Design Report Amendment and
Addendum to Wolf Ranch Master Development Drainage Plan
Project Dox #: STM-REV23-0098

Wolf Ranch Development (Detention F18/F19)
Colorado Springs, Colorado

Prepared for:
Development Management, Inc.
111 South Tejon Street, Suite 222
Colorado Springs, Colorado 80903

Prepared by:

Kiowa
Engineering Corporation
7175 West Jefferson Avenue, Suite 2200
Lakewood, Colorado 80235
Ph: (303)692-0369

Kiowa Project No. 22035

April 27, 2023

TABLE OF CONTENTS

STATEMENTS AND APPROVALS

ENGINEER'S STATEMENT:

This report and plan for the drainage design of the Wolf Ranch Detention F18/F19 and Amendment to Wolf Ranch Master Development Drainage Plan was prepared by me (or under my direct supervision) and is correct to the best of my knowledge and belief. Said report and plan has been prepared in accordance with the City of Colorado Springs Drainage Criteria Manual and is in conformity with the master plan of the drainage basin. I understand that the City of Colorado Springs does not and will not assume liability for drainage facilities designed by others. I accept responsibility for any liability caused by any negligent acts, errors or omissions on my part in preparing this report.

4/27/23

Matthew W. Erichsen, PE (PE #36713) Date

For and on Behalf of Kiowa Engineering Corporation

DEVELOPER'S STATEMENT:

Development Management, Inc. hereby certifies that the drainage facilities for Wolf Ranch Detention F18/F19 and Amendment to Wolf Ranch Master Development Drainage Plan shall constructed according to the design presented in this report. I understand that the City of Colorado Springs does not and will not assume liability for the drainage facilities designed and/or certified by my engineer and that are submitted to the City of Colorado Springs pursuant to section 7.7.906 of the City Code; and cannot, on behalf of Wolf Ranch Detention F18/F19 and Amendment to Wolf Ranch Master Development Drainage Plan guarantee that final drainage design review will absolve Development Management, Inc. Development and/or their successors and/or assigns of future liability for improper design. I further understand that approval of the final plat does not imply approval of my engineer's drainage design

Development Management, Inc.
Name of Developer

Authorized Signature: _____ Date: 4/27/23

Printed Name: Gregory J. Barbuto

Title: Vice President

Address: 111 South Tejon Street, Suite 222
Colorado Springs, Colorado 80903

CITY OF COLORADO SPRINGS STATEMENT:

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

_____ 2023/05/08

For City Engineer Date

I. PROJECT BACKGROUND

This report is provided as an amendment to the Wolf Ranch Master Development Drainage Plan (MDDP) and Wolf Ranch Detention Basin F18/F19 Design Report. The MDDP amendment is due to modifications to the areas tributary to Detention F18/F19. The F18/F19 design report amendment is due to the proposed addition of three forebays to detention F18/F19 and modifications to the outlet structure and internal embankment to address the tributary area modifications and re-routing of runoff/flows to different locations within the overall facility than originally assumed.

The MDDP for Wolf Ranch was last updated and approved by the City in December 2020 in the report titled *Master Development Drainage Plan Amendment, Wolf Ranch Development (Detention F14, F28, G), Addendum to Wolf Ranch Master Development Plan Update.*

The proposed master plan amendment includes changes to Sub-basins F8-F12, F16-F19 in portions of Wolf Ranch that remain to be developed. The proposed changes include modifications to sub-basins, removal of drainage channels and installation of storm sewers. Small tributary areas have been moved from F18 and routed to F19. Modifications to existing Detention F18/F19 are necessary to compensate for these flow changes. The proposed detention basin modifications will slightly change flow rates but will not affect the sizing of the major drainageway, storm sewer within sub-basin F of Wolf Ranch. Final detailed design of Detention Basin F18/F19 is provided.

II. GENERAL LOCATION AND DESCRIPTION

The Detention Basin F18/F19 site is located within the Wolf Ranch development, to the north of Briargate Parkway, roughly 2000 feet east of Wolf Lake Drive in Colorado Springs. Detention Basin F18/F19 is a Full Spectrum Detention basin providing storm water quality enhancement, release rates approximating undeveloped conditions and the developed 100-year runoff at a rate below the historic rate. Detention Basin F18/F19 discharges to a storm sewer crossing under Briargate Parkway which discharges into Tributary Four. The majority of improvements for the detention basin were constructed in 2019 with the exception of the permanent forebays for the storm sewer outfalls into the basin.

For the WQCV and EURV, the detention basin is separated into two basins by an embankment to keep the tributary area below 1 square mile as required by the City for WQCV treatment. The tributary area to DP F18 is 0.74+/- square miles and the tributary area to DP F19 is 0.46+/- square miles. For flows greater than the EURV, the two basins (F18 and F19) will be combined to provide regional detention. Developed flows will enter the detention basin via storm sewer. The detention basin is referred to as Detention F18/F19 and is one of a series of regional detention basins within the overall development. Detention F18/F19 serves basins F1-F6, F8-F12 and F16-F19, as shown in the MDDP. The MDDP forms the basis for the hydrologic and hydraulic design shown on the final design plans.

Detention Basin F18/F19 is currently located within un-platted land belonging to the developers of Wolf Ranch. The land will be platted in the future. Once the detention facility is completed and accepted by the City of Colorado Springs, easements and or tracts will be dedicated to the City for the purposes of maintenance access by the City. The detention facility itself will ultimately be operated and maintained by the City of Colorado Springs. To this point, the facility functions as a temporary sediment/detention basin maintained by the property owner until the upstream development occurs and the facility is turned over to the City. A vicinity map is provided in the Appendix showing the site location.

The modifications to the F sub-basins will include routing sub-basins F-6 into F18/F19, previously routed to Detention F14. Basins F8-F12, F16-F19 have been re-configured to match the updated development plan. Small portions of area tributary to Detention F18 have been routed to F19.

Additional tributary areas to F19 increase the EURV volume, this requires the embankment separating F18/F19 to be raised. The F19 outlet structure will also be raised to match the embankment spillway. Orifice plate modifications to outlet structure F19 are required to match historic flows.

III. FLOODPLAIN AND ENVIRONMENTAL

Detention Basin F18/F19 does not lie within a regulatory floodplain and as such there will not be a requirement to obtain a floodplain development permit for the construction of the improvements. Flood Insurance Rate Map 08041C0529 G (effective date of December 7, 2018). The portion of the FIRM panel showing the project location is presented in the Appendix.

The proposed limits of construction for the Detention Basin F18/F19 improvements are not within a jurisdictional wetland.

Based upon reports and acknowledgements from the United States Fish and Wildlife Service (USFWS), Wolf Ranch in general has been shown to not exhibit the existence of Preble's Meadows Jumping Mouse (PMJM) habitat. There are no other known environmental issues in regard to endangered species that would affect the construction of the drainage structures shown on the design plans. The site disqualification report related to PMJM habitat is provided in the original F18/F19 Design Report.

Design criteria used to develop the design and forebay design followed the City of Colorado Springs Drainage Criteria Manual (DCM) Volume 1 along with Mile High Flood District (MHFD) Urban Storm Drainage Criteria Manual (USDCM) Volumes 2 and 3.

IV. HYDROLOGY

The hydrology used to determine the required detention storage volume and release rates is based on the most current version of the City of Colorado Springs Drainage Criteria Manual adopted in 2014. The MDDP for Wolf Ranch was last updated and approved by the City in December 2020 in the report titled *Master Development Drainage Plan Amendment, Wolf Ranch Development (Detention F14, F28, G), Addendum to Wolf Ranch Master Development Plan Update.* The HEC-1 hydrology inputs and outputs included within this amendment summarize the revised existing and proposed 5-year and 100-year discharges for the major sub-watersheds within the Wolf Ranch development. The hydrology presented in the MDDP is based upon the criteria described in the 1987 City of Colorado Springs and El Paso County Drainage Criteria Manual. The 1987 DCM required that a 24-hour Type IIA storm be applied when estimating peak discharges for the purposes of designing major drainageway and regional detention facilities. The 1987 DCM also required that rainfall depths be determined using NOAA Atlas 2, Volume III, Colorado.

To summarize, the hydrology model used to determine the inflow and outflow peak discharges and the required 100-year storage volume for Detention Basin F18/19 assumed a 24-hour duration storm with a total rainfall depth as obtained from NOAA Atlas 14. The depth duration curve presented in Table 3 of Reference 5 were used in the compilation of the USACOE HEC-1 Hydrograph model. Rainfall depths for the 100-year 24-hour storm were obtained from Table 2 of Reference 5.

Detention Basin F18/F19: The tributary area is 768.5 acres to Detention Basin F18/F19. The watershed within the property limits will be developed into a combination of low to medium density residential uses, school and areas for parks or open space. The offsite watershed areas are currently developed as rural residential low density with lot sizes varying from 2.5 acres to 10 acres. The proposed percent imperviousness for the tributary area is assumed to be 15.2% based off a weighted CN value from the MDDP and corresponding percent impervious. Soils in the watershed are all grouped into NRCS Hydrologic Soils Group B.

Following is the volume and flow information for the Detention Basin F18/F19, as summarized in the updated MDDP hydrology.

Detention Basin F18/F19 (WQCV and EURV for DP F18, 100 yr Detention for DP F18/F19)

	Inflow	Release Rate	Volume	Elevation	Time to Drain 99% of inflow volume
WQCV		1.2 cfs	2.80 ac-ft	7137.52	42 hrs
EURV		1.3 cfs	5.00 ac-ft	7138.24	63 hrs
5-Year	160 cfs	17 cfs	10.8 ac-ft	7139.38	
100-Year	846 cfs	222 cfs	30.5 ac-ft	7142.39	

Detention Basin F19 (WQCV and EURV only)

	Inflow	Release Rate	Volume	Elevation	Time to Drain 99% of inflow volume
WQCV		1.1 cfs	2.76 ac-ft	7140.20	41 hrs
EURV		1.3 cfs	5.93 ac-ft	7141.62	71 hrs

The developed 100-year release rate for Detention F18/F19 and Detention F28 (located downstream along Tributary Four) were determined by analyzing the entire "F" Drainage Basins into Cottonwood Creek at Design Point F (DP F). DP F is located at the downstream end of the property where Tributary Four flows into Cottonwood Creek. The combined release rate of these detention basins results in a 100-year flow slightly less than the historic condition 100-year flow at DP F. Following is a table showing the historic and proposed developed flow from Basin F into Cottonwood Creek. Refer to the HEC1 model in the Appendix for additional information.

Flow at Design Point DP F (located at the Confluence with Cottonwood Creek)

	DP F at Cottonwood Creek
100-year Flow – Historic *	599 cfs
100-year Flow - Proposed Developed	596 cfs

* Historic Flow taken from Wolf Ranch MDDP Update dated June 8, 2018

Flow changes at Design Points in Basin F

	2021 MDDP Update	Revised MDDP due to F18/F19 Modifications
DP F11	90 cfs	95 cfs
DB F14 (IN)	250 cfs	252 cfs
DB F14 (OUT)	80 cfs	81 cfs
DP F23(old)/DPF23A	59 cfs	86 cfs
DB F18/F19 (IN)	750 cfs	846 cfs
DB F18/F19 (OUT)	215 cfs	222 cfs
F22	230 cfs	234 cfs
DP F25	136 cfs	146 cfs
DP F30	394 cfs	398 cfs
DP F29	405 cfs	417 cfs
DP F28 (IN)	695 cfs	780 cfs

DP F28 (OUT)	531 cfs	590 cfs
F	545 cfs	596 cfs

Detention Basin F18/F19 operates as a full spectrum detention basin. The EURV for both detention area/outlet structure F19 and F18/F19 were estimated for the entire area tributary (off-site and on-site sub basins) to the design point. The stage, storage and release rate curves for the final design are contained in the Appendix. The release rate curves are based on the water surface depth and the corresponding release rate through the outlet structure. The revised Figure 6 from the MDDP is also included within the Appendix. The US Army Corps of Engineers HEC-1 Hydrograph Package was used to route the developed runoff through Detention F14. The design storm is based on the NOAA Atlas 14 24-hour rainfall depth for Colorado Springs. The NRCS Curve Number Loss and Dimensionless Unit Hydrograph Method to estimate peak flows and runoff volumes was applied in the HEC-1 model. The input and output data for the hydrology model has been included within the Appendix.

V. HYDRAULICS

Detention Basin F18/F19 includes two phased outlet structures. The F19 outlet structure is capable of controlling the WQCV, EURV and passing the 100-year inflow volume over the spillway into Basin F18. The F18 outlet structure is capable of controlling the Design Point F18 WQCV, EURV and the combined F18/F19 100-year inflow volume at the discharges listed above. The Full Spectrum Detention outlet structures are designed to control the release of the WQCV and minor storm events to historic levels. The calculations related to the modifications to the WQCV/EURV perforated plate are contained in the Appendix.

The 100-year storage volume and release rate is controlled by the F18 Outlet Structure pipe opening size and storm sewer discharging from the outlet structure. The 100-year outflow discharge drains into the storm sewer crossing under Briargate Parkway and outfalling into upper tributary four downstream of the Wolf Lake spillway. A surface emergency spillway does not exist for the detention basin as described in the original report. A second outlet structure (spillway grate) handles emergency spillway flows. The separate HEC-1 model assuming the primary outlet structure is completed blocked, was updated and included in the Appendix, to determine the required flow through the emergency grate.

VI. DESIGN SUMMARY

Runoff will enter Detention Basin F18/F19 from multiple locations. DP F18: one on the northeast end and north side. DP F19: two on the west end. These flows will be piped into the detention basin. Two impact basins with forebays and one forebay are proposed for the flows coming into the detention basin. The impact basins are designed per MHFD and USBR standards, they will have an attached concrete forebays designed to achieve the required volume and a slot to control the flow release rate at the downstream end of the forebay. The existing 54" RCP located in the western end of F19 will have a concrete forebay added. The concrete forebay will be designed per the DCM. Flows from the 54" RCP are lower than previously calculated, therefore the pipe is oversized and a type VI impact basin would not function as intended. A typical concrete forebay with baffle block would be more applicable to this situation.

A concrete low flow channel carries flows from the forebays to the outlet structures.

Modified design parameters for Detention Basin F18/F19 are listed below.

- Freeboard between emergency grate design water surface and top of embankment: 2.97 feet
- Emergency Grate - Outlet Structure Grate elevation: 7142.90 (AB)

- Emergency Grate – Discharge: 136 cubic feet per second
- Emergency Grate – Maximum water surface elevation: 7144.53
- Emergency Grate – Volume at Maximum water depth: 46.91 ac-ft

The improvements described in this report have been designed with the intent to not cause adverse impacts to the downstream and surrounding developments.

VII. DRAINAGE FEES AND REIMBURSABLE FACILITIES

Refer to the Drainage Fees and Reimbursable Facilities section in the original report.

The Wolf Ranch property has been closed so there will be no reimbursable expenses related to the proposed improvements described in this report.

VIII. REFERENCES

1) Wolf Ranch, Master Development Drainage Plan Update, by Kiowa Engineering Corporation, dated December 21, 2020 (July 26, 2019) (June 8, 2018) (September 4, 2013).

2) City of Colorado Springs and El Paso County Flood Insurance Study, prepared by the Federal Emergency Management Agency, dated December 2018.

3) City of Colorado Springs, Drainage Criteria Manual, Volumes 1 and 2, current edition.

4) Urban Storm Drainage Criteria Manual, Vol. 1, 2 and 3, and Spreadsheets, Mile High Flood District, latest revisions.

5) An Evaluation of Atlas 14 24-hour Design Storms for Estimating Peak Runoff in the Fountain Creek Watershed of Colorado", prepared by Matrix Design Group and dated July 14, 2017.

APPENDIX TABLE OF CONTENTS

APPENDIX A

Figure 1: Vicinity Map

FEMA Flood Insurance Rate Map

NRCS Soils Map and Report

SCALE: NTS

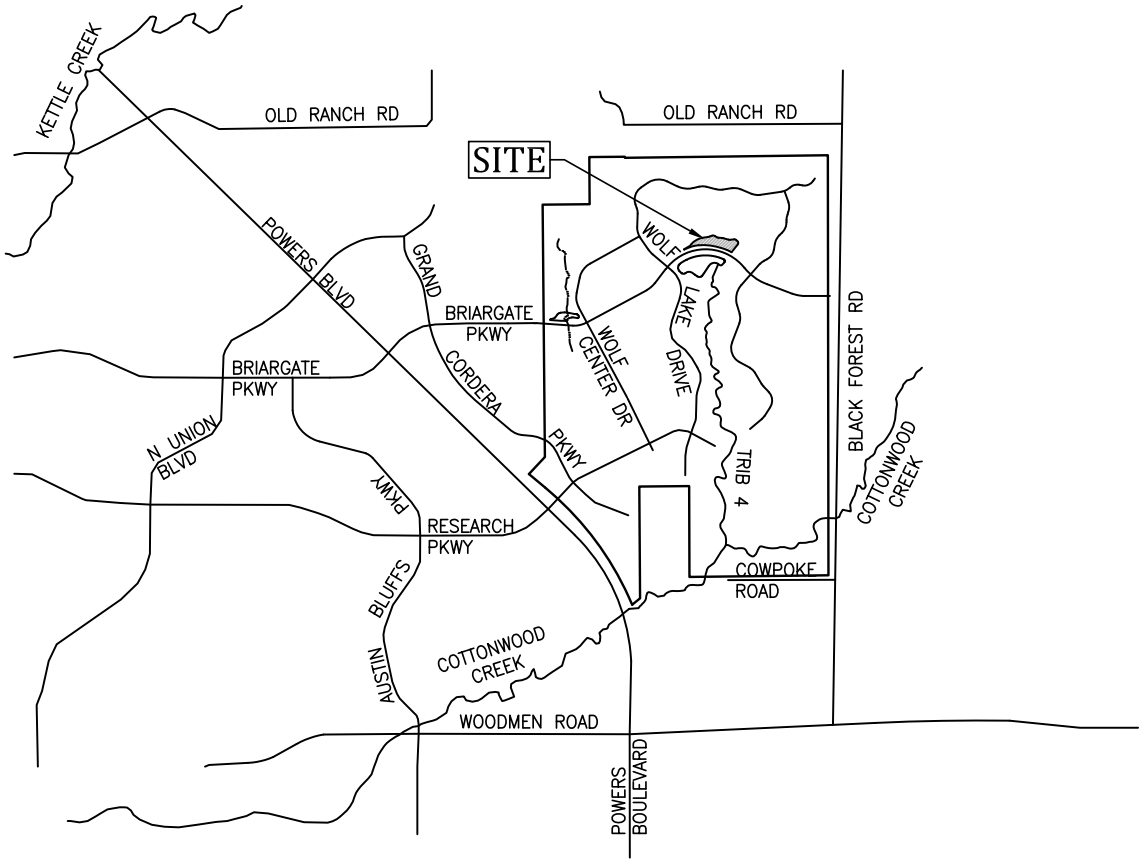


FIGURE 1
VICINITY MAP
DETENTION BASIN F18 / F19

NOTES TO USERS

This map is for use in administering the National Flood Insurance Program. It does not necessarily identify all areas subject to flooding, particularly from local drainage sources of small size. The **community map repository** should be consulted for possible updated or additional flood hazard information.

To obtain more detailed information in areas where **Base Flood Elevations** (BFEs) and/or **floodways** have been determined, users are encouraged to consult the Flood Profiles and Floodway Data and/or Summary of Stillwater Elevations tables contained within the Flood Insurance Study (FIS) report that accompanies this FIRM. Users should be aware that BFEs shown on the FIRM represent rounded whole-foot elevations. These BFEs are intended for flood insurance rating purposes only and should not be used as the sole source of flood elevation information. Accordingly, flood elevation data presented in the FIS report should be utilized in conjunction with the FIRM for purposes of construction and/or floodplain management.

Coastal Base Flood Elevations shown on this map apply only landward of 0.0' North American Vertical Datum of 1988 (NAVD88). Users of this FIRM should be aware that coastal flood elevations are also provided in the Summary of Stillwater Elevations table in the Flood Insurance Study report for this jurisdiction. Elevations shown in the Summary of Stillwater Elevations table should be used for construction and/or floodplain management purposes when they are higher than the elevations shown on this FIRM.

Boundaries of the **floodways** were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the National Flood Insurance Program. Floodway widths and other pertinent floodway data are provided in the Flood Insurance Study report for this jurisdiction.

Certain areas not in Special Flood Hazard Areas may be protected by **flood control structures**. Refer to section 2.4 "Flood Protection Measures" of the Flood Insurance Study report for information on flood control structures for this jurisdiction.

The **projection** used in the preparation of this map was Universal Transverse Mercator (UTM) zone 13. The **horizontal datum** was NAD83, GRS80 spheroid. Differences in datum, spheroid, projection or UTM zones zones used in the production of FIRMs for adjacent jurisdictions may result in slight positional differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of this FIRM.

Flood elevations on this map are referenced to the **North American Vertical Datum of 1988 (NAVD88)**. These flood elevations must be compared to structure and ground elevations referenced to the same **vertical datum**. For information regarding conversion between the National Geodetic Vertical Datum of 1929 and the North American Vertical Datum of 1988, visit the National Geodetic Survey website at http://www.ngs.noaa.gov/ or contact the National Geodetic Survey at the following address:

NGS Information Services
NOAA, N/NGS12
National Geodetic Survey
SSMC-3, #9202
1315 East-West Highway
Silver Spring, MD 20910-3282

To obtain current elevation, description, and/or location information for **bench marks** shown on this map, please contact the Information Services Branch of the National Geodetic Survey at (301) 713-3242 or visit its website at http://www.ngs.noaa.gov/.

Base Map information shown on this FIRM was provided in digital format by El Paso County, Colorado Springs Utilities, and Anderson Consulting Engineers, Inc. These data are current as of 2008.

This map reflects more detailed and up-to-date **stream channel configurations and floodplain delineations** than those shown on the previous FIRM for this jurisdiction. The floodplains and floodways that were transferred from the previous FIRM may have been adjusted to conform to these new stream channel configurations. As a result, the Flood Profiles and Floodway Data tables in the Flood Insurance Study Report (which contains authoritative hydraulic data) may reflect stream channel distances that differ from what is shown on this map. The profile baselines depicted on this map represent the hydraulic modeling baselines that match the flood profiles and Floodway Data Tables if applicable, in the FIS report. As a result, the profile baselines may deviate significantly from the new base map channel representation and may appear outside of the floodplain.

Corporate limits shown on this map are based on the best data available at the time of publication. Because changes due to annexations or de-annexations may have occurred after this map was published, map users should contact appropriate community officials to verify current corporate limit locations.

Please refer to the separately printed **Map Index** for an overview map of the county showing the layout of map panels; community map repository addresses; and a Listing of Communities table containing National Flood Insurance Program dates for each community as well as a listing of the panels on which each community is located.

Contact **FEMA Map Service Center** (MSC) via the FEMA Map Information eXchange (FMIX) 1-877-336-2627 for information on available products associated with this FIRM. Available products may include previously issued Letters of Map Change, a Flood Insurance Study Report, and/or digital versions of this map. The MSC may also be reached by Fax at 1-800-358-9620 and its website at http://www.msc.fema.gov/.

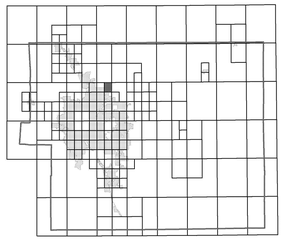
If you have **questions about this map** or questions concerning the National Flood Insurance Program in general, please call **1-877-FEMA MAP** (1-877-336-2627) or visit the FEMA website at http://www.fema.gov/business/nfip.

El Paso County Vertical Datum Offset Table

Flooding Source	Vertical Datum Offset (ft)

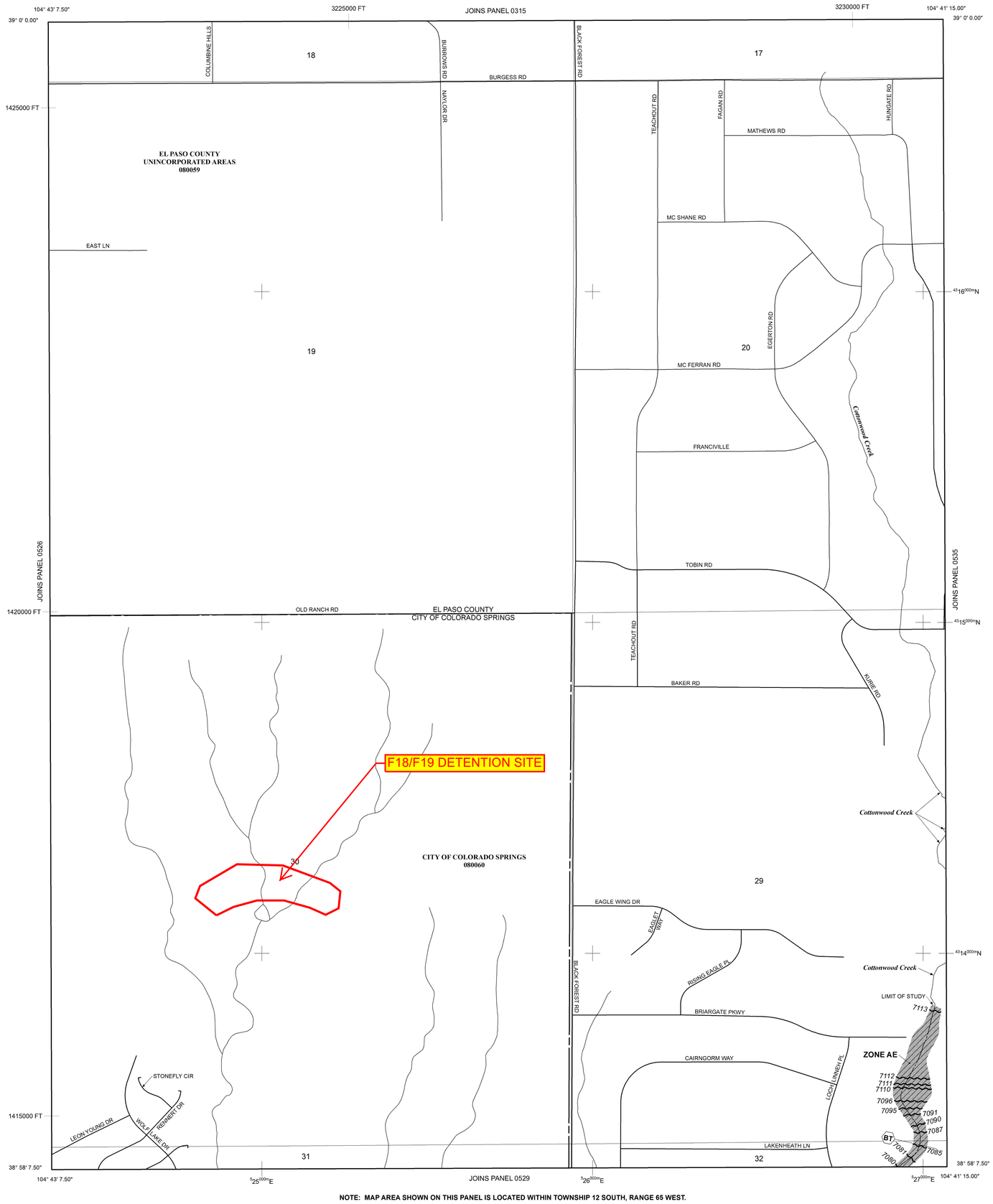
REFER TO SECTION 3.3 OF THE EL PASO COUNTY FLOOD INSURANCE STUDY FOR STREAM BY STREAM VERTICAL DATUM CONVERSION INFORMATION

Panel Location Map



This Digital Flood Insurance Rate Map (DFIRM) was produced through a Cooperating Technical Partner (CTP) agreement between the State of Colorado Water Conservation Board (CWCB) and the Federal Emergency Management Agency (FEMA).

Additional Flood Hazard information and resources are available from local communities and the Colorado Water Conservation Board.



NOTE: MAP AREA SHOWN ON THIS PANEL IS LOCATED WITHIN TOWNSHIP 12 SOUTH, RANGE 65 WEST.

LEGEND

SPECIAL FLOOD HAZARD AREAS (SFHAS) SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD

The 1% annual chance flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, A99, V, and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.

ZONE A No Base Flood Elevations determined.

ZONE AE Base Flood Elevations determined.

ZONE AH Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.

ZONE AO Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.

ZONE AR Special Flood Hazard Area Formerly protected from the 1% annual chance flood by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.

ZONE A99 Area to be protected from 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations determined.

ZONE V Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.

ZONE VE Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.

FLOODWAY AREAS IN ZONE AE

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

OTHER FLOOD AREAS

ZONE X Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.

OTHER AREAS

ZONE X Areas determined to be outside the 0.2% annual chance floodplain.

ZONE D Areas in which flood hazards are undetermined, but possible.

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.

- Floodplain boundary
- Floodway boundary
- Zone D Boundary
- CBRS and OPA boundary
- Boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths or flood velocities.
- 513 — Base Flood Elevation line and value; elevation in feet*
- (EL 987) — Base Flood Elevation value where uniform within zone; elevation in feet*

* Referenced to the North American Vertical Datum of 1988 (NAVD 88)

- A — A — Cross section line
- 23 — 23 — Transect line
- 97° 07' 30.00" / 32° 22' 30.00" — Geographic coordinates referenced to the North American Datum of 1983 (NAD 83)
- 4276000mN — 1000-meter Universal Transverse Mercator grid ticks, zone 13
- 6000000 FT — 5000-foot grid ticks: Colorado State Plane coordinate system, central zone (FIPSZONE 0502), Lambert Conformal Conic Projection
- DX5510 × — Bench mark (see explanation in Notes to Users section of this FIRM panel)
- M1.5 — River Mile

MAP REPOSITORIES
Refer to Map Repositories list on Map Index

EFFECTIVE DATE OF COUNTYWIDE FLOOD INSURANCE RATE MAP
MARCH 17, 1997

EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL
DECEMBER 7, 2018 - to update corporate limits, to change Base Flood Elevations and Special Flood Hazard Areas, to update map format, to add roads and road names, and to incorporate previously issued Letters of Map Revision.

For community map revision history prior to countywide mapping, refer to the Community Map History Table located in the Flood Insurance Study report for this jurisdiction.

To determine if flood insurance is available in this community, contact your insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

MAP SCALE 1" = 500'

250 0 500 1000 FEET

150 0 150 300 METERS

NFIP

PANEL 0527G

NATIONAL FLOOD INSURANCE PROGRAM

FIRM

FLOOD INSURANCE RATE MAP

EL PASO COUNTY, COLORADO AND INCORPORATED AREAS

PANEL 527 OF 1300

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

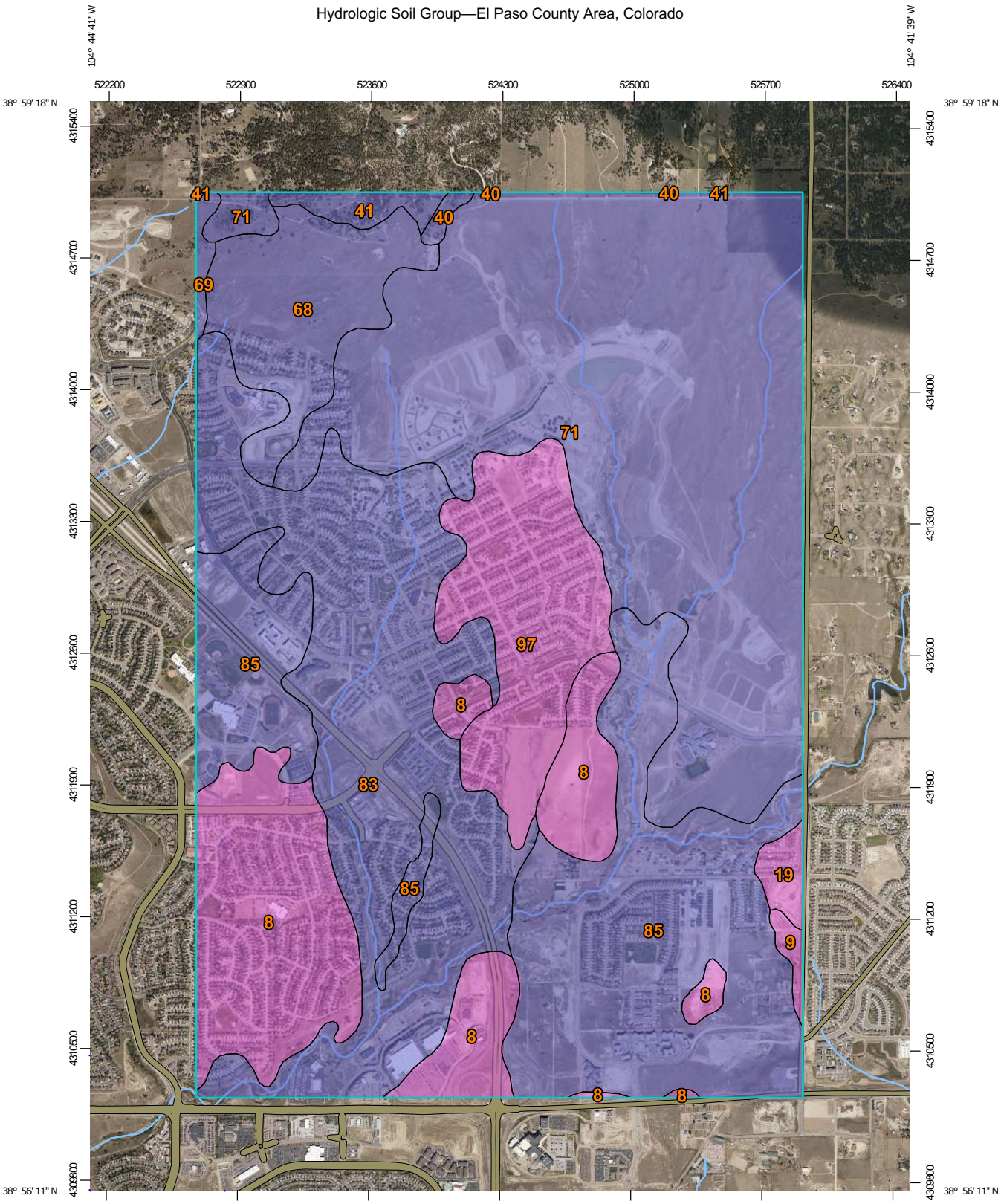
COMMUNITY	NUMBER	PANEL	SUFFIX
COLORADO SPRINGS, CITY OF	080060	0527	G
EL PASO COUNTY	080059	0527	G

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

MAP NUMBER
08041C0527G

MAP REVISED
DECEMBER 7, 2018

Federal Emergency Management Agency



Map Scale: 1:28,200 if printed on A portrait (8.5" x 11") sheet.

N

Meters: 0 400 800 1600 2400

Feet: 0 1000 2000 4000 6000

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 13N WGS84

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Rating Polygons

A

A/D

B

B/D

C

C/D

D

Not rated or not available

Soil Rating Lines

A

A/D

B

B/D

C

C/D

D

Not rated or not available

Soil Rating Points

A

A/D

B

B/D

C

C/D

D

Not rated or not available

Water Features

Streams and Canals

Transportation

Rails

Interstate Highways

US Routes

Major Roads

Local Roads

Background

Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: El Paso County Area, Colorado
Survey Area Data: Version 20, Sep 2, 2022

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Aug 19, 2018—Oct 20, 2018

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
8	Blakeland loamy sand, 1 to 9 percent slopes	A	484.1	12.5%
9	Blakeland-Fluvaquentic Haplaquolls	A	12.0	0.3%
19	Columbine gravelly sandy loam, 0 to 3 percent slopes	A	23.9	0.6%
40	Kettle gravelly loamy sand, 3 to 8 percent slopes	B	8.2	0.2%
41	Kettle gravelly loamy sand, 8 to 40 percent slopes	B	30.2	0.8%
68	Peyton-Pring complex, 3 to 8 percent slopes	B	216.6	5.6%
69	Peyton-Pring complex, 8 to 15 percent slopes	B	13.2	0.3%
71	Pring coarse sandy loam, 3 to 8 percent slopes	B	1,258.3	32.6%
83	Stapleton sandy loam, 3 to 8 percent slopes	B	762.3	19.7%
85	Stapleton-Bernal sandy loams, 3 to 20 percent slopes	B	767.1	19.8%
97	Truckton sandy loam, 3 to 9 percent slopes	A	289.0	7.5%
Totals for Area of Interest			**3,864.9**	**100.0%**

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

APPENDIX B

Curve Number and % Impervious Calculation

F18 & F19 Forebay Sizing Calculations

Detention Basin F18/F19
Detention Area Calculations

Weighted Percent Impervious Calculation

Sub-Basin / Design Pt	Basins	Basin Area		CN 61		CN 73		CN 79		CN 85		CN 92		Weighted CN Value	Weighted % Imperv.	Tc	Lag Time
				% Imp	Area	% Imp	Area	% Imp	Area	% Imp	Area	% Imp	Area				
F-3		0.0942 mi	60.29ac	2%	60.3ac									61.0	2.00%		
F-4		0.2681 mi	171.58ac	2%	171.6ac									61.0	2.00%		
F-5		0.1073 mi	68.67ac	2%	68.7ac									61.0	2.00%		
F-6		0.0310 mi	19.84ac	2%	19.8ac									61.0	2.00%		
F-11		0.0404 mi	25.87ac	2%	5.0ac	33%	16.1ac	52%	4.8ac					71.8	30.54%	14.0 min.	8.4 min.
F-12		0.0899 mi	57.55ac	2%	9.4ac	33%	48.2ac							71.0	27.96%	16.7 min.	10.0 min.
F-16		0.0759 mi	48.59ac	2%	10.8ac			52%	37.8ac					75.0	40.86%	16.5 min.	9.9 min.
F-18		0.0285 mi	18.23ac	2%	11.8ac			52%	3.2ac			85.0%	3.3ac	69.7	25.59%	14.2 min.	8.5 min.
DP F18		0.7354 mi	470.63ac	2%	357.3ac	33.0%	64.3ac	52%	45.8ac	65%	0.0ac	85%	3.3ac	64.6	11.67%		
DP F18 (Wolf Site Only)	F3-F6, F11-F12, F16-F19	0.2348 mi	150.25ac	2%	37.0ac	33.0%	64.3ac	52%	45.8ac	65%	0.0ac	85%	3.3ac	72.3	32.29%		
F-1		0.1659 mi	106.18ac	2%	106.2ac									61.0	2.00%		
F-2		0.0424 mi	27.14ac	2%	27.1ac									61.0	2.00%		
F-8		0.0402 mi	25.71ac	2%	5.5ac			52%	20.2ac					75.1	41.30%	15.3 min.	9.2 min.
F-9		0.0639 mi	40.88ac	2%	8.2ac	33%	15.1ac	52%	17.6ac					73.2	34.93%	31.6 min.	19.0 min.
F-10		0.1084 mi	69.39ac	2%	12.9ac	33%	35.5ac	52%	20.9ac					72.6	32.95%	17.8 min.	10.7 min.
F-17		0.0370 mi	23.71ac	2%	1.2ac			52%	22.5ac					78.1	49.45%	13.4 min.	8.1 min.
F-19		0.0077 mi	4.91ac	2%	4.9ac									61.0	2.00%	8.9 min.	5.3 min.
DP F19		0.4655 mi	297.91ac	2%	166.1ac	33%	50.6ac	52%	81.2ac	65%	0.0ac	85%	0.0ac	67.9	20.90%		
DP F19 (Wolf Site Only)	F1, F2, F8, F9, F10 F19	0.2572 mi	164.60ac	2%	32.8ac	33%	50.6ac	52%	81.2ac	65%	0.0ac	85%	0.0ac	73.6	36.20%		
DP F18+ F19		1.2008 mi	768.54ac	2%	523.4ac	33%	114.9ac	52%	127.0ac	65%	0.0ac	85%	3.3ac	65.9	15.25%		
DP F18+F19 (Wolf Site Only)	DP F18 + DP F19	0.4919 mi	314.85ac	2%	69.7ac	33%	114.9ac	52%	127.0ac	65%	0.0ac	85%	3.3ac	73.0	34.33%		

Detention Basin F18/F19
Detention Area Calculations

Detention Basin F14															
F-6		0.0310 mi	19.8ac	2%	19.8ac									61.0	2.00%
F-7		0.0782 mi	50.0ac	2%	50.0ac									61.0	2.00%
F-14		0.1275 mi	81.6ac	2%	9.2ac	33%	64.0ac	52%	8.4ac					72.3	31.46%
F-15		0.0213 mi	13.6ac	2%	0.9ac			52%	12.7ac					77.8	48.58%
F-23		0.0306 mi	19.6ac	2%				52%	7.3ac	65%	12.3ac			82.8	60.15%
Det F14		0.2887 mi	184.75ac	2%	80.0ac	33.0%	64.0ac	52%	28.4ac	65%	12.3ac	85%	0.0ac	69.5	24.62%

Detention Basin G															
G-3		0.1676 mi	107.24ac			33%	75.3ac	52%	31.9ac					74.8	38.66%

Sub-Basin / Design Pt	Basins	Basin Area		CN 61		CN 68		CN 73		CN 79		CN 88		CN 92		**Weighted**	**Weighted**
				% Imp	Area	% Imp	Area	% Imp	Area	% Imp	Area	% Imp	Area	% Imp	Area		
F-22		0.0640 mi	41.0ac	2%	37.1ac					52%	3.9ac					62.7	6.71%
F-24		0.0887 mi	56.8ac							52%	20.2ac	72%	19.2ac	85%	17.4ac	86.0	68.86%
F-25		0.0887 mi	56.8ac	2%	3.4ac			33%	29.1ac	52%	24.3ac					74.9	39.31%
F-27		0.2553 mi	163.4ac	2%	65.0ac			33%	8.5ac	52%	49.6ac	72%	24.9ac	85%	15.4ac	74.1	37.27%
F-28		0.0418 mi	26.8ac	2%	15.0ac					52%	11.7ac					68.9	23.90%
F-29		0.0226 mi	14.5ac	2%	1.3ac					52%	13.2ac					77.4	47.47%
F-30		0.0212 mi	13.5ac					33%	3.6ac	52%	9.9ac					77.4	46.95%
F-41		0.0810 mi	51.8ac			20%	51.8ac									68.0	20.00%
F-42		0.0529 mi	33.8ac					33%	33.8ac							73.0	33.00%
Det F28		0.7161 mi	458.3ac	2%	121.8ac	20%	51.8ac	33%	75.0ac	52%	132.8ac	72%	44.1ac	85%	32.7ac	73.8	36.26%

Detention Basin F18/F19
Detention Calculations

F19 Presedementation / Forebay Sizing

Forebay	100 Yr Flow	Detention WQCV	Total Req'd Forebay Vol 3.0% WQCV		% of Total 100yr Flow	Required Forebay Volume	Forebay Design (30"max depth for over 25 ac) Area	Depth	Volume	Discharge Design Flow 2.0% 100yr	Slot Outlet Design Calc'd Width (1"min)	**Design Width**
F19-1 (Ex. 54")	59cfs	129,043 cf	3,871cf		15.1%	583cf	470sf	2.00-ft	940 cf	1.18 cfs	6.5-inch	**7.0-inch**
F19-2 (Elevate)	333cfs				84.9%	3,289cf	1,320sf	2.50-ft	3,300 cf	6.66 cfs	12.7-inch	**13.0-inch**
Totals	392cfs	129,043 cf	3,871cf		100.0%							

F18 Presedementation / Forebay Sizing

Forebay	100 Yr Flow	Detention WQCV	Total Req'd Forebay Vol 3.0% WQCV		% of Total 100yr Flow	Required Forebay Volume	Forebay Design (30"max depth for over 25 ac) Area	Depth	Volume	Discharge Design Flow 2.0% 100yr	Slot Outlet Design Calc'd Width (1"min)	**Design Width**
F18-3 (Future)	124cfs	130,288 cf	3,909cf		26.4%	1,033cf	450sf	2.50-ft	1,125 cf	2.48 cfs	8.5-inch	**10.0-inch**
F18-4 (Sage)	345cfs				73.6%	2,875cf	1,200sf	2.50-ft	3,000 cf	6.90 cfs	13.0-inch	**13.0-inch**
Totals	469cfs	130,288 cf	3,909cf		100.0%							

Opening Width Equation for Rectangular Opening

$L = Q / (CH^{1.5}) \times 12 + 0.2xH$ (UD-BMP Spreadsheet -- EDB tab) C = 3.0

Design based on Extended Detention Basin design recommendations from Volume 3, USDCM

Orifice Equation:

$Q = CA(2gH)^{0.5}$

C = Orifice coefficient

$g = 32.2$ ft/sec^2

H = Head above pipe centerline (ft)

APPENDIX C

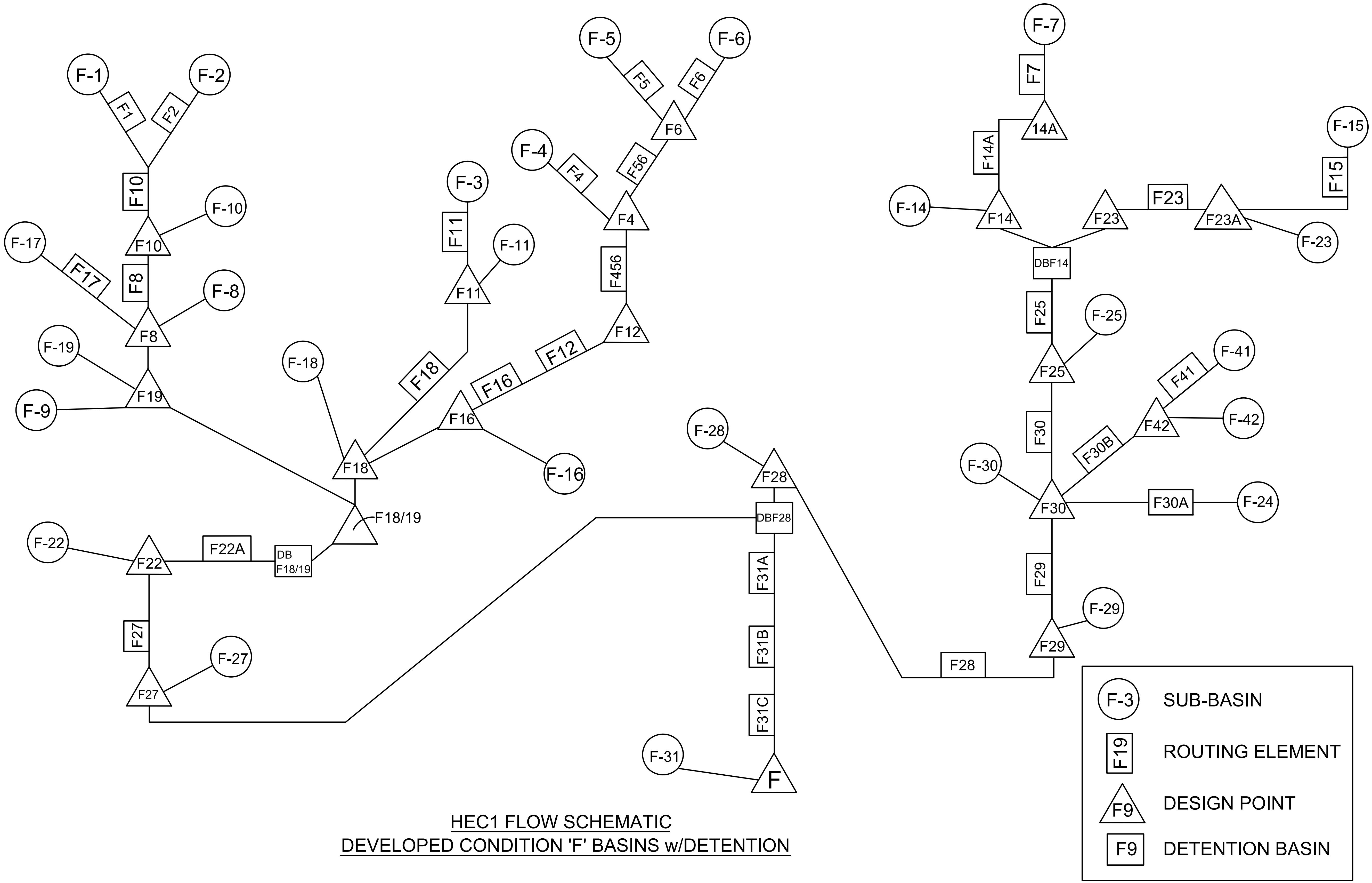
Revised Figure F – Hydrologic Model Schematic

Detention Basin F18 and F19 MHFD WQCV and EURV Sizing

Detention Basin F18/F19 Stage-Storage

Revised HEC-1 Hydrologic Input & Output – Basin F (24 Hour Rainfall)

HEC-1 Input & Output – Basin F (Plugged F18/F19 Outlet Structure)



HEC1 FLOW SCHEMATIC

DEVELOPED CONDITION 'F' BASINS w/DETENTION

Kiowa Engineering Corporation
1604 South 21st St.
Colorado Springs, Colorado
80904 - 4208
(719) 630-7342

WOLF RANCH
HYDROLOGIC MODEL SCHEMATIC
FIGURE F
COLORADO SPRINGS, COLORADO

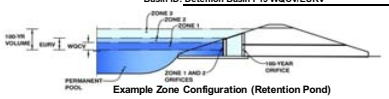
Project No.:	22035
Scale:	
Date:	07/13/2022
Design:	RNW
Drawn:	MTR
Check:	MWE
Revisions:	01/25/23

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

UD-Detention, Version 3.07 (February 2017)

Project: Wolf Ranch

Basin ID: Detenion Basin F19 WQCV/EURV



Example Zone Configuration (Retention Pond)

Required Volume Calculation

Selected BMP Type =	EDB	
Watershed Area =	297.91	acres
Watershed Length =	6,150	ft
Watershed Slope =	0.029	ft/ft
Watershed Imperviousness =	20.90%	percent
Percentage Hydrologic Soil Group A =	0.0%	percent
Percentage Hydrologic Soil Group B =	100.0%	percent
Percentage Hydrologic Soil Groups C/D =	0.0%	percent
Desired WQCV Drain Time =	40.0	hours
Location for 1-hr Rainfall Depths =	User Input	
Water Quality Capture Volume (WQCV) =	2.963	acre-feet
Excess Urban Runoff Volume (EURV) =	6.208	acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	4.591	acre-feet
5-yr Runoff Volume (P1 = 1.5 in.) =	6.729	acre-feet
10-yr Runoff Volume (P1 = 1.75 in.) =	11.433	acre-feet
25-yr Runoff Volume (P1 = 2 in.) =	22.145	acre-feet
50-yr Runoff Volume (P1 = 2.25 in.) =	29.014	acre-feet
100-yr Runoff Volume (P1 = 2.52 in.) =	37.998	acre-feet
500-yr Runoff Volume (P1 = 3.2 in.) =	56.745	acre-feet
Approximate 2-yr Detention Volume =	4.277	acre-feet
Approximate 5-yr Detention Volume =	6.309	acre-feet
Approximate 10-yr Detention Volume =	10.074	acre-feet
Approximate 25-yr Detention Volume =	12.375	acre-feet
Approximate 50-yr Detention Volume =	13.071	acre-feet
Approximate 100-yr Detention Volume =	16.005	acre-feet

Optional User Override 1-hr Precipitation

1.19	inches
1.50	inches
1.75	inches
2.00	inches
2.25	inches
2.52	inches
3.20	inches

Stage-Storage Calculation

Zone 1 Volume (WQCV) =	2.963	acre-feet
Zone 2 Volume (EURV - Zone 1) =	3.245	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	9.797	acre-feet
Total Detention Basin Volume =	16.005	acre-feet
Initial Surcharge Volume (ISV) =	user	ft^3
Initial Surcharge Depth (ISD) =	user	ft
Total Available Detention Depth (H_{total}) =	user	ft
Depth of Trickle Channel (H_{TC}) =	user	ft
Slope of Trickle Channel (S_{TC}) =	user	ft/ft
Slopes of Main Basin Sides (S_{main}) =	user	H:V
Basin Length-to-Width Ratio ($R_{L/W}$) =	user	
Initial Surcharge Area (A_{ISV}) =	user	ft^2
Surcharge Volume Length (L_{ISV}) =	user	ft
Surcharge Volume Width (W_{ISV}) =	user	ft
Depth of Basin Floor (H_{FLOOR}) =	user	ft
Length of Basin Floor (L_{FLOOR}) =	user	ft
Width of Basin Floor (W_{FLOOR}) =	user	ft
Area of Basin Floor (A_{FLOOR}) =	user	ft^2
Volume of Basin Floor (V_{FLOOR}) =	user	ft^3
Depth of Main Basin (H_{MAIN}) =	user	ft
Length of Main Basin (L_{MAIN}) =	user	ft
Width of Main Basin (W_{MAIN}) =	user	ft
Area of Main Basin (A_{MAIN}) =	user	ft^2
Volume of Main Basin (V_{MAIN}) =	user	ft^3
Calculated Total Basin Volume (V_{total}) =	user	acre-feet

Depth Increment = ft

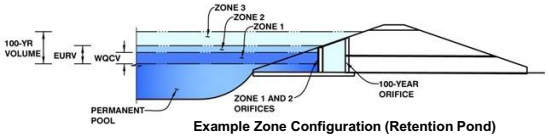
Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
Top of Micropool	--	0.00	--	--	--	20	0.000		
	--	0.80	--	--	--	20	0.000	16	0.000
	--	1.80	--	--	--	2,716	0.062	1,357	0.031
	--	2.80	--	--	--	14,822	0.340	10,153	0.233
	--	3.80	--	--	--	45,231	1.038	40,179	0.922
	--	4.80	--	--	--	85,506	1.963	105,548	2.423
	--	5.80	--	--	--	100,764	2.313	198,683	4.561
	--	6.80	--	--	--	107,573	2.470	302,851	6.953
	--	7.30	--	--	--	111,162	2.552	357,535	8.208

Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)

Project: Wolf Ranch

Basin ID: Detention Basin F19 WQCV/EURV



Example Zone Configuration (Retention Pond)

	Stage (ft)	Zone Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	5.07	2.963	Orifice Plate
Zone 2 (EURV)	6.50	3.245	Orifice Plate
Zone 3 (100-year)		9.797	Weir&Pipe (Restrict)
		16.005	Total

User Input: Orifice at Underdrain Outlet (typically used to drain WQCV in a Filtration BMP)

Underdrain Orifice Invert Depth =	N/A	ft (distance below the filtration media surface)
Underdrain Orifice Diameter =	N/A	inches

Calculated Parameters for Underdrain

Underdrain Orifice Area =	N/A	ft^2
Underdrain Orifice Centroid =	N/A	feet

User Input: Orifice Plate with one or more orifices or Elliptical Slot Weir (typically used to drain WQCV and/or EURV in a sedimentation BMP)

Invert of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Orifice Plate =	6.52	ft (relative to basin bottom at Stage = 0 ft)
Orifice Plate: Orifice Vertical Spacing =	N/A	inches
Orifice Plate: Orifice Area per Row =	N/A	inches

Calculated Parameters for Plate

WQ Orifice Area per Row =	N/A	ft^2
Elliptical Half-Width =	N/A	feet
Elliptical Slot Centroid =	N/A	feet
Elliptical Slot Area =	N/A	ft^2

User Input: Stage and Total Area of Each Orifice Row (numbered from lowest to highest)

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00	1.92	3.84					
Orifice Area (sq. inches)	7.000	8.000	3.500					

	Row 9 (optional)	Row 10 (optional)	Row 11 (optional)	Row 12 (optional)	Row 13 (optional)	Row 14 (optional)	Row 15 (optional)	Row 16 (optional)
Stage of Orifice Centroid (ft)								
Orifice Area (sq. inches)								

User Input: Vertical Orifice (Circular or Rectangular)

	Not Selected	Not Selected	
Invert of Vertical Orifice =	N/A	N/A	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Vertical Orifice =	N/A	N/A	ft (relative to basin bottom at Stage = 0 ft)
Vertical Orifice Diameter =	N/A	N/A	inches

Calculated Parameters for Vertical Orifice

	Not Selected	Not Selected	
Vertical Orifice Area =	N/A	N/A	ft^2
Vertical Orifice Centroid =	N/A	N/A	feet

User Input: Overflow Weir (Dropbox) and Grate (Flat or Sloped)

	Zone 3 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	6.52	N/A	ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length =	7.00	N/A	feet
Overflow Weir Slope =	0.00	N/A	H:V (enter zero for flat grate)
Horiz. Length of Weir Sides =	4.00	N/A	feet
Overflow Grate Open Area % =	70%	N/A	%, grate open area/total area
Debris Clogging % =	50%	N/A	%

Calculated Parameters for Overflow Weir

	Zone 3 Weir	Not Selected	
Height of Grate Upper Edge, H_t =	6.52	N/A	feet
Over Flow Weir Slope Length =	4.00	N/A	feet
Grate Open Area / 100-yr Orifice Area =	11.09	N/A	should be ≥ 4
Overflow Grate Open Area w/o Debris =	19.60	N/A	ft^2
Overflow Grate Open Area w/ Debris =	9.80	N/A	ft^2

User Input: Outlet Pipe w/ Flow Restriction Plate (Circular Orifice, Restrictor Plate, or Rectangular Orifice)

	Zone 3 Restrictor	Not Selected	
Depth to Invert of Outlet Pipe =	0.33	N/A	ft (distance below basin bottom at Stage = 0 ft)
Outlet Pipe Diameter =	18.00	N/A	inches
Restrictor Plate Height Above Pipe Invert =	18.00		inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

	Zone 3 Restrictor	Not Selected	
Outlet Orifice Area =	1.77	N/A	ft^2
Outlet Orifice Centroid =	0.75	N/A	feet
Half-Central Angle of Restrictor Plate on Pipe =	3.14	N/A	radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	6.52	ft (relative to basin bottom at Stage = 0 ft)
Spillway Crest Length =	80.00	feet
Spillway End Slopes =	4.00	H:V
Freeboard above Max Water Surface =	0.50	feet

Calculated Parameters for Spillway

Spillway Design Flow Depth=	1.62	feet
Stage at Top of Freeboard =	8.64	feet
Basin Area at Top of Freeboard =	2.55	acres

Routed Hydrograph Results

Design Storm Return Period =	WQCV	EURV
One-Hour Rainfall Depth (in) =	0.53	1.07
Calculated Runoff Volume (acre-ft) =	2.963	6.208
OPTIONAL Override Runoff Volume (acre-ft) =		
Inflow Hydrograph Volume (acre-ft) =	2.960	6.198
Predevelopment Unit Peak Flow, q (cfs/acre) =	0.00	0.00
Predevelopment Peak Q (cfs) =	0.0	0.0
Peak Inflow Q (cfs) =	45.5	93.9
Peak Outflow Q (cfs) =	1.1	1.3
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A
Structure Controlling Flow =	Plate	Plate
Max Velocity through Grate 1 (fps) =	N/A	N/A
Max Velocity through Grate 2 (fps) =	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =	39	68
Time to Drain 99% of Inflow Volume (hours) =	**41**	71
Maximum Ponding Depth (ft) =	4.97	6.39
Area at Maximum Ponding Depth (acres) =	2.02	2.40
Maximum Volume Stored (acre-ft) =	2.762	5.929

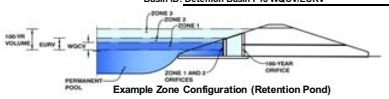
The UD-Detention spreadsheet used to size the WQCV and EURV only. HEC-1 was used to size the flood storage volume and release rate from the detention basin. Refer to the HEC-1 output for the 5 year and 100 year design information.

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

UD-Detention, Version 3.07 (February 2017)

Project: Wolf Ranch

Basin ID: Detenion Basin F18 WQCV/EURV



Example Zone Configuration (Retention Pond)

Required Volume Calculation

Selected BMP Type =	EDB	
Watershed Area =	470.63	acres
Watershed Length =	6,150	ft
Watershed Slope =	0.029	ft/ft
Watershed Imperviousness =	11.67%	percent
Percentage Hydrologic Soil Group A =	0.0%	percent
Percentage Hydrologic Soil Group B =	100.0%	percent
Percentage Hydrologic Soil Groups C/D =	0.0%	percent
Desired WQCV Drain Time =	40.0	hours
Location for 1-hr Rainfall Depths =	User Input	
Water Quality Capture Volume (WQCV) =	2.991	acre-feet
Excess Urban Runoff Volume (EURV) =	5.226	acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	3.649	acre-feet
5-yr Runoff Volume (P1 = 1.5 in.) =	5.607	acre-feet
10-yr Runoff Volume (P1 = 1.75 in.) =	11.903	acre-feet
25-yr Runoff Volume (P1 = 2 in.) =	29.510	acre-feet
50-yr Runoff Volume (P1 = 2.25 in.) =	40.558	acre-feet
100-yr Runoff Volume (P1 = 2.52 in.) =	54.992	acre-feet
500-yr Runoff Volume (P1 = 3.2 in.) =	84.640	acre-feet
Approximate 2-yr Detention Volume =	3.389	acre-feet
Approximate 5-yr Detention Volume =	5.250	acre-feet
Approximate 10-yr Detention Volume =	10.213	acre-feet
Approximate 25-yr Detention Volume =	13.901	acre-feet
Approximate 50-yr Detention Volume =	14.598	acre-feet
Approximate 100-yr Detention Volume =	18.691	acre-feet

Optional User Override 1-hr Precipitation

1.19	inches
1.50	inches
1.75	inches
2.00	inches
2.25	inches
2.52	inches
3.20	inches

Stage-Storage Calculation

Zone 1 Volume (WQCV) =	2.991	acre-feet
Zone 2 Volume (EURV - Zone 1) =	2.235	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	13.465	acre-feet
Total Detention Basin Volume =	18.691	acre-feet
Initial Surcharge Volume (ISV) =	user	ft^3
Initial Surcharge Depth (ISD) =	user	ft
Total Available Detention Depth (H_{total}) =	user	ft
Depth of Trickle Channel (H_{TC}) =	user	ft
Slope of Trickle Channel (S_{TC}) =	user	ft/ft
Slopes of Main Basin Sides (S_{main}) =	user	H:V
Basin Length-to-Width Ratio ($R_{L/W}$) =	user	
Initial Surcharge Area (A_{ISV}) =	user	ft^2
Surcharge Volume Length (L_{ISV}) =	user	ft
Surcharge Volume Width (W_{ISV}) =	user	ft
Depth of Basin Floor (H_{FLOOR}) =	user	ft
Length of Basin Floor (L_{FLOOR}) =	user	ft
Width of Basin Floor (W_{FLOOR}) =	user	ft
Area of Basin Floor (A_{FLOOR}) =	user	ft^2
Volume of Basin Floor (V_{FLOOR}) =	user	ft^3
Depth of Main Basin (H_{MAIN}) =	user	ft
Length of Main Basin (L_{MAIN}) =	user	ft
Width of Main Basin (W_{MAIN}) =	user	ft
Area of Main Basin (A_{MAIN}) =	user	ft^2
Volume of Main Basin (V_{MAIN}) =	user	ft^3
Calculated Total Basin Volume (V_{total}) =	user	acre-feet

Depth Increment = ft

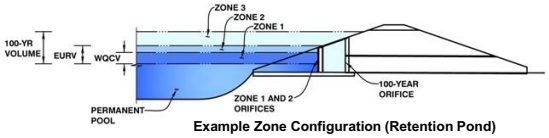
Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
Top of Micropool	--	0.00	--	--	--	250	0.006		
7134	--	1.30	--	--	--	766	0.018	653	0.015
7135	--	2.30	--	--	--	6,208	0.143	4,147	0.095
7136	--	3.30	--	--	--	30,385	0.698	22,444	0.515
7137	--	4.30	--	--	--	75,257	1.728	75,265	1.728
7138	--	5.30	--	--	--	140,214	3.219	183,000	4.201
7139	--	6.30	--	--	--	172,835	3.968	339,524	7.794
7140	--	7.30	--	--	--	182,661	4.193	517,272	11.875
7141	--	8.30	--	--	--	191,876	4.405	704,541	16.174
7142	--	9.30	--	--	--	309,808	7.112	955,383	21.933
7143	--	10.30	--	--	--	327,554	7.520	1,274,064	29.248
7144	--	11.30	--	--	--	341,309	7.835	1,608,495	36.926
7145	--	12.30	--	--	--	352,435	8.091	1,955,367	44.889
7146	--	13.30	--	--	--	363,566	8.346	2,313,368	53.108
7147	--	14.30	--	--	--	374,944	8.608	2,682,623	61.585
7147.5	--	14.80	--	--	--	380,240	8.729	2,871,419	65.919

Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)

Project: Wolf Ranch

Basin ID: Detention Basin F18 WQCV/EURV - New



Example Zone Configuration (Retention Pond)

	Stage (ft)	Zone Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	4.89	2.991	Orifice Plate
Zone 2 (EURV)	5.61	2.235	Orifice Plate
Zone 3 (100-year)	8.80	13.465	Weir&Pipe (Restrict)
		18.691	Total

User Input: Orifice at Underdrain Outlet (typically used to drain WQCV in a Filtration BMP)

Underdrain Orifice Invert Depth =	N/A	ft (distance below the filtration media surface)
Underdrain Orifice Diameter =	N/A	inches

Calculated Parameters for Underdrain

Underdrain Orifice Area =	N/A	ft^2
Underdrain Orifice Centroid =	N/A	feet

User Input: Orifice Plate with one or more orifices or Elliptical Slot Weir (typically used to drain WQCV and/or EURV in a sedimentation BMP)

Invert of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Orifice Plate =	6.00	ft (relative to basin bottom at Stage = 0 ft)
Orifice Plate: Orifice Vertical Spacing =	N/A	inches
Orifice Plate: Orifice Area per Row =	N/A	inches

Calculated Parameters for Plate

WQ Orifice Area per Row =	N/A	ft^2
Elliptical Half-Width =	N/A	feet
Elliptical Slot Centroid =	N/A	feet
Elliptical Slot Area =	N/A	ft^2

User Input: Stage and Total Area of Each Orifice Row (numbered from lowest to highest)

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00	2.00	4.00					
Orifice Area (sq. inches)	7.000	7.500	7.500					

	Row 9 (optional)	Row 10 (optional)	Row 11 (optional)	Row 12 (optional)	Row 13 (optional)	Row 14 (optional)	Row 15 (optional)	Row 16 (optional)
Stage of Orifice Centroid (ft)								
Orifice Area (sq. inches)								

User Input: Vertical Orifice (Circular or Rectangular)

	Not Selected	Not Selected	
Invert of Vertical Orifice =	N/A	N/A	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Vertical Orifice =	N/A	N/A	ft (relative to basin bottom at Stage = 0 ft)
Vertical Orifice Diameter =	N/A	N/A	inches

Calculated Parameters for Vertical Orifice

	Not Selected	Not Selected	
Vertical Orifice Area =	N/A	N/A	ft^2
Vertical Orifice Centroid =	N/A	N/A	feet

User Input: Overflow Weir (Dropbox) and Grate (Flat or Sloped)

	Zone 3 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	6.20	N/A	ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length =	15.00	N/A	feet
Overflow Weir Slope =	0.00	N/A	H:V (enter zero for flat grate)
Horiz. Length of Weir Sides =	8.00	N/A	feet
Overflow Grate Open Area % =	70%	N/A	%, grate open area/total area
Debris Clogging % =	50%	N/A	%

Calculated Parameters for Overflow Weir

	Zone 3 Weir	Not Selected	
Height of Grate Upper Edge, H_t =	6.20	N/A	feet
Over Flow Weir Slope Length =	8.00	N/A	feet
Grate Open Area / 100-yr Orifice Area =	5.28	N/A	should be ≥ 4
Overflow Grate Open Area w/o Debris =	84.00	N/A	ft^2
Overflow Grate Open Area w/ Debris =	42.00	N/A	ft^2

User Input: Outlet Pipe w/ Flow Restriction Plate (Circular Orifice, Restrictor Plate, or Rectangular Orifice)

	Zone 3 Restrictor	Not Selected	
Depth to Invert of Outlet Pipe =	1.34	N/A	ft (distance below basin bottom at Stage = 0 ft)
Outlet Pipe Diameter =	54.00	N/A	inches
Restrictor Plate Height Above Pipe Invert =	54.00		inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

	Zone 3 Restrictor	Not Selected	
Outlet Orifice Area =	15.90	N/A	ft^2
Outlet Orifice Centroid =	2.25	N/A	feet
Half-Central Angle of Restrictor Plate on Pipe =	3.14	N/A	radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	10.20	ft (relative to basin bottom at Stage = 0 ft)
Spillway Crest Length =	15.00	feet
Spillway End Slopes =	0.00	H:V
Freeboard above Max Water Surface =	0.50	feet

Calculated Parameters for Spillway

Spillway Design Flow Depth=	7.41	feet
Stage at Top of Freeboard =	18.11	feet
Basin Area at Top of Freeboard =	8.73	acres

Routed Hydrograph Results

	WQCV	EURV
Design Storm Return Period =		
One-Hour Rainfall Depth (in) =	0.53	1.07
Calculated Runoff Volume (acre-ft) =	2.991	5.226
OPTIONAL Override Runoff Volume (acre-ft) =		
Inflow Hydrograph Volume (acre-ft) =	2.988	5.217
Predevelopment Unit Peak Flow, q (cfs/acre) =	0.00	0.00
Predevelopment Peak Q (cfs) =	0.0	0.0
Peak Inflow Q (cfs) =	52.8	91.2
Peak Outflow Q (cfs) =	1.2	1.3
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A
Structure Controlling Flow =	Plate	Plate
Max Velocity through Grate 1 (fps) =	N/A	N/A
Max Velocity through Grate 2 (fps) =	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =	40	60
Time to Drain 99% of Inflow Volume (hours) =	**42**	63
Maximum Ponding Depth (ft) =	4.82	5.54
Area at Maximum Ponding Depth (acres) =	2.49	3.40
Maximum Volume Stored (acre-ft) =	2.803	4.995

The UD-Detention spreadsheet used to size the WQCV and EURV only. HEC-1 was used to size the flood storage volume and release rate from the detention basin. Refer to the HEC-1 output for the 5 year and 100 year design information.

100 Year Detention Summary

Detention Area	Total Acres	% Imperv.	Soil Group		HEC 1 Required Detention Volume V100
100yr Detention F18+F19	768.54 ac	15.2%	B		**30.52 ac-ft** / **1,329,451 cf**

Detention Basin Earthwork

Elevation	Area (A)	Avg. Area	Volume	Depth	Cumulative Volume		Elev.
7132.7	250sf	Lowest Orifice			**0cf**	**0.00ac-ft**	7132.7
7134	526sf	388sf	504cf	1.3 ft	**504cf**	**0.01ac-ft**	7134
7135	6,214sf	3,370sf	3,370cf	2.3 ft	**3,874cf**	**0.09ac-ft**	7135
7136	30,488sf	18,351sf	18,351cf	3.3 ft	**22,225cf**	**0.51ac-ft**	7136
7137	80,271sf	55,379sf	55,379cf	4.3 ft	**77,604cf**	**1.78ac-ft**	7137
7138	156,141sf	118,206sf	118,206cf	5.3 ft	**195,810cf**	**4.50ac-ft**	7138
7139	218,292sf	187,217sf	187,217cf	6.3 ft	**383,027cf**	**8.79ac-ft**	7139
7140	267,900sf	243,096sf	243,096cf	7.3 ft	**626,123cf**	**14.37ac-ft**	7140
7141	292,079sf	279,989sf	279,989cf	8.3 ft	**906,112cf**	**20.80ac-ft**	7141
7142	309,286sf	300,682sf	300,682cf	9.3 ft	**1,206,794cf**	**27.70ac-ft**	7142
7143	327,554sf	318,420sf	318,420cf	10.3 ft	**1,525,215cf**	**35.01ac-ft**	7143
7144	341,313sf	334,434sf	334,434cf	11.3 ft	**1,859,648cf**	**42.69ac-ft**	7144
7145	352,435sf	346,874sf	346,874cf	12.3 ft	**2,206,522cf**	**50.65ac-ft**	7145
7146	363,566sf	358,000sf	358,000cf	13.3 ft	**2,564,523cf**	**58.87ac-ft**	7146
7147	374,944sf	369,255sf	369,255cf	14.3 ft	**2,933,777cf**	**67.35ac-ft**	7147
7147.5	380,240sf	377,592sf	188,796cf	14.8 ft	**3,122,573cf**	**71.68ac-ft**	7147.5
		---	---	---	**---**	**---**	---
		---	---	---	**---**	**---**	---
		---	---	---	**---**	**---**	---
		---	---	---	**---**	**---**	---
		---	---	---	**---**	**---**	---
		---	---	---	**---**	**---**	---

Average End Area Formula: V = (A1+A2)/2 x Elev Difference

				Depth
		Lowest Orifice =	7132.70 ft	0.00 ft
100yr Volume =	1,329,451 cf	30.52 ac-ft	7142.39 ft	9.6852
		Detention Freeboard Depth =	0.61	
Emergency Grate Crest =	1,525,215 cf	35.01 ac-ft	7143.00 ft	10.30 ft
Emergency Grate Max. W.S. El =	2,403,422 cf	55.17 ac-ft	7145.55 ft	12.85 ft
Top of Embankment =	3,122,573 cf	71.68 ac-ft	7147.50 ft	14.80 ft

Basin F
24 Hour Rainfall

```
1****************************************
****************************************
 *                                      *                                                *
*
 *   FLOOD HYDROGRAPH PACKAGE  (HEC-1)  *                                                *    U.S. ARMY CORPS OF
ENGINEERS     *
 *               JUN   1998             *                                                *    HYDROLOGIC
ENGINEERING CENTER    *
 *            VERSION 4.1               *                                                *          609 SECOND
STREET          *
 *                                      *                                                *       DAVIS, CALIFORNIA
95616       *
 *  RUN DATE   19JAN23  TIME  14:36:48  *                                                *           (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

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

    1         ID            Wolf Ranch Tributary Four   FN FBAS-REV.DAT
    2         ID            Detention basin at design  point 14
    3         ID            F-Basins future developed condition with detention
    4         ID            Sub basins to F18/19 revised to match new DP
    5         ID            Final design of detention basin F18/19  Briargate Parkway
    6         ID            5-year and 100 Year, 24HR RAINFALL NOAA ATLAS 2 TYPE II STORM
    7         ID            REVISED 1-20-2023
              *DIAGRAM
    8         IT       5       0       0     300
    9         IO       5       0
   10         JR    PREC     .56     1.0

   11         KK     F-1
   12         KM        RUNOFF FOR SUB-BASIN F-1
   13         BA   .1659
   14         IN      15
   15         PB     4.4
   16         PC       0    .002    .005    .008    .011   .0104   .0170     .02    .023    .026
   17         PC    .029    .032    .035    .038    .041    .044    .048    .052    .056     .06
   18         PC   .0604    .068    .072    .076     .08    .085     .09    .095      .1    .105
   19         PC     .11    .115     .12    .126    .133     .14    .147    .155    .163    .172
   20         PC    .181    .191    .203    .218    .236    .257    .283    .387    .663    .707
   21         PC    .735    .758    .776    .791    .804    .815    .825    .834    .842    .849
   22         PC    .856    .863    .869    .875    .881    .887    .893    .898    .903    .908
   23         PC    .913    .918    .922    .926     .93    .934    .938    .942    .946     .95
   24         PC    .953    .956    .959    .962    .965    .968    .971    .974    .977     .98
   25         PC    .983    .986    .989    .992    .995    .998
   26         LS       0      61
   27         UD     .20

   28         KK     RF1
   29         KM        ROUTE FLOW FROM SUB-BASIN F-1 TO DP F2
   30         RD    1450   0.037    0.04            TRAP      10       6

   31         KK     F-2
   32         KM        RUNOFF FROM SUB BASIN F-2
   33         BA    .042
   34         LS       0      61
   35         UD     .19

   36         KK     RF2
```

IT=TIME SPECIFICATION, 5 min intervals, 300 hydrograph ordinates
JR=MULTIRATION, PREC=RATIOS OF PRECIPITATION
0.56(PB)=5YR, 1.0(PB)=100YR

BA=SUB-BASIN AREA (SQUARE MILES)IN=TIME INTERVAL FOR INPUT DATA, 15 minutes in tabulation interval PB=BASIN AVERAGE PRECIPITATION, 4.4 inches

PC=CUMULATIVE PRECIPITATION TIME SERIES

LS=SCS CURVE NUMBER LOSS RATE, 0=initial abstraction computed from curve number of 61SCS DIMENSIONLESS UNIT HYDROGRAPH, scs lag in hours =0.20

RD=MUSKINGUM-CUNGE ROUTINGchannel length =1400ft, slope=3.7%, Manning's n=0.04 trapezoidal channel, 10-ft bottom width, 6:1 side slopes

```
                37           KM         ROUTE FLOW FROM SB F-2 TO DP F2
                38           RD    1200     .04    .035            CIRC       3

                39           KK    DPF2
                40           KM         COMBINE RF1 AND RF2
                41           HC       2                          HC=COMBINE HYDROGRAPHS, 2 hydrographs combined

                42           KK    RF10
                43           KM         ROUTE FLOW FROM DP F2 TO DP F10
                44           RD     540     .03    .013            CIRC       4
1                                                HEC-1 INPUT                                                    PAGE  2

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


                45           KK    F-10
                46           KM         RUNOFF FROM BASIN F-10
                47           BA    .108
                48           LS       0    72.6
                49           UD    .178

                50           KK   DPF10
                51           KM         COMBINE FLOW FROM SB F-10 AND RF10
                52           HC       2

                53           KK     RF8
                54           KM         ROUTE FLOW FROM DP F-10 TO DP F19
                55           RD    1100     .03    .016            CIRC     4.5

                56           KK     F-8
                57           KM         RUNOFF FROM SB F-8
                58           BA   .0402
                59           LS       0    75.1
                60           UD    .153

                61           KK    F-17
                62           KM        RUNOFF FROM SUB BASIN F-17
                63           BA    .037
                64           LS       0    78.1
                65           UD    .135

                66           KK    DPF8
                67           KM         COMBINE RF-8,SUB BASIN F-8 AND SUB BASIN F-17
                68           HC       3
```

```
   69          KK     F-9
   70          KM         RUNOFF FOR BASIN F-9
   71          BA   .0639
   72          LS       0    73.2
   73          UD    .317

   74          KK    F-19
   75          KM        RUNOFF FROM SUB-BASIN F-19
   76          BA   .0077
   77          LS       0      61
   78          UD   0.088

   79          KK   DPF19
   80          KM        COMBINE FLOW FROM DP F8, SB F-9, SB F-19
   81          KM        THIS IS THE INFLOW TO DB F19
   82          HC       3

   83          KK     F-3
   84          KM         RUNOFF FOR SUB-BASIN F-3
   85          BA   .0942
   86          LS       0      61
   87          UD     .22
```



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

   88          KK    RF11
   89          KM        ROUTE FLOW FROM SUB-BASIN F-3 TO DESIGN POINT F11
   90          RD    1050    0.03    0.04            CIRC     103

   91          KK    F-11
   92          KM         RUNOFF FOR SUB-BASIN F-11
   93          BA   .0404
   94          LS       0    71.8
   95          UD     .14

   96          KK   DPF11
   97          KM        COMBINE FLOW FROM SUB-BASIN F-11 AND RF11
   98          HC       2

   99          KK    RF18
  100          KM        ROUTE FLOW FROM DESIGN POINT F11 TO DETENTION POINT DP18
  101          RD    1200    0.03    .013            CIRC       3
```

```
 102          KK    F-18
 103          KM        RUNOFF FROM SB F-18
 104          BA   .0285
 105          LS       0    69.7
 106          UD    .142

 107          KK     F-4
 108          KM         RUNOFF FROM SUB-BASIN F-4
 109          BA   .2681
 110          LS       0      61
 111          UD     .28

 112          KK     RF4
 113          KM        ROUTE FLOW FROM SUB-BASIN F-4 TO DESIGN POINT F4
 114          RD     650   0.044   0.013            CIRC       4

 115          KK     F-6
 116          KM        RUNOFF FROM SUB-BASIN F-6
 117          BA    .031
 118          LS       0      61
 119          UD     .19

 120          KK     RF6
 121          KM        ROUTE FLOW FROM F6 TO DP F6
 122          RD     980     .03    .013            CIRC     2.5

 123          KK     F-5
 124          KM         RUNOFF FOR SUB-BASIN F-5
 125          BA   .1073
 126          LS       0      61
 127          UD     .34
1                                        HEC-1 INPUT                                                PAGE  4

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


 128          KK     RF5
 129          KM        ROUTE FLOW FROM SUB-BASIN F-5 TO DESIGN POINT F6
 130          RD     500     .04    .013            CIRC       3

 131          KK    DPF6
 132          KM        COMBINE RF5 AND RF6
 133          HC       2

 134          KK    RF56
```

```
135          KM          ROUTE DPF6 TO DPF4
136          RD    1020     .03    .013            CIRC       4

137          KK     DP4
138          KM         COMBINE RF4 AND RF56
139          HC       2

140          KK   RF456
141          KM        ROUTE DPF4 TO DP12
142          RD     640     .03    .013            CIRC       4

143          KK    F-12
144          KM         RUNOFF FOR SUB-BASIN F-12
145          BA   .0899
146          LS       0      71
147          UD    .167

148          KK   DPF12
149          KM        COMBINE FLOW FROM SUB-BASIN F-12 AND RF456
150          HC       2

151          KK    RF12
152          KM        ROUTE FLOW FROM DESIGN POINT F12 TO RF16
153          RD     720    0.02   0.013            CIRC       4

154          KK    RF16
155          KM        ROUTE FLOW FROM RF12 TO RF16
156          RD     820     .03    .013            CIRC     4.5

157          KK    F-16
158          KM        RUNOFF FROM SB F-16
159          BA   .0759
160          LS       0      75
161          UD    .165

162          KK   DPF16
163          KM        COMBINE FLOW FROM SB F-16 AND RF16
164          HC       2

165          KK   DPF18
166          KM        COMBINE FLOW FROM SUB-BASIN F-18, DP16 AND RF18
167          HC       3
```

PC=CUMULATIVE
PRECIPITATION TIME SERIES


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

```
168          KK  DP1819
169          KM         COMBINE DPF18 AND DPF19
170          KM        INFLOW TO DET BASIN 1819
171          HC       2

172          KK  DB1819
173          KM          ROUTE DPF1819  THROUGH DETENTION BASIN DB1819
174          KM          THIS IS OUTFLOW FROM DETENTION BASIN 18-19
175          RS       1    ELEV  7132.7
176          SV       0     .01     .02      .1     .32    1.76    4.43    8.72    14.3   20.74
177          SV   27.65      37   42.64    48.9    58.8      65    69.1
178          SE  7132.7  7133.5    7134    7135    7136    7137    7138    7139    7140    7141
179          SE    7142    7143    7144    7145    7146    7147  7147.5
180          SQ       0      .4      .5      .8     1.1     1.5     1.9     2.2    41.3   133.8
181          SQ   217.3   230.4   242.8   253.3   257.1   268.2   271.7

182          KK   RF22A
183          KM        ROUTE FLOW FROM DETENTION BASIN 1819 TO DESIGN POINT DP F22
184          RD    1800   0.027    0.02            TRAP      10       6

185          KK    F-22
186          KM         RUNOFF FOR SUB-BASIN F-22
187          BA    .059
188          LS       0    62.7
189          UD     .21

190          KK   DPF22
191          KM        COMBINE FLOW FROM SUB-BASIN F-22, AND RF22A
192          HC       2

193          KK   RF27
194          KM        ROUTE FLOW FROM DESIGN POINT DPF22 TO DESIGN POINT F27
195          RD    3700    0.04    0.04            TRAP      20       3

196          KK    F-27
197          KM        RUNOFF FROM SUB BASIN F-27
198          BA    .255
199          LS       0      74
200          UD     .32

201          KK   DPF27
202          KM        COMBINE RF27 AND SUB BASIN F-27
203          HC       2
```

RS=STORAGE ROUTING, 1 step, elevation for beginning of the first time period=7132.7

Detention Basin F18/F19
Volume-Stage-Discharge

SV=RESERVOIR VOLUME (acre-ft) SE=ELEVATION (ft) corresponding to volume in same field on preceding SV recordSQ=DISCHARGE (cfs) corresponding to volume and elevation in same field on preceding SV and SE records example: 48.9 ac-ft corresponds to an elevation of 7145 ft and a discharge of 253.3 cfs

```
 204          KK    F-7
 205          KM         RUNOFF FOR SUB-BASIN F-7
 206          BA   .0782
 207          LS       0      61
 208          UD     .19
```



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

 209          KK    RF7
 210          KM        ROUTE FLOW FROM SUB-BASIN F-7 TO DESIGN POINT F14A
 211          RD    1200   0.033    0.04            TRAP      10       6

 212          KK   RF14A
 213          KM        ROUTE FLOW FROM DESIGN POINT F14A TO DP 23
 214          KM        DESIGN PONT 14A = RF-14A
 215          RD     400   0.027   0.013            CIRC       4

 216          KK    F-14
 217          KM        RUNOFF FROM SB F-14
 218          BA    .128
 219          LS       0    72.3
 220          UD     .25

 221          KK    DP14
 222          KM         COMBINE RF 14A AND SB F14
 223          HC       2

 224          KK    F-15
 225          KM         RUNOFF FROM SUB-BASIN F-15
 226          BA   .0210
 227          LS       0    77.8
 228          UD     .15

 229          KK    RF15
 230          KM          ROUTE RUNOFF FROM F-15  TO DESIGN POINT F23A
 231          RD    1100    .023     .04            TRAP      10       3

 232          KK    F-23
 233          KM         RUNOFF FROM SUB BASIN F-23
 234          BA   .0310
 235          LS       0    82.8
 236          UD     .18
```

```
 237          KK  DPF23A
 238          KM         COMBINE FLOW FROM RF15 AND  SUB-BASIN F-23
 239          HC       2

 240          KK    RF23
 241          KM         ROUTE FLOW FROM DP F23 TO DP23
 242          RD     300     .03    .013            CIRC     2.5

 243          KK   DPF23
 244          KM        COMBINE FLOW FROM DP14 AND RF23
 245          KM          THIS IS INFLOW TO DETENTION BASIN DB F14
 246          HC       2

 247          KK   DBF14
 248          KM         DETENTION BASIN DBF14                                          Detention Basin F14
 249          KM          THIS IS OUTFLOW FROM DETENTION BASIN 14                       Volume-Stage-Discharge
 250          RS       1    ELEV  7124.5
 251          SV       0    .006    .011    .133     .59    1.56    2.94    4.49    5.30    6.14
 252          SV    7.89    8.81    9.76   11.73   12.75
1                                        HEC-1 INPUT                                                PAGE  7

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

 253          SE  7124.5  7125.5  7126.0  7127.0  7128.0  7129.0  7130.0  7131.0  7131.5  7132.0
 254          SE    7133  7133.5    7134  7135.0  7135.5
 255          SQ       0     .19     .24     .43     .58     .82    1.00    1.14     5.2    27.6
 256          SQ    78.5    81.0   191.3   666.5     994

 257          KK    RF25
 258          KM        ROUTE FLOW FROM DETENTION BASIN DB F14 TO DESIGN POINT F25
 259          RD    2600   0.023   0.013            CIRC       3

 260          KK    F-25
 261          KM         RUNOFF FOR SUB-BASIN F-25
 262          BA   .0890
 263          LS       0    74.9
 264          UD     .28

 265          KK   DPF25
 266          KM        COMBINE FLOW FROM RF25 AND SB 25
 267          HC       2

 268          KK    RF30
 269          KM        ROUTE FLOW FROM DESIGN POINT F25 TO DESIGN POINT F30
```

```
 270          RD     750   0.027   0.013           CIRC       4

 271          KK    F-24
 272          KM         RUNOFF FOR SUB-BASIN F-24
 273          BA   .0890
 274          LS       0      86
 275          UD     .26

 276          KK   RF30A
 277          KM        ROUTE FLOW FROM SUB-BASIN    F24 TO DESIGN POINT F30
 278          RD     920   0.033   0.013           CIRC     3.5

 279          KK    F-30
 280          KM         RUNOFF FOR SUB-BASIN F-30
 281          BA   .0212
 282          LS       0    77.4
 283          UD     .18

 284          KK    F-41
 285          KM         RUNOFF FROM SUB-BASIN F-41
 286          BA    .081
 287          LS       0      68
 288          UD     .22

 289          KK    RF41
 290          KM         ROUTE RUNOFF FROM  SUB-BASIN F-41 TO DP42
 291          RD    1450     .03    .013           CIRC     2.5

 292          KK    F-42
 293          KM         RUNOFF FROM SUB-BASIN F-42
 294          BA    .053
 295          LS              73
 296          UD     .22
```

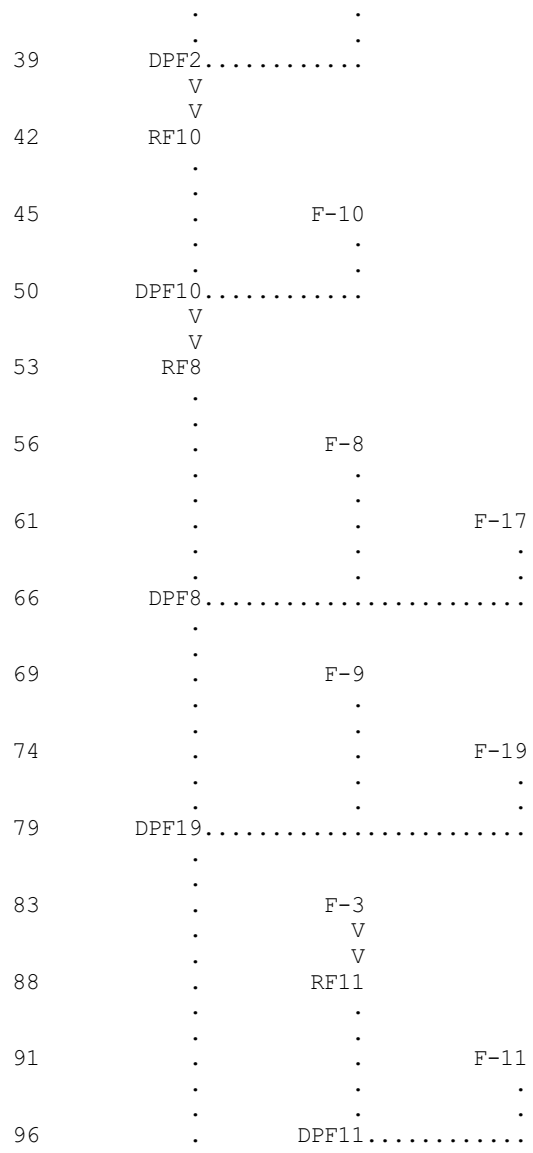


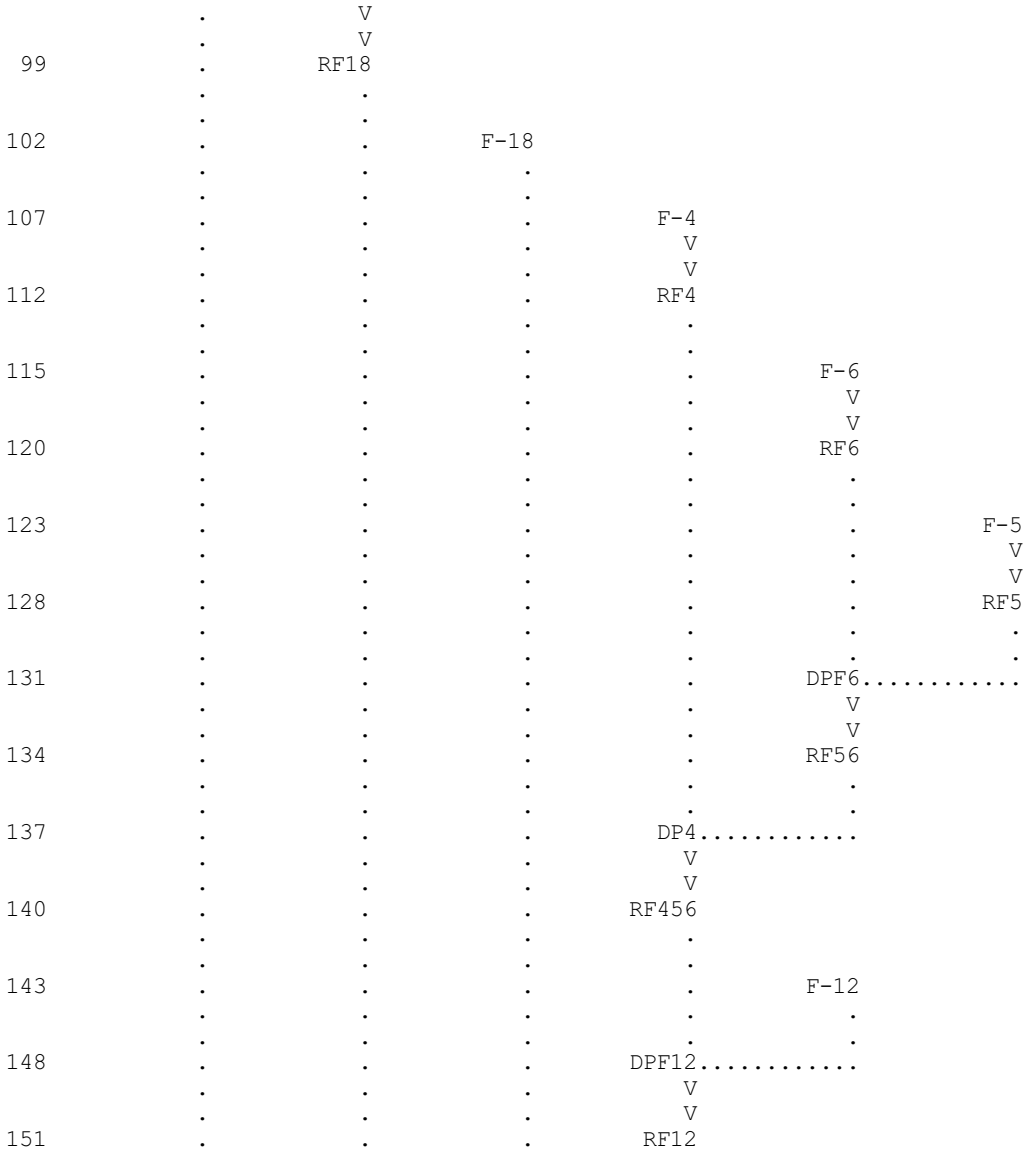
```
LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 297          KK   DPF42
 298          KM        COMBINE RUNOFF FROM F-42 AND RF41
 299          HC       2

 300          KK   RF30B
 301          KM        ROUTE FLOW FROM DESIGN POINT F42 TO DESIGN POINT F30
 302          RD     600     .03    .013           CIRC       3
```

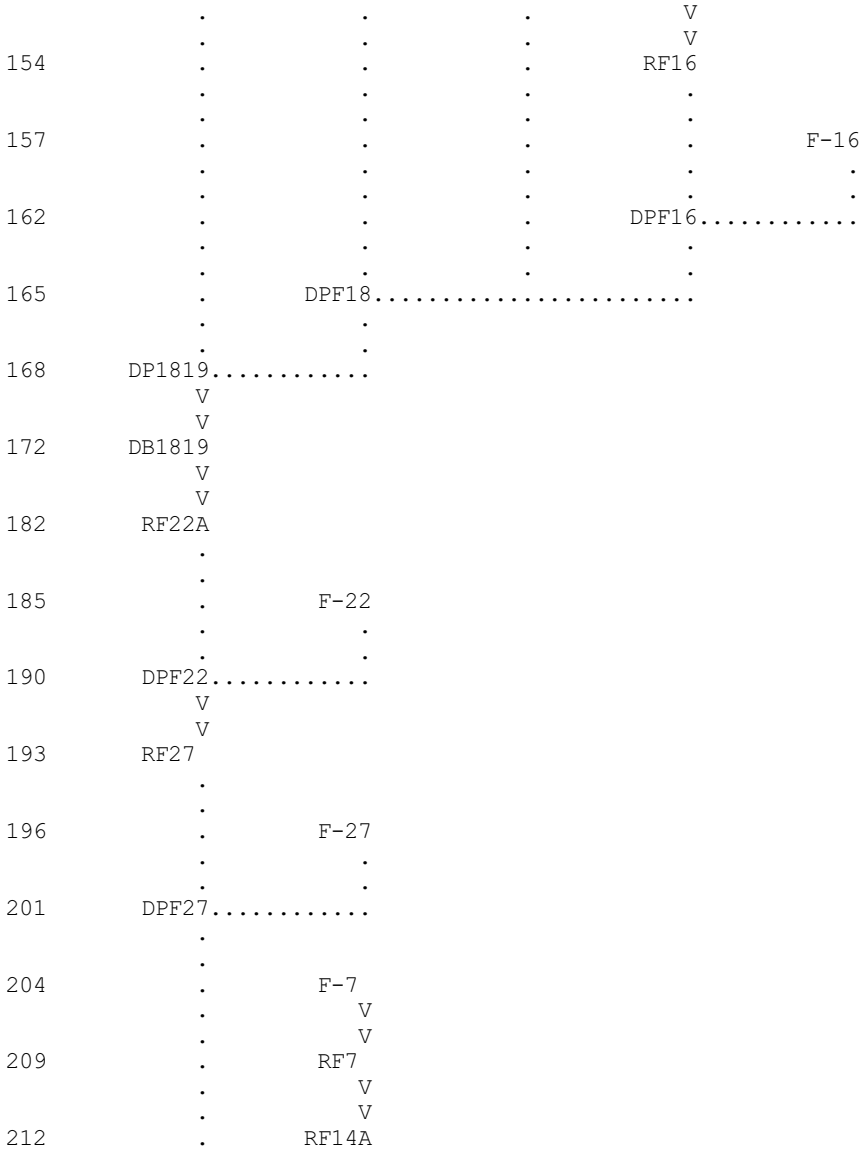
```
KK   DPF30
KM         COMBINE FLOW FROM RF30B,RF30A, RF30 AND SUB-BASIN F-30
HC       4

KK   RF-29
KM         ROUTE FLOW FROM DESIGN POINT F30 TO DESIGN POINT F29
RD    2350   0.027    0.04            TRAP       6       3

KK    F-29
KM         RUNOFF FOR SUB-BASIN F-29
BA   .0226
LS       0    77.4
UD     .19

KK  DPF29
KM         COMBINE FLOW FROM RF29 AND SUB-BASIN F-29
HC       2

KK    RF28
KM         ROUTE FLOW FROM DESIGN POINT F29 TO DESIGN POINT F28
RD     750   0.015    0.04            TRAP      20       3

KK    F-28
KM         RUNOFF FOR SUB-BASIN F-28
BA    .042
LS       0    68.9
UD     .23

KK   DPF28
KM         COMBINE FLOW FROM RF28, SB F-28
HC       2

KK  DPF28A
KM         COMBINE DP F27 AND DP F28
KM         THIS IS INFLOW TO DETENTION BASIN F28
HC       2

KK   DBF28
KM         ROUTE DPF28 THROUGH DETENTION BASIN DBF28
KM         THIS IS OUTFLOW FROM DETENTION BASIN F28
KM         AS-BUILT STAGE-STORAGE-DISCHARGE CURVE
RS       1    ELEV    6968
SV       0    1.07    2.23   10.56    16.7    20.2      24   32.76      43
SE    6968    6970    6972    6974    6976    6977    6978    6980    6982
```

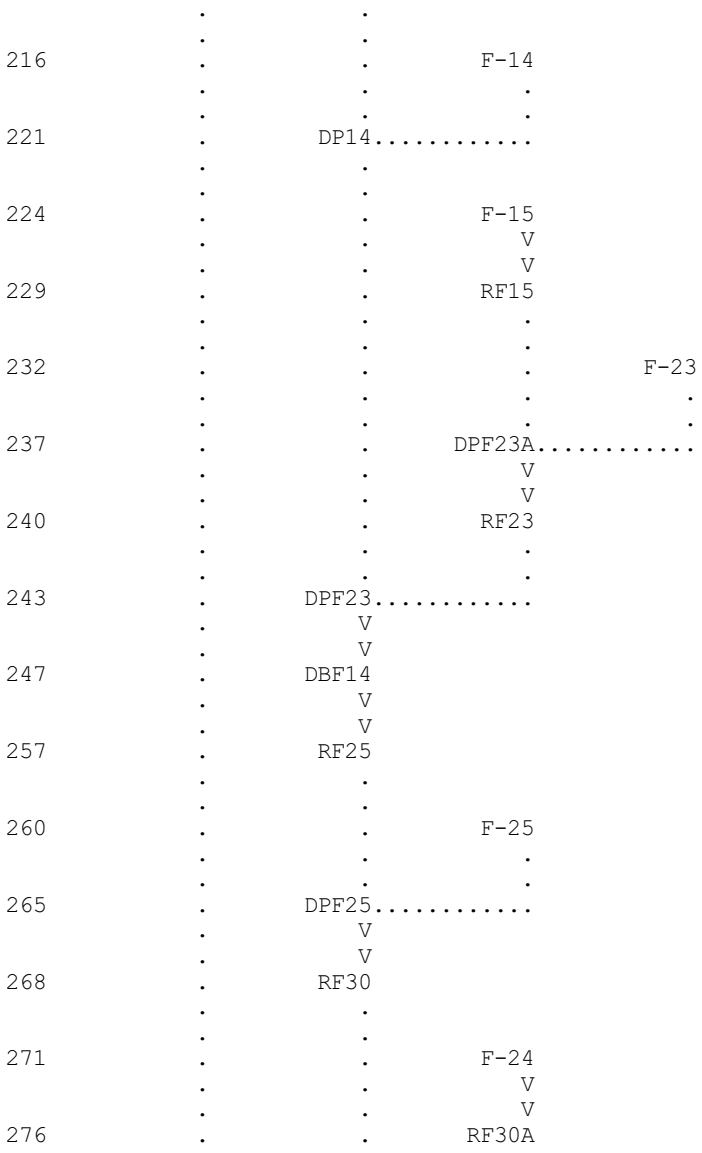
Detention Basin F28
Volume-Stage-Discharge

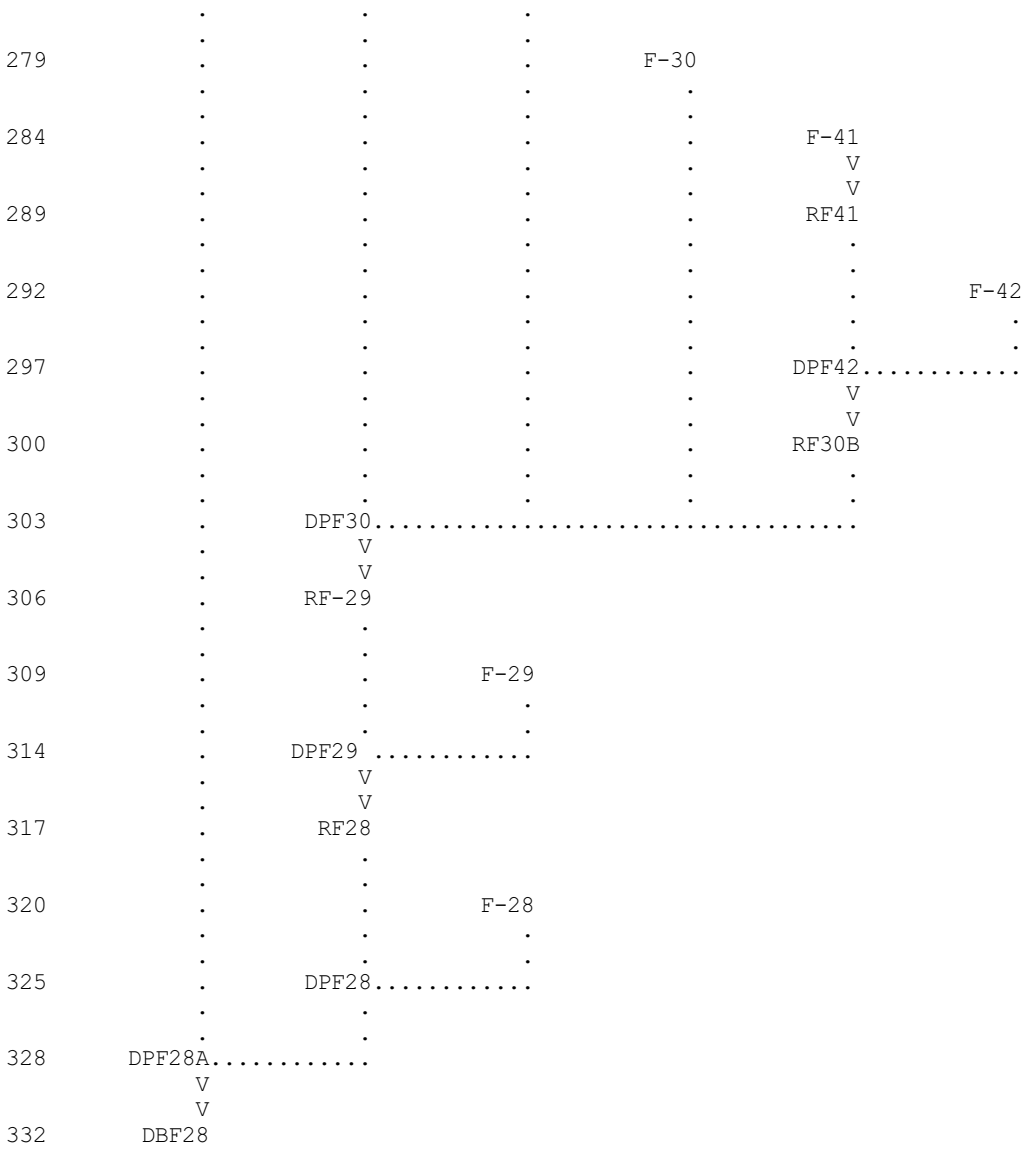
```
          339          SQ       0     1.5     4.8    10.2    15.6     340     520     880    1000
1                                                  HEC-1 INPUT                                                PAGE  9

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


          340          KK   RF31A
          341          KM        ROUTE FLOW FROM DB F28 TO RF31B
          342          RD    1000    .024     .04            TRAP      20       3

          343          KK   RF31B
          344          KM        ROUTE FLOW FROM RF31A TO RF31C
          345          RD    1500    .024    0.04            TRAP      20       3

          346          KK   RF31C
          347          KM        ROUTE FLOW FROM  RF31B TO DP F
          348          RD    1000    .024     .04            TRAP      20       3

          349          KK    F-31
          350          KM         RUNOFF FOR SUB-BASIN F-31
          351          BA    .069
          352          LS       0      61
          353          UD     .25

          354          KK     DPF
          355          KM        COMBINE FLOW FROM RF31 AND F-31
          356          HC       2
          357          ZZ
1                                                                  ZZ=End of Job
               SCHEMATIC DIAGRAM OF STREAM NETWORK

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

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

    11         F-1
               V
               V
    28         RF1
               .
               .
    31         .         F-2
               .           V
               .           V
    36         .         RF2
```

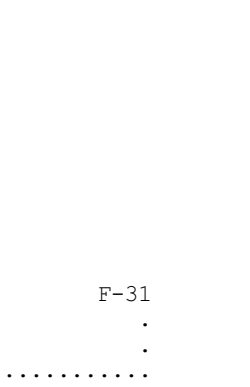

39
DPF2
42
RF10
45
F-10
50
DPF10
53
RF8
56
F-8
61
F-17
66
DPF8
69
F-9
74
F-19
79
DPF19
83
F-3
88
RF11
91
F-11
96
DPF11


V
V
99 RF18
102 F-18
107 F-4
V
V
112 RF4
115 F-6
V
V
120 RF6
123 F-5
V
V
128 RF5
131 DPF6
V
V
134 RF56
137 DP4
V
V
140 RF456
143 F-12
148 DPF12
V
V
151 RF12


154
157
162
165
168
172
182
185
190
193
196
201
204
209
212
RF16
F-16
DPF16
DPF18
DP1819
DB1819
RF22A
F-22
DPF22
RF27
F-27
DPF27
F-7
RF7
RF14A


216
F-14
221
DP14
224
F-15
229
RF15
232
F-23
237
DPF23A
240
RF23
243
DPF23
247
DBF14
257
RF25
260
F-25
265
DPF25
268
RF30
271
F-24
276
RF30A


279
F-30
284
F-41
289
RF41
292
F-42
297
DPF42
300
RF30B
303
DPF30
306
RF-29
309
F-29
314
DPF29
317
RF28
320
F-28
325
DPF28
328
DPF28A
332
DBF28



(***) RUNOFF ALSO COMPUTED AT THIS LOCATION

```
1*************************************
************************************
 *                                   *                                   *
*
 *   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *                                   *    U.S. ARMY CORPS OF
ENGINEERS     *
 *               JUN   1998              *                                   *    HYDROLOGIC
ENGINEERING CENTER    *
 *            VERSION 4.1                *                                   *          609 SECOND
STREET          *
 *                                       *                                   *       DAVIS, CALIFORNIA
95616       *
 *  RUN DATE   19JAN23  TIME  14:36:48   *                                   *           (916) 756-1104
*
 *                                       *                                   *
*
 ****************************************
****************************************
```

Wolf Ranch Tributary Four FN FBAS-REV.DAT
Detention basin at design point 14
F-Basins future developed condition with detention
Sub basins to F18/19 revised to match new DP
Final design of detention basin F18/19 Briargate Parkway

5-year and 100 Year, 24HR RAINFALL NOAA ATLAS 2 TYPE II STORM
REVISED 1-20-2023

```
    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          300  NUMBER OF HYDROGRAPH ORDINATES
                       NDDATE      2    0  ENDING DATE
                       NDTIME         0055  ENDING TIME
                        ICENT           19  CENTURY MARK

                    COMPUTATION INTERVAL     .08 HOURS
                         TOTAL TIME BASE   24.92 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
1

               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
                                                      RATIO 1 = 5-yr
                                                      RATIO 2 = 100-yr
                                                                  RATIOS APPLIED TO PRECIPITATION
 OPERATION       STATION     AREA    PLAN                    RATIO 1  RATIO 2
                                                                .56     1.00
```

HYDROGRAPH AT						
+	F-1	.17	1	FLOW	8.	94.
				TIME	12.25	12.08
ROUTED TO						
+	RF1	.17	1	FLOW	7.	95.
				TIME	12.33	12.17
HYDROGRAPH AT						
+	F-2	.04	1	FLOW	2.	25.
				TIME	12.17	12.08
ROUTED TO						
+	RF2	.04	1	FLOW	2.	24.
				TIME	12.25	12.17
2 COMBINED AT						
+	DPF2	.21	1	FLOW	9.	119.
				TIME	12.33	12.17
ROUTED TO						
+	RF10	.21	1	FLOW	9.	118.
				TIME	12.33	12.17
HYDROGRAPH AT						
+	F-10	.11	1	FLOW	34.	131.
				TIME	12.08	12.08
2 COMBINED AT						
+	DPF10	.32	1	FLOW	36.	230.
				TIME	12.17	12.17
ROUTED TO						
+	RF8	.32	1	FLOW	36.	230.
				TIME	12.17	12.17
HYDROGRAPH AT						
+	F-8	.04	1	FLOW	17.	57.
				TIME	12.08	12.08
HYDROGRAPH AT						
+	F-17	.04	1	FLOW	20.	59.
				TIME	12.08	12.08

3 COMBINED AT						
+	DPF8	.39	1	FLOW	70.	333.
				TIME	12.08	12.08
HYDROGRAPH AT						
+	F-9	.06	1	FLOW	15.	59.
				TIME	12.25	12.25
HYDROGRAPH AT						
+	F-19	.01	1	FLOW	1.	6.
				TIME	12.08	12.00
3 COMBINED AT						
+	DPF19	.46	1	FLOW	81.	386.
				TIME	12.08	12.08
HYDROGRAPH AT						
+	F-3	.09	1	FLOW	4.	52.
				TIME	12.25	12.17
ROUTED TO						
+	RF11	.09	1	FLOW	4.	51.
				TIME	12.25	12.17
HYDROGRAPH AT						
+	F-11	.04	1	FLOW	13.	50.
				TIME	12.08	12.08
2 COMBINED AT						
+	DPF11	.13	1	FLOW	15.	95.
				TIME	12.08	12.08
ROUTED TO						
+	RF18	.13	1	FLOW	14.	92.
				TIME	12.08	12.08
HYDROGRAPH AT						
+	F-18	.03	1	FLOW	7.	32.
				TIME	12.08	12.08
HYDROGRAPH AT						
+	F-4	.27	1	FLOW	11.	128.
				TIME	12.33	12.17
ROUTED TO						

+	RF4	.27	1	FLOW	11.	127.
				TIME	12.33	12.25
HYDROGRAPH AT						
+	F-6	.03	1	FLOW	1.	18.
				TIME	12.17	12.08
ROUTED TO						
+	RF6	.03	1	FLOW	1.	18.
				TIME	12.25	12.17
HYDROGRAPH AT						
+	F-5	.11	1	FLOW	4.	46.
				TIME	12.42	12.25
ROUTED TO						
+	RF5	.11	1	FLOW	4.	46.
				TIME	12.42	12.25
2 COMBINED AT						
+	DPF6	.14	1	FLOW	5.	60.
				TIME	12.42	12.25
ROUTED TO						
+	RF56	.14	1	FLOW	5.	60.
				TIME	12.42	12.25
2 COMBINED AT						
+	DP4	.41	1	FLOW	15.	187.
				TIME	12.33	12.25
ROUTED TO						
+	RF456	.41	1	FLOW	15.	187.
				TIME	12.33	12.25
HYDROGRAPH AT						
+	F-12	.09	1	FLOW	25.	104.
				TIME	12.08	12.08
2 COMBINED AT						
+	DPF12	.50	1	FLOW	32.	265.
				TIME	12.17	12.17
ROUTED TO						
+	RF12	.50	1	FLOW	32.	263.

```
                                        TIME        12.17    12.17

 ROUTED TO
+                   RF16       .50      1   FLOW          31.     261.
                                            TIME        12.17    12.17

 HYDROGRAPH AT
+                    F-16      .08      1   FLOW          31.     105.
                                            TIME        12.08    12.08

  2 COMBINED AT
+                   DPF16      .57      1   FLOW          58.     345.
                                            TIME        12.08    12.17

  3 COMBINED AT
+                   DPF18      .74      1   FLOW          79.     459.
                                            TIME        12.08    12.08

  2 COMBINED AT
+                  DP1819     1.20      1   FLOW         160.     846.
                                            TIME        12.08    12.08

 ROUTED TO
+                  DB1819     1.20      1   FLOW          17.     222.
                                            TIME        15.33    12.75

                                    ** PEAK STAGES IN FEET **
                                    1   STAGE     7139.38  7142.39
                                            TIME        15.33    12.75

 ROUTED TO
+                   RF22A      1.20      1   FLOW          17.     222.
                                            TIME        15.42    12.83

 HYDROGRAPH AT
+                    F-22      .06      1   FLOW           4.      37.
                                            TIME        12.17    12.17

  2 COMBINED AT
+                   DPF22      1.26      1   FLOW          18.     234.
                                            TIME        15.33    12.50

 ROUTED TO
+                   RF27       1.26      1   FLOW          18.     238.
                                            TIME        15.58    12.58
```

Detention Basin F18/F19
5-yr Discharge=17cfs. 5-yr WSE=7139.38
100-yr Discharge=222cfs. 100-yr WSE=7142.39

HYDROGRAPH AT						
+	F-27	.25	1	FLOW	66.	241.
				TIME	12.25	12.25
2 COMBINED AT						
+	DPF27	1.51	1	FLOW	66.	398.
				TIME	12.25	12.42
HYDROGRAPH AT						
+	F-7	.08	1	FLOW	4.	46.
				TIME	12.17	12.08
ROUTED TO						
+	RF7	.08	1	FLOW	4.	46.
				TIME	12.33	12.17
ROUTED TO						
+	RF14A	.08	1	FLOW	4.	46.
				TIME	12.33	12.17
HYDROGRAPH AT						
+	F-14	.13	1	FLOW	33.	129.
				TIME	12.17	12.17
2 COMBINED AT						
+	DP14	.21	1	FLOW	34.	175.
				TIME	12.17	12.17
HYDROGRAPH AT						
+	F-15	.02	1	FLOW	11.	33.
				TIME	12.08	12.08
ROUTED TO						
+	RF15	.02	1	FLOW	11.	31.
				TIME	12.17	12.08
HYDROGRAPH AT						
+	F-23	.03	1	FLOW	21.	55.
				TIME	12.08	12.08
2 COMBINED AT						
+	DPF23A	.05	1	FLOW	31.	86.
				TIME	12.08	12.08

```
 ROUTED TO
+                   RF23       .05     1   FLOW          30.      85.
                                           TIME        12.08    12.08

  2 COMBINED AT
+                  DPF23       .26     1   FLOW          63.     252.
                                           TIME        12.17    12.17

 ROUTED TO
+                  DBF14       .26     1   FLOW           3.      81.
                                           TIME        19.92    12.58

                                       ** PEAK STAGES IN FEET **
                                       1   STAGE     7131.22  7133.45
                                           TIME        19.92    12.58

 ROUTED TO
+                   RF25       .26     1   FLOW           3.      81.
                                           TIME        20.00    12.58

 HYDROGRAPH AT
+                   F-25       .09     1   FLOW          27.      95.
                                           TIME        12.17    12.17

  2 COMBINED AT
+                  DPF25       .35     1   FLOW          27.     146.
                                           TIME        12.17    12.33

 ROUTED TO
+                   RF30       .35     1   FLOW          27.     144.
                                           TIME        12.25    12.33

 HYDROGRAPH AT
+                   F-24       .09     1   FLOW          62.     147.
                                           TIME        12.17    12.17

 ROUTED TO
+                  RF30A       .09     1   FLOW          61.     146.
                                           TIME        12.17    12.17

 HYDROGRAPH AT
+                   F-30       .02     1   FLOW          10.      31.
                                           TIME        12.08    12.08

 HYDROGRAPH AT
```

+	F-41	.08	1	FLOW	13.	69.
				TIME	12.17	12.17
ROUTED TO						
+	RF41	.08	1	FLOW	13.	69.
				TIME	12.17	12.17
HYDROGRAPH AT						
+	F-42	.05	1	FLOW	15.	58.
				TIME	12.17	12.08
2 COMBINED AT						
+	DPF42	.13	1	FLOW	28.	126.
				TIME	12.17	12.17
ROUTED TO						
+	RF30B	.13	1	FLOW	28.	125.
				TIME	12.17	12.17
4 COMBINED AT						
+	DPF30	.59	1	FLOW	125.	398.
				TIME	12.17	12.17
ROUTED TO						
+	RF-29	.59	1	FLOW	125.	395.
				TIME	12.25	12.25
HYDROGRAPH AT						
+	F-29	.02	1	FLOW	10.	32.
				TIME	12.08	12.08
2 COMBINED AT						
+	DPF29	.61	1	FLOW	133.	417.
				TIME	12.25	12.25
ROUTED TO						
+	RF28	.61	1	FLOW	129.	414.
				TIME	12.25	12.25
HYDROGRAPH AT						
+	F-28	.04	1	FLOW	8.	37.
				TIME	12.17	12.17
2 COMBINED AT						
+	DPF28	.66	1	FLOW	136.	445.

```
                                        TIME        12.25    12.25

  2 COMBINED AT
+                 DPF28A      2.17     1   FLOW         202.     780.
                                        TIME        12.25    12.33

 ROUTED TO
+                  DBF28      2.17     1   FLOW          31.     590.
                                        TIME        16.83    12.67

                                    ** PEAK STAGES IN FEET **
                                    1   STAGE     6976.05  6978.39
                                        TIME        16.75    12.67

 ROUTED TO
+                  RF31A      2.17     1   FLOW          31.     589.
                                        TIME        16.83    12.67

 ROUTED TO
+                  RF31B      2.17     1   FLOW          31.     588.
                                        TIME        17.00    12.67

 ROUTED TO
+                  RF31C      2.17     1   FLOW          31.     586.
                                        TIME        17.00    12.75

 HYDROGRAPH AT
+                   F-31       .07     1   FLOW           3.      36.
                                        TIME        12.25    12.17

  2 COMBINED AT
+                   DPF       2.24     1   FLOW          32.     596.
                                        TIME        17.00    12.75
1
                                    SUMMARY OF KINEMATIC WAVE - MUSKINGUM-CUNGE ROUTING
                                        (FLOW IS DIRECT RUNOFF WITHOUT BASE FLOW)
                                                                    INTERPOLATED TO
                                                                  COMPUTATION INTERVAL
            ISTAQ    ELEMENT      DT       PEAK    TIME TO     VOLUME      DT       PEAK    TIME TO     VOLUME
                                                      PEAK                                      PEAK

                                  (MIN)     (CFS)      (MIN)      (IN)     (MIN)     (CFS)      (MIN)       (IN)

          FOR PLAN = 1  RATIO=  .00
               RF1  MANE         1.25      7.82    738.75       .19      5.00      7.39    740.00         .19
```

```
1****************************************
****************************************
 *                                      *
*
 *   FLOOD HYDROGRAPH PACKAGE   (HEC-1)   *
ENGINEERS     *
 *               JUN   1998             *
ENGINEERING CENTER    *
 *            VERSION 4.1               *
STREET          *
 *                                      *
95616       *
 *  RUN DATE   24AUG22  TIME  13:32:42   *
*
 *                                      *
*
 ****************************************
****************************************
```

Basin F
24 Hour Rainfall
Plugged F18/F19 Outlet Structure

```
*                                      *
*    U.S. ARMY CORPS OF
*    HYDROLOGIC
*          609 SECOND
*       DAVIS, CALIFORNIA
*           (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

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

   1          ID             Wolf Ranch Tributary Four   FN FBASALT1.DAT
   2          ID             Detention basin at design  point 14 ADDED
   3          ID             F-Basins future developed condition with detention
   4          ID             Sub basins to F18/19 revised to match new DP
   5          ID             Final design of detention basin F18/19  Briargate Parkway
   6          ID             Water quaility storage in DB 18/19 assumed full
   7          ID             5-year and 100 Year, 24HR RAINFALL NOAA ATLAS 2 TYPE II STORM
   8          ID             REVISED 8-24-2022
              *DIAGRAM
   9          IT       5       0       0     300
  10          IO       5       0
  11          JR    PREC     .56     1.0

  12          KK     F-1
  13          KM        RUNOFF FOR SUB-BASIN F-1
  14          BA   .1659
  15          IN      15
  16          PB     4.4
  17          PC       0    .002    .005    .008    .011   .0104   .0170     .02    .023    .026
  18          PC    .029    .032    .035    .038    .041    .044    .048    .052    .056     .06
  19          PC   .0604    .068    .072    .076     .08    .085     .09    .095      .1    .105
  20          PC     .11    .115     .12    .126    .133     .14    .147    .155    .163    .172
  21          PC    .181    .191    .203    .218    .236    .257    .283    .387    .663    .707
  22          PC    .735    .758    .776    .791    .804    .815    .825    .834    .842    .849
  23          PC    .856    .863    .869    .875    .881    .887    .893    .898    .903    .908
  24          PC    .913    .918    .922    .926     .93    .934    .938    .942    .946     .95
  25          PC    .953    .956    .959    .962    .965    .968    .971    .974    .977     .98
  26          PC    .983    .986    .989    .992    .995    .998
  27          LS       0      61
  28          UD     .20

  29          KK     RF1
  30          KM         ROUTE FLOW FROM SUB-BASIN F-1 TO DP F2
  31          RD    1450   0.037    0.04            TRAP      10       6

  32          KK     F-2
  33          KM         RUNOFF FROM SUB BASIN F-2
  34          BA    .042
  35          LS       0      61
  36          UD     .19
```

```
   37          KK     RF2
   38          KM         ROUTE FLOW FROM SB F-2 TO DP F2
   39          RD    1200     .04    .035            CIRC       3

   40          KK    DPF2
   41          KM         COMBINE RF1 AND RF2
   42          HC       2

   43          KK    RF10
   44          KM         ROUTE FLOW FROM DP F2 TO DP F10
   45          RD     540     .03    .013            CIRC       4
1                                      HEC-1 INPUT                                                    PAGE  2

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

   46          KK    F-10
   47          KM         RUNOFF FROM BASIN F-10
   48          BA    .108
   49          LS       0    72.6
   50          UD    .178

   51          KK   DPF10
   52          KM         COMBINE FLOW FROM SB F-10 AND RF10
   53          HC       2

   54          KK     RF8
   55          KM         ROUTE FLOW FROM DP F-10 TO DP F19
   56          RD    1100     .03    .016            CIRC     4.5

   57          KK     F-8
   58          KM         RUNOFF FROM SB F-8
   59          BA   .0402
   60          LS       0    75.1
   61          UD    .153

   62          KK    F-17
   63          KM        RUNOFF FROM SUB BASIN F-17
   64          BA    .037
   65          LS       0    78.1
   66          UD    .135

   67          KK    DPF8
   68          KM         COMBINE RF-8,SUB BASIN F-8 AND SUB BASIN F-17
   69          HC       3
```

```
   70          KK     F-9
   71          KM         RUNOFF FOR BASIN F-9
   72          BA   .0639
   73          LS       0    73.2
   74          UD    .317

   75          KK    F-19
   76          KM        RUNOFF FROM SUB-BASIN F-19
   77          BA   .0077
   78          LS       0      61
   79          UD   0.088

   80          KK   DPF19
   81          KM        COMBINE FLOW FROM DP F8, SB F-9, SB F-19
   82          KM        THIS IS THE INFLOW TO DB F19
   83          HC       3

   84          KK     F-3
   85          KM         RUNOFF FOR SUB-BASIN F-3
   86          BA   .0942
   87          LS       0      61
   88          UD     .22
```



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

   89          KK    RF11
   90          KM        ROUTE FLOW FROM SUB-BASIN F-3 TO DESIGN POINT F11
   91          RD    1050    0.03    0.04            CIRC     103

   92          KK    F-11
   93          KM         RUNOFF FOR SUB-BASIN F-11
   94          BA   .0404
   95          LS       0    71.8
   96          UD     .14

   97          KK   DPF11
   98          KM        COMBINE FLOW FROM SUB-BASIN F-11 AND RF11
   99          HC       2

  100          KK    RF18
  101          KM        ROUTE FLOW FROM DESIGN POINT F11 TO DETENTION POINT DP18
  102          RD    1200    0.03    .013            CIRC       3
```

```
 103          KK    F-18
 104          KM        RUNOFF FROM SB F-18
 105          BA   .0285
 106          LS       0    69.7
 107          UD    .142

 108          KK     F-4
 109          KM         RUNOFF FROM SUB-BASIN F-4
 110          BA   .2681
 111          LS       0      61
 112          UD     .28

 113          KK     RF4
 114          KM        ROUTE FLOW FROM SUB-BASIN F-4 TO DESIGN POINT F4
 115          RD     650   0.044   0.013           CIRC       4

 116          KK     F-6
 117          KM        RUNOFF FROM SUB-BASIN F-6
 118          BA    .031
 119          LS       0      61
 120          UD     .19

 121          KK     RF6
 122          KM        ROUTE FLOW FROM F6 TO DP F6
 123          RD     980     .03    .013           CIRC     2.5

 124          KK     F-5
 125          KM         RUNOFF FOR SUB-BASIN F-5
 126          BA   .1073
 127          LS       0      61
 128          UD     .34
1                                        HEC-1 INPUT                                                PAGE  4

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


 129          KK     RF5
 130          KM        ROUTE FLOW FROM SUB-BASIN F-5 TO DESIGN POINT F6
 131          RD     500     .04    .013           CIRC       3

 132          KK    DPF6
 133          KM        COMBINE RF5 AND RF6
 134          HC       2
```

```
135          KK    RF56
136          KM          ROUTE DPF6 TO DPF4
137          RD    1020     .03    .013            CIRC       4

138          KK     DP4
139          KM         COMBINE RF4 AND RF56
140          HC       2

141          KK   RF456
142          KM        ROUTE DPF4 TO DP12
143          RD     640     .03    .013            CIRC       4

144          KK    F-12
145          KM         RUNOFF FOR SUB-BASIN F-12
146          BA   .0899
147          LS       0      71
148          UD    .167

149          KK   DPF12
150          KM        COMBINE FLOW FROM SUB-BASIN F-12 AND RF456
151          HC       2

152          KK    RF12
153          KM        ROUTE FLOW FROM DESIGN POINT F12 TO RF16
154          RD     720    0.02   0.013            CIRC       4

155          KK    RF16
156          KM        ROUTE FLOW FROM RF12 TO RF16
157          RD     820     .03    .013            CIRC     4.5

158          KK    F-16
159          KM        RUNOFF FROM SB F-16
160          BA   .0759
161          LS       0      75
162          UD    .165

163          KK   DPF16
164          KM        COMBINE FLOW FROM SB F-16 AND RF16
165          HC       2

166          KK   DPF18
167          KM        COMBINE FLOW FROM SUB-BASIN F-18, DP16 AND RF18
168          HC       3
```

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

 169          KK  DP1819
 170          KM         COMBINE DPF18 AND DPF19
 171          KM        INFLOW TO DET BASIN 1819
 172          HC       2

 173          KK  DB1819
 174          KM          ROUTE DPF1819  THROUGH DETENTION BASIN DB1819
 175          KM          THIS IS OUTFLOW FROM DETENTION BASIN 18-19
 176          KM          WATER QUALTY STORAGE POOL ASSUMED FULL
 177          RS       1    ELEV  7137.5
 178          SV       0     1.4    5.01     9.1   15.34   22.25   29.56   37.23    45.2   53.42
 179          SV   61.89   66.23
 180          SE  7137.5    7138    7139    7140    7141    7142    7143    7144    7145    7146
 181          SE    7147  7147.5
 182          SQ       0      .1     .15      .2     .25      .3      .5    69.4   196.4   344.8
 183          SQ   357.5   363.7

 184          KK   RF22A
 185          KM        ROUTE FLOW FROM DETENTION BASIN 1819 TO DESIGN POINT DP F22
 186          RD    1800   0.027    0.02            TRAP      10       6

 187          KK    F-22
 188          KM         RUNOFF FOR SUB-BASIN F-22
 189          BA    .059
 190          LS       0    62.7
 191          UD     .21

 192          KK   DPF22
 193          KM        COMBINE FLOW FROM SUB-BASIN F-22, AND RF22A
 194          HC       2

 195          KK   RF27
 196          KM        ROUTE FLOW FROM DESIGN POINT DPF22 TO DESIGN POINT F27
 197          RD    3700    0.04    0.04            TRAP      20       3

 198          KK    F-27
 199          KM        RUNOFF FROM SUB BASIN F-27
 200          BA     .255
 201          LS       0    74
 202          UD     .32

 203          KK   DPF27
```

F18/F19 outlet structure grate modeled as plugged. No significant flows out until WSE= spillway grate elevation

```
 204          KM        COMBINE RF27 ANS SUB BASIN F-27
 205          HC       2

 206          KK    F-7
 207          KM         RUNOFF FOR SUB-BASIN F-7
 208          BA   .0782
 209          LS       0      61
 210          UD     .19
```



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


 211          KK    RF7
 212          KM         ROUTE FLOW FROM SUB-BASIN F-7 TO DESIGN POINT F14A
 213          RD    1200   0.033    0.04            TRAP      10       6

 214          KK   RF14A
 215          KM         ROUTE FLOW FROM DESIGN POINT F14A TO DB 14
 216          RD     400   0.027   0.013            CIRC       4

 217          KK    F-14
 218          KM         RUNOFF FROM SB F-14
 219          BA    .128
 220          LS       0    72.3
 221          UD     .25

 222          KK    DP14
 223          KM         COMBINE RF 14A AND SB F14
 224          HC       2

 225          KK    F-15
 226          KM         RUNOFF FROM SUB-BASIN F-15
 227          BA   .0210
 228          LS       0    77.8
 229          UD     .15

 230          KK    RF15
 231          KM           ROUTE RUNOFF FROM F-15  TO DESIGN POINT F23A
 232          RD    1100    .023     .04            TRAP      10       3

 233          KK    F-23
 234          KM         RUNOFF FROM SUB BASIN F-23
 235          BA   .0310
 236          LS       0    82.8
```

```
 237          UD     .18

 238          KK  DPF23A
 239          KM         COMBINE FLOW FROM RF15 AND  SUB-BASIN F-23
 240          HC       2

 241          KK    RF23
 242          KM         ROUTE FLOW FROM DP F23 TO DP23
 243          RD     300     .03    .013            CIRC     2.5

 244          KK   DPF23
 245          KM        COMBINE FLOW FROM DP14 AND RF23
 246          KM          THIS IS INFLOW TO DETENTION BASIN DB14
 247          HC       2

 248          KK    DB14
 249          KM         DETENTION BASIN DB14
 250          KM          THIS IS OUTFLOW FROM DETENTION BASIN 14
 251          RS       1    ELEV  7124.5
 252          SV       0    .006    .011    .133     .59    1.56    2.94    4.49    5.30    6.14
 253          SV    7.89    8.81    9.76   11.73   12.75
 254          SE  7124.5  7125.5  7126.0  7127.0  7128.0  7129.0  7130.0  7131.0  7131.5  7132.0
1                                        HEC-1 INPUT                                          PAGE  7

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

 255          SE    7133  7133.5    7134  7135.0  7135.5
 256          SQ       0     .19     .24     .43     .58     .82    1.00    1.14     5.2    27.6
 257          SQ    78.5    81.0   191.3   666.5     994

 258          KK    RF25
 259          KM        ROUTE FLOW FROM DETENTION BASIN DB  14 TO DESIGN POINT F25
 260          RD    2600   0.023   0.013            CIRC       3

 261          KK    F-25
 262          KM         RUNOFF FOR SUB-BASIN F-25
 263          BA   .0890
 264          LS       0    74.9
 265          UD     .28

 266          KK   DPF25
 267          KM        COMBINE FLOW FROM RF25 AND SB 25
 268          HC       2

 269          KK    RF30
```

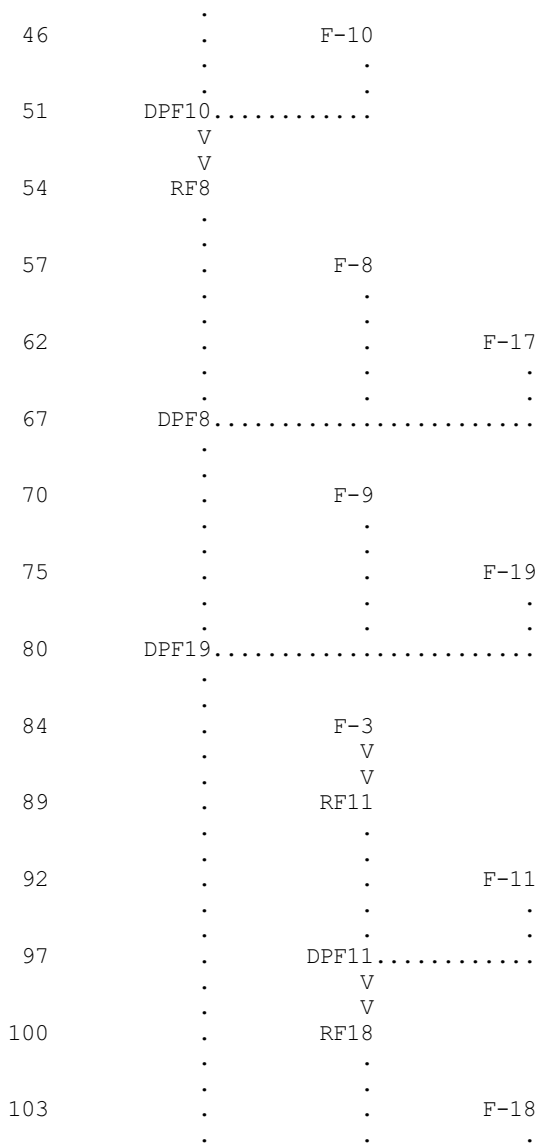
```
 270          KM        ROUTE FLOW FROM DESIGN POINT F25 TO DESIGN POINT F30
 271          RD     750   0.027   0.013            CIRC       4

 272          KK    F-24
 273          KM         RUNOFF FOR SUB-BASIN F-24
 274          BA   .0890
 275          LS       0      86
 276          UD     .26

 277          KK   RF30A
 278          KM        ROUTE FLOW FROM SUB-BASIN    F24 TO DESIGN POINT F30
 279          RD     920   0.033   0.013            CIRC     3.5

 280          KK    F-30
 281          KM         RUNOFF FOR SUB-BASIN F-30
 282          BA   .0212
 283          LS       0    77.4
 284          UD     .18

 285          KK    F-41
 286          KM         RUNOFF FROM SUB-BASIN F-41
 287          BA    .081
 288          LS       0      68
 289          UD     .22

 290          KK    RF41
 291          KM         ROUTE RUNOFF FROM  SUB-BASIN F-41 TO DP42
 292          RD    1450     .03    .013            CIRC     2.5

 293          KK    F-42
 294          KM         RUNOFF FROM SUB-BASIN F-42
 295          BA    .053
 296          LS              73
 297          UD     .22
```

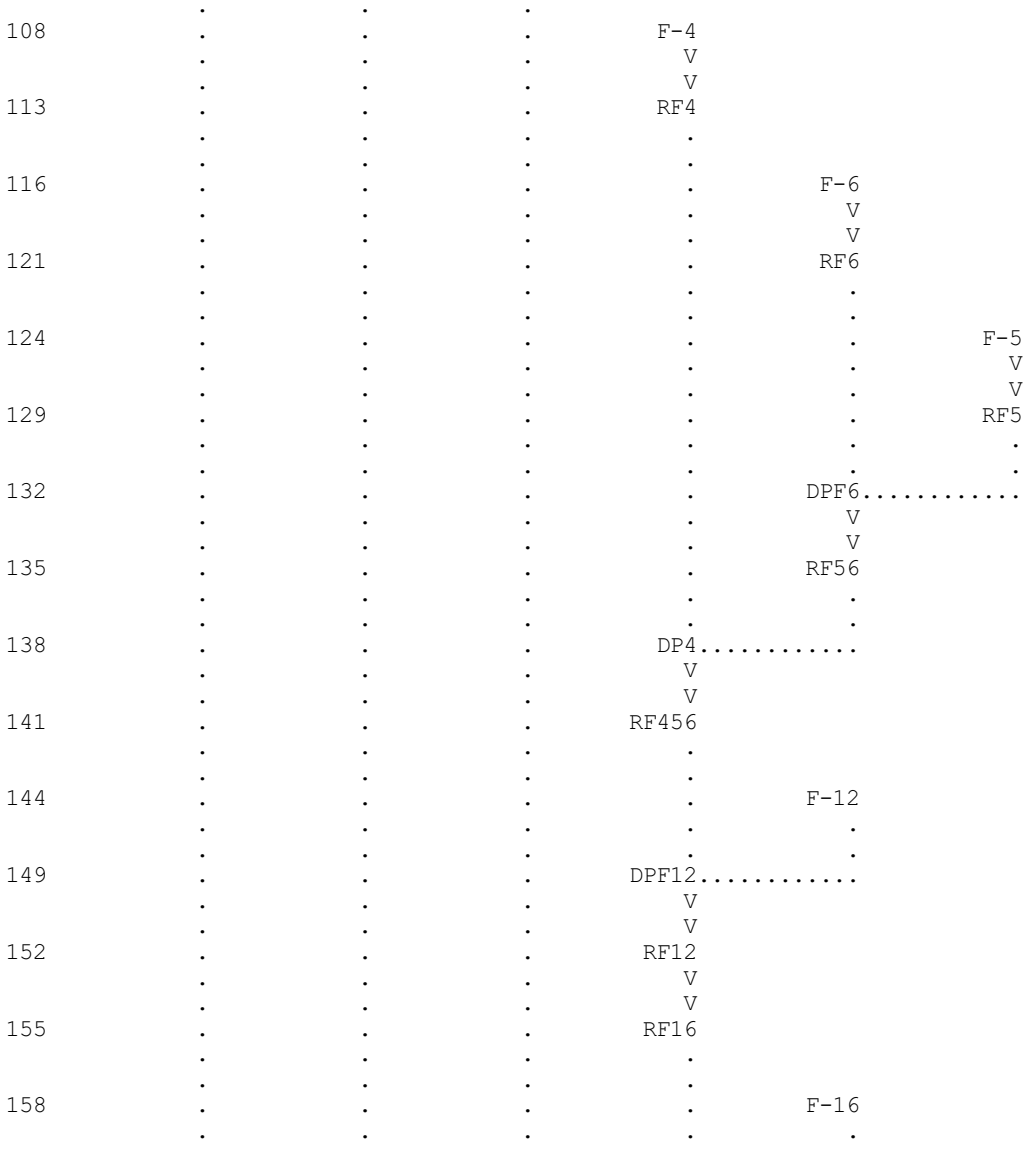


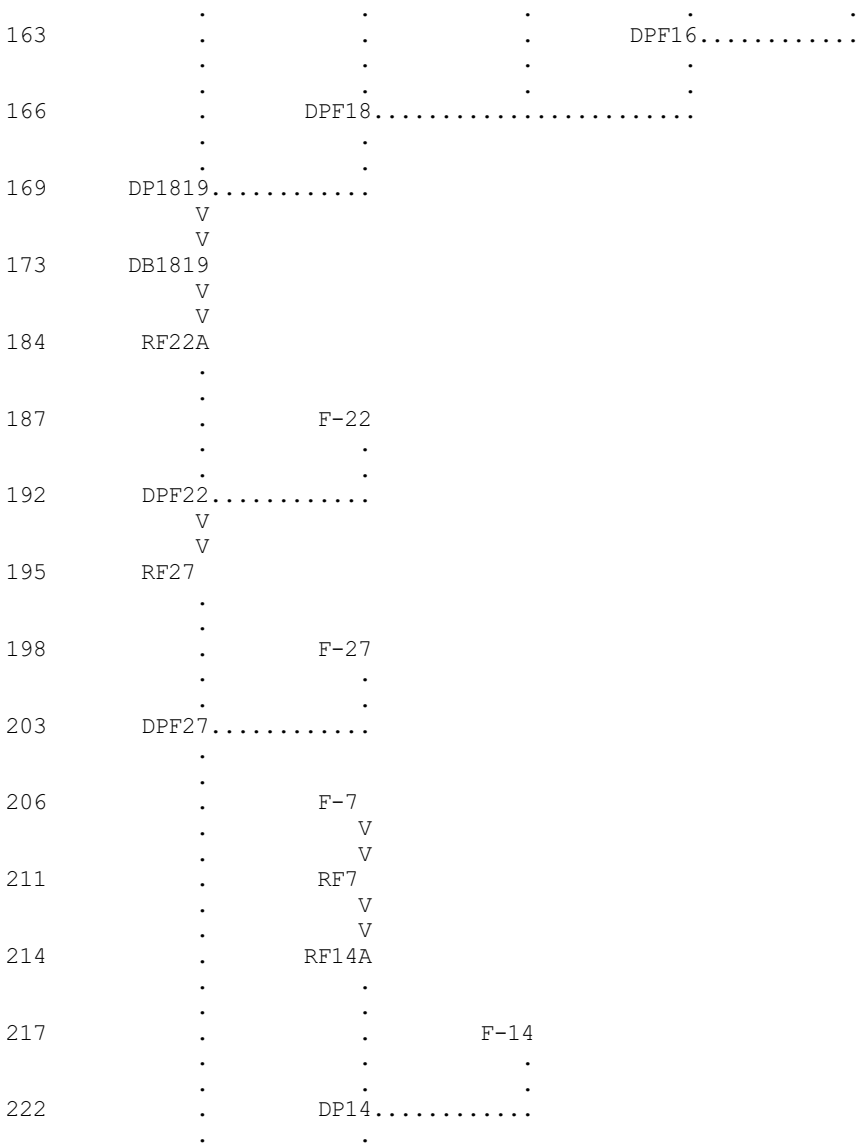
```
LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 298          KK   DPF42
 299          KM        COMBINE RUNOFF FROM F-42 AND RF41
 300          HC       2

 301          KK   RF30B
 302          KM        ROUTE FLOW FROM DESIGN POINT F42 TO DESIGN POINT F30
```

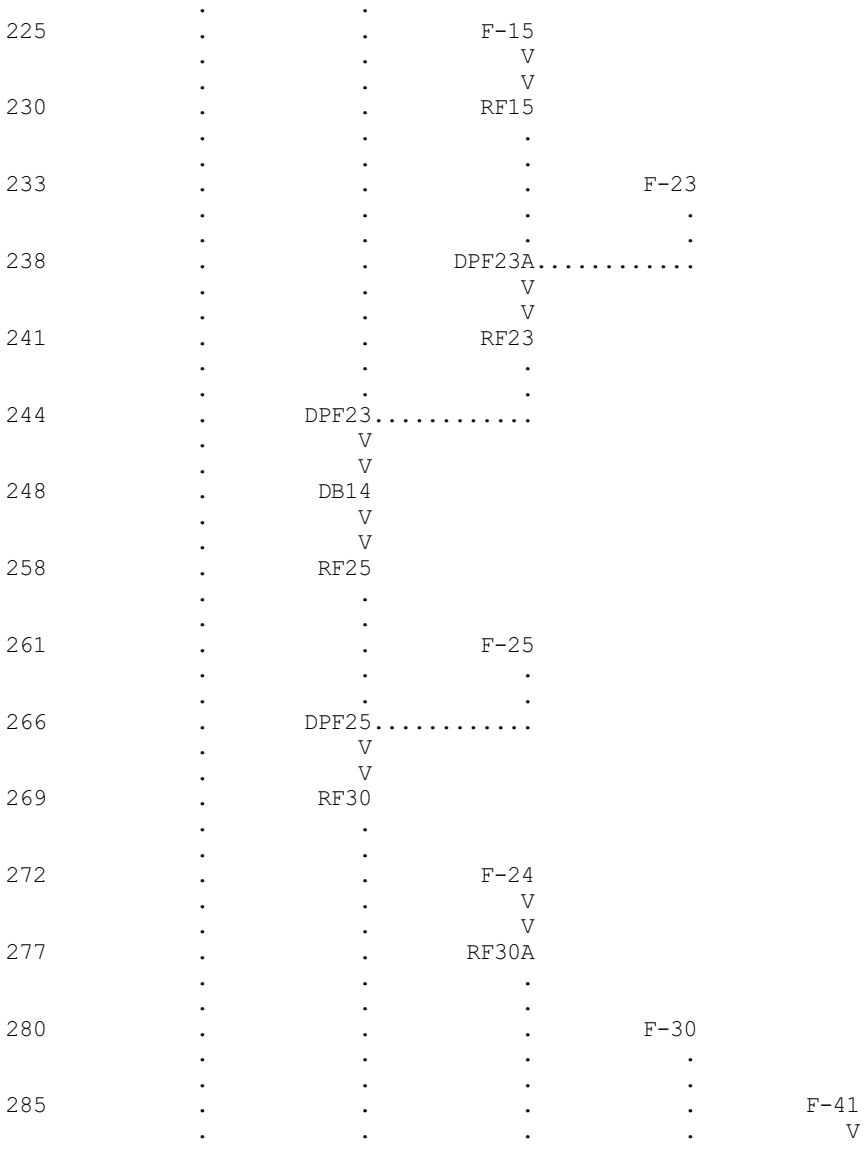
```
303          RD     600     .03    .013           CIRC       3

304          KK   DPF30
305          KM         COMBINE FLOW FROM RF30B,RF30A, RF30 AND SUB-BASIN F-30
306          HC       4

307          KK   RF-29
308          KM        ROUTE FLOW FROM DESIGN POINT F30 TO DESIGN POINT F29
309          RD    2350   0.027    0.04           TRAP       6       3

310          KK    F-29
311          KM         RUNOFF FOR SUB-BASIN F-29
312          BA   .0226
313          LS       0    77.4
314          UD     .19

315          KK  DPF29
316          KM        COMBINE FLOW FROM RF29 AND SUB-BASIN F-29
317          HC       2

318          KK    RF28
319          KM        ROUTE FLOW FROM DESIGN POINT F29 TO DESIGN POINT F28
320          RD     750   0.015    0.04           TRAP      20       3

321          KK    F-28
322          KM         RUNOFF FOR SUB-BASIN F-28
323          BA    .042
324          LS       0    68.9
325          UD     .23

326          KK   DPF28
327          KM        COMBINE FLOW FROM RF28, SB F-28
328          HC       2

329          KK  DPF28A
330          KM        COMBINE DP F27 AND DP F28
331          KM        THIS IS INFLOW TO DETENTION BASIN F28
332          HC       2

333          KK   DBF28
334          KM        ROUTE DPF28 THROUGH DETENTION BASIN DBF28
335          KM        THIS IS OUTFLOW FROM DETENTION BASIN F28
336          KM        FINAL DESIGN STAGE DISCHARGE
337          RS       1    ELEV    6968
338          SV       0    1.07    5.23   10.56    16.7    20.2      24   32.76      43
```

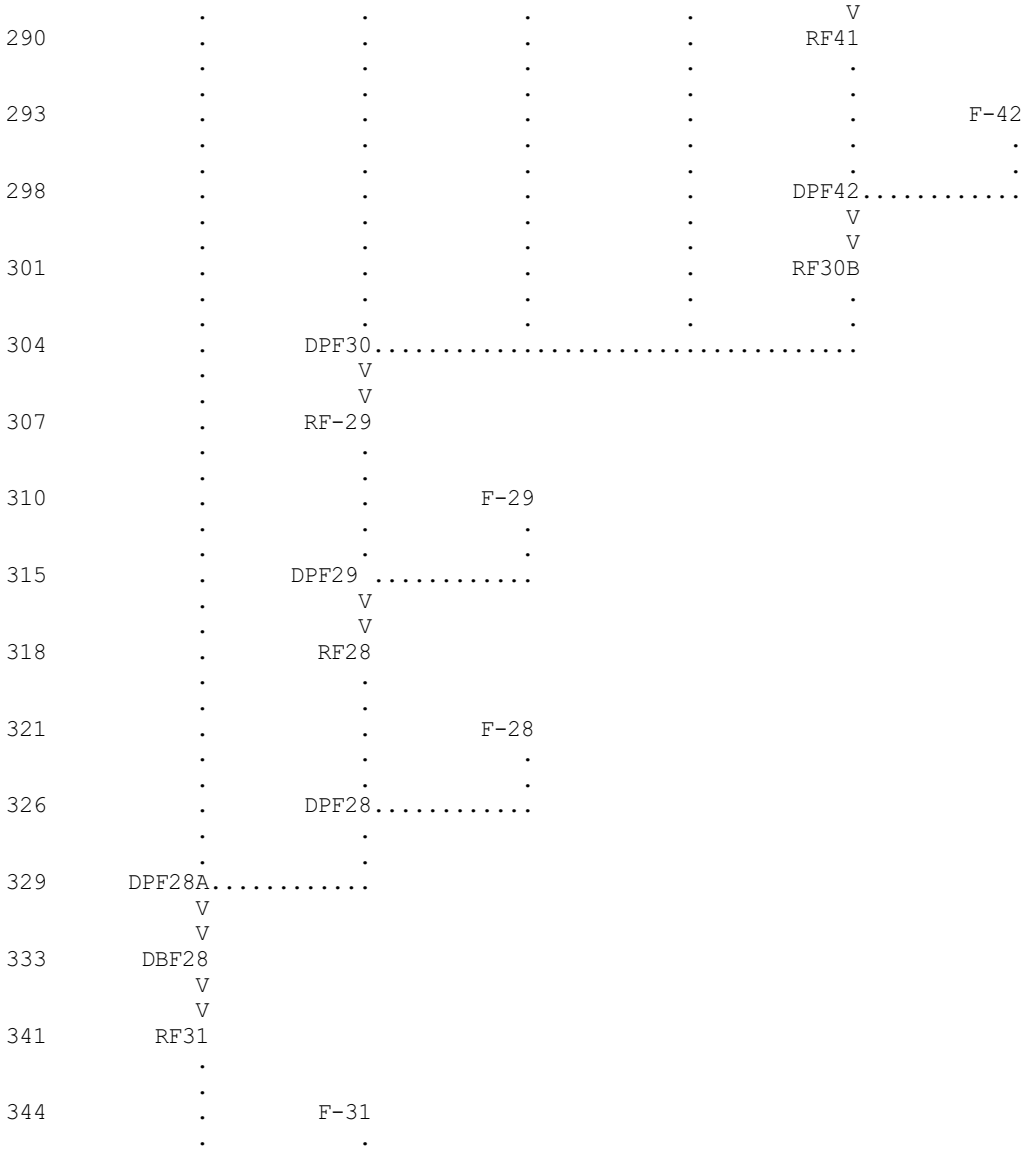
```
            339           SE    6968    6970    6972    6974    6976    6977    6978    6980    6982
            340           SQ       0     1.5     4.8    10.2    15.6     340     520     880    1000
1                                                    HEC-1 INPUT                                                PAGE  9

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


            341           KK    RF31
            342           KM        ROUTE FLOW FROM DB F28 TO DESIGN POINT F
            343           RD    3500   0.023    0.04            TRAP      20       3

            344           KK    F-31
            345           KM         RUNOFF FOR SUB-BASIN F-31
            346           BA    .069
            347           LS       0      61
            348           UD     .34

            349           KK     DPF
            350           KM        COMBINE FLOW FROM RF31 AND F-31
            351           HC       2
            352           ZZ
1
                 SCHEMATIC DIAGRAM OF STREAM NETWORK
 INPUT
  LINE      (V) ROUTING          (--->) DIVERSION OR PUMP FLOW

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

    12         F-1
                 V
                 V
    29         RF1
                 .
                 .
    32           .         F-2
                 .           V
                 .           V
    37           .         RF2
                 .           .
                 .           .
    40         DPF2.............
                 V
                 V
    43         RF10
                 .
```


46
F-10
51
DPF10
54
RF8
57
F-8
62
F-17
67
DPF8
70
F-9
75
F-19
80
DPF19
84
F-3
89
RF11
92
F-11
97
DPF11
100
RF18
103
F-18


108
F-4
V
V
113
RF4
116
F-6
V
V
121
RF6
124
F-5
V
V
129
RF5
132
DPF6
V
V
135
RF56
138
DP4
V
V
141
RF456
144
F-12
149
DPF12
V
V
152
RF12
V
V
155
RF16
158
F-16


163
DPF16
166
DPF18
169
DP1819
173
DB1819
184
RF22A
187
F-22
192
DPF22
195
RF27
198
F-27
203
DPF27
206
F-7
211
RF7
214
RF14A
217
F-14
222
DP14


225
F-15
230
RF15
233
F-23
238
DPF23A
241
RF23
244
DPF23
248
DB14
258
RF25
261
F-25
266
DPF25
269
RF30
272
F-24
277
RF30A
280
F-30
285
F-41


290
293
298
301
304
307
310
315
318
321
326
329
333
341
344
RF41
F-42
DPF42
RF30B
DPF30
RF-29
F-29
DPF29
RF28
F-28
DPF28
DPF28A
DBF28
RF31
F-31

```
                .          .
   349         DPF.....
```

```
 (***) RUNOFF ALSO COMPUTED AT THIS LOCATION
1****************************************
****************************************
 *                                      *                                                    *
*
 *   FLOOD HYDROGRAPH PACKAGE  (HEC-1)  *                                                    *    U.S. ARMY CORPS OF
ENGINEERS     *
 *               JUN   1998             *                                                    *    HYDROLOGIC
ENGINEERING CENTER    *
 *            VERSION 4.1               *                                                    *          609 SECOND
STREET          *
 *                                      *                                                    *       DAVIS, CALIFORNIA
95616       *
 *  RUN DATE   24AUG22  TIME  13:32:42  *                                                    *            (916) 756-1104
*
 *                                      *                                                    *
*
 ****************************************
****************************************
```

```
                                    Wolf Ranch Tributary Four   FN FBASALT1.DAT
                                    Detention basin at design  point 14 ADDED
                                    F-Basins future developed condition with detention
                                    Sub basins to F18/19 revised to match new DP
                                    Final design of detention basin F18/19  Briargate Parkway
                                    Water quaility storage in DB 18/19 assumed full
                                    5-year and 100 Year, 24HR RAINFALL NOAA ATLAS 2 TYPE II STORM
                                    REVISED 8-24-2022

   10 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         300  NUMBER OF HYDROGRAPH ORDINATES
                      NDDATE      2    0  ENDING DATE
                      NDTIME          55  ENDING TIME
                      ICENT           19  CENTURY MARK

                   COMPUTATION INTERVAL     .08 HOURS
                       TOTAL TIME BASE   24.92 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
1

               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
+                    F-1       .17     1   FLOW                    8.      94.
                                           TIME                 12.25    12.08

 ROUTED TO
+                    RF1       .17     1   FLOW                    7.      95.
                                           TIME                 12.33    12.17

 HYDROGRAPH AT
+                    F-2       .04     1   FLOW                    2.      25.
                                           TIME                 12.17    12.08
```

ROUTED TO						
+	RF2	.04	1	FLOW	2.	24.
				TIME	12.25	12.17
2 COMBINED AT						
+	DPF2	.21	1	FLOW	9.	119.
				TIME	12.33	12.17
ROUTED TO						
+	RF10	.21	1	FLOW	9.	118.
				TIME	12.33	12.17
HYDROGRAPH AT						
+	F-10	.11	1	FLOW	34.	131.
				TIME	12.08	12.08
2 COMBINED AT						
+	DPF10	.32	1	FLOW	36.	230.
				TIME	12.17	12.17
ROUTED TO						
+	RF8	.32	1	FLOW	36.	230.
				TIME	12.17	12.17
HYDROGRAPH AT						
+	F-8	.04	1	FLOW	17.	57.
				TIME	12.08	12.08
HYDROGRAPH AT						
+	F-17	.04	1	FLOW	20.	59.
				TIME	12.08	12.08
3 COMBINED AT						
+	DPF8	.39	1	FLOW	70.	333.
				TIME	12.08	12.08
HYDROGRAPH AT						
+	F-9	.06	1	FLOW	15.	59.
				TIME	12.25	12.25
HYDROGRAPH AT						
+	F-19	.01	1	FLOW	1.	6.
				TIME	12.08	12.00

3 COMBINED AT						
+	DPF19	.46	1	FLOW	81.	386.
				TIME	12.08	12.08
HYDROGRAPH AT						
+	F-3	.09	1	FLOW	4.	52.
				TIME	12.25	12.17
ROUTED TO						
+	RF11	.09	1	FLOW	4.	51.
				TIME	12.25	12.17
HYDROGRAPH AT						
+	F-11	.04	1	FLOW	13.	50.
				TIME	12.08	12.08
2 COMBINED AT						
+	DPF11	.13	1	FLOW	15.	95.
				TIME	12.08	12.08
ROUTED TO						
+	RF18	.13	1	FLOW	14.	92.
				TIME	12.08	12.08
HYDROGRAPH AT						
+	F-18	.03	1	FLOW	7.	32.
				TIME	12.08	12.08
HYDROGRAPH AT						
+	F-4	.27	1	FLOW	11.	128.
				TIME	12.33	12.17
ROUTED TO						
+	RF4	.27	1	FLOW	11.	127.
				TIME	12.33	12.25
HYDROGRAPH AT						
+	F-6	.03	1	FLOW	1.	18.
				TIME	12.17	12.08
ROUTED TO						
+	RF6	.03	1	FLOW	1.	18.
				TIME	12.25	12.17
HYDROGRAPH AT						

+	F-5	.11	1	FLOW	4.	46.
				TIME	12.42	12.25
ROUTED TO						
+	RF5	.11	1	FLOW	4.	46.
				TIME	12.42	12.25
2 COMBINED AT						
+	DPF6	.14	1	FLOW	5.	60.
				TIME	12.42	12.25
ROUTED TO						
+	RF56	.14	1	FLOW	5.	60.
				TIME	12.42	12.25
2 COMBINED AT						
+	DP4	.41	1	FLOW	15.	187.
				TIME	12.33	12.25
ROUTED TO						
+	RF456	.41	1	FLOW	15.	187.
				TIME	12.33	12.25
HYDROGRAPH AT						
+	F-12	.09	1	FLOW	25.	104.
				TIME	12.08	12.08
2 COMBINED AT						
+	DPF12	.50	1	FLOW	32.	265.
				TIME	12.17	12.17
ROUTED TO						
+	RF12	.50	1	FLOW	32.	263.
				TIME	12.17	12.17
ROUTED TO						
+	RF16	.50	1	FLOW	31.	261.
				TIME	12.17	12.17
HYDROGRAPH AT						
+	F-16	.08	1	FLOW	31.	105.
				TIME	12.08	12.08
2 COMBINED AT						
+	DPF16	.57	1	FLOW	58.	345.

				TIME	12.08	12.17
3 COMBINED AT						
+	DPF18	.74	1	FLOW	79.	459.
				TIME	12.08	12.08
2 COMBINED AT						
+	DP1819	1.20	1	FLOW	160.	846.
				TIME	12.08	12.08
ROUTED TO						
+	DB1819	1.20	1	FLOW	0.	136.
				TIME	23.92	13.17
			** PEAK STAGES IN FEET **			
			1	STAGE	7141.86	7144.53
				TIME	24.50	13.17
ROUTED TO						
+	RF22A	1.20	1	FLOW	0.	136.
				TIME	24.17	13.25
HYDROGRAPH AT						
+	F-22	.06	1	FLOW	4.	37.
				TIME	12.17	12.17
2 COMBINED AT						
+	DPF22	1.26	1	FLOW	4.	142.
				TIME	12.17	13.25
ROUTED TO						
+	RF27	1.26	1	FLOW	5.	142.
				TIME	12.58	13.33
HYDROGRAPH AT						
+	F-27	.24	1	FLOW	75.	248.
				TIME	12.25	12.25
2 COMBINED AT						
+	DPF27	1.50	1	FLOW	75.	284.
				TIME	12.25	12.25
HYDROGRAPH AT						
+	F-7	.08	1	FLOW	4.	46.
				TIME	12.17	12.08

ROUTED TO						
+	RF7	.08	1	FLOW	4.	46.
				TIME	12.33	12.17
ROUTED TO						
+	RF14A	.08	1	FLOW	4.	46.
				TIME	12.33	12.17
HYDROGRAPH AT						
+	F-14	.13	1	FLOW	33.	129.
				TIME	12.17	12.17
2 COMBINED AT						
+	DP14	.21	1	FLOW	34.	175.
				TIME	12.17	12.17
HYDROGRAPH AT						
+	F-15	.02	1	FLOW	11.	33.
				TIME	12.08	12.08
ROUTED TO						
+	RF15	.02	1	FLOW	11.	31.
				TIME	12.17	12.08
HYDROGRAPH AT						
+	F-23	.03	1	FLOW	21.	55.
				TIME	12.08	12.08
2 COMBINED AT						
+	DPF23A	.05	1	FLOW	31.	86.
				TIME	12.08	12.08
ROUTED TO						
+	RF23	.05	1	FLOW	30.	85.
				TIME	12.08	12.08
2 COMBINED AT						
+	DPF23	.26	1	FLOW	63.	252.
				TIME	12.17	12.17
ROUTED TO						
+	DB14	.26	1	FLOW	3.	81.
				TIME	19.92	12.58

```
                                        ** PEAK STAGES IN FEET **
                                        1   STAGE     7131.22  7133.45
                                            TIME        19.92   12.58

 ROUTED TO
+                   RF25       .26      1   FLOW           3.      81.
                                            TIME        20.00   12.58

 HYDROGRAPH AT
+                   F-25       .09      1   FLOW          27.      95.
                                            TIME        12.17   12.17

  2 COMBINED AT
+                   DPF25      .35      1   FLOW          27.     146.
                                            TIME        12.17   12.33

 ROUTED TO
+                   RF30       .35      1   FLOW          27.     144.
                                            TIME        12.25   12.33

 HYDROGRAPH AT
+                   F-24       .09      1   FLOW          62.     147.
                                            TIME        12.17   12.17

 ROUTED TO
+                   RF30A      .09      1   FLOW          61.     146.
                                            TIME        12.17   12.17

 HYDROGRAPH AT
+                   F-30       .02      1   FLOW          10.      31.
                                            TIME        12.08   12.08

 HYDROGRAPH AT
+                   F-41       .08      1   FLOW          13.      69.
                                            TIME        12.17   12.17

 ROUTED TO
+                   RF41       .08      1   FLOW          13.      69.
                                            TIME        12.17   12.17

 HYDROGRAPH AT
+                   F-42       .05      1   FLOW          15.      58.
                                            TIME        12.17   12.08

  2 COMBINED AT
```

```
+                 DPF42       .13     1   FLOW          28.     126.
                                          TIME        12.17    12.17

 ROUTED TO
+                 RF30B       .13     1   FLOW          28.     125.
                                          TIME        12.17    12.17

  4 COMBINED AT
+                 DPF30       .59     1   FLOW         125.     398.
                                          TIME        12.17    12.17

 ROUTED TO
+                 RF-29       .59     1   FLOW         125.     395.
                                          TIME        12.25    12.25

 HYDROGRAPH AT
+                  F-29       .02     1   FLOW          10.      32.
                                          TIME        12.08    12.08

  2 COMBINED AT
+                DPF29        .61     1   FLOW         133.     417.
                                          TIME        12.25    12.25

 ROUTED TO
+                  RF28       .61     1   FLOW         129.     414.
                                          TIME        12.25    12.25

 HYDROGRAPH AT
+                  F-28       .04     1   FLOW           8.      37.
                                          TIME        12.17    12.17

  2 COMBINED AT
+                 DPF28       .66     1   FLOW         136.     445.
                                          TIME        12.25    12.25

  2 COMBINED AT
+                DPF28A      2.15     1   FLOW         211.     730.
                                          TIME        12.25    12.25

 ROUTED TO
+                 DBF28      2.15     1   FLOW          14.     484.
                                          TIME        18.25    12.50

                                    ** PEAK STAGES IN FEET **
                                    1   STAGE     6975.26  6977.80
```

```
                                          TIME        18.25    12.50

 ROUTED TO
+                   RF31      2.15     1  FLOW          14.     526.
                                          TIME        18.50    12.50

 HYDROGRAPH AT
+                   F-31       .07     1  FLOW           3.      30.
                                          TIME        12.42    12.25

  2 COMBINED AT
+                    DPF      2.22     1  FLOW          14.     548.
                                          TIME        17.83    12.50
1


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

APPENDIX D

Revised Figure 6: Wolf Ranch MDDP Update

DESIGN POINT DISCHARGE SUMMARY w/DETENTION			
DESIGN POINT	AREA(sm)	Q_5 (cfs)	Q_{100} (cfs)
A1	0.06	3	32
A3	0.21	49	194
A4 (IN)	0.30	87	334
A4 (OUT)	0.30	8	87
A5 (IN)	0.74	193	663
A5 (OUT)	0.74	27	114
A6	0.52	118	391
A7	0.18	90	292
A	1.02	154	236
A9	0.11	49	161
B	0.04	60	122
C3	0.05	33	100
C	0.16	104	314
E5	0.13	85	241
E2 (IN)	0.18	111	335
D2 (IN)	0.10	49	160
DBDE (OUT)	0.18	13	157

DESIGN POINT DISCHARGE SUMMARY w/DETENTION			
DESIGN POINT	AREA(sm)	Q_5 (cfs)	Q_{100} (cfs)
F2	0.21	9	119
F4	0.41	15	187
F6	0.14	5	60
F8	0.39	70	333
F10	0.32	36	230
F11	0.13	15	95
F12	0.50	32	265
F14	0.21	34	175
F23A	0.05	31	86
F23	0.26	63	252
F14 (IN)	0.26	63	252
F14 (OUT)	0.26	3	81
F16	0.57	58	345
F18	0.74	79	459
F19	0.46	81	386
F18 / F19 (IN)	1.20	160	846
F18 / F19 (OUT)	1.20	17	222
F22	1.26	18	234
F25	0.35	27	146
F42	0.13	28	126
F30	0.59	125	398
F29	0.61	133	417
F27	1.50	66	398
F28	0.66	136	445
F28A	2.15	202	780
F28 (IN)	2.18	202	780
F28 (OUT)	2.18	31	590
F	2.22	32	596

DESIGN POINT DISCHARGE SUMMARY w/DETENTION			
DESIGN POINT	AREA(sm)	Q_5 (cfs)	Q_{100} (cfs)
G3 (1)	0.168	16	91
G3 (OUT) (1)	0.168	1	10
G-4 (1)	.027	5	25

(1) UPDATED HYDROLOGY FOR BASINS F, G, AND H. DETERMINED USING CITY OF COLORADO SPRINGS DCM 2014.

DETENTION BASIN E/D DATA (2)	
Q_5 IN = 160 cfs	Q_{100} IN = 492 cfs
Q_5 OUT = 13 cfs	Q_{100} OUT = 155 cfs (1)
VOL_5 = 5.9 AC–FT	
VOL_{100} = 14.8 AC–FT	
WS_5 = 55.2	
WS_{100} = 57.8	

(1) TOTAL OUTFLOW. OUTFLOW TO BE CONTROLLED TO EXISTING LEVELS AT DP E2 & DP D2
(2) DETENTION BASIN IN AS–BUILT CONDITION

DETENTION BASIN DB F18/F19 DATA (1)	
Q_5 IN = 160 cfs	Q_{100} IN = 846 cfs
Q_5 OUT = 17 cfs	Q_{100} OUT = 222 cfs
VOL_5 = 10.8 AC–FT	
VOL_{100} = 30.5 AC–FT	

(1) NOAA ATLAS 14 24 HR RAINFALL. 30% DESIGN STORM DISTRIBUTION.

DETENTION BASIN DB F28 DATA(1)(2)	
Q_5 IN = 202 cfs	Q_{100} IN = 780 cfs
Q_5 OUT = 31 cfs	Q_{100} OUT = 590 cfs
VOL_5 = 16.9 AC–FT	
VOL_{100} = 25.7 AC–FT	

(1) NOAA ATLAS 14 24 HR RAINFALL .30% DESIGN STORM DISTRIBUTION. (2) UPDATED HYDROLOGY FOR BASIN F

DETENTION BASIN DB F14 DATA (1)	
Q_5 IN = 63 cfs	Q_{100} IN = 252 cfs
Q_5 OUT = 3 cfs	Q_{100} OUT = 81 cfs
VOL_5 = 4.7 AC–FT	
VOL_{100} = 8.5 AC–FT	

(1) NOAA ATLAS 14 24 HR RAINFALL. 30% DESIGN STORM DISTRIBUTION.

DETENTION BASIN A DATA (1)	
Q_5 IN = 193 cfs	Q_{100} IN = 663 cfs
Q_5 OUT = 27 cfs	Q_{100} OUT = 114 cfs
VOL_5 = 6.9 AC–FT	
VOL_{100} = 28.2 AC–FT	

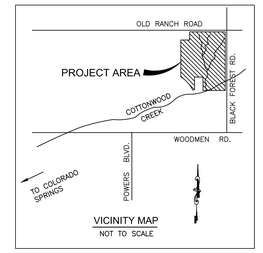
(1) DETENTION BASIN MODELED ITS AS–BUILT CONDITION

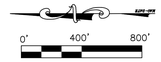
DETENTION BASIN A4 DATA	
Q_5 IN = 87 cfs	Q_{100} IN = 334 cfs
Q_5 OUT = 8 cfs	Q_{100} OUT = 87 cfs
VOL_5 = 4.6 AC–FT	
VOL_{100} = 10.9 AC–FT	

(1) DETENTION BASIN MODELED AS A FSD

DETENTION BASIN G DATA (1)	
Q_5 IN = 16 cfs	Q_{100} IN = 91 cfs
Q_5 OUT = 1 cfs	Q_{100} OUT = 10 cfs
VOL_5 = 1.5 AC–FT	
VOL_{100} = 6.6 AC–FT	

(1) 1 HOUR DESIGN STORM w/2 HOUR DISTRIBUTION PER 2014 DCM





LEGEND	
G4 / .07 / 61	BASIN NUMBER, BASIN AREA (SM), CN–VALUE
1	DESIGN POINT
	DRAINAGE BASIN BOUNDARY
C–13	CONVEYANCE ELEMENT/ HYDRAULIC STRUCTURE
	TIME OF CONCENTRATION FLOW PATH
	EXISTING DETENTION BASIN

STORM SEWER SYSTEMS SHOWN FOR SUB-BASINS C-3 & C-2 OBTAINED FROM WESTCREEK FILINGS 1, 2, 3, 4 & 5 FINAL DRAINAGE REPORT.

TYPICAL GRASSLINED SWALE SECTION
NTS

TYPICAL GRASSLINED & RIPRAP SWALE
NTS

Kiowa
Engineering Corporation
7175 West Jefferson Avenue, Suite 2200
Lakewood, Colorado 80235
(303) 892-0369

WOLF RANCH
MASTER DEVELOPMENT DRAINAGE PLAN UPDATE
PROPOSED FACILITIES
COLORADO SPRINGS, COLORADO

Project No.:	12055
Date:	11/20/2020
Design:	RNW
Drawn:	MTR
Check:	MWE
Revisions:	
7/27/21	Detention F14
04/27/23	Detention F18/F19

Fig. 6

APPENDIX E

Wolf Ranch – Detention F18/F19 - Variance Request

Kiowa
Engineering Corporation

April 19, 2023

Mr. Jonathan Scherer
City of Colorado Springs
Water Resources Engineering Division
30 South Nevada Ave, Suite 401
Colorado Springs, CO 80903

RE: Wolf Ranch – Detention F18/F19 - Variance Request
Kiowa Project Number 22035

Dear Mr. Scherer:

This letter is being submitted to request variance for the requirement to use a Type VI impact basin for a storm sewer pipe outfall greater than 48-inches in diameter. This request is for one of the existing pipe outfalls into Detention Basin F18/F19. The variances are for public infrastructure.

Variance for the impact basin requirement stated in Chapter 10, Section 4.3 of the *City of Colorado Springs, Drainage Criteria Manual, Volume 1* which references Mile High Flood District (MHFD) for requirements (Chapter 9, Section 3.2.4 of *Volume 2 of the Urban Storm Drainage Criteria Manual* (USDCM) prepared by MHFD). Following are the two standards:

> City of Colorado Springs manual: "The use of concrete impact stilling basins is discouraged where moderate outlet conditions exist, but there are situations when the design engineer may have to consider using an impact stilling basin. Those situations are generally discussed in the Hydraulic Structures Chapter of Volume 2 of the UDFCD Manual. Impact stilling basins shall be designed in accordance with the Hydraulic Structures Chapter of Volume 2 of the UDFCD Manual."
>
> Volume 2, USDCM: Figures 9-43 and 9-44 provide design layout for circular outlets up to 48 inches in diameter. Unlike the Type VI impact basin used for large outlets, the modified basin does not require sizing for flow under velocities recommended in the Streets, Inlets, and Storm Drains chapter. However, use of this detail is limited to exit velocities of 18 feet per second or less. For larger conduits and higher exit velocities, use the Type VI impact basin.

The existing 54-inch storm sewer pipe outfall into the west end of Detention Basin F18/F19 includes a 100-year flow of 59 cfs, flow velocity = 7.7 ft/sec, flow depth = 2.2-ft and pipe slope = 0.4%, Froude Number=1.05. The existing pipe includes an FES on the end of the pipe and a depressed riprap area. No Type VI stilling basin. The flow in this pipe can be considered "moderate" to low because it is well below the full flow capacity of the pipe and the flow velocity is less than 18 ft/sec. The pipe is oversized for the 100-year flow as the upstream tributary area has been reduced from 0.102mi^2 (123cfs) to 0.064mi^2 (59cfs) since pipe installation (see Appendix). This reduction in the tributary area to the 54-inch pipe is due to a revision in the site layout and the preparation of the final grading for these areas upstream of the storm sewer. The 100-yr flow (59cfs) accounts for all known future development tributary to the existing 54-inch pipe. In the future, if the flow at this pipe outfall/impact basin increases, the developer will be responsible for analyzing the outlet to confirm it will function as required by City criteria. The 100-yr flow (59 cfs) could be conveyed by a 42-inch pipe. If the pipe was 48-inches it would be able to convey 91 cfs using the same slope and not under pressure. See Appendix for calculation.

Kiowa
Engineering Corporation

The 100-yr energy grade line (EGL) has been calculated for the proposed forebay structure to determine the maximum water surface height. The EGL calculation is based on the water surface depth flowing over the downstream end of the forebay and no flows through the forebay notch or over the sidewalls. These assumptions resulted in a higher EGL than is likely for the proposed flow. The EGL is calculated to be at Elevation=7143.50 and the top of structure at and upstream of the baffle is 7146.39, providing roughly 2.9-feet of freeboard at the baffle block where there is the highest risk of backsplash beyond the wingwalls.

Mile High Flood District and the State of Colorado Water Resources-Dam Safety division were contacted to get guidance on calculations to determine the backsplash. Neither were able to provide a calculation method and both pointed to USBR. Kiowa has reviewed several USBR and hydraulic documents/manuals and did not find a calculation method. The closest method is the determination of side wall height for a Baffled Chute Spillway from the Design of Small Dams (Section 9.8.i). The calculation is 3 x 0.8 or 0.9 x Critical Flow Depth (Dc). Using the critical flow depth out of the pipe of 2.23-ft, the side wall height should be at least 6.02-ft (3 x 0.9 x 2.23') at the baffle to minimize the chance of splash over the walls. The structure includes 6.39-ft high walls at and upstream of the baffle. The Design of Small Dams manual also states, "This wall height will contain the main flow and most of the splash. It is not necessary or practical to build the walls high enough to contain all the splash." Kiowa feels this calculation is conservative.

The calculations were completed assuming an empty detention basin with no backwater, it is likely there will be water in the structure which will reduce the velocity of the flows exiting the pipe and reduce the splash height. The proposed design minimizes the possibility of water splashing outside the structure and causing erosion behind the wingwalls. With the low likelihood of negative impacts caused from backsplash we do not feel there is a need to make changes to the inspection and maintenance manual of the facility.

The use of a Type VI impact basin will not work in this location due to the minimal vertical drop between the end of the existing pipe and the bottom of forebay. The existing 54-inch storm sewer is sloped at 0.4% and the existing trickle channel is sloping up to the pipe at 0.5%. Where the pipe and trickle channel meet there is only a 2-inches fall from the pipe outlet. The flows from the pipe will go under the hanging baffle. In addition, the flows in the pipe are at a moderate to low velocity and nearly subcritical (if the flow was higher it would be subcritical, for comparison, a flow of 123 cfs has a Froude number of 0.80). The next upstream manhole along the existing 54-inch pipe is 262-ft upstream with a 0.5-ft fall through the manhole. It would not be possible to create enough drop at the end of the pipe even if the pipe was re-laid.

For these reasons, a variance is being requested to not use a Type VI impact basin and instead use a more appropriate impact basin similar to the one shown in Figures 9-43 and 9-44 of the USDCM.

These variances will not increase flows or decrease water quality in Fountain Creek.

Sincerely,
Kiowa Engineering Corporation

Matthew Erichsen, P.E., CFM
Senior Civil Engineer

7175 West Jefferson Avenue Suite 2200, Lakewood, Colorado 80235
Ph: (303) 692-0369 www.kiowaengineering.com

Kiowa
Engineering Corporation

APPENDIX TABLE OF CONTENTS

APPENDIX A

Figure 1: Vicinity Map

Wolf Ranch PCM Plans

SCALE: NTS

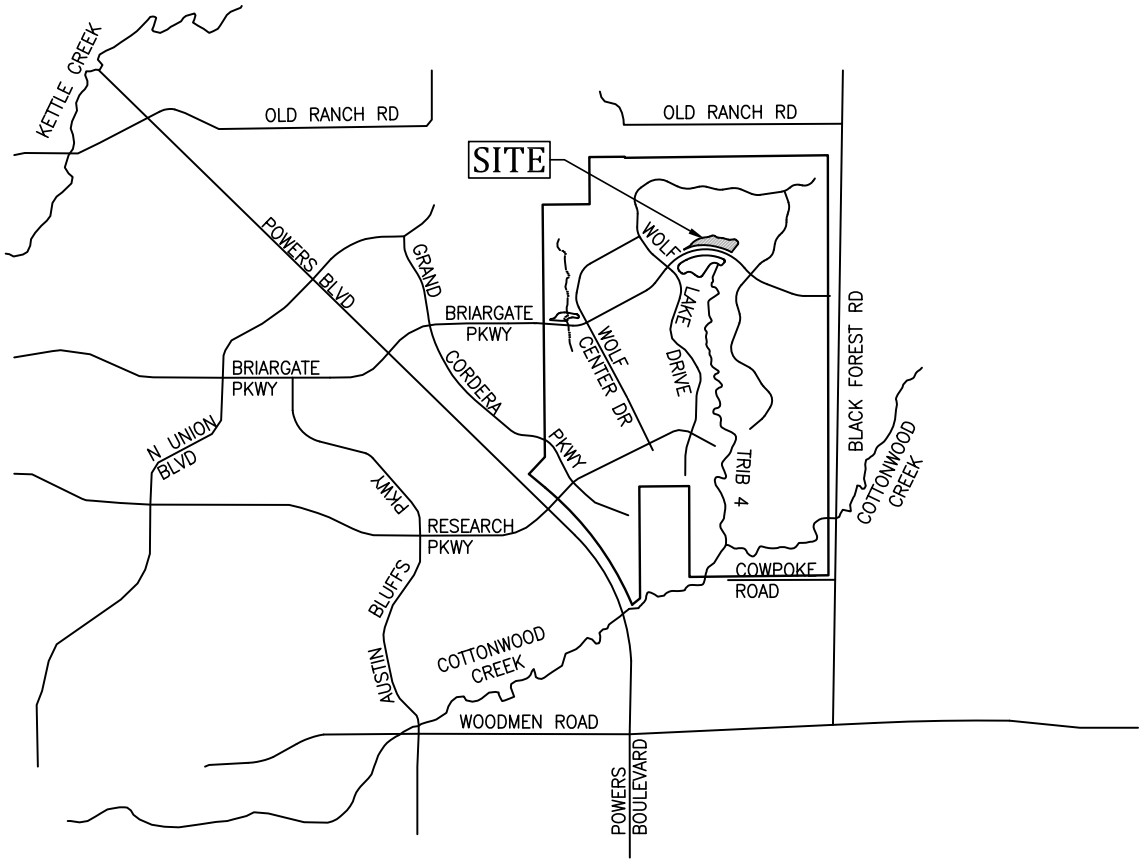


FIGURE 1
VICINITY MAP
DETENTION BASIN F18 / F19

PUBLIC PCM CONSTRUCTION PLANS
WOLF RANCH
DETENTION BASIN F18/F19
COLORADO SPRINGS, COLORADO

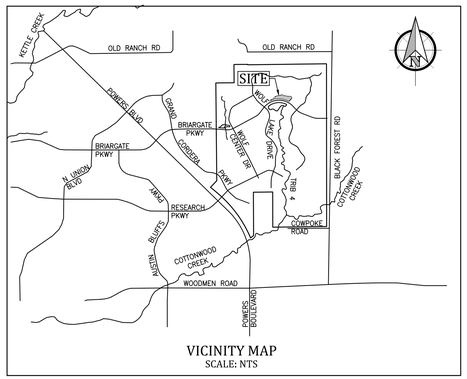
GENERAL NOTES:
1. ALL WORK SHALL BE CONDUCTED IN CONFORMANCE WITH THE MOST CURRENT VERSION OF THE CITY OF COLORADO SPRINGS STANDARD SPECIFICATIONS.
2. THE CONTRACTOR SHALL HAVE IN HIS POSSESSION AT ALL TIMES ONE (1) SIGNED COPY OF THE PLANS AND SPECIFICATIONS WHICH HAVE BEEN APPROVED BY THE CITY OF COLORADO SPRINGS (CITY).
3. CONTRACTOR SHALL OBTAIN ALL NECESSARY PERMITS FROM THE STATE OF COLORADO, COLORADO DEPARTMENT OF TRANSPORTATION AND THE CITY FOR CONSTRUCTION ACTIVITIES ON THE SITE AND WITHIN THE PUBLIC RIGHT-OF-WAY.
4. IT SHALL BE THE CONTRACTOR'S RESPONSIBILITY TO NOTIFY THE OWNER/DEVELOPER OF ANY PROBLEM IN CONFORMING TO THE APPROVED PLANS FOR ANY ELEMENT OF THE PROPOSED IMPROVEMENT PRIOR TO ITS CONSTRUCTION.
5. IT SHALL BE THE RESPONSIBILITY OF THE GENERAL CONTRACTOR DURING CONSTRUCTION ACTIVITIES TO RESOLVE CONSTRUCTION PROBLEMS DUE TO CHANGED CONDITIONS OR DESIGN ERRORS ENCOUNTERED BY THE CONTRACTOR DURING THE PROGRESS OF ANY PORTION OF THE PROPOSED WORK. ANY IMPROVEMENTS CONSTRUCTED NOT IN ACCORDANCE WITH THE APPROVED PLANS, OR THE APPROVED REVISED PLANS, SHALL BE REMOVED AND THE IMPROVEMENTS SHALL BE RECONSTRUCTED ACCORDING TO THE APPROVED PLANS.
6. THE CONTRACTOR SHALL BE RESPONSIBLE FOR PROVIDING AS-BUILT INFORMATION ON A SET OF RECORD DRAWINGS.
7. FLOODPLAIN: THE SITE IS NOT LOCATED WITHIN A DESIGNATED FEMA FLOODPLAIN, BASED ON FLOOD INSURANCE RATE MAP FOR EL PASO COUNTY, CO, PANEL NO. 08041C0527G, EFFECTIVE DATE 12/07/2018.
8. PROJECT DOX MASTER #: STM-MP23-0018. APPROVAL DATE: TBD
9. PROJECT DOX PCM #: STM-REV23-0096.
10. GESQCP PROJECT DOX #: STM-REV23-0097. "GRADING AND EROSION CONTROL PLAN: WOLF RANCH DETENTION BASIN F18 AND F19"
11. VARIANCE PROJECT DOX #: STM-REV23-0105. APPROVAL DATE: TBD
12. PARCEL #: 5200000558
13. DETENTION AREA F18/F19 TO BE TRANSFERRED TO THE CITY OF COLORADO SPRINGS ONCE IMPROVEMENTS ARE COMPLETE AND ACCEPTED BY THE CITY.
14. ANTICIPATED SCHEDULE:
    14.1. STARTING AND COMPLETION TIME PERIOD OF SITE GRADING: JUNE-SEPTEMBER 2023.
    14.2. EXPECTED DATE OF FINAL STABILIZATION: SEPTEMBER 2023.
15. BASIS OF BEARINGS: WOLF RANCH SUBDIVISION PLATS AS PREPARED BY ROCKWELL CONSULTING, INC.
16. BENCHMARK: FIMS MONUMENT NO. 69 IS A 3-1/4" ALUMINUM CAP SET APPROXIMATELY 30' WEST OF THE BLACK FOREST ROAD CENTERLINE AND 1,200 FEET NORTH OF COWPOKE ROAD (300' SOUTH OF THE COTTONWOOD CREEK BRIDGE CROSSING). EL=6975.735 (NGVD 29 WITH 1960 SUPPLEMENTARY ADJUSTMENT) VERTICAL DATUM.
17. BENCHMARK POINTS

1354	15774.71800	20727.18700	7085.869	#4RB WITH RED CAP AT SW CORNER CONCRETE ELECTRIC VAULTS
2005	15748.23500	21152.72100	7092.274	MAG & WASHER IN MIDDLE ON CONCRETE ELECTRIC VAULT

GRADING NOTES:
1. REFER TO GRADING AND EROSION CONTROL CONTROL PLANS FOR GRADING NOTES AND REQUIREMENTS.

SITE CONCRETE NOTES:
1. ALL CONSTRUCTION INVOLVING THE PLACEMENT OF STRUCTURAL CONCRETE SHALL BE COMPLETED IN ACCORDANCE WITH SECTION 600 OF THE CITY OF COLORADO SPRINGS ENGINEERING DIVISION STANDARD SPECIFICATIONS, AND AS SUPPLEMENTED BY THE COLORADO DEPARTMENT OF TRANSPORTATION STANDARD SPECIFICATIONS FOR ROADWAY AND BRIDGE CONSTRUCTION.
2. ALL CONCRETE SUBGRADE SOIL SHALL BE SCARIFIED TO A MINIMUM DEPTH OF 6-INCHES AND RECOMPACTED TO 95% OF THE MATERIALS STANDARD PROCTOR MAXIMUM DRY DENSITY (ASTM D698) AND TO 0 TO +2% OF THE OPTIMUM MOISTURE CONTENT FOR CLAY SOILS AND -2 TO +2% OF THE OPTIMUM MOISTURE CONTENT FOR SANDY SOILS TO A MINIMUM DEPTH OF 8-INCHES, UNLESS OTHERWISE NOTED.
3. FOOTING EXCAVATIONS SHALL BE EXAMINED BY THE GEOTECHNICAL ENGINEER WITH A 24-HOUR MINIMUM NOTIFICATION FOR SOIL AND/OR CONCRETE TESTING. PLACEMENT OF CONCRETE IN THE ABSENCE OF TESTING SHALL BE COMPLETED AT THE SOLE RISK OF THE CONTRACTOR.
4. FINISH: SACK FINISH EXPOSED TRICKLE CHANNEL SURFACES.
5. CONTROL (CONTRACTION) AND CONSTRUCTION JOINTS: CONTROL JOINTS SHOULD SEPARATE CONCRETE INTO PANELS AS RECOMMENDED BY ACI. THE CONTROL JOINTS SHALL BE TOOLED TO A MINIMUM DEPTH OF ONE-QUARTER (1/4) OF THE TOTAL THICKNESS OF THE CONCRETE. WHEN APPROVED BY OWNER A SAWED CONTROL JOINT MAY BE USED AND MUST BE DONE NO LATER THAN 24 HOURS AFTER CONCRETE IS POURED.
    5.1. TRICKLE CHANNEL CONTROL JOINT SPACING (3/16" WIDE) SHALL BE 5' MINIMUM AND 10' MAXIMUM, UNLESS SPECIFIED OTHERWISE. PROVIDE CONSTRUCTION JOINTS @ 25' O.C. MAX. AND AT CURVES, TANGENTS AND CORNERS. RUN #4 REBAR CONTINUOUS THROUGH CONSTRUCTION JOINTS.
6. EXPANSION (ISOLATION) JOINTS: INSTALL WHEN ABUTTING EXISTING CONCRETE SLABS, INLETS, FIRE HYDRANTS, POLES, STRUCTURES AND OTHER FIXED OBJECTS. TOOLED 1/4" RADIUS EDGES. EXPANSION JOINT MATERIAL SHALL BE 1/2" THICK, SHALL EXTEND THE FULL DEPTH OF CONTACT SURFACE, LEAVE 1/2" BELOW TOP OF PAVEMENT AND SEAL WITH 1/4" THICK JOINT SEALANT.
    6.1. TRICKLE CHANNEL EXPANSION JOINT SPACING: 400-FT MAX. ON STRAIGHT SECTIONS.
7. MIX DESIGN: PRIOR TO PLACING CONCRETE, THE CONTRACTOR SHALL SUBMIT CONCRETE MIX DESIGN TO THE OWNER'S REPRESENTATIVE FOR APPROVAL. SUBMITTAL SHALL INCLUDE ALL INFORMATION USED IN DESIGNING THE MIX.
8. RECORD OF WORK: A RECORD SHALL BE KEPT BY THE GENERAL CONTRACTOR LISTING THE TIME AND DATE OF PLACEMENT OF ALL CONCRETE. SUCH RECORD SHALL BE KEPT UNTIL THE COMPLETION OF THE PROJECT AND SHALL BE AVAILABLE TO THE OWNER'S REPRESENTATIVE FOR EXAMINATION AT ANY TIME.
9. DISCHARGE ALL CONCRETE TRANSMITTED IN A TRUCK MIXER, AGITATOR OR OTHER TRANSPORTATION DEVICE WITHIN 1-1/2 HOURS AFTER THE MIXING WATER HAS BEEN ADDED.
10. CURING: CONCRETE SHALL BE CURED BY PROTECTING IT AGAINST LOSS OF MOISTURE, RAPID TEMPERATURE CHANGE AND MECHANICAL INJURY FOR AT LEAST 5 DAYS AFTER PLACEMENT. AFTER FINISHING AND TEXTURING OPERATIONS HAVE COMPLETED AND IMMEDIATELY AFTER FREE WATER HAS EVAPORATED, THE EXPOSED SURFACE OF THE CONCRETE AND ANY EXPOSED EDGES SHOULD BE UNIFORMLY COATED WITH A WHITE PIGMENTED MEMBRANE FORMING CURING COMPOUND MEETING ASTM C309 OR C1315 (TYPE II) SHALL BE APPLIED AS RECOMMENDED BY THE MANUFACTURER. IN GENERAL, WITHIN 30 MINUTES OF PLACING THE OVERLAY, CURING COMPOUND SHOULD BE APPLIED AT TWICE THE STANDARD RATE.
11. WEATHER REQUIREMENTS: THE MIXED CONCRETE TEMPERATURE SHALL BE BETWEEN 50° AND 90° FAHRENHEIT AT THE TIME OF PLACEMENT. CONCRETE SHALL NOT BE PLACED ON FROZEN GROUND. BEFORE CONCRETE PLACEMENT, ALL ICE, SNOW AND FROST SHALL BE COMPLETELY REMOVED FROM WITHIN FORMWORK. SALT SHALL NOT BE USED TO THAW ICE, SNOW OR FROST. WHEN CONCRETE HAS BEEN PLACED IN COLD WEATHER AND THE AMBIENT TEMPERATURE MAY DROP BELOW 35°F, PROVIDE INSULATED CURING BLANKETS OR OTHER SUITABLE MATERIALS TO MAINTAIN THE CONCRETE TEMPERATURE ABOVE 50°F. DURING THE CURING PERIOD. THE MINIMUM CURING PERIOD SHALL BE FIVE (5) DAYS. IT SHALL BE THE CONTRACTOR'S RESPONSIBILITY TO DETERMINE FOR HIMSELF THE NECESSITY FOR UNDERTAKING PROTECTIVE MEASURES. CONCRETE INJURED BY FROST ACTION SHALL BE REMOVED AND REPLACED AT THE CONCRETE PAVING CONTRACTOR'S EXPENSE. PROTECT NEWLY FINISHED CONCRETE FROM RAIN DAMAGE.
12. CONTROL TESTS. UNLESS OTHERWISE INDICATED IN CONTRACT DOCUMENTS; CONTROL TESTS OF CONCRETE WORK FOR INLETS AND MANHOLES SHALL BE MADE A MINIMUM OF ONCE DURING EACH DAY'S POUR. CONTROL TESTS OF CONCRETE WORK FOR SIDEWALK, CURB AND GUTTER SHALL BE MADE AS REQUIRED BY THE CITY OR A MINIMUM OF TWICE DURING EACH DAY'S POUR, PLUS ONE (1) PER 100 CUBIC YARDS. EACH TEST SHALL CONSIST OF FOUR (4) STANDARD 6" TEST CYLINDERS CAST AND CURED IN ACCORDANCE WITH C31 AND C172. TESTS SHALL BE MADE AT THE TIME CONTROL TESTS ARE TAKEN AND SO STATED IN THE REPORTS TO DETERMINE THE SLUMP, AIR CONTENT, UNIT WEIGHT AND TEMPERATURE OF THE CONCRETE. ALL TESTS SHALL BE MADE IN ACCORDANCE WITH C391, C138, OR C231.

CITY STANDARD PCM NOTES:
1. THIS PCM PLAN WILL BE SUBJECT TO RE-REVIEW AND RE-ACCEPTANCE BY SWENT IF WORK ON THE PCM DOES NOT COMMENCE WITHIN TWELVE (12) MONTHS OF PLAN APPROVAL, OR SHOULD ANY OF THE FOLLOWING OCCUR: A CHANGE IN PROPERTY OWNERSHIP, PROPOSED DEVELOPMENT CHANGES, OR PROPOSED PCM REVISIONS.
2. THE CONTRACTOR SHOULD CONTACT THE ENGINEER OF RECORD AND SWENT LEAD REVIEWER IMMEDIATELY SHOULD CONSTRUCTION OF THE PCM VARY IN ANY WAY FROM THE PLANS.
3. A PROFESSIONAL ENGINEER (PE) CERTIFICATION THAT THE PCM HAS BEEN INSTALLED AND CONSTRUCTED IN GENERAL CONFORMANCE WITH THESE PLANS WILL BE REQUIRED ONCE THE PCM IS FULLY CONSTRUCTED. AN AS-CONSTRUCTED SURVEY MUST BE COMPLETED TO VERIFY FACILITY VOLUMES AND ELEVATIONS. THE AS-BUILT DRAWINGS MUST BE SUBMITTED ALONG WITH THE PE CERTIFICATION. A PE CERTIFICATION REQUIRES PERIODIC ON-SITE OBSERVATIONS BY THE ENGINEER OF RECORD OR A PERSON UNDER THEIR RESPONSIBLE CHARGE. COORDINATION WITH THE ENGINEER OF RECORD TO ENSURE THAT THE NECESSARY ON-SITE OBSERVATIONS ARE COMPLETED IS THE RESPONSIBILITY OF THE APPLICANT.
4. ACCEPTANCE OF THIS PLAN DOES NOT CONSTITUTE APPROVAL TO GRADE OR CAUSE ANY DISTURBANCE WITHIN IN ANY UTILITY EASEMENT OR RIGHT-OF-WAY. APPROVALS TO WORK WITHIN UTILITY EASEMENTS MUST BE OBTAINED FROM THE APPROPRIATE UTILITY COMPANY. IT IS NOT PERMISSIBLE FOR ANY PERSON TO MODIFY THE GRADE OF THE EARTH ON ANY UTILITY EASEMENT OR RIGHT-OF-WAY WITHOUT THE APPROPRIATE WRITTEN APPROVAL. THE PLAN SHALL NOT INCREASE OR DIVERT WATER TOWARD UTILITY FACILITIES. ANY CHANGES TO EXISTING UTILITY FACILITIES TO ACCOMMODATE THE PLAN MUST BE APPROVED BY THE AFFECTED UTILITY OWNER PRIOR TO IMPLEMENTING THE PLAN. THE APPLICANT IS RESPONSIBLE FOR THE COST TO RELOCATE OR PROTECT EXISTING UTILITIES OR TO PROVIDE INTERIM ACCESS.



VICINITY MAP
SCALE: NTS

INDEX OF SHEETS	
C200	PCM CONSTRUCTION PLAN - COVER SHEET
C201	PCM PLAN - DETENTION BASIN F18 PLAN
C202	PCM PLAN - DETENTION BASIN F19 PLAN
C203	PCM DETAILS - IMPACT BASINS
C204	PCM DETAILS - FOREBAY/OUTLET STRUCTURE

ABBREVIATIONS

ASSY	= ASSEMBLY	NTS	= NOT TO SCALE
BNDY	= BOUNDARY	OD	= OUTSIDE DIAMETER
BOP	= BOTTOM OF PIPE	PC	= POINT OF HORIZONTAL CURVATURE
C&G	= CURB & GUTTER	PLBG	= PLUMBING
CL	= CENTERLINE	POC	= POINT OF CONNECTION
CO	= CLEAN OUT	PP	= PROPOSED
CRA	= CONCRETE REVERSE ANCHOR	PRC	= POINT OF REVERSE CURVE
CR	= POINT OF CURB RETURN	PROP	= PROPERTY
CS	= CROSS SLOPE	PRT	= PRIVATE
CTB	= CONCRETE THRUST BLOCK	PT	= POINT OF HORIZONTAL TANGENCY
DIP	= DUCTILE IRON PIPE	PVC	= POLY VINYL CHLORIDE PIPE
DTL	= DETAIL	PVC	= POINT OF VERTICAL CURVATURE
EL	= ELEVATION	PVI	= POINT OF VERTICAL INTERSECTION
EOA	= EDGE OF ASPHALT	PVT	= POINT OF VERTICAL TANGENCY
ESMT	= EASEMENT	R	= RADIUS
EX	= EXISTING	R	= RIGHT
FC	= FACE OF CURB	RCP	= REINFORCED CONCRETE PIPE
FES	= FLARED END SECTION	RD	= ROOF DRAIN (STORM LINE)
FLG	= FLANGE	ROW	= RIGHT OF WAY
FL	= FLOWLINE	RT	= RIGHT
GB	= GRADE BREAK	SHT	= SHEET
GI	= GREASE INTERCEPTOR	SS	= SANITARY SEWER
HP	= HIGH POINT	STA	= STATION
HORIZ	= HORIZONTAL	STD	= STANDARD
HYD	= HYDRANT	TA	= TOP OF ASPHALT
ID	= INSIDE DIAMETER	TB	= THRUST BLOCK
L	= LEFT	TC	= TOP OF CURB
LT	= LEFT	TOA	= TOP OF ASPHALT
LF	= LINEAR FEET	TOC	= TOP OF CONCRETE
LP	= LOW POINT	TOP	= TOP OF PIPE
MAX	= MAXIMUM	TOR	= TOP OF ROCK
MH	= MANHOLE	TYP	= TYPICAL
MIN	= MINIMUM	VC	= VERTICAL CURVE

PRE-EXCAVATION CHECKLIST

- ☐ GAS AND OTHER UTILITY LINES OF RECORD SHOWN ON PLANS.
- ☐ UTILITIES CENTRAL LOCATING CALLED AT LEAST 2 BUSINESS DAYS AHEAD.
- ☐ UTILITIES LOCATED AND MARKED.
- ☐ EMPLOYEES BRIEFED ON MARKING AND COLOR CODES.*
- ☐ EMPLOYEES TRAINED ON EXCAVATION AND SAFETY PROCEDURES FOR NATURAL GAS LINES.
- ☐ WHEN EXCAVATION APPROACHES GAS LINES. EMPLOYEES EXPOSE LINES BY CAREFUL PROBING AND HAND DIGGING.

*A.G.A./A.P.W.A. STANDARD UTILITY MARKING COLOR CODE

NATURAL GAS	YELLOW	WATER	BLUE
ELECTRIC	RED	WASTEWATER	GREEN

811 Know what's below. Call before you dig.

OPINION OF COST FOR PCM

ITEM	QUANTITY	UNIT	UNIT COST	AMOUNT
Earthwork	3,500	CY	$5	$17,500
Outlet Structure Adjustments	1	EA	$8,000	$8,000
Impact Basin (Sage & Elevate)	2	LS	$100,000	$200,000
54" RCP Forebay	1	LS	$45,000	$45,000
Spillway (Type M Raprap)	320	CY	$60	$19,200
Spillway (Concrete cutoff wall)	1	LS	$6,500	$6,500
Trickle Channel - Concrete	72	LF	$60	$4,320
Maintenance Trail	6800	SF	$2	$13,600
			Subtotal	$314,120
			Contingency (10%)	$31,412
			TOTAL	$345,532

ENGINEER'S STATEMENT
This Permanent Control Measure (PCM) Plan was prepared under my direction and supervision, was designed in accordance with the City of Colorado Springs Drainage Criteria Manual (May 2014), and is correct to the best of my knowledge and belief. I accept responsibility for any liability caused by any negligent acts, error or omissions on my part in preparation of this PCM Plan.

For and on Behalf of Kiowa Engineering Corporation — Date

Matthew Erichsen, P.E. — merichsen@kiowaengineering.com
Printed Name — E-mail Address

DEVELOPER'S/OWNER'S STATEMENT
Nor'Wood Development hereby certifies that the Permanent BMP for Wolf Ranch Detention Basin F18/F19 Improvements shall be constructed according to the design presented in this plan. I understand that the City of Colorado Springs does not and will not assume liability for the drainage facilities designed and/or certified by my engineer and that are submitted to the City of Colorado Springs pursuant to section 7.7.906 of the City Code; and cannot, on behalf of Wolf Ranch Detention Basin F18/F19 Improvements guarantee that the final drainage design review will absolve Nor'Wood Development, and/or their successors and/or assigns of future liability for improper design.

Developer/Owner Signature: _____ Date: _____

Name of Developer/Owner: Nor'wood Development

DBA: _____ Phone: (719) 593-2619

Title: _____ Email: _____

Address: 111 S. Tejon St., Suite 222, Colorado Springs, CO 80903 Fax: _____

CITY OF COLORADO SPRINGS STATEMENT
Filed in accordance with Section 7.7.906 of the Code of the City of Colorado Springs, 2001, as amended.

For the City Engineer — Date

Conditions:

The City of Colorado Springs approved these plans based upon the non-jurisdictional status of the facility. It is the design engineer's responsibility to follow up with the State Division of Water Resources for jurisdictional determination. If upon State review the classification changes to Jurisdictional, additional City review and approval will be necessary.

Kiowa Engineering Corporation
7175 West Jefferson Avenue, Suite 2200
Lakewood, Colorado 80235
(303) 692-0369

WOLF RANCH
DETENTION BASIN F18 AND F19
PCM CONSTRUCTION PLAN - COVER SHEET
COLORADO SPRINGS, COLORADO

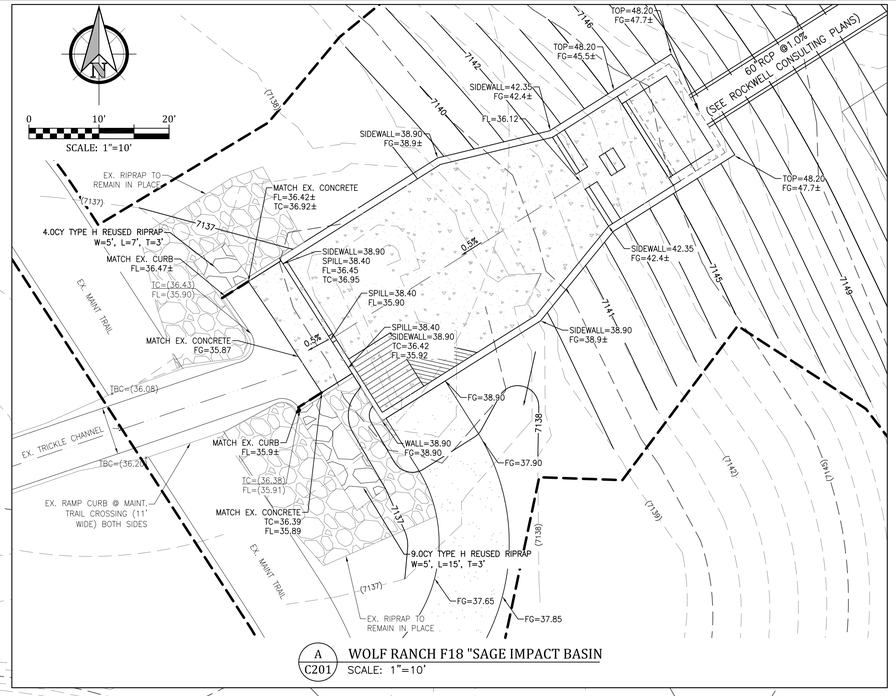
Project No.:	22035
Date:	April 11, 2023
Design:	MWE/MTR
Drawn:	MTR
Check:	MWE
Revisions:	

SHEET
C200

NOTES:
1. REFER TO INITIAL GRADING AND EROSION CONTROL PLAN FOR IMPROVEMENTS TO BE DEMOLISHED/REMOVED.

F18 WQCV AND EURV BASIN			
	WATER SURFACE ELEV. (FT)	REQUIRED STORAGE VOLUME	RELEASE RATE
WQCV	7137.52	2.80 AC-FT	
EURV	7138.24	4.99 AC-FT	
100-YEAR	7142.39		
SPILLWAY CREST ELEVATION: 7142.90			
TOP OF EMBANKMENT MINIMUM ELEVATION: 7148.00			
NOTES: 1. AS-BUILT SURVEY AND VOLUME CERTIFICATION REQUIRED BY A LICENSED PROFESSIONAL LAND SURVEYOR, SEE GRADING NOTES.			

F19 WQCV AND EURV BASIN			
	WATER SURFACE ELEV. (FT)	REQUIRED STORAGE VOLUME	RELEASE RATE
WQCV	7140.20	2.76 AC-FT	
EURV	7141.62	5.93 AC-FT	
100-YEAR	7142.39		
SPILLWAY CREST ELEVATION: 7141.75			
TOP OF EMBANKMENT MINIMUM ELEVATION: 7143.25			
NOTES: 1. AS-BUILT SURVEY AND VOLUME CERTIFICATION REQUIRED BY A LICENSED PROFESSIONAL LAND SURVEYOR, SEE GRADING NOTES.			



LEGEND

	PROPERTY OR ROW LINE
	EXISTING EASEMENT
ex w	EXISTING WATER LINE
(6020)	EXISTING CONTOURS
6020	PROPOSED CONTOURS
(14.79)	EXISTING SPOT ELEVATION
(14.8±)	APPROXIMATE EXISTING SPOT ELEVATION. ELEVATION TO BE FIELD VERIFIED PRIOR TO CONSTRUCTION.
15.41	PROPOSED SPOT ELEVATION
(2.3%)	EXISTING FLOW DIRECTION AND SLOPE
2.3%	PROPOSED FLOW DIRECTION AND SLOPE
4:1	PROPOSED SLOPE
	APPROXIMATE LIMIT OF DISTURBANCE
	STORMWATER OVERFLOW PATH

Kiowa Engineering Corporation
7175 West Jefferson Avenue, Suite 2200
Lakewood, Colorado 80235
(303) 692-0369

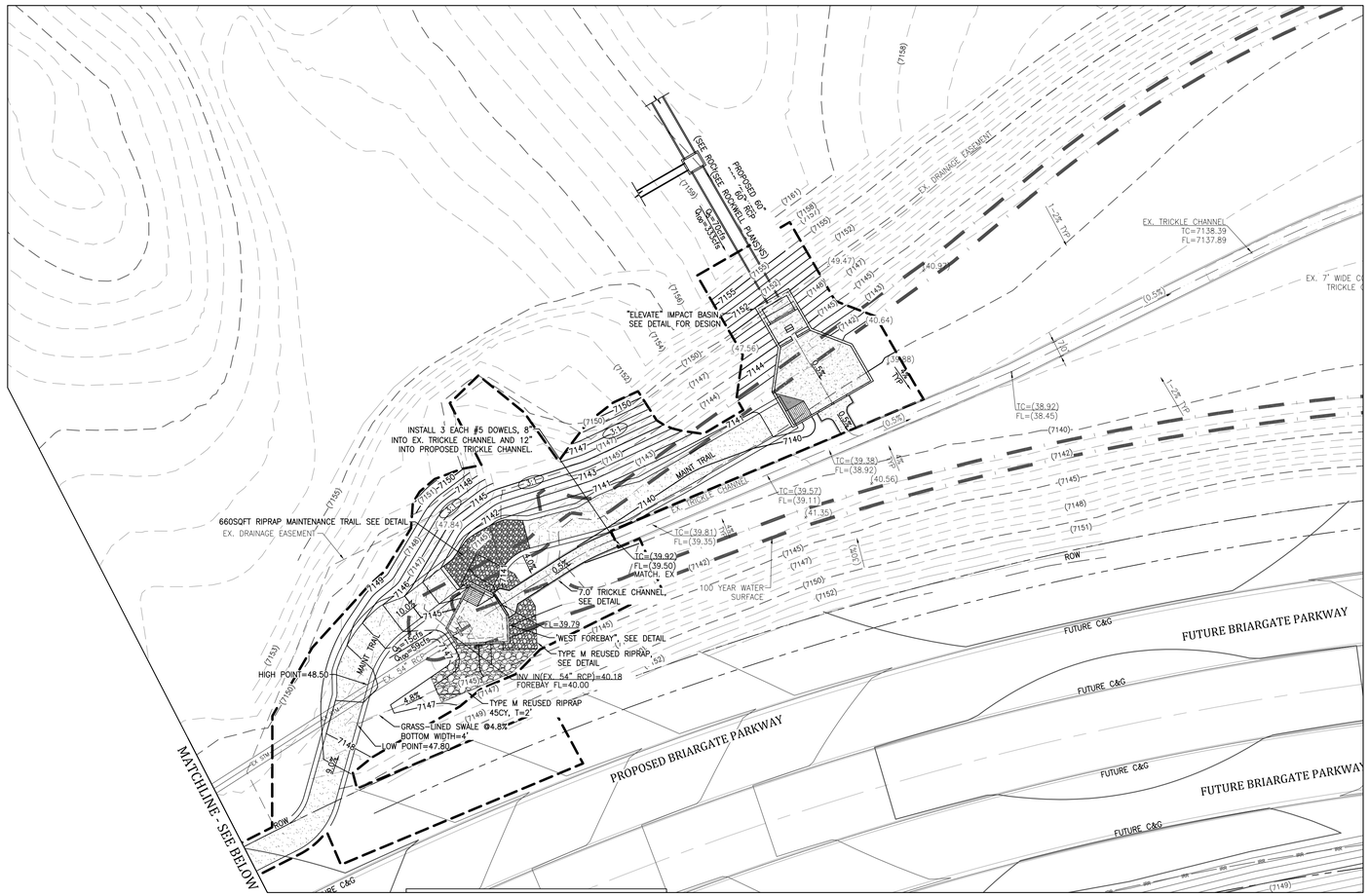
WOLF RANCH
DETENTION BASIN F18 AND F19
PCM PLAN - DETENTION BASIN F18 PLAN
COLORADO SPRINGS, COLORADO

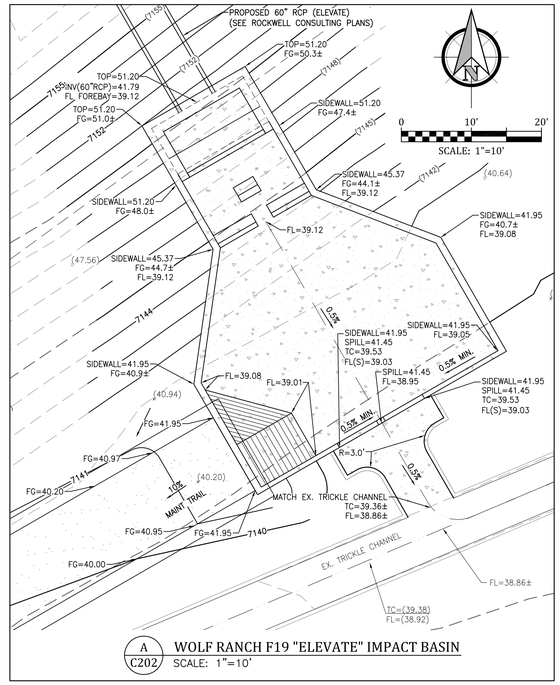
Project No.:	22035
Date:	April 11, 2023
Design:	MWE/MTR
Drawn:	MTR
Check:	MWE
Revisions:	

SHEET
C201

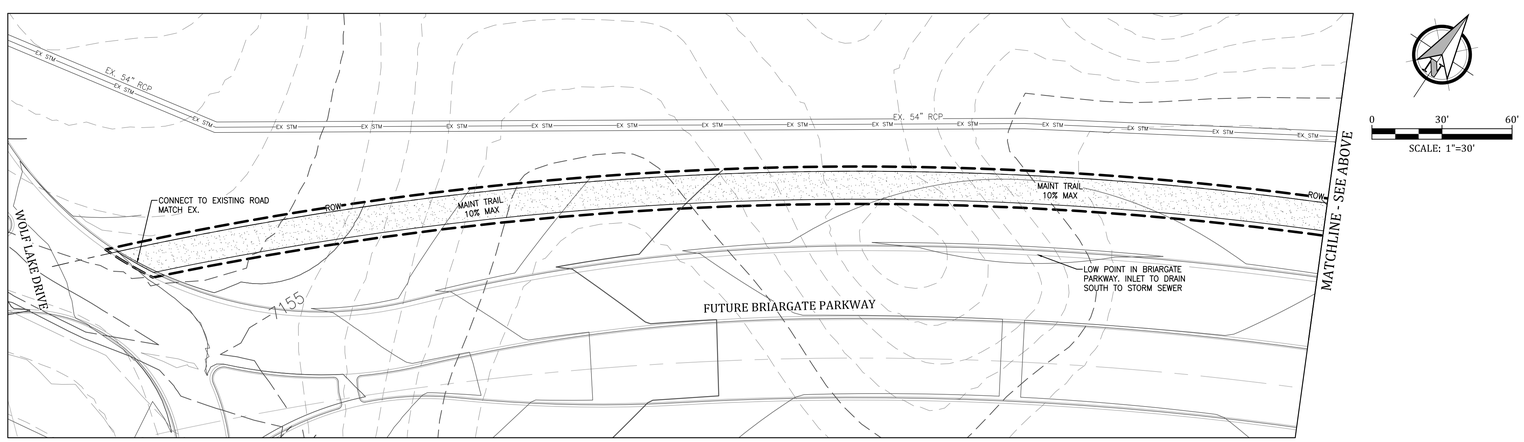
811 Know what's below. Call before you dig.

NOTES:
1. REFER TO INITIAL GRADING AND EROSION CONTROL PLAN FOR IMPROVEMENTS TO BE DEMOLISHED/REMOVED.





A C202 WOLF RANCH F19 "ELEVATE" IMPACT BASIN
SCALE: 1"=10'



LEGEND

	PROPERTY OR ROW LINE
	EXISTING EASEMENT
ex w	EXISTING WATER LINE
(6020)	EXISTING CONTOURS
6020	PROPOSED CONTOURS
(14.79)	EXISTING SPOT ELEVATION
(14.8±)	APPROXIMATE EXISTING SPOT ELEVATION. ELEVATION TO BE FIELD VERIFIED PRIOR TO CONSTRUCTION.
15.41	PROPOSED SPOT ELEVATION
(2.3%)	EXISTING FLOW DIRECTION AND SLOPE
2.3%	PROPOSED FLOW DIRECTION AND SLOPE
4:1	PROPOSED SLOPE
	APPROXIMATE LIMIT OF DISTURBANCE
	PERMANENT STABILIZATION – GRASS

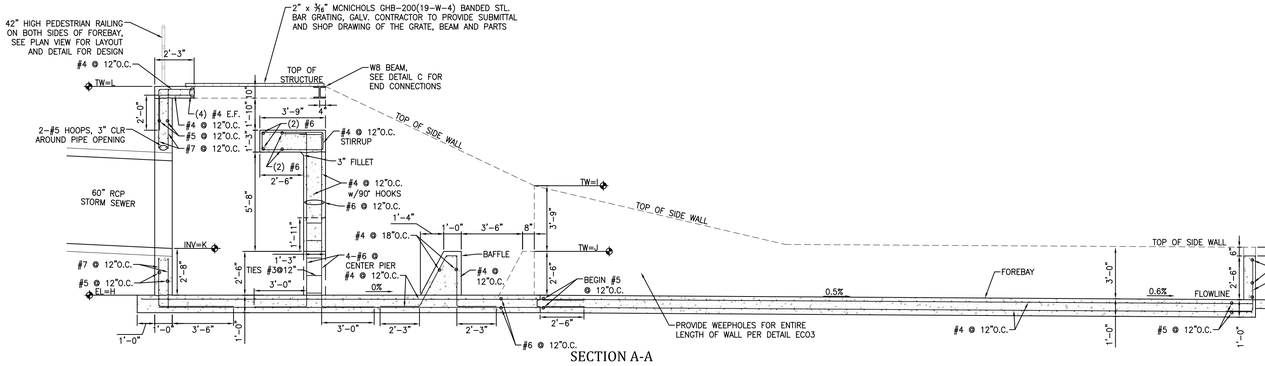
Kiowa Engineering Corporation
7175 West Jefferson Avenue, Suite 2200
Lakewood, Colorado 80235
(303) 692-0369

WOLF RANCH
DETENTION BASIN F18 AND F19
PCM PLAN - DETENTION BASIN F19 PLAN
COLORADO SPRINGS, COLORADO

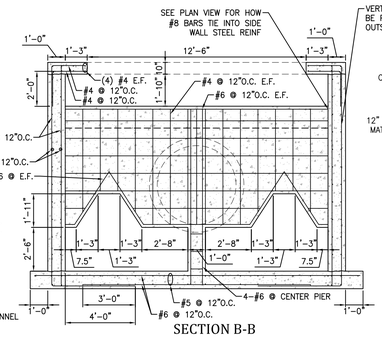
Project No.:	22035
Date:	April 11, 2023
Design:	MWE/MTR
Drawn:	MTR
Check:	MWE
Revisions:	

SHEET
C202

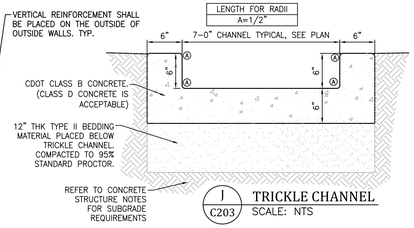
Know what's below.
Call before you dig.



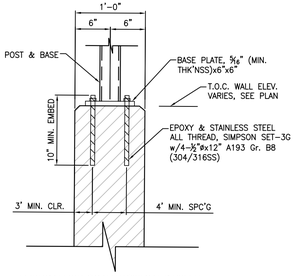
SECTION A-A



SECTION B-B

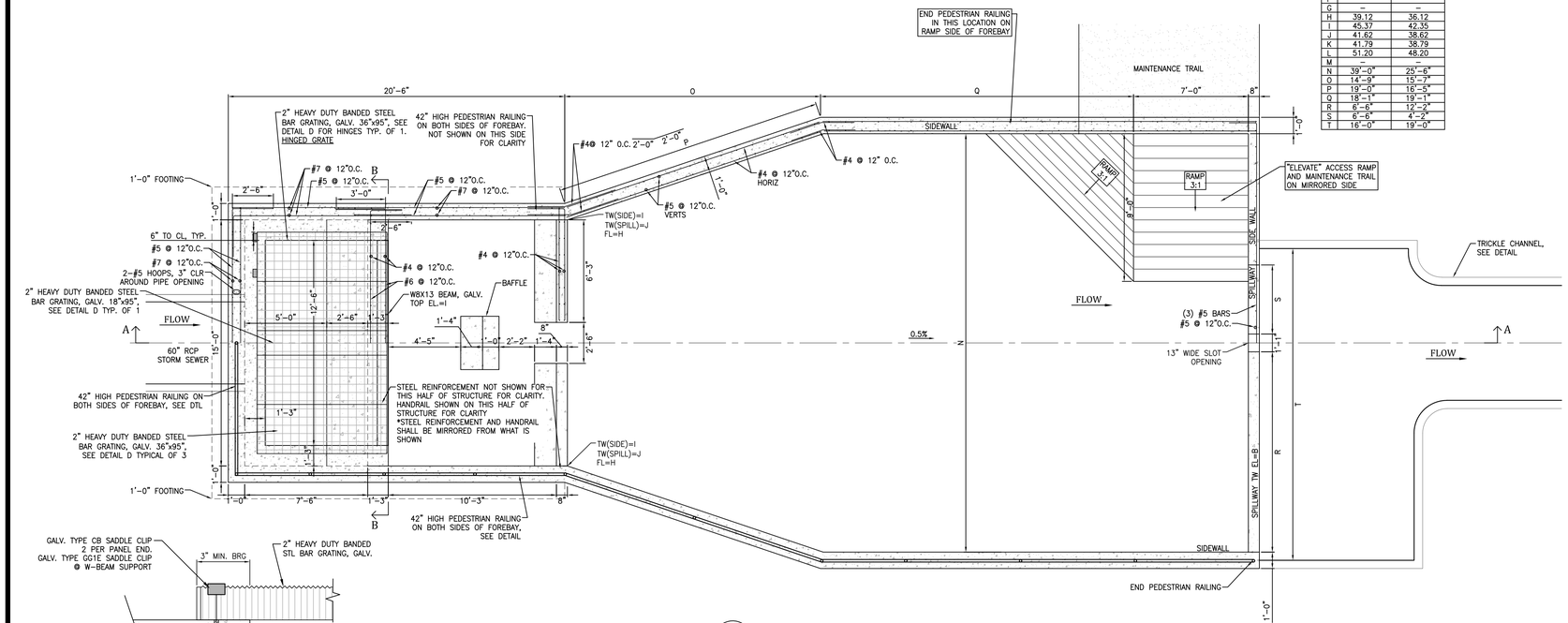


J C203 TRICKLE CHANNEL
SCALE: NTS



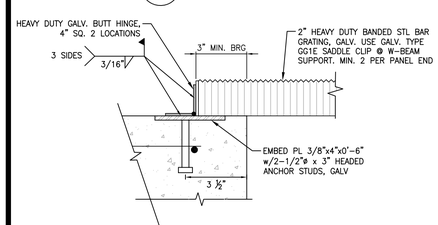
ALTERNATE CONNECTION DETAIL

	ELEVATE (NW)	SAGE (NE)
A	–	–
B	41.45	38.40
C	41.95	38.90
D	–	–
E	–	–
F	–	–
G	–	–
H	39.12	36.12
I	45.37	42.35
J	41.62	38.62
K	41.79	38.79
L	51.20	48.20
M		
N	39'-0"	25'-6"
O	14'-9"	15'-7"
P	19'-0"	16'-5"
Q	18'-1"	19'-1"
R	6'-6"	12'-2"
S	6'-6"	4'-2"
T	16'-0"	19'-0"

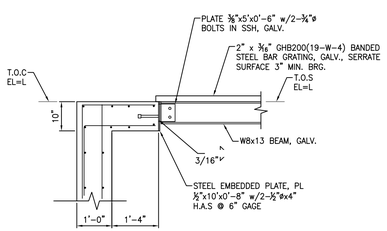


A C203 SAGE/ELEVATE IMPACT BASIN DETAIL
SCALE: NTS

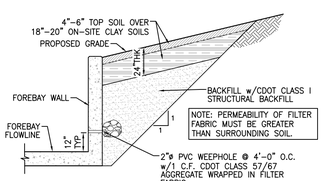
C C203 FIXED CONNECTION
SCALE: NTS



D C203 HINGED CONNECTION
SCALE: NTS

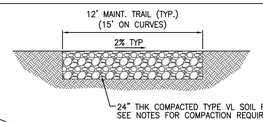


L C203 BEAM CONNECTION TO SLAB
SCALE: NTS

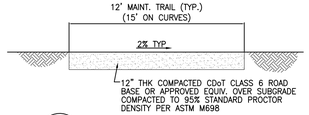


E C203 FOREBAY WALL BACKFILL
SCALE: NTS

MAINTENANCE TRAIL NOTES:
1. 10% MAX SLOPE ALONG MAINT. TRAIL.
2. SUBGRADE BELOW TRIAL SECTION TO BE COMPACTED TO 95% STANDARD PROCTOR DENSITY PER ASTM D698.
3. CDoT CLASS 5 ROAD BASE OR APPROVED EQUAL TO BE COMPACTED TO 95% MODIFIED PROCTOR DENSITY PER D1557.
4. TYPE VL SOIL RIPRAP SHALL BE WELL COMPACTED AND REVIEWED BY GEOTECHNICAL ENGINEER TO VERIFY ADEQUATE COMPACTION. RIDE ALONG RIPRAP SECTION SHALL BE SMOOTH.

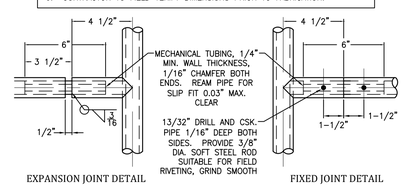


K C203 RIPRAP MAINTENANCE TRAIL SECTION
SEE PLAN FOR LOCATIONS
SCALE: NTS

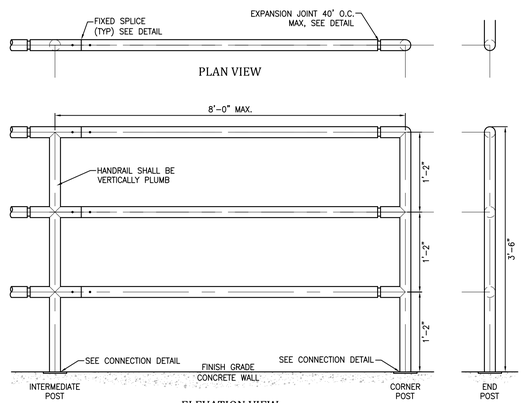


I C203 MAINTENANCE TRAIL SECTION
SCALE: NTS

PEDESTRIAN RAILING/HANDRAIL NOTES:
1. ALL HANDRAIL SHALL BE FABRICATED WITH NEW 1-1/2" (1-7/8" OD) DIAMETER STANDARD WEIGHT STEEL PIPE.
2. WELD ALL PIPE JOINTS WITH 1/8" REINFORCED WELDS AND DRESS SMOOTH.
3. CORNERS AND EDGES OF ALL BARS, PLATES AND PIPE ENDS SHALL BE SANDED SMOOTH AND FREE OF BURRS.
4. ALL HANDRAIL MATERIAL REQUIRED FOR COMPLETE INSTALLATION SHALL BE PROVIDED.
5. HANDRAIL FINISH SHALL BE ONE COAT METAL PRIMER AND TWO COATS SHERWIN WILLIAMS PAINT. COLOR SHALL BE DETERMINED BY OWNER. CONTRACTOR TO SUBMIT COLOR SAMPLE FOR APPROVAL PRIOR TO APPLICATION.
6. CONTRACTOR TO FIELD VERIFY DIMENSIONS PRIOR TO FABRICATION.



EXPANSION JOINT DETAIL FIXED JOINT DETAIL



ELEVATION VIEW

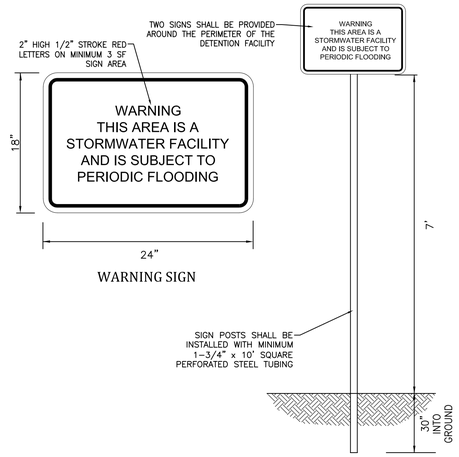
B C203 PEDESTRIAN RAILING/HANDRAIL
SCALE: NTS

Kiowa Engineering Corporation
7175 West Jefferson Avenue, Suite 2200
Lakewood, Colorado 80235
(303) 692-0369

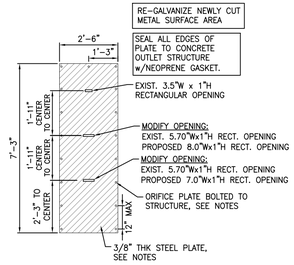
WOLF RANCH
DETENTION BASIN F18 AND F19
PCM DETAILS
COLORADO SPRINGS, COLORADO

Project No.:	22035
Date:	April 11, 2023
Design:	MWE/MTR
Drawn:	MTR
Check:	MWE
Revisions:	

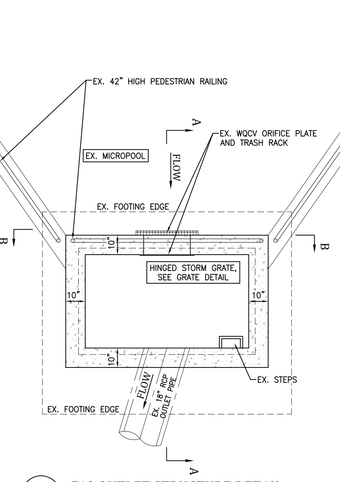
SHEET
C203



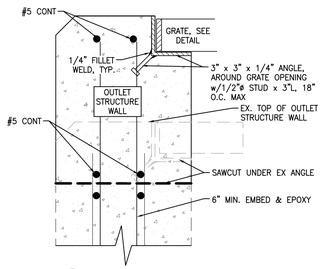
J C204 DETENTION WARNING SIGN
SCALE: NTS



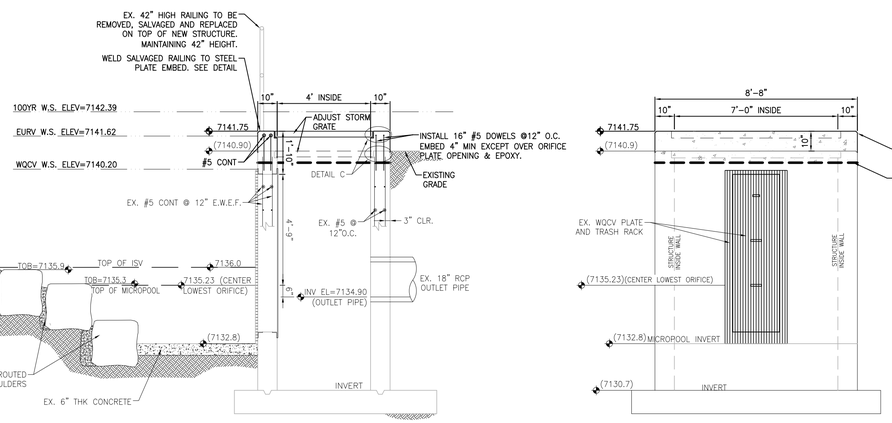
D C204 F19 WQCV ORIFICE PLATE
SCALE: NTS



E C204 F19 OUTLET STRUCTURE DETAIL
PLAN VIEW
SCALE: NTS

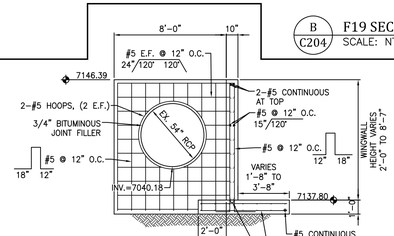


C C204 F19 DETAIL C
SCALE: NTS

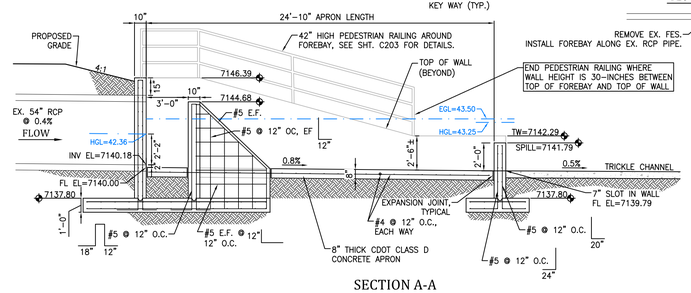


A C204 F19 SECTION A-A
SCALE: NTS

B C204 F19 SECTION B-B
SCALE: NTS

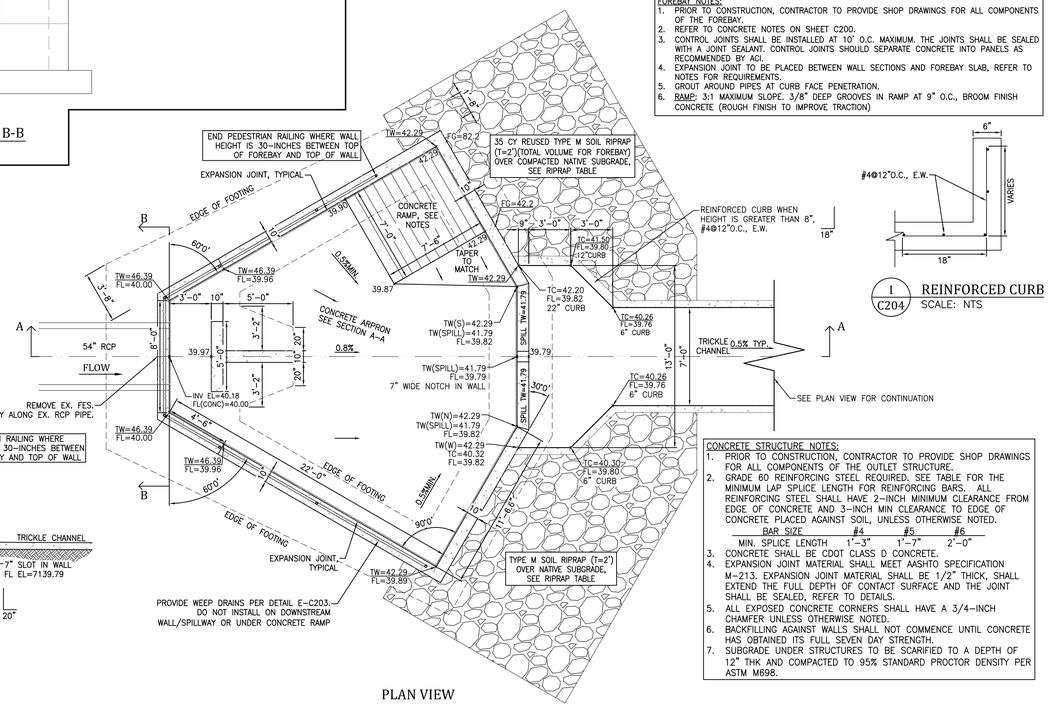


SECTION B-B



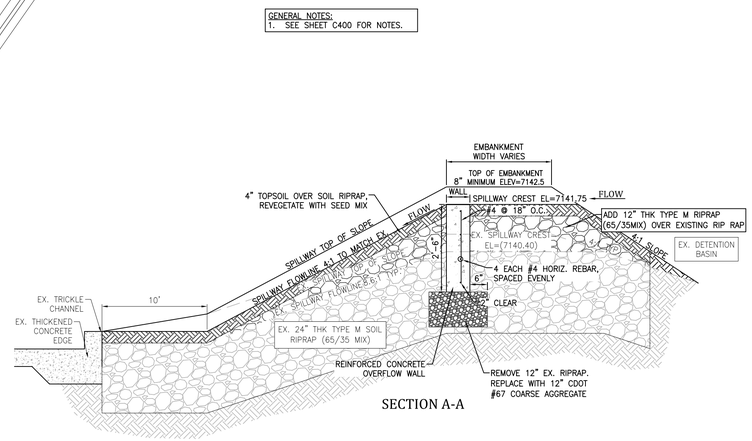
SECTION A-A

H C204 FOREBAY DETAIL
SCALE: NTS

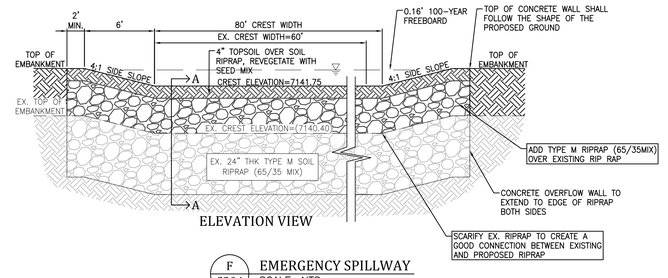


PLAN VIEW

I C204 REINFORCED CURB
SCALE: NTS

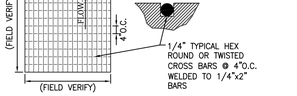


SECTION A-A



ELEVATION VIEW

F C204 EMERGENCY SPILLWAY
SCALE: NTS



K C204 STORM GRATE DETAIL
SCALE: NTS

CLASSIFICATION AND GRADATION OF RIPRAP			
RIPRAP DESIGNATION	% SMALLER THAN GIVEN SIZE BY WEIGHT	INTERMEDIATE ROCK DIMENSION (INCHES)	d50* (INCHES)
TYPE VL	70–100 50–70 35–50 2–10	12 9 6 2	6**
TYPE L	70–100 50–70 35–50 2–10	15 12 9 3	9**
TYPE M	70–100 50–70 35–50 2–10	21 18 12 4	12**
TYPE H	100 50–70 35–50 2–10	30 24 18 6	18
TYPE VH	100 50–70 35–50 2–10	42 33 24 9	24

* d50=MEAN PARTICLE SIZE (INTERMEDIATE DIMENSION) BY WEIGHT.
** MIX VL, L AND M RIPRAP WITH 35% TOPSOIL (BY VOLUME) AND BURY WITH 4–6 INCHES OF TOPSOIL, ALL VIBRATION COMPACTED & REVEGETATE. (CLASSIFICATION AND GRADATION OF ORDINARY RIPRAP, UDFCD, DRAINAGE CRITERIA MANUAL, VOL. 1)

GRADATION OF TYPE II GRANULAR BEDDING	
U.S. STANDARD SIEVE	PERCENT PASSING BY WEIGHT (TYPE II CDOT SECT. 703.09 CLASS A)
3 INCHES	90–100
3/4 INCHES	20–90
#4	0–20
#200	0–3

FOREBAY NOTES:
1. PRIOR TO CONSTRUCTION, CONTRACTOR TO PROVIDE SHOP DRAWINGS FOR ALL COMPONENTS OF THE FOREBAY.
2. REFER TO CONCRETE NOTES ON SHEET C200.
3. CONTROL JOINTS SHALL BE INSTALLED AT 10' O.C. MAXIMUM. THE JOINTS SHALL BE SEALED WITH A JOINT SEALANT. CONTROL JOINTS SHOULD SEPARATE CONCRETE INTO PANELS AS RECOMMENDED BY ACI.
4. EXPANSION JOINT TO BE PLACED BETWEEN WALL SECTIONS AND FOREBAY SLAB, REFER TO NOTES FOR REQUIREMENTS.
5. GROUT AROUND PIPES AT CURB FACE PENETRATION.
6. RAMP: 3:1 MAXIMUM SLOPE. 3/8" DEEP GROOVES IN RAMP AT 9" O.C., BROOM FINISH CONCRETE (ROUGH FINISH TO IMPROVE TRACTION)

CONCRETE STRUCTURE NOTES:
1. PRIOR TO CONSTRUCTION, CONTRACTOR TO PROVIDE SHOP DRAWINGS FOR ALL COMPONENTS OF THE OUTLET STRUCTURE.
2. GRADE 60 REINFORCING STEEL REQUIRED. SEE TABLE FOR THE MINIMUM LAP SPLICE LENGTH FOR REINFORCING BARS. ALL REINFORCING STEEL SHALL HAVE 2-INCH MINIMUM CLEARANCE FROM EDGE OF CONCRETE AND 3-INCH MIN CLEARANCE TO EDGE OF CONCRETE PLACED AGAINST SOIL, UNLESS OTHERWISE NOTED.

BAR SIZE	#4	#5	#6
MIN. SPLICE LENGTH	1'-3"	1'-7"	2'-0"

3. CONCRETE SHALL BE CDOT CLASS D CONCRETE.
4. EXPANSION JOINT MATERIAL SHALL MEET AASHTO SPECIFICATION M-213. EXPANSION JOINT MATERIAL SHALL BE 1/2" THICK, SHALL EXTEND THE FULL DEPTH OF CONTACT SURFACE AND THE JOINT SHALL BE SEALED, REFER TO DETAILS.
5. ALL EXPOSED CONCRETE CORNERS SHALL HAVE A 3/4-INCH CHAMFER UNLESS OTHERWISE NOTED.
6. BACKFILLING AGAINST WALLS SHALL NOT COMMENCE UNTIL CONCRETE HAS OBTAINED ITS FULL SEVEN DAY STRENGTH.
7. SUBGRADE UNDER STRUCTURES TO BE SCARIFIED TO A DEPTH OF 12" THK AND COMPACTED TO 95% STANDARD PROCTOR DENSITY PER ASTM M698.

Kiowa Engineering Corporation
7175 West Jefferson Avenue, Suite 2200
Lakewood, Colorado 80235
(303) 692-0369

WOLF RANCH
DETENTION BASIN F18 AND F19
PCM DETAILS
COLORADO SPRINGS, COLORADO

Project No.:	22035
Date:	April 11, 2023
Design:	MWE/MTR
Drawn:	MTR
Check:	MWE
Revisions:	

SHEET
C204

APPENDIX B

Curve Number and % Impervious Calculation

MHFD Culvert Calculations

Energy Grade Line Calculations

Proposed Forebay Elevation View

7175 West Jefferson Avenue Suite 2200, Lakewood, Colorado 80235
Ph: (303) 692-0369 www.kiowaengineering.com

Detention Basin F18/F19
Detention Area Calculations

Weighted Percent Impervious Calculation

Sub-Basin / Design Pt	Basins	Basin Area		CN 61		CN 73		CN 79		CN 85		CN 92		Weighted CN Value	Weighted % Imperv.	Tc	Lag Time
				% Imp	Area	% Imp	Area	% Imp	Area	% Imp	Area	% Imp	Area				
F-3		0.0942 mi	60.29ac	2%	60.3ac									61.0	2.00%		
F-4		0.2681 mi	171.58ac	2%	171.6ac									61.0	2.00%		
F-5		0.1073 mi	68.67ac	2%	68.7ac									61.0	2.00%		
F-6		0.0310 mi	19.84ac	2%	19.8ac									61.0	2.00%		
F-11		0.0404 mi	25.87ac	2%	5.0ac	33%	16.1ac	52%	4.8ac					71.8	30.54%	14.0 min.	8.4 min.
F-12		0.0899 mi	57.55ac	2%	9.4ac	33%	48.2ac							71.0	27.96%	16.7 min.	10.0 min.
F-16		0.0759 mi	48.59ac	2%	10.8ac			52%	37.8ac					75.0	40.86%	16.5 min.	9.9 min.
F-18		0.0285 mi	18.23ac	2%	11.8ac			52%	3.2ac			85.0%	3.3ac	69.7	25.59%	14.2 min.	8.5 min.
DP F18		0.7354 mi	470.63ac	2%	357.3ac	33.0%	64.3ac	52%	45.8ac	65%	0.0ac	85%	3.3ac	64.6	11.67%		
DP F18 (Wolf Site Only)	F3-F6, F11-F12, F16-F19	0.2348 mi	150.25ac	2%	37.0ac	33.0%	64.3ac	52%	45.8ac	65%	0.0ac	85%	3.3ac	72.3	32.29%		
F-1		0.1659 mi	106.18ac	2%	106.2ac									61.0	2.00%		
F-2		0.0424 mi	27.14ac	2%	27.1ac									61.0	2.00%		
F-8		0.0402 mi	25.71ac	2%	5.5ac			52%	20.2ac					75.1	41.30%	15.3 min.	9.2 min.
F-9		0.0639 mi	40.88ac	2%	8.2ac	33%	15.1ac	52%	17.6ac					73.2	34.93%	31.6 min.	19.0 min.
F-10		0.1084 mi	69.39ac	2%	12.9ac	33%	35.5ac	52%	20.9ac					72.6	32.95%	17.8 min.	10.7 min.
F-17		0.0370 mi	23.71ac	2%	1.2ac			52%	22.5ac					78.1	49.45%	13.4 min.	8.1 min.
F-19		0.0077 mi	4.91ac	2%	4.9ac									61.0	2.00%	8.9 min.	5.3 min.
DP F19		0.4655 mi	297.91ac	2%	166.1ac	33%	50.6ac	52%	81.2ac	65%	0.0ac	85%	0.0ac	67.9	20.90%		
DP F19 (Wolf Site Only)	F1, F2, F8, F9, F10 F19	0.2572 mi	164.60ac	2%	32.8ac	33%	50.6ac	52%	81.2ac	65%	0.0ac	85%	0.0ac	73.6	36.20%		
DP F18+ F19		1.2008 mi	768.54ac	2%	523.4ac	33%	114.9ac	52%	127.0ac	65%	0.0ac	85%	3.3ac	65.9	15.25%		
DP F18+F19 (Wolf Site Only)	DP F18 + DP F19	0.4919 mi	314.85ac	2%	69.7ac	33%	114.9ac	52%	127.0ac	65%	0.0ac	85%	3.3ac	73.0	34.33%		

Detention Basin F18/F19
Detention Area Calculations

Detention Basin F14															
F-6		0.0310 mi	19.8ac	2%	19.8ac									61.0	2.00%
F-7		0.0782 mi	50.0ac	2%	50.0ac									61.0	2.00%
F-14		0.1275 mi	81.6ac	2%	9.2ac	33%	64.0ac	52%	8.4ac					72.3	31.46%
F-15		0.0213 mi	13.6ac	2%	0.9ac			52%	12.7ac					77.8	48.58%
F-23		0.0306 mi	19.6ac	2%				52%	7.3ac	65%	12.3ac			82.8	60.15%
Det F14		0.2887 mi	184.75ac	2%	80.0ac	33.0%	64.0ac	52%	28.4ac	65%	12.3ac	85%	0.0ac	69.5	24.62%

Detention Basin G															
G-3		0.1676 mi	107.24ac			33%	75.3ac	52%	31.9ac					74.8	38.66%

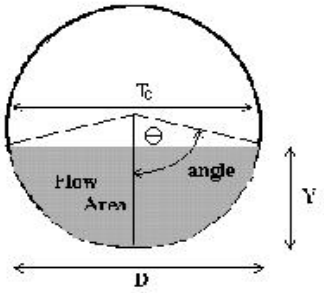
Sub-Basin / Design Pt	Basins	Basin Area		CN 61		CN 68		CN 73		CN 79		CN 88		CN 92		**Weighted**	**Weighted**
				% Imp	Area	% Imp	Area	% Imp	Area	% Imp	Area	% Imp	Area	% Imp	Area		
F-22		0.0640 mi	41.0ac	2%	37.1ac					52%	3.9ac					62.7	6.71%
F-24		0.0887 mi	56.8ac							52%	20.2ac	72%	19.2ac	85%	17.4ac	86.0	68.86%
F-25		0.0887 mi	56.8ac	2%	3.4ac			33%	29.1ac	52%	24.3ac					74.9	39.31%
F-27		0.2553 mi	163.4ac	2%	65.0ac			33%	8.5ac	52%	49.6ac	72%	24.9ac	85%	15.4ac	74.1	37.27%
F-28		0.0418 mi	26.8ac	2%	15.0ac					52%	11.7ac					68.9	23.90%
F-29		0.0226 mi	14.5ac	2%	1.3ac					52%	13.2ac					77.4	47.47%
F-30		0.0212 mi	13.5ac					33%	3.6ac	52%	9.9ac					77.4	46.95%
F-41		0.0810 mi	51.8ac			20%	51.8ac									68.0	20.00%
F-42		0.0529 mi	33.8ac					33%	33.8ac							73.0	33.00%
Det F28		0.7161 mi	458.3ac	2%	121.8ac	20%	51.8ac	33%	75.0ac	52%	132.8ac	72%	44.1ac	85%	32.7ac	73.8	36.26%

CIRCULAR CONDUIT FLOW (Normal & Critical Depth Computation)

MHFD-Culvert, Version 4.00 (May 2020)

Project: Wolf Ranch Detention F18/F19

Pipe ID: West Pipe Outfall (Existing 54" Pipe)



Design Information (Input)			
Pipe Invert Slope	So =	0.0040	ft/ft
Pipe Manning's n-value	n =	0.0130	
Pipe Diameter	D =	54.00	inches
Design discharge	Q =	59.00	cfs

Full-Flow Capacity (Calculated)			
Full-flow area	Af =	15.90	sq ft
Full-flow wetted perimeter	Pf =	14.14	ft
Half Central Angle	Theta =	3.14	radians
Full-flow capacity	Qf =	124.71	cfs

Calculation of Normal Flow Condition			
Half Central Angle (0<Theta<3.14)	Theta =	1.54	radians
Flow area	An =	7.63	sq ft
Top width	Tn =	4.50	ft
Wetted perimeter	Pn =	6.93	ft
Flow depth	Yn =	2.18	ft
Flow velocity	Vn =	7.73	fps
Discharge	Qn =	59.00	cfs
Percent of Full Flow	Flow =	47.3%	of full flow
Normal Depth Froude Number	Fr_n =	1.05	supercritical

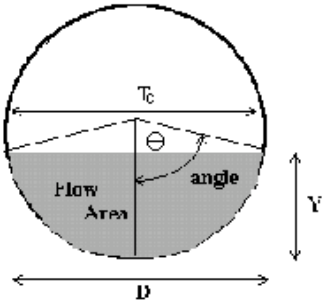
Calculation of Critical Flow Condition			
Half Central Angle (0<Theta-c<3.14)	Theta-c =	1.56	radians
Critical flow area	Ac =	7.87	sq ft
Critical top width	Tc =	4.50	ft
Critical flow depth	Yc =	2.23	ft
Critical flow velocity	Vc =	7.50	fps
Critical Depth Froude Number	Fr_c =	1.00	

CIRCULAR CONDUIT FLOW (Normal & Critical Depth Computation)

MHFD-Culvert, Version 4.00 (May 2020)

Project: Wolf Ranch Detention F18/F19

Pipe ID: West Pipe Outfall (Existing 54" Pipe...if 48" Pipe)



Design Information (Input)			
Pipe Invert Slope	So =	0.0040	ft/ft
Pipe Manning's n-value	n =	0.0130	
Pipe Diameter	D =	48.00	inches
Design discharge	Q =	91.00	cfs

Full-Flow Capacity (Calculated)			
Full-flow area	Af =	12.57	sq ft
Full-flow wetted perimeter	Pf =	12.57	ft
Half Central Angle	Theta =	3.14	radians
Full-flow capacity	Qf =	91.09	cfs

Calculation of Normal Flow Condition			
Half Central Angle (0<Theta<3.14)	Theta =	2.26	radians
Flow area	An =	11.01	sq ft
Top width	Tn =	3.08	ft
Wetted perimeter	Pn =	9.05	ft
Flow depth	Yn =	3.27	ft
Flow velocity	Vn =	8.26	fps
Discharge	Qn =	91.00	cfs
Percent of Full Flow	Flow =	99.9%	of full flow
Normal Depth Froude Number	Fr_n =	0.77	subcritical

Calculation of Critical Flow Condition			
Half Central Angle (0<Theta-c<3.14)	Theta-c =	2.03	radians
Critical flow area	Ac =	9.73	sq ft
Critical top width	Tc =	3.58	ft
Critical flow depth	Yc =	2.89	ft
Critical flow velocity	Vc =	9.35	fps
Critical Depth Froude Number	Fr_c =	1.00	

Kiowa Engineering Corporation

Project Name: Wolf Ranch Detention F18/F19 Project No: 22035

Description: Energy Grade Line through Forebay calculation

By: MTR Date: 3/17/23

Energy Grade line @ pipe = flow depth + $\frac{V^2}{2g}$ + z"(above forebay floor)

flow depth = 2.18' - from MHFD Culvert

V = 7.73 ft/s - from MHFD culvert

EGL = $2.18' + \frac{7.73^2}{2 \cdot 32.2} + 2'' =$ **3.28'** - above forebay floor

Energy Grade Line @ forebay Spillway

EGL = spillway height + depth over spillway + $\frac{V^2}{2g}$

Spillway height = 2.0'

depth over spillway = $\sqrt[1.5]{\frac{Q}{L \cdot C}}$

Weir Equation

$Q = H^{1.5} L C$

C = 3.33

L = 10'

Q = 59 cfs

Q = 59 cfs

C = 3.33 - sharp crested weir

L = 10'

depth over spillway = $\sqrt[1.5]{\frac{59 cfs}{10' \cdot 3.33}} = 1.46'$

Velocity over spillway = $\frac{Q}{A} = \frac{59 cfs}{10' \cdot 1.46'} = 4.04 ft/s$

EGL over spillway = $2.0' + 1.46' + \frac{4.04^2}{2 \cdot 32.2} =$ **3.71 ft**

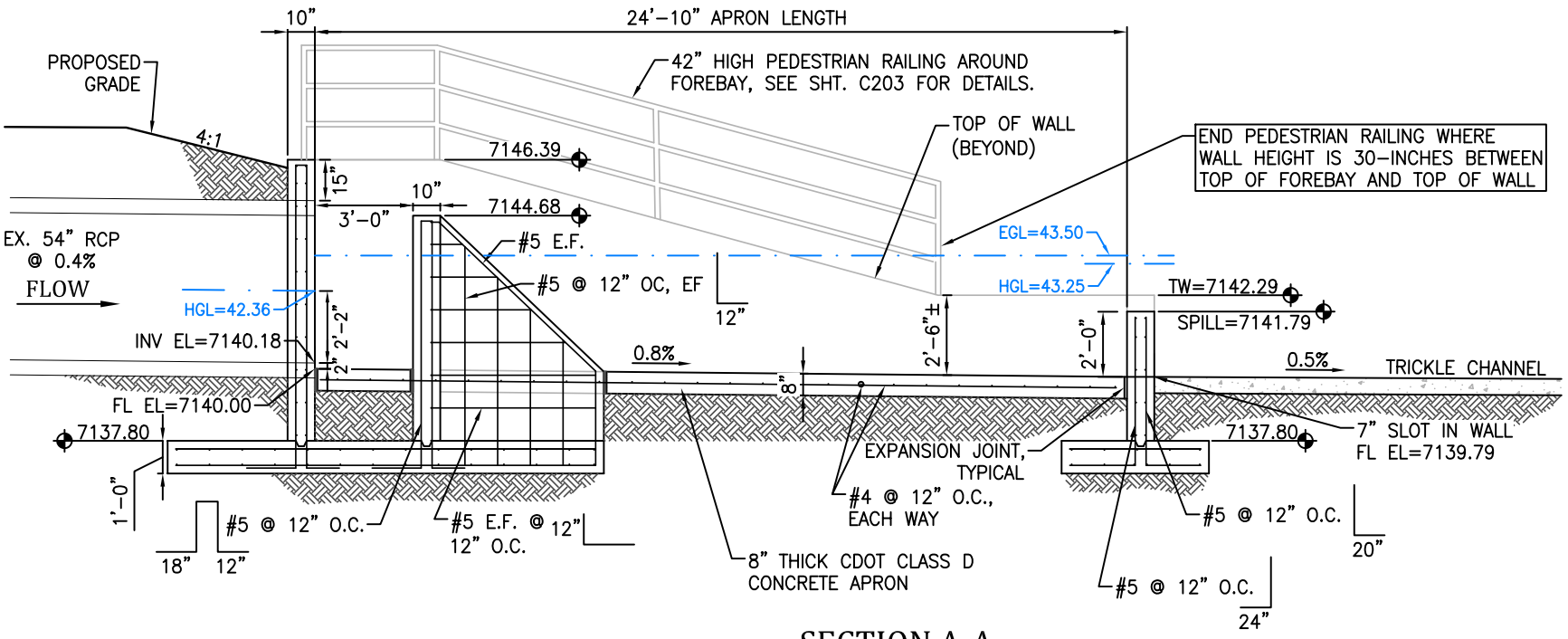
Max EGL = 3.71 ft

Max forebay wall height = 6.39' → near pipe and baffle block

Freeboard = 6.39' - 3.71' = 2.68'

→ Erosion due to backsplash will not occur due to ≈2.7' freeboard.

See proposed forebay elevation view for EGL visual reference



SECTION A-A

FOREBAY SECTION
VARIANCE REQUEST
WOLF RANCH DETENTION F18/F19

APPENDIX C

Revised Figure 6: Wolf Ranch MDDP Update

Revised HEC-1 Hydrologic Input & Output – Basin F (24 Hour Rainfall)

7175 West Jefferson Avenue Suite 2200, Lakewood, Colorado 80235
Ph: (303) 692-0369 www.kiowaengineering.com

DESIGN POINT DISCHARGE SUMMARY w/DETENTION			
DESIGN POINT	AREA(sm)	Q_5 (cfs)	Q_{100} (cfs)
A1	0.06	3	32
A3	0.21	49	194
A4 (IN)	0.30	87	334
A4 (OUT)	0.30	8	87
A5 (IN)	0.74	193	663
A5 (OUT)	0.74	27	114
A6	0.52	118	391
A7	0.18	90	292
A	1.02	154	236
A9	0.11	49	161
B	0.04	60	122
C3	0.05	33	100
C	0.16	104	314
E5	0.13	85	241
E2 (IN)	0.18	111	335
D2 (IN)	0.10	49	160
DBDE (OUT)	0.18	13	157

DESIGN POINT DISCHARGE SUMMARY w/DETENTION			
DESIGN POINT	AREA(sm)	Q_5 (cfs)	Q_{100} (cfs)
F2	0.21	9	119
F4	0.41	15	187
F6	0.14	5	60
F8	0.39	70	333
F10	0.32	36	230
F11	0.13	15	95
F12	0.50	32	265
F14	0.21	34	175
F23A	0.05	31	86
F23	0.26	63	252
F14 (IN)	0.26	63	252
F14 (OUT)	0.26	3	81
F16	0.57	58	345
F18	0.74	79	459
F19	0.46	81	386
F18 / F19 (IN)	1.20	160	846
F18 / F19 (OUT)	1.20	17	222
F22	1.26	18	234
F25	0.35	27	146
F42	0.13	28	126
F30	0.59	125	398
F29	0.61	133	417
F27	1.50	66	398
F28	0.66	136	445
F28A	2.15	202	780
F28 (IN)	2.18	202	780
F28 (OUT)	2.18	31	590
F	2.22	32	596

DESIGN POINT DISCHARGE SUMMARY w/DETENTION			
DESIGN POINT	AREA(sm)	Q_5 (cfs)	Q_{100} (cfs)
G3 (1)	0.168	16	91
G3 (OUT) (1)	0.168	1	10
G-4 (1)	.027	5	25

(1) UPDATED HYDROLOGY FOR BASINS F, G, AND H. DETERMINED USING CITY OF COLORADO SPRINGS DCM 2014.

DETENTION BASIN E/D DATA (2)

Q_5 IN = 160 cfs Q_{100} IN = 492 cfs
Q_5 OUT = 13 cfs Q_{100} OUT = 155 cfs (1)
VOL_5 = 5.9 AC–FT
VOL_{100} = 14.8 AC–FT
WS_5 = 55.2
WS_{100} = 57.8

(1) TOTAL OUTFLOW. OUTFLOW TO BE CONTROLLED TO EXISTING LEVELS AT DP E2 & DP D2
(2) DETENTION BASIN IN AS–BUILT CONDITION

DETENTION BASIN DB F18/F19 DATA (1)

Q_5 IN = 160 cfs Q_{100} IN = 846 cfs
Q_5 OUT = 17 cfs Q_{100} OUT = 222 cfs
VOL_5 = 10.8 AC–FT
VOL_{100} = 30.5 AC–FT

(1) NOAA ATLAS 14 24 HR RAINFALL. 30% DESIGN STORM DISTRIBUTION.

DETENTION BASIN DB F28 DATA(1)(2)

Q_5 IN = 202 cfs Q_{100} IN = 780 cfs
Q_5 OUT = 31 cfs Q_{100} OUT = 590 cfs
VOL_5 = 16.9 AC–FT
VOL_{100} = 25.7 AC–FT

(1) NOAA ATLAS 14 24 HR RAINFALL .30% DESIGN STORM DISTRIBUTION. (2) UPDATED HYDROLOGY FOR BASIN F

DETENTION BASIN DB F14 DATA (1)

Q_5 IN = 63 cfs Q_{100} IN = 252 cfs
Q_5 OUT = 3 cfs Q_{100} OUT = 81 cfs
VOL_5 = 4.7 AC–FT
VOL_{100} = 8.5 AC–FT

(1) NOAA ATLAS 14 24 HR RAINFALL. 30% DESIGN STORM DISTRIBUTION.

DETENTION BASIN A DATA (1)

Q_5 IN = 193 cfs Q_{100} IN = 663 cfs
Q_5 OUT = 27 cfs Q_{100} OUT = 114 cfs
VOL_5 = 6.9 AC–FT
VOL_{100} = 28.2 AC–FT

(1) DETENTION BASIN MODELED ITS AS–BUILT CONDITION

DETENTION BASIN A4 DATA

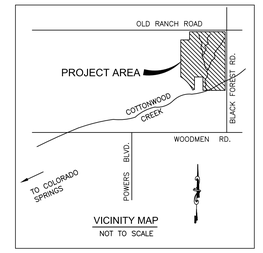
Q_5 IN = 87 cfs Q_{100} IN = 334 cfs
Q_5 OUT = 8 cfs Q_{100} OUT = 87 cfs
VOL_5 = 4.6 AC–FT
VOL_{100} = 10.9 AC–FT

(1) DETENTION BASIN MODELED AS A FSD

DETENTION BASIN G DATA (1)

Q_5 IN = 16 cfs Q_{100} IN = 91 cfs
Q_5 OUT = 1 cfs Q_{100} OUT = 10 cfs
VOL_5 = 1.5 AC–FT
VOL_{100} = 6.6 AC–FT

(1) 1 HOUR DESIGN STORM w/2 HOUR DISTRIBUTION PER 2014 DCM



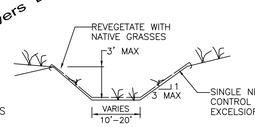
0' 400' 800'

Black Forest Road
Old Ranch Road
Stribrgate Parkway
Research Pkwy
Powers Boulevard
COWPOKE ROAD
WOLF VALLEY DRIVE
WOLF LAKE DRIVE
VALEMOUNT DRIVE
WOLF CENTER DRIVE
WOLF VILLAGE DRIVE
LEONYOUNG DRIVE
TUTT BLVD
GRAND CORDERA DRIVE
Tributary Four
WOLF LAKE
Cottonwood Creek

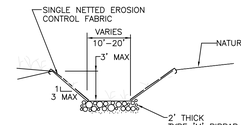
EXISTING CULVERT TO BE REPLACED WITH BRIDGE
FOR CHANNEL LINING AND DROP STRUCTURE IMPROVEMENTS FOR COTTONWOOD CREEK, SEE SHEETS PP4–PP6.
ONSITE DETENTION BASINS TO BE REQUIRED WITHIN SUB–BASINS J–1 & J–2
FOR DRAINAGE FACILITIES SOUTH OF RESEARCH PARKWAY, SEE ACADEMY SCHOOL DISTRICT 20 FINAL DRAINAGE REPORT
FUTURE COWPOKE ROAD ALIGNMENT
PROPOSED WESTCREEK WQ BASIN
EXISTING BRIDGE ON COWPOKE ROAD TO BE REMOVED WHEN TUTT BLVD. IS CONSTRUCTED ACROSS COTTONWOOD CREEK
FUTURE BRIDGE
EXISTING DETENTION BASIN DBE/D (WEST CREEK)
GRASSLINED SWALE w/RIPRAP INVERT BW=15', S=2.6% dtoe=2.4'
GRASSLINED SWALE w/RIPRAP INVERT BW=15', S=3.2% dtoe=2.1'
DETENTION BASIN F14
DETENTION BASIN H
DETENTION BASIN G
EX. DETENTION BASIN F18/F19
EX. DETENTION BASIN F28
EXISTING DETENTION BASIN A4
EXISTING DETENTION BASIN A
WOLF RANCH WATER TANK SITE
EX. STOCK POND TO BE REMOVED
WATER QUALITY AREA
OUTFALL STRUCTURE, TYP.
STORM SEWER DRAIN TO DP F16
60" RCP (DETENTION OUTFALL)
FOR CHANNEL LINING AND DROP STRUCTURE IMPROVEMENTS FOR TRIBUTARY FOUR, SEE UPPER AND LOWER TRIBUTARY FOUR DESIGN PLANS BY KIOWA ENGINEERING APPENDIX C
SHADED AREA DENOTES FILINGS 1–12 OF THE WESTCREEK SUBDIVISION
EX 48" RCP @ 2.8% W/ GRASSED OVERFLOW SWALE
DEVELOPED RUNOFF FROM SUB–BASIN B–1 TO BE CONVEYED BY EXISTING 42" RCP
INFLOW FROM EXISTING CORDERA DETENTION BASIN
EX. 8'x12' CBC
Wolf Ranch Property Line

LEGEND	
G4 / .07 / 61	BASIN NUMBER, BASIN AREA (SM), CN–VALUE
1	DESIGN POINT
	DRAINAGE BASIN BOUNDARY
C–13	CONVEYANCE ELEMENT/ HYDRAULIC STRUCTURE
	TIME OF CONCENTRATION FLOW PATH
	EXISTING DETENTION BASIN

STORM SEWER SYSTEMS SHOWN FOR SUB-BASINS C-3 & C-2 OBTAINED FROM WESTCREEK FILINGS 1, 2, 3, 4 & 5 FINAL DRAINAGE REPORT.



TYPICAL GRASSLINED SWALE SECTION
NTS



TYPICAL GRASSLINED & RIPRAP SWALE
NTS

Kiowa Engineering Corporation
7175 West Jefferson Avenue, Suite 2200
Lakewood, Colorado 80235
(303) 692-0369

WOLF RANCH
MASTER DEVELOPMENT DRAINAGE PLAN UPDATE
PROPOSED FACILITIES
COLORADO SPRINGS, COLORADO

Project No.:	12055
Date:	11/20/2020
Design:	RNW
Drawn:	MTR
Check:	MWE
Revisions:	
7/27/21	Detention F14
01/25/23	Detention F18/F19

Fig. 6

Basin F
24 Hour Rainfall

```
1****************************************
****************************************
 *                                      *                                                *
*
 *   FLOOD HYDROGRAPH PACKAGE  (HEC-1)  *                                                *    U.S. ARMY CORPS OF
ENGINEERS     *
 *               JUN   1998             *                                                *    HYDROLOGIC
ENGINEERING CENTER    *
 *            VERSION 4.1               *                                                *          609 SECOND
STREET          *
 *                                      *                                                *       DAVIS, CALIFORNIA
95616       *
 *  RUN DATE   19JAN23  TIME  14:36:48  *                                                *           (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

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

    1         ID            Wolf Ranch Tributary Four   FN FBAS-REV.DAT
    2         ID            Detention basin at design  point 14
    3         ID            F-Basins future developed condition with detention
    4         ID            Sub basins to F18/19 revised to match new DP
    5         ID            Final design of detention basin F18/19  Briargate Parkway
    6         ID            5-year and 100 Year, 24HR RAINFALL NOAA ATLAS 2 TYPE II STORM
    7         ID            REVISED 1-20-2023
              *DIAGRAM
    8         IT       5       0       0     300
    9         IO       5       0
   10         JR    PREC     .56     1.0

   11         KK     F-1
   12         KM        RUNOFF FOR SUB-BASIN F-1
   13         BA   .1659
   14         IN      15
   15         PB     4.4
   16         PC       0    .002    .005    .008    .011   .0104   .0170     .02    .023    .026
   17         PC    .029    .032    .035    .038    .041    .044    .048    .052    .056     .06
   18         PC   .0604    .068    .072    .076     .08    .085     .09    .095      .1    .105
   19         PC     .11    .115     .12    .126    .133     .14    .147    .155    .163    .172
   20         PC    .181    .191    .203    .218    .236    .257    .283    .387    .663    .707
   21         PC    .735    .758    .776    .791    .804    .815    .825    .834    .842    .849
   22         PC    .856    .863    .869    .875    .881    .887    .893    .898    .903    .908
   23         PC    .913    .918    .922    .926     .93    .934    .938    .942    .946     .95
   24         PC    .953    .956    .959    .962    .965    .968    .971    .974    .977     .98
   25         PC    .983    .986    .989    .992    .995    .998
   26         LS       0      61
   27         UD     .20

   28         KK     RF1
   29         KM        ROUTE FLOW FROM SUB-BASIN F-1 TO DP F2
   30         RD    1450   0.037    0.04            TRAP      10       6

   31         KK     F-2
   32         KM        RUNOFF FROM SUB BASIN F-2
   33         BA    .042
   34         LS       0      61
   35         UD     .19

   36         KK     RF2
```

IT=TIME SPECIFICATION, 5 min intervals, 300 hydrograph ordinates
JR=MULTIRATION, PREC=RATIOS OF PRECIPITATION
0.56(PB)=5YR, 1.0(PB)=100YR

BA=SUB-BASIN AREA (SQUARE MILES)IN=TIME INTERVAL FOR INPUT DATA, 15 minutes in tabulation interval PB=BASIN AVERAGE PRECIPITATION, 4.4 inches

PC=CUMULATIVE PRECIPITATION TIME SERIES

LS=SCS CURVE NUMBER LOSS RATE, 0=initial abstraction computed from curve number of 61SCS DIMENSIONLESS UNIT HYDROGRAPH, scs lag in hours =0.20

RD=MUSKINGUM-CUNGE ROUTINGchannel length =1400ft, slope=3.7%, Manning's n=0.04 trapezoidal channel, 10-ft bottom width, 6:1 side slopes

```
                37           KM         ROUTE FLOW FROM SB F-2 TO DP F2
                38           RD    1200     .04    .035            CIRC       3

                39           KK    DPF2
                40           KM         COMBINE RF1 AND RF2
                41           HC       2                          HC=COMBINE HYDROGRAPHS, 2 hydrographs combined

                42           KK    RF10
                43           KM         ROUTE FLOW FROM DP F2 TO DP F10
                44           RD     540     .03    .013            CIRC       4
1                                                HEC-1 INPUT                                                    PAGE  2

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


                45           KK    F-10
                46           KM         RUNOFF FROM BASIN F-10
                47           BA    .108
                48           LS       0    72.6
                49           UD    .178

                50           KK   DPF10
                51           KM         COMBINE FLOW FROM SB F-10 AND RF10
                52           HC       2

                53           KK     RF8
                54           KM         ROUTE FLOW FROM DP F-10 TO DP F19
                55           RD    1100     .03    .016            CIRC     4.5

                56           KK     F-8
                57           KM         RUNOFF FROM SB F-8
                58           BA   .0402
                59           LS       0    75.1
                60           UD    .153

                61           KK    F-17
                62           KM        RUNOFF FROM SUB BASIN F-17
                63           BA    .037
                64           LS       0    78.1
                65           UD    .135

                66           KK    DPF8
                67           KM         COMBINE RF-8,SUB BASIN F-8 AND SUB BASIN F-17
                68           HC       3
```

```
   69          KK     F-9
   70          KM         RUNOFF FOR BASIN F-9
   71          BA    .0639
   72          LS       0    73.2
   73          UD     .317

   74          KK     F-19
   75          KM         RUNOFF FROM SUB-BASIN F-19
   76          BA    .0077
   77          LS       0      61
   78          UD    0.088

   79          KK    DPF19
   80          KM         COMBINE FLOW FROM DP F8, SB F-9, SB F-19
   81          KM         THIS IS THE INFLOW TO DB F19
   82          HC       3

   83          KK     F-3
   84          KM         RUNOFF FOR SUB-BASIN F-3
   85          BA    .0942
   86          LS       0      61
   87          UD     .22
```



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

   88          KK    RF11
   89          KM         ROUTE FLOW FROM SUB-BASIN F-3 TO DESIGN POINT F11
   90          RD    1050    0.03    0.04            CIRC     103

   91          KK    F-11
   92          KM         RUNOFF FOR SUB-BASIN F-11
   93          BA    .0404
   94          LS       0    71.8
   95          UD     .14

   96          KK    DPF11
   97          KM         COMBINE FLOW FROM SUB-BASIN F-11 AND RF11
   98          HC       2

   99          KK    RF18
  100          KM         ROUTE FLOW FROM DESIGN POINT F11 TO DETENTION POINT DP18
  101          RD    1200    0.03    .013            CIRC       3
```

```
 102          KK    F-18
 103          KM        RUNOFF FROM SB F-18
 104          BA   .0285
 105          LS       0    69.7
 106          UD    .142

 107          KK     F-4
 108          KM         RUNOFF FROM SUB-BASIN F-4
 109          BA   .2681
 110          LS       0      61
 111          UD     .28

 112          KK     RF4
 113          KM        ROUTE FLOW FROM SUB-BASIN F-4 TO DESIGN POINT F4
 114          RD     650   0.044   0.013            CIRC       4

 115          KK     F-6
 116          KM        RUNOFF FROM SUB-BASIN F-6
 117          BA    .031
 118          LS       0      61
 119          UD     .19

 120          KK     RF6
 121          KM        ROUTE FLOW FROM F6 TO DP F6
 122          RD     980     .03    .013            CIRC     2.5

 123          KK     F-5
 124          KM         RUNOFF FOR SUB-BASIN F-5
 125          BA   .1073
 126          LS       0      61
 127          UD     .34
1                                        HEC-1 INPUT                                                PAGE  4

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


 128          KK     RF5
 129          KM        ROUTE FLOW FROM SUB-BASIN F-5 TO DESIGN POINT F6
 130          RD     500     .04    .013            CIRC       3

 131          KK    DPF6
 132          KM        COMBINE RF5 AND RF6
 133          HC       2

 134          KK    RF56
```

```
135          KM          ROUTE DPF6 TO DPF4
136          RD    1020     .03    .013            CIRC       4

137          KK     DP4
138          KM         COMBINE RF4 AND RF56
139          HC       2

140          KK   RF456
141          KM        ROUTE DPF4 TO DP12
142          RD     640     .03    .013            CIRC       4

143          KK    F-12
144          KM         RUNOFF FOR SUB-BASIN F-12
145          BA   .0899
146          LS       0      71
147          UD    .167

148          KK   DPF12
149          KM        COMBINE FLOW FROM SUB-BASIN F-12 AND RF456
150          HC       2

151          KK    RF12
152          KM        ROUTE FLOW FROM DESIGN POINT F12 TO RF16
153          RD     720    0.02   0.013            CIRC       4

154          KK    RF16
155          KM        ROUTE FLOW FROM RF12 TO RF16
156          RD     820     .03    .013            CIRC     4.5

157          KK    F-16
158          KM        RUNOFF FROM SB F-16
159          BA   .0759
160          LS       0      75
161          UD    .165

162          KK   DPF16
163          KM        COMBINE FLOW FROM SB F-16 AND RF16
164          HC       2

165          KK   DPF18
166          KM        COMBINE FLOW FROM SUB-BASIN F-18, DP16 AND RF18
167          HC       3
```

PC=CUMULATIVE
PRECIPITATION TIME SERIES


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

```
168          KK  DP1819
169          KM         COMBINE DPF18 AND DPF19
170          KM        INFLOW TO DET BASIN 1819
171          HC       2

172          KK  DB1819
173          KM          ROUTE DPF1819  THROUGH DETENTION BASIN DB1819
174          KM          THIS IS OUTFLOW FROM DETENTION BASIN 18-19
175          RS       1    ELEV  7132.7
176          SV       0     .01     .02      .1     .32    1.76    4.43    8.72    14.3   20.74
177          SV   27.65      37   42.64    48.9    58.8      65    69.1
178          SE  7132.7  7133.5    7134    7135    7136    7137    7138    7139    7140    7141
179          SE    7142    7143    7144    7145    7146    7147  7147.5
180          SQ       0      .4      .5      .8     1.1     1.5     1.9     2.2    41.3   133.8
181          SQ   217.3   230.4   242.8   253.3   257.1   268.2   271.7

182          KK   RF22A
183          KM        ROUTE FLOW FROM DETENTION BASIN 1819 TO DESIGN POINT DP F22
184          RD    1800   0.027    0.02            TRAP      10       6

185          KK    F-22
186          KM         RUNOFF FOR SUB-BASIN F-22
187          BA    .059
188          LS       0    62.7
189          UD     .21

190          KK   DPF22
191          KM        COMBINE FLOW FROM SUB-BASIN F-22, AND RF22A
192          HC       2

193          KK   RF27
194          KM        ROUTE FLOW FROM DESIGN POINT DPF22 TO DESIGN POINT F27
195          RD    3700    0.04    0.04            TRAP      20       3

196          KK    F-27
197          KM        RUNOFF FROM SUB BASIN F-27
198          BA    .255
199          LS       0      74
200          UD     .32

201          KK   DPF27
202          KM        COMBINE RF27 AND SUB BASIN F-27
203          HC       2
```

RS=STORAGE ROUTING, 1 step, elevation for beginning of the first time period=7132.7

Detention Basin F18/F19
Volume-Stage-Discharge

SV=RESERVOIR VOLUME (acre-ft) SE=ELEVATION (ft) corresponding to volume in same field on preceding SV recordSQ=DISCHARGE (cfs) corresponding to volume and elevation in same field on preceding SV and SE records example: 48.9 ac-ft corresponds to an elevation of 7145 ft and a discharge of 253.3 cfs

```
 204          KK    F-7
 205          KM         RUNOFF FOR SUB-BASIN F-7
 206          BA   .0782
 207          LS       0      61
 208          UD     .19
```



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

 209          KK    RF7
 210          KM        ROUTE FLOW FROM SUB-BASIN F-7 TO DESIGN POINT F14A
 211          RD    1200   0.033    0.04            TRAP      10       6

 212          KK   RF14A
 213          KM        ROUTE FLOW FROM DESIGN POINT F14A TO DP 23
 214          KM        DESIGN PONT 14A = RF-14A
 215          RD     400   0.027   0.013            CIRC       4

 216          KK    F-14
 217          KM        RUNOFF FROM SB F-14
 218          BA    .128
 219          LS       0    72.3
 220          UD     .25

 221          KK    DP14
 222          KM         COMBINE RF 14A AND SB F14
 223          HC       2

 224          KK    F-15
 225          KM         RUNOFF FROM SUB-BASIN F-15
 226          BA   .0210
 227          LS       0    77.8
 228          UD     .15

 229          KK    RF15
 230          KM          ROUTE RUNOFF FROM F-15  TO DESIGN POINT F23A
 231          RD    1100    .023     .04            TRAP      10       3

 232          KK    F-23
 233          KM         RUNOFF FROM SUB BASIN F-23
 234          BA   .0310
 235          LS       0    82.8
 236          UD     .18
```

```
 237          KK  DPF23A
 238          KM         COMBINE FLOW FROM RF15 AND  SUB-BASIN F-23
 239          HC       2

 240          KK    RF23
 241          KM         ROUTE FLOW FROM DP F23 TO DP23
 242          RD     300     .03    .013            CIRC     2.5

 243          KK   DPF23
 244          KM        COMBINE FLOW FROM DP14 AND RF23
 245          KM          THIS IS INFLOW TO DETENTION BASIN DB F14
 246          HC       2

 247          KK   DBF14
 248          KM         DETENTION BASIN DBF14                                          Detention Basin F14
 249          KM          THIS IS OUTFLOW FROM DETENTION BASIN 14                       Volume-Stage-Discharge
 250          RS       1    ELEV  7124.5
 251          SV       0    .006    .011    .133     .59    1.56    2.94    4.49    5.30    6.14
 252          SV    7.89    8.81    9.76   11.73   12.75
1                                        HEC-1 INPUT                                                PAGE  7

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

 253          SE  7124.5  7125.5  7126.0  7127.0  7128.0  7129.0  7130.0  7131.0  7131.5  7132.0
 254          SE    7133  7133.5    7134  7135.0  7135.5
 255          SQ       0     .19     .24     .43     .58     .82    1.00    1.14     5.2    27.6
 256          SQ    78.5    81.0   191.3   666.5     994

 257          KK    RF25
 258          KM        ROUTE FLOW FROM DETENTION BASIN DB F14 TO DESIGN POINT F25
 259          RD    2600   0.023   0.013            CIRC       3

 260          KK    F-25
 261          KM         RUNOFF FOR SUB-BASIN F-25
 262          BA   .0890
 263          LS       0    74.9
 264          UD     .28

 265          KK   DPF25
 266          KM        COMBINE FLOW FROM RF25 AND SB 25
 267          HC       2

 268          KK    RF30
 269          KM        ROUTE FLOW FROM DESIGN POINT F25 TO DESIGN POINT F30
```

```
 270          RD     750   0.027   0.013           CIRC       4

 271          KK    F-24
 272          KM         RUNOFF FOR SUB-BASIN F-24
 273          BA   .0890
 274          LS       0      86
 275          UD     .26

 276          KK   RF30A
 277          KM        ROUTE FLOW FROM SUB-BASIN    F24 TO DESIGN POINT F30
 278          RD     920   0.033   0.013           CIRC     3.5

 279          KK    F-30
 280          KM         RUNOFF FOR SUB-BASIN F-30
 281          BA   .0212
 282          LS       0    77.4
 283          UD     .18

 284          KK    F-41
 285          KM         RUNOFF FROM SUB-BASIN F-41
 286          BA    .081
 287          LS       0      68
 288          UD     .22

 289          KK    RF41
 290          KM         ROUTE RUNOFF FROM  SUB-BASIN F-41 TO DP42
 291          RD    1450     .03    .013           CIRC     2.5

 292          KK    F-42
 293          KM         RUNOFF FROM SUB-BASIN F-42
 294          BA    .053
 295          LS              73
 296          UD     .22
```

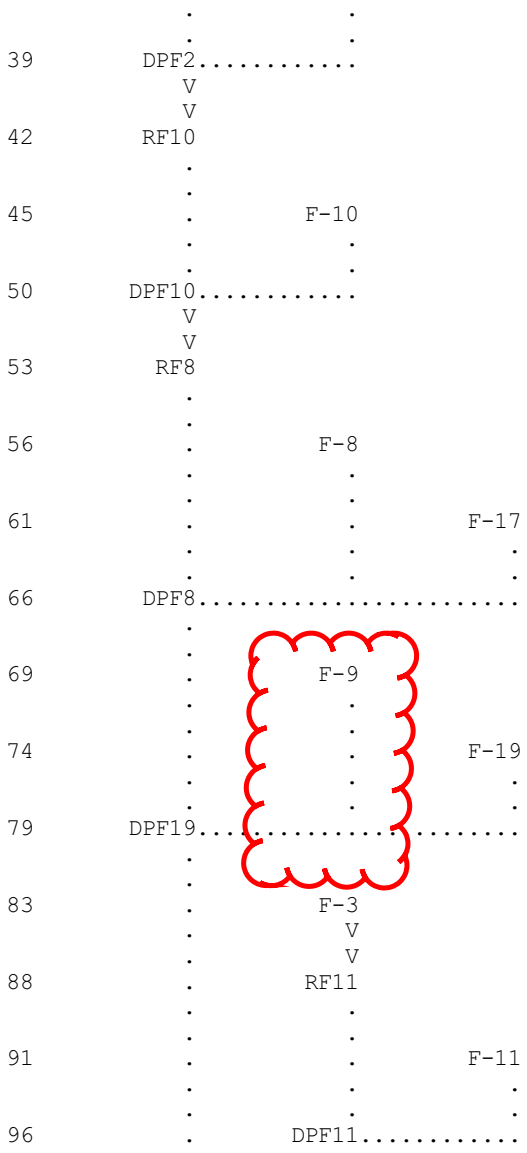


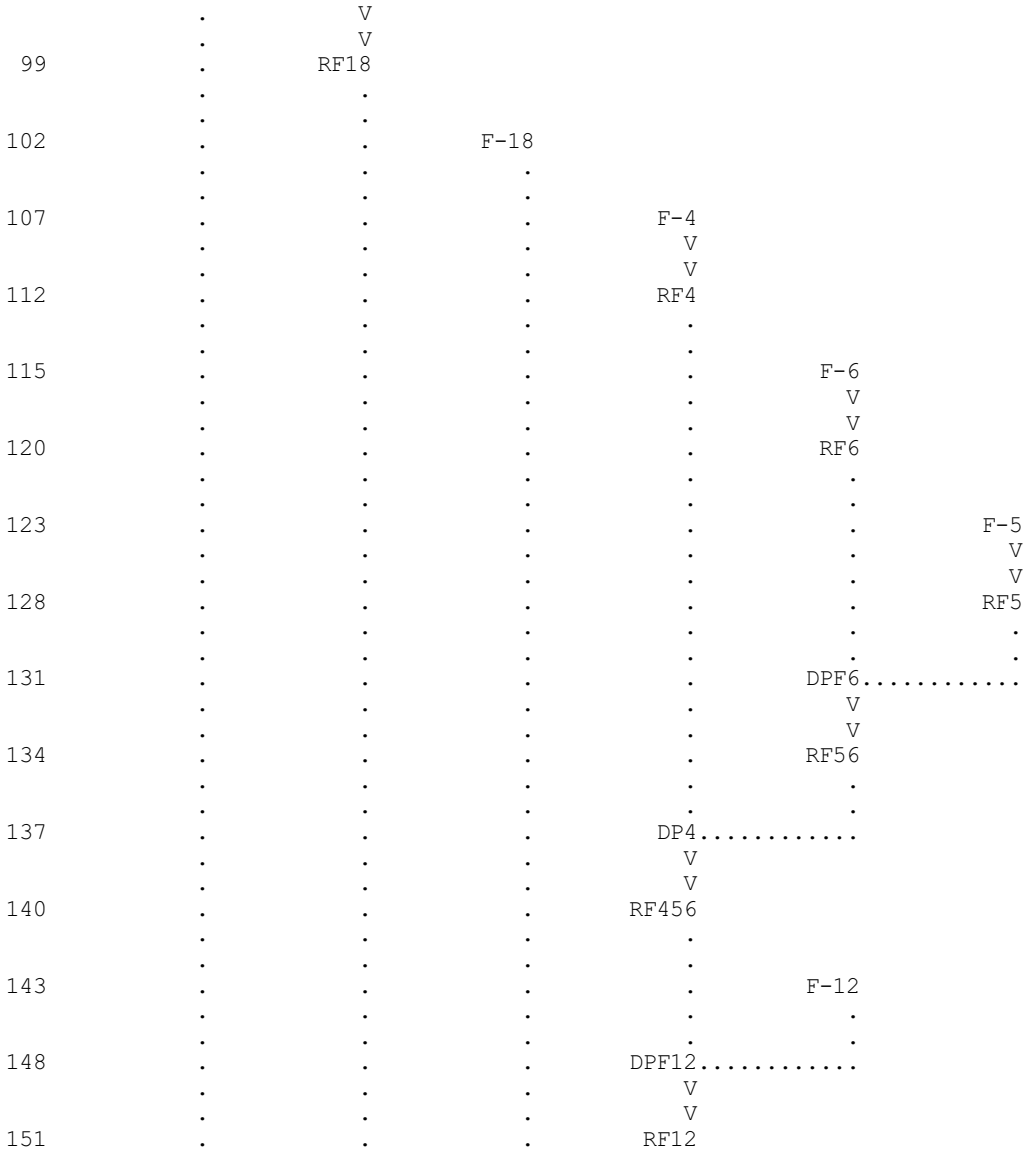
```
LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 297          KK   DPF42
 298          KM        COMBINE RUNOFF FROM F-42 AND RF41
 299          HC       2

 300          KK   RF30B
 301          KM        ROUTE FLOW FROM DESIGN POINT F42 TO DESIGN POINT F30
 302          RD     600     .03    .013           CIRC       3
```

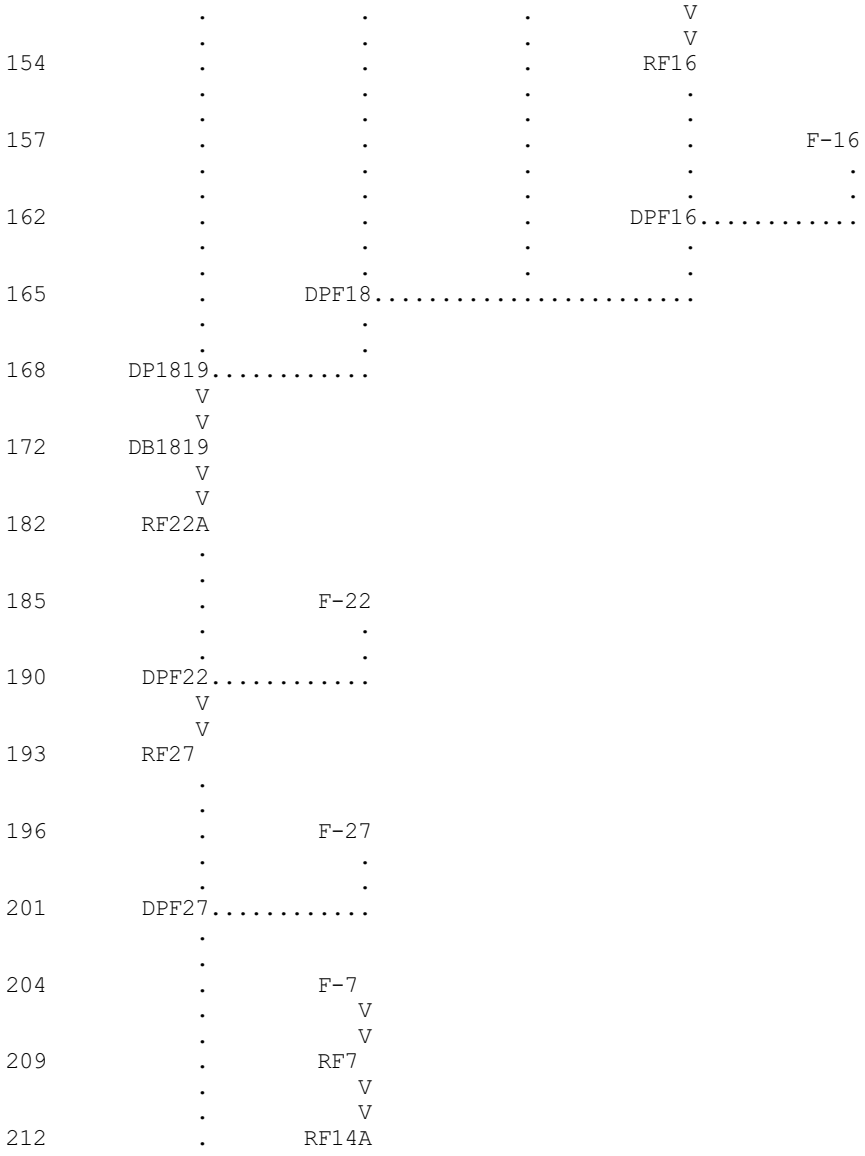
```
KK   DPF30
KM         COMBINE FLOW FROM RF30B,RF30A, RF30 AND SUB-BASIN F-30
HC       4

KK   RF-29
KM         ROUTE FLOW FROM DESIGN POINT F30 TO DESIGN POINT F29
RD    2350   0.027    0.04            TRAP       6       3

KK    F-29
KM         RUNOFF FOR SUB-BASIN F-29
BA   .0226
LS       0    77.4
UD     .19

KK  DPF29
KM         COMBINE FLOW FROM RF29 AND SUB-BASIN F-29
HC       2

KK    RF28
KM         ROUTE FLOW FROM DESIGN POINT F29 TO DESIGN POINT F28
RD     750   0.015    0.04            TRAP      20       3

KK    F-28
KM         RUNOFF FOR SUB-BASIN F-28
BA    .042
LS       0    68.9
UD     .23

KK   DPF28
KM         COMBINE FLOW FROM RF28, SB F-28
HC       2

KK  DPF28A
KM         COMBINE DP F27 AND DP F28
KM         THIS IS INFLOW TO DETENTION BASIN F28
HC       2

KK   DBF28
KM         ROUTE DPF28 THROUGH DETENTION BASIN DBF28
KM         THIS IS OUTFLOW FROM DETENTION BASIN F28
KM         AS-BUILT STAGE-STORAGE-DISCHARGE CURVE
RS       1    ELEV    6968
SV       0    1.07    2.23   10.56    16.7    20.2      24   32.76      43
SE    6968    6970    6972    6974    6976    6977    6978    6980    6982
```

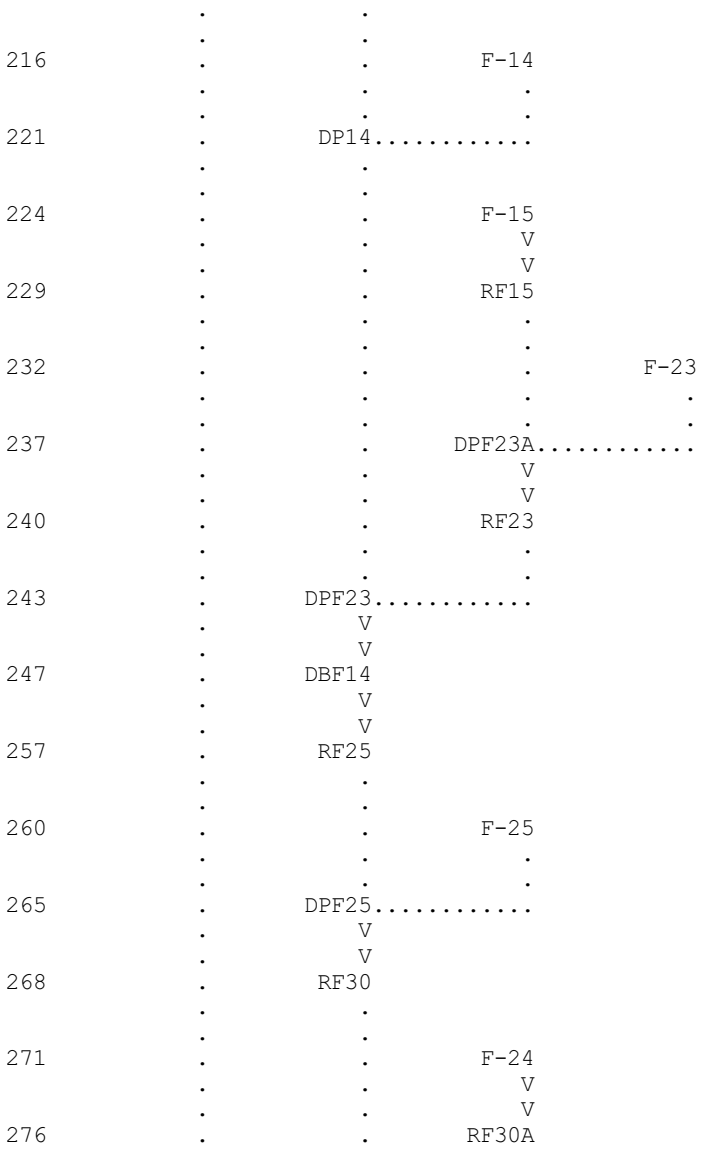
Detention Basin F28
Volume-Stage-Discharge

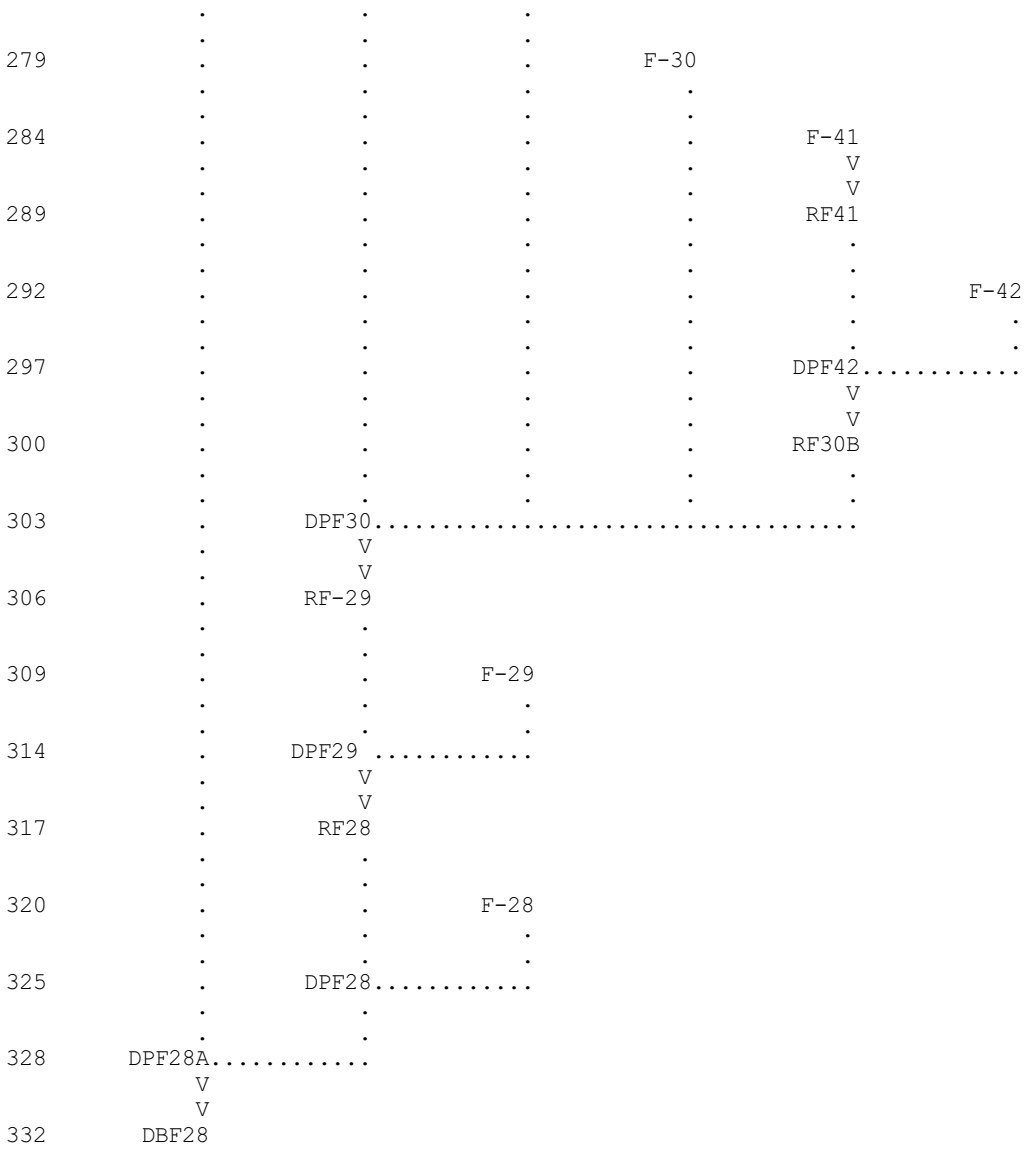
```
          339          SQ       0     1.5     4.8    10.2    15.6     340     520     880    1000
1                                                  HEC-1 INPUT                                                PAGE  9

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


          340          KK   RF31A
          341          KM        ROUTE FLOW FROM DB F28 TO RF31B
          342          RD    1000    .024     .04            TRAP      20       3

          343          KK   RF31B
          344          KM        ROUTE FLOW FROM RF31A TO RF31C
          345          RD    1500    .024    0.04            TRAP      20       3

          346          KK   RF31C
          347          KM        ROUTE FLOW FROM  RF31B TO DP F
          348          RD    1000    .024     .04            TRAP      20       3

          349          KK    F-31
          350          KM         RUNOFF FOR SUB-BASIN F-31
          351          BA    .069
          352          LS       0      61
          353          UD     .25

          354          KK     DPF
          355          KM        COMBINE FLOW FROM RF31 AND F-31
          356          HC       2
          357          ZZ
1                                                                  ZZ=End of Job
               SCHEMATIC DIAGRAM OF STREAM NETWORK

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

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

    11         F-1
               V
               V
    28         RF1
               .
               .
    31         .         F-2
               .           V
               .           V
    36         .         RF2
```

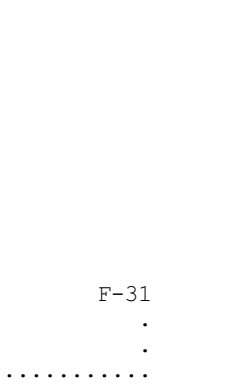

39
DPF2
42
RF10
45
F-10
50
DPF10
53
RF8
56
F-8
61
F-17
66
DPF8
69
F-9
74
F-19
79
DPF19
83
F-3
88
RF11
91
F-11
96
DPF11


V
V
99 RF18
102 F-18
107 F-4
V
V
112 RF4
115 F-6
V
V
120 RF6
123 F-5
V
V
128 RF5
131 DPF6
V
V
134 RF56
137 DP4
V
V
140 RF456
143 F-12
148 DPF12
V
V
151 RF12


154
157
162
165
168
172
182
185
190
193
196
201
204
209
212
RF16
F-16
DPF16
DPF18
DP1819
DB1819
RF22A
F-22
DPF22
RF27
F-27
DPF27
F-7
RF7
RF14A


216
F-14
221
DP14
224
F-15
229
RF15
232
F-23
237
DPF23A
240
RF23
243
DPF23
247
DBF14
257
RF25
260
F-25
265
DPF25
268
RF30
271
F-24
276
RF30A


279
F-30
284
F-41
289
RF41
292
F-42
297
DPF42
300
RF30B
303
DPF30
306
RF-29
309
F-29
314
DPF29
317
RF28
320
F-28
325
DPF28
328
DPF28A
332
DBF28



(***) RUNOFF ALSO COMPUTED AT THIS LOCATION

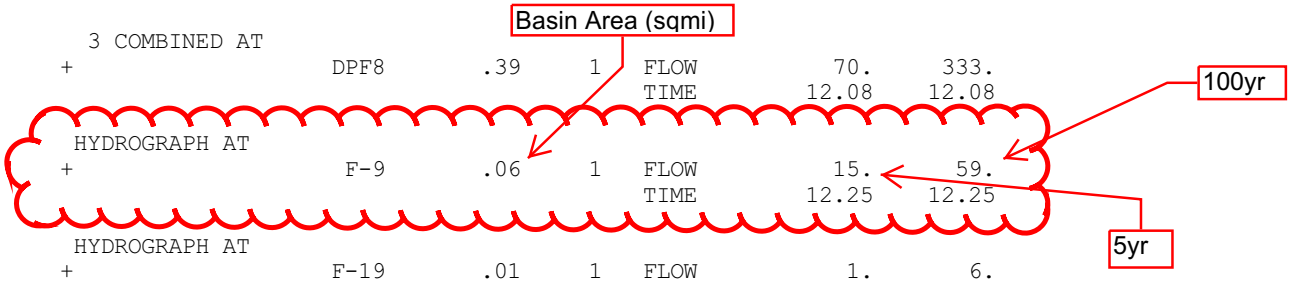
```
1*************************************
************************************
 *                                   *                                   *
*
 *   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *                                   *    U.S. ARMY CORPS OF
ENGINEERS     *
 *               JUN   1998              *                                   *    HYDROLOGIC
ENGINEERING CENTER    *
 *            VERSION 4.1                *                                   *          609 SECOND
STREET          *
 *                                       *                                   *       DAVIS, CALIFORNIA
95616       *
 *  RUN DATE   19JAN23  TIME  14:36:48   *                                   *           (916) 756-1104
*
 *                                       *                                   *
*
 ****************************************
****************************************
```

Wolf Ranch Tributary Four FN FBAS-REV.DAT
Detention basin at design point 14
F-Basins future developed condition with detention
Sub basins to F18/19 revised to match new DP
Final design of detention basin F18/19 Briargate Parkway

5-year and 100 Year, 24HR RAINFALL NOAA ATLAS 2 TYPE II STORM
REVISED 1-20-2023

```
    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          300  NUMBER OF HYDROGRAPH ORDINATES
                       NDDATE      2    0  ENDING DATE
                       NDTIME         0055  ENDING TIME
                        ICENT           19  CENTURY MARK

                    COMPUTATION INTERVAL     .08 HOURS
                         TOTAL TIME BASE   24.92 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
1

               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
                                                      RATIO 1 = 5-yr
                                                      RATIO 2 = 100-yr
                                                                  RATIOS APPLIED TO PRECIPITATION
 OPERATION       STATION     AREA    PLAN                    RATIO 1  RATIO 2
                                                                .56     1.00
```

HYDROGRAPH AT						
+	F-1	.17	1	FLOW	8.	94.
				TIME	12.25	12.08
ROUTED TO						
+	RF1	.17	1	FLOW	7.	95.
				TIME	12.33	12.17
HYDROGRAPH AT						
+	F-2	.04	1	FLOW	2.	25.
				TIME	12.17	12.08
ROUTED TO						
+	RF2	.04	1	FLOW	2.	24.
				TIME	12.25	12.17
2 COMBINED AT						
+	DPF2	.21	1	FLOW	9.	119.
				TIME	12.33	12.17
ROUTED TO						
+	RF10	.21	1	FLOW	9.	118.
				TIME	12.33	12.17
HYDROGRAPH AT						
+	F-10	.11	1	FLOW	34.	131.
				TIME	12.08	12.08
2 COMBINED AT						
+	DPF10	.32	1	FLOW	36.	230.
				TIME	12.17	12.17
ROUTED TO						
+	RF8	.32	1	FLOW	36.	230.
				TIME	12.17	12.17
HYDROGRAPH AT						
+	F-8	.04	1	FLOW	17.	57.
				TIME	12.08	12.08
HYDROGRAPH AT						
+	F-17	.04	1	FLOW	20.	59.
				TIME	12.08	12.08




```
  3 COMBINED AT
+                   DPF8       .39     1   FLOW          70.      333.
                                           TIME       12.08    12.08

 HYDROGRAPH AT
+                    F-9       .06     1   FLOW          15.       59.
                                           TIME       12.25    12.25

 HYDROGRAPH AT
+                   F-19       .01     1   FLOW           1.        6.
                                           TIME       12.08    12.00

  3 COMBINED AT
+                  DPF19       .46     1   FLOW          81.      386.
                                           TIME       12.08    12.08

 HYDROGRAPH AT
+                    F-3       .09     1   FLOW           4.       52.
                                           TIME       12.25    12.17

 ROUTED TO
+                   RF11       .09     1   FLOW           4.       51.
                                           TIME       12.25    12.17

 HYDROGRAPH AT
+                   F-11       .04     1   FLOW          13.       50.
                                           TIME       12.08    12.08

  2 COMBINED AT
+                  DPF11       .13     1   FLOW          15.       95.
                                           TIME       12.08    12.08

 ROUTED TO
+                   RF18       .13     1   FLOW          14.       92.
                                           TIME       12.08    12.08

 HYDROGRAPH AT
+                   F-18       .03     1   FLOW           7.       32.
                                           TIME       12.08    12.08

 HYDROGRAPH AT
+                    F-4       .27     1   FLOW          11.      128.
                                           TIME       12.33    12.17

 ROUTED TO
```

+	RF4	.27	1	FLOW	11.	127.
				TIME	12.33	12.25
HYDROGRAPH AT						
+	F-6	.03	1	FLOW	1.	18.
				TIME	12.17	12.08
ROUTED TO						
+	RF6	.03	1	FLOW	1.	18.
				TIME	12.25	12.17
HYDROGRAPH AT						
+	F-5	.11	1	FLOW	4.	46.
				TIME	12.42	12.25
ROUTED TO						
+	RF5	.11	1	FLOW	4.	46.
				TIME	12.42	12.25
2 COMBINED AT						
+	DPF6	.14	1	FLOW	5.	60.
				TIME	12.42	12.25
ROUTED TO						
+	RF56	.14	1	FLOW	5.	60.
				TIME	12.42	12.25
2 COMBINED AT						
+	DP4	.41	1	FLOW	15.	187.
				TIME	12.33	12.25
ROUTED TO						
+	RF456	.41	1	FLOW	15.	187.
				TIME	12.33	12.25
HYDROGRAPH AT						
+	F-12	.09	1	FLOW	25.	104.
				TIME	12.08	12.08
2 COMBINED AT						
+	DPF12	.50	1	FLOW	32.	265.
				TIME	12.17	12.17
ROUTED TO						
+	RF12	.50	1	FLOW	32.	263.

```
                                        TIME        12.17    12.17

 ROUTED TO
+                   RF16       .50      1   FLOW          31.     261.
                                            TIME        12.17    12.17

 HYDROGRAPH AT
+                    F-16      .08      1   FLOW          31.     105.
                                            TIME        12.08    12.08

  2 COMBINED AT
+                   DPF16      .57      1   FLOW          58.     345.
                                            TIME        12.08    12.17

  3 COMBINED AT
+                   DPF18      .74      1   FLOW          79.     459.
                                            TIME        12.08    12.08

  2 COMBINED AT
+                  DP1819     1.20      1   FLOW         160.     846.
                                            TIME        12.08    12.08

 ROUTED TO
+                  DB1819     1.20      1   FLOW          17.     222.
                                            TIME        15.33    12.75

                                    ** PEAK STAGES IN FEET **
                                    1   STAGE     7139.38  7142.39
                                            TIME        15.33    12.75

 ROUTED TO
+                   RF22A      1.20      1   FLOW          17.     222.
                                            TIME        15.42    12.83

 HYDROGRAPH AT
+                    F-22      .06      1   FLOW           4.      37.
                                            TIME        12.17    12.17

  2 COMBINED AT
+                   DPF22      1.26      1   FLOW          18.     234.
                                            TIME        15.33    12.50

 ROUTED TO
+                   RF27       1.26      1   FLOW          18.     238.
                                            TIME        15.58    12.58
```

Detention Basin F18/F19
5-yr Discharge=17cfs. 5-yr WSE=7139.38
100-yr Discharge=222cfs. 100-yr WSE=7142.39

HYDROGRAPH AT						
+	F-27	.25	1	FLOW	66.	241.
				TIME	12.25	12.25
2 COMBINED AT						
+	DPF27	1.51	1	FLOW	66.	398.
				TIME	12.25	12.42
HYDROGRAPH AT						
+	F-7	.08	1	FLOW	4.	46.
				TIME	12.17	12.08
ROUTED TO						
+	RF7	.08	1	FLOW	4.	46.
				TIME	12.33	12.17
ROUTED TO						
+	RF14A	.08	1	FLOW	4.	46.
				TIME	12.33	12.17
HYDROGRAPH AT						
+	F-14	.13	1	FLOW	33.	129.
				TIME	12.17	12.17
2 COMBINED AT						
+	DP14	.21	1	FLOW	34.	175.
				TIME	12.17	12.17
HYDROGRAPH AT						
+	F-15	.02	1	FLOW	11.	33.
				TIME	12.08	12.08
ROUTED TO						
+	RF15	.02	1	FLOW	11.	31.
				TIME	12.17	12.08
HYDROGRAPH AT						
+	F-23	.03	1	FLOW	21.	55.
				TIME	12.08	12.08
2 COMBINED AT						
+	DPF23A	.05	1	FLOW	31.	86.
				TIME	12.08	12.08

```
 ROUTED TO
+                   RF23       .05     1   FLOW          30.      85.
                                           TIME        12.08    12.08

  2 COMBINED AT
+                  DPF23       .26     1   FLOW          63.     252.
                                           TIME        12.17    12.17

 ROUTED TO
+                  DBF14       .26     1   FLOW           3.      81.
                                           TIME        19.92    12.58

                                       ** PEAK STAGES IN FEET **
                                       1   STAGE     7131.22  7133.45
                                           TIME        19.92    12.58

 ROUTED TO
+                   RF25       .26     1   FLOW           3.      81.
                                           TIME        20.00    12.58

 HYDROGRAPH AT
+                   F-25       .09     1   FLOW          27.      95.
                                           TIME        12.17    12.17

  2 COMBINED AT
+                  DPF25       .35     1   FLOW          27.     146.
                                           TIME        12.17    12.33

 ROUTED TO
+                   RF30       .35     1   FLOW          27.     144.
                                           TIME        12.25    12.33

 HYDROGRAPH AT
+                   F-24       .09     1   FLOW          62.     147.
                                           TIME        12.17    12.17

 ROUTED TO
+                  RF30A       .09     1   FLOW          61.     146.
                                           TIME        12.17    12.17

 HYDROGRAPH AT
+                   F-30       .02     1   FLOW          10.      31.
                                           TIME        12.08    12.08

 HYDROGRAPH AT
```

+	F-41	.08	1	FLOW	13.	69.
				TIME	12.17	12.17
ROUTED TO						
+	RF41	.08	1	FLOW	13.	69.
				TIME	12.17	12.17
HYDROGRAPH AT						
+	F-42	.05	1	FLOW	15.	58.
				TIME	12.17	12.08
2 COMBINED AT						
+	DPF42	.13	1	FLOW	28.	126.
				TIME	12.17	12.17
ROUTED TO						
+	RF30B	.13	1	FLOW	28.	125.
				TIME	12.17	12.17
4 COMBINED AT						
+	DPF30	.59	1	FLOW	125.	398.
				TIME	12.17	12.17
ROUTED TO						
+	RF-29	.59	1	FLOW	125.	395.
				TIME	12.25	12.25
HYDROGRAPH AT						
+	F-29	.02	1	FLOW	10.	32.
				TIME	12.08	12.08
2 COMBINED AT						
+	DPF29	.61	1	FLOW	133.	417.
				TIME	12.25	12.25
ROUTED TO						
+	RF28	.61	1	FLOW	129.	414.
				TIME	12.25	12.25
HYDROGRAPH AT						
+	F-28	.04	1	FLOW	8.	37.
				TIME	12.17	12.17
2 COMBINED AT						
+	DPF28	.66	1	FLOW	136.	445.

```
                                        TIME        12.25    12.25

  2 COMBINED AT
+                 DPF28A      2.17     1   FLOW         202.     780.
                                        TIME        12.25    12.33

 ROUTED TO
+                  DBF28      2.17     1   FLOW          31.     590.
                                        TIME        16.83    12.67

                                    ** PEAK STAGES IN FEET **
                                    1   STAGE     6976.05  6978.39
                                        TIME        16.75    12.67

 ROUTED TO
+                  RF31A      2.17     1   FLOW          31.     589.
                                        TIME        16.83    12.67

 ROUTED TO
+                  RF31B      2.17     1   FLOW          31.     588.
                                        TIME        17.00    12.67

 ROUTED TO
+                  RF31C      2.17     1   FLOW          31.     586.
                                        TIME        17.00    12.75

 HYDROGRAPH AT
+                   F-31       .07     1   FLOW           3.      36.
                                        TIME        12.25    12.17

  2 COMBINED AT
+                   DPF       2.24     1   FLOW          32.     596.
                                        TIME        17.00    12.75
1
                                    SUMMARY OF KINEMATIC WAVE - MUSKINGUM-CUNGE ROUTING
                                        (FLOW IS DIRECT RUNOFF WITHOUT BASE FLOW)
                                                                    INTERPOLATED TO
                                                                  COMPUTATION INTERVAL
            ISTAQ    ELEMENT      DT       PEAK    TIME TO     VOLUME      DT       PEAK    TIME TO     VOLUME
                                                      PEAK                                      PEAK

                                  (MIN)     (CFS)      (MIN)      (IN)     (MIN)     (CFS)      (MIN)       (IN)

          FOR PLAN = 1  RATIO=  .00
               RF1  MANE         1.25      7.82    738.75       .19      5.00      7.39    740.00         .19
```

APPENDIX D

Previous Wolf Ranch MDDP

Previous HEC-1 Hydrologic Input & Output – Basin F (24 Hour Rainfall)

7175 West Jefferson Avenue Suite 2200, Lakewood, Colorado 80235
Ph: (303) 692-0369 www.kiowaengineering.com

DESIGN POINT DISCHARGE SUMMARY w/DETENTION			
DESIGN POINT	AREA(sm)	Q_5 (cfs)	Q_{100} (cfs)
A1	0.06	3	32
A3	0.21	49	194
A4 (IN)	0.30	87	334
A4 (OUT)	0.30	8	87
A5 (IN)	0.74	193	663
A5 (OUT)	0.74	27	114
A6	0.52	118	391
A7	0.18	90	292
A	1.02	154	236
A9	0.11	49	161
B	0.04	60	122
C3	0.05	33	100
C	0.16	104	314
E5	0.13	85	241
E2 (IN)	0.18	111	335
D2 (IN)	0.10	49	160
DBDE (OUT)	0.18	13	157

DESIGN POINT DISCHARGE SUMMARY w/DETENTION			
DESIGN POINT	AREA(sm)	Q_5 (cfs)	Q_{100} (cfs)
F9 (1)	0.21	16	134
F10 (1)	0.06	4	40
F11 (1)	0.14	11	90
F12 (1)	0.43	20	211
F13 (1)	0.05	2	25
F14A (2)	0.12	4	67
F14 (IN) (2)	0.30	50	250
F14 (OUT) (2)	0.30	5	80
F18 / F19 (IN) (1)	1.14	113	750
F18 / F19 (OUT) (1)	1.14	12	215
F22 (1)	1.24	15	230
F23 (1)	0.05	14	59
F25 (2)	0.39	27	132
F42 (2)	0.13	28	126
F30 (2)	0.64	124	407
F29 (2)	0.66	132	419
F28 (IN) (2)	2.18	211	709
F28 (OUT) (2)	2.18	30	532
F (2)	2.25	31	546

(1) UPDATED HYDROLOGY FOR BASINS F, G, AND H. DETERMINED USING CITY OF COLORADO SPRINGS DCM 2014.
(2) UPDATED HYDROLOGY FOR BASIN F BASED ON PROPOSED ADDITION OF DETENTION BASIN F14, AND DIVERSION OF SUB-BASIN F41 TO TRIBUTARY 4

DESIGN POINT DISCHARGE SUMMARY w/DETENTION			
DESIGN POINT	AREA(sm)	Q_5 (cfs)	Q_{100} (cfs)
G3 (1)	0.168	16	91
G3 (OUT) (1)	0.168	1	10
G-4 (1)	.027	5	25

(1) UPDATED HYDROLOGY FOR BASINS F, G, AND H. DETERMINED USING CITY OF COLORADO SPRINGS DCM 2014.

DETENTION BASIN E/D DATA (2)

Q_5 IN = 160 cfs — Q_{100} IN = 492 cfs
Q_5 OUT = 13 cfs — Q_{100} OUT = 155 cfs (1)
VOL_5 = 5.9 AC–FT
VOL_{100} = 14.8 AC–FT
WS_5 = 55.2
WS_{100} = 57.8

(1) TOTAL OUTFLOW. OUTFLOW TO BE CONTROLLED TO EXISTING LEVELS AT DP E2 & DP D2
(2) DETENTION BASIN IN AS–BUILT CONDITION

DETENTION BASIN DB F18/F19 DATA (1)

Q_5 IN = 113 cfs — Q_{100} IN = 750 cfs
Q_5 OUT = 12 cfs — Q_{100} OUT = 215 cfs
VOL_5 = 9.8 AC–FT
VOL_{100} = 27.7 AC–FT

(1) NOAA ATLAS 14 24 HR RAINFALL. 30% DESIGN STORM DISTRIBUTION.

DETENTION BASIN DB F28 DATA(1)(2)

Q_5 IN = 211 cfs — Q_{100} IN = 709 cfs
Q_5 OUT = 30 cfs — Q_{100} OUT = 532 cfs
VOL_5 = 16.7 AC–FT
VOL_{100} = 24.8 AC–FT

(1) NOAA ATLAS 14 24 HR RAINFALL .30% DESIGN STORM DISTRIBUTION. (2) UPDATED HYDROLOGY FOR BASIN F

DETENTION BASIN DB F14 DATA (1)

Q_5 IN = 50 cfs — Q_{100} IN = 250 cfs
Q_5 OUT = 5 cfs — Q_{100} OUT = 80 cfs
VOL_5 = 3.1 AC–FT
VOL_{100} = 8.5 AC–FT

(1) NOAA ATLAS 14 24 HR RAINFALL. 30% DESIGN STORM DISTRIBUTION.

DETENTION BASIN A DATA (1)

Q_5 IN = 193 cfs — Q_{100} IN = 663 cfs
Q_5 OUT = 27 cfs — Q_{100} OUT = 114 cfs
VOL_5 = 6.9 AC–FT
VOL_{100} = 28.2 AC–FT

(1) DETENTION BASIN MODELED ITS AS–BUILT CONDITION

DETENTION BASIN A4 DATA

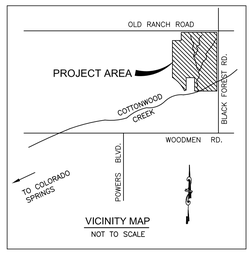
Q_5 IN = 87 cfs — Q_{100} IN = 334 cfs
Q_5 OUT = 8 cfs — Q_{100} OUT = 87 cfs
VOL_5 = 4.6 AC–FT
VOL_{100} = 10.9 AC–FT

(1) DETENTION BASIN MODELED AS A FSD

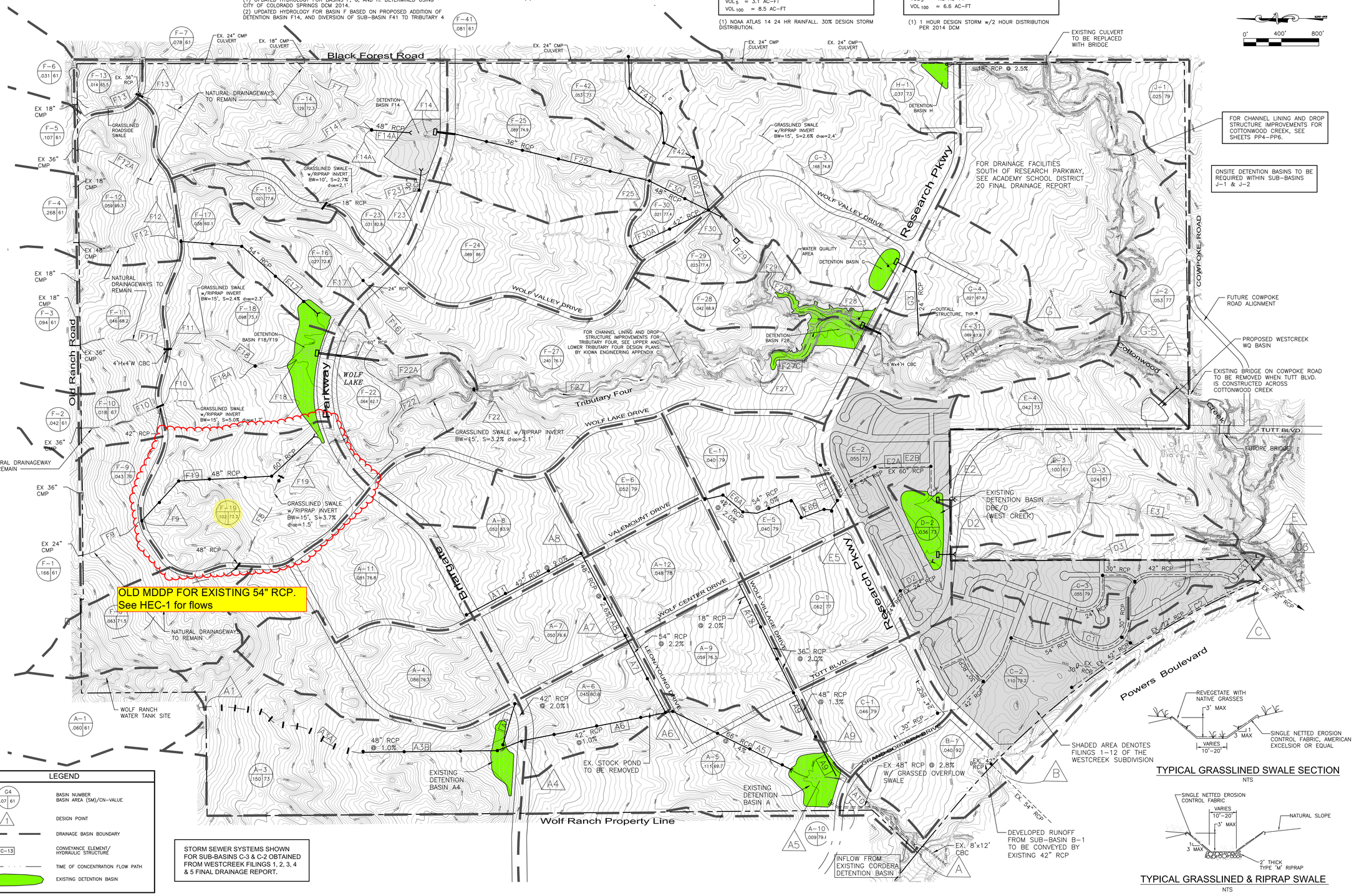
DETENTION BASIN G DATA (1)

Q_5 IN = 16 cfs — Q_{100} IN = 91 cfs
Q_5 OUT = 1 cfs — Q_{100} OUT = 10 cfs
VOL_5 = 1.5 AC–FT
VOL_{100} = 6.6 AC–FT

(1) 1 HOUR DESIGN STORM w/2 HOUR DISTRIBUTION PER 2014 DCM



0' 400' 800'



LEGEND	
G4 / .07 / 61	BASIN NUMBER BASIN AREA (SM)/CN–VALUE
1	DESIGN POINT
	DRAINAGE BASIN BOUNDARY
C–13	CONVEYANCE ELEMENT/ HYDRAULIC STRUCTURE
	TIME OF CONCENTRATION FLOW PATH
	EXISTING DETENTION BASIN

STORM SEWER SYSTEMS SHOWN FOR SUB-BASINS C-3 & C-2 OBTAINED FROM WESTCREEK FILINGS 1, 2, 3, 4 & 5 FINAL DRAINAGE REPORT.

TYPICAL GRASSLINED SWALE SECTION
NTS

TYPICAL GRASSLINED & RIPRAP SWALE
NTS

Kiowa Engineering Corporation
7175 West Jefferson Avenue, Suite 2200
Lakewood, Colorado 80235
(303) 692-0369

WOLF RANCH
MASTER DEVELOPMENT DRAINAGE PLAN UPDATE
PROPOSED FACILITIES
COLORADO SPRINGS, COLORADO

Project No.:	12055
Date:	11/20/2020
Design:	RNW
Drawn:	MTR
Check:	MWE
Revisions:	

Fig. 6

```
1*****************************************
 *                                       *
 *   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *
 *               JUN   1998              *
 *            VERSION 4.1                *
 *                                       *
 *  RUN DATE   08NOV20  TIME  15:38:42   *
 *                                       *
 *****************************************
```

Basin F
24 Hour Rainfall

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

OLD HYDRLOGY FOR EXISTING 54" RCP. WEST END DETENTION BASIN F19

See clouded text for basin F19 information. F19 was the basin previously tributary to the existing 54" RCP

```
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             Wolf Ranch Tributary Four   FN F14-24HRT2.DAT
            2       ID             Detention basin added at design  point 14
            3       ID             F-Basins future developed condition with detention
            4       ID             Final design of detention basin F18/19  Briargate Parkway
            5       ID             5-year and 100 Year, 24HR RAINFALL NOAA ATLAS 2 TYPE II STORM
            6       ID             WR MDDP UPDATE 11-08-2020
                    *DIAGRAM
            7       IT       5       0       0     300
            8       IO       5       0
            9       JR    PREC     .56     1.0

           10       KK     F-8
           11       KM        RUNOFF FOR SUB-BASIN F-8
           12       BA   .0630
           13       IN     15
           14       PB    4.4
           15       PC       0    .002    .005    .008    .011   .0104   .0170     .02    .023    .026
           16       PC    .029    .032    .035    .038    .041    .044    .048    .052    .056     .06
           17       PC   .0604    .068    .072    .076     .08    .085     .09    .095      .1    .105
           18       PC     .11    .115     .12    .126    .133     .14    .147    .155    .163    .172
           19       PC    .181    .191    .203    .218    .236    .257    .283    .387    .663    .707
```

IT=TIME SPECIFICATION, 5 min intervals, 300 hydrograph ordinates
JR=MULTIRATION, PREC=RATIOS OF PRECIPITATION
0.56(PB)=5YR, 1.0(PB)=100YR

BA=SUB-BASIN AREA (SQUARE MILES)IN=TIME INTERVAL FOR INPUT DATA, 15 minutes in tabulation interval PB=BASIN AVERAGE PRECIPITATION, 4.4 inches

PC=CUMULATIVE PRECIPITATION TIME SERIES

```
   20          PC    .735    .758    .776    .791    .804    .815    .825    .834    .842    .849
   21          PC    .856    .863    .869    .875    .881    .887    .893    .898    .903    .908
   22          PC    .913    .918    .922    .926     .93    .934    .938    .942    .946     .95
   23          PC    .953    .956    .959    .962    .965    .968    .971    .974    .977     .98
   24          PC    .983    .986    .989    .992    .995    .998
   25          LS       0    71.5
   26          UD    0.22
   27          KK    RF-8
   28          KM         ROUTE FLOW FROM SUB-BASIN F-8 TO DETENTION BASIN DB 19
   29          RD    1800   0.037    0.04            TRAP      15       4
   30          KK     F-1
   31          KM         RUNOFF FOR BASIN F-1
   32          BA   .1659
   33          LS       0      61
   34          UD     .20
   35          KK    RF-9
   36          KM         ROUTE FLOW FROM SUB-BASIN F-1 TO DESIGN POINT F9
   37          RD     700   0.037    0.04            TRAP      10       6
   38          KK     F-9
   39          KM         RUNOFF FOR BASIN F-9
   40          BA   .0430
   41          LS       0      70
   42          UD     .16
   43          KK    DPF9
   44          KM        COMBINE FLOW FROM SUB-BASIN F-9 AND RF-9
   45          HC       2
1                                        HEC-1 INPUT                                        PAGE   2

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

   46          KK   RF-19
   47          KM         ROUTE FLOW FROM DESIGN POINT DP F9 TO RF-19A
   48          RD    1600   0.018   0.013            CIRC       4
   49          KK  RF-19A
   50          KM         ROUTE FLOW FROM RF-=19 TO DP F19
   51          RK     400     .02    .013            CIRC       5
   52          KK    F-19
   53          KM         RUNOFF FOR BASIN F-19
   54          BA   .1020
   55          LS       0    73.2
   56          UD     .19
   57          KK   DPF19
   58          KM        COMBINE FLOW FROM SUB-BASIN F-19, RF-8 AND RF19
   59          HC       3
   60          KK     F-2
   61          KM         RUNOFF FOR BASIN F-2
   62          BA   .0424
   63          LS       0      61
   64          UD     .19
```

LS=SCS CURVE NUMBER LOSS RATE, 0=initial abstraction computed from curve number of 71.5 SCS DIMENSIONLESS UNIT HYDROGRAPH, scs lag in hours =0.22

RD=MUSKINGUM-CUNGE ROUTINGchannel length =1800ft, slope=3.7%, Manning's n=0.04 trapezoidal channel, 15-ft bottom width, 4:1 side slopes

HC=COMBINE HYDROGRAPHS, 2 hydrographs combined

RK=KINEMATIC WAVE CHANNEL ROUTING channel length =400 feet, slope=2%, Manning's n=.013 circular channel, 5-ft bottom width

```
   65          KK   RF-10
   66          KM        ROUTE FLOW FROM SUB-BASIN F-2 TO DESIGN POINT F10
   67          RD     850   0.059    0.04            TRAP      10       6

   68          KK    F-10
   69          KM        RUNOFF FOR BASIN F-10
   70          BA   .0180
   71          LS       0      67
   72          UD     .15

   73          KK   DPF10
   74          KM       COMBINE FLOW FROM SUB-BASIN F-10 AND RF10
   75          HC       2

   76          KK  RF-18A
   77          KM       ROUTE FLOW FROM DESIGN POINT DP F10 TO DETENTION BASIN DB 18
   78          RD    1600   0.050    0.04            TRAP      15       4

   79          KK     F-3
   80          KM        RUNOFF FOR SUB-BASIN F-3
   81          BA   .0942
   82          LS       0      61
   83          UD     .22

   84          KK   RF-11
   85          KM       ROUTE FLOW FROM SUB-BASIN F-3 TO DESIGN POINT F11
   86          RD     950   0.038    0.04            TRAP      10       6
1                                      HEC-1 INPUT                                                PAGE  3

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

   87          KK    F-11
   88          KM        RUNOFF FOR SUB-BASIN F-11
   89          BA   .0460
   90          LS       0    68.2
   91          UD     .17

   92          KK   DPF11
   93          KM       COMBINE FLOW FROM SUB-BASIN F-11 AND RF-11
   94          HC       2

   95          KK   RF-18
   96          KM       ROUTE FLOW FROM DESIGN POINT F11 TO DETENTION BASIN DB 18
   97          RD    1600   0.029    0.04            TRAP      15       4

   98          KK     F-4
   99          KM        RUNOFF FOR SUB-BASIN F-4
  100          BA   .2681
  101          LS       0      61
  102          UD     .28

  103          KK   RF-12
  104          KM       ROUTE FLOW FROM SUB-BASIN F-4 TO DESIGN POINT F12
  105          RD    1150   0.044    0.04            TRAP      10       6

  106          KK     F-5
  107          KM        RUNOFF FOR SUB-BASIN F-5
```

```
 108          BA   .1073
 109          LS      0      61
 110          UD     .34

 111          KK  RF-12A
 112          KM        ROUTE FLOW FROM SUB-BASIN F-5 TO DESIGN POINT F12
 113          RD    1600   0.035    0.04            TRAP      10       6

 114          KK    F-12
 115          KM         RUNOFF FOR SUB-BASIN F-12
 116          BA   .0590
 117          LS      0    69.3
 118          UD     .20

 119          KK   DPF12
 120          KM        COMBINE FLOW FROM SUB-BASIN RF-12 RF-12A, AND F-12
 121          HC       3

 122          KK   RF-17
 123          KM        ROUTE FLOW FROM DESIGN POINT F-12 TO DETENTION BASIN DB 18
 124          RD    1600   0.020   0.013            CIRC     4.5

 125          KK    F-17
 126          KM         RUNOFF FOR SUB-BASIN F-17
 127          BA   .0380
 128          LS      0    60.1
 129          UD     .21
1                                      HEC-1 INPUT                                          PAGE  4

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


 130          KK    F-18
 131          KM         RUNOFF FOR SUB-BASIN F-18
 132          BA   .0980
 133          LS      0    73.1
 134          UD     .21

 135          KK   DPF18
 136          KM        COMBINE FLOW FROM SUB-BASINS F-18, F17, RF-18A, RF-18, RF-17
 137          KM        THIS IS INFLOW TO DETENTION BASIN F-18
 138          HC       5

 139          KK  DP1819
 140          KM         COMBINE DPF18 AND F19
 141          KM        INFLOW TO DET BASIN F18-19
 142          HC       2

 143          KK  DF1819
 144          KM          ROUTE DPF1819  THROUGH DETENTION BASIN F 18-19
 145          KM          THIS IS OUTFLOW FROM DETENTION BASIN F 18-19
 146          RS       1    ELEV  7132.7
 147          SV       0     .01     .02      .1      .52    1.76    4.43    8.72    14.3   20.74
 148          SV   27.65      37   42.64    48.9      58.8    65.0    69.1
 149          SE  7132.7  7133.5    7134    7135      7136    7137    7138    7139    7140    7141
 150          SE    7142    7143    7144    7145      7146    7147  7147.5
 151          SQ       0      .4      .5      .8       1.1     1.5     1.9     2.2    41.3   133.8
 152          SQ   217.3   230.4   242.8   253.3     257.1   268.2   271.7
```

RS=STORAGE ROUTING, 1 step, elevation for beginning of the first time period=7132.7

Detention Basin F18/F19
Volume-Stage-Discharge

SV=RESERVOIR VOLUME (acre-ft) SE=ELEVATION (ft) corresponding to volume in same field on preceding SV recordSQ=DISCHARGE (cfs) corresponding to volume and elevation in same field on preceding SV and SE records
example: 48.9 ac-ft corresponds to an elevation of 7145 ft and a discharge of 253.3 cfs

```
153          KK  RF-22A
154          KM        ROUTE FLOW FROM DETENTION BASIN F1819 TO DESIGN POINT DP F22
155          RD    1800   0.027    0.02            TRAP      10       6

156          KK    F-22
157          KM         RUNOFF FOR SUB-BASIN F-22
158          BA   .0640
159          LS       0    64.1
160          UD     .21

161          KK    F-16
162          KM           RUNOFF FROM SUB-BASIN F-16
163          BA    .027
164          LS       0    72.8
165          UD     .21

166          KK   RF-16
167          KM          ROUTE FLOW FROM SUB-BASIN F-16 TO DP F22
168          RD    1800    .045    .013            CIRC     2.5

169          KK   DPF22
170          KM        COMBINE FLOW FROM SUB-BASIN F-22, RF-16 AND RF-22A
171          HC       3
1                                      HEC-1 INPUT                                      PAGE  5

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

172          KK  RF-27
173          KM        ROUTE FLOW FROM DESIGN POINT DPF22 TO DESIGN POINT F27
174          RD    3700   0.020    0.04            TRAP      50       3

175          KK  RF-27C
176          KM        ROUTE FLOW FROM RF-27 TO DESIGN POINT F28
177          RD    1400   0.019    0.04            TRAP      50       3

178          KK    F-7
179          KM         RUNOFF FOR SUB-BASIN F-7
180          BA   .0782
181          LS       0      61
182          UD     .19

183          KK   RF-7
184          KM        ROUTE FLOW FROM SUB-BASIN F-7 TO DESIGN POINT F14A
185          RD    1200   0.033    0.04            TRAP      10       6

186          KK    F-6
187          KM         RUNOFF FOR SUB-BASIN F-6
188          BA   .0310
189          LS       0      61
190          UD     .19

191          KK   RF-13
192          KM        ROUTE FLOW FROM SUB-BASIN F-6 TO DESIGN POINT F13
193          RD     800   0.038    0.04            TRAP      10       6

194          KK    F-13
195          KM         RUNOFF FOR SUB-BASIN F-13
196          BA   .0140
```

```
197          LS       0      61
198          UD     .14

199          KK  DPF13
200          KM        COMBINE FLOW FROM RF-13 AND F-13
201          HC       2

202          KK   RF-14
203          KM        ROUTE FLOW FROM DESIGN POINT F13 TO RF-14A
204          RD    2400   0.027    0.04            TRAP      20       6

205          KK   DP14A
206          KM        COMBINE  RF-7 AND RF 14
207          HC       2

208          KK  RF-14A
209          KM         ROUTE FLOW FROM DP 14A TO DP F14
210          RK     800     .02    .013            CIRC       4
1                                      HEC-1 INPUT                                                    PAGE  6

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

211          KK    F-15
212          KM         RUNOFF FDROM F-15
213          BA   .0210
214          LS       0    69.1
215          UD     .15

216          KK   RF-23
217          KM          ROUTE RUN OFF FROM F-15  TO DESIGN PONT F23
218          RD    1200    .023     .04            TRAP      10       3

219          KK    F-23
220          KM         RUNOFF FROM SUB BASIN F23
221          BA   .0310
222          LS       0      73
223          UD     .18

224          KK   DPF23
225          KM         COMBINE FLOW FROM RF-23 AND  F-23
226          HC       2

227          KK  RF-23A
228          KM          ROUTE RUNOFF FROM DP F23 TO DP 14
229          RD     700    .016    .013            CIRC       3

230          KK    F-14
231          KM         RUNOFF FROM SUB BASIN F-14
232          BA   .1290
233          LS       0    72.3
234          UD     .23

235          KK  DPF14
236          KM        COMBINE FLOW FROM RF-23A   F-14, AND RF-14A
237          KM       THIS IS INFLOW TO DB 14
238          HC       3

239          KK   DB 14
```

```
  240          KM         DETENTION BASIN 14
  241          KM          THIS IS OUTFLOW FROM DETENTION BASIN 14
  242          RS       1    ELEV  7124.5
  243          SV       0     .01     .05     .31    1.14    2.82     5.4    8.45   11.77   15.25
  244          SV    17.1    18.9    20.8    22.8
  245          SE  7124.5  7125.5  7126.5  7127.5  7128.5  7129.5  7130.5  7131.5  7132.5  7133.5
  246          SE    7134  7134.5    7135  7135.5
  247          SQ       0     .15     .29     .43     .66     .91    31.6    82.2      89    95.2
  248          SQ     206   410.7   681.6  1009.5

  249          KK   RF-25
  250          KM       ROUTE FLOW FROM DETENTION BASIN DB  14 TO DESIGN POINT F25
  251          RD    2600   0.023   0.013           CIRC       3
1                                    HEC-1 INPUT                                          PAGE  7

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

  252          KK    F-25
  253          KM         RUNOFF FOR SUB-BASIN F-25
  254          BA   .0890
  255          LS       0    74.9
  256          UD     .28

  257          KK  DPF25
  258          KM       COMBINE FLOW FROM RF-25 AND RF-14
  259          HC       2

  260          KK   RF-30
  261          KM       ROUTE FLOW FROM DESIGN POINT F25 TO DESIGN POINT F30
  262          RD     750   0.027   0.013           CIRC       4

  263          KK    F-24
  264          KM         RUNOFF FOR SUB-BASIN F-24
  265          BA   .0890
  266          LS       0      86
  267          UD     .26

  268          KK  RF-30A
  269          KM       ROUTE FLOW FROM SUB-BASIN    F24 TO DESIGN POINT F30
  270          RD     920   0.033   0.013           CIRC     3.5

  271          KK    F-30
  272          KM         RUNOFF FOR SUB-BASIN F-30
  273          BA   .0212
  274          LS       0    77.4
  275          UD     .18

  276          KK    F-41
  277          KM         RUNOFF FROM SUB-BASIN F-41
  278          BA    .081
  279          LS       0      68
  280          UD     .22

  281          KK   RF 41
  282          KM         ROUTE RUNOFF FROM  SUB-B ASIN F-41 TO DP 42
  283          RD    1450     .03    .013           CIRC     2.5

  284          KK    F-42
```

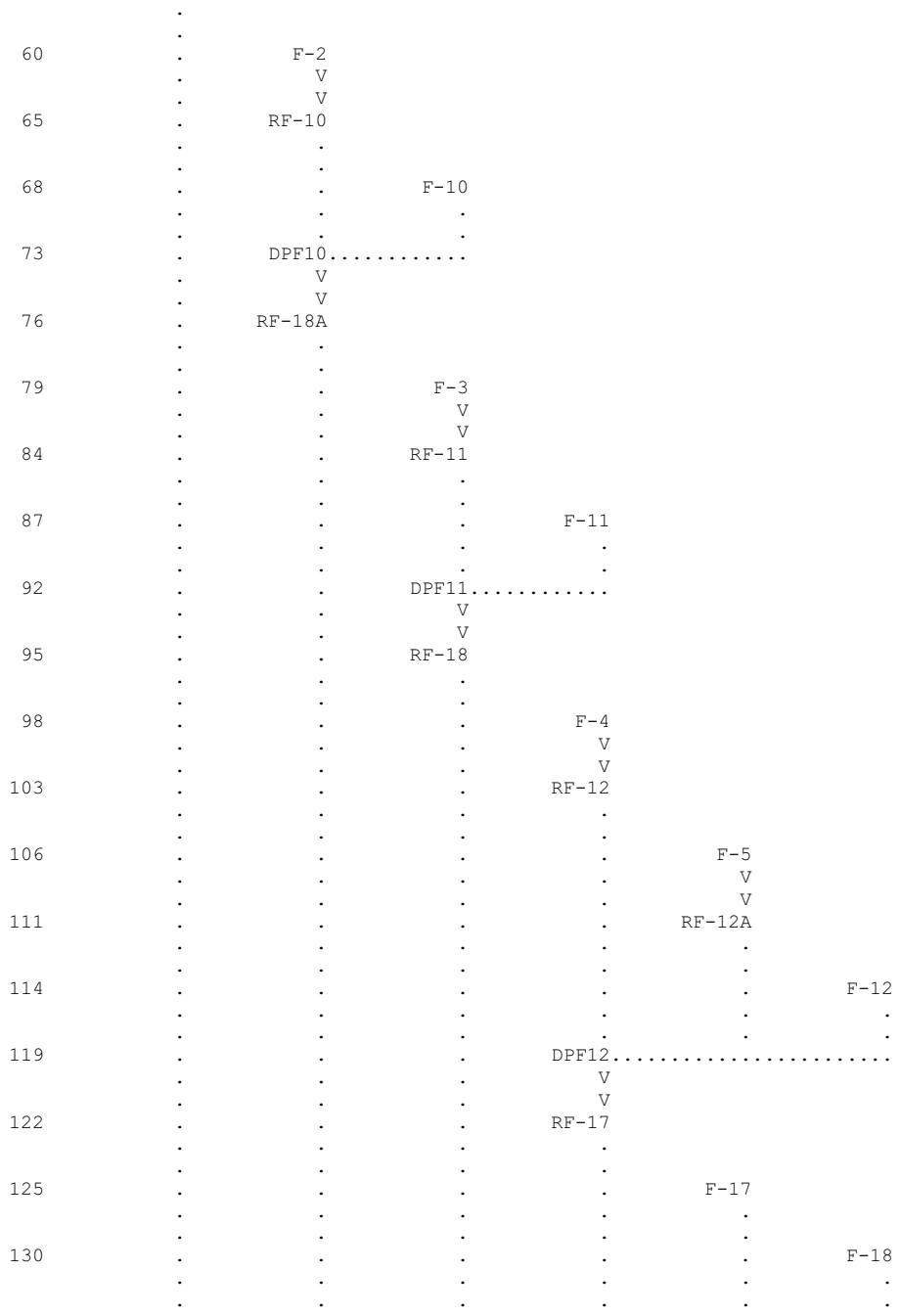
Detention Basin F14
Volume-Stage-Discharge

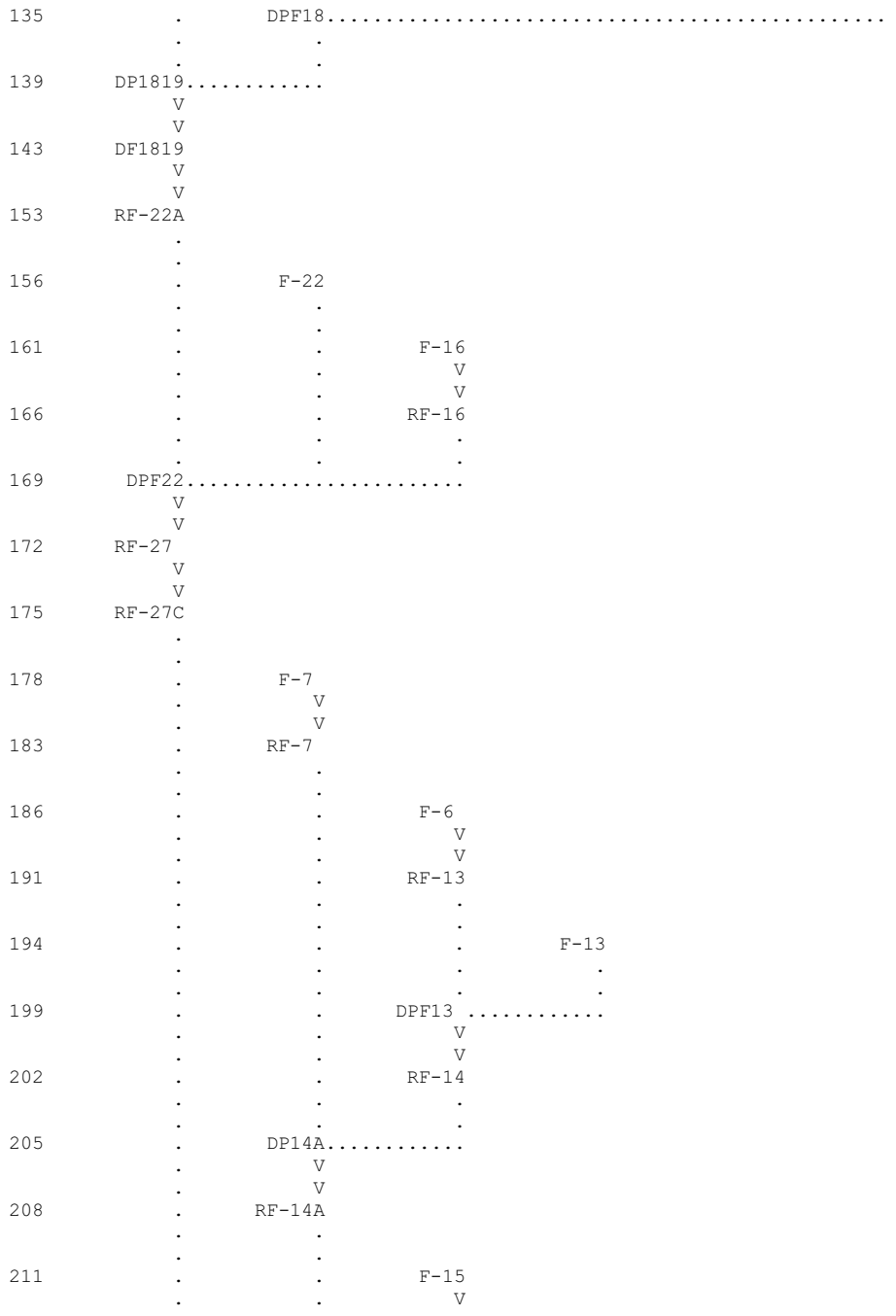
```
          285          KM         RUNOFF FROM SUB-BASIN F-42
          286          BA    .053
          287          LS              73
          288          UD     .22

          289          KK   DPF42
          290          KM        COMBINE RUNOFF FROM F-42 AND RF-41
          291          HC       2
1                                        HEC-1 INPUT                                                    PAGE  8

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


          292          KK  RF 30B
          293          KM        ROUTE FLOW FROM DP F42 TO DP F30
          294          RD     600     .03    .013            CIRC       3

          295          KK   DPF30
          296          KM         COMBINE FLOW FROM RF30B,RF30A, RF30 AND SUB-BASIN F-30
          297          HC       4

          298          KK   RF-29
          299          KM        ROUTE FLOW FROM DESIGN POINT F30 TO DESIGN POINT F29
          300          RD    2350   0.027    0.04            TRAP       6       3

          301          KK    F-29
          302          KM         RUNOFF FOR SUB-BASIN F-29
          303          BA   .0226
          304          LS       0    77.4
          305          UD     .19

          306          KK  DPF29
          307          KM        COMBINE FLOW FROM RF-29 AND F-29
          308          HC       2

          309          KK   RF-28
          310          KM        ROUTE FLOW FROM DESIGN POINT F29 TO DESIGN POINT F28
          311          RD     750   0.015    0.04            TRAP      20       3

          312          KK    F-28
          313          KM         RUNOFF FOR SUB-BASIN F-28
          314          BA    .042
          315          LS       0      68
          316          UD     .23

          317          KK    F-27
          318          KM         RUNOFF FOR SUB-BASIN F-27
          319          BA    .240
          320          LS       0    76.2
          321          UD     .32

          322          KK   DPF28
          323          KM        COMBINE FLOW FROM RF-27C, RF-28, F-28 AND F-27
          324          KM        THIS IS INFLOW TO DETENTION BASIN F-28
          325          HC       4

          326          KK   DBF28
          327          KM        ROUTE DPF28 THROUGH DETENTION BASIN F-28
          328          KM        THIS IS OUTFLOW FROM DETENTION BASIN F-28
```

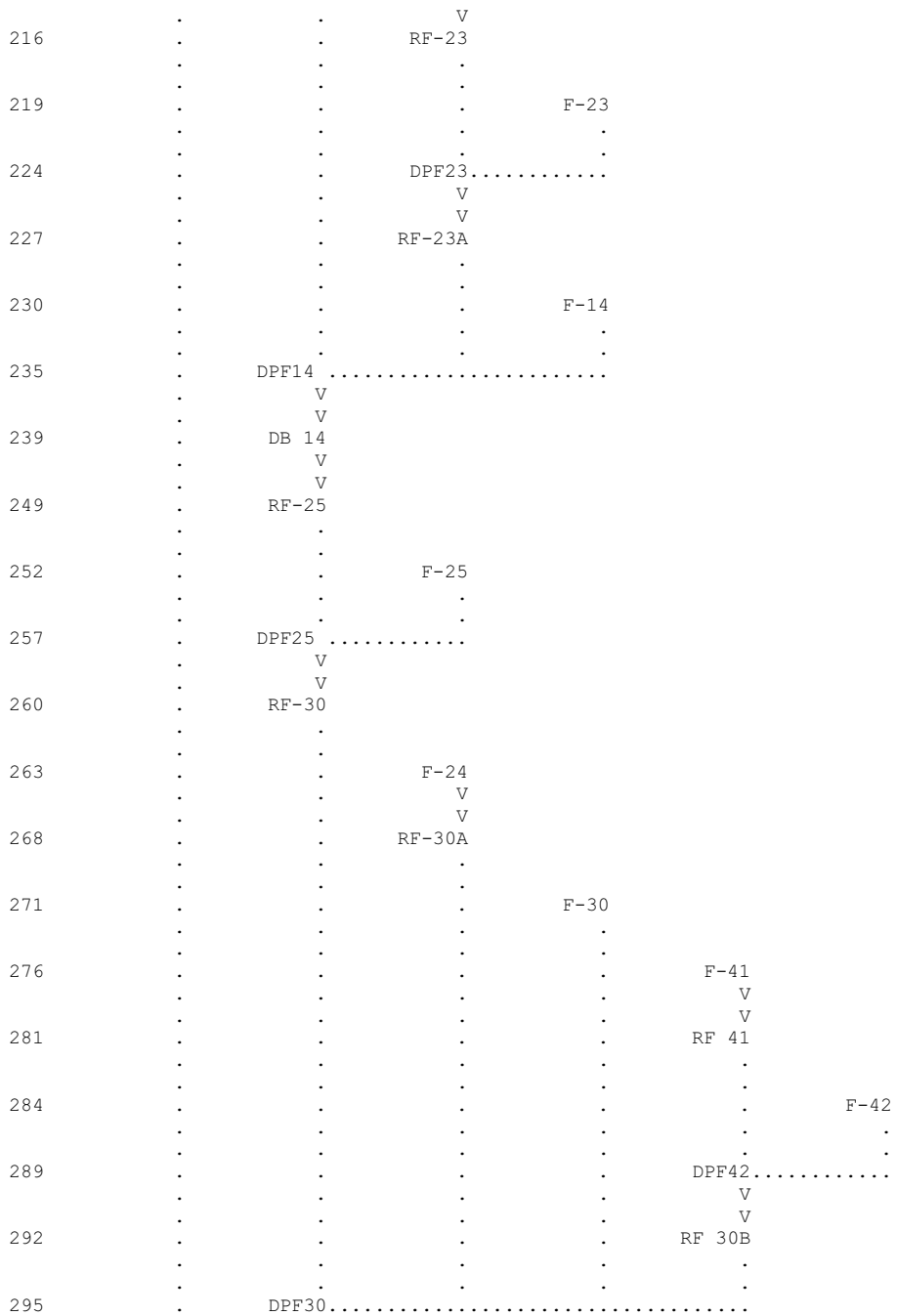
```
          329          KM        FINAL DESIGN STAGE DISCHARGE
          330          RS       1    ELEV    6968
          331          SV       0    1.07    5.23   10.56    16.7    20.2      24   32.76      43
          332          SE    6968    6970    6972    6974    6976    6977    6978    6980    6982
          333          SQ       0     1.5     4.8    10.2    15.6     340     520     880    1000
1                                                    HEC-1 INPUT                                  PAGE  9

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


          334          KK   RF-31
          335          KM        ROUTE FLOW FROM DPF TO DESIGN POINT F
          336          RD    3500   0.023    0.04            TRAP      20       3

          337          KK    F-31
          338          KM         RUNOFF FOR SUB-BASIN F-31
          339          BA    .069
          340          LS       0      61
          341          UD     .34

          342          KK    DP F
          343          KM        COMBINE FLOW FROM RF-31 AND F-31
          344          HC       2
          345          ZZ
1
               SCHEMATIC DIAGRAM OF STREAM NETWORK
 INPUT
  LINE      (V) ROUTING          (--->) DIVERSION OR PUMP FLOW

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

    10         F-8
                 V
                 V
    27         RF-8
                 .
                 .
    30           .         F-1
                 .           V
                 .           V
    35           .        RF-9
                 .           .
                 .           .
    38           .           .         F-9
                 .           .           .
                 .           .           .
    43           .        DPF9............
                 .           V
                 .           V
    46           .       RF-19
                 .           V
                 .           V
    49           .      RF-19A
                 .           .
                 .           .
    52           .           .         F-19
                 .           .           .
                 .           .           .
    57      DPF19.........................
```

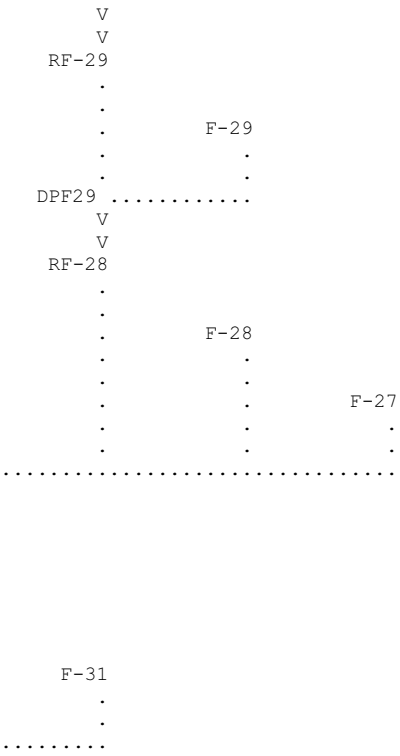
Detention Basin F28
Volume-Stage-Discharge

ZZ=END OF JOB


60
F-2
65
RF-10
68
F-10
73
DPF10
76
RF-18A
79
F-3
84
RF-11
87
F-11
92
DPF11
95
RF-18
98
F-4
103
RF-12
106
F-5
111
RF-12A
114
F-12
119
DPF12
122
RF-17
125
F-17
130
F-18


135
DPF18
139
DP1819
143
DF1819
153
RF-22A
156
F-22
161
F-16
166
RF-16
169
DPF22
172
RF-27
175
RF-27C
178
F-7
183
RF-7
186
F-6
191
RF-13
194
F-13
199
DPF13
202
RF-14
205
DP14A
208
RF-14A
211
F-15


216 RF-23
219 F-23
224 DPF23
227 RF-23A
230 F-14
235 DPF14
239 DB 14
249 RF-25
252 F-25
257 DPF25
260 RF-30
263 F-24
268 RF-30A
271 F-30
276 F-41
281 RF 41
284 F-42
289 DPF42
292 RF 30B
295 DPF30



(***) RUNOFF ALSO COMPUTED AT THIS LOCATION

```
1*****************************************
 *                                       *
 *   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *
 *              JUN   1998               *
 *            VERSION 4.1                *
 *                                       *
 *  RUN DATE   08NOV20  TIME  15:38:42   *
 *                                       *
 *****************************************
```

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

Wolf Ranch Tributary Four FN F14-24HRT2.DAT
Detention basin added at design point 14
F-Basins future developed condition with detention
Final design of detention basin F18/19 Briargate Parkway
5-year and 100 Year, 24HR RAINFALL NOAA ATLAS 2 TYPE II STORM
WR MDDP UPDATE 11-08-2020

8 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         300  NUMBER OF HYDROGRAPH ORDINATES
                      NDDATE      2    0  ENDING DATE
                      NDTIME        0055  ENDING TIME
                      ICENT          19  CENTURY MARK

                   COMPUTATION INTERVAL     .08 HOURS
                        TOTAL TIME BASE   24.92 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
1

               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
                                               RATIO 1 = 5-yr
                                               RATIO 2 = 100-yr
                                                   RATIOS APPLIED TO PRECIPITATION
 OPERATION       STATION     AREA    PLAN            RATIO 1  RATIO 2
                                                        .56     1.00

 HYDROGRAPH AT
+                    F-8       .06     1   FLOW          16.      64.
                                           TIME        12.17    12.08

 ROUTED TO
+                   RF-8       .06     1   FLOW          16.      65.
                                           TIME        12.25    12.17

 HYDROGRAPH AT
+                    F-1       .17     1   FLOW           8.      94.
                                           TIME        12.25    12.08

 ROUTED TO
+                   RF-9       .17     1   FLOW           8.      93.
                                           TIME        12.25    12.17

 HYDROGRAPH AT
+                    F-9       .04     1   FLOW          11.      48.
                                           TIME        12.08    12.08
```

```
  2 COMBINED AT
+                   DPF9        .21     1   FLOW          16.      134.
                                             TIME        12.17    12.08

 ROUTED TO
+                   RF-19       .21     1   FLOW          15.      132.
                                             TIME        12.17    12.17

 ROUTED TO
+                  RF-19A       .21     1   FLOW          15.      131.
                                             TIME        12.25    12.17

 HYDROGRAPH AT
+                   F-19        .10     1   FLOW          32.      123.
                                             TIME        12.08    12.08

  3 COMBINED AT
+                   DPF19       .37     1   FLOW          58.      306.
                                             TIME        12.17    12.17

 HYDROGRAPH AT
+                    F-2        .04     1   FLOW           2.       25.
                                             TIME        12.17    12.08

 ROUTED TO
+                   RF-10       .04     1   FLOW           2.       25.
                                             TIME        12.25    12.17

 HYDROGRAPH AT
+                    F-10       .02     1   FLOW           3.       18.
                                             TIME        12.08    12.08

  2 COMBINED AT
+                   DPF10       .06     1   FLOW           4.       40.
                                             TIME        12.17    12.08

 ROUTED TO
+                  RF-18A       .06     1   FLOW           4.       38.
                                             TIME        12.33    12.17

 HYDROGRAPH AT
+                    F-3        .09     1   FLOW           4.       52.
                                             TIME        12.25    12.17

 ROUTED TO
+                   RF-11       .09     1   FLOW           4.       51.
                                             TIME        12.33    12.17

 HYDROGRAPH AT
+                    F-11       .05     1   FLOW           9.       46.
                                             TIME        12.08    12.08

  2 COMBINED AT
+                   DPF11       .14     1   FLOW          11.       90.
                                             TIME        12.17    12.17

 ROUTED TO
+                   RF-18       .14     1   FLOW          11.       87.
```

```
                                        TIME        12.33    12.25

 HYDROGRAPH AT
+                    F-4       .27     1   FLOW          11.     128.
                                        TIME        12.33    12.17

 ROUTED TO
+                  RF-12       .27     1   FLOW          11.     128.
                                        TIME        12.42    12.25

 HYDROGRAPH AT
+                    F-5       .11     1   FLOW           4.      46.
                                        TIME        12.42    12.25

 ROUTED TO
+                 RF-12A       .11     1   FLOW           4.      46.
                                        TIME        12.58    12.33

 HYDROGRAPH AT
+                   F-12       .06     1   FLOW          12.      57.
                                        TIME        12.17    12.08

  3 COMBINED AT
+                  DPF12       .43     1   FLOW          20.     211.
                                        TIME        12.33    12.25

 ROUTED TO
+                  RF-17       .43     1   FLOW          20.     209.
                                        TIME        12.42    12.25

 HYDROGRAPH AT
+                   F-17       .04     1   FLOW           1.      20.
                                        TIME        12.25    12.17

 HYDROGRAPH AT
+                   F-18       .10     1   FLOW          29.     111.
                                        TIME        12.17    12.08

  5 COMBINED AT
+                  DPF18       .77     1   FLOW          57.     443.
                                        TIME        12.25    12.17

  2 COMBINED AT
+                 DP1819      1.14     1   FLOW         113.     750.
                                        TIME        12.17    12.17

 ROUTED TO
+                 DF1819      1.14     1   FLOW          12.     215.
                                        TIME        17.00    12.75

                                    ** PEAK STAGES IN FEET **
                                    1   STAGE     7139.26  7141.97
                                        TIME        17.00    12.75

 ROUTED TO
+                 RF-22A      1.14     1   FLOW          12.     214.
                                        TIME        17.08    12.83

 HYDROGRAPH AT
```

+	F-22	.06	1	FLOW	6.	44.
				TIME	12.17	12.08
HYDROGRAPH AT						
+	F-16	.03	1	FLOW	8.	30.
				TIME	12.17	12.08
ROUTED TO						
+	RF-16	.03	1	FLOW	8.	29.
				TIME	12.17	12.17
3 COMBINED AT						
+	DPF22	1.24	1	FLOW	15.	230.
				TIME	12.17	12.75
ROUTED TO						
+	RF-27	1.24	1	FLOW	20.	230.
				TIME	12.58	12.92
ROUTED TO						
+	RF-27C	1.24	1	FLOW	16.	230.
				TIME	12.83	13.00
HYDROGRAPH AT						
+	F-7	.08	1	FLOW	4.	46.
				TIME	12.17	12.08
ROUTED TO						
+	RF-7	.08	1	FLOW	4.	46.
				TIME	12.33	12.17
HYDROGRAPH AT						
+	F-6	.03	1	FLOW	1.	18.
				TIME	12.17	12.08
ROUTED TO						
+	RF-13	.03	1	FLOW	1.	18.
				TIME	12.25	12.17
HYDROGRAPH AT						
+	F-13	.01	1	FLOW	1.	10.
				TIME	12.08	12.08
2 COMBINED AT						
+	DPF13	.05	1	FLOW	2.	25.
				TIME	12.25	12.17
ROUTED TO						
+	RF-14	.05	1	FLOW	2.	25.
				TIME	12.67	12.25
2 COMBINED AT						
+	DP14A	.12	1	FLOW	4.	67.
				TIME	12.67	12.25
ROUTED TO						
+	RF-14A	.12	1	FLOW	4.	66.
				TIME	12.67	12.25

```
 HYDROGRAPH AT
+                   F-15        .02     1   FLOW           5.      23.
                                            TIME        12.08    12.08

 ROUTED TO
+                  RF-23        .02     1   FLOW           5.      23.
                                            TIME        12.17    12.17

 HYDROGRAPH AT
+                   F-23        .03     1   FLOW          10.      38.
                                            TIME        12.08    12.08

  2 COMBINED AT
+                  DPF23        .05     1   FLOW          14.      59.
                                            TIME        12.17    12.08

 ROUTED TO
+                RF-23A         .05     1   FLOW          14.      57.
                                            TIME        12.17    12.08

 HYDROGRAPH AT
+                   F-14        .13     1   FLOW          34.     134.
                                            TIME        12.17    12.17

  3 COMBINED AT
+                  DPF14        .30     1   FLOW          50.     250.
                                            TIME        12.17    12.17

 ROUTED TO
+                  DB 14        .30     1   FLOW           5.      80.
                                            TIME        14.83    12.58

                                        ** PEAK STAGES IN FEET **
                                        1   STAGE     7129.64  7131.46
                                            TIME        14.83    12.58

 ROUTED TO
+                  RF-25        .30     1   FLOW           5.      80.
                                            TIME        14.92    12.67

 HYDROGRAPH AT
+                   F-25        .09     1   FLOW          27.      95.
                                            TIME        12.17    12.17

  2 COMBINED AT
+                  DPF25        .39     1   FLOW          27.     132.
                                            TIME        12.17    12.33

 ROUTED TO
+                  RF-30        .39     1   FLOW          27.     132.
                                            TIME        12.25    12.33

 HYDROGRAPH AT
+                   F-24        .09     1   FLOW          62.     147.
                                            TIME        12.17    12.17

 ROUTED TO
+                 RF-30A        .09     1   FLOW          61.     146.
                                            TIME        12.17    12.17
```

Detention Basin F14
5-yr Discharge=5cfs. 5-yr WSE=7129.64
100-yr Discharge=80cfs. 100-yr WSE=7131.46

HYDROGRAPH AT						
+	F-30	.02	1	FLOW	10.	31.
				TIME	12.08	12.08
HYDROGRAPH AT						
+	F-41	.08	1	FLOW	13.	69.
				TIME	12.17	12.17
ROUTED TO						
+	RF 41	.08	1	FLOW	13.	69.
				TIME	12.17	12.17
HYDROGRAPH AT						
+	F-42	.05	1	FLOW	15.	58.
				TIME	12.17	12.08
2 COMBINED AT						
+	DPF42	.13	1	FLOW	28.	126.
				TIME	12.17	12.17
ROUTED TO						
+	RF 30B	.13	1	FLOW	28.	125.
				TIME	12.17	12.17
4 COMBINED AT						
+	DPF30	.64	1	FLOW	124.	407.
				TIME	12.17	12.17
ROUTED TO						
+	RF-29	.64	1	FLOW	125.	397.
				TIME	12.25	12.25
HYDROGRAPH AT						
+	F-29	.02	1	FLOW	10.	32.
				TIME	12.08	12.08
2 COMBINED AT						
+	DPF29	.66	1	FLOW	132.	419.
				TIME	12.25	12.25
ROUTED TO						
+	RF-28	.66	1	FLOW	129.	416.
				TIME	12.25	12.25
HYDROGRAPH AT						
+	F-28	.04	1	FLOW	7.	35.
				TIME	12.17	12.17
HYDROGRAPH AT						
+	F-27	.24	1	FLOW	76.	249.
				TIME	12.25	12.25
4 COMBINED AT						
+	DPF28	2.18	1	FLOW	211.	709.
				TIME	12.25	12.25
ROUTED TO						
+	DBF28	2.18	1	FLOW	30.	532.

```
                                        TIME        17.00    12.67

                                    ** PEAK STAGES IN FEET **
                                    1   STAGE     6976.04  6978.06
                                        TIME        17.00    12.67

 ROUTED TO
+                  RF-31      2.18     1   FLOW          30.     532.
                                        TIME        17.25    12.83

 HYDROGRAPH AT
+                   F-31       .07     1   FLOW           3.      30.
                                        TIME        12.42    12.25

  2 COMBINED AT
+                   DP F      2.25     1   FLOW          31.     546.
                                        TIME        17.25    12.67
1


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

APPENDIX E

PCM IM Plan Addendum App I

19 April 2023

APPENDIX I

PERMANENT CONTROL MEASURE IM PLAN ADDENDUM

PROJECT NO./NAME: Wolf Ranch Detention Basin F18/F19

SUBDIVISION: Not platted

THE FOLLOWING ITEMS DEVIATE FROM CITY PCM STANDARDS BUT HAVE BEEN APPROVED THROUGH THE VARIANCE PROCESS:

1) The existing 54" RCP coming into the west end of F19 will be a forebay like the one detailed in figures 9-43 and 9-44 of the USDCM, instead of a USBR type VI impact basin. This is due to the reduced flows in the existing pipe.

INSPECTION AND MAINTENANCE OF THE DEVIATIONS ARE DETAILED BELOW:

1) Inspect for erosion behind wingwalls of forebay at the end of the 54" RCP, located on the west end of Detention Basin F19. Increased inspection frequency not needed.

DESIGN ENGINEER SIGNATURE (Affix Seal):