Master Development Drainage Plan
Sentinel Ridge at the
Garden of the Gods Club

Colorado Springs, Colorado

Kiowa Engineering Corporation

Master Development Drainage Plan
Sentinel Ridge at the
Garden of the Gods Club

Colorado Springs, Colorado

Prepared For:

Sunshine Company
3310 Mesa Road Suite 150
Colorado Springs, Colorado 80904

Prepared By:

Kiowa Engineering Corporation
1604 South 21st Street
Colorado Springs, Colorado 80904

January 2008
Revised September 2008
Revised October 1, 2008
Project No. 07028

ENGINEER'S STATEMENT:

The attached drainage plan and report was prepared under my direction and supervision and are correct to the best of my knowledge and belief. Said drainage report has been prepared according to the criteria established by the City for drainage reports and said report is in conformity with the master plan of the drainage basin. I accept responsibility for any liability caused by any negligent acts, errors and omissions on my part in preparing this report.

Kiowa Engineering Corporation, 1604 South 21st Street, Colorado Springs, CO 80904

Richard N. Wray
Registered Engineer #19310

Date 10/1/08

OWNER'S STATEMENT:

The Owner and/or his representative has read and will comply with all of the requirements specified in this drainage report and plan.

BY: _____ Date 10/4/8

ADDRESS:

~~Sunshine Company~~ Garden of the Gods Club LLC

3310 Mesa Road Suite 150

Colorado Springs, CO 80904

CITY OF COLORADO SPRINGS

Filed in accordance with Section 7.7.906 of the Code of the City of Colorado Springs, 2001, as amended.

City Engineer

10/10/08
Dated

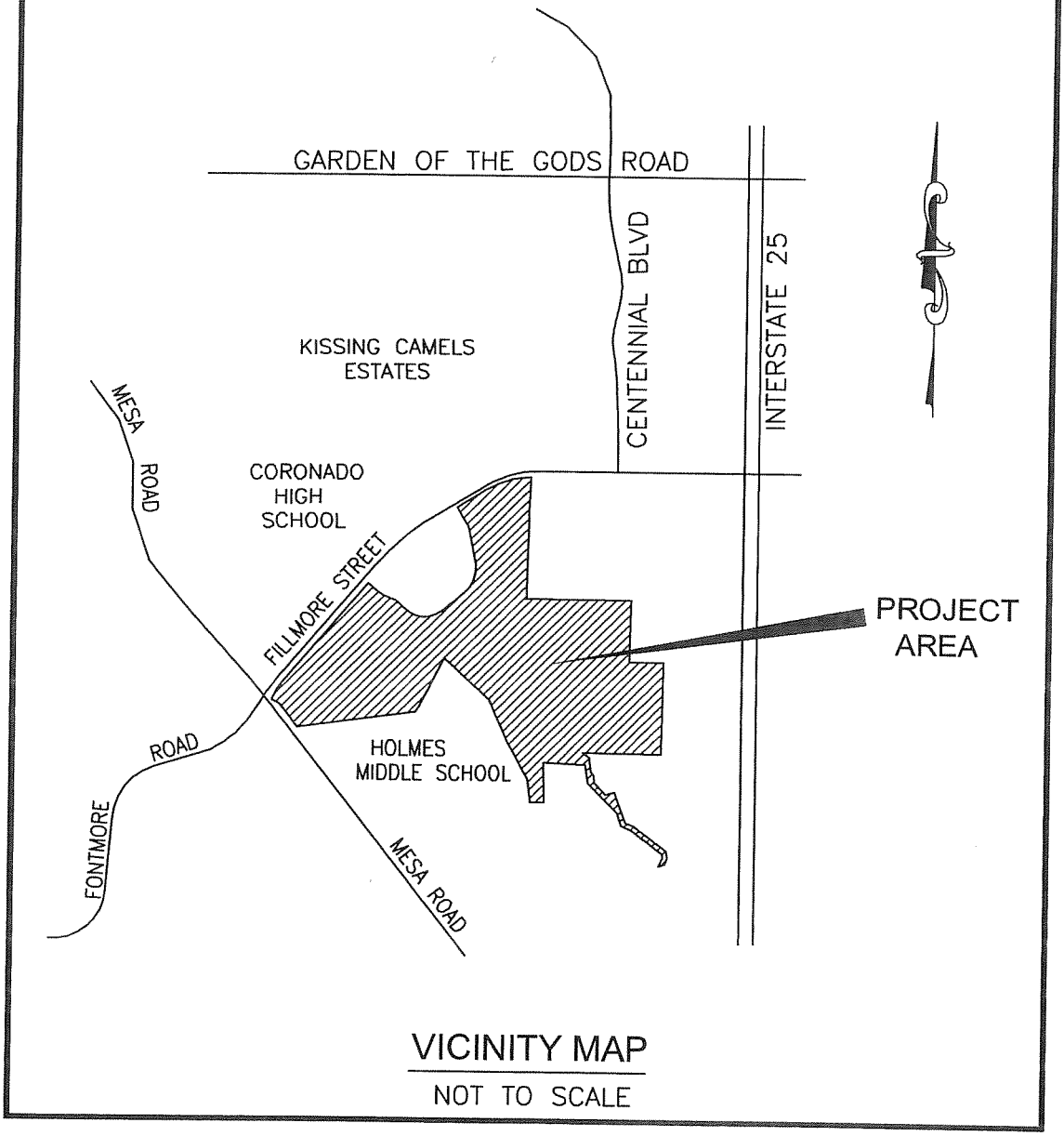
PROJECT DESCRIPTION

The Sentinel Ridge at Garden of the Gods Club will be a varying density residential development located south of West Fillmore Street and west of Centennial Boulevard west-central Colorado Springs. The land encompassed by the Sentinel Ridge project as formerly contained within the ownership of Hill Development. The property will be broken into individual filings as phased development occurs. The overall property subject to this master development drainage plan covers 137 acres. Sentinel Ridge West at the Garden of the Gods Club Filing No. 1 will be the first phase, and covers approximately 40 acres. A separate final drainage report will be prepared for Filing No. 1 and submitted concurrently with this master development drainage plan.

The property is located within portions of Sections 35 and 36 Township 13 South Range 67 West of the 6th Principal Meridian, in Colorado Springs, Colorado. The property is bounded on the south, southwest and east by undeveloped land that is owned by School District 11, privately held parcels and by the City of Colorado Springs and on the northwest by Fillmore Street. The estimated total of the developable land within Sentinel Ridge is 90 acres. The location of the site is shown on Figure 1.

The site lies within the Mesa Drainage basin. The site is drained by two forks of the Mesa Basin Drainageway the flow in generally a southerly direction. The two branches have been termed the as East Fork Mesa Basin and the West Fork Mesa Basin in this master development drainage plan (MDDP). Both of these drainageways are relatively steep with longitudinal gradients ranging from 3 to 5 percent. The East Fork is unimproved with only one stream crossing within the limits of the project. The West Fork is mostly unimproved except at the outfall point from the site where the drainageway enters an existing detention basin.

Soils within the property are classified to be within Hydrologic Soils Group A as shown in the El Paso County Soils Survey. A very small portion of the project area has Hydrologic soils classified as D. The type D soils occur mostly of the slopes of the terraces and mesas. The soils are classified as Ascalon sand and Chaseville sandy gravels. These soils are very well drained and have relatively low runoff curve numbers (i.e., 50 to 60) depending upon vegetative cover and condition. The existing vegetative cover within the area subject to development is in good condition on the mesa areas and poor to fair on the side slopes of the mesas. The mesas and side slopes are vegetated with mostly native grasses and shrubs. There are areas of wetland habitat within the property that occur mainly along the East and West forks of the Mesa Basin drainageway.



VICINITY MAP

NOT TO SCALE

Kiowa Engineering Corporation

1604 South 21st Street
Colorado Springs, Colorado
80904-4208
(719) 630-7342

SENTINEL RIDGE

COLORADO SPRINGS, COLORADO

FIGURE 1

PROJECT NO.: 07028
DATE: 12/26/07
DESIGN: RNW
REVISIONS:

PREVIOUS REPORTS

The following reports and plans were reviewed in the process of preparing this master development drainage plan:

1. Soil Survey for El Paso County, Colorado, dated June 1981.

2. "City of Colorado Springs/El Paso County Drainage Criteria Manual", prepared by City of Colorado Springs, El Paso County, dated May 1987, revised 1996.

3. "Flood Insurance Studies for Colorado Springs, and El Paso County, Colorado", prepared by the Federal Emergency Management Agency (FEMA), revised March, 1997.

4. Mesa Drainage Basin Drainage Basin Planning Study, prepared GMS, Inc., dated September 1989.

5. Master Development Drainage Plan for Hill Properties, prepared by Rockwell-Minchow Consultants, Inc. dated October 1995.

6. Preliminary and Final Drainage Report for Grand Vista Filing No. 1, prepared by Rockwell-Minchow Consultants, Inc. dated December 1995.

7. Final Design Report and Final Design Plans, Mesa Drainage Basin Detention Basin 5A and 5B, prepared by Kiowa Engineering, Inc. dated March 2000.

Reference 5 was prepared for the City of Colorado Springs and has been used in the planning of major drainageway facilities within the basin since the time that it was approved. This DBPS identified drainageway improvements and detention storage sites within entire basin, several of which were shown within the Hill Development property, and two within the limits of Sentinel Ridge. All of the detention basins in the DBPS that were shown north of West Fillmore have been built as the Hill Development holdings have been developed. The DBPS called for a detention basin on the West Fork located at design point 14 of this MDDP. Design point 14 coincides with design point 26 of the DBPS. This detention basin was built in 2001. On the East Fork, Detention basin 5B was proposed in the DBPS. Detention basin 5B was built in 1999. Downstream of Fillmore along the East Fork five off-stream detention basins and 1 on-stream detention basin were proposed that would lie within Sentinel Ridge. None of the detention basins on the East Fork downstream of Fillmore Street have been constructed at this time. The East Fork drainageway was proposed in the DBPS to remain in its natural condition. Selective areas of bank lining were shown in the DBPS in order to maintain the lateral stability of the West Fork, however none of the locations shown in the DBPS lie within Sentinel Ridge. No major roadway crossings were shown in the DBPS within the Sentinel Ridge property.

Reference 5 was prepared for Hill Development and covers the entire property that was owned by Hill Development, including Sentinel Ridge. This MDDP was used as a supplement to Reference 4, and identified alternative detention storage sites. Two of the regional detention sites north of Fillmore Street, namely detention basins 5A and 5B were constructed in order to achieve the hydrologic goals put forth in Reference 4. Reference 5 was also prepared in order to address changes in the land use patterns from those assumed when Reference 4 was prepared and to assess the affects of development upon the hydrology and in turn the major drainageways of the Mesa Basin drainage basin.

Reference 6 was completed when the multi-family development project known as Grand Vista was advanced through the development planning process. The detention basin noted as detention basin 14 in this report was designed and built as part of the Grand Vista project. Detention basin 14 is owned and operated by the City of Colorado Springs and designed to accommodate the developed runoff from Grand Vista as well as area offsite from Grand Vista that included the Sentinel Ridge property.

Reference 7 was prepared in order to supplement the analyses contained within References 4 and 5 and to provide the hydrologic and hydraulic information needed to design detention basin 5A and 5B. These detention basins are owned and operated by the owner of the Garden of the Gods Club and provides regional storage of developed runoff and water quality volume for the portion of Mesa Basin that were then part of the Hill Development holdings. As part of the development of the Grandview Marketplace that lies east of detention basin 5B and north of West Fillmore Street, a water quality grate and trash rack were added to the outlet structure of detention basin 5B. The hydrology model was updated in order to revise the storage and outflow curve so that the water quality storage aspect of the detention basin was accounted for.

EXISTING BASIN CONDITIONS

Contained within map pocket of this report is Exhibit 1 that displays the hydrologic sub-basins and peak discharges for all the sub-basins and design points within Sentinel Ridge. Sub-basin and design points were developed in this MDDP to coincide with the sub-basins and design points depicted in the DBPS so that hydrologic comparisons could be made. Offsite design points and sub-basins are also presented on Exhibit 1. The 100-year floodplain for the East and West forks are presented on Exhibit 1.

Five sub-basins were delineated within Sentinel Ridge in order to assess the existing hydrologic conditions. Fours sub-basins were delineated that are tributary to the

East Fork (i.e., sub-basins M17.1, M17.2, M18.1 and M18.2), and one sub-basin delineated for the West Fork, (sub-basin M14). Each of these sub-basins can be characterized as watersheds that have terraces with slopes varying from one to five percent, and slopes off of the terraces ranging from 10 to 30 percent. Per the soil survey, the side slopes of the terraces have soils classified in the Hydrologic Soil class D, and the terraces themselves have soils classified into Hydrologic soils class A. Both the East and the West forks of the Mesa Basin drainageway are unimproved except for an outfall structure that was built with detention basin 14 on the West Fork, and a utility crossing over the East Fork at design point 18.1.

Presented on Table 1 is a comparison of the peak discharges for the existing development condition between this MMDP and the DBPS. The variance in the discharges between the DBPS and the MDDP are mostly attributable differences in methodology, basin divides, land use assumptions and whether or not detention storage was modeled. A good correlation in discharge between the DBPS and the MDDP was obtained at the inflow point to detention basin 5B. All of the other points of comparison do not show any strong correlations. The existing condition discharges obtained for this MDDP and Reference 6 correlate closely at each of the West Fork design points on Fillmore Street.

PROPOSED BASIN DESCRIPTIONS

Two major flow paths with five sub-basins on the East Fork and three sub-basins on the West Fork were defined in order to estimate runoff rates for the proposed development condition. The sub-basins and design points for the proposed conditions are displayed on Exhibit 2 that is contained within the map pocket of this report. The 100-year floodplain for the East and West forks are presented on Exhibit 1. A description of each sub-basin follows.

Sub-basin M14A: This sub-basin is comprised mostly of the natural drainageways and valley with a small portion of single-family development proposed for about ten percent of the total sub-basin area. The sub-basin covers 20.2 acres. Contained within this sub-basin is existing detention basin 14 that was built with the Grand Vista apartment project was developed. The drainageways through this sub-basin are both unimproved but stable as they outfall to detention basin 14. Within the DBPS pipe outfalls were called for to carry runoff arriving at design points 10 and 13 (DBPS design points 20 and 25, respectively) to the existing detention basin at design point 14. Due to the wetland resources along these drainageways it was decided to not outfall the runoff

Table 1: Comparison of DBPS and MDDP Design Point Discharges
Sentinel Ridge at Garden of the Gods Club Master Development Drainage Plan

DBPS DP NO.	Discharge (4) 5 year	100-year	EQUIV. MDDP DP NO.	Discharge (4) 5 year	100-year
20	75	136	10	20	68
25	10	19	13	30	155
26 (3)	93	302	14	54	245
9 (1)	212	647	5B	176	729
12 (2)	193	375	18.1	111	261

Notes:

(1) Inflow to detention basin 5B

(2) DBPS discharges do not reflect storage in detention basin 5B

(3) DBPS discharges do not reflect storage in detention basins within Kissing Camels Golf course

(4) 24-hour duration Type IIA storm

from design points 10 and 13 via a storm sewer in favor of utilizing the natural swales described above. Soils in this basin are mostly Type A, with Type D soils occurring on slopes of the terraces. Surface soils in the areas that will be subject to grading were assumed to be Type B. The development will occur on the terraces, and will consist of single-family residential homes accessed by public streets. Three local storm sewers will pass into this sub-basin and outfall to the West Fork Mesa Basin channel. The 5-year and 100-year discharges for this sub-basin are estimated at 1 and 11 cubic feet per second, respectively.

Sub-basin M14C: This sub-basin will be comprised mostly of single-family development proposed for the majority of the area but a small neighborhood park is proposed near design point 14.1. This sub-basin covers 13.9 acres. This sub-basin will be drained to inlets within a low point at design point 13.1 and then to a storm sewer that will convey the 100-year discharge to the West Fork Mesa Basin downstream of design point 13.2. Soils in this sub-basin are mostly Type A, but were assumed to be Type B in the developed condition. Slopes in this sub-basin are expected to range from 2 to 4 percent. Offsite runoff enters the basin at design point 13 via a 48-inch storm sewer that conveys runoff from areas west of Fillmore Street. The 5-year and 100-year discharges for this sub-basin are estimated at 7 and 31 cubic feet per second, respectively.

Sub-basin M14D: This sub-basin will be comprised mostly of single-family development. This sub-basin covers 7.9 acres. This sub-basin will be drained to inlets within a low point at design point 14.1 then to a storm sewer that will convey the 100-year discharge to the West Fork Mesa Basin downstream of design point 14.2. Soils in this sub-basin are mostly Type A, but were assumed to be Type B in the developed condition. Slopes in this sub-basin are expected to range from 2 to 4 percent. Offsite runoff enters the basin at design point 14.1 via a 36-inch storm sewer that conveys runoff from areas west of Fillmore Street as well as the runoff from the Grand Vista apartment complex. The 5-year and 100-year discharges for this sub-basin are estimated at 6 and 19 cubic feet per second, respectively.

Sub-basin M17A: This sub-basin will be comprised mostly of the natural terrace slopes that cover a third of the basin with the balance of the area being developed into office and commercial uses. The majority of this sub-basin does not lie within Sentinel Ridge but will outfall to the East Fork Mesa Basin at design point 17.1 that does lie within Sentinel Ridge. It has been assumed that this sub-basin will discharge to the East

Fork at fully developed condition rates of runoff. The sub-basin covers 24.7 acres. Soils in this basin are comprised of Type D soils occurring on slopes of the terraces and Type B soils for the area that will be subject to grading. The development will occur on the terrace and will consist of office/commercial uses. The 5-year and 100-year discharges for this sub-basin are estimated at 40 and 91 cubic feet per second, respectively.

Sub-basin M17B: This sub-basin will be comprised mostly of the natural terrace slopes that cover almost two-thirds of the basin with the balance of the area being developed into office and commercial uses. It has been assumed that this sub-basin will discharge to the East Fork at fully developed condition rates of runoff carried to the drainageway by a storm sewer. Offsite runoff from areas west of Fillmore Street will enter this sub-basin at design point 5B via the 36-inch outlet pipe from detention basin 5B. The East Fork drainageway through this sub-basin is unimproved but stable. Wetland vegetation exists along the drainageway. The sub-basin covers 19.5 acres. Soils in this basin are comprised of Type D soils occurring on slopes of the terraces and Type B soils for the area that will be subject to grading. The development that will occur on the terrace has been assumed to consist of office/commercial uses. The 5-year and 100-year discharges for this sub-basin are estimated at 24 and 64 cubic feet per second, respectively.

Sub-basin M18A: This sub-basin will be comprised mostly of the natural terrace slopes that cover most of the sub-basin with a very small portion area being developed into office or commercial uses. Approximately one-third of the sub-basin is comprised of area that is offsite from Sentinel Ridge and will outfall to the East Fork Mesa Basin at design point 18.1. The East Fork drainageway through this sub-basin is unimproved but stable. Wetland vegetation exists along the drainageway. It has been assumed that this sub-basin will discharge to the East Fork at fully developed condition rates of runoff. The sub-basin covers 22.7 acres. Soils in this basin are comprised of Type D soils occurring on slopes of the terraces and Type B soils for the area that will be subject to grading.

Sub-basin M18B: This sub-basin will be comprised mostly of the natural and graded terrace slopes that cover most of the sub-basin. A public roadway is proposed to cross through this sub-basin. The embankment of this roadway will form the impoundment for detention basin 18.1. This sub-basin will be drained via public streets to inlets within at the low point located at design point 18.1. At the low point a storm

sewer will convey the 100-year discharge to detention basin 18.1. The sub-basin covers 13.2 acres. Soils in this basin are comprised of Type D soils occurring on slopes of the terraces and Type B soils for the area that will be subject to grading. The 5-year and 100-year discharges for this sub-basin are estimated at 1 and 12 cubic feet per second, respectively.

Sub-basin M18C: This sub-basin will be comprised mostly of single-family development proposed for the majority of the area. This sub-basin covers 20.1 acres. This sub-basin will be drained via public streets to inlets within at the terminus of the cul-de-sac shown on Exhibit 2. At this point a storm sewer will convey the 100-year discharge to the East Fork Mesa Basin upstream of design point 18.2. It has been assumed that this sub-basin will discharge to the East Fork at fully developed condition rates of runoff. The impact of the development within this sub-basin upon peak discharges will be addressed by over-detaining the developed runoff that reaches design point 18.1, so that the 100-year existing rate of runoff at design point 18.2 can be maintained at 279 cubic feet per second. Soils in this sub-basin are mostly Type A, but were assumed to be Type B in the developed condition. Slopes in this sub-basin are expected to range from 2 to 4 percent. The 5-year and 100-year discharges for this sub-basin are estimated at 18 and 53 cubic feet per second, respectively.

Sub-basin M18D: This sub-basin will be comprised mostly of the natural terrace slopes that cover most of the sub-basin with approximately one-fourth of the sub-basin being developed with single-family homes. The East Fork drainageway through this sub-basin is unimproved but stable. Wetland vegetation exists along the drainageway. It has been assumed that this sub-basin will discharge to the East Fork at fully developed condition rates of runoff. The impact of the development within this sub-basin upon peak discharges will be addressed by over-detaining the developed runoff that reaches design point 18.1, so that the 100-year existing rate of runoff at design point 18.2 can be maintained at 279 cubic feet per second. The sub-basin covers 24.7 acres. Soils in this basin are comprised of Type D soils occurring on slopes of the terraces and Type B soils for the area that will be subject to grading. The 5-year and 100-year discharges for this sub-basin are estimated at 28 and 78 cubic feet per second, respectively.

HYDROLOGY

The onsite hydrology for the site was estimated using the methods outlined in the City/County Storm Drainage Criteria Manual. Topographic mapping was prepared in

June 2007. The mapping was compiled from a field survey at a one-foot contour interval and a horizontal scale of 100-feet. The mapping was used to verify the onsite and offsite sub-basin boundaries. The evaluation of offsite runoff that reaches the site was conducted using field review and FIMS mapping.

The hydrologic analysis for the sub-basins contained within the Sentinel Ridge property was completed using the U. S. Army Corps of Engineers HEC-1 Flood Hydrograph Program. This method was used to estimate peak discharges for the 5- and 100-year frequencies for the existing and proposed development conditions. The peak flow data and volumes generated using HEC-1 were used to size storm sewers within the project subdivision, evaluate major drainageway improvements for the East and West forks, to verify the capacity of detention basin 14, and to size detention storage for the area tributary to the East Fork. The drainage basin area, time of concentration, and rainfall intensity were determined for each of the sub-basins within the property. Because of the small acreages associated some of the sub-basin a ten-minute minimum time of concentration was applied to the sub-basins that were less than 5 acres in size. For the estimation of runoff, curve numbers as supplied in Table 5-5 of the DCM were used in the hydrograph model. Presented on Exhibits 1 and 2 is the existing and proposed condition sub-basin boundaries and peak discharges for the various sub-basins and design points within and adjacent to Sentinel Ridge. Peak discharges for each sub-basin and design points are presented in the calculations contained within Appendix.

HYDRAULICS AND PROPOSED FACILITIES

The evaluation related to the sizing of the onsite drainage improvements were carried out in accordance with the City/County Storm Drainage Criteria Manual. The capacities of the proposed onsite facilities were calculated in accordance with the Criteria Manual. The developed portions of the site will be drained primarily via sheet flow into the public streets. Once the street capacity has been reached, inlets will be provided that will collect the surface runoff and covey it to storm sewer. All inlets and storm sewers should be sized to collect and convey the 100-year runoff, thus minimizing the potential for overflow onto terrace slopes. The size, type and locations of the proposed stormwater collection facilities are presented on Exhibit 3.

The East and West Fork major drainageways are proposed to remain in their present location and cross-section. Geotechnical concerns regarding slope stability issues related to the terraces above the drainageways requires that minimal disturbance be affected at the toe of the terrace slopes. Also it is necessary to prevent the invert of the major drainageways from degrading and dropping in elevation. It has therefore been

proposed to construct check structures at the general locations shown on the plan and profiles. It is further recommended that the checks be constructed from soil cement so that they can withstand overtopping in a major event. Finally, soil/riprap bank linings should be constructed at outside bends of each drainageway where the stability of the terrace slope above could be comprised by bank sloughing. The location of the selective bank lining has been shown on the plan and profiles, along with typical bank and check sections.

Stormwater detention needs to be implemented within the Sentinel Ridge site so that peak rates of runoff can be maintained at present levels. Due to the clustering of the development activities on the top of the terraces there are limited locations to implement stormwater detention basins. There is also a geotechnical concern regarding the storage of stormwater on the terraces as it relates to slope stability. On the West Fork, detention basin 14 functions to limit discharges from the developed areas to historic conditions. Hydrologic modeling of detention basin 14 confirmed that the present embankment and outlet structure is sufficient to detain and route the runoff collected from the area downstream of Fillmore Street, including Sentinel Ridge and discharge the runoff to the West Fork at historic conditions.

On the East Fork a stormwater detention basin is proposed upstream of design point 18.1. At this point along the drainageway a roadway crossing is proposed. It is recommended that the roadway's embankment be engineered so as to function as stormwater impoundment as well. A phased outlet structure is proposed to limit the discharge from the detention basin to below historic conditions thereby over-detain so that the development downstream of design point 18.1 can be discharged directly to the East Fork without causing the rates of runoff at design point 18.2 to exceed historic levels. An on-stream detention basin was proposed in the DBPS near this location. The detention storage areas shown in the DBPS on the terrace slopes are not recommended due to slope stability and construction issues. An emergency spillway needs to be provided in order to prevent the roadway from being overtopped should the principal outlet become blocked. The location of this detention basin is shown on Exhibit 3 and on the plan and profiles.

The required improvements to the East Fork drainageway between design points 17.1 and 17.2 are to be provided by the owner of the underlying property at the time of development. It is envisioned that selective banks linings and grade control will be needed similar in nature to those proposed for the East Fork in this MDDP.

The East Fork below design point 18.2 is currently and will remain under the ownerships and maintenance of the City of Colorado Springs. It will function as a

natural drainageway in order to preserve the wetland, riparian and flood plain habitat that exists along this reach of the East Fork. In the future selective bank lining and grade control may be needed to stabilize the invert and banks, but at this time the drainageway is generally stable.

The West Fork below design point 14 is currently and will remain under the ownerships and maintenance of the City of Colorado Springs. It will function as a natural drainageway in order to preserve the wetland, riparian and flood plain habitat that exists along this reach of the West Fork. As part of the Sentinel Ridge project it is proposed to provide a grade control structure and selective bank lining at the outlet side of the existing detention basin at design point 14. These improvements are needed to stabilize the invert and banks in this location that are currently being affected by erosion. Below this point selective bank lining and grade control may be needed to stabilize the invert and banks, but at this time the drainageway is generally stable.

FLOODPLAIN STATEMENT

Shown on Figure 2 is the City of Colorado Springs and El Paso County Flood Insurance Study FIRM panel that covers the area encompassed by the Sentinel Ridge project site. There are areas within the proposed site that lie within a delineated 100-year or 500-year floodplain. The floodplain for the West Fork as depicted in the most current version of the City of Colorado Springs flood insurance study, including map revisions, is shown on all of the exhibits contained within this MDDP. There are no habitable structures that currently or will be proposed to lie within the 100-yaer floodplain of the West Fork Mesa Basin drainageway. Should improvements to drainageway such as channel and invert linings, relocations to the flow path, or roadway crossing be proposed, a letter of map revision may have to be submitted to FEMA if changes to the base flood elevation of floodway limits are proposed.

DRAINAGE FEES

The site lies within the Mesa Basin Drainage Basin. Drainage and bridge and fees have been established for this basin. As such drainage and bridge fees will be due when platting of parcels within Sentinel Ridge occurs. The cost of construction of major drainageway improvements that were identified in the DBPS can be used to offset drainage fees.

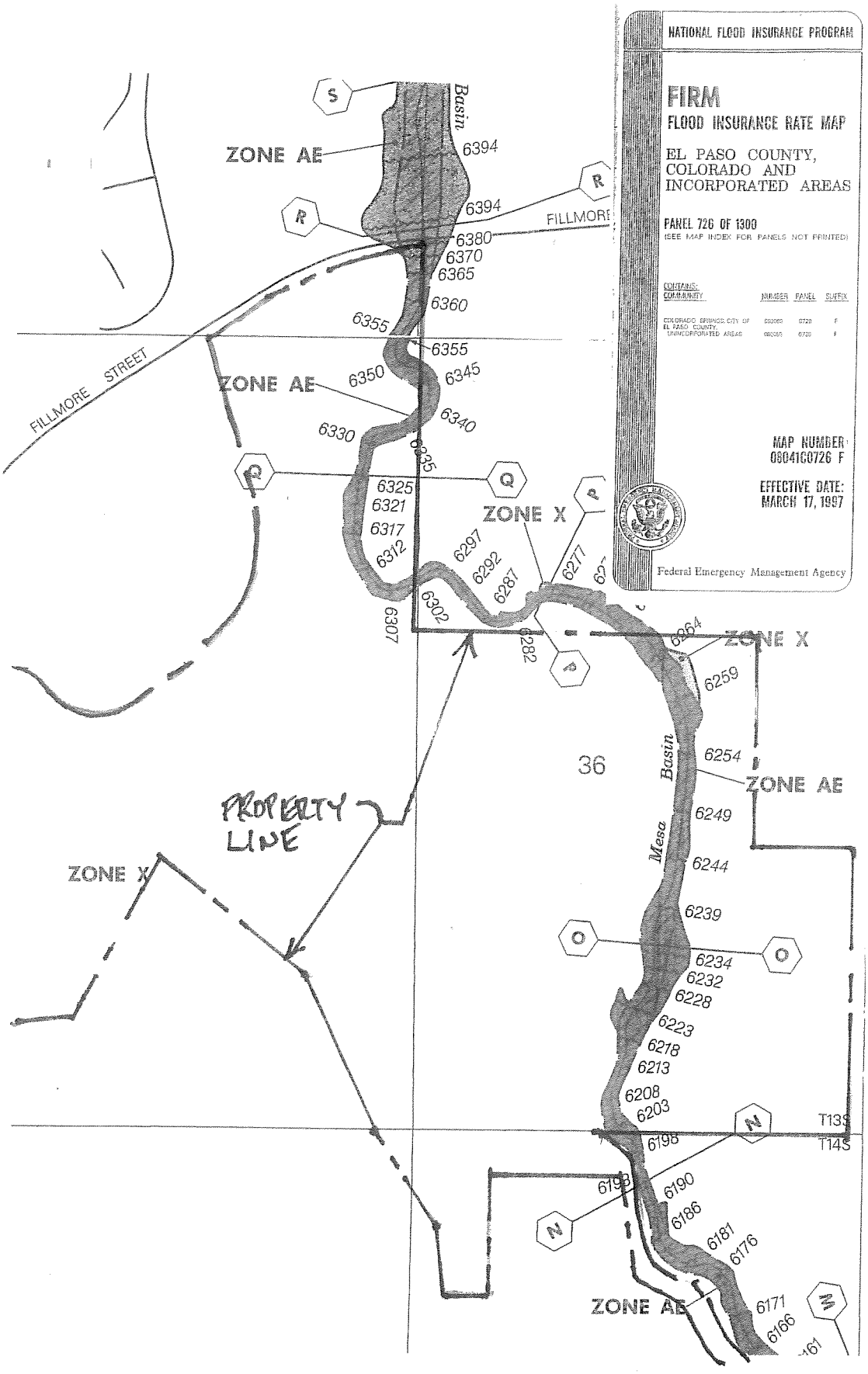


FIGURE 2
FLOODPLAIN INFORMATION

DRAINAGE FACILTY COSTS

Presented on Table 2 is a summary of the costs for the major drainageways, detention storage and local storm sewer systems shown on Exhibit 3. The improvements to the major drainageways and the regional detention storage would be subject to reimbursement or could be used as credit against drainage fees owed once approved and accepted by the City of Colorado Springs.

WATER QUALITY MEASURES

As required by the City in Volume 2 of the Drainage Criteria Manual, water quality measures need to be introduced in new developments in order to reduce the detrimental effects of impervious areas upon stormwater runoff. The water quality measures that will be instituted for the Sentinel Ridge project will be phased into interim and permanent facilities.

The existing detention basin at design point 14 was hydrological analyzed to check its ability to store the water quality capture volume generated by the portion of Sentinel Ridge that outfalls to it. It was found that the existing detention basin does have adequate volume to store the developed runoff and reduce it to historic conditions as well as store the required water quality capture volume from the tributary watershed.

The proposed detention basin at design point 18.1 has been sized to be able to store the water quality capture volume from the residential development within Sentinel Ridge that is tributary to it. Water quality capture volume will need to be provided for separately within the proposed commercial area shown on the Exhibits in sub-basin 17B. Water quality capture volume within sub-basin 17A will have to be provided for separately as well when the property within 17A that lies offsite from Sentinel Ridge develops.

Permanent and Interim water quality measures:

1. Within the areas proposed for residential development, it is recommend that the pervious area associated with each lot be disconnected from the street and storm sewer system. This can be achieved by directing roof leaders and runoff from driveways onto grassed areas.
2. Temporary sedimentation basins will be constructed at the outfall points of future subdivisions with the intent that they remain in place until all land disturbing activities tributary to the sediment basin reach final stabilization.
3. The check structures proposed for the West and East forks will slow the low flows along the drainageway and allow for percolation into the soil. This

Table 2: Summary of Storm Drainage Facility Costs
Sentinel Ridge at the Garden of the Gods Club Master Development Drainage Plan

Non-reimbursable storm sewer system costs

Item	Quantity	Units	Unit Cost	Estimated Cost
Storm Sewer Collection Systems				
4' Type 'R' Inlet	3	EA	$ 3,000.00	$ 9,000.00
6' Type 'R' Inlet	5	EA	$ 3,500.00	$ 17,500.00
8' Type 'R' Inlet	2	EA	$ 4,000.00	$ 8,000.00
10' Type 'R' Inlet	1	EA	$ 5,000.00	$ 5,000.00
Storm sewer manholes	2	EA	$ 3,500.00	$ 7,000.00
18" RCP CLIII	530	LF	$ 42.00	$ 22,260.00
24" RCP CL III	1,950	LF	$ 54.00	$ 105,300.00
			SUBTOTAL	**$ 174,060.00**
			10% Engineering	**$ 17,406.00**
			5% Contingency	**$ 8,703.00**
			TOTAL	**$ 200,169.00**

Reimbursable major drainageway and detention system costs

Item	Quantity	Units	Unit Cost	Estimated Cost
Storm Sewer Outfall Systems				
54" RCP CL III	520	LF	$ 150.00	$ 78,000.00
Junction structure	1	EA	$ 15,000.00	$ 15,000.00
Storm sewer oulet structure	1	EA	$ 10,000.00	$ 10,000.00
Detention Storage				
Storage pool and embankment construction	5	AF	$ 15,000.00	$ 75,000.00
Outlet Structure	1	EA	$ 8,000.00	$ 8,000.00
Outlet pipe: 48-inch RCP	160	LF	$ 120.00	$ 19,200.00
Storm sewer outlet structure	1	EA	$ 8,000.00	$ 8,000.00
Major Drainageway Structures				
Soil/riprap channel linings	1,390	LF	$ 250.00	$ 347,500.00
Soil cement check structures	12	EA	$ 20,000.00	$ 240,000.00
			SUBTOTAL	**$ 800,700.00**
			10% Engineering	**$ 80,070.00**
			5% Contingency	**$ 40,035.00**
			TOTAL	**$ 920,805.00**

combined with leaving the drainageway in the natural state will provide for treatment of urban stormwater that will be collected and conveyed by these drainageways.

4. Within the proposed commercial area shown in sub-basin M17B water quality capture can be provided prior to discharge to the storm sewer outfall system. Mechanical systems such as oil and grease separators and stormceptors, could be employed as well as surface retention. Retention of the water quality capture volume on the terraces will require that the receiving storage basin(s) be lined to prevent saturation of the soils beneath them.
5. Within outlying parking areas of the commercial site, porous pavement systems can be implemented to reduce the effective imperviousness of the site. As with the water quality storage areas, these pavement systems should be constructed with an under-drain system to prevent saturation of the soil beneath them.

EROSION CONTROL PLAN

The City of Colorado Springs and El Paso County Drainage Criteria Manual specifies that an Erosion Control Plan and associated cost estimate be submitted in conjunction with Final Drainage Report. It is requested on the behalf of the Owner that the Erosion Control Plan be submitted with the Final Construction Grading Plan upon which the cost for the erosion control will be shown. Assurances for the erosion control facilities will be posted as part of obtaining a grading permit.

CONCLUSIONS

The drainageway and detention storage facilities proposed in this MDDP will combine collect and convey runoff generated from the Sentinel Ridge development and the offsite areas that pass through it in a non-erosive manner and without out impact to the drainageways that lie downstream of the development. The major drainageway and storage facilities are in general conformance with those proposed in the DBPS.

The drainage improvements to the West Fork will be completed as Sentinel Ridge West at Garden of the Gods Club Filing No. 1 is developed. This includes the selective bank lining and grade control structure that lie downstream of the existing detention basin at design point 14.

The drainageway and detention facilities for the East Fork will be constructed as filings that are tributary to them are developed. Onsite storage could be implemented within the proposed commercial site that basin and thereby forego the need to construct the detention basin at design point 18.1. However the storage facility at design point 18.1

will need to be constructed prior to any development occurring within sub-basins M18C and M18D.

Any construction proposed that could affect the wetland areas delineated on the plans will need authorization from the U. S. Army Corps of Engineers. Contact will be made with the Corps as the final design plans for the drainageway improvements are prepared. A re-delineation for the wetland areas may be required if construction within these drainageways does not commence within five years.

APPENDIX A

HYDROLOGY CALCULATIONS

Kiowa Engineering Corporation

CLIENT Sentinel Ridge | JOB NO. 07028 | PAGE 1
PROJECT | DATE CHECKED | DATE 12/20/07
DETAIL | CHECKED BY | COMPUTED BY RWW

Hydrology - Future Conditions

Basin Data: WEST FARM

BASIN #	Area (ac)	CN	Land Use
M14.1	19.2	85	Apts / Multi Family
M14A	20.2	53	90% O/S; 10% SF Mix
M14B	9.1	71	7 SF Lots; 1.7 DU/Ac
M14C	8.6	69	18 SF lots; 2.1 DU/Ac
M14D	7.9	74	25 SF Lots; 3.2 DU/Ac

Soils assume all 'B'; except for Open space where A will remain

CN FOR A- soils, unless Paved; 50

B: Soils

Roadways: CN = 98

Multi-Family (> 8 lots/ac) CN = 85

COMMERCIAL = 92

Rev. 9/9/08

Hydrology - Future Conditions

Basin Data: East Fork

Basin #	Area (Ac)	CN	Land Use
M17A	24.7	89	2/3 OS/Comm; 1/3 Slopes
M17B	19.5 ~~25.5~~	84	1/3 Comm / 2/3 OS, slop
M18A	22.7	50	OS or Existing
M18B	15.2	40	80% OS; 20% Roads
M18C	20.1	78	SF + Roadways
M18D	24.7	82	80% O/S; 20% SF CN=75 (Ext CN)

Assume all 'B' Soils, except for Open Spaces where 'A' Soils will remain.

CN = 50 for OS, terraces (Hyd. Soils A)

CN = 82 for OS; Slopes (Hyd. Soils D)

TABLE 5-5
RUNOFF CURVE NUMBERS FOR HYDROLOGIC SOIL COVER COMPLEXES - URBAN AND SUBURBAN CONDITIONS 1/
(Antecedent Moisture Condition II)
(From: U.S. Dept. of Agriculture, Soil Conservation Service, 1977)

Land Use		Average % Impervious 3/	Hydrologic Soil Group A	B	C	D
Open spaces, lawns, parks, golf courses, cemeteries, etc.						
	Good condition: grass cover on 75% or more of the area		39*	61	74	80
	Fair condition: grass cover on 50% to 75% of the area		49*	69	79	84
Commercial and Business areas (85% Impervious)			89*	92	94	95
Industrial Districts 72% Impervious)			81*	88	91	93
Residential: 2/						
Acres per Dwelling Unit						
1/8 acre or less		65	77*	85	90	92
1/4 acre		38	61*	75	83	87
1/3 acre		30	57*	72	81	86
1/2 acre		25	54*	70	80	85
1 acre		20	51*	68	79	84
Paved parking lots, roofs, driveways, etc.			98	98	98	98
Streets and Roads:						
paved with curbs and storm sewers			98	98	98	98
gravel			76*	85	89	91
dirt			72*	82	87	89

1/ For a more detailed description of agricultural land use curve numbers, refer to the National Engineering Handbook (U.S. Dept. of Agriculture, Soil Conservation Service, 1972).
2/ Curve numbers are computed assuming the runoff from the house and driveway is directed towards the street with a minimum of roof water directed to lawns where additional infiltration could occur.
3/ The remaining pervious areas (lawn) are considered to be in good pasture condition for these curve numbers.

* Not to be used wherever overlot grading or filling is to occur.

Time of Concentration / Lag Time $T_{lag} = .6 T_c$

Basin #	Length	T_c* (min)	T_{lag} (hr)
M14A	1600	13.9	.139
M14B	—	10	.10
M14C	840	10.5	.105
M14D	2250	12.5	.125
M17A	(1)	—	.17
M17B	1600	13.9	.139
M18A	1820	15.1	.15
M18B	1720	14.6	.146
M18C	2450	18.6	.186
M18D	2250	12.5	.125

(1) Use existing runoff conditions.

* T_c = 10 min for all basins < 5 acres

T_c = Length of Basin / 180 (3 fps average travel time) + 5

```
1*****************************************
 *                                       *
 *   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *
 *               JUN   1998              *
 *            VERSION 4.1                *
 *                                       *
 *  RUN DATE   28DEC07  TIME  10:55:05   *
 *                                       *
 *****************************************
```

```
*****************************************
*                                       *
*    U.S. ARMY CORPS OF ENGINEERS       *
*    HYDROLOGIC ENGINEERING CENTER      *
*          609 SECOND STREET            *
*       DAVIS, CALIFORNIA 95616         *
*           (916) 756-1104              *
*                                       *
*****************************************
```

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

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

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

1

HEC-1 INPUT


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

  1           ID        MESA DRAINAGE BASIN                PROJECT NUMBER 07028
  2           ID        SENTINEL RIDGE MASTER DEVELOPMENT DRAINAGE PLAN
  3           ID        WEST FORK BRANCH
  4           ID        EXISTING DEVELOPMENT CONDITIONS WITH EXISTING DETENTION BASINS
  5           ID        5 AND 100-YEAR STORMS  24-HOUR TYPE IIA
  6           ID        KIOWA ENGINEERING CORPORATION      FILENAME WFSREX.DAT
              *DIAGRAM
  7           IT       4        0        0     288
  8           IO       5
  9           JR    PREC      .56     1.0

 10           KK    SBM7
 11           KM        RUNOFF FROM SUB-BASIM M7
 12           IN      15
```

WEST FORK EXISTING

```
 13          PB     4.1
 14          PC     0.0   .0005   .0015   .0030   .0045   .0060   .0080   .0100   .0120   .0143
 15          PC   .0165   .0188   .0210   .0233   .0255   .0278   .0320   .0390   .0460   .0530
 16          PC   .0600   .0750   .1000   .4000   .7000   .7250   .7500   .7650   .7800   .7900
 17          PC   .8000   .8100   .8200   .8250   .8300   .8350   .8400   .8450   .8500   .8550
 18          PC   .8600   .8638   .8675   .8713   .8750   .8788   .8825   .8863   .8900   .8938
 19          PC   .8975   .9013   .9050   .9083   .9115   .9148   .9180   .9210   .9240   .9270
 20          PC   .9300   .9325   .9350   .9375   .9400   .9425   .9450   .9475   .9500   .9525
 21          PC   .9550   .9575   .9600   .9625   .9650   .9675   .9700   .9725   .9750   .9775
 22          PC   .9800   .9813   .9825   .9838   .9850   .9863   .9875   .9888   .9900   .9913
 23          PC   .9963   .9975   .9988  1.0000
 24          BA   .0528
 25          LS      0      66
 26          UD    .27

 27          KK    RTM7
 28          KM        ROUTE RUNOFF FROM SUB-BASIN M7 TO DP 8
 29          RK    3000    .021     .03       0    TRAP      20      10

 30          KK    SBM8
 31          KM         RUNOFF FROM SUB-BASIN M8
 32          BA   .1243
 33          LS      0      66
 34          UD    .45

 35          KK   SBM11
 36          KM       RUNOFF FROM SUB-BASIN M11
 37          BA   .0467
 38          LS      0    71.6
 39          UD    .36

 40          KK   RTM11
 41          KM        ROUTE SUB-BASIN M11 TO DP 9
 42          RK    2600     .03     .03       0    TRAP       4       4

 43          KK     M9
 44          KM        RUNOFF FROM SUB-BASIN M9
 45          BA   .0844
 46          LS      0      69
 47          UD    .45
```



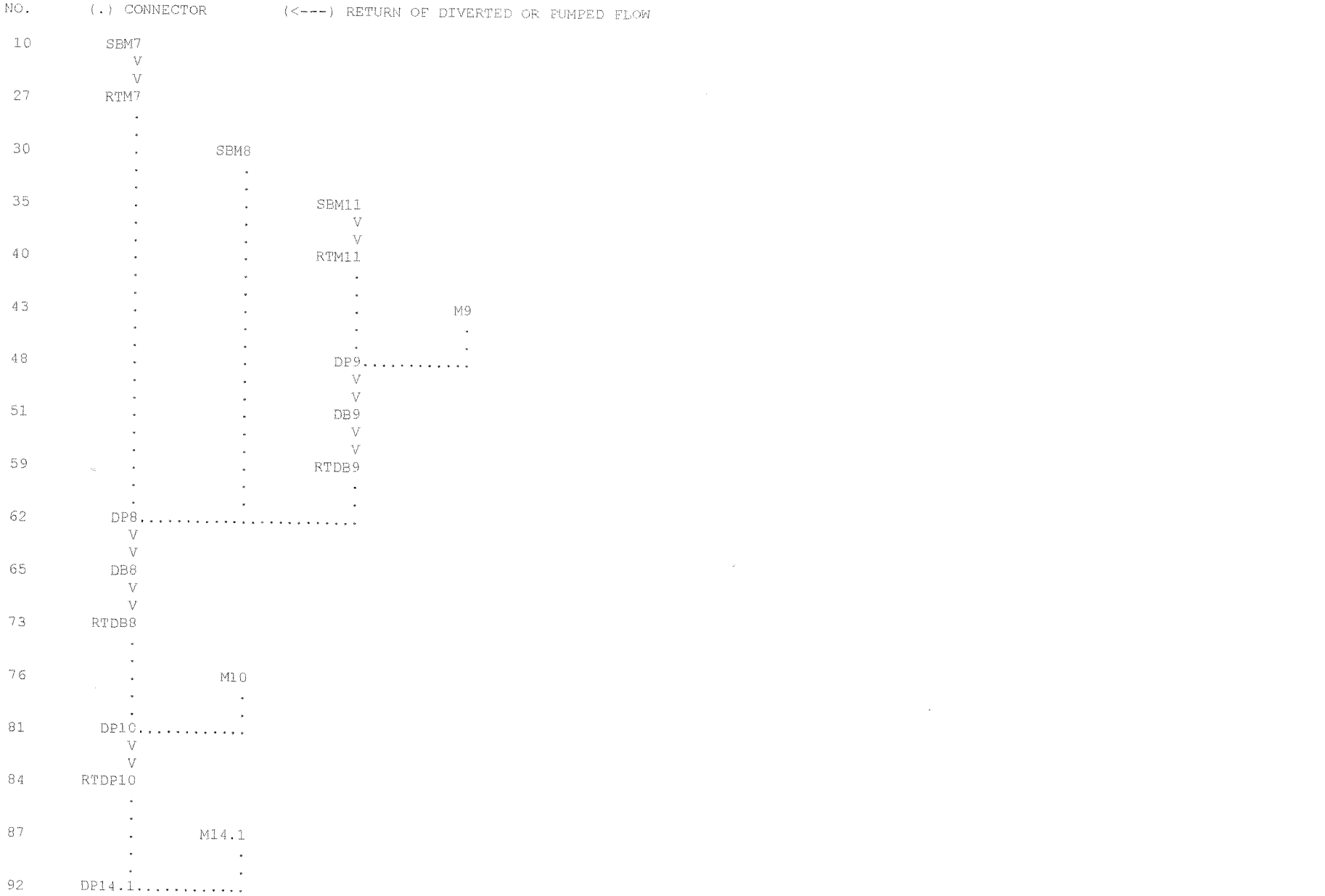
```
LINE          ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

 48          KK     DP9
 49          KM        COMBINE SMM9 AND RTM11
 50          HC       2

 51          KK     DB9
 52          KM        ROUTE FLOW FROM DP 9 THROUGH DETENTION BASIN DB 9
 53          RS       1    ELEV    6463
```

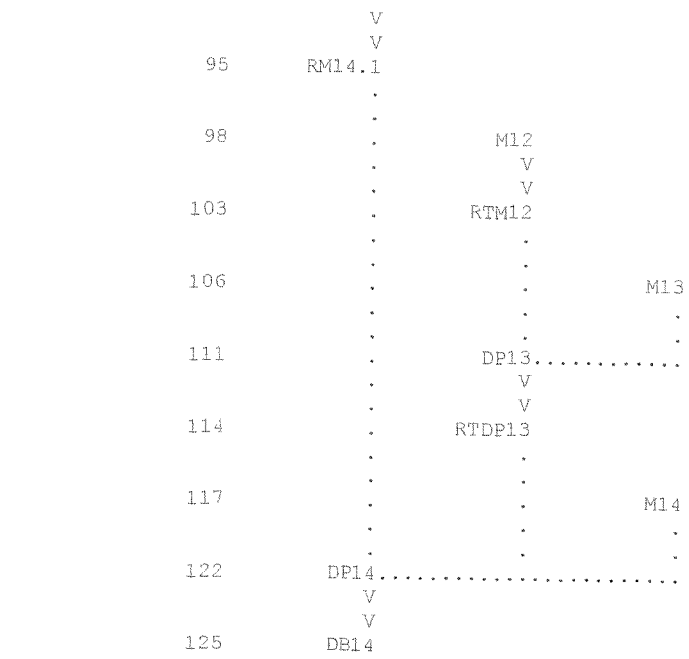
```
54          SQ       0      16      37      45     158
55          SA       0    .624    .701    .771       1
56          SE    6463    6465    6467    6468  6468.5
57          SS    6468      25       3     1.5
58          ST    6468     200       3     1.5

59          KK   RTDB9
60          KM        ROUTE OPUTFLOW FROM DB 9 TO DESIGN POINT 8
61          RK    1800    .025     .03       0    TRAP      20      10

62          KK     DP8
63          KM       COMBINE RTDB9, RTM7 AND SUB-BASIN M8
64          HC       3

65          KK     DB8
66          KM       ROUTER RUNOFF AT DP 8 THROUGH DETENTION BASIN DB8
67          RS       1    ELEV  6401.5
68          SQ       0     8.5      15      20     220
69          SA    2.12    2.35    2.73    3.25     3.5
70          SE    6402    6404    6406    6408  6408.5
71          SS    6406      25       3     1.5
72          ST    6408     200       3     1.5

73          KK   RTDB8
74          KM         ROUTE OUTFLOW FROM DETENTION BASIN 8 TO DP 10
75          RK    1300     .02    .013       0    CIRC    2.25

76          KK     M10
77          KM       RUNOFF FROM SUB-BASIN M10
78          BA   .0512
79          LS       0      77
80          UD     .35

81          KK    DP10
82          KM         COMBINE RUNOFF FROM SUB-BASIN M10 AND RTDB8
83          HC       2

84          KK  RTDP10
85          KM         ROUTE RUNOFF FROM DP 10 TO DP 14A
86          RK     800     .05    .013       0    CIRC       3

87          KK   M14.1
88          KM         RUNOFF FROM SUB-BASIN M14.1
89          BA    .012
90          LS       0      95
91          UD     .15
```



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

92          KK  DP14.1
```

```
  93          KM        COMBINE SUB-BASIN M14.1 AND RTDP10
  94          HC       2

  95          KK  RM14.1
  96          KM          ROUTE RUNOFF FROM DP 14.1 TO DP 14
  97          RK     800    .045     .04       0    TRAP       6       5

  98          KK     M12
  99          KM         RUNOFF FROM SUB-BASIN M12
 100          BA    .114
 101          LS       0      70
 102          UD     .43

 103          KK   RTM12
 104          KM         ROUTE RUNOFF FROM SB M12 TO DP 13
 105          RK    1700    .024    .024       0    TRAP       3       1

 106          KK     M13
 107          KM        RUNOFF FROM SUB-BASIN M13
 108          BA   .0949
 109          LS       0      67
 110          UD     .39

 111          KK    DP13
 112          KM         COMBINE RUNOFF FROM SB M13 AND RTM12
 113          HC       2

 114          KK  RTDP13
 115          KM          ROUTE RUNOFF AT DP 13 TO DP 14
 116          RK    1700    .029    .018       0    TRAP       8       1

 117          KK     M14
 118          KM        RUNOFF FROM SB M14
 119          BA   .0503
 120          LS       0      50
 121          UD     .23

 122          KK    DP14
 123          KM         COMBINE RUNOFF FROM M14, RM14.1 AND RTDP13
 124          HC       3

 125          KK    DB14
 126          KM         ROUTE RUNOFF AT DP 14 THROUGH DETENTION BASIN DB 14
 127          RS       1    ELEV    6306
 128          SQ       0    24.5    73.4   100.8     122     141     157
 129          SE    6306    6308    6310    6312    6314    6316    6318
 130          SV       0     .18     .66    1.55    3.05    5.22     8.1
 131          ZZ
1
                SCHEMATIC DIAGRAM OF STREAM NETWORK
 INPUT
  LINE      (V) ROUTING          (---->) DIVERSION OR PUMP FLOW
```


NO.
(.) CONNECTOR
(<---) RETURN OF DIVERTED OR PUMPED FLOW
10
SBM7
27
RTM7
30
SBM8
35
SBM11
40
RTM11
43
M9
48
DP9
51
DB9
59
RTDB9
62
DP8
65
DB8
73
RTDB8
76
M10
81
DP10
84
RTDP10
87
M14.1
92
DP14.1



(***) RUNOFF ALSO COMPUTED AT THIS LOCATION

```
1*****************************************
*                                       *
*    FLOOD HYDROGRAPH PACKAGE  (HEC-1)  *
*                JUN  1998              *
*             VERSION 4.1               *
*                                       *
*  RUN DATE   28DEC07  TIME  10:55:05   *
*                                       *
*****************************************
```

```
*****************************************
*                                       *
*    U.S. ARMY CORPS OF ENGINEERS       *
*    HYDROLOGIC ENGINEERING CENTER      *
*          609 SECOND STREET            *
*       DAVIS, CALIFORNIA 95616         *
*           (916) 756-1104              *
*                                       *
*****************************************
```

MESA DRAINAGE BASIN PROJECT NUMBER 07028
SENTINEL RIDGE MASTER DEVELOPMENT DRAINAGE PLAN
WEST FORK BRANCH
EXISTING DEVELOPMENT CONDITIONS WITH EXISTING DETENTION BASINS
5 AND 100-YEAR STORMS 24-HOUR TYPE IIA
KIOWA ENGINEERING CORPORATION FILENAME WFSREX.DAT

8 IO OUTPUT CONTROL VARIABLES
IPRNT 5 PRINT CONTROL

```
                    IPLOT          0  PLOT CONTROL
                    QSCAL          0.  HYDROGRAPH PLOT SCALE

      IT          HYDROGRAPH TIME DATA
                    NMIN           4  MINUTES IN COMPUTATION INTERVAL
                   IDATE      1    0  STARTING DATE
                   ITIME         0000  STARTING TIME
                      NQ         288  NUMBER OF HYDROGRAPH ORDINATES
                  NDDATE      1    0  ENDING DATE
                  NDTIME         1908  ENDING TIME
                   ICENT           19  CENTURY MARK

                COMPUTATION INTERVAL      .07 HOURS
                     TOTAL TIME BASE   19.13 HOURS

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

      JP          MULTI-PLAN OPTION
                    NPLAN          1  NUMBER OF PLANS

      JR          MULTI-RATIO OPTION
                  RATIOS OF PRECIPITATION
                  .56      1.00

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

                                                                  RATIOS APPLIED TO PRECIPITATION
 OPERATION        STATION      AREA     PLAN                 RATIO 1  RATIO 2
                                                                .56      1.00

 HYDROGRAPH AT
+                   SBM7        .05      1    FLOW             6.       38.
                                              TIME           6.20     6.20

 ROUTED TO
+                   RTM7        .05      1    FLOW             6.       38.
                                              TIME           6.47     6.27

 HYDROGRAPH AT
+                   SBM8        .12      1    FLOW             9.       64.
                                              TIME           6.40     6.33

 HYDROGRAPH AT
```

+	SBM11	.05	1	FLOW	9.	40.
				TIME	6.27	6.27
ROUTED TO						
+	RTM11	.05	1	FLOW	9.	39.
				TIME	6.40	6.27
HYDROGRAPH AT						
+	M9	.08	1	FLOW	10.	53.
				TIME	6.40	6.33
2 COMBINED AT						
+	DP9	.13	1	FLOW	19.	92.
				TIME	6.40	6.33
ROUTED TO						
+	DB9	.13	1	FLOW	13.	44.
				TIME	6.67	6.73
			** PEAK STAGES IN FEET **			
			1	STAGE	6464.63	6467.92
				TIME	6.67	6.73
ROUTED TO						
+	RTDB9	.13	1	FLOW	13.	44.
				TIME	6.73	6.80
3 COMBINED AT						
+	DP8	.31	1	FLOW	26.	128.
				TIME	6.53	6.33
ROUTED TO						
+	DB8	.31	1	FLOW	4.	16.
				TIME	8.73	9.00
			** PEAK STAGES IN FEET **			
			1	STAGE	6402.97	6406.58
				TIME	8.73	9.00
ROUTED TO						
+	RTDB8	.31	1	FLOW	4.	16.
				TIME	8.73	9.00
HYDROGRAPH AT						
+	M10	.05	1	FLOW	17.	59.
				TIME	6.27	6.20
2 COMBINED AT						
+	DP10	.36	1	FLOW	17.	61.
				TIME	6.27	6.20
ROUTED TO						

+	RTDP10	.36	1	FLOW	17.	61.
				TIME	6.27	6.27
HYDROGRAPH AT						
+	M14.1	.01	1	FLOW	18.	36.
				TIME	6.00	6.00
2 COMBINED AT						
+	DP14.1	.37	1	FLOW	28.	82.
				TIME	6.07	6.13
ROUTED TO						
+	RM14.1	.37	1	FLOW	28.	81.
				TIME	6.13	6.13
HYDROGRAPH AT						
+	M12	.11	1	FLOW	16.	79.
				TIME	6.40	6.33
ROUTED TO						
+	RTM12	.11	1	FLOW	16.	78.
				TIME	6.40	6.33
HYDROGRAPH AT						
+	M13	.09	1	FLOW	9.	58.
				TIME	6.33	6.27
2 COMBINED AT						
+	DP13	.21	1	FLOW	25.	135.
				TIME	6.40	6.33
ROUTED TO						
+	RTDP13	.21	1	FLOW	24.	135.
				TIME	6.40	6.33
HYDROGRAPH AT						
+	M14	.05	1	FLOW	0.	8.
				TIME	19.07	6.20
3 COMBINED AT						
+	DP14	.63	1	FLOW	44.	210.
				TIME	6.33	6.27
ROUTED TO						
+	DB14	.63	1	FLOW	42.	130.
				TIME	6.47	6.60

** PEAK STAGES IN FEET **

1	STAGE	6308.71	6314.81
	TIME	6.47	6.60

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

```
1**************************************
*                                    *
*    FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *
*                JUN   1998          *
*             VERSION 4.1            *
*                                    *
*  RUN DATE   08SEP08  TIME  11:50:25   *
*                                    *
**************************************
```

```
**************************************
*                                    *
*    U.S. ARMY CORPS OF ENGINEERS    *
*    HYDROLOGIC ENGINEERING CENTER   *
*          609 SECOND STREET         *
*       DAVIS, CALIFORNIA 95616      *
*           (916) 756-1104           *
*                                    *
**************************************
```

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

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

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

1

HEC-1 INPUT


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

  1           ID        MESA DRAINAGE BASIN
  2           ID        SENTINEL RIDGE MASTER DEVELOPMENT DRAINAGE PLAN
  3           ID        WEST FORK BRANCH
  4           ID        24-HOUR TYPE IIA RAINFALL DISTRIBUTION
  5           ID        FUTURE   DEVELOPMENT CONDITIONS WITH EXISTING DETENTION AT DP 14
  6           ID        5 AND 100-YEAR STORMS  24HOUR TYPE IIA
  7           ID        KIOWA ENGINEERING CORPORATION      FILENAME WFSRFUT.DAT
              *DIAGRAM
  8           IT       3       0       0     288
  9           IO       5
 10           JR     PREC     .56     1.0

 11           KK     SBM7
 12           KM        RUNOFF FROM SUB-BASIN M7
```

WEST FORK FUTURE

```
 13          IN      15
 14          PB     4.1
 15          PC     0.0    .0005   .0015   .0030   .0045   .0060   .0080   .0100   .0120   .0143
 16          PC   .0165    .0188   .0210   .0233   .0255   .0278   .0320   .0390   .0460   .0530
 17          PC   .0600    .0750   .1000   .4000   .7000   .7250   .7500   .7650   .7800   .7900
 18          PC   .8000    .8100   .8200   .8250   .8300   .8350   .8400   .8450   .8500   .8550
 19          PC   .8600    .8638   .8675   .8713   .8750   .8788   .8825   .8863   .8900   .8938
 20          PC   .8975    .9013   .9050   .9083   .9115   .9148   .9180   .9210   .9240   .9270
 21          PC   .9300    .9325   .9350   .9375   .9400   .9425   .9450   .9475   .9500   .9525
 22          PC   .9550    .9575   .9600   .9625   .9650   .9675   .9700   .9725   .9750   .9775
 23          PC   .9800    .9813   .9825   .9838   .9850   .9863   .9875   .9888   .9900   .9913
 24          PC   .9963    .9975   .9988  1.0000
 25          BA   .0528
 26          LS      0       66
 27          UD    .27

 28          KK    RTM7
 29          KM         ROUTE RUNOFF FROM SUB-BASIN M7 TO DP 8
 30          RK    3000     .021     .03        0    TRAP       20       10

 31          KK    SBM8
 32          KM          RUNOFF FROM SUB-BASIN M8
 33          BA   .1243
 34          LS      0       66
 35          UD    .45

 36          KK   SBM11
 37          KM        RUNOFF FROM SUB-BASIN M11
 38          BA   .0467
 39          LS      0     71.6
 40          UD    .36

 41          KK   RTM11
 42          KM         ROUTE SUB-BASIN M11 TO DP 9
 43          RK    2600     .03     .03        0    TRAP        4        4
```



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

 44          KK      M9
 45          KM         RUNOFF FROM SUB-BASIN M9
 46          BA   .0844
 47          LS      0       69
 48          UD    .45

 49          KK     DP9
 50          KM         COMBINE SMM9 AND RTM11
 51          HC       2

 52          KK     DB9
 53          KM         ROUTE FLOW FROM DP 9 THROUGH DETENTION BASIN DB 9
```

```
54          RS       1    ELEV    6463
55          SQ       0      16      37      45     158
56          SA       0    .624    .701    .771       1
57          SE    6463    6465    6467    6468  6468.5
58          SS    6468      25       3     1.5
59          ST    6468     200       3     1.5

60          KK   RTDB9
61          KM        ROUTE OPUTFLOW FROM DB 9 TO DESIGN POINT 8
62          RK    1800    .025     .03       0    TRAP      20      10

63          KK     DP8
64          KM       COMBINE RTDB9, RTM7 AND SUB-BASIN M8
65          HC       3

66          KK     DB8
67          KM       ROUTER RUNOFF AT DP 8 THROUGH DETENTION BASIN DB8
68          RS       1    ELEV  6401.5
69          SQ       0     8.5      15      20     220
70          SA    2.12    2.35    2.73    3.25     3.5
71          SE    6402    6404    6406    6408  6408.5
72          SS    6406      25       3     1.5
73          ST    6408     200       3     1.5

74          KK   RTDB8
75          KM         ROUTE OUTFLOW FROM DETENTION BASIN 8 TO DP 10
76          RK    1300     .02    .013       0    CIRC    2.25

77          KK     M10
78          KM       RUNOFF FROM SUB-BASIN M10
79          BA   .0512
80          LS       0      77
81          UD     .35

82          KK    DP10
83          KM         COMBINE RUNOFF FROM SUB-BASIN M10 AND RTDB8
84          HC       2
1                                        HEC-1 INPUT                                                    PAGE  3
LINE        ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

85          KK   RDP10
86          KM         ROUTE RUNOFF FROM DP 10 TO DP 14.1
87          RK     800     .05    .013       0    CIRC       3

88          KK   M14.1
89          KM         RUNOFF FROM SUB-3ASIN M14.1
90          BA    .012
91          LS       0      85
92          UD     .15
```

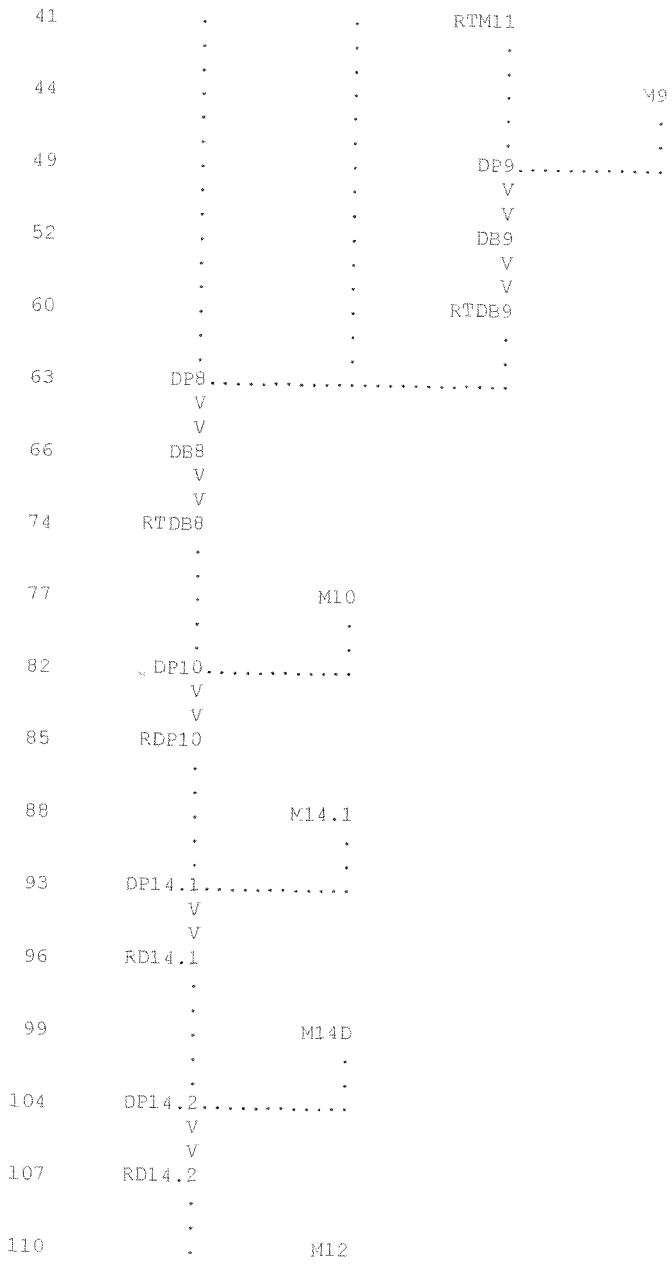
```
 93          KK  DP14.1
 94          KM        COMBINE SUB-BASIN M14.1 AND RDP10
 95          HC        2

 96          KK  RD14.1
 97          KM          ROUTE RUNOFF FROM DP 14.1 TO DP 14.2
 98          RK     300     .045     .013        0     CIRC      3.5

 99          KK    M14D
100          KM           RUNOFF FROM SUB-BASIN M14D
101          BA    .0104
102          LS        0       75
103          UD     .125

104          KK  DP14.2
105          KM           COMBINE M14D AND RD14.1
106          HC        2

107          KK  RD14.2
108          KM         ROUTE DP 14.2 TO DETENTION BASIN DB14
109          RK     500     .045     .035             TRAP        6        5

110          KK     M12
111          KM         RUNOFF FROM SUB-BASIN M12
112          BA    .114
113          LS        0       70
114          UD     .43

115          KK   RTM12
116          KM         ROUTE RUNOFF FROM SB M12 TO DP 13
117          RK    1700     .024     .024        0     TRAP        3        1

118          KK     M13
119          KM        RUNOFF FROM SUB-BASIN M13
120          BA   .0949
121          LS        0       67
122          UD     .39

123          KK    DP13
124          KM         COMBINE RUNOFF FROM SB M13 AND RTM12
125          HC        2
1                                        HEC-1 INPUT                                                    PAGE  4
LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

126          KK   RDP13
127          KM          ROUTE RUNOFF AT DP 13 TO DP 13.1
128          RK     350     .05     .013        0     CIRC        4

129          KK    M14C
130          KM        RUNOFF FROM SB M14C
```

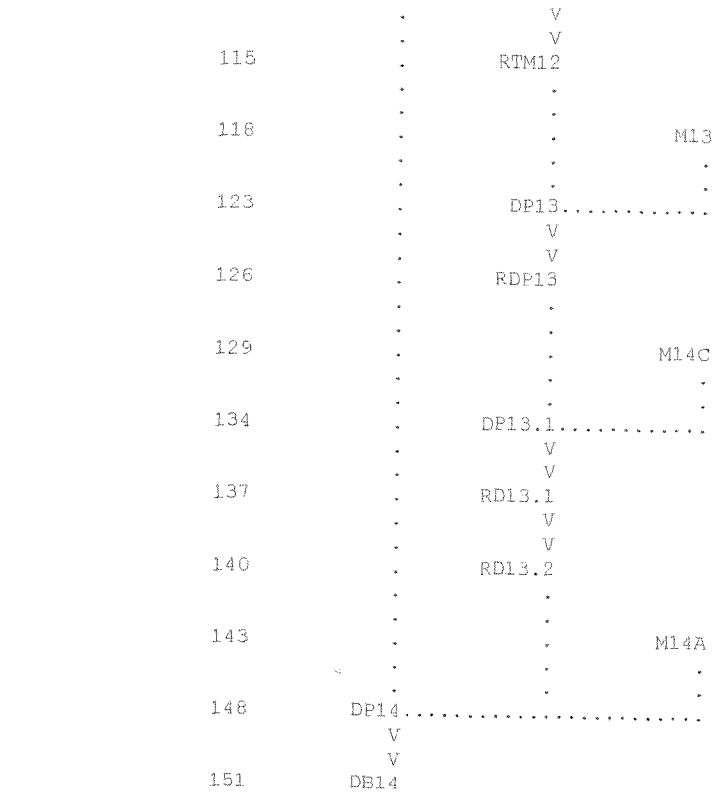
```
131          BA   .0217
132          LS              69
133          UD    .115

134          KK  DP13.1
135          KM         COMBINE RUNOFF FROM M14C AND RDP13
136          HC       2

137          KK  RD13.1
138          KM   ROUTE DP13.1 TO DP 13.2
139          RK     380     .03     .013            CIRC       4

140          KK  RD13.2
141          KM         ROUTE RD 13.1 TO DETENTION BASIN DB14
142          RK    1450     .045     .03            TRAP       6       2

143          KK    M14A
144          KM         RUNOFF FROM SUB-BASIN M14A
145          BA   .0315
146          LS       0       53
147          UD    .139

148          KK    DP14
149          KM        COMBINE M14A, RD14.2  AND RD13.2
150          HC       3

151          KK    DB14
152          KM          ROUTE RUNOFF AT DP 14 THROUGH DETENTION BASIN DB 14
153          RS       1    ELEV    6306
154          SQ       0    24.5    73.4   100.8     122     141     157
155          SE    6306    6308    6310    6312    6314    6316    6318
156          SV       0     .18     .66    1.55    3.05    5.22     8.1
157          ZZ
```

1

SCHEMATIC DIAGRAM OF STREAM NETWORK

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

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

    11        SBM7
                V
                V
    28        RTM7
                .
                .
    31          .         SBM8
                .           .
                .           .
    36          .           .        SBM11
                .           .           V
                .           .           V
```


41
RTM11
44
M9
49
DP9
52
DB9
60
RTDB9
63
DP8
66
DB8
74
RTDB8
77
M10
82
DP10
85
RDP10
88
M14.1
93
DP14.1
96
RD14.1
99
M14D
104
DP14.2
107
RD14.2
110
M12



(***) RUNOFF ALSO COMPUTED AT THIS LOCATION

```
1*****************************************
*                                       *
*    FLOOD HYDROGRAPH PACKAGE  (HEC-1)  *
*                JUN   1998             *
*             VERSION 4.1               *
*                                       *
*  RUN DATE   08SEP08  TIME  11:50:25   *
*                                       *
*****************************************
```

```
*****************************************
*                                       *
*    U.S. ARMY CORPS OF ENGINEERS       *
*    HYDROLOGIC ENGINEERING CENTER      *
*          609 SECOND STREET            *
*        DAVIS, CALIFORNIA 95616        *
*           (916) 756-1104              *
*                                       *
*****************************************
```

MESA DRAINAGE BASIN
SENTINEL RIDGE MASTER DEVELOPMENT DRAINAGE PLAN
WEST FORK BRANCH

24-HOUR TYPE IIA RAINFALL DISTRIBUTION
FUTURE DEVELOPMENT CONDITIONS WITH EXISTING DETENTION AT DP 14
5 AND 100-YEAR STORMS 24HOUR TYPE IIA
KIOWA ENGINEERING CORPORATION FILENAME WFSRFUT.DAT

9 IO OUTPUT CONTROL VARIABLES

IPRNT	5	PRINT CONTROL
IPLOT	0	PLOT CONTROL
QSCAL	0.	HYDROGRAPH PLOT SCALE

IT HYDROGRAPH TIME DATA

NMIN	3	MINUTES IN COMPUTATION INTERVAL
IDATE	1 0	STARTING DATE
ITIME	0000	STARTING TIME
NQ	288	NUMBER OF HYDROGRAPH ORDINATES
NDDATE	1 0	ENDING DATE
NDTIME	1421	ENDING TIME
ICENT	19	CENTURY MARK

COMPUTATION INTERVAL .05 HOURS
TOTAL TIME BASE 14.35 HOURS

ENGLISH UNITS

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

JP MULTI-PLAN OPTION
NPLAN 1 NUMBER OF PLANS

JR MULTI-RATIO OPTION
RATIOS OF PRECIPITATION
.56 1.00

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

OPERATION	STATION	AREA	PLAN		RATIOS APPLIED TO PRECIPITATION RATIO 1 .56	RATIO 2 1.00
HYDROGRAPH AT						
+	SBM7	.05	1	FLOW	7.	45.
				TIME	6.20	6.15

ROUTED TO						
+	RTM7	.05	1	FLOW	7.	44.
				TIME	6.40	6.25
HYDROGRAPH AT						
+	SBM8	.12	1	FLOW	12.	74.
				TIME	6.40	6.35
HYDROGRAPH AT						
+	SBM11	.05	1	FLOW	11.	45.
				TIME	6.30	6.25
ROUTED TO						
+	RTM11	.05	1	FLOW	10.	45.
				TIME	6.35	6.30
HYDROGRAPH AT						
+	M9	.08	1	FLOW	12.	61.
				TIME	6.40	6.35
2 COMBINED AT						
+	DP9	.13	1	FLOW	23.	105.
				TIME	6.40	6.30
ROUTED TO						
+	DB9	.13	1	FLOW	15.	77.
				TIME	6.70	6.55
			**	PEAK STAGES IN FEET **		
			1	STAGE	6464.83	6468.08
				TIME	6.70	6.55
ROUTED TO						
+	RTDB9	.13	1	FLOW	15.	75.
				TIME	6.75	6.60
3 COMBINED AT						
+	DP8	.31	1	FLOW	31.	149.
				TIME	6.50	6.60
ROUTED TO						
+	DB8	.31	1	FLOW	5.	18.
				TIME	8.70	9.00
			**	PEAK STAGES IN FEET **		
			1	STAGE	6403.16	6407.08
				TIME	8.70	9.00
ROUTED TO						
+	RTDB8	.31	1	FLOW	5.	18.
				TIME	8.70	9.00

HYDROGRAPH AT						
+	M10	.05	1	FLOW	20.	66.
				TIME	6.25	6.20
2 COMBINED AT						
+	DP10	.36	1	FLOW	20.	68.
				TIME	6.25	6.25
ROUTED TO						
+	RDP10	.36	1	FLOW	20.	68.
				TIME	6.25	6.25
HYDROGRAPH AT						
+	M14.1	.01	1	FLOW	12.	30.
				TIME	6.05	6.05
2 COMBINED AT						
+	DP14.1	.37	1	FLOW	26.	85.
				TIME	6.15	6.15
ROUTED TO						
+	RD14.1	.37	1	FLOW	26.	85.
				TIME	6.15	6.15
HYDROGRAPH AT						
+	M14D	.01	1	FLOW	6.	19.
				TIME	6.05	6.05
2 COMBINED AT						
+	DP14.2	.38	1	FLOW	31.	100.
				TIME	6.10	6.10
ROUTED TO						
+	RD14.2	.38	1	FLOW	30.	99.
				TIME	6.10	6.10
HYDROGRAPH AT						
+	M12	.11	1	FLOW	19.	89.
				TIME	6.35	6.30
ROUTED TO						
+	RTM12	.11	1	FLOW	19.	89.
				TIME	6.40	6.35
HYDROGRAPH AT						
+	M13	.09	1	FLOW	12.	67.
				TIME	6.35	6.30
2 COMBINED AT						
+	DP13	.21	1	FLOW	30.	155.
				TIME	6.40	6.30

ROUTED TO						
+	RDP13	.21	1	FLOW	30.	155.
				TIME	6.40	6.30
HYDROGRAPH AT						
+	M14C	.02	1	FLOW	7.	31.
				TIME	6.05	6.05
2 COMBINED AT						
+	DP13.1	.23	1	FLOW	32.	161.
				TIME	6.40	6.30
ROUTED TO						
+	RD13.1	.23	1	FLOW	32.	161.
				TIME	6.40	6.30
ROUTED TO						
+	RD13.2	.23	1	FLOW	32.	159.
				TIME	6.40	6.30
HYDROGRAPH AT						
+	M14A	.03	1	FLOW	0.	13.
				TIME	8.00	6.10
3 COMBINED AT						
+	DP14	.64	1	FLOW	54.	245.
				TIME	6.30	6.25
ROUTED TO						
+	DB14	.64	1	FLOW	51.	143.
				TIME	6.45	6.65
				** PEAK STAGES IN FEET **		
			1	STAGE	6309.08	6316.19
				TIME	6.45	6.65

1

1

SUMMARY OF DAM OVERTOPPING/BREACH ANALYSIS FOR STATION DB9
(PEAKS SHOWN ARE FOR INTERNAL TIME STEP USED DURING BREACH FORMATION)

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	6463.00	6468.00	6468.00
STORAGE	0.	2.	2.
OUTFLOW	0.	45.	45.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS

.56	6464.83	.00	0.	15.	.00	6.70	.00
1.00	6468.08	.08	3.	77.	.30	6.55	.00

1 SUMMARY OF DAM OVERTOPPING/BREACH ANALYSIS FOR STATION DB8
(PEAKS SHOWN ARE FOR INTERNAL TIME STEP USED DURING BREACH FORMATION)

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	6401.50	6406.00	6408.00
STORAGE	0.	10.	16.
OUTFLOW	0.	15.	20.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.56	6403.16	.00	3.	5.	.00	8.70	.00
1.00	6407.08	.00	13.	18.	.00	9.00	.00

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

```
1*****************************************
*                                       *
*    FLOOD HYDROGRAPH PACKAGE  (HEC-1)  *
*                JUN  1998              *
*             VERSION 4.1               *
*                                       *
*  RUN DATE   31DEC07  TIME  09:55:19   *
*                                       *
*****************************************
```

```
*************************************
*                                   *
*    U.S. ARMY CORPS OF ENGINEERS   *
*    HYDROLOGIC ENGINEERING CENTER  *
*          609 SECOND STREET        *
*       DAVIS, CALIFORNIA 95616     *
*           (916) 756-1104          *
*                                   *
*************************************
```

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

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

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

1 HEC-1 INPUT PAGE 1

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

  1           ID        MESA DRAINAGE BASIN
  2           ID        SENTINEL RIDGE MASTER DEVELOPMENT DRAINAGE PLAN
  3           ID        EAST FORK BRANCH MESA BASIN EXISTING CONDITIONS
  4           ID        24-HOUR TYPE IIA RAINFALL DISTRIBUTION
  5           ID        EXISTING DEVELOPMENT CONDTIONS WITH EXISTING DETENTION BASINS
  6           ID        5 AND 100-YEAR STORMS  24HOUR TYPE IIA
  7           ID        KIOWA ENGINEERING CORPORATION      FILENAME EPSREX.DAT
              *DIAGRAM
  8           IT       5       0       0     288
  9           IO       5
 10           JR    PREC     .56     1.0

 11           KK    PKR3
 12           KM        PARKER DESIGN POINT 3 (BASINS 1 2 AND 3)
```

EAST Fork EXISTING

```
IN      15
PB     4.1
PC      0.0   .0005   .0015   .0030   .0045   .0060   .0080   .0100   .0120   .0143
PC    .0165   .0188   .0210   .0233   .0255   .0278   .0320   .0390   .0460   .0530
PC    .0600   .0750   .1000   .4000   .7000   .7250   .7500   .7650   .7800   .7900
PC    .8000   .8100   .8200   .8250   .8300   .8350   .8400   .8450   .8500   .8550
PC    .8600   .8638   .8675   .8713   .8750   .8788   .8825   .8863   .8900   .8938
PC    .8975   .9013   .9050   .9083   .9115   .9148   .9180   .9210   .9240   .9270
PC    .9300   .9325   .9350   .9375   .9400   .9425   .9450   .9475   .9500   .9525
PC    .9550   .9575   .9600   .9625   .9650   .9675   .9700   .9725   .9750   .9775
PC    .9800   .9813   .9825   .9838   .9850   .9863   .9875   .9888   .9900   .9913
PC    .9963   .9975   .9988  1.0000
BA    .2244
LS       0    84.5
UD     .38

KK  RTPKR3
KM        ROUTE PKR3 THRU PKR3A
RK    2930    .024     .03       0    TRAP       5       4

KK   PRK3A
KM   PARKER DESIGN POINT 3A (HILL CIRCLE) PORTION OF PARKER BASIN 4
BA    .134
LS       0      83
UD      .2

KK    DP3A
KM   COMBINE RTPKR3 AND PRK3A
HC       2

KK  RTDP3A
KM   ROUTE DP3A THRU DP5A
RK    1150    .018     .04       0    TRAP      10       5

KK    M6A
KM   RUNOFF FROM SUB-BASIN M6A
BA    .069
LS       0      74
UD     .12
```



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

KK    DP5A
KM   COMBINE RTDP3A AND M6A
HC       2

KK    DB5A
KM   ROUTE FLOWS THRU DP5A THROUGH DET DET BASIN 5A (48" RCP OUTLET)
RS       1    ELEV  6398.2
SQ       0      10      24      73     115     148     180    1500
```

```
54          SV        0     .005     .106     .623     1.44     2.73     4.62     7.19
55          SE   6398.2     6399     6400     6402     6404     6406     6408     6410

56          KK   RTDB5A
57          KM          ROUTE OUTFLOW FROM DETENTION BASIN 5A TO DP 5
58          RK      600     .018      .04        0     TRAP       20       10

59          KK       M5
60          KM          RUNOFF FROM SUB-BASIN M5
61          BA     .099
62          LS        0       82
63          UD      .31

64          KK       M6
65          KM           RUNOFF FROM SUB-BASIN M7
66          BA    .0163
67          LS        0       82
68          UD      .15

69          KK      DP5
70          KM         COMBINE RTDB5A, M5 AND M6
71          HC         3

72          KK     DB5B
73          KM           ROUTE FLOW FROM DP 5 THROUGH DETENTION BASIN 5B
74          RS        1    ELEV  6368.7
75          SQ        0       8       18       40       65       81       95      108      119      128
76          SQ      138     140      160      180     1600
77          SV        0    .002     .059      .46     1.22      2.3     3.71     5.47      7.6     10.3
78          SV     13.7    18.1     23.2     26.5     29.1
79          SE   6368.7    6369     6370     6372     6374     6376     6378     6380     6382     6384
80          SE     6386    6388     6390     6391     6392
81          SS     6392     165        3      1.5
82          ST     6394     500        3      1.5

83          KK   RTDB5B
84          KM           ROUTE RUNOFF FROM DETENTION BASIN 5B
85          RK     1500    .048     .030        0     TRAP        8        1

86          KK    M17.1
87          KM           RUNOFF FROM SUB-BASIN M17.1
88          BA    .0399
89          LS        0       74
90          UD      .17
```



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

91          KK  DP17.1
92          KM         COMBINE SUB-BASIN M17.1 AND RTDB5B
93          HC         2
```

```
 94          KK   R17.1
 95          KM         ROUTE DP 17.1 TO DP 17.2
 96          RK     800      .04     .030        0     TRAP        8        1

 97          KK   M17.2
 98          KM        RUNOFF FROM SUB-BASIN M17.2
 99          BA   .0386
100          LS        0       61
101          UD      .17

102          KK  DP17.2
103          KM         COMBINE RUNOFF FROM SUB-BASIN M17.2 AND R17.1
104          HC        2

105          KK   R17.2
106          KM        ROUTE DP 17.2 TO DP 18.1
107          RK    1000     .035      .03        0     TRAP        8        3

108          KK   M18.1
109          KM         RUNOFF FROM SUB-BASIN M18.1
110          BA   .0584
111          LS        0       53
112          UD      .22

113          KK  DP18.1
114          KM        COMBINE SUB-BASIN M18.2 AND R17.2
115          HC        2

116          KK   R18.1
117          KM         ROUTE DP 18.1 TO DP 18.2
118          RK    1600     .031      .03        0     TRAP        8        2

119          KK   M18.2
120          KM         RUNOFF FROM SUB-BASIN M18.2
121          BA   .0556
122          LS        0       85
123          UD       .2

124          KK  DP18.2
125          KM        COMBINE SUB-BASIN M18.2 AND R18.1
126          HC        2
127          ZZ
```

1

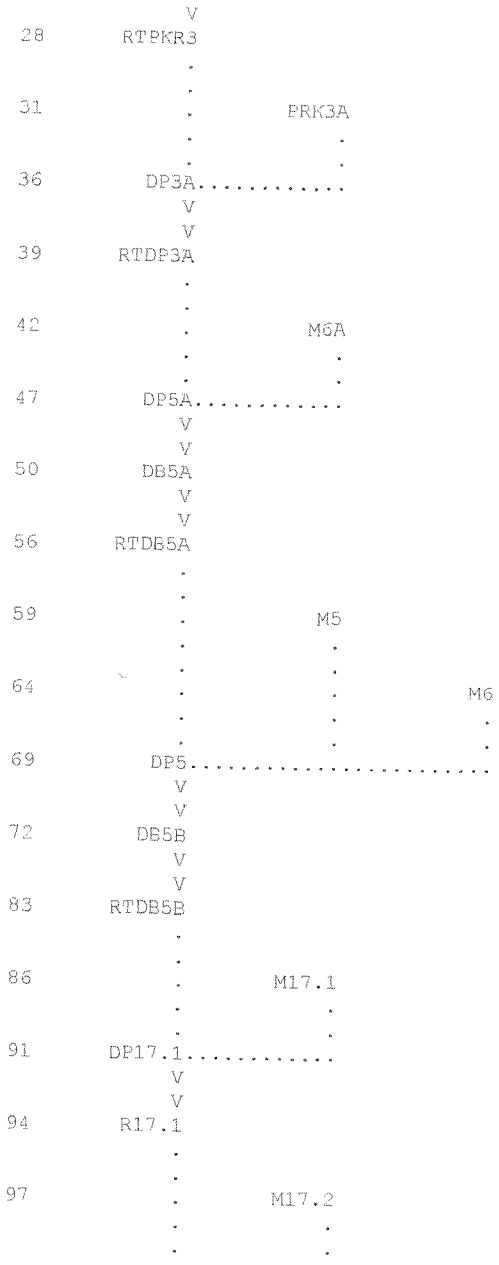
SCHEMATIC DIAGRAM OF STREAM NETWORK

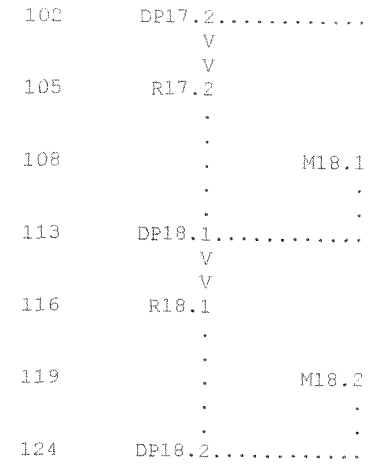
INPUT LINE NO.

(V) ROUTING (---->) DIVERSION OR PUMP FLOW

(.) CONNECTOR (<----) RETURN OF DIVERTED OR PUMPED FLOW

11 PKR3
V


28
RTPKR3
31
PRK3A
36
DP3A
39
RTDP3A
42
M6A
47
DP5A
50
DB5A
56
RTDB5A
59
M5
64
M6
69
DP5
72
DB5B
83
RTDB5B
86
M17.1
91
DP17.1
94
R17.1
97
M17.2



(***) RUNOFF ALSO COMPUTED AT THIS LOCATION

```
1*****************************************
*                                       *
*    FLOOD HYDROGRAPH PACKAGE  (HEC-1)  *
*                JUN  1998              *
*             VERSION 4.1               *
*                                       *
*  RUN DATE  31DEC07  TIME  09:55:19    *
*                                       *
*****************************************
```

```
*****************************************
*                                       *
*    U.S. ARMY CORPS OF ENGINEERS       *
*    HYDROLOGIC ENGINEERING CENTER      *
*          609 SECOND STREET            *
*       DAVIS, CALIFORNIA 95616         *
*           (916) 756-1104              *
*                                       *
*****************************************
```

MESA DRAINAGE BASIN
SENTINEL RIDGE MASTER DEVELOPMENT DRAINAGE PLAN
EAST FORK BRANCH MESA BASIN EXISTING CONDITIONS
24-HOUR TYPE IIA RAINFALL DISTRIBUTION
EXISTING DEVELOPMENT CONDTIONS WITH EXISTING DETENTION BASINS
5 AND 100-YEAR STORMS 24HOUR TYPE IIA
KIOWA ENGINEERING CORPORATION FILENAME EFSREX.DAT

9 IO OUTPUT CONTROL VARIABLES

IPRNT	5	PRINT CONTROL
IPLOT	0	PLOT CONTROL
QSCAL	0.	HYDROGRAPH PLOT SCALE

IT HYDROGRAPH TIME DATA

NMIN	5	MINUTES IN COMPUTATION INTERVAL
IDATE	1 0	STARTING DATE
ITIME	0000	STARTING TIME
NQ	288	NUMBER OF HYDROGRAPH ORDINATES
NDDATE	1 0	ENDING DATE
NDTIME	2355	ENDING TIME
ICENT	19	CENTURY MARK

COMPUTATION INTERVAL .08 HOURS
TOTAL TIME BASE 23.92 HOURS

ENGLISH UNITS

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

JP MULTI-PLAN OPTION
NPLAN 1 NUMBER OF PLANS

JR MULTI-RATIO OPTION
RATIOS OF PRECIPITATION
.56 1.00

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

OPERATION	STATION	AREA	PLAN		RATIOS APPLIED TO PRECIPITATION RATIO 1 .56	RATIO 2 1.00
HYDROGRAPH AT						
+	PKR3	.22	1	FLOW	118.	321.
				TIME	6.25	6.25
ROUTED TO						
+	RTPKR3	.22	1	FLOW	116.	318.
				TIME	6.33	6.25
HYDROGRAPH AT						
+	PRK3A	.13	1	FLOW	90.	247.
				TIME	6.08	6.08
2 COMBINED AT						
+	DP3A	.36	1	FLOW	176.	503.
				TIME	6.17	6.17
ROUTED TO						
+	RTDP3A	.36	1	FLOW	172.	498.
				TIME	6.25	6.17
HYDROGRAPH AT						
+	M6A	.07	1	FLOW	26.	100.
				TIME	6.08	6.00

2 COMBINED AT						
+	DP5A	.43	1	FLOW	186.	553.
				TIME	6.17	6.17
ROUTED TO						
+	DB5A	.43	1	FLOW	138.	595.
				TIME	6.42	6.17
			** PEAK STAGES IN FEET **			
			1	STAGE	6405.40	6408.63
				TIME	6.42	6.17
ROUTED TO						
+	RTDB5A	.43	1	FLOW	138.	564.
				TIME	6.50	6.17
HYDROGRAPH AT						
+	M5	.10	1	FLOW	49.	144.
				TIME	6.17	6.17
HYDROGRAPH AT						
+	M6	.02	1	FLOW	11.	31.
				TIME	6.08	6.00
3 COMBINED AT						
+	DP5	.54	1	FLOW	176.	729.
				TIME	6.25	6.17
ROUTED TO						
+	DB5B	.54	1	FLOW	106.	168.
				TIME	6.92	7.17
			** PEAK STAGES IN FEET **			
			1	STAGE	6379.65	6390.40
				TIME	6.92	7.17
ROUTED TO						
+	RTDB5B	.54	1	FLOW	106.	168.
				TIME	6.92	7.17
HYDROGRAPH AT						
+	M17.1	.04	1	FLOW	14.	53.
				TIME	6.08	6.08
2 COMBINED AT						
+	DP17.1	.58	1	FLOW	107.	172.
				TIME	6.92	7.08
ROUTED TO						
+	R17.1	.58	1	FLOW	107.	172.
				TIME	6.92	7.08

HYDROGRAPH AT						
+	M17.2	.04	1	FLOW	1.	23.
				TIME	6.17	6.08
2 COMBINED AT						
+	DP17.2	.62	1	FLOW	108.	177.
				TIME	6.92	6.17
ROUTED TO						
+	R17.2	.62	1	FLOW	107.	176.
				TIME	6.92	6.17
HYDROGRAPH AT						
+	M18.1	.06	1	FLOW	0.	13.
				TIME	22.58	6.17
2 COMBINED AT						
+	DP18.1	.68	1	FLOW	107.	189.
				TIME	6.92	6.17
ROUTED TO						
+	R18.1	.68	1	FLOW	107.	186.
				TIME	7.00	6.17
HYDROGRAPH AT						
+	M18.2	.06	1	FLOW	43.	110.
				TIME	6.08	6.08
2 COMBINED AT						
+	DP18.2	.74	1	FLOW	111.	279.
				TIME	6.92	6.17

1

SUMMARY OF DAM OVERTOPPING/BREACH ANALYSIS FOR STATION DB5B
(PEAKS SHOWN ARE FOR INTERNAL TIME STEP USED DURING BREACH FORMATION)

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	6368.70	6392.00	6394.00
STORAGE	0.	29.	34.
OUTFLOW	0.	1600.	4440.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.56	6379.65	.00	5.	106.	.00	6.92	.00
1.00	6390.40	.00	25.	168.	.00	7.17	.00

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

```
1*****************************************
*                                       *
*    FLOOD HYDROGRAPH PACKAGE  (HEC-1)  *
*                JUN  1998              *
*             VERSION 4.1               *
*                                       *
*  RUN DATE   09SEP08  TIME  11:42:37   *
*                                       *
*****************************************
```


```
*****************************************
*                                       *
*    U.S. ARMY CORPS OF ENGINEERS       *
*    HYDROLOGIC ENGINEERING CENTER      *
*          609 SECOND STREET            *
*       DAVIS, CALIFORNIA 95616         *
*          (916) 756-1104               *
*                                       *
*****************************************
```


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

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

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

1

HEC-1 INPUT


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

  1           ID        MESA DRAINAGE BASIN
  2           ID        SENTINEL RIDGE MASTER DEVELOPMENT DRAINAGE PLAN
  3           ID        EAST FORK BRANCH
  4           ID        24-HOUR TYPE IIA RAINFALL DISTRIBUTION
  5           ID        FUTURE   DEVELOPMENT CONDTIONS WITH EXISTING AND PROPOSED DETENTION
  6           ID        5 AND 100-YEAR STORMS  24HOUR TYPE IIA
  7           ID        KIOWA ENGINEERING CORPORATION      FILENAME EFSRFUI.DAT
              *DIAGRAM
  8           IT      5       0       0     288
  9           IO      5
 10           JR    PREC     .56     1.0

 11           KK    PKR3
 12           KM        PARKER DESIGN POINT 3 (BASINS 1 2 AND 3)
```

EAST FORK FUTURE

```
13          IN      15
14          PB     4.1
15          PC     0.0   .0005   .0015   .0030   .0045   .0060   .0080   .0100   .0120   .0143
16          PC   .0165   .0188   .0210   .0233   .0255   .0278   .0320   .0390   .0460   .0530
17          PC   .0600   .0750   .1000   .4000   .7000   .7250   .7500   .7650   .7800   .7900
18          PC   .8000   .8100   .8200   .8250   .8300   .8350   .8400   .8450   .8500   .8550
19          PC   .8600   .8638   .8675   .8713   .8750   .8788   .8825   .8863   .8900   .8938
20          PC   .8975   .9013   .9050   .9083   .9115   .9148   .9180   .9210   .9240   .9270
21          PC   .9300   .9325   .9350   .9375   .9400   .9425   .9450   .9475   .9500   .9525
22          PC   .9550   .9575   .9600   .9625   .9650   .9675   .9700   .9725   .9750   .9775
23          PC   .9800   .9813   .9825   .9838   .9850   .9863   .9875   .9888   .9900   .9913
24          PC   .9963   .9975   .9988  1.0000
25          BA   .2244
26          LS      0    84.5
27          UD    .38

28          KK  RTPKR3
29          KM        ROUTE PKR3 THRU PKR3A
30          RK   2930    .024     .03       0    TRAP       5       4

31          KK   PRK3A
32          KM   PARKER DESIGN POINT 3A (HILL CIRCLE) PORTION OF PARKER BASIN 4
33          BA    .134
34          LS      0      83
35          UD     .2

36          KK    DP3A
37          KM   COMBINE RTPKR3 AND PRK3A
38          HC       2

39          KK  RTDP3A
40          KM   ROUTE DP3A THRU DP5A
41          RK   1150    .018     .04       0    TRAP      10      .5

42          KK     M6A
43          KM   RUNOFF FROM SUB-BASIN M6A
44          BA    .069
45          LS      0      74
46          UD     .12
```



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

47          KK    DP5A
48          KM   COMBINE RTDP3A AND M6A
49          HC       2

50          KK    DB5A
51          KM   ROUTE FLOWS THRU DP5A THROUGH DET DET BASIN 5A (48" RCP OUTLET)
52          RS       1    ELEV  6398.2
53          SQ       0      10      24     .73     115     148     180    1500
```

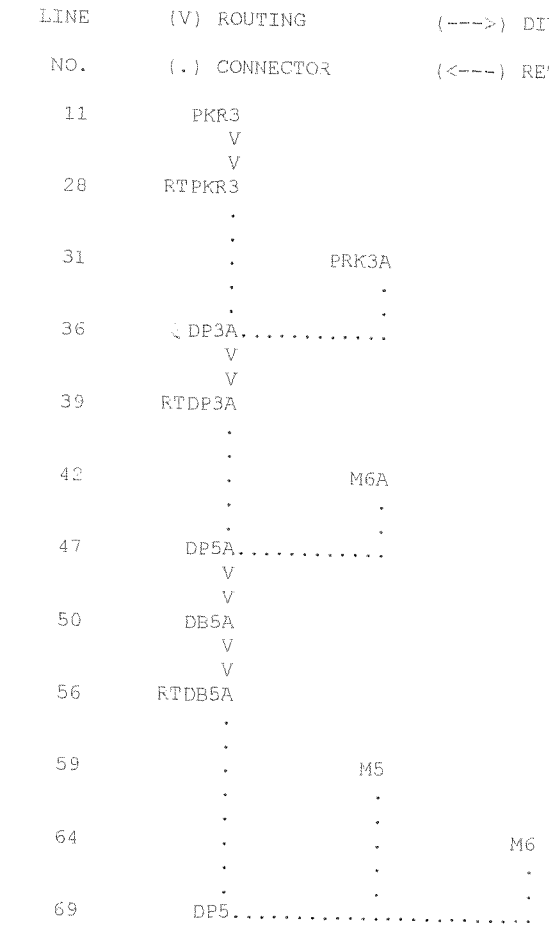
```
54          SV       0     .005     .106     .623     1.44     2.73     4.62     7.19
55          SE  6398.2     6399     6400     6402     6404     6406     6408     6410

56          KK  RTDB5A
57          KM        ROUTE OUTFLOW FROM DETENTION BASIN 5A TO DP 5
58          RK     600     .018      .04        0     TRAP       20       10

59          KK      M5
60          KM        RUNOFF FROM SUB-BASIN M5
61          BA    .099
62          LS       0       82
63          UD     .31

64          KK      M6
65          KM          RUNOFF FROM SUB-BASIN M7
66          BA   .0163
67          LS       0       82
68          UD     .15

69          KK     DP5
70          KM        COMBINE RTDB5A, M5 AND M6
71          HC       3

72          KK    DB5B
73          KM          ROUTE FLOW FROM DP 5 THROUGH DETENTION BASIN 5B
74          RS       1    ELEV  6368.7
75          SQ       0       8       18       40       65       81       95      108      119      128
76          SQ     138     140      160      180     1600
77          SV       0    .002     .059      .46     1.22      2.3     3.71     5.47      7.6     10.3
78          SV    13.7    18.1     23.2     26.5     29.1
79          SE  6368.7    6369     6370     6372     6374     6376     6378     6380     6382     6384
80          SE    6386    6388     6390     6391     6392
81          SS    6392     165        3      1.5
82          ST    6394     500        3      1.5

83          KK   RDB5B
84          KM          ROUTE RUNOFF FROM DETENTION BASIN 5B
85          RK    1500    .048     .030        0     TRAP        8        1

86          KK    M17B
87          KM          RUNOFF FROM SUB-BASIN M17B
88          BA   .0304
89          LS       0       84
90          UD    .139
1                                        HEC-1 INPUT                                                    PAGE  3
LINE        ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

91          KK  DP17.1
92          KM          COMBINE SUB-BASIN M17B  AND RDB5B
93          HC       2
```

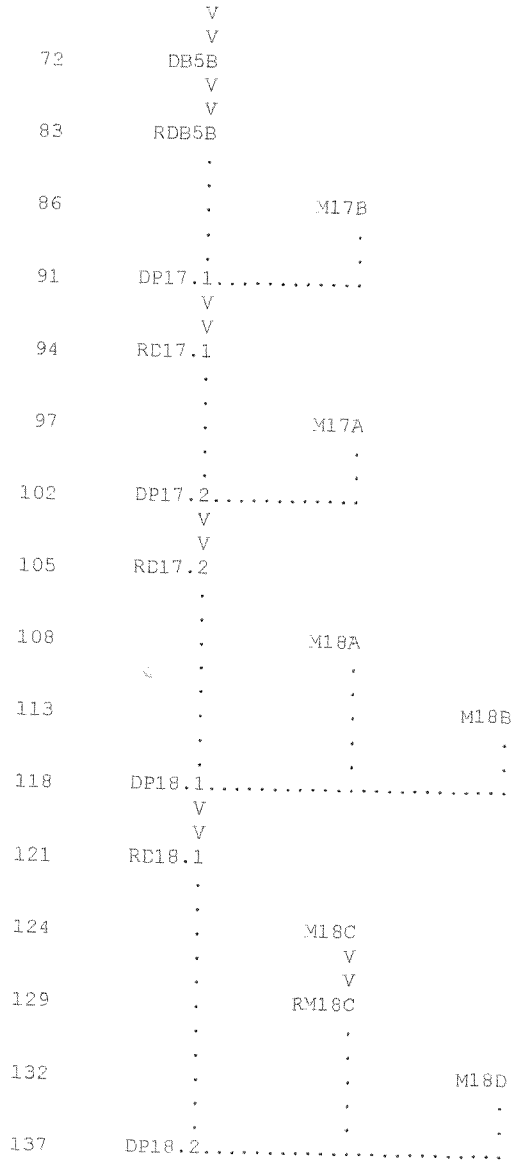
```
 94          KK  RD17.1
 95          KM         ROUTE DP 17.1 TO DP 17.2
 96          RK     800      .04     .030        0     TRAP        8        1

 97          KK    M17A
 98          KM         RUNOFF FROM SUB-BASIN M17A
 99          BA   .0386
100          LS       0       89
101          UD     .17

102          KK  DP17.2
103          KM         COMBINE RUNOFF FROM SUB-BASIN M17.2 AND RD17.1
104          HC       2

105          KK  RD17.2
106          KM        ROUTE DP 17.2 TO DP 18.1
107          RK    1000     .035      .03        0     TRAP        8        3

108          KK    M18A
109          KM         RUNOFF FROM SUB-BASIN M18A
110          BA   .0354
111          LS       0       50
112          UD     .15

113          KK    M18B
114          KM         RUNOFF FROM SUB-BASIN M18B
115          BA   .0206
116          LS       0       60
117          UD    .146

118          KK  DP18.1
119          KM        COMBINE SUB-BASIN M18A, M18B AND RD17.2
120          HC       3

121          KK  RD18.1
122          KM         ROUTE DP 18.1 TO DP 18.2
123          RK    1600     .031      .03        0     TRAP        8        2

124          KK    M18C
125          KM         RUNOFF FROM SUB-BASIN M18C
126          BA   .0314
127          LS       0       80
128          UD    .186

129          KK   RM18C
130          KM       ROUTE SUB-BASIN M18C TO DP18.2
131          RK     520      .05     .013             CIRC        3
1                                        HEC-1 INPUT                                                    PAGE  4

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

```
132          KK    M18D
133          KM         RUNOFF FROM SUB BASIN M18D
134          BA   .0386
135          LS      0      82
136          UD    .125

137          KK  DP18.2
138          KM         COMBINE SUB-BASIN  SUBBASIN M18D, RM18C AND RD18.1
139          HC       3
140          ZZ
```

1

SCHEMATIC DIAGRAM OF STREAM NETWORK





(***) RUNOFF ALSO COMPUTED AT THIS LOCATION

```
*    FLOOD HYDROGRAPH PACKAGE  (HEC-1)    *
*              JUN  1998                  *
*            VERSION 4.1                  *
*                                         *
*  RUN DATE   09SEP08  TIME  11:42:37     *
*                                         *
*******************************************
```

```
*    U.S. ARMY CORPS OF ENGINEERS       *
*    HYDROLOGIC ENGINEERING CENTER      *
*         609 SECOND STREET             *
*       DAVIS, CALIFORNIA 95616         *
*         (916) 756-1104                *
*                                       *
*****************************************
```

MESA DRAINAGE BASIN
SENTINEL RIDGE MASTER DEVELOPMENT DRAINAGE PLAN
EAST FORK BRANCH
24-HOUR TYPE IIA RAINFALL DISTRIBUTION
FUTURE DEVELOPMENT CONDTIONS WITH EXISTING AND PROPOSED DETENTION
5 AND 100-YEAR STORMS 24HOUR TYPE IIA
KIOWA ENGINEERING CORPORATION FILENAME EFSRFUT.DAT

9 IO OUTPUT CONTROL VARIABLES

IPRNT	5	PRINT CONTROL
IPLOT	0	PLOT CONTROL
QSCAL	0.	HYDROGRAPH PLOT SCALE

IT HYDROGRAPH TIME DATA

NMIN		5	MINUTES IN COMPUTATION INTERVAL
IDATE	1	0	STARTING DATE
ITIME		0000	STARTING TIME
NQ		288	NUMBER OF HYDROGRAPH ORDINATES
NDDATE	1	0	ENDING DATE
NDTIME		2355	ENDING TIME
ICENT		19	CENTURY MARK

COMPUTATION INTERVAL .08 HOURS
TOTAL TIME BASE 23.92 HOURS

ENGLISH UNITS

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

JP MULTI-PLAN OPTION
NPLAN 1 NUMBER OF PLANS

JR MULTI-RATIO OPTION
RATIOS OF PRECIPITATION
.56 1.00

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

OPERATION	STATION	AREA	PLAN		RATIOS APPLIED TO PRECIPITATION RATIO 1 .56	RATIO 2 1.00
HYDROGRAPH AT						
+	PKR3	.22	1	FLOW	118.	321.
				TIME	6.25	6.25
ROUTED TO						
+	RTPKR3	.22	1	FLOW	116.	318.
				TIME	6.33	6.25
HYDROGRAPH AT						
+	PRK3A	.13	1	FLOW	90.	247.
				TIME	6.08	6.08
2 COMBINED AT						
+	DP3A	.36	1	FLOW	176.	503.
				TIME	6.17	6.17
ROUTED TO						
+	RTDP3A	.36	1	FLOW	172.	498.
				TIME	6.25	6.17
HYDROGRAPH AT						
+	M6A	.07	1	FLOW	26.	100.
				TIME	6.08	6.00
2 COMBINED AT						
+	DP5A	.43	1	FLOW	186.	553.
				TIME	6.17	6.17
ROUTED TO						
+	DB5A	.43	1	FLOW	138.	595.
				TIME	6.42	6.17
			** PEAK STAGES IN FEET **			
			1	STAGE	6405.40	6408.63
				TIME	6.42	6.17
ROUTED TO						
+	RTDB5A	.43	1	FLOW	138.	564.
				TIME	6.50	6.17
HYDROGRAPH AT						

+	M5	.10	1	FLOW	49.	144.
				TIME	6.17	6.17
HYDROGRAPH AT						
+	M6	.02	1	FLOW	11.	31.
				TIME	6.08	6.00
3 COMBINED AT						
+	DP5	.54	1	FLOW	176.	729.
				TIME	6.25	6.17
ROUTED TO						
+	DB5B	.54	1	FLOW	106.	168.
				TIME	6.92	7.17
			**	PEAK STAGES IN FEET **		
			1	STAGE	6379.65	6390.40
				TIME	6.92	7.17
ROUTED TO						
+	RDB5B	.54	1	FLOW	106.	168.
				TIME	6.92	7.17
HYDROGRAPH AT						
+	M17B	.03	1	FLOW	24.	64.
				TIME	6.00	6.00
2 COMBINED AT						
+	DP17.1	.57	1	FLOW	107.	171.
				TIME	6.92	7.08
ROUTED TO						
+	RD17.1	.57	1	FLOW	107.	171.
				TIME	6.92	7.08
HYDROGRAPH AT						
+	M17A	.04	1	FLOW	40.	91.
				TIME	6.08	6.00
2 COMBINED AT						
+	DP17.2	.61	1	FLOW	111.	245.
				TIME	6.08	6.08
ROUTED TO						
+	RD17.2	.61	1	FLOW	111.	243.
				TIME	6.17	6.08
HYDROGRAPH AT						
+	M18A	.04	1	FLOW	0.	6.
				TIME	22.58	6.08
HYDROGRAPH AT						

+	M18B	.02	1	FLOW	1.	12.
				TIME	6.08	6.08
3 COMBINED AT						
+	DP18.1	.67	1	FLOW	111.	261.
				TIME	6.17	6.08
ROUTED TO						
+	RD18.1	.67	1	FLOW	110.	255.
				TIME	7.00	6.08
HYDROGRAPH AT						
+	M18C	.03	1	FLOW	18.	53.
				TIME	6.08	6.08
ROUTED TO						
+	RM18C	.03	1	FLOW	17.	53.
				TIME	6.08	6.08
HYDROGRAPH AT						
+	M18D	.04	1	FLOW	28.	78.
				TIME	6.00	6.00
3 COMBINED AT						
+	DP18.2	.74	1	FLOW	145.	378.
				TIME	6.08	6.08

1

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

APPENDIX B

HYDRAULIC CALCULATIONS

WEIGHTED CURVE NUMBER ESTIMATION EAST FORK MESA BASIN
PROJECT: SENTINEL RIDGE MDDP
PROJECT NO: 07028

SUB-BASIN NO.	AREA (SM)	PERCENT OF AREA	EXISTING CN
M17.1	0.0399	0.2073	74
M17.2	0.0386	0.2005	61
M18.1	0.0584	0.3034	53
M18.2	0.0556	0.2888	85
	0.1925		
WEIGHTED CN			68.2

SUB-BASIN NO.	AREA (SM)	PERCENT OF AREA	DEVELOPED CN
M17B	0.0278	0.1445	85
M17A	0.0386	0.2006	89
M18A	0.0354	0.1840	50
M18B	0.0206	0.1071	60
M18C	0.0314	0.1632	80
M18D	0.0386	0.2006	82
	0.1924		
			75.3

Req'd Det. Storage Est. RF: 2.3" 5yr ; 4.1" 100 year

100-year @ CN = 68 Runoff = 1.27"
@ CN = 75 Runoff = 1.74" Δ = .47"

Vol = .47/12 (.1924)(640) = 4.8 AF

5-year @ CN = 68 Runoff = .31"
@ CN = 75 Runoff = .54" Δ = .23"

Vol = .23/12 (.1924)(640) = 2.4 AF

OUTLET PIPE
DET BASIN 18

CURRENT DATE: 12-31-2007
CURRENT TIME: 14:51:33

FILE DATE: 12-31-2007
FILE NAME: EFDET

FHWA CULVERT ANALYSIS
HY-8, VERSION 6.1

CULV NO.	SITE DATA			CULVERT SHAPE, MATERIAL, INLET				
	INLET ELEV. (ft)	OUTLET ELEV. (ft)	CULVERT LENGTH (ft)	BARRELS SHAPE MATERIAL	SPAN (ft)	RISE (ft)	MANNING n	INLET TYPE
1	6019.00	6016.00	160.03	1 RCP	4.00	4.00	.012	CONVENTIONAL
2								
3								
4								
5								
6								

SUMMARY OF CULVERT FLOWS (cfs) FILE: EFDET DATE: 12-31-2007

ELEV (ft)	TOTAL	1	2	3	4	5	6	ROADWAY	ITR
6019.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	1
6021.27	30.0	30.0	0.0	0.0	0.0	0.0	0.0	0.00	1
6022.50	60.0	60.0	0.0	0.0	0.0	0.0	0.0	0.00	1
6023.70	90.0	90.0	0.0	0.0	0.0	0.0	0.0	0.00	1
6025.24	120.0	120.0	0.0	0.0	0.0	0.0	0.0	0.00	1
6027.27	150.0	150.0	0.0	0.0	0.0	0.0	0.0	0.00	1
6029.79	180.0	180.0	0.0	0.0	0.0	0.0	0.0	0.00	1
6032.75	210.0	210.0	0.0	0.0	0.0	0.0	0.0	0.00	1
6035.86	240.0	237.8	0.0	0.0	0.0	0.0	0.0	0.00	1
6036.21	270.0	240.6	0.0	0.0	0.0	0.0	0.0	0.00	13
6036.33	300.0	241.7	0.0	0.0	0.0	0.0	0.0	27.82	6
6036.00	238.9	238.9	0.0	0.0	0.0	0.0	0.0	56.80	4
								OVERTOPPING	

SUMMARY OF ITERATIVE SOLUTION ERRORS FILE: EFDET DATE: 12-31-2007

HEAD ELEV (ft)	HEAD ERROR (ft)	TOTAL FLOW (cfs)	FLOW ERROR (cfs)	% FLOW ERROR
6019.00	0.000	0.00	0.00	0.00
6021.27	0.000	30.00	0.00	0.00
6022.50	0.000	60.00	0.00	0.00
6023.70	0.000	90.00	0.00	0.00
6025.24	0.000	120.00	0.00	0.00
6027.27	0.000	150.00	0.00	0.00
6029.79	0.000	180.00	0.00	0.00
6032.75	0.000	210.00	0.00	0.00
6035.86	-0.010	240.00	2.21	0.92
6036.21	-0.004	270.00	1.54	0.57
6036.33	-0.004	300.00	1.50	0.50

<1> TOLERANCE (ft) = 0.010 <2> TOLERANCE (%) = 1.000

CURRENT DATE: 12-31-2007
CURRENT TIME: 14:51:33

FILE DATE: 12-31-2007
FILE NAME: EFDET

PERFORMANCE CURVE FOR CULVERT 1 - 1(4.00 (ft) BY 4.00 (ft)) RCP

DIS-CHARGE FLOW (cfs)	HEAD-WATER ELEV. (ft)	INLET CONTROL DEPTH (ft)	OUTLET CONTROL DEPTH (ft)	FLOW TYPE <F4>	NORMAL DEPTH (ft)	CRIT. DEPTH (ft)	OUTLET DEPTH (ft)	TW DEPTH (ft)	OUTLET VEL. (fps)	TW VEL. (fps)
0.00	6019.00	0.00	0.00	0-NF	0.00	0.00	0.00	0.00	0.00	0.00
30.00	6021.27	2.27	2.27	1-S2n	0.99	1.62	0.92	0.56	13.57	4.54
60.00	6022.50	3.50	3.50	1-S2n	1.44	2.33	1.52	0.84	13.68	5.72
90.00	6023.70	4.70	4.70	5-S2n	1.81	2.87	1.94	1.05	14.90	6.50
120.00	6025.24	6.24	6.24	5-S2n	2.14	3.28	2.32	1.23	15.88	7.10
150.00	6027.27	8.27	8.27	5-S2n	2.47	3.59	2.68	1.39	16.75	7.60
180.00	6029.79	10.79	10.79	5-S2n	2.81	3.91	3.03	1.54	17.69	8.02
210.00	6032.74	13.74	10.40	6-S2n	3.22	4.00	3.44	1.67	18.33	8.39
237.79	6035.86	16.86	13.06	6-S2n	4.00	4.00	3.90	1.79	19.17	8.72
240.64	6036.20	17.20	13.35	6-S2n	4.00	4.00	3.90	1.90	19.40	9.02
241.70	6036.33	17.33	13.46	6-S2n	4.00	4.00	3.90	2.01	19.49	9.29

El. inlet face invert 6019.00 ft
El. inlet throat invert 0.00 ft
El. outlet invert 6016.00 ft
El. inlet crest 0.00 ft

***** SITE DATA ***** CULVERT INVERT **********

INLET STATION	100.00 ft
INLET ELEVATION	6019.00 ft
OUTLET STATION	260.00 ft
OUTLET ELEVATION	6016.00 ft
NUMBER OF BARRELS	1
SLOPE (V/H)	0.0188
CULVERT LENGTH ALONG SLOPE	160.03 ft

***** CULVERT DATA SUMMARY **********

BARREL SHAPE	CIRCULAR
BARREL DIAMETER	4.00 ft
BARREL MATERIAL	CONCRETE
BARREL MANNING'S n	0.012
INLET TYPE	CONVENTIONAL
INLET EDGE AND WALL	SQUARE EDGE WITH HEADWALL
INLET DEPRESSION	NONE

CURRENT DATE: 12-31-2007
CURRENT TIME: 14:51:33

FILE DATE: 12-31-2007
FILE NAME: EFDET

TAILWATER

******* REGULAR CHANNEL CROSS SECTION **********

BOTTOM WIDTH	10.00 ft
SIDE SLOPE H/V (X:1)	3.0
CHANNEL SLOPE V/H (ft/ft)	0.030
MANNING'S n (.01-0.1)	0.035
CHANNEL INVERT ELEVATION	6016.00 ft
CULVERT NO.1 OUTLET INVERT ELEVATION	6016.00 ft

******* UNIFORM FLOW RATING CURVE FOR DOWNSTREAM CHANNEL

FLOW (cfs)	W.S.E. (ft)	FROUDE NUMBER	DEPTH (ft)	VEL. (f/s)	SHEAR (psf)
0.00	6016.00	0.000	0.00	0.00	0.00
30.00	6016.56	1.066	0.56	4.54	1.06
60.00	6016.84	1.100	0.84	5.72	1.57
90.00	6017.05	1.117	1.05	6.50	1.97
120.00	6017.23	1.127	1.23	7.10	2.31
150.00	6017.39	1.134	1.39	7.60	2.61
180.00	6017.54	1.140	1.54	8.02	2.88
210.00	6017.67	1.144	1.67	8.39	3.12
240.00	6017.79	1.148	1.79	8.72	3.35
270.00	6017.90	1.151	1.90	9.02	3.57
300.00	6018.01	1.154	2.01	9.29	3.77

ROADWAY OVERTOPPING DATA

ROADWAY SURFACE	PAVED
EMBANKMENT TOP WIDTH	40.00 ft
CREST LENGTH	100.00 ft
OVERTOPPING CREST ELEVATION	6036.00 ft

Detention Storage Volume Calculation PN 07028

Sentinel Ridge

Colorado Springs, Colorado

DET BASIN 1B

elevation	area (sf)	area (ac)	average area (ac)	Interval (ft)	Incremental Volume (ac-ft)	Cumulative Volume (ac-ft)
6023	0	0.000				
			0.01	1	0.01	0.01
6024	967	0.02				
			0.18	6	1.10	1.11
6030	15000	0.34				
			0.39	2	0.78	1.89
6032	18800	0.43				
			0.44	2	0.89	2.77
6034	19800	0.45				
			0.64	2	1.28	4.05
6036	36000	0.83				

```
1**************************************
*                                    *
*    FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *
*                JUN  1998           *
*             VERSION 4.1            *
*                                    *
*  RUN DATE   09SEP08  TIME  12:03:07    *
*                                    *
**************************************
```

```
**************************************
*                                    *
*    U.S. ARMY CORPS OF ENGINEERS    *
*    HYDROLOGIC ENGINEERING CENTER   *
*          609 SECOND STREET         *
*       DAVIS, CALIFORNIA 95616      *
*           (916) 756-1104           *
*                                    *
**************************************
```

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

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

THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 31. THIS IS THE FORTRAN77 VERSION
NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL LOSS RATE:GREEN AND AMPT INFILTRATION
KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM

1

HEC-1 INPUT


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

  1           ID        MESA DRAINAGE BASIN
  2           ID        SENTINEL RIDGE MASTER DEVELOPMENT DRAINAGE PLAN
  3           ID        EAST FORK BRANCH WITH DETENTION AT DEP 18.1
  4           ID        24-HOUR TYPE IIA RAINFALL DISTRIBUTION
  5           ID        FUTURE   DEVELOPMENT CONDTIONS WITH EXISTING AND PROPOSED DETENTION
  6           ID        5 AND 100-YEAR STORMS  24HOUR TYPE IIA
  7           ID        KIOWA ENGINEERING CORPORATION      FILENAME EFSRDET.DAT
              *DIAGRAM
  8           IT       5       0       0     288
  9           IO       5
 10           JR     PREC     .56     1.0

 11           KK     PKR3
 12           KM        PARKER DESIGN POINT 3 (BASINS 1 2 AND 3)
```

EAST FORK W/ DETENTION

```
13          IN      15
14          PB    4.1
15          PC     0.0    .0005    .0015    .0030    .0045    .0060    .0080    .0100    .0120    .0143
16          PC   .0165    .0188    .0210    .0233    .0255    .0278    .0320    .0390    .0460    .0530
17          PC   .0600    .0750    .1000    .4000    .7000    .7250    .7500    .7650    .7800    .7900
18          PC   .8000    .8100    .8200    .8250    .8300    .8350    .8400    .8450    .8500    .8550
19          PC   .8600    .8638    .8675    .8713    .8750    .8788    .8825    .8863    .8900    .8938
20          PC   .8975    .9013    .9050    .9083    .9115    .9148    .9180    .9210    .9240    .9270
21          PC   .9300    .9325    .9350    .9375    .9400    .9425    .9450    .9475    .9500    .9525
22          PC   .9550    .9575    .9600    .9625    .9650    .9675    .9700    .9725    .9750    .9775
23          PC   .9800    .9813    .9825    .9838    .9850    .9863    .9875    .9888    .9900    .9913
24          PC   .9963    .9975    .9988  1.0000
25          BA   .2244
26          LS      0     84.5
27          UD    .38

28          KK  RTPKR3
29          KM        ROUTE PKR3 THRU PKR3A
30          RK    2930    .024     .03       0    TRAP       5       4

31          KK   PRK3A
32          KM   PARKER DESIGN POINT 3A (HILL CIRCLE) PORTION OF PARKER BASIN 4
33          BA    .134
34          LS       0      83
35          UD      .2

36          KK    DP3A
37          KM   COMBINE RTPKR3 AND PRK3A
38          HC       2

39          KK  RTDP3A
40          KM   ROUTE DP3A THRU DP5A
41          RK    1150    .018     .04       0    TRAP      10       .5

42          KK     M6A
43          KM   RUNOFF FROM SUB-BASIN M6A
44          BA    .069
45          LS       0      74
46          UD     .12
```



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

47          KK    DP5A
48          KM   COMBINE RTDP3A AND M6A
49          HC       2

50          KK    DB5A
51          KM   ROUTE FLOWS THRU DP5A THROUGH DET DET BASIN 5A (48" RCP OUTLET)
52          RS       1    ELEV  6398.2
53          SQ       0      10      24      73     115     148     180    1500
```

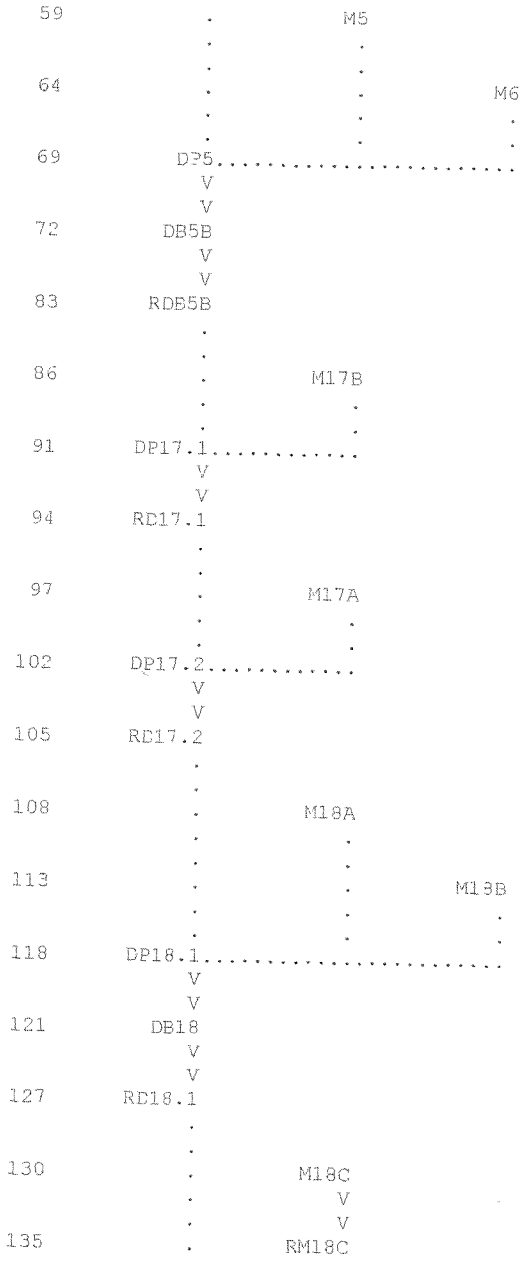
```
54          SV       0    .005    .106    .623    1.44    2.73    4.62    7.19
55          SE  6398.2    6399    6400    6402    6404    6406    6408    6410

56          KK  RTDB5A
57          KM        ROUTE OUTFLOW FROM DETENTION BASIN 5A TO DP 5
58          RK     600    .018     .04       0    TRAP      20      10

59          KK      M5
60          KM        RUNOFF FROM SUB-BASIN M5
61          EA    .099
62          LS       0      82
63          UD     .31

64          KK      M6
65          KM         RUNOFF FROM SUB-BASIN M7
66          EA   .0163
67          LS       0      82
68          UD     .15

69          KK     DP5
70          KM        COMBINE RTDB5A, M5 AND M6
71          HC       3

72          KK    DB5B
73          KM         ROUTE FLOW FROM DP 5 THROUGH DETENTION BASIN 5B
74          RS       1    ELEV  6368.7
75          SQ       0       8      18      40      65      81      95     108     119     128
76          SQ     138     140     160     180    1600
77          SV       0    .002    .059     .46    1.22     2.3    3.71    5.47     7.6    10.3
78          SV    13.7    18.1    23.2    26.5    29.1
79          SE  6368.7    6369    6370    6372    6374    6376    6378    6380    6382    6384
80          SE    6386    6388    6390    6391    6392
81          SS    6392     165       3     1.5
82          ST    6394     500       3     1.5

83          KK   RDB5B
84          KM         ROUTE RUNOFF FROM DETENTION BASIN 5B
85          RK    1500    .048    .030       0    TRAP       8       1

86          KK    M17B
87          KM         RUNOFF FROM SUB-BASIN M17B
88          BA   .0304
89          LS       0      84
90          UD    .139
```

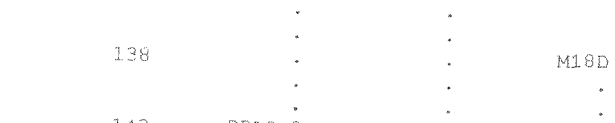


```
LINE        ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

91          KK  DP17.1
92          KM         COMBINE SUB-BASIN M17B  AND RDB5B
93          HC       2
```

```
 94          KK  RD17.1
 95          KM         ROUTE DP 17.1 TO DP 17.2
 96          RK     800      .04     .030        0     TRAP        8        1

 97          KK    M17A
 98          KM        RUNOFF FROM SUB-BASIN M17A
 99          BA   .0386
100          LS       0       89
101          UD     .17

102          KK  DP17.2
103          KM         COMBINE RUNOFF FROM SUB-BASIN M17.2 AND RD17.1
104          HC       2

105          KK  RD17.2
106          KM        ROUTE DP 17.2 TO DP 18.1
107          RK    1000     .035      .03        0     TRAP        8        3

108          KK    M18A
109          KM         RUNOFF FROM SUB-BASIN M18A
110          BA   .0354
111          LS       0       50
112          UD     .15

113          KK    M18B
114          KM          RUNOFF FROM SUB-BASIN M18B
115          BA   .0206
116          LS       0       60
117          UD    .146

118          KK  DP18.1
119          KM        COMBINE SUB-BASIN M18A, M18B AND RD17.2
120          HC       3

121          KK    DB18
122          KM          ROUTE DP 18.1 THROUGH DETENTION BASIN DB18
123          RS       1    ELEV    6223
124          SQ       0      75     150     160     175     180
125          SV       0      .1      1.1     1.9     2.8     4.1
126          SE    6223    6224    6230    6232    6234    6236

127          KK  RD18.1
128          KM         ROUTE OUTFLOW FROM DB 18 TO DP 18.2
129          RK    1600     .031      .03        0     TRAP        8        2
1                                      HEC-1 INPUT                                                    PAGE  4
LINE         ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

130          KK    M18C
131          KM         RUNOFF FROM SUB-BASIN M18C
```

```
132           BA   .0314
133           LS      0      80
134           UD    .186

135           KK   RM18C
136           KM       ROUTE SUB-BASIN M18C TO DP18.2
137           RK     520     .05     .013            CIRC       3

138           KK    M18D
139           KM        RUNOFF FROM SUB BASIN M18D
140           BA   .0386
141           LS      0      82
142           UD    .125

143           KK  DP18.2
144           KM        COMBINE SUB-BASIN  SUBBASIN M18D, RM18C AND RD18.1
145           HC       3
146           ZZ
1
                    SCHEMATIC DIAGRAM OF STREAM NETWORK
INPUT
 LINE       (V) ROUTING           (--->) DIVERSION OR PUMP FLOW

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

   11          PKR3
               V
               V
   28        RTPKR3
             .
             .
   31        .       PRK3A
             .         .
             .         .
   36        DP3A.............
               V
               V
   39        RTDP3A
             .
             .
   42        .         M6A
             .           .
             .           .
   47        DP5A.............
               V
               V
   50          DB5A
               V
               V
   56        RTDB5A
             .
             .
```


59
M5
64
M6
69
DP5
72
DB5B
83
RDB5B
86
M17B
91
DP17.1
94
RD17.1
97
M17A
102
DP17.2
105
RD17.2
108
M18A
113
M18B
118
DP18.1
121
DB18
127
RD18.1
130
M18C
135
RM18C



(***) RUNOFF ALSO COMPUTED AT THIS LOCATION

```
1*****************************************
*                                       *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *
*               JUN  1998               *
*            VERSION 4.1                *
*                                       *
*  RUN DATE   09SEP08  TIME  12:03:07   *
*                                       *
*****************************************
```

```
*****************************************
*                                       *
*    U.S. ARMY CORPS OF ENGINEERS       *
*    HYDROLOGIC ENGINEERING CENTER      *
*          609 SECOND STREET            *
*       DAVIS, CALIFORNIA 95616         *
*           (916) 756-1104              *
*                                       *
*****************************************
```

MESA DRAINAGE BASIN
SENTINEL RIDGE MASTER DEVELOPMENT DRAINAGE PLAN
EAST FORK BRANCH WITH DETENTION AT DEP 18.1
24-HOUR TYPE IIA RAINFALL DISTRIBUTION
FUTURE DEVELOPMENT CONDTIONS WITH EXISTING AND PROPOSED DETENTION
5 AND 100-YEAR STORMS 24HOUR TYPE IIA
KIOWA ENGINEERING CORPORATION FILENAME EFSRDET.DAT

9 IO OUTPUT CONTROL VARIABLES

IPRNT	5	PRINT CONTROL
IPLOT	0	PLOT CONTROL
QSCAL	0.	HYDROGRAPH PLOT SCALE

IT HYDROGRAPH TIME DATA

NMIN		5	MINUTES IN COMPUTATION INTERVAL
IDATE	1	0	STARTING DATE
ITIME		0000	STARTING TIME
NQ		288	NUMBER OF HYDROGRAPH ORDINATES
NDDATE	1	0	ENDING DATE
NDTIME		2355	ENDING TIME
ICENT		19	CENTURY MARK

COMPUTATION INTERVAL .08 HOURS
TOTAL TIME BASE 23.92 HOURS

ENGLISH UNITS

DRAINAGE AREA	SQUARE MILES
PRECIPITATION DEPTH	INCHES
LENGTH, ELEVATION	FEET
FLOW	CUBIC FEET PER SECOND

STORAGE VOLUME ACRE-FEET
SURFACE AREA ACRES
TEMPERATURE DEGREES FAHRENHEIT

JP MULTI-PLAN OPTION
NPLAN 1 NUMBER OF PLANS

JR MULTI-RATIO OPTION
RATIOS OF PRECIPITATION
.56 1.00

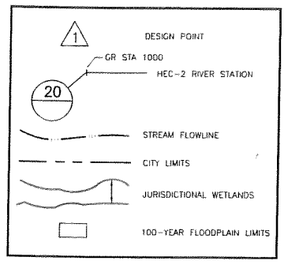
PEAK FLOW AND STAGE (END-OF-PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND, AREA IN SQUARE MILES
TIME TO PEAK IN HOURS

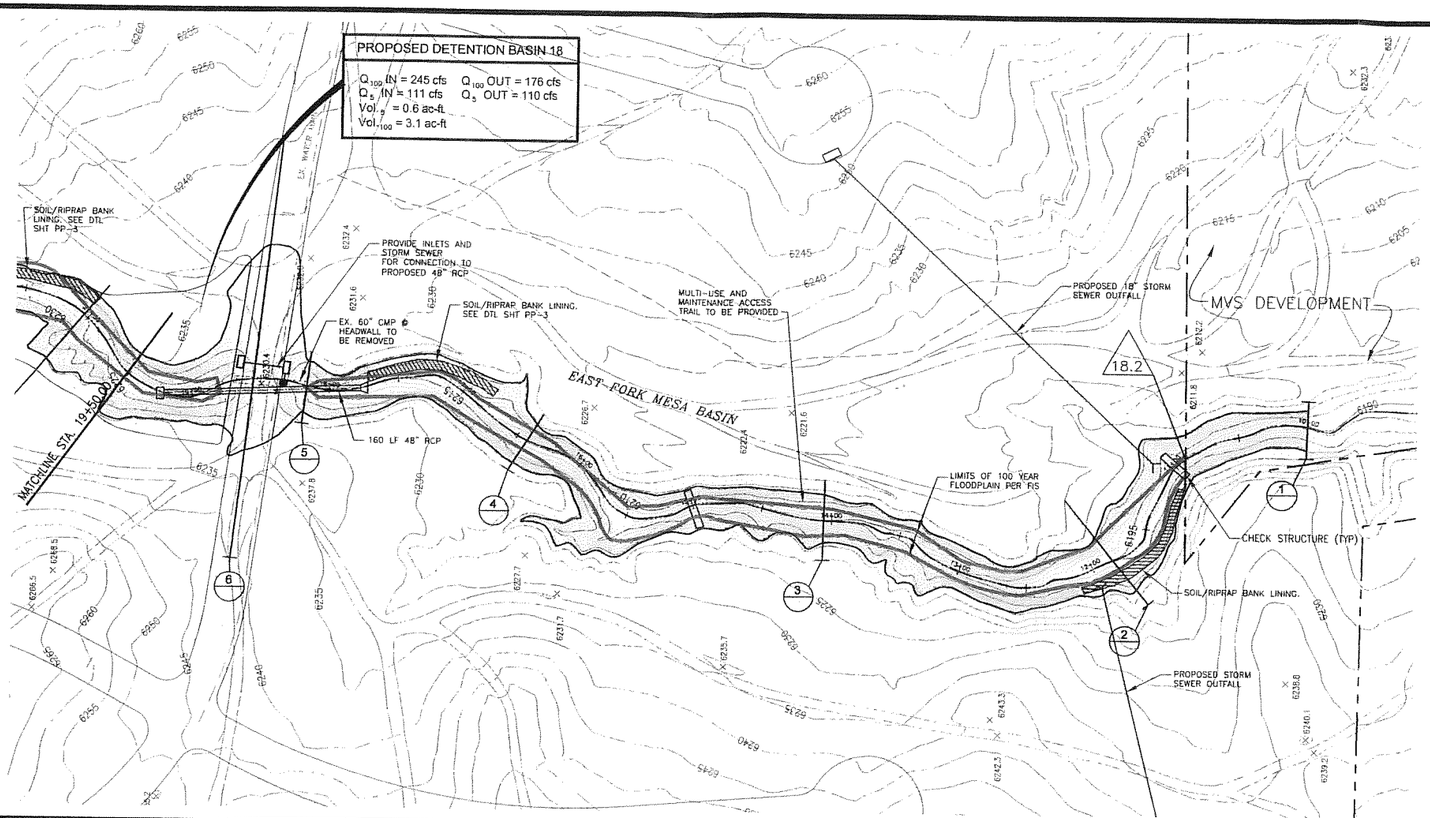
OPERATION	STATION	AREA	PLAN		RATIOS APPLIED TO PRECIPITATION RATIO 1 .56	RATIO 2 1.00
HYDROGRAPH AT						
+	PKR3	.22	1	FLOW	118.	321.
				TIME	6.25	6.25
ROUTED TO						
+	RTPKR3	.22	1	FLOW	116.	318.
				TIME	6.33	6.25
HYDROGRAPH AT						
+	PRK3A	.13	1	FLOW	90.	247.
				TIME	6.08	6.08
2 COMBINED AT						
+	DP3A	.36	1	FLOW	176.	503.
				TIME	6.17	6.17
ROUTED TO						
+	RTDP3A	.36	1	FLOW	172.	498.
				TIME	6.25	6.17
HYDROGRAPH AT						
+	M6A	.07	1	FLOW	26.	100.
				TIME	6.08	6.00
2 COMBINED AT						
+	DP5A	.43	1	FLOW	186.	553.
				TIME	6.17	6.17
ROUTED TO						
+	DB5A	.43	1	FLOW	138.	595.
				TIME	6.42	6.17

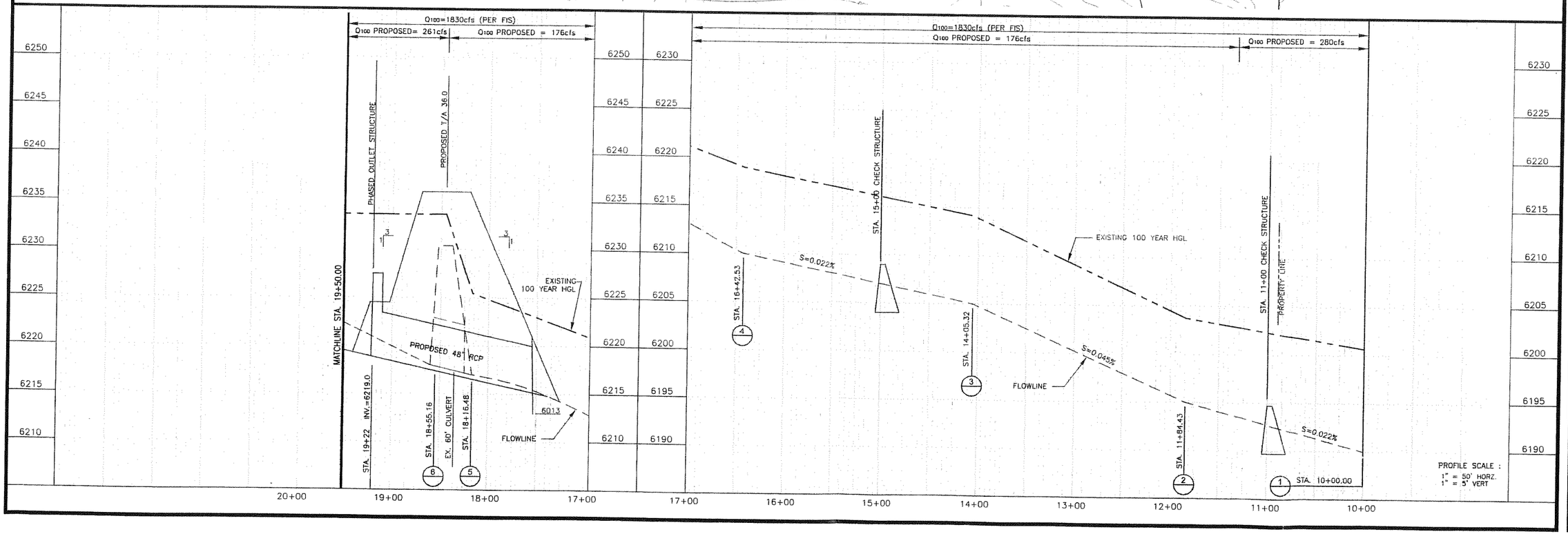
** PEAK STAGES IN FEET **

			1	STAGE	6405.40	6408.63
				TIME	6.42	6.17
ROUTED TO						
+	RTDB5A	.43	1	FLOW	138.	564.
				TIME	6.50	6.17
HYDROGRAPH AT						
+	M5	.10	1	FLOW	49.	144.
				TIME	6.17	6.17
HYDROGRAPH AT						
+	M6	.02	1	FLOW	11.	31.
				TIME	6.08	6.00
3 COMBINED AT						
+	DP5	.54	1	FLOW	176.	729.
				TIME	6.25	6.17
ROUTED TO						
+	DB5B	.54	1	FLOW	106.	168.
				TIME	6.92	7.17
			** PEAK STAGES IN FEET **			
			1	STAGE	6379.65	6390.40
				TIME	6.92	7.17
ROUTED TO						
+	RDB5B	.54	1	FLOW	106.	168.
				TIME	6.92	7.17
HYDROGRAPH AT						
+	M17B	.03	1	FLOW	24.	64.
				TIME	6.00	6.00
2 COMBINED AT						
+	DP17.1	.57	1	FLOW	107.	171.
				TIME	6.92	7.08
ROUTED TO						
+	RD17.1	.57	1	FLOW	107.	171.
				TIME	6.92	7.08
HYDROGRAPH AT						
+	M17A	.04	1	FLOW	40.	91.
				TIME	6.08	6.00
2 COMBINED AT						
+	DP17.2	.61	1	FLOW	111.	245.
				TIME	6.08	6.08
ROUTED TO						

```
+                    RD17.2        .61     1   FLOW          111.      243.
                                               TIME          6.17      6.08

 HYDROGRAPH AT
+                    M18A          .04     1   FLOW            0.        6.
                                               TIME         22.58      6.08

 HYDROGRAPH AT
+                    M18B          .02     1   FLOW            1.       12.
                                               TIME          6.08      6.08

   3 COMBINED AT
+                    DP18.1        .67     1   FLOW          111.      261.
                                               TIME          6.17      6.08

 ROUTED TO
+                    DB18          .67     1   FLOW          110.      176.
                                               TIME          7.08      7.33

                                          ** PEAK STAGES IN FEET **
                                           1   STAGE       6226.78   6234.42
                                               TIME          7.08      7.33

 ROUTED TO
+                    RD18.1        .67     1   FLOW          110.      176.
                                               TIME          7.08      7.33

 HYDROGRAPH AT
+                    M18C          .03     1   FLOW           18.       53.
                                               TIME          6.08      6.08

 ROUTED TO
+                    RM18C         .03     1   FLOW           17.       53.
                                               TIME          6.08      6.08

 HYDROGRAPH AT
+                    M18D          .04     1   FLOW           28.       78.
                                               TIME          6.00      6.00

   3 COMBINED AT
+                    DP18.2        .74     1   FLOW          127.      280.
                                               TIME          6.08      6.08
1


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







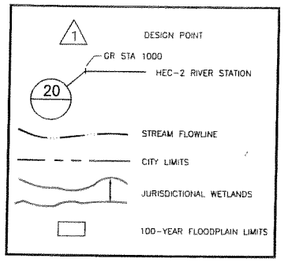
Kiowa Engineering Corporation
1604 South 21st Street
Colorado Springs, Colorado 80904
(719) 630-7342

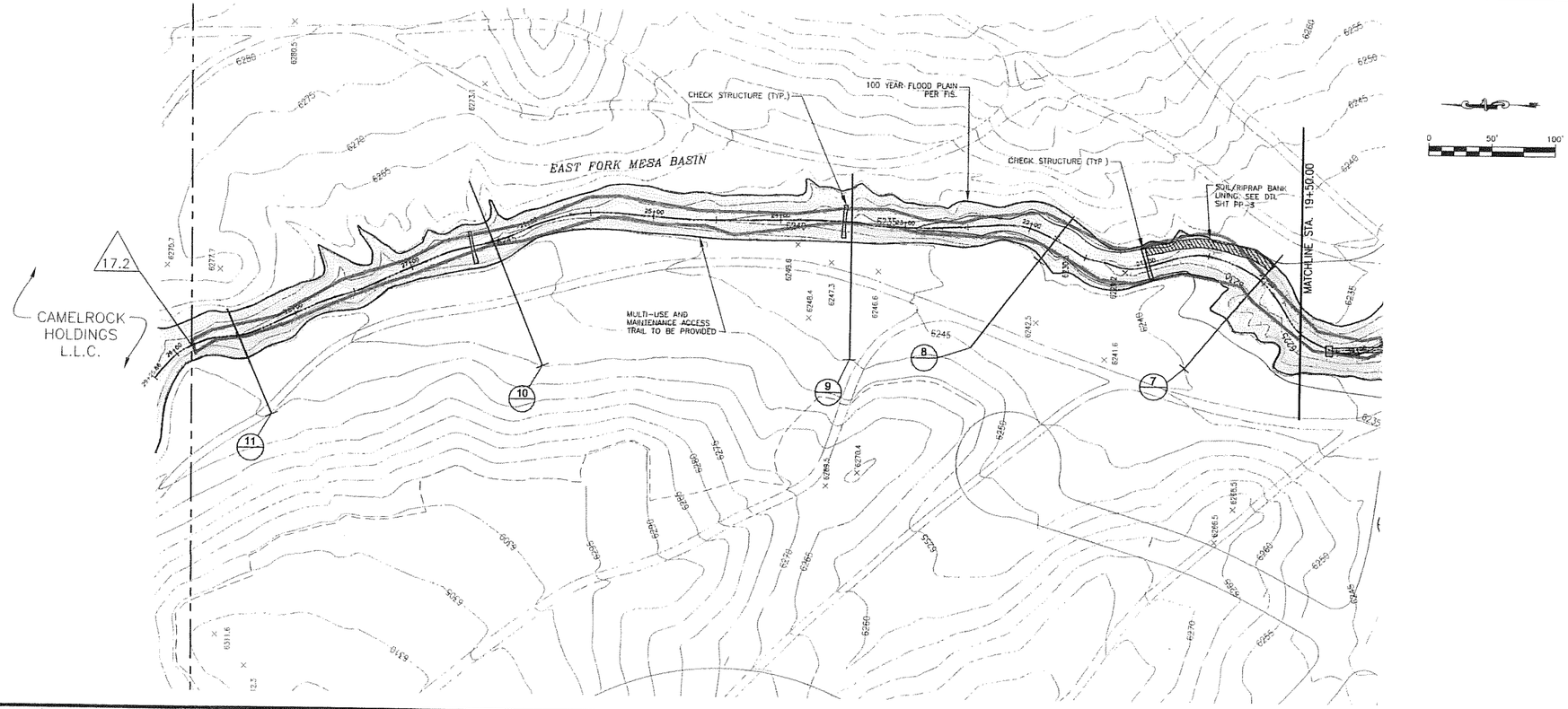
SENTINEL RIDGE
MASTER DEVELOPMENT DRAINAGE PLAN
EAST FORK MESA BASIN PLAN AND PROFILE
COLORADO SPRINGS, COLORADO

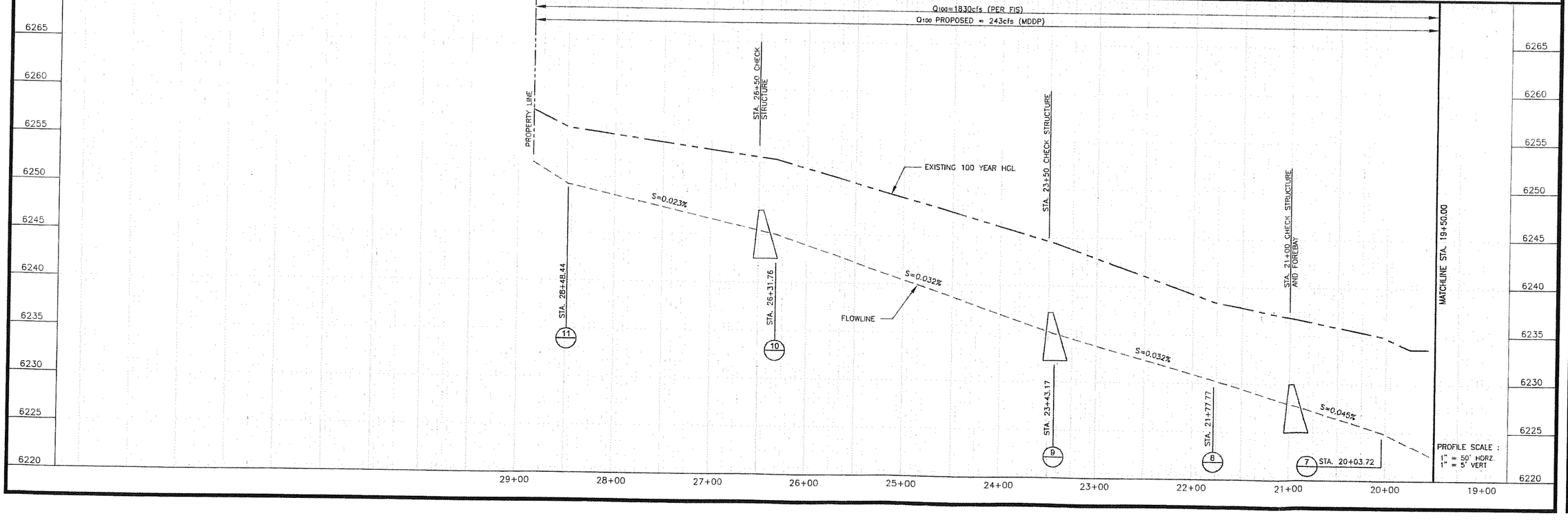
Project No.:	07028
Date:	SEPTEMBER 2008
Design:	RNW
Drawn:	MFA
Check:	RNW
Revisions:	

SHEET
PP-1
OF X SHEETS

07028-PP1-4.dwg/Oct 01, 2008







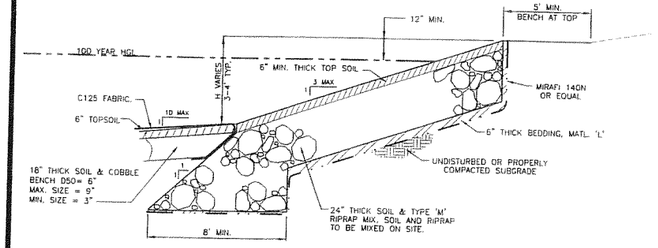
Kiowa Engineering Corporation
1604 South 21st Street
Colorado Springs, Colorado 80904
(719) 630-7342

SENTINEL RIDGE
MASTER DEVELOPMENT DRAINAGE PLAN
EAST FORK MESA BASIN PLAN AND PROFILE
COLORADO SPRINGS, COLORADO

Project No.:	07028
Date:	SEPTEMBER 2008
Design:	RNW
Drawn:	MFA
Check:	RNW
Revisions:	

SHEET
PP-2
OF X SHEETS

07028-PP1-Aug/Oct 01, 2008



TYPICAL CHANNEL BANK LINING DETAIL

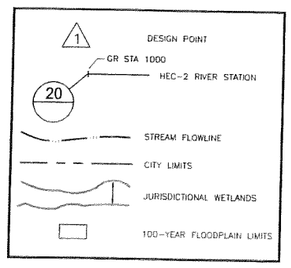
SCALE : 1/4" = 1'

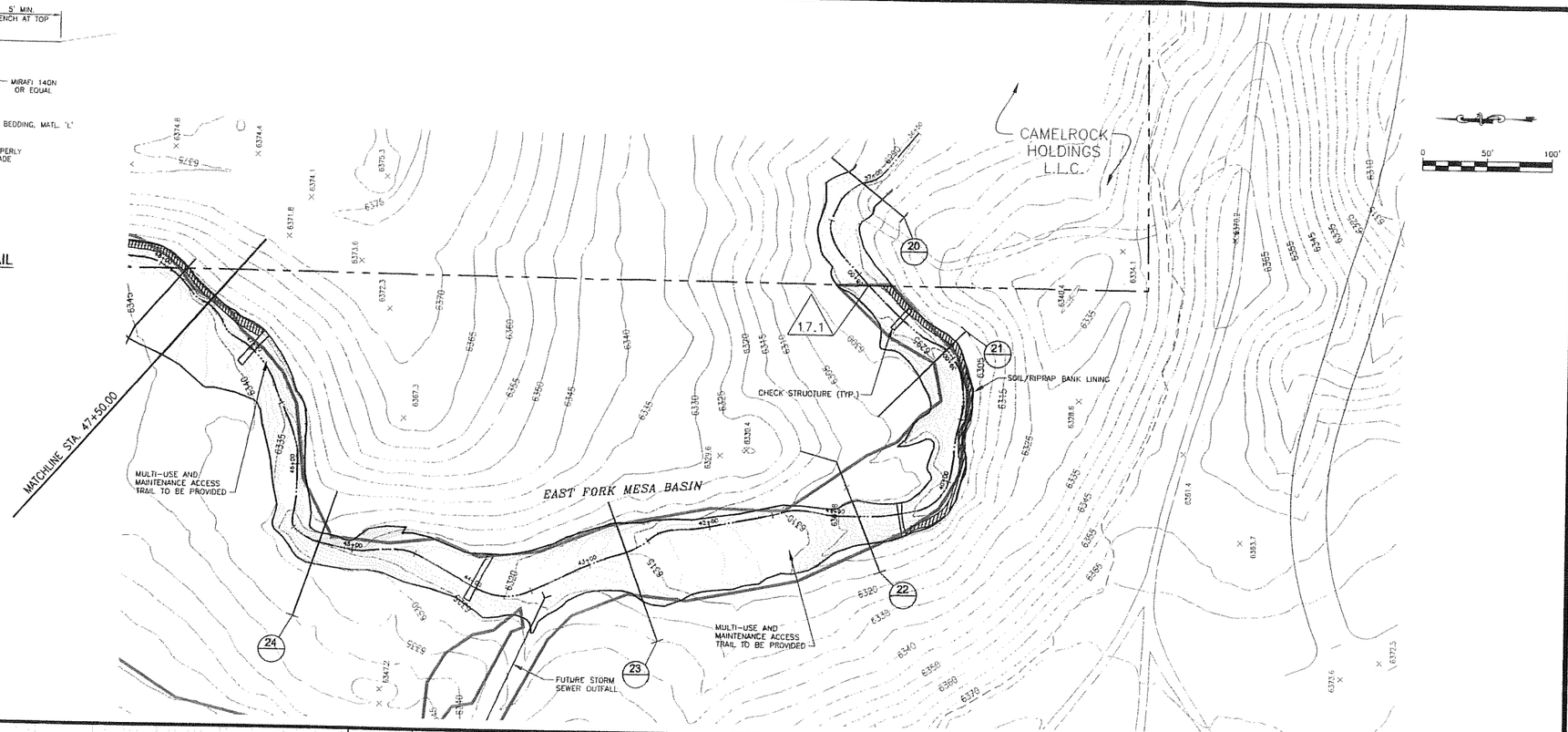
SOIL/RIPRAP NOTES :

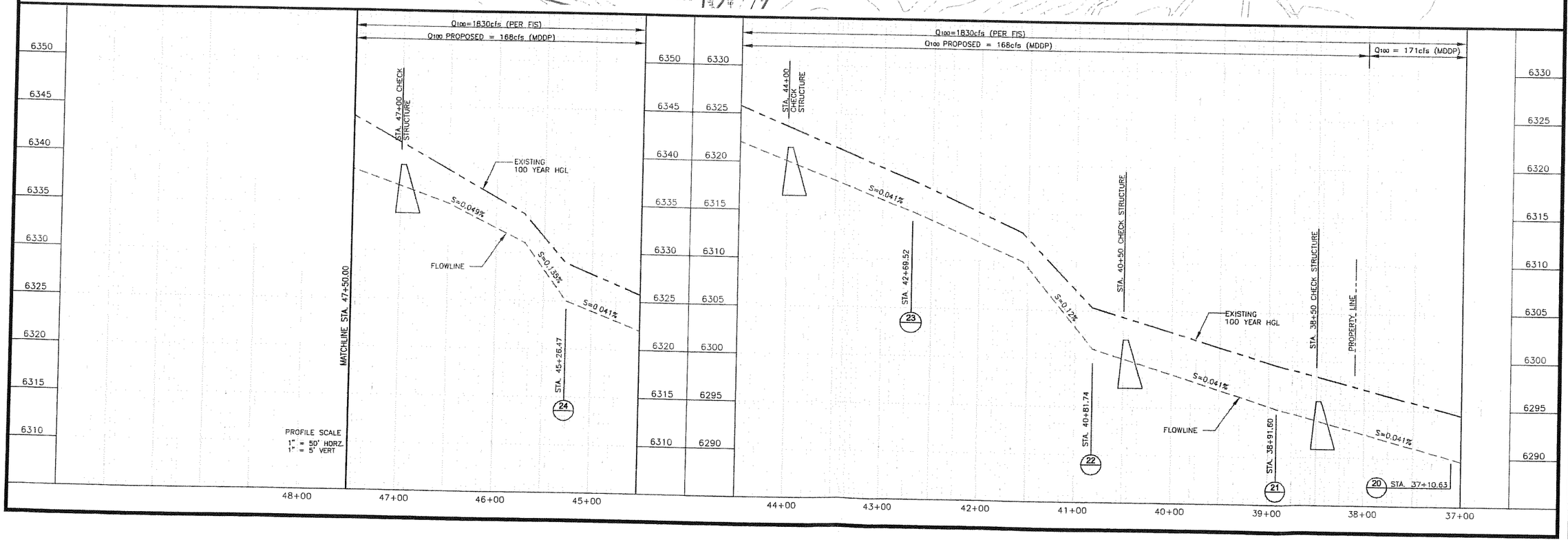
1. SOIL USED TO MIX WITH RIPRAP SHALL BE CLEAN, WELL GRADED NATIVE SOIL FREE OF ROOTS, DEBRIS AND OTHER DELETERIOUS MATERIALS. STOCKPILE OF SOIL TO BE USED FOR SOIL/RIPRAP BANK LININGS TO BE APPROVED BY THE ENGINEER.

2. SOIL SHALL BE MIXED WITH RIPRAP AND STOCKPILED PRIOR TO PLACEMENT. SOIL/RIPRAP STOCKPILE TO BE APPROVED BY ENGINEER.

3. NO MORE THAN 25% OF THE VOLUME OF THE SOIL/RIPRAP MIXTURE SHALL BE CLEAN NATIVE SOIL MATERIAL.







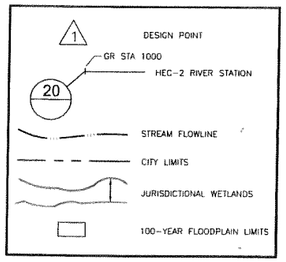
Kiowa Engineering Corporation
1604 South 21st Street
Colorado Springs, Colorado 80904
(719) 630-7342

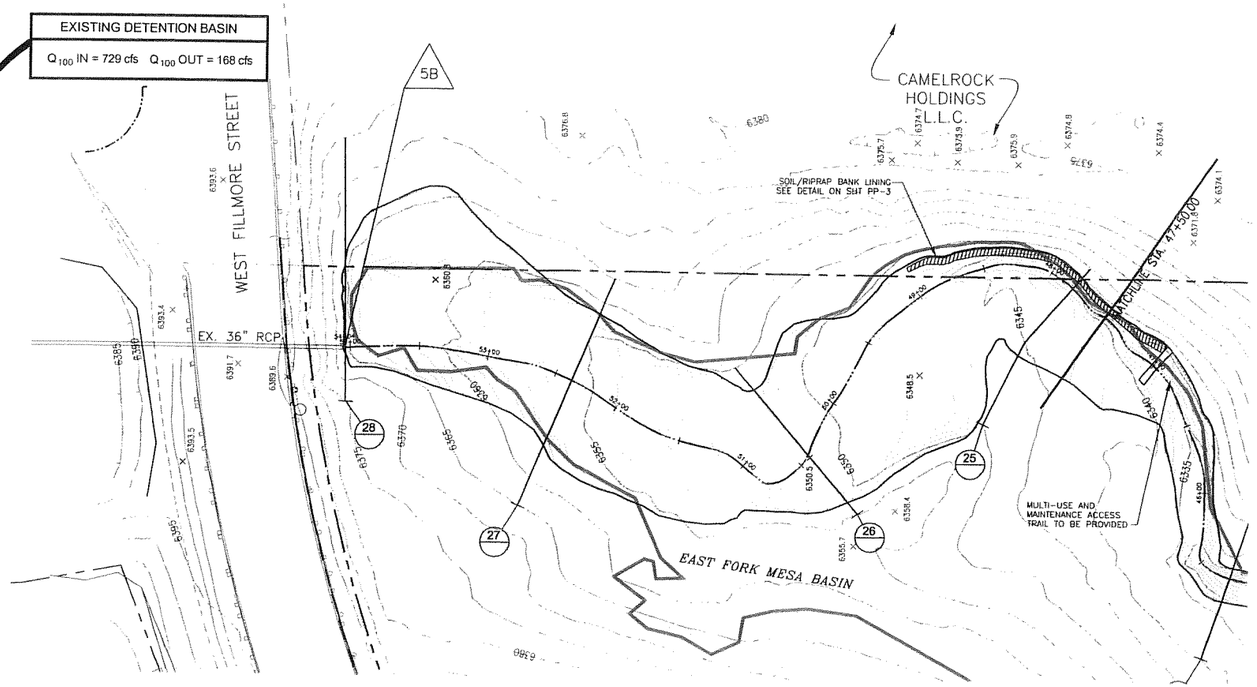
SENTINEL RIDGE
MASTER DEVELOPMENT DRAINAGE PLAN
EAST FORK MESA BASIN PLAN AND PROFILE
COLORADO SPRINGS, COLORADO

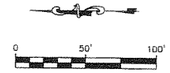
Project No.:	07028
Date:	SEPTEMBER 2008
Design:	RNW
Drawn:	MFA
Check:	RNW
Revisions:	

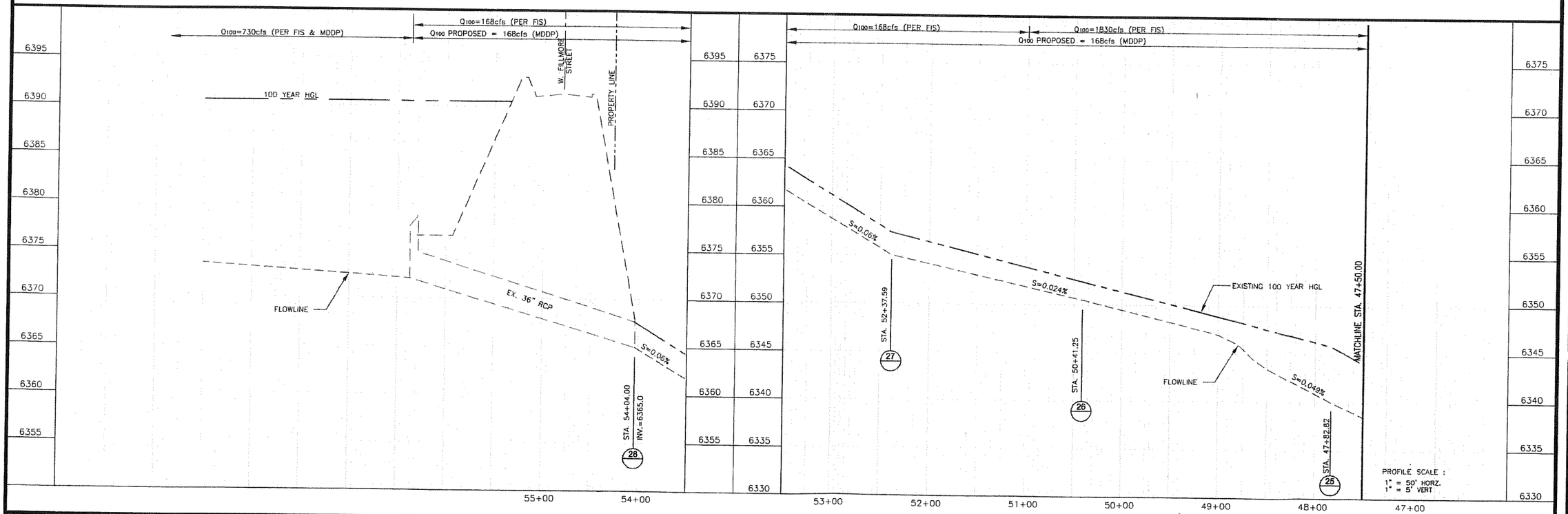
SHEET
PP-3
OF X SHEETS

07028-PP1-4.dwg/Oct 01, 2008









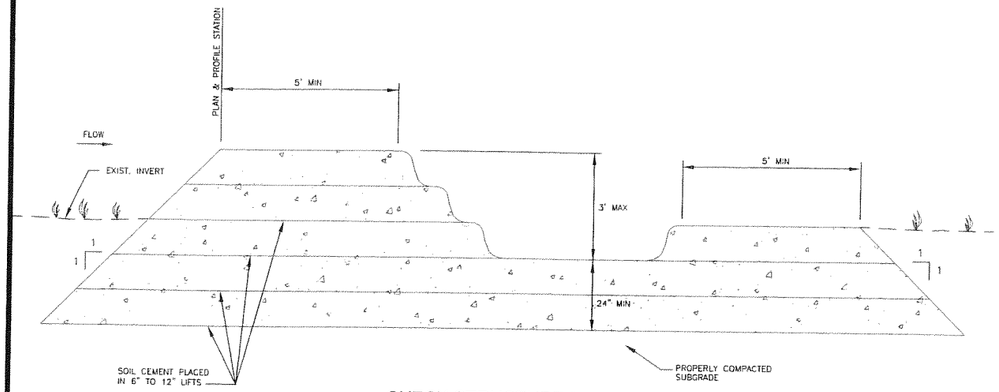
Kiowa Engineering Corporation
1604 South 21st Street
Colorado Springs, Colorado 80904
(719) 630-7342

SENTINEL RIDGE
MASTER DEVELOPMENT DRAINAGE PLAN
EAST FORK MESA BASIN PLAN AND PROFILE
COLORADO SPRINGS, COLORADO

Project No.:	07028
Date:	SEPTEMBER 2008
Design:	RNW
Drawn:	MFA
Check:	RNW
Revisions:	

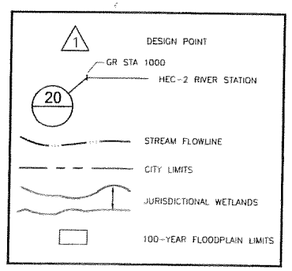
SHEET
PP-4
OF X SHEETS

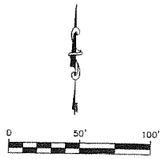
D7028-PP1-4.dwg/Sep 09, 2008

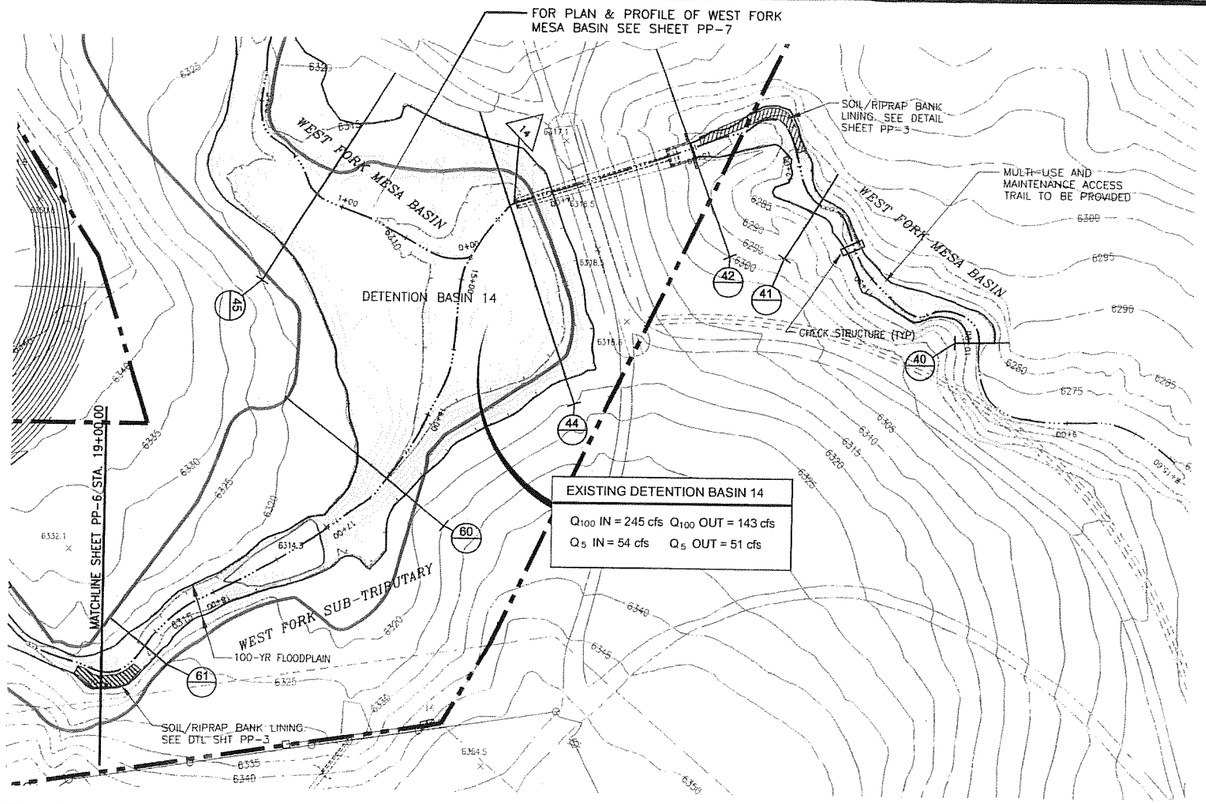


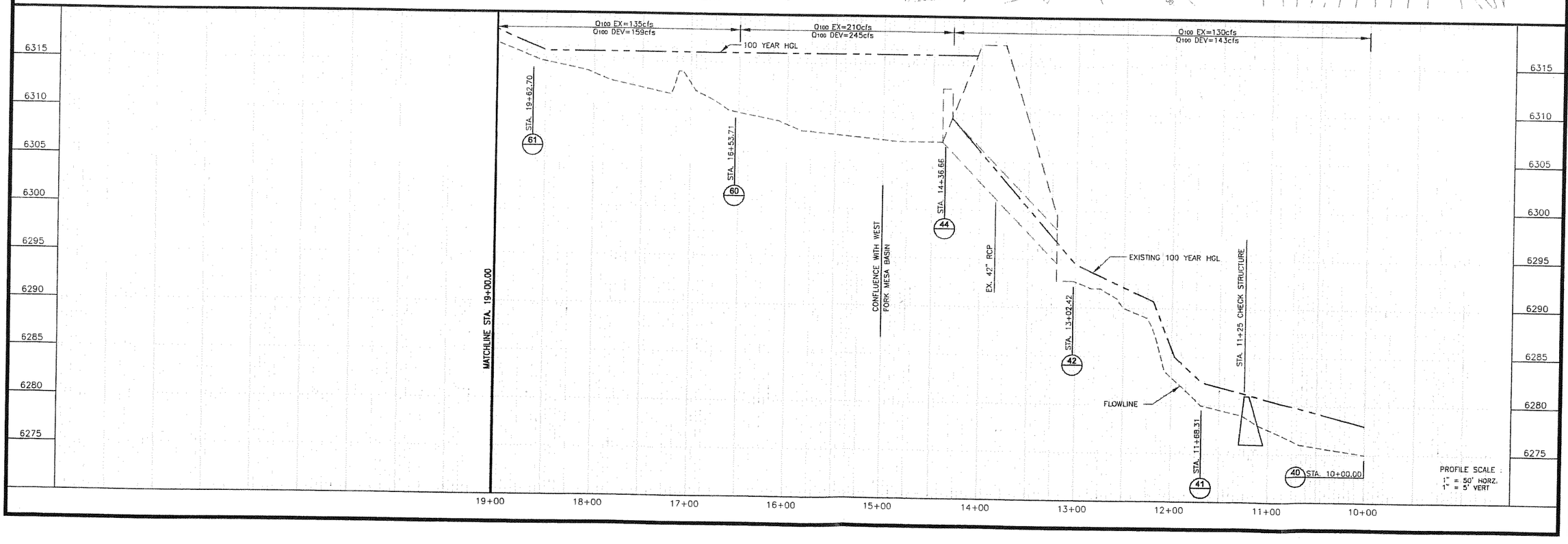
CHECK STRUCTURE DETAIL
TYPICAL

SCALE: 1"=2'-0"









Kiowa Engineering Corporation
1604 South 21st Street
Colorado Springs, Colorado 80904
(719) 630-7342

SENTINEL RIDGE
MASTER DEVELOPMENT DRAINAGE PLAN
WEST FORK SUB-TRIBUTARY MESA BASIN
PLAN AND PROFILE
COLORADO SPRINGS, COLORADO

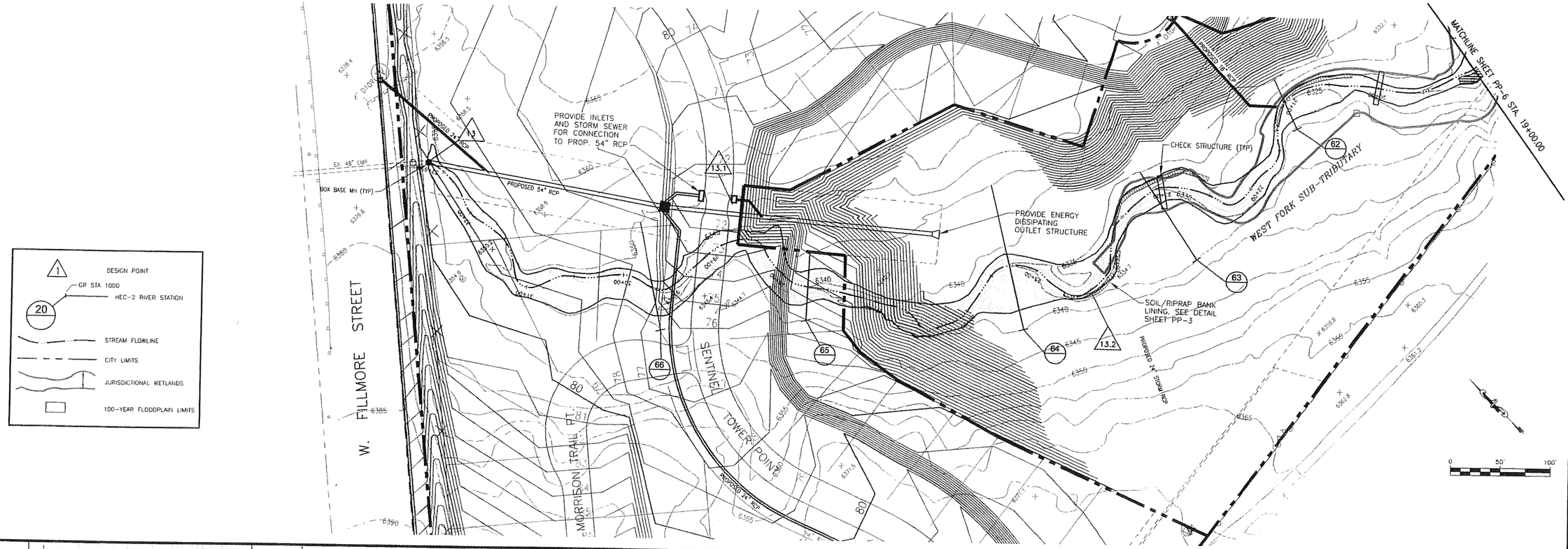
Project No.:	07028
Date:	SEPTEMBER 2008
Design:	RNW
Drawn:	MFA
Check:	RNW
Revisions:	

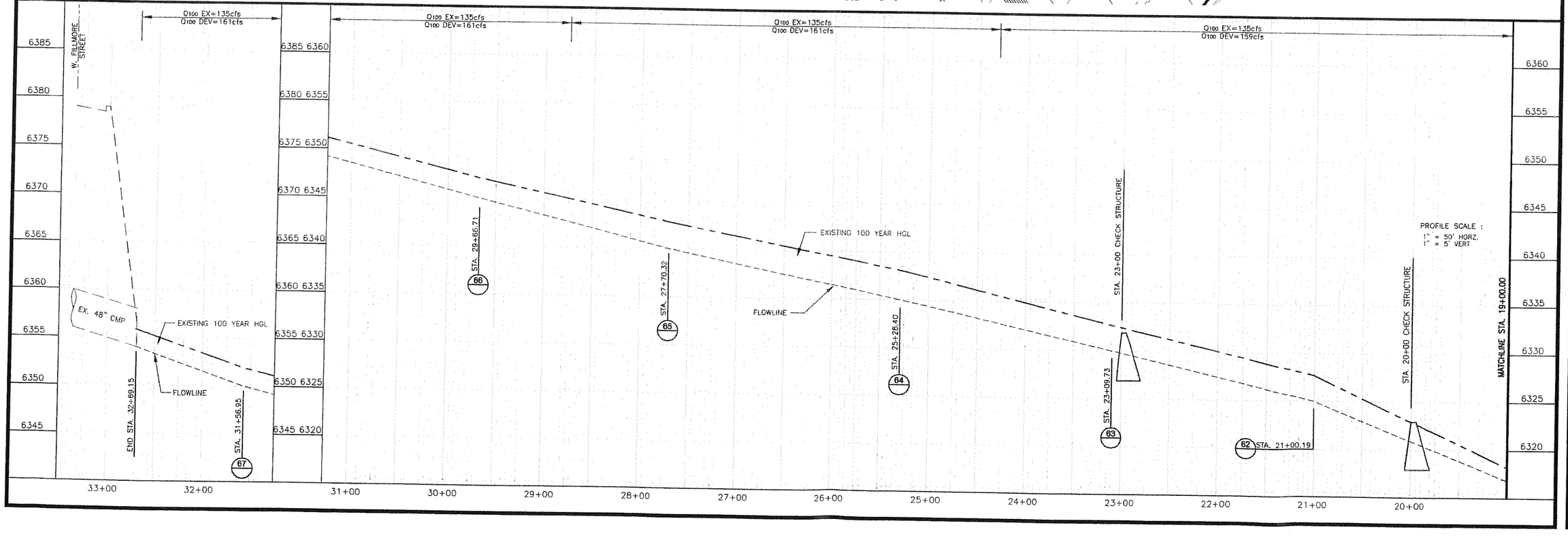
SHEET

PP-5

OF X SHEETS

07028-PP5-7.dwg/Oct 01, 2008





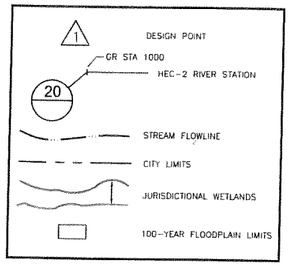
Kiowa Engineering Corporation
1604 South 21st Street
Colorado Springs, Colorado 80904
(719) 630-7342

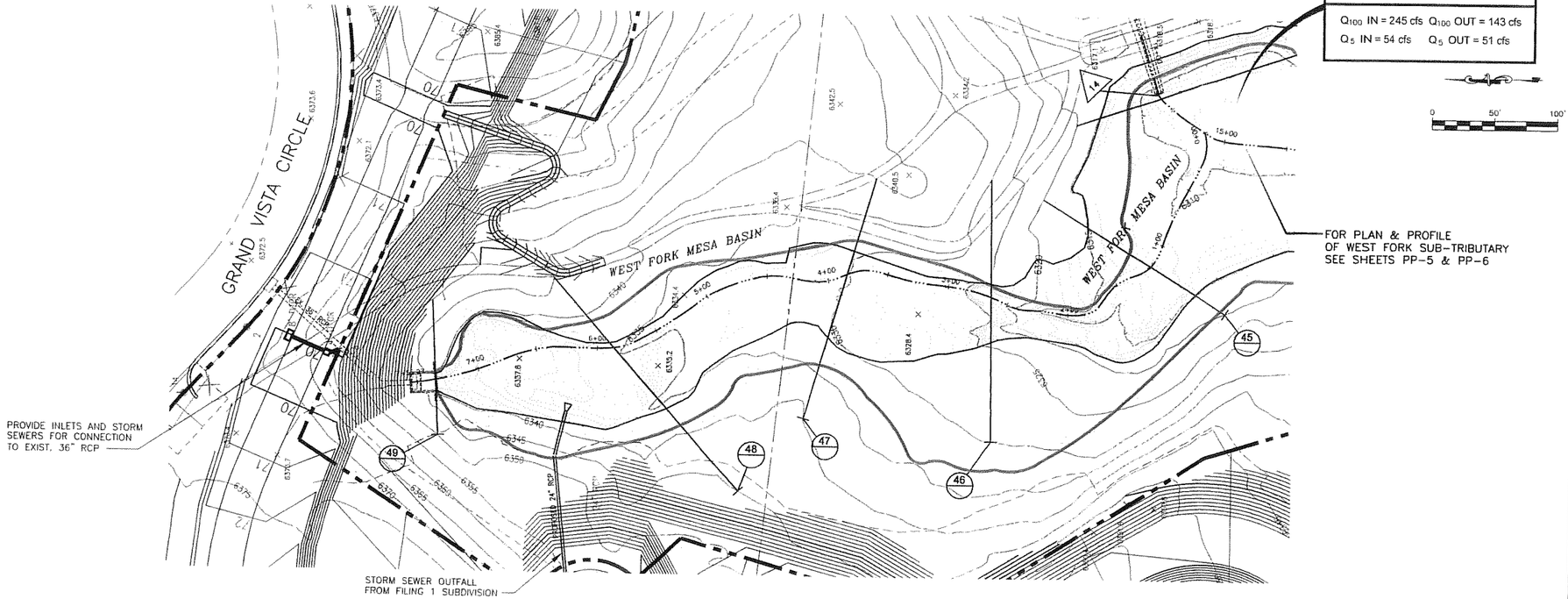
SENTINEL RIDGE
MASTER DEVELOPMENT DRAINAGE PLAN
WEST FORK SUB-TRIBUTARY MESA BASIN
PLAN AND PROFILE
COLORADO SPRINGS, COLORADO

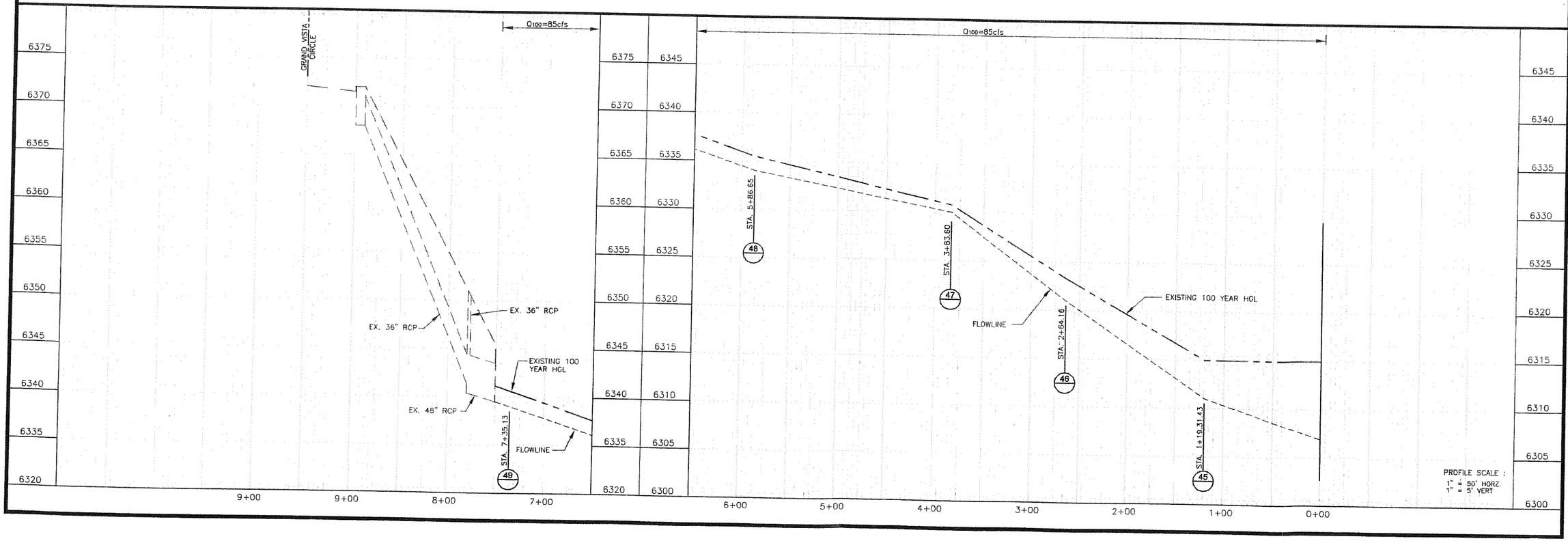
Project No.:	07028
Date:	SEPTEMBER 2008
Design:	RNW
Drawn:	MFA
Check:	RNW
Revisions:	

SHEET
PP-6
OF X SHEETS

07028-PP6-7.dwg/Oct 01, 2008







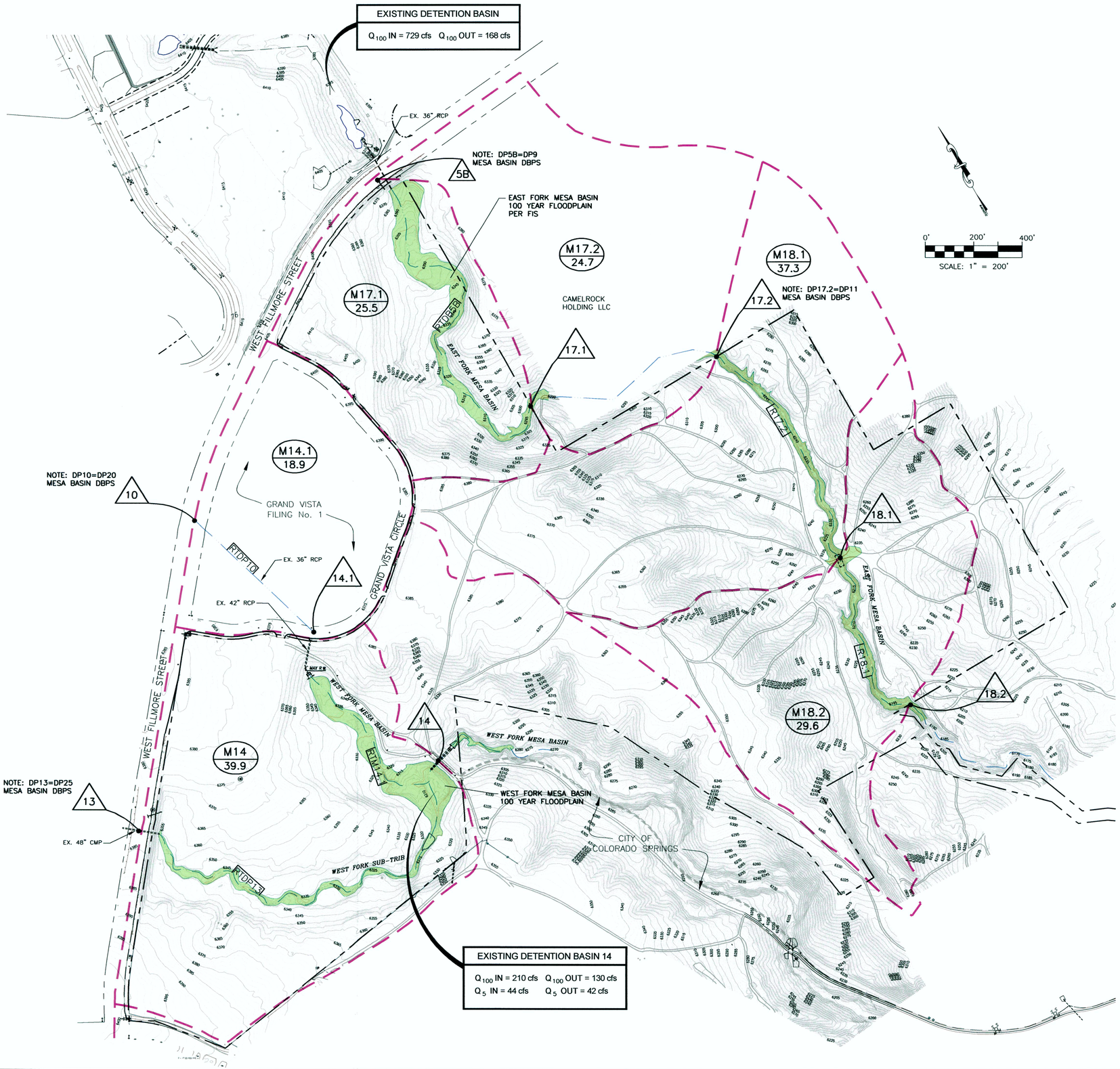
Kiowa Engineering Corporation
1604 South 21st Street
Colorado Springs, Colorado 80904
(719) 630-7342

SENTINEL RIDGE
MASTER DEVELOPMENT DRAINAGE PLAN
WEST FORK MESA BASIN
PLAN AND PROFILE
COLORADO SPRINGS, COLORADO

Project No.:	07028
Date:	SEPTEMBER 2008
Design:	RNW
Drawn:	MFA
Check:	RNW
Revisions:	

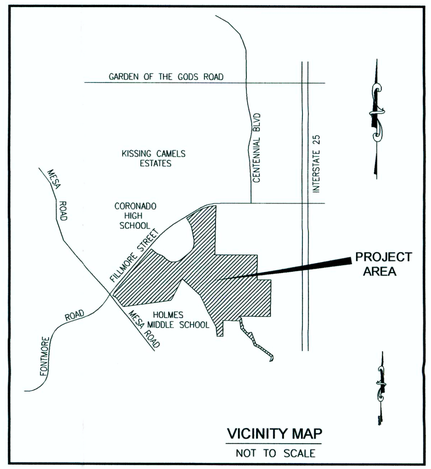
SHEET
PP-7
OF X SHEETS

07028-PP5-7.dwg/Oct 01, 2008



LEGEND

- R / 10.4 ac — SUB-BASIN DESIGNATION / SUB-BASIN AREA
- 1 — DESIGN POINT
- DRAINAGE BASIN BOUNDARY
- STREAM INVERT
- R17.2 — HEC-1 ROUTING ELEMENT



VICINITY MAP
NOT TO SCALE

DESIGN POINT DISCHARGES

DESIGN POINT	5-YEAR FLOW	100-YEAR FLOW
5B	106	168
10	17	61
13	25	135
14 (1)	44	210
14.1	28	82
17.1	107	172
17.2	108	177
18.1	107	189
18.2 (2)	111	279

(1) DP 14=DP 26 DBPS
(2) DP 18.1=DP 12 DBPS

SUB-BASIN DISCHARGES

BASIN	Q_5	Q_{100}
M14	1	6
M14.1	18	35
M17.1	14	53
M17.2	1	23
M18.1	1	13
M18.2	43	110

Kiowa Engineering Corporation
1604 South 21st Street
Colorado Springs, Colorado 80904
(719) 630-7342

SENTINEL RIDGE
MASTER DEVELOPMENT DRAINAGE PLAN
SUB-BASIN MAP
EXISTING BASIN CONDITIONS
COLORADO SPRINGS, COLORADO,

Project No.:	07028
Date:	September 2008
Design:	RNW
Drawn:	MFA
Check:	RNW
Revisions:	

SHEET
EXH 1
OF X SHEETS

07028 Exh1.dwg/Oct 01, 2008

EXISTING DETENTION BASIN

Q_{100} IN = 729 cfs Q_{100} OUT = 168 cfs

EX. 36" RCP

NOTE: DP5B=DP9
MESA BASIN DBPS

5B

EAST FORK MESA BASIN
100 YEAR FLOODPLAIN
PER FIS

M17A
24.7

M18A
22.7

17.2

CAMELROCK
HOLDING LLC

PROPOSED
COMMERCIAL

RD9&8

WEST FILLMORE STREET

17.1

RD17.1

WEST FORK MESA BASIN

M17B
19.5

RD17.2

M14.1
19.2

NOTE: DP10=DP20
MESA BASIN DBPS

10

GRAND VISTA
FILING No. 1

M18B
13.2

18.1

RD10&7

EX. 36" RCP

14.1

14.2

GRAND VISTA CIRCLE

EX. 42" RCP

RD14.1

M18C
20.1

M18D
24.7

EAST FORK MESA BASIN

RD18.1

WEST FILLMORE STREET

WEST FORK MESA BASIN

18.2

14

M14D
6.7

WEST FORK MESA BASIN

RM18C

CITY OF
COLORADO SPRINGS

RD14.2

NOTE: DP13=DP25
MESA BASIN DBPS

WEST FORK MESA BASIN
100 YEAR FLOODPLAIN
PER FIS

13

EX. 48" CMP

RD13

RD13.1

CITY OF
COLORADO SPRINGS

13.1

WEST FORK SUB-TRIB

SENTINEL RIDGE WEST AT
GARDEN OF THE GODS
CLUB FILING NO. 1

RM14B

M14A
20.2

M14C
13.9

13.2

EXISTING DETENTION BASIN 14

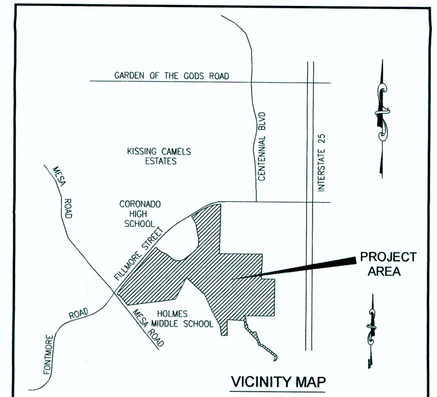
Q_{100} IN = 245 cfs Q_{100} OUT = 143 cfs
Q_5 IN = 54 cfs Q_5 OUT = 51 cfs

0' 200' 400'

SCALE: 1" = 200'

LEGEND

- R / 10.4 ac — SUB-BASIN DESIGNATION / SUB-BASIN AREA
- 1 — DESIGN POINT
- DRAINAGE BASIN BOUNDARY
- STREAM INVERT
- R17.2 — HEC-1 ROUTING ELEMENT



VICINITY MAP
NOT TO SCALE

DESIGN POINT DISCHARGES W/O PROPOSED DETENTION

DESIGN POINT	5-YEAR FLOW	100-YEAR FLOW
5B	106	168
10	20	68
13	30	155
13.1	32	161
14 (1)	54	245
14.1	26	85
14.2	31	100
17.1	107	171
17.2	111	245
18.1 (2)	111	261
18.2	145	378

(1) DP 14=DP 26 DBPS
(2) DP 18.1=DP 12 DBPS

SUB-BASIN DISCHARGES

BASIN	Q_5	Q_{100}
M14.1	12	30
M14A	1	13
M14C	7	31
M14D	6	19
M17A	40	91
M17B	24	64
M18A	1	6
M18B	1	12
M18C	18	53
M18D	28	78

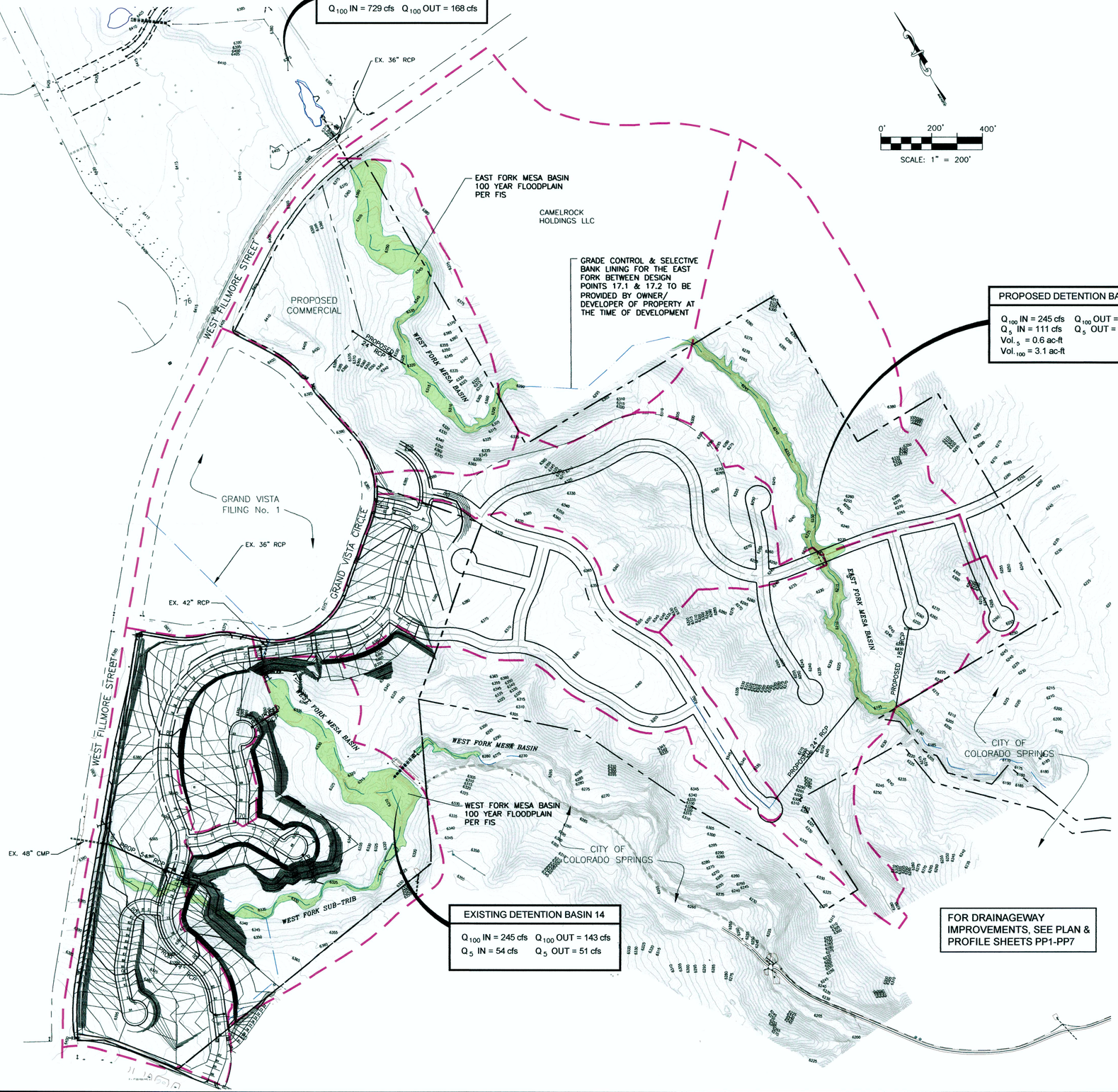
Kiowa Engineering Corporation
1604 South 21st Street
Colorado Springs, Colorado 80904
(719) 630-7342

SENTINEL RIDGE
MASTER DEVELOPMENT DRAINAGE PLAN
SUB-BASIN MAP
PROPOSED BASIN CONDITIONS
COLORADO SPRINGS, COLORADO,

Project No.: 07028
Date: SEPTEMBER 2008
Design: RNW
Drawn: MFA/JLN
Check: RNW
Revisions:

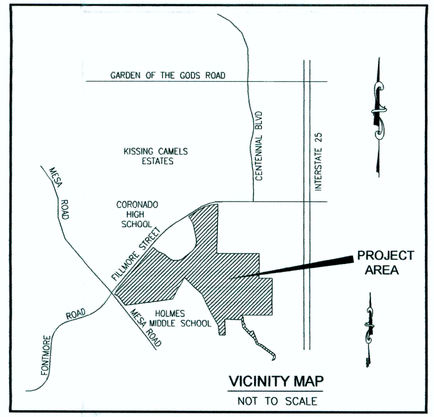
SHEET
EXH 2
OF X SHEETS

07028 Exh2.dwg/Oct 01, 2008



LEGEND

R – 10.4 ac	SUB-BASIN DESIGNATION / SUB-BASIN AREA
1	DESIGN POINT
	DRAINAGE BASIN BOUNDARY
	STREAM INVERT
R17.2	HEC-1 ROUTING ELEMENT



VICINITY MAP
NOT TO SCALE

DESIGN POINT FLOWS W/O PROPOSED DETENTION

DESIGN POINT	5-YEAR FLOW	100-YEAR FLOW
56	106	168
10	20	68
13	30	155
13.1	32	161
14 (1)	54	245
14.1	26	85
14.2	31	100
17.1	107	171
17.2	111	245
18.1	111	261
18.2	145	378

(1) OUTFLOW FROM EXISTING DETENTION BASIN

DESIGN POINT FLOWS WITH DETENTION

DESIGN POINT	5-YEAR FLOW	100-YEAR FLOW
18.1	111	261
18 (1)	110	176
18.2	127	280

(1) OUTFLOW FROM PROPOSED DETENTION BASIN @ DP 18.1

Kiowa Engineering Corporation
1604 South 21st Street
Colorado Springs, Colorado 80904
(719) 630-7342

SENTINEL RIDGE
MASTER DEVELOPMENT DRAINAGE PLAN
PROPOSED FACILITIES
COLORADO SPRINGS, COLORADO,

Project No.:	07028
Date:	SEPTEMBER 2008
Design:	RNW
Drawn:	MFA/JLN
Check:	RNW
Revisions:	

SHEET
EXH 3
OF X SHEETS

07028 Exh3.dwg/Oct 01, 2008