

**RECONSTITUTION OF 1979
FLOOD PEAKS,
NORTH CLEAR CREEK,
GREGORY GULCH, AND
CHASE GULCH**

PREPARED FOR:

**COLORADO WATER CONSERVATION BOARD
1313 Sherman Street, Room 721
Denver, Colorado 80203**

PREPARED BY:

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April 26, 2001

Job No. 0107A

Love & Associates, Inc.

April 26, 2001

Mr. Mark Matulik, P.E.
Colorado Water Conservation Board
1313 Sherman Street, Room 721
Denver, Colorado 80203

**REF: 0107A: North Clear Creek, Gregory Gulch, and Chase Gulch Flood Peaks
Final Report Document**

Dear Mark:

Enclosed, please find five (5) copies of the final report *Reconstitution of 1979 Flood Peaks, North Clear Creek, Gregory Gulch, and Chase Gulch*, for your use. We were able to calibrate the TR20 model to the 1979 flood peaks using slight and reasonable adjustments in Curve Numbers. We found we had to use a "Type IA" 24-hour storm distribution for North Clear Creek and a 24-hour "Type II" storm distribution for Gregory and Chase Gulch to produce reasonable calibration results. We also analyzed the impact of Dorothy Lee and Chase Gulch Water Supply Reservoirs on flood peaks.

It has been a pleasure to work with you and Larry on this project. Please contact us if you have any questions. Thank you.

Sincerely,

LOVE & ASSOCIATES, INC.



By

Roger J. Peterson
Roger J. Peterson, P.E.
Project Engineer

By

David J. Love
David J. Love, P.E.
Principal

Attachment: Larry Lang, P.E.

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RECONSTITUTION OF 1979 FLOOD PEAKS, NORTH CLEAR CREEK, GREGORY GULCH, AND CHASE GULCH

INTRODUCTION

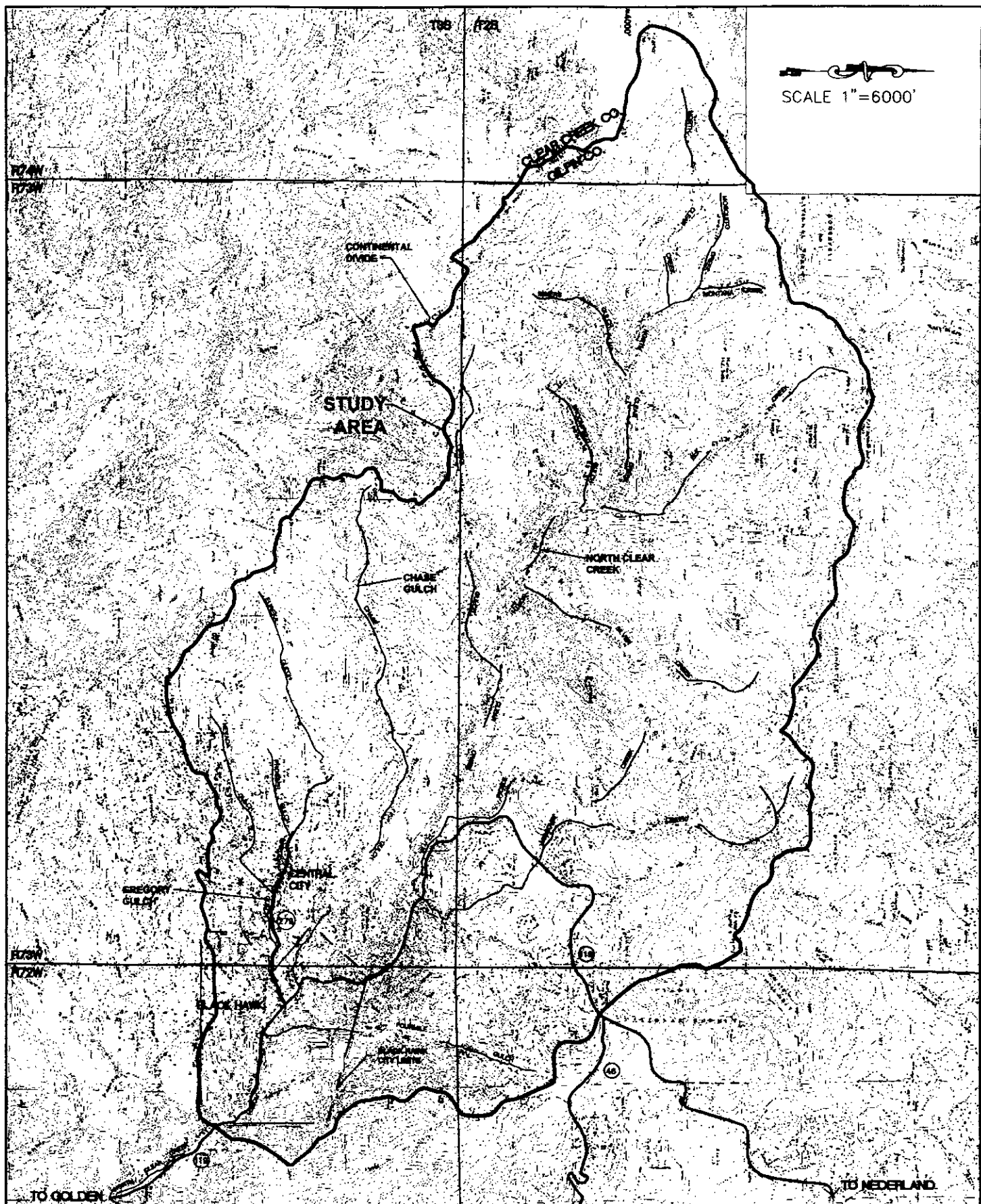
The Colorado Water Conservation Board (CWCB) contracted with Love & Associates, Inc., to reconstitute the hydrologic analysis performed by the CWCB in 1979 for North Clear Creek, Gregory Gulch, and Chase Gulch for the City of Black Hawk, Colorado (City), using a computer model. The study tasks include;

1. Obtain information on soils, hydrologic parameters, and land use for the North Clear Creek, Gregory Gulch, and Chase Gulch watersheds;
2. Delineate sub-watersheds and probable flow paths using topographic maps provided by CWCB;
3. Calculate flood hydrology for the 10, 50, and 100-year storms for North Clear Creek, Gregory Gulch, and Chase Gulch using TR-20 with SCS Type II precipitation distribution and 1980 land use at approximately 10 design points within the study area;
4. Calibrate the TR-20 model to 1980 flood peak predictions for North Clear Creek, Gregory Gulch, and Chase Gulch using the curve number and, if necessary, rainfall distribution,
5. Define flood hydrology for the 500-year storm event using graphically-based probability analysis or other methods as approved by the CWCB;
6. Prepare a final report, and;
7. Coordinate with CWCB and perform a field review of the watershed.

STUDY AREA

The study area is located within a portion of the North Clear Creek watershed, part of the Clear Creek and South Platte River watersheds, in part of Townships 2 and 3 South and Ranges 71 and 72 West. Please refer to Location Map, Figure 1. The study area extends from the Continental Divide to the lower boundary of the City of Black Hawk, Colorado. The project area is located east of the Continental Divide, and is characterized by narrow valleys bordered by steep slopes ranging from approximately 20 to 60 per cent. Elevation within the study area ranges from approximately 7,500 to over 12,000 feet msl. The steep upslope areas are covered with a variety of rock outcroppings, thin residual soils on bedrock, and thicker debris, alluvium, and slope wash deposits and are vegetated with grasses, trees, and shrubs. Deeper soils and wetland vegetation are found on alluvial deposits adjacent to streams. The study area has been subject to underground and surface mining and residential and commercial developments. Roads, buildings, and mining-related features such as mine shaft openings and tailings have sometimes altered historic stormwater flow paths and runoff characteristics within the study area.

The City of Black Hawk (City) is located within Gilpin County, Colorado. North Clear Creek, Gregory Gulch, and Chase Gulch flow through the City. North Clear Creek flows eastwardly through the City adjacent to State Highway 119, eventually joining Clear



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FIGURE 1 — VICINITY MAP

APRIL 20, 2001

Creek near the intersection of State Highway 119 and U.S. Highway 6. Gregory Gulch flows from the City of Central into the City of Black Hawk on State Highway 279, passing through part of Black Hawk's business district. Chase Gulch flows through the City along Chase Street, passing through a residential area. Gregory and Chase Gulches join North Clear Creek above State Highway 119 within the Black Hawk city limits.

The North Clear Creek drainage catchment is approximately 34.9 square miles in area at the lower City boundary. Gregory and Chase Gulches are approximately 3.5 and 4.2 square miles, respectively, at their confluence with North Clear Creek. The three streams are capable of transporting large volumes of water and debris at dangerously high velocities and occasionally cause widespread damage.

BACKGROUND

North Clear Creek, Gregory Gulch, and Chase Gulch flood peaks were analyzed in 1979 by the CWCB using graphical methods. The original data used for this analysis is no longer available. However, graphical development of the triangular hydrographs used for the 1979 analysis exist (Owens Ayers, 1980). Examining these data, it appears the 1979 analysis of North Clear Creek used a 24-hour storm distribution with an SCS "Type IA" distribution with a Curve Number of 79. The analysis of Gregory Gulch and Chase Gulch used a 6-hour storm with an SCS "Type IIA" distribution. The Gregory Gulch analysis used a Curve Number of between 81 and 85, and Chase Gulch analysis used a Curve Number between 78 to 83. Curve numbers were estimated using the graphical analysis, and a discussion of the methods used are presented in the Appendix.

The 100-year flood peak estimate for North Clear Creek from the 1979 analysis is 2,050 cfs and 2,670 cfs at the upstream and downstream Black Hawk city limits, respectively. The analysis indicated the 100-year flood peak estimate for Gregory and Chase Gulch at their confluence with North Clear Creek equals 1,240 and 1,160 cfs, respectively.

Subsequent to the 1979 analysis, two reservoirs were constructed on Chase Gulch and Gregory Gulch which could attenuate the magnitude of flood peaks in these streams as well as North Clear Creek. A water supply reservoir was constructed on Chase Gulch by Central City in 1996 and provides inadvertent flood storage above the spillway. A small detention facility, Dorothy Lee Reservoir, was constructed in 1991 above Central City for flood protection.

The impact of the Dorothy Lee Reservoir on flood peaks was examined using an HEC-1 hydrologic model developed for the City of Central (RMC, 1991). This model was subsequently extended through Black Hawk to North Clear Creek for a CDOT project (J.F. Sato, 1996). The two studies used a 24-hour storm and an SCS "Type IIA" distribution with an average Curve Number of 69. The 1996 study by Sato indicated the Dorothy Lee Reservoir reduced flood peaks in Gregory Gulch by approximately 200 cfs at its confluence with North Clear Creek.

A number of additional curve-number based hydrologic methods have been used for flood peak estimates within the study area. J.F. Sato (1996) reports an HEC-1 analysis done for North Clear Creek by Futura Engineering which used a Curve Number of 55. An HEC-1 analysis of Running Gulch, a small tributary to North Clear Creek within the City of Black Hawk, used an average Curve Number of 75 (Taggart Engineering, 1995). An HEC-1 analysis of Fourmile and Silver Gulches used Curve Numbers between 73 and 76 (Carroll & Lange, 2000).

HYDROLOGIC ANALYSIS

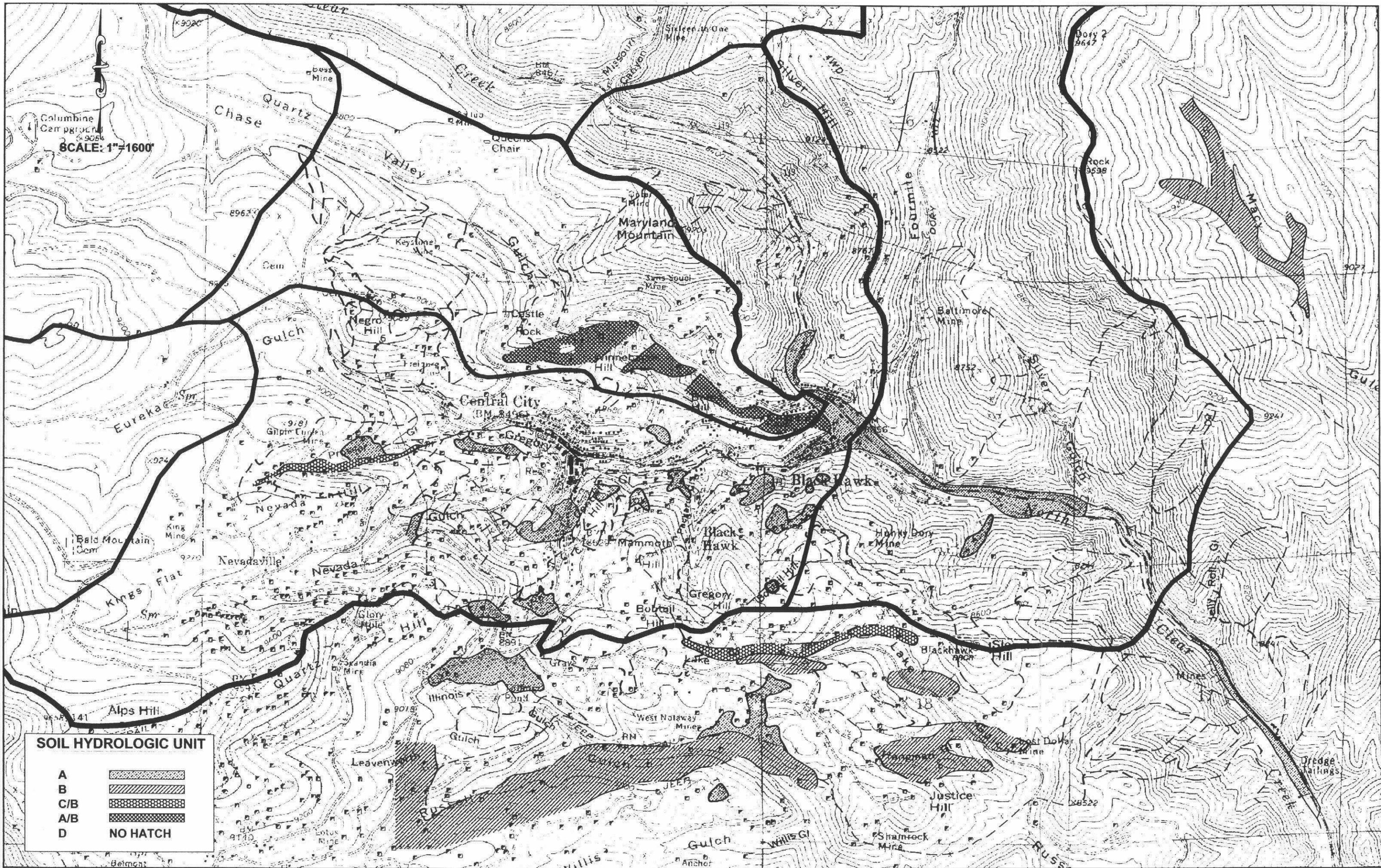
The reconstituted hydrologic analysis of North Clear Creek, Gregory Gulch, and Chase Gulch uses the TR20 hydrologic model, Version 2.04, developed by the SCS (SCS, 1992). The model uses information on precipitation, soils, land use, geometric parameters of the watershed, and hydraulic structures to estimate flood hydrographs and flood peak discharges.

Point precipitation estimates for the 24-hour storm were obtained from the NOAA Atlas 2 (Miller et al., 1977). Point precipitation values were obtained using the May through October maps, which represent non-snowfall events. Point precipitation values for the 24-hour 100-, 50-, and 10-year storms are 3.3, 3.0, and 2.2 inches, respectively. Precipitation distribution used standard distributions available internally within the TR20 model. The precipitation distribution was selected using trial runs with the preliminary model. "Best fits" to the 1979 flood peaks were found using the SCS 24-hour "Type IA" distribution for North Clear Creek and the SCS 24-hour "Type II" distribution for Gregory and Chase Gulches. These distributions are presented in the Appendix to this report.

Soils have only been mapped in the vicinity of the City in the study area. The soils map in this area is presented on Figure 2. The map indicates the majority of the soils in the mapped area are Hydrologic Soil Group "D". It was assumed for this study all soils in the study area are Hydrologic Soil Group "D".

Land use in the study area is defined using land use information from 1979. A USGS topographic map and aerial photography used for the 1979 analysis were obtained from the CWCB. The map delineated areas of high and low density forest based on the density of shading on the aerial photographs. This shading density on the aerial photographs closely matched the shading density on the USGS map. Land use was subdivided into high density forest, low density forest, meadow, high density residential, low density residential, and commercial. This information was compiled and is shown on Figure 3.

The study area was divided into catchments shown on Figure 4. Catchments were numbered following requirements in TR20. Design points are defined at various points in the study area. Design points were placed at major confluences and at detention storage areas. Time of concentrations were determined for each catchment for overland, shallow, and channelized flows, following methods described in TR-55 (SCS, 1986). Channel flow velocities represent sub-critical to critical conditions following



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SOIL HYDROLOGIC GROUPS

FIGURE 2

LEGEND

CATCHMENT I.D.



CATCHMENT BOUNDARY



OUTFALL FLOW PATH



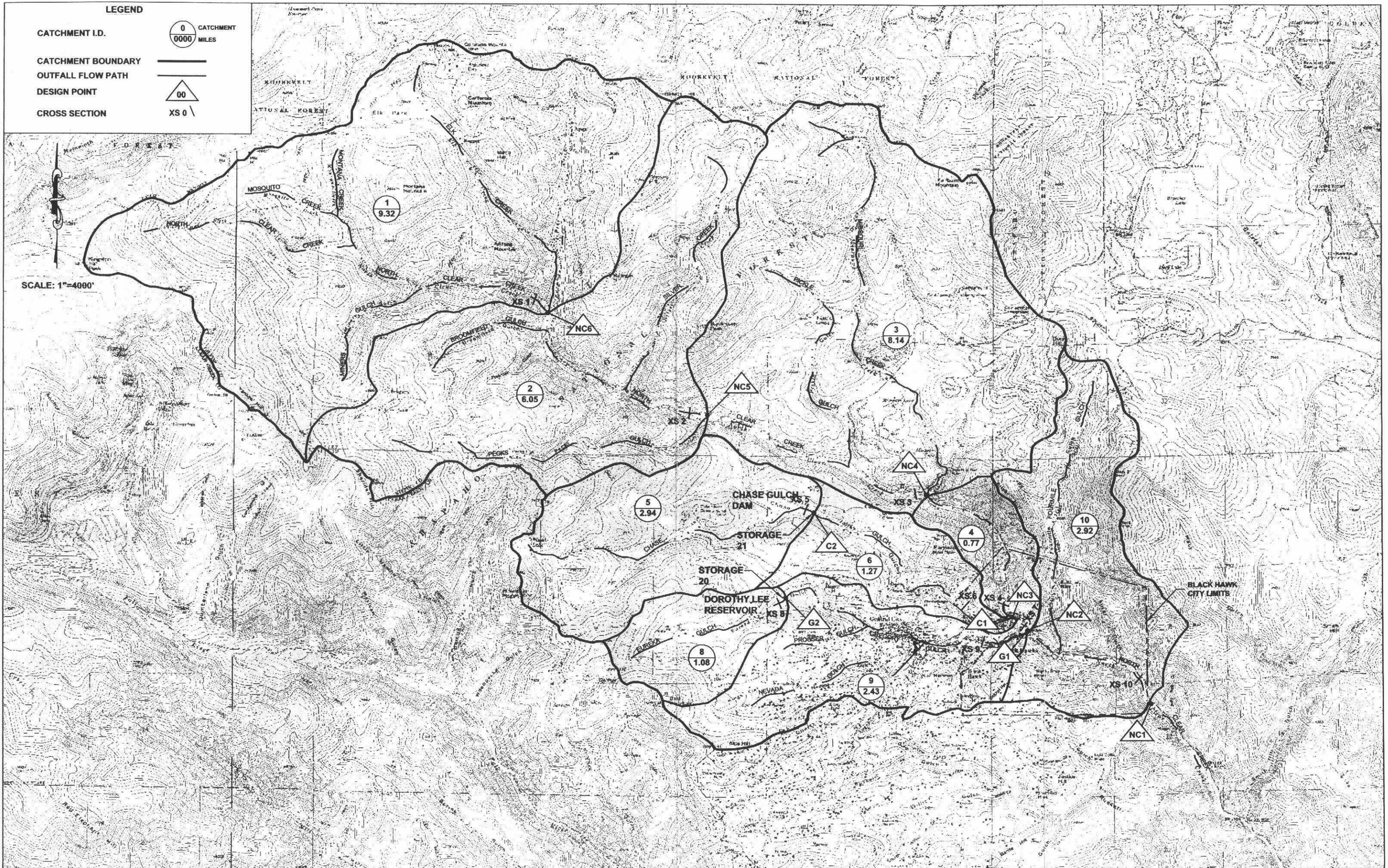
DESIGN POINT



CROSS SECTION



SCALE: 1"=4000'



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CATCHMENT AREAS

FIGURE 4

LEGEND

CATCHMENT I.D.



CATCHMENT BOUNDARY



OUTFALL FLOW PATH



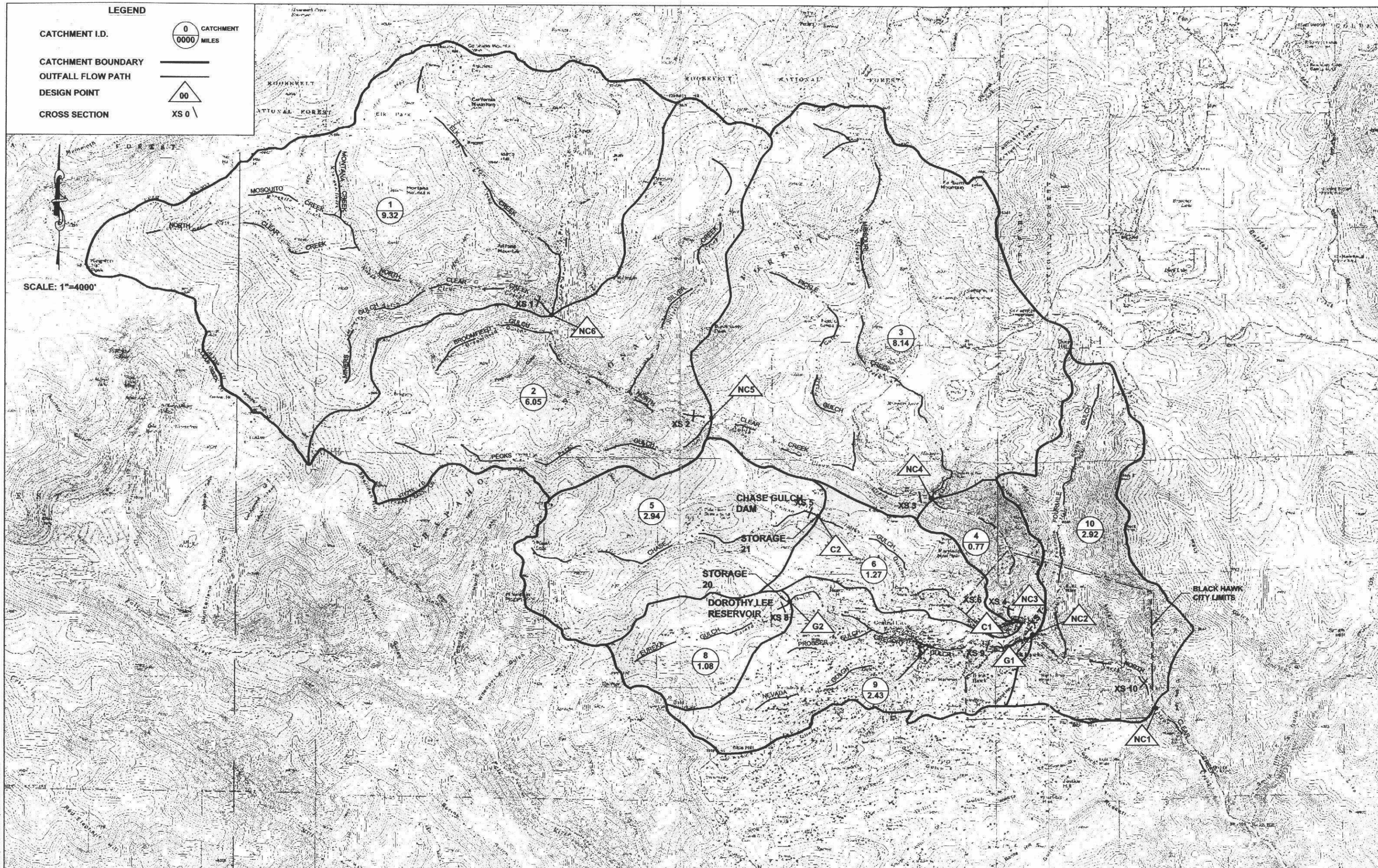
DESIGN POINT



CROSS SECTION



SCALE: 1"=4000'



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CATCHMENT AREAS

FIGURE 4

recommendations based on studies of mountain streams in Colorado (Jarrett, 1985). Channel velocities were determined using an HEC-2 subcritical analysis of surveyed cross sections or estimated using SCS velocity curves (SCS, 1986).

Curve Numbers were obtained following recommendations for Hydrologic Soil Group "D" soils (SCS, 1986). Using this information, the per cent of land use in each category in each catchment was determined using Figure 3, and average curve numbers were calculated for each catchment. An average ARC (AMC) of II was assumed. Please refer to Table 1. Time of concentration calculations are shown in the Appendix. Time of concentrations for each catchment are summarized in Table 2.

Table 1. Preliminary Curve Number Calculations, Catchments 1-10, 1979 Land Use.

Land Use	CN	1	2	3	4	5	6	8	9	10
Area (ac)		5962	3875	5208	490	1884	810	691	1552	1870
Area (sq.mi.)		9.32	6.05	8.14	0.77	2.94	1.27	1.08	2.43	2.92
High Density Forest - D soil	79	65%	49%	64%	50%	65%	12%	48%	37%	69%
High Density Forest - A soil (calibration)	36	0%	0%	0%	0%	0%	0%	0%	0%	0%
Low Density Forest - D soil	83	19%	31%	21%	25%	15%	45%	21%	4%	0%
Meadow	75	16%	20%	10%	21%	20%	40%	31%	50%	23%
Low Density Residential	84	0%	0%	5%	0%	0%	0%	0%	0%	7%
Med. Density Residential	90	0%	0%	0%	3%	0%	2%	0%	3%	0%
Commercial	95	0%	0%	0%	1%	0%	1%	0%	6%	1%
Average CN		79	79	80	80	79	80	79	78	79

Note: See Figure 3 for land use and Figure 4 for Catchment locations.

Table 2. Summary of Time of Concentrations, Catchments 1-10.

Catchment	Tc (hr)	Comment
1	0.85	NC6
2	1.23	Silver Crk. + 45% NC5 to NC6
3	1.82	Missouri G.
4	1.01	NCC Catchment 4 + NC3-NC4
5	0.85	Chase U/S
6	1.26	Chase D/S + 80% C1-C2
7	N/A	
8	0.60	Gregory U/S
9	1.30	Gregory D/S (Prosser G.) + 65% G1-G2
10	1.24	Fourmile + 80% NC1-NC2

Note: See Figure 4 for Catchment identification and design point locations.

CALIBRATION

Flood peak discharges were calibrated by making slight adjustments to Curve Numbers. As noted on Figure 2, a small portion of the watershed includes soils of Hydrologic Soils Group A, B, or C. Calibration was affected by substituting "A" soils for "D" soils in the high density forest category. The results of the curve number adjustment are shown in Table 3. Curve numbers were decreased by about 4 points in most catchments. The resulting average curve numbers are within the range used by previous hydrologic analysis in the study area.

Table 3. Curve Number Adjustments for Calibration, Catchments 1-10, 1979 Land Use.

Land Use	CN	1	2	3	4	5	6	8	9	10
Area (ac)		5962	3875	5208	490	1884	810	691	1552	1870
Area (sq.mi.)		9.32	6.05	8.14	0.77	2.94	1.27	1.08	2.43	2.92
High Density Forest - D soil	79	56%	40%	56%	41%	55%	2%	45%	32%	60%
High Density Forest - A soil (calibration)	36	9%	9%	8%	9%	10%	10%	3%	5%	9%
Low Density Forest - D soil	83	19%	31%	21%	25%	15%	45%	21%	4%	0%
Meadow	75	16%	20%	10%	24%	20%	40%	31%	50%	23%
Low Density Residential	84	0%	0%	5%	0%	0%	0%	0%	0%	7%
Med. Density Residential	90	0%	0%	0%	0%	0%	2%	0%	3%	0%
Commercial	95	0%	0%	0%	1%	0%	1%	0%	6%	1%
Average CN		75	75	76	75	74	75	77	76	74

Note: See Figure 4 for Catchment location.

RESULTS

Flood peaks for the 100-year flood obtained from the TR20 hydrologic analysis are compared to the flood peaks in the 1979 study in Table 4. The flood peak from the 1979 study did not include Silver Gulch, and the peak was adjusted using weighted area calculations for mountainous areas recommended by CWCB (McCain et al., 1976). The results on Table 4 indicate this study has successfully reconstituted the 1979 flood peak estimates using 1979 data with the TR20 using only minor adjustments to curve numbers. Program output is found in the Appendix to this report.

Table 4. Comparison of 1979 Flood Peak Estimates to TR20 Model Estimates, 100-Year Event.

Chase and Gregory Gulches

Design Point	100-year peak (cfs)		time to peak (hr)
	1979 est.	2001 Model	
C1	1160	1179	12.87
C2	N/A	1157	12.44
G1	1240	1248	12.68
G2	N/A	619	12.26

North Clear Creek

Design Point	100-year peak (cfs)		time to peak (hr)
	1979 est.	2001 Model	
NC1	2694	2702	9.54
NC2	2528	2524	9.39
NC3	2280	2267	9.42
NC4	N/A	1924	9.25
NC5	N/A	1311	8.89
NC6	N/A	929	8.48

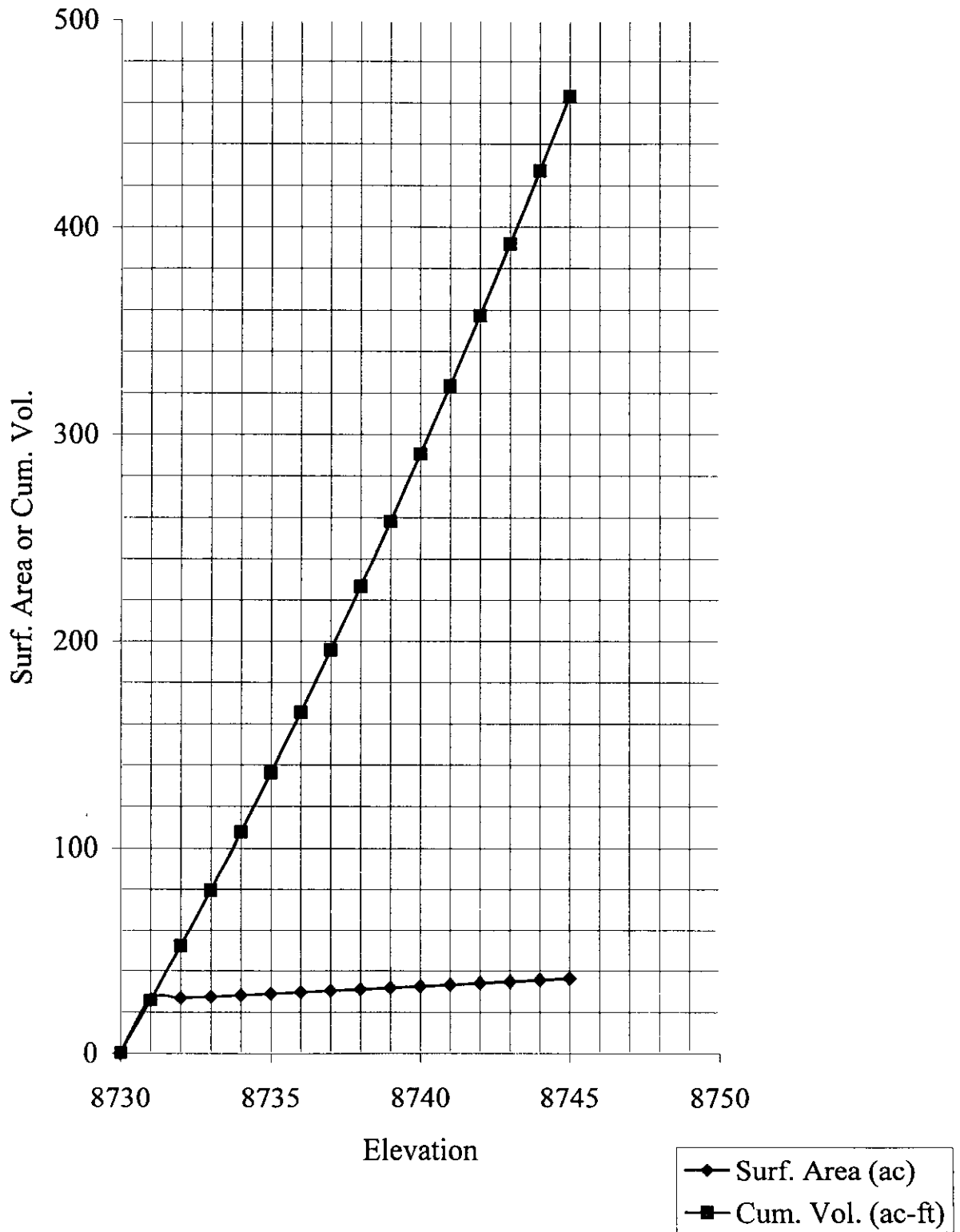
Note: See Figure 4 for design points.

IMPACT OF RESERVOIR STORAGE ON FLOOD PEAKS

The impact of the Chase Gulch and Dorothy Lee Reservoirs on flood peak discharges was identified using the TR20 hydrologic models calibrated to reconstitute 1979 100-year flood peak estimates. Storage/elevation curves (Figures 5 and 6) were developed from design and as-constructed drawings of the two reservoirs (RMC, 1991, and RMC, 1994). The discharge curve for Chase Gulch Reservoir uses the spillway discharge curve developed for the reservoir shown in the Appendix. The discharge curve for Dorothy Lee Reservoir was calculated using the FHWA HY-8 program in the Appendix.

The results of the analysis for the 10-, 50-, and 100-year event are summarized at selected design points on Table 5. The results for the 100-year event are found in the Appendix. The results indicate detention storage above the Chase Gulch water supply reservoir spillway reduces flood peaks significantly at the outlet. At the outlet, design point C1, 100-year discharges are reduced from 1179 cfs to 551 cfs. Dorothy Lee Reservoir has only a minor impact on flood peaks during the 100-year event at the outlet of Gregory Gulch. At the outlet, design point G1, 100-year discharges are reduced from 1248 cfs to 1159 cfs. This reduction is less than predicted by a recent HEC-1 analysis by J.F. Sato (1996), which assumed a slightly lower curve number causing a lower peak discharge than the current study. In addition, the current study defined the storage and discharge relationship of Dorothy Lee Reservoir using design drawings and hydraulic calculations. The 1996 Sato study used simplified hydraulic relationships and did not examine the as-built information when modeling the reservoir. The TR20 model indicates the reservoir overtops during the 100-year event.

**Figure 5. Chase Gulch Water Supply Reservoir
Storage Above Spillway**



**Figure 6. Dorothy Lee Detention Reservoir
Eureka/Gregory Gulch**

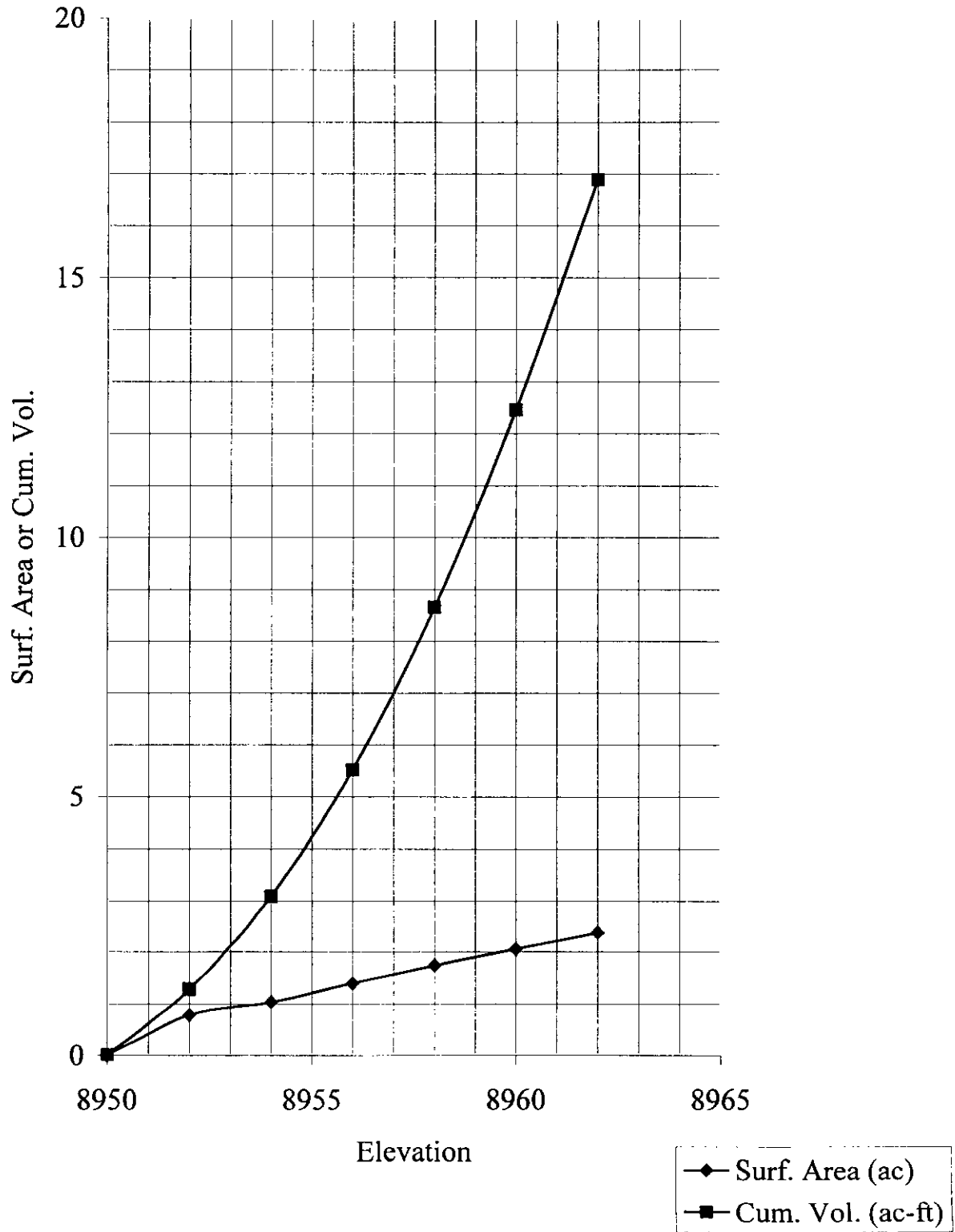


Table 5. Flood Peaks for the 10-, 50-, and 100-Year Events at Selected Design Points Including Storage Effects of Detention Along Chase and Eureka/Gregory Gulches.

Chase and Gregory Gulches

Design Point	100-year		50-year		10-year	
	Peak (cfs)	Time (hr)	Peak (cfs)	Time (hr)	Peak (cfs)	Time (hr)
C1	551	12.97	432	12.97	176	12.92
C2	378	13.31	295	13.37	98	13.93
G1	1159	12.78	859	12.83	291	12.82
G2	551	12.41	441	12.43	120	12.75

North Clear Creek

Design Point	100-year		50-year		10-year	
	Peak (cfs)	Time (hr)	Peak (cfs)	Time (hr)	Peak (cfs)	Time (hr)
NC1	2520	9.58	1931	9.7	717	10.53
NC2	2344	9.44	1797	9.54	666	10.3
NC3	2121	9.46	1631	9.57	599	10.31
NC4	1924	9.25	1482	9.34	539	9.33
NC5	1311	8.89	1001	8.95	350	9.52
NC6	929	8.48	710	8.51	232	8.74

Note: See Figure 4 for design points.

Table 5 indicates the reservoirs slightly reduce flood peaks along North Clear Creek. At design point N1 at the City limits, for example, the reservoirs reduce 100-year flood peaks from 2702 to 2520 cfs.

Table 5 indicates the time of concentration for North Clear Creek is less than the time of concentration for Gregory and Chase Gulch, which is counter-intuitive given the relative size of the watershed areas. The time of concentration difference is partly due to the different precipitation distributions used for the model. The "Type IA" distribution is less peaked and, as a result, causes a later peak than the "Type II" distribution. Flood peak attenuation by Chase Gulch Reservoir also increases the time of concentration for Chase Gulch.

In the 1979 study, the 500-year flood peak for North Clear Creek equals 3800 cfs upstream of Chase Gulch and 4950 cfs at the wastewater treatment facility, and the 500-year flood peak for Gregory Gulch and Chase Gulch equals 1790 cfs and 2100 cfs, respectively, at their confluence with North Clear Creek. These flood peak estimates were identified using frequency analysis. Since the reservoirs are assumed ineffective during the 500-year event, the 500-year flood estimates are not modified by the TR20 model study.

CONCLUSION

Flood peaks developed during 1979 for North Clear Creek, Gregory Gulch, and Chase Gulch for the City of Black Hawk were reconstituted using the SCS TR20 computer model. Similar to the 1979 analysis, the TR20 model uses a SCS "Type IA" distribution for North Clear Creek and a SCS "Type II" precipitation distribution for Gregory and Chase Gulch. Assuming Hydrologic Soil Group "B" soils, an ARC (AMC) of II, and 1979 land use, an average Curve Number of 79 was calculated for the study area. The curve number was used to calibrate the TR20 model to 1979 flood peak calculations, and the calibration resulted in a slight lowering of the average Curve Number in the study area to 75.5. The Curve Number of 75.5 is within the range of curve numbers used for other studies in the catchment which, ignoring the unrealistically low curve number of 55 used by Futura, ranged from 69 to 85.

The construction of reservoirs within Chase and Gregory Gulch watersheds reduce the magnitude of flood peaks downstream of the reservoirs. Chase Gulch Reservoir reduces the magnitude of historic 100-year flood peaks by approximately 50 per cent at the outlet of Chase Gulch. Chase Gulch Reservoir was modeled assuming the reservoir is full, and inadvertent flood detention storage is provided above the emergency spillway only. The emergency spillway elevation/discharge relationship developed by the design engineer for the Reservoir was used in the TR20 model. Dorothy Lee Reservoir, a detention facility, has only a minor effect on the magnitude of 100-year flood peaks at the outlet of Gregory Gulch. At the downstream limit of the study area along North Clear Creek, 100-year flood peaks are reduced by approximately 200 cfs.

RECOMMENDATIONS

Flood peak discharges for the 10-, 50-, and 100-year flood events in North Clear Creek, Gregory Gulch, and Chase Gulch calculated by the TR20 model with Chase and Dorothy Lee Reservoirs summarized in Table 5 should be adopted by the Colorado Water Conservation Board. The flood peaks shown in this table represents current (2001) conditions in the watersheds. Since the reservoirs are assumed ineffective in reducing flood peaks during the 500-year event, 500-year event flood peaks developed in 1979 using frequency analysis will not change.

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Type IA Rainfall Distribution

TR20 ----- SCS -
 NCC NORTH CLEAR CREEK RECONSTITUTION 1979 CWCB HYDROLOGY VERSION
 04/19/** Type II storm, Calibration, no reservoirs 2.04TEST
 11:02:32 PASS 1 JOB NO. 1 PAGE 7

TABLE NO. TIME INCREMENT
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.0000	.0022	.0043	.0063	.0082
.0100	.0118	.0137	.0157	.0178
.0200	.0228	.0257	.0287	.0318
.0350	.0380	.0410	.0439	.0470
.0500	.0531	.0563	.0595	.0628
.0660	.0692	.0724	.0756	.0788
.0820	.0851	.0883	.0915	.0947
.0980	.1015	.1050	.1086	.1123
.1160	.1197	.1234	.1272	.1311
.1350	.1390	.1431	.1473	.1516
.1560	.1606	.1653	.1701	.1750
.1800	.1849	.1900	.1952	.2005
.2060	.2120	.2181	.2243	.2306
.2370	.2429	.2488	.2549	.2613
.2680	.2752	.2829	.2912	.3002
.3100	.3314	.3547	.3788	.4026
.4250	.4394	.4517	.4623	.4716
.4800	.4890	.4975	.5055	.5130
.5200	.5266	.5329	.5389	.5446
.5500	.5556	.5612	.5666	.5718
.5770	.5820	.5868	.5916	.5964
.6010	.6058	.6104	.6150	.6196
.6240	.6284	.6326	.6368	.6410
.6450	.6489	.6527	.6565	.6603
.6640	.6677	.6715	.6753	.6791
.6830	.6866	.6903	.6939	.6974
.7010	.7047	.7084	.7120	.7155
.7190	.7225	.7259	.7293	.7326
.7360	.7394	.7428	.7461	.7495
.7528	.7561	.7594	.7627	.7660
.7692	.7725	.7757	.7789	.7821
.7853	.7885	.7916	.7947	.7979
.8010	.8041	.8071	.8102	.8132
.8163	.8193	.8223	.8252	.8282
.8312	.8341	.8370	.8399	.8428
.8457	.8486	.8514	.8542	.8570
.8598	.8626	.8654	.8681	.8709
.8736	.8763	.8790	.8817	.8844
.8870	.8896	.8923	.8949	.8974
.9000	.9026	.9051	.9076	.9101
.9126	.9151	.9176	.9200	.9225
.9249	.9273	.9297	.9321	.9344
.9368	.9391	.9414	.9437	.9460
.9482	.9505	.9527	.9550	.9572
.9594	.9615	.9637	.9658	.9680
.9701	.9722	.9743	.9764	.9784
.9804	.9825	.9845	.9865	.9884
.9904	.9924	.9943	.9962	.9981
1.0000	1.0000	1.0000	1.0000	1.0000

ENDTBL

Type II Rainfall Distribution

TR20 ----- SCS -
 NCC NORTH CLEAR CREEK RECONSTITUTION 1979 CWCB HYDROLOGY VERSION
 04/19/** Type II storm, Calibration, no reservoirs 2.04TEST
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TABLE NO.	TIME INCREMENT				
RAINFL 2	.1000				
	.0000	.0010	.0020	.0030	.0041
	.0051	.0062	.0072	.0083	.0094
	.0105	.0116	.0127	.0138	.0150
	.0161	.0173	.0184	.0196	.0208
	.0220	.0232	.0244	.0257	.0269
	.0281	.0294	.0306	.0319	.0332
	.0345	.0358	.0371	.0384	.0398
	.0411	.0425	.0439	.0452	.0466
	.0480	.0494	.0508	.0523	.0538
	.0553	.0568	.0583	.0598	.0614
	.0630	.0646	.0662	.0679	.0696
	.0712	.0730	.0747	.0764	.0782
	.0800	.0818	.0836	.0855	.0874
	.0892	.0912	.0931	.0950	.0970
	.0990	.1010	.1030	.1051	.1072
	.1093	.1114	.1135	.1156	.1178
	.1200	.1222	.1246	.1270	.1296
	.1322	.1350	.1379	.1408	.1438
	.1470	.1502	.1534	.1566	.1598
	.1630	.1663	.1697	.1733	.1771
	.1810	.1851	.1895	.1941	.1989
	.2040	.2094	.2152	.2214	.2280
	.2350	.2427	.2513	.2609	.2715
	.2830	.3068	.3544	.4308	.5679
	.6630	.6820	.6986	.7130	.7252
	.7350	.7434	.7514	.7588	.7656
	.7720	.7780	.7836	.7890	.7942
	.7990	.8036	.8080	.8122	.8162
	.8200	.8237	.8273	.8308	.8342
	.8376	.8409	.8442	.8474	.8505
	.8535	.8565	.8594	.8622	.8649
	.8676	.8702	.8728	.8753	.8777
	.8800	.8823	.8845	.8868	.8890
	.8912	.8934	.8955	.8976	.8997
	.9018	.9038	.9058	.9078	.9097
	.9117	.9136	.9155	.9173	.9192
	.9210	.9228	.9245	.9263	.9280
	.9297	.9313	.9330	.9346	.9362
	.9377	.9393	.9408	.9423	.9438
	.9452	.9466	.9480	.9493	.9507
	.9520	.9533	.9546	.9559	.9572
	.9584	.9597	.9610	.9622	.9635
	.9647	.9660	.9672	.9685	.9697
	.9709	.9722	.9734	.9746	.9758
	.9770	.9782	.9794	.9806	.9818
	.9829	.9841	.9853	.9864	.9876
	.9887	.9899	.9910	.9922	.9933
	.9944	.9956	.9967	.9978	.9989
	1.0000	1.0000	1.0000	1.0000	1.0000

ENDTBL

EVALUATION OF RUNOFF CURVE NUMBERS (CN) FOR NORTH CLEAR CREEK, GREGORY GULCH, AND CHASE GULCH

The reconstruction of the TR-20 evaluation of the three watersheds requires that the CN's be reestablished if possible. The information available does not explicitly show the CN values for the watersheds, but sufficient information is shown on the hydrographs to estimate the CN values at the watershed outlets, giving the weighted CN's for the three tributaries at the reference location of the hydrographs.

North Clear Creek

The 1980 *Black Hawk Floodplain Information Technical Addendum* (BFITA) by Owens Ayers, page 2-9, shows the hyetograph and triangular hydrographs for the North Clear Creek Watershed. The information also shows the Creek was evaluated for a 100-year 24-hour storm. The drainage area is shown as 33.88 square miles with a 100-year peak Q of 2,640 cfs occurring at 11.5 hours from the beginning of the storm event. The hydrograph shows runoff occurring at 4 hours after the beginning of the rainfall. The hyetograph shows that 0.5" of rainfall has occurred at 4 hours. This is the Initial Abstraction (Ia).

The USDA National Engineering Handbook Section 4 (NEH 4) equation 10.9 gives the empirical relationship between Ia and the variable S, a function of the total retention (the rainfall that does not become runoff due to interception and infiltration). In turn, S is directly related to the runoff curve number (CN) by equation 10.11 of NEH 4.

$$Ia = 0.2 S \quad (10.9)$$

$$CN = 1000 / (S+10) \quad (10.11)$$

For Ia = 0.5, S = 2.5, and the related curve number is 80.

For comparison, we computed the CN by taking the BFITA $q_p = 484 * A * Q / T_p$, and computing Q, then S, and CN for each watershed. For North Clear Creek the CN from BFITA q_p values is 79. These values are close, and support the anecdotal evidence that a CN value of 79 was used.

Chase Gulch

The BFITA, page 2-8 shows the hyetograph and triangular hydrographs for the Chase Tributary. The information also shows that the creek was evaluated for a 100-year 6-hour storm. BFITA page 2-3 shows the 100-year peak runoff value of 1,160 cfs, which is consistent with the hydrograph shown on page 2-8. The drainage area is shown as 4.17 square miles with the peak occurring about 3.95 hours from the beginning of the storm event. The hydrograph shows runoff occurring 3 hours after the beginning of the rainfall. The hyetograph shows that 0.4" of rainfall has occurred at 3 hours. This is the Initial Abstraction (Ia).

For these values, $I_a = 0.4''$, $S = 2$, and the related curve number is 83.

For comparison, we computed the CN by taking the BFITA $q_p = 484 * A * Q / T_p$, and computing Q , then S , and CN for each watershed. For Chase, the CN from BFITA q_p values is 78.

We would expect the CN values to be closer, so it is likely that there are other adjustments made in the peak q determination. From this information it appears that the CN used was somewhere in the range of 78 to 83. If other adjustments were made that would impact the watershed variables such as time to peak or drainage area, then the CN values could be outside of the range observed here.

Gregory Gulch

Similar to Chase Gulch, the Gregory Gulch 100-year 6-hour hydrograph and hyetograph are shown on page 2-8 of BFITA. The drainage area from page 2-6 is 3.47 square miles. The peak runoff value is 1,240 cfs. The runoff starts at hour 3 of the storm where 0.35'' of total rainfall is shown, so $I_a = 0.35''$.

For these values, $I_a = 0.35''$, $S = 1.75$, and the related curve number is 85.

For comparison, we computed the CN by taking the BFITA $q_p = 484 * A * Q / T_p$, and computing Q , then S , and CN for each watershed. For Gregory Gulch the CN from BFITA q_p values is 81.

Again, we would expect the CN values to be closer, so it is likely that there are other adjustments made in the peak q determination. From this information it appears that the CN used was somewhere in the range of 81 to 85. If other adjustments were made that would impact the watershed variables such as time to peak or drainage area, then the CN values could be outside of the range observed here.

For Gregory Gulch, the triangular hydrograph for time = 3 hours was checked. Reading the peak $q = 700$ cfs from the plotted triangle, area $A = 3.47$ sq. mi., and $T_p = 0.68$ hours from the triangle, incremental Q , runoff inches = 0.283''. The incremental rainfall for that period was 1.16 inches. From NEH 4, figure 10.1, the intersection of the rainfall and runoff occurs at CN 85. So the triangular hydrograph was definitely developed with this curve number. Graphically summing the triangular hydrographs yields a value for the 100-year peak flow between the curves shown on the plotted hydrograph. It appears that either plotting errors occurred or adjustments were made and reflected in the plotted hydrograph for the 100-year flows, but not in the triangular hydrographs. From the available information we cannot determine which of these impacts may have occurred.

**ESTIMATION OF RUNOFF CURVE NUMBERS (CN)
FROM BLACKHAWK FLOODPLAIN INFORMATION TECHNICAL ADDENDUM (BFITA)**

	P	I _a	S	CN est. from I _a	Q	DA	T _p	q _p est from I _a	BFITA q _p	Revised Q (inches)	Revised S from BFITA q _p values	I _a from BFITA q _p values	CN from BFITA q _p values
North Clear Creek	3.04	0.5	2.5	80	1.28	33.88	7.5	2799	2640	1.2074702	2.69	0.54	79
Chase	2.13	0.4	2	83	0.80	4.17	0.95	1705	1160	0.5460095	2.87	0.57	78
Gregory Gulch	2.13	0.35	1.75	85	0.90	3.47	0.95	1587	1240	0.7014076	2.3	0.46	81

Note that Chase and Gregory values from the BFITA are not proportional to their respective Drainage areas. Re-evaluate the curve numbers by back calculating from the hydrograph data and compare to values derived from the I_a values

P = rainfall values from BFITA pages 2-8 and 2-9

I_a = Initial abstraction, from the hietograph on BFITA pages 2-8 and 2-9

S = retention variable, computed from NRCS empirical formula; I_a = 0.2 * S

CN est from I_a = the NRCS CN from the formula CN = 1000/(S+10)

Q = inches of runoff using NRCS formula $Q = (P-0.2S)^2 / (P+0.8S)$

DA = drainage area from BFITA pages 2-3,5,6

T_p = time to peak measured from hydrographs on BFITA pages 2-8, 9

q_p = peak q, cfs, from NRCS formula $q_p = 484 * A * Q / T_p$, using values derived from I_a estimate

BFITA q_p = the peak q, cfs, from the hydrographs on BFITA pages 2-8, 9

Revised Q (inches) = the runoff value that yields the BFITA q_p using the same A and T_p values taken from hydrographs

Revised S = the retention variable back calculated from Revised Q = $(P-0.2S)^2 / (P+0.8S)$

I_a from BFITA q_p values = the I_a calculated using the Revised S in the formula I_a = 0.2 * S

CN from BFITA q_p values = the CN calculated using the Revised S in the formula CN = 1000/(S+10)

Time of Concentration - basins

Catchments at the Divide	Overland Flow					Shallow Flow						Channel						outlet t_c (min)	outlet t_c (hr)
	Elevation		Length (ft)	Slope (ft/ft)	t_{of} (min)	Elevation		Length (ft)	Slope (ft/ft)	V_{sf} (fps)	t_{sf} (min)	Elevation		Length (ft)	Slope (ft/ft)	$V_{channel}$ (fps)	$t_{channel}$ (min)		
	U/S	D/S				U/S	D/S					U/S	D/S						
NCC U/S (1)	12147	12100	300	0.16	15	12100	11360	2000	0.37	9	4	11360	9240	21660	0.10	11	33	51	0.85
NCC Basin 4	8960	8940	300	0.07	21	8940	8360	1000	0.58	10	2						20	43	0.71
Silver Creek	10929	10870	300	0.20	13	10870	10420	2000	0.23	8	4	10420	8920	13880	0.11	5	46	64	1.07
Missouri Creek	10200	10160	300	0.13	16	10160	9800	2000	0.18	7	5	9800	8380	21320	0.07	4	89	109	1.82
Fourmile Gulch	9290	9240	300	0.17	14	9240	9070	2000	0.09	5	7	9070	8000	12035	0.09	5	42	63	1.05
Gregory U/S (8)	9620	9560	300	0.20	13	9560	9350	1000	0.21	8	2	9350	8940	7440	0.06	6	20	36	0.60
Gregory D/S (9)	9974	9960	300	0.05	24	9960	9520	2000	0.22	8	4	9520	8040	9200	0.16	6	26	55	0.91
Chase U/S (5)	10081	9980	300	0.34	11	9980	9560	1000	0.42	10	2	9560	8660	13925	0.06	6	38	51	0.85
Chase D/S (6)	8995	8993	100	0.02	14	8993	8940	1000	0.05	3.60	5	8940	8870	3600	0.02	2.1	29	47	0.78

$n = .15$ short grass (Table 3-1, TR55)
2yr, 24-hr rain = 1.6 in

V_{sf} (Figure 3-1 TR55)

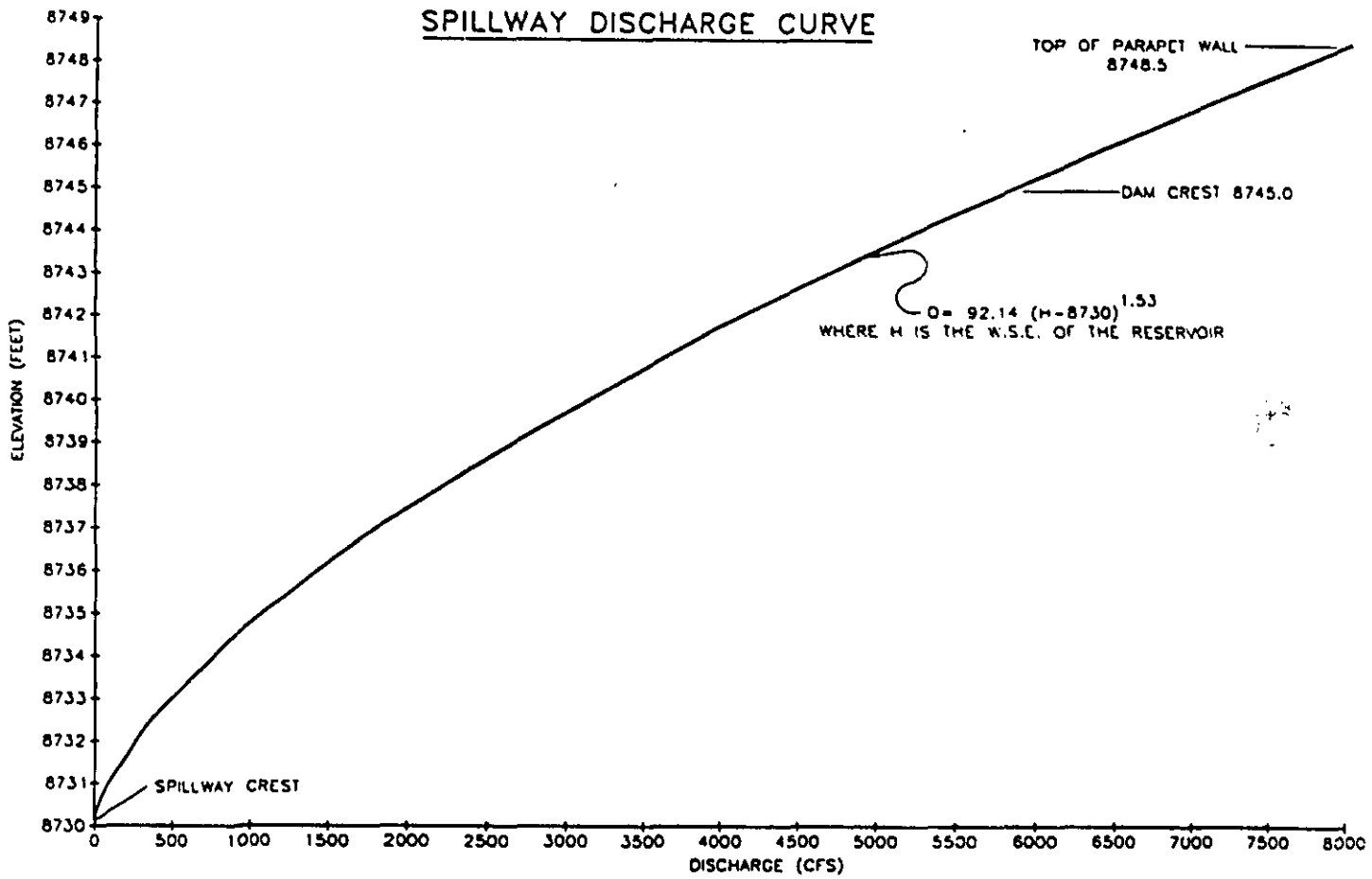
$V_{channel}$ from subcritical HEC-2, bankfull, Chase and Greg. D/S & NC U/S
remainder from SCS velocity curve, grassed waterway

Time of Concentration - reaches

Downstream Channels	Channel Reach	Elevation		Length (ft)	Slope (ft/ft)	V _{ch} (fps)	t _{channel} (min)	t _{channel} (hr)
		U/S	D/S					
North Clear Creek	NC1-NC2	8040	7820	7150	0.03	8.50	14	0.23
	NC2-NC3	8050	8040	1100	0.01	7.66	2	0.04
	NC3-NC4	8380	8050	8250	0.04	7.66	18	0.30
	NC4-NC5	8710	8380	11340	0.03	8.26	23	0.38
	NC5-NC6	9240	8710	10200	0.05	7.66	22	0.37
Gregory Gulch	G1-G2	8940	8040	12670	0.07	5.00	42	0.70
Chase Gulch	C1-C2	8660	8050	12125	0.05	5.71	35	0.59

V_{ch} from subcritical HEC-2 analysis, bankfull event

Chase Reservoir (RMC, 1994)



NORTH CLEAR CREEK (TR 20 MODEL)

100-YEAR EVENT

CALIBRATION

NO RESERVOIRS

EXECUTIVE CONTROL LIST 0. 0. 0.

LISTING OF CURRENT DATA

XSECTN NO.	DRAINAGE AREA	BANKFULL	ZERO DAMAGE	LOW GROUND
XSECTN 1	1.0000	9410.3000	.0000	.0000
	ELEVATION	DISCHARGE	END AREA	
	9409.00	.00	.00	
	9410.23	50.00	9.54	
	9412.91	500.00	71.45	
	9416.00	1500.00	149.22	
	9419.43	3000.00	238.09	
	9423.15	5000.00	334.89	

ENDTBL

XSECTN NO.	DRAINAGE AREA	BANKFULL	ZERO DAMAGE	LOW GROUND
XSECTN 2	1.0000	8608.6000	.0000	.0000
	ELEVATION	DISCHARGE	END AREA	
	8606.60	.00	.00	
	8607.38	50.00	10.51	
	8609.67	500.00	84.36	
	8611.36	1500.00	217.17	
	8613.03	3000.00	404.88	
	8614.68	5000.00	644.26	

ENDTBL

XSECTN NO.	DRAINAGE AREA	BANKFULL	ZERO DAMAGE	LOW GROUND
XSECTN 3	1.0000	8322.0000	.0000	.0000
	ELEVATION	DISCHARGE	END AREA	
	8313.10	.00	.00	
	8316.33	500.00	60.54	
	8318.64	1500.00	141.32	
	8320.78	3000.00	240.88	
	8322.87	5000.00	359.25	

ENDTBL

TR20
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NORTH CLEAR CREEK RECONSTITUTION 1979 CWCB HYDROLOGY
Type IA storm, Calibration, no reservoirs
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XSECTN	XSECTN NO.	DRAINAGE AREA	BANKFULL	ZERO DAMAGE	LOW GROUND
	4	1.0000	8074.0000	.0000	.0000
		ELEVATION	DISCHARGE	END AREA	
		8065.00	.00	.00	
		8068.94	500.00	65.27	
		8071.63	1500.00	144.82	
		8073.69	3000.00	217.28	
		8077.78	5000.00	626.39	

ENDTBL

XSECTN	XSECTN NO.	DRAINAGE AREA	BANKFULL	ZERO DAMAGE	LOW GROUND
	5	1.0000	8913.4000	.0000	.0000
		ELEVATION	DISCHARGE	END AREA	
		8910.40	.00	.00	
		8912.63	100.00	16.53	
		8914.29	400.00	52.50	
		8914.85	550.00	71.35	
		8917.59	1800.00	217.42	

ENDTBL

XSECTN	XSECTN NO.	DRAINAGE AREA	BANKFULL	ZERO DAMAGE	LOW GROUND
	6	1.0000	8161.5000	.0000	.0000
		ELEVATION	DISCHARGE	END AREA	
		8159.70	.00	.00	
		8160.87	100.00	19.73	
		8163.20	600.00	98.22	
		8164.92	1200.00	186.00	
		8167.64	2500.00	330.06	

ENDTBL

XSECTN	XSECTN NO.	DRAINAGE AREA	BANKFULL	ZERO DAMAGE	LOW GROUND
	7	1.0000	8047.0000	.0000	.0000
		ELEVATION	DISCHARGE	END AREA	
		8038.00	.00	.00	
		8041.94	500.00	65.27	
		8044.63	1500.00	144.82	
		8046.69	3000.00	217.28	
		8050.78	5000.00	626.39	

ENDTBL

TR20
NCC
04/19/**
11:02:06

NORTH CLEAR CREEK RECONSTITUTION 1979 CWCB HYDROLOGY
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XSECTN NO.	DRAINAGE AREA	BANKFULL	ZERO DAMAGE	LOW GROUND
XSECTN 8	1.0000	9112.0000	.0000	.0000
	ELEVATION	DISCHARGE	END AREA	
	9109.00	.00	.00	
	9111.23	100.00	16.53	
	9112.89	400.00	52.50	
	9113.45	550.00	71.35	
	9116.19	1800.00	217.42	

ENDTBL

XSECTN NO.	DRAINAGE AREA	BANKFULL	ZERO DAMAGE	LOW GROUND
XSECTN 9	1.0000	8165.3000	.0000	.0000
	ELEVATION	DISCHARGE	END AREA	
	8162.70	.00	.00	
	8164.00	50.00	27.40	
	8165.30	100.00	54.90	
	8166.81	600.00	96.90	
	8167.67	1200.00	123.30	
	8169.65	2500.00	190.64	

ENDTBL

XSECTN NO.	DRAINAGE AREA	BANKFULL	ZERO DAMAGE	LOW GROUND
XSECTN 10	1.0000	7893.8600	.0000	.0000
	ELEVATION	DISCHARGE	END AREA	
	7890.90	.00	.00	
	7893.86	500.00	58.79	
	7896.32	1500.00	131.51	
	7898.81	3000.00	220.36	
	7901.33	5000.00	325.21	

ENDTBL

XSECTN NO.	DRAINAGE AREA	BANKFULL	ZERO DAMAGE	LOW GROUND
XSECTN 11	1.0000	7893.8600	.0000	.0000
	ELEVATION	DISCHARGE	END AREA	
	7890.90	.00	.00	
	7893.86	500.00	58.79	
	7896.32	1500.00	131.51	
	7898.81	3000.00	220.36	
	7901.33	5000.00	325.21	

ENDTBL

TR20

SCS -

NCC

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COMPUTED TIME INCREMENT

DIMHYD

.0200

.0000	.0300	.1000	.1900	.3100
.4700	.6600	.8200	.9300	.9900
1.0000	.9900	.9300	.8600	.7800
.6800	.5600	.4600	.3900	.3300
.2800	.2410	.2070	.1740	.1470
.1260	.1070	.0910	.0770	.0660
.0550	.0470	.0400	.0340	.0290
.0250	.0210	.0180	.0150	.0130
.0110	.0090	.0080	.0070	.0060
.0050	.0040	.0030	.0020	.0010
.0000	.0000	.0000	.0000	.0000

ENDTBL

COMPUTED PEAK RATE FACTOR = 484.000

TR20
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STANDARD CONTROL INSTRUCTIONS

RUNOFF	1	1	9.3200	74.8000	.85001	0	0	1	0	1	
REACH	2	1	2	10200.0000	.0000	.00001	0	0	1	0	1
RUNOFF	2	1	1	6.0500	74.8000	1.23001	0	0	1	0	1
ADDHYD	2	1	2	3		1	0	0	1	0	1
RUNOFF	3	2	8.1400	75.8000	1.82001	0	0	1	0	1	
REACH	3	3	1	11340.0000	.0000	.00001	0	0	1	0	1
ADDHYD	3	1	2	3		1	0	0	1	0	1
RUNOFF	4	1	.7700	74.8000	1.01001	0	0	1	0	1	
REACH	4	3	2	8250.0000	.0000	.00001	0	0	1	0	1
ADDHYD	4	1	2	3		1	0	0	1	0	1
RUNOFF	5	6	2.9400	74.0000	.85001	0	0	1	0	1	
REACH	6	6	5	12150.0000	.0000	.00001	0	0	1	0	1
RUNOFF	6	6	1.2700	75.0000	1.26001	0	0	1	0	1	
ADDHYD	6	5	6	1		1	0	0	1	0	1
ADDHYD	4	3	1	6		1	0	0	1	0	1
REACH	7	6	1	1100.0000	.0000	.00001	0	0	1	0	1
RUNOFF	8	6	1.0800	76.5000	.60001	0	0	1	0	1	
REACH	9	6	5	12670.0000	.0000	.00001	0	0	1	0	1
RUNOFF	9	6	2.4300	75.5000	1.30001	0	0	1	0	1	
ADDHYD	9	5	6	3		1	0	0	1	0	1
ADDHYD	7	3	1	6		1	0	0	1	0	1
RUNOFF	10	1	2.9200	73.5000	1.24001	0	0	1	0	1	
REACH	10	6	2	7150.0000	.0000	.00001	0	0	1	0	1
ADDHYD	10	1	2	3		1	0	0	1	0	1
ENDATA											

END OF LISTING

SUMMARY TABLE 1

SELECTED RESULTS OF STANDARD AND EXECUTIVE CONTROL IN ORDER PERFORMED.
 A CHARACTER FOLLOWING THE PEAK DISCHARGE TIME AND RATE (CFS) INDICATES:
 F-FLAT TOP HYDROGRAPH T-TRUNCATED HYDROGRAPH R-RISING TRUNCATED HYDROGRAPH

XSECTION/ STRUCTURE ID	STANDARD CONTROL OPERATION	DRAINAGE AREA (SQ MI)	RUNOFF AMOUNT (IN)	PEAK DISCHARGE			
				ELEVATION (FT)	TIME (HR)	RATE (CFS)	RATE (CSM)

RAINFALL OF 3.30 inches AND 24.00 hr DURATION, BEGINS AT .0 hrs.
 RAINFALL NUMBER 3, ARC 2
 MAIN TIME INCREMENT .100 HOURS

ALTERNATE		0	STORM	1				
XSECTION	1	RUNOFF	9.32	1.15	---	8.48	929	99.7
XSECTION	2	REACH	9.32	1.15	8610.16	8.94	789	84.7
XSECTION	2	RUNOFF	6.05	1.15	---	8.80	528	87.3
XSECTION	2	ADDHYD	15.37	1.15	8611.04	8.89	1311	85.3
XSECTION	3	RUNOFF	8.14	1.21	---	9.30	668	82.1
XSECTION	3	REACH	15.37	1.15	8318.08	9.23	1257	81.8
XSECTION	3	ADDHYD	23.51	1.17	8319.25	9.25	1924	81.8
XSECTION	4	RUNOFF	.77	1.15	---	8.61	72	93.5
XSECTION	4	REACH	23.51	1.17	8072.19	9.46	1906	81.1
XSECTION	4	ADDHYD	24.28	1.17	8072.26	9.45	1960	80.7
XSECTION	5	RUNOFF	2.94	1.10	---	8.49	272	92.5
XSECTION	6	REACH	2.94	1.10	8161.41	9.14	216	73.5
XSECTION	6	RUNOFF	1.27	1.16	---	8.82	112	88.2
XSECTION	6	ADDHYD	4.21	1.12	8161.91	9.01	323	76.7
XSECTION	4	ADDHYD	28.49	1.16	8072.68	9.42	2267	79.6
XSECTION	7	REACH	28.49	1.16	8045.68	9.42	2267	79.6
XSECTION	8	RUNOFF	1.08	1.25	---	8.28	139	128.7
XSECTION	9	REACH	1.08	1.25	8164.52	10.03	70	64.8
XSECTION	9	RUNOFF	2.43	1.19	---	8.84	220	90.5
XSECTION	9	ADDHYD	3.51	1.21	8165.82	9.00	271	77.2
XSECTION	7	ADDHYD	32.00	1.17	8046.04	9.39	2524	78.9
XSECTION	10	RUNOFF	2.92	1.07	---	8.83	226	77.4
XSECTION	10	REACH	32.00	1.17	7898.00	9.57	2512	78.5
XSECTION	10	ADDHYD	34.92	1.16	7898.32	9.54	2702	77.4

END OF 1 JOBS IN THIS RUN

SCS TR-20, VERSION 2.04TEST
NCC . FILES

INPUT = NCLEAR1.DAT , GIVEN DATA FILE
OUTPUT = NCLEAR1.OUT , DATED 04/19/**,11:02:06

FILES GENERATED - DATED 04/19/**,11:02:06

NONE!

TOTAL NUMBER OF WARNINGS = 1, MESSAGES = 0

JOB ENDED AT 11:02:06
*** TR-20 RUN COMPLETED ***

**GREGORY AND CHASE GULCHES
(TR 20 MODEL)**

100-YEAR EVENT

CALIBRATION

NO RESERVOIRS

EXECUTIVE CONTROL LIST 0. 0. 0.

LISTING OF CURRENT DATA

XSECTN NO.	DRAINAGE AREA	BANKFULL	ZERO DAMAGE	LOW GROUND
XSECTN 1	1.0000	9410.3000	.0000	.0000
	ELEVATION	DISCHARGE	END AREA	
	9409.00	.00	.00	
	9410.23	50.00	9.54	
	9412.91	500.00	71.45	
	9416.00	1500.00	149.22	
	9419.43	3000.00	238.09	
	9423.15	5000.00	334.89	

ENDTBL

XSECTN NO.	DRAINAGE AREA	BANKFULL	ZERO DAMAGE	LOW GROUND
XSECTN 2	1.0000	8608.6000	.0000	.0000
	ELEVATION	DISCHARGE	END AREA	
	8606.60	.00	.00	
	8607.38	50.00	10.51	
	8609.67	500.00	84.36	
	8611.36	1500.00	217.17	
	8613.03	3000.00	404.88	
	8614.68	5000.00	644.26	

ENDTBL

XSECTN NO.	DRAINAGE AREA	BANKFULL	ZERO DAMAGE	LOW GROUND
XSECTN 3	1.0000	8322.0000	.0000	.0000
	ELEVATION	DISCHARGE	END AREA	
	8313.10	.00	.00	
	8316.33	500.00	60.54	
	8318.64	1500.00	141.32	
	8320.78	3000.00	240.88	
	8322.87	5000.00	359.25	

ENDTBL

XSECTN	XSECTN NO.	DRAINAGE AREA	BANKFULL	ZERO DAMAGE	LOW GROUND
	4	1.0000	8074.0000	.0000	.0000

ELEVATION	DISCHARGE	END AREA
8065.00	.00	.00
8068.94	500.00	65.27
8071.63	1500.00	144.82
8073.69	3000.00	217.28
8077.78	5000.00	626.39

ENDTBL

XSECTN	XSECTN NO.	DRAINAGE AREA	BANKFULL	ZERO DAMAGE	LOW GROUND
	5	1.0000	8913.4000	.0000	.0000

ELEVATION	DISCHARGE	END AREA
8910.40	.00	.00
8912.63	100.00	16.53
8914.29	400.00	52.50
8914.85	550.00	71.35
8917.59	1800.00	217.42

ENDTBL

XSECTN	XSECTN NO.	DRAINAGE AREA	BANKFULL	ZERO DAMAGE	LOW GROUND
	6	1.0000	8161.5000	.0000	.0000

ELEVATION	DISCHARGE	END AREA
8159.70	.00	.00
8160.87	100.00	19.73
8163.20	600.00	98.22
8164.92	1200.00	186.00
8167.64	2500.00	330.06

ENDTBL

XSECTN	XSECTN NO.	DRAINAGE AREA	BANKFULL	ZERO DAMAGE	LOW GROUND
	7	1.0000	8047.0000	.0000	.0000

ELEVATION	DISCHARGE	END AREA
8038.00	.00	.00
8041.94	500.00	65.27
8044.63	1500.00	144.82
8046.69	3000.00	217.28
8050.78	5000.00	626.39

ENDTBL

XSECTN NO.	DRAINAGE AREA	BANKFULL	ZERO DAMAGE	LOW GROUND
8	1.0000	9112.0000	.0000	.0000
	ELEVATION	DISCHARGE	END AREA	
	9109.00	.00	.00	
	9111.23	100.00	16.53	
	9112.89	400.00	52.50	
	9113.45	550.00	71.35	
	9116.19	1800.00	217.42	

ENDTBL

XSECTN NO.	DRAINAGE AREA	BANKFULL	ZERO DAMAGE	LOW GROUND
9	1.0000	8164.0000	.0000	.0000
	ELEVATION	DISCHARGE	END AREA	
	8162.70	.00	.00	
	8164.00	50.00	27.40	
	8165.30	100.00	54.90	
	8166.81	600.00	96.90	
	8167.67	1200.00	123.30	
	8169.65	2500.00	190.64	

ENDTBL

XSECTN NO.	DRAINAGE AREA	BANKFULL	ZERO DAMAGE	LOW GROUND
10	1.0000	7893.8600	.0000	.0000
	ELEVATION	DISCHARGE	END AREA	
	7890.90	.00	.00	
	7893.86	500.00	58.79	
	7896.32	1500.00	131.51	
	7898.81	3000.00	220.36	
	7901.33	5000.00	325.21	

ENDTBL

XSECTN NO.	DRAINAGE AREA	BANKFULL	ZERO DAMAGE	LOW GROUND
11	1.0000	7893.8600	.0000	.0000
	ELEVATION	DISCHARGE	END AREA	
	7890.90	.00	.00	
	7893.86	500.00	58.79	
	7896.32	1500.00	131.51	
	7898.81	3000.00	220.36	
	7901.33	5000.00	325.21	

ENDTBL

TR20 ----- SCS -
 NCC NORTH CLEAR CREEK RECONSTITUTION 1979 CWCB HYDROLOGY VERSION
 04/19/** Type II storm, Calibration, no reservoirs 2.04TEST
 11:02:32 PASS 1 JOB NO. 1 PAGE 4

COMPUTED TIME INCREMENT

DIMHYD	.0200				
	.0000	.0300	.1000	.1900	.3100
	.4700	.6600	.8200	.9300	.9900
	1.0000	.9900	.9300	.8600	.7800
	.6800	.5600	.4600	.3900	.3300
	.2800	.2410	.2070	.1740	.1470
	.1260	.1070	.0910	.0770	.0660
	.0550	.0470	.0400	.0340	.0290
	.0250	.0210	.0180	.0150	.0130
	.0110	.0090	.0080	.0070	.0060
	.0050	.0040	.0030	.0020	.0010
	.0000	.0000	.0000	.0000	.0000

ENDTBL

COMPUTED PEAK RATE FACTOR = 484.000

TR20

SCS -

NCC

NORTH CLEAR CREEK RECONSTITUTION 1979 CWCB HYDROLOGY

VERSION

04/19/**

Type II storm, Calibration, no reservoirs

2.04TEST

11:02:32

PASS 1 JOB NO. 1

PAGE 11

STANDARD CONTROL INSTRUCTIONS

RUNOFF	1	1	9.3200	74.8000	.85001	0	0	1	0	1	
REACH	2	1	2	10200.0000	.0000	.00001	0	0	1	0	1
RUNOFF	2	1	1	6.0500	74.8000	1.23001	0	0	1	0	1
ADDHYD	2	1	2	3		1	0	0	1	0	1
RUNOFF	3	2	8.1400	75.8000	1.82001	0	0	1	0	1	
REACH	3	3	1	11340.0000	.0000	.00001	0	0	1	0	1
ADDHYD	3	1	2	3		1	0	0	1	0	1
RUNOFF	4	1	.7700	74.8000	1.01001	0	0	1	0	1	
REACH	4	3	2	8250.0000	.0000	.00001	0	0	1	0	1
ADDHYD	4	1	2	3		1	0	0	1	0	1
RUNOFF	5	6	2.9400	74.0000	.85001	0	0	1	0	1	
REACH	6	6	5	12150.0000	.0000	.00001	0	0	1	0	1
RUNOFF	6	6	1.2700	75.0000	1.26001	0	0	1	0	1	
ADDHYD	6	5	6	1		1	0	0	1	0	1
ADDHYD	4	3	1	6		1	0	0	1	0	1
REACH	7	6	1	1100.0000	.0000	.00001	0	0	1	0	1
RUNOFF	8	6	1.0800	76.5000	.60001	0	0	1	0	1	
REACH	9	6	5	12670.0000	.0000	.00001	0	0	1	0	1
RUNOFF	9	6	2.4300	75.5000	1.30001	0	0	1	0	1	
ADDHYD	9	5	6	3		1	0	0	1	0	1
ADDHYD	7	3	1	6		1	0	0	1	0	1
RUNOFF	10	1	2.9200	73.5000	1.24001	0	0	1	0	1	
REACH	10	6	2	7150.0000	.0000	.00001	0	0	1	0	1
ADDHYD	10	1	2	3		1	0	0	1	0	1
ENDATA											

END OF LISTING

EXECUTIVE CONTROL ENDCMP COMPUTATIONS COMPLETED FOR PASS 1

TR20 ----- SCS -
 NCC NORTH CLEAR CREEK RECONSTITUTION 1979 CWCB HYDROLOGY VERSION
 04/19/** Type II storm, Calibration, no reservoirs 2.04TEST
 11:02:32 SUMMARY, JOB NO. 1 PAGE 20

SUMMARY TABLE 1

SELECTED RESULTS OF STANDARD AND EXECUTIVE CONTROL IN ORDER PERFORMED.
 A CHARACTER FOLLOWING THE PEAK DISCHARGE TIME AND RATE (CFS) INDICATES:
 F-FLAT TOP HYDROGRAPH T-TRUNCATED HYDROGRAPH R-RISING TRUNCATED HYDROGRAPH

XSECTION/ STRUCTURE ID	STANDARD CONTROL OPERATION	DRAINAGE AREA (SQ MI)	RUNOFF AMOUNT (IN)	PEAK DISCHARGE			
				ELEVATION (FT)	TIME (HR)	RATE (CFS)	RATE (CSM)

RAINFALL OF 3.30 inches AND 24.00 hr DURATION, BEGINS AT .0 hrs.
 RAINFALL NUMBER 2, ARC 2
 MAIN TIME INCREMENT .100 HOURS

ALTERNATE 0 STORM 1

XSECTION	1	RUNOFF	9.32	1.15	---	12.43	3859	414.1
XSECTION	2	REACH	9.32	1.15	8613.04	12.76	3013	323.3
XSECTION	2	RUNOFF	6.05	1.15	---	12.69	1946	321.7
XSECTION	2	ADDHYD	15.37	1.15	8614.64	12.74	4952	322.2
XSECTION	3	RUNOFF	8.14	1.21	---	13.08	2108	259.0
XSECTION	3	REACH	15.37	1.15	8322.51	12.97	4654	302.8
XSECTION	3	ADDHYD	23.51	1.17	8324.69	12.99	6741	286.7
XSECTION	4	RUNOFF	.77	1.15	---	12.54	285	370.1
XSECTION	4	REACH	23.51	1.17	8079.55	13.38	5868	249.6
XSECTION	4	ADDHYD	24.28	1.17	8079.78	13.37	5980	246.3
XSECTION	5	RUNOFF	2.94	1.10	---	12.44	1157	393.5
XSECTION	6	REACH	2.94	1.10	8163.77	12.94	798	271.4
XSECTION	6	RUNOFF	1.27	1.16	---	12.71	408	321.3
XSECTION	6	ADDHYD	4.21	1.12	8164.86	12.87	1179	280.0
XSECTION	4	ADDHYD	28.49	1.16	8081.64	13.31	6888	241.8
XSECTION	7	REACH	28.49	1.16	8054.63	13.42	6885	241.7
XSECTION	8	RUNOFF	1.08	1.25	---	12.26	619	573.1
XSECTION	9	REACH	1.08	1.25	8166.43	12.63	473	438.0
XSECTION	9	RUNOFF	2.43	1.19	---	12.73	785	323.0
XSECTION	9	ADDHYD	3.51	1.21	8167.74	12.68	1248	355.6
XSECTION	7	ADDHYD	32.00	1.17	8055.98	13.36	7541	235.7
XSECTION	10	RUNOFF	2.92	1.07	---	12.70	862	295.2
XSECTION	10	REACH	32.00	1.17	7904.49	13.50	7505	234.5
XSECTION	10	ADDHYD	34.92	1.16	7905.03	13.47	7939	227.3

SCS TR-20, VERSION 2.04TEST
 NCC FILES

INPUT = CSGREG1.DAT , GIVEN DATA FILE
 OUTPUT = CSGREG1.OUT , DATED 04/19/**,11:02:32

FILES GENERATED - DATED 04/19/**,11:02:32

NONE!

TOTAL NUMBER OF WARNINGS = 3, MESSAGES = 0

JOB ENDED AT 11:02:32
 *** TR-20 RUN COMPLETED ***

NORTH CLEAR CREEK (TR 20 MODEL)

100-YEAR EVENT

WITH RESERVOIRS

TR20

NCC
04/19/**
11:02:18

NORTH CLEAR CREEK RECONSTITUTION 1979 CWCB HYDROLOGY
Type IA storm, includes Chase and Dorothy Lee Res.
PASS 1 JOB NO. 1

SCS -
VERSION
2.04TEST
PAGE 1

EXECUTIVE CONTROL LIST 0. 0. 0.

LISTING OF CURRENT DATA

XSECTN NO.	DRAINAGE AREA	BANKFULL	ZERO DAMAGE	LOW GROUND
XSECTN 1	1.0000	9410.3000	.0000	.0000
	ELEVATION	DISCHARGE	END AREA	
	9409.00	.00	.00	
	9410.23	50.00	9.54	
	9412.91	500.00	71.45	
	9416.00	1500.00	149.22	
	9419.43	3000.00	238.09	
	9423.15	5000.00	334.89	

ENDTBL

XSECTN NO.	DRAINAGE AREA	BANKFULL	ZERO DAMAGE	LOW GROUND
XSECTN 2	1.0000	8608.6000	.0000	.0000
	ELEVATION	DISCHARGE	END AREA	
	8606.60	.00	.00	
	8607.38	50.00	10.51	
	8609.67	500.00	84.36	
	8611.36	1500.00	217.17	
	8613.03	3000.00	404.88	
	8614.68	5000.00	644.26	

ENDTBL

XSECTN NO.	DRAINAGE AREA	BANKFULL	ZERO DAMAGE	LOW GROUND
XSECTN 3	1.0000	8322.0000	.0000	.0000
	ELEVATION	DISCHARGE	END AREA	
	8313.10	.00	.00	
	8316.33	500.00	60.54	
	8318.64	1500.00	141.32	
	8320.78	3000.00	240.88	
	8322.87	5000.00	359.25	

ENDTBL

TR20 ----- SCS -
 NCC NORTH CLEAR CREEK RECONSTITUTION 1979 CWCB HYDROLOGY VERSION
 04/19/** Type IA storm, includes Chase and Dorothy Lee Res. 2.04TEST
 11:02:18 PASS 1 JOB NO. 1 PAGE 2

XSECTN	DRAINAGE	BANKFULL	ZERO	LOW
NO.	AREA		DAMAGE	GROUND
4	1.0000	8074.0000	.0000	.0000
	ELEVATION	DISCHARGE	END AREA	
	8065.00	.00	.00	
	8068.94	500.00	65.27	
	8071.63	1500.00	144.82	
	8073.69	3000.00	217.28	
	8077.78	5000.00	626.39	

ENDTBL

XSECTN	DRAINAGE	BANKFULL	ZERO	LOW
NO.	AREA		DAMAGE	GROUND
5	1.0000	8913.4000	.0000	.0000
	ELEVATION	DISCHARGE	END AREA	
	8910.40	.00	.00	
	8912.63	100.00	16.53	
	8914.29	400.00	52.50	
	8914.85	550.00	71.35	
	8917.59	1800.00	217.42	

ENDTBL

XSECTN	DRAINAGE	BANKFULL	ZERO	LOW
NO.	AREA		DAMAGE	GROUND
6	1.0000	8161.5000	.0000	.0000
	ELEVATION	DISCHARGE	END AREA	
	8159.70	.00	.00	
	8160.87	100.00	19.73	
	8163.20	600.00	98.22	
	8164.92	1200.00	186.00	
	8167.64	2500.00	330.06	

ENDTBL

XSECTN	DRAINAGE	BANKFULL	ZERO	LOW
NO.	AREA		DAMAGE	GROUND
7	1.0000	8047.0000	.0000	.0000
	ELEVATION	DISCHARGE	END AREA	
	8038.00	.00	.00	
	8041.94	500.00	65.27	
	8044.63	1500.00	144.82	
	8046.69	3000.00	217.28	
	8050.78	5000.00	626.39	

ENDTBL

TR20
NCC
04/19/**
11:02:18

NORTH CLEAR CREEK RECONSTITUTION 1979 CWCB HYDROLOGY
Type IA storm, includes Chase and Dorothy Lee Res.
PASS 1 JOB NO. 1

SCS -
VERSION
2.04TEST
PAGE 3

XSECTN	DRAINAGE	BANKFULL	ZERO	LOW
NO.	AREA		DAMAGE	GROUND
XSECTN 8	1.0000	9112.0000	.0000	.0000
	ELEVATION	DISCHARGE	END AREA	
	9109.00	.00	.00	
	9111.23	100.00	16.53	
	9112.89	400.00	52.50	
	9113.45	550.00	71.35	
	9116.19	1800.00	217.42	

ENDTBL

XSECTN	DRAINAGE	BANKFULL	ZERO	LOW
NO.	AREA		DAMAGE	GROUND
XSECTN 9	1.0000	8165.3000	.0000	.0000
	ELEVATION	DISCHARGE	END AREA	
	8162.70	.00	.00	
	8164.00	50.00	27.40	
	8165.30	100.00	54.90	
	8166.81	600.00	96.90	
	8167.67	1200.00	123.30	
	8169.65	2500.00	190.64	

ENDTBL

XSECTN	DRAINAGE	BANKFULL	ZERO	LOW
NO.	AREA		DAMAGE	GROUND
XSECTN 10	1.0000	7893.8600	.0000	.0000
	ELEVATION	DISCHARGE	END AREA	
	7890.90	.00	.00	
	7893.86	500.00	58.79	
	7896.32	1500.00	131.51	
	7898.81	3000.00	220.36	
	7901.33	5000.00	325.21	

ENDTBL

XSECTN	DRAINAGE	BANKFULL	ZERO	LOW
NO.	AREA		DAMAGE	GROUND
XSECTN 11	1.0000	7893.8600	.0000	.0000
	ELEVATION	DISCHARGE	END AREA	
	7890.90	.00	.00	
	7893.86	500.00	58.79	
	7896.32	1500.00	131.51	
	7898.81	3000.00	220.36	
	7901.33	5000.00	325.21	

ENDTBL

TR20 ----- SCS -
 NCC NORTH CLEAR CREEK RECONSTITUTION 1979 CWCB HYDROLOGY VERSION
 04/19/** Type IA storm, includes Chase and Dorothy Lee Res. 2.04TEST
 11:02:18 PASS 1 JOB NO. 1 PAGE 4

STRUCT	STRUCT NO.	ELEVATION	DISCHARGE	STORAGE
	20			
		8950.00	.00	.00
		8952.00	10.00	1.28
		8954.00	20.00	3.09
		8956.00	30.00	5.51
		8958.00	40.00	8.65
		8960.00	510.00	12.45

ENDTBL

STRUCT	STRUCT NO.	ELEVATION	DISCHARGE	STORAGE
	21			
		8730.00	.00	.00
		8731.00	100.00	25.80
		8732.00	300.00	52.20
		8733.00	500.00	79.50
		8734.00	850.00	107.00
		8735.00	1115.00	136.00

ENDTBL

COMPUTED TIME INCREMENT

DIMHYD					
		.0200			
	.0000	.0300	.1000	.1900	.3100
	.4700	.6600	.8200	.9300	.9900
	1.0000	.9900	.9300	.8600	.7800
	.6800	.5600	.4600	.3900	.3300
	.2800	.2410	.2070	.1740	.1470
	.1260	.1070	.0910	.0770	.0660
	.0550	.0470	.0400	.0340	.0290
	.0250	.0210	.0180	.0150	.0130
	.0110	.0090	.0080	.0070	.0060
	.0050	.0040	.0030	.0020	.0010
	.0000	.0000	.0000	.0000	.0000

ENDTBL

COMPUTED PEAK RATE FACTOR = 484.000

TR20 ----- SCS -
 NCC NORTH CLEAR CREEK RECONSTITUTION 1979 CWCB HYDROLOGY VERSION
 04/19/** Type IA storm, includes Chase and Dorothy Lee Res. 2.04TEST
 11:02:18 PASS 1 JOB NO. 1 PAGE 11

STANDARD CONTROL INSTRUCTIONS

RUNOFF	1	1	9.3200	74.8000	.85001	0	0	1	0	1
REACH	2	1	2	10200.0000	.0000	.00001	0	0	1	0
RUNOFF	2	1	1	6.0500	74.8000	1.23001	0	0	1	0
ADDHYD	2	1	2	3		1	0	0	1	0
RUNOFF	3	2	8.1400	75.8000	1.82001	0	0	1	0	1
REACH	3	3	1	11340.0000	.0000	.00001	0	0	1	0
ADDHYD	3	1	2	3		1	0	0	1	0
RUNOFF	4	1	.7700	74.8000	1.01001	0	0	1	0	1
REACH	4	3	2	8250.0000	.0000	.00001	0	0	1	0
ADDHYD	4	1	2	3		1	0	0	1	0
RUNOFF	5	6	2.9400	74.0000	.85001	0	0	1	0	1

SUMMARY TABLE 1

 SELECTED RESULTS OF STANDARD AND EXECUTIVE CONTROL IN ORDER PERFORMED.
 A CHARACTER FOLLOWING THE PEAK DISCHARGE TIME AND RATE (CFS) INDICATES:
 F-FLAT TOP HYDROGRAPH T-TRUNCATED HYDROGRAPH R-RISING TRUNCATED HYDROGRAPH

XSECTION/ STRUCTURE ID	STANDARD CONTROL OPERATION	DRAINAGE AREA (SQ MI)	RUNOFF AMOUNT (IN)	PEAK DISCHARGE				
				ELEVATION (FT)	TIME (HR)	RATE (CFS)	RATE (CSM)	
RAINFALL OF 3.30 inches AND 24.00 hr DURATION, BEGINS AT .0 hrs.								
RAINTABLE NUMBER 3, ARC 2								
MAIN TIME INCREMENT .100 HOURS								
ALTERNATE 0 STORM 1								
XSECTION	1	RUNOFF	9.32	1.15	---	8.48	929	99.7
XSECTION	2	REACH	9.32	1.15	8610.16	8.94	789	84.7
XSECTION	2	RUNOFF	6.05	1.15	---	8.80	528	87.3
XSECTION	2	ADDHYD	15.37	1.15	8611.04	8.89	1311	85.3
XSECTION	3	RUNOFF	8.14	1.21	---	9.30	668	82.1
XSECTION	3	REACH	15.37	1.15	8318.08	9.23	1257	81.8
XSECTION	3	ADDHYD	23.51	1.17	8319.25	9.25	1924	81.8
XSECTION	4	RUNOFF	.77	1.15	---	8.61	72	93.5
XSECTION	4	REACH	23.51	1.17	8072.19	9.46	1906	81.1
XSECTION	4	ADDHYD	24.28	1.17	8072.26	9.45	1960	80.7
XSECTION	5	RUNOFF	2.94	1.10	---	8.49	272	92.5
STRUCTURE	21	RESVOR	2.94	1.10	8731.15	11.74	130	44.2
XSECTION	6	REACH	2.94	1.10	8161.00	12.45	128	43.5
XSECTION	6	RUNOFF	1.27	1.16	---	8.82	112	88.2
XSECTION	6	ADDHYD	4.21	1.12	8161.27	11.78	187	44.4
XSECTION	4	ADDHYD	28.49	1.16	8072.48	9.46	2121	74.4
XSECTION	7	REACH	28.49	1.16	8045.48	9.46	2121	74.4
XSECTION	8	RUNOFF	1.08	1.25	---	8.28	139	128.7
STRUCTURE	20	RESVOR	1.08	1.25	8958.21	9.03	90	83.3
XSECTION	9	REACH	1.08	1.25	8164.03	12.00	51	47.2
XSECTION	9	RUNOFF	2.43	1.19	---	8.84	220	90.5
XSECTION	9	ADDHYD	3.51	1.21	8165.71	8.97	236	67.2
XSECTION	7	ADDHYD	32.00	1.17	8045.79	9.44	2344	73.3
XSECTION	10	RUNOFF	2.92	1.07	---	8.83	226	77.4
XSECTION	10	REACH	32.00	1.17	7897.70	9.61	2333	72.9
XSECTION	10	ADDHYD	34.92	1.16	7898.01	9.58	2520	72.2

TR20 ----- SCS -
NCC NORTH CLEAR CREEK RECONSTITUTION 1979 CWCB HYDROLOGY VERSION
04/19/** Type IA storm, includes Chase and Dorothy Lee Res. 2.04TEST

END OF 1 JOBS IN THIS RUN

SCS TR-20, VERSION 2.04TEST
NCC FILES

INPUT = NCLEAR2.DAT , GIVEN DATA FILE
OUTPUT = NCLEAR2.OUT , DATED 04/19/**,11:02:18

FILES GENERATED - DATED 04/19/**,11:02:18

NONE!

TOTAL NUMBER OF WARNINGS = 1, MESSAGES = 0

JOB ENDED AT 11:02:19
*** TR-20 RUN COMPLETED ***

**GREGORY AND CHASE GULCHES
(TR 20 MODEL)**

100-YEAR EVENT

WITH RESERVOIRS

TR20 ----- SCS -
 NCC NORTH CLEAR CREEK RECONSTITUTION 1979 CWCB HYDROLOGY VERSION
 04/19/** Type II storm, includes Chase and Dorothy Lee Res. 2.04TEST
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EXECUTIVE CONTROL LIST 0. 0. 0.

LISTING OF CURRENT DATA

XSECTN NO.	DRAINAGE AREA	BANKFULL	ZERO DAMAGE	LOW GROUND
XSECTN 1	1.0000	9410.3000	.0000	.0000
	ELEVATION	DISCHARGE	END AREA	
	9409.00	.00	.00	
	9410.23	50.00	9.54	
	9412.91	500.00	71.45	
	9416.00	1500.00	149.22	
	9419.43	3000.00	238.09	
	9423.15	5000.00	334.89	

ENDTBL

XSECTN NO.	DRAINAGE AREA	BANKFULL	ZERO DAMAGE	LOW GROUND
XSECTN 2	1.0000	8608.6000	.0000	.0000
	ELEVATION	DISCHARGE	END AREA	
	8606.60	.00	.00	
	8607.38	50.00	10.51	
	8609.67	500.00	84.36	
	8611.36	1500.00	217.17	
	8613.03	3000.00	404.88	
	8614.68	5000.00	644.26	

ENDTBL

XSECTN NO.	DRAINAGE AREA	BANKFULL	ZERO DAMAGE	LOW GROUND
XSECTN 3	1.0000	8322.0000	.0000	.0000
	ELEVATION	DISCHARGE	END AREA	
	8313.10	.00	.00	
	8316.33	500.00	60.54	
	8318.64	1500.00	141.32	
	8320.78	3000.00	240.88	
	8322.87	5000.00	359.25	

ENDTBL

XSECTN	XSECTN NO.	DRAINAGE AREA	BANKFULL	ZERO DAMAGE	LOW GROUND
	4	1.0000	8074.0000	.0000	.0000
		ELEVATION	DISCHARGE	END AREA	
		8065.00	.00	.00	
		8068.94	500.00	65.27	
		8071.63	1500.00	144.82	
		8073.69	3000.00	217.28	
		8077.78	5000.00	626.39	

ENDTBL

XSECTN	XSECTN NO.	DRAINAGE AREA	BANKFULL	ZERO DAMAGE	LOW GROUND
	5	1.0000	8913.4000	.0000	.0000
		ELEVATION	DISCHARGE	END AREA	
		8910.40	.00	.00	
		8912.63	100.00	16.53	
		8914.29	400.00	52.50	
		8914.85	550.00	71.35	
		8917.59	1800.00	217.42	

ENDTBL

XSECTN	XSECTN NO.	DRAINAGE AREA	BANKFULL	ZERO DAMAGE	LOW GROUND
	6	1.0000	8161.5000	.0000	.0000
		ELEVATION	DISCHARGE	END AREA	
		8159.70	.00	.00	
		8160.87	100.00	19.73	
		8163.20	600.00	98.22	
		8164.92	1200.00	186.00	
		8167.64	2500.00	330.06	

ENDTBL

XSECTN	XSECTN NO.	DRAINAGE AREA	BANKFULL	ZERO DAMAGE	LOW GROUND
	7	1.0000	8047.0000	.0000	.0000
		ELEVATION	DISCHARGE	END AREA	
		8038.00	.00	.00	
		8041.94	500.00	65.27	
		8044.63	1500.00	144.82	
		8046.69	3000.00	217.28	
		8050.78	5000.00	626.39	

ENDTBL

TR20

NCC
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NORTH CLEAR CREEK RECONSTITUTION 1979 CWCB HYDROLOGY
Type II storm, includes Chase and Dorothy Lee Res.
PASS 1 JOB NO. 1

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PAGE 3

XSECTN NO.	DRAINAGE AREA	BANKFULL	ZERO DAMAGE	LOW GROUND
XSECTN 8	1.0000	9112.0000	.0000	.0000
	ELEVATION	DISCHARGE	END AREA	
	9109.00	.00	.00	
	9111.23	100.00	16.53	
	9112.89	400.00	52.50	
	9113.45	550.00	71.35	
	9116.19	1800.00	217.42	

ENDTBL

XSECTN NO.	DRAINAGE AREA	BANKFULL	ZERO DAMAGE	LOW GROUND
XSECTN 9	1.0000	8164.0000	.0000	.0000
	ELEVATION	DISCHARGE	END AREA	
	8162.70	.00	.00	
	8164.00	50.00	27.40	
	8165.30	100.00	54.90	
	8166.81	600.00	96.90	
	8167.67	1200.00	123.30	
	8169.65	2500.00	190.64	

ENDTBL

XSECTN NO.	DRAINAGE AREA	BANKFULL	ZERO DAMAGE	LOW GROUND
XSECTN 10	1.0000	7893.8600	.0000	.0000
	ELEVATION	DISCHARGE	END AREA	
	7890.90	.00	.00	
	7893.86	500.00	58.79	
	7896.32	1500.00	131.51	
	7898.81	3000.00	220.36	
	7901.33	5000.00	325.21	

ENDTBL

XSECTN NO.	DRAINAGE AREA	BANKFULL	ZERO DAMAGE	LOW GROUND
XSECTN 11	1.0000	7893.8600	.0000	.0000
	ELEVATION	DISCHARGE	END AREA	
	7890.90	.00	.00	
	7893.86	500.00	58.79	
	7896.32	1500.00	131.51	
	7898.81	3000.00	220.36	
	7901.33	5000.00	325.21	

ENDTBL

TR20

SCS -

NCC

NORTH CLEAR CREEK RECONSTITUTION 1979 CWCB HYDROLOGY

VERSION

04/19/**

Type II storm, includes Chase and Dorothy Lee Res.

2.04TEST

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PASS 1 JOB NO. 1

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STRUCT	STRUCT NO.	ELEVATION	DISCHARGE	STORAGE
	20			
		8950.00	.00	.00
		8952.00	10.00	1.28
		8954.00	20.00	3.09
		8956.00	30.00	5.51
		8958.00	40.00	8.65
		8960.00	510.00	12.50
		8962.00	1000.00	16.90

ENDTBL

STRUCT	STRUCT NO.	ELEVATION	DISCHARGE	STORAGE
	21			
		8730.00	.00	.00
		8731.00	100.00	25.80
		8732.00	300.00	52.20
		8733.00	500.00	79.50
		8734.00	850.00	107.00
		8735.00	1115.00	136.00
		8736.00	1500.00	166.00

ENDTBL

DIMHYD	COMPUTED TIME INCREMENT				
		.0200			
	.0000	.0300	.1000	.1900	.3100
	.4700	.6600	.8200	.9300	.9900
	1.0000	.9900	.9300	.8600	.7800
	.6800	.5600	.4600	.3900	.3300
	.2800	.2410	.2070	.1740	.1470
	.1260	.1070	.0910	.0770	.0660
	.0550	.0470	.0400	.0340	.0290
	.0250	.0210	.0180	.0150	.0130
	.0110	.0090	.0080	.0070	.0060
	.0050	.0040	.0030	.0020	.0010
	.0000	.0000	.0000	.0000	.0000

ENDTBL

COMPUTED PEAK RATE FACTOR = 484.000

TR20
NCC
04/19/**
11:07:07

NORTH CLEAR CREEK RECONSTITUTION 1979 CWCB HYDROLOGY
Type II storm, includes Chase and Dorothy Lee Res.
PASS 1 JOB NO. 1

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VERSION
2.04TEST
PAGE 11

STANDARD CONTROL INSTRUCTIONS

RUNOFF	1	1	9.3200	74.8000	.85001	0	0	1	0	1	
REACH	2	1	2	10200.0000	.0000	.00001	0	0	1	0	1
RUNOFF	2	1	1	6.0500	74.8000	1.23001	0	0	1	0	1
ADDHYD	2	1	2	3		1	0	0	1	0	1
RUNOFF	3	2	8.1400	75.8000	1.82001	0	0	1	0	1	
REACH	3	3	1	11340.0000	.0000	.00001	0	0	1	0	1
ADDHYD	3	1	2	3		1	0	0	1	0	1
RUNOFF	4	1	.7700	74.8000	1.01001	0	0	1	0	1	
REACH	4	3	2	8250.0000	.0000	.00001	0	0	1	0	1
ADDHYD	4	1	2	3		1	0	0	1	0	1
RUNOFF	5	6	2.9400	74.0000	.85001	0	0	1	0	1	
RESVOR	21	6	7	8730.0000		1	0	1	1	0	1
REACH	6	7	5	12150.0000	.0000	.00001	0	0	1	0	1
RUNOFF	6	6	1.2700	75.0000	1.26001	0	0	1	0	1	
ADDHYD	6	5	6	1		1	0	0	1	0	1
ADDHYD	4	3	1	6		1	0	0	1	0	1
REACH	7	6	1	1100.0000	.0000	.00001	0	0	1	0	1
RUNOFF	8	6	1.0800	76.5000	.60001	0	0	1	0	1	
RESVOR	20	6	7	8950.0000		1	0	1	1	0	1
REACH	9	7	5	12670.0000	.0000	.00001	0	0	1	0	1
RUNOFF	9	6	2.4300	75.5000	1.30001	0	0	1	0	1	
ADDHYD	9	5	6	3		1	0	0	1	0	1
ADDHYD	7	3	1	6		1	0	0	1	0	1
RUNOFF	10	1	2.9200	73.5000	1.24001	0	0	1	0	1	
REACH	10	6	2	7150.0000	.0000	.00001	0	0	1	0	1
ADDHYD	10	1	2	3		1	0	0	1	0	1
ENDATA											

END OF LISTING

SUMMARY TABLE 1

SELECTED RESULTS OF STANDARD AND EXECUTIVE CONTROL IN ORDER PERFORMED.
 A CHARACTER FOLLOWING THE PEAK DISCHARGE TIME AND RATE (CFS) INDICATES:
 F-FLAT TOP HYDROGRAPH T-TRUNCATED HYDROGRAPH R-RISING TRUNCATED HYDROGRAPH

XSECTION/ STRUCTURE ID	STANDARD CONTROL OPERATION	DRAINAGE AREA (SQ MI)	RUNOFF AMOUNT (IN)	PEAK DISCHARGE				
				ELEVATION (FT)	TIME (HR)	RATE (CFS)	RATE (CSM)	
RAINFALL OF 3.30 inches AND 24.00 hr DURATION, BEGINS AT .0 hrs.								
RAINTABLE NUMBER 2, ARC 2								
MAIN TIME INCREMENT .100 HOURS								
ALTERNATE 0 STORM 1								
XSECTION	1	RUNOFF	9.32	1.15	---	12.43	3859	414.1
XSECTION	2	REACH	9.32	1.15	8613.04	12.76	3013	323.3
XSECTION	2	RUNOFF	6.05	1.15	---	12.69	1946	321.7
XSECTION	2	ADDHYD	15.37	1.15	8614.64	12.74	4952	322.2
XSECTION	3	RUNOFF	8.14	1.21	---	13.08	2108	259.0
XSECTION	3	REACH	15.37	1.15	8322.51	12.97	4654	302.8
XSECTION	3	ADDHYD	23.51	1.17	8324.69	12.99	6741	286.7
XSECTION	4	RUNOFF	.77	1.15	---	12.54	285	370.1
XSECTION	4	REACH	23.51	1.17	8079.55	13.38	5868	249.6
XSECTION	4	ADDHYD	24.28	1.17	8079.78	13.37	5980	246.3
XSECTION	5	RUNOFF	2.94	1.10	---	12.44	1157	393.5
STRUCTURE	21	RESVOR	2.94	1.10	8732.39	13.31	378	128.6
XSECTION	6	REACH	2.94	1.10	8161.99	14.06	340	115.6
XSECTION	6	RUNOFF	1.27	1.16	---	12.71	408	321.3
XSECTION	6	ADDHYD	4.21	1.12	8162.97	12.97	551	130.9
XSECTION	4	ADDHYD	28.49	1.16	8080.85	13.36	6500	228.2
XSECTION	7	REACH	28.49	1.16	8053.85	13.46	6499	228.1
XSECTION	8	RUNOFF	1.08	1.25	---	12.26	619	573.1
STRUCTURE	20	RESVOR	1.08	1.25	8960.17	12.41	551	510.2
XSECTION	9	REACH	1.08	1.25	8166.15	12.83	381	352.8
XSECTION	9	RUNOFF	2.43	1.19	---	12.73	785	323.0
XSECTION	9	ADDHYD	3.51	1.21	8167.61	12.78	1159	330.2
XSECTION	7	ADDHYD	32.00	1.17	8055.19	13.41	7154	223.6
XSECTION	10	RUNOFF	2.92	1.07	---	12.70	862	295.2
XSECTION	10	REACH	32.00	1.17	7904.00	13.55	7119	222.5
XSECTION	10	ADDHYD	34.92	1.16	7904.52	13.51	7533	215.7

SCS TR-20, VERSION 2.04TEST
NCC FILES

INPUT = CSGREG2.DAT , GIVEN DATA FILE
OUTPUT = CSGREG2.OUT , DATED 04/19/**,11:07:07

FILES GENERATED - DATED 04/19/**,11:07:07

NONE!

TOTAL NUMBER OF WARNINGS = 3, MESSAGES = 0

JOB ENDED AT 11:07:07
*** TR-20 RUN COMPLETED ***