DRAINAGE STUDY
FOR
BAILEY CANYON BASIN

LOCATED IN
WASHOE COUNTY AND STOREY COUNTY, NEVADA

PREPARED FOR:
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25TH ANNIVERSARY
Since 1981

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INTRODUCTION

This report presents the result of our drainage study for the Bailey Canyon Basin located in Washoe County and Storey County, Nevada. The primary purpose of this study is to perform a detailed hydrologic study to estimate the basin discharge for 100yr / 24hr storm event. The study includes a hydraulic analysis of Bailey Creek adjacent to State Route 341 (Geiger Grade). This analysis, which was performed by Stantec Consulting, attached in Appendix I.

SITE DESCRIPTION

Bailey Canyon is a headwater basin which is approximately 15.18 sq.miles in size and lies between latitude 39°18' and 39°24' and longitude 119°39' and 119°44'. The basin is located south of Geiger Grade and northwest of Virginia City (Refer to Figures 1 & 2). The basin vegetation consists of pinyon, juniper and pine trees over a ground cover of litter, grass, and brush. Bailey Canyon Creek is an ephemeral stream that generally consists of cobbles and boulders with vertical drops and meanders.

HYDROLOGIC METHODS

The basin was modeled using the Corps of Engineers HEC-HMS computer program and the SCS Curve Number Method. For lag time, the USBR lag equation and Upland method were used. The rainfall depths and storm distribution was obtained/developed from the NOAA Atlas 14. For the evaluation of the model, several other methodologies were utilized including the Green & Ampt Loss Method, a USGS regression equation (NFF), and the USGS Frequency Analysis program (PEAKFQ). Hydraulic calculations for Bailey Creek were performed with the Corps of Engineers HEC-RAS program.

PREVIOUS STUDIES

1. The Flood Insurance Study for Washoe County by FEMA (FEMA, 1990) estimated a 100yr / 24hr peak flow at the mouth of Bailey Canyon Creek as 1,120 cfs using a regional regression analysis.

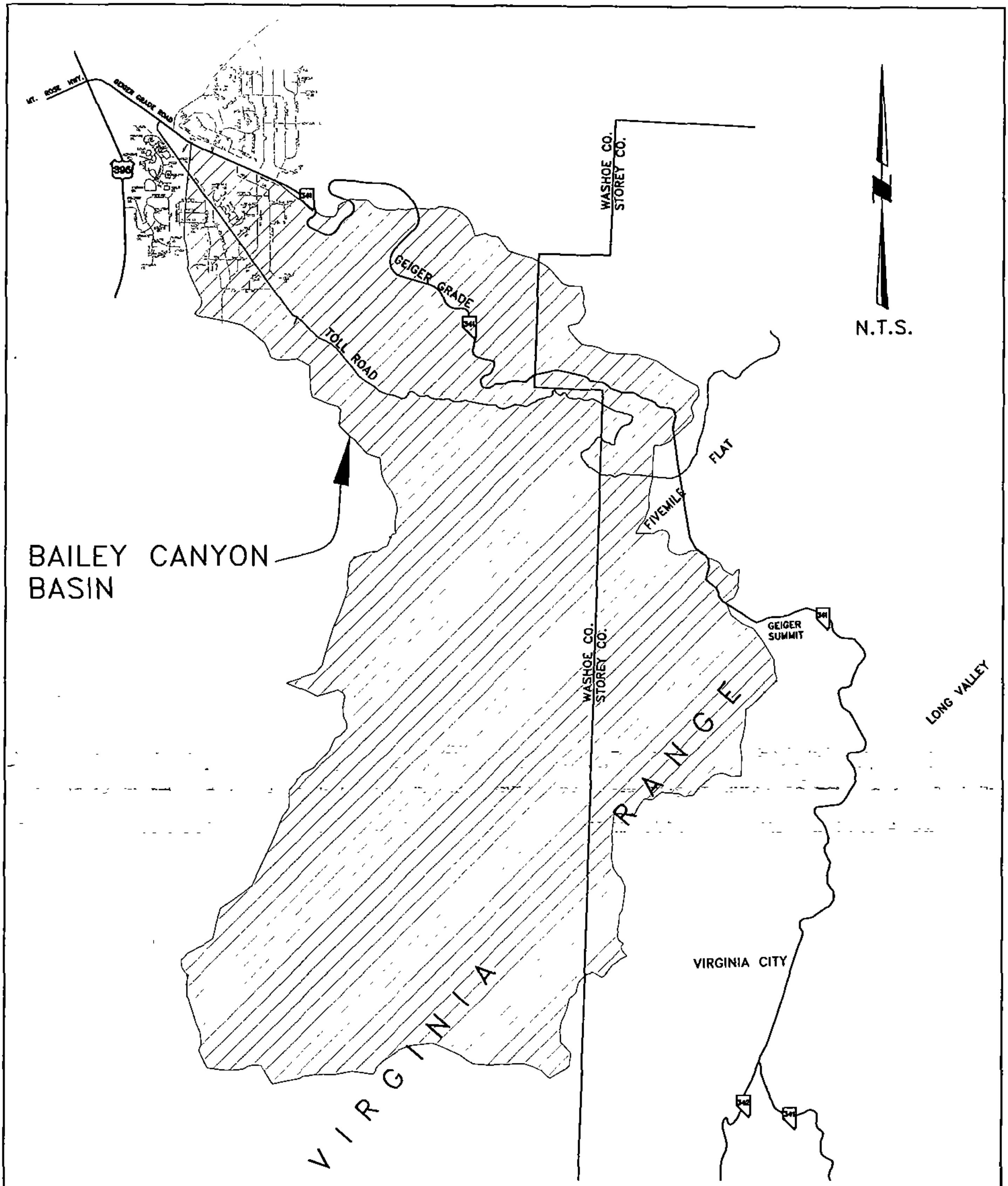

FIGURE # 1

VICINITY MAP

BAILEY CANYON

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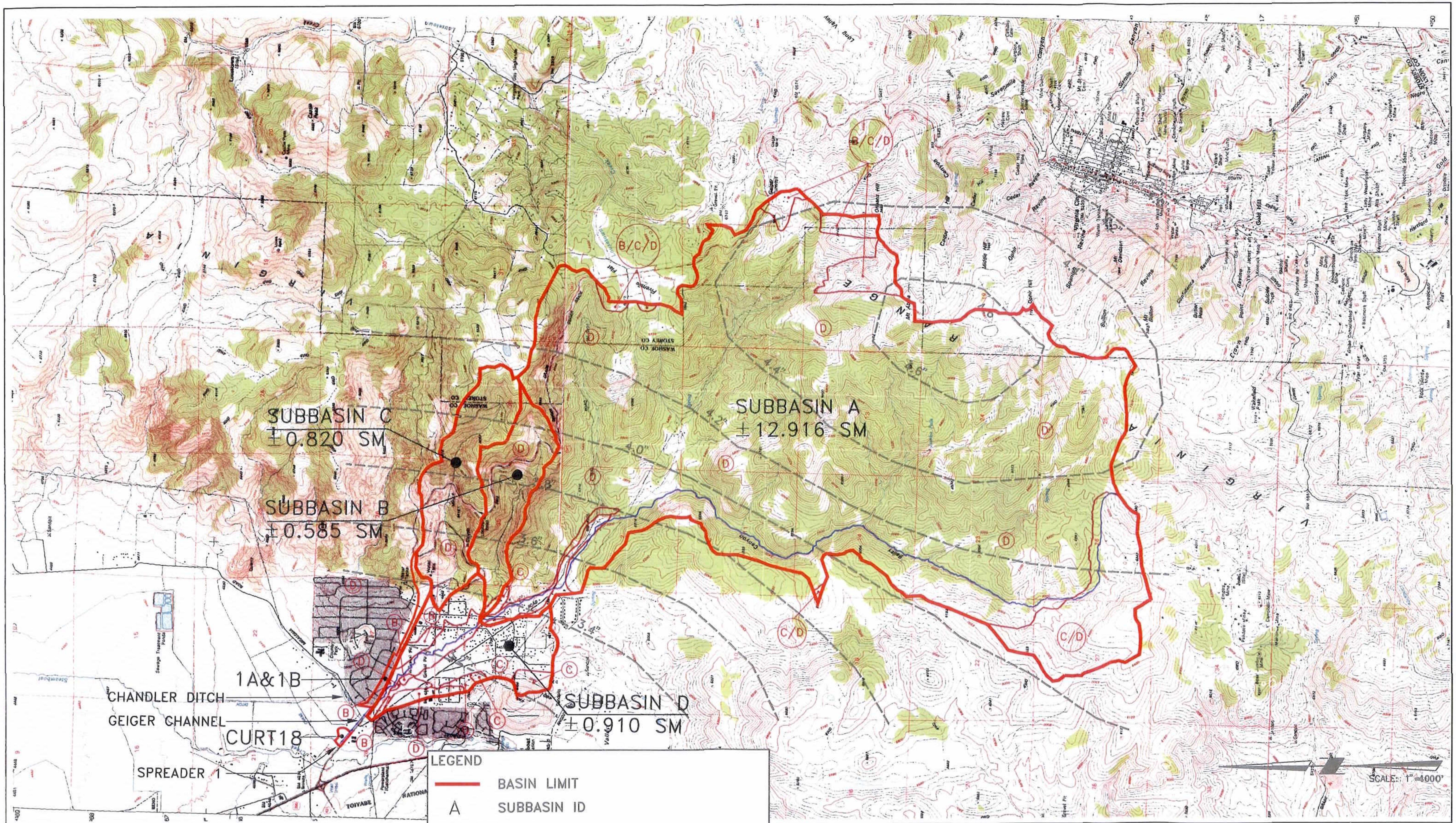

LEGEND

	BASIN LIMIT
A	SUBBASIN ID
	100yr/24hr ISOHYETAL LINE
	HYDROLOGIC SOIL GROUP BOUNDARY
D	HYDROLOGIC SOIL GROUP
	LONGEST WATERCOURSE

cfa

FIGURE # 2
BAILEY CANYON (4 SUB-BASINS)
HYDROLOGICAL MAP

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2. Nimbus Engineers performed hydrology study for Cottonwood Creek Estates in February 1995 (Nimbus, 1995a). This study utilized the SCS method and USBR lag equation to obtain a 100yr peak flow of 3673 cfs (Appendix G).
3. The Southeast Truckee Meadows Flood Control Master Plan by Nimbus Engineers in September 1995 (Nimbus, 1995b) calculated the 100yr peak flow as 2158 cfs. This model used the SCS Upland method for time of concentration / lag time determination.
4. In August 1999, Stantec Consulting prepared a Master Drainage Report for Geiger Grade / Toll Road Improvements. Using a 100yr discharge value of 3673 cfs (Nimbus, 1995a) they estimated that approximately 680 cfs would overtop Geiger Grade to the south. This was assuming the Geiger Grade improvements in the interim condition, which is more or less the pre-developed condition.
5. The Master Drainage Report for Curti Ranch Two Development (CFA, 2003a) established flows for the Curti Ranch on the north side of Geiger Grade.
6. The Hydrology & Hydraulics Report for Curti Ranch 2 –Unit 5 (CFA, 2003b) analyzed the Chandler Ditch flow split on the north side of Geiger Grade.
7. In 2004, Odyssey Engineering prepared an Addendum to Hydrology & Hydraulics Report for Curti Ranch 2 which modified the Master Drainage Report (CFA, 2003a). A diversion was constructed upstream of Mira Loma Road which diverted some additional flow to the Geiger Channel.

FIELD RECONNAISSANCE AND CONDITION SURVEY

A detail basin condition survey along the major watercourse and upper elevations was conducted over three days to verify channel roughness and vegetative cover. The vegetation in the basin typically consists of pinyon, juniper and pine trees over a ground cover of litter, grass, and brush (Figure 3, Refer Appendix A for additional photos). Besides a relatively small amount of development in the lower elevations, the basin is undeveloped and for the most part appears to be in good condition. The primary channels generally consist of cobbles and boulders with drops and meanders (Figure 4). Extensive future development of this basin seems to be doubtful due to its steep slopes.

Figure 3. Typical Ground Cover

Figure 4. Typical Bailey Canyon Creek Channel

MODEL INPUT AND PARAMETERS

Basin Mapping. As shown in Figure 2, a 1:24,000 scale USGS quad was utilized for the delineation of the watershed. From this mapping, total basin area of 15.18 sq. mi. and a longest watercourse length of 7.7 miles were calculated. The basin slopes range from 3% at the lower elevations to 60% at higher elevations. The basin was split into 4 approximately homogeneous subbasins: A, B, C & D.

Precipitation Depths and Distribution. Point values of the 100-year/24-hour precipitation depths from the NOAA 14 Atlas were plotted over the basin. Isohyetal contours were then interpreted from the point values on the basin map (Figure 2). This resulted in an average precipitation depth for the basin of 4.10 inches for the 100-year/24-hour event.

A site-specific storm distribution for Bailey Canyon was developed based on the NOAA Atlas 14 precipitation frequency estimates (Table B.1 and Figure B.1, Appendix B). The new distribution was developed since the SCS Type II and IA curves were based on out-dated NOAA Atlas 2 precipitation values. For comparison, the NOAA 14 design storm is plotted with the SCS Type IA and II synthetic curves in Figure 5. As shown, the design storm lies between the two SCS curves, which appear to be reasonable since the site is near the geographical boundary between the Type IA and II zones.

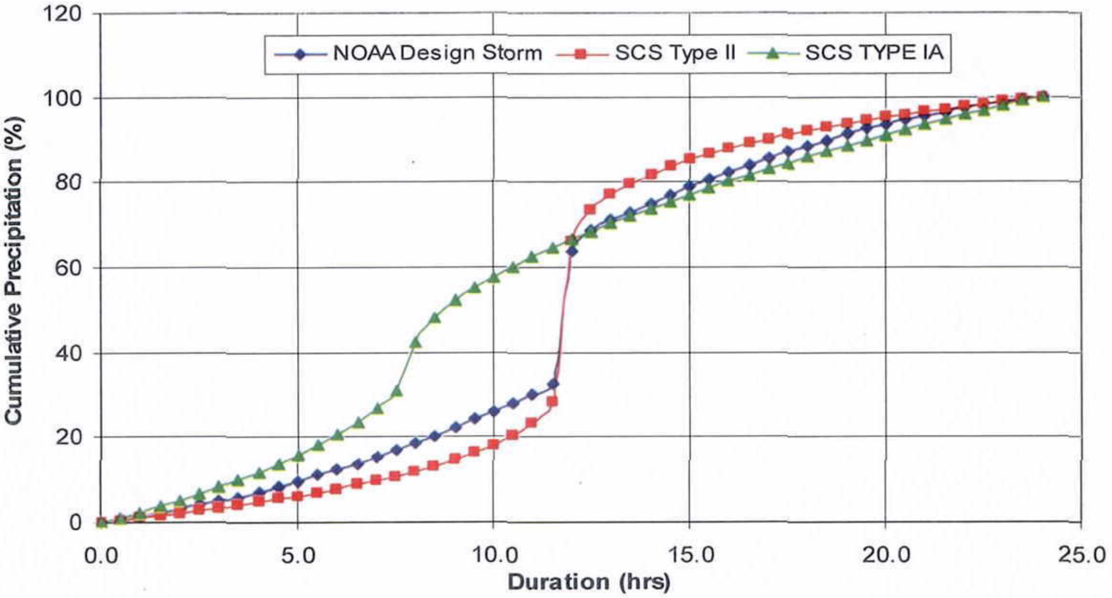

Figure 5. Hyetograph Comparison (24 hours)

Lag Time. For lag time, the USBR lag time equation and upland method were used (Appendix B). WRC (Washoe County Drainage Design Manual) adjusted the USBR lag equation for the Washoe County area. Based on a channel roughness coefficient of 0.06, the lag times for subbasins A, B & C were calculated as 1.71, 0.54, and 0.59 hours respectively.

SCS Curve Number. The most sensitive parameter in the SCS methodology is the Curve Number (CN), which is a parameter based on soil permeability and vegetative cover (Refer sensitivity analysis on pages 9 & 10). Soil types were plotted in the basin, with most of the soil falling into the D category for all subbasins except subbasin D (Figure 2 and Table B.4, Appendix B). The CNs for subbasins A, B, C & D were calculated as 74.7, 75.4, 80, and 61.8, respectively. The weighted average for the entire basin is 74.2.

Basin D, which is developed to a certain extent, was assumed to have 30% impervious area. This corresponds to the Washoe County Land use designation of Medium Density Suburban (3 lots/acre).

HYDROLOGIC MODEL RESULTS

Bailey Canyon SCS Model Results. A HEC-HMS model with SCS method was configured with the parameters identified above, which resulted in a 100-year/ 24-hour peak discharge of 2908 cfs (Figure 6).

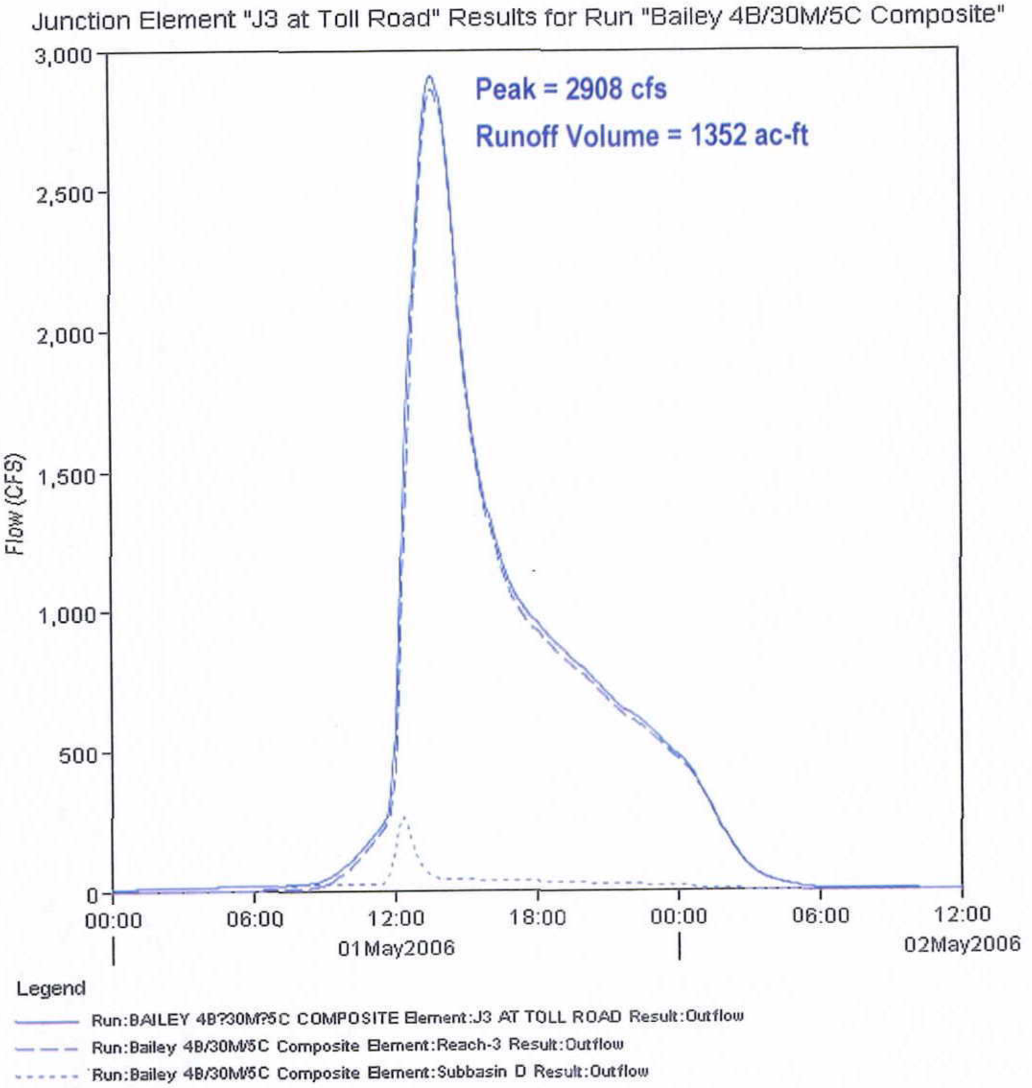

Figure 6. Hydrograph for 100 Yr/24 hr Storm Event using the SCS Method

Composite SCS Model. A composite SCS model was developed to estimate the 100 year flows in the Geiger Channel on the north side of Geiger Grade (Refer to Figures 7 & 8). The composite model utilized NOAA 14 rainfall values with model parameters from previous reports (e.g., Odyssey, 2004 & CFA, 2003a) for basin 1A, 1B and Curt 18.

Due to inadequate channel and culvert capacities at Toll Road, Stantec determined that approximately 352 cfs of Bailey Canyon flow diverts north across Geiger Grade: ± 93 cfs in the Chandler Ditch culvert and ± 259 cfs as sheetflow over Geiger Grade (Appendix I). Of the 352 cfs, 22 cfs was calculated to flow north in the Chandler Ditch (CFA, 2003b), while the rest of the split flow (330 cfs) discharges to the Geiger Channel where it combines with flow from basins 1A and 1B. Geiger Channel flows southwesterly to Curti Ranch Spreader 1, where flow from Curti Area 18 is added. The composite 100yr / 24hr flow at Curti Spreader #1 was estimated as 336cfs.

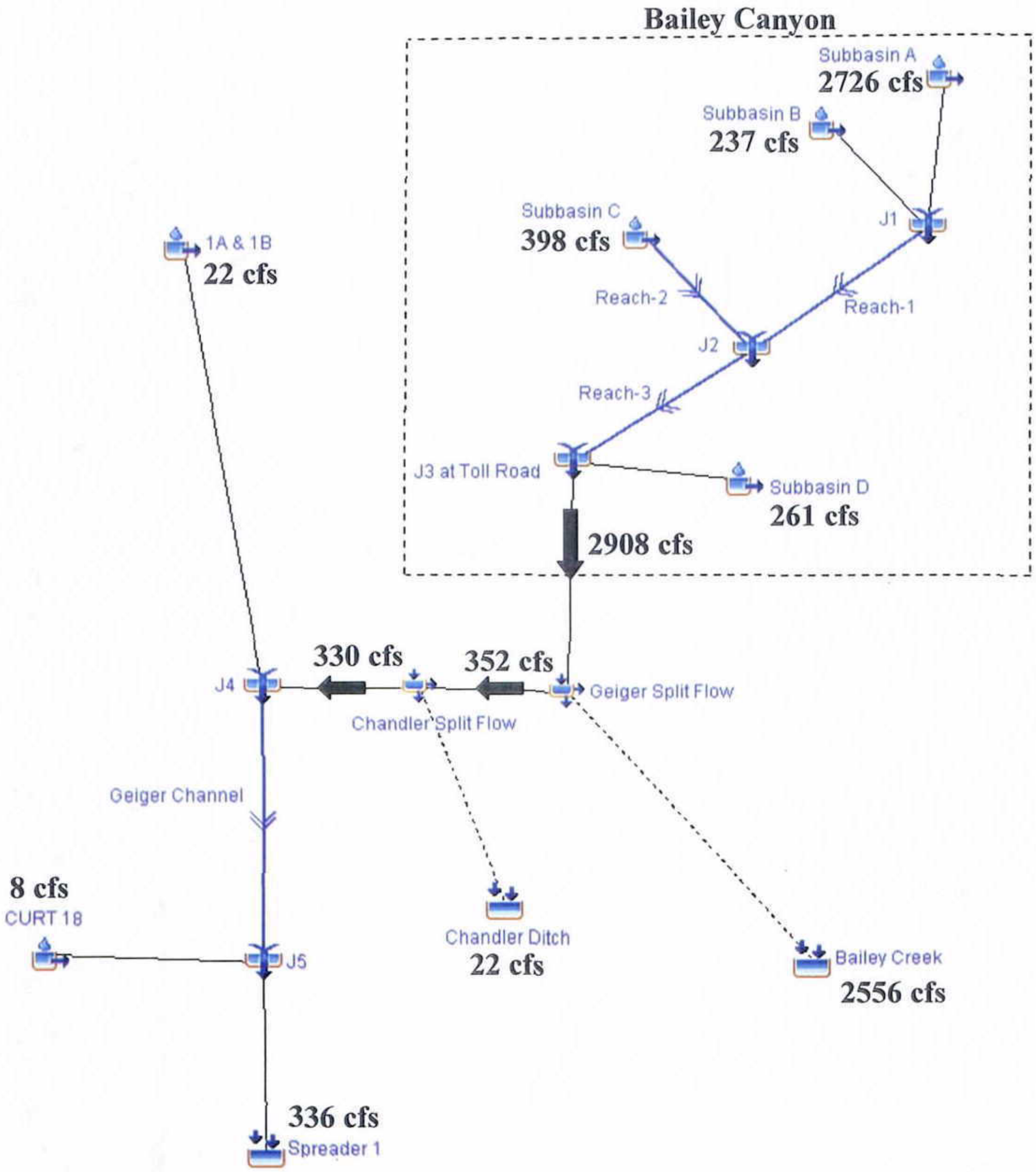

Figure 7. Composite 100yr / 24hr Peak Flow Summary using SCS Method

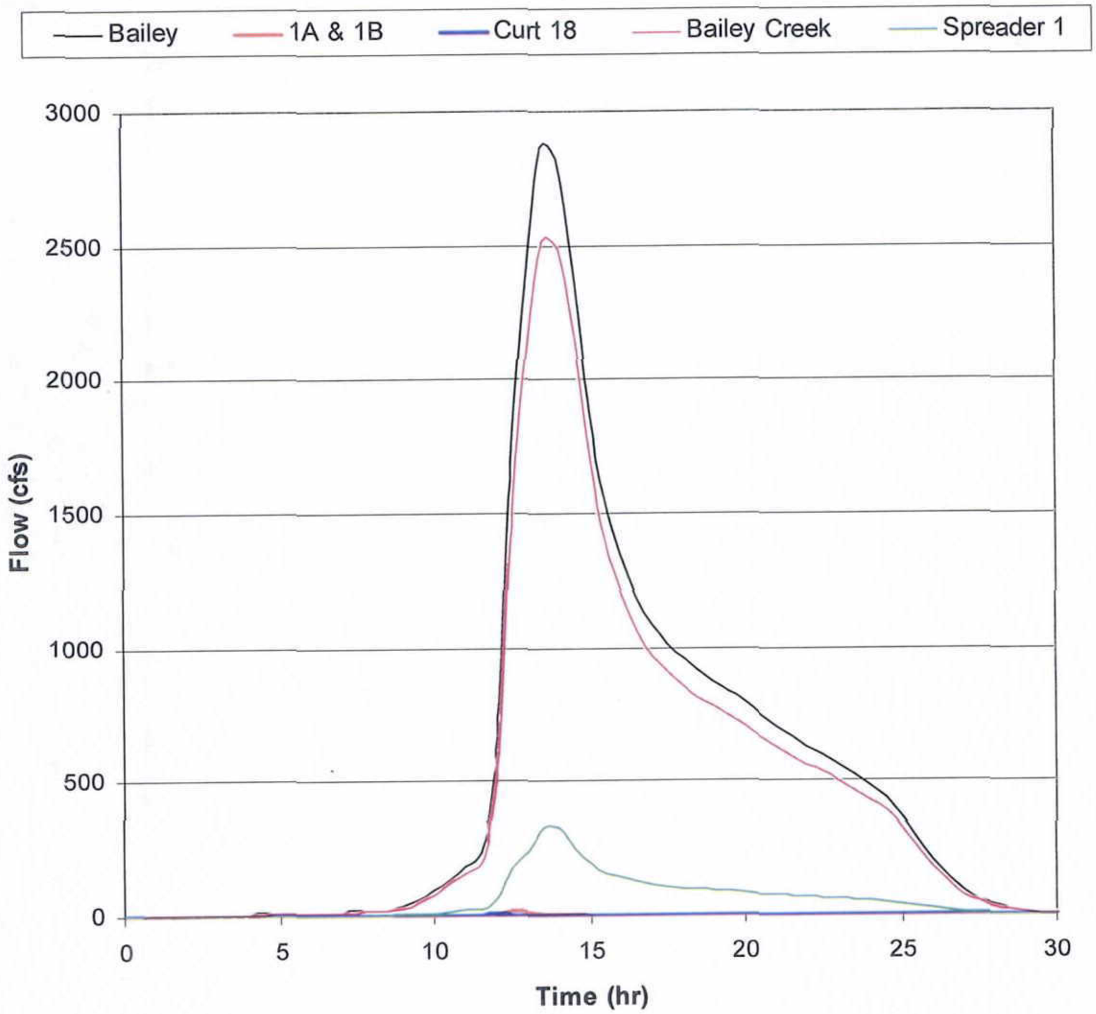

Figure 8. Hydrograph Summary using SCS Method

HYDROLOGIC MODEL EVALUATION

The reasonableness of the SCS model was evaluated by comparison with other methodologies. The model was first compared to results obtained by using the Green & Ampt Loss Method.

Green & Ampt Parameters. As suggested by the US Army Corps of Engineers HEC-HMS Technical Reference Manual (March 2000), initial loss was estimated as 0.68 inches using SCS initial abstraction (Appendix C). The soil parameters for each soil type were obtained from the Maricopa County, Arizona Drainage Design Manual. The weighted averages of hydraulic conductivity, wetting front suction, and average volumetric soil moisture deficit were estimated (Refer Table C.1 through C.4, Appendix C). The USBR lag time equation and upland method were used with a SCS transform.

<u>Bailey Canyon Green & Ampt Model Results</u>. For the Green and Ampt Loss method, the 100-year/24-hour peak discharge was estimated as 2968 cfs (Figure 9).

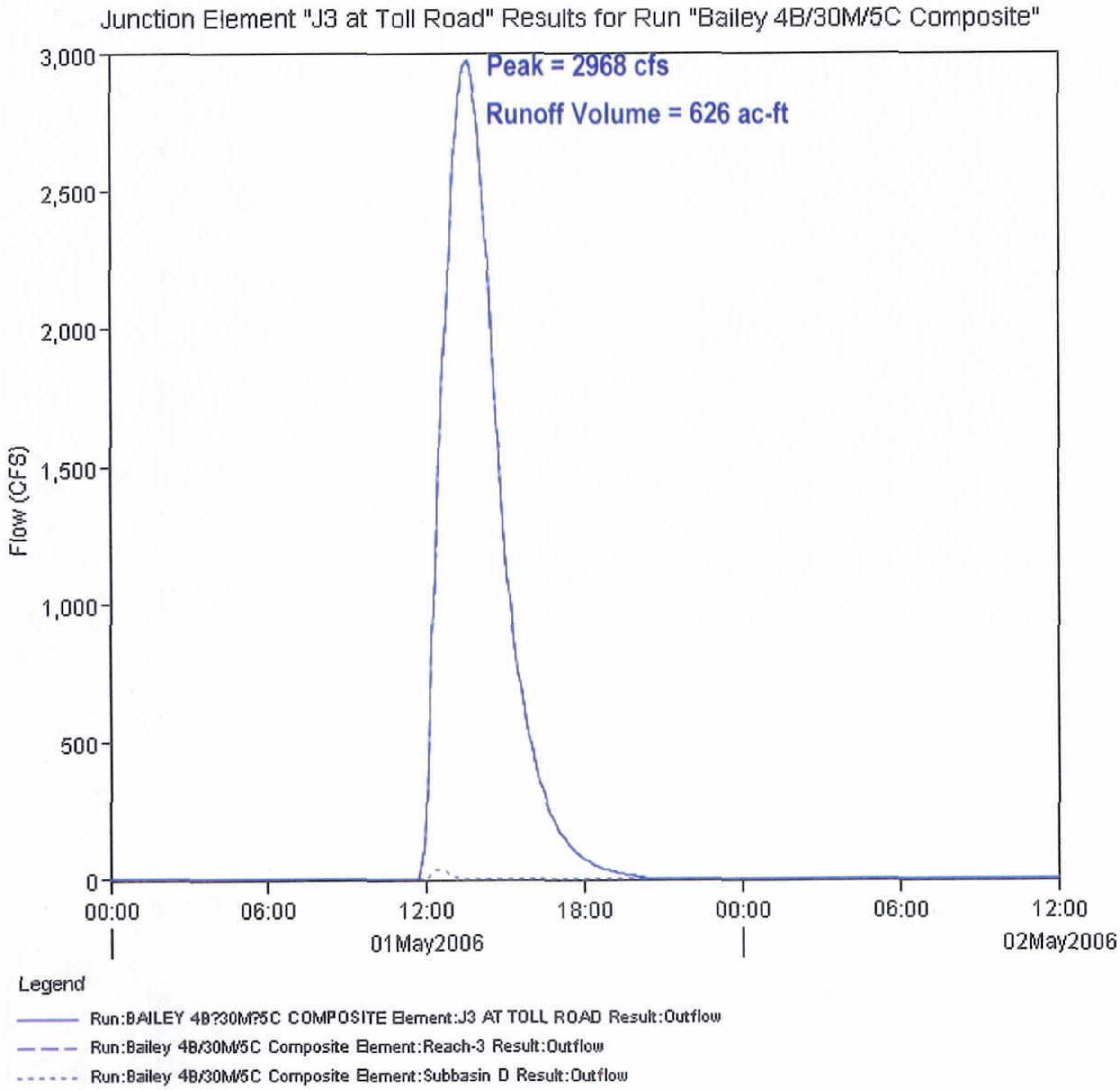

Figure 9. Hydrograph for 100 Yr- 24 hr Storm Event using Green & Ampt Loss Method

SCS Method and Green & Ampt Loss Method Comparison. For Bailey Canyon, there was good agreement in the peaks between the SCS and Green & Ampt methodologies (Figure 10). The Green & Ampt method peak of 2968 cfs is only 2% greater than the SCS peak of 2908 cfs. However, the hydrographs differ significantly in shape and volume. The SCS volume is almost two times the Green & Ampt volume.

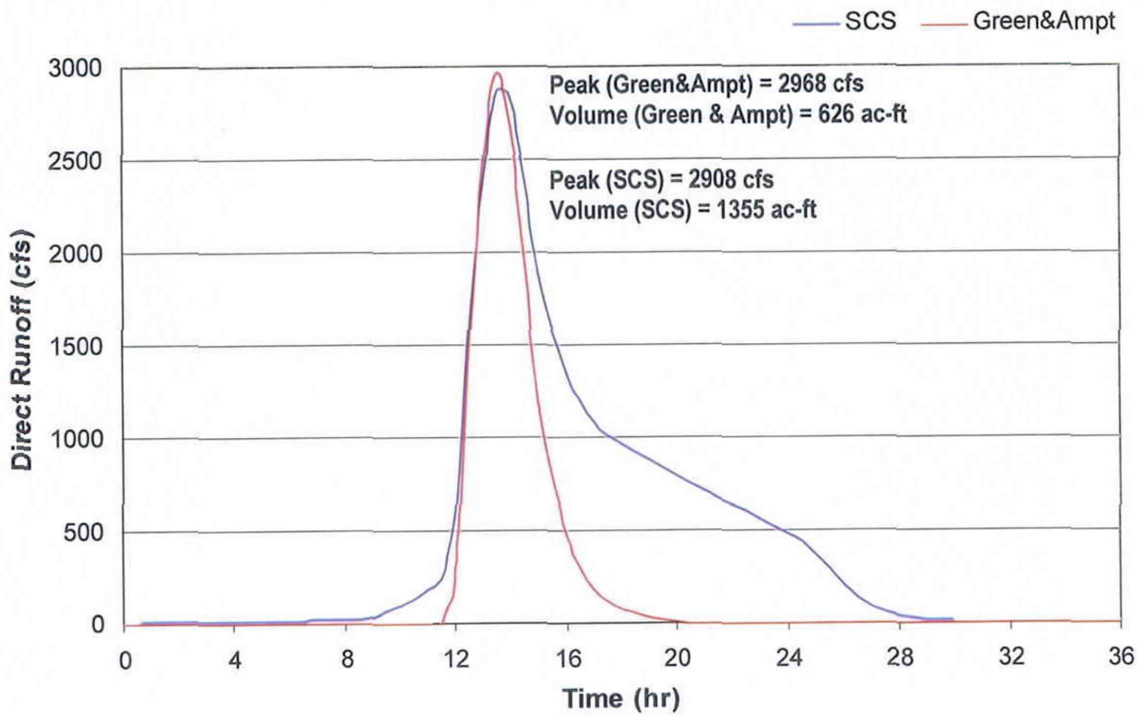

Figure 10. Comparison of Hydrographs for SCS Method and Green & Ampt Loss Method

Sensitivity Analysis. A sensitivity analysis was performed with the CN and lag time parameters in order to identify the parameters the model is most sensitive to. While holding one parameter constant at the estimated value, the other parameter was varied plus and minus 5%. As shown in the figure 11 and 12, the model is much more sensitive to curve number, where a 5% change in the curve number yields a flow change of 18%.

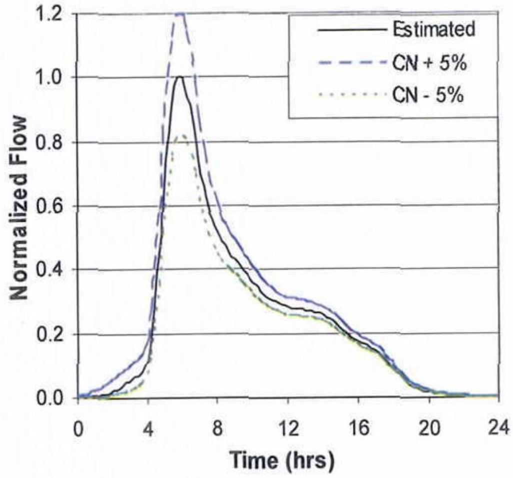

Figure 11. Sensitivity to CN. Plot indicates a 5% a increase in CN yields 19% increase in peak and a 5% decrease in CN yields 18% decrease in peak flow.

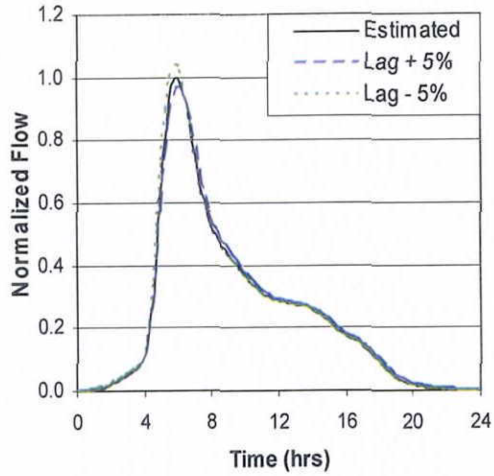

Figure 12. Sensitivity to Lag Time. Plot indicates that a 5 % increase in lag time yields 4% increase in flow and a 5 %decrease in lag time yields 3% decrease in peak flow.

Frequency analysis. Using the USGS peak flow data for Bailey Canyon, a frequency analysis was performed and resulted in flow of 2152 cfs (Appendix D). However, since there was only 4 years of recorded peak data, these results are not very reliable.

USGS Regression Equation (NFF Program). A USGS regression equation analysis was performed for Bailey Canyon resulting in a 100-year peak discharge of 2040 cfs (Appendix E). The regression equations in the NFF program were developed based on regional watershed and climatic characteristics.

Bryant Creek Comparison. Bryant Creek basin, a gaged basin, which has similar soils type, ground cover and basin orientation was used to evaluate the reasonableness of the Bailey Canyon curve number. Since the basin is gaged with several years of peak flow data, a frequency analysis can be performed with improved reliability. Bryant Creek basin is approximately 31.5 sq.miles in size and lies south of Gardnerville, NV. The 100-year peak flow for Bryant Creek using the USGS frequency analysis program, PEAKFQ, was estimated as 4146 cfs (Appendix F). An SCS model was then calibrated by varying the curve number until the peak flow of 4146 cfs was obtained. The resultant calibrated curve number of 61.6 is much less than the weighted average of 74.2 for the Bailey Canyon

Basin.

December 2005 Storm Observations. On December 30 and 31, 2005, the Reno and Carson City areas experienced a significant storm/runoff event. Flooding was observed in many locations including the South Reno area. Bailey Canyon Creek was observed flooding over Toll Road and areas downstream (Reference photographs, Figures G.24 to G.31, Appendix G).

While the flows were contained within the banks upstream of Toll Road, the flooding appeared to be caused by inadequate culvert capacity under Toll Road. Downstream of Toll Road, the stormwaters sheetflooded the properties south of Geiger Grade.

A portion of the flow reached the roadside ditch along the south side of Geiger Grade, where it caused shallow flooding of the south lane of Geiger Grade. Two locations of flooding onto Geiger Grade were observed which appeared to be due to insufficient capacity of driveway culverts. Flooding over Geiger Grade was not observed. However, the Chandler and Crane ditch culvert crossings were running full.

There are three NOAA rainfall gages in the Reno area: Reno-Tahoe Airport, South Reno at Wolf Run Golf Course, and Carson City (Ref. Figure G.1 Appendix G). Data was obtained from NOAA and Western Regional Climatic Center for the primary storm over a 28-hour period (Figure G.2, G.4, and G.6, Appendix G). 24-hour cumulative amounts were estimated for the Reno Airport, South Reno, and Carson gages as 2.32", 3.86", and 5.40", respectively (Figure G.3, G.5, and G.7, Appendix G).

A simple comparison to NOAA 14 frequency precipitation depths indicates that the storm exceeded the 200-year storm at the South Reno Gage (Table G.2, Appendix G). However, the exceedence at Reno Airport and Carson City were 50 year and 1000 year, respectively.

In addition to the NOAA gages, Washoe County maintains several gages in the Truckee Meadows (Ref Figure G.1, Appendix G). The gages in South Reno indicate that the storm was more intense in the central and western portion of the Valley. The eastern gage in Bailey Canyon recorded a cumulative 24 hr rainfall of 3.07" which is approximately a 16 year storm event based on NOAA 14 data (Figures G.8 & G.9 & Table G.4).

A review of radar images from NOAA NEXRAD during the storm period was conducted. The composite reflectivity, which indicates storm intensity, showed that the storm intensity over Bailey Canyon was equal to or greater than the intensity at the South Reno gage (Figure G.18 to G.23, Appendix G). This would suggest that the cumulative rainfall in Bailey Canyon may have been around 4 inches. However, this is not supported by the Bailey Canyon gage data.

Evaluation Summary. Table 1 is a summary of 100 year peak flows estimated previously and per this study using different models and methodology. As shown, the values range from 1,120 cfs to 3673 cfs.

Table 1. Summary of 100 Year Peak Flow Values

	Studies	Peak Flow (cfs)
1	Flood Insurance Study (FIS) for Washoe County (FEMA, 1990)	1,120
2	Cottonwood Creek Estates Study (Nimbus, 1995a)	3,673
3	Southeast Truckee Meadows Flood Control Master Plan (Nimbus, 1995b)	2,158
4	**SCS Method (CFA, 2006)**	**2,908**
5	Green and Ampt Loss Method (CFA, 2006)	2,968
6	Frequency Analysis (CFA, 2006)	2,152
7	USGS Regression Equation (CFA, 2006)	2,040

HYDRAULIC ANALYSIS

The flood flow hydraulics for Bailey Canyon channel at Toll Road was reanalyzed by Stantec Consulting using updated topography and peak flows. They used HEC-RAS to develop the water surface profiles and split-flows over Geiger Grade (Appendix I).

As shown in their results, the modeled 100yr / 24hr flow of 2908 cfs resulted in a split flow over Geiger Grade of 259 cfs. With a Chandler Ditch culvert flow of 93 cfs, the total flow to the north side of Geiger Grade is estimated at 352 cfs.

DISCUSSION AND RECOMMONDATIONS

Discussion. This study has shown that peak flow prediction may vary significantly depending on the methodology and model parameters.

In February of 1995, the Cottonwood Creek Estates Study (Nimbus, 1995a) established the currently recognized flow of 3673 cfs. This study, using the SCS methodology, utilized lower resolution topography which resulted in a larger basin delineation and shorter watercourse length. For the lag time, the USBR equation adjusted for Las Vegas was used. Since then, a more appropriate equation has been developed for Washoe County (Washoe County, 1996). Rainfall was based on an SCS Type II storm and the older NOAA atlas 2.

The Southeast Truckee Meadows Flood Control Master Plan (Nimbus 1995b) estimated a peak flow of 2158 cfs in September of 1995. The Master Plan used the SCS upland method for lag time, which may not be appropriate for the size of the basin. The rainfall was also based on an SCS Type II storm and the NOAA Atlas 2.

The FIS study (FEMA, 1990) and USGS regression equations (CFA, 2006) are regional in scale and do not take into account particular basin characteristics. As such, they should only be used as a ballpark estimate. They do, however, support a reduction in the current recognized flow of 3673 cfs.

The frequency analysis of Bailey Canyon gage date (CFA, 2006) is based on only 4 peak flows and is not a reliable estimate of the 100 year flow. However, the flow of 2152 cfs does not indicate that the *flow should be set higher than modeled flows.*

The SCS method (CFA, 2006) and the Green & Ampt (CFA, 2006) method are in agreement within the magnitude of error inherent in conceptual models. The SCS flow of 2908 cfs is just 2% less than the Green & Ampt flow of 2968 cfs. These models were based on the best information available including a NOAA Atlas 14 storm distribution, topography, USBR Lag equation adjusted for the region, upland method, and a thorough field survey.

To judge the reasonableness of the curve number selected for Bailey Canyon, a similar gaged watershed (Bryant Creek) was modeled. *Compared to a Bryant Creek calibrated curve number of* 61.6, the Bailey Canyon average curve number of 74.2 appears to be very reasonable.

The December 30 and 31 precipitation records indicate that a storm in the magnitude of 200 years occurred in South Reno. The NEXRAD radar images in Appendix G indicate that the storm was at least as intense over Bailey Canyon as it was at the South Reno gage. However, this is not supported by the rainfall gage in the Bailey Canyon.

Recommendations. The model results for the SCS provides a good peak flow estimate for the basin. It is supported by other hydrologic method results. In light of these considerations, a 100yr / 24hr peak flow of 2908 cfs for Bailey Canyon is recommended. This will result in an estimated split-flow across Geiger Grade of 352 cfs and a resultant flow of 336 cfs at the Curti Ranch Spreader #1.

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Washoe County (1996), "Hydrologic Criteria and Drainage Design Manual".

APPENDIX

A

APPENDIX A
FIELD RECONNAISSANCE AND CONDITION SURVEY FOR BAILEY CANYON

PHOTOGRAPHS OF BAILEY CANYON FIELD CONDITION SURVEY, 2005

Figure A.1. Terrain at upper elevations of Bailey

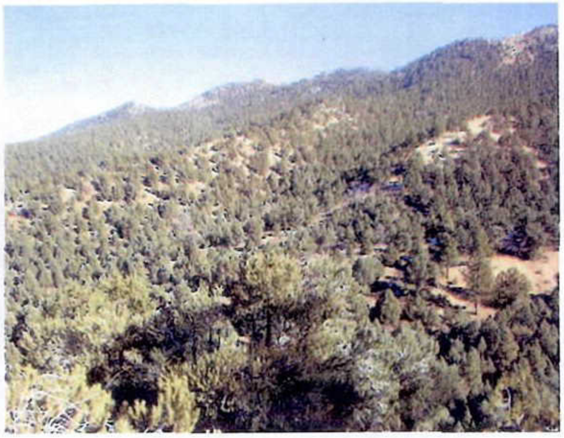


Figure A.2. Terrain at upper elevations of Bailey

Figure A.3. Terrain at upper elevations of Bailey

Figure A.4. Terrain at upper elevations of Bailey

Figure A.5. Terrain at upper elevations of Bailey

Figure A.6. Terrain at lower elevation slopes

Figure A.7. Tributary to main channel

Figure A.8. Typical ground cover along main channel

Figure A.9. Main channel upper elevation vertical drop

Figure A.10. Terrain off of Toll Road

Figure A.11. Terrain at upper elevation of Toll Road

Figure A.12. Terrain at upper elevation of Toll Road

Figure A.13. Terrain at upper elevation of subbasin D

Figure A.14. Developed area in subbasin D

Figure A.15. Bailey Creek in subbasin D

Figure A.16. Bailey Creek in subbasin D

B

APPENDIX B

SCS METHOD ANALYSIS FOR BAILEY CANYON

Table B.1. Cumulative Precipitation for 100 yr – 24 hr Storm Event (NOAA 14 Data)

Design Storm Hyetograph Calculation									
Duration min	Duration (hr)	Precip * (inches)	Inc. Depth (inches)	Rank	Re-Ordered (inches)	Cumulative (inches)	Cumulative %	Cumul. w/ P= 4.1	Cumul*.98 DAR
0	0.0	0.00			0.00	0	0	0.000	0.000
30	0.5	0.95	0.95	1.00	0.02	0.02	0.66	0.027	0.027
60	1.0	1.10	0.15	2.00	0.02	0.04	1.32	0.054	0.053
90	1.5	1.17	0.07	3.00	0.02	0.06	1.98	0.081	0.080
120	2.0	1.23	0.07	4.00	0.03	0.09	2.97	0.122	0.119
150	2.5	1.30	0.06	5.00	0.03	0.12	3.96	0.162	0.159
180	3.0	1.36	0.06	6.00	0.03	0.15	4.95	0.203	0.199
210	3.5	1.42	0.06	7.00	0.03	0.18	5.94	0.244	0.239
240	4.0	1.48	0.06	8.00	0.03	0.21	6.93	0.284	0.278
270	4.5	1.54	0 06	9.00	0.04	0.25	8.25	0.338	0.332
300	5.0	1.60	0.06	10.00	0.04	0.29	9.57	0.392	0.385
330	5.5	1.66	0.06	11.00	0.04	0.33	10.89	0.447	0.438
360	6.0	1.71	0.06	12.00	0.04	0.37	12.21	0.501	0.491
390	6.5	1.77	0.06	13.00	0.04	0.41	13.53	0.555	0.544
420	7.0	1.82	0.05	14.00	0.05	0.46	15.18	0.622	0.610
450	7.5	1.88	0.05	15.00	0.05	0.51	16.83	0.690	0.676
480	8.0	1.93	0.05	16.00	0.05	0.56	18.48	0.758	0.743
510	8.5	1.98	0.05	17.00	0.05	0.61	20.13	0.825	0.809
540	9.0	2.03	0.05	18.00	0.06	0.67	22.11	0.907	0.888
570	9.5	2.08	0 05	19.00	0.06	0.73	24.09	0.988	0.968
600	10.0	2.13	0 05	20.00	0.06	0.79	26.07	1.069	1.048
630	10.5	2.18	0.05	21.00	0.06	0.85	28.05	1.150	1 127
660	11.0	2.22	0.05	22.00	0.06	0.91	30.03	1.231	1.207
690	11.5	2.27	0 04	23.00	0.07	0.98	32.34	1.326	1 300
720	12.0	2.31	0.04	24.00	0.95	1.93	63.70	2.612	2 559
750	12.5	2.35	0.04	25.00	0.15	2.08	68.65	2.815	2.758
780	13.0	2.39	0.04	26.00	0.07	2.15	70.96	2.909	2.851
810	13.5	2.43	0 04	27 00	0.06	2.21	72.94	2.990	2.931
840	14.0	2.47	0 04	28.00	0.06	2.27	74.92	3.072	3.010
870	14.5	2.51	0.04	29.00	0.06	2.33	76.90	3.153	3.090
900	15.0	2.55	0.04	30 00	0.06	2.39	78.88	3.234	3.169
930	15.5	2.58	0.04	31.00	0.05	2 44	80.53	3.302	3.236
960	16.0	2.62	0.03	32.00	0.05	2.49	82.18	3.369	3.302
990	16.5	2.65	0.03	33.00	0.05	2.54	83.83	3.437	3.368
1020	17.0	2.69	0.03	34.00	0.05	2.59	85.48	3.505	3.435
1050	17.5	2.72	0.03	35.00	0.05	2.64	87.13	3.572	3.501
1080	18.0	2.75	0 03	36.00	0.04	2.68	88.45	3.626	3.554
1110	18.5	2 78	0.03	37.00	0.04	2.72	89.77	3.681	3.607
1140	19.0	2.81	0 03	38.00	0.04	2.76	91.09	3 735	3.660
1170	19.5	2.83	0 03	39.00	0 04	2.80	92.41	3.789	3.713
1200	20.0	2.86	0.03	40.00	0.03	2.83	93.40	3.829	3.753
1230	20.5	2.89	0.03	41.00	0.03	2.86	94.39	3.870	3.793
1260	21.0	2.91	0.02	42.00	0.03	2.89	95.38	3.911	3.832
1290	21.5	2.93	0.02	43.00	0.03	2.92	96.37	3.951	3.872
1320	22.0	2.95	0.02	44.00	0.03	2.95	97.36	3.992	3.912
1350	22.5	2.98	0.02	45.00	0.02	2.97	98.02	4.019	3.938
1380	23.0	3.00	0.02	46.00	0.02	2.99	98.68	4.046	3.965
1410	23.5	3.01	0.02	47.00	0.02	3.01	99.34	4.073	3 991
1440	24.0	3.03	0.02	48.00	0.02	3.03	100.00	4.100	4.018

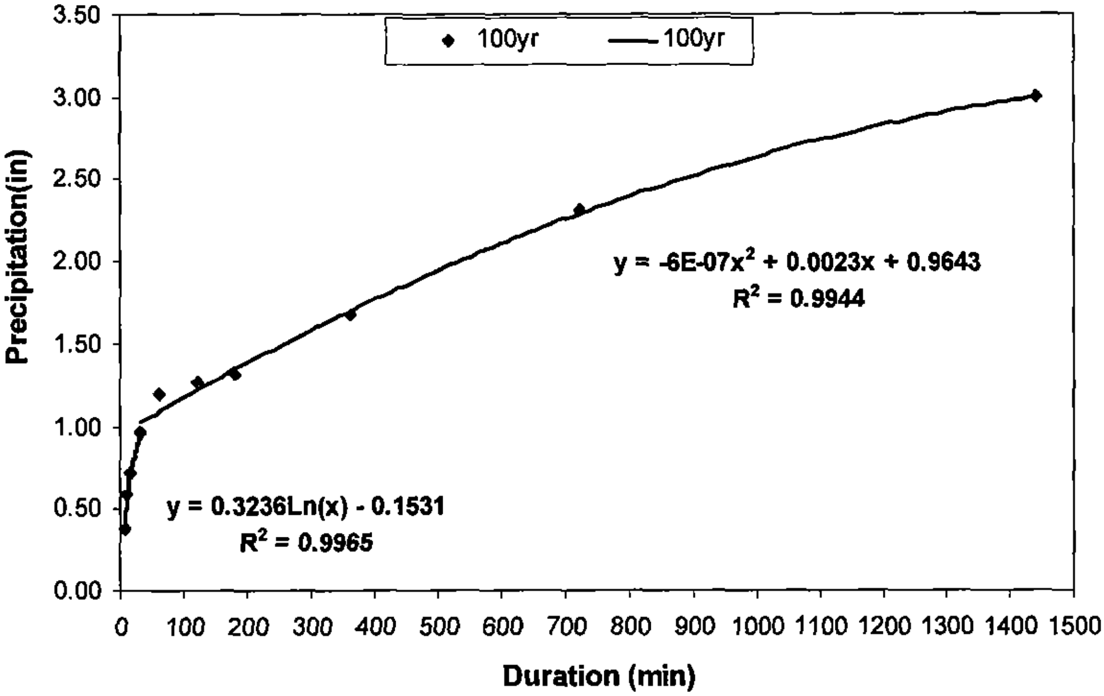


Figure B.1 Bailey Canyon Precipitation / Frequency Curve (NOAA 14 Data)

Lag Time (TLAG) Calculation

$$TLAG = 22.1\ K_n\ (LLc/S^{0.5})^{0.33}$$

Where
K_n = Roughness factor for the basin channels
L = Length of longest watercourse (miles)
L_c = Length of longest watercourse measured upstream to a point opposite the centroid of the basin (miles)
S = Representative (average) slope of the longest watercourse (ft/mile)

This equation is based on the United States *Bureau of Reclamation's (USBR's) analysis of the above* parameters for several drainage basins in the Southwest desert, Great basin, and Colorado Plateau are (U.S. Department of Interior, 1989). Since the Soil Conversion Services (SCS) and the USBR define lag differently, this equation was developed by *modifying the USBR's S-graph lag equation to correspond to* the SCS's definition of the dimensionless unit hydrograph lag equation.

Table B.2. Summary of Lag Time Calculations for Subbasins A,B & C *Using USBR Equation for Washoe County*

$T_{LAG} = 22.1 \cdot K_n \cdot (L \cdot L_c / S^{0.5})^{0.33}$ hours

Basin A

L(ft)	H_1(ft)	H_2(ft)	$H=(H_1-H_2)$ (ft)	$I=(L^3/H)^{0.5}$
17016	5320	4720	600	90617.1899
18256	6120	5320	800	87209.4298
5395	6860	6120	740	14567.0400
40667				**192393.6597**

S= **0.04467893** ft/ft
S= **235.9047** ft/mile

L_c =	**22824**	ft	**4.3227**	mile
L =	**40667**	ft	**7.7021**	mile
K_n =	**0.06**			

T_{LAG}=	1.712	hours
T_{LAG}=	103	min

Basin B

L(ft)	H_1(ft)	H_2(ft)	$H=(H_1-H_2)$ (ft)	$I=(L^3/H)^{0.5}$
1280	6460	6200	260	2840.0650
4066	6200	5320	880	8739.9656
6417	5320	4720	600	20985.6504
11763				**32565.6811**

S= **0.130471563** ft/ft
S= **688.8899** ft/mile

L_c =	**5346**	ft	**1.0125**	mile
L =	**11763**	ft	**2.2278**	mile
K_n =	***0.055***			

T_{LAG}=	0.541	hours
T_{LAG}=	32	min

Basin C

L(ft)	H_1(ft)	H_2(ft)	$H=(H_1-H_2)$ (ft)	$I=(L^3/H)^{0.5}$
2397	6560	6000	560	4959.1591
2855	6000	5680	320	8527.7445
2097	5680	5140	540	4132.3849
2259	5140	4900	240	6930.5663
2885	4900	4740	160	12250.6388
12493				**36800.4936**

S= **0.115246088** ft/ft
S= ***608.4993*** *ft/mile*

L_c =	**6020**	ft	**1.1402**	mile
L =	**12493**	ft	**2.3661**	mile
K_n =	**0.055**			

T_{LAG}=	0.586	hours
T_{LAG}=	35	min

Table B.3. Summary of Lag Time Calculations for Subbasins D Using Upland Method

SHEET FLOW: 1		
Time of Concetration(Tc) = $0.007(nL)^{0.8}/(P_2^{0.5}*s^{0.4})$		
Surface Description	Range	
Manning's Roughness	n	0.13
Flow Length (ft)	L	300
2yr-24hr Rainfall (inch)	P_2	1.4
Land Slope (ft/ft)	s	0.045
Travel Time (hr)	T_c	**0.383**

SHALLOW CONCENTRATED FLOW: 2		
Time of Concetration(T_c) = L/(3600V/)		
Surface Description	Earthen and paved surfaces	
Flow Length (ft)	L	5658
Watercourse Slope (ft/ft)	s	0.035
Average Velocity (ft/s)	V	3.7
Travel Time (hr)	T_c	**0.425**

Travel Time(T_t) = L/3600V	Trapezoidal Channel	
Cross Sectional Area (ft^2)	a	128
Wetted Perimeter	P_w	41.54
Hydraulic Radius (ft) **(a/P_w)**	r	3.08
Channel Slope	s	0.015
Manning's Roughness	n	0.040
Velocity (ft/s) **($1.49\ r^{2/3}s^{1/2}/n$)**	V	9.66
Flow Length (ft)	L	3555
Travel Time (hr)	T_t	**0.084**

Total Time of Concentration (Tc) =	**0.892**	**hours**
Lag Time (T_{lag}) =	**0.535**	**hours**
Lag Time (T_{lag}) =	**32**	**mins**

Table B.4. Summary of Weighted CN Calculations for Subbasins

Basin A 360081630 SF 8266.34 AC 12.9162 SM

Soil Name	Area (SF)	Hydro. Group	Area (AC)	C_n	C_n x Area
251	2109026	C	48.42	67	3243.91
251	409874	C	9.41	67	630.43
482	2478083	B	56.89	49.5	2816.06
893	286613	C & D	6.58	71.25	468.81
893	24153101	C & D	554.48	71.25	39506.62
1410	4028341	B, C, & D	92.48	64	5918.59
1410	1980262	B, C, & D	45.46	64	2909.48
1410	1736498	B, C, & D	39.86	64	2551.33
1410	198829	B, C, & D	4.56	64	292.13
1410	367997	B, C, & D	8.45	64	540.68
1520	322333006	D	7399.75	75.5	558680.94
		Sum:	8266.34		617558.97

Ave. C_n = 74.71

Basin B 16322126 SF 374.70 AC 0.5855 SM

Soil Name	Area (SF)	Hydro. Group	Area (AC)	C_n	C_n x Area
251	202787	C	4.66	67	311.91
1520	16119339	D	370.05	75.5	27938.71
		Sum:	374.70		28250.62

Ave. C_n = 75.39

Basin C 22874325 SF 525.12 AC 0.8205 SM

Soil Name	Area (SF)	Hydro. Group	Area (AC)	C_n	C_n x Area
1520	22874325	D	525.12	80	42009.78
		Sum:	525.12		42009.78

Ave. C_n = *80.00*

Basin D 25367266 SF 582.35 AC 0.9099 SM

Soil Name	Area (SF)	Hydro. Group	Area (AC)	C_n	C_n x Area
110	77494	D	1.78	70	124.53
171	1610467	D	36.97	70	2587.99
251	12554294	C	288.21	63	18157.04
360	160511	B	3.68	51	187.93
482	4018282	B	92.25	51	4704.60
880	242698	C	5.57	63	351.01
930	521187	D	11.96	70	837.54
971	1265612	B	29.05	51	1481.78
971	805460	B	18.49	51	943.03
1520	4111261	D	94.38	70	6606.71
		Sum:	582.35		35982.15

Ave. C_n = 61.79

Weighted Average CN for Subbasins A, B, C, & D = 74.2

Table B.5.1. Curve No. for Arid and Semiarid Rangelands (SCS TR-55)

Table 2-2d.—Runoff curve numbers for arid and semiarid rangelands[1]

Cover description		Curve numbers for hydrologic soil group—			
Cover type	Hydrologic condition[2]	A[3]	B	C	D
Herbaceous—mixture of grass, weeds, and low-growing brush, with brush the minor element.	Poor		80	87	93
	Fair		71	81	89
	Good		62	74	85
Oak-aspen—mountain brush mixture of oak brush, aspen, mountain mahogany, bitter brush, maple, and other brush.	Poor		66	74	79
	Fair		48	57	63
	Good		30	41	48
Pinyon-juniper—pinyon, juniper, or both; grass understory.	Poor		75	85	89
SUBBASIN C →	Fair		58 49.5	73 67	80 75.5
SUBBASINS A & B →	Good		41	61	71
Sagebrush with grass understory.	Poor		67	80	85
Sub-Basin D →	Fair		51	63	70
W 30% IMPERVIOUS	Good		35	47	55
Desert shrub—major plants include saltbush, greasewood, creosotebush, blackbrush, bursage, palo verde, mesquite, and cactus.	Poor	63	77	85	88
	Fair	55	72	81	86
	Good	49	68	79	84

[1]Average runoff condition, and $I_a = 0.2S$. For range in humid regions, use table 2-2c.

[2]Poor: <30% ground cover (litter, grass, and brush overstory).
Fair: 30 to 70% ground cover.
Good: >70% ground cover.

[3]Curve numbers for group A have been developed only for desert shrub.

CN: for Hydrologic Soil Group

	B	C	D
Sub-Basin A Sub-Basin B	49.5	67.	75.5
Sub-Basin C	58	73	80
Sub-Basin D	51	63	70

Used in Sub-Basin A } CN for Soil Group C & D = 71.25
CN for Soil Group B, C & D = 64.0

Table B.5.2. Curve No. for Urban Areas (SCS, TR-55)

FOR SUBBASIN D, LAND USE IS MEDIUM DESITY SUBURBAN ≈ 3 LOTS/ACRE ≈ 30% IMPERVIOUS

Table 2-2a.—Runoff curve numbers for urban areas[1]

Cover description: Cover type and hydrologic condition	Average percent impervious area[2]	Curve numbers for hydrologic soil group— A	B	C	D
Fully developed urban areas (vegetation established)					
Open space (lawns, parks, golf courses, cemeteries, etc.)[3]:					
Poor condition (grass cover < 50%)		68	79	86	89
Fair condition (grass cover 50% to 75%)		49	69	79	84
Good condition (grass cover > 75%)		39	61	74	80
Impervious areas:					
Paved parking lots, roofs, driveways, etc. (excluding right-of-way)		98	98	98	98
Streets and roads:					
Paved; curbs and storm sewers (excluding right-of-way)		98	98	98	98
Paved; open ditches (including right-of-way)		83	89	92	93
Gravel (including right-of-way)		76	85	89	91
Dirt (including right-of-way)		72	82	87	89
Western desert urban areas:					
Natural desert landscaping (pervious areas only)[4]		63	77	85	88
Artificial desert landscaping (impervious weed barrier, desert shrub with 1- to 2-inch sand or gravel mulch and basin borders)		96	96	96	96
Urban districts:					
Commercial and business	85	89	92	94	95
Industrial	72	81	88	91	93
Residential districts by average lot size:					
1/8 acre or less (town houses)	65	77	85	90	92
1/4 acre MDS	38	61	75	83	87
1/3 acre ← 3 LOTS/ACRE	30	57	72	81	86
1/2 acre	25	54	70	80	85
1 acre	20	51	68	79	84
2 acres	12	46	65	77	82
Developing urban areas					
Newly graded areas (pervious areas only, no vegetation)[5]		77	86	91	94
Idle lands (CN's are determined using cover types similar to those in table 2-2c).					

[1] Average runoff condition, and $I_a = 0.2S$.
[2] The average percent impervious area shown was used to develop the composite CN's. Other assumptions are as follows: impervious areas are directly connected to the drainage system, impervious areas have a CN of 98, and pervious areas are considered equivalent to open space in good hydrologic condition. CN's for other combinations of conditions may be computed using figure 2-3 or 2-4.
[3] CN's shown are equivalent to those of pasture. Composite CN's may be computed for other combinations of open space cover type.
[4] Composite CN's for natural desert landscaping should be computed using figures 2-3 or 2-4 based on the impervious area percentage (CN = 98) and the pervious area CN. The pervious area CN's are assumed equivalent to desert shrub in poor hydrologic condition.
[5] Composite CN's to use for the design of temporary measures during grading and construction should be computed using figure 2-3 or 2-4, based on the degree of development (impervious area percentage) and the CN's for the newly graded pervious areas.

Table B.6. HEC-HMS Results using SCS Method for Composite Basins

Project: *Bailey-SCS*	*Simulation Run:* Bailey 4B/30M/5C Composite		
Start of Run:	01May2006, 00:00	Basin Model:	Bailey 4B Composite
End of Run:	02May2006, 12:00	Meteorologic Model:	NOAA 14 UNIT
Execution Time:	29Jun2006, 13:25:46	Control Specifications:	Control 5 min
Volume Units:	AC-FT		

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (AC-FT)
1A & 1B	0.0714	22.29	01May2006, 12:25	4.61
Bailey Creek	0.0000	2555.61	01May2006, 13:40	1210.47
CURT 18	0.0113	8.18	01May2006, 12:05	1.00
Chandler Ditch	0.0000	22.00	01May2006, 13:30	11.62
Chandler Split Flow	15.2309	329.92	01May2006, 13:40	130.27
Geiger Channel	15.3023	335.00	01May2006, 13:45	134.89
Geiger Split Flow	15.2309	351.92	01May2006, 13:40	141.89
J1	13.5010	2773.59	01May2006, 13:40	1213.69
J2	14.3210	2861.50	01May2006, 13:40	1291.48
J3 at Toll Road	15.2309	2907.53	01May2006, 13:40	1352.35
J4	15.3023	335.29	01May2006, 13:40	134.88
J5	15.3136	335.67	01May2006, 13:45	135.89
Reach-1	13.5010	2772.23	01May2006, 13:40	1213.70
Reach-2	0.8200	393.47	01May2006, 12:25	77.78
Reach-3	14.3210	2859.60	01May2006, 13:45	1291.53
Spreader 1	15.3136	335.67	01May2006, 13:45	135.89
Subbasin A	12.9160	2725.91	01May2006, 13:40	1167.95
Subbasin B	0.5850	237.09	01May2006, 12:25	45.74
Subbasin C	0.8200	398.31	01May2006, 12:25	77.79
Subbasin D	0.9099	261.04	01May2006, 12:20	60.83

Table B.7. Summary of Bailey Canyon (4-Subbasins) Parameters

Subbasin Area [Bailey 4...

Show Elements:

Subbasin	Area (MI2)
1A & 1B	0.0714
CURT 18	0.0113
Subbasin A	12.916
Subbasin B	0.585
Subbasin C	0.82
Subbasin D	0.9099

SCS Transform [Bailey 4

Show Elements:

Subbasin	Lag Time (MIN)
1A & 1B	36
CURT 18	13.2
Subbasin A	103
Subbasin B	32 5
Subbasin C	35
Subbasin D	32

Curve Number Loss [Bailey 4B Composite]

Show Elements:

Subbasin	Initial Abstraction (IN)	Curve Number	Impervious (%)
1A & 1B		77	0.0
CURT 18		86	0.0
Subbasin A		74.7	0.0
Subbasin B		75.39	0.0
Subbasin C		80	0.0
Subbasin D		61.8	30

Muskingum Cunge Channel Routing [Bailey 4B Composite]

Show Elements:

Reach	Length (FT)	Slope (FT/FT)	Manning's n	Shape	Diameter (FT)	Width (FT)	Side Slope (xH:1V)
Geiger Channel	2170	0.02	0.03	Trapezoid		9	3
Reach-1	1796	0.015	0.04	Trapezoid		20	2.5
Reach-2	1650	0.02	0.04	Triangle			3
Reach-3	5263	0.015	0.04	Trapezoid		25	2.5

C

APPENDIX C
GREEN & AMPT LOSS METHOD ANALYSIS FOR BAILEY CANYON

Table C.1. Weighted Green & Ampt Loss Rate Parameter Values for Subbasin A

Soil Type	Soil Texture	Soil Infiltration Parameters							
		Soil Percentage (%/100)	A_s=(Total Area) x (Soil Percentage) (acres)	Volumetric Soil Moisture Deficit θ	θ x A_s	Wetting Front Suction Head ψ (in)	ψ x A_s	Hydraulic Conductivity K (in/hr)	K x A_s
251 - Cassiro gravelly sandy loam (Total Area = 57.83 acres)									
Cassiro	Sandy Loam	1.00	57.83	0.300	17.35	4.30	248.67	0.40	23.13
482 - Holbrook cobbly loamy sand (Total Area = 145.72 acres)									
Holbrook	Loamy Sand	1.00	56.89	0.325	18.49	2.40	136.54	1.20	68.27
893 - Indiano-Duco-Cagle association (Total Area = 561.06 acres)									
Indiano	Sandy Loam	0.42	235.65	0.300	70.69	4.30	1013.27	0.40	94.26
Duco	Sandy Loam	0.36	201.98	0.300	60.59	4.30	868.52	0.40	80.79
Cagle	Clay Loam	0.22	123.43	0.200	24.69	8.20	1012.15	0.04	4.94
1410 - Bumborough-Ticino-Gabica association (Total Area = 190.82 acres)									
Bumborough	Loam	0.42	80.14	0.300	24.04	3.50	280.51	0.25	20.04
Ticino	Sandy Loam	0.36	68.70	0.300	20.61	4.30	295.39	0.40	27.48
Gabica	Sandy Loam	0.22	41.98	0.300	12.59	4.30	180.52	0.40	16.79
1520 - Duco-Smallcone-Cagle association (Total Area = 8355.91 acres)									
Duco	Sandy Loam	0.47	3477.88	0.300	1043.36	4.30	14954.89	0.40	1391.15
Smallcone	Sandy Loam	0.36	2663.91	0.300	799.17	4.30	11454.81	0.40	1065.56
Cagle	Clay Loam	0.17	1257.96	0.200	251.59	8.20	10315.25	0.04	50.32
		(sum) Σ=	**8266.35**		**2343.19**		**40760.52**		**2842.73**

Avg. θ =	**0.283**	**Avg. ψ (in) =**	**4.93**	**Avg. K (in/hr) =**	**0.34**

Uncertainties: Exact soil classification for type #360 (Pits) are not available
Loamy Sand / Sand parameters were used for soil type #360's porosity, wetting front suction, and hydraulic conductivity

Source: Green and Ampt infiltration parameters were obtained from *Drainage Design Manual for Maricopa County, Arizona, 4th Edition, (Flood Control District of Maricopa County and City of Phoenix, November 2003, Draft)*

Table C.2. Weighted Green & Ampt Loss Rate Parameter Values for Subbasin B

Soil Type	Soil Texture	Soil Infiltration Parameters: Soil Percentage (%/100)	A_s=(Total Area) x (Soil Percentage) (acres)	Volumetric Soil Moisture Deficit θ	θ x A_s	Wetting Front Suction Head ψ (in)	ψ x A_s	Hydraulic Conductivity K (in/hr)	K x A_s
251 - Cassiro gravelly sandy loam (Total Area = 294.23 acres)									
Cassiro	Sandy Loam	1 00	4 66	0 300	1.40	4.30	20 04	0.40	1.86
1520 - Duco-Smallcone-Cagle association (Total Area = 8355.91 acres)									
Duco	Sandy Loam	0.47	173 92	0.300	52 18	4.30	747.87	0.40	69.57
Smallcone	Sandy Loam	0.36	133 22	0.300	39.97	4.30	572.84	0.40	53.29
Cagle	Clay Loam	0.17	62.91	0.200	12 58	8.20	515.85	0 04	2.52
		(sum) Σ=	**374.71**		**106.12**		**1856.60**		**127.24**

Avg. θ =	0.283	Avg. ψ (in) =	4.95	Avg. K (in/hr) =	0.34

Uncertainties: Exact soil classification for type #360 (Pits) are not available.
Loamy Sand / Sand parameters were used for soil type #360's porosity, wetting front suction, and hydraulic conductivity.

Source: Green and Ampt infiltration parameters were obtained from *Drainage Design Manual for Maricopa County, Arizona, 4th Edition, (Flood Control District of Maricopa County and City of Phoenix, November 2003, Draft)*

Table C.3. Weighted Green & Ampt Loss Rate Parameter Values for Subbasin C

Soil Type	Soil Texture	Soil Infiltration Parameters							
		Soil Percentage (%/100)	A_s=(Total Area) x (Soil Percentage) (acres)	Volumetric Soil Moisture Deficit θ	θ x A_s	Wetting Front Suction Head ψ (in)	ψ x A_s	Hydraulic Conductivity K (in/hr)	K x A_s
1520 - Duco-Smallcone-Cagle association (Total Area = 8355.91 acres)									
Duco	Sandy Loam	0.47	246.81	0 300	74.04	4 30	1061.27	0.40	98 72
Smallcone	Sandy Loam	0.36	189 04	0 300	56.71	4.30	812.89	0 40	75.62
Cagle	Clay Loam	0.17	89 27	0 200	17.85	8.20	732.02	0.04	3.57
		(sum) Σ=	525.12		148.61		2606.17		177.91

Avg. θ = 0.283	Avg. ψ (in) = 4.96	Avg. K (in/hr) = 0.34

Uncertainties: Exact soil classification for type #360 (Pits) are not available.
Loamy Sand / Sand parameters were used for soil type #360's porosity, wetting front suction, and hydraulic conductivity

Source: Green and Ampt infiltration parameters were obtained from *Drainage Design Manual for Maricopa County, Arizona, 4th Edition, (Flood Control District of Maricopa County and City of Phoenix, November 2003, Draft)*

Table C.4. Weighted Green & Ampt Loss Rate Parameter Values for Subasin D

Soil Type	Soil Texture	Soil Infiltration Parameters							
		Soil Percentage (%/100)	A_s=(Total Area) x (Soil Percentage) (acres)	Volumetric Soil Moisture Deficit θ	θ x A_s	Wetting Front Suction Head ψ (in)	ψ x A_s	Hydraulic Conductivity K (in/hr)	K x A_s
110 - Jowec Variant sandy loam (Total Area = 1.78 acres)									
Jowec	Sandy Loam	1.00	1 78	0.300	0.53	4.30	7.65	0.40	0.71
171 - Indian Creek gravelly sandy loam (Total Area = 54.97 acres)									
Indian Creek	Sandy Loam	1.00	36.97	0.300	11.09	4.30	158.97	0.40	14.79
251 - Cassiro gravelly sandy loam (Total Area = 294.23 acres)									
Cassiro	Sandy Loam	1.00	288.21	0 300	86 46	4.30	1239.30	0.40	115 28
360 - Pits (Total Area = 3.68)									
n/a	n/a	1.00	3 68	0.300	1.10	2.40	8.83	1.20	4 42
482 - Holbrook cobbly loamy sand (Total Area = 145.72 acres)									
Holbrook	Loamy Sand	1.00	92.25	0.325	29 98	2.40	221.40	1.20	110.70
880 - Zephan-Rock Outcrop-Smallcone complex (Total Area = 33.26 acres)									
Zephan	Sandy Loam	0.55	3.06	0.300	0.92	4.30	13.17	0.40	1.23
Smallcone	Sandy Loam	0.45	2 51	0.300	0.75	4.30	10.78	0.40	1.00
930 - Old Camp stony sandy loam (Total Area = 19.50 acres)									
Old Camp	Sandy Loam	1.00	11.96	0.300	3.59	4.30	51.43	0.40	4.78
971 - Aladshi sandy loam (Total Area = 44.62 acres)									
Aladshi	Sandy Loam	1.00	47.54	0.300	14 26	4.30	204.42	0.40	19.02
1520 - Duco-Smallcone-Cagle association (Total Area = 8355.91 acres)									
Duco	Sandy Loam	0 47	44.36	0.300	13.31	4 30	190 74	0 40	17.74
Smallcone	Sandy Loam	0.36	33.98	0.300	10 19	4.30	146.10	0.40	13.59
Cagle	Clay Loam	0.17	16 04	0 200	3.21	8 20	131.57	0.04	0.64
		(sum) Σ=	582.34		175.40		2384.37		303.90

Avg. θ =	0.301	Avg. ψ (in) =	4.09	Avg. K (in/hr) =	0.52

Uncertainties: Exact soil classification for type #360 (Pits) are not available.
Loamy Sand / Sand parameters were used for soil type #360's porosity, wetting front suction, and hydraulic conductivity.

Source: Green and Ampt infiltration parameters were obtained from *Drainage Design Manual for Maricopa County, Arizona, 4th Edition, (Flood Control District of Maricopa County and City of Phoenix, November 2003, Draft)*

may not be correct. Incorrect results could cause serious consequences for flood control planning and design. Therefore, it is recommended that, for watersheds consisting of relatively small subareas of sand, the Green and Ampt parameter values for loamy sand be used for the sand portion of the watershed. If the area contains a large portion of sand, then either the Green and Ampt method should be used with the parameter values for loamy sand or the IL+ULR method should be used with the appropriately determined values for the parameters.

Table 4.1
GREEN AND AMPT LOSS RATE PARAMETER VALUES FOR BARE GROUND

Soil Texture Classification	XKSAT inches/hour	PSIF inches	DTHETA[1]		
			Dry	Normal	Saturated
(1)	(2)	(3)	(4)	(5)	(6)
loamy sand & sand	1.20	2.4	0.35	0.30	0
sandy loam	0.40	4.3	0.35	0.25	0
loam	0.25	3.5	0.35	0.25	0
silty loam	0.15	6.6	0.40	0.25	0
silt	0.10	7.5	0.35	0.15	0
sandy clay loam	0.06	8.6	0.25	0.15	0
clay loam	0.04	8.2	0.25	0.15	0
silty clay loam	0.04	10.8	0.30	0.15	0
sandy clay	0.02	9.4	0.20	0.10	0
silty clay	0.02	11.5	0.20	0.10	0
clay	0.01	12.4	0.15	0.05	0

Notes:

1. Selection of DTHETA

Dry	=	Nonirrigated lands, such as desert and rangeland;
Normal	=	Irrigated lawn, turf, and permanent pasture;
Saturated	=	Irrigated agricultural land.

Initial Loss Calculation used for Green & Ampt Loss Model:

According to the Hydrologic Modeling System HEC-HMS Technical Reference Manual (US Army Corps of Engineers, March 2000), initial loss (or initial abstraction) for the Green & Ampt Loss Model may be estimated using similar methods as other loss models. Therefore, the initial abstraction concept derived from the Soil Conservation Service (SCS) Curve Number Loss Model, which is based on antecedent moisture and soil cover characteristics, can be used to estimate the initial loss for the Green and Ampt model.

SCS Curve Number uses the following equation to estimate the initial loss, $\mathbf{I_a}$, which was developed from an empirical relationship shared with the potential maximum retention, **S**, derived from analysis of many small watersheds:

$$I_a = 0.2*S$$

Also, the potential maximum retention, **S**, and watershed characteristics are related through the curve number, **CN**, with the following equation:

$$S = [1000-(10*CN)] / CN \qquad \text{(US system)}$$

Therefore, the initial loss equation can be summarized as:

$$I_a = 0.2*([1000-(10*CN)] / CN)$$

Summary of Initial Loss (I_a)

Basin	CN	I_a (in)
A	74.74	0.68
B	75.39	0.65
C	80.00	0.50
D	61.79	1.24

Sources:

- *US Army Corps of Engineers, March 2000, Hydrologic Modeling System HEC-HMS Technical Reference Manual, pp 40-42.*

Project : Bailey-Green and Ampt   Simulation Run : Bailey 4B/30M/5C Composite   Junction: J3 at Toll Road

Start of Run :	01May2006, 00:00	Basin Model :	Bailey 4B Composite
End of Run :	02May2006, 12:00	Meteorologic Model :	NOAA 14 UNIT
Execution Time :	26Jun2006, 14:35:22	Control Specifications :	Control 5 min

Volume Units : IN AC-FT

Computed Results

Peak Outflow : 2968.41 (CFS)   Date/Time of Peak Outflow : 01May2006, 13:35
Total Outflow : 625.94 (AC-FT)

Figure C.1. HEC-HMS Results using Green & Ampt Loss Method

D

APPENDIX D
FREQUENCY ANALYSIS FOR BAILEY CANYON BASIN

Water Resources

Data Category: Surface Water **Geographic Area:** United States go

Peak Streamflow for the Nation

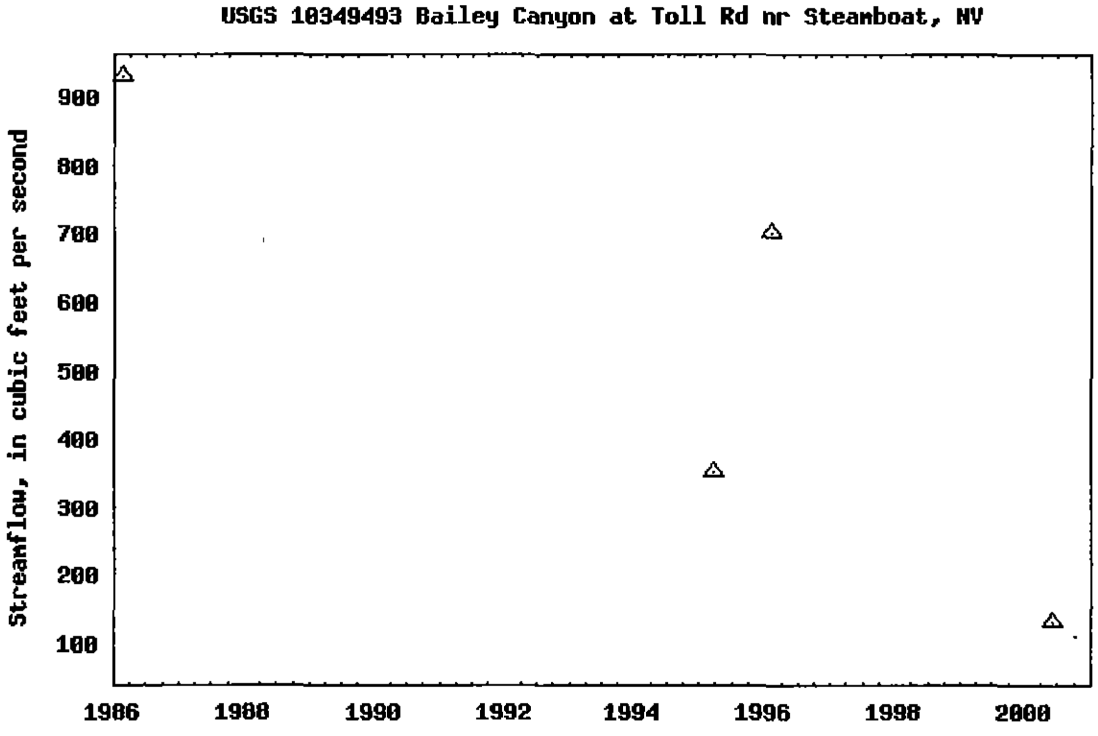
USGS 10349493 Bailey Canyon at Toll Rd nr Steamboat, NV

Available data for this site Site home page GO

Washoe County, Nevada
Hydrologic Unit Code 16050102
Latitude 39°22'31", Longitude 119°42'51" NAD27
Drainage area 12.7 square miles
Gage datum 4,830. feet above sea level NGVD29

Output formats

- Table
- Graph
- Tab-separated file
- WATSTORE formatted file
- Reselect output format



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INPUT SKEW AND PROBABILITY TO FIND LP3 DEVIATE, K

Note: It appears that this is a close estimate to the table (see table comparison)

$$K = \frac{2}{G}\left\{\left[\left(Z_{1-P} - \frac{G}{6}\right)\frac{G}{6} + 1\right]^3 - 1\right\}$$

where:

$P \le 0.5$

$$Z_{1-p} = t - \frac{C_0 + C_1 t + C_2 t^2}{1 + d_1 t + d_2 t^2 + d_3 t^3}$$

$$t = \left[-2\ln(P)\right]^{\frac{1}{2}}$$

$P > 0.5$

$$Z_{1-p} = -\left(t - \frac{C_0 + C_1 t + C_2 t^2}{1 + d_1 t + d_2 t^2 + d_3 t^3}\right)$$

$$t = \left[-2\ln(1-P)\right]^{\frac{1}{2}}$$

Enter G (Use 0.000001 for 0)

Skew, G = -0.891600

$C_0 = 2.515517$ $d_1 = 1.432788$

$C_1 = 0.802853$ $d_2 = 0.189269$

$C_2 = 0.010328$ $d_3 = 0.001308$

Probability, P	Z_{1-P}	t less	t greater	Deviate, K	
0.0100	2.3268	3.0349	0.14178	1.676	**Result**
Enter P					

STATISTICS AND FREQUENCY CURVE COORDINATES
Bailey Canyon (Gage) Basin, Nevada

Year	Annual Max Peak Flow (cfs) X	Sorted Year	Sorted Peak Flow (cfs) X	Y=logX	Y^2	Y^3	Rank m	Weibull Plot *f* P=m/n+1 *x100*	Annual Max Peak Flow (cfs) X
1986	930	1986	930	2.96848	8.81189	26.15795	1	100.0	930
1995	350	1996	700	2.84510	8.09458	23.02988	2	200.0	700
1996	700	1995	350	2.54407	6.47228	16.46593	3	300.0	350
2000	130	2000	130	2.11394	4.46876	9.44670	4	400.0	130
			SUM =	**10.4716**	**27.8475**	**75.1005**			

MEAN: Y_m= sumY/n = 2.6179

STD. DEVIATION: S = ((sumY^2-(sumY)^2/n)/(n-1))$^{0.5}$ = 0.3803

SKEW COEFF: G = ((n^2*sumY^3)-(3*n*sumY*sumY^2)+2*(sumY)^3)/(n*(n-1)*(n-2)*S^3) = -0.8916

FREQUENCY CURVE COORDINATES: LOG-PEARSON TYPE III **WITH G =** -0.8916
(unweighted)

log X = Ym + KS

Return Period (Tr)	Exceedance Probability (%)	Devate K (Table)	log X	Pk. Flow X (cfs)
100.0	1.000	1.6760	3.2553	1800

AREA ADJUSTMENT:

Peak flow for Bailey Canyon = (1800/12.7)*15.18 =2152 cfs

E

APPENDIX E
USGS REGRESSION ANALYSIS FOR BAILEY CANYON

National Flood Frequency Program
Version 3.0
Based on Water-Resources Investigations Report 02-4168
Equations from database C:\Program Files\NFF\NFF files\NFFv3.2_2004-12-14.mdb
Updated by kries 9/22/2004 at 4:03:24 PM fixed decimal place in constant
Equations for Nevada developed using English units

Site: Bailey Canyon, Nevada
User: Mathy
Date: Friday, January 13, 2006 11:33 AM

Rural Estimate: Bailey-Gage
Basin Drainage Area: 15.2 mi2
1 Region
Region: Eastern_Sierras_Region_5
Drainage_Area = 15.2 mi2
Mean_Basin_Elevation = 6160 ft
Latitude_of_Site = 39.4 decimal degrees
Crippen & Bue Region 16

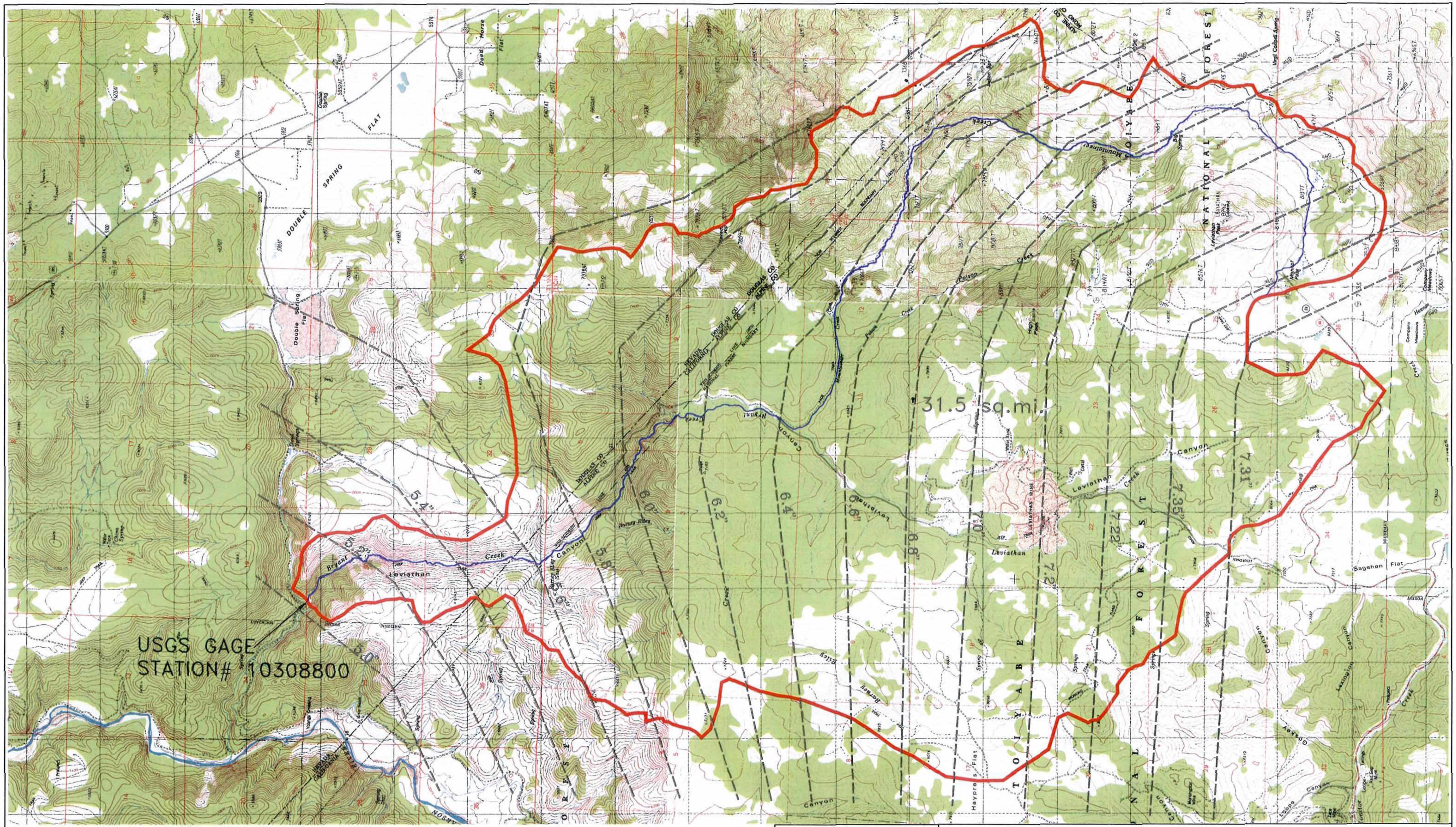
Flood Peak Discharges, in cubic feet per second

Estimate	Recurrence Interval, yrs	Peak, cfs	Standard Error, %	Equivalent Years
Bailey-Gage	2	75.8	140	0.2
	5	244	100	0.7
	10	466	84	1.7
	25	923	87	2.6
	50	1420	91	3.3
	100	**2040**	95	3.8
	500	4590		

Maximum: 86700 (for C&B region 16)

F

APPENDIX F
SCS METHOD ANALYSIS FOR BRYANT CREEK



LEGEND
- BASIN LIMIT
- 100yr/24hr ISOHYETAL LINE
- LONGEST WATERCOURSE

cfa

FIGURE # F.1

BRYANT CREEK

HYDROLOGICAL MAP

File: X:\Projects\98006.33\Dwg\Bailey and Bryant Basin dwgs\ Bailey & Bryant_topo.dwg
<Mathy> Fri, 07 Apr 2006 - 10:55am

Water Resources

Data Category: Surface Water

Geographic Area: United States

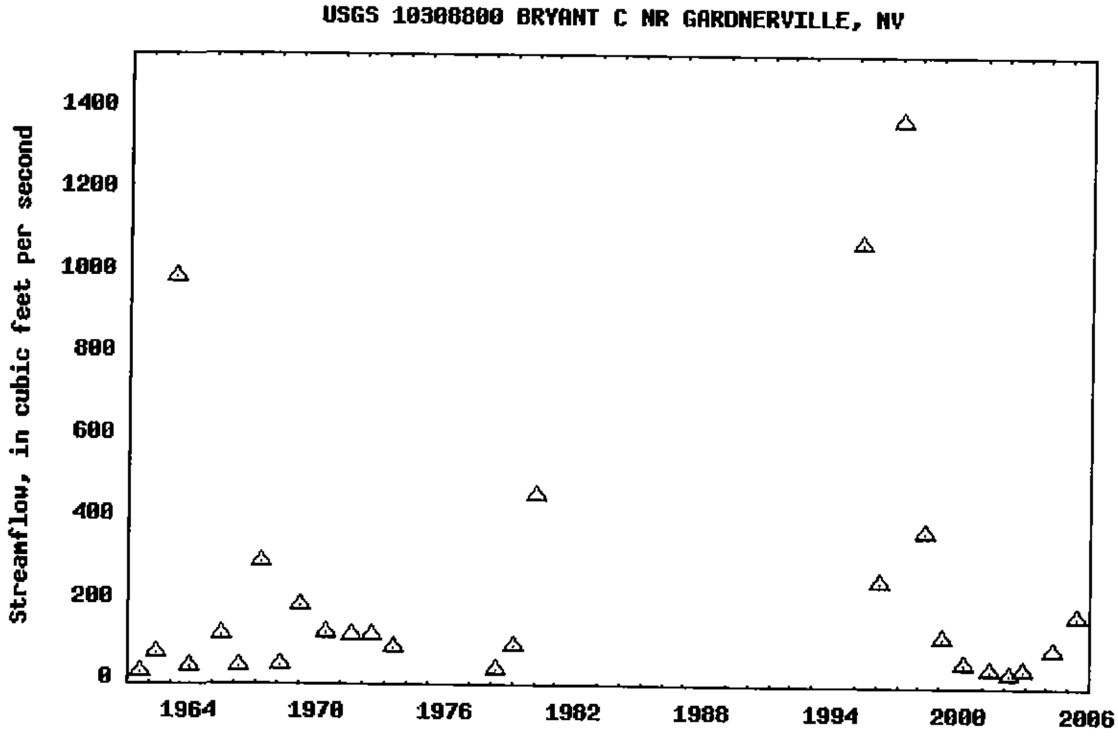
go

Peak Streamflow for the Nation

USGS 10308800 BRYANT C NR GARDNERVILLE, NV

Available data for this site Site home page GO

	Output formats
Douglas County, Nevada Hydrologic Unit Code 16050201 Latitude 38°47'38", Longitude 119°40'18" NAD27 Drainage area 31.5 square miles Gage datum 5,445.91 feet above sea level NGVD29	Table Graph Tab-separated file WATSTORE formatted file Reselect output format



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Questions about data Water Webserver Team
Feedback on this website NWISWeb Support Team

Top
Explanation of terms

Surface Water for USA: Peak Streamflow
http://waterdata.usgs.gov/nwis/peak?

Retrieved on 2006-04-07 15:42:16 EDT
Department of the Interior, U.S. Geological Survey
Privacy Statement || Disclaimer || Accessibility || FOIA
1.86 1.87 nadww01

U. S. GEOLOGICAL SURVEY
ANNUAL PEAK FLOW FREQUENCY ANALYSIS
Following Bulletin 17-B Guidelines
Program peakfq
(Version 4.1, February, 2002)

--- PROCESSING DATE/TIME ---

2005 DEC 21 09:52:32

--- PROCESSING OPTIONS ---

```
Plot option          = None
Basin char output    = None
Print option         = Yes
Debug print          = No
Input peaks listing  = Long
Input peaks format   = WATSTORE peak file
```

U. S. GEOLOGICAL SURVEY
ANNUAL PEAK FLOW FREQUENCY ANALYSIS
Following Bulletin 17-B Guidelines
Program peakfq
(Version 4.1, February, 2002)

Station - 10308800 BRYANT C NR GARDNERVILLE, NV
2005 DEC 21 09:52:32

I N P U T   D A T A   S U M M A R Y

```
Number of peaks in record                =      26
Peaks not used in analysis               =       0
Systematic peaks in analysis             =      26
Historic peaks in analysis               =       0
Years of historic record                 =       0
Generalized skew                         =   0.153
Standard error of generalized skew       =   0.550
Skew option                              =  WEIGHTED
Gage base discharge                      =     0.0
User supplied high outlier threshold     =   --
User supplied low outlier criterion      =   --
Plotting position parameter              =    0.00
```

```
*********  NOTICE  --  Preliminary machine computations.          *********
*********  User responsible for assessment and interpretation.    *********

WCF134I-NO SYSTEMATIC PEAKS WERE BELOW GAGE BASE.                     0.0
WCF195I-NO LOW OUTLIERS WERE DETECTED BELOW CRITERION.                2.9
WCF163I-NO HIGH OUTLIERS OR HISTORIC PEAKS EXCEEDED HHBASE.        2765.5
```

Station - 10308800 BRYANT C NR GARDNERVILLE, NV
2005 DEC 21 09:52:32

ANNUAL FREQUENCY CURVE PARAMETERS -- LOG-PEARSON TYPE III

```
          FLOOD BASE                     LOGARITHMIC
    ----------------------  ---------------------------------
```

	DISCHARGE	EXCEEDANCE PROBABILITY	MEAN	STANDARD DEVIATION	SKEW
SYSTEMATIC RECORD	0.0	1.0000	1.9517	0.5955	0.399
BULL.17B ESTIMATE	0.0	1.0000	1.9517	0.5955	0.293

ANNUAL FREQUENCY CURVE -- DISCHARGES AT SELECTED EXCEEDANCE PROBABILITIES

ANNUAL EXCEEDANCE PROBABILITY	BULL.17B ESTIMATE	SYSTEMATIC RECORD	'EXPECTED PROBABILITY' ESTIMATE	95-PCT CONFIDENCE LIMITS FOR BULL. 17B ESTIMATES LOWER	UPPER
0.9950	3.8	4.4	2.9	1.3	7.8
0.9900	5.0	5.5	4.0	1.8	9.8
0.9500	10.6	11.1	9.5	4.7	18.8
0.9000	16.2	16.5	15.1	7.9	27.3
0.8000	27.8	27.7	26.8	15.2	44.5
0.5000	83.7	81.7	83.7	52.9	131.4
0.2000	277.1	274.2	290.2	173.4	503.8
0.1000	538.5	544.3	591.9	316.6	1125.0
0.0400	1127.0	1179.0	1347.0	602.3	2818.0
0.0200	1847.0	1986.0	2392.0	917.6	5255.0
0.0100	2911.0	3226.0	4146.0	1347.0	9373.0
0.0050	4458.0	5095.0	7092.0	1925.0	16150.0
0.0020	7563.0	9017.0	14260.0	2988.0	31810.0
0.6667	47.1	(1.50-year flood)			
0.4292	106.5	(2.33-year flood)			

Station - 10308800 BRYANT C NR GARDNERVILLE, NV
2005 DEC 21 09:52:32

I N P U T   D A T A   L I S T I N G

WATER YEAR	DISCHARGE	CODES	WATER YEAR	DISCHARGE	CODES
1961	8.0		1978	19.9	
1962	58.0		1979	78.0	
1963	975.0		1980	442.0	
1964	24.0		1995	1060.0	
1965	99.0		1996	236.0	
1966	25.0		1997	1360.0	
1967	278.0		1998	356.0	
1968	28.0		1999	103.0	
1969	176.0		2000	40.0	
1970	106.0		2001	22.0	
1971	103.0		2002	15.0	
1972	100.0		2003	25.0	
1973	70.0		2004	70.0	

Explanation of peak discharge qualification codes

PEAKFQ CODE	WATSTORE CODE	DEFINITION
D	3	Dam failure, non-recurrent flow anomaly
G	8	Discharge greater than stated value
X	3+8	Both of the above
L	4	Discharge less than stated value
K	6 OR C	Known effect of regulation or urbanization
H	7	Historic peak

Station - 10308800 BRYANT C NR GARDNERVILLE, NV
2005 DEC 21 09:52:32

EMPIRICAL FREQUENCY CURVES -- WEIBULL PLOTTING POSITIONS

WATER YEAR	RANKED DISCHARGE	SYSTEMATIC RECORD	BULL.17B ESTIMATE
1997	1360.0	0.0370	0.0370
1995	1060.0	0.0741	0.0741
1963	975.0	0.1111	0.1111
1980	442.0	0.1481	0.1481
1998	356.0	0.1852	0.1852
1967	278.0	0.2222	0.2222
1996	236.0	0.2593	0.2593
1969	176.0	0.2963	0.2963
1970	106.0	0.3333	0.3333
1971	103.0	0.3704	0.3704
1999	103.0	0.4074	0.4074
1972	100.0	0.4444	0.4444
1965	99.0	0.4815	0.4815
1979	78.0	0.5185	0.5185
1973	70.0	0.5556	0.5556
2004	70.0	0.5926	0.5926
1962	58.0	0.6296	0.6296
2000	40.0	0.6667	0.6667
1968	28.0	0.7037	0.7037
1966	25.0	0.7407	0.7407

Project :	Bailey Canyon	Run Name :	Run 134	Subbasin :	Bryant(6.6" Rain)
	Start of Run :	17Aug05 0000		Basin Model :	Bryant(6.6" Rain)
	End of Run :	18Aug05 1200		Met. Model :	NOAA-30 Bryant-6.6"
	Execution Time :	11Jan06 1446		Control Specs :	Control-30 Min

Volume Units : Inches Acre-Feet

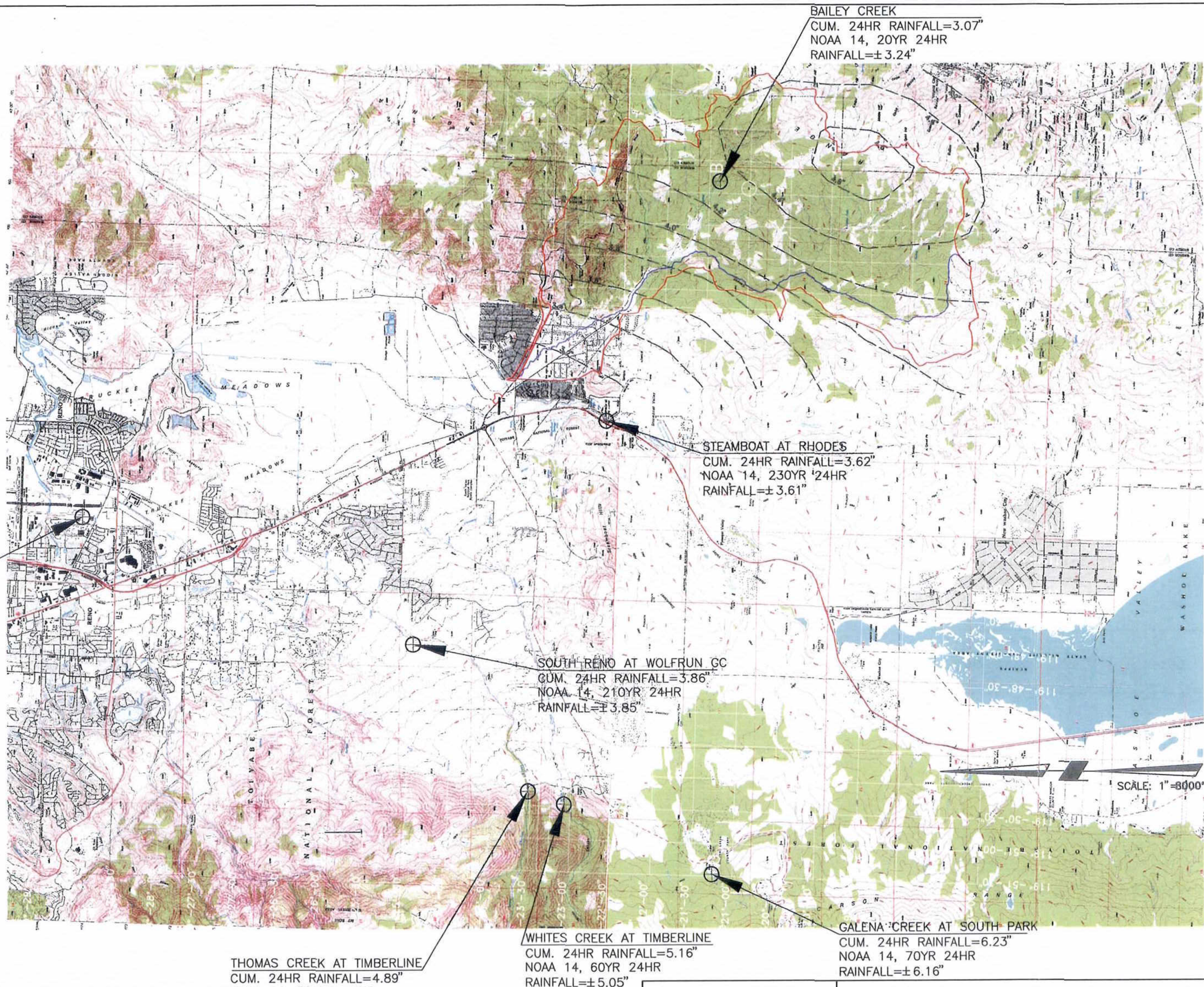
Computed Results

Peak Discharge :	4142.7	(cfs)	Date/Time of Peak Discharge :	17 Aug 05 1530	
Total Precipitation :	6.49	(in)	Total Direct Runoff :	4021	(ac-ft)
Total Loss :	4.09	(in)	Total Baseflow :	0.0	(ac-ft)
Total Excess :	2.39	(in)	Total Discharge :	4020.7	(ac-ft)

Figure F.2. Bryant Creek Results with mean rainfall (6.62") (CN = 61.6, Lag = 1.916 hrs)

G

APPENDIX G
DECEMBER 2005 STORM OBSERVATIONS



LEGEND

BASIN LIMIT

100yr/24hr ISOHYETAL LINE

LONGEST WATERCOURSE

cfa

FIGURE # G.1

GAGE DATA
CUMULATIVE 24 HR RAINFALL (12/30/05-12/31/05)
HYDROLOGICAL MAP

File: X:\Projects\98006.33\Dwg\Bailey and Bryant Basin dwgs\ Bailey & Bryant_topo.dwg
<Mathy> Fri, 07 Apr 2006 - 10:56am

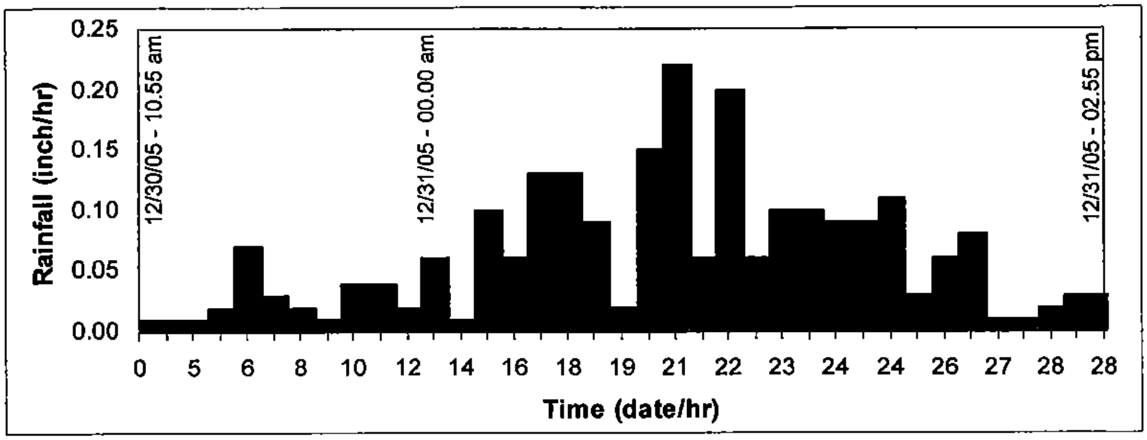


Figure G.2. Incremental Rainfall Data for Gage at Reno-Tahoe Airport (12/30/05-12/31/05).

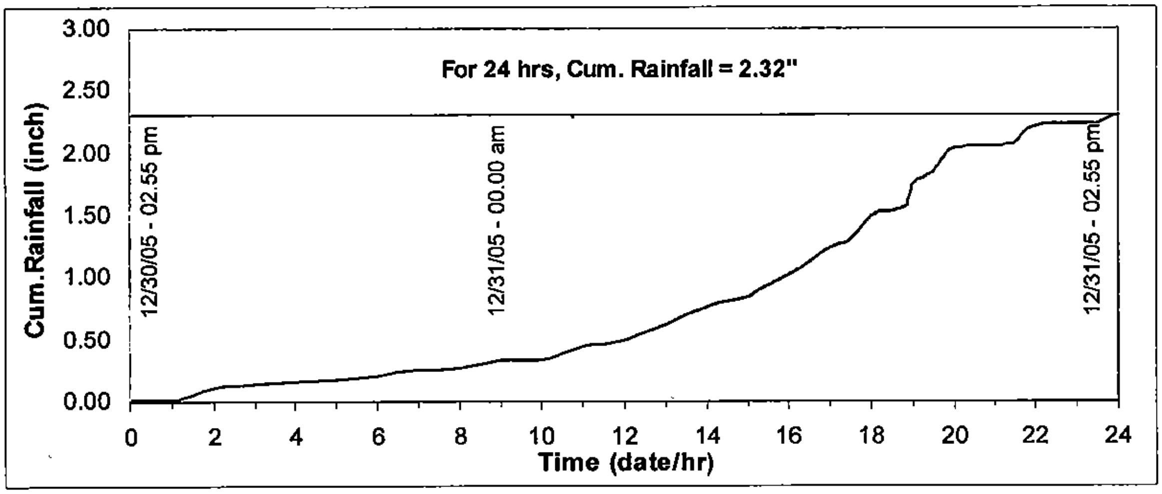


Figure G.3. Cumulative Rainfall Data for Gage at Reno-Tahoe Airport (12/30/05-12/31/05).

Table G.1. NOAA Atlas 14 Precipitation Frequency Estimates for Gage at Reno-Tahoe Airport.

Precipitation Frequency Estimates (inches)

ARI* (years)	5 min	10 min	15 min	30 min	60 min	120 min	3 hr	6 hr	12 hr	24 hr	48 hr	4 day	7 day	10 day	20 day	30 day	45 day	60 day
2	0.11	0.16	0.20	0.27	0.33	0.45	0.53	0.73	0.92	1.11	1.33	1.56	1.81	2.02	2.39	2.69	3.20	3.71
5	0.14	0.22	0.27	0.36	0.45	0.58	0.67	0.90	1.16	1.43	1.72	2.02	2.35	2.62	3.09	3.45	4.11	4.75
10	0.17	0.26	0.33	0.44	0.55	0.68	0.76	1.02	1.34	1.68	2.02	2.40	2.79	3.09	3.62	4.04	4.80	5.50
25	0.23	0.34	0.43	0.57	0.71	0.83	0.90	1.18	1.57	2.03	2.46	2.93	3.40	3.74	4.33	4.83	5.71	6.46
50	0.27	0.41	0.51	0.69	0.85	0.95	1.00	1.30	1.75	2.31	2.82	3.35	3.89	4.26	4.87	5.43	6.40	7.16
100	0.33	0.50	0.61	0.83	1.02	1.09	1.14	1.41	1.93	2.60	3.18	3.80	4.42	4.81	5.44	6.05	7.09	7.83
200	0.39	0.59	0.73	0.99	1.22	1.24	1.29	1.52	[illegible]	2.92	3.57	4.27	4.96	5.37	5.99	6.67	7.78	8.47
500	0.49	0.75	0.93	1.25	1.55	1.56	1.61	1.65	[illegible]	3.34	4.11	4.93	5.74	6.14	6.76	7.50	8.70	9.31
1000	0.58	0.89	1.10	1.49	1.84	1.86	1.90	[illegible]	2.49	3.67	4.55	5.47	6.37	6.75	7.33	8.13	9.39	9.89

Cumulative 24 hr Rainfall = 2.32", Approximately a 50 year storm event

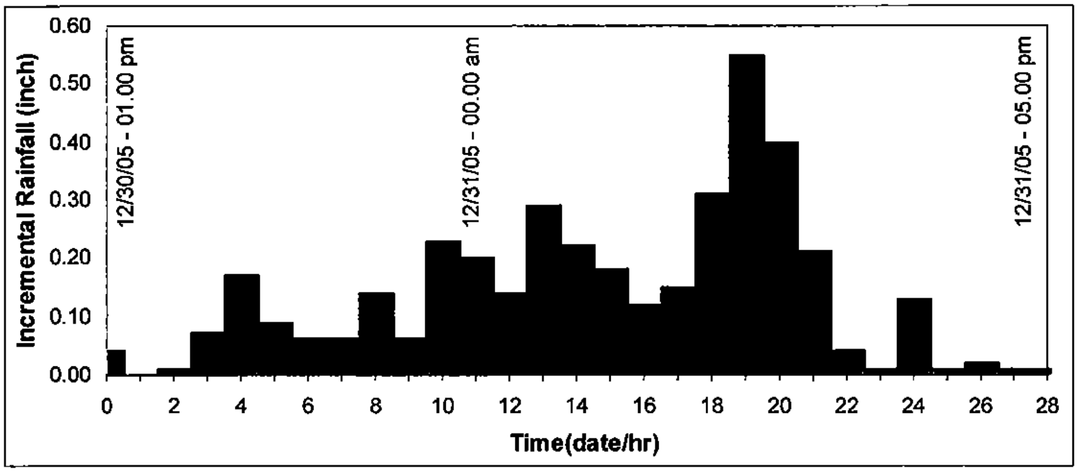


Figure G.4. Incremental Rainfall Data for Gage at South Reno (Wolf Run Golf Course) (12/30/05-12/31/05).

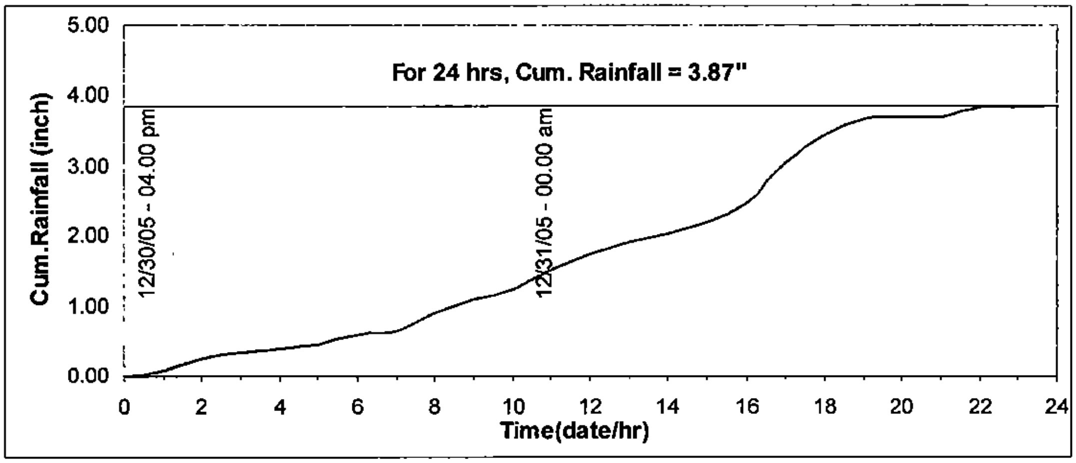


Figure G.5. Cumulative Rainfall Data for Gage at South Reno (Wolf Run Golf Course) (12/30/05-12/31/05).

Table G.2. NOAA Atlas 14 Precipitation Frequency Estimates for Gage at South Reno (Wolf Run Golf Course).

Precipitation Frequency Estimates (inches)

ARI* (years)	5 min	10 min	15 min	30 min	60 min	120 min	3 hr	6 hr	12 hr	24 hr	48 hr	4 day	7 day	10 day	20 day	30 day	45 day	60 day
2	0.12	0.18	0.22	0.30	0.37	0.49	0.59	0.84	1.10	1.42	1.72	2.10	2.46	2.77	3.47	4.08	4.91	5.64
5	0.16	0.24	0.30	0.41	0.51	0.64	0.75	1.05	1.40	1.82	2.22	2.73	3 23	3 65	4 55	5.35	6.42	7 36
10	0.20	0.30	0.38	0.51	0.62	0.76	0.87	1.21	1.64	2.15	2.62	3.25	3.87	4 35	5 39	6 32	7.55	8.60
25	0.26	0.40	0.49	0 66	0.82	0.95	1 04	1.41	1.94	2.61	3.21	4.00	4.75	5.33	6.53	7.65	9.07	10.19
50	0.32	0.48	0.60	0.81	1.00	1.10	1.17	1.56	2.18	2.98	3.68	4.62	5.48	6.10	7.41	8.68	10.22	11.37
100	0.39	0.59	0.73	0.98	1.22	1.28	1.33	1.72	2.42	3.37	4.17	5.27	6 25	6.92	8.33	9.74	11.39	12.51
200	0.47	0.71	0.88	1.19	1.47	1.49	1.55	1.87	2.66	3.78	4.70	5.97	7 06	7.78	9 26	10.82	12.55	13 61
500	0.60	0.91	1.13	1.52	1.88	1.91	1.96	2.08	2.9[illegible]	4.35	5.45	6.98	8 22	8.96	10.55	12.30	14.11	15.04
1000	0.72	1.10	1.36	1.83	2.27	2.29	2.33	2.35	[illegible].23	4.81	6.05	7.80	9.17	9.91	11.55	13.45	15.29	16.06

Cumulative 24 hr Rainfall = 3.86", Approximately a 215 year storm event

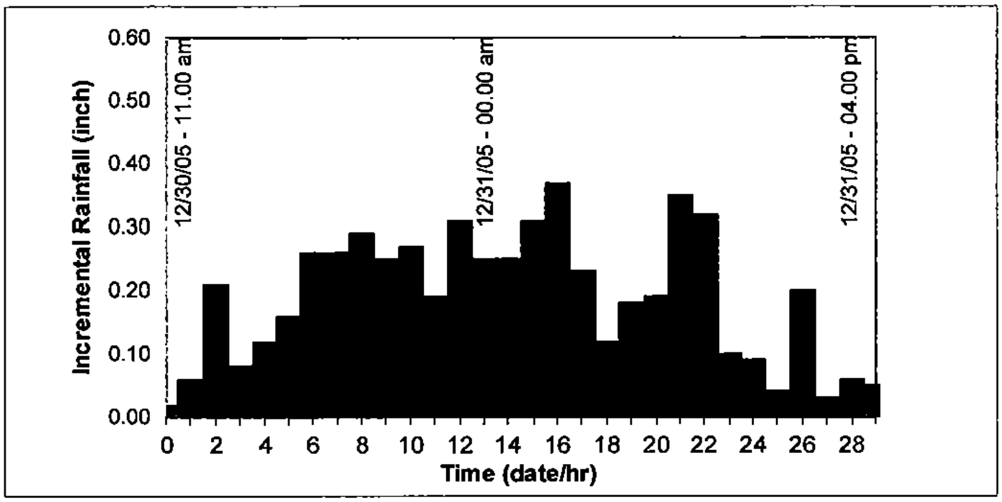


Figure G.6. Incremental Rainfall Data for Gage at Carson City (12/30/05-12/31/05).

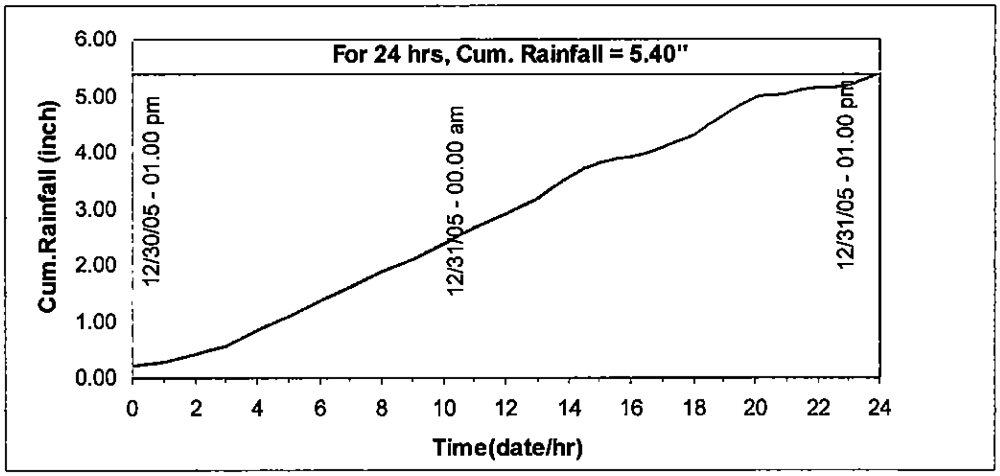


Figure G.7. Cumulative Rainfall Data for Gage at Carson City (12/30/05-12/31/05).

Table G.3. NOAA Atlas 14 Precipitation Frequency Estimates for Gage at Carson City.

	Precipitation Frequency Estimates (inches)																	
ARI* (years)	**5 min**	**10 min**	**15 min**	**30 min**	**60 min**	**120 min**	**3 hr**	**6 hr**	**12 hr**	**24 hr**	**48 hr**	**4 day**	**7 day**	**10 day**	**20 day**	**30 day**	**45 day**	**60 day**
2	0.12	0.19	0.23	0 32	0.39	0.53	0.64	0.91	1.22	1.67	2.07	2.53	2 97	3 36	4.26	4 99	6.00	7.02
5	0.17	0.25	0 32	0.42	0.53	0.68	0.81	1.14	1.56	2.13	2.67	3.29	3.89	4.40	5.55	6.49	7.80	9.11
10	0.21	0.32	0.39	0.53	0.66	0.81	0.94	1.31	1.82	2.50	3.15	3.92	4.63	5.23	6.53	7.64	9.15	10.61
25	0.28	0.42	0.52	0.70	0.86	1 01	1.13	1.55	2.17	3.01	3.84	4.80	5.68	6.37	7.87	9.19	10.94	12.53
50	0.34	0.51	0.63	0.85	1.06	1.18	1.28	1.73	2.44	3.43	4.39	5.52	6.53	7.28	8.89	10.38	12.29	13.93
100	0.41	0.62	0.77	1.04	1.29	1.38	1.45	1.91	2.72	3.86	4.98	6.29	7.43	8.23	9.96	11.61	13.66	15.31
200	0.50	0.76	0 94	1.26	1.57	1.63	1.70	2.11	3.00	4.31	5.60	7.12	8.39	9.22	11.03	12.85	15.03	16.65
500	0.64	0.97	1.21	1.62	2.01	2.05	2.10	2.39	3.38	4.93	6.47	8.28	9.73	10 59	12.49	14.53	16.84	18.35
1000	0.77	1.17	1.45	1.96	2.42	2.46	2 50	2.63	3.6[illegible]	5.43	7.18	9.23	10.83	11.68	13.62	15.83	18.23	19.60

Cumulative 24 hr Rainfall = 5.40", Approximately a 1000 year storm event

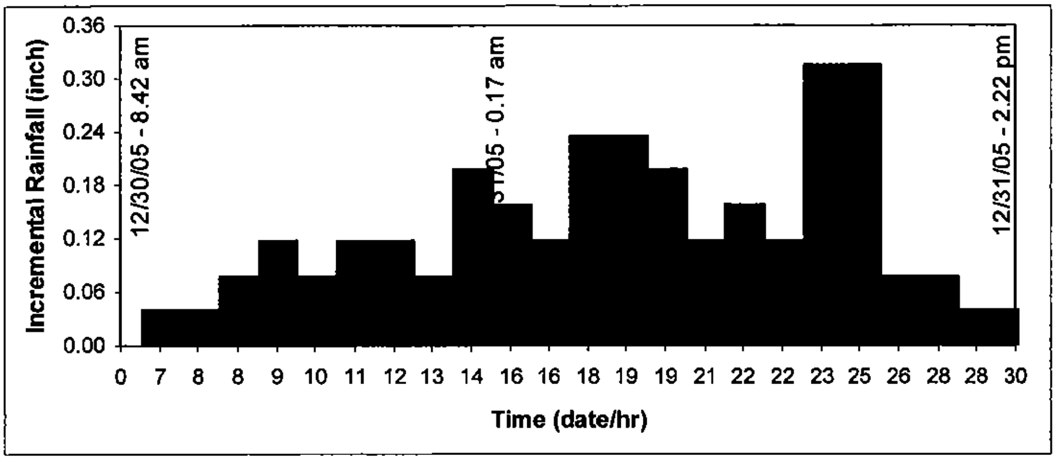


Figure G.8. Incremental Rainfall Data for Gage at Bailey Creek (12/30/05-12/31/05).

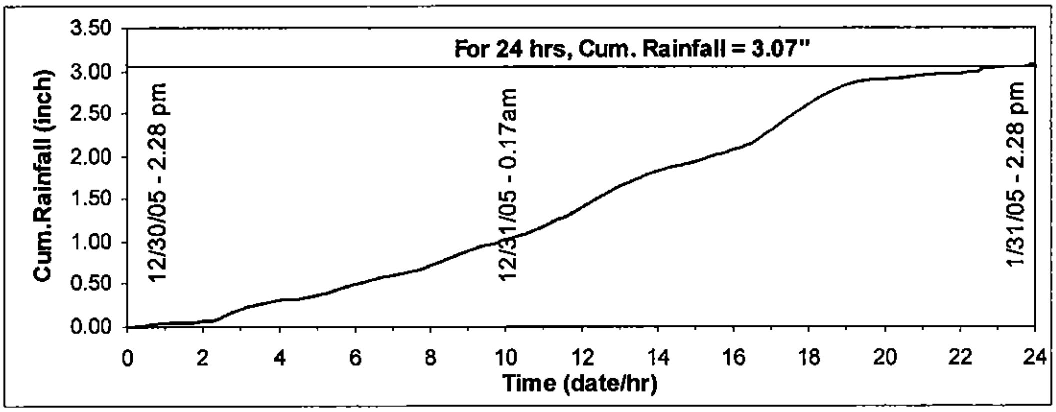


Figure G.9. Cumulative Rainfall Data for Gage at Bailey Creek (12/30/05-12/31/05).

Table G.4. NOAA Atlas 14 Precipitation Frequency Estimates for Gage at Bailey Creek.

Precipitation Frequency Estimates (inches)																	
ARI* (years)	5 min	10 min	15 min	30 min	60 min	120 min	3 hr	6 hr	12 hr	24 hr	48 hr	4 day	7 day	10 day	20 day	30 day	45 day	60 day
2	0.14	0.21	0.26	0.35	0.43	0.57	0.70	1.01	1.39	1.81	2 29	2.85	3.37	3.81	4.90	5.84	7.03	8.34
5	0.18	0.28	0.35	0.47	0.58	0.73	0.87	1.25	1.76	2.32	2.96	3.71	4.41	4.98	6 36	7.58	9.11	10.78
10	0.23	0.34	0.43	0.57	0.71	0.87	1.01	1.44	2.05	2.73	3.51	4.42	5.25	5.91	7.49	8.92	10.68	12.54
25	0.29	0.45	0.55	0.75	0.92	1.08	1.20	1.68	2.44	3.31	4.28	5.43	6.45	7.21	9.01	10.73	12.79	14.81
50	0.36	0.54	0.67	0.90	1.12	1.25	1.36	1.86	[illegible]	3.77	4.90	6.24	7.42	8.24	10.19	12.13	14.39	16.48
100	0.43	0.65	0.81	1.09	1.35	1.45	1.54	2.04	[illegible]	4.25	5 56	7.12	8.45	9.33	11.42	13.56	16.01	18.12
200	0.52	0.79	0.97	1.31	1.62	1.69	1.79	2.24	[illegible]	4.76	6.26	8.04	9.54	10.46	12.65	15.02	17.65	19.73
500	0.66	1.00	1.24	1.67	2.07	2.14	2 23	2.49	3.74	5.47	7 25	9.35	11.10	12.03	14.34	16.99	19.84	21.77
1000	0.79	1.21	1.49	2.01	2.49	2.56	2 64	[illegible]	4.05	6 03	8 04	10.42	12.36	13.28	15.65	18.51	21.52	23.28

Cumulative 24 hr Rainfall = 3.07", Approximately a 16 year storm event

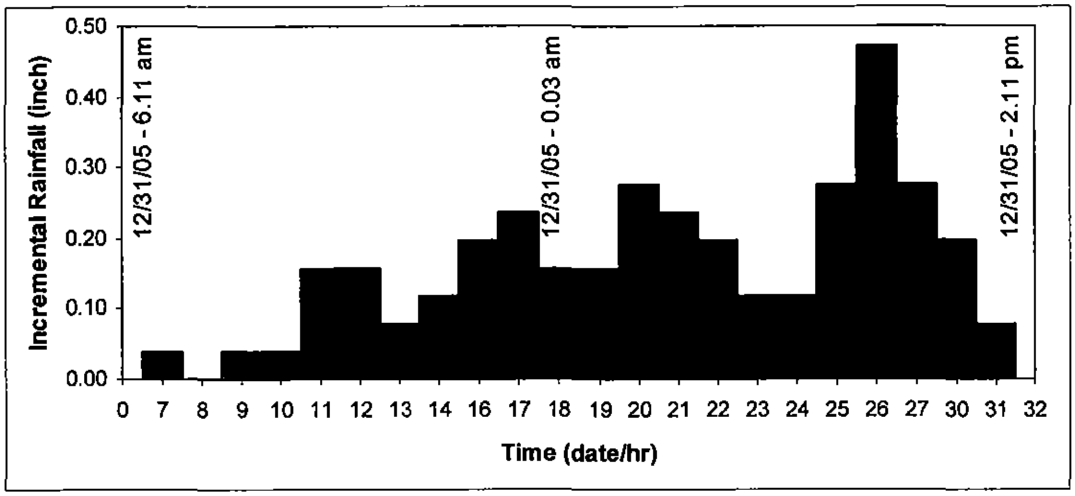


Figure G.10. Incremental Rainfall Data for Gage at Steamboat at Rhodes (12/30/05-12/31/05).

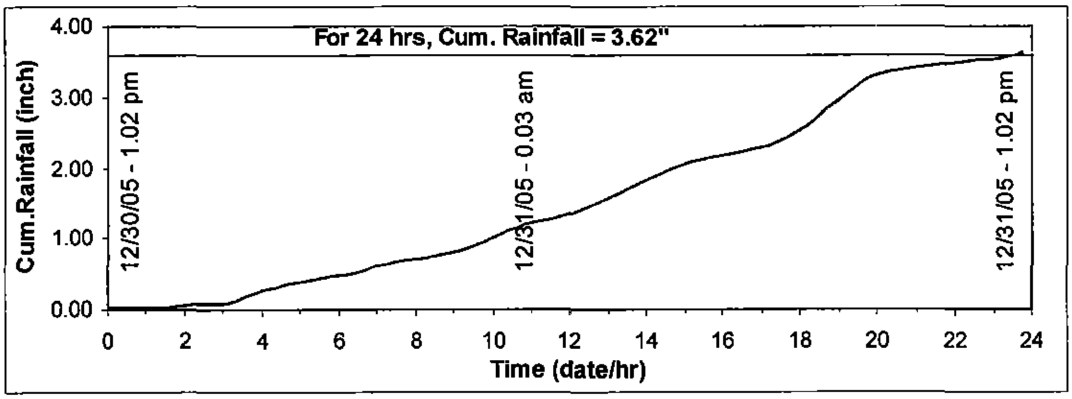


Figure G.11. Cumulative Rainfall Data for Gage at Steamboat at Rhodes (12/30/05-12/31/05).

Table G.5. NOAA Atlas 14 Precipitation Frequency Estimates for Gage at Steamboat at Rhodes.

Precipitation Frequency Estimates (inches)																	
ARI* (years)	5 min	10 min	15 min	30 min	60 min	120 min	3 hr	6 hr	12 hr	24 hr	48 hr	4 day	7 day	10 day	20 day	30 day	45 day	60 day
2	0.12	0.18	0.22	0.30	0.37	0.49	0.59	0.82	1.08	1.34	1.61	1.97	2.30	2.57	3.10	3.55	4.22	4.91
5	0.16	0.25	0.30	0.41	0.51	0.64	0.76	1.04	1.39	1.72	2.06	2.54	2.98	3.34	4.02	4.59	5.45	6.33
10	0.20	0.31	0.38	0.51	0.63	0.77	0.88	1.21	1.63	2.02	2.43	3.00	3.53	3.95	4.72	5.38	6.36	7.34
25	0.27	0.41	0.50	0.68	0.84	0.96	1.06	1.42	1.94	2.44	2.94	3.66	4.30	4.79	5.67	6.45	7.54	8.62
50	0.33	0.50	0.61	0.83	1.02	1.12	1.20	1.59	2.19	2.78	3.35	4.19	4.92	5.46	6.40	7.26	8.41	9.53
100	0.40	0.60	0.75	1.01	1.25	1.31	1.37	1.75	2.44	3.13	3.79	4.76	5.57	6.15	7.15	8.08	9.26	10.40
200	0.48	0.73	0.91	1.22	1.51	1.55	1.60	1.93	2.69	3.51	4.24	5.36	6.25	6.86	7.89	8.90	10.08	11.22
500	0.62	0.94	1.17	1.57	1.95	1.97	2.02	2.17	3.03	4.03	4.88	6.21	7.21	7.83	8.90	10.01	11.12	12.20
1000	0.74	1.13	1.41	1.89	2.34	2.37	2.41	2.44	[illegible]	4.45	5.39	6.89	7.98	8.60	9.67	10.84	11.85	12.85

Cumulative 24 hr Rainfall = 3.62", Approximately a 234 year storm event

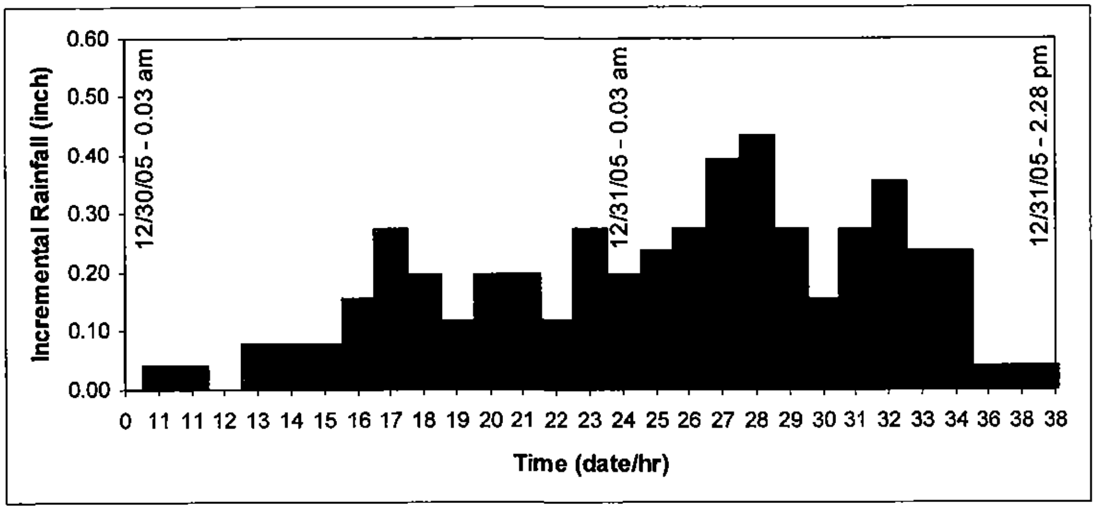


Figure G.12. Incremental Rainfall Data for Gage at Thomas Creek at Timberline (12/30/05-12/31/05).

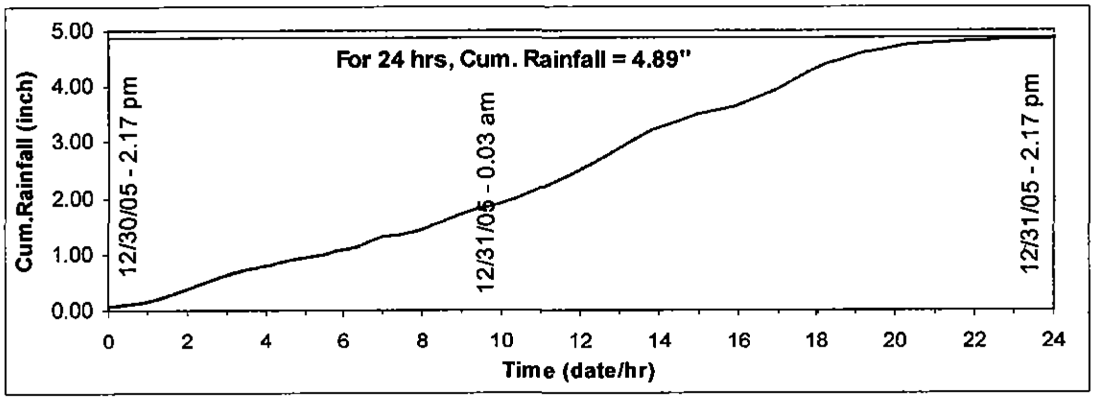


Figure G.13. Cumulative Rainfall Data for Gage at Thomas Creek at Timberline (12/30/05-12/31/05).

Table G.6. NOAA Atlas 14 Precipitation Frequency Estimates for Gage at Thomas Creek at Timberline.

Precipitation Frequency Estimates (inches)																		
ARI* (years)	**5 min**	**10 min**	**15 min**	**30 min**	**60 min**	**120 min**	**3 hr**	**6 hr**	**12 hr**	**24 hr**	**48 hr**	**4 day**	**7 day**	**10 day**	**20 day**	**30 day**	**45 day**	**60 day**
2	0.14	0.22	0.27	0.36	0.45	0.60	0.73	1.08	1.50	2.15	2.74	3.66	4.41	5.07	6.68	8.18	10.01	11.56
5	0.20	0.30	0.37	0.50	0.61	0.78	0.93	1.37	1.93	2.79	3.60	4.87	5 95	6.84	8.95	10.95	13.35	15.42
10	0.24	0.37	0.46	0.62	0.76	0.93	1.09	1.59	2.27	3 31	4.32	5.89	7.22	8 27	10.73	13.11	15.90	18.23
25	0.32	0.49	0.60	0.81	1.01	1.17	1.31	1.87	2.73	4.06	5.35	7 36	9.04	10.29	13.20	16.10	19.37	21.89
50	0.39	0.60	0.74	1.00	1.24	1.36	1.49	2.08	3.08	4.67	6.21	8.59	10.54	11.93	15.15	18.46	22.06	24.63
100	0.48	0.73	0.91	1.22	1.51	1.59	1.68	2.30	3.44	5.32	7.13	9.93	12.18	13.68	17.22	20.94	24.85	27.39
200	0.58	0.89	1.10	1.49	1.84	1.91	2.00	2.52	[illegible]	6.01	8.12	11.38	13.94	15 54	19.37	23.52	27.71	30.14
500	0.76	1.15	1.43	1.92	2.38	2.44	2.53	2.82	[illegible]	7.00	9.56	13 50	16.48	18.18	22.38	27.10	31.64	33.80
1000	0.92	1.40	1.73	2.33	2.88	2 95	3.04	3.09	4.71	7.80	10.75	15.28	18.59	20.32	24.77	29.94	34.74	36 56

Cumulative 24 hr Rainfall = 4.89", Approximately a 51 year storm event

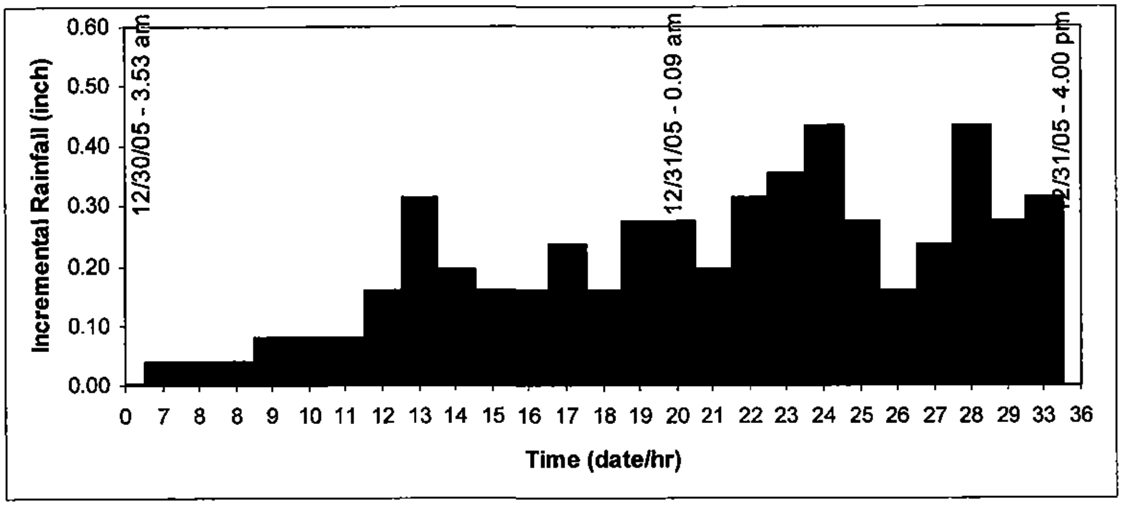


Figure G.14. Incremental Rainfall Data for Gage at Whites Creek at Timberline (12/30/05-12/31/05).

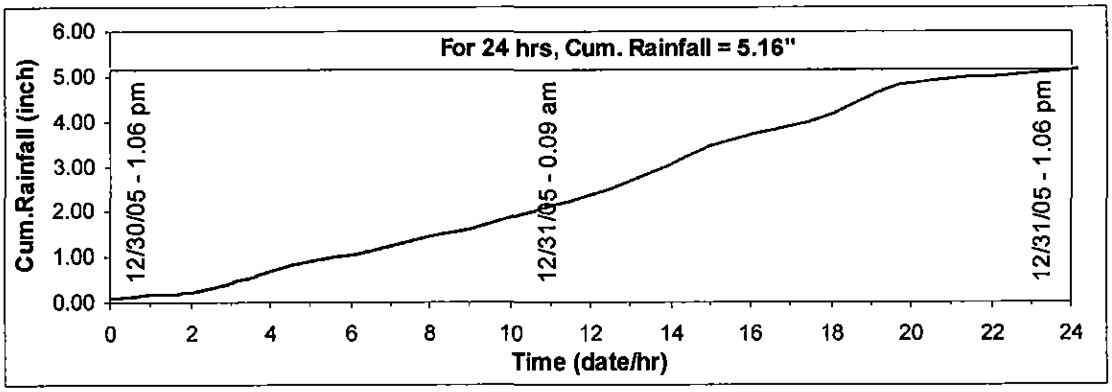


Figure G.15. Cumulative Rainfall Data for Gage at Whites Creek at Timberline (12/30/05-12/31/05).

Table G.7. NOAA Atlas 14 Precipitation Frequency Estimates for Gage at Whites Creek at Timberline.

Precipitation Frequency Estimates (inches)																		
ARI* (years)	**5 min**	**10 min**	**15 min**	**30 min**	**60 min**	**120 min**	**3 hr**	**6 hr**	**12 hr**	**24 hr**	**48 hr**	**4 day**	**7 day**	**10 day**	**20 day**	**30 day**	**45 day**	**60 day**
2	0.14	0.22	0.27	0.36	0.45	0.60	0.74	1.08	1.50	2.16	2.74	3.73	4.49	5.15	6.78	8.32	10.18	11.75
5	0.20	0.30	0.37	0.50	0.62	0.78	0.94	1.37	1.94	2.81	3.61	4.96	6.06	6.96	9.09	11.14	13.58	15.68
10	0.24	0.37	0.46	0.62	0.77	0.94	1.10	1.60	2.27	3.33	4.33	5.99	7.35	8.41	10.90	13.35	16.18	18.54
25	0.32	0.49	0.61	0.82	1.02	1.18	1.32	1.89	2.74	4.09	5.37	7.50	9.20	10.46	13.41	16.40	19.70	22.26
50	0.40	0.61	0.75	1.01	1.25	1.38	1.50	2.11	3.10	4.70	6.23	8.74	10.74	12.13	15.40	18.80	22.43	25.06
100	0.49	0.74	0.92	1.24	1.53	1.61	1.70	2.33	3.47	5.37	7.17	10.11	12.40	13.92	17.50	21.33	25.26	27.85
200	0.59	0.91	1.12	1.51	1.87	1.94	2.03	2.56	3.8[illegible]	6.07	8.17	11.60	14.19	15.81	19.70	23.96	28.16	30.65
500	0.77	1.17	1.45	1.95	2.42	2.48	2.58	2.86	[illegible]37	7.07	9.62	13.76	16.78	18.49	22.76	27.61	32.13	34.34
1000	0.93	1.42	1.76	2.37	2.94	3.00	3.09	3.14	4.77	7.89	10.83	15.58	18.93	20.68	25.20	30.51	35.26	37.14

Cumulative 24 hr Rainfall = 5.16", Approximately a 65 year storm event

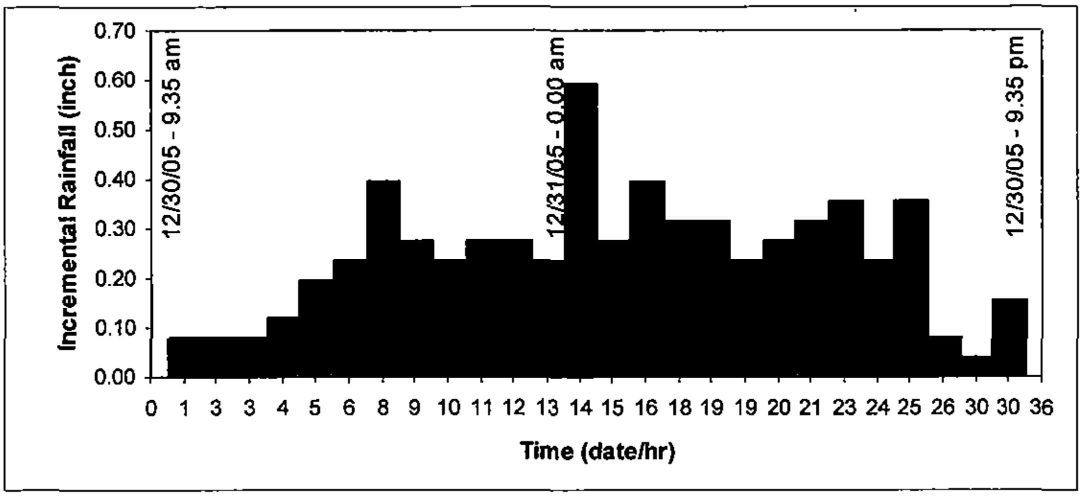


Figure G.16. Incremental Rainfall Data for Gage at Galena Creek at South Park (12/30/05-12/31/05).

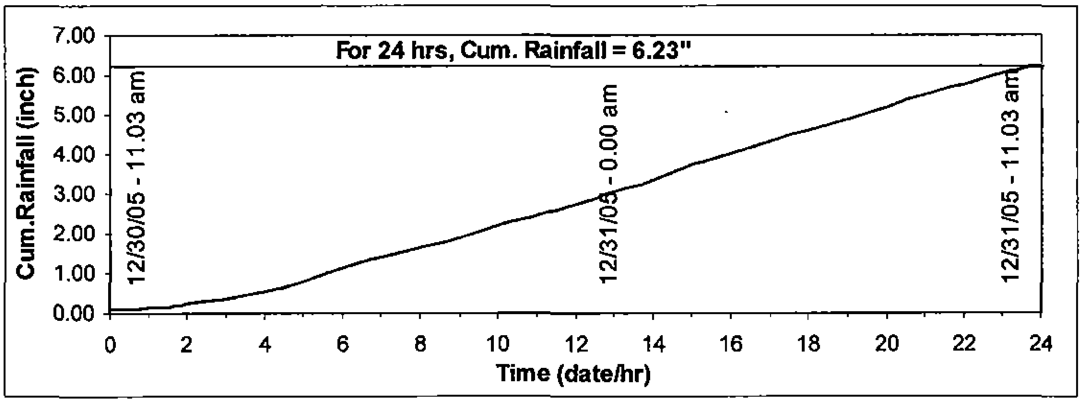


Figure G.17. Cumulative Rainfall Data for Gage at Galena Creek at South Park (12/30/05-12/31/05).

Table G.8. NOAA Atlas 14 Precipitation Frequency Estimates for Gage at Galena Creek at South Park.

Precipitation Frequency Estimates (inches)																		
ARI* (years)	**5 min**	**10 min**	**15 min**	**30 min**	**60 min**	**120 min**	**3 hr**	**6 hr**	**12 hr**	**24 hr**	**48 hr**	**4 day**	**7 day**	**10 day**	**20 day**	**30 day**	**45 day**	**60 day**
2	0.15	0.23	0.28	0.38	0.47	0.63	0.78	1.16	1.62	2.42	3.11	4.54	5.46	6.29	8.36	10.29	12.58	14.53
5	0.21	0.32	0.39	0.53	0.65	0.82	1.00	1.48	2.11	3.20	4.16	6.07	7.43	8.57	11.31	13.89	16.89	19.53
10	0.26	0.40	0.49	0.66	0.82	0 99	1.18	1.73	2.48	3.84	5.03	7.36	9.05	10.40	13.63	16.70	20.18	23.17
25	0.35	0.53	0.65	0.88	1.09	1.25	1.42	2.05	3.00	4.76	6.30	9.25	11.38	13.00	16.86	20.60	24.64	27.92
50	0.43	0.65	0.81	1.08	1.34	1.47	1.62	2.30	3.41	5.52	7.37	10.82	13.31	15.12	19.43	23.70	28.11	31.48
100	0.52	0.80	0.99	1.33	1.65	1.72	1.83	2.55	3.83	6.35	8.53	12.55	15.42	17.39	22.16	26.96	31.69	35.06
200	0.64	0.98	1.21	1.63	2.02	2.09	2.20	2.81	[illegible]	7.23	9.79	14.44	17.69	19.81	25.02	30.37	35.36	38.62
500	0.83	1.27	1.57	2.12	2.62	2.69	2.80	3.15	[illegible]	8.51	11.63	17.22	20.99	23.25	29.02	35.11	40.38	43.32
1000	1.01	1.54	1.91	2.57	3.19	3.27	3.38	3.41	5.34	9.57	13.18	19.55	23.73	26.07	32.24	38.89	44.31	46.87

Cumulative 24 hr Rainfall = 6.23", Approximately a 75 year storm event

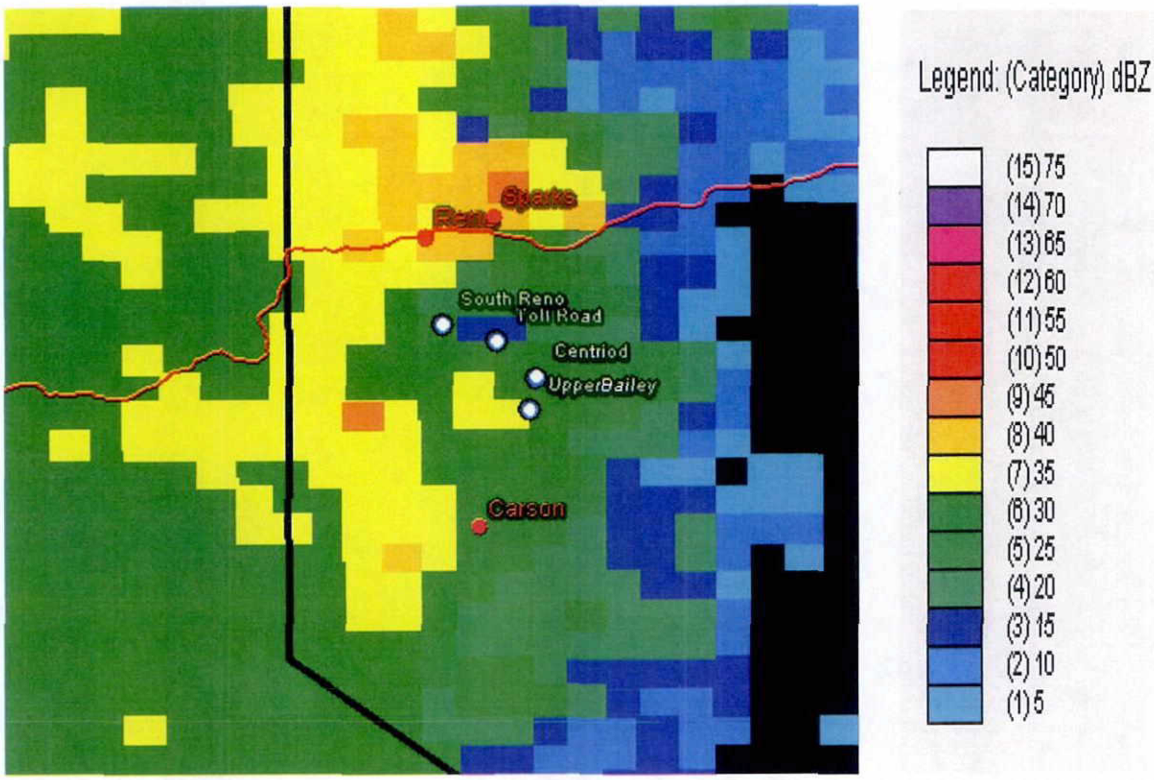


Figure G.18. NEXRAD Composite Reflectivity on 12/30/05 at 4.00 pm

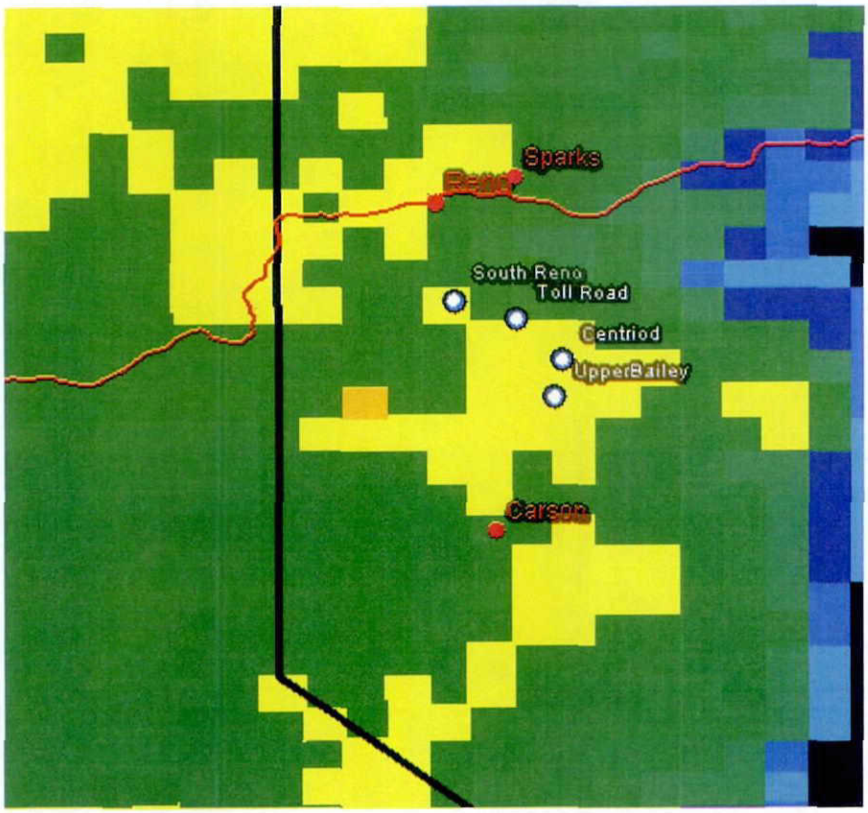


Figure G.19. NEXRAD Composite Reflectivity on 12/30/05 at 8.00 pm

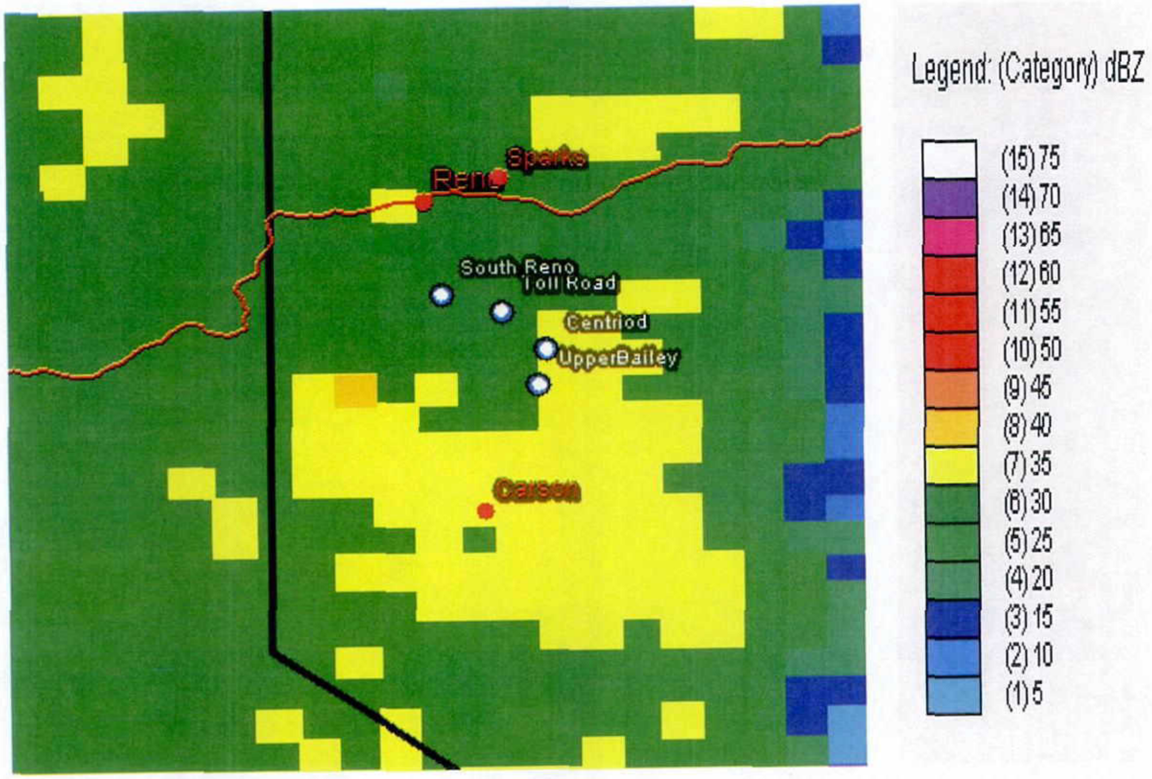


Figure G.20. NEXRAD Composite Reflectivity on 12/31/05 at 0.00 am

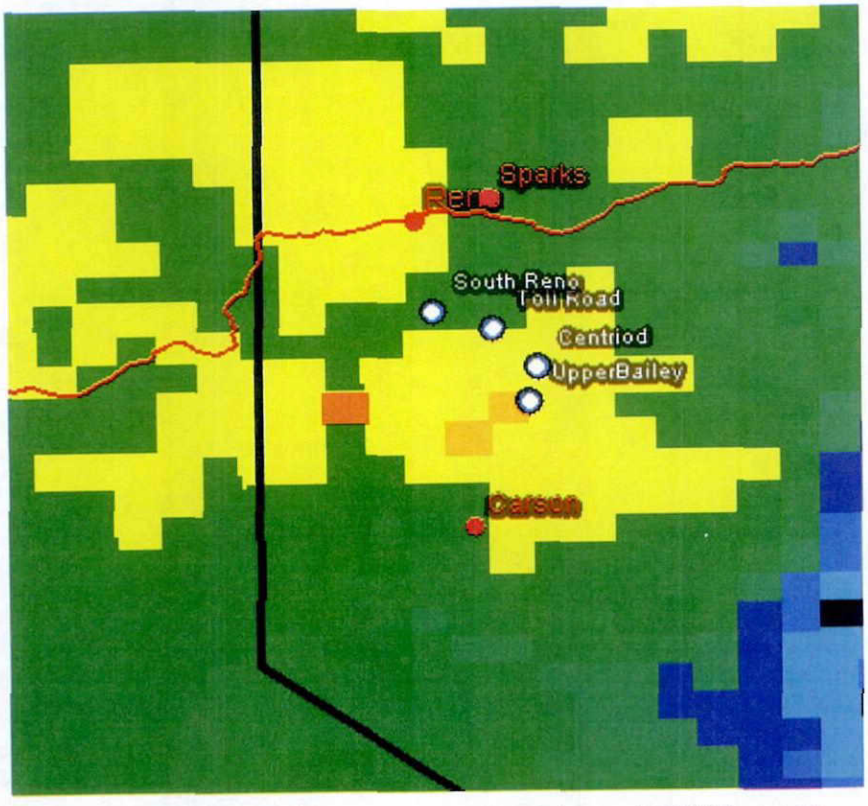


Figure G.21. NEXTRAD Composite Reflectivity on 12/31/05 at 4.00 am

Figure G.28. Bailey Canyon Creek looking west along Geiger Grade

Figure G.29. Bailey Canyon Creek looking west along Geiger Grade

Figure G.30. Geiger Channel & Chandler overflowing (north side of Geiger)

Figure G.31. Geiger Channel & Chandler overflowing (north side of Geiger)

H

APPENDIX H
NIMBUS ENGINEERS' COTTONWOOD CREEK ESTATES STUDY

Nimbus Engineers

3710 Grant Dr., Suite D • Reno, NV 89509
Mail: P.O. Box 10220 • Reno, NV 89510
(702) 689-8630 • Fax (702) 689-8614

RECEIVED

FEB 1 3 1995

OFFICE OF
WASHOE COUNTY ENGINEER

February 13, 1995

Ms. Kris Klein
Engineering Department
Washoe County Public Works
1001 E. 9th Street
Reno, Nv 89520

RE: Cottonwood Creek Estates Hydrology

Dear Ms. Klein:

At your request, Nimbus Engineers has reevaluated the hydrology for the upper Bailey Canyon Creek watershed. The total 24-hour rainfall depth was revised and an areal reduction factor was used in accordance with the NOAA. The basin slope was recalculated using the mean slope method (Hydrology Manual for Engineering Design and Floodplain Management, Pima County Flood Control District, 1979). The lag time was computed using the lag equation developed by converting the U.S. Bureau of Reclamation's S-graph lag equation to a dimensionless unit hydrograph lag equation (Hydrologic Criteria and Drainage Design Manual, Clark County Regional Flood Control District, 1990). These changes generated a new 100-year peak flow of 3673 cfs.

Nimbus feels this revised model adequately reflects the Bailey Canyon Creek watershed. We have enclosed the revised HEC-1 model and supporting documentation for your review.

Sincerely,
Nimbus Engineers

Ann C Pagni

Ann C. Pagni, E.I.T.

RETURN TO WASHOE COUNTY ENGINEERING

Attached HEC-1 Calcs & peak flow OK per Leonard Crowe. 2/14/95
Called Ann Pagni 2/14/95 & told her the attached HEC-1 run & flows are acceptable

Per Ann, the attached calcs will be included

```
**************************************                    **************************************
*                                    *                    *                                    *
* 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  02/10/95  TIME  11:47:16 *                    *         (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
```

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                                   HEC-1 INPUT                                            PAGE  1

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

  1          ID   **************************************************************************
  2          ID   *                                                                        *
  3          ID   *             HYDROLOGIC STUDY PERFORMED FOR COTTONWOOD ESTATES          *
  4          ID   *                                                                        *
  5          ID   *                                                                        *
  6          ID   * NIMBUS JOB #:       9411                                               *
  7          ID   *                                                                        *
  8          ID   * FILENAME:           STEIN.DAT                                          *
  9          ID   * VERSION:            FINAL                                              *
 10          ID   * DATE:               FEBRUARY 10, 1995                                  *
 11          ID   * ORIGINAL FILE:      COMSTOCK.DAT (JANUARY 1994)                        *
 12          ID   *                                                                        *
 13          ID   * NOTES/COMMENTS:     1. TOTAL 24-HOUR RAINFALL DEPTH ON PB RECORD -     *
 14          ID   *                        AREAL REDUCTION .98 FROM NOAA                   *
 15          ID   *                     2. SCS TYPE II RAINFALL DISTRIBUTION.              *
 16          ID   *                     3. BUREAU OF RECLAMATION METHOD USED FOR LAG TIME  *
 17          ID   *                     4. KO AND KF RECORDS ADDED TO PLOT HYDROGRAPH IN   *
 18          ID   *                        EXCEL FORMAT.                                   *
 19          ID   *                     5. IT.04 SET TO 450 TO COMPUTE ENTIRE HYDROGRAPH.  *
 20          ID   *                     6. SCS CURVE NUMBER LOSS MODEL.                    *
 21          ID   *                                                                        *
 22          ID   **************************************************************************
```

```
23        IT      5                    450
24        IO      5       0
25        IN     15
26        JR   PREC    .98

27        KK    B35BAILEY CANYON
28        BA   15.3
29        PB   2.95
30        PC   .000    .002    .005    .008    .011    .014    .017    .020    .023    .026
31        PC   .029    .032    .035    .038    .041    .044    .048    .052    .056    .060
32        PC   .064    .068    .072    .076    .080    .085    .090    .095    .100    .105
33        PC   .110    .115    .120    .126    .133    .140    .147    .155    .163    .172
34        PC   .181    .191    .203    .218    .236    .257    .283    .387    .663    .707
35        PC   .735    .758    .776    .791    .804    .815    .825    .834    .842    .849
36        PC   .856    .863    .869    .875    .881    .887    .893    .898    .903    .908
37        PC   .913    .918    .922    .926    .930    .934    .938    .942    .946    .950
38        PC   .953    .956    .959    .962    .965    .968    .971    .974    .977    .980
39        PC   .983    .986    .989    .992    .995    .998   1.000
40        LS             80
41        UD    1.2
42        KP        (F12.2)
43        KO                          1
44        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          *
 DATE  02/10/95  TIME  11:47:16        *                          *         (916) 551-1748               *
                                       *                          *                                      *
****************************************                          ****************************************
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***************************************************************************
*                                                                         *
*          HYDROLOGIC STUDY PERFORMED FOR COTTONWOOD ESTATES              *
*                                                                         *
*                                                                         *
* NIMBUS JOB #:      9411                                                 *
*                                                                         *
* FILENAME:          STEIN.DAT                                            *
* VERSION:           FINAL                                                *
* DATE:              FEBRUARY 10, 1995                                    *
* ORIGINAL FILE:     COMSTOCK.DAT (JANUARY 1994)                          *
*                                                                         *
* NOTES/COMMENTS:    1. TOTAL 24-HOUR RAINFALL DEPTH ON PB RECORD -       *
*                       AREAL REDUCTION .98 FROM NOAA                     *
*                    2. SCS TYPE II RAINFALL DISTRIBUTION.                *
*                    3. BUREAU OF RECLAMATION METHOD USED FOR LAG TIME    *
*                    4. KO AND KP RECORDS ADDED TO PLOT HYDROGRAPH IN     *
*                       EXCEL FORMAT.                                     *
*                    5. IT.04 SET TO 450 TO COMPUTE ENTIRE HYDROGRAPH.    *
*                    6. SCS CURVE NUMBER LOSS MODEL.                      *
*                                                                         *
***************************************************************************
```

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

 IT          HYDROGRAPH TIME DATA
                  NMIN           5  MINUTES IN COMPUTATION INTERVAL
                 IDATE     1     0  STARTING DATE
                 ITIME        0000  STARTING TIME
                    NQ         450  NUMBER OF HYDROGRAPH ORDINATES
                NDDATE     2     0  ENDING DATE
                NDTIME        1325  ENDING TIME
                 ICENT          19  CENTURY MARK

             COMPUTATION INTERVAL    0.08 HOURS
                  TOTAL TIME BASE   37.42 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

 JP          MULTI-PLAN OPTION
                  NPLAN          1  NUMBER OF PLANS

 JR          MULTI-RATIO OPTION
                RATIOS OF PRECIPITATION
                 0.98

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

          **************
          *            *
 27 KK    *      B35   *    BAILEY CANYON
          *            *
          **************

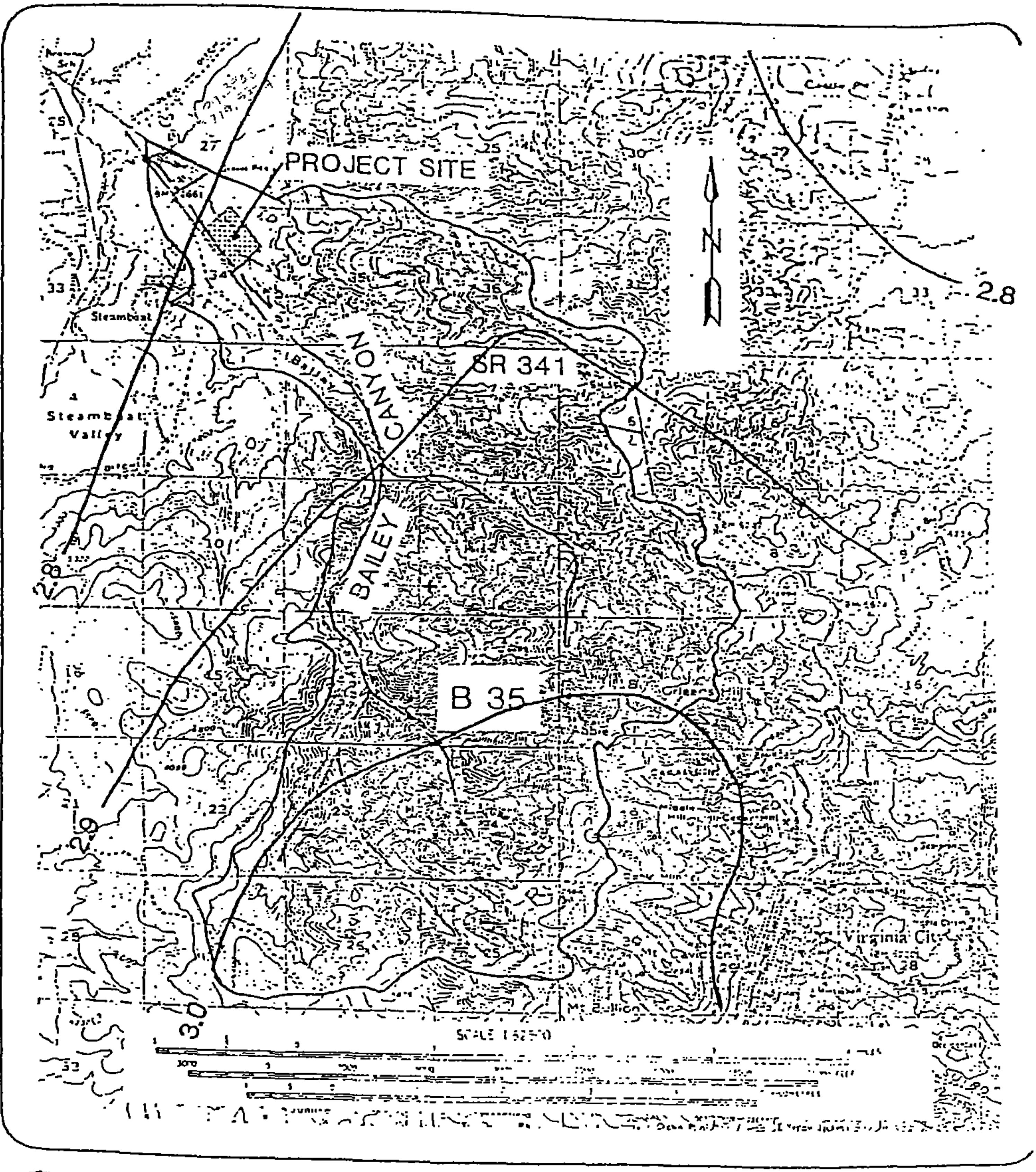
 43 KO          OUTPUT CONTROL VARIABLES
                     IPRNT           5  PRINT CONTROL
                     IPLOT           0  PLOT CONTROL
                     QSCAL          0.  HYDROGRAPH PLOT SCALE
                     IPNCH           1  PUNCH COMPUTED HYDROGRAPH
                      IOUT           0  SAVE HYDROGRAPH ON THIS UNIT
                     ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                     ISAV2         450  LAST ORDINATE PUNCHED OR SAVED
                    TIMINT       0.083  TIME INTERVAL IN HOURS


            PEAK FLOW AND STAGE (END-OF-PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
                              FLOWS IN CUBIC FEET PER SECOND,  AREA IN SQUARE MILES
                                            TIME TO PEAK IN HOURS
```

RATIOS APPLIED TO PRECIPITATION

RATION	STATION	AREA	PLAN		RATIO 1
					0.98
OGRAPH AT					
	B35	15.30	1	FLOW	3673.
				TIME	13.17

NORMAL END OF HEC-1 ***



Nimbus Engineers
3710 Grant Dr., Suite D, Reno, NV 89509
Mail : P.O. Box 10220, Reno, NV 89510
(702) 689-8630

LOCATION/WATERSHED MAP
FIGURE 1

Nimbus Engineers
3710 Grant Dr., Suite A · Reno, NV 89509
Mail: P.O. Box 10220 · Reno, NV 89510
(702) 689-8630 FAX (702) 689-8614

JOB ____
SHEET NO. ____ OF ____
CALCULATED BY ACP DATE 2/6/95
CHECKED BY ____ DATE ____
SCALE ____

REVISED LAG TIME CALCULATION

$$T_{LAG} = 20\, K_n \left(\frac{L L_c}{S^{.5}} \right)^{.33}$$

$K_n = .050$

$L = 7.51$ MI

$L_c = 3.7$ MI

$$S = \frac{.0484\ \text{FT}}{\text{FT}} \left(\frac{5280\ \text{FT}}{\text{MI}} \right) = 255.55\ \text{FT/MI}$$

$$T_{LAG} = 20\,(.050) \left[\frac{(7.51)(3.7)}{(255.55)^{.5}} \right]^{.33}$$

$T_{LAG} = 1.20$ HRS

determined for the SCS Unit Hydrograph method based on the storm excess precipitation applied to the unit hydrograph whose parameters are determined by TLAG. TLAG is defined and discussed in Section 606.3.

606.2 ASSUMPTIONS

The basic assumptions make when applying the SCS Unit Hydrograph method (and all other unit hydrograph methods) are as follows:

1. The effects of all physical characteristics of a given drainage basin are reflected in the shape of the storm runoff hydrograph for that basin.

2. At a given point on a stream, discharge ordinates of different unitgraphs of the same unit time of rainfall excess are mutually proportional to respective volumes.

3. A hydrograph of storm discharge that would result from a series of bursts of excess rain or from continuous excess rain of variable intensity may be constructed from a series of overlapping unitgraphs each resulting from a single increment of excess rain of unit duration.

606.3 LAG TIME

Input data for the Soil Conservation Service, SCS dimensionless unit hydrograph method (SCS, 1985) consists of a single parameter, TLAG, which is equal to the lag (in hours) between the center of mass of rainfall excess and the peak of the unit hydrograph. For small drainage basins (less than one square mile) in the Clark County area, the lag time may be related to the time of concentration, t_c, by the following empirical relationship:

$$TLAG = 0.6\, t_c \tag{612}$$

The t_c is computed as presented in Section 602.

For larger drainage basins (greater than one square mile), the lag time (and t_c) is generally governed mostly by the concentrated flow travel time, not the initial overland flow time. In addition, as the basin gets increasingly larger, the average flow velocity (and associated travel time) becomes more difficult to estimate. Therefore, for these basins, the following lag equation is recommended for use in computing TLAG:

$$TLAG = 20\, K_n\, (L\, L_c / S^{0.5})^{0.33} \tag{613}$$

where K_n = Manning's roughness factor for the basin channels

L = Length of longest watercourse (miles)

L_c = Length along longest watercourse measured upstream to a point opposite the centroid of the basin (miles)

S = Representative (average) slope of the longest watercourse (feet per mile)

This lag equation is based on the United States Bureau of Reclamations analysis of the above parameters for several drainage basins in the Southwest desert, Great Basin, and Colorado Plateau area (USBR, 1989). This equation was developed by converting the USBR's S-graph lag equation to a dimensionless unit hydrograph lag equation.

In order to obtain comparable results between the t_c calculation and the TLAG calculation, it is recommended that either method be used as a check of the other method for drainage areas around one square mile in size.

606.3.1 ROUGHNESS FACTOR

The selection of a proper roughness factor for use in the lag time calculation is highly subjective. Therefore, in order to obtain more consistent lag time and runoff analysis results, the roughness factor, K_n, shall be determined using the factors presented in Table 604. These factors are based on roughness factor analysis by the USACE (1982) and USBR (1989) as compared to the typical watershed channels found in the Clark County area. The reader is referred to these documents for further discussion on selection of a proper roughness factor.

For partially developed basins, the roughness factor should be interpolated in relationship to the percent of each land use in the basin.

606.4 UNIT STORM DURATION

The minimum unit duration, Δt, is dependent on the time of concentration of a given basin. If the basin is large (i.e. > one square mile), a larger unit duration may be used. If the basin is small (i.e. < one square mile) a smaller unit duration should be used. The unit duration, Δt, should be $\leq .25\ T_p$, where T_p is the time-to-peak of the unit hydrograph. For the CCRFCD area the maximum unit storm duration should be 5 minutes unless conditions warrant otherwise.

606.5 SUB-BASIN SIZING

The determination of the peak rate of runoff at a given design point is affected by the discretization of sub-basins in the subject basin. Typically, the more discrete the analysis of a given basin (more

LAG EQUATION ROUGHNESS FACTORS

WATERSHED CHARACTERISTICS	ROUGHNESS FACTOR, K_n
Urbanized Areas: Water courses in the drainage area consist of street, storm sewer, and improved channels.	.015
Natural Areas: Water courses in the drainage area are well defined, unimproved channels or washes. Watershed has minimal vegetation.	.030
Natural Areas: Water courses in the drainage area are not well defined, and consist of many small rills and braided wash areas. Runoff from area combines slowly into channels. Includes mountainous channels with large boulders and flow restrictions.	.050

Revision	Date

Nimbus Engineers
3710 Grant Dr., Suite A - Reno, NV 89509
Mail: P.O. Box 10220 - Reno, NV 89510
(702) 689-8630 FAX (702) 689-8614

JOB 3211
SHEET NO. ____ OF ____
CALCULATED BY AZP DATE 2/6/19
CHECKED BY ____ DATE ____
SCALE ____

MEAN SLOPE

$$S = \left(\frac{L}{I}\right)^2 \qquad I = \left(\frac{L_1^3}{H_1}\right)^{1/2} + \left(\frac{L_2^3}{H_2}\right)^{1/2} + \left(\frac{L_3^3}{H_3}\right)^{1/2} + \ldots$$

$L_1 = 300$, $H_1 = 20$, $I = 1162$

$L_2 = 3400$, $H_2 = 360$, $I = 10449$

$L_3 = 1800$, $H_3 = 120$, $I = 6971$

$L_4 = 11200$, $H_4 = 480$, $I = 54101$

$L_5 = 2000$, $H_5 = 120$, $I = 8165$

$L_6 = 8200$, $H_6 = 360$, $I = 39135$

$L_7 = 3400$, $H_7 = 120$, $I = 18098$

$L_8 = 4000$, $H_8 = 240$, $I = 16330$

$L_9 = 1800$, $H_9 = 80$, $I = 8538$

$L_{10} = 600$, $H_{10} = 40$, $I = 2323$

$L_{11} = 3000$, $H_{11} = 120$, $I = 15000$

TOTAL $I = 180,272$ FT

TOTAL $L = 39,700$ FT

$$S = \left(\frac{39,700}{180,272}\right)^2 = .0484 \text{ FT/FT}$$

DETERMINATION OF MEAN SLOPE (S_c)

To determine the mean slope (S_c) of the longest watercourse within a watershed, the following equation should be used:

$$S_c = \left[\frac{L_c}{I}\right]^2 \quad \text{(ft./ft.)}.$$

Where

L_c = the length of the longest watercourse within the watershed, in feet.

$$I = \left[\frac{L_1{}^3}{H_1}\right]^{1/2} + \left[\frac{L_2{}^3}{H_2}\right]^{1/2} + \left[\frac{L_3{}^3}{H_3}\right]^{1/2} + \ldots\text{(feet)}.$$

And

L_1, L_2, L_3, etc. = incremental changes in length (L_i) along longest watercourse, in feet.

H_1, H_2, H_3, etc. = incremental changes in height (H_i) along longest watercourse, in feet.

This equation is defined as a hypothetical uniform slope for the longest watercourse within a watershed which would give the same travel time through the watershed as reach by reach calculation. (An assumption is made in the derivation of the equation that the roughness coefficient and hydraulic radius of the watercourse are the same for all reaches of the watershed; that is, the watershed is homogeneous).

EXAMPLE:

The longest watercourse within a watershed has a length of 15,000 feet, and the following profile:

Incremental Change in Length (L_i)	Incremental Change in Height (H_i)
3,000 feet	300 feet
8,000 feet	200 feet
4,000 feet	40 feet

Determine the mean slope (S_c).

First, "I" is computed:

$$I = \left[\frac{(3000)^3}{300}\right]^{1/2} + \left[\frac{(8000)^3}{200}\right]^{1/2} + \left[\frac{(4000)^3}{40}\right]^{1/2} \text{ feet}.$$

$$I = 100{,}083 \text{ feet}.$$

Then

$$S_c = \left[\frac{15,000}{100,083}\right]^{.2} = \underline{\underline{.0225 \text{ ft./ft.}}}$$

Note that if the slope for the watershed had been calculated in the conventional manner, dividing the total length by the total change in height, a value of .036 ft./ft. would have resulted, leading to a shorter time of concentration and consequently higher peak rate of discharge than might actually occur.

The number of "slope breaks", or incremental segments of channel length, to be utilized in calculating the mean slope (S_C) depends to a great extent upon the profile along the main channel length (L_C). However, the maximum number of segments generally need not exceed four (4) unless the watershed under investigation is unusually complex and contains numerous topographic variations. Typically, new incremental segments should be initiated whenever a significant change in the slope of the main channel length profile becomes apparent. This can usually best be estimated with the use of U.S.G.S. quad sheets and/or topographic maps.

APPENDIX I
HYDRAULIC ANALYSIS

Stantec Consulting Inc.
6980 Sierra Center Parkway Suite 100
Reno NV 89511
Tel: (775) 850-0777 Fax: (775) 850-0787
stantec.com

Stantec

June 30, 2006
Project No. 180100953

Mr. Patrick Fritchel, PE
CFA, INC.
1150 Corporate Blvd.
Reno, Nevada 89502

RE: Bailey Canyon Creek Split Flow Analysis – Results Summary (revised)

Dear Mr. Fritchel:

We are pleased to present the results of the hydraulic split flow analysis for Bailey Canyon Creek, located in Washoe County, Nevada.

Introduction

Stantec analyzed a portion of Bailey Canyon Creek from approximately 1,150-feet upstream of the intersection of Toll Road and Geiger Grade Road to approximately 815-feet downstream of the same intersection. The creek is located southwest of Geiger Grade Road and runs roughly parallel to this road. See *Figure I.1 – Vicinity Map*.

The original Bailey Canyon Creek hydraulic and split flow analysis was conducted by Stantec in August 1999. The model created for this analysis utilized an initial flow rate of 3,673 cfs at the upstream end. CFA contracted Stantec to reevaluate the split flow analysis based upon a new hydrologic study conducted by CFA in January 2006, entitled *Drainage Study for Bailey Canyon Basin* (CFA Study). The flow rate determined by this study was 2,824 cfs for Bailey Canyon Creek at the location of interest. During the hydraulic analysis, utilizing the new flow rate, it was determined that significant physical changes to the channel had occurred since the original model was created in August 1999. Therefore, CFA authorized Stantec to acquire new field survey in order to update the model with more accurate cross section information and re-run the hydraulic model.

The CFA Study was revised and reissued June 30, 2006, indicating a different flow rate at the location of interest equal to 2,908 cfs, which is also addressed in the hydraulic analyses.

Hydraulic Analyses

Stantec imported the original hydraulic HEC-2 model into HEC-RAS in order to facilitate the incorporation of new survey data and the analysis of various flow rates. HEC-RAS was utilized to evaluate the original flow rate of 3,673 cfs, as well as the flow rate of 2,824 cfs determined by the January 2006 CFA Study and the flow rate of 2,908 cfs determined by the revised CFA Study issued June 30, 2006. In order to determine the effects of recent physical changes to the channel, two models were created for each of these flow rates for comparison purposes. One was based on the original 1999 cross section data. The other was also based on the original 1999 cross section data, but incorporated new field survey acquired by Stantec in March 2006 at select locations. The model results are summarized in *Table I.1 – Flow Summary*. Several other flow rates were also evaluated in order to determine the nature of split flows across a range of flows. The model results for these analyses are also summarized in *Table I.1 – Flow*

Summary. The culvert flow beneath Geiger Grade Road shown in *Table I.1 – Flow Summary* occurs approximately 220-feet northwest of the intersection of Toll Road and Geiger Grade Road via a 3.5-foot by 2.5-foot box culvert and 2.5-foot metal pipe. Although the original model utilized HEC-2, all results shown in this table are based on HEC-RAS analyses. Therefore, the results may differ from a HEC-2 model utilizing the same parameters, even though the HEC-RAS models were calculated in HEC-2 style (an option available within HEC-RAS).

The change in initial flow rate from 3,673 cfs to 2,908 cfs resulted in a reduction of the amount of flow overtopping Geiger Grade Road of approximately 52%, from 678 cfs to 326 cfs, based on the original cross section data. Recent physical changes to the channel reflected a further reduction in flows overtopping Geiger Grade Road, from 326 cfs to 259 cfs, or a reduction of approximately 21%, at the initial flow rate of 2,908 cfs.

The following are attached: *Attachment I.1 – HEC-RAS Model Results* (HEC-RAS model results for each of the flow scenarios), *Figure I.1 – Vicinity Map*, and *Figure I.2 – Hydraulic Work Map* (cross section layout with split flow locations/magnitudes at the initial flow rate of 2,908 cfs).

Stantec appreciates the opportunity to be of service to you on this project. Should you have any questions, or require additional information please do not hesitate to call us at (775) 850-0777.

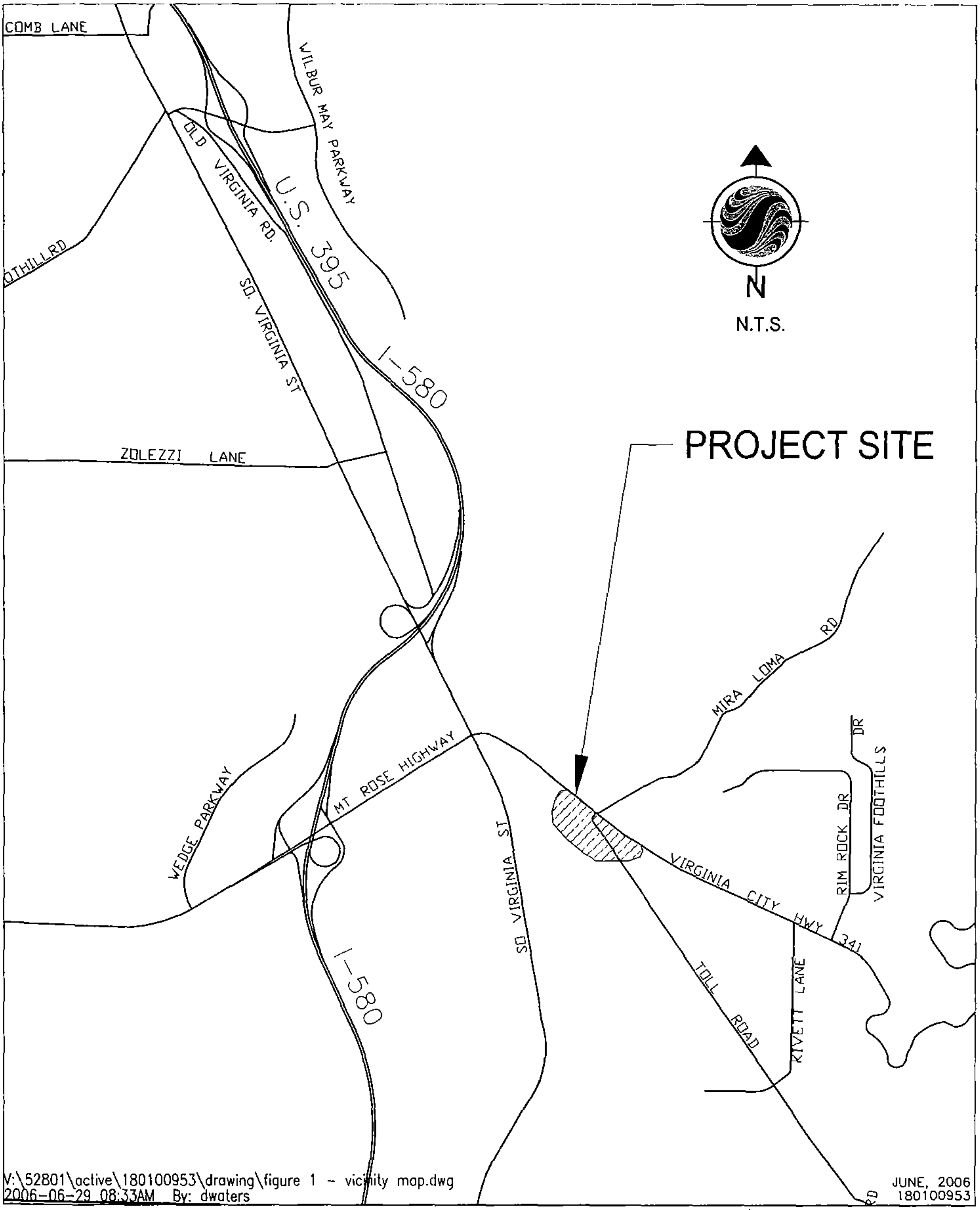
Sincerely,

STANTEC CONSULTING INC.

PROFESSIONAL ENGINEER - STATE OF NEVADA
DUSTIN S. WATERS
Exp: 6/30/08
CIVIL
No. 16594
6/30/06

Dustin Waters, PE, CFM
Project Engineer, Water Resources

DW:dw
Enclosures
V:\5280\active\180100953\report\Bailey split flow w new flow_june.doc



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Stantec

Client/Project

CFA, INC.

BAILEY CANYON CREEK
SPLIT FLOW ANALYSES

Figure No

I.1

Title

VICINITY MAP

Table I.1
Flow Summary

Initial Flow Rate (cfs)	Cumulative Flow *remaining in* Bailey Canyon Creek (cfs)	Cumulative Flow adjacent to (south of) Geiger Grade Road (cfs)	Cumulative Flow over Geiger Grade Road (cfs)	Culvert Flow beneath Geiger Grade Road (cfs)	Cumulative Flow over and beneath Geiger Grade Road (cfs)
3673[1]	2407	496	678	92	770
3673[2]	2468	552	559	94	653
2908[1]	2027	465	326	90	416
2908[2]	2064	492	259	93	352
2824[1]	1972	456	306	90	396
2824[2]	1999	488	245	92	337
2400[2]	1730	424	155	91	246
2000[2]	1424	392	95	89	184
1500[2]	1044	319	52	85	137
1000[2]	666	228	26	80	106

[1]Analysis based on cross section data contained in the original model, August 1999.

[2]Analysis based on cross section data contained in the original model, August 1999, and new field survey acquired at select locations, March 2006.

HEC-RAS Plan Old (3673) Profile PF 1

River	Reach	River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl
Geiger	Main	4793	1326.98	4583.63	4586.37		4586.57	0.000525	3.77	377.38	448.22	0.43
Geiger	Main	4792.2	Lat Struct									
Geiger	Main	4792	1292.43	4582.40	4585.98		4586.52	0.010510	3.85	286.94	199.31	0.50
Geiger	Main	4791.1	Lat Struct									
Geiger	Main	4791	1258.93	4582.50	4585.76		4585.93	0.003756	2.56	442.43	240.50	0.30
Geiger	Main	4790.2	Lat Struct									
Geiger	Main	4790.1	Lat Struct									
Geiger	Main	4790	1123.19	4581.80	4584.88		4585.53	0.010763	2.60	288.04	211.37	0.38
Geiger	Main	4700.3	Lat Struct									
Geiger	Main	4700.2	Lat Struct									
Geiger	Main	4700.1	Lat Struct									
Geiger	Main	4700	817.27	4583.00	4584.48	4584.48	4584.90	0.010510	6.35	207.75	440.84	1.15
Geiger	Main	4670.2	Lat Struct									
Geiger	Main	4670.1	Lat Struct									
Geiger	Main	4670	606.18	4580.40	4581.84	4581.84	4582.27	0.011763	2.61	133.29	168.43	0.47
Geiger	Main	4661.2	Lat Struct									
Geiger	Main	4661	558.63	4579.00	4580.68	4580.35	4580.79	0.009489	2.82	222.46	261.25	0.43
Geiger	Main	4651.2	Lat Struct									
Geiger	Main	4651	540.75	4576.80	4579.28	4579.28	4579.51	0.015787	5.33	167.63	305.89	0.77
Geiger	Main	4640.2	Lat Struct									
Geiger	Main	4640	533.26	4574.66	4576.85	4576.85	4577.18	0.018369	5.17	128.35	177.33	0.82
Geiger	Main	4630.2	Lat Struct									
Geiger	Main	4630.1	Lat Struct									
Geiger	Main	4630	531.85	4574.60	4575.38	4575.38	4575.68	0.010709	6.38	156.40	265.00	1.53
Geiger	Main	4620.1	Lat Struct									
Geiger	Main	4620	528.93	4570.50	4572.97	4572.97	4573.33	0.018347	6.45	138.41	175.04	0.94
Geiger	Main	4600.2	Lat Struct									
Geiger	Main	4600	495.61	4569.20	4571.53	4571.48	4571.80	0.017031	5.81	147.58	191.14	0.89
Bailey	Upper	500	3673.00	4597.40	4605.94	4605.94	4607.16	0.008468	10.66	523.37	182.50	0.77
Bailey	Upper	498	3673.00	4595.80	4603.33	4603.33	4604.80	0.008659	10.62	459.78	293.65	0.80
Bailey	Upper	496	3673.00	4594.20	4601.06	4601.06	4602.74	0.010732	12.19	422.49	233.12	0.89
Bailey	Upper	494	3673.00	4592.50	4598.77	4598.77	4600.22	0.010989	11.82	466.94	160.16	0.90
Bailey	Upper	492	3673.00	4591.60	4598.03	4598.03	4598.88	0.009071	11.06	680.42	330.67	0.81
Bailey	Upper	490.1	Lat Struct									
Bailey	Upper	490	3626.80	4590.60	4596.70	4596.70	4597.38	0.007976	8.62	785.02	515.06	0.74
Bailey	Upper	488.2	Lat Struct									
Bailey	Upper	488.1	Lat Struct									
Bailey	Upper	488	3566.75	4589.60	4595.27	4595.27	4595.88	0.011938	8.67	780.25	498.00	0.85
Bailey	Upper	486.2	Lat Struct									
Bailey	Upper	486.1	Lat Struct									
Bailey	Upper	486	3478.23	4588.40	4593.19	4593.19	4593.85	0.014401	8.65	710.23	477.18	0.92
Bailey	Upper	484.2	Lat Struct									
Bailey	Upper	484.1	Lat Struct									
Bailey	Upper	484	3403.68	4587.30	4591.77	4591.77	4592.39	0.012075	9.43	748.55	453.00	0.87
Bailey	Upper	482.2	Lat Struct									
Bailey	Upper	482.1	Lat Struct									
Bailey	Upper	482	3115.10	4584.90	4589.45		4589.84	0.011777	8.06	730.75	454.00	0.82
Bailey	Upper	481.2	Lat Struct									
Bailey	Upper	481.1	Lat Struct									
Bailey	Upper	481	2749.79	4582.60	4587.39	4587.39	4588.03	0.019659	9.66	523.18	379.53	1.02
Bailey	Upper	479.6	Lat Struct									
Bailey	Upper	479.4	2679.52	4584.35	4586.41	4586.41	4586.97	0.002446	6.91	483.92	411.06	0.90
Bailey	Lower	4793	1352.54	4584.72	4586.10	4586.09	4586.58	0.002881	5.74	254.73	428.51	0.91
Bailey	Lower	470	1928.17	4579.80	4584.73	4584.73	4585.16	0.039574	7.01	421.76	719.73	0.88
Bailey	Lower	469	2300.98	4577.60	4581.84	4581.84	4582.37	0.013602	8.87	540.69	521.86	0.89
Bailey	Lower	468	2348.53	4576.20	4579.91		4580.19	0.011265	6.81	699.67	582.91	0.79
Bailey	Lower	467	2366.41	4574.30	4578.53	4578.29	4578.82	0.013001	7.72	663.21	541.36	0.80

HEC-RAS Plan Old (3673) Profile PF 1

River	Reach	River Sta	Q US	Q Leaving Total	Q DS	Q Weir	Q Gates	Wr Top Wdth	Weir Max Depth	Weir Avg Depth	Min El Weir Flow	E.G. US	W.S. US	E.G. DS	W.S. DS
			(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)
Geiger	Main	4792.2	1326.98	34.54	1292.43	34.54		11.01	2.09	1.04	4584.28	4586.57	4586.37	4586.52	4585.98
Geiger	Main	4791.1	1292.43	40.17	1123.19	40.17		53.92	0.70	0.37	4585.00	4586.52	4585.98	4585.91	4585.70
Geiger	Main	4790.2	1258.93	14.15	1123.19	14.15		8.99	1.32	0.66	4583.60	4585.93	4585.76	4585.55	4584.92
Geiger	Main	4790.1	1258.93	118.30	817.27	118.30		59.00	0.81	0.78	4584.10	4585.93	4585.76	4585.49	4584.85
Geiger	Main	4700.3	1123.19	91.55	817.27	118.30		59.00	0.81	0.78	4584.10	4585.53	4584.88	4585.53	4584.88
Geiger	Main	4700.2	1123.19	157.58	817.27	157.58		37.00	1.31	1.29	4583.20	4585.53	4584.88	4584.95	4584.51
Geiger	Main	4700.1	1123.19	53.45	817.27	53.45		25.00	0.85	0.82	4583.70	4585.53	4584.88	4585.02	4584.55
Geiger	Main	4670.2	817.27	201.39	606.18	201.39		71.00	1.27	0.98	4582.20	4584.90	4584.48	4583.28	4582.65
Geiger	Main	4670.1	817.27	9.69	606.18	9.69		12.25	0.77	0.39	4583.20	4584.90	4584.48	4582.51	4582.08
Geiger	Main	4661.2	606.18	47.38	558.63	47.38		59.15	0.52	0.45	4580.40	4582.27	4581.84	4580.99	4580.84
Geiger	Main	4651.2	558.63	17.84	540.75	17.84		39.03	0.33	0.31	4579.80	4580.79	4580.66	4579.59	4579.36
Geiger	Main	4640.2	540.75	7.50	531.85	7.50		40.86	0.30	0.16	4577.60	4579.51	4579.28	4576.04	4575.74
Geiger	Main	4630.2	533.26	1.83	528.93	1.83		8.47	0.34	0.18	4575.00	4577.18	4576.85	4575.63	4575.34
Geiger	Main	4630.1	533.26	0.44	531.85	0.44		15.90	0.08	0.04	4575.30	4577.18	4576.85	4575.68	4575.38
Geiger	Main	4620.1	531.85	2.04	528.93	2.04		31.01	0.12	0.08	4573.30	4575.68	4575.38	4573.35	4572.99
Geiger	Main	4600.2	528.93	33.86	495.61	33.86		73.00	0.53	0.31	4571.00	4573.33	4572.97	4571.80	4571.53
Bailey	Upper	490.1	3673.00	46.50	3626.80	46.50		82.00	0.38	0.34	4596.40	4598.88	4598.03	4597.46	4596.78
Bailey	Upper	488.2	3626.80	6.78	3566.75	6.78		41.67	0.27	0.13	4595.10	4597.38	4596.70	4595.99	4595.37
Bailey	Upper	488.1	3626.80	54.60	3478.23	54.60		99.00	0.38	0.33	4594.85	4597.38	4596.70	4595.85	4595.23
Bailey	Upper	486.2	3566.75	14.54	3478.23	14.54		67.00	0.19	0.18	4593.60	4595.88	4595.27	4594.44	4593.79
Bailey	Upper	486.1	3566.75	71.96	3478.23	71.96		103.00	0.48	0.38	4593.10	4595.88	4595.27	4593.95	4593.29
Bailey	Upper	484.2	3478.23	21.60	3403.68	21.60		57.20	0.47	0.24	4591.30	4593.85	4593.19	4592.39	4591.77
Bailey	Upper	484.1	3478.23	53.80	3403.68	53.80		96.00	0.43	0.32	4591.40	4593.85	4593.19	4592.45	4591.83
Bailey	Upper	482.2	3403.68	124.45	3115.10	124.45		101.00	0.75	0.56	4589.00	4592.39	4591.77	4590.17	4589.75
Bailey	Upper	482.1	3403.68	165.69	3115.10	165.69		152.00	0.63	0.52	4588.90	4592.39	4591.77	4589.88	4589.48
Bailey	Upper	481.2	3115.10	354.25	2679.52	354.25		181.00	0.98	0.82	4586.00	4589.84	4589.45	4587.01	4586.45
Bailey	Upper	481.1	3115.10	60.84	2749.79	60.84		92.00	0.55	0.36	4587.50	4589.84	4589.45	4588.24	4587.63
Bailey	Upper	479.6	2749.79	20.00	2679.52	60.84		92.00	0.55	0.36	4587.50	4588.03	4587.39	4588.03	4587.39

HEC-RAS Plan Final (3673) Profile PF 1

River	Reach	River Sta	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Geiger	Main	4793	1305 27	4583 72	4586 28		4586 51	0.000582	3 99	347 10	420 15	0 46
Geiger	Main	4792 2	Lat Struct									
Geiger	Main	4792	1225 56	4583 75	4586 05		4586 47	0 009510	3 76	291 10	219.98	0 48
Geiger	Main	4791.2	Lat Struct									
Geiger	Main	4791.1	Lat Struct									
Geiger	Main	4791	1180.10	4583 19	4585 44		4585 66	0 009528	3 43	328 51	250.11	0 46
Geiger	Main	4790.2	Lat Struct									
Geiger	Main	4790.1	Lat Struct									
Geiger	Main	4790	1076 91	4582 08	4584 99		4585 22	0 005228	2 04	410 19	261.90	0 28
Geiger	Main	4700.3	Lat Struct									
Geiger	Main	4700.2	Lat Struct									
Geiger	Main	4700.1	Lat Struct									
Geiger	Main	4700	700 53	4582.25	4584 45	4584 45	4584 83	0 074237	4 93	142 02	450.13	1 03
Geiger	Main	4670.1	Lat Struct									
Geiger	Main	4670	694 68	4580 40	4581.85	4581 85	4582 26	0 014585	5 13	135 51	168 68	1 01
Geiger	Main	4661 2	Lat Struct									
Geiger	Main	4661	641 44	4579 00	4580 75	4580 44	4580 87	0 009326	2 88	241 23	261 69	0 43
Geiger	Main	4651.2	Lat Struct									
Geiger	Main	4651	618.17	4576.80	4579 30	4579.30	4579 56	0 017190	5.62	173 76	306 89	0 81
Geiger	Main	4640.2	Lat Struct									
Geiger	Main	4640	598 42	4574 66	4576 90	4576 90	4577 25	0 018362	5.32	138 28	182 30	0 82
Geiger	Main	4630 2	Lat Struct									
Geiger	Main	4630.1	Lat Struct									
Geiger	Main	4630	595 19	4574.60	4575 41	4575 41	4575 73	0 010771	6 61	163 64	265 00	1 55
Geiger	Main	4620.1	Lat Struct									
Geiger	Main	4620	591 96	4570 50	4573 01	4573 01	4573 39	0.018491	6 60	145 85	179 70	0 95
Geiger	Main	4600.2	Lat Struct									
Geiger	Main	4600	551 50	4569 20	4571 57	4571 51	4571 85	0 017018	5 93	155 56	193 17	0 89
Bailey	Upper	500	3673 00	4597 40	4605 86	4605 86	4607 11	0 008708	10 75	509 93	181 91	0 78
Bailey	Upper	498	3673 00	4595.80	4603 25	4603 25	4604 75	0 008982	10 91	447 86	293 09	0 81
Bailey	Upper	496	3673 00	4594 20	4601 03	4601 03	4602 64	0 010324	11 92	418 90	232 59	0 88
Bailey	Upper	494	3673 00	4592 50	4598 79	4598 79	4600 16	0 010408	11 53	469 76	160 42	0.87
Bailey	Upper	492	3673 00	4589 73	4597 26	4597 26	4598 43	0 008287	10 96	525 24	231 53	0 77
Bailey	Upper	490 1	Lat Struct									
Bailey	Upper	490	3672 95	4588 03	4596 53	4596 53	4597 26	0.007592	8 20	728 65	511 29	0 70
Bailey	Upper	488 2	Lat Struct									
Bailey	Upper	488.1	Lat Struct									
Bailey	Upper	488	3629 71	4586 78	4595 33	4595 33	4596 02	0 006972	9 34	851 65	496 60	0 67
Bailey	Upper	486.2	Lat Struct									
Bailey	Upper	486.1	Lat Struct									
Bailey	Upper	486	3540 06	4584 10	4593.33	4593 33	4594 09	0.006222	9 15	833 75	479 10	0 63
Bailey	Upper	484 2	Lat Struct									
Bailey	Upper	484.1	Lat Struct									
Bailey	Upper	484	3455 48	4582 20	4591 73	4591 73	4592 44	0 006465	9 08	614 23	453 50	0 64
Bailey	Upper	482 2	Lat Struct									
Bailey	Upper	482.1	Lat Struct									
Bailey	Upper	482	3162 31	4580 49	4589 62	4589 62	4590 28	0 006769	8 87	752 60	451 10	0 63
Bailey	Upper	481.2	Lat Struct									
Bailey	Upper	481.1	Lat Struct									
Bailey	Upper	481	2752 05	4582 36	4586 75		4587 16	0 008293	7 16	605 78	346 66	0 70
Bailey	Upper	479 6	Lat Struct									
Bailey	Upper	479 4	2732 05	4584 35	4586 41	4586 41	4586 99	0 002487	6 97	483 52	411 01	0 90
Bailey	Lower	4793	1426 79	4584 69	4585 99	4585 99	4586 51	0 003073	5 75	255 36	411 99	0 93
Bailey	Lower	470	2017 11	4579 24	4584 47	4584 47	4584 94	0 039714	6 59	409 60	682 28	0 87
Bailey	Lower	469	2330 94	4577 60	4581 81	4581 81	4582.33	0 013439	8 76	525 31	510 43	0 89
Bailey	Lower	468	2384 17	4576 20	4579 85		4580 14	0 011645	6 61	666 25	577 32	0 80
Bailey	Lower	467	2407 44	4574 30	4578 40	4578 25	4578 74	0 013005	7 59	594 48	528 13	0 80

HEC-RAS Plan Final (3673) Profile PF 1

River	Reach	River Sta	Q US	Q Leaving Total	Q DS	Q Weir	Q Gates	Wr Top Wdth	Weir Max Depth	Weir Avg Depth	Min El Weir Flow	E.G. US.	W.S. US.	E.G. DS	W.S. DS
			(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)
Geiger	Main	4792.2	1305.27	79.83	1225.56	79.83		14.00	2.36	1.66	4583.92	4586.51	4586.28	4586.47	4586.05
Geiger	Main	4791.2	1225.56	37.97	1180.10	37.97		32.88	0.73	0.52	4585.32	4586.47	4586.05	4585.66	4585.44
Geiger	Main	4791.1	1225.56	7.72	1180.10	7.72		35.39	0.33	0.16	4585.11	4586.47	4586.05	4585.66	4585.44
Geiger	Main	4790.2	1180.10	17.21	1076.91	17.21		9.89	1.41	0.70	4583.58	4585.66	4585.44	4585.22	4584.99
Geiger	Main	4790.1	1180.10	86.34	1076.91	86.34		57.00	0.82	0.64	4584.17	4585.66	4585.44	4585.22	4584.99
Geiger	Main	4700.3	1076.91	94.38	700.53	88.34		57.00	0.82	0.84	4584.17	4585.22	4584.99	4585.22	4584.99
Geiger	Main	4700.2	1076.91	238.95	700.53	238.95		40.00	1.65	1.62	4582.80	4585.22	4584.99	4584.83	4584.45
Geiger	Main	4700.1	1076.91	43.27	700.53	43.27		23.00	0.82	0.75	4583.77	4585.22	4584.99	4584.83	4584.45
Geiger	Main	4670.1	700.53	5.85	694.68	5.85		9.03	0.68	0.34	4583.20	4584.83	4584.45	4582.26	4581.85
Geiger	Main	4661.2	694.68	53.57	641.44	53.57		71.52	0.55	0.43	4580.40	4582.26	4581.85	4580.87	4580.75
Geiger	Main	4651.2	641.44	23.33	618.17	23.33		39.04	0.39	0.38	4579.80	4580.87	4580.75	4579.56	4579.30
Geiger	Main	4640.2	618.17	19.77	598.42	19.77		74.45	0.49	0.20	4577.60	4579.56	4579.30	4577.25	4576.90
Geiger	Main	4630.2	598.42	2.30	595.19	2.30		8.43	0.41	0.21	4575.00	4577.25	4576.90	4575.73	4575.41
Geiger	Main	4630.1	598.42	0.95	595.19	0.95		22.29	0.11	0.08	4575.30	4577.25	4576.90	4575.73	4575.41
Geiger	Main	4620.1	595.19	3.23	591.96	3.23		36.16	0.15	0.09	4573.30	4575.73	4575.41	4573.39	4573.01
Geiger	Main	4600.2	591.96	40.58	551.50	40.58		73.00	0.57	0.35	4571.00	4573.39	4573.01	4571.85	4571.58
Bailey	Upper	490.1	3673.00	0.05	3672.95	0.05		8.66	0.03	0.01	4596.50	4598.43	4597.26	4597.26	4596.53
Bailey	Upper	488.2	3672.95	4.60	3629.71	4.60		36.84	0.23	0.11	4595.10	4597.26	4596.53	4596.02	4595.33
Bailey	Upper	488.1	3672.95	38.65	3629.71	38.65		97.00	0.45	0.26	4594.88	4597.26	4596.53	4596.02	4595.33
Bailey	Upper	486.2	3629.71	3.48	3540.06	3.48		30.07	0.23	0.11	4593.60	4596.02	4595.33	4594.09	4593.33
Bailey	Upper	486.1	3629.71	86.29	3540.06	86.29		108.00	0.57	0.41	4593.21	4596.02	4595.33	4594.09	4593.33
Bailey	Upper	484.2	3540.06	21.34	3455.48	21.34		65.52	0.43	0.21	4591.30	4594.09	4593.33	4592.44	4591.73
Bailey	Upper	484.1	3540.06	63.54	3455.48	63.54		100.00	0.47	0.36	4591.40	4594.09	4593.33	4592.44	4591.73
Bailey	Upper	482.2	3455.48	95.56	3162.31	95.56		101.00	0.61	0.47	4589.00	4592.44	4591.73	4590.28	4589.62
Bailey	Upper	482.1	3455.48	198.93	3162.31	198.93		154.00	0.72	0.57	4589.00	4592.44	4591.73	4590.28	4589.62
Bailey	Upper	481.2	3162.31	391.50	2752.05	391.50		161.00	0.94	0.89	4585.84	4590.28	4589.62	4587.18	4586.75
Bailey	Upper	481.1	3162.31	24.38	2752.05	24.38		45.84	0.59	0.30	4587.94	4590.28	4589.62	4587.18	4586.75
Bailey	Upper	479.6	2752.05	20.00	2732.05	24.38		45.84	0.59	0.30	4587.94	4587.18	4586.75	4587.18	4586.75

HEC-RAS Plan Old(2908) Profile PF 1

River	Reach	River Sta	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Geiger	Main	4793	1192 94	4583 83	4586 30		4586 47	0,000459	3 46	363 59	443 26	0.40
Geiger	Main	4792.2	Lat Struct									
Geiger	Main	4792	1161 81	4582 40	4585 84		4586 42	0.010991	3 73	262 53	190 50	0 50
Geiger	Main	4791.1	Lat Struct									
Geiger	Main	4791	1140 90	4582 50	4585 64		4585 80	0 003844	2 50	416 18	239 02	0 31
Geiger	Main	4790.2	Lat Struct									
Geiger	Main	4790.1	Lat Struct									
Geiger	Main	4790	1025 62	4581.60	4584 83		4585 41	0 010125	2.48	278 25	210.56	0 37
Geiger	Main	4700.3	Lat Struct									
Geiger	Main	4700.2	Lat Struct									
Geiger	Main	4700.1	Lat Struct									
Geiger	Main	4700	738 68	4583 00	4584 39	4584 39	4584 80	0,011131	6 26	185 46	435 19	1 19
Geiger	Main	4670 2	Lat Struct									
Geiger	Main	4670.1	Lat Struct									
Geiger	Main	4670	552 77	4580.40	4581.79	4581 79	4582 19	0.012357	2 59	124.76	167 46	0 48
Geiger	Main	4661.2	Lat Struct									
Geiger	Main	4661	512 25	4579 00	4580 64	4580 31	4580 74	0 009201	2 72	211 50	261 00	0 42
Geiger	Main	4651.2	Lat Struct									
Geiger	Main	4651	498 05	4576 80	4579 23	4579 23	4579 46	0,016309	5 30	152 31	303 38	0 78
Geiger	Main	4640 2	Lat Struct									
Geiger	Main	4640	493.14	4574 66	4576 82		4577 13	0 017317	4 94	123 37	174 78	0.79
Geiger	Main	4630 2	Lat Struct									
Geiger	Main	4630	492 57	4574 60	4575 33	4575 33	4575 62	0 012029	6 33	142 81	265 00	1 59
Geiger	Main	4620 1	Lat Struct									
Geiger	Main	4620	491 29	4570 50	4572 91	4572 91	4573 26	0 018520	6 30	127 64	169 86	0 93
Geiger	Main	4600 2	Lat Struct									
Geiger	Main	4600	465 49	4569 20	4571.48	4571 41	4571 74	0 017018	5 67	138 59	188.83	0 88
Bailey	Upper	500	2908 00	4597.40	4605 46	4605 46	4606 57	0 007881	9 92	437 47	178 70	0 73
Bailey	Upper	498	2908 00	4595 80	4602 74	4602 74	4604 09	0 008841	10 16	371 32	265 04	0 79
Bailey	Upper	496	2908 00	4594 20	4600.51	4600 51	4601 94	0 010052	11 04	355 48	226 90	0 85
Bailey	Upper	494	2908 00	4592 50	4598 38	4598 38	4599 57	0 009748	10 59	405 40	154 15	0 83
Bailey	Upper	492	2908 00	4591 80	4597 15		4598 14	0 011308	11 05	433 60	224 99	0 88
Bailey	Upper	490	2908 00	4590 60	4596 40	4596 40	4597 03	0 007589	8 00	630 56	507 19	0 71
Bailey	Upper	488	2908 00	4589 60	4594 90	4594 90	4595 53	0 013558	8 51	600 00	455.47	0 89
Bailey	Upper	486 1	Lat Struct									
Bailey	Upper	486	2898 82	4588 40	4592 99	4592 99	4593 59	0 014140	8 13	611 73	464 59	0 90
Bailey	Upper	484 2	Lat Struct									
Bailey	Upper	484.1	Lat Struct									
Bailey	Upper	484	2874 60	4587 30	4591 59	4591 59	4592 16	0.011610	8 93	664 06	453 00	0 85
Bailey	Upper	482 2	Lat Struct									
Bailey	Upper	482.1	Lat Struct									
Bailey	Upper	482	2711 64	4584 90	4589 29		4589 65	0 011456	7 66	657 15	454 00	0 81
Bailey	Upper	481 2	Lat Struct									
Bailey	Upper	481 1	Lat Struct									
Bailey	Upper	481	2471 93	4582 60	4587 19	4587 19	4587 83	0,020647	9 42	448 93	369 62	1 03
Bailey	Upper	479 6	Lat Struct									
Bailey	Upper	479.4	2416 47	4584 35	4586 33	4586 33	4586 65	0 002393	6 64	450 36	407 31	0 88
Bailey	Lower	4793	1223 54	4584 72	4586 01	4586 01	4586 47	0 002998	5 57	233 17	422 09	0 92
Bailey	Lower	470	1601 83	4579 80	4584.60	4584 60	4585 00	0 035497	6 57	362 11	695.10	0 83
Bailey	Lower	469	1938 93	4577 60	4581 66	4581 66	4582 15	0 013189	8 39	452 89	452 72	0 87
Bailey	Lower	468	1979 45	4576 20	4579 69		4579 97	0 011602	6 48	576 13	561 98	0 78
Bailey	Lower	467	1993 66	4574 30	4578 23	4578 12	4578 57	0 013021	7 43	507 65	492 91	0 80

HEC-RAS Plan Final(2908) Profile PF 1

River	Reach	River Sta	Q Total	Min Ch El	W S Elev	Crit W.S.	E.G. Elev	E G Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Geiger	Main	4793	1177 39	4583 72	4586.16		4586.37	0 000569	3 82	326 73	416 87	0.45
Geiger	Main	4792 2	Lat Struct									
Geiger	Main	4792	1104.21	4583 75	4585 98		4586 34	0 009044	3 57	278 42	218 22	0 46
Geiger	Main	4791.2	Lat Struct									
Geiger	Main	4791.1	Lat Struct									
Geiger	Main	4791	1069 37	4583 19	4585.36		4585 56	0 009485	3 32	311 21	249 37	0 46
Geiger	Main	4790.2	Lat Struct									
Geiger	Main	4790.1	Lat Struct									
Geiger	Main	4790	981 60	4582 08	4584 92		4585 13	0 005118	1 97	392 28	261 90	0 27
Geiger	Main	4700 3	Lat Struct									
Geiger	Main	4700.2	Lat Struct									
Geiger	Main	4700.1	Lat Struct									
Geiger	Main	4700	623.63	4582 25	4584 41	4584 41	4584 75	0 070734	4 67	133 62	445 31	1 00
Geiger	Main	4670.1	Lat Struct									
Geiger	Main	4670	618 71	4580.40	4581 78	4581 78	4582 17	0 015681	4 98	124.35	167 42	1 02
Geiger	Main	4661.2	Lat Struct									
Geiger	Main	4661	575 98	4579 00	4580 70	4580 38	4580 80	0 009380	2 82	225 78	261 33	0 42
Geiger	Main	4651 2	Lat Struct									
Geiger	Main	4651	557 47	4576 80	4579 27	4579 27	4579 51	0 016445	5 42	164 35	305 36	0 79
Geiger	Main	4640.2	Lat Struct									
Geiger	Main	4640	541 93	4574 66	4576 85	4576 85	4577 19	0 018311	5 17	129 22	177 77	0 82
Geiger	Main	4630 2	Lat Struct									
Geiger	Main	4630.1	Lat Struct									
Geiger	Main	4630	539 93	4574 60	4575 37	4575 37	4575 67	0 011519	6 48	152 13	265 00	1 58
Geiger	Main	4620 1	Lat Struct									
Geiger	Main	4620	538 41	4570 50	4572 96	4572 96	4573 32	0 018402	6 43	136 62	174.19	0.94
Geiger	Main	4600.2	Lat Struct									
Geiger	Main	4600	505 66	4569 20	4571 53	4571 46	4571 79	0 016996	5 79	146 74	190 93	0 89
Bailey	Upper	500	2908 00	4597 40	4605 46	4605 46	4606 57	0 007861	9 92	437.47	178 70	0 73
Bailey	Upper	498	2908 00	4595 80	4602 74	4602 74	4604 09	0 006841	10 16	371 32	265 04	0.79
Bailey	Upper	496	2908 00	4594 20	4600 51	4600 51	4601 94	0 010052	11 04	355 48	226 90	0 85
Bailey	Upper	494	2908 00	4592 50	4598 38	4598 38	4599 57	0 009748	10 59	405 40	154 15	0 83
Bailey	Upper	492	2908.00	4589 73	4596 70		4597 89	0 008791	10 62	411 74	183 36	0 78
Bailey	Upper	490	2908 00	4588 03	4596 29	4596 29	4596 94	0 006862	7 50	608 94	496 89	0.66
Bailey	Upper	488.1	Lat Struct									
Bailey	Upper	488	2906 38	4586 78	4595 03	4595 03	4595 72	0 006814	8 92	702 61	494 52	0 66
Bailey	Upper	486 1	Lat Struct									
Bailey	Upper	486	2884 46	4584 10	4593 09	4593 09	4593 80	0 005702	8 53	717 86	468 06	0 60
Bailey	Upper	484.2	Lat Struct									
Bailey	Upper	484.1	Lat Struct									
Bailey	Upper	484	2871 54	4582 20	4591 46	4591 46	4592 18	0 006436	8 80	690 99	444 44	0 63
Bailey	Upper	482 2	Lat Struct									
Bailey	Upper	482 1	Lat Struct									
Bailey	Upper	482	2745.19	4580 49	4589 40	4589 40	4590 10	0 006929	8 84	654 14	445 82	0 63
Bailey	Upper	481.2	Lat Struct									
Bailey	Upper	481.1	Lat Struct									
Bailey	Upper	481	2439 98	4582 36	4586 66		4587 04	0 007445	6 69	576 52	346 17	0 66
Bailey	Upper	479.6	Lat Struct									
Bailey	Upper	479.4	2419 98	4584.35	4586 32	4586.32	4586 86	0 002453	6 70	446 98	406 93	0 69
Bailey	Lower	4793	1242 60	4584 69	4585 90	4585 90	4586 37	0 003019	5 42	234 99	409 65	0 91
Bailey	Lower	470	1647.03	4579 24	4584 32	4584 32	4584 78	0 041004	6 33	342 55	648 25	0 87
Bailey	Lower	469	1939 85	4577 60	4581 66	4581 66	4582 15	0 013186	8,39	453 11	452 91	0 87
Bailey	Lower	468	1982 57	4576 20	4579 69		4579 97	0 011571	6 48	577 50	562 21	0 78
Bailey	Lower	467	2001 08	4574 30	4578.24	4578 12	4578 57	0 013016	7 43	509 34	494 12	0 80

HEC-RAS Plan Old(2908) Profile PF 1

River	Reach	River Sta	Q US	Q Leaving Total	Q DS	Q Weir	Q Gates	Wr Top Wdth	Weir Max Depth	Weir Avg Depth	Min El Weir Flow	E.G. US.	W.S. US.	E.G. DS	W.S. DS
			(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)
Geiger	Main	4792.2	1192.94	31.15	1161.81	31.15		10.44	2.02	1.01	4584.28	4586.47	4586.30	4586.42	4585.84
Geiger	Main	4791.1	1161.81	26.09	1025.62	26.09		44.90	0.59	0.32	4585.00	4586.42	4585.84	4585.77	4585.59
Geiger	Main	4790.2	1140.90	12.73	1025.62	12.73		8.56	1.27	0.63	4583.60	4585.80	4585.64	4585.42	4584.87
Geiger	Main	4790.1	1140.90	100.81	738.68	100.81		59.00	0.73	0.70	4584.10	4585.80	4585.64	4585.37	4584.80
Geiger	Main	4700.3	1025.62	90.36	738.68	100.81		59.00	0.73	0.70	4584.10	4585.41	4584.83	4585.41	4584.83
Geiger	Main	4700.2	1025.62	145.77	738.68	145.77		37.00	1.23	1.23	4583.20	4585.41	4584.83	4584.85	4584.42
Geiger	Main	4700.1	1025.62	47.38	738.68	47.38		25.00	0.77	0.75	4583.70	4585.41	4584.83	4584.92	4584.47
Geiger	Main	4670.2	738.68	178.55	552.77	178.55		71.00	1.19	0.90	4582.20	4584.80	4584.39	4583.19	4582.78
Geiger	Main	4670.1	738.68	7.31	552.77	7.31		11.06	0.69	0.34	4583.20	4584.80	4584.39	4582.43	4582.02
Geiger	Main	4661.2	552.77	40.53	512.25	40.53		58.38	0.47	0.41	4580.40	4582.19	4581.79	4580.94	4580.80
Geiger	Main	4651.2	512.25	14.24	498.05	14.24		39.03	0.28	0.27	4579.80	4580.74	4580.64	4579.54	4579.31
Geiger	Main	4640.2	498.05	4.84	492.57	4.84		39.10	0.25	0.12	4577.60	4579.46	4579.23	4575.98	4575.69
Geiger	Main	4630.2	493.14	1.23	491.29	1.23		7.27	0.29	0.15	4575.00	4577.13	4576.82	4575.57	4575.29
Geiger	Main	4620.1	492.57	0.60	491.29	0.60		22.53	0.07	0.04	4573.30	4575.62	4575.33	4573.28	4572.93
Geiger	Main	4600.2	491.29	25.87	465.49	25.87		73.00	0.49	0.25	4571.00	4573.26	4572.91	4571.74	4571.49
Bailey	Upper	486.1	2908.00	9.18	2898.82	9.18		95.10	0.17	0.10	4593.10	4595.53	4594.90	4593.68	4593.08
Bailey	Upper	484.2	2898.82	6.04	2874.60	6.04		33.68	0.29	0.14	4591.30	4593.59	4592.99	4592.16	4591.59
Bailey	Upper	484.1	2898.82	18.17	2874.60	18.17		73.67	0.24	0.19	4591.40	4593.59	4592.99	4592.21	4591.64
Bailey	Upper	482.2	2874.60	71.68	2711.64	71.68		101.00	0.59	0.39	4589.00	4592.16	4591.59	4589.98	4589.59
Bailey	Upper	482.1	2874.60	91.36	2711.64	91.36		152.00	0.45	0.34	4588.90	4592.16	4591.59	4589.68	4589.32
Bailey	Upper	481.2	2711.64	249.62	2416.47	249.62		161.00	0.80	0.65	4586.00	4589.65	4589.29	4586.89	4586.36
Bailey	Upper	481.1	2711.64	25.67	2471.93	25.67		81.48	0.39	0.21	4587.50	4589.65	4589.29	4588.04	4587.43
Bailey	Upper	479.6	2471.93	20.00	2416.47	25.67		81.48	0.39	0.21	4587.50	4587.83	4587.19	4587.83	4587.19

HEC-RAS Plan Final(2908) Profile PF 1

River	Reach	River Sta	Q US	Q Leaving Total	Q DS	Q Weir	Q Gates	Wr Top Wdth	Weir Max Depth	Weir Avg Depth	Min El Weir Flow	E.G. US.	W.S. US.	E.G. DS	W.S. DS
			(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)
Geiger	Main	4792.2	1177.39	73.18	1104.21	73.18		14.00	2.24	1.57	4583.92	4586.37	4586.16	4586.34	4585.98
Geiger	Main	4791.2	1104.21	30.84	1069.37	30.84		31.69	0.66	0.47	4585.32	4586.34	4585.98	4585.56	4585.36
Geiger	Main	4791.1	1104.21	4.00	1069.37	4.00		27.28	0.25	0.13	4585.11	4586.34	4585.98	4585.56	4585.36
Geiger	Main	4790.2	1069.37	15.18	981.60	15.18		9.40	1.34	0.67	4583.56	4585.56	4585.36	4585.13	4584.92
Geiger	Main	4790.1	1069.37	72.59	981.60	72.59		57.00	0.75	0.57	4584.17	4585.56	4585.36	4585.13	4584.92
Geiger	Main	4700.3	981.60	92.63	623.63	72.59		57.00	0.75	0.57	4584.17	4585.13	4584.92	4585.13	4584.92
Geiger	Main	4700.2	981.60	226.85	623.63	226.85		40.00	1.61	1.56	4582.80	4585.13	4584.92	4584.75	4584.41
Geiger	Main	4700.1	981.60	38.56	623.63	38.56		23.00	0.75	0.69	4583.77	4585.13	4584.92	4584.75	4584.41
Geiger	Main	4670.1	623.63	4.93	618.71	4.93		8.37	0.64	0.32	4583.20	4584.75	4584.41	4582.17	4581.78
Geiger	Main	4661.2	618.71	42.77	575.98	42.77		70.51	0.48	0.37	4580.40	4582.17	4581.78	4580.80	4580.70
Geiger	Main	4651.2	575.98	18.53	557.47	18.53		39.03	0.33	0.32	4579.80	4580.80	4580.70	4579.51	4579.27
Geiger	Main	4640.2	557.47	15.48	541.93	15.48		71.54	0.46	0.17	4577.60	4579.51	4579.27	4577.19	4576.85
Geiger	Main	4630.2	541.93	1.74	539.93	1.74		7.52	0.37	0.18	4575.00	4577.19	4576.85	4575.67	4575.37
Geiger	Main	4630.1	541.93	0.27	539.93	0.27		13.33	0.07	0.03	4575.30	4577.19	4576.85	4575.67	4575.37
Geiger	Main	4620.1	539.93	1.53	538.41	1.53		28.74	0.10	0.07	4573.30	4575.67	4575.37	4573.32	4572.96
Geiger	Main	4600.2	538.41	32.77	505.66	32.77		73.00	0.53	0.30	4571.00	4573.32	4572.96	4571.80	4571.53
Bailey	Upper	488.1	2908.00	1.62	2906.38	1.62		50.90	0.15	0.04	4594.88	4596.94	4596.29	4595.72	4595.03
Bailey	Upper	486.1	2906.38	21.91	2884.46	21.91		87.91	0.29	0.19	4593.21	4595.72	4595.03	4593.80	4593.09
Bailey	Upper	484.2	2884.46	1.78	2871.54	1.78		24.63	0.16	0.08	4591.30	4593.80	4593.09	4592.18	4591.46
Bailey	Upper	484.1	2884.46	11.09	2871.54	11.09		87.32	0.21	0.12	4591.40	4593.80	4593.09	4592.18	4591.46
Bailey	Upper	482.2	2871.54	32.57	2745.19	32.57		101.00	0.40	0.23	4589.00	4592.18	4591.46	4590.10	4589.40
Bailey	Upper	482.1	2871.54	92.30	2745.19	92.30		154.00	0.50	0.33	4589.00	4592.18	4591.46	4590.10	4589.40
Bailey	Upper	481.2	2745.19	297.08	2439.98	297.08		161.00	0.82	0.74	4585.84	4590.10	4589.40	4587.04	4586.66
Bailey	Upper	481.1	2745.19	8.71	2439.98	8.71		32.62	0.38	0.19	4587.94	4590.10	4589.40	4587.04	4586.66
Bailey	Upper	479.6	2439.98	20.00	2419.98	8.71		32.62	0.38	0.19	4587.94	4587.04	4586.66	4587.04	4586.66

HEC-RAS Plan Old (2824) Profile PF 1

River	Reach	River Sta	Q Total	Min Ch El	W.S Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Geiger	Main	4793	1177 28	4583 83	4586 28		4586 45	0 000460	3 44	360.00	441 94	0 40
Geiger	Main	4792.2	Lat Struct									
Geiger	Main	4792	1146 82	4582 40	4585 83		4586 40	0 010936	3 71	260 95	190 24	0 50
Geiger	Main	4791.1	Lat Struct									
Geiger	Main	4791	1127 06	4582 50	4585 63		4585 78	0.003855	2 50	413 05	238 84	0 31
Geiger	Main	4790 2	Lat Struct									
Geiger	Main	4790.1	Lat Struct									
Geiger	Main	4790	1014 34	4581 60	4584 83		4585 39	0 010019	2 46	277.33	210 48	0 37
Geiger	Main	4700.3	Lat Struct									
Geiger	Main	4700.2	Lat Struct									
Geiger	Main	4700.1	Lat Struct									
Geiger	Main	4700	729 07	4583 00	4584 38	4584 38	4584 79	0 011295	6 27	182 48	434 43	1 20
Geiger	Main	4670.2	Lat Struct									
Geiger	Main	4670.1	Lat Struct									
Geiger	Main	4670	551 75	4580 40	4581 78	4581 78	4582 19	0 012543	2 61	124.11	167 39	0 48
Geiger	Main	4661.2	Lat Struct									
Geiger	Main	4661	512 50	4579 00	4580 62	4580 32	4580 72	0 010071	2 82	205 76	260 87	0 44
Geiger	Main	4651 2	Lat Struct									
Geiger	Main	4651	498 98	4576 80	4579 25	4579 25	4579 46	0 014225	5 01	160 03	304 65	0 73
Geiger	Main	4640.2	Lat Struct									
Geiger	Main	4640	498 98	4574 66	4576 80	4576 80	4577 13	0 019046	5 13	120 31	173 20	0 83
Geiger	Main	4630 2	Lat Struct									
Geiger	Main	4630	498 98	4574 60	4575 36	4575 36	4575 63	0 010302	6 07	150 19	265 00	1 49
Geiger	Main	4620 1	Lat Struct									
Geiger	Main	4620	498 98	4570 50	4572 92	4572 92	4573 27	0 018530	6 32	129 05	170 55	0 94
Geiger	Main	4600.2	Lat Struct									
Geiger	Main	4600	471 82	4569 20	4571 49	4571 42	4571 75	0 017019	5 69	139 88	189 17	0 88
Bailey	Upper	500	2824 00	4597 40	4605 43	4605 43	4606 51	0 007677	9 77	431 37	178 43	0 72
Bailey	Upper	498	2824 00	4595 80	4602 67	4602 67	4604 01	0 008817	10 06	362 35	264 51	0 79
Bailey	Upper	496	2824,00	4594 20	4600 45	4600 45	4601 85	0 010041	10 95	347 78	226 23	0 85
Bailey	Upper	494	2824 00	4592 50	4598 33	4598 33	4599 50	0 009680	10 48	397 74	153.39	0 83
Bailey	Upper	492	2824 00	4591 60	4597 11		4598 09	0 011105	10 91	426 19	221 51	0 87
Bailey	Upper	490	2824 00	4590 60	4596 37	4596 37	4596 99	0 007519	7 93	615 97	505 39	0 71
Bailey	Upper	488	2824 00	4589 60	4594 87	4594 87	4595 50	0 013528	8 44	586 48	452 24	0 89
Bailey	Upper	486.1	Lat Struct									
Bailey	Upper	486	2824 00	4588 40	4592 96	4592 96	4593 56	0 014071	8 06	601 09	462 85	0 90
Bailey	Upper	484 2	Lat Struct									
Bailey	Upper	484.1	Lat Struct									
Bailey	Upper	484	2808 56	4587 30	4591 57	4591 57	4592 13	0 011522	8 86	654 77	453 00	0 85
Bailey	Upper	482.2	Lat Struct									
Bailey	Upper	482.1	Lat Struct									
Bailey	Upper	482	2658 47	4584 90	4589 27		4589 63	0 011508	7 63	647 17	454 00	0 81
Bailey	Upper	481.2	Lat Struct									
Bailey	Upper	481.1	Lat Struct									
Bailey	Upper	481	2429 60	4582 60	4587 18	4587 18	4587 81	0 020430	9 34	444.78	369 05	1 03
Bailey	Upper	479.6	Lat Struct									
Bailey	Upper	479.4	2375 46	4584 35	4586 31	4586 31	4586 84	0 002454	6 66	441 22	406 28	0 89
Bailey	Lower	4793	1198 18	4584 72	4585 99	4585 99	4586 46	0 003016	5 54	229 60	421 34	0 92
Bailey	Lower	470	1554 98	4579 80	4584 62	4584 62	4584 98	0 031878	6 23	369 44	698 20	0 79
Bailey	Lower	469	1889 71	4577 60	4581 65	4581 65	4582 13	0 013070	8 31	444 99	445 98	0 87
Bailey	Lower	468	1928 95	4576 20	4579 67		4579 94	0 011602	6 44	564 08	559 89	0 78
Bailey	Lower	467	1942 47	4574 30	4578 21	4578 10	4578 54	0.013016	7 41	496 67	484 93	0 80

HEC-RAS Plan Old (2824) Profile PF 1

River	Reach	River Sta	Q US	Q Leaving Total	Q DS	Q Weir	Q Gates	Wr Top Wdth	Weir Max Depth	Weir Avg Depth	Min El Weir Flow	E.G. US	W.S. US	E.G. DS	W.S. DS
			(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)
Geiger	Main	4792.2	1177.28	30.53	1146.82	30.53		10.37	2.00	1.00	4584.28	4586.45	4586.28	4586.40	4585.83
Geiger	Main	4791.1	1146.82	24.77	1014.34	24.77		44.05	0.57	0.31	4585.00	4586.40	4585.83	4585.76	4585.57
Geiger	Main	4790.2	1127.06	12.59	1014.34	12.59		8.52	1.26	0.63	4583.60	4585.78	4585.63	4585.41	4584.87
Geiger	Main	4790.1	1127.06	98.91	729.07	98.91		59.00	0.72	0.69	4584.10	4585.78	4585.63	4585.35	4584.80
Geiger	Main	4700.3	1014.34	90.24	729.07	98.91		59.00	0.72	0.69	4584.10	4585.39	4584.83	4585.39	4584.83
Geiger	Main	4700.2	1014.34	144.39	729.07	144.39		37.00	1.23	1.22	4583.20	4585.39	4584.83	4584.84	4584.41
Geiger	Main	4700.1	1014.34	46.69	729.07	46.69		25.00	0.76	0.75	4583.70	4585.39	4584.83	4584.91	4584.46
Geiger	Main	4670.2	729.07	175.80	551.75	175.80		71.00	1.18	0.89	4582.20	4584.79	4584.38	4583.19	4582.78
Geiger	Main	4670.1	729.07	7.03	551.75	7.03		10.91	0.68	0.34	4583.20	4584.79	4584.38	4582.43	4582.02
Geiger	Main	4661.2	551.75	38.59	512.50	38.59		58.26	0.46	0.40	4580.40	4582.19	4581.78	4580.92	4580.78
Geiger	Main	4651.2	512.50	13.28	498.98	13.28		39.03	0.28	0.26	4579.80	4580.72	4580.62	4579.54	4579.34
Geiger	Main	4640.2	498.98	5.86	498.98	5.86		39.66	0.27	0.14	4577.60	4579.46	4579.25	4575.99	4575.71
Geiger	Main	4630.2	498.98	1.53	498.98	1.53		7.88	0.31	0.16	4575.00	4577.13	4576.80	4575.58	4575.31
Geiger	Main	4620.1	498.98	1.20	498.98	1.20		26.12	0.09	0.06	4573.30	4575.63	4575.36	4573.29	4572.94
Geiger	Main	4600.2	498.98	26.92	471.82	26.92		73.00	0.49	0.26	4571.00	4573.27	4572.92	4571.75	4571.49
Bailey	Upper	486.1	2824.00	6.12	2824.00	6.12		87.50	0.15	0.08	4593.10	4595.50	4594.87	4593.65	4593.05
Bailey	Upper	484.2	2824.00	5.01	2808.56	5.01		31.15	0.27	0.13	4591.30	4593.56	4592.96	4592.13	4591.57
Bailey	Upper	484.1	2824.00	15.44	2808.56	15.44		70.60	0.22	0.17	4591.40	4593.56	4592.96	4592.19	4591.62
Bailey	Upper	482.2	2808.56	66.01	2658.47	66.01		101.00	0.56	0.37	4589.00	4592.13	4591.57	4589.95	4589.56
Bailey	Upper	482.1	2808.56	83.40	2658.47	83.40		152.00	0.43	0.32	4588.90	4592.13	4591.57	4589.66	4589.30
Bailey	Upper	481.2	2658.47	240.54	2375.46	240.54		161.00	0.78	0.63	4586.00	4589.63	4589.27	4586.87	4586.34
Bailey	Upper	481.1	2658.47	22.86	2429.60	22.86		79.31	0.37	0.20	4587.50	4589.63	4589.27	4588.02	4587.42
Bailey	Upper	479.6	2429.60	20.00	2375.46	22.86		79.31	0.37	0.20	4587.50	4587.81	4587.18	4587.81	4587.18

HEC-RAS Plan. Final (2824) Profile PF 1

River	Reach	River Sta	Q Total	Min Ch El	W.S Elev	Crit W.S	E.G Elev	E.G Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Geiger	Main	4793	1148 76	4583 72	4586 13		4586 34	0.000566	3 78	322.10	416 12	0 45
Geiger	Main	4792.2	Lat Struct									
Geiger	Main	4792	1077 11	4583.75	4585 96		4586 31	0 008957	3 53	275 31	217.79	0 46
Geiger	Main	4791.2	Lat Struct									
Geiger	Main	4791.1	Lat Struct									
Geiger	Main	4791	1044 56	4583 19	4585 35		4585 54	0 009473	3 29	307 22	249 20	0 46
Geiger	Main	4790.2	Lat Struct									
Geiger	Main	4790.1	Lat Struct									
Geiger	Main	4790	960 10	4582 08	4584 91		4585 11	0 005071	1 95	388 58	261 90	0.27
Geiger	Main	4700.3	Lat Struct									
Geiger	Main	4700.2	Lat Struct									
Geiger	Main	4700.1	Lat Struct									
Geiger	Main	4700	606 86	4582 25	4584 39	4584.39	4584.73	0 072080	4 65	130 43	443 46	1 01
Geiger	Main	4670.2	Lat Struct									
Geiger	Main	4670.1	Lat Struct									
Geiger	Main	4670	591.11	4580 40	4581 76	4581 76	4582 14	0 015849	4.89	120 84	167 02	1 01
Geiger	Main	4661.2	Lat Struct									
Geiger	Main	4661	551 64	4579 00	4580 67	4580 35	4580 78	0 009334	2 78	220 29	261 21	0 42
Geiger	Main	4651.2	Lat Struct									
Geiger	Main	4651	534 78	4576 80	4579 25	4579 25	4579 49	0 016339	5 37	160 03	304.65	0 78
Geiger	Main	4640.2	Lat Struct									
Geiger	Main	4640	520 82	4574 66	4576 84	4576 83	4577 16	0 017996	5 08	126 45	176.36	0 81
Geiger	Main	4630.2	Lat Struct									
Geiger	Main	4630	519 25	4574 60	4575 35	4575 35	4575 65	0 011653	6 40	148 37	265 00	1 58
Geiger	Main	4620.1	Lat Struct									
Geiger	Main	4620	518 17	4570 50	4572 94	4572 94	4573 29	0 018511	6 38	132 65	172 29	0 94
Geiger	Main	4600.2	Lat Struct									
Geiger	Main	4600	488 45	4569 20	4571 51	4571 44	4571 77	0 017000	5 74	143 30	190 05	0 88
Bailey	Upper	500	2824 00	4597 40	4605 43	4605 43	4606 51	0 007677	9 77	431.37	178 43	0 72
Bailey	Upper	498	2824 00	4595 80	4602 67	4602 67	4604 01	0 008817	10 06	362 35	264 51	0 79
Bailey	Upper	496	2824 00	4594 20	4600 45	4600 45	4601 85	0 010041	10 95	347 78	226 23	0 85
Bailey	Upper	494	2824 00	4592 50	4598 33	4598 33	4599 50	0 009680	10 48	397.74	153 39	0 83
Bailey	Upper	492	2824 00	4589 73	4596 70		4597 82	0 008318	10 32	411 12	183 11	0 76
Bailey	Upper	490	2824 00	4588 03	4596 21	4596 21	4596 91	0 007381	7 67	567 67	491 53	0 68
Bailey	Upper	488.1	Lat Struct									
Bailey	Upper	488	2823 50	4586 78	4595 00	4595 00	4595 68	0 006717	8.82	687 78	464 32	0 65
Bailey	Upper	486.1	Lat Struct									
Bailey	Upper	486	2806 38	4584 10	4593 05	4593 05	4593 76	0 005661	8 47	701 45	465 84	0 60
Bailey	Upper	484.2	Lat Struct									
Bailey	Upper	484.1	Lat Struct									
Bailey	Upper	484	2794.64	4582 20	4591 46	4591 46	4592 15	0 006040	8 53	694 03	444 52	0 61
Bailey	Upper	482.2	Lat Struct									
Bailey	Upper	482.1	Lat Struct									
Bailey	Upper	482	2669 26	4580 49	4589 39	4589 39	4590 07	0 006592	8 62	652 18	445 68	0 62
Bailey	Upper	481.2	Lat Struct									
Bailey	Upper	481.1	Lat Struct									
Bailey	Upper	481	2370 75	4582 36	4586 64		4587 01	0 007252	6 57	569 76	346 05	0 65
Bailey	Upper	479.6	Lat Struct									
Bailey	Upper	479.4	2350 75	4584 35	4586 30	4586 30	4586 83	0 002431	6 62	439 44	406 08	0 88
Bailey	Lower	4793	1201 99	4584 69	4585 88	4585 88	4586 34	0 003077	5 39	228 56	408 91	0 92
Bailey	Lower	470	1598 43	4579 24	4584 32	4584 32	4584 75	0 036920	6 17	341 44	647 67	0 85
Bailey	Lower	469	1897 22	4577 60	4581 65	4581 65	4582 13	0 013081	8 32	446 30	447 10	0 87
Bailey	Lower	468	1936 69	4576 20	4579 67		4579 95	0 011572	6 44	566.54	560 32	0 78
Bailey	Lower	467	1953 55	4574 30	4578 22	4578 10	4578 55	0 013018	7 41	499 04	486 66	0 80

HEC-RAS Plan Final (2824) Profile PF 1

River	Reach	River Sta	Q US	Q Leaving Total	Q DS	Q Weir	Q Gates	Wr Top Wdth	Weir Max Depth	Weir Avg Depth	Min El Weir Flow	E.G. US	W.S. US	E.G. DS	W.S. DS
			(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)
Geiger	Main	4792.2	1148.76	71.64	1077.11	71.64		14.00	2.21	1.55	4583.92	4586.34	4586.13	4586.31	4585.96
Geiger	Main	4791.2	1077.11	29.21	1044.56	29.21		31.40	0.64	0.45	4585.32	4586.31	4585.96	4585.54	4585.35
Geiger	Main	4791.1	1077.11	3.34	1044.56	3.34		25.36	0.23	0.12	4585.11	4586.31	4585.96	4585.54	4585.35
Geiger	Main	4790.2	1044.56	14.77	960.10	14.77		9.30	1.33	0.66	4583.58	4585.54	4585.35	4585.11	4584.91
Geiger	Main	4790.1	1044.56	69.70	960.10	69.70		57.00	0.74	0.55	4584.17	4585.54	4585.35	4585.11	4584.91
Geiger	Main	4700.3	960.10	92.26	606.86	69.70		57.00	0.74	0.55	4584.17	4585.11	4584.91	4585.11	4584.91
Geiger	Main	4700.2	960.10	223.56	606.86	223.56		40.00	1.59	1.55	4582.80	4585.11	4584.91	4584.73	4584.39
Geiger	Main	4700.1	960.10	37.31	606.86	37.31		23.00	0.74	0.68	4583.77	4585.11	4584.91	4584.73	4584.39
Geiger	Main	4670.2	606.86	11.12	591.11	11.12		42.39	1.19	0.54	4582.20	4584.73	4584.39	4582.14	4581.76
Geiger	Main	4670.1	606.86	4.61	591.11	4.61		8.14	0.62	0.31	4583.20	4584.73	4584.39	4582.14	4581.76
Geiger	Main	4661.2	591.11	39.32	551.64	39.32		70.19	0.46	0.35	4580.40	4582.14	4581.76	4580.78	4580.67
Geiger	Main	4651.2	551.64	16.87	534.78	16.87		39.03	0.32	0.30	4579.80	4580.78	4580.67	4579.49	4579.25
Geiger	Main	4640.2	534.78	13.96	520.82	13.96		68.52	0.45	0.16	4577.60	4579.49	4579.25	4577.16	4576.84
Geiger	Main	4630.2	520.82	1.57	519.25	1.57		7.23	0.35	0.18	4575.00	4577.16	4576.84	4575.65	4575.35
Geiger	Main	4620.1	519.25	1.10	518.17	1.10		26.13	0.09	0.06	4573.30	4575.65	4575.35	4573.29	4572.94
Geiger	Main	4600.2	518.17	29.72	488.45	29.72		73.00	0.51	0.28	4571.00	4573.29	4572.94	4571.77	4571.51
Bailey	Upper	488.1	2824.00	0.50	2823.50	0.50		24.53	0.12	0.03	4594.88	4596.91	4596.21	4595.68	4595.00
Bailey	Upper	486.1	2823.50	17.12	2806.38	17.12		82.39	0.26	0.16	4593.21	4595.68	4595.00	4593.76	4593.05
Bailey	Upper	484.2	2806.38	1.86	2794.64	1.86		24.20	0.16	0.08	4591.30	4593.76	4593.05	4592.15	4591.46
Bailey	Upper	484.1	2806.38	9.88	2794.64	9.88		81.79	0.19	0.11	4591.40	4593.76	4593.05	4592.15	4591.46
Bailey	Upper	482.2	2794.64	32.72	2669.26	32.72		101.00	0.39	0.23	4589.00	4592.15	4591.46	4590.07	4589.39
Bailey	Upper	482.1	2794.64	92.40	2669.26	92.40		154.00	0.50	0.33	4589.00	4592.15	4591.46	4590.07	4589.39
Bailey	Upper	481.2	2669.26	289.78	2370.75	289.78		161.00	0.80	0.72	4585.84	4590.07	4589.39	4587.01	4586.64
Bailey	Upper	481.1	2669.26	8.33	2370.75	8.33		31.78	0.37	0.19	4587.94	4590.07	4589.39	4587.01	4586.64
Bailey	Upper	479.6	2370.75	20.00	2350.75	8.33		31.78	0.37	0.19	4587.94	4587.01	4586.64	4587.01	4586.64

HEC-RAS Plan Final (2400) Profile PF 1

River	Reach	River Sta	Q Total	Min Ch El	W S. Elev	Crit W S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Geiger	Main	4793	1042 41	4583 72	4586.03		4586.22	0 000554	3 62	304 52	413 23	0 44
Geiger	Main	4792.2	Lat Struct									
Geiger	Main	4792	976 55	4583 75	4585 89		4586 19	0 008600	3 37	263 62	216.55	0.45
Geiger	Main	4791 2	Lat Struct									
Geiger	Main	4791 1	Lat Struct									
Geiger	Main	4791	953 04	4583 19	4585 29		4585 46	0 009203	3 17	294 06	248 64	0 45
Geiger	Main	4790.2	Lat Struct									
Geiger	Main	4790.1	Lat Struct									
Geiger	Main	4790	892 61	4582.08	4584 86		4585 04	0 004934	1 88	376 30	261 90	0 26
Geiger	Main	4700.3	Lat Struct									
Geiger	Main	4700.2	Lat Struct									
Geiger	Main	4700.1	Lat Struct									
Geiger	Main	4700	554 55	4582 25	4584 34	4584 34	4584 67	0 074840	4 57	121 40	438 18	1 02
Geiger	Main	4670 2	Lat Struct									
Geiger	Main	4670 1	Lat Struct									
Geiger	Main	4670	554.55	4580 40	4581 73	4581 73	4582 09	0 016453	4 81	115 39	166 40	1 02
Geiger	Main	4661 2	Lat Struct									
Geiger	Main	4661	520 36	4579 00	4580 64	4580 33	4580 74	0 009383	2 75	212 26	261.02	0 42
Geiger	Main	4651 2	Lat Struct									
Geiger	Main	4651	520 36	4576 80	4579 25	4579 25	4579 48	0 015429	5 22	160 18	304 67	0 76
Geiger	Main	4640.2	Lat Struct									
Geiger	Main	4640	520 36	4574 66	4576 82	4576 82	4577 16	0 019243	5 21	123.45	174 83	0 83
Geiger	Main	4630.2	Lat Struct									
Geiger	Main	4630	520.36	4574.60	4575 37	4575 37	4575 65	0 010831	6 27	151 61	265 00	1 53
Geiger	Main	4620	520 36	4570 50	4572 94	4572 94	4573 30	0 018537	6 39	132 99	172 45	0 94
Geiger	Main	4600.2	Lat Struct									
Geiger	Main	4600	490 44	4569.20	4571 51	4571 44	4571 78	0 017009	5 75	143 67	190 14	0 89
Bailey	Upper	500	2400 00	4597 40	4605 13	4605 13	4606 17	0 007412	9 37	378 41	176 04	0 71
Bailey	Upper	498	2400 00	4595 80	4602 28	4602 28	4603 59	0 009212	9 74	305 30	260.32	0 80
Bailey	Upper	496	2400 00	4594 20	4600 10	4600 10	4601 42	0 010122	10 48	305 57	222 50	0 84
Bailey	Upper	494	2400 00	4592 50	4598 07	4598 07	4599 14	0 009296	9 90	357 76	149 34	0 81
Bailey	Upper	492	2400 00	4589 73	4596 55		4597 47	0 006961	9 28	384 34	171 90	0 69
Bailey	Upper	490	2400 00	4588 03	4595 98	4595 98	4596 69	0 007657	7 50	456 66	443 54	0 69
Bailey	Upper	488	2400 00	4586 78	4594 81	4594 81	4595.47	0 006377	8 40	601 95	438 48	0 63
Bailey	Upper	486.1	Lat Struct									
Bailey	Upper	486	2400.00	4584 10	4592 87	4592 87	4593 55	0 005336	8 06	616 64	456 07	0 58
Bailey	Upper	484	2400 00	4582 20	4591 23	4591 23	4591 95	0 006097	8 41	594 33	421 80	0 61
Bailey	Upper	482.2	Lat Struct									
Bailey	Upper	482 1	Lat Struct									
Bailey	Upper	482	2349 15	4580 49	4589 30	4589 30	4589 91	0 005791	8 04	612 92	442 85	0 58
Bailey	Upper	481.2	Lat Struct									
Bailey	Upper	481 1	Lat Struct									
Bailey	Upper	481	2105 34	4582.36	4586 57		4586 88	0 006460	6 10	543 96	342.69	0 61
Bailey	Upper	479.6	Lat Struct									
Bailey	Upper	479.4	2085 34	4584.35	4586 22	4586 22	4586 71	0 002406	6 37	405 69	402 26	0 87
Bailey	Lower	4793	1042 92	4584 69	4585 80	4585 80	4586 22	0 003039	5 08	209 14	406 68	0 90
Bailey	Lower	470	1352.60	4579 24	4584 26	4584 26	4584 62	0 034400	5 64	312 14	632 16	0 79
Bailey	Lower	469	1609 60	4577 60	4581 53	4581 53	4581 98	0 012691	7 97	394 83	415 83	0 85
Bailey	Lower	468	1643 79	4576 20	4579 54		4579 80	0 011609	6 17	491 88	530 92	0 78
Bailey	Lower	467	1643 79	4574.30	4578 07	4577 91	4578 40	0 013023	7 27	431 35	434 46	0 79

HEC-RAS Plan: Final (2400) Profile: PF 1

River	Reach	River Sta	Q US	Q Leaving Total	Q DS	Q Weir	Q Gates	Wr Top Wdth	Weir Max Depth	Weir Avg Depth	Min El Weir Flow	E.G. US	W.S. US	E.G. DS	W.S. DS
			(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)
Geiger	Main	4792.2	1042.41	65.86	976.55	65.86		14.00	2.11	1.46	4583.92	4586.22	4586.03	4586.19	4585.89
Geiger	Main	4791.2	976.55	23.52	953.04	23.52		30.38	0.57	0.40	4585.32	4586.19	4585.89	4585.46	4585.29
Geiger	Main	4791.1	976.55	1.62	953.04	1.62		18.88	0.18	0.09	4585.11	4586.19	4585.89	4585.46	4585.29
Geiger	Main	4790.2	953.04	13.48	892.61	13.48		8.95	1.28	0.64	4583.58	4585.46	4585.29	4585.04	4584.86
Geiger	Main	4790.1	953.04	60.47	892.61	60.47		57.00	0.69	0.50	4584.17	4585.46	4585.29	4585.04	4584.86
Geiger	Main	4700.3	892.61	91.06	554.55	60.47		57.00	0.69	0.50	4584.17	4585.04	4584.86	4585.04	4584.86
Geiger	Main	4700.2	892.61	213.60	554.55	213.60		40.00	1.54	1.50	4582.80	4585.04	4584.86	4584.67	4584.34
Geiger	Main	4700.1	892.61	33.55	554.55	33.55		23.00	0.69	0.63	4583.77	4585.04	4584.86	4584.67	4584.34
Geiger	Main	4670.2	554.55	18.46	554.55	18.46		38.80	1.14	0.51	4582.20	4584.67	4584.34	4582.09	4581.73
Geiger	Main	4670.1	554.55	3.83	554.55	3.83		7.59	0.57	0.29	4583.20	4584.67	4584.34	4582.09	4581.73
Geiger	Main	4661.2	554.55	34.35	520.36	34.35		69.69	0.43	0.33	4580.40	4582.09	4581.73	4580.74	4580.64
Geiger	Main	4651.2	520.36	14.85	520.36	14.85		39.03	0.30	0.28	4579.80	4580.74	4580.64	4579.48	4579.25
Geiger	Main	4640.2	520.36	13.52	520.36	13.52		66.55	0.45	0.16	4577.60	4579.48	4579.25	4577.16	4576.82
Geiger	Main	4630.2	520.36	1.70	520.36	1.70		7.44	0.36	0.18	4575.00	4577.16	4576.82	4575.65	4575.37
Geiger	Main	4600.2	520.36	30.01	490.44	30.01		73.00	0.51	0.28	4571.00	4573.30	4572.94	4571.78	4571.51
Bailey	Upper	486.1	2400.00	0.78	2400.00	0.78		36.49	0.07	0.03	4593.21	4595.47	4594.81	4593.55	4592.87
Bailey	Upper	482.2	2400.00	10.25	2349.15	10.25		65.80	0.30	0.13	4589.00	4591.95	4591.23	4589.91	4589.30
Bailey	Upper	482.1	2400.00	50.93	2349.15	50.93		110.13	0.40	0.28	4589.00	4591.95	4591.23	4589.91	4589.30
Bailey	Upper	481.2	2349.15	242.94	2105.34	242.94		161.00	0.73	0.64	4585.84	4589.91	4589.30	4586.88	4586.57
Bailey	Upper	481.1	2349.15	4.28	2105.34	4.28		24.53	0.28	0.14	4587.94	4589.91	4589.30	4586.88	4586.57
Bailey	Upper	479.6	2105.34	20.00	2085.34	4.28		24.53	0.28	0.14	4587.94	4586.88	4586.57	4586.88	4586.57

HEC-RAS Plan. Final (2000) Profile PF 1

River	Reach	River Sta	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Geiger	Main	4793	916.87	4583.72	4585.91		4586.08	0.000531	3.41	284.23	409.83	0.42
Geiger	Main	4792.2	Lat Struct									
Geiger	Main	4792	857.84	4583.75	4585.60		4586.05	0.008202	3.18	248.48	216.30	0.43
Geiger	Main	4791.2	Lat Struct									
Geiger	Main	4791	841.27	4583.19	4585.19		4585.34	0.009393	3.06	272.08	247.70	0.45
Geiger	Main	4790.2	Lat Struct									
Geiger	Main	4790.1	Lat Struct									
Geiger	Main	4790	783.79	4582.08	4584.78		4584.93	0.004703	1.77	355.33	261.90	0.26
Geiger	Main	4700.3	Lat Struct									
Geiger	Main	4700.2	Lat Struct									
Geiger	Main	4700.1	Lat Struct									
Geiger	Main	4700	469.49	4582.25	4584.27	4584.27	4584.57	0.077922	4.37	107.44	429.87	1.03
Geiger	Main	4670.2	Lat Struct									
Geiger	Main	4670.1	Lat Struct									
Geiger	Main	4670	443.10	4580.40	4581.63	4581.63	4581.94	0.018380	4.48	98.82	164.50	1.02
Geiger	Main	4661.2	Lat Struct									
Geiger	Main	4661	422.72	4579.00	4580.55	4580.23	4580.63	0.009344	2.62	186.67	260.43	0.42
Geiger	Main	4651.2	Lat Struct									
Geiger	Main	4651	414.71	4576.80	4579.18	4579.18	4579.39	0.015007	4.96	137.47	295.65	0.75
Geiger	Main	4640.2	Lat Struct									
Geiger	Main	4640	407.56	4574.68	4576.72	4576.72	4577.01	0.017654	4.74	106.65	165.95	0.79
Geiger	Main	4630.2	Lat Struct									
Geiger	Main	4630	406.58	4574.60	4575.29	4575.29	4575.52	0.010753	5.65	132.33	264.61	1.49
Geiger	Main	4620	406.58	4570.50	4572.80	4572.80	4573.13	0.019484	6.11	109.00	160.35	0.95
Geiger	Main	4600.2	Lat Struct									
Geiger	Main	4600	392.44	4569.20	4571.40	4571.35	4571.64	0.017008	5.42	122.99	184.76	0.87
Bailey	Upper	500	2000.00	4597.40	4604.82	4604.82	4605.81	0.007053	8.90	323.77	173.72	0.69
Bailey	Upper	498	2000.00	4595.80	4601.72	4601.72	4603.10	0.011012	9.78	237.31	212.56	0.85
Bailey	Upper	496	2000.00	4594.20	4599.73	4599.73	4600.96	0.010131	9.95	263.06	219.48	0.83
Bailey	Upper	494	2000.00	4592.50	4597.75	4597.75	4598.77	0.009326	9.46	310.49	145.61	0.80
Bailey	Upper	492	2000.00	4589.73	4596.41		4597.13	0.005560	8.15	360.82	161.43	0.62
Bailey	Upper	490	2000.00	4588.03	4595.46	4595.46	4596.38	0.011039	8.14	301.83	199.32	0.81
Bailey	Upper	488	2000.00	4586.78	4594.61	4594.61	4595.24	0.005912	7.90	519.95	403.32	0.61
Bailey	Upper	486	2000.00	4584.10	4592.63	4592.63	4593.32	0.005109	7.72	512.08	432.61	0.56
Bailey	Upper	484	2000.00	4582.20	4591.08	4591.08	4591.72	0.005250	7.70	530.44	410.86	0.57
Bailey	Upper	482.1	Lat Struct									
Bailey	Upper	482	1982.33	4580.49	4589.14	4589.14	4589.71	0.005248	7.58	539.84	437.52	0.55
Bailey	Upper	481.2	Lat Struct									
Bailey	Upper	481	1806.79	4582.36	4586.47		4586.73	0.005594	5.56	511.44	330.02	0.57
Bailey	Upper	479.6	Lat Struct									
Bailey	Upper	479.4	1786.79	4584.35	4586.12	4586.12	4586.57	0.002356	6.05	366.24	397.75	0.86
Bailey	Lower	4793	869.93	4584.69	4585.70	4585.70	4586.08	0.002991	4.72	186.26	404.04	0.88
Bailey	Lower	470	1104.49	4579.24	4584.12	4584.12	4584.48	0.035319	5.50	254.16	577.06	0.79
Bailey	Lower	469	1373.78	4577.60	4581.42	4581.42	4581.85	0.012151	7.60	352.54	397.25	0.82
Bailey	Lower	468	1394.15	4576.20	4579.41		4579.65	0.011496	5.87	426.41	484.92	0.76
Bailey	Lower	467	1402.16	4574.30	4577.94	4577.82	4578.26	0.013004	7.13	378.77	366.69	0.79

HEC-RAS Plan Final (2000) Profile PF 1

River	Reach	River Sta	Q US	Q Leaving Total	Q DS	Q Weir	Q Gates	Wr Top Wdth	Weir Max Depth	Weir Avg Depth	Min El Weir Flow	E.G. US.	W.S. US.	E.G. DS.	W.S. DS
			(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)
Geiger	Main	4792.2	916.87	59.04	857.84	59.04		14.00	1.99	1.36	4583.92	4586.08	4585.91	4586.05	4585.80
Geiger	Main	4791.2	857.84	16.60	841.27	16.60		28.90	0.48	0.33	4585.32	4586.05	4585.80	4585.34	4585.19
Geiger	Main	4790.2	841.27	11.43	783.79	11.43		8.37	1.20	0.60	4583.58	4585.34	4585.19	4584.93	4584.78
Geiger	Main	4790.1	841.27	46.07	783.79	46.07		57.00	0.61	0.41	4584.17	4585.34	4585.19	4584.93	4584.78
Geiger	Main	4700.3	783.79	89.00	469.49	46.07		57.00	0.61	0.41	4584.17	4584.93	4584.78	4584.93	4584.78
Geiger	Main	4700.2	783.79	197.56	469.49	197.56		40.00	1.47	1.43	4582.80	4584.93	4584.78	4584.57	4584.27
Geiger	Main	4700.1	783.79	27.68	469.49	27.68		23.00	0.61	0.56	4583.77	4584.93	4584.78	4584.57	4584.27
Geiger	Main	4670.2	469.49	23.69	443.10	23.69		34.14	1.07	0.47	4582.20	4584.57	4584.27	4581.94	4581.63
Geiger	Main	4670.1	469.49	2.70	443.10	2.70		6.54	0.50	0.25	4583.20	4584.57	4584.27	4581.94	4581.63
Geiger	Main	4661.2	443.10	20.45	422.72	20.45		68.14	0.33	0.23	4580.40	4581.94	4581.63	4580.63	4580.55
Geiger	Main	4651.2	422.72	8.03	414.71	8.03		39.02	0.21	0.18	4579.80	4580.63	4580.55	4579.39	4579.18
Geiger	Main	4640.2	414.71	7.12	407.56	7.12		47.83	0.37	0.13	4577.60	4579.39	4579.18	4577.01	4576.72
Geiger	Main	4630.2	407.56	0.97	406.58	0.97		5.93	0.29	0.15	4575.00	4577.01	4576.72	4575.52	4575.29
Geiger	Main	4600.2	406.58	14.18	392.44	14.18		71.29	0.40	0.16	4571.00	4573.13	4572.80	4571.64	4571.40
Bailey	Upper	482.1	2000.00	18.03	1982.33	18.03		91.99	0.24	0.16	4589.00	4591.72	4591.08	4589.71	4589.14
Bailey	Upper	481.2	1982.33	174.63	1806.79	174.63		161.00	0.63	0.51	4585.84	4589.71	4589.14	4586.73	4586.47
Bailey	Upper	479.6	1806.79	20.00	1786.79	174.63		161.00	0.63	0.51	4585.84	4586.73	4586.47	4586.73	4586.47

HEC-RAS Plan: Final (1500) Profile PF 1

River	Reach	River Sta	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Geiger	Main	4793	754 68	4583 72	4585 74		4585 88	0 000496	3 11	256 61	405 09	0 40
Geiger	Main	4792 2	Lat Struct									
Geiger	Main	4792	704 93	4583.75	4585 67		4585 86	0.007732	2 93	226 30	215 93	0 41
Geiger	Main	4791.2	Lat Struct									
Geiger	Main	4791	696 45	4583 19	4585 06		4585 19	0 009313	2 67	243 45	241 65	0 44
Geiger	Main	4790.2	Lat Struct									
Geiger	Main	4790.1	Lat Struct									
Geiger	Main	4790	657.98	4582 08	4584.67		4584.78	0 004555	1 66	326 17	281 90	0 25
Geiger	Main	4700 3	Lat Struct									
Geiger	Main	4700 2	Lat Struct									
Geiger	Main	4700 1	Lat Struct									
Geiger	Main	4700	374 18	4582 25	4584 20	4584 20	4584 45	0 076151	4 01	93 40	420 90	1 00
Geiger	Main	4670 2	Lat Struct									
Geiger	Main	4670 1	Lat Struct									
Geiger	Main	4670	341 24	4580 40	4581 52	4581.52	4581.80	0 020277	4.17	81.78	155 05	1 01
Geiger	Main	4661 2	Lat Struct									
Geiger	Main	4661	332 25	4579.00	4580 44	4580 13	4580 52	0 009211	2 46	159 75	259 81	0 41
Geiger	Main	4651 2	Lat Struct									
Geiger	Main	4651	329 56	4576 80	4579 11	4579 11	4579 30	0,014257	4 68	118 20	276 12	0 72
Geiger	Main	4640 2	Lat Struct									
Geiger	Main	4640	325 52	4574 66	4576 68	4576 62	4576 90	0 013620	4.04	100 00	162 30	0 69
Geiger	Main	4630 2	Lat Struct									
Geiger	Main	4630	325 17	4574 60	4575 19	4575 19	4575 42	0 014444	5 56	106 60	259 70	1 65
Geiger	Main	4620	325 17	4570 50	4572 68	4572 68	4572 99	0 019705	5.77	91 22	144 41	0 94
Geiger	Main	4600 2	Lat Struct									
Geiger	Main	4600	318 59	4569 20	4571 31	4571 26	4571 53	0 017005	5 13	105 71	180 14	0 86
Bailey	Upper	500	1500 00	4597 40	4603 87	4603 87	4605 22	0,009900	9 64	180 86	95 99	0 80
Bailey	Upper	498	1500 00	4595 60	4601 05	4601 05	4602 35	0 012570	9 27	175 90	182 23	0 88
Bailey	Upper	496	1500 00	4594 20	4599 14	4599 14	4600 28	0 010752	9 32	201 32	185 46	0 84
Bailey	Upper	494	1500 00	4592 50	4597 36	4597 36	4598 23	0 008483	8 49	255 39	141 52	0 75
Bailey	Upper	492	1500 00	4589.73	4596 01		4596 59	0 004717	7 13	302 14	131 60	0 56
Bailey	Upper	490	1500 00	4588 03	4594 94	4594.94	4595 87	0 013167	7 89	213 70	142 65	0 86
Bailey	Upper	488	1500 00	4586 78	4594 24	4594 24	4594 88	0 005838	7 48	378 58	364 71	0 60
Bailey	Upper	486	1500 00	4584.10	4590 51	4590 51	4592 77	0 017301	12 07	124 33	27 72	1 00
Bailey	Upper	484	1500 00	4582 20	4590.70	4590 70	4591 37	0 005029	7 29	380 06	386 45	0 55
Bailey	Upper	482.1	Lat Struct									
Bailey	Upper	482	1500 00	4580.49	4588 75	4588 75	4589 38	0,005203	7 38	376 97	385 58	0 54
Bailey	Upper	481 2	Lat Struct									
Bailey	Upper	481	1427 39	4582 36	4586 33		4586.53	0 004479	4 82	465 87	311 41	0 50
Bailey	Upper	479.6	Lat Struct									
Bailey	Upper	479.4	1407.39	4584 35	4585 98	4585 98	4586 37	0 002333	5 64	308 30	388 41	0 84
Bailey	Lower	4793	652 71	4584 69	4585 56	4585 56	4585 89	0 003013	4 23	152 73	391 73	0 86
Bailey	Lower	470	775 07	4579 24	4583 83	4583 83	4584 23	0 036372	5 64	165,02	283.16	0 80
Bailey	Lower	469	1021 72	4577.60	4581 24	4581 24	4581 62	0.011146	6 94	286 37	326 73	0 78
Bailey	Lower	468	1030 71	4576 20	4579 17		4579 38	0 011239	5 30	333 17	323 48	0 74
Bailey	Lower	467	1033 41	4574 30	4577 69	4577 61	4578 00	0 013019	6 88	294 23	334 40	0 79

HEC-RAS Plan Final (1500) Profile PF 1

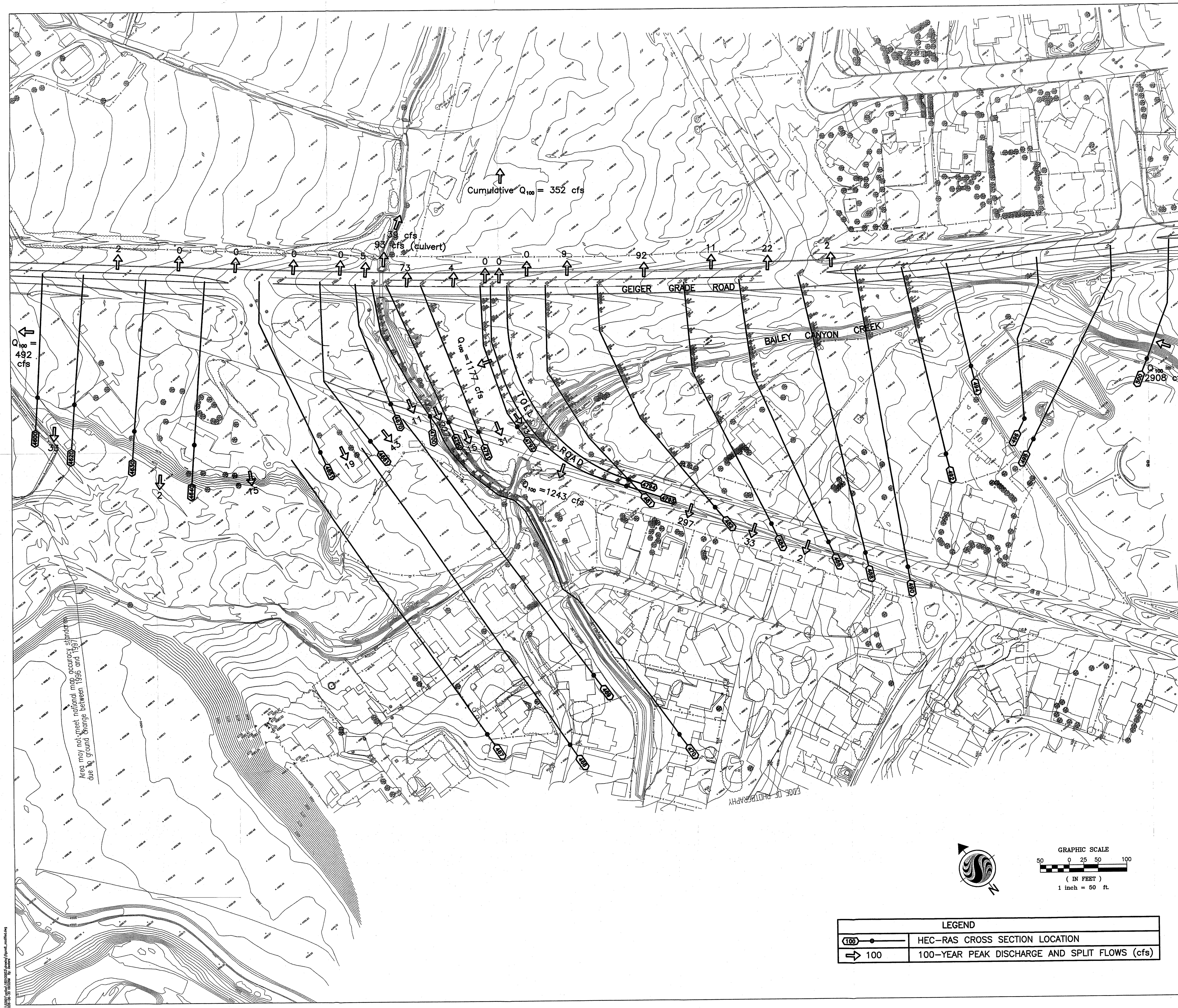
River	Reach	River Sta	Q US	Q Leaving Total	Q DS	Q Weir	Q Gates	Wr Top Wdth	Weir Max Depth	Weir Avg Depth	Min El Weir Flow	E.G. US.	W.S. US.	E.G. DS	W.S. DS
			(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)
Geiger	Main	4792.2	754.68	49.79	704.93	49.79		14.00	1.82	1.21	4583.92	4585.88	4585.74	4585.86	4585.67
Geiger	Main	4791.2	704.93	8.50	696.45	8.50		26.82	0.35	0.22	4585.32	4585.86	4585.67	4585.19	4585.06
Geiger	Main	4790.2	696.45	8.94	657.98	8.94		7.57	1.09	0.54	4583.58	4585.19	4585.06	4584.78	4584.67
Geiger	Main	4790.1	696.45	29.45	657.98	29.45		53.61	0.50	0.31	4584.17	4585.19	4585.08	4584.78	4584.67
Geiger	Main	4700.3	657.98	84.90	374.18	29.45		53.61	0.50	0.31	4584.17	4584.78	4584.67	4584.78	4584.67
Geiger	Main	4700.2	657.98	178.63	374.18	178.63		40.00	1.40	1.33	4582.80	4584.78	4584.67	4584.45	4584.20
Geiger	Main	4700.1	657.98	21.04	374.18	21.04		23.00	0.50	0.46	4583.77	4584.78	4584.67	4584.45	4584.20
Geiger	Main	4670.2	374.18	31.29	341.24	31.29		25.02	1.00	0.43	4582.20	4584.45	4584.20	4581.80	4581.52
Geiger	Main	4670.1	374.18	1.78	341.24	1.78		5.49	0.43	0.21	4583.20	4584.45	4584.20	4581.80	4581.52
Geiger	Main	4661.2	341.24	8.91	332.25	8.91		66.50	0.23	0.13	4580.40	4581.80	4581.52	4580.52	4580.44
Geiger	Main	4651.2	332.25	2.70	329.56	2.70		39.01	0.12	0.09	4579.80	4580.52	4580.44	4579.30	4579.11
Geiger	Main	4640.2	329.56	4.07	325.52	4.07		32.52	0.30	0.11	4577.60	4579.30	4579.11	4576.90	4576.68
Geiger	Main	4630.2	325.52	0.35	325.17	0.35		3.98	0.19	0.10	4575.00	4576.90	4576.68	4575.42	4575.19
Geiger	Main	4600.2	325.17	6.61	318.59	6.61		37.57	0.31	0.15	4571.00	4572.99	4572.68	4571.53	4571.31
Bailey	Upper	482.1	1500.00	0.00	1500.00						4589.00	4591.37	4590.70	4589.38	4588.75
Bailey	Upper	481.2	1500.00	72.61	1427.39	72.61		137.18	0.49	0.31	4585.84	4589.38	4588.75	4586.53	4586.33
Bailey	Upper	479.6	1427.39	20.00	1407.39	72.61		137.18	0.49	0.31	4585.84	4586.53	4586.33	4586.53	4586.33

HEC-RAS Plan: Final (1000) Profile PF 1

River	Reach	River Sta	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Geiger	Main	4793	564.92	4583.72	4585.53		4585.63	0.000437	2.69	222.35	388.57	0.37
Geiger	Main	4792.2	Lat Struct									
Geiger	Main	4792	526.66	4583.75	4585.48		4585.61	0.007295	2.61	194.13	212.87	0.39
Geiger	Main	4791.2	Lat Struct									
Geiger	Main	4791	525.35	4583.19	4584.89		4584.99	0.008988	2.56	206.25	222.23	0.42
Geiger	Main	4790.2	Lat Struct									
Geiger	Main	4790.1	Lat Struct									
Geiger	Main	4790	505.71	4582.08	4584.52		4584.60	0.004267	1.49	288.19	261.90	0.24
Geiger	Main	4700.3	Lat Struct									
Geiger	Main	4700.2	Lat Struct									
Geiger	Main	4700.1	Lat Struct									
Geiger	Main	4700	262.12	4582.25	4584.07	4584.07	4584.29	0.078551	3.76	69.70	383.54	1.01
Geiger	Main	4670.2	Lat Struct									
Geiger	Main	4670.1	Lat Struct									
Geiger	Main	4670	231.47	4580.40	4581.38	4581.38	4581.61	0.024099	3.82	60.60	138.09	1.02
Geiger	Main	4661.2	Lat Struct									
Geiger	Main	4661	230.88	4579.00	4580.28	4579.98	4580.35	0.009230	2.24	122.17	215.67	0.40
Geiger	Main	4651.2	Lat Struct									
Geiger	Main	4651	230.88	4576.80	4579.02	4579.02	4579.19	0.012490	4.18	94.81	250.37	0.67
Geiger	Main	4640.2	Lat Struct									
Geiger	Main	4640	229.22	4574.66	4576.58	4576.44	4576.74	0.010552	3.36	84.37	156.86	0.59
Geiger	Main	4630	229.22	4574.60	4575.09	4575.09	4575.28	0.019202	5.03	79.03	249.00	1.79
Geiger	Main	4620	229.22	4570.50	4572.50	4572.50	4572.79	0.020824	5.33	67.95	120.41	0.94
Geiger	Main	4600.2	Lat Struct									
Geiger	Main	4600	227.86	4569.20	4571.17	4571.15	4571.37	0.017013	4.75	81.12	167.76	0.84
Bailey	Upper	500	1000.00	4597.40	4602.26	4602.26	4603.92	0.016951	10.36	97.05	32.66	0.99
Bailey	Upper	498	1000.00	4595.80	4600.06	4600.06	4601.30	0.018343	8.93	112.17	118.97	1.01
Bailey	Upper	496	1000.00	4594.20	4598.43	4598.43	4599.42	0.011356	8.37	142.58	163.98	0.83
Bailey	Upper	494	1000.00	4592.50	4596.77	4596.77	4597.57	0.008614	7.69	174.15	128.54	0.73
Bailey	Upper	492	1000.00	4589.73	4595.29		4595.81	0.004700	6.43	213.54	114.87	0.54
Bailey	Upper	490	1000.00	4588.03	4594.78	4594.15	4595.27	0.007490	5.70	191.42	129.23	0.64
Bailey	Upper	488	1000.00	4586.78	4592.22	4592.22	4594.10	0.017844	11.00	90.92	24.23	1.00
Bailey	Upper	486	1000.00	4584.10	4589.86		4591.22	0.011619	9.34	107.04	26.19	0.81
Bailey	Upper	484	1000.00	4582.20	4588.71	4587.97	4590.06	0.011397	9.33	107.24	25.38	0.80
Bailey	Upper	482	1000.00	4580.49	4586.02	4586.02	4588.11	0.019197	11.59	86.31	20.90	1.00
Bailey	Upper	481.2	Lat Struct									
Bailey	Upper	481	997.32	4582.36	4586.12		4586.25	0.003233	3.89	403.32	292.79	0.42
Bailey	Upper	479.6	Lat Struct									
Bailey	Upper	479.4	977.32	4584.35	4585.77	4585.77	4586.11	0.002340	5.09	231.96	357.90	0.82
Bailey	Lower	4793	412.40	4584.69	4585.39	4585.39	4585.63	0.002751	3.41	114.67	375.74	0.79
Bailey	Lower	470	453.34	4579.24	4582.49	4582.49	4583.73	0.053191	8.96	50.62	28.30	1.01
Bailey	Lower	469	662.46	4577.60	4581.02	4581.02	4581.34	0.009524	6.02	214.96	313.27	0.71
Bailey	Lower	468	663.05	4576.20	4578.86		4579.02	0.010628	4.63	242.99	257.25	0.70
Bailey	Lower	467	663.05	4574.30	4577.39	4577.33	4577.69	0.013017	6.54	196.43	296.37	0.78

HEC-RAS Plan Final (1000) Profile PF 1

River	Reach	River Sta	Q US	Q Leaving Total	Q DS	Q Weir	Q Gates	Wr Top Wdth	Weir Max Depth	Weir Avg Depth	Min El Weir Flow	E.G. US	W.S. US	E.G. DS	W.S. DS
			(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)
Geiger	Main	4792.2	564.92	38.26	526.66	38.26		14.00	1.61	1.00	4583.92	4585.63	4585.53	4585.61	4585.48
Geiger	Main	4791.2	526.66	1.31	525.35	1.31		17.35	0.16	0.08	4585.32	4585.61	4585.48	4584.99	4584.89
Geiger	Main	4790.2	525.35	6.22	505.71	6.22		8.53	0.94	0.47	4583.58	4584.99	4584.89	4584.60	4584.52
Geiger	Main	4790.1	525.35	13.42	505.71	13.42		41.72	0.35	0.22	4584.17	4584.99	4584.89	4584.60	4584.52
Geiger	Main	4700.3	505.71	79.55	262.12	13.42		41.72	0.35	0.22	4584.17	4584.60	4584.52	4584.60	4584.52
Geiger	Main	4700.2	505.71	151.66	262.12	151.66		40.00	1.27	1.20	4582.80	4584.60	4584.52	4584.29	4584.07
Geiger	Main	4700.1	505.71	12.38	262.12	12.38		23.00	0.35	0.33	4583.77	4584.60	4584.52	4584.29	4584.07
Geiger	Main	4670.2	262.12	29.90	231.47	29.90		20.64	0.87	0.41	4582.20	4584.29	4584.07	4581.61	4581.38
Geiger	Main	4670.1	262.12	0.71	231.47	0.71		3.79	0.30	0.15	4583.20	4584.29	4584.07	4581.61	4581.38
Geiger	Main	4661.2	231.47	0.58	230.88	0.58		26.15	0.08	0.04	4580.40	4581.61	4581.38	4580.35	4580.28
Geiger	Main	4651.2	230.88	0.00	230.88						4579.80	4580.35	4580.28	4579.19	4579.02
Geiger	Main	4640.2	230.88	1.63	229.22	1.63		15.86	0.21	0.11	4577.60	4579.19	4579.02	4576.74	4576.58
Geiger	Main	4600.2	229.22	1.37	227.86	1.37		19.20	0.17	0.08	4571.00	4572.79	4572.50	4571.37	4571.17
Bailey	Upper	481.2	1000.00	2.69	997.32	2.69		15.61	0.28	0.14	4585.84	4588.11	4586.02	4586.25	4586.12
Bailey	Upper	479.6	997.32	20.00	977.32	2.69		15.61	0.28	0.14	4585.84	4586.25	4586.12	4586.25	4586.12



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Consultants

Legend

File Name:

Dwn. Chkd. Dsgn. YY.MM.DD

Client/Project
CFA, INC.

BAILEY CANYON CREEK
SPLIT FLOW ANALYSES
WASHOE COUNTY, NV U.S.A.

Title
EXISTING CONDITIONS
HYDRAULIC WORK MAP

Project No. 180100953
Scale

Drawing No. I.2
Sheet 1 of 1