DRAINAGE REPORT

FOR THE

SANTA MARGARITA QUARRY

April 18, 2013

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FOR REVIEW ONLY

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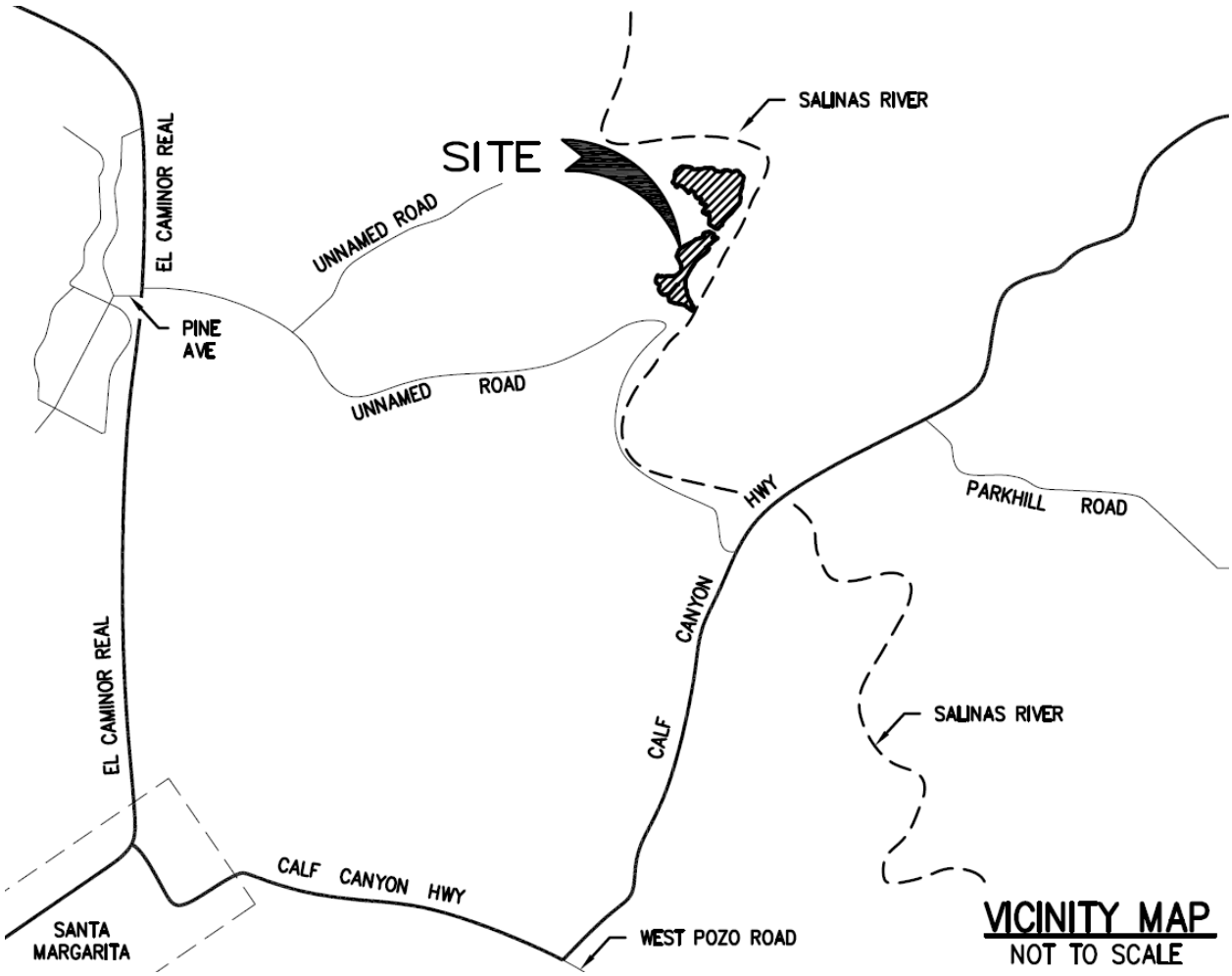
INTRODUCTION

Hanson Aggregates Mid-Pacific (Hanson) operates the Santa Margarita Quarry, which is located approximately 2.5 miles northeast of the town of Santa Margarita in San Luis Obispo County, California (see the Vicinity Map). In order to extend the existing quarry operations, Hanson is applying for a modification to their existing Conditional Use Permit and a Reclamation Plan Amendment (RPA). It is estimated that current permitted reserves will be depleted in approximately 21 years if further reserves are not secured. Development of the adjacent aggregate resources will add approximately 21.5 million tons and 38 years of mining beyond the depletion of the current reserves. The currently approved reclamation plan boundary will increase from by approximately 33 acres to 193 acres.



This report contains drainage analyses of the post-reclamation flow rates from the extended mining area as well as the Lower Area. The Lower Area is directly south of the mining area and currently supports two hot mix asphalt plants, access roads, stockpiles, silt ponds and a concrete and asphalt recycling facility. Portions of the Lower Area will be mass graded since this area was proposed to be mass graded pursuant to the approved 1981 reclamation plan. An intent of the mass grading is to allow sheet flow to be conveyed over a smoothened ground surface. The

northerly portion of the mass graded Lower Area will direct storm runoff to existing ponds near its northeasterly corner. The mass graded area just south of this will direct storm runoff to an infiltration area created within the pad. There is a smaller area further to the south covering approximately 1.31 acres that will be graded and direct storm runoff towards the proposed infiltration area. The existing ponds and infiltration area will provide some water quality benefits to storm runoff within the Lower Area.

San Luis Obispo County's *2011 Public Improvement Standards* indicates that for drainage areas less than 1 square mile (640 acres), a project's proposed drainage system shall convey the 25-year storm runoff with freeboard and the 50-year storm without freeboard. The overall drainage area for the mining area covers just over 82 acres and is just over 62 acres for the grading within the Lower Area, so the project is subject to these requirements. Furthermore, the Surface Mining and Reclamation Act (SMARA) states that erosion control methods shall be designed for the 20-year storm, and shall control erosion and sedimentation during operations as well as after reclamation is complete (see *California Code of Regulations*, Title 14, Section 3706). The *2011 Public Improvement Standards* provide parameters for the 25-year storm event, but not the 20-year event. The 25-year event was analyzed in this report in order to satisfy the requirements for the 20- and 25-year events. Since the 25-year event is greater than the 20-year event, the 25-year results will provide a factor-of-safety for SMARA's requirements. The 50-year event was also analyzed in accordance with the *2011 Public Improvement Standards*.

HYDROLOGIC ANALYSES

Under pre-project conditions (with the current quarry operations), surface runoff from the extended mining area project footprint primarily flows in a northerly direction over a natural hillside area and ultimately enters the Salinas River. The southerly drainage boundary on the Mining Area Rational Method Work Map in the map pocket is the ridge line along the extended quarry. The area north of the drainage boundary flows north to the river and the area south of the drainage boundary flows south across a rural area. The extended project will result in a mining pit that captures and stores precipitation onto its direct footprint as well as a small portion of the adjacent tributary hillside. Since the mining pit will act as a retention basin while the quarry is in operation and also following reclamation, the project will not adversely increase off-site flow rates or flow volumes. Consequently, hydrologic analyses were only performed for the proposed (post-project or reclaimed) conditions. The *2011 Public Improvement Standards* specify the rational method for drainage areas less than 200 acres. The overall mining area study limits covers just over 85 acres, so the rational method was used for the analyses.

Under pre-project conditions, the Lower Area generally sheet flows towards the Salinas River. Hanson personnel have indicated that a drainage facility does not exist that intentionally conveys runoff from the Lower Area to the River. Much of the storm runoff is understood to pond within the Lower Area and infiltrate or evaporate. The Federal Emergency Management Agency's (FEMA) *Flood Insurance Rate Map* (included following this report text) shows that the 100-year floodplain extends onto much of the Lower Area suggesting that the Lower Area is subject to inundation during large storm events. The overall Lower Area study limits covers just over 62 acres, so the rational method was used for the analyses.

The rational method input parameters are summarized below and the supporting data is included in Appendix A:

- Rainfall Intensity: The 25- and 50-year intensity-duration-frequency data were established using San Luis Obispo County's "Rainfall Intensity Data" (Drawing No. H-4). The average annual precipitation at the site from Drawing No. H-1 is 21 inches, so Table 3 from Drawing No. H-4 was used.

- Drainage area: The proposed condition (i.e., post-reclamation) drainage basins were delineated from the base topography prepared for the project and the proposed Reclamation Plan Amendment grading representing the ultimate site configuration. The Mining Area and Lower Area Rational Method Work Maps in the map pocket at the back of this report contains the existing topography, proposed grading, drainage basin boundaries, rational method node numbers, and drainage basin areas.

- Runoff coefficients: The proposed site conditions within the project footprint will contain negligible impervious surfaces and a final surface condition representative of a mineral extraction site and mass graded pads (natural surfaces with revegetation in some areas capable of sustaining vegetation). Drawing No. H-3a from the *2011 Public Improvement Standards* provides a table used to establish runoff coefficients for undeveloped areas. The table categorizes undeveloped areas into their relief, soil infiltration, vegetal cover, and surface storage.

  For the mining area, the post-reclamation relief is classified as extreme within and above the pit walls, but low on the pit floor. The soil infiltration was assigned as extreme since the site is a hard rock quarry. The vegetal cover was assumed to be high to reflect the poor to fair vegetative cover after reclamation. The surface storage was assigned a value of high since the project will provide ditches and swales to direct runoff towards the lower end of the pit. From this, the runoff coefficient for the pit walls and above is 0.64 and for the pit floor is 0.44.

  For the Lower Area, the post-reclamation relief is classified as low within the mass graded pads and high within the natural hillside area tributary to the pads. The soil infiltration was assigned as normal. The vegetal cover was assumed to be high to reflect the poor to fair vegetative cover after reclamation and within the natural hillside. The surface storage was assigned a value of low within the mass graded pads since the pads are relatively level and runoff will enter ponds or an infiltration area. The surface storage was assigned a value of high within the natural hillside. From this, the runoff coefficient for the mass graded pads is 0.33 and for the natural hillside tributary to the mass graded pads is 0.50.

- Flow lengths and elevations: The flow lengths and elevations were obtained from the topographic mapping and Reclamation Plan Amendment grading. The time of concentration for each initial subarea was calculated using a spreadsheet based on the equation from Drawing No. H-2. The time of concentration was assigned a value of 5 minutes if the

equation yielded less than 5 minutes. The 5 minutes partially reflects the time for initial precipitation to overcome surface storage and occur as runoff.

The rational method analyses were performed using the CivilDesign Universal Rational Method Hydrology Program. This program was customized to meet the San Luis Obispo County hydrologic criteria. The County's intensity-duration data was input into the program. The times of concentration for initial subareas were calculated using a spreadsheet of the time of concentration equation (or minimum 5 minutes), which is included in Appendix A. The initial time of concentration values from the spreadsheet were entered as user-specified data in the program. After the initial subarea is modeled, the program can route the flow in channels, streets, pipes, etc. The channel routing routine was used to model the flow in naturally-lined drainages and the proposed flow paths. The program also allows for flow in separate streams to be confluenced.

The CivilDesign program requires a land use to be entered (e.g., undeveloped poor cover, etc.). However, the runoff coefficients entered in the program were based on the user-defined values defined above, rather than the program specified land use and soil group. Therefore, while the land uses listed in the output provide a general description of the land use, they were not used for determination of the runoff coefficients.

The overall 25- and 50-year existing and proposed condition rational method output are included in Appendix A. For the mining area, the overall 25-year flow rate is 96 cubic feet per second and the 50-year flow rate is 111 cfs. In order to convey runoff across the site, natural-lined ditches will be grading within the inner portions of the benches. These are modeled as v-ditches with 2:1 (horizontal:vertical) side slopes in the rational method analyses. The maximum 50-year flow depth along a ditch is just over 1.5 feet (30 cfs from Node 58 to 60). A normal depth analysis is included after this report text. Based on this, the benches can adequately convey the required 50-year runoff.

For the Lower Area, the 25-year flow rates to northesterly ponds, proposed infiltration area, and smaller southerly graded area are 61, 25, and 1.9 cfs, respectively (at Nodes 76, 84, and 92 on the Lower Area Rational Method Work Map). The 50-year flow rates are 71, 29, and 2.1 cfs, respectively.

CONCLUSION

Drainage analyses have been performed for the Santa Margarita Quarry. The final reclamation will essentially create a large retention basin wherein all on-site mining area drainage flows are directed. This basin is surrounded by manufactured slopes and hillsides thereby preventing drainage flows from being directed to adjacent off-site areas. Consequently, the project will not adversely impact flooding on adjacent areas. The in-pit flows will be conveyed by naturally-lined ditches within the proposed benches and basin floor. The ditches will have capacity for the 50-year flow (which will meet SMARA's 20-year requirement). Since the project is a quarry with no associated development, the only improved drainage conveyances will be the ditches. The

proposed downdrains (ditches aligned down the pit wall) shall be lined to prevent erosion. An exception would be if the underlying soil contains non-erodible rock.

Since the pit will be self-contained, it will also act as a desilting basin that captures any sediment runoff. Given the conveyance of post-project drainage flows into an on-site retention basin, the proposed project will not violate any water quality standards, will not discharge into surface waters or otherwise alter surface water quality in any off-site areas, and will not change the quantity of movement of available surface water in any off-site areas. Surface runoff stored in the pit will not have a negligible impact on the Salinas River flows since the Salinas River watershed near the site covers over 300 square miles.

The drainage analyses have also determined the 25- and 50-year flow rates within the mass graded Lower Area. Impervious surfaces will not be added to the lower area, so the flow rate and volume will essentially be maintained within the area. The 25- and 50-year flows will primarily occur as broad sheet flow over the mass graded surfaces. The flows will be directed to either existing ponds or a proposed infiltration area.

The Federal Emergency Management Agency's (FEMA) *Flood Insurance Rate Map* (included following this report text) delineates the Salinas River 100-year floodplain along the project site. The floodplain is a Zone A floodplain, which is based on approximate methods rather than a detailed engineering analysis. In order to confirm whether the extended project impacts the floodplain, additional research was performed. FEMA indicates that the 100-year flow rate in the Salinas River below the confluence with Paso Robles Creek is 42,000 cubic feet per second. The confluence is over 10 miles upstream of the site, so the 100-year flow rate at the site will be higher. A review of topographic mapping indicates that this flow rate can be conveyed within the existing drainage course along the site and that the extended pit does not encroach within the 100-year floodplain.

Worksheet for Triangular Ditch on Benches

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.018	
Channel Slope	0.01000	ft/ft
Left Side Slope	2.00	ft/ft (H:V)
Right Side Slope	2.00	ft/ft (H:V)
Discharge	30.00	ft^3/s

Results

Normal Depth	1.53	ft
Flow Area	4.68	ft^2
Wetted Perimeter	6.84	ft
Hydraulic Radius	0.68	ft
Top Width	6.12	ft
Critical Depth	1.69	ft
Critical Slope	0.00579	ft/ft
Velocity	6.41	ft/s
Velocity Head	0.64	ft
Specific Energy	2.17	ft
Froude Number	1.29	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

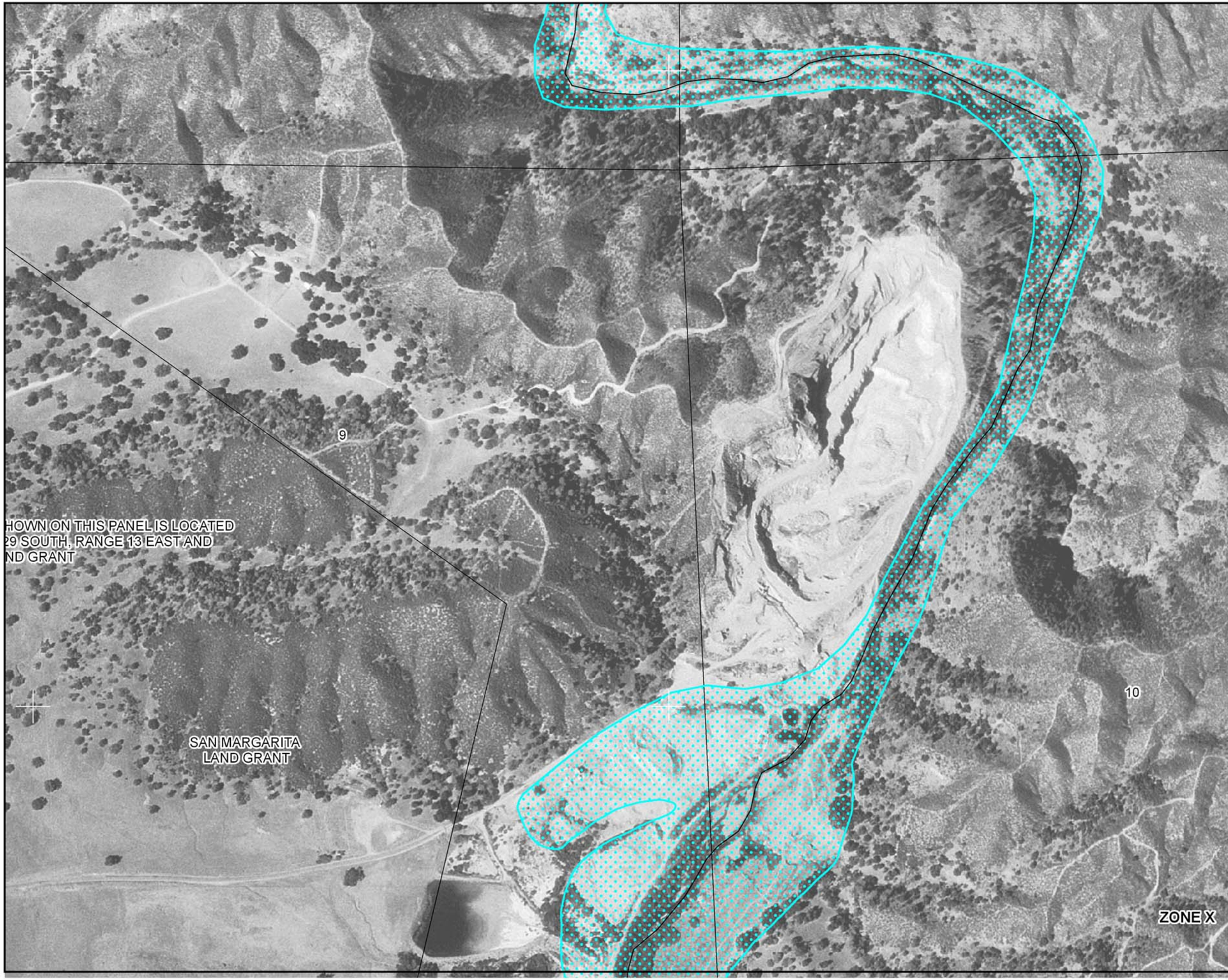
GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	1.53	ft
Critical Depth	1.69	ft
Channel Slope	0.01000	ft/ft
Critical Slope	0.00579	ft/ft

Table 1. Summary of Discharges

Flooding Source and Location	Drainage Area (Square Miles)	Peak Discharges (Cubic Feet per Second) 10-Year	50-Year	100-Year	500-Year
Graves Creek					
At Del Rio Road	12.2	1,910	4,500	5,500	6,990
At Confluence With Salinas River	15.3	2,050	5,020	6,190	7,990
North Fork Paloma Creek					
At U.S. Highway 101	1.6	160	500	660	830
Paloma Creek					
6,400 Feet Above U.S. Highway 101	1.1	108	450	570	720
At U.S. Highway 101	3.4	440	1,180	1,550	1,940
At Southern Pacific Railroad	5.8	600	1,730	2,290	2,880
Salinas River					
Below Confluence With Santa Margarita Creek	200	7,800	14,500	21,000	31,000
Below Confluence With Paso Robles Creek	331	15,500	32,000	42,000	62,500
At U.S. Geological Survey Gage at Paso Robles	387	16,000	33,000	43,000	66,000
Santa Margarita Creek					
Near El Camino Real 400 Feet Southwest of Wilhelmina Avenue	11.2	2,130	4,580	5,400	7,040
At Confluence With Yerba Buena Creek	19.4	3,390	7,510	8,220	8,500
At El Camino Real	22.4	3,450	7,850	9,435	12,300
At Confluence With Trout Creek	23.2	4,800	11,300	13,800	18,100
South Branch Toad Creek					
Above U.S. Highway 101	1.1	290	600	720	920
Below U.S. Highway 101	1.1	160[1]	290[1]	320[1]	380[1]

[1]Reduced or Constant Flow Values Due to Capacity Restriction



MAP SCALE 1" = 500'

250 0 500 1000 FEET

METER

NFIP

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0862F

FIRM

FLOOD INSURANCE RATE MAP

SAN LUIS OBISPO COUNTY, CALIFORNIA
AND INCORPORATED AREAS

PANEL 862 OF 2050

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
SAN LUIS OBISPO COUNTY	060304	0862	F

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
06079C0862F

EFFECTIVE DATE
AUGUST 28, 2008

Federal Emergency Management Agency

This is an official copy of a portion of the above referenced flood map. It was extracted using F-MIT On-Line. This map does not reflect changes or amendments which may have been made subsequent to the date on the title block. For the latest product information about National Flood Insurance Program flood maps check the FEMA Flood Map Store at www.msc.fema.gov

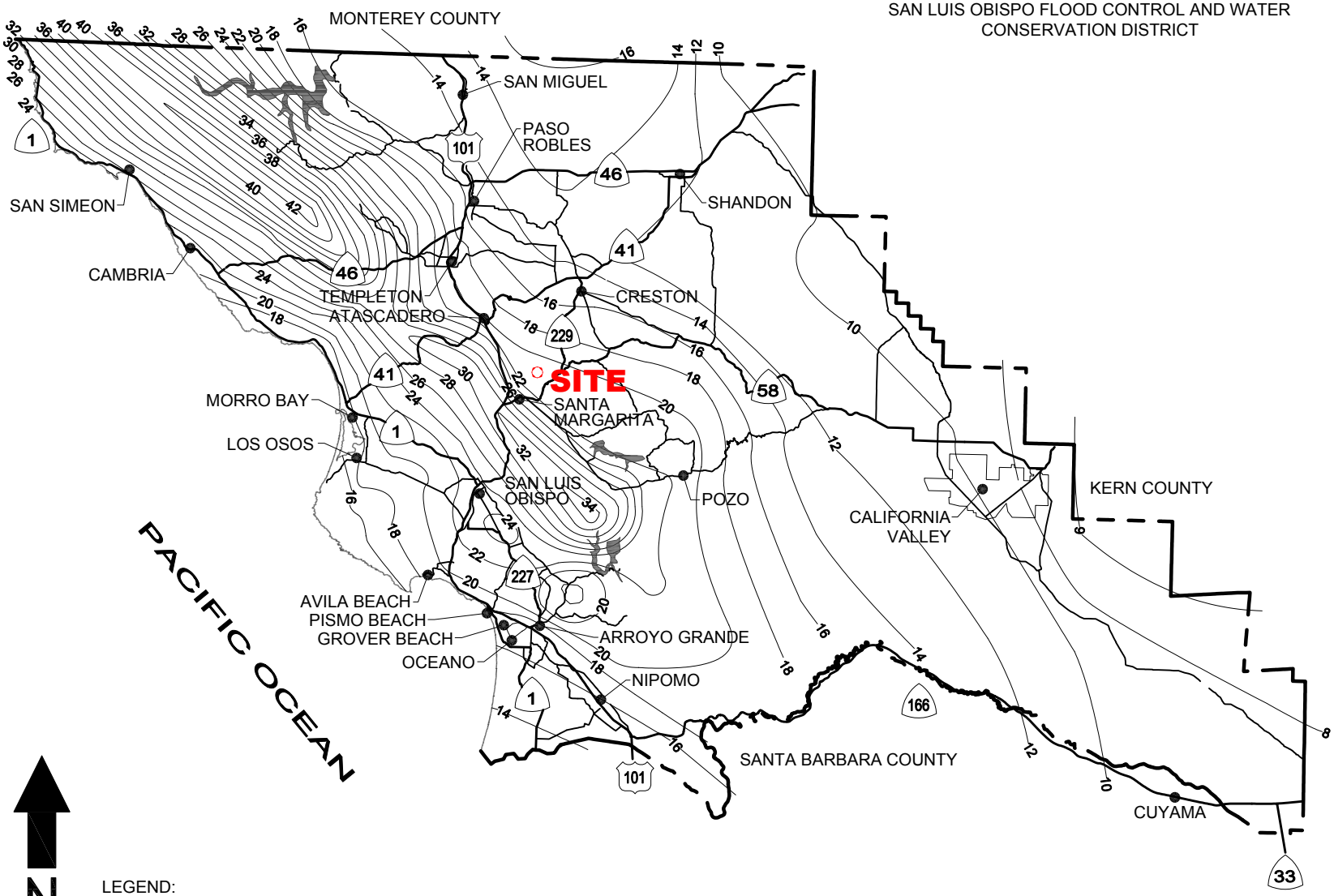
APPENDIX A

RATIONAL METHOD INPUT DATA AND ANALYSES

SAN LUIS OBISPO COUNTY
AVERAGE ANNUAL PRECIPITATION

(JULY 1 THROUGH JUNE 30) FOR 42 YEAR PERIOD
FROM 1955-56 THROUGH 1997-98)

SAN LUIS OBISPO FLOOD CONTROL AND WATER
CONSERVATION DISTRICT



LEGEND:
22 - AVERAGE ANNUAL PRECIPITATION (INCHES)

N

DEPARTMENT OF PUBLIC WORKS & TRANSPORTATION

AVERAGE ANNUAL RAINFALL

Scale: NTS

Adopted: 2011

Drawing No: H-1

Sheet No: 1 OF 1

Revisions

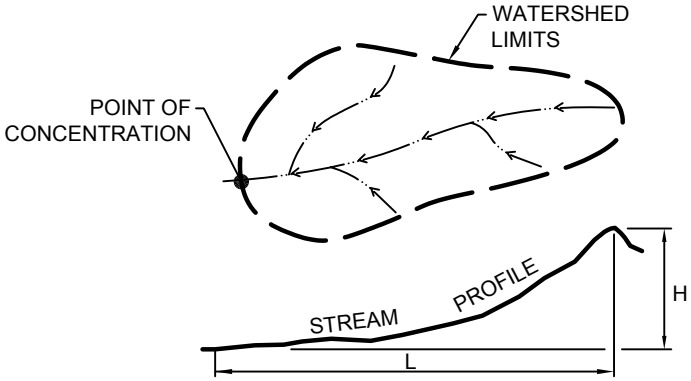
Description	Approved	Date	Description	Approved	Date

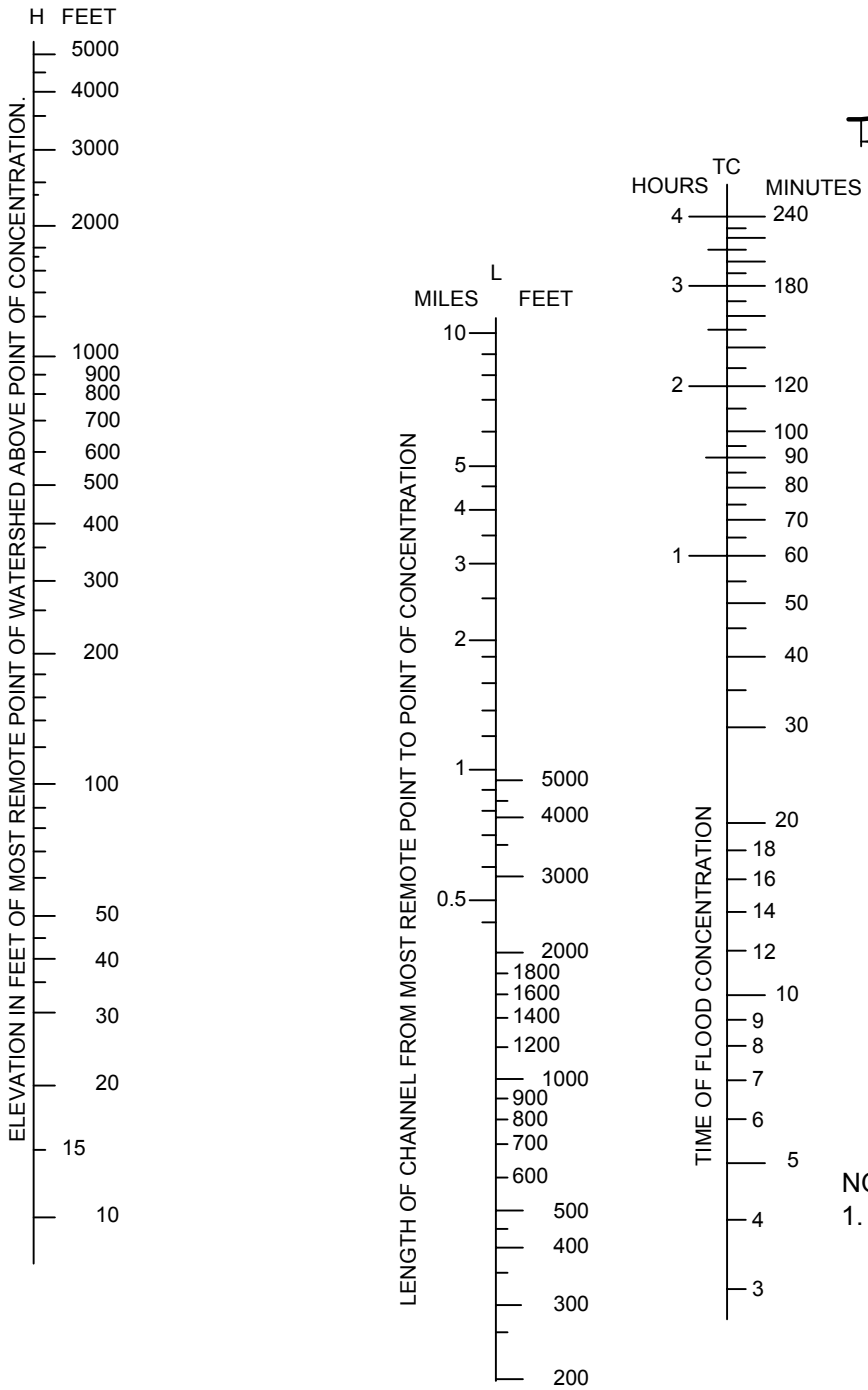
RATIONAL METHOD INPUT DATA

TIME OF CONCENTRATION EQUATION FOR INITIAL SUBAREAS

Nodes	Up Elev., ft	Down Elev., ft	H, feet	L, feet	L, miles	Tc (calculated), min.	Tc (used), min.
10-12	1,255.0	1,140.0	115.0	277	0.0525	0.8	5.0
28-30	1,022.5	1,010.0	12.5	167	0.0316	1.1	5.0
34-36	1,249.0	1,041.0	208.0	752	0.1424	2.1	5.0
52-54	1,364.5	1,225.4	139.1	210	0.0398	0.6	5.0
64-66	887.0	882.2	4.8	954	0.1807	11.8	11.8
70-72	1,374.0	1,092.0	282.0	997	0.1888	2.6	5.0
80-82	1,228.0	980.1	247.9	961	0.1820	2.6	5.0
90-92	974.9	969.0	5.9	332	0.0629	3.2	5.0

Revisions					
Description	Approved	Date	Description	Approved	Date
ADD REF.	GDM	NOV 08			





EQUATIONS FOR ESTIMATED "TIME OF CONCENTRATION"

$$Tc = \left(\frac{11.9L^3}{H}\right)^{0.385}$$

LEGEND:

Tc = TIME OF CONCENTRATION IN HOURS.

L = LENGTH OF CHANNEL IN MILES.

H = DIFFERENCE IN ELEVATION BETWEEN MOST REMOTE POINT AND THE POINT OF CONCENTRATION IN FEET.

NOTES:

1. THIS NOMOGRAPH IS TO BE LIMITED TO WATERSHED AREAS OF 200 ACRES OR LESS. FOR LARGER WATERSHEDS REFER TO THE DESIGN STANDARDS.

DEPARTMENT OF PUBLIC WORKS & TRANSPORTATION

TIME OF CONCENTRATION

FOR WATERSHEDS LESS THAN 200 ACRES

Scale:	Adopted: 2011
Drawing No:	H-2
Sheet No:	1 OF 1

Revisions					
Description	Approved	Date	Description	Approved	Date
CORRECT TO MATCH HWY. DES. MAN.	REM	NOV 07			

TABLE 2: RATIONAL METHOD STANDARD RUNOFF COEFFICIENTS FOR UNDEVELOPED AREAS

	EXTREME	HIGH	NORMAL	LOW
RELIEF	0.28 TO 0.35 STEEP, RUGGED TERRAIN WITH AVERAGE SLOPES ABOVE 30% 0.31	0.20 TO 0.28 HILLY, WITH AVERAGE SLOPES OF 10% TO 30% 0.24	0.14 TO 0.20 ROLLING, WITH AVERAGE SLOPE OF 5% TO 10%	0.08 TO 0.14 RELATIVELY FLAT LAND, WITH AVERAGE SLOPES OF 0% TO 5% 0.11
SOIL INFILTRATION	0.12 TO 0.16 NO EFFECTIVE SOIL COVER, EITHER ROCK OR THIN MANTLE OF NEGLIGIBLE INFILTRATION CAPACITY 0.14	0.08 TO 0.12 SLOW TO TAKE UP WATER, CLAY OR SHALLOW LOAM SOILS OF LOW INFILTRATION CAPACITY, IMPERFECTLY OR POORLY DRAINED	0.06 TO 0.08 NORMAL; WELL DRAINED LIGHT OR MEDIUM TEXTURED SOILS, SANDY LOAMS, SILT AND SILT LOAMS 0.07	0.04 TO 0.06 HIGH; DEEP SAND OR OTHER SOILS THAT TAKES UP WATER READILY, VERY LIGHT WELL DRAINED SOILS
VEGETAL COVER	0.12 TO 0.16 NO EFFECTIVE PLANT COVER, BARE OR VERY SPARSE COVER	0.08 TO 0.12 POOR TO FAIR; CULTIVATION CROPS, OR POOR NATURAL COVER, LESS THAN 20% OF DRAINAGE AREA OVER GOOD COVER 0.10	0.06 TO 0.08 FAIR TO GOOD; ABOUT 50% OF AREA IN GOOD GRASSLAND OR WOODLAND, NOT MORE THAN 50% OF AREA IN CULTIVATED CROPS	0.04 TO 0.06 GOOD TO EXCELLENT; ABOUT 90% OF DRAINAGE AREA IN GOOD GRASSLAND, WOODLAND, OR EQUIVALENT COVER
SURFACE STORAGE	0.10 TO 0.12 NEGLIGIBLE SURFACE DEPRESSIONS FEW AND SHALLOW; DRAINAGE WAYS STEEP AND SMALL, NO MARSHES	0.08 TO 0.10 LOW; WELL DEFINED SYSTEM OF SMALL DRAINAGE WAYS, NO PONDS OR MARSHES 0.09	0.06 TO 0.08 NORMAL; CONSIDERABLE SURFACE STORAGE, LAKES AND POND MARSHES	0.04 TO 0.06 HIGH; SURFACE STORAGE, HIGH; DRAINAGE SYSTEM NOT SHARPLY DEFINED; LARGE FLOOD PLAIN STORAGE OR LARGE NUMBER OF PONDS OR MARSHES

(REFERENCES FIGURE 819.2A OF HIGHWAY DESIGN MANUAL)

0.05

EXAMPLE:

GIVEN: AN UNDEVELOPED WATERSHED CONSISTING OF:
1. ROLLING TERRAIN WITH AVERAGE SLOPES OF 5%
2. CLAY SOILS
3. GOOD GRASSLAND AREA
4. NORMAL SURFACE DEPRESSIONS

FIND: THE RUNOFF COEFFICIENT FOR THE ABOVE WATERSHED

SOLUTION:
1. RELIEF = 0.14
2. SOIL INFILTRATION = 0.08
3. VEGETAL COVER = 0.04
4. SURFACE STORAGE = 0.06

ANSWER: THE RUNOFF COEFFICIENT, C = 0.32

DEPARTMENT OF PUBLIC WORKS & TRANSPORTATION

RUNOFF COEFFICIENTS FOR UNDEVELOPED AREAS

Scale:

Adopted: 2011

Drawing No: H-3a

Sheet No: 2 OF 2

Revisions					
Description	Approved	Date	Description	Approved	Date

TABLE 1: ANNUAL RAINFALL < 14":

Recurrence Interval (Years)	Duration							
	10 Min	15 Min	30 Min	1 Hr	2 Hr	3 Hr	6 Hr	10 Hr
2	1.00	0.90	0.60	0.40	0.26	0.22	0.18	0.14
5	1.40	1.20	0.80	0.50	0.37	0.32	0.25	0.20
10	1.70	1.40	1.00	0.60	0.44	0.38	0.30	0.23
25	2.00	1.70	1.10	0.70	0.54	0.47	0.37	0.28
50	2.20	1.90	1.30	0.80	0.60	0.53	0.44	0.34
100	2.40	2.10	1.40	0.90	0.65	0.59	0.48	0.36

TABLE 2: ANNUAL RAINFALL 14" TO 17":

Recurrence Interval (Years)	Duration							
	10 Min	15 Min	30 Min	1 Hr	2 Hr	3 Hr	6 Hr	10 Hr
2	1.30	1.10	0.80	0.50	0.35	0.30	0.23	0.18
5	1.90	1.60	1.10	0.70	0.49	0.42	0.33	0.26
10	2.30	1.90	1.30	0.80	0.60	0.51	0.40	0.30
25	2.60	2.20	1.50	1.00	0.71	0.63	0.50	0.38
50	3.00	2.50	1.70	1.10	0.81	0.74	0.60	0.47
100	3.20	2.70	1.90	1.20	0.90	0.80	0.65	0.49

TABLE 3: ANNUAL RAINFALL 18" TO 21":

Recurrence Interval (Years)	Duration							
	10 Min	15 Min	30 Min	1 Hr	2 Hr	3 Hr	6 Hr	10 Hr
2	1.70	1.40	1.00	0.65	0.44	0.37	0.29	0.22
5	2.30	1.90	1.30	0.85	0.60	0.52	0.41	0.33
10	2.80	2.40	1.60	1.03	0.74	0.64	0.50	0.38
25	3.20	2.70	1.90	1.20	0.92	0.80	0.64	0.50
50	3.70	3.10	2.10	1.40	1.05	0.92	0.74	0.58
100	4.00	3.40	2.30	1.50	1.13	1.00	0.80	0.62

TABLE 4: ANNUAL RAINFALL 22" TO 28":

Recurrence Interval (Years)	Duration							
	10 Min	15 Min	30 Min	1 Hr	2 Hr	3 Hr	6 Hr	10 Hr
2	2.10	1.80	1.20	0.77	0.55	0.47	0.36	0.28
5	2.80	2.50	1.70	1.05	0.76	0.64	0.52	0.42
10	3.60	3.00	2.10	1.30	0.92	0.81	0.64	0.48
25	3.90	3.50	2.40	1.50	1.10	0.98	0.78	0.60
50	4.50	3.90	2.60	1.70	1.28	1.15	0.94	0.72
100	5.00	4.30	2.90	1.85	1.40	1.25	0.98	0.76

UNIVERSAL RATIONAL METHOD HYDROLOGY PROGRAM

CIVILCADD/CIVILDESIGN Engineering Software, (c) 1989- 2005 Version 7.1
Rational Hydrology Study Date: 04/18/13

Santa Margarita Quarry
Proposed Conditions
25-Year Storm Event

********* Hydrology Study Control Information **********

Program License Serial Number 4028

Rational hydrology study storm event year is 25.0
Number of [time,intensity] data pairs = 8

No.	Time -	Intensity
1	5.000	4.400(In.)
2	10.000	3.200(In.)
3	15.000	2.700(In.)
4	30.000	1.900(In.)
5	60.000	1.200(In.)
6	120.000	0.920(In.)
7	180.000	0.800(In.)
8	360.000	0.640(In.)

English Input Units Used
English Output Units Used:
Area = acres, Distance = feet, Flow q = ft^3/s, Pipe diam. = inches
Runoff coefficient method used:
Runoff coefficient 'C' value calculated for the
equation Q=KCIA [K=unit constant(1 if English Units, 1/360 if SI Units),
I=rainfall intensity, A=area];
by the following method:
Manual entry of 'C' values

Rational Hydrology Method used:

The modified rational hydrology method is used
where the total area of each stream, area averaged 'C' value
using equation ct = (C1A1 + C2A2 + ... CnAn)/at
and rainfall intensity for each particular point is used
to determine the runoff flow q at each point.

Stream flow confluence option used:

Stream flow confluence method of 2 - 5 streams:

```
Note: in all cases, if the time of concentration
or TC of all streams are identical, then q = sum of stream flows
Variables p=peak; i=intensity; Fm=loss rate; a=area; 1...n flows
q = flow rate, t = time in minutes
Peak flow qp is a function of time, TC:
    usual case q1>q2 and t1>t2 then qp = q1 + q2*(i1/i2), tp=t1
    some cases q1>q2 and t1<t2 then qp = q2 + q1*(t2/t1), tp=t2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Process from Point/Station       10.000 to Point/Station       12.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________
UNDEVELOPED (average cover) subarea
Initial subarea data:
Equations shown use english units, converted if necessary to (SI)
Initial area flow distance =   277.000(Ft.)
Top (of initial area) elevation =  1255.000(Ft.)
Bottom (of initial area) elevation =  1140.000(Ft.)
Difference in elevation =   115.000(Ft.)
Slope =    0.41516  s(%)=      41.52
Manual entry of initial area time of concentration, TC
Initial area time of concentration =    5.000 min.
Rainfall intensity =      4.400(In/Hr) for a    25.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.640
Subarea runoff =      0.732(CFS)
Total initial stream area =        0.260(Ac.)


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Process from Point/Station       12.000 to Point/Station       14.000
**** IMPROVED CHANNEL TRAVEL TIME ****
______________________________________________________________________
Upstream point elevation =  1140.000(Ft.)
Downstream point elevation =  1020.000(Ft.)
Channel length thru subarea  =   810.000(Ft.)
Channel base width    =    0.000(Ft.)
Slope or 'Z' of left channel bank =   2.000
Slope or 'Z' of right channel bank =   2.000
Estimated mean flow rate at midpoint of channel =      1.915(CFS)
Manning's 'N'    = 0.030
Maximum depth of channel  =    1.000(Ft.)
Flow(q) thru subarea =      1.915(CFS)
Depth of flow =   0.398(Ft.), Average velocity =   6.036(Ft/s)
Channel flow top width =    1.593(Ft.)
Flow Velocity =    6.04(Ft/s)
Travel time  =    2.24 min.
Time of concentration =    7.24 min.
Critical depth =      0.563(Ft.)
 Adding area flow to channel
UNDEVELOPED (average cover) subarea
Rainfall intensity =      3.863(In/Hr) for a    25.0 year storm
```

```
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.640
Subarea runoff =      1.988(CFS) for      0.840(Ac.)
Total runoff =      2.720(CFS)   Total area =       1.100(Ac.)


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Process from Point/Station       14.000 to Point/Station       16.000
**** IMPROVED CHANNEL TRAVEL TIME ****
______________________________________________________________________
Upstream point elevation =  1020.000(Ft.)
Downstream point elevation =  1007.700(Ft.)
Channel length thru subarea  =   461.000(Ft.)
Channel base width    =    0.000(Ft.)
Slope or 'Z' of left channel bank =   2.000
Slope or 'Z' of right channel bank =   2.000
Estimated mean flow rate at midpoint of channel =      3.350(CFS)
Manning's 'N'    = 0.030
Maximum depth of channel  =    1.000(Ft.)
Flow(q) thru subarea =      3.350(CFS)
Depth of flow =   0.677(Ft.), Average velocity =   3.650(Ft/s)
Channel flow top width =    2.710(Ft.)
Flow Velocity =    3.65(Ft/s)
Travel time  =    2.11 min.
Time of concentration =    9.34 min.
Critical depth =      0.703(Ft.)
 Adding area flow to channel
UNDEVELOPED (average cover) subarea
Rainfall intensity =      3.358(In/Hr) for a    25.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.640
Subarea runoff =      0.740(CFS) for      0.510(Ac.)
Total runoff =      3.460(CFS)   Total area =       1.610(Ac.)


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Process from Point/Station       16.000 to Point/Station       18.000
**** IMPROVED CHANNEL TRAVEL TIME ****
______________________________________________________________________
Upstream point elevation =  1007.700(Ft.)
Downstream point elevation =   958.200(Ft.)
Channel length thru subarea  =    54.000(Ft.)
Channel base width    =    0.500(Ft.)
Slope or 'Z' of left channel bank =   2.000
Slope or 'Z' of right channel bank =   2.000
Manning's 'N'    = 0.015
Maximum depth of channel  =    1.000(Ft.)
Flow(q) thru subarea =      3.460(CFS)
Depth of flow =   0.178(Ft.), Average velocity =  22.747(Ft/s)
Channel flow top width =    1.211(Ft.)
Flow Velocity =   22.75(Ft/s)
Travel time  =    0.04 min.
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Time of concentration =    9.38 min.
Critical depth =      0.602(Ft.)


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Process from Point/Station       16.000 to Point/Station       18.000
**** SUBAREA FLOW ADDITION ****
______________________________________________________________________
UNDEVELOPED (average cover) subarea
Time of concentration =     9.38 min.
Rainfall intensity =      3.348(In/Hr) for a    25.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.640
Subarea runoff =      6.505(CFS) for      3.040(Ac.)
Total runoff =      9.965(CFS)   Total area =       4.650(Ac.)


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Process from Point/Station       18.000 to Point/Station       20.000
**** IMPROVED CHANNEL TRAVEL TIME ****
______________________________________________________________________
Upstream point elevation =   958.200(Ft.)
Downstream point elevation =   932.800(Ft.)
Channel length thru subarea  =  1316.000(Ft.)
Channel base width    =    0.000(Ft.)
Slope or 'Z' of left channel bank =   2.000
Slope or 'Z' of right channel bank =   2.000
Estimated mean flow rate at midpoint of channel =     14.005(CFS)
Manning's 'N'    = 0.030
Maximum depth of channel  =    1.500(Ft.)
Flow(q) thru subarea =     14.005(CFS)
Depth of flow =   1.231(Ft.), Average velocity =   4.622(Ft/s)
Channel flow top width =    4.923(Ft.)
Flow Velocity =    4.62(Ft/s)
Travel time  =    4.75 min.
Time of concentration =   14.13 min.
Critical depth =      1.250(Ft.)
 Adding area flow to channel
UNDEVELOPED (average cover) subarea
Rainfall intensity =      2.787(In/Hr) for a    25.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.640
Subarea runoff =      5.055(CFS) for      3.770(Ac.)
Total runoff =     15.020(CFS)   Total area =       8.420(Ac.)


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Process from Point/Station       20.000 to Point/Station       22.000
**** IMPROVED CHANNEL TRAVEL TIME ****
______________________________________________________________________
Upstream point elevation =   932.800(Ft.)
Downstream point elevation =   884.100(Ft.)
```

```
Channel length thru subarea  =    49.000(Ft.)
Channel base width    =    0.500(Ft.)
Slope or 'Z' of left channel bank =   2.000
Slope or 'Z' of right channel bank =   2.000
Manning's 'N'    = 0.015
Maximum depth of channel  =    1.000(Ft.)
Flow(q) thru subarea =     15.020(CFS)
Depth of flow =   0.358(Ft.), Average velocity =  34.562(Ft/s)
Channel flow top width =    1.930(Ft.)
Flow Velocity =   34.56(Ft/s)
Travel time  =    0.02 min.
Time of concentration =   14.15 min.
Critical depth =      1.148(Ft.)


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Process from Point/Station       22.000 to Point/Station       24.000
**** IMPROVED CHANNEL TRAVEL TIME ****
______________________________________________________________________
Upstream point elevation =   884.100(Ft.)
Downstream point elevation =   878.700(Ft.)
Channel length thru subarea  =   124.000(Ft.)
Channel base width    =    0.500(Ft.)
Slope or 'Z' of left channel bank =   2.000
Slope or 'Z' of right channel bank =   2.000
Estimated mean flow rate at midpoint of channel =     17.660(CFS)
Manning's 'N'    = 0.015
Maximum depth of channel  =    1.000(Ft.)
Flow(q) thru subarea =     17.660(CFS)
Depth of flow =   0.771(Ft.), Average velocity =  11.205(Ft/s)
Channel flow top width =    3.586(Ft.)
Flow Velocity =   11.20(Ft/s)
Travel time  =    0.18 min.
Time of concentration =   14.33 min.
Critical depth =      1.227(Ft.)
 Adding area flow to channel
UNDEVELOPED (average cover) subarea
Rainfall intensity =      2.767(In/Hr) for a    25.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.640
Subarea runoff =      5.129(CFS) for      2.960(Ac.)
Total runoff =     20.149(CFS)   Total area =      11.380(Ac.)


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Process from Point/Station       24.000 to Point/Station       24.000
**** SUBAREA FLOW ADDITION ****
______________________________________________________________________
UNDEVELOPED (average cover) subarea
Time of concentration =    14.33 min.
Rainfall intensity =      2.767(In/Hr) for a    25.0 year storm
Effective runoff coefficient used for total area
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```
(Q=KCIA) is C = 0.640
Subarea runoff =      4.356(CFS) for      2.460(Ac.)
Total runoff =     24.505(CFS)   Total area =      13.840(Ac.)


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Process from Point/Station       24.000 to Point/Station       26.000
**** IMPROVED CHANNEL TRAVEL TIME ****
______________________________________________________________________
Upstream point elevation =   878.700(Ft.)
Downstream point elevation =   877.400(Ft.)
Channel length thru subarea  =   193.000(Ft.)
Channel base width    =    0.000(Ft.)
Slope or 'Z' of left channel bank =   2.000
Slope or 'Z' of right channel bank =   2.000
Manning's 'N'    = 0.030
Maximum depth of channel  =    2.500(Ft.)
Flow(q) thru subarea =     24.505(CFS)
Depth of flow =   1.849(Ft.), Average velocity =   3.582(Ft/s)
Channel flow top width =    7.398(Ft.)
Flow Velocity =    3.58(Ft/s)
Travel time  =    0.90 min.
Time of concentration =   15.23 min.
Critical depth =      1.563(Ft.)


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Process from Point/Station       24.000 to Point/Station       26.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________
Along Main Stream number: 1 in normal stream number 1
Stream flow area =     13.840(Ac.)
Runoff from this stream =     24.505(CFS)
Time of concentration =   15.23 min.
Rainfall intensity =     2.688(In/Hr)


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Process from Point/Station       28.000 to Point/Station       30.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________
UNDEVELOPED (average cover) subarea
Initial subarea data:
Equations shown use english units, converted if necessary to (SI)
Initial area flow distance =   167.000(Ft.)
Top (of initial area) elevation =  1022.500(Ft.)
Bottom (of initial area) elevation =  1010.000(Ft.)
Difference in elevation =    12.500(Ft.)
Slope =    0.07485  s(%)=       7.49
Manual entry of initial area time of concentration, TC
Initial area time of concentration =    5.000 min.
Rainfall intensity =      4.400(In/Hr) for a    25.0 year storm
```

```
Effective runoff coefficient used for area (Q=KCIA) is C = 0.640
Subarea runoff =      0.422(CFS)
Total initial stream area =        0.150(Ac.)


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Process from Point/Station       30.000 to Point/Station       26.000
**** IMPROVED CHANNEL TRAVEL TIME ****
______________________________________________________________________
Upstream point elevation =  1010.000(Ft.)
Downstream point elevation =   877.400(Ft.)
Channel length thru subarea  =   990.000(Ft.)
Channel base width    =    0.500(Ft.)
Slope or 'Z' of left channel bank =   2.000
Slope or 'Z' of right channel bank =   2.000
Estimated mean flow rate at midpoint of channel =      6.801(CFS)
Manning's 'N'    = 0.015
Maximum depth of channel  =    1.000(Ft.)
Flow(q) thru subarea =      6.801(CFS)
Depth of flow =   0.394(Ft.), Average velocity =  13.390(Ft/s)
Channel flow top width =    2.077(Ft.)
Flow Velocity =   13.39(Ft/s)
Travel time  =    1.23 min.
Time of concentration =    6.23 min.
Critical depth =      0.820(Ft.)
 Adding area flow to channel
UNDEVELOPED (average cover) subarea
Rainfall intensity =      4.104(In/Hr) for a    25.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.640
Subarea runoff =     11.871(CFS) for      4.530(Ac.)
Total runoff =     12.293(CFS)   Total area =       4.680(Ac.)


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Process from Point/Station       30.000 to Point/Station       26.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________
Along Main Stream number: 1 in normal stream number 2
Stream flow area =      4.680(Ac.)
Runoff from this stream =     12.293(CFS)
Time of concentration =    6.23 min.
Rainfall intensity =     4.104(In/Hr)
Summary of stream data:

Stream   Flow rate      TC            Rainfall Intensity
 No.       (CFS)       (min)                 (In/Hr)


1       24.505     15.23            2.688
2       12.293      6.23            4.104
Qmax(1) =
```

```
        1.000 *    1.000 *    24.505) +
        0.655 *    1.000 *    12.293) + =      32.554
Qmax(2) =
        1.000 *    0.409 *    24.505) +
        1.000 *    1.000 *    12.293) + =      22.319

Total of 2 streams to confluence:
Flow rates before confluence point:
      24.505      12.293
Maximum flow rates at confluence using above data:
       32.554       22.319
Area of streams before confluence:
       13.840        4.680
Results of confluence:
Total flow rate =     32.554(CFS)
Time of concentration =    15.233 min.
Effective stream area after confluence =     18.520(Ac.)


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Process from Point/Station       26.000 to Point/Station       32.000
**** IMPROVED CHANNEL TRAVEL TIME ****
______________________________________________________________________
Upstream point elevation =   877.400(Ft.)
Downstream point elevation =   875.500(Ft.)
Channel length thru subarea  =  1212.000(Ft.)
Channel base width    =    3.000(Ft.)
Slope or 'Z' of left channel bank =   2.000
Slope or 'Z' of right channel bank =   2.000
Manning's 'N'    = 0.015
Maximum depth of channel  =    1.500(Ft.)
Flow(q) thru subarea =     32.554(CFS)
Depth of flow =   1.478(Ft.), Average velocity =   3.699(Ft/s)
Channel flow top width =    8.911(Ft.)
Flow Velocity =    3.70(Ft/s)
Travel time  =    5.46 min.
Time of concentration =   20.69 min.
Critical depth =      1.188(Ft.)


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Process from Point/Station       26.000 to Point/Station       32.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________
Along Main Stream number: 1 in normal stream number 1
Stream flow area =     18.520(Ac.)
Runoff from this stream =     32.554(CFS)
Time of concentration =   20.69 min.
Rainfall intensity =     2.396(In/Hr)


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Process from Point/Station       34.000 to Point/Station       36.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________
UNDEVELOPED (average cover) subarea
Initial subarea data:
Equations shown use english units, converted if necessary to (SI)
Initial area flow distance =   752.000(Ft.)
Top (of initial area) elevation =  1249.000(Ft.)
Bottom (of initial area) elevation =  1041.000(Ft.)
Difference in elevation =   208.000(Ft.)
Slope =    0.27660  s(%)=      27.66
Manual entry of initial area time of concentration, TC
Initial area time of concentration =    5.000 min.
Rainfall intensity =      4.400(In/Hr) for a    25.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.640
Subarea runoff =      6.927(CFS)
Total initial stream area =        2.460(Ac.)


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Process from Point/Station       36.000 to Point/Station       38.000
**** IMPROVED CHANNEL TRAVEL TIME ****
______________________________________________________________________
Upstream point elevation =  1041.000(Ft.)
Downstream point elevation =  1001.800(Ft.)
Channel length thru subarea  =    27.000(Ft.)
Channel base width    =    0.000(Ft.)
Slope or 'Z' of left channel bank =   2.000
Slope or 'Z' of right channel bank =   2.000
Manning's 'N'    = 0.015
Maximum depth of channel  =    1.000(Ft.)
Flow(q) thru subarea =      6.927(CFS)
Depth of flow =   0.324(Ft.), Average velocity =  32.946(Ft/s)
Channel flow top width =    1.297(Ft.)
Flow Velocity =   32.95(Ft/s)
Travel time  =    0.01 min.
Time of concentration =    5.01 min.
Critical depth =      0.945(Ft.)


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Process from Point/Station       38.000 to Point/Station       40.000
**** IMPROVED CHANNEL TRAVEL TIME ****
______________________________________________________________________
Upstream point elevation =  1001.800(Ft.)
Downstream point elevation =  1001.400(Ft.)
Channel length thru subarea  =   184.000(Ft.)
Channel base width    =    0.000(Ft.)
Slope or 'Z' of left channel bank =   2.000
Slope or 'Z' of right channel bank =   2.000
Estimated mean flow rate at midpoint of channel =      8.786(CFS)
Manning's 'N'    = 0.030
```

```
Maximum depth of channel  =    1.500(Ft.)
Flow(q) thru subarea =      8.786(CFS)
Depth of flow =   1.546(Ft.), Average velocity =   1.841(Ft/s)
!!Warning: Water is above left or right bank elevations
Channel flow top width =    6.000(Ft.)
Flow Velocity =    1.84(Ft/s)
Travel time  =    1.67 min.
Time of concentration =    6.68 min.
Critical depth =      1.039(Ft.)
ERROR - Channel depth exceeds maximum allowable depth
 Adding area flow to channel
UNDEVELOPED (average cover) subarea
Rainfall intensity =      3.997(In/Hr) for a    25.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.640
Subarea runoff =      2.742(CFS) for      1.320(Ac.)
Total runoff =      9.669(CFS)   Total area =       3.780(Ac.)


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Process from Point/Station       40.000 to Point/Station       42.000
**** IMPROVED CHANNEL TRAVEL TIME ****
______________________________________________________________________
Upstream point elevation =  1001.400(Ft.)
Downstream point elevation =   952.100(Ft.)
Channel length thru subarea  =   265.000(Ft.)
Channel base width    =    0.500(Ft.)
Slope or 'Z' of left channel bank =   2.000
Slope or 'Z' of right channel bank =   2.000
Manning's 'N'    = 0.015
Maximum depth of channel  =    1.000(Ft.)
Flow(q) thru subarea =      9.669(CFS)
Depth of flow =   0.430(Ft.), Average velocity =  16.556(Ft/s)
Channel flow top width =    2.219(Ft.)
Flow Velocity =   16.56(Ft/s)
Travel time  =    0.27 min.
Time of concentration =    6.95 min.
Critical depth =      0.961(Ft.)


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Process from Point/Station       42.000 to Point/Station       44.000
**** IMPROVED CHANNEL TRAVEL TIME ****
______________________________________________________________________
Upstream point elevation =   952.100(Ft.)
Downstream point elevation =   950.800(Ft.)
Channel length thru subarea  =   105.000(Ft.)
Channel base width    =    0.000(Ft.)
Slope or 'Z' of left channel bank =   2.000
Slope or 'Z' of right channel bank =   2.000
Estimated mean flow rate at midpoint of channel =     12.023(CFS)
Manning's 'N'    = 0.030
```

```
Maximum depth of channel  =    1.500(Ft.)
Flow(q) thru subarea =     12.023(CFS)
Depth of flow =   1.263(Ft.), Average velocity =   3.767(Ft/s)
Channel flow top width =    5.053(Ft.)
Flow Velocity =    3.77(Ft/s)
Travel time  =    0.46 min.
Time of concentration =    7.41 min.
Critical depth =      1.172(Ft.)
 Adding area flow to channel
UNDEVELOPED (average cover) subarea
Rainfall intensity =      3.821(In/Hr) for a    25.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.640
Subarea runoff =      4.075(CFS) for      1.840(Ac.)
Total runoff =     13.745(CFS)   Total area =       5.620(Ac.)


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Process from Point/Station       44.000 to Point/Station       46.000
**** IMPROVED CHANNEL TRAVEL TIME ****
______________________________________________________________________
Upstream point elevation =   950.800(Ft.)
Downstream point elevation =   901.300(Ft.)
Channel length thru subarea  =    55.000(Ft.)
Channel base width    =    0.500(Ft.)
Slope or 'Z' of left channel bank =   2.000
Slope or 'Z' of right channel bank =   2.000
Manning's 'N'    = 0.015
Maximum depth of channel  =    1.000(Ft.)
Flow(q) thru subarea =     13.745(CFS)
Depth of flow =   0.351(Ft.), Average velocity =  32.559(Ft/s)
Channel flow top width =    1.905(Ft.)
Flow Velocity =   32.56(Ft/s)
Travel time  =    0.03 min.
Time of concentration =    7.44 min.
Critical depth =      1.109(Ft.)


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Process from Point/Station       46.000 to Point/Station       48.000
**** IMPROVED CHANNEL TRAVEL TIME ****
______________________________________________________________________
Upstream point elevation =   901.300(Ft.)
Downstream point elevation =   901.100(Ft.)
Channel length thru subarea  =    19.000(Ft.)
Channel base width    =    0.000(Ft.)
Slope or 'Z' of left channel bank =   2.000
Slope or 'Z' of right channel bank =   2.000
Estimated mean flow rate at midpoint of channel =     14.882(CFS)
Manning's 'N'    = 0.030
Maximum depth of channel  =    1.500(Ft.)
Flow(q) thru subarea =     14.882(CFS)
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```
Depth of flow =   1.411(Ft.), Average velocity =   3.738(Ft/s)
Channel flow top width =    5.643(Ft.)
Flow Velocity =    3.74(Ft/s)
Travel time  =    0.08 min.
Time of concentration =    7.52 min.
Critical depth =      1.281(Ft.)
 Adding area flow to channel
UNDEVELOPED (average cover) subarea
Rainfall intensity =      3.794(In/Hr) for a    25.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.640
Subarea runoff =      2.161(CFS) for      0.930(Ac.)
Total runoff =     15.906(CFS)   Total area =       6.550(Ac.)


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Process from Point/Station       48.000 to Point/Station       32.000
**** IMPROVED CHANNEL TRAVEL TIME ****
______________________________________________________________________
Upstream point elevation =   908.100(Ft.)
Downstream point elevation =   875.500(Ft.)
Channel length thru subarea  =    26.000(Ft.)
Channel base width    =    0.500(Ft.)
Slope or 'Z' of left channel bank =   2.000
Slope or 'Z' of right channel bank =   2.000
Manning's 'N'    = 0.015
Maximum depth of channel  =    1.000(Ft.)
Flow(q) thru subarea =     15.906(CFS)
Depth of flow =   0.348(Ft.), Average velocity =  38.234(Ft/s)
Channel flow top width =    1.892(Ft.)
Flow Velocity =   38.23(Ft/s)
Travel time  =    0.01 min.
Time of concentration =    7.54 min.
Critical depth =      1.172(Ft.)


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Process from Point/Station       48.000 to Point/Station       32.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________
Along Main Stream number: 1 in normal stream number 2
Stream flow area =      6.550(Ac.)
Runoff from this stream =     15.906(CFS)
Time of concentration =    7.54 min.
Rainfall intensity =     3.792(In/Hr)
Summary of stream data:

Stream   Flow rate      TC            Rainfall Intensity
 No.       (CFS)       (min)                 (In/Hr)


1       32.554     20.69            2.396
```

```
2       15.906      7.54            3.792
Qmax(1) =
        1.000 *    1.000 *    32.554) +
        0.632 *    1.000 *    15.906) + =      42.607
Qmax(2) =
        1.000 *    0.364 *    32.554) +
        1.000 *    1.000 *    15.906) + =      27.760

Total of 2 streams to confluence:
Flow rates before confluence point:
      32.554      15.906
Maximum flow rates at confluence using above data:
       42.607       27.760
Area of streams before confluence:
       18.520        6.550
Results of confluence:
Total flow rate =     42.607(CFS)
Time of concentration =    20.693 min.
Effective stream area after confluence =     25.070(Ac.)


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Process from Point/Station       32.000 to Point/Station       50.000
**** IMPROVED CHANNEL TRAVEL TIME ****
______________________________________________________________________
Upstream point elevation =   875.500(Ft.)
Downstream point elevation =   875.300(Ft.)
Channel length thru subarea  =   116.000(Ft.)
Channel base width    =    0.000(Ft.)
Slope or 'Z' of left channel bank =   2.000
Slope or 'Z' of right channel bank =   2.000
Manning's 'N'    = 0.030
Maximum depth of channel  =    3.000(Ft.)
Flow(q) thru subarea =     42.607(CFS)
Depth of flow =   2.938(Ft.), Average velocity =   2.468(Ft/s)
Channel flow top width =   11.753(Ft.)
Flow Velocity =    2.47(Ft/s)
Travel time  =    0.78 min.
Time of concentration =   21.48 min.
Critical depth =      1.953(Ft.)


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Process from Point/Station       32.000 to Point/Station       50.000
**** CONFLUENCE OF MAIN STREAMS ****
______________________________________________________________________
The following data inside Main Stream is listed:
In Main Stream number: 1
Stream flow area =     25.070(Ac.)
Runoff from this stream =     42.607(CFS)
Time of concentration =   21.48 min.
Rainfall intensity =     2.355(In/Hr)
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Program is now starting with Main Stream No. 2


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       52.000 to Point/Station       54.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________
UNDEVELOPED (average cover) subarea
Initial subarea data:
Equations shown use english units, converted if necessary to (SI)
Initial area flow distance =   210.000(Ft.)
Top (of initial area) elevation =  1364.500(Ft.)
Bottom (of initial area) elevation =  1225.400(Ft.)
Difference in elevation =   139.100(Ft.)
Slope =    0.66238  s(%)=      66.24
Manual entry of initial area time of concentration, TC
Initial area time of concentration =    5.000 min.
Rainfall intensity =      4.400(In/Hr) for a    25.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.640
Subarea runoff =      2.084(CFS)
Total initial stream area =        0.740(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       54.000 to Point/Station       56.000
**** IMPROVED CHANNEL TRAVEL TIME ****
______________________________________________________________________
Upstream point elevation =  1225.400(Ft.)
Downstream point elevation =  1207.900(Ft.)
Channel length thru subarea  =  1070.000(Ft.)
Channel base width    =    0.000(Ft.)
Slope or 'Z' of left channel bank =   2.000
Slope or 'Z' of right channel bank =   2.000
Estimated mean flow rate at midpoint of channel =     10.194(CFS)
Manning's 'N'    = 0.030
Maximum depth of channel  =    1.500(Ft.)
Flow(q) thru subarea =     10.194(CFS)
Depth of flow =   1.127(Ft.), Average velocity =   4.012(Ft/s)
Channel flow top width =    4.508(Ft.)
Flow Velocity =    4.01(Ft/s)
Travel time  =    4.44 min.
Time of concentration =    9.44 min.
Critical depth =      1.102(Ft.)
 Adding area flow to channel
UNDEVELOPED (average cover) subarea
Rainfall intensity =      3.333(In/Hr) for a    25.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.640
Subarea runoff =     11.782(CFS) for      5.760(Ac.)
Total runoff =     13.866(CFS)   Total area =       6.500(Ac.)
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Process from Point/Station       56.000 to Point/Station       58.000
**** IMPROVED CHANNEL TRAVEL TIME ****
______________________________________________________________________
Upstream point elevation =  1207.900(Ft.)
Downstream point elevation =  1107.800(Ft.)
Channel length thru subarea  =   140.000(Ft.)
Channel base width    =    0.500(Ft.)
Slope or 'Z' of left channel bank =   2.000
Slope or 'Z' of right channel bank =   2.000
Manning's 'N'    = 0.015
Maximum depth of channel  =    1.000(Ft.)
Flow(q) thru subarea =     13.866(CFS)
Depth of flow =   0.372(Ft.), Average velocity =  29.960(Ft/s)
Channel flow top width =    1.988(Ft.)
Flow Velocity =   29.96(Ft/s)
Travel time  =    0.08 min.
Time of concentration =    9.52 min.
Critical depth =      1.109(Ft.)


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Process from Point/Station       56.000 to Point/Station       58.000
**** SUBAREA FLOW ADDITION ****
______________________________________________________________________
UNDEVELOPED (average cover) subarea
Time of concentration =     9.52 min.
Rainfall intensity =      3.315(In/Hr) for a    25.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.640
Subarea runoff =      6.223(CFS) for      2.970(Ac.)
Total runoff =     20.089(CFS)   Total area =       9.470(Ac.)


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Process from Point/Station       58.000 to Point/Station       60.000
**** IMPROVED CHANNEL TRAVEL TIME ****
______________________________________________________________________
Upstream point elevation =  1107.800(Ft.)
Downstream point elevation =  1094.300(Ft.)
Channel length thru subarea  =   574.000(Ft.)
Channel base width    =    0.000(Ft.)
Slope or 'Z' of left channel bank =   2.000
Slope or 'Z' of right channel bank =   2.000
Estimated mean flow rate at midpoint of channel =     23.981(CFS)
Manning's 'N'    = 0.030
Maximum depth of channel  =    2.500(Ft.)
Flow(q) thru subarea =     23.981(CFS)
Depth of flow =   1.451(Ft.), Average velocity =   5.694(Ft/s)
Channel flow top width =    5.805(Ft.)
Flow Velocity =    5.69(Ft/s)
Travel time  =    1.68 min.
```

```
Time of concentration =   11.20 min.
Critical depth =      1.547(Ft.)
 Adding area flow to channel
UNDEVELOPED (average cover) subarea
Rainfall intensity =      3.080(In/Hr) for a    25.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.640
Subarea runoff =      5.810(CFS) for      3.670(Ac.)
Total runoff =     25.899(CFS)   Total area =      13.140(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       60.000 to Point/Station       62.000
**** IMPROVED CHANNEL TRAVEL TIME ****
______________________________________________________________________
Upstream point elevation =  1094.300(Ft.)
Downstream point elevation =   877.200(Ft.)
Channel length thru subarea  =   201.000(Ft.)
Channel base width    =    1.000(Ft.)
Slope or 'Z' of left channel bank =   2.000
Slope or 'Z' of right channel bank =   2.000
Estimated mean flow rate at midpoint of channel =     35.518(CFS)
Manning's 'N'    = 0.015
Maximum depth of channel  =    1.000(Ft.)
Flow(q) thru subarea =     35.518(CFS)
Depth of flow =   0.435(Ft.), Average velocity =  43.663(Ft/s)
Channel flow top width =    2.740(Ft.)
Flow Velocity =   43.66(Ft/s)
Travel time  =    0.08 min.
Time of concentration =   11.28 min.
Critical depth =      1.563(Ft.)
 Adding area flow to channel
UNDEVELOPED (average cover) subarea
Rainfall intensity =      3.072(In/Hr) for a    25.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.640
Subarea runoff =     19.125(CFS) for      9.760(Ac.)
Total runoff =     45.024(CFS)   Total area =      22.900(Ac.)


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Process from Point/Station       62.000 to Point/Station       50.000
**** IMPROVED CHANNEL TRAVEL TIME ****
______________________________________________________________________
Upstream point elevation =   877.200(Ft.)
Downstream point elevation =   875.500(Ft.)
Channel length thru subarea  =   413.000(Ft.)
Channel base width    =    3.000(Ft.)
Slope or 'Z' of left channel bank =   2.000
Slope or 'Z' of right channel bank =   2.000
Manning's 'N'    = 0.030
Maximum depth of channel  =    2.000(Ft.)
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Flow(q) thru subarea =     45.024(CFS)
Depth of flow =   1.913(Ft.), Average velocity =   3.448(Ft/s)
Channel flow top width =   10.652(Ft.)
Flow Velocity =    3.45(Ft/s)
Travel time  =    2.00 min.
Time of concentration =   13.28 min.
Critical depth =      1.406(Ft.)


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Process from Point/Station       62.000 to Point/Station       50.000
**** CONFLUENCE OF MAIN STREAMS ****
______________________________________________________________________
The following data inside Main Stream is listed:
In Main Stream number: 2
Stream flow area =     22.900(Ac.)
Runoff from this stream =     45.024(CFS)
Time of concentration =   13.28 min.
Rainfall intensity =     2.872(In/Hr)
Program is now starting with Main Stream No. 3


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       64.000 to Point/Station       66.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________
UNDEVELOPED (average cover) subarea
Initial subarea data:
Equations shown use english units, converted if necessary to (SI)
Initial area flow distance =   954.000(Ft.)
Top (of initial area) elevation =   885.700(Ft.)
Bottom (of initial area) elevation =   880.900(Ft.)
Difference in elevation =     4.800(Ft.)
Slope =    0.00503  s(%)=       0.50
Manual entry of initial area time of concentration, TC
Initial area time of concentration =   11.800 min.
Rainfall intensity =      3.020(In/Hr) for a    25.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.440
Subarea runoff =      9.009(CFS)
Total initial stream area =        6.780(Ac.)


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Process from Point/Station       66.000 to Point/Station       50.000
**** IMPROVED CHANNEL TRAVEL TIME ****
______________________________________________________________________
Upstream point elevation =   880.900(Ft.)
Downstream point elevation =   875.500(Ft.)
Channel length thru subarea  =  1766.000(Ft.)
Channel base width    =    0.000(Ft.)
Slope or 'Z' of left channel bank =  50.000
Slope or 'Z' of right channel bank =  50.000
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Estimated mean flow rate at midpoint of channel =     27.220(CFS)
Manning's 'N'    = 0.030
Maximum depth of channel  =    2.000(Ft.)
Flow(q) thru subarea =     27.220(CFS)
Depth of flow =   0.649(Ft.), Average velocity =   1.293(Ft/s)
Channel flow top width =   64.886(Ft.)
Flow Velocity =    1.29(Ft/s)
Travel time  =   22.76 min.
Time of concentration =   34.56 min.
Critical depth =      0.449(Ft.)
 Adding area flow to channel
UNDEVELOPED (average cover) subarea
Rainfall intensity =      1.794(In/Hr) for a    25.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.440
Subarea runoff =     17.972(CFS) for     27.410(Ac.)
Total runoff =     26.981(CFS)   Total area =      34.190(Ac.)


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Process from Point/Station       66.000 to Point/Station       50.000
**** CONFLUENCE OF MAIN STREAMS ****
______________________________________________________________________
The following data inside Main Stream is listed:
In Main Stream number: 3
Stream flow area =     34.190(Ac.)
Runoff from this stream =     26.981(CFS)
Time of concentration =   34.56 min.
Rainfall intensity =     1.794(In/Hr)
Summary of stream data:

Stream   Flow rate      TC            Rainfall Intensity
 No.       (CFS)       (min)                 (In/Hr)


1       42.607     21.48            2.355
2       45.024     13.28            2.872
3       26.981     34.56            1.794
Qmax(1) =
        1.000 *    1.000 *    42.607) +
        0.820 *    1.000 *    45.024) +
        1.000 *    0.621 *    26.981) + =      96.280
Qmax(2) =
        1.000 *    0.618 *    42.607) +
        1.000 *    1.000 *    45.024) +
        1.000 *    0.384 *    26.981) + =      81.725
Qmax(3) =
        0.762 *    1.000 *    42.607) +
        0.624 *    1.000 *    45.024) +
        1.000 *    1.000 *    26.981) + =      87.550

Total of 3 main streams to confluence:
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Flow rates before confluence point:
      42.607      45.024      26.981
Maximum flow rates at confluence using above data:
       96.280       81.725       87.550
Area of streams before confluence:
       25.070       22.900       34.190


Results of confluence:
Total flow rate =     96.280(CFS)
Time of concentration =    21.477 min.
Effective stream area after confluence  =     82.160(Ac.)


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Process from Point/Station       70.000 to Point/Station       72.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________
UNDEVELOPED (average cover) subarea
Initial subarea data:
Equations shown use english units, converted if necessary to (SI)
Initial area flow distance =   997.000(Ft.)
Top (of initial area) elevation =  1374.000(Ft.)
Bottom (of initial area) elevation =  1092.000(Ft.)
Difference in elevation =   282.000(Ft.)
Slope =    0.28285  s(%)=      28.28
Manual entry of initial area time of concentration, TC
Initial area time of concentration =    5.000 min.
Rainfall intensity =      4.400(In/Hr) for a    25.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.500
Subarea runoff =     11.198(CFS)
Total initial stream area =        5.090(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       72.000 to Point/Station       74.000
**** IMPROVED CHANNEL TRAVEL TIME ****
______________________________________________________________________
Upstream point elevation =  1092.000(Ft.)
Downstream point elevation =   970.000(Ft.)
Channel length thru subarea  =  1118.000(Ft.)
Channel base width    =    3.000(Ft.)
Slope or 'Z' of left channel bank =   3.000
Slope or 'Z' of right channel bank =   3.000
Estimated mean flow rate at midpoint of channel =     40.491(CFS)
Manning's 'N'    = 0.040
Maximum depth of channel  =    3.000(Ft.)
Flow(q) thru subarea =     40.491(CFS)
Depth of flow =   0.861(Ft.), Average velocity =   8.427(Ft/s)
Channel flow top width =    8.164(Ft.)
Flow Velocity =    8.43(Ft/s)
Travel time  =    2.21 min.
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Time of concentration =    7.21 min.
Critical depth =      1.219(Ft.)
 Adding area flow to channel
UNDEVELOPED (average cover) subarea
Rainfall intensity =      3.869(In/Hr) for a    25.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.500
Subarea runoff =     50.170(CFS) for     26.630(Ac.)
Total runoff =     61.368(CFS)   Total area =      31.720(Ac.)


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Process from Point/Station       74.000 to Point/Station       76.000
**** IMPROVED CHANNEL TRAVEL TIME ****
______________________________________________________________________
Upstream point elevation =   972.000(Ft.)
Downstream point elevation =   965.000(Ft.)
Channel length thru subarea  =   712.000(Ft.)
Channel base width    =    5.000(Ft.)
Slope or 'Z' of left channel bank =  10.000
Slope or 'Z' of right channel bank =  10.000
Estimated mean flow rate at midpoint of channel =     71.815(CFS)
Manning's 'N'    = 0.030
Maximum depth of channel  =    3.000(Ft.)
Flow(q) thru subarea =     71.815(CFS)
Depth of flow =   1.151(Ft.), Average velocity =   3.780(Ft/s)
Channel flow top width =   28.015(Ft.)
Flow Velocity =    3.78(Ft/s)
Travel time  =    3.14 min.
Time of concentration =   10.35 min.
Critical depth =      1.039(Ft.)
 Adding area flow to channel
UNDEVELOPED (poor cover) subarea
Rainfall intensity =      3.165(In/Hr) for a    25.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.457
Subarea runoff =      0.109(CFS) for     10.800(Ac.)
Total runoff =     61.477(CFS)   Total area =      42.520(Ac.)


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Process from Point/Station       74.000 to Point/Station       76.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________
Along Main Stream number: 1 in normal stream number 1
Stream flow area =     42.520(Ac.)
Runoff from this stream =     61.477(CFS)
Time of concentration =   10.35 min.
Rainfall intensity =     3.165(In/Hr)


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Process from Point/Station       80.000 to Point/Station       82.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________
UNDEVELOPED (average cover) subarea
Initial subarea data:
Equations shown use english units, converted if necessary to (SI)
Initial area flow distance =   961.000(Ft.)
Top (of initial area) elevation =  1228.000(Ft.)
Bottom (of initial area) elevation =   980.100(Ft.)
Difference in elevation =   247.900(Ft.)
Slope =    0.25796  s(%)=      25.80
Manual entry of initial area time of concentration, TC
Initial area time of concentration =    5.000 min.
Rainfall intensity =      4.400(In/Hr) for a    25.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.500
Subarea runoff =     18.502(CFS)
Total initial stream area =        8.410(Ac.)


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Process from Point/Station       82.000 to Point/Station       84.000
**** IMPROVED CHANNEL TRAVEL TIME ****
______________________________________________________________________
Upstream point elevation =   980.100(Ft.)
Downstream point elevation =   966.500(Ft.)
Channel length thru subarea  =   876.000(Ft.)
Channel base width    =    5.000(Ft.)
Slope or 'Z' of left channel bank =  10.000
Slope or 'Z' of right channel bank =  10.000
Estimated mean flow rate at midpoint of channel =     29.381(CFS)
Manning's 'N'    = 0.030
Maximum depth of channel  =    3.000(Ft.)
Flow(q) thru subarea =     29.381(CFS)
Depth of flow =   0.693(Ft.), Average velocity =   3.553(Ft/s)
Channel flow top width =   18.862(Ft.)
Flow Velocity =    3.55(Ft/s)
Travel time  =    4.11 min.
Time of concentration =    9.11 min.
Critical depth =      0.672(Ft.)
 Adding area flow to channel
UNDEVELOPED (average cover) subarea
Rainfall intensity =      3.414(In/Hr) for a    25.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.408
Subarea runoff =      6.995(CFS) for      9.890(Ac.)
Total runoff =     25.497(CFS)   Total area =      18.300(Ac.)


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Process from Point/Station       82.000 to Point/Station       84.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________
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Along Main Stream number: 1 in normal stream number 2
Stream flow area =     18.300(Ac.)
Runoff from this stream =     25.497(CFS)
Time of concentration =    9.11 min.
Rainfall intensity =     3.414(In/Hr)


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Process from Point/Station       90.000 to Point/Station       92.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________
UNDEVELOPED (average cover) subarea
Initial subarea data:
Equations shown use english units, converted if necessary to (SI)
Initial area flow distance =   332.000(Ft.)
Top (of initial area) elevation =   974.900(Ft.)
Bottom (of initial area) elevation =   969.000(Ft.)
Difference in elevation =     5.900(Ft.)
Slope =    0.01777  s(%)=       1.78
Manual entry of initial area time of concentration, TC
Initial area time of concentration =    5.000 min.
Rainfall intensity =      4.400(In/Hr) for a    25.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.330
Subarea runoff =      1.902(CFS)
Total initial stream area =        1.310(Ac.)


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Process from Point/Station       90.000 to Point/Station       92.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________
Along Main Stream number: 1 in normal stream number 3
Stream flow area =      1.310(Ac.)
Runoff from this stream =      1.902(CFS)
Time of concentration =    5.00 min.
Rainfall intensity =     4.400(In/Hr)
Summary of stream data:

Stream   Flow rate      TC            Rainfall Intensity
 No.       (CFS)       (min)                 (In/Hr)


1       61.477     10.35            3.165
2       25.497      9.11            3.414
3        1.902      5.00            4.400
Qmax(1) =
        1.000 *    1.000 *    61.477) +
        0.927 *    1.000 *    25.497) +
        0.719 *    1.000 *     1.902) + =      86.483
Qmax(2) =
        1.000 *    0.880 *    61.477) +
        1.000 *    1.000 *    25.497) +
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        0.776 *    1.000 *     1.902) + =      81.078
Qmax(3) =
        1.000 *    0.483 *    61.477) +
        1.000 *    0.549 *    25.497) +
        1.000 *    1.000 *     1.902) + =      45.596

Total of 3 streams to confluence:
Flow rates before confluence point:
      61.477      25.497       1.902
Maximum flow rates at confluence using above data:
       86.483       81.078       45.596
Area of streams before confluence:
       42.520       18.300        1.310
Results of confluence:
Total flow rate =     86.483(CFS)
Time of concentration =    10.350 min.
Effective stream area after confluence =     62.130(Ac.)
End of computations, total study area =         144.290 (Ac.)
```

UNIVERSAL RATIONAL METHOD HYDROLOGY PROGRAM

CIVILCADD/CIVILDESIGN Engineering Software, (c) 1989- 2005 Version 7.1
Rational Hydrology Study Date: 04/18/13

Santa Margarita Quarry
Proposed Conditions
50-Year Storm Event

********* Hydrology Study Control Information **********

Program License Serial Number 4028

Rational hydrology study storm event year is 50.0
Number of [time,intensity] data pairs = 8

No.	Time -	Intensity
1	5.000	4.900(In.)
2	10.000	3.700(In.)
3	15.000	3.100(In.)
4	30.000	2.100(In.)
5	60.000	1.400(In.)
6	120.000	1.050(In.)
7	180.000	0.920(In.)
8	360.000	0.740(In.)

English Input Units Used
English Output Units Used:
Area = acres, Distance = feet, Flow q = ft^3/s, Pipe diam. = inches
Runoff coefficient method used:
Runoff coefficient 'C' value calculated for the
equation Q=KCIA [K=unit constant(1 if English Units, 1/360 if SI Units),
I=rainfall intensity, A=area];
by the following method:
Manual entry of 'C' values

Rational Hydrology Method used:

The modified rational hydrology method is used
where the total area of each stream, area averaged 'C' value
using equation ct = (C1A1 + C2A2 + ... CnAn)/at
and rainfall intensity for each particular point is used
to determine the runoff flow q at each point.

Stream flow confluence option used:

Stream flow confluence method of 2 - 5 streams:

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Note: in all cases, if the time of concentration
or TC of all streams are identical, then q = sum of stream flows
Variables p=peak; i=intensity; Fm=loss rate; a=area; 1...n flows
q = flow rate, t = time in minutes
Peak flow qp is a function of time, TC:
    usual case q1>q2 and t1>t2 then qp = q1 + q2*(i1/i2), tp=t1
    some cases q1>q2 and t1<t2 then qp = q2 + q1*(t2/t1), tp=t2


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Process from Point/Station       10.000 to Point/Station       12.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________
UNDEVELOPED (average cover) subarea
Initial subarea data:
Equations shown use english units, converted if necessary to (SI)
Initial area flow distance =   277.000(Ft.)
Top (of initial area) elevation =  1255.000(Ft.)
Bottom (of initial area) elevation =  1140.000(Ft.)
Difference in elevation =   115.000(Ft.)
Slope =    0.41516  s(%)=      41.52
Manual entry of initial area time of concentration, TC
Initial area time of concentration =    5.000 min.
Rainfall intensity =      4.900(In/Hr) for a    50.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.640
Subarea runoff =      0.815(CFS)
Total initial stream area =        0.260(Ac.)


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Process from Point/Station       12.000 to Point/Station       14.000
**** IMPROVED CHANNEL TRAVEL TIME ****
______________________________________________________________________
Upstream point elevation =  1140.000(Ft.)
Downstream point elevation =  1020.000(Ft.)
Channel length thru subarea  =   810.000(Ft.)
Channel base width    =    0.000(Ft.)
Slope or 'Z' of left channel bank =   2.000
Slope or 'Z' of right channel bank =   2.000
Estimated mean flow rate at midpoint of channel =      2.132(CFS)
Manning's 'N'    = 0.030
Maximum depth of channel  =    1.000(Ft.)
Flow(q) thru subarea =      2.132(CFS)
Depth of flow =   0.415(Ft.), Average velocity =   6.200(Ft/s)
Channel flow top width =    1.659(Ft.)
Flow Velocity =    6.20(Ft/s)
Travel time  =    2.18 min.
Time of concentration =    7.18 min.
Critical depth =      0.590(Ft.)
 Adding area flow to channel
UNDEVELOPED (average cover) subarea
Rainfall intensity =      4.377(In/Hr) for a    50.0 year storm
```

```
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.640
Subarea runoff =      2.266(CFS) for      0.840(Ac.)
Total runoff =      3.082(CFS)   Total area =       1.100(Ac.)


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Process from Point/Station       14.000 to Point/Station       16.000
**** IMPROVED CHANNEL TRAVEL TIME ****
______________________________________________________________________
Upstream point elevation =  1020.000(Ft.)
Downstream point elevation =  1007.700(Ft.)
Channel length thru subarea  =   461.000(Ft.)
Channel base width    =    0.000(Ft.)
Slope or 'Z' of left channel bank =   2.000
Slope or 'Z' of right channel bank =   2.000
Estimated mean flow rate at midpoint of channel =      3.796(CFS)
Manning's 'N'    = 0.030
Maximum depth of channel  =    1.000(Ft.)
Flow(q) thru subarea =      3.796(CFS)
Depth of flow =   0.710(Ft.), Average velocity =   3.766(Ft/s)
Channel flow top width =    2.840(Ft.)
Flow Velocity =    3.77(Ft/s)
Travel time  =    2.04 min.
Time of concentration =    9.22 min.
Critical depth =      0.742(Ft.)
 Adding area flow to channel
UNDEVELOPED (average cover) subarea
Rainfall intensity =      3.888(In/Hr) for a    50.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.640
Subarea runoff =      0.924(CFS) for      0.510(Ac.)
Total runoff =      4.006(CFS)   Total area =       1.610(Ac.)


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Process from Point/Station       16.000 to Point/Station       18.000
**** IMPROVED CHANNEL TRAVEL TIME ****
______________________________________________________________________
Upstream point elevation =  1007.700(Ft.)
Downstream point elevation =   958.200(Ft.)
Channel length thru subarea  =    54.000(Ft.)
Channel base width    =    0.500(Ft.)
Slope or 'Z' of left channel bank =   2.000
Slope or 'Z' of right channel bank =   2.000
Manning's 'N'    = 0.015
Maximum depth of channel  =    1.000(Ft.)
Flow(q) thru subarea =      4.006(CFS)
Depth of flow =   0.192(Ft.), Average velocity =  23.675(Ft/s)
Channel flow top width =    1.266(Ft.)
Flow Velocity =   23.68(Ft/s)
Travel time  =    0.04 min.
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Time of concentration =    9.26 min.
Critical depth =      0.645(Ft.)


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Process from Point/Station       16.000 to Point/Station       18.000
**** SUBAREA FLOW ADDITION ****
______________________________________________________________________
UNDEVELOPED (average cover) subarea
Time of concentration =     9.26 min.
Rainfall intensity =      3.879(In/Hr) for a    50.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.640
Subarea runoff =      7.537(CFS) for      3.040(Ac.)
Total runoff =     11.543(CFS)   Total area =       4.650(Ac.)


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Process from Point/Station       18.000 to Point/Station       20.000
**** IMPROVED CHANNEL TRAVEL TIME ****
______________________________________________________________________
Upstream point elevation =   958.200(Ft.)
Downstream point elevation =   932.800(Ft.)
Channel length thru subarea  =  1316.000(Ft.)
Channel base width    =    0.000(Ft.)
Slope or 'Z' of left channel bank =   2.000
Slope or 'Z' of right channel bank =   2.000
Estimated mean flow rate at midpoint of channel =     16.222(CFS)
Manning's 'N'    = 0.030
Maximum depth of channel  =    1.500(Ft.)
Flow(q) thru subarea =     16.222(CFS)
Depth of flow =   1.301(Ft.), Average velocity =   4.795(Ft/s)
Channel flow top width =    5.202(Ft.)
Flow Velocity =    4.80(Ft/s)
Travel time  =    4.57 min.
Time of concentration =   13.83 min.
Critical depth =      1.328(Ft.)
 Adding area flow to channel
UNDEVELOPED (average cover) subarea
Rainfall intensity =      3.240(In/Hr) for a    50.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.640
Subarea runoff =      5.919(CFS) for      3.770(Ac.)
Total runoff =     17.462(CFS)   Total area =       8.420(Ac.)


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Process from Point/Station       20.000 to Point/Station       22.000
**** IMPROVED CHANNEL TRAVEL TIME ****
______________________________________________________________________
Upstream point elevation =   932.800(Ft.)
Downstream point elevation =   884.100(Ft.)
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Channel length thru subarea  =    49.000(Ft.)
Channel base width    =    0.500(Ft.)
Slope or 'Z' of left channel bank =   2.000
Slope or 'Z' of right channel bank =   2.000
Manning's 'N'    = 0.015
Maximum depth of channel  =    1.000(Ft.)
Flow(q) thru subarea =     17.462(CFS)
Depth of flow =   0.384(Ft.), Average velocity =  35.926(Ft/s)
Channel flow top width =    2.034(Ft.)
Flow Velocity =   35.93(Ft/s)
Travel time  =    0.02 min.
Time of concentration =   13.85 min.
Critical depth =      1.219(Ft.)


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Process from Point/Station       22.000 to Point/Station       24.000
**** IMPROVED CHANNEL TRAVEL TIME ****
______________________________________________________________________
Upstream point elevation =   884.100(Ft.)
Downstream point elevation =   878.700(Ft.)
Channel length thru subarea  =   124.000(Ft.)
Channel base width    =    0.500(Ft.)
Slope or 'Z' of left channel bank =   2.000
Slope or 'Z' of right channel bank =   2.000
Estimated mean flow rate at midpoint of channel =     20.531(CFS)
Manning's 'N'    = 0.015
Maximum depth of channel  =    1.000(Ft.)
Flow(q) thru subarea =     20.531(CFS)
Depth of flow =   0.823(Ft.), Average velocity =  11.636(Ft/s)
Channel flow top width =    3.790(Ft.)
Flow Velocity =   11.64(Ft/s)
Travel time  =    0.18 min.
Time of concentration =   14.03 min.
Critical depth =      1.313(Ft.)
 Adding area flow to channel
UNDEVELOPED (average cover) subarea
Rainfall intensity =      3.216(In/Hr) for a    50.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.640
Subarea runoff =      5.964(CFS) for      2.960(Ac.)
Total runoff =     23.425(CFS)   Total area =      11.380(Ac.)


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Process from Point/Station       24.000 to Point/Station       24.000
**** SUBAREA FLOW ADDITION ****
______________________________________________________________________
UNDEVELOPED (average cover) subarea
Time of concentration =    14.03 min.
Rainfall intensity =      3.216(In/Hr) for a    50.0 year storm
Effective runoff coefficient used for total area
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```
(Q=KCIA) is C = 0.640
Subarea runoff =      5.064(CFS) for      2.460(Ac.)
Total runoff =     28.489(CFS)   Total area =      13.840(Ac.)


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Process from Point/Station       24.000 to Point/Station       26.000
**** IMPROVED CHANNEL TRAVEL TIME ****
______________________________________________________________________
Upstream point elevation =   878.700(Ft.)
Downstream point elevation =   877.400(Ft.)
Channel length thru subarea  =   193.000(Ft.)
Channel base width    =    0.000(Ft.)
Slope or 'Z' of left channel bank =   2.000
Slope or 'Z' of right channel bank =   2.000
Manning's 'N'    = 0.030
Maximum depth of channel  =    2.500(Ft.)
Flow(q) thru subarea =     28.489(CFS)
Depth of flow =   1.957(Ft.), Average velocity =   3.720(Ft/s)
Channel flow top width =    7.828(Ft.)
Flow Velocity =    3.72(Ft/s)
Travel time  =    0.86 min.
Time of concentration =   14.90 min.
Critical depth =      1.656(Ft.)


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Process from Point/Station       24.000 to Point/Station       26.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________
Along Main Stream number: 1 in normal stream number 1
Stream flow area =     13.840(Ac.)
Runoff from this stream =     28.489(CFS)
Time of concentration =   14.90 min.
Rainfall intensity =     3.113(In/Hr)


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Process from Point/Station       28.000 to Point/Station       30.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________
UNDEVELOPED (average cover) subarea
Initial subarea data:
Equations shown use english units, converted if necessary to (SI)
Initial area flow distance =   167.000(Ft.)
Top (of initial area) elevation =  1022.500(Ft.)
Bottom (of initial area) elevation =  1010.000(Ft.)
Difference in elevation =    12.500(Ft.)
Slope =    0.07485  s(%)=       7.49
Manual entry of initial area time of concentration, TC
Initial area time of concentration =    5.000 min.
Rainfall intensity =      4.900(In/Hr) for a    50.0 year storm
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Effective runoff coefficient used for area (Q=KCIA) is C = 0.640
Subarea runoff =      0.470(CFS)
Total initial stream area =        0.150(Ac.)


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Process from Point/Station       30.000 to Point/Station       26.000
**** IMPROVED CHANNEL TRAVEL TIME ****
______________________________________________________________________
Upstream point elevation =  1010.000(Ft.)
Downstream point elevation =   877.400(Ft.)
Channel length thru subarea  =   990.000(Ft.)
Channel base width    =    0.500(Ft.)
Slope or 'Z' of left channel bank =   2.000
Slope or 'Z' of right channel bank =   2.000
Estimated mean flow rate at midpoint of channel =      7.573(CFS)
Manning's 'N'    = 0.015
Maximum depth of channel  =    1.000(Ft.)
Flow(q) thru subarea =      7.573(CFS)
Depth of flow =   0.414(Ft.), Average velocity =  13.764(Ft/s)
Channel flow top width =    2.157(Ft.)
Flow Velocity =   13.76(Ft/s)
Travel time  =    1.20 min.
Time of concentration =    6.20 min.
Critical depth =      0.859(Ft.)
 Adding area flow to channel
UNDEVELOPED (average cover) subarea
Rainfall intensity =      4.612(In/Hr) for a    50.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.640
Subarea runoff =     13.344(CFS) for      4.530(Ac.)
Total runoff =     13.815(CFS)   Total area =       4.680(Ac.)


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Process from Point/Station       30.000 to Point/Station       26.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________
Along Main Stream number: 1 in normal stream number 2
Stream flow area =      4.680(Ac.)
Runoff from this stream =     13.815(CFS)
Time of concentration =    6.20 min.
Rainfall intensity =     4.612(In/Hr)
Summary of stream data:

Stream   Flow rate      TC            Rainfall Intensity
 No.       (CFS)       (min)                 (In/Hr)


1       28.489     14.90            3.113
2       13.815      6.20            4.612
Qmax(1) =
```

```
        1.000 *    1.000 *    28.489) +
        0.675 *    1.000 *    13.815) + =      37.812
Qmax(2) =
        1.000 *    0.416 *    28.489) +
        1.000 *    1.000 *    13.815) + =      25.671

Total of 2 streams to confluence:
Flow rates before confluence point:
      28.489      13.815
Maximum flow rates at confluence using above data:
       37.812       25.671
Area of streams before confluence:
       13.840        4.680
Results of confluence:
Total flow rate =     37.812(CFS)
Time of concentration =    14.895 min.
Effective stream area after confluence =     18.520(Ac.)


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Process from Point/Station       26.000 to Point/Station       32.000
**** IMPROVED CHANNEL TRAVEL TIME ****
______________________________________________________________________
Upstream point elevation =   877.400(Ft.)
Downstream point elevation =   875.500(Ft.)
Channel length thru subarea  =  1212.000(Ft.)
Channel base width    =    3.000(Ft.)
Slope or 'Z' of left channel bank =   2.000
Slope or 'Z' of right channel bank =   2.000
Manning's 'N'    = 0.015
Maximum depth of channel  =    1.500(Ft.)
Flow(q) thru subarea =     37.812(CFS)
Depth of flow =   1.574(Ft.), Average velocity =   3.911(Ft/s)
!!Warning: Water is above left or right bank elevations
Channel flow top width =    9.000(Ft.)
Flow Velocity =    3.91(Ft/s)
Travel time  =    5.16 min.
Time of concentration =   20.06 min.
Critical depth =      1.281(Ft.)
ERROR - Channel depth exceeds maximum allowable depth


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Process from Point/Station       26.000 to Point/Station       32.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________
Along Main Stream number: 1 in normal stream number 1
Stream flow area =     18.520(Ac.)
Runoff from this stream =     37.812(CFS)
Time of concentration =   20.06 min.
Rainfall intensity =     2.763(In/Hr)
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Process from Point/Station       34.000 to Point/Station       36.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________
UNDEVELOPED (average cover) subarea
Initial subarea data:
Equations shown use english units, converted if necessary to (SI)
Initial area flow distance =   752.000(Ft.)
Top (of initial area) elevation =  1249.000(Ft.)
Bottom (of initial area) elevation =  1041.000(Ft.)
Difference in elevation =   208.000(Ft.)
Slope =    0.27660  s(%)=      27.66
Manual entry of initial area time of concentration, TC
Initial area time of concentration =    5.000 min.
Rainfall intensity =      4.900(In/Hr) for a    50.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.640
Subarea runoff =      7.715(CFS)
Total initial stream area =        2.460(Ac.)


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Process from Point/Station       36.000 to Point/Station       38.000
**** IMPROVED CHANNEL TRAVEL TIME ****
______________________________________________________________________
Upstream point elevation =  1041.000(Ft.)
Downstream point elevation =  1001.800(Ft.)
Channel length thru subarea  =    27.000(Ft.)
Channel base width    =    0.000(Ft.)
Slope or 'Z' of left channel bank =   2.000
Slope or 'Z' of right channel bank =   2.000
Manning's 'N'    = 0.015
Maximum depth of channel  =    1.000(Ft.)
Flow(q) thru subarea =      7.715(CFS)
Depth of flow =   0.338(Ft.), Average velocity =  33.845(Ft/s)
Channel flow top width =    1.350(Ft.)
Flow Velocity =   33.84(Ft/s)
Travel time  =    0.01 min.
Time of concentration =    5.01 min.
Critical depth =      0.984(Ft.)


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Process from Point/Station       38.000 to Point/Station       40.000
**** IMPROVED CHANNEL TRAVEL TIME ****
______________________________________________________________________
Upstream point elevation =  1001.800(Ft.)
Downstream point elevation =  1001.400(Ft.)
Channel length thru subarea  =   184.000(Ft.)
Channel base width    =    0.000(Ft.)
Slope or 'Z' of left channel bank =   2.000
Slope or 'Z' of right channel bank =   2.000
```

```
Estimated mean flow rate at midpoint of channel =      9.784(CFS)
Manning's 'N'    = 0.030
Maximum depth of channel  =    1.500(Ft.)
Flow(q) thru subarea =      9.784(CFS)
Depth of flow =   1.599(Ft.), Average velocity =   1.922(Ft/s)
!!Warning: Water is above left or right bank elevations
Channel flow top width =    6.000(Ft.)
Flow Velocity =    1.92(Ft/s)
Travel time  =    1.60 min.
Time of concentration =    6.61 min.
Critical depth =      1.086(Ft.)
ERROR - Channel depth exceeds maximum allowable depth
 Adding area flow to channel
UNDEVELOPED (average cover) subarea
Rainfall intensity =      4.514(In/Hr) for a    50.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.640
Subarea runoff =      3.205(CFS) for      1.320(Ac.)
Total runoff =     10.920(CFS)   Total area =       3.780(Ac.)


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Process from Point/Station       40.000 to Point/Station       42.000
**** IMPROVED CHANNEL TRAVEL TIME ****
______________________________________________________________________
Upstream point elevation =  1001.400(Ft.)
Downstream point elevation =   952.100(Ft.)
Channel length thru subarea  =   265.000(Ft.)
Channel base width    =    0.500(Ft.)
Slope or 'Z' of left channel bank =   2.000
Slope or 'Z' of right channel bank =   2.000
Manning's 'N'    = 0.015
Maximum depth of channel  =    1.000(Ft.)
Flow(q) thru subarea =     10.920(CFS)
Depth of flow =   0.454(Ft.), Average velocity =  17.077(Ft/s)
Channel flow top width =    2.316(Ft.)
Flow Velocity =   17.08(Ft/s)
Travel time  =    0.26 min.
Time of concentration =    6.87 min.
Critical depth =      1.016(Ft.)


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Process from Point/Station       42.000 to Point/Station       44.000
**** IMPROVED CHANNEL TRAVEL TIME ****
______________________________________________________________________
Upstream point elevation =   952.100(Ft.)
Downstream point elevation =   950.800(Ft.)
Channel length thru subarea  =   105.000(Ft.)
Channel base width    =    0.000(Ft.)
Slope or 'Z' of left channel bank =   2.000
Slope or 'Z' of right channel bank =   2.000
```

```
Estimated mean flow rate at midpoint of channel =     13.578(CFS)
Manning's 'N'    = 0.030
Maximum depth of channel  =    1.500(Ft.)
Flow(q) thru subarea =     13.578(CFS)
Depth of flow =   1.322(Ft.), Average velocity =   3.883(Ft/s)
Channel flow top width =    5.289(Ft.)
Flow Velocity =    3.88(Ft/s)
Travel time  =    0.45 min.
Time of concentration =    7.32 min.
Critical depth =      1.234(Ft.)
 Adding area flow to channel
UNDEVELOPED (average cover) subarea
Rainfall intensity =      4.344(In/Hr) for a    50.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.640
Subarea runoff =      4.703(CFS) for      1.840(Ac.)
Total runoff =     15.623(CFS)   Total area =       5.620(Ac.)


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Process from Point/Station       44.000 to Point/Station       46.000
**** IMPROVED CHANNEL TRAVEL TIME ****
______________________________________________________________________
Upstream point elevation =   950.800(Ft.)
Downstream point elevation =   901.300(Ft.)
Channel length thru subarea  =    55.000(Ft.)
Channel base width    =    0.500(Ft.)
Slope or 'Z' of left channel bank =   2.000
Slope or 'Z' of right channel bank =   2.000
Manning's 'N'    = 0.015
Maximum depth of channel  =    1.000(Ft.)
Flow(q) thru subarea =     15.623(CFS)
Depth of flow =   0.373(Ft.), Average velocity =  33.650(Ft/s)
Channel flow top width =    1.991(Ft.)
Flow Velocity =   33.65(Ft/s)
Travel time  =    0.03 min.
Time of concentration =    7.35 min.
Critical depth =      1.164(Ft.)


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Process from Point/Station       46.000 to Point/Station       48.000
**** IMPROVED CHANNEL TRAVEL TIME ****
______________________________________________________________________
Upstream point elevation =   901.300(Ft.)
Downstream point elevation =   901.100(Ft.)
Channel length thru subarea  =    19.000(Ft.)
Channel base width    =    0.000(Ft.)
Slope or 'Z' of left channel bank =   2.000
Slope or 'Z' of right channel bank =   2.000
Estimated mean flow rate at midpoint of channel =     16.916(CFS)
Manning's 'N'    = 0.030
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```
Maximum depth of channel  =    1.500(Ft.)
Flow(q) thru subarea =     16.916(CFS)
Depth of flow =   1.480(Ft.), Average velocity =   3.860(Ft/s)
Channel flow top width =    5.921(Ft.)
Flow Velocity =    3.86(Ft/s)
Travel time  =    0.08 min.
Time of concentration =    7.43 min.
Critical depth =      1.344(Ft.)
 Adding area flow to channel
UNDEVELOPED (average cover) subarea
Rainfall intensity =      4.317(In/Hr) for a    50.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.640
Subarea runoff =      2.475(CFS) for      0.930(Ac.)
Total runoff =     18.098(CFS)   Total area =       6.550(Ac.)


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Process from Point/Station       48.000 to Point/Station       32.000
**** IMPROVED CHANNEL TRAVEL TIME ****
______________________________________________________________________
Upstream point elevation =   908.100(Ft.)
Downstream point elevation =   875.500(Ft.)
Channel length thru subarea  =    26.000(Ft.)
Channel base width    =    0.500(Ft.)
Slope or 'Z' of left channel bank =   2.000
Slope or 'Z' of right channel bank =   2.000
Manning's 'N'    = 0.015
Maximum depth of channel  =    1.000(Ft.)
Flow(q) thru subarea =     18.098(CFS)
Depth of flow =   0.370(Ft.), Average velocity =  39.528(Ft/s)
Channel flow top width =    1.978(Ft.)
Flow Velocity =   39.53(Ft/s)
Travel time  =    0.01 min.
Time of concentration =    7.44 min.
Critical depth =      1.234(Ft.)


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Process from Point/Station       48.000 to Point/Station       32.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________
Along Main Stream number: 1 in normal stream number 2
Stream flow area =      6.550(Ac.)
Runoff from this stream =     18.098(CFS)
Time of concentration =    7.44 min.
Rainfall intensity =     4.315(In/Hr)
Summary of stream data:

Stream   Flow rate      TC            Rainfall Intensity
 No.       (CFS)       (min)                 (In/Hr)
```

```
1       37.812     20.06            2.763
2       18.098      7.44            4.315
Qmax(1) =
        1.000 *    1.000 *    37.812) +
        0.640 *    1.000 *    18.098) + =      49.400
Qmax(2) =
        1.000 *    0.371 *    37.812) +
        1.000 *    1.000 *    18.098) + =      32.120

Total of 2 streams to confluence:
Flow rates before confluence point:
      37.812      18.098
Maximum flow rates at confluence using above data:
       49.400       32.120
Area of streams before confluence:
       18.520        6.550
Results of confluence:
Total flow rate =     49.400(CFS)
Time of concentration =    20.060 min.
Effective stream area after confluence =     25.070(Ac.)


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Process from Point/Station       32.000 to Point/Station       50.000
**** IMPROVED CHANNEL TRAVEL TIME ****
______________________________________________________________________
Upstream point elevation =   875.500(Ft.)
Downstream point elevation =   875.300(Ft.)
Channel length thru subarea  =   116.000(Ft.)
Channel base width    =    0.000(Ft.)
Slope or 'Z' of left channel bank =   2.000
Slope or 'Z' of right channel bank =   2.000
Manning's 'N'    = 0.030
Maximum depth of channel  =    3.000(Ft.)
Flow(q) thru subarea =     49.400(CFS)
Depth of flow =   3.086(Ft.), Average velocity =   2.596(Ft/s)
!!Warning: Water is above left or right bank elevations
Channel flow top width =   12.000(Ft.)
Flow Velocity =    2.60(Ft/s)
Travel time  =    0.74 min.
Time of concentration =   20.80 min.
Critical depth =      2.063(Ft.)
ERROR - Channel depth exceeds maximum allowable depth


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       32.000 to Point/Station       50.000
**** CONFLUENCE OF MAIN STREAMS ****
______________________________________________________________________
The following data inside Main Stream is listed:
In Main Stream number: 1
```

```
Stream flow area =     25.070(Ac.)
Runoff from this stream =     49.400(CFS)
Time of concentration =   20.80 min.
Rainfall intensity =     2.713(In/Hr)
Program is now starting with Main Stream No. 2


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       52.000 to Point/Station       54.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________
UNDEVELOPED (average cover) subarea
Initial subarea data:
Equations shown use english units, converted if necessary to (SI)
Initial area flow distance =   210.000(Ft.)
Top (of initial area) elevation =  1364.500(Ft.)
Bottom (of initial area) elevation =  1225.400(Ft.)
Difference in elevation =   139.100(Ft.)
Slope =    0.66238  s(%)=      66.24
Manual entry of initial area time of concentration, TC
Initial area time of concentration =    5.000 min.
Rainfall intensity =      4.900(In/Hr) for a    50.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.640
Subarea runoff =      2.321(CFS)
Total initial stream area =        0.740(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       54.000 to Point/Station       56.000
**** IMPROVED CHANNEL TRAVEL TIME ****
______________________________________________________________________
Upstream point elevation =  1225.400(Ft.)
Downstream point elevation =  1207.900(Ft.)
Channel length thru subarea  =  1070.000(Ft.)
Channel base width    =    0.000(Ft.)
Slope or 'Z' of left channel bank =   2.000
Slope or 'Z' of right channel bank =   2.000
Estimated mean flow rate at midpoint of channel =     11.352(CFS)
Manning's 'N'    = 0.030
Maximum depth of channel  =    1.500(Ft.)
Flow(q) thru subarea =     11.352(CFS)
Depth of flow =   1.174(Ft.), Average velocity =   4.122(Ft/s)
Channel flow top width =    4.694(Ft.)
Flow Velocity =    4.12(Ft/s)
Travel time  =    4.33 min.
Time of concentration =    9.33 min.
Critical depth =      1.148(Ft.)
 Adding area flow to channel
UNDEVELOPED (average cover) subarea
Rainfall intensity =      3.862(In/Hr) for a    50.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.640
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```
Subarea runoff =     13.743(CFS) for      5.760(Ac.)
Total runoff =     16.064(CFS)   Total area =       6.500(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       56.000 to Point/Station       58.000
**** IMPROVED CHANNEL TRAVEL TIME ****
______________________________________________________________________
Upstream point elevation =  1207.900(Ft.)
Downstream point elevation =  1107.800(Ft.)
Channel length thru subarea  =   140.000(Ft.)
Channel base width    =    0.500(Ft.)
Slope or 'Z' of left channel bank =   2.000
Slope or 'Z' of right channel bank =   2.000
Manning's 'N'    = 0.015
Maximum depth of channel  =    1.000(Ft.)
Flow(q) thru subarea =     16.064(CFS)
Depth of flow =   0.398(Ft.), Average velocity =  31.113(Ft/s)
Channel flow top width =    2.093(Ft.)
Flow Velocity =   31.11(Ft/s)
Travel time  =    0.07 min.
Time of concentration =    9.40 min.
Critical depth =      1.180(Ft.)


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Process from Point/Station       56.000 to Point/Station       58.000
**** SUBAREA FLOW ADDITION ****
______________________________________________________________________
UNDEVELOPED (average cover) subarea
Time of concentration =     9.40 min.
Rainfall intensity =      3.844(In/Hr) for a    50.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.640
Subarea runoff =      7.231(CFS) for      2.970(Ac.)
Total runoff =     23.295(CFS)   Total area =       9.470(Ac.)


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Process from Point/Station       58.000 to Point/Station       60.000
**** IMPROVED CHANNEL TRAVEL TIME ****
______________________________________________________________________
Upstream point elevation =  1107.800(Ft.)
Downstream point elevation =  1094.300(Ft.)
Channel length thru subarea  =   574.000(Ft.)
Channel base width    =    0.000(Ft.)
Slope or 'Z' of left channel bank =   2.000
Slope or 'Z' of right channel bank =   2.000
Estimated mean flow rate at midpoint of channel =     27.809(CFS)
Manning's 'N'    = 0.030
Maximum depth of channel  =    2.500(Ft.)
Flow(q) thru subarea =     27.809(CFS)
```

```
Depth of flow =   1.534(Ft.), Average velocity =   5.909(Ft/s)
Channel flow top width =    6.136(Ft.)
Flow Velocity =    5.91(Ft/s)
Travel time  =    1.62 min.
Time of concentration =   11.02 min.
Critical depth =      1.641(Ft.)
 Adding area flow to channel
UNDEVELOPED (average cover) subarea
Rainfall intensity =      3.577(In/Hr) for a    50.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.640
Subarea runoff =      6.790(CFS) for      3.670(Ac.)
Total runoff =     30.085(CFS)   Total area =      13.140(Ac.)


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Process from Point/Station       60.000 to Point/Station       62.000
**** IMPROVED CHANNEL TRAVEL TIME ****
______________________________________________________________________
Upstream point elevation =  1094.300(Ft.)
Downstream point elevation =   877.200(Ft.)
Channel length thru subarea  =   201.000(Ft.)
Channel base width    =    1.000(Ft.)
Slope or 'Z' of left channel bank =   2.000
Slope or 'Z' of right channel bank =   2.000
Estimated mean flow rate at midpoint of channel =     41.259(CFS)
Manning's 'N'    = 0.015
Maximum depth of channel  =    1.000(Ft.)
Flow(q) thru subarea =     41.259(CFS)
Depth of flow =   0.469(Ft.), Average velocity =  45.446(Ft/s)
Channel flow top width =    2.875(Ft.)
Flow Velocity =   45.45(Ft/s)
Travel time  =    0.07 min.
Time of concentration =   11.09 min.
Critical depth =      1.688(Ft.)
 Adding area flow to channel
UNDEVELOPED (average cover) subarea
Rainfall intensity =      3.569(In/Hr) for a    50.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.640
Subarea runoff =     22.217(CFS) for      9.760(Ac.)
Total runoff =     52.302(CFS)   Total area =      22.900(Ac.)


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Process from Point/Station       62.000 to Point/Station       50.000
**** IMPROVED CHANNEL TRAVEL TIME ****
______________________________________________________________________
Upstream point elevation =   877.200(Ft.)
Downstream point elevation =   875.500(Ft.)
Channel length thru subarea  =   413.000(Ft.)
Channel base width    =    3.000(Ft.)
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```
Slope or 'Z' of left channel bank =   2.000
Slope or 'Z' of right channel bank =   2.000
Manning's 'N'    = 0.030
Maximum depth of channel  =    2.000(Ft.)
Flow(q) thru subarea =     52.302(CFS)
Depth of flow =   2.043(Ft.), Average velocity =   3.613(Ft/s)
!!Warning: Water is above left or right bank elevations
Channel flow top width =   11.000(Ft.)
Flow Velocity =    3.61(Ft/s)
Travel time  =    1.91 min.
Time of concentration =   13.00 min.
Critical depth =      1.516(Ft.)
ERROR - Channel depth exceeds maximum allowable depth


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Process from Point/Station       62.000 to Point/Station       50.000
**** CONFLUENCE OF MAIN STREAMS ****
______________________________________________________________________
The following data inside Main Stream is listed:
In Main Stream number: 2
Stream flow area =     22.900(Ac.)
Runoff from this stream =     52.302(CFS)
Time of concentration =   13.00 min.
Rainfall intensity =     3.340(In/Hr)
Program is now starting with Main Stream No. 3


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Process from Point/Station       64.000 to Point/Station       66.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________
UNDEVELOPED (average cover) subarea
Initial subarea data:
Equations shown use english units, converted if necessary to (SI)
Initial area flow distance =   954.000(Ft.)
Top (of initial area) elevation =   885.700(Ft.)
Bottom (of initial area) elevation =   880.900(Ft.)
Difference in elevation =     4.800(Ft.)
Slope =    0.00503  s(%)=       0.50
Manual entry of initial area time of concentration, TC
Initial area time of concentration =   11.800 min.
Rainfall intensity =      3.484(In/Hr) for a    50.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.440
Subarea runoff =     10.393(CFS)
Total initial stream area =        6.780(Ac.)


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Process from Point/Station       66.000 to Point/Station       50.000
**** IMPROVED CHANNEL TRAVEL TIME ****
______________________________________________________________________
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Upstream point elevation =   880.900(Ft.)
Downstream point elevation =   875.500(Ft.)
Channel length thru subarea  =  1766.000(Ft.)
Channel base width    =    0.000(Ft.)
Slope or 'Z' of left channel bank =  50.000
Slope or 'Z' of right channel bank =  50.000
Estimated mean flow rate at midpoint of channel =     31.403(CFS)
Manning's 'N'    = 0.030
Maximum depth of channel  =    2.000(Ft.)
Flow(q) thru subarea =     31.403(CFS)
Depth of flow =   0.685(Ft.), Average velocity =   1.340(Ft/s)
Channel flow top width =   68.459(Ft.)
Flow Velocity =    1.34(Ft/s)
Travel time  =   21.96 min.
Time of concentration =   33.76 min.
Critical depth =      0.477(Ft.)
 Adding area flow to channel
UNDEVELOPED (average cover) subarea
Rainfall intensity =      2.012(In/Hr) for a    50.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.440
Subarea runoff =     19.877(CFS) for     27.410(Ac.)
Total runoff =     30.271(CFS)   Total area =      34.190(Ac.)


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Process from Point/Station       66.000 to Point/Station       50.000
**** CONFLUENCE OF MAIN STREAMS ****
______________________________________________________________________
The following data inside Main Stream is listed:
In Main Stream number: 3
Stream flow area =     34.190(Ac.)
Runoff from this stream =     30.271(CFS)
Time of concentration =   33.76 min.
Rainfall intensity =     2.012(In/Hr)
Summary of stream data:

Stream   Flow rate      TC            Rainfall Intensity
 No.       (CFS)       (min)                 (In/Hr)


1       49.400     20.80            2.713
2       52.302     13.00            3.340
3       30.271     33.76            2.012
Qmax(1) =
        1.000 *    1.000 *    49.400) +
        0.812 *    1.000 *    52.302) +
        1.000 *    0.616 *    30.271) + =     110.537
Qmax(2) =
        1.000 *    0.625 *    49.400) +
        1.000 *    1.000 *    52.302) +
        1.000 *    0.385 *    30.271) + =      94.826
```

```
Qmax(3) =
        0.742 *    1.000 *    49.400) +
        0.602 *    1.000 *    52.302) +
        1.000 *    1.000 *    30.271) + =      98.419

Total of 3 main streams to confluence:
Flow rates before confluence point:
      49.400      52.302      30.271
Maximum flow rates at confluence using above data:
      110.537       94.826       98.419
Area of streams before confluence:
       25.070       22.900       34.190


Results of confluence:
Total flow rate =    110.537(CFS)
Time of concentration =    20.804 min.
Effective stream area after confluence  =     82.160(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       70.000 to Point/Station       72.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________
UNDEVELOPED (average cover) subarea
Initial subarea data:
Equations shown use english units, converted if necessary to (SI)
Initial area flow distance =   997.000(Ft.)
Top (of initial area) elevation =  1374.000(Ft.)
Bottom (of initial area) elevation =  1092.000(Ft.)
Difference in elevation =   282.000(Ft.)
Slope =    0.28285  s(%)=      28.28
Manual entry of initial area time of concentration, TC
Initial area time of concentration =    5.000 min.
Rainfall intensity =      4.900(In/Hr) for a    50.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.500
Subarea runoff =     12.471(CFS)
Total initial stream area =        5.090(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       72.000 to Point/Station       74.000
**** IMPROVED CHANNEL TRAVEL TIME ****
______________________________________________________________________
Upstream point elevation =  1092.000(Ft.)
Downstream point elevation =   970.000(Ft.)
Channel length thru subarea  =  1118.000(Ft.)
Channel base width    =    3.000(Ft.)
Slope or 'Z' of left channel bank =   3.000
Slope or 'Z' of right channel bank =   3.000
Estimated mean flow rate at midpoint of channel =     45.092(CFS)
Manning's 'N'    = 0.040
```

```
Maximum depth of channel  =    3.000(Ft.)
Flow(q) thru subarea =     45.092(CFS)
Depth of flow =   0.908(Ft.), Average velocity =   8.676(Ft/s)
Channel flow top width =    8.448(Ft.)
Flow Velocity =    8.68(Ft/s)
Travel time  =    2.15 min.
Time of concentration =    7.15 min.
Critical depth =      1.281(Ft.)
 Adding area flow to channel
UNDEVELOPED (average cover) subarea
Rainfall intensity =      4.385(In/Hr) for a    50.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.500
Subarea runoff =     57.069(CFS) for     26.630(Ac.)
Total runoff =     69.539(CFS)   Total area =      31.720(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       74.000 to Point/Station       76.000
**** IMPROVED CHANNEL TRAVEL TIME ****
______________________________________________________________________
Upstream point elevation =   972.000(Ft.)
Downstream point elevation =   965.000(Ft.)
Channel length thru subarea  =   712.000(Ft.)
Channel base width    =    5.000(Ft.)
Slope or 'Z' of left channel bank =  10.000
Slope or 'Z' of right channel bank =  10.000
Estimated mean flow rate at midpoint of channel =     81.378(CFS)
Manning's 'N'    = 0.030
Maximum depth of channel  =    3.000(Ft.)
Flow(q) thru subarea =     81.378(CFS)
Depth of flow =   1.215(Ft.), Average velocity =   3.903(Ft/s)
Channel flow top width =   29.308(Ft.)
Flow Velocity =    3.90(Ft/s)
Travel time  =    3.04 min.
Time of concentration =   10.19 min.
Critical depth =      1.109(Ft.)
 Adding area flow to channel
UNDEVELOPED (poor cover) subarea
Rainfall intensity =      3.677(In/Hr) for a    50.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.457
Subarea runoff =      1.891(CFS) for     10.800(Ac.)
Total runoff =     71.431(CFS)   Total area =      42.520(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       74.000 to Point/Station       76.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________
Along Main Stream number: 1 in normal stream number 1
Stream flow area =     42.520(Ac.)
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Runoff from this stream =     71.431(CFS)
Time of concentration =   10.19 min.
Rainfall intensity =     3.677(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       80.000 to Point/Station       82.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________
UNDEVELOPED (average cover) subarea
Initial subarea data:
Equations shown use english units, converted if necessary to (SI)
Initial area flow distance =   961.000(Ft.)
Top (of initial area) elevation =  1228.000(Ft.)
Bottom (of initial area) elevation =   980.100(Ft.)
Difference in elevation =   247.900(Ft.)
Slope =    0.25796  s(%)=      25.80
Manual entry of initial area time of concentration, TC
Initial area time of concentration =    5.000 min.
Rainfall intensity =      4.900(In/Hr) for a    50.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.500
Subarea runoff =     20.605(CFS)
Total initial stream area =        8.410(Ac.)


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Process from Point/Station       82.000 to Point/Station       84.000
**** IMPROVED CHANNEL TRAVEL TIME ****
______________________________________________________________________
Upstream point elevation =   980.100(Ft.)
Downstream point elevation =   966.500(Ft.)
Channel length thru subarea  =   876.000(Ft.)
Channel base width    =    5.000(Ft.)
Slope or 'Z' of left channel bank =  10.000
Slope or 'Z' of right channel bank =  10.000
Estimated mean flow rate at midpoint of channel =     32.720(CFS)
Manning's 'N'    = 0.030
Maximum depth of channel  =    3.000(Ft.)
Flow(q) thru subarea =     32.720(CFS)
Depth of flow =   0.729(Ft.), Average velocity =   3.655(Ft/s)
Channel flow top width =   19.573(Ft.)
Flow Velocity =    3.65(Ft/s)
Travel time  =    3.99 min.
Time of concentration =    8.99 min.
Critical depth =      0.711(Ft.)
 Adding area flow to channel
UNDEVELOPED (average cover) subarea
Rainfall intensity =      3.941(In/Hr) for a    50.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.408
Subarea runoff =      8.832(CFS) for      9.890(Ac.)
Total runoff =     29.436(CFS)   Total area =      18.300(Ac.)
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Process from Point/Station       82.000 to Point/Station       84.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________
Along Main Stream number: 1 in normal stream number 2
Stream flow area =     18.300(Ac.)
Runoff from this stream =     29.436(CFS)
Time of concentration =    8.99 min.
Rainfall intensity =     3.941(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       90.000 to Point/Station       92.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________
UNDEVELOPED (average cover) subarea
Initial subarea data:
Equations shown use english units, converted if necessary to (SI)
Initial area flow distance =   332.000(Ft.)
Top (of initial area) elevation =   974.900(Ft.)
Bottom (of initial area) elevation =   969.000(Ft.)
Difference in elevation =     5.900(Ft.)
Slope =    0.01777  s(%)=       1.78
Manual entry of initial area time of concentration, TC
Initial area time of concentration =    5.000 min.
Rainfall intensity =      4.900(In/Hr) for a    50.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.330
Subarea runoff =      2.118(CFS)
Total initial stream area =        1.310(Ac.)


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Process from Point/Station       90.000 to Point/Station       92.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________
Along Main Stream number: 1 in normal stream number 3
Stream flow area =      1.310(Ac.)
Runoff from this stream =      2.118(CFS)
Time of concentration =    5.00 min.
Rainfall intensity =     4.900(In/Hr)
Summary of stream data:

Stream   Flow rate      TC            Rainfall Intensity
 No.       (CFS)       (min)                 (In/Hr)


1       71.431     10.19            3.677
2       29.436      8.99            3.941
3        2.118      5.00            4.900
Qmax(1) =
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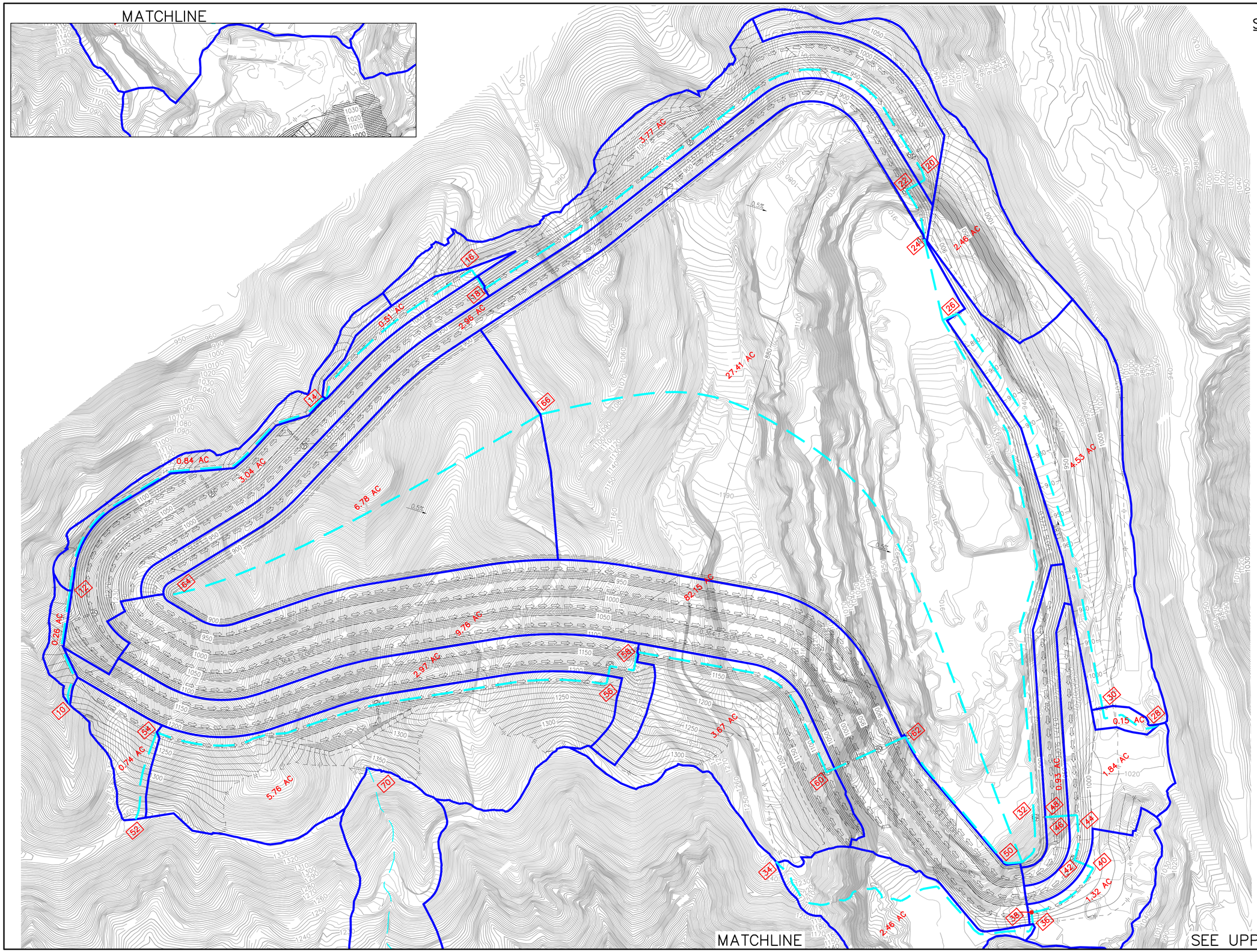
```
        1.000 *    1.000 *    71.431) +
        0.933 *    1.000 *    29.436) +
        0.751 *    1.000 *     2.118) + =     100.486
Qmax(2) =
        1.000 *    0.883 *    71.431) +
        1.000 *    1.000 *    29.436) +
        0.804 *    1.000 *     2.118) + =      94.205
Qmax(3) =
        1.000 *    0.491 *    71.431) +
        1.000 *    0.556 *    29.436) +
        1.000 *    1.000 *     2.118) + =      53.538

Total of 3 streams to confluence:
Flow rates before confluence point:
      71.431      29.436       2.118
Maximum flow rates at confluence using above data:
      100.486       94.205       53.538
Area of streams before confluence:
       42.520       18.300        1.310
Results of confluence:
Total flow rate =    100.486(CFS)
Time of concentration =    10.188 min.
Effective stream area after confluence =     62.130(Ac.)
End of computations, total study area =         144.290 (Ac.)
```

SANTA MARGARITA QUARRY

MINING AREA

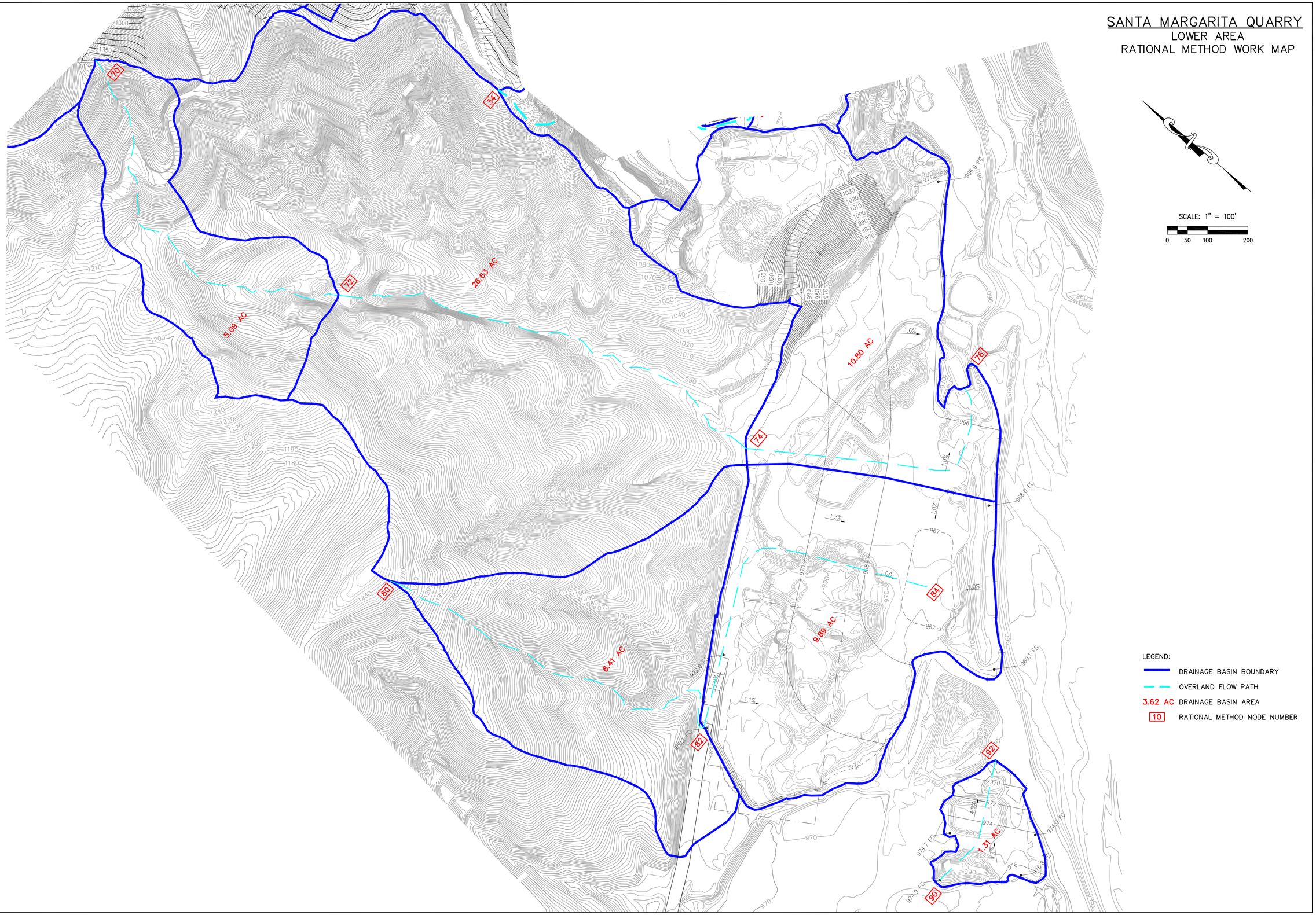
RATIONAL METHOD WORK MAP



LEGEND:

- DRAINAGE BASIN BOUNDARY
- OVERLAND FLOW PATH
- 3.62 AC DRAINAGE BASIN AREA
- 10 RATIONAL METHOD NODE NUMBER

SANTA MARGARITA QUARRY

LOWER AREA

RATIONAL METHOD WORK MAP