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FINAL HYDROLOGY REPORT

FOR

TATUM BOULEVARD

CAIDA DEL SOL TO SHEA BOULEVARD

CITY OF PHOENIX

PROJECT NO. P-886515

REGISTERED PROFESSIONAL ENGINEER (CIVIL)
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INTRODUCTION

This report presents the existing hydrologic conditions for Tatum Boulevard between Caida Del Sol and Shea Boulevard. This section of Tatum Boulevard is within the jurisdiction of the City of Phoenix. However, the east right of way of Tatum Boulevard coincides with the boundary between the City of Phoenix and the Town of Paradise Valley. Tatum Boulevard is a four-lane arterial street that will be upgraded to a six-lane arterial street (three lanes in each direction) with a raised, landscaped median.

This report provides the hydrologic assumptions, criteria and calculations necessary to determine the existing offsite peak flows contributing to Tatum Boulevard. A review of the preliminary version of this report, Preliminary Hydrology Report For Tatum Boulevard, Mockingbird Lane to Shea Boulevard, dated March 30, 1990, was made by Kaminski-Hubbard Engineering, Inc. This review prompted changes to the preliminary hydrology which are addressed in this final report.

STUDY AREA

The study area (See Figure 1) is located in northeast Phoenix near the Town of Paradise Valley. The study area is bound to the west and south by the Phoenix Mountain Preserve, to the east by Tatum Boulevard, and to the north by Shea Boulevard. A large percentage of storm runoff originates in the mountains west of Tatum Boulevard which naturally drains easterly to the Indian Bend Wash. Much of the study area is impervious because of rock outcrops in the mountains and the high degree of developments throughout the area.

The storm runoff is conveyed primarily along residential streets and subdivision drainage ways. Runoff reaching Tatum Boulevard either "sheet flows" across the roadway via dips or flows under the roadway via pipe culverts. The Tatum Foothills and Rancho Alta Vida subdivisions (See Plate 1) have retention basins that collect both onsite and offsite runoff. These retention basins decrease the amount of storm runoff reaching Tatum Boulevard from the Phoenix Mountains.

The study area contains two significant unnamed washes that drain a large portion of the Phoenix Mountain Preserve. One wash located in the southern half of the study area discharges runoff directly onto Tatum Boulevard at Doubletree Ranch Road. Runoff either flows northerly along Tatum Boulevard or easterly along Doubletree Ranch Road to the Indian Bend Wash. The second wash is located in the northern half of the study area and discharges runoff into six 36" x 22" corrugated metal pipe (CMP) arch culverts that convey flow easterly under Tatum Boulevard to a man-made downstream channel.

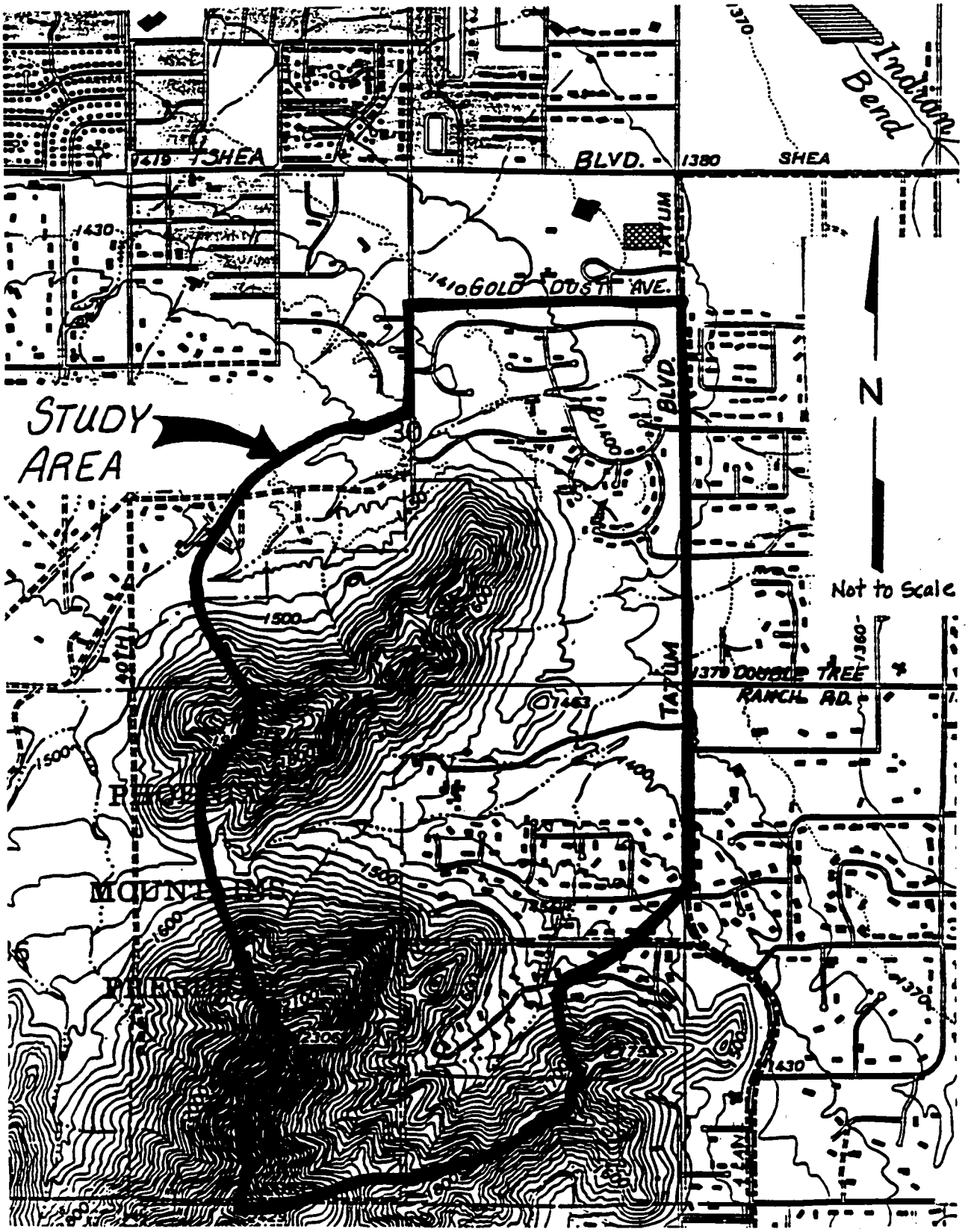
STUDY AREA
SHEA BLVD.
SHEA
Indian Bend
GOLD DUST AVE.
TATUM BLVD.
TATUM
DOUBLE TREE RANCH RD.
40TH
N
Not to Scale
1500
1400
1430
1380
1370
1360
1600
7463
7531

FIGURE 1

Runoff along the eastern half of Tatum Boulevard proceeds easterly along residential streets or along subdivision drainageways. The subdivisions east of Tatum Boulevard are located within the Town of Paradise Valley. As storm runoff approaches Indian Bend Wash, the longitudinal slope begins to flatten to approximately 0.5 percent. This flattening of longitudinal slopes creates both a flooding problem and a sedimentation problem. According to our investigations, no plans have been made by the Town of Paradise Valley to implement a storm drainage plan to alleviate these drainage problems. The Town of Paradise Valley has a drainage concept of maintaining the existing drainage patterns within the study area.

EXISTING DRAINAGE FACILITIES

The two previously mentioned unnamed washes that drain a large portion of the Phoenix Mountain Preserve become channelized through subdivisions west of Tatum Boulevard. One channel is located within the Doubletree Canyon subdivision and drains an area of approximately 360 acres. This gunite-lined channel begins at Horseshoe Road and continues northeasterly through the subdivision to 47th Place. Upstream of 47th Place, the channel composition changes from gunite to grass and gradually widens as it approaches Tatum Boulevard. This portion of Tatum Boulevard has received a number of flooding complaints from residents along Doubletree Ranch Road.

The other channel is trenched through the Rancho Alta Vida subdivision and drains approximately 152 acres. This channel begins at 44th Street and conveys storm runoff to six 36" x 22" CMP culverts. These culverts convey storm runoff under Tatum Boulevard and discharge directly into the Mountain View Estates subdivision located in the Town of Paradise Valley.

Drainage from the Tatum Foothills subdivision is collected in retention basins located west of Tatum Boulevard between Doubletree Ranch Road and Fanfol Drive (West). These basins will collect nuisance water from the Tatum Foothills subdivision and overflow across Tatum Boulevard for large storm events. This flow will continue easterly in a channel through the Foothills Estates II subdivision.

There are approximately four retention basins located within the Rancho Alta Vida subdivision. Each of these basins have overflow spillways that will discharge runoff into residential streets. These overflows will eventually end up in Tatum Boulevard.

The only storm drain facility along Tatum Boulevard is an existing 36" storm drain collector line that extends approximately 764 feet south of the Shea Boulevard 78" storm drain trunk line. There are three curb opening type catch basins north of Mountain View Road along Tatum Boulevard that collect pavement drainage. These catch basins are connected to the six 36" x 22" CMP arch culverts.

Numerous dips along Tatum Boulevard have allowed the continuation of surface flows eastward along residential streets. This surface flow across Tatum Boulevard has been both a nuisance to area residents and a hazard to motorists travelling in both directions.

HYDROLOGY

The HEC-1 computer program was used to determine the rainfall runoff relationship for offsite areas contributing to Tatum Boulevard. The offsite peak discharges for the 2-, 10-, 25-, 50- and 100-year storm events were determined using a 6-hour and 24-hour storm duration. The study area was divided into a number of subareas to better define the runoff process by taking into account the variations in topography and urbanization.

The 6- and 24-hour rainfall depths were obtained from the City of Phoenix Storm Drain Design Manual. The rainfall distribution for the 6-hour storm duration was obtained from the Flood Control District of Maricopa County's (FCDMC) Drainage Design Manual. The City of Phoenix rainfall distribution for a 24-hour storm duration was used. The rainfall depths and distributions are presented in Appendix A.

Based on the General Soil Map of Maricopa County by the Soil Conservation Service (SCS), soils within the study area would be classified as a "Group D" soil. Soil Group D has a high runoff potential with very slow infiltration rates and very slow transmission rates.

Curve numbers are assigned to each soil-cover complex. In areas with mixed land use, a composite or weighted curve number was developed based on the percentage of the total area that is made up of each land use. A curve number of 86 was used for zoning classification RE-43, which is the classification for all residential areas within the study area. A minimum curve number of 95 was used for mountainous terrain having slopes greater than 10 percent.

A time of concentration for each subarea was computed using the method outlined in the manual, Urban Hydrology for Small Watersheds, by the U.S. Department of Agriculture. This method involves the summation of sheet flow, shallow concentrated flow, open channel or street flow, or some combination of these. A minimum time of concentration of 10 minutes was used.

The Muskingum-Cunge method of channel routing was used to route a hydrograph through a downstream subarea. Channel cross-sections, slopes and Manning's roughness coefficients were estimated using topographic mapping and field observations. The Modified Puls Method of reservoir routing was used to route a hydrograph through a detention basin. Detention basin volume calculations were performed using survey cross-sections. Pipe culvert capacities were determined using HEC-5 procedures.

The Rational Method of hydrology was used to compute the peak runoff within the study area for offsite drainage areas less than 40 acres. The peak discharges were computed for the 2-, 10-, 50-. and 100-year storm event using the City of Phoenix rainfall intensity-duration-frequency curves. A runoff coefficient of 0.50 to 0.60 was used for residential areas and 0.70 for mountainous terrain with slopes greater than 10 percent.

Gutter velocities for paved streets were computed using the "Gutter Flow" chart on page 26 of the City of Phoenix Storm Drain Design Manual. The drainage path length was divided by the gutter velocity to obtain the time of concentration. Where applicable, the overland flow time was determined using the nomograph on page 21 in the City of Phoenix Storm Drain Design Manual.

The retention volume requirements for a contributing area was computed using two methods. One method estimates the area under a hydrograph for the 2-, 10-, 50-, and 100-year storm event using a 2-hour storm duration.

$$\text{Volume in ft}^3 = Q_i \times 7200$$

The second method is similar to the first, except the computed time of concentration, Tc, for the contributing area was used in the following equation:

$$\text{Volume in ft}^3 = Q_i \times 2.67 \times Tc \times 0.5 \times 60$$

The computed retention volume using Method 1 was approximately two to three times greater than volumes computed using Method 2. Therefore, Method 1 retention volumes were compared against existing retention volumes to determine each basins level of protection. The existing volumes were determined by planimetering the area of retention basins using 1" = 100' aerials and multiplying these areas by an average depth of 3 ft.

HYDRAULICS

The culvert conveyance capacities were computed using the procedures outlined in HEC-5, Hydraulic Design of Highway Culverts. Channel capacities were computed using the Mannings' equation.

HYDROLOGIC RESULTS FOR EXISTING CONDITIONS

Drainage Area No. 1

Drainage Area No. 1 consists of approximately 68 percent mountainous areas and 32 percent residential areas. The mountainous areas are within the Phoenix Mountain Preserve and characterized by rugged terrain, steep gradients and somewhat "impermeable" soils (Group D soil). Prior to development, this area contained numerous washes that flowed from the mountains into an unnamed wash that flowed northeasterly to Doubletree Ranch Road. This wash has since been channelized through the Doubletree Canyon subdivision as a part of their development.

Plate 1 illustrates the delineation of subareas for Drainage Area No. 1, which encompasses approximately 404 acres. The HEC-1 computer model was used to determine peak discharges from Sub-Basin Nos. 100-104, 200-201, 300-302 and 501-503. This runoff is collected and conveyed by the above mentioned channel through the Doubletree Canyon subdivision. This gunite-lined channel begins at Horseshoe Road and continues northeasterly through the subdivision to 47th Place. Prior to reaching 47th Place, the channel changes from gunite to grass. Also, the channel cross-section gradually widens as it approaches Tatum Boulevard. The channel was designed for the 100-year storm event. Runoff discharging from the Doubletree Canyon subdivision channel has been a source of flooding at the Tatum Boulevard - Doubletree Ranch Road intersection.

The analysis presented in the Preliminary Hydrology Report for Tatum Boulevard for Drainage Area No. 1 has been revised to reflect drainage delineation changes made for Sub-Basin No. 500. For the new analysis, Sub-Basin No. 500 has been subdivided into Sub-Basin Nos. 500-1, 501, 502 and 503 as shown on Plate 1. The revised peak discharge results for a point southwest of the Tatum Boulevard and Doubletree Ranch Road intersection are presented in Table 1. The 6-hour duration peak discharge results are greater than the 24-hour results. The HEC-1 input and output files for the 6-hour storm duration are presented in Appendix B-1. Appendix B-2 contains the sub-basin areas, weighted curve number computations and time of concentration calculations.

The Rational Method was used to determine peak discharges from Sub-Basin Nos. 500-1, 510-1, 510-2 and 510-3. Offsite runoff from Sub-Basin No. 510-1 presently drains to Tatum Boulevard and then continues to flow north along the west pavement edge to an existing 24-inch pipe located approximately 216 feet south of Tomahawk Trail. This pipe also collects offsite runoff from Sub-Basin No. 510-2. This pipe conveys runoff under Tatum Boulevard and outlets into a natural drainage channel. The peak discharge results for Sub-Basin Nos. 500-1, 510-1, 510-2 and 510-3 are presented in Table 2. Appendix B-2 contains the peak discharge results for these areas.

TABLE 1

PEAK DISCHARGE SUMMARY SOUTHWEST OF TATUM BOULEVARD AND DOUBLETREE RANCH ROAD

STORM FREQUENCY (YR)	PEAK DISCHARGE (CFS)	
	6-HR	24-HR
2	363	224
10	858	478
25	1,215	661
50	1,438	769
100	1,466	882

TABLE 2

PEAK DISCHARGE SUMMARY FOR A PORTION OF DRAINAGE AREA NO. 1

STORM FREQUENCY (YR)	PEAK DISCHARGE (CFS)			
	500-1	510-1	510-2	510-3
2	26.5	5.5	5.7	8.2
10	43.0	8.9	9.2	13.3
25	50.2	10.7	10.8	15.9
50	55.9	12.2	12.1	17.9
100	64.5	13.7	13.8	20.1

Drainage Area No. 2

This region consists of approximately 31 percent mountainous areas and 69 percent residential areas. The area encompasses a portion of the Phoenix Mountain Preserve and the following subdivisions: a portion of Doubletree Canyon; Tatum Foothills; and a portion of Rancho Alta Vida. Prior to development, this region contained a network of numerous washes flowing from west to east that collected at a low point west of Tatum Boulevard between Arabian Way and Berneil Drive.

Plate 1 illustrates the delineation of subareas for Drainage Area No. 2, which encompasses an area of approximately 185 acres. Runoff from Sub-Basin Nos. 400 and 410 presently drain into two retention basins located west of Tatum Boulevard between Doubletree Ranch Road and Fanfol Drive (West). These basins were designed to retain nuisance water from the Tatum Foothills subdivision and overflow across Tatum Boulevard for large storm events. Once flows cross Tatum Boulevard, they are diverted north to a channel running easterly through the Foothills Estates II subdivision located in Paradise Valley. This channel has an approximate downstream capacity of 110 CFS.

The remaining portion of Drainage Area No. 2 includes runoff from the southern half of the Rancho Alta Vida subdivision. Runoff from Sub-Basin Nos. 423 and 432 presently drain into onsite retention basins within the subdivision. The initial subarea delineation for Sub-Basin No. 423 as presented in the Preliminary Hydrology Report for Tatum Boulevard has been revised to include the area south of Mountain View Road and east of 44th Street as shown on Plate 1.

Runoff from Sub-Basin Nos. 421-1, 421-2, 422, 431-1, 431-2A and 431-2B presently drain to Tatum Boulevard. Runoff crosses Tatum Boulevard via dips in the roadway. Runoff from Sub-Basin Nos. 422 and 421-2 proceeds easterly along Berneil Drive (East). Runoff from Sub-Basin No. 421-1 crosses Tatum Boulevard via a dip north of Fanfol Drive and proceeds easterly along Fanfol Drive. Runoff from Sub-Basin 431-1 and 431-2A crosses Tatum Boulevard via a dip at Mountain View Road and continues easterly along Mountain View Road.

Peak discharges for Sub-Basin Nos. 400 and 410 were computed using the HEC-1 computer model for the 2-, 10-, 25-, 50- and 100-year storm events. Flow was reservoir routed through the retention basins located west of Tatum Boulevard. The peak discharge results for 6-hour and 24-hour storm durations are presented in Table 3 and the HEC-1 input and output files for the 6-hour storm duration are presented in Appendix C-1. The 6-hour duration peak discharge results were greater than the 24-hour duration results.

Peak discharges for Sub-Basin Nos. 421-1, 421-2, 422, 423, 431-1, 431-2A, 431-2B and 432 were determined using the Rational Method because the corresponding drainage areas were less than 40 acres. The peak discharge results are presented in Table 4 for the 2-, 10-, 25-, 50- and 100-year storm events. The peak discharge calculations are presented in Appendix C-2.

Storm runoff from Sub-Basin Nos. 423 and 432 are collected in retention basins that have the capacity to retain the 10-year event. Therefore, these areas can be excluded from the 2-year storm analysis to determine the drainage impacts of Drainage Area No. 2 on Tatum Boulevard. The retention basin computations are presented in Appendix C-2.

TABLE 3

PEAK DISCHARGE SUMMARY FOR SUB-BASINS #400 AND #410

STORM FREQUENCY (YR)	PEAK DISCHARGE (CFS) SUB-BASINS NOS. 400 & 410	
	6-HR	24-HR
2	32	33
10	155	101
25	304	175
50	386	206
100	465	238

TABLE 4

PEAK DISCHARGE SUMMARY FOR A PORTION OF DRAINAGE AREA NO. 2

SUB-BASIN NO.	PEAK DISCHARGE (CFS) STORM FREQUENCY (YR)				
	2	10	25	50	100
421-1	5.4	8.5	10.0	11.1	12.3
421-2	6.8	10.7	12.7	14.1	15.5
422	9.7	15.7	18.6	20.6	23.3
423	49.8	79.7	94.7	104.7	117.1
431-1	4.6	7.4	8.6	9.6	10.8
431-2A	1.8	2.9	3.5	3.8	4.3
431-2B	2.2	3.5	4.0	4.5	5.1
432	9.3	14.8	17.5	19.4	21.4

Drainage Area No. 3

This region contains approximately 50 percent mountainous areas and 50 percent residential areas. The mountainous areas are within the Phoenix Mountain Preserve and characterized by rugged, steep gradients sloping from south to north. Before urbanization, this region contained numerous small washes flowing northeasterly to a large unnamed wash which flowed easterly through what is now the Rancho Alta Vida subdivision. This large wash intersects Tatum Boulevard between Mountain View Road and Onyx Avenue, and thus creates the main concentration point for Drainage Area No. 3.

Plate 1 illustrates the delineation of subareas for Drainage Area No. 3, which encompasses an area of approximately 152 acres. Runoff from Sub-Basin No. 443 is collected at 44th Street and conveyed by a man-made channel through Sub-Basin Nos. 442 and 441 to six 36" x 22" CMP arch culverts. These culverts convey storm runoff under Tatum Boulevard and discharge directly into the Mountain View Estates subdivision located in the Town of Paradise Valley.

Peak discharges for Drainage Area No. 3 were computed using the HEC-1 computer model for the 2-, 10-, 25-, 50- and 100-year return periods. The peak discharge results at Tatum Boulevard for the 6-hour and 24-hour storm durations are presented in Table 5 and the HEC-1 input and output files for the 6-hour storm duration are presented in Appendix D-1. Appendix D-2 contains the sub-basin areas, weighted curve number and time of concentration calculations. The 6-hour duration peak discharges were larger than the 24-hour duration results.

The existing six 36" x 22" CMP arch culverts have the capacity to convey 150 CFS without overtopping the west curb of Tatum Boulevard. These culverts were found to function under outlet control conditions having pipe losses equal to 2.5 feet. The downstream channel between Tatum Boulevard and 48th Place was designed to convey 210 CFS with 1.0 foot of freeboard. This channel then discharges onto Turquoise Avenue which has a street capacity of approximately 150 CFS. The pipe culvert and downstream channel capacity calculations are presented in Appendix D-2.

The rainfall distribution pattern for the 24-hour storm duration was incorrectly typed into the HEC-1 input files for Drainage Area No. 3 as presented in the Preliminary Hydrology Report for Tatum Boulevard. The rainfall distribution was corrected and the results presented in Table 5.

TABLE 5

PEAK DISCHARGE SUMMARY FOR DRAINAGE AREA NO. 3

STORM FREQUENCY) (YR)	PEAK DISCHARGE (CFS)	
	6-HR	24-HR
2	81	60
10	241	163
25	402	256
50	487	300
100	571	347

Drainage Area No. 4

This region is predominantly residential and encompasses an area of approximately 64 acres. Flow occurs along residential streets and is typically northerly or easterly through the northern portion of the Rancho Alta Vida subdivision. Flows ultimately drain to the intersection of Gold Dust Avenue and Tatum Boulevard. This intersection has a history of flooding during heavy rains and remains a nuisance area for smaller storms.

Plate 1 illustrates the delineation of subareas for Drainage Area No. 4. Runoff from Sub-Basin Nos. 452 and 453 presently drain into retention basins located within the Rancho Alta Vida subdivision. Runoff from Sub-Basin Nos. 451-1, 451-2, 451-3 and 451-4 contribute directly to the intersection of Tatum Boulevard and Gold Dust Avenue.

The initial subarea delineation for Drainage Area No. 4 as presented in the Preliminary Hydrology Report for Tatum Boulevard has been revised to include an area west of 44th Street and south of Gold Dust Avenue. The boundary between Sub-Basin Nos. 451 and 452 has also been revised.

Peak discharges from Sub-Basin Nos. 451-1, 451-2, 451-3, 451-4, 452 and 453 were computed using the Rational Method for the 2-, 10-, 25-, 50- and 100-year storm events. The peak discharge results are presented in Table 6 and the computations are presented in Appendix E.

The retention basin computations are presented for Sub-Basin Nos. 452 and 453 in Appendix E. The retention basin for Sub-Basin No. 453 has the capacity to retain the 100-year storm event. The retention basin for Sub-Basin No. 452 has enough capacity to retain the 25-year storm event. Therefore, Sub-Basin Nos. 452 and 453 can be excluded from the 2-year storm analysis study when determining drainage impacts on Tatum Boulevard.

TABLE 6

PEAK DISCHARGE SUMMARY FOR DRAINAGE AREA NO. 4

SUB-BASIN NO.	PEAK DISCHARGE (CFS)				
	STORM FREQUENCY (YR)				
	2	10	25	50	100
451-1	5.5	8.6	10.2	11.5	12.8
451-2	11.1	18.3	21.6	24.4	27.3
451-3	17.8	28.8	34.0	37.7	42.9
451-4	2.9	4.7	5.4	6.1	6.9
452	13.8	22.5	26.1	29.8	33.4
453	7.8	12.3	14.6	16.2	17.8

CONCLUSIONS AND RECOMMENDATIONS

The existing drainage patterns for storm runoff within the Tatum Boulevard Study Area are presented on Plate 1. Development has minimal impact on the overall drainage pattern within the study area. Street flooding along Tatum Boulevard continues to occur in locations where historical flows had once collected based on pre-development conditions.

The existing peak discharge results within the study area have been presented. Every effort must be made to maintain the existing drainage patterns for this project. When applicable, existing drainage structures should be replaced with structures of equal capacity. However, the paramount consideration should be not to make conditions worse for downstream property owners than they are today.

For Drainage Area No. 1, we propose that a detention basin be constructed in a drainage tract located southwest of the Tatum Boulevard and Doubletree Ranch Road intersection. Ideally, the detention basin should be designed with the objective that the maximum outflow from the basin during a 100-year storm event not exceed the capacity of the downstream conveyance structure.

This conveyance structure could be a channel alongside Doubletree Ranch Road or an underground pipe system. However, this structure would be entirely located within the Town of Paradise Valley. The Town of Paradise Valley has no future plans for collecting and conveying eastward surface flows to the Indian Bend Wash. Their philosophy for surface runoff is to maintain the historical drainage patterns throughout the area of development.

Any proposed underground drainage structure at the Tatum Boulevard and Doubletree Ranch Road intersection may require the acquisition of right-of-way from the Town of Paradise Valley. Also, a coordinated effort between the City of Phoenix and the Town of Paradise Valley would be required for any downstream improvements along Doubletree Ranch Road.

We recommend that the existing 24" pipe culvert located south of Tomahawk Trail collect and convey runoff across Tatum Boulevard from Sub-Basin Nos. 510-1 and 510-2. These two concentration points will be connected by a pipe system. Any overflows will continue north along Tatum Boulevard to the Doubletree Ranch Road intersection.

A storm drain system is proposed to collect flows from Sub-Basin Nos. 500-1 and 510-3. This pipe system will outfall at the same location as the conveyance structure proposed at the Doubletree Ranch Road and Tatum Boulevard intersection. Any overflows will drain to the Doubletree Ranch Road - Tatum Boulevard intersection and proceed easterly along Doubletree Ranch Road to the Indian Bend Wash.

The retention basins collecting runoff from Sub-Basin Nos. 400 and 410 within Drainage Area No. 2 may experience a slight volume reduction as a result of the proposed street widening of Tatum Boulevard. However, we are proposing an underground pipe culvert at this location to convey flows across Tatum Boulevard. This culvert would raise the existing roadway profile and may compensate for the loss retention volume resulting from this roadway widening.

We recommend a storm drain system in Tatum Boulevard to alleviate the runoff from Sub-Basin Nos. 421-1, 421-2 and 422 for the 2-year storm event. This storm drain system would outlet at the same location as the pipe culvert draining the retention basins for Sub-Basin Nos. 400 and 410. Runoff in excess of the 2-year storm will follow historical drainage patterns along subdivision drainageways and residential streets.

For Drainage Area No. 3, the six 36" x 22" CMP arch culvert were found to convey 150 cfs. We recommend that these pipes be replaced by culverts of equal capacity. This replacement is necessary to satisfy the criteria of not making conditions any worse downstream than they are now.

For Drainage Area No. 4, we recommend the installation of a storm drain system in Tatum Boulevard to alleviate the runoff from Sub-Basin Nos. 451-1, 451-2, 451-3 and 451-4 for the 2-year storm event. This storm drain system will ultimately outfall into the 78-inch trunk lines located in Shea Boulevard.

APPENDIX A

HYDROLOGIC DESIGN PARAMETERS & CHARTS

Rainfall Table

(Percent total rainfall/100 by 0.5 hour increments for 24 hour storm)

.000	.004	.008	.013	.018
.022	.026	.031	.035	.040
.044	.048	.053	.057	.062
.066	.071	.075	.080	.093
.107	.120	.14	.17	.50
.83	.86	.88	.893	.907
.92	.924	.928	.933	.937
.942	.947	.951	.956	.96
.964	.969	.973	.978	.982
.987	.991	.995	1.00	1.00

PHOENIX WBO RECORDS*

(24-hour duration storm)

Return Periods, Years	Precipitation, Inches
1	1.02
2	1.44
5	2.10
10	2.53
25	3.12
50	3.57
100	4.04

*Technical Memorandum WBTM WR-44

ESTIMATED RETURN PERIODS FOR
SHORT-DURATION PRECIPITATION
IN ARIZONA
(Inches)

Station: Phoenix WBC
Latitude: 33° 26′
Longitude: 112° 01′
Elevation (feet): 117

RETURN PERIOD (YEARS)

DURATIONS	1	2	5	10	25	50	100
5 min.	0.17	0.26	0.38	0.47	0.59	0.66	0.77
10 min.	0.27	0.40	0.59	0.72	0.81	1.06	1.20
15 min.	0.34	0.50	0.74	0.92	1.15	1.34	1.52
30 min.	0.47	0.70	1.3	1.27	1.60	1.86	2.10
1 hr.	0.80	0.88	1.30	1.61	2.02	2.35	2.66
2 hr.	0.65	0.94	1.39	1.72	2.15	2.49	2.82
3 hr.	0.68	1.01	1.48	1.82	2.27	2.62	2.97
6 hr.	0.81	1.16	1.70	2.07	2.57	2.96	3.35
12 hr.	0.91	1.30	1.90	2.30	2.84	3.25	3.69
24 hr.	1.02	1.44	2.10	2.53	3.12	3.57	4.04

6-HOUR STORM RAINFALL DISTRIBUTIONS
(Furnished By FCDMC's Maricopa County Unit Hydrograph Procedure 2)
Cumulative Rainfall Table

Storm Time	Watershed Area (SQ. MI.)				
(Hours)	≤ 0.5	2.8	16	90	500
0.00	0.000	0.000	0.000	0.000	0.000
0.25	0.008	0.009	0.015	0.021	0.024
0.50	0.016	0.016	0.020	0.035	0.043
0.75	0.025	0.025	0.030	0.051	0.059
1.00	0.033	0.034	0.048	0.071	0.078
1.25	0.041	0.042	0.063	0.087	0.098
1.50	0.050	0.051	0.076	0.105	0.119
1.75	0.058	0.059	0.090	0.125	0.141
2.00	0.066	0.067	0.105	0.143	0.162
2.25	0.074	0.076	0.119	0.160	0.186
2.50	0.087	0.087	0.135	0.179	0.212
2.75	0.099	0.100	0.152	0.201	0.239
3.00	0.118	0.120	0.175	0.232	0.271
3.25	0.138	0.163	0.222	0.281	0.321
3.50	0.216	0.252	0.304	0.364	0.408
3.75	0.377	0.451	0.472	0.500	0.515
4.00	0.834	0.694	0.670	0.658	0.627
4.25	0.911	0.837	0.796	0.773	0.735
4.50	0.931	0.900	0.868	0.841	0.814
4.75	0.950	0.938	0.912	0.888	0.864
5.00	0.962	0.950	0.946	0.927	0.907
5.25	0.972	0.963	0.960	0.945	0.930
5.50	0.983	0.975	0.973	0.964	0.954
5.75	0.991	0.988	0.987	0.982	0.977
6.00	1.000	1.000	1.000	1.000	1.000

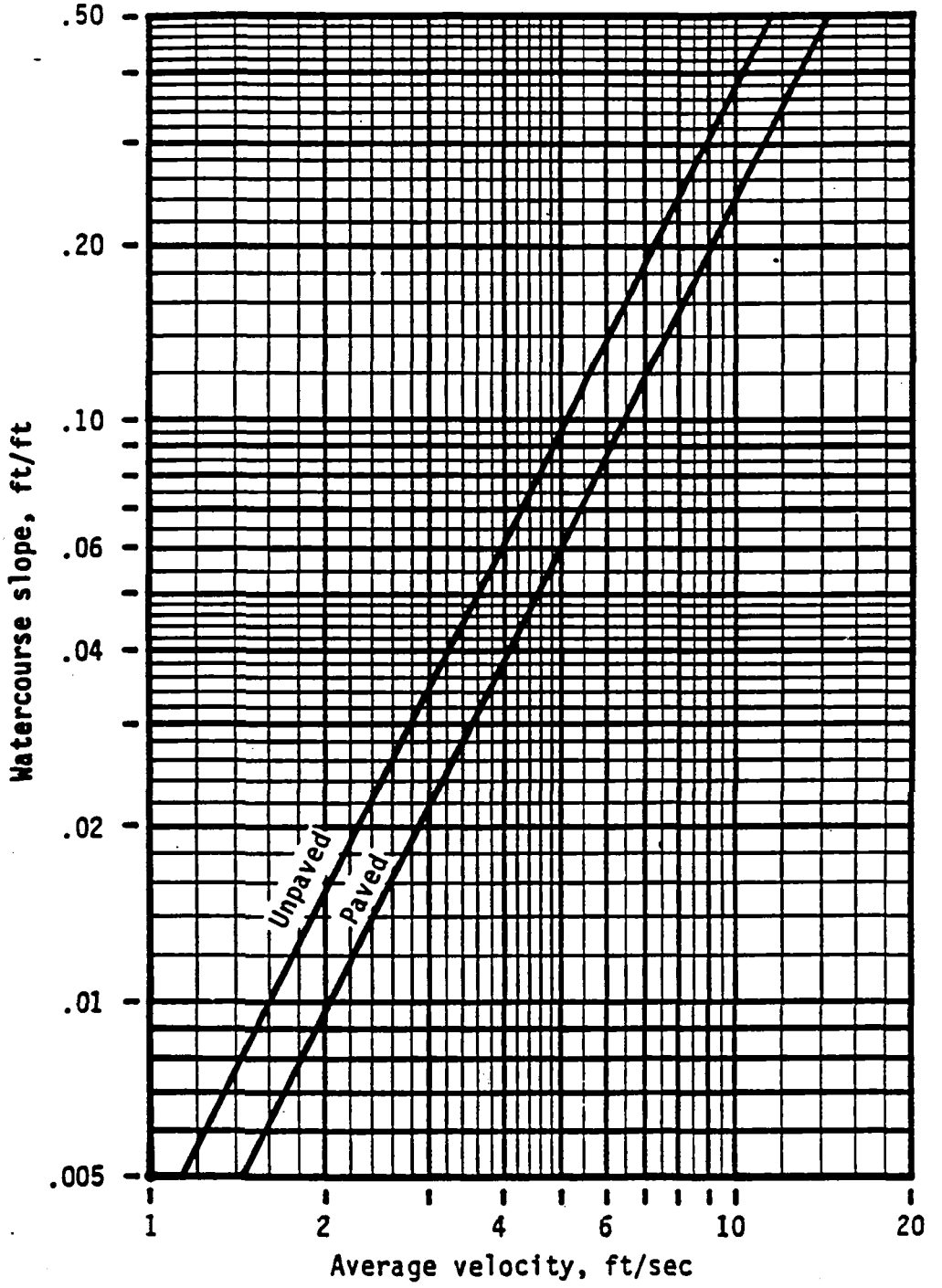

Figure 3-1.—Average velocities for estimating travel time for shallow concentrated flow.

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 stead uniform flow, (2) constant intensity of rainfall exces (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 figur 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 append F for figure 3-1. Tillage can affect the direction of shallow concentrated flow. Flow may not always b directly down the watershed slope if tillage runs across the slope.

After determining average velocity in figure 3-1, us equation 3-1 to estimate travel time for the shallow concentrated flow segment.

Open channels

Open channels are assumed to begin where survey cross section information has been obtained, where channels are visible on aerial photographs, or wher blue lines (indicating streams) appear on United States Geological Survey (USGS) quadrangle sheet Manning's equation or water surface profile information can be used to estimate average flow velocity. Average flow velocity is usually determin for bank-full elevation.

APPENDIX B-1

DRAINAGE AREA NO. 1
HEC-1 OUTPUT

```
****************************************
*                                      *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)  *
*              MAY   1991              *
*           VERSION 4.0.1E             *
*                                      *
* RUN DATE  01/14/93  TIME  07:38:08   *
*                                      *
****************************************
```

```
****************************************
*                                      *
*    U.S. ARMY CORPS OF ENGINEERS      *
*    HYDROLOGIC ENGINEERING CENTER     *
*          609 SECOND STREET           *
*       DAVIS, CALIFORNIA 95616        *
*           (916) 551-1748             *
*                                      *
****************************************
```

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

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

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

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

  1           ID                 CITY OF PHOENIX PROJECT NO. P-886515
  2           ID              TATUM BLVD. - MOCKINGBIRD LANE TO SHEA BLVD.
  3           ID           KAMINSKI - HUBBARD ENGINEERING, INC. - JOB NO. 0118
  4           ID                     HEC-1 FILENAME :  118-19.DAT
  5           ID                       2 YEAR - 6 HOUR STORM
  6           ID                 REVISED:  AUGUST 27, 1990 BY D.L.B.
              *DIAGRAM
  7           IT       4 07FEB90    1000     300 08FEB90    1000
  8           IO       5

  9           KK     100
 10           KM                     Subarea No. 100
 11           BA   .0852
 12           IN      15
 13           PB    1.16
 14           PC    .000    .008    .016    .025    .033    .041    .050    .058    .066    .074
 15           PC    .087    .099    .118    .138    .216    .377    .834    .911    .931    .950
 16           PC    .962    .972    .983    .991   1.000
 17           LS            95.0
 18           UD    .100

 19           KK    101R
 20           KM            Route Hydrograph 100 thru 101
 21           RD
 22           RC    .030    .030    .030    1360    .072
 23           RX      10      15      22      29      31      38      45      50
 24           RY       6       5       4       3       3       4       5       6

 25           KK     101
 26           KM                    Subarea No. 101
 27           BA   .0789
 28           LS            95.0
 29           UD    .106

 30           KK    101C
 31           KM            Combine Hydrographs 100 & 101
 32           HC       2

 33           KK    104R
 34           KM            Route Hydrographs 100/101 thru 104
 35           RD
 36           RC     .03     .03     .03    2320    .039
 37           RX      10      15      20      25      27      32      37      42
 38           RY       6       5       4       3       3       4       5       6

 39           KK     102
 40           KM            Subarea No. 102
 41           BA   .0259
 42           LS            92.0
 43           UD    .100
```

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

 44           KK    104R
 45           KM              Route Hydrograph 102 thru 104
 46           RD
 47           RC   -_.03     .03     .03    1600    .044
 48           RX      10      12      22      32      34      44      54      56
 49           RY       8       7       5       3       3       5       7       8

 50           KK     103
 51           KM             Subarea No. 103
 52           BA   .0318
 53           LS           94.0
 54           UD    .100

 55           KK    104R
 56           KM             Route Hydrograph 103 thru 104
 57           RD
 58           RC     .03     .03     .03    1320    .064
 59           RX      10      12      22      32      34      44      54      56
 60           RY       8       7       5       3       3       5       7       8

 61           KK     200
 62           KM             Subarea No. 200
 63           BA   .1858
 64           LS           95.0
 65           UD    .100

 66           KK    201R
 67           KM             Route Hydrograph 200 thru 201
 68           RD     640    .031    .030            TRAP       2       4

 69           KK     201
 70           KM             Subarea No. 201
 71           BA   .0035
 72           LS           86.0
 73           UD    .100

 74           KK    201C
 75           KM             Combine Hydrographs 200 & 201
 76           HC       2

 77           KK    104R
 78           KM             Route Hydrograph 200/201 thru 104
 79           RD     720    .022    .030            TRAP      10       9

 80           KK     104
 81           KM             Subarea No. 104
 82           BA   .0071
 83           LS           86.0
 84           UD    .100
```

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

 85           KK    104C
 86           KM            Combine Hydrographs 100-101/102/103/200-201 & 104
 87           HC       5

 88           KK    302R
 89           KM            Route Hydrographs 100-104/200-201 thru 302
 90           RD
 91           RC     .03    .018     .030     350   .0148
 92           RX    21.2    23.2     25.2      34      56    64.8    66.8    68.8
 93           RY     7.4     6.4      6.4       2       2     6.4     6.4     7.4

 94           KK     300
 95           KM            Subarea No. 300
 96           BA   .0224
 97           LS           93.2
 98           UD    .100

 99           KK    301R
100           KM            Route Hydrograph 300 thru 301
101           RD     720   .025     .015            TRAP       0      50

102           KK     301
103           KM            Subarea No. 301
104           BA   .0021
105           LS           86.0
106           UD    .131

107           KK    301C
108           KM            Combine Hydrographs 300-301
109           HC       2

110           KK    302R
111           KM            Route Hydrographs 300-301 thru 302
112           RD
113           RC     .03    .018      .03     350   .0148
114           RX    21.2    23.2     25.2      34      56    64.8    66.8    68.8
115           RY     7.4     6.4      6.4       2       2     6.4     6.4     7.4

116           KK     302
117           KM            Subarea No. 302
118           BA   .0029
119           LS           86.0
120           UD    .103

121           KK    302C
122           KM            Combine Hydrographs 100-104/200-201 & 300-302
123           HC       3

124           KK    501R
125           KM            Route Hydrographs 100-104/200-201 & 300-302 thru 501
126           RD
127           RC     .03    .018      .03     500   .0148
128           RX       8      10       12      24      50      62      64      66
129           RY       7       6        6       2       2       6       6       7
```

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

 130          KK     501
 131          KM             Subarea No. 501
 132          BA   .0007
 133          LS -         86.0
 134          UD    .100

 135          KK    501C
 136          KM             Combine Hydrographs 100-104/200-201/300-302 & 501
 137          HC       2

 138          KK    502R
 139          KM             Route Hydrographs 100-104/200-201/300-302 & 501 thru 502
 140          RD
 141          RC    .025    .025    .025     310   .0047
 142          RX    87.2    89.2    91.2     100     200   208.8   210.8   212.8
 143          RY     7.4     6.4     6.4       2       2     6.4     6.4     7.4

 144          KK     502
 145          KM             Subarea No. 502
 146          BA   .0027
 147          LS           63.0
 148          UD    .100

 149          KK    502C
 150          KM             Combine Hydrographs 100-104/200-201/300-302 & 501-502
 151          HC       2

 152          KK    503R
 153          KM             Route Hydrographs 100-104/200-201/300-302 & 501-502 thru 503
 154          RD
 155          RC    .025    .025    .025     260    .010
 156          RX      40      42      44      50     330     336     338     340
 157          RY       6       5       5       2       2       5       5       6

 158          KK     503
 159          KM           Subarea No. 503
 160          BA   .0039
 161          LS           63.0
 162          UD    .100

 163          KK    503C
 164          KM           Combine Hydrographs 100-104/200-201/300-302 & 501-503
 165          HC       2
 166          ZZ
```

SCHEMATIC DIAGRAM OF STREAM NETWORK

```
INPUT
 LINE      (V) ROUTING          (--->) DIVERSION OR PUMP FLOW

  NO.      (.) CONNECTOR        (<---) RETURN OF DIVERTED OR PUMPED FLOW

   9         100
               V
               V
  19         101R
               .
               .
  25           .         101
               .           .
               .           .
  30         101C............
               V
               V
  33         104R
               .
               .
  39           .         102
               .           V
               .           V
  44           .        104R
               .           .
               .           .
  50           .           .        103
               .           .          V
               .           .          V
  55           .           .       104R
               .           .          .
               .           .          .
  61           .           .          .        200
               .           .          .          V
               .           .          .          V
  66           .           .          .       201R
               .           .          .          .
               .           .          .          .
  69           .           .          .          .        201
               .           .          .          .          .
               .           .          .          .          .
  74           .           .          .       201C............
               .           .          .          V
               .           .          .          V
  77           .           .          .       104R
               .           .          .          .
               .           .          .          .
  80           .           .          .          .        104
               .           .          .          .          .
               .           .          .          .          .
  85         104C.......................................................
               V
               V
  88         302R
               .
               .
  94           .         300
               .           V
               .           V
  99           .        301R
               .           .
               .           .
 102           .           .        301
               .           .          .
```

```
                .          .          .
107             .       301C............
                .          V
                .          V
110             .       302R
                .          .
                .          .
116             .          .        302
                .          .--        .
                .          .          .
121          302C........................
                V
                V
124          501R
                .
                .
130             .        501
                .          .
                .          .
135          501C............
                V
                V
138          502R
                .
                .
144             .        502
                .          .
                .          .
149          502C............
                V
                V
152          503R
                .
                .
158             .        503
                .          .
                .          .
163          503C............
```

(***) RUNOFF ALSO COMPUTED AT THIS LOCATION

```
****************************************
*                                      *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)  *
*              MAY   1991              *
*           VERSION 4.0.1E             *
*                                      *
*  RUN DATE  01/14/93  TIME  07:38:08  *
*                                      *
****************************************
```

```
****************************************
*                                      *
*    U.S. ARMY CORPS OF ENGINEERS      *
*    HYDROLOGIC ENGINEERING CENTER     *
*          609 SECOND STREET           *
*       DAVIS, CALIFORNIA 95616        *
*          (916) 551-1748              *
*                                      *
****************************************
```

CITY OF PHOENIX PROJECT NO. P-886515
TATUM BLVD. - MOCKINGBIRD LANE TO SHEA BLVD.
KAMINSKI - HUBBARD ENGINEERING, INC. - JOB NO. 0118
HEC-1 FILENAME : 118-19.DAT
2 YEAR - 6 HOUR STORM
REVISED: AUGUST 27, 1990 BY D.L.B.

```
  8 IO          OUTPUT CONTROL VARIABLES
                      IPRNT          5  PRINT CONTROL
                      IPLOT          0  PLOT CONTROL
                      QSCAL         0.  HYDROGRAPH PLOT SCALE

   IT           HYDROGRAPH TIME DATA
                       NMIN          4  MINUTES IN COMPUTATION INTERVAL
                      IDATE     7FEB90  STARTING DATE
                      ITIME       1000  STARTING TIME
                         NQ        361  NUMBER OF HYDROGRAPH ORDINATES
                     NDDATE     8FEB90  ENDING DATE
                     NDTIME       1000  ENDING TIME
                      ICENT         19  CENTURY MARK

                COMPUTATION INTERVAL    0.07 HOURS
                     TOTAL TIME BASE   24.00 HOURS

         ENGLISH UNITS
              DRAINAGE AREA         SQUARE MILES
              PRECIPITATION DEPTH   INCHES
              LENGTH, ELEVATION     FEET
              FLOW                  CUBIC FEET PER SECOND
              STORAGE VOLUME        ACRE-FEET
              SURFACE AREA          ACRES
              TEMPERATURE           DEGREES FAHRENHEIT
```

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	100	83.	4.00	6.	2.	2.	0.09		
ROUTED TO	101R	81.	4.07	6.	2.	2.	0.09		
HYDROGRAPH AT	101	76.	4.00	6.	1.	1.	0.08		
2 COMBINED AT	101C	152.	4.07	12.	3.	3.	0.16		
ROUTED TO	104R	153.	4.07	13.	3.	3.	0.16		
HYDROGRAPH AT	102	20.	4.00	1.	0.	0.	0.03		
ROUTED TO	104R	19.	4.07	1.	0.	0.	0.03		
HYDROGRAPH AT	103	29.	4.00	2.	1.	1.	0.03		
ROUTED TO	104R	28.	4.07	2.	1.	1.	0.03		
HYDROGRAPH AT	200	182.	4.00	14.	4.	4.	0.19		
ROUTED TO	201R	175.	4.00	14.	4.	4.	0.19		
HYDROGRAPH AT	201	2.	4.07	0.	0.	0.	0.00		
2 COMBINED AT	201C	176.	4.00	14.	4.	4.	0.19		
ROUTED TO	104R	174.	4.07	14.	4.	4.	0.19		
HYDROGRAPH AT	104	3.	4.07	0.	0.	0.	0.01		
5 COMBINED AT	104C	377.	4.07	31.	8.	8.	0.42		
ROUTED TO	302R	373.	4.07	31.	8.	8.	0.42		
HYDROGRAPH AT	300	19.	4.00	1.	0.	0.	0.02		
ROUTED TO	301R	19.	4.07	1.	0.	0.	0.02		
HYDROGRAPH AT	301	1.	4.07	0.	0.	0.	0.00		
2 COMBINED AT	301C	19.	4.07	1.	0.	0.	0.02		
ROUTED TO	302R	19.	4.07	1.	0.	0.	0.02		
HYDROGRAPH AT	302	1.	4.07	0.	0.	0.	0.00		
3 COMBINED AT	302C	393.	4.07	32.	8.	8.	0.45		
ROUTED TO	501R	386.	4.07	32.	8.	8.	0.45		
HYDROGRAPH AT	501	0.	4.07	0.	0.	0.	0.00		
2 COMBINED AT	501C	386.	4.07	32.	8.	8.	0.45		
ROUTED TO	502R	372.	4.07	32.	8.	8.	0.45		
HYDROGRAPH AT	502	0.	0.07	0.	0.	0.	0.00		

2 COMBINED AT	502C	372.	4.07	32.	8.	8.	0.45
ROUTED TO	503R	363.	4.13	32.	8.	8.	0.45
HYDROGRAPH AT	503	0.	0.07	0.	0.	0.	0.00
2 COMBINED AT	503C	363.	4.13	32.	8.	8.	0.45

SUMMARY OF KINEMATIC WAVE - MUSKINGUM-CUNGE ROUTING
(FLOW IS DIRECT RUNOFF WITHOUT BASE FLOW)

ISTAQ	ELEMENT	DT (MIN)	PEAK (CFS)	TIME TO PEAK (MIN)	VOLUME (IN)	INTERPOLATED TO COMPUTATION INTERVAL DT (MIN)	PEAK (CFS)	TIME TO PEAK (MIN)	VOLUME (IN)
101R	MANE	2.37	81.48	241.85	0.70	4.00	80.58	244.00	0.70

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.3199E+01 EXCESS=0.0000E+00 OUTFLOW=0.3200E+01 BASIN STORAGE=0.1681E-03 PERCENT ERROR= 0.0

104R	MANE	3.39	153.29	243.87	0.71	4.00	153.14	244.00	0.71

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.6173E+01 EXCESS=0.0000E+00 OUTFLOW=0.6178E+01 BASIN STORAGE=0.4053E-03 PERCENT ERROR= -0.1

104R	MANE	2.20	19.63	246.40	0.52	4.00	19.23	244.00	0.53

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.7249E+00 EXCESS=0.0000E+00 OUTFLOW=0.7251E+00 BASIN STORAGE=0.1624E-03 PERCENT ERROR= -0.1

104R	MANE	3.14	27.56	242.00	0.64	4.00	27.53	244.00	0.64

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.1081E+01 EXCESS=0.0000E+00 OUTFLOW=0.1081E+01 BASIN STORAGE=0.1372E-03 PERCENT ERROR= -0.1

201R	MANE	1.04	179.63	240.83	0.70	4.00	174.72	240.00	0.70

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.6973E+01 EXCESS=0.0000E+00 OUTFLOW=0.6974E+01 BASIN STORAGE=0.2236E-03 PERCENT ERROR= 0.0

104R	MANE	1.68	175.81	242.07	0.70	4.00	174.17	244.00	0.70

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.7039E+01 EXCESS=0.0000E+00 OUTFLOW=0.7039E+01 BASIN STORAGE=0.5034E-03 PERCENT ERROR= 0.0

302R	MANE	0.47	375.03	244.32	0.68	4.00	372.83	244.00	0.68

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.1515E+02 EXCESS=0.0000E+00 OUTFLOW=0.1515E+02 BASIN STORAGE=0.2016E-04 PERCENT ERROR= 0.0

301R	MANE	2.44	18.55	244.25	0.59	4.00	18.54	244.00	0.59

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.7050E+00 EXCESS=0.0000E+00 OUTFLOW=0.7051E+00 BASIN STORAGE=0.3034E-03 PERCENT ERROR= -0.1

302R	MANE	2.22	18.92	245.96	0.56	4.00	18.79	244.00	0.56

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.7362E+00 EXCESS=0.0000E+00 OUTFLOW=0.7361E+00 BASIN STORAGE=0.2852E-04 PERCENT ERROR= 0.0

501R	MANE	0.71	390.90	244.65	0.67	4.00	385.70	244.00	0.67

```
CONTINUITY SUMMARY (AC-FT) - INFLOW=0.1595E+02 EXCESS=0.0000E+00 OUTFLOW=0.1596E+02 BASIN STORAGE=0.3541E-04 PERCENT ERROR=   0.0

            502R  MANE        1.26    381.44    245.13      0.67      4.00    371.76    244.00        0.67

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.1600E+02 EXCESS=0.0000E+00 OUTFLOW=0.1600E+02 BASIN STORAGE=0.5665E-04 PERCENT ERROR=   0.0

            503R  MANE        1.63    369.75    245.39      0.67      4.00    363.49    248.00        0.67

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.1601E+02 EXCESS=0.0000E+00 OUTFLOW=0.1601E+02 BASIN STORAGE=0.3425E-04 PERCENT ERROR=   0.0


*** NORMAL END OF HEC-1 ***
```

```
****************************************
*                                      *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)  *
*              MAY   1991              *
*           VERSION 4.0.1E             *
*                                      *
*  RUN DATE  01/14/93  TIME  07:34:46  *
*                                      *
****************************************
```

```
****************************************
*                                      *
*    U.S. ARMY CORPS OF ENGINEERS      *
*    HYDROLOGIC ENGINEERING CENTER     *
*          609 SECOND STREET           *
*       DAVIS, CALIFORNIA 95616        *
*          (916) 551-1748              *
*                                      *
****************************************
```

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

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

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

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

  1           ID                  CITY OF PHOENIX PROJECT NO. P-886515
  2           ID               TATUM BLVD. - MOCKINGBIRD LANE TO SHEA BLVD.
  3           ID            KAMINSKI - HUBBARD ENGINEERING, INC. - JOB NO. 0118
  4           ID                      HEC-1 FILENAME :  118-18.DAT
  5           ID                        10 YEAR - 6 HOUR STORM
  6           ID                 REVISED:  AUGUST 27, 1990 BY D.L.B.
              *DIAGRAM
  7           IT       4 07FEB90    1000     300 08FEB90    1000
  8           IO       5

  9           KK     100
 10           KM                     Subarea No. 100
 11           BA   .0852
 12           IN      15
 13           PB    2.07
 14           PC    .000    .008    .016    .025    .033    .041    .050    .058    .066    .074
 15           PC    .087    .099    .118    .138    .216    .377    .834    .911    .931    .950
 16           PC    .962    .972    .983    .991   1.000
 17           LS            95.0
 18           UD    .100

 19           KK    101R
 20           KM            Route Hydrograph 100 thru 101
 21           RD
 22           RC    .030    .030    .030    1360    .072
 23           RX      10      15      22      29      31      38      45      50
 24           RY       6       5       4       3       3       4       5       6

 25           KK     101
 26           KM                   Subarea No. 101
 27           BA   .0789
 28           LS            95.0
 29           UD    .106

 30           KK    101C
 31           KM            Combine Hydrographs 100 & 101
 32           HC       2

 33           KK    104R
 34           KM            Route Hydrographs 100/101 thru 104
 35           RD
 36           RC     .03     .03     .03    2320    .039
 37           RX      10      15      20      25      27      32      37      42
 38           RY       6       5       4       3       3       4       5       6

 39           KK     102
 40           KM            Subarea No. 102
 41           BA   .0305
 42           LS            92.0
 43           UD    .100
```

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

 44           KK    104R
 45           KM              Route Hydrograph 102 thru 104
 46           RD
 47           RC     .03     .03     .03    1600    .044
 48           RX      10      12      22      32      34      44      54      56
 49           RY       8       7       5       3       3       5       7       8

 50           KK     103
 51           KM             Subarea No. 103
 52           BA   .0333
 53           LS           94.0
 54           UD    .100

 55           KK    104R
 56           KM             Route Hydrograph 103 thru 104
 57           RD
 58           RC     .03     .03     .03    1320    .064
 59           RX      10      12      22      32      34      44      54      56
 60           RY       8       7       5       3       3       5       7       8

 61           KK     200
 62           KM             Subarea No. 200
 63           BA   .1858
 64           LS           95.0
 65           UD    .100

 66           KK    201R
 67           KM             Route Hydrograph 200 thru 201
 68           RD     640    .031    .030            TRAP       2       4

 69           KK     201
 70           KM             Subarea No. 201
 71           BA   .0117
 72           LS           86.0
 73           UD    .100

 74           KK    201C
 75           KM             Combine Hydrographs 200 & 201
 76           HC       2

 77           KK    104R
 78           KM             Route Hydrograph 200/201 thru 104
 79           RD     720    .022    .030            TRAP      10       9

 80           KK     104
 81           KM             Subarea No. 104
 82           BA   .0235
 83           LS           86.0
 84           UD    .100
```

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

 85           KK    104C
 86           KM            Combine Hydrographs 100-101/102/103/200-201 & 104
 87           HC       5

 88           KK    302R
 89           KM        -   Route Hydrographs 100-104/200-201 thru 302
 90           RD
 91           RC     .03    .018     .030     350   .0148
 92           RX    21.2    23.2     25.2      34      56    64.8    66.8    68.8
 93           RY     7.4     6.4      6.4       2       2     6.4     6.4     7.4

 94           KK     300
 95           KM            Subarea No. 300
 96           BA   .0245
 97           LS           93.2
 98           UD    .100

 99           KK    301R
100           KM            Route Hydrograph 300 thru 301
101           RD     720   .025     .015            TRAP       0      50

102           KK     301
103           KM            Subarea No. 301
104           BA   .0070
105           LS           86.0
106           UD    .131

107           KK    301C
108           KM            Combine Hydrographs 300-301
109           HC       2

110           KK    302R
111           KM            Route Hydrographs 300-301 thru 302
112           RD
113           RC     .03    .018      .03     350   .0148
114           RX    21.2    23.2     25.2      34      56    64.8    66.8    68.8
115           RY     7.4     6.4      6.4       2       2     6.4     6.4     7.4

116           KK     302
117           KM            Subarea No. 302
118           BA   .0097
119           LS           86.0
120           UD    .103

121           KK    302C
122           KM            Combine Hydrographs 100-104/200-201 & 300-302
123           HC       3

124           KK    501R
125           KM            Route Hydrographs 100-104/200-201 & 300-302 thru 501
126           RD
127           RC     .03    .018      .03     500   .0148
128           RX       8      10       12      24      50      62      64      66      -
129           RY       7       6        6       2       2       6       6       7
```

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

 130          KK     501
 131          KM             Subarea No. 501
 132          BA   .0023
 133          LS            86.0
 134          UD    .100

 135          KK    501C
 136          KM             Combine Hydrographs 100-104/200-201/300-302 & 501
 137          HC       2

 138          KK    502R
 139          KM             Route Hydrographs 100-104/200-201/300-302 & 501 thru 502
 140          RD
 141          RC    .025    .025    .025     310   .0047
 142          RX    87.2    89.2    91.2     100     200   208.8   210.8   212.8
 143          RY     7.4     6.4     6.4       2       2     6.4     6.4     7.4

 144          KK     502
 145          KM             Subarea No. 502
 146          BA   .0027
 147          LS            63.0
 148          UD    .100

 149          KK    502C
 150          KM             Combine Hydrographs 100-104/200-201/300-302 & 501-502
 151          HC       2

 152          KK    503R
 153          KM             Route Hydrographs 100-104/200-201/300-302 & 501-502 thru 503
 154          RD
 155          RC    .025    .025    .025     260    .010
 156          RX      40      42      44      50     330     336     338     340
 157          RY       6       5       5       2       2       5       5       6

 158          KK     503
 159          KM            Subarea No. 503
 160          BA   .0039
 161          LS            63.0
 162          UD    .100

 163          KK    503C
 164          KM            Combine Hydrographs 100-104/200-201/300-302 & 501-503
 165          HC       2
 166          ZZ
```

SCHEMATIC DIAGRAM OF STREAM NETWORK

```
INPUT
 LINE     (V) ROUTING          (--->) DIVERSION OR PUMP FLOW

 NO.      (.) CONNECTOR        (<---) RETURN OF DIVERTED OR PUMPED FLOW

  9        100
            V
            V
 19       101R
            .
            .
 25         .        101
            .          .
            .          .
 30       101C............
            V
            V
 33       104R
            .
            .
 39         .        102
            .          V
            .          V
 44         .       104R
            .          .
            .          .
 50         .          .        103
            .          .          V
            .          .          V
 55         .          .       104R
            .          .          .
            .          .          .
 61         .          .          .        200
            .          .          .          V
            .          .          .          V
 66         .          .          .       201R
            .          .          .          .
            .          .          .          .
 69         .          .          .          .        201
            .          .          .          .          .
            .          .          .          .          .
 74         .          .          .       201C............
            .          .          .          V
            .          .          .          V
 77         .          .          .       104R
            .          .          .          .
            .          .          .          .
 80         .          .          .          .        104
            .          .          .          .          .
            .          .          .          .          .
 85       104C.............................................
            V
            V
 88       302R
            .
            .
 94         .        300
            .          V
            .          V
 99         .       301R
            .          .
            .          .
102         .          .        301
            .          .          .
```

```
                .          .          .
107             .       301C...........
                .          V
                .          V
110             .       302R
                .          .
                .          .
116             .          .        302
                .          .          .
                .          .          .
121          302C......................
                V
                V
124          501R
                .
                .
130             .        501
                .          .
                .          .
135          501C...........
                V
                V
138          502R
                .
                .
144             .        502
                .          .
                .          .
149          502C...........
                V
                V
152          503R
                .
                .
158             .        503
                .          .
                .          .
163          503C...........
```

(***) RUNOFF ALSO COMPUTED AT THIS LOCATION

```
****************************************
*                                      *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)  *
*              MAY   1991              *
*           VERSION 4.0.1E             *
*                                      *
*  RUN DATE  01/14/93  TIME  07:34:46  *
*                                      *
****************************************
```

```
****************************************
*                                      *
*    U.S. ARMY CORPS OF ENGINEERS      *
*    HYDROLOGIC ENGINEERING CENTER     *
*          609 SECOND STREET           *
*       DAVIS, CALIFORNIA 95616        *
*          (916) 551-1748              *
*                                      *
****************************************
```

CITY OF PHOENIX PROJECT NO. P-886515
TATUM BLVD. - MOCKINGBIRD LANE TO SHEA BLVD.
KAMINSKI - HUBBARD ENGINEERING, INC. - JOB NO. 0118
HEC-1 FILENAME : 118-18.DAT
10 YEAR - 6 HOUR STORM
REVISED: AUGUST 27, 1990 BY D.L.B.

```
 8 IO        OUTPUT CONTROL VARIABLES
                  IPRNT          5  PRINT CONTROL
                  IPLOT          0  PLOT CONTROL
                  QSCAL         0.  HYDROGRAPH PLOT SCALE

   IT        HYDROGRAPH TIME DATA
                   NMIN          4  MINUTES IN COMPUTATION INTERVAL
                  IDATE     7FEB90  STARTING DATE
                  ITIME       1000  STARTING TIME
                     NQ        361  NUMBER OF HYDROGRAPH ORDINATES
                 NDDATE     8FEB90  ENDING DATE
                 NDTIME       1000  ENDING TIME
                  ICENT         19  CENTURY MARK

            COMPUTATION INTERVAL    0.07 HOURS
                 TOTAL TIME BASE   24.00 HOURS

       ENGLISH UNITS
            DRAINAGE AREA         SQUARE MILES
            PRECIPITATION DEPTH   INCHES
            LENGTH, ELEVATION     FEET
            FLOW                  CUBIC FEET PER SECOND
            STORAGE VOLUME        ACRE-FEET
            SURFACE AREA          ACRES
            TEMPERATURE           DEGREES FAHRENHEIT
```

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	100	173.	4.00	14.	4.	4.	0.09		
ROUTED TO	101R	165.	4.00	14.	4.	4.	0.09		
HYDROGRAPH AT	101	157.	4.00	13.	3.	3.	0.08		
2 COMBINED AT	101C	322.	4.00	27.	7.	7.	0.16		
ROUTED TO	104R	317.	4.07	27.	7.	7.	0.16		
HYDROGRAPH AT	102	55.	4.00	4.	1.	1.	0.03		
ROUTED TO	104R	54.	4.07	4.	1.	1.	0.03		
HYDROGRAPH AT	103	65.	4.00	5.	1.	1.	0.03		
ROUTED TO	104R	62.	4.07	5.	1.	1.	0.03		
HYDROGRAPH AT	200	376.	4.00	31.	8.	8.	0.19		
ROUTED TO	201R	367.	4.00	31.	8.	8.	0.19		
HYDROGRAPH AT	201	15.	4.00	1.	0.	0.	0.01		
2 COMBINED AT	201C	382.	4.00	32.	8.	8.	0.20		
ROUTED TO	104R	365.	4.07	32.	8.	8.	0.20		
HYDROGRAPH AT	104	31.	4.00	2.	1.	1.	0.02		
5 COMBINED AT	104C	828.	4.07	71.	18.	18.	0.45		
ROUTED TO	302R	825.	4.07	71.	18.	18.	0.45		
HYDROGRAPH AT	300	46.	4.00	4.	1.	1.	0.02		
ROUTED TO	301R	44.	4.07	4.	1.	1.	0.02		
HYDROGRAPH AT	301	9.	4.07	1.	0.	0.	0.01		
2 COMBINED AT	301C	53.	4.07	4.	1.	1.	0.03		
ROUTED TO	302R	52.	4.07	4.	1.	1.	0.03		
HYDROGRAPH AT	302	13.	4.00	1.	0.	0.	0.01		
3 COMBINED AT	302C	889.	4.07	77.	19.	19.	0.49		
ROUTED TO	501R	883.	4.07	77.	19.	19.	0.49		
HYDROGRAPH AT	501	3.	4.00	0.	0.	0.	0.00		
2 COMBINED AT	501C	886.	4.07	77.	19.	19.	0.49		
ROUTED TO	502R	873.	4.07	77.	19.	19.	0.49		
HYDROGRAPH AT	502	0.	4.07	0.	0.	0.	0.00		

2 COMBINED AT	502C	873.	4.07	77.	19.	19.	0.50
ROUTED TO	503R	857.	4.07	77.	19.	19.	0.50
HYDROGRAPH AT	503	1.	4.07	0.	0.	0.	0.00
2 COMBINED AT	503C	858.	4.07	77.	19.	19.	0.50

SUMMARY OF KINEMATIC WAVE - MUSKINGUM-CUNGE ROUTING
(FLOW IS DIRECT RUNOFF WITHOUT BASE FLOW)

ISTAQ	ELEMENT	DT (MIN)	PEAK (CFS)	TIME TO PEAK (MIN)	VOLUME (IN)	INTERPOLATED TO COMPUTATION INTERVAL DT (MIN)	PEAK (CFS)	TIME TO PEAK (MIN)	VOLUME (IN)
101R	MANE	1.83	170.13	241.69	1.55	4.00	164.95	240.00	1.55

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.7047E+01 EXCESS=0.0000E+00 OUTFLOW=0.7047E+01 BASIN STORAGE=0.1365E-03 PERCENT ERROR= 0.0

104R	MANE	2.84	316.97	244.08	1.55	4.00	316.65	244.00	1.55

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.1358E+02 EXCESS=0.0000E+00 OUTFLOW=0.1358E+02 BASIN STORAGE=0.4210E-03 PERCENT ERROR= 0.0

104R	MANE	3.58	54.19	243.69	1.31	4.00	53.78	244.00	1.31

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.2124E+01 EXCESS=0.0000E+00 OUTFLOW=0.2125E+01 BASIN STORAGE=0.2115E-03 PERCENT ERROR= -0.1

104R	MANE	2.47	63.22	241.59	1.46	4.00	62.42	244.00	1.46

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.2598E+01 EXCESS=0.0000E+00 OUTFLOW=0.2599E+01 BASIN STORAGE=0.1255E-03 PERCENT ERROR= 0.0

201R	MANE	0.87	373.65	240.77	1.55	4.00	366.89	240.00	1.55

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.1536E+02 EXCESS=0.0000E+00 OUTFLOW=0.1536E+02 BASIN STORAGE=0.2601E-03 PERCENT ERROR= 0.0

104R	MANE	1.37	378.64	242.21	1.51	4.00	365.47	244.00	1.51

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.1593E+02 EXCESS=0.0000E+00 OUTFLOW=0.1593E+02 BASIN STORAGE=0.4557E-03 PERCENT ERROR= 0.0

302R	MANE	0.35	824.87	243.94	1.48	4.00	824.86	244.00	1.48

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.3539E+02 EXCESS=0.0000E+00 OUTFLOW=0.3539E+02 BASIN STORAGE=0.1999E-04 PERCENT ERROR= 0.0

301R	MANE	1.95	45.47	242.38	1.39	4.00	44.18	244.00	1.39

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.1823E+01 EXCESS=0.0000E+00 OUTFLOW=0.1823E+01 BASIN STORAGE=0.2972E-03 PERCENT ERROR= 0.0

302R	MANE	1.40	52.35	242.76	1.29	4.00	52.24	244.00	1.29

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.2160E+01 EXCESS=0.0000E+00 OUTFLOW=0.2160E+01 BASIN STORAGE=0.1996E-04 PERCENT ERROR= 0.0

501R	MANE	0.52	884.42	244.16	1.46	4.00	882.95	244.00	1.46

```
CONTINUITY SUMMARY (AC-FT) - INFLOW=0.3805E+02 EXCESS=0.0000E+00 OUTFLOW=0.3805E+02 BASIN STORAGE=0.3120E-04 PERCENT ERROR=   0.0

            502R  MANE        0.84    875.83    244.28      1.46      4.00    872.83    244.00        1.46

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.3821E+02 EXCESS=0.0000E+00 OUTFLOW=0.3821E+02 BASIN STORAGE=0.4209E-04 PERCENT ERROR=   0.0

            503R  MANE        0.94    862.66    245.17      1.45      4.00    857.48    244.00        1.45

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.3827E+02 EXCESS=0.0000E+00 OUTFLOW=0.3827E+02 BASIN STORAGE=0.3733E-04 PERCENT ERROR=   0.0


*** NORMAL END OF HEC-1 ***
```

```
*************************************
*                                   *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)  *
*              MAY   1991           *
*           VERSION 4.0.1E          *
*                                   *
* RUN DATE  01/14/93  TIME  07:31:58 *
*                                   *
*************************************
```

```
*************************************
*                                   *
*    U.S. ARMY CORPS OF ENGINEERS   *
*    HYDROLOGIC ENGINEERING CENTER  *
*          609 SECOND STREET        *
*       DAVIS, CALIFORNIA 95616     *
*           (916) 551-1748          *
*                                   *
*************************************
```

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

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

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

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

  1           ID                 CITY OF PHOENIX PROJECT NO. P-886515
  2           ID              TATUM BLVD. - MOCKINGBIRD LANE TO SHEA BLVD.
  3           ID           KAMINSKI - HUBBARD ENGINEERING, INC. - JOB NO. 0118
  4           ID                     HEC-1 FILENAME :  118-17.DAT
  5           ID                       25 YEAR - 6 HOUR STORM
  6           ID                 REVISED:  AUGUST 27, 1990 BY D.L.B.
              *DIAGRAM
  7           IT       4 07FEB90    1000     300 08FEB90    1000
  8           IO       5

  9           KK     100
 10           KM                     Subarea No. 100
 11           BA   .0852
 12           IN      15
 13           PB    2.57
 14           PC    .000    .008    .016    .025    .033    .041    .050    .058    .066    .074
 15           PC    .087    .099    .118    .138    .216    .377    .834    .911    .931    .950
 16           PC    .962    .972    .983    .991   1.000
 17           LS            95.0
 18           UD    .100

 19           KK    101R
 20           KM            Route Hydrograph 100 thru 101
 21           RD
 22           RC    .030    .030    .030    1360    .072
 23           RX      10      15      22      29      31      38      45      50
 24           RY       6       5       4       3       3       4       5       6

 25           KK     101
 26           KM                    Subarea No. 101
 27           BA   .0789
 28           LS            95.0
 29           UD    .106

 30           KK    101C
 31           KM            Combine Hydrographs 100 & 101
 32           HC       2

 33           KK    104R
 34           KM            Route Hydrographs 100/101 thru 104
 35           RD
 36           RC     .03     .03     .03    2320    .039
 37           RX      10      15      20      25      27      32      37      42
 38           RY       6       5       4       3       3       4       5       6

 39           KK     102
 40           KM            Subarea No. 102
 41           BA   .0358
 42           LS            92.0
 43           UD    .100
```

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

 44           KK    104R
 45           KM              Route Hydrograph 102 thru 104
 46           RD
 47           RC  -_ .03     .03     .03    1600    .044
 48           RX      10      12      22      32      34      44      54      56
 49           RY       8       7       5       3       3       5       7       8

 50           KK     103
 51           KM             Subarea No. 103
 52           BA   .0350
 53           LS            94.0
 54           UD    .100

 55           KK    104R
 56           KM             Route Hydrograph 103 thru 104
 57           RD
 58           RC     .03     .03     .03    1320    .064
 59           RX      10      12      22      32      34      44      54      56
 60           RY       8       7       5       3       3       5       7       8

 61           KK     200
 62           KM             Subarea No. 200
 63           BA   .1858
 64           LS            95.0
 65           UD    .100

 66           KK    201R
 67           KM             Route Hydrograph 200 thru 201
 68           RD     640   .031    .030            TRAP       2       4

 69           KK     201
 70           KM             Subarea No. 201
 71           BA   .0211
 72           LS            86.0
 73           UD    .100

 74           KK    201C
 75           KM             Combine Hydrographs 200 & 201
 76           HC       2

 77           KK    104R
 78           KM             Route Hydrograph 200/201 thru 104
 79           RD     720   .022    .030            TRAP      10       9

 80           KK     104
 81           KM             Subarea No. 104
 82           BA   .0423
 83           LS            86.0
 84           UD    .100
```

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

 85           KK    104C
 86           KM            Combine Hydrographs 100-101/102/103/200-201 & 104
 87           HC       5

 88           KK    302R
 89           KM            Route Hydrographs 100-104/200-201 thru 302
 90           RD
 91           RC     .03    .018     .030     350    .0148
 92           RX    21.2    23.2     25.2      34       56    64.8    66.8    68.8
 93           RY     7.4     6.4      6.4       2        2     6.4     6.4     7.4

 94           KK     300
 95           KM            Subarea No. 300
 96           BA   .0268
 97           LS           93.2
 98           UD    .100

 99           KK    301R
100           KM            Route Hydrograph 300 thru 301
101           RD     720    .025     .015            TRAP       0      50

102           KK     301
103           KM            Subarea No. 301
104           BA   .0111
105           LS           86.0
106           UD    .131

107           KK    301C
108           KM            Combine Hydrographs 300-301
109           HC       2

110           KK    302R
111           KM            Route Hydrographs 300-301 thru 302
112           RD
113           RC     .03    .018      .03     350    .0148
114           RX    21.2    23.2     25.2      34       56    64.8    66.8    68.8
115           RY     7.4     6.4      6.4       2        2     6.4     6.4     7.4

116           KK     302
117           KM            Subarea No. 302
118           BA   .0155
119           LS           86.0
120           UD    .103

121           KK    302C
122           KM            Combine Hydrographs 100-104/200-201 & 300-302
123           HC       3

124           KK    501R
125           KM            Route Hydrographs 100-104/200-201 & 300-302 thru 501
126           RD
127           RC     .03    .018      .03     500    .0148
128           RX       8      10       12      24       50      62      64      66
129           RY       7       6        6       2        2       6       6       7
```

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

 130          KK     501
 131          KM             Subarea No. 501
 132          BA   .0041
 133          LS            86.0
 134          UD    .100

 135          KK    501C
 136          KM             Combine Hydrographs 100-104/200-201/300-302 & 501
 137          HC       2

 138          KK    502R
 139          KM             Route Hydrographs 100-104/200-201/300-302 & 501 thru 502
 140          RD
 141          RC    .025    .025    .025     310   .0047
 142          RX    87.2    89.2    91.2     100     200   208.8   210.8   212.8
 143          RY     7.4     6.4     6.4       2       2     6.4     6.4     7.4

 144          KK     502
 145          KM             Subarea No. 502
 146          BA   .0027
 147          LS            63.0
 148          UD    .100

 149          KK    502C
 150          KM             Combine Hydrographs 100-104/200-201/300-302 & 501-502
 151          HC       2

 152          KK    503R
 153          KM             Route Hydrographs 100-104/200-201/300-302 & 501-502 thru 503
 154          RD
 155          RC    .025    .025    .025     260    .010
 156          RX      40      42      44      50     330     336     338     340
 157          RY       6       5       5       2       2       5       5       6

 158          KK     503
 159          KM            Subarea No. 503
 160          BA   .0039
 161          LS            63.0
 162          UD    .100

 163          KK    503C
 164          KM            Combine Hydrographs 100-104/200-201/300-302 & 501-503
 165          HC       2
 166          ZZ
```

SCHEMATIC DIAGRAM OF STREAM NETWORK

```
INPUT
 LINE     (V) ROUTING          (--->) DIVERSION OR PUMP FLOW

  NO.     (.) CONNECTOR        (<---) RETURN OF DIVERTED OR PUMPED FLOW

   9        100
             V
             V
  19        101R
             .
             .
  25         .        101
             .          .
             .          .
  30        101C............
             V
             V
  33        104R
             .
             .
  39         .        102
             .          V
             .          V
  44         .       104R
             .          .
             .          .
  50         .          .        103
             .          .          V
             .          .          V
  55         .          .       104R
             .          .          .
             .          .          .
  61         .          .          .        200
             .          .          .          V
             .          .          .          V
  66         .          .          .       201R
             .          .          .          .
             .          .          .          .
  69         .          .          .          .        201
             .          .          .          .          .
             .          .          .          .          .
  74         .          .          .       201C............
             .          .          .          V
             .          .          .          V
  77         .          .          .       104R
             .          .          .          .
             .          .          .          .
  80         .          .          .          .        104
             .          .          .          .          .
             .          .          .          .          .
  85        104C.............................................
             V
             V
  88        302R
             .
             .
  94         .        300
             .          V
             .          V
  99         .       301R
             .          .
             .          .
 102         .          .        301
             .          .          .
```

```
                .          .          .
107             .       301C...........
                .          V
                .          V
110             .       302R
                .          .
                .          .
116             .          .        302
                .          .  -       .
                .          .  -       .
121          302C......................
                V
                V
124          501R
                .
                .
130             .        501
                .          .
                .          .
135          501C...........
                V
                V
138          502R
                .
                .
144             .        502
                .          .
                .          .
149          502C...........
                V
                V
152          503R
                .
                .
158             .        503
                .          .
                .          .
163          503C...........
```

(***) RUNOFF ALSO COMPUTED AT THIS LOCATION

```
****************************************
*                                      *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)  *
*              MAY   1991              *
*           VERSION 4.0.1E             *
*                                      *
*  RUN DATE  01/14/93  TIME  07:31:58  *
*                                      *
****************************************
```

```
****************************************
*                                      *
*    U.S. ARMY CORPS OF ENGINEERS      *
*    HYDROLOGIC ENGINEERING CENTER     *
*          609 SECOND STREET           *
*       DAVIS, CALIFORNIA 95616        *
*          (916) 551-1748              *
*                                      *
****************************************
```

CITY OF PHOENIX PROJECT NO. P-886515
TATUM BLVD. - MOCKINGBIRD LANE TO SHEA BLVD.
KAMINSKI - HUBBARD ENGINEERING, INC. - JOB NO. 0118
HEC-1 FILENAME : 118-17.DAT
25 YEAR - 6 HOUR STORM
REVISED: AUGUST 27, 1990 BY D.L.B.

```
  8 IO          OUTPUT CONTROL VARIABLES
                      IPRNT          5  PRINT CONTROL
                      IPLOT          0  PLOT CONTROL
                      QSCAL         0.  HYDROGRAPH PLOT SCALE

    IT          HYDROGRAPH TIME DATA
                       NMIN          4  MINUTES IN COMPUTATION INTERVAL
                      IDATE     7FEB90  STARTING DATE
                      ITIME       1000  STARTING TIME
                         NQ        361  NUMBER OF HYDROGRAPH ORDINATES
                     NDDATE     8FEB90  ENDING DATE
                     NDTIME       1000  ENDING TIME
                      ICENT         19  CENTURY MARK

                COMPUTATION INTERVAL    0.07 HOURS
                     TOTAL TIME BASE   24.00 HOURS

          ENGLISH UNITS
               DRAINAGE AREA          SQUARE MILES
               PRECIPITATION DEPTH    INCHES
               LENGTH, ELEVATION      FEET
               FLOW                   CUBIC FEET PER SECOND
               STORAGE VOLUME         ACRE-FEET
               SURFACE AREA           ACRES
               TEMPERATURE            DEGREES FAHRENHEIT
```

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	100	221.	4.00	19.	5.	5.	0.09		
ROUTED TO	101R	212.	4.00	19.	5.	5.	0.09		
HYDROGRAPH AT	101	202.	4.00	17.	4.	4.	0.08		
2 COMBINED AT	101C	413.	4.00	36.	9.	9.	0.16		
ROUTED TO	104R	403.	4.07	36.	9.	9.	0.16		
HYDROGRAPH AT	102	85.	4.00	7.	2.	2.	0.04		
ROUTED TO	104R	82.	4.07	7.	2.	2.	0.04		
HYDROGRAPH AT	103	88.	4.00	7.	2.	2.	0.04		
ROUTED TO	104R	85.	4.07	7.	2.	2.	0.04		
HYDROGRAPH AT	200	482.	4.00	41.	10.	10.	0.19		
ROUTED TO	201R	471.	4.00	41.	10.	10.	0.19		
HYDROGRAPH AT	201	39.	4.00	3.	1.	1.	0.02		
2 COMBINED AT	201C	511.	4.00	44.	11.	11.	0.21		
ROUTED TO	104R	489.	4.00	44.	11.	11.	0.21		
HYDROGRAPH AT	104	79.	4.00	6.	1.	1.	0.04		
5 COMBINED AT	104C	1130.	4.07	99.	25.	25.	0.48		
ROUTED TO	302R	1128.	4.07	100.	25.	25.	0.48		
HYDROGRAPH AT	300	66.	4.00	5.	1.	1.	0.03		
ROUTED TO	301R	63.	4.00	5.	1.	1.	0.03		
HYDROGRAPH AT	301	19.	4.07	2.	0.	0.	0.01		
2 COMBINED AT	301C	82.	4.07	7.	2.	2.	0.04		
ROUTED TO	302R	81.	4.07	7.	2.	2.	0.04		
HYDROGRAPH AT	302	29.	4.00	2.	1.	1.	0.02		
3 COMBINED AT	302C	1236.	4.07	109.	27.	27.	0.54		
ROUTED TO	501R	1230.	4.07	109.	27.	27.	0.54		
HYDROGRAPH AT	501	8.	4.00	1.	0.	0.	0.00		
2 COMBINED AT	501C	1238.	4.07	109.	27.	27.	0.54		
ROUTED TO	502R	1225.	4.07	109.	27.	27.	0.54		
HYDROGRAPH AT	502	1.	4.07	0.	0.	0.	0.00		

2 COMBINED AT	502C	1227.	4.07	110.	27.	27.	0.54
ROUTED TO	503R	1214.	4.07	110.	27.	27.	0.54
HYDROGRAPH AT	503	2.	4.07	0.	0.	0.	0.00
2 COMBINED AT	503C	1215.	4.07	110.	27.	27.	0.55

SUMMARY OF KINEMATIC WAVE - MUSKINGUM-CUNGE ROUTING
(FLOW IS DIRECT RUNOFF WITHOUT BASE FLOW)

ISTAQ	ELEMENT	DT (MIN)	PEAK (CFS)	TIME TO PEAK (MIN)	VOLUME (IN)	INTERPOLATED TO COMPUTATION INTERVAL DT (MIN)	PEAK (CFS)	TIME TO PEAK (MIN)	VOLUME (IN)
101R	MANE	1.58	218.78	241.85	2.03	4.00	211.52	240.00	2.03

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.9228E+01 EXCESS=0.0000E+00 OUTFLOW=0.9229E+01 BASIN STORAGE=0.1555E-03 PERCENT ERROR= 0.0

104R	MANE	2.69	407.67	242.33	2.03	4.00	403.30	244.00	2.03

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.1776E+02 EXCESS=0.0000E+00 OUTFLOW=0.1777E+02 BASIN STORAGE=0.3267E-03 PERCENT ERROR= 0.0

104R	MANE	3.17	82.48	244.23	1.76	4.00	82.23	244.00	1.76

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.3358E+01 EXCESS=0.0000E+00 OUTFLOW=0.3359E+01 BASIN STORAGE=0.1518E-03 PERCENT ERROR= 0.0

104R	MANE	2.26	86.30	241.67	1.94	4.00	84.75	244.00	1.94

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.3615E+01 EXCESS=0.0000E+00 OUTFLOW=0.3616E+01 BASIN STORAGE=0.1173E-03 PERCENT ERROR= 0.0

201R	MANE	0.81	478.50	240.63	2.03	4.00	471.45	240.00	2.03

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.2013E+02 EXCESS=0.0000E+00 OUTFLOW=0.2013E+02 BASIN STORAGE=0.2102E-03 PERCENT ERROR= 0.0

104R	MANE	1.27	505.33	242.00	1.96	4.00	489.01	240.00	1.96

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.2160E+02 EXCESS=0.0000E+00 OUTFLOW=0.2160E+02 BASIN STORAGE=0.3883E-03 PERCENT ERROR= 0.0

302R	MANE	0.31	1127.71	244.04	1.91	4.00	1127.50	244.00	1.91

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.4931E+02 EXCESS=0.0000E+00 OUTFLOW=0.4931E+02 BASIN STORAGE=0.1963E-04 PERCENT ERROR= 0.0

301R	MANE	1.79	64.55	241.40	1.86	4.00	62.63	240.00	1.86

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.2663E+01 EXCESS=0.0000E+00 OUTFLOW=0.2663E+01 BASIN STORAGE=0.3109E-03 PERCENT ERROR= 0.0

302R	MANE	1.10	81.43	241.95	1.70	4.00	81.36	244.00	1.70

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.3430E+01 EXCESS=0.0000E+00 OUTFLOW=0.3430E+01 BASIN STORAGE=0.2100E-04 PERCENT ERROR= 0.0

501R	MANE	0.47	1231.14	244.21	1.88	4.00	1230.46	244.00	1.88

```
CONTINUITY SUMMARY (AC-FT) - INFLOW=0.5388E+02 EXCESS=0.0000E+00 OUTFLOW=0.5388E+02 BASIN STORAGE=0.2879E-04 PERCENT ERROR=   0.0

            502R  MANE        0.73   1227.04    244.27      1.88      4.00   1225.45    244.00        1.88

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.5422E+02 EXCESS=0.0000E+00 OUTFLOW=0.5422E+02 BASIN STORAGE=0.5187E-04 PERCENT ERROR=   0.0

            503R  MANE        0.77   1217.90    244.72      1.87      4.00   1213.68    244.00        1.87

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.5432E+02 EXCESS=0.0000E+00 OUTFLOW=0.5432E+02 BASIN STORAGE=0.2949E-04 PERCENT ERROR=   0.0


*** NORMAL END OF HEC-1 ***
```

```
****************************************
*                                      *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)  *
*              MAY   1991              *
*           VERSION 4.0.1E             *
*                                      *
*  RUN DATE  01/13/93  TIME  16:40:53  *
*                                      *
****************************************
```

```
****************************************
*                                      *
*    U.S. ARMY CORPS OF ENGINEERS      *
*    HYDROLOGIC ENGINEERING CENTER     *
*          609 SECOND STREET           *
*       DAVIS, CALIFORNIA 95616        *
*           (916) 551-1748             *
*                                      *
****************************************
```

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

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

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

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

  1           ID                  CITY OF PHOENIX PROJECT NO. P-886515
  2           ID                TATUM BLVD. - MOCKINGBIRD LANE TO SHEA BLVD.
  3           ID            KAMINSKI - HUBBARD ENGINEERING, INC. - JOB NO. 0118
  4           ID                      HEC-1 FILENAME :  118-16.DAT
  5           ID                         50 YEAR - 6 HOUR STORM
  6           ID                 REVISED:  AUGUST 27, 1990 BY D.L.B.
              *DIAGRAM
  7           IT       4 07FEB90    1000     300 08FEB90    1000
  8           IO       5

  9           KK     100
 10           KM                     Subarea No. 100
 11           BA   .0852
 12           IN      15
 13           PB    2.96
 14           PC    .000    .008    .016    .025    .033    .041    .050    .058    .066    .074
 15           PC    .087    .099    .118    .138    .216    .377    .834    .911    .931    .950
 16           PC    .962    .972    .983    .991   1.000
 17           LS            95.0
 18           UD    .100

 19           KK    101R
 20           KM            Route Hydrograph 100 thru 101
 21           RD
 22           RC    .030    .030    .030    1360    .072
 23           RX      10      15      22      29      31      38      45      50
 24           RY       6       5       4       3       3       4       5       6

 25           KK     101
 26           KM                     Subarea No. 101
 27           BA   .0789
 28           LS            95.0
 29           UD    .106

 30           KK    101C
 31           KM            Combine Hydrographs 100 & 101
 32           HC       2

 33           KK    104R
 34           KM            Route Hydrographs 100/101 thru 104
 35           RD
 36           RC     .03     .03     .03    2320    .039
 37           RX      10      15      20      25      27      32      37      42
 38           RY       6       5       4       3       3       4       5       6

 39           KK     102
 40           KM            Subarea No. 102
 41           BA   .0358
 42           LS            92.0
 43           UD    .100
```

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

 44           KK    104R
 45           KM              Route Hydrograph 102 thru 104
 46           RD
 47           RC     .03     .03     .03    1600    .044
 48           RX      10      12      22      32      34      44      54      56
 49           RY       8       7       5       3       3       5       7       8

 50           KK     103
 51           KM             Subarea No. 103
 52           BA   .0350
 53           LS            94.0
 54           UD    .100

 55           KK    104R
 56           KM             Route Hydrograph 103 thru 104
 57           RD
 58           RC     .03     .03     .03    1320    .064
 59           RX      10      12      22      32      34      44      54      56
 60           RY       8       7       5       3       3       5       7       8

 61           KK     200
 62           KM             Subarea No. 200
 63           BA   .1858
 64           LS            95.0
 65           UD    .100

 66           KK    201R
 67           KM             Route Hydrograph 200 thru 201
 68           RD     640    .031    .030            TRAP       2       4

 69           KK     201
 70           KM             Subarea No. 201
 71           BA   .0211
 72           LS            86.0
 73           UD    .100

 74           KK    201C
 75           KM             Combine Hydrographs 200 & 201
 76           HC       2

 77           KK    104R
 78           KM             Route Hydrograph 200/201 thru 104
 79           RD     720    .022    .030            TRAP      10       9

 80           KK     104
 81           KM             Subarea No. 104
 82           BA   .0423
 83           LS            86.0
 84           UD    .100
```

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

  85          KK    104C
  86          KM            Combine Hydrographs 100-101/102/103/200-201 & 104
  87          HC       5

  88          KK    302R
  89          KM            Route Hydrographs 100-104/200-201 thru 302
  90          RD
  91          RC     .03    .018     .030     350   .0148
  92          RX    21.2    23.2     25.2      34      56    64.8    66.8    68.8
  93          RY     7.4     6.4      6.4       2       2     6.4     6.4     7.4

  94          KK     300
  95          KM            Subarea No. 300
  96          BA   .0268
  97          LS            93.2
  98          UD    .100

  99          KK    301R
 100          KM            Route Hydrograph 300 thru 301
 101          RD     720   .025     .015            TRAP       0      50

 102          KK     301
 103          KM            Subarea No. 301
 104          BA   .0111
 105          LS            86.0
 106          UD    .131

 107          KK    301C
 108          KM            Combine Hydrographs 300-301
 109          HC       2

 110          KK    302R
 111          KM            Route Hydrographs 300-301 thru 302
 112          RD
 113          RC     .03    .018      .03     350   .0148
 114          RX    21.2    23.2     25.2      34      56    64.8    66.8    68.8
 115          RY     7.4     6.4      6.4       2       2     6.4     6.4     7.4

 116          KK     302
 117          KM            Subarea No. 302
 118          BA   .0155
 119          LS            86.0
 120          UD    .103

 121          KK    302C
 122          KM            Combine Hydrographs 100-104/200-201 & 300-302
 123          HC       3

 124          KK    501R
 125          KM            Route Hydrographs 100-104/200-201 & 300-302 thru 501
 126          RD
 127          RC     .03    .018      .03     500   .0148
 128          RX       8      10       12      24      50      62      64      66
 129          RY       7       6        6       2       2       6       6       7
```

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

 130          KK     501
 131          KM             Subarea No. 501
 132          BA   .0041
 133          LS             86.0
 134          UD    .100

 135          KK    501C
 136          KM             Combine Hydrographs 100-104/200-201/300-302 & 501
 137          HC       2

 138          KK    502R
 139          KM             Route Hydrographs 100-104/200-201/300-302 & 501 thru 502
 140          RD
 141          RC    .025    .025    .025     310   .0047
 142          RX    87.2    89.2    91.2     100     200   208.8   210.8   212.8
 143          RY     7.4     6.4     6.4       2       2     6.4     6.4     7.4

 144          KK     502
 145          KM             Subarea No. 502
 146          BA   .0027
 147          LS             63.0
 148          UD    .100

 149          KK    502C
 150          KM             Combine Hydrographs 100-104/200-201/300-302 & 501-502
 151          HC       2

 152          KK    503R
 153          KM             Route Hydrographs 100-104/200-201/300-302 & 501-502 thru 503
 154          RD
 155          RC    .025    .025    .025     260    .010
 156          RX      40      42      44      50     330     336     338     340
 157          RY       6       5       5       2       2       5       5       6

 158          KK     503
 159          KM             Subarea No. 503
 160          BA   .0039
 161          LS             63.0
 162          UD    .100

 163          KK    503C
 164          KM             Combine Hydrographs 100-104/200-201/300-302 & 501-503
 165          HC       2
 166          ZZ
```

SCHEMATIC DIAGRAM OF STREAM NETWORK

```
INPUT
 LINE     (V) ROUTING          (--->) DIVERSION OR PUMP FLOW

  NO.     (.) CONNECTOR        (<---) RETURN OF DIVERTED OR PUMPED FLOW

   9        100
             V
             V
  19        101R
             .
             .
  25         .        101
             .          .
             .          .
  30        101C............
             V
             V
  33        104R
             .
             .
  39         .        102
             .          V
             .          V
  44         .       104R
             .          .
             .          .
  50         .          .        103
             .          .          V
             .          .          V
  55         .          .       104R
             .          .          .
             .          .          .
  61         .          .          .       200
             .          .          .         V
             .          .          .         V
  66         .          .          .      201R
             .          .          .         .
             .          .          .         .
  69         .          .          .         .        201
             .          .          .         .          .
             .          .          .         .          .
  74         .          .          .      201C............
             .          .          .         V
             .          .          .         V
  77         .          .          .      104R
             .          .          .         .
             .          .          .         .
  80         .          .          .         .        104
             .          .          .         .          .
             .          .          .         .          .
  85        104C.............................................
             V
             V
  88        302R
             .
             .
  94         .        300
             .          V
             .          V
  99         .       301R
             .          .
             .          .
 102         .          .        301
             .          .          .
```

```
                .          .          .
107             .       301C...........
                .          V
                .          V
110             .       302R
                .          .
                .          .
116             .          .        302
                .          .  -       .
                .          .  -       .
121          302C........................
                V
                V
124          501R
                .
                .
130             .        501
                .          .
                .          .
135          501C............
                V
               -V
138          502R
                .
                .
144             .        502
                .          .
                .          .
149          502C............
                V
                V
152          503R
                .
                .
158             .        503
                .          .
                .          .
163          503C............
```

(***) RUNOFF ALSO COMPUTED AT THIS LOCATION

```
****************************************
*                                      *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)  *
*              MAY   1991              *
*           VERSION 4.0.1E             *
*                                      *
*  RUN DATE  01/13/93  TIME  16:40:53  *
*                                      *
****************************************
```

```
****************************************
*                                      *
*    U.S. ARMY CORPS OF ENGINEERS      *
*    HYDROLOGIC ENGINEERING CENTER     *
*          609 SECOND STREET           *
*       DAVIS, CALIFORNIA 95616        *
*          (916) 551-1748              *
*                                      *
****************************************
```

CITY OF PHOENIX PROJECT NO. P-886515
TATUM BLVD. - MOCKINGBIRD LANE TO SHEA BLVD.
KAMINSKI - HUBBARD ENGINEERING, INC. - JOB NO. 0118
HEC-1 FILENAME : 118-16.DAT
50 YEAR - 6 HOUR STORM
REVISED: AUGUST 27, 1990 BY D.L.B.

```
8 IO        OUTPUT CONTROL VARIABLES
                 IPRNT          5  PRINT CONTROL
                 IPLOT          0  PLOT CONTROL
                 QSCAL         0.  HYDROGRAPH PLOT SCALE

  IT        HYDROGRAPH TIME DATA
                  NMIN          4  MINUTES IN COMPUTATION INTERVAL
                 IDATE     7FEB90  STARTING DATE
                 ITIME       1000  STARTING TIME
                    NQ        361  NUMBER OF HYDROGRAPH ORDINATES
                NDDATE     8FEB90  ENDING DATE
                NDTIME       1000  ENDING TIME
                 ICENT         19  CENTURY MARK

            COMPUTATION INTERVAL    0.07 HOURS
                 TOTAL TIME BASE   24.00 HOURS

      ENGLISH UNITS
          DRAINAGE AREA          SQUARE MILES
          PRECIPITATION DEPTH    INCHES
          LENGTH, ELEVATION      FEET
          FLOW                   CUBIC FEET PER SECOND
          STORAGE VOLUME         ACRE-FEET
          SURFACE AREA           ACRES
          TEMPERATURE            DEGREES FAHRENHEIT
```

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	100	259.	4.00	22.	6.	6.	0.09		
ROUTED TO	101R	248.	4.00	22.	6.	6.	0.09		
HYDROGRAPH AT	101	236.	4.00	20.	5.	5.	0.08		
2 COMBINED AT	101C	485.	4.00	43.	11.	11.	0.16		
ROUTED TO	104R	472.	4.07	43.	11.	11.	0.16		
HYDROGRAPH AT	102	101.	4.00	8.	2.	2.	0.04		
ROUTED TO	104R	98.	4.07	8.	2.	2.	0.04		
HYDROGRAPH AT	103	104.	4.00	9.	2.	2.	0.04		
ROUTED TO	104R	100.	4.07	9.	2.	2.	0.04		
HYDROGRAPH AT	200	565.	4.00	48.	12.	12.	0.19		
ROUTED TO	201R	553.	4.00	48.	12.	12.	0.19		
HYDROGRAPH AT	201	49.	4.00	4.	1.	1.	0.02		
2 COMBINED AT	201C	601.	4.00	52.	13.	13.	0.21		
ROUTED TO	104R	578.	4.00	52.	13.	13.	0.21		
HYDROGRAPH AT	104	98.	4.00	7.	2.	2.	0.04		
5 COMBINED AT	104C	1328.	4.07	119.	30.	30.	0.48		
ROUTED TO	302R	1326.	4.07	119.	30.	30.	0.48		
HYDROGRAPH AT	300	78.	4.00	6.	2.	2.	0.03		
ROUTED TO	301R	74.	4.00	6.	2.	2.	0.03		
HYDROGRAPH AT	301	24.	4.07	2.	0.	0.	0.01		
2 COMBINED AT	301C	97.	4.07	8.	2.	2.	0.04		
ROUTED TO	302R	97.	4.07	8.	2.	2.	0.04		
HYDROGRAPH AT	302	35.	4.00	3.	1.	1.	0.02		
3 COMBINED AT	302C	1456.	4.07	130.	32.	32.	0.54		
ROUTED TO	501R	1451.	4.07	130.	33.	33.	0.54		
HYDROGRAPH AT	501	9.	4.00	1.	0.	0.	0.00		
2 COMBINED AT	501C	1460.	4.07	131.	33.	33.	0.54		
ROUTED TO	502R	1448.	4.07	131.	33.	33.	0.54		
HYDROGRAPH AT	502	2.	4.07	0.	0.	0.	0.00		

2 COMBINED AT	502C	1450.	4.07	131.	33.	33.	0.54
ROUTED TO	503R	1435.	4.07	131.	33.	33.	0.54
HYDROGRAPH AT	503	3.	4.07	0.	0.	0.	0.00
2 COMBINED AT	503C	1438.	4.07	131.	33.	33.	0.55

SUMMARY OF KINEMATIC WAVE - MUSKINGUM-CUNGE ROUTING
(FLOW IS DIRECT RUNOFF WITHOUT BASE FLOW)

ISTAQ	ELEMENT	DT (MIN)	PEAK (CFS)	TIME TO PEAK (MIN)	VOLUME (IN)	INTERPOLATED TO COMPUTATION INTERVAL DT (MIN)	PEAK (CFS)	TIME TO PEAK (MIN)	VOLUME (IN)
101R	MANE	1.50	256.78	241.64	2.41	4.00	248.35	240.00	2.41

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.1095E+02 EXCESS=0.0000E+00 OUTFLOW=0.1095E+02 BASIN STORAGE=0.1163E-03 PERCENT ERROR= 0.0

104R	MANE	2.60	473.92	241.88	2.41	4.00	471.80	244.00	2.41

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.2109E+02 EXCESS=0.0000E+00 OUTFLOW=0.2109E+02 BASIN STORAGE=0.4153E-03 PERCENT ERROR= 0.0

104R	MANE	3.01	99.25	243.50	2.13	4.00	97.81	244.00	2.12

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.4056E+01 EXCESS=0.0000E+00 OUTFLOW=0.4057E+01 BASIN STORAGE=0.1464E-03 PERCENT ERROR= 0.0

104R	MANE	2.16	101.93	241.81	2.31	4.00	99.66	244.00	2.32

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.4318E+01 EXCESS=0.0000E+00 OUTFLOW=0.4319E+01 BASIN STORAGE=0.7566E-04 PERCENT ERROR= 0.0

201R	MANE	0.78	559.69	240.54	2.41	4.00	552.59	240.00	2.41

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.2388E+02 EXCESS=0.0000E+00 OUTFLOW=0.2388E+02 BASIN STORAGE=0.2336E-03 PERCENT ERROR= 0.0

104R	MANE	1.21	597.18	241.46	2.33	4.00	578.13	240.00	2.33

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.2574E+02 EXCESS=0.0000E+00 OUTFLOW=0.2574E+02 BASIN STORAGE=0.4096E-03 PERCENT ERROR= 0.0

302R	MANE	0.29	1326.66	243.92	2.28	4.00	1325.93	244.00	2.28

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.5890E+02 EXCESS=0.0000E+00 OUTFLOW=0.5890E+02 BASIN STORAGE=0.1975E-04 PERCENT ERROR= 0.0

301R	MANE	1.71	77.14	241.81	2.23	4.00	74.39	240.00	2.23

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.3194E+01 EXCESS=0.0000E+00 OUTFLOW=0.3194E+01 BASIN STORAGE=0.2719E-03 PERCENT ERROR= 0.0

302R	MANE	0.99	97.54	241.67	2.05	4.00	96.96	244.00	2.06

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.4153E+01 EXCESS=0.0000E+00 OUTFLOW=0.4153E+01 BASIN STORAGE=0.1964E-04 PERCENT ERROR= 0.0

501R	MANE	0.44	1451.72	244.15	2.25	4.00	1451.38	244.00	2.25

```
CONTINUITY SUMMARY (AC-FT) - INFLOW=0.6446E+02 EXCESS=0.0000E+00 OUTFLOW=0.6446E+02 BASIN STORAGE=0.2846E-04 PERCENT ERROR=   0.0

            502R  MANE        0.67   1448.32    243.67      2.25      4.00   1448.01    244.00        2.25

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.6487E+02 EXCESS=0.0000E+00 OUTFLOW=0.6487E+02 BASIN STORAGE=0.4322E-04 PERCENT ERROR=   0.0

            503R  MANE        0.70   1439.18    244.27      2.24      4.00   1435.30    244.00        2.24

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.6498E+02 EXCESS=0.0000E+00 OUTFLOW=0.6498E+02 BASIN STORAGE=0.3329E-04 PERCENT ERROR=   0.0


*** NORMAL END OF HEC-1 ***
```

```
*****************************************
*                                       *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *
*              MAY   1991               *
*           VERSION 4.0.1E              *
*                                       *
* RUN DATE  01/13/93  TIME  16:38:05    *
*                                       *
*****************************************
```

```
*****************************************
*                                       *
*   U.S. ARMY CORPS OF ENGINEERS        *
*   HYDROLOGIC ENGINEERING CENTER       *
*         609 SECOND STREET             *
*      DAVIS, CALIFORNIA 95616          *
*          (916) 551-1748               *
*                                       *
*****************************************
```

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

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

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

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

  1           ID                 CITY OF PHOENIX PROJECT NO. P-886515
  2           ID              TATUM BLVD. - MOCKINGBIRD LANE TO SHEA BLVD.
  3           ID           KAMINSKI - HUBBARD ENGINEERING, INC. - JOB NO. 0118
  4           ID                     HEC-1 FILENAME :  118-15.DAT
  5           ID                       100 YEAR - 6 HOUR STORM
  6           ID                REVISED:  AUGUST 27, 1990 BY D.L.B.
              *DIAGRAM
  7           IT       4 07FEB90    1000     300 08FEB90    1000
  8           IO       5

  9           KK     100
 10           KM                     Subarea No. 100
 11           BA   .0852
 12           IN      15
 13           PB    3.35
 14           PC    .000    .008    .016    .025    .033    .041    .050    .058    .066    .074
 15           PC    .087    .099    .118    .138    .216    .377    .834    .911    .931    .950
 16           PC    .962    .972    .983    .991   1.000
 17           LS            95.0
 18           UD    .170

 19           KK    101R
 20           KM            Route Hydrograph 100 thru 101
 21           RD
 22           RC    .030    .030    .030    1360    .072
 23           RX      10      15      22      29      31      38      45      50
 24           RY       6       5       4       3       3       4       5       6

 25           KK     101
 26           KM                    Subarea No. 101
 27           BA   .0789
 28           LS            95.0
 29           UD    .170

 30           KK    101C
 31           KM            Combine Hydrographs 100 & 101
 32           HC       2

 33           KK    104R
 34           KM            Route Hydrographs 100/101 thru 104
 35           RD
 36           RC     .03     .03     .03    2320    .039
 37           RX      10      15      20      25      27      32      37      42
 38           RY       6       5       4       3       3       4       5       6

 39           KK     102
 40           KM            Subarea No. 102
 41           BA   .0358
 42           LS            92.0
 43           UD    .170
```

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

 44           KK    104R
 45           KM              Route Hydrograph 102 thru 104
 46           RD
 47           RC     .03     .03     .03    1600    .044
 48           RX      10      12      22      32      34      44      54      56
 49           RY       8       7       5       3       3       5       7       8

 50           KK     103
 51           KM             Subarea No. 103
 52           BA   .0350
 53           LS            94.0
 54           UD    .170

 55           KK    104R
 56           KM             Route Hydrograph 103 thru 104
 57           RD
 58           RC     .03     .03     .03    1320    .064
 59           RX      10      12      22      32      34      44      54      56
 60           RY       8       7       5       3       3       5       7       8

 61           KK     200
 62           KM             Subarea No. 200
 63           BA   .1858
 64           LS            95.0
 65           UD    .170

 66           KK    201R
 67           KM             Route Hydrograph 200 thru 201
 68           RD     640    .031    .030            TRAP       2       4

 69           KK     201
 70           KM             Subarea No. 201
 71           BA   .0211
 72           LS            86.0
 73           UD    .170

 74           KK    201C
 75           KM             Combine Hydrographs 200 & 201
 76           HC       2

 77           KK    104R
 78           KM             Route Hydrograph 200/201 thru 104
 79           RD     720    .022    .030            TRAP      10       9

 80           KK     104
 81           KM             Subarea No. 104
 82           BA   .0423
 83           LS            86.0
 84           UD    .170
```

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

 85           KK    104C
 86           KM            Combine Hydrographs 100-101/102/103/200-201 & 104
 87           HC       5

 88           KK    302R
 89           KM            Route Hydrographs 100-104/200-201 thru 302
 90           RD
 91           RC     .03    .018    .030     350   .0148
 92           RX    21.2    23.2    25.2      34      56    64.8    66.8    68.8
 93           RY     7.4     6.4     6.4       2       2     6.4     6.4     7.4

 94           KK     300
 95           KM            Subarea No. 300
 96           BA   .0268
 97           LS           93.2
 98           UD    .170

 99           KK    301R
100           KM            Route Hydrograph 300 thru 301
101           RD     720    .025    .015            TRAP       0      50

102           KK     301
103           KM            Subarea No. 301
104           BA   .0111
105           LS           86.0
106           UD    .170

107           KK    301C
108           KM            Combine Hydrographs 300-301
109           HC       2

110           KK    302R
111           KM            Route Hydrographs 300-301 thru 302
112           RD
113           RC     .03    .018     .03     350   .0148
114           RX    21.2    23.2    25.2      34      56    64.8    66.8    68.8
115           RY     7.4     6.4     6.4       2       2     6.4     6.4     7.4

116           KK     302
117           KM            Subarea No. 302
118           BA   .0155
119           LS           86.0
120           UD    .170

121           KK    302C
122           KM            Combine Hydrographs 100-104/200-201 & 300-302
123           HC       3

124           KK    501R
125           KM            Route Hydrographs 100-104/200-201 & 300-302 thru 501
126           RD
127           RC     .03    .018     .03     500   .0148
128           RX       8      10      12      24      50      62      64      66
129           RY       7       6       6       2       2       6       6       7
```

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

 130          KK     501
 131          KM             Subarea No. 501
 132          BA   .0041
 133          LS            86.0
 134          UD    .170

 135          KK    501C
 136          KM             Combine Hydrographs 100-104/200-201/300-302 & 501
 137          HC       2

 138          KK    502R
 139          KM             Route Hydrographs 100-104/200-201/300-302 & 501 thru 502
 140          RD
 141          RC    .025    .025    .025     310   .0047
 142          RX    87.2    89.2    91.2     100     200   208.8   210.8   212.8
 143          RY     7.4     6.4     6.4       2       2     6.4     6.4     7.4

 144          KK     502
 145          KM             Subarea No. 502
 146          BA   .0027
 147          LS            63.0
 148          UD    .170

 149          KK    502C
 150          KM             Combine Hydrographs 100-104/200-201/300-302 & 501-502
 151          HC       2

 152          KK    503R
 153          KM             Route Hydrographs 100-104/200-201/300-302 & 501-502 thru 503
 154          RD
 155          RC    .025    .025    .025     260    .010
 156          RX      40      42      44      50     330     336     338     340
 157          RY       6       5       5       2       2       5       5       6

 158          KK     503
 159          KM            Subarea No. 503
 160          BA   .0039
 161          LS            63.0
 162          UD    .170

 163          KK    503C
 164          KM            Combine Hydrographs 100-104/200-201/300-302 & 501-503
 165          HC       2
 166          ZZ
```

SCHEMATIC DIAGRAM OF STREAM NETWORK

```
INPUT
 LINE     (V) ROUTING          (--->) DIVERSION OR PUMP FLOW

  NO.     (.) CONNECTOR        (<---) RETURN OF DIVERTED OR PUMPED FLOW

   9        100
              V
              V
  19       101R
              .
              .
  25          .        101
              .          .
              .          .
  30       101C............
              V
              V
  33       104R
              .
              .
  39          .        102
              .          V
              .          V
  44          .       104R
              .          .
              .          .
  50          .          .        103
              .          .          V
              .          .          V
  55          .          .       104R
              .          .          .
              .          .          .
  61          .          .          .        200
              .          .          .          V
              .          .          .          V
  66          .          .          .       201R
              .          .          .          .
              .          .          .          .
  69          .          .          .          .        201
              .          .          .          .          .
              .          .          .          .          .
  74          .          .          .       201C............
              .          .          .          V
              .          .          .          V
  77          .          .          .       104R
              .          .          .          .
              .          .          .          .
  80          .          .          .          .        104
              .          .          .          .          .
              .          .          .          .          .
  85       104C.............................................
              V
              V
  88       302R
              .
              .
  94          .        300
              .          V
              .          V
  99          .       301R
              .          .
              .          .
 102          .          .        301
              .          .          .
```

```
                .          .          .
 107            .       301C...........
                .          V
                .          V
 110            .       302R
                .          .
                .          .
 116            .          .        302
                .          .  -       .
                .          .          .
 121         302C......................
                V
                V
 124         501R
                .
                .
 130            .        501
                .          .
                .          .
 135         501C...........
                V
                V
 138         502R
                .
                .
 144            .        502
                .          .
                .          .
 149         502C...........
                V
                V
 152         503R
                .
                .
 158            .        503
                .          .
                .          .
 163         503C...........
```

(***) RUNOFF ALSO COMPUTED AT THIS LOCATION

```
****************************************
*                                      *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)  *
*              MAY   1991              *
*           VERSION 4.0.1E             *
*                                      *
*  RUN DATE  01/13/93  TIME  16:38:05  *
*                                      *
****************************************
```

```
****************************************
*                                      *
*    U.S. ARMY CORPS OF ENGINEERS      *
*    HYDROLOGIC ENGINEERING CENTER     *
*          609 SECOND STREET           *
*       DAVIS, CALIFORNIA 95616        *
*           (916) 551-1748             *
*                                      *
****************************************
```

CITY OF PHOENIX PROJECT NO. P-886515
TATUM BLVD. - MOCKINGBIRD LANE TO SHEA BLVD.
KAMINSKI - HUBBARD ENGINEERING, INC. - JOB NO. 0118
HEC-1 FILENAME : 118-15.DAT
100 YEAR - 6 HOUR STORM
REVISED: AUGUST 27, 1990 BY D.L.B.

```
8 IO        OUTPUT CONTROL VARIABLES
                 IPRNT          5  PRINT CONTROL
                 IPLOT          0  PLOT CONTROL
                 QSCAL         0.  HYDROGRAPH PLOT SCALE

  IT        HYDROGRAPH TIME DATA
                  NMIN          4  MINUTES IN COMPUTATION INTERVAL
                 IDATE     7FEB90  STARTING DATE
                 ITIME       1000  STARTING TIME
                    NQ        361  NUMBER OF HYDROGRAPH ORDINATES
                NDDATE     8FEB90  ENDING DATE
                NDTIME       1000  ENDING TIME
                 ICENT         19  CENTURY MARK

            COMPUTATION INTERVAL    0.07 HOURS
                 TOTAL TIME BASE   24.00 HOURS

      ENGLISH UNITS
           DRAINAGE AREA          SQUARE MILES
           PRECIPITATION DEPTH    INCHES
           LENGTH, ELEVATION      FEET
           FLOW                   CUBIC FEET PER SECOND
           STORAGE VOLUME         ACRE-FEET
           SURFACE AREA           ACRES
           TEMPERATURE            DEGREES FAHRENHEIT
```

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	100	259.	4.07	26.	6.	6.	0.09		
ROUTED TO	101R	251.	4.07	26.	6.	6.	0.09		
HYDROGRAPH AT	101	239.	4.07	24.	6.	6.	0.08		
2 COMBINED AT	101C	491.	4.07	49.	12.	12.	0.16		
ROUTED TO	104R	475.	4.13	49.	12.	12.	0.16		
HYDROGRAPH AT	102	101.	4.07	10.	2.	2.	0.04		
ROUTED TO	104R	97.	4.13	10.	2.	2.	0.04		
HYDROGRAPH AT	103	104.	4.07	10.	3.	3.	0.04		
ROUTED TO	104R	101.	4.07	10.	3.	3.	0.04		
HYDROGRAPH AT	200	564.	4.07	56.	14.	14.	0.19		
ROUTED TO	201R	556.	4.07	56.	14.	14.	0.19		
HYDROGRAPH AT	201	50.	4.07	4.	1.	1.	0.02		
2 COMBINED AT	201C	606.	4.07	60.	15.	15.	0.21		
ROUTED TO	104R	588.	4.07	60.	15.	15.	0.21		
HYDROGRAPH AT	104	100.	4.07	9.	2.	2.	0.04		
5 COMBINED AT	104C	1348.	4.07	138.	35.	35.	0.48		
ROUTED TO	302R	1335.	4.07	138.	35.	35.	0.48		
HYDROGRAPH AT	300	78.	4.07	8.	2.	2.	0.03		
ROUTED TO	301R	76.	4.07	8.	2.	2.	0.03		
HYDROGRAPH AT	301	26.	4.07	2.	1.	1.	0.01		
2 COMBINED AT	301C	102.	4.07	10.	2.	2.	0.04		
ROUTED TO	302R	100.	4.07	10.	2.	2.	0.04		
HYDROGRAPH AT	302	37.	4.07	3.	1.	1.	0.02		
3 COMBINED AT	302C	1471.	4.07	152.	38.	38.	0.54		
ROUTED TO	501R	1463.	4.13	152.	38.	38.	0.54		
HYDROGRAPH AT	501	10.	4.07	1.	0.	0.	0.00		
2 COMBINED AT	501C	1472.	4.13	153.	38.	38.	0.54		
ROUTED TO	502R	1468.	4.13	153.	38.	38.	0.54		
HYDROGRAPH AT	502	2.	4.13	0.	0.	0.	0.00		

2 COMBINED AT	502C	1470.	4.13	153.	38.	38.	0.54
ROUTED TO	503R	1463.	4.13	153.	38.	38.	0.54
HYDROGRAPH AT	503	3.	4.13	0.	0.	0.	0.00
2 COMBINED AT	503C	1466.	4.13	153.	38.	38.	0.55

SUMMARY OF KINEMATIC WAVE - MUSKINGUM-CUNGE ROUTING
(FLOW IS DIRECT RUNOFF WITHOUT BASE FLOW)

ISTAQ	ELEMENT	DT (MIN)	PEAK (CFS)	TIME TO PEAK (MIN)	VOLUME (IN)	INTERPOLATED TO COMPUTATION INTERVAL DT (MIN)	PEAK (CFS)	TIME TO PEAK (MIN)	VOLUME (IN)
101R	MANE	1.50	253.46	244.76	2.79	4.00	251.35	244.00	2.79

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.1269E+02 EXCESS=0.0000E+00 OUTFLOW=0.1269E+02 BASIN STORAGE=0.1278E-03 PERCENT ERROR= 0.0

104R	MANE	2.59	485.30	246.36	2.79	4.00	475.07	248.00	2.79

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.2443E+02 EXCESS=0.0000E+00 OUTFLOW=0.2443E+02 BASIN STORAGE=0.4117E-03 PERCENT ERROR= 0.0

104R	MANE	3.00	99.79	246.01	2.49	4.00	96.56	248.00	2.49

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.4760E+01 EXCESS=0.0000E+00 OUTFLOW=0.4761E+01 BASIN STORAGE=0.1255E-03 PERCENT ERROR= 0.0

104R	MANE	2.16	102.40	246.06	2.69	4.00	100.81	244.00	2.70

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.5024E+01 EXCESS=0.0000E+00 OUTFLOW=0.5025E+01 BASIN STORAGE=0.7584E-04 PERCENT ERROR= 0.0

201R	MANE	0.78	559.97	244.54	2.79	4.00	555.61	244.00	2.79

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.2766E+02 EXCESS=0.0000E+00 OUTFLOW=0.2766E+02 BASIN STORAGE=0.2221E-03 PERCENT ERROR= 0.0

104R	MANE	1.21	597.21	245.85	2.71	4.00	588.02	244.00	2.71

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.2990E+02 EXCESS=0.0000E+00 OUTFLOW=0.2990E+02 BASIN STORAGE=0.4741E-03 PERCENT ERROR= 0.0

302R	MANE	0.29	1347.09	244.47	2.66	4.00	1334.71	244.00	2.66

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.6857E+02 EXCESS=0.0000E+00 OUTFLOW=0.6857E+02 BASIN STORAGE=0.2001E-04 PERCENT ERROR= 0.0

301R	MANE	1.71	76.50	245.06	2.61	4.00	75.68	244.00	2.61

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.3730E+01 EXCESS=0.0000E+00 OUTFLOW=0.3730E+01 BASIN STORAGE=0.2602E-03 PERCENT ERROR= 0.0

302R	MANE	0.96	101.61	245.12	2.42	4.00	99.71	244.00	2.43

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.4892E+01 EXCESS=0.0000E+00 OUTFLOW=0.4893E+01 BASIN STORAGE=0.2092E-04 PERCENT ERROR= 0.0

501R	MANE	0.44	1471.01	244.65	2.62	4.00	1463.21	248.00	2.62

```
CONTINUITY SUMMARY (AC-FT) - INFLOW=0.7514E+02 EXCESS=0.0000E+00 OUTFLOW=0.7514E+02 BASIN STORAGE=0.2928E-04 PERCENT ERROR=   0.0

            502R  MANE        0.67   1468.57    247.45      2.62      4.00   1468.37    248.00        2.62

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.7562E+02 EXCESS=0.0000E+00 OUTFLOW=0.7562E+02 BASIN STORAGE=0.4903E-04 PERCENT ERROR=   0.0

            503R  MANE        0.70   1463.63    247.87      2.61      4.00   1463.44    248.00        2.61

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.7576E+02 EXCESS=0.0000E+00 OUTFLOW=0.7577E+02 BASIN STORAGE=0.2962E-04 PERCENT ERROR=   0.0


*** NORMAL END OF HEC-1 ***
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APPENDIX B-2

DRAINAGE AREA NO. 1
DESIGN CALCULATIONS

KAMINSKI HUBBARD engineering inc. • Surveying • Civil • Hydrology	Made by D.L.B	Date 2-16-90	Job No. 011B
	Checked by	Date	Sheet No.
	For		

SUBBASIN No. 100

Drainage Area = 0.08515 mi.^{2} = 54.49 Ac.

Zoning : Hillside (over 10% sloping)
Type D CN = 95

'C' Coefficient = 0.70

SUBBASIN NO. 101

Drainage Area = 0.07885 mi.^{2} = 50.46 Ac.

Zoning : Hillside (over 10% sloping)
Type D CN = 95

'C' Coefficient = 0.70

SUBBASIN NO. 102

Total Drainage Area = 0.03709 mi.^{2} = 23.74 Ac.

a. Zoning : RE-43 CN = 86 C = 0.45
Drainage Area = 0.0132 mi.^{2} = 8.45 Ac.
Assume 90% Contributes
∴ Drainage Area = 0.01188 mi.^{2} = 7.60 Ac.

b. Zoning : Hillside (over 10% sloping) CN = 95
Drainage Area = 0.02389 mi.^{2} = 15.29 Ac.
C = 0.70

Weighted Curve No.

$$CN = \frac{(86)(0.01188) + (95)(0.02389)}{0.03577} = 92$$

Weighted 'C' Coefficient:

$$C = \frac{(0.45)(0.01188) + (0.70)(0.02389)}{0.03577} = 0.62$$

Total Contributing Drainage Area = 0.03577 mi.^{2} = 22.89 Ac.

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	For		

SUBBASIN NO. 103

Total Drainage Area = 0.03536 mi.^{2} = 22.63 Ac.

a. Zoning: RE-43 CN = 86 C = 0.45
Drainage Area = 0.00416 mi.^{2} = 2.66 Ac.
Assume 90% Contributes
∴ Drainage Area = 0.00374 mi.^{2} = 2.40 Ac.

b. Zoning: Hillside (over 10% sloping) CN = 95 C = 0.70
Drainage Area = 0.0312 mi.^{2} = 19.97 Ac.

Weighted Curve No.

$$CN = \frac{(86)(0.00374) + (95)(0.0312)}{0.03494} = 94$$

Weighted 'C' Coefficient:

$$C = \frac{(0.45)(0.00374) + (0.70)(0.0312)}{0.03494} = 0.67$$

Total Contributing Drainage Area = 0.03494 mi.^{2} = 22.37 Ac.

SUBBASIN NO. 104

Drainage Area = 0.04700 mi.^{2} = 30.08 Ac.

Zoning: RE-43
Assume 90% Contributes
∴ Drainage Area = 0.04230 mi.^{2} = 27.07 Ac.
Type D CN = 86

'C' Coefficient = 0.45

SUBBASIN NO. 200

Drainage Area = 0.18579 mi.^{2} = 118.91 Ac.

Zoning: Hillside (over 10% sloping)
Type D CN = 95

'C' Coefficient = 0.70

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	For		

SUBBASIN NO. 201

Drainage Area = 0.02344 mi.^{2} = 15.00 Ac.

Zoning: RE-43
Assume 90% Contributes
∴ Drainage Area = 0.02110 mi.^{2} = 13.50 Ac.
Type D CN = 86

'C' Coefficient = 0.45

SUBBASIN NO. 300

Total Drainage Area = 0.02739 mi.^{2} = 17.53 Ac.

a. Zoning: RE-43 CN = 86 C = 0.45
Drainage Area = 0.00588 mi.^{2} = 3.76 Ac.
Assume 90% Contributes
∴ Drainage Area = 0.00529 mi.^{2} = 3.39 Ac.

b. Zoning: Hillside (over 10% sloping)
CN = 95 C = 0.70
Drainage Area = 0.02151 mi.^{2} = 13.77 Ac.

Total Contributing Drainage Area = 0.02680 mi.^{2} = 17.16 Ac.

Weighted Curve No.

$$CN = \frac{(86)(0.00529) + (95)(0.02151)}{0.02680} = 93.2$$

Weighted 'C' Coefficient

$$C = \frac{(0.45)(0.00529) + (0.70)(0.02151)}{0.02680} = 0.65$$

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	For		

SUBBASIN NO. 301

Drainage Area = 0.01385 mi.^{2} = 8.86 Ac.

Zoning: RE-43
Assume 80% Contributes
∴ Drainage Area = 0.01108 mi.^{2} = 7.09 Ac.
Type D CN(1hr.) = 86
CN(24hr.) = 78.8

'C' Coefficient = 0.45

SUBBASIN NO. 302

Drainage Area = 0.01935 mi.^{2} = 12.38 Ac.

Zoning: RE-43
Assume 80% Contributes
∴ Drainage Area = 0.01548 mi.^{2} = 9.91 Ac.
Type D CN = 86
'C' Coefficient = 0.45

SUBBASIN NO. 501

Total Drainage Area = $\left(\frac{6.46}{2}\right)(200)^2 \div (5280)^2$ = 0.00463 mi.^{2} = 2.97 Ac.

Zoning: RE-43, Type 'D' soils CN = 86

SUBBASIN NO. 502

Total Drainage Area = $\left(\frac{3.71}{2}\right)(200^2) \div (5280)^2$ = 0.00266 mi.^{2} = 1.70 Ac.

Grass Cover: CN = 63

SUBBASIN NO. 503

Total Drainage Area = $\left(\frac{5.40}{2}\right)(200^2) \div (5280^2)$ = 0.0039 mi.^{2} = 2.48 Ac.

Grass Cover: CN = 63

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	Checked by	Date	Sheet No. 1
	For		

DRAINAGE AREA NO. 1 - Contributing Areas

Assumption: For 2-Year storm event, only impervious areas will contribute. For RE-43 Zoning, 15% is impervious.

For RE-43 Zoning:
- For 10-Year storm event, 50% of area is contributing which would be the front half of each lot.
- For 25-, 50- and 100-year storm events, 90% of area is contributing.

SubArea 100 — Hillside Area = 100%
For all storms, D.A. = 0.0852 mi^2

SubArea 101 — Hillside Area = 100%
For all storms, D.A. = 0.0789 mi^2

SubArea 102 — RE-43 Area = 0.0132 mi^2
Hillside Area = 0.0239 mi^2

$D.A._{2YR} = 0.0239 + 0.15(0.0132) = 0.0259\ mi^2$

$D.A._{10YR} = 0.0239 + 0.50(0.0132) = 0.0305\ mi^2$

$D.A._{25YR} = D.A._{50YR} = D.A._{100YR} = 0.0239 + 0.90(0.0132) = 0.0358\ mi^2$

SubArea 103 — RE-43 Area = 0.0042 mi^2
Hillside Area = 0.0312 mi^2

$D.A._{2YR} = 0.0312 + 0.15(0.0042) = 0.0318\ mi^2$

$D.A._{10YR} = 0.0312 + 0.50(0.0042) = 0.0333\ mi^2$

$D.A._{25YR} = D.A._{50YR} = D.A._{100YR} = 0.0312 + 0.90(0.0042) = 0.0350\ mi^2$

SubArea 104 — RE-43 Area = 100%

$D.A._{2YR} = 0.15(0.0470) = 0.0071\ mi^2$

$D.A._{10YR} = 0.50(0.0470) = 0.0235\ mi^2$

$D.A._{25YR} = D.A._{50YR} = D.A._{100YR} = 0.90(0.0470) = 0.0423\ mi^2$

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	Checked by	Date	Sheet No. 2
	For		

DRAINAGE AREA NO. 1 (CONT'D)

SubArea 200 Hillside Area = 100%
For All Storms, D.A. = 0.1858 mi^2

SubArea 201 RE-43 Area = 100%

$D.A._{2YR} = 0.15(0.0234) = 0.0035\ mi^2$

$D.A._{10YR} = 0.50(0.0234) = 0.0117\ mi^2$

$D.A._{25YR} = D.A._{50YR} = D.A._{100YR} = (0.90)(0.0234) = 0.0211\ mi^2$

SubArea 300 RE-43 Area = 0.0059 mi^2
Hillside Area = 0.0215 mi^2

$D.A._{2YR} = 0.0215 + 0.15(0.0059) = 0.0224\ mi^2$

$D.A._{10YR} = 0.0215 + 0.50(0.0059) = 0.0245\ mi^2$

$D.A._{25YR} = D.A._{50YR} = D.A._{100YR} = 0.0215 + 0.90(0.0059) = 0.0268\ mi^2$

SubArea 301 RE-43 Area = 100%

$D.A._{2YR} = 0.15(0.0139) = 0.0021\ mi^2$

$D.A._{10YR} = 0.50(0.0139) = 0.0070\ mi^2$

For this SubArea, we assumed 80% contributing for the remaining storms.

$D.A._{25YR} = D.A._{50YR} = D.A._{100YR} = 0.80(0.0139) = 0.0111\ mi^2$

SubArea 302 RE-43 Area = 100%

$D.A._{2YR} = 0.15(0.0194) = 0.0029\ mi^2$

$D.A._{10YR} = 0.50(0.0194) = 0.0097\ mi^2$

For this SubArea, we assumed 80% contributing for the remaining storms.

$D.A._{25YR} = D.A._{50YR} = D.A._{100YR} = 0.80(0.0194) = 0.0155\ mi^2$

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	For		

DRAINAGE AREA NO. 1 (CONT'D)

Sub Area 501 RE-43 Area = 100%

$D.A._{2YR} = 0.15(0.0046) = 0.0007\ mi.^2$

$D.A._{10YR} = 0.50(0.0046) = 0.0023\ mi^2$

$D.A._{25YR} = D.A._{50YR} = D.A._{100YR} = 0.90(0.0046) = 0.0041\ mi^2$

Sub Area 502

For all storms, $D.A. = 0.0027\ mi^2$

Sub Area 503

For all storms, $D.A. = 0.0039\ mi^2$

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	Checked by	Date	Sheet No.
	For		

SUBBASIN NO. 500-1

(1) OFFSITE RUNOFF (Thru Tatum Mt. Estates)

$C = 0.60$

Drainage Area $= (30.90/2)(200)^2 = 618{,}000$ SF $= 14.187$ Ac.

Assume 90% contributes

$\therefore$ Contributing Drainage Area $= \underline{556{,}200 \text{ SF} = 12.769 \text{ Ac.}}$

TIME OF CONC., t_{c_1}

$t_{c_1} = (0.167 + 0.023 + 0.074) \times 60 = \underline{15.8 \text{ min.}}$

(2) ONSITE RUNOFF (Thru Doubletree Canyon) *

* Drainage Area & Time of Conc. calculations per "Doubletree Canyon" Drainage Report by Collar, Williams & White, April 1979.

Total Lot Area $= 3.72 + 0.93 + 4.96 = 9.61$ Ac.
$(C = 0.61)$

Total Street Area $= 0.58 + 0.09 + 0.24 = 0.91$ Ac.
$(C = 0.90)$

TIME OF CONC., t_{c_2}

$L_1 = 250'$, $S_1 = 0.032$ 1/1 (Gunite Channel) $\rightarrow V = 5.8$ fps
$\therefore \Delta t_1 = 250/60 \times 5.8 = 0.7$ min

$L_2 = 600'$, $S_2 = 0.0225$ 1/1 $\rightarrow V = 6.0$ fps
$\therefore \Delta t_2 = 600/60 \times 6 = 1.7$ min.

$\therefore t_{c_2} = 0.7 + 1.7 = 2.4$ min.

(3) TOTAL TIME OF CONC., t_c

$t_c = t_{c_1} + t_{c_2} = 15.8 + 2.4 = 18.2$ min

$Q = \Sigma CAI = [(0.60)(12.769) + (0.61)(9.61) + (0.90)(0.91)]\, I = 14.3425\, I$

Description	2Yr.	10Yr.	25Yr.	50Yr.	100Yr.
I, in/hr	1.85	3.00	3.50	3.90	4.5
Q, CFS	26.53	43.03	50.20	55.94	64.54

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	Checked by	Date	Sheet No.
	For		

SUBBASIN NO. 510-1

(1) offsite Runoff
Drainage Area = $(13.40/2)(200)^2$ = 268,000 SF = 6.152 Ac.
(C = 0.60)

(2) Tatum Blvd. R.O.W.
Drainage Area = (505 - 192)(55) = 17,215 SF = 0.395 Ac.
(C = 0.95)

(3) Time of Conc., t_c (Use Overland Flow Time, C.O.P. Manual Pg. 21)
$L_1 = 250'$, $S_1 = 0.031/ft$ → $\Delta t_1 = 7.5$ min.
$L_2 = 900'$, $S_2 = 0.03'/ft$ → $\Delta t_2 = 12.2$ min.
$L_3 = 170'$, $S_3 = 0.03'/ft$ → $\Delta t_3 = 6.5$ min

$\therefore t_c = 7.5 + 12.2 + 6.5 = 26.2$ min

$Q = \Sigma CA\ I = 4.066\ I$

Description	2Yr.	10Yr.	25Yr.	50Yr.	100Yr
I, in/hr.	1.5	2.4	2.9	3.3	3.7
① Q, CFS (INCLUDES TATUM)	6.10	9.76	11.79	13.42	15.05
② Q, CFS (OFFSITE)	5.54	8.86	10.70	12.18	13.66

① Peak Discharge includes Offsite Runoff and Tatum Blvd. R.O.W. Runoff

② Peak Discharge for Offsite Runoff Only.

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	Checked by	Date	Sheet No.
	For		

SUBBASIN NO. 510-2

(1) OFFSITE RUNOFF

Drainage Area = $(11.88/2)(200)^2$ = 237,600 SF = 5.455 Ac.
(C = 0.60)

(2) Tatum Blvd. R.O.W.

Drainage Area = (192 + 305)(55) = 27,335 SF = 0.628 Ac.
(C = 0.95)

(3) Time of Conc., t_c

L = 1050' S = 0.030'/ft
t_c = 2 (10 min.) = 20 min.

Q = ΣCAI = 3.8696 I

Description	2Yr.	10Yr.	25Yr.	50Yr.	100Yr.
I, in/hr	1.75	2.8	3.3	3.7	4.2
① Q, CFS (INCLUDES TATUM)	6.77	10.83	12.77	14.32	16.25
② Q, CFS (OFFSITE)	5.73	9.16	10.80	12.11	13.75

① Peak Discharge includes Offsite Runoff and Tatum Blvd. ROW Runoff.

② Peak Discharge for Offsite Runoff Only.

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	Checked by	Date	Sheet No.
	For		

SUBBASIN NO. 510-3

(1) OFFSITE RUNOFF

Drainage Area = $(13.27/2)(200)^2$ = 265,400 SF = 6.093 Ac.
($C = 0.75$)

(2) Tatum Blvd. R.O.W.

Drainage Area = (457)(55) = 25,135 S.F. = 0.5770 Ac.
($C = 0.95$)

(3) Time of Conc., t_c (Use Overland Flow Time, C.O.P. Manual Pg. 21)

$L_1 = 125'$ $S_1 = 0.020$ '/ft $\Delta t_{c1} = 6$ min.
$L_2 = 370'$ $S_2 = 0.030$ '/ft (Asphalt) $\Delta t_{c2} = 6.2$ min.
$L_3 = 650'$ $S_3 = 0.030$ '/ft $\Delta t_{c3} = 10.8$ min.

$\therefore t_c = 6 + 6.2 + 10.8 = 23.0$ min.

$Q = \Sigma CA\ I = [(6.093)(0.75) + (0.5770)(0.95)]\ I = 5.1179\ I$

Description	2Yr.	10Yr.	25Yr.	50Yr.	100Yr.
I, in/hr	1.6	2.6	3.1	3.5	3.9
① Q, CFS (INCLUDES TATUM)	8.2	13.3	15.9	17.9	20.0
② Q, CFS (OFFSITE)	7.3	11.9	14.2	16.0	17.8

① Peak Discharge includes Offsite Runoff and Tatum Blvd. R.O.W. Runoff

② Peak Discharge for Offsite Runoff Only.

Worksheet 3: Time of concentration (T_c) or travel time (T_t)

Project Tatum Blvd. By DLB Date 2-1-90

Location Phoenix, AZ Checked ____ Date ____

Circle one: Present Developed

Circle one: (T_c) T_t through subarea Subbasin #100

NOTES: Space for as many as two segments per flow type can be used for each worksheet.

Include a map, schematic, or description of flow segments.

Sheet flow (Applicable to T_c only)		Segment ID	A100 - B100		
1. Surface description (table 3-1)			Fallow		
2. Manning's roughness coeff., n (table 3-1) ..			0.05		
3. Flow length, L (total L ≤ 300 ft)	ft		100		
4. Two-yr 24-hr rainfall, P_2	in		1.4		
5. Land slope, s	ft/ft		0.57		
6. $T_t = \frac{0.007\ (nL)^{0.8}}{P_2^{0.5}\ s^{0.4}}$ Compute T_t	hr		0.027	+	= 0.027

Shallow concentrated flow		Segment ID	B100 - C100		
7. Surface description (paved or unpaved)			Unpaved		
8. Flow length, L	ft		225		
9. Watercourse slope, s	ft/ft		0.77		
10. Average velocity, V (figure 3-1)	ft/s		14		
11. $T_t = \frac{L}{3600\ V}$ Compute T_t	hr		0.005	+	= 0.005

Channel flow		Segment ID	C100 - D100	D100 - 100
12. Cross sectional flow area, a	ft^2			
13. Wetted perimeter, p_w	ft			
14. Hydraulic radius, $r = \frac{a}{p_w}$ Compute r	ft			
15. Channel slope, s	ft/ft		0.362	0.182
16. Manning's roughness coeff., n				
17. $V = \frac{1.49\ r^{2/3}\ s^{1/2}}{n}$ Compute V	ft/s		14.9	16.7
18. Flow length, L	ft		1160	1100
19. $T_t = \frac{L}{3600\ V}$ Compute T_t	hr		0.022	+ 0.018	≈ 0.04

20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19) ..... hr 0.072

or 4.3 min

use 10 min.

Worksheet 3: Time of concentration (T_c) or travel time (T_t)

Project Tatum Blvd. By DLB Date 2-1-90

Location Phoenix, AZ Checked ____ Date ____

Circle one: Present Developed

Circle one: (T_c) T_t through subarea Subbasin #101

NOTES: Space for as many as two segments per flow type can be used for each worksheet.

Include a map, schematic, or description of flow segments.

Sheet flow (Applicable to T_c only)	Segment ID	A101 – B101		
1. Surface description (table 3-1)		Fallow		
2. Manning's roughness coeff., n (table 3-1) ..		0.05		
3. Flow length, L (total L ≤ 300 ft)	ft	300		
4. Two-yr 24-hr rainfall, P_2	in	1.4		
5. Land slope, s	ft/ft	0.23		
6. $T_t = \frac{0.007\,(nL)^{0.8}}{P_2^{0.5}\,s^{0.4}}$ Compute T_t	hr	0.093	+	= 0.093

Shallow concentrated flow	Segment ID	B101 – C101		
7. Surface description (paved or unpaved)		Unpaved		
8. Flow length, L	ft	420		
9. Watercourse slope, s	ft/ft	0.21		
10. Average velocity, V (figure 3-1)	ft/s	7.5		
11. $T_t = \frac{L}{3600\,V}$ Compute T_t	hr	0.016	+	= 0.016

Channel flow	Segment ID	C101 – D101	D101 – E101	E101 – 1001
12. Cross sectional flow area, a	ft^2			
13. Wetted perimeter, p_w	ft			
14. Hydraulic radius, $r = \frac{a}{p_w}$ Compute r	ft			
15. Channel slope, s	ft/ft	0.28	0.13	0.05
16. Manning's roughness coeff., n				
17. $V = \frac{1.49\,r^{2/3}\,s^{1/2}}{n}$ Compute V	ft/s	11.8	10.0	8.5
18. Flow length, L	ft	1000	380	1020
19. $T_t = \frac{L}{3600\,V}$ Compute T_t	hr	0.024	+ 0.011	+ 0.033

20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19) ..... hr 0.177

≈ 10.6 min.

Worksheet 3: Time of concentration (T_c) or travel time (T_t)

Project Tatum Blvd. By DLB Date 2-1-90

Location Phoenix, AZ Checked ____ Date ____

Circle one: Present Developed

Circle one: (T_c) T_t through subarea Subbasin #102

NOTES: Space for as many as two segments per flow type can be used for each worksheet.

Include a map, schematic, or description of flow segments.

Sheet flow (Applicable to T_c only)		Segment ID	A102 - B102			
1. Surface description (table 3-1)			Fallow			
2. Manning's roughness coeff., n (table 3-1) ..			0.05			
3. Flow length, L (total L ≤ 300 ft)	ft		100			
4. Two-yr 24-hr rainfall, P_2	in		1.4			
5. Land slope, s	ft/ft		0.65			
6. $T_t = \frac{0.007\ (nL)^{0.8}}{P_2^{0.5}\ s^{0.4}}$ Compute T_t	hr		0.025	+		= 0.025

Shallow concentrated flow		Segment ID	B102 - C102			
7. Surface description (paved or unpaved)			Unpaved			
8. Flow length, L	ft		380			
9. Watercourse slope, s	ft/ft		0.47			
10. Average velocity, V (figure 3-1)	ft/s		11.0			
11. $T_t = \frac{L}{3600\ V}$ Compute T_t	hr		0.010	+		= 0.010

Channel flow		Segment ID	C102 - D102	D102 - 100Z		
12. Cross sectional flow area, a	ft^2					
13. Wetted perimeter, p_w	ft					
14. Hydraulic radius, $r = \frac{a}{p_w}$ Compute r	ft					
15. Channel slope, s	ft/ft		0.096	0.036		
16. Manning's roughness coeff., n						
17. $V = \frac{1.49\ r^{2/3}\ s^{1/2}}{n}$ Compute V	ft/s		8.4	4.7		
18. Flow length, L	ft		1080	400		
19. $T_t = \frac{L}{3600\ V}$ Compute T_t	hr		0.036	+ 0.024		= 0.06

20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19) ..... hr 0.095

≈ 5.7 min.

Use 10min

Worksheet 3: Time of concentration (T_c) or travel time (T_t)

Project Tatum Blvd. By DLB Date 2-1-90

Location Phoenix, AZ Checked ____ Date ____

Circle one: Present Developed

Circle one: (T_c) T_t through subarea Sub basin # 103

NOTES: Space for as many as two segments per flow type can be used for each worksheet.

Include a map, schematic, or description of flow segments.

Sheet flow (Applicable to T_c only)		Segment ID	A103 - B103			
1. Surface description (table 3-1)			Fallow			
2. Manning's roughness coeff., n (table 3-1) ..			0.05			
3. Flow length, L (total L ≤ 300 ft)	ft		300			
4. Two-yr 24-hr rainfall, P_2	in		1.4			
5. Land slope, s	ft/ft		0.67			
6. $T_t = \frac{0.007\ (nL)^{0.8}}{P_2^{0.5}\ s^{0.4}}$ Compute T_t	hr		0.061	+		= 0.061

Shallow concentrated flow		Segment ID	B103 - C103			
7. Surface description (paved or unpaved)			Unpaved			
8. Flow length, L	ft		380			
9. Watercourse slope, s	ft/ft		0.65			
10. Average velocity, V (figure 3-1)	ft/s		13.0			
11. $T_t = \frac{L}{3600\ V}$ Compute T_t	hr		0.008	+		= 0.008

Channel flow		Segment ID	C103 - D103		D103 - E103		E103 - 1003
12. Cross sectional flow area, a	ft^2						
13. Wetted perimeter, p_w	ft						
14. Hydraulic radius, $r = \frac{a}{p_w}$ Compute r	ft						
15. Channel slope, s	ft/ft		0.26		0.11		0.038
16. Manning's roughness coeff., n							
17. $V = \frac{1.49\ r^{2/3}\ s^{1/2}}{n}$ Compute V	ft/s		10.1		9.0		8.0
18. Flow length, L	ft		820		380		260
19. $T_t = \frac{L}{3600\ V}$ Compute T_t	hr		0.023	+	0.012	+	0.009

20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19) ..... hr 0.113

≈ 6.8 min.
use 10 min

Worksheet 3: Time of concentration (T_c) or travel time (T_t)

Project Tatum Blvd. By DLB Date 2-2-90

Location Phoenix, AZ Checked ____ Date ____

Circle one: Present Developed

Circle one: (T_c) T_t through subarea Subbasin #104

NOTES: Space for as many as two segments per flow type can be used for each worksheet.

Include a map, schematic, or description of flow segments.

Sheet flow (Applicable to T_c only)		Segment ID	A104 - B104		
1. Surface description (table 3-1)			Fallow		
2. Manning's roughness coeff., n (table 3-1) ..			0.05		
3. Flow length, L (total L ≤ 300 ft)	ft		100		
4. Two-yr 24-hr rainfall, P_2	in		1.4		
5. Land slope, s	ft/ft		0.21		
6. $T_t = \frac{0.007\ (nL)^{0.8}}{P_2^{0.5}\ s^{0.4}}$ Compute T_t	hr		0.04	+	= 0.04

Shallow concentrated flow		Segment ID	B104 - C104		
7. Surface description (paved or unpaved)			Unpaved		
8. Flow length, L	ft		140		
9. Watercourse slope, s	ft/ft		0.078		
10. Average velocity, V (figure 3-1)	ft/s		4.5		
11. $T_t = \frac{L}{3600\ V}$ Compute T_t	hr		0.01	+	= 0.01

Channel flow		Segment ID	C104 - D104	D104 - 1004
12. Cross sectional flow area, a	ft^2			
13. Wetted perimeter, p_w	ft			
14. Hydraulic radius, $r = \frac{a}{p_w}$ Compute r	ft			
15. Channel slope, s	ft/ft		0.085	0.040
16. Manning's roughness coeff., n				
17. $V = \frac{1.49\ r^{2/3}\ s^{1/2}}{n}$ Compute V	ft/s		6.2	4.6
18. Flow length, L	ft		280	1260
19. $T_t = \frac{L}{3600\ V}$ Compute T_t	hr		0.013	+ 0.076 = 0.089

20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19) ..... hr 0.139 ≈ 8.3

Use 10 min = 0.1 hr.

Worksheet 3: Time of concentration (T_c) or travel time (T_t)

Project Tatum Blvd. By DLB Date 2-2-90

Location Phoenix, AZ Checked ____ Date ____

Circle one: Present Developed

Circle one: (T_c) T_t through subarea Sub basin #200

NOTES: Space for as many as two segments per flow type can be used for each worksheet.

Include a map, schematic, or description of flow segments.

Sheet flow (Applicable to T_c only)	Segment ID	A200-B200		
1. Surface description (table 3-1)		Fallow		
2. Manning's roughness coeff., n (table 3-1) ..		0.05		
3. Flow length, L (total L ≤ 300 ft)	ft	200		
4. Two-yr 24-hr rainfall, P_2	in	1.4		
5. Land slope, s	ft/ft	0.50		
6. $T_t = \frac{0.007\ (nL)^{0.8}}{P_2^{0.5}\ s^{0.4}}$ Compute T_t	hr	0.049 +		= 0.049

Shallow concentrated flow	Segment ID	B200-C200		
7. Surface description (paved or unpaved)		Unpaved		
8. Flow length, L	ft	720		
9. Watercourse slope, s	ft/ft	0.40		
10. Average velocity, V (figure 3-1)	ft/s	10.0		
11. $T_t = \frac{L}{3600\ V}$ Compute T_t	hr	0.02 +		= 0.02

Channel flow	Segment ID	C200-D200	D200-E200	E200-2000
12. Cross sectional flow area, a	ft^2			
13. Wetted perimeter, p_w	ft			
14. Hydraulic radius, $r = \frac{a}{p_w}$ Compute r	ft			
15. Channel slope, s	ft/ft	0.080	0.042	0.029
16. Manning's roughness coeff., n				
17. $V = \frac{1.49\ r^{2/3}\ s^{1/2}}{n}$ Compute V	ft/s	9.9	9.7	9.5
18. Flow length, L	ft	1120	480	1020
19. $T_t = \frac{L}{3600\ V}$ Compute T_t	hr	0.031 +	0.014 +	0.030
20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19)	hr			0.144

velocity computed using Avg. V Sect.

≈ 8.6 min.
use 10 min

Worksheet 3: Time of concentration (T_c) or travel time (T_t)

Project Tatum Blvd. By DLB Date 2-2-90

Location Phoenix, AZ Checked ____ Date ____

Circle one: Present Developed

Circle one: (T_c) T_t through subarea Sub basin # 201

NOTES: Space for as many as two segments per flow type can be used for each worksheet.

Include a map, schematic, or description of flow segments.

Sheet flow (Applicable to T_c only)		Segment ID	A201 - B201		
1. Surface description (table 3-1)			Fallow		
2. Manning's roughness coeff., n (table 3-1) ..			0.05		
3. Flow length, L (total L ≤ 300 ft)	ft		220		
4. Two-yr 24-hr rainfall, P_2	in		1.4		
5. Land slope, s	ft/ft		0.59		
6. $T_t = \frac{0.007\ (nL)^{0.8}}{P_2^{0.5}\ s^{0.4}}$ Compute T_t	hr		0.050	+	= 0.050

Shallow concentrated flow		Segment ID	B201 - C201	C201 - D201	
7. Surface description (paved or unpaved)			Unpaved	Unpaved	
8. Flow length, L	ft		260	200	
9. Watercourse slope, s	ft/ft		0.39	0.10	
10. Average velocity, V (figure 3-1)	ft/s		10.0	5.2	
11. $T_t = \frac{L}{3600\ V}$ Compute T_t	hr		0.007	+ 0.011	≈ 0.018

Channel flow		Segment ID	D201 - E201	E201 - 2001	
12. Cross sectional flow area, a	ft^2				
13. Wetted perimeter, p_w	ft				
14. Hydraulic radius, $r = \frac{a}{p_w}$ Compute r	ft				
15. Channel slope, s	ft/ft		0.086	0.034	
16. Manning's roughness coeff., n					
17. $V = \frac{1.49\ r^{2/3}\ s^{1/2}}{n}$ Compute V	ft/s		6.5	5.6	
18. Flow length, L	ft		560	580	
19. $T_t = \frac{L}{3600\ V}$ Compute T_t	hr		0.024	+ 0.029	= 0.053

20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19) ..... hr 0.121

≈ 7.3 min
Use 10 min

Worksheet 3: Time of concentration (T_c) or travel time (T_t)

Project Tatum Blvd. By DLB Date 2-2-90

Location Phoenix, AZ Checked ____ Date ____

Circle one: Present Developed

Circle one: (T_c) T_t through subarea Sub basin #300

NOTES: Space for as many as two segments per flow type can be used for each worksheet.

Include a map, schematic, or description of flow segments.

Sheet flow (Applicable to T_c only)	Segment ID	A300-B300		
1. Surface description (table 3-1)		Fallow		
2. Manning's roughness coeff., n (table 3-1) ..		0.05		
3. Flow length, L (total L ≤ 300 ft)	ft	250		
4. Two-yr 24-hr rainfall, P_2	in	1.4		
5. Land slope, s	ft/ft	0.61		
6. $T_t = \frac{0.007\ (nL)^{0.8}}{P_2^{0.5}\ s^{0.4}}$ Compute T_t	hr	0.054	+	= 0.054

Shallow concentrated flow	Segment ID	B300-C300		
7. Surface description (paved or unpaved)		Unpaved		
8. Flow length, L	ft	360		
9. Watercourse slope, s	ft/ft	0.44		
10. Average velocity, V (figure 3-1)	ft/s	10.5		
11. $T_t = \frac{L}{3600\ V}$ Compute T_t	hr	0.010	+	= 0.010

Channel flow	Segment ID	C300-D300	D300-3000
12. Cross sectional flow area, a	ft^2		
13. Wetted perimeter, p_w	ft		
14. Hydraulic radius, $r = \frac{a}{p_w}$ Compute r	ft		
15. Channel slope, s	ft/ft	0.18	0.035
16. Manning's roughness coeff., n			
17. $V = \frac{1.49\ r^{2/3}\ s^{1/2}}{n}$ Compute V	ft/s	8.3	5.5
18. Flow length, L	ft	400	530
19. $T_t = \frac{L}{3600\ V}$ Compute T_t	hr	0.013 +	0.027 = 0.04

20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19) ..... hr 0.104

≈ 6.2 min

Worksheet 3: Time of concentration (T_c) or travel time (T_t)

Project Tatum Blvd. By DLB Date 2-2-90

Location Phoenix, AZ Checked ____ Date ____

Circle one: Present Developed

Circle one: (T_c) T_t through subarea Subbasin #301

NOTES: Space for as many as two segments per flow type can be used for each worksheet.

Include a map, schematic, or description of flow segments.

Sheet flow (Applicable to T_c only)		Segment ID	A301-B301		
1. Surface description (table 3-1)			Fallow		
2. Manning's roughness coeff., n (table 3-1) ..			0.05		
3. Flow length, L (total L $\leq$ 300 ft)	ft		200		
4. Two-yr 24-hr rainfall, P_2	in		1.4		
5. Land slope, s	ft/ft		0.03		
6. $T_t = \frac{0.007\ (nL)^{0.8}}{P_2^{0.5}\ s^{0.4}}$ Compute T_t	hr		0.152	+	= 0.152

Shallow concentrated flow		Segment ID	B301-C301		
7. Surface description (paved or unpaved)			Paved		
8. Flow length, L	ft		380		
9. Watercourse slope, s	ft/ft		0.015		
10. Average velocity, V (figure 3-1)	ft/s		2.6		
11. $T_t = \frac{L}{3600\ V}$ Compute T_t	hr		0.041	+	= 0.041

Channel flow		Segment ID	C301-3001		
12. Cross sectional flow area, a	ft^2				
13. Wetted perimeter, p_w	ft				
14. Hydraulic radius, $r = \frac{a}{p_w}$ Compute r	ft				
15. Channel slope, s	ft/ft		0.018		
16. Manning's roughness coeff., n					
17. $V = \frac{1.49\ r^{2/3}\ s^{1/2}}{n}$ Compute V	ft/s		3.6		
18. Flow length, L	ft		320		
19. $T_t = \frac{L}{3600\ V}$ Compute T_t	hr		0.025	+	= 0.025

20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19) ..... hr 0.218

≈ 13.1 min

Worksheet 3: Time of concentration (T_c) or travel time (T_t)

Project Tatum Blvd. By DLB Date 2-2-90

Location Phoenix, AZ Checked ____ Date ____

Circle one: Present Developed

Circle one: (T_c) T_t through subarea Subbasin #302

NOTES: Space for as many as two segments per flow type can be used for each worksheet.

Include a map, schematic, or description of flow segments.

Sheet flow (Applicable to T_c only)		Segment ID	A302-B302		
1. Surface description (table 3-1)			Fallow		
2. Manning's roughness coeff., n (table 3-1) ..			0.05		
3. Flow length, L (total L $\leq$ 300 ft)	ft		70		
4. Two-yr 24-hr rainfall, P_2	in		1.4		
5. Land slope, s	ft/ft		0.09		
6. $T_t = \frac{0.007\ (nL)^{0.8}}{P_2^{0.5}\ s^{0.4}}$ Compute T_t	hr		0.042	+	= 0.042

Shallow concentrated flow		Segment ID			
7. Surface description (paved or unpaved)					
8. Flow length, L	ft				
9. Watercourse slope, s	ft/ft				
10. Average velocity, V (figure 3-1)	ft/s				
11. $T_t = \frac{L}{3600\ V}$ Compute T_t	hr			+	=

Channel flow		Segment ID	B302-C302	C302-3002	
12. Cross sectional flow area, a	ft^2				
13. Wetted perimeter, p_w	ft				
14. Hydraulic radius, $r = \frac{a}{p_w}$ Compute r	ft				
15. Channel slope, s	ft/ft		0.037	0.021	
16. Manning's roughness coeff., n					
17. $V = \frac{1.49\ r^{2/3}\ s^{1/2}}{n}$ Compute V	ft/s		3.1	6.5	
18. Flow length, L	ft		1200	480	
19. $T_t = \frac{L}{3600\ V}$ Compute T_t	hr		0.108	+ 0.021	= 0.129

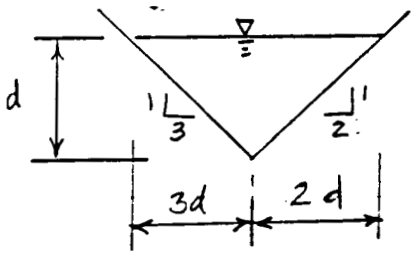
20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19) ..... hr 0.171

≈ 10.3 min

KAMINSKI HUBBARD engineering inc. • Surveying • Civil • Hydrology	Made by D.L.B.	Date 2-2-90	Job No. 0118
	Checked by	Date	Sheet No.
	For Channel X-Sections		

SUBBASIN #100

$Q = 1.6\ CFS/Ac \times 7.1\ Ac \approx 11.4\ CFS$



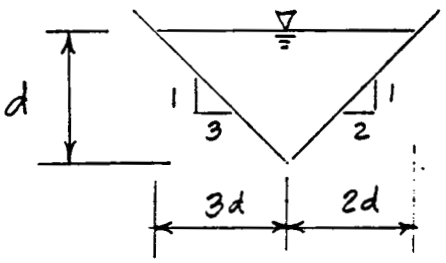
$n = 0.03$
$S = 0.36\ ft/ft$

$A = 2.5d^2$
$P = \sqrt{15}\ d$
$Q = \frac{1.486}{n} A R^{2/3} S^{1/2}$

Try $d = 0.55'$ → $A = 0.76\ ft^2$
$P = 2.13\ ft$

$Q = 11.3\ CFS$ ok

$\therefore V = \frac{Q}{A} = \frac{11.3}{0.76} = 14.9\ fps$



$n = 0.030$
$S = 0.18\ ft/ft$

$Q = 1.6\ CFS/Ac \times 30.72\ Ac \approx 49\ CFS$

$A = 2.5d^2$
$P = \sqrt{15}\ d$

Try $d = 1.10'$ → $A = 3.03\ ft^2$
$P = 4.26\ ft$

$Q = 50.6\ CFS$ ok

$\therefore V = \frac{Q}{A} = \frac{50.6}{3.03} = 16.7\ fps$

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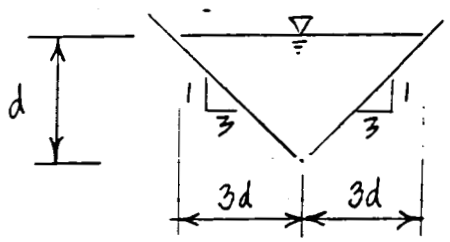
	Checked by	Date	Sheet No.
	For Channel X-Section		

SUBBASIN #101

$Q = 1.6\ CFS/Ac \times 4.72\ Ac = 7.55\ CFS$



$n = 0.030$
$S = 0.28\ '/ft$

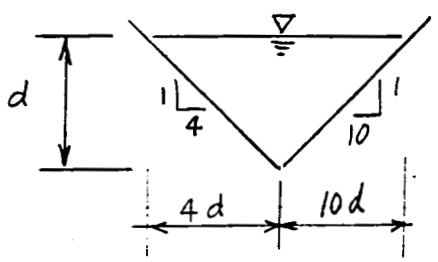
$A = 3d^2$
$P = \sqrt{20}\ d$

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

Try $d = 0.45'$ → $A = 0.61\ ft^2$
$P = 2.01\ ft$

$Q = 7.2\ cfs \approx 7.5\ cfs$ ok

$\therefore V = Q/A = \frac{7.2}{0.61} = 11.8\ fps$



$n = 0.030$
$S = 0.05'/ft.$

$Q = 1.6\ CFS/Ac \times 42.52\ Ac = 68\ CFS$

$A = 7d^2$
$P = \sqrt{118}\ d$

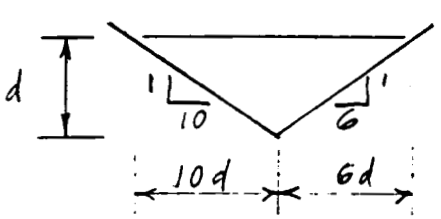
Try $d = 1.05'$ → $A = 7.71\ ft^2$
$P = 11.41\ ft$

$Q = 65.9\ CFS \approx 68\ CFS$ ok

$\therefore V = Q/A = \frac{65.9}{7.71} = 8.5\ fps$

SUBBASIN #102

#C102 – #D102



$n = 0.030$
$S = 0.096\ '/ft$

$Q = 1.6\ CFS/Ac \times \cancel{2.75}\ 15.61\ Ac = 25\ CFS$

$A = 8d^2$
$P = \sqrt{138}\ d$

Try $d = 0.23'$ → $A = 2.88\ ft^2$
$P = 7.04\ ft$

$Q = 24.3\ cfs$ ok

$\therefore V = \frac{24.3}{2.88} = 8.4\ fps$

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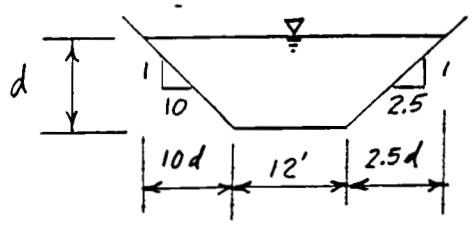
	Checked by	Date	Sheet No.
	For Channel X-Sections		

SUBBASIN #102

#D102 – #1002



$n = 0.030$
$S = 0.036'/ft$

$Q = 1.6\ cfs/Ac \times 17.1\ Ac = 27.3\ cfs$

$A = 12d + 6.25d^2$
$P = \sqrt{108.25}\,d + 12$

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

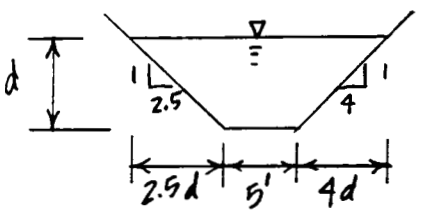
Try $d = 0.40'$ → $A = 5.80\ ft^2$, $P = 16.16\ ft$

$Q = 27.5\ cfs$ ok

$\therefore V = \frac{Q}{A} = \frac{27.5}{5.8} = 4.74\ fps$

SUBBASIN #103

#C103 to #D103



$n = 0.030$
$S = 0.26'/ft$

$Q = 1.6\ cfs/Ac \times 9.2\ Ac \cong 15\ cfs$

$A = 5d + 3.25d^2$

$P = \sqrt{24.25}\,d + 5$

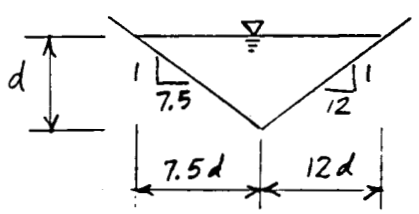
Try $d = 0.27'$ → $A = 1.59\ ft^2$, $P = 6.33\ ft$

$Q = 16\ cfs$ ok

$\therefore V = Q/A = \frac{16}{1.59} = 10.1\ fps$

SUBBASIN #104

#D104 to #1004



$n = 0.030$
$S = 0.04\ '/ft.$

D.A. = 8.86 Ac.
Assume $t_c < 10\ min$, → ∴ $i = 2.4\ in/hr.$
$Q = CIA = (0.45)(2.4)(8.86) \cong 10\ cfs$

$A = 9.75d^2$
$P = \sqrt{202.25}\,d$

Try $d = 0.47'$ → $A = 2.15\ ft^2$, $P = 6.68\ ft$

$Q = 10\ cfs$ ok

$\therefore V = Q/A = 10/2.15 = 4.6\ fps$

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	Checked by	Date	Sheet No.
	For Channel X-Section		

ENTIRE DRAINAGE AREA

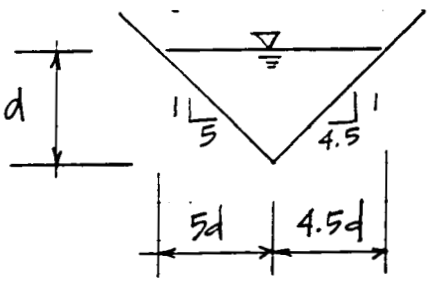
Assume $t_c = 15$ min → $i = 2.3$ in/hr (2-Year Storm)

$Q = CIA = (0.70)(2.3)(118.91)$

$= 166$ CFS

SUBBASIN # 200

Section 1 C200 – D200



$Q = 1.6$ CFS/Ac $\times$ 22.09 Ac $\cong$ 35 CFS

$A = \frac{1}{2}(5d^2 + 4.5d^2) = 4.75d^2$

$P = \sqrt{d^2 + 25d^2 + d^2 + 20.25d^2}$

$= \sqrt{47.25}\, d$

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

$n = 0.030$

$S = 0.08$ '/ft

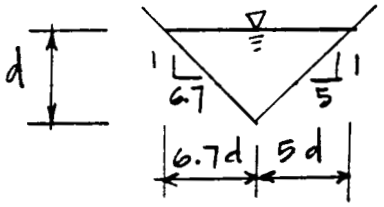
Try $d = 0.86'$ → $A = 3.51$ ft^2

$P = 5.91$ ft

$Q = 34.8$ CFS OK

$\therefore V = \frac{34.8}{3.51} = 9.9$ fps

E200 – 2000



$A = 5.85d^2$

$P = \sqrt{71.89}\, d$

$n = 0.030$

$S = 0.029$ '/ft

Try $d = 1.75'$ → $A = 17.92$ ft^2

$P = 14.84$ ft

$Q = 171$ CFS OK

$\therefore V = 171/17.92 = 9.5$ fps

KAMINSKI HUBBARD engineering inc. • Surveying • Civil • Hydrology	Made by D.L.B.	Date 2-6-90	Job No. 0118
	Checked by	Date	Sheet No.
	For Channel X-Section		

SUBBASIN #201

#D201 to #E201

$S = 0.086$ '/ft

$A = 5.75$ Ac.

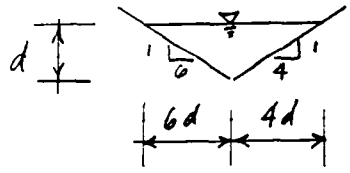
$t_c = 10$ min. → $i = 2.4$ in/hr.

$Q = CIA = (0.45)(2.4)(5.75) = 6.2$ CFS

Page 26 (C.O.P. Storm Drain Manual) $V = 7$ fps

Round down to 6.5 fps, to account for nat. grd.

#E201 to #2001



$n = 0.030$

$S = 0.034$ '/ft

$A = 12.8$ Ac.

$t_c = 10$ min. → $i = 2.4$ in/hr

$Q = CIA = (0.45)(2.4)(12.8) \approx 14$ CFS

$A = 5d^2$

$P = \sqrt{54}\, d$

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

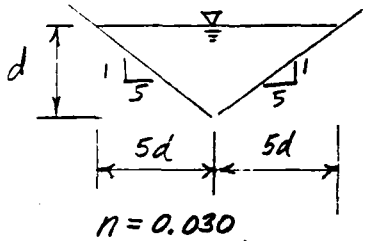
Try $d = 0.71'$ → $A = 2.52 ft^2$ & $P = 5.22$ ft

$Q = 14.2$ CFS OK

$\therefore V = Q/A = 14.2/2.52 = 5.6$ fps

SUBBASIN #300

#C300 to #D300



$n = 0.030$

$S = 0.18$ '/ft

D.A. = 3.3 Ac

$Q = 1.6$ CFS/Ac $\times$ 3.3 Ac $= 5.3$ CFS

$A = 5d^2$

$P = \sqrt{52}\, d$

Try $d = 0.36'$ → $A = 0.65 ft^2$, $P = 2.60$ ft

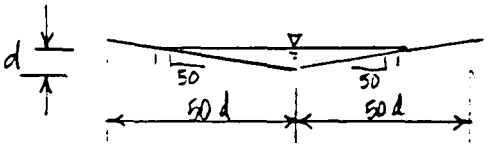
$Q = 5.4$ CFS OK

$\therefore V = Q/A = 5.4/0.65 = 8.3$ fps

#D300 to #3000

D.A. = 9.55 Ac.

$Q = [(0.70)(6.57) + (0.45)(2.99)](2.4) = 14.3$ CFS



$n = 0.015$

$S = 0.035$ '/ft

$A = 50d^2$

$P = \sqrt{5002}\, d$

Try $d = 0.23'$ → $A = 2.65 ft^2$, $P = 16.27$ ft

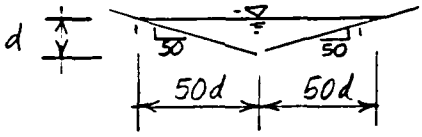
$Q = 14.6$ CFS OK

$\therefore V = Q/A = \frac{14.6}{2.65} = 5.5$ fps

KAMINSKI HUBBARD engineering inc. • Surveying • Civil • Hydrology	Made by D.L.B.	Date 2-6-90	Job No. 0118
	Checked by	Date	Sheet No.
	For		

SUBBASIN #301

#B301 to #C301



$n = 0.015$

$S = 0.018\ ft/ft$

D.A. = 7.07 Ac.

$t_c = 10$ min. → $i = 2.4$ in/hr

$Q = CIA = (0.45)(2.4)(7.07) = 7.6$ CFS

$A = 50d^2$

$P = \sqrt{5002}\ d$

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

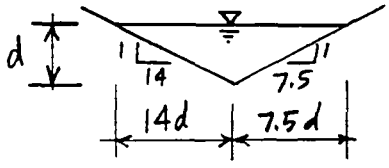
Try $d = 0.2'$ → $A = 2.00\ ft^2$, $P = 14.14$ ft

$Q = 7.2$ CFS ok

$\therefore V = Q/A = 7.2/2 = 3.6$ fps

SUBBASIN #302

#B302 - #C302



$n = 0.030$

$S = 0.037\ ft/ft$

D.A. = 2.20 Ac.

$t_c = 10$ min. → $i = 2.4$ in/hr

$Q = CIA = (0.45)(2.4)(2.20)$
$= 2.4$ CFS

$A = 10.75d^2$

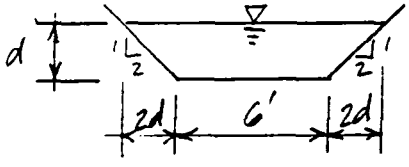
$P = \sqrt{254.25}\ d$

Try $d = 0.27'$ → $A = 0.78\ ft^2$, $P = 4.31$ ft

$Q = 2.4$ CFS ok

$\therefore V = Q/A = 2.4/0.78 = 3.1$ fps

#C302 - #3002



$n = 0.013$

$S = 0.021\ ft/ft$

D.A. = 10 Ac.

$t_c = 10$ min. → $i = 2.4$ in/hr

$Q = CIA = (0.45)(2.4)(10) = 10.8$ CFS

$A = 6d + 2d^2$

$P = \sqrt{10}\ d + 6$

Try $d = 0.26'$ → $A = 1.70\ ft^2$ & $P = 6.82$ ft

$Q = 11.1$ CFS ok

$\therefore V = Q/A = 11.1/1.70 = 6.5$ fps

APPENDIX C-1

DRAINAGE AREA NO. 2
HEC-1 OUTPUT FOR SUB-BASIN NOS. 400 & 410

KAMINSKI HUBBARD engineering inc. • Surveying • Civil • Hydrology	Made by D.L.B.	Date 3-28-90	Job No. 0118
	Checked by	Date	Sheet No.
	For		

COMBINE SUB-BASINS # 400 & #410

1. Mountains D.A. = 18.03 + 22.16 = 40.19 Ac.
   CN = 95

2. Assume 80% of this RE-43 Contributes
   D.A. = (0.80)(23.21) = 18.57 Ac.

3. Assume 90% of this RE-43 Contributes
   D.A. = (0.90)(13.71) = 12.34 Ac.

4. Assume 85% of this RE-43 Contributes
   D.A. = (0.85)(28.95) = 24.61 Ac.

} CN = 86

Total D.A. Contributing = 95.71 Ac. = 0.14955 mi.^{2}

$$\text{Weighted CN} = \frac{(86)(18.57 + 12.34 + 24.61) + (95)(40.19)}{95.71}$$

$$= \underline{\underline{89.8}}$$

KAMINSKI HUBBARD engineering inc. • Surveying • Civil • Hydrology	Made by DLB	Date 1-12-93	Job No. 0118
	Checked by	Date	Sheet No.
	For		

DRAINAGE AREA NO. 2 - Contributing Area

Sub Area 400/410:

Hillside Area = (18.03 + 22.16) ÷ 640 = 0.0628 mi^2
(100% Contributes for all storms)

RE-43 (Doubletree Canyon) Area = 23.21 ÷ 640 = 0.0363 mi^2
For 2-Year storm, 15% Contributes
For 10-Year storm, 50% Contributes
For 25-, 50- & 100-Year storm, 80% Contributes

RE-43 (Tatum Foothills) Area = (13.71 + 28.95) ÷ 640 = 0.0667 mi^2
For 2-Year storm, 20% Contributes
For 10-Year storm, 50% Contributes
For 25-, 50- & 100-Year Storm, 90% Contributes

$D.A._{2YR} = 0.0628 + (0.15)(0.0363) + (0.20)(0.0667) = 0.0816\ mi^2$

$D.A._{10YR} = 0.0628 + (0.50)(0.0363 + 0.0667) = 0.1143\ mi^2$

$D.A._{25YR} = D.A._{50YR} = D.A._{100YR} = 0.0628 + (0.80)(0.0363) + (0.90)(0.0667)$
$= 0.1519\ mi^2$

Worksheet 3: Time of concentration (T_c) or travel time (T_t)

Project Tatum Blvd. By D.L.B. Date 2-9-90

Location Mockingbird Ln. to Shea Blvd. Checked ____ Date ____

Circle one: Present Developed

Circle one: (T_c) T_t through subarea Subbasin #400

NOTES: Space for as many as two segments per flow type can be used for each worksheet.

Include a map, schematic, or description of flow segments.

Sheet flow (Applicable to T_c only)					
Segment ID		A400 - B400			
1. Surface description (table 3-1)		Fallow			
2. Manning's roughness coeff., n (table 3-1) ..		0.10			
3. Flow length, L (total L ≤ 300 ft)	ft	285			
4. Two-yr 24-hr rainfall, P_2	in	1.4			
5. Land slope, s	ft/ft	0.56			
6. $T_t = \frac{0.007\ (nL)^{0.8}}{P_2^{0.5}\ s^{0.4}}$ Compute T_t	hr	0.109	+		= 0.109

Shallow concentrated flow					
Segment ID		B400 - C400			
7. Surface description (paved or unpaved)		Unpaved			
8. Flow length, L	ft	910			
9. Watercourse slope, s 232/910	ft/ft	0.25			
10. Average velocity, V (figure 3-1)	ft/s	8.0			
11. $T_t = \frac{L}{3600\ V}$ Compute T_t	hr	0.032	+		= 0.032

Channel flow					
Segment ID		C400 - D400	D400 - 4000		
12. Cross sectional flow area, a	ft^2				
13. Wetted perimeter, p_w	ft				
14. Hydraulic radius, $r = \frac{a}{p_w}$ Compute r	ft				
15. Channel slope, s 21/870	ft/ft	0.024	0.018		
16. Manning's roughness coeff., n					
17. $V = \frac{1.49\ r^{2/3}\ s^{1/2}}{n}$ Compute V	ft/s	6.7	8.0		
18. Flow length, L	ft	870	1140		
19. $T_t = \frac{L}{3600\ V}$ Compute T_t	hr	0.036	+ 0.040	=	0.076
20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19)	hr				0.217

```
*************************************
*                                   *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)  *
*              MAY   1991           *
*           VERSION 4.0.1E          *
*                                   *
*  RUN DATE  01/14/93  TIME  09:55:20  *
*                                   *
*************************************
```

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*************************************
*                                   *
*    U.S. ARMY CORPS OF ENGINEERS   *
*    HYDROLOGIC ENGINEERING CENTER  *
*          609 SECOND STREET        *
*       DAVIS, CALIFORNIA 95616     *
*           (916) 551-1748          *
*                                   *
*************************************
```

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

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

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

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

  1           ID                  CITY OF PHOENIX PROJECT NO. P-886515
  2           ID               TATUM BLVD. - MOCKINGBIRD LANE TO SHEA BLVD.
  3           ID            KAMINSKI - HUBBARD ENGINEERING, INC. - JOB NO. 0118
  4           ID                      HEC-1 FILENAME :  118-29.DAT
  5           ID                         2 YEAR - 6 HOUR STORM
  6           IT       2 07FEB90    1000     300 08FEB90    1000
  7           IO       5

  8           KK     400
  9           KM                     Subarea No. 400/410
 10           BA   .0816
 11           IN      15
 12           PB    1.16
 13           PC    .000    .008    .016    .025    .033    .041    .050    .058    .066    .074
 14           PC    .087    .099    .118    .138    .216    .377    .834    .911    .931    .950
 15           PC    .962    .972    .983    .991   1.000
 16           LS            89.8
 17           UD     .13

 18           KK    400R           Subarea No. 400/410
 19           KM     Route Flows Through Retention Basin - Outflow Under Tatum Blvd.
 20           KO       3
 21           RS       1    ELEV  1372.2
 22           SV       0   0.034   0.140   0.543   1.211   1.711    2.66    3.59
 23           SE  1372.2  1372.5    1373    1374    1375  1375.4    1376  1376.5
 24           SQ       0       0      16      45      59      64      96     194     380     680
 25           SE  1372.2    1374  1374.5    1375  1375.2  1375.4 1375.75    1376 1376.25  1376.5
 26           ZZ
```

```
****************************************                    ****************************************
*                                      *                    *                                      *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)  *                    *   U.S. ARMY CORPS OF ENGINEERS       *
*              MAY   1991              *                    *   HYDROLOGIC ENGINEERING CENTER      *
*           VERSION 4.0.1E             *                    *         609 SECOND STREET            *
*                                      *                    *      DAVIS, CALIFORNIA 95616         *
*  RUN DATE  01/14/93  TIME  09:55:20  *                    *          (916) 551-1748              *
*                                      *                    *                                      *
****************************************                    ****************************************
```

CITY OF PHOENIX PROJECT NO. P-886515
TATUM BLVD. - MOCKINGBIRD LANE TO SHEA BLVD.
KAMINSKI - HUBBARD ENGINEERING, INC. - JOB NO. 0118
HEC-1 FILENAME : 118-29.DAT
2 YEAR - 6 HOUR STORM

```
  7 IO          OUTPUT CONTROL VARIABLES
                      IPRNT          5  PRINT CONTROL
                      IPLOT          0  PLOT CONTROL
                      QSCAL         0.  HYDROGRAPH PLOT SCALE

    IT          HYDROGRAPH TIME DATA
                       NMIN          2  MINUTES IN COMPUTATION INTERVAL
                      IDATE     7FEB90  STARTING DATE
                      ITIME       1000  STARTING TIME
                         NQ        721  NUMBER OF HYDROGRAPH ORDINATES
                     NDDATE     8FEB90  ENDING DATE
                     NDTIME       1000  ENDING TIME
                      ICENT         19  CENTURY MARK

                 COMPUTATION INTERVAL    0.03 HOURS
                      TOTAL TIME BASE   24.00 HOURS

        ENGLISH UNITS
             DRAINAGE AREA         SQUARE MILES
             PRECIPITATION DEPTH   INCHES
             LENGTH, ELEVATION     FEET
             FLOW                  CUBIC FEET PER SECOND
             STORAGE VOLUME        ACRE-FEET
             SURFACE AREA          ACRES
             TEMPERATURE           DEGREES FAHRENHEIT


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


          **************
          *            *
 18 KK    *     400R   *              Subarea No. 400/410
          *            *
          **************

 20 KO          OUTPUT CONTROL VARIABLES
                      IPRNT          3  PRINT CONTROL
                      IPLOT          0  PLOT CONTROL
                      QSCAL         0.  HYDROGRAPH PLOT SCALE

             HYDROGRAPH ROUTING DATA

 21 RS          STORAGE ROUTING
                      NSTPS          1  NUMBER OF SUBREACHES
```

ITYP	ELEV	TYPE OF INITIAL CONDITION
RSVRIC	1372.20	INITIAL CONDITION
X	0.00	WORKING R AND D COEFFICIENT

22 SV	STORAGE	0.0	0.0	0.1	0.5	1.2	1.7	2.7	3.6		
23 SE	ELEVATION	1372.20	1372.50	1373.00	1374.00	1375.00	1375.40	1376.00	1376.50		
24 SQ	DISCHARGE	0.	0.	16.	45.	59.	64.	96.	194.	380.	680.
25 SE	ELEVATION	1372.20	1374.00	1374.50	1375.00	1375.20	1375.40	1375.75	1376.00	1376.25	1376.50

***

COMPUTED STORAGE-OUTFLOW-ELEVATION DATA

STORAGE	0.00	0.03	0.14	0.54	0.88	1.21	1.46	1.71	2.26	2.66
OUTFLOW	0.00	0.00	0.00	0.00	16.00	45.00	59.00	64.00	96.00	194.00
ELEVATION	1372.20	1372.50	1373.00	1374.00	1374.50	1375.00	1375.20	1375.40	1375.75	1376.00
STORAGE	3.13	3.59								
OUTFLOW	380.00	680.00								
ELEVATION	1376.25	1376.50								

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

HYDROGRAPH AT STATION 400R

PEAK FLOW (CFS)	TIME (HR)		MAXIMUM AVERAGE FLOW 6-HR	24-HR	72-HR	24.00-HR
24.	4.23	(CFS)	3.	1.	1.	1.
		(INCHES)	0.296	0.296	0.296	0.296
		(AC-FT)	1.	1.	1.	1.

PEAK STORAGE (AC-FT)	TIME (HR)	MAXIMUM AVERAGE STORAGE 6-HR	24-HR	72-HR	24.00-HR
1.	4.20	1.	0.	0.	0.

PEAK STAGE (FEET)	TIME (HR)	MAXIMUM AVERAGE STAGE 6-HR	24-HR	72-HR	24.00-HR
1374.64	4.23	1374.08	1373.73	1373.73	1373.73

CUMULATIVE AREA = 0.08 SQ MI

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	400	51.	4.07	4.	1.	1.	0.08		
ROUTED TO	400R	24.	4.23	3.	1.	1.	0.08	1374.64	4.23

*** NORMAL END OF HEC-1 ***

```
*****************************************
*                                       *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *
*              MAY   1991               *
*           VERSION 4.0.1E              *
*                                       *
*  RUN DATE  01/14/93  TIME  09:54:41   *
*                                       *
*****************************************
```

```
*****************************************
*                                       *
*    U.S. ARMY CORPS OF ENGINEERS       *
*    HYDROLOGIC ENGINEERING CENTER      *
*          609 SECOND STREET            *
*       DAVIS, CALIFORNIA 95616         *
*           (916) 551-1748              *
*                                       *
*****************************************
```

```
X     X  XXXXXXX   XXXXX          X
X     X  X        X     X        XX
X     X  X        X               X
XXXXXXX  XXXX     X        XXXXX  X
X     X  X        X               X
X     X  X        X     X         X
x     x  xxxxxxx   xxxxx         xxx
```

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

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

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

  1           ID                 CITY OF PHOENIX PROJECT NO. P-886515
  2           ID              TATUM BLVD. - MOCKINGBIRD LANE TO SHEA BLVD.
  3           ID           KAMINSKI - HUBBARD ENGINEERING, INC. - JOB NO. 0118
  4           ID                      HEC-1 FILENAME :  118-28.DAT
  5           ID                        10 YEAR - 6 HOUR STORM
  6           IT       2 07FEB90    1000     300 08FEB90    1000
  7           IO       5 -

  8           KK     400
  9           KM                    Subarea No. 400/410
 10           BA   .1143
 11           IN      15
 12           PB    2.07
 13           PC    .000    .008    .016    .025    .033    .041    .050    .058    .066    .074
 14           PC    .087    .099    .118    .138    .216    .377    .834    .911    .931    .950
 15           PC    .962    .972    .983    .991   1.000
 16           LS            89.8
 17           UD     .13

 18           KK    400R            Subarea No. 400/410
 19           KM          Route Flows Through Retention Basin - Outflow Under Tatum Blvd.
 20           KO       3
 21           RS       1    ELEV  1372.2
 22           SV       0    .034    .140    .543   1.211   1.711    2.66    3.59
 23           SE  1372.2  1372.5    1373    1374    1375  1375.4    1376  1376.5
 24           SQ       0       0      16      45      59      64      96     194     380     680
 25           SE  1372.2    1374  1374.5    1375  1375.2  1375.4 1375.75    1376 1376.25  1376.5
 26           ZZ
```

```
*************************************
*                                   *
*  FLOOD HYDROGRAPH PACKAGE  (HEC-1)*
*            MAY   1991             *
*          VERSION 4.0.1E           *
*                                   *
* RUN DATE  01/14/93  TIME  09:54:41*
*                                   *
*************************************
```

```
*************************************
*                                   *
*   U.S. ARMY CORPS OF ENGINEERS    *
*   HYDROLOGIC ENGINEERING CENTER   *
*         609 SECOND STREET         *
*      DAVIS, CALIFORNIA 95616      *
*          (916) 551-1748           *
*                                   *
*************************************
```

CITY OF PHOENIX PROJECT NO. P-886515
TATUM BLVD. - MOCKINGBIRD LANE TO SHEA BLVD.
KAMINSKI - HUBBARD ENGINEERING, INC. - JOB NO. 0118
HEC-1 FILENAME : 118-28.DAT
10 YEAR - 6 HOUR STORM

```
 7 IO        OUTPUT CONTROL VARIABLES
                  IPRNT          5  PRINT CONTROL
                  IPLOT          0  PLOT CONTROL
                  QSCAL         0.  HYDROGRAPH PLOT SCALE

  IT         HYDROGRAPH TIME DATA
                   NMIN          2  MINUTES IN COMPUTATION INTERVAL
                  IDATE     7FEB90  STARTING DATE
                  ITIME       1000  STARTING TIME
                     NQ        721  NUMBER OF HYDROGRAPH ORDINATES
                 NDDATE     8FEB90  ENDING DATE
                 NDTIME       1000  ENDING TIME
                  ICENT         19  CENTURY MARK

            COMPUTATION INTERVAL    0.03 HOURS
                 TOTAL TIME BASE   24.00 HOURS

      ENGLISH UNITS
           DRAINAGE AREA          SQUARE MILES
           PRECIPITATION DEPTH    INCHES
           LENGTH, ELEVATION      FEET
           FLOW                   CUBIC FEET PER SECOND
           STORAGE VOLUME         ACRE-FEET
           SURFACE AREA           ACRES
           TEMPERATURE            DEGREES FAHRENHEIT
```

*** ***

```
          **************
          *            *
 18 KK    *     400R   *              Subarea No. 400/410
          *            *
          **************

 20 KO        OUTPUT CONTROL VARIABLES
                  IPRNT          3  PRINT CONTROL
                  IPLOT          0  PLOT CONTROL
                  QSCAL         0.  HYDROGRAPH PLOT SCALE

            HYDROGRAPH ROUTING DATA

 21 RS        STORAGE ROUTING
                  NSTPS          1  NUMBER OF SUBREACHES
```

ITYP	ELEV	TYPE OF INITIAL CONDITION	
RSVRIC	1372.20	INITIAL CONDITION	
X	0.00	WORKING R AND D COEFFICIENT	

22 SV	STORAGE	0.0	0.0	0.1	0.5	1.2	1.7	2.7	3.6		
23 SE	ELEVATION	1372.20	1372.50	1373.00	1374.00	1375.00	1375.40	1376.00	1376.50		
24 SQ	DISCHARGE	0.	0.	16.	45.	59.	64.	96.	194.	380.	680.
25 SE	ELEVATION	1372.20	1374.00	1374.50	1375.00	1375.20	1375.40	1375.75	1376.00	1376.25	1376.50

***

COMPUTED STORAGE-OUTFLOW-ELEVATION DATA

STORAGE	0.00	0.03	0.14	0.54	0.88	1.21	1.46	1.71	2.26	2.66
OUTFLOW	0.00	0.00	0.00	0.00	16.00	45.00	59.00	64.00	96.00	194.00
ELEVATION	1372.20	1372.50	1373.00	1374.00	1374.50	1375.00	1375.20	1375.40	1375.75	1376.00

STORAGE	3.13	3.59
OUTFLOW	380.00	680.00
ELEVATION	1376.25	1376.50

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

HYDROGRAPH AT STATION 400R

PEAK FLOW (CFS)	TIME (HR)		MAXIMUM AVERAGE FLOW 6-HR	24-HR	72-HR	24.00-HR
145.	4.13	(CFS)	13.	3.	3.	3.
		(INCHES)	1.051	1.051	1.051	1.051
		(AC-FT)	6.	6.	6.	6.

PEAK STORAGE (AC-FT)	TIME (HR)	MAXIMUM AVERAGE STORAGE 6-HR	24-HR	72-HR	24.00-HR
2.	4.13	1.	1.	1.	1.

PEAK STAGE (FEET)	TIME (HR)	MAXIMUM AVERAGE STAGE 6-HR	24-HR	72-HR	24.00-HR
1375.87	4.13	1374.27	1373.80	1373.80	1373.80

CUMULATIVE AREA = 0.11 SQ MI

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	400	179.	4.03	14.	4.	4.	0.11		
ROUTED TO	400R	145.	4.13	13.	3.	3.	0.11	1375.87	4.13

*** NORMAL END OF HEC-1 ***

```
*************************************
*                                   *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)  *
*              MAY   1991           *
*           VERSION 4.0.1E          *
*                                   *
* RUN DATE  01/14/93  TIME  09:53:56 *
*                                   *
*************************************
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```
*************************************
*                                   *
*   U.S. ARMY CORPS OF ENGINEERS    *
*   HYDROLOGIC ENGINEERING CENTER   *
*         609 SECOND STREET         *
*      DAVIS, CALIFORNIA 95616      *
*          (916) 551-1748           *
*                                   *
*************************************
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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

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

  1           ID                  CITY OF PHOENIX PROJECT NO. P-886515
  2           ID               TATUM BLVD. - MOCKINGBIRD LANE TO SHEA BLVD.
  3           ID            KAMINSKI - HUBBARD ENGINEERING, INC. - JOB NO. 0118
  4           ID                      HEC-1 FILENAME :  118-27.DAT
  5           ID                         25 YEAR - 6 HOUR STORM
  6           IT       2 07FEB90    1000     300 08FEB90    1000
  7           IO       5

  8           KK     400
  9           KM                     Subarea No. 400/410
 10           BA   .1519
 11           IN      15
 12           PB    2.57
 13           PC    .000    .008    .016    .025    .033    .041    .050    .058    .066    .074
 14           PC    .087    .099    .118    .138    .216    .377    .834    .911    .931    .950
 15           PC    .962    .972    .983    .991   1.000
 16           LS            89.8
 17           UD     .13

 18           KK    400R             Subarea No. 400/410
 19           KM          Route Flows Through Retention Basin - Outflow Under Tatum Blvd.
 20           KO       3
 21           RS       1    ELEV  1372.2
 22           SV       0    .034    .140    .543   1.211   1.711    2.66    3.59
 23           SE  1372.2  1372.5    1373    1374    1375  1375.4    1376  1376.5
 24           SQ       0       0      16      45      59      64      96     194     380     680
 25           SE  1372.2    1374  1374.5    1375  1375.2  1375.4 1375.75    1376 1376.25  1376.5
 26           ZZ
```

```
****************************************
*                                      *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)  *
*              MAY   1991              *
*           VERSION 4.0.1E             *
*                                      *
*  RUN DATE  01/14/93  TIME  09:53:56  *
*                                      *
****************************************
```

```
****************************************
*                                      *
*    U.S. ARMY CORPS OF ENGINEERS      *
*    HYDROLOGIC ENGINEERING CENTER     *
*          609 SECOND STREET           *
*       DAVIS, CALIFORNIA 95616        *
*           (916) 551-1748             *
*                                      *
****************************************
```

CITY OF PHOENIX PROJECT NO. P-886515
TATUM BLVD. - MOCKINGBIRD LANE TO SHEA BLVD.
KAMINSKI - HUBBARD ENGINEERING, INC. - JOB NO. 0118
HEC-1 FILENAME : 118-27.DAT
25 YEAR - 6 HOUR STORM

```
  7 IO        OUTPUT CONTROL VARIABLES
                    IPRNT          5  PRINT CONTROL
                    IPLOT          0  PLOT CONTROL
                    QSCAL         0.  HYDROGRAPH PLOT SCALE

    IT        HYDROGRAPH TIME DATA
                     NMIN          2  MINUTES IN COMPUTATION INTERVAL
                    IDATE     7FEB90  STARTING DATE
                    ITIME       1000  STARTING TIME
                       NQ        721  NUMBER OF HYDROGRAPH ORDINATES
                   NDDATE     8FEB90  ENDING DATE
                   NDTIME       1000  ENDING TIME
                    ICENT         19  CENTURY MARK

              COMPUTATION INTERVAL    0.03 HOURS
                   TOTAL TIME BASE   24.00 HOURS

        ENGLISH UNITS
             DRAINAGE AREA          SQUARE MILES
             PRECIPITATION DEPTH    INCHES
             LENGTH, ELEVATION      FEET
             FLOW                   CUBIC FEET PER SECOND
             STORAGE VOLUME         ACRE-FEET
             SURFACE AREA           ACRES
             TEMPERATURE            DEGREES FAHRENHEIT


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


          **************
          *            *
 18 KK    *     400R   *                Subarea No. 400/410
          *            *
          **************

 20 KO        OUTPUT CONTROL VARIABLES
                    IPRNT          3  PRINT CONTROL
                    IPLOT          0  PLOT CONTROL
                    QSCAL         0.  HYDROGRAPH PLOT SCALE

            HYDROGRAPH ROUTING DATA

 21 RS        STORAGE ROUTING
                    NSTPS          1  NUMBER OF SUBREACHES
```

ITYP	ELEV	TYPE OF INITIAL CONDITION
RSVRIC	1372.20	INITIAL CONDITION
X	0.00	WORKING R AND D COEFFICIENT

22 SV	STORAGE	0.0	0.0	0.1	0.5	1.2	1.7	2.7	3.6		
23 SE	ELEVATION	1372.20	1372.50	1373.00	1374.00	1375.00	1375.40	1376.00	1376.50		
24 SQ	DISCHARGE	0.	0.	16.	45.	59.	64.	96.	194.	380.	680.
25 SE	ELEVATION	1372.20	1374.00	1374.50	1375.00	1375.20	1375.40	1375.75	1376.00	1376.25	1376.50

***

COMPUTED STORAGE-OUTFLOW-ELEVATION DATA

STORAGE	0.00	0.03	0.14	0.54	0.88	1.21	1.46	1.71	2.26	2.66
OUTFLOW	0.00	0.00	0.00	0.00	16.00	45.00	59.00	64.00	96.00	194.00
ELEVATION	1372.20	1372.50	1373.00	1374.00	1374.50	1375.00	1375.20	1375.40	1375.75	1376.00

STORAGE	3.13	3.59
OUTFLOW	380.00	680.00
ELEVATION	1376.25	1376.50

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

HYDROGRAPH AT STATION 400R

PEAK FLOW (CFS)	TIME (HR)		MAXIMUM AVERAGE FLOW 6-HR	24-HR	72-HR	24.00-HR
314.	4.07	(CFS)	25.	6.	6.	6.
		(INCHES)	1.511	1.511	1.511	1.511
		(AC-FT)	12.	12.	12.	12.

PEAK STORAGE (AC-FT)	TIME (HR)	MAXIMUM AVERAGE STORAGE 6-HR	24-HR	72-HR	24.00-HR
3.	4.07	1.	1.	1.	1.

PEAK STAGE (FEET)	TIME (HR)	MAXIMUM AVERAGE STAGE 6-HR	24-HR	72-HR	24.00-HR
1376.16	4.07	1374.38	1373.84	1373.84	1373.84

CUMULATIVE AREA = 0.15 SQ MI

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	400	323.	4.03	26.	6.	6.	0.15		
ROUTED TO	400R	314.	4.07	25.	6.	6.	0.15	1376.16	4.07

*** NORMAL END OF HEC-1 ***

```
*************************************
*                                   *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)  *
*              MAY   1991           *
*           VERSION 4.0.1E          *
*                                   *
* RUN DATE  01/14/93  TIME  09:53:17 *
*                                   *
*************************************
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```
*************************************
*                                   *
*   U.S. ARMY CORPS OF ENGINEERS    *
*   HYDROLOGIC ENGINEERING CENTER   *
*         609 SECOND STREET         *
*      DAVIS, CALIFORNIA 95616      *
*          (916) 551-1748           *
*                                   *
*************************************
```

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

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

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

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

  1           ID                  CITY OF PHOENIX PROJECT NO. P-886515
  2           ID                TATUM BLVD. - MOCKINGBIRD LANE TO SHEA BLVD.
  3           ID             KAMINSKI - HUBBARD ENGINEERING, INC. - JOB NO. 0118
  4           ID                        HEC-1 FILENAME :  118-26.DAT
  5           ID                           50 YEAR - 6 HOUR STORM
  6           IT       2 07FEB90    1000     300 08FEB90    1000
  7           IO       5 -

  8           KK     400
  9           KM                     Subarea No. 400/410
 10           BA   .1519
 11           IN      15
 12           PB    2.96
 13           PC    .000    .008    .016    .025    .033    .041    .050    .058    .066    .074
 14           PC    .087    .099    .118    .138    .216    .377    .834    .911    .931    .950
 15           PC    .962    .972    .983    .991   1.000
 16           LS            89.8
 17           UD     .13

 18           KK    400R             Subarea No. 400/410
 19           KM          Route Flows Through Retention Basin - Outflow Under Tatum Blvd.
 20           KO       3
 21           RS       1    ELEV  1372.2
 22           SV       0    .034    .140    .543   1.211   1.711    2.66    3.59
 23           SE  1372.2  1372.5    1373    1374    1375  1375.4    1376  1376.5
 24           SQ       0       0      16      45      59      64      96     194     380     680
 25           SE  1372.2    1374  1374.5    1375  1375.2  1375.4 1375.75    1376 1376.25  1376.5
 26           ZZ
```

```
*************************************                    *************************************
*                                   *                    *                                   *
*  FLOOD HYDROGRAPH PACKAGE  (HEC-1)*                    *  U.S. ARMY CORPS OF ENGINEERS     *
*             MAY   1991            *                    *  HYDROLOGIC ENGINEERING CENTER    *
*          VERSION 4.0.1E           *                    *        609 SECOND STREET          *
*                                   *                    *     DAVIS, CALIFORNIA 95616       *
* RUN DATE  01/14/93  TIME  09:53:17*                    *        (916) 551-1748             *
*                                   *                    *                                   *
*************************************                    *************************************
                                --
```

CITY OF PHOENIX PROJECT NO. P-886515
TATUM BLVD. - MOCKINGBIRD LANE TO SHEA BLVD.
KAMINSKI - HUBBARD ENGINEERING, INC. - JOB NO. 0118
HEC-1 FILENAME : 118-26.DAT
50 YEAR - 6 HOUR STORM

```
 7 IO        OUTPUT CONTROL VARIABLES
                  IPRNT          5  PRINT CONTROL
                  IPLOT          0  PLOT CONTROL
                  QSCAL         0.  HYDROGRAPH PLOT SCALE

   IT        HYDROGRAPH TIME DATA
                   NMIN          2  MINUTES IN COMPUTATION INTERVAL
                  IDATE     7FEB90  STARTING DATE
                  ITIME       1000  STARTING TIME
                     NQ        721  NUMBER OF HYDROGRAPH ORDINATES
                 NDDATE     8FEB90  ENDING DATE
                 NDTIME       1000  ENDING TIME
                  ICENT         19  CENTURY MARK

             COMPUTATION INTERVAL    0.03 HOURS
                  TOTAL TIME BASE   24.00 HOURS

        ENGLISH UNITS
            DRAINAGE AREA          SQUARE MILES
            PRECIPITATION DEPTH    INCHES
            LENGTH, ELEVATION      FEET
            FLOW                   CUBIC FEET PER SECOND
            STORAGE VOLUME         ACRE-FEET
            SURFACE AREA           ACRES
            TEMPERATURE            DEGREES FAHRENHEIT


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


          **************
          *            *
 18 KK    *     400R   *                Subarea No. 400/410
          *            *
          **************

 20 KO        OUTPUT CONTROL VARIABLES
                  IPRNT          3  PRINT CONTROL
                  IPLOT          0  PLOT CONTROL
                  QSCAL         0.  HYDROGRAPH PLOT SCALE

            HYDROGRAPH ROUTING DATA

 21 RS        STORAGE ROUTING
                  NSTPS          1  NUMBER OF SUBREACHES
```

ITYP	ELEV	TYPE OF INITIAL CONDITION	
RSVRIC	1372.20	INITIAL CONDITION	
X	0.00	WORKING R AND D COEFFICIENT	

22 SV	STORAGE	0.0	0.0	0.1	0.5	1.2	1.7	2.7	3.6		
23 SE	ELEVATION	1372.20	1372.50	1373.00	1374.00	1375.00	1375.40	1376.00	1376.50		
24 SQ	DISCHARGE	0.	0.	16.	45.	59.	64.	96.	194.	380.	680.
25 SE	ELEVATION	1372.20	1374.00	1374.50	1375.00	1375.20	1375.40	1375.75	1376.00	1376.25	1376.50

***

COMPUTED STORAGE-OUTFLOW-ELEVATION DATA

STORAGE	0.00	0.03	0.14	0.54	0.88	1.21	1.46	1.71	2.26	2.66
OUTFLOW	0.00	0.00	0.00	0.00	16.00	45.00	59.00	64.00	96.00	194.00
ELEVATION	1372.20	1372.50	1373.00	1374.00	1374.50	1375.00	1375.20	1375.40	1375.75	1376.00

STORAGE	3.13	3.59
OUTFLOW	380.00	680.00
ELEVATION	1376.25	1376.50

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

HYDROGRAPH AT STATION 400R

PEAK FLOW (CFS)	TIME (HR)		MAXIMUM AVERAGE FLOW 6-HR	24-HR	72-HR	24.00-HR
381.	4.07	(CFS)	30.	8.	8.	8.
		(INCHES)	1.863	1.863	1.863	1.863
		(AC-FT)	15.	15.	15.	15.

PEAK STORAGE (AC-FT)	TIME (HR)	MAXIMUM AVERAGE STORAGE 6-HR	24-HR	72-HR	24.00-HR
3.	4.07	1.	1.	1.	1.

PEAK STAGE (FEET)	TIME (HR)	MAXIMUM AVERAGE STAGE 6-HR	24-HR	72-HR	24.00-HR
1376.25	4.07	1374.42	1373.86	1373.86	1373.86

CUMULATIVE AREA = 0.15 SQ MI

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	400	389.	4.03	32.	8.	8.	0.15		
ROUTED TO	400R	381.	4.07	30.	8.	8.	0.15	1376.25	4.07

*** NORMAL END OF HEC-1 ***

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****************************************
*                                      *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)  *
*              MAY   1991              *
*           VERSION 4.0.1E             *
*                                      *
* RUN DATE  01/14/93  TIME  09:50:55   *
*                                      *
****************************************
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****************************************
*                                      *
*   U.S. ARMY CORPS OF ENGINEERS       *
*   HYDROLOGIC ENGINEERING CENTER      *
*         609 SECOND STREET            *
*      DAVIS, CALIFORNIA 95616         *
*          (916) 551-1748              *
*                                      *
****************************************
```

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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

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

  1           ID                  CITY OF PHOENIX PROJECT NO. P-886515
  2           ID                TATUM BLVD. - MOCKINGBIRD LANE TO SHEA BLVD.
  3           ID            KAMINSKI - HUBBARD ENGINEERING, INC. - JOB NO. 0118
  4           ID                      HEC-1 FILENAME :  118-25.DAT
  5           ID                        100 YEAR - 6 HOUR STORM
  6           IT       2 07FEB90    1000     300 08FEB90    1000
  7           IO       5

  8           KK     400
  9           KM                    Subarea No. 400/410
 10           BA   .1519
 11           IN      15
 12           PB    3.35
 13           PC    .000    .008    .016    .025    .033    .041    .050    .058    .066    .074
 14           PC    .087    .099    .118    .138    .216    .377    .834    .911    .931    .950
 15           PC    .962    .972    .983    .991   1.000
 16           LS            89.8
 17           UD     .13

 18           KK    400R             Subarea No. 400/410
 19           KM          Route Flows Through Retention Basin - Outflow Under Tatum Blvd.
 20           KO       3
 21           RS       1    ELEV  1372.2
 22           SV       0    .034    .140    .543   1.211   1.711    2.66    3.59
 23           SE  1372.2  1372.5    1373    1374    1375  1375.4    1376  1376.5
 24           SQ       0       0      16      45      59      64      96     194     380     680
 25           SE  1372.2    1374  1374.5    1375  1375.2  1375.4 1375.75    1376 1376.25  1376.5
 26           ZZ
```

```
****************************************
*                                      *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)  *
*              MAY   1991              *
*           VERSION 4.0.1E             *
*                                      *
*  RUN DATE  01/14/93  TIME  09:50:55  *
*                                      *
****************************************
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****************************************
*                                      *
*    U.S. ARMY CORPS OF ENGINEERS      *
*    HYDROLOGIC ENGINEERING CENTER     *
*          609 SECOND STREET           *
*       DAVIS, CALIFORNIA 95616        *
*           (916) 551-1748             *
*                                      *
****************************************
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CITY OF PHOENIX PROJECT NO. P-886515
TATUM BLVD. - MOCKINGBIRD LANE TO SHEA BLVD.
KAMINSKI - HUBBARD ENGINEERING, INC. - JOB NO. 0118
HEC-1 FILENAME : 118-25.DAT
100 YEAR - 6 HOUR STORM

```
  7 IO        OUTPUT CONTROL VARIABLES
                    IPRNT          5  PRINT CONTROL
                    IPLOT          0  PLOT CONTROL
                    QSCAL         0.  HYDROGRAPH PLOT SCALE

   IT         HYDROGRAPH TIME DATA
                     NMIN          2  MINUTES IN COMPUTATION INTERVAL
                    IDATE     7FEB90  STARTING DATE
                    ITIME       1000  STARTING TIME
                       NQ        721  NUMBER OF HYDROGRAPH ORDINATES
                   NDDATE     8FEB90  ENDING DATE
                   NDTIME       1000  ENDING TIME
                    ICENT         19  CENTURY MARK

              COMPUTATION INTERVAL    0.03 HOURS
                   TOTAL TIME BASE   24.00 HOURS

        ENGLISH UNITS
             DRAINAGE AREA         SQUARE MILES
             PRECIPITATION DEPTH   INCHES
             LENGTH, ELEVATION     FEET
             FLOW                  CUBIC FEET PER SECOND
             STORAGE VOLUME        ACRE-FEET
             SURFACE AREA          ACRES
             TEMPERATURE           DEGREES FAHRENHEIT


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


          **************
          *            *
 18 KK    *     400R   *                Subarea No. 400/410
          *            *
          **************

 20 KO        OUTPUT CONTROL VARIABLES
                    IPRNT          3  PRINT CONTROL
                    IPLOT          0  PLOT CONTROL
                    QSCAL         0.  HYDROGRAPH PLOT SCALE

             HYDROGRAPH ROUTING DATA

 21 RS        STORAGE ROUTING
                    NSTPS          1  NUMBER OF SUBREACHES
```

ITYP	ELEV	TYPE OF INITIAL CONDITION	
RSVRIC	1372.20	INITIAL CONDITION	
X	0.00	WORKING R AND D COEFFICIENT	

22 SV	STORAGE	0.0	0.0	0.1	0.5	1.2	1.7	2.7	3.6		
23 SE	ELEVATION	1372.20	1372.50	1373.00	1374.00	1375.00	1375.40	1376.00	1376.50		
24 SQ	DISCHARGE	0.	0.	16.	45.	59.	64.	96.	194.	380.	680.
25 SE	ELEVATION	1372.20	1374.00	1374.50	1375.00	1375.20	1375.40	1375.75	1376.00	1376.25	1376.50

***

COMPUTED STORAGE-OUTFLOW-ELEVATION DATA

STORAGE	0.00	0.03	0.14	0.54	0.88	1.21	1.46	1.71	2.26	2.66
OUTFLOW	0.00	0.00	0.00	0.00	16.00	45.00	59.00	64.00	96.00	194.00
ELEVATION	1372.20	1372.50	1373.00	1374.00	1374.50	1375.00	1375.20	1375.40	1375.75	1376.00
STORAGE	3.13	3.59								
OUTFLOW	380.00	680.00								
ELEVATION	1376.25	1376.50								

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

HYDROGRAPH AT STATION 400R

PEAK FLOW (CFS)	TIME (HR)		MAXIMUM AVERAGE FLOW 6-HR	24-HR	72-HR	24.00-HR
451.	4.07	(CFS)	36.	9.	9.	9.
		(INCHES)	2.223	2.223	2.223	2.223
		(AC-FT)	18.	18.	18.	18.

PEAK STORAGE (AC-FT)	TIME (HR)	MAXIMUM AVERAGE STORAGE 6-HR	24-HR	72-HR	24.00-HR
3.	4.07	1.	1.	1.	1.

PEAK STAGE (FEET)	TIME (HR)	MAXIMUM AVERAGE STAGE 6-HR	24-HR	72-HR	24.00-HR
1376.31	4.07	1374.46	1373.88	1373.88	1373.88

CUMULATIVE AREA = 0.15 SQ MI

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	400	455.	4.03	37.	9.	9.	0.15		
ROUTED TO	400R	451.	4.07	36.	9.	9.	0.15	1376.31	4.07

*** NORMAL END OF HEC-1 ***

APPENDIX C-2

DRAINAGE AREA NO. 2
PEAK DISCHARGE & RETENTION CALCULATIONS FOR
SUB-BASIN NOS. 421-423 & 431-432

KAMINSKI HUBBARD engineering inc. • Surveying • Civil • Hydrology	Made by D.L.B.	Date 7-30-90	Job No. 0118
	Checked by	Date	Sheet No.
	For		

SUB-BASIN NO. 421

(1) SUBAREA 421-1

Assumes 90% Contributes

Residential Area $= [2.90 \times 200^2 \div 43560] \times 0.90 = 2.40$ Ac.
(C = 0.60)

R.O.W. Area $= [0.90 \times 200^2 \div 43560] = 0.83$ Ac.
(C = 0.95)

$t_c = 10$ min. $\quad Q = \Sigma CAI = 2.2285\ I$

Description	2 Yr	10 Yr	25 Yr	50 Yr	100 Yr
I, in/hr	2.4	3.8	4.5	5.0	5.5
Q, CFS	5.35	8.47	10.03	11.14	12.26

(2) SUBAREA 421-2

Residential Area $= [3.66 \times 200^2 \div 43560] \times 0.90 = 3.36$ Ac.
(C = 0.60)

R.O.W. Area $= [0.91 \times 200^2 \div 43560] = 0.84$ Ac.
(C = 0.95)

$t_c = 10$ min. $\quad Q = \Sigma CAI = 2.8140\ I$

Description	2 Yr	10 Yr	25 Yr	50 Yr	100 Yr
I, in/hr	2.4	3.8	4.5	5.0	5.5
Q, CFS	6.75	10.69	12.66	14.07	15.48

KAMINSKI HUBBARD engineering inc. • Surveying • Civil • Hydrology	Made by D.L.B.	Date 7-31-90	Job No. 0118
	Checked by	Date	Sheet No.
	For		

SUB-BASIN NO. 422

Residential Area = $[9.76 \times 200^2 \div 43560] \times 0.90 = 8.07$ Ac.
($C = 0.50$)

R.O.W. Area = $[2.04 \times 200^2 \div 43560] = 1.87$ Ac.
($C = 0.95$)

Time of Conc., t_c.

Overland Time : $L = 350'$, $S = 0.020'/ft$, bare soil
$\Delta t_o = 12.3$ min (Page 21, C.O.P. Manual)

Gutter Flow Time: (From Graph on Page 26, C.O.P. Manual)
ALONG 47th Street - Fanfol Drive

$L_1 = 110'$, $S_1 = 0.0105'/ft$, $Q = 2.5$ CFS $\rightarrow V = 3.0$ fps $\rightarrow \Delta t_c = \frac{110}{3 \times 60} = 0.6$ min.

$L_2 = 624'$, $S_2 = 0.0020'/ft$, $Q = 3.0$ CFS $\rightarrow V = 1.6$ fps $\rightarrow \Delta t_c = \frac{624}{1.6 \times 60} = 6.5$ min.

$L_3 = 239'$, $S_3 = 0.0129'/ft$, $Q = 3.0$ CFS $\rightarrow V = 3.2$ fps $\rightarrow \Delta t_c = \frac{239}{3.2 \times 60} = 1.2$ min.

$L_4 = 272'$, $S_4 = 0.011'/ft$, $Q = 3.0$ CFS $\rightarrow V = 3.1$ fps $\rightarrow \Delta t_c = \frac{272}{3.1 \times 60} = 1.5$ min

Sub-Total = 9.8 min.

$t_c = 12.3 + 9.8 = 22.10$ min.

Description	2 Yr.	10 Yr.	25 Yr.	50 Yr.	100 Yr.
I, in/hr	1.66	2.70	3.20	3.55	4.0
Q, CFS	9.65	15.69	18.60	20.63	23.25

$$Q = \Sigma CA\,I = [(8.07)(0.50) + (1.87)(0.95)]\,I$$
$$= 5.8115\,I$$

KAMINSKI HUBBARD engineering inc. • Surveying • Civil • Hydrology	Made by D.L.B.	Date 3-16-90	Job No. 0118
	Checked by	Date	Sheet No.
	For		

DRAINAGE CALCULATIONS FOR SUBBASIN NO. 423

(1) Zoning :

RE-43 Area $= \left[\left(\frac{25.96+20.58}{2}\right)(200)^2 \div 43560\right] \times 0.90 = 19.23$ Ac.
(C = 0.50) (90% Contributes)

Hillside Area $= \left(\frac{47.61}{2}\right)(200)^2 \div 43560 = 21.86$ Ac.
(C = 0.70)

$t_c = 15.3$ min. $\quad Q = \Sigma CAI = \left[(0.50)(19.23) + (0.70)(21.86)\right] I = 24.92\ I$

Description	2YR.	10 YR.	25 YR.	50 YR.	100 YR.
Intensity, in/hr	2.0	3.2	3.8	4.2	4.7
Q, CFS	49.8	79.7	94.7	104.7	117.1

(2) Retention Basin Storage

From Collar, Williams & White Grading Plan :

Volume = 162,203 ft^3

(3) Retention Basin Storage vs. Peak Discharge (2hr duration) Using City of Phoenix Method

Required Capacity = 7200 Q (Ft^3)

Description	2 YR.	10 YR.	25 YR.	50 YR.	100 YR.
Intensity, in/hr	0.48	0.80	0.96	1.10	1.25
Q, CFS	12.0	19.9	23.9	27.4	31.2
Required Capacity (ft^3)	86,124	143,540	172,247	197,366	224,280

KAMINSKI HUBBARD engineering inc. • Surveying • Civil • Hydrology	Made by D.L.B.	Date 3-16-90	Job No. 0118
	Checked by	Date	Sheet No.
	For		

DRAINAGE CALC'S. SUBBASIN 423 (CONTD)

(4) Retention Basin Storage vs. Peak Discharge (t_c)

Volume (ft^3) = $Q_i \times 2.67 \times t_c \times 0.5 \times 60$

Description	2 YR.	10 YR.	25 YR	50 YR.	100 YR.
Q, CFS	49.8	79.7	94.7	104.7	117.1
Volume, ft^3	61,031	97,675	116,058	128,313	143,509

Worksheet 3: Time of concentration (T_c) or travel time (T_t)

Project Tatum Blvd. By ____ Date 3-15-90

Location Mockingbird Lane to Shea Blvd. Checked ____ Date ____

Circle one: Present Developed

Circle one: (T_c) T_t through subarea Subbasin #423

NOTES: Space for as many as two segments per flow type can be used for each worksheet.

Include a map, schematic, or description of flow segments.

Sheet flow (Applicable to T_c only)		Segment ID	A423-B423		
1. Surface description (table 3-1)			Fallow		
2. Manning's roughness coeff., n (table 3-1) ..			0.05		
3. Flow length, L (total L ≤ 300 ft)	ft		300		
4. Two-yr 24-hr rainfall, P_2	in		1.4		
5. Land slope, s 130/300	ft/ft		0.43		
6. $T_t = \frac{0.007\ (nL)^{0.8}}{P_2^{0.5}\ s^{0.4}}$ Compute T_t	hr		0.072	+	= 0.072

Shallow concentrated flow		Segment ID	B423-C423		
7. Surface description (paved or unpaved)			Unpaved		
8. Flow length, L	ft		400		
9. Watercourse slope, s 54/400	ft/ft		0.14		
10. Average velocity, V (figure 3-1)	ft/s		6.0		
11. $T_t = \frac{L}{3600\ V}$ Compute T_t	hr		0.019	+	= 0.019

Channel flow		Segment ID			
12. Cross sectional flow area, a	ft^2				
13. Wetted perimeter, p_w	ft				
14. Hydraulic radius, $r = \frac{a}{p_w}$ Compute r	ft				
15. Channel slope, s 30/2360	ft/ft		0.013		
16. Manning's roughness coeff., n					
17. $V = \frac{1.49\ r^{2/3}\ s^{1/2}}{n}$ Compute V	ft/s		4.0		
18. Flow length, L	ft		2360		
19. $T_t = \frac{L}{3600\ V}$ Compute T_t	hr		0.164	+	= 0.164

20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19) ..... hr 0.255

= 15.3 min

Revised 8-20-90

KAMINSKI HUBBARD engineering inc. • Surveying • Civil • Hydrology	Made by DLB	Date 7-30-90	Job No. 0118
	Checked by	Date	Sheet No.
	For		

SUBAREA NO. 431-1 HYDROLOGY

Mountain View Rd. (South Half)

Assume 90% Contributes

Residential Area $= [3.73 \times 200^2 \div 43560] \times 0.90$
(C = 0.55) $= 3.08$ Ac.

R.O.W. Area $= [0.81 \times 200^2 \div 43560]$
(C = 0.95) $= 0.74$ Ac.

Time of Conc., t_c

(1) Overland Flow Time: $L_1 = 200'$, $S_1 = 0.02$ '/ft

$\Delta t_{c1} = 15$ min (Page 21, C.O.P. Manual)

(2) Street Flow Time: $L_2 = 184'$, $S_2 = 0.0080$ '/ft

$Q = 3$ CFS (Assumed) $\rightarrow V = 3.2$ ft/sec (Page 26, C.O.P. Manual)

$\Delta t_{c2} = \frac{184}{60 \times 2.7} = 1.1$ min.

$L_3 = 226'$, $S_3 = 0.0223$ '/ft., $Q = 3$ CFS (Assumed) $\hookrightarrow V = 3.8$ ft/sec

$\Delta t_{c3} = \frac{226}{60 \times 3.8} = 1.0$ min.

$t_c = \Delta t_{c1} + \Delta t_{c2} + \Delta t_{c3} = 15 + 1.1 + 1.0 = 17.1$ min.

$Q = \Sigma CAI = [(0.55)(3.08) + (0.95)(0.74)]\, I$

$= 2.397\, I$

Description	2 Yr.	10 Yr.	25 Yr.	50 Yr.	100 Yr.
I, in/hr.	1.9	3.1	3.6	4.0	4.5
Q, CFS	4.55	7.43	8.6	9.6	10.8

KAMINSKI HUBBARD engineering inc. • Surveying • Civil • Hydrology	Made by D.L.B.	Date 3-12-91	Job No. 0118
	Checked by	Date	Sheet No.
	For		

SUBAREA NO. 431-2

Subdivided into 2 areas because of Grade & Alignment changes.

(1) Subarea No. 431-2A

Assume 90% Contributes

Residential Area $= [1.00 \times 200^2 \div 43560] \times 0.90$
$(C = 0.55)$ $= 0.83$ Ac.

R.O.W. Area $= [0.52 \times 200^2 \div 43560]$
$(C = 0.95)$ $= 0.48$ Ac.

Time of Conc., t_c

Overland Flow Time, $L_1 = 150'$, $s_1 = 0.02'/ft$, $\Delta t_{c1} = 13$ min

Street Time, $L_2 = 400'$, $s_2 = 0.017'/ft$, $Q = 2$ CFS (Assumed)
$\therefore \Delta t_{c2} = 400/60 \times 3.2 = 2.1$ min

$t_c = \Delta t_{c1} + \Delta t_{c2} = 13 + 2.1 = 15$ min.

$Q = \Sigma CAI = 0.9125\ I$

For 2 Year, $I = 2.0$ in/hr. $\therefore Q_2 = 1.83$ CFS

For 10 Year, $I = 3.2$ in/hr. $\therefore Q_{10} = 2.92$ CFS

(2) Subarea No. 431-2B

Assume 90% Contributes

Residential Area $= (1.01 \times 200^2 \div 43560) \times 0.90$
$(C = 0.55)$ $= 0.835$ Ac.

R.O.W. Area $= [0.54 \times 200^2 \div 43560]$
$(C = 0.95)$ $= 0.50$ Ac.

Time of Conc., t_c

Overland Flow Time, $L = 450'$, $s = 0.020'/ft$, $\Delta t_{c1} = 10$ min (p. 21)

Street Time, $L = 75'$, $s = 0.0022'/ft$, $Q = 2$ CFS (Assumed)
$\therefore \Delta t_{c2} = 75/60 \times 1.5$ $V = 1.5$ fps (p. 26)
$= 0.8$ min.

$t_c = \Delta t_{c1} + \Delta t_{c2} = 10 + 0.8 = 10.8$ min.

KAMINSKI HUBBARD engineering inc. • Surveying • Civil • Hydrology	Made by D.L.B.	Date 3-12-91	Job No. 0118
	Checked by	Date	Sheet No.
	For		

SUBAREA NO. 431-2 (Cont'd)

(2) Subarea No. 431-2B (Cont'd)

$Q = \Sigma C A I = 0.9343 I$

For 2 Year, $I = 2.3$ in/hr $\therefore Q_2 = 2.15$ CFS

For 10 Year, $I = 3.7$ in/hr $\therefore Q_{10} = 3.46$ CFS

For 25 Year, $I = 4.3$ in/hr $Q_{25} = 4.02$ CFS

For 50 Year, $I = 4.8$ in/hr $Q_{50} = 4.48$ CFS

For 100 Year, $I = 5.4$ in/hr. $Q_{100} = 5.05$ CFS.

KAMINSKI HUBBARD engineering inc. • Surveying • Civil • Hydrology	Made by D.L.B.	Date 3-16-90	Job No. 0118
	Checked by	Date	Sheet No.
	For		

DRAINAGE CALCULATIONS FOR SUBBASIN NO. 432

(1) Zoning: 100% RE-43 (Total Area = 9.60 Ac)
Drainage Area = 8.64 Ac.
'C' Coefficient = 0.45
Time of Conc., t_c = 10 min.

Assume 90% Contributes
D.A. = 0.90 × 9.60 = 8.64 Ac.

Rational Eq. Q = CIA

Description	2 YR.	10 YR.	25 YR.	50 YR.	100 YR.
Intensity, in/hr	2.4	3.8	4.5	5.0	5.5
Q, CFS	9.3	14.8	17.5	19.4	21.4

(2) Retention Basin Storage

Surface Area = 46,050 ft^2 = 1.05716 Ac
Avg. Depth = 3 ft

∴ Avg. Volume = (46,050)(3) = 138,150

From Collar, Williams & White Grading Plan:
Retention Vol. = 167,247 ft^3

(3) Retention Basin storage vs. Peak Discharge (2 hr. Duration) Using City of Phoenix Method

Required Capacity = 7200 Q (ft^3)

Description	2 YR.	10 YR	25 YR	50 YR	100 YR.
Intensity, in/hr	0.48	0.80	0.96	1.10	1.25
Q, CFS	1.9	3.1	3.7	4.3	4.9
Volume, ft^3	13,437	22,395	26,874	30,793	34,992

KAMINSKI HUBBARD engineering inc. • Surveying • Civil • Hydrology	Made by D.L.B.	Date 3-16-90	Job No. 0118
	Checked by	Date	Sheet No.
	For		

DRAINAGE CALCS. FOR SUBBASIN NO. 432 (CONTD)

(4) Retention Basin Storage vs. Peak Discharge (t_c)

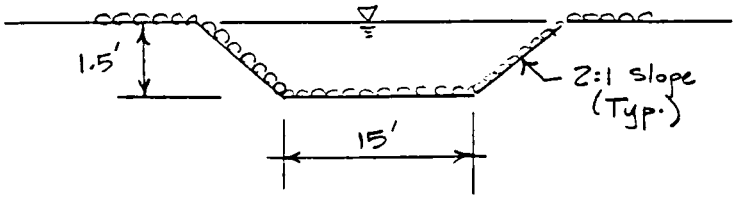
Volume (ft^3) = $Q_i \times 2.67 \times t_c \times 0.5 \times 60$

Description	2YR.	10YR.	25YR.	50YR.	100YR.
Q, CFS	9.3	14.8	17.5	19.4	21.4
Volume, ft^3	7,449	11,855	14,018	15,539	17,141

KAMINSKI HUBBARD engineering inc. • Surveying • Civil • Hydrology	Made by D.L.B	Date 9-5-90	Job No. 0118
	Checked by	Date	Sheet No.
	For		

Capacity of Downstream Channel @ Sta. 32+20 Rt.

Location: Foothills Estates II subdivision



$n = 0.030$

$S = 0.0050'/ft$

$A = (15)(1.5) + (3)(1.5) = 27.0\ ft^2$

$P = 15 + 2\sqrt{3^2 + 1.5^2} = 21.7\ ft$

$$Q = \frac{1.486}{0.030}(27.0)\left(\frac{27.0}{21.7}\right)^{2/3}(0.0050)^{1/2}$$

$$= \underline{\underline{109.4\ CFS}}$$

APPENDIX D-1

DRAINAGE AREA NO. 3
HEC-1 OUTPUT

```
*************************************
*                                   *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)  *
*              MAY   1991           *
*           VERSION 4.0.1E          *
*                                   *
*  RUN DATE  01/14/93  TIME  08:10:02  *
*                                   *
*************************************
```

```
*************************************
*                                   *
*    U.S. ARMY CORPS OF ENGINEERS   *
*    HYDROLOGIC ENGINEERING CENTER  *
*          609 SECOND STREET        *
*       DAVIS, CALIFORNIA 95616     *
*           (916) 551-1748          *
*                                   *
*************************************
```

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

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

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

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

  1           ID                    CITY OF PHOENIX PROJECT NO. P-886515
  2           ID                 TATUM BLVD. - MOCKINGBIRD LANE TO SHEA BLVD.
  3           ID              KAMINSKI - HUBBARD ENGINEERING, INC. - JOB NO. 0118
  4           ID                        HEC-1 FILENAME :  118-39.DAT
  5           ID                           2 YEAR - 6 HOUR STORM
  6           ID         -              REVISED:  JANUARY 11, 1993
              *DIAGRAM
  7           IT       4 07FEB90    1000     300 08FEB90    1000
  8           IO       5

  9           KK     443
 10           KM                     Subarea No. 443
 11           BA   .1307
 12           IN      15
 13           PB    1.16
 14           PC    .000    .008    .016    .025    .033    .041    .050    .058    .066    .074
 15           PC    .087    .099    .118    .138    .216    .377    .834    .911    .931    .950
 16           PC    .962    .972    .983    .991   1.000
 17           LS            91.3
 18           UD    .174

 19           KK    442R
 20           KM                     Route Hydrograph 443 thru 442
 21           RD
 22           RC     .03     .03     .03    1550    .015
 23           RX      10      12      14      62      72     112     114     116
 24           RY       8       7       7       1       1       9       9      10

 25           KK     442
 26           KM                     Subarea No. 442
 27           BA   .0128
 28           LS              86
 29           UD    .100

 30           KK    442C
 31           KM                     Combine Hydrographs 443 & 442
 32           HC       2

 33           KK    441R
 34           KM                     Route Hydrographs 443\442 thru 441
 35           RD
 36           RC     .03     .03     .03    1200    .011
 37           RX      10      12      14      24      42      52      54      56
 38           RY       8       7       7       2       2       7       7       8

 39           KK     441
 40           KM                     Subarea No. 441
 41           BA   .0107
 42           LS              86
 43           UD    .100
```

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

  44          KK    441C
  45          KM                    Combine Hydrographs 443\442 & 441
  46          HC       2
  47          ZZ
                  - -
```

SCHEMATIC DIAGRAM OF STREAM NETWORK

```
INPUT
 LINE      (V) ROUTING          (--->) DIVERSION OR PUMP FLOW

  NO.      (.) CONNECTOR        (<---) RETURN OF DIVERTED OR PUMPED FLOW

    9        443
               V
               V
   19       442R
               .
               .
   25          .         442
               .           .
               .           .
   30       442C............
               V
               V
   33       441R
               .
               .
   39          .         441
               .           .
               .           .
   44       441C............
```

(***) RUNOFF ALSO COMPUTED AT THIS LOCATION

```
*****************************************
*                                       *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *
*              MAY   1991               *
*           VERSION 4.0.1E              *
*                                       *
*  RUN DATE  01/14/93  TIME  08:10:02   *
*                                       *
*****************************************
```

```
*************************************
*                                   *
*   U.S. ARMY CORPS OF ENGINEERS    *
*   HYDROLOGIC ENGINEERING CENTER   *
*         609 SECOND STREET         *
*      DAVIS, CALIFORNIA 95616      *
*          (916) 551-1748           *
*                                   *
*************************************
```

CITY OF PHOENIX PROJECT NO. P-886515
TATUM BLVD. - MOCKINGBIRD LANE TO SHEA BLVD.
KAMINSKI - HUBBARD ENGINEERING, INC. - JOB NO. 0118
HEC-1 FILENAME : 118-39.DAT
2 YEAR - 6 HOUR STORM
REVISED: JANUARY 11, 1993

```
 8 IO          OUTPUT CONTROL VARIABLES
                    IPRNT          5  PRINT CONTROL
                    IPLOT          0  PLOT CONTROL
                    QSCAL         0.  HYDROGRAPH PLOT SCALE

  IT           HYDROGRAPH TIME DATA
                     NMIN          4  MINUTES IN COMPUTATION INTERVAL
                    IDATE     7FEB90  STARTING DATE
                    ITIME       1000  STARTING TIME
                       NQ        361  NUMBER OF HYDROGRAPH ORDINATES
                   NDDATE     8FEB90  ENDING DATE
                   NDTIME       1000  ENDING TIME
                    ICENT         19  CENTURY MARK

              COMPUTATION INTERVAL    0.07 HOURS
                   TOTAL TIME BASE   24.00 HOURS

        ENGLISH UNITS
             DRAINAGE AREA          SQUARE MILES
             PRECIPITATION DEPTH    INCHES
             LENGTH, ELEVATION      FEET
             FLOW                   CUBIC FEET PER SECOND
             STORAGE VOLUME         ACRE-FEET
             SURFACE AREA           ACRES
             TEMPERATURE            DEGREES FAHRENHEIT
```

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	443	79.	4.07	7.	2.	2.	0.13		
ROUTED TO	442R	76.	4.13	7.	2.	2.	0.13		
HYDROGRAPH AT	442	6.	4.07	0.	0.	0.	0.01		
2 COMBINED AT	442C	80.	4.13	7.	2.	2.	0.14		
ROUTED TO	441R	79.	4.20	7.	2.	2.	0.14		
HYDROGRAPH AT	441	5.	4.07	0.	0.	0.	0.01		
2 COMBINED AT	441C	81.	4.20	8.	2.	2.	0.15		

SUMMARY OF KINEMATIC WAVE - MUSKINGUM-CUNGE ROUTING
(FLOW IS DIRECT RUNOFF WITHOUT BASE FLOW)

ISTAQ	ELEMENT	DT	PEAK	TIME TO PEAK	VOLUME	INTERPOLATED TO COMPUTATION INTERVAL DT	PEAK	TIME TO PEAK	VOLUME
		(MIN)	(CFS)	(MIN)	(IN)	(MIN)	(CFS)	(MIN)	(IN)
442R	MANE	2.20	77.44	248.60	0.49	4.00	76.00	248.00	0.49

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.3410E+01 EXCESS=0.0000E+00 OUTFLOW=0.3413E+01 BASIN STORAGE=0.1211E-03 PERCENT ERROR= -0.1

441R	MANE	2.60	79.43	252.20	0.47	4.00	78.95	252.00	0.47

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.3608E+01 EXCESS=0.0000E+00 OUTFLOW=0.3620E+01 BASIN STORAGE=0.1695E-03 PERCENT ERROR= -0.3

*** NORMAL END OF HEC-1 ***

```
*************************************
*                                   *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)  *
*              MAY   1991           *
*           VERSION 4.0.1E          *
*                                   *
*  RUN DATE  01/14/93  TIME  08:08:40  *
*                                   *
*************************************
```

```
*************************************
*                                   *
*    U.S. ARMY CORPS OF ENGINEERS   *
*    HYDROLOGIC ENGINEERING CENTER  *
*          609 SECOND STREET        *
*       DAVIS, CALIFORNIA 95616     *
*           (916) 551-1748          *
*                                   *
*************************************
```

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

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

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

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

  1           ID                  CITY OF PHOENIX PROJECT NO. P-886515
  2           ID                TATUM BLVD. - MOCKINGBIRD LANE TO SHEA BLVD.
  3           ID            KAMINSKI - HUBBARD ENGINEERING, INC. - JOB NO. 0118
  4           ID                      HEC-1 FILENAME :  118-38.DAT
  5           ID                        10 YEAR - 6 HOUR STORM
  6           ID                      REVISED:  JANUARY 11, 1993
              *DIAGRAM
  7           IT       4 07FEB90    1000     300 08FEB90    1000
  8           IO       5

  9           KK     443
 10           KM                     Subarea No. 443
 11           BA   .1625
 12           IN      15
 13           PB    2.07
 14           PC    .000    .008    .016    .025    .033    .041    .050    .058    .066    .074
 15           PC    .087    .099    .118    .138    .216    .377    .834    .911    .931    .950
 16           PC    .962    .972    .983    .991   1.000
 17           LS            91.3
 18           UD    .174

 19           KK    442R
 20           KM                     Route Hydrograph 443 thru 442
 21           RD
 22           RC     .03     .03     .03    1550    .015
 23           RX      10      12      14      62      72     112     114     116
 24           RY       8       7       7       1       1       9       9      10

 25           KK     442
 26           KM                     Subarea No. 442
 27           BA   .0128
 28           LS              86
 29           UD    .100

 30           KK    442C
 31           KM                     Combine Hydrographs 443 & 442
 32           HC       2

 33           KK    441R
 34           KM                     Route Hydrographs 443\442 thru 441
 35           RD
 36           RC     .03     .03     .03    1200    .011
 37           RX      10      12      14      24      42      52      54      56
 38           RY       8       7       7       2       2       7       7       8

 39           KK     441
 40           KM                     Subarea No. 441
 41           BA   .0107
 42           LS              86
 43           UD    .100
```

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

 --           KK    441C
 45           KM                    Combine Hydrographs 443\442 & 441
 46           HC       2
 47           ZZ
                 - -
```

SCHEMATIC DIAGRAM OF STREAM NETWORK

```
INPUT
 LINE      (V) ROUTING          (--->) DIVERSION OR PUMP FLOW

  NO.      (.) CONNECTOR        (<---) RETURN OF DIVERTED OR PUMPED FLOW

    9        443
               V
               V
   19       442R
               .
               .
   25          .         442
               .           .
               .           .
   30       442C............
               V
               V
   33       441R
               .
               .
   39          .         441
               .           .
               .           .
   44       441C............

(***) RUNOFF ALSO COMPUTED AT THIS LOCATION
```

```
*************************************
*                                   *
*  FLOOD HYDROGRAPH PACKAGE  (HEC-1) *
*            MAY   1991             *
*         VERSION 4.0.1E            *
*                                   *
* RUN DATE  01/14/93  TIME  08:08:40 *
*                                   *
*************************************
```

```
*************************************
*                                   *
*   U.S. ARMY CORPS OF ENGINEERS    *
*   HYDROLOGIC ENGINEERING CENTER   *
*        609 SECOND STREET          *
*      DAVIS, CALIFORNIA 95616      *
*         (916) 551-1748            *
*                                   *
*************************************
```

CITY OF PHOENIX PROJECT NO. P-886515
TATUM BLVD. - MOCKINGBIRD LANE TO SHEA BLVD.
KAMINSKI - HUBBARD ENGINEERING, INC. - JOB NO. 0118
HEC-1 FILENAME : 118-38.DAT
10 YEAR - 6 HOUR STORM
REVISED: JANUARY 11, 1993

```
8 IO        OUTPUT CONTROL VARIABLES
                 IPRNT          5  PRINT CONTROL
                 IPLOT          0  PLOT CONTROL
                 QSCAL         0.  HYDROGRAPH PLOT SCALE

 IT         HYDROGRAPH TIME DATA
                  NMIN          4  MINUTES IN COMPUTATION INTERVAL
                 IDATE     7FEB90  STARTING DATE
                 ITIME       1000  STARTING TIME
                    NQ        361  NUMBER OF HYDROGRAPH ORDINATES
                NDDATE     8FEB90  ENDING DATE
                NDTIME       1000  ENDING TIME
                 ICENT         19  CENTURY MARK

            COMPUTATION INTERVAL    0.07 HOURS
                 TOTAL TIME BASE   24.00 HOURS

      ENGLISH UNITS
           DRAINAGE AREA          SQUARE MILES
           PRECIPITATION DEPTH    INCHES
           LENGTH, ELEVATION      FEET
           FLOW                   CUBIC FEET PER SECOND
           STORAGE VOLUME         ACRE-FEET
           SURFACE AREA           ACRES
           TEMPERATURE            DEGREES FAHRENHEIT
```

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	443	240.	4.07	22.	5.	5.	0.16		
ROUTED TO	442R	229.	4.13	22.	5.	5.	0.16		
HYDROGRAPH AT	442	17.	4.00	1.	0.	0.	0.01		
2 COMBINED AT	442C	240.	4.13	23.	6.	6.	0.18		
ROUTED TO	441R	232.	4.13	23.	6.	6.	0.18		
HYDROGRAPH AT	441	14.	4.00	1.	0.	0.	0.01		
2 COMBINED AT	441C	241.	4.13	24.	6.	6.	0.19		

SUMMARY OF KINEMATIC WAVE - MUSKINGUM-CUNGE ROUTING
(FLOW IS DIRECT RUNOFF WITHOUT BASE FLOW)

ISTAQ	ELEMENT	DT	PEAK	TIME TO PEAK	VOLUME	INTERPOLATED TO COMPUTATION INTERVAL DT	PEAK	TIME TO PEAK	VOLUME
		(MIN)	(CFS)	(MIN)	(IN)	(MIN)	(CFS)	(MIN)	(IN)
442R	MANE	3.90	231.00	249.46	1.25	4.00	229.07	248.00	1.25

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.1080E+02 EXCESS=0.0000E+00 OUTFLOW=0.1081E+02 BASIN STORAGE=0.1829E-03 PERCENT ERROR= -0.1

441R	MANE	2.74	237.08	249.45	1.22	4.00	231.90	248.00	1.22

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.1143E+02 EXCESS=0.0000E+00 OUTFLOW=0.1144E+02 BASIN STORAGE=0.1623E-03 PERCENT ERROR= -0.1

*** NORMAL END OF HEC-1 ***

```
****************************************
*                                      *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)  *
*              MAY   1991              *
*           VERSION 4.0.1E             *
*                                      *
*  RUN DATE  01/14/93  TIME  08:07:26  *
*                                      *
****************************************
```

```
****************************************
*                                      *
*   U.S. ARMY CORPS OF ENGINEERS       *
*   HYDROLOGIC ENGINEERING CENTER      *
*         609 SECOND STREET            *
*      DAVIS, CALIFORNIA 95616         *
*          (916) 551-1748              *
*                                      *
****************************************
```

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

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

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

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

  1           ID                  CITY OF PHOENIX PROJECT NO. P-886515
  2           ID               TATUM BLVD. - MOCKINGBIRD LANE TO SHEA BLVD.
  3           ID            KAMINSKI - HUBBARD ENGINEERING, INC. - JOB NO. 0118
  4           ID                     HEC-1 FILENAME :  118-37.DAT
  5           ID                       25 YEAR - 6 HOUR STORM
  6           ID                     REVISED:  JANUARY 11, 1993
              *DIAGRAM
  7           IT       4 07FEB90    1000     300 08FEB90    1000
  8           IO       5

  9           KK     443
 10           KM                     Subarea No. 443
 11           BA   .1987
 12           IN      15
 13           PB    2.57
 14           PC    .000    .008    .016    .025    .033    .041    .050    .058    .066    .074
 15           PC    .087    .099    .118    .138    .216    .377    .834    .911    .931    .950
 16           PC    .962    .972    .983    .991   1.000
 17           LS            91.3
 18           UD    .174

 19           KK    442R
 20           KM                     Route Hydrograph 443 thru 442
 21           RD
 22           RC     .03     .03     .03    1550    .015
 23           RX      10      12      14      62      72     112     114     116
 24           RY       8       7       7       1       1       9       9      10

 25           KK     442
 26           KM                     Subarea No. 442
 27           BA   .0144
 28           LS              86
 29           UD    .100

 30           KK    442C
 31           KM                     Combine Hydrographs 443 & 442
 32           HC       2

 33           KK    441R
 34           KM                     Route Hydrographs 443\442 thru 441
 35           RD
 36           RC     .03     .03     .03    1200    .011
 37           RX      10      12      14      24      42      52      54      56
 38           RY       8       7       7       2       2       7       7       8

 39           KK     441
 40           KM                     Subarea No. 441
 41           BA   .0121
 42           LS              86
 43           UD    .100
```

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

  44          KK    441C
  45          KM                     Combine Hydrographs 443\442 & 441
  46          HC       2
  47          ZZ
                  - -
```

SCHEMATIC DIAGRAM OF STREAM NETWORK

```
INPUT
 LINE      (V) ROUTING          (--->) DIVERSION OR PUMP FLOW

  NO.      (.) CONNECTOR        (<---) RETURN OF DIVERTED OR PUMPED FLOW

    9        443
               V
               V
   19       442R
               .
               .
   25          .         442
               .           .
               .           .
   30       442C............
               V
               V
   33       441R
               .
               .
   39          .         441
               .           .
               .           .
   44       441C............

(***) RUNOFF ALSO COMPUTED AT THIS LOCATION
```

```
*************************************
*                                   *
*  FLOOD HYDROGRAPH PACKAGE  (HEC-1)*
*              MAY   1991           *
*           VERSION 4.0.1E          *
*                                   *
* RUN DATE  01/14/93  TIME  08:07:26*
*                                   *
*************************************
```

```
*************************************
*                                   *
*   U.S. ARMY CORPS OF ENGINEERS    *
*   HYDROLOGIC ENGINEERING CENTER   *
*         609 SECOND STREET         *
*      DAVIS, CALIFORNIA 95616      *
*          (916) 551-1748           *
*                                   *
*************************************
```

CITY OF PHOENIX PROJECT NO. P-886515
TATUM BLVD. - MOCKINGBIRD LANE TO SHEA BLVD.
KAMINSKI - HUBBARD ENGINEERING, INC. - JOB NO. 0118
HEC-1 FILENAME : 118-37.DAT
25 YEAR - 6 HOUR STORM
REVISED: JANUARY 11, 1993

```
 8 IO        OUTPUT CONTROL VARIABLES
                  IPRNT          5  PRINT CONTROL
                  IPLOT          0  PLOT CONTROL
                  QSCAL         0.  HYDROGRAPH PLOT SCALE

  IT         HYDROGRAPH TIME DATA
                   NMIN          4  MINUTES IN COMPUTATION INTERVAL
                  IDATE     7FEB90  STARTING DATE
                  ITIME       1000  STARTING TIME
                     NQ        361  NUMBER OF HYDROGRAPH ORDINATES
                 NDDATE     8FEB90  ENDING DATE
                 NDTIME       1000  ENDING TIME
                  ICENT         19  CENTURY MARK

            COMPUTATION INTERVAL    0.07 HOURS
                 TOTAL TIME BASE   24.00 HOURS

      ENGLISH UNITS
           DRAINAGE AREA          SQUARE MILES
           PRECIPITATION DEPTH    INCHES
           LENGTH, ELEVATION      FEET
           FLOW                   CUBIC FEET PER SECOND
           STORAGE VOLUME         ACRE-FEET
           SURFACE AREA           ACRES
           TEMPERATURE            DEGREES FAHRENHEIT
```

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	443	393.	4.07	36.	9.	9.	0.20		
ROUTED TO	442R	376.	4.13	36.	9.	9.	0.20		
HYDROGRAPH AT	442	27.	4.00	2.	1.	1.	0.01		
2 COMBINED AT	442C	393.	4.13	38.	10.	10.	0.21		
ROUTED TO	441R	388.	4.13	38.	10.	10.	0.21		
HYDROGRAPH AT	441	23.	4.00	2.	0.	0.	0.01		
2 COMBINED AT	441C	402.	4.13	40.	10.	10.	0.23		

SUMMARY OF KINEMATIC WAVE - MUSKINGUM-CUNGE ROUTING
(FLOW IS DIRECT RUNOFF WITHOUT BASE FLOW)

ISTAQ	ELEMENT	DT (MIN)	PEAK (CFS)	TIME TO PEAK (MIN)	VOLUME (IN)	INTERPOLATED TO COMPUTATION INTERVAL DT (MIN)	PEAK (CFS)	TIME TO PEAK (MIN)	VOLUME (IN)
442R	MANE	3.33	383.00	246.31	1.70	4.00	376.08	248.00	1.70

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.1800E+02 EXCESS=0.0000E+00 OUTFLOW=0.1801E+02 BASIN STORAGE=0.1448E-03 PERCENT ERROR= 0.0

441R	MANE	2.29	389.55	249.38	1.67	4.00	387.87	248.00	1.67

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.1898E+02 EXCESS=0.0000E+00 OUTFLOW=0.1898E+02 BASIN STORAGE=0.1493E-03 PERCENT ERROR= 0.0

*** NORMAL END OF HEC-1 ***

```
****************************************
*                                      *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)  *
*              MAY   1991              *
*           VERSION 4.0.1E             *
*                                      *
* RUN DATE  01/14/93  TIME  08:05:54   *
*                                      *
****************************************
```

```
****************************************
*                                      *
*   U.S. ARMY CORPS OF ENGINEERS       *
*   HYDROLOGIC ENGINEERING CENTER      *
*         609 SECOND STREET            *
*      DAVIS, CALIFORNIA 95616         *
*          (916) 551-1748              *
*                                      *
****************************************
```

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

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

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

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

  1           ID                    CITY OF PHOENIX PROJECT NO. P-886515
  2           ID                 TATUM BLVD. - MOCKINGBIRD LANE TO SHEA BLVD.
  3           ID              KAMINSKI - HUBBARD ENGINEERING, INC. - JOB NO. 0118
  4           ID                        HEC-1 FILENAME :  118-36.DAT
  5           ID                           50 YEAR - 6 HOUR STORM
  6           ID         -               REVISED:  JANUARY 11, 1993
              *DIAGRAM
  7           IT       4 07FEB90    1000     300 08FEB90    1000
  8           IO       5

  9           KK     443
 10           KM                      Subarea No. 443
 11           BA   .1987
 12           IN      15
 13           PB    2.96
 14           PC    .000    .008    .016    .025    .033    .041    .050    .058    .066    .074
 15           PC    .087    .099    .118    .138    .216    .377    .834    .911    .931    .950
 16           PC    .962    .972    .983    .991   1.000
 17           LS            91.3
 18           UD    .174

 19           KK    442R
 20           KM                      Route Hydrograph 443 thru 442
 21           RD
 22           RC     .03     .03     .03    1550    .015
 23           RX      10      12      14      62      72     112     114     116
 24           RY       8       7       7       1       1       9       9      10

 25           KK     442
 26           KM                      Subarea No. 442
 27           BA   .0144
 28           LS              86
 29           UD    .100

 30           KK    442C
 31           KM                      Combine Hydrographs 443 & 442
 32           HC       2

 33           KK    441R
 34           KM                      Route Hydrographs 443\442 thru 441
 35           RD
 36           RC     .03     .03     .03    1200    .011
 37           RX      10      12      14      24      42      52      54      56
 38           RY       8       7       7       2       2       7       7       8

 39           KK     441
 40           KM                      Subarea No. 441
 41           BA   .0121
 42           LS              86
 43           UD    .100
```

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

  44          KK    441C
  45          KM                        Combine Hydrographs 443\442 & 441
  46          HC       2
  47          ZZ
                 - -
```

SCHEMATIC DIAGRAM OF STREAM NETWORK

```
INPUT
 LINE      (V) ROUTING          (--->) DIVERSION OR PUMP FLOW

  NO.      (.) CONNECTOR        (<---) RETURN OF DIVERTED OR PUMPED FLOW

    9        443
               V
               V
   19       442R
               .
               .
   25          .         442
               .           .
               .           .
   30       442C............
               V
               V
   33       441R
               .
               .
   39          .         441
               .           .
               .           .
   44       441C............

(***) RUNOFF ALSO COMPUTED AT THIS LOCATION
```

```
*************************************
*                                   *
*  FLOOD HYDROGRAPH PACKAGE  (HEC-1)*
*             MAY   1991            *
*          VERSION 4.0.1E           *
*                                   *
* RUN DATE  01/14/93  TIME  08:05:54*
*                                   *
*************************************
```

```
*************************************
*                                   *
*   U.S. ARMY CORPS OF ENGINEERS    *
*   HYDROLOGIC ENGINEERING CENTER   *
*         609 SECOND STREET         *
*      DAVIS, CALIFORNIA 95616      *
*          (916) 551-1748           *
*                                   *
*************************************
```

CITY OF PHOENIX PROJECT NO. P-886515
TATUM BLVD. - MOCKINGBIRD LANE TO SHEA BLVD.
KAMINSKI - HUBBARD ENGINEERING, INC. - JOB NO. 0118
HEC-1 FILENAME : 118-36.DAT
50 YEAR - 6 HOUR STORM
REVISED: JANUARY 11, 1993

```
 8 IO        OUTPUT CONTROL VARIABLES
                  IPRNT          5  PRINT CONTROL
                  IPLOT          0  PLOT CONTROL
                  QSCAL         0.  HYDROGRAPH PLOT SCALE

  IT         HYDROGRAPH TIME DATA
                   NMIN          4  MINUTES IN COMPUTATION INTERVAL
                  IDATE     7FEB90  STARTING DATE
                  ITIME       1000  STARTING TIME
                     NQ        361  NUMBER OF HYDROGRAPH ORDINATES
                 NDDATE     8FEB90  ENDING DATE
                 NDTIME       1000  ENDING TIME
                  ICENT         19  CENTURY MARK

            COMPUTATION INTERVAL    0.07 HOURS
                 TOTAL TIME BASE   24.00 HOURS

      ENGLISH UNITS
           DRAINAGE AREA          SQUARE MILES
           PRECIPITATION DEPTH    INCHES
           LENGTH, ELEVATION      FEET
           FLOW                   CUBIC FEET PER SECOND
           STORAGE VOLUME         ACRE-FEET
           SURFACE AREA           ACRES
           TEMPERATURE            DEGREES FAHRENHEIT
```

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	443	470.	4.07	44.	11.	11.	0.20		
ROUTED TO	442R	452.	4.13	44.	11.	11.	0.20		
HYDROGRAPH AT	442	33.	4.00	3.	1.	1.	0.01		
2 COMBINED AT	442C	473.	4.13	47.	12.	12.	0.21		
ROUTED TO	441R	470.	4.13	47.	12.	12.	0.21		
HYDROGRAPH AT	441	28.	4.00	2.	1.	1.	0.01		
2 COMBINED AT	441C	487.	4.13	49.	12.	12.	0.23		

SUMMARY OF KINEMATIC WAVE - MUSKINGUM-CUNGE ROUTING
(FLOW IS DIRECT RUNOFF WITHOUT BASE FLOW)

ISTAQ	ELEMENT	DT (MIN)	PEAK (CFS)	TIME TO PEAK (MIN)	VOLUME (IN)	INTERPOLATED TO COMPUTATION INTERVAL DT (MIN)	PEAK (CFS)	TIME TO PEAK (MIN)	VOLUME (IN)
442R	MANE	3.16	463.51	246.61	2.06	4.00	452.44	248.00	2.06

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.2183E+02 EXCESS=0.0000E+00 OUTFLOW=0.2184E+02 BASIN STORAGE=0.1222E-03 PERCENT ERROR= 0.0

441R	MANE	2.15	470.86	247.33	2.03	4.00	469.79	248.00	2.03

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.2308E+02 EXCESS=0.0000E+00 OUTFLOW=0.2309E+02 BASIN STORAGE=0.1433E-03 PERCENT ERROR= 0.0

*** NORMAL END OF HEC-1 ***

```
****************************************
*                                      *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)  *
*              MAY   1991              *
*           VERSION 4.0.1E             *
*                                      *
* RUN DATE  01/14/93  TIME  08:04:07   *
*                                      *
****************************************
```

```
****************************************
*                                      *
*    U.S. ARMY CORPS OF ENGINEERS      *
*    HYDROLOGIC ENGINEERING CENTER     *
*          609 SECOND STREET           *
*       DAVIS, CALIFORNIA 95616        *
*           (916) 551-1748             *
*                                      *
****************************************
```

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

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

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

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

  1           ID                  CITY OF PHOENIX PROJECT NO. P-886515
  2           ID               TATUM BLVD. - MOCKINGBIRD LANE TO SHEA BLVD.
  3           ID            KAMINSKI - HUBBARD ENGINEERING, INC. - JOB NO. 0118
  4           ID                      HEC-1 FILENAME :  118-35.DAT
  5           ID                        100 YEAR - 6 HOUR STORM
  6           ID        -               REVISED:  JANUARY 11, 1993
              *DIAGRAM
  7           IT       4 07FEB90    1000     300 08FEB90    1000
  8           IO       5

  9           KK     443
 10           KM                     Subarea No. 443
 11           BA   .1987
 12           IN      15
 13           PB    3.35
 14           PC    .000    .008    .016    .025    .033    .041    .050    .058    .066    .074
 15           PC    .087    .099    .118    .138    .216    .377    .834    .911    .931    .950
 16           PC    .962    .972    .983    .991   1.000
 17           LS            91.3
 18           UD    .174

 19           KK    442R
 20           KM                     Route Hydrograph 443 thru 442
 21           RD
 22           RC     .03     .03     .03    1550    .015
 23           RX      10      12      14      62      72     112     114     116
 24           RY       8       7       7       1       1       9       9      10

 25           KK     442
 26           KM                     Subarea No. 442
 27           BA   .0144
 28           LS              86
 29           UD    .100

 30           KK    442C
 31           KM                     Combine Hydrographs 443 & 442
 32           HC       2

 33           KK    441R
 34           KM                     Route Hydrographs 443\442 thru 441
 35           RD
 36           RC     .03     .03     .03    1200    .011
 37           RX      10      12      14      24      42      52      54      56
 38           RY       8       7       7       2       2       7       7       8

 39           KK     441
 40           KM                     Subarea No. 441
 41           BA   .0121
 42           LS              86
 43           UD    .100
```

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

  44          KK    441C
  45          KM                    Combine Hydrographs 443\442 & 441
  46          HC       2
  47          ZZ    --
```

SCHEMATIC DIAGRAM OF STREAM NETWORK

```
INPUT
 LINE      (V) ROUTING          (--->) DIVERSION OR PUMP FLOW

  NO.      (.) CONNECTOR        (<---) RETURN OF DIVERTED OR PUMPED FLOW

    9        443
               V
               V
   19       442R
               .
               .
   25          .         442
               .           .
               .           .
   30       442C............
               V
               V
   33       441R
               .
               .
   39          .         441
               .           .
               .           .
   44       441C............

(***) RUNOFF ALSO COMPUTED AT THIS LOCATION
```

```
*************************************
*                                   *
*  FLOOD HYDROGRAPH PACKAGE  (HEC-1) *
*            MAY   1991             *
*          VERSION 4.0.1E           *
*                                   *
* RUN DATE  01/14/93  TIME  08:04:07 *
*                                   *
*************************************
```

```
*************************************
*                                   *
*   U.S. ARMY CORPS OF ENGINEERS    *
*   HYDROLOGIC ENGINEERING CENTER   *
*         609 SECOND STREET         *
*      DAVIS, CALIFORNIA 95616      *
*          (916) 551-1748           *
*                                   *
*************************************
```

CITY OF PHOENIX PROJECT NO. P-886515
TATUM BLVD. - MOCKINGBIRD LANE TO SHEA BLVD.
KAMINSKI - HUBBARD ENGINEERING, INC. - JOB NO. 0118
HEC-1 FILENAME : 118-35.DAT
100 YEAR - 6 HOUR STORM
REVISED: JANUARY 11, 1993

```
8 IO        OUTPUT CONTROL VARIABLES
                 IPRNT          5  PRINT CONTROL
                 IPLOT          0  PLOT CONTROL
                 QSCAL         0.  HYDROGRAPH PLOT SCALE

  IT        HYDROGRAPH TIME DATA
                  NMIN          4  MINUTES IN COMPUTATION INTERVAL
                 IDATE     7FEB90  STARTING DATE
                 ITIME       1000  STARTING TIME
                    NQ        361  NUMBER OF HYDROGRAPH ORDINATES
                NDDATE     8FEB90  ENDING DATE
                NDTIME       1000  ENDING TIME
                 ICENT         19  CENTURY MARK

            COMPUTATION INTERVAL    0.07 HOURS
                 TOTAL TIME BASE   24.00 HOURS

      ENGLISH UNITS
           DRAINAGE AREA          SQUARE MILES
           PRECIPITATION DEPTH    INCHES
           LENGTH, ELEVATION      FEET
           FLOW                   CUBIC FEET PER SECOND
           STORAGE VOLUME         ACRE-FEET
           SURFACE AREA           ACRES
           TEMPERATURE            DEGREES FAHRENHEIT
```

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	443	548.	4.07	52.	13.	13.	0.20		
ROUTED TO	442R	530.	4.13	52.	13.	13.	0.20		
HYDROGRAPH AT	442	40.	4.00	3.	1.	1.	0.01		
2 COMBINED AT	442C	554.	4.13	55.	14.	14.	0.21		
ROUTED TO	441R	551.	4.13	55.	14.	14.	0.21		
HYDROGRAPH AT	441	33.	4.00	3.	1.	1.	0.01		
2 COMBINED AT	441C	571.	4.13	57.	14.	14.	0.23		

SUMMARY OF KINEMATIC WAVE - MUSKINGUM-CUNGE ROUTING
(FLOW IS DIRECT RUNOFF WITHOUT BASE FLOW)

ISTAQ	ELEMENT	DT	PEAK	TIME TO PEAK	VOLUME	INTERPOLATED TO COMPUTATION INTERVAL DT	PEAK	TIME TO PEAK	VOLUME
		(MIN)	(CFS)	(MIN)	(IN)	(MIN)	(CFS)	(MIN)	(IN)
442R	MANE	3.01	542.24	246.88	2.43	4.00	529.80	248.00	2.43

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.2573E+02 EXCESS=0.0000E+00 OUTFLOW=0.2573E+02 BASIN STORAGE=0.2111E-03 PERCENT ERROR= 0.0

441R	MANE	2.04	551.34	246.88	2.40	4.00	550.87	248.00	2.39

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.2723E+02 EXCESS=0.0000E+00 OUTFLOW=0.2724E+02 BASIN STORAGE=0.1274E-03 PERCENT ERROR= 0.0

*** NORMAL END OF HEC-1 ***

APPENDIX D-2

DRAINAGE AREA NO. 3
DESIGN COMPUTATIONS & PIPE CULVERT CALCULATIONS

KAMINSKI HUBBARD engineering inc. • Surveying • Civil • Hydrology	Made by D.L.B.	Date 2-28-90	Job No. 0118
	Checked by	Date	Sheet No.
	For		

SUBBASIN NO. 443

Total Drainage Area = 0.20781 mi.^{2} = 132.99 Ac.

a. Zoning: RE-43 CN = 86
Drainage Area = 0.09074 mi.^{2} = 58.07 Ac.
Assume 90% Contributes
∴ Drainage Area = 0.08166 mi.^{2} = 52.26 Ac.

b. Zoning: Hillside (over 10% Sloping) CN (1hr) = 95
Drainage Area = 0.11707 mi.^{2} = 74.92 Ac.

Weighted Curve No.

$$CN = \frac{(86)(0.08166) + (95)(0.11707)}{0.19873} = 91.3$$

Weighted 'C' Coefficient

$$C = \frac{(0.45)(0.08166) + (0.70)(0.11707)}{0.19873} = 0.60$$

Total Contributing Area = 0.19873 mi.^{2} = 127.18 Ac.

SUBBASIN NO. 442

Total Drainage Area = $\left(\frac{22.34}{2}\right)(200^2) \div 43560$ = 10.26 Ac = 0.016 mi^2

Zoning: RE-43 CN = 86

Assume 90% Contributes

Drainage Area = 0.90 × 0.016 = 0.0144 mi^2

SUBBASIN NO. 441

Total Drainage Area = $\left(\frac{18.64}{2}\right)(200^2) \div 43560$ = 8.56 Ac.
= 0.0134 mi^2

Zoning: RE-43 CN = 86
Assume 90% Contributes

∴ Drainage Area = 0.90 × 0.0134 = 0.0120 mi.^{2}

KAMINSKI HUBBARD engineering inc. • Surveying • Civil • Hydrology	Made by DLB	Date 1-11-93	Job No. 0118
	Checked by	Date	Sheet No.
	For		

DRAINAGE AREA No. 3 - Contributing Areas

Assumption: For 2-Year storm event, only impervious areas will contribute. For RE-43 Zoning, 15% is impervious.

For RE-43 Zoning:
- For 10-Year storm event, 50% of area is contributing which would be the front half of each lot.
- For 25-, 50- and 100-Year storm events, 90% of area is contributing.

SubArea 441 — Essentially Undeveloped - assume 80% contributing for 2- and 10-Year storm; otherwise use 90%.

$D.A._{2YR} = D.A._{10YR} = 0.80 \times 0.0134\ mi^2 = 0.0107\ mi^2$

$D.A._{25YR} = D.A._{50YR} = D.A._{100YR} = 0.90 \times 0.0134 = 0.0121\ mi^2$

SubArea 442 — Essentially Undeveloped - assume 80% contributing for 2- and 10-Year storm; otherwise use 90%.

$D.A._{2YR} = D.A._{10YR} = 0.80 \times 0.016\ mi^2 = 0.0128\ mi^2$

$D.A._{25YR} = D.A._{50YR} = D.A._{100YR} = 0.90 \times 0.016 = 0.0144\ mi^2$

SubArea 443 — RE-43 Area $= 0.0907\ mi^2$
Hillside Area $= 0.1171\ mi^2$

$D.A._{2YR} = 0.1171 + 0.15(0.0907) = 0.1307\ mi^2$

$D.A._{10YR} = 0.1171 + 0.50(0.0907) = 0.1625\ mi^2$

$D.A._{25YR} = D.A._{50YR} = D.A._{100YR} = 0.1171 + 0.90(0.0907) = 0.1987\ mi^2$

Worksheet 3: Time of concentration (T_c) or travel time (T_t)

Project Tatum Blvd. By ____ Date 3-15-90

Location Mockingbird Lane to Shea Blvd. Checked ____ Date ____

Circle one: Present Developed

Circle one: (T_c) T_t through subarea Subbasin #441

NOTES: Space for as many as two segments per flow type can be used for each worksheet.

Include a map, schematic, or description of flow segments.

Sheet flow (Applicable to T_c only) — Segment ID

1. Surface description (table 3-1) .....
2. Manning's roughness coeff., n (table 3-1) ..
3. Flow length, L (total L $\leq$ 300 ft) ..... ft
4. Two-yr 24-hr rainfall, P_2 ..... in
5. Land slope, s ..... ft/ft
6. $T_t = \frac{0.007\ (nL)^{0.8}}{P_2^{0.5}\ s^{0.4}}$ Compute T_t ..... hr

Shallow concentrated flow — Segment ID

7. Surface description (paved or unpaved) .....
8. Flow length, L ..... ft
9. Watercourse slope, s ..... ft/ft
10. Average velocity, V (figure 3-1) ..... ft/s
11. $T_t = \frac{L}{3600\ V}$ Compute T_t ..... hr

Channel flow — Segment ID

12. Cross sectional flow area, a ..... ft^2
13. Wetted perimeter, p_w ..... ft
14. Hydraulic radius, $r = \frac{a}{p_w}$ Compute r ..... ft
15. Channel slope, s ..... ft/ft
16. Manning's roughness coeff., n .....
17. $V = \frac{1.49\ r^{2/3}\ s^{1/2}}{n}$ Compute V ..... ft/s
18. Flow length, L ..... ft
19. $T_t = \frac{L}{3600\ V}$ Compute T_t ..... hr
20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19) ..... hr

< 10min

Use 10min

Worksheet 3: Time of concentration (T_c) or travel time (T_t)

Project Tatum Blvd. By D.L.B. Date 3-15-90

Location Mockingbird Lane to Shea Blvd. Checked ____ Date ____

Circle one: Present Developed

Circle one: (T_c) T_t through subarea Subbasin #442

NOTES: Space for as many as two segments per flow type can be used for each worksheet.

Include a map, schematic, or description of flow segments.

Sheet flow (Applicable to T_c only)		Segment ID	A442-B442			
1. Surface description (table 3-1)			Fallow			
2. Manning's roughness coeff., n (table 3-1) ..			0.05			
3. Flow length, L (total L ≤ 300 ft)	ft		300			
4. Two-yr 24-hr rainfall, P_2	in		1.40			
5. Land slope, s	ft/ft		0.42			
6. $T_t = \frac{0.007\ (nL)^{0.8}}{P_2^{0.5}\ s^{0.4}}$ Compute T_t	hr		0.073	+		= 0.073

Shallow concentrated flow		Segment ID	B442-C442			
7. Surface description (paved or unpaved)			Unpaved			
8. Flow length, L	ft		680			
9. Watercourse slope, s	ft/ft		0.23			
10. Average velocity, V (figure 3-1)	ft/s		7.8			
11. $T_t = \frac{L}{3600\ V}$ Compute T_t	hr		0.024	+		= 0.024

Channel flow		Segment ID	C442-D442	D442-4420		
12. Cross sectional flow area, a	ft^2					
13. Wetted perimeter, p_w	ft					
14. Hydraulic radius, $r = \frac{a}{p_w}$ Compute r	ft					
15. Channel slope, s	ft/ft		0.015	0.012		
16. Manning's roughness coeff., n						
17. $V = \frac{1.49\ r^{2/3}\ s^{1/2}}{n}$ Compute V	ft/s		4.5	3.2		
18. Flow length, L	ft		1060	1000		
19. $T_t = \frac{L}{3600\ V}$ Compute T_t	hr		0.065	+ 0.087	=	0.152

20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19) ..... hr 0.249

= 14.9 min

Worksheet 3: Time of concentration (T_c) or travel time (T_t)

Project Tatum Blvd. By D.L.B. Date 3-1-90

Location Mockingbird Lane to Shea Blvd. Checked ____ Date ____

Circle one: Present Developed

Circle one: (T_c) T_t through subarea Subbasin # 443

NOTES: Space for as many as two segments per flow type can be used for each worksheet.

Include a map, schematic, or description of flow segments.

Sheet flow (Applicable to T_c only)		Segment ID	A443-B443		
1. Surface description (table 3-1)			Fallow		
2. Manning's roughness coeff., n (table 3-1) ..			0.05		
3. Flow length, L (total L $\leq$ 300 ft)	ft		200		
4. Two-yr 24-hr rainfall, P_2	in		1.40		
5. Land slope, s	ft/ft		0.51		
6. $T_t = \frac{0.007\ (nL)^{0.8}}{P_2^{0.5}\ s^{0.4}}$ Compute T_t	hr		0.049	+	= 0.049

Shallow concentrated flow		Segment ID	B443-C443	C443-D443	
7. Surface description (paved or unpaved)			Unpaved	Unpaved	
8. Flow length, L	ft		380	1340	
9. Watercourse slope, s	ft/ft		0.54	0.16	
10. Average velocity, V (figure 3-1)	ft/s		12.0	6.5	
11. $T_t = \frac{L}{3600\ V}$ Compute T_t	hr		0.009	+ 0.057	= 0.066

Channel flow		Segment ID	D443-443D		
12. Cross sectional flow area, a	ft^2				
13. Wetted perimeter, p_w	ft				
14. Hydraulic radius, $r = \frac{a}{p_w}$ Compute r	ft				
15. Channel slope, s	ft/ft		0.014		
16. Manning's roughness coeff., n					
17. $V = \frac{1.49\ r^{2/3}\ s^{1/2}}{n}$ Compute V	ft/s		3.5		
18. Flow length, L	ft		2200		
19. $T_t = \frac{L}{3600\ V}$ Compute T_t	hr		0.175	+	= 0.175

20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19) ..... hr 0.29

= 17.4 min

PROJECT: Tatum Blvd. Mockingbird Lane to Shea Blvd.	STATION:	CULVERT DESIGN FORM
	SHEET ____ OF ____	DESIGNER / DATE: D.L.B. / 2-22-90
		REVIEWER / DATE: ____ / ____

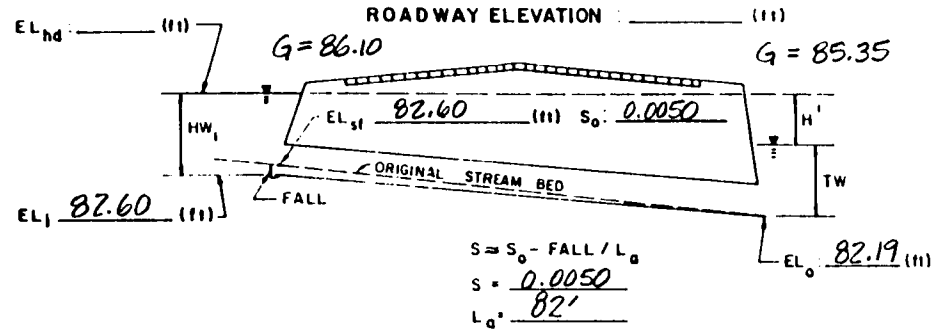
HYDROLOGICAL DATA

SEE ADD'L SHTS.

- ☐ METHOD: HEC-1
- ☐ DRAINAGE AREA: 41 Ac. ☐ STREAM SLOPE: ____
- ☐ CHANNEL SHAPE: ____
- ☐ ROUTING: ____ ☐ OTHER: ____

DESIGN FLOWS/TAILWATER

R I (YEARS)	FLOW (cfs)	TW (ft)
50	108	
100	130	



CULVERT DESCRIPTION: MATERIAL - SHAPE - SIZE - ENTRANCE

	TOTAL FLOW Q (cfs)	FLOW PER BARREL Q/N (1)	HEADWATER CALCULATIONS: INLET CONTROL HW_i/D (2)	HW_i	FALL (3)	EL_{hi} (4)	OUTLET CONTROL TW (5)	d_c	$\frac{d_c+D}{2}$	h_o (6)	h_e	H (7)	EL_{ho} (8)	CONTROL HEADWATER ELEVATION	OUTLET VELOCITY	COMMENTS
6 - 36" x 22" C.M.P.A. Hdwl.	108	18	1.0	1.83	–	84.43	1.83	1.09	1.46	1.83	0.5	1.22	85.24	85.24	4.1	
6 - 36" x 22" C.M.P.A. Hdwl.	141	23.5	1.28	2.35	–	84.95	1.83	1.27	1.55	1.83	0.5	2.08	86.10	86.10	5.3	Peak Q for Max. H
" " "	150	25	1.35	2.48	–	85.08		1.32	1.58	1.58	0.5	2.33	86.10	86.10	5.7	Assume $h_o = \frac{d_c+D}{2}$

TECHNICAL FOOTNOTES:

(1) USE Q/NB FOR BOX CULVERTS

(2) HW_i/D = HW/D OR HW_i/D FROM DESIGN CHARTS

(3) FALL = $HW_i - (EL_{hd} - EL_{sf})$; FALL IS ZERO FOR CULVERTS ON GRADE

(4) $EL_{hi} = HW_i + EL_i$ (INVERT OF INLET CONTROL SECTION)

(5) TW BASED ON DOWN STREAM CONTROL OR FLOW DEPTH IN CHANNEL.

(6) h_o = TW or $(d_c + D/2)$ (WHICHEVER IS GREATER)

(7) $H = \left[1 + k_e + (29n^2 L)/R^{1.33}\right] V^2/2g$

(8) $EL_{ho} = EL_o + H + h_o$

SUBSCRIPT DEFINITIONS:

- o. APPROXIMATE
- f CULVERT FACE
- hd. DESIGN HEADWATER
- hi HEADWATER IN INLET CONTROL
- ho HEADWATER IN OUTLET CONTROL
- i INLET CONTROL SECTION
- o. OUTLET
- sf. STREAMBED AT CULVERT FACE
- tw TAILWATER

COMMENTS / DISCUSSION:

Exist. 6-36" x 22" C.M.P.A. will convey 150 CFS without overtopping Vert. C.O.G., provided that $h_o = \frac{d_c+D}{2}$

CULVERT BARREL SELECTED:

SIZE: ____

SHAPE: ____

MATERIAL: ____ n ____

ENTRANCE: ____

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	For		

Outlet Velocity of 6 - 36" x 22" C.M.P.A.

a) $Q = 18$ CFS / Barrel $\quad n = 0.024 \quad S = 0.0050$ '/ft

$K = 185$ (Table VI)

$Q_{full} = K S^{1/2} = 185 (0.0050)^{1/2} = 13.1$ CFS < 18 CFS

$\therefore V = Q/A = 18/4.4 = 4.1$ fps

b) $Q = 23.5$ CFS / barrel $\quad n = 0.024 \quad S = 0.0050$ '/ft

$Q_{full} = 13.1$ CFS < 23.5 CFS

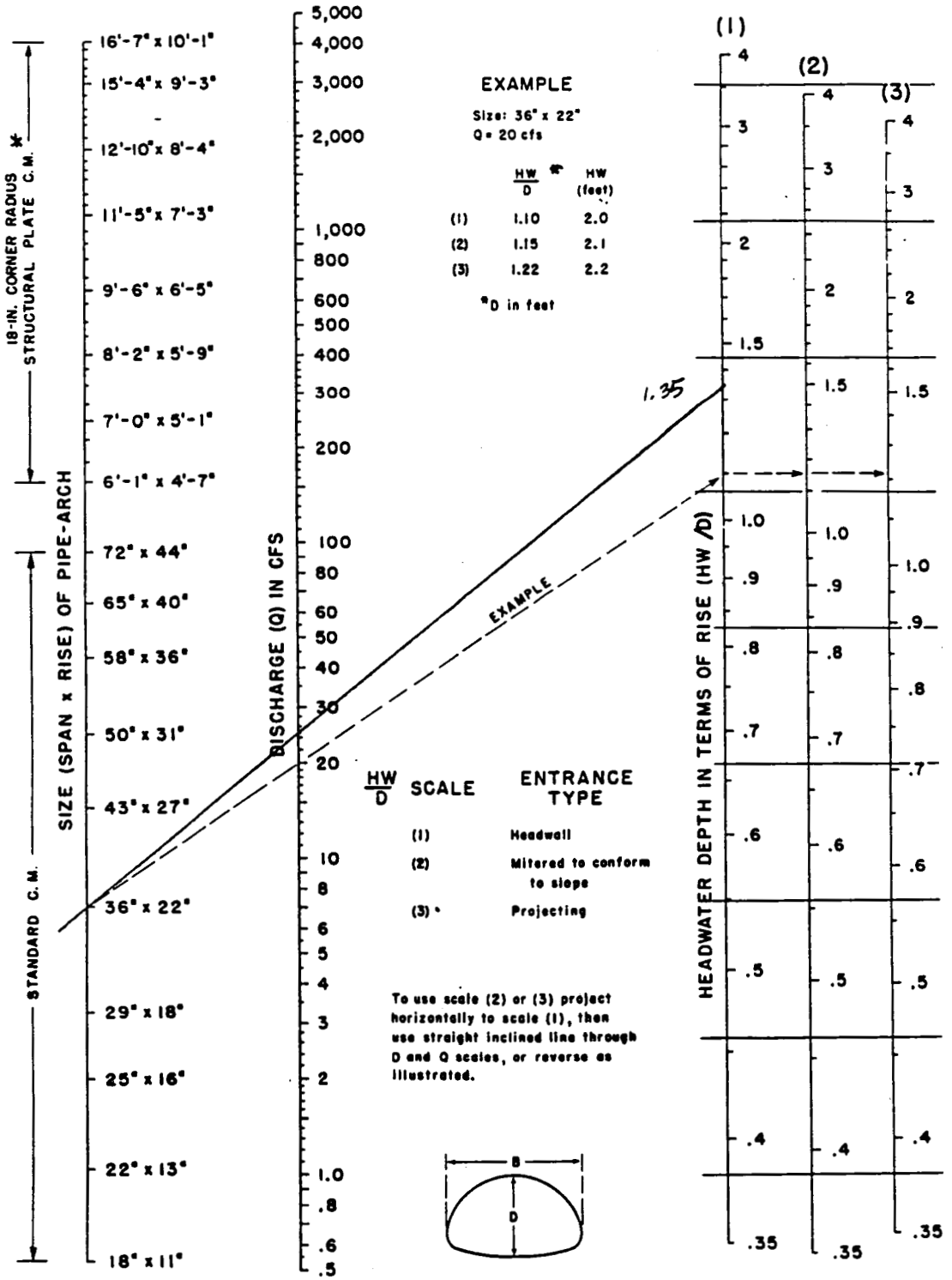
$\therefore V = Q/A = 23.5/4.4 = 5.3$ fps

c) $Q = 25$ CFS / barrel $\quad n = 0.024 \quad S = 0.0050$ '/ft

$Q_{full} = 13.1$ CFS < 25 CFS

$\therefore V = Q/A = 25/4.4 = 5.7$ fps

CHART 34

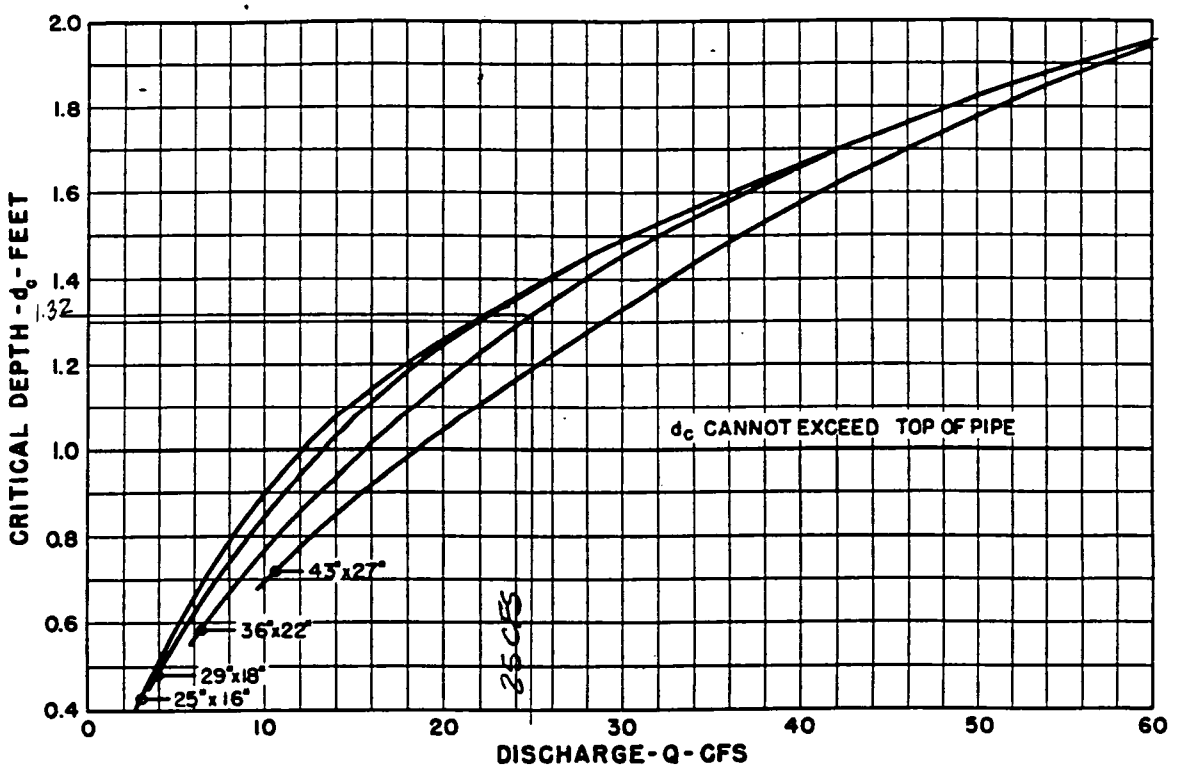


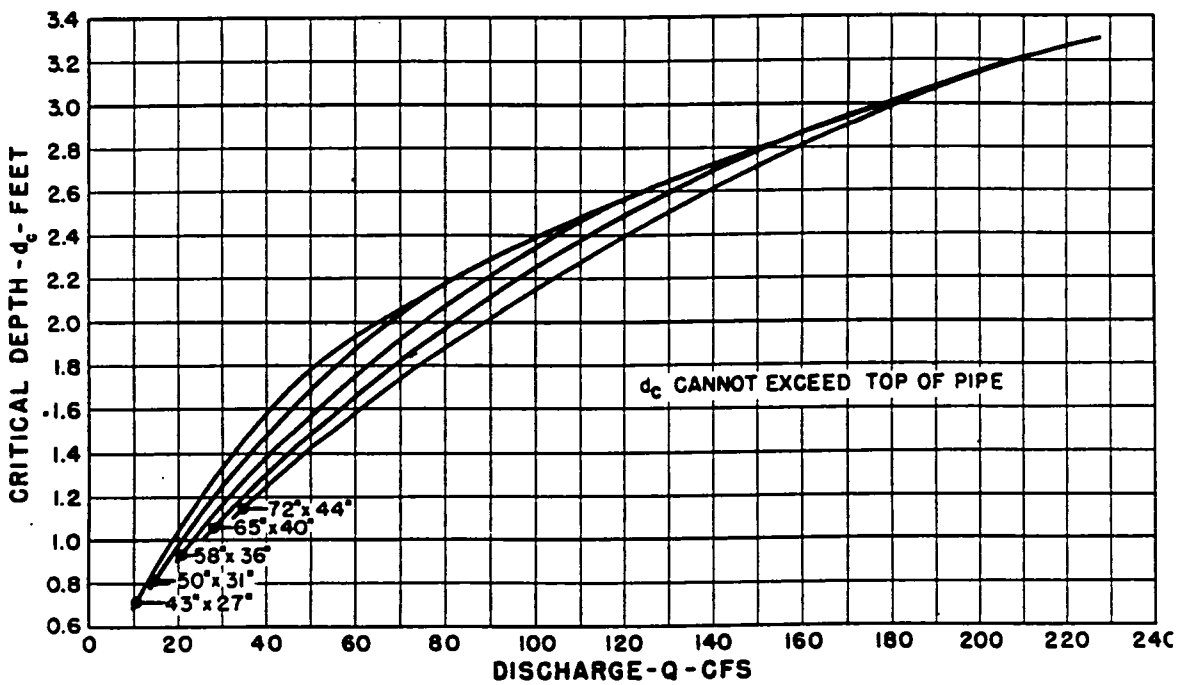
*ADDITIONAL SIZES NOT DIMENSIONED ARE LISTED IN FABRICATOR'S CATALOG

BUREAU OF PUBLIC ROADS JAN. 1963

HEADWATER DEPTH FOR C. M. PIPE-ARCH CULVERTS WITH INLET CONTROL

CHART 37



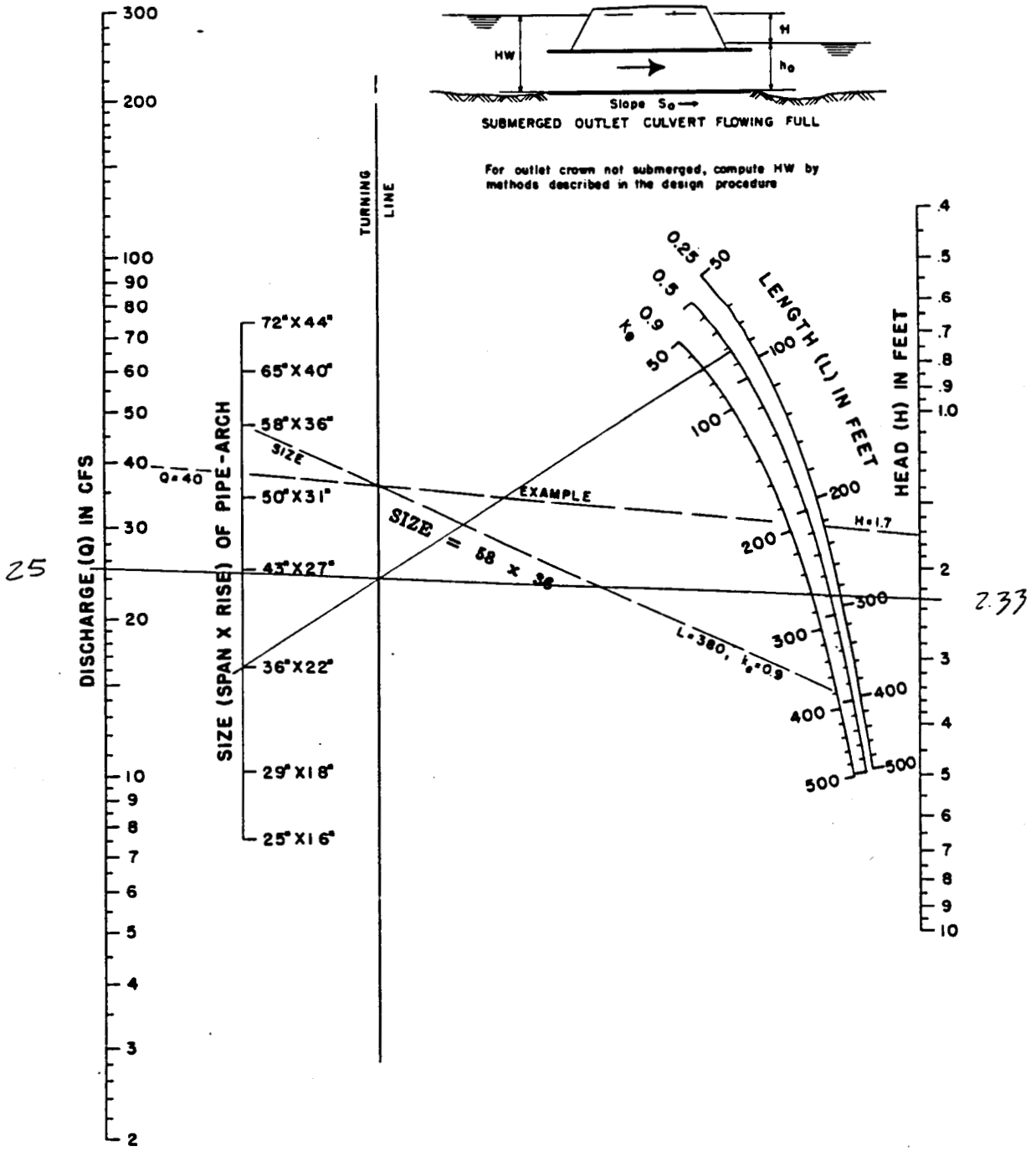


BUREAU OF PUBLIC ROADS

JAN. 1964

CRITICAL DEPTH
STANDARD C.M. PIPE-ARCH

CHART 39



HEAD FOR
STANDARD C. M. PIPE-ARCH CULVERTS
FLOWING FULL
n=0.024

BUREAU OF PUBLIC ROADS JAN. 1963

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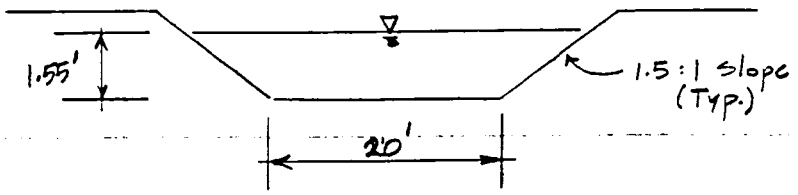
	Checked by	Date	Sheet No.
	For		

Capacity of Downstream Channel in Mountain View Estates

(a) Exist. 6- 36"×22" CMPA discharge into :



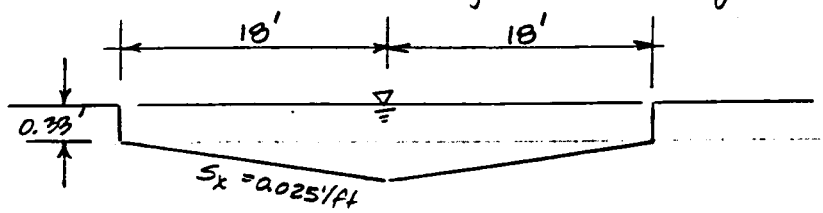
$n = 0.025$
$S = 0.0050$ '/ft

$A = (1.55)(2.33) + (1.55)(20) = 34.6 \text{ ft}^2$
$P = 2(2.79) + 20 = 25.6 \text{ ft}$

$$Q = \frac{1.486}{0.025}(34.6)\left(\frac{34.6}{25.6}\right)^{2/3}(0.0050)^{1/2}$$

$$= \underline{\underline{178 \text{ CFS}}}$$

(b) The above channel discharges onto Turquoise Ave.



$n = 0.015$
$S = 0.012$ '/ft

$A = (0.33)(36) + (0.025)(18)(18) = 20.0 \text{ ft}^2$
$P = 2(18) + 2(0.33) = 36.7 \text{ ft}$

$$Q = \frac{1.486}{0.015}(20.0)\left(\frac{20.0}{36.7}\right)^{2/3}(0.012)^{1/2}$$

$$= \underline{\underline{145 \text{ CFS}}}$$

APPENDIX E

DRAINAGE AREA NO. 4
PEAK DISCHARGE & RETENTION CALCULATIONS

KAMINSKI HUBBARD engineering inc. • Surveying • Civil • Hydrology	Made by D.L.B.	Date 8-14-90	Job No. 0118
	Checked by	Date	Sheet No.
	For		

SUBAREA NO. 451-1 HYDROLOGY

(1) Offsite Runoff
Drainage Area = $(6.40/2)(200^2) = 128{,}000\ ft^2 = 2.94$ Ac.
$C = 0.60$

(2) Tatum Blvd. R.O.W.
Drainage Area = $(702)(55) = 38{,}610\ ft^2 = 0.886$ Ac.
$C = 0.95$

(3) Time of Conc., t_c
$L_1 = 300'$ (Between Paved & Bare Soil), $S_1 = 0.017$ ft/ft $\therefore \Delta t_1 = 8.7$ min. (p. 21)
$L_2 = 702'$, Assume $Q = 3$ CFS, $S_2 = 0.0040$ ft/ft $\rightarrow V = 2.1$ fps (p. 26)
$\therefore \Delta t_1 = 702/60 \times 2.1 = 5.6$ min.

Total $t_c = 8.7 + 5.6 = 14.3$ min.

Description	2Yr	10Yr	25Yr	50Yr	100Yr
I, in/hr	2.1	3.3	3.9	4.4	4.9
Q, CFS	5.47	8.60	10.16	11.46	12.77

$\Sigma CA = 2.61$

SUBAREA NO. 451-2 HYDROLOGY

Total Drainage Area $= (43.48/2)(200)^2 = 869{,}600\ ft^2 = 19.96$ Ac.
$C = 0.60$ * Assume 60% contributes; D.A. $= 0.60 \times 19.96 = 11.98$ Ac.

Time of Conc., t_c
$L_1 = 170'$, $S_1 = 0.020$ ft/ft $\therefore \Delta t_1 = 9.2$ min (p. 21)
$L_2 = 2380'$, Assume $Q = 3$ CFS, $S_2 = 0.011$ ft/ft $\rightarrow V = 3.0$ fps (p. 26)
$\therefore \Delta t_2 = 13.2$ min.
$L_3 = 320'$, $V = 3.0$ fps $\rightarrow \Delta t_3 = 320/60 \times 3.0 = 1.8$ min.

Total $t_c = 9.2 + 13.2 + 1.8 = 24.2$ min.

Description	2Yr	10Yr	25Yr	50Yr	100Yr
I, in/hr	1.55	2.55	3.0	3.4	3.8
Q, CFS	11.14	18.33	21.56	24.44	27.31

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	Checked by	Date	Sheet No.
	For		

SUBAREA NO. 451-3 HYDROLOGY

Flow Split at 44th St. & Gold Dust Ave.
Based on field observation, 85% flows east along Gold Dust Ave and 15% north along 44th St. Therefore, assume 85% of drainage area west of 44th St. contributes to Tatum Blvd.

$$\text{Drainage Area} = 0.85\left(\frac{25.10}{2}\right)(200^2) + \left(\frac{16.68}{2}\right)(200^2)$$
$$= 760{,}300 \text{ SF} = 17.45 \text{ Ac.}$$

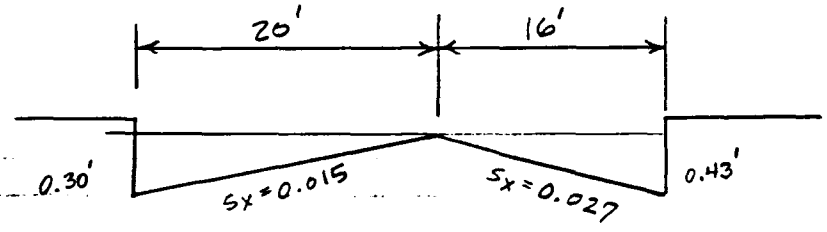
$C = 0.60$

Time of Conc., t_c Assume D.A. west of 44th St. has a $t_c = 12$ min.

For Gold Dust Ave., $Q = 10$ CFS, $S = 0.012$ ft/ft
From p. 26, $V = 4.5$ fps $\rightarrow \therefore t_c = 2520/60 \times 4.5 = 9.3$ min.

Total $t_c = 12.0 + 9.3 = 21.3$ min.

Description	2 Yr	10 Yr	25 Yr	50 Yr	100 Yr
I, in/hr	1.70	2.75	3.25	3.60	4.10
Q, CFS	17.80	28.80	34.04	37.70	42.94



½ street Capacity - Left $A = 3.0 \text{ ft}^2$ $P = 20.3$ ft $S = 0.0124$ ft/ft
$Q = 0.56(4444.4)(0.0124)^{1/2}(0.30)^{8/3} = 11.18$ CFS

½ street Capacity - Right $A = 3.456 \text{ ft}^2$ $P = 16.43$ ft $S = 0.0124$ ft/ft
$Q = 0.56(2469.14)(0.0124)^{1/2}(0.43)^{8/3} = 16.22$ CFS

For 2-Year storm, water will overflow from Left to Right.

$\therefore$ Overflow $Q = 17.80 - 11.18 = 6.62$ CFS < 16.22 CFS

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	Checked by	Date	Sheet No.
	For		

SUBAREA NO. 451-4

Drainage Area along Gold Dust Ave. = (2520)(25) = 63,000 S.F. = 1.446 Ac.
C = 0.95

Time of Conc., t_c — For Q = 3 CFS, s = 0.012 '/ft.
V = 3.1 fps
t_c = 2520/60 × 3.1 = 13.5 min

Description	2Yr	10Yr	25Yr	50Yr	100Yr
I, in/hr	2.1	3.4	3.9	4.4	5.0
Q, CFS	2.89	4.67	5.36	6.05	6.87

Half Street Capacity

* For 2Yr storm, Q = 6.62 + 2.89 = 9.51 CFS < 16.22 CFS OK
where Q overflow from left side of Gold Dust Ave = 6.62 CFS

SUBAREA NO. 451-5 Deleted

Drainage Area (Tatum R.O.W.) = (121)(55) + (12)(25) = 6955 ft² = 0.160 Ac.
C = 0.95

Drainage Area (Lot) = (100)(85) = 8500 ft² = 0.195 Ac.
C = 0.80

Time of Conc., t_c = 10 min. Q = ΣCAI = 0.3078 I

Description	2Yr	10Yr	25Yr	50Yr	100Yr
I, in/hr	2.4	3.8	4.5	5.0	5.5
Q, CFS	0.74	1.17	1.39	1.54	1.69

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	Checked by	Date	Sheet No.
	For		

DRAINAGE CALCULATIONS FOR SUBBASIN NO. 452

Total Area $= \left(\frac{14.58 + 14.69}{2}\right)(200^2) \div 43560 = 13.44$ Ac.

Zoning:- RE-43 $C = 0.60$

Assume 90% Contributes $\rightarrow$ D.A. $= 0.90 \times 13.44 = 12.10$ Ac.

$t_c = 16.5$ min.

$Q = CIA = (0.60)(12.10)\,I = 7.26\,I$

Description	2-YR.	10-YR.	25 YR.	50 YR.	100 YR.
Intensity, in/hr	1.9	3.1	3.6	4.1	4.6
Q, CFS	13.8	22.5	26.1	29.8	33.4

(2) Retention Basin Storage

Surface Area $= 28{,}150\ ft^2 = 0.64624$ Ac.

Avg. Depth $= 3$ ft.

$\therefore$ Volume $= 84{,}450\ ft^3$

From Collar, Williams & White Grading Plan:

Vol. $= 87{,}100\ ft^3$

(3) Retention Basin Storage vs. Peak Storage (2-hr. Duration) Using City of Phoenix Method

Required Capacity $= 7200\ Q\ (ft^3)$

Description	2 YR.	10 YR.	25 YR.	50 YR.	100 YR.
Intensity, in/hr	0.48	0.80	0.96	1.10	1.25
Q, CFS	5.8	9.6	11.5	13.2	15.0
Volume, ft^3	41,570	69,284	83,141	95,266	108,257

Worksheet 3: Time of concentration (T_c) or travel time (T_t)

Project Tatum Blvd. By D.L.B. Date 3-16-90

Location Mockingbird Lane to Shea Blvd. Checked ____ Date ____

Circle one: Present Developed

Circle one: (T_c) T_t through subarea Subbasin # 452

NOTES: Space for as many as two segments per flow type can be used for each worksheet.

Include a map, schematic, or description of flow segments.

Sheet flow (Applicable to T_c only)		Segment ID	A452-B452		
1. Surface description (table 3-1)			Fallow		
2. Manning's roughness coeff., n (table 3-1) ..			0.05		
3. Flow length, L (total L ≤ 300 ft)	ft		110		
4. Two-yr 24-hr rainfall, P_2	in		1.4		
5. Land slope, s	ft/ft		0.017		
6. $T_t = \frac{0.007\ (nL)^{0.8}}{P_2^{0.5}\ s^{0.4}}$ Compute T_t	hr		0.118	+	= 0.118

Shallow concentrated flow		Segment ID	B452-C452		
7. Surface description (paved or unpaved)			Paved		
8. Flow length, L ..... 3.6 x 200	ft		720		
9. Watercourse slope, s	ft/ft		0.012		
10. Average velocity, V (figure 3-1)	ft/s		1.8		
11. $T_t = \frac{L}{3600\ V}$ Compute T_t	hr		0.111	+	= 0.111

Channel flow		Segment ID	C452-D452		
12. Cross sectional flow area, a	ft^2				
13. Wetted perimeter, p_w	ft				
14. Hydraulic radius, $r = \frac{a}{p_w}$ Compute r	ft				
15. Channel slope, s	ft/ft		0.010		
16. Manning's roughness coeff., n					
17. $V = \frac{1.49\ r^{2/3}\ s^{1/2}}{n}$ Compute V	ft/s		3.0		
18. Flow length, L ..... 2.5 x 200	ft		500		
19. $T_t = \frac{L}{3600\ V}$ Compute T_t	hr		0.046	+	= 0.046

20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19) ..... hr 0.275

= 16.5 min.

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	Checked by	Date	Sheet No.
	For		

DRAINAGE CALCULATIONS FOR SUBBASIN NO. 453

(1) Zoning: 100% RE-43
Drainage Area, A = 7.21 Ac.
'C' Coefficient = 0.45
Time of Conc., t_c = 10 min

Rational Eq.: $Q = CIA$

Description	2 YR.	10 YR.	25 YR.	50 YR.	100 YR
Intensity, in/hr	2.4	3.8	4.5	5.0	5.5
Q, CFS	7.8	12.3	14.6	16.2	17.8

(2) Retention Basin Storage

Surface Area = 30,750 ft^2 = 0.70592 Ac.
Avg. Depth = 3 ft

∴ Volume = (30,750)(3) = 92,250 ft^3

From Collar, Williams & White Grading Plan:
Vol. = 34,340 ft^3

(3) Retention Basin Storage vs. Peak Discharge (2hr. Duration) Using City of Phoenix Method

Required Capacity = 7200 Q (ft^3)

Description	2 YR.	10 YR.	25 YR.	50 YR	100 YR
Intensity, in/hr	0.48	0.80	0.96	1.10	1.25
Q, CFS	1.6	2.6	3.1	3.6	4.1
Volume (ft^3)	11,213	18,688	22,426	25,696	29,201

TATUM BOULEVARD
CAIDA DEL SOL TO SHEA BOULEVARD

1) **Drainage Area No. 1**

Sub-Basin Nos. 100 to 104, 200, 201, 300 to 302 and 501 to 503

HEC-1 Filename	Description
118-10.DAT	100-year 24-hour duration storm
118-11.DAT	50-year 24-hour duration storm
118-12.DAT	25-year 24-hour duration storm
118-13.DAT	10-year 24-hour duration storm
118-14.DAT	2-year 24-hour duration storm
118-15.DAT	100-year 6-hour duration storm
118-16.DAT	50-year 6-hour duration storm
118-17.DAT	25-year 6-hour duration storm
118-18.DAT	10-year 6-hour duration storm
118-19.DAT	2-year 6-hour duration storm

2) **Drainage Area No. 2**

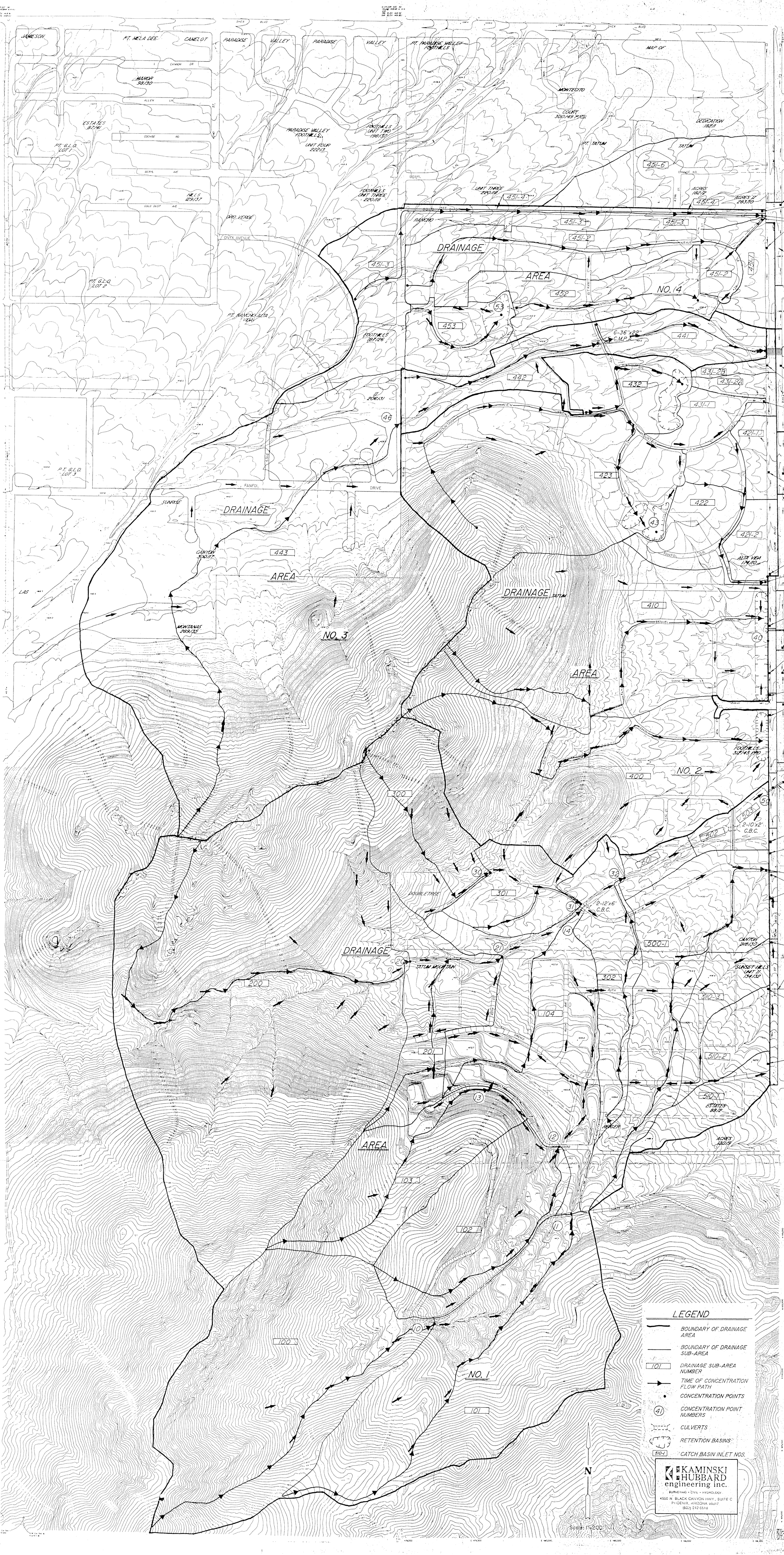
Sub-Basin Nos. 400 and 410

HEC-1 Filename	Description
118-20.DAT	100-year 24-hour duration storm
118-21.DAT	50-year 24-hour duration storm
118-22.DAT	25-year 24-hour duration storm
118-23.DAT	10-year 24-hour duration storm
118-24.DAT	2-year 24-hour duration storm
118-25.DAT	100-year 6-hour duration storm
118-26.DAT	50-year 6-hour duration storm
118-27.DAT	25-year 6-hour duration storm
118-28.DAT	10-year 6-hour duration storm
118-29.DAT	2-year 6-hour duration storm

(3) Drainage Area No. 3

Sub-Basin Nos. 441, 442 and 443

HEC-1 Filename	Description
118-30.DAT	100-year 24-hour duration storm
118-31.DAT	50-year 24-hour duration storm
118-32.DAT	25-year 24-hour duration storm
118-33.DAT	10-year 24-hour duration storm
118-34.DAT	2-year 24-hour duration storm
118-35.DAT	100-year 6-hour duration storm
118-36.DAT	50-year 6-hour duration storm
118-37.DAT	25-year 6-hour duration storm
118-38.DAT	10-year 6-hour duration storm
118-39.DAT	2-year 6-hour duration storm


DRAINAGE
AREA
NO. 1
NO. 2
NO. 3
NO. 4
LEGEND
BOUNDARY OF DRAINAGE AREA
BOUNDARY OF DRAINAGE SUB-AREA
101
DRAINAGE SUB-AREA NUMBER
TIME OF CONCENTRATION FLOW PATH
CONCENTRATION POINTS
41
CONCENTRATION POINT NUMBERS
CULVERTS
RETENTION BASINS
301-1
CATCH BASIN INLET NOS.
N
Scale: 1"=200'
KAMINSKI HUBBARD engineering inc.
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4550 N. BLACK CANYON HWY., SUITE C
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(602) 242-5515