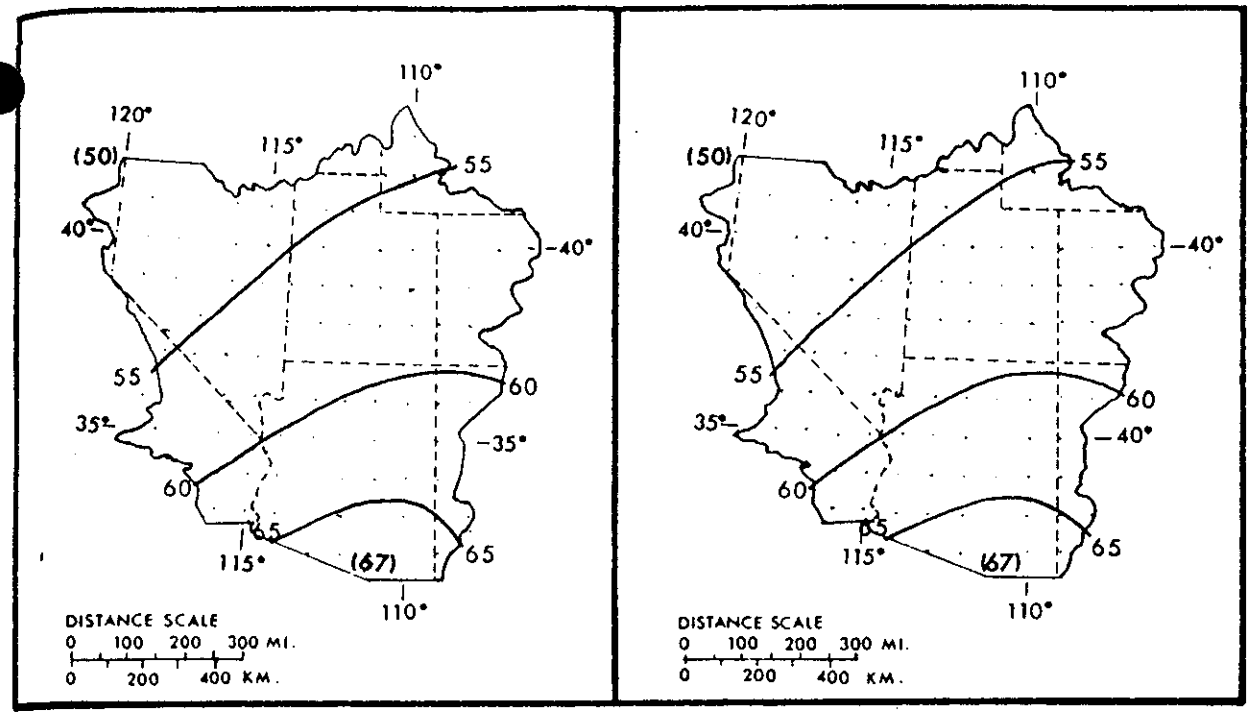
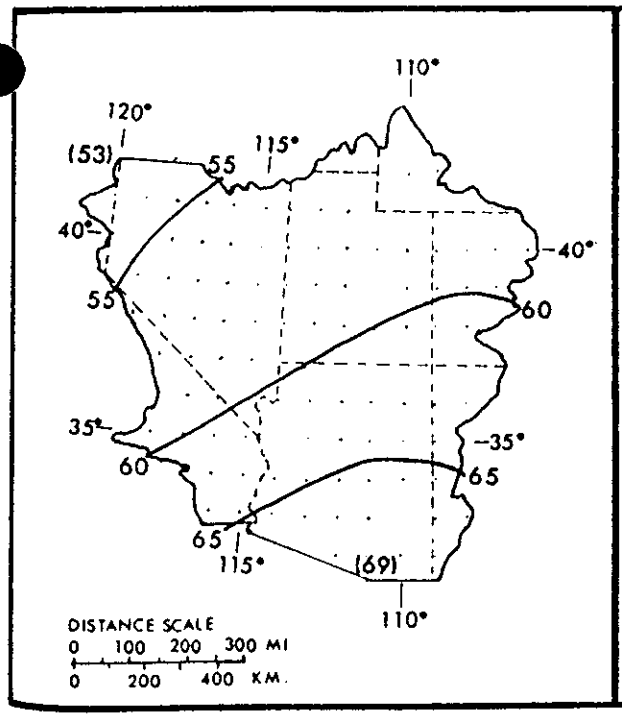


Figure 2.18.--Percent of 1000-mb (100-kPa) convergence PMP resulting from effective elevation and barrier considerations. Isolines drawn for every five percent.

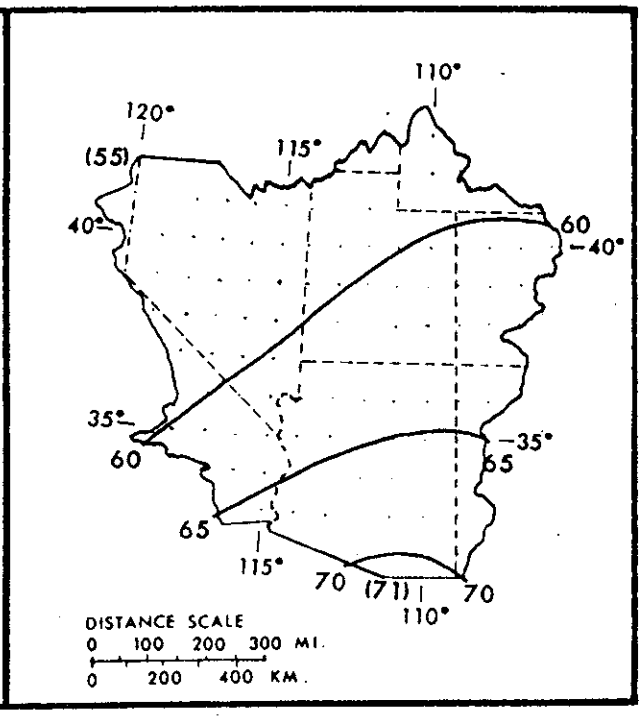


January

February



March



April

Figure 2.25.--Regional variation of 6/24-hr ratios by month (percent). Values in parentheses are limiting values and are to facilitate extrapolation beyond the indicated gradient.

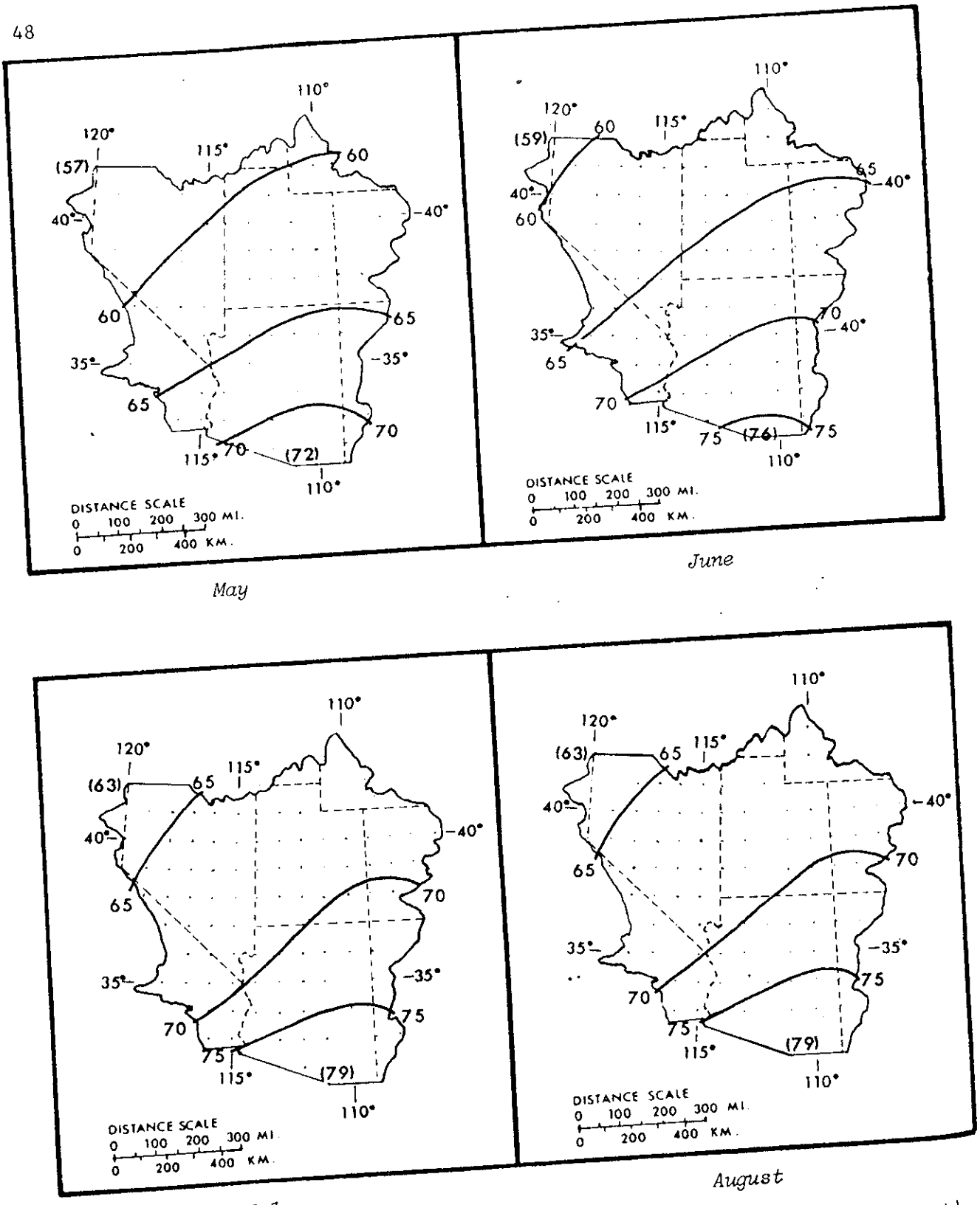
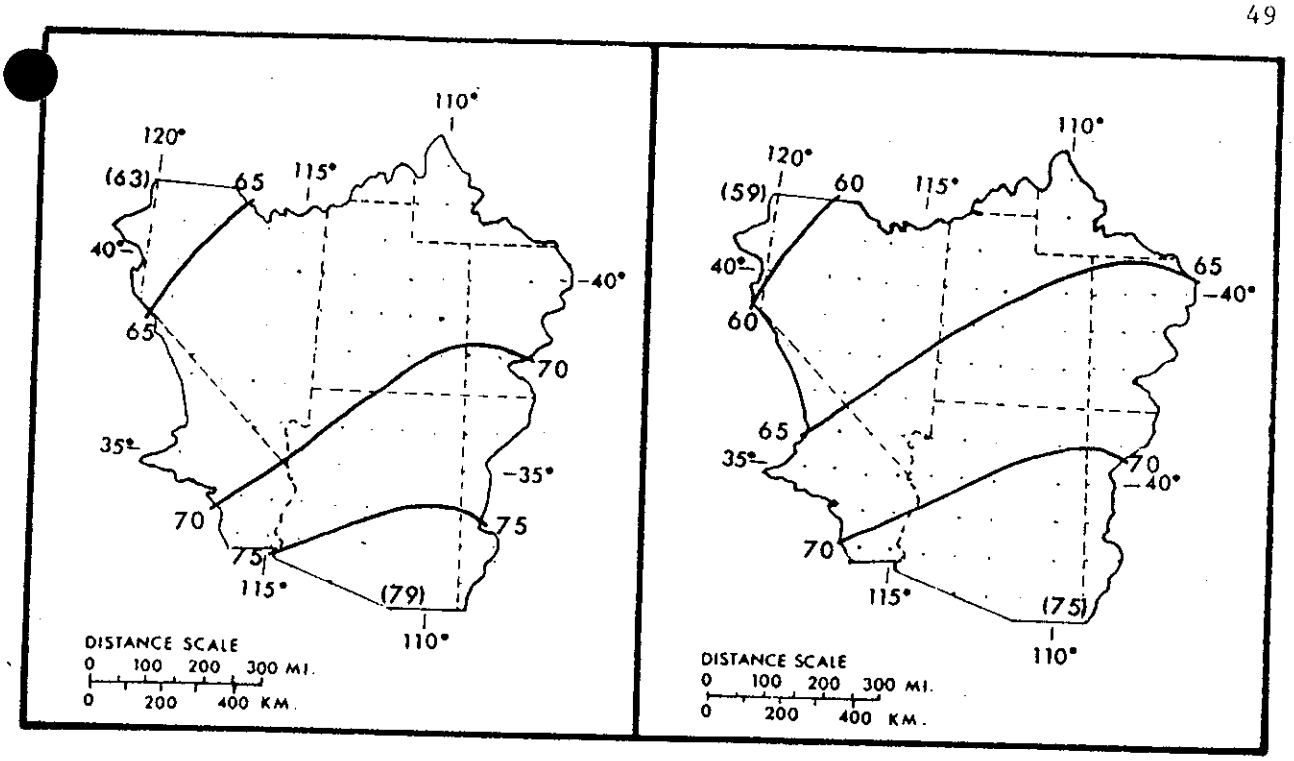
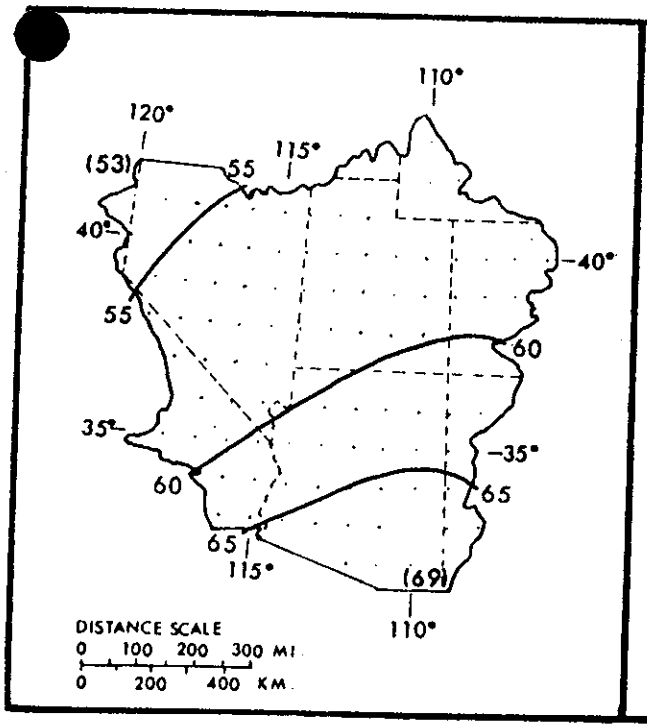


Figure 2.26.--Regional variation of 6/24-hr ratios by month (percent). Values in parentheses are limiting values and are to facilitate extrapolation beyond the indicated gradient.

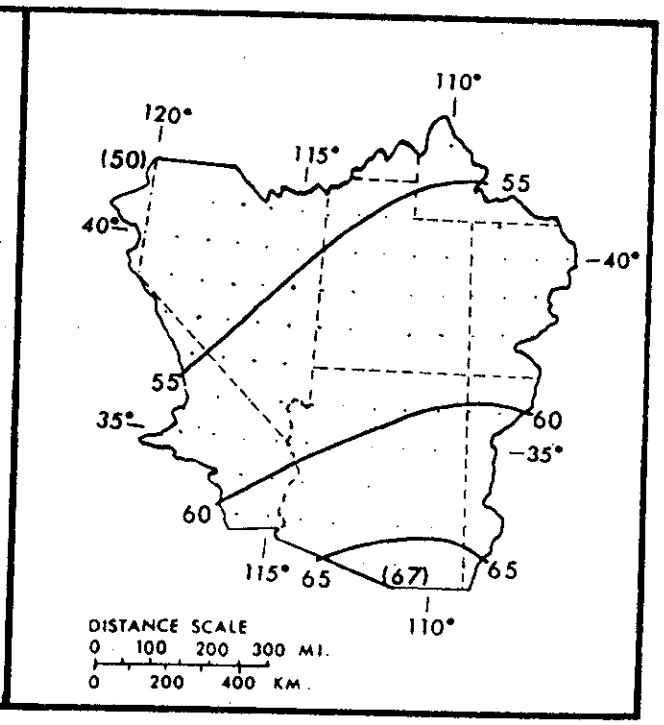


September

October



November



December

Figure 2.27.--Regional variation of 6/24-hr ratios by month (percent). Values in parentheses are limiting values and are to facilitate extrapolation beyond the indicated gradient.

For the range of 6/24-hr ratios included in figures 2.25 to 2.27, depth-duration values in percent of 24-hr amounts are found in table 2.7. The regional ratio maps, and the depth-duration curves presented in figure 2.20 were used in adjusting the major storm data to 24-hr amounts listed in table 2.1.

Table 2.7.--Durational variation of convergence PMP (in percent of 24-hr amount).

Duration (Hrs)						Duration (Hrs)					
6	12	18	24	48	72	6	12	18	24	48	72
50	76	90	100	129	150	66	84	93	100	116	124
51	77	90	100	128	148	67	85	94	100	116	123
52	77	90	100	127	146	68	85	94	100	115	122
53	77	91	100	127	144	69	86	94	100	115	121
54	78	91	100	126	142						
55	78	91	100	125	140	70	87	94	100	114	120
56	79	91	100	124	138	71	87	95	100	114	119
57	79	92	100	123	137	72	88	95	100	113	118
58	80	92	100	122	135	73	88	95	100	113	118
59	80	92	100	121	134	74	89	95	100	112	117
						75	89	96	100	112	116
60	81	92	100	120	132	76	90	96	100	111	115
61	81	92	100	120	131	77	90	96	100	110	114
62	82	93	100	119	129	78	91	96	100	110	114
63	82	93	100	118	128	79	92	97	100	109	113
64	83	93	100	117	126						
65	84	93	100	117	125	80	92	97	100	109	113

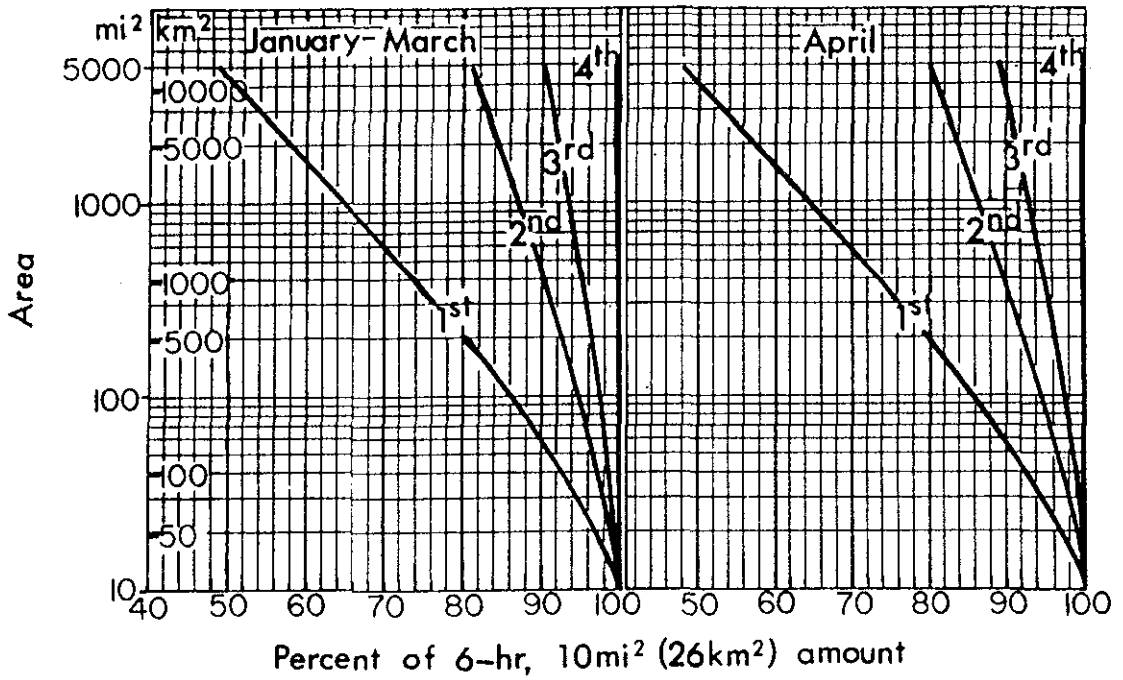
Note: For use, enter first column (6 hr) with 6/24-hr ratio from figures 2.25 to 2.27.

2.5 Areal Reduction for Basin Size

For operational use, basin average values of convergence PMP are needed rather than 10-mi^2 (26-km^2) values. Preferably, the method for reducing 10-mi^2 (26-km^2) values to basin average rainfalls should be derived from depth-area relations of storms in the region. However, all general storms in the region include large proportions of orographic precipitation.

Our solution was to use generalized depth-area relations developed for PMP estimates within bordering zones in the Central and Eastern United States (Riedel et al. 1956). The smoothed areal variations adopted for the Southwestern States are shown in figures 2.28 and 2.29 for each month or a combination of months where differences are insignificant.

Figures 2.28 and 2.29 give depth-area relations that reduce 10-mi^2 (26-km^2) convergence PMP for basin sizes up to 5,000 mi^2 (12,950 km^2) for each month. Areal variations are given for the 4 greatest (1st to 4th) 6-hr PMP increments. After the 4th increment no reduction for basin size is required. Application of these figures will become clear through consideration of an example of PMP computation in chapter 6.



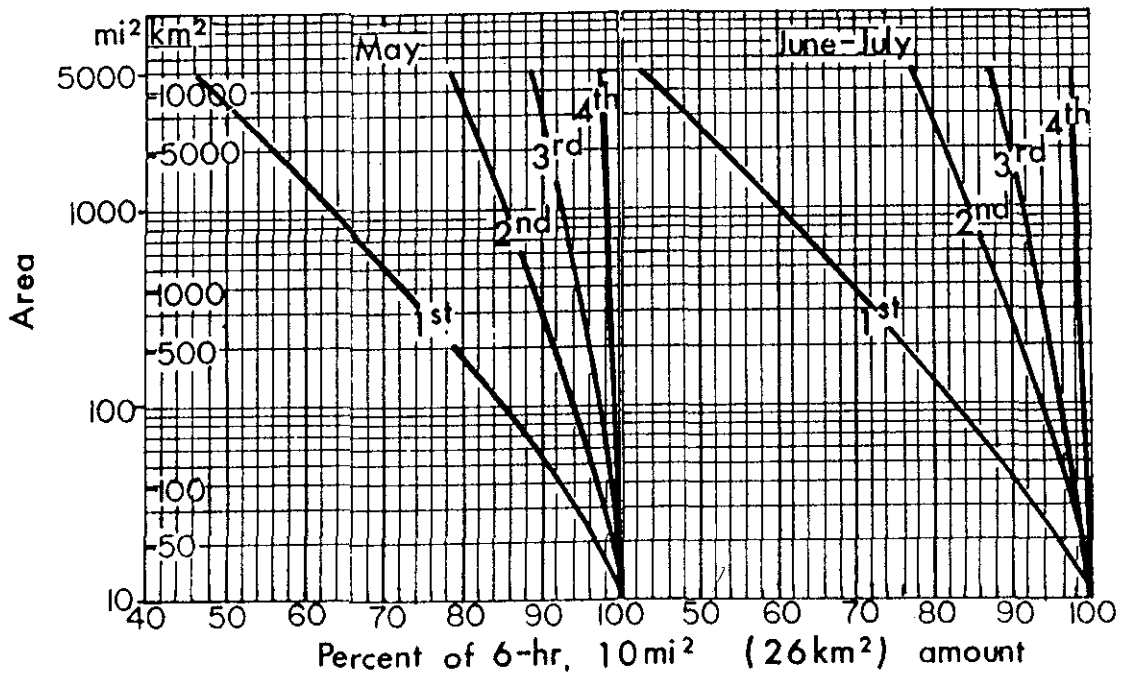
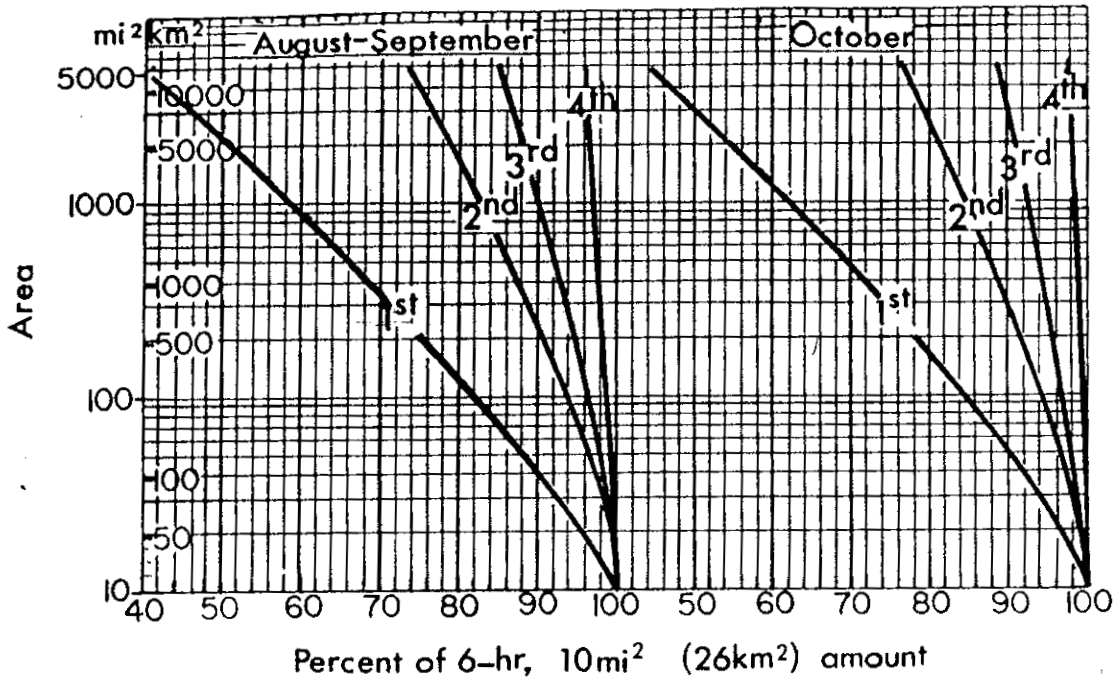


Figure 2.28.--Depth-area variation for convergence PMP for first to fourth 6-hr increments.



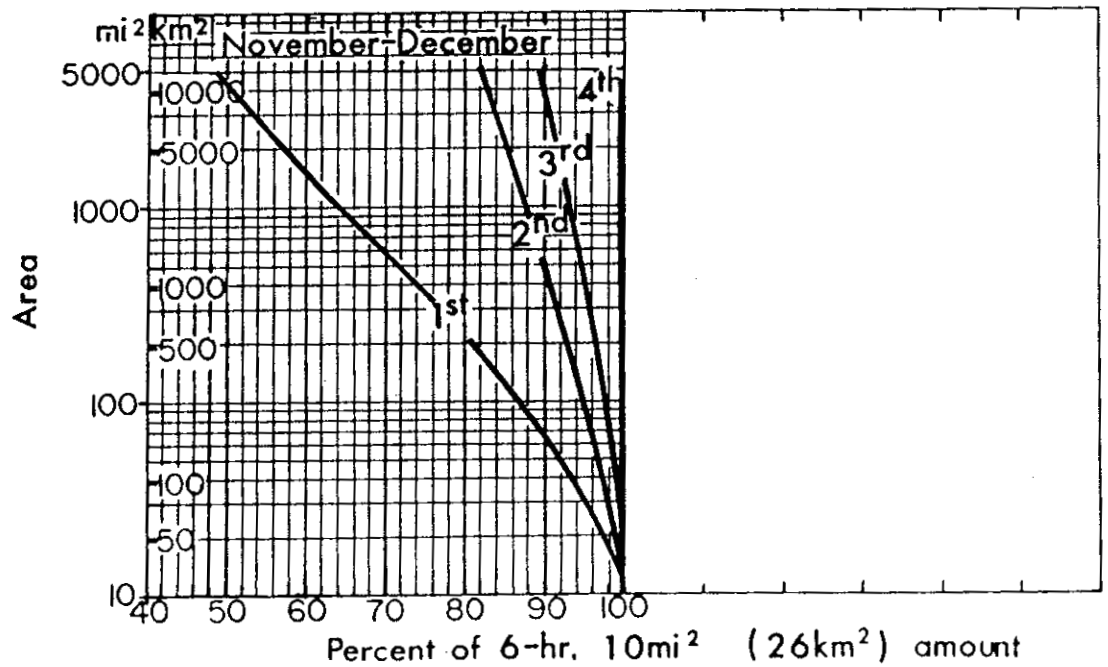


Figure 2.29.--Depth-area variation for convergence PMP for first to fourth 6-hr increments.

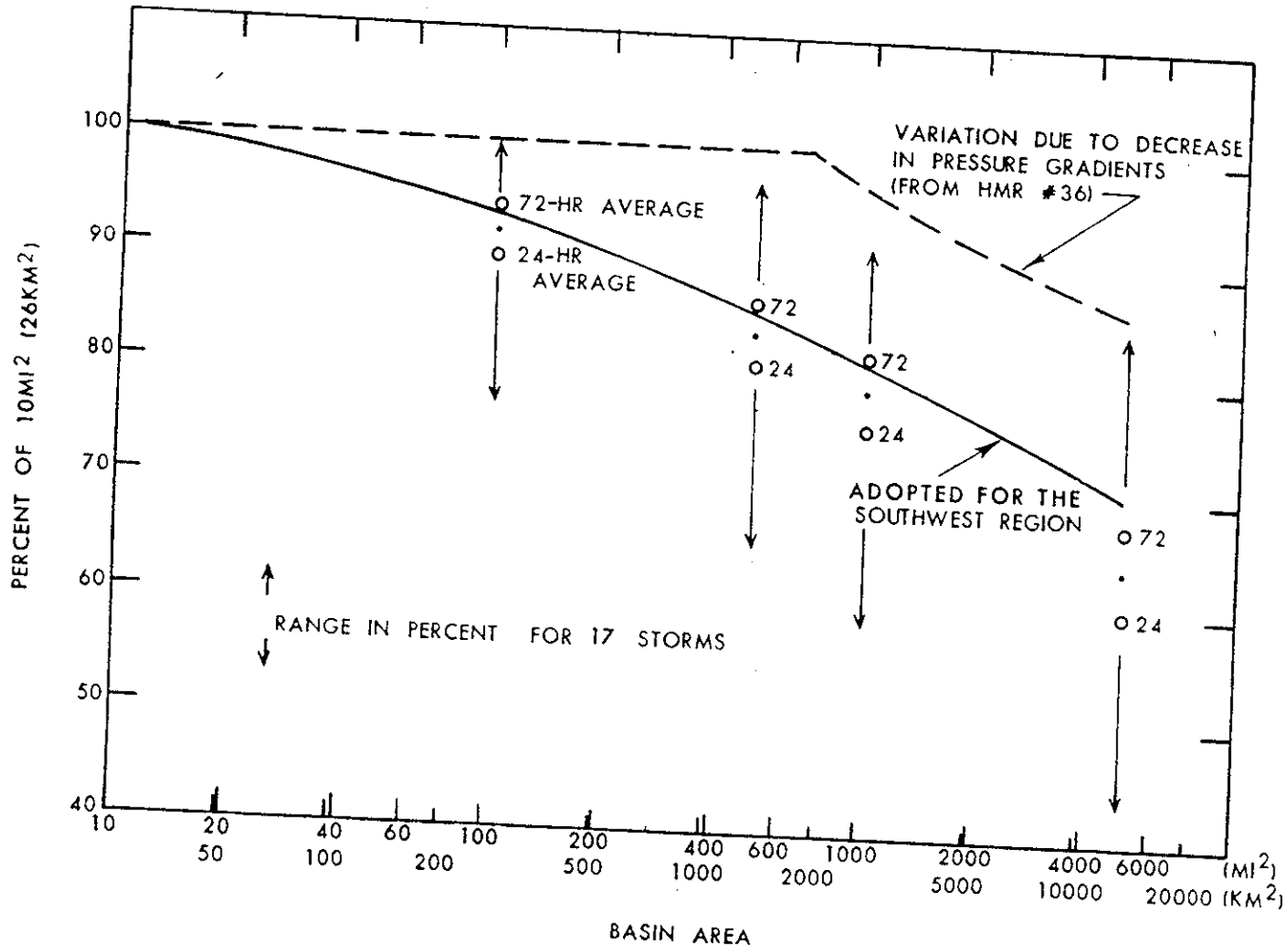
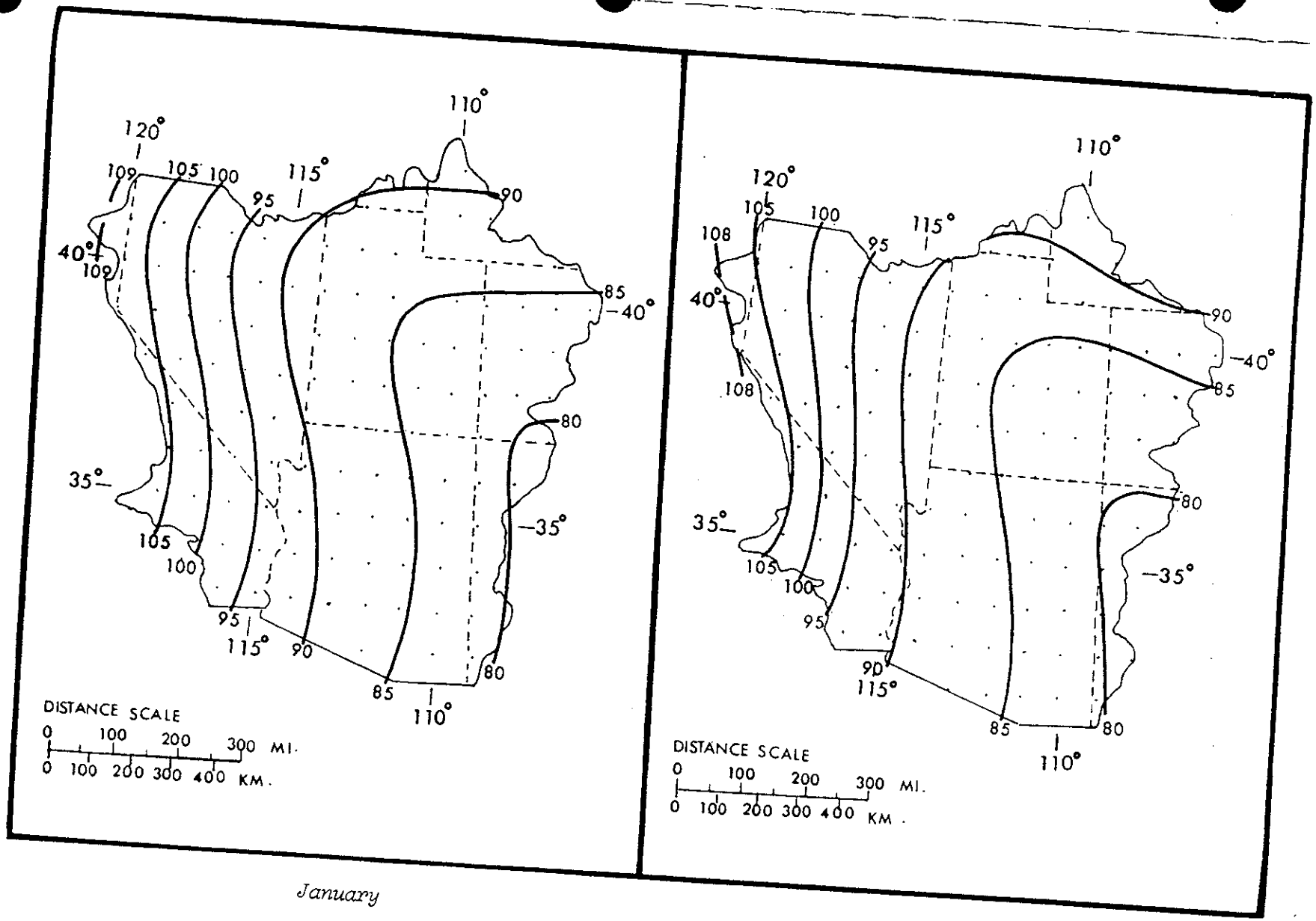


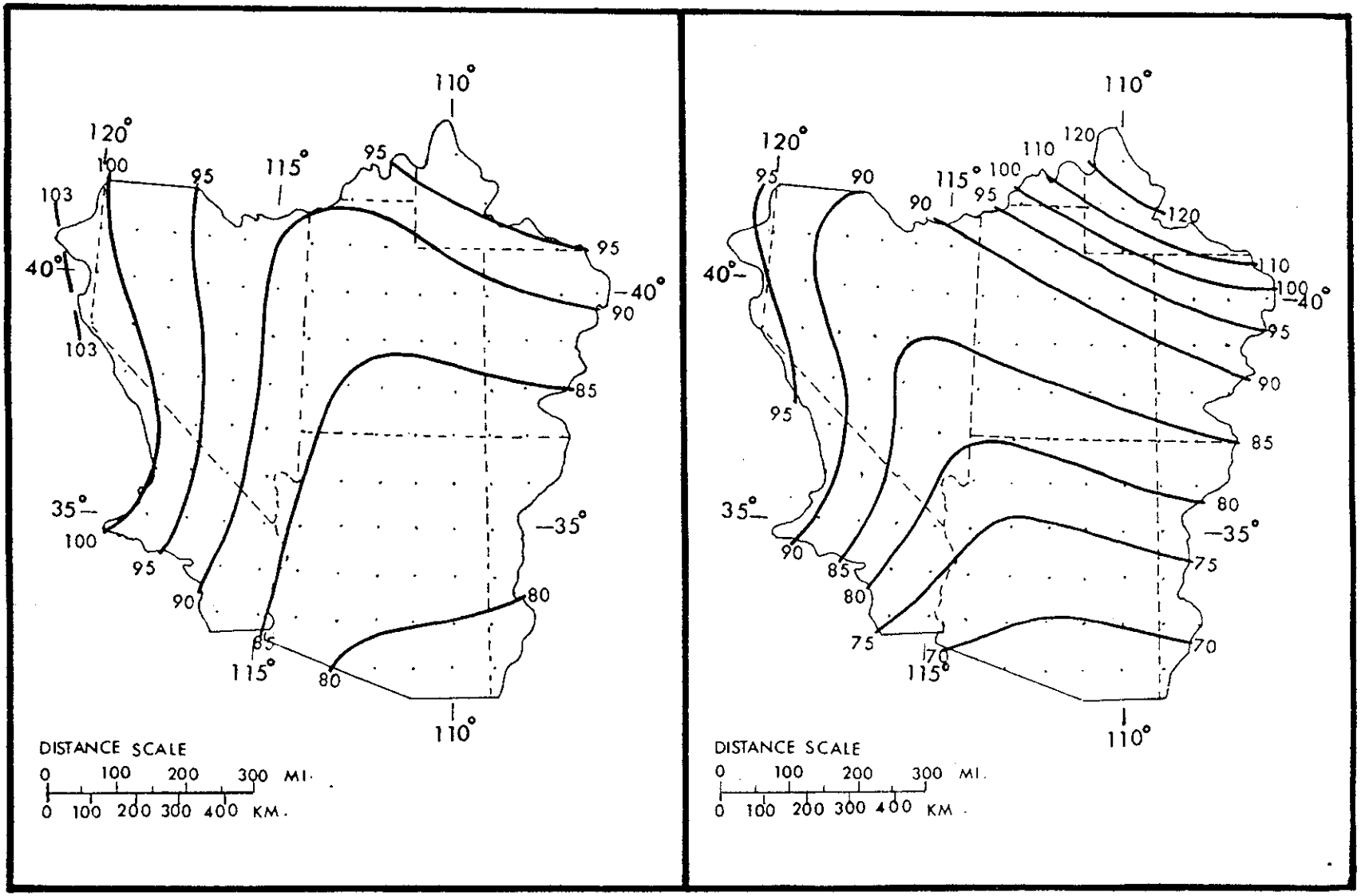
Figure 3.20.--Variation of orographic PMP with basin size.



January

February

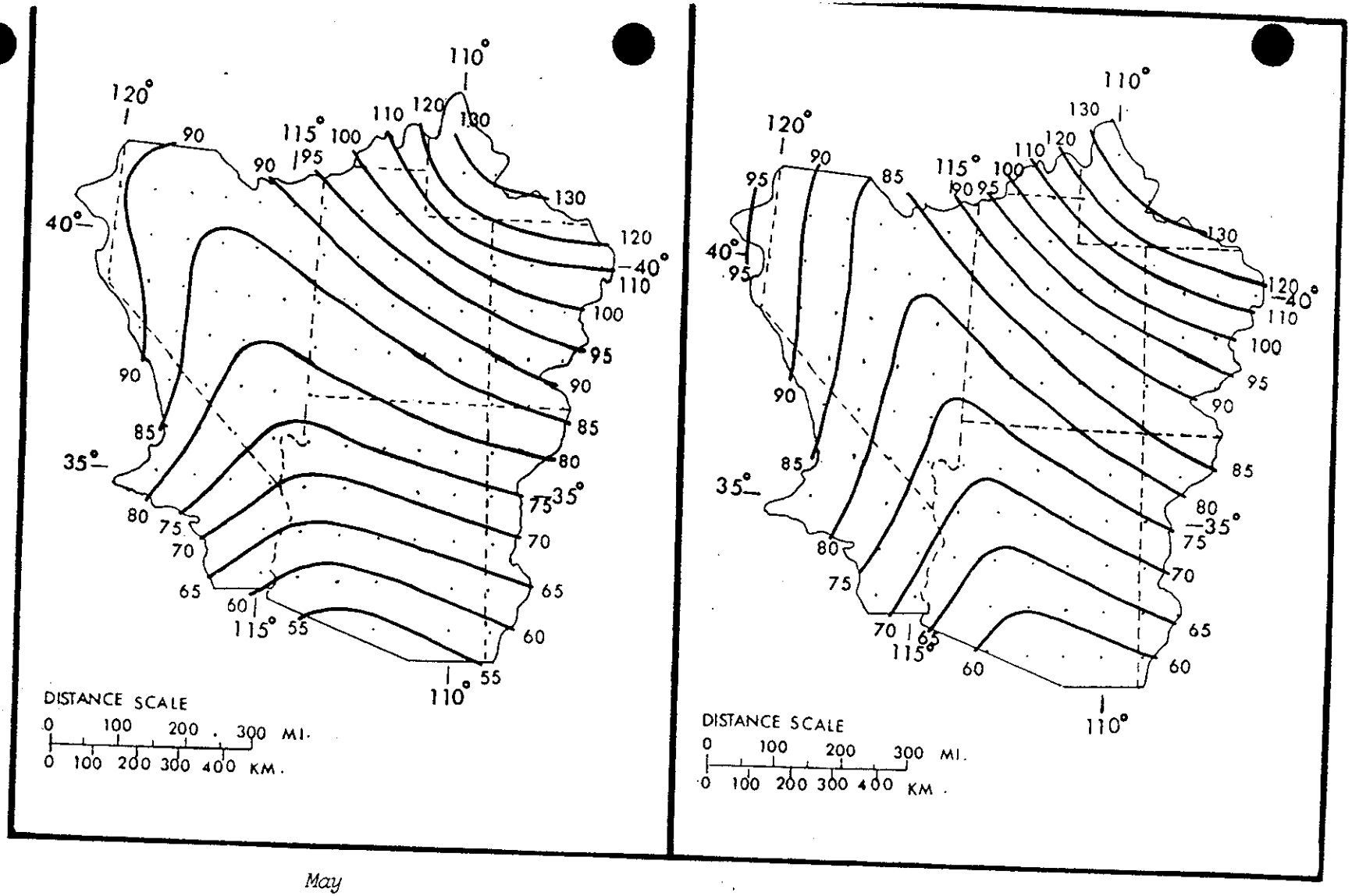
Figure 3.12.--Seasonal variation in 10-mi^2 (26-km^2) 24-hr orographic PMP for the study region (in percent of values in figure 3.11).



March

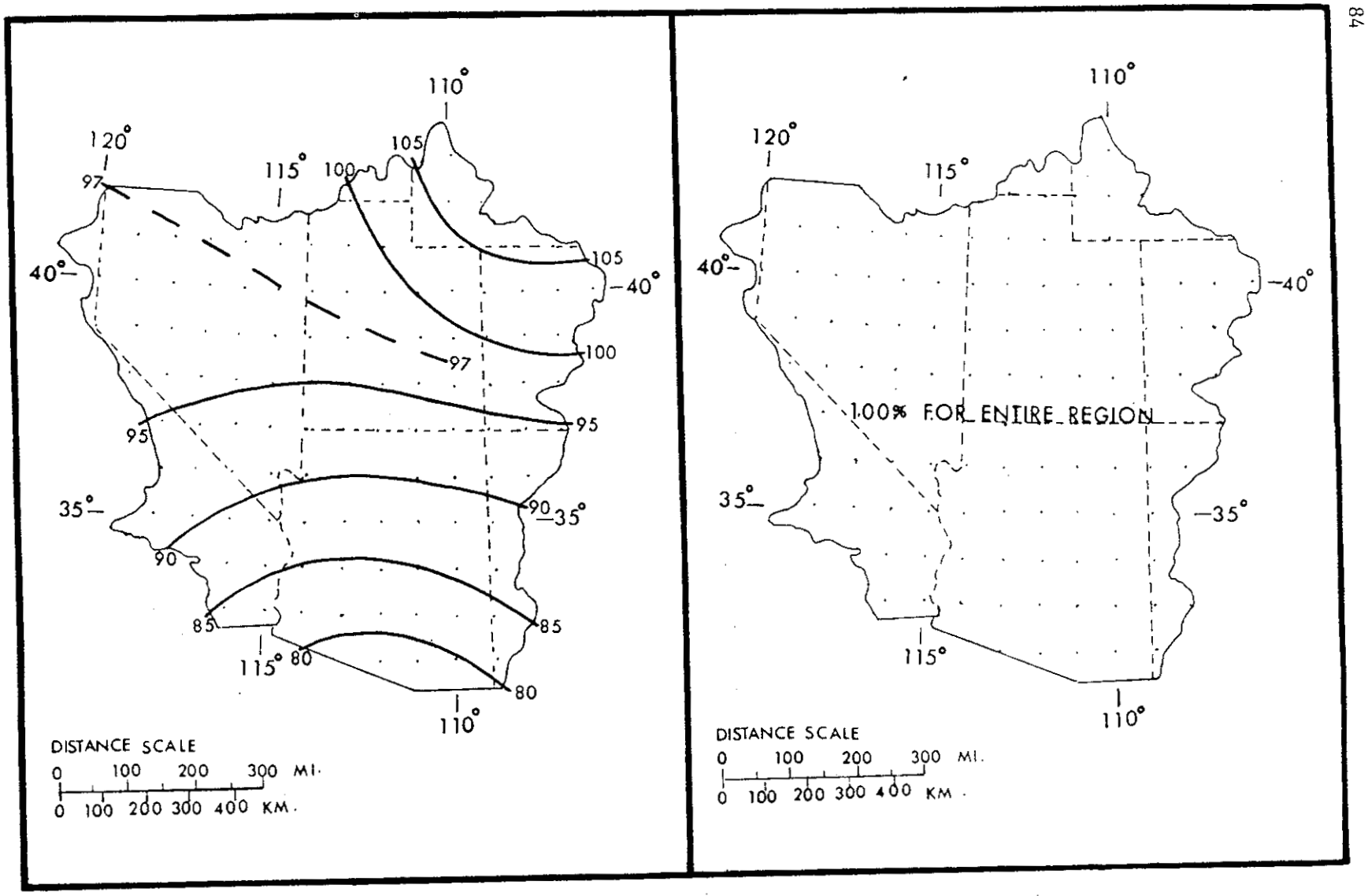
April

Figure 3.13.--Seasonal variation in 10-mi^2 (26-km^2) 24-hr orographic PMP for the study region (in percent of values in figure 3.11).



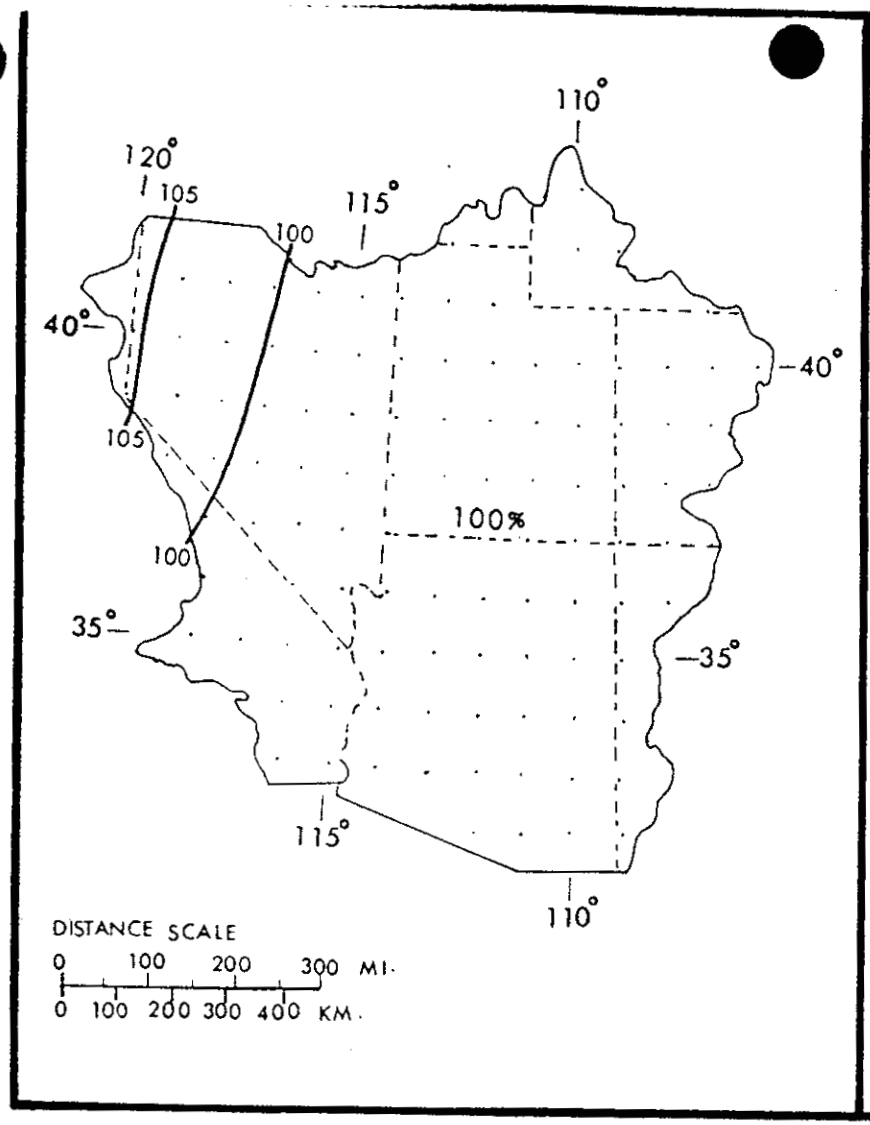
May *June*

Figure 3.14.--Seasonal variation in 10-mi^2 (26-km^2) 24-hr orographic PMP for the study region (in percent of values in figure 3.11).

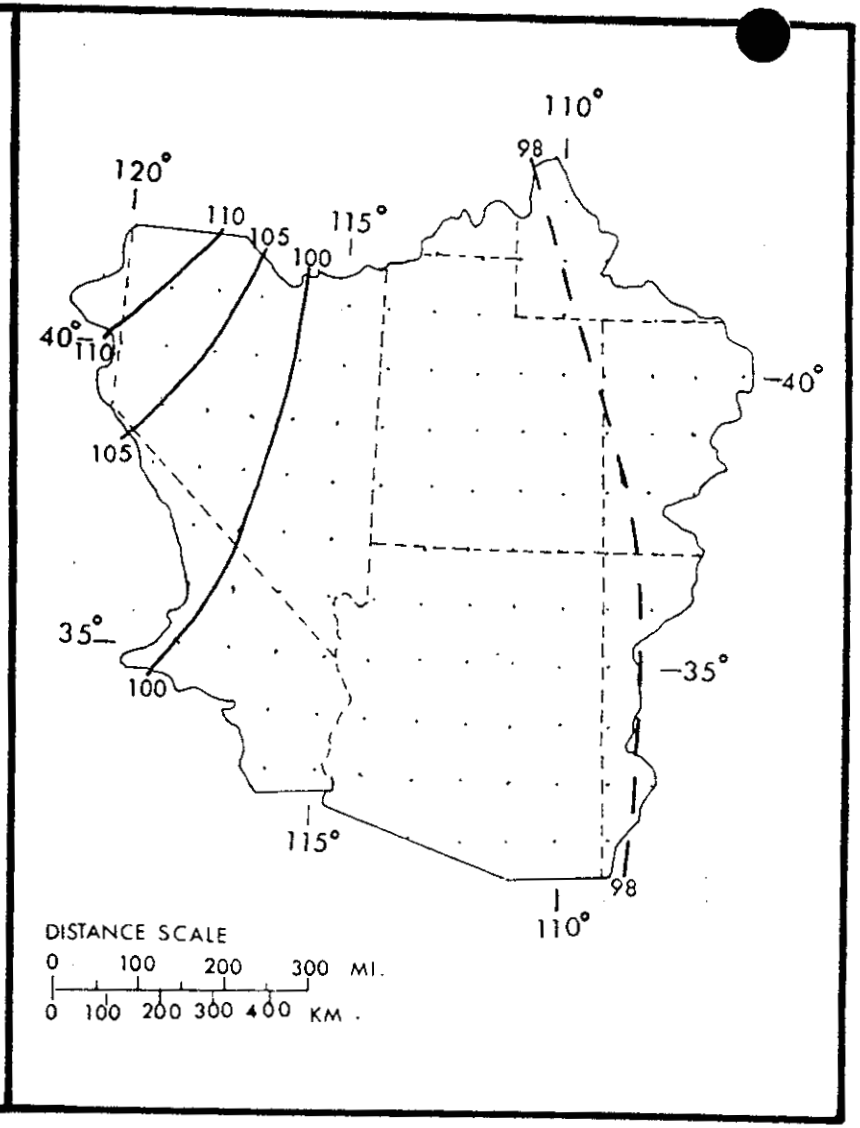


July *August*

Figure 3.15.--Seasonal variation in 10-mi^2 (26-km^2) 24-hr orographic PMP for the study region (in percent of values in figure 3.11).

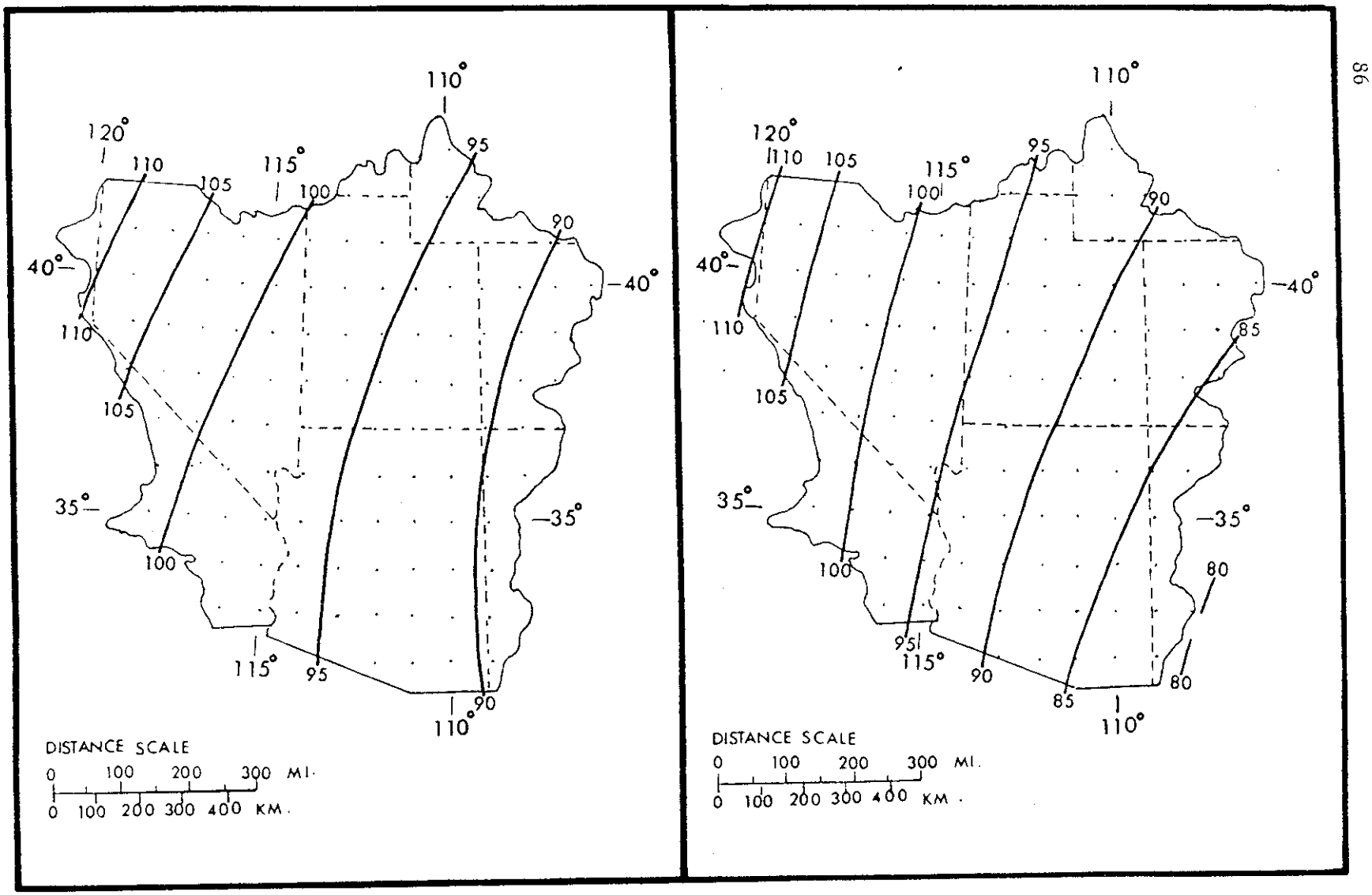


September



October

Figure 3.16.--Seasonal variation in 10-mi^2 (26-km^2) 24-hr orographic PMP for the study region (in percent of values in figure 3.11).



November *December*

Figure 3.17.--Seasonal variation in 10-mi^2 (26-km^2) 24-hr orographic PMP for the study region (in percent of values in figure 3.11).

Table 3.9.--Durational variation of orographic PMP

Latitude °N	Percent of 24-hr value					
	6 hr	12	18	24	48	72
42	28	55	79	100	161	190
41	29	56	79	100	160	189
40	30	57	80	100	159	187
39	30	57	80	100	157	185
38	31	58	81	100	155	182
37	32	59	81	100	152	177
36	33	60	82	100	149	172
35	34	61	82	100	146	167
34	35	62	83	100	143	162
33	36	63	84	100	139	157
32	37	64	84	100	135	152
31	39	66	85	100	132	146

4. LOCAL-STORM PMP FOR THE SOUTHWESTERN REGION AND CALIFORNIA

4.1 Introduction

This chapter provides generalized estimates of local or thunderstorm probable maximum precipitation. By "generalized" is meant that mapped values are given from which estimates of PMP may be determined for any selected drainage.

4.1.1 Region of Interest

Local-storm PMP was not included in the "Interim Report, Probable Maximum Precipitation in California" (HMR No. 36). During the formulation of the present study, we decided that the local-storm part of the study should include California west of the Sierra Nevada. It was also noted that PMP for summer thunderstorms was not considered west of the Cascade Divide in the Northwestern Region (HMR No. 43). As stated in the latter report, "No summer thunderstorms have been reported there (west of the Divide) of an intensity of those to the east, for which the moisture source is often the Gulf of Mexico or Gulf of California. The Cascade Divide offers an additional barrier to such moisture inflows to coastal areas where, in addition, the Pacific Ocean to the west has a stabilizing influence on the air to hinder the occurrence of intense summer local storms." Therefore, it was necessary to establish some continuation of the Cascade Divide into California so that the local-storm PMP definition would have continuity between the two regions.

The stabilizing influence of the Pacific air is at times interrupted by the warm moist tropical air from the south pushing into California, although it is difficult to determine where the limit of southerly flow occurs. General storms having the tropical characteristic of excessive thunderstorm rains are observed as far north as the northern end of the Sacramento Valley. Thus, a northern boundary has been selected for this study, excluding that portion of

B.2. Physical Parameter Calculations

B.2.1. Soils

B.2.2. Land Use

B.2.3. S-graph

B.2.4. Hydraulic Length and Slope

B.2.5. WMS Green and Ampt Verification

B.2.1. Soils

Soil Type Summary

Yavapai County Soil Parameter Estimation

Soil Type Summary

APPENDIX B.2.1: Soil Type Summary

Entellus

CLIENT: FCDMC

JOB: Wittmann Area Drainage Master Study Update **JOB NO.** 310.032

Basin* ID	Total Basin Area (sqmiles)	Soil Type (WMS)	Soil Type (DDMSW)	Soil Type % Area	Soil Type Area (sqmiles)	XKSAT (in/hr)	RTIMP
IW310	25.81	645110	110	2.98%	0.77	0.13	0
IW310	25.81	645112	112	3.78%	0.98	0.39	0
IW310	25.81	645113	113	0.27%	0.07	0.39	0
IW310	25.81	645119	119	0.26%	0.07	0.14	0
IW310	25.81	64513	13	0.28%	0.07	0.01	0
IW310	25.81	6452	2	0.17%	0.04	0.41	0
IW310	25.81	64521	21	0.26%	0.07	0.38	0
IW310	25.81	64522	22	17.13%	4.42	0.04	0
IW310	25.81	64528	28	0.20%	0.05	0.02	0
IW310	25.81	64529	29	11.83%	3.05	0.34	0
IW310	25.81	6453	3	1.21%	0.31	0.58	0
IW310	25.81	64542	42	0.19%	0.05	0.17	0
IW310	25.81	64544	44	6.20%	1.6	0.03	0
IW310	25.81	64546	46	16.67%	4.3	0.03	0
IW310	25.81	64548	48	2.04%	0.53	0.06	0
IW310	25.81	64549	49	0.31%	0.08	0.06	0
IW310	25.81	64553	53	8.08%	2.08	0.02	0
IW310	25.81	64555	55	3.81%	0.98	0.27	0
IW310	25.81	64558	58	3.41%	0.88	0.34	0
IW310	25.81	64560	60	0.22%	0.06	0.26	0
IW310	25.81	64564	64	1.13%	0.29	0.14	25
IW310	25.81	64566	66	0.11%	0.03	0.23	0
IW310	25.81	64568	68	0.11%	0.03	0.63	0
IW310	25.81	64570	70	3.11%	0.8	0.36	0
IW310	25.81	64573	73	0.98%	0.25	0.09	30
IW310	25.81	64574	74	1.43%	0.37	0.08	0
IW310	25.81	64575	75	1.97%	0.51	0.23	0
IW310	25.81	64576	76	2.48%	0.64	0.23	0
IW310	25.81	64577	77	0.68%	0.17	0.05	0
IW310	25.81	64578	78	1.25%	0.32	0.05	0
IW310	25.81	64594	94	0.78%	0.2	0.33	0
IW310	25.81	64598	98	6.67%	1.72	0.37	0
IW350	4.21	645121	121	4.94%	0.21	0.12	0
IW350	4.21	64531	31	5.04%	0.21	0.33	35
IW350	4.21	64533	33	9.39%	0.39	0.23	0
IW350	4.21	64536	36	16.04%	0.67	0.07	0
IW350	4.21	64539	39	2.58%	0.11	0.29	0
IW350	4.21	64542	42	6.87%	0.29	0.17	0
IW350	4.21	64563	63	36.75%	1.54	0.14	25
IW350	4.21	64566	66	3.33%	0.14	0.23	0
IW350	4.21	6457	7	1.13%	0.05	0.62	0
IW350	4.21	64573	73	11.53%	0.48	0.09	30
IW350	4.21	64594	94	2.41%	0.1	0.33	0
PD700	7.26	64510	10	1.54%	0.11	0.94	0
PD700	7.26	645100	100	7.91%	0.57	0.40	20
PD700	7.26	645103	103	0.25%	0.02	0.10	65
PD700	7.26	645108	108	0.25%	0.02	0.31	30
PD700	7.26	645110	110	17.21%	1.25	0.13	0
PD700	7.26	645113	113	1.39%	0.1	0.39	0
PD700	7.26	645118	118	0.31%	0.02	0.42	0
PD700	7.26	64518	18	1.11%	0.08	0.33	15
PD700	7.26	64521	21	0.15%	0.01	0.38	0
PD700	7.26	64547	47	2.13%	0.15	0.11	0
PD700	7.26	64548	48	0.40%	0.03	0.06	0

APPENDIX B.2.1: Soil Type Summary

Entellus

CLIENT: FCDMC

JOB: Wittmann Area Drainage Master Study Update **JOB NO.** 310.032

Basin* ID	Total Basin Area (sqmiles)	Soil Type (WMS)	Soil Type (DDMSW)	Soil Type % Area	Soil Type Area (sqmiles)	XKSAT (in/hr)	RTIMP
PD700	7.26	64552	52	17.61%	1.28	0.16	20
PD700	7.26	64568	68	1.27%	0.09	0.63	0
PD700	7.26	64570	70	0.62%	0.04	0.36	0
PD700	7.26	64598	98	10.32%	0.75	0.37	0
PD700	7.26	651203222	AGB	0.34%	0.02	0.40	0
PD700	7.26	651203424	AHC	4.88%	0.35	0.38	0
PD700	7.26	651285026	EPD	0.15%	0.01	0.12	0
PD700	7.26	6513244	GM	4.32%	0.31	0.29	0
PD700	7.26	651326426	GWD	4.23%	0.31	0.35	0
PD700	7.26	651326826	GYD	2.66%	0.19	0.26	0
PD700	7.26	651445822	MTB	8.74%	0.63	0.15	0
PD700	7.26	6514462	MV	4.36%	0.32	0.15	0
PD700	7.26	651505422	PRB	0.43%	0.03	0.28	0
PD700	7.26	651506422	PWB	0.37%	0.03	0.38	0
PD700	7.26	651585022	TPB	5.75%	0.42	0.12	0
PD700	7.26	651585624	TSC	1.30%	0.09	0.14	0
PD710	6.72	645103	103	0.17%	0.01	0.10	65
PD710	6.72	645110	110	3.34%	0.22	0.13	0
PD710	6.72	645113	113	8.01%	0.54	0.39	0
PD710	6.72	645115	115	0.07%	0	0.39	0
PD710	6.72	6452	2	1.00%	0.07	0.41	0
PD710	6.72	64521	21	0.63%	0.04	0.38	0
PD710	6.72	64552	52	5.51%	0.37	0.16	20
PD710	6.72	64555	55	3.87%	0.26	0.27	0
PD710	6.72	64558	58	4.44%	0.3	0.34	0
PD710	6.72	64570	70	5.17%	0.35	0.36	0
PD710	6.72	64580	80	2.34%	0.16	0.08	0
PD710	6.72	64598	98	36.44%	2.45	0.37	0
PD710	6.72	651203222	AGB	1.50%	0.1	0.40	0
PD710	6.72	651203424	AHC	1.57%	0.11	0.38	0
PD710	6.72	6512042	AL	3.54%	0.24	0.40	0
PD710	6.72	6513244	GM	12.21%	0.82	0.29	0
PD710	6.72	651326426	GWD	0.30%	0.02	0.35	0
PD710	6.72	651445822	MTB	8.24%	0.55	0.15	0
PD710	6.72	6514462	MV	0.87%	0.06	0.15	0
PD710	6.72	651585022	TPB	0.80%	0.05	0.12	0
PD730	0.48	645100	100	20.87%	0.1	0.40	20
PD730	0.48	645108	108	1.46%	0.01	0.31	30
PD730	0.48	645109	109	66.02%	0.3	0.35	35
PD730	0.48	645110	110	9.22%	0.04	0.13	0
PD730	0.48	64547	47	2.43%	0.01	0.11	0
PD735	3.23	64510	10	2.71%	0.09	0.94	0
PD735	3.23	645108	108	13.06%	0.42	0.31	30
PD735	3.23	645109	109	66.44%	2.14	0.35	35
PD735	3.23	645110	110	1.53%	0.05	0.13	0
PD735	3.23	645113	113	0.56%	0.02	0.39	0
PD735	3.23	64521	21	1.60%	0.05	0.38	0
PD735	3.23	64547	47	0.63%	0.02	0.11	0
PD735	3.23	64549	49	1.04%	0.03	0.06	0
PD735	3.23	64552	52	0.49%	0.02	0.16	20
PD735	3.23	64555	55	0.28%	0.01	0.27	0
PD735	3.23	64598	98	11.67%	0.38	0.37	0
PD740	0.87	645109	109	17.14%	0.15	0.35	35
PD740	0.87	645110	110	47.01%	0.41	0.13	0

APPENDIX B.2.1: Soil Type Summary

Entellus

CLIENT: FCDMC

JOB: Wittmann Area Drainage Master Study Update **JOB NO.** 310.032

Basin* ID	Total Basin Area (sqmiles)	Soil Type (WMS)	Soil Type (DDMSW)	Soil Type % Area	Soil Type Area (sqmiles)	XKSAT (in/hr)	RTIMP
PD740	0.87	645113	113	27.53%	0.24	0.39	0
PD740	0.87	64598	98	8.31%	0.07	0.37	0
PD745	1.98	645108	108	0.11%	0	0.31	30
PD745	1.98	645109	109	29.98%	0.59	0.35	35
PD745	1.98	64549	49	23.11%	0.45	0.06	0
PD745	1.98	64555	55	13.62%	0.27	0.27	0
PD745	1.98	64598	98	33.18%	0.65	0.37	0
PD760	2.72	645108	108	0.91%	0.02	0.31	30
PD760	2.72	645109	109	6.78%	0.18	0.35	35
PD760	2.72	645112	112	18.68%	0.51	0.39	0
PD760	2.72	645113	113	3.31%	0.09	0.39	0
PD760	2.72	6452	2	1.98%	0.05	0.41	0
PD760	2.72	6453	3	3.64%	0.1	0.58	0
PD760	2.72	64549	49	6.94%	0.19	0.06	0
PD760	2.72	64570	70	1.40%	0.04	0.36	0
PD760	2.72	64598	98	56.36%	1.53	0.37	0
PD780	19.17	645108	108	2.25%	0.43	0.31	30
PD780	19.17	645109	109	27.23%	5.21	0.35	35
PD780	19.17	645110	110	2.51%	0.48	0.13	0
PD780	19.17	645113	113	0.59%	0.11	0.39	0
PD780	19.17	6453	3	1.92%	0.37	0.58	0
PD780	19.17	64531	31	39.96%	7.65	0.33	35
PD780	19.17	64533	33	0.33%	0.06	0.23	0
PD780	19.17	64544	44	9.06%	1.74	0.03	0
PD780	19.17	64545	45	3.75%	0.72	0.03	0
PD780	19.17	64546	46	1.90%	0.36	0.03	0
PD780	19.17	64547	47	2.51%	0.48	0.11	0
PD780	19.17	64548	48	0.55%	0.11	0.06	0
PD780	19.17	64549	49	0.41%	0.08	0.06	0
PD780	19.17	64552	52	0.04%	0.01	0.16	20
PD780	19.17	64563	63	2.78%	0.53	0.14	25
PD780	19.17	64574	74	4.12%	0.79	0.08	0
PD780	19.17	64598	98	0.12%	0.02	0.37	0
PI600	12.03	645112	112	0.26%	0.03	0.39	0
PI600	12.03	645115	115	1.18%	0.14	0.39	0
PI600	12.03	64518	18	0.15%	0.02	0.33	15
PI600	12.03	6453	3	0.06%	0.01	0.58	0
PI600	12.03	64552	52	2.18%	0.26	0.16	20
PI600	12.03	64555	55	7.26%	0.87	0.27	0
PI600	12.03	64558	58	5.71%	0.69	0.34	0
PI600	12.03	64570	70	7.19%	0.86	0.36	0
PI600	12.03	64578	78	0.30%	0.04	0.05	0
PI600	12.03	64580	80	1.36%	0.16	0.08	0
PI600	12.03	64598	98	13.61%	1.63	0.37	0
PI600	12.03	651202320	AbA	0.02%	0	0.38	0
PI600	12.03	651202720	AdA	0.41%	0.05	0.40	0
PI600	12.03	651202722	AdB	0.93%	0.11	0.40	0
PI600	12.03	651203222	AGB	2.11%	0.25	0.40	0
PI600	12.03	651203424	AHC	4.59%	0.55	0.38	0
PI600	12.03	6512448	CO	0.34%	0.04	0.29	20
PI600	12.03	6512457	Cs	0.19%	0.02	0.19	0
PI600	12.03	6512857	Es	1.90%	0.23	0.25	0
PI600	12.03	651323320	GgA	0.13%	0.02	0.25	0
PI600	12.03	6513244	GM	34.75%	4.17	0.29	0

APPENDIX B.2.1: Soil Type Summary

Entellus

CLIENT: FCDMC

JOB: Wittmann Area Drainage Master Study Update **JOB NO.** 310.032

Basin* ID	Total Basin Area (sqmiles)	Soil Type (WMS)	Soil Type (DDMSW)	Soil Type % Area	Soil Type Area (sqmiles)	XKSAT (in/hr)	RTIMP
PI600	12.03	6514451	Mp	1.75%	0.21	0.25	0
PI600	12.03	6514455	Mr	1.10%	0.13	0.05	0
PI600	12.03	651445822	MTB	7.43%	0.89	0.15	0
PI600	12.03	6514462	MV	3.17%	0.38	0.15	0
PI600	12.03	651502922	PeB	0.06%	0.01	0.38	0
PI600	12.03	6515456	RS	0.35%	0.04	0.40	65
PI600	12.03	651585022	TPB	0.86%	0.1	0.12	0
PI600	12.03	651585520	TrA	0.30%	0.04	0.11	0
PI600	12.03	651585522	TrB	0.09%	0.01	0.13	0
PI600	12.03	6516221	Va	0.06%	0.01	0.39	0
PI600	12.03	6516229	Ve	0.21%	0.02	0.25	0
PI640	17.56	64510	10	1.82%	0.32	0.94	0
PI640	17.56	645108	108	0.29%	0.05	0.31	30
PI640	17.56	645110	110	0.42%	0.07	0.13	0
PI640	17.56	645112	112	2.11%	0.37	0.39	0
PI640	17.56	645113	113	5.60%	0.98	0.39	0
PI640	17.56	645114	114	0.68%	0.12	0.39	0
PI640	17.56	6452	2	0.19%	0.03	0.41	0
PI640	17.56	64529	29	10.00%	1.75	0.34	0
PI640	17.56	6453	3	0.35%	0.06	0.58	0
PI640	17.56	64533	33	0.10%	0.02	0.23	0
PI640	17.56	64544	44	20.55%	3.6	0.03	0
PI640	17.56	64545	45	23.99%	4.21	0.03	0
PI640	17.56	64547	47	0.01%	0	0.11	0
PI640	17.56	64548	48	2.90%	0.51	0.06	0
PI640	17.56	64549	49	1.27%	0.22	0.06	0
PI640	17.56	64555	55	9.19%	1.61	0.27	0
PI640	17.56	64558	58	6.63%	1.16	0.34	0
PI640	17.56	64563	63	0.18%	0.03	0.14	25
PI640	17.56	64574	74	8.31%	1.46	0.08	0
PI640	17.56	64575	75	1.69%	0.3	0.23	0
PI640	17.56	64580	80	1.57%	0.28	0.08	0
PI640	17.56	64598	98	2.15%	0.38	0.37	0
PI680	16.89	637244526	CmD	18.27%	3.08	0.00	0
PI680	16.89	6374229	Le	8.17%	1.38	0.00	0
PI680	16.89	6374235	Lh	7.66%	1.29	0.00	0
PI680	16.89	6375455	Rr	2.28%	0.39	0.00	0
PI680	16.89	64510	10	0.01%	0	0.94	0
PI680	16.89	645104	104	0.13%	0.02	0.14	60
PI680	16.89	64516	16	1.78%	0.3	0.44	15
PI680	16.89	64531	31	19.01%	3.21	0.33	35
PI680	16.89	64533	33	0.19%	0.03	0.23	0
PI680	16.89	64534	34	1.55%	0.26	0.23	0
PI680	16.89	64544	44	0.12%	0.02	0.03	0
PI680	16.89	64545	45	0.07%	0.01	0.03	0
PI680	16.89	64563	63	20.71%	3.5	0.14	25
PI680	16.89	64572	72	17.43%	2.94	0.09	30
PI680	16.89	64574	74	0.54%	0.09	0.08	0
PI680	16.89	6458	8	2.06%	0.35	0.96	0
SV200	31.33	6451	1	0.10%	0.03	0.41	0
SV200	31.33	645100	100	16.21%	5.08	0.40	20
SV200	31.33	645112	112	10.48%	3.28	0.39	0
SV200	31.33	645113	113	6.20%	1.94	0.39	0
SV200	31.33	645115	115	0.34%	0.11	0.39	0

APPENDIX B.2.1: Soil Type Summary

Entellus

CLIENT: FCDMC

JOB: Wittmann Area Drainage Master Study Update **JOB NO.** 310.032

Basin* ID	Total Basin Area (sqmiles)	Soil Type (WMS)	Soil Type (DDMSW)	Soil Type % Area	Soil Type Area (sqmiles)	XKSAT (in/hr)	RTIMP
SV200	31.33	645124	124	3.63%	1.14	0.39	0
SV200	31.33	6452	2	0.06%	0.02	0.41	0
SV200	31.33	64522	22	3.92%	1.23	0.04	0
SV200	31.33	64529	29	7.98%	2.5	0.34	0
SV200	31.33	6453	3	2.63%	0.83	0.58	0
SV200	31.33	64548	48	16.50%	5.17	0.06	0
SV200	31.33	64549	49	1.67%	0.52	0.06	0
SV200	31.33	64550	50	2.00%	0.63	0.26	0
SV200	31.33	64553	53	3.67%	1.15	0.02	0
SV200	31.33	64555	55	6.28%	1.97	0.27	0
SV200	31.33	64564	64	0.04%	0.01	0.14	25
SV200	31.33	64570	70	1.32%	0.41	0.36	0
SV200	31.33	64575	75	5.68%	1.78	0.23	0
SV200	31.33	64576	76	4.93%	1.54	0.23	0
SV200	31.33	64577	77	3.11%	0.98	0.05	0
SV200	31.33	64578	78	0.16%	0.05	0.05	0
SV200	31.33	64598	98	0.49%	0.15	0.37	0
SV200	31.33	651203222	AGB	0.13%	0.04	0.40	0
SV200	31.33	6512042	AL	0.45%	0.14	0.40	0
SV200	31.33	6513244	GM	1.13%	0.35	0.29	0
SV200	31.33	651445822	MTB	0.72%	0.23	0.15	0
SV200	31.33	651585624	TSC	0.18%	0.06	0.14	0
SV220	16.95	645110	110	0.97%	0.16	0.13	0
SV220	16.95	645112	112	25.24%	4.27	0.39	0
SV220	16.95	645113	113	0.82%	0.14	0.39	0
SV220	16.95	64522	22	22.15%	3.75	0.04	0
SV220	16.95	64546	46	0.89%	0.15	0.03	0
SV220	16.95	64553	53	30.74%	5.21	0.02	0
SV220	16.95	64570	70	3.79%	0.64	0.36	0
SV220	16.95	64576	76	14.59%	2.47	0.23	0
SV220	16.95	64578	78	0.65%	0.11	0.05	0
SV220	16.95	64580	80	0.17%	0.03	0.08	0
TW400	12.99	6451	1	0.16%	0.02	0.41	0
TW400	12.99	645100	100	7.30%	0.94	0.40	20
TW400	12.99	645112	112	7.09%	0.92	0.39	0
TW400	12.99	645113	113	0.09%	0.01	0.39	0
TW400	12.99	645115	115	0.78%	0.1	0.39	0
TW400	12.99	64522	22	0.28%	0.04	0.04	0
TW400	12.99	6453	3	0.29%	0.04	0.58	0
TW400	12.99	64548	48	3.08%	0.4	0.06	0
TW400	12.99	64553	53	2.60%	0.34	0.02	0
TW400	12.99	64598	98	0.09%	0.01	0.37	0
TW400	12.99	651202720	AdA	0.21%	0.03	0.40	0
TW400	12.99	6512029	Ae	0.24%	0.03	0.39	0
TW400	12.99	651203222	AGB	6.86%	0.89	0.40	0
TW400	12.99	6512042	AL	11.96%	1.55	0.40	0
TW400	12.99	6512257	Bs	0.03%	0	0.39	0
TW400	12.99	6512448	CO	1.32%	0.17	0.29	20
TW400	12.99	6512451	Cp	0.16%	0.02	0.40	0
TW400	12.99	6512457	Cs	0.17%	0.02	0.19	0
TW400	12.99	651285026	EPD	3.24%	0.42	0.12	0
TW400	12.99	651323320	GgA	2.39%	0.31	0.25	0
TW400	12.99	6513244	GM	10.36%	1.34	0.29	0
TW400	12.99	651326722	GxB	0.02%	0	0.24	0

APPENDIX B.2.1: Soil Type Summary

Entellus

CLIENT: FCDMC

JOB: Wittmann Area Drainage Master Study Update **JOB NO.** 310.032

Basin* ID	Total Basin Area (sqmiles)	Soil Type (WMS)	Soil Type (DDMSW)	Soil Type % Area	Soil Type Area (sqmiles)	XKSAT (in/hr)	RTIMP
TW400	12.99	651422520	LcA	0.05%	0.01	0.25	0
TW400	12.99	6514451	Mp	0.45%	0.06	0.25	0
TW400	12.99	6514455	Mr	0.88%	0.11	0.05	0
TW400	12.99	651445822	MTB	20.86%	2.7	0.15	0
TW400	12.99	651505422	PRB	1.77%	0.23	0.28	0
TW400	12.99	6515456	RS	0.43%	0.06	0.40	65
TW400	12.99	6515833	Tg	0.36%	0.05	0.04	0
TW400	12.99	651585520	TrA	0.14%	0.02	0.11	0
TW400	12.99	651585522	TrB	2.15%	0.28	0.13	0
TW400	12.99	651585624	TSC	11.64%	1.51	0.14	0
TW400	12.99	6516229	Ve	1.44%	0.19	0.25	0
TW400	12.99	6516231	Vf	0.69%	0.09	0.01	0
TW400	12.99	6516255	Vr	0.42%	0.05	0.63	0
TW420	10.89	645112	112	5.19%	0.56	0.39	0
TW420	10.89	645113	113	17.56%	1.91	0.39	0
TW420	10.89	64522	22	4.23%	0.46	0.04	0
TW420	10.89	64523	23	0.93%	0.1	0.01	0
TW420	10.89	64529	29	2.08%	0.23	0.34	0
TW420	10.89	6453	3	1.96%	0.21	0.58	0
TW420	10.89	64544	44	12.64%	1.37	0.03	0
TW420	10.89	64546	46	0.78%	0.09	0.03	0
TW420	10.89	64548	48	8.51%	0.93	0.06	0
TW420	10.89	64553	53	0.95%	0.1	0.02	0
TW420	10.89	64555	55	4.76%	0.52	0.27	0
TW420	10.89	64558	58	19.60%	2.13	0.34	0
TW420	10.89	64570	70	1.63%	0.18	0.36	0
TW420	10.89	64576	76	2.08%	0.23	0.23	0
TW420	10.89	64578	78	3.77%	0.41	0.05	0
TW420	10.89	64580	80	2.04%	0.22	0.08	0
TW420	10.89	64598	98	11.28%	1.23	0.37	0
TW460	2.44	6453	3	2.31%	0.06	0.58	0
TW460	2.44	64535	35	9.53%	0.23	0.23	0
TW460	2.44	64536	36	19.52%	0.47	0.07	0
TW460	2.44	64539	39	28.31%	0.69	0.29	0
TW460	2.44	64543	43	1.20%	0.03	0.17	0
TW460	2.44	64544	44	8.42%	0.2	0.03	0
TW460	2.44	64546	46	5.37%	0.13	0.03	0
TW460	2.44	64548	48	0.37%	0.01	0.06	0
TW460	2.44	64564	64	5.74%	0.14	0.14	25
TW460	2.44	6457	7	12.58%	0.3	0.62	0
TW460	2.44	64594	94	6.66%	0.16	0.33	0
TW480	12.72	637244526	CmD	19.13%	2.43	0.00	0
TW480	12.72	637244730	CnF	0.12%	0.02	0.00	0
TW480	12.72	6374229	Le	9.55%	1.22	0.00	0
TW480	12.72	6374235	Lh	6.98%	0.89	0.00	0
TW480	12.72	6375455	Rr	10.36%	1.32	0.00	0
TW480	12.72	645104	104	0.74%	0.09	0.14	60
TW480	12.72	64516	16	0.14%	0.02	0.44	15
TW480	12.72	64531	31	2.15%	0.27	0.33	35
TW480	12.72	64534	34	3.08%	0.39	0.23	0
TW480	12.72	64536	36	1.02%	0.13	0.07	0
TW480	12.72	64543	43	0.78%	0.1	0.17	0
TW480	12.72	64562	62	0.07%	0.01	0.15	0
TW480	12.72	64563	63	40.24%	5.12	0.14	25

APPENDIX B.2.1: Soil Type Summary

Entellus

CLIENT: FCDMC

JOB: Wittmann Area Drainage Master Study Update **JOB NO.** 310.032

Basin* ID	Total Basin Area (sqmiles)	Soil Type (WMS)	Soil Type (DDMSW)	Soil Type % Area	Soil Type Area (sqmiles)	XKSAT (in/hr)	RTIMP
TW480	12.72	6457	7	0.79%	0.1	0.62	0
TW480	12.72	64572	72	4.37%	0.56	0.09	30
TW480	12.72	64597	97	0.48%	0.06	0.07	0
WI500	9.16	645115	115	1.55%	0.14	0.39	0
WI500	9.16	64522	22	2.66%	0.24	0.04	0
WI500	9.16	64550	50	0.05%	0	0.26	0
WI500	9.16	64555	55	0.79%	0.07	0.27	0
WI500	9.16	64558	58	19.74%	1.8	0.34	0
WI500	9.16	64560	60	0.81%	0.07	0.26	0
WI500	9.16	64575	75	9.02%	0.82	0.23	0
WI500	9.16	64580	80	1.50%	0.14	0.08	0
WI500	9.16	651202720	AdA	0.76%	0.07	0.40	0
WI500	9.16	6512457	Cs	0.71%	0.07	0.19	0
WI500	9.16	651323320	GgA	1.35%	0.12	0.25	0
WI500	9.16	6513244	GM	18.76%	1.71	0.29	0
WI500	9.16	6514449	Mo	0.22%	0.02	0.39	0
WI500	9.16	6514451	Mp	1.16%	0.11	0.25	0
WI500	9.16	651445822	MTB	30.42%	2.77	0.15	0
WI500	9.16	651583120	TfA	0.20%	0.02	0.37	0
WI500	9.16	6515835	Th	1.48%	0.13	0.04	0
WI500	9.16	651585520	TrA	0.81%	0.07	0.11	0
WI500	9.16	651585522	TrB	0.07%	0.01	0.13	0
WI500	9.16	651585624	TSC	4.48%	0.41	0.14	0
WI500	9.16	6516229	Ve	3.44%	0.31	0.25	0
WI500	9.16	6516231	Vf	0.02%	0	0.01	0
WI505	6.67	64529	29	0.27%	0.02	0.34	0
WI505	6.67	64544	44	0.07%	0	0.03	0
WI505	6.67	64555	55	11.20%	0.75	0.27	0
WI505	6.67	64558	58	36.47%	2.43	0.34	0
WI505	6.67	64575	75	2.25%	0.15	0.23	0
WI505	6.67	645999	999	1.08%	0.07	0.00	0
WI505	6.67	651202722	AdB	0.13%	0.01	0.40	0
WI505	6.67	651203222	AGB	3.90%	0.26	0.40	0
WI505	6.67	6512457	Cs	1.35%	0.09	0.19	0
WI505	6.67	6513244	GM	24.50%	1.63	0.29	0
WI505	6.67	6514451	Mp	1.21%	0.08	0.25	0
WI505	6.67	651445822	MTB	17.53%	1.17	0.15	0
WI505	6.67	651585520	TrA	0.03%	0	0.11	0
WI510	9.31	645112	112	2.77%	0.26	0.39	0
WI510	9.31	645113	113	0.70%	0.07	0.39	0
WI510	9.31	6452	2	0.02%	0	0.41	0
WI510	9.31	64522	22	1.25%	0.12	0.04	0
WI510	9.31	64553	53	1.21%	0.11	0.02	0
WI510	9.31	64555	55	1.62%	0.15	0.27	0
WI510	9.31	64557	57	1.11%	0.1	0.06	0
WI510	9.31	64558	58	0.34%	0.03	0.34	0
WI510	9.31	64564	64	0.05%	0	0.14	25
WI510	9.31	64575	75	0.34%	0.03	0.23	0
WI510	9.31	64577	77	3.45%	0.32	0.05	0
WI510	9.31	64580	80	9.67%	0.9	0.08	0
WI510	9.31	6512457	Cs	0.87%	0.08	0.19	0
WI510	9.31	6512857	Es	0.12%	0.01	0.25	0
WI510	9.31	651323320	GgA	2.97%	0.28	0.25	0
WI510	9.31	6513244	GM	24.25%	2.26	0.29	0

APPENDIX B.2.1: Soil Type Summary

Entellus

CLIENT: FCDMC

JOB: Wittmann Area Drainage Master Study Update **JOB NO.** 310.032

Basin* ID	Total Basin Area (sqmiles)	Soil Type (WMS)	Soil Type (DDMSW)	Soil Type % Area	Soil Type Area (sqmiles)	XKSAT (in/hr)	RTIMP
WI510	9.31	6514451	Mp	0.63%	0.06	0.25	0
WI510	9.31	6514455	Mr	0.22%	0.02	0.05	0
WI510	9.31	651445822	MTB	42.09%	3.91	0.15	0
WI510	9.31	651583120	TfA	1.62%	0.15	0.37	0
WI510	9.31	6515835	Th	0.22%	0.02	0.04	0
WI510	9.31	651585520	TrA	0.27%	0.02	0.11	0
WI510	9.31	651585522	TrB	0.87%	0.08	0.13	0
WI510	9.31	651585624	TSC	0.51%	0.05	0.14	0
WI510	9.31	6516229	Ve	1.74%	0.16	0.25	0
WI510	9.31	6516231	Vf	1.13%	0.11	0.01	0
WI520	16.39	645110	110	10.93%	1.79	0.13	0
WI520	16.39	645113	113	5.13%	0.84	0.39	0
WI520	16.39	645115	115	1.80%	0.29	0.39	0
WI520	16.39	645121	121	0.51%	0.08	0.12	0
WI520	16.39	64531	31	0.97%	0.16	0.33	35
WI520	16.39	64533	33	0.97%	0.16	0.23	0
WI520	16.39	64544	44	3.55%	0.58	0.03	0
WI520	16.39	64545	45	0.49%	0.08	0.03	0
WI520	16.39	64547	47	1.03%	0.17	0.11	0
WI520	16.39	64548	48	5.92%	0.97	0.06	0
WI520	16.39	64552	52	3.51%	0.57	0.16	20
WI520	16.39	64555	55	7.97%	1.3	0.27	0
WI520	16.39	64558	58	8.17%	1.34	0.34	0
WI520	16.39	64562	62	1.54%	0.25	0.15	0
WI520	16.39	64563	63	16.12%	2.64	0.14	25
WI520	16.39	64564	64	3.56%	0.58	0.14	25
WI520	16.39	64568	68	0.99%	0.16	0.63	0
WI520	16.39	64574	74	5.25%	0.86	0.08	0
WI520	16.39	64575	75	11.94%	1.95	0.23	0
WI520	16.39	64577	77	0.96%	0.16	0.05	0
WI520	16.39	64597	97	0.66%	0.11	0.07	0
WI520	16.39	64598	98	8.03%	1.31	0.37	0
WI540	11.64	64510	10	0.08%	0.01	0.94	0
WI540	11.64	645108	108	0.46%	0.05	0.31	30
WI540	11.64	645115	115	2.85%	0.33	0.39	0
WI540	11.64	64522	22	0.08%	0.01	0.04	0
WI540	11.64	64529	29	5.22%	0.61	0.34	0
WI540	11.64	6453	3	0.98%	0.11	0.58	0
WI540	11.64	64531	31	0.12%	0.01	0.33	35
WI540	11.64	64533	33	0.08%	0.01	0.23	0
WI540	11.64	64544	44	8.66%	1.01	0.03	0
WI540	11.64	64545	45	16.75%	1.95	0.03	0
WI540	11.64	64550	50	0.39%	0.04	0.26	0
WI540	11.64	64552	52	0.60%	0.07	0.16	20
WI540	11.64	64555	55	2.83%	0.33	0.27	0
WI540	11.64	64558	58	31.23%	3.64	0.34	0
WI540	11.64	64563	63	7.93%	0.92	0.14	25
WI540	11.64	64574	74	7.07%	0.82	0.08	0
WI540	11.64	64575	75	0.02%	0	0.23	0
WI540	11.64	64598	98	14.67%	1.71	0.37	0
WI580	30.35	645110	110	1.06%	0.32	0.13	0
WI580	30.35	645112	112	4.51%	1.37	0.39	0
WI580	30.35	645113	113	7.76%	2.35	0.39	0
WI580	30.35	645115	115	0.56%	0.17	0.39	0

APPENDIX B.2.1: Soil Type Summary

Entellus

CLIENT: FCDMC

JOB: Wittmann Area Drainage Master Study Update **JOB NO.** 310.032

Basin* ID	Total Basin Area (sqmiles)	Soil Type (WMS)	Soil Type (DDMSW)	Soil Type % Area	Soil Type Area (sqmiles)	XKSAT (in/hr)	RTIMP
WI580	30.35	645121	121	3.14%	0.95	0.12	0
WI580	30.35	6452	2	0.25%	0.08	0.41	0
WI580	30.35	64522	22	1.80%	0.55	0.04	0
WI580	30.35	6453	3	0.24%	0.07	0.58	0
WI580	30.35	64533	33	1.15%	0.35	0.23	0
WI580	30.35	64538	38	4.45%	1.35	0.13	0
WI580	30.35	64539	39	1.77%	0.54	0.29	0
WI580	30.35	64542	42	2.64%	0.8	0.17	0
WI580	30.35	64543	43	2.38%	0.72	0.17	0
WI580	30.35	64544	44	11.37%	3.45	0.03	0
WI580	30.35	64545	45	8.78%	2.66	0.03	0
WI580	30.35	64548	48	0.55%	0.17	0.06	0
WI580	30.35	64553	53	0.43%	0.13	0.02	0
WI580	30.35	64555	55	0.98%	0.3	0.27	0
WI580	30.35	64557	57	0.20%	0.06	0.06	0
WI580	30.35	64562	62	3.72%	1.13	0.15	0
WI580	30.35	64563	63	4.10%	1.24	0.14	25
WI580	30.35	64564	64	0.69%	0.21	0.14	25
WI580	30.35	64568	68	0.44%	0.13	0.63	0
WI580	30.35	64573	73	0.75%	0.23	0.09	30
WI580	30.35	64574	74	6.49%	1.97	0.08	0
WI580	30.35	64575	75	5.23%	1.59	0.23	0
WI580	30.35	64577	77	7.39%	2.24	0.05	0
WI580	30.35	64578	78	0.34%	0.1	0.05	0
WI580	30.35	64580	80	4.40%	1.33	0.08	0
WI580	30.35	64594	94	0.66%	0.2	0.33	0
WI580	30.35	64597	97	0.78%	0.24	0.07	0
WI580	30.35	64598	98	11.01%	3.34	0.37	0
WT100	3.84	645100	100	15.32%	0.59	0.40	20
WT100	3.84	651202320	AbA	0.29%	0.01	0.38	0
WT100	3.84	651202720	AdA	4.74%	0.18	0.40	0
WT100	3.84	651202722	AdB	2.87%	0.11	0.40	0
WT100	3.84	6512029	Ae	1.46%	0.06	0.39	0
WT100	3.84	651203222	AGB	4.15%	0.16	0.40	0
WT100	3.84	651203424	AHC	18.77%	0.72	0.38	0
WT100	3.84	6512042	AL	8.01%	0.31	0.40	0
WT100	3.84	6512448	CO	1.35%	0.05	0.29	20
WT100	3.84	651285026	EPD	23.39%	0.9	0.12	0
WT100	3.84	651323320	GgA	3.74%	0.14	0.25	0
WT100	3.84	6514455	Mr	0.99%	0.04	0.05	0
WT100	3.84	6515456	RS	14.33%	0.55	0.40	65
WT100	3.84	6515829	Te	0.41%	0.02	0.25	0
WT100	3.84	651583122	TfB	0.18%	0.01	0.36	0
WT110	2.9	645100	100	6.43%	0.18	0.40	20
WT110	2.9	64548	48	3.68%	0.11	0.06	0
WT110	2.9	6512021	Aa	0.39%	0.01	0.26	0
WT110	2.9	651202722	AdB	8.93%	0.26	0.40	0
WT110	2.9	6512029	Ae	1.65%	0.05	0.39	0
WT110	2.9	651203222	AGB	10.34%	0.3	0.40	0
WT110	2.9	651203424	AHC	18.73%	0.54	0.38	0
WT110	2.9	651204122	AkB	5.80%	0.17	0.27	0
WT110	2.9	6512042	AL	9.64%	0.28	0.40	0
WT110	2.9	651285026	EPD	30.09%	0.86	0.12	0
WT110	2.9	6515456	RS	4.23%	0.12	0.40	65

APPENDIX B.2.1: Soil Type Summary

Entellus

CLIENT: FCDMC

JOB: Wittmann Area Drainage Master Study Update **JOB NO.** 310.032

Basin* ID	Total Basin Area (sqmiles)	Soil Type (WMS)	Soil Type (DDMSW)	Soil Type % Area	Soil Type Area (sqmiles)	XKSAT (in/hr)	RTIMP
WT110	2.9	6515822	TB	0.08%	0	0.40	0
WT120	2.82	645100	100	5.03%	0.14	0.40	20
WT120	2.82	64548	48	2.40%	0.07	0.06	0
WT120	2.82	651203222	AGB	2.56%	0.07	0.40	0
WT120	2.82	651203424	AHC	27.56%	0.77	0.38	0
WT120	2.82	651204122	AkB	6.95%	0.2	0.27	0
WT120	2.82	6512448	CO	0.32%	0.01	0.29	20
WT120	2.82	651285026	EPD	49.04%	1.38	0.12	0
WT120	2.82	6515822	TB	5.51%	0.15	0.40	0
WT120	2.82	6516255	Vr	0.64%	0.02	0.63	0
WT130	2.54	64510	10	0.53%	0.01	0.94	0
WT130	2.54	645100	100	41.45%	1.05	0.40	20
WT130	2.54	64548	48	4.52%	0.11	0.06	0
WT130	2.54	651203222	AGB	0.71%	0.02	0.40	0
WT130	2.54	651203424	AHC	3.63%	0.09	0.38	0
WT130	2.54	651204122	AkB	2.57%	0.07	0.27	0
WT130	2.54	6512448	CO	2.21%	0.06	0.29	20
WT130	2.54	651285026	EPD	28.61%	0.72	0.12	0
WT130	2.54	6515456	RS	1.95%	0.05	0.40	65
WT130	2.54	6515822	TB	13.37%	0.34	0.40	0
WT130	2.54	6516255	Vr	0.44%	0.01	0.63	0
WT140	3.8	64510	10	0.12%	0	0.94	0
WT140	3.8	645100	100	97.22%	3.68	0.40	20
WT140	3.8	64548	48	2.66%	0.1	0.06	0
WT150	5.85	64510	10	0.58%	0.03	0.94	0
WT150	5.85	645100	100	96.08%	5.6	0.40	20
WT150	5.85	64548	48	2.61%	0.15	0.06	0
WT150	5.85	651285026	EPD	0.23%	0.01	0.12	0
WT150	5.85	6515822	TB	0.50%	0.03	0.40	0
WT160	0.82	645100	100	82.09%	0.67	0.40	20
WT160	0.82	64548	48	9.37%	0.08	0.06	0
WT160	0.82	6512448	CO	6.89%	0.06	0.29	20
WT160	0.82	651285026	EPD	1.65%	0.01	0.12	0

Yavapai County Soil Parameter Estimation

Yavapai Soil Parameters

XKSAT values for the portion of the Wittmann Area located within Yavapai County were not available. The soil types were identified using the *Soil Survey of Yavapai County, Arizona, Western Part* **(Reference 7).**
XKSAT calculations were based on the procedures outlined in the *Drainage Design Manual for Maricopa County, Arizona, Volume 1-Hydrology* (**Reference 15**). The six Yavapai County soil types identified in the Wittmann project area are as follows:

CmD
- 5% Rock Outcrop
- 65% Sandy Loam
- 20% Gravelly Sandy Loam
- 10% Clayey Soil

CnF
- 20% Rock Outcrop
- 75% Sandy Loam
- 5% Clay

Le
- 4% Rock Outcrop
- 48% Clay
- 48% Clay Loam

Lh
- 40% Rock Outcrop
- 50% Clay Loam
- 10% Clay

MkF
- 20% Rock Outcrop
- 70% Gravelly Loam
- 10% Gravelly Clay Loam

Rr
- 60% Rock Outcrop
- 40% Clay

Copies of the relevant pages from the Soil Survey are included at the end of this section.

The XKSAT values for the soils were obtained from Table 4.2 (Green and Ampt Loss Rate Parameters for Bare Ground) in *Design Manual for Maricopa County, Arizona, Volume 1-Hydrology* (**Reference 15**).

Because the XKSAT value is the hydraulic conductivity at natural saturation in inches/hour, Rock Outcrop cannot be included due to its impermeability. The area associated with this impermeable Rock must be excluded from the calculations. This exclusion can be seen in the Final % Soil (Not including Rock Outcrop) column of the following table. Once this is achieved and a relative percentage of each soil type is obtained (excluding Rock Outcrop), the XKSAT can be calculated as:

$$XKSAT = ALOG[\ (\%soil_1 * LOG(XKSAT_1) + \ldots\ (\%soil_x * LOG(XKSAT_x)]$$

Where ALOG is 10 raised to the power of the stack ($\%soil_1 * LOG(XKSAT_1)$ …). The results of this are found in the following table.

Table MD-B.1. Soil Parameters

CmD

Description	Soil %	Final % Soil (Not including Rock Outcrop)	XKSAT (in/hr)	%*LOG(XKSAT)
Gravelly Sandy Loam *	20.0%	21.1%	0.40	-0.0838
Clay	10.0%	10.5%	0.01	-0.2105
Rock Outcrop	5.0%	0.0%		
Sandy Loam	65.0%	68.4%	0.40	-0.2723
Sum	100.0%	100.0%		-0.5666
			Final XKSAT (in/hr)	0.2713

CnF

Description	Soil %	Final % Soil (Not including Rock Outcrop)	XKSAT (in/hr)	%*LOG(XKSAT)
Rock Outcrop	20.0%	0.0%		
Sandy Loam	75.0%	93.8%	0.40	-0.3731
Clay	5.0%	6.3%	0.01	-0.1250
Sum	100.0%	100.0%		-0.4981
			Final XKSAT (in/hr)	0.3176

Le

Description	Soil %	Final % Soil (Not including Rock Outcrop)	XKSAT (in/hr)	%*LOG(XKSAT)
Rock Outcrop	4.0%	0.0%		
Clay	48.0%	50.0%	0.01	-1.0000
Clay Loam	48.0%	50.0%	0.04	-0.6990
Sum	100.0%	100.0%		-1.6990
			Final XKSAT (in/hr)	0.0200

* Gravelly Sandy Loam was not included in Table 4.2. The closest value (Sandy Loam) was used

Table MD-B.1. Soil Parameters (Cont.)

Lh

Description	Soil %	Final % Soil (Not including Rock Outcrop)	XKSAT (in/hr)	%*LOG(XKSAT)
Rock Outcrop	40.0%	0.0%		
Clay	10.0%	16.7%	0.01	-0.3333
Clay Loam	50.0%	83.3%	0.04	-1.1650
Sum	100.0%	100.0%		-1.4983
			Final XKSAT (in/hr)	0.0317

MkF

Description	Soil %	Final % Soil (Not including Rock Outcrop)	XKSAT (in/hr)	%*LOG(XKSAT)
Gravelly Loam**	70.0%	87.5%	0.25	-0.5268
Gravelly Clay Loam ***	10.0%	12.5%	0.04	-0.1747
Rock Outcrop	20.0%	0.0%		
Sum	100.0%	100.0%		-0.7015
			Final XKSAT (in/hr)	0.1988

Rr

Description	Soil %	Final % Soil (Not including Rock Outcrop)	XKSAT (in/hr)	%*LOG(XKSAT)
Rock Outcrop	60.0%	0.0%		
Clay	40.0%	100.0%	0.01	-2.0000
Sum	100.0%	100.0%	0.00	-2.0000
			Final XKSAT (in/hr)	0.0100

** Gravelly Loam was not included in Table 4.2. The closest value (Loam) was used

* Gravelly Clay Loam was not included in Table 4.2. The closest value (Clay Loam) was used

Drainage Design for Maricopa County, Volume 1–Hydrology [Reference 15]

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

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	1.2	2.4	0.35	0.30	0
sandy loam	0.40	4.3	0.35	0.25	0
loam	0.25	3.5	0.35	0.25	0
silty loam	0.15	6.6	0.40	0.25	0
silt	0.10	7.5	0.35	0.15	0
sandy clay loam	0.06	8.6	0.25	0.15	0
clay loam	0.04	8.2	0.25	0.15	0
silty clay loam	0.04	10.8	0.30	0.15	0
sandy clay	0.02	9.4	0.20	0.10	0
silty clay	0.02	11.5	0.20	0.10	0
clay	0.01	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.

fans. The Continental soil is on ridgetops and has more gentle slopes.

Included with these soils in mapping are areas of cobbly Cave soils and exposures of tuff or agglomerate along steep drainageways. Also included are areas of Anthony gravelly sandy loam in the drainageways. These included soils make up about 10 percent of the acreage.

Runoff is medium on these soils. The hazard of erosion is moderate.

These soils are used for range, wildlife habitat, mining, and watershed catchment areas. Both parts in capability unit VIIe–1. Cave part in Caliche Upland range site, 8- to 12-inch precipitation zone; Continental part in Loam Upland range site, 8- to 12-inch precipitation zone. Cave part in wildlife group 3; Continental part in wildlife group 2.

Cellar Series

The Cellar series consists of well-drained soils that are shallow and very shallow over granite. These soils are on gently sloping to steep granite hills and mountains. Slopes range from 2 to 60 percent. Elevation ranges from 2,000 to 4,500 feet. The vegetation is desert shrubs and cactuses and an understory of grass. Annual precipitation is 8 to 12 inches. The average annual air temperature is 57° to 69° F, and the frost-free period is 180 to 270 days.

In a representative profile the surface layer is pale-brown very stony sandy loam about 1 inch thick. The underlying layer is brown very gravelly loam about 7 inches thick. It is underlain by granite that is weathered or fractured in places.

Permeability is moderately rapid. Available water capacity is low, and the effective rooting depth is less than 20 inches.

These soils are used mainly for seasonal range, wildlife habitat, mining, and watershed catchment areas.

Representative profile of Cellar very stony sandy loam in an area of Cellar very gravelly sandy loam, 8 to 30 percent slopes, near Merritt Pass, approximately 0.4 mile NW. of the SE. corner, sec. 8, T. 7 N., R. 2 W.:

A1—0 to 1 inch, pale-brown (10YR 6/3) very stony sandy loam, brown (10YR 4/3) when moist; weak, thin and medium, platy structure; slightly hard when dry, friable when moist, nonsticky and slightly plastic when wet; common very fine roots; few fine tubular pores and common fine interstitial pores; moderately alkaline; abrupt, smooth boundary.

C—1 to 8 inches, brown (7.5YR 5/4) very gravelly heavy loam, dark brown (7.5YR 4/4) when moist; weak, fine, subangular blocky structure; hard when dry, friable when moist, slightly sticky and slightly plastic when wet; many very fine and fine roots; common fine tubular pores and many fine interstitial pores; moderately alkaline; abrupt, irregular boundary.

R—8 to 9 inches, white (N 8/0) granite, stained with few thin yellowish-red (5YR 4/6) coatings; noneffervescent to slightly effervescent in spots.

Depth to granite ranges from 4 to 15 inches but is generally about 8 inches. The soils range from noneffervescent to strongly effervescent and in reaction from neutral to moderately alkaline. Content of coarse fragments averages more than 50 percent.

In the A horizon hue is 10YR or 7.5YR, value is 5 or 6 dry and 3 or 4 moist, and chroma is 3 or 4. The A horizon is gravelly or very gravelly sandy loam, cobbly or very cobbly sandy loam, very stony sandy loam, or gravelly loamy sand.

In the C horizon hue is 7.5YR or 10YR, value is 4 to 6 dry and 3 or 4 moist, and chroma is 4 to 6. The C horizon ranges from very gravelly sandy loam or very gravelly heavy loam to cobbly or very cobbly and very stony sandy loam.

Cellar very gravelly sandy loam, 8 to 30 percent slopes (CmD).—This soil is on granite or schist hills that are dissected by a few long extended drainageways and numerous short drainageways. The profile described as representative of the series is in an area of this soil.

Included with this soil in mapping, and making up about 10 percent of the acreage, are small areas of a clayey soil that is shallow over schist, and some very rocky and cobbly Cellar soils. Also included, and making up about 20 percent of the acreage, are areas of Cellar very gravelly sandy loam that has 30 to 60 percent slopes.

Runoff is medium on this soil. The hazard of erosion is moderate.

This soil is used for seasonal range, wildlife habitat, mining, and watershed catchment areas. Capability unit VIIs–1; Loam Hills range site, 8- to 12-inch precipitation zone; wildlife group 4.

Cellar very rocky sandy loam, 2 to 15 percent slopes (CnC).—This soil is on low granite hills that are dissected by numerous short drainageways. It has a profile similar to the one described as representative of the series, but it is gently sloping to strongly sloping, and rock outcrops make up about 20 percent of the acreage. Included in mapping, and making up about 10 percent of the acreage, are areas of Chiricahua gravelly sandy loam that has 2 to 8 percent slopes.

Runoff is slow on this soil. The hazard of erosion is slight.

This soil is used for seasonal grazing, wildlife habitat, mining, and watershed catchment areas. Capability unit VIIs–1; Loam Hills range site, 8- to 12-inch precipitation zone; wildlife group 4.

Cellar very rocky sandy loam, 15 to 60 percent slopes (CnE).—This soil is on hills and mountains that are dissected by numerous short drainageways. It has a profile similar to the one described as representative of the series, but the surface has numerous rock outcrops. These outcrops make up about 20 percent of the acreage. Included in mapping, and making up about 10 percent of the acreage, are areas of Chiricahua gravelly sandy loam that has 15 to 30 percent slopes.

Runoff is medium to rapid on this soil. The hazard of erosion is moderate to high.

This soil is used for seasonal grazing, wildlife habitat, mining, and watershed catchment areas. Capability unit VIIs–1; Loam Hills range site, 8- to 12-inch precipitation zone; wildlife group 4.

Cellar-Chiricahua complex, 8 to 30 percent slopes (CoD).—This complex is about 60 percent Cellar gravelly and very stony sandy loams that have slopes of 8 to 30 percent and about 25 percent Chiricahua gravelly and very stony sandy loams that have slopes of 8 to 15 percent. One of the Chiricahua soils has the profile described as representative of the Chiricahua series.

Included with these soils in mapping, and making up

hard lime concretions; moderately alkaline; clear, broken boundary.

C3ca—43 to 50 inches, stratified white (N 8/0) and pinkish-gray (7.5YR 7/2) gravelly sandy loam, pink (7.5YR 7/4) and dark brown (7.5YR 4/4) when moist; massive; very hard when dry, firm when moist, nonsticky and nonplastic when wet; few fine tubular pores; violently effervescent.

Depth to the Cca horizon ranges from 14 to 30 inches. In the A1 horizon hue is 7.5YR or 10YR, value is 5 to 7 dry and 4 or 5 moist, and chroma is 2 to 4. The A1 horizon is dominantly gravelly sandy loam and sandy loam. Content of lime nodules in the surface layer ranges from few to none.

In the C1 and C2ca horizons hue is dominantly 7.5YR or 10YR, value is 5 to 8 dry and 4 to 7 moist, and chroma is 2 to 4. The C1 and C2 horizons are fine sandy loam, loam, or silt loam. In some places the Cca horizon extends to a depth of 6 feet or more and has limy, but less nodular, material below a depth of 3 feet. The Cca horizon is weakly cemented in places. Size and content of lime nodules in the Cca horizon varies from few, fine to many, medium and coarse.

Latene gravelly sandy loam (Lα).—This nearly level to gently sloping soil is on alluvial fans or plains that are dissected by numerous long shallow drainageways. It has the profile described as representative of the series.

Included with this soil in mapping are small areas of Anthony and Mohave sandy loams on the fan tops and Vekol loam in swales. These included soils make up about 10 percent of the acreage.

Runoff is slow on this soil. The hazard of erosion is slight.

This soil is used mainly for range, wildlife habitat, and watershed catchment areas. Capability unit VIIc–1; Loam Upland range site, 8- to 12-inch precipitation zone; wildlife group 2.

Latene-Mohave complex (Lc).—This complex is about 55 percent Latene gravelly sandy loam and 35 percent Mohave sandy loam. These soils are in an intricate pattern on nearly level to undulating fans. The Latene soil is on low ridgetops or higher lying areas, and the Mohave soil is on side slopes and in swales where slopes generally are less than 3 percent.

Included with these soils in mapping, and making up about 10 percent of the acreage, are small areas of Anthony sandy loam and narrow areas of Vekol loam. The Anthony soil is on the fan tops and the Vekol soil is in swales.

Runoff is slow on these soils. The hazard of erosion is slight.

These soils are used for range, wildlife habitat, and watershed catchment areas. Capability unit VIIc–1; Loam Upland range site, 8- to 12-inch precipitation zone; wildlife group 2.

Lehmans Series

The Lehmans series consists of shallow, well-drained soils that are underlain by bedrock at a depth of 10 to 20 inches. These soils formed in material weathered from andesite or related tuff and agglomerate. They are in areas where there are moderately sloping to very steep hills or mountains. Slopes range from 8 to 60 percent. Elevation ranges from 1,800 to 4,000 feet. The vegetation is desert shrubs and cactuses and an understory of scattered grasses. Annual precipitation is 8 to 11 inches. The average annual air temperature is about 65° F, and the frost-free period is 200 to 250 days.

In a representative profile the surface layer is brown gravelly clay loam about 1 inch thick. The subsoil is reddish-brown and brown gravelly clay and clay about 13 inches thick. It is underlain by pale-red extremely hard andesite or tuffaceous agglomerate.

Permeability is slow. Available water capacity is low, and the effective rooting depth is less than 20 inches.

These soils are used mainly for seasonal grazing, mining, wildlife habitat, and watershed catchment areas.

Representative profile of Lehmans gravelly clay loam, 8 to 45 percent slopes, 0.24 mile S. and 0.12 mile E. of the NW. corner, sec. 22, T. 8 N., R. 1 W.:

A1—0 to 1 inch, brown (7.5YR 5/2) gravelly clay loam, dark brown (7.5YR 3/2) when moist; moderate, fine, granular structure; slightly hard when dry, friable when moist, sticky and plastic when wet; common fine roots; many fine interstitial pores; moderately alkaline; abrupt, wavy boundary.

B21t—1 to 8 inches, reddish-brown (5YR 5/3) gravelly clay, reddish brown (5YR 4/4) when moist; moderate, medium and fine, subangular blocky structure; very hard when dry, friable when moist, sticky and plastic when wet; common very fine and few coarse roots; few fine tubular pores and common fine interstitial pores; many thin clay films on ped faces and in pores; neutral; clear, wavy boundary.

B22t—8 to 14 inches, brown (7.5YR 5/4) light clay, dark brown (7.5YR 4/4) when moist; weak, medium, subangular blocky structure; hard when dry, firm when moist, sticky and plastic when wet; common very fine roots; very few fine tubular pores and common fine interstitial pores; common thin clay films on ped faces and in pores; neutral; abrupt, wavy boundary.

R—14 to 16 inches, pale-red (10R 6/4), reddish-gray (10R 5/1), and red (10R 5/6) massive, extremely hard andesite.

Depth to bedrock ranges from 10 to 20 inches but is dominantly 14 to 18 inches. Coarse fragments range from gravel to stone size and from 10 to 30 percent by volume.

In the A horizon hue is 10YR to 5YR but is dominantly 7.5YR. Value is 4 to 6 dry and 3 or 4 moist. Chroma is 2 to 6. In the B2t horizon hue is 7.5YR to 2.5YR but is dominantly 5YR and 7.5YR. Value is 4 or 5 dry and 3 to 5 moist. Chroma is 3 to 6. The B2t horizon is gravelly heavy clay loam, clay, and gravelly clay.

Lehmans gravelly clay loam, 8 to 45 percent slopes (Le).—This soil is on andesite, tuff, or agglomerate hills and mountains that are dissected by numerous steep-sided drainageways. It has the profile described as representative of the series.

Included with this soil in mapping are areas where rock outcrops and stones are common. Also included are deep, colluvial soils on the lower parts of side slopes and coarse-textured alluvial soils in the drainageways. These included soils make up about 10 percent of the acreage.

Runoff is medium on this soil. The hazard of erosion is moderate.

This soil is used for range, wildlife habitat, mining, and watershed catchment areas. Capability unit VIIe–1; Loam Hills range site, 8- to 12-inch precipitation zone; wildlife group 4.

Lehmans extremely rocky clay loam, 8 to 60 percent slopes.—This soil is on andesite, tuff, or agglomerate hills and mountains that are dissected by numerous short drainageways and a few long drainageways that have steep sides. About 40 percent of the acreage is rock outcrops and exposures of tuff and agglomerate.

Included with these soils in mapping, and making up about 10 percent of the acreage, are deep colluvial soils on the lower parts of side slopes and coarse-textured alluvial soils in the drainageways.

Runoff is medium to rapid on these soils. The hazard of erosion is moderate to high.

These soils are used for range, wildlife habitat, mining, and watershed catchment areas. Capability unit VIIs–1; Loam Hills range site, 8- to 12-inch precipitation zone, wildlife group 4.

Loamy Alluvial Land

Loamy alluvial land consists of stratified, gravelly, medium-textured soils that are underlain by moderate to shallow, stratified gravelly loamy sand and sand. This material is in and adjacent to shallow drainageways. The alluvium weathered from a wide variety of rocks but is dominantly acid igneous material. Areas are rarely flooded, and then only for short periods.

Permeability is moderate. Available water capacity is low to moderate. Effective rooting depth is 60 inches or more.

This land type is used for limited grazing, wildlife habitat, and watershed.

This land type is mapped only in association with continental soils. Capability unit VIIw–1; Loam Bottoms range site, 8- to 12-inch precipitation zone; wildlife group 1.

Lonti Series

The Lonti series consists of deep, well-drained soils. These soils formed in mixed alluvium weathered from granite, schist, basalt, and sandstone. Lonti soils are on nearly level plains to very steep alluvial fans. Slopes range from 0 to 60 percent. Elevation ranges from 4,000 to 5,500 feet. The vegetation is grass, brush, and some pinyon pine and juniper at higher elevations. Annual precipitation is 12 to 20 inches. The average annual air temperature is 52° to 57° F, and the frost-free period is 140 to 200 days.

In a representative profile the surface layer is grayish-brown gravelly sandy loam about 2 inches thick. The subsoil is dark-brown gravelly sandy clay loam and reddish-brown gravelly clay and gravelly clay loam about 43 inches thick. The substratum is pink and light reddish-brown gravelly sandy clay loam to a depth of 68 inches or more.

Permeability is slow. Available water capacity is high, and the effective rooting depth is more than 60 inches.

These soils are used mainly for range, wildlife habitat, recreation, and watershed catchment areas. Limited acreages of Lonti soils are used for irrigated crops in the Chino Valley area. Small areas have been subdivided for use as homesites and for small commercial buildings.

Representative profile of Lonti gravelly sandy loam, 0 to 8 percent slopes, from an area of Lonti-Abra gravelly sandy loams, 0 to 8 percent slopes, 0.5 mile W. and 0.3 mile N. of the SE. corner, sec. 3, T. 15 N., R. 4 W.:

A1—0 to 2 inches, grayish-brown (10YR 5/2) gravelly sandy loam, very dark grayish brown (10YR 3/2) when moist; weak, medium and thick, platy structure; slightly hard when dry, very friable when moist; slightly sticky and slightly plastic when wet; common very fine and fine roots; many very fine and fine vesicular pores; neutral; clear, wavy boundary.

B1t—2 to 5 inches, dark-brown (10YR 3/3) dry and moist, gravelly sandy clay loam; moderate, very fine and fine, subangular blocky structure; hard when dry, friable when moist, sticky and plastic when wet; many very fine and fine roots; many fine and very fine interstitial pores and common very fine and fine tubular pores; few thin clay films on ped faces; neutral; clear, wavy boundary.

B21t—5 to 10 inches, reddish-brown (5YR 4/3) gravelly light clay, reddish brown (5YR 4/4) when moist; weak, fine and medium, subangular blocky structure; very hard when dry, firm when moist, sticky and plastic when wet; many very fine and fine roots; common fine interstitial pores; common thin clay films on ped faces; slightly acid; clear, smooth boundary.

B22t—10 to 26 inches, reddish-brown (5YR 4/4) gravelly light clay, dark reddish brown (5YR 3/4) when moist; moderate, medium, subangular blocky structure; very hard when dry, firm when moist, sticky and plastic when wet; common fine and medium roots; common very fine and fine tubular pores and many fine interstitial pores; common moderately thick clay films on ped faces; many pressure faces; slightly acid; clear, wavy boundary.

B3t—26 to 45 inches, reddish-brown (5YR 5/4) gravelly clay loam, reddish brown (5YR 4/4) when moist; weak, medium, subangular blocky structure; very hard when dry, firm when moist, sticky and plastic when wet; few fine and very fine roots; few very fine and fine tubular pores and common fine interstitial pores; common moderately thick clay films on ped faces; common pressure faces; moderately alkaline; gradual, wavy boundary.

C1ca—45 to 55 inches, pink (5YR 7/3) gravelly sandy clay loam, yellowish red (5YR 5/6) when moist; massive; very hard when dry, firm when moist, slightly sticky and plastic when wet; few fine and very fine roots; very few fine tubular pores and common fine interstitial pores; few pressure faces; slightly effervescent in matrix but violently effervescent in common, medium, prominent, white (10YR 8/1), soft lime segregations; moderately alkaline; gradual, irregular boundary.

C2ca—55 to 68 inches, light reddish-brown (5YR 6/4) very gravelly sandy clay loam, reddish brown (5YR 5/4) when moist; massive; hard when dry, friable when moist, sticky and plastic when wet; few fine roots; common fine tubular pores and many interstitial pores; noneffervescent in matrix but strongly effervescent in common, medium, prominent, white (10YR 8/1), soft lime segregations; moderately alkaline.

Depth to the Cca horizon ranges from 18 to 45 inches. Content of coarse fragments averages from 15 to 35 percent by volume. Reaction ranges from slightly acid to neutral in the A1 and B1t horizons, from slightly acid to moderately alkaline in the B2t horizon, and from mildly alkaline to moderately alkaline in the B3t and Cca horizons.

In the A and B1t horizons, hue ranges from 5YR to 10YR but is dominantly 7.5YR or 10YR. Value is 3 to 5 dry and 3 or 4 moist. The A horizon is gravelly sandy loam, sandy loam, gravelly loam, and cobbly loam.

In the B2t horizon hue is 5YR or 7.5YR, value is 4 and 5 dry, and chroma is 3 to 6. The B2t horizon is heavy clay loam, gravelly clay loam, clay, and gravelly clay. Structure of the

Runoff is medium to rapid on this soil. The hazard of erosion is moderate to high.

This soil is used for trees, wildlife habitat, recreation, mining, and watershed catchment areas. Capability unit VIe–2; timber group 1; wildlife group 11.

Mirabal gravelly sandy loam, 20 to 60 percent slopes (MbF).—This soil is on mountainous areas that are dissected by numerous short drainageways and a few long drainageways. It has the profile described as representative of the series.

Included with this soil in mapping, and making up about 20 percent of the acreage, are areas of Dandrea gravelly loam, areas of rock outcrops, and narrow areas of coarse-textured, recent alluvial soils in the drainageways.

Runoff is rapid on this soil. The hazard of erosion is high.

This soil is used for trees, wildlife habitat, recreation, mining, and watershed catchment areas. Capability unit VIIe–2; timber group 1; wildlife group 11.

Mirabal-Dandrea complex, 20 to 60 percent slopes (MdF).—This complex is about 55 percent Mirabal gravelly sandy loam and 35 percent Dandrea gravelly loam. These soils are in an intricate pattern on moderately steep to very steep hills and mountains that are dissected by numerous short drainageways and a few long drainageways.

Included with these soils in mapping, and making up about 10 percent of the acreage, are areas of rock outcrops, very stony areas, areas of Mirabel gravelly sandy loam, and areas of Dandrea gravelly sandy loam that has slopes of 8 to 15 percent.

Runoff is medium on these soils. The hazard of erosion is high.

These soils are used for trees, wildlife habitat, recreation, mining, and watershed catchment areas. Both parts in capability unit VII–2. Mirabal part in timber group 1; Dandrea part in timber group 1. Both parts in wildlife group 11.

Moano Series

The Moano series consists of well-drained soils that are very shallow and shallow over schist. These soils formed in place on gently sloping to very steep hills. Slopes range from 0 to 60 percent. Elevation ranges from 4,000 to 5,500 feet. The vegetation at higher elevations is brush and an understory of grass. At the lower elevations grasses are dominant. Annual precipitation is 12 to 16 inches. The average annual air temperature is 50° to 57° F, and the frost-free period is 140 to 200 days.

In a representative profile the surface layer is brown gravelly loam about 3 inches thick. The next layer is brown gravelly heavy loam about 6 inches thick. It is underlain by olive-brown schist.

Permeability is moderate. Available water capacity is low, and the effective rooting depth is less than 20 inches.

These soils are used mainly for range, wildlife habitat, mining, and watershed catchment areas. The underlying rock is used for building stone in limited amounts.

Representative profile of Moano gravelly loam, 0 30 percent slopes, 0.2 mile E. and 0.1 mile S. of the N\ corner, sec. 23, T. 12 N., R. 1 E.:

A1—0 to 3 inches, brown (7.5YR 4/4) gravelly loam, da brown (7.5YR 3/2) when moist; moderate, very fi and fine, granular structure; soft when dry, frial when moist, slightly sticky and slightly plas when wet; common very fine and fine roots; ma fine interstitial pores; neutral; clear, irregul boundary.

C—3 to 9 inches, brown (7.5YR 4/4) gravelly heavy loa brown (7.5YR 4/4) when moist; massive; sligh hard when dry, friable when moist, slightly stic and plastic when wet; many fine and medium a few coarse roots; many fine interstitial pores; m erately alkaline; clear, irregular boundary.

R1—9 to 14 inches, olive (5Y 4/4) to olive-brown (2.5Y 4/ hard, slightly weathered schist.

R2—14 to 16 inches, pale-yellow (2.5YR 7/4), extrem hard schist.

Depth to bedrock ranges from 6 to 20 inches but genera is 6 to 16 inches. Because of the variability of parent ro reaction ranges from slightly acid to moderately alkali throughout.

In the A horizon hue is 10YR or 7.5YR, value is 4 or 5 d and 3 or 4 moist, and chroma is 2 to 4. The A horizon gravelly loam or very gravelly loam. Structure of the horizon ranges from platy to granular.

In the C horizon hue is 10YR to 5YR, value is 4 to 6 d and 3 or 4 moist, and chroma is 4 to 6. The C horizon gravelly loam or gravelly light clay loam. Content of grav in the C horizon ranges from 15 to 35 percent by volume.

Moano gravelly loam, 0 to 30 percent slopes (MgD).—This soil is on hills that are dissected by numerous sho drainageways and a few long drainageways. It has tl profile described as representative of the series.

Included with this soil in mapping, and making u about 15 percent of the acreage, are small areas of A gravelly clay loam that has slopes of 0 to 15 perce and areas of Lynx loam in the drainageways.

Runoff is medium to rapid on this soil. The hazar of erosion is moderate.

This soil is used for range, wildlife habitat, minin and watershed catchment areas. Capability unit VIIe 1; Granitic Loam Hills range site, 12- to 16-inch pr cipitation zone; wildlife group 5.

Moano very rocky loam, 15 to 60 percent slopes (MkF —This complex is about 70 percent Moano gravel loam and 20 percent rock outcrops. This complex is c moderately steep and very steep hills and mountai that are dissected by numerous short drainageways.

Included with this soil in mapping, and making u about 10 percent of the acreage, are small areas of A gravelly clay loam that has slopes of 8 to 30 perce and narrow areas of Lynx soils in the drainageways.

Runoff is rapid. The hazard of erosion is modera to high.

This soil is used for range, wildlife habitat, minin and watershed catchment areas. Capability un VIIs–1; Granitic Loam Hills range site, 12- to 16-inc precipitation zone; wildlife group 5.

Moano extremely rocky loam, 15 to 30 percent slop (MoD).—This complex is about 60 percent Moano gravell loam and about 30 percent rock outcrops. It is c strongly sloping and moderately steep hills that a dissected by numerous short drainageways.

Included with this soil in mapping, and making u about 10 percent of the acreage, are small areas of A

range from few to many. Secondary calcium carbonate and lime nodules are present in places immediately above the parent rock. Cracks that are 2 inches or more wide and 20 to 36 inches deep are common if the soil is dry.

In the A1 horizon hue is 2.5YR to 7.5YR, value is 4 or 5 dry and 2 to 4 moist, and chroma is 2 to 4. The A horizon is clay, silty clay, heavy silty clay loam, or clay loam, all of which are modified by coarse fragments. In the C horizon hue is 7.5YR to 2.5YR, value is 3 to 5 dry and 2 to 4 moist, and chroma is 2 to 4. The C horizon is clay or silty clay.

Rimrock cobbly clay (Rk).—This nearly level to undulating soil is on basalt plains. It has the profile described as representative of the series.

Included with this soil in mapping, and making up about 10 percent of the acreage, are areas of Rimrock gravelly clay loam, Rimrock very stony clay, Graham gravelly clay loam, and Cave gravelly sandy loam.

Runoff is very slow on this soil. The hazard of erosion is slight.

This soil is used for range, wildlife habitat, and watershed catchment areas. Capability unit VIIs–1; Loam Hills range site, 8- to 12-inch precipitation zone; wildlife group 4.

Rimrock-Cave complex (Rm).—This complex is about 60 percent Rimrock cobbly clay and 30 percent Cave gravelly sandy loam. These soils are in an intricate pattern on nearly level to gently sloping basalt plains and mesa tops. The Cave soil has slopes of less than 5 percent.

Included with these soils in mapping are small areas of rock outcrops, areas of Rimrock very stony clay, and areas of Rimrock cobbly clay that has slopes of 8 to 15 percent. Also included are narrow areas of clay loam alluvial soils in drainageways. These included soils make up about 10 percent of the acreage.

Runoff is very slow and slow on these soils. The hazard of erosion is slight.

These soils are used for range, wildlife habitat, and watershed catchment areas. Both parts in capability unit VIIs–1. Rimrock part in Loam Hills range site, 8- to 12-inch precipitation zone; Cave part in Caliche Upland range site, 8- to 12-inch precipitation zone. Rimrock part in wildlife group 4; Cave part in wildlife group 3.

Rimrock-Graham complex, 3 to 15 percent slopes (Rn). This complex is about 60 percent Rimrock cobbly clay that has slopes of 0 to 8 percent and 30 percent Graham very stony clay loam that has slopes of 8 to 15 percent. These soils are in an intricate pattern on gently to strongly sloping basalt plains that are dissected by a few deep drainageways that have steep sides. The Graham soil is on low ridges and slightly higher lying areas, or near the edges of steep drainageways

Included with these soils in mapping are small areas of Rimrock gravelly clay loam and Graham very stony clay loam that has slopes of 0 to 8 percent. Also included are areas of House Mountain very rocky and gravelly loam and rock outcrops in the Graham soil. These included areas make up about 10 percent of the acreage.

Runoff is slow to medium on these soils. The hazard of erosion is slight to moderate.

These soils are used for range, wildlife habitat, and watershed catchment areas. Capability unit VIIe–1; Loam Hills range site, 8- to 12-inch precipitation zone; wildlife group 4.

Rock Land

Rock land (Ro) consists of 50 to 90 percent rock outcrops, and the rest is shallow and very shallow soils. It is gently rolling and steep on hills, mountains, and divides that are dissected by numerous drainageways and vertical escarpments. The rock outcrops are granite, basalt, limestone, sandstone, or tuff.

Runoff is medium to high. The hazard of erosion is slight.

The vegetation is grass, chaparral, or juniper. Forage production is limited because of the rock outcrops and shallow and very shallow soil depth (fig. 8). Capability unit VIIs–1.

Rock Land, Low Rainfall

Rock land, low rainfall (Rr) consists of 50 to 90 percent rock outcrops, and the rest is shallow and very shallow soils. It is in desert areas and is gently sloping to steep on hills, mountains, and divides that are dissected by numerous drainageways and vertical escarpments. The rock outcrops are basalt, andesite, granite, or tuff. Annual precipitation is less than 12 inches.

Runoff is medium to high. The hazard of erosion is slight.

The vegetation is a sparse cover of desert shrubs and an understory that is dominantly annual grasses. Forage production is severely limited because of the rock outcrops, limited rainfall, and shallow and very shallow depth to bedrock. Capability unit VIIs–1.

Rough Broken Land

Rough broken land (Rs) consists of very shallow to deep soils and soil materials that range from sandy loam to clay loam and are generally calcareous. It is moderately steep and very steep on fans that are highly dissected by numerous steep-sided drainageways. Slopes are highly variable but are dominantly 15 to 60 percent. The soils and soil materials are variable because of the wide variety of materials that form the fans. The surface layer in some areas is gravelly. Soil slipping is common. Tuffaceous material is exposed along some of the drainageways. Geologic erosion is active.

Included with this land type in mapping are small areas of Lonti gravelly loam and similar soils that appear to be remnants of old surfaces.

Runoff is rapid. The hazard of erosion is high.

This land type is used for limited grazing, wildlife habitat, and watershed catchment areas. Capability unit VIIe–1.

Rune Series

The Rune series consists of deep, well-drained soils. These soils formed in mixed alluvium that weathered from shale, limestone, sandstone, and basalt. They are

B.2.2. Land Use

Land Use Description

Future Land Use

Existing Land Use

Municipalities Land Use Plans

Land Use Description

Entellus

SHEET		OF	
BY	JCS	DATE	12/10/2003
CHECK	RAS	DATE	12/10/2003
JOB NO.	310.032		

CLIENT: FCDMC

JOB: Wittmann Area Drainage Master Study Update

Land Use Descriptions

Land Use ID	WMS ID	Land Use Description	IA(inches)	RTIMP(%)	VEG (%)	SAT
AGR	750	Agriculture	0.50	0	85	normal
COM-1	200	General Commercial (Commercial where no detail available)	0.10	80	60	normal
COM-2	210	Specialty Commercial (<=50,000 sq. ft.)	0.10	80	65	normal
COM-3	220	Neighborhood Commercial (50,000 to 100,000 sq. ft.)	0.10	80	65	normal
COM-4	230	Community Commercial (100,000 to 500,000 sq. ft.)	0.10	80	75	normal
COM-5	240	Regional Commercial (500,000 to 1,000,000 sq. ft.)	0.10	80	65	normal
COM-6	250	Super-Regional Commercial (>= 1,000,000 sq. ft.)	0.10	80	70	normal
COM-7	510	Tourist and Visitor Accommodations (Hotels, motels and resorts)	0.10	80	75	normal
COM-8	560	Special Events (Includes stadiums, sports complexes and fairgrounds)	0.10	80	75	normal
FWY-1	600	General Transportation (Transportation where no detail available)	0.10	80	30	normal
FWY-2	610	Transportation (Includes railroads, railyards, transit centers and freeways)	0.10	80	30	normal
HDR	180	High Density Residential - Multi Family (10-15 du per acre)	0.25	65	50	normal
IND-1	300	General Industrial (Industrial where no detail available)	0.15	55	60	normal
IND-2	310	Warehouse/Distribution Centers	0.15	80	75	normal
IND-3	320	Industrial	0.15	55	60	normal
IND-4	570	Other Employment - low (Proving grounds and land fills)	0.15	80	25	normal
IND-5	580	Other Employment - medium	0.15	80	75	normal
IND-6	590	Other Employment - high	0.15	80	75	normal
INS-1	520	Educational (Public schools, private schools and universities)	0.25	45	80	normal
INS-2	530	Institutional (Includes hospitals and churches)	0.10	80	75	normal
INS-3	540	Cemeteries	0.20	5	90	normal
LDR-2	130	Large Lot Residential - Single Family (1 du per acre to 2 du per acre)	0.30	15	50	normal
MDR-1	140	Medium Lot Residential - Single Family (2-4 du per acre)	0.25	30	50	normal
MDR-2	170	Medium Density Residential - Muli Family (5-10 du per acre)	0.25	45	50	normal
OFC-1	400	Office General (Office where no detail available)	0.10	80	75	normal
OFC-2	410	Office Low Rise (1-4 stories)	0.10	80	75	normal
OFC-3	420	Office Mid Rise (5-12 stories)	0.10	80	75	normal
OFC-4	430	Office High Rise (13 stories or more)	0.10	80	75	normal
OPEN-1	700	General Open Space (Open space where no detail available)	0.35	5	30	normal
OPEN-2	710	Active Open Space (Includes parks)	0.20	5	50	normal
OPEN-3	720	Golf courses	0.20	5	75	normal
OPEN-4	730	Passive Open Space (Includes mountain preserves and washes)	0.35	0	30	normal
SLR	150	Small Lot Residential - Single Family (4-6 du per acre)	0.25	35	50	normal
VAC	900	Vacant (Existing land use database only)	0.35	0	25	dry
VHDR	190	Very High Density Residential - Multi Family (> 15 du per acre)	0.25	85	50	normal
VLDR	110	Rural Residential (<= 1/5 du per acre)	0.30	5	30	normal
VSLR	160	Very Small Lot Residential - Single Family (>6 du per acre-includes mobile home	0.25	40	50	normal
WTR	740	Water	0.00	0	0	wet

IA = Initial Abstraction; RTIMP = Effective Impervious Area; Veg = Vegetation Cover; Sat = Saturated Condition

TABLE 4.2

***IA, RTIMP,* AND VEGETATIVE COVER DENSITY FOR REPRESENTATIVE LAND USES IN MARICOPA COUNTY**

Land Use[1] Code	Land Use Category	Description	IA[2] inches	RTIMP[2,3] %	Vegetation Cover[2,4] %
VLDR	Very Low Density Residential[3]	40,000 sq. feet and greater lot size	0.30	5	30
LDR	Low Density Residential[3]	12,000 – 40,000 sq. feet lot size	0.30	15	50
MDR	Medium Density Residential[3]	6,000 – 12,000 sq. feet lot size	0.25	30	50
MFR	Multiple Family Residential[3]	1,000 – 6,000 sq. feet lot size (# du/ac)	0.25	45	50
I1	Industrial 1[3]	Light and General	0.15	55	60
I2	Industrial 2[3]	General and Heavy	0.15	55	60
C1	Commercial 1[3]	Light, Neighborhood, Residential	0.10	80	75
C2	Commercial 2[3]	Central, General, Office, Intermediate	0.10	80	75
P	Pavement and Rooftops	Asphalt and Concrete, Sloped Rooftops	0.05	95	0
GR	Gravel Roadways & Shoulders	Graded and Compacted, Treated and Untreated	0.10	5	0
AG	Agricultural	Tilled Fields, Irrigated Pastures, slopes < 1%	0.50	0	85
LPC	Lawns/Parks/Cemeteries 1	Over 80% maintained lawn	0.20	Varies[5]	80
DL1	Desert Landscaping 1	Landscaping with impervious under treatment	0.10	95	30
DL2	Desert Landscaping 2	Landscaping without impervious under treatment	0.20	0	30
NDR	Undeveloped Desert Rangeland	Little topographic relief, slopes < 5%	0.35	Varies[5]	Varies[6]
NHS	Hillslopes, Sonoran Desert	Moderate topographic relief, slopes > 5%	0.15	Varies[5]	Varies[6]
NMT	Mountain Terrain	High topographic relief, slopes > 10%	0.25	Varies[5]	Varies[6]

Notes:

1. Other land use or zoning classifications, such as Planned Area Development and Schools must be evaluated on a case by case basis.
2. These values have been selected to fit many typical settings in Maricopa County; however, the engineer/hydrologist should always evaluate the specific circumstances in any particular watershed for hydrologic variations from these typical values.
3. RTIMP = Percent Effective Impervious Area, including right-of-way. Effective means that all impervious areas are assumed to be hydraulically connected. The RTIMP values may need to be adjusted based on an evaluation of hydraulic connectivity.
4. Vegetation Cover = Percent vegetation cover for pervious areas only.
5. RTIMP values must be estimated on a case by case basis.
6. Vegetation Cover values must be estimated on a case by case basis.

Table 4.2a IA, RTIMP, and Percent Vegetation Cover for Representative Land Uses in Maricopa County

Land Use Category	IA (inches)	RTIMP ** (percent)	Percent ** Veg. Cover	Gilbert Zoning Unit	Gilbert Description	Chandler Zoning Unit	Chandler Description	Mesa Zoning Unit	Mesa Description	Tempe Zoning Unit	Tempe Description	County Zoning Unit	County Description	Phoenix Zoning Unit	Phoenix Description
Agriculture	0.5*	0*	85*	AG	Agriculture	AG-1	Agriculture	AG	Agriculture	AG	Agriculture				
Very Low Density Residential	0.3*	5*	30*					R1-90	Single Residence			RURAL-190	190,000 sq. ft./dwelling unit	S-1	Ranch or Farm Residential, > 1 acre
								SR	Suburban Ranch			RURAL-70	70,000 sq. ft./dwelling unit	S-2	Ranch or Farm Commercial
				R1-43	Rural							RURAL-43	one acre/dwelling unit	RE-43	Single Family, 1 acre minimum
Low Density Residential	0.3*	15*	50*	R1-35	Rural Residential	SF-33	Single Family	R1-35	Single Residence			R1-35	Single Family Residential, 35,000 sq. ft./dwelling unit	RE-35	SF, 35,000 sq.ft min.
														RE-24	SF, 24,000 sq.ft min.
				R1-20	SF, Residential	SF-18	Single Family					R1-18	SFR, 18,000 sq. ft./unit	R1-18	SF, 18,000 sq.ft min.
				R1-15	" "			R1-15	Single Residence	R1-15	One Family Residential			R1-14	SF, 14,000 sq.ft min.
Medium Density Residential	0.25*	30*	50*	R1-10	" "	SF-10	Single Family	R1-9	Single Residence	R1-10	One Family Residential	R1-10	SFR, 10,000 sq. ft./unit	R1-10	SF, 10,000 sq.ft min.
				R1-8	" "					R1-8	One Family Residential	R1-8	SFR, 8,000 sq. ft./unit	R1-8	SF, 8,000 sq.ft min.
				R1-7	" "	SF-7	Single Family	R1-7	Single Residence	R1-7	One Family Residential				
								R1-6	Single Residence	R1-6	One Family Residential	R1-6	SFR, 6,000 sq. ft./unit	R1-6	SF, 6,000 sq.ft min.
								TCR-1	Town Center, Single Family	RO	Residence/Office			R-O	Res. Office
Multiple Family Residential	0.25*	45*	50*	R-2	Duplex	MF-1	Medium Density	R-2	Restricted Multiple Resid.	R-2	Multi-Family Residential	R-2	2 Family Residence	R-2	MF, 4,000 sq.ft./unit
				R-3	Multi-Family, Apartments	MF-2	Multi-Family	R-3	Limited Multiple Resid.	R-3R	Multi-Family Restricted	R-3	Multiple Family, Residential	R-3	MF, 3,000 sq.ft./unit
				R-4	Multi-Family, General	MF-3	High Density	R-4	General Multiple Resid.	R-3	Multi-Family Limited	R-4	Multiple Family, Residential	R-4	MF, 1,500 sq.ft./unit
				R-5	Townhouse Residential					R-4	Multi-Family General	R-5	Multiple Family, Residential	R-4A	MF, 1,000 sq.ft./unit
										R-Th	Townhouse			R-5	MF, 1,000 sq.ft./unit
				MH	Mobile Home	MH-1	Mobile Homes	TCR-2	TC, Restricted Multi-Res.	RMH	Mobile Home Residence	MHR	Manufactured Housing, Resid.	CP/BP	Business Park
				CTP	Commercial Trailer Park			TCR-3	TC, General Res.	MHS	Manufactured Housing Subd.			R-H	Resort District
										TP	Trailer Park				
Industrial	0.15*	55*	60*	I-1	Garden Type Industrial			M-1	Limited Industrial	I-1	Light Industrial			IND PARK	Industrial Park
				I-2	Light Industrial	I-1	Light Industrial			I-2	General Industrial	I-2	Light Industrial	A-1	Light Industrial
				I-3	General Industrial	I-2	General Industrial	M-2	General Industrial	I-3	Heavy Industrial	I-3	Heavy Industrial	A-2	Heavy Industrial
Commercial	0.1*	80*	75*	C-1	Light Commercial	C-1	Neighborhood Commercial	C-1	Neighborhood Comm.	CCR	Convenience Commercial	C-1	Neighborhood Commercial	C-1	Neighborhood Commercial
				C-2	General Commercial	C-2	Community Commercial	C-2	Limited Comm.	C-1	Neighborhood Commercial	C-2	Intermediate Commercial	C-2	Intermediate Commercial
				C-3	Central Commercial	C-3	Regional Commercial	C-3	General Comm.	C-2	General Commercial	C-3	General Commercial	C-3	General Commercial
				RS	Residential Services			OS	Office-Sercives	CCD	Central Comm. District	C-O	Commercial Office	C-O	Commercial Office
				RCC	Residential Conveniences			TCC	TC,High Intensity Mixed Use					HR	High Rise District
								TCB-1	TC, Limited Comm./General Manufacturing						
								TCB-2	TC, General Comm./ Light Manufacturing						
MISCELLANEOUS CATEGORIES: These zoning units should be evaluated on a case by case basis.															
				PAD	Planned Area Development	PAD	Planned Area Development			S	Private School	PD	Planned Development Overlay	PAD	Planned Area Development
				PSC-1	Planned Neighborhood Shopping										
				PSC-2	Planned Shopping Center							CS	Planned Shopping Center	PSC	Planned Shopping Center
				IB	Industrial Buffer										
						PCO	Planned C Offices	PEP	Planned Employment Park						
								PF	Public Facilities			SU	Special Uses		
												SC	Senior Citizen Overlay	PCD	Planned Community Development
												NUP	Neighborhood Plan of Development		
												RUP	Residential Plan of Development		
												IUP	Industrial Plan of Development		
														R.O.W.	Right of Way
														P-1	Parking, Open
														P-2	Parking, Structures
														D.G	Dwelling Group

NOTES

* These values have been selected to fit many typical settings in Maricopa County.
However, the engineer/hydrologist should ALWAYS evaluate the specific circumstances in any particular watershed for hydrological variations from these typical values.

** RTIMP = Percent Effective Impervious Area, Including R.O.W.
** Percent Veg. Cover = Percent vegetation cover for pervious area only

Existing Land Use

Appendix B.2.2

Entellus

		SHEET		OF	
		BY	JCS	DATE	12/10/2003
CLIENT:	FCDMC	CHECK	RAS	DATE	12/10/2003
JOB:	Wittmann Area Drainage Master Study Update	JOB NO.	310.032		

Existing Land Use Summary by Basin

Basin ID	Area (sqmiles)	WMS Land Use Code	Mag Land Use Code	IA (in) Initial Abstractions	RTIMP	% Vegetation	Land Use Definition
IW310	0.6	110	VLDR	0.30	5	30	Rural Residential (<= 1/5 du per acre)
IW310	0.57	120	LDR-1	0.30	10	30	Estate Residential (1/5 du per acre to 1 du per acre)
IW310	0.32	130	LDR-2	0.30	15	50	Large Lot Residential - Single Family (1 du per acre to 2 du per acre)
IW310	0.04	140	MDR-1	0.25	30	50	Medium Lot Residential - Single Family (2-4 du per acre)
IW310	0.04	160	VSLR	0.25	40	50	Very Small Lot Residential - Single Family (>6 du per acre-includes mobile home
IW310	0.01	520	INS-1	0.25	45	80	Educational (Public schools, private schools and universities)
IW310	0.08	570	IND-4	0.15	80	25	Other Employment - low (Proving grounds and land fills)
IW310	0.53	610	FWY-2	0.10	80	30	Transportation (Includes railroads, railyards, transit centers and freeways)
IW310	23.47	700	OPEN-1	0.35	5	30	General Open Space (Open space where no detail available)
IW310	0.07	730	OPEN-4	0.35	0	30	Passive Open Space (Includes mountain preserves and washes)
IW310	0.07	740	WTR	0.00	0	0	Water
IW350	1.74	700	OPEN-1	0.35	5	30	General Open Space (Open space where no detail available)
IW350	2.44	730	OPEN-4	0.35	0	30	Passive Open Space (Includes mountain preserves and washes)
PD700	0.17	300	IND-1	0.15	55	60	General Industrial (Industrial where no detail available)
PD700	0.18	570	IND-4	0.15	80	25	Other Employment - low (Proving grounds and land fills)
PD700	6.81	700	OPEN-1	0.35	5	30	General Open Space (Open space where no detail available)
PD700	0.09	740	WTR	0.00	0	0	Water
PD710	1.4	120	LDR-1	0.30	10	30	Estate Residential (1/5 du per acre to 1 du per acre)
PD710	5.2	700	OPEN-1	0.35	5	30	General Open Space (Open space where no detail available)
PD710	0.12	740	WTR	0.00	0	0	Water
PD730	0.27	700	OPEN-1	0.35	5	30	General Open Space (Open space where no detail available)
PD730	0.18	730	OPEN-4	0.35	0	30	Passive Open Space (Includes mountain preserves and washes)
PD730	0.01	740	WTR	0.00	0	0	Water
PD735	0.1	700	OPEN-1	0.35	5	30	General Open Space (Open space where no detail available)
PD735	3.12	730	OPEN-4	0.35	0	30	Passive Open Space (Includes mountain preserves and washes)
PD735	0.01	740	WTR	0.00	0	0	Water
PD740	0.14	700	OPEN-1	0.35	5	30	General Open Space (Open space where no detail available)
PD740	0.71	730	OPEN-4	0.35	0	30	Passive Open Space (Includes mountain preserves and washes)
PD740	0.01	740	WTR	0.00	0	0	Water
PD745	0.52	700	OPEN-1	0.35	5	30	General Open Space (Open space where no detail available)
PD745	1.43	730	OPEN-4	0.35	0	30	Passive Open Space (Includes mountain preserves and washes)
PD760	0.94	110	VLDR	0.30	5	30	Rural Residential (<= 1/5 du per acre)
PD760	1.5	700	OPEN-1	0.35	5	30	General Open Space (Open space where no detail available)
PD760	0.15	730	OPEN-4	0.35	0	30	Passive Open Space (Includes mountain preserves and washes)
PD760	0.02	740	WTR	0.00	0	0	Water
PD760	0.11	750	AGR	0.50	0	85	Agriculture
PD780	0.56	610	FWY-2	0.10	80	30	Transportation (Includes railroads, railyards, transit centers and freeways)
PD780	3.58	700	OPEN-1	0.35	5	30	General Open Space (Open space where no detail available)
PD780	0.91	720	OPEN-3	0.20	5	75	Golf courses

Appendix B.2.2

Entellus

		SHEET		OF	
		BY	JCS	DATE	12/10/2003
CLIENT:	FCDMC	CHECK	RAS	DATE	12/10/2003
JOB:	Wittmann Area Drainage Master Study Update	JOB NO.	310.032		

Existing Land Use Summary by Basin

Basin ID	Area (sqmiles)	WMS Land Use Code	Mag Land Use Code	IA (in) Initial Abstractions	RTIMP	% Vegetation	Land Use Definition
PD780	14.1	730	OPEN-4	0.35	0	30	Passive Open Space (Includes mountain preserves and washes)
PI600	0.01	110	VLDR	0.30	5	30	Rural Residential (<= 1/5 du per acre)
PI600	2.66	120	LDR-1	0.30	10	30	Estate Residential (1/5 du per acre to 1 du per acre)
PI600	0.83	130	LDR-2	0.30	15	50	Large Lot Residential - Single Family (1 du per acre to 2 du per acre)
PI600	0.12	210	COM-2	0.10	80	65	Specialty Commercial (<=50,000 sq. ft.)
PI600	0.1	300	IND-1	0.15	55	60	General Industrial (Industrial where no detail available)
PI600	0.1	610	FWY-2	0.10	80	30	Transportation (Includes railroads, railyards, transit centers and freeways)
PI600	0.61	620	INS-5	0.15	55	60	Airports (Includes public use airports)
PI600	7.2	700	OPEN-1	0.35	5	30	General Open Space (Open space where no detail available)
PI600	0.14	730	OPEN-4	0.35	0	30	Passive Open Space (Includes mountain preserves and washes)
PI600	0.16	740	WTR	0.00	0	0	Water
PI600	0.08	750	AGR	0.50	0	85	Agriculture
PI640	0.54	110	VLDR	0.30	5	30	Rural Residential (<= 1/5 du per acre)
PI640	0.3	300	IND-1	0.15	55	60	General Industrial (Industrial where no detail available)
PI640	0.28	570	IND-4	0.15	80	25	Other Employment - low (Proving grounds and land fills)
PI640	0.37	610	FWY-2	0.10	80	30	Transportation (Includes railroads, railyards, transit centers and freeways)
PI640	15.88	700	OPEN-1	0.35	5	30	General Open Space (Open space where no detail available)
PI640	0.04	740	WTR	0.00	0	0	Water
PI640	0.11	750	AGR	0.50	0	85	Agriculture
PI680	0.03	110	VLDR	0.30	5	30	Rural Residential (<= 1/5 du per acre)
PI680	0.97	700	OPEN-1	0.35	5	30	General Open Space (Open space where no detail available)
PI680	15.88	730	OPEN-4	0.35	0	30	Passive Open Space (Includes mountain preserves and washes)
SV200	0.63	120	LDR-1	0.30	10	30	Estate Residential (1/5 du per acre to 1 du per acre)
SV200	0.27	610	FWY-2	0.10	80	30	Transportation (Includes railroads, railyards, transit centers and freeways)
SV200	0.2	620	INS-5	0.15	55	60	Airports (Includes public use airports)
SV200	20.25	700	OPEN-1	0.35	5	30	General Open Space (Open space where no detail available)
SV200	9.69	730	OPEN-4	0.35	0	30	Passive Open Space (Includes mountain preserves and washes)
SV200	0.28	740	WTR	0.00	0	0	Water
SV220	0.04	110	VLDR	0.30	5	30	Rural Residential (<= 1/5 du per acre)
SV220	0.28	120	LDR-1	0.30	10	30	Estate Residential (1/5 du per acre to 1 du per acre)
SV220	0.65	130	LDR-2	0.30	15	50	Large Lot Residential - Single Family (1 du per acre to 2 du per acre)
SV220	0.13	620	INS-5	0.15	55	60	Airports (Includes public use airports)
SV220	15.66	700	OPEN-1	0.35	5	30	General Open Space (Open space where no detail available)
SV220	0.17	740	WTR	0.00	0	0	Water
TW400	0.54	570	IND-4	0.15	80	25	Other Employment - low (Proving grounds and land fills)
TW400	0.09	610	FWY-2	0.10	80	30	Transportation (Includes railroads, railyards, transit centers and freeways)
TW400	0.63	620	INS-5	0.15	55	60	Airports (Includes public use airports)
TW400	10.2	700	OPEN-1	0.35	5	30	General Open Space (Open space where no detail available)
TW400	1.45	730	OPEN-4	0.35	0	30	Passive Open Space (Includes mountain preserves and washes)

Appendix B.2.2

Entellus

		SHEET		OF	
		BY	JCS	DATE	12/10/2003
CLIENT:	FCDMC	CHECK	RAS	DATE	12/10/2003
JOB:	Wittmann Area Drainage Master Study Update	JOB NO.	310.032		

Existing Land Use Summary by Basin

Basin ID	Area (sqmiles)	WMS Land Use Code	Mag Land Use Code	IA (in) Initial Abstractions	RTIMP	% Vegetation	Land Use Definition
TW400	0.01	740	WTR	0.00	0	0	Water
TW420	0.13	110	VLDR	0.30	5	30	Rural Residential (<= 1/5 du per acre)
TW420	0.22	120	LDR-1	0.30	10	30	Estate Residential (1/5 du per acre to 1 du per acre)
TW420	0.17	130	LDR-2	0.30	15	50	Large Lot Residential - Single Family (1 du per acre to 2 du per acre)
TW420	0.29	140	MDR-1	0.25	30	50	Medium Lot Residential - Single Family (2-4 du per acre)
TW420	0.14	610	FWY-2	0.10	80	30	Transportation (Includes railroads, railyards, transit centers and freeways)
TW420	9.9	700	OPEN-1	0.35	5	30	General Open Space (Open space where no detail available)
TW420	0.02	740	WTR	0.00	0	0	Water
TW460	0.01	610	FWY-2	0.10	80	30	Transportation (Includes railroads, railyards, transit centers and freeways)
TW460	2.41	700	OPEN-1	0.35	5	30	General Open Space (Open space where no detail available)
TW480	1	700	OPEN-1	0.35	5	30	General Open Space (Open space where no detail available)
TW480	11.73	730	OPEN-4	0.35	0	30	Passive Open Space (Includes mountain preserves and washes)
WI500	0.8	110	VLDR	0.30	5	30	Rural Residential (<= 1/5 du per acre)
WI500	0.24	120	LDR-1	0.30	10	30	Estate Residential (1/5 du per acre to 1 du per acre)
WI500	0.15	130	LDR-2	0.30	15	50	Large Lot Residential - Single Family (1 du per acre to 2 du per acre)
WI500	0.01	310	IND-2	0.15	80	75	Warehouse/Distribution Centers
WI500	0.19	610	FWY-2	0.10	80	30	Transportation (Includes railroads, railyards, transit centers and freeways)
WI500	0.21	620	INS-5	0.15	55	60	Airports (Includes public use airports)
WI500	7.39	700	OPEN-1	0.35	5	30	General Open Space (Open space where no detail available)
WI500	0.11	740	WTR	0.00	0	0	Water
WI505	0.25	110	VLDR	0.30	5	30	Rural Residential (<= 1/5 du per acre)
WI505	0.85	120	LDR-1	0.30	10	30	Estate Residential (1/5 du per acre to 1 du per acre)
WI505	0.45	130	LDR-2	0.30	15	50	Large Lot Residential - Single Family (1 du per acre to 2 du per acre)
WI505	0.2	610	FWY-2	0.10	80	30	Transportation (Includes railroads, railyards, transit centers and freeways)
WI505	0	620	INS-5	0.15	55	60	Airports (Includes public use airports)
WI505	3.84	700	OPEN-1	0.35	5	30	General Open Space (Open space where no detail available)
WI505	0.09	740	WTR	0.00	0	0	Water
WI505	0.99	750	AGR	0.50	0	85	Agriculture
WI510	0.05	110	VLDR	0.30	5	30	Rural Residential (<= 1/5 du per acre)
WI510	0.34	120	LDR-1	0.30	10	30	Estate Residential (1/5 du per acre to 1 du per acre)
WI510	0.85	130	LDR-2	0.30	15	50	Large Lot Residential - Single Family (1 du per acre to 2 du per acre)
WI510	0.24	310	IND-2	0.15	80	75	Warehouse/Distribution Centers
WI510	0.78	570	IND-4	0.15	80	25	Other Employment - low (Proving grounds and land fills)
WI510	0.74	620	INS-5	0.15	55	60	Airports (Includes public use airports)
WI510	6.21	700	OPEN-1	0.35	5	30	General Open Space (Open space where no detail available)
WI510	0.09	740	WTR	0.00	0	0	Water
WI520	0.56	110	VLDR	0.30	5	30	Rural Residential (<= 1/5 du per acre)
WI520	0.23	120	LDR-1	0.30	10	30	Estate Residential (1/5 du per acre to 1 du per acre)
WI520	1.67	570	IND-4	0.15	80	25	Other Employment - low (Proving grounds and land fills)

Appendix B.2.2

Entellus

		SHEET		OF	
		BY	JCS	DATE	12/10/2003
CLIENT:	FCDMC	CHECK	RAS	DATE	12/10/2003
JOB:	Wittmann Area Drainage Master Study Update	JOB NO.	310.032		

Existing Land Use Summary by Basin

Basin ID	Area (sqmiles)	WMS Land Use Code	Mag Land Use Code	IA (in) Initial Abstractions	RTIMP	% Vegetation	Land Use Definition
WI520	0.4	610	FWY-2	0.10	80	30	Transportation (Includes railroads, railyards, transit centers and freeways)
WI520	12.97	700	OPEN-1	0.35	5	30	General Open Space (Open space where no detail available)
WI520	0.5	730	OPEN-4	0.35	0	30	Passive Open Space (Includes mountain preserves and washes)
WI520	0.02	740	WTR	0.00	0	0	Water
WI540	3.94	570	IND-4	0.15	80	25	Other Employment - low (Proving grounds and land fills)
WI540	0.09	610	FWY-2	0.10	80	30	Transportation (Includes railroads, railyards, transit centers and freeways)
WI540	7.6	700	OPEN-1	0.35	5	30	General Open Space (Open space where no detail available)
WI540	0.02	740	WTR	0.00	0	0	Water
WI580	1.18	110	VLDR	0.30	5	30	Rural Residential (<= 1/5 du per acre)
WI580	0.89	120	LDR-1	0.30	10	30	Estate Residential (1/5 du per acre to 1 du per acre)
WI580	0.23	130	LDR-2	0.30	15	50	Large Lot Residential - Single Family (1 du per acre to 2 du per acre)
WI580	0.38	150	SLR	0.25	35	50	Small Lot Residential - Single Family (4-6 du per acre)
WI580	0.7	610	FWY-2	0.10	80	30	Transportation (Includes railroads, railyards, transit centers and freeways)
WI580	26.76	700	OPEN-1	0.35	5	30	General Open Space (Open space where no detail available)
WI580	0.04	730	OPEN-4	0.35	0	30	Passive Open Space (Includes mountain preserves and washes)
WI580	0.07	740	WTR	0.00	0	0	Water
WI580	0.09	750	AGR	0.50	0	85	Agriculture
WT100	0.01	610	FWY-2	0.10	80	30	Transportation (Includes railroads, railyards, transit centers and freeways)
WT100	2.43	700	OPEN-1	0.35	5	30	General Open Space (Open space where no detail available)
WT100	1.39	730	OPEN-4	0.35	0	30	Passive Open Space (Includes mountain preserves and washes)
WT110	1.78	700	OPEN-1	0.35	5	30	General Open Space (Open space where no detail available)
WT110	1.08	730	OPEN-4	0.35	0	30	Passive Open Space (Includes mountain preserves and washes)
WT120	1.61	700	OPEN-1	0.35	5	30	General Open Space (Open space where no detail available)
WT120	1.2	730	OPEN-4	0.35	0	30	Passive Open Space (Includes mountain preserves and washes)
WT130	0.47	700	OPEN-1	0.35	5	30	General Open Space (Open space where no detail available)
WT130	2.06	730	OPEN-4	0.35	0	30	Passive Open Space (Includes mountain preserves and washes)
WT140	3.79	730	OPEN-4	0.35	0	30	Passive Open Space (Includes mountain preserves and washes)
WT150	5.83	730	OPEN-4	0.35	0	30	Passive Open Space (Includes mountain preserves and washes)
WT160	0.81	730	OPEN-4	0.35	0	30	Passive Open Space (Includes mountain preserves and washes)

Future Land Use

Appendix B.2.2

Entellus

		SHEET		OF	
		BY	JCS	DATE	12/10/2003
CLIENT:	FCDMC	CHECK	RAS	DATE	2/16/2004
JOB:	Wittmann Area Drainage Master Study Update	JOB NO.	310.032		

Future Land Use Summary by Basin

Basin ID	Area (sqmiles)	WMS Land Use Code	Mag Land Use Code	IA (in) Initial Abstractions	RTIMP	% Vegetation	Land Use Definition
IW310	5.82	110	VLDR	0.30	5	30	Rural Residential (<= 1/5 du per acre)
IW310	14.86	120	LDR-1	0.30	10	30	Estate Residential (1/5 du per acre to 1 du per acre)
IW310	0.02	140	MDR-1	0.25	30	50	Medium Lot Residential - Single Family (2-4 du per acre)
IW310	0.99	150	SLR	0.25	35	50	Small Lot Residential - Single Family (4-6 du per acre)
IW310	1.98	170	MDR-2	0.25	45	50	Medium Density Residential - Muli Family (5-10 du per acre)
IW310	0.04	200	COM-1	0.10	80	60	General Commercial (Commercial where no detail available)
IW310	1.43	550	INS-4	0.10	80	75	Public Facilities (Includes community centers, power sub-stations, libraries, etc.)
IW310	0.64	710	OPEN-2	0.20	5	50	Active Open Space (Includes parks)
IW350	1.42	110	VLDR	0.30	5	30	Rural Residential (<= 1/5 du per acre)
IW350	2.76	710	OPEN-2	0.20	5	50	Active Open Space (Includes parks)
PD700	5.21	120	LDR-1	0.30	10	30	Estate Residential (1/5 du per acre to 1 du per acre)
PD700	1.16	130	LDR-2	0.30	15	50	Large Lot Residential - Single Family (1 du per acre to 2 du per acre)
PD700	0.07	150	SLR	0.25	35	50	Small Lot Residential - Single Family (4-6 du per acre)
PD700	0.03	190	VHDR	0.25	85	50	Very High Density Residential - Multi Family (> 15 du per acre)
PD700	0.07	550	INS-4	0.10	80	75	Public Facilities (Includes community centers, power sub-stations, libraries, etc.)
PD700	0.6	710	OPEN-2	0.20	5	50	Active Open Space (Includes parks)
PD700	0.13	740	WTR	0.00	0	0	Water
PD710	5.9	120	LDR-1	0.30	10	30	Estate Residential (1/5 du per acre to 1 du per acre)
PD710	0.21	130	LDR-2	0.30	15	50	Large Lot Residential - Single Family (1 du per acre to 2 du per acre)
PD710	0.37	140	MDR-1	0.25	30	50	Medium Lot Residential - Single Family (2-4 du per acre)
PD710	0.05	150	SLR	0.25	35	50	Small Lot Residential - Single Family (4-6 du per acre)
PD710	0.07	700	OPEN-1	0.35	5	30	General Open Space (Open space where no detail available)
PD710	0.09	710	OPEN-2	0.20	5	50	Active Open Space (Includes parks)
PD710	0.03	740	WTR	0.00	0	0	Water
PD730	0.4	120	LDR-1	0.30	10	30	Estate Residential (1/5 du per acre to 1 du per acre)
PD730	0.04	130	LDR-2	0.30	15	50	Large Lot Residential - Single Family (1 du per acre to 2 du per acre)
PD730	0	150	SLR	0.25	35	50	Small Lot Residential - Single Family (4-6 du per acre)
PD730	0.02	550	INS-4	0.10	80	75	Public Facilities (Includes community centers, power sub-stations, libraries, etc.)
PD735	1.48	120	LDR-1	0.30	10	30	Estate Residential (1/5 du per acre to 1 du per acre)
PD735	0.53	130	LDR-2	0.30	15	50	Large Lot Residential - Single Family (1 du per acre to 2 du per acre)
PD735	0.07	150	SLR	0.25	35	50	Small Lot Residential - Single Family (4-6 du per acre)
PD735	0.08	180	HDR	0.25	65	50	High Density Residential - Multi Family (10-15 du per acre)
PD735	0.03	230	COM-4	0.10	80	75	Community Commercial (100,000 to 500,000 sq. ft.)
PD735	0	550	INS-4	0.10	80	75	Public Facilities (Includes community centers, power sub-stations, libraries, etc.)
PD735	1.02	710	OPEN-2	0.20	5	50	Active Open Space (Includes parks)
PD740	0.34	120	LDR-1	0.30	10	30	Estate Residential (1/5 du per acre to 1 du per acre)
PD740	0.35	130	LDR-2	0.30	15	50	Large Lot Residential - Single Family (1 du per acre to 2 du per acre)
PD740	0.17	710	OPEN-2	0.20	5	50	Active Open Space (Includes parks)

Appendix B.2.2

Entellus

		SHEET		OF	
		BY	JCS	DATE	12/10/2003
CLIENT:	FCDMC	CHECK	RAS	DATE	2/16/2004
JOB:	Wittmann Area Drainage Master Study Update	JOB NO.	310.032		

Future Land Use Summary by Basin

Basin ID	Area (sqmiles)	WMS Land Use Code	Mag Land Use Code	IA (in) Initial Abstractions	RTIMP	% Vegetation	Land Use Definition
PD740	0	740	WTR	0.00	0	0	Water
PD745	1.15	120	LDR-1	0.30	10	30	Estate Residential (1/5 du per acre to 1 du per acre)
PD745	0.12	130	LDR-2	0.30	15	50	Large Lot Residential - Single Family (1 du per acre to 2 du per acre)
PD745	0.69	710	OPEN-2	0.20	5	50	Active Open Space (Includes parks)
PD760	2.17	120	LDR-1	0.30	10	30	Estate Residential (1/5 du per acre to 1 du per acre)
PD760	0.12	130	LDR-2	0.30	15	50	Large Lot Residential - Single Family (1 du per acre to 2 du per acre)
PD760	0.15	150	SLR	0.25	35	50	Small Lot Residential - Single Family (4-6 du per acre)
PD760	0.03	230	COM-4	0.10	80	75	Community Commercial (100,000 to 500,000 sq. ft.)
PD760	0.25	710	OPEN-2	0.20	5	50	Active Open Space (Includes parks)
PD780	0.83	110	VLDR	0.30	5	30	Rural Residential (<= 1/5 du per acre)
PD780	3.19	120	LDR-1	0.30	10	30	Estate Residential (1/5 du per acre to 1 du per acre)
PD780	1.34	130	LDR-2	0.30	15	50	Large Lot Residential - Single Family (1 du per acre to 2 du per acre)
PD780	0.08	150	SLR	0.25	35	50	Small Lot Residential - Single Family (4-6 du per acre)
PD780	0.16	180	HDR	0.25	65	50	High Density Residential - Multi Family (10-15 du per acre)
PD780	0.03	190	VHDR	0.25	85	50	Very High Density Residential - Multi Family (> 15 du per acre)
PD780	0.06	200	COM-1	0.10	80	60	General Commercial (Commercial where no detail available)
PD780	0.17	230	COM-4	0.10	80	75	Community Commercial (100,000 to 500,000 sq. ft.)
PD780	0.04	550	INS-4	0.10	80	75	Public Facilities (Includes community centers, power sub-stations, libraries, etc.)
PD780	13.03	710	OPEN-2	0.20	5	50	Active Open Space (Includes parks)
PD780	0.21	810	INS-6	0.10	80	75	Business Park (Includes enclosed industrial, office or retail in a planned envir
PI600	3.28	120	LDR-1	0.30	10	30	Estate Residential (1/5 du per acre to 1 du per acre)
PI600	2.86	140	MDR-1	0.25	30	50	Medium Lot Residential - Single Family (2-4 du per acre)
PI600	4.37	150	SLR	0.25	35	50	Small Lot Residential - Single Family (4-6 du per acre)
PI600	0	170	MDR-2	0.25	45	50	Medium Density Residential - Muti Family (5-10 du per acre)
PI600	0.71	580	IND-5	0.15	80	75	Other Employment - medium
PI600	0.21	700	OPEN-1	0.35	5	30	General Open Space (Open space where no detail available)
PI600	0.58	730	OPEN-4	0.35	0	30	Passive Open Space (Includes mountain preserves and washes)
PI640	0.39	110	VLDR	0.30	5	30	Rural Residential (<= 1/5 du per acre)
PI640	8.67	120	LDR-1	0.30	10	30	Estate Residential (1/5 du per acre to 1 du per acre)
PI640	3.86	130	LDR-2	0.30	15	50	Large Lot Residential - Single Family (1 du per acre to 2 du per acre)
PI640	0.12	150	SLR	0.25	35	50	Small Lot Residential - Single Family (4-6 du per acre)
PI640	1.87	570	IND-4	0.15	80	25	Other Employment - low (Proving grounds and land fills)
PI640	2.62	710	OPEN-2	0.20	5	50	Active Open Space (Includes parks)
PI680	0.01	110	VLDR	0.30	5	30	Rural Residential (<= 1/5 du per acre)
PI680	10.73	710	OPEN-2	0.20	5	50	Active Open Space (Includes parks)
PI680	6.14	730	OPEN-4	0.35	0	30	Passive Open Space (Includes mountain preserves and washes)
SV200	5.75	120	LDR-1	0.30	10	30	Estate Residential (1/5 du per acre to 1 du per acre)
SV200	1.37	140	MDR-1	0.25	30	50	Medium Lot Residential - Single Family (2-4 du per acre)

Appendix B.2.2

Entellus

		SHEET		OF	
		BY	JCS	DATE	12/10/2003
CLIENT:	FCDMC	CHECK	RAS	DATE	2/16/2004
JOB:	Wittmann Area Drainage Master Study Update	JOB NO.	310.032		

Future Land Use Summary by Basin

Basin ID	Area (sqmiles)	WMS Land Use Code	Mag Land Use Code	IA (in) Initial Abstractions	RTIMP	% Vegetation	Land Use Definition
SV200	8.91	150	SLR	0.25	35	50	Small Lot Residential - Single Family (4-6 du per acre)
SV200	2.56	170	MDR-2	0.25	45	50	Medium Density Residential - Muli Family (5-10 du per acre)
SV200	0.23	180	HDR	0.25	65	50	High Density Residential - Multi Family (10-15 du per acre)
SV200	0.16	190	VHDR	0.25	85	50	Very High Density Residential - Multi Family (> 15 du per acre)
SV200	0.62	200	COM-1	0.10	80	60	General Commercial (Commercial where no detail available)
SV200	0.38	510	COM-7	0.10	80	75	Tourist and Visitor Accommodations (Hotels, motels and resorts)
SV200	0.97	550	INS-4	0.10	80	75	Public Facilities (Includes community centers, power sub-stations, libraries, etc.)
SV200	9.14	710	OPEN-2	0.20	5	50	Active Open Space (Includes parks)
SV200	1.24	730	OPEN-4	0.35	0	30	Passive Open Space (Includes mountain preserves and washes)
SV220	5.66	120	LDR-1	0.30	10	30	Estate Residential (1/5 du per acre to 1 du per acre)
SV220	2.07	140	MDR-1	0.25	30	50	Medium Lot Residential - Single Family (2-4 du per acre)
SV220	1.08	150	SLR	0.25	35	50	Small Lot Residential - Single Family (4-6 du per acre)
SV220	8.12	170	MDR-2	0.25	45	50	Medium Density Residential - Muli Family (5-10 du per acre)
TW400	0.7	120	LDR-1	0.30	10	30	Estate Residential (1/5 du per acre to 1 du per acre)
TW400	3.58	150	SLR	0.25	35	50	Small Lot Residential - Single Family (4-6 du per acre)
TW400	0.63	170	MDR-2	0.25	45	50	Medium Density Residential - Muli Family (5-10 du per acre)
TW400	0	200	COM-1	0.10	80	60	General Commercial (Commercial where no detail available)
TW400	3.34	550	INS-4	0.10	80	75	Public Facilities (Includes community centers, power sub-stations, libraries, etc.)
TW400	2.04	570	IND-4	0.15	80	25	Other Employment - low (Proving grounds and land fills)
TW400	1.5	710	OPEN-2	0.20	5	50	Active Open Space (Includes parks)
TW400	1.14	730	OPEN-4	0.35	0	30	Passive Open Space (Includes mountain preserves and washes)
TW420	9.9	120	LDR-1	0.30	10	30	Estate Residential (1/5 du per acre to 1 du per acre)
TW420	0.2	150	SLR	0.25	35	50	Small Lot Residential - Single Family (4-6 du per acre)
TW420	0.78	550	INS-4	0.10	80	75	Public Facilities (Includes community centers, power sub-stations, libraries, etc.)
TW460	0.76	110	VLDR	0.30	5	30	Rural Residential (<= 1/5 du per acre)
TW460	0	120	LDR-1	0.30	10	30	Estate Residential (1/5 du per acre to 1 du per acre)
TW460	1.65	710	OPEN-2	0.20	5	50	Active Open Space (Includes parks)
TW480	0.89	110	VLDR	0.30	5	30	Rural Residential (<= 1/5 du per acre)
TW480	5.96	710	OPEN-2	0.20	5	50	Active Open Space (Includes parks)
TW480	5.87	730	OPEN-4	0.35	0	30	Passive Open Space (Includes mountain preserves and washes)
WI500	2.02	120	LDR-1	0.30	10	30	Estate Residential (1/5 du per acre to 1 du per acre)
WI500	2.51	150	SLR	0.25	35	50	Small Lot Residential - Single Family (4-6 du per acre)
WI500	1.43	170	MDR-2	0.25	45	50	Medium Density Residential - Muli Family (5-10 du per acre)
WI500	0.41	180	HDR	0.25	65	50	High Density Residential - Multi Family (10-15 du per acre)
WI500	0.28	190	VHDR	0.25	85	50	Very High Density Residential - Multi Family (> 15 du per acre)
WI500	0.3	200	COM-1	0.10	80	60	General Commercial (Commercial where no detail available)
WI500	1.52	550	INS-4	0.10	80	75	Public Facilities (Includes community centers, power sub-stations, libraries, etc.)
WI500	0.65	730	OPEN-4	0.35	0	30	Passive Open Space (Includes mountain preserves and washes)

Appendix B.2.2

Entellus

		SHEET		OF	
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JOB:	Wittmann Area Drainage Master Study Update	JOB NO.	310.032		

Future Land Use Summary by Basin

Basin ID	Area (sqmiles)	WMS Land Use Code	Mag Land Use Code	IA (in) Initial Abstractions	RTIMP	% Vegetation	Land Use Definition
WI505	1.91	120	LDR-1	0.30	10	30	Estate Residential (1/5 du per acre to 1 du per acre)
WI505	2.88	150	SLR	0.25	35	50	Small Lot Residential - Single Family (4-6 du per acre)
WI505	1.62	170	MDR-2	0.25	45	50	Medium Density Residential - Muli Family (5-10 du per acre)
WI505	0.04	200	COM-1	0.10	80	60	General Commercial (Commercial where no detail available)
WI505	0.17	550	INS-4	0.10	80	75	Public Facilities (Includes community centers, power sub-stations, libraries, etc.)
WI505	0.04	730	OPEN-4	0.35	0	30	Passive Open Space (Includes mountain preserves and washes)
WI510	0.22	120	LDR-1	0.30	10	30	Estate Residential (1/5 du per acre to 1 du per acre)
WI510	2.52	150	SLR	0.25	35	50	Small Lot Residential - Single Family (4-6 du per acre)
WI510	0.47	180	HDR	0.25	65	50	High Density Residential - Multi Family (10-15 du per acre)
WI510	3.37	550	INS-4	0.10	80	75	Public Facilities (Includes community centers, power sub-stations, libraries, etc.)
WI510	1.68	570	IND-4	0.15	80	25	Other Employment - low (Proving grounds and land fills)
WI510	1.04	730	OPEN-4	0.35	0	30	Passive Open Space (Includes mountain preserves and washes)
WI520	5.58	110	VLDR	0.30	5	30	Rural Residential (<= 1/5 du per acre)
WI520	4.06	120	LDR-1	0.30	10	30	Estate Residential (1/5 du per acre to 1 du per acre)
WI520	0.83	150	SLR	0.25	35	50	Small Lot Residential - Single Family (4-6 du per acre)
WI520	0.44	170	MDR-2	0.25	45	50	Medium Density Residential - Muli Family (5-10 du per acre)
WI520	0.01	200	COM-1	0.10	80	60	General Commercial (Commercial where no detail available)
WI520	0.87	550	INS-4	0.10	80	75	Public Facilities (Includes community centers, power sub-stations, libraries, etc.)
WI520	2.19	570	IND-4	0.15	80	25	Other Employment - low (Proving grounds and land fills)
WI520	2.36	710	OPEN-2	0.20	5	50	Active Open Space (Includes parks)
WI540	0	110	VLDR	0.30	5	30	Rural Residential (<= 1/5 du per acre)
WI540	4.22	120	LDR-1	0.30	10	30	Estate Residential (1/5 du per acre to 1 du per acre)
WI540	0.84	150	SLR	0.25	35	50	Small Lot Residential - Single Family (4-6 du per acre)
WI540	0.26	170	MDR-2	0.25	45	50	Medium Density Residential - Muli Family (5-10 du per acre)
WI540	0.11	550	INS-4	0.10	80	75	Public Facilities (Includes community centers, power sub-stations, libraries, etc.)
WI540	4.45	570	IND-4	0.15	80	25	Other Employment - low (Proving grounds and land fills)
WI540	1.76	710	OPEN-2	0.20	5	50	Active Open Space (Includes parks)
WI580	7.02	110	VLDR	0.30	5	30	Rural Residential (<= 1/5 du per acre)
WI580	16.76	120	LDR-1	0.30	10	30	Estate Residential (1/5 du per acre to 1 du per acre)
WI580	1.19	150	SLR	0.25	35	50	Small Lot Residential - Single Family (4-6 du per acre)
WI580	0.13	170	MDR-2	0.25	45	50	Medium Density Residential - Muli Family (5-10 du per acre)
WI580	0.02	200	COM-1	0.10	80	60	General Commercial (Commercial where no detail available)
WI580	0.95	550	INS-4	0.10	80	75	Public Facilities (Includes community centers, power sub-stations, libraries, etc.)
WI580	4.27	710	OPEN-2	0.20	5	50	Active Open Space (Includes parks)
WT100	1.8	120	LDR-1	0.30	10	30	Estate Residential (1/5 du per acre to 1 du per acre)
WT100	0.63	140	MDR-1	0.25	30	50	Medium Lot Residential - Single Family (2-4 du per acre)
WT100	0	150	SLR	0.25	35	50	Small Lot Residential - Single Family (4-6 du per acre)
WT100	1.35	710	OPEN-2	0.20	5	50	Active Open Space (Includes parks)

Appendix B.2.2

Entellus

		SHEET		OF	
		BY	JCS	DATE	12/10/2003
CLIENT:	FCDMC	CHECK	RAS	DATE	2/16/2004
JOB:	Wittmann Area Drainage Master Study Update	JOB NO.	310.032		

Future Land Use Summary by Basin

Basin ID	Area (sqmiles)	WMS Land Use Code	Mag Land Use Code	IA (in) Initial Abstractions	RTIMP	% Vegetation	Land Use Definition
WT100	0.05	730	OPEN-4	0.35	0	30	Passive Open Space (Includes mountain preserves and washes)
WT110	1.55	120	LDR-1	0.30	10	30	Estate Residential (1/5 du per acre to 1 du per acre)
WT110	0.24	140	MDR-1	0.25	30	50	Medium Lot Residential - Single Family (2-4 du per acre)
WT110	1.08	710	OPEN-2	0.20	5	50	Active Open Space (Includes parks)
WT120	1.61	120	LDR-1	0.30	10	30	Estate Residential (1/5 du per acre to 1 du per acre)
WT120	1.2	710	OPEN-2	0.20	5	50	Active Open Space (Includes parks)
WT130	0.47	120	LDR-1	0.30	10	30	Estate Residential (1/5 du per acre to 1 du per acre)
WT130	2.06	710	OPEN-2	0.20	5	50	Active Open Space (Includes parks)
WT140	3.79	710	OPEN-2	0.20	5	50	Active Open Space (Includes parks)
WT150	5.83	710	OPEN-2	0.20	5	50	Active Open Space (Includes parks)
WT160	0.81	710	OPEN-2	0.20	5	50	Active Open Space (Includes parks)

Municipalities Land Use Plans

Appendix B.2.2.3

Entellus

SHEET		OF	
BY	AMG	DATE	11/6/2003
CHECK		DATE	
JOB NO.	310.032		

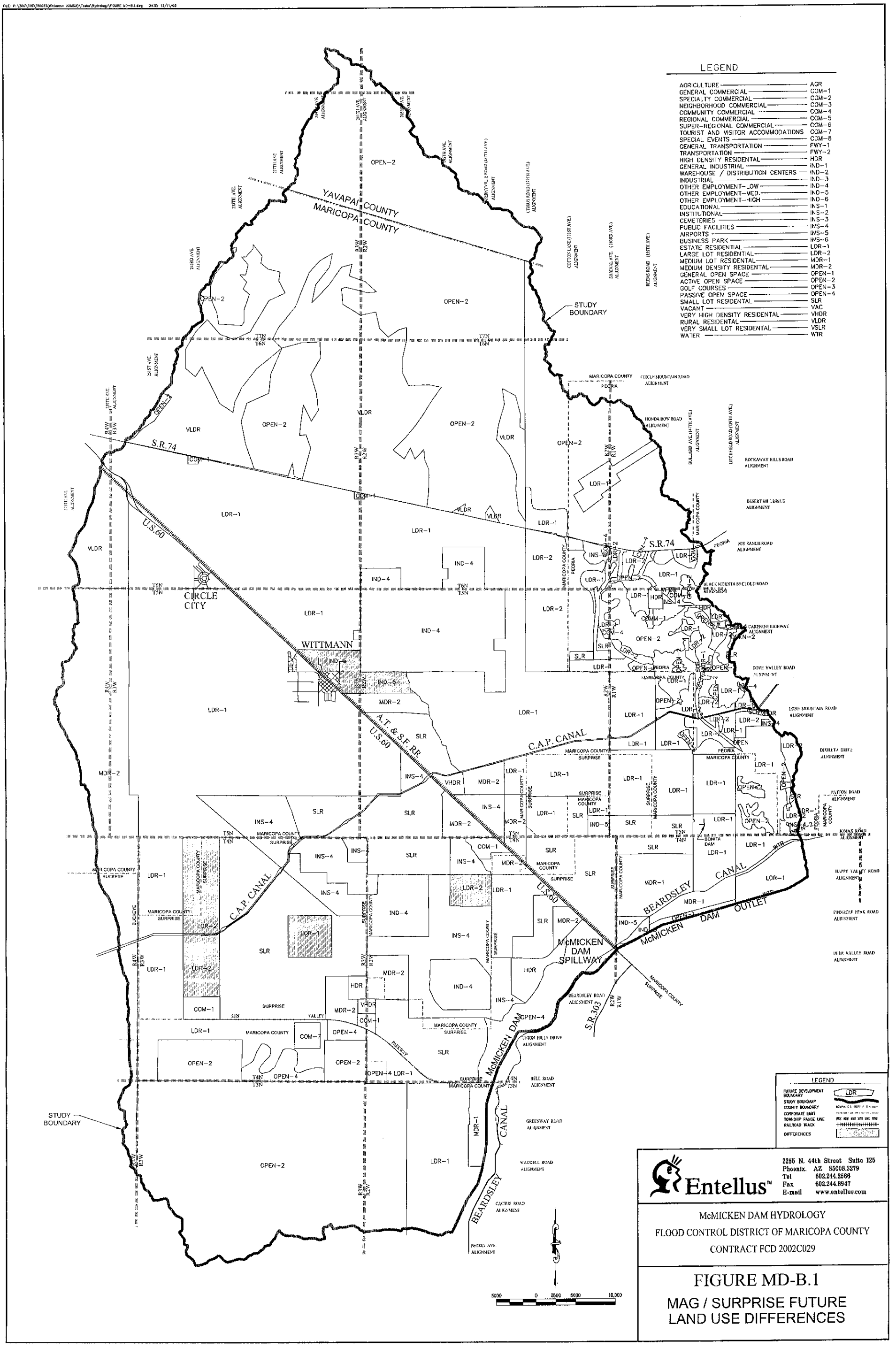
CLIENT: FCDMC

JOB: Wittmann Area Drainage Master Study Update

Future Land Use Comparison

MAG			City of Surprise			Conflict Area
Land Use ID	*Unit/Acre*	*% Impervious*	*Land Use ID*	*Unit/Acre*	*% Impervious*	*s.mi.*
MDR-2	Medium Density Residential - Muli Family (5-10 du per acre)	45	LDR-2	Suburban Residential (1 to 3 du per acre)	15-30	3.36
LDR-1	Estate Residential (1/5 du per acre to 1 du per acre)	10	LDR-2	Suburban Residential (1 to 3 du per acre)	15-30	0.75
INS-4	Public Facilities	80	IND-5	Employment	80	1.55
SLR	Small Lot Residential-Single Family (4 to 6 due per acre)	35	LDR-1	Rural Residential (0 to 1 du per acre)	5-10	1.03

FILE: P:\300\310\310032(McMicken AOMSU)\Tasks\Hydrology\FIGURE MD-B1.dwg DATE: 12/11/03



LEGEND

FUTURE DEVELOPMENT BOUNDARY	LDR
STUDY BOUNDARY	
COUNTY BOUNDARY	
CORPORATE LIMIT	
TOWNSHIP RANGE LINE	
RAILROAD TRACK	
DIFFERENCES	

Entellus™
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E-mail www.entellus.com

McMICKEN DAM HYDROLOGY

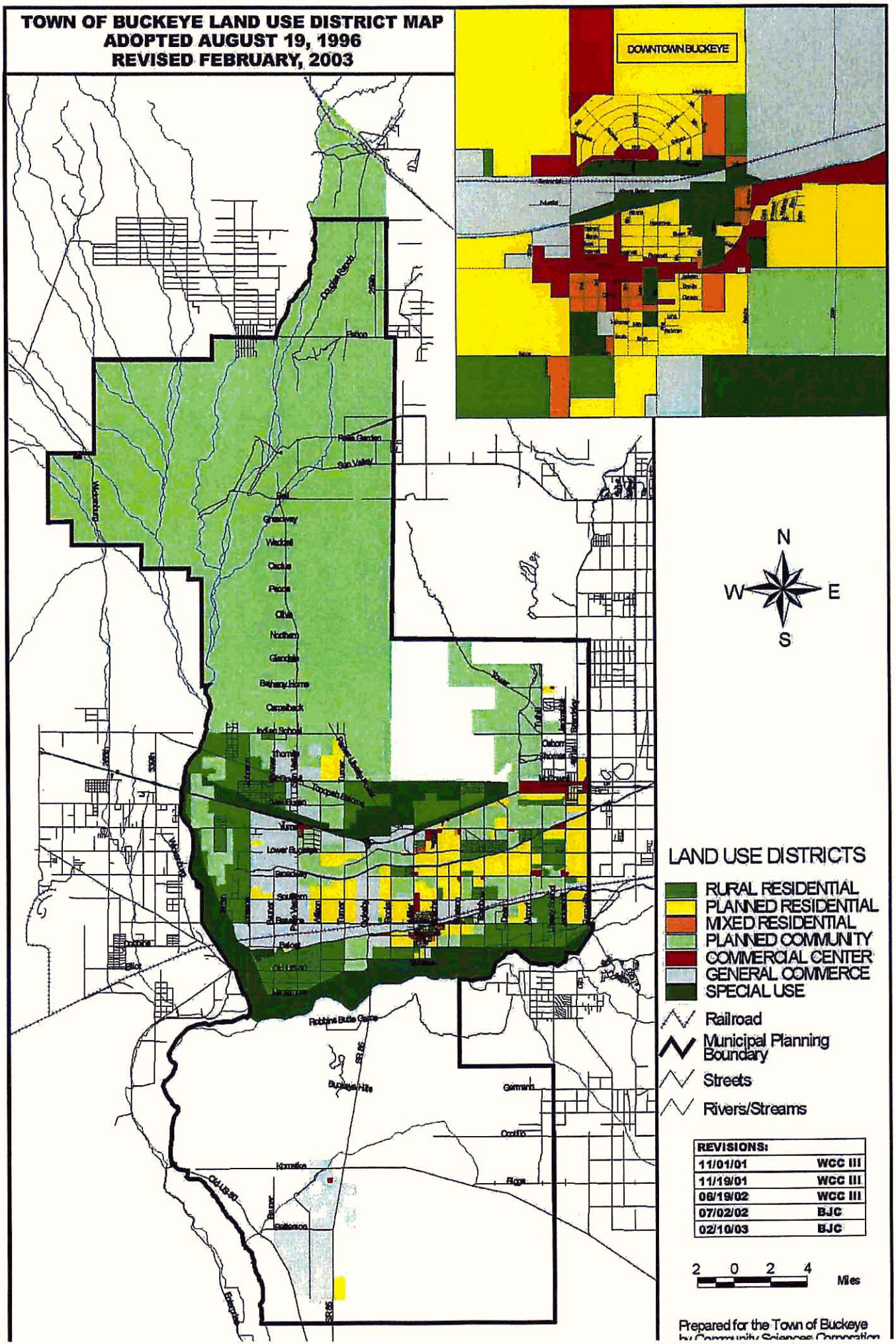
FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

CONTRACT FCD 2002C029

FIGURE MD-B.1

MAG / SURPRISE FUTURE LAND USE DIFFERENCES

TOWN OF BUCKEYE LAND USE DISTRICT MAP
ADOPTED AUGUST 19, 1996
REVISED FEBRUARY, 2003



City of Peoria General Plan

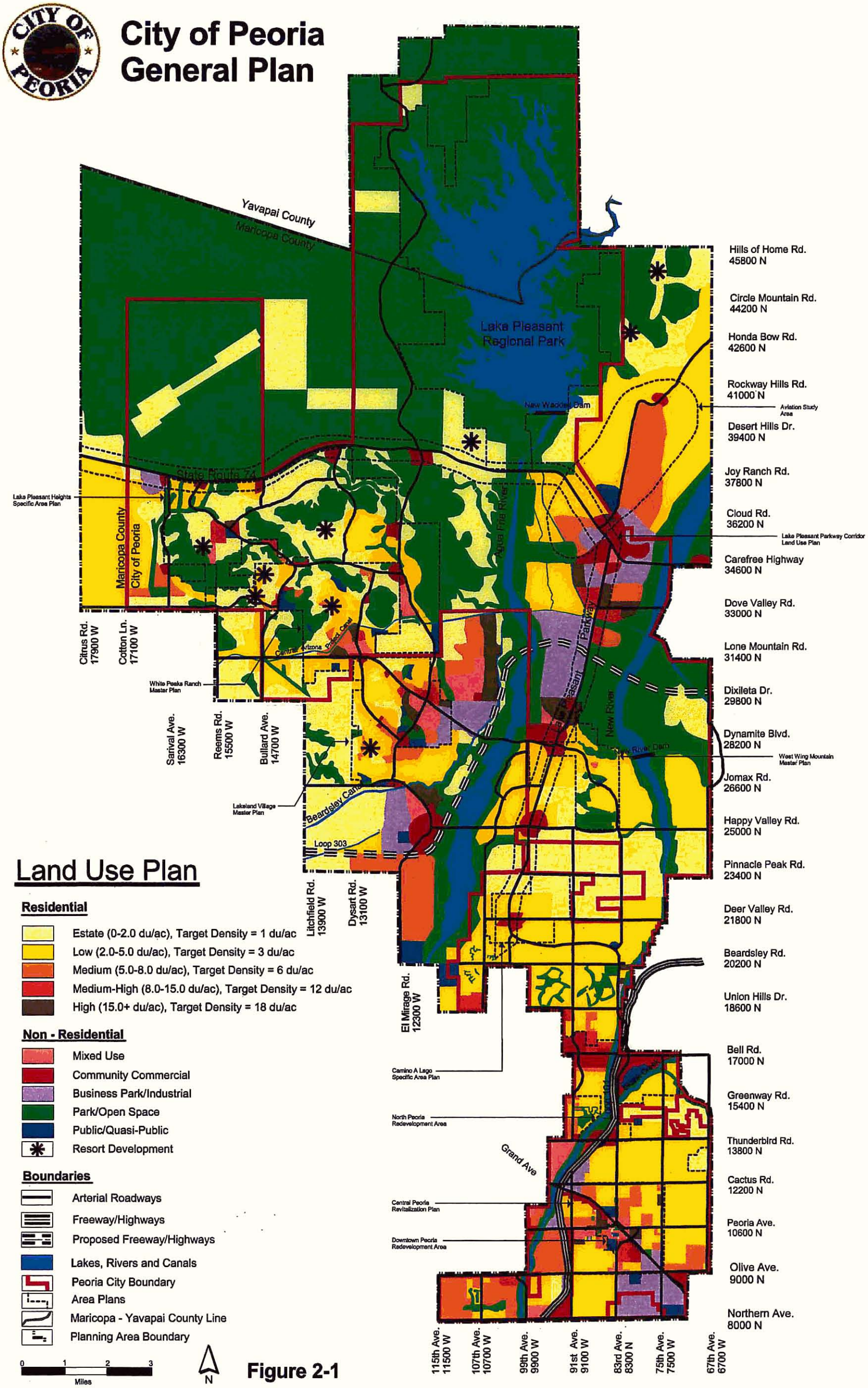
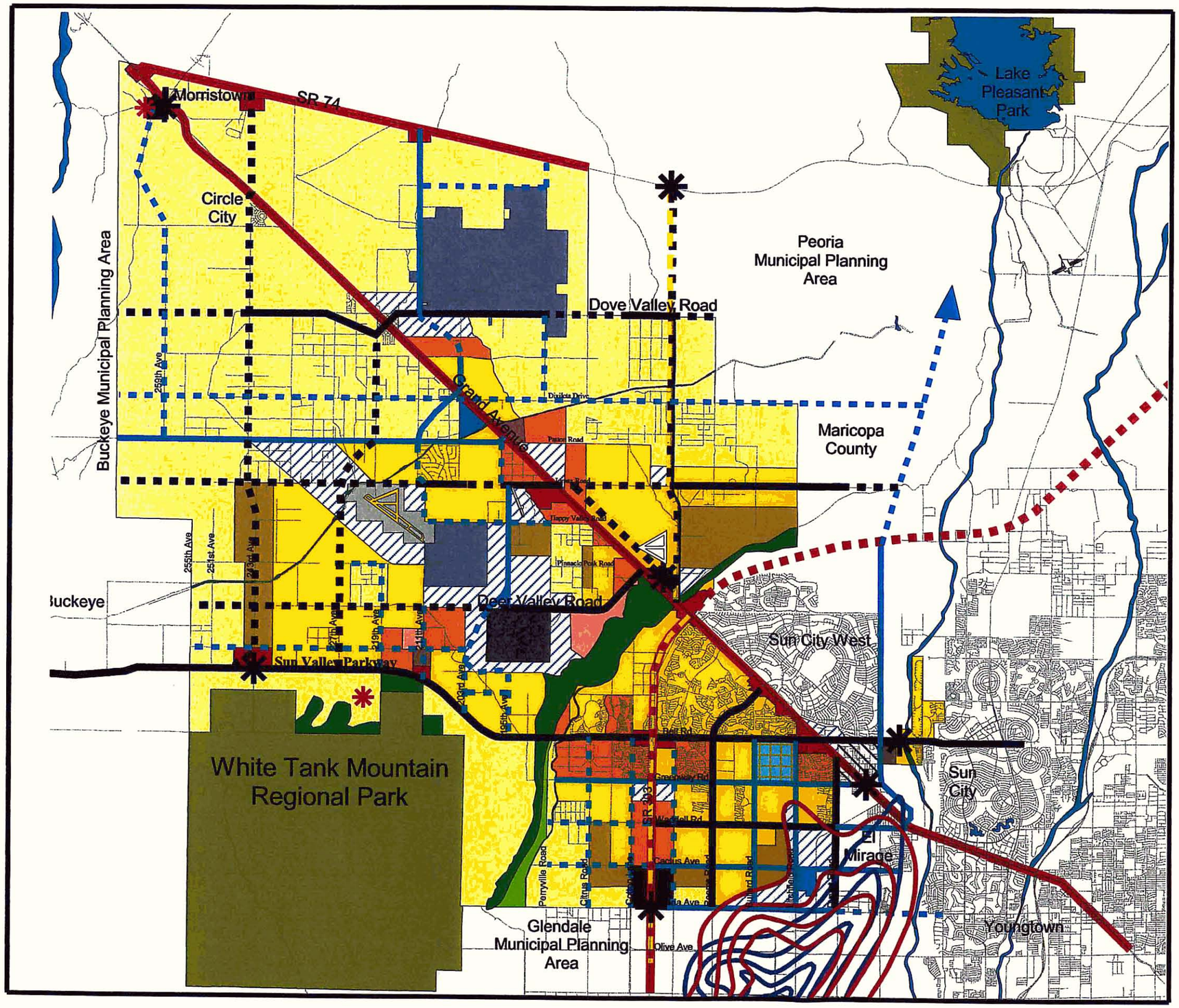


Figure 2-1

Source: BRW, Inc, January 2001.

p 1/8/01 c:/peoria/projects/preferred_revised.apr



Land Use Plan

Figure 4-1

Land Use Classification

- Rural Residential (0-1 DU/AC) [1]
- Suburban Residential (1-3 DU/AC)
- Low Density Residential (3-5 DU/AC)
- Medium Density Residential (5-8 DU/AC)
- Medium/High Density Residential (8-15 DU/AC)
- High Density Residential (15-21 DU/AC)
- Surprise Center
- Original Townsite [2]
- Commercial (Greater than 25 acres) [3]
- Employment
- Mixed Use
- Agriculture
- Landfill
- Military
- Open Space
- Public Facilities
- Proving Grounds
- Resort Development
- Gateway

[1] Reference Rural Development Standards and Design Guidelines Policy

[2] See Original Townsite Revilization Specific Plan

[3] Commercial under 25 acres can be approved in other land use classifications per criteria in the General Plan.

Street Classification

- Principal Arterial
- Major Arterial
- Minor Arterial
- Proposed Principal Arterial
- Proposed Major Arterial
- Proposed Minor Arterial
- Special Corridor
- 1988 MAG Noise Contours
- 1995 Luke A.F.B Noise Contours (1997 Revised)

Surprise General Plan 2020: Imagine the Possibilities
Surprise, AZ

1 0 1 2 Miles

Partners for Strategic Action, Inc.
Neill/Vecchia and Associates
David Evans and Associates, Inc.

Revised by City of Surprise
December, 2001

B.2.3. S-graph

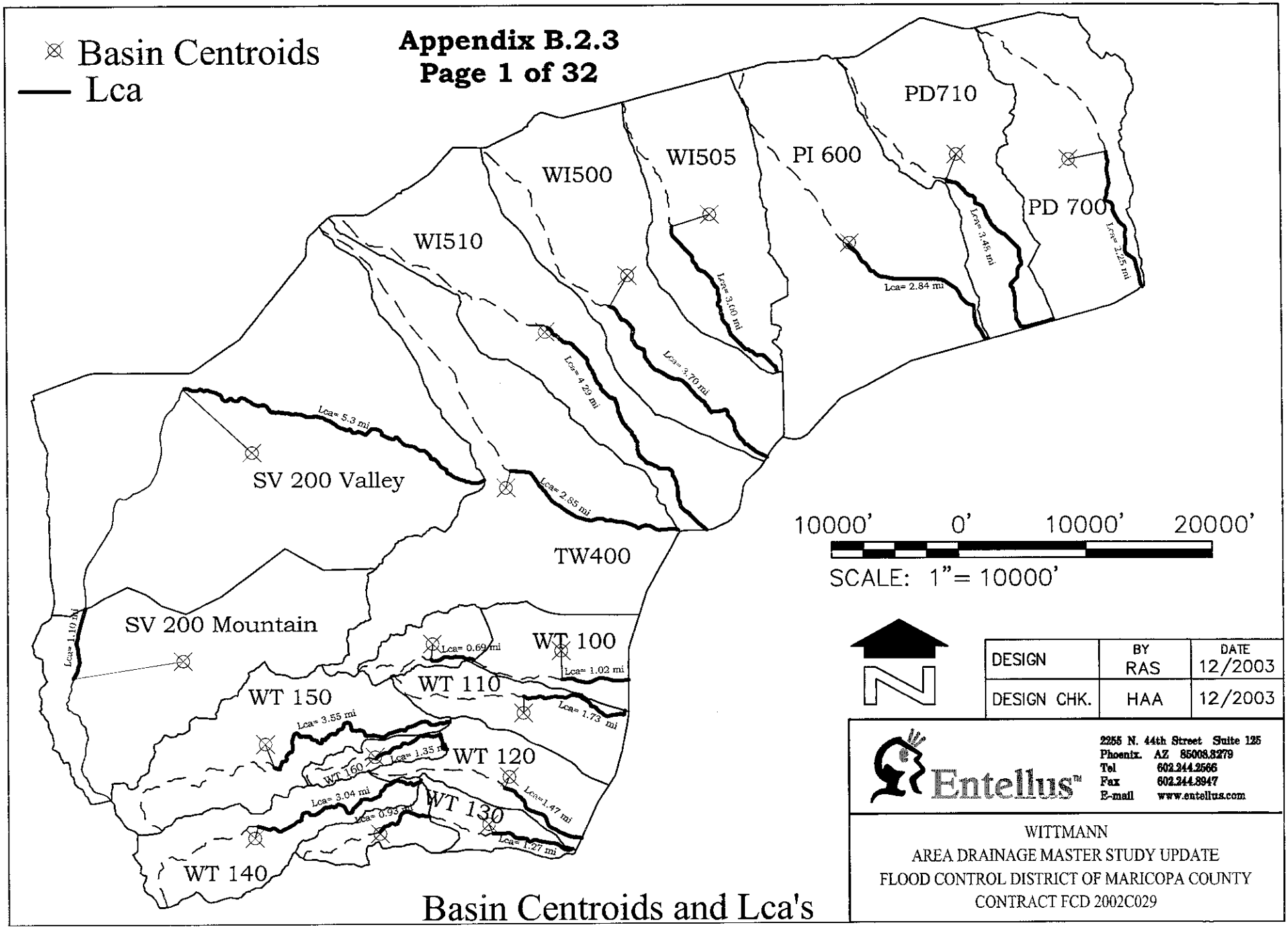
General S-graph Parameters

Weight S-graph Parameters

100-yr, 200-yr, and 500-yr S-graphs

6-hr, 72-hr S-graphs

General S-graph Parameters



Basin Centroids and Lca's

DESIGN	BY RAS	DATE 12/2003
DESIGN CHK.	HAA	12/2003

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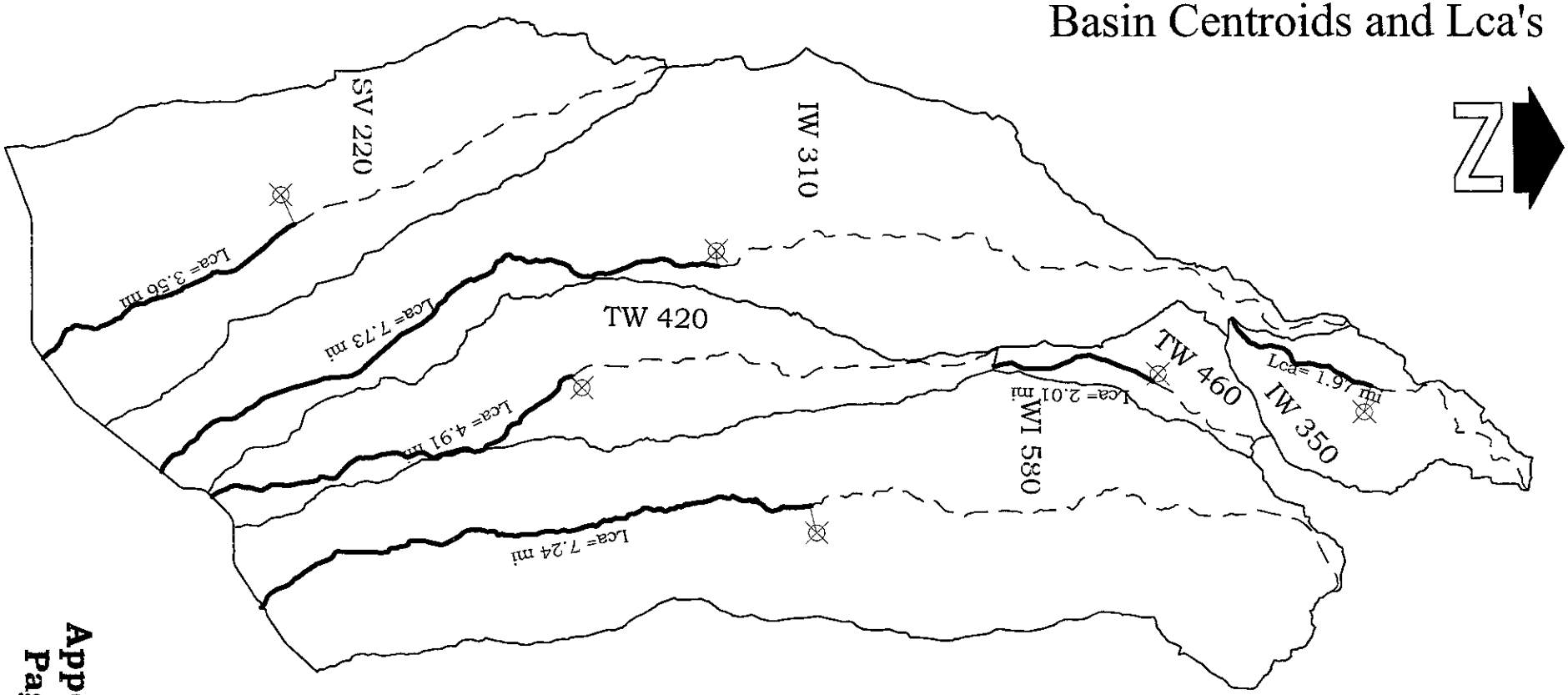
FLOOD CONTROL DISTRICT OF MARICOPA COUNTY
CONTRACT FCD 2002C029

Basin Centroids and Lca's



10000' 0' 10000' 20000'

SCALE: 1"= 10000'

Basin Centroids

Lca

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DESIGN	BY RAS	DATE 12/2003
DESIGN CHK.	HAA	12/2003

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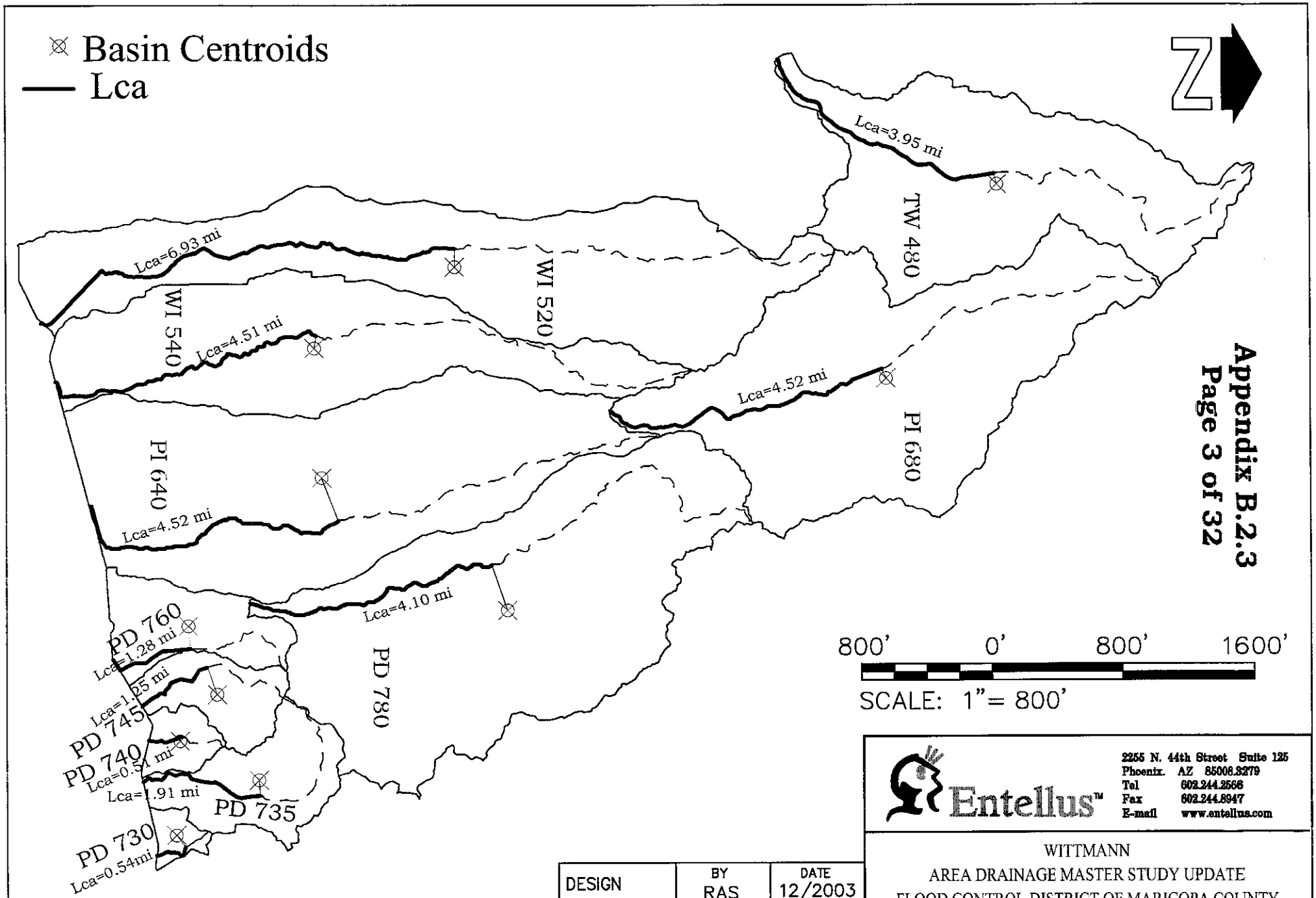
FLOOD CONTROL DISTRICT OF MARICOPA COUNTY
CONTRACT FCD 2002C029



Appendix B.2.3
Page 3 of 32

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DESIGN CHK.	HAA	12/2003

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FLOOD CONTROL DISTRICT OF MARICOPA COUNTY
CONTRACT FCD 2002C029

Basin Centroids and Lca's

Appendix B.2.3
Summary of Lca and Kn values

	Basin ID	Basin Area (acres)	Basin Area (sqmiles)	Time of Concentration Length (ft)	Time of Concentration Length (miles)	U/S Elev. (ft)	D/S Elev. (ft)	Slope (ft/mile)	K_n	L_{ca} (Miles)	K_{nPMF}	Basin Lag (Hours)	Basin Lag $_{PMF}$ (Hours)	S-Graph Type
	IW310	16521	25.8	85390	16.2	2450	1550	55.7	0.030	7.73	0.025	2.10	1.75	Valley
	IW350	2693	4.2	25490	4.8	3380	2260	232.0	0.030	1.97	0.025	0.60	0.50	Valley
	PD700	4648	7.3	27040	5.1	1540	1310	44.9	0.030	2.25	0.025	0.89	0.74	Valley
	PD710	4299	6.7	32593	6.2	1545.8	1314.3	37.5	0.035	3.48	0.030	1.35	1.16	Valley
	PD730	305	0.5	5020	1.0	1810	1540	284.0	0.050	0.54	0.045	0.32	0.29	Mountain
	PD735	2048	3.2	23890	4.5	2170	1540	139.2	0.030	1.91	0.025	0.64	0.53	Mountain
	PD740	556	0.9	6450	1.2	1800	1540	212.8	0.030	0.51	0.025	0.22	0.18	Valley
	PD745	1269	2.0	14130	2.7	2170	1540	235.4	0.030	1.25	0.025	0.40	0.34	Valley
	PD760	1728	2.7	16900	3.2	2320	1550	240.6	0.030	1.28	0.025	0.43	0.36	Valley
	PD780	12268	19.2	50820	9.6	2850.4	1669.7	122.7	0.030	4.10	0.025	1.17	0.97	Valley
	PI600	7701	12.0	31880	6.0	1540	1320	36.4	0.035	2.84	0.030	1.25	1.07	Valley
	PI640	11240	17.6	52172	9.9	2305	1544	77.0	0.030	4.52	0.025	1.34	1.11	Valley
	PI680	10808	16.9	48990	9.3	4200	2190	216.6	0.050	4.52	0.045	1.79	1.61	Mountain
*	SV200M	5978	9.3	17496	3.3	2860	1815	315.4	0.050	1.10	0.045	0.66	0.59	Mountain
*	SV200V	14067	22.0	48462	9.2	1815	1415	43.6	0.030	5.30	0.025	1.54	1.28	Valley
	SV220	10850	17.0	44850	8.5	1830	1540	34.1	0.030	3.56	0.025	1.34	1.12	Valley
	TW400	8312	13.0	40010	7.6	1560	1340	29.0	0.035	2.85	0.030	1.42	1.22	Valley
	TW420	6972	10.9	54410	10.3	2080	1550	51.4	0.030	4.91	0.025	1.51	1.26	Valley
	TW460	1562	2.4	18660	3.5	2435	2070	103.3	0.030	2.01	0.025	0.63	0.52	Valley
	TW480	8152	12.7	48570	9.2	4190	2400	194.6	0.050	3.95	0.045	1.73	1.55	Mountain
	WI500	5861	9.2	35147	6.7	1545.4	1343.6	30.3	0.035	3.70	0.030	1.48	1.27	Valley
	WI505	4270	6.7	27252	5.2	1541.4	1351.7	36.8	0.035	3.00	0.030	1.20	1.03	Valley
	WI510	5960	9.3	42795	8.1	1555.4	1336.3	27.0	0.035	4.29	0.030	1.73	1.48	Valley
	WI520	10490	16.4	69440	13.2	3150	1550	121.7	0.030	6.93	0.025	1.61	1.34	Valley
	WI540	7450	11.6	56740	10.7	2430	1550	81.9	0.030	4.51	0.025	1.36	1.14	Valley
	WI580	19422	30.3	77820	14.7	2670	1550	76.0	0.030	7.24	0.025	1.87	1.55	Valley
*	WT100M	804	1.3	10528	2.0	3000	1515	744.8	0.050	0.69	0.045	0.39	0.35	Mountain
*	WT100V	1658	2.6	12879	2.4	1515	1365	61.5	0.030	1.02	0.025	0.47	0.39	Valley
	WT110	1853	2.9	21030	4.0	2440	1340	276.2	0.030	1.73	0.025	0.52	0.43	Valley
	WT120	1802	2.8	18937	3.6	2020	1340	189.6	0.030	1.47	0.025	0.50	0.42	Valley
*	WT130M	822	1.3	12076	2.3	2870	1565	570.6	0.050	0.93	0.045	0.48	0.43	Mountain
*	WT130V	832	1.3	12313	2.3	1565	1350	92.2	0.030	1.27	0.025	0.46	0.38	Valley
	WT140	2432	3.8	29050	5.5	3770	1605	393.5	0.050	3.04	0.045	1.12	1.01	Mountain
	WT150	3742	5.8	37010	7.0	3790	1535	321.7	0.050	3.55	0.045	1.36	1.22	Mountain
	WT160	523	0.8	14290	2.7	2940	1545	515.4	0.050	1.35	0.045	0.60	0.54	Mountain

* Basin was divided into Valley Mountain region and a corresponding lag time was calculated for the respective region.

FLOOD CONTROL DISTRICT
OF MARICOPA COUNTY

S-GRAPH STUDY

Contract FCD 86-36

GEORGE V. SABOL
CONSULTING ENGINEER
BRIGHTON, COLORADO

November 1987

Phoenix Valley, Arizona (#56)- This S-graph was derived from flood reconstitutions for the streamgages and storm events shown in Table 5. The S-graph from the reconstitution of the September 1970 flood event for Skunk Creek near Phoenix was selected by the Los Angeles District as being representative of S-graphs #1 through #11. S-graph #56 is identical to #4. This S-graph is for general use in valley and urbanized areas in and around Phoenix. This S-graph may be applicable to other areas in Arizona.

Phoenix Mountain, Arizona (#57)- This S-graph was derived from flood reconstitutions for the streamgages and storm events shown in Table 6. The S-graph from the reconstitution of the September 1970 flood event for New River near Rock Springs was selected by the Los Angeles District as being representative of S-graphs #12 through #15. S-graph #57 is identical to #13. This S-graph is for general use in mountainous, non-urbanized areas around Phoenix. This S-graph may be applicable to other areas in Arizona.

Gila River Basin, Arizona, basins less than 1500 square miles (#58)- This S-graph is based on S-graphs for:

1. Blue River near Clifton, Arizona
2. Temecula Creek at Pauba Canyon, California (#28)
3. Murrieta Creek at Temecula, California (#25)
4. Santa Margarita Creek near Fallbrook, California (#27).

The Phoenix Mountain S-graph (#57) is used by the Los Angeles District in place of #58.

Gila River Basin, Arizona, basins greater than 1500 square miles (#59)- This S-graph is based on S-graphs for:

1. Gila River near Clifton, Arizona
2. Gila River at Connor No. 4 Dam Site, Arizona
3. San Francisco River at junction with Blue River, Arizona
4. Santa Ana River at Prado Dam, California.

Average Salt River, Tonto Creek, Verde River, Arizona (#60)- This S-graph is to be provided in the USBR Third Edition of Design of Small Dams as representative of the Southwest Desert, Great Basin, and Colorado Plateau. It is an average of individual S-graphs for the three watersheds.

Table 5.- Streamgages and storm events used in flood reconstitutions for the development of the Phoenix Valley, Arizona S-graph (#56) (Los Angeles District, 1974).

Stream Gage	USGS Gage No.	Drainage area sq. mi.	Peak Discharge from Storm, in cfs	
			Dec 1967	Sept 1970
(1)	(2)	(3)	(4)	(5)
New River at Bell Road	09513835	187.0	14,600	11,900
Skunk Creek near Phoenix	09513860	64.6	6,800	9,650
Cave Creek at Phoenix	09512400	70.0[1]	4,080	780
Queen Creek Trib. at Apache Junct.	09492200	.51		
Part 1			28	138
Part 2				84.5
Agua Fria Trib. at Youngtown	09513700	.13		
Part 1				15.8
Part 2				40.5

Note:

1. USGS Water Resources Data for Arizona indicates drainage area of 252 square miles. The contributing drainage area is 70.0 square miles because of the noncontributing area controlled by Cave Creek Dam.

Table 6.- Streamgages and storm events used in flood reconstitution for the development of the Phoenix Mountain, Arizona S-graph (#57) (Los Angeles District, 1974).

Stream Gage	USGS Gage No.	Drainage area sq. mi.	Peak Discharge from Storm, in cfs	
			Dec 1967	Sept 1970
(1)	(2)	(3)	(4)	(5)
New River near Rock Springs	09513780	67.3	10,500	18,600
New River at New River	09513800	85.7	12,500	19,500

% ULTIMATE DISCHARGE	TIME IN % LAG (S-graph is identified by number)					
	#53	#54	#55	#56	#57	#58
0	0	0	0	0.0	0.0	0
2	37	24	30	23.0	23.0	30
4	44	32	37	30.0	31.0	39
6	49	38	42	36.0	37.0	46
8	53	43	46	41.0	42.0	51
10	57	46	51	45.7	46.0	56
12	61	50	54	50.0	49.8	60
14	63	52	57	54.1	53.4	63
16	66	54	60	58.0	56.8	66
18	68	56	62	61.7	60.0	68
20	71	58	65	65.2	63.1	71
22	73	60	67	68.5	66.1	74
24	75	62	70	71.6	69.0	76
26	77	65	72	74.6	71.8	78
28	79	67	74	77.5	74.4	80
30	81	69	76	80.2	76.8	82
32	83	72	78	82.7	79.1	83
34	85	74	81	85.0	81.2	85
36	87	77	83	87.2	83.2	86
38	88	80	85	89.0	85.1	88
40	90	83	87	91.1	86.8	90
42	92	86	90	92.9	88.8	92
44	94	89	92	94.6	91.0	94
46	96	93	94	96.3	93.8	96
48	98	96	97	98.1	96.8	98
50	100	100	100	100.0	100.0	100
52	102	104	103	102.0	103.4	102
54	105	108	106	104.1	107.0	104
56	107	113	110	106.3	110.8	107
58	110	117	113	108.6	114.7	110
60	112	122	117	111.0	118.7	112
62	115	127	121	113.5	122.9	115
64	118	133	126	116.1	127.3	118
66	121	138	131	118.8	131.9	121
68	124	145	136	121.6	136.7	124
70	128	152	142	124.5	141.7	128
72	134	160	148	127.5	147.1	132
74	138	168	155	130.7	152.8	137
76	144	177	162	134.1	158.8	143
78	150	187	171	137.7	165.5	150
80	158	198	182	141.5	172.9	159
82	168	211	194	145.5	181.6	168
84	179	226	207	149.9	191.0	180
86	190	242	225	154.6	201.0	194
88	207	261	244	159.6	212.0	213
90	226	283	266	165.6	226.0	235
92	250	310	294	173.6	244.0	264
94	283	345	330	186.6	265.0	306
96	327	390	378	200.6	295.0	371
98	400	460	455	223.6	342.0	510
100	600	600	600	298.6	462.0	690

Weighted S-graph Parameters

Weighted Composite S-Graph

Per District staff direction, Entellus has developed the following procedure that is used in the Wittmann ADMSU. Regional S-graphs for Phoenix Valley region (#56) and Phoenix Mountainous region (#57) were developed by the District as a part of *S-Graph Study by George Sabol, Contract FCD 86-36* (**Reference 29**). In this study, composite S-graphs were developed for individual basins in the Wittmann project area, which contain a certain percentage of both valley and mountainous areas.

Composite S-Graphs were developed for three individual basins (SV-200, WT-130 and WT-100) in the watershed. Only basins containing a percentage area greater than 90% of Valley and 10% of mountains (or vice versa) were selected to develop a composite S-Graph for the individual basin. The percentage of areas for valley and mountainous regions, for each of the three basins, is tabulated in the attached table. The graphical representation of the same is displayed in the attached figure.

The listings of digitized S-graphs for Phoenix Valley area (#56) and Phoenix Mountainous area (#57) are extracted from the *S-Graph Study* (**Reference 29**), the relevant copies of which are attached. These digitized values of % $Q_{ultimate}$ and % lag time for #56 and #57 are summarized in Column 1, 2 and 3 of the attached table. The % lag time for valley area and mountain area for each of the three basins is then weighted to generate the weighted % lag time for the individual basin. These values of composite weighted % lag time are tabulated in Column 6, 9 and 12 of the table. The graphical representation of the composite S-graph for the three basins, and their correlation to S-graph for Phoenix valley area and Phoenix mountainous area, is shown in the attached figures.

APPENDIX B.2.3

Summary of Weighted Composite S-Graph

	#56	#57	Basin SV-200			Basin WT-130			Basin WT-100		
% Q_{ult}	Phx-V	Phx-M	70% V	30% M	70%V+30%M	56% V	44%M	56%V+44%M	67% V	33%M	67%V+33%M
0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	23.00	23.00	16.10	6.90	23.00	12.88	10.12	23.00	15.41	7.59	23.00
4	30.00	31.00	21.00	9.30	30.30	16.80	13.64	30.44	20.10	10.23	30.33
6	36.00	37.00	25.20	11.10	36.30	20.16	16.28	36.44	24.12	12.21	36.33
8	41.00	42.00	28.70	12.60	41.30	22.96	18.48	41.44	27.47	13.86	41.33
10	45.70	46.00	31.99	13.80	45.79	25.59	20.24	45.83	30.62	15.18	45.80
12	50.00	49.80	35.00	14.94	49.94	28.00	21.91	49.91	33.50	16.43	49.93
14	54.10	53.40	37.87	16.02	53.89	30.30	23.50	53.79	36.25	17.62	53.87
16	58.00	56.80	40.60	17.04	57.64	32.48	24.99	57.47	38.86	18.74	57.60
18	61.70	60.00	43.19	18.00	61.19	34.55	26.40	60.95	41.34	19.80	61.14
20	65.20	63.10	45.64	18.93	64.57	36.51	27.76	64.28	43.68	20.82	64.51
22	68.50	66.10	47.95	19.83	67.78	38.36	29.08	67.44	45.90	21.81	67.71
24	71.60	69.00	50.12	20.70	70.82	40.10	30.36	70.46	47.97	22.77	70.74
26	74.60	71.80	52.22	21.54	73.76	41.78	31.59	73.37	49.98	23.69	73.68
28	77.50	74.40	54.25	22.32	76.57	43.40	32.74	76.14	51.93	24.55	76.48
30	80.20	76.80	56.14	23.04	79.18	44.91	33.79	78.70	53.73	25.34	79.08
32	82.70	79.10	57.89	23.73	81.62	46.31	34.80	81.12	55.41	26.10	81.51
34	85.00	81.20	59.50	24.36	83.86	47.60	35.73	83.33	56.95	26.80	83.75
36	87.20	83.20	61.04	24.96	86.00	48.83	36.61	85.44	58.42	27.46	85.88
38	89.00	85.10	62.30	25.53	87.83	49.84	37.44	87.28	59.63	28.08	87.71
40	91.10	86.80	63.77	26.04	89.81	51.02	38.19	89.21	61.04	28.64	89.68
42	92.90	88.80	65.03	26.64	91.67	52.02	39.07	91.10	62.24	29.30	91.55
44	94.60	91.00	66.22	27.30	93.52	52.98	40.04	93.02	63.38	30.03	93.41
46	96.30	93.80	67.41	28.14	95.55	53.93	41.27	95.20	64.52	30.95	95.48
48	98.10	96.80	68.67	29.04	97.71	54.94	42.59	97.53	65.73	31.94	97.67
50	100.00	100.00	70.00	30.00	100.00	56.00	44.00	100.00	67.00	33.00	100.00
52	102.00	103.40	71.40	31.02	102.42	57.12	45.50	102.62	68.34	34.12	102.46
54	104.10	107.00	72.87	32.10	104.97	58.30	47.08	105.38	69.75	35.31	105.06
56	106.30	110.80	74.41	33.24	107.65	59.53	48.75	108.28	71.22	36.56	107.79
58	108.60	114.70	76.02	34.41	110.43	60.82	50.47	111.28	72.76	37.85	110.61
60	111.00	118.70	77.70	35.61	113.31	62.16	52.23	114.39	74.37	39.17	113.54
62	113.50	122.90	79.45	36.87	116.32	63.56	54.08	117.64	76.05	40.56	116.60
64	116.10	127.30	81.27	38.19	119.46	65.02	56.01	121.03	77.79	42.01	119.80
66	118.80	131.90	83.16	39.57	122.73	66.53	58.04	124.56	79.60	43.53	123.12
68	121.60	136.70	85.12	41.01	126.13	68.10	60.15	128.24	81.47	45.11	126.58
70	124.50	141.70	87.15	42.51	129.66	69.72	62.35	132.07	83.42	46.76	130.18
72	127.50	147.10	89.25	44.13	133.38	71.40	64.72	136.12	85.43	48.54	133.97

Summary of Weighted Composite S-Graph

	#56	#57	Basin SV-200			Basin WT-130			Basin WT-100		
% Q_{ult}	Phx-V	Phx-M	70% V	30% M	70%V+30%M	56% V	44%M	56%V+44%M	67% V	33%M	67%V+33%M
74	130.70	152.80	91.49	45.84	137.33	73.19	67.23	140.42	87.57	50.42	137.99
76	134.10	158.80	93.87	47.64	141.51	75.10	69.87	144.97	89.85	52.40	142.25
78	137.70	165.50	96.39	49.65	146.04	77.11	72.82	149.93	92.26	54.62	146.87
80	141.50	172.90	99.05	51.87	150.92	79.24	76.08	155.32	94.81	57.06	151.86
82	145.50	181.60	101.85	54.48	156.33	81.48	79.90	161.38	97.49	59.93	157.41
84	149.90	191.00	104.93	57.30	162.23	83.94	84.04	167.98	100.43	63.03	163.46
86	154.60	201.00	108.22	60.30	168.52	86.58	88.44	175.02	103.58	66.33	169.91
88	159.60	212.00	111.72	63.60	175.32	89.38	93.28	182.66	106.93	69.96	176.89
90	165.60	226.00	115.92	67.80	183.72	92.74	99.44	192.18	110.95	74.58	185.53
92	173.60	244.00	121.52	73.20	194.72	97.22	107.36	204.58	116.31	80.52	196.83
94	186.60	265.00	130.62	79.50	210.12	104.50	116.60	221.10	125.02	87.45	212.47
96	200.60	295.00	140.42	88.50	228.92	112.34	129.80	242.14	134.40	97.35	231.75
98	223.60	342.00	156.52	102.60	259.12	125.22	150.48	275.70	149.81	112.86	262.67
100	298.60	462.00	209.02	138.60	347.62	167.22	203.28	370.50	200.06	152.46	352.52

Basin SV-200

	Sq. Mi	Wtd Area (%)
Mountain Area	9.340	30
Valley Area	21.980	70
Total Area	31.320	100

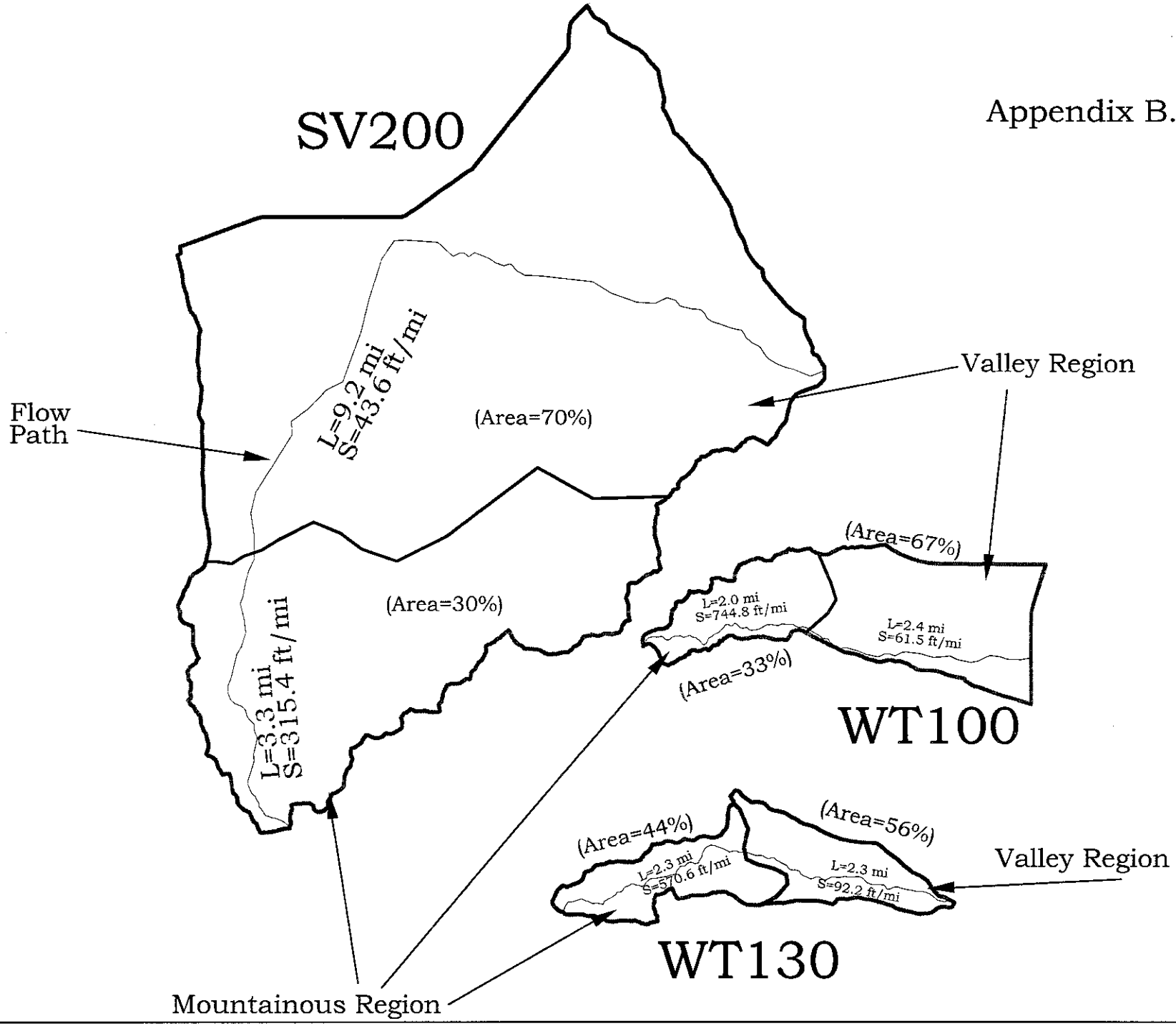
Basin WT-130

	Sq. Mi	Wtd Area (%)
Mountain Area	1.284	44
Valley Area	1.626	56
Total Area	2.910	100

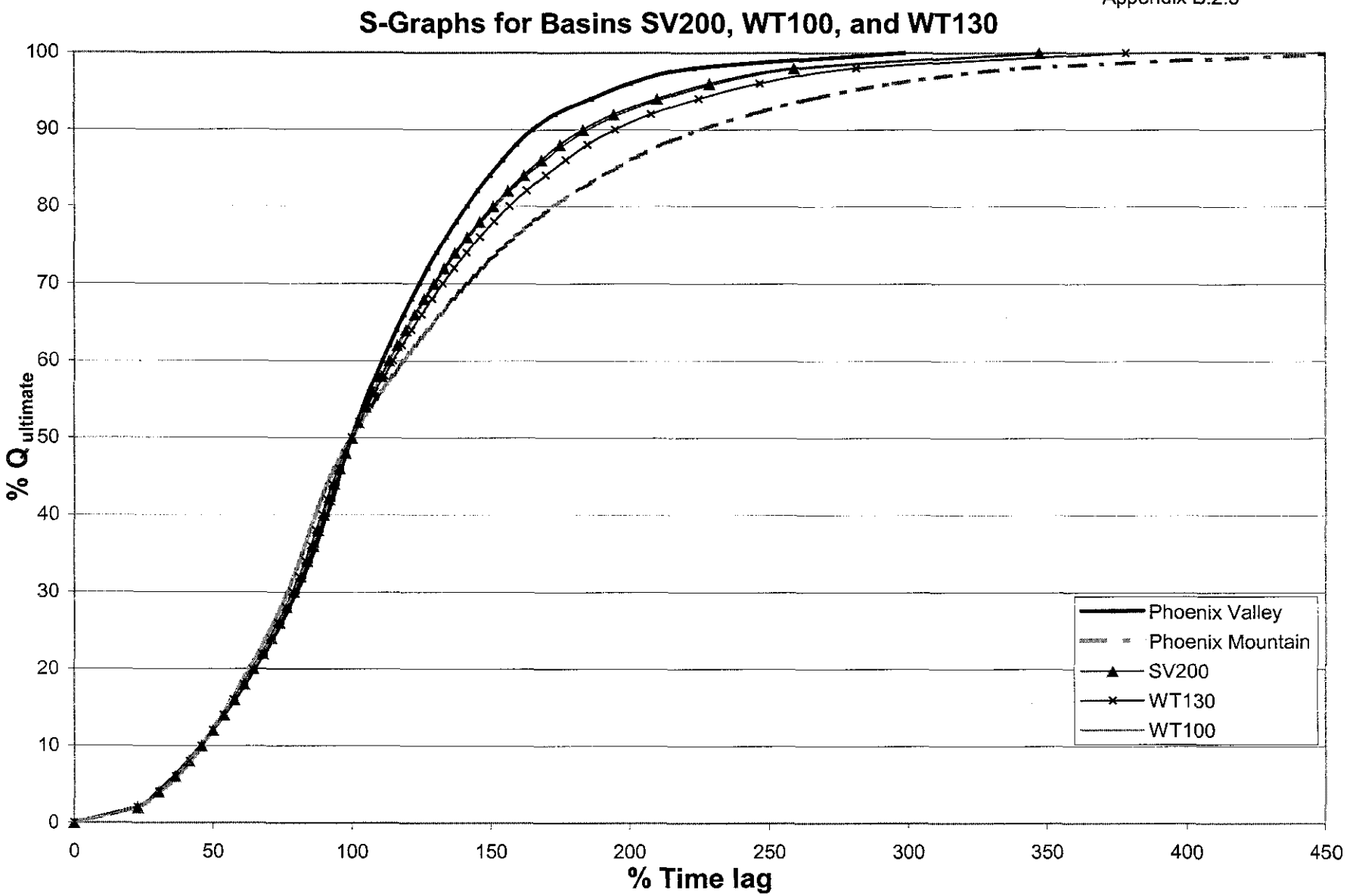
Basin WT-100

	Sq. Mi	Wtd Area (%)
Mountain Area	1.256	33
Valley Area	2.590	67
Total Area	3.846	100

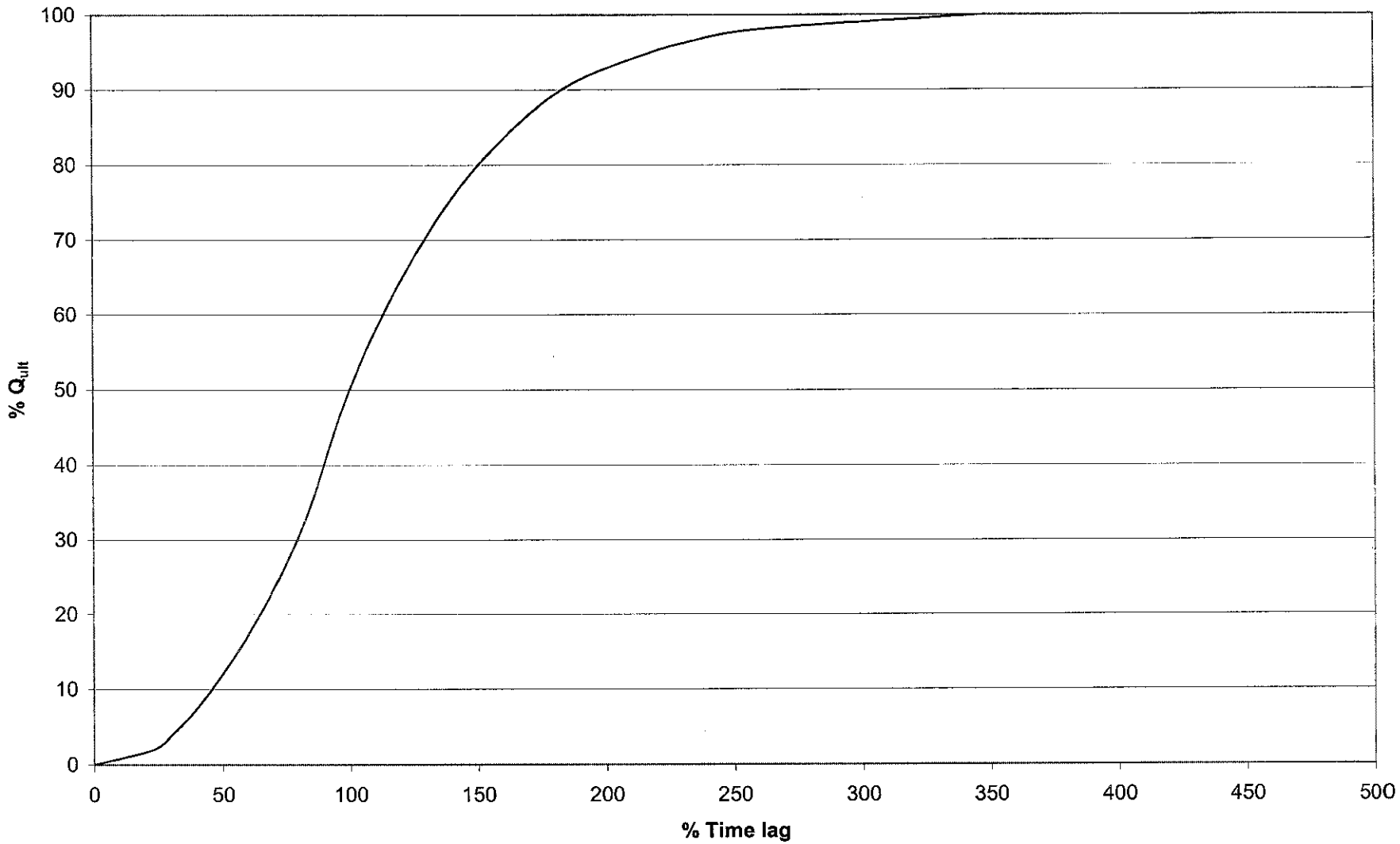
Appendix B.2.3



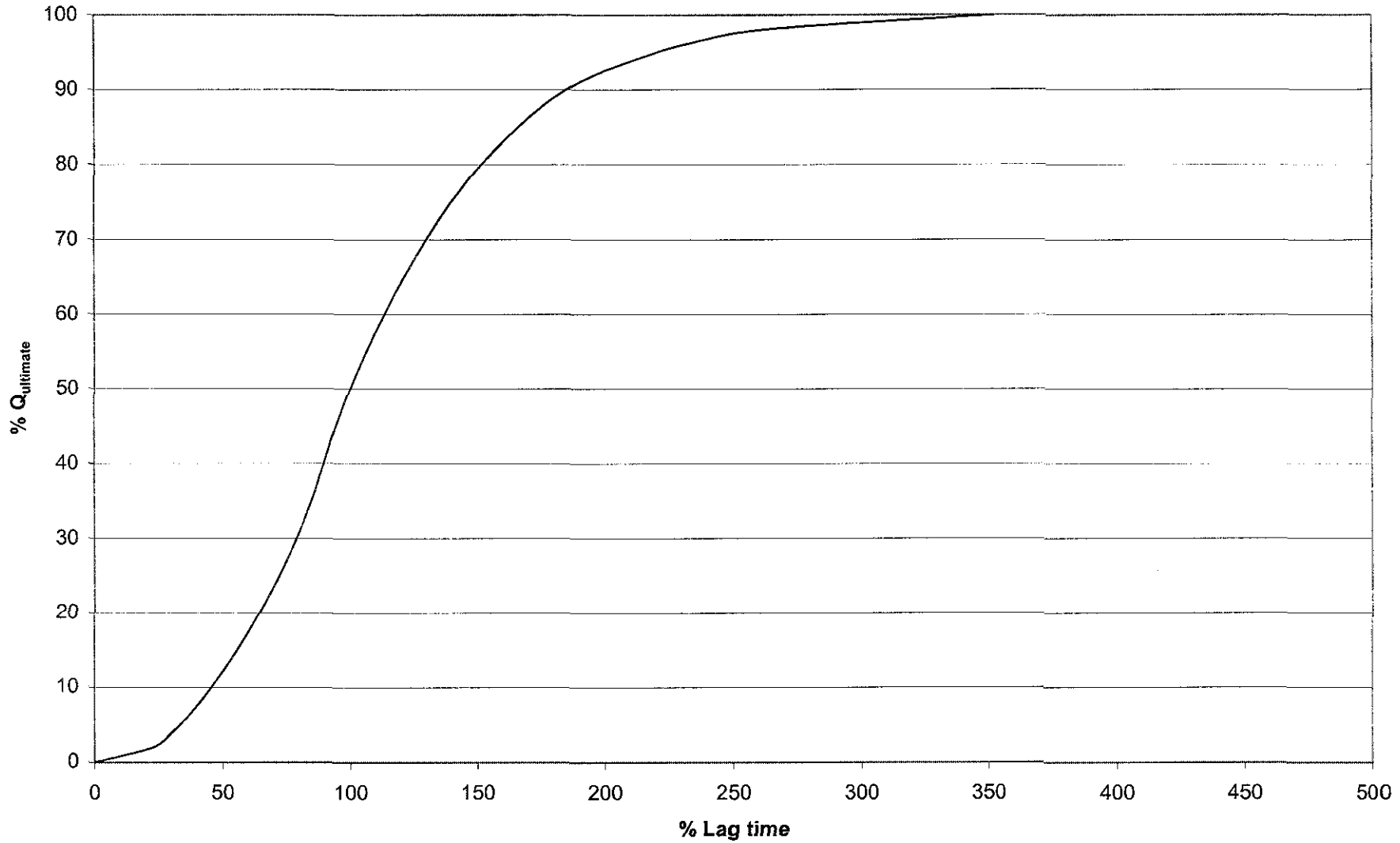
Appendix B.2.3



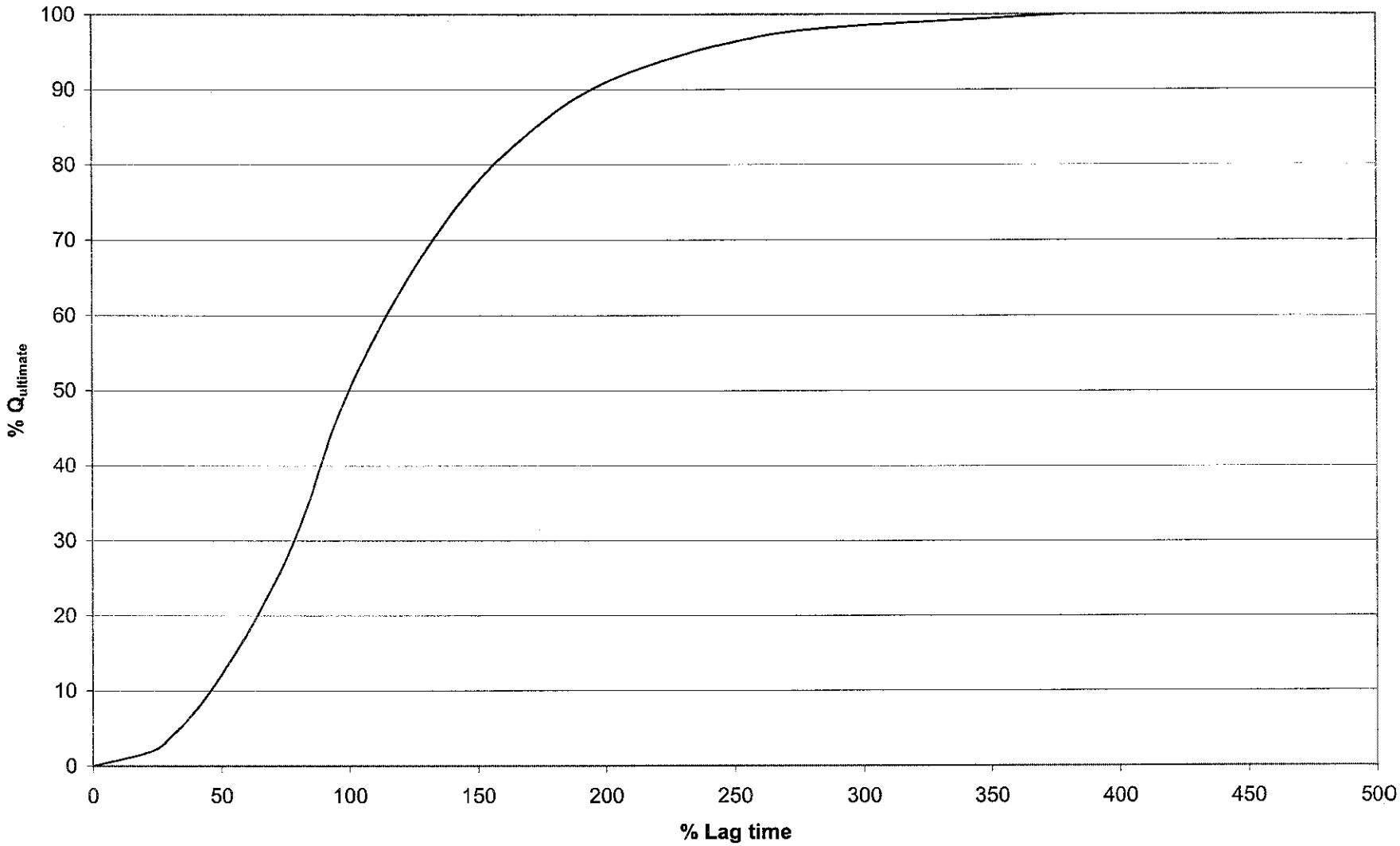
Composite S-Curve for Basin SV200



Composite S-Graph for Basin WT100



Composite S-Graph for Basin WT130



100-yr, 200-yr, and 500-yr S-graphs

Entellus

CLIENT: FCDMC

JOB: Wittmann ADMSU **JOB NO.** 310.032

S-Graph and Unit Graph Generation

The following process was utilized to compute the Composite S-graphs

1.) Compute Area and Basin Lag
2.) Compute Q_{ult} by the following equation

$$Q_{ult} = \frac{645.33 * A}{D}$$

where: Q_{ult} = Ultimate Discharge (cfs)
A = Drainage Area (mi^2)
D = Duration of rainfall excess

3.) Calculate % Lag from Phoenix Mountain and Phoenix Valley S-graphs
4.) Construct table using % Q_{ult}, Discharge, % Lag and Time
5.) Transform S-Graph into a 15-min Unit Hydrograph through linear interpolation
6.) Construct UI Cards

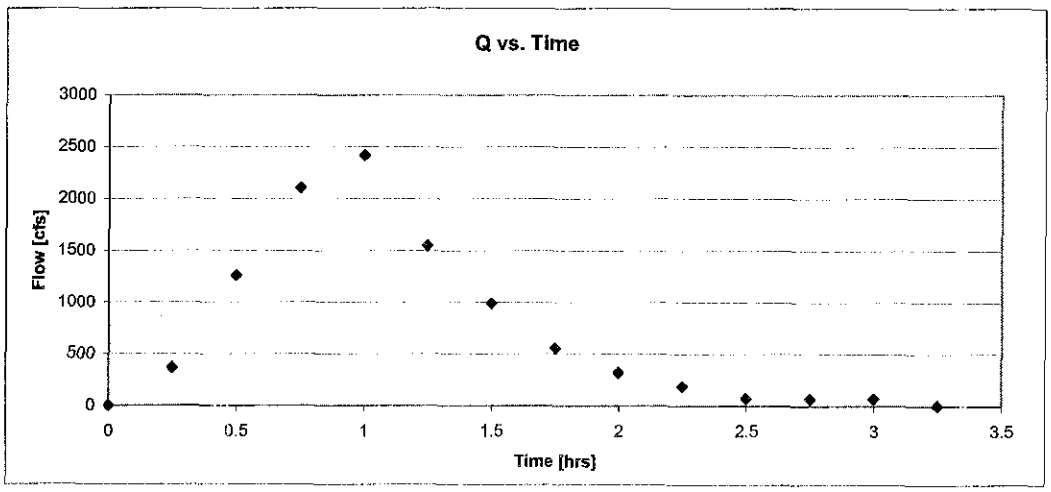
Entellus

BY	RAS	DATE	3/24/2004
CLIENT:	FCDMC		
JOB NO.	310.032		
JOB:	Wittmann ADMSU		

S-Graph Parameters for 100, 200, 500-yr 24-hr Storm Events

Basin Name	WT100	
Basin Area [sq mi]	3.84	
Basin Lag [hr]	0.86	
Time Step [min]	15	
Time Step [hr]	0.2500	
Q_{ult}	9925	
S-Graph Type	Combined	Percent
	Phoenix Valley	67%
	Phoenix Mountain	33%
	Desert/Rangeland	0%
	Agricultural	0%
		100%

```
UI AND COMMENT CARDS
* Combined S-Graph for Basin WT100: Phoenix Valley:67%, Phoenix Mountain:33%
* Basin Area [sq mi] = 3.8448
* Basin Lag [hr] = 0.86
* Time Step [min] = 15
* Qult = 9924.7
*
UI     0   362.9  1255.2  2098.8  2415.5  1543.4   987.6   551.8   317.7   186.6
UI  68.6    64.2    64.2       0
```



Entellus

BY RAS DATE 3/24/2004

CLIENT: FCDMC

JOB NO. 310.032

JOB: Wittmann ADMSU

S-Graph Parameters for 100, 200, 500-yr 24-hr Storm Events

WT100

Time (hrs)	Time (min)	% Q_{ult}	Q	% Lag Combined
0.00000	0.00	0	0	0.00
0.19780	11.87	2	198	23.00
0.26084	15.65	4	397	30.33
0.31244	18.75	6	595	36.33
0.35544	21.33	8	794	41.33
0.39387	23.63	10	992	45.80
0.42943	25.77	12	1191	49.93
0.46327	27.80	14	1389	53.87
0.49539	29.72	16	1588	57.60
0.52580	31.55	18	1786	61.14
0.55476	33.29	20	1985	64.51
0.58229	34.94	22	2183	67.71
0.60838	36.50	24	2382	70.74
0.63361	38.02	26	2580	73.68
0.65770	39.46	28	2779	76.48
0.68007	40.80	30	2977	79.08
0.70100	42.06	32	3176	81.51
0.72022	43.21	34	3374	83.75
0.73857	44.31	36	3573	85.88
0.75433	45.26	38	3771	87.71
0.77126	46.28	40	3970	89.68
0.78730	47.24	42	4168	91.55
0.80334	48.20	44	4367	93.41
0.82109	49.27	46	4565	95.48
0.83997	50.40	48	4764	97.67
0.86000	51.60	50	4962	100.00
0.88117	52.87	52	5161	102.46
0.90349	54.21	54	5359	105.06
0.92695	55.62	56	5558	107.79
0.95127	57.08	58	5756	110.61
0.97645	58.59	60	5955	113.54
1.00278	60.17	62	6153	116.60
1.03025	61.81	64	6352	119.80
1.05886	63.53	66	6550	123.12
1.08861	65.32	68	6749	126.58
1.11951	67.17	70	6947	130.18
1.15212	69.13	72	7146	133.97
1.18674	71.20	74	7344	137.99
1.22336	73.40	76	7543	142.25
1.26312	75.79	78	7741	146.87
1.30601	78.36	80	7940	151.86
1.35375	81.23	82	8138	157.41
1.40578	84.35	84	8337	163.46
1.46124	87.67	86	8535	169.91
1.52127	91.28	88	8734	176.89
1.59558	95.73	90	8932	185.53
1.69276	101.57	92	9131	196.83
1.82726	109.64	94	9329	212.47
1.99307	119.58	96	9528	231.75
2.25898	135.54	98	9726	262.67
3.03169	181.90	100	9925	352.52

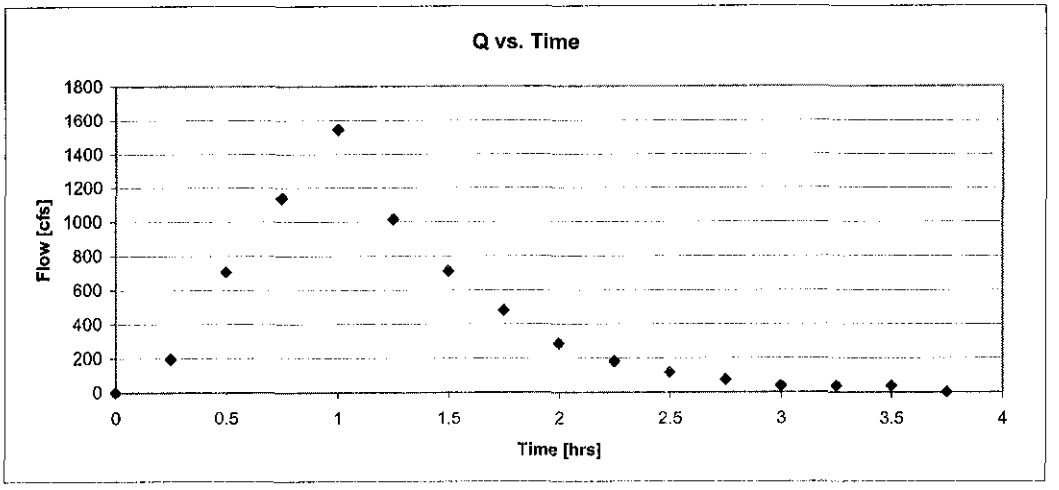
Entellus

BY	RAS	DATE	3/24/2004
CLIENT:	FCDMC		
JOB NO.	310.032		
JOB:	Wittmann ADMSU		

S-Graph Parameters for 100, 200, 500-yr 24-hr Storm Events

Basin Name	WT130	
Basin Area [sq mi]	2.54	
Basin Lag [hr]	0.94	
Time Step [min]	15	
Time Step [hr]	0.2500	
Q_{ult}	6560	
S-Graph Type	Combined	Percent
	Phoenix Valley	51%
	Phoenix Mountain	49%
	Desert/Rangeland	0%
	Agricultural	0%
		100%

```
UI AND COMMENT CARDS
* Combined S-Graph for Basin WT130: Phoenix Valley:51%, Phoenix Mountain:49%
* Basin Area [sq mi] = 2.5413
* Basin Lag [hr] = 0.94
* Time Step [min] = 15
* Qult = 6559.9
*
UI     0   194.2     705  1137.3  1543.8  1013.3   710.4   480.7   286.8   181.2
UI 117.1    73.9      36      36      36       0
```



Entellus

BY RAS DATE 3/24/2004

CLIENT: FCDMC

JOB NO. 310.032

JOB: Wittmann ADMSU

S-Graph Parameters for 100, 200, 500-yr 24-hr Storm Events

WT130

Time (hrs)	Time (min)	% Q_{out}	Q	% Lag Combined
0.00000	0.00	0	0	0.00
0.21620	12.97	2	131	23.00
0.28661	17.20	4	262	30.49
0.34301	20.58	6	394	36.49
0.39001	23.40	8	525	41.49
0.43096	25.86	10	656	45.85
0.46908	28.14	12	787	49.90
0.50532	30.32	14	918	53.76
0.53967	32.38	16	1050	57.41
0.57215	34.33	18	1181	60.87
0.60321	36.19	20	1312	64.17
0.63285	37.97	22	1443	67.32
0.66106	39.66	24	1574	70.33
0.68834	41.30	26	1706	73.23
0.71422	42.85	28	1837	75.98
0.73822	44.29	30	1968	78.53
0.76080	45.65	32	2099	80.94
0.78150	46.89	34	2230	83.14
0.80126	48.08	36	2362	85.24
0.81864	49.12	38	2493	87.09
0.83653	50.19	40	2624	88.99
0.85438	51.26	42	2755	90.89
0.87266	52.36	44	2886	92.84
0.89371	53.62	46	3018	95.08
0.91615	54.97	48	3149	97.46
0.94000	56.40	50	3280	100.00
0.96525	57.91	52	3411	102.69
0.99190	59.51	54	3542	105.52
1.01995	61.20	56	3674	108.51
1.04894	62.94	58	3805	111.59
1.07887	64.73	60	3936	114.77
1.11020	66.61	62	4067	118.11
1.14293	68.58	64	4198	121.59
1.17706	70.62	66	4330	125.22
1.21259	72.76	68	4461	129.00
1.24952	74.97	70	4592	132.93
1.28878	77.33	72	4723	137.10
1.33037	79.82	74	4854	141.53
1.37431	82.46	76	4986	146.20
1.42243	85.35	78	5117	151.32
1.47473	88.48	80	5248	156.89
1.53398	92.04	82	5379	163.19
1.59837	95.90	84	5510	170.04
1.66696	100.02	86	5642	177.34
1.74159	104.50	88	5773	185.28
1.83484	110.09	90	5904	195.20
1.95610	117.37	92	6035	208.10
2.11515	126.91	94	6166	225.02
2.32045	139.23	96	6298	246.86
2.64719	158.83	98	6429	281.62
3.55946	213.57	100	6560	378.67

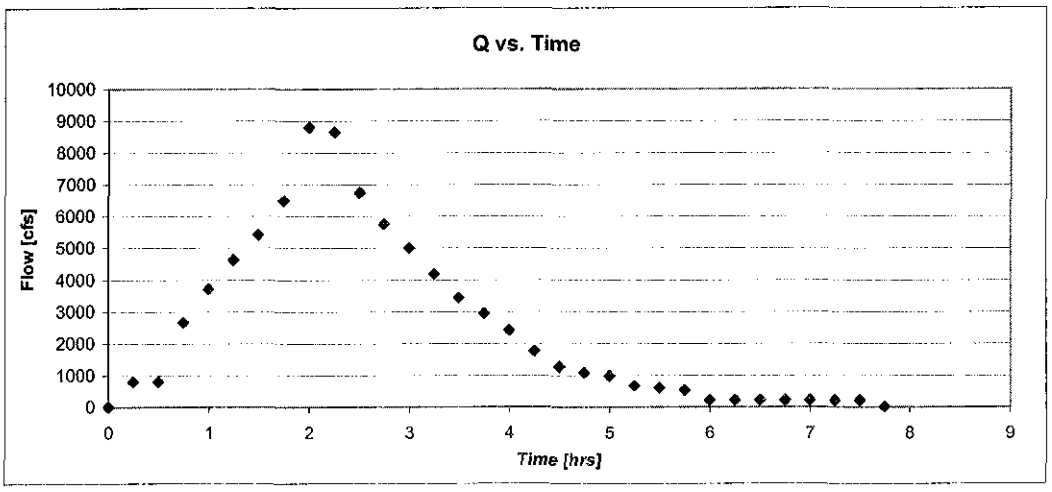
Entellus

BY	RAS	DATE	3/24/2004
CLIENT:	FCDMC		
JOB NO.	310.032		
JOB:	Wittmann ADMSU		

S-Graph Parameters for 100, 200, 500-yr 24-hr Storm Events

Basin Name	SV200	
Basin Area [sq mi]	31.33	
Basin Lag [hr]	2.20	
Time Step [min]	15	
Time Step [hr]	0.2500	
Q_{ult}	80862	
S-Graph Type	Combined	Percent
	Phoenix Valley	70%
	Phoenix Mountain	30%
	Desert/Rangeland	0%
	Agricultural	0%
		100%

```
UI AND COMMENT CARDS
* Combined S-Graph for Basin SV200: Phoenix Valley:70%, Phoenix Mountain:30%
* Basin Area [sq mi] = 31.326
* Basin Lag [hr] = 2.2
* Time Step [min] = 15
* Qult = 80862.4
*
UI      0     799     799  2658.2  3709.1  4618.2  5419.9  6497.5  8799.7  8649.4
UI6742.8  5756.1  4993.6  4189.3  3432.1  2937.8  2408.2  1757.3    1258  1083.4
UI 977.5     662   608.5   529.4   207.7   207.7   207.7   207.7   207.7   207.7
UI 207.7       0
```



Entellus

BY RAS DATE 3/24/2004

CLIENT: FCDMC

JOB NO. 310.032

JOB: Wittmann ADMSU

S-Graph Parameters for 100, 200, 500-yr 24-hr Storm Events

SV200

Time (hrs)	Time (min)	% Q_{ult}	Q	% Lag Combined
0.00000	0.00	0	0	0.00
0.50600	30.36	2	1617	23.00
0.66660	40.00	4	3234	30.30
0.79860	47.92	6	4852	36.30
0.90860	54.52	8	6469	41.30
1.00738	60.44	10	8086	45.79
1.09868	65.92	12	9703	49.94
1.18558	71.13	14	11321	53.89
1.26808	76.08	16	12938	57.64
1.34618	80.77	18	14555	61.19
1.42054	85.23	20	16172	64.57
1.49116	89.47	22	17790	67.78
1.55804	93.48	24	19407	70.82
1.62272	97.36	26	21024	73.76
1.68454	101.07	28	22641	76.57
1.74196	104.52	30	24259	79.18
1.79564	107.74	32	25876	81.62
1.84492	110.70	34	27493	83.86
1.89200	113.52	36	29110	86.00
1.93226	115.94	38	30728	87.83
1.97582	118.55	40	32345	89.81
2.01674	121.00	42	33962	91.67
2.05744	123.45	44	35579	93.52
2.10210	126.13	46	37197	95.55
2.14962	128.98	48	38814	97.71
2.20000	132.00	50	40431	100.00
2.25324	135.19	52	42048	102.42
2.30934	138.56	54	43666	104.97
2.36830	142.10	56	45283	107.65
2.42946	145.77	58	46900	110.43
2.49282	149.57	60	48517	113.31
2.55904	153.54	62	50135	116.32
2.62812	157.69	64	51752	119.46
2.70006	162.00	66	53369	122.73
2.77486	166.49	68	54986	126.13
2.85252	171.15	70	56604	129.66
2.93436	176.06	72	58221	133.38
3.02126	181.28	74	59838	137.33
3.11322	186.79	76	61455	141.51
3.21288	192.77	78	63073	146.04
3.32024	199.21	80	64690	150.92
3.43926	206.36	82	66307	156.33
3.56906	214.14	84	67924	162.23
3.70744	222.45	86	69542	168.52
3.85704	231.42	88	71159	175.32
4.04184	242.51	90	72776	183.72
4.28384	257.03	92	74393	194.72
4.62264	277.36	94	76011	210.12
5.03624	302.17	96	77628	228.92
5.70064	342.04	98	79245	259.12
7.64764	458.86	100	80862	347.62

6-hr and 72-hr S-graphs

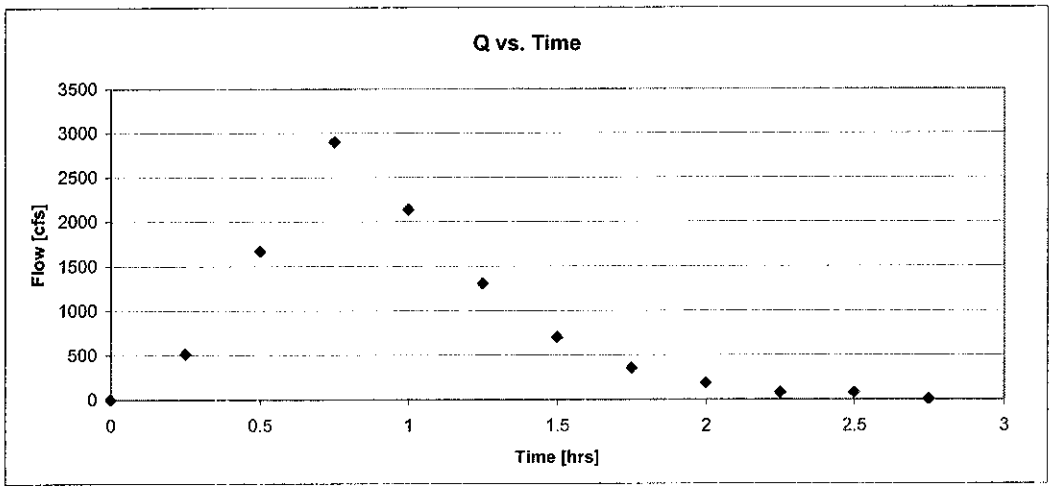
Entellus

BY	RAS	DATE	3/24/2004
CLIENT:	FCDMC		
JOB NO.	310.032		
JOB:	Wittmann ADMSU		

S-Graph Parameters for 6-hr and 72-hr Storm Events

Basin Name	WT100 PMP	
Basin Area [sq mi]	3.84	
Basin Lag [hr]	0.74	
Time Step [min]	15	
Time Step [hr]	0.2500	
Q_{ult}	9925	
S-Graph Type	Combined	Percent
	Phoenix Valley	67%
	Phoenix Mountain	33%
	Desert/Rangeland	0%
	Agricultural	0%
		100%

```
UI AND COMMENT CARDS
* Combined S-Graph for Basin WT100 PMP: Phoenix Valley:67%, Phoenix Mountain:33%
* Basin Area [sq mi] = 3.8448
* Basin Lag [hr] = 0.74
* Time Step [min] = 15
* Qult = 9924.7
*
UI     0   511.2  1663.5  2896.6    2132  1301.3   700.6   352.9   184.9    74.6
UI  74.6       0
```



Entellus

BY RAS **DATE** 3/24/2004

CLIENT: FCDMC

JOB NO. 310.032

JOB: Wittmann ADMSU

S-Graph Parameters for 6-hr and 72-hr Storm Events

WT100 PMP

Time (hrs)	Time (min)	% Q_{ult}	Q	% Lag Combined
0.00000	0.00	0	0	0.00
0.17020	10.21	2	198	23.00
0.22444	13.47	4	397	30.33
0.26884	16.13	6	595	36.33
0.30584	18.35	8	794	41.33
0.33891	20.33	10	992	45.80
0.36951	22.17	12	1191	49.93
0.39863	23.92	14	1389	53.87
0.42627	25.58	16	1588	57.60
0.45243	27.15	18	1786	61.14
0.47735	28.64	20	1985	64.51
0.50104	30.06	22	2183	67.71
0.52349	31.41	24	2382	70.74
0.54520	32.71	26	2580	73.68
0.56593	33.96	28	2779	76.48
0.58518	35.11	30	2977	79.08
0.60319	36.19	32	3176	81.51
0.61972	37.18	34	3374	83.75
0.63551	38.13	36	3573	85.88
0.64908	38.94	38	3771	87.71
0.66364	39.82	40	3970	89.68
0.67745	40.65	42	4168	91.55
0.69125	41.47	44	4367	93.41
0.70652	42.39	46	4565	95.48
0.72277	43.37	48	4764	97.67
0.74000	44.40	50	4962	100.00
0.75822	45.49	52	5161	102.46
0.77742	46.65	54	5359	105.06
0.79761	47.86	56	5558	107.79
0.81854	49.11	58	5756	110.61
0.84020	50.41	60	5955	113.54
0.86285	51.77	62	6153	116.60
0.88649	53.19	64	6352	119.80
0.91111	54.67	66	6550	123.12
0.93671	56.20	68	6749	126.58
0.96330	57.80	70	6947	130.18
0.99136	59.48	72	7146	133.97
1.02115	61.27	74	7344	137.99
1.05266	63.16	76	7543	142.25
1.08687	65.21	78	7741	146.87
1.12378	67.43	80	7940	151.86
1.16486	69.89	82	8138	157.41
1.20963	72.58	84	8337	163.46
1.25735	75.44	86	8535	169.91
1.30900	78.54	88	8734	176.89
1.37294	82.38	90	8932	185.53
1.45656	87.39	92	9131	196.83
1.57229	94.34	94	9329	212.47
1.71496	102.90	96	9528	231.75
1.94377	116.63	98	9726	262.67
2.60866	156.52	100	9925	352.52

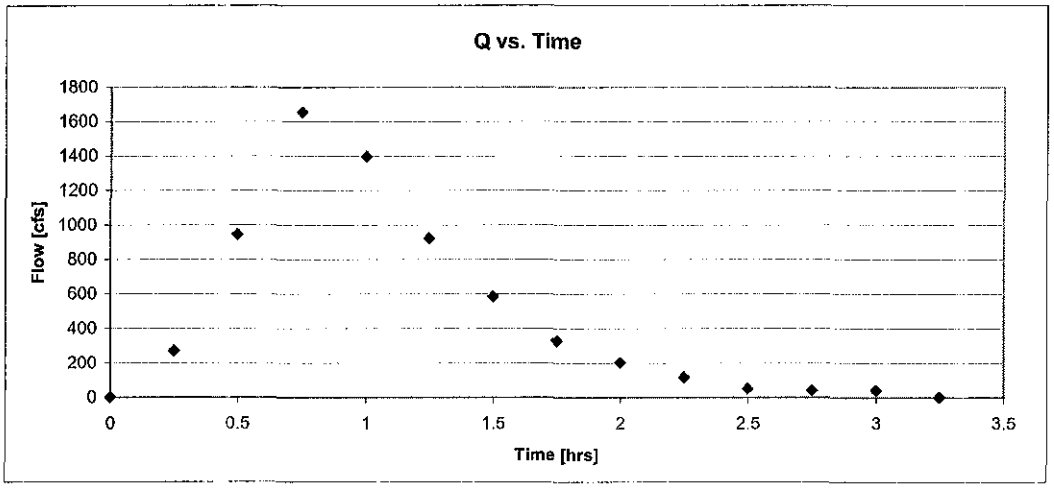
Entellus

BY	RAS	DATE	3/24/2004
CLIENT:	FCDMC		
JOB NO.	310.032		
JOB:	Wittmann ADMSU		

S-Graph Parameters for 6-hr and 72-hr Storm Events

Basin Name	WT130 PMP	
Basin Area [sq mi]	2.54	
Basin Lag [hr]	0.81	
Time Step [min]	15	
Time Step [hr]	0.2500	
Q_{ult}	6560	
S-Graph Type	Combined	Percent
	Phoenix Valley	51%
	Phoenix Mountain	49%
	Desert/Rangeland	0%
	Agricultural	0%
		100%

```
UI AND COMMENT CARDS
* Combined S-Graph for Basin WT130 PMP: Phoenix Valley:51%, Phoenix Mountain:49%
* Basin Area [sq mi] = 2.5413
* Basin Lag [hr] = 0.81
* Time Step [min] = 15
* Qult = 6559.9
*
UI     0   270.6   944.4    1655  1395.9   921.6   583.8   325.6   200.9   116.5
UI    51    41.7    41.7       0
```



Entellus

BY RAS DATE 3/24/2004

CLIENT: FCDMC

JOB NO. 310.032

JOB: Wittmann ADMSU

S-Graph Parameters for 6-hr and 72-hr Storm Events

WT130 PMP

Time (hrs)	Time (min)	% Quit	Q	% Lag Combined
0.00000	0.00	0	0	0.00
0.18630	11.18	2	131	23.00
0.24697	14.82	4	262	30.49
0.29557	17.73	6	394	36.49
0.33607	20.16	8	525	41.49
0.37136	22.28	10	656	45.85
0.40421	24.25	12	787	49.90
0.43543	26.13	14	918	53.76
0.46504	27.90	16	1050	57.41
0.49302	29.58	18	1181	60.87
0.51979	31.19	20	1312	64.17
0.54532	32.72	22	1443	67.32
0.56964	34.18	24	1574	70.33
0.59315	35.59	26	1706	73.23
0.61545	36.93	28	1837	75.98
0.63613	38.17	30	1968	78.53
0.65558	39.33	32	2099	80.94
0.67342	40.41	34	2230	83.14
0.69044	41.43	36	2362	85.24
0.70542	42.33	38	2493	87.09
0.72084	43.25	40	2624	88.99
0.73622	44.17	42	2755	90.89
0.75197	45.12	44	2886	92.84
0.77011	46.21	46	3018	95.08
0.78945	47.37	48	3149	97.46
0.81000	48.60	50	3280	100.00
0.83176	49.91	52	3411	102.69
0.85472	51.28	54	3542	105.52
0.87889	52.73	56	3674	108.51
0.90387	54.23	58	3805	111.59
0.92966	55.78	60	3936	114.77
0.95666	57.40	62	4067	118.11
0.98486	59.09	64	4198	121.59
1.01427	60.86	66	4330	125.22
1.04489	62.69	68	4461	129.00
1.07672	64.60	70	4592	132.93
1.11054	66.63	72	4723	137.10
1.14638	68.78	74	4854	141.53
1.18424	71.05	76	4986	146.20
1.22571	73.54	78	5117	151.32
1.27078	76.25	80	5248	156.89
1.32183	79.31	82	5379	163.19
1.37732	82.64	84	5510	170.04
1.43642	86.19	86	5642	177.34
1.50074	90.04	88	5773	185.28
1.58109	94.87	90	5904	195.20
1.68558	101.13	92	6035	208.10
1.82263	109.36	94	6166	225.02
1.99953	119.97	96	6298	246.86
2.28109	136.87	98	6429	281.62
3.06719	184.03	100	6560	378.67

Entellus

BY RAS DATE 3/24/2004

CLIENT: FCDMC

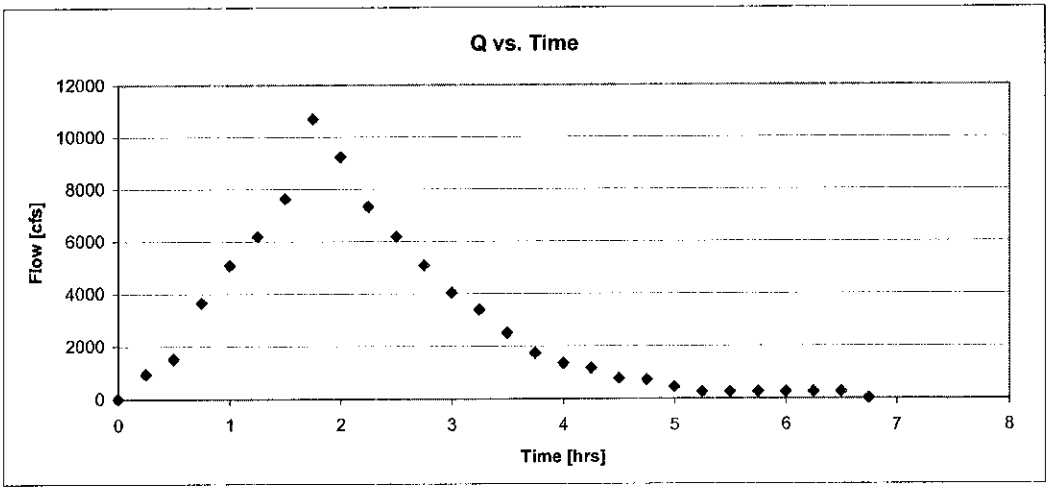
JOB NO. 310.032

JOB: Wittmann ADMSU

S-Graph Parameters for 6-hr and 72-hr Storm Events

Basin Name	SV200 PMP	
Basin Area [sq mi]	31.33	
Basin Lag [hr]	1.87	
Time Step [min]	15	
Time Step [hr]	0.2500	
Q_{ult}	80862	
S-Graph Type	Combined	Percent
	Phoenix Valley	70%
	Phoenix Mountain	30%
	Desert/Rangeland	0%
	Agricultural	0%
		100%

```
UI AND COMMENT CARDS
* Combined S-Graph for Basin SV200 PMP: Phoenix Valley:70%, Phoenix Mountain:30%
* Basin Area [sq mi] = 31.326
* Basin Lag [hr] = 1.87
* Time Step [min] = 15
* Qult = 80862.4
*
UI      0     940  1505.3  3637.7  5068.1  6167.4  7625.4 10685.6  9232.1    7316
UI6170.1  5062.5  4020.1  3366.2  2486.1  1721.3  1332.1  1150.1   769.4   715.9
UI 424.5   244.3   244.3   244.3   244.3   244.3   244.3       0
```



Entellus

BY RAS DATE 3/24/2004

CLIENT: FCDMC

JOB NO. 310.032

JOB: Wittmann ADMSU

S-Graph Parameters for 6-hr and 72-hr Storm Events

SV200 PMP

Time (hrs)	Time (min)	% Q_{ult}	Q	% Lag Combined
0.00000	0.00	0	0	0.00
0.43010	25.81	2	1617	23.00
0.56661	34.00	4	3234	30.30
0.67881	40.73	6	4852	36.30
0.77231	46.34	8	6469	41.30
0.85627	51.38	10	8086	45.79
0.93388	56.03	12	9703	49.94
1.00774	60.46	14	11321	53.89
1.07787	64.67	16	12938	57.64
1.14425	68.66	18	14555	61.19
1.20746	72.45	20	16172	64.57
1.26749	76.05	22	17790	67.78
1.32433	79.46	24	19407	70.82
1.37931	82.76	26	21024	73.76
1.43186	85.91	28	22641	76.57
1.48067	88.84	30	24259	79.18
1.52629	91.58	32	25876	81.62
1.56818	94.09	34	27493	83.86
1.60820	96.49	36	29110	86.00
1.64242	98.55	38	30728	87.83
1.67945	100.77	40	32345	89.81
1.71423	102.85	42	33962	91.67
1.74882	104.93	44	35579	93.52
1.78679	107.21	46	37197	95.55
1.82718	109.63	48	38814	97.71
1.87000	112.20	50	40431	100.00
1.91525	114.92	52	42048	102.42
1.96294	117.78	54	43666	104.97
2.01306	120.78	56	45283	107.65
2.06504	123.90	58	46900	110.43
2.11890	127.13	60	48517	113.31
2.17518	130.51	62	50135	116.32
2.23390	134.03	64	51752	119.46
2.29505	137.70	66	53369	122.73
2.35863	141.52	68	54986	126.13
2.42464	145.48	70	56604	129.66
2.49421	149.65	72	58221	133.38
2.56807	154.08	74	59838	137.33
2.64624	158.77	76	61455	141.51
2.73095	163.86	78	63073	146.04
2.82220	169.33	80	64690	150.92
2.92337	175.40	82	66307	156.33
3.03370	182.02	84	67924	162.23
3.15132	189.08	86	69542	168.52
3.27848	196.71	88	71159	175.32
3.43556	206.13	90	72776	183.72
3.64126	218.48	92	74393	194.72
3.92924	235.75	94	76011	210.12
4.28080	256.85	96	77628	228.92
4.84554	290.73	98	79245	259.12
6.50049	390.03	100	80862	347.62

B.2.4. Hydraulic length and slope

APPENDIX B.2.4

Entellus

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BY	JCS	DATE	12/10/2003
CHECK	RAS	DATE	12/10/2003
JOB NO.	310.032		

CLIENT: FCDMC

JOB: Wittmann Area Drainage Master Study Update

Wittmann ADMSU: McMicken Dam Hydrology
Basin Hydraulic Length Summary

	Basin ID	Basin Area (sqmiles)	Time of Concentration Length (ft)	Time of Concentration Length (miles)	U/S Elev. (ft)	D/S Elev. (ft)	Slope (ft/mile)	Slope (ft/ft)
	IW310	25.8	85390	16.2	2450	1550	55.7	0.011
	IW350	4.2	25490	4.8	3380	2260	232.0	0.044
	PD700	7.3	27040	5.1	1540	1310	44.9	0.009
	PD710	6.7	32593	6.2	1545.8	1314.3	37.5	0.007
	PD730	0.5	5020	1.0	1810	1540	284.0	0.054
	PD735	3.2	23890	4.5	2170	1540	139.2	0.026
	PD740	0.9	6450	1.2	1800	1540	212.8	0.040
	PD745	2.0	14130	2.7	2170	1540	235.4	0.045
	PD760	2.7	16900	3.2	2320	1550	240.6	0.046
	PD780	19.2	50820	9.6	2850.4	1669.7	122.7	0.023
	PI600	12.0	31880	6.0	1540	1320	36.4	0.007
	PI640	17.6	52172	9.9	2305	1544	77.0	0.015
	PI680	16.9	48990	9.3	4200	2190	216.6	0.041
*	SV200	31.3	65958	12.5	2860	1415	115.7	0.022
	SV220	17.0	44850	8.5	1830	1540	34.1	0.006
	TW400	13.0	40010	7.6	1560	1340	29.0	0.005
	TW420	10.9	54410	10.3	2080	1550	51.4	0.010
	TW460	2.4	18660	3.5	2435	2070	103.3	0.020
	TW480	12.7	48570	9.2	4190	2400	194.6	0.037
	WI500	9.2	35147	6.7	1545.4	1343.6	30.3	0.006
	WI505	6.7	27252	5.2	1541.4	1351.7	36.8	0.007
	WI510	9.3	42795	8.1	1555.4	1336.3	27.0	0.005
	WI520	16.4	69440	13.2	3150	1550	121.7	0.023
	WI540	11.6	56740	10.7	2430	1550	81.9	0.016
	WI580	30.3	77820	14.7	2670	1550	76.0	0.014
*	WT100	3.8	23406	4.4	3000	1365	368.8	0.070
	WT110	2.9	21030	4.0	2440	1340	276.2	0.052
	WT120	2.8	18937	3.6	2020	1340	189.6	0.036
*	WT130	2.5	24389	4.6	2870	1350	329.1	0.062
	WT140	3.8	29050	5.5	3770	1605	393.5	0.075
	WT150	5.8	37010	7.0	3790	1535	321.7	0.061
	WT160	0.8	14290	2.7	2940	1545	515.4	0.098

* For the S-Graph computations these basins were divided into Mountain and Valley regions

B.2.5. WMS Green and Ampt Verification

APPENDIX B.2.5

Entellus

SHEET		OF	
BY	JCS	DATE	12/11/2003
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JOB NO.	310.032		

CLIENT: FCDMC

JOB: Wittmann Area Drainage Master Study Update

Wittmann ADMSU: McMicken Dam Hydrology

Basin Green and Ampt Parameter Summary: EXISTING CONDITIONS

Basin ID	Basin Area (sqmiles)	IA	DTHETA	PSIF	XKSAT	RTIMP
WT160	0.8	0.35	0.25	4.395	0.334	17.796
WT150	5.8	0.35	0.25	4.085	0.384	19.216
WT140	3.8	0.35	0.25	4.093	0.383	19.444
WT130	2.5	0.35	0.25	4.731	0.281	10.926
WT120	2.8	0.35	0.25	5.264	0.243	3.934
WT110	2.9	0.35	0.25	4.792	0.284	7.155
WT100	3.8	0.349	0.25	4.571	0.318	16.009
WI580	30.3	0.339	0.182	6.675	0.143	8.718
WI540	11.6	0.28	0.25	5.888	0.187	33.223
WI520	16.4	0.321	0.25	5.691	0.207	20.375
WI500	9.1	0.302	0.248	5.804	0.204	18.286
WI505	6.7	0.349	0.247	4.645	0.354	7.715
WI510	9.2	0.329	0.247	5.232	0.254	8.075
TW480	12.7	0.35	0.227	6.229	0.169	31.82
TW460	2.4	0.349	0.25	5.72	0.2	6.85
TW420	10.9	0.341	0.25	5.699	0.209	6.912
TW400	13.0	0.33	0.25	5.215	0.245	12.509
SV220	17.0	0.342	0.149	7.51	0.102	5.803
SV200	31.3	0.342	0.248	5.368	0.228	7.735
PI680	16.9	0.35	0.25	5.858	0.191	30.844
PI640	17.4	0.337	0.15	7.212	0.114	8.758
PI600	12.0	0.315	0.247	4.635	0.342	11.728
PD780	19.0	0.336	0.25	5.252	0.254	28.226
PD760	2.7	0.336	0.248	4.33	0.412	7.136
PD745	2.0	0.35	0.25	5.011	0.28	11.865
PD740	0.9	0.345	0.246	5.026	0.277	6.818
PD735	3.2	0.349	0.249	4.295	0.415	27.418
PD730	0.5	0.342	0.244	4.406	0.374	30.607
PD710	6.5	0.333	0.245	4.556	0.348	7.16
PD700	7.3	0.336	0.247	5.179	0.255	13.475
IW310	25.8	0.35	0.232	6.183	0.172	16.489
IW350	4.2	0.34	0.15	7.293	0.11	7.655

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Entellus

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CLIENT: FCDMC

JOB: Wittmann Area Drainage Master Study Update

Wittmann ADMSU: McMicken Dam Hydrology

Basin Green and Ampt Parameter Summary: FUTURE CONDITIONS

Basin ID	Basin Area (sqmiles)	IA	DTHETA	PSIF	XKSAT	RTIMP
WT160	0.8	0.2	0.25	4.395	0.347	22.796
WT150	5.8	0.2	0.25	4.085	0.386	24.216
WT140	3.8	0.2	0.25	4.093	0.385	24.444
WT130	2.5	0.219	0.25	4.731	0.299	15.926
WT120	2.8	0.257	0.25	5.264	0.259	8.934
WT110	2.9	0.258	0.25	4.792	0.301	13.801
WT100	3.8	0.257	0.25	4.571	0.327	24.088
WI580	30.3	0.277	0.183	6.675	0.148	12.926
WI540	11.6	0.221	0.25	5.888	0.196	44.54
WI520	16.4	0.251	0.25	5.691	0.22	28.93
WI500	9.1	0.19	0.25	5.804	0.234	56.461
WI505	6.7	0.26	0.25	4.645	0.37	31.474
WI510	9.2	0.238	0.25	5.232	0.295	40.465
TW480	12.7	0.276	0.227	6.229	0.183	32.122
TW460	2.4	0.232	0.25	5.72	0.222	6.443
TW420	10.9	0.285	0.25	5.699	0.214	15.475
TW400	13.0	0.201	0.25	5.215	0.276	48.331
SV220	17.0	0.267	0.15	7.51	0.114	30.822
SV200	31.3	0.239	0.25	5.368	0.256	27.428
PI680	16.9	0.255	0.25	5.858	0.211	33.728
PI640	17.4	0.269	0.15	7.212	0.12	18.003
PI600	12.0	0.264	0.25	4.635	0.374	28.192
PD780	19.0	0.226	0.25	5.252	0.286	33.957
PD760	2.7	0.286	0.25	4.33	0.42	14.434
PD745	2.0	0.265	0.25	5.011	0.301	19.085
PD740	0.9	0.279	0.249	5.026	0.308	16.987
PD735	3.2	0.264	0.25	4.295	0.456	39.149
PD730	0.5	0.293	0.25	4.406	0.383	40.267
PD710	6.5	0.295	0.249	4.556	0.356	12.509
PD700	7.3	0.284	0.246	5.179	0.264	16.866
IW310	25.8	0.234	0.232	6.183	0.192	19.413
IW350	4.2	0.28	0.15	7.293	0.115	17.002

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Client FCDMC
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Comparison of Green and Ampt values

The Green and Ampt parameters used in the HEC-1, LG card were generated using the WMS program (**Reference 14**). Entellus wanted to verify the results using the software package DDMS (**Reference 19**) as distributed through the Flood Control District of Maricopa County. The watersheds WT100, WT120, WT130, WT135, WT140 and WT145 were used to check the model. First, the WMS values were retrieved from the LG card. The parameters are as follows:

IA: Initial loss (abstraction) in inches (mm).
DTHETA: Volumetric moisture deficit. If this value is 0, then the method reduces to the initial loss equal to IA and a constant loss equal to XKSAT.
PSIF: Wetting front suction in inches (mm). If this value is 0, then the method reduces to the initial loss equal to IA and a constant loss equal to XKSAT.
XKSAT: Hydraulic conductivity at natural saturation in inches/hour (mm/hour).
RTIMP: Percentage of drainage basin that is impervious.

The basin information was then entered into DDMS: area, length, slope and S-graph type (Mountain or Valley). Before the analysis was run, it was necessary to determine the LCA value, the length to the centroid of each basin (see **Appendix B.2.3**). This was done graphically using AutoCAD and estimating the centroid based upon areas. For the initial DDMS run, the default land use values were used as provided in the DDMS program. Land use #120 was determined to be L.D.R., # 140 and #150 were M.D.R. and #710 and #730 were determined to be OPEN. The Green and Ampt parameters returned for this initial run are contained in the table below under Run #1. There were variations in the returned DDMS values compared to WMS.

To determine the reason for the differences the specific land use parameters for the various land uses in WMS were compared to the DDMS default values. Different Kn values were tried (versus the composite Kn value). These values were obtained from the *Drainage Design Manual for Maricopa County, Arizona, Volume 1 Hydrology* (**Reference 15**). Section 5 of the manual contains a table for suggested Kn values based upon land type for Arizona. The values for the Phoenix Valley area were used for basins WT100, WT120, WT130

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and WT140, and the Phoenix Mountain values were implemented for basins WT135 and WT145. A range of Kn values were used based upon the MIN, AVG and MAX for each region. The Kn values used for the Phoenix Valley areas were 0.015 (MIN), 0.083 (AVG), and 0.15 (MAX). The Kn values used for the Phoenix Mountain areas were 0.045 (MIN), 0.05 (AVG), and 0.055 (MAX). The resulting Green and Ampt parameters are found in the table under Run #2 (MIN), Run #3 (AVG), and Run #4 (MAX), respectfully. As can be seen, the changes in Kn values had no affect on the Green and Ampt parameters.

Land use parameters were compared and it was found that the DDMS default values for OPEN SPACE did not match. A comparison was performed on the default OPEN SPACE and the ACTIVE and PASSIVE OPEN SPACE land uses obtained from the MAG land use values used in WMS. There was a significant difference between the G&A values. The significant change was a result the addition of 5 % impervious (RTIMP), DDMS default was zero, and the percent vegetation cover values which were 50 vs 90 and 30 vs 25% for Active(parks) and Passive(Desert) respectively. It was decided to use the default vegetation percentage with the addition of the 5 RTIMP for both the ACTIVE and PASSIVE OPEN SPACE. Once these changes were made, the DDMS values correlated very closely to the WMS values. Run #5 represents the DDMS run with the changed percent vegetation, but not the addition of the 5 RTIMP. Run #6 includes the 5 additional RTIMP. The table below summarizes the results.

The conclusion is that WMS is consistently determining the G&A parameters correctly compared to DDMS.

Basin	Method	Run Number	IA	DTHETA	PSIF	XKSAT	RTIMP
WT100							
	WMS		0.217	0.25	4.566	0.339	21.592
	DDMS	Run #1	0.22	0.29	4.55	0.36	24
		Run #2 (MIN)	0.22	0.25	4.55	0.43	22
		Run #3 (AVG)	0.22	0.25	4.55	0.43	22
		Run #4 (MAX)	0.22	0.25	4.55	0.43	22
		Run #5	0.22	0.25	4.55	0.34	20
		Run #6	0.22	0.25	4.55	0.34	22

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WT120						
	WMS		0.224	0.25	4.719	0.338	10.873
	DDMS	Run #1	0.22	0.29	4.7	0.33	15
		Run #2 (MIN)	0.22	0.25	4.7	0.38	11
		Run #3 (AVG)	0.22	0.25	4.7	0.38	11
		Run #4 (MAX)	0.22	0.25	4.7	0.38	11
		Run #5	0.22	0.25	4.7	0.3	9
		Run #6	0.22	0.25	4.7	0.3	11
WT130							
	WMS		0.203	0.25	5.26	0.294	7.262
	DDMS	Run #1	0.2	0.31	5.3	0.24	10
		Run #2 (MIN)	0.2	0.25	5.3	0.31	7
		Run #3 (AVG)	0.2	0.25	5.3	0.31	7
		Run #4 (MAX)	0.2	0.25	5.3	0.31	7
		Run #5	0.2	0.25	5.3	0.22	5
		Run #6	0.2	0.25	5.3	0.22	7
WT140							
	WMS		0.16	0.25	4.87	0.316	13.419
	DDMS	Run #1	0.16	0.32	4.9	0.27	13
		Run #2 (MIN)	0.16	0.25	4.9	0.41	14
		Run #3 (AVG)	0.16	0.25	4.9	0.41	14
		Run #4 (MAX)	0.16	0.25	4.9	0.41	14
		Run #5	0.16	0.25	4.9	0.25	10
		Run #6	0.16	0.25	4.9	0.25	14
WT135							
	WMS		0.1	0.25	4.127	0.387	24.062
	DDMS	Run #1	0.1	0.35	4.15	0.37	19
		Run #2 (MIN)	0.1	0.25	4.15	0.7	24
		Run #3 (AVG)	0.1	0.25	4.15	0.7	24
		Run #4 (MAX)	0.1	0.25	4.15	0.7	24
		Run #5	0.1	0.25	4.15	0.37	19
		Run #6	0.1	0.25	4.15	0.37	24
WT145							
	WMS		0.1	0.25	4.1	0.39	24.291
	DDMS	Run #1	0.1	0.35	4.1	0.38	19
		Run #2 (MIN)	0.1	0.25	4.1	0.72	24
		Run #3 (AVG)	0.1	0.25	4.1	0.72	24
		Run #4 (MAX)	0.1	0.25	4.1	0.72	24
		Run #5	0.1	0.25	4.1	0.38	19
		Run #6	0.1	0.25	4.1	0.38	24

B.3. Hydrograph Routing Data

Entellus

Appendix B.3

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JOB NO.	310.032		

CLIENT: FCDMC

JOB: Wittmann Area Drainage Master Study Update

Wittmann ADMSU: McMicken Dam Hydrology

Hydrograph Route Development

GEOMETRY AND ROUGHNESS

Topography provided by the District was used to develop cross-sections along various hydrograph routes. Aerial photography and field photos were examined in order to estimate hydrologic parameters along various hydrograph routes. It was found that many routes shared similar cross-section geometries and Manning's "n" value characteristics. Typical cross sections were developed for routes that shared similar cross-section geometries. Six different typical cross sections were created, and are described in this appendix. Typical "roughness classifications" were developed for routes that shared similar "n" value profiles. Three roughness classifications were created, and are described in this appendix.

SLOPES AND LENGTHS

The length of each route was determined using aerial photography. The slope of each route was determined using the topogrpahy supplied by the District. The slopes and lengths of each route are summarized in this appendix.

N-STEPS AND VELOCITIES

The number of n-steps used in HEC-1 were set to an initial value. After obtaining an output flow, the velocity was calculated and compared to the normal depth velocity. The number of n-steps for each route was iterated until the normal depth velocity was approached. These calculations have been performed for all models and are included as part of this appendix.

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SHEET	2	**OF**	13
BY	RAS	**DATE**	12/8/2003
CHECK	JCS	**DATE**	12/12/2003
JOB NO	310.032		

CLIENT: FCDMC

JOB: Wittmann Area Drainage Master Study Update

Wittmann ADMSU: McMicken Dam Hydrology
Routing Summary

Route ID	Length miles	Length ft	Upstream Elevation ft	Upstream Conc. Pt.	Downstream Elevation ft	Downstream Conc. Pt.	Slope (ft/ft)	Slope (ft/mile)	Typical Section Size	Roughness Classification
100400	2.4	12851	1335	100	1337	400	.001*	5.3*	McMicken Channel	Channel
110100	0.5	2465	1339	110	1335	100	.001*	5.3*	McMicken Channel	Channel
120110	1.9	10283	1341	120	1339	110	.001*	5.3*	McMicken Channel	Channel
130120	0.2	1225	1348	130	1341	120	.001*	5.3*	McMicken Channel	Channel
140130	2.7	14043	1594	140	1348	130	0.018	92.5	Small Wash	Mountainous
150120	2.7	14187	1530	150	1341	120	0.013	70.3	Small Wash	Mountainous
160120	2.7	14018	1546	160	1341	120	0.015	77.2	Small Wash	Mountainous
200400	3.1	16311	1412	200	1337	400	0.005	24.3	Large Wash	Valley
220200	5.0	26218	1522	220	1412	200	0.004	22.2	Medium Wash	Valley
310200	4.7	24622	1546	310	1412	200	0.005	28.7	Large Wash	Valley
350310	14.7	77773	2257	350	1546	310	0.009	48.3	Medium Wash	Mountainous
400510	0.5	2671	1337	400	1336	510	.001*	5.3*	McMicken Channel	Channel
420200	5.0	26213	1547	420	1412	200	0.005	27.2	Medium Wash	Valley
460420	10.2	53954	2080	460	1547	420	0.010	52.2	Medium Wash	Mountainous
480460	3.5	18660	2392	480	2080	460	0.017	88.3	Small Wash	Mountainous
500500	0.4	2214	*	500.2	*	500.3	.001*	5.3*	McMicken Channel	Channel
500600	3.4	18203	1330	500.3	1315	600	.001*	5.3*	McMicken Channel	Channel
505500	1.0	5161	1351.5	505	1330	500.3	0.004	22.0	Medium Wash	Valley
510500	1.4	7342	1336	510	1330	500.2	.001*	5.3*	McMicken Channel	Channel
520500	6.5	34143	1534	520	1330	500.1	0.006	31.5	Medium Wash	Valley
540500	6.2	32882	1558	540	1330	500.1	0.007	36.6	Medium Wash	Valley
580510	7.5	39351	1545	580	1337	510	0.005	27.9	Large Wash	Valley
600710	0.8	4403	1315	600	1312	710	.001*	5.3*	McMicken Channel	Channel
640505	4.8	25169	1544	640	1330	505	0.009	44.9	Medium Wash	Valley
640600	6.0	31873	1542	640	1315	600	0.007	37.6	Medium Wash	Valley
680640	8.6	45524	2182	680	1544	640	0.014	74.0	Medium Wash	Mountainous
710700	1.4	7571	1312	710	1306	700	.001*	5.3*	McMicken Channel	Channel
735700	5.1	27046	1520	735	1306	700	0.008	41.8	Small Wash	Mountainous
740710	5.2	27269	1516	740	1312	710	0.007	39.5	Medium Wash	Valley
760710	5.4	28446	1540	760	1315	710	0.008	41.8	Medium Wash	Valley
780760	2.3	12100	1670	780	1548	760	0.010	53.2	Medium Wash	Mountainous

* McMicken dam impoundment area, minimum slope of .001 used.

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Entellus

SHEET	3	OF	13
BY	RAS	DATE	2/12/2004
CHECK		DATE	
JOB NO.	310.032		

CLIENT: FCDMC

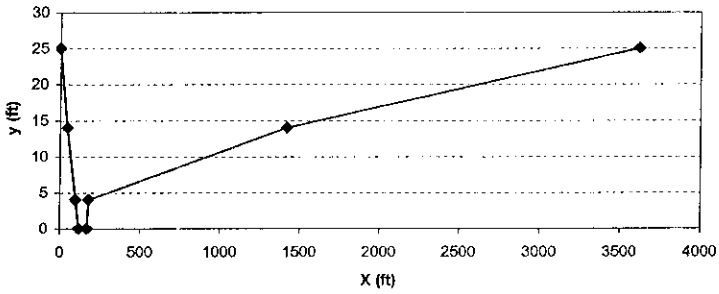
JOB: Wittmann Area Drainage Master Study Update

Wittmann ADMSU: McMicken Dam Hydrology

Route Geometry Guide 1 0f 2

McMicken Channel

X coord	Y coord
0	25
46	14
101	4
121	0
171	0
181	4
1421	14
3621	25

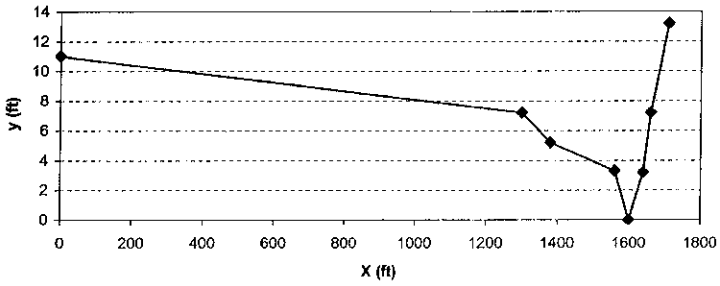


Routes Classified using this Geometry

100400
110100
120110
130120
400510
500500
500600
510500
600710
710700

Small Wash

X coord	Y coord
0	11
1300	7.2
1380	5.2
1560	3.3
1600	0
1640	3.2
1660	7.2
1710	13.2



Routes Classified using this Geometry

140130
150120
160120
480460
735700

Entellus

SHEET	4	OF	13
BY	RAS	DATE	2/12/2004
CHECK		DATE	
JOB NO.	310.032		

CLIENT: FCDMC

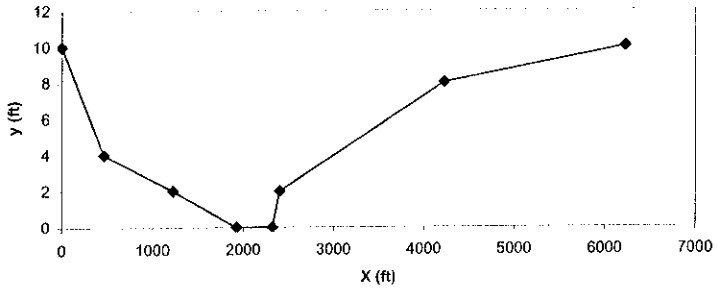
JOB: Wittmann Area Drainage Master Study Update

Wittmann ADMSU: McMicken Dam Hydrology

Route Geometry Guide 2 of 2

Large Wash

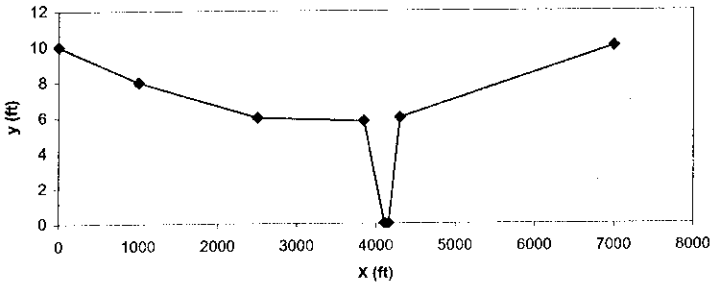
X coord	Y coord
0	10
465	4
1225	2
1925	0
2325	0
2405	2
4225	8
6225	10



Routes Classified using this Geometry
200400
310200
580510

Medium Wash

X coord	Y coord
0	10
1000	8
2500	6
3846	5.8
4110	0
4160	0
4300	6
7000	10



Routes Classified using this Geometry
220200
350310
420200
460420
505500
520500
540500
640505
640600
680640
740710
760710
780760

Entellus

SHEET	5	OF	13
BY	RAS	DATE	12/11/2003
CHECK	JCS	DATE	12/12/2003
JOB NO.	310.032		

CLIENT: FCDMC

JOB: Wittmann Area Drainage Master Study Update: McMicken Dam Hydrology

Storm: 100-yr, 24-hr Existing Conditions

Route N-Step vs Velocity

Route	Previous time to Peak [hr]	Route Time to Peak [hr]	Difference in Time to peak [hr]	Route Length [ft]	HEC-1 Velocity [fps]	Normal Depth Velocity [fps]	HEC-1 Flow [cfs]	Normal Depth Flow [cfs]	X-sect Type	Route Slope [ft/ft]	Manning's n Value	HEC-1 nstep
680640	13.50	15.50	2.00	45524	6.32	5.31	5311	5317	medium	0.014	0.064	7
780760 x	13.25	14.25	0.60	12100	5.60	5.15	7768	7775	medium	0.010	0.064	3
640505	15.75	17.25	1.50	25169	4.66	3.86	1114	1122	medium	0.009	0.046	6
505500 x	13.25	13.50	0.40	5161	3.58	3.76	3246	3254	medium	0.004	0.046	2
150120	13.25	14.00	0.75	14187	5.25	5.44	2303	2312	small	0.013	0.064	4
140130	13.00	13.75	0.75	14043	5.20	5.64	1634	1643	small	0.018	0.064	4
130120 x	13.00	13.25	0.10	1225	3.40	4.09	2311	2320	channel	0.001	0.035	1
160120	12.50	13.50	1.00	14018	3.89	3.88	476	485	small	0.015	0.064	5
120110	13.75	14.75	1.00	10283	2.86	4.83	4165	4174	channel	0.001	0.035	3
110100 x	14.75	14.75	0.20	2465	3.42	4.80	4074	4083	channel	0.001	0.035	1
100400 x	13.00	14.25	1.00	12851	3.57	4.93	4475	4484	channel	0.001	0.035	8
350310	12.50	18.00	5.50	77773	3.93	3.05	1154	1162	medium	0.009	0.064	22
310200	14.25	16.00	1.75	24622	3.91	3.18	7259	7260	large	0.005	0.046	7
220200	14.00	15.75	1.75	26218	4.16	4.18	4935	4942	medium	0.004	0.046	7
480460 x	13.50	14.00	0.80	18660	6.48	7.41	5338	5345	small	0.017	0.064	3
460420	14.00	16.75	2.75	53954	5.45	4.38	4069	4076	medium	0.010	0.064	11
420200	13.50	15.00	1.50	26213	4.85	4.45	4550	4557	medium	0.005	0.046	6
200400	15.50	16.50	1.00	16311	4.53	3.92	16144	16141	large	0.005	0.046	4
400510 *	16.50	16.50	0.25	2671	2.97	7.23	18953	18961	channel	0.001	0.035	1
580510	14.00	17.00	3.00	39351	3.64	3.08	6454	6455	large	0.005	0.046	12
510500 x	16.75	17.25	0.40	7342	5.10	7.59	22822	22830	channel	0.001	0.035	2
520500	13.75	15.50	1.75	34143	5.42	5.07	5847	5854	medium	0.006	0.046	8
540500	15.75	18.50	2.75	32882	3.32	3.14	713	722	medium	0.007	0.046	11
500500 x	17.25	17.25	0.10	2214	6.15	7.74	24686	24693	channel	0.001	0.035	1
500600	17.25	18.50	1.25	18203	4.05	7.71	24290	24297	channel	0.001	0.035	3
640600	15.75	17.75	2.00	31873	4.43	3.99	1822	1831	medium	0.007	0.046	8
600710 x	18.50	18.75	0.25	4403	4.89	7.82	25643	25650	channel	0.001	0.035	1
760710	15.75	17.25	1.50	28446	5.27	4.91	3380	3388	medium	0.008	0.046	6
740710	12.75	15.50	2.75	27269	2.75	2.44	273	282	medium	0.007	0.046	11
710700 x	18.75	19.00	0.40	7571	5.26	8.01	28157	28163	channel	0.001	0.035	2
735700	12.75	14.50	1.75	27046	4.29	3.97	1355	1364	small	0.008	0.064	6

* Time lapse less than time step of 15 minutes, so 1 time step was assumed for HEC-1 Velocity Calculation

** Modified Typical X-Section

x Modified Time To Peak Used

Entellus

SHEET	6	OF	13
BY	RAS	DATE	12/11/2003
CHECK	JCS	DATE	12/12/2003
JOB NO.	310.032		

CLIENT: FCDMC

JOB: Wittmann Area Drainage Master Study Update: McMicken Dam Hydrology

Storm: 100-yr, 24-hr Future Conditions

Route N-Step vs Velocity

Route	Previous time to Peak [hr]	Route Time to Peak [hr]	Difference in Time to peak [hr]	Route Length [ft]	HEC-1 Velocity [fps]	Normal Depth Velocity [fps]	HEC-1 Flow [cfs]	Normal Depth Flow [cfs]	X-sect Type	Route Slope [ft/ft]	Manning's n Value	HEC-1 nstep
680640 x	13.50	15.25	1.75	45524	7.23	5.40	5696	5703	medium	0.014	0.064	9
780760	13.25	14.00	0.75	12100	4.48	5.16	7805	7813	medium	0.010	0.064	3
640505	15.75	17.25	1.50	25169	4.66	3.89	1146	1155	medium	0.009	0.046	9
505500 x	13.25	13.50	0.35	5161	4.10	3.92	3850	3858	medium	0.004	0.046	1
150120	13.25	14.00	0.75	14187	5.25	5.44	2302	2311	small	0.013	0.064	3
140130	13.00	13.75	0.75	14043	5.20	5.64	1638	1646	small	0.018	0.064	3
130120 x	13.00	13.25	0.10	1225	3.40	4.78	2463	2473	channel	0.001	0.035	1
160120	12.50	13.50	1.00	14018	3.89	3.87	471	480	small	0.015	0.064	4
120110	13.75	14.50	0.75	10283	3.81	4.91	4417	4426	channel	0.001	0.035	5
110100 x	14.50	14.75	0.20	2465	3.42	4.89	4362	4371	channel	0.001	0.035	1
100400 x	13.00	15.25	0.75	12851	4.76	4.91	4411	4420	channel	0.001	0.035	3
350310	12.50	18.00	5.50	77773	3.93	3.12	1256	1264	medium	0.009	0.064	25
310200	14.25	16.00	1.75	24622	3.91	3.24	7784	7783	large	0.005	0.046	4
220200	14.00	15.75	1.75	26218	4.16	4.23	5181	5189	medium	0.004	0.046	8
480460 x	13.50	14.00	0.75	18660	6.91	7.40	5316	5323	small	0.017	0.064	3
460420	14.00	16.75	2.75	53954	5.45	4.41	4213	4220	medium	0.010	0.064	15
420200	13.50	15.00	1.50	26213	4.85	4.49	4749	4756	medium	0.005	0.046	11
200400	15.50	16.50	1.00	16311	4.53	4.06	18446	18449	large	0.005	0.046	4
400510 x	16.25	16.50	0.10	2671	7.42	7.50	21851	21858	channel	0.001	0.035	1
580510	14.00	17.00	3.00	39351	3.64	3.17	7121	7122	large	0.005	0.046	8
510500 x	16.75	17.25	0.40	7342	5.10	7.84	25946	25953	channel	0.001	0.035	1
520500	13.75	15.50	1.75	34143	5.42	5.07	5838	5843	medium	0.006	0.046	6
540500	15.75	18.50	2.75	32882	3.32	3.17	741	750	medium	0.007	0.046	14
500500	17.00	17.25	0.10	2214	6.15	8.03	28442	28448	channel	0.001	0.035	1
500600	17.25	18.25	1.00	18203	5.06	8.01	28191	28199	channel	0.001	0.035	3
640600	15.75	17.75	2.00	31873	4.43	4.03	1880	1888	medium	0.007	0.046	10
600710	18.25	18.50	0.25	4403	4.89	8.12	29704	29711	channel	0.001	0.035	1
760710	15.75	17.25	1.50	28446	5.27	4.94	3443	3450	medium	0.008	0.046	6
740710	12.75	15.50	2.75	27269	2.75	2.46	282	292	medium	0.007	0.046	10
710700	18.50	18.75	0.25	7571	8.41	8.30	32308	32316	channel	0.001	0.035	1
735700	12.75	14.50	1.75	27046	4.29	4.19	1684	1693	small	0.008	0.064	8

* Time lapse less than time step of 15 minutes, so 1 time step was assumed for HEC-1 Velocity Calculation

** Modified Typical X-Section

x Modified Time To Peak Used

Entellus

SHEET	7	OF	13
BY	RAS	DATE	12/11/2003
CHECK	JCS	DATE	12/12/2003
JOB NO.	310.032		

CLIENT: FCDMC

JOB: Wittmann Area Drainage Master Study Update: McMicken Dam Hydrology

Storm: 200-yr, 24-hr Existing Conditions **Route N-Step vs Velocity**

Route	Previous time to Peak [hr]	Route Time to Peak [hr]	Difference in Time to peak [hr]	Route Length [ft]	HEC-1 Velocity [fps]	Normal Depth Velocity [fps]	HEC-1 Flow [cfs]	Normal Depth Flow [cfs]	X-sect Type	Route Slope [ft/ft]	Manning's n Value	HEC-1 nstep
680640	13.50	15.25	1.75	45524	7.23	5.58	6491	6497	medium	0.014	0.064	7
780760 **	13.25	14.25	1.00	12100	3.36	5.52	10253	10259	medium	0.010	0.064	3
640505	15.75	17.50	1.75	25169	4.00	3.92	1183	1191	medium	0.009	0.046	6
505500 x	13.25	13.50	0.30	5161	4.78	3.91	3800	3807	medium	0.004	0.046	2
150120 x	13.25	13.75	0.75	14187	5.25	5.68	2741	2749	small	0.013	0.064	4
140130	13.00	13.75	0.75	14043	5.20	5.93	1997	2006	small	0.018	0.064	4
130120 x	13.50	13.75	0.10	1225	3.40	4.30	2750	2759	channel	0.001	0.035	1
160120	12.50	13.50	1.00	14018	3.89	4.02	550	560	small	0.015	0.064	5
120110	13.75	14.50	0.75	10283	3.81	5.06	4944	4952	channel	0.001	0.035	3
110100	14.50	14.75	0.25	2465	2.74	5.03	4816	4825	channel	0.001	0.035	1
100400 x	13.00	14.50	1.00	12851	3.57	5.05	4909	4918	channel	0.001	0.035	8
350310	12.50	17.75	5.25	77773	4.11	3.20	1395	1404	medium	0.009	0.064	22
310200	14.25	16.00	1.75	24622	3.91	3.33	8636	8639	large	0.005	0.046	7
220200	13.75	15.75	2.00	26218	3.64	4.24	5226	5233	medium	0.004	0.046	7
480460	13.50	14.00	0.75	18660	6.91	7.67	6109	6117	small	0.017	0.064	3
460420 x	14.00	16.50	2.75	53954	5.45	4.50	4533	4541	medium	0.010	0.064	11
420200	13.50	15.00	1.50	26213	4.85	4.46	4618	4625	medium	0.005	0.046	6
200400	15.50	16.50	1.00	16311	4.53	4.10	19146	19141	large	0.005	0.046	4
400510 x	16.50	16.50	0.10	2671	7.42	7.58	22679	22685	channel	0.001	0.035	1
580510	14.00	16.75	2.75	39351	3.97	3.26	7983	7986	large	0.005	0.046	12
510500	16.75	17.25	0.50	7342	4.08	7.96	27478	27484	channel	0.001	0.035	2
520500	13.75	15.50	1.75	34143	5.42	5.20	6445	6450	medium	0.006	0.046	8
540500	15.75	18.75	3.00	32882	3.04	3.19	757	766	medium	0.007	0.046	11
500500 x	17.00	17.25	0.10	2214	6.15	8.14	29934	29942	channel	0.001	0.035	1
500600	17.25	18.25	1.00	18203	5.06	8.11	29581	29588	channel	0.001	0.035	3
640600	15.75	17.75	2.00	31873	4.43	4.06	1940	1948	medium	0.007	0.046	8
600710 x	18.25	18.50	0.20	4403	6.12	8.21	30955	30962	channel	0.001	0.035	1
760710	15.75	17.50	1.75	28446	4.52	4.98	3552	3560	medium	0.008	0.046	6
740710	12.75	15.75	3.00	27269	2.52	2.51	306	315	medium	0.007	0.046	11
710700	18.50	19.00	0.50	7571	4.21	8.37	33431	33437	channel	0.001	0.035	2
735700	12.75	14.50	1.75	27046	4.29	4.17	1643	1652	small	0.008	0.064	6

* Time lapse less than time step of 15 minutes, so 1 time step was assumed for HEC-1 Velocity Calculation

** Modified Typical X-Section

x Modified Time To Peak Used

Entellus

SHEET	8	OF	13
BY	RAS	DATE	12/11/2003
CHECK	JCS	DATE	12/12/2003
JOB NO.	310.032		

CLIENT: FCDMC

JOB: Wittmann Area Drainage Master Study Update: McMicken Dam Hydrology

Storm: 200-yr, 24-hr Future Conditions

Route N-Step vs Velocity

Route	Previous time to Peak [hr]	Route Time to Peak [hr]	Difference in Time to peak [hr]	Route Length [ft]	HEC-1 Velocity [fps]	Normal Depth Velocity [fps]	HEC-1 Flow [cfs]	Normal Depth Flow [cfs]	X-sect Type	Route Slope [ft/ft]	Manning's n Value	HEC-1 nstep
680640	13.50	15.25	1.75	45524	7.23	5.60	6553	6560	medium	0.014	0.064	9
780760 **	13.25	14.25	1.00	12100	3.36	5.63	11090	11093	medium	0.010	0.064	5
640505	16.00	17.50	1.50	25169	4.66	3.95	1210	1218	medium	0.009	0.046	9
505500	13.25	13.50	0.25	5161	5.73	4.06	4402	4409	medium	0.004	0.046	1
150120 x	13.25	13.75	0.75	14187	5.25	5.56	2527	2536	small	0.013	0.064	2
140130	13.00	13.75	0.75	14043	5.20	5.90	1956	1965	small	0.018	0.064	3
130120 x	13.00	13.25	0.10	1225	3.40	4.97	2881	2890	channel	0.001	0.035	1
160120	12.50	13.50	1.00	14018	3.89	4.01	541	550	small	0.015	0.064	4
120110	13.75	14.50	0.75	10283	3.81	5.12	5146	5155	channel	0.001	0.035	5
110100	14.25	14.50	0.25	2465	2.74	5.10	5066	5075	channel	0.001	0.035	1
100400 x	13.00	15.25	1.00	12851	3.57	5.12	5144	5153	channel	0.001	0.035	3
350310	12.50	17.75	5.25	77773	4.11	3.27	1507	1516	medium	0.009	0.064	25
310200	14.25	15.75	1.50	24622	4.56	3.38	9141	9142	large	0.005	0.046	4
220200	13.75	15.75	2.00	26218	3.64	4.23	5192	5198	medium	0.004	0.046	8
480460 x	13.50	14.00	0.75	18660	6.91	7.66	6079	6086	small	0.017	0.064	3
460420	14.00	16.50	2.50	53954	5.99	4.58	4865	4872	medium	0.010	0.064	15
420200	13.50	15.00	1.50	26213	4.85	4.66	5475	5482	medium	0.005	0.046	11
200400	15.25	16.25	1.00	16311	4.53	4.23	21584	21577	large	0.005	0.046	4
400510 *	16.25	16.25	0.25	2671	2.97	7.82	25673	25681	channel	0.001	0.035	1
580510	14.00	16.75	2.75	39351	3.97	3.34	8761	8760	large	0.005	0.046	8
510500 x	16.50	17.00	0.35	7342	5.83	8.23	31220	31226	channel	0.001	0.035	1
520500	13.75	15.50	1.75	34143	5.42	5.17	6294	6301	medium	0.006	0.046	6
540500	16.00	18.50	2.50	32882	3.65	3.20	770	779	medium	0.007	0.046	14
500500 x	17.00	17.00	0.10	2214	6.15	8.43	34292	34298	channel	0.001	0.035	1
500600	17.00	18.00	1.00	18203	5.06	8.38	33590	33598	channel	0.001	0.035	3
640600	16.00	17.75	1.75	31873	5.06	4.08	1976	1984	medium	0.007	0.046	10
600710	18.00	18.25	0.25	4403	4.89	8.48	35099	35106	channel	0.001	0.035	1
760710	16.00	17.50	1.50	28446	5.27	5.00	3627	3634	medium	0.008	0.046	6
740710	12.75	15.75	3.00	27269	2.52	2.53	313	322	medium	0.007	0.046	10
710700	18.25	18.75	0.50	7571	4.21	8.63	37717	37723	channel	0.001	0.035	1
735700	12.75	14.50	1.75	27046	4.29	4.37	1990	1999	small	0.008	0.064	8

* Time lapse less than time step of 15 minutes, so 1 time step was assumed for HEC-1 Velocity Calculation

** Modified Typical X-Section

x Modified Time To Peak Used

Entellus

SHEET	9	OF	13
BY	RAS	DATE	12/11/2003
CHECK	JCS	DATE	12/12/2003
JOB NO.	310.032		

CLIENT: FCDMC

JOB: Wittmann Area Drainage Master Study Update: McMicken Dam Hydrology

Storm: 500-yr, 24-hr Existing Conditions

Route N-Step vs Velocity

Route	Previous time to Peak [hr]	Route Time to Peak [hr]	Difference in Time to peak [hr]	Route Length [ft]	HEC-1 Velocity [fps]	Normal Depth Velocity [fps]	HEC-1 Flow [cfs]	Normal Depth Flow [cfs]	X-sect Type	Route Slope [ft/ft]	Manning's n Value	HEC-1 nstep
680640	13.50	15.25	1.75	45524	7.23	5.85	7796	7802	medium	0.014	0.064	7
780760 **	13.25	14.00	0.75	12100	4.48	5.79	12367	12372	medium	0.010	0.064	3
640505	16.00	17.50	1.50	25169	4.66	4.00	1279	1287	medium	0.009	0.046	6
505500	13.25	13.50	0.25	5161	5.73	4.17	4932	4940	medium	0.004	0.046	2
150120	13.25	13.75	0.50	14187	7.88	5.79	2964	2972	small	0.013	0.064	4
140130	13.00	13.75	0.75	14043	5.20	6.10	2249	2257	small	0.018	0.064	4
130120 x	13.50	13.50	0.10	1225	3.40	4.54	3348	3357	channel	0.001	0.035	1
160120	12.50	13.50	1.00	14018	3.89	4.15	625	634	small	0.015	0.064	5
120110	13.75	14.25	0.50	10283	5.71	5.24	5632	5641	channel	0.001	0.035	3
110100	14.25	14.50	0.25	2465	2.74	5.23	5590	5599	channel	0.001	0.035	1
100400 x	13.00	14.75	0.75	12851	4.76	5.31	5900	5908	channel	0.001	0.035	8
350310	12.50	17.50	5.00	77773	4.32	3.38	1721	1729	medium	0.009	0.064	22
310200	14.25	15.75	1.50	24622	4.56	3.54	10862	10860	large	0.005	0.046	7
220200	13.75	16.50	2.75	26218	2.65	4.27	5400	5407	medium	0.004	0.046	7
480460	13.50	14.00	0.50	18660	10.37	7.89	6870	6878	small	0.017	0.064	3
460420	14.00	16.50	2.50	53954	5.99	4.71	5455	5463	medium	0.010	0.064	11
420200	13.75	15.00	1.25	26213	5.83	4.65	5455	5462	medium	0.005	0.046	6
200400	15.50	16.25	0.75	16311	6.04	4.28	22659	22659	large	0.005	0.046	4
400510	16.25	16.50	0.25	2671	2.97	7.88	26370	26377	channel	0.001	0.035	1
580510	14.00	16.75	2.75	39351	3.97	3.50	10461	10459	large	0.005	0.046	12
510500	16.50	17.00	0.50	7342	4.08	8.35	33172	33179	channel	0.001	0.035	2
520500	13.75	15.50	1.75	34143	5.42	5.19	6415	6421	medium	0.006	0.046	8
540500	16.00	18.50	2.50	32882	3.65	3.23	798	807	medium	0.007	0.046	11
500500 x	16.75	17.00	0.10	2214	6.15	8.57	36617	36623	channel	0.001	0.035	1
500600	17.00	18.25	1.25	18203	4.05	8.53	35930	35938	channel	0.001	0.035	3
640600	16.00	17.75	1.75	31873	5.06	4.13	2073	2081	medium	0.007	0.046	8
600710	18.25	18.50	0.25	4403	4.89	8.62	37416	37421	channel	0.001	0.035	1
760710	16.00	17.50	1.50	28446	5.27	5.06	3803	3811	medium	0.008	0.046	6
740710	12.75	15.75	3.00	27269	2.52	2.59	344	353	medium	0.007	0.046	11
710700	18.50	19.00	0.50	7571	4.21	8.78	40322	40329	channel	0.001	0.035	2
735700	12.75	14.50	1.75	27046	4.29	4.39	2023	2032	small	0.008	0.064	6

* Time lapse less than time step of 15 minutes, so 1 time step was assumed for HEC-1 Velocity Calculation

** Modified Typical X-Section

x Modified Time To Peak Used

Entellus

SHEET	10	OF	13
BY	RAS	DATE	12/11/2003
CHECK	JCS	DATE	12/12/2003
JOB NO.	310.032		

CLIENT: FCDMC

JOB: Wittmann Area Drainage Master Study Update: McMicken Dam Hydrology

Storm: 500-yr, 24-hr Future Conditions

Route N-Step vs Velocity

Route	Previous time to Peak [hr]	Route Time to Peak [hr]	Difference in Time to peak [hr]	Route Length [ft]	HEC-1 Velocity [fps]	Normal Depth Velocity [fps]	HEC-1 Flow [cfs]	Normal Depth Flow [cfs]	X-sect Type	Route Slope [ft/ft]	Manning's n Value	HEC-1 nstep
680640	13.50	15.25	1.75	45524	7.23	5.85	7834	7839	medium	0.014	0.064	9
780760 **	13.25	14.00	0.75	12100	4.48	5.69	11508	11511	medium	0.010	0.064	2
640505	15.75	17.00	1.25	25169	5.59	4.39	1830	1838	medium	0.009	0.046	9
505500	13.25	13.50	0.25	5161	5.73	4.25	5289	5297	medium	0.004	0.046	1
150120	13.25	13.75	0.50	14187	7.88	5.85	3102	3110	small	0.013	0.064	2
140130	13.00	13.75	0.75	14043	5.20	6.17	2340	2349	small	0.018	0.064	3
130120 x	13.50	13.50	0.10	1225	3.40	5.21	3480	3489	channel	0.001	0.035	1
160120	12.50	13.50	1.00	14018	3.89	4.14	616	625	small	0.015	0.064	4
120110 x	13.75	14.50	0.75	10283	3.81	5.41	6318	6327	channel	0.001	0.035	5
110100 x	14.25	14.50	0.15	2465	4.56	5.40	6273	6281	channel	0.001	0.035	1
100400	13.00	15.25	2.25	12851	1.59	5.41	6334	6342	channel	0.001	0.035	3
350310	12.50	17.50	5.00	77773	4.32	3.44	1849	1857	medium	0.009	0.064	25
310200	14.25	15.75	1.50	24622	4.56	3.58	11357	11357	large	0.005	0.046	4
220200	13.75	16.00	2.25	26218	3.24	4.27	5388	5395	medium	0.004	0.046	8
480460	13.50	14.00	0.50	18660	10.37	7.97	7153	7160	small	0.017	0.064	3
460420	14.00	16.50	2.50	53954	5.99	4.81	5911	5918	medium	0.010	0.064	15
420200	13.75	15.00	1.25	26213	5.83	4.75	5903	5909	medium	0.005	0.046	11
200400	15.25	16.25	1.00	16311	4.53	4.42	25548	25543	large	0.005	0.046	4
400510 x	16.00	16.25	0.10	2671	7.42	8.17	30402	30410	channel	0.001	0.035	1
580510	14.00	16.75	2.75	39351	3.97	3.57	11258	11255	large	0.005	0.046	8
510500	16.50	17.00	0.50	7342	4.08	8.63	37609	37614	channel	0.001	0.035	1
520500	13.75	15.75	2.00	34143	4.74	5.18	6358	6364	medium	0.006	0.046	6
540500	15.75	17.75	2.00	32882	4.57	3.53	1127	1135	medium	0.007	0.046	14
500500 x	16.75	17.00	0.10	2214	6.15	8.86	41788	41794	channel	0.001	0.035	1
500600	17.00	18.00	1.00	18203	5.06	8.80	40654	40661	channel	0.001	0.035	3
640600	15.75	17.25	1.50	31873	5.90	4.35	2539	2547	medium	0.007	0.046	10
600710 x	18.00	18.25	0.20	4403	6.12	8.88	42200	42204	channel	0.001	0.035	1
760710	15.75	17.00	1.25	28446	6.32	5.19	4179	4186	medium	0.008	0.046	6
740710	12.75	15.75	3.00	27269	2.52	2.60	348	357	medium	0.007	0.046	10
710700	18.25	18.75	0.50	7571	4.21	9.02	44779	44784	channel	0.001	0.035	1
735700	12.75	14.25	1.50	27046	5.01	4.58	2415	2424	small	0.008	0.064	8

* Time lapse less than time step of 15 minutes, so 1 time step was assumed for HEC-1 Velocity Calculation

** Modified Typical X-Section

x Modified Time To Peak Used

Entellus

SHEET	11	OF	13
BY	RAS	DATE	12/11/2003
CHECK	JCS	DATE	12/12/2003
JOB NO.	310.032		

CLIENT: FCDMC

JOB: Wittmann Area Drainage Master Study Update: McMicken Dam Hydrology

Storm: 6-hr PMP Future Conditions **Route N-Step vs Velocity**

Route	Previous time to Peak [hr]	Route Time to Peak [hr]	Difference in Time to peak [hr]	Route Length [ft]	HEC-1 Velocity [fps]	Normal Depth Velocity [fps]	HEC-1 Flow [cfs]	Normal Depth Flow [cfs]	X-sect Type	Route Slope [ft/ft]	Manning's n Value	HEC-1 nstep
680640 **	4.75	8.75	4.00	45524	3.16	6.22	9958	9961	medium	0.014	0.064	8
780760	4.50	5.25	0.75	12100	4.48	6.70	22094	22099	medium	0.010	0.064	2
640505 **	5.00	7.00	2.00	25169	3.50	6.17	7002	7008	medium	0.009	0.046	2
505500 **	4.50	5.00	0.50	5161	2.87	4.71	7941	7948	medium	0.004	0.046	1
150120	4.50	5.00	0.50	14187	7.88	6.87	5889	5897	small	0.013	0.064	3
140130	4.25	5.00	0.75	14043	5.20	7.14	4214	4222	small	0.018	0.064	3
130120 x	4.75	4.75	0.10	1225	3.40	5.49	6679	6687	channel	0.001	0.035	1
160120	4.00	5.00	1.00	14018	3.89	4.56	913	922	small	0.015	0.064	3
120110	5.00	5.50	0.50	10283	5.71	6.32	11335	11343	channel	0.001	0.035	1
110100 x	5.50	5.50	0.10	2465	6.85	6.35	11501	11509	channel	0.001	0.035	1
100400 x	4.25	5.75	0.75	12851	4.76	6.60	13376	13385	channel	0.001	0.035	4
350310	4.00	8.25	4.25	77773	5.08	4.12	3746	3753	medium	0.009	0.064	23
310200	5.25	6.75	1.50	24622	4.56	4.27	22345	22338	large	0.005	0.046	3
220200 **	4.75	7.00	2.25	26218	3.24	5.31	12831	12836	medium	0.004	0.046	4
480460	4.75	5.50	0.75	18660	6.91	9.12	12220	12225	small	0.017	0.064	3
460420	5.50	8.75	3.25	53954	4.61	5.10	7459	7466	medium	0.010	0.064	9
420200 **	4.75	7.25	2.50	26213	2.91	5.36	9541	9545	medium	0.005	0.046	8
200400	6.50	7.25	0.75	16311	6.04	5.38	55530	55516	large	0.005	0.046	3
400510 x	7.00	7.25	0.15	2671	4.95	9.99	67060	67063	channel	0.001	0.035	1
580510	5.00	7.50	2.50	39351	4.37	4.50	27516	27513	large	0.005	0.046	11
510500	7.25	7.75	0.50	7342	4.08	10.83	92019	92020	channel	0.001	0.035	1
520500 **	4.75	7.25	2.50	34143	3.79	5.96	11122	11125	medium	0.006	0.046	4
540500	5.00	7.50	2.50	32882	3.65	5.45	6209	6215	medium	0.007	0.046	4
500500 x **	7.75	7.75	0.10	2214	6.15	11.29	108611	108615	channel	0.001	0.035	1
500600	7.75	8.50	0.75	18203	6.74	11.31	109268	109270	channel	0.001	0.035	3
640600	5.00	7.50	2.50	31873	3.54	5.66	7187	7194	medium	0.007	0.046	7
600710	8.50	8.75	0.25	4403	4.89	11.46	115101	115101	channel	0.001	0.035	1
760710 **	5.00	7.50	2.50	28446	3.16	6.42	9709	9714	medium	0.008	0.046	9
740710	4.50	7.25	2.75	27269	2.75	2.77	443	452	medium	0.007	0.046	10
710700	8.75	9.25	0.50	7571	4.21	11.58	120287	120292	channel	0.001	0.035	1
735700	4.50	5.75	1.25	27046	6.01	5.16	3873	3881	small	0.008	0.064	8

* Time lapse less than time step of 15 minutes, so 1 time step was assumed for HEC-1 Velocity Calculation

** Modified Typical X-Section

x Modified Time To Peak Used

Entellus

SHEET	12	OF	13
BY	RAS	DATE	12/11/2003
CHECK	JCS	DATE	12/12/2003
JOB NO.	310.032		

CLIENT: FCDMC

JOB: Wittmann Area Drainage Master Study Update: McMicken Dam Hydrology

Storm: 72-hr PMP Future Conditions **Route N-Step vs Velocity**

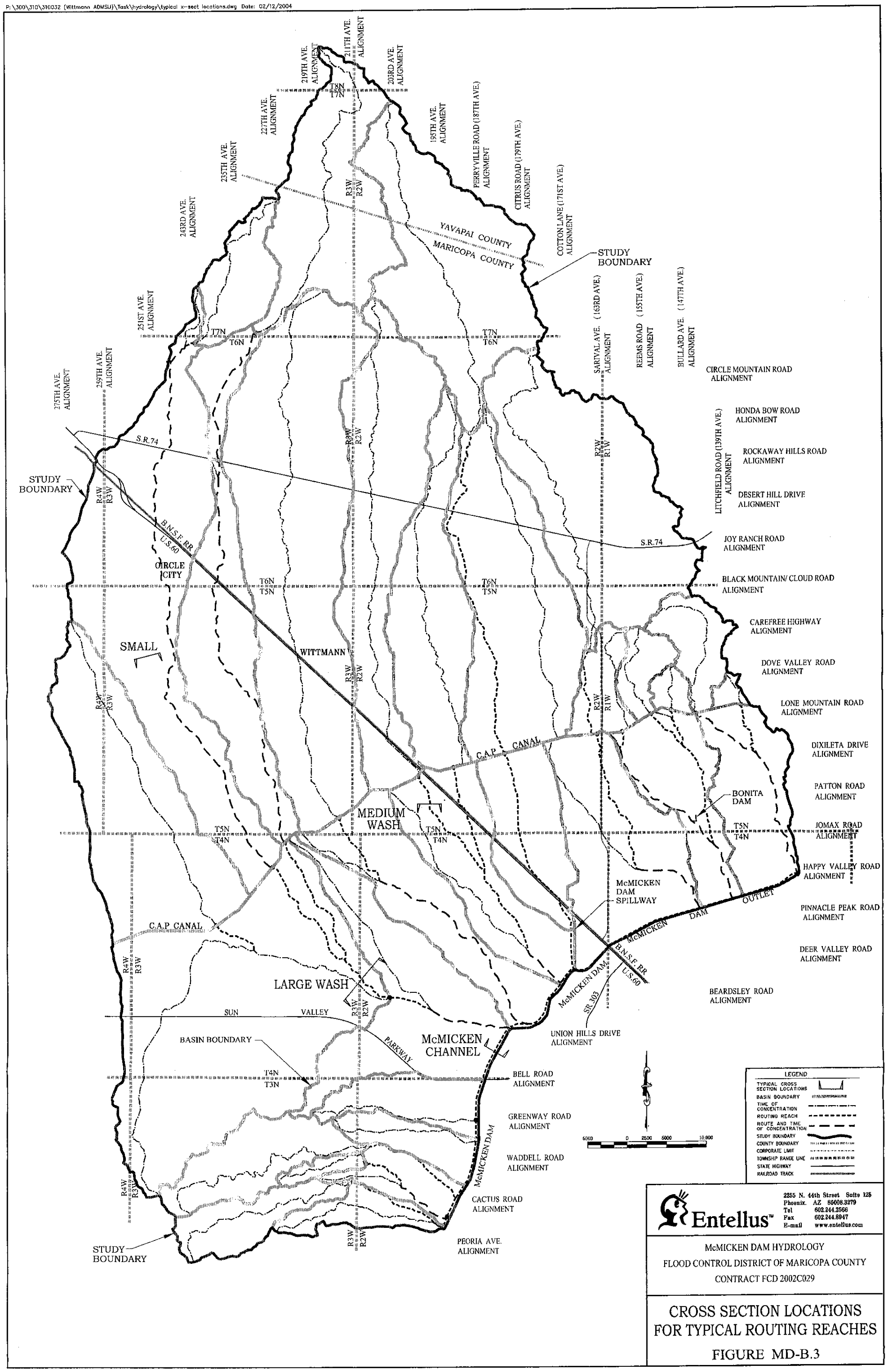
Route	Previous time to Peak [hr]	Route Time to Peak [hr]	Difference in Time to peak [hr]	Route Length [ft]	HEC-1 Velocity [fps]	Normal Depth Velocity [fps]	HEC-1 Flow [cfs]	Normal Depth Flow [cfs]	X-sect Type	Route Slope [ft/ft]	Manning's n Value	HEC-1 nstep
680640 **	18.25	21.25	3.00	45524	4.22	6.22	9990	9997	medium	0.014	0.064	8
780760 x **	18.25	18.25	0.50	12100	6.72	5.72	11814	11820	medium	0.010	0.064	2
640505 **	18.25	19.25	1.00	25169	6.99	6.72	9789	9793	medium	0.009	0.046	2
505500 x **	18.50	19.00	0.25	5161	5.73	5.31	12849	12852	medium	0.004	0.046	1
150120 x	18.25	18.50	0.60	14187	6.57	5.90	3194	3202	small	0.013	0.064	3
140130 x	18.25	18.50	0.75	14043	5.20	5.99	2082	2090	small	0.018	0.064	3
130120 x	18.25	18.25	0.10	1225	3.40	4.61	3538	3547	channel	0.001	0.035	1
160120 x	18.25	18.25	1.00	14018	3.89	3.85	458	468	small	0.015	0.064	3
120110 x	18.25	18.50	0.50	10283	5.71	5.89	8668	8677	channel	0.001	0.035	1
110100 x	18.25	18.25	0.15	2465	4.56	6.16	10261	10270	channel	0.001	0.035	1
100400	18.25	18.75	0.50	12851	7.14	6.46	12283	12292	channel	0.001	0.035	4
350310 x	18.25	20.25	4.50	77773	4.80	3.77	2644	2653	medium	0.009	0.064	23
310200 x	18.50	19.50	1.50	24622	4.56	4.10	19199	19195	large	0.005	0.046	3
220200	18.25	19.50	1.25	26218	5.83	5.15	11374	11379	medium	0.004	0.046	4
480460 x	18.25	18.50	0.50	18660	10.37	8.28	8327	8333	small	0.017	0.064	3
460420	18.25	21.00	2.75	53954	5.45	5.09	7400	7407	medium	0.010	0.064	9
420200	18.25	20.00	1.75	26213	4.16	5.84	13440	13446	medium	0.005	0.046	8
200400	19.25	20.00	0.75	16311	6.04	5.45	58113	58108	large	0.005	0.046	3
400510 x	19.25	19.50	0.10	2671	7.42	10.20	72788	72792	channel	0.001	0.035	1
580510 x	18.25	19.50	2.50	39351	4.37	4.14	19884	19882	large	0.005	0.046	11
510500	19.25	19.50	0.25	7342	8.16	10.98	97162	97167	channel	0.001	0.035	1
520500	18.25	20.25	2.00	34143	4.74	5.64	8890	8895	medium	0.006	0.046	4
540500 x	18.25	19.00	1.75	32882	5.22	5.73	7561	7567	medium	0.007	0.046	4
500500 x	19.50	19.50	0.05	2214	12.30	11.46	115418	115419	channel	0.001	0.035	1
500600	19.50	20.00	0.50	18203	10.11	11.72	126156	126158	channel	0.001	0.035	3
640600	18.25	20.50	2.25	31873	3.93	6.16	10095	10100	medium	0.007	0.046	7
600710 x	20.25	20.50	0.15	4403	8.15	11.95	136257	136259	channel	0.001	0.035	1
760710 **	18.25	19.25	1.00	28446	7.90	6.58	10717	10722	medium	0.008	0.046	9
740710	18.25	20.00	1.75	27269	4.33	2.72	415	424	medium	0.007	0.046	10
710700	20.25	20.50	0.25	7571	8.41	12.17	146342	146344	channel	0.001	0.035	1
735700 x	18.25	18.75	2.00	27046	3.76	4.42	2082	2091	small	0.008	0.064	8

* Time lapse less than time step of 15 minutes, so 1 time step was assumed for HEC-1 Velocity Calculation

** Modified Typical X-Section

x Modified Time To Peak Used

P:\300\310\310032 (Wittmann ADMSU)\Task\hydrology\typical x-sect locations.dwg Date: 02/12/2004



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McMICKEN DAM HYDROLOGY

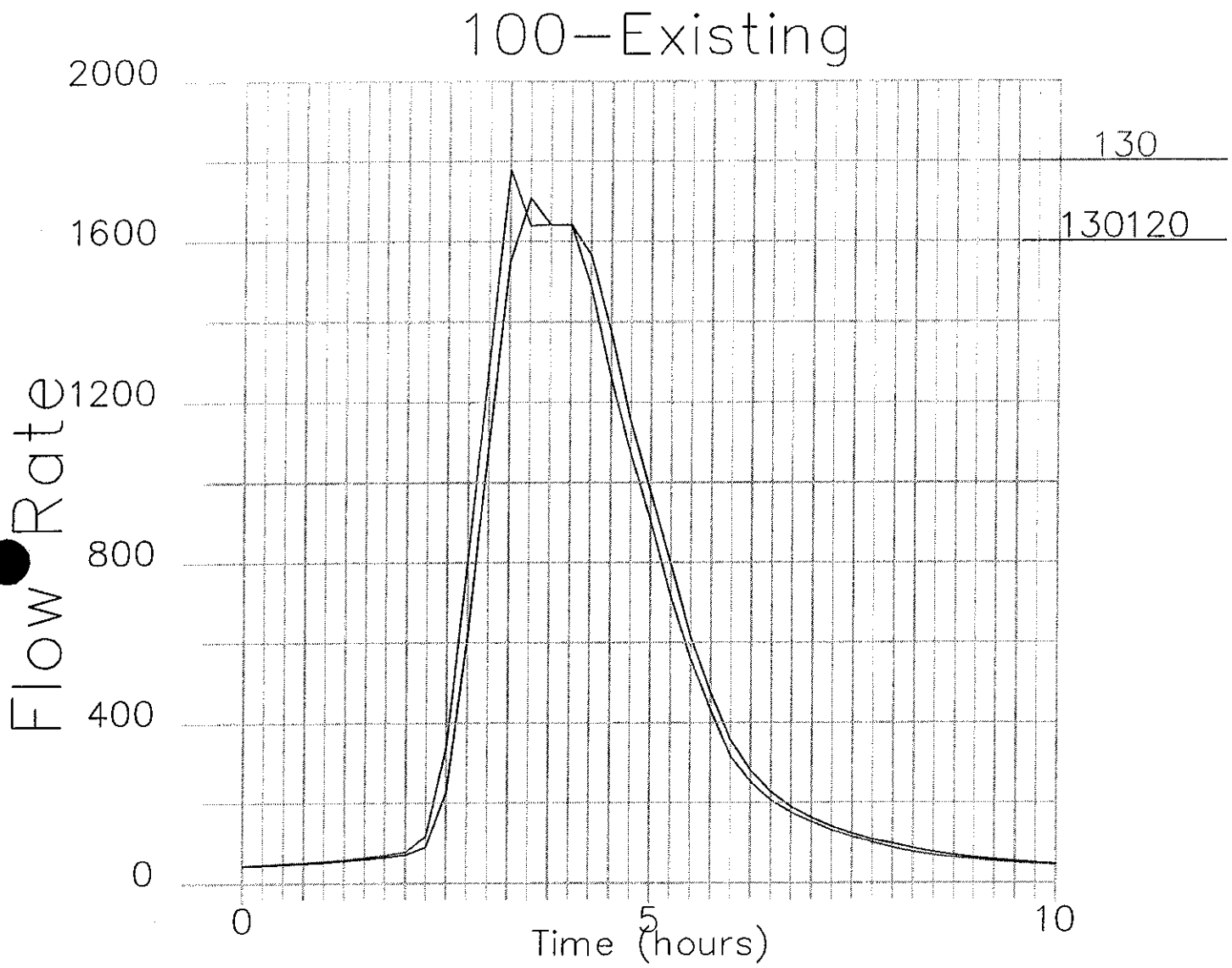
FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

CONTRACT FCD 2002C029

CROSS SECTION LOCATIONS FOR TYPICAL ROUTING REACHES

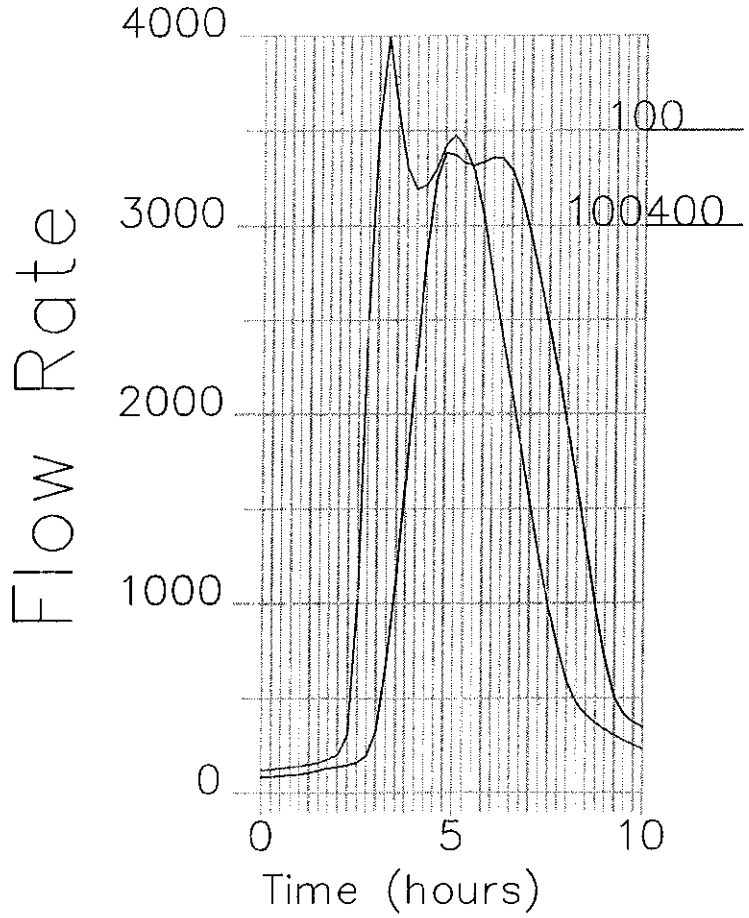
FIGURE MD-B.3

Route Velocity Check for 100-Yr Existing



A difference in
Time to Peak of
0.10 hrs was used

100—Existing



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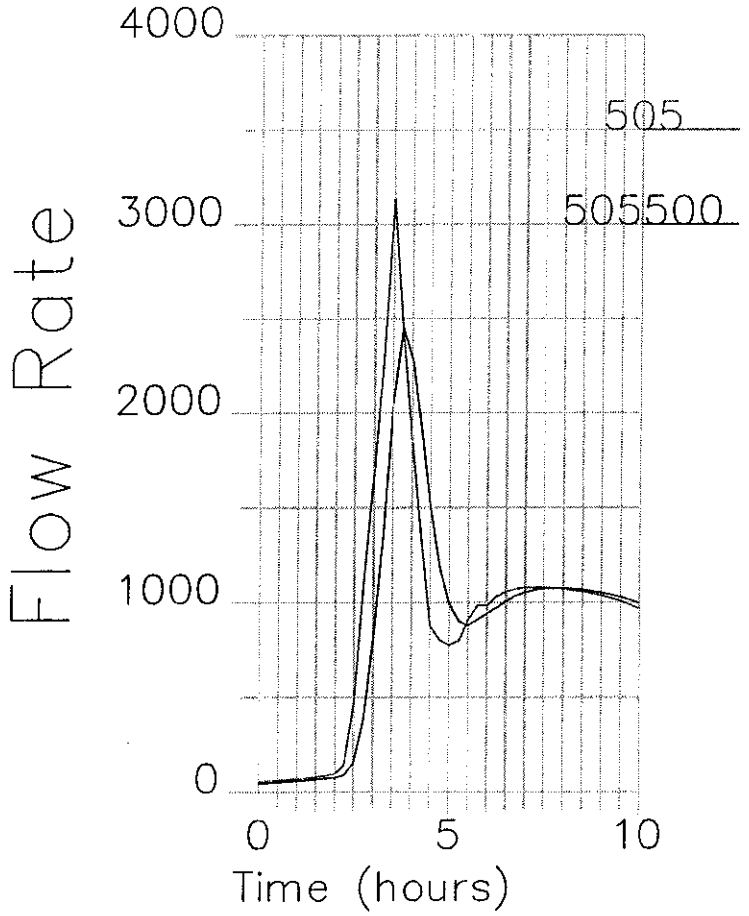
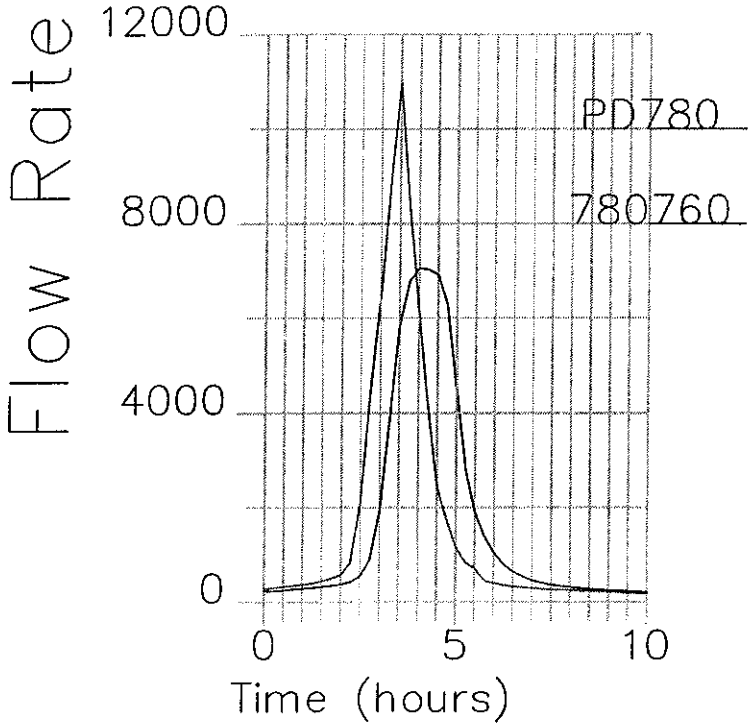
Time to Peak of
1.00 hrs was used

100–Existing

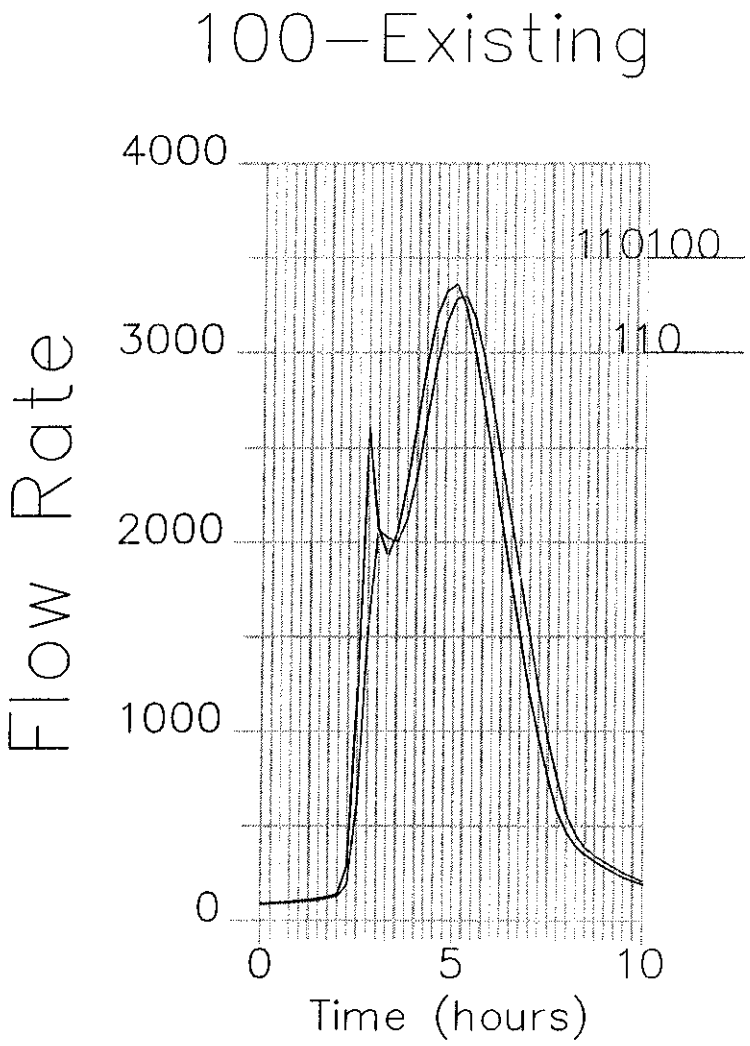


A difference in
Time to Peak of
0.40 hrs was used

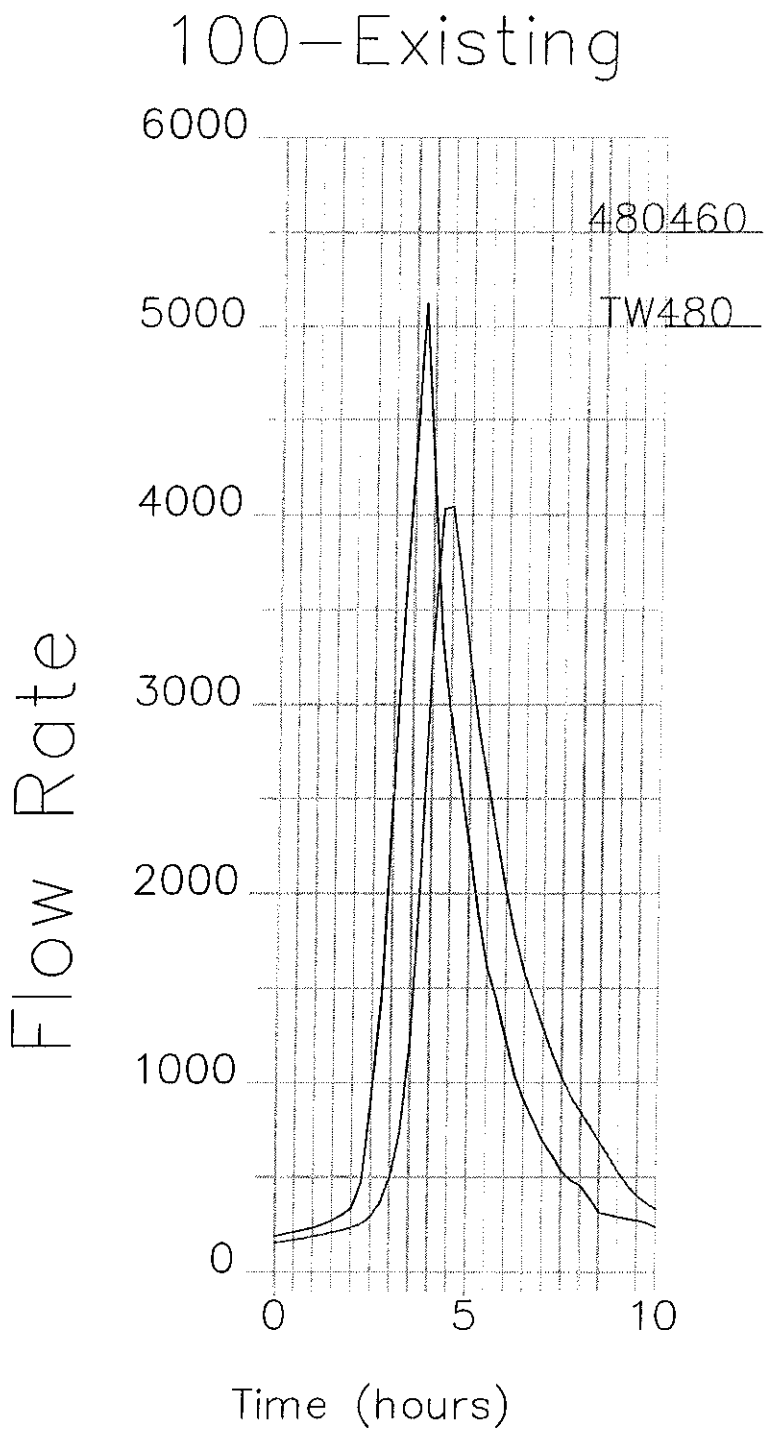
100–Existing



A difference in
Time to Peak of
0.60 hrs was used

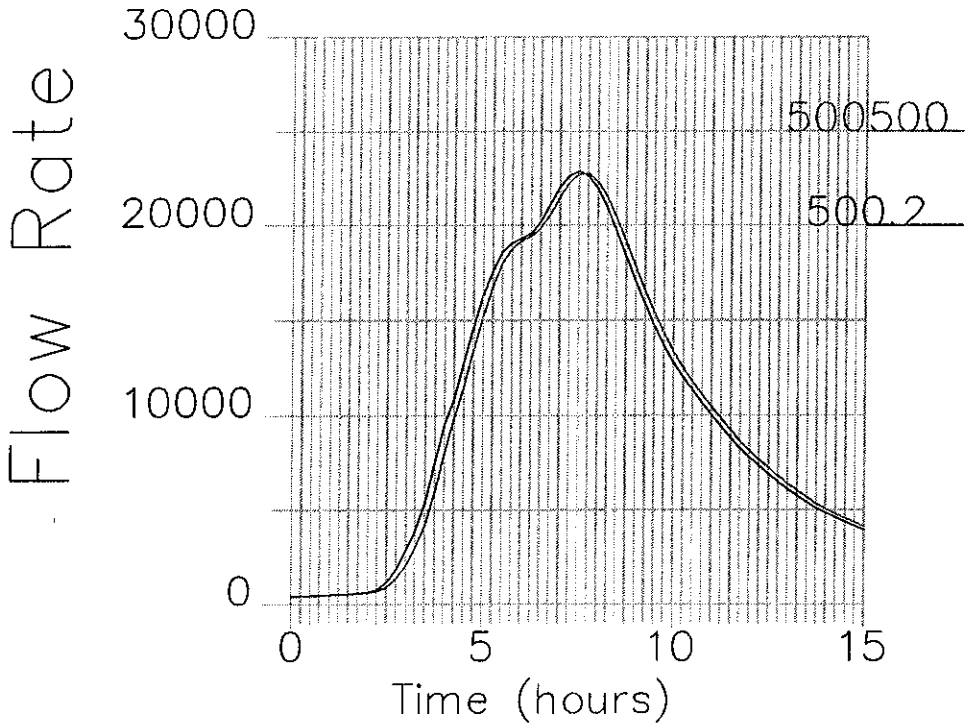


A difference in
Time to Peak of
0.20 hrs was used



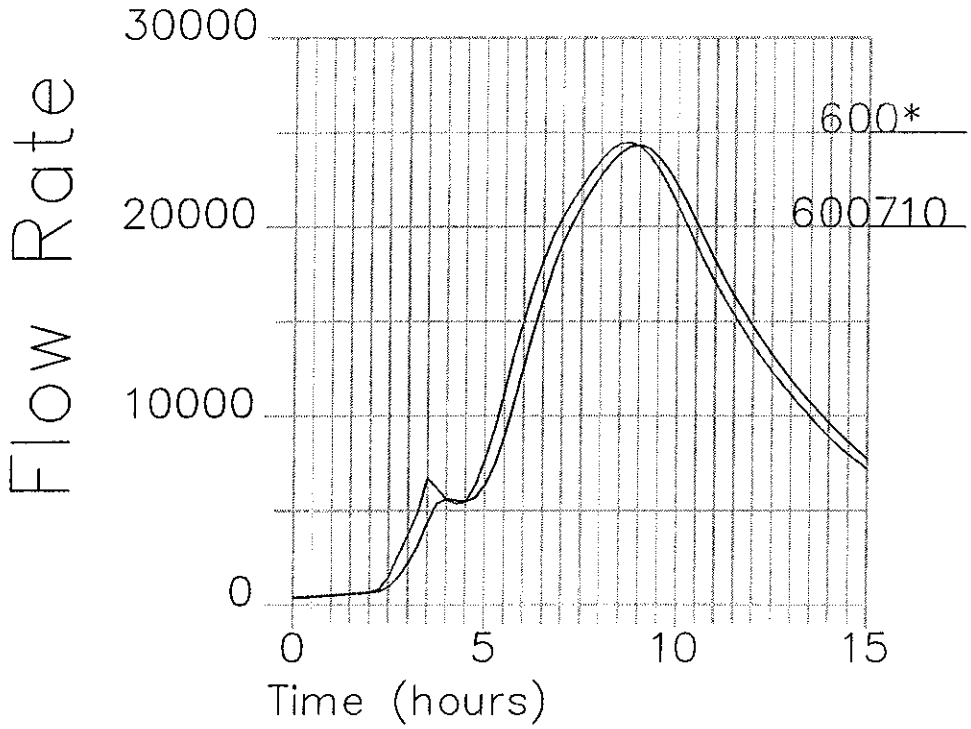
A difference in Time to Peak of 0.80 hrs was used

100–Existing



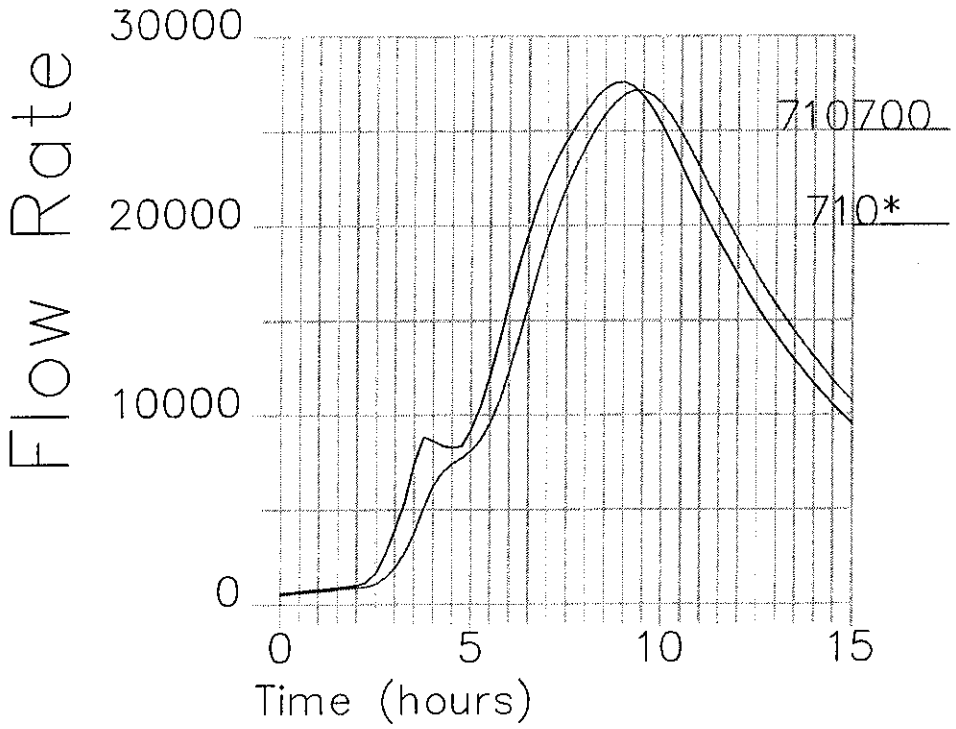
A difference in
Time to Peak of
0.10 hrs was used

100–Existing



A difference in
Time to Peak of
0.25 hrs was used

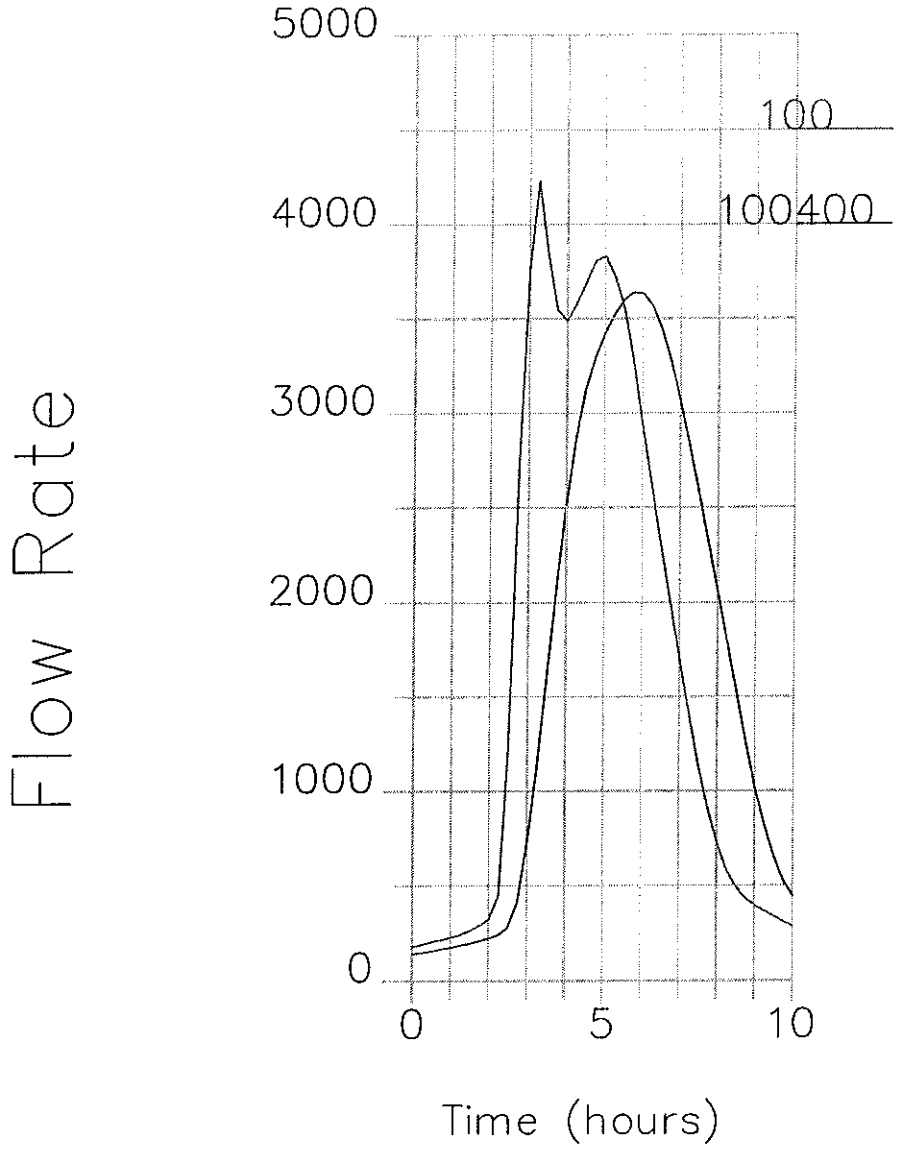
100–Existing



A difference in
Time to Peak of
0.40 hrs was used

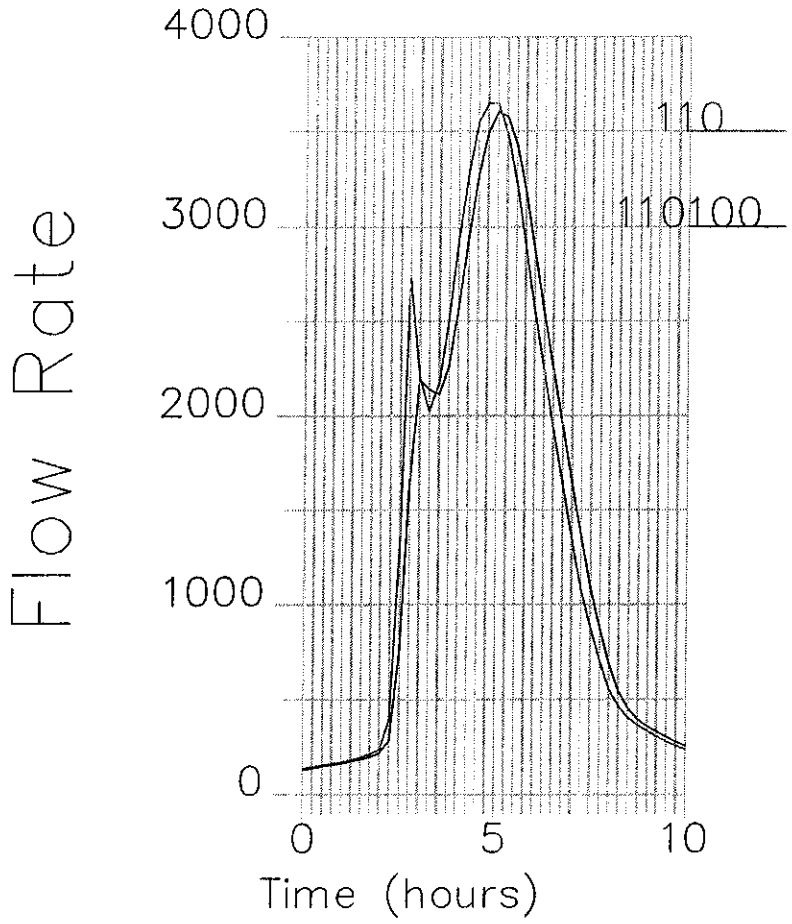
Route Velocity Check for 100-Yr Future

100–Future



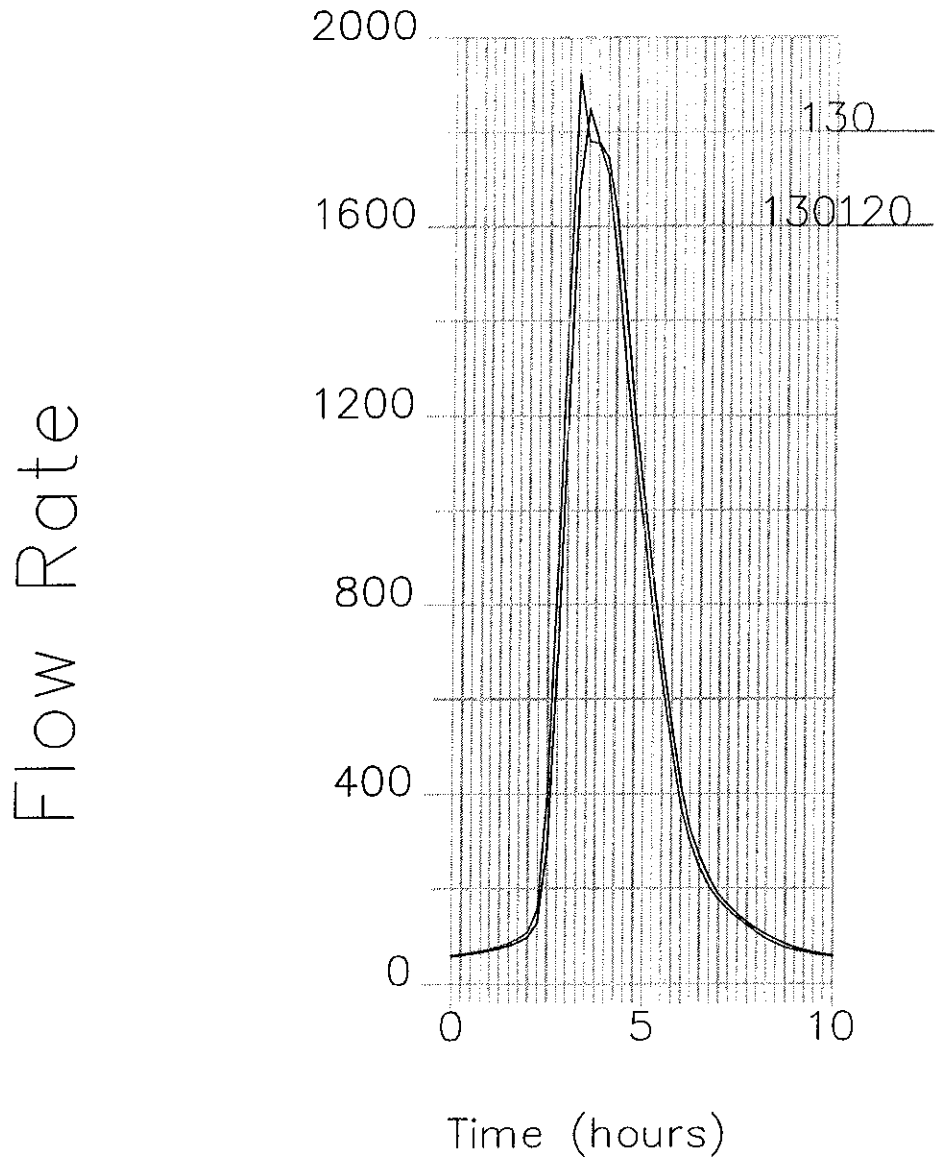
A difference in
Time to Peak of
0.75 hrs was used

100–Future



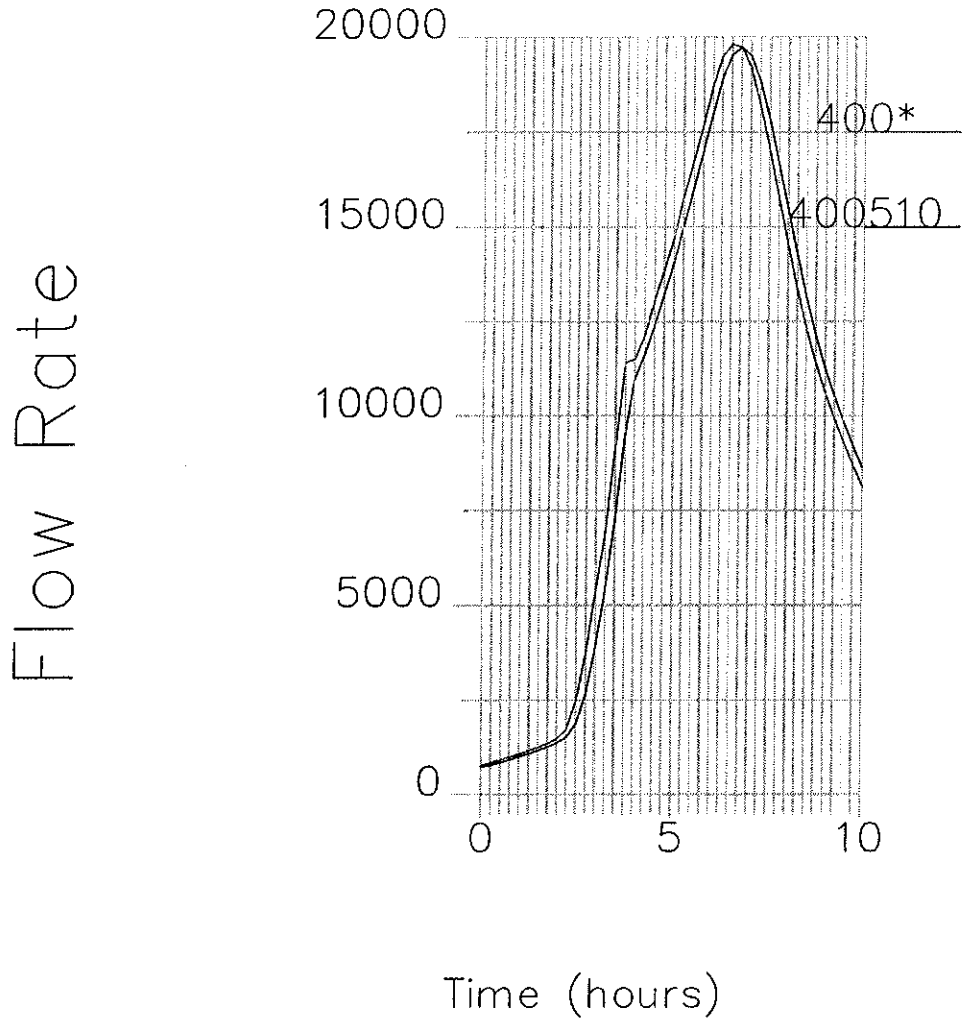
A difference in
Time to Peak of
0.20 hrs was used

100–Future



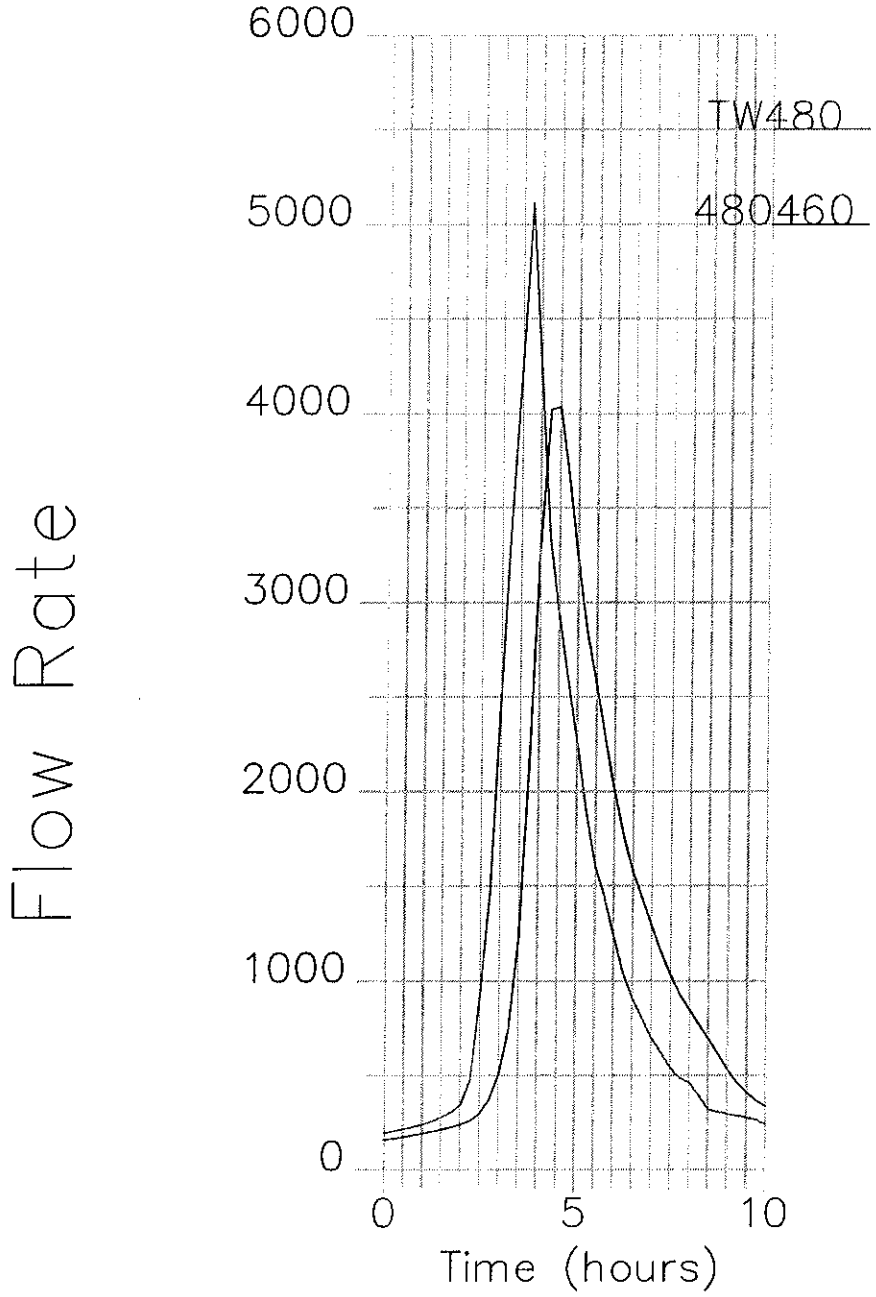
A difference in
Time to Peak of
0.10 hrs was used

100-Future



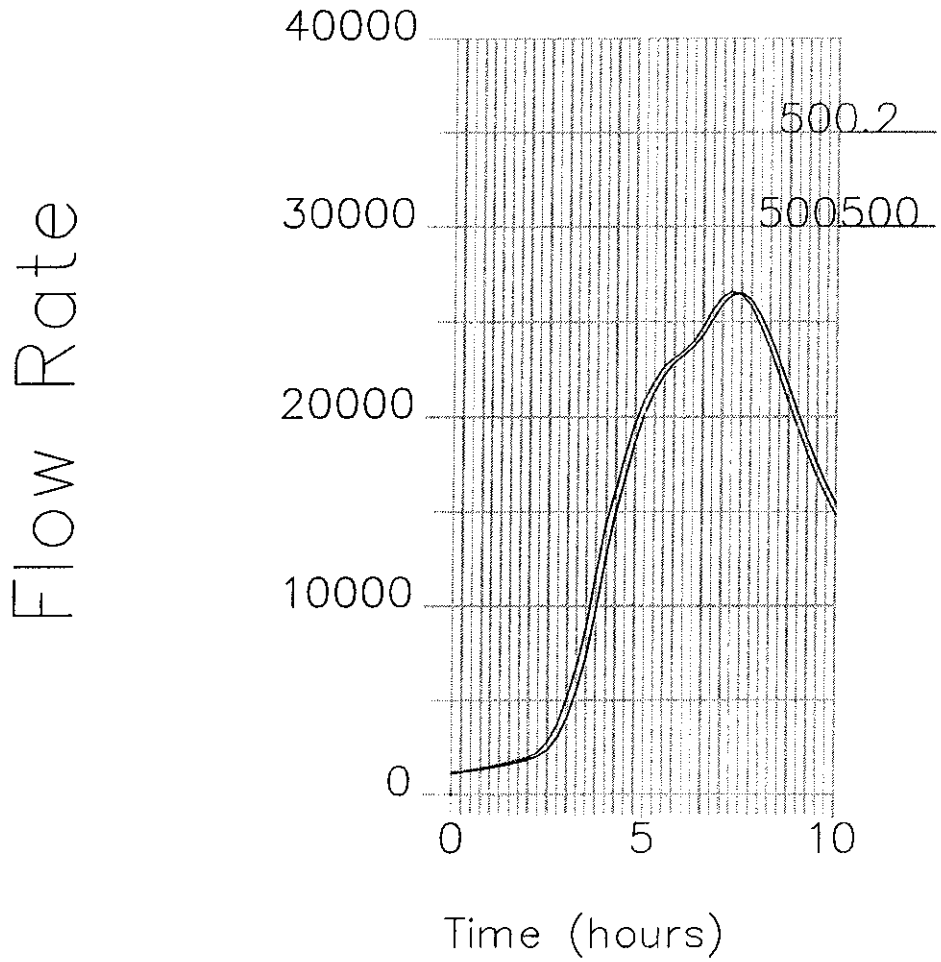
A difference in
Time to Peak of
0.10 hrs was used

100-Future



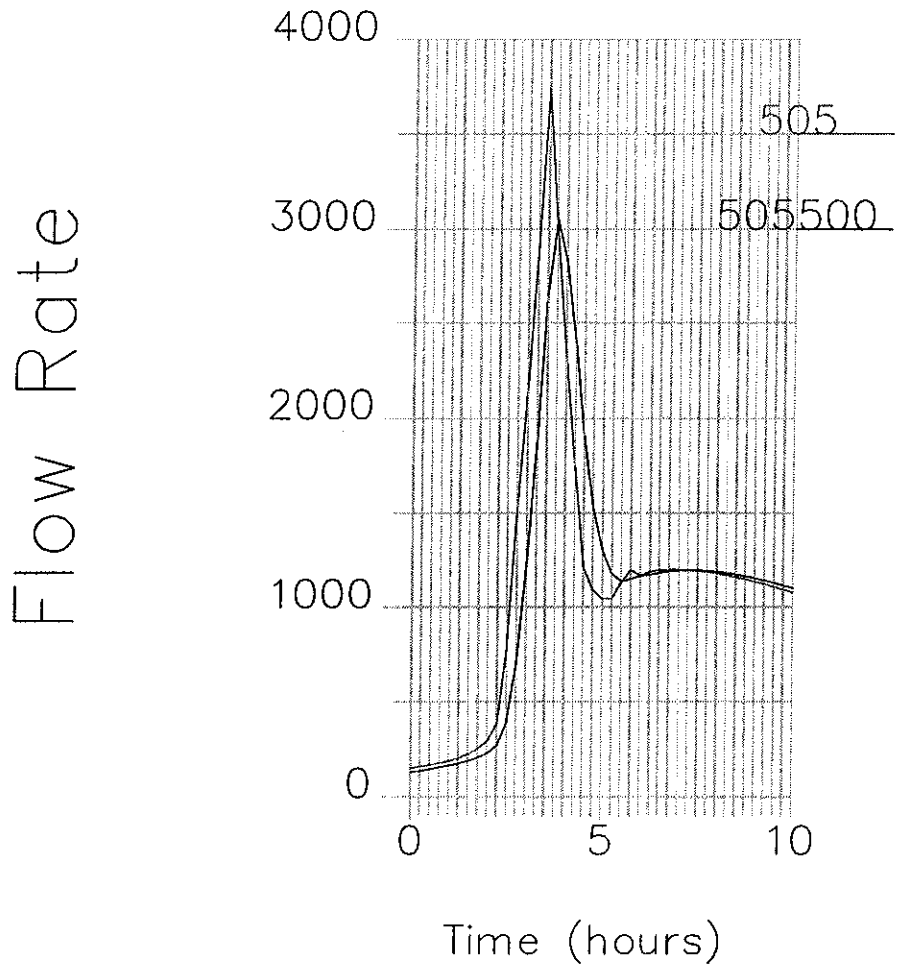
A difference in
Time to Peak of
0.75 hrs was used

100–Future



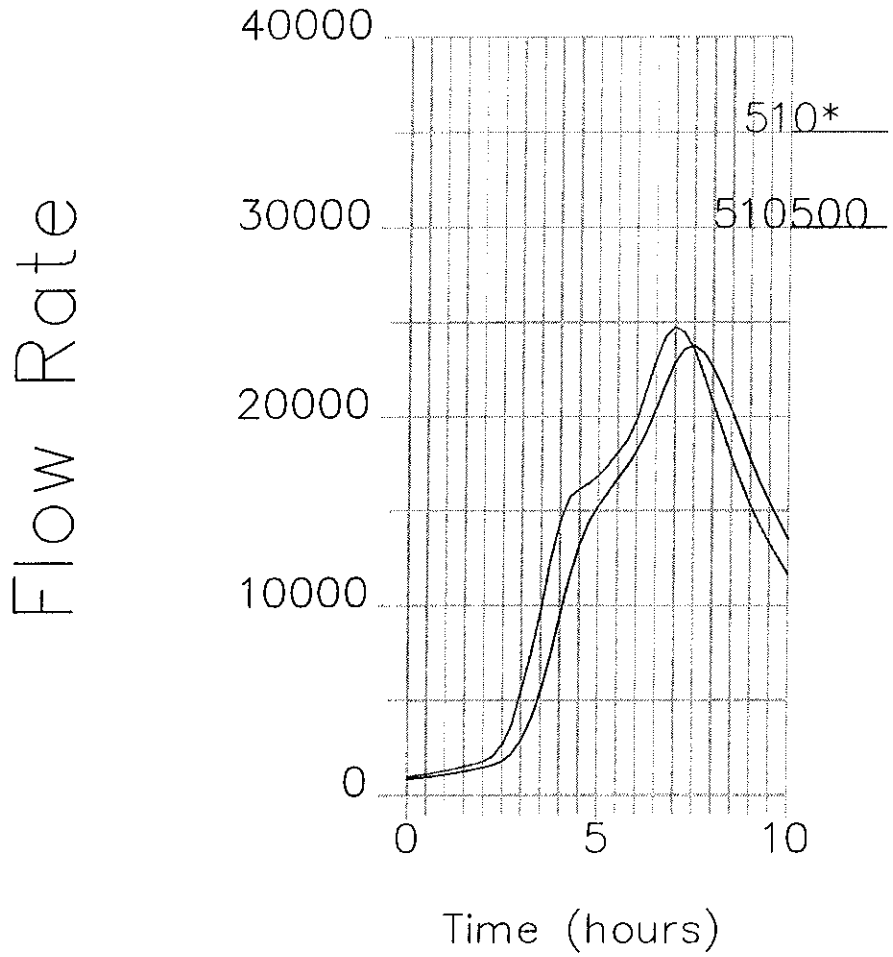
A difference in
Time to Peak of
0.10 hrs was used

100–Future



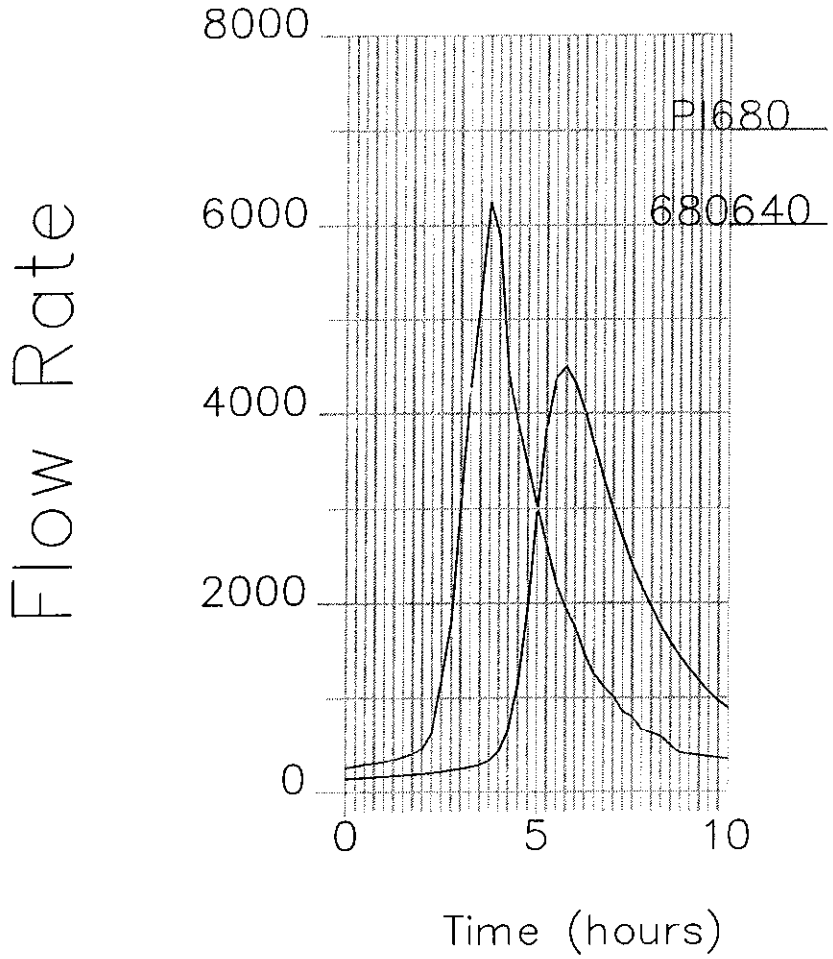
A difference in
Time to Peak of
0.35 hrs was used

100–Future



A difference in
Time to Peak of
0.40 hrs was used

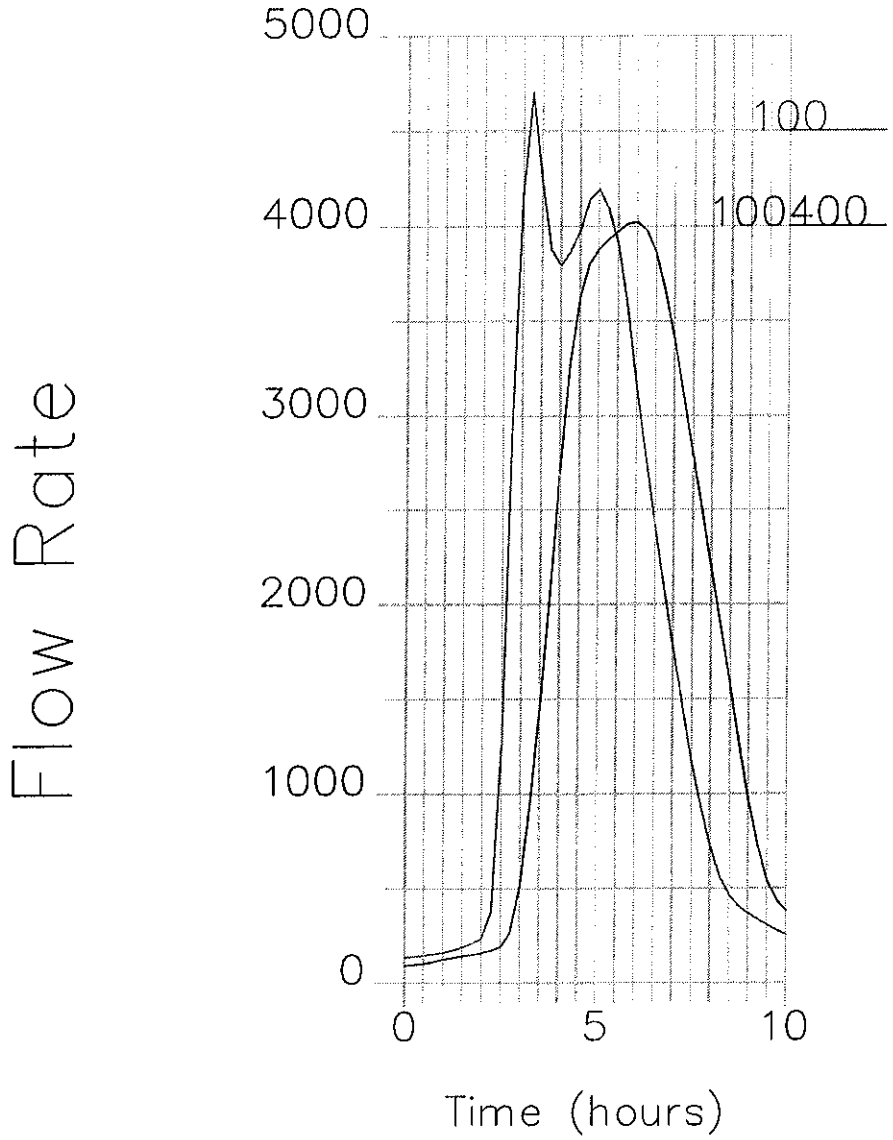
100–Future



A difference in
Time to Peak of
1.75 hrs was used

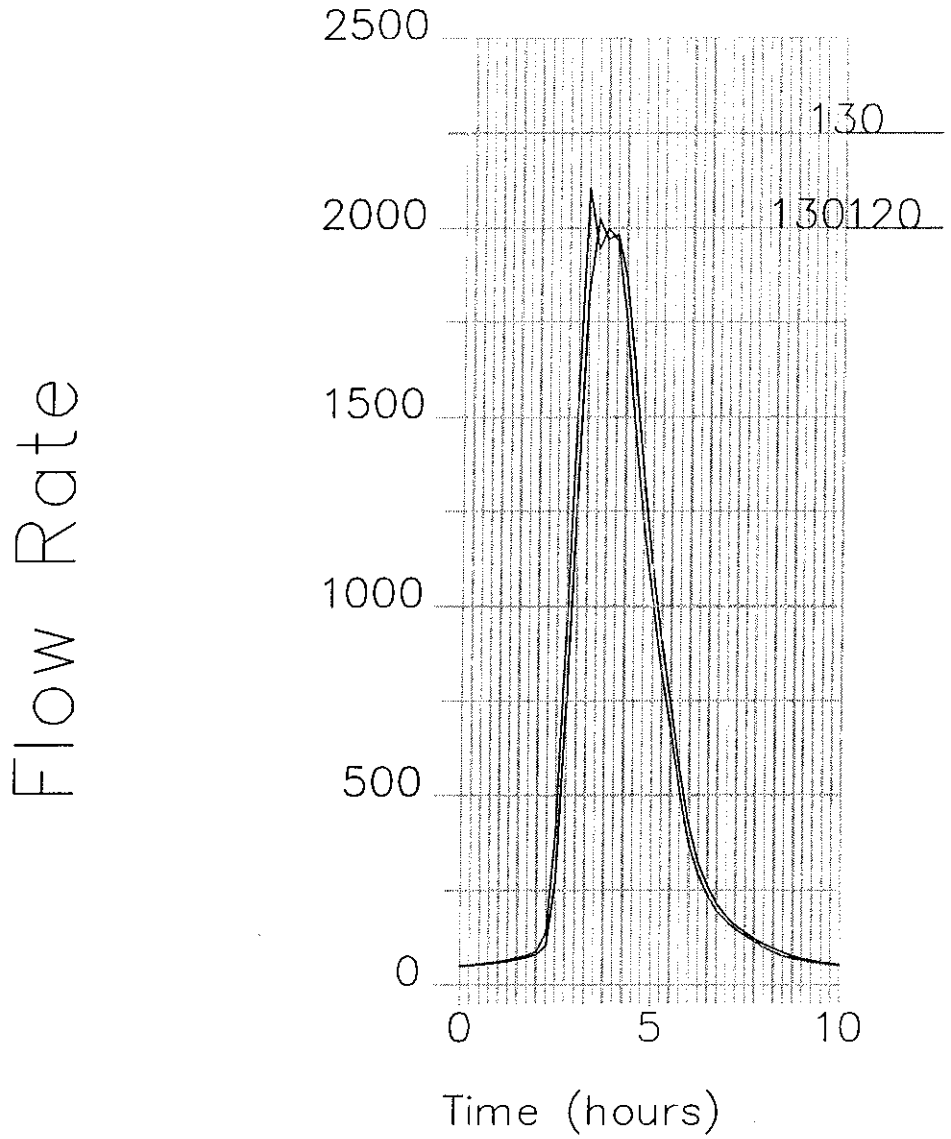
Route Velocity Check for 200-Yr Existing

200—Existing



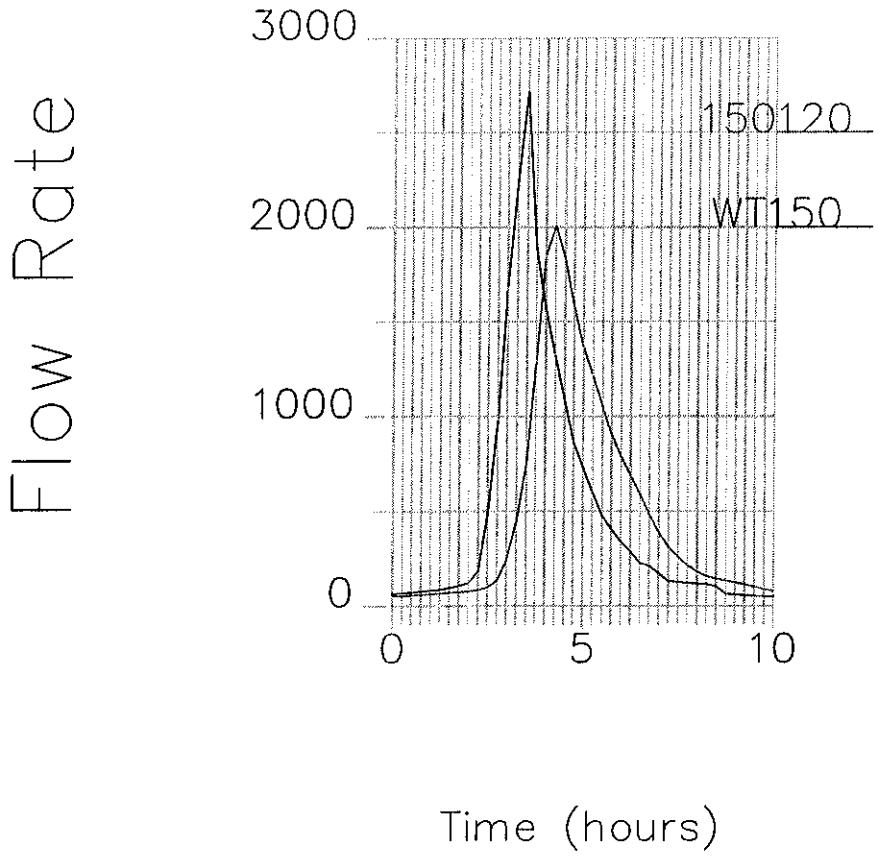
A difference in
Time to Peak of
1.00 hrs was used

200—Existing



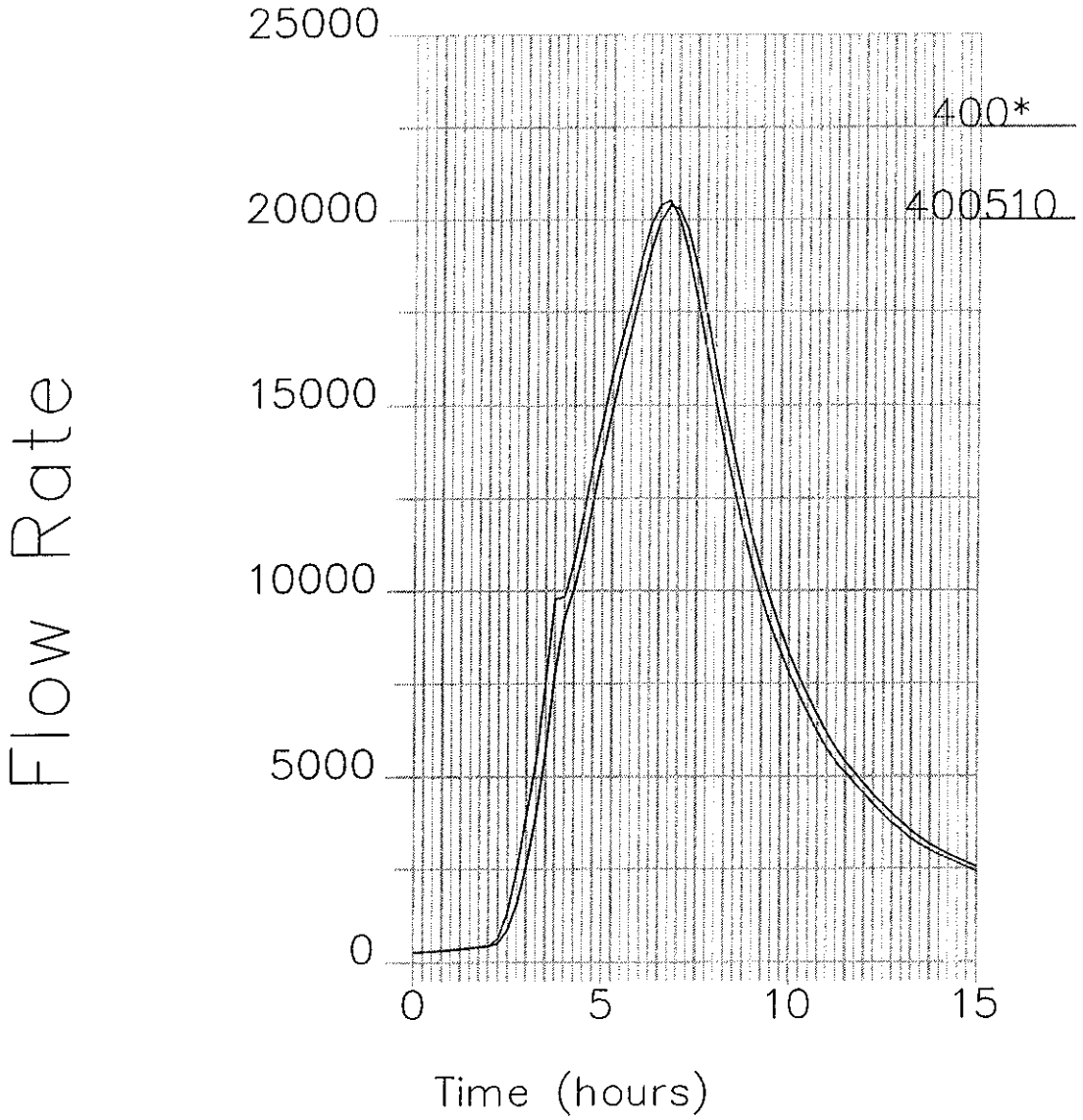
A difference in
Time to Peak of
0.10 hrs was used

200–Existing



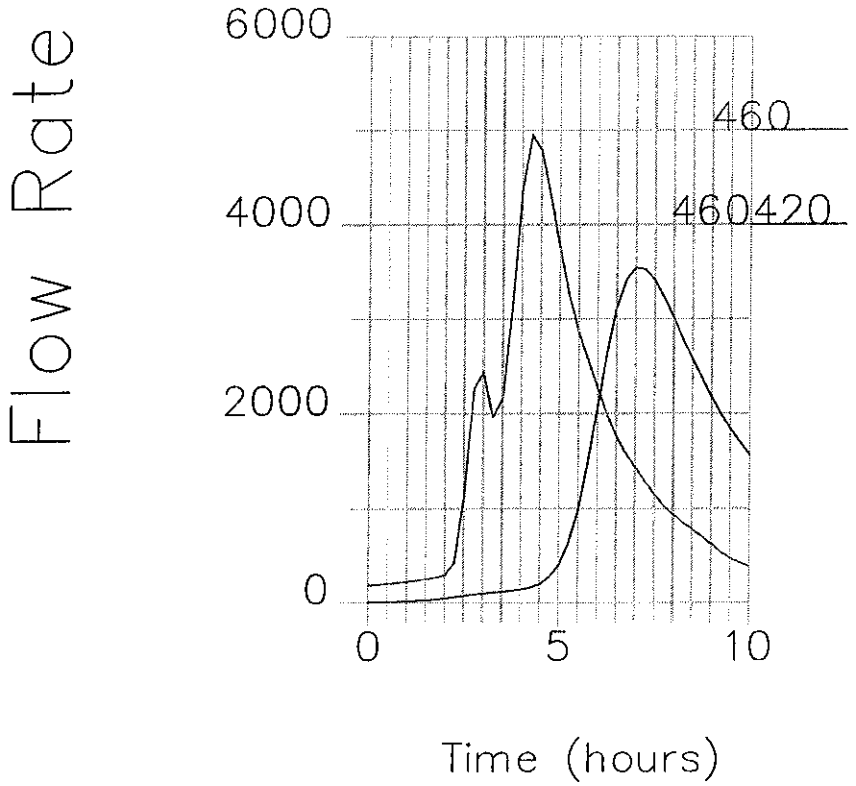
A difference in
Time to Peak of
0.75 hrs was used

200–Existing



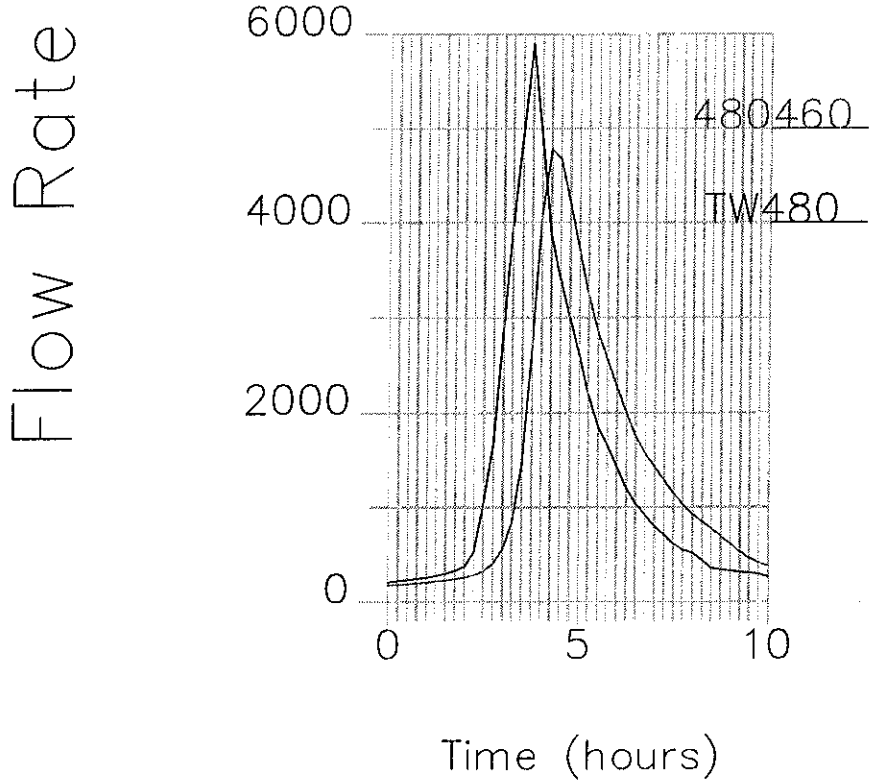
A difference in
Time to Peak of
0.10 hrs was used

200–Existing



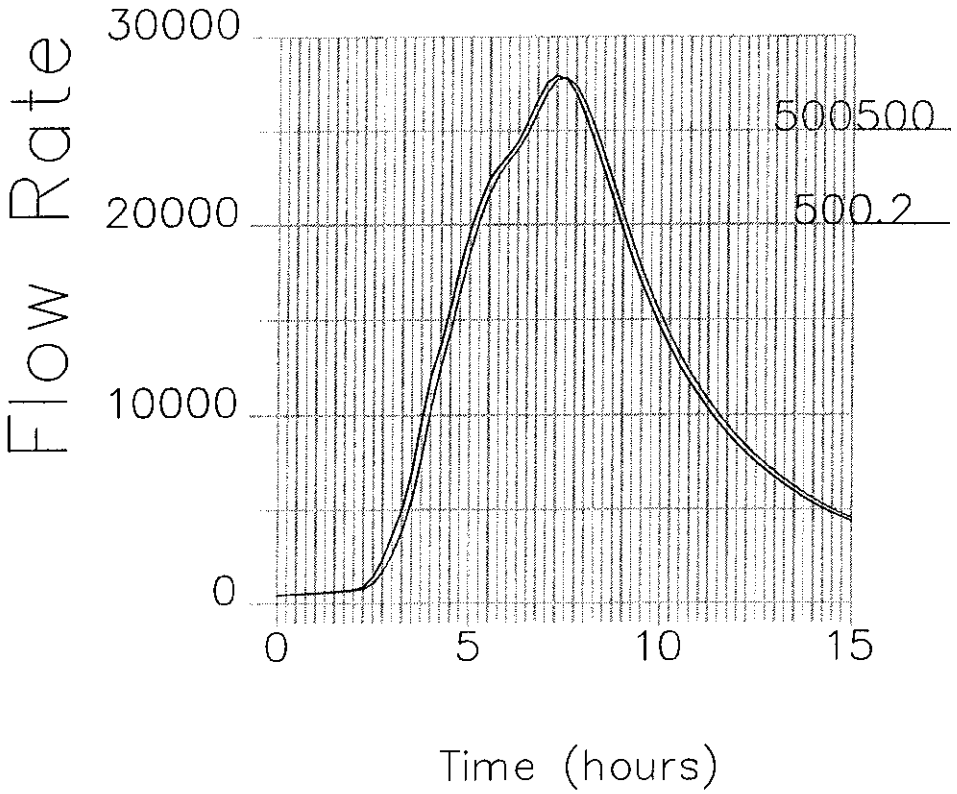
A difference in
Time to Peak of
2.75 hrs was used

200–Existing



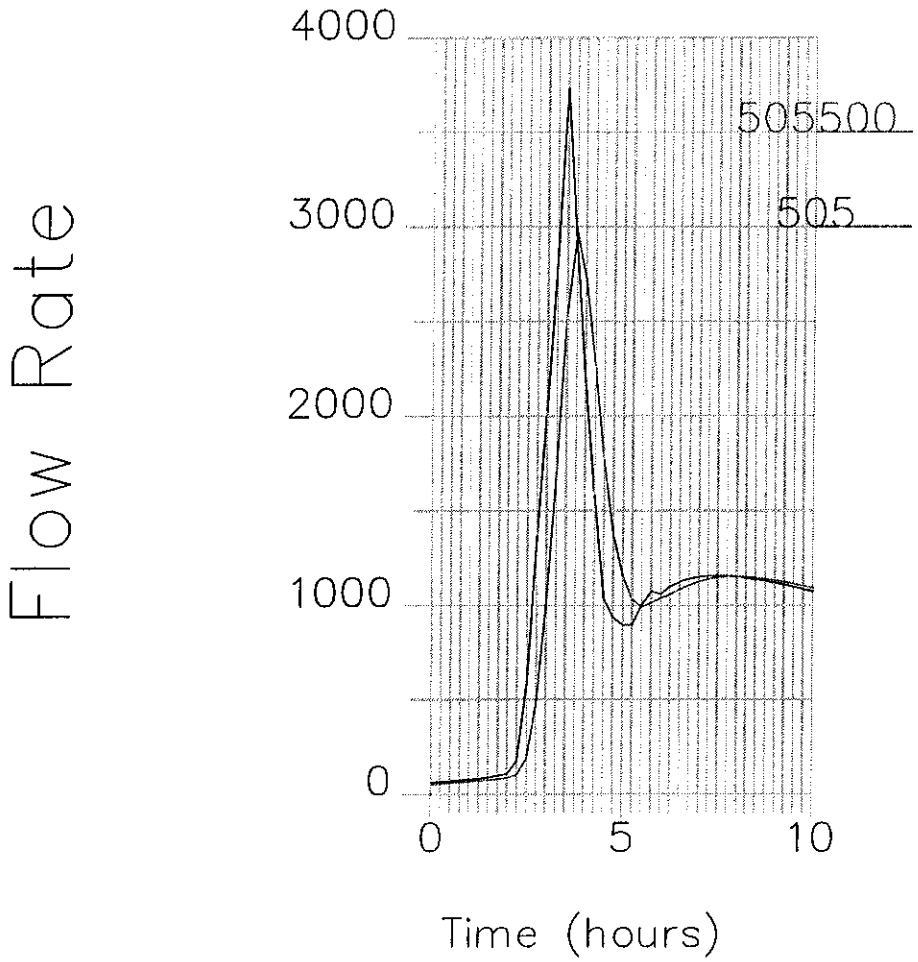
A difference in
Time to Peak of
0.75 hrs was used

200–Existing



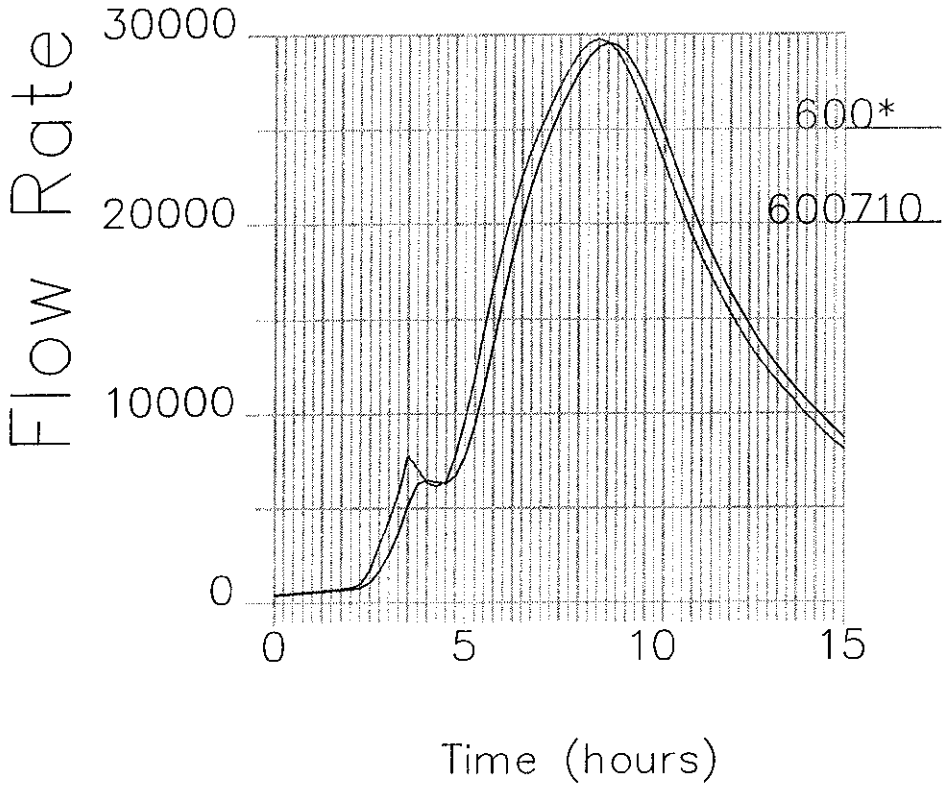
A difference in
Time to Peak of
0.10 hrs was used

200–Existing



A difference in
Time to Peak of
0.30 hrs was used

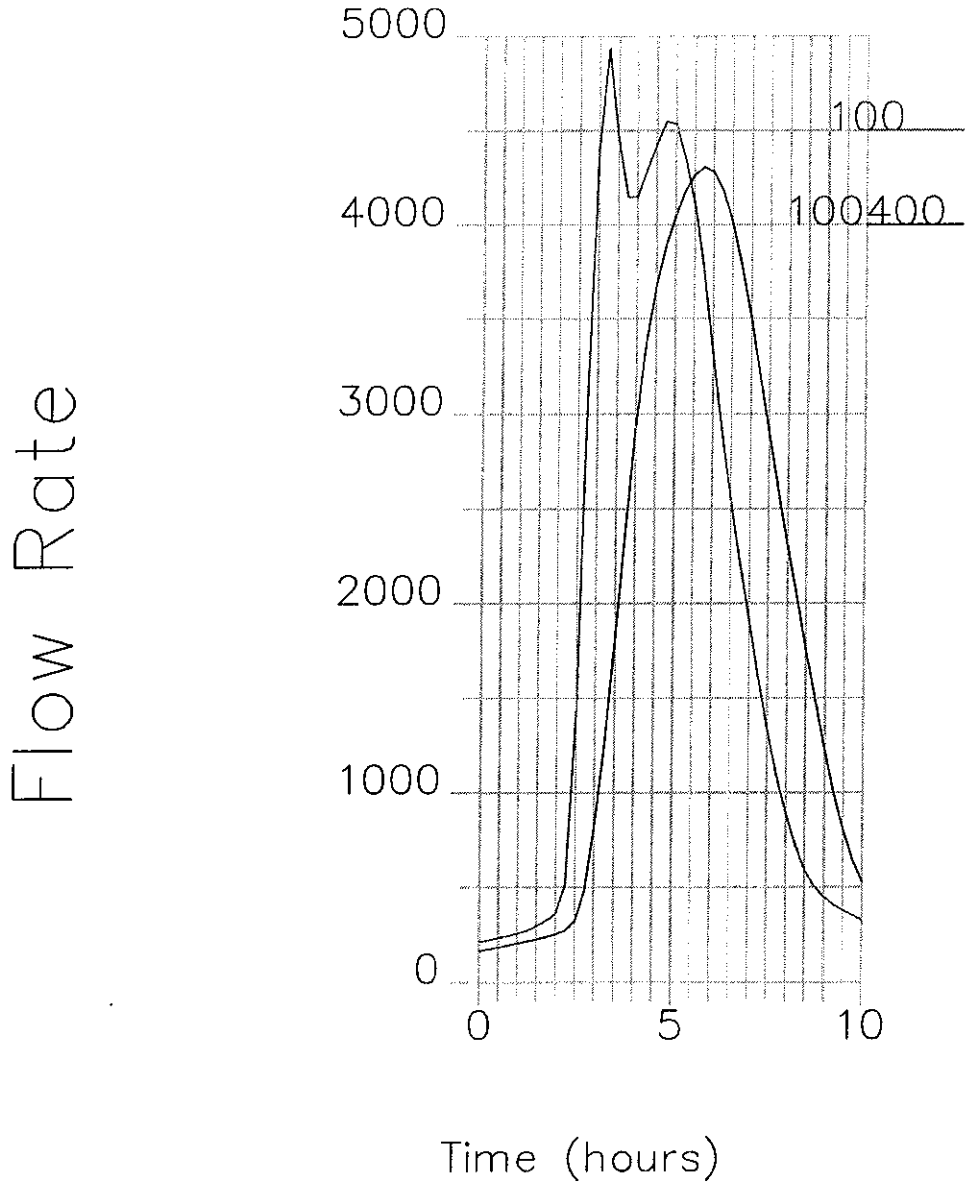
200–Existing



A difference in
Time to Peak of
0.20 hrs was used

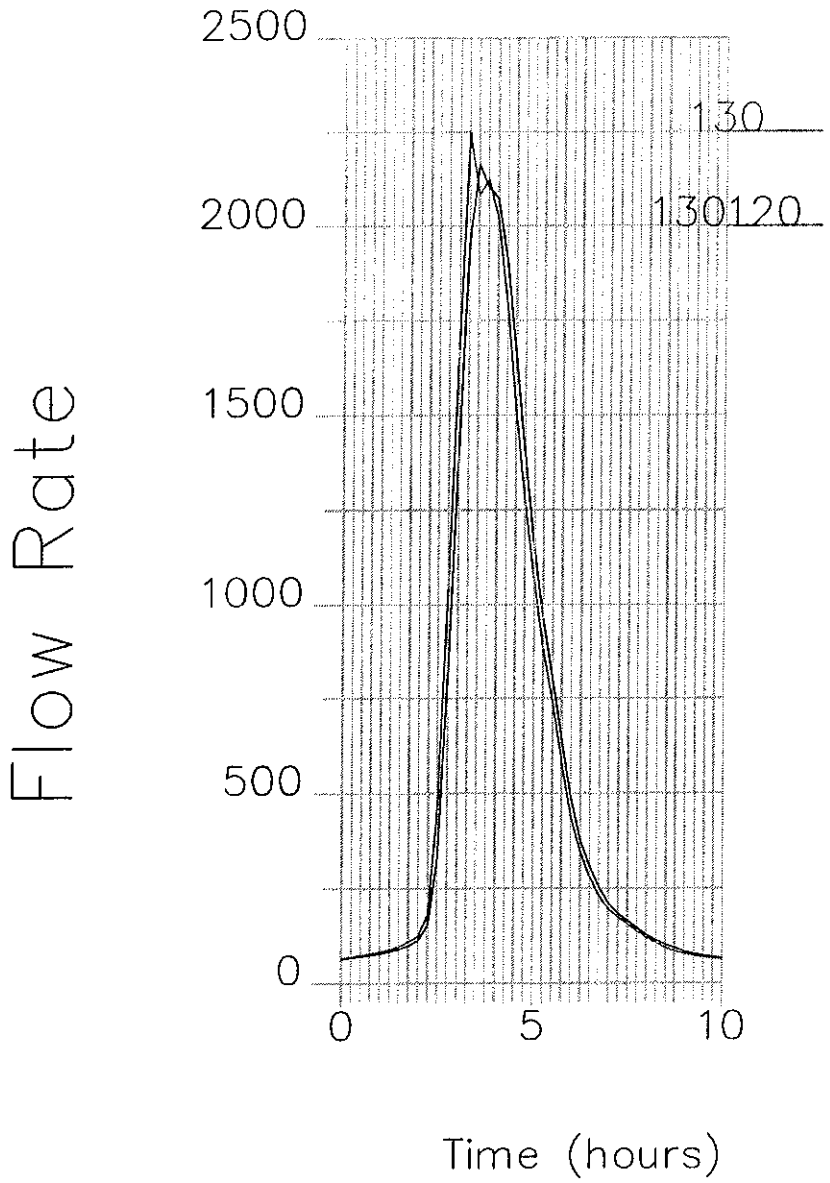
Route Velocity Check for 200-Yr Future

200–Future



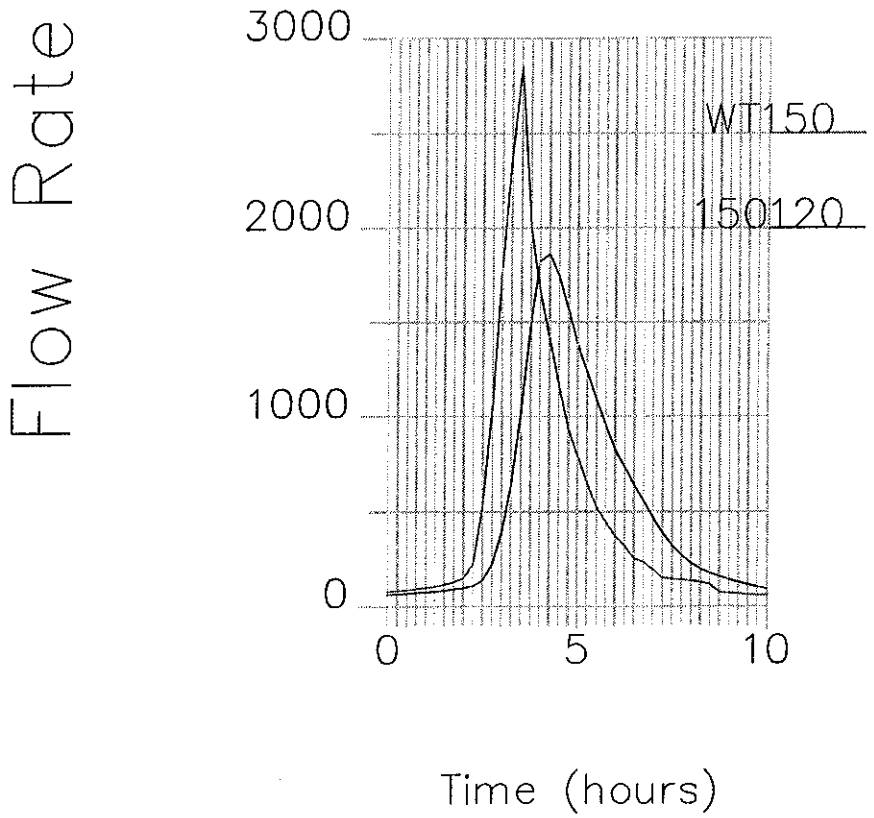
A difference in
Time to Peak of
1.00 hrs was used

200–Future



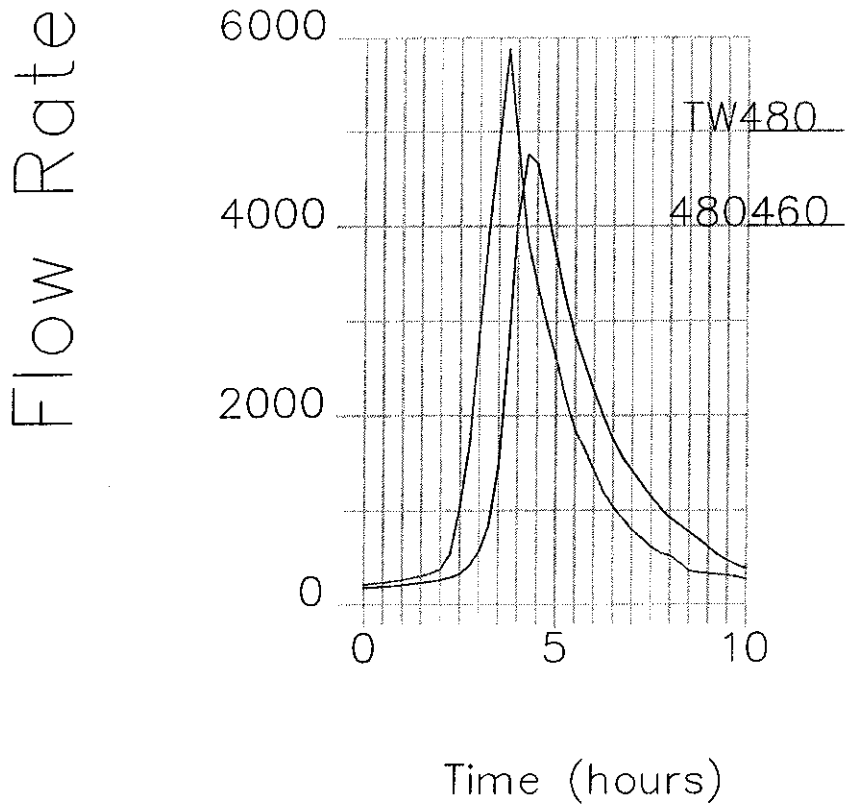
A difference in
Time to Peak of
0.10 hrs was used

200–Future



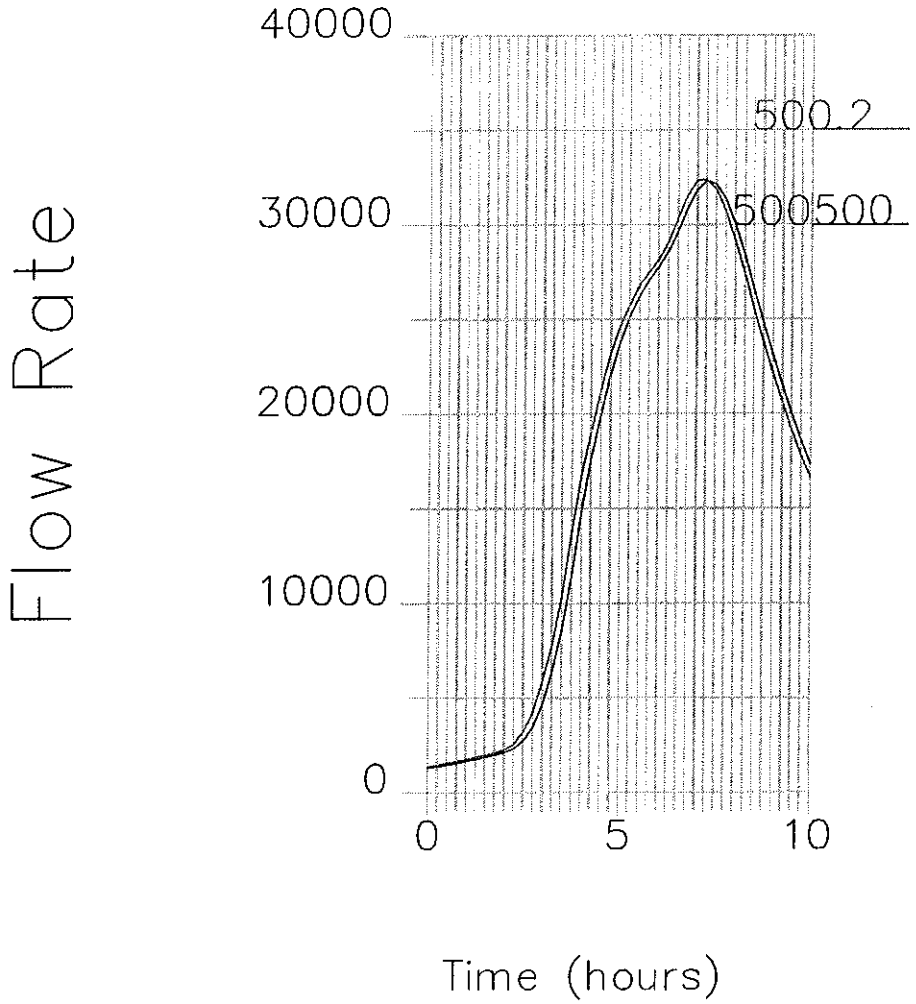
A difference in
Time to Peak of
0.75 hrs was used

200–Future



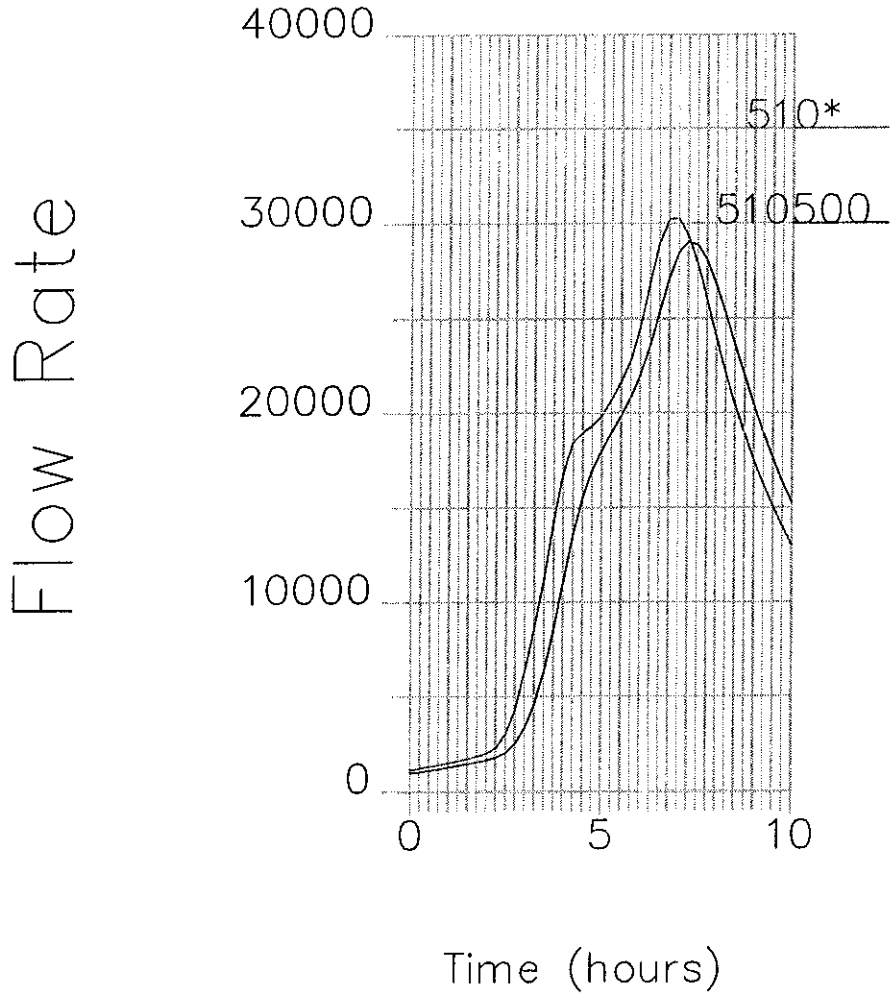
A difference in
Time to Peak of
0.75 hrs was used

200–Future



A difference in
Time to Peak of
0.10 hrs was used

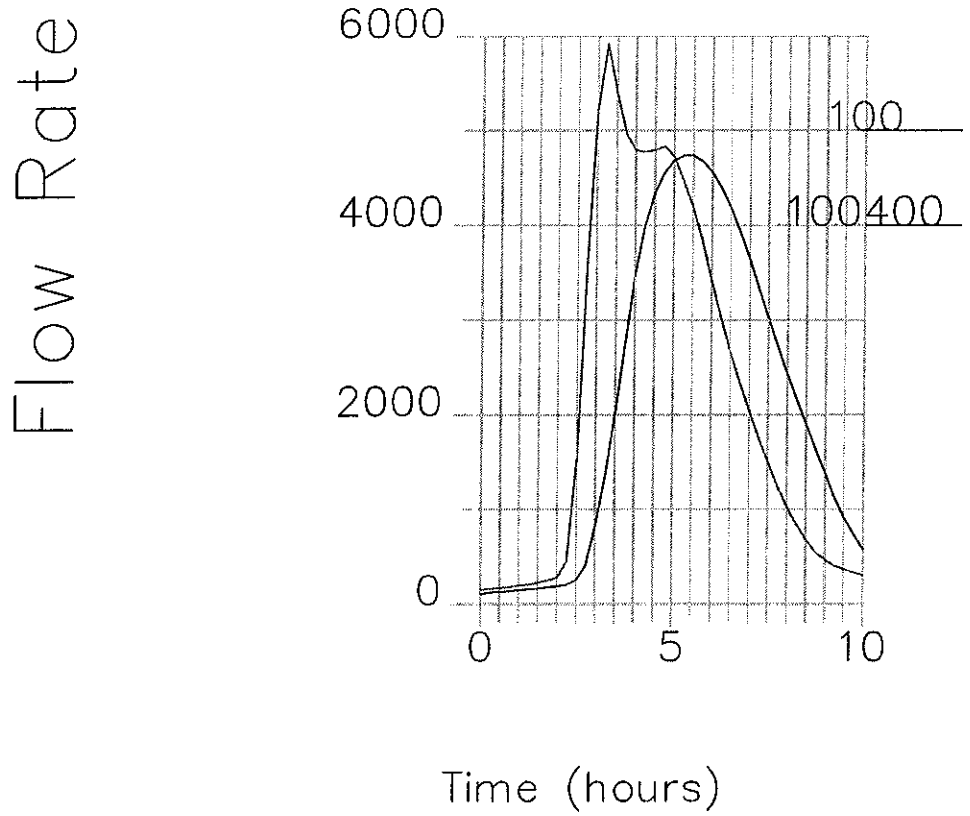
200–Future



A difference in
Time to Peak of
0.35 hrs was used

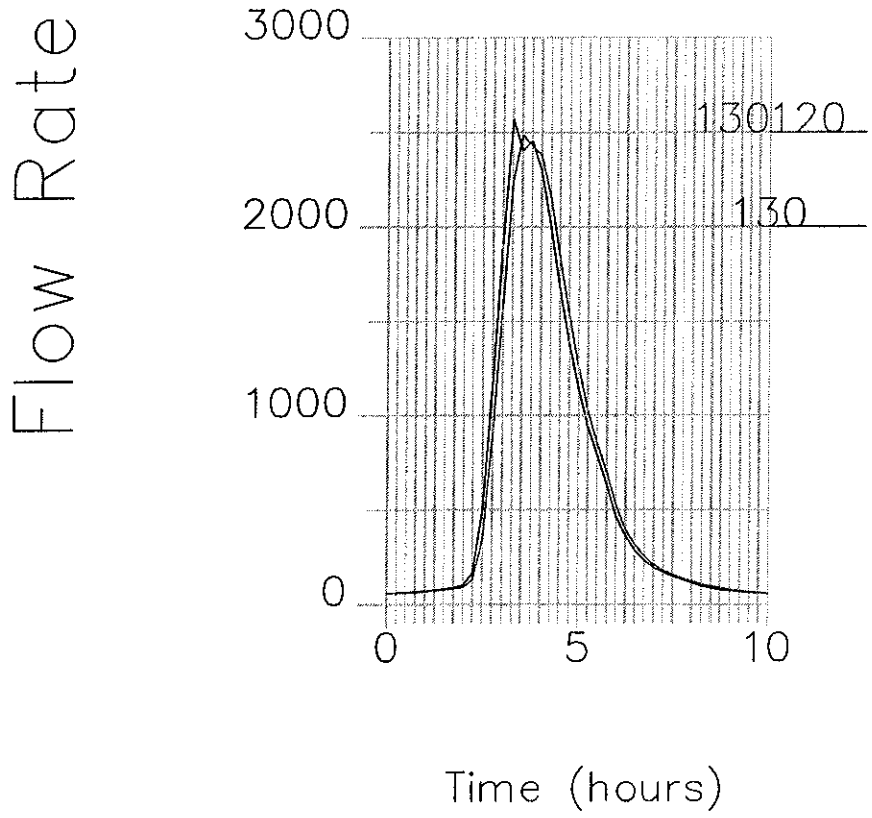
Route Velocity Check for 500-Yr Existing

500–Existing



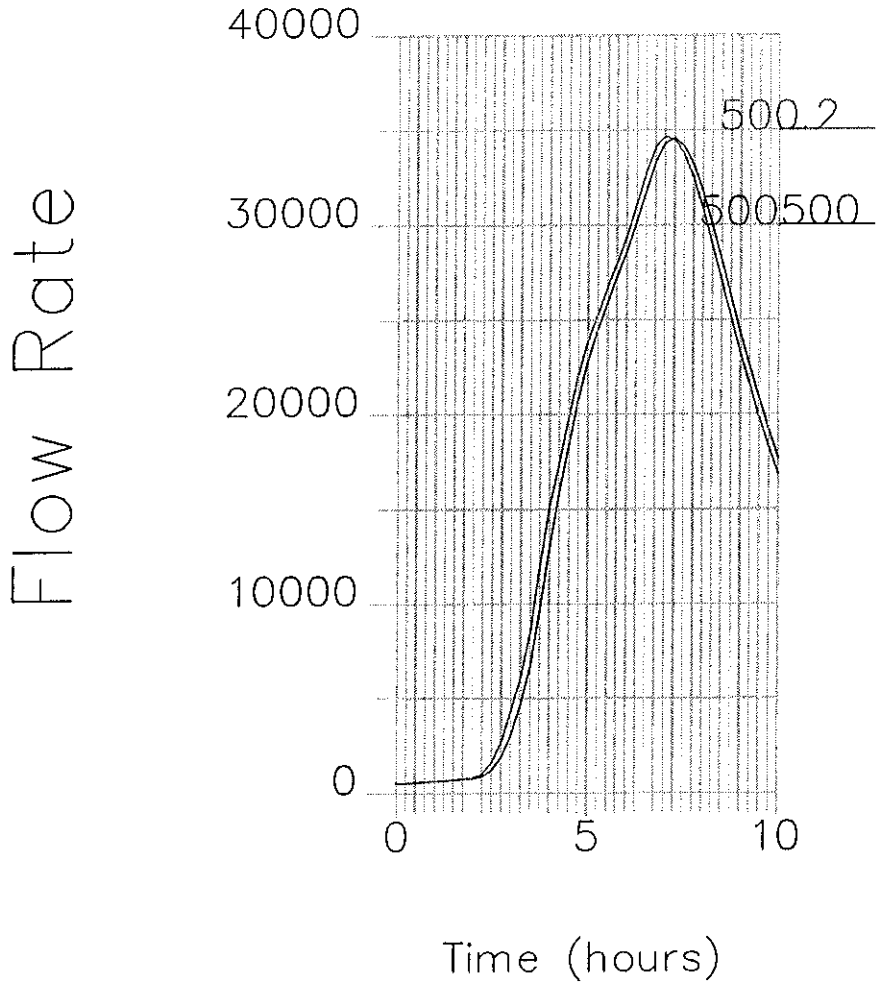
A difference in
Time to Peak of
0.75 hrs was used

500–Existing



A difference in
Time to Peak of
0.10 hrs was used

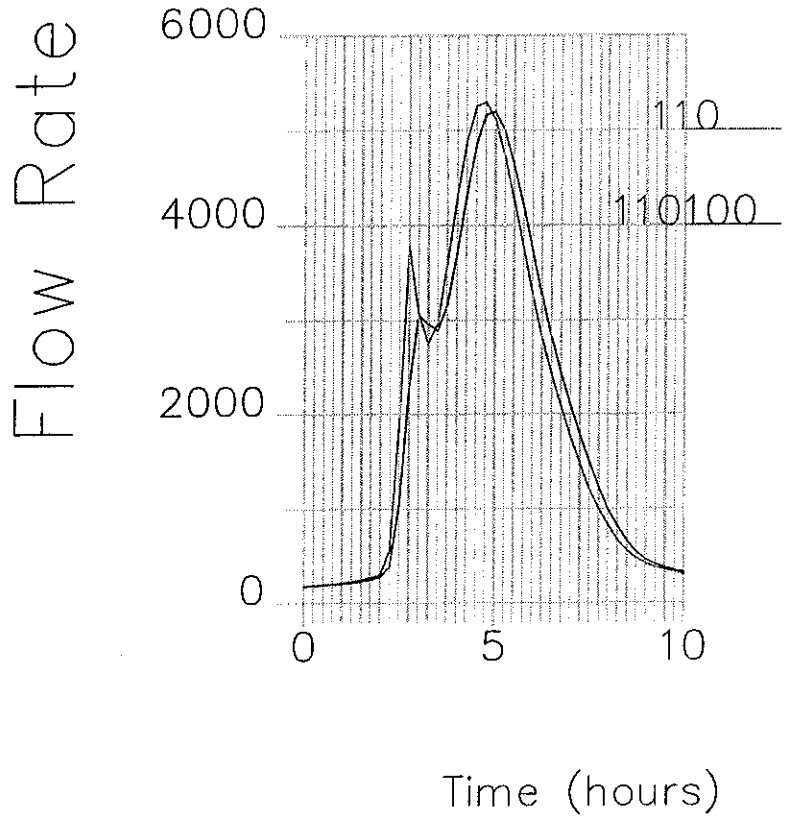
500–Existing



A difference in
Time to Peak of
0.10 hrs was used

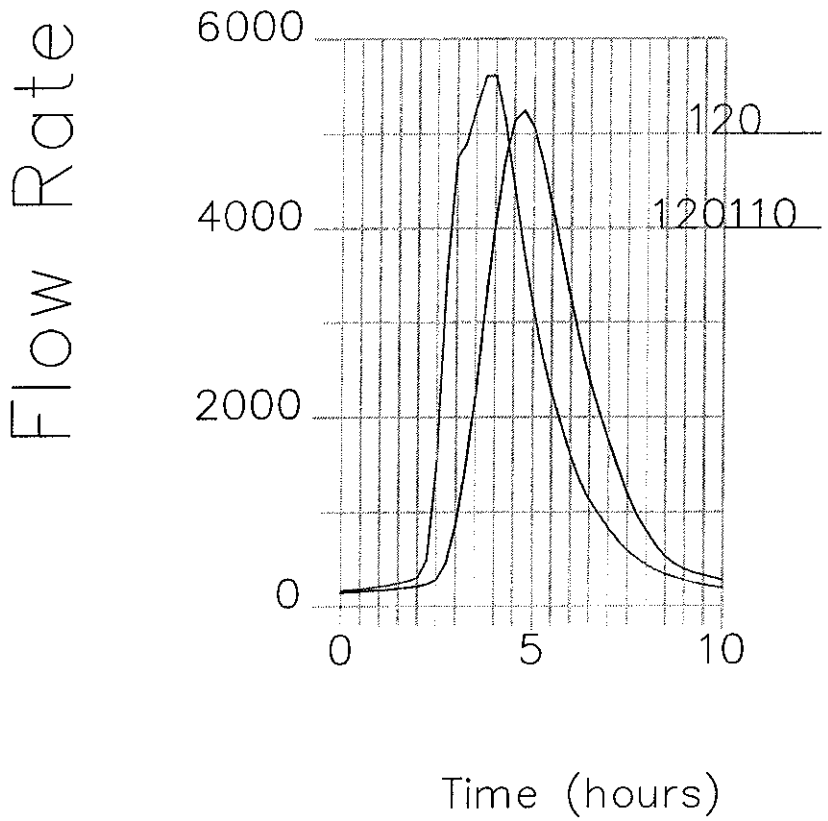
Route Velocity Check for 500-Yr Future

500–Future



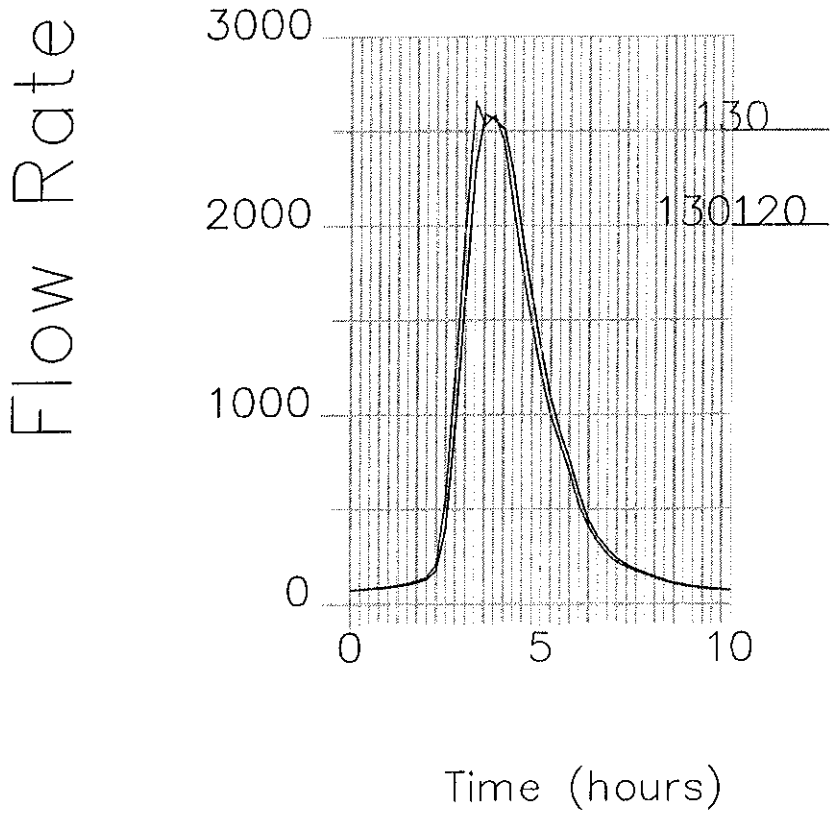
A difference in
Time to Peak of
0.15 hrs was used

500–Future



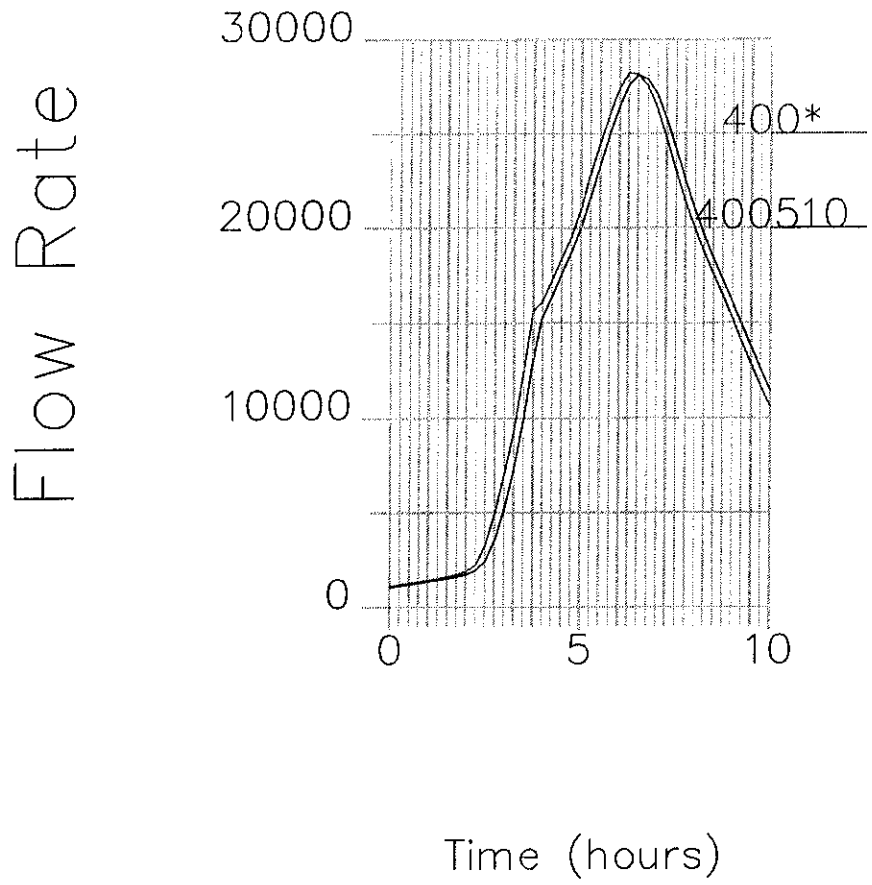
A difference in
Time to Peak of
0.15 hrs was used

500–Future



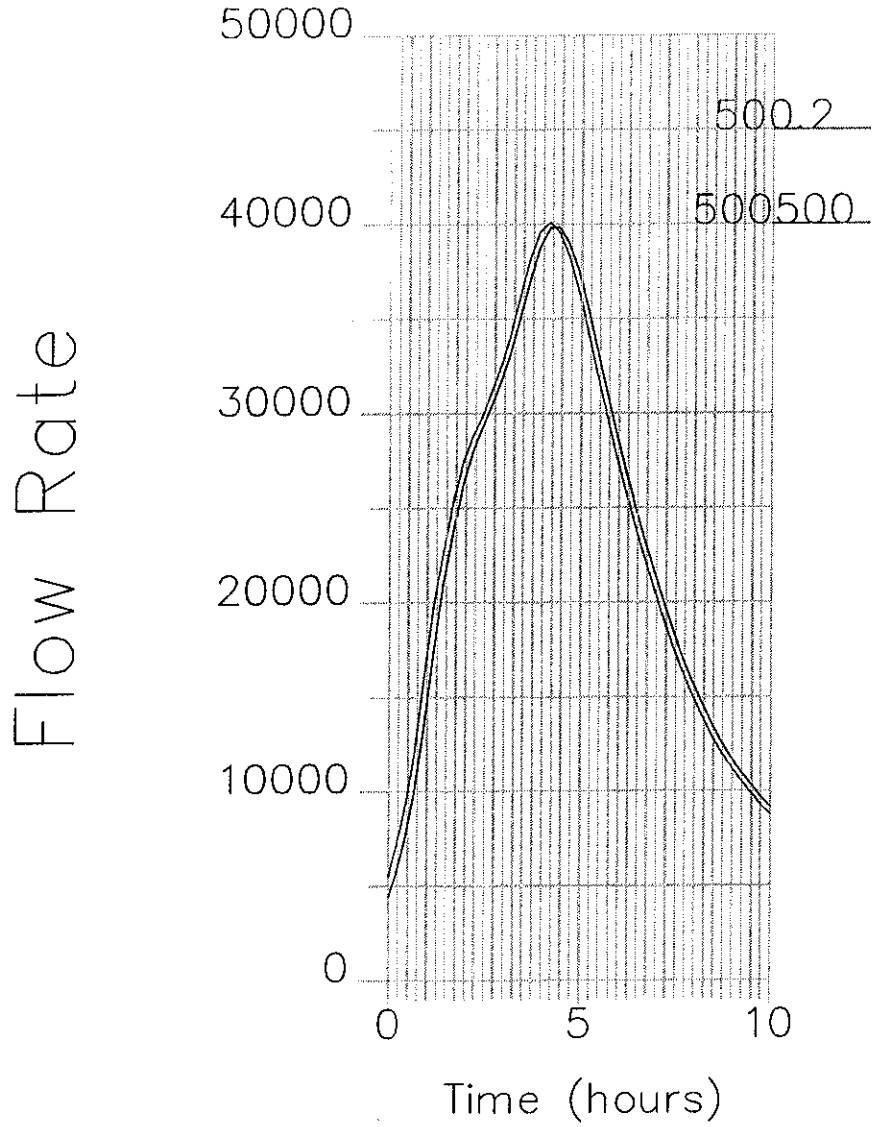
A difference in
Time to Peak of
0.10 hrs was used

500–Future



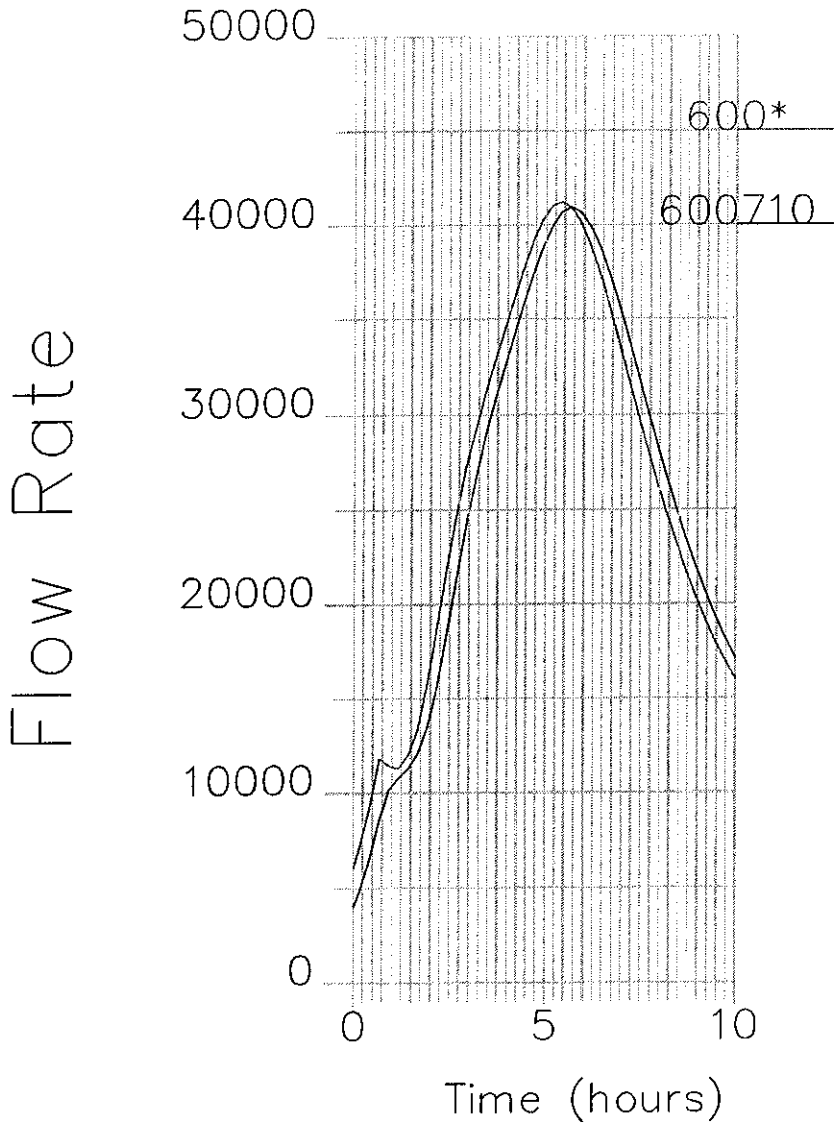
A difference in
Time to Peak of
0.10 hrs was used

500–Future



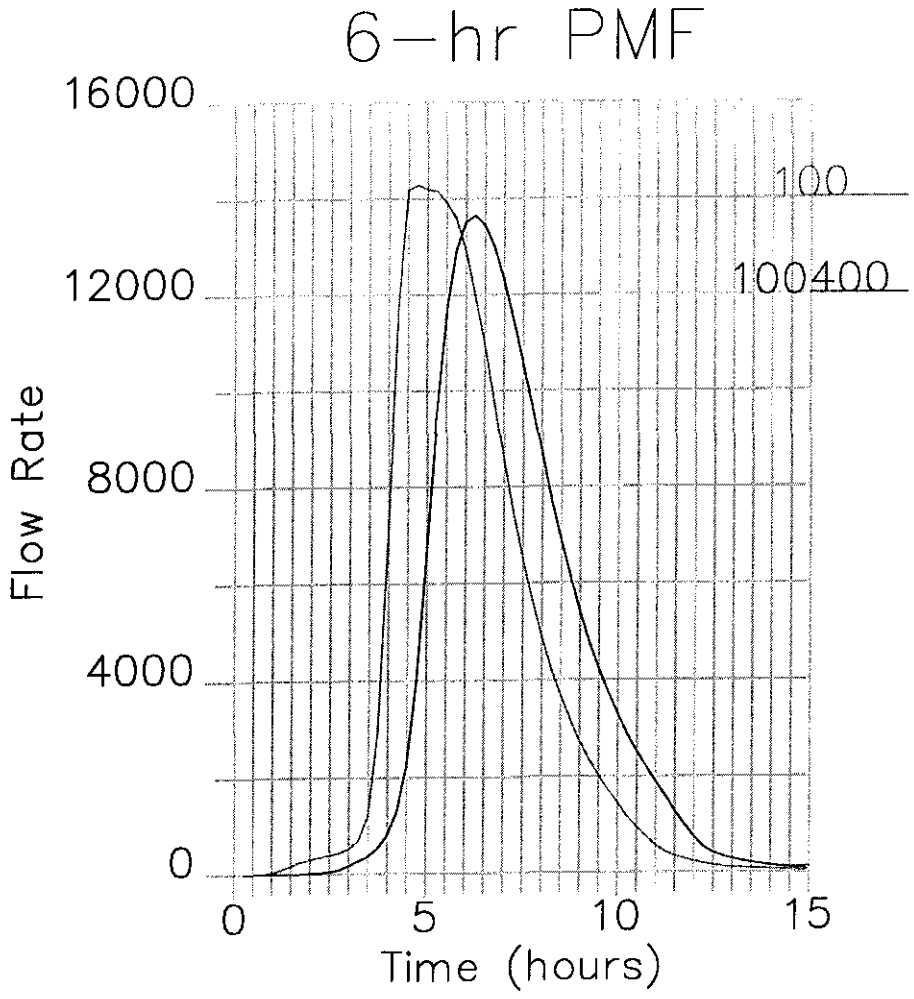
A difference in
Time to Peak of
0.10 hrs was used

500–Future

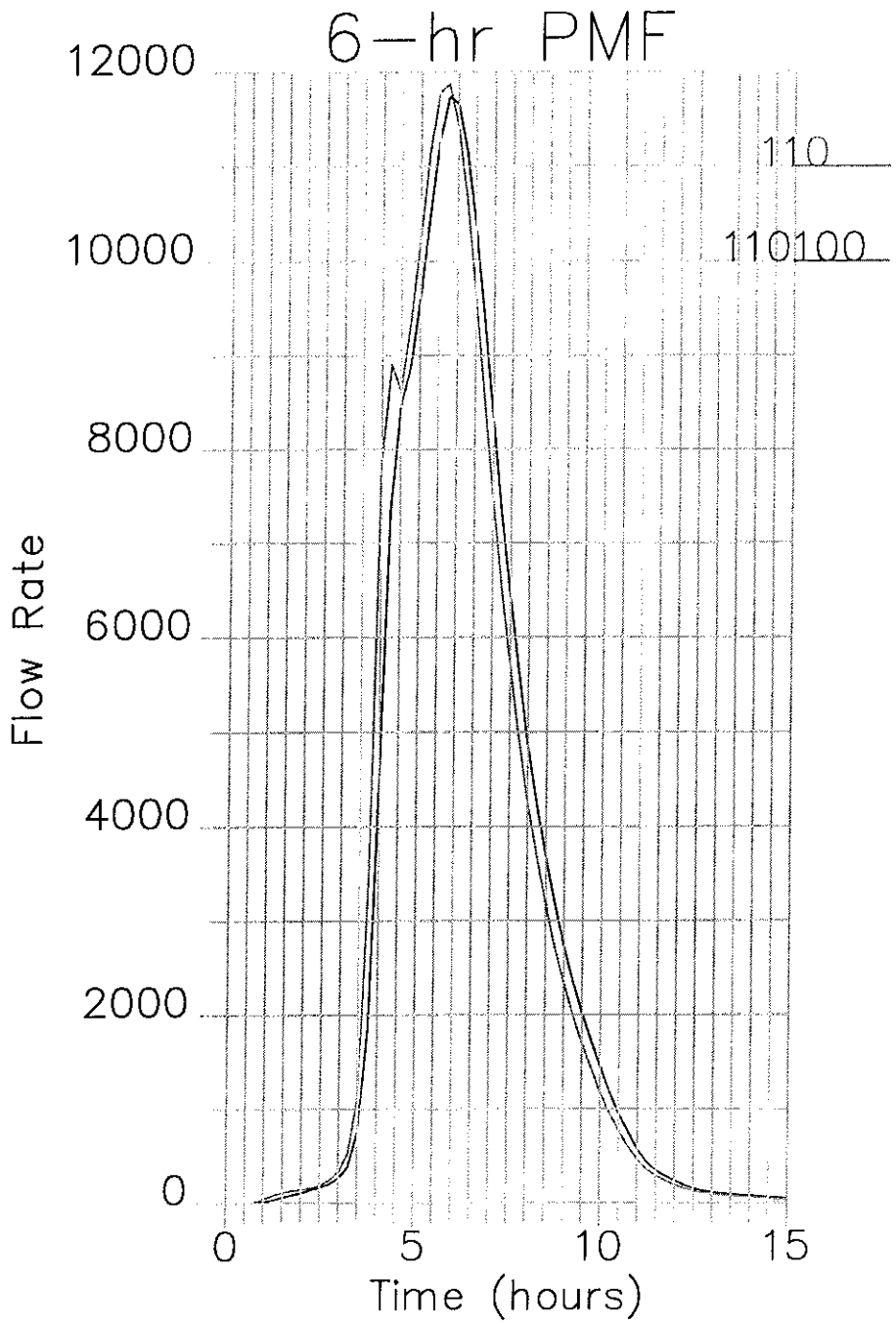


A difference in
Time to Peak of
0.20 hrs was used

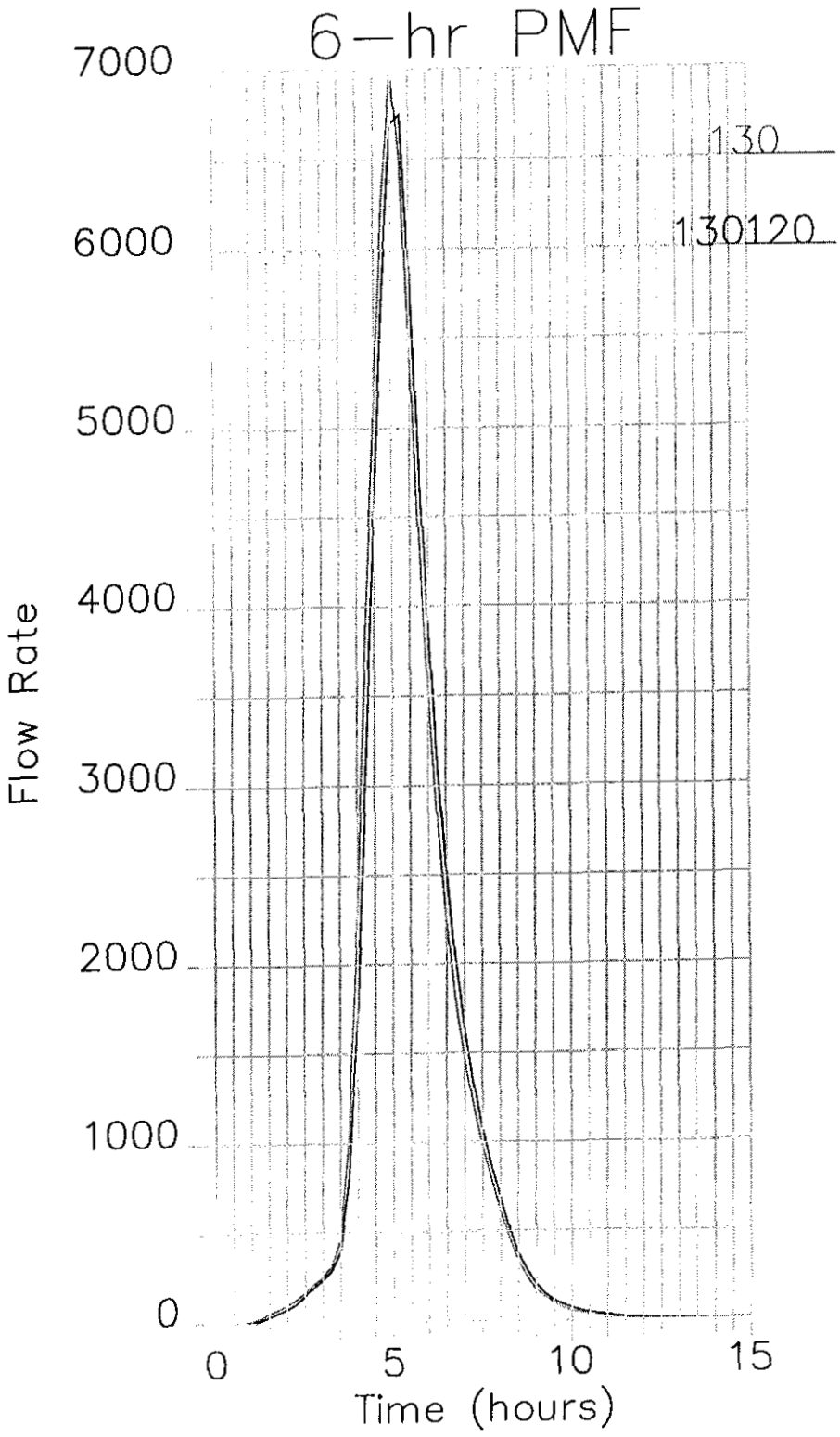
Route Velocity Check for 6-hr PMF



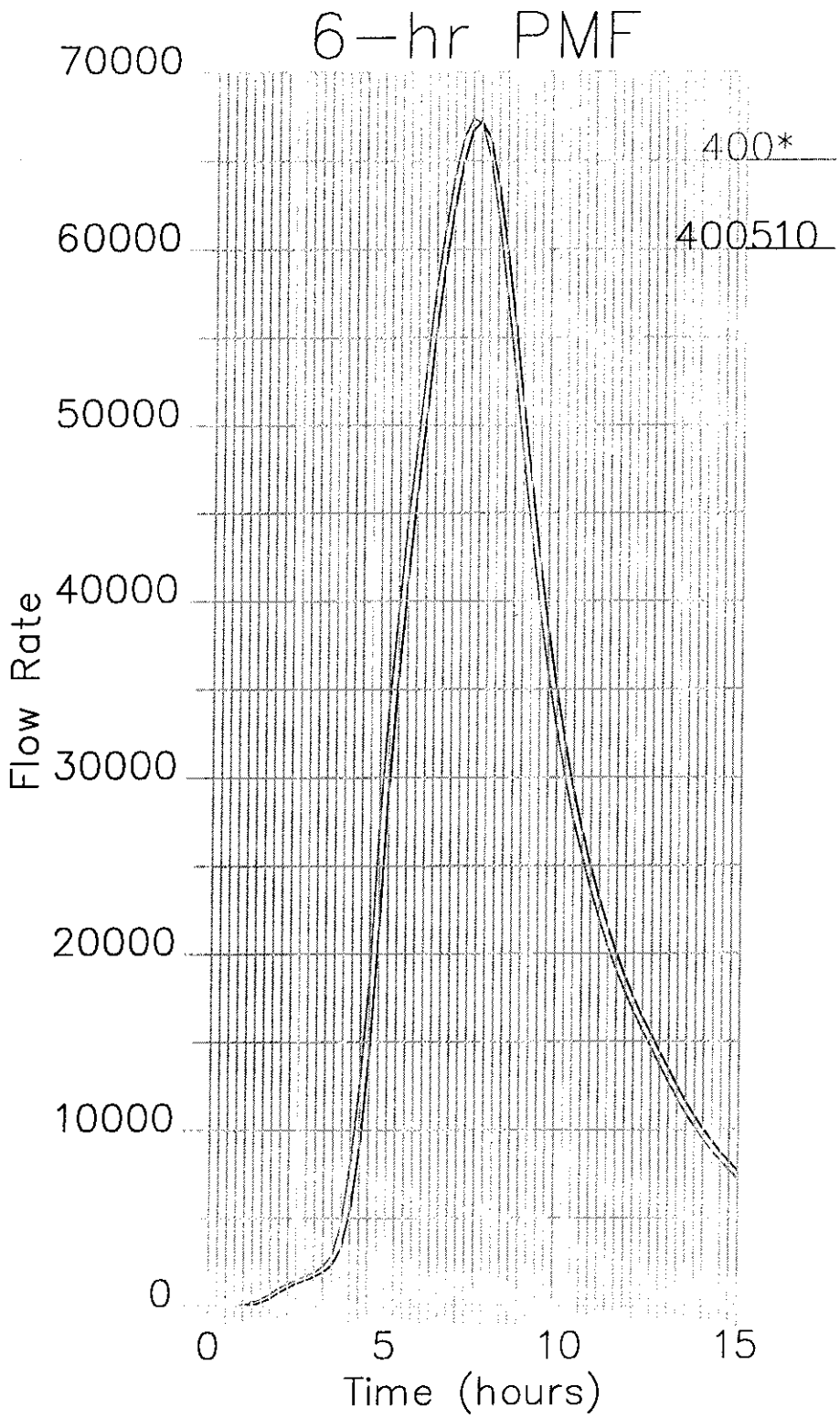
A difference in
Time to Peak of
0.75 hrs was used



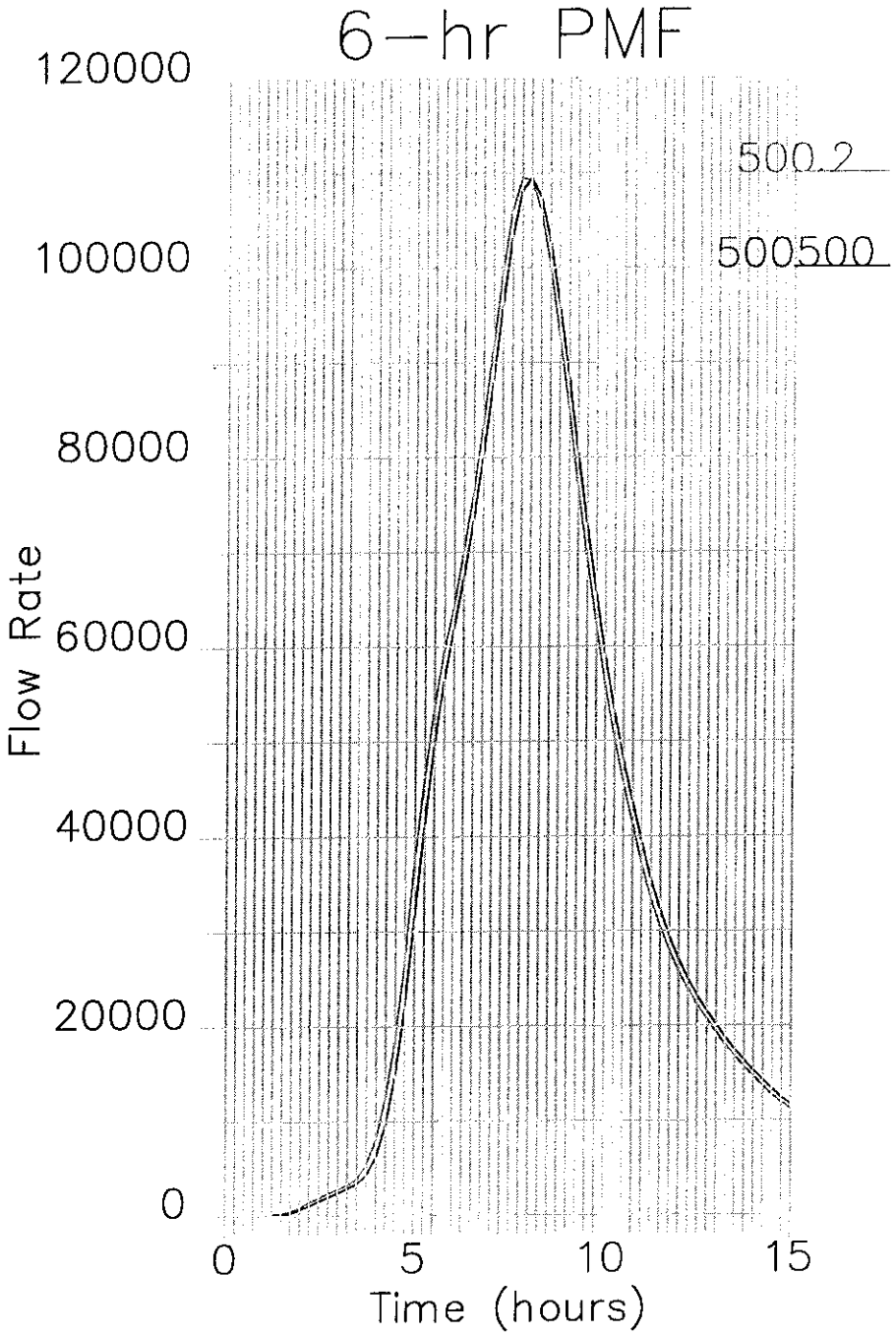
A difference in Time to Peak of 0.10 hrs was used



A difference in
Time to Peak of
0.10 hrs was used

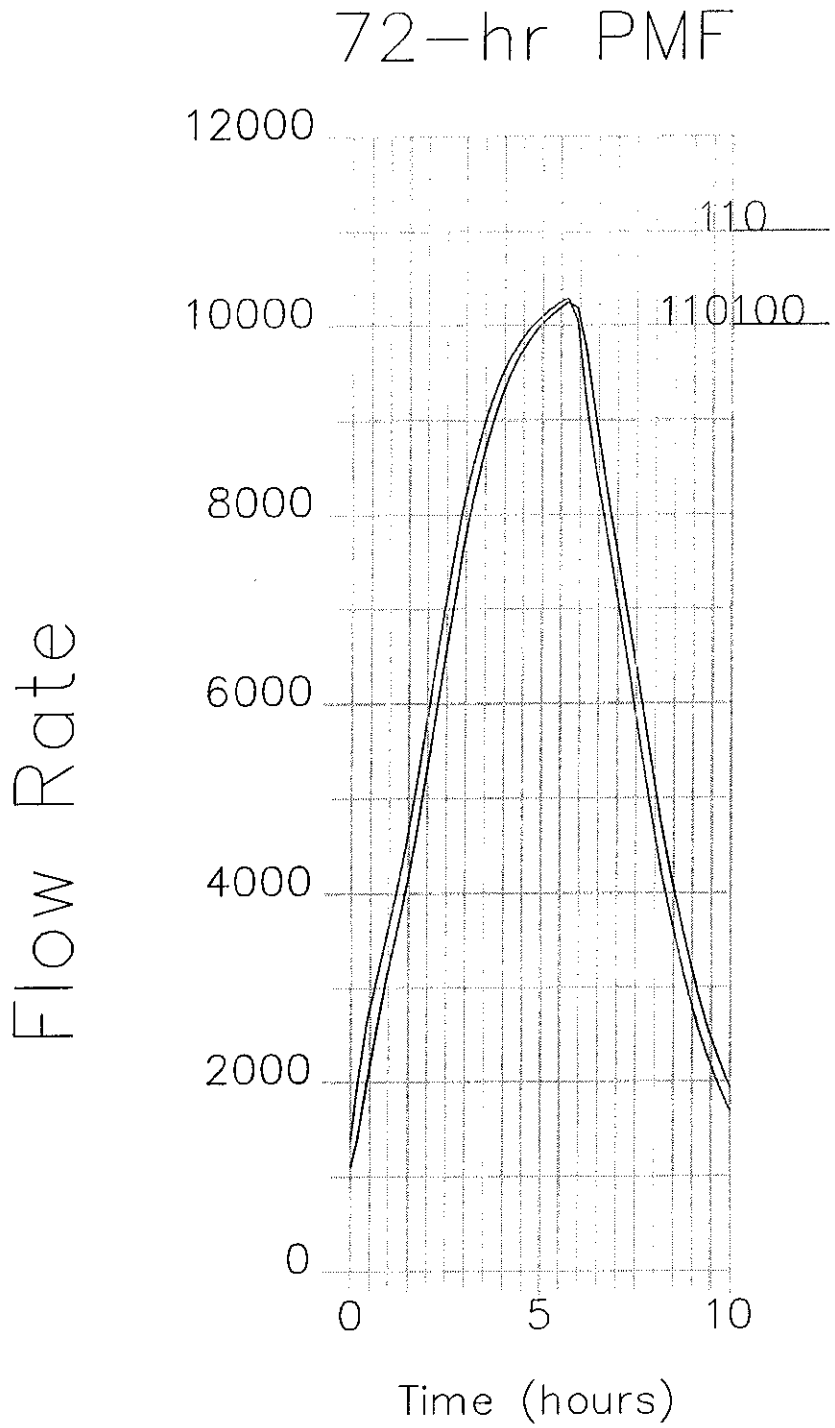


A difference in
Time to Peak of
0.15 hrs was used



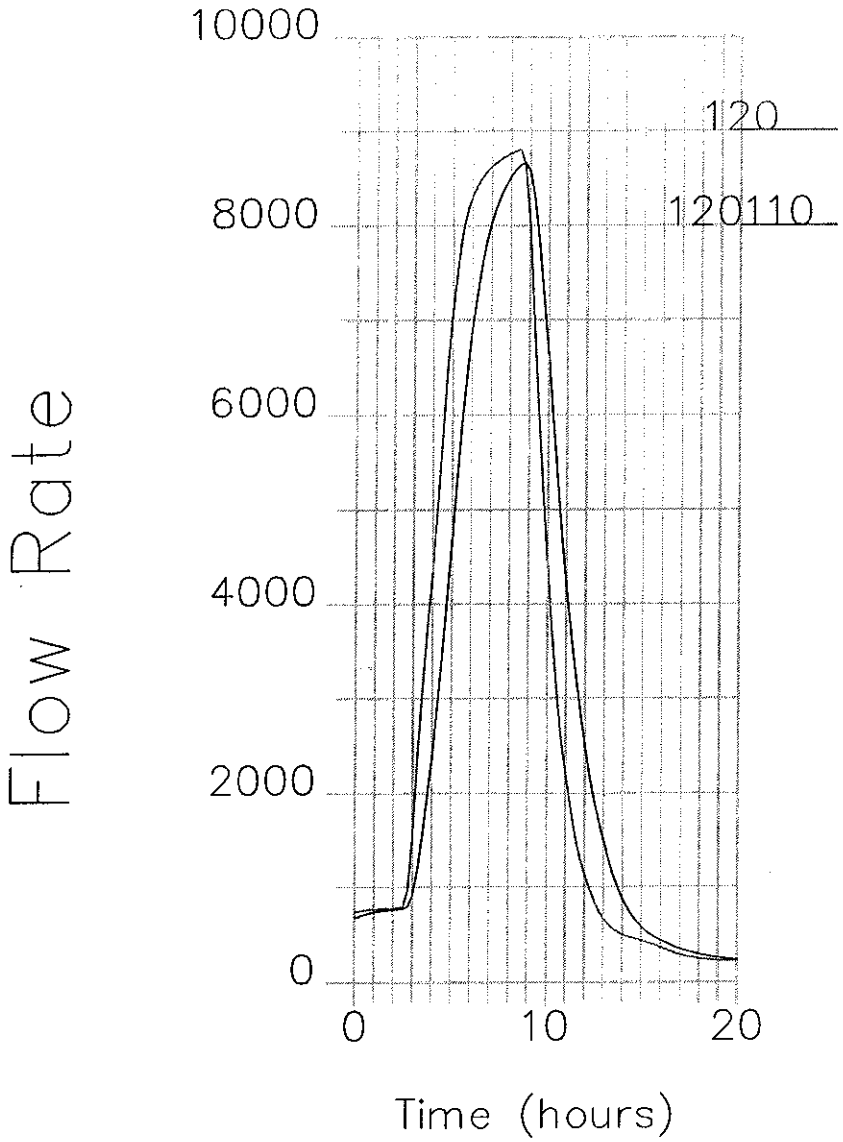
A difference in
Time to Peak of
0.10 hrs was used

Route Velocity Check for 72-hr PMF



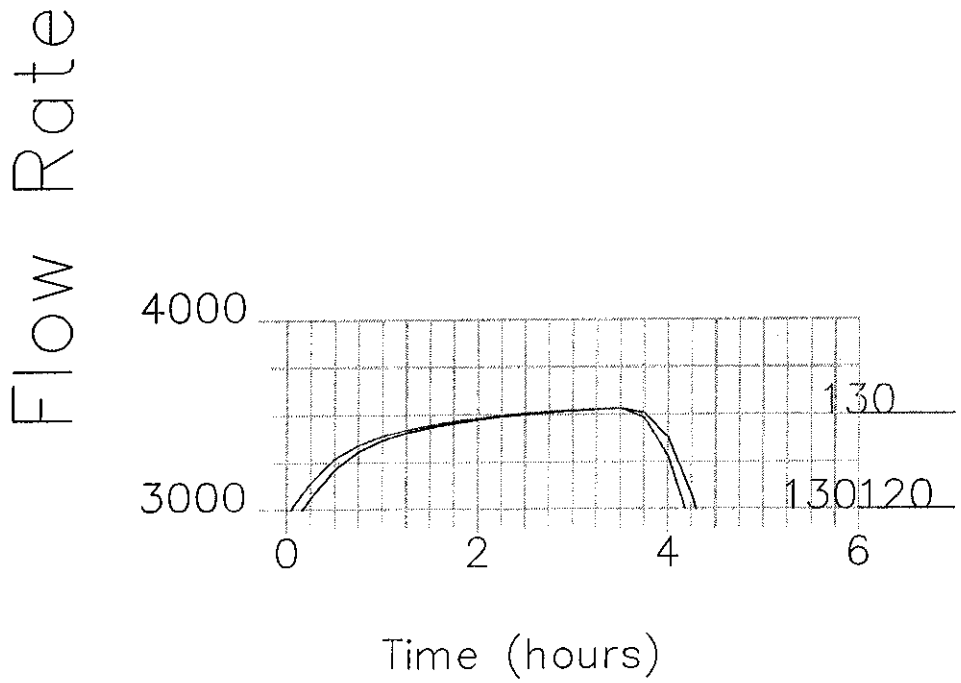
A difference in
Time to Peak of
0.15 hrs was used

72-hr PMF



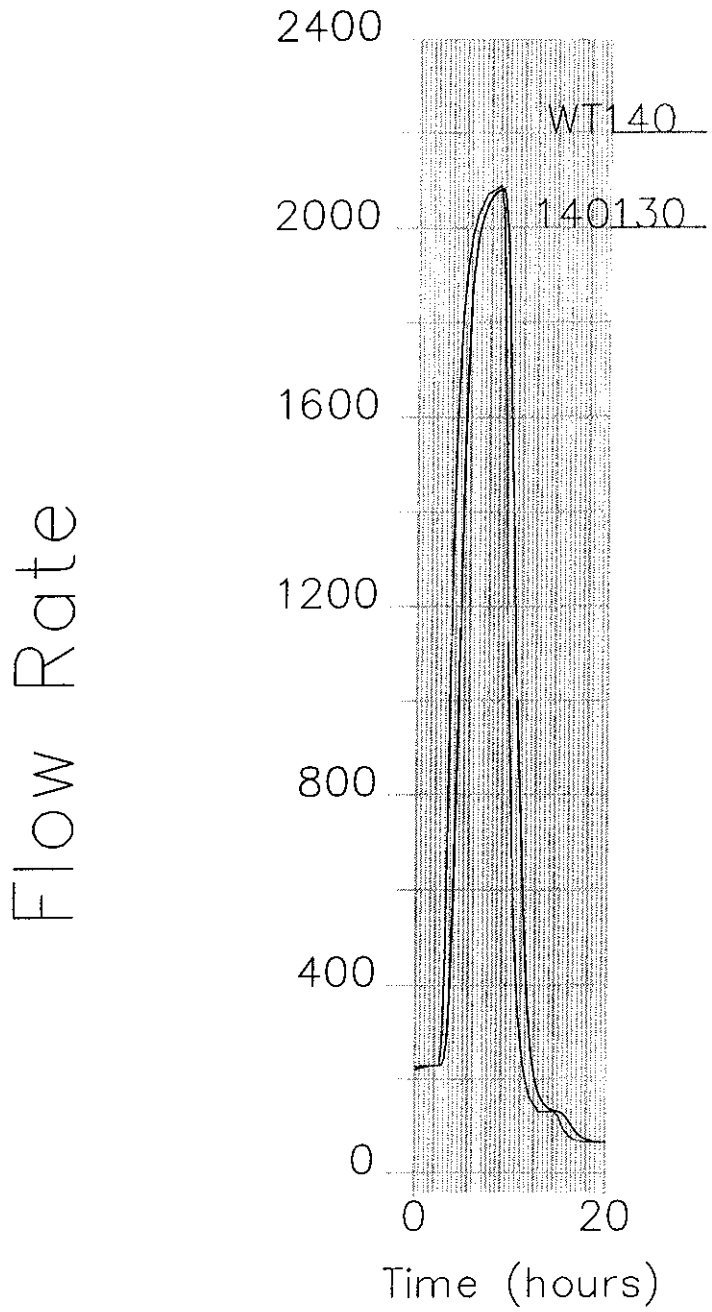
A difference in
Time to Peak of
0.50 hrs was used

72-hr PMF



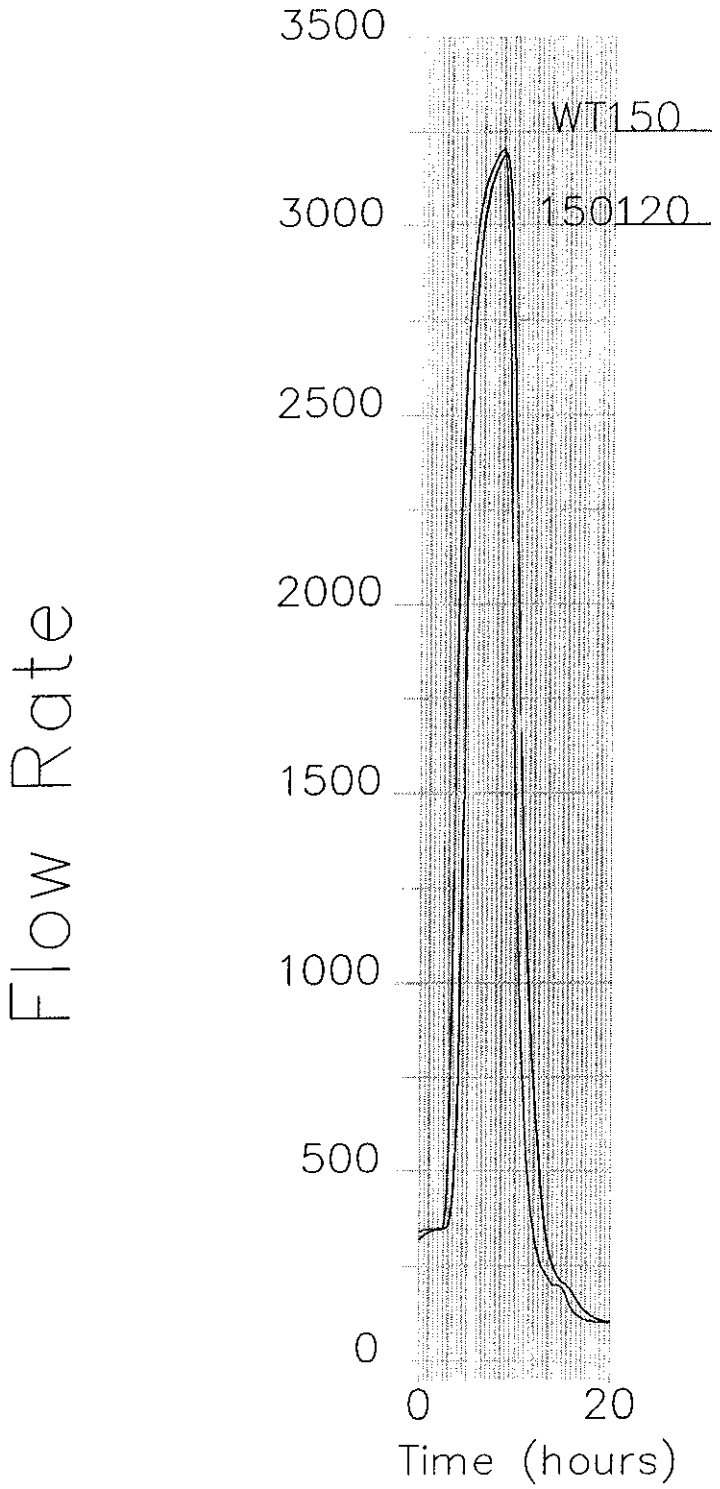
A difference in
Time to Peak of
0.10 hrs was used

72-hr PMF



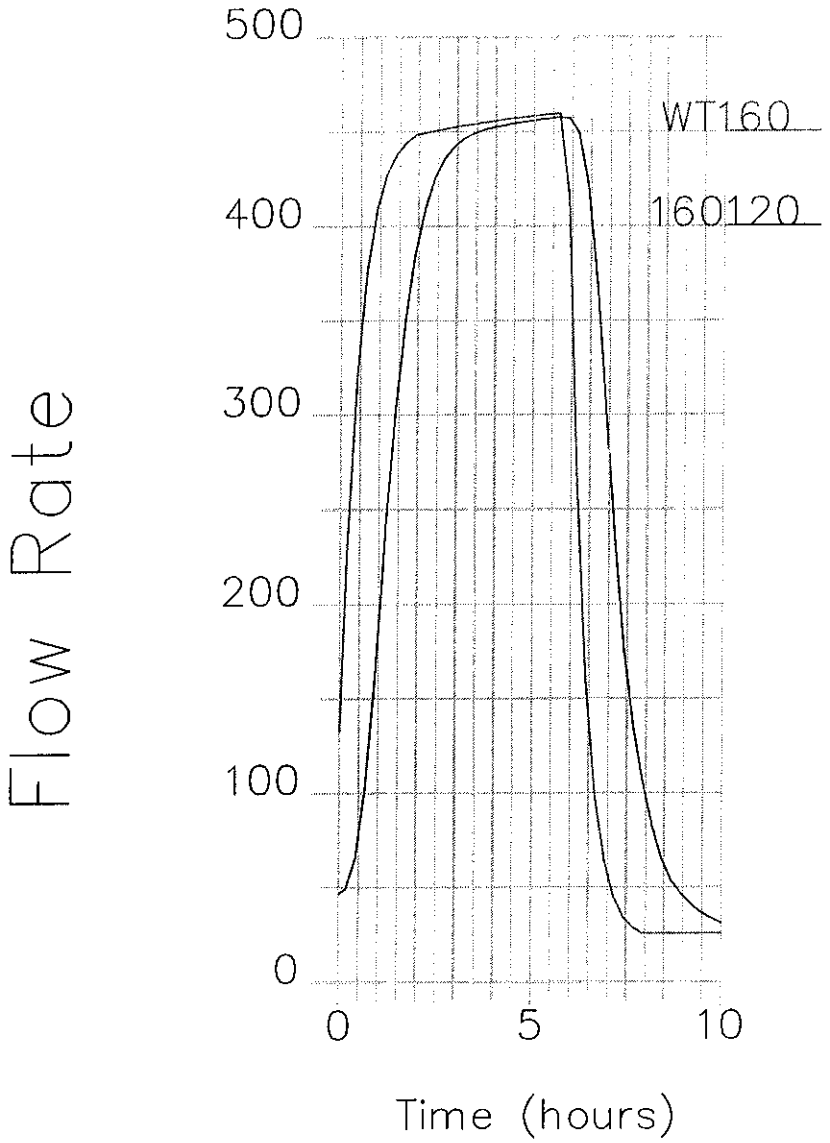
A difference in
Time to Peak of
0.75 hrs was used

72-hr PMF



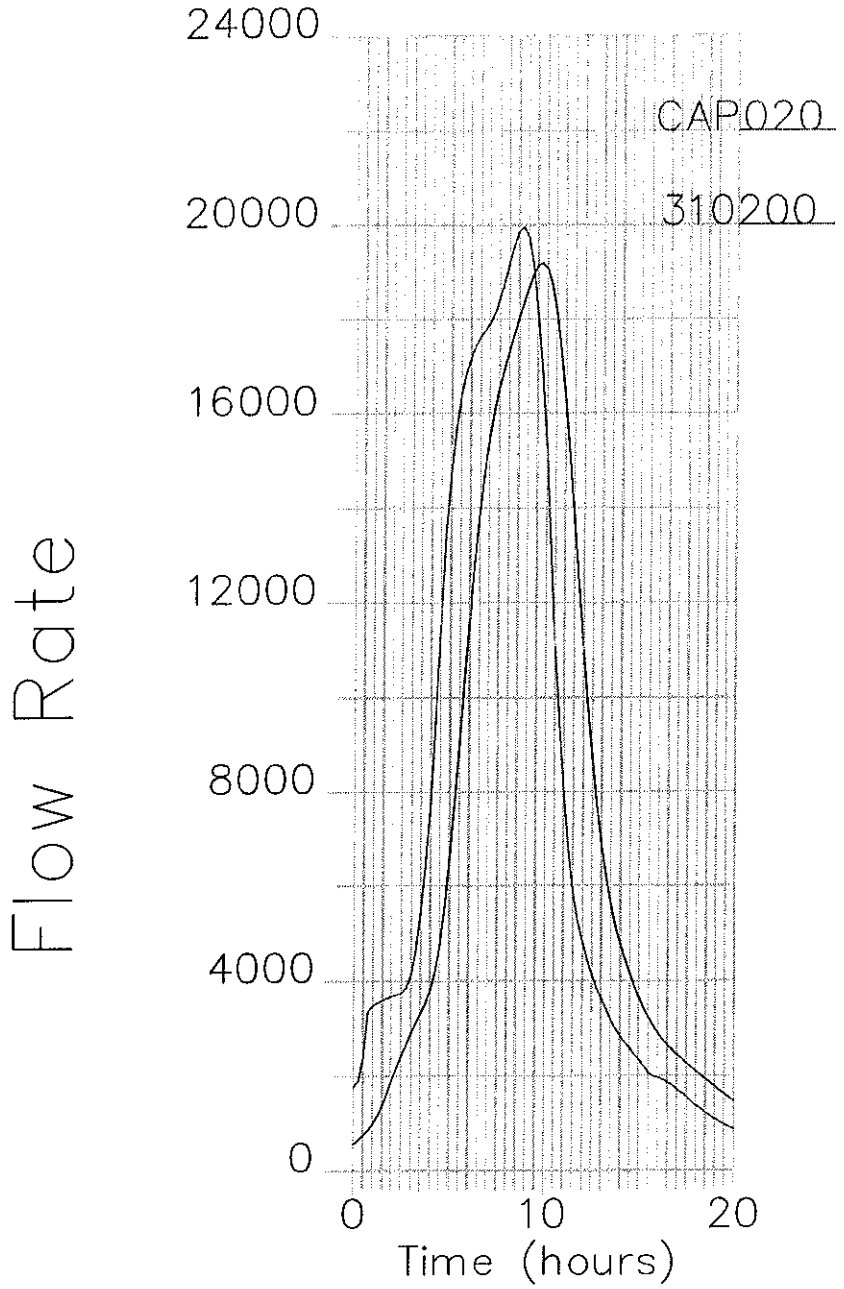
A difference in Time to Peak of 0.60 hrs was used

72-hr PMF



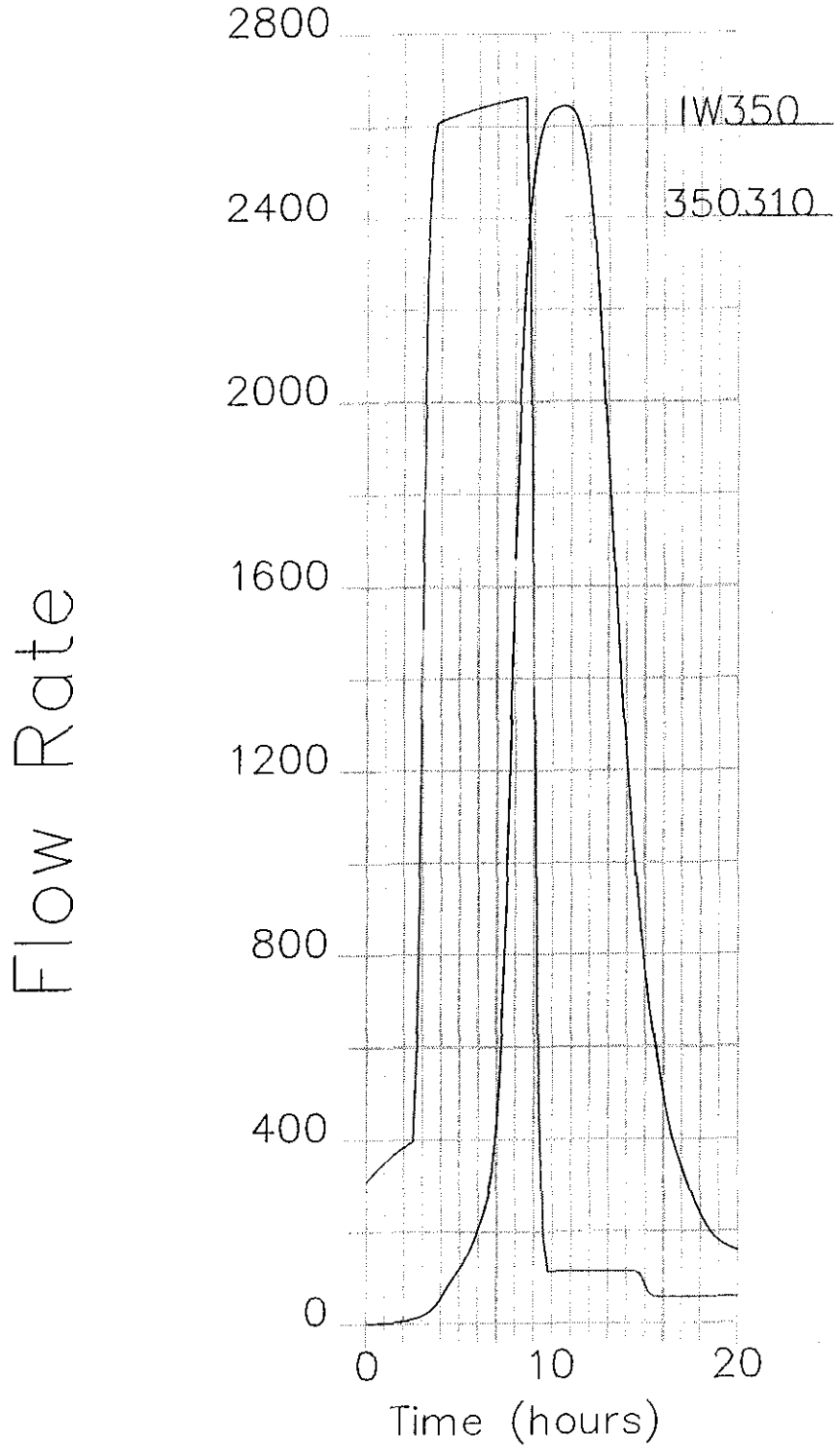
A difference in
Time to Peak of
1.00 hrs was used

72-hr PMF



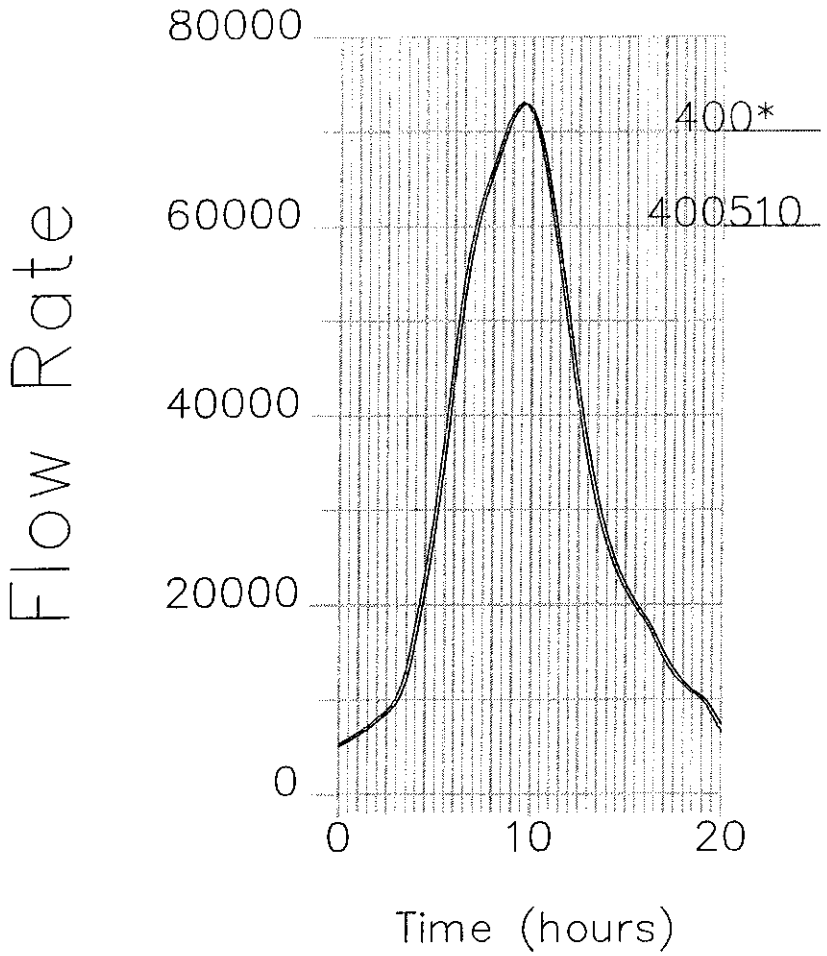
A difference in
Time to Peak of
1.50 hrs was used

72-hr PMF



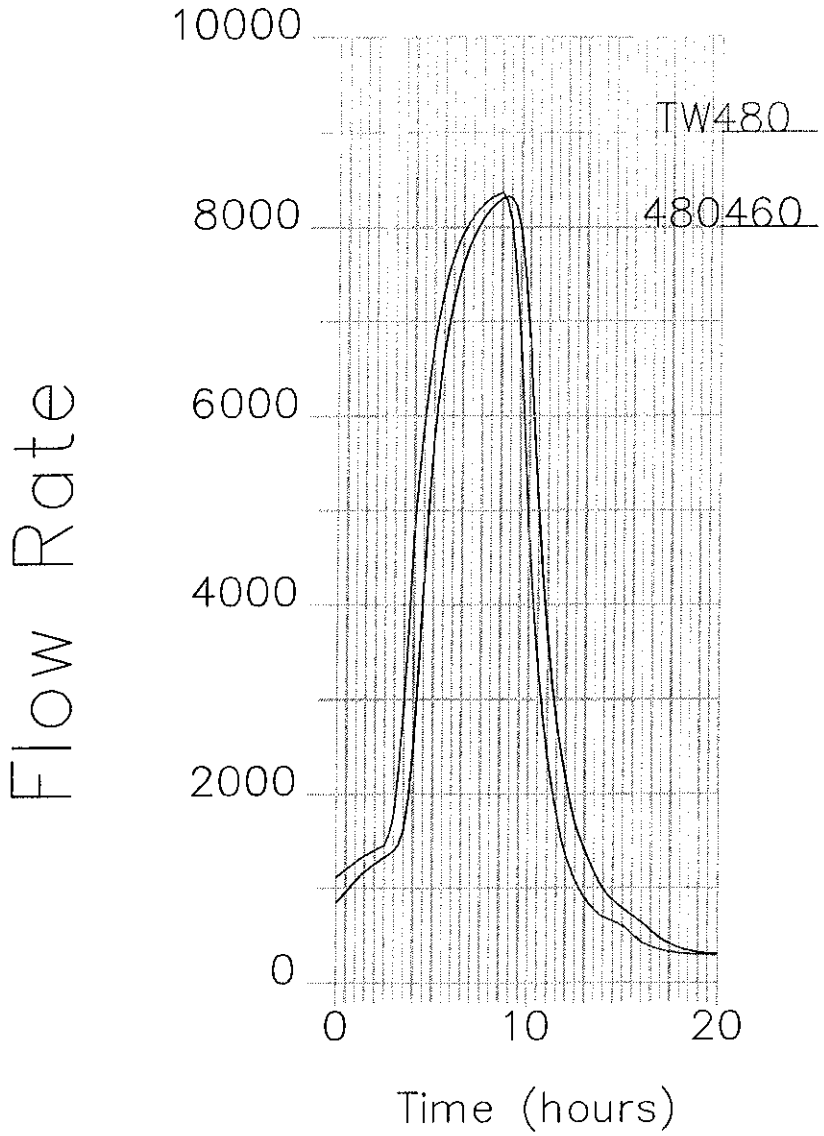
A difference in Time to Peak of 4.50 hrs was used

72-hr PMF

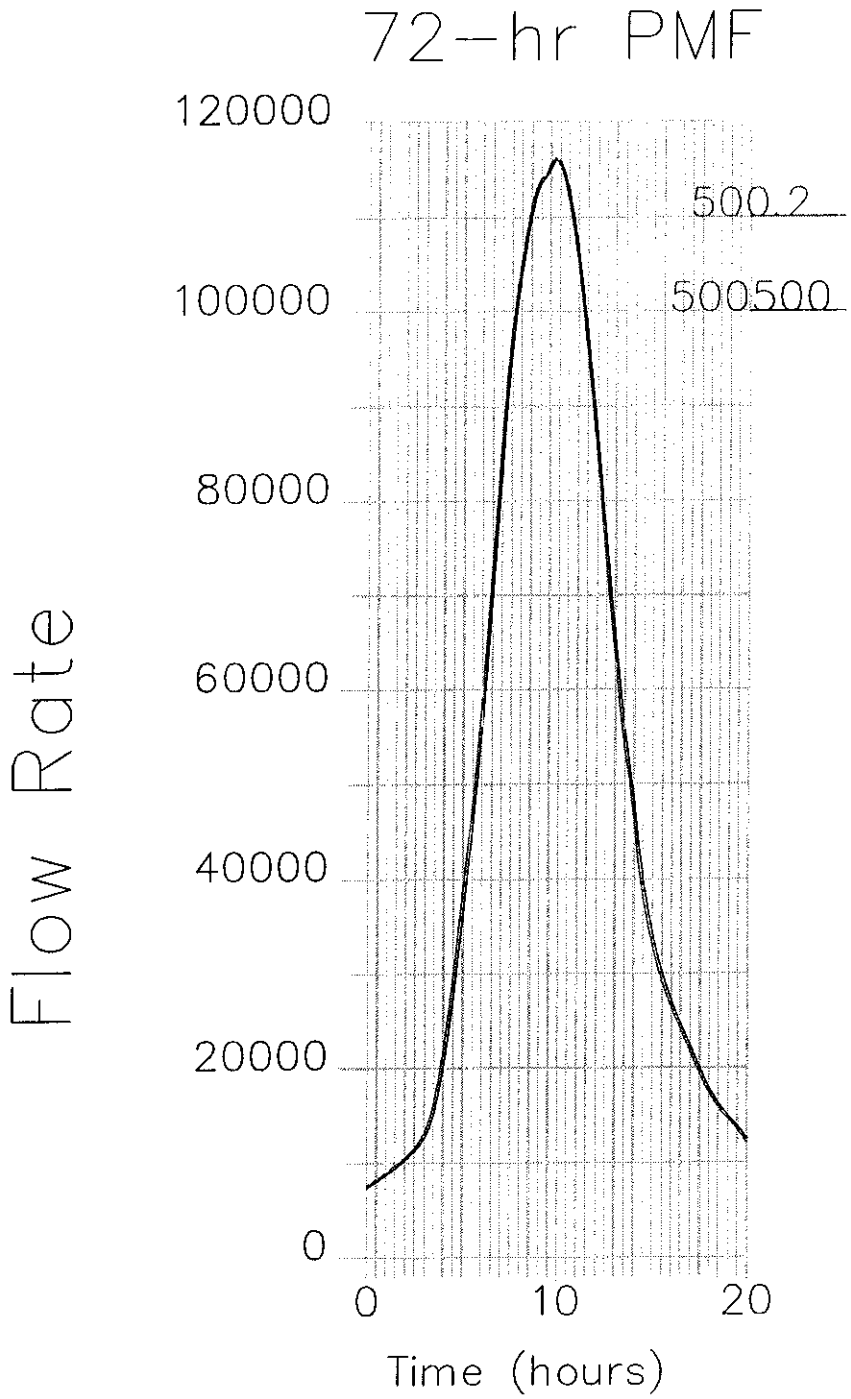


A difference in
Time to Peak of
0.10 hrs was used

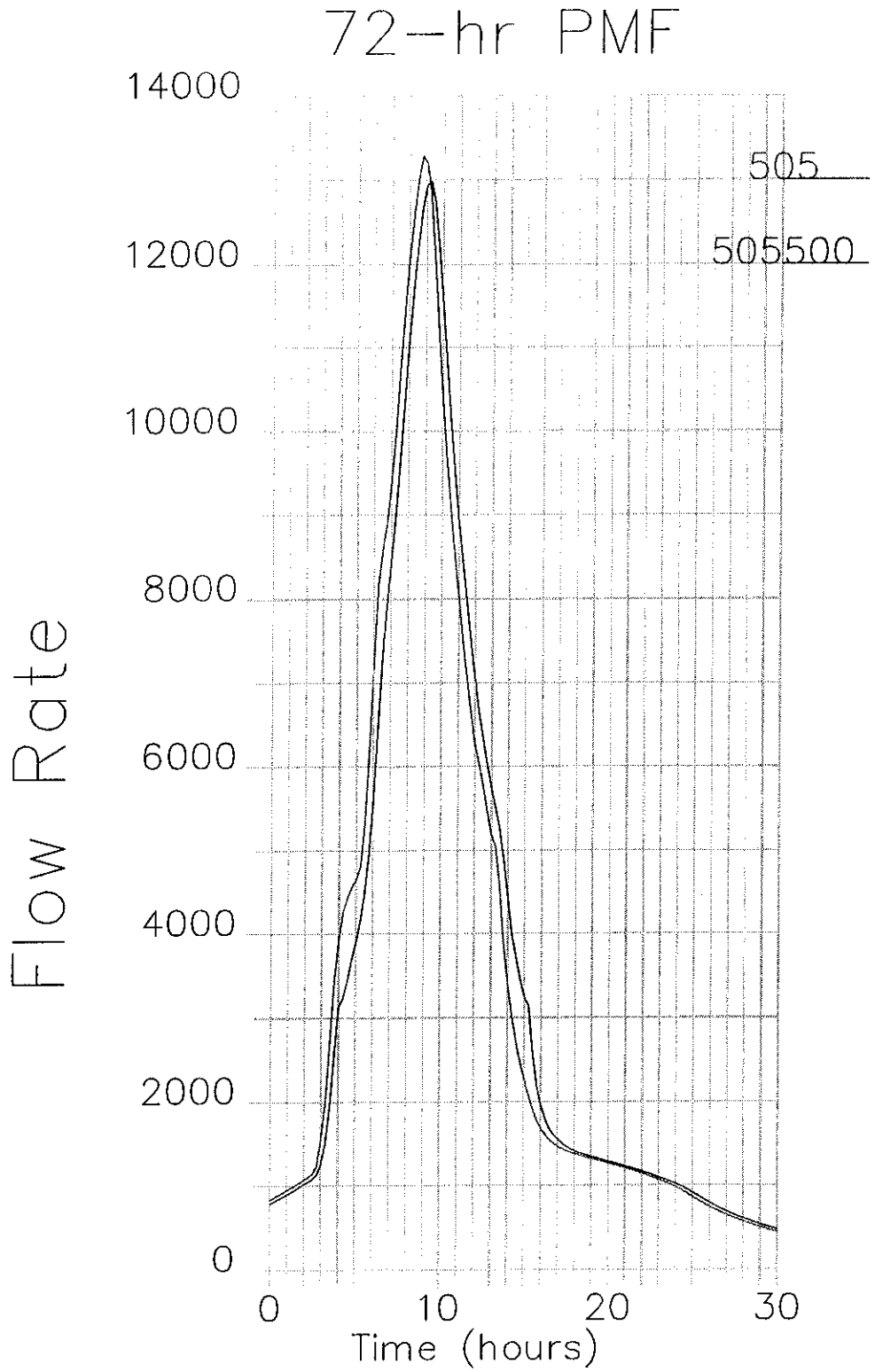
72-hr PMF



A difference in
Time to Peak of
0.50 hrs was used

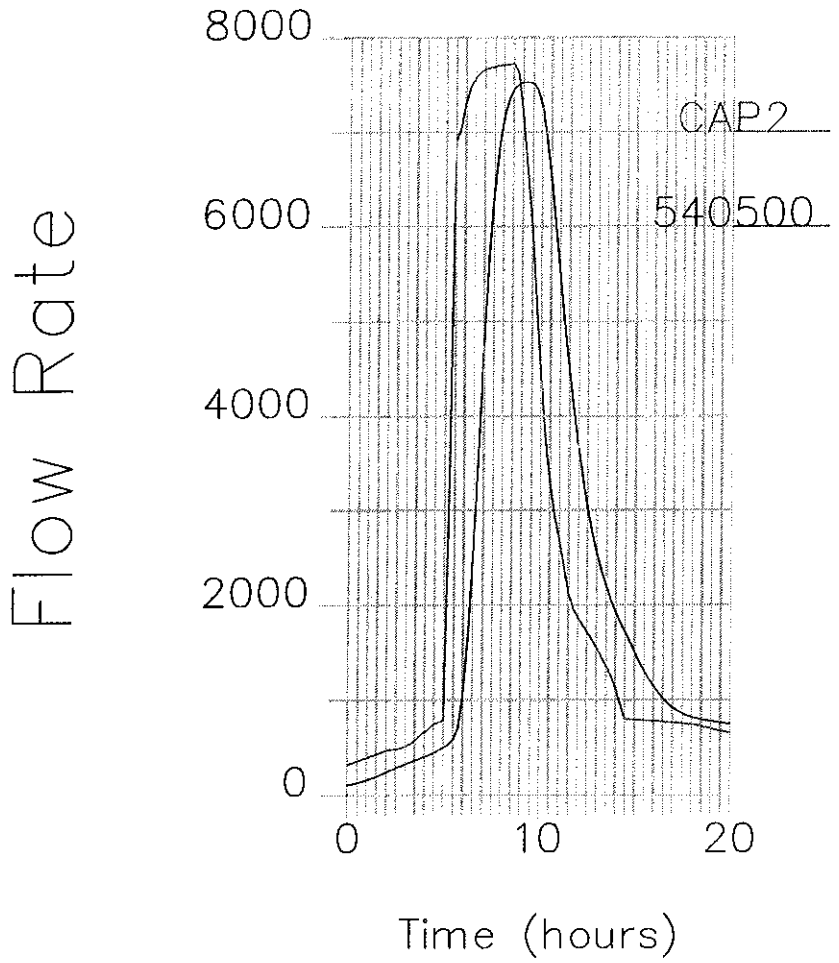


A difference in
Time to Peak of
0.05 hrs was used

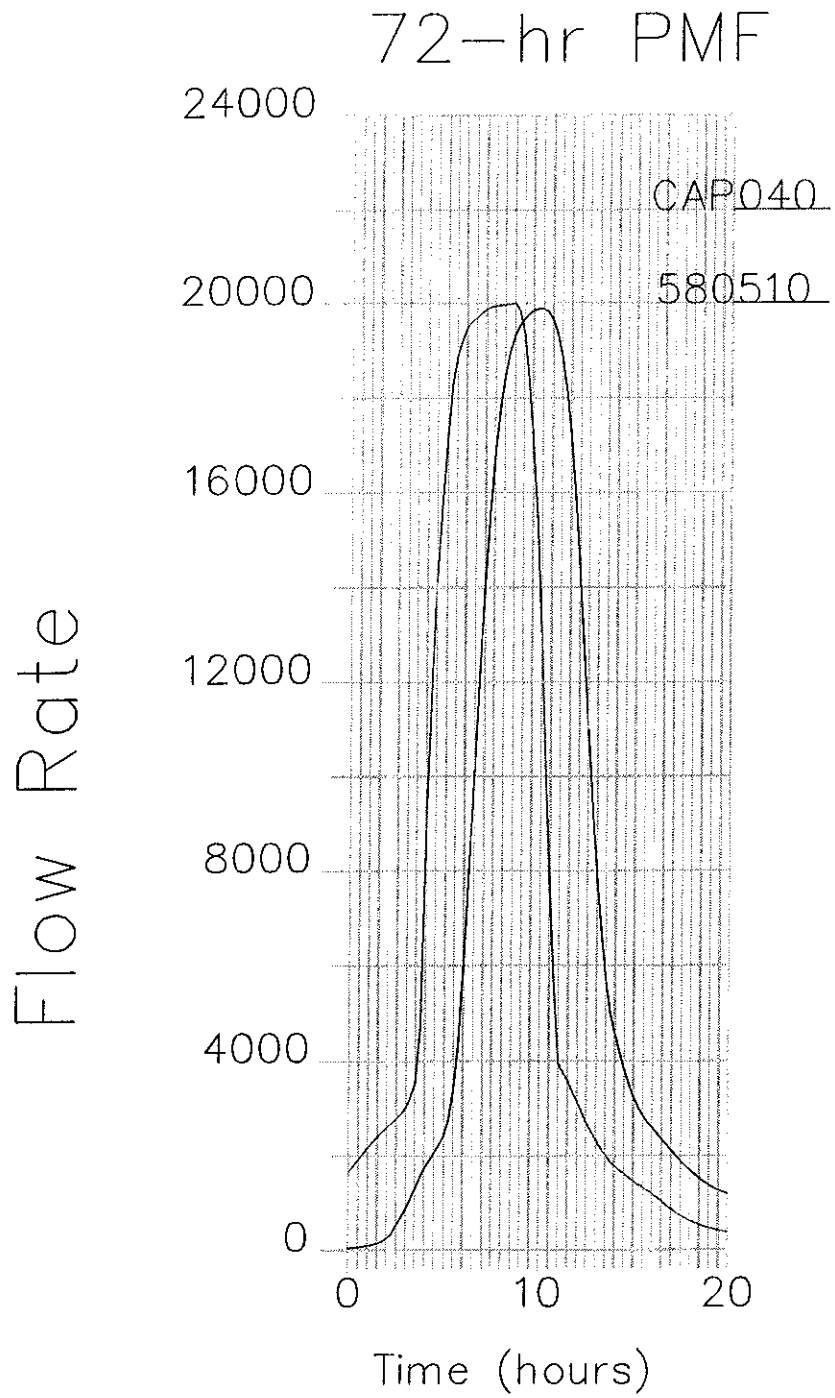


A difference in
Time to Peak of
0.25 hrs was used

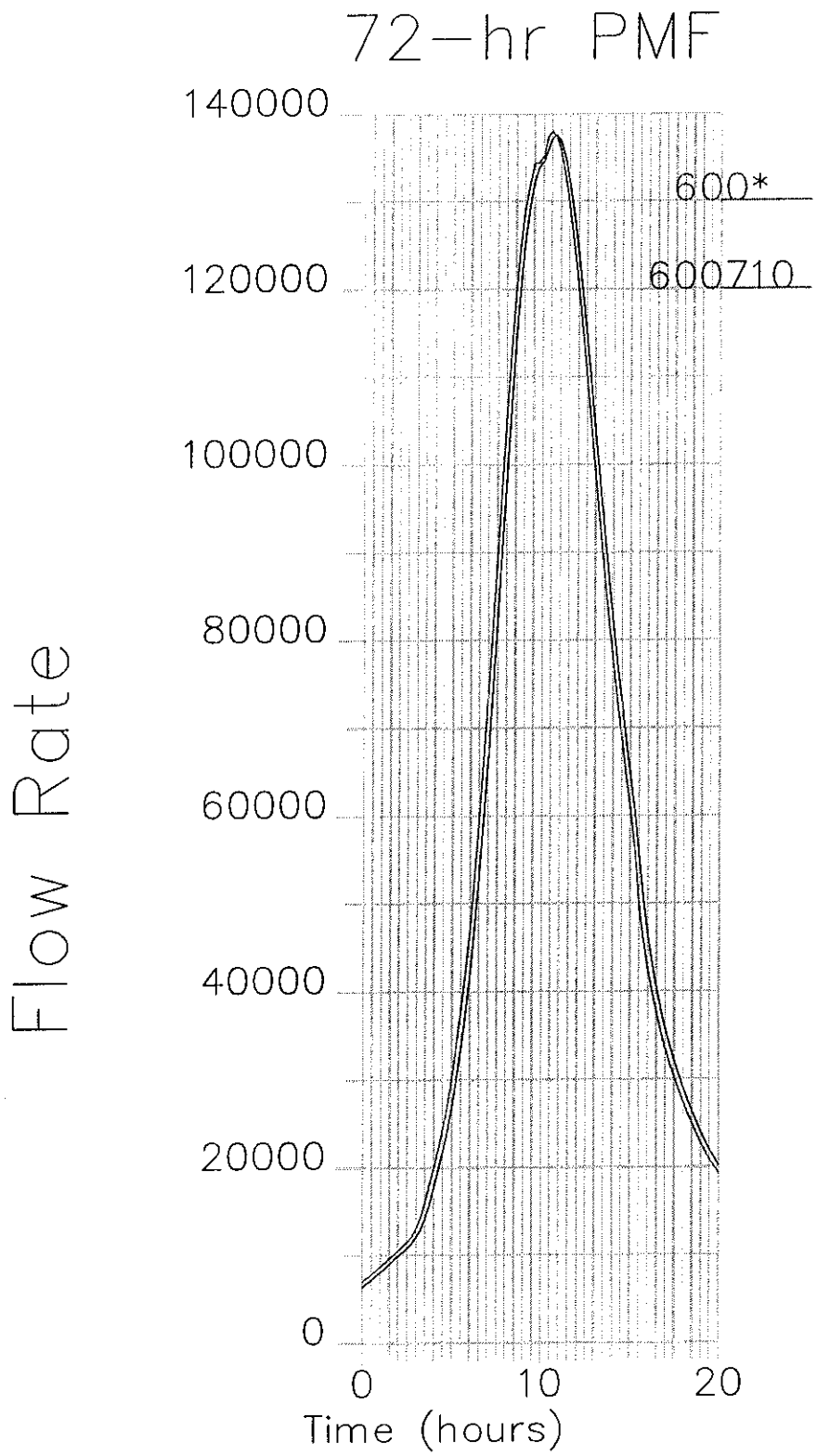
72-hr PMF



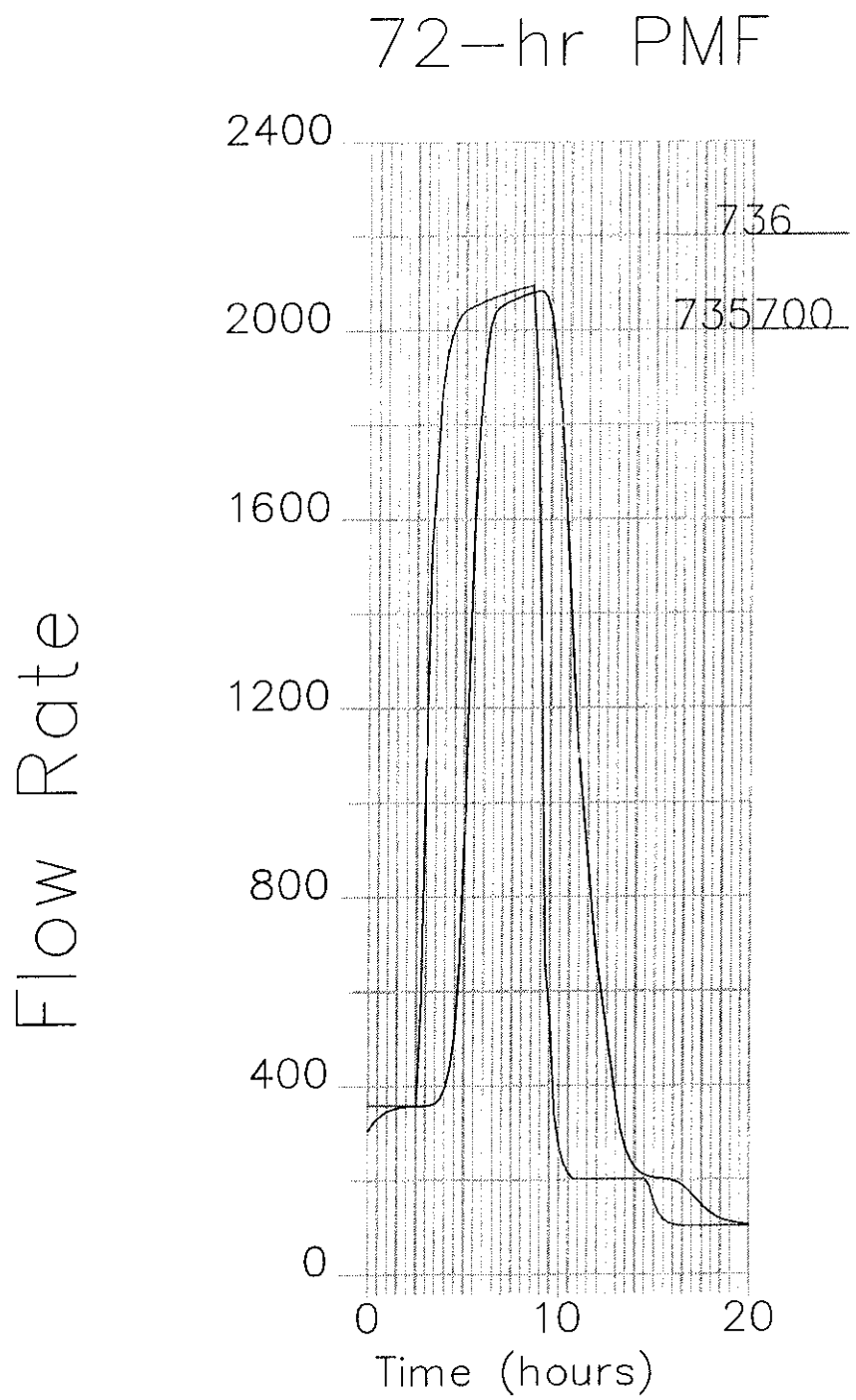
A difference in
Time to Peak of
1.75 hrs was used



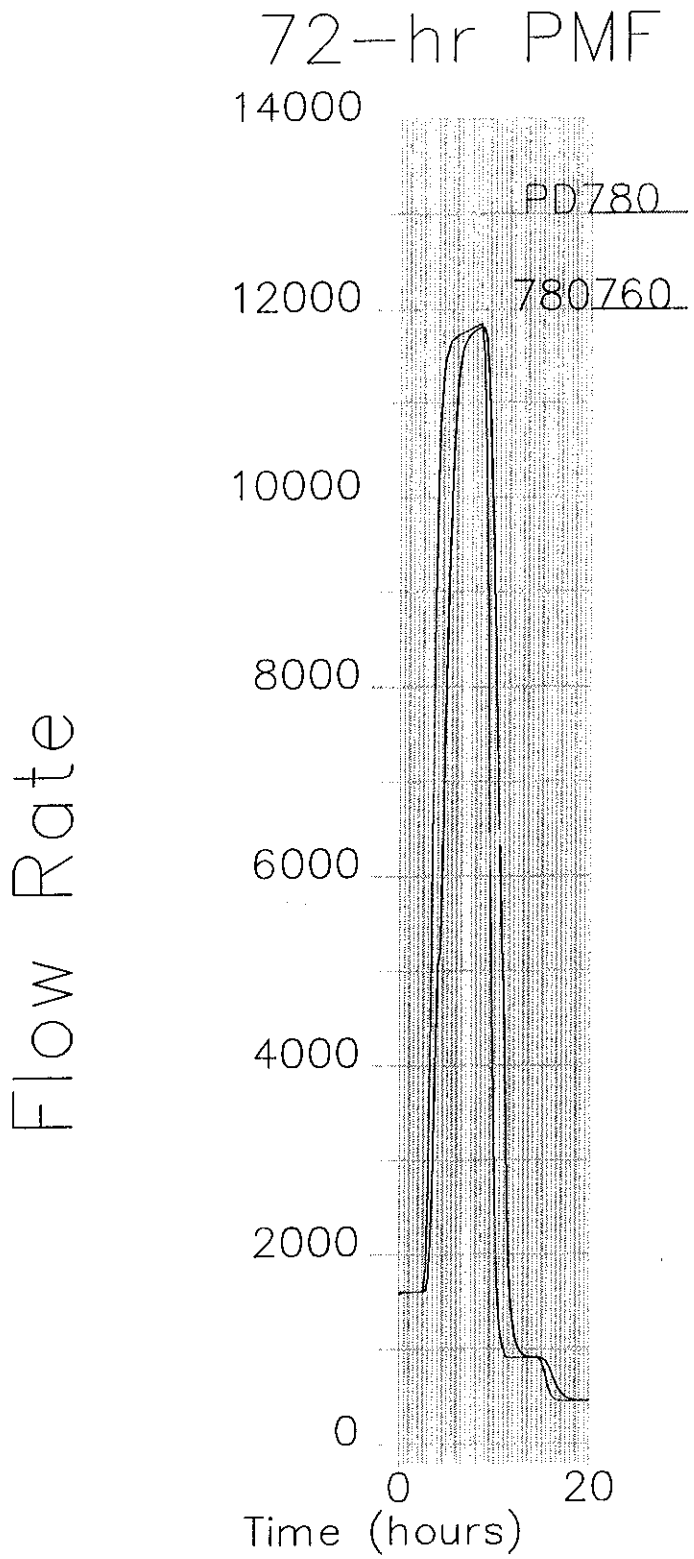
A difference in
Time to Peak of
2.50 hrs was used



A difference in Time to Peak of 0.15 hrs was used



A difference in
Time to Peak of
2.00 hrs was used



A difference in
Time to Peak of
0.50 hrs was used

B.4. Storage Routing Data

Flow Calculations:

In calculating the stage discharge at the CAP canal, Federal Highway Administration (FHA) nomograph, Chart 1 was utilized for the culverts. Various stages were chosen up to and including the berm elevation as determined from the mapping. In addition, calculations were made for the potential overtopping of the CAP Canal. The structure inverts were taken from the Wittmann ADMP CAP Canal Structure Surveys **(Reference 13)** report. The storage areas were computed based upon the contours and the storage volumes were estimated using the Conic Method for Reservoir Volumes as described by the HEC-1 program **(Reference 28)**.

The stage discharge relationship was calculated differently for the overchutes. Since these wide rectangular overchutes are relatively long, it was assumed that the flow will pass through critical depth at some point along the overchute. Based on this assumption the Froude number at critical depth is defined as follows:

$$Fr = 1 = \frac{BQ^2}{gA_c^3}$$

where:

B = Overchute Width
Q = Flow (cfs)
g = Gravity (ft/s^2)
A_c = Cross Sectional Area (ft^2)

This can be rearranged to yield:

$$Q = \left[\frac{gA_c^3}{B}\right]^{1/2}$$

The iterative process of calculating the flow begins by assuming a critical Y_c of some value, calculating the area ($A_c = Y_c * B$) and then solving for the flow. Then a check is performed to make sure that the assumed Y_c was correct for the given stage. The velocity head is calculated as follows:

$$\frac{V^2}{2g} = \left(\frac{Q}{A_c}\right)^2 * \frac{1}{2g}$$

It is assumed that there is no energy loss as the flow crosses the overchute. Based on this, the check is simply a conservation of energy equation where the Y_c is specific to the ponding stage. The check becomes: Stage = Invert Elevation + Y_c + $V^2/2g$. If this stage does not match the desired stage, a new value of Y_c must be assumed and the process repeated. This iterative process was used to compute the critical depths for various stages using the Critical Depth/ Energy Calculations spreadsheets that are included in this appendix. An example of the energy calculations for CAP 010 has been included as well.

For overtopping at the CAP Canal, the weir equation was utilized.

$$Q_{weir} = C * B * H^{3/2}$$

where:

C=Weir Coefficient
B=Weir Length
H=Water Depth Over Weir

A weir coefficient of 2.7 was assumed for all weirs, and the weir length was assumed to be the berm length where overtopping would occur. In the situation of overtopping, the flow was calculated for culvert flow as well as weir flow, and the total flow was the summation of the two.

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		BY	RAS	DATE	9/08/2003
CLIENT:	FCDMC	CHECK	JS	DATE	9/12/2003
JOB:	Wittmann Area Drainage Master Study Update	JOB NO.	310.032		

Structure: CAP 010

Invert Elevation = 1537.52

Width (B) = 67'

Equations:

$$Q = \left[\frac{gA_c^3}{B}\right]^{1/2}$$

$$A = Y_c * B$$

$$\frac{V^2}{2g} = \left(\frac{Q}{A}\right)^2 * \frac{1}{2g}$$

$$Stage = Invert + Y_c + \frac{V^2}{2g}$$

Storage at 1538:

Assume $Y_c = 0.32'$

$A = 0.32'*67' = 21.44\ ft^2$

$Q = ((21.44^3 * 32.2)/67')^{1/2} = 68.82$ cfs

$V^2/2g = (68.82/21.44)^2*(1/(2*32.2)) = 0.16'$

Stage = 1537.52 + 0.32 + 0.16 =1538.0

Since the final stage matches the assumed stage of 1538 the assumed Y_c of 0.32' was correct. If a discrepancy existed another value of Y_c would be chosen and the calculations would be repeated until the calculated stage matches the assumed stage.

Storage at 1540:

Assume $Y_c = 1.65'$

$A = 1.65 * 67' = 110.77\ ft^2$

$Q = ((110.77^3 * 32.2)/67')^{1/2} = 808.25$ cfs

$V^2/2g = (808.25/110.77)^2*(1/(2*32.2)) = 0.83'$

Stage = 1537.52 + 0.83 + 1.65 =1540.0

So the assumed Y_c of 1.65' was correct for the stage of 1540.

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		BY	RAS	DATE	9/08/2003
CLIENT:	FCDMC	CHECK	JS	DATE	9/12/2003
JOB:	Wittmann Area Drainage Master Study Update	JOB NO.	310.032		

Structure: CAP 010

Invert Elevation = 1537.52

Width (B) = 67'

Storage at 1542:

Assume Y_c = 2.99'

$A = 2.99'*67' = 200.11\ ft^2$

$Q = ((200.11^3 * 32.2)/67')^{1/2} = 1962.38$ cfs

$V^2/2g = (1962.38/200.11)^2*(1/(2*32.2)) = 1.49'$

Stage = 1537.52 + 1.49 + 2.99 = 1542.0

So the assumed Y_c of 2.99' was correct for the stage of 1542.

Storage at 1546:

Assume Y_c = 5.65'

$A = 5.65'*67' = 378.77\ ft^2$

$Q = ((378.77^3 * 32.2)/67')^{1/2} = 5110.46$ cfs

$V^2/2g = (5110.46/378.77)^2*(1/(2*32.2)) = 2.83'$

Stage = 1537.52 + 2.83 + 5.65 = 1546.0

So the assumed Y_c of 5.65' was correct for the stage of 1546.

Storage at 1546.2:

Assume Y_c = 5.79'

$A = 5.79'*67' = 387.65\ ft^2$

$Q = ((387.65^3 * 32.2)/67')^{1/2} = 5291.15$ cfs

$V^2/2g = (5291.15/387.65)^2*(1/(2*32.2)) = 2.89'$

Stage = 1537.52 + 2.89 + 5.79 + = 1546.2

So the assumed Y_c of 5.79' was correct for the stage of 1546.2.

Storage Volume Calculations:

The storage volume calculations were performed using the Conic Method for Reservoir Volumes as described by the HEC-1 program **(Reference 28)**. Contours were used to first calculate the area at given elevations, 1540, 1542… etc, using AutoCAD. Due to the nature of the natural landscape there are many depressions and rises along the impoundment area of the CAP Canal. These additional areas were included or excluded from the storage area as appropriate thus adjusting the storage area. The areas (sq ft) were then converted to acres. The Conic Method was then applied to estimate the change in storage volume. It was assumed that the contour below the lowest estimated storage area elevation was the zero area and zero volume contour. This was necessary to calculate the lowest stage storage volume. For example if the lowest contour that would pond was 1530, and the mapping was in 2-foot contours, 1528 would be assumed to have zero storage area and zero storage volume. Linear interpolations were made for the invert elevations and top of berm elevations since contours were not available at most of those specific elevations. To estimate the top of berm storage area and volume, one contour higher than the berm was calculated (area and volume) assuming that the Canal was the boundary of the contour and linear interpolation was again used. Details of these calculations can be found in the following table.

APPENDIX B.4

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SHEET	5	OF	42
BY	RAS	DATE	12-Sep-03
CHECK	JS	DATE	12-Sep-03
JOB NO.	310.032		

CLIENT: FCDMC

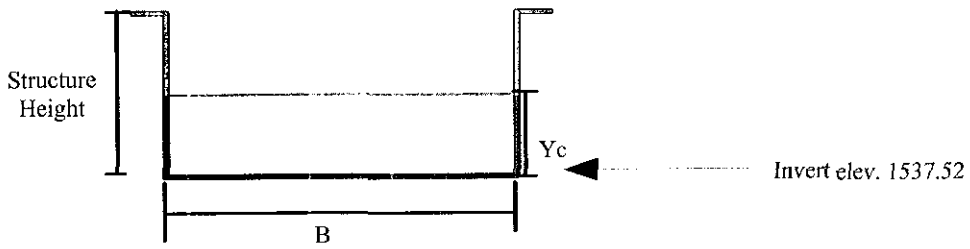
JOB: Wittmann Area Drainage Master Study Update

Structure: CAP 010, Reach 8 Sta. 466+00

CRITICAL DEPTH/ ENERGY CALCULATIONS

LOCATION CAP 010

Bottom Width =	67	(ft)
Left side Slope =	0	:1
Rigth Side Slopes =	0	:1
Invert Elevation=	1537.52	(ft)
Berm Elevation=	1546.2	(ft)



Stage (ft)	Critical Depth yc (ft)	Bottom Width B (ft)	Area A (ft^2)	Velocity Head (ft)	Discharge (cfs)	Storage Area (ac)
1530.0	0.00	67.00	0.00	0.00	0.00	0.10
1532.0	0.00	67.00	0.00	0.00	0.00	0.25
1534.0	0.00	67.00	0.00	0.00	0.00	0.47
1536.0	0.00	67.00	0.00	0.00	0.00	1.86
1537.5	0.00	67.00	0.00	0.00	0.00	9.86
1538.0	0.32	67.00	21.44	0.16	68.82	12.53
1540.0	1.65	67.00	110.77	0.83	808.25	26.53
1542.0	2.99	67.00	200.11	1.49	1962.38	59.20
1544.0	4.32	67.00	289.44	2.16	3413.72	117.50

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Entellus

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BY	JS	DATE	9/8/2003
CHECK	PAW	DATE	9/10/2003
JOB NO.	310.032		

CLIENT FCDMC

JOB: Wittmann Area Drainage Master Study Update

CAP Overchute Discharge vs Water Surface Elevation/ Storage Area

Location/ Description: CAP 010

Water Surface Elevation [ft]	h [ft]	Storage Area [acre]	Storage Volume** [acre ft]	Discharge* [cfs]
1530	0	0.1	0.0	0
1532	2	0.3	0.3	0
1534	2	0.5	1.0	0
1536	2	1.9	3.2	0
1537	1	9.9	8.5	0
1538	1	12.5	19.7	68.82
1540	2	26.5	57.9	808.25
1542	2	59.2	141.4	1962.38
1544	2	117.5	314.6	3413.72
1546	2	184.0	613.3	5110.46
1546.2	0.2	191.9	650.8	5291.15

*Discharge calculated using energy method

**Storage volume calculated using conic method, V_{12}=.333h*(A_1+A_2+(A_1*A_2)^.5)

Legend

Elevation = 1546
Storage Area = 183.5 Ac
Storage Volume = 610.3 Ac. ft

Elevation = 1544
Storage Area = 117.5 Ac
Storage Volume = 311.3 Ac. ft

Elevation = 1542
Storage Area = 59.2 Ac
Storage Volume = 137.9 Ac. ft

Elevation = 1540
Storage Area = 26.5 Ac
Storage Volume = 54.3 Ac. ft

Elevation = 1538
Storage Area = 12.5 Ac
Storage Volume = 16.1 Ac. ft

Elevation = 1536
Storage Area = 1.9 Ac
Storage Volume = 3.3 Ac. ft

Elevation = 1534
Storage Area = 0.5 Ac
Storage Volume = 1.1 Ac. ft

Elevation = 1532
Storage Area = 0.3 Ac
Storage Volume = 0.4 Ac. ft

Elevation = 1530
Storage Area = 0.1 Ac
Storage Volume = 0.1 Ac. ft

CAP Canal

CAP 010
STA 466+00
67' Overshoot

800' 0' 800' 1600'

SCALE: 1"= 800'

N

Based upon 2' contours from FCDMC

DESIGN	BY RAS	DATE 08/2003
DESIGN CHK.	CJL	08/2003

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APPENDIX B.4

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SHEET	8	OF	42
BY	RAS	DATE	12-Sep-03
CHECK	JS	DATE	12-Sep-03
JOB NO.	310.032		

CLIENT: FCDMC

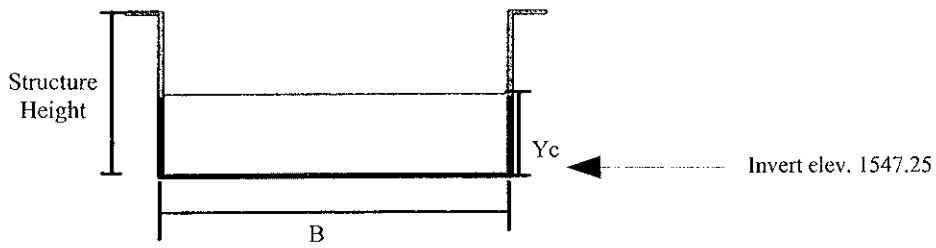
JOB: Wittmann Area Drainage Master Study Update

Structure: CAP 020, Reach 8 Sta. 572+50

CRITICAL DEPTH/ ENERGY CALCULATIONS

LOCATION CAP 020

Bottom Width =	47	(ft)
Left side Slope =	0	:1
Rigth Side Slopes =	0	:1
Invert Elevation=	1547.25	(ft)
Berm Elevation=	1553	(ft)



Stage (ft)	Critical Depth yc (ft)	Bottom Width B (ft)	Area A (ft^2)	Velocity Head (ft)	Discharge (cfs)	Storage Area (ac)
1546.0	0.00	47.00	0.00	0.00	0.00	5.50
1547.3	0.00	47.00	0.00	0.00	0.00	13.56
1548.0	0.50	47.00	23.50	0.25	94.29	17.90
1550.0	1.83	47.00	86.17	0.92	662.05	67.00
1552.0	3.17	47.00	148.83	1.58	1502.90	99.20
1553.0	3.83	47.00	180.17	1.92	2001.76	118.26

Note: Elevations obtained from survey report. Storage areas estimated using topographic maps

APPENDIX B.4

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BY	JS	DATE	9/8/2003
CHECK	PAW	DATE	9/10/2003
JOB NO.	310.032		

CLIENT FCDMC

JOB: Wittmann Area Drainage Master Study Update

CAP Overchute Discharge vs Water Surface Elevation/ Storage Area

Location/ Description: CAP 020

Water Surface Elevation [ft]	h [ft]	Storage Area [acre]	Storage Volume** [acre ft]	Discharge* [cfs]
1546	0	5.5	0.0	0
1547.3	1.3	13.6	12.0	0
1548	0.7	17.9	23.0	94.29
1550	2	67.0	102.6	662.05
1552	2	99.2	267.5	1502.9
1553	1	118.3	376.0	2001.76

*Discharge calculated using energy method

**Storage volume calculated using conic method, V_{12}=.333h*(A_1+A_2+(A_1*A_2)^.5)

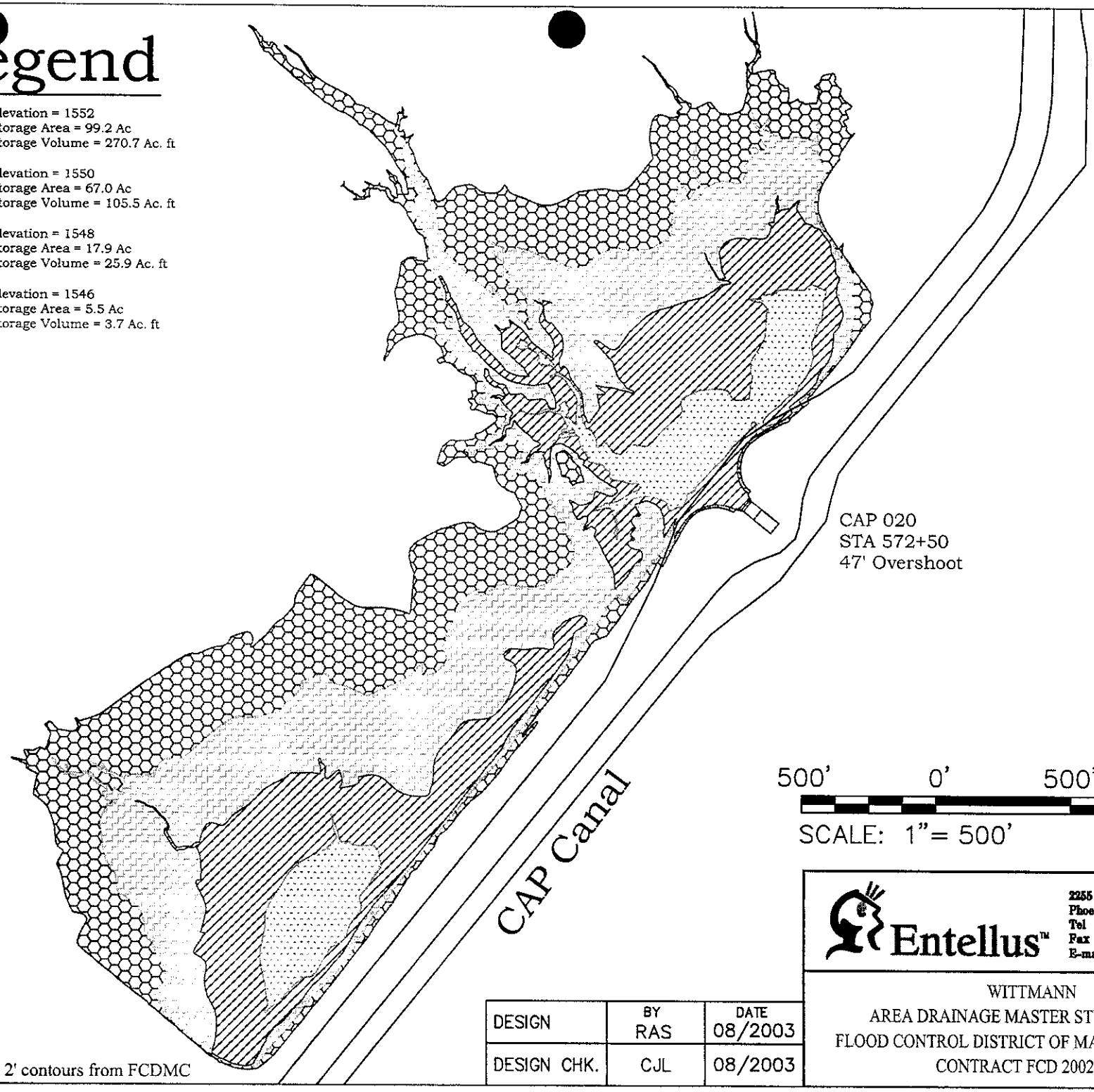
Legend

Elevation = 1552
Storage Area = 99.2 Ac
Storage Volume = 270.7 Ac. ft

Elevation = 1550
Storage Area = 67.0 Ac
Storage Volume = 105.5 Ac. ft

Elevation = 1548
Storage Area = 17.9 Ac
Storage Volume = 25.9 Ac. ft

Elevation = 1546
Storage Area = 5.5 Ac
Storage Volume = 3.7 Ac. ft



Based upon 2' contours from FCDMC

DESIGN	BY RAS	DATE 08/2003
DESIGN CHK.	CJL	08/2003

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SHEET	11	OF	42
BY	RAS	DATE	12-Sep-03
CHECK	JS	DATE	12-Sep-03
JOB NO.	310.032		

CLIENT: FCDMC

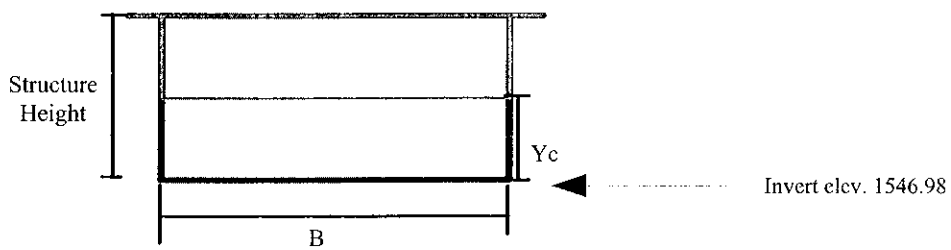
JOB: Wittmann Area Drainage Master Study Update

Structure: CAP 030, Reach 8 Sta. 609+00

CRITICAL DEPTH/ ENERGY CALCULATIONS

LOCATION CAP 030

Bottom Width =	135	(ft)
Left side Slope =	0	:1
Rigth Side Slopes =	0	:1
Invert Elevation=	1546.98	(ft)
Berm Elevation=	1556	(ft)



Stage (ft)	Critical Depth yc (ft)	Bottom Width B (ft)	Area A (ft^2)	Velocity Head (ft)	Discharge (cfs)	Storage Area (ac)
1547.0	0.00	135.00	0.00	0.00	0.00	0.33
1548.0	0.68	135.00	91.80	0.34	429.56	0.66
1550.0	2.01	135.00	271.80	1.01	2188.44	2.13
1552.0	3.35	135.00	451.80	1.67	4690.08	5.99
1554.0	4.68	135.00	631.80	2.34	7755.87	10.04
1556.0	6.01	135.00	811.80	3.01	11296.26	16.10

Note: Elevations obtained from survey report. Storage areas estimated using topographic maps

APPENDIX B.4

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SHEET	12	OF	42
BY	JS	DATE	9/8/2003
CHECK	PAW	DATE	9/10/2003
JOB NO.	310.032		

CLIENT FCDMC

JOB: Wittmann Area Drainage Master Study Update

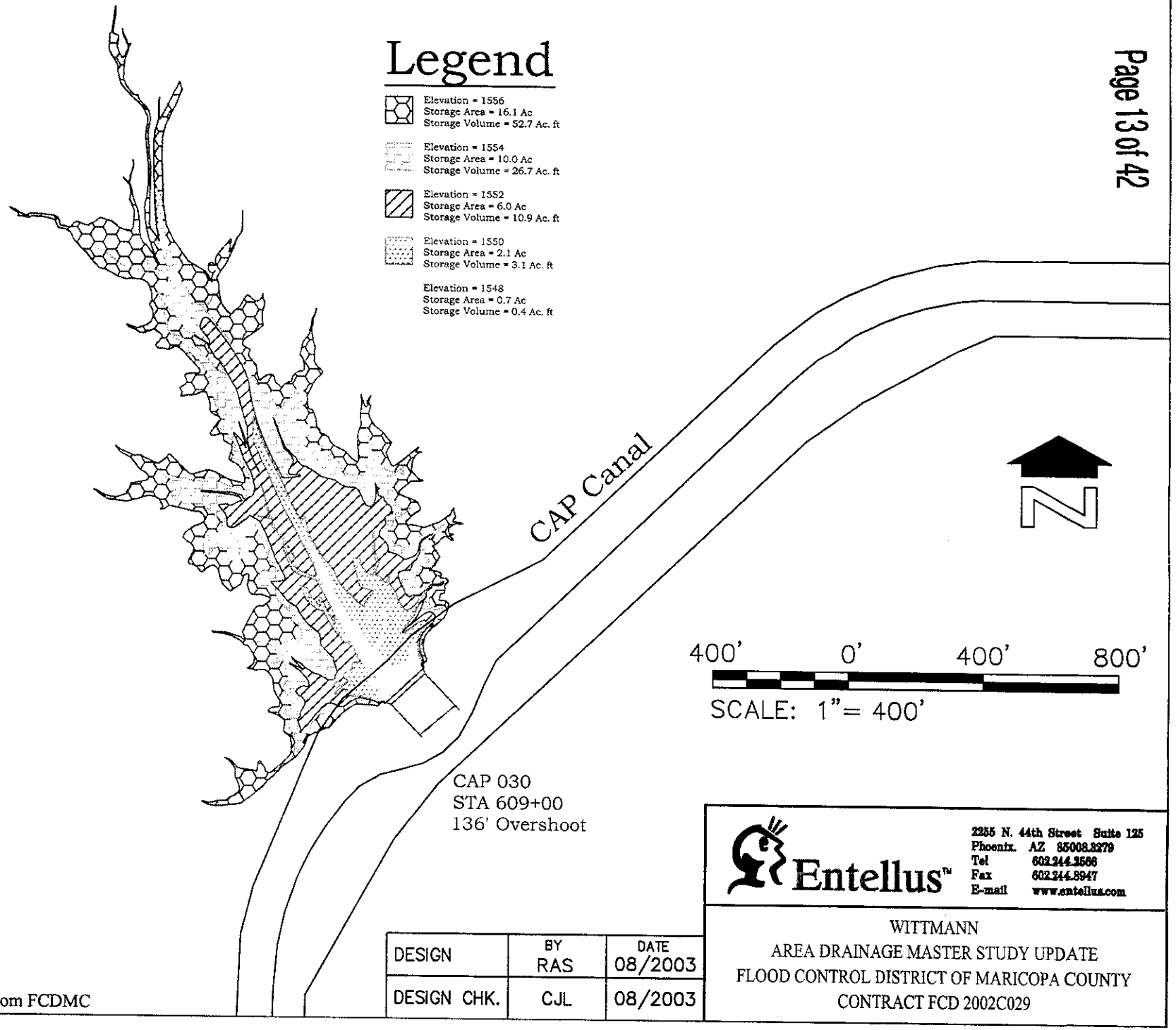
CAP Overchute Discharge vs Water Surface Elevation/ Storage Area

Location/ Description: CAP 030

Water Surface Elevation [ft]	h [ft]	Storage Area [acre]	Storage Volume** [acre ft]	Discharge* [cfs]
1547	0	0.3	0.0	0
1548	1	0.7	0.5	429.56
1550	2	2.1	3.1	2188.44
1552	2	6.0	10.9	4690.08
1554	2	10.0	26.8	7755.87
1556	2	16.1	52.6	11296.26

*Discharge calculated using energy method

**Storage volume calculated using conic method, V_{12}=.333h*(A_1+A_2+(A_1*A_2)^.5)



Based upon 2' contours from FCDMC

DESIGN	BY RAS	DATE 08/2003
DESIGN CHK.	CJL	08/2003

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SHEET	14	OF	42
BY	RAS	DATE	12-Sep-03
CHECK	JS	DATE	12-Sep-03
JOB NO.	310.032		

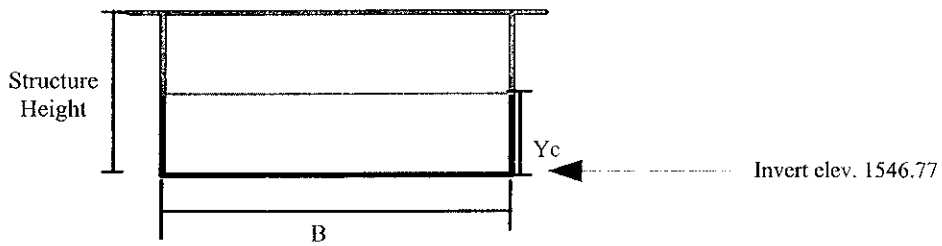
CLIENT: FCDMC

JOB: Wittmann Area Drainage Master Study Update

Structure: CAP 040, Reach 8 Sta. 688+00

CRITICAL DEPTH/ ENERGY CALCULATIONS

LOCATION	CAP 040	
Bottom Width =	87	(ft)
Left side Slope =	0	:1
Rigth Side Slopes =	0	:1
Invert Elevation=	1546.77	(ft)
Berm Elevation=	1552.7	(ft)



Stage (ft)	Critical Depth yc (ft)	Bottom Width B (ft)	Area A (ft^2)	Velocity Head (ft)	Discharge (cfs)	Storage Area (ac)
1540.0	0.00	87.00	0.00	0.00	0.00	0.48
1542.0	0.00	87.00	0.00	0.00	0.00	1.59
1544.0	0.00	87.00	0.00	0.00	0.00	3.04
1546.0	0.00	87.00	0.00	0.00	0.00	22.06
1546.8	0.00	87.00	0.00	0.00	0.00	37.08
1548.0	0.82	87.00	71.34	0.41	366.58	61.08
1550.0	2.15	87.00	187.34	1.08	1559.96	105.10
1552.0	3.49	87.00	303.34	1.74	3214.13	160.80
1552.7	3.95	87.00	343.94	1.98	3880.54	181.30

Note: Elevations obtained from survey report. Storage areas estimated using topographic maps

APPENDIX B.4

Entellus

SHEET	15	OF	42
BY	JS	DATE	9/8/2003
CHECK	PAW	DATE	9/10/2003
JOB NO.	310.032		

CLIENT FCDMC

JOB: Wittmann Area Drainage Master Study Update

CAP Overchute Discharge vs Water Surface Elevation/ Storage Area

Location/ Description: CAP 040

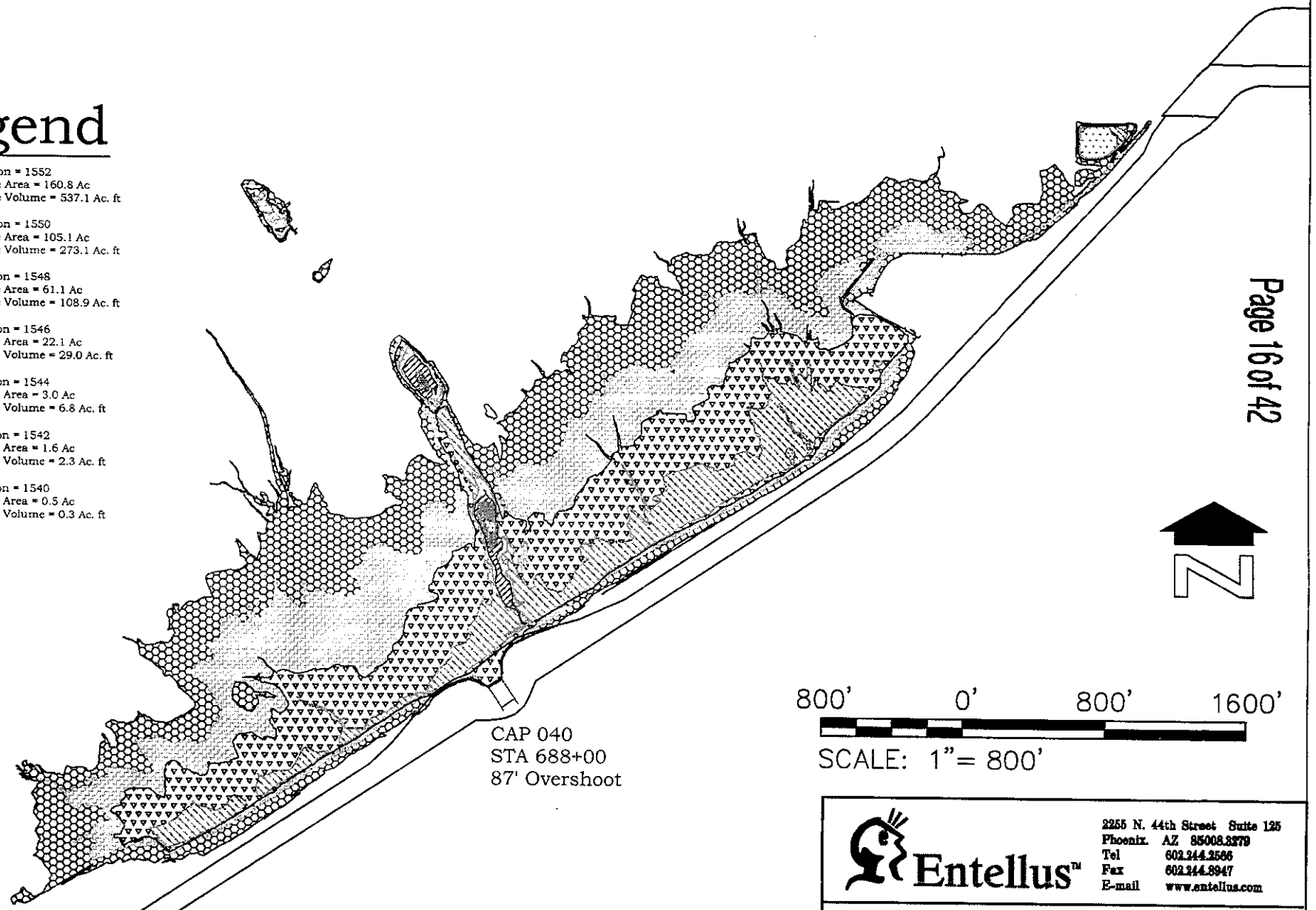
Water Surface Elevation [ft]	h [ft]	Storage Area [acre]	Storage Volume** [acre ft]	Discharge* [cfs]
1540	0	0.5	0.0	0
1542	2	1.6	2.0	0
1544	2	3.0	6.5	0
1546	2	22.1	28.7	0
1546.8	0.8	37.1	52.1	0
1548	1.2	61.1	110.3	366.58
1550	2	105.1	274.3	1559.96
1552	2	160.8	538.0	3214.13
1552.7	0.7	181.3	657.5	3880.54

*Discharge calculated using energy method

**Storage volume calculated using conic method, V_{12}=.333h*(A_1+A_2+(A_1*A_2)^.5)

Legend

- Elevation = 1552
  Storage Area = 160.8 Ac
  Storage Volume = 537.1 Ac. ft
- Elevation = 1550
  Storage Area = 105.1 Ac
  Storage Volume = 273.1 Ac. ft
- Elevation = 1548
  Storage Area = 61.1 Ac
  Storage Volume = 108.9 Ac. ft
- Elevation = 1546
  Storage Area = 22.1 Ac
  Storage Volume = 29.0 Ac. ft
- Elevation = 1544
  Storage Area = 3.0 Ac
  Storage Volume = 6.8 Ac. ft
- Elevation = 1542
  Storage Area = 1.6 Ac
  Storage Volume = 2.3 Ac. ft
- Elevation = 1540
  Storage Area = 0.5 Ac
  Storage Volume = 0.3 Ac. ft



Based upon 2' contours from FCDMC

DESIGN	BY RAS	DATE 08/2003
DESIGN CHK.	CJL	08/2003

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SHEET	17	OF	42
BY	RAS	DATE	12-Sep-03
CHECK	JS	DATE	12-Sep-03
JOB NO.	310.032		

CLIENT: FCDMC

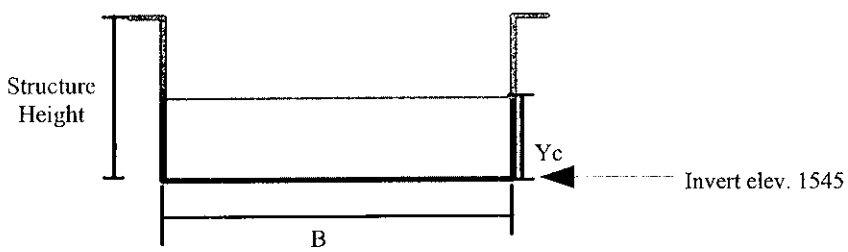
JOB: Wittmann Area Drainage Master Study Update

Structure: CAP 050, Reach 8 Sta. 804+50

CRITICAL DEPTH/ ENERGY CALCULATIONS

LOCATION CAP 050

Bottom Width =	67	(ft)
Left side Slope =	0	:1
Rigth Side Slope =	0	:1
Invert Elevation=	1545	(ft)
Berm Elevation=	1553	(ft)



Stage (ft)	Critical Depth yc (ft)	Bottom Width B (ft)	Area A (ft^2)	Velocity Head (ft)	Discharge (cfs)	Storage Area (ac)
1545.0	0.00	67.00	0.00	0.00	0.00	0.00
1546.0	0.00	67.00	0.00	0.00	0.00	0.05
1548.0	2.00	67.00	134.01	1.00	1075.52	0.74
1550.0	3.33	67.00	223.37	1.67	2314.32	11.45
1552.0	4.67	67.00	312.67	2.33	3832.77	35.26
1553.0	5.33	67.00	357.38	2.67	4683.60	54.05

Note: Elevations obtained from survey report. Storage areas estimated using topographic maps

APPENDIX B.4

Entellus

SHEET	18	OF	42
BY	JS	DATE	9/8/2003
CHECK	PAW	DATE	9/10/2003
JOB NO.	310.032		

CLIENT FCDMC

JOB: Wittmann Area Drainage Master Study Update

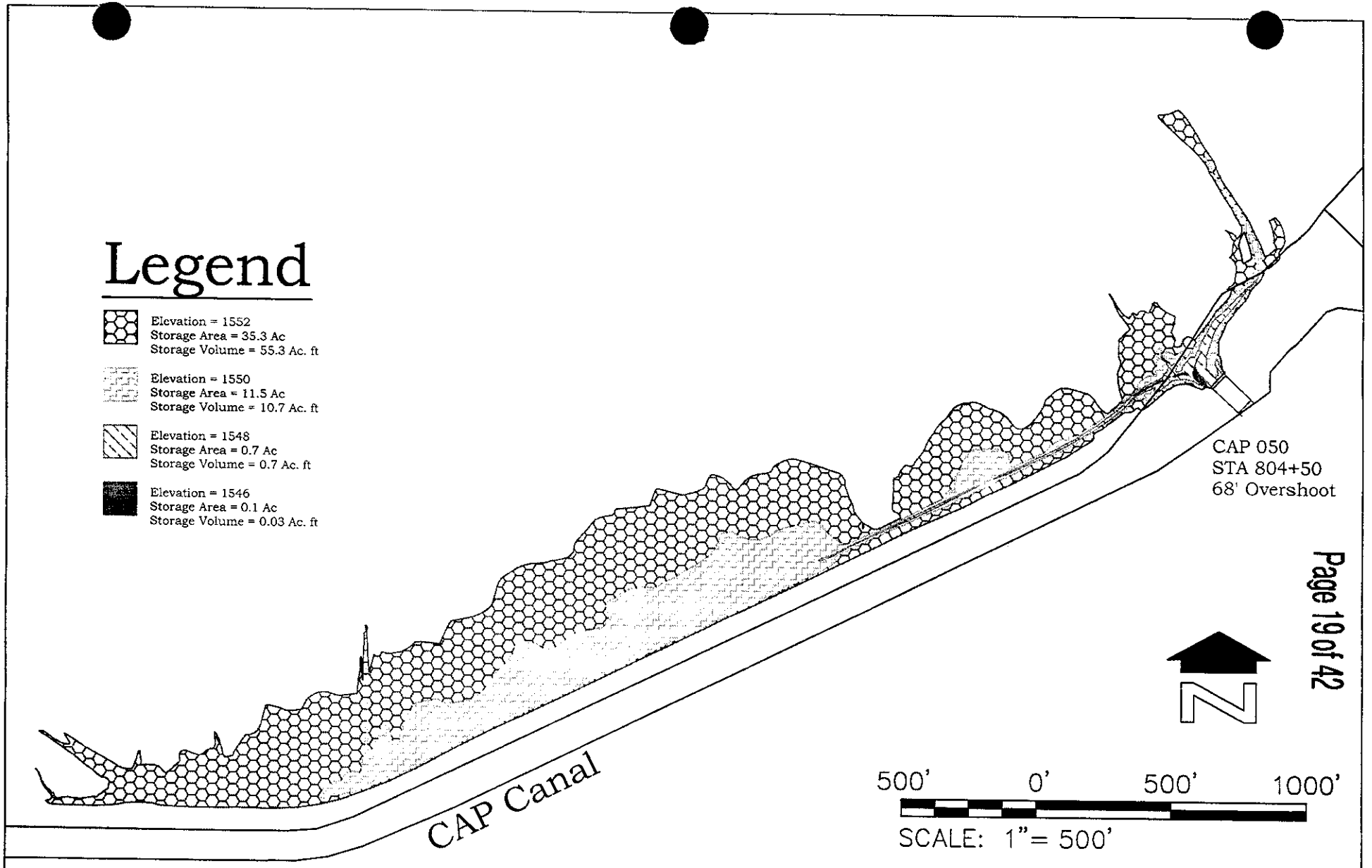
CAP Overchute Discharge vs Water Surface Elevation/ Storage Area

Location/ Description: CAP 050

Water Surface Elevation [ft]	h [ft]	Storage Area [acre]	Storage Volume** [acre ft]	Discharge* [cfs]
1545	0	0.0	0.0	0
1546	1	0.1	0.0	0
1548	2	0.7	0.7	1075.52
1550	2	11.5	10.7	2314.32
1552	2	35.3	55.2	3832.77
1553	1	54.1	99.5	4683.6

*Discharge calculated using energy method

**Storage volume calculated using conic method, V_{12}=.333h*(A_1+A_2+(A_1*A_2)^.5)



Based upon 2' contours from FCDMC

DESIGN	BY RAS	DATE 08/2003
DESIGN CHK.	CJL	08/2003

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WITTMANN
AREA DRAINAGE MASTER STUDY UPDATE
FLOOD CONTROL DISTRICT OF MARICOPA COUNTY
CONTRACT FCD 2002C029

APPENDIX B.4

Entellus

SHEET	20	OF	42
BY	JS	DATE	9/8/2003
CHECK	PAW	DATE	9/10/2003
JOB NO.	310.032		

CLIENT FCDMC

JOB: Wittmann Area Drainage Master Study Update

CAP Culvert Discharge vs Water Surface Elevation/ Storage Area

Location/ Description: Impoundment Area East of US60 CAP60-190

Water Surface Elevation [ft]	h [ft]	Storage Area [acre]	Storage Volume** [acre ft]	Discharge* [cfs]
1528	0	0.0	0.0	0
1532	4	0.2	0.3	0
1536	4	0.8	2.2	0
1540	4	4.4	11.6	0
1544	4	60.5	119.8	698
1546	2	130.7	306.3	2229
1548	2	195.1	629.7	3747
1550	2	348.8	1165.6	5188
1552	2	486.0	1995.8	6380
1554	2	625.3	3103.1	7215
1556	2	763.8	4488.5	7985

*Discharge calculated using nomograph

**Storage volume calculated using conic method, V_{12}=.333h*(A_1+A_2+(A_1*A_2)^.5)

APPENDIX B.4

Entellus

SHEET	21	OF	42
BY	JS	DATE	9/8/2003
CHECK	PAW	DATE	9/10/2003
JOB NO.	310.032		

CLIENT: FCDMC

JOB: Wittmann Area Drainage Master Study Update

Discharge Calculations for Culvert System

Location/ Description: Impoundment Area East of US60 along CAP canal

Water Surface Elevation: 1544

Culvert ID	Station	Description	Invert Elevation [feet]	D [inches]	HW [ft]	HW/D [ft/ft]	Q* [cfs]
CAP060	36+12	72" RCP	1543.29	72	0.71	0.12	15
CAP070	52+80	72" RCP	1543.1	72	0.9	0.15	19
CAP080	85+70	72" RCP	1542.93	72	1.07	0.18	22
CAP090	119+70	72" RCP	1542.55	72	1.45	0.24	27
CAP100	159+50	72" RCP	1542.3	72	1.7	0.28	32
CAP110	180+50	72" RCP	1542.2	72	1.8	0.30	32
CAP120	190+60	72" RCP	1542.61	72	1.39	0.23	27
CAP130	216+80	72" RCP	1542.4	72	1.6	0.27	32
CAP140	240+00	72" RCP	1544.65	72	-0.65	-0.11	0
CAP150	253+00	72" RCP	1542.85	72	1.15	0.19	22
CAP160	272+35	3 - 72" RCP	1541.32	72	2.68	0.45	165
CAP170	279+00	72" RCP	1541.37	72	2.63	0.44	55
CAP180	298+70	72" RCP	1541.23	72	2.77	0.46	55
CAP190	315+00	3 - 72" RCP	1541.02	72	2.98	0.50	195
					Q Total [CFS]:		698

* Flows were calculated using nomograph for inlet control culverts

APPENDIX B.4

Entellus

SHEET	22	OF	42
BY	JS	DATE	9/8/2003
CHECK	PAW	DATE	9/10/2003
JOB NO.	310.032		

CLIENT: FCDMC

JOB: Wittmann Area Drainage Master Study Update

Discharge Calculations for Culvert System

Location/ Description: Impoundment Area East of US60 along CAP canal

Water Surface Elevation: 1546

Culvert ID	Station	Description	Invert Elevation [feet]	D [inches]	HW [ft]	HW/D [ft/ft]	Q* [cfs]
CAP060	36+12	72" RCP	1543.29	72	2.71	0.45	55
CAP070	52+80	72" RCP	1543.1	72	2.9	0.48	65
CAP080	85+70	72" RCP	1542.93	72	3.07	0.51	65
CAP090	119+70	72" RCP	1542.55	72	3.45	0.58	82
CAP100	159+50	72" RCP	1542.3	72	3.7	0.62	91
CAP110	180+50	72" RCP	1542.2	72	3.8	0.63	95
CAP120	190+60	72" RCP	1542.61	72	3.39	0.57	82
CAP130	216+80	72" RCP	1542.4	72	3.6	0.60	76
CAP140	240+00	72" RCP	1544.65	72	1.35	0.22	27
CAP150	253+00	72" RCP	1542.85	72	3.15	0.53	66
CAP160	272+35	3 - 72" RCP	1541.32	72	4.68	0.78	555
CAP170	279+00	72" RCP	1541.37	72	4.63	0.77	185
CAP180	298+70	72" RCP	1541.23	72	4.77	0.79	185
CAP190	315+00	3 - 72" RCP	1541.02	72	4.98	0.83	600
					Q Total [CFS]:		2229

* Flows were calculated using nomograph for inlet control culverts

APPENDIX B.4

Entellus

SHEET	23	OF	42
BY	JS	DATE	9/8/2003
CHECK	PAW	DATE	9/10/2003
JOB NO.	310.032		

CLIENT: FCDMC

JOB: Wittmann Area Drainage Master Study Update

Discharge Calculations for Culvert System

Location/ Description: Impoundment Area East of US60 along CAP canal

Water Surface Elevation: 1548

Culvert ID	Station	Description	Invert Elevation [feet]	D [inches]	HW [ft]	HW/D [ft/ft]	Q* [cfs]
CAP060	36+12	72" RCP	1543.29	72	4.71	0.79	143
CAP070	52+80	72" RCP	1543.1	72	4.9	0.82	150
CAP080	85+70	72" RCP	1542.93	72	5.07	0.84	157
CAP090	119+70	72" RCP	1542.55	72	5.45	0.91	172
CAP100	159+50	72" RCP	1542.3	72	5.7	0.95	185
CAP110	180+50	72" RCP	1542.2	72	5.8	0.97	200
CAP120	190+60	72" RCP	1542.61	72	5.39	0.90	172
CAP130	216+80	72" RCP	1542.4	72	5.6	0.93	185
CAP140	240+00	72" RCP	1544.65	72	3.35	0.56	66
CAP150	253+00	72" RCP	1542.85	72	5.15	0.86	157
CAP160	272+35	3 - 72" RCP	1541.32	72	6.68	1.11	810
CAP170	279+00	72" RCP	1541.37	72	6.63	1.11	270
CAP180	298+70	72" RCP	1541.23	72	6.77	1.13	270
CAP190	315+00	3 - 72" RCP	1541.02	72	6.98	1.16	810
					Q Total [CFS]:		3747

* Flows were calculated using nomograph for inlet control culverts

APPENDIX B.4

Entellus

SHEET	24	OF	42
BY	JS	DATE	9/8/2003
CHECK	PAW	DATE	9/10/2003
JOB NO.	310.032		

CLIENT: FCDMC

JOB: Wittmann Area Drainage Master Study Update

Discharge Calculations for Culvert System

Location/ Description: Impoundment Area East of US60 along CAP canal

Water Surface Elevation: 1550

Culvert ID	Station	Description	Invert Elevation [feet]	D [inches]	HW [ft]	HW/D [ft/ft]	Q* [cfs]
CAP060	36+12	72" RCP	1543.29	72	6.71	1.12	238
CAP070	52+80	72" RCP	1543.1	72	6.9	1.15	238
CAP080	85+70	72" RCP	1542.93	72	7.07	1.18	245
CAP090	119+70	72" RCP	1542.55	72	7.45	1.24	260
CAP100	159+50	72" RCP	1542.3	72	7.7	1.28	270
CAP110	180+50	72" RCP	1542.2	72	7.8	1.30	270
CAP120	190+60	72" RCP	1542.61	72	7.39	1.23	260
CAP130	216+80	72" RCP	1542.4	72	7.6	1.27	270
CAP140	240+00	72" RCP	1544.65	72	5.35	0.89	172
CAP150	253+00	72" RCP	1542.85	72	7.15	1.19	245
CAP160	272+35	3 - 72" RCP	1541.32	72	8.68	1.45	1005
CAP170	279+00	72" RCP	1541.37	72	8.63	1.44	335
CAP180	298+70	72" RCP	1541.23	72	8.77	1.46	345
CAP190	315+00	3 - 72" RCP	1541.02	72	8.98	1.50	1035
					Q Total [CFS]:		5188

* Flows were calculated using nomograph for inlet control culverts

APPENDIX B.4

Entellus

SHEET	25	OF	42
BY	JS	DATE	9/8/2003
CHECK	PAW	DATE	9/10/2003
JOB NO.	310.032		

CLIENT: FCDMC

JOB: Wittmann Area Drainage Master Study Update

Discharge Calculations for Culvert System

Location/ Description: Impoundment Area East of US60 along CAP canal

Water Surface Elevation: 1552

Culvert ID	Station	Description	Invert Elevation [feet]	D [inches]	HW [ft]	HW/D [ft/ft]	Q* [cfs]
CAP060	36+12	72" RCP	1543.29	72	8.71	1.45	305
CAP070	52+80	72" RCP	1543.1	72	8.9	1.48	320
CAP080	85+70	72" RCP	1542.93	72	9.07	1.51	320
CAP090	119+70	72" RCP	1542.55	72	9.45	1.58	335
CAP100	159+50	72" RCP	1542.3	72	9.7	1.62	345
CAP110	180+50	72" RCP	1542.2	72	9.8	1.63	345
CAP120	190+60	72" RCP	1542.61	72	9.39	1.57	332
CAP130	216+80	72" RCP	1542.4	72	9.6	1.60	332
CAP140	240+00	72" RCP	1544.65	72	7.35	1.22	260
CAP150	253+00	72" RCP	1542.85	72	9.15	1.53	320
CAP160	272+35	3 - 72" RCP	1541.32	72	10.68	1.78	1170
CAP170	279+00	72" RCP	1541.37	72	10.63	1.77	390
CAP180	298+70	72" RCP	1541.23	72	10.77	1.80	400
CAP190	315+00	3 - 72" RCP	1541.02	72	10.98	1.83	1200
					Q Total [CFS]:		6374

* Flows were calculated using nomograph for inlet control culverts

APPENDIX B.4

Entellus

SHEET	26	OF	42
BY	JS	DATE	9/8/2003
CHECK	PAW	DATE	9/10/2003
JOB NO.	310.032		

CLIENT: FCDMC

JOB: Wittmann Area Drainage Master Study Update

Discharge Calculations for Culvert System

Location/ Description: Impoundment Area East of US60 along CAP canal

Water Surface Elevation: 1554

Culvert ID	Station	Description	Invert Elevation [feet]	D [inches]	HW [ft]	HW/D [ft/ft]	Q* [cfs]
CAP060	36+12	72" RCP	1543.29	72	10.71	1.79	370
CAP070	52+80	72" RCP	1543.1	72	10.9	1.82	375
CAP080	85+70	72" RCP	1542.93	72	11.07	1.84	375
CAP090	119+70	72" RCP	1542.55	72	11.45	1.91	380
CAP100	159+50	72" RCP	1542.3	72	11.7	1.95	390
CAP110	180+50	72" RCP	1542.2	72	11.8	1.97	400
CAP120	190+60	72" RCP	1542.61	72	11.39	1.90	380
CAP130	216+80	72" RCP	1542.4	72	11.6	1.93	390
CAP140	240+00	72" RCP	1544.65	72	9.35	1.56	335
CAP150	253+00	72" RCP	1542.85	72	11.15	1.86	380
CAP160	272+35	3 - 72" RCP	1541.32	72	12.68	2.11	1290
CAP170	279+00	72" RCP	1541.37	72	12.63	2.11	430
CAP180	298+70	72" RCP	1541.23	72	12.77	2.13	430
CAP190	315+00	3 - 72" RCP	1541.02	72	12.98	2.16	1290
					Q Total [CFS]:		7215

* Flows were calculated using nomograph for inlet control culverts

APPENDIX B.4

Entellus

SHEET	27A	OF	42
BY	RAS	DATE	12/8/2003
CHECK	HAA	DATE	12/8/2003
JOB NO.	310.032		

CLIENT: FCDMC

JOB: Wittmann Area Drainage Master Study Update

Discharge Calculations for Culvert System

Location/ Description: Impoundment Area East of US60 along CAP canal

Water Surface Elevation: 1556

Culvert ID	Station	Description	Invert Elevation [feet]	D [inches]	HW [ft]	HW/D [ft/ft]	Q* [cfs]
CAP060	36+12	72" RCP	1543.29	72	12.71	2.12	415
CAP070	52+80	72" RCP	1543.1	72	12.9	2.15	430
CAP080	85+70	72" RCP	1542.93	72	13.07	2.18	430
CAP090	119+70	72" RCP	1542.55	72	13.45	2.24	430
CAP100	159+50	72" RCP	1542.3	72	13.7	2.28	440
CAP110	180+50	72" RCP	1542.2	72	13.8	2.30	440
CAP120	190+60	72" RCP	1542.61	72	13.39	2.23	430
CAP130	216+80	72" RCP	1542.4	72	13.6	2.27	440
CAP140	240+00	72" RCP	1544.65	72	11.35	1.89	380
CAP150	253+00	72" RCP	1542.85	72	13.15	2.19	430
CAP160	272+35	3 - 72" RCP	1541.32	72	14.68	2.45	1395
CAP170	279+00	72" RCP	1541.37	72	14.63	2.44	465
CAP180	298+70	72" RCP	1541.23	72	14.77	2.46	465
CAP190	315+00	3 - 72" RCP	1541.02	72	14.98	2.50	1395
					Q Total [CFS]:		7985

* Flows were calculated using nomograph for inlet control culverts

APPENDIX B.4

Entellus

SHEET	27B	OF	42
BY	RAS	DATE	12/8/2003
CHECK	HAA	DATE	12/8/2003
JOB NO.	310.032		

CLIENT: FCDMC

JOB: Wittmann Area Drainage Master Study Update

Discharge Calculations for Culvert System

Location/ Description: Impoundment Area East of US60 along CAP canal

Water Surface Elevation: 1557

Culvert ID	Station	Description	Invert Elevation [feet]	D [inches]	HW [ft]	HW/D [ft/ft]	Q* [cfs]
CAP060	36+12	72" RCP	1543.29	72	13.71	2.29	440
CAP070	52+80	72" RCP	1543.1	72	13.9	2.32	440
CAP080	85+70	72" RCP	1542.93	72	14.07	2.34	440
CAP090	119+70	72" RCP	1542.55	72	14.45	2.41	455
CAP100	159+50	72" RCP	1542.3	72	14.7	2.45	465
CAP110	180+50	72" RCP	1542.2	72	14.8	2.47	465
CAP120	190+60	72" RCP	1542.61	72	14.39	2.40	455
CAP130	216+80	72" RCP	1542.4	72	14.6	2.43	455
CAP140	240+00	72" RCP	1544.65	72	12.35	2.06	415
CAP150	253+00	72" RCP	1542.85	72	14.15	2.36	455
CAP160	272+35	3 - 72" RCP	1541.32	72	15.68	2.61	1440
CAP170	279+00	72" RCP	1541.37	72	15.63	2.61	480
CAP180	298+70	72" RCP	1541.23	72	15.77	2.63	480
CAP190	315+00	3 - 72" RCP	1541.02	72	15.98	2.66	1500

Weir Flow Over CAP Embankment

Basin	Weir Coefficient	Berm Elevation [ft]	H [ft]	Weir Length (B) [ft]	Q** [cfs]
WI500	2.7	1556	1	6475	17483
WI505	2.7	1556	1	8746	23614
PI600	2.7	1556	1	8813	23795
PD710	2.7	1556	1	6566	17728

Q Total [CFS]:	91005

* Flows were calculated using nomograph for inlet control culverts

APPENDIX B.4

Entellus

SHEET	27C	OF	42
BY	RAS	DATE	12/8/2003
CHECK	HAA	DATE	12/8/2003
JOB NO.	310.032		

CLIENT: FCDMC

JOB: Wittmann Area Drainage Master Study Update

Discharge Calculations for Culvert System

Location/ Description: Impoundment Area East of US60 along CAP canal

Water Surface Elevation: 1558

Culvert ID	Station	Description	Invert Elevation [feet]	D [inches]	HW [ft]	HW/D [ft/ft]	Q* [cfs]
CAP060	36+12	72" RCP	1543.29	72	14.71	2.45	465
CAP070	52+80	72" RCP	1543.1	72	14.9	2.48	465
CAP080	85+70	72" RCP	1542.93	72	15.07	2.51	465
CAP090	119+70	72" RCP	1542.55	72	15.45	2.58	480
CAP100	159+50	72" RCP	1542.3	72	15.7	2.62	480
CAP110	180+50	72" RCP	1542.2	72	15.8	2.63	480
CAP120	190+60	72" RCP	1542.61	72	15.39	2.57	480
CAP130	216+80	72" RCP	1542.4	72	15.6	2.60	480
CAP140	240+00	72" RCP	1544.65	72	13.35	2.22	430
CAP150	253+00	72" RCP	1542.85	72	15.15	2.53	465
CAP160	272+35	3 - 72" RCP	1541.32	72	16.68	2.78	1560
CAP170	279+00	72" RCP	1541.37	72	16.63	2.77	520
CAP180	298+70	72" RCP	1541.23	72	16.77	2.80	520
CAP190	315+00	3 - 72" RCP	1541.02	72	16.98	2.83	1560

Weir Flow Over CAP Embankment

Basin	Weir Coefficient	Berm Elevation [ft]	H [ft]	Weir Length (B) [ft]	Q** [cfs]
WI500	2.7	1556	2	6475	49448
WI505	2.7	1556	2	8746	66791
PI600	2.7	1556	2	8813	67303
PD710	2.7	1556	2	6566	50143

Q Total [CFS]: 242535

* Flows were calculated using nomograph for inlet control culverts

** Flows were calculated using the weir equation: $Q=C_w*B*H^{3/2}$

Entellus™

SHEET 28 OF 42
BY RAS DATE 8-25-03
CHECK CJL DATE 9-8-03

CLIENT FCDMC

JOB NAME Wittmann Area Drainage Master Study Update JOB NO. 36.032

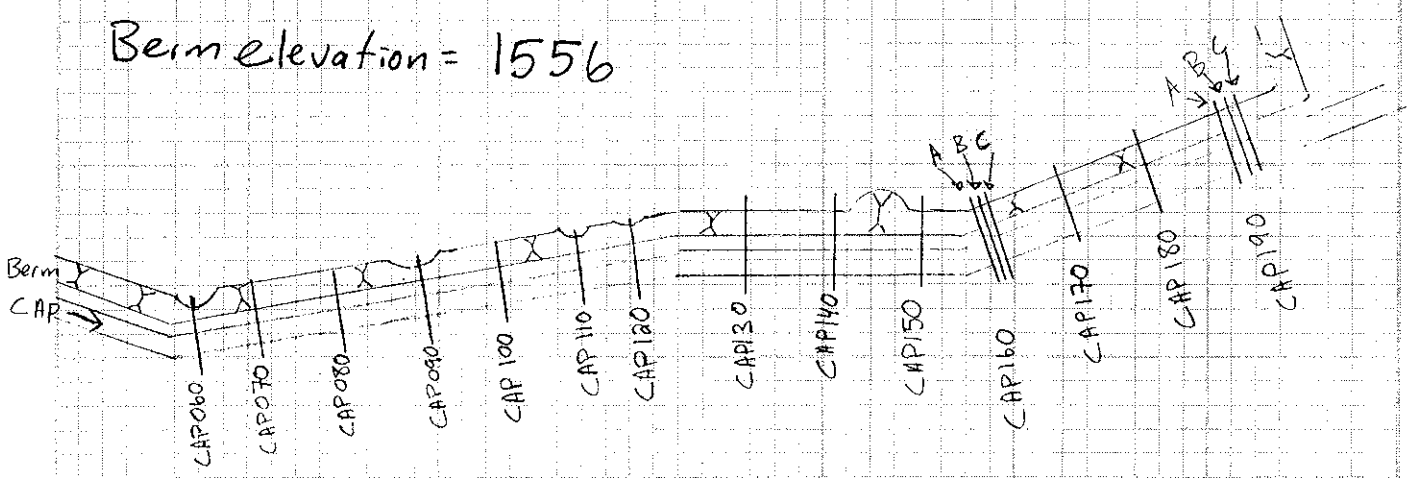
CAP IMPOUNDMENT CAP060 thru 190

All 72" pipe overchutes

Structures:	Sta.
CAP060	36+12
CAP070	52+80
CAP080	85+70
CAP090	119+70
CAP100	159+50
CAP 110	180+50
CAP 120	190+60
CAP 130	216+80
CAP 140	240+00
CAP 150	253+00
CAP 160	272+35 (3 barrels)
CAP 170	279+00
CAP 180	298+70
CAP 190	315+00 (3 barrels)

N

Berm elevation = 1556

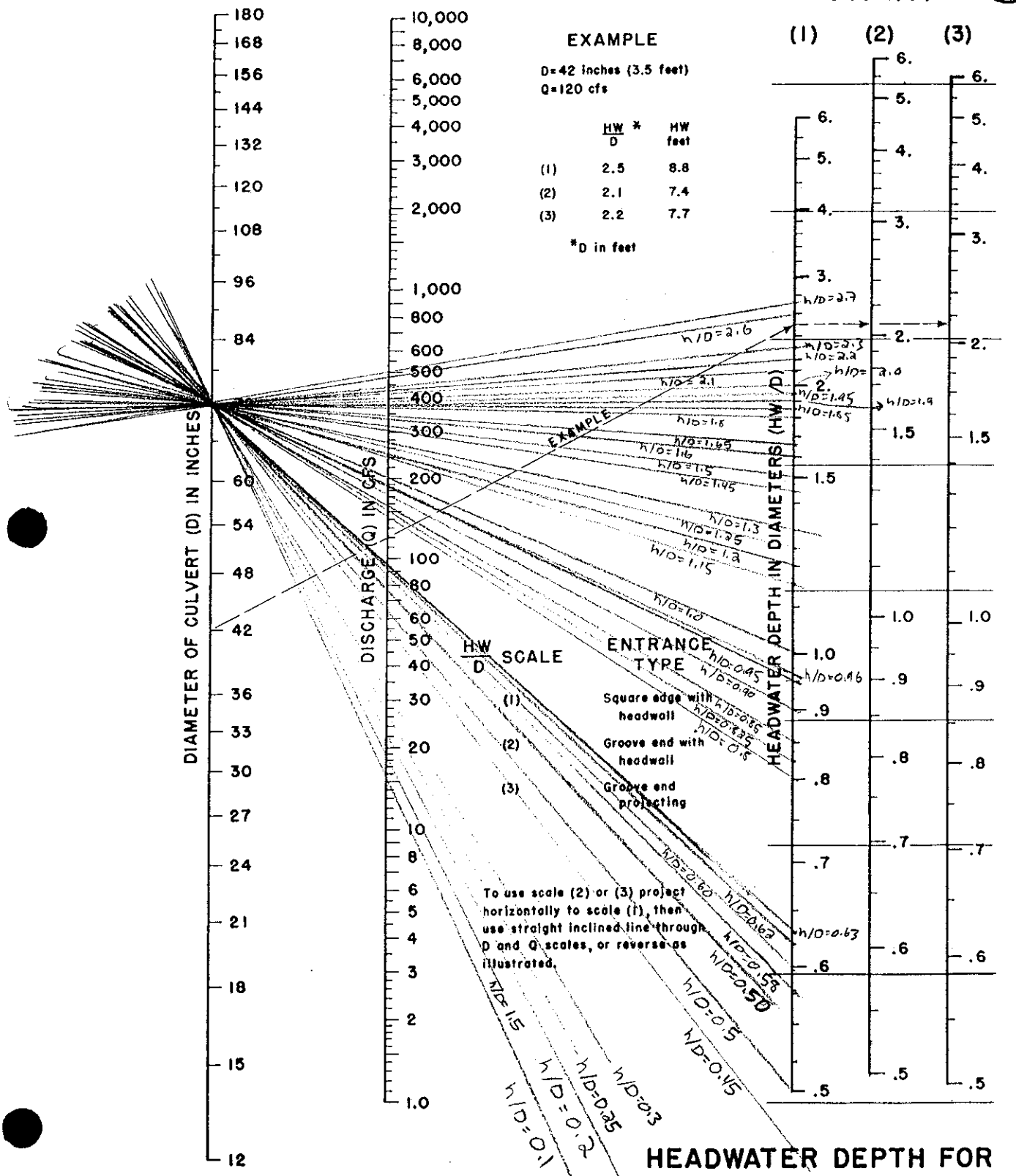


Entellus™

SHEET 29 OF 42
BY RAS DATE 8-25-03
CHECK CJL DATE 9-8-03

CLIENT FCDMC-Wittmann Area Drainage Master Study Update

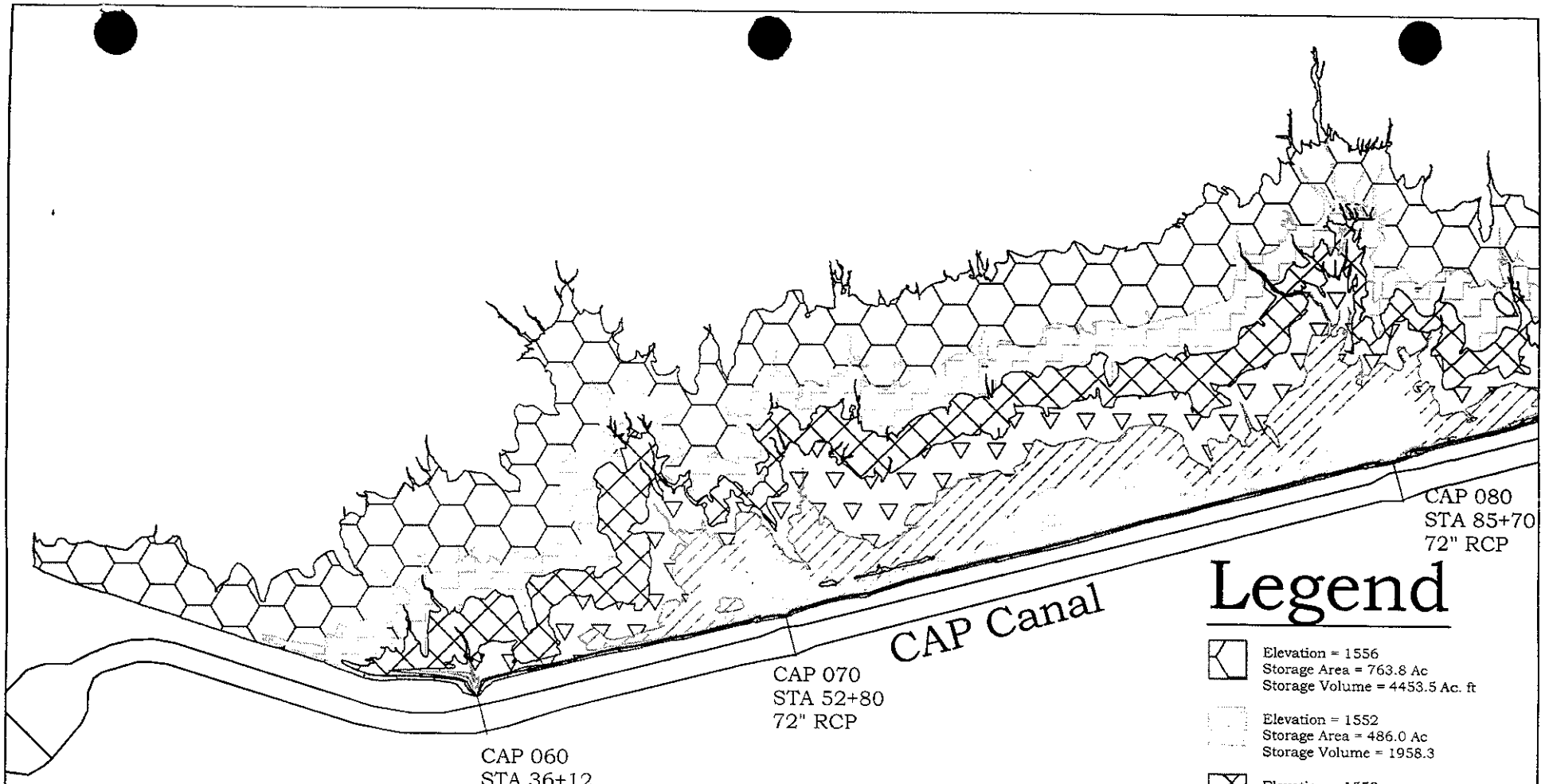
CHART 1



HEADWATER DEPTH FOR CONCRETE PIPE CULVERTS WITH INLET CONTROL

HEADWATER SCALES 2&3
REVISED MAY 1964

BUREAU OF PUBLIC ROADS JAN. 1963



Legend

- Elevation = 1556
  Storage Area = 763.8 Ac
  Storage Volume = 4453.5 Ac. ft
- Elevation = 1552
  Storage Area = 486.0 Ac
  Storage Volume = 1958.3
- Elevation = 1550
  Storage Area = 348.8 Ac
  Storage Volume = 1127.3 Ac. ft
- Elevation = 1548
  Storage Area = 191.2 Ac
  Storage Volume = 595.1 Ac. ft
- Elevation = 1546
  Storage Area = 130.7 Ac
  Storage Volume = 275.1 Ac. ft
- Elevation = 1544
  Storage Area = 60.5 Ac
  Storage Volume = 88.4 Ac. ft
- Elevation = 1540
  Storage Area = 4.4 Ac
  Storage Volume = 11.67 Ac. ft
- Elevation = 1536
  Storage Area = 0.8 Ac
  Storage Volume = 2.2 Ac. ft
- Elevation = 1532
  Storage Area = 0.2 Ac
  Storage Volume = 0.3 Ac. ft

Based upon 2' AND 4' contours from FCDMC

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Fax 602.244.8947
E-mail www.entellus.com

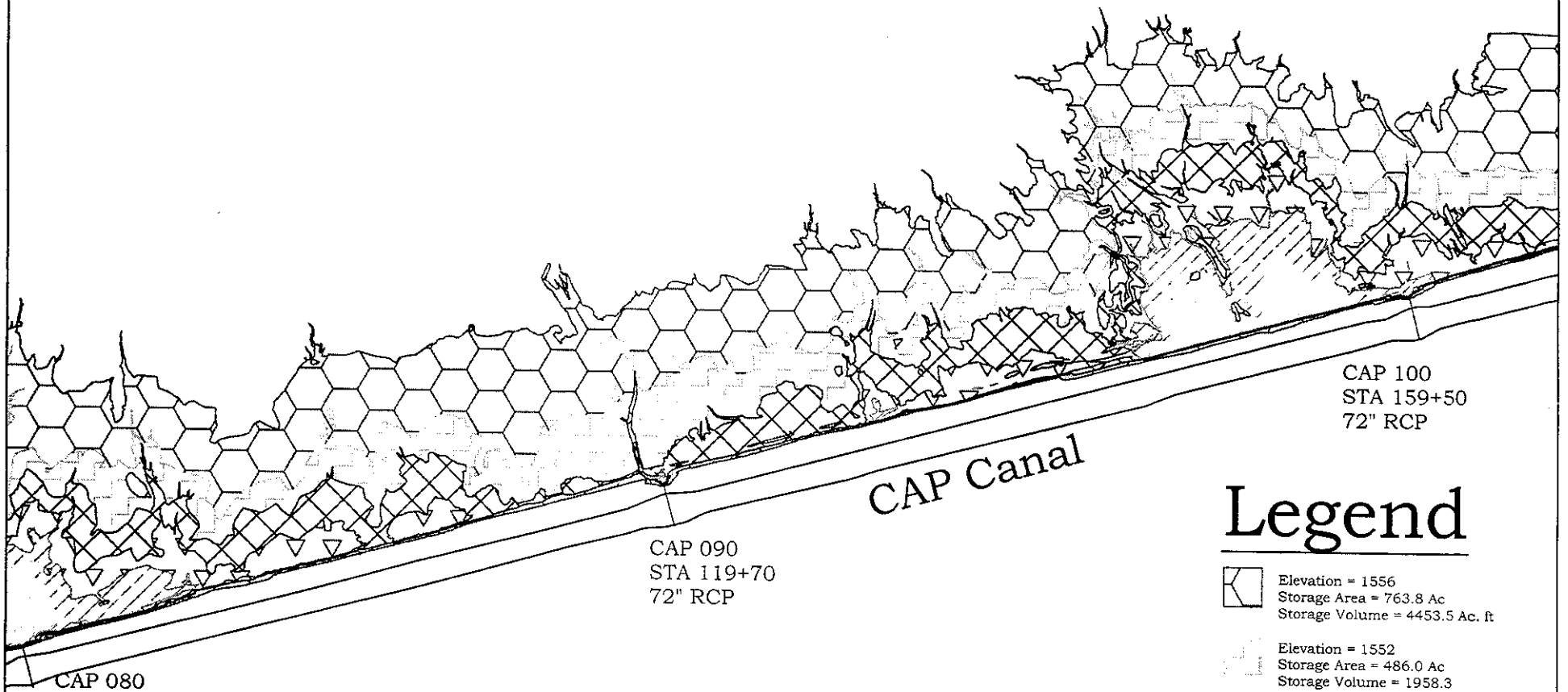
800' 0' 800' 1600'

SCALE: 1"= 800'

N

WITTMANN
AREA DRAINAGE MASTER STUDY UPDATE
FLOOD CONTROL DISTRICT OF MARICOPA COUNTY
CONTRACT FCD 2002C029

	BY	DATE
DESIGN	RAS	08/2003
DESIGN CHK.	CJL	08/2003



Legend

- Elevation = 1556
  Storage Area = 763.8 Ac
  Storage Volume = 4453.5 Ac. ft
- Elevation = 1552
  Storage Area = 486.0 Ac
  Storage Volume = 1958.3
- Elevation = 1550
  Storage Area = 348.8 Ac
  Storage Volume = 1127.3 Ac. ft
- Elevation = 1548
  Storage Area = 191.2 Ac
  Storage Volume = 595.1 Ac. ft
- Elevation = 1546
  Storage Area = 130.7 Ac
  Storage Volume = 275.1 Ac. ft
- Elevation = 1544
  Storage Area = 60.5 Ac
  Storage Volume = 88.4 Ac. ft
- Elevation = 1540
  Storage Area = 4.4 Ac
  Storage Volume = 11.67 Ac. ft
- Elevation = 1536
  Storage Area = 0.8 Ac
  Storage Volume = 2.2 Ac. ft
- Elevation = 1532
  Storage Area = 0.2 Ac
  Storage Volume = 0.3 Ac. ft

Based upon 2' AND 4' contours from FCDMC

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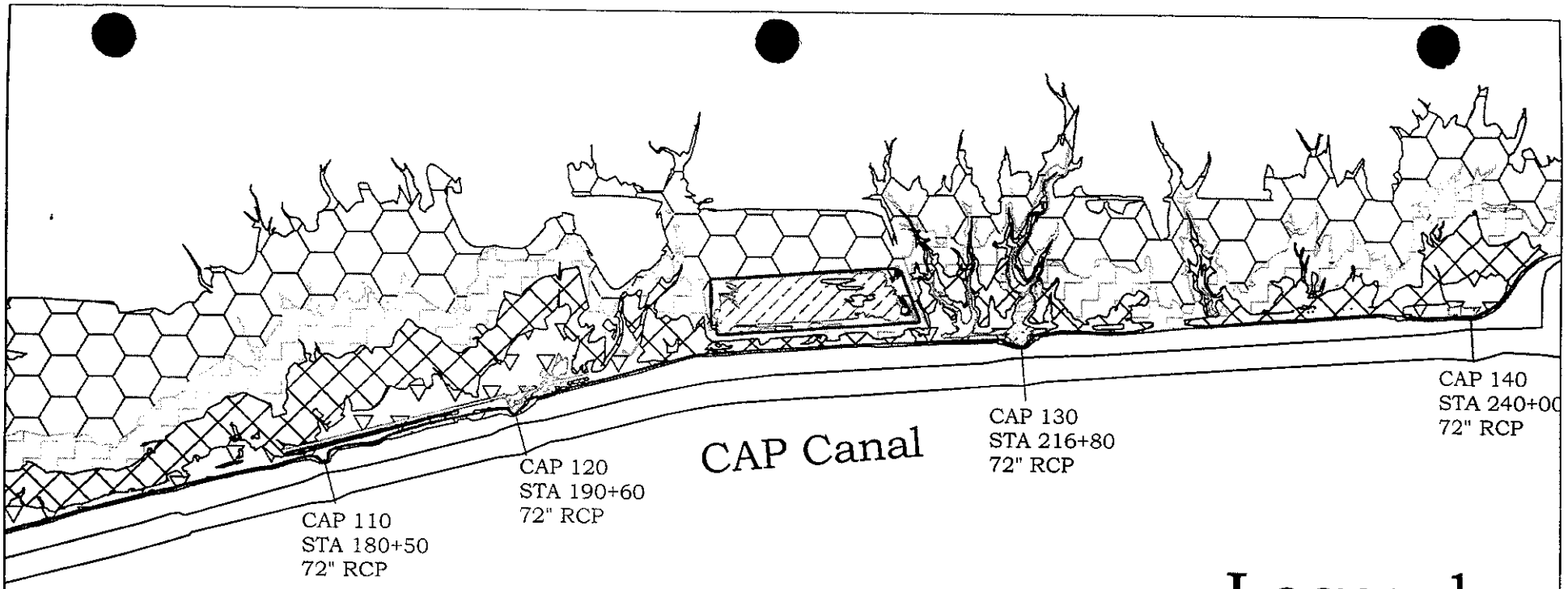
800' 0' 800' 1600'

SCALE: 1"= 800'

WITTMANN
AREA DRAINAGE MASTER STUDY UPDATE
FLOOD CONTROL DISTRICT OF MARICOPA COUNTY
CONTRACT FCD 2002C029

	BY	DATE
DESIGN	RAS	08/2003
DESIGN CHK.	CJL	08/2003



Legend

- Elevation = 1556
  Storage Area = 763.8 Ac
  Storage Volume = 4453.5 Ac. ft
- Elevation = 1552
  Storage Area = 486.0 Ac
  Storage Volume = 1958.3
- Elevation = 1550
  Storage Area = 348.8 Ac
  Storage Volume = 1127.3 Ac. ft
- Elevation = 1548
  Storage Area = 191.2 Ac
  Storage Volume = 595.1 Ac. ft
- Elevation = 1546
  Storage Area = 130.7 Ac
  Storage Volume = 275.1 Ac. ft
- Elevation = 1544
  Storage Area = 60.5 Ac
  Storage Volume = 88.4 Ac. ft
- Elevation = 1540
  Storage Area = 4.4 Ac
  Storage Volume = 11.67 Ac. ft
- Elevation = 1536
  Storage Area = 0.8 Ac
  Storage Volume = 2.2 Ac. ft
- Elevation = 1532
  Storage Area = 0.2 Ac
  Storage Volume = 0.3 Ac. ft

Based upon 2' AND 4' contours from FCDMC

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800' 0' 800' 1600'

SCALE: 1"= 800'

WITTMANN
AREA DRAINAGE MASTER STUDY UPDATE
FLOOD CONTROL DISTRICT OF MARICOPA COUNTY
CONTRACT FCD 2002C029

	BY	DATE
DESIGN	RAS	08/2003
DESIGN CHK.	CJL	08/2003

Legend

Elevation = 1556
Storage Area = 763.8 Ac
Storage Volume = 4453.5 Ac. ft

Elevation = 1552
Storage Area = 486.0 Ac
Storage Volume = 1958.3

Elevation = 1550
Storage Area = 348.8 Ac
Storage Volume = 1127.3 Ac. ft

Elevation = 1548
Storage Area = 191.2 Ac
Storage Volume = 595.1 Ac. ft

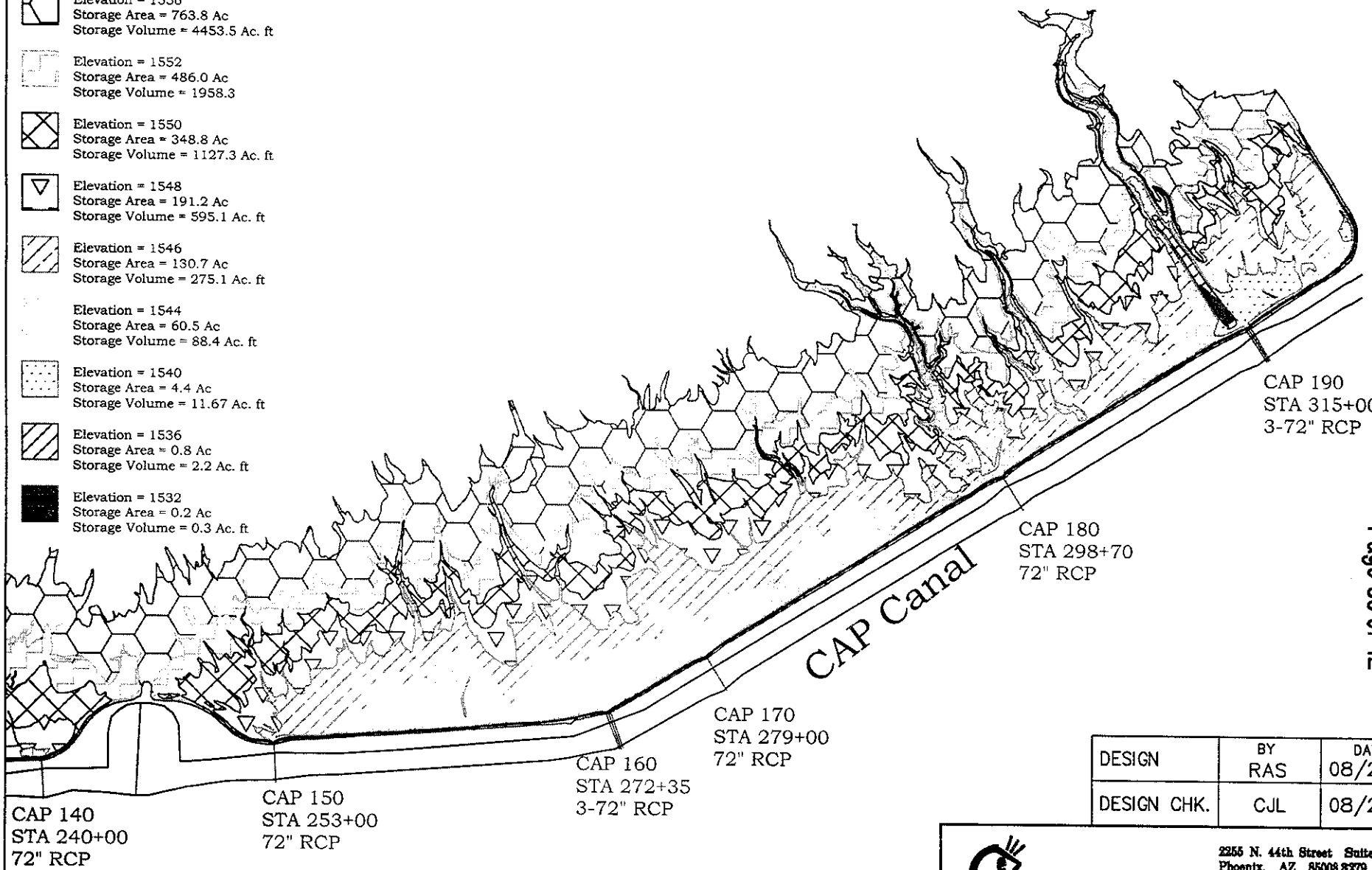
Elevation = 1546
Storage Area = 130.7 Ac
Storage Volume = 275.1 Ac. ft

Elevation = 1544
Storage Area = 60.5 Ac
Storage Volume = 88.4 Ac. ft

Elevation = 1540
Storage Area = 4.4 Ac
Storage Volume = 11.67 Ac. ft

Elevation = 1536
Storage Area = 0.8 Ac
Storage Volume = 2.2 Ac. ft

Elevation = 1532
Storage Area = 0.2 Ac
Storage Volume = 0.3 Ac. ft



800' 0' 800' 1600'

SCALE: 1"= 800'

Based upon 2' and 4' contours from FCDMC

DESIGN	BY RAS	DATE 08/2003
DESIGN CHK.	CJL	08/2003

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WITTMANN
AREA DRAINAGE MASTER STUDY UPDATE
FLOOD CONTROL DISTRICT OF MARICOPA COUNTY
CONTRACT FCD 2002C029

APPENDIX B.4

Entellus

SHEET	34	OF	42
BY	JS	DATE	9/8/2003
CHECK	PAW	DATE	9/10/2003
JOB NO.	310.032		

CLIENT FCDMC

JOB: Wittmann Area Drainage Master Study Update

CAP Culvert Discharge vs Water Surface Elevation/ Storage Area

Location/ Description: Impoundment Area East of US60 CAP200 Sta. 342+40 72" RCP

Diameter [inches] 72
Invert Elevation [feet] 1518.5
Berm Elevation [feet] 1541.4

Water Surface Elevation [ft]	h [ft]	Storage Area [acre]	Storage Volume** [acre ft]	H/D [ft/ft]	Discharge* [cfs]
1520	0	0.0	0.0	0.3	25
1524	4	1.3	2.0	0.9	175
1528	4	6.0	15.3	1.6	335
1532	4	18.0	61.1	2.3	440
1536	4	40.0	174.2	2.9	530
1540	4	69.9	391.0	3.6	600
1541.4	1.4	80.6	496.1	3.8	620

*Discharge calculated using nomograph

**Storage volume calculated using conic method, V_{12}=.333h*(A_1+A_2+(A_1*A_2)^.5)

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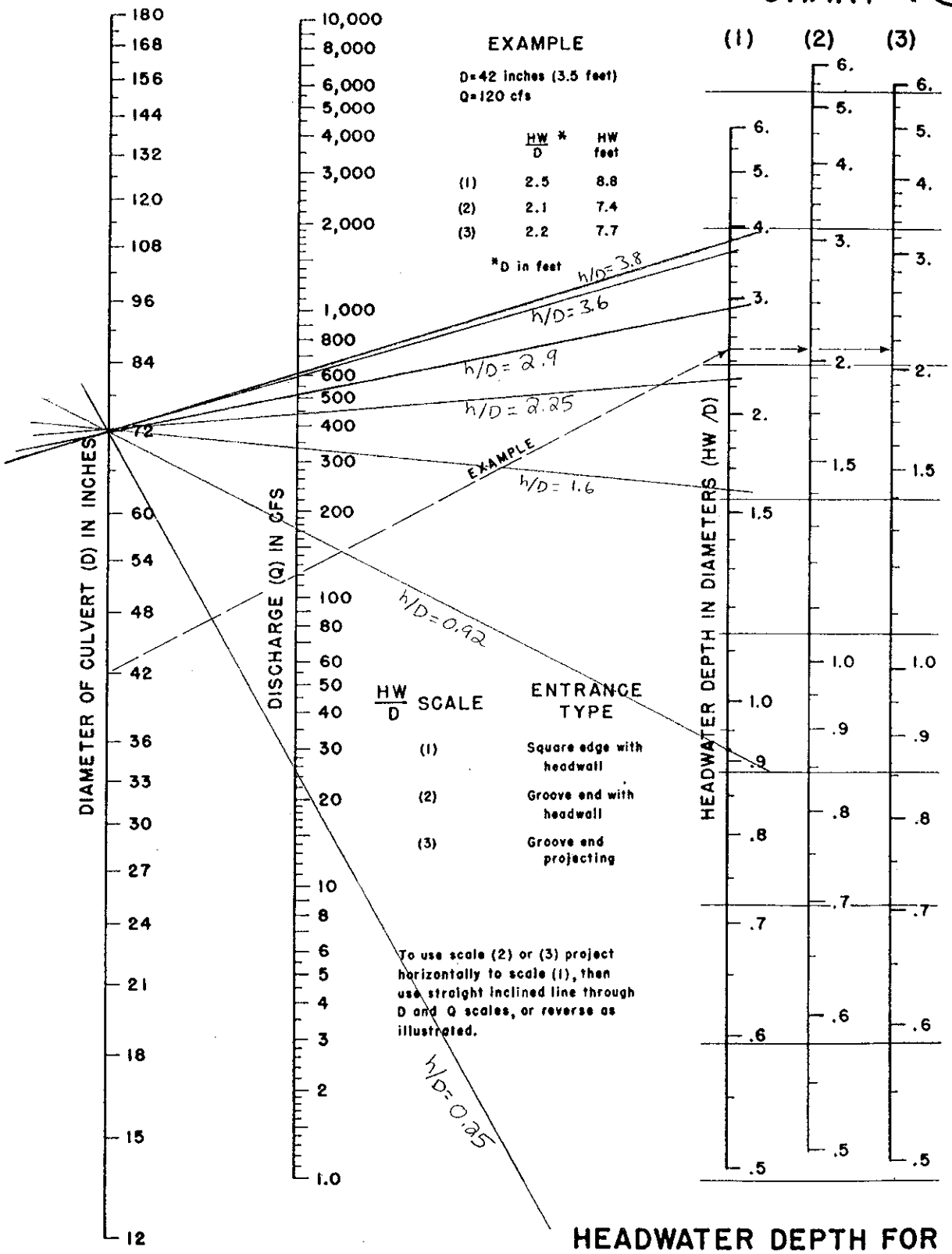
SHEET 35 OF 42
BY RAS DATE 8-20-03
CHECK CJL DATE 9-8-03

CLIENT FCDMC: Wittmann Area Drainage Master Study Update
CAP200

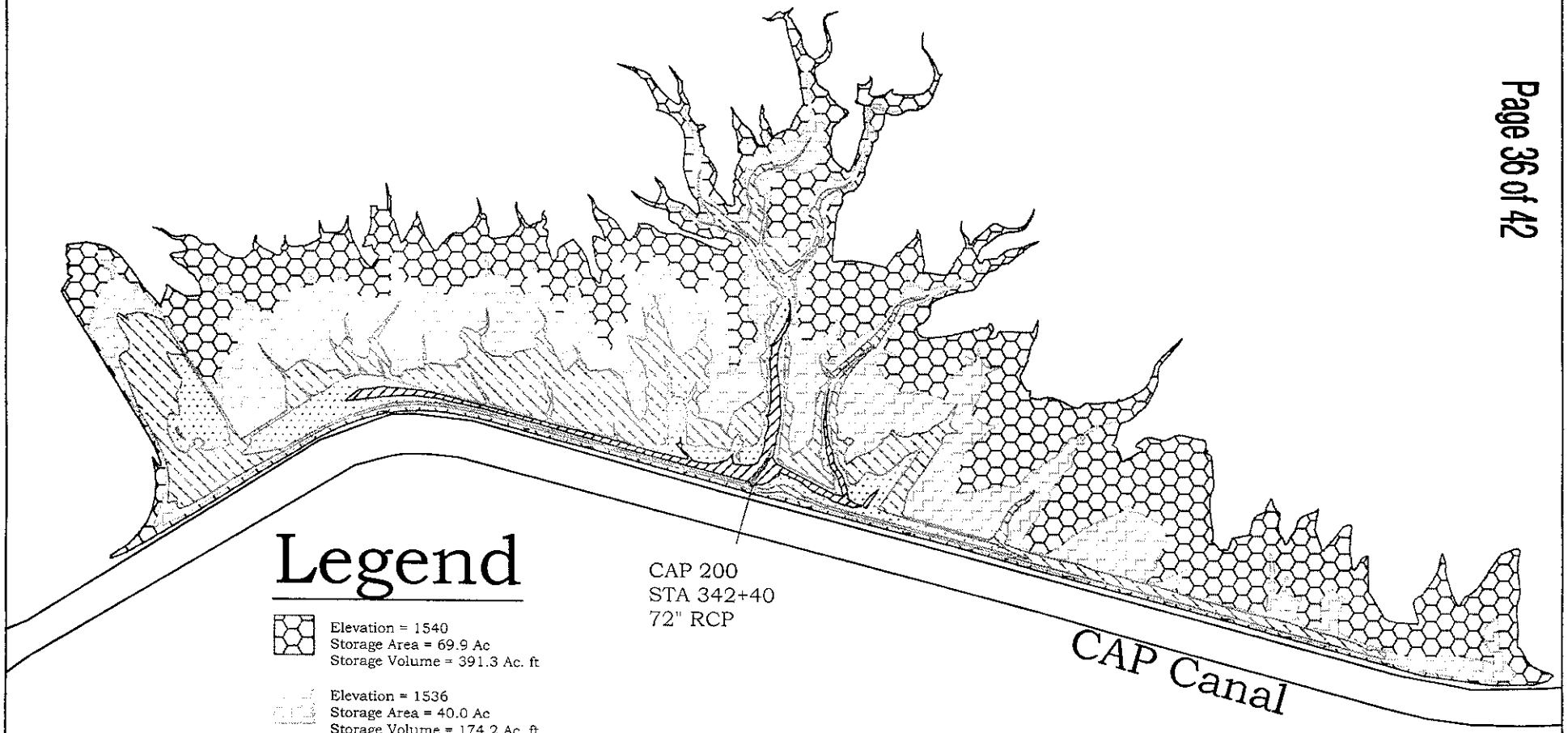
CHART 1



HEADWATER SCALES 2&3
REVISED MAY 1964

BUREAU OF PUBLIC ROADS JAN. 1963

HEADWATER DEPTH FOR CONCRETE PIPE CULVERTS WITH INLET CONTROL



Legend

- Elevation = 1540
  Storage Area = 69.9 Ac
  Storage Volume = 391.3 Ac. ft
- Elevation = 1536
  Storage Area = 40.0 Ac
  Storage Volume = 174.2 Ac. ft
- Elevation = 1532
  Storage Area = 18.0 Ac
  Storage Volume = 61.0 Ac. ft
- Elevation = 1528
  Storage Area = 5.9 Ac
  Storage Volume = 15.3 Ac. ft
- Elevation = 1524
  Storage Area = 1.3 Ac
  Storage Volume = 2.0 Ac. ft
- Elevation = 1520
  Storage Area = 0.02 Ac
  Storage Volume = 0.03 Ac. ft

500' 0' 500' 1000'

SCALE: 1"= 500'

N

Based upon 4' contours from FCDMC and 2' ASCII grid files

	BY	DATE
DESIGN	RAS	08/2003
DESIGN CHK.	CJL	08/2003

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AREA DRAINAGE MASTER STUDY UPDATE
FLOOD CONTROL DISTRICT OF MARICOPA COUNTY
CONTRACT FCD 2002C029

APPENDIX B.4

Entellus

SHEET	37	OF	42
BY	JS	DATE	9/8/2003
CHECK	PAW	DATE	9/10/2003
JOB NO.	310.032		

CLIENT FCDMC

JOB: Wittmann Area Drainage Master Study Update

CAP Culvert Discharge vs Water Surface Elevation/ Storage Area

Location/ Description: Impoundment Area East of US60 CAP210 Sta. 376+80 4 x 84" RCP

Diameter [inches] 84
Invert Elevation [feet] 1512.7
Berm Elevation [feet] 1541.8

Water Surface Elevation [ft]	h [ft]	Storage Area [acre]	Storage Volume** [acre ft]	H/D [ft/ft]	Discharge* [cfs]
1516	0	0.3	0.0	0.5	372
1520	4	0.8	2.0	1.0	1240
1524	4	1.4	6.3	1.6	1900
1528	4	2.7	14.3	2.2	2480
1532	4	6.5	32.1	2.8	2880
1536	4	13.8	71.7	3.3	3280
1540	4	22.4	143.4	3.9	3600
1542	2	27.0	192.7	4.2	3760

*Discharge calculated using nomograph

**Storage volume calculated using conic method, V_{12}=.333h*(A_1+A_2+(A_1*A_2)^.5)

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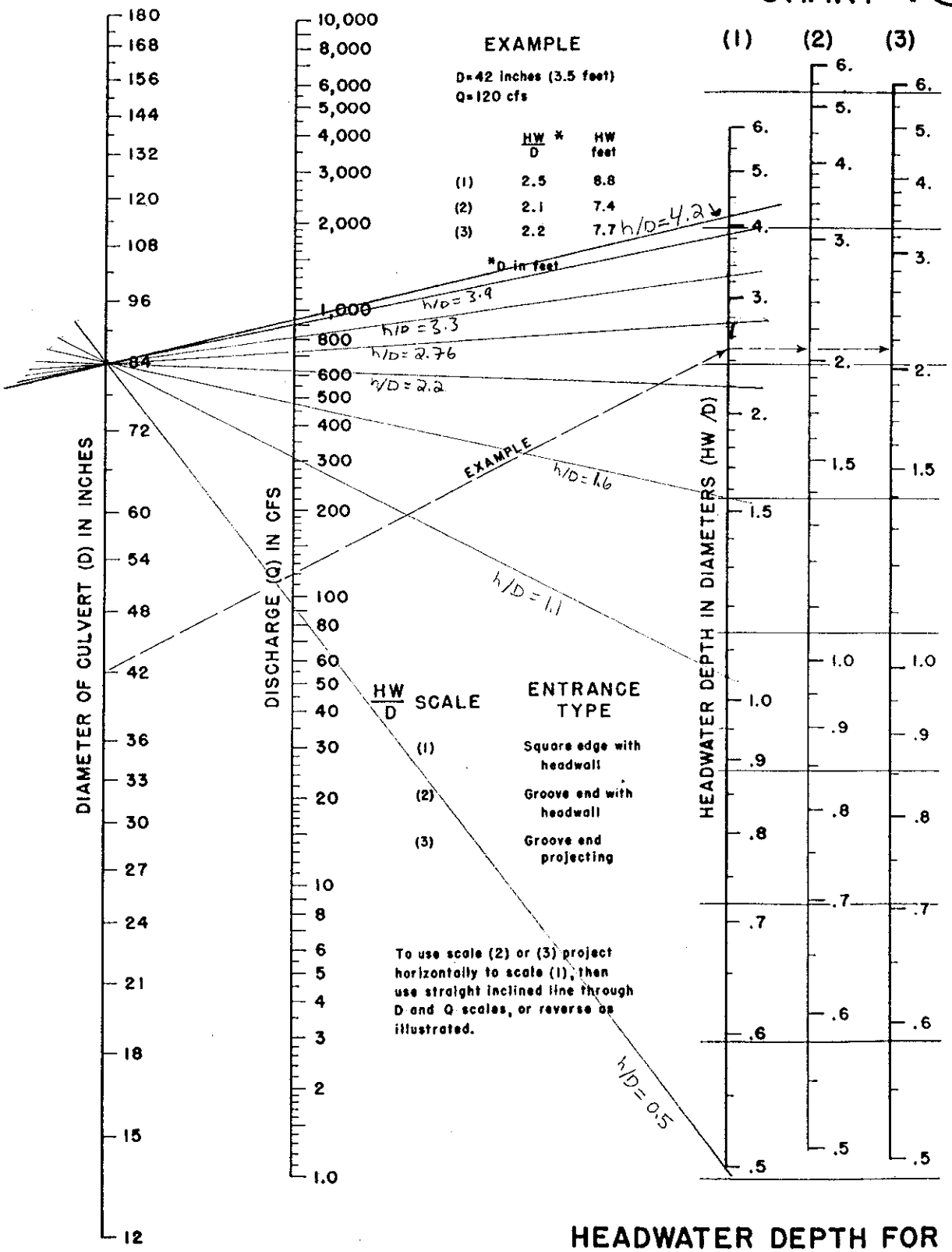
SHEET 38 OF 42
BY RAS DATE 8-20-03
CHECK CJL DATE 9-8-03

CLIENT FCDMC - Wittmann Area Drainage Master Study Update
CAP 210

CHART 1



HEADWATER SCALES 2&3
REVISED MAY 1964

BUREAU OF PUBLIC ROADS JAN. 1963

HEADWATER DEPTH FOR CONCRETE PIPE CULVERTS WITH INLET CONTROL

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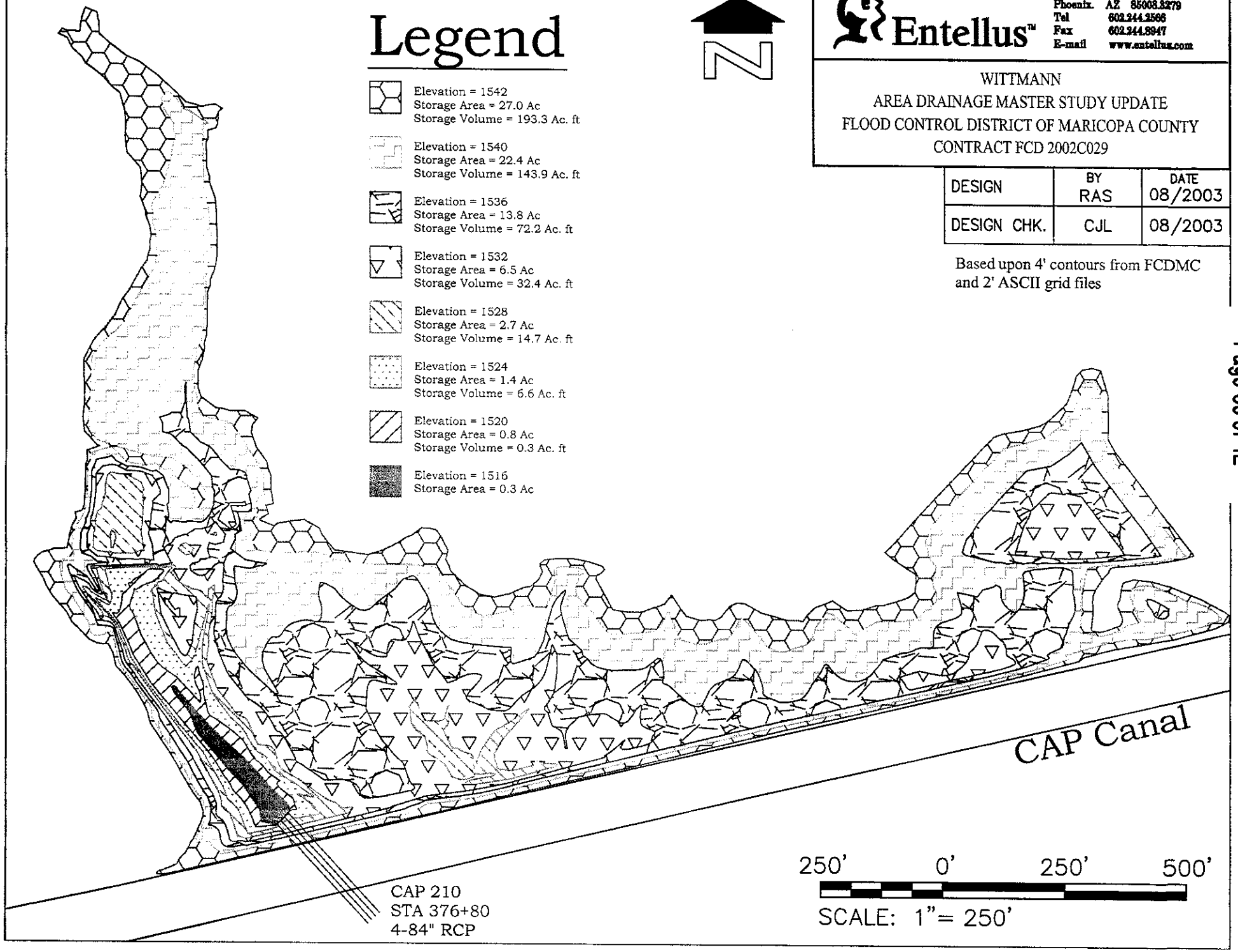
WITTMANN
AREA DRAINAGE MASTER STUDY UPDATE
FLOOD CONTROL DISTRICT OF MARICOPA COUNTY
CONTRACT FCD 2002C029

	BY	DATE
DESIGN	RAS	08/2003
DESIGN CHK.	CJL	08/2003

Based upon 4' contours from FCDMC and 2' ASCII grid files



APPENDIX B.4

Entellus

SHEET	40	OF	42
BY	JS	DATE	9/8/2003
CHECK	PAW	DATE	9/10/2003
JOB NO.	310.032		

CLIENT FCDMC

JOB: Wittmann Area Drainage Master Study Update

CAP Culvert Discharge vs Water Surface Elevation/ Storage Area

Location/ Description: Impoundment Area East of US60 CAP220 Sta. 433+85 72" RCP

Diameter [inches] 72
Invert Elevation [feet] 1514.9
Berm Elevation [feet] 1540

Water Surface Elevation [ft]	h [ft]	Storage Area [acre]	Storage Volume** [acre ft]	H/D [ft/ft]	Discharge* [cfs]
1516	0	0.0	0.0	0.2	25
1520	4	0.1	0.1	0.8	175
1524	4	0.2	0.7	1.5	335
1528	4	0.5	2.1	2.2	440
1532	4	4.4	10.7	2.8	530
1536	4	15.4	48.1	3.5	600
1540	4	29.2	135.7	4.2	620

*Discharge calculated using nomograph

**Storage volume calculated using conic method, V_{12}=.333h*(A_1+A_2+(A_1*A_2)^.5)

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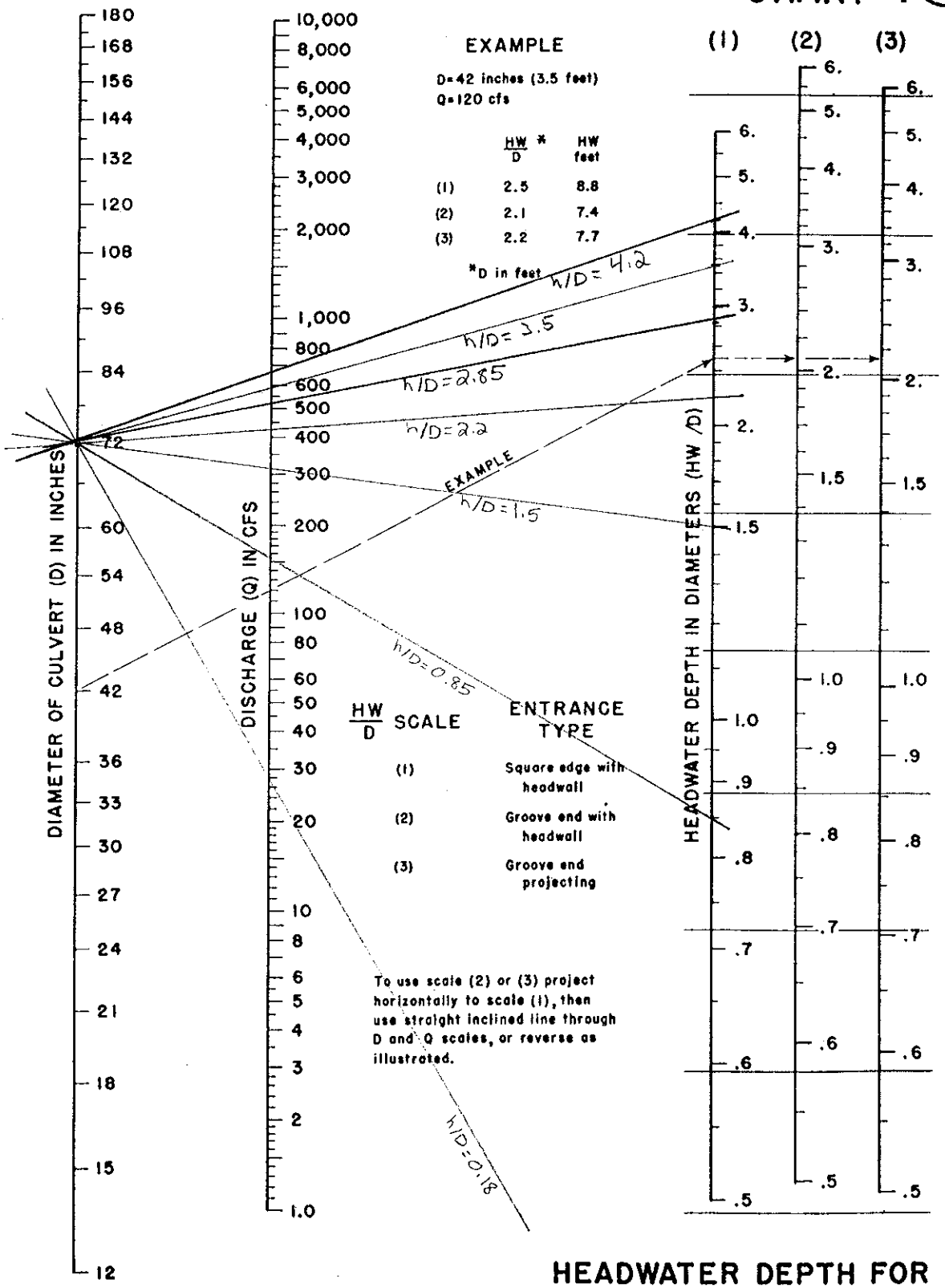
SHEET 41 OF 42
BY RAS DATE 8-19-03
CHECK CJL DATE 9-8-03

CLIENT FCDMC-Wittmann Area Drainage Master Plan Update

CAP 220

CHART 1



HEADWATER SCALES 2&3
REVISED MAY 1964

BUREAU OF PUBLIC ROADS JAN. 1963

HEADWATER DEPTH FOR CONCRETE PIPE CULVERTS WITH INLET CONTROL

Legend

Elevation = 1540
Storage Area = 29.2 Ac
Storage Volume = 135.8 Ac. ft

Elevation = 1536
Storage Area = 15.4 Ac
Storage Volume = 48.2 Ac. ft

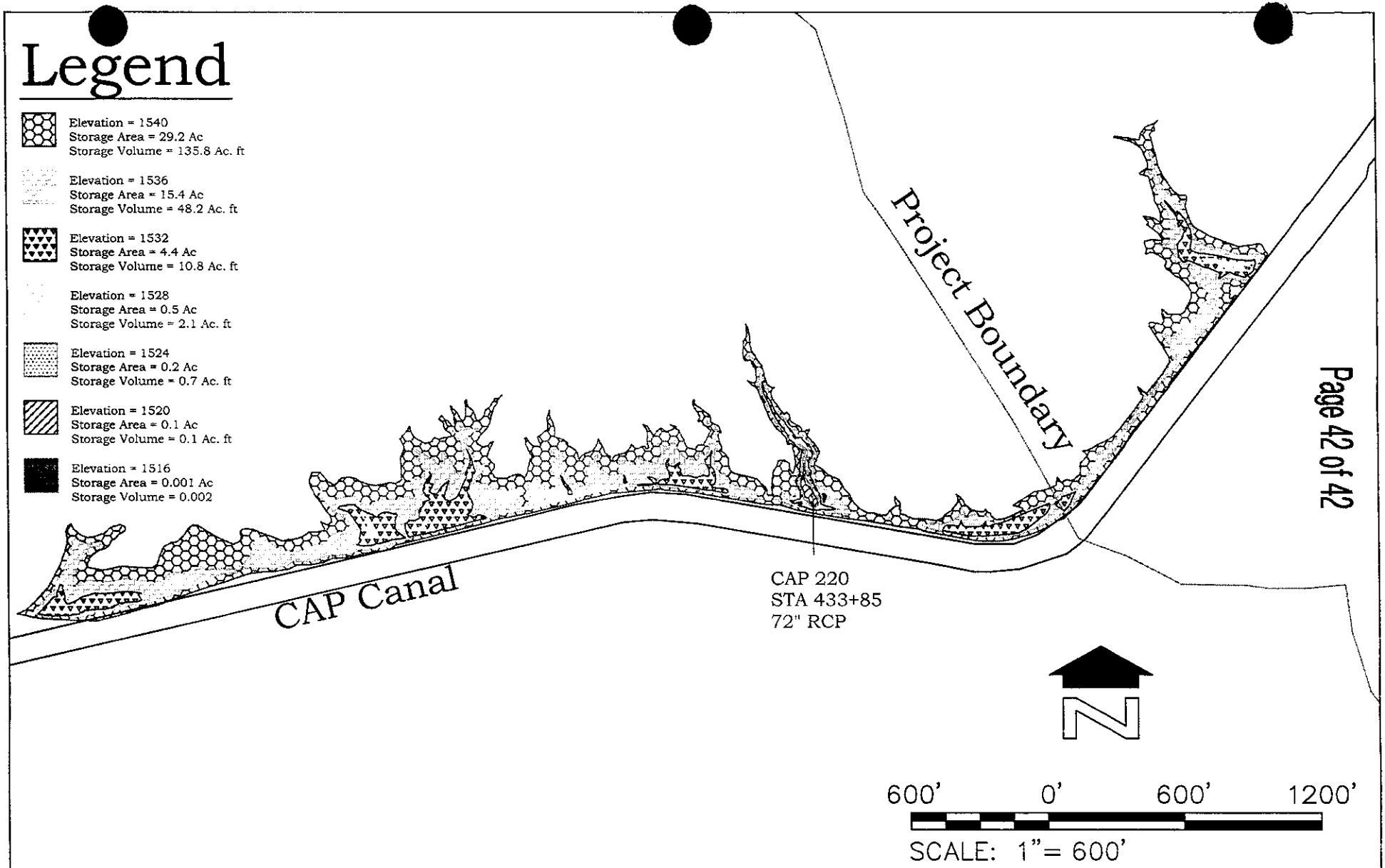
Elevation = 1532
Storage Area = 4.4 Ac
Storage Volume = 10.8 Ac. ft

Elevation = 1528
Storage Area = 0.5 Ac
Storage Volume = 2.1 Ac. ft

Elevation = 1524
Storage Area = 0.2 Ac
Storage Volume = 0.7 Ac. ft

Elevation = 1520
Storage Area = 0.1 Ac
Storage Volume = 0.1 Ac. ft

Elevation = 1516
Storage Area = 0.001 Ac
Storage Volume = 0.002



Based upon 4' contours from
FCDMC and ASCII grid files

DESIGN	BY RAS	DATE 08/2003
DESIGN CHK.	CJL	08/2003

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WITTMANN
AREA DRAINAGE MASTER STUDY UPDATE
FLOOD CONTROL DISTRICT OF MARICOPA COUNTY
CONTRACT FCD 2002C029

Entellus

BY RAS DATE 12/12/2003

CHECK JCS DATE 12/12/2003

CLIENT: FCDMC

JOB NO. 310.032

JOB: Wittmann Area Drainage Master Study Update

Diversion Calculations Based on Ponding at CAP Canal:

In order to determine the Split Flows at the CAP Canal, the following table was utilized in which the relative percentage of flow through the routes was calculated based upon the CAP structures flowing into the routes. As shown below, structures CAP060 and CAP070 flow into Route 540500, structures CAP080 to CAP100 flow into route 640505, structures CAP110 and CAP150 flow into route 640600 and structures CAP160 to CAP190 flow into route 760710. The flows for the various structures as calculated in **Appendix B.4** and shown in the table below, were utilized to calculate the percentage of flow that will pass through a given route at a given stage. The Peak Stage as discussed on the next page is 1553.7, and based upon the information below, at this approximate stage, route 540500 will receive 10% of the flow, 640505 will receive 16% of the flow, 640600 will receive 25% of the flow and route 760710 will receive the 49% of the flow.

Route

Stage	540500 (From CAP to CP 500)		640505 (From CAP to CP 505)		640600 (From CAP to CP 600)		760710 (From CAP to CP 710)	
1558	CAP060 =	465	CAP080 =	465	CAP110 =	480	CAP160 =	1560
	CAP070 =	465	CAP090 =	480	CAP120 =	480	CAP170 =	520
			CAP100 =	480	CAP130 =	480	CAP180 =	520
					CAP140 =	430	CAP190 =	1560
					CAP150 =	465		
	Basin Weir Flow		Basin Weir Flow		Basin Weir Flow		Basin Weir Flow	
		49448		66791		67303		50143
	Sum	50378		68216		69638		54303
	% of total	21%		28%		29%		22%
1557	CAP060 =	440	CAP080 =	440	CAP110 =	465	CAP160 =	1440
	CAP070 =	440	CAP090 =	455	CAP120 =	455	CAP170 =	480
			CAP100 =	465	CAP130 =	455	CAP180 =	480
					CAP140 =	415	CAP190 =	1500
					CAP150 =	455		
	Basin Weir Flow		Basin Weir Flow		Basin Weir Flow		Basin Weir Flow	
		17483		23614		23795		17728
	Sum	18363		24974		26040		21628
	% of total	20%		27%		29%		24%
1556.9	CAP060 =	438	CAP080 =	439	CAP110 =	463	CAP160 =	1436
	CAP070 =	439	CAP090 =	453	CAP120 =	453	CAP170 =	479
			CAP100 =	463	CAP130 =	454	CAP180 =	479
					CAP140 =	412	CAP190 =	1490
					CAP150 =	453		
	Basin Weir Flow		Basin Weir Flow		Basin Weir Flow		Basin Weir Flow	
		15735		21253		21416		15955
	Sum	16611		22607		23648		19837
	% of total	20%		27%		29%		24%
1556	CAP060 =	415	CAP080 =	430	CAP110 =	440	CAP160 =	1395
	CAP070 =	430	CAP090 =	430	CAP120 =	430	CAP170 =	465
			CAP100 =	440	CAP130 =	440	CAP180 =	465
					CAP140 =	380	CAP190 =	1395
					CAP150 =	430		
	Sum	845		1300		2120		3720
	% of total	11%		16%		27%		47%

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APPENDIX B.5

SHEET	2	OF	18
BY	RAS	DATE	12/12/2003
CHECK	JCS	DATE	12/12/2003
JOB NO.	310.032		

CLIENT: FCDMC

JOB: Wittmann Area Drainage Master Study Update

Diversion Calculations Based on Ponding at CAP Canal:

Route

Stage	540500 (From CAP to CP 500)		640505 (From CAP to CP 505)		640600 (From CAP to CP 600)		760710 (From CAP to CP 710)	
1554	CAP060 =	370	CAP080 =	375	CAP110 =	400	CAP160 =	1290
	CAP070 =	375	CAP090 =	380	CAP120 =	380	CAP170 =	430
			CAP100 =	390	CAP130 =	390	CAP180 =	430
					CAP140 =	315	CAP190 =	1290
					CAP150 =	380		
	Sum	745		1145		1865		3440
	% of total	10%		16%		26%		48%
1553.5	CAP060 =	350	CAP080 =	355	CAP110 =	375	CAP160 =	1200
	CAP070 =	355	CAP090 =	365	CAP120 =	370	CAP170 =	400
			CAP100 =	370	CAP130 =	375	CAP180 =	405
					CAP140 =	315	CAP190 =	1230
					CAP150 =	360		
	Sum	705		1090		1795		3235
	% of total	10%		16%		26%		47%
1553.2	CAP060 =	340	CAP080 =	348	CAP110 =	369	CAP160 =	1194
	CAP070 =	348	CAP090 =	354	CAP120 =	358	CAP170 =	398
			CAP100 =	365	CAP130 =	362	CAP180 =	404
					CAP140 =	303	CAP190 =	1224
					CAP150 =	351		
	Sum	688		1067		1744		3219
	% of total	10%		16%		26%		48%
1552	CAP060 =	305	CAP080 =	320	CAP110 =	345	CAP160 =	1170
	CAP070 =	320	CAP090 =	315	CAP120 =	315	CAP170 =	390
			CAP100 =	345	CAP130 =	315	CAP180 =	400
					CAP140 =	260	CAP190 =	1200
					CAP150 =	320		
	Sum	625		980		1555		3160
	% of total	10%		16%		25%		50%
1550	CAP060 =	238	CAP080 =	245	CAP110 =	270	CAP160 =	1005
	CAP070 =	238	CAP090 =	260	CAP120 =	260	CAP170 =	315
			CAP100 =	270	CAP130 =	270	CAP180 =	345
					CAP140 =	172	CAP190 =	1035
					CAP150 =	245		
	Sum	476		775		1217		2700
	% of total	9%		15%		24%		52%

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BY RAS DATE 12/12/2003

CHECK JCS DATE 12/12/2003

CLIENT: FCDMC

JOB NO. 310.032

JOB: Wittmann Area Drainage Master Study Update

Diversion Calculations Based on Ponding at CAP Canal:

Route

Stage	540500 (From CAP to CP 500)		640505 (From CAP to CP 505)		640600 (From CAP to CP 600)		760710 (From CAP to CP 710)	
1546	CAP060 =	55	CAP080 =	65	CAP110 =	95	CAP160 =	555
	CAP070 =	65	CAP090 =	82	CAP120 =	82	CAP170 =	185
			CAP100 =	91	CAP130 =	76	CAP180 =	185
					CAP140 =	27	CAP190 =	600
					CAP150 =	66		
	Sum	120		238		346		1525
	% of total	5%		11%		16%		68%
1544	CAP060 =	15	CAP080 =	22	CAP110 =	32	CAP160 =	165
	CAP070 =	19	CAP090 =	27	CAP120 =	27	CAP170 =	55
			CAP100 =	32	CAP130 =	32	CAP180 =	55
					CAP140 =	0	CAP190 =	195
					CAP150 =	22		
	Sum	34		81		113		470
	% of total	5%		12%		16%		67%

Peak Stage:

The Peak Stage was taken from the HEC-1 output. For the 100, 200 and 500-year events, the Peak Stage was retrieved by interpolating HEC-1 output . For the 6 and 72-hour PMF's flow events, the peak stage was given in the HEC-1 output. As can be seen, the Peak Stage varied from 1553.7 to 1556.7. Despite this, the percentage of contributing flow to each of the four routes remained constant for all the events except the 72-hr PMF, when the berm was overtopped. The HEC-1 output is shown on the following pages.

	Storage Area sq. mi		
	40	**69.96**	80
100-yr Existing Peak Stage	1554	**1553.7**	1553.6

	Storage Area sq. mi		
	60	**69.96**	90
200-yr Existing Peak Stage	1554.8	**1554.7**	1554.6

	Storage Area sq. mi		
	60	**69.96**	90
500-yr Existing Peak Stage	1556	**1555.9**	1555.8

72-hr PMF Peak Stage **1556.4**

6-hr PMF Peak Stage **1556.7**

*** ***

```
              **************
              *            *
  204 KK      *     STOR   *
              *            *
              **************

                 HYDROGRAPH ROUTING DATA

  205 RS           STORAGE ROUTING
                         NSTPS          1  NUMBER OF SUBREACHES
                          ITYP       STOR  TYPE OF INITIAL CONDITION
                        RSVRIC       0.00  INITIAL CONDITION
                             X       0.00 WORKING R AND D COEFFICIENT

  208 SA              AREA        4.4       60.5      130.7      348.8      486.0      625.3      763.8      763.9
764.0

  209 SE           ELEVATION   1540.00    1544.00    1546.00    1550.00    1552.00    1554.00    1556.00    1557.00
1558.00

  206 SQ           DISCHARGE        0.       698.      2229.      5188.      6380.      7215.      7985.     91005.
242535.

  207 SE           ELEVATION   1540.00    1544.00    1546.00    1550.00    1552.00    1554.00    1556.00    1557.00
1558.00

                                                                         ***

                                                          COMPUTED STORAGE-ELEVATION DATA

              STORAGE        0.00     108.29     295.04    1219.05    2050.07    3158.45    4545.24    5309.09    6073.04
            ELEVATION     1540.00    1544.00    1546.00    1550.00    1552.00    1554.00    1556.00    1557.00    1558.00

                                                      COMPUTED STORAGE-OUTFLOW-ELEVATION DATA

              STORAGE        0.00     108.29     295.04    1219.05    2050.07    3158.45    4545.24    5309.09    6073.04
              OUTFLOW        0.00     698.00    2229.00    5188.00    6380.00    7215.00    7985.00   91005.00 242535.00
            ELEVATION     1540.00    1544.00    1546.00    1550.00    1552.00    1554.00    1556.00    1557.00    1558.00

 *** WARNING *** MODIFIED PULS ROUTING MAY BE NUMERICALLY UNSTABLE FOR OUTFLOWS BETWEEN      7985. TO    242535.
                 THE ROUTED HYDROGRAPH SHOULD BE EXAMINED FOR OSCILLATIONS OR OUTFLOWS GREATER THAN PEAK
INFLOWS.
                 THIS CAN BE CORRECTED BY DECREASING THE TIME INTERVAL OR INCREASING STORAGE (USE A LONGER
REACH.)

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

                         HYDROGRAPH AT STATION     STOR
                       TRANSPOSITION AREA      0.0 SQ MI

  PEAK FLOW      TIME                       MAXIMUM AVERAGE FLOW
                                   6-HR        24-HR        72-HR     49.75-HR
+    (CFS)       (HR)
                        (CFS)
+     7638.     16.00              7340.        3879.        1912.        1912.
                      (INCHES)     0.975        2.062        2.107        2.107
                       (AC-FT)     3640.        7694.        7862.        7862.

 PEAK STORAGE    TIME                      MAXIMUM AVERAGE STORAGE
                                   6-HR        24-HR        72-HR     49.75-HR
+  (AC-FT)       (HR)
     3920.      16.00              3412.        1367.         666.         666.

  PEAK STAGE     TIME                       MAXIMUM AVERAGE STAGE
                                   6-HR        24-HR        72-HR     49.75-HR
+   (FEET)       (HR)
   1555.10      16.00            1554.34      1548.50      1544.34      1544.34

                        CUMULATIVE AREA =    69.96 SQ MI

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                    HYDROGRAPH AT STATION     STOR
                  TRANSPOSITION AREA     10.0 SQ MI

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                     6-HR       24-HR       72-HR     49.75-HR
+   (CFS)       (HR)
                          (CFS)
+    7447.     15.75                7144.       3636.       1791.        1791.
                        (INCHES)    0.949       1.933       1.974        1.974
                         (AC-FT)    3542.       7211.       7364.        7364.

 PEAK STORAGE   TIME                         MAXIMUM AVERAGE STORAGE
                                     6-HR       24-HR       72-HR     49.75-HR
+  (AC-FT)      (HR)
     3575.     15.75                3099.       1211.        590.         590.

  PEAK STAGE    TIME                          MAXIMUM AVERAGE STAGE
                                     6-HR       24-HR       72-HR     49.75-HR
+   (FEET)      (HR)
   1554.60     15.75              1553.84     1548.04     1544.09      1544.09

                       CUMULATIVE AREA =   69.96 SQ MI


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

                    HYDROGRAPH AT STATION     STOR
                  TRANSPOSITION AREA     20.0 SQ MI

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                     6-HR       24-HR       72-HR     49.75-HR
+   (CFS)       (HR)
                          (CFS)
+    7323.     15.75                7011.       3477.       1713.        1713.
                        (INCHES)    0.932       1.848       1.887        1.887
                         (AC-FT)    3477.       6897.       7042.        7042.

 PEAK STORAGE   TIME                         MAXIMUM AVERAGE STORAGE
                                     6-HR       24-HR       72-HR     49.75-HR
+  (AC-FT)      (HR)
     3354.     15.75                2899.       1115.        543.         543.

  PEAK STAGE    TIME                          MAXIMUM AVERAGE STAGE
                                     6-HR       24-HR       72-HR     49.75-HR
+   (FEET)      (HR)
   1554.28     15.75              1553.52     1547.74     1543.94      1543.94

                       CUMULATIVE AREA =   69.96 SQ MI


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

                    HYDROGRAPH AT STATION     STOR
                  TRANSPOSITION AREA     40.0 SQ MI

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                     6-HR       24-HR       72-HR     49.75-HR
+   (CFS)       (HR)
                          (CFS)
+    7206.     15.75                6873.       3327.       1638.        1638.
                        (INCHES)    0.913       1.768       1.805        1.805
                         (AC-FT)    3408.       6599.       6736.        6736.

 PEAK STORAGE   TIME                         MAXIMUM AVERAGE STORAGE
                                     6-HR       24-HR       72-HR     49.75-HR
+  (AC-FT)      (HR)
     3146.     15.75                2706.       1027.        500.         500.

  PEAK STAGE    TIME                          MAXIMUM AVERAGE STAGE
                                     6-HR       24-HR       72-HR     49.75-HR
+   (FEET)      (HR)
   1553.98     15.75              1553.18     1547.46     1543.79      1543.79

                       CUMULATIVE AREA =   69.96 SQ MI


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                    HYDROGRAPH AT STATION     STOR
                  TRANSPOSITION AREA     80.0 SQ MI

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                      6-HR       24-HR       72-HR     49.75-HR
+   (CFS)       (HR)
                            (CFS)
+    7059.     15.75                 6730.       3183.       1567.        1567.
                         (INCHES)   0.894       1.692       1.727        1.727
                          (AC-FT)   3337.       6313.       6444.        6444.

 PEAK STORAGE   TIME                          MAXIMUM AVERAGE STORAGE
                                      6-HR       24-HR       72-HR     49.75-HR
+  (AC-FT)      (HR)
     2951.     15.75                 2531.        948.        462.         462.

  PEAK STAGE    TIME                          MAXIMUM AVERAGE STAGE
                                      6-HR       24-HR       72-HR     49.75-HR
+   (FEET)      (HR)
   1553.63     15.75               1552.86     1547.19     1543.65      1543.65

                     CUMULATIVE AREA =   69.96 SQ MI
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      ***            ***            ***            ***            ***

                    HYDROGRAPH AT STATION     STOR
                  TRANSPOSITION AREA    120.0 SQ MI

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                      6-HR       24-HR       72-HR     49.75-HR
+   (CFS)       (HR)
                            (CFS)
+    6980.     15.50                 6650.       3105.       1529.        1529.
                         (INCHES)   0.884       1.650       1.684        1.684
                          (AC-FT)   3297.       6158.       6285.        6285.

 PEAK STORAGE   TIME                          MAXIMUM AVERAGE STORAGE
                                      6-HR       24-HR       72-HR     49.75-HR
+  (AC-FT)      (HR)
     2846.     15.50                 2438.        906.        442.         442.

  PEAK STAGE    TIME                          MAXIMUM AVERAGE STAGE
                                      6-HR       24-HR       72-HR     49.75-HR
+   (FEET)      (HR)
   1553.44     15.50               1552.68     1547.04     1543.57      1543.57

                     CUMULATIVE AREA =   69.96 SQ MI
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      ***            ***            ***            ***            ***

                    HYDROGRAPH AT STATION     STOR
                  TRANSPOSITION AREA    200.0 SQ MI

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                      6-HR       24-HR       72-HR     49.75-HR
+   (CFS)       (HR)
                            (CFS)
+    6879.     15.50                 6541.       3003.       1478.        1478.
                         (INCHES)   0.869       1.596       1.629        1.629
                          (AC-FT)   3243.       5956.       6079.        6079.

 PEAK STORAGE   TIME                          MAXIMUM AVERAGE STORAGE
                                      6-HR       24-HR       72-HR     49.75-HR
+  (AC-FT)      (HR)
     2712.     15.50                 2315.        853.        416.         416.

  PEAK STAGE    TIME                          MAXIMUM AVERAGE STAGE
                                      6-HR       24-HR       72-HR     49.75-HR
+   (FEET)      (HR)
   1553.19     15.50               1552.44     1546.85     1543.48      1543.48

                     CUMULATIVE AREA =   69.96 SQ MI
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      ***             ***             ***             ***             ***

                    HYDROGRAPH AT STATION     STOR
                  TRANSPOSITION AREA    300.0 SQ MI

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                     6-HR       24-HR       72-HR     49.75-HR
+   (CFS)       (HR)
                           (CFS)
+    6812.     15.50                6464.       2934.       1445.        1445.
                        (INCHES)    0.859       1.560       1.592        1.592
                         (AC-FT)    3206.       5820.       5941.        5941.

 PEAK STORAGE   TIME                         MAXIMUM AVERAGE STORAGE
                                     6-HR       24-HR       72-HR     49.75-HR
+  (AC-FT)      (HR)
     2623.     15.50                2232.        818.        399.         399.

  PEAK STAGE    TIME                          MAXIMUM AVERAGE STAGE
                                     6-HR       24-HR       72-HR     49.75-HR
+   (FEET)      (HR)
   1553.03     15.50              1552.28     1546.73     1543.41      1543.41

                     CUMULATIVE AREA =   69.96 SQ MI


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

                    HYDROGRAPH AT STATION     STOR
                  TRANSPOSITION AREA    500.0 SQ MI

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                     6-HR       24-HR       72-HR     49.75-HR
+   (CFS)       (HR)
                           (CFS)
+    6705.     15.50                6335.       2823.       1390.        1390.
                        (INCHES)    0.842       1.501       1.532        1.532
                         (AC-FT)    3141.       5600.       5716.        5716.

 PEAK STORAGE   TIME                         MAXIMUM AVERAGE STORAGE
                                     6-HR       24-HR       72-HR     49.75-HR
+  (AC-FT)      (HR)
     2481.     15.50                2100.        763.        372.         372.

  PEAK STAGE    TIME                          MAXIMUM AVERAGE STAGE
                                     6-HR       24-HR       72-HR     49.75-HR
+   (FEET)      (HR)
   1552.78     15.50              1552.02     1546.52     1543.31      1543.31

                     CUMULATIVE AREA =   69.96 SQ MI

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


                    INTERPOLATED HYDROGRAPH AT     STOR

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                     6-HR       24-HR       72-HR     49.75-HR
+   (CFS)       (HR)
                           (CFS)
+    7087.     15.75                6757.       3211.       1581.        1581.
                        (INCHES)    0.898       1.707       1.742        1.742
                         (AC-FT)    3351.       6368.       6500.        6500.

                     CUMULATIVE AREA =   69.96 SQ MI

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            *            *
  204 KK    *      STOR  *
            *            *
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               HYDROGRAPH ROUTING DATA

  205 RS          STORAGE ROUTING
                       NSTPS            1  NUMBER OF SUBREACHES
                        ITYP         STOR  TYPE OF INITIAL CONDITION
                      RSVRIC         0.00  INITIAL CONDITION
                           X         0.00 WORKING R AND D COEFFICIENT

  208 SA              AREA          4.4      60.5     130.7     348.8     486.0     625.3     763.8     763.9
764.0

  209 SE          ELEVATION     1540.00   1544.00   1546.00   1550.00   1552.00   1554.00   1556.00   1557.00
1558.00

  206 SQ          DISCHARGE          0.      698.     2229.     5188.     6380.     7215.     7985.    91005.
242535.

  207 SE          ELEVATION     1540.00   1544.00   1546.00   1550.00   1552.00   1554.00   1556.00   1557.00
1558.00

                                                                  ***

                                                   COMPUTED STORAGE-ELEVATION DATA

            STORAGE       0.00    108.29    295.04   1219.05   2050.07   3158.45   4545.24   5309.09   6073.04
          ELEVATION    1540.00   1544.00   1546.00   1550.00   1552.00   1554.00   1556.00   1557.00   1558.00

                                              COMPUTED STORAGE-OUTFLOW-ELEVATION DATA

            STORAGE       0.00    108.29    295.04   1219.05   2050.07   3158.45   4545.24   5309.09   6073.04
            OUTFLOW       0.00    698.00   2229.00   5188.00   6380.00   7215.00   7985.00  91005.00 242535.00
          ELEVATION    1540.00   1544.00   1546.00   1550.00   1552.00   1554.00   1556.00   1557.00   1558.00

 *** WARNING *** MODIFIED PULS ROUTING MAY BE NUMERICALLY UNSTABLE FOR OUTFLOWS BETWEEN     7985. TO   242535.
                 THE ROUTED HYDROGRAPH SHOULD BE EXAMINED FOR OSCILLATIONS OR OUTFLOWS GREATER THAN PEAK
INFLOWS.
                 THIS CAN BE CORRECTED BY DECREASING THE TIME INTERVAL OR INCREASING STORAGE (USE A LONGER
REACH.)

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

                        HYDROGRAPH AT STATION     STOR
                      TRANSPOSITION AREA      0.0 SQ MI

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                     6-HR       24-HR       72-HR     49.75-HR
+   (CFS)       (HR)
                            (CFS)
+   15228.     15.50                8258.       4481.       2211.        2211.
                         (INCHES)   1.097       2.382       2.437        2.437
                          (AC-FT)   4095.       8888.       9092.        9092.

 PEAK STORAGE   TIME                          MAXIMUM AVERAGE STORAGE
                                     6-HR       24-HR       72-HR     49.75-HR
+  (AC-FT)      (HR)
     4612.     15.50                4074.       1696.        826.         826.

  PEAK STAGE    TIME                          MAXIMUM AVERAGE STAGE
                                     6-HR       24-HR       72-HR     49.75-HR
+   (FEET)      (HR)
   1556.09     15.50              1555.32     1549.40     1544.82      1544.82

                        CUMULATIVE AREA =   69.96 SQ MI

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                    HYDROGRAPH AT STATION     STOR
                  TRANSPOSITION AREA     10.0 SQ MI

  PEAK FLOW     TIME                        MAXIMUM AVERAGE FLOW
                                     6-HR       24-HR       72-HR     49.75-HR
+   (CFS)       (HR)
                          (CFS)
+    7858.     16.00                7561.       4142.       2043.        2043.
                        (INCHES)   1.005       2.201       2.251        2.251
                         (AC-FT)   3749.       8215.       8400.        8400.

 PEAK STORAGE   TIME                       MAXIMUM AVERAGE STORAGE
                                     6-HR       24-HR       72-HR     49.75-HR
+  (AC-FT)      (HR)
     4317.     16.00                3787.       1549.        754.         754.

  PEAK STAGE    TIME                        MAXIMUM AVERAGE STAGE
                                     6-HR       24-HR       72-HR     49.75-HR
+   (FEET)      (HR)
   1555.67     16.00              1554.90     1549.01     1544.60      1544.60

                     CUMULATIVE AREA =   69.96 SQ MI


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

                    HYDROGRAPH AT STATION     STOR
                  TRANSPOSITION AREA     20.0 SQ MI

  PEAK FLOW     TIME                        MAXIMUM AVERAGE FLOW
                                     6-HR       24-HR       72-HR     49.75-HR
+   (CFS)       (HR)
                          (CFS)
+    7681.     16.00                7384.       3921.       1933.        1933.
                        (INCHES)   0.981       2.084       2.130        2.130
                         (AC-FT)   3661.       7777.       7946.        7946.

 PEAK STORAGE   TIME                       MAXIMUM AVERAGE STORAGE
                                     6-HR       24-HR       72-HR     49.75-HR
+  (AC-FT)      (HR)
     3999.     16.00                3485.       1397.        680.         680.

  PEAK STAGE    TIME                        MAXIMUM AVERAGE STAGE
                                     6-HR       24-HR       72-HR     49.75-HR
+   (FEET)      (HR)
   1555.21     16.00              1554.45     1548.58     1544.38      1544.38

                     CUMULATIVE AREA =   69.96 SQ MI


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

                    HYDROGRAPH AT STATION     STOR
                  TRANSPOSITION AREA     60.0 SQ MI

  PEAK FLOW     TIME                        MAXIMUM AVERAGE FLOW
                                     6-HR       24-HR       72-HR     49.75-HR
+   (CFS)       (HR)
                          (CFS)
+    7507.     15.75                7200.       3701.       1823.        1823.
                        (INCHES)   0.957       1.967       2.009        2.009
                         (AC-FT)   3570.       7341.       7497.        7497.

 PEAK STORAGE   TIME                       MAXIMUM AVERAGE STORAGE
                                     6-HR       24-HR       72-HR     49.75-HR
+  (AC-FT)      (HR)
     3685.     15.75                3188.       1252.        610.         610.

  PEAK STAGE    TIME                        MAXIMUM AVERAGE STAGE
                                     6-HR       24-HR       72-HR     49.75-HR
+   (FEET)      (HR)
   1554.76     15.75              1553.98     1548.17     1544.16      1544.16

                     CUMULATIVE AREA =   69.96 SQ MI
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                    HYDROGRAPH AT STATION     STOR
                 TRANSPOSITION AREA     90.0 SQ MI

  PEAK FLOW     TIME                        MAXIMUM AVERAGE FLOW
                                    6-HR       24-HR       72-HR     49.75-HR
+   (CFS)       (HR)
                          (CFS)
+    7443.     15.75                7128.       3619.       1782.        1782.
                        (INCHES)    0.947       1.923       1.964        1.964
                         (AC-FT)    3535.       7177.       7328.        7328.

 PEAK STORAGE   TIME                       MAXIMUM AVERAGE STORAGE
                                    6-HR       24-HR       72-HR     49.75-HR
+  (AC-FT)      (HR)
     3569.     15.75                3077.       1200.        585.         585.

  PEAK STAGE    TIME                        MAXIMUM AVERAGE STAGE
                                    6-HR       24-HR       72-HR     49.75-HR
+   (FEET)      (HR)
   1554.59     15.75              1553.81     1548.01     1544.07      1544.07

                    CUMULATIVE AREA =   69.96 SQ MI
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                    HYDROGRAPH AT STATION     STOR
                 TRANSPOSITION AREA    120.0 SQ MI

  PEAK FLOW     TIME                        MAXIMUM AVERAGE FLOW
                                    6-HR       24-HR       72-HR     49.75-HR
+   (CFS)       (HR)
                          (CFS)
+    7396.     15.75                7075.       3558.       1752.        1752.
                        (INCHES)    0.940       1.891       1.931        1.931
                         (AC-FT)    3508.       7058.       7205.        7205.

 PEAK STORAGE   TIME                       MAXIMUM AVERAGE STORAGE
                                    6-HR       24-HR       72-HR     49.75-HR
+  (AC-FT)      (HR)
     3485.     15.75                2997.       1162.        566.         566.

  PEAK STAGE    TIME                        MAXIMUM AVERAGE STAGE
                                    6-HR       24-HR       72-HR     49.75-HR
+   (FEET)      (HR)
   1554.47     15.75              1553.68     1547.89     1544.01      1544.01

                    CUMULATIVE AREA =   69.96 SQ MI
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                    HYDROGRAPH AT STATION     STOR
                 TRANSPOSITION AREA    150.0 SQ MI

  PEAK FLOW     TIME                        MAXIMUM AVERAGE FLOW
                                    6-HR       24-HR       72-HR     49.75-HR
+   (CFS)       (HR)
                          (CFS)
+    7358.     15.75                7032.       3509.       1728.        1728.
                        (INCHES)    0.934       1.865       1.904        1.904
                         (AC-FT)    3487.       6959.       7104.        7104.

 PEAK STORAGE   TIME                       MAXIMUM AVERAGE STORAGE
                                    6-HR       24-HR       72-HR     49.75-HR
+  (AC-FT)      (HR)
     3416.     15.75                2932.       1132.        552.         552.

  PEAK STAGE    TIME                        MAXIMUM AVERAGE STAGE
                                    6-HR       24-HR       72-HR     49.75-HR
+   (FEET)      (HR)
   1554.37     15.75              1553.57     1547.80     1543.96      1543.96

                    CUMULATIVE AREA =   69.96 SQ MI
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                        HYDROGRAPH AT STATION     STOR
                      TRANSPOSITION AREA    300.0 SQ MI

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                    6-HR       24-HR       72-HR     49.75-HR
+   (CFS)       (HR)
                            (CFS)
+    7254.     15.75                6909.       3373.       1661.        1661.
                         (INCHES)   0.918       1.793       1.830        1.830
                          (AC-FT)   3426.       6690.       6828.        6828.

 PEAK STORAGE   TIME                         MAXIMUM AVERAGE STORAGE
                                    6-HR       24-HR       72-HR     49.75-HR
+  (AC-FT)      (HR)
     3229.     15.75                2757.       1051.        512.         512.

  PEAK STAGE    TIME                          MAXIMUM AVERAGE STAGE
                                    6-HR       24-HR       72-HR     49.75-HR
+   (FEET)      (HR)
   1554.10     15.75              1553.27     1547.54     1543.83      1543.83

                       CUMULATIVE AREA =   69.96 SQ MI


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

                        HYDROGRAPH AT STATION     STOR
                      TRANSPOSITION AREA    500.0 SQ MI

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                    6-HR       24-HR       72-HR     49.75-HR
+   (CFS)       (HR)
                            (CFS)
+    7157.     15.75                6804.       3264.       1607.        1607.
                         (INCHES)   0.904       1.735       1.770        1.770
                          (AC-FT)   3374.       6474.       6607.        6607.

 PEAK STORAGE   TIME                         MAXIMUM AVERAGE STORAGE
                                    6-HR       24-HR       72-HR     49.75-HR
+  (AC-FT)      (HR)
     3082.     15.75                2621.        990.        483.         483.

  PEAK STAGE    TIME                          MAXIMUM AVERAGE STAGE
                                    6-HR       24-HR       72-HR     49.75-HR
+   (FEET)      (HR)
   1553.86     15.75              1553.02     1547.34     1543.72      1543.72

                       CUMULATIVE AREA =   69.96 SQ MI

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


                       INTERPOLATED HYDROGRAPH AT     STOR

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                    6-HR       24-HR       72-HR     49.75-HR
+   (CFS)       (HR)
                            (CFS)
+    7483.     15.75                7173.       3670.       1808.        1808.
                         (INCHES)   0.953       1.951       1.992        1.992
                          (AC-FT)   3557.       7279.       7433.        7433.

                       CUMULATIVE AREA =   69.96 SQ MI
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             *            *
  204 KK     *      STOR  *
             *            *
             **************

  205 KO          OUTPUT CONTROL VARIABLES
                        IPRNT           3  PRINT CONTROL
                        IPLOT           0  PLOT CONTROL
                        QSCAL          0.  HYDROGRAPH PLOT SCALE
                        IPNCH           1  PUNCH COMPUTED HYDROGRAPH
                         IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                        ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                        ISAV2         200  LAST ORDINATE PUNCHED OR SAVED
                       TIMINT       0.250  TIME INTERVAL IN HOURS


                HYDROGRAPH ROUTING DATA

  206 RS          STORAGE ROUTING
                        NSTPS           1  NUMBER OF SUBREACHES
                         ITYP        STOR  TYPE OF INITIAL CONDITION
                       RSVRIC        0.00  INITIAL CONDITION
                            X        0.00 WORKING R AND D COEFFICIENT

  209 SA               AREA         4.4      60.5     130.7     348.8     486.0     625.3     763.8     763.9
764.0

  210 SE          ELEVATION     1540.00   1544.00   1546.00   1550.00   1552.00   1554.00   1556.00   1557.00
1558.00

  207 SQ          DISCHARGE          0.      698.     2229.     5188.     6380.     7215.     7985.    91005.
242535.

  208 SE          ELEVATION     1540.00   1544.00   1546.00   1550.00   1552.00   1554.00   1556.00   1557.00
1558.00

                                                                  ***

                                                   COMPUTED STORAGE-ELEVATION DATA

            STORAGE       0.00    108.29    295.04   1219.05   2050.07   3158.45   4545.24   5309.09   6073.04
          ELEVATION    1540.00   1544.00   1546.00   1550.00   1552.00   1554.00   1556.00   1557.00   1558.00

                                              COMPUTED STORAGE-OUTFLOW-ELEVATION DATA

            STORAGE       0.00    108.29    295.04   1219.05   2050.07   3158.45   4545.24   5309.09   6073.04
            OUTFLOW       0.00    698.00   2229.00   5188.00   6380.00   7215.00   7985.00  91005.00 242535.00
          ELEVATION    1540.00   1544.00   1546.00   1550.00   1552.00   1554.00   1556.00   1557.00   1558.00

 *** WARNING *** MODIFIED PULS ROUTING MAY BE NUMERICALLY UNSTABLE FOR OUTFLOWS BETWEEN     7985. TO   242535.
                 THE ROUTED HYDROGRAPH SHOULD BE EXAMINED FOR OSCILLATIONS OR OUTFLOWS GREATER THAN PEAK
INFLOWS.
                 THIS CAN BE CORRECTED BY DECREASING THE TIME INTERVAL OR INCREASING STORAGE (USE A LONGER
REACH.)

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

                         HYDROGRAPH AT STATION     STOR
                       TRANSPOSITION AREA      0.0 SQ MI

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                     6-HR       24-HR       72-HR     49.75-HR
+   (CFS)       (HR)
                            (CFS)
+   23739.     14.75                10555.       5231.       2580.        2580.
                         (INCHES)    1.403       2.781       2.843        2.843
                          (AC-FT)    5234.      10375.      10610.       10610.

 PEAK STORAGE   TIME                          MAXIMUM AVERAGE STORAGE
                                     6-HR       24-HR       72-HR     49.75-HR
+  (AC-FT)      (HR)
     4690.     14.75                 4283.       1832.        893.         893.

  PEAK STAGE    TIME                          MAXIMUM AVERAGE STAGE
```

```
                                        6-HR        24-HR        72-HR      49.75-HR
+   (FEET)       (HR)
   1556.19      14.75                1555.62      1549.79      1545.05      1545.05

                          CUMULATIVE AREA =   69.96 SQ MI


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

                          HYDROGRAPH AT STATION     STOR
                       TRANSPOSITION AREA     10.0 SQ MI

  PEAK FLOW      TIME                          MAXIMUM AVERAGE FLOW
                                        6-HR        24-HR        72-HR      49.75-HR
+   (CFS)        (HR)
                             (CFS)
+   20652.       15.00                 9354.        4832.        2384.        2384.
                          (INCHES)     1.243        2.569        2.627        2.627
                           (AC-FT)     4638.        9585.        9803.        9803.

 PEAK STORAGE    TIME                          MAXIMUM AVERAGE STORAGE
                                        6-HR        24-HR        72-HR      49.75-HR
+  (AC-FT)       (HR)
     4662.      15.00                 4182.        1760.         857.         857.

  PEAK STAGE     TIME                          MAXIMUM AVERAGE STAGE
                                        6-HR        24-HR        72-HR      49.75-HR
+   (FEET)       (HR)
   1556.15      15.00                1555.47      1549.58      1544.93      1544.93

                          CUMULATIVE AREA =   69.96 SQ MI


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

                          HYDROGRAPH AT STATION     STOR
                       TRANSPOSITION AREA     30.0 SQ MI

  PEAK FLOW      TIME                          MAXIMUM AVERAGE FLOW
                                        6-HR        24-HR        72-HR      49.75-HR
+   (CFS)        (HR)
                             (CFS)
+   14851.       15.50                 8527.        4572.        2256.        2256.
                          (INCHES)     1.133        2.430        2.486        2.486
                           (AC-FT)     4228.        9068.        9277.        9277.

 PEAK STORAGE    TIME                          MAXIMUM AVERAGE STORAGE
                                        6-HR        24-HR        72-HR      49.75-HR
+  (AC-FT)       (HR)
     4608.      15.50                 4110.        1717.         836.         836.

  PEAK STAGE     TIME                          MAXIMUM AVERAGE STAGE
                                        6-HR        24-HR        72-HR      49.75-HR
+   (FEET)       (HR)
   1556.08      15.50                1555.37      1549.46      1544.85      1544.85

                          CUMULATIVE AREA =   69.96 SQ MI


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

                          HYDROGRAPH AT STATION     STOR
                       TRANSPOSITION AREA     60.0 SQ MI

  PEAK FLOW      TIME                          MAXIMUM AVERAGE FLOW
                                        6-HR        24-HR        72-HR      49.75-HR
+   (CFS)        (HR)
                             (CFS)
+    8480.       16.00                 7711.        4314.        2129.        2129.
                          (INCHES)     1.025        2.293        2.346        2.346
                           (AC-FT)     3824.        8556.        8755.        8755.

 PEAK STORAGE    TIME                          MAXIMUM AVERAGE STORAGE
                                        6-HR        24-HR        72-HR      49.75-HR
+  (AC-FT)       (HR)
     4550.      16.00                 4016.        1669.         813.         813.
```

```
  PEAK STAGE     TIME                          MAXIMUM AVERAGE STAGE
                                        6-HR        24-HR        72-HR      49.75-HR
+   (FEET)       (HR)
   1556.01     16.00                1555.24      1549.32      1544.78       1544.77

                         CUMULATIVE AREA =   69.96 SQ MI


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

                          HYDROGRAPH AT STATION     STOR
                        TRANSPOSITION AREA     90.0 SQ MI

  PEAK FLOW      TIME                          MAXIMUM AVERAGE FLOW
                                        6-HR        24-HR        72-HR      49.75-HR
+   (CFS)        (HR)
                            (CFS)
+    7914.     16.00                 7621.        4219.        2082.         2082.
                         (INCHES)   1.013        2.243        2.294         2.294
                          (AC-FT)   3779.        8368.        8560.         8560.

 PEAK STORAGE    TIME                          MAXIMUM AVERAGE STORAGE
                                        6-HR        24-HR        72-HR      49.75-HR
+  (AC-FT)       (HR)
     4417.     16.00                 3891.        1604.         781.          781.

  PEAK STAGE     TIME                          MAXIMUM AVERAGE STAGE
                                        6-HR        24-HR        72-HR      49.75-HR
+   (FEET)       (HR)
   1555.82     16.00                1555.05      1549.15      1544.68       1544.68

                         CUMULATIVE AREA =   69.96 SQ MI


      ***             ***             ***             ***             ***
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                          HYDROGRAPH AT STATION     STOR
                        TRANSPOSITION AREA    120.0 SQ MI

  PEAK FLOW      TIME                          MAXIMUM AVERAGE FLOW
                                        6-HR        24-HR        72-HR      49.75-HR
+   (CFS)        (HR)
                            (CFS)
+    7858.     16.00                 7567.        4150.        2047.         2047.
                         (INCHES)   1.006        2.206        2.256         2.256
                          (AC-FT)   3752.        8231.        8417.         8417.

 PEAK STORAGE    TIME                          MAXIMUM AVERAGE STORAGE
                                        6-HR        24-HR        72-HR      49.75-HR
+  (AC-FT)       (HR)
     4317.     16.00                 3796.        1555.         757.          757.

  PEAK STAGE     TIME                          MAXIMUM AVERAGE STAGE
                                        6-HR        24-HR        72-HR      49.75-HR
+   (FEET)       (HR)
   1555.67     16.00                1554.92      1549.02      1544.61       1544.61

                         CUMULATIVE AREA =   69.96 SQ MI


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

                          HYDROGRAPH AT STATION     STOR
                        TRANSPOSITION AREA    150.0 SQ MI

  PEAK FLOW      TIME                          MAXIMUM AVERAGE FLOW
                                        6-HR        24-HR        72-HR      49.75-HR
+   (CFS)        (HR)
                            (CFS)
+    7814.     16.00                 7523.        4094.        2019.         2019.
                         (INCHES)   1.000        2.176        2.225         2.225
                          (AC-FT)   3730.        8120.        8302.         8302.

 PEAK STORAGE    TIME                          MAXIMUM AVERAGE STORAGE
                                        6-HR        24-HR        72-HR      49.75-HR
+  (AC-FT)       (HR)
     4237.     16.00                 3720.        1515.         738.          738.
```

```
  PEAK STAGE    TIME                          MAXIMUM AVERAGE STAGE
                                     6-HR        24-HR       72-HR     49.75-HR
+   (FEET)      (HR)
   1555.55     16.00              1554.80     1548.91     1544.55      1544.55

                        CUMULATIVE AREA =   69.96 SQ MI


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

                        HYDROGRAPH AT STATION     STOR
                     TRANSPOSITION AREA    300.0 SQ MI

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                     6-HR        24-HR       72-HR     49.75-HR
+   (CFS)       (HR)
                           (CFS)
+    7689.      16.00                7397.       3937.       1941.        1941.
                         (INCHES)   0.983       2.093       2.139        2.139
                          (AC-FT)   3668.       7809.       7980.        7980.

 PEAK STORAGE   TIME                          MAXIMUM AVERAGE STORAGE
                                     6-HR        24-HR       72-HR     49.75-HR
+  (AC-FT)      (HR)
     4012.     16.00                3506.       1408.        686.         686.

  PEAK STAGE    TIME                          MAXIMUM AVERAGE STAGE
                                     6-HR        24-HR       72-HR     49.75-HR
+   (FEET)      (HR)
   1555.23     16.00              1554.48     1548.62     1544.39      1544.39

                        CUMULATIVE AREA =   69.96 SQ MI


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

                        HYDROGRAPH AT STATION     STOR
                     TRANSPOSITION AREA    500.0 SQ MI

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                     6-HR        24-HR       72-HR     49.75-HR
+   (CFS)       (HR)
                           (CFS)
+    7591.      16.00                7295.       3814.       1879.        1879.
                         (INCHES)   0.969       2.027       2.071        2.071
                          (AC-FT)   3617.       7564.       7727.        7727.

 PEAK STORAGE   TIME                          MAXIMUM AVERAGE STORAGE
                                     6-HR        24-HR       72-HR     49.75-HR
+  (AC-FT)      (HR)
     3835.     16.00                3339.       1326.        646.         646.

  PEAK STAGE    TIME                          MAXIMUM AVERAGE STAGE
                                     6-HR        24-HR       72-HR     49.75-HR
+   (FEET)      (HR)
   1554.98     16.00              1554.22     1548.38     1544.27      1544.27

                        CUMULATIVE AREA =   69.96 SQ MI

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


                        INTERPOLATED HYDROGRAPH AT     STOR

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                     6-HR        24-HR       72-HR     49.75-HR
+   (CFS)       (HR)
                           (CFS)
+    8265.      16.00                7677.       4278.       2111.        2111.
                         (INCHES)   1.020       2.274       2.326        2.326
                          (AC-FT)   3807.       8485.       8681.        8681.

                        CUMULATIVE AREA =   69.96 SQ MI
*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***
*** *** *** *** ***
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*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***
*** *** *** *** ***              **************
              *            *
  106 KK      *      STOR  *
              *            *
              **************

  107 KO          OUTPUT CONTROL VARIABLES
                        IPRNT           3  PRINT CONTROL
                        IPLOT           0  PLOT CONTROL
                        QSCAL          0.  HYDROGRAPH PLOT SCALE
                        IPNCH           1  PUNCH COMPUTED HYDROGRAPH
                         IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                        ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                        ISAV2         200  LAST ORDINATE PUNCHED OR SAVED
                       TIMINT       0.250  TIME INTERVAL IN HOURS


                HYDROGRAPH ROUTING DATA

  108 RS          STORAGE ROUTING
                        NSTPS           1  NUMBER OF SUBREACHES
                         ITYP        STOR  TYPE OF INITIAL CONDITION
                       RSVRIC        0.00  INITIAL CONDITION
                            X        0.00 WORKING R AND D COEFFICIENT

  111 SA               AREA         4.4      60.5     130.7     348.8     486.0     625.3     763.8     763.9
764.0

  112 SE          ELEVATION     1540.00   1544.00   1546.00   1550.00   1552.00   1554.00   1556.00   1557.00
1558.00

  109 SQ          DISCHARGE          0.      698.     2229.     5188.     6380.     7215.     7985.    91005.
242535.

  110 SE          ELEVATION     1540.00   1544.00   1546.00   1550.00   1552.00   1554.00   1556.00   1557.00
1558.00
                                                   COMPUTED STORAGE-ELEVATION DATA

            STORAGE       0.00    108.29    295.04   1219.05   2050.07   3158.45   4545.24   5309.09   6073.04
          ELEVATION    1540.00   1544.00   1546.00   1550.00   1552.00   1554.00   1556.00   1557.00   1558.00

                                                COMPUTED STORAGE-OUTFLOW-ELEVATION DATA

            STORAGE       0.00    108.29    295.04   1219.05   2050.07   3158.45   4545.24   5309.09   6073.04
            OUTFLOW       0.00    698.00   2229.00   5188.00   6380.00   7215.00   7985.00  91005.00 242535.00
          ELEVATION    1540.00   1544.00   1546.00   1550.00   1552.00   1554.00   1556.00   1557.00   1558.00

 *** WARNING *** MODIFIED PULS ROUTING MAY BE NUMERICALLY UNSTABLE FOR OUTFLOWS BETWEEN     7985. TO   242535.
                THE ROUTED HYDROGRAPH SHOULD BE EXAMINED FOR OSCILLATIONS OR OUTFLOWS GREATER THAN PEAK
INFLOWS.
                THIS CAN BE CORRECTED BY DECREASING THE TIME INTERVAL OR INCREASING STORAGE (USE A LONGER
REACH.)
       **             ***             ***             ***             ***
                         HYDROGRAPH AT STATION     STOR
                       TRANSPOSITION AREA      0.1 SQ MI
  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                     6-HR        24-HR        72-HR      49.75-HR
+   (CFS)       (HR)
                            (CFS)
+   62969.      5.00                21038.        8210.        3967.        3967.
                         (INCHES)    2.796        4.364        4.372        4.372
                          (AC-FT)   10432.       16284.       16312.       16312.

 PEAK STORAGE   TIME                          MAXIMUM AVERAGE STORAGE
                                     6-HR        24-HR        72-HR      49.75-HR
+  (AC-FT)      (HR)
     5051.      5.00                 4663.        2214.        1069.        1069.

  PEAK STAGE    TIME                          MAXIMUM AVERAGE STAGE
                                     6-HR        24-HR        72-HR      49.75-HR
+   (FEET)      (HR)
   1556.66      5.00               1556.15      1550.39      1545.05      1545.05

                         CUMULATIVE AREA =   69.96 SQ MI
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*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***
*** *** *** *** ***
                *              *
  104 KK        *      STOR    *
                *              *
                ***************

  105 KO          OUTPUT CONTROL VARIABLES
                        IPRNT           3  PRINT CONTROL
                        IPLOT           0  PLOT CONTROL
                        QSCAL          0.  HYDROGRAPH PLOT SCALE
                        IPNCH           1  PUNCH COMPUTED HYDROGRAPH
                         IOUT          21  SAVE HYDROGRAPH ON THIS UNIT
                        ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                        ISAV2        1500  LAST ORDINATE PUNCHED OR SAVED
                       TIMINT       0.250  TIME INTERVAL IN HOURS
                  HYDROGRAPH ROUTING DATA

  106 RS          STORAGE ROUTING
                        NSTPS           1  NUMBER OF SUBREACHES
                         ITYP        STOR  TYPE OF INITIAL CONDITION
                       RSVRIC        0.00  INITIAL CONDITION
                            X        0.00 WORKING R AND D COEFFICIENT

  109 SA               AREA         4.4      60.5     130.7     348.8     486.0     625.3     763.8     763.9
764.0

  110 SE          ELEVATION     1540.00   1544.00   1546.00   1550.00   1552.00   1554.00   1556.00   1557.00
1558.00

  107 SQ          DISCHARGE          0.      698.     2229.     5188.     6380.     7215.     7985.    91005.
242535.

  108 SE          ELEVATION     1540.00   1544.00   1546.00   1550.00   1552.00   1554.00   1556.00   1557.00
1558.00

                                                                  ***

                                                   COMPUTED STORAGE-ELEVATION DATA

            STORAGE       0.00    108.29    295.04   1219.05   2050.07   3158.45   4545.24   5309.09   6073.04
          ELEVATION    1540.00   1544.00   1546.00   1550.00   1552.00   1554.00   1556.00   1557.00   1558.00

                                              COMPUTED STORAGE-OUTFLOW-ELEVATION DATA

            STORAGE       0.00    108.29    295.04   1219.05   2050.07   3158.45   4545.24   5309.09   6073.04
            OUTFLOW       0.00    698.00   2229.00   5188.00   6380.00   7215.00   7985.00  91005.00 242535.00
          ELEVATION    1540.00   1544.00   1546.00   1550.00   1552.00   1554.00   1556.00   1557.00   1558.00

 *** WARNING *** MODIFIED PULS ROUTING MAY BE NUMERICALLY UNSTABLE FOR OUTFLOWS BETWEEN     7985. TO   242535.
                 THE ROUTED HYDROGRAPH SHOULD BE EXAMINED FOR OSCILLATIONS OR OUTFLOWS GREATER THAN PEAK
INFLOWS.
                 THIS CAN BE CORRECTED BY DECREASING THE TIME INTERVAL OR INCREASING STORAGE (USE A LONGER
REACH.)

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

                        HYDROGRAPH AT STATION     STOR
                      TRANSPOSITION AREA      0.0 SQ MI

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                     6-HR        24-HR        72-HR    374.75-HR
+   (CFS)       (HR)
                            (CFS)
+   40365.     18.25                33506.       13849.        5540.        1071.
                        (INCHES)     4.453        7.361        8.835        8.891
                         (AC-FT)    16615.       27469.       32967.       33177.

 PEAK STORAGE   TIME                          MAXIMUM AVERAGE STORAGE
                                     6-HR        24-HR        72-HR    374.75-HR
+  (AC-FT)      (HR)
     4843.     18.25                 4780.        3278.        1237.         239.

  PEAK STAGE    TIME                          MAXIMUM AVERAGE STAGE
                                     6-HR        24-HR        72-HR    374.75-HR
+   (FEET)      (HR)
   1556.39     18.25               1556.31      1553.77      1547.84      1541.55
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                    CUMULATIVE AREA =   69.96 SQ MI

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

                    HYDROGRAPH AT STATION     STOR
                  TRANSPOSITION AREA    500.0 SQ MI

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                     6-HR       24-HR       72-HR    374.75-HR
+   (CFS)       (HR)
                            (CFS)
+   40365.     18.25                33506.      13849.       5540.        1071.
                         (INCHES)    4.453       7.361       8.835        8.891
                          (AC-FT)   16615.      27469.      32967.       33177.

 PEAK STORAGE   TIME                          MAXIMUM AVERAGE STORAGE
                                     6-HR       24-HR       72-HR    374.75-HR
+  (AC-FT)      (HR)
     4843.     18.25                 4780.       3278.       1237.         239.

  PEAK STAGE    TIME                          MAXIMUM AVERAGE STAGE
                                     6-HR       24-HR       72-HR    374.75-HR
+   (FEET)      (HR)
   1556.39     18.25               1556.31     1553.77     1547.84      1541.55

                    CUMULATIVE AREA =   69.96 SQ MI

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                    INTERPOLATED HYDROGRAPH AT     STOR

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                     6-HR       24-HR       72-HR    374.75-HR
+   (CFS)       (HR)
                            (CFS)
+   40365.     18.25                33506.      13849.       5540.        1071.
                         (INCHES)    4.453       7.361       8.835        8.891
                          (AC-FT)   16615.      27469.      32967.       33177.

                    CUMULATIVE AREA =   69.96 SQ MI
*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***
*** *** *** *** ***
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B.5. Flow Splits and Diversions Data

B.6. Summary of Peak Discharge

Table MD-6: Summary of Peak Discharges

Basin or CP ID	100-yr 24-hr Storm		200-yr 24-hr Storm		500-yr 24-hr Storm		10-day 100-yr	6-hr PMF	72-hr PMF
	Exst. Cond. Q [cfs]	Fut. Cond. Q [cfs]	Exst. Cond. Q [cfs]	Fut. Cond. Q [cfs]	Exst. Cond. Q [cfs]	Fut. Cond. Q [cfs]	Fut. Cond. Q [cfs]	Fut. Cond. Q [cfs]	Fut. Cond. Q [cfs]
100	5462	5668	6257	6456	7996	7708	***	***	12482
110	4165	4417	4944	5146	5684	6344	***	***	10308
120	3511	3628	4047	4208	4815	4908	***	***	5287
130	2411	2557	2800	2935	3413	3558	***	***	3540
200	16943	19641	20046	22803	24258	26855	***	***	***
310	11821	12193	13475	13831	16125	16456	***	***	***
400	16144	18692	19247	22013	22659	25935	***	***	***
420	5868	6132	6723	6982	8128	8382	***	***	***
460	5458	5433	6240	6204	7084	7357	***	***	***
500.1	6415	6809	6837	7031	7297	8257	***	***	***
500.2	24831	28560	30094	34358	36706	42038	***	***	115437
500.3	25608	29492	30877	35346	37639	42934	7649	115625	127499
505	4053	4650	4683	5272	5672	6260	***	***	***
510	6482	7405	8061	9147	10461	11594	***	***	***
600	7289	7848	8438	8987	10013	10568	***	***	***
640	11653	11905	13201	13487	15641	15922	***	***	***
700	6366	6472	7303	7402	8588	8676	***	***	***
710	4102	4455	4755	5114	5731	6084	***	***	***
736	2973	3035	3171	3231	3431	3470	***	***	***
100400	4475	4411	4909	5144	5900	6334	***	***	***
110100	4074	4362	4816	5066	5590	6273	***	***	***
120110	4165	4417	4944	5146	5632	6318	***	***	***
130120	2311	2463	2750	2881	3348	3480	***	***	***
140130	1634	1638	1997	1956	2249	2340	***	***	***
150120	2303	2302	2741	2527	2964	3102	***	***	***
160120	476	471	550	541	625	616	***	***	***
200400	16144	18446	19146	21584	22659	25548	***	***	***
220200	4935	5181	5226	5192	5400	5388	***	***	***
310200	7259	7784	8636	9141	10862	11357	***	***	***
350310	1154	1256	1395	1507	1721	1849	***	***	***
400510	18953	21851	22679	25673	26370	30402	***	***	***
420200	4550	4749	4618	5475	5455	5903	***	***	***
460420	4069	4213	4533	4865	5455	5911	***	***	***
480460	5338	5316	6109	6079	6870	7153	***	***	***
500500	24686	28442	29934	34292	36617	41788	***	***	***
500600	24290	28191	29581	33590	35930	40654	***	***	***
505500	3246	3850	3800	4402	4932	5289	***	***	***
510500	22822	25946	27478	31220	33172	37609	***	***	***
520500	5847	5838	6445	6294	6415	6358	***	***	***
540500	713	741	757	770	798	1127	***	***	***
580510	6454	7121	7983	8761	10461	11258	***	***	***
600710	25643	29704	30955	35099	37416	42200	***	***	***
640505	1114	1146	1183	1210	1279	1830	***	***	***
640600	1822	1880	1940	1976	2073	2539	***	***	***
680640	5311	5696	6491	6553	7796	7834	***	***	***
710700	28157	32308	33431	37717	40322	44779	***	***	***

Table MD-6: Summary of Peak Discharges

Basin or CP ID	100-yr 24-hr Storm		200-yr 24-hr Storm		500-yr 24-hr Storm		10-day 100-yr	6-hr PMF	72-hr PMF
	Exst. Cond. Q [cfs]	Fut. Cond. Q [cfs]	Exst. Cond. Q [cfs]	Fut. Cond. Q [cfs]	Exst. Cond. Q [cfs]	Fut. Cond. Q [cfs]	Fut. Cond. Q [cfs]	Fut. Cond. Q [cfs]	Fut. Cond. Q [cfs]
735700	1355	1684	1643	1990	2023	2415	***	***	***
740710	273	282	306	313	344	348	***	***	***
760710	3380	3443	3552	3627	3803	4179	***	***	***
780760	7768	7805	10253	11090	12367	11508	***	***	***
120*	4729	4862	5662	5548	6605	6892	***	***	8825
400*	19115	21956	22805	25862	26535	30577	***	***	73007
510*	23515	27205	28973	32646	34714	39503	***	***	97760
600*	25825	29887	31204	35359	37705	42525	***	***	136691
700*	28185	32368	33470	37795	40366	44870	***	***	147770
710*	28626	32785	34028	38280	40744	45588	***	***	146936
CAP	25606	26246	26147	26705	31526	32976	***	***	***
CAP010	7131	8559	9786	12435	13996	14321	***	***	***
CAP020	11559	11963	13508	13884	16072	16372	***	***	***
CAP030	5537	5769	6301	6555	7632	7881	***	***	***
CAP040	13327	13693	15675	15985	19516	19825	***	***	***
CAP1	1123	1151	1191	1215	1361	2443	***	***	***
CAP2	727	747	764	773	862	1663	***	***	***
CAP200	378	381	398	400	423	425	***	***	***
CAP210	2526	2581	2696	2747	2927	2975	***	***	***
CAP220	457	462	484	493	523	527	***	***	***
CAP3	1841	1894	1951	1986	2158	3255	***	***	***
CAP4	3397	3458	3576	3646	3884	4707	***	***	***
IW310	11939	12310	13584	13938	16248	16577	***	***	***
IW350	4129	4139	4697	4701	5448	5443	***	***	***
PD700	6281	6357	7218	7287	8462	8521	***	***	***
PD710	3617	3724	4227	4332	5010	5116	***	***	***
PD730	613	633	706	724	821	839	***	***	***
PD735	2721	2857	3131	3253	3678	3794	***	***	***
PD740	1457	1473	1673	1686	1943	1954	***	***	***
PD745	2473	2513	2846	2881	3318	3349	***	***	***
PD760	3484	3585	4052	4146	4789	4875	***	***	***
PD780	13677	13880	15461	15651	18363	18504	***	***	***
PI600	7289	7848	8438	8987	10013	10568	***	***	***
PI640	11751	12006	13297	13534	15709	15923	***	***	***
PI680	7704	7764	8716	8759	10298	10323	***	***	***
STOR	7087	7249	7483	7620	8265	12068	***	***	***
SV200	10672	11930	12271	13548	14836	16107	***	***	***
SV220	11508	12073	13017	13551	15343	15837	***	***	***
TW400	7599	8875	8705	9983	10315	11577	***	***	***
TW420	6092	6353	7022	7277	8292	8542	***	***	***
TW460	2146	2124	2476	2450	2898	2867	***	***	***
TW480	6463	6439	7319	7286	8553	8510	***	***	***
WI500	5169	5927	5962	6727	7024	7778	***	***	***
WI505	4153	4717	4851	5409	5747	6304	***	***	***
WI510	5045	5897	5780	6631	6764	7605	***	***	***

Table MD-6: Summary of Peak Discharges

Basin or CP ID	100-yr 24-hr Storm		200-yr 24-hr Storm		500-yr 24-hr Storm		10-day 100-yr	6-hr PMF	72-hr PMF
	Exst. Cond. Q [cfs]	Fut. Cond. Q [cfs]	Exst. Cond. Q [cfs]	Fut. Cond. Q [cfs]	Exst. Cond. Q [cfs]	Fut. Cond. Q [cfs]	Fut. Cond. Q [cfs]	Fut. Cond. Q [cfs]	Fut. Cond. Q [cfs]
WI520	8699	9032	9898	10218	11774	12076	***	***	***
WI540	7839	8161	8890	9205	10366	10669	***	***	***
WI580	14206	14456	16247	16483	19545	19757	***	***	***
WT100	2869	2991	3321	3438	3901	4012	***	***	***
WT110	3134	3195	3611	3667	4217	4267	***	***	***
WT120	3376	3418	3897	3931	4555	4583	***	***	***
WT130	1848	1889	2136	2173	2510	2542	***	***	***
WT140	2297	2394	2659	2751	3123	3210	***	***	***
WT150	3069	3203	3548	3678	4167	4291	***	***	***
WT160	751	772	868	887	1015	1031	***	***	***

B.7. Manning's n Value Report

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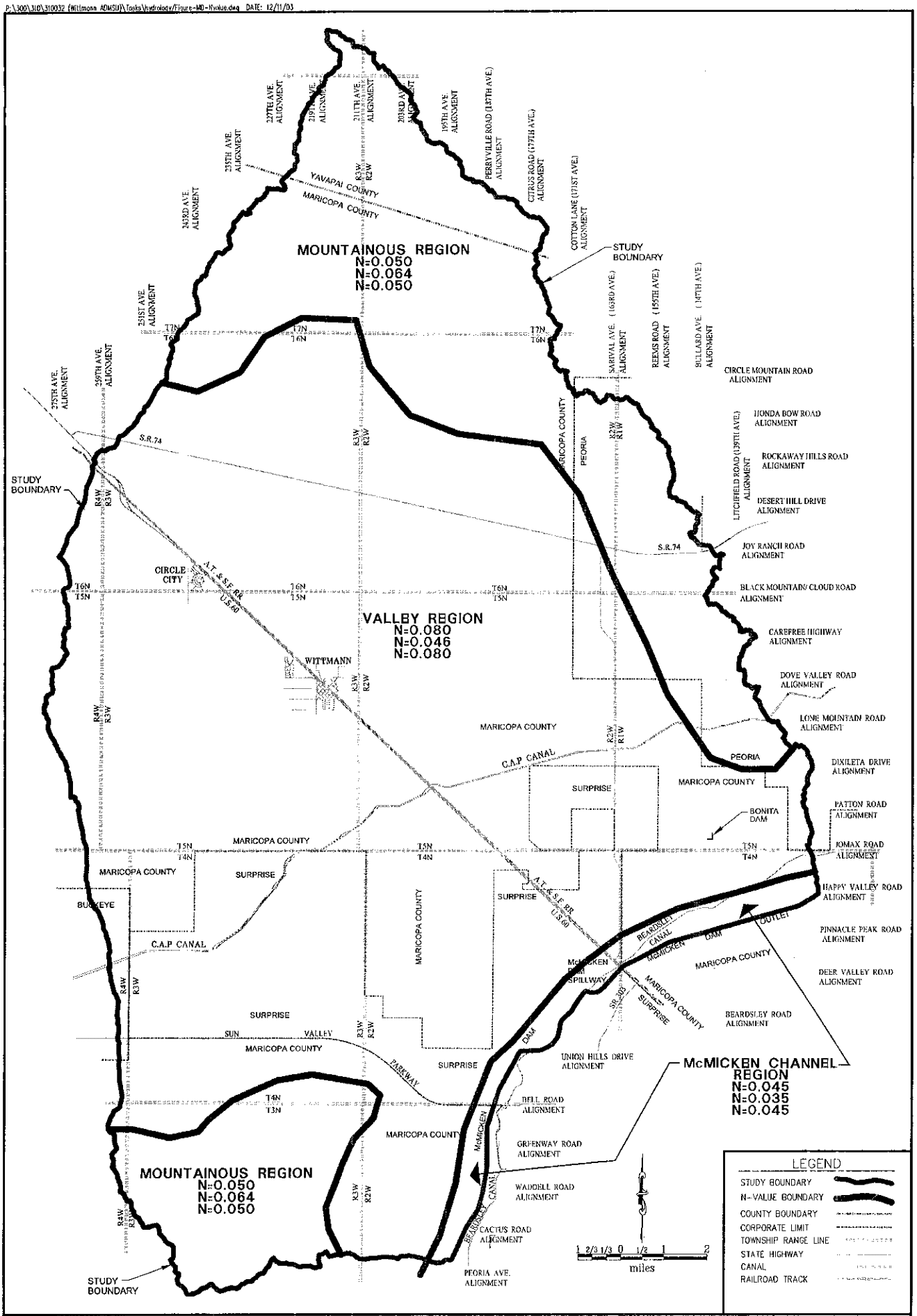

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2255 N. 44th Street Suite 125
Phoenix, AZ 85008-3279
Tel 602.244.2568
Fax 602.244.8947
E-mail www.entellus.com

McMICKEN DAM HYDROLOGY
FLOOD CONTROL DISTRICT OF MARICOPA COUNTY
CONTRACT FCD 2002C029

TYPICAL AREA "n" VALUES
FIGURE MD-B.2

Appendix B.7
Table MD-B.7.1

Project: Wittmann Area Drainage Master Study Update (ADMSU)
Stream: North and South Mountainous area
Location: **Reaches** - North and South portion of watershed

Channel Conditions		Manning's n Adjustment		Left Overbank (West)	Channel	Right Overbank (East)
Channel Material	Concrete	n_b	.012 - .018			
	Firm Soil		.025 -.032			
	Coarse Sand		.026 - .035			
	Gravel		.028 - .035			
	Cobble		.030 - .050	.042	.040	.042
	Boulder		.040 - .070			
Degree of Irregularity	Smooth	n_1	0			
	Minor		.001 - .005	.001		.001
	Moderate		.006 - .010		.010	
	Severe		.011 - .020			
Effects of Obstruction	Negligible	n_2	.000 - .004	0	0	0
	Minor		.005 - .015			
	Appreciable		.020 - .030			
	Severe		.040 - .060			
Vegetation	Small	n_3	.002 - .010	.005	.002	.005
	Medium		.010 - .025			
	Large		.025 - .050			
	Very Large		.050 - .100			
Variations in Channel Cross section	Gradual	n_4	0			
	Occ. Alt.		.001 - .005	.002	.004	0.002
	Freq. Alt.		.010 - .015			
				0.05	0.056	0.05
Degree of Meandering	Minor	m	1	1		1
	Appreciable		1.15		1.15	
	Sever		1.3			
$n = (n_b+n_1+n_2+n_3+n_4)m$				0.05	0.064	0.05

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Appendix B.7
Figure MD-B.7.1
Mountain Wash

Appendix B.7
Table MD-B.7.2

Project: Wittmann Area Drainage Master Study Update (ADMSU)
Stream: Central Valley Area
Location: **Reaches** - Central portion of watershed

Channel Conditions		Manning's n Adjustment		Left Overbank (West)	Channel	Right Overbank (East)
Channel Material	Concrete	n_b	.012 - .018			
	Firm Soil		.025 -.032			
	Coarse Sand		.026 - .035	.030	0.028	.030
	Gravel		.028 - .035			
	Cobble		.030 - .050			
	Boulder		.040 - .070			
Degree of Irregularity	Smooth	n_1	0			
	Minor		.001 - .005	0.005	0.002	0.005
	Moderate		.006 - .010			
	Severe		.011 - .020			
Effects of Obstruction	Negligible	n_2	.000 - .004		0	
	Minor		.005 - .015	0.005		0.005
	Appreciable		.020 - .030			
	Severe		.040 - .060			
Vegetation	Small	n_3	.002 - .010			
	Medium		.010 - .025		.015	
	Large		.025 - .050	0.040		0.040
	Very Large		.050 - .100			
Variations in Channel Cross section	Gradual	n_4	0	0		0
	Occ. Alt.		.001 - .005		0.001	
	Freq. Alt.		.010 - .015			
				0.08	0.046	0.08
Degree of Meandering	Minor	m	1	1	1	1
	Appreciable		1.15			
	Sever		1.3			
$n = (n_b+n_1+n_2+n_3+n_4)m$				0.080	0.046	0.08

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Appendix B.7
Figure MD-B.7.2

Typical bank for a wash in the valley region

Typical wash in the central valley region

Looking downstream of a wash in the central valley region

Appendix B.7
Table MD-B.7.3

Project: Wittmann Area Drainage Master Study Update (ADMSU)
Stream: McMicken Dam Channel
Location: **Reaches** - South-Eastern portion of watershed

Channel Conditions		Manning's n Adjustment		Left Overbank (West)	Channel	Right Overbank (East)
Channel Material	Concrete	n_b	.012 - .018			
	Firm Soil		.025 -.032		.025	
	Coarse Sand		.026 - .035	0.03		.03
	Gravel		.028 - .035			
	Cobble		.030 - .050			
	Boulder		.040 - .070			
Degree of Irregularity	Smooth	n_1	0	0	0	0
	Minor		.001 - .005			
	Moderate		.006 - .010			
	Severe		.011 - .020			
Effects of Obstruction	Negligible	n_2	.000 - .004	0	0	0
	Minor		.005 - .015			
	Appreciable		.020 - .030			
	Severe		.040 - .060			
Vegetation	Small	n_3	.002 - .010		.010	
	Medium		.010 - .025	0.015		0.015
	Large		.025 - .050			
	Very Large		.050 - .100			
Variations in Channel Cross section	Gradual	n_4	0	0	0	0
	Occ. Alt.		.001 - .005			
	Freq. Alt.		.010 - .015			
				0.045	0.035	0.045
Degree of Meandering	Minor	m	1	1	1	1
	Appreciable		1.15			
	Sever		1.3			
$n = (n_b+n_1+n_2+n_3+n_4)m$				0.045	0.035	0.045

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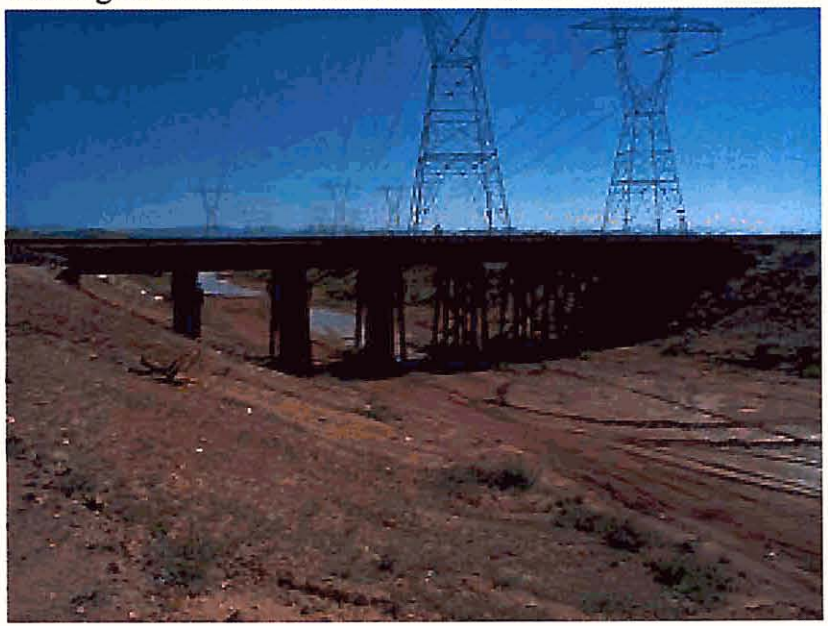
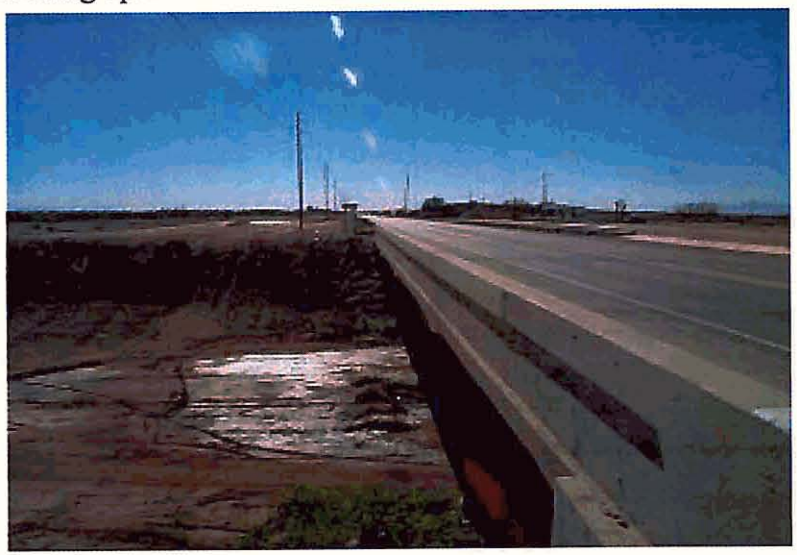
Appendix B.7
Figure MD-B.7.3

Looking downstream of McMicken Channel

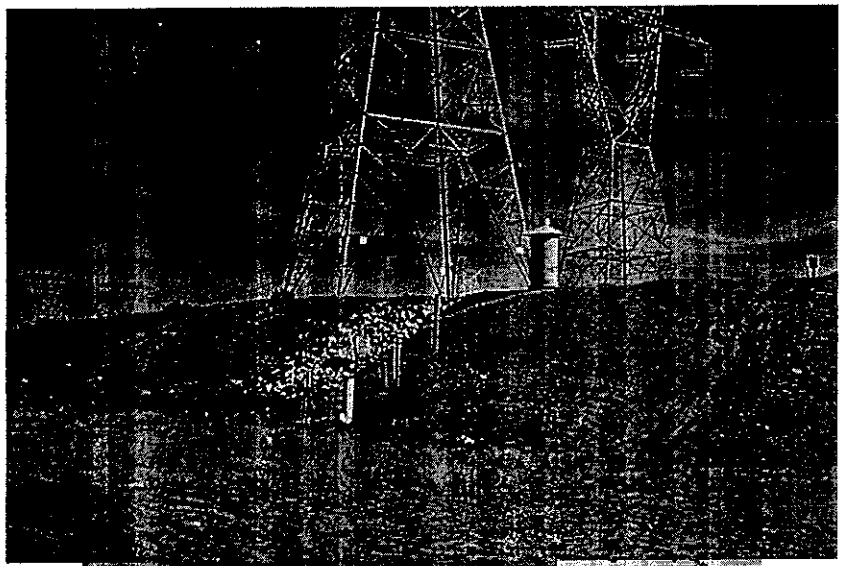


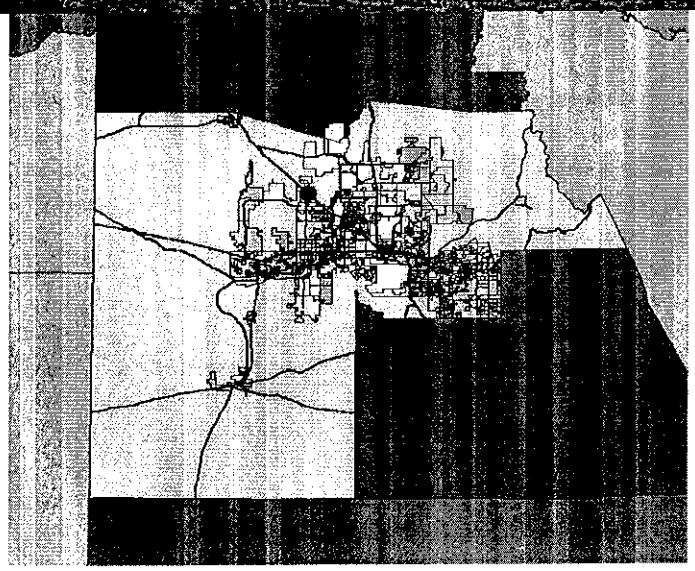
Looking upstream of McMicken Channel



B.8. Gage Data

STATION: McMicken Floodway GAGE ID: 5438





HOVER CURSOR OVER PHOTOS AND ICONS FOR DESCRIPTION AND SELECT ANY FOR FURTHER INFORMATION

FCD CURRENT CONDITIONS | STATION DESCRIPTION | RATING CURVE | RATING TBL (PDF) | GAGE X-SECTION

GAGE ID HISTORY | SITE DATA | RATING IN BRIEF | WATER YEAR PEAKS | RUNOFF HISTORY | FLOOD FLOW FREQUENCY

CREST GAGES | STAFF GAGES

Maricopa County Flood Control District Gage Information, www.fcd.maricopa.gov/services/ALERT, May 2003

Gage site is near the intersection of 163rd Avenue and Grand Avenue (US60). Instrumentation is located on the right bank of McMicken Floodway downstream of Grand Avenue.

GAGE ID HISTORY

ID	Elev of Instr. in GH	Elev of Instr. in M.S.L.	Period
5438	0.15	1,323.32	9/3/92 - present
Chart	Undetermined	Undetermined	5/19/92 - 9/3/92

SITE DATA

DRAINAGE AREA	305 MI^2
JURISDICTION	SURPRISE, ARIZONA
WATERSHED	TRILBY
SECTION/TOWNSHIP/RANGE	NW1/4 SW 1/4 S18 T4N R1W
LATITUDE	N33 41 04
LONGITUDE	W112 24 33
USGS QUAD MAP	McMICKEN DAM 7.5-MINUTE
INSTALLATION DATE	MAY 19, 1992 (WY 1992)
LENGTH OF RECORD (AS OF 10/01/02)	10.37 YEARS
STAGE GAGE TYPE	PRESSURE TRANSDUCER
STAFF GAGE	TWO, UPSTREAM OF BRIDGE
CREST STAGE GAGE	TWO
ZERO GAGE HEIGHT ELEVATION	1,323.17 FEET M.S.L.
STAGE GAGE ELEVATION	0.15 FEET GAGE HEIGHT
POINT OF ZERO FLOW	0.00 FEET GAGE HEIGHT
	JULY 15, 1999 &

PEAK FLOOD	98 CFS	1.65 FEET G.H.	JULY 31, 1992

RATING INFORMATION

RATING TABLE			
CURRENT RATING NUMBER 1, DATED MAY 19, 1992			
GAGE HEIGHT (FEET)	DISCHARGE (CFS)	GAGE HEIGHT (FEET)	DISCHARGE (CFS)
0.00	0	9.00	4,202
1.00	48	11.00	6,524
3.00	355	13.00	9,366
5.00	1,123	14.00	10,728
7.00	2,395	14.06	11,822

WATER YEAR PEAKS

Water Year	Peak Gage Height (feet)	Peak Discharge (cfs)	Date of Peak
2003			
2002	2.20	180	9/7/02
2001	0.35	8	10/27/00
2000	0.25	6	3/5/00
1999	1.65	98	7/15/99
1998	1.08	53	2/17/98
1997	0.25	6	9/25/97
1996	1.08	53	7/15/96
1995	0.15	0	---
1994	0.15	0	---
1993	1.15	59	1/11/93

Maricopa County Flood Control District Gage Information, www.fcd.maricopa.gov/services/ALERT, May 2003

1992	1.65	98	7/31/92

RUNOFF EVENT HISTORY

ANNUAL REPORT
MEAN DAILY FLOW

Event Date	Peak Stage feet G.H.	Peak Discharge (cfs)	Water Year
9/7/02	2.20	180	2002
7/24/02	1.42	80	2002
9/20/99	1.38	76	1999
7/15/99	1.65	98	1999
2/17/98	1.08	53	1998
7/15/96	1.08	53	1996
1/11/93	1.15	59	1993
9/20/92	1.05	52	1992
7/31/92	1.65	98	1992

FLOOD FLOW FREQUENCY

Flood Flow Frequency (FEMA 9/95, "at confluence with McMicken Dam")		
Magnitude and Probability of Instantaneous Peak Flow		
Discharge, in cfs, for Indicated Recurrence Interval		
10-year	50-year	100-year
2,610	4,280	5,090

CREST STAGE GAGE INFORMATION

Maricopa County Flood Control District Gage Information, www.fcd.maricopa.gov/services/ALERT, May 2003

CREST GAGE NUMBER	PIN ELEVATION (FEET, GAGE HEIGHT)	CREST GAGE NUMBER	PIN ELEVATION (FEET, GAGE HEIGHT)
1	0.97	2	4.86

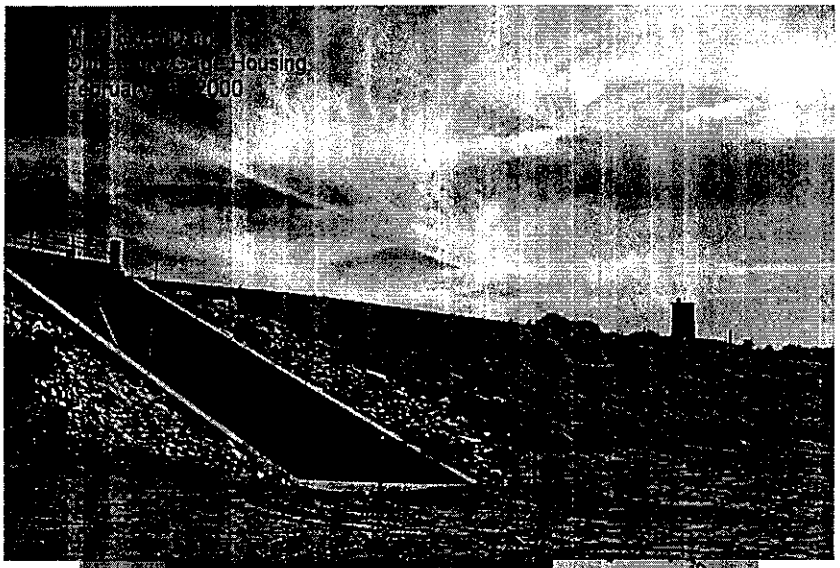
STAFF GAGE INFORMATION

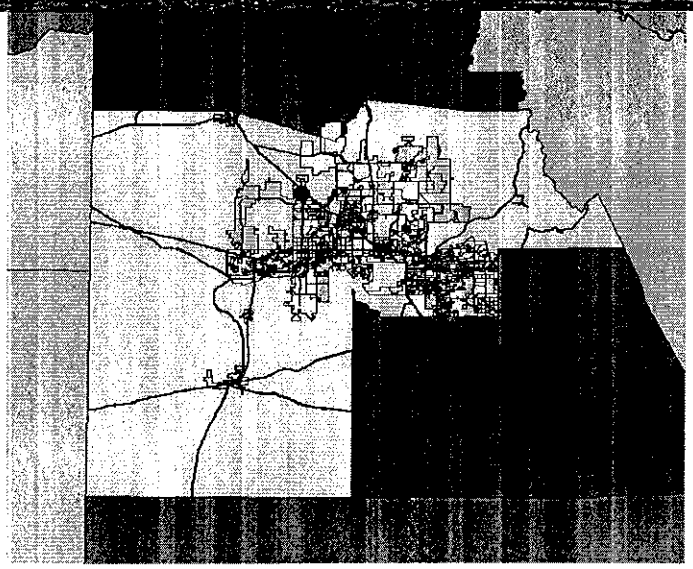
STAFF GAGE RANGE	LOW POINT	STAFF GAGE INFORMATION
0 - 7	0.00	
7 - 13	7.00	

Page last updated on December 9, 2002

Maricopa County Flood Control District Gage Information, www.fcd.maricopa.gov/services/ALERT, May 2003

STATION: McMicken Dam GAGE ID: 5448





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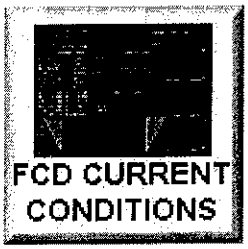
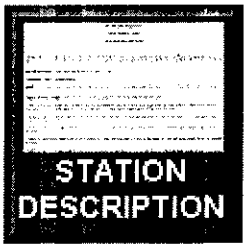
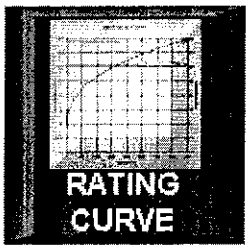
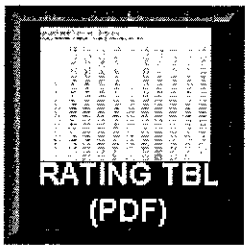
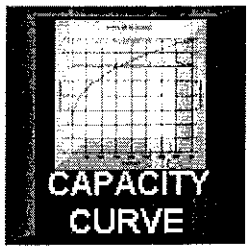


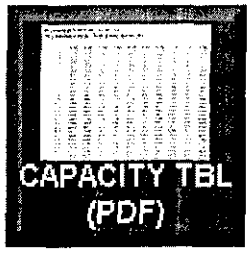


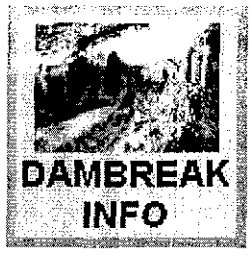






Maricopa County Flood Control District Gage Information, www.fcd.maricopa.gov/services/ALERT, May 2003





GAGE ID HISTORY | SITE DATA | RATING IN BRIEF | WATER YEAR PEAKS | IMPOUND HISTORY | STAFF GAGES

Station is located in the city of Surprise, near Grand Avenue (US 60) and 163rd Avenue.

GAGE ID HISTORY

ID	Elev of Instr. in GH	Elev of Instr. in MSL	Period
5448	0.00	1,332.02	6/15/92 - present
1603	0.00	1,332.02	10/1/87 - 6/15/92
47	Unknown	Unknown	3/20/83 - 10/1/87

SITE DATA

DRAINAGE AREA	247 MI^2
JURISDICTION	SURPRISE, ARIZONA
WATERSHED	TRILBY
SECTION/TOWNSHIP/RANGE	SW1/4 SW1/4 NW1/4 S24 T4N R2W
LATITUDE	N 33 40 38
LONGITUDE	W 112 25 23
USGS QUAD MAP	McMICKEN DAM 7.5-MINUTE
INSTALLATION DATE	MARCH 20, 1983
LENGTH OF RECORD (AS OF 10/01/02)	19.53 YEARS

Maricopa County Flood Control District Gage Information, www.fcd.maricopa.gov/services/ALERT, May 2003

STAGE GAGE TYPE	**PRESSURE TRANSDUCER**
STAFF GAGE	**THREE**
CREST STAGE GAGE	**NONE**
ZERO GAGE HEIGHT ELEVATION	**1,332.02 FEET M.S.L.**
STAGE GAGE ELEVATION	**0.00 FEET GAGE HEIGHT**
POINT OF ZERO FLOW	**1.68 FEET GAGE HEIGHT**
SPILLWAY CREST ELEVATION	**21.1 FEET GAGE HEIGHT**
TOP OF DAM ELEVATION	**29.0 FEET GAGE HEIGHT**

RATING INFORMATION

RATING TABLE

DISCHARGE RATING NUMBER 2, APPLIED AS OF MARCH 24, 1983

CAPACITY RATING NUMBER 2, APPLIED AS OF OCTOBER 1, 1994

(FLOW BEGINS AT ABOUT 1.7 FEET GAGE HEIGHT)

(ABOUT 100 ACRE-FEET OF STORAGE OCCURS BEFORE DETECTION BY THE GAGE)

GAGE HEIGHT (FEET)	ELEVATION (FEET NGVD 29)	DISCHARGE (CFS)	VOLUME (ACRE-FEET)
0.0	1,332.56	0	0
1.0	1,333.56	0	249
1.7	1,334.26	0	356
2.0	1,334.56	10	402
5.0	1,337.56	351	1,351
7.0	1,339.56	711	2,041
10.0	1,342.56	1,390	4,012
12.0	1,344.56	1,780	5,436
15.0	1,347.56	2,480	9,216
20.0	1,352.56	3,387	17,917

Maricopa County Flood Control District Gage Information, www.fcd.maricopa.gov/services/ALERT, May 2003

21.1	1,353.66	3,600	20,070
23.0	1,355.56	19,100	24,500
25.0	1,357.56	no data	29,608
27.0	1,359.56	no data	35,202

WATER YEAR PEAKS

WATER YEAR	EVENT DATE	PEAK WATER LEVEL (FEET GH)	PEAK VOLUME (ACRE-FEET)
2003			
2002	9/8/02	0.60	188
2001	10/27/00	0.60	188
2000	---	---	0
1999	---	---	0
1998	---	---	0
1997	---	---	0
1996	---	---	0
1995	---	---	0
1994	---	---	0
1993	1/11/93	3.60	868
1992	9/20/92	3.20	730
1991	10/1/90	2.80	592
1990	9/4/90	4.90	1,316
1989	8/15/89	0.70	203
1988	8/21/88	3.70	902
1987	No data available	No data available	No data available
1986	No data available	No data available	No data available

1985	No data available	No data available	No data available
1984	No data available	No data available	No data available
1983	No data available	No data available	No data available

IMPOUNDMENT HISTORY

ANNUAL REPORT MEAN DAILY STAGE

ANNUAL REPORT MEAN DAILY VOL.

(All events occurred over multiple days)

PEAK DATE	PEAK STAGE (FEET, G.H.)	PEAK VOLUME (ACRE-FEET)	WATER YEAR
9/11/02	0.55	180	2002
9/8/02	0.60	188	2002
10/27/00	0.60	188	2001
2/9/93	1.40	310	1993
1/19/93	2.80	592	1993
1/11/93	3.60	868	1993
9/24/92	2.20	387	1992
9/20/92	3.20	730	1992
8/26/92	0.70	203	1992
8/7/92	0.20	127	1992
7/30/92	0.10	111	1992
7/24/92	0.30	142	1992
3/15/92	0.10	111	1992
2/2/92	0.70	203	1992
1/27/92	0.90	234	1992

1/6/92	2.40	463	1992
11/7/91	0.80	218	1992
3/28/91	1.30	295	1991
2/28/91	0.70	203	1991
10/1/90	2.80	592	1991
9/4/90	4.90	1,316	1990
8/15/89	0.70	203	1989
8/24/88	2.10	417	1988
8/21/88	3.70	902	1988

STAFF GAGE INFORMATION

STAFF GAGE RANGE	STAFF GAGE INFORMATION
1338 - 1346 (MSL)	SUBTRACT 1,333.88 FEET TO GET GAGE HEIGHT
1346 - 1354 (MSL)	SUBTRACT 1,333.71 FEET TO GET GAGE HEIGHT
1354 - 1362 (MSL)	SUBTRACT 1,333.48 FEET TO GET GAGE HEIGHT
NOTES:	STAFF GAGES IN MAIN OUTLET READS DEPTH IN THE OUTLET ONLY AND ARE NOT RELATED TO GAGE HEIGHT M.S.L. DATUM IS EQUIVALENT TO NGVD 1929 DATUM

Page last updated on May 21, 2003

Maricopa County Flood Control District Gage Information, www.fcd.maricopa.gov/services/ALERT, May 2003

APPENDIX C. MCMICKEN DAM SOUTH PORTION 6-HR MODELS

The McMicken Dam south portion 6-hour model was not developed because this portion of the watershed was isolated from the rest of the watershed.

APPENDIX D. 100-YR, 24-HR HEC-1 OUTPUT

D.1. Existing Conditions

D.2. Future Conditions

D.1. Existing Conditions

```
1****************************************
*                                      *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)  *
*             JUN  1998                *
*           VERSION 4.1                *
*                                      *
* RUN DATE   26APR04  TIME  08:14:35   *
*                                      *
****************************************
```

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

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

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

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

1
PAGE 1

HEC-1 INPUT

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

  1           ID
  2           ID   ******************************************************************************
  3           ID   **                                                                          **
  4           ID   **                    McMICKEN DAM HYDROLOGY MODEL                          **
  5           ID   **                                                                          **
  6           ID   ******************************************************************************
  7           ID   ******************************************************************************
  8           ID   PROJECT:                 WITTMANN ADMS Update
  9           ID   CLIENT:                  Flood Control District of Maricopa County
 10           ID   PREPARED BY:             Entellus, Inc.
 11           ID   PROJECT No:              FCD 2002C029              Entellus 310.032
 12           ID   FILE NAME: ex-100.hc1                     CREATED DATE: Sept 3, 2003
 13           ID                                            MODIFIED DATE: Apr 26, 2004
 14           ID   STORM:                   100-year 24-hour Storm
 15           ID   DEVELOPMENT CONDITIONS: Existing Conditions
 16           ID
 17           ID
 18           ID   Changes made to Model:
 19           ID                        -Basin WT130 was adjusted to reflect improvements at
 20           ID                          southwest portion of the dam.
 21           ID                        -Basins PD790 and PD780 were combined to form PD780.
 22           ID                        -Basins PI640 and PI620 were combined to form PI640.
 23           ID                        -Basins PD720 and PD710 were combined to form PD710.
 24           ID                        -Changed the following concentration point names:
 25           ID                                CP 400 changed to 400*
 26           ID                                CP 510 changed to 510*
 27           ID                                CP 500 changed to 500.3
 28           ID                                CP 600 changed to 600*
 29           ID                                CP 710 changed to 710*
 30           ID                                CP 700 changed to 700*
 31           ID                        -Added concentration points 400, 510, 500.1, 500.2,
 32           ID                          600, 710 and 700.
 33           ID                        -Adjusted CAP culvert system (structures CAP060-CAP190)
 34           ID                          to account for the overtopping of the CAP Canal
 35           ID                        -Adjusted Time of COncentrations and routes for basins
 36           ID                          along McMicken Dam channel.
 37           ID                        -Changed Typical Cross Sections for Routes
 38           ID                        -Corrected S-Graphs for WI500, WI510, WT100, WT120,
```

```
 39          ID                          WT130 and SV200
 40          ID                        04-26-2004
 41          ID                        -Increased number of ordinates, added CP and
 42          ID                          rearranged combines in White Tanks area.
 43          ID
 44          ID
             *DIAGRAM
 45          IT      15  1JAN94       0    1500
 46          IO       3
 47          IN      15 01JAN94       0
 48          JD   4.159    0.01
             * 24-hour distribution
 49          PC     0.0   0.002   0.005   0.008   0.011   0.014   0.017    0.02   0.023   0.026
 50          PC   0.029   0.032   0.035   0.038   0.041   0.044   0.048   0.052   0.056    0.06
 51          PC   0.064   0.068   0.072   0.076    0.08   0.085    0.09   0.095     0.1   0.105
 52          PC    0.11   0.115    0.12   0.126   0.133    0.14   0.147   0.155   0.163   0.172
 53          PC   0.181   0.191   0.203   0.218   0.236   0.257   0.283   0.387   0.663   0.707
1                                          HEC-1 INPUT
PAGE  2

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

 54          PC   0.735   0.758   0.776   0.791   0.804   0.815   0.825   0.834   0.842   0.849
 55          PC   0.856   0.863   0.869   0.875   0.881   0.887   0.893   0.898   0.903   0.908
 56          PC   0.913   0.918   0.922   0.926    0.93   0.934   0.938   0.942   0.946    0.95
 57          PC   0.953   0.956   0.959   0.962   0.965   0.968   0.971   0.974   0.977    0.98
 58          PC   0.983   0.986   0.989   0.992   0.995   0.998     1.0
 59          IN      15 01JAN94       0
 60          JD   3.952    10.0
             * 24-hour distribution
 61          PC     0.0   0.002   0.005   0.008   0.011   0.014   0.017    0.02   0.023   0.026
 62          PC   0.029   0.032   0.035   0.038   0.041   0.044   0.048   0.052   0.056    0.06
 63          PC   0.064   0.068   0.072   0.076    0.08   0.085    0.09   0.095     0.1   0.105
 64          PC    0.11   0.115    0.12   0.126   0.133    0.14   0.147   0.155   0.163   0.172
 65          PC   0.181   0.191   0.203   0.218   0.236   0.257   0.283   0.387   0.663   0.707
 66          PC   0.735   0.758   0.776   0.791   0.804   0.815   0.825   0.834   0.842   0.849
 67          PC   0.856   0.863   0.869   0.875   0.881   0.887   0.893   0.898   0.903   0.908
 68          PC   0.913   0.918   0.922   0.926    0.93   0.934   0.938   0.942   0.946    0.95
 69          PC   0.953   0.956   0.959   0.962   0.965   0.968   0.971   0.974   0.977    0.98
 70          PC   0.983   0.986   0.989   0.992   0.995   0.998     1.0
 71          IN      15 01JAN94       0
 72          JD   3.818    20.0
             * 24-hour distribution
 73          PC     0.0   0.002   0.005   0.008   0.011   0.014   0.017    0.02   0.023   0.026
 74          PC   0.029   0.032   0.035   0.038   0.041   0.044   0.048   0.052   0.056    0.06
 75          PC   0.064   0.068   0.072   0.076    0.08   0.085    0.09   0.095     0.1   0.105
 76          PC    0.11   0.115    0.12   0.126   0.133    0.14   0.147   0.155   0.163   0.172
 77          PC   0.181   0.191   0.203   0.218   0.236   0.257   0.283   0.387   0.663   0.707
 78          PC   0.735   0.758   0.776   0.791   0.804   0.815   0.825   0.834   0.842   0.849
 79          PC   0.856   0.863   0.869   0.875   0.881   0.887   0.893   0.898   0.903   0.908
 80          PC   0.913   0.918   0.922   0.926    0.93   0.934   0.938   0.942   0.946    0.95
 81          PC   0.953   0.956   0.959   0.962   0.965   0.968   0.971   0.974   0.977    0.98
 82          PC   0.983   0.986   0.989   0.992   0.995   0.998     1.0
 83          IN      15 01JAN94       0
 84          JD   3.689    40.0
             * 24-hour distribution
 85          PC     0.0   0.002   0.005   0.008   0.011   0.014   0.017    0.02   0.023   0.026
 86          PC   0.029   0.032   0.035   0.038   0.041   0.044   0.048   0.052   0.056    0.06
 87          PC   0.064   0.068   0.072   0.076    0.08   0.085    0.09   0.095     0.1   0.105
 88          PC    0.11   0.115    0.12   0.126   0.133    0.14   0.147   0.155   0.163   0.172
 89          PC   0.181   0.191   0.203   0.218   0.236   0.257   0.283   0.387   0.663   0.707
 90          PC   0.735   0.758   0.776   0.791   0.804   0.815   0.825   0.834   0.842   0.849
 91          PC   0.856   0.863   0.869   0.875   0.881   0.887   0.893   0.898   0.903   0.908
 92          PC   0.913   0.918   0.922   0.926    0.93   0.934   0.938   0.942   0.946    0.95
 93          PC   0.953   0.956   0.959   0.962   0.965   0.968   0.971   0.974   0.977    0.98
 94          PC   0.983   0.986   0.989   0.992   0.995   0.998     1.0
 95          IN      15 01JAN94       0
 96          JD   3.565    80.0
             * 24-hour distribution
 97          PC     0.0   0.002   0.005   0.008   0.011   0.014   0.017    0.02   0.023   0.026
 98          PC   0.029   0.032   0.035   0.038   0.041   0.044   0.048   0.052   0.056    0.06
```

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 99          PC   0.064   0.068   0.072   0.076    0.08   0.085    0.09   0.095     0.1   0.105
100          PC    0.11   0.115    0.12   0.126   0.133    0.14   0.147   0.155   0.163   0.172
101          PC   0.181   0.191   0.203   0.218   0.236   0.257   0.283   0.387   0.663   0.707
102          PC   0.735   0.758   0.776   0.791   0.804   0.815   0.825   0.834   0.842   0.849
103          PC   0.856   0.863   0.869   0.875   0.881   0.887   0.893   0.898   0.903   0.908
104          PC   0.913   0.918   0.922   0.926    0.93   0.934   0.938   0.942   0.946    0.95
1                                          HEC-1 INPUT
PAGE  3

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

105          PC   0.953   0.956   0.959   0.962   0.965   0.968   0.971   0.974   0.977    0.98
106          PC   0.983   0.986   0.989   0.992   0.995   0.998     1.0
107          IN      15 01JAN94       0
108          JD   3.498   120.0
             * 24-hour distribution
109          PC     0.0   0.002   0.005   0.008   0.011   0.014   0.017    0.02   0.023   0.026
110          PC   0.029   0.032   0.035   0.038   0.041   0.044   0.048   0.052   0.056    0.06
111          PC   0.064   0.068   0.072   0.076    0.08   0.085    0.09   0.095     0.1   0.105
112          PC    0.11   0.115    0.12   0.126   0.133    0.14   0.147   0.155   0.163   0.172
113          PC   0.181   0.191   0.203   0.218   0.236   0.257   0.283   0.387   0.663   0.707
114          PC   0.735   0.758   0.776   0.791   0.804   0.815   0.825   0.834   0.842   0.849
115          PC   0.856   0.863   0.869   0.875   0.881   0.887   0.893   0.898   0.903   0.908
116          PC   0.913   0.918   0.922   0.926    0.93   0.934   0.938   0.942   0.946    0.95
117          PC   0.953   0.956   0.959   0.962   0.965   0.968   0.971   0.974   0.977    0.98
118          PC   0.983   0.986   0.989   0.992   0.995   0.998     1.0
119          IN      15 01JAN94       0
120          JD   3.411   200.0
             * 24-hour distribution
121          PC     0.0   0.002   0.005   0.008   0.011   0.014   0.017    0.02   0.023   0.026
122          PC   0.029   0.032   0.035   0.038   0.041   0.044   0.048   0.052   0.056    0.06
123          PC   0.064   0.068   0.072   0.076    0.08   0.085    0.09   0.095     0.1   0.105
124          PC    0.11   0.115    0.12   0.126   0.133    0.14   0.147   0.155   0.163   0.172
125          PC   0.181   0.191   0.203   0.218   0.236   0.257   0.283   0.387   0.663   0.707
126          PC   0.735   0.758   0.776   0.791   0.804   0.815   0.825   0.834   0.842   0.849
127          PC   0.856   0.863   0.869   0.875   0.881   0.887   0.893   0.898   0.903   0.908
128          PC   0.913   0.918   0.922   0.926    0.93   0.934   0.938   0.942   0.946    0.95
129          PC   0.953   0.956   0.959   0.962   0.965   0.968   0.971   0.974   0.977    0.98
130          PC   0.983   0.986   0.989   0.992   0.995   0.998     1.0
131          IN      15 01JAN94       0
132          JD   3.353   300.0
             * 24-hour distribution
133          PC     0.0   0.002   0.005   0.008   0.011   0.014   0.017    0.02   0.023   0.026
134          PC   0.029   0.032   0.035   0.038   0.041   0.044   0.048   0.052   0.056    0.06
135          PC   0.064   0.068   0.072   0.076    0.08   0.085    0.09   0.095     0.1   0.105
136          PC    0.11   0.115    0.12   0.126   0.133    0.14   0.147   0.155   0.163   0.172
137          PC   0.181   0.191   0.203   0.218   0.236   0.257   0.283   0.387   0.663   0.707
138          PC   0.735   0.758   0.776   0.791   0.804   0.815   0.825   0.834   0.842   0.849
139          PC   0.856   0.863   0.869   0.875   0.881   0.887   0.893   0.898   0.903   0.908
140          PC   0.913   0.918   0.922   0.926    0.93   0.934   0.938   0.942   0.946    0.95
141          PC   0.953   0.956   0.959   0.962   0.965   0.968   0.971   0.974   0.977    0.98
142          PC   0.983   0.986   0.989   0.992   0.995   0.998     1.0
143          IN      15 01JAN94       0
144          JD   3.257   500.0
             * 24-hour distribution
145          PC     0.0   0.002   0.005   0.008   0.011   0.014   0.017    0.02   0.023   0.026
146          PC   0.029   0.032   0.035   0.038   0.041   0.044   0.048   0.052   0.056    0.06
147          PC   0.064   0.068   0.072   0.076    0.08   0.085    0.09   0.095     0.1   0.105
148          PC    0.11   0.115    0.12   0.126   0.133    0.14   0.147   0.155   0.163   0.172
149          PC   0.181   0.191   0.203   0.218   0.236   0.257   0.283   0.387   0.663   0.707
150          PC   0.735   0.758   0.776   0.791   0.804   0.815   0.825   0.834   0.842   0.849
151          PC   0.856   0.863   0.869   0.875   0.881   0.887   0.893   0.898   0.903   0.908
152          PC   0.913   0.918   0.922   0.926    0.93   0.934   0.938   0.942   0.946    0.95
153          PC   0.953   0.956   0.959   0.962   0.965   0.968   0.971   0.974   0.977    0.98
154          PC   0.983   0.986   0.989   0.992   0.995   0.998     1.0
             *
             *
             *
             *
             * *** Basin PI680: Mountainous basin located in North of watershed: CP=680
             * *** CP 680 is located at approximately Honda Bow Road and 187th Ave alignments
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PAGE  4

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


 155          KK   PI680
 156          KO       0       0     0.0       1      21
 157          BA  16.887
 158          LG    0.35    0.25   5.858   0.191  30.844
              * PI680
 159          UI     0.0  530.39  884.69 2068.28 3278.38 3999.79 5277.68 5197.06 3429.47 2961.47
 160          UI  2576.9  2215.5 1865.18 1487.75 1270.51 1149.45  907.22  707.05  623.29  570.21
 161          UI  406.63  406.63  271.71  259.55  259.55  171.38  101.66  101.66  101.66  101.66
 162          UI  101.66  101.66  101.66  101.66
              *
              *
              * *** Route 680640: from CP 680 to CP 640 at the CAP.
              * *** Mountainous wash.  This is Picacho Wash.
              * *** CP 640 is located at approximately 187th ave alignment and the CAP Canal.

 163          KK  680640
 164          KO       0       0     0.0       0      21
 165          RS       7    FLOW
 166          RC    0.05   0.064    0.05 45524.0   0.014     0.0
              * Medium Wash
 167          RX       0    1000    2500    3846    4110    4160    4300    7000
 168          RY      10       8       6     5.8       0       0       6      10
              *
              *
              * *** Basin PI640: basin with some urban areas located in east-central part
              * *** of watershed: CP=640.

 169          KK   PI640
 170          KO       0       0     0.0       1      21
 171          BA  17.562
 172          LG   0.337    0.15   7.212   0.114   8.758
              * PI640_NEW
 173          UI     0.0  737.48 2239.28 3840.43 5041.98 7522.05 8271.37 5962.39 4416.49 3082.87
 174          UI  1530.3 1080.12  713.02  226.16  226.16  226.16     0.0
              *
              *
              * *** Combine 640 *** Combines PI640 and 680640 at CP 640

 175          KK     640
 176          KO       0       0     0.0       0      21
 177          HC       2
              *
              *
              * *** Basin WI540: basin with some urban areas located in east-central part
              * *** of watershed: CP=540.
              * *** CP 540 is located at approximately 195th ave alignment and the CAP Canal.

 178          KK   WI540
 179          KO       0       0     0.0       1      21
 180          BA  11.640
 181          LG   0.28     0.25   5.888   0.187  33.223
              * WI540
 182          UI     0.0  479.61 1408.71  2467.3 3220.83 4668.81 5566.38 4008.55 3002.78  2180.2
 183          UI  1101.3   776.0  479.61  207.51  147.08  147.08  147.08     0.0
              *
              *
              * *** Basin PD780: valley basin located in east part of watershed: CP=780.
              * *** CP 780 is located at approximately 163rd ave & carefree highway alignments
1                                                HEC-1 INPUT
PAGE  5

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


 184          KK   PD780
```

```
185          KO       0       0     0.0       1      21
186          BA  19.169
187          LG   0.336    0.25   5.252   0.254  28.226
             * PD780_NEW
188          UI     0.0  921.92 3426.52 5287.12 7504.6110926.62 7886.94 5628.87 3670.47  1701.7
189          UI  1136.8  561.51  282.72  282.72     0.0
             *
             *
             * *** Route 780760: from CP 780 to CP 760 at the CAP.Mountainous wash.
             * *** CP 760 is located at approximately 163rd ave alignment and the CAP canal.

190          KK  780760
191          KO       0       0     0.0       0      21
192          RS       3    FLOW
193          RC    0.05   0.064    0.05   12100   0.010     0.0
             * Medium Wash
194          RX       0    1000    2500    3846    4110    4160    4300    7000
195          RY      10       8       6     5.8       0       0       6      10
             *
             *
             * *** Basin PD760: Slightly urban basin located in east part of watershed: CP=76

196          KK   PD760
197          KO       0       0     0.0       1      21
198          BA  2.7248
199          LG   0.336   0.248   4.330   0.412   7.136
             * PD760
200          UI     0.0 1110.28 3340.52 2005.05  449.67   108.0     0.0
             *
             *
             *
             * *** Basin PD745: foothills basin located in east part of watershed: CP=745.
             * *** CP 745 is located at approximately 155th ave alignment and the CAP canal.

201          KK   PD745
202          KO       0       0     0.0       1      2
203          BA  1.9822
204          LG    0.35    0.25   5.011    0.28  11.865
             * PD745
205          UI     0.0   986.5 2210.72  1045.9  483.49  217.98   95.35   52.86     0.0
             *
             *
             *
             * *** Combine CAP *** Combines 640*, WI540, 780760, PD760 and PD745 at CP CAP

206          KK     CAP
207          KO       0       0     0.0       0      21
208          HC       5
             *
             *
             * *** Storage STOR at CAP canal
1                                          HEC-1 INPUT
PAGE  6

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


209          KK    STOR
210          RS       1    STOR       0
211          SQ       0     698    2229    5188    6380    7215    7985   91005  242535
212          SE    1540    1544    1546    1550    1552    1554    1556    1557    1558
213          SA     4.4    60.5   130.7   348.8     486   625.3   763.8   763.9     764
214          SE    1540    1544    1546    1550    1552    1554    1556    1557    1558
             *
             *
             * The flow from STOR is distributed to ROUTES 640505, 540500, 640600 & 760710.
             * The breakdown of where the flow is distributed to is shown below, with the SQ
             * card being the summation of the flows at any given elevation.
             *
             * ******************************************************************** *ROUTES*
             *     0 *    81 *   238 *   775 *  1000 *  1145 *  1278 * 24974 * 68216 *640505*
```

```
*     0 *    34 *   120 *   476 *   625 *   745 *   799 * 18363 * 50378 *540500*
*     0 *   113 *   346 *  1217 *  1595 *  1885 *  2076 * 26040 * 69638 *640600*
*     0 *   470 *  1525 *  2720 *  3160 *  3440 *  3832 * 21628 * 54303 *760710*
* ---------------------------------------------------------------------------*
* SQ  0 *   698 *  2229 *  5188 *  6380 *  7215 *  7985 * 91005 *242535        *
*                                                                            *
* ***************************************************************************
*
* The flows were calculated based upon the capacities of the overchutes or
* culverts.  Once the culvert capacities (inlet controled) were calculated up
* to the berm elevation (1556), a combined culvert inlet control and weir
* equation were utilized to calculate the flows (1557 & 1558).  2.7 was used for
* the weir coefficient and the weir length was the basin boundary where
* overtopping would occur.
*
*
* *** Diversion: CAP2.  Mainflow to 640505, diverted flow to 540500.
* *** CAP ********************************************************
* This Diversion is for the Impoundment Area upstream of the CAP.
*
*
* DDM   ***** Preserved *****

KK    CAP1
KO       0       0     0.0       0      21
DT    CAP2
* This diversion was calculated on the capacities of the overchutes.
* The overchutes that contribute to route 640505 are CAP 80 to 100.
* The capacities of the culverts in this system can be found in the appendix.
DI       0     698    2229    5188    6380    7215    7985   91005  242535
DQ       0     617    1991    4413    5380    6070    6707   66031  174319
*
*
* *** Route 640505: from CP 640 to CP 505. Valley wash.
* *** CP 505 is located at approximately Happy Valley rd. & 171st ave alignment
```



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

KK  640505
*
* This Route is from the CAP to concentration point 505.
*
KO       0       0     0.0       0      21
RS       6    FLOW
RC    0.08   0.046    0.08 25169.0   0.009     0.0
* Medium Wash
RX       0    1000    2500    3846    4110    4160    4300    7000
RY      10       8       6     5.8       0       0       6      10
*
*
* *** Basin WI505: slightly urban basin located in central part of
* *** watershed: CP=505.

KK   WI505
KO       0       0     0.0       1      21
BA  6.6716
LG   0.349   0.247   4.645   0.354   7.715
* WI505
UI     0.0   312.2 1116.51  1754.2 2431.56 3707.04 2801.09 2033.26 1394.62  663.31
UI  437.06  252.75   95.74   95.74   95.74     0.0
*
* ***************************************************************************
* ***************************************************************************
* Concentration point 505 was hard coded to account for the diverted flow above.
* The area was calculated based upon the peak stage as calculated through HEC-1.
* The peak stage was taken for this culvert system (structures CAP060 to CAP190)
* and the percentage of flow diverted to each concentration point was calculated
* as shown in appendix B.5.  The calculations show that the concentration points
```

```
                 * should receive following distribution of area.                          *
                 *                                                                         *
                 * concentration     percentage     area                                   *
                 *    point             area       (sq mi)                                  *
                 * ----------------------------------------                                *
                 *     505               16%       11.194                                   *
                 *     500               10%        6.997                                   *
                 *     600               26%       18.191                                   *
                 *     710               48%       33.583                                   *
                 * ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~                                *
                 *  SUM OF ALL          100%       69.965                                   *
                 * ***************************************************************************
                 * ***************************************************************************
                 *
                 * *** Combine 505 *** Combines 640505 & WI505 at CP 505.

 232             KK     505
 233             KO       0       0     0.0       0      21
 234             HC       2 17.8656
                 *        17.8656 =
                 *                + 11.1940 (640505-diversion)
                 *                +  6.6716 (WI505)
                 *
                 * *** Route 505500: from CP 505 to CP 500.3 @ McMicken Dam Spillway. Valley wash
                 * *** CP 500.3 is located at the McMicken Dam Spillway.
1                                                HEC-1 INPUT
PAGE  8

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


 235             KK  505500
 236             KO       0       0     0.0       0      21
 237             RS       1    FLOW
 238             RC    0.08   0.046    0.08  5161.0   0.004     0.0
                 * Medium Wash
 239             RX       0    1000    2500    3846    4110    4160    4300    7000
 240             RY      10       8       6     5.8       0       0       6      10
                 *
                 *
                 * *** Basin WT140: Mountain basin located in south portion of watershed: CP=140.
                 * *** CP 140 is located north of the Cactus Rd and 211th Ave aligments.

 241             KK   WT140
 242             KO       0       0     0.0       1      21
 243             BA  3.7989
 244             LG    0.35    0.25   4.093   0.383  19.444
                 * WT140
 245             UI     0.0  189.63  716.34 1293.07 1933.38 1378.87 1023.44  815.74  607.47  458.74
 246             UI  358.34  252.58  202.47  145.39  106.74    92.8   57.72   36.35   36.35   36.35
 247             UI   36.35     0.0
                 *
                 *
                 *
                 * *** Route 140130: from CP 140 to CP 130 at the McMicken Dam. Mountainous wash.
                 * *** CP 130 is located @ McMicken Dam north of Peoria and 195th Ave alignments.

 248             KK  140130
 249             KO       0       0     0.0       0      21
 250             RS       4    FLOW
 251             RC    0.05   0.064    0.05   14043   0.018     0.0
                 * Small Wash
 252             RX       0    1300    1380    1560    1600    1640    1660    1710
 253             RY      11     7.2     5.2     3.3       0     3.2     7.2    13.2
                 *
                 *
                 * *** Basin WT130: Combination basin of Mountain and Foothills.
                 * *** This basin is located in south portion of watershed: CP=130.

 254             KK   WT130
 255             KO       0       0     0.0       1      21
```

```
256          BA  2.5413
257          LG    0.35    0.25   4.731   0.281  10.926
             * THIS S-GRAPH WAS CALCULATED MANUALLY (SEE APPENDIX) *
             * Combined S-Graph for Basin WT130: Phoenix Valley:51%, Phoenix Mountain:49%
             * Basin Area [sq mi] = 2.5413
             * Basin Lag [hr] = 0.94
             * Time Step [min] = 15
             * Qult = 6559.9
             *
258          UI       0   194.2     705  1137.3  1543.8  1013.3   710.4   480.7   286.8   181.2
259          UI   117.1    73.9      36      36      36       0
             *
             *
             * *** Combine 130 *** Combines 140130 and WT130.
1                                          HEC-1 INPUT
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LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


260          KK     130
261          KO       0       0     0.0       0      21
262          HC       2
             *
             *
             * *** Route 130120: from CP130 to CP120 along McMicken Dam. McMicken Dam Channel
             * *** CP 120 is located south of Cactus Rd & 195th Ave alignments @ McMicken Dam

263          KK  130120
264          KO       0       0     0.0       0      21
265          RS       1    FLOW
266          RC   0.045   0.035    .045    1225   0.001     0.0
             * McMicken Dam Channel
267          RX       0      46     101     121     171     181    1421    3621
268          RY      25      14       4       0       0       4      14      25
             *
             *
             * *** Basin WT150: Mountain basin located in south portion of watershed: CP=150.
             * *** CP 150 is located north of the Waddell Rd and 211th Ave alignments.

269          KK   WT150
270          KO       0       0     0.0       1      21
271          BA  5.8463
272          LG    0.35    0.25   4.085   0.384  19.216
             * WT150
273          UI     0.0  241.41   653.6 1376.47 1859.31 2614.97 1671.65 1337.57 1114.33   904.5
274          UI  676.83  565.08  453.31  333.61  276.02  217.23  185.08  120.56  118.14   88.75
275          UI   46.27   46.27   46.27   46.27   46.27   46.27     0.0
             *
             *
             * *** Route 150120: from CP 150 to CP 120 at the CAP. Mountainous wash.
             * *** CP 120 is located @ McMicken Dam north of Cactus Rd & 187th Ave alignments

276          KK  150120
277          KO       0       0     0.0       0      21
278          RS       4    FLOW
279          RC    0.05   0.064    0.05 14187.0   0.013     0.0
             * Small Wash
280          RX       0    1300    1380    1560    1600    1640    1660    1710
281          RY      11     7.2     5.2     3.3       0     3.2     7.2    13.2
             *
             *
             * *** Basin WT160: Mountain basin located in south portion of watershed: CP=160
             * *** CP 160 is located south of Waddell Rd and 211th Ave alignments

282          KK   WT160
283          KO       0       0     0.0       1      21
284          BA  0.8167
285          LG    0.35    0.25   4.395   0.334  17.796
             * WT160
286          UI     0.0  166.64  599.46   563.9  323.31   189.8  109.78    67.4   38.83    19.0
```

```
 287          UI   14.67   14.67
              *
              *
              *
              * *** Route 160120: from CP 160 to CP 120 at McMicken Dam. Mountainous wash.
1                                          HEC-1 INPUT
PAGE 10

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


 288          KK  160120
 289          KO       0       0     0.0       0      21
 290          RS       5    FLOW
 291          RC    0.05   0.064    0.05 14018.0   0.015     0.0
              * Small Wash
 292          RX       0    1300    1380    1560    1600    1640    1660    1710
 293          RY      11     7.2     5.2     3.3       0     3.2     7.2    13.2
              *
              *
              * *** Basin WT120: Valley basin located in south portion of watershed: CP=120

 294          KK   WT120
 295          KO       0       0     0.0       1      21
 296          BA  2.8156
 297          LG    0.35    0.25   5.264   0.243   3.934
              *
              * Phoenix Valley S-Graph for Basin WT120
              * Basin Area [sq mi] = 2.8156
              * Basin Lag [hr] = 0.5
              * Time Step [min] = 15
              * Qult = 7268
              *
 298          UI       0   872.2  2761.8  2474.2   862.8   202.8       0
              *
              *
              *
              * *** Combine 120 *** Combines 150120, 160120 & WT120

 299          KK     120
 300          KO       0       0     0.0       0      21
 301          HC       3
              *
              *
              * *** Combine 120* *** Combines 120 and 130120

 302          KK    120*
 303          HC       2
              *
              *
              * *** Route 120110: from CP 120 to CP 110 along McMicken Dam Channel.
              * *** CP 110 is located @ McMicken Dam Channel North of Waddell Rd and 187th Ave

 304          KK  120110
 305          KO       0       0     0.0       0      21
 306          RS       4    FLOW
 307          RC   0.045   0.035   0.045   10283   0.001     0.0
              * McMicken Dam Channel
 308          RX       0      46     101     121     171     181    1421    3621
 309          RY      25      14       4       0       0       4      14      25
              *
              *
              * *** Basin WT110: Foothills basin located in south portion of watershed: CP=110
1                                          HEC-1 INPUT
PAGE 11

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


 310          KK   WT110
 311          KO       0       0     0.0       1      21
```

```
312          BA  2.8956
313          LG    0.35    0.25   4.792   0.284   7.155
             * WT110
314          UI     0.0  846.92 2752.89  1740.0  985.45  540.16  291.19  161.26   64.91   60.46
315          UI     0.0
             *
             *
             * *** Combine 110 *** Combines 120* & WT110

316          KK     110
317          KO       0       0     0.0       0      21
318          HC       2
             *
             *
             * *** Route 110100: from CP 110 to CP 100 along McMicken Dam Channel.
             * *** CP 100 is located at McMicken Dam Channel at Greenway Rd and 187th Ave.

319          KK  110100
320          KO       0       0     0.0       0      21
321          RS       1    FLOW
322          RC   0.045   0.035   0.045    2465   0.001     0.0
             * McMicken Dam Channel
323          RX       0      46     101     121     171     181    1421    3621
324          RY      25      14       4       0       0       4      14      25
             *
             *
             * *** Basin WT100: Combination basin of Foothills and Valley.
             * *** THis basin is in the south portion of the watershed: CP=100.

325          KK   WT100
326          KO       0       0     0.0       1      21
327          BA  3.8448
328          LG   0.349    0.25   4.571   0.318  16.009
             * THIS S-GRAPH WAS CALCULATED MANUALLY (SEE APPENDIX) *
             * Combined S-Graph for Basin WT100: Phoenix Valley:67%, Phoenix Mountain:33%
             * Basin Area [sq mi] = 3.8448
             * Basin Lag [hr] = 0.86
             * Time Step [min] = 15
             * Qult = 9924.7
             *
329          UI       0   362.9  1255.2  2098.8  2415.5  1543.4   987.6   551.8   317.7   186.6
330          UI    68.6    64.2    64.2       0
             *
             *
             *
             * *** Combine 100 *** Combines 110100 & WT100
1                                          HEC-1 INPUT
PAGE 12

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


331          KK     100
332          KO       0       0     0.0       0      21
333          HC       2
             *
             *
             * *** Route 100400: from CP 100 to CP 400 along McMicken Dam Channel.
             * *** CP 400 is located @ McMicken Dam Channel @ Union Hills Drive and 187th Ave

334          KK  100400
335          KO       0       0     0.0       0      21
336          RS       8    FLOW
337          RC   0.045   0.035   0.045   12851   0.001     0.0
             * McMicken Dam Channel
338          RX       0      46     101     121     171     181    1421    3621
339          RY      25      14       4       0       0       4      14      25
             *
             *
             * *** Basin IW350: foothills basin located in NW portion of watershed: CP=350.
             * *** CP 350 is located North of Circle Mountain Rd and 243rd Ave aligments.
```

```
340          KK   IW350
341          KO       0       0     0.0       1      21
342          BA  4.2081
343          LG    0.35   0.232   6.183   0.172  16.489
             * IW350
344          UI     0.0  849.51 3050.45 2921.47 1672.13  981.75  573.23  349.61  202.91  102.19
345          UI   75.23   75.23     0.0
             *
             *
             * *** Route 350310: from CP 350 to CP310: Mountainous wash. This is Iona Wash.
             * *** CP 310 is located at CAP North of Happy Valley Rd and west of 227th Ave.

346          KK  350310
347          KO       0       0     0.0       0      21
348          RS      22    FLOW
349          RC    0.05   0.064    0.05 77773.0   0.009     0.0
             * Medium Wash
350          RX       0    1000    2500    3846    4110    4160    4300    7000
351          RY      10       8       6     5.8       0       0       6      10
             *
             *
             * *** Basin IW310: Less urban basin located west portion of watershed: CP=310

352          KK   IW310
353          KO       0       0     0.0       1      21
354          BA  25.814
355          LG    0.34    0.15   7.293    0.11   7.655
             * IW310
356          UI     0.0  689.21  793.68 2444.89 3317.73 3946.42 4700.23 5756.22 8106.57 7995.44
357          UI  6297.8  5316.6 4354.66 3594.68 2811.74 1672.93 1192.21 1072.51  689.21  593.07
358          UI  211.36  211.36  211.36  211.36  211.36  211.36     0.0
             *
             *
             * *** Combine 310 *** Combines 350310 & IW310
                                          HEC-1 INPUT
PAGE 13

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


359          KK     310
360          KO       0       0     0.0       0      21
361          HC       2
             *
             *
             * *** Storage CAP020 *** This storage is located at CP 310 at the CAP Canal.

362          KK  CAP020
363          KO                                      21
364          RS       1    STOR       0
             * CAP 020, R-8 STA 572+50
             * THE WEIR LENGTH IS 3700 FT WEIR COEF = 2.7
             * THE WEIR FLOW WAS CALCULATED FOR H = 1 FT (1554) AND H = 2 FT (1555)
365          SQ       0       0    94.3   662.1  1502.9  2001.8   11992   30258
366          SE    1546  1547.3    1548    1550    1552    1553    1554    1555
367          SA     5.5    13.6    17.9      67    99.2   118.3   118.4   118.5
368          SE    1546  1547.3    1548    1550    1552    1553    1554    1555
             *
             *
             * *** Route 310200: from CP 310 to CP 200: Valley wash. This is Iona Wash.
             * *** CP 200 is located south of Beardsley Rd and 203rd Ave alignments.

369          KK  310200
370          KO       0       0     0.0       0      21
371          RS       4    FLOW
372          RC    0.08   0.046    0.08 24622.0   0.005     0.0
             * Large Wash
373          RX       0     465    1225    1925    2325    2405    4225    6225
374          RY      10       4       2       0       0       2       8      10
             *
```

```
                 *
                 * *** Basin SV220: Less urban basin located in west portion of watershed: CP=220
                 * *** CP 220 is located @ CAP Canal south of Happy Valley Rd & west of 235th Ave

375              KK   SV220
376              KO       0       0     0.0       1      21
377              BA  16.953
378              LG   0.342   0.149    7.51   0.102   5.803
                 * SV220
379              UI     0.0  707.39 2124.71  3669.0 4806.37 7097.06 8040.46 5781.67  4297.4 3047.67
380              UI  1516.3 1070.46  707.39  230.76  216.93  216.93  216.93
                 *
                 *
                 * *** Storage CAP010 *** This storage is located at CP 220 at the CAP Canal.

381              KK  CAP010
382              KO                                      21
383              RS       1    STOR       0
                 * CAP 010, R-8 STA 466+00
                 * THE WEIR LENGTH IS 7900 FT AND THE WEIR COEFF = 2.7
                 * THE WEIR FLOW WAS CALCULATED FOR H = 1 FT (1547.2) AND H = 2 FT (1548.2)
384              SQ       0       0       0       0       0    68.8   808.3  1962.4  3413.7  5110.5
385              SQ  5291.2   26621   65621
386              SE    1530    1532    1534    1536  1537.5    1538    1540    1542    1544    1546
1                                                HEC-1 INPUT
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LINE             ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

387              SE  1546.2  1547.2  1548.2
388              SA      .1     .25      .5     1.9     9.9    12.5    26.5    59.2   117.5     184
389              SA   191.9     192   192.1
390              SE    1530    1532    1534    1536  1537.5    1538    1540    1542    1544    1546
391              SE  1546.2  1547.2  1548.2
                 *
                 *
                 * *** Route 220200: from CP 220 to CP 200: Valley wash.

392              KK  220200
393              KO       0       0     0.0       0      21
394              RS       6    FLOW
395              RC    0.08   0.046    0.08 26218.0   0.004     0.0
                 * Medium Wash
396              RX       0    1000    2500    3846    4110    4160    4300    7000
397              RY      10       8       6     5.8       0       0       6      10
                 *
                 *
                 * *** Basin TW480: Mountain basin located in north portion of watershed: CP=480
                 * *** CP 480 is located just North of T7N & T6N boundary and west of 227th Ave.

398              KK   TW480
399              KO       0       0     0.0       1      21
400              BA  12.724
401              LG    0.35   0.227   6.229   0.169   31.82
                 * TW480
402              UI     0.0  413.47  732.23 1716.58 2619.87 3204.59 4470.41 3523.69 2552.37  2215.0
403              UI  1916.9 1641.31 1332.45 1056.04  952.84  798.76  620.72  517.42  452.85  358.59
404              UI   317.0  245.75  202.34  202.34  156.22   79.25   79.25   79.25   79.25   79.25
405              UI   79.25   79.25     0.0
                 *
                 *
                 * *** Route 480460: from CP 480 to CP 460: Mountain wash.  This is Trilbey Wash.
                 * *** CP 460 is located North of Rockaway Hills Rd & west of 235th Ave Alignment

406              KK  480460
407              KO       0       0     0.0       0      21
408              RS       3    FLOW
409              RC    0.05   0.064    0.05 18660.0   0.017     0.0
                 * Small Wash
410              RX       0    1300    1380    1560    1600    1640    1660    1710
411              RY      11     7.2     5.2     3.3       0     3.2     7.2    13.2
```

```
                 *
                 *
                 * *** Basin TW460: Valley Basin located in Northwest portion of watershed.

 412             KK   TW460
 413             KO       0       0     0.0       1      21
 414             BA  2.4410
 415             LG   0.349    0.25    5.72     0.2    6.85
                 * TW460
 416             UI     0.0  447.26 1592.55 1756.92  995.49  598.04   368.0  220.24  132.07   80.94
 417             UI   41.74   41.74     0.0
                 *
                 *
                 * *** Combine 460 *** Combines 480460 & TW460.
1                                                HEC-1 INPUT
PAGE 15

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


 418             KK     460
 419             KO       0       0     0.0       0      21
 420             HC       2
                 *
                 *
                 * *** Route 460420: from CP 460 to CP 420: Mountain wash.  This is Trilbey Wash.
                 * *** CP 420 is located at CAP Canal south of Jomax Rd and east of 227th Ave.

 421             KK  460420
 422             KO       0       0     0.0       0      21
 423             RS      12    FLOW
 424             RC    0.05   0.064    0.05 53954.0    0.01     0.0
                 * Medium Wash
 425             RX       0    1000    2500    3846    4110    4160    4300    7000
 426             RY      10       8       6     5.8       0       0       6      10
                 *
                 *
                 * *** Basin TW420: Less urban basin west-cetral portion of watershed.

 427             KK   TW420
 428             KO       0       0     0.0       1      21
 429             BA  10.893
 430             LG   0.341    0.25   5.699   0.209   6.912
                 * TW420
 431             UI     0.0  403.97 1006.02 1907.36 2457.49 3202.52 4824.48 4097.17 3152.55 2414.17
 432             UI  1805.2  950.38  678.69  440.76  273.39  123.88  123.88  123.88  123.88     0.0
                 *
                 *
                 *
                 * *** Combine 420 *** Combines 460420 & TW420.

 433             KK     420
 434             KO       0       0     0.0       0      21
 435             HC       2
                 *
                 *
                 * *** Storage CAP030 *** This storage is located at the CAP Canal at CP 420.

 436             KK  CAP030
 437             KO                                      21
 438             RS       1    STOR       0
                 * CAP 030, R-8 STA 609+00
 439             SQ       0  429.56 2188.44 4690.08    6223  7755.9    9526 11296.3
 440             SE    1547    1548    1550    1552    1553    1554    1555    1556
 441             SA      .3      .7     2.1       6      10      10   13.05    16.1
 442             SE    1547    1548    1550    1552    1553    1554    1555    1556
                 *
                 *
                 * *** Route 420200: from CP 420 to CP 200: Valley Wash.  This is Trilbey Wash.
                                                  HEC-1 INPUT
PAGE 16
```

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

 443          KK  420200
 444          KO       0       0     0.0       0      21
 445          RS      12    FLOW
 446          RC    0.08   0.046    0.08 26213.0   0.005     0.0
              * Medium Wash
 447          RX       0    1000    2500    3846    4110    4160    4300    7000
 448          RY      10       8       6     5.8       0       0       6      10
              *
              *
              *

 449          KK   SV200
 450          KO       0       0     0.0       1      21
 451          BA  31.326
 452          LG   0.342   0.248   5.368   0.228   7.735
              *
              * THIS S-GRAPH WAS GENERATED MANUALLY (SEE APPENDIX) *
              * Combined S-Graph for Basin SV200: Phoenix Valley:70%, Phoenix Mountain:30%
              * Basin Area [sq mi] = 31.326
              * Basin Lag [hr] = 2.2
              * Time Step [min] = 15
              * Qult = 80862.4
              *
 453          UI       0     799     799  2658.2  3709.1  4618.2  5419.9  6497.5  8799.7  8649.4
 454          UI  6742.8  5756.1  4993.6  4189.3  3432.1  2937.8  2408.2  1757.3    1258  1083.4
 455          UI   977.5     662   608.5   529.4   207.7   207.7   207.7   207.7   207.7   207.7
 456          UI   207.7       0
              *
              *
              *
              * *** Combine 200 *** Combines 310200, 220200 & 420200 SV200

 457          KK     200
 458          KO       0       0     0.0       0      21
 459          HC       4
              *
              *
              * *** Route 200400: from CP 200 to CP 400: Valley Wash.  This is Trilbey Wash.

 460          KK  200400
 461          KO       0       0     0.0       0      21
 462          RS       5    FLOW
 463          RC    0.08   0.046    0.08   16311   0.005     0.0
              * Large Wash
 464          RX       0     465    1225    1925    2325    2405    4225    6225
 465          RY      10       4       2       0       0       2       8      10
              *
              *
              *
              * *** Basin TW400: Slightly urban basin located in southwest part of watershed.
1                                          HEC-1 INPUT
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LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 466          KK   TW400
 467          KO       0       0     0.0       1      21
 468          BA  12.988
 469          LG   0.330    0.25   5.215   0.245  12.509
              * TW400
 470          UI     0.0  512.19 1402.98 2550.53 3293.94  4549.4 6195.06 4613.14 3536.26 2651.18
 471          UI  1647.5  881.67  649.87  415.35  157.07  157.07  157.07     0.0
              *
              *
              *
              * *** Combine 400 *** Combines 200400 & TW400.
```

```
472          KK     400
473          KO       0       0     0.0       0      21
474          HC       2
             *
             *
             * *** Combine 400* *** Combines 100400 & 400.

475          KK    400*
476          KO       0       0     0.0       0      21
477          HC       2
             *
             *
             * *** Route 400510: from CP 400 to CP 510 along McMicken Dam Channel.
             * *** CP 510 is located at McMicken Dam Channel at Beardsley Rd and 171st Ave.

478          KK  400510
479          KO       0       0     0.0       0      21
480          RS       1    FLOW
481          RC   0.045   0.035   0.045  2671.0   0.001     0.0
             * McMICKEN DAM CHANNEL
482          RX       0      46     101     121     171     181    1421    3621
483          RY      25      14       4       0       0       4      14      25
             *
             *
             * *** Basin WI580: Less urban basin located in the central portion of watershed

484          KK   WI580
485          KO       0       0     0.0       1      21
486          BA  30.346
487          LG   0.339   0.182   6.675   0.143   8.718
             * WI580
488          UI     0.0  912.94 1505.34 3600.13 4761.14 5747.77 7107.6310110.8210748.08 8226.59
489          UI  6779.2 5421.02  4335.0 2888.56  1606.3 1480.71  912.94  712.63  279.97  279.97
490          UI  279.97  279.97  279.97     0.0
             *
             *
             *
             * *** Storage CAP040 *** This storage is located at the CAP Canal at CP 580.
             * *** CP 580 is located at CAP Canal south of Patton Rd and west of 211th Ave.
1                                          HEC-1 INPUT
PAGE 18

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


491          KK  CAP040
492          KO       0       0     0.0       0      21
493          RS       1    STOR       0
             * CAP 040, R-8 STA 688+00
             * THE WEIR LENGTH IS 5100 FT AND THE WEIR COEF - 2.7
             * THE WEIR FLOW WAS CALCULATED AT H = 1 FT (1553.7) AND H = 2 FT (1554.7)
494          SQ       0       0       0       0       0  366.58 1559.96 3214.13 3880.54   17650
495          SQ   42827
496          SE    1540    1542    1544    1546 1546.77    1548    1550    1552  1552.7  1553.7
497          SE  1554.7
498          SA      .5     1.6       3    22.1    37.1    61.1   105.1   160.8   181.3   181.4
499          SA   181.5
500          SE    1540    1542    1544    1546 1546.77    1548    1550    1552  1552.7  1553.7
501          SE  1554.7
             *
             *
             * *** Route 580510: from CP 580 to CP510: Valley Wash

502          KK  580510
503          KO       0       0     0.0       0      21
504          RS       7    FLOW
505          RC    0.08   0.046    0.08 39351.0   0.005     0.0
             * Large Wash
506          RX       0     465    1225    1925    2325    2405    4225    6225
507          RY      10       4       2       0       0       2       8      10
```

```
                    *
                    *
                    * *** Basin WI510:Slightly urban basin located in southcentral part of watershed

508                 KK   WI510
509                 KO       0       0     0.0       1      21
510                 BA  9.3124
511                 LG   0.302   0.248   5.804   0.204  18.286
                    *
                    * Phoenix Valley S-Graph for Basin WI510
                    * Basin Area [sq mi] = 9.3124
                    * Basin Lag [hr] = 1.73
                    * Time Step [min] = 15
                    * Qult = 24038.3
                    *
512                 UI       0   302.1     584  1277.6  1658.2  2052.2  2671.6  3751.4  2996.3  2398.5
513                 UI  1900.4  1499.9  1011.7   535.5   473.2   302.1   191.7    92.6    92.6    92.6
514                 UI    92.6       0
                    *
                    *
                    *
                    *
                    * *** Combine 510 *** Combines 580510 & WI510.
1                                                HEC-1 INPUT
PAGE 19

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


515                 KK     510
516                 KO       0       0     0.0       0      21
517                 HC       2
                    *
                    * *** Combine 510* *** Combines 400510 & 510.

518                 KK    510*
519                 KO       0       0     0.0       0      21
520                 HC       2
                    *
                    *
                    * *** Route 510500: from CP 510 to CP 500.2 along McMicken Dam Channel.
                    * *** CP 500.2 is located North of Beardsley Rd and East of 179th Ave.

521                 KK  510500
522                 KO       0       0     0.0       0      21
523                 RS       2    FLOW
524                 RC   0.045   0.035   0.045  7342.0   0.001     0.0
                    * McMICKEN DAM CHANNEL
525                 RX       0      46     101     121     171     181    1421    3621
526                 RY      25      14       4       0       0       4      14      25
                    *
                    *
                    * *** Basin WI520: Less Urban Basin located in central portion of watershed.

527                 KK   WI520
528                 KO       0       0     0.0       1      21
529                 BA  16.390
530                 LG   0.321    0.25   5.691   0.207  20.375
                    * WI520
531                 UI     0.0  572.64 1279.07 2574.95 3324.27 4197.33 6065.25 6650.63  4957.5 3910.12
532                 UI  3031.2 2108.55 1109.31  899.49  572.64  320.74  175.61  175.61  175.61  175.61
533                 UI     0.0
                    *
                    *
                    * *** Storage CAP050 *** This storage is located at the CAP Canal at CP 520.
                    * *** CP 520 is located at the CAP Canal at Dixileta Dr and 203rd Ave aligments.
                    *
                    * THIS STORAGE WAS REMOVED DUE TO COMPUTATIONAL INSTABILITY.
                    * THIS COULD BE CORRECTED BY DECREASING THE COMPUTATION INTERVAL
                    * BUT DUE TO THE USE OF S-GRAPHS NO CHANGE IN THE COMPUTATION INTERVAL
                    * COULD BE MADE.
```

```
                    *
                    * KKCAP050
                    * KO                                    21
                    * RS     1    STOR       0
                    * CAP 050, R-8 STA 804+50
                    * THE WEIR LENGTH IS 4100 FT AND THE WEIR COEF - 2.7
                    * THE WEIR FLOW WAS CALCULATED AT H = 1 FT (1554) AND H = 2 FT (1555)
                    * SQ   0.0  1075.5  2314.3  3832.8  4683.6   14900   35141
                    * SE  1546    1548    1550    1552    1553    1554    1555
                    * SA    .1      .7    11.5    35.3      54    54.1    54.2
                    * SE  1546    1548    1550    1552    1553    1554    1555
                    *
                    *
                    * *** Route 520500: from CP 520 to CP 500.1: Valley Wash.
                    * *** CP 500.1 is located North of Beardsley Rd and East of 179th Ave.
                    * *** CP 500.1 and 500.2 are located at the same location.
1                                          HEC-1 INPUT
PAGE 20

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


       534          KK  520500
       535          KO       0       0     0.0       0      21
       536          RS       8    FLOW
       537          RC    0.08   0.046    0.08 34143.0   0.006     0.0
                    * Medium Wash
       538          RX       0    1000    2500    3846    4110    4160    4300    7000
       539          RY      10       8       6     5.8       0       0       6      10
                    *
                    *
                    * *** Diversion Recover CAP ************************************
                    * Recovers flows from CAP impoundment area

       540          KK    CAP2
       541          DR    CAP2
                    *
                    * *** CAP ******************************************************
                    * This diversion is for the Impoundment area upstream of the CAP.
                    *
                    *
                    * DDM   *****PRESERVED*****

       542          KK    CAP2
       543          KO       0       0       0       0      21
       544          DT    CAP3
                    * This diversion was calculated on the capacities of the overchutes.
                    * The overchutes that contribute to route 540500 are CAP 60 & 70.
                    * The capacities of the culverts in this system can be found in the appendix.
       545          DI       0     617    1991    4413    5380    6070    6707   66031  174319
       546          DQ       0     583    1871    3937    4755    5325    5908   47668  123941
                    *
                    *
                    * *** Route 540500: from CP 540 to CP 500.1: Valley Wash.

       547          KK  540500
       548          KO       0       0       0       0      21
       549          RS       9    FLOW
       550          RC    0.08   0.046    0.08 32882.0   0.007       0
                    * Medium Wash
       551          RX       0    1000    2500    3846    4110    4160    4300    7000
       552          RY      10       8       6     5.8       0       0       6      10
                    *
                    *
                    * *** Basin WI500:Slightly Urban Basin located in southcentral part of watershed

       553          KK   WI500
       554          KO       0       0     0.0       1      21
       555          BA  9.1574
       556          LG   0.329   0.247   5.232   0.254   8.075
                    * Phoenix Valley S-Graph for Basin WI500
```

```
                    * Basin Area [sq mi] = 9.1574
                    * Basin Lag [hr] = 1.48
                    * Time Step [min] = 15
                    * Qult = 23638.2
                    *
1                                          HEC-1 INPUT
PAGE 21

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

 557                UI       0   347.2   896.5  1670.8  2152.3  2859.1  4212.7  3365.2  2597.2  1969.1
 558                UI  1400.5   720.7   544.7   347.2   163.6   106.5   106.5   106.5       0
                    *
                    *
                    *
                    * This concentration point is hard-coded to account for 10% of the split
                    * at the CAP (See Appendix and note above concentration point 505).
                    * *** Combine 500.1 *** Combines 520500, 540500 & WI500.

 559                KK   500.1
 560                KO       0       0     0.0       0      21
 561                HC       3 32.5444
                    *        32.5444 =  16.3900 (520500)
                    *                +   6.9970 (540500-diversion)
                    *                +   9.1574 (WI500)
                    *
                    *
                    *
                    * *** Combine 500.2 *** Combines 510500 & 500.1.

 562                KK   500.2
 563                KO       0       0     0.0       0      21
 564                HC       2
                    *
                    *
                    *
                    * *** Route 500500: This route is contained along the McMicken Dam Channel in
                    * ***               Basin WI500, and routes concentration point 500.2 to
                    * ***               concentration point 500.3.

 565                KK  500500
 566                KO       0       0     0.0       0      21
 567                RS       1    FLOW
 568                RC   0.045   0.035   0.045  2214.0   0.001     0.0
                    * McMICKEN DAM CHANNEL
 569                RX       0      46     101     121     171     181    1421    3621
 570                RY      25      14       4       0       0       4      14      25
                    *
                    *
                    *
                    * Concentration POInt 500.3 is the McMicken Dam Spillway
                    * *** Combine 500.3 *** Combines 500500 & 505500.

 571                KK   500.3
 572                KO       0       0     0.0       0      21
 573                HC       2
                    *
                    *
                    *
                    * *** Route 500600: from CP 500 to CP 600 along McMicken Dam Outlet Channel.
                    * *** CP 600 is located at McMicken Dam Outlet Channel south of Happy Valley Rd.
                    * *** and 147th Ave alignments.
1                                          HEC-1 INPUT
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LINE                ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 574                KK  500600
 575                KO       0       0     0.0       0      21
 576                RS       3    FLOW
```

```
577          RC   0.045   0.035   0.045 18203.0   0.001     0.0
             * McMICKEN DAM CHANNEL
578          RX       0      46     101     121     171     181    1421    3621
579          RY      25      14       4       0       0       4      14      25
             *
             *
             * *** Basin PI600: Slightly Urban Basin located in southeast part of watershed.

580          KK   PI600
581          KO       0       0     0.0       1      21
582          BA  12.033
583          LG   0.315   0.247   4.635   0.342  11.728
             * PI600
584          UI     0.0  540.35 1821.67 2946.35 3969.05 6261.74 5234.94 3836.18 2769.89 1504.77
585          UI  910.08  549.84  232.03  165.71  165.71     0.0
             *
             *
             *
             * *** Diversion Recover CAP ***********************************
             * Recovers flows from CAP impoundment area

586          KK    CAP3
587          DR    CAP3
             *
             * *** CAP *******************************************************
             * This diversion is for the Impoundment area upstream of the CAP.
             *
             *
             * DDM   *****PRESERVED*****

588          KK    CAP3
589          KO       0       0     0.0       0      21
590          DT    CAP4
             *
             * This diversion was calculated on the capacities of the overchutes.
             * The overchutes that contribute to route 640600 are CAP 110 to 150.
             * The capacities of the culverts in this system can be found in the appendix.
591          DI       0     583    1871    3937    4755    5325    5908   47668  123941
592          DQ       0     470    1525    2720    3160    3440    3832   21628   54303
             *
             *
             * *** Route 640600: from CP 640 to CP 600: Valley Wash.

593          KK  640600
594          KO       0       0     0.0       0      21
595          RS       9    FLOW
596          RC    0.08   0.046    0.08 31873.0   0.007     0.0
             * Medium Wash
597          RX       0    1000    2500    3846    4110    4160    4300    7000
598          RY      10       8       6     5.8       0       0       6      10
             *
             *
             * *** Combine 600 *** Combines PI600 & 640600.
1                                          HEC-1 INPUT
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LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


599          KK     600
600          KO       0       0     0.0       0      21
             *
             * This concentration point is hard-coded to account for 26% of the split
             * at the CAP (See Appendix and note above concentration point 505).
             *
601          HC       2 30.2230
             *        30.2230 =
             *                + 12.0330 (PI600)
             *                + 18.1910 (640600-diversion)
             *
             *
```

```
                 *
                 * *** Combine 600* *** Combines 500600 & 600

602              KK    600*
603              KO       0       0     0.0       0      21
604              HC       2
                 *
                 *
                 *
                 * *** Route 600710: from CP 600 to CP 710 along McMicken Dam Outlet Channel
                 * *** CP 710 is located along McMIcken Dam Outlet Channel south of Happy Valley
                 * *** Rd. and 139th Ave. alignments.

605              KK  600710
606              KO       0       0     0.0       0      21
607              RS       1    FLOW
608              RC   0.045   0.035   0.045  4403.0   0.001     0.0
                 * McMICKEN DAM CHANNEL
609              RX       0      46     101     121     171     181    1421    3621
610              RY      25      14       4       0       0       4      14      25
                 *
                 *
                 * *** Diversion Recover CAP ************************************
                 * Recovers flows from CAP impoundment area

611              KK    CAP4
612              KO       0       0     0.0       0      21
613              DR    CAP4
                 *
                 * The overchutes that contribute to route 760710 are CAP 160 to 190.
                 * The capacities of the culverts in this system can be found in the appendix.
                 *
                 *
                 * *** Route 760710: from CP 760 to 710: Valley Wash.

614              KK  760710
615              KO       0       0     0.0       0      21
616              RS       5    FLOW
617              RC    0.08   0.046    0.08 28446.0   0.008     0.0
                 * Medium Wash
618              RX       0    1000    2500    3846    4110    4160    4300    7000
619              RY      10       8       6     5.8       0       0       6      10
                 *
                 *
                 * *** Basin PD710: Slightly Urban Basin located in southeast part of watershed.
1                                                HEC-1 INPUT
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LINE             ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


620              KK   PD710
621              KO       0       0     0.0       1      21
622              BA  6.7175
623              LG   0.333   0.245   4.556   0.348    7.16
                 * PD710_NEW
624              UI     0.0  278.61  828.03 1439.46 1882.56 2755.43 3200.47 2300.02  1717.2  1234.6
625              UI  614.69  435.49  278.61   105.0   85.44   85.44   85.44     0.0
                 *
                 *
                 * *** Basin PD 740: foothills basin located in eastcentral part of watershed.

626              KK   PD740
627              KO       0       0     0.0       1      21
628              BA  0.8688
629              LG   0.345   0.246   5.026   0.277   6.818
                 * PD740
630              UI     0.0 1305.48  723.54  170.11   43.03
                 *
                 *
                 * *** Storage CAP200 *** This storage is located at the CAP Canal at CP 740.
```

```
                 * *** CP 740 is located at the CAP Canal at Lone Mountain Rd and 147th Ave.

631              KK  CAP200
632              RS       1    STOR       0
                 * CAP 200, R-8 STA 342+40
                 * THE WEIR LENGTH IS 3800 FT AND THE WEIR COEF - 2.7
                 * THE WEIR FLOW WAS CALCULATED AT H = 1 FT (1542.4) AND H = 2 FT (1543.4)
633              SQ     0.0    25.0   175.0   335.0   440.0   530.0   600.0   620.0   10880   29640
634              SE    1516    1520    1524    1528    1532    1536    1540  1541.4  1542.4  1543.4
635              SA       0       0     1.3     6.0    18.0      40    69.9    80.6    80.7    80.8
636              SE    1516    1520    1524    1528    1532    1536    1540  1541.4  1542.4  1543.4
                 *
                 *
                 * *** Route 740710: from CP 740 to 710: Valley Wash.

637              KK  740710
638              KO       0       0     0.0       0      21
639              RS      11    FLOW
640              RC    0.08   0.046    0.08 27269.0   0.007     0.0
                 * Medium Wash
641              RX       0    1000    2500    3846    4110    4160    4300    7000
642              RY      10       8       6     5.8       0       0       6      10
                 *
                 *
                 * *** Combine 710 *** Combines 760710, PD710 & 740710

643              KK     710
644              KO       0       0     0.0       0      21
                 *
                 * This concentration point is hard-coded to account for 48% of the split
                 * at the CAP (See Appendix and note above concentration point 505).
                 *
                 *
645              HC       3 41.1693
                 *        41.1693 =
                 *                +  33.5830 (760710-diversion)
                 *                +   6.7175 (PD710)
                 *                +   0.8688 (740710)
                 *
                 *
                 * *** Combine 710* *** Combines 600710 & 710.
1                                                HEC-1 INPUT
PAGE 25

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


646              KK    710*
647              KO       0       0     0.0       0      21
648              HC       2
                 *
                 *
                 *
                 * *** Route 710700: from CP 710 to CP 700 along McMicken Dam outlet Channel
                 * *** CP 700 is located at southeast-most point in watershed
                 * *** CP 700 is the Outlet point of the watershed

649              KK  710700
650              KO       0       0     0.0       0      21
651              RS       1    FLOW
652              RC   0.045   0.035   0.045  7571.0   0.001     0.0
                 * McMicken Dam Channel
653              RX       0      46     101     121     171     181    1421    3621
654              RY      25      14       4       0       0       4      14      25
                 *
                 *
                 * *** Basin PD730: mountain basin located in eastcentral portion of watershed.

655              KK   PD730
656              KO       0       0     0.0       1      21
657              BA  0.4765
```

```
658          LG   0.342   0.244   4.406   0.374  30.607
             * PD730
659          UI     0.0  384.95  540.81  193.45   71.19   25.24     0.0
             *
             *
             * *** Storage CAP220 *** This storage is located at the CAP Canal at CP 730.
             * *** CP 730 is located at the CAP Canal at Lone Mountain Rd east of 139th Ave.

660          KK  CAP220
661          KO                                      21
662          RS       1    STOR       0
             * CAP 220, R-8 STA 433+85
             * THE WEIR LENGTH IS 2000 FT AND THE WEIR COEF - 2.7
             * THE WEIR FLOW WAS CALCULATED AT H = 1 FT (1541) AND H = 2 FT (1542)
663          SQ     0.0    28.0   155.0   315.0   425.0   525.0   600.0   670.0    6070 15943.5
664          SE    1512    1516    1520    1524    1528    1532    1536    1540    1541    1542
665          SA       0      .1      .2      .5     4.4    15.4    29.2    29.3    29.4
666          SE    1512    1520    1524    1528    1532    1536    1540    1541    1542
             *
             *
             *
             * *** Basin PD735: mountain basin located in eastcentral portion of watershed.

667          KK   PD735
668          KO       0       0     0.0       1      21
669          BA  3.2311
670          LG   0.349   0.249   4.295   0.415  27.418
             * PD735-Mountain
             * UI    0.0  603.62 1774.11 3033.05 1821.19  713.75  252.36   86.95     0.0
671          UI     0.0  570.26 2032.42 2342.37 1326.24  809.22  505.26  302.41  181.68  117.51
1                                          HEC-1 INPUT
PAGE 26

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

672          UI   54.34   54.34     0.0
             *
             *
             * *** Storage CAP210 *** This storage is located at the CAP Canal at CP 735.
             * *** CP 735 is located @ the CAP Canal @ Lone Mountain Rd and east of 147th Ave

673          KK  CAP210
674          KO       0       0     0.0       0      21
675          RS       1    STOR       0
             * CAP 210, R-8 STA 376+80
             * THE WEIR LENGTH IS 2200 FT AND THE WEIR COEF - 2.7
             * THE WEIR FLOW WAS CALCULATED AT H = 1 FT (1543) AND H = 2 FT (1544)
676          SQ     0.0   372.0  1240.0  1900.0  2480.0  2888.0  3280.0  3600.0  3760.0    9700
677          SQ   20561
678          SE    1512    1516    1520    1524    1528    1532    1536    1540    1542    1543
679          SE    1544
680          SA       0      .3      .8     1.4     2.7     6.5    13.8    22.4      27    27.1
681          SA    27.2
682          SE    1512    1516    1520    1524    1528    1532    1536    1540    1542    1543
683          SE    1544
             *
             *
             * *** Combine 736 *** Combines CAP210 and CAP220

684          KK     736
685          KO       0       0     0.0       0      21
686          HC       2
             *
             * *** Route 735700: from CP 735 to CP 700: mountainous wash.

687          KK  735700
688          KO       0       0     0.0       0      21
689          RS       6    FLOW
690          RC    0.05   0.064    0.05 27046.0   0.008     0.0
             * Small Wash
691          RX       0    1300    1380    1560    1600    1640    1660    1710
```

```
692          RY      11     7.2     5.2     3.3       0     3.2     7.2    13.2
             *
             *
             *
             *
             * *** Basin PD700: Less Urban basin located in southeast portion of watershed.

693          KK   PD700
694          KO       0       0     0.0       1      21
695          BA  7.2631
696          LG   0.336   0.247   5.179   0.255  13.475
             * PD700
697          UI     0.0  655.84 2198.42 3476.21 5214.62 3425.79 2083.76  866.41   464.3  141.21
698          UI  141.21     0.0
             *
             *
             *
             * *** Combine 700 *** Combines Concentration Point 736 & Basin PD700.
1                                          HEC-1 INPUT
PAGE 27

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


699          KK     700
700          KO       0       0     0.0       0      21
701          HC       2
             *
             *
             *
             * *** Combine 700* *** Combines 710700 & 700.

702          KK    700*
703          KO       0       0     0.0       0      21
704          HC       2
             *
705          ZZ
1
```

```
                SCHEMATIC DIAGRAM OF STREAM NETWORK
OUT
LINE      (V) ROUTING          (--->) DIVERSION OR PUMP FLOW

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

155        PI680
               V
               V
163       680640
               .
               .
169            .       PI640
               .           .
               .           .
175          640............
               .
               .
178            .       WI540
               .           .
               .           .
184            .           .       PD780
               .           .           V
               .           .           V
190            .           .      780760
               .           .           .
               .           .           .
196            .           .           .       PD760
               .           .           .           .
               .           .           .           .
201            .           .           .           .       PD745
               .           .           .           .           .
               .           .           .           .           .
206          CAP.............................................
               V
               V
209         STOR
               .
               .
217            .------->    CAP2
215         CAP1
               V
               V
220       640505
               .
               .
226            .       WI505
               .           .
               .           .
232          505............
               V
               V
235       505500
               .
               .
241            .       WT140
               .           V
               .           V
248            .      140130
               .           .
               .           .
254            .           .       WT130
               .           .           .
               .           .           .
260            .         130............
               .           V
               .           V
263            .      130120
               .           .
               .           .
269            .           .       WT150
```

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                .           .           V
                .           .           V
276             .           .      150120
                .           .           .
                .           .           .
282             .           .           .      WT160
                .           .           .          V
                .           .           .          V
288             .           .           .     160120
                .           .           .           .
                .           .           .           .
294             .           .           .           .       WT120
                .           .           .           .           .
                .           .           .           .           .
299             .           .         120.......................
                .           .           .
                .           .           .
302             .        120*............
                .           V
                .           V
304             .      120110
                .           .
                .           .
310             .           .       WT110
                .           .           .
                .           .           .
316             .         110............
                .           V
                .           V
319             .      110100
                .           .
                .           .
325             .           .       WT100
                .           .           .
                .           .           .
331             .         100............
                .           V
                .           V
334             .      100400
                .           .
                .           .
340             .           .       IW350
                .           .           V
                .           .           V
346             .           .      350310
                .           .           .
                .           .           .
352             .           .           .       IW310
                .           .           .           .
                .           .           .           .
359             .           .         310............
                .           .           V
                .           .           V
362             .           .      CAP020
                .           .           V
                .           .           V
369             .           .      310200
                .           .           .
                .           .           .
375             .           .           .       SV220
                .           .           .           V
                .           .           .           V
381             .           .           .      CAP010
                .           .           .           V
                .           .           .           V
392             .           .           .      220200
                .           .           .           .
                .           .           .           .
398             .           .           .           .       TW480
                .           .           .           .           V
                .           .           .           .           V
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406                                   480460
                                          .
                                          .
412                                       .        TW460
                                          .           .
                                          .           .
418                                     460............
                                          V
                                          V
421                                   460420
                                          .
                                          .
427                                       .        TW420
                                          .           .
                                          .           .
433                                     420............
                                          V
                                          V
436                                   CAP030
                                          V
                                          V
443                                   420200
                                          .
                                          .
449                                       .        SV200
                                          .           .
                                          .           .
457                         200.................................
                              V
                              V
460                       200400
                              .
                              .
466                           .       TW400
                              .           .
                              .           .
472                         400............
                              .
                              .
475                     400*............
                          V
                          V
478                   400510
                          .
                          .
484                       WI580
                              V
                              V
491                       CAP040
                              V
                              V
502                       580510
                              .
                              .
508                           .       WI510
                              .           .
                              .           .
515                         510............
                              .
                              .
518                     510*............
                          V
                          V
521                   510500
                          .
                          .
527                       WI520
                              V
                              V
534                       520500
                              .
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            .           .           .
541         .           .           .           .<-------    CAP2
540         .           .           .        CAP2
            .           .           .           .
            .           .           .           .
544         .           .           .           .------->    CAP3
542         .           .           .        CAP2
            .           .           .           V
            .           .           .           V
547         .           .           .      540500
            .           .           .           .
            .           .           .           .
553         .           .           .           .       WI500
            .           .           .           .           .
            .           .           .           .           .
559         .           .       500.1.......................
            .           .           .
            .           .           .
562         .       500.2............
            .           V
            .           V
565         .      500500
            .           .
            .           .
571      500.3............
            V
            V
574     500600
            .
            .
580         .       PI600
            .           .
            .           .
587         .           .           .<-------    CAP3
586         .           .        CAP3
            .           .           .
            .           .           .
590         .           .           .------->    CAP4
588         .           .        CAP3
            .           .           V
            .           .           V
593         .           .      640600
            .           .           .
            .           .           .
599         .         600............
            .           .
            .           .
602       600*...........
            V
            V
605     600710
            .
            .
613         .           .<-------    CAP4
611         .        CAP4
            .           V
            .           V
614         .      760710
            .           .
            .           .
620         .           .       PD710
            .           .           .
            .           .           .
626         .           .           .       PD740
            .           .           .           V
            .           .           .           V
631         .           .           .      CAP200
            .           .           .           V
            .           .           .           V
637         .           .           .      740710
            .           .           .           .
```

```
                .          .          .          .
643             .        710.......................
                .          .
                .          .
646           710*...........
                V
                V
649         710700
                .
                .
655             .      PD730
                .          V
                .          V
660             .     CAP220
                .          .
                .          .
667             .          .       PD735
                .          .           V
                .          .           V
673             .          .      CAP210
                .          .           .
                .          .           .
684             .        736...........
                .          V
                .          V
687             .     735700
                .          .
                .          .
693             .          .       PD700
                .          .           .
                .          .           .
699             .        700...........
                .          .
                .          .
702           700*...........
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RUNOFF SUMMARY
FLOW IN CUBIC FEET PER SECOND
TIME IN HOURS, AREA IN SQUARE MILES

TIME OF MAX STAGE	OPERATION	STATION	PEAK FLOW	TIME OF PEAK	AVERAGE FLOW FOR MAXIMUM PERIOD 6-HOUR	24-HOUR	72-HOUR	BASIN AREA	MAXIMUM STAGE
+	HYDROGRAPH AT	PI680	7704.	13.50	3007.	930.	312.	16.89	
+	ROUTED TO	680640	5311.	15.50	2880.	922.	312.	16.89	
+	HYDROGRAPH AT	PI640	11751.	13.50	3104.	822.	274.	17.56	
+	2 COMBINED AT	640	11653.	13.50	5392.	1656.	560.	34.45	
+	HYDROGRAPH AT	WI540	7839.	13.50	2255.	681.	228.	11.64	
+	HYDROGRAPH AT	PD780	13677.	13.25	3291.	983.	328.	19.17	
+	ROUTED TO	780760	7768.	14.25	3284.	980.	328.	19.17	
+	HYDROGRAPH AT	PD760	3484.	12.50	355.	95.	32.	2.72	
	HYDROGRAPH AT	PD745	2473.	12.50	301.	82.	27.	1.98	
+	5 COMBINED AT	CAP	25606.	13.50	10639.	3230.	1092.	69.96	
+	ROUTED TO	STOR	7087.	15.75	6757.	3211.	1092.	69.96	
+	DIVERSION TO	CAP2	5964.	15.75	5692.	2738.	932.	69.96	
+	HYDROGRAPH AT	CAP1	1123.	15.75	1065.	473.	160.	69.96	
+	ROUTED TO	640505	1114.	17.25	1049.	472.	160.	69.96	
+	HYDROGRAPH AT	WI505	4153.	13.25	897.	240.	80.	6.67	
+	2 COMBINED AT	505	4053.	13.25	1535.	741.	253.	17.87	
+	ROUTED TO	505500	3246.	13.50	1503.	741.	253.	17.87	
+	HYDROGRAPH AT	WT140	2297.	13.00	588.	170.	57.	3.80	
+	ROUTED TO	140130	1634.	13.75	586.	170.	57.	3.80	
+	HYDROGRAPH AT	WT130	1848.	13.00	384.	105.	35.	2.54	
	2 COMBINED AT								

+	130	2411.	13.00	960.	272.	91.	6.34
ROUTED TO +	130120	2311.	13.25	959.	272.	91.	6.34
HYDROGRAPH AT +	WT150	3069.	13.25	892.	260.	87.	5.85
ROUTED TO +	150120	2303.	14.00	887.	260.	87.	5.85
HYDROGRAPH AT +	WT160	751.	12.50	131.	37.	12.	.82
ROUTED TO +	160120	476.	13.50	130.	37.	12.	.82
HYDROGRAPH AT +	WT120	3376.	12.50	397.	103.	34.	2.82
3 COMBINED AT +	120	3511.	12.50	1391.	395.	133.	9.48
2 COMBINED AT +	120*	4729.	13.75	2270.	646.	216.	15.82
ROUTED TO +	120110	4165.	14.75	2253.	645.	216.	15.82
HYDROGRAPH AT +	WT110	3134.	12.50	415.	110.	37.	2.90
2 COMBINED AT +	110	4165.	14.75	2616.	746.	250.	18.71
ROUTED TO	110100	4074.	14.75	2586.	740.	248.	18.71
HYDROGRAPH AT +	WT100	2869.	13.00	596.	168.	56.	3.84
2 COMBINED AT +	100	5462.	13.00	3096.	885.	298.	22.56
ROUTED TO +	100400	4475.	14.25	3064.	885.	298.	22.56
HYDROGRAPH AT +	IW350	4129.	12.50	729.	204.	68.	4.21
ROUTED TO +	350310	1154.	18.00	627.	201.	68.	4.21
HYDROGRAPH AT +	IW310	11939.	14.00	4421.	1171.	391.	25.81
2 COMBINED AT +	310	11821.	14.00	4522.	1324.	449.	30.02
ROUTED TO +	CAP020	11559.	14.25	4150.	1321.	447.	30.02
ROUTED TO +	310200	7259.	16.00	3789.	1317.	447.	30.02
HYDROGRAPH AT +	SV220	11508.	13.50	3027.	786.	262.	16.95
ROUTED TO	CAP010	7131.	14.00	2992.	781.	260.	16.95

	ROUTED TO	220200	4935.	15.75	2855.	780.	260.	16.95
+	HYDROGRAPH AT	TW480	6463.	13.50	2383.	733.	246.	12.72
+	ROUTED TO	480460	5338.	14.00	2346.	732.	246.	12.72
+	HYDROGRAPH AT	TW460	2146.	12.75	373.	98.	33.	2.44
+	2 COMBINED AT	460	5458.	14.00	2626.	817.	275.	15.16
+	ROUTED TO	460420	4069.	16.75	2454.	810.	275.	15.16
+	HYDROGRAPH AT	TW420	6092.	13.50	1620.	428.	143.	10.89
+	2 COMBINED AT	420	5868.	13.50	3216.	1174.	400.	26.06
+	ROUTED TO	CAP030	5537.	13.50	3217.	1174.	400.	26.06
+	ROUTED TO	420200	4550.	15.00	3106.	1173.	400.	26.06
+	HYDROGRAPH AT	SV200	10672.	14.00	4219.	1144.	382.	31.33
+	4 COMBINED AT	200	16943.	15.50	11262.	3972.	1354.	104.36
+	ROUTED TO	200400	16144.	16.50	11113.	3964.	1354.	104.36
+	HYDROGRAPH AT	TW400	7599.	13.50	1971.	542.	181.	12.99
+	2 COMBINED AT	400	16144.	16.50	11393.	4371.	1502.	117.35
+	2 COMBINED AT	400*	19115.	16.50	13746.	5073.	1742.	139.91
+	ROUTED TO	400510	18953.	16.50	13713.	5072.	1742.	139.91
+	HYDROGRAPH AT	WI580	14206.	14.00	4797.	1278.	427.	30.35
+	ROUTED TO	CAP040	13327.	14.00	4481.	1253.	418.	30.35
+	ROUTED TO	580510	6454.	17.00	3856.	1250.	418.	30.35
+	HYDROGRAPH AT	WI510	5045.	13.75	1572.	445.	149.	9.31
+	2 COMBINED AT	510	6482.	17.00	3971.	1602.	546.	39.66
+	2 COMBINED AT	510*	23515.	16.75	16844.	6422.	2203.	179.56
+	ROUTED TO	510500	22822.	17.25	16706.	6421.	2203.	179.56

	HYDROGRAPH AT							
		WI520	8699.	13.75	2727.	782.	261.	16.39
	ROUTED TO							
+		520500	5847.	15.50	2676.	777.	261.	16.39
	HYDROGRAPH AT							
+		CAP2	5964.	15.75	5692.	2738.	932.	69.96
	DIVERSION TO							
+		CAP3	5238.	15.75	5013.	2450.	835.	69.96
	HYDROGRAPH AT							
+		CAP2	727.	15.75	680.	288.	97.	69.96
	ROUTED TO							
+		540500	713.	18.50	660.	287.	97.	69.96
	HYDROGRAPH AT							
+		WI500	5169.	13.50	1341.	358.	119.	9.16
	3 COMBINED AT							
+		500.1	6415.	15.25	3976.	1365.	463.	32.54
	2 COMBINED AT							
+		500.2	24831.	17.25	19432.	7534.	2583.	212.11
	ROUTED TO							
+		500500	24686.	17.25	19403.	7534.	2583.	212.11
	2 COMBINED AT							
+		500.3	25608.	17.25	20358.	8112.	2781.	229.97
	ROUTED TO							
		500600	24290.	18.50	19840.	8109.	2781.	229.97
	HYDROGRAPH AT							
+		PI600	7289.	13.25	1696.	467.	156.	12.03
	HYDROGRAPH AT							
+		CAP3	5238.	15.75	5013.	2450.	835.	69.96
	DIVERSION TO							
+		CAP4	3397.	15.75	3286.	1703.	582.	69.96
	HYDROGRAPH AT							
+		CAP3	1841.	15.75	1727.	748.	253.	69.96
	ROUTED TO							
+		640600	1822.	17.75	1698.	746.	253.	69.96
	2 COMBINED AT							
+		600	7289.	13.25	2631.	1282.	438.	30.22
	2 COMBINED AT							
+		600*	25825.	18.50	21330.	9075.	3115.	260.20
	ROUTED TO							
+		600710	25643.	18.75	21227.	9074.	3115.	260.20
	HYDROGRAPH AT							
+		CAP4	3397.	15.75	3286.	1703.	582.	69.96
	ROUTED TO							
+		760710	3380.	17.25	3255.	1700.	582.	69.96
	HYDROGRAPH AT							
+		PD710	3617.	13.50	910.	242.	81.	6.72
	HYDROGRAPH AT							

+	PD740	1457.	12.25	127.	34.	11.	.87
ROUTED TO							
+	CAP200	378.	12.75	127.	34.	11.	.87
ROUTED TO							
+	740710	273.	15.50	121.	34.	11.	.87
3 COMBINED AT							
+	710	4102.	13.50	3466.	1990.	682.	41.17
2 COMBINED AT							
+	710*	28626.	18.75	24218.	10754.	3696.	301.37
ROUTED TO							
+	710700	28157.	19.00	23974.	10749.	3696.	301.37
HYDROGRAPH AT							
+	PD730	613.	12.50	85.	26.	9.	.48
ROUTED TO							
+	CAP220	457.	12.50	86.	26.	9.	.48
HYDROGRAPH AT							
+	PD735	2721.	12.75	539.	162.	54.	3.23
ROUTED TO							
+	CAP210	2526.	12.75	539.	162.	54.	3.23
2 COMBINED AT							
+	736	2973.	12.75	622.	187.	63.	3.71
ROUTED TO							
+	735700	1355.	14.50	613.	186.	63.	3.71
HYDROGRAPH AT							
+	PD700	6281.	13.00	1130.	313.	104.	7.26
2 COMBINED AT							
+	700	6366.	13.00	1700.	489.	165.	10.97
2 COMBINED AT							
+	700*	28185.	19.00	24084.	11086.	3817.	312.34

*** NORMAL END OF HEC-1 ***

D.2. Future Conditions

```
1****************************************
*                                      *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)  *
*             JUN   1998               *
*           VERSION 4.1                *
*                                      *
*  RUN DATE   26APR04  TIME  08:15:26  *
*                                      *
****************************************
```

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

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

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

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

```
1                                                    HEC-1 INPUT
PAGE  1

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

             1          ID
             2          ID   ****************************************************************************
             3          ID   **                                                                        **
             4          ID   **                     McMICKEN DAM HYDROLOGY MODEL                       **
             5          ID   **                                                                        **
             6          ID   ****************************************************************************
             7          ID   ****************************************************************************
             8          ID   PROJECT:                 WITTMANN ADMS Update
             9          ID   CLIENT:                  Flood Control District of Maricopa County
            10          ID   PREPARED BY:             Entellus, Inc.
            11          ID   PROJECT No:              FCD 2002C029              Entellus 310.032
            12          ID   FILE NAME: fut100.hc1                     CREATED DATE: Sept 3, 2003
            13          ID                                            MODIFIED DATE: Apr 26, 2004
            14          ID   STORM:                   100-year 24-hour Storm
            15          ID   DEVELOPMENT CONDITIONS: Future Conditions
            16          ID
            17          ID
            18          ID   Changes made to Model:
            19          ID                        -Basin WT130 was adjusted to reflect improvements at
            20          ID                          southwest portion of the dam.
            21          ID                        -Basins PD790 and PD780 were combined to form PD780.
            22          ID                        -Basins PI640 and PI620 were combined to form PI640.
            23          ID                        -Basins PD720 and PD710 were combined to form PD710.
            24          ID                        -Changed the following concentration point names:
            25          ID                                CP 400 changed to 400*
            26          ID                                CP 510 changed to 510*
            27          ID                                CP 500 changed to 500.3
            28          ID                                CP 600 changed to 600*
            29          ID                                CP 710 changed to 710*
            30          ID                                CP 700 changed to 700*
            31          ID                        -Added concentration points 400, 510, 500.1, 500.2,
            32          ID                          600, 710 and 700.
            33          ID                        -Adjusted CAP culvert system (structures CAP060-CAP190)
            34          ID                          to account for the overtopping of the CAP Canal
            35          ID                        -Adjusted Time of COncentrations and routes for basins
            36          ID                          along McMicken Dam channel.
            37          ID                        -Corrected S-Graphs for WI500, WI510, WT100, WT120,
```

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 38          ID                          WT130 and SV200
 39          ID                        04-26-2004
 40          ID                        -Increased number of ordinates, added CP and
 41          ID                          rearranged combines in White Tanks area.
 42          ID
 43          ID
             *DIAGRAM
 44          IT      15  1JAN94       0    1500
 45          IO       3
 46          IN      15 01JAN94       0
 47          JD   4.159    0.01
             * 24-hour distribution
 48          PC     0.0   0.002   0.005   0.008   0.011   0.014   0.017    0.02   0.023   0.026
 49          PC   0.029   0.032   0.035   0.038   0.041   0.044   0.048   0.052   0.056    0.06
 50          PC   0.064   0.068   0.072   0.076    0.08   0.085    0.09   0.095     0.1   0.105
 51          PC    0.11   0.115    0.12   0.126   0.133    0.14   0.147   0.155   0.163   0.172
 52          PC   0.181   0.191   0.203   0.218   0.236   0.257   0.283   0.387   0.663   0.707
 53          PC   0.735   0.758   0.776   0.791   0.804   0.815   0.825   0.834   0.842   0.849
1                                          HEC-1 INPUT
PAGE  2

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

 54          PC   0.856   0.863   0.869   0.875   0.881   0.887   0.893   0.898   0.903   0.908
 55          PC   0.913   0.918   0.922   0.926    0.93   0.934   0.938   0.942   0.946    0.95
 56          PC   0.953   0.956   0.959   0.962   0.965   0.968   0.971   0.974   0.977    0.98
 57          PC   0.983   0.986   0.989   0.992   0.995   0.998     1.0
 58          IN      15 01JAN94       0
 59          JD   3.952    10.0
             * 24-hour distribution
 60          PC     0.0   0.002   0.005   0.008   0.011   0.014   0.017    0.02   0.023   0.026
 61          PC   0.029   0.032   0.035   0.038   0.041   0.044   0.048   0.052   0.056    0.06
 62          PC   0.064   0.068   0.072   0.076    0.08   0.085    0.09   0.095     0.1   0.105
 63          PC    0.11   0.115    0.12   0.126   0.133    0.14   0.147   0.155   0.163   0.172
 64          PC   0.181   0.191   0.203   0.218   0.236   0.257   0.283   0.387   0.663   0.707
 65          PC   0.735   0.758   0.776   0.791   0.804   0.815   0.825   0.834   0.842   0.849
 66          PC   0.856   0.863   0.869   0.875   0.881   0.887   0.893   0.898   0.903   0.908
 67          PC   0.913   0.918   0.922   0.926    0.93   0.934   0.938   0.942   0.946    0.95
 68          PC   0.953   0.956   0.959   0.962   0.965   0.968   0.971   0.974   0.977    0.98
 69          PC   0.983   0.986   0.989   0.992   0.995   0.998     1.0
 70          IN      15 01JAN94       0
 71          JD   3.818    20.0
             * 24-hour distribution
 72          PC     0.0   0.002   0.005   0.008   0.011   0.014   0.017    0.02   0.023   0.026
 73          PC   0.029   0.032   0.035   0.038   0.041   0.044   0.048   0.052   0.056    0.06
 74          PC   0.064   0.068   0.072   0.076    0.08   0.085    0.09   0.095     0.1   0.105
 75          PC    0.11   0.115    0.12   0.126   0.133    0.14   0.147   0.155   0.163   0.172
 76          PC   0.181   0.191   0.203   0.218   0.236   0.257   0.283   0.387   0.663   0.707
 77          PC   0.735   0.758   0.776   0.791   0.804   0.815   0.825   0.834   0.842   0.849
 78          PC   0.856   0.863   0.869   0.875   0.881   0.887   0.893   0.898   0.903   0.908
 79          PC   0.913   0.918   0.922   0.926    0.93   0.934   0.938   0.942   0.946    0.95
 80          PC   0.953   0.956   0.959   0.962   0.965   0.968   0.971   0.974   0.977    0.98
 81          PC   0.983   0.986   0.989   0.992   0.995   0.998     1.0
 82          IN      15 01JAN94       0
 83          JD   3.689    40.0
             * 24-hour distribution
 84          PC     0.0   0.002   0.005   0.008   0.011   0.014   0.017    0.02   0.023   0.026
 85          PC   0.029   0.032   0.035   0.038   0.041   0.044   0.048   0.052   0.056    0.06
 86          PC   0.064   0.068   0.072   0.076    0.08   0.085    0.09   0.095     0.1   0.105
 87          PC    0.11   0.115    0.12   0.126   0.133    0.14   0.147   0.155   0.163   0.172
 88          PC   0.181   0.191   0.203   0.218   0.236   0.257   0.283   0.387   0.663   0.707
 89          PC   0.735   0.758   0.776   0.791   0.804   0.815   0.825   0.834   0.842   0.849
 90          PC   0.856   0.863   0.869   0.875   0.881   0.887   0.893   0.898   0.903   0.908
 91          PC   0.913   0.918   0.922   0.926    0.93   0.934   0.938   0.942   0.946    0.95
 92          PC   0.953   0.956   0.959   0.962   0.965   0.968   0.971   0.974   0.977    0.98
 93          PC   0.983   0.986   0.989   0.992   0.995   0.998     1.0
 94          IN      15 01JAN94       0
 95          JD   3.565    80.0
             * 24-hour distribution
 96          PC     0.0   0.002   0.005   0.008   0.011   0.014   0.017    0.02   0.023   0.026
 97          PC   0.029   0.032   0.035   0.038   0.041   0.044   0.048   0.052   0.056    0.06
```

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 98          PC   0.064   0.068   0.072   0.076    0.08   0.085    0.09   0.095     0.1   0.105
 99          PC    0.11   0.115    0.12   0.126   0.133    0.14   0.147   0.155   0.163   0.172
100          PC   0.181   0.191   0.203   0.218   0.236   0.257   0.283   0.387   0.663   0.707
101          PC   0.735   0.758   0.776   0.791   0.804   0.815   0.825   0.834   0.842   0.849
102          PC   0.856   0.863   0.869   0.875   0.881   0.887   0.893   0.898   0.903   0.908
103          PC   0.913   0.918   0.922   0.926    0.93   0.934   0.938   0.942   0.946    0.95
104          PC   0.953   0.956   0.959   0.962   0.965   0.968   0.971   0.974   0.977    0.98
1                                          HEC-1 INPUT
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LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

105          PC   0.983   0.986   0.989   0.992   0.995   0.998     1.0
106          IN      15 01JAN94       0
107          JD   3.498   120.0
             * 24-hour distribution
108          PC     0.0   0.002   0.005   0.008   0.011   0.014   0.017    0.02   0.023   0.026
109          PC   0.029   0.032   0.035   0.038   0.041   0.044   0.048   0.052   0.056    0.06
110          PC   0.064   0.068   0.072   0.076    0.08   0.085    0.09   0.095     0.1   0.105
111          PC    0.11   0.115    0.12   0.126   0.133    0.14   0.147   0.155   0.163   0.172
112          PC   0.181   0.191   0.203   0.218   0.236   0.257   0.283   0.387   0.663   0.707
113          PC   0.735   0.758   0.776   0.791   0.804   0.815   0.825   0.834   0.842   0.849
114          PC   0.856   0.863   0.869   0.875   0.881   0.887   0.893   0.898   0.903   0.908
115          PC   0.913   0.918   0.922   0.926    0.93   0.934   0.938   0.942   0.946    0.95
116          PC   0.953   0.956   0.959   0.962   0.965   0.968   0.971   0.974   0.977    0.98
117          PC   0.983   0.986   0.989   0.992   0.995   0.998     1.0
118          IN      15 01JAN94       0
119          JD   3.411   200.0
             * 24-hour distribution
120          PC     0.0   0.002   0.005   0.008   0.011   0.014   0.017    0.02   0.023   0.026
121          PC   0.029   0.032   0.035   0.038   0.041   0.044   0.048   0.052   0.056    0.06
122          PC   0.064   0.068   0.072   0.076    0.08   0.085    0.09   0.095     0.1   0.105
123          PC    0.11   0.115    0.12   0.126   0.133    0.14   0.147   0.155   0.163   0.172
124          PC   0.181   0.191   0.203   0.218   0.236   0.257   0.283   0.387   0.663   0.707
125          PC   0.735   0.758   0.776   0.791   0.804   0.815   0.825   0.834   0.842   0.849
126          PC   0.856   0.863   0.869   0.875   0.881   0.887   0.893   0.898   0.903   0.908
127          PC   0.913   0.918   0.922   0.926    0.93   0.934   0.938   0.942   0.946    0.95
128          PC   0.953   0.956   0.959   0.962   0.965   0.968   0.971   0.974   0.977    0.98
129          PC   0.983   0.986   0.989   0.992   0.995   0.998     1.0
130          IN      15 01JAN94       0
131          JD   3.353   300.0
             * 24-hour distribution
132          PC     0.0   0.002   0.005   0.008   0.011   0.014   0.017    0.02   0.023   0.026
133          PC   0.029   0.032   0.035   0.038   0.041   0.044   0.048   0.052   0.056    0.06
134          PC   0.064   0.068   0.072   0.076    0.08   0.085    0.09   0.095     0.1   0.105
135          PC    0.11   0.115    0.12   0.126   0.133    0.14   0.147   0.155   0.163   0.172
136          PC   0.181   0.191   0.203   0.218   0.236   0.257   0.283   0.387   0.663   0.707
137          PC   0.735   0.758   0.776   0.791   0.804   0.815   0.825   0.834   0.842   0.849
138          PC   0.856   0.863   0.869   0.875   0.881   0.887   0.893   0.898   0.903   0.908
139          PC   0.913   0.918   0.922   0.926    0.93   0.934   0.938   0.942   0.946    0.95
140          PC   0.953   0.956   0.959   0.962   0.965   0.968   0.971   0.974   0.977    0.98
141          PC   0.983   0.986   0.989   0.992   0.995   0.998     1.0
142          IN      15 01JAN94       0
143          JD   3.257   500.0
             * 24-hour distribution
144          PC     0.0   0.002   0.005   0.008   0.011   0.014   0.017    0.02   0.023   0.026
145          PC   0.029   0.032   0.035   0.038   0.041   0.044   0.048   0.052   0.056    0.06
146          PC   0.064   0.068   0.072   0.076    0.08   0.085    0.09   0.095     0.1   0.105
147          PC    0.11   0.115    0.12   0.126   0.133    0.14   0.147   0.155   0.163   0.172
148          PC   0.181   0.191   0.203   0.218   0.236   0.257   0.283   0.387   0.663   0.707
149          PC   0.735   0.758   0.776   0.791   0.804   0.815   0.825   0.834   0.842   0.849
150          PC   0.856   0.863   0.869   0.875   0.881   0.887   0.893   0.898   0.903   0.908
151          PC   0.913   0.918   0.922   0.926    0.93   0.934   0.938   0.942   0.946    0.95
152          PC   0.953   0.956   0.959   0.962   0.965   0.968   0.971   0.974   0.977    0.98
153          PC   0.983   0.986   0.989   0.992   0.995   0.998     1.0
             *
             *
             *
             *
             * *** Basin PI680: mountainous basin located in North of watershed: CP=680
             * *** CP 680 is located at approximately Honda Bow Road and 187th Ave alignments
```

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


 154          KK   PI680
 155          KO       0       0     0.0       1      21
 156          BA  16.887
 157          LG   0.255    0.25   5.858   0.211  33.728
              * PI680
 158          UI     0.0  530.39  884.69 2068.28 3278.38 3999.79 5277.68 5197.06 3429.47 2961.47
 159          UI  2576.9  2215.5 1865.18 1487.75 1270.51 1149.45  907.22  707.05  623.29  570.21
 160          UI  406.63  406.63  271.71  259.55  259.55  171.38  101.66  101.66  101.66  101.66
 161          UI  101.66  101.66  101.66  101.66
              *
              *
              * *** Route 680640: from CP 680 to CP 640 at the CAP.
              * *** Mountainous wash.  This is Picacho Wash.
              * *** CP 640 is located at approximately 187th ave alignment and the CAP Canal.

 162          KK  680640
 163          KO       0       0     0.0       0      21
 164          RS       9    FLOW
 165          RC    0.05   0.064    0.05 45524.0   0.014     0.0
              * Medium Wash
 166          RX       0    1000    2500    3846    4110    4160    4300    7000
 167          RY      10       8       6     5.8       0       0       6      10
              *
              *
              * *** Basin PI640: basin with some urban areas located in east-central part
              * *** of watershed: CP=640.

 168          KK   PI640
 169          KO       0       0     0.0       1      21
 170          BA  17.562
 171          LG   0.269    0.15   7.212    0.12  18.003
              * PI640_NEW
 172          UI     0.0  737.48 2239.28 3840.43 5041.98 7522.05 8271.37 5962.39 4416.49 3082.87
 173          UI  1530.3 1080.12  713.02  226.16  226.16  226.16     0.0
              *
              *
              * *** Combine 640 *** Combines PI640 and 680640 at CP 640

 174          KK     640
 175          KO       0       0     0.0       0      21
 176          HC       2
              *
              *
              * *** Basin WI540: basin with some urban areas located in east-central part
              * *** of watershed: CP=540.
              * *** CP 540 is located at approximately 195th ave alignment and the CAP Canal.

 177          KK   WI540
 178          KO       0       0     0.0       1      21
 179          BA  11.640
 180          LG   0.221    0.25   5.888   0.196  44.540
              * WI540
 181          UI     0.0  479.61 1408.71  2467.3 3220.83 4668.81 5566.38 4008.55 3002.78  2180.2
 182          UI  1101.3   776.0  479.61  207.51  147.08  147.08  147.08     0.0
              *
              *
              * *** Basin PD780: valley basin located in east part of watershed: CP=780.
              * *** CP 780 is located at approximately 163rd ave & carefree highway alignments
1                                                    HEC-1 INPUT
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LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


 183          KK   PD780
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184          KO       0       0     0.0       1      21
185          BA  19.169
186          LG   0.226    0.25   5.252   0.286  33.957
             * PD780_NEW
187          UI     0.0  921.92 3426.52 5287.12 7504.6110926.62 7886.94 5628.87 3670.47  1701.7
188          UI  1136.8  561.51  282.72  282.72     0.0
             *
             *
             * *** Route 780760: from CP 780 to CP 760 at the CAP.Mountainous wash.
             * *** CP 760 is located at approximately 163rd ave alignment and the CAP canal.

189          KK  780760
190          KO       0       0     0.0       0      21
191          RS       3    FLOW
192          RC    0.05   0.064    0.05   12100   0.010     0.0
             * Medium Wash
193          RX       0    1000    2500    3846    4110    4160    4300    7000
194          RY      10       8       6     5.8       0       0       6      10
             *
             *
             * *** Basin PD760: Slightly urban basin located in east part of watershed: CP=76

195          KK   PD760
196          KO       0       0     0.0       1      21
197          BA  2.7248
198          LG   0.286   0.250   4.330   0.420  14.434
             * PD760
199          UI     0.0 1110.28 3340.52 2005.05  449.67   108.0     0.0
             *
             *
             *
             * *** Basin PD745: foothills basin located in east part of watershed: CP=745.
             * *** CP 745 is located at approximately 155th ave alignment and the CAP canal.

200          KK   PD745
201          KO       0       0     0.0       1      21
202          BA  1.9822
203          LG   0.265    0.25   5.011   0.301  19.085
             * PD745
204          UI     0.0   986.5 2210.72  1045.9  483.49  217.98   95.35   52.86     0.0
             *
             *
             *
             * *** Combine CAP *** Combines 640*, WI540, 780760, PD760 and PD745 at CP CAP

205          KK     CAP
206          KO       0       0     0.0       0      21
207          HC       5
             *
             *
             * *** Storage STOR at CAP canal
1                                          HEC-1 INPUT
PAGE  6

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


208          KK    STOR
209          RS       1    STOR       0
210          SQ       0     698    2229    5188    6380    7215    7985   91005  242535
211          SE    1540    1544    1546    1550    1552    1554    1556    1557    1558
212          SA     4.4    60.5   130.7   348.8     486   625.3   763.8   763.9     764
213          SE    1540    1544    1546    1550    1552    1554    1556    1557    1558
             *
             *
             * The flow from STOR is distributed to ROUTES 640505, 540500, 640600 & 760710.
             * The breakdown of where the flow is distributed to is shown below, with the SQ
             * card being the summation of the flows at any given elevation.
             *
             * ******************************************************************* *ROUTES*
             *     0 *    81 *   238 *   775 *  1000 *  1145 *  1278 * 24974 * 68216 *640505*
```

```
*      0 *    34 *   120 *   476 *   625 *   745 *   799 * 18363 * 50378 *540500*
*      0 *   113 *   346 *  1217 *  1595 *  1885 *  2076 * 26040 * 69638 *640600*
*      0 *   470 *  1525 *  2720 *  3160 *  3440 *  3832 * 21628 * 54303 *760710*
* ---------------------------------------------------------------------------*
* SQ   0 *   698 *  2229 *  5188 *  6380 *  7215 *  7985 * 91005 *242535        *
*                                                                             *
* ***************************************************************************
*
* The flows were calculated based upon the capacities of the overchutes or
* culverts.  Once the culvert capacities (inlet controled) were calculated up
* to the berm elevation (1556), a combined culvert inlet control and weir
* equation were utilized to calculate the flows (1557 & 1558).  2.7 was used for
* the weir coefficient and the weir length was the basin boundary where
* overtopping would occur.
*
*
* *** Diversion: CAP2.  Mainflow to 640505, diverted flow to 540500.
* *** CAP ***********************************************************
* This Diversion is for the Impoundment Area upstream of the CAP.
*
*
* DDM   ***** Preserved *****

214     KK    CAP1
215     KO       0       0     0.0       0      21
216     DT    CAP2
        * This diversion was calculated on the capacities of the overchutes.
        * The overchutes that contribute to route 640505 are CAP 80 to 100.
        * The capacities of the culverts in this system can be found in the appendix.
217     DI       0     698    2229    5188    6380    7215    7985   91005  242535
218     DQ       0     617    1991    4413    5380    6070    6707   66031  174319
        *
        *
        * *** Route 640505: from CP 640 to CP 505. Valley wash.
        * *** CP 505 is located at approximately Happy Valley rd. & 171st ave alignment
                                        HEC-1 INPUT
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LINE    ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


219     KK  640505
        *
        * This Route is from the CAP to concentration point 505.
        *
220     KO       0       0     0.0       0      21
221     RS       9    FLOW
222     RC    0.08   0.046    0.08 25169.0   0.009     0.0
        * Medium Wash
223     RX       0    1000    2500    3846    4110    4160    4300    7000
224     RY      10       8       6     5.8       0       0       6      10
        *
        *
        * *** Basin WI505: slightly urban basin located in central part of
        * *** watershed: CP=505.

225     KK   WI505
226     KO       0       0     0.0       1      21
227     BA  6.6716
228     LG    0.26    0.25   4.645    0.37  31.474
        * WI505
229     UI     0.0   312.2 1116.51  1754.2 2431.56 3707.04 2801.09 2033.26 1394.62  663.31
230     UI  437.06  252.75   95.74   95.74   95.74     0.0
        *
        * ***************************************************************************
        * ***************************************************************************
        * Concentration point 505 was hard coded to account for the diverted flow above.
        * The area was calculated based upon the peak stage as calculated through HEC-1.
        * The peak stage was taken for this culvert system (structures CAP060 to CAP190)
        * and the percentage of flow diverted to each concentration point was calculated
        * as shown in appendix B.5.  The calculations show that the concentration points
```

```
                 * should receive following distribution of area.                                  *
                 *                                                                                 *
                 * concentration     percentage     area                                          *
                 *    point             area       (sq mi)                                        *
                 * ----------------------------------------                                        *
                 *     505               16%       11.194                                         *
                 *     500               10%        6.997                                         *
                 *     600               26%       18.191                                         *
                 *     710               48%       33.583                                         *
                 * ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~                                        *
                 *  SUM OF ALL          100%       69.965                                         *
                 * ********************************************************************************
                 * ********************************************************************************
                 *
                 * *** Combine 505 *** Combines 640505 & WI505 at CP 505.

 231             KK     505
 232             KO       0       0     0.0       0      21
 233             HC       2 17.8656
                 *        17.8656 =
                 *                + 11.1940 (640505-diversion)
                 *                +  6.6716 (WI505)
                 *
                 * *** Route 505500: from CP 505 to CP 500.3 @ McMicken Dam Spillway. Valley wash
                 * *** CP 500.3 is located at the McMicken Dam Spillway.
1                                                HEC-1 INPUT
PAGE  8

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


 234             KK  505500
 235             KO       0       0     0.0       0      21
 236             RS       1    FLOW
 237             RC    0.08   0.046    0.08  5161.0   0.004     0.0
                 * Medium Wash
 238             RX       0    1000    2500    3846    4110    4160    4300    7000
 239             RY      10       8       6     5.8       0       0       6      10
                 *
                 *
                 * *** Basin WT140: Mountain basin located in south portion of watershed: CP=140.
                 * *** CP 140 is located north of the Cactus Rd and 211th Ave aligments.

 240             KK   WT140
 241             KO       0       0     0.0       1      21
 242             BA  3.7989
 243             LG     0.2    0.25   4.093   0.385  24.444
                 * WT140
 244             UI     0.0  189.63  716.34 1293.07 1933.38 1378.87 1023.44  815.74  607.47  458.74
 245             UI  358.34  252.58  202.47  145.39  106.74    92.8   57.72   36.35   36.35   36.35
 246             UI   36.35     0.0
                 *
                 *
                 *
                 * *** Route 140130: from CP 140 to CP 130 at the McMicken Dam. Mountainous wash.
                 * *** CP 130 is located @ McMicken Dam north of Peoria and 195th Ave alignments.

 247             KK  140130
 248             KO       0       0     0.0       0      21
 249             RS       3    FLOW
 250             RC    0.05   0.064    0.05   14043   0.018     0.0
                 * Small Wash
 251             RX       0    1300    1380    1560    1600    1640    1660    1710
 252             RY      11     7.2     5.2     3.3       0     3.2     7.2    13.2
                 *
                 *
                 * *** Basin WT130: Combination basin of Mountain and Foothills.
                 * *** This basin is located in south portion of watershed: CP=130.

 253             KK   WT130
 254             KO       0       0     0.0       1      21
```

```
 255          BA  2.5413
 256          LG   0.219    0.25   4.731   0.299  15.926
              * THIS S-GRAPH WAS CALCULATED MANUALLY (SEE APPENDIX) *
              * Combined S-Graph for Basin WT130: Phoenix Valley:51%, Phoenix Mountain:49%
              * Basin Area [sq mi] = 2.5413
              * Basin Lag [hr] = 0.94
              * Time Step [min] = 15
              * Qult = 6559.9
              *
 257          UI       0   194.2     705  1137.3  1543.8  1013.3   710.4   480.7   286.8   181.2
 258          UI   117.1    73.9      36      36      36       0
              *
              * *** Combine 130 *** Combines 140130 and WT130.
1                                          HEC-1 INPUT
PAGE  9

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


 259          KK     130
 260          KO       0       0     0.0       0      21
 261          HC       2
              *
              *
              * *** Route 130120: from CP130 to CP120 along McMicken Dam. McMicken Dam Channel
              * *** CP 120 is located south of Cactus Rd & 195th Ave alignments @ McMicken Dam

 262          KK  130120
 263          KO       0       0     0.0       0      21
 264          RS       1    FLOW
 265          RC   0.045   0.035    .045    1225   0.001     0.0
              * McMICKEN DAM CHANNEL
 266          RX       0      46     101     121     171     181    1421    3621
 267          RY      25      14       4       0       0       4      14      25
              *
              *
              *
              * *** Basin WT150: Mountain basin located in south portion of watershed: CP=150.
              * *** CP 150 is located north of the Waddell Rd and 211th Ave alignments.

 268          KK   WT150
 269          KO       0       0     0.0       1      21
 270          BA  5.8463
 271          LG     0.2    0.25   4.085   0.386  24.216
              * WT150
 272          UI     0.0  241.41   653.6 1376.47 1859.31 2614.97 1671.65 1337.57 1114.33   904.5
 273          UI  676.83  565.08  453.31  333.61  276.02  217.23  185.08  120.56  118.14   88.75
 274          UI   46.27   46.27   46.27   46.27   46.27   46.27     0.0
              *
              *
              *
              *
              * *** Route 150120: from CP 150 to CP 120 at the CAP. Mountainous wash.
              * *** CP 120 is located @ McMicken Dam north of Cactus Rd & 187th Ave alignments

 275          KK  150120
 276          KO       0       0     0.0       0      21
 277          RS       3    FLOW
 278          RC    0.05   0.064    0.05 14187.0   0.013     0.0
              * Small Wash
 279          RX       0    1300    1380    1560    1600    1640    1660    1710
 280          RY      11     7.2     5.2     3.3       0     3.2     7.2    13.2
              *
              *
              *
              * *** Basin WT160: Mountain basin located in south portion of watershed: CP=160
              * *** CP 160 is located south of Waddell Rd and 211th Ave alignments
1                                          HEC-1 INPUT
PAGE 10

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

```
281          KK   WT160
282          KO       0       0     0.0       1      21
283          BA  0.8167
284          LG     0.2    0.25   4.395   0.347  22.796
             * WT160
285          UI     0.0  166.64  599.46   563.9  323.31   189.8  109.78    67.4   38.83    19.0
286          UI   14.67   14.67
             *
             *
             *
             * *** Route 160120: from CP 160 to CP 120 at McMicken Dam. Mountainous wash.

287          KK  160120
288          KO       0       0     0.0       0      21
289          RS       4    FLOW
290          RC    0.05   0.064    0.05 14018.0   0.015     0.0
             * Small Wash
291          RX       0    1300    1380    1560    1600    1640    1660    1710
292          RY      11     7.2     5.2     3.3       0     3.2     7.2    13.2
             *
             *
             * *** Basin WT120: Valley basin located in south portion of watershed: CP=120

293          KK   WT120
294          KO       0       0     0.0       1      21
295          BA  2.8156
296          LG   0.257    0.25   5.264   0.259   8.934
             *
             * Phoenix Valley S-Graph for Basin WT120
             * Basin Area [sq mi] = 2.8156
             * Basin Lag [hr] = 0.5
             * Time Step [min] = 15
             * Qult = 7268
             *
297          UI       0   872.2  2761.8  2474.2   862.8   202.8       0
             *
             *
             *
             * *** Combine 120 *** Combines 150120, 160120 & WT120

298          KK     120
299          KO       0       0     0.0       0      21
300          HC       3
             *
             *
             * *** Combine 120* *** Combines 120 130120

301          KK    120*
302          HC       2
             *
             *
             * *** Route 120110: from CP 120 to CP 110 along McMicken Dam Channel.
             * *** CP 110 is located @ McMicken Dam Channel North of Waddell Rd and 187th Ave
1                                          HEC-1 INPUT
PAGE 11

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


303          KK  120110
304          KO       0       0     0.0       0      21
305          RS       5    FLOW
306          RC   0.045   0.035   0.045   10283   0.001     0.0
             * McMICKEN DAM CHANNEL
307          RX       0      46     101     121     171     181    1421    3621
308          RY      25      14       4       0       0       4      14      25
             *
             *
             * *** Basin WT110: Foothills basin located in south portion of watershed: CP=110
```

```
309          KK   WT110
310          KO       0       0     0.0       1      21
311          BA  2.8956
312          LG   0.258    0.25   4.792   0.301  13.801
             * WT110
313          UI     0.0  846.92 2752.89  1740.0  985.45  540.16  291.19  161.26   64.91   60.46
314          UI     0.0
             *
             *
             * *** Combine 110 *** Combines 120* & WT110

315          KK     110
316          KO       0       0     0.0       0      21
317          HC       2
             *
             *
             * *** Route 110100: from CP 110 to CP 100 along McMicken Dam Channel.
             * *** CP 100 is located at McMicken Dam Channel at Greenway Rd and 187th Ave.

318          KK  110100
319          KO       0       0     0.0       0      21
320          RS       1    FLOW
321          RC   0.045   0.035   0.045    2465   0.001     0.0
             * McMICKEN DAM CHANNEL
322          RX       0      46     101     121     171     181    1421    3621
323          RY      25      14       4       0       0       4      14      25
             *
             *
             * *** Basin WT100: Combination basin of Foothills and Valley.
             * *** THis basin is in the south portion of the watershed: CP=100.

324          KK   WT100
325          KO       0       0     0.0       1      21
326          BA  3.8448
327          LG   0.257    0.25   4.571   0.327  24.088
             * THIS S-GRAPH WAS CALCULATED MANUALLY (SEE APPENDIX) *
             * Combined S-Graph for Basin WT100: Phoenix Valley:67%, Phoenix Mountain:33%
             * Basin Area [sq mi] = 3.8448
             * Basin Lag [hr] = 0.86
             * Time Step [min] = 15
             * Qult = 9924.7
             *
328          UI       0   362.9  1255.2  2098.8  2415.5  1543.4   987.6   551.8   317.7   186.6
1                                          HEC-1 INPUT
PAGE 12

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

329          UI    68.6    64.2    64.2       0
             *
             *
             *
             * *** Combine 100 *** Combines 110100 & WT100

330          KK     100
331          KO       0       0     0.0       0      21
332          HC       2
             *
             *
             * *** Route 100400: from CP 100 to CP 400 along McMicken Dam Channel.
             * *** CP 400 is located @ McMicken Dam Channel @ Union Hills Drive and 187th Ave

333          KK  100400
334          KO       0       0     0.0       0      21
335          RS       3    FLOW
336          RC   0.045   0.035   0.045   12851   0.001     0.0
             * McMICKEN DAM CHANNEL
337          RX       0      46     101     121     171     181    1421    3621
338          RY      25      14       4       0       0       4      14      25
             *
```

```
                 *
                 * *** Basin IW350: foothills basin located in NW portion of watershed: CP=350.
                 * *** CP 350 is located North of Circle Mountain Rd and 243rd Ave aligments.

 339             KK   IW350
 340             KO       0       0     0.0       1      21
 341             BA  4.2081
 342             LG   0.234   0.232   6.183   0.192  19.413
                 * IW350
 343             UI     0.0  849.51 3050.45 2921.47 1672.13  981.75  573.23  349.61  202.91  102.19
 344             UI   75.23   75.23     0.0
                 *
                 *
                 * *** Route 350310: from CP 350 to CP310: Mountainous wash. This is Iona Wash.
                 * *** CP 310 is located at CAP North of Happy Valley Rd and west of 227th Ave.

 345             KK  350310
 346             KO       0       0     0.0       0      21
 347             RS      25    FLOW
 348             RC    0.05   0.064    0.05 77773.0   0.009     0.0
                 * Medium Wash
 349             RX       0    1000    2500    3846    4110    4160    4300    7000
 350             RY      10       8       6     5.8       0       0       6      10
                 *
                 *
                 * *** Basin IW310: Less urban basin located west portion of watershed: CP=310

 351             KK   IW310
 352             KO       0       0     0.0       1      21
 353             BA  25.814
 354             LG    0.28   0.150   7.293   0.115  17.002
                 * IW310
 355             UI     0.0  689.21  793.68 2444.89 3317.73 3946.42 4700.23 5756.22 8106.57 7995.44
1
PAGE 13
                                                HEC-1 INPUT

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

 356             UI  6297.8  5316.6 4354.66 3594.68 2811.74 1672.93 1192.21 1072.51  689.21  593.07
 357             UI  211.36  211.36  211.36  211.36  211.36  211.36     0.0
                 *
                 *
                 * *** Combine 310 *** Combines 350310 & IW310

 358             KK     310
 359             KO       0       0     0.0       0      21
 360             HC       2
                 *
                 *
                 * *** Storage CAP020 *** This storage is located at CP 310 at the CAP Canal.

 361             KK  CAP020
 362             KO                                      21
 363             RS       1    STOR       0
                 * CAP 020, R-8 STA 572+50
                 * THE WEIR LENGTH IS 3700 FT WEIR COEF = 2.7
                 * THE WEIR FLOW WAS CALCULATED FOR H = 1 FT (1554) AND H = 2 FT (1555)
 364             SQ       0       0    94.3   662.1  1502.9  2001.8   11992   30258
 365             SE    1546  1547.3    1548    1550    1552    1553    1554    1555
 366             SA     5.5    13.6    17.9      67    99.2   118.3   118.4   118.5
 367             SE    1546  1547.3    1548    1550    1552    1553    1554    1555
                 *
                 *
                 * *** Route 310200: from CP 310 to CP 200: Valley wash. This is Iona Wash.
                 * *** CP 200 is located south of Beardsley Rd and 203rd Ave alignments.

 368             KK  310200
 369             KO       0       0     0.0       0      21
 370             RS       4    FLOW
 371             RC    0.08   0.046    0.08 24622.0   0.005     0.0
                 * Large Wash
```

```
372          RX       0     465    1225    1925    2325    2405    4225    6225
373          RY      10       4       2       0       0       2       8      10
             *
             *
             * *** Basin SV220: Less urban basin located in west portion of watershed: CP=220
             * *** CP 220 is located @ CAP Canal south of Happy Valley Rd & west of 235th Ave

374          KK   SV220
375          KO       0       0     0.0       1      21
376          BA  16.953
377          LG   0.267   0.150   7.510   0.114  30.822
             * SV220
378          UI     0.0  707.39 2124.71  3669.0 4806.37 7097.06 8040.46 5781.67  4297.4 3047.67
379          UI  1516.3 1070.46  707.39  230.76  216.93  216.93  216.93
             *
             *
             * *** Storage CAP010 *** This storage is located at CP 220 at the CAP Canal.
1                                          HEC-1 INPUT
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LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


380          KK  CAP010
381          KO                                      21
382          RS       1    STOR       0
             * CAP 010, R-8 STA 466+00
             * THE WEIR LENGTH IS 7900 FT AND THE WEIR COEFF = 2.7
             * THE WEIR FLOW WAS CALCULATED FOR H = 1 FT (1547.2) AND H = 2 FT (1548.2)
383          SQ       0       0       0       0       0    68.8   808.3  1962.4  3413.7  5110.5
384          SQ  5291.2   26621   65621
385          SE    1530    1532    1534    1536  1537.5    1538    1540    1542    1544    1546
386          SE  1546.2  1547.2  1548.2
387          SA      .1     .25      .5     1.9     9.9    12.5    26.5    59.2   117.5     184
388          SA   191.9     192   192.1
389          SE    1530    1532    1534    1536  1537.5    1538    1540    1542    1544    1546
390          SE  1546.2  1547.2  1548.2
             *
             *
             * *** Route 220200: from CP 220 to CP 200: Valley wash.

391          KK  220200
392          KO       0       0     0.0       0      21
393          RS       8    FLOW
394          RC    0.08   0.046    0.08 26218.0   0.004     0.0
             * Medium Wash
395          RX       0    1000    2500    3846    4110    4160    4300    7000
396          RY      10       8       6     5.8       0       0       6      10
             *
             *
             * *** Basin TW480: Mountain basin located in north portion of watershed: CP=480
             * *** CP 480 is located just North of T7N & T6N boundary and west of 227th Ave.

397          KK   TW480
398          KO       0       0     0.0       1      21
399          BA  12.724
400          LG   0.276   0.227   6.229   0.183  32.122
             * TW480
401          UI     0.0  413.47  732.23 1716.58 2619.87 3204.59 4470.41 3523.69 2552.37  2215.0
402          UI  1916.9 1641.31 1332.45 1056.04  952.84  798.76  620.72  517.42  452.85  358.59
403          UI   317.0  245.75  202.34  202.34  156.22   79.25   79.25   79.25   79.25   79.25
404          UI   79.25   79.25     0.0
             *
             *
             * *** Route 480460: from CP 480 to CP 460: Mountain wash.  This is Trilbey Wash.
             * *** CP 460 is located North of Rockaway Hills Rd & west of 235th Ave Alignment

405          KK  480460
406          KO       0       0     0.0       0      21
407          RS       3    FLOW
408          RC    0.05   0.064    0.05 18660.0   0.017     0.0
```

```
                 * Small Wash
 409             RX       0    1300    1380    1560    1600    1640    1660    1710
 410             RY      11     7.2     5.2     3.3       0     3.2     7.2    13.2
                 *
                 *
                 * *** Basin TW460: Valley Basin located in Northwest portion of watershed.
1                                          HEC-1 INPUT
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LINE             ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


 411             KK   TW460
 412             KO       0       0     0.0       1      21
 413             BA  2.4410
 414             LG   0.232    0.25    5.72   0.222   6.443
                 * TW460
 415             UI     0.0  447.26 1592.55 1756.92  995.49  598.04   368.0  220.24  132.07   80.94
 416             UI   41.74   41.74     0.0
                 *
                 *
                 * *** Combine 460 *** Combines 480460 & TW460.

 417             KK     460
 418             KO       0       0     0.0       0      21
 419             HC       2
                 *
                 *
                 * *** Route 460420: from CP 460 to CP 420: Mountain wash.  This is Trilbey Wash.
                 * *** CP 420 is located at CAP Canal south of Jomax Rd and east of 227th Ave.

 420             KK  460420
 421             KO       0       0     0.0       0      21
 422             RS      15    FLOW
 423             RC    0.05   0.064    0.05 53954.0    0.01     0.0
                 * Medium Wash
 424             RX       0    1000    2500    3846    4110    4160    4300    7000
 425             RY      10       8       6     5.8       0       0       6      10
                 *
                 *
                 * *** Basin TW420: Less urban basin west-cetral portion of watershed.

 426             KK   TW420
 427             KO       0       0     0.0       1      21
 428             BA  10.893
 429             LG   0.285    0.25   5.699   0.214  15.475
                 * TW420
 430             UI     0.0  403.97 1006.02 1907.36 2457.49 3202.52 4824.48 4097.17 3152.55 2414.17
 431             UI  1805.2  950.38  678.69  440.76  273.39  123.88  123.88  123.88  123.88     0.0
                 *
                 *
                 *
                 * *** Combine 420 *** Combines 460420 & TW420.

 432             KK     420
 433             KO       0       0     0.0       0      21
 434             HC       2
                 *
                 *
                 * *** Storage CAP030 *** This storage is located at the CAP Canal at CP 420.
1                                          HEC-1 INPUT
PAGE 16

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


 435             KK  CAP030
 436             KO                                      21
 437             RS       1    STOR       0
                 * CAP 030, R-8 STA 609+00
 438             SQ       0  429.56 2188.44 4690.08    6223  7755.9    9526 11296.3
```

```
439          SE    1547    1548    1550    1552    1553    1554    1555    1556
440          SA      .3      .7     2.1       6      10      10   13.05    16.1
441          SE    1547    1548    1550    1552    1553    1554    1555    1556
             *
             *
             * *** Route 420200: from CP 420 to CP 200: Valley Wash.  This is Trilbey Wash.

442          KK  420200
443          KO       0       0     0.0       0      21
444          RS      11    FLOW
445          RC    0.08   0.046    0.08 26213.0   0.005     0.0
             * Medium Wash
446          RX       0    1000    2500    3846    4110    4160    4300    7000
447          RY      10       8       6     5.8       0       0       6      10
             *
             *
             *

448          KK   SV200
449          KO       0       0     0.0       1      21
450          BA  31.326
451          LG   0.239    0.25   5.368   0.256  27.428
             * THIS S-GRAPH WAS GENERATED MANUALLY (SEE APPENDIX) *
             * Combined S-Graph for Basin SV200: Phoenix Valley:70%, Phoenix Mountain:30%
             * Basin Area [sq mi] = 31.326
             * Basin Lag [hr] = 2.2
             * Time Step [min] = 15
             * Qult = 80862.4
             *
452          UI       0     799     799  2658.2  3709.1  4618.2  5419.9  6497.5  8799.7  8649.4
453          UI  6742.8  5756.1  4993.6  4189.3  3432.1  2937.8  2408.2  1757.3    1258  1083.4
454          UI   977.5     662   608.5   529.4   207.7   207.7   207.7   207.7   207.7   207.7
455          UI   207.7       0
             *
             *
             *
             * *** Combine 200 *** Combines 310200, 220200 & 420200 SV200

456          KK     200
457          KO       0       0     0.0       0      21
458          HC       4
             *
             *
             * *** Route 200400: from CP 200 to CP 400: Valley Wash.  This is Trilbey Wash.
1                                          HEC-1 INPUT
PAGE 17

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


459          KK  200400
460          KO       0       0     0.0       0      21
461          RS       4    FLOW
462          RC    0.08   0.046    0.08   16311   0.005     0.0
             * Large Wash
463          RX       0     465    1225    1925    2325    2405    4225    6225
464          RY      10       4       2       0       0       2       8      10
             *
             *
             *
             * *** Basin TW400: Slightly urban basin located in southwest part of watershed.

465          KK   TW400
466          KO       0       0     0.0       1      21
467          BA  12.988
468          LG   0.201    0.25   5.215   0.276  48.331
             * TW400
469          UI     0.0  512.19 1402.98 2550.53 3293.94  4549.4 6195.06 4613.14 3536.26 2651.18
470          UI  1647.5  881.67  649.87  415.35  157.07  157.07  157.07     0.0
             *
             *
```

```
                 *
                 * *** Combine 400 *** Combines 200400 & TW400.

471              KK     400
472              KO       0       0     0.0       0      21
473              HC       2
                 *
                 *
                 * *** Combine 400* *** Combines 100400 & 400.

474              KK    400*
475              KO       0       0     0.0       0      21
476              HC       2
                 *
                 *
                 * *** Route 400510: from CP 400 to CP 510 along McMicken Dam Channel.
                 * *** CP 510 is located at McMicken Dam Channel at Beardsley Rd and 171st Ave.

477              KK  400510
478              KO       0       0     0.0       0      21
479              RS       1    FLOW
480              RC   0.045   0.035   0.045  2671.0   0.001     0.0
                 * McMICKEN DAM CHANNEL
481              RX       0      46     101     121     171     181    1421    3621
482              RY      25      14       4       0       0       4      14      25
                 *
                 *
                 * *** Basin WI580: Less urban basin located in the central portion of watershed
1                                                HEC-1 INPUT
PAGE 18

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


483              KK   WI580
484              KO       0       0     0.0       1      21
485              BA  30.346
486              LG   0.277   0.183   6.675   0.148  12.926
                 * WI580
487              UI     0.0  912.94 1505.34 3600.13 4761.14 5747.77 7107.6310110.8210748.08 8226.59
488              UI  6779.2 5421.02  4335.0 2888.56  1606.3 1480.71  912.94  712.63  279.97  279.97
489              UI  279.97  279.97  279.97     0.0
                 *
                 *
                 *
                 * *** Storage CAP040 *** This storage is located at the CAP Canal at CP 580.
                 * *** CP 580 is located at CAP Canal south of Patton Rd and west of 211th Ave.

490              KK  CAP040
491              KO       0       0     0.0       0      21
492              RS       1    STOR       0
                 * CAP 040, R-8 STA 688+00
                 * THE WEIR LENGTH IS 5100 FT AND THE WEIR COEF - 2.7
                 * THE WEIR FLOW WAS CALCULATED AT H = 1 FT (1553.7) AND H = 2 FT (1554.7)
493              SQ       0       0       0       0       0  366.58 1559.96 3214.13 3880.54   17650
494              SQ   42827
495              SE    1540    1542    1544    1546 1546.77    1548    1550    1552  1552.7  1553.7
496              SE  1554.7
497              SA      .5     1.6       3    22.1    37.1    61.1   105.1   160.8   181.3   181.4
498              SA   181.5
499              SE    1540    1542    1544    1546 1546.77    1548    1550    1552  1552.7  1553.7
500              SE  1554.7
                 *
                 *
                 * *** Route 580510: from CP 580 to CP510: Valley Wash

501              KK  580510
502              KO       0       0     0.0       0      21
503              RS       8    FLOW
504              RC    0.08   0.046    0.08 39351.0   0.005     0.0
                 * Large Wash
```

```
505          RX       0     465    1225    1925    2325    2405    4225    6225
506          RY      10       4       2       0       0       2       8      10
             *
             *
             * *** Basin WI510:Slightly urban basin located in southcentral part of watershed

507          KK   WI510
508          KO       0       0     0.0       1      21
509          BA  9.3124
510          LG    0.19    0.25   5.804   0.234  56.461
             *
             * Phoenix Valley S-Graph for Basin WI510
             * Basin Area [sq mi] = 9.3124
             * Basin Lag [hr] = 1.73
             * Time Step [min] = 15
             * Qult = 24038.3
             *
1                                          HEC-1 INPUT
PAGE 19

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

511          UI       0   302.1     584  1277.6  1658.2  2052.2  2671.6  3751.4  2996.3  2398.5
512          UI  1900.4  1499.9  1011.7   535.5   473.2   302.1   191.7    92.6    92.6    92.6
513          UI    92.6       0
             *
             *
             *
             * *** Combine 510 *** Combines 580510 & WI510.

514          KK     510
515          KO       0       0     0.0       0      21
516          HC       2
             *
             * *** Combine 510* *** Combines 400510 & 510.

517          KK    510*
518          KO       0       0     0.0       0      21
519          HC       2
             *
             *
             * *** Route 510500: from CP 510 to CP 500.2 along McMicken Dam Channel.
             * *** CP 500.2 is located North of Beardsley Rd and East of 179th Ave.

520          KK  510500
521          KO       0       0     0.0       0      21
522          RS       1    FLOW
523          RC   0.045   0.035   0.045  7342.0   0.001     0.0
             * McMICKEN DAM CHANNEL
524          RX       0      46     101     121     171     181    1421    3621
525          RY      25      14       4       0       0       4      14      25
             *
             *
             * *** Basin WI520: Less Urban Basin located in central portion of watershed.

526          KK   WI520
527          KO       0       0     0.0       1      21
528          BA  16.390
529          LG   0.251    0.25   5.691   0.220  28.930
             * WI520
530          UI     0.0  572.64 1279.07 2574.95 3324.27 4197.33 6065.25 6650.63  4957.5 3910.12
531          UI  3031.2 2108.55 1109.31  899.49  572.64  320.74  175.61  175.61  175.61  175.61
532          UI     0.0
             *
             *
             * *** Storage CAP050 *** This storage is located at the CAP Canal at CP 520.
             * *** CP 520 is located at the CAP Canal at Dixileta Dr and 203rd Ave aligments.
             *
             * THIS STORAGE WAS REMOVED DUE TO COMPUTATIONAL INSTABILITY.
             * THIS COULD BE CORRECTED BY DECREASING THE COMPUTATION INTERVAL
             * BUT DUE TO THE USE OF S-GRAPHS NO CHANGE INTEH COMPUTATION INTERVAL
```

```
                    * COULD BE MADE.
                    *
                    * KKCAP050
                    * KO                                        21
                    * RS     1     STOR        0
                    * CAP 050, R-8 STA 804+50
                    * THE WEIR LENGTH IS 4100 FT AND THE WEIR COEF - 2.7
                    * THE WEIR FLOW WAS CALCULATED AT H = 1 FT (1554) AND H = 2 FT (1555)
                    * SQ   0.0  1075.5  2314.3  3832.8  4683.6   14900   35141
                    * SE  1546    1548    1550    1552    1553    1554    1555
                    * SA    .1      .7    11.5    35.3      54    54.1    54.2
                    * SE  1546    1548    1550    1552    1553    1554    1555
                    *
                    *
                    * *** Route 520500: from CP 520 to CP 500.1: Valley Wash.
                    * *** CP 500.1 is located North of Beardsley Rd and East of 179th Ave.
                    * *** CP 500.1 and 500.2 are located at the same location.
1                                                HEC-1 INPUT
PAGE 20

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


         533        KK  520500
         534        KO       0       0     0.0       0      21
         535        RS       6    FLOW
         536        RC    0.08   0.046    0.08 34143.0   0.006     0.0
                    * Medium Wash
         537        RX       0    1000    2500    3846    4110    4160    4300    7000
         538        RY      10       8       6     5.8       0       0       6      10
                    *
                    *
                    * *** Diversion Recover CAP ***********************************
                    * Recovers flows from CAP impoundment area

         539        KK    CAP2
         540        DR    CAP2
                    *
                    * *** CAP *****************************************************
                    * This diversion is for the Impoundment area upstream of the CAP.
                    *
                    *
                    * DDM   *****PRESERVED*****

         541        KK    CAP2
         542        KO       0       0       0       0      21
         543        DT    CAP3
                    * This diversion was calculated on the capacities of the overchutes.
                    * The overchutes that contribute to route 540500 are CAP 60 & 70.
                    * The capacities of the culverts in this system can be found in the appendix.
         544        DI       0     617    1991    4413    5380    6070    6707   66031  174319
         545        DQ       0     583    1871    3937    4755    5325    5908   47668  123941
                    *
                    *
                    * *** Route 540500: from CP 540 to CP 500.1: Valley Wash.

         546        KK  540500
         547        KO       0       0       0       0      21
         548        RS      14    FLOW
         549        RC    0.08   0.046    0.08 32882.0   0.007       0
                    * Medium Wash
         550        RX       0    1000    2500    3846    4110    4160    4300    7000
         551        RY      10       8       6     5.8       0       0       6      10
                    *
                    *
                    * *** Basin WI500:Slightly Urban Basin located in southcentral part of watershed

         552        KK   WI500
         553        KO       0       0     0.0       1      21
         554        BA  9.1574
         555        LG   0.238    0.25   5.232   0.295  40.465
```

```
                    *
                    * Phoenix Valley S-Graph for Basin WI500
                    * Basin Area [sq mi] = 9.1574
                    * Basin Lag [hr] = 1.48
                    * Time Step [min] = 15
                    * Qult = 23638.2
                    *
1                                                HEC-1 INPUT
PAGE 21

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

 556                UI       0   347.2   896.5  1670.8  2152.3  2859.1  4212.7  3365.2  2597.2  1969.1
 557                UI  1400.5   720.7   544.7   347.2   163.6   106.5   106.5   106.5       0
                    *
                    *
                    *
                    * This concentration point is hard-coded to account for 10% of the split
                    * at the CAP (See Appendix and note above concentration point 505).
                    * *** Combine 500.1 *** Combines 520500, 540500 & WI500.

 558                KK   500.1
 559                KO       0       0     0.0       0      21
 560                HC       3 32.5444
                    *        32.5444 =  16.3900 (520500)
                    *                +   6.9970 (540500-diversion)
                    *                +   9.1574 (WI500)
                    *
                    *
                    *
                    * *** Combine 500.2 *** Combines 510500 & 500.1.

 561                KK   500.2
 562                KO       0       0     0.0       0      21
 563                HC       2
                    *
                    *
                    *
                    * *** Route 500500: This route is contained along the McMicken Dam Channel in
                    * ***               Basin WI500, and routes concentration point 500.2 to
                    * ***               concentration point 500.3.

 564                KK  500500
 565                KO       0       0     0.0       0      21
 566                RS       1    FLOW
 567                RC   0.045   0.035   0.045  2214.0   0.001     0.0
                    * McMICKEN DAM CHANNEL
 568                RX       0      46     101     121     171     181    1421    3621
 569                RY      25      14       4       0       0       4      14      25
                    *
                    *
                    *
                    * Concentration POInt 500.3 is the McMicken Dam Spillway
                    * *** Combine 500.3 *** Combines 500500 & 505500.

 570                KK   500.3
 571                KO       0       0     0.0       0      21
 572                HC       2
                    *
                    *
                    *
                    * *** Route 500600: from CP 500 to CP 600 along McMicken Dam Outlet Channel.
                    * *** CP 600 is located at McMicken Dam Outlet Channel south of Happy Valley Rd.
                    * *** and 147th Ave alignments.
1                                                HEC-1 INPUT
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LINE                ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 573                KK  500600
```

```
574          KO       0       0     0.0       0      21
575          RS       3    FLOW
576          RC   0.045   0.035   0.045 18203.0   0.001     0.0
             * McMICKEN DAM CHANNEL
577          RX       0      46     101     121     171     181    1421    3621
578          RY      25      14       4       0       0       4      14      25
             *
             *
             * *** Basin PI600: Slightly Urban Basin located in southeast part of watershed.

579          KK   PI600
580          KO       0       0     0.0       1      21
581          BA  12.033
582          LG   0.264   0.250   4.635   0.374  28.192
             * PI600
583          UI     0.0  540.35 1821.67 2946.35 3969.05 6261.74 5234.94 3836.18 2769.89 1504.77
584          UI  910.08  549.84  232.03  165.71  165.71     0.0
             *
             *
             *
             * *** Diversion Recover CAP ************************************
             * Recovers flows from CAP impoundment area

585          KK    CAP3
586          DR    CAP3
             *
             * *** CAP ******************************************************
             * This diversion is for the Impoundment area upstream of the CAP.
             *
             *
             * DDM   *****PRESERVED*****

587          KK    CAP3
588          KO       0       0     0.0       0      21
589          DT    CAP4
             *
             * This diversion was calculated on the capacities of the overchutes.
             * The overchutes that contribute to route 640600 are CAP 110 to 150.
             * The capacities of the culverts in this system can be found in the appendix.
590          DI       0     583    1871    3937    4755    5325    5908   47668  123941
591          DQ       0     470    1525    2720    3160    3440    3832   21628   54303
             *
             *
             * *** Route 640600: from CP 640 to CP 600: Valley Wash.

592          KK  640600
593          KO       0       0     0.0       0      21
594          RS      10    FLOW
595          RC    0.08   0.046    0.08 31873.0   0.007     0.0
             * Medium Wash
596          RX       0    1000    2500    3846    4110    4160    4300    7000
597          RY      10       8       6     5.8       0       0       6      10
             *
             *
             * *** Combine 600 *** Combines PI600 & 640600.
1                                          HEC-1 INPUT
PAGE 23

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


598          KK     600
599          KO       0       0     0.0       0      21
             *
             * This concentration point is hard-coded to account for 26% of the split
             * at the CAP (See Appendix and note above concentration point 505).
             *
600          HC       2 30.2230
             *        30.2230 =
             *                + 12.0330 (PI600)
             *                + 18.1910 (640600-diversion)
```

```
                 *
                 *
                 *
                 * *** Combine 600* *** Combines 500600 & 600

601              KK    600*
602              KO       0       0     0.0       0      21
603              HC       2
                 *
                 *
                 *
                 * *** Route 600710: from CP 600 to CP 710 along McMicken Dam Outlet Channel
                 * *** CP 710 is located along McMIcken Dam Outlet Channel south of Happy Valley
                 * *** Rd. and 139th Ave. alignments.

604              KK  600710
605              KO       0       0     0.0       0      21
606              RS       1    FLOW
607              RC   0.045   0.035   0.045  4403.0   0.001     0.0
                 * McMICKEN DAM CHANNEL
608              RX       0      46     101     121     171     181    1421    3621
609              RY      25      14       4       0       0       4      14      25
                 *
                 *
                 * *** Diversion Recover CAP ***********************************
                 * Recovers flows from CAP impoundment area

610              KK    CAP4
611              KO       0       0     0.0       0      21
612              DR    CAP4
                 *
                 * The overchutes that contribute to route 760710 are CAP 160 to 190.
                 * The capacities of the culverts in this system can be found in the appendix.
                 *
                 *
                 * *** Route 760710: from CP 760 to 710: Valley Wash.

613              KK  760710
614              KO       0       0     0.0       0      21
615              RS       6    FLOW
616              RC    0.08   0.046    0.08 28446.0   0.008     0.0
                 * Medium Wash
617              RX       0    1000    2500    3846    4110    4160    4300    7000
618              RY      10       8       6     5.8       0       0       6      10
                 *
                 *
                 * *** Basin PD710: Slightly Urban Basin located in southeast part of watershed.
1                                                HEC-1 INPUT
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LINE             ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


619              KK   PD710
620              KO       0       0     0.0       1      21
621              BA  6.7175
622              LG   0.295   0.249   4.556   0.356  12.509
                 * PD710_NEW
623              UI     0.0  278.61  828.03 1439.46 1882.56 2755.43 3200.47 2300.02  1717.2  1234.6
624              UI  614.69  435.49  278.61   105.0   85.44   85.44   85.44     0.0
                 *
                 *
                 * *** Basin PD 740: foothills basin located in eastcentral part of watershed.

625              KK   PD740
626              KO       0       0     0.0       1      21
627              BA  0.8688
628              LG   0.279   0.249   5.026   0.308  16.987
                 * PD740
629              UI     0.0 1305.48  723.54  170.11   43.03
                 *
```

```
                 *
                 * *** Storage CAP200 *** This storage is located at the CAP Canal at CP 740.
                 * *** CP 740 is located at the CAP Canal at Lone Mountain Rd and 147th Ave.

630              KK  CAP200
631              RS       1    STOR       0
                 * CAP 200, R-8 STA 342+40
                 * THE WEIR LENGTH IS 3800 FT AND THE WEIR COEF - 2.7
                 * THE WEIR FLOW WAS CALCULATED AT H = 1 FT (1542.4) AND H = 2 FT (1543.4)
632              SQ     0.0    25.0   175.0   335.0   440.0   530.0   600.0   620.0   10880   29640
633              SE    1516    1520    1524    1528    1532    1536    1540  1541.4  1542.4  1543.4
634              SA       0       0     1.3     6.0    18.0      40    69.9    80.6    80.7    80.8
635              SE    1516    1520    1524    1528    1532    1536    1540  1541.4  1542.4  1543.4
                 *
                 *
                 * *** Route 740710: from CP 740 to 710: Valley Wash.

636              KK  740710
637              KO       0       0     0.0       0      21
638              RS      10    FLOW
639              RC    0.08   0.046    0.08 27269.0   0.007     0.0
                 * Medium Wash
640              RX       0    1000    2500    3846    4110    4160    4300    7000
641              RY      10       8       6     5.8       0       0       6      10
                 *
                 *
                 * *** Combine 710 *** Combines 760710, PD710 & 740710

642              KK     710
643              KO       0       0     0.0       0      21
                 *
                 * This concentration point is hard-coded to account for 48% of the split
                 * at the CAP (See Appendix and note above concentration point 505).
                 *
                 *
644              HC       3 41.1693
                 *        41.1693 =
                 *                +  33.5830 (760710-diversion)
                 *                +   6.7175 (PD710)
                 *                +   0.8688 (740710)
                 *
                 *
                 * *** Combine 710* *** Combines 600710 & 710.
```



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


645              KK    710*
646              KO       0       0     0.0       0      21
647              HC       2
                 *
                 *
                 *
                 * *** Route 710700: from CP 710 to CP 700 along McMicken Dam outlet Channel
                 * *** CP 700 is located at southeast-most point in watershed
                 * *** CP 700 is the Outlet point of the watershed

648              KK  710700
649              KO       0       0     0.0       0      21
650              RS       1    FLOW
651              RC   0.045   0.035   0.045  7571.0   0.001     0.0
                 * McMICKEN DAM CHANNEL
652              RX       0      46     101     121     171     181    1421    3621
653              RY      25      14       4       0       0       4      14      25
                 *
                 *
                 * *** Basin PD730: mountain basin located in eastcentral portion of watershed.

654              KK   PD730
```

```
655          KO       0       0     0.0       1      21
656          BA  0.4765
657          LG   0.293    0.25   4.406   0.383  40.267
             * PD730
658          UI     0.0  384.95  540.81  193.45   71.19   25.24     0.0
             *
             *
             * *** Storage CAP220 *** This storage is located at the CAP Canal at CP 730.
             * *** CP 730 is located at the CAP Canal at Lone Mountain Rd east of 139th Ave.

659          KK  CAP220
660          KO                                      21
661          RS       1    STOR       0
             * CAP 220, R-8 STA 433+85
             * THE WEIR LENGTH IS 2000 FT AND THE WEIR COEF - 2.7
             * THE WEIR FLOW WAS CALCULATED AT H = 1 FT (1541) AND H = 2 FT (1542)
662          SQ     0.0    28.0   155.0   315.0   425.0   525.0   600.0   670.0    6070 15943.5
663          SE    1512    1516    1520    1524    1528    1532    1536    1540    1541    1542
664          SA       0      .1      .2      .5     4.4    15.4    29.2    29.3    29.4
665          SE    1512    1520    1524    1528    1532    1536    1540    1541    1542
             *
             *
             * *** Basin PD735: mountain basin located in eastcentral portion of watershed.

666          KK   PD735
667          KO       0       0     0.0       1      21
668          BA  3.2311
669          LG   0.264    0.25   4.295   0.456  39.149
             * PD735-mountain S-graph
             * UI    0.0  603.62 1774.11 3033.05 1821.19  713.75  252.36   86.95     0.0
670          UI     0.0  570.26 2032.42 2342.37 1326.24  809.22  505.26  302.41  181.68  117.51
671          UI   54.34   54.34     0.0
             *
             *
             * *** Storage CAP210 *** This storage is located at the CAP Canal at CP 735.
             * *** CP 735 is located @ the CAP Canal @ Lone Mountain Rd and east of 147th Ave
                                          HEC-1 INPUT
PAGE 26

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


672          KK  CAP210
673          KO       0       0     0.0       0      21
674          RS       1    STOR       0
             * CAP 210, R-8 STA 376+80
             * THE WEIR LENGTH IS 2200 FT AND THE WEIR COEF - 2.7
             * THE WEIR FLOW WAS CALCULATED AT H = 1 FT (1543) AND H = 2 FT (1544)
675          SQ     0.0   372.0  1240.0  1900.0  2480.0  2888.0  3280.0  3600.0  3760.0    9700
676          SQ   20561
677          SE    1512    1516    1520    1524    1528    1532    1536    1540    1542    1543
678          SE    1544
679          SA       0      .3      .8     1.4     2.7     6.5    13.8    22.4      27    27.1
680          SA    27.2
681          SE    1512    1516    1520    1524    1528    1532    1536    1540    1542    1543
682          SE    1544
             *
             *
             *
             * *** Combine 736 *** Combines CAP210 and CAP220

683          KK     736
684          KO       0       0     0.0       0      21
685          HC       2
             *
             *
             * *** Route 735700: from CP 735 to CP 700: mountainous wash.

686          KK  735700
687          KO       0       0     0.0       0      21
688          RS       8    FLOW
```

```
689          RC    0.05   0.064    0.05 27046.0   0.008     0.0
             * Small Wash
690          RX       0    1300    1380    1560    1600    1640    1660    1710
691          RY      11     7.2     5.2     3.3       0     3.2     7.2    13.2
             *
             *
             *
             * *** Basin PD700: Less Urban basin located in southeast portion of watershed.

692          KK   PD700
693          KO       0       0     0.0       1      21
694          BA  7.2631
695          LG   0.284   0.246   5.179   0.264  16.866
             * PD700
696          UI     0.0  655.84 2198.42 3476.21 5214.62 3425.79 2083.76  866.41   464.3  141.21
697          UI  141.21     0.0
             *
             *
             *
             * *** Combine 700 *** Combines Concentration Point 736 & Basin PD700.
1                                          HEC-1 INPUT
PAGE 27

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


698          KK     700
699          KO       0       0     0.0       0      21
700          HC       2
             *
             *
             *
             * *** Combine 700* *** Combines 710700 & 700.

701          KK    700*
702          KO       0       0     0.0       0      21
703          HC       2
             *
704          ZZ
```

```
                SCHEMATIC DIAGRAM OF STREAM NETWORK
OUT
LINE      (V) ROUTING          (--->) DIVERSION OR PUMP FLOW

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

154        PI680
               V
               V
162       680640
               .
               .
168            .       PI640
               .           .
               .           .
174          640............
               .
               .
177            .       WI540
               .           .
               .           .
183            .           .       PD780
               .           .           V
               .           .           V
189            .           .      780760
               .           .           .
               .           .           .
195            .           .           .       PD760
               .           .           .           .
               .           .           .           .
200            .           .           .           .       PD745
               .           .           .           .           .
               .           .           .           .           .
205          CAP.............................................
               V
               V
208         STOR
               .
               .
216            .-------->    CAP2
214         CAP1
               V
               V
219       640505
               .
               .
225            .       WI505
               .           .
               .           .
231          505............
               V
               V
234       505500
               .
               .
240            .       WT140
               .           V
               .           V
247            .      140130
               .           .
               .           .
253            .           .       WT130
               .           .           .
               .           .           .
259            .         130............
               .           V
               .           V
262            .      130120
               .           .
               .           .
268            .           .       WT150
```

```
                 .           .           V
                 .           .           V
275              .           .      150120
                 .           .           .
                 .           .           .
281              .           .           .      WT160
                 .           .           .          V
                 .           .           .          V
287              .           .           .     160120
                 .           .           .           .
                 .           .           .           .
293              .           .           .           .       WT120
                 .           .           .           .           .
                 .           .           .           .           .
298              .           .         120.......................
                 .           .           .
                 .           .           .
301              .       120*............
                 .          V
                 .          V
303              .     120110
                 .           .
                 .           .
309              .           .      WT110
                 .           .           .
                 .           .           .
315              .        110............
                 .          V
                 .          V
318              .     110100
                 .           .
                 .           .
324              .           .      WT100
                 .           .           .
                 .           .           .
330              .        100............
                 .          V
                 .          V
333              .     100400
                 .           .
                 .           .
339              .           .      IW350
                 .           .          V
                 .           .          V
345              .           .     350310
                 .           .           .
                 .           .           .
351              .           .           .      IW310
                 .           .           .           .
                 .           .           .           .
358              .           .         310............
                 .           .           V
                 .           .           V
361              .           .     CAP020
                 .           .          V
                 .           .          V
368              .           .     310200
                 .           .           .
                 .           .           .
374              .           .           .      SV220
                 .           .           .          V
                 .           .           .          V
380              .           .           .     CAP010
                 .           .           .          V
                 .           .           .          V
391              .           .           .     220200
                 .           .           .           .
                 .           .           .           .
397              .           .           .           .       TW480
                 .           .           .           .           V
                 .           .           .           .           V
```

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405                                   480460
                                           .
                                           .
411                                        .        TW460
                                           .            .
                                           .            .
417                                     460............
                                          V
                                          V
420                                   460420
                                           .
                                           .
426                                        .        TW420
                                           .            .
                                           .            .
432                                     420............
                                          V
                                          V
435                                   CAP030
                                          V
                                          V
442                                   420200
                                           .
                                           .
448                                        .        SV200
                                           .            .
                                           .            .
456                          200.................................
                               V
                               V
459                        200400
                                .
                                .
465                             .       TW400
                                .           .
                                .           .
471                          400............
                                .
                                .
474                      400*............
                           V
                           V
477                    400510
                                .
                                .
483                         WI580
                               V
                               V
490                        CAP040
                               V
                               V
501                        580510
                                .
                                .
507                             .       WI510
                                .           .
                                .           .
514                          510............
                                .
                                .
517                      510*............
                           V
                           V
520                    510500
                                .
                                .
526                         WI520
                               V
                               V
533                        520500
                                .
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                .           .           .
540             .           .           .           .<-------    CAP2
539             .           .           .        CAP2
                .           .           .           .
                .           .           .           .
543             .           .           .           .------->    CAP3
541             .           .           .        CAP2
                .           .           .           V
                .           .           .           V
546             .           .           .      540500
                .           .           .           .
                .           .           .           .
552             .           .           .           .       WI500
                .           .           .           .           .
                .           .           .           .           .
558             .           .       500.1.......................
                .           .           .
                .           .           .
561             .       500.2............
                .           V
                .           V
564             .      500500
                .           .
                .           .
570       500.3............
              V
              V
573      500600
                .
                .
579             .       PI600
                .           .
                .           .
586             .           .           .<-------    CAP3
585             .           .       CAP3
                .           .           .
                .           .           .
589             .           .           .------->    CAP4
587             .           .       CAP3
                .           .           V
                .           .           V
592             .           .      640600
                .           .           .
                .           .           .
598             .         600............
                .           .
                .           .
601        600*............
              V
              V
604      600710
                .
                .
612             .           .<-------    CAP4
610             .        CAP4
                .           V
                .           V
613             .      760710
                .           .
                .           .
619             .           .       PD710
                .           .           .
                .           .           .
625             .           .           .       PD740
                .           .           .           V
                .           .           .           V
630             .           .           .      CAP200
                .           .           .           V
                .           .           .           V
636             .           .           .      740710
                .           .           .           .
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                .          .          .          .
642             .        710.......................
                .          .
                .          .
645          710*...........
                V
                V
648        710700
                .
                .
654             .      PD730
                .          V
                .          V
659             .     CAP220
                .          .
                .          .
666             .          .       PD735
                .          .           V
                .          .           V
672             .          .      CAP210
                .          .           .
                .          .           .
683             .        736...........
                .          V
                .          V
686             .     735700
                .          .
                .          .
692             .          .       PD700
                .          .           .
                .          .           .
698             .        700...........
                .          .
                .          .
701          700*...........
```

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

MAXIMUM MAX STAGE	TIME OF OPERATION	STATION	PEAK FLOW	TIME OF PEAK	AVERAGE FLOW FOR MAXIMUM PERIOD 6-HOUR	24-HOUR	72-HOUR	BASIN AREA	STAGE
+	HYDROGRAPH AT	PI680	7764.	13.50	3062.	959.	322.	16.89	
+	ROUTED TO	680640	5696.	15.25	2959.	952.	322.	16.89	
+	HYDROGRAPH AT	PI640	12006.	13.50	3299.	919.	307.	17.56	
+	2 COMBINED AT	640	11905.	13.50	5641.	1772.	602.	34.45	
+	HYDROGRAPH AT	WI540	8161.	13.50	2455.	772.	258.	11.64	
+	HYDROGRAPH AT	PD780	13880.	13.25	3439.	1052.	352.	19.17	
+	ROUTED TO	780760	7805.	14.00	3432.	1049.	352.	19.17	
+	HYDROGRAPH AT	PD760	3585.	12.50	392.	110.	37.	2.72	
+	HYDROGRAPH AT	PD745	2513.	12.50	323.	92.	31.	1.98	
+	5 COMBINED AT	CAP	26246.	13.50	11266.	3521.	1192.	69.96	
+	ROUTED TO	STOR	7249.	15.75	6936.	3492.	1192.	69.96	
+	DIVERSION TO	CAP2	6098.	15.75	5840.	2977.	1017.	69.96	
+	HYDROGRAPH AT	CAP1	1151.	15.75	1097.	515.	175.	69.96	
+	ROUTED TO	640505	1146.	17.25	1089.	515.	175.	69.96	
+	HYDROGRAPH AT	WI505	4717.	13.25	1180.	360.	120.	6.67	
+	2 COMBINED AT	505	4650.	13.25	1823.	891.	307.	17.87	
+	ROUTED TO	505500	3850.	13.50	1792.	890.	307.	17.87	
+	HYDROGRAPH AT	WT140	2394.	13.00	631.	187.	63.	3.80	
+	ROUTED TO	140130	1638.	13.75	628.	186.	63.	3.80	
+	HYDROGRAPH AT	WT130	1889.	13.00	406.	114.	38.	2.54	
	2 COMBINED AT								

+	130	2557.	13.00	1023.	298.	100.	6.34
ROUTED TO +	130120	2463.	13.25	1022.	298.	100.	6.34
HYDROGRAPH AT +	WT150	3203.	13.25	957.	286.	96.	5.85
ROUTED TO +	150120	2302.	14.00	951.	285.	96.	5.85
HYDROGRAPH AT +	WT160	772.	12.50	139.	41.	14.	.82
ROUTED TO +	160120	471.	13.50	138.	40.	14.	.82
HYDROGRAPH AT +	WT120	3418.	12.50	419.	112.	37.	2.82
3 COMBINED AT +	120	3628.	12.50	1482.	433.	145.	9.48
2 COMBINED AT +	120*	4862.	13.75	2422.	708.	238.	15.82
ROUTED TO +	120110	4417.	14.50	2408.	707.	238.	15.82
HYDROGRAPH AT +	WT110	3195.	12.50	447.	124.	41.	2.90
2 COMBINED AT +	110	4417.	14.50	2786.	817.	275.	18.71
ROUTED TO +	110100	4362.	14.75	2766.	815.	274.	18.71
HYDROGRAPH AT +	WT100	2991.	13.00	653.	192.	64.	3.84
2 COMBINED AT +	100	5668.	13.00	3328.	981.	331.	22.56
ROUTED TO +	100400	4411.	15.25	3240.	980.	331.	22.56
HYDROGRAPH AT +	IW350	4139.	12.50	742.	211.	70.	4.21
ROUTED TO +	350310	1256.	18.00	650.	208.	70.	4.21
HYDROGRAPH AT +	IW310	12310.	14.00	4703.	1313.	439.	25.81
2 COMBINED AT +	310	12193.	14.00	4816.	1470.	500.	30.02
ROUTED TO +	CAP020	11963.	14.25	4432.	1464.	498.	30.02
ROUTED TO +	310200	7784.	16.00	4094.	1456.	498.	30.02
HYDROGRAPH AT +	SV220	12073.	13.50	3498.	1031.	345.	16.95
ROUTED TO	CAP010	8559.	14.00	3433.	1026.	343.	16.95

	ROUTED TO	220200	5181.	15.75	3347.	1021.	343.	16.95
+	HYDROGRAPH AT	TW480	6439.	13.50	2377.	733.	246.	12.72
+	ROUTED TO	480460	5316.	14.00	2340.	731.	246.	12.72
+	HYDROGRAPH AT	TW460	2124.	12.75	368.	97.	32.	2.44
+	2 COMBINED AT	460	5433.	14.00	2616.	815.	274.	15.16
+	ROUTED TO	460420	4213.	16.75	2465.	809.	274.	15.16
+	HYDROGRAPH AT	TW420	6353.	13.50	1773.	495.	165.	10.89
+	2 COMBINED AT	420	6132.	13.50	3352.	1227.	421.	26.06
+	ROUTED TO	CAP030	5769.	13.50	3354.	1227.	421.	26.06
+	ROUTED TO	420200	4749.	15.00	3246.	1226.	421.	26.06
+	HYDROGRAPH AT	SV200	11930.	14.00	5105.	1549.	519.	31.33
+	4 COMBINED AT	200	19641.	15.50	13033.	4739.	1633.	104.36
+	ROUTED TO	200400	18446.	16.50	12858.	4733.	1633.	104.36
+	HYDROGRAPH AT	TW400	8875.	13.50	2716.	868.	291.	12.99
+	2 COMBINED AT	400	18692.	16.50	13712.	5403.	1878.	117.35
+	2 COMBINED AT	400*	21956.	16.25	16357.	6210.	2152.	139.91
+	ROUTED TO	400510	21851.	16.50	16309.	6210.	2152.	139.91
+	HYDROGRAPH AT	WI580	14456.	14.00	4968.	1358.	454.	30.35
+	ROUTED TO	CAP040	13693.	14.00	4652.	1334.	445.	30.35
+	ROUTED TO	580510	7121.	17.00	4092.	1329.	445.	30.35
+	HYDROGRAPH AT	WI510	5897.	13.75	2122.	692.	232.	9.31
+	2 COMBINED AT	510	7405.	17.00	4635.	1879.	652.	39.66
+	2 COMBINED AT	510*	27205.	16.75	20059.	7815.	2710.	179.56
+	ROUTED TO	510500	25946.	17.25	19719.	7812.	2710.	179.56

	HYDROGRAPH AT	WI520	9032.	13.75	2939.	877.	293.	16.39
+	ROUTED TO	520500	5838.	15.50	2871.	870.	293.	16.39
+	HYDROGRAPH AT	CAP2	6098.	15.75	5840.	2977.	1017.	69.96
+	DIVERSION TO	CAP3	5351.	15.75	5135.	2661.	911.	69.96
+	HYDROGRAPH AT	CAP2	747.	15.75	704.	315.	107.	69.96
+	ROUTED TO	540500	741.	18.50	695.	315.	107.	69.96
+	HYDROGRAPH AT	WI500	5927.	13.50	1807.	565.	189.	9.16
+	3 COMBINED AT	500.1	6809.	15.25	4606.	1664.	570.	32.54
+	2 COMBINED AT	500.2	28560.	17.00	23023.	9200.	3190.	212.11
+	ROUTED TO	500500	28442.	17.25	22982.	9200.	3190.	212.11
+	2 COMBINED AT	500.3	29492.	17.25	24205.	9913.	3437.	229.97
	ROUTED TO	500600	28191.	18.25	23579.	9905.	3437.	229.97
+	HYDROGRAPH AT	PI600	7848.	13.25	2015.	606.	203.	12.03
+	HYDROGRAPH AT	CAP3	5351.	15.75	5135.	2661.	911.	69.96
+	DIVERSION TO	CAP4	3458.	15.75	3348.	1843.	633.	69.96
+	HYDROGRAPH AT	CAP3	1894.	15.75	1788.	818.	277.	69.96
+	ROUTED TO	640600	1880.	17.75	1766.	816.	277.	69.96
+	2 COMBINED AT	600	7848.	13.25	2963.	1467.	507.	30.22
+	2 COMBINED AT	600*	29887.	18.25	25229.	11045.	3834.	260.20
+	ROUTED TO	600710	29704.	18.50	25140.	11043.	3834.	260.20
+	HYDROGRAPH AT	CAP4	3458.	15.75	3348.	1843.	633.	69.96
+	ROUTED TO	760710	3443.	17.25	3328.	1840.	633.	69.96
	HYDROGRAPH AT	PD710	3724.	13.50	970.	268.	90.	6.72
	HYDROGRAPH AT							

+		PD740	1473.	12.25	139.	39.	13.	.87
	ROUTED TO							
+		CAP200	381.	12.75	139.	40.	13.	.87
	ROUTED TO							
+		740710	282.	15.50	132.	39.	13.	.87
	3 COMBINED AT							
+		710	4455.	13.50	3631.	2161.	744.	41.17
	2 COMBINED AT							
+		710*	32785.	18.50	28257.	12886.	4472.	301.37
	ROUTED TO							
+		710700	32308.	18.75	27999.	12877.	4472.	301.37
	HYDROGRAPH AT							
+		PD730	633.	12.50	93.	29.	10.	.48
	ROUTED TO							
+		CAP220	462.	12.50	94.	29.	10.	.48
	HYDROGRAPH AT							
+		PD735	2857.	12.75	605.	190.	64.	3.23
	ROUTED TO							
+		CAP210	2581.	12.75	605.	190.	64.	3.23
	2 COMBINED AT							
+		736	3035.	12.75	696.	219.	73.	3.71
	ROUTED TO							
+		735700	1684.	14.50	690.	217.	73.	3.71
	HYDROGRAPH AT							
+		PD700	6357.	13.00	1171.	330.	110.	7.26
	2 COMBINED AT							
+		700	6472.	13.00	1817.	537.	181.	10.97
	2 COMBINED AT							
+		700*	32368.	18.75	28164.	13255.	4607.	312.34

*** NORMAL END OF HEC-1 ***

APPENDIX E. 200-YR, 24-HR HEC-1 OUTPUT

E.1. Existing Conditions

E.2. Future Conditions

E.1. Existing Conditions

```
1*************************************                    *************************************
                                    *                    *                                   *
 FLOOD HYDROGRAPH PACKAGE  (HEC-1)  *                    *   U.S. ARMY CORPS OF ENGINEERS    *
              JUN   1998            *                    *   HYDROLOGIC ENGINEERING CENTER   *
            VERSION 4.1             *                    *         609 SECOND STREET         *
                                    *                    *      DAVIS, CALIFORNIA 95616      *
  RUN DATE   26APR04  TIME  08:14:52 *                    *          (916) 756-1104           *
                                    *                    *                                   *
*************************************                    *************************************
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```
X     X  XXXXXXX   XXXXX          X
X     X  X        X     X        XX
X     X  X        X               X
XXXXXXX  XXXX     X        XXXXX  X
X     X  X        X               X
X     X  X        X     X         X
X     X  XXXXXXX   XXXXX         XXX
```

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

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

1 HEC-1 INPUT
PAGE 1

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

    1          ID
    2          ID   ******************************************************************************
    3          ID   **                                                                          **
    4          ID   **                    McMICKEN DAM HYDROLOGY MODEL                          **
    5          ID   **                                                                          **
    6          ID   ******************************************************************************
    7          ID   ******************************************************************************
    8          ID   PROJECT:                 WITTMANN ADMS Update
    9          ID   CLIENT:                  Flood Control District of Maricopa County
   10          ID   PREPARED BY:             Entellus, Inc.
   11          ID   PROJECT No:              FCD 2002C029              Entellus 310.032
   12          ID   FILE NAME: ex-200.hc1                     CREATED DATE: Sept 3, 2003
   13          ID                                            MODIFIED DATE: Apr 26, 2004
   14          ID   STORM:                   200-year 24-hour Storm
   15          ID   DEVELOPMENT CONDITIONS: Existing Conditions
   16          ID
   17          ID
   18          ID   Changes made to Model:
   19          ID                         -Basin WT130 was adjusted to reflect improvements at
   20          ID                           southwest portion of the dam.
   21          ID                         -Basins PD790 and PD780 were combined to form PD780.
   22          ID                         -Basins PI640 and PI620 were combined to form PI640.
   23          ID                         -Basins PD720 and PD710 were combined to form PD710.
   24          ID                         -Changed the following concentration point names:
   25          ID                                CP 400 changed to 400*
   26          ID                                CP 510 changed to 510*
   27          ID                                CP 500 changed to 500.3
   28          ID                                CP 600 changed to 600*
   29          ID                                CP 710 changed to 710*
   30          ID                                CP 700 changed to 700*
   31          ID                         -Added concentration points 400, 510, 500.1, 500.2,
   32          ID                           600, 710 and 700.
   33          ID                         -Adjusted CAP culvert system (structures CAP060-CAP190)
   34          ID                           to account for the overtopping of the CAP Canal
   35          ID                         -Adjusted Time of COncentrations and routes for basins
   36          ID                           along McMicken Dam channel.
   37          ID                         -Changed Typical Cross Sections for Routes
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 38          ID                          -Corrected S-Graphs for WI500, WI510, WT100, WT120,
 39          ID                            WT130 and SV200
 40          ID                          04-26-2004
 41          ID                          -Increased number of ordinates, added CP and
 42          ID                            rearranged combines in White Tanks area.
 43          ID
 44          ID
             *DIAGRAM
 45          IT      15  1JAN94       0    1500
 46          IO       3
 47          IN      15 01JAN94       0
 48          JD   4.66     0.01
             * precipl: 24-hour distribution
 49          PC     0.0    0.002   0.005   0.008   0.011   0.014   0.017    0.02   0.023   0.026
 50          PC   0.029    0.032   0.035   0.038   0.041   0.044   0.048   0.052   0.056    0.06
 51          PC   0.064    0.068   0.072   0.076    0.08   0.085    0.09   0.095     0.1   0.105
 52          PC    0.11    0.115    0.12   0.126   0.133    0.14   0.147   0.155   0.163   0.172
 53          PC   0.181    0.191   0.203   0.218   0.236   0.257   0.283   0.387   0.663   0.707
1                                          HEC-1 INPUT
PAGE  2

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

 54          PC   0.735    0.758   0.776   0.791   0.804   0.815   0.825   0.834   0.842   0.849
 55          PC   0.856    0.863   0.869   0.875   0.881   0.887   0.893   0.898   0.903   0.908
 56          PC   0.913    0.918   0.922   0.926    0.93   0.934   0.938   0.942   0.946    0.95
 57          PC   0.953    0.956   0.959   0.962   0.965   0.968   0.971   0.974   0.977    0.98
 58          PC   0.983    0.986   0.989   0.992   0.995   0.998     1.0
 59          IN      15 01JAN94       0
 60          JD   4.380     10.0
             * precipl: 24-hour distribution
 61          PC     0.0    0.002   0.005   0.008   0.011   0.014   0.017    0.02   0.023   0.026
 62          PC   0.029    0.032   0.035   0.038   0.041   0.044   0.048   0.052   0.056    0.06
 63          PC   0.064    0.068   0.072   0.076    0.08   0.085    0.09   0.095     0.1   0.105
 64          PC    0.11    0.115    0.12   0.126   0.133    0.14   0.147   0.155   0.163   0.172
 65          PC   0.181    0.191   0.203   0.218   0.236   0.257   0.283   0.387   0.663   0.707
 66          PC   0.735    0.758   0.776   0.791   0.804   0.815   0.825   0.834   0.842   0.849
 67          PC   0.856    0.863   0.869   0.875   0.881   0.887   0.893   0.898   0.903   0.908
 68          PC   0.913    0.918   0.922   0.926    0.93   0.934   0.938   0.942   0.946    0.95
 69          PC   0.953    0.956   0.959   0.962   0.965   0.968   0.971   0.974   0.977    0.98
 70          PC   0.983    0.986   0.989   0.992   0.995   0.998     1.0
 71          IN      15 01JAN94       0
 72          JD   4.194     20.0
             * precipl: 24-hour distribution
 73          PC     0.0    0.002   0.005   0.008   0.011   0.014   0.017    0.02   0.023   0.026
 74          PC   0.029    0.032   0.035   0.038   0.041   0.044   0.048   0.052   0.056    0.06
 75          PC   0.064    0.068   0.072   0.076    0.08   0.085    0.09   0.095     0.1   0.105
 76          PC    0.11    0.115    0.12   0.126   0.133    0.14   0.147   0.155   0.163   0.172
 77          PC   0.181    0.191   0.203   0.218   0.236   0.257   0.283   0.387   0.663   0.707
 78          PC   0.735    0.758   0.776   0.791   0.804   0.815   0.825   0.834   0.842   0.849
 79          PC   0.856    0.863   0.869   0.875   0.881   0.887   0.893   0.898   0.903   0.908
 80          PC   0.913    0.918   0.922   0.926    0.93   0.934   0.938   0.942   0.946    0.95
 81          PC   0.953    0.956   0.959   0.962   0.965   0.968   0.971   0.974   0.977    0.98
 82          PC   0.983    0.986   0.989   0.992   0.995   0.998     1.0
 83          IN      15 01JAN94       0
 84          JD   4.007     60.0
             * precipl: 24-hour distribution
 85          PC     0.0    0.002   0.005   0.008   0.011   0.014   0.017    0.02   0.023   0.026
 86          PC   0.029    0.032   0.035   0.038   0.041   0.044   0.048   0.052   0.056    0.06
 87          PC   0.064    0.068   0.072   0.076    0.08   0.085    0.09   0.095     0.1   0.105
 88          PC    0.11    0.115    0.12   0.126   0.133    0.14   0.147   0.155   0.163   0.172
 89          PC   0.181    0.191   0.203   0.218   0.236   0.257   0.283   0.387   0.663   0.707
 90          PC   0.735    0.758   0.776   0.791   0.804   0.815   0.825   0.834   0.842   0.849
 91          PC   0.856    0.863   0.869   0.875   0.881   0.887   0.893   0.898   0.903   0.908
 92          PC   0.913    0.918   0.922   0.926    0.93   0.934   0.938   0.942   0.946    0.95
 93          PC   0.953    0.956   0.959   0.962   0.965   0.968   0.971   0.974   0.977    0.98
 94          PC   0.983    0.986   0.989   0.992   0.995   0.998     1.0
 95          IN      15 01JAN94       0
 96          JD   3.937     90.0
             * precipl: 24-hour distribution
 97          PC     0.0    0.002   0.005   0.008   0.011   0.014   0.017    0.02   0.023   0.026
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 98          PC   0.029   0.032   0.035   0.038   0.041   0.044   0.048   0.052   0.056    0.06
 99          PC   0.064   0.068   0.072   0.076    0.08   0.085    0.09   0.095     0.1   0.105
100          PC    0.11   0.115    0.12   0.126   0.133    0.14   0.147   0.155   0.163   0.172
101          PC   0.181   0.191   0.203   0.218   0.236   0.257   0.283   0.387   0.663   0.707
102          PC   0.735   0.758   0.776   0.791   0.804   0.815   0.825   0.834   0.842   0.849
103          PC   0.856   0.863   0.869   0.875   0.881   0.887   0.893   0.898   0.903   0.908
104          PC   0.913   0.918   0.922   0.926    0.93   0.934   0.938   0.942   0.946    0.95
1                                          HEC-1 INPUT
PAGE  3

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

105          PC   0.953   0.956   0.959   0.962   0.965   0.968   0.971   0.974   0.977    0.98
106          PC   0.983   0.986   0.989   0.992   0.995   0.998     1.0
107          IN      15 01JAN94       0
108          JD   3.886   120.0
             * precip1: 24-hour distribution
109          PC     0.0   0.002   0.005   0.008   0.011   0.014   0.017    0.02   0.023   0.026
110          PC   0.029   0.032   0.035   0.038   0.041   0.044   0.048   0.052   0.056    0.06
111          PC   0.064   0.068   0.072   0.076    0.08   0.085    0.09   0.095     0.1   0.105
112          PC    0.11   0.115    0.12   0.126   0.133    0.14   0.147   0.155   0.163   0.172
113          PC   0.181   0.191   0.203   0.218   0.236   0.257   0.283   0.387   0.663   0.707
114          PC   0.735   0.758   0.776   0.791   0.804   0.815   0.825   0.834   0.842   0.849
115          PC   0.856   0.863   0.869   0.875   0.881   0.887   0.893   0.898   0.903   0.908
116          PC   0.913   0.918   0.922   0.926    0.93   0.934   0.938   0.942   0.946    0.95
117          PC   0.953   0.956   0.959   0.962   0.965   0.968   0.971   0.974   0.977    0.98
118          PC   0.983   0.986   0.989   0.992   0.995   0.998     1.0
119          IN      15 01JAN94       0
120          JD   3.844   150.0
             * precip1: 24-hour distribution
121          PC     0.0   0.002   0.005   0.008   0.011   0.014   0.017    0.02   0.023   0.026
122          PC   0.029   0.032   0.035   0.038   0.041   0.044   0.048   0.052   0.056    0.06
123          PC   0.064   0.068   0.072   0.076    0.08   0.085    0.09   0.095     0.1   0.105
124          PC    0.11   0.115    0.12   0.126   0.133    0.14   0.147   0.155   0.163   0.172
125          PC   0.181   0.191   0.203   0.218   0.236   0.257   0.283   0.387   0.663   0.707
126          PC   0.735   0.758   0.776   0.791   0.804   0.815   0.825   0.834   0.842   0.849
127          PC   0.856   0.863   0.869   0.875   0.881   0.887   0.893   0.898   0.903   0.908
128          PC   0.913   0.918   0.922   0.926    0.93   0.934   0.938   0.942   0.946    0.95
129          PC   0.953   0.956   0.959   0.962   0.965   0.968   0.971   0.974   0.977    0.98
130          PC   0.983   0.986   0.989   0.992   0.995   0.998     1.0
131          IN      15 01JAN94       0
132          JD   3.728   300.0
             * precip1: 24-hour distribution
133          PC     0.0   0.002   0.005   0.008   0.011   0.014   0.017    0.02   0.023   0.026
134          PC   0.029   0.032   0.035   0.038   0.041   0.044   0.048   0.052   0.056    0.06
135          PC   0.064   0.068   0.072   0.076    0.08   0.085    0.09   0.095     0.1   0.105
136          PC    0.11   0.115    0.12   0.126   0.133    0.14   0.147   0.155   0.163   0.172
137          PC   0.181   0.191   0.203   0.218   0.236   0.257   0.283   0.387   0.663   0.707
138          PC   0.735   0.758   0.776   0.791   0.804   0.815   0.825   0.834   0.842   0.849
139          PC   0.856   0.863   0.869   0.875   0.881   0.887   0.893   0.898   0.903   0.908
140          PC   0.913   0.918   0.922   0.926    0.93   0.934   0.938   0.942   0.946    0.95
141          PC   0.953   0.956   0.959   0.962   0.965   0.968   0.971   0.974   0.977    0.98
142          PC   0.983   0.986   0.989   0.992   0.995   0.998     1.0
143          IN      15 01JAN94       0
144          JD   3.634   500.0
             * precip1: 24-hour distribution
145          PC     0.0   0.002   0.005   0.008   0.011   0.014   0.017    0.02   0.023   0.026
146          PC   0.029   0.032   0.035   0.038   0.041   0.044   0.048   0.052   0.056    0.06
147          PC   0.064   0.068   0.072   0.076    0.08   0.085    0.09   0.095     0.1   0.105
148          PC    0.11   0.115    0.12   0.126   0.133    0.14   0.147   0.155   0.163   0.172
149          PC   0.181   0.191   0.203   0.218   0.236   0.257   0.283   0.387   0.663   0.707
150          PC   0.735   0.758   0.776   0.791   0.804   0.815   0.825   0.834   0.842   0.849
151          PC   0.856   0.863   0.869   0.875   0.881   0.887   0.893   0.898   0.903   0.908
152          PC   0.913   0.918   0.922   0.926    0.93   0.934   0.938   0.942   0.946    0.95
153          PC   0.953   0.956   0.959   0.962   0.965   0.968   0.971   0.974   0.977    0.98
154          PC   0.983   0.986   0.989   0.992   0.995   0.998     1.0
             *
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RUNOFF SUMMARY
FLOW IN CUBIC FEET PER SECOND
TIME IN HOURS, AREA IN SQUARE MILES

TIME OF MAX STAGE +	OPERATION	STATION	PEAK FLOW	TIME OF PEAK	AVERAGE FLOW FOR MAXIMUM PERIOD 6-HOUR	24-HOUR	72-HOUR	BASIN AREA	MAXIMUM STAGE
+	HYDROGRAPH AT	PI680	8716.	13.50	3400.	1047.	351.	16.89	
+	ROUTED TO	680640	6491.	15.25	3286.	1040.	351.	16.89	
+	HYDROGRAPH AT	PI640	13297.	13.50	3567.	942.	314.	17.56	
+	2 COMBINED AT	640	13201.	13.50	6207.	1889.	638.	34.45	
+	HYDROGRAPH AT	WI540	8890.	13.50	2558.	770.	257.	11.64	
+	HYDROGRAPH AT	PD780	15461.	13.25	3718.	1105.	369.	19.17	
+	ROUTED TO	780760	10253.	14.25	3712.	1102.	369.	19.17	
+	HYDROGRAPH AT	PD760	4052.	12.50	417.	111.	37.	2.72	
	HYDROGRAPH AT	PD745	2846.	12.50	349.	95.	32.	1.98	
+	5 COMBINED AT	CAP	26147.	13.50	12275.	3697.	1249.	69.96	
+	ROUTED TO	STOR	7483.	15.75	7173.	3670.	1249.	69.96	
+	DIVERSION TO	CAP2	6292.	15.75	6035.	3122.	1064.	69.96	
+	HYDROGRAPH AT	CAP1	1191.	15.75	1138.	548.	186.	69.96	
+	ROUTED TO	640505	1183.	17.50	1127.	546.	186.	69.96	
+	HYDROGRAPH AT	WI505	4851.	13.25	1053.	281.	94.	6.67	
+	2 COMBINED AT	505	4683.	13.25	1708.	850.	290.	17.87	
+	ROUTED TO	505500	3800.	13.50	1676.	850.	290.	17.87	
+	HYDROGRAPH AT	WT140	2659.	13.00	682.	196.	66.	3.80	
+	ROUTED TO	140130	1997.	13.75	680.	196.	66.	3.80	
+	HYDROGRAPH AT	WT130	2136.	13.00	445.	121.	40.	2.54	
	2 COMBINED AT								

+	130	2800.	13.50	1112.	314.	105.	6.34
ROUTED TO +	130120	2750.	13.75	1111.	314.	105.	6.34
HYDROGRAPH AT +	WT150	3548.	13.25	1034.	300.	100.	5.85
ROUTED TO +	150120	2741.	13.75	1029.	299.	100.	5.85
HYDROGRAPH AT +	WT160	868.	12.50	151.	43.	14.	.82
ROUTED TO +	160120	550.	13.50	151.	43.	14.	.82
HYDROGRAPH AT +	WT120	3897.	12.50	463.	119.	40.	2.82
3 COMBINED AT +	120	4047.	12.50	1613.	456.	153.	9.48
2 COMBINED AT +	120*	5662.	13.75	2609.	739.	247.	15.82
ROUTED TO +	120110	4944.	14.50	2591.	738.	247.	15.82
HYDROGRAPH AT +	WT110	3611.	12.50	483.	128.	43.	2.90
2 COMBINED AT +	110	4944.	14.50	3010.	854.	286.	18.71
ROUTED TO +	110100	4816.	14.75	2966.	845.	284.	18.71
HYDROGRAPH AT +	WT100	3321.	13.00	691.	194.	65.	3.84
2 COMBINED AT +	100	6257.	13.00	3554.	1011.	340.	22.56
ROUTED TO +	100400	4909.	14.50	3493.	1010.	340.	22.56
HYDROGRAPH AT +	IW350	4697.	12.50	842.	234.	78.	4.21
ROUTED TO +	350310	1395.	17.75	733.	231.	78.	4.21
HYDROGRAPH AT +	IW310	13584.	14.00	5087.	1345.	449.	25.81
2 COMBINED AT +	310	13475.	14.00	5257.	1524.	516.	30.02
ROUTED TO +	CAP020	13508.	14.25	4829.	1521.	514.	30.02
ROUTED TO +	310200	8636.	16.00	4427.	1516.	514.	30.02
HYDROGRAPH AT +	SV220	13017.	13.50	3488.	905.	302.	16.95
ROUTED TO	CAP010	9786.	13.75	3446.	899.	300.	16.95

	ROUTED TO	220200	5226.	15.75	3298.	898.	300.	16.95
+	HYDROGRAPH AT	TW480	7319.	13.50	2706.	829.	278.	12.72
+	ROUTED TO	480460	6109.	14.00	2663.	827.	278.	12.72
+	HYDROGRAPH AT	TW460	2476.	12.75	435.	114.	38.	2.44
+	2 COMBINED AT	460	6240.	14.00	2981.	924.	310.	15.16
+	ROUTED TO	460420	4533.	16.50	2773.	916.	310.	15.16
+	HYDROGRAPH AT	TW420	7022.	13.50	1878.	495.	165.	10.89
+	2 COMBINED AT	420	6723.	13.50	3716.	1333.	454.	26.06
+	ROUTED TO	CAP030	6301.	13.50	3718.	1333.	454.	26.06
+	ROUTED TO	420200	4618.	15.00	3534.	1331.	454.	26.06
+	HYDROGRAPH AT	SV200	12271.	14.00	4858.	1314.	439.	31.33
+	4 COMBINED AT	200	20046.	15.50	13369.	4616.	1571.	104.36
+	ROUTED TO	200400	19146.	16.50	13199.	4608.	1571.	104.36
+	HYDROGRAPH AT	TW400	8705.	13.50	2262.	620.	207.	12.99
+	2 COMBINED AT	400	19247.	16.50	13570.	5075.	1739.	117.35
+	2 COMBINED AT	400*	22805.	16.50	16405.	5906.	2023.	139.91
+	ROUTED TO	400510	22679.	16.50	16361.	5905.	2023.	139.91
+	HYDROGRAPH AT	WI580	16247.	14.00	5524.	1468.	490.	30.35
+	ROUTED TO	CAP040	15675.	14.00	5187.	1444.	481.	30.35
+	ROUTED TO	580510	7983.	16.75	4517.	1439.	481.	30.35
+	HYDROGRAPH AT	WI510	5780.	13.75	1807.	510.	170.	9.31
+	2 COMBINED AT	510	8061.	16.75	4807.	1846.	629.	39.66
+	2 COMBINED AT	510*	28973.	16.75	20278.	7489.	2563.	179.56
+	ROUTED TO	510500	27478.	17.25	19923.	7487.	2563.	179.56

	HYDROGRAPH AT	WI520	9898.	13.75	3103.	886.	296.	16.39
+	ROUTED TO	520500	6445.	15.50	3049.	881.	296.	16.39
+	HYDROGRAPH AT	CAP2	6292.	15.75	6035.	3122.	1064.	69.96
+	DIVERSION TO	CAP3	5528.	15.75	5303.	2785.	950.	69.96
+	HYDROGRAPH AT	CAP2	764.	15.75	732.	337.	114.	69.96
+	ROUTED TO	540500	757.	18.75	718.	336.	114.	69.96
+	HYDROGRAPH AT	WI500	5962.	13.50	1552.	413.	138.	9.16
+	3 COMBINED AT	500.1	6837.	15.25	4536.	1561.	529.	32.54
+	2 COMBINED AT	500.2	30094.	17.00	23113.	8794.	3010.	212.11
+	ROUTED TO	500500	29934.	17.25	23096.	8794.	3010.	212.11
+	2 COMBINED AT	500.3	30877.	17.25	24149.	9471.	3241.	229.97
	ROUTED TO	500600	29581.	18.25	23701.	9468.	3241.	229.97
+	HYDROGRAPH AT	PI600	8438.	13.25	1969.	539.	180.	12.03
+	HYDROGRAPH AT	CAP3	5528.	15.75	5303.	2785.	950.	69.96
+	DIVERSION TO	CAP4	3576.	15.75	3442.	1913.	655.	69.96
+	HYDROGRAPH AT	CAP3	1951.	15.75	1861.	873.	295.	69.96
+	ROUTED TO	640600	1940.	17.75	1842.	871.	295.	69.96
+	2 COMBINED AT	600	8438.	13.25	2958.	1479.	506.	30.22
+	2 COMBINED AT	600*	31204.	18.25	25308.	10604.	3633.	260.20
+	ROUTED TO	600710	30955.	18.50	25218.	10602.	3633.	260.20
+	HYDROGRAPH AT	CAP4	3576.	15.75	3442.	1913.	655.	69.96
+	ROUTED TO	760710	3552.	17.50	3422.	1909.	655.	69.96
+	HYDROGRAPH AT	PD710	4227.	13.50	1066.	283.	94.	6.72
	HYDROGRAPH AT							

+		PD740	1673.	12.25	148.	39.	13.	.87
	ROUTED TO							
+		CAP200	398.	12.75	148.	39.	13.	.87
	ROUTED TO							
+		740710	306.	15.75	141.	39.	13.	.87
	3 COMBINED AT							
+		710	4755.	13.50	3723.	2239.	768.	41.17
	2 COMBINED AT							
+		710*	34028.	18.50	28363.	12503.	4290.	301.37
	ROUTED TO							
+		710700	33431.	19.00	28089.	12498.	4290.	301.37
	HYDROGRAPH AT							
+		PD730	706.	12.50	98.	30.	10.	.48
	ROUTED TO							
+		CAP220	484.	12.75	98.	30.	10.	.48
	HYDROGRAPH AT							
+		PD735	3131.	12.75	619.	185.	62.	3.23
	ROUTED TO							
+		CAP210	2696.	12.75	619.	185.	62.	3.23
	2 COMBINED AT							
+		736	3171.	12.75	714.	214.	71.	3.71
	ROUTED TO							
+		735700	1643.	14.50	704.	212.	71.	3.71
	HYDROGRAPH AT							
+		PD700	7218.	13.00	1303.	359.	120.	7.26
	2 COMBINED AT							
+		700	7303.	13.00	1953.	559.	188.	10.97
	2 COMBINED AT							
+		700*	33470.	19.00	28221.	12896.	4432.	312.34

*** NORMAL END OF HEC-1 ***

E.2. Future Conditions

```
1****************************************
*                                      *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)  *
*             JUN   1998               *
*           VERSION 4.1                *
*                                      *
*  RUN DATE   26APR04  TIME  08:15:47  *
*                                      *
****************************************
```

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

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

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

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

1
PAGE 1

HEC-1 INPUT

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

    1          ID
    2          ID   ****************************************************************************
    3          ID   **                                                                        **
    4          ID   **                    McMICKEN DAM HYDROLOGY MODEL                        **
    5          ID   **                                                                        **
    6          ID   ****************************************************************************
    7          ID   ****************************************************************************
    8          ID   PROJECT:                 WITTMANN ADMS Update
    9          ID   CLIENT:                  Flood Control District of Maricopa County
   10          ID   PREPARED BY:             Entellus, Inc.
   11          ID   PROJECT No:              FCD 2002C029              Entellus 310.032
   12          ID   FILE NAME: fut200.hc1                     CREATED DATE: Sept 3, 2003
   13          ID                                            MODIFIED DATE: Apr 26, 2004
   14          ID   STORM:                   200-year 24-hour Storm
   15          ID   DEVELOPMENT CONDITIONS: Future Conditions
   16          ID
   17          ID
   18          ID   Changes made to Model:
   19          ID                        -Basin WT130 was adjusted to reflect improvements at
   20          ID                          southwest portion of the dam.
   21          ID                        -Basins PD790 and PD780 were combined to form PD780.
   22          ID                        -Basins PI640 and PI620 were combined to form PI640.
   23          ID                        -Basins PD720 and PD710 were combined to form PD710.
   24          ID                        -Changed the following concentration point names:
   25          ID                               CP 400 changed to 400*
   26          ID                               CP 510 changed to 510*
   27          ID                               CP 500 changed to 500.3
   28          ID                               CP 600 changed to 600*
   29          ID                               CP 710 changed to 710*
   30          ID                               CP 700 changed to 700*
   31          ID                        -Added concentration points 400, 510, 500.1, 500.2,
   32          ID                          600, 710 and 700.
   33          ID                        -Adjusted CAP culvert system (structures CAP060-CAP190)
   34          ID                          to account for the overtopping of the CAP Canal
   35          ID                        -Adjusted Time of COncentrations and routes for basins
   36          ID                          along McMicken Dam channel.
   37          ID                        -Corrected S-Graphs for WI500, WI510, WT100, WT120,
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 38          ID                          WT130 and SV200
 39          ID                        04-26-2004
 40          ID                        -Increased number of ordinates, added CP and
 41          ID                          rearranged combines in White Tanks area.
 42          ID
 43          ID
             *DIAGRAM
 44          IT      15  1JAN94       0    1500
 45          IO       3
 46          IN      15 01JAN94       0
 47          JD   4.66     0.01
             * precip1: 24-hour distribution
 48          PC     0.0    0.002   0.005   0.008   0.011   0.014   0.017    0.02   0.023   0.026
 49          PC   0.029    0.032   0.035   0.038   0.041   0.044   0.048   0.052   0.056    0.06
 50          PC   0.064    0.068   0.072   0.076    0.08   0.085    0.09   0.095     0.1   0.105
 51          PC    0.11    0.115    0.12   0.126   0.133    0.14   0.147   0.155   0.163   0.172
 52          PC   0.181    0.191   0.203   0.218   0.236   0.257   0.283   0.387   0.663   0.707
 53          PC   0.735    0.758   0.776   0.791   0.804   0.815   0.825   0.834   0.842   0.849
1                                          HEC-1 INPUT
PAGE  2

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

 54          PC   0.856    0.863   0.869   0.875   0.881   0.887   0.893   0.898   0.903   0.908
 55          PC   0.913    0.918   0.922   0.926    0.93   0.934   0.938   0.942   0.946    0.95
 56          PC   0.953    0.956   0.959   0.962   0.965   0.968   0.971   0.974   0.977    0.98
 57          PC   0.983    0.986   0.989   0.992   0.995   0.998     1.0
 58          IN      15 01JAN94       0
 59          JD   4.380     10.0
             * precip1: 24-hour distribution
 60          PC     0.0    0.002   0.005   0.008   0.011   0.014   0.017    0.02   0.023   0.026
 61          PC   0.029    0.032   0.035   0.038   0.041   0.044   0.048   0.052   0.056    0.06
 62          PC   0.064    0.068   0.072   0.076    0.08   0.085    0.09   0.095     0.1   0.105
 63          PC    0.11    0.115    0.12   0.126   0.133    0.14   0.147   0.155   0.163   0.172
 64          PC   0.181    0.191   0.203   0.218   0.236   0.257   0.283   0.387   0.663   0.707
 65          PC   0.735    0.758   0.776   0.791   0.804   0.815   0.825   0.834   0.842   0.849
 66          PC   0.856    0.863   0.869   0.875   0.881   0.887   0.893   0.898   0.903   0.908
 67          PC   0.913    0.918   0.922   0.926    0.93   0.934   0.938   0.942   0.946    0.95
 68          PC   0.953    0.956   0.959   0.962   0.965   0.968   0.971   0.974   0.977    0.98
 69          PC   0.983    0.986   0.989   0.992   0.995   0.998     1.0
 70          IN      15 01JAN94       0
 71          JD   4.194     20.0
             * precip1: 24-hour distribution
 72          PC     0.0    0.002   0.005   0.008   0.011   0.014   0.017    0.02   0.023   0.026
 73          PC   0.029    0.032   0.035   0.038   0.041   0.044   0.048   0.052   0.056    0.06
 74          PC   0.064    0.068   0.072   0.076    0.08   0.085    0.09   0.095     0.1   0.105
 75          PC    0.11    0.115    0.12   0.126   0.133    0.14   0.147   0.155   0.163   0.172
 76          PC   0.181    0.191   0.203   0.218   0.236   0.257   0.283   0.387   0.663   0.707
 77          PC   0.735    0.758   0.776   0.791   0.804   0.815   0.825   0.834   0.842   0.849
 78          PC   0.856    0.863   0.869   0.875   0.881   0.887   0.893   0.898   0.903   0.908
 79          PC   0.913    0.918   0.922   0.926    0.93   0.934   0.938   0.942   0.946    0.95
 80          PC   0.953    0.956   0.959   0.962   0.965   0.968   0.971   0.974   0.977    0.98
 81          PC   0.983    0.986   0.989   0.992   0.995   0.998     1.0
 82          IN      15 01JAN94       0
 83          JD   4.007     60.0
             * precip1: 24-hour distribution
 84          PC     0.0    0.002   0.005   0.008   0.011   0.014   0.017    0.02   0.023   0.026
 85          PC   0.029    0.032   0.035   0.038   0.041   0.044   0.048   0.052   0.056    0.06
 86          PC   0.064    0.068   0.072   0.076    0.08   0.085    0.09   0.095     0.1   0.105
 87          PC    0.11    0.115    0.12   0.126   0.133    0.14   0.147   0.155   0.163   0.172
 88          PC   0.181    0.191   0.203   0.218   0.236   0.257   0.283   0.387   0.663   0.707
 89          PC   0.735    0.758   0.776   0.791   0.804   0.815   0.825   0.834   0.842   0.849
 90          PC   0.856    0.863   0.869   0.875   0.881   0.887   0.893   0.898   0.903   0.908
 91          PC   0.913    0.918   0.922   0.926    0.93   0.934   0.938   0.942   0.946    0.95
 92          PC   0.953    0.956   0.959   0.962   0.965   0.968   0.971   0.974   0.977    0.98
 93          PC   0.983    0.986   0.989   0.992   0.995   0.998     1.0
 94          IN      15 01JAN94       0
 95          JD   3.937     90.0
             * precip1: 24-hour distribution
 96          PC     0.0    0.002   0.005   0.008   0.011   0.014   0.017    0.02   0.023   0.026
 97          PC   0.029    0.032   0.035   0.038   0.041   0.044   0.048   0.052   0.056    0.06
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 98          PC   0.064   0.068   0.072   0.076    0.08   0.085    0.09   0.095     0.1   0.105
 99          PC    0.11   0.115    0.12   0.126   0.133    0.14   0.147   0.155   0.163   0.172
100          PC   0.181   0.191   0.203   0.218   0.236   0.257   0.283   0.387   0.663   0.707
101          PC   0.735   0.758   0.776   0.791   0.804   0.815   0.825   0.834   0.842   0.849
102          PC   0.856   0.863   0.869   0.875   0.881   0.887   0.893   0.898   0.903   0.908
103          PC   0.913   0.918   0.922   0.926    0.93   0.934   0.938   0.942   0.946    0.95
104          PC   0.953   0.956   0.959   0.962   0.965   0.968   0.971   0.974   0.977    0.98
1                                          HEC-1 INPUT
PAGE  3

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

105          PC   0.983   0.986   0.989   0.992   0.995   0.998     1.0
106          IN      15 01JAN94       0
107          JD   3.886   120.0
             * precip1: 24-hour distribution
108          PC     0.0   0.002   0.005   0.008   0.011   0.014   0.017    0.02   0.023   0.026
109          PC   0.029   0.032   0.035   0.038   0.041   0.044   0.048   0.052   0.056    0.06
110          PC   0.064   0.068   0.072   0.076    0.08   0.085    0.09   0.095     0.1   0.105
111          PC    0.11   0.115    0.12   0.126   0.133    0.14   0.147   0.155   0.163   0.172
112          PC   0.181   0.191   0.203   0.218   0.236   0.257   0.283   0.387   0.663   0.707
113          PC   0.735   0.758   0.776   0.791   0.804   0.815   0.825   0.834   0.842   0.849
114          PC   0.856   0.863   0.869   0.875   0.881   0.887   0.893   0.898   0.903   0.908
115          PC   0.913   0.918   0.922   0.926    0.93   0.934   0.938   0.942   0.946    0.95
116          PC   0.953   0.956   0.959   0.962   0.965   0.968   0.971   0.974   0.977    0.98
117          PC   0.983   0.986   0.989   0.992   0.995   0.998     1.0
118          IN      15 01JAN94       0
119          JD   3.844   150.0
             * precip1: 24-hour distribution
120          PC     0.0   0.002   0.005   0.008   0.011   0.014   0.017    0.02   0.023   0.026
121          PC   0.029   0.032   0.035   0.038   0.041   0.044   0.048   0.052   0.056    0.06
122          PC   0.064   0.068   0.072   0.076    0.08   0.085    0.09   0.095     0.1   0.105
123          PC    0.11   0.115    0.12   0.126   0.133    0.14   0.147   0.155   0.163   0.172
124          PC   0.181   0.191   0.203   0.218   0.236   0.257   0.283   0.387   0.663   0.707
125          PC   0.735   0.758   0.776   0.791   0.804   0.815   0.825   0.834   0.842   0.849
126          PC   0.856   0.863   0.869   0.875   0.881   0.887   0.893   0.898   0.903   0.908
127          PC   0.913   0.918   0.922   0.926    0.93   0.934   0.938   0.942   0.946    0.95
128          PC   0.953   0.956   0.959   0.962   0.965   0.968   0.971   0.974   0.977    0.98
129          PC   0.983   0.986   0.989   0.992   0.995   0.998     1.0
130          IN      15 01JAN94       0
131          JD   3.728   300.0
             * precip1: 24-hour distribution
132          PC     0.0   0.002   0.005   0.008   0.011   0.014   0.017    0.02   0.023   0.026
133          PC   0.029   0.032   0.035   0.038   0.041   0.044   0.048   0.052   0.056    0.06
134          PC   0.064   0.068   0.072   0.076    0.08   0.085    0.09   0.095     0.1   0.105
135          PC    0.11   0.115    0.12   0.126   0.133    0.14   0.147   0.155   0.163   0.172
136          PC   0.181   0.191   0.203   0.218   0.236   0.257   0.283   0.387   0.663   0.707
137          PC   0.735   0.758   0.776   0.791   0.804   0.815   0.825   0.834   0.842   0.849
138          PC   0.856   0.863   0.869   0.875   0.881   0.887   0.893   0.898   0.903   0.908
139          PC   0.913   0.918   0.922   0.926    0.93   0.934   0.938   0.942   0.946    0.95
140          PC   0.953   0.956   0.959   0.962   0.965   0.968   0.971   0.974   0.977    0.98
141          PC   0.983   0.986   0.989   0.992   0.995   0.998     1.0
142          IN      15 01JAN94       0
143          JD   3.634   500.0
             * precip1: 24-hour distribution
144          PC     0.0   0.002   0.005   0.008   0.011   0.014   0.017    0.02   0.023   0.026
145          PC   0.029   0.032   0.035   0.038   0.041   0.044   0.048   0.052   0.056    0.06
146          PC   0.064   0.068   0.072   0.076    0.08   0.085    0.09   0.095     0.1   0.105
147          PC    0.11   0.115    0.12   0.126   0.133    0.14   0.147   0.155   0.163   0.172
148          PC   0.181   0.191   0.203   0.218   0.236   0.257   0.283   0.387   0.663   0.707
149          PC   0.735   0.758   0.776   0.791   0.804   0.815   0.825   0.834   0.842   0.849
150          PC   0.856   0.863   0.869   0.875   0.881   0.887   0.893   0.898   0.903   0.908
151          PC   0.913   0.918   0.922   0.926    0.93   0.934   0.938   0.942   0.946    0.95
152          PC   0.953   0.956   0.959   0.962   0.965   0.968   0.971   0.974   0.977    0.98
153          PC   0.983   0.986   0.989   0.992   0.995   0.998     1.0
             *
             *
             *
             *
             *
```

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

TIME OF MAX STAGE	OPERATION	STATION	PEAK FLOW	TIME OF PEAK	AVERAGE FLOW FOR MAXIMUM PERIOD 6-HOUR	24-HOUR	72-HOUR	BASIN AREA	MAXIMUM STAGE
+	HYDROGRAPH AT	PI680	8759.	13.50	3451.	1076.	361.	16.89	
+	ROUTED TO	680640	6553.	15.25	3339.	1069.	361.	16.89	
+	HYDROGRAPH AT	PI640	13534.	13.50	3762.	1044.	349.	17.56	
+	2 COMBINED AT	640	13487.	13.50	6439.	2008.	682.	34.45	
+	HYDROGRAPH AT	WI540	9205.	13.50	2767.	866.	290.	11.64	
+	HYDROGRAPH AT	PD780	15651.	13.25	3872.	1179.	394.	19.17	
+	ROUTED TO	780760	11090.	14.25	3868.	1177.	394.	19.17	
+	HYDROGRAPH AT	PD760	4146.	12.50	455.	127.	42.	2.72	
	HYDROGRAPH AT	PD745	2881.	12.50	372.	106.	35.	1.98	
+	5 COMBINED AT	CAP	26705.	13.50	12901.	4006.	1355.	69.96	
+	ROUTED TO	STOR	7620.	16.00	7332.	3964.	1355.	69.96	
+	DIVERSION TO	CAP2	6405.	16.00	6167.	3372.	1154.	69.96	
+	HYDROGRAPH AT	CAP1	1215.	16.00	1165.	592.	201.	69.96	
+	ROUTED TO	640505	1210.	17.50	1160.	591.	201.	69.96	
+	HYDROGRAPH AT	WI505	5409.	13.25	1352.	410.	137.	6.67	
+	2 COMBINED AT	505	5272.	13.25	2014.	1007.	348.	17.87	
+	ROUTED TO	505500	4402.	13.50	1980.	1006.	348.	17.87	
+	HYDROGRAPH AT	WT140	2751.	13.00	726.	214.	71.	3.80	
+	ROUTED TO	140130	1956.	13.75	722.	213.	71.	3.80	
	HYDROGRAPH AT	WT130	2173.	13.00	468.	131.	44.	2.54	
	2 COMBINED AT								

+	130	2935.	13.00	1175.	341.	114.	6.34
ROUTED TO							
+	130120	2881.	13.25	1175.	341.	114.	6.34
HYDROGRAPH AT							
+	WT150	3678.	13.25	1099.	327.	109.	5.85
ROUTED TO							
+	150120	2527.	13.75	1089.	326.	109.	5.85
HYDROGRAPH AT							
+	WT160	887.	12.50	160.	46.	15.	.82
ROUTED TO							
+	160120	541.	13.50	159.	46.	15.	.82
HYDROGRAPH AT							
+	WT120	3931.	12.50	485.	130.	43.	2.82
3 COMBINED AT							
+	120	4208.	12.50	1700.	496.	166.	9.48
2 COMBINED AT							
+	120*	5548.	13.75	2761.	804.	270.	15.82
ROUTED TO							
+	120110	5146.	14.50	2746.	803.	270.	15.82
HYDROGRAPH AT							
+	WT110	3667.	12.50	516.	143.	48.	2.90
2 COMBINED AT							
+	110	5146.	14.25	3174.	928.	312.	18.71
ROUTED TO							
+	110100	5066.	14.50	3146.	924.	311.	18.71
HYDROGRAPH AT							
+	WT100	3438.	13.00	750.	219.	73.	3.84
2 COMBINED AT							
+	100	6456.	13.00	3786.	1113.	375.	22.56
ROUTED TO							
+	100400	5144.	15.25	3681.	1112.	375.	22.56
HYDROGRAPH AT							
+	IW350	4701.	12.50	852.	241.	80.	4.21
ROUTED TO							
+	350310	1507.	17.75	755.	238.	80.	4.21
HYDROGRAPH AT							
+	IW310	13938.	14.00	5369.	1495.	500.	25.81
2 COMBINED AT							
+	310	13831.	14.00	5555.	1677.	569.	30.02
ROUTED TO							
+	CAP020	13884.	14.25	5115.	1671.	567.	30.02
ROUTED TO							
+	310200	9141.	15.75	4753.	1661.	567.	30.02
HYDROGRAPH AT							
+	SV220	13551.	13.50	3960.	1162.	389.	16.95
ROUTED TO							
	CAP010	12435.	13.75	3884.	1157.	387.	16.95

	ROUTED TO	220200	5192.	15.75	3788.	1152.	387.	16.95
+	HYDROGRAPH AT	TW480	7286.	13.50	2694.	827.	277.	12.72
+	ROUTED TO	480460	6079.	14.00	2651.	825.	277.	12.72
+	HYDROGRAPH AT	TW460	2450.	12.75	427.	112.	37.	2.44
+	2 COMBINED AT	460	6204.	14.00	2964.	920.	309.	15.16
+	ROUTED TO	460420	4865.	16.50	2799.	913.	309.	15.16
+	HYDROGRAPH AT	TW420	7277.	13.50	2038.	567.	189.	10.89
+	2 COMBINED AT	420	6982.	13.50	3867.	1389.	476.	26.06
+	ROUTED TO	CAP030	6555.	13.50	3869.	1389.	476.	26.06
+	ROUTED TO	420200	5475.	15.00	3756.	1388.	476.	26.06
+	HYDROGRAPH AT	SV200	13548.	14.00	5790.	1749.	586.	31.33
+	4 COMBINED AT	200	22803.	15.25	15247.	5435.	1869.	104.36
+	ROUTED TO	200400	21584.	16.25	15051.	5429.	1869.	104.36
+	HYDROGRAPH AT	TW400	9983.	13.50	3049.	972.	325.	12.99
+	2 COMBINED AT	400	22013.	16.25	16094.	6191.	2146.	117.35
+	2 COMBINED AT	400*	25862.	16.25	19157.	7122.	2462.	139.91
+	ROUTED TO	400510	25673.	16.25	19100.	7122.	2462.	139.91
+	HYDROGRAPH AT	WI580	16483.	14.00	5697.	1553.	519.	30.35
+	ROUTED TO	CAP040	15985.	14.00	5360.	1529.	510.	30.35
+	ROUTED TO	580510	8761.	16.75	4765.	1522.	510.	30.35
+	HYDROGRAPH AT	WI510	6631.	13.75	2383.	775.	260.	9.31
+	2 COMBINED AT	510	9147.	16.75	5508.	2143.	742.	39.66
+	2 COMBINED AT	510*	32646.	16.50	23659.	8980.	3107.	179.56
+	ROUTED TO	510500	31220.	17.00	23275.	8977.	3107.	179.56

	HYDROGRAPH AT	WI520	10218.	13.75	3321.	987.	330.	16.39
	ROUTED TO							
+		520500	6294.	15.50	3247.	980.	330.	16.39
	HYDROGRAPH AT							
+		CAP2	6405.	16.00	6167.	3372.	1154.	69.96
	DIVERSION TO							
+		CAP3	5632.	16.00	5418.	3007.	1031.	69.96
	HYDROGRAPH AT							
+		CAP2	773.	16.00	749.	365.	123.	69.96
	ROUTED TO							
+		540500	770.	18.50	741.	364.	123.	69.96
	HYDROGRAPH AT							
+		WI500	6727.	13.50	2047.	638.	213.	9.16
	3 COMBINED AT							
+		500.1	7031.	15.25	5188.	1877.	644.	32.54
	2 COMBINED AT							
+		500.2	34358.	17.00	27073.	10577.	3659.	212.11
	ROUTED TO							
+		500500	34292.	17.00	27043.	10576.	3659.	212.11
	2 COMBINED AT							
+		500.3	35346.	17.00	28363.	11396.	3943.	229.97
	ROUTED TO							
		500600	33590.	18.00	27641.	11386.	3943.	229.97
	HYDROGRAPH AT							
+		PI600	8987.	13.25	2304.	689.	230.	12.03
	HYDROGRAPH AT							
+		CAP3	5632.	16.00	5418.	3007.	1031.	69.96
	DIVERSION TO							
+		CAP4	3646.	16.00	3510.	2062.	710.	69.96
	HYDROGRAPH AT							
+		CAP3	1986.	16.00	1908.	945.	320.	69.96
	ROUTED TO							
+		640600	1976.	17.75	1892.	943.	320.	69.96
	2 COMBINED AT							
+		600	8987.	13.25	3307.	1673.	579.	30.22
	2 COMBINED AT							
+		600*	35359.	18.00	29392.	12706.	4403.	260.20
	ROUTED TO							
+		600710	35099.	18.25	29290.	12704.	4403.	260.20
	HYDROGRAPH AT							
+		CAP4	3646.	16.00	3510.	2062.	710.	69.96
	ROUTED TO							
+		760710	3627.	17.50	3497.	2059.	710.	69.96
	HYDROGRAPH AT							
+		PD710	4332.	13.50	1129.	311.	104.	6.72
	HYDROGRAPH AT							

+		PD740	1686.	12.25	161.	45.	15.	.87
	ROUTED TO							
+		CAP200	400.	12.75	161.	46.	15.	.87
	ROUTED TO							
+		740710	313.	15.75	153.	45.	15.	.87
	3 COMBINED AT							
+		710	5114.	13.50	3902.	2419.	835.	41.17
	2 COMBINED AT							
+		710*	38280.	18.25	32544.	14775.	5119.	301.37
	ROUTED TO							
+		710700	37717.	18.75	32256.	14765.	5119.	301.37
	HYDROGRAPH AT							
+		PD730	724.	12.50	106.	33.	11.	.48
	ROUTED TO							
+		CAP220	493.	12.75	107.	33.	11.	.48
	HYDROGRAPH AT							
+		PD735	3253.	12.75	687.	215.	72.	3.23
	ROUTED TO							
+		CAP210	2747.	12.75	687.	215.	72.	3.23
	2 COMBINED AT							
+		736	3231.	12.75	790.	247.	83.	3.71
	ROUTED TO							
+		735700	1990.	14.50	783.	245.	83.	3.71
	HYDROGRAPH AT							
+		PD700	7287.	13.00	1344.	378.	126.	7.26
	2 COMBINED AT							
+		700	7402.	13.00	2074.	610.	206.	10.97
	2 COMBINED AT							
+		700*	37795.	18.75	32469.	15207.	5277.	312.34

*** NORMAL END OF HEC-1 ***

APPENDIX F. 500-YR, 24-HR HEC-1 OUTPUT

F.1. Existing Conditions

F.2. Future Conditions

F.1. Existing Conditions

```
1****************************************
*                                      *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)  *
*             JUN   1998               *
*           VERSION 4.1                *
*                                      *
*  RUN DATE   26APR04  TIME  08:15:10  *
*                                      *
****************************************
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```
*************************************
*                                   *
*    U.S. ARMY CORPS OF ENGINEERS   *
*    HYDROLOGIC ENGINEERING CENTER  *
*          609 SECOND STREET        *
*       DAVIS, CALIFORNIA 95616     *
*           (916) 756-1104          *
*                                   *
*************************************
```

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

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

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

1
PAGE 1

HEC-1 INPUT

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

  1           ID
  2           ID   ****************************************************************************
  3           ID   **                                                                        **
  4           ID   **                    McMICKEN DAM HYDROLOGY MODEL                        **
  5           ID   **                                                                        **
  6           ID   ****************************************************************************
  7           ID   ****************************************************************************
  8           ID   PROJECT:                 WITTMANN ADMS Update
  9           ID   CLIENT:                  Flood Control District of Maricopa County
 10           ID   PREPARED BY:             Entellus, Inc.
 11           ID   PROJECT No:              FCD 2002C029              Entellus 310.032
 12           ID   FILE NAME: ex-500.hc1                     CREATED DATE: Sept 3, 2003
 13           ID                                            MODIFIED DATE: Apr 26, 2004
 14           ID   STORM:                   500-year 24-hour Storm
 15           ID   DEVELOPMENT CONDITIONS: Existing Conditions
 16           ID
 17           ID
 18           ID   Changes made to Model:
 19           ID                        -Basin WT130 was adjusted to reflect improvements at
 20           ID                          southwest portion of the dam.
 21           ID                        -Basins PD790 and PD780 were combined to form PD780.
 22           ID                        -Basins PI640 and PI620 were combined to form PI640.
 23           ID                        -Basins PD720 and PD710 were combined to form PD710.
 24           ID                        -Changed the following concentration point names:
 25           ID                                CP 400 changed to 400*
 26           ID                                CP 510 changed to 510*
 27           ID                                CP 500 changed to 500.3
 28           ID                                CP 600 changed to 600*
 29           ID                                CP 710 changed to 710*
 30           ID                                CP 700 changed to 700*
 31           ID                        -Added concentration points 400, 510, 500.1, 500.2,
 32           ID                          600, 710 and 700.
 33           ID                        -Adjusted CAP culvert system (structures CAP060-CAP190)
 34           ID                          to account for the overtopping of the CAP Canal
 35           ID                        -Adjusted Time of COncentrations and routes for basins
 36           ID                          along McMicken Dam channel.
 37           ID                        -Changed Typical Cross Sections for Routes
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 38          ID                          -Corrected S-Graphs for WI500, WI510, WT100, WT120,
 39          ID                            WT130 and SV200
 40          ID                          04-26-2004
 41          ID                          -Increased number of ordinates, added CP and
 42          ID                            rearranged combines in White Tanks area.
 43          ID
 44          ID
             *DIAGRAM
 45          IT      15  1JAN94       0    1500
 46          IO       3
 47          IN      15 01JAN94       0
 48          JD    5.26    0.01
             * precip1: 24-hour distribution
 49          PC     0.0   0.002   0.005   0.008   0.011   0.014   0.017    0.02   0.023   0.026
 50          PC   0.029   0.032   0.035   0.038   0.041   0.044   0.048   0.052   0.056    0.06
 51          PC   0.064   0.068   0.072   0.076    0.08   0.085    0.09   0.095     0.1   0.105
 52          PC    0.11   0.115    0.12   0.126   0.133    0.14   0.147   0.155   0.163   0.172
 53          PC   0.181   0.191   0.203   0.218   0.236   0.257   0.283   0.387   0.663   0.707
1                                          HEC-1 INPUT
PAGE  2

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

 54          PC   0.735   0.758   0.776   0.791   0.804   0.815   0.825   0.834   0.842   0.849
 55          PC   0.856   0.863   0.869   0.875   0.881   0.887   0.893   0.898   0.903   0.908
 56          PC   0.913   0.918   0.922   0.926    0.93   0.934   0.938   0.942   0.946    0.95
 57          PC   0.953   0.956   0.959   0.962   0.965   0.968   0.971   0.974   0.977    0.98
 58          PC   0.983   0.986   0.989   0.992   0.995   0.998     1.0
 59          IN      15 01JAN94       0
 60          JD   4.944   10.00
             * precip1: 24-hour distribution
 61          PC     0.0   0.002   0.005   0.008   0.011   0.014   0.017    0.02   0.023   0.026
 62          PC   0.029   0.032   0.035   0.038   0.041   0.044   0.048   0.052   0.056    0.06
 63          PC   0.064   0.068   0.072   0.076    0.08   0.085    0.09   0.095     0.1   0.105
 64          PC    0.11   0.115    0.12   0.126   0.133    0.14   0.147   0.155   0.163   0.172
 65          PC   0.181   0.191   0.203   0.218   0.236   0.257   0.283   0.387   0.663   0.707
 66          PC   0.735   0.758   0.776   0.791   0.804   0.815   0.825   0.834   0.842   0.849
 67          PC   0.856   0.863   0.869   0.875   0.881   0.887   0.893   0.898   0.903   0.908
 68          PC   0.913   0.918   0.922   0.926    0.93   0.934   0.938   0.942   0.946    0.95
 69          PC   0.953   0.956   0.959   0.962   0.965   0.968   0.971   0.974   0.977    0.98
 70          PC   0.983   0.986   0.989   0.992   0.995   0.998     1.0
 71          IN      15 01JAN94       0
 72          JD   4.734   30.00
             * precip1: 24-hour distribution
 73          PC     0.0   0.002   0.005   0.008   0.011   0.014   0.017    0.02   0.023   0.026
 74          PC   0.029   0.032   0.035   0.038   0.041   0.044   0.048   0.052   0.056    0.06
 75          PC   0.064   0.068   0.072   0.076    0.08   0.085    0.09   0.095     0.1   0.105
 76          PC    0.11   0.115    0.12   0.126   0.133    0.14   0.147   0.155   0.163   0.172
 77          PC   0.181   0.191   0.203   0.218   0.236   0.257   0.283   0.387   0.663   0.707
 78          PC   0.735   0.758   0.776   0.791   0.804   0.815   0.825   0.834   0.842   0.849
 79          PC   0.856   0.863   0.869   0.875   0.881   0.887   0.893   0.898   0.903   0.908
 80          PC   0.913   0.918   0.922   0.926    0.93   0.934   0.938   0.942   0.946    0.95
 81          PC   0.953   0.956   0.959   0.962   0.965   0.968   0.971   0.974   0.977    0.98
 82          PC   0.983   0.986   0.989   0.992   0.995   0.998     1.0
 83          IN      15 01JAN94       0
 84          JD   4.524   60.00
             * precip1: 24-hour distribution
 85          PC     0.0   0.002   0.005   0.008   0.011   0.014   0.017    0.02   0.023   0.026
 86          PC   0.029   0.032   0.035   0.038   0.041   0.044   0.048   0.052   0.056    0.06
 87          PC   0.064   0.068   0.072   0.076    0.08   0.085    0.09   0.095     0.1   0.105
 88          PC    0.11   0.115    0.12   0.126   0.133    0.14   0.147   0.155   0.163   0.172
 89          PC   0.181   0.191   0.203   0.218   0.236   0.257   0.283   0.387   0.663   0.707
 90          PC   0.735   0.758   0.776   0.791   0.804   0.815   0.825   0.834   0.842   0.849
 91          PC   0.856   0.863   0.869   0.875   0.881   0.887   0.893   0.898   0.903   0.908
 92          PC   0.913   0.918   0.922   0.926    0.93   0.934   0.938   0.942   0.946    0.95
 93          PC   0.953   0.956   0.959   0.962   0.965   0.968   0.971   0.974   0.977    0.98
 94          PC   0.983   0.986   0.989   0.992   0.995   0.998     1.0
 95          IN      15 01JAN94       0
 96          JD   4.445   90.00
             * precip1: 24-hour distribution
 97          PC     0.0   0.002   0.005   0.008   0.011   0.014   0.017    0.02   0.023   0.026
```

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 98          PC   0.029   0.032   0.035   0.038   0.041   0.044   0.048   0.052   0.056    0.06
 99          PC   0.064   0.068   0.072   0.076    0.08   0.085    0.09   0.095     0.1   0.105
100          PC    0.11   0.115    0.12   0.126   0.133    0.14   0.147   0.155   0.163   0.172
101          PC   0.181   0.191   0.203   0.218   0.236   0.257   0.283   0.387   0.663   0.707
102          PC   0.735   0.758   0.776   0.791   0.804   0.815   0.825   0.834   0.842   0.849
103          PC   0.856   0.863   0.869   0.875   0.881   0.887   0.893   0.898   0.903   0.908
104          PC   0.913   0.918   0.922   0.926    0.93   0.934   0.938   0.942   0.946    0.95
1                                          HEC-1 INPUT
PAGE  3

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

105          PC   0.953   0.956   0.959   0.962   0.965   0.968   0.971   0.974   0.977    0.98
106          PC   0.983   0.986   0.989   0.992   0.995   0.998     1.0
107          IN      15 01JAN94       0
108          JD   4.387   120.0
             * precip1: 24-hour distribution
109          PC     0.0   0.002   0.005   0.008   0.011   0.014   0.017    0.02   0.023   0.026
110          PC   0.029   0.032   0.035   0.038   0.041   0.044   0.048   0.052   0.056    0.06
111          PC   0.064   0.068   0.072   0.076    0.08   0.085    0.09   0.095     0.1   0.105
112          PC    0.11   0.115    0.12   0.126   0.133    0.14   0.147   0.155   0.163   0.172
113          PC   0.181   0.191   0.203   0.218   0.236   0.257   0.283   0.387   0.663   0.707
114          PC   0.735   0.758   0.776   0.791   0.804   0.815   0.825   0.834   0.842   0.849
115          PC   0.856   0.863   0.869   0.875   0.881   0.887   0.893   0.898   0.903   0.908
116          PC   0.913   0.918   0.922   0.926    0.93   0.934   0.938   0.942   0.946    0.95
117          PC   0.953   0.956   0.959   0.962   0.965   0.968   0.971   0.974   0.977    0.98
118          PC   0.983   0.986   0.989   0.992   0.995   0.998     1.0
119          IN      15 01JAN94       0
120          JD    4.34   150.0
             * precip1: 24-hour distribution
121          PC     0.0   0.002   0.005   0.008   0.011   0.014   0.017    0.02   0.023   0.026
122          PC   0.029   0.032   0.035   0.038   0.041   0.044   0.048   0.052   0.056    0.06
123          PC   0.064   0.068   0.072   0.076    0.08   0.085    0.09   0.095     0.1   0.105
124          PC    0.11   0.115    0.12   0.126   0.133    0.14   0.147   0.155   0.163   0.172
125          PC   0.181   0.191   0.203   0.218   0.236   0.257   0.283   0.387   0.663   0.707
126          PC   0.735   0.758   0.776   0.791   0.804   0.815   0.825   0.834   0.842   0.849
127          PC   0.856   0.863   0.869   0.875   0.881   0.887   0.893   0.898   0.903   0.908
128          PC   0.913   0.918   0.922   0.926    0.93   0.934   0.938   0.942   0.946    0.95
129          PC   0.953   0.956   0.959   0.962   0.965   0.968   0.971   0.974   0.977    0.98
130          PC   0.983   0.986   0.989   0.992   0.995   0.998     1.0
131          IN      15 01JAN94       0
132          JD   4.208   300.0
             * precip1: 24-hour distribution
133          PC     0.0   0.002   0.005   0.008   0.011   0.014   0.017    0.02   0.023   0.026
134          PC   0.029   0.032   0.035   0.038   0.041   0.044   0.048   0.052   0.056    0.06
135          PC   0.064   0.068   0.072   0.076    0.08   0.085    0.09   0.095     0.1   0.105
136          PC    0.11   0.115    0.12   0.126   0.133    0.14   0.147   0.155   0.163   0.172
137          PC   0.181   0.191   0.203   0.218   0.236   0.257   0.283   0.387   0.663   0.707
138          PC   0.735   0.758   0.776   0.791   0.804   0.815   0.825   0.834   0.842   0.849
139          PC   0.856   0.863   0.869   0.875   0.881   0.887   0.893   0.898   0.903   0.908
140          PC   0.913   0.918   0.922   0.926    0.93   0.934   0.938   0.942   0.946    0.95
141          PC   0.953   0.956   0.959   0.962   0.965   0.968   0.971   0.974   0.977    0.98
142          PC   0.983   0.986   0.989   0.992   0.995   0.998     1.0
143          IN      15 01JAN94       0
144          JD   4.103   500.0
             * precip1: 24-hour distribution
145          PC     0.0   0.002   0.005   0.008   0.011   0.014   0.017    0.02   0.023   0.026
146          PC   0.029   0.032   0.035   0.038   0.041   0.044   0.048   0.052   0.056    0.06
147          PC   0.064   0.068   0.072   0.076    0.08   0.085    0.09   0.095     0.1   0.105
148          PC    0.11   0.115    0.12   0.126   0.133    0.14   0.147   0.155   0.163   0.172
149          PC   0.181   0.191   0.203   0.218   0.236   0.257   0.283   0.387   0.663   0.707
150          PC   0.735   0.758   0.776   0.791   0.804   0.815   0.825   0.834   0.842   0.849
151          PC   0.856   0.863   0.869   0.875   0.881   0.887   0.893   0.898   0.903   0.908
152          PC   0.913   0.918   0.922   0.926    0.93   0.934   0.938   0.942   0.946    0.95
153          PC   0.953   0.956   0.959   0.962   0.965   0.968   0.971   0.974   0.977    0.98
154          PC   0.983   0.986   0.989   0.992   0.995   0.998     1.0
             *
```

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

TIME OF MAX STAGE	OPERATION	STATION	PEAK FLOW	TIME OF PEAK	AVERAGE FLOW FOR MAXIMUM PERIOD 6-HOUR	24-HOUR	72-HOUR	BASIN AREA	MAXIMUM STAGE
+	HYDROGRAPH AT	PI680	10298.	13.50	4029.	1233.	414.	16.89	
+	ROUTED TO	680640	7796.	15.25	3900.	1226.	414.	16.89	
+	HYDROGRAPH AT	PI640	15709.	13.50	4321.	1138.	380.	17.56	
+	2 COMBINED AT	640	15641.	13.50	7473.	2257.	762.	34.45	
+	HYDROGRAPH AT	WI540	10366.	13.50	2992.	896.	299.	11.64	
+	HYDROGRAPH AT	PD780	18363.	13.25	4420.	1306.	437.	19.17	
+	ROUTED TO	780760	12367.	14.00	4412.	1303.	437.	19.17	
+	HYDROGRAPH AT	PD760	4789.	12.50	499.	132.	44.	2.72	
+	HYDROGRAPH AT	PD745	3318.	12.50	412.	112.	37.	1.98	
+	5 COMBINED AT	CAP	31526.	13.50	14441.	4320.	1459.	69.96	
+	ROUTED TO	STOR	8265.	16.00	7677.	4278.	1459.	69.96	
+	DIVERSION TO	CAP2	6904.	16.00	6451.	3631.	1239.	69.96	
+	HYDROGRAPH AT	CAP1	1361.	16.00	1226.	647.	220.	69.96	
+	ROUTED TO	640505	1279.	17.50	1218.	646.	220.	69.96	
+	HYDROGRAPH AT	WI505	5747.	13.25	1254.	333.	111.	6.67	
+	2 COMBINED AT	505	5672.	13.25	2305.	1061.	361.	17.87	
+	ROUTED TO	505500	4932.	13.50	2280.	1061.	361.	17.87	
+	HYDROGRAPH AT	WT140	3123.	13.00	802.	230.	77.	3.80	
+	ROUTED TO	140130	2249.	13.75	799.	229.	77.	3.80	
+	HYDROGRAPH AT	WT130	2510.	13.00	526.	142.	48.	2.54	
	2 COMBINED AT								

+	130	3413.	13.50	1310.	368.	123.	6.34
ROUTED TO +	130120	3348.	13.50	1309.	368.	123.	6.34
HYDROGRAPH AT +	WT150	4167.	13.25	1217.	351.	117.	5.85
ROUTED TO +	150120	2964.	13.75	1205.	350.	117.	5.85
HYDROGRAPH AT +	WT160	1015.	12.50	178.	50.	17.	.82
ROUTED TO +	160120	625.	13.50	177.	50.	17.	.82
HYDROGRAPH AT +	WT120	4555.	12.50	552.	142.	47.	2.82
3 COMBINED AT +	120	4815.	12.50	1899.	536.	180.	9.48
2 COMBINED AT +	120*	6605.	13.75	3123.	881.	295.	15.82
ROUTED TO +	120110	5632.	14.25	3085.	879.	295.	15.82
HYDROGRAPH AT +	WT110	4217.	12.50	574.	151.	51.	2.90
2 COMBINED AT +	110	5684.	14.25	3572.	1015.	341.	18.71
ROUTED TO	110100	5590.	14.50	3556.	1015.	341.	18.71
HYDROGRAPH AT +	WT100	3901.	13.00	812.	227.	76.	3.84
2 COMBINED AT +	100	7996.	13.00	4270.	1217.	409.	22.56
ROUTED TO +	100400	5900.	14.75	4142.	1215.	409.	22.56
HYDROGRAPH AT +	IW350	5448.	12.50	995.	276.	92.	4.21
ROUTED TO +	350310	1721.	17.50	879.	272.	92.	4.21
HYDROGRAPH AT +	IW310	16248.	14.00	6195.	1635.	546.	25.81
2 COMBINED AT +	310	16125.	14.00	6475.	1853.	627.	30.02
ROUTED TO +	CAP020	16072.	14.25	5972.	1850.	625.	30.02
ROUTED TO +	310200	10862.	15.75	5523.	1845.	625.	30.02
HYDROGRAPH AT +	SV220	15343.	13.50	4231.	1095.	365.	16.95
ROUTED TO	CAP010	13996.	13.75	4173.	1090.	363.	16.95

	ROUTED TO						
	220200	5400.	16.50	4017.	1089.	363.	16.95
	HYDROGRAPH AT						
+	TW480	8553.	13.50	3182.	969.	325.	12.72
	ROUTED TO						
+	480460	6870.	14.00	3113.	967.	325.	12.72
	HYDROGRAPH AT						
+	TW460	2898.	12.75	518.	136.	45.	2.44
	2 COMBINED AT						
+	460	7084.	14.00	3526.	1088.	366.	15.16
	ROUTED TO						
+	460420	5455.	16.50	3288.	1080.	366.	15.16
	HYDROGRAPH AT						
+	TW420	8292.	13.50	2241.	589.	197.	10.89
	2 COMBINED AT						
+	420	8128.	13.50	4572.	1599.	543.	26.06
	ROUTED TO						
+	CAP030	7632.	13.75	4573.	1599.	543.	26.06
	ROUTED TO						
+	420200	5455.	15.00	4373.	1597.	543.	26.06
	HYDROGRAPH AT						
+	SV200	14836.	14.00	5905.	1592.	532.	31.33
	4 COMBINED AT						
+	200	24258.	15.50	16244.	5477.	1861.	104.36
	ROUTED TO						
+	200400	22659.	16.25	15928.	5466.	1861.	104.36
	HYDROGRAPH AT						
+	TW400	10315.	13.50	2696.	735.	246.	12.99
	2 COMBINED AT						
+	400	22659.	16.25	16521.	6033.	2064.	117.35
	2 COMBINED AT						
+	400*	26535.	16.25	19803.	7007.	2396.	139.91
	ROUTED TO						
+	400510	26370.	16.50	19749.	7007.	2396.	139.91
	HYDROGRAPH AT						
+	WI580	19545.	14.00	6733.	1783.	595.	30.35
	ROUTED TO						
+	CAP040	19516.	14.00	6358.	1759.	587.	30.35
	ROUTED TO						
+	580510	10461.	16.75	5624.	1754.	587.	30.35
	HYDROGRAPH AT						
+	WI510	6764.	13.75	2128.	598.	200.	9.31
	2 COMBINED AT						
+	510	10461.	16.75	6112.	2224.	757.	39.66
	2 COMBINED AT						
+	510*	34714.	16.50	24702.	8891.	3038.	179.56
	ROUTED TO						
+	510500	33172.	17.00	24261.	8890.	3038.	179.56

	HYDROGRAPH AT	WI520	11774.	13.75	3701.	1052.	351.	16.39
	ROUTED TO							
+		520500	6415.	15.50	3639.	1046.	351.	16.39
	HYDROGRAPH AT							
+		CAP2	6904.	16.00	6451.	3631.	1239.	69.96
	DIVERSION TO							
+		CAP3	6042.	16.00	5672.	3231.	1105.	69.96
	HYDROGRAPH AT							
+		CAP2	862.	16.00	779.	400.	135.	69.96
	ROUTED TO							
+		540500	798.	18.50	769.	398.	135.	69.96
	HYDROGRAPH AT							
+		WI500	7024.	13.50	1841.	489.	163.	9.16
	3 COMBINED AT							
+		500.1	7297.	16.00	5556.	1889.	641.	32.54
	2 COMBINED AT							
+		500.2	36706.	16.75	28060.	10431.	3564.	212.11
	ROUTED TO							
+		500500	36617.	17.00	28028.	10430.	3564.	212.11
	2 COMBINED AT							
+		500.3	37639.	17.00	29226.	11238.	3839.	229.97
	ROUTED TO							
		500600	35930.	18.25	28671.	11234.	3839.	229.97
	HYDROGRAPH AT							
+		PI600	10013.	13.25	2343.	639.	213.	12.03
	HYDROGRAPH AT							
+		CAP3	6042.	16.00	5672.	3231.	1105.	69.96
	DIVERSION TO							
+		CAP4	3884.	16.00	3672.	2196.	754.	69.96
	HYDROGRAPH AT							
+		CAP3	2158.	16.00	2000.	1035.	350.	69.96
	ROUTED TO							
+		640600	2073.	17.75	1984.	1033.	350.	69.96
	2 COMBINED AT							
+		600	10013.	13.25	3746.	1764.	603.	30.22
	2 COMBINED AT							
+		600*	37705.	18.25	30404.	12591.	4307.	260.20
	ROUTED TO							
+		600710	37416.	18.50	30282.	12590.	4307.	260.20
	HYDROGRAPH AT							
+		CAP4	3884.	16.00	3672.	2196.	754.	69.96
	ROUTED TO							
+		760710	3803.	17.50	3653.	2192.	754.	69.96
	HYDROGRAPH AT							
+		PD710	5010.	13.50	1267.	335.	112.	6.72
	HYDROGRAPH AT							

+		PD740	1943.	12.25	175.	46.	15.	.87
	ROUTED TO							
+		CAP200	423.	12.75	176.	46.	15.	.87
	ROUTED TO							
+		740710	344.	15.75	167.	46.	15.	.87
	3 COMBINED AT							
+		710	5731.	13.50	4206.	2588.	890.	41.17
	2 COMBINED AT							
+		710*	40744.	18.50	33647.	14784.	5066.	301.37
	ROUTED TO							
+		710700	40322.	19.00	33479.	14781.	5066.	301.37
	HYDROGRAPH AT							
+		PD730	821.	12.50	114.	34.	11.	.48
	ROUTED TO							
+		CAP220	523.	12.75	116.	35.	12.	.48
	HYDROGRAPH AT							
+		PD735	3678.	12.75	726.	216.	72.	3.23
	ROUTED TO							
+		CAP210	2927.	13.00	726.	216.	72.	3.23
	2 COMBINED AT							
+		736	3431.	12.75	837.	249.	83.	3.71
	ROUTED TO							
+		735700	2023.	14.50	827.	247.	83.	3.71
	HYDROGRAPH AT							
		PD700	8462.	13.00	1538.	422.	141.	7.26
	2 COMBINED AT							
+		700	8588.	13.00	2309.	657.	221.	10.97
	2 COMBINED AT							
+		700*	40366.	18.75	33653.	15250.	5234.	312.34

*** NORMAL END OF HEC-1 ***

F.2. Future Conditions

```
1****************************************
*                                      *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)  *
*             JUN   1998               *
*           VERSION 4.1                *
*                                      *
*  RUN DATE   26APR04  TIME  08:16:06  *
*                                      *
****************************************
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```
****************************************
*                                      *
*    U.S. ARMY CORPS OF ENGINEERS      *
*    HYDROLOGIC ENGINEERING CENTER     *
*          609 SECOND STREET           *
*       DAVIS, CALIFORNIA 95616        *
*           (916) 756-1104             *
*                                      *
****************************************
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X     X  XXXXXXX   XXXXX          X
X     X  X        X     X        XX
X     X  X        X               X
XXXXXXX  XXXX     X        XXXXX  X
X     X  X        X               X
X     X  X        X     X         X
X     X  XXXXXXX   XXXXX         XXX
```

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

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

1
PAGE 1

HEC-1 INPUT

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

   1          ID
   2          ID   ****************************************************************************
   3          ID   **                                                                        **
   4          ID   **                    McMICKEN DAM HYDROLOGY MODEL                        **
   5          ID   **                                                                        **
   6          ID   ****************************************************************************
   7          ID   ****************************************************************************
   8          ID   PROJECT:                 WITTMANN ADMS Update
   9          ID   CLIENT:                  Flood Control District of Maricopa County
  10          ID   PREPARED BY:             Entellus, Inc.
  11          ID   PROJECT No:              FCD 2002C029              Entellus 310.032
  12          ID   FILE NAME: fut500.hc1                     CREATED DATE: Sept 3, 2003
  13          ID                                            MODIFIED DATE: Apr 26, 2004
  14          ID   STORM:                   500-year 24-hour Storm
  15          ID   DEVELOPMENT CONDITIONS: Future Conditions
  16          ID
  17          ID
  18          ID   Changes made to Model:
  19          ID                        -Basin WT130 was adjusted to reflect improvements at
  20          ID                          southwest portion of the dam.
  21          ID                        -Basins PD790 and PD780 were combined to form PD780.
  22          ID                        -Basins PI640 and PI620 were combined to form PI640.
  23          ID                        -Basins PD720 and PD710 were combined to form PD710.
  24          ID                        -Changed the following concentration point names:
  25          ID                               CP 400 changed to 400*
  26          ID                               CP 510 changed to 510*
  27          ID                               CP 500 changed to 500.3
  28          ID                               CP 600 changed to 600*
  29          ID                               CP 710 changed to 710*
  30          ID                               CP 700 changed to 700*
  31          ID                        -Added concentration points 400, 510, 500.1, 500.2,
  32          ID                          600, 710 and 700.
  33          ID                        -Adjusted CAP culvert system (structures CAP060-CAP190)
  34          ID                          to account for the overtopping of the CAP Canal
  35          ID                        -Adjusted Time of COncentrations and routes for basins
  36          ID                          along McMicken Dam channel.
  37          ID                        -Corrected S-Graphs for WI500, WI510, WT100, WT120,
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38          ID                          WT130 and SV200
39          ID                        04-26-2004
40          ID                        -Increased number of ordinates, added CP and
41          ID                          rearranged combines in White Tanks area.
42          ID
            *DIAGRAM
43          IT      15  1JAN94       0    1500
44          IO       3
45          IN      15 01JAN94       0
46          JD    5.26    0.01
            * precip1: 24-hour distribution
47          PC     0.0   0.002   0.005   0.008   0.011   0.014   0.017    0.02   0.023   0.026
48          PC   0.029   0.032   0.035   0.038   0.041   0.044   0.048   0.052   0.056    0.06
49          PC   0.064   0.068   0.072   0.076    0.08   0.085    0.09   0.095     0.1   0.105
50          PC    0.11   0.115    0.12   0.126   0.133    0.14   0.147   0.155   0.163   0.172
51          PC   0.181   0.191   0.203   0.218   0.236   0.257   0.283   0.387   0.663   0.707
52          PC   0.735   0.758   0.776   0.791   0.804   0.815   0.825   0.834   0.842   0.849
53          PC   0.856   0.863   0.869   0.875   0.881   0.887   0.893   0.898   0.903   0.908
1                                          HEC-1 INPUT
PAGE  2

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

54          PC   0.913   0.918   0.922   0.926    0.93   0.934   0.938   0.942   0.946    0.95
55          PC   0.953   0.956   0.959   0.962   0.965   0.968   0.971   0.974   0.977    0.98
56          PC   0.983   0.986   0.989   0.992   0.995   0.998     1.0
57          IN      15 01JAN94       0
58          JD   4.944   10.00
            * precip1: 24-hour distribution
59          PC     0.0   0.002   0.005   0.008   0.011   0.014   0.017    0.02   0.023   0.026
60          PC   0.029   0.032   0.035   0.038   0.041   0.044   0.048   0.052   0.056    0.06
61          PC   0.064   0.068   0.072   0.076    0.08   0.085    0.09   0.095     0.1   0.105
62          PC    0.11   0.115    0.12   0.126   0.133    0.14   0.147   0.155   0.163   0.172
63          PC   0.181   0.191   0.203   0.218   0.236   0.257   0.283   0.387   0.663   0.707
64          PC   0.735   0.758   0.776   0.791   0.804   0.815   0.825   0.834   0.842   0.849
65          PC   0.856   0.863   0.869   0.875   0.881   0.887   0.893   0.898   0.903   0.908
66          PC   0.913   0.918   0.922   0.926    0.93   0.934   0.938   0.942   0.946    0.95
67          PC   0.953   0.956   0.959   0.962   0.965   0.968   0.971   0.974   0.977    0.98
68          PC   0.983   0.986   0.989   0.992   0.995   0.998     1.0
69          IN      15 01JAN94       0
70          JD   4.734   30.00
            * precip1: 24-hour distribution
71          PC     0.0   0.002   0.005   0.008   0.011   0.014   0.017    0.02   0.023   0.026
72          PC   0.029   0.032   0.035   0.038   0.041   0.044   0.048   0.052   0.056    0.06
73          PC   0.064   0.068   0.072   0.076    0.08   0.085    0.09   0.095     0.1   0.105
74          PC    0.11   0.115    0.12   0.126   0.133    0.14   0.147   0.155   0.163   0.172
75          PC   0.181   0.191   0.203   0.218   0.236   0.257   0.283   0.387   0.663   0.707
76          PC   0.735   0.758   0.776   0.791   0.804   0.815   0.825   0.834   0.842   0.849
77          PC   0.856   0.863   0.869   0.875   0.881   0.887   0.893   0.898   0.903   0.908
78          PC   0.913   0.918   0.922   0.926    0.93   0.934   0.938   0.942   0.946    0.95
79          PC   0.953   0.956   0.959   0.962   0.965   0.968   0.971   0.974   0.977    0.98
80          PC   0.983   0.986   0.989   0.992   0.995   0.998     1.0
81          IN      15 01JAN94       0
82          JD   4.524   60.00
            * precip1: 24-hour distribution
83          PC     0.0   0.002   0.005   0.008   0.011   0.014   0.017    0.02   0.023   0.026
84          PC   0.029   0.032   0.035   0.038   0.041   0.044   0.048   0.052   0.056    0.06
85          PC   0.064   0.068   0.072   0.076    0.08   0.085    0.09   0.095     0.1   0.105
86          PC    0.11   0.115    0.12   0.126   0.133    0.14   0.147   0.155   0.163   0.172
87          PC   0.181   0.191   0.203   0.218   0.236   0.257   0.283   0.387   0.663   0.707
88          PC   0.735   0.758   0.776   0.791   0.804   0.815   0.825   0.834   0.842   0.849
89          PC   0.856   0.863   0.869   0.875   0.881   0.887   0.893   0.898   0.903   0.908
90          PC   0.913   0.918   0.922   0.926    0.93   0.934   0.938   0.942   0.946    0.95
91          PC   0.953   0.956   0.959   0.962   0.965   0.968   0.971   0.974   0.977    0.98
92          PC   0.983   0.986   0.989   0.992   0.995   0.998     1.0
93          IN      15 01JAN94       0
94          JD   4.445   90.00
            * precip1: 24-hour distribution
95          PC     0.0   0.002   0.005   0.008   0.011   0.014   0.017    0.02   0.023   0.026
96          PC   0.029   0.032   0.035   0.038   0.041   0.044   0.048   0.052   0.056    0.06
97          PC   0.064   0.068   0.072   0.076    0.08   0.085    0.09   0.095     0.1   0.105
```

```
 98          PC    0.11    0.115     0.12    0.126    0.133     0.14    0.147    0.155    0.163    0.172
 99          PC   0.181    0.191    0.203    0.218    0.236    0.257    0.283    0.387    0.663    0.707
100          PC   0.735    0.758    0.776    0.791    0.804    0.815    0.825    0.834    0.842    0.849
101          PC   0.856    0.863    0.869    0.875    0.881    0.887    0.893    0.898    0.903    0.908
102          PC   0.913    0.918    0.922    0.926     0.93    0.934    0.938    0.942    0.946     0.95
103          PC   0.953    0.956    0.959    0.962    0.965    0.968    0.971    0.974    0.977     0.98
104          PC   0.983    0.986    0.989    0.992    0.995    0.998      1.0
1                                              HEC-1 INPUT
PAGE  3

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

105          IN      15 01JAN94        0
106          JD   4.387    120.0
             * precip1: 24-hour distribution
107          PC     0.0    0.002    0.005    0.008    0.011    0.014    0.017     0.02    0.023    0.026
108          PC   0.029    0.032    0.035    0.038    0.041    0.044    0.048    0.052    0.056     0.06
109          PC   0.064    0.068    0.072    0.076     0.08    0.085     0.09    0.095      0.1    0.105
110          PC    0.11    0.115     0.12    0.126    0.133     0.14    0.147    0.155    0.163    0.172
111          PC   0.181    0.191    0.203    0.218    0.236    0.257    0.283    0.387    0.663    0.707
112          PC   0.735    0.758    0.776    0.791    0.804    0.815    0.825    0.834    0.842    0.849
113          PC   0.856    0.863    0.869    0.875    0.881    0.887    0.893    0.898    0.903    0.908
114          PC   0.913    0.918    0.922    0.926     0.93    0.934    0.938    0.942    0.946     0.95
115          PC   0.953    0.956    0.959    0.962    0.965    0.968    0.971    0.974    0.977     0.98
116          PC   0.983    0.986    0.989    0.992    0.995    0.998      1.0
117          IN      15 01JAN94        0
118          JD    4.34    150.0
             * precip1: 24-hour distribution
119          PC     0.0    0.002    0.005    0.008    0.011    0.014    0.017     0.02    0.023    0.026
120          PC   0.029    0.032    0.035    0.038    0.041    0.044    0.048    0.052    0.056     0.06
121          PC   0.064    0.068    0.072    0.076     0.08    0.085     0.09    0.095      0.1    0.105
122          PC    0.11    0.115     0.12    0.126    0.133     0.14    0.147    0.155    0.163    0.172
123          PC   0.181    0.191    0.203    0.218    0.236    0.257    0.283    0.387    0.663    0.707
124          PC   0.735    0.758    0.776    0.791    0.804    0.815    0.825    0.834    0.842    0.849
125          PC   0.856    0.863    0.869    0.875    0.881    0.887    0.893    0.898    0.903    0.908
126          PC   0.913    0.918    0.922    0.926     0.93    0.934    0.938    0.942    0.946     0.95
127          PC   0.953    0.956    0.959    0.962    0.965    0.968    0.971    0.974    0.977     0.98
128          PC   0.983    0.986    0.989    0.992    0.995    0.998      1.0
129          IN      15 01JAN94        0
130          JD   4.208    300.0
             * precip1: 24-hour distribution
131          PC     0.0    0.002    0.005    0.008    0.011    0.014    0.017     0.02    0.023    0.026
132          PC   0.029    0.032    0.035    0.038    0.041    0.044    0.048    0.052    0.056     0.06
133          PC   0.064    0.068    0.072    0.076     0.08    0.085     0.09    0.095      0.1    0.105
134          PC    0.11    0.115     0.12    0.126    0.133     0.14    0.147    0.155    0.163    0.172
135          PC   0.181    0.191    0.203    0.218    0.236    0.257    0.283    0.387    0.663    0.707
136          PC   0.735    0.758    0.776    0.791    0.804    0.815    0.825    0.834    0.842    0.849
137          PC   0.856    0.863    0.869    0.875    0.881    0.887    0.893    0.898    0.903    0.908
138          PC   0.913    0.918    0.922    0.926     0.93    0.934    0.938    0.942    0.946     0.95
139          PC   0.953    0.956    0.959    0.962    0.965    0.968    0.971    0.974    0.977     0.98
140          PC   0.983    0.986    0.989    0.992    0.995    0.998      1.0
141          IN      15 01JAN94        0
142          JD   4.103    500.0
             * precip1: 24-hour distribution
143          PC     0.0    0.002    0.005    0.008    0.011    0.014    0.017     0.02    0.023    0.026
144          PC   0.029    0.032    0.035    0.038    0.041    0.044    0.048    0.052    0.056     0.06
145          PC   0.064    0.068    0.072    0.076     0.08    0.085     0.09    0.095      0.1    0.105
146          PC    0.11    0.115     0.12    0.126    0.133     0.14    0.147    0.155    0.163    0.172
147          PC   0.181    0.191    0.203    0.218    0.236    0.257    0.283    0.387    0.663    0.707
148          PC   0.735    0.758    0.776    0.791    0.804    0.815    0.825    0.834    0.842    0.849
149          PC   0.856    0.863    0.869    0.875    0.881    0.887    0.893    0.898    0.903    0.908
150          PC   0.913    0.918    0.922    0.926     0.93    0.934    0.938    0.942    0.946     0.95
151          PC   0.953    0.956    0.959    0.962    0.965    0.968    0.971    0.974    0.977     0.98
152          PC   0.983    0.986    0.989    0.992    0.995    0.998      1.0
```

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

TIME OF MAX STAGE	OPERATION	STATION	PEAK FLOW	TIME OF PEAK	AVERAGE FLOW FOR MAXIMUM PERIOD 6-HOUR	24-HOUR	72-HOUR	BASIN AREA	MAXIMUM STAGE
+	HYDROGRAPH AT	PI680	10323.	13.50	4072.	1263.	424.	16.89	
+	ROUTED TO	680640	7834.	15.25	3947.	1255.	424.	16.89	
+	HYDROGRAPH AT	PI640	15923.	13.50	4516.	1247.	416.	17.56	
+	2 COMBINED AT	640	15922.	13.50	7701.	2383.	808.	34.45	
+	HYDROGRAPH AT	WI540	10669.	13.50	3211.	1001.	335.	11.64	
+	HYDROGRAPH AT	PD780	18504.	13.25	4574.	1386.	463.	19.17	
+	ROUTED TO	780760	11508.	14.00	4557.	1380.	463.	19.17	
+	HYDROGRAPH AT	PD760	4875.	12.50	540.	150.	50.	2.72	
	HYDROGRAPH AT	PD745	3349.	12.50	436.	124.	41.	1.98	
+	5 COMBINED AT	CAP	32976.	13.50	15074.	4651.	1573.	69.96	
+	ROUTED TO	STOR	12068.	15.75	8128.	4589.	1573.	69.96	
+	DIVERSION TO	CAP2	9625.	15.75	6781.	3882.	1332.	69.96	
+	HYDROGRAPH AT	CAP1	2443.	15.75	1347.	706.	240.	69.96	
+	ROUTED TO	640505	1830.	17.00	1342.	705.	240.	69.96	
+	HYDROGRAPH AT	WI505	6304.	13.25	1573.	474.	158.	6.67	
+	2 COMBINED AT	505	6260.	13.25	2771.	1246.	430.	17.87	
+	ROUTED TO	505500	5289.	13.50	2729.	1245.	430.	17.87	
+	HYDROGRAPH AT	WT140	3210.	13.00	847.	248.	83.	3.80	
+	ROUTED TO	140130	2340.	13.75	843.	248.	83.	3.80	
	HYDROGRAPH AT	WT130	2542.	13.00	549.	153.	51.	2.54	
	2 COMBINED AT								

+	130	3558.	13.50	1375.	397.	133.	6.34
ROUTED TO +	130120	3480.	13.50	1375.	397.	133.	6.34
HYDROGRAPH AT +	WT150	4291.	13.25	1284.	380.	127.	5.85
ROUTED TO +	150120	3102.	13.75	1272.	378.	127.	5.85
HYDROGRAPH AT +	WT160	1031.	12.50	186.	54.	18.	.82
ROUTED TO +	160120	616.	13.50	186.	54.	18.	.82
HYDROGRAPH AT +	WT120	4583.	12.50	574.	153.	51.	2.82
3 COMBINED AT +	120	4908.	12.50	1994.	578.	194.	9.48
2 COMBINED AT +	120*	6892.	13.75	3283.	951.	319.	15.82
ROUTED TO +	120110	6318.	14.50	3268.	950.	319.	15.82
HYDROGRAPH AT +	WT110	4267.	12.50	608.	167.	56.	2.90
2 COMBINED AT +	110	6344.	14.25	3781.	1100.	370.	18.71
ROUTED TO +	110100	6273.	14.50	3765.	1100.	370.	18.71
HYDROGRAPH AT +	WT100	4012.	13.00	874.	254.	85.	3.84
2 COMBINED AT +	100	7708.	13.00	4538.	1327.	447.	22.56
ROUTED TO +	100400	6334.	15.25	4409.	1325.	447.	22.56
HYDROGRAPH AT +	IW350	5443.	12.50	1002.	282.	94.	4.21
ROUTED TO +	350310	1849.	17.50	900.	278.	94.	4.21
HYDROGRAPH AT +	IW310	16577.	14.00	6476.	1796.	600.	25.81
2 COMBINED AT +	310	16456.	14.00	6774.	2018.	684.	30.02
ROUTED TO +	CAP020	16372.	14.25	6310.	2010.	681.	30.02
ROUTED TO +	310200	11357.	15.75	5882.	2000.	681.	30.02
HYDROGRAPH AT +	SV220	15837.	13.50	4699.	1372.	458.	16.95
ROUTED TO	CAP010	14321.	13.75	4602.	1367.	457.	16.95

	ROUTED TO	220200	5388.	16.00	4469.	1361.	457.	16.95
	HYDROGRAPH AT	TW480	8510.	13.50	3163.	966.	324.	12.72
+	ROUTED TO	480460	7153.	14.00	3112.	964.	324.	12.72
+	HYDROGRAPH AT	TW460	2867.	12.75	508.	133.	44.	2.44
+	2 COMBINED AT	460	7357.	14.00	3510.	1083.	364.	15.16
+	ROUTED TO	460420	5911.	16.50	3327.	1076.	364.	15.16
+	HYDROGRAPH AT	TW420	8542.	13.50	2408.	667.	223.	10.89
+	2 COMBINED AT	420	8382.	13.50	4741.	1658.	567.	26.06
+	ROUTED TO	CAP030	7881.	13.75	4736.	1658.	567.	26.06
+	ROUTED TO	420200	5903.	15.00	4616.	1657.	567.	26.06
+	HYDROGRAPH AT	SV200	16107.	14.00	6883.	2068.	693.	31.33
+	4 COMBINED AT	200	26855.	15.25	18178.	6355.	2181.	104.36
+	ROUTED TO	200400	25548.	16.25	17939.	6350.	2181.	104.36
+	HYDROGRAPH AT	TW400	11577.	13.50	3532.	1120.	375.	12.99
+	2 COMBINED AT	400	25935.	16.25	19125.	7228.	2499.	117.35
+	2 COMBINED AT	400*	30577.	16.00	22733.	8322.	2869.	139.91
+	ROUTED TO	400510	30402.	16.25	22674.	8322.	2869.	139.91
+	HYDROGRAPH AT	WI580	19757.	14.00	6905.	1874.	626.	30.35
+	ROUTED TO	CAP040	19825.	14.00	6532.	1850.	617.	30.35
+	ROUTED TO	580510	11258.	16.75	5883.	1842.	617.	30.35
+	HYDROGRAPH AT	WI510	7605.	13.75	2732.	886.	297.	9.31
+	2 COMBINED AT	510	11594.	16.75	6852.	2546.	880.	39.66
+	2 COMBINED AT	510*	39503.	16.50	28297.	10504.	3625.	179.56
+	ROUTED TO	510500	37609.	17.00	27862.	10501.	3625.	179.56

	HYDROGRAPH AT	WI520	12076.	13.75	3927.	1161.	388.	16.39
	ROUTED TO							
+		520500	6358.	15.75	3838.	1153.	388.	16.39
	HYDROGRAPH AT							
+		CAP2	9625.	15.75	6781.	3882.	1332.	69.96
	DIVERSION TO							
+		CAP3	7962.	15.75	5916.	3443.	1184.	69.96
	HYDROGRAPH AT							
+		CAP2	1663.	15.75	864.	439.	148.	69.96
	ROUTED TO							
+		540500	1127.	17.75	858.	438.	148.	69.96
	HYDROGRAPH AT							
+		WI500	7778.	13.50	2364.	733.	245.	9.16
	3 COMBINED AT							
+		500.1	8257.	13.50	6340.	2247.	771.	32.54
	2 COMBINED AT							
+		500.2	42038.	16.75	32246.	12360.	4267.	212.11
	ROUTED TO							
+		500500	41788.	17.00	32217.	12359.	4267.	212.11
	2 COMBINED AT							
+		500.3	42934.	17.00	33673.	13318.	4599.	229.97
	ROUTED TO							
		500600	40654.	18.00	32858.	13305.	4599.	229.97
	HYDROGRAPH AT							
+		PI600	10568.	13.25	2706.	805.	269.	12.03
	HYDROGRAPH AT							
+		CAP3	7962.	15.75	5916.	3443.	1184.	69.96
	DIVERSION TO							
+		CAP4	4707.	15.75	3789.	2330.	806.	69.96
	HYDROGRAPH AT							
+		CAP3	3255.	15.75	2127.	1113.	378.	69.96
	ROUTED TO							
+		640600	2539.	17.25	2115.	1112.	378.	69.96
	2 COMBINED AT							
+		600	10568.	13.25	4240.	1976.	684.	30.22
	2 COMBINED AT							
+		600*	42525.	18.00	34736.	14857.	5140.	260.20
	ROUTED TO							
+		600710	42200.	18.25	34608.	14854.	5140.	260.20
	HYDROGRAPH AT							
+		CAP4	4707.	15.75	3789.	2330.	806.	69.96
	ROUTED TO							
+		760710	4179.	17.00	3775.	2326.	806.	69.96
	HYDROGRAPH AT							
		PD710	5116.	13.50	1335.	366.	122.	6.72
	HYDROGRAPH AT							

+		PD740	1954.	12.25	189.	53.	18.	.87
	ROUTED TO							
+		CAP200	425.	12.75	189.	53.	18.	.87
	ROUTED TO							
+		740710	348.	15.75	179.	53.	18.	.87
	3 COMBINED AT							
+		710	6084.	13.50	4467.	2748.	952.	41.17
	2 COMBINED AT							
+		710*	45588.	18.25	38068.	17229.	5964.	301.37
	ROUTED TO							
+		710700	44779.	18.75	37736.	17218.	5964.	301.37
	HYDROGRAPH AT							
+		PD730	839.	12.50	123.	38.	13.	.48
	ROUTED TO							
+		CAP220	527.	12.75	125.	39.	13.	.48
	HYDROGRAPH AT							
+		PD735	3794.	12.75	798.	248.	83.	3.23
	ROUTED TO							
+		CAP210	2975.	13.00	798.	248.	83.	3.23
	2 COMBINED AT							
+		736	3470.	12.75	919.	286.	96.	3.71
	ROUTED TO							
+		735700	2415.	14.25	911.	284.	96.	3.71
	HYDROGRAPH AT							
+		PD700	8521.	13.00	1580.	442.	148.	7.26
	2 COMBINED AT							
+		700	8676.	13.00	2437.	713.	240.	10.97
	2 COMBINED AT							
+		700*	44870.	18.75	37985.	17734.	6147.	312.34

*** NORMAL END OF HEC-1 ***

APPENDIX G. 100-YR, 10-DAY PRINCIPAL SPILLWAY HYDROGRAPH (PSH)

Entellus

SHEET 1 OF 39

BY AMG DATE 12/11/2003

CLIENT: FCDMC

CHECK CJL DATE 12/11/2003

JOB: Wittmann Area Drainage Master Study Update

JOB NO. 310.032

Table MD-G.1: 100-yr, 10-day Principal Spillway Hydrograph

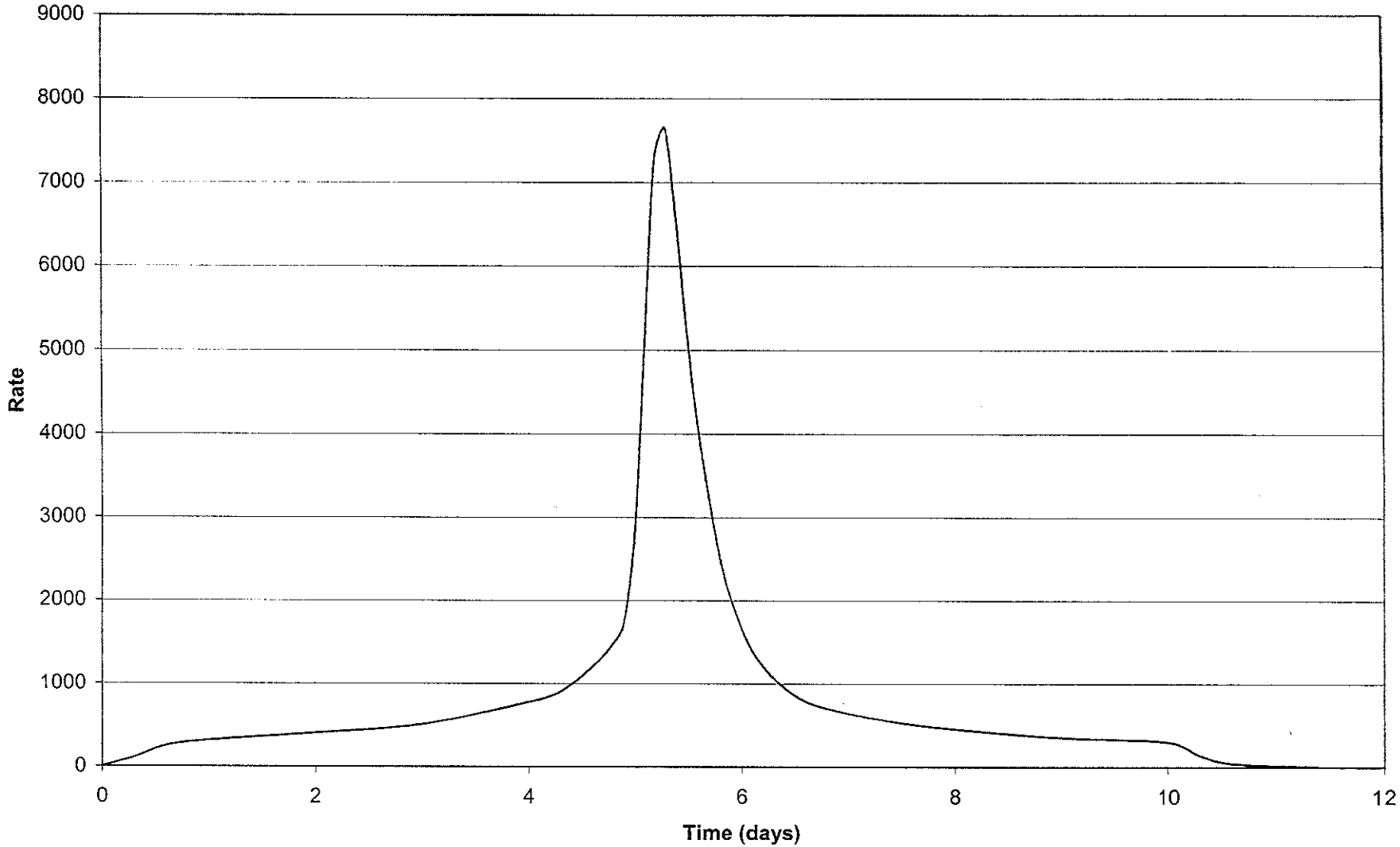
Time	csf/AQ10	PSH	Acc.Q/Q10	PSMC
0	0	0	0	0.00
0.3	0.302	108	0.0011	0.00
0.6	0.701	251	0.007	0.01
1	0.878	314	0.0189	0.03
2	1.124	403	0.0557	0.09
3	1.414	506	0.1022	0.16
4	2.164	775	0.1658	0.26
4.3	2.507	898	0.1913	0.30
4.6	3.345	1198	0.2234	0.35
4.8	4.148	1486	0.2508	0.39
4.9	4.855	1739	0.2674	0.41
5	7.736	2771	0.2907	0.45
5.1	14.079	5042	0.3309	0.51
5.2	20.236	7248	0.3942	0.61
5.3	21.358	7649	0.471	0.73
5.4	18.384	6584	0.5443	0.84
5.5	14.463	5180	0.6049	0.94
5.6	11.327	4057	0.6525	1.01
5.8	7	2507	0.7192	1.11
6	4.649	1665	0.7615	1.18
6.2	3.366	1206	0.7907	1.23
6.5	2.389	856	0.822	1.27
6.8	1.948	698	0.8457	1.31
7.4	1.519	544	0.8837	1.37
8	1.262	452	0.9144	1.42
9	0.977	350	0.9559	1.48
10	0.822	294	0.9898	1.53
10.3	0.377	135	0.9967	1.54
10.6	0.107	38	0.9991	1.55
11.4	0	0	1	1.55

Q_{10}*A
358.15

A = 247 s.m.
Q10 = 1.45

Appendix G

Figure MD-G.1: 100-yr, 10-day Principal Spillway Hydrograph



Entellus™

SHEET 3 OF 39
BY UP DATE 7/28/03
CHECK CTL DATE 8/19/03

CLIENT FCDMC

JOB NAME Wittman - 10 day storm Analysis JOB NO. 310.032

100 Yr - 10 day Principal Spillway Hydrograph (PSH)

Data Available.

Watershed drainage Area = 247 sq mi

Time of concentration T_c = 10.83 hr [Attached calculations]

Average Annual precipitation = 9" [Ref 30]

Average annual temperature = 70°F [Ref 31]

Run off curve numbers CN = 85 [Ref 32] TR-55

STEP 1 Compile the 1-day and 10-day point rainfall amounts.

From TP49 U-S weather bureau maps: [Ref 21]

100 Yr frequency 10 day equals 8 inches.

From rainfall frequency atlas: [Ref 33]

100 yr - 1 day equals ~~4 inches~~. 4.2 inches.

STEP 2: Determine the aerial rainfall.

Adjustment factors from table 21.1* [Ref 20]

For drainage area of 247 mi², adjustment factors are 0.914 and 0.957 for 1-day and 10day resply.

The aerial rainfall is (0.914)(4.2) = 3.838 in &

(0.957)8 = 7.656 in for 1-day and 10-day rain resply.

STEP 3: Determine CN for 10 day rain

From table 21.2*, with 1 day CN of 85, 10 day CN is 72 [Ref 20]

[Ref 34]

* Basic tables in TP 49 were used in STEP 2 and STEP 3

Table 21.1.--Ratios for areal adjustment of rainfall amount

Area	Area/point ratio for 1 day	Area/point ratio for 10 days	Area	Area/point ratio for 1 day	Area/point ratio for 10 days
sq. mi.			sq. mi.		
10 or less	1.000	1.000	80	937	0.968
15	.978	.991	100	932	.966
20	.969	.986		28	.964
25	.964	.983		.925	.962
30	.960	.981		.922	.961
35	.957		180	.920	.960
40	.952		200	.918	.959
50			250	.914	.957
60		.972	300	.911	.956
70	.9	.970	400	.910	.955

Use Revised Table in TR-60

rainfall for the structure site is 6 or more inches, the CN for the 10-day storm is taken from table 21.2. If it is less than 6 inches, the CN for the 10-day storm is the same as that for the 1-day storm. The 10-day CN is used only with the total 10-day rainfall.

CLIMATIC INDEX. The climatic index used in this part of the chapter is:

$$Ci = \frac{100\ Pa}{(Ta)^2} \qquad (21.1)$$

where Ci = climatic index
Pa = average annual precipitation in inches
Ta = average annual temperature in degrees Fahrenheit

Precipitation and temperature data for U.S. Weather Bureau stations can be obtained from the following Weather Bureau publications:

Climatological Data. Issued annually and monthly for each State or a combination of States and for Puerto Rico and Virgin Islands. The annual issues contain annual and monthly data and averages or departures; monthly issues contain similar information for individual months.

Climatic Summary of the United States - Supplement for 1931-1952. Issued once for each State or a combination of States.

Climates of the States. Issued once for each State and for Puerto Rico and Virgin Islands.

Monthly Normals of Temperature, Precipitation, and Heating Degree Days. Issued once for each State or a combination of States. Also contains annual averages.

ble 21.2.--Ten-day runoff curve numbers*

Runoff curve numbers for:					
1 day	10 days	1 day	10 days	1 day	10 days
100	100	80	65	60	41
99	98	79	64	59	40
98	96	78	62	58	39
97	94	77	61	57	38
96	92	76	60	56	37
95	90	75	58		36
94	88	74	57		35
93	86	73			34
92	84	72		52	33
91	82			51	32
90			52	50	32
89		69	51	49	31
88		68	50	48	30
87	70	67	48	47	29
86	74	66	47	46	28
85	72	65	46	45	27
84	71	64	45	44	27
83	69	63	44	43	26
82	68	62	43	42	25
81	66	61	42	41	24

Use Revised Table in TR-60

* This table is used only if the 100-year frequency 10-day point rainfall is 6 or more inches. If it is less, the 10-day CN is the same as that for 1 day.

TR-60

equivalent tables of table 21.1 & 21.2 [Ref 20]

TABLE 2-3

PRINCIPAL SPILLWAY VOLUME ADJUSTMENTS

A. Minimum Areal Adjustment Ratios for Precipitation

Area Sq. Mi.	Area/Point Ratio for: 1 Day	10 Days	Area Sq. Mi.	Area/Point Ratio for: 1 Day	10 Days
10. or less	1.000	1.000	45.	0.951	0.976
15.	0.977	0.991	50.	0.948	0.974
20.	0.969	0.987	60.	0.944	0.972
25.	0.965	0.983	70.	0.940	0.970
30.	0.961	0.981	80.	0.937	0.969
35.	0.957	0.979	90.	0.935	0.967
40.	0.954	0.977	100.	0.932	0.966

B. Ten-Day Runoff Curve Number Adjustment*

Runoff Curve Numbers for:

1 Day	10 Days	1 Day	10 Days	1 Day	10 Days
100	100	80	65	60	41
99	98	79	64	59	40
98	96	78	62	58	39
97	94	77	61	57	38
96	92	76	60	56	37
95	90	75	58	55	36
94	88	74	57	54	35
93	86	73	56	53	34
92	84	72	54	52	33
91	82	71	53	51	33
90	81	70	52	50	32
89	79	69	51	49	31
88	77	68	50	48	30
87	76	67	49	47	29
86	74	66	47	46	28
85	72	65	46	45	28
84	71	64	45	44	27
83	69	63	44	43	26
82	68	62	43	42	25
81	66	61	42	41	24

*This Table is used only if the 100-year frequency 10-day point rainfall is 6 or more inches. If it is less, the 10-day CN is the same as that for the 1-day CN.

RAINFALL FREQUENCY ATLAS OF THE WESTERN U.S

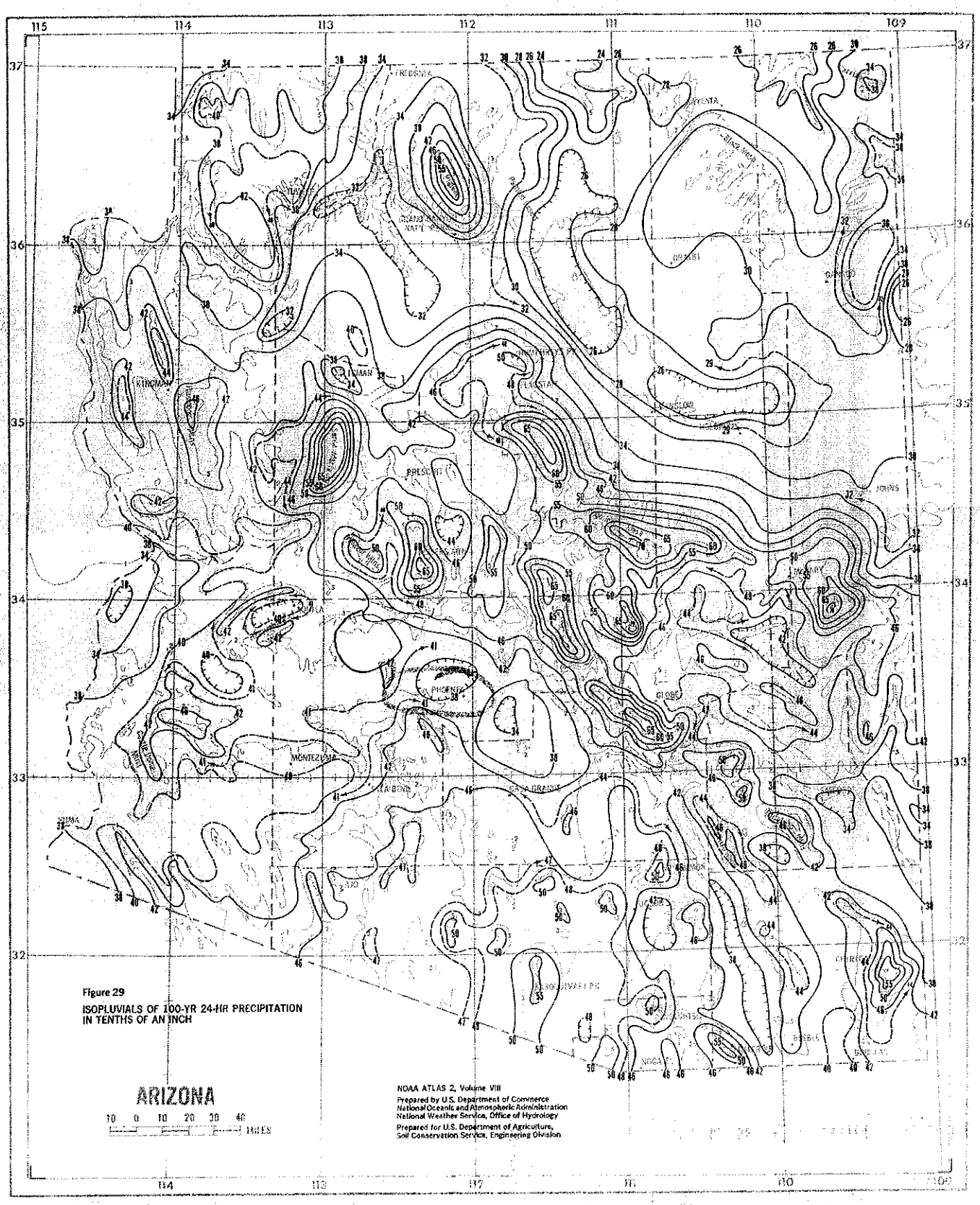


Figure 29

ISOPLUVIALS OF 100-YR 24-HR PRECIPITATION IN TENTHS OF AN INCH

http://hdsc.nwf.nccc.noaa.gov/oa/documentlibrary/rainfall.html

http://www.wrcc.dri.edu/pcpnfreq.html

http://www.wrcc.dri.edu/pcpnfreq/AZ100y24.gif

STEP 4: Direct runoff for 1 & 10 days

From figure 10.1 [Ref 20]

$Q_1 = \cancel{2.65}\ 2.30$ in & $Q_{10} = \cancel{4.7}\ 4.4$ in

Need to use aerially adjusted rainfall values of $P_1 = 3.838$ and $P_{10} = 7.656$

STEP 5: Compute the Climatic Index

$$C_i = \frac{(100)(9)}{(70)^2} = 0.184$$

∴ $C_i < 1$, the channel loss may be used to reduce direct runoff.

STEP 6: Estimate the net runoff

Net runoff = direct runoff − channel losses

But when table 21.3 [Ref 20] is used, the net runoff is obtained by a multiplication, not subtraction.

From table 21.3 [Ref 20], reduction factor = 0.33 for $A = 250\ mi^2$

Multiplying Q_1 & Q_{10} by 0.33 gives net runoffs of

$(\cancel{2.65}\ 2.30)(0.33) = \cancel{0.875}\ 0.759$ and $(\cancel{4.7}\ 4.4)(0.33) = \cancel{1.55}\ 1.45$

STEP 7: Compute Q_1/Q_{10} ratio.

$$\frac{Q_1}{Q_{10}} = \frac{\cancel{0.875}\ 0.759}{\cancel{1.55}\ 1.45} = 0.564 = 0.5234$$

STEP 8: Find PSH & PMC tabulation in table 21.10 [Ref 20]

From table 21.9 [Ref 20], with a ratio of ~~0.564~~ 0.5234 and T_c of 10.83 hr, we find PSH with values nearest to those in No. 28

Appendix G

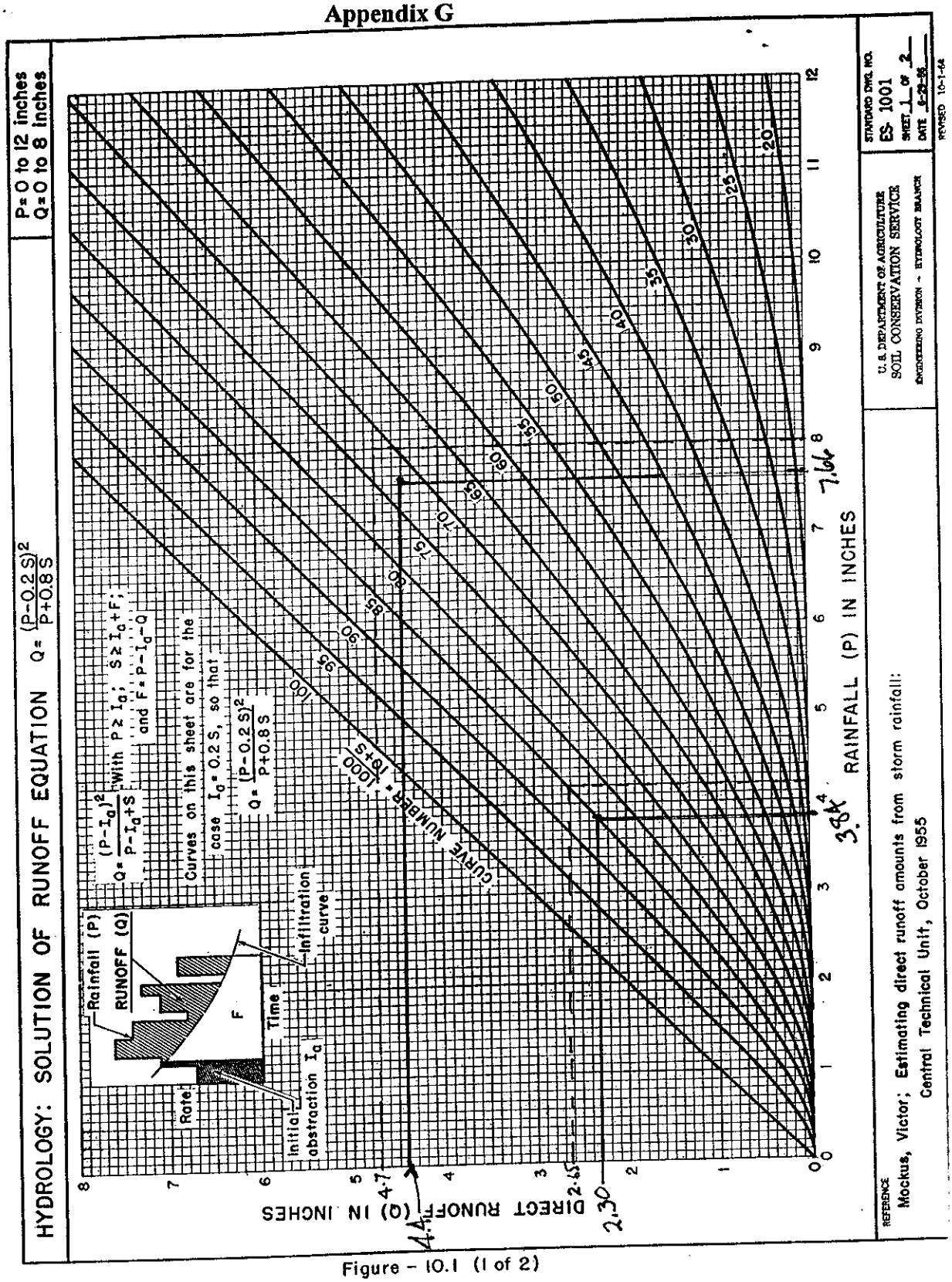


Figure – 10.1 (1 of 2)

TABLE 21.3--CHANNEL-LOSS FACTORS FOR REDUCTION OF DIRECT RUNOFF

DRAINAGE AREA	CLIMATIC INDEX CI						
	1.0	0.9	0.8	0.7	0.6	0.5	0.4 OR LESS
SQ. MI.							
1. OR LESS	1.00	1.00	1.00	1.00	1.00	1.00	1.00
2.	1.00	.98	.97	.95	.93	.90	.87
3.	1.00	.98	.95	.92	.89	.85	.80
4.	1.00	.97	.94	.90	.86	.81	.76
5.	1.00	.96	.92	.88	.84	.78	.73
6.	1.00	.96	.92	.87	.82	.76	.70
7.	1.00	.96	.91	.86	.81	.75	.68
8.	1.00	.95	.90	.85	.79	.73	.66
9.	1.00	.95	.90	.84	.78	.72	.65
10.	1.00	.95	.89	.84	.77	.71	.63
20.	1.00	.93	.86	.79	.72	.64	.55
30.	1.00	.93	.85	.77	.69	.60	.51
40.	1.00	.92	.84	.75	.66	.57	.48
50.	1.00	.91	.83	.74	.65	.55	.46
60.	1.00	.91	.82	.73	.63	.54	.44
70.	1.00	.91	.81	.72	.62	.53	.43
80.	1.00	.90	.81	.71	.62	.52	.42
90.	1.00	.90	.80	.71	.61	.51	.41
100.	1.00	.90	.80	.70	.60	.50	.40
150.	1.00	.89	.78	.68	.57	.47	.37
200.	1.00	.89	.77	.66	.56	.45	.35
250.	1.00	.88	.77	.65	.54	.44	.33
300.	1.00	.88	.76	.64	.53	.42	.32
350.	1.00	.87	.75	.64	.52	.41	.31
400.	1.00	.87	.75	.63	.51	.41	.30

*U.S. GOVERNMENT PRINTING OFFICE: 1981— 340-691:201

2. Flood-route the upstream structure releases or outflows to the lower structure. Chapter 17 discusses flood-routing procedures.

3. Add the routed flows to the preliminary PSH to get the PSH for the lower structure.

Note that if an upstream structure is itself a lower structure in a series then the procedure of example 21.4 must be followed for it first.

Table 21.9.--Serial numbers of PSH and PSMC

T_c	Q_1/Q_{10}							
	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
hours	Serial numbers							
1.5*	1	2	3	4	5	6	7	8
3	9	10	11	12	13	14	15	16
6	17	18	19	20	21	22	23	24
12	25	26	27	28	29	30	31	32
18	33	34	35	36	37	38	39	40
24	41	42	43	44	45	46	47	48
30	49	50	51	52	53	54	55	56
36	57	58	59	60	61	62	63	64
42	65	66	67	68	69	70	71	72
48	73	74	75	76	77	78	79	80
54	81	82	83	84	85	86	87	88
60	89	90	91	92	93	94	95	96
66	97	98	99	100	101	102	103	104
72**	105	106	107	108	109	110	111	112

* Use this row for all T_c less than 1.5 hours.

** Use this row for all T_c over 72 hours.

Entellus™

BY ~~wf~~ DATE 7/28/03.

CHECK CJL DATE 8/19/03

CLIENT FCDMC

JOB NAME Wittmann 10-day 100yr Storm. JOB NO. 310.032

(Contd...)

Looking @ the appropriate column in table 21.10 [Ref 20], columns 1, 2 & 4 are ~~set~~ of table A are summarized to show the time, rate and mass tabulations taken from table 21.10. Figure 8 show the PSH & PMC reply.

Appendix G

Table 21.10.--(Continued)

T_c = 12 hours

Serial No. :	25		26		27		28	
Q_1/Q_{10} :	0.2		0.3		0.4		0.5	
Time	PSH	PSMC	PSH	PSMC	PSH	PSMC	PSH	PSMC
days	cfs/AQ_{10}	Q/Q_{10}	cfs/AQ_{10}	Q/Q_{10}	cfs/AQ_{10}	Q/Q_{10}	cfs/AQ_{10}	Q/Q_{10}
0	0	0	0	0	0	0	0	0
.3	.678	.0026	.509	.0019	.377	.0014	.302	.0011
.6	1.577	.0158	1.183	.0118	.879	.0088	.701	.0070
1.0	1.967	.0426	1.475	.0319	1.165	.0242	.878	.0189
2.0	2.156	.1198	1.764	.0926	1.379	.0714	1.124	.0557
3.0	2.408	.2043	2.075	.1631	1.726	.1278	1.414	.1022
4.0	2.842	.3006	2.748	.2502	2.486	.2035	2.164	.1658
4.3	3.105	.3336	2.992	.2818	2.979	.2325	2.507	.1913
4.6	3.485	.3701	3.711	.3187	3.630	.2677	3.345	.2234
4.8	3.804	.3971	4.310	.3483	4.377	.2971	4.148	.2508
4.9	4.043	.4116	4.768	.3651	4.995	.3144	4.855	.2674
5.0	4.540	.4275	5.944	.3849	6.976	.3365	7.736	.2907
5.1	5.388	.4459	8.174	.4110	11.052	.3698	14.079	.3309
5.2	6.200	.4673	10.329	.4452	15.007	.4179	20.236	.3942
5.3	6.451	.4908	10.879	.4844	15.865	.4749	21.358	.4710
5.4	6.163	.5141	9.984	.5230	14.080	.5302	18.384	.5443
5.5	5.659	.5360	8.609	.5574	11.562	.5776	14.463	.6049
5.6	5.157	.5561	7.374	.5870	9.437	.6164	11.327	.6525
5.8	4.298	.5910	5.483	.6342	6.345	.6741	7.000	.7192
6.0	3.706	.6205	4.796	.6533	4.558	.7138	4.649	.7615
6.2	3.331	.6465	3.500	.6985	3.519	.7434	3.366	.7907
6.5	2.940	.6812	2.893	.7335	2.684	.7772	2.389	.8220
6.8	2.717	.7126	2.569	.7638	2.286	.8046	1.948	.8457
7.4	2.477	.7702	2.161	.8159	1.848	.8502	1.519	.8837
8.0	2.283	.8232	1.875	.8608	1.582	.8880	1.262	.9144
9.0	2.086	.9036	1.601	.9253	1.341	.9418	.977	.9559
10.0	1.826	.9772	1.439	.9820	1.053	.9870	.822	.9898
10.3	.844	.9926	.667	.9942	.480	.9958	.377	.9967
10.6	.239	.9981	.189	.9985	.136	.9989	.107	.9991
11.4	0	1.0000	0	1.0000	0	1.0000	0	1.0000

Appendix G

PSMC

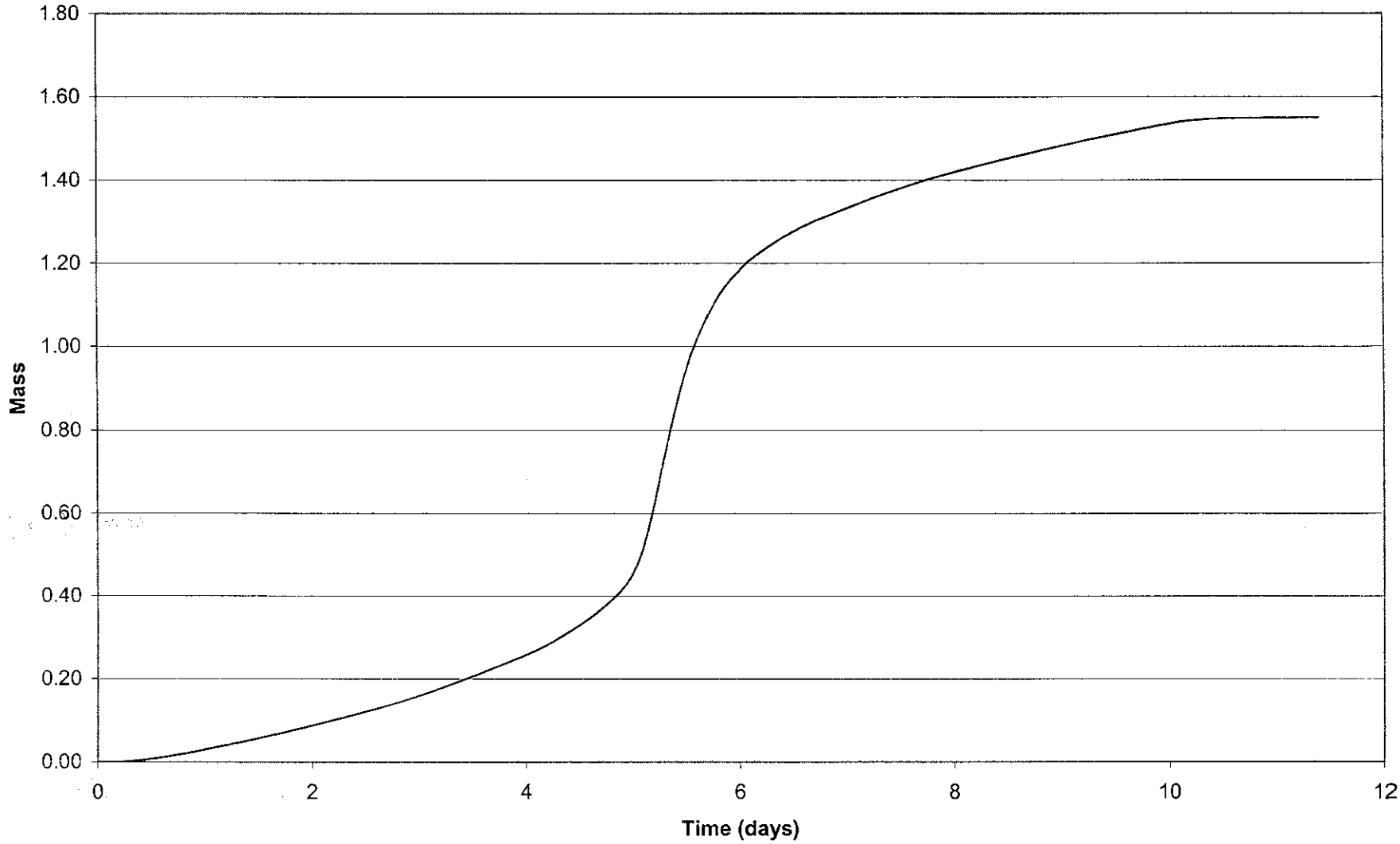


table 21.3 with the drainage area 15.0 square miles and the Ci of 0.603 and by interpolation find a reduction factor of 0.75. Multiply Q_1 and Q_{10} of step 4 by the factor to get net runoffs of 3.28 and 4.76 inches respectively. The net runoffs will be Q_1 and Q_{10} in the rest of this example.

7. Compute the Q_1/Q_{10} ratio. From step 6, $Q_1/Q_{10} = 3.28/4.76 = 0.689$.

8. Find the PSH and PSMC tabulations in table 21.10. Enter table 21.9 with the ratio 0.689 and T_c of 7.1 hours and find that the PSH with values nearest those is No. 22. Locate the appropriate tabulations in table 21.10 by looking up PSH No. 22. Columns 1, 2, and 4 of table 21.6 show the time, rate, and mass tabulations taken from table 21.10.

9. Compute PSH discharges in cfs. First find the product of drainage area and Q_{10}. This is 15.0(4.76) = 71.40 mile^2-inches. Multiply the entries in column 2, table 21.6 by 71.40, to get the discharges in cfs in column 3.

10. Compute PSMC amounts in inches. Multiply the entries in column 4, table 21.6, by Q_{10} (4.76) to get accumulated runoff in inches as shown in column 5. If amounts in acre-feet or another unit are desired, convert Q_{10} to the desired unit before making the series of multiplications.

The example is completed with step 10. The next step is that of routing the PSH or PSMC through the structure; see chapter 17 for routing methods.

In the second example the steps concerning channel loss are omitted and steps concerning QRF are included.

Example 21.2--Develop the 25-year frequency PSH and PSMC for a watershed at latitude _____, longitude _____. The watershed has a drainage area of 8.0 square miles, time of concentration of 2.0 hours, average annual precipitation of 30.5 inches, average annual temperature of 53.1°F, and a runoff curve number of 75. QRF during flood periods is estimated to be 5 cfs. There are no upstream structures in the watershed.

1. Compile the 1- and 10-day point rainfall amounts from U.S. Weather Bureau maps. For this location TP-40 and TP-49 are used. The 25-year frequency 1- and 10-day amounts are 5.6 and 12.5 inches respectively.

2. Determine the areal rainfall. Because the drainage area is not over 10 square miles the areal rainfall is the same as the point rainfall. The amounts in step 1 will be used.

which the table is prepared, therefore choose that set having a Q_1/Q_{10} ratio and T_c nearest those of the watershed. It is easier to make the choice on table 21.9, which gives available PSH and PSMC and their serial numbers, and then to look up the serial number in table 21.10 for the tabulations.

Examples

The procedure by which a PSH or PSMC is developed will be illustrated by four examples. In example 21.1, channel losses are taken from direct runoff before development of a PSH and PSMC; in example 21.2, QRF is added to a PSH and PSMC; in example 21.3, runoff volume and rate maps (exhibit 21.1 through 21.5) are used to obtain runoff; and in example 21.4, upstream releases are added to a PSH.

Example 21.1.--Develop the 50-year frequency PSH and PSMC for a watershed located at latitude _____, longitude_____. The watershed has a drainage area of 15.0 square miles, time of concentration of 7.1 hours, average annual precipitation of 22.8 inches, average annual temperature of 61.5°F, and a runoff curve number (CN) of 80. There are no upstream structures.

1. Compile the 1- and 10-day point rainfall amounts from U.S. Weather Bureau maps. For this location TP-40 and TP-49 are used. The 50-year frequency 1- and 10-day amounts are 6.8 and 11.0 inches respectively.

2. Determine the areal rainfall. Get the adjustment factors from table 21.1. For the drainage area of 15.0 square miles they are 0.978 and 0.991 for the 1- and 10-day rains respectively. The areal rainfall is 0.978(6.8) = 6.65 inches for the 1-day rain and 0.991(11.0) = 10.9 inches for the 10-day rain.

3. Determine the CN for the 10-day rain. First check whether the 100-year frequency 10-day point rainfall amount is 6 or more inches. The appropriate map in TP-49 shows it is, therefore enter table 21.2 with the 1-day CN of 80 and find the 10-day CN is 65.

4. Estimate the direct runoff for 1 and 10 days. Enter figure 10.1 with the rainfall amounts from step 2 and the appropriate CN from step 3 and find Q_1 = 4.37 and Q_{10} = 6.34 inches.

5. Compute the climatic index. Using the given data and equation 21.1, the index Ci is $100(22.8)/61.5^2 = 0.603$. Because the Ci is less than 1 the channel loss may be used to reduce direct runoff.

6. Estimate the net runoff. The net runoff is the direct runoff minus the channel loss but when table 21.3 is used the net runoff is obtained by a multiplication not a subtraction. Enter

Time of Concentration [TR-55, chapter 3] [Ref No. 32]

1: Sheet flow:

$L = 300\,ft$

$n = 0.035$

$s = \frac{4185 - 4135}{300} = 0.167\ ft/ft$

$P_2 = 1.6''$ [From NOAA map for 2 yr - 24 hr rainfall] [Ref No. 35]

Travel time

$$T_{t_1} = \frac{0.007\,(nL)^{0.8}}{(P_2)^{0.5}\,s^{0.4}} = \frac{(0.007)\,(0.035 \times 300)^{0.8}}{(1.6)^{0.5}\,(0.167)^{0.4}}$$

$$T_{t_1} = \underline{0.074\ hr}$$

2: Shallow Concentrated flow

$L = 1500\ ft$

$n = 0.035$

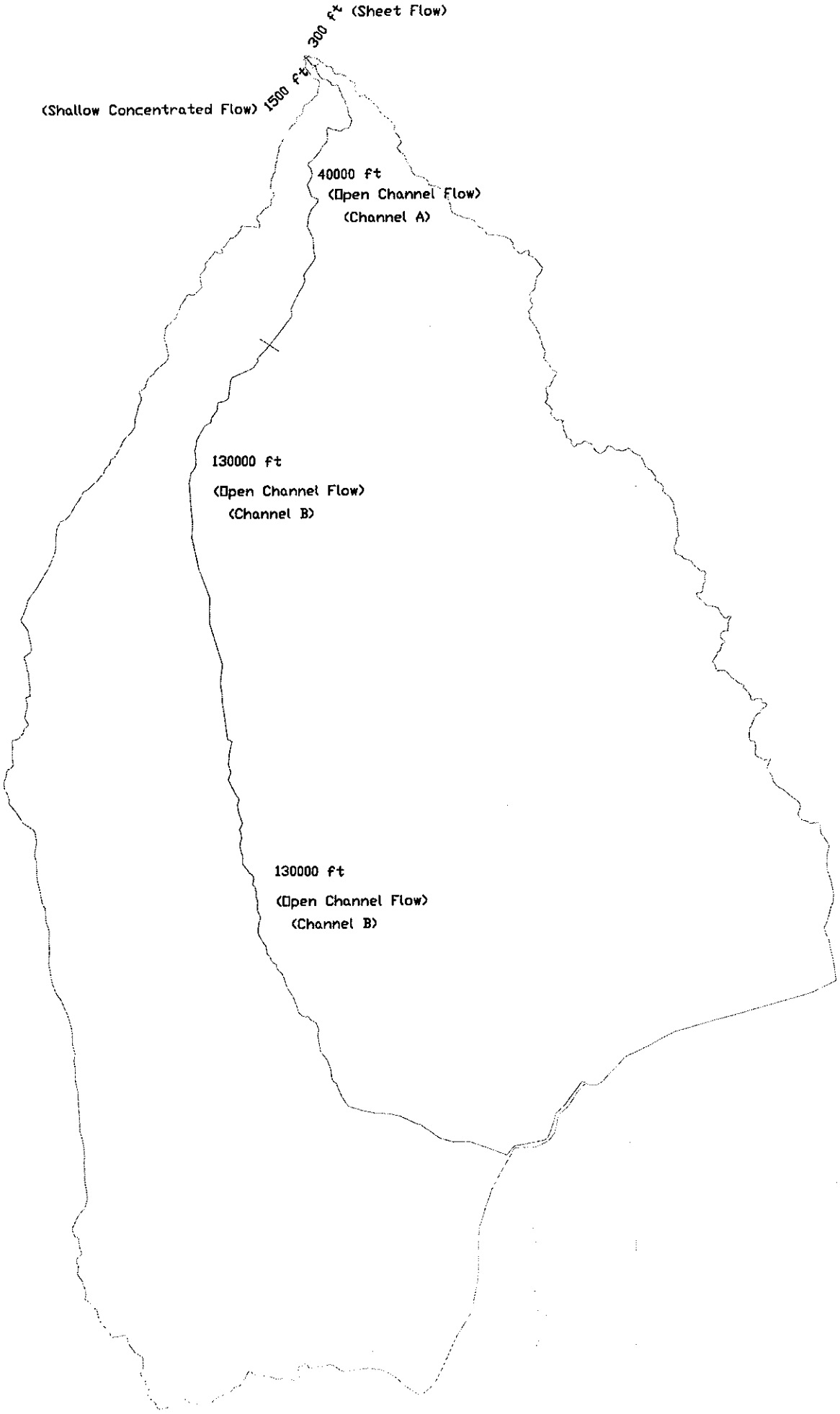
$s = \frac{4135 - 3875}{1500} = 0.173\ ft/ft$

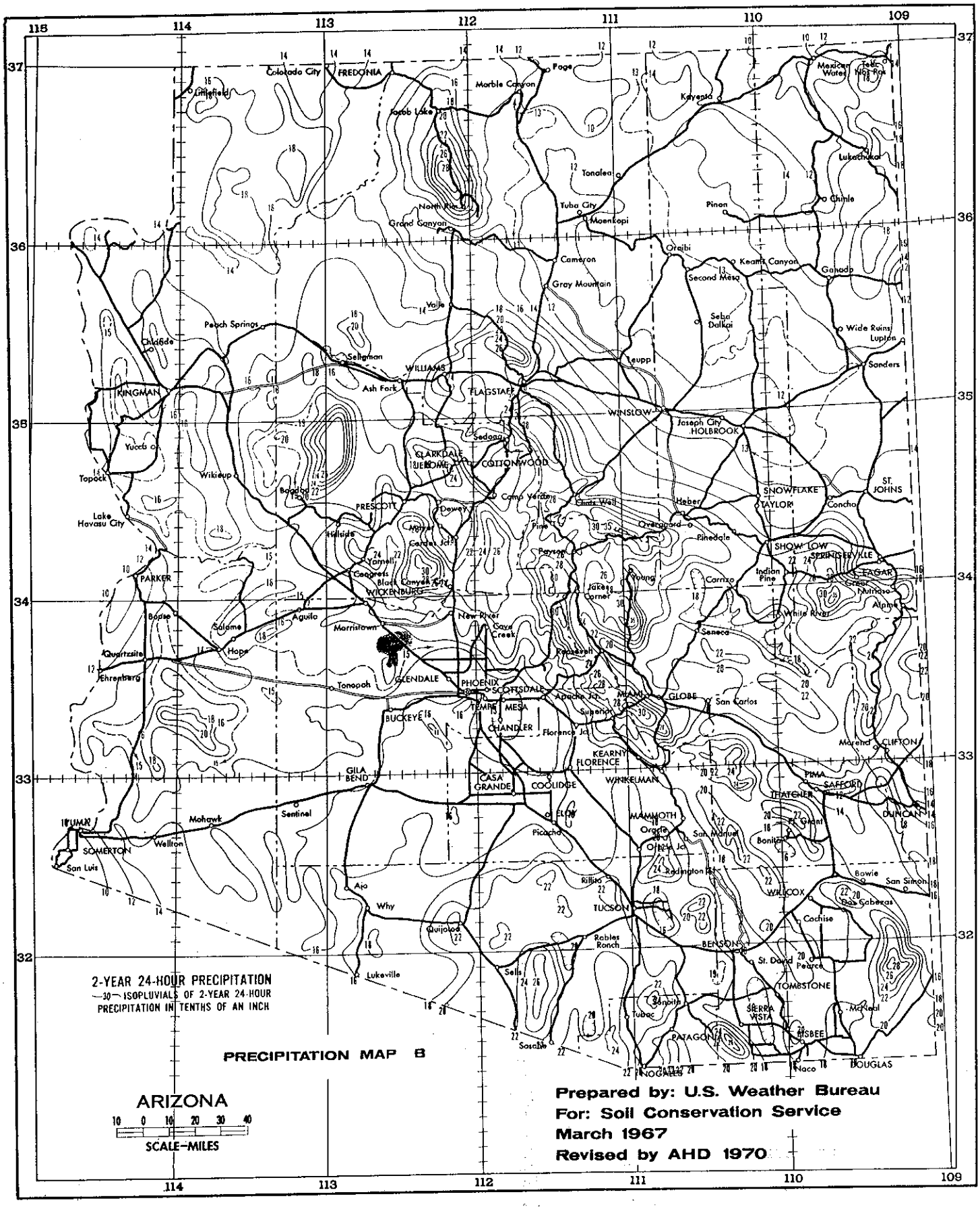
$V = 6.7\ ft/s$ [fig 3-1 TR-55, Ref No. 32]

Travel time

$$T_{t_2} = \frac{L}{3600\,V} = \frac{1500}{3600 \times 6.7}$$

$$T_{t_2} = \underline{0.062\ hr}$$


300 ft (Sheet Flow)
1500 ft (Shallow Concentrated Flow)
40000 ft
(Open Channel Flow)
(Channel A)
130000 ft
(Open Channel Flow)
(Channel B)
130000 ft
(Open Channel Flow)
(Channel B)


2-YEAR 24-HOUR PRECIPITATION
—30— ISOPLUVIALS OF 2-YEAR 24-HOUR PRECIPITATION IN TENTHS OF AN INCH
PRECIPITATION MAP B
ARIZONA
SCALE-MILES
Prepared by: U.S. Weather Bureau
For: Soil Conservation Service
March 1967
Revised by AHD 1970
FREDONIA
Colorado City
Page
Marble Canyon
Kayenta
Tonalea
Tuba City
Moenkopi
Grand Canyon
Cameron
Gray Mountain
Oraibi
Keams Canyon
Second Mesa
Ganado
Pinon
Chinle
Lukachukai
Wide Ruins
Lupton
Sanders
Leupp
Seba Dalkai
Peach Springs
Seligman
WILLIAMS
Ash Fork
FLAGSTAFF
WINSLOW
Joseph City
HOLBROOK
KINGMAN
Yucca
Topock
Lake Havasu City
Wikieup
Bagdad
PRESCOTT
Dewey
Camp Verde
Sedona
CLARKDALE
JEROME
COTTONWOOD
Clints Well
Heber
Overgaard
Pinedale
SNOWFLAKE
TAYLOR
Concho
ST. JOHNS
SHOW LOW
SPRINGERVILLE
EAGAR
Alpine
Indian Pine
Carrizo
Young
Payson
Pine
Hillside
Cordes Jct.
Yarnell
Congress
Black Canyon City
WICKENBURG
PARKER
Bouse
Salome
Aguila
Morristown
New River
Cave Creek
Kaysersh
Seneca
Quartzsite
Hope
Ehrenberg
Tonopah
GLENDALE
PHOENIX
SCOTTSDALE
TEMPE
MESA
CHANDLER
BUCKEYE
Apache Jct.
Superior
MIAMI
GLOBE
San Carlos
Florence Jct.
KEARNY
FLORENCE
WINKELMAN
Morenci
CLIFTON
GILA BEND
CASA GRANDE
COOLIDGE
ELOY
PIMA
SAFFORD
THATCHER
DUNCAN
Sentinel
Mohawk
YUMA
SOMERTON
San Luis
Wellton
Picacho
MAMMOTH
Oracle
San Manuel
Oracle Jct.
Redington
Bonita
Bowie
San Simon
WILCOX
Ajo
Why
Rillito
TUCSON
Quijotoa
Robles Ranch
BENSON
Cochise
St. David
Pearce
TOMBSTONE
Lukeville
Sells
Tubac
Sonoita
SIERRA VISTA
Mescal
BISBEE
PATAGONIA
NOGALES
Naco
DOUGLAS

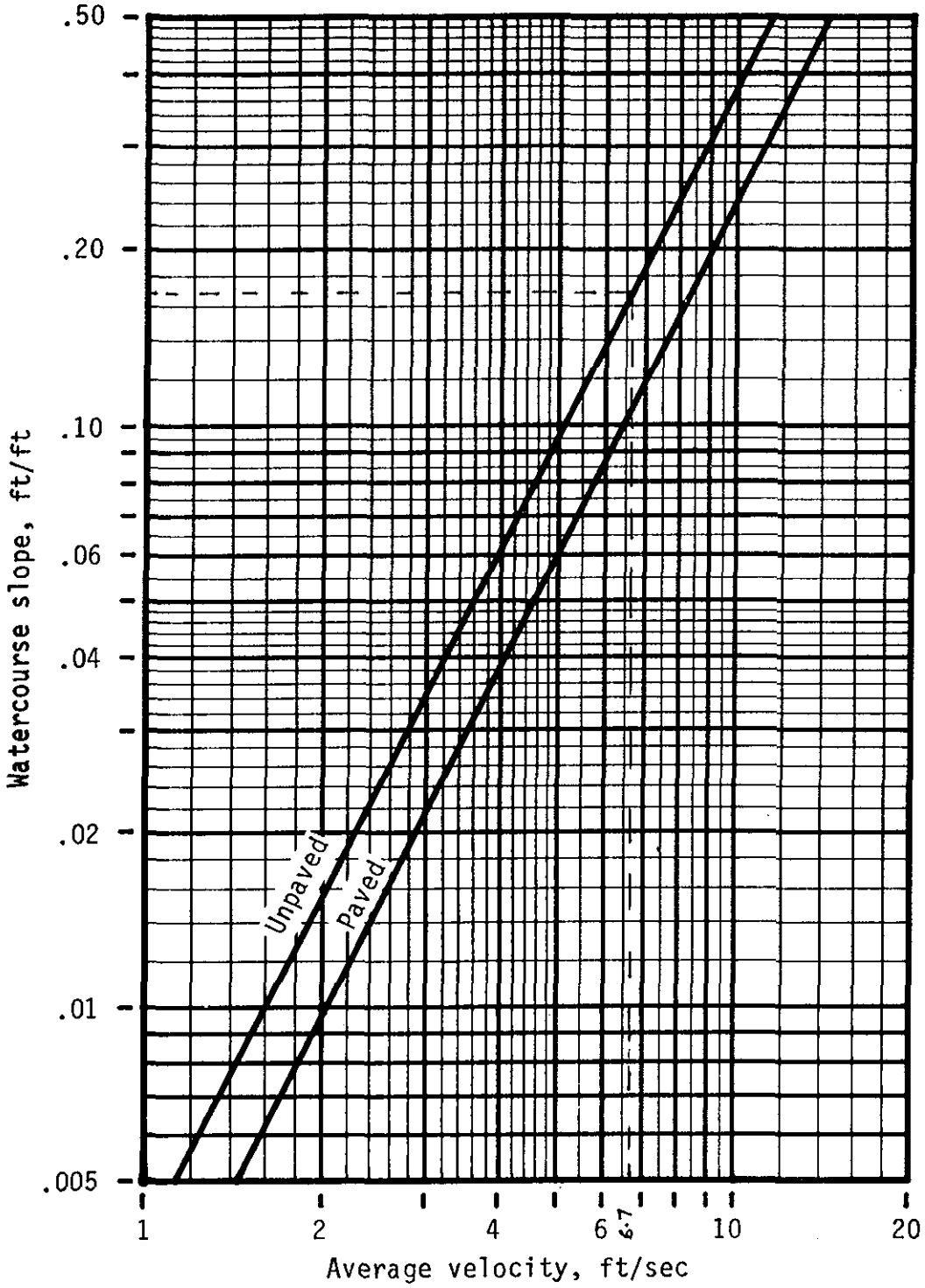


Figure 3-1.—Average velocities for estimating travel time for shallow concentrated flow.

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SHEET 21 OF 39
BY UP DATE 8/15/03
CHECK CJL DATE 8/19/03

CLIENT FCOMC
JOB NAME
JOB NO. 310.032

3: Open channel flow

channel A : $L_A = 40{,}000$ ft

$n_A = 0.035$

$A_A = \frac{1}{2}(250)(4) = 500$ sq ft.

$P_A = 2\left[\sqrt{125^2 + 4^2}\right] \approx 250$ ft

$R_A = \frac{A_A}{P_A} = 2$

$S_A = \frac{3875 - 2505}{40{,}000} = 0.034$ ft/ft

Ave Velocity for Channel A

$$V_A = \frac{1.49\, R_A^{2/3}\, S_A^{1/2}}{n}$$

$$V_A = \frac{1.49\,(2)^{2/3}(0.034)^{1/2}}{0.035} = 12.46 \text{ ft/sec.}$$

Travel time

$$T_{t_{3A}} = \frac{L}{3600\, V_A} = \frac{40{,}000}{3600 \times 12.46} = \underline{\underline{0.89 \text{ hr}}}$$

Channel B : $L_B = 130{,}000$ ft

$n_B = 0.05$

$A_B = \frac{1}{2}(400)(3) = 600$ sq ft.

$P_B = 2\left[\sqrt{200^2 + 3^2}\right] \approx 400$ ft

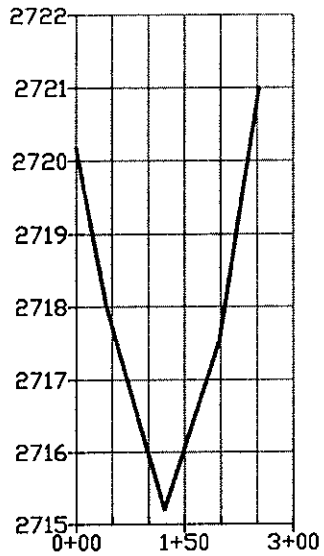
$R_B = \frac{A_B}{P_B} = 1.5$

$S_B = \frac{2505 - 1350}{130{,}000} = 0.0089$ ft/ft.

Average Velocity for Channel B

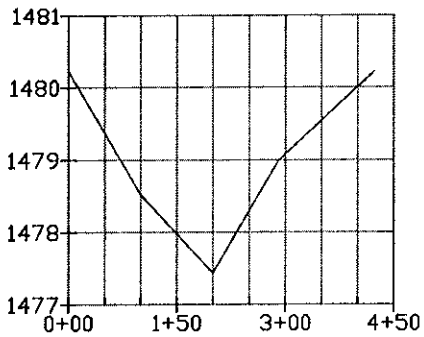
$$V_B = \frac{1.49\,(1.5)^{2/3}(0.0089)^{1/2}}{0.05} = 3.68 \text{ ft/sec}$$

Travel time $T_{t_{3B}} = \frac{130{,}000}{3600\,(3.68)} = \underline{\underline{9.81 \text{ hr}}}$



1

Channel A



2

Channel B

Entellus™

SHEET 23 OF 39

BY UP DATE 8/15/03

CHECK CJL DATE 8/19/03

CLIENT FCDMC

JOB NAME

JOB NO. 310.032

Time of concentration $T_c = T_{t_1} + T_{t_2} + T_{t_{3A}} + T_{t_{3B}}$

$= 0.074 + 0.062 + 0.89 + 9.81$ hr

$T_c = 10.83$ hr

Ave. velocity from
top to bottom ≈ 4.3 fps
∴ OK
Similar to 4 fps assumption
made in previous FCDMC
study of McMicken Dam
Watershed.

Chapter 3: Time of concentration and travel time

Travel time (T_t) is the time it takes water to travel from one location to another in a watershed. T_t is a component of time of concentration (T_c), which is the time for runoff to travel from the hydraulically most distant point of the watershed to a point of interest within the watershed. T_c is computed by summing all the travel times for consecutive components of the drainage conveyance system.

T_c influences the shape and peak of the runoff hydrograph. Urbanization usually decreases T_c, thereby increasing the peak discharge. But T_c can be increased as a result of (a) ponding behind small or inadequate drainage systems, including storm drain inlets and road culverts, or (b) reduction of land slope through grading.

Factors affecting time of concentration and travel time

Surface roughness

One of the most significant effects of urban development on flow velocity is less retardance to flow. That is, undeveloped areas with very slow and shallow overland flow through vegetation become modified by urban development: the flow is then delivered to streets, gutters, and storm sewers that transport runoff downstream more rapidly. Travel time through the watershed is generally decreased.

Channel shape and flow patterns

In small non-urban watersheds, much of the travel time results from overland flow in upstream areas. Typically, urbanization reduces overland flow lengths by conveying storm runoff into a channel as soon as possible. Since channel designs have efficient hydraulic characteristics, runoff flow velocity increases and travel time decreases.

Slope

Slopes may be increased or decreased by urbanization, depending on the extent of site grading or the extent to which storm sewers and street ditches are used in the design of the water management system. Slope will tend to increase when channels are straightened and decrease when overland flow is directed through storm sewers, street gutters, and diversions.

Computation of travel time and time of concentration

Water moves through a watershed as sheet flow, shallow concentrated flow, open channel flow, or some combination of these. The type that occurs is a function of the conveyance system and is best determined by field inspection.

Travel time (T_t) is the ratio of flow length to flow velocity:

$$T_t = \frac{L}{3600\ V} \qquad \text{[Eq. 3-1]}$$

where

T_t = travel time (hr),
L = flow length (ft),
V = average velocity (ft/s), and
3600 = conversion factor from seconds to hours.

Time of concentration (T_c) is the sum of T_t values for the various consecutive flow segments:

$$T_c = T_{t_1} + T_{t_2} + \ldots T_{t_m} \qquad \text{[Eq. 3-2]}$$

where

T_c = time of concentration (hr) and
m = number of flow segments.

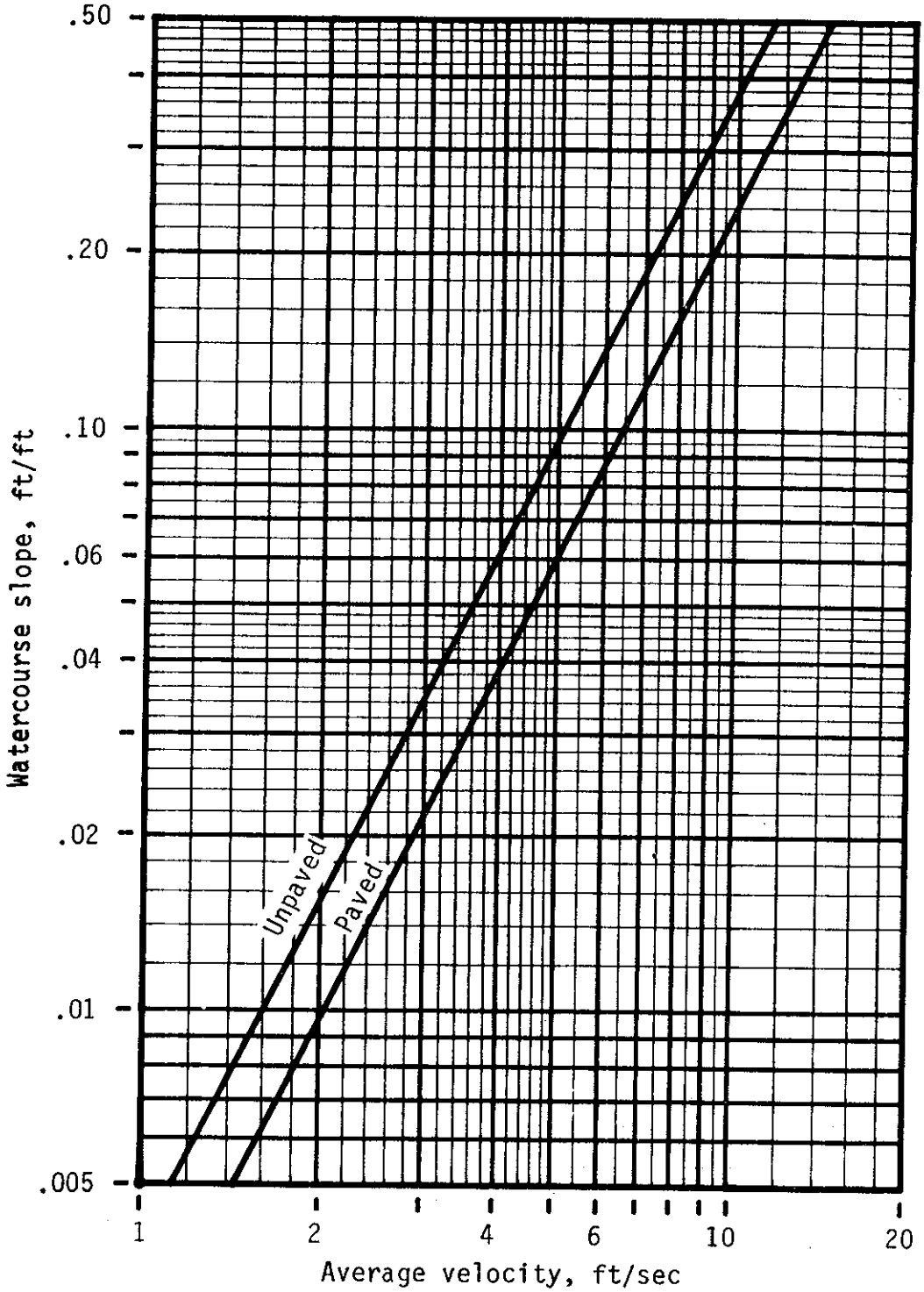


Figure 3-1.—Average velocities for estimating travel time for shallow concentrated flow.

Sheet flow

Sheet flow is flow over plane surfaces. It usually occurs in the headwater of streams. With sheet flow, the friction value (Manning's n) is an effective roughness coefficient that includes the effect of raindrop impact; drag over the plane surface; obstacles such as litter, crop ridges, and rocks; and erosion and transportation of sediment. These n values are for very shallow flow depths of about 0.1 foot or so. Table 3-1 gives Manning's n values for sheet flow for various surface conditions.

For sheet flow of less than 300 feet, use Manning's kinematic solution (Overton and Meadows 1976) to compute T_t:

$$T_t = \frac{0.007\,(nL)^{0.8}}{(P_2)^{0.5}\,s^{0.4}} \qquad \text{[Eq. 3-3]}$$

Table 3-1.—Roughness coefficients (Manning's n) for sheet flow

Surface description	n[1]
Smooth surfaces (concrete, asphalt, gravel, or bare soil)	0.011
Fallow (no residue)	0.05
Cultivated soils:	
Residue cover ≤20%	0.06
Residue cover >20%	0.17
Grass:	
Short grass prairie	0.15
Dense grasses[2]	0.24
Bermudagrass	0.41
Range (natural)	0.13
Woods:[3]	
Light underbrush	0.40
Dense underbrush	0.80

[1]The n values are a composite of information compiled by Engman (1986).
[2]Includes species such as weeping lovegrass, bluegrass, buffalo grass, blue grama grass, and native grass mixtures.
[3]When selecting n, consider cover to a height of about 0.1 ft. This is the only part of the plant cover that will obstruct sheet flow.

where

T_t = travel time (hr),
n = Manning's roughness coefficient (table 3-1),
L = flow length (ft),
P_2 = 2-year, 24-hour rainfall (in), and
s = slope of hydraulic grade line (land slope, ft/ft).

This simplified form of the Manning's kinematic solution is based on the following: (1) shallow steady uniform flow, (2) constant intensity of rainfall excess (that part of a rain available for runoff), (3) rainfall duration of 24 hours, and (4) minor effect of infiltration on travel time. Rainfall depth can be obtained from appendix B.

Shallow concentrated flow

After a maximum of 300 feet, sheet flow usually becomes shallow concentrated flow. The average velocity for this flow can be determined from figure 3-1, in which average velocity is a function of watercourse slope and type of channel. For slopes less than 0.005 ft/ft, use equations given in appendix F for figure 3-1. Tillage can affect the direction of shallow concentrated flow. Flow may not always be directly down the watershed slope if tillage runs across the slope.

After determining average velocity in figure 3-1, use equation 3-1 to estimate travel time for the shallow concentrated flow segment.

Open channels

Open channels are assumed to begin where surveyed cross section information has been obtained, where channels are visible on aerial photographs, or where blue lines (indicating streams) appear on United States Geological Survey (USGS) quadrangle sheets. Manning's equation or water surface profile information can be used to estimate average flow velocity. Average flow velocity is usually determined for bank-full elevation.

Manning's equation is

$$V = \frac{1.49\ r^{2/3}\ s^{1/2}}{n} \qquad \text{[Eq. 3-4]}$$

where

- V = average velocity (ft/s),
- r = hydraulic radius (ft) and is equal to a/p_w,
- a = cross sectional flow area (ft^2),
- p_w = wetted perimeter (ft),
- s = slope of the hydraulic grade line (channel slope, ft/ft), and
- n = Manning's roughness coefficient for open channel flow.

Manning's n values for open channel flow can be obtained from standard textbooks such as Chow (1959) or Linsley et al. (1982). After average velocity is computed using equation 3-4, T_t for the channel segment can be estimated using equation 3-1.

Reservoirs or lakes

Sometimes it is necessary to estimate the velocity of flow through a reservoir or lake at the outlet of a watershed. This travel time is normally very small and can be assumed as zero.

Limitations

- Manning's kinematic solution should not be used for sheet flow longer than 300 feet. Equation 3-3 was developed for use with the four standard rainfall intensity-duration relationships.

- In watersheds with storm sewers, carefully identify the appropriate hydraulic flow path to estimate T_c. Storm sewers generally handle only a small portion of a large event. The rest of the peak flow travels by streets, lawns, and so on, to the outlet. Consult a standard hydraulics textbook to determine average velocity in pipes for either pressure or nonpressure flow.

- The minimum T_c used in TR-55 is 0.1 hour.

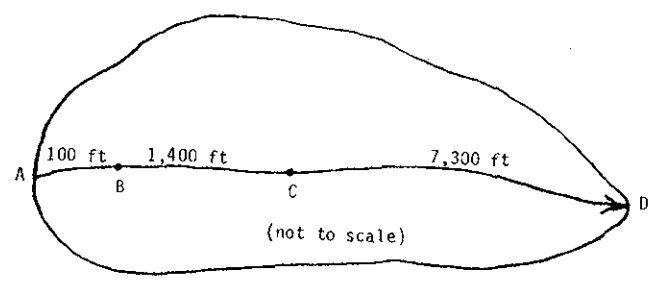
- A culvert or bridge can act as a reservoir outlet if there is significant storage behind it. The procedures in TR-55 can be used to determine the peak flow upstream of the culvert. Detailed storage routing procedures should be used to determine the outflow through the culvert.

Example 3-1

The sketch below shows a watershed in Dyer County, northwestern Tennessee. The problem is to compute T_c at the outlet of the watershed (point D). The 2-year 24-hour rainfall depth is 3.6 inches. All three types of flow occur from the hydraulically most distant point (A) to the point of interest (D). To compute T_c, first determine T_t for each segment from the following information:

Segment AB:	Sheet flow; dense grass; slope (s) = 0.01 ft/ft; and length (L) = 100 ft.
Segment BC:	Shallow concentrated flow; unpaved; s = 0.01 ft/ft; and L = 1400 ft.
Segment CD:	Channel flow; Manning's n = .05; flow area (a) = 27 ft^2; wetted perimeter (p_w) = 28.2 ft; s = 0.005 ft/ft; and L = 7300 ft.

See figure 3-2 for the computations made on worksheet 3.



ARIZONA

ANNUAL PRECIPITATION SUMMARY
(Inches)

	PERIOD OF RECORD	MEAN	PRECIPITATION MAX YEAR	YR	MIN YEAR	YR	MAX DAY	YEARMODY	S MEAN
AGUILA	1924-2000	8.67	18.72	41	2.45	56	4.50	20001022	0.5
AJO	1914-2000	8.50	15.27	46	3.33	28	4.15	19460918	0.1
AJO WELL	1948-1975	7.45	12.13	67	2.03	56	2.90	19510828	0.0
ALAMO DAM 6 ESE	1962-1974	7.26	10.89	65	3.26	68	3.60	19640802	0.2
ALAMO DAM	1975-2000	9.01	15.93	78	2.39	96	2.50	19840814	0.1
ALHAMBRA	1948-1976	7.51	12.78	65	3.03	50	2.74	19660913	0.0
ALPINE	1904-2000	20.93	37.56	5	11.23	56	2.83	19621021	56.1
ALPINE 8 SSE	1989-2000	22.53	30.01	92	12.74	95	3.39	19920824	38.3
AMADO	1948-1976	13.33	18.88	67	6.03	53	4.52	19640910	0.8
ANVIL RANCH	1948-2000	11.75	24.93	83	4.26	56	4.30	19620926	0.3
APACHE JUNCTION 5 NE	1987-2000	13.45	22.99	93	7.48	96	2.19	19900814	0.1
APACHE 6 WNW	1938-1980	18.20	27.87	67	8.06	70	3.00	19770816	1.6
APACHE JUNCTION	1962-1979	9.46	16.51	78	6.49	74	2.82	19700905	0.0
APACHE POWDER COMPANY	1923-1990	13.20	20.25	31	5.61	47	3.35	19260926	1.2
ARIVACA 1 E	1956-2000	18.04	28.46	83	11.01	75	3.07	19601009	2.9
ARIZONA SONORA DESERT M	1962-1973	10.47	15.53	71	8.22	69	1.95	19700903	1.1
ASH FORK 6 N	1902-1987	12.72	22.15	40	6.82	50	2.80	19690912	16.5
ASH FORK 2	1948-1999	12.74	17.30	90	6.67	89	2.30	19510828	21.2
ASH FORK 5 N	1976-1983	17.54	24.93	83	11.01	79	3.46	19830924	20.6
SHURST HAYDEN DAM	1956-2000	10.41	20.63	78	4.63	89	2.70	19610815	0.0
AGDAD 2	1978-1986	21.24	26.84	83	17.43	85	3.51	19800214	5.3
BAGDAD	1925-2000	14.39	27.94	92	2.93	56	4.65	19970926	2.9
BAGDAD 8 NE	1950-1975	16.91	37.24	65	5.42	56	5.38	19510829	10.3
BAR T BAR RANCH	1952-1979	17.40	24.02	59	8.21	56	5.30	19700905	0.1
BARTLETT DAM	1939-2000	13.74	30.59	92	4.37	48	4.50	19700906	0.0
BEACH RANCH	1948-1956	14.44	16.79	49	13.54	55	2.55	19480722	5.9
BEARDSLEY	1950-1978	7.33	19.83	51	3.13	53	3.25	19510828	0.0
BEAR VALLEY	1948-1957	19.55	25.09	54	11.88	53	3.10	19550805	4.5
BEAVER CREEK RANGER STN	1957-2000	15.49	27.04	65	7.52	89	3.60	19920822	2.3
BEAVER DAM	1956-2000	7.48	14.32	78	3.12	68	1.63	19671129	0.3
BEAVERHEAD LODGE	1948-1969	24.30	34.77	57	13.19	56	4.17	19490113	-99.0
BENSON	1894-1975	11.34	19.57	19	1.43	2	5.55	19150129	1.8
BENSON 6 SE	1990-2000	13.66	17.74	93	10.94	98	2.05	19910723	0.0
BETATAKIN	1948-2000	12.14	20.25	82	6.47	56	2.00	19810516	54.1
BISBEE	1892-1985	18.63	26.86	19	10.47	47	4.25	19100722	10.1
BISBEE 2	1961-1997	15.10	21.25	94	11.33	62	3.71	19740815	0.7
BISBEE 2 WNW	1985-2000	21.75	30.63	86	11.95	99	5.19	19860715	10.2
BLACK MOUNTAIN MISSION	1952-1965	8.31	10.48	63	6.00	60	1.19	19610909	6.1
BLACK RIVER PUMPS	1948-2000	18.77	30.16	83	9.60	50	2.42	19560718	11.7
BLUE	1903-1989	20.73	34.50	5	8.89	17	4.40	19721019	24.6
BLUE RIDGE RANGER STN	1967-2000	19.85	27.34	82	14.57	89	2.60	19700906	48.0
BOSLEY RANCH	1948-1966	14.87	23.31	65	6.94	56	2.75	19540322	7.9
BOUSE	1952-2000	5.57	11.67	92	1.24	56	2.75	19820812	0.0
BOWIE	1899-2000	10.75	19.96	14	3.01	56	2.75	19511030	1.9
BRIGHT ANGEL RANGER STN	1948-2000	25.48	45.03	78	14.19	89	5.06	19511230	140.2
BUCKEYE	1893-2000	7.65	21.80	5	1.40	56	4.90	18940902	0.0
ULLHEAD CITY	1977-2000	6.61	11.59	83	1.72	89	3.05	19830817	0.0
UMBLE BEE	1952-1979	15.57	35.84	65	5.27	56	4.61	19671219	1.6
BURRUS RANCH	1948-1968	17.20	22.92	65	8.83	56	3.12	19511230	53.6
ARIZONA FALLS 1 WNW	1948-1963	7.13	13.51	51	4.17	60	2.73	19510827	0.1

CAMERON 1 NNE	1962-1992	5.66	10.09	72	2.56	77	3.00	19821208	1.9
CAMP WOOD	1948-1979	20.74	33.85	65	10.34	56	4.74	19540324	28.1
CANELO 1 NW	1910-2000	18.21	29.04	31	10.06	96	6.39	19550826	5.5
CANYON DE CHELLY	1970-2000	9.51	17.95	82	3.29	89	5.00	19830117	6.2
CAREFREE	1962-2000	13.13	23.85	93	4.90	97	3.60	19721019	0.1
CARL PLEASENT RESERVOIR	1949-1958	10.05	20.11	51	3.33	53	4.42	19510828	0.0
CASA GRANDE	1898-2000	8.45	19.52	5	3.20	-1	4.50	19360725	0.1
CASA GRANDE NATL MONUME	1906-2000	9.05	19.22	41	3.56	56	5.40	19060801	0.0
CASCABEL	1969-2000	14.12	24.58	83	8.92	76	5.03	19920824	2.3
CASTLE HOT SPRINGS	1959-2000	15.42	32.56	78	6.13	60	4.00	19660912	0.2
CASTLE HOT SPRINGS 4 N	1949-1958	15.76	29.92	51	7.54	50	5.32	19510828	0.0
CAVE CREEK	1950-1961	11.11	20.63	51	5.23	56	2.35	19510828	0.1
CAVE CREEK DAM	1949-1969	9.09	14.86	51	5.20	53	2.85	19510828	0.1
CEDAR GLADE	1915-1954	13.75	25.14	41	6.86	42	4.89	19390906	14.6
CHANDLER	1948-1980	6.77	16.28	78	2.41	56	2.36	19510828	0.0
CHANDLER HEIGHTS	1948-2000	9.03	20.18	92	3.84	56	2.43	19920823	0.0
CHEVELON R S	1959-2000	18.65	25.34	93	11.88	70	3.50	19710827	45.2
CHILDS	1915-2000	18.12	34.15	65	4.63	56	5.17	19151231	0.9
CHINLE	1908-1970	9.17	19.89	41	3.52	50	2.50	19430124	12.4
CHINO VALLEY	1948-2000	11.93	22.14	65	5.25	89	3.64	19530716	7.6
CHIRICAHUA NATL MONUMEN	1909-2000	19.46	32.93	83	9.82	70	4.50	19110611	11.1
CIBECUE	1927-1979	18.54	30.42	41	8.96	47	3.40	19300718	18.5
CLAY SPRINGS	1971-1987	17.86	28.39	78	15.06	81	2.30	19840926	0.0
CLIFTON	1893-2000	12.91	22.53	19	4.85	24	2.95	19620926	1.2
COCHISE 4 SSE	1899-1954	10.78	22.27	5	1.30	0	3.00	18990906	3.9
COCHISE STRONGHOLD	1925-1948	18.85	27.42	31	13.52	29	3.30	19370208	5.4
COLORADO CITY	1963-2000	13.39	26.36	98	7.23	89	3.20	19820802	19.8
CONGRESS	1970-1980	11.97	13.55	72	6.42	75	2.50	19781111	0.4
COPPER MINE TRADING POS	1948-1976	7.34	12.39	52	4.31	75	4.40	19630710	6.5
CORDES	1948-2000	15.18	29.30	65	6.01	56	3.74	19781111	2.3
CORONADO NATL MONUMENT	1960-2000	20.80	33.26	78	9.97	89	4.69	20001011	5.7
CORTARO 3 SW	1948-1976	11.18	18.47	71	6.27	56	4.75	19620926	0.4
COTTONWOOD	1949-1977	11.84	26.07	65	4.22	56	2.96	19550613	4.2
COVERED WELLS 1 E	1956-1963	11.80	14.98	59	10.18	57	3.82	19580729	0.3
CROWN KING	1914-1995	28.47	56.42	78	14.31	60	7.65	19170417	37.2
DATELAND	1952-1968	3.03	6.07	65	0.58	56	2.00	19631018	0.0
DATELAND WHITEWING RANC	1972-2000	4.85	10.87	83	1.42	99	3.10	19730820	0.0
DAVIS DAM # 2	1958-1977	4.33	11.36	65	0.80	64	2.81	19760911	0.0
DAVIS DAM	1948-1961	4.36	7.56	51	0.07	56	2.03	19510829	0.3
DEER VALLEY	1950-1985	8.43	16.79	78	2.98	77	2.25	19660819	0.0
DINNEHOTSO	1950-1974	5.69	8.79	72	2.37	56	1.46	19700905	6.9
DOS CABEZAS 1 SE	1951-1975	13.48	17.83	65	7.40	53	2.50	19620729	5.4
DOUGLAS	1948-1994	14.60	22.09	84	10.26	76	2.95	19910904	0.0
DOUGLAS FAA AP	1948-2000	13.13	21.01	83	4.18	56	2.50	19500719	1.3
DOUGLAS SMELTER	1903-1973	12.29	22.35	14	4.76	36	3.58	19260927	2.0
DRAKE RANGER STN	1954-1962	12.96	16.61	59	5.97	56	1.58	19550725	8.9
DUDLEYVILLE	1893-1925	14.71	20.94	14	8.37	-7	2.65	19070821	1.1
DUGAS 2 SE	1960-1972	17.00	19.41	63	12.13	71	2.92	19651125	2.9
DUNCAN	1901-2000	10.88	19.74	5	3.49	56	2.43	19870608	0.8
EAGLE CREEK	1928-1973	15.91	25.39	31	7.81	53	2.83	19330909	6.0
EAGLE CREEK 2	1973-1989	17.88	25.79	83	12.17	75	3.02	19831002	4.9
EHRENBERG	1948-1977	3.55	7.76	51	0.84	61	2.42	19510826	0.0
EHRENBERG 2 E	1977-2000	5.06	11.22	92	1.99	89	3.80	19800824	0.0
ELGIN 5 N	1912-1970	15.02	25.77	19	5.38	53	3.25	19160120	5.4
ELOY 4 NE	1951-2000	9.75	20.54	93	5.41	73	3.13	19900814	0.0
FAIRBANK 1 S	1909-1973	11.92	17.86	26	4.82	53	3.04	19660728	1.5
FALCON FIELD	1948-1976	8.08	13.30	65	3.15	56	2.20	19510827	0.0
FLAGSTAFF 4 SW	1984-2000	24.15	34.08	92	11.50	89	3.05	19871101	90.7
FLAGSTAFF WSO AP	1950-2000	21.60	36.59	65	10.37	56	3.93	19930219	99.4
FLORENCE	1892-2000	10.04	20.01	78	3.89	89	3.25	19880729	0.1

FLYING H RANCH	1948-1958	20.01	27.77	58	11.52	56	3.53	19550820	6.8
FORESTDALE	1948-1971	18.83	27.69	49	10.62	53	3.90	19591030	40.0
FORT DEFIANCE	1897-1949	12.43	20.65	5	6.49	34	1.80	18990206	33.3
FORT GRANT	1900-1974	12.83	23.03	41	5.08	4	3.20	19550820	3.9
FORT HUACHUCA	1900-1981	15.64	36.97	5	7.21	62	3.90	19050110	6.9
FORT THOMAS	1958-1966	8.80	8.72	63	6.90	62	1.67	19630827	1.3
FORT THOMAS 2 SW	1966-2000	10.02	16.50	78	3.93	89	2.80	19831001	0.2
FORT VALLEY	1909-2000	22.39	37.29	65	10.24	100	3.50	19900715	85.3
FOSSIL SPRINGS	1951-1970	22.34	36.20	65	11.14	56	2.90	19550614	0.1
FOUNTAIN HILLS	1979-2000	12.70	22.47	92	5.56	99	2.24	19931115	0.0
FREDONIA	1948-1975	9.25	14.53	57	4.03	56	1.57	19651123	22.3
FRITZ RANCH	1948-1980	14.20	22.24	72	8.36	53	3.00	19721019	2.0
GANADO	1948-2000	10.71	17.59	65	4.50	89	3.00	19590807	22.5
GILA BEND	1892-2000	6.12	16.59	83	2.02	56	2.61	19510828	0.0
GILA BEND AVIATION	1948-1966	5.68	10.10	65	1.30	56	3.00	19510827	0.0
GISELA	1895-2000	17.89	30.12	78	7.87	56	4.35	19460918	3.0
GLOBE	1894-1975	15.90	24.31	35	8.22	56	3.58	19591030	3.9
GLOBE 2	1975-1981	18.72	23.86	78	12.88	77	1.83	19781218	4.5
GLOBE	1981-2000	16.67	28.05	83	10.97	89	3.14	19830930	2.4
GOULDS RANCH	1915-1960	7.63	12.29	51	2.71	56	3.15	19510827	0.0
GRAND CANYON AIRWAYS	1948-1967	13.71	18.88	65	8.19	56	2.19	19510829	21.9
GRAND CANYON NATL PARK	1903-1957	15.68	36.74	7	7.59	56	2.70	19370929	61.2
GRAND CANYON NATL PARK	1957-1977	14.24	20.70	65	11.43	62	3.98	19700301	59.9
GRAND CANYON N P 2	1976-2000	17.34	25.51	82	10.28	77	3.14	19830725	46.3
GRANITE REEF DAM	1893-1979	9.10	18.47	5	2.89	56	3.20	19510828	0.1
GRANVILLE	1955-1975	18.22	33.79	58	9.80	56	3.32	19640725	9.0
GRAY MOUNTAIN TRADING P	1956-1962	5.11	6.72	57	4.05	59	1.31	19601015	8.5
GREEN VALLEY	1988-2000	15.08	22.00	93	10.07	96	3.22	19900715	0.1
GREER	1948-2000	23.39	36.86	83	13.74	89	3.38	19940903	101.5
GREYS PEAK MNTC YD	1975-1981	18.87	30.55	78	15.68	76	2.09	19760210	43.7
GRIGGS 3 W	1950-1990	7.71	18.20	78	1.52	56	3.20	19510828	0.0
GROOM CREEK	1948-1976	23.44	38.74	65	16.24	68	4.25	19700905	33.9
HAPPY JACK RANGER STN	1969-2000	27.09	46.53	82	12.97	89	3.54	19821201	97.1
HARQUAHALA PLAINS	1952-1979	6.15	12.51	65	2.51	53	2.25	19630909	0.0
HAWLEY LAKE	1967-1988	38.20	58.92	78	28.86	68	5.81	19780302	168.2
HEBER RANGER STN	1950-2000	17.84	29.60	78	12.09	56	4.35	19510828	41.0
HELVETIA SANTA RITA RAN	1916-1950	19.73	38.21	31	12.47	17	2.89	19350831	7.7
HILLSIDE 4 NNE	1899-1997	15.24	27.02	78	4.79	56	4.51	19880821	1.6
HOLBROOK	1893-2000	8.55	20.05	87	3.07	42	2.87	19140708	8.8
HORSESHOE DAM	1948-2000	14.93	32.10	78	7.16	56	5.82	19591030	0.1
INNER CANYON USGS	1948-1966	8.38	11.93	51	5.61	55	2.69	19510829	0.2
INTAKE	1906-1952	13.34	22.59	14	6.24	24	3.10	19160117	0.5
IRVING	1951-2000	20.95	33.70	65	8.36	56	3.38	19920823	2.6
JACOB LAKE	1950-1987	20.69	31.91	82	5.91	56	3.20	19750709	105.4
JEDDITO	1948-1955	8.84	13.14	52	4.46	50	1.42	19520921	25.4
JEROME	1897-2000	18.75	45.38	5	6.11	56	4.66	19781111	18.1
JUNIPINE	1948-1982	27.64	54.85	78	12.54	56	5.28	19700905	37.1
KAIBITO	1950-1961	7.28	12.15	52	4.74	55	1.68	19520921	19.1
KAYENTA	1915-1978	7.66	12.55	57	3.63	43	3.28	19151231	12.8
KEAMS CANYON	1948-2000	10.25	17.28	65	4.89	89	3.05	19720828	10.2
KEARNY	1984-2000	15.39	28.47	92	7.61	89	3.01	19930110	0.0
KELVIN	1948-1983	14.49	20.51	82	6.87	56	3.15	19591029	0.0
KINGMAN	1901-1967	10.36	21.22	19	3.58	47	6.03	19191128	3.7
KINGMAN NO 2	1967-1993	10.47	18.66	78	3.95	89	2.48	19900714	1.5
KITT PEAK	1960-2000	24.12	48.53	83	14.92	96	4.70	19831002	20.5
KLAGETOH	1950-1959	10.67	17.62	57	7.35	56	1.82	19580821	13.8
KLAGETOH 12 WNW	1959-1993	9.52	14.51	78	3.94	89	2.20	19830131	10.9
KLONDYKE 3 SE	1953-1978	15.05	21.63	72	8.43	56	2.76	19651209	1.5
KOFA MINE	1952-2000	6.92	15.83	83	1.66	56	5.60	19761023	0.0
LAKE HAVASU	1967-1991	4.57	10.13	78	1.44	75	1.87	19781021	0.0

LAKE HAVASU CITY	1991-2000	2.67	2.75	99	1.24	96	1.62	19980904	0.0
LAKE PLEASANT	1959-1977	9.46	18.28	65	5.59	61	3.12	19700905	0.0
[illegible]ESIDE RANGER STN	1948-1975	20.86	32.65	65	11.19	50	4.40	19480731	64.9
[illegible]EEN 3 SSE	1948-2000	8.24	15.22	92	2.15	56	2.77	20001031	0.0
LEES FERRY	1916-2000	6.10	10.83	57	2.70	55	2.06	19340828	2.4
LESLIE CANYON	1916-1960	12.65	20.41	19	6.87	56	2.94	19270815	3.2
LEUPP	1948-1981	6.51	11.86	72	2.98	56	2.86	19510728	5.3
LITCHFIELD PARK	1917-2000	8.21	19.09	92	2.57	50	3.36	19830929	0.0
LITTLEFIELD	1951-1995	7.16	7.54	54	2.96	53	2.05	19560216	0.0
LOOKOUT RANCH	1952-1958	13.04	11.33	54	6.23	56	2.77	19550819	2.9
LUKACHUKAI	1951-2000	9.67	17.34	88	3.27	89	2.02	19730105	17.6
MANY FARMS SCHOOL	1951-1975	7.10	12.27	65	3.90	73	1.70	19600229	4.5
MARICOPA 4 N	1960-2000	7.81	14.49	78	3.02	96	2.42	19670618	0.0
MARICOPA 9 SSW	1898-1958	7.35	16.42	41	2.09	0	3.35	19170729	0.1
MARINETTE	1913-1964	7.87	16.96	41	3.23	60	3.00	19390807	0.0
MAVERICK	1948-1967	27.86	41.08	65	15.08	50	3.66	19540323	98.0
MC NARY 2 N	1933-2000	26.41	46.74	78	10.66	50	4.43	19671220	91.0
MC NEAL	1960-2000	11.64	17.74	77	5.91	73	3.00	20001011	0.6
MESA	1896-2000	8.39	20.31	5	2.83	56	2.78	19060801	0.0
MIAMI	1914-2000	19.18	36.42	78	7.82	56	4.75	19591030	2.9
MOHAWK	1900-1951	4.23	14.23	41	0.54	29	3.55	19410810	0.0
MONTEZUMA CASTLE N M	1938-2000	13.08	22.27	65	3.52	56	3.29	19580912	2.3
MONUMENT VALLEY	1980-2000	4.77	6.07	96	1.08	88	1.50	19990707	6.2
MORMON FLAT	1923-2000	13.59	28.02	78	5.09	56	4.49	19300808	0.2
MORMON LAKE RNGR STN	1948-1968	-99.00	**********9999.00****				2.72	19550613	-99.0
MOUNT FAGAN RANCH	1956-1967	12.47	16.28	58	16.28	58	2.30	19610823	1.6
MOUNT LEMMON	1958-1986	29.56	23.24	62	23.24	62	5.10	19831001	64.9
MOUNT LEMMON	1950-1956	30.01	40.31	51	20.59	53	4.90	19540322	57.1
MOUNT TRUMBULL	1919-1977	11.73	23.54	41	5.57	56	4.37	19550724	10.7
[illegible]D'S PARK	1986-2000	25.90	39.32	92	11.11	89	3.01	19950215	77.0
[illegible]URAL BRIDGE	1893-1972	24.17	50.17	5	10.41	56	5.43	19050206	20.0
NAVAJO	1961-1976	9.45	12.12	75	7.72	62	2.00	19700906	16.7
N LAZY H RANCH	1948-1991	13.33	25.46	83	6.82	53	2.67	19831001	0.6
NOGALES	1948-1983	16.57	26.83	78	9.33	56	3.06	19771008	2.9
NOGALES OLD NOGALES	1892-1948	15.70	25.88	31	9.37	24	3.81	19160119	2.7
NOGALES 6 N	1952-2000	17.87	31.84	83	9.16	56	3.75	19771009	0.4
OAK CREEK CANYON	1982-2000	30.85	45.02	93	15.88	89	3.90	19910301	20.0
ORACLE	1893-1949	19.40	33.27	5	11.85	4	4.30	19231210	12.5
ORACLE 2 SE	1950-2000	22.71	43.85	83	11.76	60	3.23	19540923	10.9
ORAIBI	1948-1965	8.39	8.22	61	6.00	62	1.26	19630831	4.4
ORGAN PIPE CACTUS N M	1948-2000	9.65	19.65	83	3.38	50	3.48	19510827	0.0
PAGE	1957-2000	6.48	11.64	78	3.29	89	2.00	19781231	4.8
PAINTED CANYON	1951-1965	19.50	25.61	62	10.23	56	2.21	19630827	6.0
PAINTED DESERT NATL PAR	1973-2000	10.93	18.45	82	7.51	76	1.95	19820906	14.2
PALISADE RANGER STN	1965-1981	31.21	37.93	65	25.09	68	6.51	19781218	77.4
PARADISE	1906-1937	19.04	27.67	26	8.29	10	4.90	19191123	13.0
PARADISE VALLEY	1955-1970	8.39	15.72	65	3.87	56	2.29	19660913	0.2
PARKER 6 NE	1893-2000	4.80	13.59	92	0.34	56	3.43	19390905	0.0
PATAGONIA	1921-1977	17.65	26.47	31	9.57	56	4.45	19460930	1.3
PATAGONIA 2	1978-2000	19.16	27.39	92	9.49	80	3.61	19891004	1.7
PAYSON 12 NNE	1952-1976	27.91	44.20	65	15.32	53	4.66	19721019	55.2
PAYSON RANGER STN	1893-1974	20.70	30.99	65	8.93	50	6.20	19700905	21.3
PAYSON	1940-2000	21.58	32.66	78	11.63	53	5.36	19700905	24.7
PEACH SPRINGS	1948-2000	10.74	19.44	78	3.79	56	2.27	19740721	2.8
PEARCE SUNSITES	1950-2000	12.37	18.54	66	6.48	56	3.00	19600708	1.1
PERKINSVILLE	1962-1972	12.77	20.36	65	8.36	66	3.59	19630731	3.5
[illegible]RIFIED FOREST N P	1948-2000	9.62	15.57	92	3.85	50	2.54	19540723	8.7
[illegible]NTOM RANCH	1966-2000	9.53	16.43	78	4.70	89	1.85	19830725	0.3
PHOENIX INDIAN SCHOOL	1948-1975	7.28	13.65	65	3.15	50	3.41	19660913	0.0
PHOENIX SOUTH MOUNTAIN	1975-1983	7.88	15.84	78	3.10	77	1.84	19830304	0.0

PHOENIX WSFO AP	1948-2000	7.65	15.23	78	2.82	56	2.73	19510827	0.0
PHOENIX CITY	1948-1998	7.95	15.08	93	2.85	53	2.70	19920724	0.0
ICACHO RESERVOIR	1956-1983	9.35	16.84	78	4.98	60	2.70	19721019	0.0
ICACHO 8 SE	1987-2000	11.59	19.95	92	5.41	89	3.17	19900815	0.0
PIERCE FERRY 17 SSW	1963-1984	10.56	20.60	78	7.50	74	2.12	19820725	4.3
PINAL RANCH	1895-1973	24.60	58.45	5	11.84	3	5.95	19050109	19.1
PINEDALE	1912-1968	18.31	30.37	31	10.77	63	4.45	19540326	41.4
PINETOP	1980-1997	22.56	30.69	92	13.72	96	2.48	19940903	47.2
PINETOP FISH HATCHERY	1948-2000	24.50	37.59	78	13.56	66	4.66	19671220	73.8
PINON	1959-1974	8.88	10.46	72	8.65	68	2.00	19640801	19.7
PIPE SPRINGS NATL MONUM	1963-2000	10.95	19.40	95	5.65	64	1.95	19900904	9.2
PISINEMO	1948-1955	8.35	10.01	51	3.91	50	3.80	19550807	0.1
PLEASANT VALLEY R S	1964-2000	21.64	33.39	92	14.35	75	3.14	19831001	3.6
PORTAL	1914-1955	17.38	27.94	19	9.98	53	2.91	19191122	9.7
PORTAL 4 SW	1965-2000	21.47	33.67	67	14.17	70	4.20	19960630	6.4
PRESCOTT	1898-2000	19.32	39.47	5	6.88	56	7.92	19050228	25.4
PRESCOTT FAA AIRPORT	1948-1969	12.81	22.12	65	5.75	56	3.57	19680723	15.9
PUNKIN CENTER	1973-2000	18.08	39.00	78	11.92	89	3.86	19781218	1.1
QUARTZSITE	1959-2000	3.97	8.00	65	1.25	100	1.67	19630918	0.0
REDINGTON	1948-2000	14.31	23.47	92	5.48	50	5.45	19831002	0.3
RED ROCK 6 SSW	1893-1973	9.78	15.16	19	3.71	56	2.40	19520921	0.1
RENO R S	1915-1973	18.20	28.30	65	7.65	56	5.38	19591030	0.9
RIMROCK	1948-1962	12.98	17.65	58	4.71	56	2.68	19580912	3.1
ROOSEVELT 1 WNW	1905-2000	15.97	36.25	78	6.86	56	4.14	19780302	0.2
RUBY 4 NW	1895-1955	18.95	34.09	31	10.12	53	4.43	19410722	4.2
HELMET PEAK RUBY STAR R	1950-1983	13.79	29.21	78	5.21	56	2.89	19670717	0.2
RUCKER CANYON	1893-2000	19.35	30.03	26	7.20	56	3.90	19710812	3.6
SABINO CANYON	1948-1982	13.04	23.92	78	7.01	56	3.22	19710820	0.3
SACATON	1908-2000	8.88	19.66	84	1.85	56	4.45	19840723	0.0
AFFORD	1898-1973	8.91	17.41	65	3.44	50	2.40	19080825	1.8
AFFORD AGRICULTRL CTR	1948-2000	9.22	17.37	83	3.64	50	2.51	19831002	1.1
SAHUARITA 2 NW	1956-1972	10.62	16.54	64	7.60	62	3.90	19700721	1.0
SAINT JOHNS	1901-2000	11.33	19.06	84	4.63	50	2.82	19530716	18.9
ST MICHAELS 6 WNW	1906-1927	13.42	19.52	13	7.90	12	3.40	19130222	26.8
SALA RANCH	1948-1978	15.95	25.75	66	7.28	53	3.13	19670805	15.0
SALOME 1 ESE	1957-1973	6.83	13.45	65	3.70	60	2.40	19630918	0.5
SALOME 6 SE	1908-1957	7.87	16.75	41	1.28	56	2.60	19090815	0.1
SALOME 17 SE	1987-1998	6.31	9.84	88	1.43	96	3.60	19970925	0.0
SALT RIVER	1949-1966	14.66	18.59	59	8.77	53	5.00	19540325	0.8
SAN CARLOS	1948-1977	11.47	17.32	55	7.04	56	3.40	19510827	0.7
SAN CARLOS RESERVOIR	1948-2000	15.08	29.31	78	7.35	56	3.40	19540323	0.2
SANDERS	1949-2000	11.51	18.86	82	5.17	50	2.50	19850203	7.2
SANDERS 11 ESE	1961-1986	12.95	19.15	78	8.61	76	3.11	19710928	27.9
SAN MANUEL	1954-2000	14.15	26.80	83	7.77	56	2.61	19630816	3.2
SAN RAFAEL RANCH	1892-1968	17.26	26.64	31	10.82	56	3.50	19260926	2.0
SAN SIMON	1898-2000	9.67	18.87	5	4.09	56	4.00	19050301	2.6
SAN SIMON 9 ESE	1962-1986	9.86	15.86	85	5.61	70	3.15	19710810	2.0
SANTA MARGARITA	1917-1950	16.29	30.34	31	8.99	28	4.10	19350822	1.8
SANTA RITA EXP RANGE	1950-2000	22.28	34.50	84	10.51	56	4.65	19920824	4.3
SANTA ROSA SCHOOL	1959-1977	8.57	12.56	66	1.63	74	3.45	19620926	0.3
SASABE	1959-2000	17.49	33.22	83	11.31	72	4.36	19700904	1.2
SASABE 7 NW	1950-2000	18.84	35.86	83	8.15	53	4.34	19831001	2.7
SASABE 6 NNE	1987-2000	18.49	27.00	93	11.66	99	3.54	19930828	0.6
SCOTTSDALE	1968-1985	9.32	14.87	83	3.93	77	3.57	19700906	0.0
SEBA DALKAI SCHOOL	1963-1972	8.97	12.61	65	7.62	68	6.50	19700905	14.0
SEDONA RANGER STN	1948-2000	18.19	33.16	65	7.79	56	5.50	19700905	3.9
ELIGMAN	1904-2000	11.50	20.98	5	4.66	29	4.84	19700721	12.7
ELIGMAN 13 SSW	1962-1982	13.09	19.04	78	7.83	68	2.80	19650901	5.1
SELLS	1948-2000	11.94	18.99	67	6.78	56	4.08	19700907	0.2
SENTINEL	1899-1960	4.63	9.93	59	0.83	5	2.53	19110721	0.0

SHORT CREEK	1950-1963	9.12	14.41	57	4.76	56	2.35	19500718	13.1
SHOW LOW	1949-1965	14.54	19.90	52	9.81	53	1.94	19540322	41.4
[illegible]W LOW AIRPORT	1965-2000	17.80	30.21	78	10.22	89	2.38	19741029	27.8
[illegible]ERRA ANCHA	1913-1979	26.52	48.17	78	12.71	56	4.79	19721019	20.5
SIERRA VISTA	1982-2000	15.08	23.90	83	9.09	89	2.84	19920823	0.8
SIGNAL 13 SW	1952-1961	9.86	13.24	54	1.86	56	2.75	19550824	0.2
SILVER BELL	1906-1974	12.78	19.92	58	6.77	56	5.30	19580729	0.9
SILVER CREEK RANCH	1948-1967	12.83	19.04	59	7.80	50	2.97	19591030	11.7
SKULL VALLEY	1972-1980	19.04	17.45	76	11.82	75	2.75	19781111	9.6
SNOWFLAKE	1897-2000	12.29	23.28	15	3.80	50	3.24	19890723	18.1
SNOWFLAKE 15 W	1965-1998	12.30	17.35	84	7.45	70	3.58	19680723	16.3
SOUTH PHOENIX	1961-2000	8.68	15.56	78	3.30	96	2.05	19900815	0.0
SPRINGERVILLE	1911-2000	12.01	20.60	23	5.84	50	2.75	19940903	20.6
STANTON	1948-1969	15.35	32.26	65	3.17	56	4.51	19510829	5.2
STEPHENS RANCH	1928-1982	13.36	21.67	41	4.87	56	2.93	19640914	1.0
STEWART MOUNTAIN	1948-2000	12.75	24.11	92	3.93	56	4.30	19510828	0.0
SUNFLOWER 3 NNW	1948-1984	23.61	48.41	78	11.17	53	8.00	19700905	2.8
SUNRISE MOUNTAIN	1971-1982	36.75	43.44	79	30.65	74	4.35	19790329	243.0
SUNSET CRATER NATL MONU	1969-2000	17.04	25.99	92	9.29	89	2.50	19921205	63.2
SUPAI	1956-1987	8.54	12.86	78	4.13	62	2.36	19760730	1.2
SUPERIOR	1920-2000	18.52	35.77	78	9.62	89	3.80	19900814	1.5
SUPERIOR 2 ENE	1974-1996	24.80	41.17	78	13.03	89	3.83	19781218	3.3
SUPERSTITION MOUNTAIN	1948-1962	10.83	17.30	54	5.29	53	4.93	19540819	0.0
SYCAMORE RANGER STN	1919-1959	17.18	28.50	41	6.75	28	3.48	19190908	5.1
TACNA 3 NE	1969-2000	4.31	12.81	84	0.44	95	2.88	19770816	0.0
TEEC NOS POS	1962-2000	8.22	13.55	65	4.11	89	2.07	19950822	5.6
TEES TO	1952-1960	3.81	**********9999.00****				1.87	19540723	6.9
TEMPE	1926-1984	8.08	18.08	41	2.63	56	3.30	19510828	0.1
TEMPE 3 S	1905-1952	8.69	14.45	11	3.87	50	3.52	19430803	0.1
[illegible]PE A S U	1953-2000	8.77	19.50	92	3.86	56	3.87	19690915	0.0
[illegible]PLE BAR	1987-2000	5.49	9.98	92	1.44	89	2.30	19900708	0.0
THORNBURG RANCHES	1952-1960	5.84	9.11	59	2.83	53	2.89	19580913	0.0
TOLLESON 1 E	1951-2000	8.56	18.20	92	2.65	53	3.50	19660913	0.0
TOMBSTONE	1893-2000	13.98	27.84	5	7.36	24	3.00	19160119	2.7
TONOPAH	1951-1994	7.46	10.64	82	3.62	88	3.05	19620905	0.0
TONTO CREEK FISH HATCHE	1948-1975	32.76	49.13	65	17.19	50	5.63	19700906	58.7
TONTO CREEK FISH HAT 2	1975-2000	34.23	51.66	82	21.65	99	4.55	19970228	38.6
TONTO SPRINGS RS	1948-1966	17.41	31.96	65	12.58	61	3.36	19660721	4.3
TOPOCK 2 SSE	1948-1960	4.63	8.27	58	0.44	56	2.60	19510828	0.6
TRUXTON CANYON	1948-1980	10.87	20.29	78	5.16	75	2.84	19690819	2.4
TUBA CITY	1900-2000	6.55	12.72	65	2.24	96	3.40	19260927	6.8
TUCSON 17 NW	1982-2000	13.65	22.54	83	9.22	87	3.42	19820911	0.0
TUCSON CAMP AVE EXP FM	1949-2000	11.85	20.99	78	5.58	53	3.45	19831002	0.4
TUCSON MAGNETIC OBSY	1948-1994	12.79	26.22	83	5.59	53	2.57	19831002	0.6
TUCSON MOUNTAIN PARK	1949-1954	8.17	10.29	51	6.54	49	1.54	19511030	0.0
TUCSON UNIV OF ARIZONA	1894-2000	11.24	24.17	5	5.07	24	4.16	19831001	0.8
TUCSON U OF ARIZ # 1	1982-2000	12.40	23.33	83	6.25	89	3.05	19831001	0.0
TUCSON WSO AP	1948-2000	11.65	21.86	83	5.34	53	3.93	19580729	1.3
TUMACACORI NATL MONUMEN	1948-2000	16.05	29.04	83	7.49	80	3.63	19831001	0.8
TUWEEP	1948-1985	12.13	19.96	78	4.79	56	2.64	19690719	7.4
TUZIGOOT	1977-2000	13.56	19.18	83	6.75	96	2.50	19830930	1.9
VAIL 7 N	1992-2000	14.98	19.67	98	10.74	96	2.82	19990827	0.0
VALLE AIRPORT	1948-1959	9.37	12.57	49	5.25	50	1.70	19510829	14.2
WAHWEAP	1961-2000	6.25	15.92	83	2.56	74	4.00	19820204	0.7
WALLACE RANGER STN	1916-1959	18.28	26.81	52	9.85	28	4.11	19161017	58.8
WALNUT CANYON NATL MONU	1950-2000	18.39	26.91	65	9.50	56	4.05	19870813	55.9
[illegible]NUT CREEK	1915-2000	16.32	34.79	27	8.35	42	5.50	19270628	12.2
[illegible]NUT GROVE	1893-2000	17.06	33.84	65	4.33	0	5.70	19191126	4.9
WELLTON	1922-1980	4.18	9.63	26	0.44	28	3.25	19670902	0.0
WHITERIVER 1 SW	1900-2000	18.23	33.15	5	8.69	13	4.02	19320730	17.5

WICKENBURG	1908-2000	11.27	25.11	65	3.59	56	3.03	19970926	0.2
WIKIEUP	1948-2000	9.93	20.69	78	1.00	56	2.80	19930209	0.1
WILLCOX	1898-2000	12.28	23.52	5	5.82	56	3.65	19800814	3.6
WILLIAMS	1897-2000	21.74	39.93	65	12.54	10	10.35	19281125	70.5
WILLIAMS CREEK FISH HAT	1961-1975	24.34	28.28	73	20.37	63	2.75	19651125	76.0
WILLOW BEACH	1967-2000	5.46	11.72	92	1.76	68	1.99	19920308	0.0
WILLOW SPRINGS RANCH	1949-1978	15.10	23.80	57	7.46	56	3.15	19540721	3.1
WINDOW ROCK 4 SW	1937-1999	11.80	23.73	41	5.32	50	2.38	19450729	29.8
WINKELMAN 6 S	1942-1980	13.90	24.49	78	5.55	56	2.57	19740715	0.0
WINKLEMAN 12 SE	1985-1995	17.07	27.33	92	6.98	89	2.47	19950215	0.0
WINSLOW WSO AP	1898-2000	7.95	17.17	23	4.45	-1	2.43	19280801	11.4
WITTMANN	1923-1966	9.07	19.35	41	2.35	60	2.93	19290904	0.0
WUPATKI NATL MONUMENT	1948-2000	8.31	13.81	83	3.98	89	1.96	19550613	7.0
Y LIGHTNING RANCH	1939-2000	13.99	23.78	83	6.57	50	3.07	19871217	2.9
YAEGER CANYON	1917-1948	17.80	29.25	41	10.94	42	3.23	19300808	35.3
YAVA 6 ESE	1948-1975	14.33	23.80	65	2.84	56	3.40	19690819	6.5
YOUNG	1903-1964	21.02	48.19	5	12.28	4	5.27	19510828	20.0
YOUNGTOWN	1964-2000	9.10	17.78	92	4.27	75	2.73	19820824	0.0
YUCCA	1950-2000	7.54	16.80	78	0.90	56	3.61	19810906	0.2
YUMA CITRUS STATION	1920-2000	3.45	8.30	97	0.47	53	4.29	19770816	0.0
YUMA DATE ORCHARD	1905-1929	3.54	9.55	26	0.54	24	3.62	19090816	0.0
YUMA PROVING GROUND	1958-2000	3.72	10.27	92	0.64	96	3.02	19721006	0.0
YUMA QUARTERMASTER DEP	1993-2000	2.66	5.47	93	0.96	95	1.39	19941225	0.0
YUMA VALLEY	1930-1992	2.86	9.37	77	0.43	53	6.45	19770816	0.0
YUMA WSO AP	1948-1996	2.91	6.75	89	0.31	53	3.42	19890809	0.0
YUMA WB CITY	1893-1974	3.33	9.23	26	0.25	56	3.63	19210930	0.0

ARIZONA

ANNUAL TEMPERATURE SUMMARY
(Degree F)

	PERIOD OF RECORD	AVG MAX	AVG MIN	AVG	EXTREMES HIGH	YEARMODY	LOW	YEARMODY	EXTREME AVERA MAX	YR
AGUILA	1924-2000	82.2	49.1	65.6	117	19580711	11	19500104	67.7	40
AJO	1914-2000	83.9	58.9	71.4	117	19950731	17	19370122	74.2	81
ALAMO DAM 6 ESE	1962-1974	86.1	51.1	68.6	120	19720801	10	19710107	70.0	66
ALAMO DAM	1975-2000	86.5	54.8	70.7	124	19950729	19	19901226	72.8	81
ALHAMBRA	1948-1976	86.5	52.4	69.4	117	19580711	15	19500104	70.6	69
ALPINE	1904-2000	61.4	26.4	43.9	94	19730627	-32	19790130	46.6	100
ANVIL RANCH	1948-2000	83.5	48.9	66.2	116	19600620	8	19541228	67.4	89
APACHE JUNCTION 5 NE	1987-2000	86.0	57.0	71.5	119	19900626	22	19981223	72.8	96
APACHE 6 WNW	1938-1980	73.0	42.2	57.6	105	19690630	-8	19781207	59.0	71
APACHE JUNCTION	1962-1979	84.6	57.4	71.0	116	19640624	21	19781209	72.2	77
APACHE POWDER COMPANY	1923-1990	80.6	44.0	62.3	111	19730626	-7	19781208	63.5	62
ARIZONA SONORA DESERT M	1962-1973	84.5	55.1	69.8	116	19700623	13	19710105	71.3	67
ASH FORK 6 N	1902-1987	71.5	36.6	54.1	105	19370813	-17	19370122	56.9	34
ASH FORK 5 N	1976-1983	69.3	36.1	52.7	102	19770629	-14	19790130	54.3	81
BAGDAD 2	1978-1986	74.4	47.5	61.0	106	19840804	6	19850205	61.9	80
BAGDAD	1925-2000	77.0	49.1	63.1	114	19290625	8	19901223	66.1	34
BAGDAD 8 NE	1950-1975	75.2	41.1	58.1	109	19730627	0	19681222	59.1	66
BARTLETT DAM	1939-2000	84.8	56.3	70.5	122	19950729	21	19630113	73.0	89
BEAVER CREEK RANGER STN	1957-2000	76.4	46.6	61.5	111	19940628	1	19630113	62.8	63
[illegible]VER DAM	1956-2000	81.5	49.7	65.6	120	19980716	4	19901223	68.1	100
[illegible]SON	1894-1975	80.3	45.2	62.8	116	19040619	5	19130107	65.0	10
BENSON 6 SE	1990-2000	80.2	44.3	62.2	109	19900625	12	20000103	62.9	100
BETATAKIN	1948-2000	61.8	37.9	49.9	101	19540622	-14	19850201	52.2	100
BISBEE	1892-1985	73.9	48.7	61.4	106	19240612	6	19490131	66.3	27
BISBEE 2	1961-1997	75.1	49.1	62.1	108	19940702	7	19620111	65.2	95
BISBEE 2 WNW	1985-2000	73.5	44.0	58.8	106	19900625	-9	19870118	60.2	89
BLACK MOUNTAIN MISSION	1952-1965	64.4	37.8	51.1	99	19520806	-16	19630113	51.6	60
BLACK RIVER PUMPS	1948-2000	67.9	36.9	52.4	103	19900626	-20	19710104	54.3	100
BLUE	1903-1989	71.3	33.4	52.4	110	19690716	-9	19710106	54.2	77
BLUE RIDGE RANGER STN	1967-2000	62.8	31.1	47.0	98	19780723	-22	19710106	48.6	81
BOUSE	1952-2000	86.8	53.1	70.0	123	19580709	11	19740103	72.6	81
BOWIE	1899-2000	80.3	47.6	64.0	116	19360720	3	19781209	66.7	36
BRIGHT ANGEL RANGER STN	1948-2000	56.2	30.4	43.3	92	20000729	-23	19850201	46.0	50
BUCKEYE	1893-2000	87.7	52.0	69.9	125	19950728	11	19130106	73.3	81
BULLHEAD CITY	1977-2000	88.6	59.5	74.1	126	19840628	24	19901223	76.7	96
BURRUS RANCH	1948-1968	64.4	32.6	48.5	100	19580711	-19	19630112	50.5	50
ARIZONA FALLS 1 WNW	1948-1963	87.2	53.2	70.2	119	19580711	15	19630113	71.5	54
CAMERON 1 NNE	1962-1992	73.3	41.7	57.5	112	19810620	-7	19710107	59.9	86
CANELO 1 NW	1910-2000	74.0	40.7	57.4	109	19260701	-6	19490104	60.4	96
CANYON DE CHELLY	1970-2000	68.8	37.4	53.1	104	19890704	-24	19740103	55.9	96
CAREFREE	1962-2000	81.8	56.2	69.0	118	19950728	15	19630113	71.2	89
CASA GRANDE	1898-2000	87.1	53.2	70.1	122	19050706	15	19541228	72.1	89
CASA GRANDE NATL MONUME	1906-2000	87.4	51.3	69.4	123	19940630	8	19130107	72.1	81
CASCABEL	1969-2000	82.4	45.1	63.7	116	19700625	6	19710107	66.0	96
CASTLE HOT SPRINGS	1959-2000	83.4	55.8	69.6	120	19950728	17	19630112	71.2	89
CASTLE HOT SPRINGS 4 N	1949-1958	81.8	51.5	66.6	114	19580711	18	19500104	68.4	50
[illegible]E CREEK	1950-1961	83.1	53.4	68.2	115	19580711	19	19550220	69.3	54
[illegible]NDLER	1948-1980	84.9	51.7	68.3	123	19790729	16	19760102	69.9	73
CHANDLER HEIGHTS	1948-2000	84.9	55.3	70.1	117	19900626	14	19710106	72.2	81
CHEVELON R S	1959-2000	61.7	35.4	48.6	96	19730704	-21	19630113	49.6	66

CHILDS	1915-2000	81.0	47.6	64.3	118	19580712	2	19370121	67.4	89
CHINLE	1908-1970	67.9	35.8	51.9	104	19530703	-32	19190102	54.4	58
CHINO VALLEY	1948-2000	72.2	37.2	54.7	108	19570624	-15	19490130	56.2	77
CHIRICAHUA NATL MONUMEN	1909-2000	73.2	43.4	58.3	109	19090713	-10	19130107	61.5	96
CIBECUE	1927-1979	72.0	36.5	54.2	114	19390714	-14	19370124	56.6	39
CLAY SPRINGS	1971-1987	65.6	34.6	50.1	100	19740625	-22	19781209	51.0	78
CLIFTON	1893-2000	80.9	51.6	66.2	116	19940626	4	19620112	71.4	34
COCHISE 4 SSE	1899-1954	76.8	43.2	60.0	114	19120530	-4	19111225	60.9	24
COCHISE STRONGHOLD	1925-1948	75.6	44.2	59.9	105	19280523	8	19370122	61.4	28
COLORADO CITY	1963-2000	69.4	40.9	55.2	108	19850705	-9	19730105	57.4	96
CONGRESS	1970-1980	78.0	53.0	65.5	110	19730627	16	19790130	66.9	77
COPPER MINE TRADING POS	1948-1976	66.1	38.7	52.4	106	19510709	-11	19630113	53.7	54
CORDES	1948-2000	75.6	46.7	61.2	115	19950728	8	19901223	63.7	96
CORONADO NATL MONUMENT	1960-2000	75.0	46.4	60.7	106	19600619	1	19781208	62.5	81
CORTARO 3 SW	1948-1976	85.7	51.5	68.6	120	19640704	15	19490105	69.8	54
COTTONWOOD	1949-1977	78.2	45.2	61.7	114	19510730	5	19630113	63.5	54
COVERED WELLS 1 E	1956-1963	83.7	53.3	68.5	115	19580709	17	19601207	67.8	63
CROWN KING	1914-1995	68.0	39.4	53.7	104	19940630	-5	19790130	54.3	88
DATELAND	1952-1968	88.8	56.2	72.5	125	19580709	15	19630113	73.6	59
DATELAND WHITEWING RANC	1972-2000	87.7	53.8	70.8	122	19760706	17	19901223	72.8	95
DAVIS DAM # 2	1958-1977	84.9	59.9	72.4	121	19670703	20	19630113	74.5	58
DAVIS DAM	1948-1961	85.6	57.0	71.3	121	19610624	23	19490129	73.6	54
DEER VALLEY	1950-1985	85.2	54.2	69.7	118	19580710	19	19710108	72.1	81
DINNEHOTSO	1950-1974	69.7	36.5	53.1	110	19700715	-25	19740103	54.9	58
DOUGLAS	1948-1994	79.1	44.7	61.9	109	19900626	2	19781208	63.7	89
DOUGLAS FAA AP	1948-2000	78.2	45.8	62.0	110	19940626	-4	19781208	64.1	89
DOUGLAS SMELTER	1903-1973	79.2	46.3	62.8	111	19050706	-7	19130107	64.5	10
DUDLEYVILLE	1893-1925	80.4	48.5	64.5	114	19020624	9	19130107	66.6	-7
DUNCAN	1901-2000	78.3	40.7	59.5	111	19940625	-2	19531224	62.7	100
EHRENBERG	1948-1977	88.0	57.0	72.5	122	19500901	20	19620112	73.8	54
EHRENBERG 2 E	1977-2000	87.8	61.5	74.6	123	19950728	25	19781207	76.5	96
ELOY 4 NE	1951-2000	86.5	53.8	70.1	119	19900626	13	19710104	71.8	81
FALCON FIELD	1948-1976	84.7	50.1	67.4	114	19570731	15	19500104	69.9	50
FLAGSTAFF 4 SW	1984-2000	60.6	25.0	42.8	95	19840713	-37	19850201	45.3	96
FLAGSTAFF WSO AP	1950-2000	61.2	30.5	45.9	97	19730705	-23	19781208	49.4	81
FLORENCE	1892-2000	86.5	53.4	69.9	119	19830705	11	19130106	72.1	81
FLYING H RANCH	1948-1958	74.8	47.4	61.1	102	19510527	5	19490130	63.0	54
FORESTDALE	1948-1971	66.7	30.1	48.4	99	19510707	-23	19681222	50.2	54
FORT DEFIANCE	1897-1949	63.1	30.6	46.9	98	19010629	-30	19311124	48.8	0
FORT GRANT	1900-1974	75.1	48.5	61.8	111	19040805	2	19620111	63.8	1
FORT HUACHUCA	1900-1981	74.9	48.9	61.9	105	19090714	1	19130108	63.5	9
FORT THOMAS	1958-1966	81.9	42.4	62.1	115	19600619	8	19630120	64.1	59
FORT THOMAS 2 SW	1966-2000	80.1	46.3	63.2	113	19900625	3	19870117	65.6	89
FORT VALLEY	1909-2000	60.1	25.8	42.9	98	19850705	-37	19630112	45.9	34
FOUNTAIN HILLS	1979-2000	87.0	57.1	72.0	125	19950729	23	19870118	74.3	96
FREDONIA	1948-1975	69.7	34.2	52.0	107	19700626	-20	19730106	53.2	58
GANADO	1948-2000	64.1	33.2	48.7	101	19710714	-26	19630113	50.7	94
GILA BEND	1892-2000	89.3	55.8	72.6	122	19900626	10	19630113	75.2	86
GILA BEND AVIATION	1948-1966	87.6	57.8	72.7	121	19580711	18	19490104	74.5	58
GISELA	1895-2000	79.4	45.0	62.2	112	18960614	11	18951230	**********	
GLOBE	1894-1975	77.7	46.7	62.2	113	19700626	5	19741224	64.9	10
GLOBE 2	1975-1981	75.5	47.9	61.7	105	19800629	10	19751229	61.6	78
GLOBE	1981-2000	76.2	46.6	61.4	111	19900627	12	19901223	64.6	100
GOULDS RANCH	1915-1960	86.6	53.1	69.9	118	19400619	19	19370122	72.3	40
GRAND CANYON AIRWAYS	1948-1967	61.8	35.1	48.5	98	19580711	-15	19630112	51.5	54
GRAND CANYON NATL PARK	1903-1957	62.5	34.9	48.7	98	19250715	-20	19190101	51.0	54
GRAND CANYON NATL PARK	1957-1977	62.2	34.2	48.2	105	19740626	-14	19630112	49.5	63
GRAND CANYON N P 2	1976-2000	62.6	31.9	47.2	97	19850706	-20	19850201	49.8	100
GRANITE REEF DAM	1893-1979	85.5	54.1	69.8	121	19250716	13	19130106	72.0	10
GRANVILLE	1955-1975	64.9	38.3	51.6	98	19680530	-19	19600118	54.3	70

GREEN VALLEY	1988-2000	84.8	53.4	69.1	109	19980716	25	19981208	69.5	100
GREER	1948-2000	58.0	29.9	44.0	90	19710713	-24	19710106	46.2	96
[illegible]YS PEAK MNTC YD	1975-1981	63.0	39.5	51.3	96	19800706	-4	19790130	52.8	77
[illegible]OM CREEK	1948-1976	65.9	34.7	50.3	98	19500901	-8	19630113	51.4	66
HAPPY JACK RANGER STN	1969-2000	58.4	30.3	44.4	97	19940630	-35	19790130	45.9	95
HARQUAHALA PLAINS	1952-1979	85.5	49.5	67.5	124	19710710	9	19710107	67.7	74
HAWLEY LAKE	1967-1988	56.8	24.6	40.7	88	19740625	-40	19710107	43.1	81
HEBER RANGER STN	1950-2000	65.4	31.9	48.7	100	19700626	-25	19630113	50.7	54
HELVETIA SANTA RITA RAN	1916-1950	75.6	51.6	63.6	108	19200708	10	19370121	66.0	34
HILLSIDE 4 NNE	1899-1997	77.4	40.4	58.9	113	19950728	0	19901223	61.1	58
HOLBROOK	1893-2000	71.9	37.6	54.7	109	19550829	-21	18981214	58.3	96
INNER CANYON USGS	1948-1966	81.8	55.7	68.7	120	19580711	17	19630113	69.3	61
JACOB LAKE	1950-1987	57.8	31.6	44.7	95	19570812	-20	19710105	46.7	86
JEDDITO	1948-1955	68.9	35.8	52.3	104	19540622	-17	19490104	53.8	50
JEROME	1897-2000	70.1	49.0	59.6	105	18980728	5	19630113	62.0	36
JUNIPINE	1948-1982	70.1	41.3	55.7	105	19500629	-6	19790131	57.3	81
KAIBITO	1950-1961	68.6	37.0	52.8	104	19540623	-5	19600104	53.3	59
KAYENTA	1915-1978	67.4	38.0	52.7	105	19430710	-19	19611212	56.6	34
KEAMS CANYON	1948-2000	66.0	34.5	50.2	104	19760708	-25	19790130	51.7	58
KINGMAN	1901-1967	76.4	46.7	61.6	111	19150819	6	19370109	64.6	47
KINGMAN NO 2	1967-1993	74.5	48.5	61.5	110	19720714	4	19790129	64.0	81
KITT PEAK	1960-2000	64.2	45.8	55.0	98	19790628	2	19790131	58.2	89
KLAGETOH	1950-1959	65.5	29.5	47.4	100	19580710	-16	19511221	46.7	51
KLAGETOH 12 WNW	1959-1993	65.3	39.2	52.3	104	19670704	-20	19850202	54.4	81
KOFA MINE	1952-2000	84.4	61.5	73.0	119	19950728	23	19630113	75.0	96
LAKE HAVASU	1967-1991	87.3	61.6	74.5	121	19900627	25	19901224	76.3	81
LAKE HAVASU CITY	1991-2000	89.7	63.0	76.4	126	19940627	31	19930104	78.0	96
LAKE PLEASANT	1959-1977	83.5	58.0	70.8	114	19650704	32	19640215	**********	
LAVEEN 3 SSE	1948-2000	86.4	55.8	71.1	125	19950728	16	19630113	74.8	100
[illegible]S FERRY	1916-2000	76.5	48.5	62.5	116	19900626	0	19380518	64.9	86
[illegible]PP	1948-1981	71.9	35.2	53.5	110	19700626	-18	19630113	55.2	58
LITCHFIELD PARK	1917-2000	87.3	53.5	70.4	125	19900626	16	19500105	73.5	81
LITTLEFIELD	1951-1995	82.1	48.1	65.2	120	19540622	15	19560203	66.2	94
LUKACHUKAI	1951-2000	63.2	36.7	50.0	100	19850708	-25	19681222	52.1	63
MANY FARMS SCHOOL	1951-1975	69.1	35.9	52.5	104	19540622	-32	19611212	53.8	69
MARICOPA 4 N	1960-2000	86.8	52.5	69.6	124	19950728	7	19640307	72.1	96
MARICOPA 9 SSW	1898-1958	86.7	51.5	69.1	122	19050706	8	19130107	69.9	37
MARINETTE	1913-1964	87.1	51.9	69.5	120	19250717	17	19320129	72.5	34
MAVERICK	1948-1967	61.7	23.0	42.3	94	19600616	-37	19630113	44.3	58
MC NARY 2 N	1933-2000	62.4	31.8	47.1	98	19740614	-23	19490104	49.6	100
MESA	1896-2000	84.7	52.9	68.8	119	19070703	15	19500104	72.6	81
MIAMI	1914-2000	76.4	50.7	63.6	112	19950729	8	19620111	67.6	100
MOHAWK	1900-1951	89.5	58.7	74.1	123	19100707	16	19370122	77.5	40
MONTEZUMA CASTLE N M	1938-2000	80.2	42.4	61.3	117	19700625	-1	19630113	63.0	89
MONUMENT VALLEY	1980-2000	66.4	44.6	55.5	103	19890706	-9	19901224	57.7	96
MORMON FLAT	1923-2000	83.9	58.8	71.4	120	19700626	20	19370122	76.1	34
MOUNT LEMMON	1958-1986	62.2	34.8	48.5	91	19600630	-7	19630208	51.7	59
MOUNT LEMMON	1950-1956	61.1	38.2	49.6	89	19560602	-2	19560205	49.5	53
MOUNT TRUMBULL	1919-1977	67.3	38.5	52.9	98	19200708	-2	19191209	**********	
MUND'S PARK	1986-2000	62.1	29.5	45.8	95	19890707	-27	19901223	47.6	96
NATURAL BRIDGE	1893-1972	71.2	44.8	58.0	109	19700627	0	19630113	61.5	34
NAVAJO	1961-1976	67.5	34.0	50.8	104	19610622	-30	19630112	52.5	62
NOGALES	1948-1983	79.0	42.0	60.5	106	19500629	-3	19781208	62.4	81
NOGALES OLD NOGALES	1892-1948	79.7	45.9	62.8	110	19400618	6	19480129	65.9	43
NOGALES 6 N	1952-2000	79.5	42.7	61.1	112	19900626	-4	19781208	63.2	89
OAK CREEK CANYON	1982-2000	69.4	42.3	55.8	106	19850704	2	19850205	57.6	89
[illegible]CLE	1893-1949	74.6	49.9	62.2	108	19290624	2	19370122	64.6	43
[illegible]CLE 2 SE	1950-2000	74.8	49.3	62.0	109	19950728	5	19790130	64.1	59
ORAIBI	1948-1965	67.1	36.9	52.0	100	19480903	-18	19630113	52.8	63
ORGAN PIPE CACTUS N M	1948-2000	85.9	53.9	69.9	118	19900626	14	19620112	72.7	96

PAGE	1957-2000	69.9	46.5	58.2	109	19850705	-11	19630113	60.2	96
PAINTED CANYON	1951-1965	72.0	36.4	54.2	187	19620408	-11	19620111	55.1	62
PAINTED DESERT NATL PAR	1973-2000	69.0	37.5	53.1	101	19740527	-6	19740103	54.1	77
PALISADE RANGER STN	1965-1981	60.0	37.4	48.7	91	19700625	-6	19710302	50.5	72
PARADISE	1906-1937	70.2	40.0	55.1	104	19120708	-6	19330208	58.1	10
PARADISE VALLEY	1955-1970	83.9	59.9	71.9	117	19580711	23	19630114	73.2	59
PARKER 6 NE	1893-2000	88.1	54.9	71.5	127	19050707	9	19111231	75.3	81
PAYSON 12 NNE	1952-1976	68.3	34.3	51.4	101	19580711	-11	19681222	52.3	72
PAYSON RANGER STN	1893-1974	71.2	35.0	53.1	107	19580711	-18	19130112	57.4	10
PAYSON	1940-2000	72.6	38.8	55.7	107	19580711	-8	19710106	58.0	96
PEARCE SUNSITES	1950-2000	78.3	45.1	61.7	109	19600619	-8	19781208	63.8	54
PERKINSVILLE	1962-1972	75.7	38.7	57.3	110	19700625	-4	19630113	57.7	63
PETRIFIED FOREST N P	1948-2000	70.5	38.9	54.7	107	19980629	-27	19710106	58.0	100
PHANTOM RANCH	1966-2000	81.6	56.4	69.0	120	19740727	-9	19710105	70.6	67
PHOENIX SOUTH MOUNTAIN	1975-1983	79.0	61.2	70.2	109	19760627	21	19781208	72.0	81
PHOENIX WSFO AP	1948-2000	85.7	59.3	72.5	122	19900626	17	19500105	76.9	89
PHOENIX CITY	1948-1998	86.3	60.3	73.3	121	19950728	23	19500104	76.3	81
PICACHO 8 SE	1987-2000	86.6	57.8	72.2	119	19950728	20	19981224	73.5	96
PIERCE FERRY 17 SSW	1963-1984	72.3	47.2	59.8	109	19700626	3	19790129	60.6	80
PINEDALE	1912-1968	65.0	32.6	48.8	99	19340711	-29	19370123	51.0	43
PINETOP	1980-1997	63.7	34.6	49.2	98	19810622	-14	19901223	51.0	96
PINON	1959-1974	65.7	32.5	49.2	102	19610622	-20	19630113	50.8	69
PIPE SPRINGS NATL MONUM	1963-2000	70.9	38.3	54.6	110	19700626	-13	19901223	56.6	86
PISINEMO	1948-1955	85.0	51.1	68.2	115	19500901	15	19500104	69.6	50
PLEASANT VALLEY R S	1964-2000	71.7	34.9	53.3	105	19950728	-22	19901223	55.3	81
PORTAL	1914-1955	73.7	42.6	58.2	102	19480710	-4	19490104	61.3	54
PORTAL 4 SW	1965-2000	70.8	37.4	54.1	101	19900626	-5	19781208	55.7	96
PRESCOTT	1898-2000	69.3	37.0	53.1	105	19250717	-21	19370122	56.5	43
PRESCOTT FAA AIRPORT	1948-1969	70.1	40.2	55.2	102	19500630	-5	19490130	57.0	50
PUNKIN CENTER	1973-2000	81.0	48.1	64.5	118	19900626	12	19760101	65.8	91
QUARTZSITE	1959-2000	87.0	58.5	72.8	122	19950728	15	19630113	75.5	96
RED ROCK 6 SSW	1893-1973	85.1	52.8	69.0	118	19330716	14	19320129	69.3	30
RENO R S	1915-1973	80.5	49.7	65.1	116	19700626	10	19620111	65.8	70
ROOSEVELT 1 WNW	1905-2000	80.8	54.7	67.8	117	19900626	18	19061021	70.2	54
RUBY 4 NW	1895-1955	76.6	49.9	63.2	105	19440804	12	18980125	63.9	43
SABINO CANYON	1948-1982	84.6	53.0	68.8	115	19600619	15	19710105	70.9	54
SACATON	1908-2000	85.9	52.0	69.0	121	19900627	9	19130106	71.7	89
SAFFORD	1898-1973	80.9	46.7	63.8	116	19710629	8	19100107	65.8	54
SAFFORD AGRICULTRL CTR	1948-2000	79.9	46.2	63.0	114	19940630	7	19741224	65.3	100
SAHUARITA 2 NW	1956-1972	84.7	48.1	66.4	118	19660616	10	19620111	68.4	69
SAINT JOHNS	1901-2000	70.2	35.6	52.9	104	19020802	-29	19710107	55.2	96
ST MICHAELS 6 WNW	1906-1927	63.0	32.4	47.6	106	19250715	-25	19190101	49.5	21
SALOME 1 ESE	1957-1973	83.7	50.7	67.4	117	19700625	10	19660303	66.7	62
SALOME 6 SE	1908-1957	84.0	50.1	67.1	118	19290624	15	19300109	70.5	34
SALOME 17 SE	1987-1998	84.7	55.5	70.1	125	19940628	17	19901223	71.2	89
SAN CARLOS	1948-1977	81.6	44.5	63.0	115	19700625	3	19531224	64.4	54
SAN CARLOS RESERVOIR	1948-2000	80.0	51.4	65.7	116	19850825	11	19710108	68.3	89
SANDERS	1949-2000	68.9	34.8	51.8	107	19850706	-23	19790130	54.7	100
SANDERS 11 ESE	1961-1986	66.6	31.7	49.2	103	19710714	-35	19630113	51.6	81
SAN MANUEL	1954-2000	79.1	50.8	65.0	111	19700625	12	19620111	66.4	56
SAN RAFAEL RANCH	1892-1968	76.1	38.8	57.4	105	19600620	-11	19641214	58.7	57
SAN SIMON	1898-2000	79.8	44.1	62.0	114	19940626	-5	19130106	63.6	94
SAN SIMON 9 ESE	1962-1986	78.1	47.2	62.7	108	19640704	-6	19781207	63.8	72
SANTA RITA EXP RANGE	1950-2000	76.4	51.7	64.0	107	19700625	9	19731126	66.3	89
SANTA ROSA SCHOOL	1959-1977	85.1	50.9	68.0	118	19670630	12	19760105	69.5	62
SASABE	1959-2000	79.0	49.2	64.1	111	19900626	13	19710301	66.0	96
SASABE 6 NNE	1987-2000	81.2	44.2	62.6	113	19900625	9	19881228	63.8	89
SCOTTSDALE	1968-1985	85.9	53.5	69.7	117	19680620	20	19681222	70.7	84
SEBA DALKAI SCHOOL	1963-1972	68.5	40.3	54.4	101	19700626	-10	19690129	55.0	66
SEDONA RANGER STN	1948-2000	75.4	45.8	60.6	110	19810625	0	19620114	63.0	95

SELIGMAN	1904-2000	71.1	35.8	53.4	110	19250717	-18	19060102	56.6	47
SELIGMAN 13 SSW	1962-1982	70.2	34.5	52.3	105	19700626	-21	19671221	54.5	81
[illegible]LS	1948-2000	84.0	52.7	68.4	115	19570625	4	19741225	70.1	50
[illegible]TINEL	1899-1960	88.5	54.6	71.6	124	19170616	18	19130107	73.1	14
SHORT CREEK	1950-1963	69.1	39.3	54.2	107	19590712	-11	19630113	54.1	53
SHOW LOW	1949-1965	65.5	35.4	50.4	98	19570704	-16	19491212	51.8	54
SHOW LOW AIRPORT	1965-2000	65.7	37.2	51.5	100	19690531	-25	19710108	54.9	96
SIERRA ANCHA	1913-1979	72.2	45.6	58.9	105	19700626	0	19140129	61.9	72
SIERRA VISTA	1982-2000	77.0	48.9	63.0	108	19890704	11	19850201	64.7	96
SILVER BELL	1906-1974	81.0	58.2	69.5	117	19110817	14	19730129	71.1	14
SKULL VALLEY	1972-1980	73.9	40.7	57.3	105	19730627	8	19721210	58.4	77
SNOWFLAKE	1897-2000	69.5	34.3	52.0	104	19420713	-30	19370123	55.9	100
SNOWFLAKE 15 W	1965-1998	66.2	37.3	51.8	101	19950729	-25	19710106	54.5	96
SOUTH PHOENIX	1961-2000	84.8	53.8	69.3	114	19900626	12	19630113	71.9	96
SPRINGERVILLE	1911-2000	65.4	31.2	48.3	100	19530630	-28	19261227	51.0	50
STANTON	1948-1969	77.0	52.6	64.8	109	19670702	15	19490104	67.0	54
STEWART MOUNTAIN	1948-2000	84.7	53.5	69.1	120	19900627	17	19710108	71.1	100
SUNRISE MOUNTAIN	1971-1982	53.1	23.7	38.4	80	19740615	-26	19720104	39.0	74
SUNSET CRATER NATL MONU	1969-2000	63.3	28.3	45.8	99	19940625	-28	19850201	47.5	96
SUPAI	1956-1987	76.9	46.2	61.6	116	19850705	-4	19611212	65.5	81
SUPERIOR	1920-2000	79.1	58.5	68.8	112	19950729	19	19781208	70.9	89
SUPERSTITION MOUNTAIN	1948-1962	85.3	60.0	72.6	116	19600619	21	19620112	74.3	50
TACNA 3 NE	1969-2000	87.7	53.1	70.4	126	19950728	13	19901223	73.5	96
TEEC NOS POS	1962-2000	68.0	42.0	55.0	105	19740619	-18	19740103	57.8	100
TEES TO	1952-1960	69.3	35.1	52.4	103	19540622	-4	19550124	**********	
TEMPE	1926-1984	85.1	52.6	68.8	118	19700626	15	19500105	71.8	81
TEMPE 3 S	1905-1952	84.0	50.6	67.3	119	19050706	12	19130107	70.1	10
TEMPE A S U	1953-2000	86.7	53.9	70.3	119	19700626	19	19550220	74.2	89
TEMPLE BAR	1987-2000	83.1	57.4	70.3	120	19950730	18	19901223	72.2	96
[illegible]RNBURG RANCHES	1952-1960	84.8	50.5	67.6	113	19580712	17	19531224	68.6	58
[illegible]BSTONE	1893-2000	77.3	49.4	63.4	112	19890704	3	19781208	65.8	96
TONOPAH	1951-1994	86.1	54.0	70.0	121	19900626	14	19901223	71.5	89
TRUXTON CANYON	1948-1980	74.9	43.6	59.3	110	19500701	-2	19491212	60.0	77
TUBA CITY	1900-2000	70.1	39.9	55.0	110	19400620	-15	19130107	57.8	34
TUCSON 17 NW	1982-2000	83.9	56.5	70.2	115	19940630	21	19850201	72.1	89
TUCSON CAMP AVE EXP FM	1949-2000	84.1	50.1	67.1	115	19900626	9	19500106	70.0	100
TUCSON MAGNETIC OBSY	1948-1994	83.3	50.4	66.9	118	19900627	13	19640112	69.5	89
TUCSON MOUNTAIN PARK	1949-1954	83.0	57.2	70.1	110	19530630	19	19490104	72.0	50
TUCSON UNIV OF ARIZONA	1894-2000	83.4	53.6	68.5	115	19600619	6	19130107	73.5	94
TUCSON U OF ARIZ # 1	1982-2000	84.8	53.8	69.3	114	19900626	19	19881229	70.7	96
TUCSON WSO AP	1948-2000	82.5	54.6	68.5	117	19900626	16	19490104	71.4	89
TUMACACORI NATL MONUMEN	1948-2000	82.0	46.2	64.1	113	19600619	5	19781208	66.5	80
TUWEEP	1948-1985	71.3	44.2	57.8	108	19540621	0	19630112	57.7	57
TUZIGOOT	1977-2000	78.9	47.0	63.0	118	19940626	8	19901223	65.3	96
VALLE AIRPORT	1948-1959	67.1	32.3	49.7	100	19540624	-22	19490104	49.1	51
WAHWEAP	1961-2000	72.9	47.6	60.2	120	19970716	-2	19890110	61.9	96
WALLACE RANGER STN	1916-1959	63.1	32.8	48.0	96	19530625	-22	19490104	50.0	54
WALNUT CREEK	1915-2000	70.7	34.2	52.4	114	19690701	-21	19681222	55.4	100
WELLTON	1922-1980	87.3	53.2	70.2	121	19430725	14	19370124	72.5	40
WHITERIVER 1 SW	1900-2000	71.6	38.0	54.8	106	19480715	-13	19190102	57.8	43
WICKENBURG	1908-2000	83.5	47.4	65.4	121	19950728	10	19451220	68.9	100
WIKIEUP	1948-2000	83.8	48.2	66.0	119	19950728	14	19901222	67.8	96
WILLCOX	1898-2000	77.2	41.3	59.3	110	19050706	-7	19781208	62.7	96
WILLIAMS	1897-2000	63.7	34.5	49.1	102	19090701	-25	19370122	52.6	50
WILLOW BEACH	1967-2000	86.6	58.3	72.4	125	19720713	21	19901223	75.7	96
WILLOW SPRINGS RANCH	1949-1978	77.1	47.5	62.3	112	19550609	8	19681222	64.1	54
[illegible]DOW ROCK 4 SW	1937-1999	64.0	32.4	48.2	99	19570702	-29	19630113	51.7	89
[illegible]KELMAN 6 S	1942-1980	84.3	46.0	65.1	119	19700625	9	19531224	66.8	54
WINSLOW WSO AP	1898-2000	70.6	39.4	55.0	109	19710713	-20	18981111	57.4	58
[redacted]	1923-1966	84.1	54.0	69.1	117	19420707	12	19630113	72.1	34

WUPATKI NATL MONUMENT	1948-2000	71.8	43.8	57.8	108	19710713	-18	19681221	60.1	96
YOUNG	1903-1964	75.9	35.3	55.6	108	19050728	-9	19620228	58.8	5
YOUNGTOWN	1964-2000	86.5	56.6	71.6	122	19900626	20	19700103	74.6	96
YUCCA	1950-2000	80.8	53.9	67.3	120	19950728	4	19710107	71.3	96
YUMA CITRUS STATION	1920-2000	87.4	55.6	71.5	124	19950729	19	19370122	74.5	34
YUMA DATE ORCHARD	1905-1929	86.4	51.0	68.7	117	19100530	14	19111226	70.4	24
YUMA PROVING GROUND	1958-2000	87.3	60.4	73.9	124	19950728	23	19710108	76.2	96
YUMA QUARTERMASTER DEP	1993-2000	89.6	60.3	74.9	125	19950728	18	20001227	75.6	93
YUMA VALLEY	1930-1992	87.4	54.0	70.7	119	19850629	14	19370123	72.4	86
YUMA WSO AP	1948-1996	88.2	60.6	74.4	124	19950728	24	19710108	76.8	81
YUMA WB CITY	1893-1974	86.8	57.6	72.2	120	19100530	22	19111226	75.0	34

Table 2-2d.—Runoff curve numbers for arid and semiarid rangelands[1]

Cover description		Curve numbers for hydrologic soil group—			
Cover type	Hydrologic condition[2]	A[3]	B	C	D
Herbaceous—mixture of grass, weeds, and low-growing brush, with brush the minor element.	Poor		80	87	93
	Fair		71	81	89
	Good		62	74	85
Oak-aspen—mountain brush mixture of oak brush, aspen, mountain mahogany, bitter brush, maple, and other brush.	Poor		66	74	79
	Fair		48	57	63
	Good		30	41	48
Pinyon-juniper—pinyon, juniper, or both; grass understory.	Poor		75	85	89
	Fair		58	73	80
	Good		41	61	71
Sagebrush with grass understory.	Poor		67	80	85
	Fair		51	63	70
	Good		35	47	55
Desert shrub—major plants include saltbush, greasewood, creosotebush, blackbrush, bursage, palo verde, mesquite, and cactus.	Poor	63	77	85	88
	Fair	55	72	81	86
	Good	49	68	79	84

[1]Average runoff condition, and $I_a = 0.2S$. For range in humid regions, use table 2-2c.

[2]*Poor:* <30% ground cover (litter, grass, and brush overstory).
Fair: 30 to 70% ground cover.
Good: >70% ground cover.

[3]Curve numbers for group A have been developed only for desert shrub.

APPENDIX H. 6-HR PMF FUTURE CONDITIONS HEC-1 OUTPUT

Appendix H-Addendum
6-hour PMF Future Conditions

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 ****************************************                                    ****************************************
*                                        *                                  *                                        *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)    *                                  *    U.S. ARMY CORPS OF ENGINEERS        *
*              JUN   1998                *                                  *   HYDROLOGIC ENGINEERING CENTER        *
*            VERSION 4.1                 *                                  *         609 SECOND STREET              *
*                                        *                                  *       DAVIS, CALIFORNIA 95616          *
*  RUN DATE   02JUL08  TIME  15:18:23    *                                  *           (916) 756-1104               *
*                                        *                                  *                                        *
****************************************                                    ****************************************

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

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

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

1                                          HEC-1 INPUT                                                    PAGE  1

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

        1           ID
        2           ID   ******************************************************************************
        3           ID   **                                                                          **
        4           ID   **                     McMICKEN DAM HYDROLOGY MODEL                         **
        5           ID   **                                                                          **
        6           ID   ******************************************************************************
        7           ID   ******************************************************************************
        8           ID   PROJECT:                WITTMANN ADMS Update
        9           ID   CLIENT:                 Flood Control District of Maricopa County
       10           ID   PREPARED BY:            Entellus, Inc.
       11           ID   PROJECT No:             FCD 2002C029              Entellus 310.032
       12           ID   FILE NAME: 6-pmf.hc1                     CREATED DATE: Sept 3, 2003
       13           ID                                           MODIFIED DATE: July 2, 2008
       14           ID   STORM:                  6-hour PMF
       15           ID   DEVELOPMENT CONDITIONS: Future Conditions
       16           ID
       17           ID
       18           ID   Changes made to Model:
       19           ID                                -Basin WT130 was adjusted to reflect improvements at
       20           ID                                  southwest portion of the dam.
       21           ID                                -Basins PD790 and PD780 were combined to form PD780.
       22           ID                                -Basins PI640 and PI620 were combined to form PI640.
       23           ID                                -Basins PD720 and PD710 were combined to form PD710.
       24           ID                                -Changed the following concentration point names:
       25           ID                                          CP 400 changed to 400*
       26           ID                                          CP 510 changed to 510*
       27           ID                                          CP 500 changed to 500.3
       28           ID                                          CP 600 changed to 600*
       29           ID                                          CP 710 changed to 710*
       30           ID                                          CP 700 changed to 700*
       31           ID                                -Added concentration points 400, 510, 500.1, 500.2,
       32           ID                                  600, 710 and 700.
       33           ID                                -Adjusted CAP culvert system (structures CAP060-CAP190)
       34           ID                                  to account for the overtopping of the CAP Canal
       35           ID                                -Adjusted Time of COncentrations and routes for basins
       36           ID                                  along McMicken Dam channel.
       37           ID                        -Changed Typical Cross Sections for Routes
       38           ID                                -Corrected S-Graphs for WI500, WI510, WT100, WT120,
       39           ID                                  WT130 and SV200
       40           ID                                04-26-2004
       41           ID                                -Increased number of ordinates, added CP and
       42           ID                                  rearranged combines in White Tanks area.
       43           ID
       44           ID   Changes made to Model on July 2, 2008:
       45           ID                                -Corrected rainfall hydrograph per usage of correct
       46           ID                                 Average 6/1-hr ratio for drainage in the HMR49 report
       47           ID                                 method. Average 6/1-hr ratio was changed from 1.24 to
       48           ID                                 1.32 per figure 4.7 of HMR49. The average
       49           ID                        precipitation JD card was also changed as a result,
       50           ID                        from 6.04 to 6.43.
       51           ID
       52           ID
                    * JD cards were utilized in order to keep track of the associated areas with
                    * the diversion at the CAP Canal. When  PB cards are used HEC-1 does not track
                    * the associated area that is being specified on the HC card.  The end flow
                    * results are identical when using either the PB or JD cards, so JD cards
                    * were chosen for the benefit of tracking the associated area.
```

```
                    *DIAGRAM
1                                          HEC-1 INPUT                                                    PAGE  2

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

        53          IT      15  1JAN94       0    1500
        54          IO       3
        55          IN      15  1JAN94       0
        56          JD    6.43     0.1
                    *
                    * The average precipitation below changed as a result of using 1.32 as the
                    * Average 6/1-hour ratio for drainage from figure 4.7 in the HMR49 report.
                    * The average precipitation is shown above in the JD card.
                    *
                    * JD  6.04     0.1
        57          PC    0.00  0.0155  0.0327  0.0482  0.0635  0.0824  0.1011  0.1197  0.1377  0.1773
        58          PC  0.2177  0.2566  0.2952  0.5154  0.6437  0.7221  0.8003  0.8335  0.8661  0.8972
        59          PC  0.9299  0.9470  0.9656  0.9827  1.0000
                    *
                    * Rainfall distribution below was calculated using HMR49 report Figure 4.7 value
                    * of 1.24, and was corrected and changed to 1.30, generating the correct
                    * distribution above.
                    *
                    * PC  0.00  0.0083  0.0248  0.0397  0.0584  0.0745  0.0910  0.1076  0.1283
                    *   0.1490
                    * PC0.1738  0.2152  0.2763  0.5179  0.6523  0.7339  0.8140  0.8607  0.8937
                    *   0.9187
                    * PC0.9398  0.9601  0.9766  0.9899  1.0000
                    *
        60          IN      15  1JAN94
        61          JD    6.43     0.1
                    *
                    * The average precipitation below changed as a result of using 1.32 as the
                    * Average 6/1-hour ratio for drainage from figure 4.7 in the HMR49 report.
                    * The average precipitation is shown above in the JD card.
                    *
                    * JD  6.04     0.1
        62          PC    0.00  0.0155  0.0327  0.0482  0.0635  0.0824  0.1011  0.1197  0.1377  0.1773
        63          PC  0.2177  0.2566  0.2952  0.5154  0.6437  0.7221  0.8003  0.8335  0.8661  0.8972
        64          PC  0.9299  0.9470  0.9656  0.9827  1.0000
                    *
                    * Rainfall distribution below was calculated using HMR49 report Figure 4.7 value
                    * of 1.24, and was corrected and changed to 1.32, generating the correct
                    * distribution above.
                    *
                    * PC  0.00  0.0083  0.0248  0.0397  0.0584  0.0745  0.0910  0.1076  0.1283
                    *   0.1490
                    * PC0.1738  0.2152  0.2763  0.5179  0.6523  0.7339  0.8140  0.8607  0.8937
                    *   0.9187
                    * PC0.9398  0.9601  0.9766  0.9899  1.0000
                                     *
```

RUNOFF SUMMARY

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

	OPERATION	STATION	PEAK FLOW	TIME OF PEAK	AVERAGE FLOW FOR MAXIMUM PERIOD 6-HOUR	24-HOUR	72-HOUR	BASIN AREA	MAXIMUM STAGE
TIME OF MAX STAGE +									
+	HYDROGRAPH AT	PI680	17970.	4.75	7981.	2131.	710.	16.89	
+	ROUTED TO	680640	10279.	8.75	7580.	2131.	710.	16.89	
+	HYDROGRAPH AT	PI640	27091.	4.50	9179.	2324.	775.	17.56	
+	2 COMBINED AT	640	27601.	4.50	14160.	4454.	1485.	34.45	
+	HYDROGRAPH AT	WI540	17556.	4.50	6172.	1574.	525.	11.64	
+	HYDROGRAPH AT	PD780	29425.	4.50	9042.	2291.	764.	19.17	
+	ROUTED TO	780760	21937.	5.25	8921.	2291.	764.	19.17	
+	HYDROGRAPH AT	PD760	6162.	3.75	1002.	251.	84.	2.72	
+	HYDROGRAPH AT	PD745	4883.	3.75	842.	211.	70.	1.98	
+	5 COMBINED AT	CAP	62788.	4.75	30177.	8781.	2927.	69.96	
+	ROUTED TO	STOR	64803.	5.00	22832.	8766.	2927.	69.96	
+	DIVERSION TO	CAP2	47308.	5.00	17315.	6929.	2314.	69.96	
+	HYDROGRAPH AT	CAP1	17495.	5.00	5517.	1837.	613.	69.96	
+	ROUTED TO	640505	7578.	7.00	5257.	1830.	613.	69.96	
+	HYDROGRAPH AT	WI505	9682.	4.50	2939.	745.	248.	6.67	
+	2 COMBINED AT	505	9971.	4.50	7271.	2568.	861.	25.56	
+	ROUTED TO	505500	8215.	7.00	7023.	2565.	861.	25.56	
+	HYDROGRAPH AT	WT140	4726.	4.25	1575.	404.	135.	3.80	
+	ROUTED TO	140130	4188.	5.00	1565.	404.	135.	3.80	
+	HYDROGRAPH AT	WT130	3726.	4.25	1063.	268.	89.	2.54	

	2 COMBINED AT							
+		130	6911.	4.75	2608.	672.	224.	6.34
	ROUTED TO							
+		130120	6663.	4.75	2606.	672.	224.	6.34
	HYDROGRAPH AT							
+		WT150	6571.	4.50	2392.	620.	207.	5.85
	ROUTED TO							
+		150120	5854.	5.00	2373.	620.	207.	5.85
	HYDROGRAPH AT							
+		WT160	1335.	4.00	346.	87.	29.	.82
	ROUTED TO							
+		160120	903.	5.00	340.	87.	29.	.82
	HYDROGRAPH AT							
+		WT120	5827.	3.75	1162.	291.	97.	2.82
	3 COMBINED AT							
+		120	7701.	5.00	3819.	999.	333.	9.48
	2 COMBINED AT							
+		120*	14310.	5.00	6425.	1671.	557.	15.82
	ROUTED TO							
+		120110	11511.	5.50	6227.	1671.	557.	15.82
	HYDROGRAPH AT							
+		WT110	5828.	3.75	1188.	298.	99.	2.90
	2 COMBINED AT							
		110	12196.	5.50	7289.	1968.	656.	18.71
	ROUTED TO							
+		110100	11944.	5.50	7264.	1968.	656.	18.71
	HYDROGRAPH AT							
+		WT100	6050.	4.25	1662.	419.	140.	3.84
	2 COMBINED AT							
+		100	15267.	4.25	8798.	2388.	796.	22.56
	ROUTED TO							
+		100400	13605.	5.75	8618.	2388.	796.	22.56
	HYDROGRAPH AT							
+		IW350	8796.	4.00	1975.	497.	166.	4.21
	ROUTED TO							
+		350310	3830.	8.00	1746.	496.	166.	4.21
	HYDROGRAPH AT							
+		IW310	30694.	5.25	13353.	3413.	1138.	25.81
	2 COMBINED AT							
+		310	30694.	5.25	14270.	3906.	1303.	30.02
	ROUTED TO							
+		CAP020	30901.	5.25	13893.	3899.	1301.	30.02
	ROUTED TO							
+		310200	22939.	6.75	13017.	3889.	1301.	30.02
	HYDROGRAPH AT							
+		SV220	26457.	4.50	9272.	2358.	786.	16.95
	ROUTED TO							
		CAP010	26024.	4.75	8889.	2352.	784.	16.95

	ROUTED TO							
+		220200	13379.	7.00	8131.	2352.	784.	16.95
	HYDROGRAPH AT							
+		TW480	13979.	4.75	6160.	1637.	546.	12.72
	ROUTED TO							
+		480460	12301.	5.50	6088.	1637.	546.	12.72
	HYDROGRAPH AT							
+		TW460	4925.	4.00	1031.	258.	86.	2.44
	2 COMBINED AT							
+		460	12985.	5.50	7007.	1895.	632.	15.16
	ROUTED TO							
+		460420	7286.	8.00	6373.	1893.	632.	15.16
	HYDROGRAPH AT							
+		TW420	14369.	4.75	4871.	1233.	411.	10.89
	2 COMBINED AT							
+		420	14373.	4.75	8759.	3122.	1043.	26.06
	ROUTED TO							
+		CAP030	14509.	4.75	8753.	3122.	1043.	26.06
	ROUTED TO							
+		420200	9891.	7.25	8114.	3116.	1043.	26.06
	HYDROGRAPH AT							
+		SV200	30898.	5.25	14104.	3691.	1230.	31.33
	4 COMBINED AT							
		200	60806.	6.75	39635.	13028.	4358.	104.36
	ROUTED TO							
+		200400	58276.	7.25	39014.	13005.	4358.	104.36
	HYDROGRAPH AT							
+		TW400	18320.	4.75	6715.	1717.	572.	12.99
	2 COMBINED AT							
+		400	60032.	7.25	42366.	14696.	4930.	117.35
	2 COMBINED AT							
+		400*	71027.	7.00	50919.	17084.	5726.	139.91
	ROUTED TO							
+		400510	70864.	7.25	50813.	17083.	5726.	139.91
	HYDROGRAPH AT							
+		WI580	37516.	5.00	14762.	3747.	1249.	30.35
	ROUTED TO							
+		CAP040	36877.	5.00	14124.	3721.	1240.	30.35
	ROUTED TO							
+		580510	28228.	7.50	13215.	3720.	1240.	30.35
	HYDROGRAPH AT							
+		WI510	12180.	5.00	5078.	1310.	437.	9.31
	2 COMBINED AT							
+		510	30018.	7.25	16114.	5021.	1677.	39.66
	2 COMBINED AT							
+		510*	100882.	7.25	66795.	22102.	7403.	179.56
	ROUTED TO							

	510500	97137.	7.75	65928.	22095.	7403.	179.56
+ HYDROGRAPH AT	WI520	21703.	4.75	7833.	1996.	665.	16.39
+ ROUTED TO	520500	11531.	7.25	7216.	1995.	665.	16.39
+ HYDROGRAPH AT	CAP2	47308.	5.00	17315.	6929.	2314.	69.96
+ DIVERSION TO	CAP3	34488.	5.00	13374.	5662.	1892.	69.96
+ HYDROGRAPH AT	CAP2	12820.	5.00	3941.	1267.	423.	69.96
+ ROUTED TO	540500	6442.	7.75	3705.	1262.	423.	69.96
+ HYDROGRAPH AT	WI500	12371.	4.75	4456.	1138.	379.	9.16
+ 3 COMBINED AT	500.1	19240.	7.00	13914.	4385.	1467.	39.54
+ 2 COMBINED AT	500.2	115017.	7.50	79073.	26475.	8870.	219.11
+ ROUTED TO	500500	114905.	7.75	78923.	26475.	8870.	219.11
+ 2 COMBINED AT	500.3	122530.	7.75	85790.	29039.	9732.	244.67
ROUTED TO	500600	116437.	8.50	83877.	29017.	9732.	244.67
+ HYDROGRAPH AT	PI600	16973.	4.50	5135.	1301.	434.	12.03
+ HYDROGRAPH AT	CAP3	34488.	5.00	13374.	5662.	1892.	69.96
+ DIVERSION TO	CAP4	16011.	5.00	7012.	3341.	1117.	69.96
+ HYDROGRAPH AT	CAP3	18477.	5.00	6362.	2321.	774.	69.96
+ ROUTED TO	640600	7280.	8.00	6170.	2314.	774.	69.96
+ 2 COMBINED AT	600	17018.	4.50	8932.	3598.	1208.	32.32
+ 2 COMBINED AT	600*	123142.	8.50	90517.	32581.	10940.	276.99
+ ROUTED TO	600710	122229.	8.75	90210.	32577.	10940.	276.99
+ HYDROGRAPH AT	CAP4	16011.	5.00	7012.	3341.	1117.	69.96
+ ROUTED TO	760710	10321.	7.50	6823.	3331.	1117.	69.96
+ HYDROGRAPH AT	PD710	8566.	4.50	2558.	644.	215.	6.72

	HYDROGRAPH AT							
+		PD740	2330.	3.50	358.	90.	30.	.87
	ROUTED TO							
+		CAP200	466.	4.50	346.	90.	30.	.87
	ROUTED TO							
+		740710	445.	7.25	322.	90.	30.	.87
	3 COMBINED AT							
+		710	10928.	7.50	8255.	4048.	1362.	24.38
	2 COMBINED AT							
+		710*	130227.	8.75	97529.	36624.	12302.	301.37
	ROUTED TO							
+		710700	127906.	9.00	96796.	36607.	12302.	301.37
	HYDROGRAPH AT							
+		PD730	1043.	3.75	224.	57.	19.	.48
	ROUTED TO							
+		CAP220	550.	4.25	224.	57.	19.	.48
	HYDROGRAPH AT							
+		PD735	5310.	4.00	1443.	365.	122.	3.23
	ROUTED TO							
+		CAP210	3498.	4.50	1442.	366.	122.	3.23
	2 COMBINED AT							
+		736	4046.	4.50	1667.	422.	141.	3.71
	ROUTED TO							
		735700	3852.	5.75	1618.	422.	141.	3.71
	HYDROGRAPH AT							
+		PD700	12416.	4.25	3124.	786.	262.	7.26
	2 COMBINED AT							
+		700	12837.	4.25	4604.	1208.	403.	10.97
	2 COMBINED AT							
+		700*	128455.	9.00	97516.	37781.	12705.	312.34

*** NORMAL END OF HEC-1 ***

APPENDIX I. 72-HOUR PMF FUTURE CONDITIONS HEC-1 OUTPUT

```
1****************************************                    ****************************************
*                                      *                    *                                      *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)  *                    *   U.S. ARMY CORPS OF ENGINEERS       *
*             JUN  1998                *                    *   HYDROLOGIC ENGINEERING CENTER      *
*          VERSION 4.1                 *                    *         609 SECOND STREET            *
*                                      *                    *      DAVIS, CALIFORNIA 95616         *
*  RUN DATE   26APR04  TIME  08:14:21  *                    *          (916) 756-1104              *
*                                      *                    *                                      *
****************************************                    ****************************************

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

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

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

1                                                    HEC-1 INPUT
PAGE  1

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

         1          ID
         2          ID   ******************************************************************************
         3          ID   **                                                                          **
         4          ID   **                    McMICKEN DAM HYDROLOGY MODEL                          **
         5          ID   **                                                                          **
         6          ID   ******************************************************************************
         7          ID   ******************************************************************************
         8          ID   PROJECT:                 WITTMANN ADMS Update
         9          ID   CLIENT:                  Flood Control District of Maricopa County
        10          ID   PREPARED BY:             Entellus, Inc.
        11          ID   PROJECT No:              FCD 2002C029              Entellus 310.032
        12          ID   FILE NAME: 72-pmf.hc1                     CREATED DATE: Sept 3, 2003
        13          ID                                            MODIFIED DATE: Apr 26, 2004
        14          ID   STORM:                   72-hour PMF
        15          ID   DEVELOPMENT CONDITIONS: Future Conditions
        16          ID
        17          ID
        18          ID   Changes made to Model:
        19          ID                        -Basin WT130 was adjusted to reflect improvements at
        20          ID                          southwest portion of the dam.
        21          ID                        -Basins PD790 and PD780 were combined to form PD780.
        22          ID                        -Basins PI640 and PI620 were combined to form PI640.
        23          ID                        -Basins PD720 and PD710 were combined to form PD710.
        24          ID                        -Changed the following concentration point names:
        25          ID                               CP 400 changed to 400*
        26          ID                               CP 510 changed to 510*
        27          ID                               CP 500 changed to 500.3
        28          ID                               CP 600 changed to 600*
        29          ID                               CP 710 changed to 710*
        30          ID                               CP 700 changed to 700*
        31          ID                        -Added concentration points 400, 510, 500.1, 500.2,
        32          ID                          600, 710 and 700.
        33          ID                        -Adjusted CAP culvert system (structures CAP060-CAP190)
        34          ID                          to account for the overtopping of the CAP Canal
        35          ID                        -Adjusted Time of COncentrations and routes for basins
        36          ID                          along McMicken Dam channel.
        37          ID                        -Changed Typical Cross Sections for Routes
```

```
 38          ID                          -Corrected S-Graphs for WI500, WI510, WT100, WT120,
 39          ID                            WT130 and SV200
 40          ID                          04-26-2004
 41          ID                          -Increased number of ordinates, added CP and
 42          ID                            rearranged combines in White Tanks area.
 43          ID
 44          ID
 45          ID
             * JD cards were utilized in order to keep track of the associated areas with
             * the diversion at the CAP Canal. When  PB cards are used HEC-1 does not track
             * the associated area that is being specified on the HC card.  The end flow
             * results are identical when using either the PB or JD cards, so JD cards
             * were chosen for the benefit of tracking the associated area.
             *DIAGRAM
 46          IT      15  1JAN94       0    1500
 47          IO       3
 48          IN     360  1JAN94
 49          JD   15.70    0.01
1                                          HEC-1 INPUT
PAGE  2

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

 50          PI     1.1     2.3     7.2     1.3     .65     .65     .65     .65     .30     .30
 51          PI     .30     .30
             *
 52          IN     360  1JAN94
 53          JD   15.70   500.0
 54          PI     1.1     2.3     7.2     1.3     .65     .65     .65     .65     .30     .30
 55          PI     .30     .30
             *
             *
             *
             *
             * *** Basin PI680: mountainous basin located in North of watershed: CP=680
             * *** CP 680 is located at approximately Honda Bow Road and 187th Ave alignments

 56          KK   PI680
 57          KO       0       0     0.0       1      21
 58          BA  16.887
 59          LG   0.255    0.25   5.858   0.211  33.728
             * PI680-PMP-MOUNTAIN
 60          UI     0.0  589.32 1168.05 2748.95 3955.65 4970.17 6458.82  4068.1 3360.09 2884.96
 61          UI  2441.4 2005.61  1554.0 1371.27 1136.06  868.41  720.11  645.44  460.49  447.63
 62          UI  288.39  288.39  287.94  112.95  112.95  112.95  112.95  112.95  112.95  112.95
 63          UI     0.0
             *
             *
             * *** Route 680640: from CP 680 to CP 640 at the CAP.
             * *** Mountainous wash.  This is Picacho Wash.
             * *** CP 640 is located at approximately 187th ave alignment and the CAP Canal.

 64          KK  680640
 65          KO       1       0     0.0       0      21
 66          RS       8    FLOW
 67          RC    0.05   0.064    0.05 45524.0   0.014     0.0
             *
             * This X-section was modified to compensate for instabilities in the Hydrograph
             * RY Ordinate number 4 was decreased from 5.8 to 5.
             * Medium Wash (Modified)
 68          RX       0    1000    2500    3846    4110    4160    4300    7000
 69          RY      10       8       6       5       0       0       6      10
             *
             *
             * *** Basin PI640: basin with some urban areas located in east-central part
             * *** of watershed: CP=640.

 70          KK   PI640
 71          KO       0       0     0.0       1      21
 72          BA  17.562
 73          LG   0.269    0.15   7.212    0.12  18.003
```

```
                 * PI640 PMP-Valley
  74             UI     0.0  884.93 3493.48 5277.69 7913.27 10081.2 6951.65 4845.05 2677.24 1452.37
  75             UI  860.77  271.38  271.38  271.38     0.0
                 *
                 *
                 * *** Combine 640 *** Combines PI640 and 680640 at CP 640
1                                              HEC-1 INPUT
PAGE  3

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


  76             KK     640
  77             KO       0       0     0.0       0      21
  78             HC       2
                 *
                 *
                 * *** Basin WI540: basin with some urban areas located in east-central part
                 * *** of watershed: CP=540.
                 * *** CP 540 is located at approximately 195th ave alignment and the CAP Canal.

  79             KK   WI540
  80             KO       0       0     0.0       1      21
  81             BA  11.640
  82             LG   0.221    0.25   5.888   0.196  44.540
                 * WI540-PMP-VALLEY
  83             UI     0.0  575.53 2218.69 3375.56 4949.98 6691.87 4681.87 3294.91 1976.68  979.81
  84             UI   615.2  236.92  176.49  176.49     0.0
                 *
                 *
                 * *** Basin PD780: valley basin located in east part of watershed: CP=780.
                 * *** CP 780 is located at approximately 163rd ave & carefree highway alignments

  85             KK   PD780
  86             KO       0       0     0.0       1      21
  87             BA  19.169
  88             LG   0.226    0.25   5.252   0.286  33.957
                 * PD780 PMP-Valley
  89             UI     0.0  1373.0 4908.42 7449.0412399.31 9825.09 6530.97 3524.55 1712.73  873.57
  90             UI  339.28  339.28     0.0
                 *
                 *
                 * *** Route 780760: from CP 780 to CP 760 at the CAP.Mountainous wash.
                 * *** CP 760 is located at approximately 163rd ave alignment and the CAP canal.
                 *
                 * This route was adjusted to account for instabilities in the Hydrograph.
                 * RY Ordinate #4 was changed from 5.8 to 4.7.

  91             KK  780760
  92             KO       0       0     0.0       0      21
  93             RS       2    FLOW
  94             RC    0.05   0.064    0.05   12100   0.010     0.0
                 * Medium Wash (Modified)
  95             RX       0    1000    2500    3846    4110    4160    4300    7000
  96             RY      10       8       6     4.7       0       0       6      10
                 *
                 *
                 * *** Basin PD760: Slightly urban basin located in east part of watershed: CP=76

  97             KK   PD760
  98             KO       0       0     0.0       1      21
  99             BA  2.7248
 100             LG   0.286   0.250   4.330   0.420  14.434
                 * PD760-PMP-VALLEY
 101             UI     0.0 1574.28 3929.87 1288.93  198.81     0.0
                 *
                 *
                 *
                 * *** Basin PD745: foothills basin located in east part of watershed: CP=745.
                 * *** CP 745 is located at approximately 155th ave alignment and the CAP canal.
```

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


 102          KK   PD745
 103          KO       0       0     0.0       1      21
 104          BA  1.9822
 105          LG   0.265    0.25   5.011   0.301  19.085
              * PD745-PMP-VALLEY
 106          UI     0.0 1322.45 2948.58  741.22   103.0
              *
              *
              *
              * *** Combine CAP *** Combines 640*, WI540, 780760, PD760 and PD745 at CP CAP

 107          KK     CAP
 108          KO       0       0     0.0       0      21
 109          HC       5
              *
              *
              * *** Storage STOR at CAP canal

 110          KK    STOR
 111          KO       0       0     0.0       1      21
 112          RS       1    STOR       0
 113          SQ       0     698    2229    5188    6380    7215    7985   91005  242535
 114          SE    1540    1544    1546    1550    1552    1554    1556    1557    1558
 115          SA     4.4    60.5   130.7   348.8     486   625.3   763.8   763.9     764
 116          SE    1540    1544    1546    1550    1552    1554    1556    1557    1558
              *
              *
              * The flow from STOR is distributed to ROUTES 640505, 540500, 640600 & 760710.
              * The breakdown of where the flow is distributed to is shown below, with the SQ
              * card being the summation of the flows at any given elevation.
              *
              * ******************************************************************* *ROUTES*
              *     0 *    81 *   238 *   775 *  1000 *  1145 *  1278 * 24974 * 68216 *640505*
              *     0 *    34 *   120 *   476 *   625 *   745 *   799 * 18363 * 50378 *540500*
              *     0 *   113 *   346 *  1217 *  1595 *  1885 *  2076 * 26040 * 69638 *640600*
              *     0 *   470 *  1525 *  2720 *  3160 *  3440 *  3832 * 21628 * 54303 *760710*
              * ---------------------------------------------------------------------------*
              * SQ  0 *   698 *  2229 *  5188 *  6380 *  7215 *  8165 * 91005 *242535        *
              *                                                                            *
              * ****************************************************************************
              *
              * The flows were calculated based upon the capacities of the overchutes or
              * culverts.  Once the culvert capacities (inlet controled) were calculated up
              * to the berm elevation (1556), a combined culvert inlet control and weir
              * equation were utilized to calculate the flows (1557 & 1558).  2.7 was used for
              * the weir coefficient and the weir length was the basin boundary where
              * overtopping would occur.
              *
              *
              * *** Diversion: CAP2.  Mainflow to 640505, diverted flow to 540500.
              * *** CAP ******************************************************
              * This Diversion is for the Impoundment Area upstream of the CAP.
              *
              *
              * DDM   ***** Preserved *****
1                                   HEC-1 INPUT
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LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


 117          KK    CAP1
 118          DT    CAP2
              * This diversion was calculated on the capacities of the overchutes.
              * The overchutes that contribute to route 640505 are CAP 80 to 100.
```

```
                 * The capacities of the culverts in this system can be found in the appendix.
119              DI       0     698    2229    5188    6380    7215    7985   91005  242535
120              DQ       0     617    1991    4413    5380    6070    6707   66031  174319
                 *
                 *
                 * *** Route 640505: from CP 640 to CP 505. Valley wash.
                 * *** CP 505 is located at approximately Happy Valley rd. & 171st ave alignment

121              KK  640505
                 *
                 * This Route is from the CAP to concentration point 505.
                 *
                 * This X-section was modified to compensate for instabilities in the Hydrograph
                 * RY Ordinate number 4 was decreased from 5.8 to 4.5.
122              KO       0       0     0.0       0      21
123              RS       2    FLOW
124              RC    0.08   0.046    0.08 25169.0   0.009     0.0
                 * medium wash (Modified)
125              RX       0    1000    2500    3846    4110    4160    4300    7000
126              RY      10       8       6     4.5       0       0       6      10
                 *
                 *
                 * *** Basin WI505: slightly urban basin located in central part of
                 * *** watershed: CP=505.

127              KK   WI505
128              KO       0       0     0.0       1      21
129              BA  6.6716
130              LG    0.26    0.25   4.645    0.37  31.474
                 * WI505 PMP-Valley
131              UI     0.0  409.53 1548.62 2332.24 3821.43 3600.74 2443.55 1544.13  684.62  422.16
132              UI  160.43   111.7   111.7     0.0
                 *
                 * ******************************************************************************
                 * ******************************************************************************
                 * Concentration point 505 was hard coded to account for the diverted flow above.
                 * The area was calculated based upon the peak stage as calculated through HEC-1.
                 * The peak stage was taken for this culvert system (structures CAP060 to CAP190)
                 * and the percentage of flow diverted to each concentration point was calculated
                 * as shown in appendix B.5.  The calculations show that the concentration points
                 * should receive following distribution of area.                                *
                 *                                                                               *
                 * concentration     percentage     area                                        *
                 *    point             area       (sq mi)                                      *
                 * ----------------------------------------                                      *
                 *     505               27%       18.890                                       *
                 *     500               20%       13.993                                       *
                 *     600               29%       20.290                                       *
                 *     710               24%       16.792                                       *
                 * ----------------------------------------                                      *
                 *  SUM OF ALL          100%       69.965                                       *
                 * ******************************************************************************
                 * ******************************************************************************
                 *
                 * *** Combine 505 *** Combines 640505 & WI505 at CP 505.
```



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


133              KK     505
134              KO       0       0     0.0       0      21
135              HC       2 25.5616
                 *        25.5616 =
                 *                + 18.8900 (640505-diversion)
                 *                +  6.6716 (WI505)
                 *
                 * *** Route 505500: from CP 505 to CP 500.3 @ McMicken Dam Spillway. Valley wash
                 * *** CP 500.3 is located at the McMicken Dam Spillway.
                 *
```

```
                * This X-section was modified to compensate for instabilities in the Hydrograph
                * RY Ordinate number 4 was decreased from 5.8 to 4.5.

136             KK  505500
137             KO       0       0     0.0       0      21
138             RS       1    FLOW
139             RC    0.08   0.046    0.08  5161.0   0.004     0.0
                * Medium Wash (Modified)
140             RX       0    1000    2500    3846    4110    4160    4300    7000
141             RY      10       8       6     4.5       0       0       6      10
                *
                *
                *
                *
                *
                * *** Basin WT140: Mountain basin located in south portion of watershed: CP=140.
                * *** CP 140 is located north of the Cactus Rd and 211th Ave aligments.

142             KK   WT140
143             KO       0       0     0.0       1      21
144             BA  3.7989
145             LG     0.2    0.25   4.093   0.385  24.444
                * WT140-PMP-MOUNTAIN
146             UI     0.0  238.09  919.23 1568.46 2106.68 1276.78  991.54  746.08  521.68  406.74
147             UI  275.59  211.66  157.91  103.12   93.06   40.39   40.39   40.39   40.39     0.0
                *
                *
                *
                * *** Route 140130: from CP 140 to CP 130 at the McMicken Dam. Mountainous wash.
                * *** CP 130 is located @ McMicken Dam north of Peoria and 195th Ave alignments.

148             KK  140130
149             KO       0       0     0.0       0      21
150             RS       3    FLOW
151             RC    0.05   0.064    0.05   14043   0.018     0.0
                * Small Wash
152             RX       0    1300    1380    1560    1600    1640    1660    1710
153             RY      11     7.2     5.2     3.3       0     3.2     7.2    13.2
                *
                *
                * *** Basin WT130: Combination basin of Mountain and Foothills.
                * *** This basin is located in south portion of watershed: CP=130.
1                                                HEC-1 INPUT
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LINE            ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


154             KK   WT130
155             KO       0       0     0.0       1      21
156             BA  2.5413
157             LG   0.219    0.25   4.731   0.299  15.926
                * THIS S-GRAPH WAS CALCULATED MANUALLY (SEE APPENDIX) *
                * Combined S-Graph for Basin WT130 PMP: Phoenix Valley:51%, Phoenix Mountain:49%
                * Basin Area [sq mi] = 2.5413
                * Basin Lag [hr] = 0.81
                * Time Step [min] = 15
                * Qult = 6559.9
                *
158             UI       0   270.6   944.4    1655  1395.9   921.6   583.8   325.6   200.9   116.5
159             UI      51    41.7    41.7       0
                *
                *
                * *** Combine 130 *** Combines 140130 and WT130.

160             KK     130
161             KO       0       0     0.0       0      21
162             HC       2
                *
                *
                * *** Route 130120: from CP130 to CP120 along McMicken Dam. McMicken Dam Channel
```

```
                 * *** CP 120 is located south of Cactus Rd & 195th Ave alignments @ McMicken Dam

163              KK  130120
164              KO       0       0     0.0       0      21
165              RS       1    FLOW
166              RC   0.045   0.035    .045    1225   0.001     0.0
                 * McMicken Dam Channel
167              RX       0      46     101     121     171     181    1421    3621
168              RY      25      14       4       0       0       4      14      25
                 *
                 *
                 *
                 * *** Basin WT150: Mountain basin located in south portion of watershed: CP=150.
                 * *** CP 150 is located north of the Waddell Rd and 211th Ave alignments.

169              KK   WT150
170              KO       0       0     0.0       1      21
171              BA  5.8463
172              LG     0.2    0.25   4.085   0.386  24.216
                 * WT150-PMP-MOUNTAIN
173              UI     0.0  268.25  871.63 1705.52 2371.08 2525.15 1596.96 1303.06 1040.93  768.52
174              UI  621.14   485.3  345.13  290.61  205.66  163.36  131.27  109.76   51.41   51.41
175              UI   51.41   51.41   51.41     0.0
                 *
                 *
                 *
                 *
                 * *** Route 150120: from CP 150 to CP 120 at the CAP. Mountainous wash.
                 * *** CP 120 is located @ McMicken Dam north of Cactus Rd & 187th Ave alignments
1                                          HEC-1 INPUT
PAGE  8

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

176              KK  150120
177              KO       0       0     0.0       0      21
178              RS       3    FLOW
179              RC    0.05   0.064    0.05 14187.0   0.013     0.0
                 * Small Wash
180              RX       0    1300    1380    1560    1600    1640    1660    1710
181              RY      11     7.2     5.2     3.3       0     3.2     7.2    13.2
                 *
                 *
                 * *** Basin WT160: Mountain basin located in south portion of watershed: CP=160
                 * *** CP 160 is located south of Waddell Rd and 211th Ave alignments

182              KK   WT160
183              KO       0       0     0.0       1      21
184              BA  0.8167
185              LG     0.2    0.25   4.395   0.347  22.796
                 * WT160-PMP-MOUNTAIN
186              UI     0.0  215.24  739.46  500.01  292.06  164.81   89.13   50.08    25.7    16.3
187              UI     0.0
                 *
                 *
                 *
                 * *** Route 160120: from CP 160 to CP 120 at McMicken Dam. Mountainous wash.

188              KK  160120
189              KO       0       0     0.0       0      21
190              RS       3    FLOW
191              RC    0.05   0.064    0.05 14018.0   0.015     0.0
                 * Small Wash
192              RX       0    1300    1380    1560    1600    1640    1660    1710
193              RY      11     7.2     5.2     3.3       0     3.2     7.2    13.2
                 *
                 *
                 * *** Basin WT120: Valley basin located in south portion of watershed: CP=120

194              KK   WT120
```

```
195          KO       0       0     0.0       1      21
196          BA  2.8156
197          LG   0.257    0.25   5.264   0.259   8.934
             *
             * Phoenix Valley S-Graph for Basin WT120 PMP
             * Basin Area [sq mi] = 2.8156
             * Basin Lag [hr] = 0.42
             * Time Step [min] = 15
             * Qult = 7268
             *
198          UI       0  1222.7    3587  1932.4   408.6   115.4       0
             *
             *
             *
             * *** Combine 120 *** Combines 150120, 160120 & WT120
1                                          HEC-1 INPUT
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LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

199          KK     120
200          KO       0       0     0.0       0      21
201          HC       3
             *
             *
             * *** Combine 120* *** Combines 120 and 130120

202          KK    120*
203          HC       2
             *
             *
             * *** Route 120110: from CP 120 to CP 110 along McMicken Dam Channel.
             * *** CP 110 is located @ McMicken Dam Channel North of Waddell Rd and 187th Ave

204          KK  120110
205          KO       0       0     0.0       0      21
206          RS       1    FLOW
207          RC   0.045   0.035   0.045   10283   0.001     0.0
             * McMicken Dam Channel
208          RX       0      46     101     121     171     181    1421    3621
209          RY      25      14       4       0       0       4      14      25
             *
             *
             * *** Basin WT110: Foothills basin located in south portion of watershed: CP=110

210          KK   WT110
211          KO       0       0     0.0       1      21
212          BA  2.8956
213          LG   0.258    0.25   4.792   0.301  13.801
             * WT110-PMP-VALLEY
214          UI     0.0 1205.24 3598.48 2085.53  454.53  116.07     0.0
             *
             *
             * *** Combine 110 *** Combines 120* & WT110

215          KK     110
216          KO       0       0     0.0       0      21
217          HC       2
             *
             *
             * *** Route 110100: from CP 110 to CP 100 along McMicken Dam Channel.
             * *** CP 100 is located at McMicken Dam Channel at Greenway Rd and 187th Ave.

218          KK  110100
219          KO       0       0     0.0       0      21
220          RS       1    FLOW
221          RC   0.045   0.035   0.045    2465   0.001     0.0
             * McMicken Dam Channel
222          RX       0      46     101     121     171     181    1421    3621
223          RY      25      14       4       0       0       4      14      25
```

```
                    *
                    *
                    * *** Basin WT100: Combination basin of Foothills and Valley.
                    * *** THis basin is in the south portion of the watershed: CP=100.
1                                                HEC-1 INPUT
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LINE                ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


 224                KK   WT100
 225                KO       0       0     0.0       1      21
 226                BA  3.8448
 227                LG   0.257    0.25   4.571   0.327  24.088
                    * THIS S-GRAPH WAS CALCULATED MANUALLY (SEE APPENDIX) *
                    * Combined S-Graph for Basin WT100: Phoenix Valley:67%, Phoenix Mountain:33%
                    * Basin Area [sq mi] = 3.8448
                    * Basin Lag [hr] = 0.74
                    * Time Step [min] = 15
                    * Qult = 9924.7
                    *
 228                UI       0   511.2  1663.5  2896.6    2132  1301.3   700.6   352.9   184.9    74.6
 229                UI    74.6       0
                    *
                    *
                    *
                    * *** Combine 100 *** Combines 110100 & WT100

 230                KK     100
 231                KO       0       0     0.0       0      21
 232                HC       2
                    *
                    *
                    * *** Route 100400: from CP 100 to CP 400 along McMicken Dam Channel.
                    * *** CP 400 is located @ McMicken Dam Channel @ Union Hills Drive and 187th Ave

 233                KK  100400
 234                KO       0       0     0.0       0      21
 235                RS       4    FLOW
 236                RC   0.045   0.035   0.045   12851   0.001     0.0
                    * McMicken Dam Channel
 237                RX       0      46     101     121     171     181    1421    3621
 238                RY      25      14       4       0       0       4      14      25
                    *
                    *
                    * *** Basin IW350: foothills basin located in NW portion of watershed: CP=350.
                    * *** CP 350 is located North of Circle Mountain Rd and 243rd Ave aligments.

 239                KK   IW350
 240                KO       0       0     0.0       1      21
 241                BA  4.2081
 242                LG   0.234   0.232   6.183   0.192  19.413
                    * IW-350-PMP-VALLEY
 243                UI     0.0 1295.13 4098.21 3711.62 1303.56  310.94     0.0
                    *
                    *
                    * *** Route 350310: from CP 350 to CP310: Mountainous wash. This is Iona Wash.
                    * *** CP 310 is located at CAP North of Happy Valley Rd and west of 227th Ave.
1                                                HEC-1 INPUT
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LINE                ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


 244                KK  350310
 245                KO       0       0     0.0       0      21
 246                RS      23    FLOW
 247                RC    0.05   0.064    0.05 77773.0   0.009     0.0
                    * Medium Wash
 248                RX       0    1000    2500    3846    4110    4160    4300    7000
 249                RY      10       8       6     5.8       0       0       6      10
```

```
                    *
                    *
                    * *** Basin IW310: Less urban basin located west portion of watershed: CP=310

250                 KK   IW310
251                 KO       0       0     0.0       1      21
252                 BA  25.814
253                 LG    0.28   0.150   7.293   0.115  17.002
                    * IW310-PMP-VALLEY
254                 UI     0.0  827.07 1561.73 3458.28 4505.05 5540.51 7151.8310213.45 8408.96 6711.39
255                 UI  5341.9 4228.66 2970.05 1611.81  1366.4   855.8  635.21  253.63  253.63  253.63
256                 UI  253.63     0.0
                    *
                    *
                    * *** Combine 310 *** Combines 350310 & IW310

257                 KK     310
258                 KO       0       0     0.0       0      21
259                 HC       2
                    *
                    *
                    * *** Storage CAP020 *** This storage is located at CP 310 at the CAP Canal.

260                 KK  CAP020
261                 KO       0       0     0.0       0      21
262                 RS       1    STOR       0
                    * CAP 020, R-8 STA 572+50
                    * THE WEIR LENGTH IS 3700 FT WEIR COEF = 2.7
                    * THE WEIR FLOW WAS CALCULATED FOR H=1 FT (1554), H=2 FT (1555) & H=3 FT (1556).
263                 SQ       0       0    94.3   662.1  1502.9  2001.8   11992   30258   53911
264                 SE    1546  1547.3    1548    1550    1552    1553    1554    1555    1556
265                 SA     5.5    13.6    17.9      67    99.2   118.3   118.4   118.5   118.6
266                 SE    1546  1547.3    1548    1550    1552    1553    1554    1555    1556
                    *
                    *
                    * *** Route 310200: from CP 310 to CP 200: Valley wash. This is Iona Wash.
                    * *** CP 200 is located south of Beardsley Rd and 203rd Ave alignments.

267                 KK  310200
268                 KO       0       0     0.0       0      21
269                 RS       3    FLOW
270                 RC    0.08   0.046    0.08 24622.0   0.005     0.0
                    * Large Wash
271                 RX       0     465    1225    1925    2325    2405    4225    6225
272                 RY      10       4       2       0       0       2       8      10
                    *
                    *
                    * *** Basin SV220: Less urban basin located in west portion of watershed: CP=220
                    * *** CP 220 is located @ CAP Canal south of Happy Valley Rd & west of 235th Ave
1                                                HEC-1 INPUT
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LINE                ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


273                 KK   SV220
274                 KO       0       0     0.0       1      21
275                 BA  16.953
276                 LG   0.267   0.150   7.510   0.114  30.822
                    * SV220-PMP-VALLEY
277                 UI     0.0   848.9 3325.41 5035.27 7516.58 9719.81 6747.83  4713.3 2680.66 1429.49
278                 UI   848.9  274.01  260.33  260.33     0.0
                    *
                    *
                    * *** Storage CAP010 *** This storage is located at CP 220 at the CAP Canal.

279                 KK  CAP010
280                 KO                                       21
281                 RS       1    STOR       0
                    * CAP 010, R-8 STA 466+00
                    * THE WEIR LENGTH IS 7900 FT AND THE WEIR COEFF = 2.7
```

```
                 * THE WEIR FLOW WAS CALCULATED FOR H = 1 FT (1547.2) AND H = 2 FT (1548.2)
282              SQ       0       0       0       0       0    68.8   808.3  1962.4  3413.7  5110.5
283              SQ  5291.2   26621   65621
284              SE    1530    1532    1534    1536  1537.5    1538    1540    1542    1544    1546
285              SE  1546.2  1547.2  1548.2
286              SA      .1     .25      .5     1.9     9.9    12.5    26.5    59.2   117.5     184
287              SA   191.9     192   192.1
288              SE    1530    1532    1534    1536  1537.5    1538    1540    1542    1544    1546
289              SE  1546.2  1547.2  1548.2
                 *
                 *
                 * *** Route 220200: from CP 220 to CP 200: Valley wash.

290              KK  220200
291              KO       0       0     0.0       0      21
292              RS       4    FLOW
293              RC    0.08   0.046    0.08 26218.0   0.004     0.0
                 * Medium Wash
294              RX       0    1000    2500    3846    4110    4160    4300    7000
295              RY      10       8       6     5.8       0       0       6      10
                 *
                 *
                 * *** Basin TW480: Mountain basin located in north portion of watershed: CP=480
                 * *** CP 480 is located just North of T7N & T6N boundary and west of 227th Ave.

296              KK   TW480
297              KO       0       0     0.0       1      21
298              BA  12.724
299              LG   0.276   0.227   6.229   0.183  32.122
                 * TW480-PMP-MOUNTAIN
300              UI     0.0   459.4  982.38 2232.28 3166.06 4083.96 4777.75 2993.75 2522.52 2146.66
301              UI  1799.0  1417.7 1141.94  1008.3  791.94   595.6  517.44  424.05  352.21  268.27
302              UI  224.81  224.81  124.06   88.05   88.05   88.05   88.05   88.05   88.05     0.0
                 *
                 *
                 * *** Route 480460: from CP 480 to CP 460: Mountain wash.  This is Trilbey Wash.
                 * *** CP 460 is located North of Rockaway Hills Rd & west of 235th Ave Alignment
1                                                HEC-1 INPUT
PAGE 13

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


303              KK  480460
304              KO       0       0     0.0       0      21
305              RS       3    FLOW
306              RC    0.05   0.064    0.05 18660.0   0.017     0.0
                 * Small Wash
307              RX       0    1300    1380    1560    1600    1640    1660    1710
308              RY      11     7.2     5.2     3.3       0     3.2     7.2    13.2
                 *
                 *
                 * *** Basin TW460: Valley Basin located in Northwest portion of watershed.

309              KK   TW460
310              KO       0       0     0.0       1      21
311              BA  2.4410
312              LG   0.232    0.25    5.72   0.222   6.443
                 * TW460-PMP-VALLEY
313              UI     0.0  688.56 2142.42 2259.76  869.85  239.42   80.14     0.0
                 *
                 *
                 * *** Combine 460 *** Combines 480460 & TW460.

314              KK     460
315              KO       0       0     0.0       0      21
316              HC       2
                 *
                 *
                 * *** Route 460420: from CP 460 to CP 420: Mountain wash.  This is Trilbey Wash.
                 * *** CP 420 is located at CAP Canal south of Jomax Rd and east of 227th Ave.
```

```
317          KK  460420
318          KO       0       0     0.0       0      21
319          RS       9    FLOW
320          RC    0.05   0.064    0.05 53954.0    0.01     0.0
             * Medium Wash
321          RX       0    1000    2500    3846    4110    4160    4300    7000
322          RY      10       8       6     5.8       0       0       6      10
             *
             *
             * *** Basin TW420: Less urban basin west-cetral portion of watershed.

323          KK   TW420
324          KO       0       0     0.0       1      21
325          BA  10.893
326          LG   0.285    0.25   5.699   0.214  15.475
             * TW420-PMP-VALLEY
327          UI     0.0  484.76 1613.02 2625.66 3525.18 5552.57 4787.97 3503.13 2540.24 1445.68
328          UI  821.63  521.61  242.22  148.66  148.66  148.66
             *
             *
             *
             * *** Combine 420 *** Combines 460420 & TW420.
1                                          HEC-1 INPUT
PAGE 14

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


329          KK     420
330          KO       0       0     0.0       0      21
331          HC       2
             *
             *
             * *** Storage CAP030 *** This storage is located at the CAP Canal at CP 420.

332          KK  CAP030
333          KO                                      21
334          RS       1    STOR       0
             * CAP 030, R-8 STA 609+00
             * THE WEIR LENGTH IS 1050 FT AND THE WEIR COEFF = 2.7
             * THE WEIR FLOW WAS CALCULATED FOR H=1 FT (1557), H=2 FT (1558) & H=3 FT (1559).
335          SQ       0  429.56 2188.44 4690.08    6223  7755.9    9526 11296.3   14131   19315
336          SQ   26027
337          SE    1547    1548    1550    1552    1553    1554    1555    1556    1557    1558
338          SE    1559
339          SA      .3      .7     2.1       6      10      10   13.05    16.1    16.2    16.3
340          SA    16.4
341          SE    1547    1548    1550    1552    1553    1554    1555    1556    1557    1558
342          SE    1559
             *
             *
             * *** Route 420200: from CP 420 to CP 200: Valley Wash.  This is Trilbey Wash.

343          KK  420200
344          KO       0       0     0.0       0      21
345          RS       8    FLOW
346          RC    0.08   0.046    0.08 26213.0   0.005     0.0
             * Medium Wash
347          RX       0    1000    2500    3846    4110    4160    4300    7000
348          RY      10       8       6     5.8       0       0       6      10
             *
             *
             *

349          KK   SV200
350          KO       0       0     0.0       1      21
351          BA  31.326
352          LG   0.239    0.25   5.368   0.256  27.428
             * THIS S-GRAPH WAS GENERATED MANUALLY (SEE APPENDIX) *
             * Combined S-Graph for Basin SV200 PMP: Phoenix Valley:70%, Phoenix Mountain:30%
```

```
                 * Basin Area [sq mi] = 31.326
                 * Basin Lag [hr] = 1.87
                 * Time Step [min] = 15
                 * Qult = 80862.4
                 *
353              UI       0     940  1505.3  3637.7  5068.1  6167.4  7625.4 10685.6  9232.1    7316
354              UI  6170.1  5062.5  4020.1  3366.2  2486.1  1721.3  1332.1  1150.1   769.4   715.9
355              UI   424.5   244.3   244.3   244.3   244.3   244.3   244.3       0
                 *
                 *
                 * *** Combine 200 *** Combines 310200, 220200 & 420200 SV200
1                                                HEC-1 INPUT
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LINE             ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


356              KK     200
357              KO       0       0     0.0       0      21
358              HC       4
                 *
                 *
                 * *** Route 200400: from CP 200 to CP 400: Valley Wash.  This is Trilbey Wash.

359              KK  200400
360              KO       0       0     0.0       0      21
361              RS       3    FLOW
362              RC    0.08   0.046    0.08   16311   0.005     0.0
                 * Large Wash
363              RX       0     465    1225    1925    2325    2405    4225    6225
364              RY      10       4       2       0       0       2       8      10
                 *
                 *
                 *
                 * *** Basin TW400: Slightly urban basin located in southwest part of watershed.

365              KK   TW400
366              KO       0       0     0.0       1      21
367              BA  12.988
368              LG   0.201    0.25   5.215   0.276  48.331
                 * TW400-PMP-VALLEY
369              UI     0.0  597.58 2083.87 3315.72 4540.88 7051.41 5528.89 4035.34 2839.33 1412.68
370              UI  907.58  559.75  183.26  183.26  183.26     0.0
                 *
                 *
                 *
                 * *** Combine 400 *** Combines 200400 & TW400.

371              KK     400
372              KO       0       0     0.0       0      21
373              HC       2
                 *
                 *
                 * *** Combine 400* *** Combines 100400 & 400.

374              KK    400*
375              KO       0       0     0.0       0      21
376              HC       2
                 *
                 *
                 * *** Route 400510: from CP 400 to CP 510 along McMicken Dam Channel.
                 * *** CP 510 is located at McMicken Dam Channel at Beardsley Rd and 171st Ave.

377              KK  400510
378              KO       0       0     0.0       0      21
379              RS       1    FLOW
380              RC   0.045   0.035   0.045  2671.0   0.001     0.0
                 * McMICKEN DAM CHANNEL
381              RX       0      46     101     121     171     181    1421    3621
382              RY      25      14       4       0       0       4      14      25
                 *
```

```
                    *
                    * *** Basin WI580: Less urban basin located in the central portion of watershed
PAGE 16                                          HEC-1 INPUT

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

 383                KK   WI580
 384                KO       0       0     0.0       1      21
 385                BA  30.346
 386                LG   0.277   0.183   6.675   0.148  12.926
                    * WI580-PMP-VALLEY
 387                UI     0.0  1095.6 2603.93 5063.85 6516.97  8358.212573.4111784.44 8978.79 6968.26
 388                UI  5315.2 3210.12 1883.21 1428.02 1021.13  335.99  335.99  335.99  335.99     0.0
                    *
                    *
                    *
                    * *** Storage CAP040 *** This storage is located at the CAP Canal at CP 580.
                    * *** CP 580 is located at CAP Canal south of Patton Rd and west of 211th Ave.

 389                KK  CAP040
 390                KO                                      21
 391                RS       1    STOR       0
                    * CAP 040, R-8 STA 688+00
                    * THE WEIR LENGTH IS 5100 FT AND THE WEIR COEF - 2.7
                    * THE WEIR FLOW WAS CALCULATED AT H = 1 FT (1553.7) AND H = 2 FT (1554.7)
 392                SQ       0       0       0       0       0  366.58 1559.96 3214.13 3880.54   17650
 393                SQ   42827
 394                SE    1540    1542    1544    1546 1546.77    1548    1550    1552  1552.7  1553.7
 395                SE  1554.7
 396                SA      .5     1.6       3    22.1    37.1    61.1   105.1   160.8   181.3   181.4
 397                SA   181.5
 398                SE    1540    1542    1544    1546 1546.77    1548    1550    1552  1552.7  1553.7
 399                SE  1554.7
                    *
                    *
                    * *** Route 580510: from CP 580 to CP510: Valley Wash

 400                KK  580510
 401                KO       0       0     0.0       0      21
 402                RS      11    FLOW
 403                RC    0.08   0.046    0.08 39351.0   0.005     0.0
                    * Large Wash
 404                RX       0     465    1225    1925    2325    2405    4225    6225
 405                RY      10       4       2       0       0       2       8      10
                    *
                    *
                    * *** Basin WI510:Slightly urban basin located in southcentral part of watershed

 406                KK   WI510
 407                KO       0       0     0.0       1      21
 408                BA  9.3124
 409                LG    0.19    0.25   5.804   0.234  56.461
                    *
                    * Phoenix Valley S-Graph for Basin WI510 PMP
                    * Basin Area [sq mi] = 9.3124
                    * Basin Lag [hr] = 1.48
                    * Time Step [min] = 15
                    * Qult = 24038.3
                    *
 410                UI       0   353.1   911.6  1699.1  2188.8  2907.4    4284  3422.1  2641.2  2002.4
1                                                HEC-1 INPUT
PAGE 17

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

 411                UI  1424.2   732.9   553.9   353.1   166.3   108.3   108.3   108.3       0
                    *
                    *
                    *
```

```
                 * *** Combine 510 *** Combines 580510 & WI510.

412              KK     510
413              KO       0       0     0.0       0      21
414              HC       2
                 *
                 * *** Combine 510* *** Combines 400510 & 510.

415              KK    510*
416              KO       0       0     0.0       0      21
417              HC       2
                 *
                 *
                 * *** Route 510500: from CP 510 to CP 500.2 along McMicken Dam Channel.
                 * *** CP 500.2 is located North of Beardsley Rd and East of 179th Ave.

418              KK  510500
419              KO       0       0     0.0       0      21
420              RS       1    FLOW
421              RC   0.045   0.035   0.045  7342.0   0.001     0.0
                 * McMICKEN DAM CHANNEL
422              RX       0      46     101     121     171     181    1421    3621
423              RY      25      14       4       0       0       4      14      25
                 *
                 *
                 * *** Basin WI520: Less Urban Basin located in central portion of watershed.

424              KK   WI520
425              KO       0       0     0.0       1      21
426              BA  16.390
427              LG   0.251    0.25   5.691   0.220  28.930
                 * WI520-PMP-VALLEY
428              UI     0.0  687.15 2080.72  3574.7  4689.9 6980.09  7733.3 5573.27 4127.94 2894.91
429              UI  1438.7 1014.09  673.59  210.73  210.73  210.73     0.0
                 *
                 *
                 * *** Storage CAP050 *** This storage is located at the CAP Canal at CP 520.
                 * *** CP 520 is located at the CAP Canal at Dixileta Dr and 203rd Ave aligments.
                 *
                 * THIS STORAGE WAS REMOVED DUE TO COMPUTATIONAL INSTABILITY.
                 * THIS COULD BE CORRECTED BY DECREASING THE COMPUTATION INTERVAL
                 * BUT DUE TO THE USE OF S-GRAPHS NO CHANGE IN THE COMPUTATION INTERVAL
                 * COULD BE MADE.
                 *
                 * KKCAP050
                 * KO                                      21
                 * RS     1    STOR       0
                 * CAP 050, R-8 STA 804+50
                 * THE WEIR LENGTH IS 4100 FT AND THE WEIR COEF - 2.7
                 * THE WEIR FLOW WAS CALCULATED AT H = 1 FT (1554) AND H = 2 FT (1555)
                 * SQ   0.0  1075.5  2314.3  3832.8  4683.6   14900   35141
                 * SE  1546    1548    1550    1552    1553    1554    1555
                 * SA    .1      .7    11.5    35.3    54.1    54.2    54.3
                 * SE  1546    1548    1550    1552    1553    1554    1555
                 *
                 *
                 * *** Route 520500: from CP 520 to CP 500.1: Valley Wash.
                 * *** CP 500.1 is located North of Beardsley Rd and East of 179th Ave.
                 * *** CP 500.1 and 500.2 are located at the same location.
1                                          HEC-1 INPUT
PAGE 18

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


430              KK  520500
431              KO       0       0     0.0       0      21
432              RS       4    FLOW
433              RC    0.08   0.046    0.08 34143.0   0.006     0.0
                 * Medium Wash
434              RX       0    1000    2500    3846    4110    4160    4300    7000
```

```
435          RY      10       8       6     5.8       0       0       6      10
             *
             *
             * *** Diversion Recover CAP ***********************************
             * Recovers flows from CAP impoundment area

436          KK    CAP2
437          DR    CAP2
             *
             * *** CAP *****************************************************
             * This diversion is for the Impoundment area upstream of the CAP.
             *
             *
             * DDM   *****PRESERVED*****

438          KK    CAP2
439          KO       0       0       0       0      21
440          DT    CAP3
             * This diversion was calculated on the capacities of the overchutes.
             * The overchutes that contribute to route 540500 are CAP 60 & 70.
             * The capacities of the culverts in this system can be found in the appendix.
441          DI       0     617    1991    4413    5380    6070    6707   66031  174319
442          DQ       0     583    1871    3937    4755    5325    5908   47668  123941
             *
             *
             * *** Route 540500: from CP 540 to CP 500.1: Valley Wash.

443          KK  540500
444          KO       0       0       0       0      21
445          RS       4    FLOW
446          RC    0.08   0.046    0.08 32882.0   0.007       0
             * Medium Wash
447          RX       0    1000    2500    3846    4110    4160    4300    7000
448          RY      10       8       6     5.8       0       0       6      10
             *
             *
             * *** Basin WI500:Slightly Urban Basin located in southcentral part of watershed

449          KK   WI500
450          KO       0       0     0.0       1      21
451          BA  9.1574
452          LG   0.238    0.25   5.232   0.295  40.465
             *
             * Phoenix Valley S-Graph for Basin WI500
             * Basin Area [sq mi] = 9.1574
             * Basin Lag [hr] = 1.27
             * Time Step [min] = 15
             * Qult = 23638.2
             *
1                                          HEC-1 INPUT
PAGE 19

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

453          UI       0   404.6  1332.3    2180  2918.9  4591.4  4053.2  2969.2  2151.5  1275.6
454          UI   689.2   454.2   224.8   124.1   124.1   124.1       0
             *
             *
             *
             * This concentration point is hard-coded to account for 10% of the split
             * at the CAP (See Appendix and note above concentration point 505).
             * *** Combine 500.1 *** Combines 520500, 540500 & WI500.

455          KK   500.1
456          KO       0       0     0.0       0      21
457          HC       3 39.5404
             *        39.5404 =  16.3900 (520500)
             *                +  13.9930 (540500-diversion)
             *                +   9.1574 (WI500)
             *
             *
```

```
                *
                * *** Combine 500.2 *** Combines 510500 & 500.1.

458             KK   500.2
459             KO       0       0     0.0       0      21
460             HC       2
                *
                *
                *
                * *** Route 500500: This route is contained along the McMicken Dam Channel in
                * ***               Basin WI500, and routes concentration point 500.2 to
                * ***               concentration point 500.3.

461             KK  500500
462             KO       0       0     0.0       0      21
463             RS       1    FLOW
464             RC   0.045   0.035   0.045  2214.0   0.001     0.0
                * McMICKEN DAM CHANNEL
465             RX       0      46     101     121     171     181    1421    3621
466             RY      25      14       4       0       0       4      14      25
                *
                *
                *
                * Concentration POInt 500.3 is the McMicken Dam Spillway
                * *** Combine 500.3 *** Combines 500500 & 505500.

467             KK   500.3
468             KO       0       0     0.0       0      21
469             HC       2
                *
                *
                *
                * *** Route 500600: from CP 500 to CP 600 along McMicken Dam Outlet Channel.
                * *** CP 600 is located at McMicken Dam Outlet Channel south of Happy Valley Rd.
                * *** and 147th Ave alignments.
                                                HEC-1 INPUT
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LINE            ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


470             KK  500600
471             KO       0       0     0.0       0      21
472             RS       3    FLOW
473             RC   0.045   0.035   0.045 18203.0   0.001     0.0
                * McMICKEN DAM CHANNEL
474             RX       0      46     101     121     171     181    1421    3621
475             RY      25      14       4       0       0       4      14      25
                *
                *
                * *** Basin PI600: Slightly Urban Basin located in southeast part of watershed.

476             KK   PI600
477             KO       0       0     0.0       1      21
478             BA  12.033
479             LG   0.264   0.250   4.635   0.374  28.192
                * PI600-PMP-VALLEY
480             UI     0.0  651.32 2596.16 3890.13 6075.02 6803.84 4593.31 3115.25 1478.01  871.53
481             UI  447.05  193.32  193.32     0.0
                *
                *
                *
                * *** Diversion Recover CAP ************************************
                * Recovers flows from CAP impoundment area

482             KK    CAP3
483             DR    CAP3
                *
                * *** CAP ******************************************************
                * This diversion is for the Impoundment area upstream of the CAP.
                *
```

```
                 *
                 * DDM   *****PRESERVED*****

484              KK    CAP3
485              DT    CAP4
                 *
                 * This diversion was calculated on the capacities of the overchutes.
                 * The overchutes that contribute to route 640600 are CAP 110 to 150.
                 * The capacities of the culverts in this system can be found in the appendix.
486              DI       0     583    1871    3937    4755    5325    5908   47668  123941
487              DQ       0     470    1525    2720    3160    3440    3832   21628   54303
                 *
                 *
                 * *** Route 640600: from CP 640 to CP 600: Valley Wash.

488              KK  640600
489              KO       0       0     0.0       0      21
490              RS       7    FLOW
491              RC    0.08   0.046    0.08 31873.0   0.007     0.0
                 * Medium Wash
492              RX       0    1000    2500    3846    4110    4160    4300    7000
493              RY      10       8       6     5.8       0       0       6      10
                 *
                 *
                 * *** Combine 600 *** Combines PI600 & 640600.
1                                                HEC-1 INPUT
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LINE             ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


494              KK     600
495              KO       0       0     0.0       0      21
                 *
                 * This concentration point is hard-coded to account for 26% of the split
                 * at the CAP (See Appendix and note above concentration point 505).
                 *
496              HC       2 32.3230
                 *        32.3230 =
                 *               +  12.0330 (PI600)
                 *               +  20.2900 (640600-diversion)
                 *
                 *
                 *
                 * *** Combine 600* *** Combines 500600 & 600

497              KK    600*
498              KO       0       0     0.0       0      21
499              HC       2
                 *
                 *
                 *
                 * *** Route 600710: from CP 600 to CP 710 along McMicken Dam Outlet Channel
                 * *** CP 710 is located along McMIcken Dam Outlet Channel south of Happy Valley
                 * *** Rd. and 139th Ave. alignments.

500              KK  600710
501              KO       0       0     0.0       0      21
502              RS       1    FLOW
503              RC   0.045   0.035   0.045  4403.0   0.001     0.0
                 * McMICKEN DAM CHANNEL
504              RX       0      46     101     121     171     181    1421    3621
505              RY      25      14       4       0       0       4      14      25
                 *
                 *
                 * *** Diversion Recover CAP ***********************************
                 * Recovers flows from CAP impoundment area

506              KK    CAP4
507              KO       0       0     0.0       0      21
508              DR    CAP4
```

```
                    *
                    * The overchutes that contribute to route 760710 are CAP 160 to 190.
                    * The capacities of the culverts in this system can be found in the appendix.
                    *
                    *
                    * *** Route 760710: from CP 760 to 710: Valley Wash.
                    *
                    * This route was adjusted to account for instabilities in the Hydrograph.
                    * RY Ordinate #4 was changed from 5.8 to 4.5.
1                                                HEC-1 INPUT
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LINE                ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


 509                KK  760710
 510                KO       0       0     0.0       0      21
 511                RS       9    FLOW
 512                RC    0.08   0.046    0.08 28446.0   0.008     0.0
                    * Medium Wash (Modified)
 513                RX       0    1000    2500    3846    4110    4160    4300    7000
 514                RY      10       8       6     4.5       0       0       6      10
                    *
                    *
                    * *** Basin PD710: Slightly Urban Basin located in southeast part of watershed.

 515                KK   PD710
 516                KO       0       0     0.0       1      21
 517                BA  6.7175
 518                LG   0.295   0.249   4.556   0.356  12.509
                    * PD710 PMP-Valley
 519                UI     0.0  325.06 1218.28 1872.56 2673.93 3845.29 2750.05 1954.79 1263.75  579.92
 520                UI  388.83  183.54   99.68   99.68     0.0
                    *
                    *
                    * *** Basin PD 740: foothills basin located in eastcentral part of watershed.

 521                KK   PD740
 522                KO       0       0     0.0       1      21
 523                BA  0.8688
 524                LG   0.279   0.249   5.026   0.308  16.987
                    * PD740-PMP-VALLEY
 525                UI     0.0 1755.81   473.7     0.0
                    *
                    *
                    * *** Storage CAP200 *** This storage is located at the CAP Canal at CP 740.
                    * *** CP 740 is located at the CAP Canal at Lone Mountain Rd and 147th Ave.

 526                KK  CAP200
 527                KO                                      21
 528                RS       1    STOR       0
                    * CAP 200, R-8 STA 342+40
                    * THE WEIR LENGTH IS 3800 FT AND THE WEIR COEF - 2.7
                    * THE WEIR FLOW WAS CALCULATED AT H = 1 FT (1542.4) AND H = 2 FT (1543.4)
 529                SQ     0.0    25.0   175.0   335.0   440.0   530.0   600.0   620.0   10880   29640
 530                SE    1516    1520    1524    1528    1532    1536    1540  1541.4  1542.4  1543.4
 531                SA       0     1.3     6.0    18.0      40    69.9    80.6    80.7    80.8
 532                SE    1520    1524    1528    1532    1536    1540  1541.4  1542.4  1543.4
                    *
                    *
                    * *** Route 740710: from CP 740 to 710: Valley Wash.

 533                KK  740710
 534                KO       0       0     0.0       0      21
 535                RS      10    FLOW
 536                RC    0.08   0.046    0.08 27269.0   0.007     0.0
                    * Medium Wash
 537                RX       0    1000    2500    3846    4110    4160    4300    7000
 538                RY      10       8       6     5.8       0       0       6      10
                    *
                    *
```

```
                    * *** Combine 710 *** Combines 760710, PD710 & 740710
                                                HEC-1 INPUT
PAGE 23

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


 539                KK     710
 540                KO       0       0     0.0       0      21
                    *
                    * This concentration point is hard-coded to account for 48% of the split
                    * at the CAP (See Appendix and note above concentration point 505).
                    *
                    *
 541                HC       3 24.3783
                    *        24.3783 =
                    *                +  16.7920 (760710-diversion)
                    *                +   6.7175 (PD710)
                    *                +   0.8688 (740710)
                    *
                    *
                    * *** Combine 710* *** Combines 600710 & 710.

 542                KK    710*
 543                KO       0       0     0.0       0      21
 544                HC       2
                    *
                    *
                    *
                    * *** Route 710700: from CP 710 to CP 700 along McMicken Dam outlet Channel
                    * *** CP 700 is located at southeast-most point in watershed
                    * *** CP 700 is the Outlet point of the watershed

 545                KK  710700
 546                KO       0       0     0.0       0      21
 547                RS       1    FLOW
 548                RC   0.045   0.035   0.045  7571.0   0.001     0.0
                    * McMICKEN DAM CHANNEL
 549                RX       0      46     101     121     171     181    1421    3621
 550                RY      25      14       4       0       0       4      14      25
                    *
                    *
                    * *** Basin PD730: mountain basin located in eastcentral portion of watershed.

 551                KK   PD730
 552                KO       0       0     0.0       1      21
 553                BA  0.4765
 554                LG   0.293    0.25   4.406   0.383  40.267
                    * PD730-PMP-MOUNTAIN
 555                UI     0.0  493.96  492.98  164.51   55.24   17.83     0.0
                    *
                    *
                    * *** Storage CAP220 *** This storage is located at the CAP Canal at CP 730.
                    * *** CP 730 is located at the CAP Canal at Lone Mountain Rd east of 139th Ave.

 556                KK  CAP220
 557                KO                                      21
 558                RS       1    STOR       0
                    * CAP 220, R-8 STA 433+85
                    * THE WEIR LENGTH IS 2000 FT AND THE WEIR COEF - 2.7
                    * THE WEIR FLOW WAS CALCULATED AT H = 1 FT (1541) AND H = 2 FT (1542)
1                                               HEC-1 INPUT
PAGE 24

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

 559                SQ     0.0    28.0   155.0   315.0   425.0   525.0   600.0   670.0    6070 15943.5
 560                SE    1512    1516    1520    1524    1528    1532    1536    1540    1541    1542
 561                SA       0      .1      .2      .5     4.4    15.4    29.2    29.3    29.4
 562                SE    1512    1520    1524    1528    1532    1536    1540    1541    1542
                    *
```

```
                 * *** Basin PD735: mountain basin located in eastcentral portion of watershed.

563              KK   PD735
564              KO       0       0     0.0       1      21
565              BA  3.2311
566              LG   0.264    0.25   4.295   0.456  39.149
                 * PD735-PMP-MOUNTAIN
                 * UI    0.0  880.77 2711.41 3045.69 1214.34  345.79  104.32     0.0
567              UI      0.0  872.46  2961.2 1968.84 1141.43  640.15  346.36  194.02   95.12   65.16
568              UI      0.0
                 *
                 *
                 * *** Storage CAP210 *** This storage is located at the CAP Canal at CP 735.
                 * *** CP 735 is located @ the CAP Canal @ Lone Mountain Rd and east of 147th Ave

569              KK  CAP210
570              KO                                      21
571              RS       1    STOR       0
                 * CAP 210, R-8 STA 376+80
                 * THE WEIR LENGTH IS 2200 FT AND THE WEIR COEF - 2.7
                 * THE WEIR FLOW WAS CALCULATED AT H = 1 FT (1543) AND H = 2 FT (1544)
572              SQ     0.0   372.0  1240.0  1900.0  2480.0  2888.0  3280.0  3600.0  3760.0    9700
573              SQ   20561
574              SE    1512    1516    1520    1524    1528    1532    1536    1540    1542    1543
575              SE    1544
576              SA       0      .3      .8     1.4     2.7     6.5    13.8    22.4      27    27.1
577              SA    27.2
578              SE    1512    1516    1520    1524    1528    1532    1536    1540    1542    1543
579              SE    1544
                 *
                 *
                 * *** Combine 736 *** Combines CAP210 and CAP220

580              KK     736
581              KO       0       0     0.0       0      21
582              HC       2
                 *
                 *
                 * *** Route 735700: from CP 735 to CP 700: mountainous wash.

583              KK  735700
584              KO       0       0     0.0       0      21
585              RS       8    FLOW
586              RC    0.05   0.064    0.05 27046.0   0.008     0.0
                 * Small Wash
587              RX       0    1300    1380    1560    1600    1640    1660    1710
588              RY      11     7.2     5.2     3.3       0     3.2     7.2    13.2
                 *
                 *
                 *
                 * *** Basin PD700: Less Urban basin located in southeast portion of watershed.
1                                                HEC-1 INPUT
PAGE 25

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


589              KK   PD700
590              KO       0       0     0.0       1      21
591              BA  7.2631
592              LG   0.284   0.246   5.179   0.264  16.866
                 * PD700-PMP-VALLEY
593              UI     0.0  993.09 3049.93 5644.74 4713.51 2653.07  989.04  398.41  169.44     0.0
                 *
                 *
                 *
                 * *** Combine 700 *** Combines Concentration Point 736 & Basin PD700.

594              KK     700
595              KO       0       0     0.0       0      21
596              HC       2
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```
                *
                *
                *
                * *** Combine 700* *** Combines 710700 & 700.

597             KK    700*
598             KO       0       0     0.0       0      21
599             HC       2
                *
600             ZZ
```

```
  SCHEMATIC DIAGRAM OF STREAM NETWORK
OUT
LINE      (V) ROUTING          (--->) DIVERSION OR PUMP FLOW

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

 56       PI680
              V
              V
 64      680640
              .
              .
 70           .       PI640
              .           .
              .           .
 76         640............
              .
              .
 79           .       WI540
              .           .
              .           .
 85           .           .       PD780
              .           .           V
              .           .           V
 91           .           .      780760
              .           .           .
              .           .           .
 97           .           .           .       PD760
              .           .           .           .
              .           .           .           .
102           .           .           .           .       PD745
              .           .           .           .           .
              .           .           .           .           .
107         CAP.............................................
              V
              V
110         STOR
              .
              .
118           .------->    CAP2
117         CAP1
              V
              V
121      640505
              .
              .
127           .       WI505
              .           .
              .           .
133         505............
              V
              V
136      505500
              .
              .
142           .       WT140
              .           V
              .           V
148           .      140130
              .           .
              .           .
154           .           .       WT130
              .           .           .
              .           .           .
160           .         130............
              .           V
              .           V
163           .      130120
              .           .
              .           .
169           .           .       WT150
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                 .           .           V
                 .           .           V
176              .           .      150120
                 .           .           .
                 .           .           .
182              .           .           .       WT160
                 .           .           .           V
                 .           .           .           V
188              .           .           .      160120
                 .           .           .           .
                 .           .           .           .
194              .           .           .           .       WT120
                 .           .           .           .           .
                 .           .           .           .           .
199              .           .         120.......................
                 .           .           .
                 .           .           .
202              .       120*............
                 .          V
                 .          V
204              .      120110
                 .           .
                 .           .
210              .           .      WT110
                 .           .           .
                 .           .           .
215              .         110............
                 .          V
                 .          V
218              .      110100
                 .           .
                 .           .
224              .           .      WT100
                 .           .           .
                 .           .           .
230              .         100............
                 .          V
                 .          V
233              .      100400
                 .           .
                 .           .
239              .           .      IW350
                 .           .           V
                 .           .           V
244              .           .      350310
                 .           .           .
                 .           .           .
250              .           .           .       IW310
                 .           .           .           .
                 .           .           .           .
257              .           .         310............
                 .           .           V
                 .           .           V
260              .           .      CAP020
                 .           .           V
                 .           .           V
267              .           .      310200
                 .           .           .
                 .           .           .
273              .           .           .       SV220
                 .           .           .           V
                 .           .           .           V
279              .           .           .      CAP010
                 .           .           .           V
                 .           .           .           V
290              .           .           .      220200
                 .           .           .           .
                 .           .           .           .
296              .           .           .           .       TW480
                 .           .           .           .           V
                 .           .           .           .           V
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303                                   480460
                                        .
                                        .
309                                     .        TW460
                                        .          .
                                        .          .
314                                   460............
                                        V
                                        V
317                                   460420
                                        .
                                        .
323                                     .        TW420
                                        .          .
                                        .          .
329                                   420............
                                        V
                                        V
332                                   CAP030
                                        V
                                        V
343                                   420200
                                        .
                                        .
349                                     .        SV200
                                        .          .
                                        .          .
356                       200.................................
                            V
                            V
359                     200400
                            .
                            .
365                         .      TW400
                            .        .
                            .        .
371                       400............
                            .
                            .
374                 400*............
                      V
                      V
377               400510
                      .
                      .
383                   WI580
                        V
                        V
389                 CAP040
                        V
                        V
400                 580510
                        .
                        .
406                     .      WI510
                        .        .
                        .        .
412                   510............
                        .
                        .
415                 510*............
                      V
                      V
418               510500
                      .
                      .
424                   WI520
                        V
                        V
430                 520500
                        .
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437                                  .<-------    CAP2
436                              CAP2
                                    .
                                    .
440                                 .------->    CAP3
438                              CAP2
                                    V
                                    V
443                            540500
                                    .
                                    .
449                                 .       WI500
                                    .           .
                                    .           .
455                       500.1.......................
                                    .
                                    .
458                  500.2............
                        V
                        V
461                 500500
                        .
                        .
467            500.3............
                  V
                  V
470           500600
                  .
                  .
476                 PI600
                        .
                        .
483                                 .<-------    CAP3
482                        CAP3
                                    .
                                    .
485                                 .------->    CAP4
484                        CAP3
                                    V
                                    V
488                       640600
                                    .
                                    .
494                   600............
                        .
                        .
497             600*............
                  V
                  V
500           600710
                  .
                  .
508                    .<-------    CAP4
506                 CAP4
                        V
                        V
509                 760710
                        .
                        .
515                       PD710
                                    .
                                    .
521                                 .       PD740
                                    .           V
                                    .           V
526                                 .      CAP200
                                    .           V
                                    .           V
533                                 .      740710
                                    .           .
```

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                .          .          .          .
539             .        710.......................
                .          .
                .          .
542           710*...........
                V
                V
545         710700
                .
                .
551             .       PD730
                .          V
                .          V
556             .      CAP220
                .          .
                .          .
563             .          .       PD735
                .          .          V
                .          .          V
569             .          .      CAP210
                .          .          .
                .          .          .
580             .        736...........
                .          V
                .          V
583             .      735700
                .          .
                .          .
589             .          .       PD700
                .          .          .
                .          .          .
594             .        700...........
                .          .
                .          .
597           700*...........
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RUNOFF SUMMARY
FLOW IN CUBIC FEET PER SECOND
TIME IN HOURS, AREA IN SQUARE MILES

TIME OF MAX STAGE	OPERATION	STATION	PEAK FLOW	TIME OF PEAK	AVERAGE FLOW FOR MAXIMUM PERIOD 6-HOUR	24-HOUR	72-HOUR	BASIN AREA	MAXIMUM STAGE
+	HYDROGRAPH AT	PI680	10881.	18.25	9537.	3481.	1357.	16.89	
+	ROUTED TO	680640	9990.	21.25	8227.	3472.	1352.	16.89	
+	HYDROGRAPH AT	PI640	12051.	18.25	11286.	3930.	1418.	17.56	
+	2 COMBINED AT	640	18185.	18.25	16307.	7377.	2762.	34.45	
+	HYDROGRAPH AT	WI540	7890.	18.25	7372.	2649.	1060.	11.64	
+	HYDROGRAPH AT	PD780	11851.	18.25	11097.	3744.	1470.	19.17	
+	ROUTED TO	780760	11814.	18.25	10516.	3737.	1467.	19.17	
+	HYDROGRAPH AT	PD760	1357.	18.25	1281.	379.	140.	2.72	
+	HYDROGRAPH AT	PD745	1150.	18.25	1101.	330.	123.	1.98	
+	5 COMBINED AT	CAP	40396.	18.25	35926.	14410.	5550.	69.96	
+	ROUTED TO	STOR	40365.	18.25	33506.	13849.	5540.	69.96	
+	DIVERSION TO	CAP2	29845.	18.25	24944.	10785.	4411.	69.96	
+	HYDROGRAPH AT	CAP1	10520.	18.25	8562.	3064.	1129.	69.96	
+	ROUTED TO	640505	9789.	19.25	7711.	3056.	1127.	69.96	
+	HYDROGRAPH AT	WI505	3836.	18.25	3564.	1207.	474.	6.67	
+	2 COMBINED AT	505	13131.	18.50	9956.	4181.	1598.	25.56	
+	ROUTED TO	505500	12849.	19.00	9870.	4180.	1598.	25.56	
+	HYDROGRAPH AT	WT140	2089.	18.25	1886.	630.	242.	3.80	
+	ROUTED TO	140130	2082.	18.50	1842.	630.	242.	3.80	
	HYDROGRAPH AT	WT130	1458.	18.25	1351.	410.	151.	2.54	
	2 COMBINED AT								

+	130	3540.	18.25	3100.	1039.	392.	6.34
ROUTED TO +	130120	3538.	18.25	3100.	1039.	392.	6.34
HYDROGRAPH AT +	WT150	3205.	18.25	2841.	967.	371.	5.85
ROUTED TO +	150120	3194.	18.50	2789.	966.	370.	5.85
HYDROGRAPH AT +	WT160	460.	18.25	431.	136.	52.	.82
ROUTED TO +	160120	458.	18.25	416.	136.	52.	.82
HYDROGRAPH AT +	WT120	1640.	18.25	1565.	436.	154.	2.82
3 COMBINED AT +	120	5287.	18.25	4472.	1536.	575.	9.48
2 COMBINED AT +	120*	8825.	18.25	7572.	2575.	967.	15.82
ROUTED TO +	120110	8668.	18.50	7227.	2571.	966.	15.82
HYDROGRAPH AT +	WT110	1645.	18.25	1569.	454.	165.	2.90
2 COMBINED AT +	110	10308.	18.25	8399.	3023.	1130.	18.71
ROUTED TO +	110100	10261.	18.25	8381.	3022.	1130.	18.71
HYDROGRAPH AT +	WT100	2221.	18.25	2081.	663.	253.	3.84
2 COMBINED AT +	100	12482.	18.25	10148.	3680.	1381.	22.56
ROUTED TO +	100400	12283.	18.75	10020.	3679.	1380.	22.56
HYDROGRAPH AT +	IW350	2665.	18.25	2559.	786.	289.	4.21
ROUTED TO +	350310	2644.	20.25	2297.	778.	287.	4.21
HYDROGRAPH AT +	IW310	17705.	18.25	16055.	5789.	2081.	25.81
2 COMBINED AT +	310	19954.	18.25	17209.	6520.	2365.	30.02
ROUTED TO +	CAP020	19951.	18.50	17201.	6501.	2362.	30.02
ROUTED TO +	310200	19199.	19.50	16488.	6479.	2357.	30.02
HYDROGRAPH AT +	SV220	11899.	18.25	11166.	4073.	1537.	16.95
ROUTED TO	CAP010	11897.	18.25	10678.	4066.	1535.	16.95

	ROUTED TO	220200	11374.	19.50	8896.	4054.	1530.	16.95
+	HYDROGRAPH AT	TW480	8369.	18.25	7377.	2682.	1035.	12.72
+	ROUTED TO	480460	8327.	18.50	7306.	2680.	1034.	12.72
+	HYDROGRAPH AT	TW460	1459.	18.25	1390.	386.	134.	2.44
+	2 COMBINED AT	460	9762.	18.25	8407.	3065.	1168.	15.16
+	ROUTED TO	460420	7400.	21.00	7131.	3055.	1163.	15.16
+	HYDROGRAPH AT	TW420	6747.	18.25	6200.	1916.	696.	10.89
+	2 COMBINED AT	420	13981.	18.25	11260.	4938.	1848.	26.06
+	ROUTED TO	CAP030	13971.	18.25	11258.	4938.	1848.	26.06
+	ROUTED TO	420200	13440.	20.00	10297.	4934.	1847.	26.06
+	HYDROGRAPH AT	SV200	19277.	18.25	16923.	5887.	2258.	31.33
	4 COMBINED AT	200	59528.	19.25	48988.	21186.	7973.	104.36
+	ROUTED TO	200400	58113.	20.00	48579.	21172.	7968.	104.36
+	HYDROGRAPH AT	TW400	8519.	18.25	7919.	2898.	1180.	12.99
+	2 COMBINED AT	400	61123.	19.50	53845.	23939.	9125.	117.35
+	2 COMBINED AT	400*	73007.	19.25	63716.	27599.	10505.	139.91
+	ROUTED TO	400510	72788.	19.50	63649.	27597.	10505.	139.91
+	HYDROGRAPH AT	WI580	20002.	18.25	18227.	6072.	2159.	30.35
+	ROUTED TO	CAP040	19997.	18.25	18168.	6049.	2150.	30.35
+	ROUTED TO	580510	19884.	19.50	17421.	6025.	2147.	30.35
+	HYDROGRAPH AT	WI510	6386.	18.25	5879.	2249.	929.	9.31
+	2 COMBINED AT	510	25841.	18.50	21610.	8140.	3063.	39.66
+	2 COMBINED AT	510*	97760.	19.25	85259.	35737.	13565.	179.56
+	ROUTED TO	510500	97162.	19.50	84578.	35719.	13562.	179.56

	HYDROGRAPH AT	WI520	10456.	18.25	9619.	3219.	1235.	16.39
+	ROUTED TO	520500	8890.	20.25	7277.	3205.	1230.	16.39
+	HYDROGRAPH AT	CAP2	29845.	18.25	24944.	10785.	4411.	69.96
+	DIVERSION TO	CAP3	22195.	18.25	18745.	8638.	3642.	69.96
+	HYDROGRAPH AT	CAP2	7649.	18.25	6198.	2146.	769.	69.96
+	ROUTED TO	540500	7561.	19.00	5846.	2140.	768.	69.96
+	HYDROGRAPH AT	WI500	5776.	18.25	5332.	1894.	758.	9.16
+	3 COMBINED AT	500.1	20225.	18.25	16773.	7102.	2750.	39.54
+	2 COMBINED AT	500.2	115437.	19.50	101114.	42809.	16309.	219.11
+	ROUTED TO	500500	115418.	19.50	101006.	42808.	16309.	219.11
+	2 COMBINED AT	500.3	127499.	19.50	110834.	46974.	17906.	244.67
	ROUTED TO	500600	126156.	20.00	109492.	46935.	17900.	244.67
+	HYDROGRAPH AT	PI600	6756.	18.25	6253.	2086.	811.	12.03
+	HYDROGRAPH AT	CAP3	22195.	18.25	18745.	8638.	3642.	69.96
+	DIVERSION TO	CAP4	10773.	18.25	9303.	4880.	2231.	69.96
+	HYDROGRAPH AT	CAP3	11423.	18.25	9443.	3759.	1410.	69.96
+	ROUTED TO	640600	10095.	20.50	7824.	3753.	1409.	69.96
+	2 COMBINED AT	600	13885.	18.00	11439.	5697.	2213.	32.32
+	2 COMBINED AT	600*	136691.	20.25	120006.	52632.	20102.	276.99
+	ROUTED TO	600710	136257.	20.50	119766.	52624.	20100.	276.99
+	HYDROGRAPH AT	CAP4	10773.	18.25	9303.	4880.	2231.	69.96
+	ROUTED TO	760710	10717.	19.25	8767.	4877.	2229.	69.96
	HYDROGRAPH AT	PD710	3544.	18.25	3243.	975.	354.	6.72
	HYDROGRAPH AT							

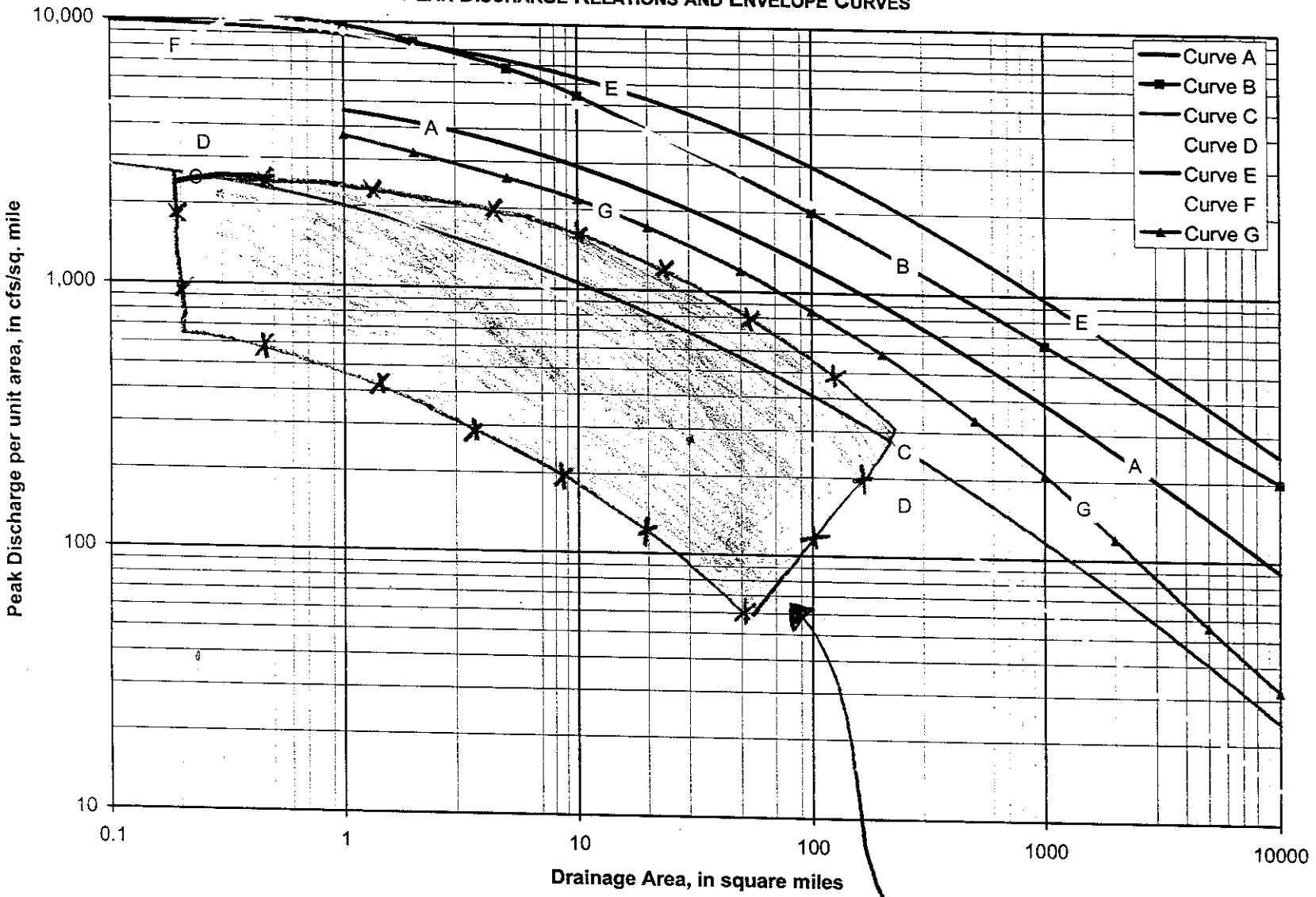
+	PD740	494.	18.25	475.	140.	52.	.87
ROUTED TO							
+	CAP200	428.	18.25	391.	140.	52.	.87
ROUTED TO							
+	740710	415.	20.00	381.	139.	51.	.87
3 COMBINED AT							
+	710	14393.	18.50	10824.	5955.	2630.	24.38
2 COMBINED AT							
+	710*	146936.	20.25	130120.	58578.	22730.	301.37
ROUTED TO							
+	710700	146342.	20.50	129474.	58555.	22726.	301.37
HYDROGRAPH AT							
+	PD730	284.	18.25	272.	94.	38.	.48
ROUTED TO							
+	CAP220	284.	18.25	272.	94.	38.	.48
HYDROGRAPH AT							
+	PD735	1810.	18.25	1701.	602.	244.	3.23
ROUTED TO							
+	CAP210	1810.	18.25	1699.	602.	244.	3.23
2 COMBINED AT							
+	736	2094.	18.25	1970.	696.	281.	3.71
ROUTED TO							
+	735700	2082.	18.75	1859.	693.	280.	3.71
HYDROGRAPH AT							
+	PD700	4299.	18.25	4058.	1214.	446.	7.26
2 COMBINED AT							
+	700	6377.	18.25	5587.	1901.	725.	10.97
2 COMBINED AT							
+	700*	147770.	20.50	131715.	60368.	23442.	312.34

*** NORMAL END OF HEC-1 ***

APPENDIX J. MODEL VERIFICATION USING INDIRECT METHODS

Figure MD-J.1
Verification of Results: Unit Peak Discharge

Figure 8.1
PEAK DISCHARGE RELATIONS AND ENVELOPE CURVES



Area of Existing and Future 100-yr HEC-1 Output.

FIGURE MD-J.2a
Verification of Results: USGS Data for Maricopa County

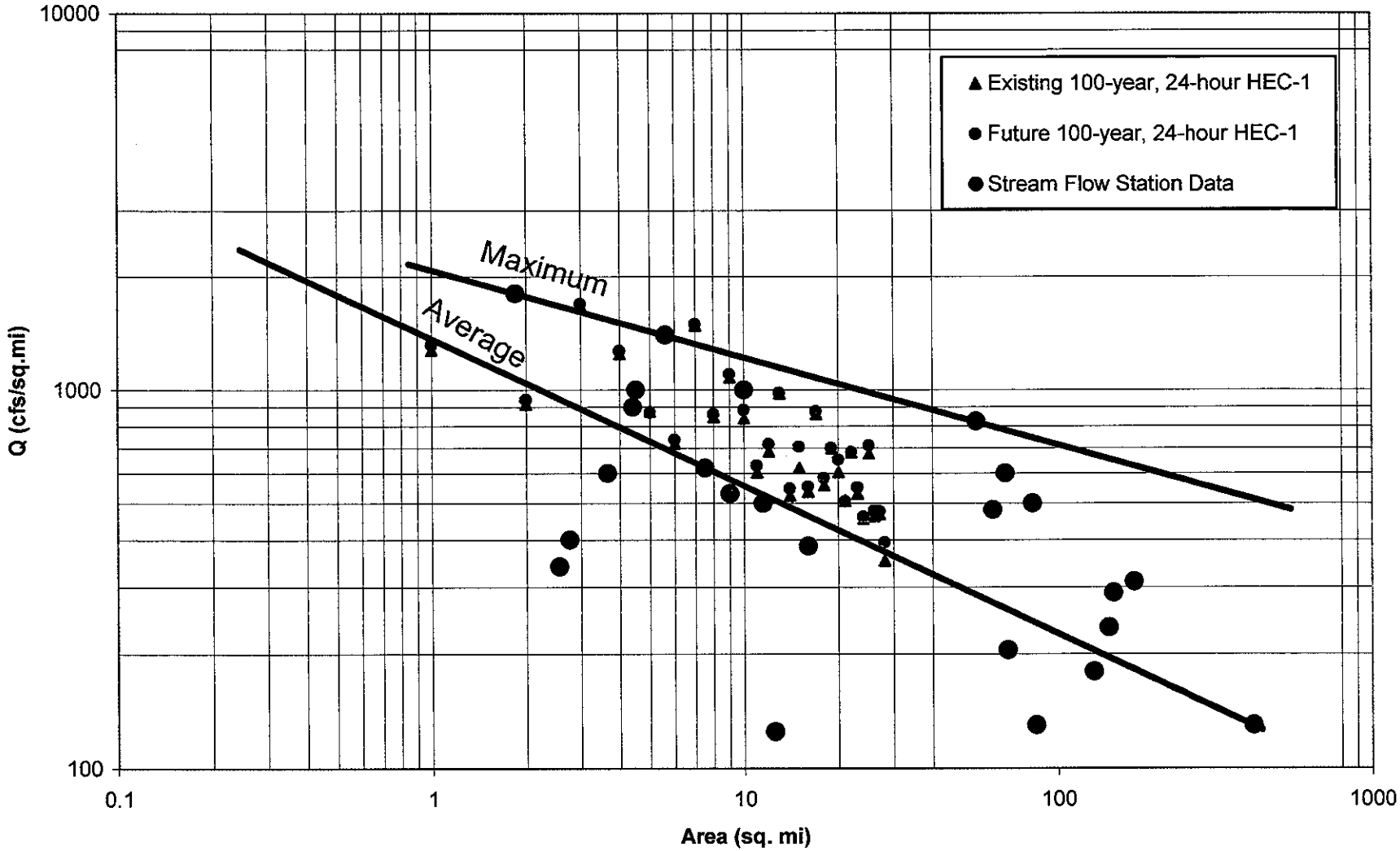


FIGURE MD-J.2b
Verification of Results: Regression Equations

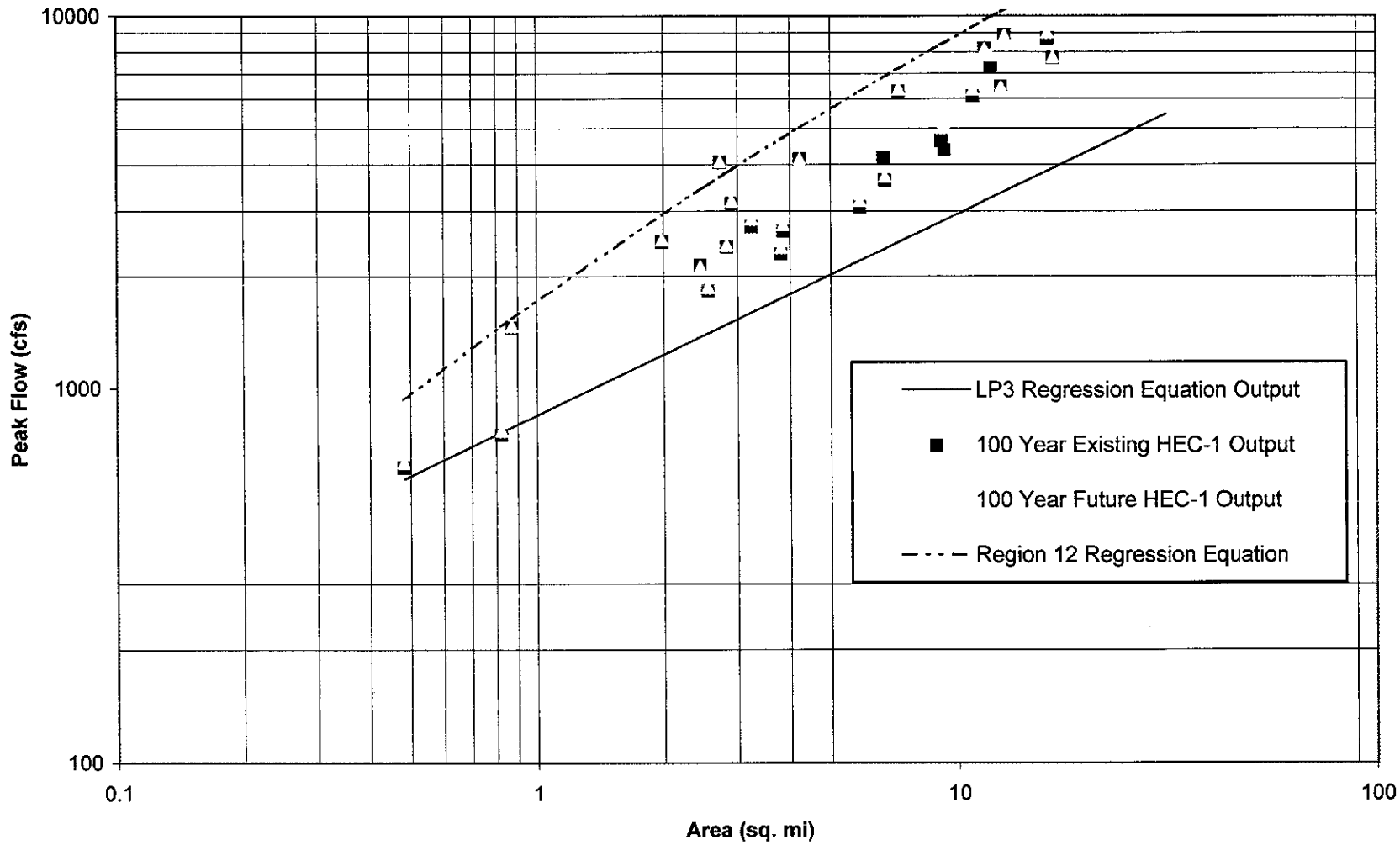
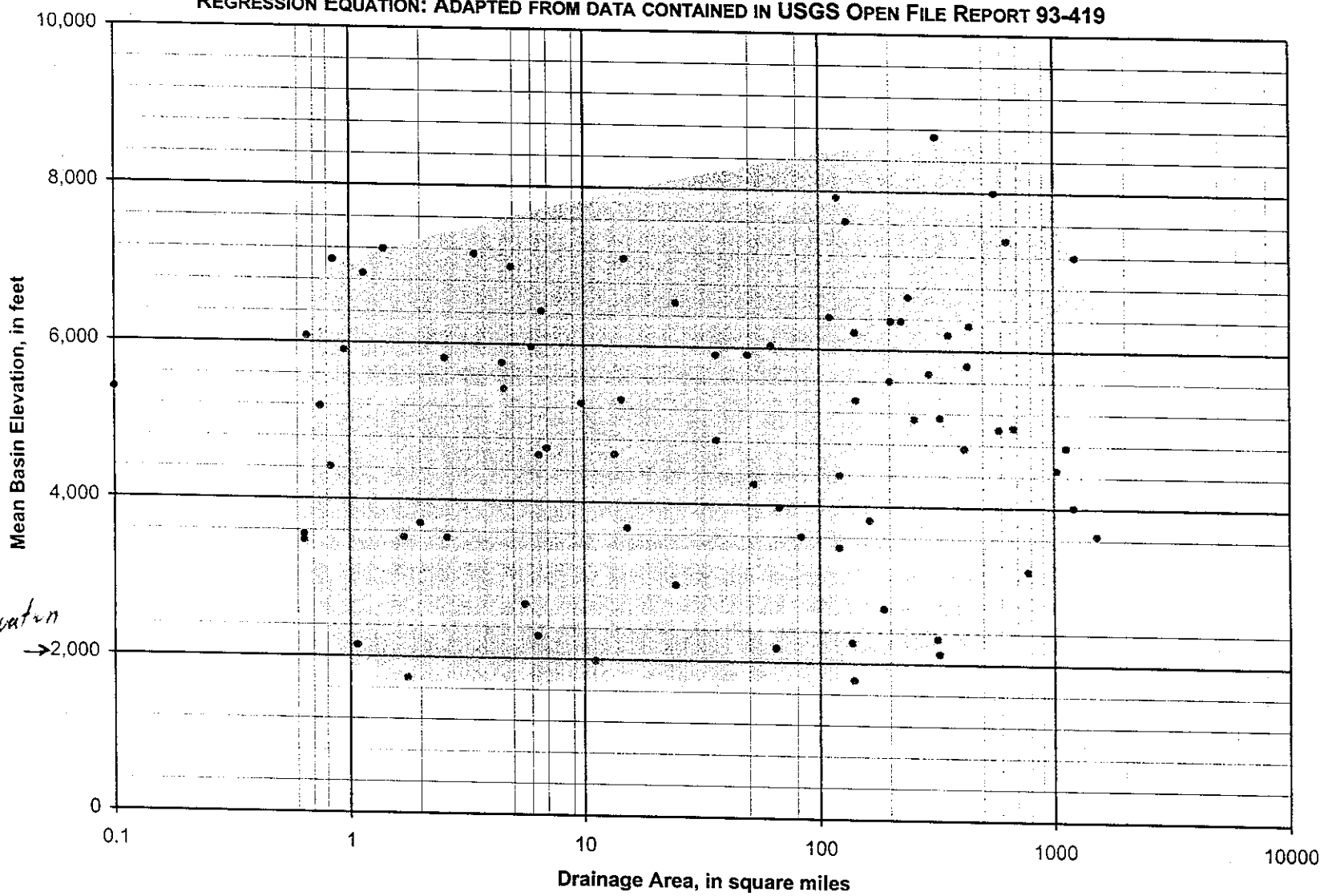


Figure MD-J.3
Verification of Results: Regression Validity Check

Figure 8.7
SCATTER DIAGRAM OF INDEPENDENT VARIABLES FOR FLOOD REGION 12
REGRESSION EQUATION: ADAPTED FROM DATA CONTAINED IN USGS OPEN FILE REPORT 93-419

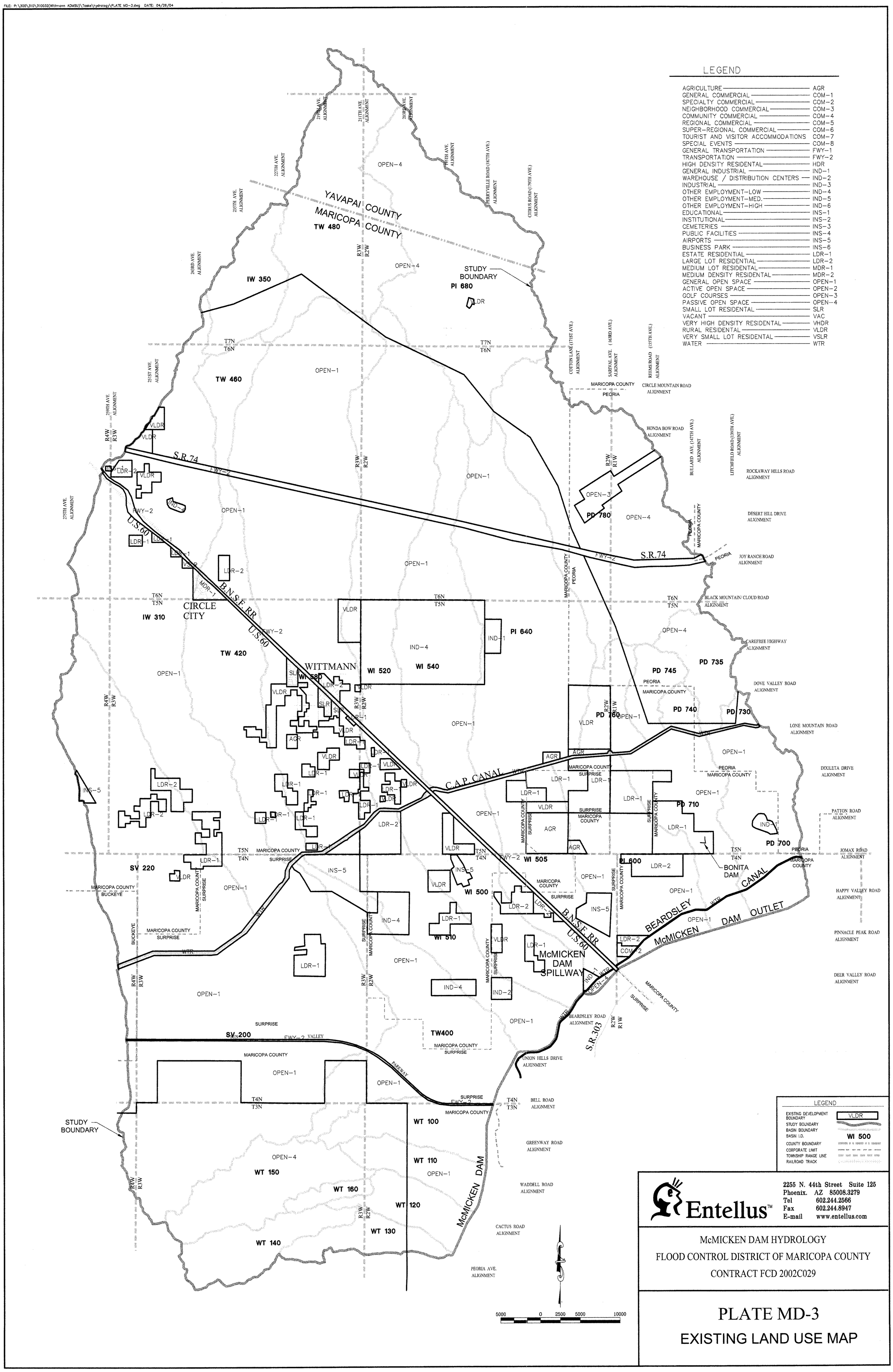


Average Elevation = 2060 ft → 2,000

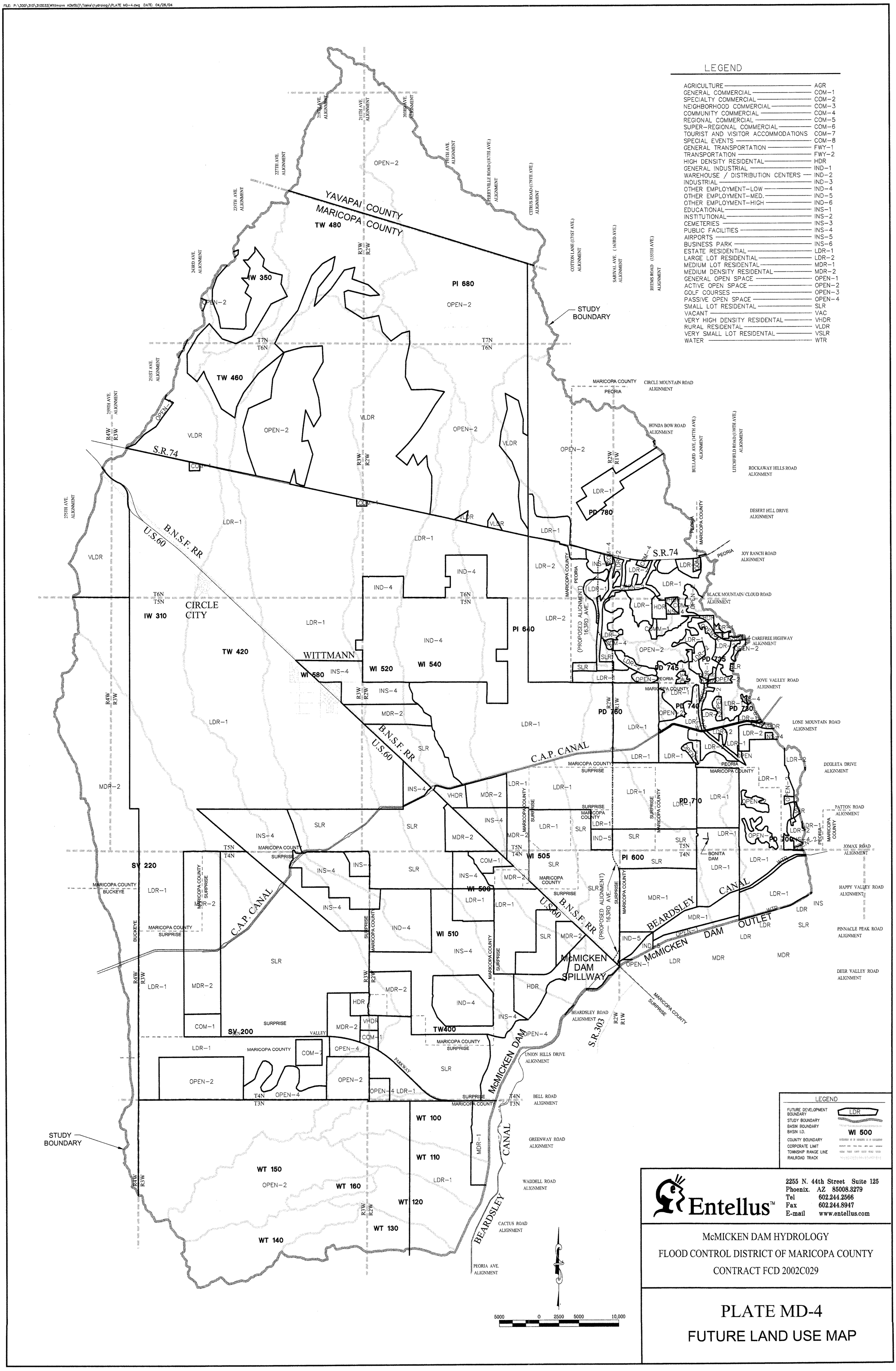
Ok.

APPENDIX K. PLATES AND ELECTRONIC FILES

FILE: P:\300\310\310032(Wittmann ADMSU)\Tasks\hydrology\PLATE MD-3.dwg DATE: 04/26/04



FILE: P:\300\310\310032(Wittmann ADMSU)\Tasks\hydrology\PLATE MD-4.dwg DATE: 04/26/04



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CONTRACT FCD 2002C029

PLATE MD-4
FUTURE LAND USE MAP

FILE: P:\300\310\310032(Wittmann ADMSU)\Tasks\hydrology\PLATE MD-5.dwg DATE: 04/26/04

NOTE:
FOR PURPOSE OF CLARITY, SOIL I.D. LABELS IN A BOX ARE SHOWN OUTSIDE OF THE SOIL BOUNDARY IT DENOTES.

LEGEND

SOIL SURVEY OF YAVAPAI COUNTY,ARIZONA,WESTERN PART

- CnF — Cellar Very Rocky Sandy Loam
- CmD — Cellar Very Gravelly Sandy Loam
- Lh — Lehmans Extremely Rocky Clay Loam
- Rr — Rockland
- Le — Lehmans Gravelly Clay Loam

SOIL SURVEY OF MARICOPA COUNTY,ARIZONA

- Aa — Agualt Loam
- AbA — Antho sandy loam
- AdA — Antho gravelly sandy loam
- AdB — Antho gravelly sandy loam
- Ae — Antho-Brios sandy loams
- AGB — Antho-Carrizo complex
- AHC — Antho-Tremant complex
- AkB — Antho-Tremant-Mohall complex
- AL — Antho association
- Bs — Brios sandy loam
- Bt — Brios loam
- CO — Cherioni-Rock outcrop complex
- Cp — Coolidge sandy loam
- Cs — Coolidge-Tremant complex
- EPD — Ebon-Pinamt complex
- Es — Estrella loam
- GgA — Gilman loam
- GM — Gilman-Antho association
- GWD — Gunsight-Pinal complex
- GxB — Gunsight-Rillito complex
- GYD — Gunsight-Rillito complex
- Lb — Laveen sandy loam
- LcA — Laveen loam
- Ma — Maripo sandy loam
- Mo — Mohall sandy loam
- Mp — Mohall loam
- Mr — Mohall clay loam
- MTB — Mohall-Tremant loam
- MV — Mohall-Laveen association
- PeB — Perryville gravelly loom
- PRB — Perryville-Rillito loam
- PWB — Pinal-Suncity complex
- RS — Rock outcrop-Cherioni complex
- TB — Torrifluvent
- TfA — Tremant gravelly loam
- TfB — Tremant gravelly loam
- Tg — Tremant clay loam
- Th — Tremant gravelly clay loam
- TPB — Tremant complex
- TrA — Tremant-Rillito complex
- TrB — Tremant-Rillito complex
- TSC — Tremant-Rillito complex
- Va — Valencia sandy loam
- Ve — Vecont loam
- Vf — Vecont clay
- Vr — Vint-Carrizo complex

SOIL SURVEY OF AGUILA-CAREFREE AREA

- 1 — Antho sandy loams
- 2 — Antho gravelly sandy loam
- 3 — Antho-Carrizo-Maripo complex
- 7 — Anthony-Arizo complex
- 8 — Arizo cobby sandy loam
- 10 — Brios-Carrizo complex
- 13 — Carefree-Beardsly complex
- 16 — Cherioni-Rock outcrop complex
- 18 — Cherioni-Rock outcrop complex
- 21 — Cipriano very gravelly loam
- 22 — Contine clay loam
- 23 — Contine clay
- 28 — Continental-Ohoca complex
- 29 — Denure-Momoli-Carrizo complex
- 31 — Dixaleta-Rock outcrop complex
- 33 — Eba very gravelly loam
- 34 — Eba very gravelly loam
- 35 — Eba very gravelly loam
- 36 — Eba-Continental complex
- 38 — Eba-Continental-Cave association
- 39 — Eba-Nickel-Cave association
- 42 — Eba-Pinaleno complex
- 43 — Eba-Pinaleno complex
- 44 — Ebon very gravelly loam
- 45 — Ebon very gravelly loam
- 46 — Ebon-Contine cmplex
- 47 — Ebon-Gunsight-Cipriano association
- 48 — Ebon-Pinamt Complex
- 49 — Ebon-Pinamt Complex
- 50 — Estrella loams
- 52 — Gachado-Lomitas-Rock outcrop complex
- 53 — Gadsden clay
- 55 — Gilman loams
- 57 — Gilman clay loam
- 58 — Gilman-Momoli-Denure complex
- 60 — Glenbar loams
- 62 — Gran-Wickenburg complex
- 63 — Gran-Wickenburg-Rock outcrop complex
- 64 — Gran-Wickenburg-Rock outcrop complex
- 66 — Greyeagle-Continental-Nickel association
- 68 — Gunsight-Cipriano complex
- 70 — Gunsight-Rillito complex
- 72 — Lehmans-Rock outcrop complex
- 73 — Lehmans-Rock outcrop complex
- 74 — Luke-Cipriano association
- 75 — Mohall loam
- 76 — Mohall loam, calcareous solum
- 77 — Mohall clay loam
- 78 — Mohall clay loam, calcareous solum
- 80 — Mohall-Tremant complex
- 94 — Nickel-Cave complex
- 97 — Pinamt-Tres Hermanos complex
- 98 — Pinamt-Tremant complex
- 100 — Quilotosa-Vaiva-Rock outcrop complex
- 103 — Rock outcrop-Gachado complex
- 104 — Rock outcrop-Lehamans complex
- 108 — Schenco-Rock outcrop complex
- 109 — Schenco-Rock outcrop complex
- 110 — Suncity-Cipriano complex
- 112 — Tremant gravelly sandy loams
- 113 — Tremant gravelly loams
- 114 — Tremant gravelly loams, low precip.
- 115 — Tremant-Antho complex
- 118 — Tremant-Rillito complex
- 119 — Tremant-Suncity complex
- 121 — Tres Hermanos-Anthony complex
- 124 — Valencia sandy loams
- W — Water

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PLATE MD-5
SOILS MAP

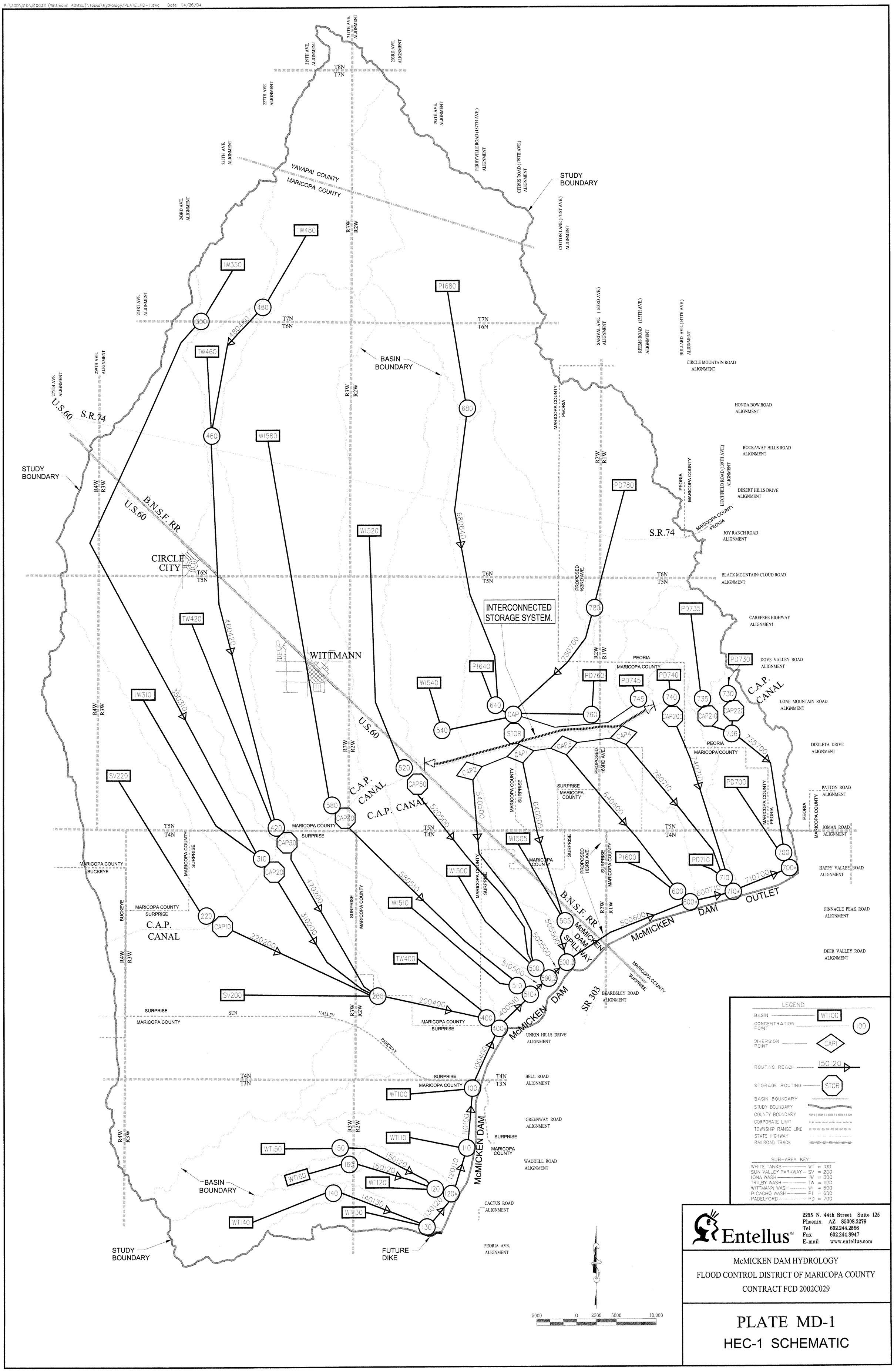

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PLATE MD-1

HEC-1 SCHEMATIC

P:\300\310\310032 (Wittmann ADMSU)\Tasks\hydrology/PLATE_MD-2.dwg Date: 04/26/04

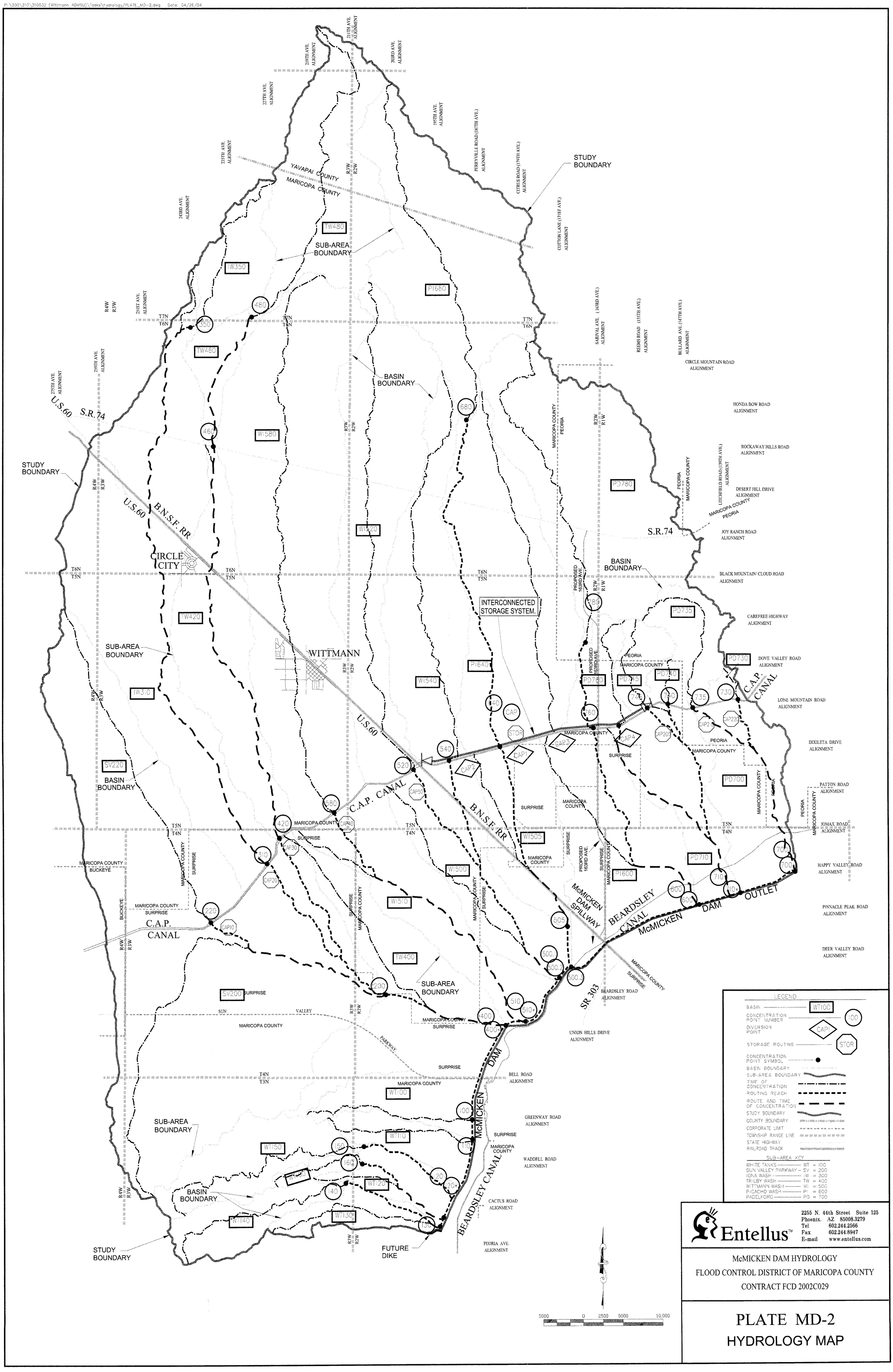

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PLATE MD-2

HYDROLOGY MAP

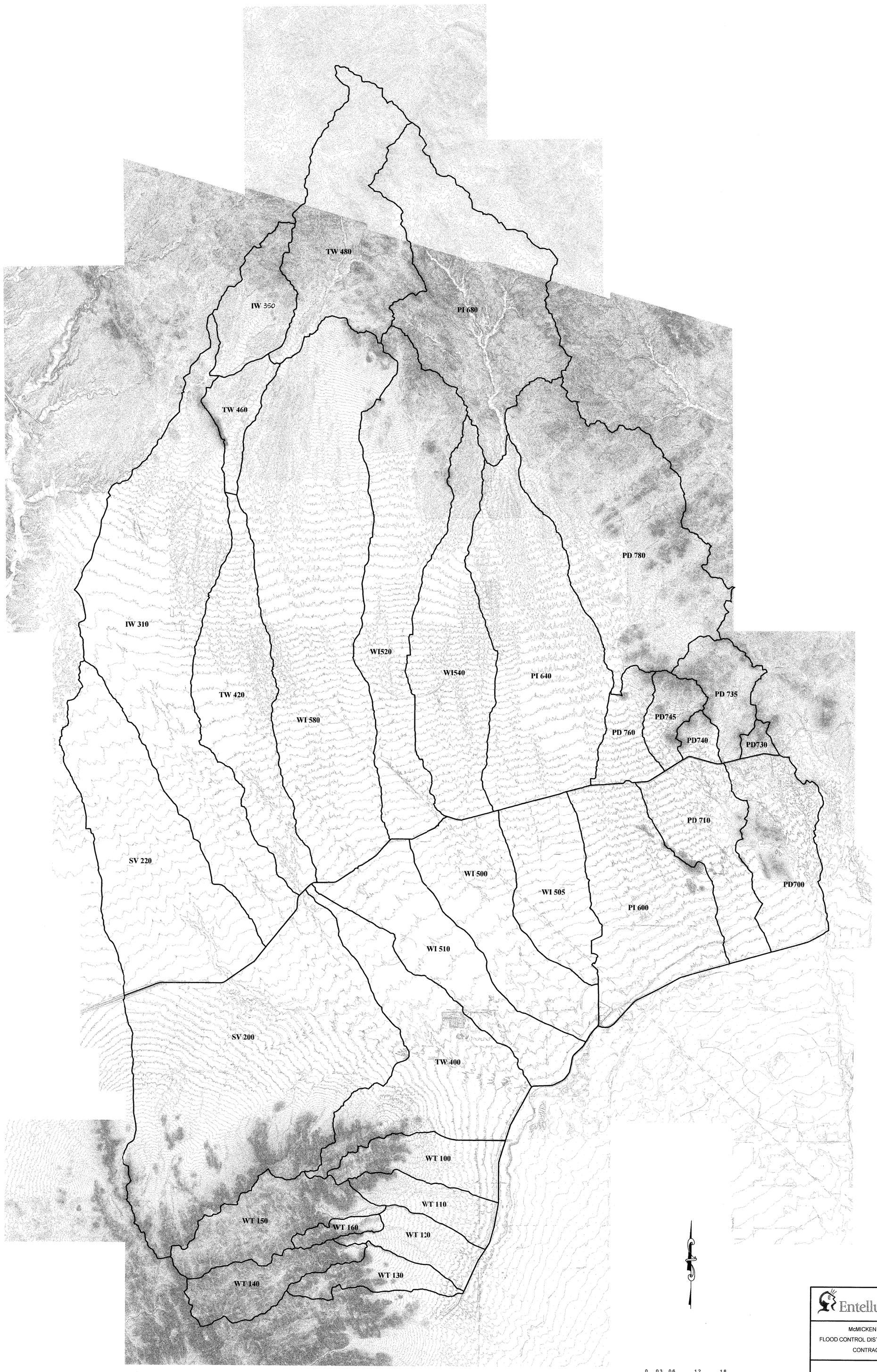

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PLATE MD-6
TOPOGRAPHIC MAP