Appendix J:

Addendum to the Stormwater, Erosion Control, and Drainage Plan (2012)

ADDENDUM TO THE
STORMWATER, EROSION CONTROL, AND DRAINAGE PLAN

MOODY FLATS QUARRY
SHASTA COUNTY, CALIFORNIA

Prepared by:
Trevor Crawford, Civil Engineer
3M Facilities Engineering
St. Paul, Minnesota

Dr. Andrew A. Kopania, PG, CH
EMKO Environmental, Inc.
El Dorado Hills, California

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1.0 INTRODUCTION AND OBJECTIVES

The Stormwater, Erosion Control, and Drainage Plan (May 2010) for the Moody Flats Quarry Project (Project) (see Figure 1 for location) was prepared to present a conceptual plan outlining site specific stormwater runoff and sediment control analysis, erosion control mechanisms, and site drainage for the Moody Flats Quarry. The objectives of this Addendum are to:

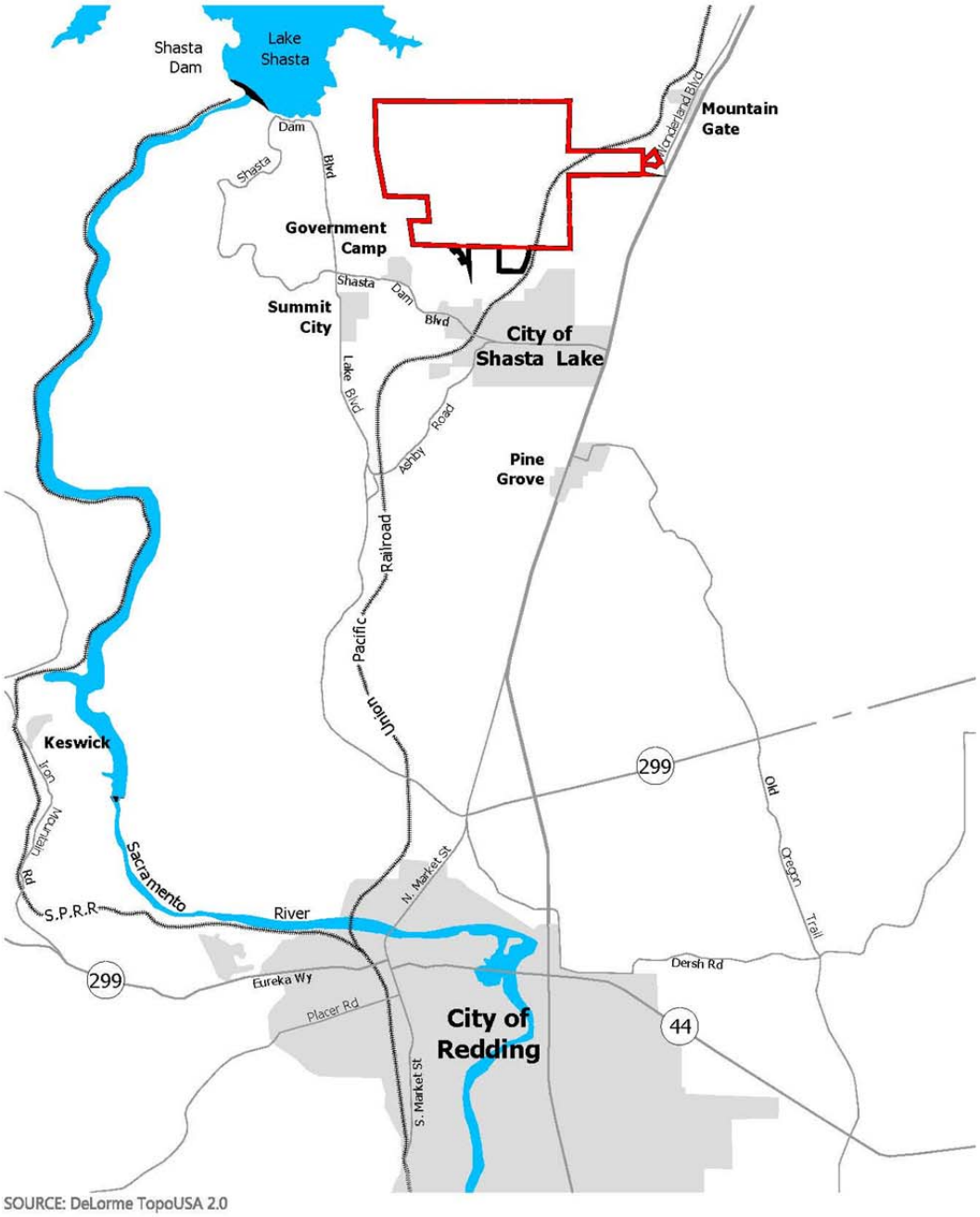
- Provide additional information and discussion of the overall stormwater, erosion control, and drainage approach at the site;
- Present updated HydroCAD stormwater modeling results;
- Demonstrate that the system meets various regulatory requirements and guidelines;
- Describe how the stormwater requirements will be coordinated with the Project water supply; and
- Provide an analysis of the stormwater, erosion control, and drainage approach for the Project within the context of the CEQA Guidelines Appendix G criteria for hydrology.

Appendix G of the CEQA Guidelines includes 10 thresholds of significance with respect to Hydrology and Water Quality. Three of these thresholds relate to drainage, erosion, and flooding. These three criteria address whether a proposed project would:

- Substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river, in a manner which would result in substantial erosion or siltation on- or off-site;
- Substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river, or substantially increase the rate or amount of surface runoff in a manner which would result in flooding on- or off-site; or
- Create or contribute runoff water which would exceed the capacity of existing or planned stormwater drainage systems, cause flooding on- and off-site, or provide substantial additional sources of polluted runoff.

The Stormwater, Erosion Control, and Drainage Plan, and this Addendum, were developed specifically to assist in the evaluation of the CEQA Appendix G significance criteria listed above. In addition, the stormwater calculations and the sizing of conveyance and storage features have been conducted consistent with various regulatory requirements and guidelines, including:

- CCR Title 14, Article 9, Section 3706(d), which requires that surface runoff and drainage from surface mining activities be controlled by berms, silt fences, sediment ponds, revegetation, hay bales, or other erosion control measures, to ensure that surrounding land and water resources are protected from erosion, gullying, sedimentation and contamination. Erosion control methods shall be designed to handle runoff from not less than the 20 year/l hour intensity storm event.
- Shasta County Development Standards, Chapter 2, Section F - Drainage (reprinted December 1997), which addresses calculation methods for estimating runoff from



SOURCE: DeLorme TopoUSA 2.0

LEGEND

Property Ownership

Site Boundary

3/4 Mile 0 1 1/2 Mile

NORTH

Scale: 1" = 1 1/2 Mile

BENCHMARK RESOURCES

Site Location
MOODY FLATS QUARRY

Figure 1

- design storm events, contains applicable hydrologic parameters for the site area, and describes the grading and drainage criteria to be followed.
- California State Water Resources Control Board (SWRCB) National Pollutant Discharge Elimination System (NPDES) General Permit for Storm Water Discharges Associated with Construction and Land Disturbance Activities, Appendix D: Sediment Basin Sizing, which identifies the appropriate calculation methods for sizing sedimentation basins used for stormwater management.
- Typical Central Valley Regional Water Quality Control Board (RWQCB) Waste Discharge Requirements (WDR) Permit criteria for retention of stormwater on mining sites in the northern Sacramento Valley, which specify that the runoff from a 25-year, 24-hour event should be retained, with two feet of freeboard remaining in the basin.

The Stormwater, Erosion Control, and Drainage Plan addresses disturbed areas of the site. This document presents detailed assumptions about watershed areas, runoff rates, basin dimensions, and conveyance feature sizing for each component or sub-area of the Project. This information is presented for conceptual design purposes, to demonstrate the feasibility of compliance with applicable regulatory requirements, and to facilitate evaluation of potential impacts based on the CEQA Guidelines Appendix G criteria. It is anticipated that final acreages, volumes, flow rates and other parameters will be similar to those evaluated in this document, but may not be identical as development of the site may vary due to actual site conditions, final Conditional Use Permit mitigation measures and Conditions of Approval, engineering, and other considerations.

Information previously provided in the Stormwater, Erosion Control, and Drainage Plan is not repeated here. The intent of this document is to provide further clarification regarding site operations, the results of additional stormwater modeling, and a specific discussion of the CEQA significance criteria with respect to the additional modeling results.

2.0 GENERAL APPROACH FOR STORMWATER MANAGEMENT

As discussed in the SB 610 Water Supply Assessment (EMKO Environmental, Inc., September 2011), the Hydrology and Water Quality Analysis Report (June 2009) and Project Description (January 2010), mining would eventually reach a production rate of two million tons of aggregate per year, with a maximum duration of 100 years. Initially, however, mining is anticipated to occur at a rate of 500,000 tons per year for 5 to 15 years, until the rail load-out facilities and additional processing capacity are constructed. Therefore, disturbance of the site will be gradual, and will not involve all areas simultaneously. Stormwater conveyance, erosion control, and drainage features will be constructed as needed, in advance of new disturbance in any given area of the Project site.

Likewise, water demand for the Project will initially be less than the maximum demand values described in the Project Description and evaluated in the SB 610 Water Supply Assessment and the Hydrology and Water Quality Analysis report. At a production rate of two million tons per year, the water demand for the Project is anticipated to be up to 260 acre-feet per year. At a

production rate of 500,000 tons per year, however, the water demand is expected to be up to 65 acre-feet per year.

Figure 2 presents the anticipated layout of the stormwater conveyance, erosion control, and drainage features. Figure 3 presents a Site Stormwater Plan Concept Map, which is a general process flow diagram for the entire Stormwater, Erosion Control, and Drainage system. Table 1, "Stormwater Design Parameters," presents a summary of the parameters used to model stormwater flow. Table 2, "Stormwater Summary," presents the results of the stormwater modeling. The stormwater modeling is discussed in more detail in Section 3.0, below. The discussion in this section, below, presents a general description of how the stormwater system will operate. The names and numerical designations for each feature discussed below are the same as those used in Table 2 and on Figures 2 and 3.

TABLE 1
STORMWATER DESIGN PARAMETERS

1. NORTH PIT						
Area	**Soil Type**	**Weighted CN**	**P-24**	**R-24**	**V-24**	**Tc**
263 ac	D	93	9.03	8.25	181 ac-ft	n/a
2. SOUTH PIT (INCLUDES PRIMARY PROCESSING AREA)						
Area	**Soil Type**	**Weighted CN**	**P-24**	**R-24**	**V-24**	**Tc**
113 ac	D	93	9.03	8.25	78 ac-ft	n/a
3. OVERBURDEN STOCKPILE AREA						
Area	**Soil Type**	**Weighted CN**	**P-24**	**R-24**	**V-24**	**Tc**
38 ac	C/D	90	9.03	7.75	25 ac-ft	32.7 min
4. NORTHEAST LOAD OUT AND PLANT AREA						
Area	**Soil Type**	**Weighted CN**	**P-24**	**R-24**	**V-24**	**Tc**
59 ac	D	89	9.03	7.7	38 ac-ft	15.6 min
WEIGHTED CN CALCULATION						
Areas:	**CN**	**Description:**				
18 ac	93	Plant Areas				
5 ac	98	Roads				
19 ac	79	Undeveloped				
17 ac	93	Load-out Facility				
5. SOUTHEAST LOAD OUT AREA AND ACCESS RAMP						
Area	**Soil Type**	**Weighted CN**	**P-24**	**R-24**	**V-24**	**Tc**
27 Acres	D	86	9.03	7.25	17 ac-ft	26.2 min
WEIGHTED CN CALCULATION						
Areas:	**CN**	**Description**				
13.5 ac	93	Load out Facility/Access Ramp				
13.5 ac	79	Undeveloped				

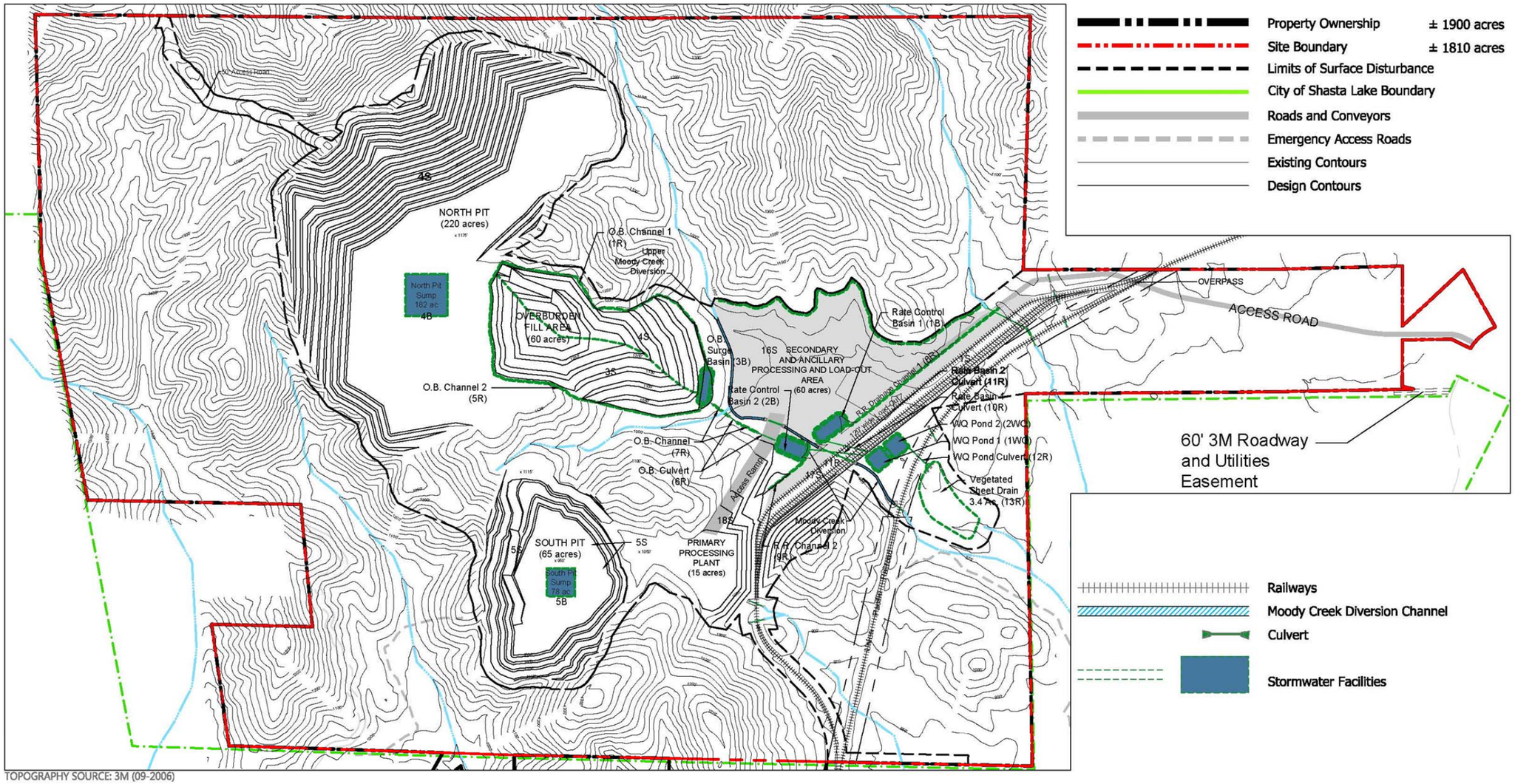
Notes: CN = Curve Number
P-24 = Total rainfall from 25-yr 24-hr storm
R-24 = Inches of rainfall that will runoff
V-24 = Volume of runoff from a 25-yr 24-hr storm
Tc = Time of concentration

TABLE 2
STORMWATER SUMMARY

		Surface Runoff (AF)			Flow Rate (cfs)				Maximum Flow Velocity (ft/sec)			Average Depth in Culvert or Channel (ft)			Feature	Nominal Size	Description
		20-yr, 1-hr	*25-yr, 24-hr*	*100-yr, 24-hr*	*20-yr, 1-hr*	*25-yr, 24-hr*	*100-yr, 24-hr*	*Capacity*	*20-yr, 1-hr*	*25-yr, 24-hr*	*100-yr, 24-hr*	*20-yr, 1-hr*	*25-yr, 24-hr*	*100-yr, 24-hr*			
PIT RUNOFF & STORAGE																	
North Pit	6S		182.1	234.5		562.5	718.6									263 acres	Watershed area of North Pit
South Pit (including Primary Processing Area)	5S		78.2	100.7		241.7	308.8									113 acres	Watershed area of South Pit and the Primary Processing Plant Area
North Pit Basin	4B															182.1 ac-ft, 400'x400'x50' (depth)	Stormwater retention basin
Pumped to Overburden Channel 1 or 2 (1R or 5R, respectively).																	
South Pit Basin	5B															78.2 ac-ft, 260'x260'x50' (depth)	Stormwater retention basin
Pumped to Overburden Surge Basin (3B) or Rate Control Basin 2 (2B).																	
OVERBURDEN RUNOFF																	
Overburden Stockpile 2	3S		11.6	15.1		34.1	44.2									17.8 acres	South side of Overburden Pile
Overburden Channel 2	5R	1.661	11.6	15.1	28.04	34.1	44.18	156.57	6.27	6.6	7.06	0.92	1.01	1.14	Overburden pile South perimeter Channel	2' deep, 2' bottom width, 3:1 side slopes	Collects water at toe of overburden slope and directs runoff to overburden (OVB) pond.
					27.46	33.52	43.5										
Overburden Stockpile 1	4S		12.4	16.2		36.6	47.4									19.1 acres	North side of Overburden Pile
Overburden Channel 1	1R	1.782	12.4	16.2	30.09	36.59	47.41	160.08	6.5	6.85	7.32	0.94	1.04	1.17	Overburden pile North perimeter Channel	2' deep, 2' bottom width, 3:1 side slopes	Collects water at toe of overburden slope and directs runoff to overburden (OVB) pond.
					29.65	36.19	46.93										
Overburden Surge Basin	3B															8.092 ac-ft, 410'(L)x150'(w)x10'(d) (3:1 side slopes)	Surge basin
Overburden Culvert	6R	3.443	24.05	31.4	53.88	66.51	86.86	102.19	14.65	15.39	16.23	1.55	1.76	2.12	Culvert from OVB Pond	36" diameter	Directs water from overburden pond to rate control pond
					53.86	66.49	86.83										
Overburden Channel	7R	3.443	24.05	31.4	53.86	66.49	86.83	187.63	4.15	4.38	4.68	1.77	1.94	2.17	Channel from OVB pond	3' deep, 2' bottom width, 3:1 side slopes	Directs water from overburden pond to rate control pond
To Rate Control Basin 1 or 2 (1B or 2B, respectively)					53.7	66.37	86.7										

		Surface Runoff (AF)			Flow Rate (cfs)				Maximum Flow Velocity (ft/sec)			Average Depth in Culvert or Channel (ft)			Feature	Nominal Size	Description
		20-yr, 1-hr	*25-yr, 24-hr*	*100-yr, 24-hr*	*20-yr, 1-hr*	*25-yr, 24-hr*	*100-yr, 24-hr*	*Capacity*	*20-yr, 1-hr*	*25-yr, 24-hr*	*100-yr, 24-hr*	*20-yr, 1-hr*	*25-yr, 24-hr*	*100-yr, 24-hr*			
NORTH AREA																	
Northeast Loading & Plant Area	1S		11.6	15		35.8	45.8									17 acres	Watershed area of NE Plant and Loading facilities
RR Channel 1	8R	1.901	11.6	15	31.36	35.76	45.85	85.3	2.75	2.83	3.02	1.6	1.68	1.87	Railroad/Loading Area North Channel	2.5' deep, 2' bottom width, 3:1 side slopes	Directs water from railroad/loading area to rate control pond
					29.83	33.38	43.11										
Plant Area	16S		26.1	34.3		79.4	104.1									42 acres	Watershed area of main Plant
Rate Control Basin 1	1B															17.6 ac-ft, 420'(L)x190'(w)x6'(d) (3:1 slopes)(this number assumes 7R is routed to 1B)	Rate control basin
Rate Basin 1 Culvert	10R	8.596	61.7	80.7	137.55	170.61	224.29	316	24.27	25.63	27.29	1.85	2.09	2.49	Culvert from Rate Control basin 1	48" diameter	Directs water from Rate Control basin 1 under the railroad tracks and to WQ basin 1
To 1WQ					137.49	170.57	224.25										
SOUTH AREA																	
Southwest Loading Area	17S		9.2	11.9		27.2	34.9									13.5 acres	Watershed of loading and railroad facilities south of Moody Creek.
RR Channel 2	9R	1.51	9.2	11.9	24	27.19	34.85	85.51	2.61	2.69	2.87	1.44	1.53	1.7	Railroad/Loading Area South Channel	2.5' deep, 2' bottom width, 3:1 side slopes	Directs water from railroad/loading area to rate control pond
					23.87	27.06	34.69										
Access Ramp	18S		7.3	9.9		20.2	27.6									13.5 acres	Watershed containing main ramp for "primary processing" plant located east of south pit. Also included is some un-touched vegetated areas.
Rate Control Basin 2	2B															6.156 ac-ft, 320'(L)x150'(w)x6'(d) (3:1 side slopes)(not assuming 7R Routing)	Rate control basin
Rate Basin 2 Culvert	11R	2.117	16.5	21.8	30.63	42.5	56.96	66.54	5.18	5.61	5.95	1.9	2.32	2.84	Culvert from Rate Control basin 2	48" diameter	Directs water from Rate Control basin 2 under the railroad tracks and to WQ basin 1
To 1WQ					30.49	42.39	56.8										
WATER QUALITY DISCHARGE																	
Water Quality Pond 1	1WQ															5.3 ac-ft, 250'x250'x4'(d)	Stormwater sediment removal basin
Water Quality Pond 2	2WQ															5.3 ac-ft, 250'x250'x4'(d)	Stormwater sediment removal basin

		Surface Runoff (AF)			Flow Rate (cfs)				Maximum Flow Velocity (ft/sec)			Average Depth in Culvert or Channel (ft)			Feature	Nominal Size	Description
		20-yr, 1-hr	*25-yr, 24-hr*	*100-yr, 24-hr*	*20-yr, 1-hr*	*25-yr, 24-hr*	*100-yr, 24-hr*	*Capacity*	*20-yr, 1-hr*	*25-yr, 24-hr*	*100-yr, 24-hr*	*20-yr, 1-hr*	*25-yr, 24-hr*	*100-yr, 24-hr*			
Water Quality Pond Culvert	12R	10.713	78.2	102.4	152.21	201.2	266.74	399.01	18.95	20.36	21.77	2.14	2.51	2.99	Culvert from WQ basin 2	60" diameter	Directs water from WQ basin 2 under the existing railroad tracks and to the vegetated sheet drain
					152.17	201.18	266.71										
Sheet Drain	13R	10.713	78.2	102.4	152.17	201.18	266.71	1806.13	2.22	2.49	2.79	0.23	0.27	0.32	Vegetated Sheet Drain	300' wide, 12" deep, 490' long	Filters the runoff from the site before it reaches the outfall
To OUT					150.78	200.33	265.78										
Output	OUT				150.78	200.33	265.78										



TOPOGRAPHY SOURCE: 3M (09-2006)

NOTES:

1. Contour Interval: 25'-0"
2. All facilities and configurations approximate only. In particular, surface disturbance boundaries are not expected to be identical to those depicted, although total acreage to be disturbed and reclaimed should be similar to depicted. While this plan reflects best available data, development may vary due to actual geologic conditions encountered, engineering and other considerations.

500' 0 1,000'

Scale: 1" = 1,000 Feet

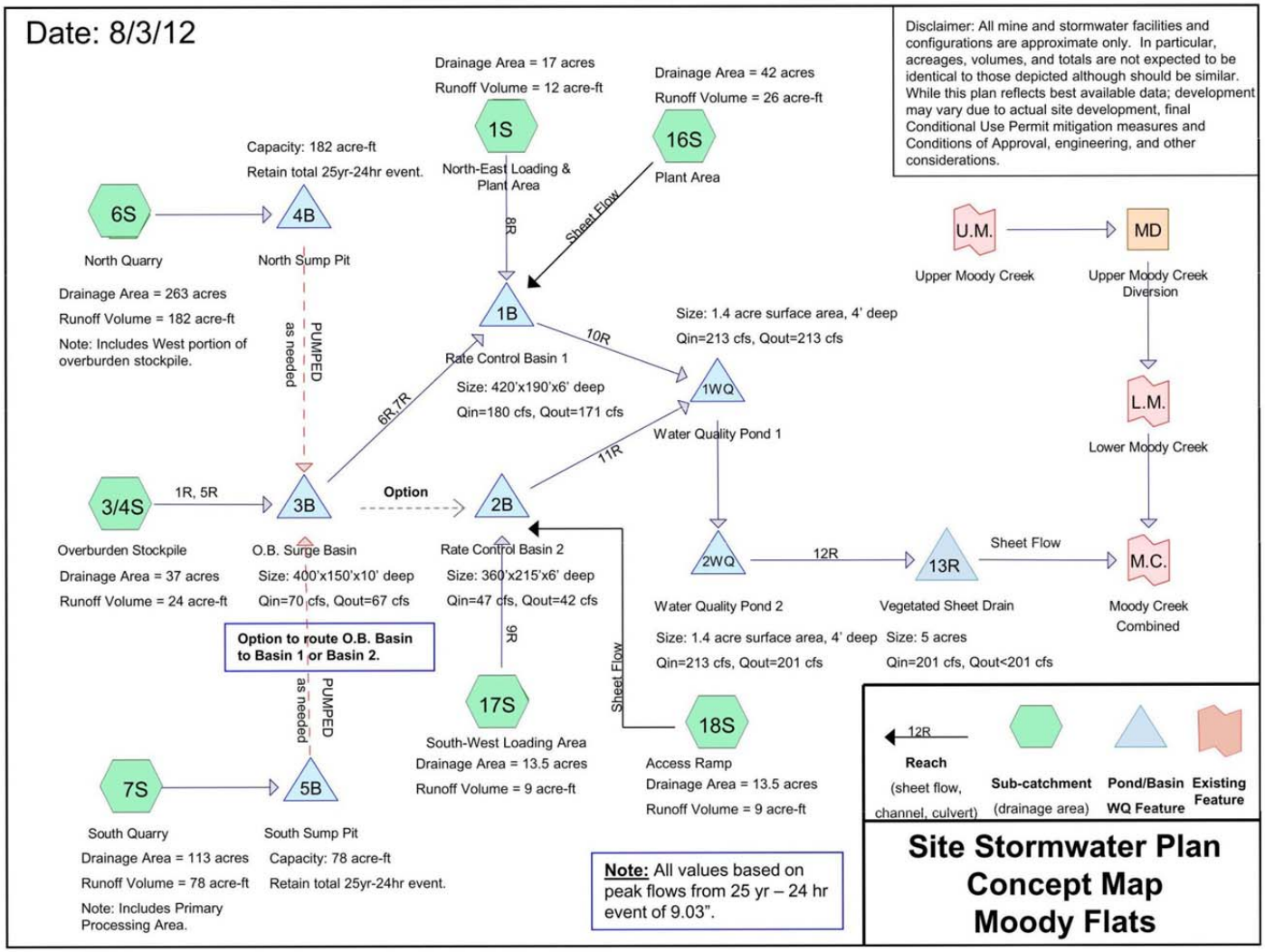
NORTH

BENCHMARK RESOURCES

Site Plan

MOODY FLATS QUARRY

Figure 2



SOURCE: HydroCAD Modeling Conducted by Trevor Crawford, 3M Facilities Engineering

Stormwater Control and Facilities Flowchart
MOODY FLATS QUARRY
Figure 3

BENCHMARK RESOURCES

In general, stormwater from the North Pit (6S) and the South Pit (7S) will be retained within sumps within each pit (i.e. the North Pit Sump-4B and the South Pit Sump-5B, respectively). Runoff from the Primary Processing Plant (5S) will also be directed into the South Pit Sump (5B). These sumps will change in size and location as each pit is developed. For example, initially the sumps will need to be constructed at the downslope edge of the pit. Once the pits are larger, the sumps will be relocated within the lowest part of the pits. Water from the sumps within the mine pits will be pumped out of the pits as needed to maintain adequate storage within the sumps. The sumps, however, will be over-sized so that they also provide storage to meet the Project water needs, as discussed further below.

The excess water in the North Pit Sump (4B) will be pumped to one of the Overburden Channels (1R or 5R), which will then direct the water to the Overburden Surge Basin (3B). Excess water from the South Pit Sump (5B) will be pumped either to the Overburden Surge Basin (3B) or to Rate Control Basin 2 (2B). It is important to note that the pit sumps will only be pumped out when there is minimal or no flow within the other stormwater conveyances, for example, between storms or at the end of the wet season. The pit sumps will not contribute to peak storm flows within the rest of the system. In this way, the stormwater system will reduce the peak storm flows from the site.

Runoff from the Overburden Fill Area (3S and 4S) will be collected by Overburden Channel 1 (1R), along the north side of the Overburden Fill Area, and by Overburden Channel 2 (5R), along the south side of the Overburden Fill Area. The two overburden channels are routed to the Overburden Surge Basin (3B). From the Overburden Surge Basin (3B), stormwater is routed to Rate Control Basin 2 (2B) by the Overburden Channel (7R) and Overburden Culvert (6R). The culvert is used to direct the stormwater under a local drainage and the Access Ramp. It is also anticipated that the system will include an option to route water from the Overburden Surge Basin to Rate Control Basin 1 (1B), depending on final site configuration and the sequencing of various Project components.

Runoff from the Primary Processing Area and the Access Ramp (18S) will move as sheet flow downslope to Rate Control Basin 2 (2B). Runoff from the Southwest Loading Area (17S) will be directed to Rate Control Basin 2 (2B) by Railroad Channel 2 (9R), once the railroad spur and load-out area is constructed. From Rate Control Basin 2 (2B), stormwater is routed to Water Quality Pond 1 (1WQ) through the Rate Basin 2 Culvert (11R).

Runoff from the Secondary and Ancillary Processing Area (16S) will move as sheet flow to Rate Control Basin 1 (1B). Runoff from the Northeast Loading and Plant Area (1S) will be collected by Railroad Drainage Channel 1 (8R) and directed to Rate Control Basin 1 (1B), once the railroad spur and load-out area is constructed. From Rate Control Basin 1 (1B), stormwater is routed to Water Quality Pond 1 (1WQ) through the Rate Basin 1 Culvert (10R).

Water Quality Pond 1 (1WQ) is designed to provide sufficient retention time to meet the size requirements specified in the SWRCB NPDES General Permit for Storm Water Discharges Associated with Construction and Land Disturbance Activities, Appendix D, for removal of

suspended sediment for the entire stormwater system. However, to provide redundancy and additional improvement in stormwater quality, a second stormwater settling pond (Water Quality Pond 2-2WQ) has been included in the system. Both Water Quality Ponds have the same dimensions and capacities. Therefore, the Water Quality Ponds provide twice the retention time recommended by the SWRCB.

Despite the fact that the Water Quality Ponds provide twice the recommended retention time for removal of sediment from stormwater, an additional measure of protection has also been added. Stormwater leaving Water Quality Pond 2 (2WQ) is directed by the Water Quality Pond Culvert (12R) to a 3.4-acre Vegetated Sheet Drain (13R). The Vegetated Sheet Drain (13R) will act to further entrain and remove any suspended particles in the storm water and to reduce, or attenuate, the rate of water flow prior to discharge to a natural drainage that is tributary to Moody Creek.

3.0 STORMWATER MODELING

As discussed in the Stormwater, Erosion Control, and Drainage Plan (May 2010), stormwater modeling has been conducted using the HydroCAD model utilizing SCS TR-20 Methodology. The HydroCAD model was used for the detailed site-wide analysis because of the site complexity and the required routing of stormwater through the proposed basins. The HydroCAD modeling has been updated for this Addendum to address comments received on the initial modeling results and to better demonstrate evaluation of the various regulatory criteria listed in Section 1.0, above. Attachment A of this document includes the design assumptions, parameters, and modeling results generated in HydroCAD.

To address the range of regulatory requirements and guidelines identified in Section 1.0 of this document, stormwater modeling was conducted for the following storm events using the parameters identified in Table 1:

- 20-year return period, 1-hour duration;
- 25-year return period, 24-hour duration; and
- 100-year return period, 24-hour duration.

The rainfall quantities and intensities for each of these design storm events are identified in Attachment A. Table 2 summarizes the results of the HydroCAD modeling for each component of the stormwater system and each different storm event. The model output in Attachment A provides graphical representations of the runoff hydrographs for each conveyance feature and the available capacity of channels and culverts.

As documented in Table 2 and Attachment A, the surface runoff (in acre-feet, or AF), flow rates (in cubic feet per second, or cfs), and maximum flow velocities (in feet per second, or ft/sec) for the 20-year, 1-hour storm event is always less than that for the larger storm events. Based on the regulatory criteria and guidelines identified in Section 1.0, above, the 25-year, 24-hour storm was selected as the design storm event. However, to provide a conservative assessment

of the adequacy of the stormwater system, the ability to safely convey the runoff from a 100-year, 24-hour storm was also evaluated. Furthermore, the modeling results are based on an assumption that, at the time a storm event begins, each of the basins (e.g. Overburden Surge Basin, Rate Control Basins, and Water Quality Ponds) are at capacity and begin to discharge at soon as runoff begins. This is an overly conservative supposition because it assumes that the basins do not provide any storage capacity or attenuation of the stormwater flows. As designed, the various basins and ponds will provide sufficient volume to retain approximately 35 percent of the design storm runoff and 25 percent of the runoff from the 100-year, 24-hour storm event. Therefore, the basins and ponds will substantially attenuate the peak flood flows and delay the timing of the discharge at the end of the system below the Vegetated Sheet Drain. As a result of the assumptions used, the updated HydroCAD modeling results in a substantially over-sized stormwater management system, in terms of both storage and conveyance capacity.

As identified in Table 2 and presented in Attachment A, the stormwater conveyance features, the Water Quality Ponds, and the Vegetated Sheet Drain are all capable of handling not only the runoff from the design storm event but also the runoff from the 100-year, 24-hour storm event with adequate capacity and at flow rates and velocities that meet applicable criteria.

The storm water control system also acts to attenuate flood flows. As described in the Stormwater, Erosion Control, and Drainage Plan (May 2010), the current peak discharge for a 25-year, 24-hour storm from the site is estimated to be approximately 633 cubic feet per second (cfs). The surge basin and rate control basins reduce the peak flow entering the Water Quality Ponds to approximately 213 cfs for the 25-year, 24-hour storm event. The peak flow rate at the end of the Vegetated Sheet Drain is further reduced to approximately 200 cfs. For the 100-year, 24-hour storm, the peak flow entering the Water Quality Ponds is approximately 281 cfs and the peak flow rate leaving the Vegetated Sheet Drain is approximately 266 cfs. Therefore, the proposed development of the property will reduce flood flows from the Project site compared to existing baseline conditions.

4.0 COORDINATION OF STORMWATER RUNOFF SYSTEM WITH PROJECT WATER SUPPLY

Initially, small disturbance areas, relative to the full Project scope, will occur in the South Pit area, the Primary Processing Plant area, and the access routes. A stormwater retention basin will be constructed near the base of the South Pit to collect stormwater runoff from the South Pit area. Once the South Pit is enlarged, the South Pit Sump (5B) will be relocated within the pit. One or both of the rate control basins, the water quality ponds, and the Vegetated Sheet Drain will be constructed at the beginning of the Project. Disturbance in the North Pit area, most of the Overburden Stockpile, and the railroad load-out area will not occur for 5 to 15 years after the Project is initiated.

During the initial 5 to 15 year operating period, the anticipated water demand for the Project is estimated to be 65 acre-feet per year, as described above. This water demand will be supplied from the initial stormwater system.

Table 2 includes a column that describes the nominal size or dimensions for the stormwater conveyance features, sumps, ponds, and basins. While the dimensions for the conveyances (channels and culverts) are considered to be representative of the sizes that will eventually be constructed in the field, several of the sumps and basins will be enlarged to provide additional storage for the quarry water supply.

For example, the nominal dimensions of the South Pit Sump (5B) are 250 feet by 250 feet, which is approximately 1.5 acres with a capacity of 78.2 acre-feet. To meet the water supply demand, the dimensions of the South Pit Sump (5B) will be expanded to approximately 350 feet by 350 feet, which will double the capacity of the sump. This increased area for the sump is very small compared to the overall size of the 65-acre South Pit area and can easily be accommodated within the planned disturbance area. This minor adjustment in the dimensions of the South Pit Sump (5B) will allow a full year of Project water supply to be retained within the sump, while leaving more than enough capacity to address the runoff from the design storm event.

As production capacity begins to increase, the water demand will increase proportionately. The additional supply be met by constructing a stormwater retention basin near the base of the North Pit to collect stormwater runoff from the North Pit area. AS with the South Pit, once the North Pit is enlarged, the North Pit Sump (4B) will be relocated within the pit. The nominal size of the North Pit Sump (4B), as shown on Table 2, is 400 feet by 400 feet, or approximately 3.7 acres with a capacity of 182 acre-feet. To meet the additional water supply demand, which will eventually be 195 acre-feet from the North Pit Sump (4B), the perimeter of the sump will be expanded to approximately 600 feet by 600 feet, or approximately 8.25 acres. This minor increase in the sump dimensions can easily be accommodated within the 220-acre North Pit area.

As described in Section 1.0, above, at this time, all mine facilities, stormwater mechanisms, and erosion control measures are approximate and/or conceptual, pending environmental review of the Project and final approval by the County. However, the approach described above demonstrates that the stormwater system can be feasibly constructed and managed to provide adequate water supply for the Project while meeting applicable regulatory requirements and guidelines. As described in the SB 610 Water Supply Assessment (September 2011), there will be adequate runoff during single and multiple dry-year conditions to meet the Project demand.

5.0 EVALUATION OF CEQA CRITERIA

As discussed in Section 1.0, above, Appendix G of the CEQA Guidelines includes 10 thresholds of significance with respect to Hydrology and Water Quality. Three of these thresholds relate to drainage, erosion, and flooding. These three criteria address whether a proposed project would:

- Substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river, in a manner which would result in substantial erosion or siltation on- or off-site;
- Substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river, or substantially increase the rate or amount of surface runoff in a manner which would result in flooding on- or off-site; or
- Create or contribute runoff water which would exceed the capacity of existing or planned stormwater drainage systems, cause flooding on- and off-site, or provide substantial additional sources of polluted runoff.

Each of these criteria is discussed below with respect to the Stormwater, Erosion Control, and Drainage System for the Project.

1. Would the Project substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river, in a manner which would result in substantial erosion or siltation on- or off-site?

The Project would substantially alter existing drainage patterns at the site. However, the Project is designed to prevent erosion and siltation by complying with County grading and drainage requirements. In addition, as discussed above, the stormwater system will reduce stormwater flow rates and volumes from the Project site, thus reducing the potential for erosion and siltation. Furthermore, the stormwater system includes redundant sediment removal capabilities with two Water Quality Ponds and the Vegetated Sheet Drain.

2. Would the Project substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river, or substantially increase the rate or amount of surface runoff in a manner which would result in flooding on- or off-site

While the Project would substantially alter the existing drainage pattern of the site, the stormwater modeling results demonstrate that both the rate and amount of surface runoff from the site would be reduced. As discussed above, the current peak discharge for a 25-year, 24-hour storm from the site is estimated to be approximately 633 cfs. The stormwater system would reduce the peak discharge for the same storm event to about 200 cfs, which is a substantial reduction. Furthermore, by retaining sufficient water to meet the Project's needs, the annual runoff volumes will be reduced initially by 65 acre-feet per year and ultimately by 260 acre-feet per year. Current runoff from the Project site is estimated to be 800 acre-feet per year (SB 610 Water Supply Assessment, September 2011).

3. Would the Project create or contribute runoff water which would exceed the capacity of existing or planned stormwater drainage systems, cause flooding on- and off-site, or provide substantial additional sources of polluted runoff?

As described in Section 3.0, above, and shown on Table 2 and in Attachment A, the stormwater system has more than adequate capacity to control runoff from the Project site. The system would reduce runoff rates and volumes, thus reducing potential sources of polluted runoff. In addition, the redundant Water Quality Ponds and the Vegetated Sheet Drain will provide reduction of suspended sediment in the final discharge beyond that recommended by the SWRCB.

Based on the discussion above, the Project will have a LESS THAN SIGNIFICANT impact with respect to the three CEQA Appendix G Criteria related to flooding and stormwater. This finding assumes that the Project Applicant will be required to:

1. Submit engineered design plans to Shasta County for the final Stormwater, Erosion Control, and Drainage Plan that comply with the County's grading and drainage requirements. Issuance of a grading permit from the County will verify compliance with this requirement;
2. Submit a Notice of Intent to prepare a Stormwater Pollution Prevention Plan (SWPPP) to the SWRCB after Project approval, but prior to any construction activities. A copy of the SWPPP should be provided to the Central Valley RWQCB (Redding Office) and the County;
3. Implement appropriate Best Management Practices (BMPs) as identified in the SWPPP; and
4. Submit annual inspection reports as required under the SWPPP to both RWQCB and the County. These reports will verify the Applicant's compliance with the conditions in the SWPPP and the effectiveness of any BMPs that are installed.

These conditions will ensure that the impacts related to flooding and stormwater remain LESS THAN SIGNIFICANT throughout the life of the Project.

ATTACHMENT A
MOODY FLATS STORMWATER PLAN

Time span=0.00-48.00 hrs, dt=0.01 hrs, 4801 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Reach 1R: OB Channel 1 Avg. Depth=0.94' Max Vel=6.50 fps Inflow=30.09 cfs 1.782 af
n=0.050 L=1,737.0' S=0.1007 '/' Capacity=160.08 cfs Outflow=29.65 cfs 1.782 af

Reach 5R: OB Channel 2 Avg. Depth=0.92' Max Vel=6.27 fps Inflow=28.04 cfs 1.661 af
n=0.050 L=2,075.0' S=0.0964 '/' Capacity=156.57 cfs Outflow=27.46 cfs 1.661 af

Reach 6R: OB CULV Avg. Depth=1.55' Max Vel=14.65 fps Inflow=53.88 cfs 3.443 af
36.0" Round Pipe n=0.012 L=400.0' S=0.0200 '/' Capacity=102.19 cfs Outflow=53.86 cfs 3.443 af

Reach 7R: OB Channel Avg. Depth=1.77' Max Vel=4.15 fps Inflow=53.86 cfs 3.443 af
n=0.050 L=400.0' S=0.0200 '/' Capacity=187.63 cfs Outflow=53.70 cfs 3.443 af

Reach 8R: RR Channel 1 Avg. Depth=1.60' Max Vel=2.75 fps Inflow=31.36 cfs 1.901 af
n=0.050 L=2,010.0' S=0.0100 '/' Capacity=85.30 cfs Outflow=29.83 cfs 1.901 af

Reach 9R: RR Channel 2 Avg. Depth=1.44' Max Vel=2.61 fps Inflow=24.00 cfs 1.510 af
n=0.050 L=460.0' S=0.0100 '/' Capacity=85.51 cfs Outflow=23.87 cfs 1.510 af

Reach 10R: Rate Basin 1 Culv Avg. Depth=1.85' Max Vel=24.27 fps Inflow=137.55 cfs 8.596 af
48.0" Round Pipe n=0.012 L=485.0' S=0.0412 '/' Capacity=316.00 cfs Outflow=137.49 cfs 8.596 af

Reach 11R: Rate Basin 2 Culv Avg. Depth=1.90' Max Vel=5.18 fps Inflow=30.63 cfs 2.117 af
48.0" Round Pipe n=0.050 L=630.0' S=0.0317 '/' Capacity=66.54 cfs Outflow=30.49 cfs 2.117 af

Reach 12R: WQ Pond Culv Avg. Depth=2.14' Max Vel=18.95 fps Inflow=152.21 cfs 10.713 af
60.0" Round Pipe n=0.012 L=300.0' S=0.0200 '/' Capacity=399.01 cfs Outflow=152.17 cfs 10.713 af

Reach 13R: Sheet Drain Avg. Depth=0.23' Max Vel=2.22 fps Inflow=152.17 cfs 10.713 af
n=0.050 L=490.0' S=0.0408 '/' Capacity=1,806.13 cfs Outflow=150.78 cfs 10.713 af

Summary for Reach 1R: OB Channel 1

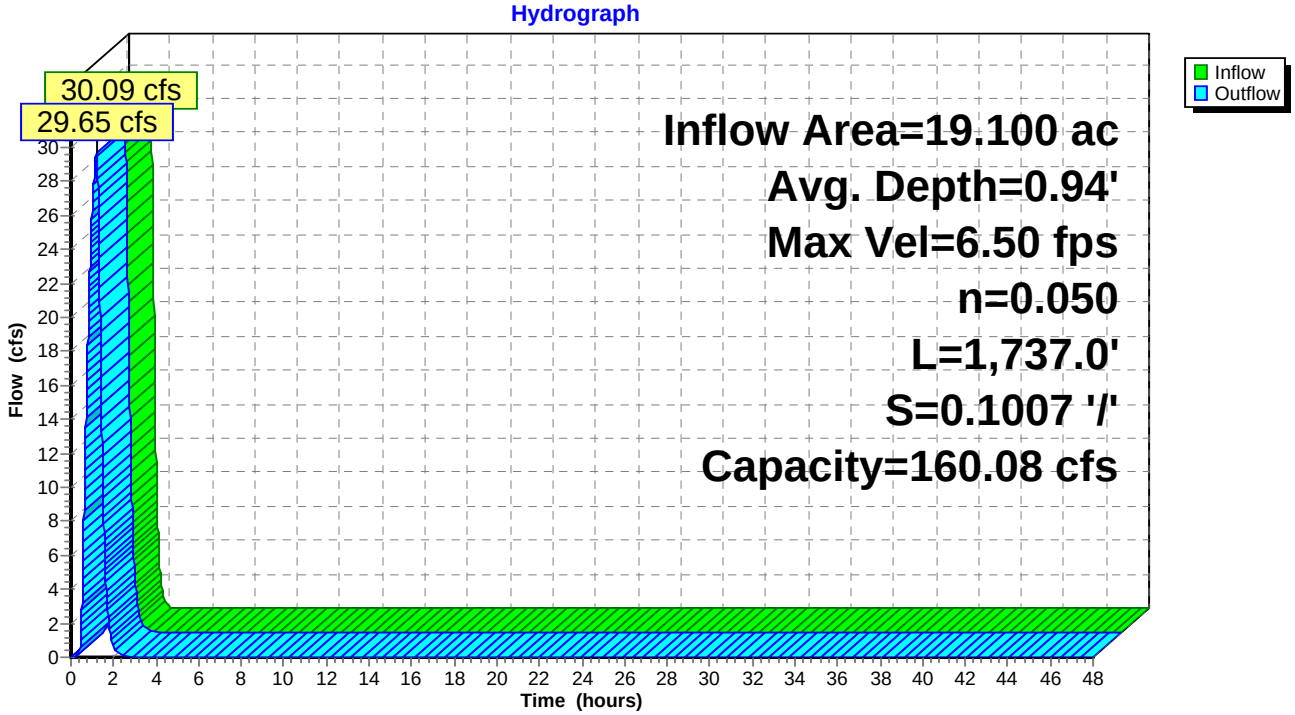
Inflow Area = 19.100 ac, 0.00% Impervious, Inflow Depth = 1.12" for 20 yr- 1 hr event
Inflow = 30.09 cfs @ 1.08 hrs, Volume= 1.782 af
Outflow = 29.65 cfs @ 1.19 hrs, Volume= 1.782 af, Atten= 1%, Lag= 6.6 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Max. Velocity= 6.50 fps, Min. Travel Time= 4.5 min
Avg. Velocity = 1.69 fps, Avg. Travel Time= 17.1 min

Peak Storage= 7,922 cf @ 1.11 hrs, Average Depth at Peak Storage= 0.94'
Bank-Full Depth= 2.00', Capacity at Bank-Full= 160.08 cfs

2.00' x 2.00' deep channel, n= 0.050 Mountain streams w/large boulders
Side Slope Z-value= 3.0 '/' Top Width= 14.00'
Length= 1,737.0' Slope= 0.1007 '/'
Inlet Invert= 2,725.00', Outlet Invert= 2,550.00'

Reach 1R: OB Channel 1



Summary for Reach 5R: OB Channel 2

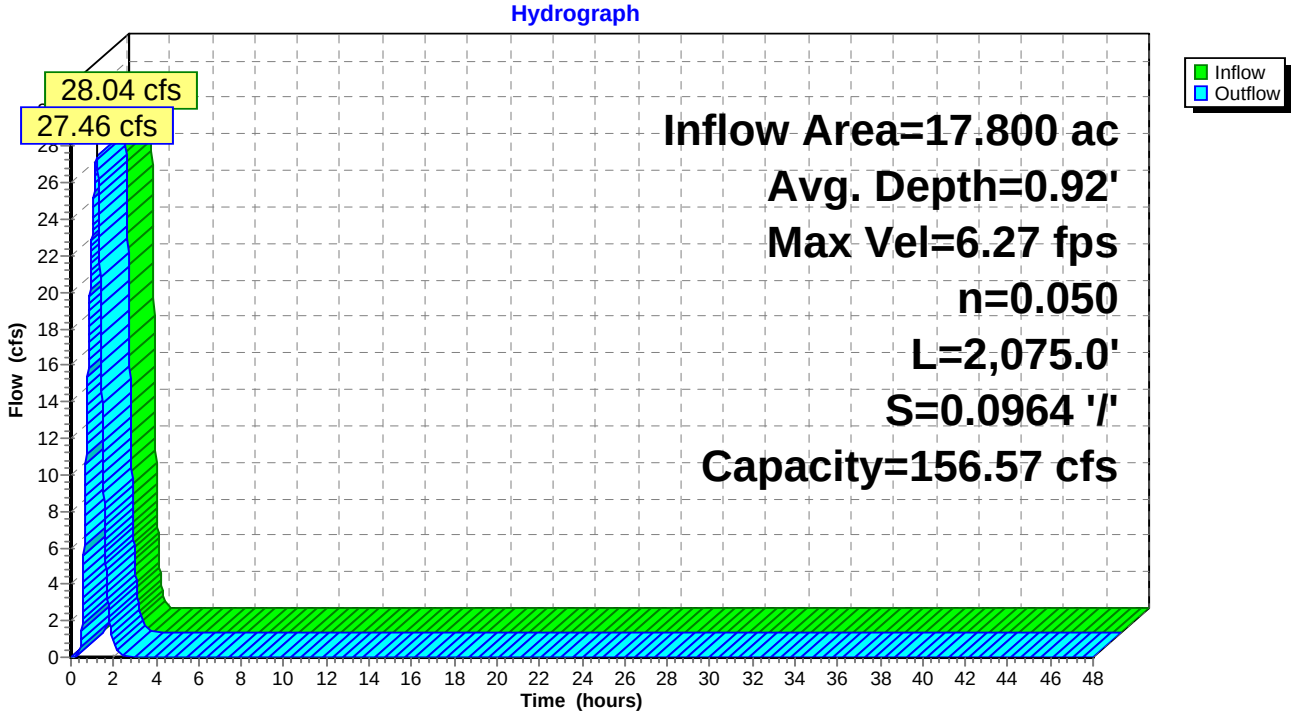
Inflow Area = 17.800 ac, 0.00% Impervious, Inflow Depth = 1.12" for 20 yr- 1 hr event
Inflow = 28.04 cfs @ 1.08 hrs, Volume= 1.661 af
Outflow = 27.46 cfs @ 1.21 hrs, Volume= 1.661 af, Atten= 2%, Lag= 8.1 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Max. Velocity= 6.27 fps, Min. Travel Time= 5.5 min
Avg. Velocity = 1.52 fps, Avg. Travel Time= 22.8 min

Peak Storage= 9,088 cf @ 1.12 hrs, Average Depth at Peak Storage= 0.92'
Bank-Full Depth= 2.00', Capacity at Bank-Full= 156.57 cfs

2.00' x 2.00' deep channel, n= 0.050 Mountain streams w/large boulders
Side Slope Z-value= 3.0 '/' Top Width= 14.00'
Length= 2,075.0' Slope= 0.0964 '/'
Inlet Invert= 2,750.00', Outlet Invert= 2,550.00'

Reach 5R: OB Channel 2



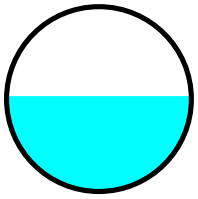
Summary for Reach 6R: OB CULV

Inflow Area = 36.900 ac, 0.00% Impervious, Inflow Depth = 1.12" for 20 yr- 1 hr event
Inflow = 53.88 cfs @ 1.27 hrs, Volume= 3.443 af
Outflow = 53.86 cfs @ 1.29 hrs, Volume= 3.443 af, Atten= 0%, Lag= 0.8 min

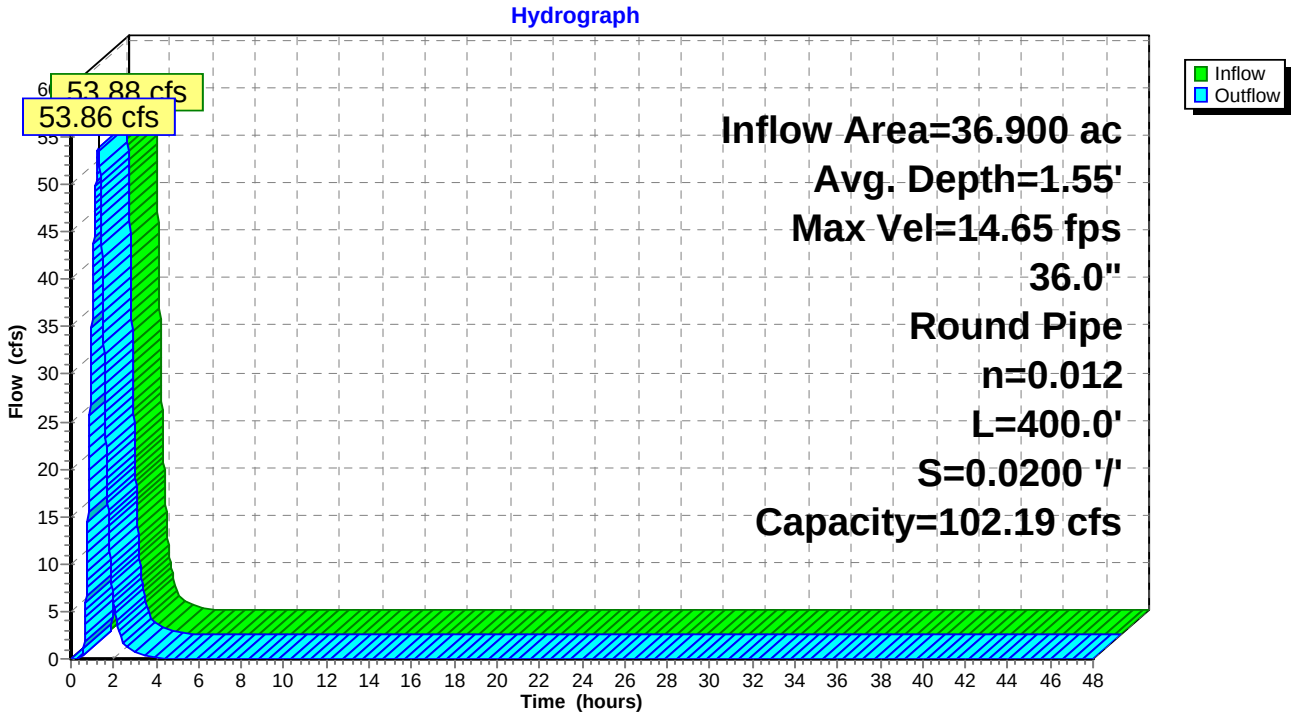
Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Max. Velocity= 14.65 fps, Min. Travel Time= 0.5 min
Avg. Velocity = 3.82 fps, Avg. Travel Time= 1.7 min

Peak Storage= 1,471 cf @ 1.28 hrs, Average Depth at Peak Storage= 1.55'
Bank-Full Depth= 3.00', Capacity at Bank-Full= 102.19 cfs

36.0" Round Pipe
n= 0.012 Concrete pipe, finished
Length= 400.0' Slope= 0.0200 '/'
Inlet Invert= 2,538.00', Outlet Invert= 2,530.00'



Reach 6R: OB CULV



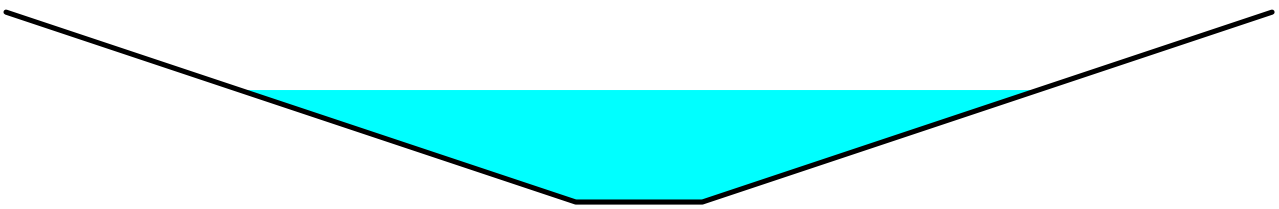
Summary for Reach 7R: OB Channel

Inflow Area = 36.900 ac, 0.00% Impervious, Inflow Depth = 1.12" for 20 yr- 1 hr event
Inflow = 53.86 cfs @ 1.29 hrs, Volume= 3.443 af
Outflow = 53.70 cfs @ 1.33 hrs, Volume= 3.443 af, Atten= 0%, Lag= 2.7 min

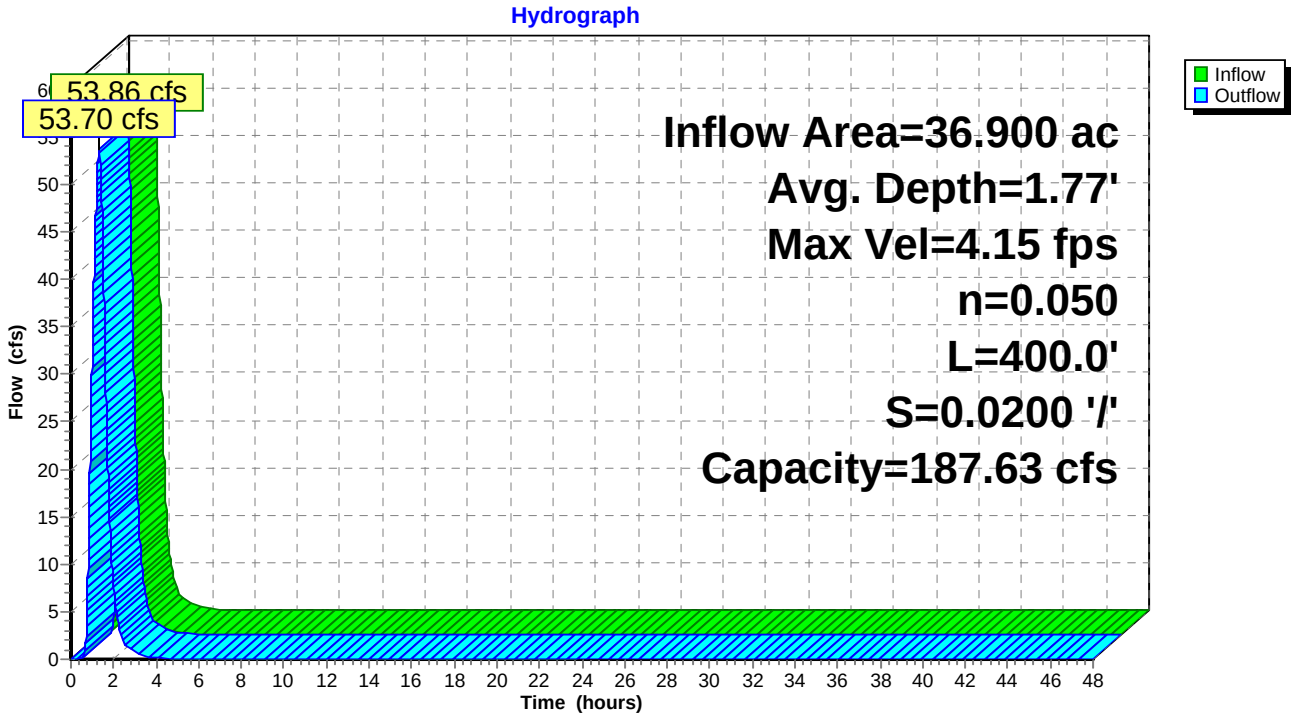
Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Max. Velocity= 4.15 fps, Min. Travel Time= 1.6 min
Avg. Velocity = 1.03 fps, Avg. Travel Time= 6.5 min

Peak Storage= 5,178 cf @ 1.31 hrs, Average Depth at Peak Storage= 1.77'
Bank-Full Depth= 3.00', Capacity at Bank-Full= 187.63 cfs

2.00' x 3.00' deep channel, n= 0.050 Mountain streams w/large boulders
Side Slope Z-value= 3.0 '/' Top Width= 20.00'
Length= 400.0' Slope= 0.0200 '/'
Inlet Invert= 2,530.00', Outlet Invert= 2,522.00'



Reach 7R: OB Channel



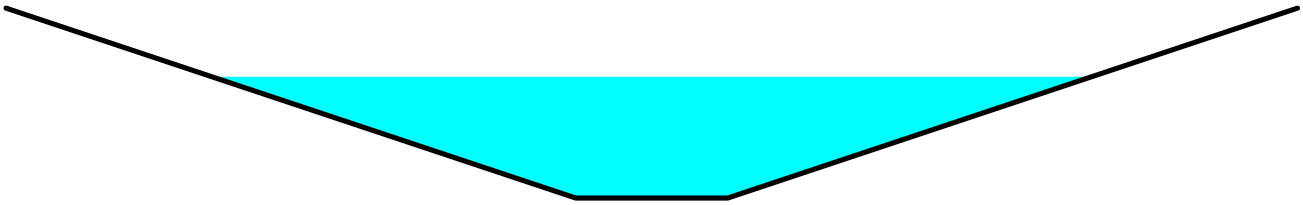
Summary for Reach 8R: RR Channel 1

Inflow Area = 17.000 ac, 0.00% Impervious, Inflow Depth = 1.34" for 20 yr- 1 hr event
Inflow = 31.36 cfs @ 1.01 hrs, Volume= 1.901 af
Outflow = 29.83 cfs @ 1.25 hrs, Volume= 1.901 af, Atten= 5%, Lag= 14.4 min

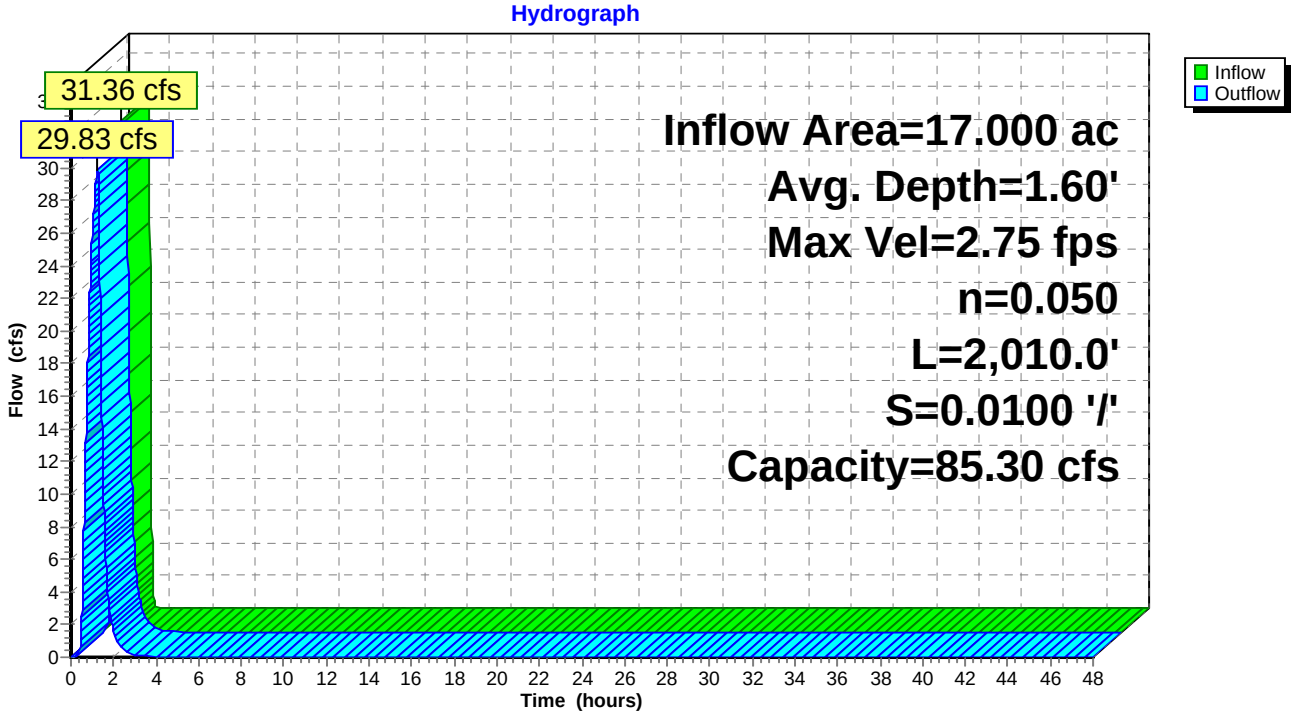
Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Max. Velocity= 2.75 fps, Min. Travel Time= 12.2 min
Avg. Velocity = 0.45 fps, Avg. Travel Time= 74.2 min

Peak Storage= 21,768 cf @ 1.05 hrs, Average Depth at Peak Storage= 1.60'
Bank-Full Depth= 2.50', Capacity at Bank-Full= 85.30 cfs

2.00' x 2.50' deep channel, n= 0.050 Mountain streams w/large boulders
Side Slope Z-value= 3.0 '/' Top Width= 17.00'
Length= 2,010.0' Slope= 0.0100 '/'
Inlet Invert= 136.00', Outlet Invert= 116.00'



Reach 8R: RR Channel 1



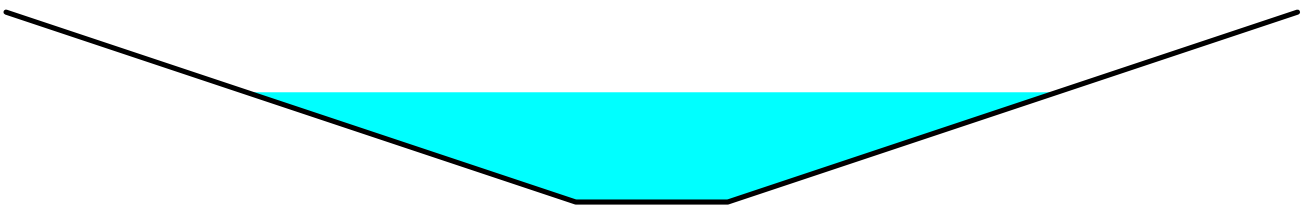
Summary for Reach 9R: RR Channel 2

Inflow Area = 13.500 ac, 0.00% Impervious, Inflow Depth = 1.34" for 20 yr- 1 hr event
Inflow = 24.00 cfs @ 1.04 hrs, Volume= 1.510 af
Outflow = 23.87 cfs @ 1.12 hrs, Volume= 1.510 af, Atten= 1%, Lag= 4.8 min

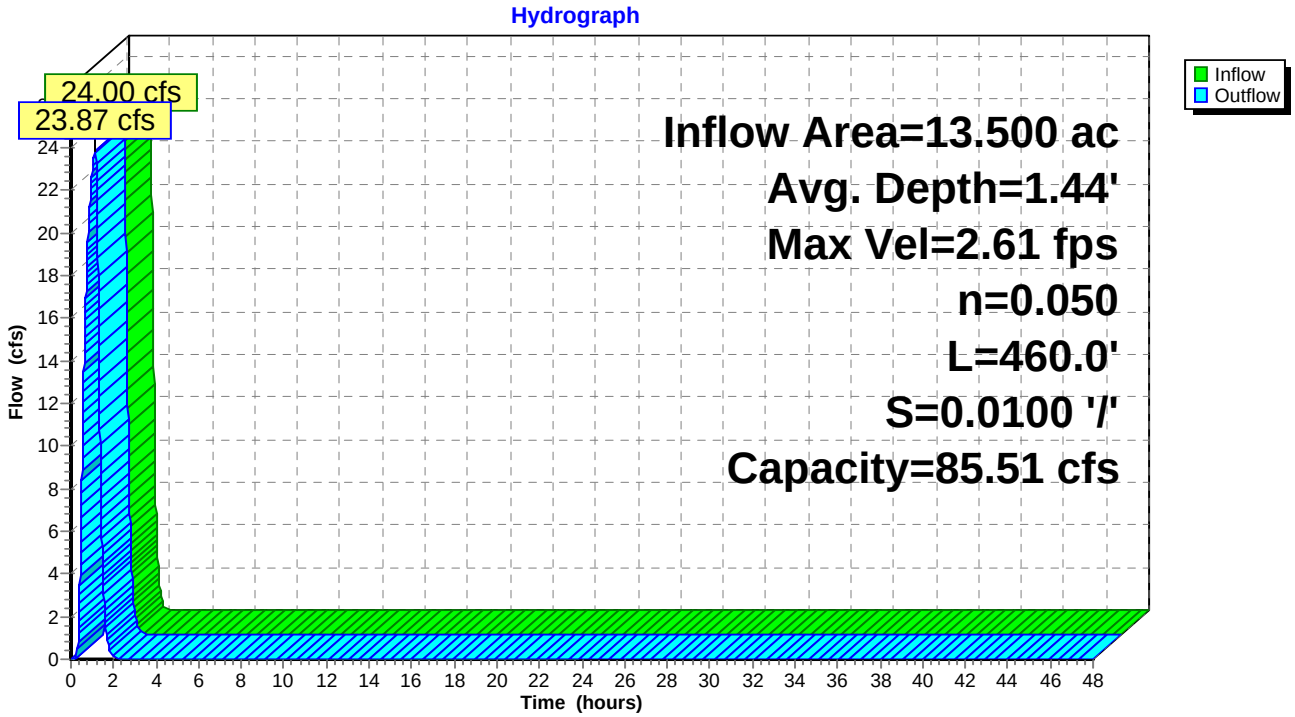
Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Max. Velocity= 2.61 fps, Min. Travel Time= 2.9 min
Avg. Velocity = 0.75 fps, Avg. Travel Time= 10.2 min

Peak Storage= 4,211 cf @ 1.07 hrs, Average Depth at Peak Storage= 1.44'
Bank-Full Depth= 2.50', Capacity at Bank-Full= 85.51 cfs

2.00' x 2.50' deep channel, n= 0.050 Mountain streams w/large boulders
Side Slope Z-value= 3.0 '/' Top Width= 17.00'
Length= 460.0' Slope= 0.0100 '/'
Inlet Invert= 1,000.00', Outlet Invert= 995.40'



Reach 9R: RR Channel 2



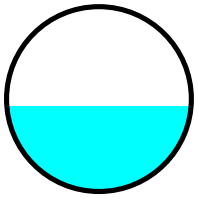
Summary for Reach 10R: Rate Basin 1 Culv

Inflow Area = 95.900 ac, 5.21% Impervious, Inflow Depth = 1.08" for 20 yr- 1 hr event
Inflow = 137.55 cfs @ 1.14 hrs, Volume= 8.596 af
Outflow = 137.49 cfs @ 1.15 hrs, Volume= 8.596 af, Atten= 0%, Lag= 0.6 min

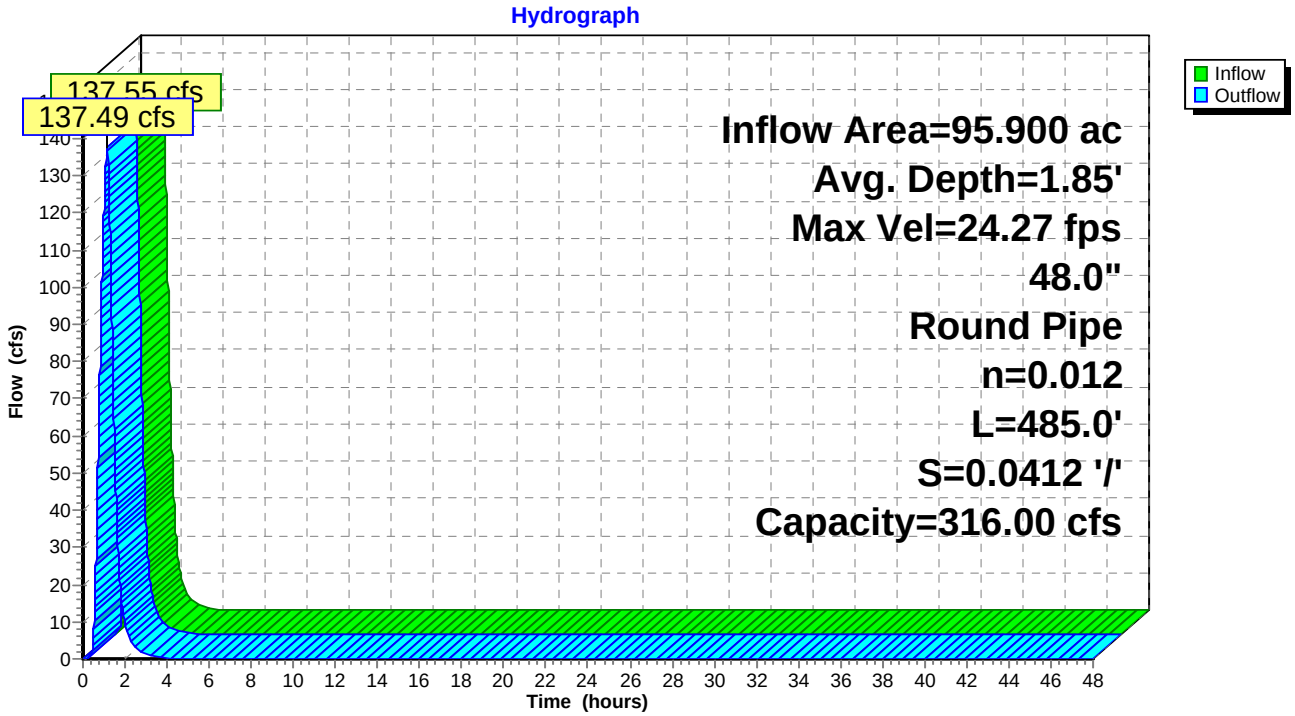
Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Max. Velocity= 24.27 fps, Min. Travel Time= 0.3 min
Avg. Velocity = 4.57 fps, Avg. Travel Time= 1.8 min

Peak Storage= 2,748 cf @ 1.14 hrs, Average Depth at Peak Storage= 1.85'
Bank-Full Depth= 4.00', Capacity at Bank-Full= 316.00 cfs

48.0" Round Pipe
n= 0.012 Concrete pipe, finished
Length= 485.0' Slope= 0.0412 '/'
Inlet Invert= 100.00', Outlet Invert= 80.00'



Reach 10R: Rate Basin 1 Culv



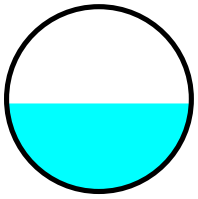
Summary for Reach 11R: Rate Basin 2 Culv

Inflow Area = 27.000 ac, 0.00% Impervious, Inflow Depth = 0.94" for 20 yr- 1 hr event
Inflow = 30.63 cfs @ 1.24 hrs, Volume= 2.117 af
Outflow = 30.49 cfs @ 1.30 hrs, Volume= 2.117 af, Atten= 0%, Lag= 3.5 min

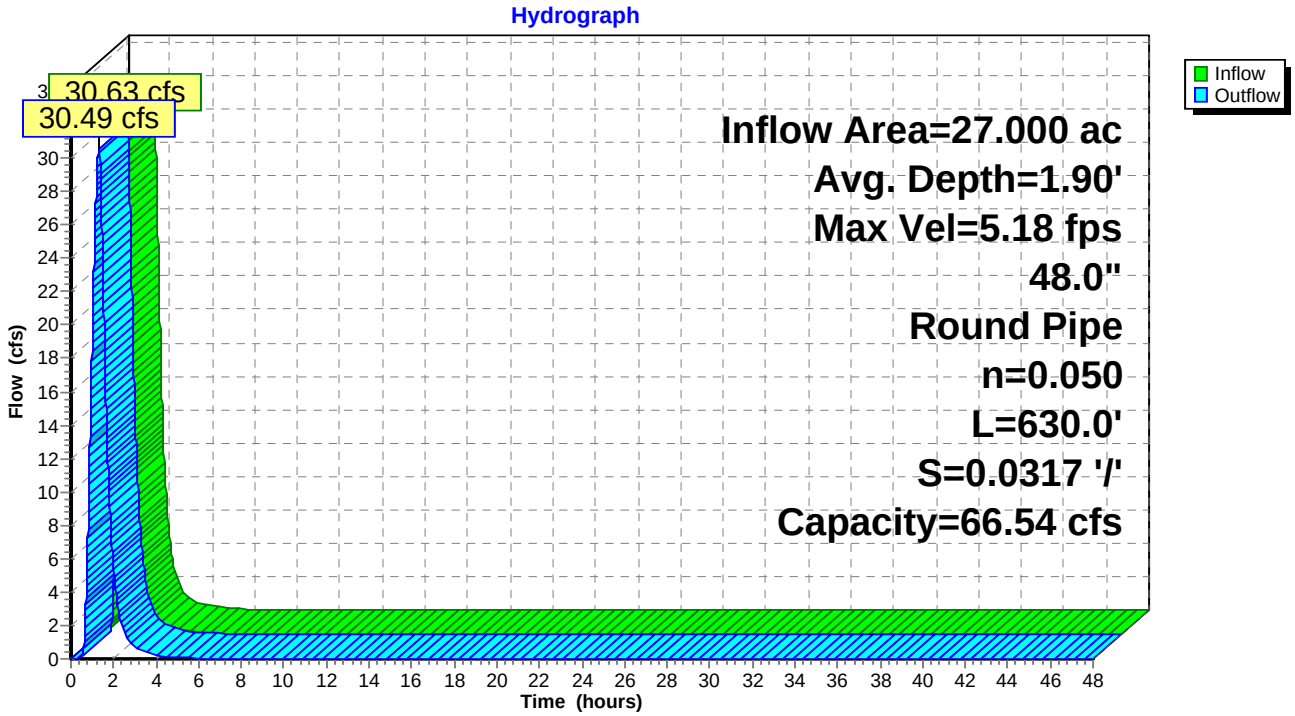
Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Max. Velocity= 5.18 fps, Min. Travel Time= 2.0 min
Avg. Velocity = 1.24 fps, Avg. Travel Time= 8.5 min

Peak Storage= 3,709 cf @ 1.27 hrs, Average Depth at Peak Storage= 1.90'
Bank-Full Depth= 4.00', Capacity at Bank-Full= 66.54 cfs

48.0" Round Pipe
n= 0.050 Mountain streams w/large boulders
Length= 630.0' Slope= 0.0317 '/'
Inlet Invert= 100.00', Outlet Invert= 80.00'



Reach 11R: Rate Basin 2 Culv



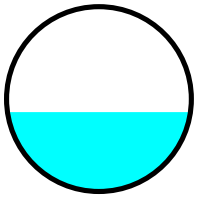
Summary for Reach 12R: WQ Pond Culv

Inflow Area = 122.900 ac, 4.07% Impervious, Inflow Depth = 1.05" for 20 yr- 1 hr event
Inflow = 152.21 cfs @ 1.30 hrs, Volume= 10.713 af
Outflow = 152.17 cfs @ 1.31 hrs, Volume= 10.713 af, Atten= 0%, Lag= 0.5 min

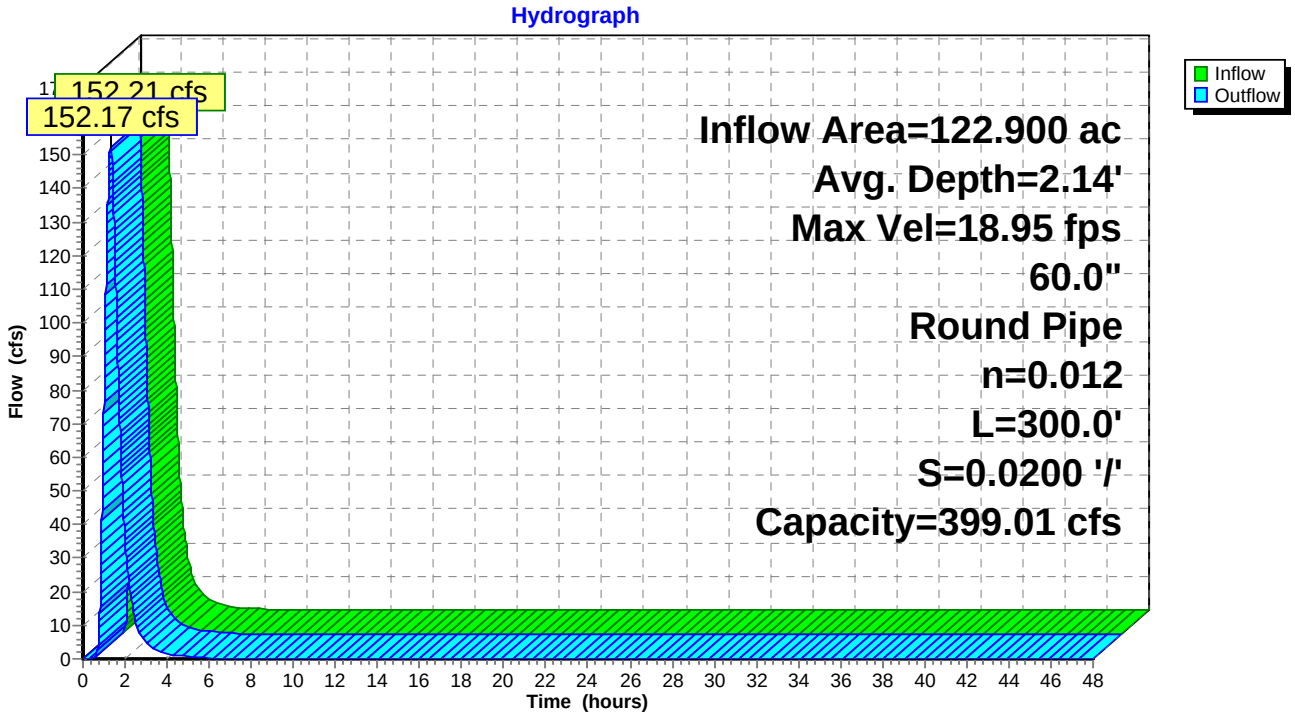
Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Max. Velocity= 18.95 fps, Min. Travel Time= 0.3 min
Avg. Velocity = 3.89 fps, Avg. Travel Time= 1.3 min

Peak Storage= 2,409 cf @ 1.31 hrs, Average Depth at Peak Storage= 2.14'
Bank-Full Depth= 5.00', Capacity at Bank-Full= 399.01 cfs

60.0" Round Pipe
n= 0.012 Concrete pipe, finished
Length= 300.0' Slope= 0.0200 '/'
Inlet Invert= 76.00', Outlet Invert= 70.00'



Reach 12R: WQ Pond Culv



Summary for Reach 13R: Sheet Drain

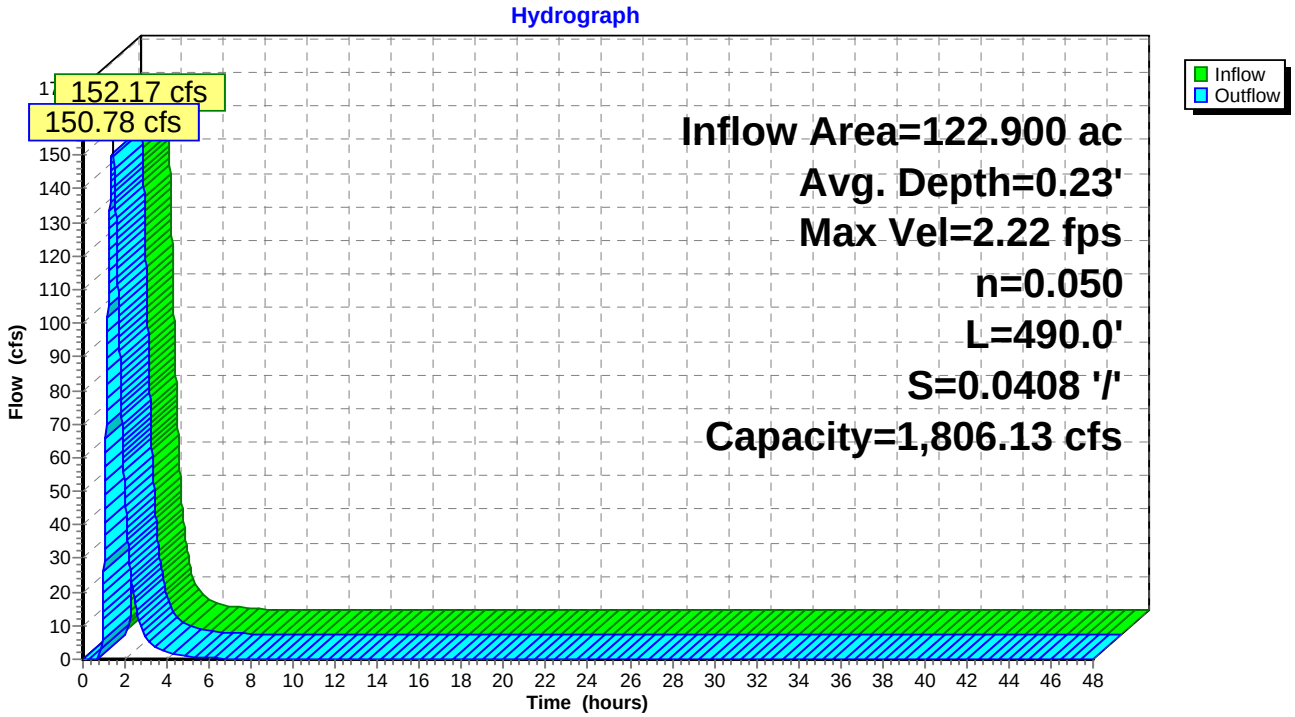
Inflow Area = 122.900 ac, 4.07% Impervious, Inflow Depth = 1.05" for 20 yr- 1 hr event
Inflow = 152.17 cfs @ 1.31 hrs, Volume= 10.713 af
Outflow = 150.78 cfs @ 1.41 hrs, Volume= 10.713 af, Atten= 1%, Lag= 6.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Max. Velocity= 2.22 fps, Min. Travel Time= 3.7 min
Avg. Velocity = 0.40 fps, Avg. Travel Time= 20.2 min

Peak Storage= 33,247 cf @ 1.35 hrs, Average Depth at Peak Storage= 0.23'
Bank-Full Depth= 1.00', Capacity at Bank-Full= 1,806.13 cfs

300.00' x 1.00' deep channel, n= 0.050 Scattered brush, heavy weeds
Side Slope Z-value= 3.0 '/' Top Width= 306.00'
Length= 490.0' Slope= 0.0408 '/'
Inlet Invert= 70.00', Outlet Invert= 50.00'

Reach 13R: Sheet Drain



Time span=0.00-48.00 hrs, dt=0.01 hrs, 4801 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Reach 1R: OB Channel 1 Avg. Depth=1.04' Max Vel=6.85 fps Inflow=36.59 cfs 12.449 af
n=0.050 L=1,737.0' S=0.1007 '/' Capacity=160.08 cfs Outflow=36.19 cfs 12.449 af

Reach 5R: OB Channel 2 Avg. Depth=1.01' Max Vel=6.60 fps Inflow=34.10 cfs 11.601 af
n=0.050 L=2,075.0' S=0.0964 '/' Capacity=156.57 cfs Outflow=33.52 cfs 11.601 af

Reach 6R: OB CULV Avg. Depth=1.76' Max Vel=15.39 fps Inflow=66.51 cfs 24.050 af
36.0" Round Pipe n=0.012 L=400.0' S=0.0200 '/' Capacity=102.19 cfs Outflow=66.49 cfs 24.050 af

Reach 7R: OB Channel Avg. Depth=1.94' Max Vel=4.38 fps Inflow=66.49 cfs 24.050 af
n=0.050 L=400.0' S=0.0200 '/' Capacity=187.63 cfs Outflow=66.37 cfs 24.050 af

Reach 8R: RR Channel 1 Avg. Depth=1.68' Max Vel=2.83 fps Inflow=35.76 cfs 11.596 af
n=0.050 L=2,010.0' S=0.0100 '/' Capacity=85.30 cfs Outflow=33.38 cfs 11.596 af

Reach 9R: RR Channel 2 Avg. Depth=1.53' Max Vel=2.69 fps Inflow=27.19 cfs 9.209 af
n=0.050 L=460.0' S=0.0100 '/' Capacity=85.51 cfs Outflow=27.06 cfs 9.209 af

Reach 10R: Rate Basin 1 Culv Avg. Depth=2.09' Max Vel=25.63 fps Inflow=170.61 cfs 61.740 af
48.0" Round Pipe n=0.012 L=485.0' S=0.0412 '/' Capacity=316.00 cfs Outflow=170.57 cfs 61.740 af

Reach 11R: Rate Basin 2 Culv Avg. Depth=2.32' Max Vel=5.61 fps Inflow=42.50 cfs 16.491 af
48.0" Round Pipe n=0.050 L=630.0' S=0.0317 '/' Capacity=66.54 cfs Outflow=42.39 cfs 16.491 af

Reach 12R: WQ Pond Culv Avg. Depth=2.51' Max Vel=20.36 fps Inflow=201.20 cfs 78.231 af
60.0" Round Pipe n=0.012 L=300.0' S=0.0200 '/' Capacity=399.01 cfs Outflow=201.18 cfs 78.231 af

Reach 13R: Sheet Drain Avg. Depth=0.27' Max Vel=2.49 fps Inflow=201.18 cfs 78.231 af
n=0.050 L=490.0' S=0.0408 '/' Capacity=1,806.13 cfs Outflow=200.33 cfs 78.231 af

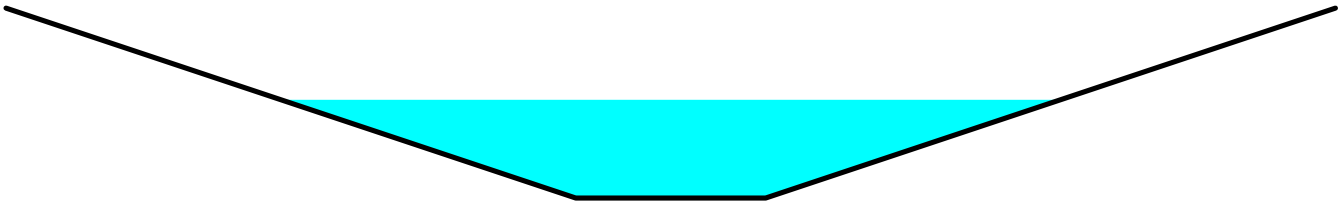
Summary for Reach 1R: OB Channel 1

Inflow Area = 19.100 ac, 0.00% Impervious, Inflow Depth = 7.82" for 25 yr event
Inflow = 36.59 cfs @ 8.07 hrs, Volume= 12.449 af
Outflow = 36.19 cfs @ 8.20 hrs, Volume= 12.449 af, Atten= 1%, Lag= 7.9 min

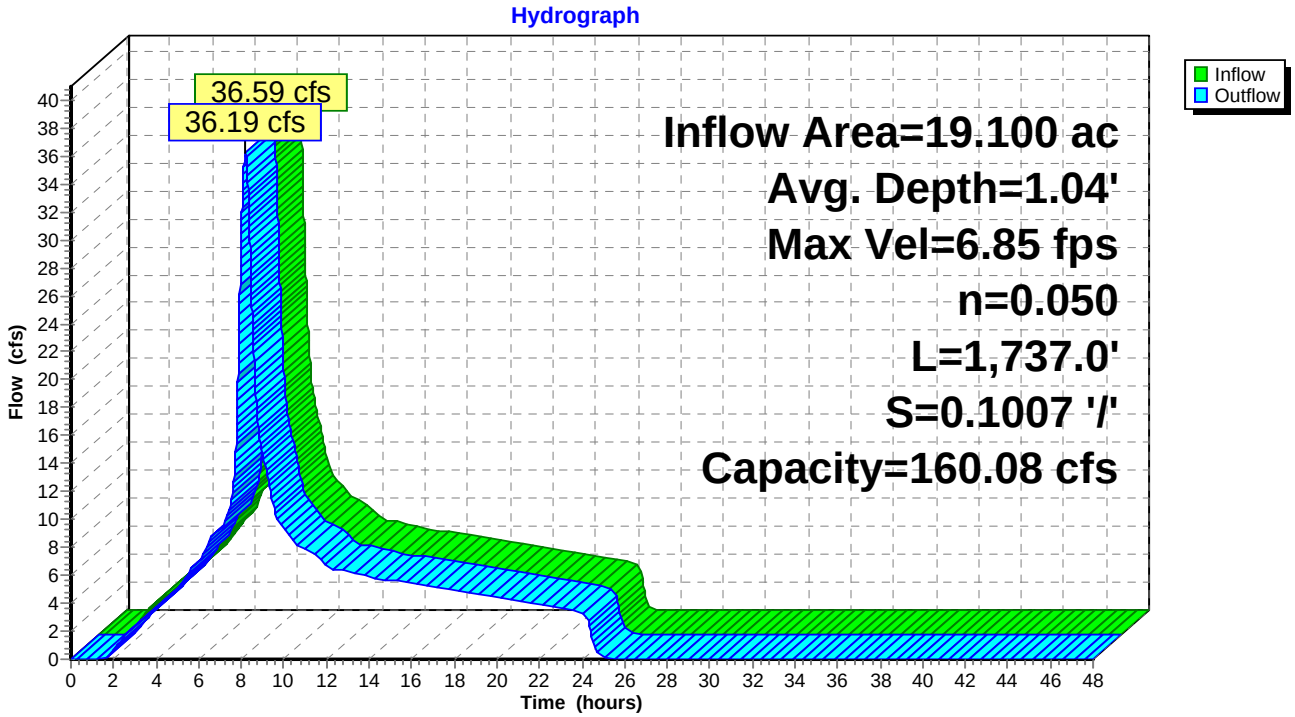
Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Max. Velocity= 6.85 fps, Min. Travel Time= 4.2 min
Avg. Velocity = 3.49 fps, Avg. Travel Time= 8.3 min

Peak Storage= 9,180 cf @ 8.13 hrs, Average Depth at Peak Storage= 1.04'
Bank-Full Depth= 2.00', Capacity at Bank-Full= 160.08 cfs

2.00' x 2.00' deep channel, n= 0.050 Mountain streams w/large boulders
Side Slope Z-value= 3.0 '/' Top Width= 14.00'
Length= 1,737.0' Slope= 0.1007 '/'
Inlet Invert= 2,725.00', Outlet Invert= 2,550.00'



Reach 1R: OB Channel 1



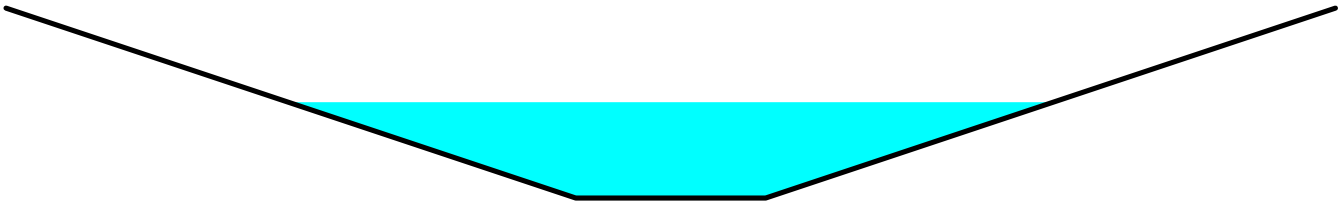
Summary for Reach 5R: OB Channel 2

Inflow Area = 17.800 ac, 0.00% Impervious, Inflow Depth = 7.82" for 25 yr event
Inflow = 34.10 cfs @ 8.07 hrs, Volume= 11.601 af
Outflow = 33.52 cfs @ 8.23 hrs, Volume= 11.601 af, Atten= 2%, Lag= 9.6 min

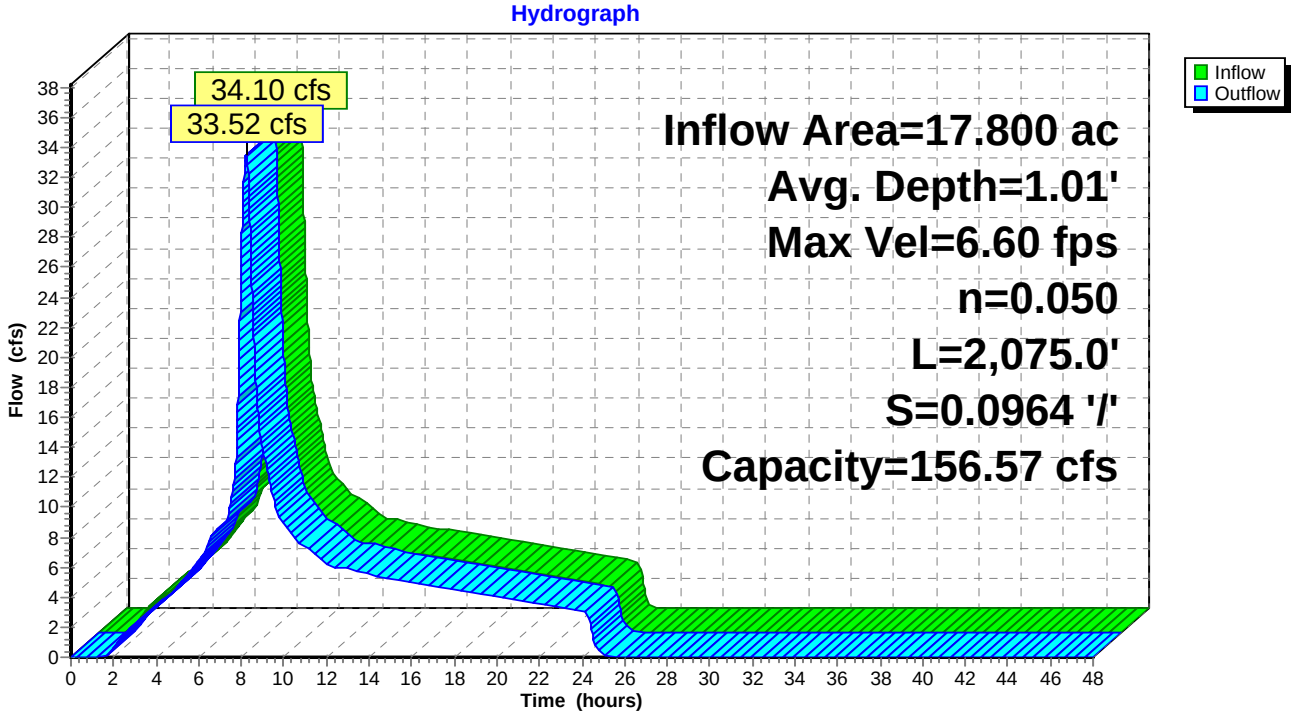
Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Max. Velocity= 6.60 fps, Min. Travel Time= 5.2 min
Avg. Velocity = 3.27 fps, Avg. Travel Time= 10.6 min

Peak Storage= 10,533 cf @ 8.14 hrs, Average Depth at Peak Storage= 1.01'
Bank-Full Depth= 2.00', Capacity at Bank-Full= 156.57 cfs

2.00' x 2.00' deep channel, n= 0.050 Mountain streams w/large boulders
Side Slope Z-value= 3.0 '/' Top Width= 14.00'
Length= 2,075.0' Slope= 0.0964 '/'
Inlet Invert= 2,750.00', Outlet Invert= 2,550.00'



Reach 5R: OB Channel 2



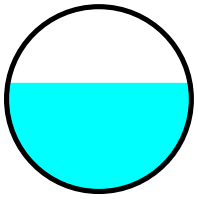
Summary for Reach 6R: OB CULV

Inflow Area = 36.900 ac, 0.00% Impervious, Inflow Depth = 7.82" for 25 yr event
Inflow = 66.51 cfs @ 8.31 hrs, Volume= 24.050 af
Outflow = 66.49 cfs @ 8.32 hrs, Volume= 24.050 af, Atten= 0%, Lag= 0.8 min

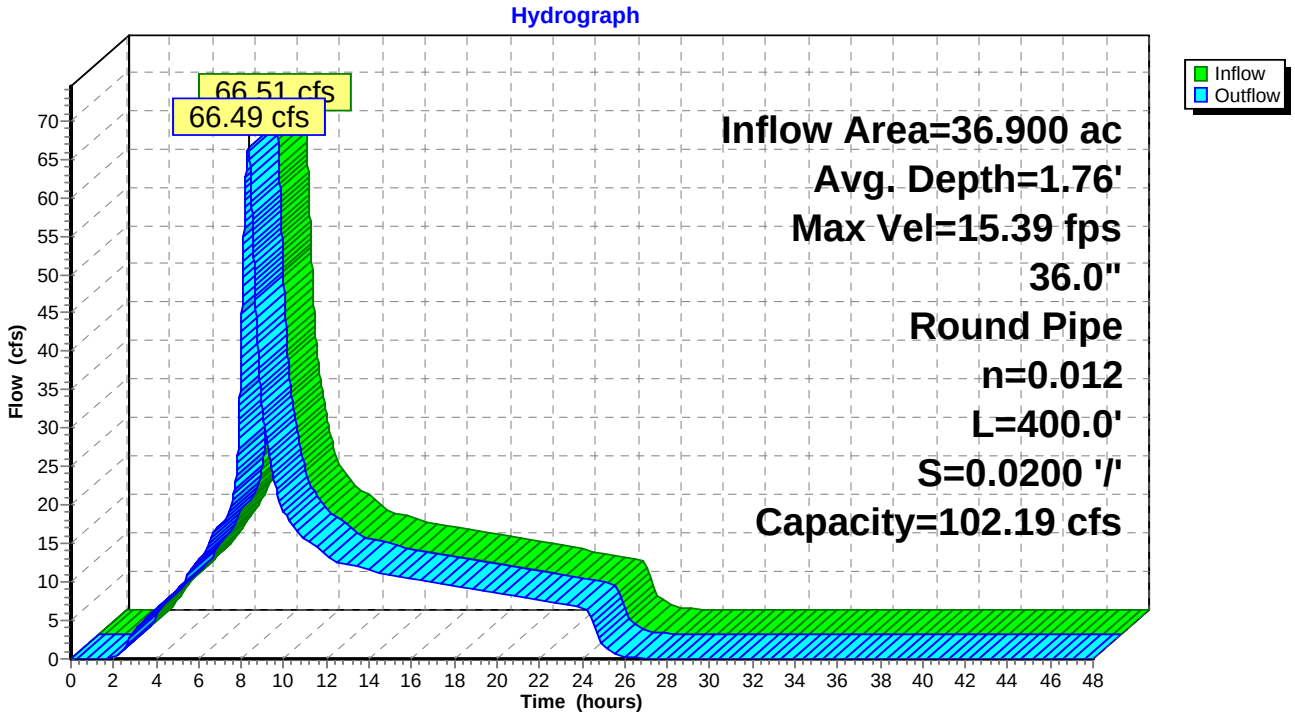
Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Max. Velocity= 15.39 fps, Min. Travel Time= 0.4 min
Avg. Velocity = 7.64 fps, Avg. Travel Time= 0.9 min

Peak Storage= 1,728 cf @ 8.31 hrs, Average Depth at Peak Storage= 1.76'
Bank-Full Depth= 3.00', Capacity at Bank-Full= 102.19 cfs

36.0" Round Pipe
n= 0.012 Concrete pipe, finished
Length= 400.0' Slope= 0.0200 '/'
Inlet Invert= 2,538.00', Outlet Invert= 2,530.00'



Reach 6R: OB CULV



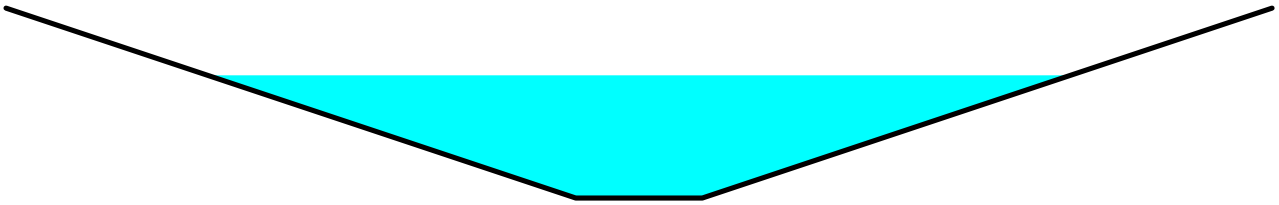
Summary for Reach 7R: OB Channel

Inflow Area = 36.900 ac, 0.00% Impervious, Inflow Depth = 7.82" for 25 yr event
Inflow = 66.49 cfs @ 8.32 hrs, Volume= 24.050 af
Outflow = 66.37 cfs @ 8.37 hrs, Volume= 24.050 af, Atten= 0%, Lag= 2.7 min

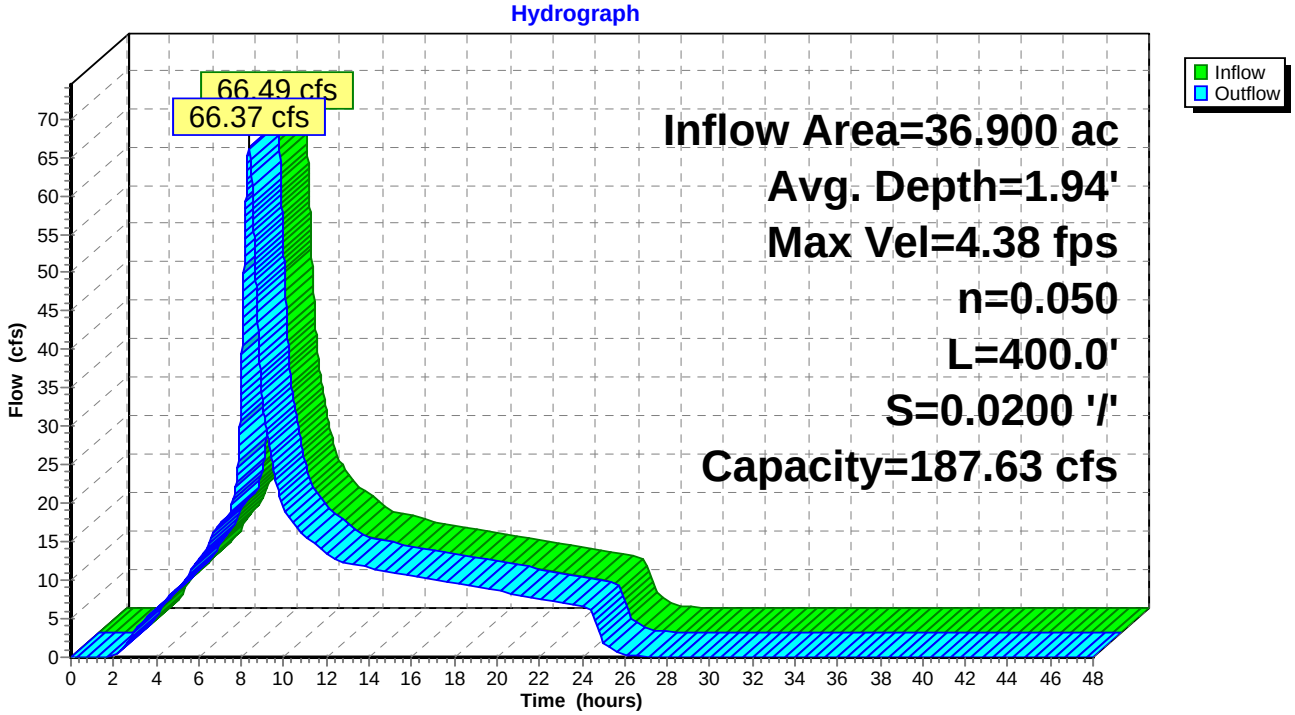
Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Max. Velocity= 4.38 fps, Min. Travel Time= 1.5 min
Avg. Velocity = 2.16 fps, Avg. Travel Time= 3.1 min

Peak Storage= 6,065 cf @ 8.34 hrs, Average Depth at Peak Storage= 1.94'
Bank-Full Depth= 3.00', Capacity at Bank-Full= 187.63 cfs

2.00' x 3.00' deep channel, n= 0.050 Mountain streams w/large boulders
Side Slope Z-value= 3.0 '/' Top Width= 20.00'
Length= 400.0' Slope= 0.0200 '/'
Inlet Invert= 2,530.00', Outlet Invert= 2,522.00'



Reach 7R: OB Channel



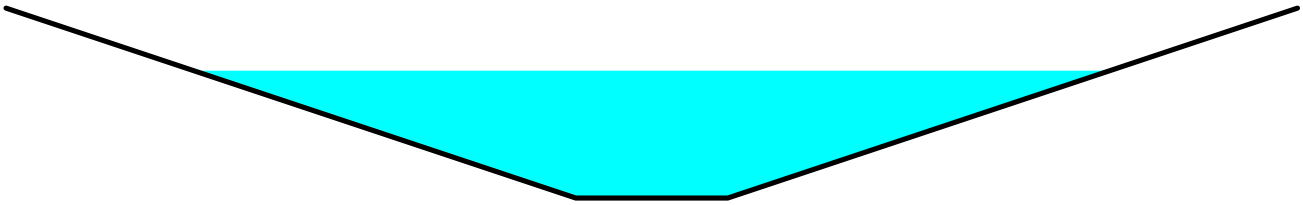
Summary for Reach 8R: RR Channel 1

Inflow Area = 17.000 ac, 0.00% Impervious, Inflow Depth = 8.19" for 25 yr event
Inflow = 35.76 cfs @ 7.90 hrs, Volume= 11.596 af
Outflow = 33.38 cfs @ 8.25 hrs, Volume= 11.596 af, Atten= 7%, Lag= 20.6 min

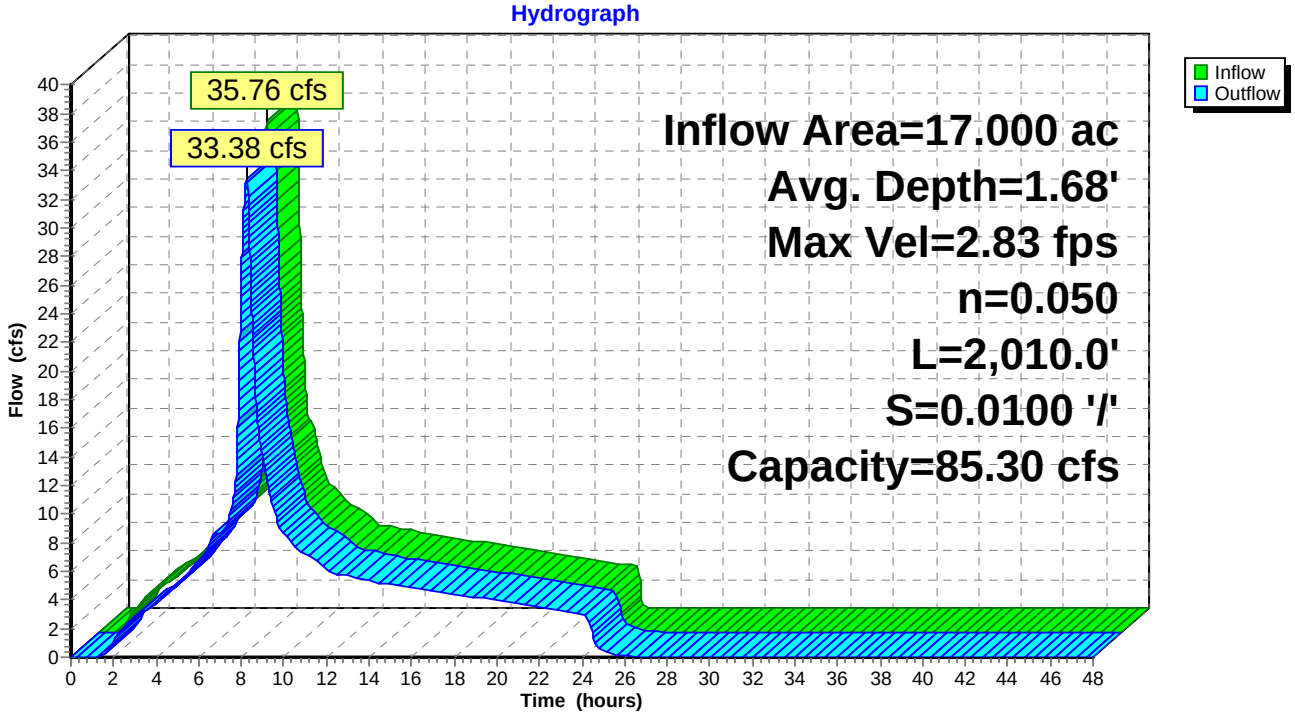
Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Max. Velocity= 2.83 fps, Min. Travel Time= 11.8 min
Avg. Velocity = 1.12 fps, Avg. Travel Time= 29.9 min

Peak Storage= 23,676 cf @ 8.05 hrs, Average Depth at Peak Storage= 1.68'
Bank-Full Depth= 2.50', Capacity at Bank-Full= 85.30 cfs

2.00' x 2.50' deep channel, n= 0.050 Mountain streams w/large boulders
Side Slope Z-value= 3.0 '/' Top Width= 17.00'
Length= 2,010.0' Slope= 0.0100 '/'
Inlet Invert= 136.00', Outlet Invert= 116.00'



Reach 8R: RR Channel 1



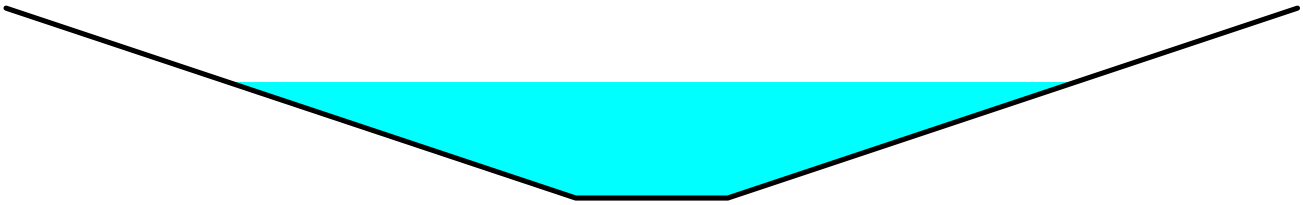
Summary for Reach 9R: RR Channel 2

Inflow Area = 13.500 ac, 0.00% Impervious, Inflow Depth = 8.19" for 25 yr event
Inflow = 27.19 cfs @ 8.04 hrs, Volume= 9.209 af
Outflow = 27.06 cfs @ 8.13 hrs, Volume= 9.209 af, Atten= 0%, Lag= 5.3 min

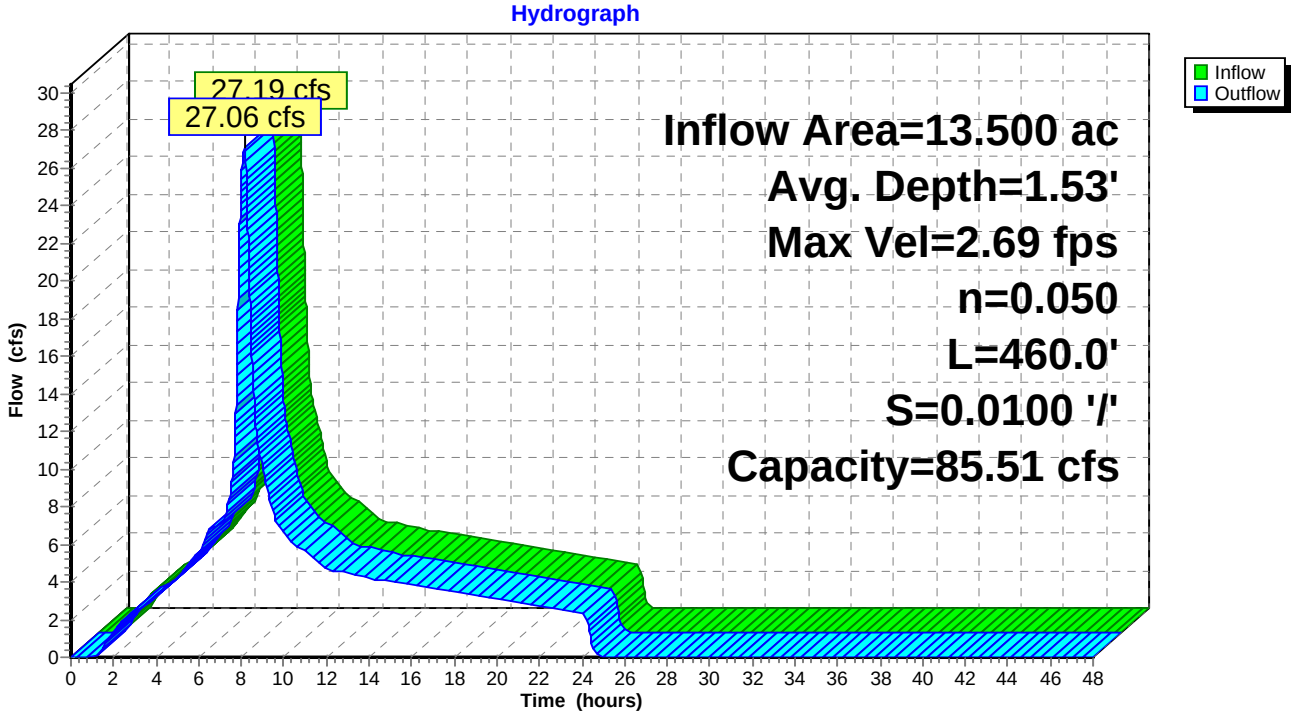
Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Max. Velocity= 2.69 fps, Min. Travel Time= 2.8 min
Avg. Velocity = 1.44 fps, Avg. Travel Time= 5.3 min

Peak Storage= 4,624 cf @ 8.09 hrs, Average Depth at Peak Storage= 1.53'
Bank-Full Depth= 2.50', Capacity at Bank-Full= 85.51 cfs

2.00' x 2.50' deep channel, n= 0.050 Mountain streams w/large boulders
Side Slope Z-value= 3.0 '/' Top Width= 17.00'
Length= 460.0' Slope= 0.0100 '/'
Inlet Invert= 1,000.00', Outlet Invert= 995.40'



Reach 9R: RR Channel 2



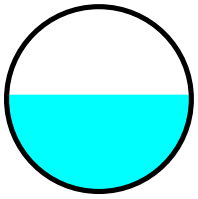
Summary for Reach 10R: Rate Basin 1 Culv

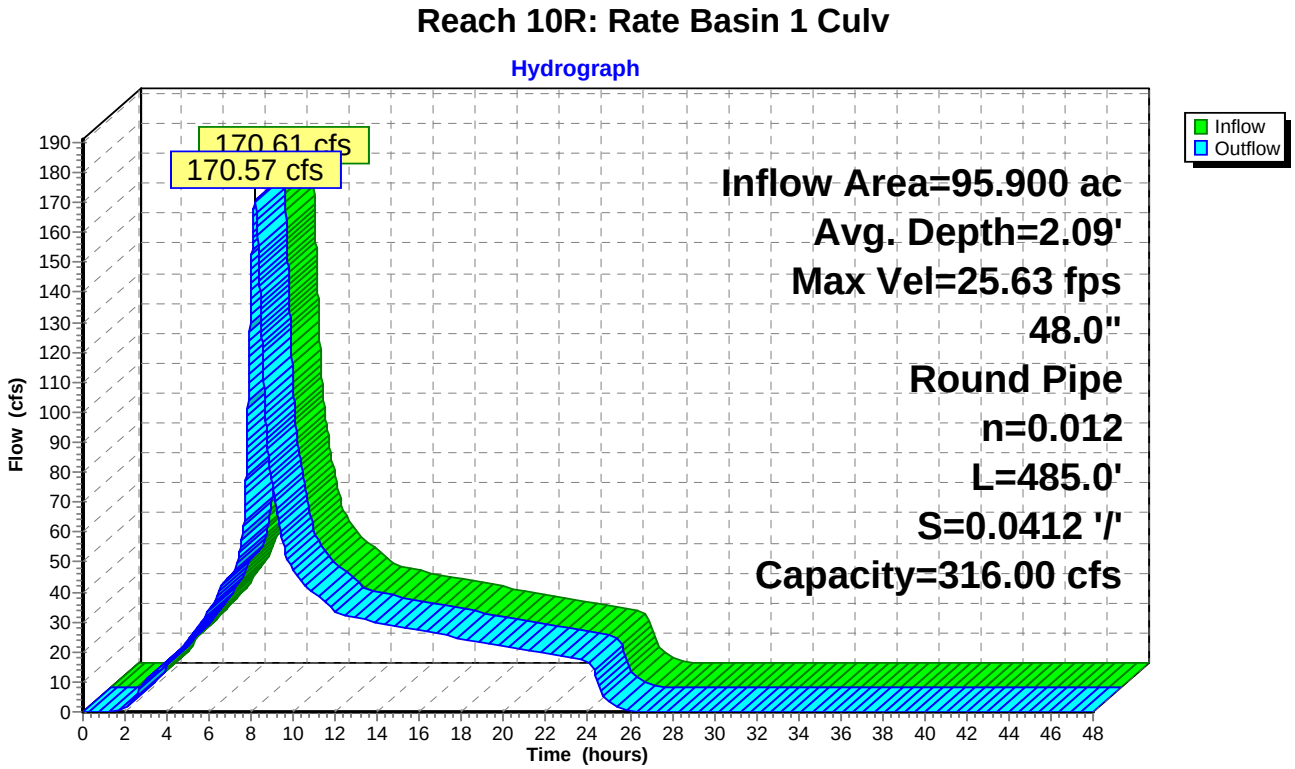
Inflow Area = 95.900 ac, 5.21% Impervious, Inflow Depth = 7.73" for 25 yr event
Inflow = 170.61 cfs @ 8.17 hrs, Volume= 61.740 af
Outflow = 170.57 cfs @ 8.18 hrs, Volume= 61.740 af, Atten= 0%, Lag= 0.6 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Max. Velocity= 25.63 fps, Min. Travel Time= 0.3 min
Avg. Velocity = 10.84 fps, Avg. Travel Time= 0.7 min

Peak Storage= 3,228 cf @ 8.18 hrs, Average Depth at Peak Storage= 2.09'
Bank-Full Depth= 4.00', Capacity at Bank-Full= 316.00 cfs

48.0" Round Pipe
n= 0.012 Concrete pipe, finished
Length= 485.0' Slope= 0.0412 '/'
Inlet Invert= 100.00', Outlet Invert= 80.00'





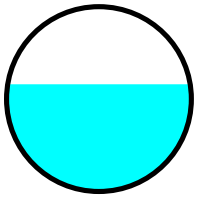
Summary for Reach 11R: Rate Basin 2 Culv

Inflow Area = 27.000 ac, 0.00% Impervious, Inflow Depth = 7.33" for 25 yr event
Inflow = 42.50 cfs @ 8.29 hrs, Volume= 16.491 af
Outflow = 42.39 cfs @ 8.35 hrs, Volume= 16.491 af, Atten= 0%, Lag= 3.3 min

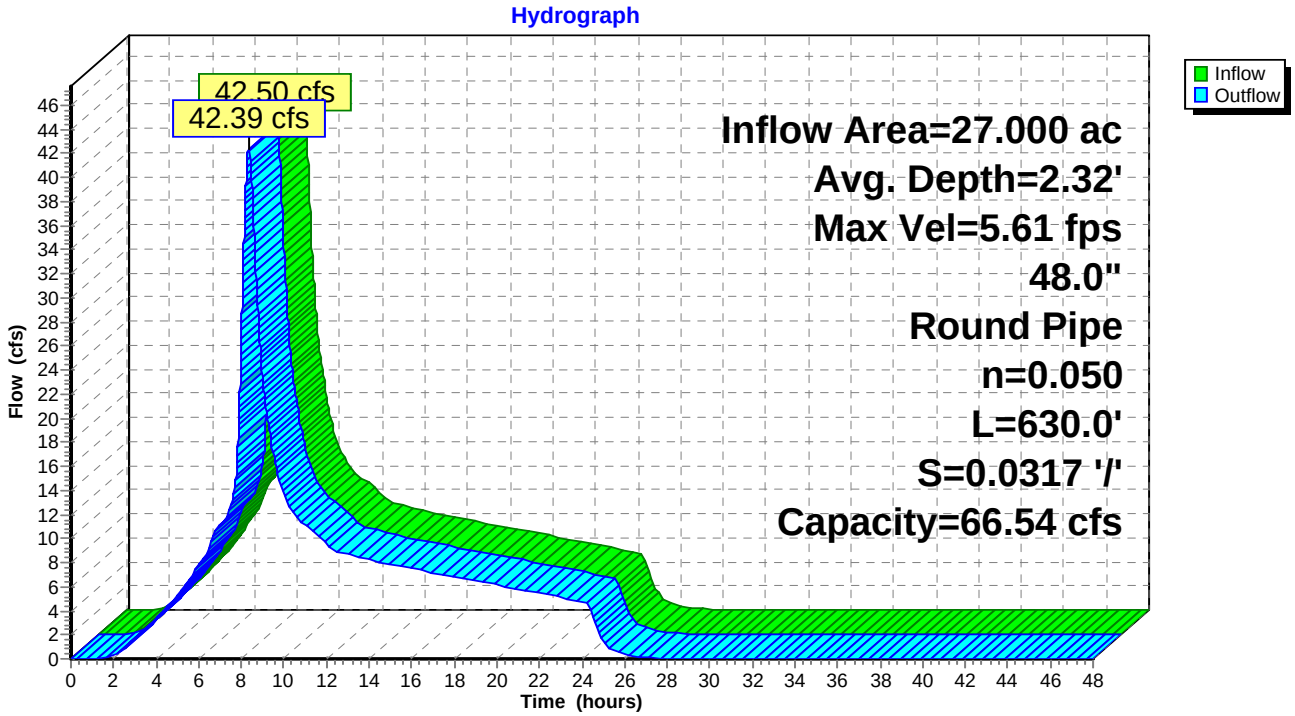
Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Max. Velocity= 5.61 fps, Min. Travel Time= 1.9 min
Avg. Velocity = 2.62 fps, Avg. Travel Time= 4.0 min

Peak Storage= 4,759 cf @ 8.31 hrs, Average Depth at Peak Storage= 2.32'
Bank-Full Depth= 4.00', Capacity at Bank-Full= 66.54 cfs

48.0" Round Pipe
n= 0.050 Mountain streams w/large boulders
Length= 630.0' Slope= 0.0317 '/'
Inlet Invert= 100.00', Outlet Invert= 80.00'



Reach 11R: Rate Basin 2 Culv



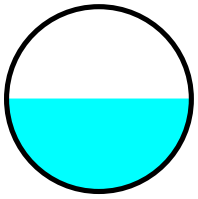
Summary for Reach 12R: WQ Pond Culv

Inflow Area = 122.900 ac, 4.07% Impervious, Inflow Depth = 7.64" for 25 yr event
Inflow = 201.20 cfs @ 8.36 hrs, Volume= 78.231 af
Outflow = 201.18 cfs @ 8.36 hrs, Volume= 78.231 af, Atten= 0%, Lag= 0.4 min

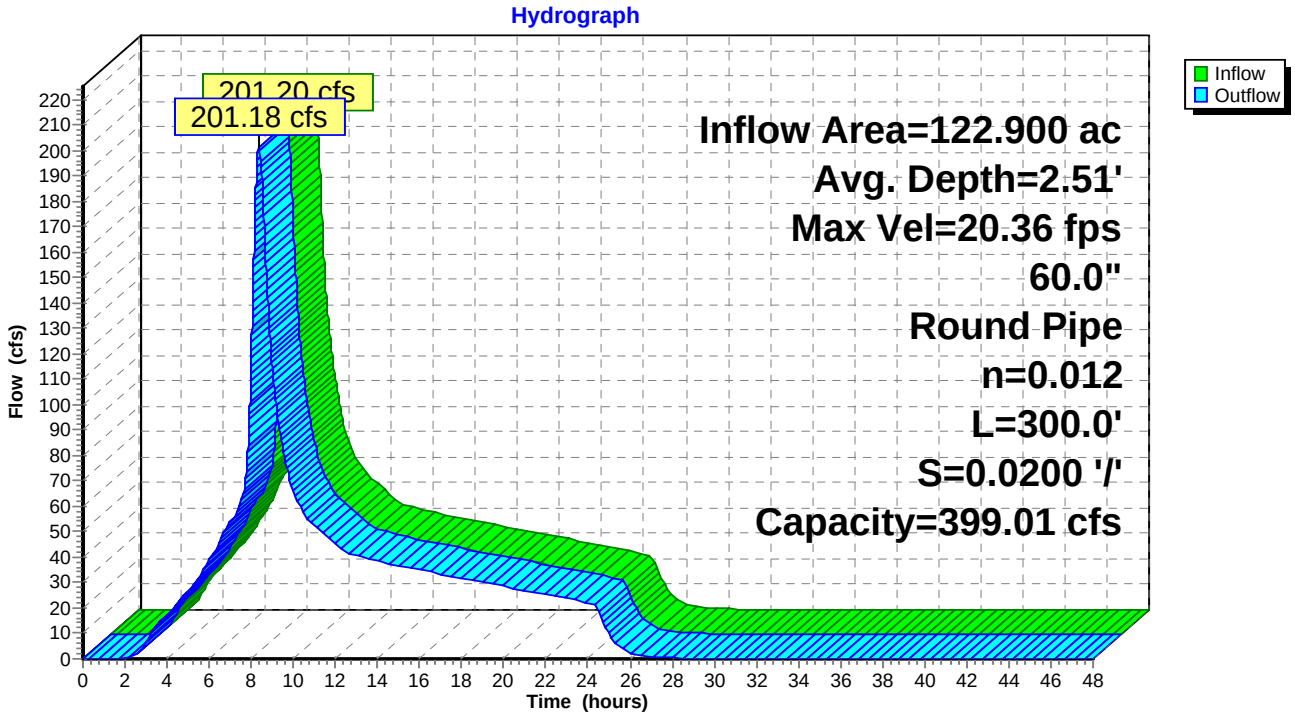
Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Max. Velocity= 20.36 fps, Min. Travel Time= 0.2 min
Avg. Velocity = 8.60 fps, Avg. Travel Time= 0.6 min

Peak Storage= 2,964 cf @ 8.36 hrs, Average Depth at Peak Storage= 2.51'
Bank-Full Depth= 5.00', Capacity at Bank-Full= 399.01 cfs

60.0" Round Pipe
n= 0.012 Concrete pipe, finished
Length= 300.0' Slope= 0.0200 '/'
Inlet Invert= 76.00', Outlet Invert= 70.00'



Reach 12R: WQ Pond Culv



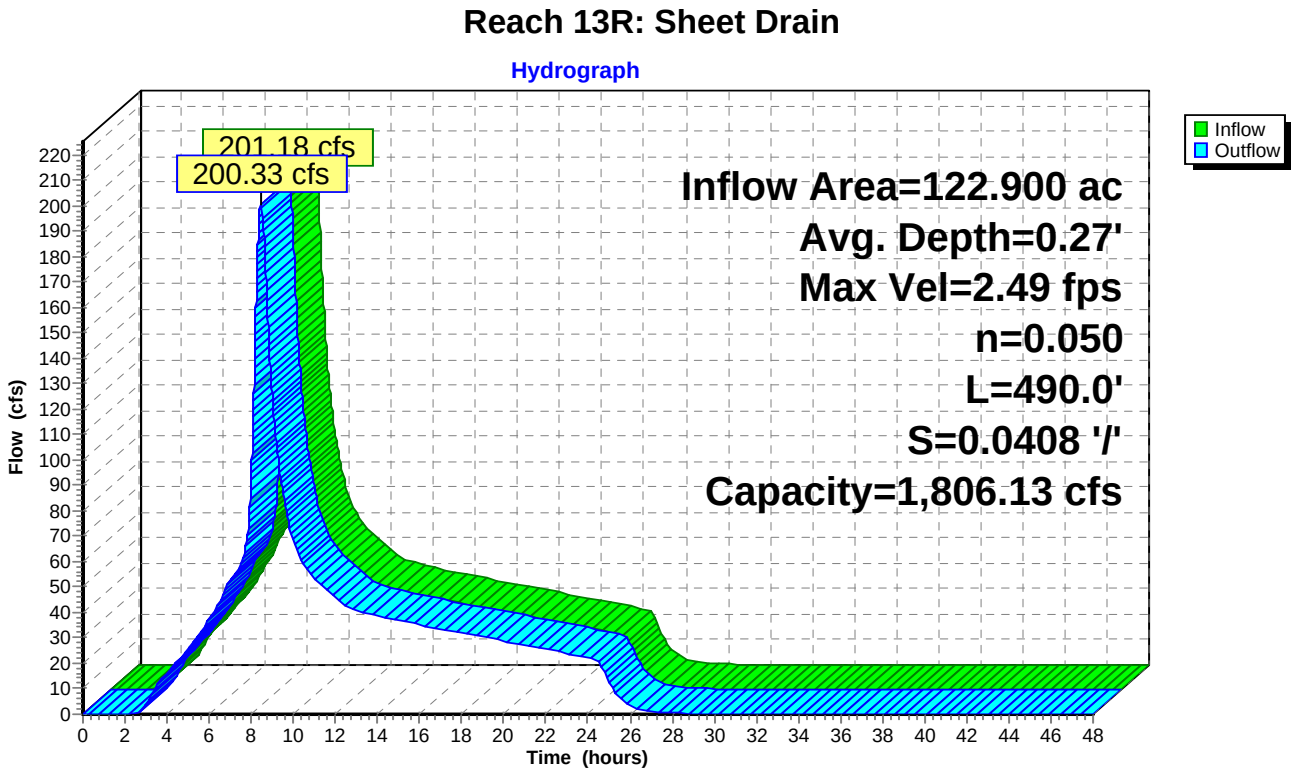
Summary for Reach 13R: Sheet Drain

Inflow Area = 122.900 ac, 4.07% Impervious, Inflow Depth = 7.64" for 25 yr event
Inflow = 201.18 cfs @ 8.36 hrs, Volume= 78.231 af
Outflow = 200.33 cfs @ 8.45 hrs, Volume= 78.231 af, Atten= 0%, Lag= 5.3 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Max. Velocity= 2.49 fps, Min. Travel Time= 3.3 min
Avg. Velocity = 0.81 fps, Avg. Travel Time= 10.0 min

Peak Storage= 39,444 cf @ 8.40 hrs, Average Depth at Peak Storage= 0.27'
Bank-Full Depth= 1.00', Capacity at Bank-Full= 1,806.13 cfs

300.00' x 1.00' deep channel, n= 0.050 Scattered brush, heavy weeds
Side Slope Z-value= 3.0 '/' Top Width= 306.00'
Length= 490.0' Slope= 0.0408 '/'
Inlet Invert= 70.00', Outlet Invert= 50.00'



Time span=0.00-48.00 hrs, dt=0.01 hrs, 4801 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Reach 1R: OB Channel 1 Avg. Depth=1.17' Max Vel=7.32 fps Inflow=47.41 cfs 16.230 af
n=0.050 L=1,737.0' S=0.1007 '/' Capacity=160.08 cfs Outflow=46.93 cfs 16.230 af

Reach 5R: OB Channel 2 Avg. Depth=1.14' Max Vel=7.06 fps Inflow=44.18 cfs 15.125 af
n=0.050 L=2,075.0' S=0.0964 '/' Capacity=156.57 cfs Outflow=43.50 cfs 15.125 af

Reach 6R: OB CULV Avg. Depth=2.12' Max Vel=16.23 fps Inflow=86.86 cfs 31.355 af
36.0" Round Pipe n=0.012 L=400.0' S=0.0200 '/' Capacity=102.19 cfs Outflow=86.83 cfs 31.355 af

Reach 7R: OB Channel Avg. Depth=2.17' Max Vel=4.68 fps Inflow=86.83 cfs 31.355 af
n=0.050 L=400.0' S=0.0200 '/' Capacity=187.63 cfs Outflow=86.70 cfs 31.355 af

Reach 8R: RR Channel 1 Avg. Depth=1.87' Max Vel=3.02 fps Inflow=45.83 cfs 14.980 af
n=0.050 L=2,010.0' S=0.0100 '/' Capacity=85.30 cfs Outflow=43.11 cfs 14.980 af

Reach 9R: RR Channel 2 Avg. Depth=1.70' Max Vel=2.87 fps Inflow=34.85 cfs 11.896 af
n=0.050 L=460.0' S=0.0100 '/' Capacity=85.51 cfs Outflow=34.69 cfs 11.896 af

Reach 10R: Rate Basin 1 Culv Avg. Depth=2.49' Max Vel=27.29 fps Inflow=224.29 cfs 80.683 af
48.0" Round Pipe n=0.012 L=485.0' S=0.0412 '/' Capacity=316.00 cfs Outflow=224.25 cfs 80.683 af

Reach 11R: Rate Basin 2 Culv Avg. Depth=2.84' Max Vel=5.95 fps Inflow=56.96 cfs 21.752 af
48.0" Round Pipe n=0.050 L=630.0' S=0.0317 '/' Capacity=66.54 cfs Outflow=56.80 cfs 21.752 af

Reach 12R: WQ Pond Culv Avg. Depth=2.99' Max Vel=21.77 fps Inflow=266.74 cfs 102.435 af
60.0" Round Pipe n=0.012 L=300.0' S=0.0200 '/' Capacity=399.01 cfs Outflow=266.71 cfs 102.435 af

Reach 13R: Sheet Drain Avg. Depth=0.32' Max Vel=2.79 fps Inflow=266.71 cfs 102.435 af
n=0.050 L=490.0' S=0.0408 '/' Capacity=1,806.13 cfs Outflow=265.78 cfs 102.435 af

Summary for Reach 1R: OB Channel 1

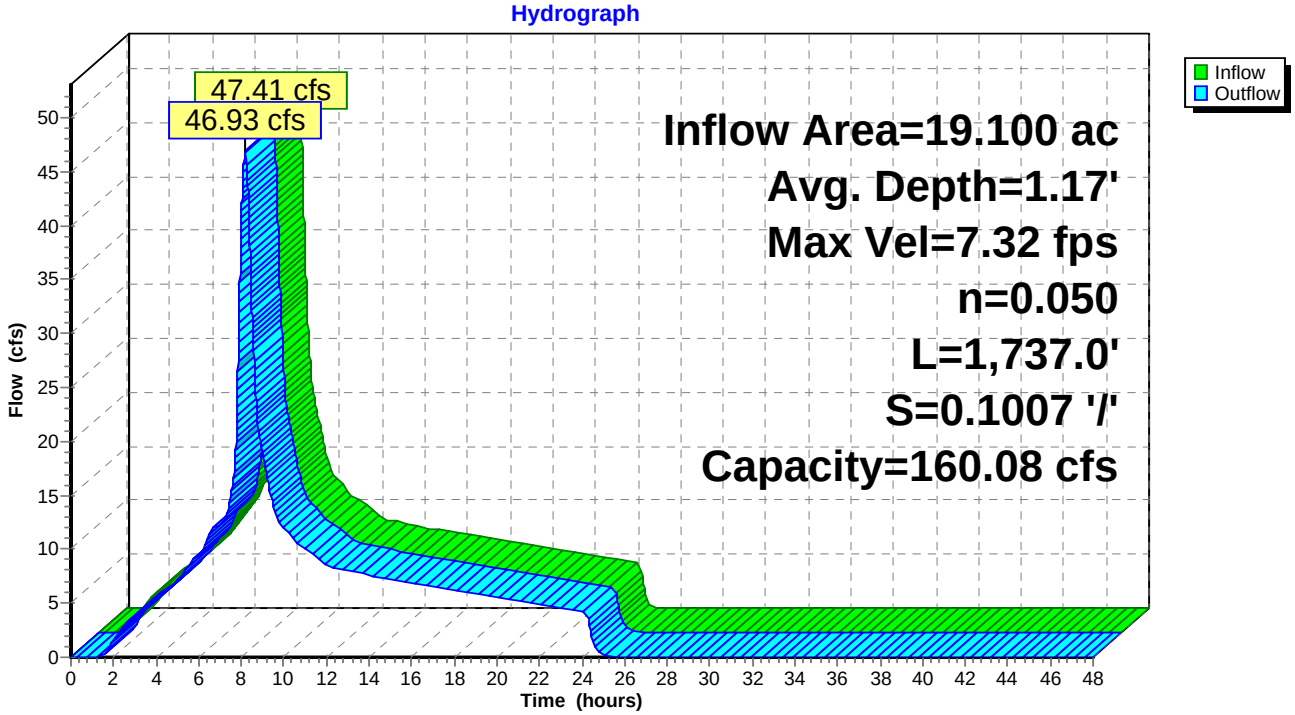
Inflow Area = 19.100 ac, 0.00% Impervious, Inflow Depth = 10.20" for 100 yr event
Inflow = 47.41 cfs @ 8.07 hrs, Volume= 16.230 af
Outflow = 46.93 cfs @ 8.19 hrs, Volume= 16.230 af, Atten= 1%, Lag= 7.1 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Max. Velocity= 7.32 fps, Min. Travel Time= 4.0 min
Avg. Velocity = 3.75 fps, Avg. Travel Time= 7.7 min

Peak Storage= 11,134 cf @ 8.13 hrs, Average Depth at Peak Storage= 1.17'
Bank-Full Depth= 2.00', Capacity at Bank-Full= 160.08 cfs

2.00' x 2.00' deep channel, n= 0.050 Mountain streams w/large boulders
Side Slope Z-value= 3.0 '/' Top Width= 14.00'
Length= 1,737.0' Slope= 0.1007 '/'
Inlet Invert= 2,725.00', Outlet Invert= 2,550.00'

Reach 1R: OB Channel 1



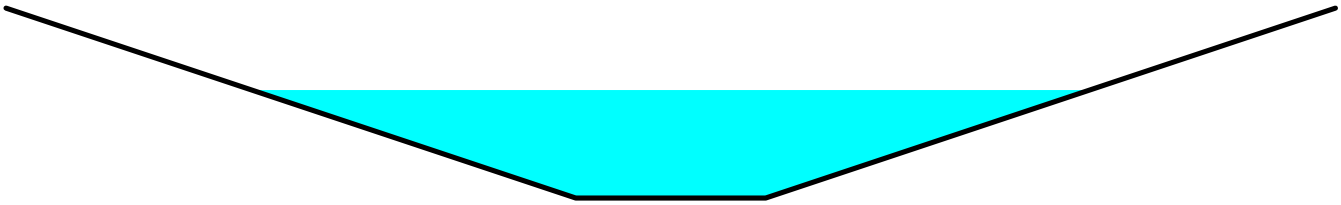
Summary for Reach 5R: OB Channel 2

Inflow Area = 17.800 ac, 0.00% Impervious, Inflow Depth = 10.20" for 100 yr event
Inflow = 44.18 cfs @ 8.07 hrs, Volume= 15.125 af
Outflow = 43.50 cfs @ 8.22 hrs, Volume= 15.125 af, Atten= 2%, Lag= 8.7 min

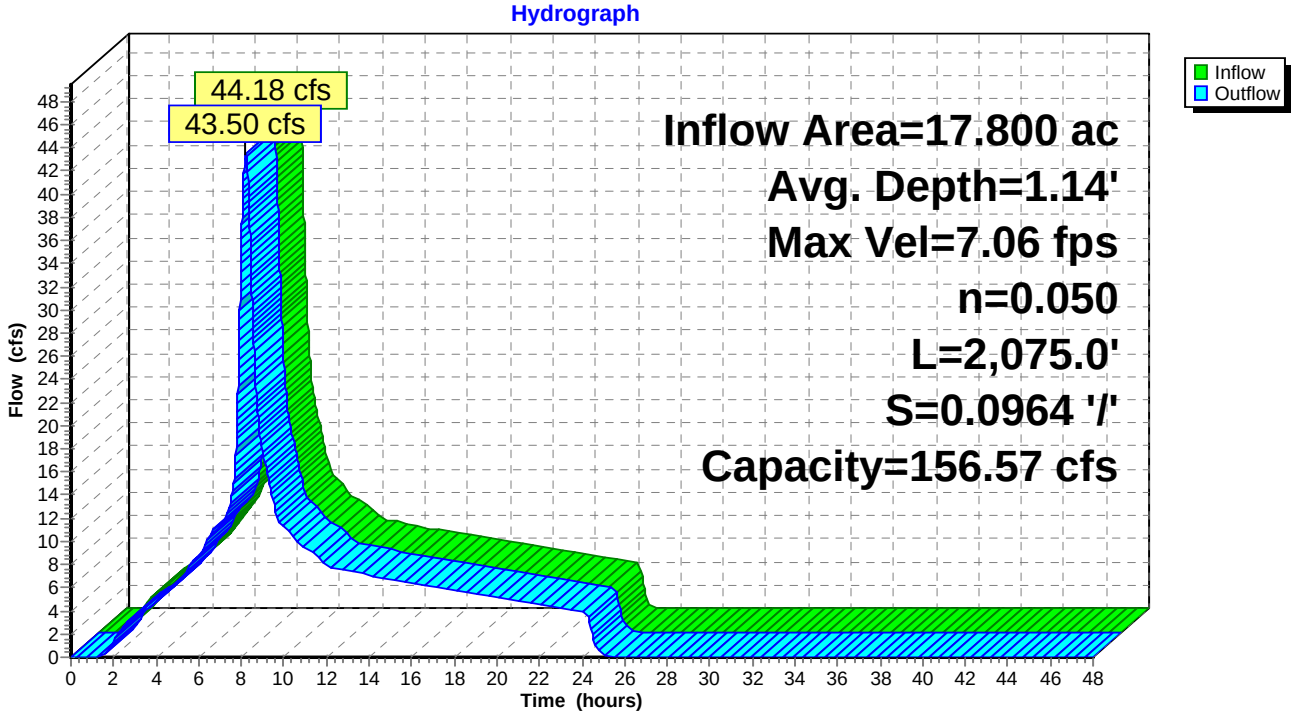
Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Max. Velocity= 7.06 fps, Min. Travel Time= 4.9 min
Avg. Velocity = 3.51 fps, Avg. Travel Time= 9.9 min

Peak Storage= 12,781 cf @ 8.14 hrs, Average Depth at Peak Storage= 1.14'
Bank-Full Depth= 2.00', Capacity at Bank-Full= 156.57 cfs

2.00' x 2.00' deep channel, n= 0.050 Mountain streams w/large boulders
Side Slope Z-value= 3.0 '/' Top Width= 14.00'
Length= 2,075.0' Slope= 0.0964 '/'
Inlet Invert= 2,750.00', Outlet Invert= 2,550.00'



Reach 5R: OB Channel 2



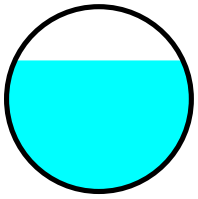
Summary for Reach 6R: OB CULV

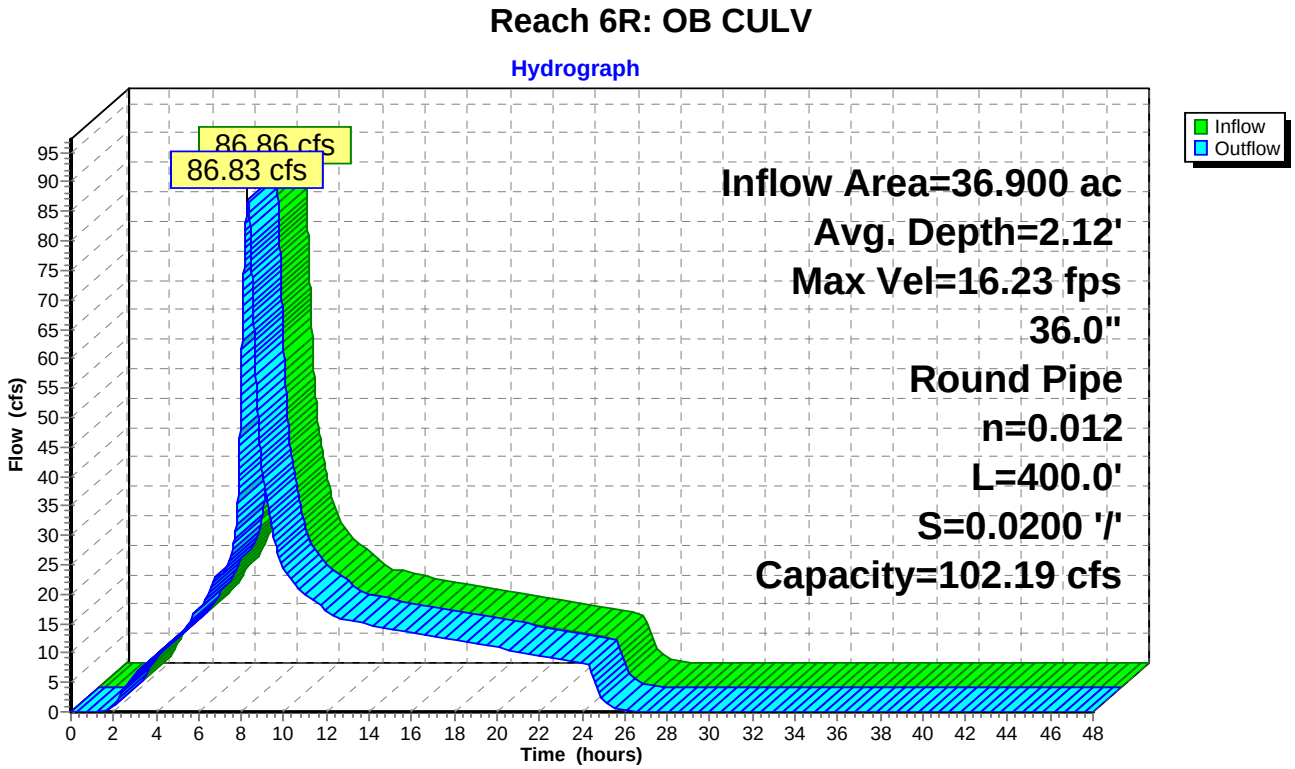
Inflow Area = 36.900 ac, 0.00% Impervious, Inflow Depth = 10.20" for 100 yr event
Inflow = 86.86 cfs @ 8.29 hrs, Volume= 31.355 af
Outflow = 86.83 cfs @ 8.30 hrs, Volume= 31.355 af, Atten= 0%, Lag= 0.8 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Max. Velocity= 16.23 fps, Min. Travel Time= 0.4 min
Avg. Velocity = 8.22 fps, Avg. Travel Time= 0.8 min

Peak Storage= 2,141 cf @ 8.30 hrs, Average Depth at Peak Storage= 2.12'
Bank-Full Depth= 3.00', Capacity at Bank-Full= 102.19 cfs

36.0" Round Pipe
n= 0.012 Concrete pipe, finished
Length= 400.0' Slope= 0.0200 '/'
Inlet Invert= 2,538.00', Outlet Invert= 2,530.00'





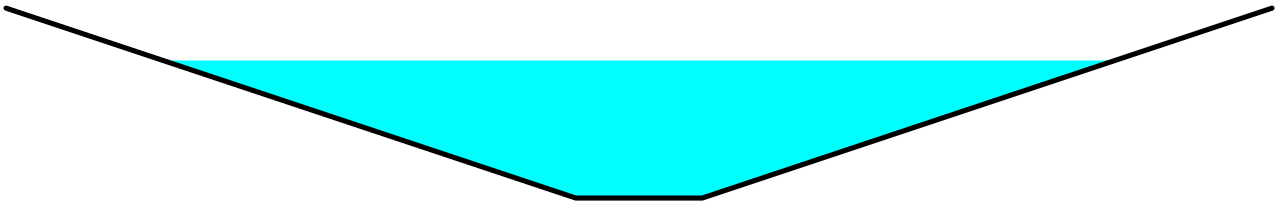
Summary for Reach 7R: OB Channel

Inflow Area = 36.900 ac, 0.00% Impervious, Inflow Depth = 10.20" for 100 yr event
Inflow = 86.83 cfs @ 8.30 hrs, Volume= 31.355 af
Outflow = 86.70 cfs @ 8.35 hrs, Volume= 31.355 af, Atten= 0%, Lag= 2.5 min

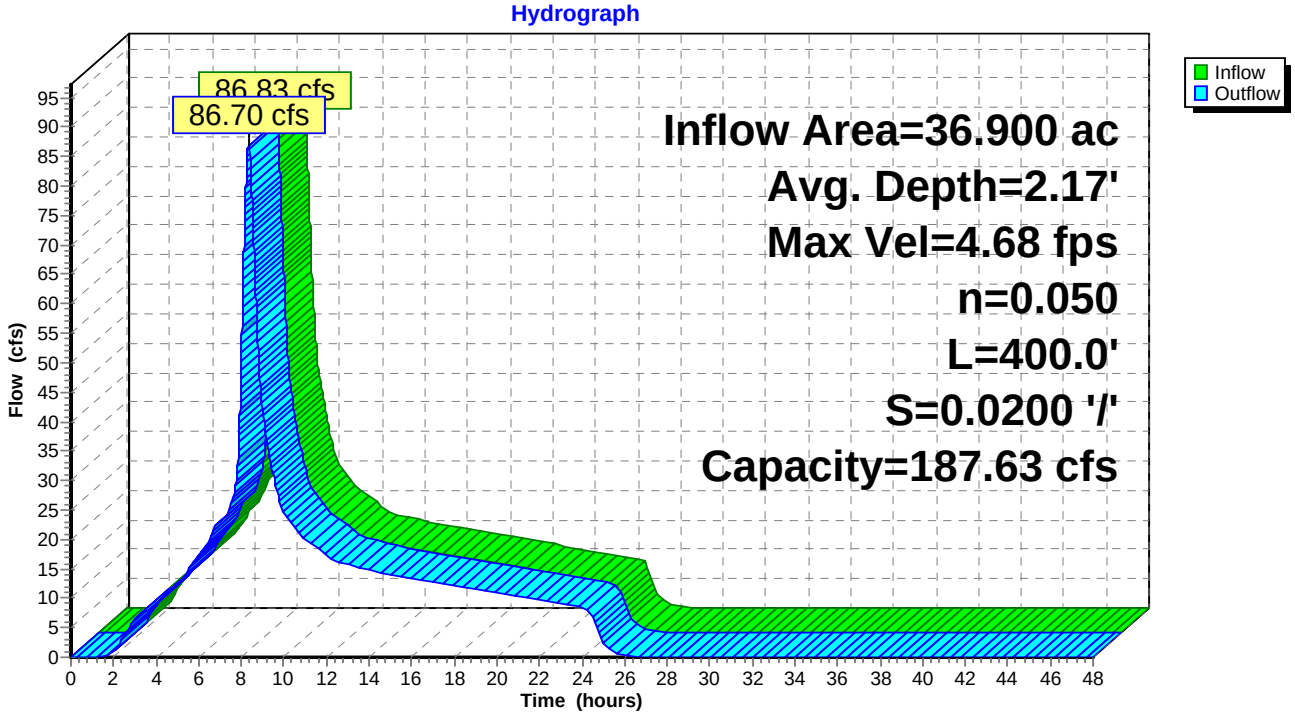
Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Max. Velocity= 4.68 fps, Min. Travel Time= 1.4 min
Avg. Velocity = 2.31 fps, Avg. Travel Time= 2.9 min

Peak Storage= 7,406 cf @ 8.32 hrs, Average Depth at Peak Storage= 2.17'
Bank-Full Depth= 3.00', Capacity at Bank-Full= 187.63 cfs

2.00' x 3.00' deep channel, n= 0.050 Mountain streams w/large boulders
Side Slope Z-value= 3.0 '/' Top Width= 20.00'
Length= 400.0' Slope= 0.0200 '/'
Inlet Invert= 2,530.00', Outlet Invert= 2,522.00'



Reach 7R: OB Channel



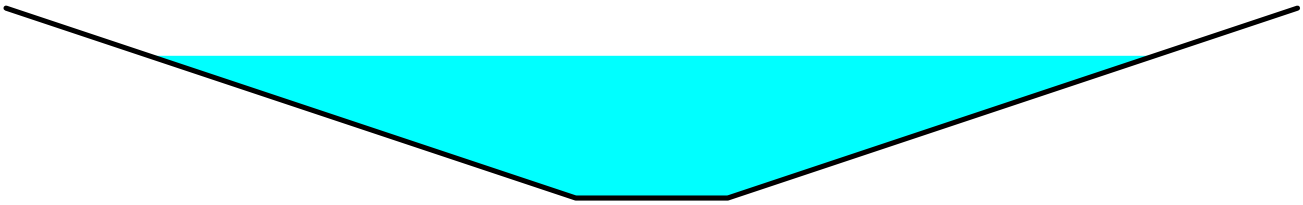
Summary for Reach 8R: RR Channel 1

Inflow Area = 17.000 ac, 0.00% Impervious, Inflow Depth = 10.57" for 100 yr event
Inflow = 45.83 cfs @ 7.90 hrs, Volume= 14.980 af
Outflow = 43.11 cfs @ 8.23 hrs, Volume= 14.980 af, Atten= 6%, Lag= 19.6 min

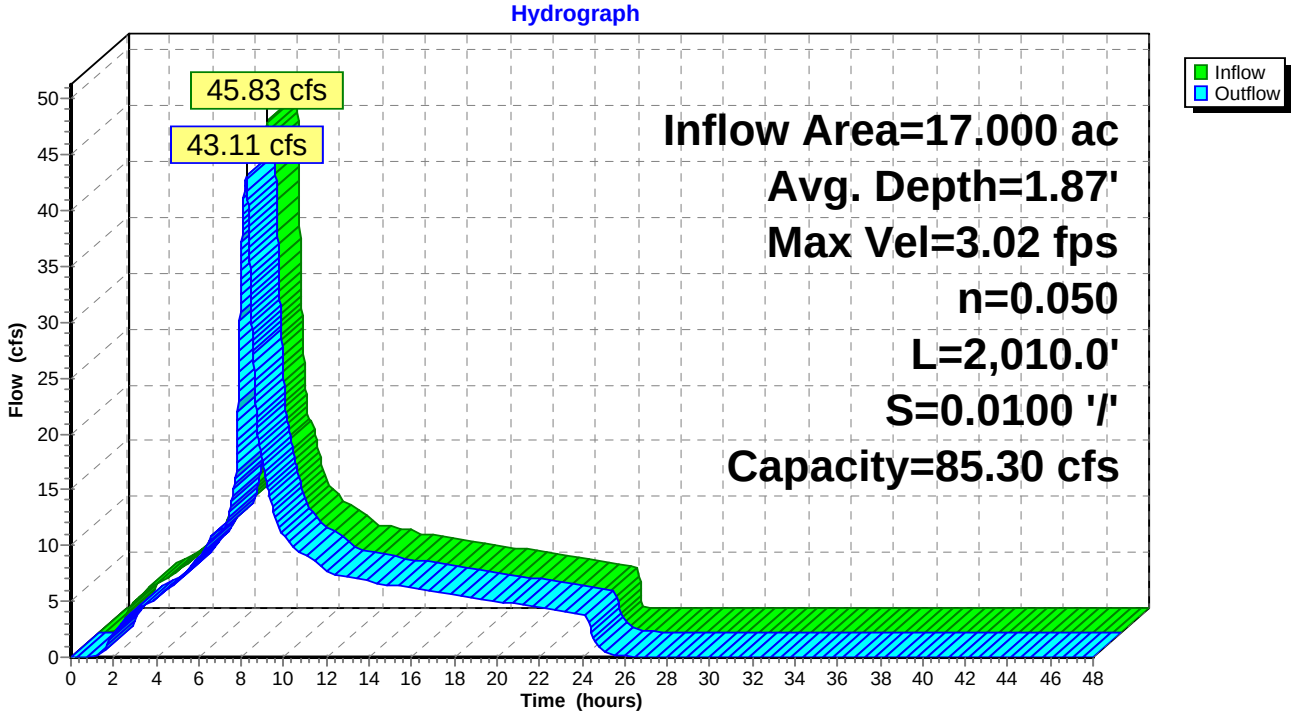
Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Max. Velocity= 3.02 fps, Min. Travel Time= 11.1 min
Avg. Velocity = 1.19 fps, Avg. Travel Time= 28.1 min

Peak Storage= 28,657 cf @ 8.04 hrs, Average Depth at Peak Storage= 1.87'
Bank-Full Depth= 2.50', Capacity at Bank-Full= 85.30 cfs

2.00' x 2.50' deep channel, n= 0.050 Mountain streams w/large boulders
Side Slope Z-value= 3.0 '/' Top Width= 17.00'
Length= 2,010.0' Slope= 0.0100 '/'
Inlet Invert= 136.00', Outlet Invert= 116.00'



Reach 8R: RR Channel 1



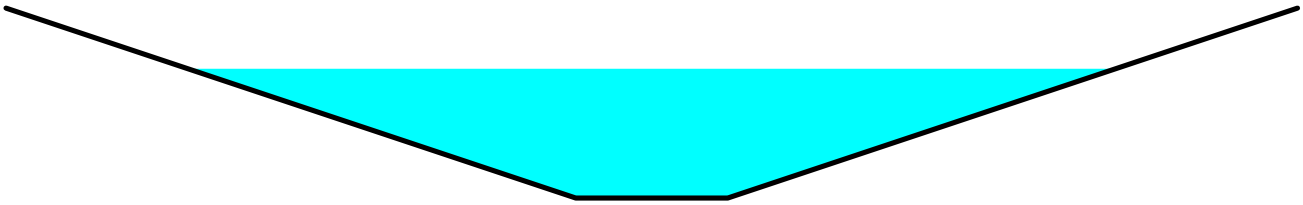
Summary for Reach 9R: RR Channel 2

Inflow Area = 13.500 ac, 0.00% Impervious, Inflow Depth = 10.57" for 100 yr event
Inflow = 34.85 cfs @ 8.04 hrs, Volume= 11.896 af
Outflow = 34.69 cfs @ 8.13 hrs, Volume= 11.896 af, Atten= 0%, Lag= 5.0 min

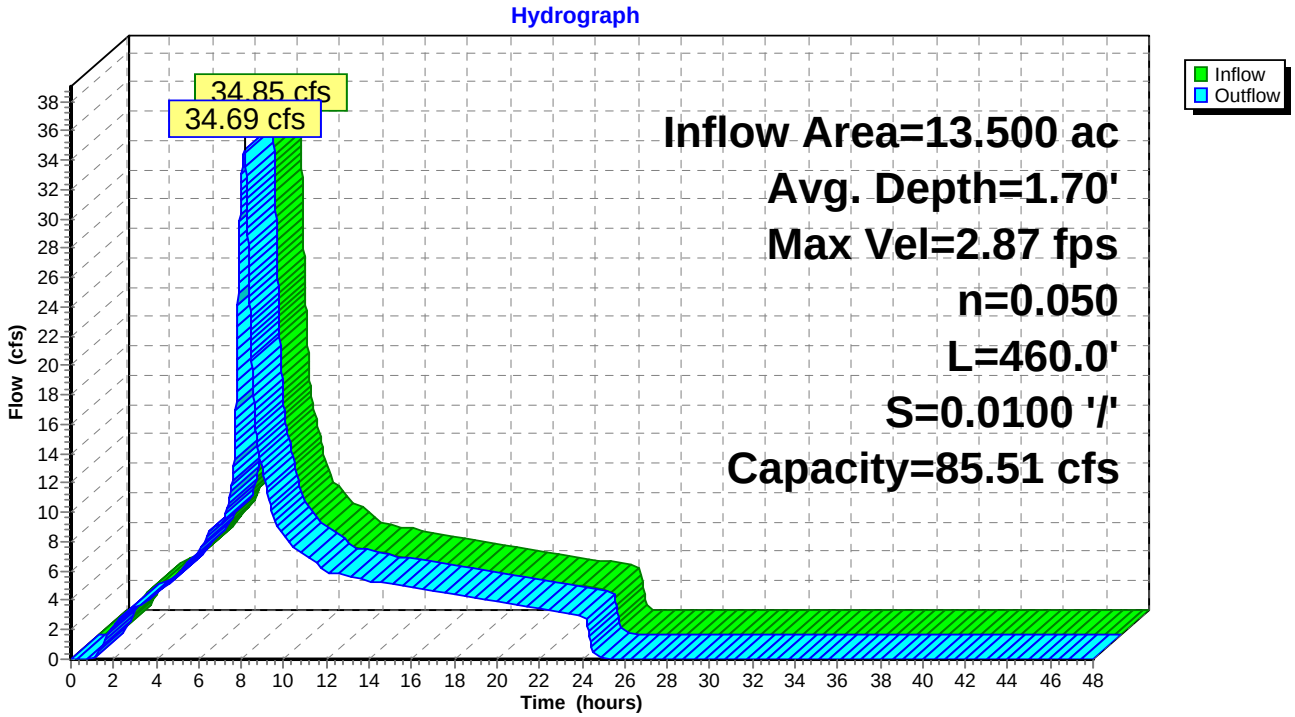
Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Max. Velocity= 2.87 fps, Min. Travel Time= 2.7 min
Avg. Velocity = 1.53 fps, Avg. Travel Time= 5.0 min

Peak Storage= 5,566 cf @ 8.08 hrs, Average Depth at Peak Storage= 1.70'
Bank-Full Depth= 2.50', Capacity at Bank-Full= 85.51 cfs

2.00' x 2.50' deep channel, n= 0.050 Mountain streams w/large boulders
Side Slope Z-value= 3.0 '/' Top Width= 17.00'
Length= 460.0' Slope= 0.0100 '/'
Inlet Invert= 1,000.00', Outlet Invert= 995.40'



Reach 9R: RR Channel 2



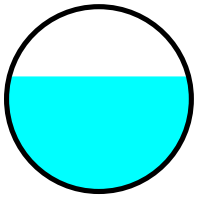
Summary for Reach 10R: Rate Basin 1 Culv

Inflow Area = 95.900 ac, 5.21% Impervious, Inflow Depth = 10.10" for 100 yr event
Inflow = 224.29 cfs @ 8.16 hrs, Volume= 80.683 af
Outflow = 224.25 cfs @ 8.17 hrs, Volume= 80.683 af, Atten= 0%, Lag= 0.5 min

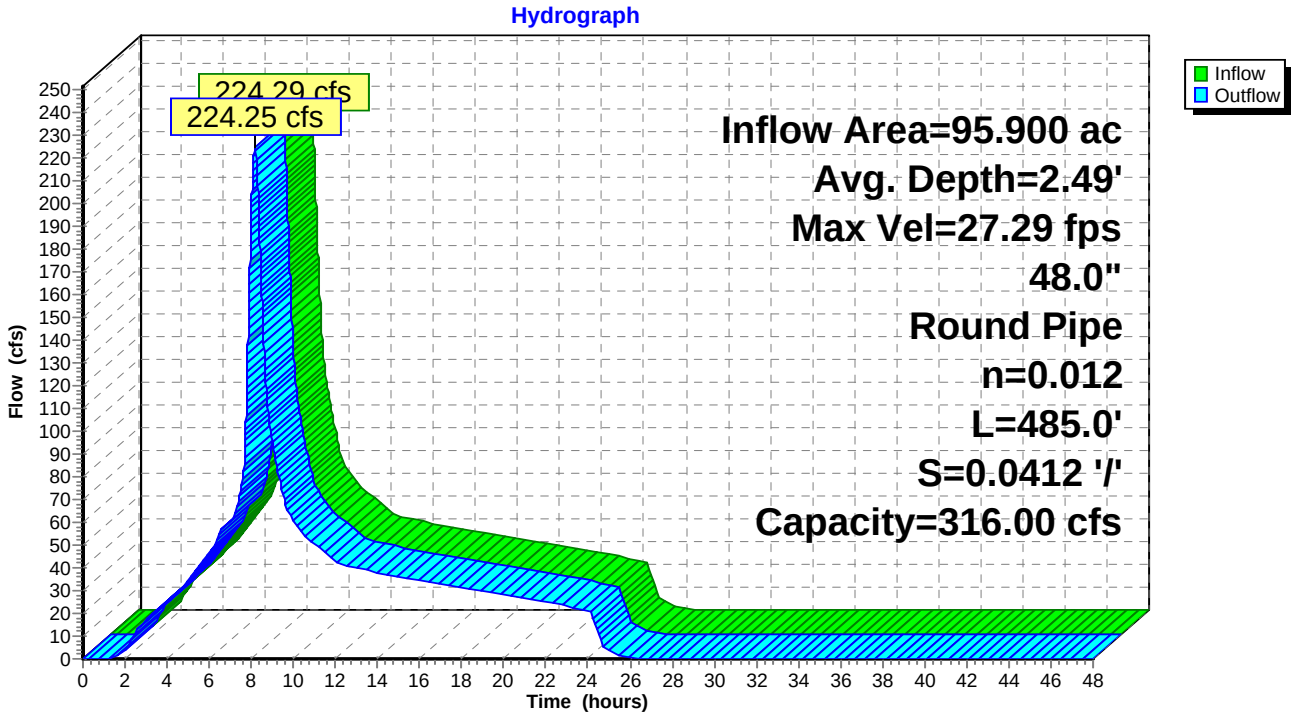
Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Max. Velocity= 27.29 fps, Min. Travel Time= 0.3 min
Avg. Velocity = 11.64 fps, Avg. Travel Time= 0.7 min

Peak Storage= 3,986 cf @ 8.17 hrs, Average Depth at Peak Storage= 2.49'
Bank-Full Depth= 4.00', Capacity at Bank-Full= 316.00 cfs

48.0" Round Pipe
n= 0.012 Concrete pipe, finished
Length= 485.0' Slope= 0.0412 '/'
Inlet Invert= 100.00', Outlet Invert= 80.00'



Reach 10R: Rate Basin 1 Culv



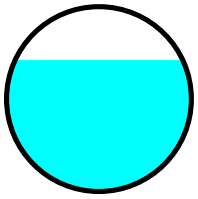
Summary for Reach 11R: Rate Basin 2 Culv

Inflow Area = 27.000 ac, 0.00% Impervious, Inflow Depth = 9.67" for 100 yr event
Inflow = 56.96 cfs @ 8.27 hrs, Volume= 21.752 af
Outflow = 56.80 cfs @ 8.33 hrs, Volume= 21.752 af, Atten= 0%, Lag= 3.3 min

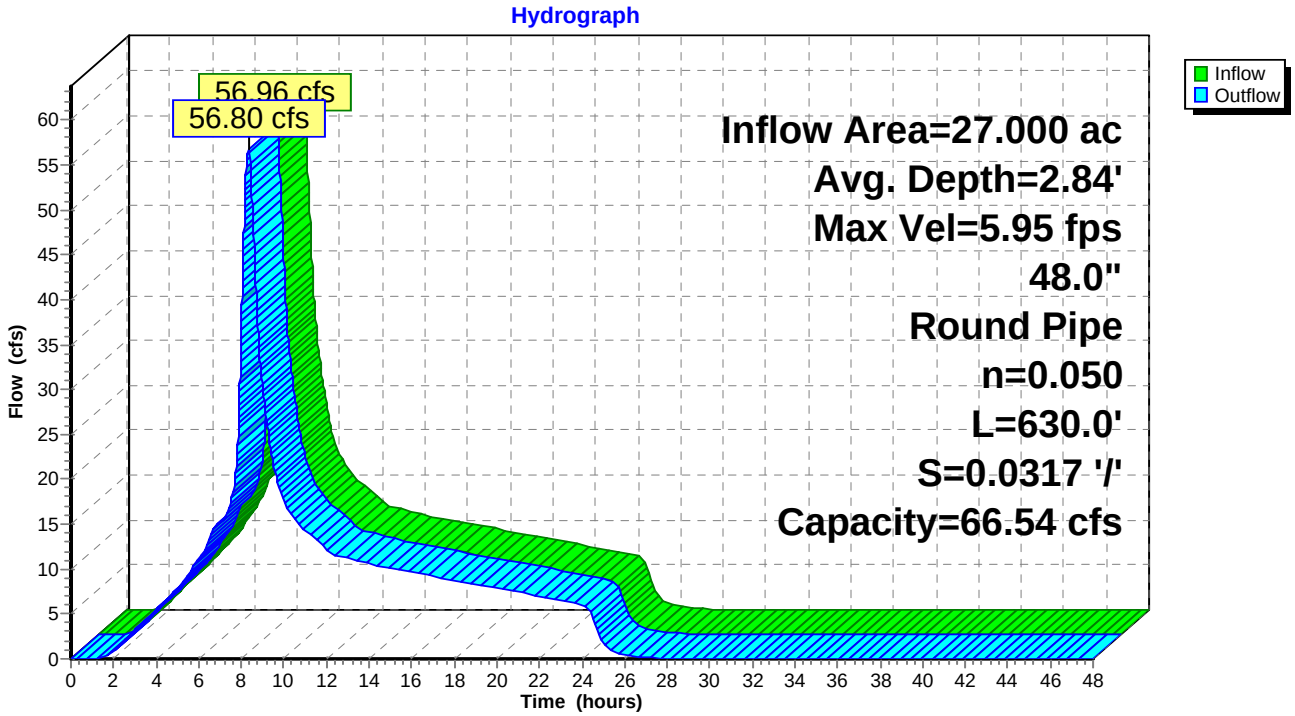
Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Max. Velocity= 5.95 fps, Min. Travel Time= 1.8 min
Avg. Velocity = 2.82 fps, Avg. Travel Time= 3.7 min

Peak Storage= 6,017 cf @ 8.30 hrs, Average Depth at Peak Storage= 2.84'
Bank-Full Depth= 4.00', Capacity at Bank-Full= 66.54 cfs

48.0" Round Pipe
n= 0.050 Mountain streams w/large boulders
Length= 630.0' Slope= 0.0317 '/'
Inlet Invert= 100.00', Outlet Invert= 80.00'



Reach 11R: Rate Basin 2 Culv



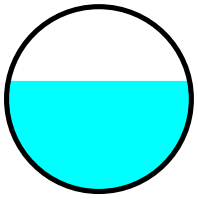
Summary for Reach 12R: WQ Pond Culv

Inflow Area = 122.900 ac, 4.07% Impervious, Inflow Depth = 10.00" for 100 yr event
Inflow = 266.74 cfs @ 8.33 hrs, Volume= 102.435 af
Outflow = 266.71 cfs @ 8.34 hrs, Volume= 102.435 af, Atten= 0%, Lag= 0.4 min

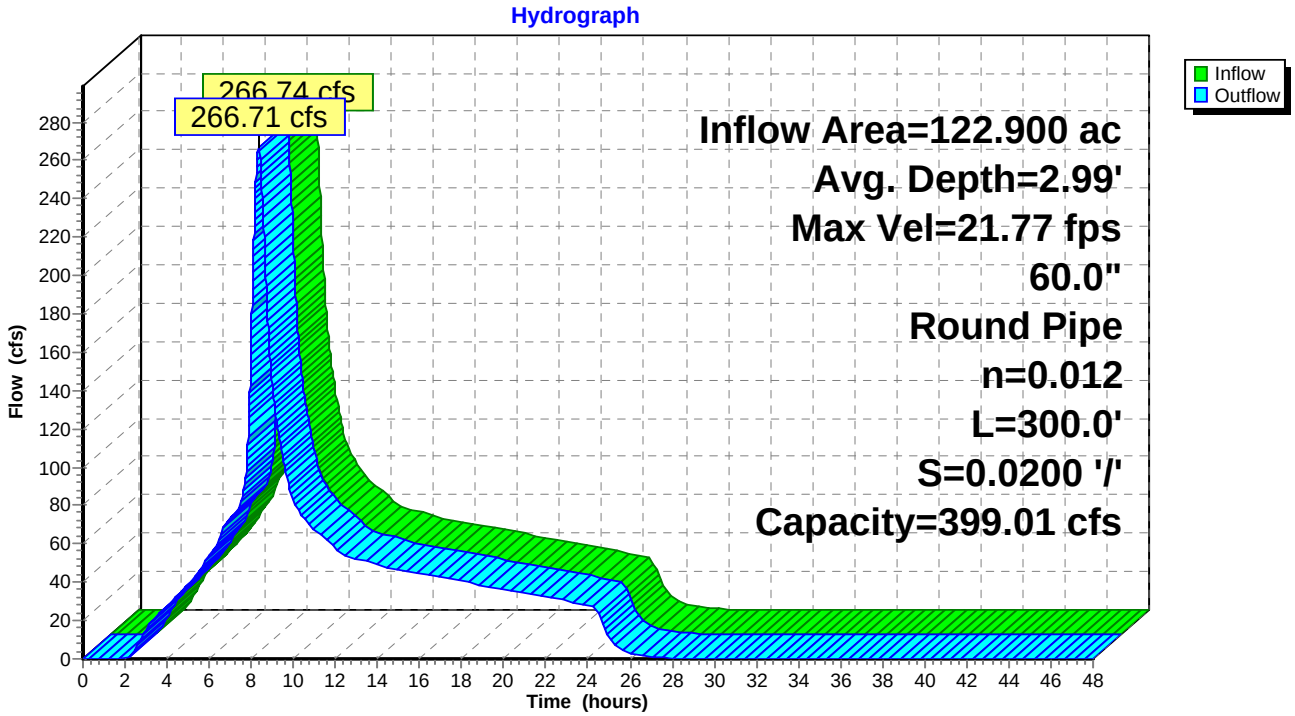
Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Max. Velocity= 21.77 fps, Min. Travel Time= 0.2 min
Avg. Velocity = 9.24 fps, Avg. Travel Time= 0.5 min

Peak Storage= 3,676 cf @ 8.34 hrs, Average Depth at Peak Storage= 2.99'
Bank-Full Depth= 5.00', Capacity at Bank-Full= 399.01 cfs

60.0" Round Pipe
n= 0.012 Concrete pipe, finished
Length= 300.0' Slope= 0.0200 '/'
Inlet Invert= 76.00', Outlet Invert= 70.00'



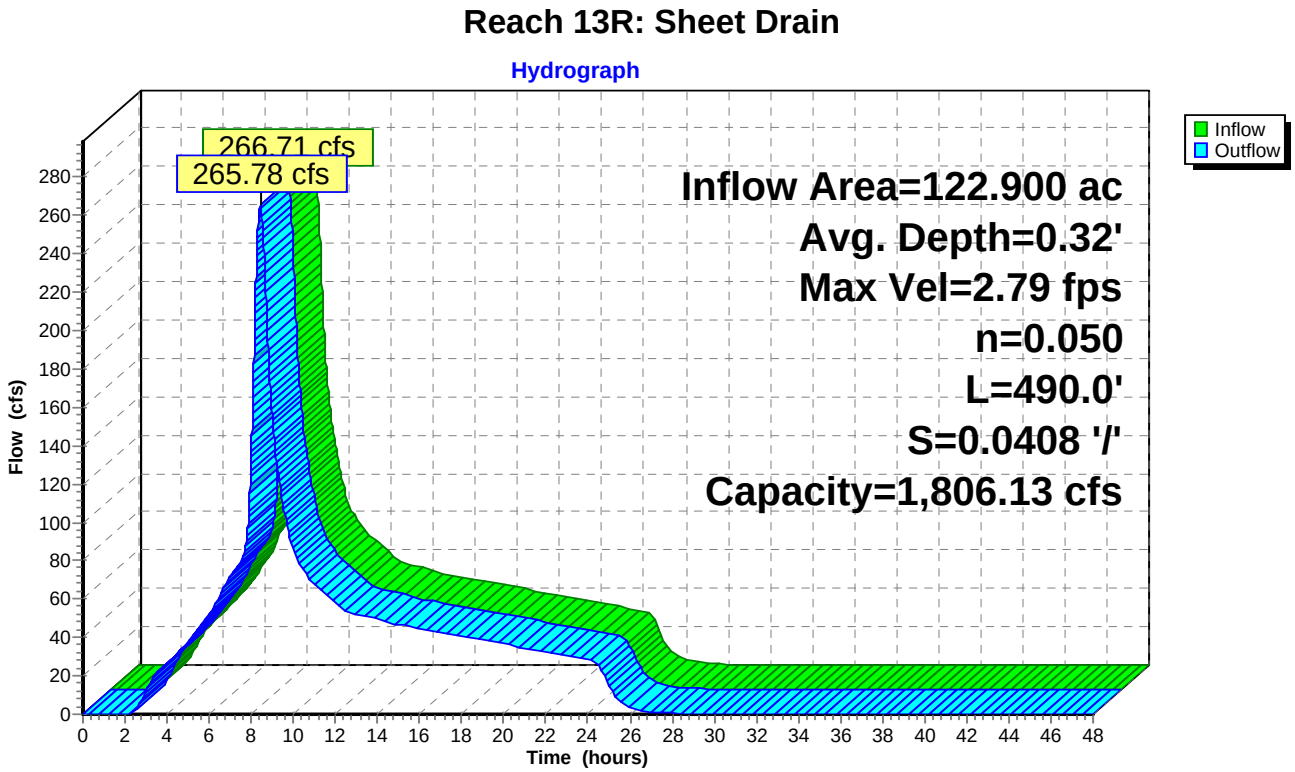
Reach 12R: WQ Pond Culv



Summary for Reach 13R: Sheet Drain

Inflow Area = 122.900 ac, 4.07% Impervious, Inflow Depth = 10.00" for 100 yr event
Inflow = 266.71 cfs @ 8.34 hrs, Volume= 102.435 af
Outflow = 265.78 cfs @ 8.42 hrs, Volume= 102.435 af, Atten= 0%, Lag= 4.8 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Max. Velocity= 2.79 fps, Min. Travel Time= 2.9 min
Avg. Velocity = 0.89 fps, Avg. Travel Time= 9.1 min

Peak Storage= 46,754 cf @ 8.37 hrs, Average Depth at Peak Storage= 0.32'
Bank-Full Depth= 1.00', Capacity at Bank-Full= 1,806.13 cfs

300.00' x 1.00' deep channel, n= 0.050 Scattered brush, heavy weeds
Side Slope Z-value= 3.0 '/' Top Width= 306.00'
Length= 490.0' Slope= 0.0408 '/'
Inlet Invert= 70.00', Outlet Invert= 50.00'