Mesa Ridge East
Master Development Drainage Plan Update
City of Fountain
El Paso County, Colorado

Prepared for:
Nor'wood Development
111 South Tejon 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. 21027

May 20, 2022

COLORADO LICENSED
STEPHEN A. BROWN
40190
PROFESSIONAL ENGINEER

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ENGINEER'S STATEMENT:

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

Kiowa Engineering Corporation, 7175 West Jefferson Avenue #2200, Lakewood CO 80235

______________________________ ______________________________

Stephen A. Brown Date
Registered Engineer # 40190

DEVELOPER'S STATEMENT:

I, the Developer, have read and will comply with all of the requirements specified in this drainage report and plan.

BY:__________________________ __________________________
Date

______________________ ___________________________

ADDRESS: 111 South Tejon Street #222
Colorado Springs, CO 80903

CITY OF FOUNTAIN

Filed in accordance with City of Fountain subdivision ordinances and regulations.

______________________________ __________________________

City Engineer Dated

I. PROJECT DESCRIPTION

Mesa Ridge Development is a master planned community located in northeast Fountain, Colorado. The master planned land includes open space, parks, drainage, residential, office, commercial, a business park, and a regional town center. The majority of the development is located on the land that lies east of Fountain Mesa Road, west of Marksheffel Road, north of C&S Road, and south of Mesa Ridge Parkway. The development lies within and adjacent to the West Fork Jimmy Camp Creek Drainage Basin. The watershed has been noted as the Jimmy Camp Creek Drainage Basin in past drainage basin planning studies. The major basins of Jimmy Camp Creek in the Mesa Ridge Development include the west basin, C&S basin located in the center, and West Fork Jimmy Camp Creek basin located in the east portion. The west basin (tributary to Hale Reservoir) has been developed and is not included in this study per discussion with the City of Fountain. Currently the reservoir and associated storm outfall are under redesign by Applegate Group. The remainder of the development within the study property is in the planning stages. The Mesa Ridge East development is entirely within the developer's property, therefor no stakeholder involvement was necessary other than coordination with the City of Fountain.

An annexation plan and overall development plan for the undeveloped portion of the development was approved by the City in 2008 and covered the portion of the Cross Creek development project that was formerly in unincorporated El Paso County. The total acreage subject to master planning in this study covers approximately 522 acres.

The property subject to ongoing development is located in portions of Sections 27, 28 and 29 of Township 15 South, Range 65 West of the 6th Principal Meridian. The watershed area subject to master drainage planning is bounded on the west by the boundary of the C&S basin, Fontaine Boulevard on the north, south by C & S Road and on the east by Marksheffel Road (see Vicinity Map in Appendix). The watershed contains areas within the City of Fountain, City of Colorado Springs and unincorporated El Paso County. The total watershed area tributary to the south boundary of the Mesa Ridge property covers 3738 acres. The project site is shown on Figure 1 of the Appendix.

II. PURPOSE OF UPDATE

The Cross Creek master development drainage plan (MDDP) covers the area that now is owned and being developed as "Mesa Ridge" by Nor'wood Development and was first submitted to the City of Fountain and El Paso County in 2002. The MDDP formed the basis for the preparation of final drainage reports for the developed west portion. Drainage infrastructure such as roadway culverts, storm sewer collection and outfall systems as well as detention in the west basins were at the time of development of these filings constructed and are currently functioning. Nor'wood purchased the undeveloped portions of Cross Creek in 2005 and began the process of annexing the eastern half of the Cross Creek Development to the City of Fountain, along with processing an Overall Development Plan (ODP). The annexation and ODP were approved in 2005 and along with this approval the Cross Creek MDDP was updated and submitted to the City as the "Mesa Ridge Master Development Drainage Plan Update". Similar to the Cross Creek MDDP, the Mesa Ridge MDDP update was reviewed by the City of Fountain and not formally approved but formed the basis for final drainage planning, design and construction for the developed west area. **It is therefore the purpose of this study to evaluate the major drainage infrastructure for the areas remaining to be developed so that future filings within the Mesa Ridge Development can proceed to final planning stages using the technical information provided in the updated MDDP.**

Several issues have caused the need for the update to the MDDP as well and are summarized below as follows:

1. The City of Fountain formally adopted the used of full spectrum detention (FSD) for all new detention basins within the City. The design criteria and methods established in the Mile High Flood District Storm Drainage Criteria Manual, Volume 3 have been adopted by the City and have now been applied in this MDDP update.

2. Stormwater runoff from areas upstream of the Mesa Ridge Development have been separated from the Fountain Mutual Irrigation Canal (FMIC) by providing conveyance under the canal. It is assumed the canal does not intercept upstream existing or developed storm flows. Conveyances under the canal for the project property include outflow from the Glen at Widefield detention at DP 1031 and the West Fork Jimmy Camp Creek flows at DP 3110 located along Mesa Ridge Parkway.

3. The most recent ODP prepared for the Mesa Ridge development as discussed above changed the land uses for development for those sub-watersheds that lay to the east of the west basins that are tributary to Hale Reservoir. This study will reconfirm the watershed limits and sub-basin boundaries and examine and refine possible regional FSD alternatives. Land uses, drainage planning and roadway layouts for the undeveloped portions of the Mesa Ridge development have been revised. This information was used to more accurately model the hydrologic characteristics of the watershed and to better define the sizes as well as the location of proposed roadway culverts and detention basins. It should however be expected that modifications in the size and location of the major drainageway facilities and FSD's as shown herein may occur depending upon the actual development of the land within the Mesa

Ridge development. In particular, the locations of the regional FSD's may be shifted as alternatives are analyzed as part of the land development process.

III. PREVIOUS REPORTS

Reports and plans reviewed in the process of preparing this final drainage plan are included in the References section of this report. In the past the City of Fountain reviewed and informally approved MDDP reports but did not provide official signature. Therefor many of the following drainage studies allowed development to proceed without City signatures.

The West Fork Jimmy Camp Creek DBPS (Reference 5) identifies feasible stormwater management plans to satisfy the existing and future needs within the West Fork Jimmy Camp Creek Drainage Basin. Drainage and bridge fees for the county portions of the West Fork Jimmy Camp Creek basin were also established in the DBPS. Data from Cross Creek at Mesa Ridge MDDP (reference 6) regarding drainage onto the site from areas north of Mesa Ridge Parkway was taken into consideration in modeling the "1200" and "3200" basins.

IV. EXISTING ENVIRONMENT

The existing land in the Mesa Ridge East Development is undeveloped and was used primarily for cattle grazing in the past. The landscape is composed of broad, fertile bottomlands with a high groundwater table and intervening uplands. Vegetation consists largely of native grasses typical of the high plains prairie, along with small amounts of tree and shrub cover. The drainageways are wide and shallow, poorly defined, and prone to sheet flow during major storm events. There is little evidence of significant erosion and water quality issues. No ponds or formal conveyance elements are found on the property.

Base mapping and topography for the project were developed from aerial photography in 2001 and referenced to the NAVD 88 elevation datum. Structure inventory was based on the 2013 Mesa Ridge MDDP (reference 8) and verified in the field in 2022.

V. HYDROLOGY

The offsite and onsite hydrology for the site was estimated using the methods outlined in the City of Colorado Springs Storm Drainage Criteria Manual (adopted by City of Fountain). Topography for the site was compiled at a two-foot contour interval and a horizontal scale of one inch to 400-feet. This topography was used to verify the onsite sub-basin boundaries. Offsite sub-basin boundaries were determined using the above referenced reports, the City of Colorado Springs FIMS mapping base, and the USGS quadrangle maps for the area. Field inspections were also carried out in order to confirm or refine subdivision limits. Presented on Hydrologic Sub-basin Map (Exhibit 1 of Appendix) are the basin divides and other related hydrologic data for the developed condition.

Developed condition peak discharges for the sub-basins and design points shown on the Hydrologic Sub-basin Map were determined for the 5-year and 100-year recurrence intervals. The DBPS and previous MDDPs used the 24-hour storm duration with a Type IIA rainfall distribution and 100-year depth of 4.4 inches. This study applies the Colorado Springs criteria of the 2-hour storm for tributary areas under 15 square miles. The Drainage Area Reduction Factor (DARF) was used for the West Fork Jimmy Camp Creek basin. Rainfall depths for the 5-year and 100-year storms were 1.59 and 3.39 inches, respectively. Full rainfall data is included in the Appendix. Previous calculated historic flows in DBPS studies (reference 3 and 5) used the 24-hour storm. The subsequent criteria change required reevaluation of the historic conditions in this study as discussed in Section VII of this report.

VI. SUB-BASIN DESCRIPTIONS

The study area is drained by two major sub-watersheds noted in the hydrologic analysis by sub-basins designated as C&S (1200 basins) and the West Fork of Jimmy Camp Creek (3200 basins). The 3200 basin designation is consistent with the sub-basins delineated in the West Fork Jimmy Camp Creek Drainage Basin Planning Study and cover the majority of the undeveloped land remaining within the Development.

As seen on Exhibits 1 and 2 of the Appendix, a future Powers Boulevard extended through the development is shown. Per City of Fountain, the alignment with a 210' wide area was to be considered as open space for the hydrology analysis of this report. The need for future construction of Powers in this area is currently undetermined. A separate hydrology model was developed to reflect runoff from the imperviousness of the roadway and is included in this report for informational purposes only. Based on a preliminary cross section design, it was assumed that the impervious road surface comprised approximately 50 percent of the area, with the remaining area designated as grassland open space. Only the C and S basin (1000s) developed conditions hydrology model was adjusted for roadway imperviousness since the alignment is almost exclusively located in this basin. The CN numbers for affected subbasins were adjusted and an output comparison to the model reflecting open space for Powers Boulevard is included in Appendix C. This comparison indicated minor increases to 100-year runoff flows which did not impact design of the downstream FSD facilities in the model. An increase in developed 100-year flows at C and S Road (DP1250B) from 141cfs to 166 cfs was noted. Final design of Powers Boulevard through the Mesa Ridge East development may include detention and water quality facilities in the median and therefore have no impact on the proposed conditions hydrology of the downstream areas. The existing Mesa Ridge Parkway along the north of the development drains to proposed conveyances and FSD facilities.

The “1200” basins outfall to two existing drainage swales located south of C & S Road. The 100-year historic discharge from design point 1260 was calculated at 341 cubic feet per second for this study in the 2-hour storm simulation. Design Point 1260 discharges through two 35-inch by 24-inch corrugated metal pipes under C & S Road to the south as noted on Exhibit 2. The inlets and outlets of these culverts are damaged and are both partially filled with sediment. The 100-year historic rate at design point 1250 was estimated to be 229 cubic feet per second in this MDDP. The corrugated metal pipes that exist at design point 1250 are inadequate to convey the discharge at design point 1250. The drainageways associated with the “1200” basins are generally poorly defined and have no base flow, however are currently stable and well vegetated. The major drainageway within the 1200 sub-basins is the channel that extends from proposed Powers Boulevard open space at design point 1210 to C & S Road at design point 1260. This drainageway has little or no low flow invert as it passes through the Nor’wood property and there are no improved bank linings such as riprap presently installed along the drainageway.

The “3200” basins discharge into West Fork Jimmy Camp Creek at design point 3280 (corresponding to design point 5011 in the DBPS, reference 5). The 100-year historic discharge at this location was estimated to be 3,745 cubic feet per second. Existing conditions 100-year flows for this study using the 2-hour storm were estimated at 2,988 cfs. Eventually, flow from these sub-basins makes its way to Jimmy Camp Creek via the West Fork. The drainageways associated with the “3200” basins south of Mesa Ridge Parkway are generally poorly defined and have no base flow. The portion of the West Fork Jimmy Camp Creek drainageway south of Mesa Ridge Parkway has a very wide and shallow floodplain. The approximate limits of the existing FEMA 100-year floodplain are shown on Exhibit 2 (reference 9). The drainageways associated with the 3200 basins have no base flow and are currently stable and well vegetated. The major drainageway within the 3200 sub-basins is West Fork Jimmy Camp Creek that extends from proposed Mesa Ridge Parkway at design point 3110 to Marksheffel Road at design point 3280. This drainageway has little or no base flow as it passes through the property and there are no improved bank linings such as riprap presently installed along the drainageway. There are three 36-inch culverts under Marksheffel Road (DP 3280/5011) that have little or no capacity to convey the flow carried by this drainageway without overtopping of Marksheffel Road.

The routing of runoff at design point 2160 to design point 3110 also represents a change to the hydrologic model from the original MDDP (reference 6). For this MDDP, runoff at design point 2160 is routed in the existing channel north of Mesa Ridge Parkway to the West Fork Jimmy Camp Creek bridge and drainageway. The diversion will eliminate the need for a culvert to convey runoff at design point 2160 under Mesa Ridge Parkway. Runoff from design point 2160 would be combined with the runoff from design point 3110 at the bridge crossing under Mesa Ridge Parkway.

VII. LAND USE AND SOILS

Curve numbers for the sub-watersheds used in this study are consistent with the values used in previous studies. The curve numbers for the existing developed sub-watersheds were determined by measurement of the impervious areas of the topographic mapping referenced above. The time of concentration for each sub-watershed was recalculated for the majority of the sub-watersheds that make up the site. The time of concentration was calculated using the methods outlined in Reference 2. The developed condition land uses assumed in the hydrologic modeling are presented on Figure 2. The land uses shown on Figure 2 have been updated in this MDDP to be in conformance with the approved Mesa Ridge Overall Development Plan. The soils within the study are presented on Figure 3. Curve numbers were determined for existing conditions from Table 6-9 ARC I and for developed conditions from Table 6-10 ARC II per Colorado Springs criteria. Existing and developed condition weighted curve number calculations for each sub-basin are included in the Appendix.

VIII. HYDROLOGY ANALYSIS

Due to the size and complexity of the watershed in the study area, computer program calculation including HEC-HMS is preferred to the Rational Method. The Mile High Flood District and the City of Colorado Springs drainage manuals recommend an area limit of between 90 and 130 acres for Rational Method use. Larger basin runoff peak flows will tend to be significantly overestimated and fail to correctly model more complex systems, particularly those with detention elements. Therefor HEC-HMS is used per criteria for the overall C &S and West Fork Jimmy Camp Creek basins to determine major drainage conveyance and 100-year volume for FSD facilities. The Rational Method should be used to determine onsite hydrology for individual Final Drainage Reports other than the overall basin conveyance system descripted by this report.

The hydrologic analysis for this project was done with the U. S. Army Corps of Engineers HEC-HMS v4.8 software. This computer model was used to estimate peak discharges for the 2-hour storm duration per City of Colorado Springs criteria for a basins less than 15 square miles. The 5- and 100-year frequencies were modeled. This method was used because it allows for routing of the runoff through the existing storm sewer systems and through the existing and proposed detention facilities. The study area was modeled assuming the fully developed condition with detention. Existing condition flows as estimated in the previous studies and through estimations conducted as part of this study were established at the key design points along C & S Road and Marksheffel Road. The existing flows were used to determine the level of flow attenuation and associated detention volume criteria necessary for the maintenance of pre-development rates due to the increase in runoff affected by the development of Mesa Ridge. It was found that without detention storage within the Mesa Ridge development that historic flow rates at the south property line cannot be maintained. Storm water facilities along the major drainageways south of C & S Road do not have sufficient capacity to safely convey the developed runoff through the downstream watershed to Jimmy Camp Creek.

IX. HISTORIC HYDROLOGY ANALYSIS

The established historic conditions peak flows used in previous studies were based on previous criteria with the 24-hour storm simulation. The change in current criteria to the 2-hour storm required reanalysis for C&S and West Fork Jimmy Camp Creek basins. However previous models of the historic analysis were not available to rerun 2-hour storm simulations. Therefore the developed conditions models for the most recent 2013 Mesa Ridge MDDP (reference 8) were altered to reflect undeveloped land use and no detention for the Mesa Ridge development. This provides a simulation of predeveloped conditions for the site using the 2-hour storm and reflects current conditions of the upstream/offsite portions of the basins. Use of the 2013 MDDP models (reference 8) was also necessary reflect conveyance of upstream basin flows under the Fountain Mutual Irrigation Canal. The key design points of interest along C&S road (DPs 1250 and 1260) and Marksheffel Road (DP 3280) provide target design flows for the Mesa Ridge developed hydrology.

Results of the onsite historic analysis, referred to as existing conditions, are shown in Table 1 below.

Table 1: Existing Conditions Peak Flows (cfs)

		2-hour Storm		24-hour Storm	
Design Point	Location	100yr	5yr	100yr	5yr
1250	C&S Road	250	46	186	35
1260	C&S Road	341	61	340	48
3280	Marksheffel Road	2988	462	3745	992

As seen from the table, peak flows for the 2-hour storm simulation compare reasonably well with those of the 24-hour storm. The exception is for the West Fork Jimmy Camp Creek peak flows at DP 3280 where the effects 2-storm are more pronounced for a much larger basin area. The Type IIA storm has a greater rainfall depth and different distribution compared to the 2-hour storm.

X. REGIONAL DETENTION HYDROLOGY

Stormwater detention storage was determined through an iterative process where an initial volume was calculated based on the changes of SCS curve numbers between the existing and developed condition. The initial volume was refined using the HEC-HMS model resulting in the storage volumes summarized in this report. The proposed development condition was modeled with sufficient detention storage so that the flow rates were maintained to existing levels or less at C & S Road and Marksheffel Road. The routing elements were modeled as open channels. The latest roadway and land use configuration for the Mesa Ridge development was used when the sub-basin boundaries were determined. Presented on Exhibits 1 and 2 in the Appendix are the basin divides, routing elements, and peak flow data at each of the key design points within the study area.

Regional detention basins within the Mesa Ridge development have been modeled so that the peak discharges at the development's south property line are maintained to the existing condition levels. The inflow and outflow characteristics and storage volumes for each are summarized on Exhibits 1 and 2.

Five regional full spectrum detention basins are proposed for the areas of Mesa Ridge remaining to be developed. These facilities operate as FSD's and as flood control measures that limit the rates of discharge for the 5-year and 100-year recurrence intervals. The water quality capture volume (WQCV) and excess urban runoff volume (EURV) were determined using the methods described in the MHFD Storm Drainage Criteria Manual, Volume 3. The 100-year storage volume was obtained using the HEC-HMS hydrograph model assuming that the EURV pool is empty at the time of the 5- or 100-year storm event. The WQCV and UERV are included in all FSD facilities of this study. The detention discharge curves in the HEC-HMS models were taken from the MHFD spreadsheets included in Appendix D. Land use data contained in this study was used to estimate the rates of imperviousness for each sub-watershed within the study area. These FSDs are noted on Exhibits 1 and 2 as FSD basins A, B, C, E, and G.

Detention Basins C and E are proposed to replace the two regional detention basins designated as basins 5021 and 5011 in reference 5 and 8. The reconfiguration consolidation of detention basins 5011 and 5021 into Detention Basin C was made possible because of the changes in the proposed roadways within this area of the Mesa Ridge development. The hydrologic effect of FSD basins C and E is to maintain the developed discharge at design point 3280 to existing levels.

The input data and output for the computer modeling for this hydrologic analysis is included in the Appendix. Peak flow data for the proposed development condition with detention is summarized on Exhibits 1 and 2 contained in the map pocket of this report. Presented in Table 2 is a summary of the discharges at each sub-basin and at design points for the developed with detention condition.

Table 2: Developed Conditions Peak Flows (cfs)

Design Point	Location	2-hour Storm 100yr	5yr
C&S BASIN			
DB 1031	GLEN DETENTION OUTFLOW	45	15
R1031	GLEN DETENTION CONVEYANCE	44	15
DP1210	MESA RIDGE UPPER BASINS	241	78
R1210	MESA RIDGE FLOWS INTO FSD G	246	74
DP1225	CROSS CREEK AVENUE	164	23
R1225A	CONVEYANCE FSD G OUTFLOW	164	23
DP1260	C&S ROAD	332	39
DB1250-B	C&S ROAD FSD B OUTFLOW	148	23
WEST FORK JIMMY CAMP CREEK BASIN			
DP3110	INLFOW FROM GLEN AND WIDEFIELD	2835	429
R3110	WEST FORK JIMY CAMP CREEK CONVEYANCE	2794	428
R3200	WEST FORK JIMY CAMP CREEK CONVEYANCE	2830	429
DP3280	MARCKSHEFFEL ROAD	2982	435

(See Exhibit 1 Hydrology Map)

XI. HYDRAULICS

The sizing of the storm sewer outfall lines and roadway culverts was accomplished through an iterative procedure. Using the HEC-HMS results at each design point, storm sewers were sized assuming a minimum slope. The required storm sewer data was input into the HEC-HMS model and the model recompiled. The hydraulic capacity of the existing and proposed storm sewer systems and channels is summarized on Exhibit 2. The several existing culverts under Marksheffel Road and C & S Road do not have adequate capacity to convey the 5-year undeveloped discharge. At some locations, a 5-year capacity facility has been sized. The refinement of the size, slope and location of these outfall lines will occur when the individual subdivision drainage reports are prepared. Presented on Exhibit 2 are the sizes, types and location of the proposed storm water facilities for the Mesa Ridge development.

XII. WETLAND RESOURCE EVALUATION

The Mesa Ridge Development project area is undeveloped land that was historically used for agricultural and ranching purposes. The landscape is composed of broad, fertile bottomlands with a high groundwater table and intervening uplands. Vegetation consists of largely of native grasses and herbs typical of the high plains prairie, along with small amounts of tree and shrub cover.

On the north border of the site is the Fountain Mutual Irrigation Canal dating back to the late 1800s and still in use today. Along with two existing manmade ponds, there is evidence of former water diversions in the form of dry ditches. Irrigation water is no longer delivered to the project area.

The U.S.G.S. Fountain Quadrangle identifies two 'blue line' streams in the project area (see Figure 4). These blue line streams are typically considered waters of the U.S. until determined otherwise. The westerly drainage was determined to be non-jurisdictional per U.S.A.C.E. Action No. 2002 00504. The other 'blue line' drainage is the West Fork of Jimmy Camp Creek which has an indistinct connection to Jimmy Camp Creek. To date, no Jurisdictional Determination has been conducted on the West Fork.

The West Fork Jimmy Camp Creek supports a wetland channel composed of sedges and rushes. At times, water is present in the channel, but at other times the channel is dry. Until a Jurisdictional Determination is conducted, the wetland channel along the West Fork should be considered a potential jurisdictional waterway with adjacent jurisdictional wetlands.

Several riparian zones exist on the site: below the FMIC Canal, around one of the dry, unused stock ponds, and along the West Fork of Jimmy Camp Creek. Riparian areas generally consist of mature plains cottonwoods, with a sparse understory of currant, chokecherry and snowberry.

Projects within areas of current and former irrigation facilities, such as the FMIC Canal, the two dry off channel stock ponds, and the various relic irrigation overflow ditches will most likely not require permits.

It is recommended that consultation with the U.S.A.C.E. should occur prior to final design for the West Fork of Jimmy Camp Creek with a formal Jurisdictional Determination Request. As an ordinary high water mark is lacking downstream from Marksheffel Road, a clear connection to Jimmy Camp Creek is not apparent, and wetlands are not present, it is possible that the agency may determine the West Fork to be a non-jurisdictional waterway where permits will not be required. Until a Jurisdictional Determination has been processed, the West Fork and adjacent wetlands should be considered a jurisdictional waterway where a permit would be required for construction activities.

XIII. FLOODPLAIN

The West Fork of Jimmy Camp Creek is shown as a Zone AE (detailed) floodplain on the Flood Insurance Rate Map (FIRM) 08041C0958G dated December 7, 2018 (see Appendix A). Figure 5 in the Appendix shows the floodplain boundary location at the east portion of the property along the West Fork of Jimmy Camp Creek. The proposed relocation and channelization of the West Fork of Jimmy Camp Creek shown on Exhibit 2 was taken from the DBPS and will require FEMA approval of a Conditional Letter of Map Revision (CLOMR) prior construction and a Letter of Map Revision (LOMR) post construction.

XIV. PROPOSED DRAINAGE FACILITIES

No drainage and bridge fees will be established for the property within the Mesa Ridge East development and no drainage and bridge fees will be due as the property is platted. All proposed drainage facilities identified by this MDDP within the Mesa Ridge East development are planned to be constructed and paid for by the Developer or Metropolitan District and will be dedicated to and maintained by the City of Fountain. Phasing of development will determine implementation of the drainage facilities downstream to maintain flows to existing levels. This includes primarily FSD facilities and associated conveyances.

Four Step Process

City of Colorado Springs criteria requires a Four Step Process "for receiving water protection that focuses on reducing runoff volumes, treating the water quality capture volume (WQCV), stabilizing drainageways and implementing long-term source controls". Future development in Mesa Ridge East should use the following steps to comply with this concept.

Step 1-Employ Runoff Reduction Practices: Runoff from pavement and buildings to be directed to pervious surfaces such as grass and landscaping were ever possible to result in Minimizing Directly Connected Impervious Areas (MDCIA). The pervious surfaces will also provide the opportunity for runoff to infiltrate into the ground. The FSD facilities will also provide additional area for infiltration and runoff reduction.

Step 2-Implement BMPs that Provide a WQCV with Slow Release: The FSD facilities will be constructed to treat and provide the slow release of flows from the site.

Step 3-Stabilize Drainageways: The West Fork Jimmy Camp Creek and other drainageways in Mesa Ridge East will be channelized with buried soil riprap or erosion control fabric to mitigate erosion. Check structures will be added to the drainageways to create a more stable channel slopes. Riprap protection will also be needed at FSD pipe outlets to further prevent erosion during storm events due to pond discharge into the channel.

Step 4-Implement Site Specific and Other Source Control BMPs: The potential pollutant sources for a commercial and residential development include: parked vehicles, deicing chemicals/snow storage, waste storage/disposal practices and landscapes (fertilizers, herbicides, pesticides, excessive irrigation). Examples of onsite source control BMPs for the development should include on site containment of pollutant spills due to vehicle maintenance or commercial operations. The application of fertilizers, pesticides and other chemicals should be done per manufacturer's recommendations.

Full Spectrum Detention

The primary conclusion of this MDDP is that full spectrum detention will be required to maintain the historic flow conditions at the Development's south property line and to be in conformance with City of Fountain drainage criteria. Five FSD facilities are proposed within the development. All the FSD facilities lay within the City of Fountain. As discussed above, the detention basins shown within the West Fork Jimmy Camp Creek basin (FSD basins C and E) is a consolidation of the two detention basins that were identified in the DBPS for this property. All proposed detention basin sites are shown on Exhibits 1 and 2. As final development planning in the basin occurs, the locations of the regional FSD basins might need to be altered somewhat from those locations shown on Exhibits 1 and 2.

The storage and outflow data for each of the detention basins are presented on Exhibits 1 and 2. FSD basins will be designed to be in conformance with the City's storm drainage technical criteria. Each FSD basin will be required to have forebays, low flow channel, outlet structure and pipe, and an emergency spillway. The outlet structures will incorporate water quality and EURV elements to the facilities as required by criteria. Easements or tracts dedicated for access and maintenance will be established at each detention basin site. Access roads are planned to be incorporated into the multi-use trail system discussed in one of the following sections of this report.

Drainageways

The City of Colorado Springs and El Paso County Drainage Criteria Manuals were used in the development of conveyance structures for the major drainageways within the Mesa Ridge East development. The City of Colorado Springs storm drainage criteria was supplemented by the Urban Storm Drainage Criteria Manual, Volumes I, II, and III prepared by the Mile High Flood District. As seen on Exhibit 2 and 3, both riprap lined channels and storm sewer pipes are recommended for conveyances within the development. Size calculations for the conveyances are based on 100-year developed flows of the hydrology model and are included in the Appendix. A minimum pipe size of 42" in diameter is required for trunk storm sewer systems per City of Fountain criteria. Equivalent conveyance structures may be substituted during final design.

Consistent with the selective improvement measures from the DBPS, the West Fork Jimmy Camp Creek 100-year floodplain will be channelized along the east portion of the site. Based on hydraulic analysis during final design, channel embankments should be either reinforced with erosion control fabric or buried riprap lining (see Exhibit 3). Check structures or other approved grade control structures should be designed along the channel bottom to maintain a stable channel slope per Figure 12-4 of the Colorado Springs Drainage Criteria Manual (reference 16). The final design will require Army Corps approval to address and mitigate existing wetland resources. In addition, channelization and relocation of the existing West Fork Jimmy Camp Creek floodplain will require CLOMR/LOMR approval by FEMA.

Drop and Check Structures

Drop and check structures in the West Fork Jimmy Camp Creek DBPS have been sited along the drainageways in order to maintain the channel invert at a stable gradient or to reduce the slope of the channel gradient so that lower velocities result along the drainageways (reference 5, see experts in the Appendix). When determining the location of check structures, a degraded slope of approximately 0.15% per Figure 12-4 of Colorado Springs criteria should be used. This assumption allows for the design to accommodate future channel degradation without modifying the existing channel sections wherever the wetland resources are proposed to remain. This assumption is consistent with the conceptual check structure siting used in the DBPS. The checks should be designed to allow for a maximum drop height of two feet once the stable slope has been reached. Taller grade control structures may be used per criteria. In the segments to be selectively lined, check structures will protect the native vegetation from the detrimental effects of stream invert head-cutting. A typical check structure detail is presented on Exhibit 3.

Additional check structures may be used for the various small drainageways shown on Exhibits 1 and 2 in the appendix. This may reduce the amount of riprap lining by decreasing channel velocities below the requirement for riprap protection (see Exhibit 3 detail).

The capacity of the existing culvert crossing of Marksheffel Road (DP 3280) is inadequate to convey 100-year flows from the Mesa Ridge Development to the downstream channel leading to Jimmy Camp Creek. The West Fork Jimmy Camp Creek DBPS (reference 5) proposed a 75' span bridge to provide adequate conveyance. Coordination will be needed with the City of Fountain and EL Paso County regarding design and construction of the crossing. The invert of the channel at the crossing location upstream of Marksheffel road on the property will likely need to be lowered to accommodate the invert of the crossing structure. As noted on the preliminary plan of the DBPS, one or more grouted sloping boulder drops may be required to lower the upstream channel on the property. An option of raising the roadway should be considered to reduce lowering of the channel.

Roadway Crossings

Summarized on Exhibit 2 are the size, type and location of roadway crossings along the major drainageways. The location of future arterials and collector streets was obtained from the current development plan for the Mesa Ridge development. A maximum 100-year headwater to depth ratio of 1.5 was assumed in the sizing of the major roadway culverts. As discussed previously, the inadequate capacity of the existing crossing structure at Marksheffel Road will need to be coordinated with EL Paso County.

As shown on Exhibit 2, the three major discharges from the Mesa Ridge East development will need to be adequately conveyed under C&S and Marksheffel Roads. Conveyance of West Fork Jimmy Camp Creek flows (100yr 2,967cfs) will require a crossing similar the existing 70' span bridge upstream bridge at Mesa Ridge Parkway. Per the DBPS, drop structures will be needed to lower the channel invert and allow for conveyance under a proposed Marksheffel bridge. The DBPS also includes a formal channel to convey flows to Jimmy Camp Creek. The bridge and downstream channel elements are outside of the development property and will need to coordinated with El Paso County.

The Conveyance of FSD B flows at DP1250B and FSD A flows at DP1260 will likely require replacement of the existing twin 35"x24" CMPs at each location under C&S Road. Existing culverts at both locations are either partially or fully buried and barely functioning. If restored, the conveyance capacity of each arch pipe is approximately 30 cfs, or 60 cfs total. Therefore replacement pipes have been sized at both locations as shown on Exhibit 1 and 2.

Multi Use Trails

Trails for access to the major drainageways need to be incorporated into the design of the improvements. For the Mesa Ridge development, multi-purpose trails that can be used for open space, channel maintenance and utility access is recommended. The siting of a trail along a drainageway should be carried out taking into account hydraulic considerations, utilities in the area, access to dedicated parks and roadway crossings. Maintenance access to the drainageway, FSD facilities, and existing utilities within the drainageway corridor can offer a multiple use aspect to a trail project.

Maintenance and Revegetation

Maintenance of drainageway facilities is essential in preventing long term degradation of the drainageway and overbank areas. Along the drainageway, clearing of debris and dead vegetation should be considered within the low flow area of the creek and its tributaries. On the overbanks, limited maintenance of the existing vegetative cover is recommended wherever possible. Yearly clearing of trash and debris at roadway crossings is also recommended to ensure the design capacity of the crossing, and to enhance the crossings for trail users if a trail exists. Caution should be taken when clearing culverts of sediment so as not to leave the dredged soil within the channel or overbank area. This disturbs the native vegetation and creates a potential water quality concern if the dredged material is subsequently washed into the drainageway by natural erosion. In those reaches designated to be selectively lined and the floodplain preserved, maintenance activities should be carried out while minimizing the disturbances to native vegetation. All proposed drainage facilities identified by this MDDP within the Mesa Ridge East development are planned to be constructed and paid for by the Developer or Metropolitan District and will be dedicated to and maintained by the City of Fountain.

Right-of-Way

It will be required that drainage channels and conveyances within the development which pass through the basin will be within dedicated tracts, easements or right-of-ways. For those segments of the drainageway where floodplain preservation is the recommended plan, a combination of open space dedication (such as park-land and greenbelts), in combination with a more narrow dedicated maintenance right-of-way along the low flow area of the drainageway should be obtained through the land development process. The dedication of easements and right-of-way for the drainageways and detention basins would be accomplished at the time of development planning and platting of the parcels that lie adjacent to or upstream of the stormwater facility.

Impact to Downstream Facilities

With the use of regional FSD basins within the Mesa Ridge development and offsite from the property, the impact upon downstream peak discharges is mitigated. At the south property line of the development, the peak discharges in the proposed condition with FSD are less than the pre-development condition as established in Reference 6. South of C & S

Road runoff from the Mesa Ridge development (and from areas offsite from Cross Creek tributary to design point 1260), will be conveyed through the Unseth subdivisions by means of an existing riprap channel. The drainageway facilities within the Unseth subdivisions have been designed to convey a discharge of 340 cfs beginning at design 1260. These channels may experience a longer duration of runoff associated with the runoff that will be carried through the Unseth subdivision. With FSD peak discharge at design points 1260 will be reduced from the levels estimated in Reference 6. However, the effect of FSD will be to reduce the peak discharges at this location from the existing levels estimated and listed in this report. The introduction of regional FSD basins in the watershed may extend duration of runoff flowing in the drainageways south of C & S Road.

The impact of developed runoff upon the West Fork Jimmy Camp Creek drainageway will be insignificant with respect to discharge. The 100-year detained discharge at design point 3280 (design point 5011 in the DBPS) will be reduced compared to the existing condition flow presented in the DBPS. At this time there is no defined West Fork Jimmy Camp Creek drainageway through the Mesa Ridge development, or downstream of Marksheffel Road. With the construction of the channel through Mesa Ridge as well as the outfall channel to Jimmy Camp Creek, the impact of the developed flow upon the area adjacent to these segments of West Fork Jimmy Camp Creek will be mitigated. The impact to the Jimmy Camp Creek drainageway with respect to peak discharge will also be minimal as long as the regional FSD concepts proposed in this study are implemented.

The combined outfall to Jimmy Camp Creek from both the Mesa Ridge East and Hale Reservoir basin will be decreased compared to existing flows according to proposed drainageway and detention plans for both areas. The current improvement design for Hale reservoir under design by the Applegate Group will reduce 100yr discharge to 210cfs from the existing 1320 cfs (Applegate Group correspondence 2022). As noted previously, propose conditions discharge from Mesa Ridge East drainageways which eventually outfall to Jimmy Camp Creek will either match or decrease compared to existing conditions flows.

The development of properties resulting in the increased imperviousness area and installation of detention facilities can increase the potential for downstream channel degradation due to increased runoff volume over a longer period of time. The discharge of cleaner water due to traditional water quality treatment can further increase downstream erosion. For this reason the Mile High Flood District developed full spectrum detention with an excess urban runoff volume (EURV) element. This design was intended to mitigate erosion from traditional detention facilities (reference 11, volume 2, section 3.2). However consideration of increased erosion to downstream channels should be evaluated during final design and mitigation measures may be indicated.

XV. REFERENCES

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

2. City of Colorado Springs Drainage Criteria Manual, prepared by City of Colorado Springs, January 2021.

3. Jimmy Camp Creek Drainage Basin Planning Study prepared by Kiowa Engineering, approved March 2015.

4. The Glen at Widefield Master Development Drainage Plan, prepared by Kiowa Engineering Corp., December 1999. Approval status unknown.

5. West Fork Jimmy Camp Creek Drainage Basin Planning Study, prepared by Kiowa Engineering Corp., approved March 2004.

6. Cross Creek at Mesa Ridge Master Development Drainage Plan prepared by Rockwell-Minchow Consultants, Inc. dated January 1999. Reviewed and approved without signature by City of Fountain.

7. Master Development Drainage Plan Update, Cross Creek Development prepared by Kiowa Engineering for Nearon Properties, June 2004. Reviewed and approved without signature by City of Fountain.

8. Mesa Ridge Development Master Development Drainage Plan Update prepared by Kiowa Engineering for Nor'wood Development, January 2013. Reviewed and approved without signature by City of Fountain.

9. El Paso County and City of Fountain Flood Insurance Study, FEMA, December 2018.

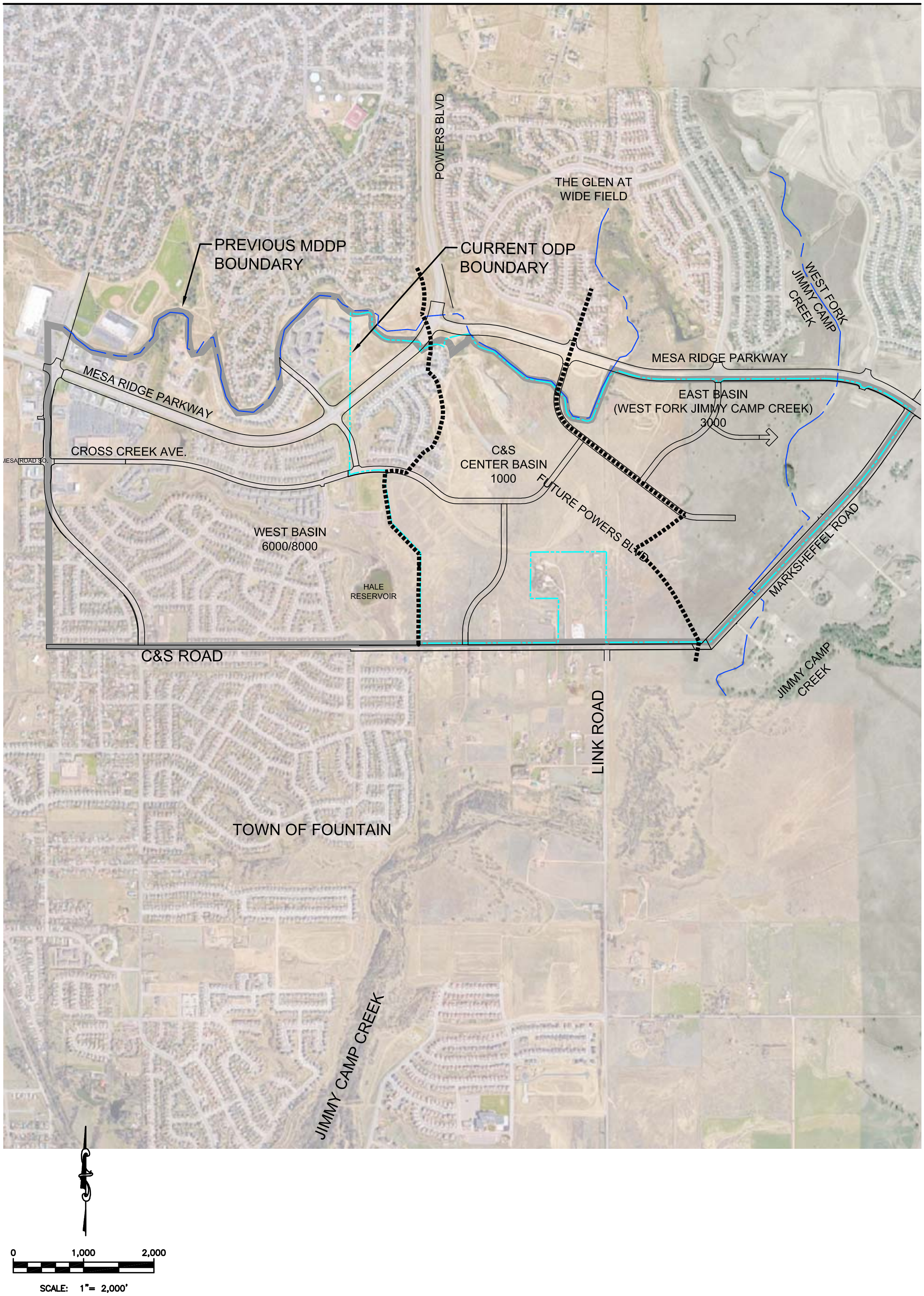
10. Preliminary Hydrology for Hale Reservoir Rehabilitation, Applegate Group 2021, correspondence with Dave Breindel. (see Appendix A2)

11. Urban Storm Drainage Criteria Manual, Volumes 1, 2, 3, Mile High Flood District, January 2016.

12. Drainage Criteria Manual Volume 1, City of Colorado Springs, revised 2021.

APPENDIX TABLE OF CONTENTS

APPENDIX A1: Figures and Reference

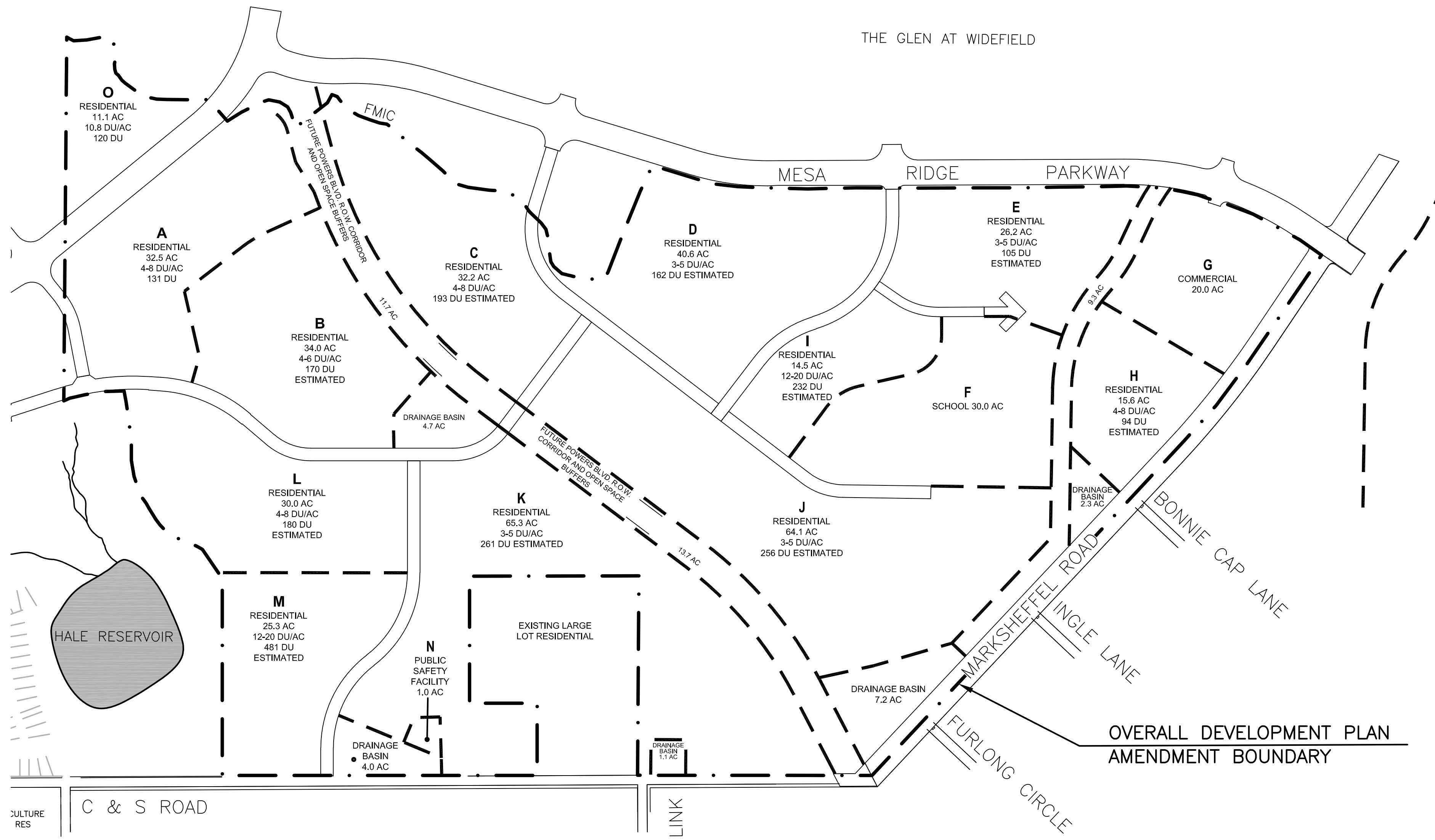


Kiowa Engineering Corporation
7175 West Jefferson Avenue, Suite 2200
Lakewood, Colorado 80235
(303) 692-0369

MESA RIDGE DEVELOPMENT
MASTER DEVELOPMENT DRAINAGE PLAN
VICINITY MAP
FOUNTAIN, COLORADO

Project No.:	21027
Date:	04/06/2022
Design:	SAB
Drawn:	MTR
Check:	SAB
Revisions:	

Fig. 1



SITE LAND USE LEGEND

LAND USE		SCS Curve Number
OS/P/D	OPEN SPACE/PARKS/DRAINAGE	61–74
RL	RESIDENTIAL – LOW DENSITY	68–79
RLM	RESIDENTIAL – LOW/MEDIUM DENSITY	75–83
RMH	RESIDENTIAL – MEDIUM/HIGH DENSITY	85–90
RH	RESIDENTIAL – HIGH DENSITY	85–90
COM/OFF	COMMERCIAL/OFFICE	92–95
SCHOOL	SCHOOL	77–85
ROADWAY	ROADWAY	98–98

NO SCALE

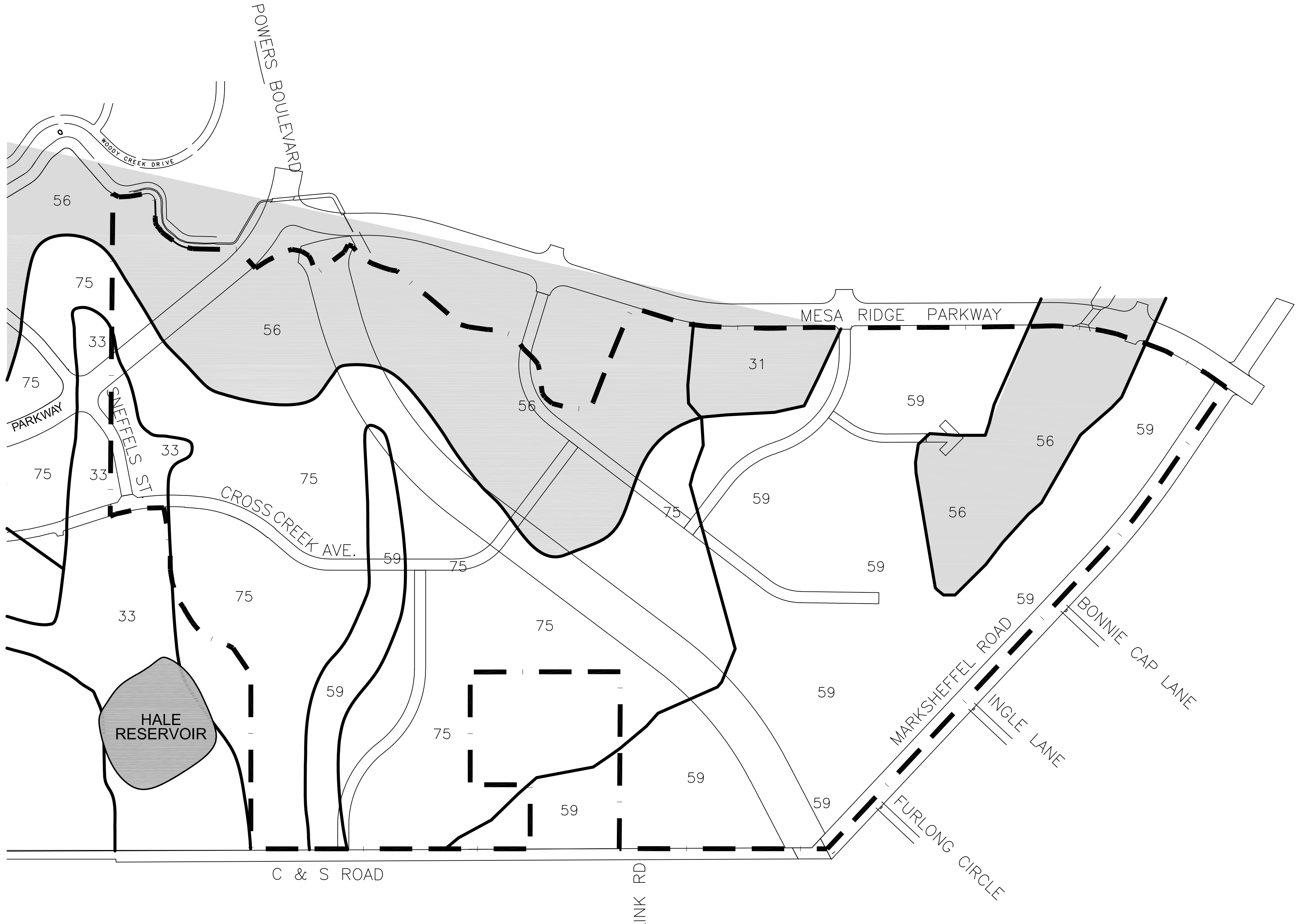
Kiowa Engineering Corporation
1604 South 21st Street
Colorado Springs, Colorado 80904
(719) 630-7342

MESA RIDGE DEVELOPMENT UPDATE
MASTER DEVELOPMENT DRAINAGE PLAN
HYDROLOGIC LAND USE MAP
FOUNTAIN, COLORADO

Project No.: 21027
Date: 04/06/2022
Design: SAB
Drawn: MTR
Check: SAB
Revisions:
04/26/2022

Fig. 2

21027 Fig2.dwg/May 19, 2022/12:12pm



SITE SOIL LEGEND

SOIL		HYDROLOGIC GROUP
31	FORT COLLINS	B
33	HELDT	C
39	KEITH	B
56	NELSON	B
59	NUNN	C
75	RAZOR	C
82	SCHAMBER	A
87	STONEHAM	B

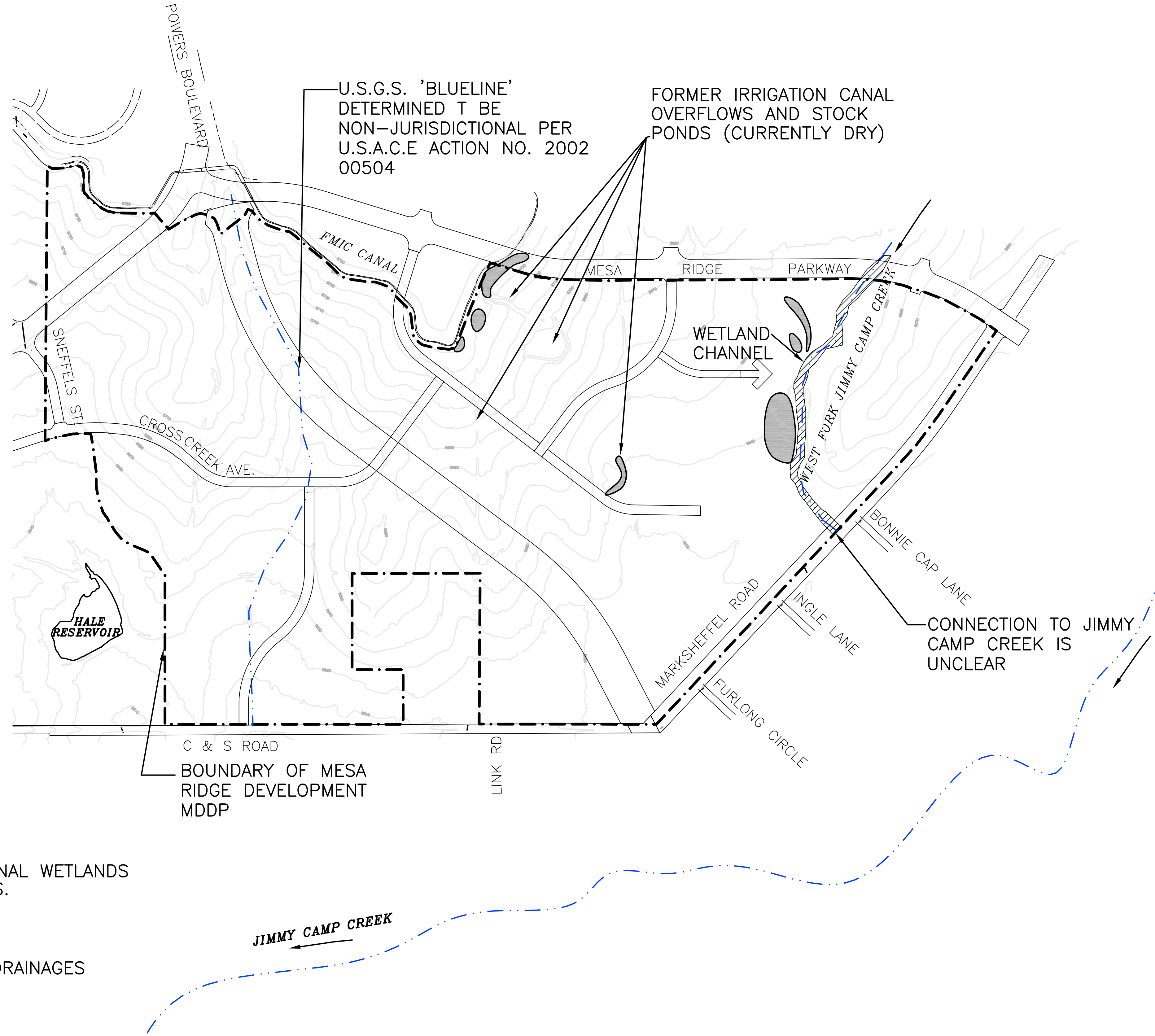
B SOILS

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

MESA RIDGE DEVELOPMENT
MASTER DEVELOPMENT DRAINAGE PLAN
SOILS MAP
FOUNTAIN, COLORADO

Project No.: 21027
Date: 04/05/2022
Design: SAB
Drawn: MTR
Check: SAB
Revisions:

Fig. 3



POTENTIAL JURISDICTIONAL WETLANDS & WATERS OF THE U.S.

RIPARIAN RESOURCES

U.S.G.S. 'BLUE LINE' DRAINAGES

NO SCALE

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

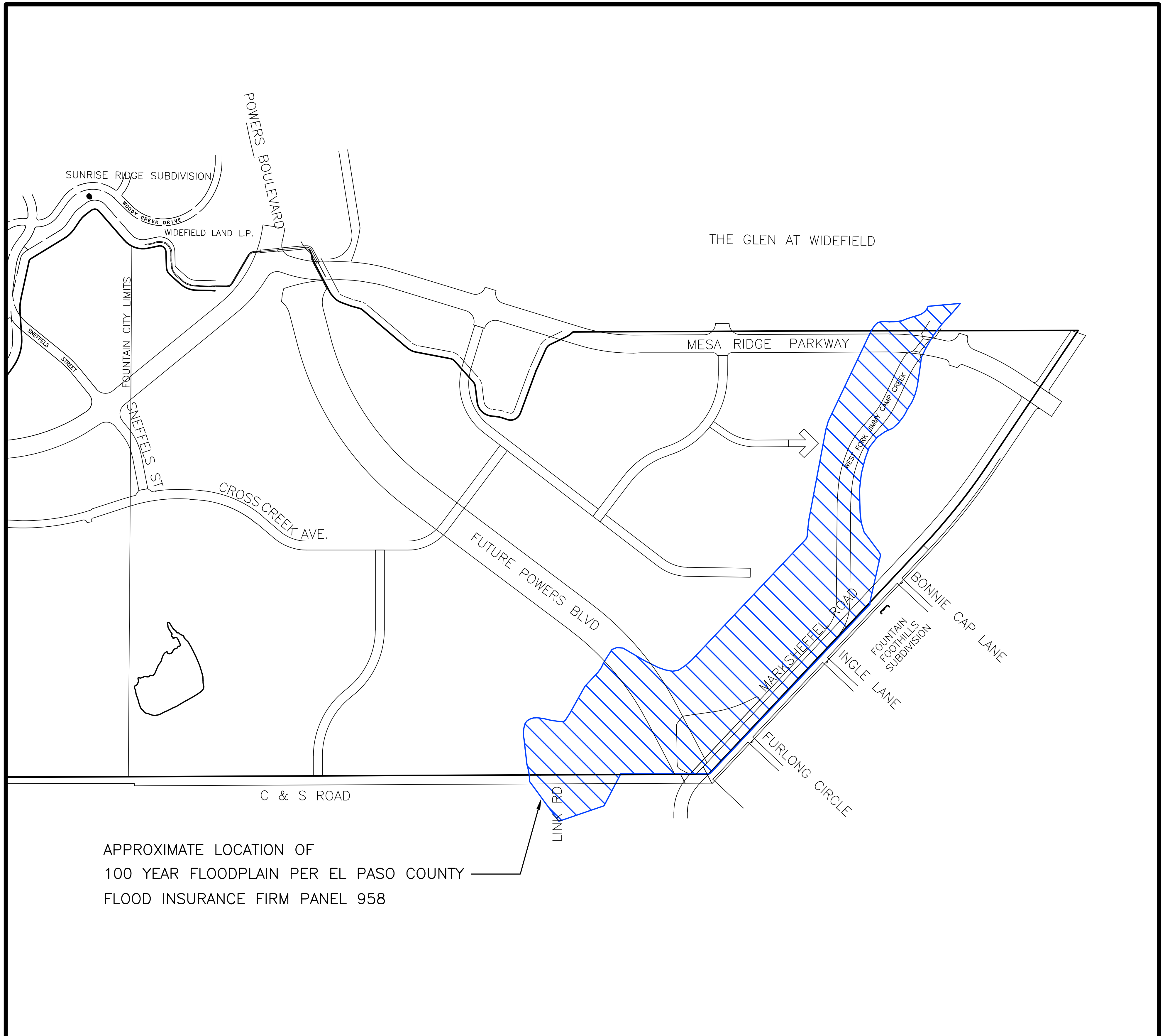
MESA RIDGE DEVELOPMENT MASTER DEVELOPMENT DRAINAGE PLAN

WETLAND RESOURCES

FOUNTAIN, COLORADO

Project No.:	21027
Date:	04/05/2022
Design:	SAB
Drawn:	MTR
Check:	SAB
Revisions:	

Fig. 4



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

MESA RIDGE DEVELOPMENT
MASTER DEVELOPMENT DRAINAGE PLAN
FLOOD HAZARD AREAS
FOUNTAIN, COLORADO

Project No.:	21027
Date:	04/05/2022
Design:	SAB
Drawn:	MTR
Check:	SAB
Revisions:	

Fig. 5

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.

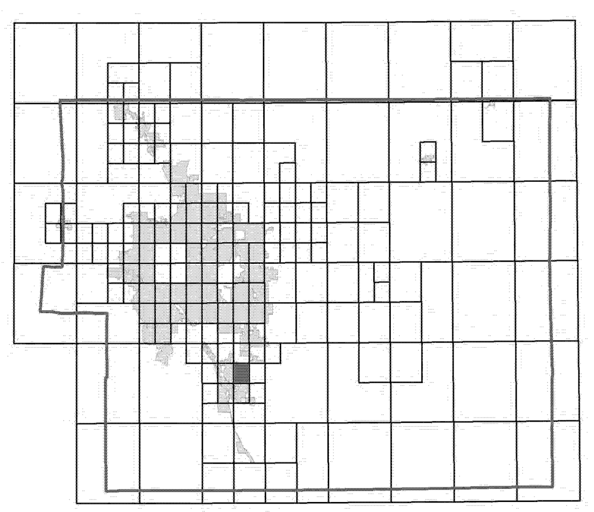
Contact **FEMA Map Service Center** (MSC) via the FEMA Map Information eXchange (FMIX) 1-877-336-2627 for information on available products associated with this FIRM. Available products may include previously issued Letters of Map Change, a Flood Insurance Study Report, and/or digital versions of this 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

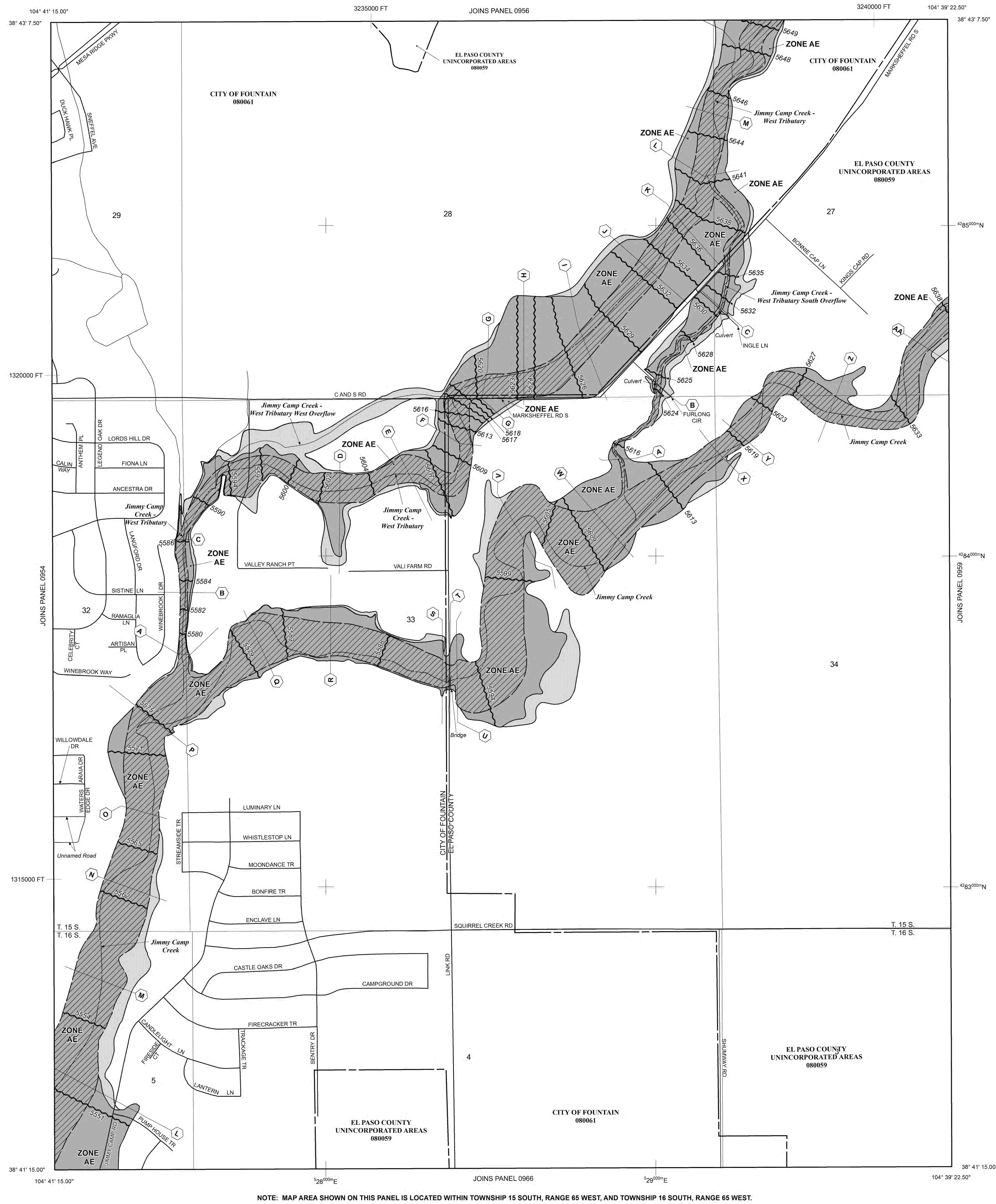
Flooding Source	Vertical Datum Offset (ft)
REFER TO SECTION 3.3 OF THE EL PASO COUNTY FLOOD INSURANCE STUDY FOR STREAM BY STREAM VERTICAL DATUM CONVERSION INFORMATION	

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.



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)
- 4275000mN 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
NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0958G

FIRM
FLOOD INSURANCE RATE MAP
EL PASO COUNTY, COLORADO
AND INCORPORATED AREAS

PANEL 958 OF 1300
(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
EL PASO COUNTY	080059	0958	G
FOUNTAIN, CITY OF	080061	0958	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
08041C0958G

MAP REVISED
DECEMBER 7, 2018

Federal Emergency Management Agency

Mesa Ridge East Drainageway Photo Log

WF JCC Mesa Ridge Parkway Bridge facing North

Downstream Mesa Ridge Pkwy Bridge facing south.

WF Jimmy Camp Creek invert facing south.

WF Jimmy Camp Creek invert facing north.

WF Jimmy Camp Creek invert facing north.

Invert along Marksheffel Rd. facing southwest.

Mesa Ridge East Drainageway Photo Log

WF JCC flowpath south of C& Road looking north.

WF JCC flowpath looking west.

DP 1250 C&S road crossing and channel to north

Downstream of DP 1250 along Valley Ranch Rd.

Crossing of Valley Ranch Rd towards Jimmy Camp Creek

APPENDIX A2: Figures and Reference Excepts

West Fork Jimmy Camp Creek DBPS Preliminary Plan

West Fork Jimmy Camp Creek DBPS Typical Details

Cottages Drainage Map

Powers Blvd Conceptual Design

Applegate Group 2021 Correspondence

WEST FORK JIMMY CAMP CREEK
DRAINAGE BASIN PLANNING STUDY

Prepared for:

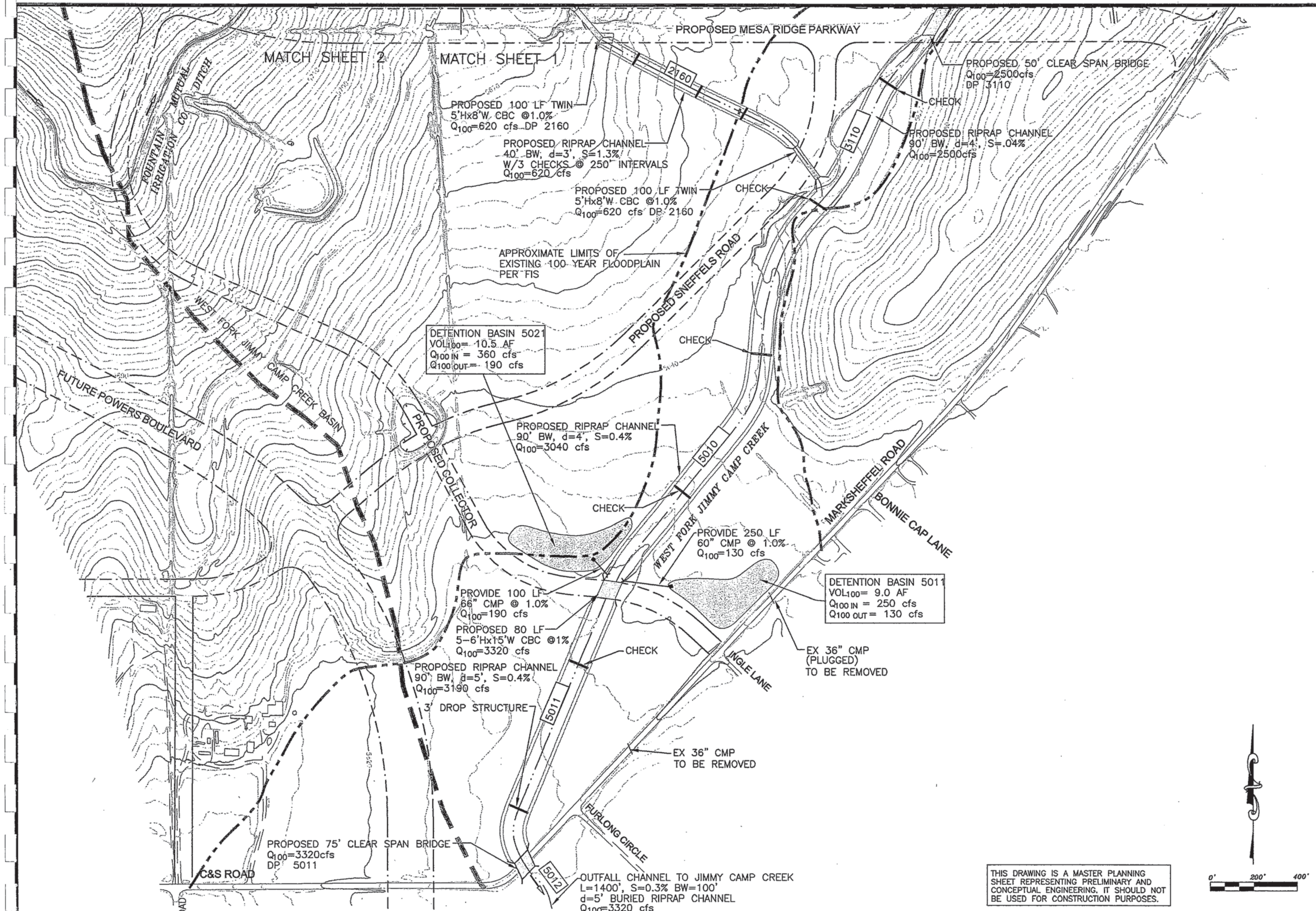
New Generation Homes, Inc.
3 Widefield Boulevard
Colorado Springs, CO 80911

Prepared by:

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

KIOWA Project No. 98.93
wfjc*.doc

June 1999
July 2000
November 2000
October 17, 2003

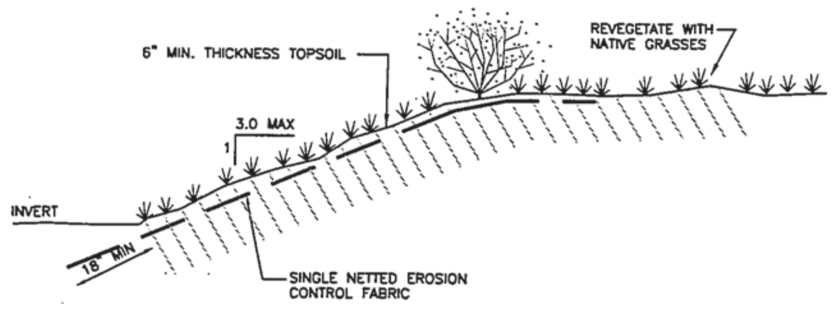


Kiowa Engineering Corporation
1604 South 21st Street
Colorado Springs, Colorado
80904
(719) 630-7342

WEST FORK JIMMY CAMP CREEK
DRAINAGE BASIN PLANNING STUDY

PRELIMINARY PLAN
EL PASO COUNTY, COLORADO

Project No.: 9893
Date: 7/00
Design: RNW
Drawn: CAD
Check: RNW
Revisions:



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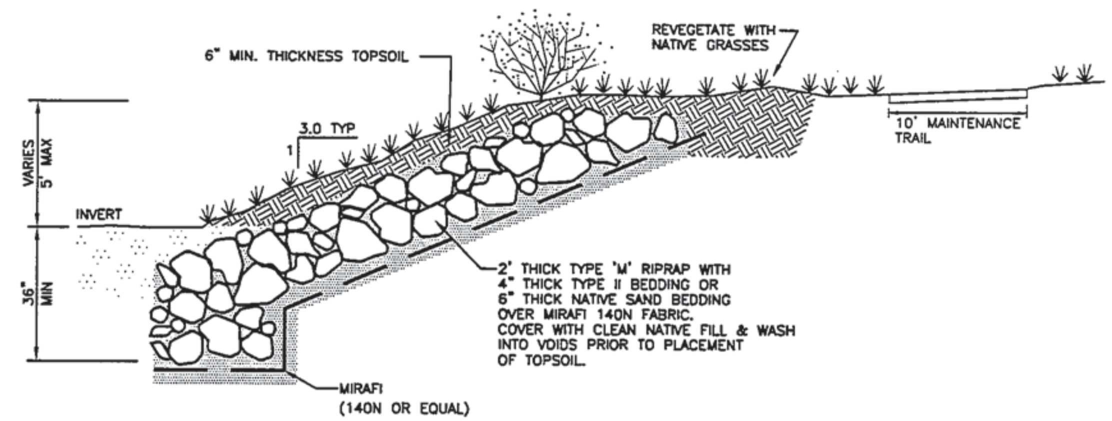
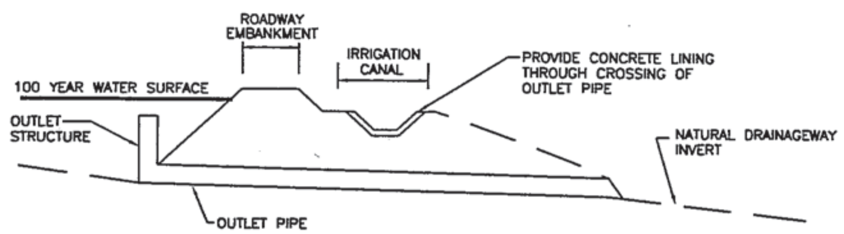


RIPRAP BANK LINING DETAIL
NTS



IRRIGATION CANAL CROSSING
AT DETENTION BASIN
(NTS)

RIPRAP GRADATIONS

TYPE H RIPRAP

INTERMEDIATE ROCK DIMENSION IN INCHES	% SMALLER THAN GIVEN SIZE BY WEIGHT	D_{50} INCHES
30	100	18
24	50-70	
18	35-50	
6	2-10	

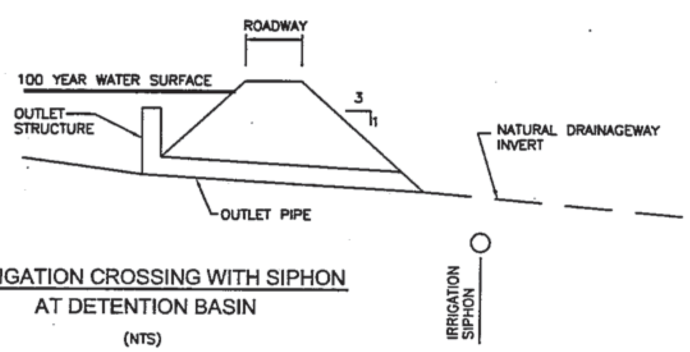
TYPE M RIPRAP

INTERMEDIATE ROCK DIMENSION IN INCHES	% SMALLER THAN GIVEN SIZE BY WEIGHT	D_{50} INCHES
21	100	12
18	50-70	
12	35-50	
4	2-10	

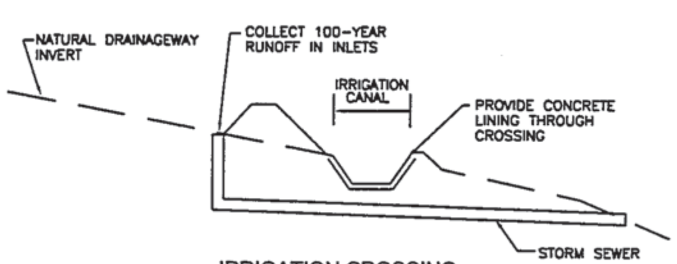
SEED MIX

AREAS DISTURBED BY THE EARTHWORK SHALL BE PERMANENTLY REVEGETATED WITH NATIVE GRASSES. NATIVE SEED MIX FOR THIS PROJECT SHALL BE AS FOLLOWS:

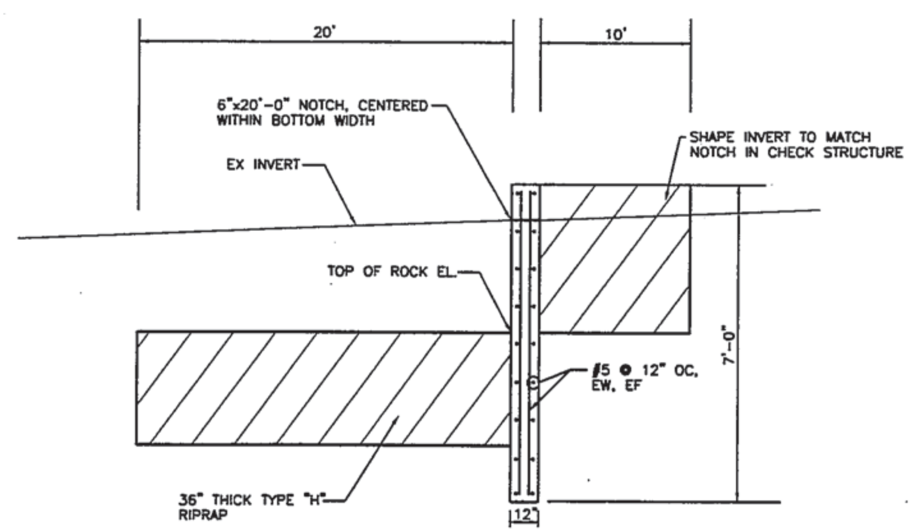
NATIVE SEED MIX		pls/acre
BLUE GRAMA	*Chondrosum hirsutum*	2.0
SIDEOATS GRAMA	*Bouteloua curtipendula*	3.0
SLENDER WHEATGRASS	*Agropyron trachycaulm trachycaulm*	2.0
WESTERN WHEATGRASS	*Agropyron smithii*	4.0
		11.0 lbs



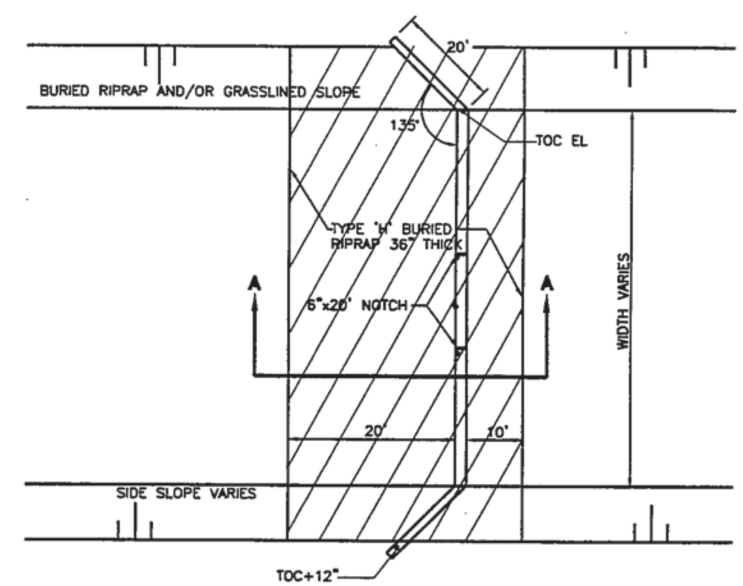
IRRIGATION CROSSING WITH SIPHON
AT DETENTION BASIN
(NTS)



IRRIGATION CROSSING
AT SEWER CROSSING
(NTS)



SECTION A–A



TYPICAL CHECK STRUCTURE PLAN
NO SCALE

Kiowa Engineering Corporation
1604 South 21st Street
Colorado Springs, Colorado
8004
(719) 630-7342

West Fork Jimmy Camp Creek
Drainage Basin Planning Study
TYPICAL DRAINAGEWAY DETAILS
EL PASO COUNTY, COLORADO

Project No.: 9893
Date: 7/00
Design: RNW
Drawn: CAD
Check: RNW
Revisions:

SHEET 7

HRGreen

HRGREEN.COM

The Cottages at Mesa Ridge
Preliminary Drainage Report

August 2021

HR Green Project No: 200541

Prepared For:

Goodwin Knight

Contact: Bryan D. Kniep

8605 Explorer Drive, Suite 250

Colorado Springs, CO 80920

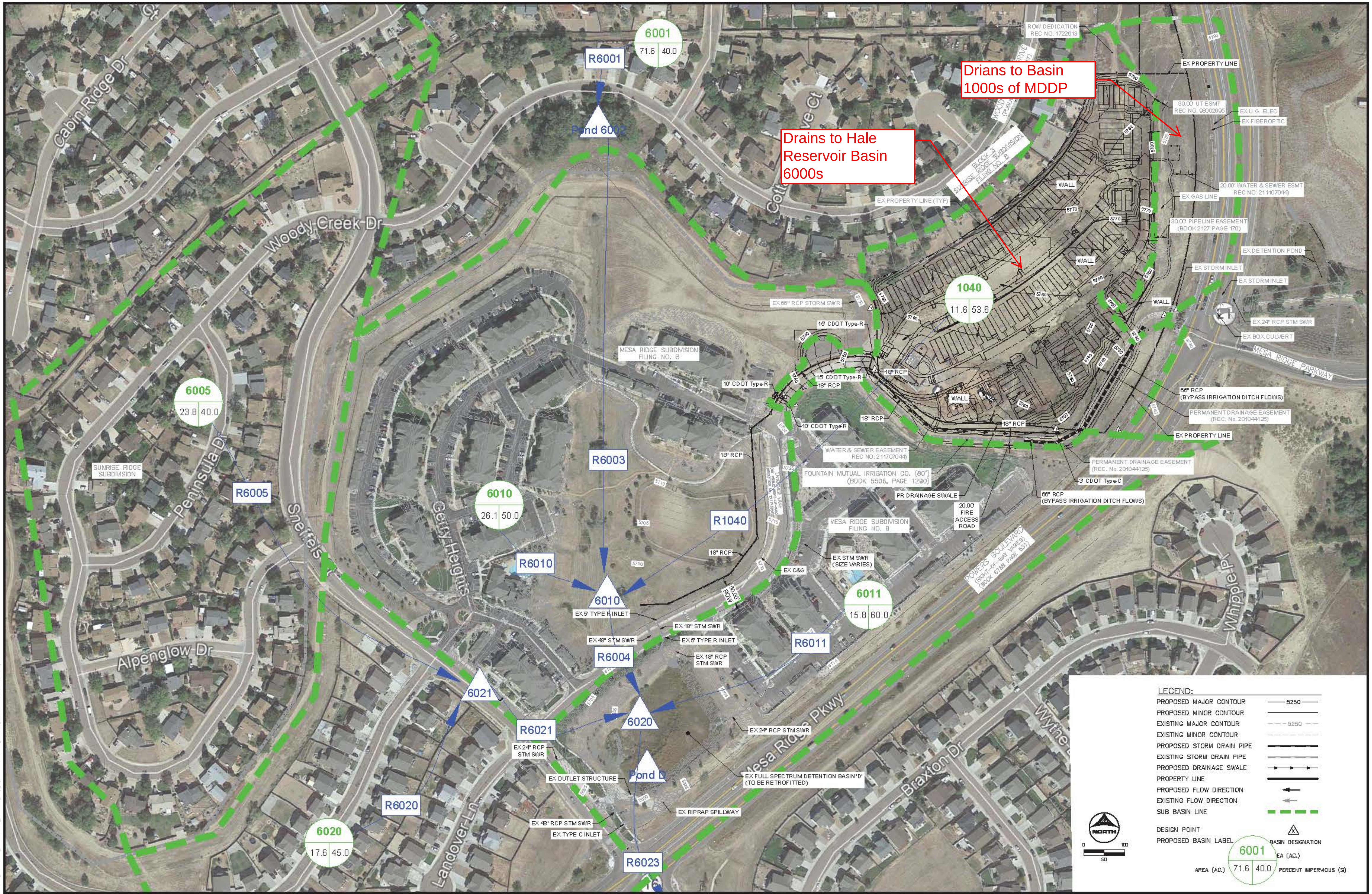
Prepared By:

HR Green Development, LLC

Contact: Ken Huhn, PE

khuhn@hrgreen.com

(720) 602-4965



DRAWN BY: NQJ	JOB DATE: 8/18/2021
APPROVED: KMH	JOB NUMBER: 200541
CAD DATE: 8/18/2021	
CAD FILE: J:\2020\200541\CAD\Dwgs\C\Drainage\PF_Drn_Map_PondD	

BAR IS ONE INCH ON OFFICIAL DRAWINGS. IF NOT ONE INCH, ADJUST SCALE ACCORDINGLY.

NO.	DATE	BY	REVISION DESCRIPTION

HRGREEN - COLORADO SPRINGS
7222 COMMERCE CENTER DR SUITE 220
COLORADO SPRINGS CO 80919
PHONE: 719.300.4140 TOLL FREE: 800.728.7805
FAX: 844.273.1057 | HRGreen.com

THE COTTAGES AT MESA RIDGE
GOODWIN KNIGHT
EL PASO COUNTY, COLORADO

PRELIMINARY DRAINAGE REPORT
REGIONAL POND D MAP

SHEET DRN 2

Memorandum

WILSON & COMPANY
HIGHER RELATIONSHIPS

To: Brandy Williams/Fountain City Engineer

From: Scott Asher/Wilson & Company

CC: Maureen Paz de Araujo, Kelly Fredell

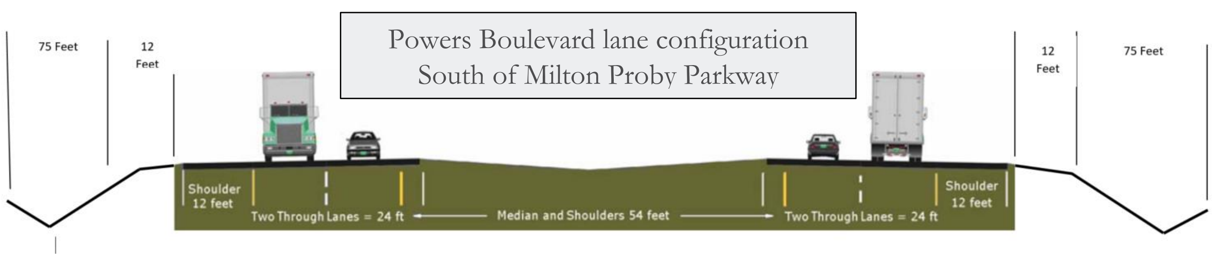
Date: 10/14/2020

Re: South Powers Boulevard Design Criteria

The purpose of this memorandum is to memorialize the agreements and direction for the South Powers Boulevard design criteria in order for the City of Fountain to provide consistent direction as the area continues to develop.

Powers Boulevard is planned to be an expressway facility with full access control that will provide for an alternate high capacity north-south facility through El Paso County. The roadway will be designed as a 70 MPH facility with a posted speed of 65 MPH. Due to the high speed nature of the facility a minimum of 300' of right of way will be required for the mainline portions of the roadway. The right of way width will increase at the full access locations. The following exhibit illustrates the typical section for the South Powers corridor. Note that there is 87 feet from edge of pavement to allow for slope grading, clear zone requirements and roadside drainage facilities.

120' of 300' impervious roadway



Due to the nature of transportation projects it is anticipated that the 300' corridor for the roadway will likely be unused for several years before construction of the roadway would progress. Through conversations with CDOT and FHWA it is recommended that the future corridor right of way is not used for uses that are inconsistent with the ultimate transportation use. Trail and bikeway facilities could be constructed at the edges of right of way or crossing perpendicular to the right of way in areas that are planned for pedestrian access. It is not desirable to have trail or pedestrian facilities with in the foot print of the roadway as shown in the typical section.

As development plans move forward and the Powers Boulevard Corridor becomes more defined, the City will share development plans and annexation agreement language with CDOT to comment on and ensure compatibility with the Powers Boulevard Corridor plan.

WILSON & COMPANY

Powers Boulevard Design Criteria to use in the review and approval of development plans is shown in the following exhibit.

Design Criteria Table			
Criteria	Unit	Value	Source
Jurisdiction		CDOT	
Roadway Type		Freeway/Expressway	
Design Speed	mph	70	
Posted Speed	mph	65	
Design Vehicle		WB-67	CDOT RDG 2018, Table 9-3
Horizontal			
Stopping Sight Distance (SSD)	ft	730	CDOT RDG 2018, Table 3-1
SSD Downgrade (3%, 6%, 9%)	ft	771, 825, 891	CDOT RDG 2018, Table 3-1
SSD Upgrade (3%, 6%, 9%)	ft	690, 658, 631	CDOT RDG 2018, Table 3-1
Passing Sight Distance	ft	1200	CDOT RDG 2018, Table 3-1
Horizontal Radius	ft	3150 @6% of 8% max	CDOT M-Standard M-203-11
Vertical			
K-Value, Crest		247	CDOT RDG 2018, Table 3-1
K-Value, Sag		181	CDOT RDG 2018, Table 3-1
Superelevation Max		emax 8% table, use 6% maximum	CDOT M-Standard M-203-11
Clearance under Road Bridge	ft	16.5	CDOT RDG 2018, Table 3-3
Min Flowline Grade	%	0.005	CDOT RDG 2018, Page 3-30
Max Grade (Level)	%	3% Rural, 4% Urban	CDOT RDG 2018, Table 3-4
Min Length of Vertical Curve	ft	300	
Cross Section Elements			
Geometric Design Type		Type A	
Number of lanes		4	
Lane Width	ft	12	CDOT RDG 2018, Table 4-1
Outside shoulder min	ft	10	CDOT RDG 2018, Table 4-1
Inside shoulder min	ft	4	CDOT RDG 2018, Table 4-1
ROW Width	ft	300	CDOT RDG 2018, Table 4-1
Access Control		Full	CDOT RDG 2018, Table 4-1
Curb Type		None	CDOT RDG 2018, Page 4-10
Z Slope	ft	12	CDOT RDG 2018, Figure 4-1,4-2
Slope Ratio		Z then 4:1/3:1(Rolling/Mountainous)	CDOT RDG 2018, Table 4-2
Tapers			
Full Deceleration Length	ft	820	CDOT RDG 2018, Table 9-7
Storage Length	ft	Depends on traffic	CDOT RDG 2018, Table 9-8
Acceleration Length	ft	1620 (from stop condition)	CDOT RDG 2018, Table 9-9
Taper Ratio		25:1, 70:1 where lengths exceed 1300ft	CDOT RDG 2018, Table 9-10

RE: Mesa Ridge MDDP

Reply | Reply All | Forward

DB
Dave Breindel <davebreindel@applegategroup.com>
To Steve Brown
Thu 10/14/2021 6:1

Steve – see the table below; let me know if this gets what you need for your submittal to Fountain. As discussed, the estimated peak flows are preliminary. I'm still working on design of the service spillway standpipe/riser to meet water quality treatment requirements and will keep you updated as we move forward.

	Outflow from Hale Reservoir (DB8075)	
Source	5-yr	100-yr
Preliminary Hydrology for Hale Reservoir Rehabilitation (Applegate, 2021) - Developed Conditions*,1	39 cfs[2]	210 cfs
Cross Creek at Mesa Ridge MDDP (Kiowa, 2013) - Developed Conditions	7 cfs	255 cfs
Cross Creek at Mesa Ridge MDDP (Rockwell, 1999)	N/A	539 cfs[3]
West Fork Jimmy Camp Creek DBPS (Kiowa, 2004)	N/A	1320 cfs[4]

Notes

*Colorado Springs 2-hour Design Storm with NOAA Atlas 14 rainfall data.

1. Assumes starting water surface elevation at normal pool (elevation 5622) and service spillway fully operational.
2. Design of service spillway standpipe to be updated based on required WQCV and EURV drain times - TO BE REVISED.
3. Historic 100-year flow at C&S Road.
4. 100-year flow based on existing development with detention and no diversion by FMIC ditch.

APPENDIX B: Existing Conditions Hydrology

MEC-HMS Model Schematics

Table 1 CN Values Calculation

Table 2 Time of Concentration Calculation

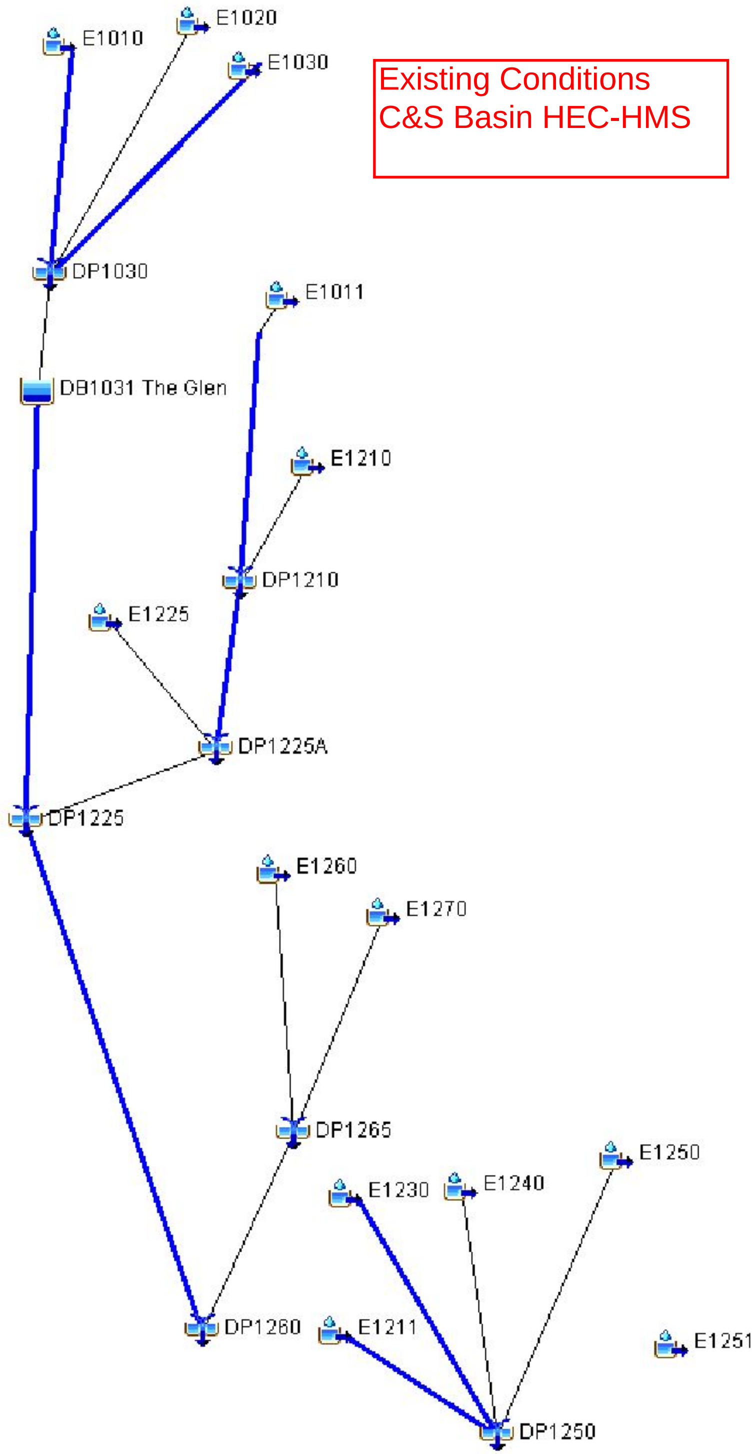
HEC HMS Peak Flow Results

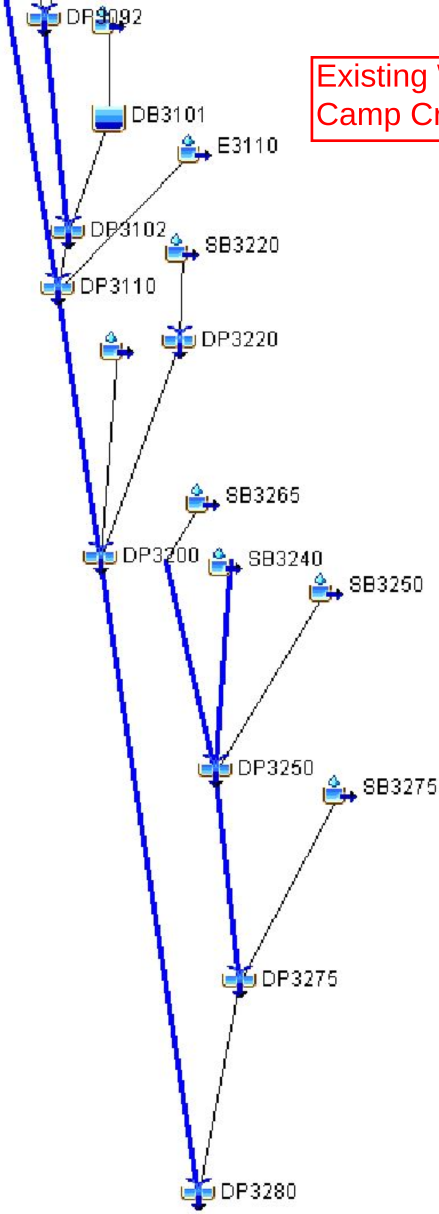
NOAA Atlas 14 Precipitation

Colorado Springs 2hr Storm Distributions

Colorado Springs NCRS Curve Numbers for Pre-Development (ARC I)

Existing Conditions
C&S Basin HEC-HMS





Existing WF Jimmy Camp Creek

Table B1
Mesa Ridge MDDP
Existing Conditions CN Values

	Land Use					
			Rangeland			
			B	C	HEC-HMS	
Basin	**Area (ac)**	**Area (Sq Miles)**	**63**	**74**	**CN**	Abstraction
C&S Basin						
E1010	12.8	0.020	0.001	0.019	73.2	0.366
E1020	26.24	0.041	0.033	0.008	65.5	0.527
E1030	12.8	0.020	0.006	0.014	70.8	0.412
E1011	14.4	0.022	0.022	0.000	63.0	0.587
E1210	40.3	0.063	0.049	0.014	65.5	0.528
E1211	32.1	0.050	0.017	0.033	70.2	0.425
E1225	45.7	0.071	0.021	0.050	70.8	0.413
E1230	18.1	0.028	0.000	0.028	74.0	0.351
E1240	28.9	0.045	0.000	0.045	74.0	0.351
E1250	29.8	0.047	0.000	0.047	74.0	0.351
E1260	32.0	0.050	0.000	0.050	74.0	0.351
E1270	43.3	0.068	0.000	0.068	74.0	0.351
Totals	**336.5**	**0.526**				
West Fork Jimmy Camp Creek Basin						
SB3220	41.6	0.065	0.024	0.035	69.5	0.439
SB3240	44.0	0.069	0.017	0.052	71.3	0.403
SB3250	20.1	0.031	0.000	0.031	74.0	0.351
SB3265	58.3	0.091	0.041	0.050	69.0	0.448
SB3275	59.8	0.093	0.007	0.086	73.1	0.368
Totals	**223.8**	**0.3**				

Table B2

Sub-Basin Data				Time of Concentration Estimate Undeveloped													
Basin / Design Point	Contributing Basins	Area	C_5	Initial/Overland Time (t_i)			Travel Time (t_t)						Comp.			Final t_c	HECHMS Lag (.6Tc)
				Length	Slope	t_i	Length	Slope	Land Type	Cv	Velocity	t_t	t_c				
E1011		14.38ac	0.16	400lf	6.1%	18.9 min.	100lf	6.1%	SP	7	1.7 ft/sec	1.0 min.	19.8 min.			**19.8 min.**	11.9
E1210		40.29ac	0.16	500lf	8.0%	19.3 min.	2100lf	8.0%	SP	7	2.0 ft/sec	17.7 min.	37.0 min.			**37.0 min.**	22.2
E1211		32.06ac	0.16	500lf	7.0%	20.1 min.	820lf	7.0%	SP	7	1.9 ft/sec	7.4 min.	27.5 min.			**27.5 min.**	16.5
E1225		45.74ac	0.16	500lf	8.3%	19.0 min.	2250lf	8.3%	SP	7	2.0 ft/sec	18.6 min.	37.7 min.			**37.7 min.**	22.6
E1230		18.08ac	0.16	500lf	7.2%	20.0 min.	380lf	7.2%	SP	7	1.9 ft/sec	3.4 min.	23.3 min.			**23.3 min.**	14.0
E1240		28.93ac	0.16	500lf	3.2%	26.1 min.	1192lf	3.2%	SP	7	1.3 ft/sec	15.8 min.	41.9 min.			**41.9 min.**	25.2
E1250		29.81ac	0.16	500lf	5.7%	21.6 min.	1100lf	5.7%	SP	7	1.7 ft/sec	11.0 min.	32.6 min.			**32.6 min.**	19.6
E1260		32.03ac	0.16	500lf	5.7%	21.6 min.	680lf	5.7%	SP	7	1.7 ft/sec	6.8 min.	28.4 min.			**28.4 min.**	17.0
E1270		43.30ac	0.16	500lf	5.1%	22.4 min.	1730lf	5.1%	SP	7	1.6 ft/sec	18.2 min.	40.6 min.			**40.6 min.**	24.4
SB3240		44.00ac	0.16	500lf	2.0%	30.5 min.	1620lf	4.0%	SP	7	1.4 ft/sec	19.3 min.	49.8 min.			**49.8 min.**	29.9
SB3250		20.14ac	0.16	500lf	1.5%	33.6 min.	780lf	1.0%	SP	7	0.7 ft/sec	18.6 min.	52.2 min.			**52.2 min.**	31.3
SB3265		58.29ac	0.16	500lf	2.5%	28.4 min.	1910lf	2.8%	SP	7	1.2 ft/sec	27.2 min.	55.5 min.			**55.5 min.**	33.3
SB3275		59.76ac	0.16	500lf	2.1%	29.9 min.	1785lf	3.2%	SP	7	1.3 ft/sec	23.8 min.	53.6 min.			**53.6 min.**	32.2

Equations:

t_i (Overland) = $0.395(1.1-C_5)L^{0.5}S^{-0.333}$

C_5 = Runoff coefficient for 5-year

L = Length of overland flow (ft)

S = Slope of flow path (ft/ft)

tc Check = (L/180)+10 (Developed Cond. Only)

L = Overall Length

Velocity (Travel Time) = $CvS^{0.5}$

Cv = Conveyance Coef (see table)

S = Watercourse slope (ft/ft)

Table 6-7: Conveyance Coef (City CS DCM, Vol 1)

Type of Land Surface	Land Type	Cv
Grassed Waterway	GW	15
Heavy Meadow	HM	2.5
Nearly Bare Ground	NBG	10
Paved Area	PV	20
Riprap (Not Buried)	RR	6.5
Short Pasture/Lawns	SP	7
Tillage/Fields	TF	5

Table B3
C&S (Center) Basin
Existing Conditions HEC-HMS Results

Element	Drainage Area Miles^2	5-Year Peak Flow cfs	100-Year Peak Flow cfs
E1011	0.022	11	56
R1011	0.022	10	54
E1210	0.063	10	62
DP1210	0.085	16	103
R1210	0.085	16	103
E1225	0.071	19	83
DP1225A	0.156	35	182
E1010	0.020	5	53
R1010	0.020	5	53
E1030	0.020	6	30
R1030	0.020	6	30
E1020	0.041	16	67
DP1030	0.081	24	109
DB1031 The Glen	0.081	17	57
R1031	0.081	17	57
DP1225	0.237	35	216
R1225A	0.237	35	214
E1260	0.050	17	76
E1270	0.047	12	59
DP1265	0.097	26	131
DP1260	**0.334**	**61**	**341**
E1211	0.050	13	67
R1211	0.050	13	67
E1230	0.028	11	48
R1230	0.028	11	47
E1250	0.047	14	67
E1240	0.045	11	55
DP1250	**0.170**	**46**	**229**
E1251	0.136	16	217

E=Subbasin
R=Routing
DP= Design Point
DB=Detention

Table B3
West Fork Jimmy Camp Creek Basin
Existing Conditions HEC-HMS Results

Element	Drainage Area Square Miles	5-Year Peak Flow cfs	100-Year Peak Flow cfs
DP3110	3.38	428	2829
R3110	3.38	427	2794
SB3220	0.07	15	84
DP3220	0.07	15	84
SB3200	0.01	2	19
DP3200	3.45	431	2812
R3200	3.45	430	2797
SB3265	0.06	6	45
R3265	0.06	6	45
SB3240	0.05	8	39
R3240	0.05	8	39
SB3250	0.09	20	84
DP3250	0.20	30	164
R3250	0.20	30	163
SB3275	0.07	13	62
DP3275	0.27	42	222
DP3280	3.72	**462**	**2988**

E=Subbasin
R=Routing
DP= Design Point
DB=Detention

NOAA Atlas 14, Volume 8, Version 2
Location name: Colorado Springs, Colorado, USA*
Latitude: 38.7286°, Longitude: -104.6783°
Elevation: 5771.51 ft**
* source: ESRI Maps
** source: USGS

POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Deborah Martin, Sandra Pavlovic, Ishani Roy, Michael St. Laurent, Carl Trypaluk, Dale Unruh, Michael Yekta, Geoffery Bonnin

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	0.253 (0.208-0.314)	0.305 (0.250-0.377)	0.396 (0.323-0.492)	0.479 (0.388-0.598)	0.604 (0.475-0.794)	0.708 (0.541-0.943)	0.820 (0.603-1.12)	0.942 (0.660-1.32)	1.11 (0.746-1.61)	1.25 (0.812-1.83)
10-min	0.371 (0.304-0.459)	0.446 (0.365-0.553)	0.579 (0.473-0.720)	0.701 (0.569-0.875)	0.884 (0.696-1.16)	1.04 (0.793-1.38)	1.20 (0.883-1.64)	1.38 (0.966-1.94)	1.63 (1.09-2.36)	1.83 (1.19-2.68)
15-min	0.452 (0.371-0.560)	0.544 (0.446-0.674)	0.707 (0.577-0.878)	0.855 (0.693-1.07)	1.08 (0.849-1.42)	1.26 (0.967-1.68)	1.47 (1.08-2.00)	1.68 (1.18-2.36)	1.99 (1.33-2.88)	2.24 (1.45-3.27)
30-min	0.655 (0.538-0.811)	0.786 (0.644-0.974)	1.02 (0.833-1.27)	1.23 (1.00-1.54)	1.56 (1.23-2.05)	1.82 (1.40-2.43)	2.11 (1.55-2.89)	2.43 (1.70-3.41)	2.87 (1.92-4.16)	3.23 (2.09-4.72)
60-min	0.851 (0.699-1.05)	1.00 (0.819-1.24)	1.28 (1.05-1.59)	1.55 (1.26-1.94)	1.98 (1.57-2.62)	2.34 (1.80-3.14)	2.75 (2.03-3.78)	3.20 (2.25-4.52)	3.85 (2.59-5.60)	4.39 (2.84-6.41)
2-hr	1.05 (0.865-1.29)	1.21 (1.00-1.49)	1.54 (1.27-1.91)	1.87 (1.53-2.32)	2.40 (1.92-3.18)	2.86 (2.22-3.83)	3.39 (2.52-4.64)	3.97 (2.82-5.59)	4.83 (3.28-6.99)	5.55 (3.63-8.05)
3-hr	1.15 (0.954-1.41)	1.31 (1.09-1.61)	1.66 (1.36-2.04)	2.01 (1.64-2.48)	2.59 (2.10-3.45)	3.13 (2.44-4.18)	3.73 (2.79-5.11)	4.41 (3.15-6.21)	5.43 (3.71-7.84)	6.28 (4.13-9.08)
6-hr	1.32 (1.10-1.60)	1.49 (1.24-1.81)	1.86 (1.54-2.27)	2.25 (1.86-2.77)	2.93 (2.39-3.88)	3.55 (2.79-4.73)	4.25 (3.22-5.81)	5.06 (3.65-7.10)	6.27 (4.33-9.02)	7.29 (4.84-10.5)
12-hr	1.46 (1.23-1.77)	1.68 (1.41-2.03)	2.11 (1.77-2.57)	2.56 (2.12-3.12)	3.29 (2.70-4.32)	3.96 (3.13-5.22)	4.71 (3.58-6.36)	5.55 (4.03-7.70)	6.80 (4.72-9.69)	7.85 (5.25-11.2)
24-hr	1.63 (1.38-1.96)	1.91 (1.61-2.29)	2.43 (2.04-2.93)	2.93 (2.44-3.55)	3.72 (3.05-4.79)	4.41 (3.50-5.74)	5.17 (3.95-6.90)	6.02 (4.39-8.26)	7.25 (5.07-10.2)	8.26 (5.58-11.7)
2-day	1.84 (1.57-2.20)	2.18 (1.85-2.60)	2.79 (2.36-3.34)	3.35 (2.82-4.03)	4.20 (3.45-5.34)	4.92 (3.92-6.32)	5.70 (4.38-7.52)	6.55 (4.81-8.88)	7.75 (5.46-10.8)	8.74 (5.95-12.3)
3-day	1.99 (1.70-2.37)	2.34 (2.00-2.79)	2.97 (2.53-3.55)	3.55 (3.00-4.26)	4.44 (3.66-5.61)	5.19 (4.15-6.63)	5.99 (4.62-7.87)	6.87 (5.07-9.28)	8.11 (5.74-11.3)	9.13 (6.26-12.8)
4-day	2.13 (1.82-2.53)	2.49 (2.13-2.95)	3.13 (2.67-3.73)	3.72 (3.15-4.45)	4.63 (3.83-5.84)	5.40 (4.33-6.88)	6.22 (4.82-8.15)	7.13 (5.28-9.60)	8.42 (5.98-11.7)	9.46 (6.51-13.2)
7-day	2.54 (2.19-3.00)	2.92 (2.51-3.45)	3.61 (3.09-4.27)	4.24 (3.61-5.04)	5.20 (4.32-6.50)	6.01 (4.85-7.61)	6.88 (5.36-8.95)	7.83 (5.84-10.5)	9.19 (6.58-12.7)	10.3 (7.14-14.3)
10-day	2.90 (2.50-3.40)	3.32 (2.86-3.90)	4.06 (3.49-4.79)	4.74 (4.05-5.62)	5.76 (4.79-7.16)	6.61 (5.36-8.33)	7.52 (5.88-9.73)	8.51 (6.37-11.3)	9.90 (7.12-13.6)	11.0 (7.69-15.3)
20-day	3.83 (3.33-4.48)	4.41 (3.83-5.15)	5.39 (4.66-6.31)	6.23 (5.36-7.34)	7.45 (6.21-9.13)	8.43 (6.86-10.5)	9.44 (7.42-12.1)	10.5 (7.91-13.8)	12.0 (8.66-16.2)	13.1 (9.23-18.1)
30-day	4.60 (4.01-5.34)	5.30 (4.62-6.17)	6.48 (5.63-7.56)	7.46 (6.44-8.75)	8.84 (7.38-10.7)	9.91 (8.08-12.2)	11.0 (8.66-13.9)	12.1 (9.15-15.8)	13.6 (9.89-18.4)	14.8 (10.4-20.3)
45-day	5.57 (4.88-6.45)	6.43 (5.63-7.46)	7.84 (6.84-9.11)	8.99 (7.79-10.5)	10.5 (8.82-12.7)	11.7 (9.59-14.4)	12.9 (10.2-16.2)	14.1 (10.7-18.3)	15.6 (11.4-20.9)	16.7 (11.9-22.8)
60-day	6.40 (5.62-7.39)	7.40 (6.49-8.55)	8.99 (7.86-10.4)	10.3 (8.93-12.0)	12.0 (10.0-14.3)	13.2 (10.8-16.1)	14.5 (11.4-18.1)	15.7 (11.9-20.2)	17.2 (12.6-22.9)	18.3 (13.1-24.9)

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

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PF graphical

Table 3: 2hr Rainfall Data
C&S Basin

min	NOAA Atlas 14 2HR 100yr Depth = CS 2Hr 100yr Distribution 0-1 miles Fraction of Total Depth	3.39 100yr CUM In	NOAA Atlas 14 2HR 10yr Depth = CS 2Hr 5yr Distribution 0-1 miles Fraction of Total Depth	1.54 10yr CUM In
0	0.000	0.000	0.000	0.000
5	0.014	0.047	0.014	0.022
10	0.046	0.156	0.046	0.071
15	0.079	0.268	0.079	0.122
20	0.120	0.407	0.120	0.185
25	0.179	0.607	0.179	0.276
30	0.258	0.875	0.258	0.397
35	0.421	1.427	0.421	0.648
40	0.712	2.414	0.712	1.096
45	0.824	2.793	0.824	1.269
50	0.892	3.024	0.892	1.374
55	0.935	3.170	0.935	1.440
60	0.972	3.295	0.972	1.497
65	1.004	3.404	1.004	1.546
70	1.018	3.451	1.018	1.568
75	1.030	3.492	1.030	1.586
80	1.041	3.529	1.041	1.603
85	1.052	3.566	1.052	1.620
90	1.063	3.604	1.063	1.637
95	1.072	3.634	1.072	1.651
100	1.082	3.668	1.082	1.666
105	1.091	3.698	1.091	1.680
110	1.100	3.729	1.100	1.694
115	1.109	3.760	1.109	1.708
120	1.119	3.793	1.119	1.723

Table 3: 2hr Rainfall Data
West Fork Jimmy Camp Creek Basin

min	NOAA Atlas 14 2HR 100yr Depth = CS 2Hr 100yr Distribution 1-5 miles Fraction of Total Depth	3.39 100yr CUM In	NOAA Atlas 14 2HR 10yr Depth = CS 2Hr 10yr Distribution 1-5 miles Fraction of Total Depth	1.54 5yr CUM In
0	0.000	0.000	0.000	0.000
5	0.014	0.047	0.014	0.022
10	0.044	0.149	0.044	0.068
15	0.076	0.258	0.076	0.117
20	0.116	0.393	0.116	0.179
25	0.176	0.597	0.176	0.271
30	0.249	0.844	0.249	0.383
35	0.396	1.342	0.396	0.610
40	0.655	2.220	0.655	1.009
45	0.756	2.563	0.756	1.164
50	0.824	2.793	0.824	1.269
55	0.866	2.936	0.866	1.334
60	0.901	3.054	0.901	1.388
65	0.934	3.166	0.934	1.438
70	0.948	3.214	0.948	1.460
75	0.962	3.261	0.962	1.481
80	0.973	3.298	0.973	1.498
85	0.984	3.336	0.984	1.515
90	0.995	3.373	0.995	1.532
95	1.006	3.410	1.006	1.549
100	1.017	3.448	1.017	1.566
105	1.026	3.478	1.026	1.580
110	1.036	3.512	1.036	1.595
115	1.045	3.543	1.045	1.609
120	1.054	3.573	1.054	1.623
			DARF Adjusted	

APPENDIX B2: NCRS Curve Numbers for Pre-Development (ARC I)

Table 6-9. NRCS Curve Numbers for Pre-Development Thunderstorms Conditions (ARC I)

Fully Developed Urban Areas (vegetation established)[1]	Treatment	Hydrologic Condition	% I	Pre-Development CN			
				HSG A	HSG B	HSG C	HSG D
Open space (lawns, parks, golf courses, cemeteries, etc.):							
Poor condition (grass cover < 50%)	-----	-----	---	47	61	72	77
Fair condition (grass cover 50% to 75%)	-----	-----	---	29	48	61	69
Good condition (grass cover > 75%)	-----	-----	---	21	40	54	63
Impervious areas:							
Paved parking lots, roofs, driveways, etc. (excluding right-of-way	-----	-----	---	95	95	95	95
Streets and roads:							
Paved; curbs and storm sewers (excluding right-of-way)	-----	-----	---	95	95	95	95
Paved; open ditches (including right-of-way)	-----	-----	---	67	77	83	85
Gravel (including right-of-way)	-----	-----	---	57	70	77	81
Dirt (including right-of-way)	-----	-----	---	52	66	74	77
Western desert urban areas:							
Natural desert landscaping (pervious areas only)	-----	-----	---	42	58	70	75
Artificial desert landscaping (impervious weed barrier, desert shrub with 1- to 2-inch sand or gravel mulch and basin borders)	-----	-----	---	91	91	91	91
Developing Urban Areas[1]	**Treatment[2]**	**Hydrologic Condition[3]**	**% I**	**HSG A**	**HSG B**	**HSG C**	**HSG D**
Newly graded areas (pervious areas only, no vegetation)	-----	-----	---	58	72	81	87
Cultivated Agricultural Lands[1]	**Treatment**	**Hydrologic Condition**	**% I**	**HSG A**	**HSG B**	**HSG C**	**HSG D**
Fallow	Bare soil	-----	---	58	72	81	87
	Crop residue cover (CR)	Poor	---	57	70	79	85
		Good	---	54	67	75	79
Row crops	Straight row (SR)	Poor	---	52	64	75	81
		Good	---	46	60	70	77
	SR + CR	Poor	---	51	63	74	79
		Good	---	43	56	66	70
	Contoured (C)	Poor	---	49	61	69	75
		Good	---	44	56	66	72
	C + CR	Poor	---	48	60	67	74
		Good	---	43	54	64	70
	Contoured & terraced (C&T)	Poor	---	45	54	63	66
		Good	---	41	51	60	64
	C&T+ CR	Poor	---	44	53	61	64
		Good	---	40	49	58	63
Small grain	SR	Poor	---	44	57	69	75
		Good	---	42	56	67	74
	SR + CR	Poor	---	43	56	67	72
		Good	---	39	52	63	69
	C	Poor	---	42	54	66	70
		Good	---	40	53	64	69
	C + CR Poor	Poor	---	41	53	64	69
		Good	---	39	52	63	67
	C&T	Poor	---	40	52	61	66
		Good	---	38	49	60	64
	C&T+ CR	Poor	---	39	51	60	64
		Good	---	37	48	58	63
Close-seeded or broadcast legumes or rotation meadow	SR	Poor	---	45	58	70	77
		Good	---	37	52	64	70
	C	Poor	---	43	56	67	70
		Good	---	34	48	60	67
	C&T	Poor	---	42	53	63	67
		Good	---	30	46	57	63

Table 6-9.
(continued)

Other Agricultural Lands[1]	Treatment	Hydrologic Condition	% I	HSG A	HSG B	HSG C	HSG D
Pasture, grassland, or range—continuous forage for grazing[4]	-----	Poor	---	47	61	72	77
	-----	Fair	---	29	48	61	69
	-----	Good	---	21	40	54	63
Meadow—continuous grass, protected from grazing and generally mowed for hay	-----	-----	---	15	37	51	60
Brush—brush-weed-grass mixture with brush the major element[5]	-----	Poor	---	28	46	58	67
	-----	Fair	---	18	35	49	58
	-----	Good	---	15	28	44	53
Woods—grass combination (orchard or tree farm)[6]	-----	Poor	---	36	53	66	72
	-----	Fair	---	24	44	57	66
	-----	Good	---	17	37	52	61
Woods[7]	-----	Poor	---	26	45	58	67
	-----	Fair	---	19	39	53	61
	-----	Good	---	15	34	49	58
Farmsteads—buildings, lanes, driveways, and surrounding lots	-----	-----	---	38	54	66	72
Arid and Semi-arid Rangelands[1]	**Treatment**	**Hydrologic Condition[8]**	**% I**	**HSG A**	**HSG B**	**HSG C**	**HSG D**
Herbaceous—mixture of grass, weeds, and low-growing brush, with brush the minor element	-----	Poor	---	-----	63	74	85
	-----	Fair	---	-----	51	64	77
	-----	Good	---	-----	41	54	70
Oak-aspen—mountain brush mixture of oak brush, aspen, mountain mahogany, bitter brush, maple, and other brush	-----	Poor	---	-----	45	54	61
	-----	Fair	---	-----	28	36	42
	-----	Good	---	-----	15	23	28
Pinyon-juniper—pinyon, juniper, or both; grass understory	-----	Poor	---	-----	56	70	77
	-----	Fair	---	-----	37	53	63
	-----	Good	---	-----	23	40	51
Sagebrush with grass understory	-----	Poor	---	-----	46	63	70
	-----	Fair	---	-----	30	42	49
	-----	Good	---	-----	18	27	34
Desert shrub—major plants include saltbush, greasewood, creosotebush, blackbrush, bursage, palo verde, mesquite, and cactus	-----	Poor	---	42	58	70	75
	-----	Fair	---	34	52	64	72
	-----	Good	---	29	47	61	69

1. Average runoff condition, and Ia = 0.1S.
2. Crop residue cover applies only if residue is on at least 5% of the surface throughout the year.
3. Hydraulic condition is based on combination factors that affect infiltration and runoff, including (a) density and canopy of vegetative areas, (b) amount of year-round cover, (c) amount of grass or close-seeded legumes, (d) percent of residue cover on the land surface (good ≥ 20%), and
(e) degree of surface roughness. Poor: Factors impair infiltration and tend to increase runoff. Good: Factors encourage average and better than average infiltration and tend to decrease runoff.
4. Poor: <50%) ground cover or heavily grazed with no mulch. Fair: 50 to 75% ground cover and not heavily grazed. Good: > 75% ground cover and lightly or only occasionally grazed.
5. Poor: <50% ground cover. Fair: 50 to 75% ground cover. Good: >75% ground cover.
6. CN's shown were computed for areas with 50% woods and 50% grass (pasture) cover. Other combinations of conditions may be computed from the CN's for woods and pasture.
7. Poor: Forest litter, small trees, and brush are destroyed by heavy grazing or regular burning. Fair: Woods are grazed but not burned, and some forest litter covers the soil. Good: Woods are protected from grazing, and litter and brush adequately cover the soil.
8. Poor: <30% ground cover (litter, grass, and brush overstory). Fair: 30 to 70% ground cover. Good: > 70% ground cover.

APPENDIX C1: Developed Hydrology

HEC-HMS Model Schematics

Table 1 CN Values Calculation

Table 2 Time of Concentration Calculation

HEC HMS Input and Output

NOAA Atlas 14 Precipitation

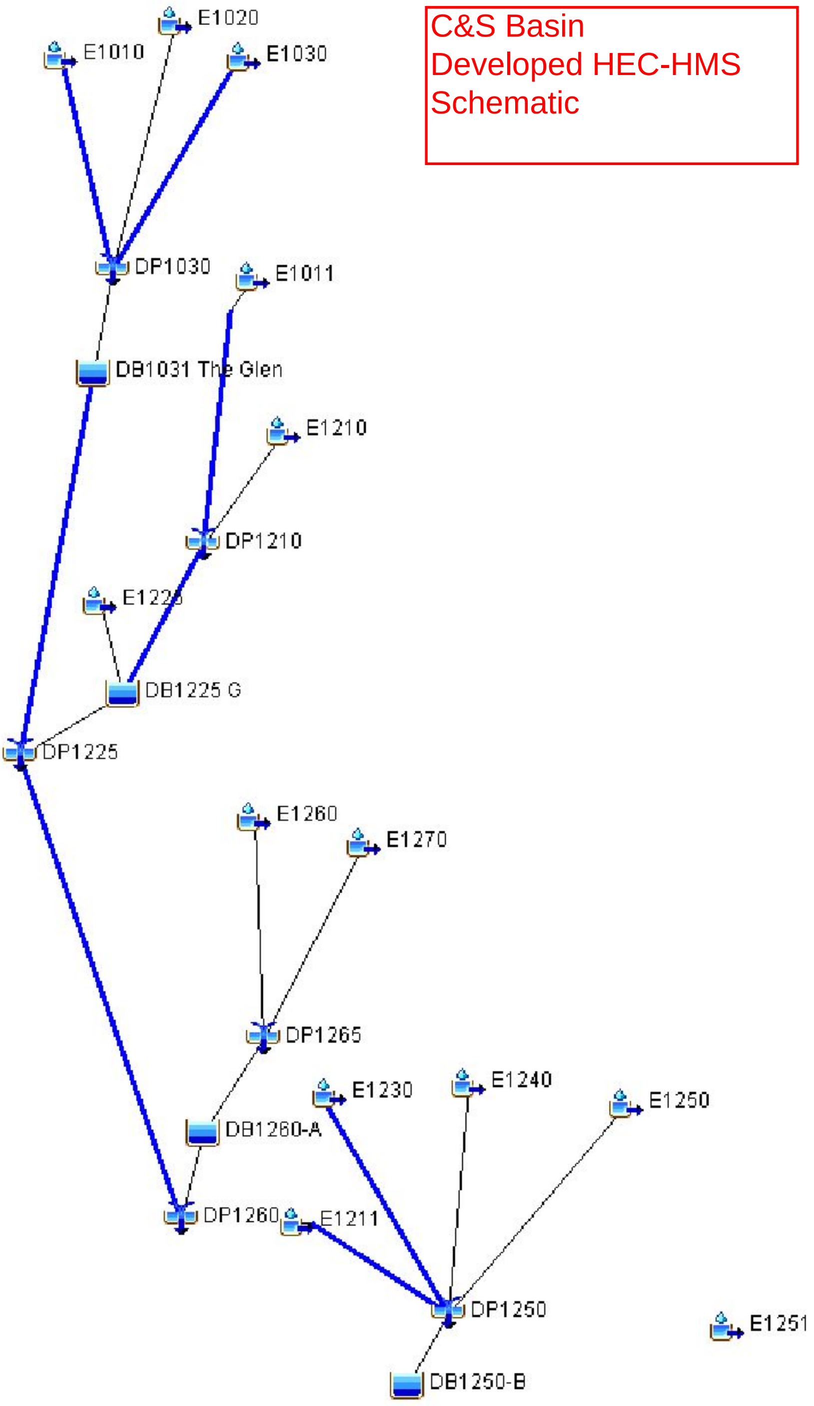
Colorado Springs 2hr Storm Distributions

Colorado Springs NCRS Curve Numbers for Development (ARC II)

Developed C&S Basin HEC-HMS Report

Developed WF JCC Basin HEC-HMS Report

C&S Basin Developed HEC-HMS Schematic



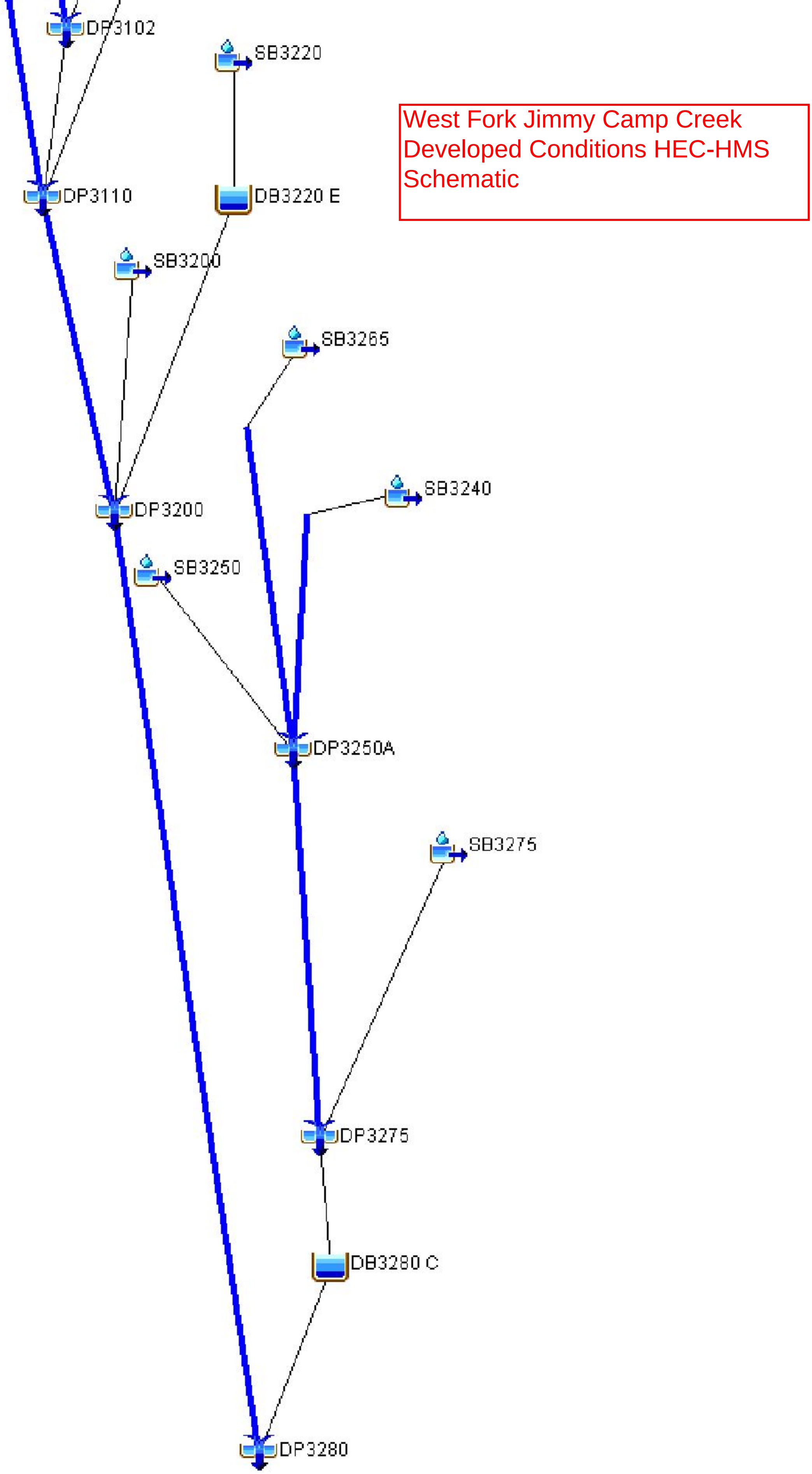

West Fork Jimmy Camp Creek
Developed Conditions HEC-HMS
Schematic
DP3102
SB3220
DP3110
DB3220 E
SB3200
SB3265
SB3240
DP3200
SB3250
DP3250A
SB3275
DP3275
DB3280 C
DP3280

Table 1
HEC-HMS Developed CN Values

			Land Use (Sq Miles) B or C Soils																		
			OP/P/D		RL		RLM		RMH		RH		COM/OFF		LL		School				
			B	C	B	C	B	C	B	C	B	C	B	C	B	C	B	C			
Basin	**Area (ac)**	**Area Miles^2**	**61**	**74**	**68**	**79**	**75**	**83**	**85**	**90**	**85**	**90**	**92**	**94**	**68**	**79**	**77**	**85**	**CN**	Abstraction	Notes
C&S Basin																					
E1010		0.020																	**73.2**	**0.366**	(1)
E1020		0.041																	**80.0**	**0.250**	(1)
E1030		0.020																	**88.8**	**0.126**	(1)
E1011	14.4	0.022							0.022										**85.0**	**0.176**	
E1210	40.3	0.063	0.007	0.007					0.049										**81.1**	**0.233**	
E1211	32.1	0.050	0.001	0.013			0.017	0.020											**77.8**	**0.286**	
E1225	45.7	0.071	0.004	0.013			0.017	0.038											**78.3**	**0.277**	
E1230	18.1	0.028		0.008				0.020											**80.5**	**0.243**	
E1240	28.9	0.045		0.009				0.036											**81.2**	**0.231**	
E1250	29.8	0.047						0.009								0.038			**79.8**	**0.254**	
E1260	32.0	0.050		0.006				0.040								0.004			**81.6**	**0.225**	
E1270	58.9	0.092		0.007								0.032						0.053	**85.9**	**0.164**	
Totals	300	0.550																			
West Fork Jimmy Camp Creek Basin																					
SB3220	39.8	0.062									0.008	0.019	0.017	0.018					**91.0**	**0.099**	
SB3240	30.0	0.047					0.008	0.039											**81.7**	**0.224**	
SB3250	48.6	0.076	0.013	0.022								0.026					0.005	0.010	**79.0**	**0.265**	
SB3265	58.3	0.091					0.073	0.018											**76.6**	**0.306**	
SB3275	45.5	0.071		0.005				0.067											**82.4**	**0.213**	
Totals	222.3	0.347																			

(1) Data and model from Cross Creek MDDP

4/20/2022

Table C2

Developed Tc

Sub-Basin Data			Time of Concentration Estimate Developed											HECHMS
Basin / Design Point	Area	C_5	Initial/Overland Time (t_i)			Travel Time (t_t)						Comp.	Final t_c	
			Length	Slope	t_i	Length	Slope	Land Type	Cv	Velocity	t_t	t_c		Lag (.6Tc)
E1011	14.38ac	0.66	50lf	6.1%	3.1 min.	450lf	6.1%	PV	20	4.9 ft/sec	1.5 min.	5.0 min.	**5.0 min.**	3.0
E1210	40.29ac	0.66	50lf	8.0%	2.9 min.	2550lf	8.0%	PV	20	5.6 ft/sec	7.5 min.	10.4 min.	**10.4 min.**	6.2
E1211	32.06ac	0.66	50lf	7.0%	3.0 min.	1270lf	7.0%	PV	20	5.3 ft/sec	4.0 min.	7.0 min.	**7.0 min.**	4.2
E1225	45.74ac	0.66	50lf	8.3%	2.8 min.	2700lf	8.3%	PV	20	5.8 ft/sec	7.8 min.	10.6 min.	**10.6 min.**	6.4
E1230	18.08ac	0.66	50lf	7.2%	3.0 min.	830lf	7.2%	PV	20	5.4 ft/sec	2.6 min.	5.5 min.	**5.5 min.**	3.3
E1240	28.93ac	0.66	50lf	3.2%	3.9 min.	1642lf	3.2%	PV	20	3.6 ft/sec	7.6 min.	11.5 min.	**11.5 min.**	6.9
E1250	29.81ac	0.66	50lf	5.7%	3.2 min.	1550lf	5.7%	PV	20	4.8 ft/sec	5.4 min.	8.6 min.	**8.6 min.**	5.2
E1260	32.03ac	0.66	50lf	5.7%	3.2 min.	1130lf	5.7%	PV	20	4.8 ft/sec	4.0 min.	7.1 min.	**7.1 min.**	4.3
E1270	58.93ac	0.66	50lf	3.7%	3.7 min.	2910lf	3.7%	PV	20	3.9 ft/sec	12.5 min.	16.2 min.	**16.2 min.**	9.7
SB3240	29.96ac	0.66	50lf	3.5%	3.7 min.	1770lf	4.0%	PV	20	4.0 ft/sec	7.4 min.	11.1 min.	**11.1 min.**	6.7
SB3250	48.65ac	0.66	50lf	2.2%	4.4 min.	1770lf	1.0%	PV	20	2.0 ft/sec	14.8 min.	19.1 min.	**19.1 min.**	11.5
SB3265	58.29ac	0.66	50lf	8.1%	2.8 min.	2060lf	2.8%	PV	20	3.3 ft/sec	10.3 min.	13.1 min.	**13.1 min.**	7.9
SB3275	45.54ac	0.66	50lf	2.8%	4.0 min.	1935lf	3.2%	PV	20	3.6 ft/sec	9.0 min.	13.1 min.	**13.1 min.**	7.8

Equations:

t_i (Overland) = $0.395(1.1-C_5)L^{0.5} S^{-0.333}$

C_5 = Runoff coefficient for 5-year

L = Length of overland flow (ft)

S = Slope of flow path (ft/ft)

tc Check = (L/180)+10 (Developed Cond. Only)

L = Overall Length

Velocity (Travel Time) = $CvS^{0.5}$

Cv = Conveyance Coef (see table)

S = Watercourse slope (ft/ft)

Table 6-7: Conveyance Coef (City CS DCM, Vol 1)

Type of Land Surface	Land Type	Cv
Grassed Waterway	GW	15
Heavy Meadow	HM	2.5
Nearly Bare Ground	NBG	10
Paved Area	PV	20
Riprap (Not Buried)	RR	6.5
Short Pasture/Lawns	SP	7
Tillage/Fields	TF	5

Table C3
C&S (Center) Basin
Developed Conditions HEC-HMS Results

Element	Drainage Area Miles^2	5-Year Peak Flow cfs	100-Year Peak Flow cfs
E1270	0.092	84	245
E1260	0.050	44	140
DP1265	0.142	119	372
E1010	0.020	5	35
R1010	0.020	5	34
E1030	0.007	3	10
E1020	0.041	16	61
R1030	0.007	3	10
DP1030	0.068	21	80
DB1031 The Glen	0.068	15	45
E1011	0.022	28	86
R1011	0.022	24	77
E1210	0.063	56	179
DP1210	0.085	79	246
R1210	0.085	74	239
E1225	0.071	48	173
DB1225 G	0.156	9	133
R1031	0.068	15	44
DP1225	0.224	23	164
R1225A	0.224	23	164
DB1260-A	0.142	17	206
DP1260	**0.366**	39	**332**
E1211	0.050	40	132
R1211	0.050	39	131
E1230	0.028	27	92
R1230	0.028	24	78
E1250	0.047	37	125
E1240	0.045	36	121
DP1250	0.170	136	454
DB1250-B	**0.170**	23	**148**
E1251	0.136	27	177

E=Subbasin
R=Routing
DP= Design Point
DB=Detention
4/20/2022

Table C3
West Fork Jimmy Camp Creek Basin
Developed Conditions HEC-HMS Results

Element	Drainage Area Square Miles	5-Year Peak Flow cfs	100-Year Peak Flow cfs
DP3110	3.376	429	2835
R3110	3.376	428	2794
SB3200	0.013	2	19
SB3220	0.065	55	178
DB3220 E	0.065	1	33
DP3200	3.454	430	2830
R3200	3.454	429	2819
SB3265	0.091	69	254
R3265	0.091	69	244
SB3250	0.076	35	149
SB3240	0.047	32	127
R3240	0.047	32	119
DP3250A	0.214	135	513
R3250	0.214	131	484
SB3275	0.071	46	182
DP3275	0.285	168	654
DB3280 C	0.285	7	177
DP3280	3.739	435	2982

E=Subbasin
R=Routing
DP= Design Point
DB=Detention
5/20/2022

NOAA Atlas 14, Volume 8, Version 2
Location name: Colorado Springs, Colorado, USA*
Latitude: 38.7286°, Longitude: -104.6783°
Elevation: 5771.51 ft**
* source: ESRI Maps
** source: USGS

POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Deborah Martin, Sandra Pavlovic, Ishani Roy, Michael St. Laurent, Carl Trypaluk, Dale Unruh, Michael Yekta, Geoffrey Bonnin

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches)[1]

Duration	Average recurrence interval (years)									
	1	**2**	**5**	**10**	**25**	**50**	**100**	**200**	**500**	**1000**
5-min	**0.253** (0.208-0.314)	**0.305** (0.250-0.377)	**0.396** (0.323-0.492)	**0.479** (0.388-0.598)	**0.604** (0.475-0.794)	**0.708** (0.541-0.943)	**0.820** (0.603-1.12)	**0.942** (0.660-1.32)	**1.11** (0.746-1.61)	**1.25** (0.812-1.83)
10-min	**0.371** (0.304-0.459)	**0.446** (0.365-0.553)	**0.579** (0.473-0.720)	**0.701** (0.569-0.875)	**0.884** (0.696-1.16)	**1.04** (0.793-1.38)	**1.20** (0.883-1.64)	**1.38** (0.966-1.94)	**1.63** (1.09-2.36)	**1.83** (1.19-2.68)
15-min	**0.452** (0.371-0.560)	**0.544** (0.446-0.674)	**0.707** (0.577-0.878)	**0.855** (0.693-1.07)	**1.08** (0.849-1.42)	**1.26** (0.967-1.68)	**1.47** (1.08-2.00)	**1.68** (1.18-2.36)	**1.99** (1.33-2.88)	**2.24** (1.45-3.27)
30-min	**0.655** (0.538-0.811)	**0.786** (0.644-0.974)	**1.02** (0.833-1.27)	**1.23** (1.00-1.54)	**1.56** (1.23-2.05)	**1.82** (1.40-2.43)	**2.11** (1.55-2.89)	**2.43** (1.70-3.41)	**2.87** (1.92-4.16)	**3.23** (2.09-4.72)
60-min	**0.851** (0.699-1.05)	**1.00** (0.819-1.24)	**1.28** (1.05-1.59)	**1.55** (1.26-1.94)	**1.98** (1.57-2.62)	**2.34** (1.80-3.14)	**2.75** (2.03-3.78)	**3.20** (2.25-4.52)	**3.85** (2.59-5.60)	**4.39** (2.84-6.41)
2-hr	**1.05** (0.865-1.29)	**1.21** (1.00-1.49)	**1.54** (1.27-1.91)	**1.87** (1.53-2.32)	**2.40** (1.92-3.18)	**2.86** (2.22-3.83)	**3.39** (2.52-4.64)	**3.97** (2.82-5.59)	**4.83** (3.28-6.99)	**5.55** (3.63-8.05)
3-hr	**1.15** (0.954-1.41)	**1.31** (1.09-1.61)	**1.66** (1.36-2.04)	**2.01** (1.64-2.48)	**2.59** (2.10-3.45)	**3.13** (2.44-4.18)	**3.73** (2.79-5.11)	**4.41** (3.15-6.21)	**5.43** (3.71-7.84)	**6.28** (4.13-9.08)
6-hr	**1.32** (1.10-1.60)	**1.49** (1.24-1.81)	**1.86** (1.54-2.27)	**2.25** (1.86-2.77)	**2.93** (2.39-3.88)	**3.55** (2.79-4.73)	**4.25** (3.22-5.81)	**5.06** (3.65-7.10)	**6.27** (4.33-9.02)	**7.29** (4.84-10.5)
12-hr	**1.46** (1.23-1.77)	**1.68** (1.41-2.03)	**2.11** (1.77-2.57)	**2.56** (2.12-3.12)	**3.29** (2.70-4.32)	**3.96** (3.13-5.22)	**4.71** (3.58-6.36)	**5.55** (4.03-7.70)	**6.80** (4.72-9.69)	**7.85** (5.25-11.2)
24-hr	**1.63** (1.38-1.96)	**1.91** (1.61-2.29)	**2.43** (2.04-2.93)	**2.93** (2.44-3.55)	**3.72** (3.05-4.79)	**4.41** (3.50-5.74)	**5.17** (3.95-6.90)	**6.02** (4.39-8.26)	**7.25** (5.07-10.2)	**8.26** (5.58-11.7)
2-day	**1.84** (1.57-2.20)	**2.18** (1.85-2.60)	**2.79** (2.36-3.34)	**3.35** (2.82-4.03)	**4.20** (3.45-5.34)	**4.92** (3.92-6.32)	**5.70** (4.38-7.52)	**6.55** (4.81-8.88)	**7.75** (5.46-10.8)	**8.74** (5.95-12.3)
3-day	**1.99** (1.70-2.37)	**2.34** (2.00-2.79)	**2.97** (2.53-3.55)	**3.55** (3.00-4.26)	**4.44** (3.66-5.61)	**5.19** (4.15-6.63)	**5.99** (4.62-7.87)	**6.87** (5.07-9.28)	**8.11** (5.74-11.3)	**9.13** (6.26-12.8)
4-day	**2.13** (1.82-2.53)	**2.49** (2.13-2.95)	**3.13** (2.67-3.73)	**3.72** (3.15-4.45)	**4.63** (3.83-5.84)	**5.40** (4.33-6.88)	**6.22** (4.82-8.15)	**7.13** (5.28-9.60)	**8.42** (5.98-11.7)	**9.46** (6.51-13.2)
7-day	**2.54** (2.19-3.00)	**2.92** (2.51-3.45)	**3.61** (3.09-4.27)	**4.24** (3.61-5.04)	**5.20** (4.32-6.50)	**6.01** (4.85-7.61)	**6.88** (5.36-8.95)	**7.83** (5.84-10.5)	**9.19** (6.58-12.7)	**10.3** (7.14-14.3)
10-day	**2.90** (2.50-3.40)	**3.32** (2.86-3.90)	**4.06** (3.49-4.79)	**4.74** (4.05-5.62)	**5.76** (4.79-7.16)	**6.61** (5.36-8.33)	**7.52** (5.88-9.73)	**8.51** (6.37-11.3)	**9.90** (7.12-13.6)	**11.0** (7.69-15.3)
20-day	**3.83** (3.33-4.48)	**4.41** (3.83-5.15)	**5.39** (4.66-6.31)	**6.23** (5.36-7.34)	**7.45** (6.21-9.13)	**8.43** (6.86-10.5)	**9.44** (7.42-12.1)	**10.5** (7.91-13.8)	**12.0** (8.66-16.2)	**13.1** (9.23-18.1)
30-day	**4.60** (4.01-5.34)	**5.30** (4.62-6.17)	**6.48** (5.63-7.56)	**7.46** (6.44-8.75)	**8.84** (7.38-10.7)	**9.91** (8.08-12.2)	**11.0** (8.66-13.9)	**12.1** (9.15-15.8)	**13.6** (9.89-18.4)	**14.8** (10.4-20.3)
45-day	**5.57** (4.88-6.45)	**6.43** (5.63-7.46)	**7.84** (6.84-9.11)	**8.99** (7.79-10.5)	**10.5** (8.82-12.7)	**11.7** (9.59-14.4)	**12.9** (10.2-16.2)	**14.1** (10.7-18.3)	**15.6** (11.4-20.9)	**16.7** (11.9-22.8)
60-day	**6.40** (5.62-7.39)	**7.40** (6.49-8.55)	**8.99** (7.86-10.4)	**10.3** (8.93-12.0)	**12.0** (10.0-14.3)	**13.2** (10.8-16.1)	**14.5** (11.4-18.1)	**15.7** (11.9-20.2)	**17.2** (12.6-22.9)	**18.3** (13.1-24.9)

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

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PF graphical

Table 3: 2hr Rainfall Data
C&S Basin

min	NOAA Atlas 14 2HR 100yr Depth = **CS 2Hr 100yr Distribution 0-1 miles** **Fraction of Total Depth**	**3.39** **100yr** **CUM In**	NOAA Atlas 14 2HR 10yr Depth = **CS 2Hr 5yr Distribution 0-1 miles** **Fraction of Total Depth**	**1.54** **10yr** **CUM In**
0	0.000	0.000	0.000	0.000
5	0.014	0.047	0.014	0.022
10	0.046	0.156	0.046	0.071
15	0.079	0.268	0.079	0.122
20	0.120	0.407	0.120	0.185
25	0.179	0.607	0.179	0.276
30	0.258	0.875	0.258	0.397
35	0.421	1.427	0.421	0.648
40	0.712	2.414	0.712	1.096
45	0.824	2.793	0.824	1.269
50	0.892	3.024	0.892	1.374
55	0.935	3.170	0.935	1.440
60	0.972	3.295	0.972	1.497
65	1.004	3.404	1.004	1.546
70	1.018	3.451	1.018	1.568
75	1.030	3.492	1.030	1.586
80	1.041	3.529	1.041	1.603
85	1.052	3.566	1.052	1.620
90	1.063	3.604	1.063	1.637
95	1.072	3.634	1.072	1.651
100	1.082	3.668	1.082	1.666
105	1.091	3.698	1.091	1.680
110	1.100	3.729	1.100	1.694
115	1.109	3.760	1.109	1.708
120	1.119	3.793	1.119	1.723

Table 3: 2hr Rainfall Data
West Fork Jimmy Camp Creek Basin

min	NOAA Atlas 14 2HR 100yr Depth = **CS 2Hr 100yr Distribution 1-5 miles** **Fraction of Total Depth**	**3.39** **100yr** **CUM In**	NOAA Atlas 14 2HR 10yr Depth = **CS 2Hr 10yr Distribution 1-5 miles** **Fraction of Total Depth**	**1.54** **5yr** **CUM In**
0	0.000	0.000	0.000	0.000
5	0.014	0.047	0.014	0.022
10	0.044	0.149	0.044	0.068
15	0.076	0.258	0.076	0.117
20	0.116	0.393	0.116	0.179
25	0.176	0.597	0.176	0.271
30	0.249	0.844	0.249	0.383
35	0.396	1.342	0.396	0.610
40	0.655	2.220	0.655	1.009
45	0.756	2.563	0.756	1.164
50	0.824	2.793	0.824	1.269
55	0.866	2.936	0.866	1.334
60	0.901	3.054	0.901	1.388
65	0.934	3.166	0.934	1.438
70	0.948	3.214	0.948	1.460
75	0.962	3.261	0.962	1.481
80	0.973	3.298	0.973	1.498
85	0.984	3.336	0.984	1.515
90	0.995	3.373	0.995	1.532
95	1.006	3.410	1.006	1.549
100	1.017	3.448	1.017	1.566
105	1.026	3.478	1.026	1.580
110	1.036	3.512	1.036	1.595
115	1.045	3.543	1.045	1.609
120	1.054	3.573	1.054	1.623
			DARF Adjusted	

Table 6-10. NRCS Curve Numbers for Frontal Storms & Thunderstorms for Developed Conditions (ARCII)

Fully Developed Urban Areas (vegetation established)[1]	Treatment	Hydrologic Condition	% I	Pre-Development CN			
				HSG A	HSG B	HSG C	HSG D
Open space (lawns, parks, golf courses, cemeteries, etc.):							
Poor condition (grass cover < 50%)	-----	-----	---	68	79	86	89
Fair condition (grass cover 50% to 75%)	-----	-----	---	49	69	79	84
Good condition (grass cover > 75%)	-----	-----	---	39	61	74	80
Impervious areas:							
Paved parking lots, roofs, driveways, etc. (excluding right-of-way	-----	-----	---	98	98	98	98
Streets and roads:							
Paved; curbs and storm sewers (excluding right-of-way)	-----	-----	---	98	98	98	98
Paved; open ditches (including right-of-way)	-----	-----	---	83	89	92	93
Gravel (including right-of-way)	-----	-----	---	76	85	89	91
Dirt (including right-of-way)	-----	-----	---	72	82	87	89
Western desert urban areas:							
Natural desert landscaping (pervious areas only)	-----	-----	---	63	77	85	88
Artificial desert landscaping (impervious weed barrier, desert shrub with 1- to 2-inch sand or gravel mulch and basin borders)	-----	-----	---	96	96	96	96
Urban districts:							
Commercial and business	-----	-----	85	89	92	94	95
Industrial	-----	-----	72	81	88	91	93
Residential districts by average lot size:							
1/8 acre or less (town houses)	-----	-----	65	77	85	90	92
1/4 acre	-----	-----	38	61	75	83	87
1/3 acre	-----	-----	30	57	72	81	86
1/2 acre	-----	-----	25	54	70	80	85
1 acre	-----	-----	20	51	68	79	84
2 acres	-----	-----	12	46	65	77	82
Developing Urban Areas[1]	**Treatment[2]**	**Hydrologic Condition[3]**	**% I**	**HSG A**	**HSG B**	**HSG C**	**HSG D**
Newly graded areas (pervious areas only, no vegetation)	-----	-----	---	77	86	91	94
Cultivated Agricultural Lands[1]	**Treatment**	**Hydrologic Condition**	**% I**	**HSG A**	**HSG B**	**HSG C**	**HSG D**
Fallow	Bare soil	-----	---	77	86	91	94
	Crop residue cover (CR)	Poor	---	76	85	90	93
		Good	---	74	83	88	90
Row crops	Straight row (SR)	Poor	---	72	81	88	91
		Good	---	67	78	85	89
	SR + CR	Poor	---	71	80	87	90
		Good	---	64	75	82	85
	Contoured (C)	Poor	---	70	79	84	88
		Good	---	65	75	82	86
	C + CR	Poor	---	69	78	83	87
		Good	---	64	74	81	85
	Contoured & terraced (C&T)	Poor	---	66	74	80	82
		Good	---	62	71	78	81
	C&T+ CR	Poor	---	65	73	79	81
		Good	---	61	70	77	80
Small grain	SR	Poor	---	65	76	84	88
		Good	---	63	75	83	87
	SR + CR	Poor	---	64	75	83	86
		Good	---	60	72	80	84
	C	Poor	---	63	74	82	85
		Good	---	61	73	81	84
	C + CR Poor	Poor	---	62	73	81	84
		Good	---	60	72	80	83
	C&T	Poor	---	61	72	79	82
		Good	---	59	70	78	81
	C&T+ CR	Poor	---	60	71	78	81
		Good	---	58	69	77	80

Table 6-10. (continued)

Other Agricultural Lands[1]	Treatment	Hydrologic Condition	% I	HSG A	HSG B	HSG C	HSG D
Pasture, grassland, or range—continuous forage for grazing[4]	-----	Poor	---	68	79	86	89
	-----	Fair	---	49	69	79	84
	-----	Good	---	39	61	74	80
Meadow—continuous grass, protected from grazing and generally mowed for hay	-----	-----	---	30	58	71	78
Brush—brush-weed-grass mixture with brush the major element[5]	-----	Poor	---	48	67	77	83
	-----	Fair	---	35	56	70	77
	-----	Good	---	30	48	65	73
Woods—grass combination (orchard or tree farm)[6]	-----	Poor	---	57	73	82	86
	-----	Fair	---	43	65	76	82
	-----	Good	---	32	58	72	79
Woods[7]	-----	Poor	---	45	66	77	83
	-----	Fair	---	36	60	73	79
	-----	Good	---	30	55	70	77
Farmsteads—buildings, lanes, driveways, and surrounding lots	-----	-----	---	59	74	82	86
Arid and Semi-arid Rangelands[1]	**Treatment**	**Hydrologic Condition[8]**	**% I**	**HSG A**	**HSG B**	**HSG C**	**HSG D**
Herbaceous—mixture of grass, weeds, and low-growing brush, with brush the minor element	-----	Poor	---	-----	80	87	93
	-----	Fair	---	-----	71	81	89
	-----	Good	---	-----	62	74	85
Oak-aspen—mountain brush mixture of oak brush, aspen, mountain mahogany, bitter brush, maple, and other brush	-----	Poor	---	-----	66	74	79
	-----	Fair	---	-----	48	57	63
	-----	Good	---	-----	30	41	48
Pinyon-juniper—pinyon, juniper, or both; grass understory	-----	Poor	---	-----	75	85	89
	-----	Fair	---	-----	58	73	80
	-----	Good	---	-----	41	61	71
Sagebrush with grass understory	-----	Poor	---	-----	67	80	85
	-----	Fair	---	-----	51	63	70
	-----	Good	---	-----	35	47	55
Desert shrub—major plants include saltbush, greasewood, creosotebush, blackbrush, bursage, palo verde, mesquite, and cactus	-----	Poor	---	63	77	85	88
	-----	Fair	---	55	72	81	86
	-----	Good	---	49	68	79	84

Ia = 0.1 S

2. Crop residue cover applies only i f residue i s on at least 5% of the surface throughout the year.

3. Hydraulic condition i s based on combination factors that affect infiltration and runoff, including (a) density and canopy of vegetative areas, (b) amount of year- round cover, (c) amount of grass or close-seeded legumes, (d) percent of residue cover on the land surface (good ≥ 20%), and (e) degree of surface roughness. Poor: Factors impair infiltration and tend to increase runoff. Good: Factors encourage average and better than average infiltration and tend to decrease runoff.

4. Poor: <50%) ground cover or heavily grazed with no mulch. Fair: 50 to 75% ground cover and not heavily grazed. Good: > 75% ground cover and l ightly or only occasional

5. Poor: <50% ground cover. Fair: 50 to 75% ground cover. Good: >75% ground cover.

6. CN's shown were computed for areas with 50% woods and 50% grass (pasture) cover. Other combinations of conditions may be computed from the CN's for woods

7. Poor: Forest l i tter, small trees, and brush are destroyed by heavy grazing or regular burning. Fair: Woods are grazed but not burned, and some forest l i tter covers the soil. Good: Woods are protected from grazing, and l i tter and brush adequately cover the soil.

8. Poor: <30% ground cover (l i tter, grass, and brush overstory). Fair: 30 to 70% ground cover. Good: > 70% ground cover.

4.6 Lag Time

While the NRCS curve numbers are used to calculate the volume of runoff and magnitude of losses, to transform the volume of runoff into a hydrograph using the NRCS dimensionless unit hydrograph, the lag time must be specified. The lag time is defined as the time from the centroid of the rainfall distribution of a storm to the peak discharge produced by the watershed. For this Manual, the lag time is defined as a fraction of the time of concentration (t_c) as shown in Equation 6-13.

$$t_{lag} = 0.6 \cdot t_c \qquad \text{(Eq. 6-13)}$$

Project: 1000s_C_and_S_Developed
Simulation Run: 2hr CS 100yr
Simulation Start: 31 December 2999, 24:00
Simulation End: 1 January 3000, 02:00

HMS Version: 4.8
Executed: 19 May 2022, 18:44

Global Parameter Summary - Subbasin

Area (ft²)

Element Name	Area (ft²)
E1270	0.09
E1260	0.05
E1010	0.02
E1030	0.01
E1020	0.04
E1011	0.02
E1210	0.06
E1225	0.07
E1211	0.05
E1230	0.03
E1250	0.05
E1240	0.04
E1251	0.14

Downstream

Element Name	Downstream
E1270	Dp1265
E1260	Dp1265
E1010	R1010
E1030	R1030
E1020	Dp1030
E1011	R1011
E1210	Dp1210
E1225	Db1225 g
E1211	R1211
E1230	R1230
E1250	Dp1250
E1240	Dp1250

Loss Rate: Scs

Element Name	Percent Impervious Area	Curve Number	Initial Abstraction
E1270	0	85.9	0.16
E1260	0	81.6	0.23
E1010	0	73.2	0.73
E1030	0	80	0.13
E1020	0	88.8	0.5
E1011	0	85	0.18
E1210	0	82.4	0.21
E1225	0	78.3	0.28
E1211	0	79	0.21
E1230	0	81.3	0.23
E1250	0	79.8	0.25
E1240	0	81.8	0.22
E1251	0	74	Not Specified

Transform: Scs

Element Name	Lag	Unitgraph Type
E1270	9.7	Standard
E1260	4.3	Standard
E1010	4.62	Standard
E1030	22.98	Standard
E1020	28.02	Standard
E1011	3	Standard
E1210	6.2	Standard
E1225	6.4	Standard
E1211	4.2	Standard
E1230	3.3	Standard
E1250	5.2	Standard
E1240	6.9	Standard
E1251	11.64	Standard

Global Parameter Summary - Reach

Downstream

Element Name	Downstream
R1010	Dp1030
R1030	Dp1030
R1011	Dp1210
R1210	Db1225 g
R1031	Dp1225
R1225a	Dp1260
R1211	Dp1250
R1230	Dp1250

Route: Kinematic Wave

Element Name	Method	Channel	Length (ft)	Energy Slope	Mannings n	Shape	Number of Subreaches	Width (ft)	Side Slope	Initial Variable	Index Parameter Type
R1010	Kinematic Wave	Kinematic Wave	450	0.02	0.01	Circular	5	3	Not Specified	Combined Inflow	Index Celerity
R1030	Kinematic Wave	Kinematic Wave	400	0.02	0.01	Circular	5	3	Not Specified	Combined Inflow	Index Celerity
R1011	Kinematic Wave	Kinematic Wave	1350	0.04	0.01	Circular	5	3	Not Specified	Combined Inflow	Index Celerity
R1210	Kinematic Wave	Kinematic Wave	600	0.03	0.04	Trapezoid	2	20	4	Combined Inflow	Index Celerity
R1031	Kinematic Wave	Kinematic Wave	2180	0.03	0.05	Trapezoid	5	20	10	Combined Inflow	Index Celerity
R1225a	Kinematic Wave	Kinematic Wave	2090	0.03	0.04	Trapezoid	5	20	4	Combined Inflow	Index Celerity
R1211	Kinematic Wave	Kinematic Wave	1700	0.01	0.01	Circular	5	3	Not Specified	Combined Inflow	Index Celerity
R1230	Kinematic Wave	Kinematic Wave	1500	0.02	0.01	Circular	5	3	Not Specified	Combined Inflow	Index Celerity

Global Results Summary

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
E1270	0.09	245.17	01Jan3000, 00:50	2.23
E1260	0.05	140.45	01Jan3000, 00:40	1.97
Dp1265	0.14	371.89	01Jan3000, 00:45	2.14
E1010	0.02	34.6	01Jan3000, 00:45	1.21
R1010	0.02	33.94	01Jan3000, 00:45	1.18
E1030	0.01	9.69	01Jan3000, 01:05	1.8
E1020	0.04	60.47	01Jan3000, 01:10	1.87
R1030	0.01	9.66	01Jan3000, 01:05	1.79
Dp1030	0.07	79.59	01Jan3000, 01:05	1.66
DB1031 The Glen	0.07	44.46	01Jan3000, 01:35	1.09
E1011	0.02	85.54	01Jan3000, 00:40	2.21
R1011	0.02	76.88	01Jan3000, 00:40	2.2
E1210	0.06	179.28	01Jan3000, 00:45	2.01
Dp1210	0.09	245.61	01Jan3000, 00:45	2.06
R1210	0.09	239.45	01Jan3000, 00:45	2.05
E1225	0.07	172.74	01Jan3000, 00:45	1.75
Db1225 g	0.16	133.07	01Jan3000, 01:05	1.22
R1031	0.07	44.37	01Jan3000, 01:40	0.9
Dp1225	0.22	163.88	01Jan3000, 01:10	1.12
R1225a	0.22	163.63	01Jan3000, 01:15	1.05
DB1260 - A	0.14	205.61	01Jan3000, 01:00	1.51
Dp1260	0.37	331.81	01Jan3000, 01:05	1.23
E1211	0.05	131.89	01Jan3000, 00:40	1.84
R1211	0.05	130.84	01Jan3000, 00:45	1.83
E1230	0.03	91.59	01Jan3000, 00:40	1.95
R1230	0.03	77.57	01Jan3000, 00:45	1.94
E1250	0.05	125.23	01Jan3000, 00:45	1.85
E1240	0.04	120.74	01Jan3000, 00:45	1.96
Dp1250	0.17	454.38	01Jan3000, 00:45	1.89
DB1250 - B	0.17	148.13	01Jan3000, 01:05	1.26
E1251	0.14	177.06	01Jan3000, 00:55	1.22

Project: 1000s_C_and_S_Developed
Simulation Run: 2hr CS 5yr
Simulation Start: 31 December 2999, 24:00
Simulation End: 1 January 3000, 02:00

HMS Version: 4.8
Executed: 19 May 2022, 18:47

Global Parameter Summary - Subbasin

Area (ft^2)

Element Name	Area (ft^2)
E1270	0.09
E1260	0.05
E1010	0.02
E1030	0.01
E1020	0.04
E1011	0.02
E1210	0.06
E1225	0.07
E1211	0.05
E1230	0.03
E1250	0.05
E1240	0.04
E1251	0.14

Downstream

Element Name	Downstream
E1270	Dp1265
E1260	Dp1265
E1010	R1010
E1030	R1030
E1020	Dp1030
E1011	R1011
E1210	Dp1210
E1225	Db1225 g
E1211	R1211
E1230	R1230
E1250	Dp1250
E1240	Dp1250

Loss Rate: Scs

Element Name	Percent Impervious Area	Curve Number	Initial Abstraction
E1270	0	85.9	0.16
E1260	0	81.6	0.23
E1010	0	73.2	0.73
E1030	0	80	0.13
E1020	0	88.8	0.5
E1011	0	85	0.18
E1210	0	82.4	0.21
E1225	0	78.3	0.28
E1211	0	79	0.21
E1230	0	81.3	0.23
E1250	0	79.8	0.25
E1240	0	81.8	0.22
E1251	0	74	Not Specified

Transform: Scs

Element Name	Lag	Unitgraph Type
E1270	9.7	Standard
E1260	4.3	Standard
E1010	4.62	Standard
E1030	22.98	Standard
E1020	28.02	Standard
E1011	3	Standard
E1210	6.2	Standard
E1225	6.4	Standard
E1211	4.2	Standard
E1230	3.3	Standard
E1250	5.2	Standard
E1240	6.9	Standard
E1251	11.64	Standard

Global Parameter Summary - Reach

Downstream

Element Name	Downstream
R1010	Dp1030
R1030	Dp1030
R1011	Dp1210
R1210	Db1225 g
R1031	Dp1225
R1225a	Dp1260
R1211	Dp1250
R1230	Dp1250

Route: Kinematic Wave

Element Name	Method	Channel	Length (ft)	Energy Slope	Mannings n	Shape	Number of Subreaches	Width (ft)	Side Slope	Initial Variable	Index Parameter Type
R1010	Kinematic Wave	Kinematic Wave	450	0.02	0.01	Circular	5	3	Not Specified	Combined Inflow	Index Celerity
R1030	Kinematic Wave	Kinematic Wave	400	0.02	0.01	Circular	5	3	Not Specified	Combined Inflow	Index Celerity
R1011	Kinematic Wave	Kinematic Wave	1350	0.04	0.01	Circular	5	3	Not Specified	Combined Inflow	Index Celerity
R1210	Kinematic Wave	Kinematic Wave	600	0.03	0.04	Trapezoid	2	20	4	Combined Inflow	Index Celerity
R1031	Kinematic Wave	Kinematic Wave	2180	0.03	0.05	Trapezoid	5	20	10	Combined Inflow	Index Celerity
R1225a	Kinematic Wave	Kinematic Wave	2090	0.03	0.04	Trapezoid	5	20	4	Combined Inflow	Index Celerity
R1211	Kinematic Wave	Kinematic Wave	1700	0.01	0.01	Circular	5	3	Not Specified	Combined Inflow	Index Celerity
R1230	Kinematic Wave	Kinematic Wave	1500	0.02	0.01	Circular	5	3	Not Specified	Combined Inflow	Index Celerity

Global Results Summary

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
E1270	0.09	83.68	01Jan3000, 00:50	0.73
E1260	0.05	44.17	01Jan3000, 00:45	0.59
Dp1265	0.14	118.53	01Jan3000, 00:45	0.68
E1010	0.02	4.61	01Jan3000, 00:50	0.2
R1010	0.02	4.57	01Jan3000, 00:50	0.17
E1030	0.01	3.05	01Jan3000, 01:05	0.56
E1020	0.04	16.14	01Jan3000, 01:15	0.5
R1030	0.01	3.03	01Jan3000, 01:05	0.55
Dp1030	0.07	20.86	01Jan3000, 01:10	0.41
DB1031 The Glen	0.07	14.85	01Jan3000, 01:30	0.3
E1011	0.02	28.07	01Jan3000, 00:40	0.71
R1011	0.02	23.87	01Jan3000, 00:40	0.71
E1210	0.06	55.5	01Jan3000, 00:45	0.61
Dp1210	0.09	78.8	01Jan3000, 00:45	0.63
R1210	0.09	74.07	01Jan3000, 00:45	0.63
E1225	0.07	47.46	01Jan3000, 00:45	0.48
Db1225 g	0.16	9.34	01Jan3000, 02:00	0.06
R1031	0.07	14.77	01Jan3000, 01:40	0.23
Dp1225	0.22	23.28	01Jan3000, 01:45	0.11
R1225a	0.22	23.24	01Jan3000, 01:55	0.08
DB1260 - A	0.14	17.25	01Jan3000, 01:25	0.17
Dp1260	0.37	38.47	01Jan3000, 01:50	0.11
E1211	0.05	39.95	01Jan3000, 00:45	0.54
R1211	0.05	38.74	01Jan3000, 00:45	0.53
E1230	0.03	26.77	01Jan3000, 00:40	0.58
R1230	0.03	24.37	01Jan3000, 00:45	0.57
E1250	0.05	36.84	01Jan3000, 00:45	0.53
E1240	0.04	36.2	01Jan3000, 00:45	0.59
Dp1250	0.17	136.15	01Jan3000, 00:45	0.55
DB1250 - B	0.17	23.08	01Jan3000, 01:15	0.19
E1251	0.14	27.43	01Jan3000, 00:55	0.21

Project: 2000_3000_WFJJC_Developed
Simulation Run: CS 2hr 100yr
Simulation Start: 31 December 2999, 24:00
Simulation End: 1 January 3000, 02:00

HMS Version: 4.8
Executed: 19 May 2022, 18:37

Global Parameter Summary - Subbasin

	Area (ft²)
Element Name	Area (ft²)
E2010	0.12
E2020	0.06
E2030	0.02
E2045	0.06
E2040	0.03
E2050	0.02
E2060	0.02
E2070	0.07
E2080	0.06
E2090	0.02
E2110	0.03
E2100	0.1
E2120	0.05
E2130	0.01
E2140	0.01
E2150	0.01
E2160	0.01
E3000	0.42
E3005	0.24
E3015	0.11
E3010	0.22
E3012	0.21
E3020	0.19
E3025	0.26
E3030	0.26
E3035	0.16
E3040	0.12
E3050	0.07
E3060	0.12
E3070	0.08
E3080	0.05
E3090	0.05
E3100	0.1
E3110	0.02
Sb3200	0.01
Sb3220	0.07
Sb3265	0.09
Sb3250	0.08
Sb3240	0.05
Sb3275	0.07

Downstream

Element Name	Downstream
E2010	R2020
E2020	Dp2020
E2030	Dp2040
E2045	R2040
E2040	Dp2040
E2050	Dp2060
E2060	Dp2060
E2070	R2080
E2080	Dp2080
E2090	Dp2090
E2110	R2101
E2100	Dp2100
E2120	Dp2120
E2130	Dp2130
E2140	Dp2160
E2150	Dp2160
E2160	Dp2160
E3000	Dp3000
E3005	Dp3000
E3015	Dp3020
E3010	R3012
E3012	Junction - 2
E3020	R3025
E3025	Junction - 2
E3030	Dp3030
E3035	Dp3030
E3040	Dp3040
E3050	Dp3050
E3060	Db3061
E3070	Dp3070
E3080	R3080
E3090	Dp3090
E3100	Db3101
E3110	Dp3110
Sb3200	Dp3200
Sb3220	Db3220 e
Sb3265	R3265
Sb3250	Dp3250a
Sb3240	R3240
Sb3275	Dp3275

Loss Rate: Scs

Element Name	Percent Impervious Area	Curve Number	Initial Abstraction
E2010	0	75	Not Specified
E2020	0	75	Not Specified
E2030	0	71	Not Specified
E2045	0	85	Not Specified
E2040	0	71	Not Specified
E2050	0	71	Not Specified
E2060	0	73.1	Not Specified
E2070	0	75	Not Specified
E2080	0	71	Not Specified
E2090	0	75	Not Specified
E2110	0	71	Not Specified
E2100	0	75.3	Not Specified
E2120	0	69	Not Specified
E2130	0	69	Not Specified
E2140	0	69	Not Specified
E2150	0	76.3	Not Specified
E2160	0	92	Not Specified
E3000	0	81	Not Specified
E3005	0	81	Not Specified
E3015	0	81	Not Specified
E3010	0	82	Not Specified
E3012	0	82	Not Specified
E3020	0	93	Not Specified
E3025	0	93	Not Specified
E3030	0	79	Not Specified
E3035	0	79	Not Specified
E3040	0	72.3	Not Specified
E3050	0	87.3	Not Specified
E3060	0	79	Not Specified
E3070	0	79.3	Not Specified
E3080	0	79.2	Not Specified
E3090	0	79	Not Specified
E3100	0	82.9	Not Specified
E3110	0	90	Not Specified
Sb3200	0	74	Not Specified
Sb3220	0	91	Not Specified
Sb3265	0	84.8	0.18
Sb3250	0	79	0.27
Sb3240	0	81.7	0.22
Sb3275	0	82.2	0.22

Transform: Scs

Element Name	Lag	Unitgraph Type
E2010	21	Standard
E2020	22.56	Standard
E2030	13.98	Standard
E2045	15.48	Standard
E2040	16.08	Standard
E2050	19.8	Standard
E2060	15.18	Standard
E2070	27.78	Standard
E2080	14.82	Standard
E2090	24.84	Standard
E2110	19.74	Standard
E2100	28.92	Standard
E2120	17.28	Standard
E2130	13.08	Standard
E2140	9.6	Standard
E2150	15.54	Standard
E2160	9.72	Standard
E3000	24.84	Standard
E3005	16.2	Standard
E3015	12.6	Standard
E3010	16.8	Standard
E3012	28.2	Standard
E3020	21.6	Standard
E3025	13.8	Standard
E3030	20.4	Standard
E3035	9.6	Standard
E3040	17.64	Standard
E3050	22.26	Standard
E3060	15.42	Standard
E3070	29.16	Standard
E3080	21.3	Standard
E3090	24.66	Standard
E3100	18.18	Standard
E3110	28.32	Standard
Sb3200	8.1	Standard
Sb3220	12.72	Standard
Sb3265	7.9	Standard
Sb3250	11.5	Standard
Sb3240	6.7	Standard
Sb3275	7.8	Standard

Global Parameter Summary - Reach

Downstream

Element Name	Downstream
R2020	Dp2020
R2030	Dp2040
R2040	Dp2040
R2050	Dp2060
R2090	Dp2090
R2080	Dp2080
R2100	Dp2100
R2101	Dp2100

R2120	Junction - 1
R2130	Dp2130
R2160	Dp3110
R3015	Dp3020
R3012	Junction - 2
R3025	Junction - 2
R3030	Dp3030
R3040	Dp3040
R3050	Dp3050
R3070	Dp3070
R3071	Junction - 3
R3080	Dp3090
R3100	Dp3102
R3110	Dp3200
R3200	Dp3280
R3265	Dp3250a
R3240	Dp3250a
R3250	Dp3275

Route: Kinematic Wave

Element Name	Method	Channel	Length (ft)	Energy Slope	Mannings n	Shape	Number of Subreaches	Width (ft)	Side Slope	Initial Variable	Index Parameter Type	Inde Celer
R2020	Kinematic Wave	Kinematic Wave	800	0.03	0.05	Trapezoid	5	20	10	Combined Inflow	Index Celerity	7
R2030	Kinematic Wave	Kinematic Wave	800	0.03	0.05	Trapezoid	5	20	8	Combined Inflow	Index Celerity	7
R2040	Kinematic Wave	Kinematic Wave	1200	0.03	0.04	Trapezoid	5	20	8	Combined Inflow	Index Celerity	7
R2050	Kinematic Wave	Kinematic Wave	600	0.03	0.03	Trapezoid	5	20	3	Combined Inflow	Index Celerity	7
R2090	Kinematic Wave	Kinematic Wave	500	0.02	0.03	Trapezoid	5	30	3	Combined Inflow	Index Celerity	7
R2080	Kinematic Wave	Kinematic Wave	1220	0.04	0.04	Trapezoid	5	10	5	Combined Inflow	Index Celerity	7
R2100	Kinematic Wave	Kinematic Wave	1800	0.02	0.03	Trapezoid	5	60	4	Combined Inflow	Index Celerity	7
R2101	Kinematic Wave	Kinematic Wave	900	0.03	0.04	Trapezoid	5	40	5	Combined Inflow	Index Celerity	7
R2120	Kinematic Wave	Kinematic Wave	1000	0.03	0.04	Trapezoid	5	40	5	Combined Inflow	Index Celerity	7
R2130	Kinematic Wave	Kinematic Wave	550	0.05	0.04	Trapezoid	5	8	3	Combined Inflow	Index Celerity	7
R2160	Kinematic Wave	Kinematic Wave	1580	0.03	0.04	Trapezoid	5	20	4	Combined Inflow	Index Celerity	7
R3015	Kinematic Wave	Kinematic Wave	3200	0.03	0.04	Trapezoid	5	15	3	Combined Inflow	Index Celerity	7
R3012	Kinematic Wave	Kinematic Wave	2600	0.03	0.04	Trapezoid	5	15	3	Combined Inflow	Index Celerity	7
R3025	Kinematic Wave	Kinematic Wave	2600	0.04	0.04	Trapezoid	5	15	3	Combined Inflow	Index Celerity	7
R3030	Kinematic Wave	Kinematic Wave	3000	0.05	0.04	Trapezoid	5	20	10	Combined Inflow	Index Celerity	7
R3040	Kinematic Wave	Kinematic Wave	1450	0.03	0.03	Trapezoid	5	30	5	Combined Inflow	Index Celerity	7
R3050	Kinematic Wave	Kinematic Wave	2850	0.01	0.03	Trapezoid	5	10	7	Combined Inflow	Index Celerity	7
R3070	Kinematic Wave	Kinematic Wave	2000	0.01	0.04	Trapezoid	5	30	10	Combined Inflow	Index Celerity	7
R3071	Kinematic Wave	Kinematic Wave	2050	0.01	0.04	Trapezoid	5	30	10	Combined Inflow	Index Celerity	7
R3080	Kinematic Wave	Kinematic Wave	1650	0.01	0.04	Trapezoid	5	30	10	Combined Inflow	Index Celerity	7
R3100	Kinematic Wave	Kinematic Wave	350	0.01	0.03	Trapezoid	5	10	10	Combined Inflow	Index Celerity	7
R3110	Kinematic Wave	Kinematic Wave	2620	0.01	0.03	Trapezoid	5	50	4	Combined Inflow	Index Celerity	7
R3200	Kinematic Wave	Kinematic Wave	1630	0.01	0.03	Trapezoid	5	50	4	Combined Inflow	Index Celerity	7
R3265	Kinematic Wave	Kinematic Wave	1225	0.02	0.03	Trapezoid	5	15	4	Combined Inflow	Index Celerity	7
R3240	Kinematic Wave	Kinematic Wave	1250	0.01	0.03	Trapezoid	5	15	4	Combined Inflow	Index Celerity	7
R3250	Kinematic Wave	Kinematic Wave	1213	0.01	0.03	Trapezoid	5	30	4	Combined Inflow	Index Celerity	7

Global Results Summary

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)

E2010	0.12	129.59	01Jan3000, 01:05	1.21
R2020	0.12	127.18	01Jan3000, 01:05	1.18
E2020	0.06	61.52	01Jan3000, 01:05	1.19
Dp2020	0.19	188.71	01Jan3000, 01:05	1.18
R2030	0.19	187.49	01Jan3000, 01:10	1.15
E2030	0.02	21.21	01Jan3000, 00:55	1.03
E2045	0.06	120.3	01Jan3000, 00:55	1.96
R2040	0.06	117.52	01Jan3000, 01:00	1.9
E2040	0.03	24.78	01Jan3000, 01:00	1.02
Dp2040	0.29	328.71	01Jan3000, 01:05	1.29
R2050	0.29	327.17	01Jan3000, 01:05	1.27
E2050	0.02	17.14	01Jan3000, 01:05	0.99
E2060	0.02	26.21	01Jan3000, 01:00	1.14
Dp2060	0.34	367.37	01Jan3000, 01:05	1.25
R2090	0.34	365.39	01Jan3000, 01:05	1.24
E2070	0.07	59.59	01Jan3000, 01:15	1.13
R2080	0.07	59.46	01Jan3000, 01:15	1.09
E2080	0.06	55.73	01Jan3000, 01:00	1.03
Dp2080	0.12	98.86	01Jan3000, 01:05	1.06
E2090	0.02	17.89	01Jan3000, 01:10	1.17
Dp2090	0.48	481.69	01Jan3000, 01:05	1.19
Db2091	0.48	436.28	01Jan3000, 01:15	1.16
R2100	0.48	432.05	01Jan3000, 01:20	1.11
E2110	0.03	29.18	01Jan3000, 01:05	0.99
R2101	0.03	28.74	01Jan3000, 01:10	0.94
E2100	0.1	82.86	01Jan3000, 01:15	1.13
Dp2100	0.61	540.45	01Jan3000, 01:15	1.1
E2120	0.05	38.03	01Jan3000, 01:00	0.9
Dp2120	0.66	568.97	01Jan3000, 01:15	1.09
R2120	0.66	563.79	01Jan3000, 01:15	1.06
Junction - 1	0.66	563.79	01Jan3000, 01:15	1.06
R2130	0.66	562.38	01Jan3000, 01:20	1.05
E2130	0.01	9.26	01Jan3000, 00:55	0.93
Dp2130	0.67	566.49	01Jan3000, 01:20	1.05
E2140	0.01	7.36	01Jan3000, 00:50	0.95
E2150	0.01	19.27	01Jan3000, 00:55	1.34
E2160	0.01	37.88	01Jan3000, 00:50	2.63
Dp2160	0.7	589.82	01Jan3000, 01:15	1.08
R2160	0.7	587.01	01Jan3000, 01:20	1.04
E3000	0.42	526	01Jan3000, 01:10	1.55
E3005	0.24	380.62	01Jan3000, 00:55	1.65
Dp3000	0.66	856.81	01Jan3000, 01:05	1.59
R3015	0.66	855.87	01Jan3000, 01:05	1.52
E3015	0.11	197.15	01Jan3000, 00:55	1.68
Dp3020	0.77	991.84	01Jan3000, 01:05	1.54
E3010	0.22	357.95	01Jan3000, 01:00	1.72
R3012	0.22	355.64	01Jan3000, 01:00	1.65
E3012	0.21	256.15	01Jan3000, 01:10	1.57
E3020	0.19	419.78	01Jan3000, 01:00	2.59
R3025	0.19	416.05	01Jan3000, 01:05	2.5
E3025	0.26	724.12	01Jan3000, 00:50	2.69
Junction - 2	1.65	2538.31	01Jan3000, 01:00	1.85
Db3021	1.65	1652.09	01Jan3000, 01:20	1.11
R3030	1.65	1636.66	01Jan3000, 01:25	1.04
E3030	0.26	332.06	01Jan3000, 01:05	1.47
E3035	0.16	299.64	01Jan3000, 00:50	1.56

Dp3030	2.07	1873.97	01Jan3000, 01:25	1.14
Db3031	2.07	1826.31	01Jan3000, 01:25	1.08
R3040	2.07	1811.03	01Jan3000, 01:30	1.06
E3040	0.12	112.55	01Jan3000, 01:00	1.08
Dp3040	2.18	1856.42	01Jan3000, 01:30	1.06
R3050	2.18	1838.06	01Jan3000, 01:30	0.98
E3050	0.07	129.97	01Jan3000, 01:05	2.07
Dp3050	2.26	1898.37	01Jan3000, 01:30	1.01
E3060	0.12	177.42	01Jan3000, 00:55	1.52
Db3061	0.12	150.74	01Jan3000, 01:05	1.45
R3070	0.12	147.32	01Jan3000, 01:15	1.31
E3070	0.08	81.06	01Jan3000, 01:15	1.37
Dp3070	0.2	228.38	01Jan3000, 01:15	1.34
R3071	0.2	227.27	01Jan3000, 01:20	1.19
Junction - 3	2.45	2099.19	01Jan3000, 01:30	1.03
E3080	0.05	67.13	01Jan3000, 01:05	1.47
R3080	0.05	66.16	01Jan3000, 01:10	1.34
E3090	0.05	62	01Jan3000, 01:10	1.42
Dp3090	0.11	128.16	01Jan3000, 01:10	1.38
Db3091	0.11	104.22	01Jan3000, 01:20	1.19
Dp3092	2.56	2201.99	01Jan3000, 01:30	1.04
R3100	2.56	2187.35	01Jan3000, 01:30	1.03
E3100	0.1	156.19	01Jan3000, 01:00	1.77
Db3101	0.1	111.05	01Jan3000, 01:15	1.65
Dp3102	2.65	2283.26	01Jan3000, 01:30	1.05
E3110	0.02	30.57	01Jan3000, 01:10	2.19
Dp3110	3.38	2834.78	01Jan3000, 01:30	1.05
R3110	3.38	2794.4	01Jan3000, 01:35	0.98
Sb3200	0.01	18.94	01Jan3000, 00:50	1.24
Sb3220	0.07	177.92	01Jan3000, 00:50	2.5
Db3220 e	0.07	33.05	01Jan3000, 01:30	0.8
Dp3200	3.45	2829.97	01Jan3000, 01:35	0.98
R3200	3.45	2818.58	01Jan3000, 01:35	0.93
Sb3265	0.09	254.22	01Jan3000, 00:45	2.16
R3265	0.09	244.25	01Jan3000, 00:50	2.12
Sb3250	0.08	148.88	01Jan3000, 00:50	1.75
Sb3240	0.05	127.34	01Jan3000, 00:45	1.96
R3240	0.05	119.4	01Jan3000, 00:50	1.89
Dp3250a	0.21	512.54	01Jan3000, 00:50	1.94
R3250	0.21	483.45	01Jan3000, 00:50	1.9
Sb3275	0.07	181.58	01Jan3000, 00:45	1.98
Dp3275	0.28	653.97	01Jan3000, 00:50	1.92
Db3280 c	0.28	177.43	01Jan3000, 01:20	0.97
Dp3280	3.74	2982.37	01Jan3000, 01:35	0.94

Project: 2000_3000_WFJJC_Developed
Simulation Run: CS 2hr 5yr
Simulation Start: 31 December 2999, 24:00
Simulation End: 1 January 3000, 02:00

HMS Version: 4.8
Executed: 19 May 2022, 18:29

Global Parameter Summary - Subbasin

	Area (ft²)
Element Name	Area (ft²)
E2010	0.12
E2020	0.06
E2030	0.02
E2045	0.06
E2040	0.03
E2050	0.02
E2060	0.02
E2070	0.07
E2080	0.06
E2090	0.02
E2110	0.03
E2100	0.1
E2120	0.05
E2130	0.01
E2140	0.01
E2150	0.01
E2160	0.01
E3000	0.42
E3005	0.24
E3015	0.11
E3010	0.22
E3012	0.21
E3020	0.19
E3025	0.26
E3030	0.26
E3035	0.16
E3040	0.12
E3050	0.07
E3060	0.12
E3070	0.08
E3080	0.05
E3090	0.05
E3100	0.1
E3110	0.02
Sb3200	0.01
Sb3220	0.07
Sb3265	0.09
Sb3250	0.08
Sb3240	0.05
Sb3275	0.07

Downstream

Element Name	Downstream
E2010	R2020
E2020	Dp2020
E2030	Dp2040
E2045	R2040
E2040	Dp2040
E2050	Dp2060
E2060	Dp2060
E2070	R2080
E2080	Dp2080
E2090	Dp2090
E2110	R2101
E2100	Dp2100
E2120	Dp2120
E2130	Dp2130
E2140	Dp2160
E2150	Dp2160
E2160	Dp2160
E3000	Dp3000
E3005	Dp3000
E3015	Dp3020
E3010	R3012
E3012	Junction - 2
E3020	R3025
E3025	Junction - 2
E3030	Dp3030
E3035	Dp3030
E3040	Dp3040
E3050	Dp3050
E3060	Db3061
E3070	Dp3070
E3080	R3080
E3090	Dp3090
E3100	Db3101
E3110	Dp3110
Sb3200	Dp3200
Sb3220	Db3220 e
Sb3265	R3265
Sb3250	Dp3250a
Sb3240	R3240
Sb3275	Dp3275

Loss Rate: Scs

Element Name	Percent Impervious Area	Curve Number	Initial Abstraction
E2010	0	75	Not Specified
E2020	0	75	Not Specified
E2030	0	71	Not Specified
E2045	0	85	Not Specified
E2040	0	71	Not Specified
E2050	0	71	Not Specified
E2060	0	73.1	Not Specified
E2070	0	75	Not Specified
E2080	0	71	Not Specified
E2090	0	75	Not Specified
E2110	0	71	Not Specified
E2100	0	75.3	Not Specified
E2120	0	69	Not Specified
E2130	0	69	Not Specified
E2140	0	69	Not Specified
E2150	0	76.3	Not Specified
E2160	0	92	Not Specified
E3000	0	81	Not Specified
E3005	0	81	Not Specified
E3015	0	81	Not Specified
E3010	0	82	Not Specified
E3012	0	82	Not Specified
E3020	0	93	Not Specified
E3025	0	93	Not Specified
E3030	0	79	Not Specified
E3035	0	79	Not Specified
E3040	0	72.3	Not Specified
E3050	0	87.3	Not Specified
E3060	0	79	Not Specified
E3070	0	79.3	Not Specified
E3080	0	79.2	Not Specified
E3090	0	79	Not Specified
E3100	0	82.9	Not Specified
E3110	0	90	Not Specified
Sb3200	0	74	Not Specified
Sb3220	0	91	Not Specified
Sb3265	0	84.8	0.18
Sb3250	0	79	0.27
Sb3240	0	81.7	0.22
Sb3275	0	82.2	0.22

Transform: Scs

Element Name	Lag	Unitgraph Type
E2010	21	Standard
E2020	22.56	Standard
E2030	13.98	Standard
E2045	15.48	Standard
E2040	16.08	Standard
E2050	19.8	Standard
E2060	15.18	Standard
E2070	27.78	Standard
E2080	14.82	Standard
E2090	24.84	Standard
E2110	19.74	Standard
E2100	28.92	Standard
E2120	17.28	Standard
E2130	13.08	Standard
E2140	9.6	Standard
E2150	15.54	Standard
E2160	9.72	Standard
E3000	24.84	Standard
E3005	16.2	Standard
E3015	12.6	Standard
E3010	16.8	Standard
E3012	28.2	Standard
E3020	21.6	Standard
E3025	13.8	Standard
E3030	20.4	Standard
E3035	9.6	Standard
E3040	17.64	Standard
E3050	22.26	Standard
E3060	15.42	Standard
E3070	29.16	Standard
E3080	21.3	Standard
E3090	24.66	Standard
E3100	18.18	Standard
E3110	28.32	Standard
Sb3200	8.1	Standard
Sb3220	12.72	Standard
Sb3265	7.9	Standard
Sb3250	11.5	Standard
Sb3240	6.7	Standard
Sb3275	7.8	Standard

Global Parameter Summary - Reach

Downstream

Element Name	Downstream
R2020	Dp2020
R2030	Dp2040
R2040	Dp2040
R2050	Dp2060
R2090	Dp2090
R2080	Dp2080
R2100	Dp2100
R2101	Dp2100

R2120	Junction - 1
R2130	Dp2130
R2160	Dp3110
R3015	Dp3020
R3012	Junction - 2
R3025	Junction - 2
R3030	Dp3030
R3040	Dp3040
R3050	Dp3050
R3070	Dp3070
R3071	Junction - 3
R3080	Dp3090
R3100	Dp3102
R3110	Dp3200
R3200	Dp3280
R3265	Dp3250a
R3240	Dp3250a
R3250	Dp3275

Route: Kinematic Wave

Element Name	Method	Channel	Length (ft)	Energy Slope	Mannings n	Shape	Number of Subreaches	Width (ft)	Side Slope	Initial Variable	Index Parameter Type	Inde Celer
R2020	Kinematic Wave	Kinematic Wave	800	0.03	0.05	Trapezoid	5	20	10	Combined Inflow	Index Celerity	7
R2030	Kinematic Wave	Kinematic Wave	800	0.03	0.05	Trapezoid	5	20	8	Combined Inflow	Index Celerity	7
R2040	Kinematic Wave	Kinematic Wave	1200	0.03	0.04	Trapezoid	5	20	8	Combined Inflow	Index Celerity	7
R2050	Kinematic Wave	Kinematic Wave	600	0.03	0.03	Trapezoid	5	20	3	Combined Inflow	Index Celerity	7
R2090	Kinematic Wave	Kinematic Wave	500	0.02	0.03	Trapezoid	5	30	3	Combined Inflow	Index Celerity	7
R2080	Kinematic Wave	Kinematic Wave	1220	0.04	0.04	Trapezoid	5	10	5	Combined Inflow	Index Celerity	7
R2100	Kinematic Wave	Kinematic Wave	1800	0.02	0.03	Trapezoid	5	60	4	Combined Inflow	Index Celerity	7
R2101	Kinematic Wave	Kinematic Wave	900	0.03	0.04	Trapezoid	5	40	5	Combined Inflow	Index Celerity	7
R2120	Kinematic Wave	Kinematic Wave	1000	0.03	0.04	Trapezoid	5	40	5	Combined Inflow	Index Celerity	7
R2130	Kinematic Wave	Kinematic Wave	550	0.05	0.04	Trapezoid	5	8	3	Combined Inflow	Index Celerity	7
R2160	Kinematic Wave	Kinematic Wave	1580	0.03	0.04	Trapezoid	5	20	4	Combined Inflow	Index Celerity	7
R3015	Kinematic Wave	Kinematic Wave	3200	0.03	0.04	Trapezoid	5	15	3	Combined Inflow	Index Celerity	7
R3012	Kinematic Wave	Kinematic Wave	2600	0.03	0.04	Trapezoid	5	15	3	Combined Inflow	Index Celerity	7
R3025	Kinematic Wave	Kinematic Wave	2600	0.04	0.04	Trapezoid	5	15	3	Combined Inflow	Index Celerity	7
R3030	Kinematic Wave	Kinematic Wave	3000	0.05	0.04	Trapezoid	5	20	10	Combined Inflow	Index Celerity	7
R3040	Kinematic Wave	Kinematic Wave	1450	0.03	0.03	Trapezoid	5	30	5	Combined Inflow	Index Celerity	7
R3050	Kinematic Wave	Kinematic Wave	2850	0.01	0.03	Trapezoid	5	10	7	Combined Inflow	Index Celerity	7
R3070	Kinematic Wave	Kinematic Wave	2000	0.01	0.04	Trapezoid	5	30	10	Combined Inflow	Index Celerity	7
R3071	Kinematic Wave	Kinematic Wave	2050	0.01	0.04	Trapezoid	5	30	10	Combined Inflow	Index Celerity	7
R3080	Kinematic Wave	Kinematic Wave	1650	0.01	0.04	Trapezoid	5	30	10	Combined Inflow	Index Celerity	7
R3100	Kinematic Wave	Kinematic Wave	350	0.01	0.03	Trapezoid	5	10	10	Combined Inflow	Index Celerity	7
R3110	Kinematic Wave	Kinematic Wave	2620	0.01	0.03	Trapezoid	5	50	4	Combined Inflow	Index Celerity	7
R3200	Kinematic Wave	Kinematic Wave	1630	0.01	0.03	Trapezoid	5	50	4	Combined Inflow	Index Celerity	7
R3265	Kinematic Wave	Kinematic Wave	1225	0.02	0.03	Trapezoid	5	15	4	Combined Inflow	Index Celerity	7
R3240	Kinematic Wave	Kinematic Wave	1250	0.01	0.03	Trapezoid	5	15	4	Combined Inflow	Index Celerity	7
R3250	Kinematic Wave	Kinematic Wave	1213	0.01	0.03	Trapezoid	5	30	4	Combined Inflow	Index Celerity	7

Global Results Summary

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)

E2010	0.12	17.85	01Jan3000, 01:10	0.18
R2020	0.12	17.76	01Jan3000, 01:15	0.17
E2020	0.06	8.49	01Jan3000, 01:15	0.18
Dp2020	0.19	26.25	01Jan3000, 01:15	0.17
R2030	0.19	25.92	01Jan3000, 01:20	0.16
E2030	0.02	2.04	01Jan3000, 01:05	0.12
E2045	0.06	28.41	01Jan3000, 01:00	0.49
R2040	0.06	28.03	01Jan3000, 01:05	0.47
E2040	0.03	2.41	01Jan3000, 01:10	0.11
Dp2040	0.29	52.45	01Jan3000, 01:10	0.22
R2050	0.29	51.83	01Jan3000, 01:10	0.21
E2050	0.02	1.71	01Jan3000, 01:15	0.11
E2060	0.02	3.05	01Jan3000, 01:05	0.15
Dp2060	0.34	56.46	01Jan3000, 01:10	0.2
R2090	0.34	56.08	01Jan3000, 01:15	0.2
E2070	0.07	8.46	01Jan3000, 01:20	0.16
R2080	0.07	8.46	01Jan3000, 01:25	0.15
E2080	0.06	5.42	01Jan3000, 01:05	0.12
Dp2080	0.12	12.49	01Jan3000, 01:20	0.13
E2090	0.02	2.51	01Jan3000, 01:15	0.17
Dp2090	0.48	70.99	01Jan3000, 01:15	0.18
Db2091	0.48	69.47	01Jan3000, 01:20	0.17
R2100	0.48	69.31	01Jan3000, 01:25	0.15
E2110	0.03	2.91	01Jan3000, 01:15	0.11
R2101	0.03	2.9	01Jan3000, 01:20	0.09
E2100	0.1	12	01Jan3000, 01:20	0.17
Dp2100	0.61	83.82	01Jan3000, 01:25	0.15
E2120	0.05	3.12	01Jan3000, 01:10	0.08
Dp2120	0.66	86.32	01Jan3000, 01:25	0.15
R2120	0.66	85.53	01Jan3000, 01:25	0.14
Junction - 1	0.66	85.53	01Jan3000, 01:25	0.14
R2130	0.66	84.97	01Jan3000, 01:30	0.13
E2130	0.01	0.72	01Jan3000, 01:05	0.09
Dp2130	0.67	85.37	01Jan3000, 01:30	0.13
E2140	0.01	0.54	01Jan3000, 01:00	0.09
E2150	0.01	2.8	01Jan3000, 01:00	0.22
E2160	0.01	12.72	01Jan3000, 00:50	0.87
Dp2160	0.7	88.74	01Jan3000, 01:25	0.15
R2160	0.7	88.71	01Jan3000, 01:30	0.13
E3000	0.42	105.1	01Jan3000, 01:10	0.32
E3005	0.24	74.83	01Jan3000, 01:00	0.34
Dp3000	0.66	169.76	01Jan3000, 01:05	0.33
R3015	0.66	169.08	01Jan3000, 01:15	0.3
E3015	0.11	38.34	01Jan3000, 00:55	0.35
Dp3020	0.77	195.03	01Jan3000, 01:10	0.31
E3010	0.22	74.21	01Jan3000, 01:00	0.38
R3012	0.22	72.6	01Jan3000, 01:05	0.35
E3012	0.21	54.08	01Jan3000, 01:15	0.34
E3020	0.19	142.99	01Jan3000, 01:05	0.89
R3025	0.19	142.35	01Jan3000, 01:05	0.84
E3025	0.26	252.41	01Jan3000, 00:55	0.93
Junction - 2	1.65	625.23	01Jan3000, 01:05	0.48
Db3021	1.65	232.36	01Jan3000, 01:45	0.2
R3030	1.65	232.33	01Jan3000, 01:50	0.17
E3030	0.26	58.57	01Jan3000, 01:05	0.27
E3035	0.16	48.55	01Jan3000, 00:55	0.3

Dp3030	2.07	264.22	01Jan3000, 01:40	0.2
Db3031	2.07	263.29	01Jan3000, 01:50	0.17
R3040	2.07	263.28	01Jan3000, 01:50	0.16
E3040	0.12	12.42	01Jan3000, 01:10	0.13
Dp3040	2.18	268.47	01Jan3000, 01:50	0.16
R3050	2.18	268.31	01Jan3000, 01:55	0.13
E3050	0.07	35.02	01Jan3000, 01:05	0.56
Dp3050	2.26	277.44	01Jan3000, 01:55	0.14
E3060	0.12	30.84	01Jan3000, 01:00	0.29
Db3061	0.12	25.88	01Jan3000, 01:10	0.27
R3070	0.12	25.63	01Jan3000, 01:25	0.22
E3070	0.08	14.92	01Jan3000, 01:20	0.26
Dp3070	0.2	39.95	01Jan3000, 01:20	0.23
R3071	0.2	39.8	01Jan3000, 01:35	0.18
Junction - 3	2.45	310.65	01Jan3000, 01:45	0.15
E3080	0.05	12.04	01Jan3000, 01:10	0.28
R3080	0.05	11.9	01Jan3000, 01:20	0.23
E3090	0.05	11.12	01Jan3000, 01:15	0.26
Dp3090	0.11	22.27	01Jan3000, 01:20	0.25
Db3091	0.11	15.64	01Jan3000, 01:40	0.17
Dp3092	2.56	325.92	01Jan3000, 01:45	0.15
R3100	2.56	325.78	01Jan3000, 01:45	0.14
E3100	0.1	33.44	01Jan3000, 01:05	0.4
Db3101	0.1	27.28	01Jan3000, 01:15	0.37
Dp3102	2.65	340.6	01Jan3000, 01:40	0.15
E3110	0.02	9.21	01Jan3000, 01:10	0.66
Dp3110	3.38	428.84	01Jan3000, 01:35	0.15
R3110	3.38	428.15	01Jan3000, 01:45	0.12
Sb3200	0.01	2.16	01Jan3000, 00:55	0.18
Sb3220	0.07	55.43	01Jan3000, 00:55	0.8
Db3220 e	0.07	1.28	01Jan3000, 02:00	0.03
Dp3200	3.45	429.95	01Jan3000, 01:45	0.12
R3200	3.45	429.12	01Jan3000, 01:45	0.1
Sb3265	0.09	68.77	01Jan3000, 00:50	0.62
R3265	0.09	68.74	01Jan3000, 00:50	0.6
Sb3250	0.08	34.6	01Jan3000, 00:55	0.43
Sb3240	0.05	31.91	01Jan3000, 00:45	0.52
R3240	0.05	31.69	01Jan3000, 00:50	0.5
Dp3250a	0.21	134.52	01Jan3000, 00:50	0.52
R3250	0.21	131.22	01Jan3000, 00:55	0.49
Sb3275	0.07	45.85	01Jan3000, 00:50	0.53
Dp3275	0.28	167.75	01Jan3000, 00:55	0.5
Db3280 c	0.28	6.55	01Jan3000, 02:00	0.02
Dp3280	3.74	434.59	01Jan3000, 01:45	0.1

APPENDIX C2: Developed Hydrology with Powers Roadway

CN Calculations with Powers Blvd Roadway

Model Comparison Powers Blvd Roadway vs Opens Space

Table 3
HEC-HMS Developed CN Values with Powers Blvd Roadway

			Land Use (Sq Miles) B or C Soils																				
			OP/P/D		RL		RLM		RMH		RH		COM/OFF		LL		School		Powers Blvd [2]				
			B	C	B	C	B	C	B	C	B	C	B	C	B	C	B	C	B	C			
Basin	**Area (ac)**	**Area Miles^2**	**61**	**74**	**68**	**79**	**75**	**83**	**85**	**90**	**85**	**90**	**92**	**94**	**68**	**79**	**77**	**85**	**80**	**86**	**CN**	Abstraction	Notes
C&S Basin																							
E1010		0.020																			**73.2**	**0.366**	(1)
E1020		0.041																			**80.0**	**0.250**	(1)
E1030		0.020																			**88.8**	**0.126**	(1)
E1011	14.4	0.022							0.022												**85.0**	**0.176**	
E1210	40.3	0.063							0.049										0.007	0.007	**84.6**	**0.183**	
E1211	32.1	0.050	0.001	0.005			0.017	0.020												0.008	**79.7**	**0.255**	
E1225	45.7	0.071	0.004	0.013			0.017	0.038													**78.3**	**0.277**	
E1230	18.1	0.028						0.020												0.008	**83.8**	**0.193**	
E1240	28.9	0.045						0.036												0.009	**83.6**	**0.196**	
E1250	29.8	0.047						0.009								0.038					**79.8**	**0.254**	
E1260	32.0	0.050		0.006				0.040								0.004					**81.6**	**0.225**	
E1270	58.9	0.092		0.007								0.032						0.053			**85.9**	**0.164**	
Totals	300	0.550																					
West Fork Jimmy Camp Creek Basin																							
SB3220	39.8	0.062									0.008	0.019	0.017	0.018							**91.0**	**0.099**	
SB3240	30.0	0.047					0.008	0.039													**81.7**	**0.224**	
SB3250	48.6	0.076	0.013	0.022								0.026					0.005	0.010			**79.0**	**0.265**	
SB3265	58.3	0.091					0.073	0.018													**76.6**	**0.306**	
SB3275	45.5	0.071						0.067												0.005	**83.2**	**0.202**	
Totals	222.3	0.347																					

(1) Data and model from Cross Creek MDDP
(2) Powers BLVD CN assumes 50% roadway (98), 50% open space (B 61,C 74)

Table 4
C&S (Center) Basin
Developed Conditions HEC-HMS Peak Flow Comparison with Powers Blvd Roadway

Element	100yr flows with Powers Open Space cfs	100yr flows with Powers Roadway cfs	Increase due to Roadway
E1270	245	245	0
E1260	140	140	0
DP1265	372	372	0
E1010	35	35	0
R1010	34	34	0
E1030	10	10	0
E1020	61	61	0
R1030	10	10	0
DP1030	80	80	0
DB1031 The Glen	45	45	0
E1011	86	86	0
R1011	77	77	0
E1210	174	193	19
DP1210	241	260	19
R1210	235	253	19
E1225	173	173	0
DB1225 G	132	140	8
R1031	44	44	0
DP1225	163	168	5
R1225A	163	167	5
DB1260-A	206	206	0
DP1260	**331**	**337**	6
E1211	125	132	8
R1211	124	132	7
E1230	91	100	10
R1230	77	85	8
E1250	125	125	0
E1240	120	129	9
DP1250	446	470	24
DB1250-B	**141**	**166**	26
E1251	177.1	177	0

E=Subbasin
R=Routing
DP= Design Point
DB=Detention
4/20/2022

APPENDIX D: Full Spectrum Detention Design

Imperviousness Calcs

MHFD Detention Calcs

(Note: Used for WQCV,EURV, and discharge curves only. See HEC-HMS for 100yr Volume calcs)

D

Mesa Ridge MDDP FSD A

Runoff Coeficient and Percent Impervious Calculation

Basin / DP	Basin or DP Area (DP contributing basins)		Soil Type	RLM % Imperv	Area 1 Land Use Area	Area 1 % Area	Area 1 Comp Land Use % Imp	LL % Imperv	Area 2 Land Use Area	Area 2 % Area	Area 2 Comp Land Use % Imp	OS % Imperv	Area 3 Land Use Area	Area 3 % Area	Area 3 Comp Land Use % Imp	RH % Imperv	Area 4 Land Use Area	Area 4 % Area	Area 4 Comp Land Use % Imp	SC % Imperv	Area 5 Land Use Area	Area 5 % Area	Area 5 Comp Land Use % Imp	Basin % Imperv
1260	1,395,306 sf	32.03ac	C	30%	29.43ac	92%	28%	20%	2.60ac	8%	2%	2%		0%	0%	65%		0%	0%	60%		0%	0%	**29.2%**
1270	2,567,180 sf	58.93ac	C	30%		0%	0%	20%		0%	0%	2%	4.49ac	8%	0%	65%	20.79ac	35%	23%	60%	33.65ac	57%	34%	**57.3%**
FSD A-DB1260	1260, 1270	90.97ac	C	30%	29.43ac	32%	10%	20%	2.60ac	3%	1%	2%	4.49ac	5%	0%	65%	20.79ac	23%	15%	60%	33.65ac	37%	22%	**47.4%**

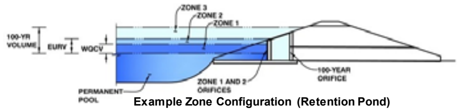
Land Use	Abb	%
Open Space	OS	2%
Large Lot	LL	20%
Residential - Low Density 2-3 DU/AC	RL	25%
Residential - Low/Medium Density 4-6 DU/AC	RLM	30%
Residential - Medium/High Density 4-8 DU/AC	RMH	40%
Residential - High Density 8+ DU/AC	RH	65%
Commercial/Office	OFF	80%
Business Park	BP	80%
School	SC	60%

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.04 (February 2021)

Project: **Mesa Ridge MDDP**

Basin ID: **FSD A - 1260**



Example Zone Configuration (Retention Pond)

Used for WQCV and EURV only; see HEC-HMS for 100yr Volume

Watershed Information

Selected BMP Type =	**EDB**			
Watershed Area =	90.97	acres		
Watershed Length =	2,000	ft		
Watershed Length to Centroid =	800	ft		
Watershed Slope =	0.023	ft/ft		
Watershed Imperviousness =	47.40%	percent		
Percentage Hydrologic Soil Group A =	0.0%	percent		
Percentage Hydrologic Soil Group B =	0.0%	percent		
Percentage Hydrologic Soil Groups C/D =	100.0%	percent		
Target WQCV Drain Time =	40.0	hours		
Location for 1-hr Rainfall Depths =	Denver - Capitol Building			

After providing required inputs above including 1-hour rainfall depths, click 'Run CUHP' to generate runoff hydrographs using the embedded Colorado Urban Hydrograph Procedure.

			Optional User Overrides	
Water Quality Capture Volume (WQCV) =	1.511	acre-feet		acre-feet
Excess Urban Runoff Volume (EURV) =	4.062	acre-feet		acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	4.708	acre-feet	1.19	inches
5-yr Runoff Volume (P1 = 1.5 in.) =	6.846	acre-feet	1.50	inches
10-yr Runoff Volume (P1 = 1.75 in.) =	8.681	acre-feet	1.75	inches
25-yr Runoff Volume (P1 = 2 in.) =	10.838	acre-feet	2.00	inches
50-yr Runoff Volume (P1 = 2.25 in.) =	12.770	acre-feet	2.25	inches
100-yr Runoff Volume (P1 = 2.52 in.) =	15.141	acre-feet	2.52	inches
500-yr Runoff Volume (P1 = 3.1 in.) =	19.683	acre-feet	3.10	inches
Approximate 2-yr Detention Volume =	3.575	acre-feet		
Approximate 5-yr Detention Volume =	5.386	acre-feet		
Approximate 10-yr Detention Volume =	6.142	acre-feet		
Approximate 25-yr Detention Volume =	6.669	acre-feet		
Approximate 50-yr Detention Volume =	6.918	acre-feet		
Approximate 100-yr Detention Volume =	7.934	acre-feet		

Define Zones and Basin Geometry

Select Zone 1 Storage Volume (Required) =		acre-feet
Select Zone 2 Storage Volume (Optional) =		acre-feet
Select Zone 3 Storage Volume (Optional) =		acre-feet
Total Detention Basin Volume =		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 = 1.00 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	--	--	--	200	0.005		
	--	1.00	--	--	--	1,000	0.023	600	0.014
	--	2.00	--	--	--	13,000	0.298	7,600	0.174
	--	3.00	--	--	--	45,000	1.033	36,600	0.840
	--	4.00	--	--	--	50,000	1.148	84,100	1.931
	--	5.00	--	--	--	55,000	1.263	136,600	3.136
	--	6.00	--	--	--	60,000	1.377	194,100	4.456
	--	7.00	--	--	--	65,000	1.492	256,600	5.891
	--	8.00	--	--	--	70,000	1.607	324,100	7.440
	--	9.00	--	--	--	75,000	1.722	396,600	9.105
	--	10.00	--	--	--	80,000	1.837	474,100	10.884
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DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.04 (February 2021)

Summary Stage-Area-Volume-Discharge Relationships

The user can create a summary S-A-V-D by entering the desired stage increments and the remainder of the table will populate automatically.

The user should graphically compare the summary S-A-V-D table to the full S-A-V-D table in the chart to confirm it captures all key transition points.

Stage - Storage Description	Stage [ft]	Area [ft ^{2}]	Area [acres]	Volume [ft ^{3}]	Volume [ac-ft]	Total Outflow [cfs]
	1.00	1,000	0.023	600	0.014	0.13
	2.00	13,000	0.298	7,600	0.174	0.19
	3.00	45,000	1.033	36,600	0.840	0.52
	3.35	46,750	1.073	52,656	1.209	0.60
	4.00	50,000	1.148	84,100	1.931	0.71
	5.00	55,000	1.263	136,600	3.136	1.86
	5.03	55,150	1.266	138,252	3.174	1.88
	6.00	60,000	1.377	194,100	4.456	24.04
	7.00	65,000	1.492	256,600	5.891	111.08
	8.00	70,000	1.607	324,100	7.440	120.36
	9.00	75,000	1.722	396,600	9.105	378.56
	10.00	80,000	1.837	474,100	10.884	870.16

For best results, include the stages of all grade slope changes (e.g. ISV and Floor) from the S-A-V table on Sheet 'Basin'.

Also include the inverts of all outlets (e.g. vertical orifice, overflow grate, and spillway, where applicable).

Mesa Ridge MDDP FSD B

Runoff Coeficient and Percent Impervious Calculation

Basin / DP	Basin or DP Area (DP contributing basins)		Soil Type	RMH	Area 1 Land Use			RLM	Area 2 Land Use			OS	Area 3 Land Use			RH	Area 4 Land Use			LL	Area 5 Land Use			Basin % Imperv
				% Imperv	Land Use Area	% Area	Comp Land Use % Imp	% Imperv	Land Use Area	% Area	Comp Land Use % Imp	% Imperv	Land Use Area	% Area	Comp Land Use % Imp	% Imperv	Land Use Area	% Area	Comp Land Use % Imp	% Imperv	Land Use Area	% Area	Comp Land Use % Imp	
1250-C	1,298,390 sf	29.81ac	C	40%		0%	0%	30%	5.74ac	19%	6%	2%		0%	0%	65%		0%	0%	20%	24.06ac	81%	16%	**21.9%**
1240-C	1,260,367 sf	28.93ac	C	40%		0%	0%	30%	25.34ac	88%	26%	2%	3.60ac	12%	0%	65%		0%	0%	20%		0%	0%	**26.5%**
1230-C	787,679 sf	18.08ac	C	40%		0%	0%	30%	14.81ac	82%	25%	2%	3.27ac	18%	0%	65%		0%	0%	20%		0%	0%	**24.9%**
1211-B	483,400 sf	11.10ac	B	40%		0%	0%	30%	10.66ac	96%	29%	2%	0.44ac	4%	0%	65%		0%	0%	20%		0%	0%	**28.9%**
1211-C	913,261 sf	20.97ac	C	40%		0%	0%	30%	18.00ac	86%	26%	2%	2.96ac	14%	0%	65%		0%	0%	20%		0%	0%	**26.0%**
FSD B -DB1250	1250, 1240, 1230, 1211	108.89ac	C	40%	0.00ac	0%	0%	30%	74.56ac	68%	21%	2%	10.27ac	9%	0%	65%	0.00ac	0%	0%	20%	24.06ac	22%	4%	**25.1%**

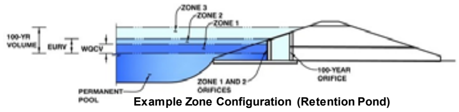
Land Use	Abb	%						
Open Space	OS	2%						
Large Lot	LL	20%						
Residential - Low Density 2-3 DU/AC	RL	25%						
Residential - Low/Medium Density 4-6 DU/AC	RLM	30%						
Residential - Medium/High Density 4-8 DU/AC	RMH	40%						
Residential - High Density 8+ DU/AC	RH	65%						
Commercial/Office	OFF	80%						
Business Park	BP	80%						
School	SC	60%						

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.04 (February 2021)

Project: **Mesa Ridge MDDP**

Basin ID: **FSD B - 1250**



Example Zone Configuration (Retention Pond)

Used for WQCV and EURV only; see HEC-HMS for 100yr Volume

Watershed Information

Selected BMP Type =	**EDB**	
Watershed Area =	108.89	acres
Watershed Length =	3,100	ft
Watershed Length to Centroid =	1,400	ft
Watershed Slope =	0.034	ft/ft
Watershed Imperviousness =	25.10%	percent
Percentage Hydrologic Soil Group A =	0.0%	percent
Percentage Hydrologic Soil Group B =	10.0%	percent
Percentage Hydrologic Soil Groups C/D =	90.0%	percent
Target WQCV Drain Time =	40.0	hours
Location for 1-hr Rainfall Depths =	Denver - Capitol Building	

After providing required inputs above including 1-hour rainfall depths, click 'Run CUHP' to generate runoff hydrographs using the embedded Colorado Urban Hydrograph Procedure.

			Optional User Overrides	
Water Quality Capture Volume (WQCV) =	1.227	acre-feet		acre-feet
Excess Urban Runoff Volume (EURV) =	2.479	acre-feet		acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	3.527	acre-feet	1.19	inches
5-yr Runoff Volume (P1 = 1.5 in.) =	5.884	acre-feet	1.50	inches
10-yr Runoff Volume (P1 = 1.75 in.) =	8.033	acre-feet	1.75	inches
25-yr Runoff Volume (P1 = 2 in.) =	10.785	acre-feet	2.00	inches
50-yr Runoff Volume (P1 = 2.25 in.) =	13.073	acre-feet	2.25	inches
100-yr Runoff Volume (P1 = 2.52 in.) =	16.085	acre-feet	2.52	inches
500-yr Runoff Volume (P1 = 3.1 in.) =	21.527	acre-feet	3.10	inches
Approximate 2-yr Detention Volume =	2.067	acre-feet		
Approximate 5-yr Detention Volume =	3.560	acre-feet		
Approximate 10-yr Detention Volume =	4.285	acre-feet		
Approximate 25-yr Detention Volume =	4.909	acre-feet		
Approximate 50-yr Detention Volume =	5.146	acre-feet		
Approximate 100-yr Detention Volume =	6.423	acre-feet		

Define Zones and Basin Geometry

Zone 1 Volume (WQCV) =	1.227	acre-feet
Zone 2 Volume (EURV - Zone 1) =	1.252	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	3.945	acre-feet
Total Detention Basin Volume =	6.423	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 = 1.00 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	--	--	--	200	0.005		
	--	1.00	--	--	--	1,000	0.023	600	0.014
	--	2.00	--	--	--	13,000	0.298	7,600	0.174
	--	3.00	--	--	--	36,000	0.826	32,100	0.737
	--	4.00	--	--	--	69,200	1.589	84,700	1.944
	--	5.00	--	--	--	73,600	1.690	156,100	3.584
	--	6.00	--	--	--	78,100	1.793	231,950	5.325
	--	7.00	--	--	--	82,800	1.901	312,400	7.172
	--	8.00	--	--	--	87,600	2.011	397,600	9.128
	--	9.00	--	--	--	92,600	2.126	487,700	11.196
	--	10.00	--	--	--	97,600	2.241	582,800	13.379
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DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.04 (February 2021)

Summary Stage-Area-Volume-Discharge Relationships

The user can create a summary S-A-V-D by entering the desired stage increments and the remainder of the table will populate automatically.

The user should graphically compare the summary S-A-V-D table to the full S-A-V-D table in the chart to confirm it captures all key transition points.

Stage - Storage Description	Stage [ft]	Area [ft ^{2}]	Area [acres]	Volume [ft ^{3}]	Volume [ac-ft]	Total Outflow [cfs]
	1.00	1,000	0.023	600	0.014	0.13
	2.00	13,000	0.298	7,600	0.174	0.29
	3.00	36,000	0.826	32,100	0.737	0.46
	3.49	52,268	1.200	53,725	1.233	0.51
	4.00	69,200	1.589	84,700	1.944	1.23
	4.34	70,696	1.623	108,482	2.490	1.46
	5.00	73,600	1.690	156,100	3.584	21.17
	6.00	78,100	1.793	231,950	5.325	89.45
	7.00	82,800	1.901	312,400	7.172	98.06
	8.00	87,600	2.011	397,600	9.128	105.97
	9.00	92,600	2.126	487,700	11.196	326.93
	10.00	97,600	2.241	582,800	13.379	751.54

For best results, include the stages of all grade slope changes (e.g. ISV and Floor) from the S-A-V table on Sheet 'Basin'.

Also include the inverts of all outlets (e.g. vertical orifice, overflow grate, and spillway, where applicable).

Mesa Ridge FSD C

Runoff Coeficient and Percent Impervious Calculation

				RMH	Area 1 Land Use			RLM	Area 2 Land Use			OS	Area 3 Land Use			RH	Area 4 Land Use			SC	Area 5 Land Use			
Basin / DP	**Basin or DP Area (DP contributing basins)**		Soil Type	% Imperv	Land Use Area	% Area	Comp Land Use % Imp	% Imperv	Land Use Area	% Area	Comp Land Use % Imp	% Imperv	Land Use Area	% Area	Comp Land Use % Imp	% Imperv	Land Use Area	% Area	Comp Land Use % Imp	% Imperv	Land Use Area	% Area	Comp Land Use % Imp	**Basin % Imperv**
3275-C	1,983,769 sf	45.54ac	C	40%		0%	0%	30%	37.38ac	82%	25%	2%	8.16ac	18%	0%	65%		0%	0%	60%		0%	0%	**25.0%**
3265-B	2,038,872 sf	46.81ac	B	40%		0%	0%	30%	46.81ac	100%	30%	2%		0%	0%	65%		0%	0%	60%		0%	0%	**30.0%**
3265-C	500,061 sf	11.48ac	C	40%		0%	0%	30%	11.48ac	100%	30%	2%		0%	0%	65%		0%	0%	60%		0%	0%	**30.0%**
3250-B	462,743 sf	11.20ac	C	40%		0%	0%	30%		0%	0%	2%		0%	0%	65%		0%	0%	60%	11.20ac	100%	60%	**60.0%**
3250-C	1,656,318 sf	37.50ac	C	40%	16.60ac	44%	18%	30%		0%	0%	2%		0%	0%	65%		0%	0%	60%	20.90ac	56%	33%	**51.1%**
3240-B	226,130 sf	5.19ac	B	40%		0%	0%	30%	5.19ac	100%	30%	2%		0%	0%	65%		0%	0%	60%		0%	0%	**30.0%**
3240-C	1,078,991 sf	24.77ac	C	40%		0%	0%	30%	24.77ac	100%	30%	2%		0%	0%	65%		0%	0%	60%		0%	0%	**30.0%**
FSD C -DB3280	3275, 3265, 3250, 3240	182.49ac	C	40%	16.60ac	9%	4%	30%	125.63ac	69%	21%	2%	8.16ac	4%	0%	65%	0.00ac	0%	0%	60%	32.10ac	18%	11%	**34.9%**

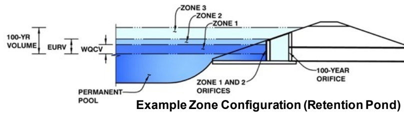
Land Use	Abb	%
Open Space	OS	2%
Residential - Low Density 2-3 DU/AC	RL	25%
Residential - Low/Medium Density 4-6 DU/AC	RLM	30%
Residential - Medium/High Density 4-8 DU/AC	RMH	40%
Residential - High Density 8+ DU/AC	RH	65%
Commercial/Office	OFF	80%
Business Park	BP	80%
School	SC	60%

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.04 (February 2021)

Project: Mesa Ridge MDDP

Basin ID: FSD C - 3280 **Used for WQCV and EURV only; see HEC-HMS for 100-year volume**



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	**EDB**	
Watershed Area =	182.19	acres
Watershed Length =	4,300	ft
Watershed Length to Centroid =	2,300	ft
Watershed Slope =	0.022	ft/ft
Watershed Imperviousness =	34.90%	percent
Percentage Hydrologic Soil Group A =	0.0%	percent
Percentage Hydrologic Soil Group B =	34.3%	percent
Percentage Hydrologic Soil Groups C/D =	65.7%	percent
Target WQCV Drain Time =	40.0	hours
Location for 1-hr Rainfall Depths =	User Input	

After providing required inputs above including 1-hour rainfall depths, click 'Run CUHP' to generate runoff hydrographs using the embedded Colorado Urban Hydrograph Procedure.

			Optional User Overrides	
Water Quality Capture Volume (WQCV) =	2.520	acre-feet		acre-feet
Excess Urban Runoff Volume (EURV) =	6.106	acre-feet		acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	7.235	acre-feet	1.19	inches
5-yr Runoff Volume (P1 = 1.5 in.) =	11.205	acre-feet	1.50	inches
10-yr Runoff Volume (P1 = 1.75 in.) =	14.844	acre-feet	1.75	inches
25-yr Runoff Volume (P1 = 2 in.) =	19.478	acre-feet	2.00	inches
50-yr Runoff Volume (P1 = 2.25 in.) =	23.300	acre-feet	2.25	inches
100-yr Runoff Volume (P1 = 2.52 in.) =	28.276	acre-feet	2.52	inches
500-yr Runoff Volume (P1 = 3.1 in.) =	37.509	acre-feet	3.10	inches
Approximate 2-yr Detention Volume =	4.971	acre-feet		
Approximate 5-yr Detention Volume =	7.684	acre-feet		
Approximate 10-yr Detention Volume =	9.450	acre-feet		
Approximate 25-yr Detention Volume =	10.580	acre-feet		
Approximate 50-yr Detention Volume =	11.070	acre-feet		
Approximate 100-yr Detention Volume =	13.135	acre-feet		

Define Zones and Basin Geometry

Zone 1 Volume (WQCV) =	2.520	acre-feet
Zone 2 Volume (EURV - Zone 1) =	3.586	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	7.029	acre-feet
Total Detention Basin Volume =	13.135	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 = 1.00 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	--	--	--	475	0.011		
	--	1.00	--	--	--	1,200	0.028	837	0.019
	--	2.00	--	--	--	12,000	0.275	7,437	0.171
	--	3.00	--	--	--	108,565	2.492	67,719	1.555
	--	4.00	--	--	--	115,007	2.640	179,505	4.121
	--	5.00	--	--	--	121,635	2.792	297,826	6.837
	--	6.00	--	--	--	128,448	2.949	422,868	9.708
	--	7.00	--	--	--	135,447	3.109	554,815	12.737
	--	8.00	--	--	--	142,632	3.274	693,854	15.929
	--	9.00	--	--	--	150,000	3.444	840,170	19.288
	--	10.00	--	--	--	157,559	3.617	993,950	22.818
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DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.04 (February 2021)

Summary Stage-Area-Volume-Discharge Relationships

The user can create a summary S-A-V-D by entering the desired stage increments and the remainder of the table will populate automatically.

The user should graphically compare the summary S-A-V-D table to the full S-A-V-D table in the chart to confirm it captures all key transition points.

Stage - Storage Description	Stage [ft]	Area [ft^2]	Area [acres]	Volume [ft^3]	Volume [ac-ft]	Total Outflow [cfs]
	1.00	1,200	0.028	837	0.019	0.17
	2.00	12,000	0.275	7,437	0.171	0.24
	3.00	108,565	2.492	67,719	1.555	0.87
	3.37	110,949	2.547	108,329	2.487	0.99
	4.00	115,007	2.640	179,505	4.121	1.16
	4.66	119,381	2.741	256,853	5.897	1.99
	5.00	121,635	2.792	297,826	6.837	12.81
	6.00	128,448	2.949	422,868	9.708	98.27
	7.00	135,447	3.109	554,815	12.737	137.17
	8.00	142,632	3.274	693,854	15.929	148.97
	9.00	150,000	3.444	840,170	19.288	189.59
	10.00	157,559	3.617	993,950	22.818	619.07

For best results, include the stages of all grade slope changes (e.g. ISV and Floor) from the S-A-V table on Sheet 'Basin'.

Also include the inverts of all outlets (e.g. vertical orifice, overflow grate, and spillway, where applicable).

Mesa Ridge FSD E

Runoff Coeficient and Percent Impervious Calculation

Basin / DP	Basin or DP Area (DP contributing basins)		Soil Type	RMH % Imperv	Area 1 Land Use Area	Area 1 % Area	Area 1 Comp Land Use % Imp	RLM % Imperv	Area 2 Land Use Area	Area 2 % Area	Area 2 Comp Land Use % Imp	OS % Imperv	Area 3 Land Use Area	Area 3 % Area	Area 3 Comp Land Use % Imp	RH % Imperv	Area 4 Land Use Area	Area 4 % Area	Area 4 Comp Land Use % Imp	OFF % Imperv	Area 5 Land Use Area	Area 5 % Area	Area 5 Comp Land Use % Imp	Basin % Imperv
3220-B	847,503 sf	19.46ac	B	40%		0%	0%	30%		0%	0%	2%		0%	0%	65%	5.37ac	28%	18%	80%	9.96ac	51%	41%	**58.9%**
3220-C	964,593 sf	22.14ac	C	40%		0%	0%	30%		0%	0%	2%		0%	0%	65%	11.97ac	54%	35%	80%	10.18ac	46%	37%	**71.9%**
FSD E -DB3220	3220,	41.60ac	C	40%	4.13ac	10%	4%	30%	0.00ac	0%	0%	2%	0.00ac	0%	0%	65%	17.34ac	42%	27%	80%	20.13ac	48%	39%	**69.8%**

Land Use	Abb	%
Open Space	OS	2%
Residential - Low Density 2-3 DU/AC	RL	25%
Residential - Low/Medium Density 4-6 DU/AC	RLM	30%
Residential - Medium/High Density 4-8 DU/AC	RMH	40%
Residential - High Density 8+ DU/AC	RH	65%
Commercial/Office	OFF	80%
Business Park	BP	80%
School	SC	60%

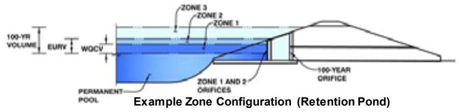
DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.04 (February 2021)

Project: **Mesa Ridge MDDP**

Basin ID: **FSD E - 3220**

Used for WQCV and EURV only; see HEC-HMS for 100yr Volume



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	**EDB**	
Watershed Area =	41.60	acres
Watershed Length =	2,000	ft
Watershed Length to Centroid =	1,200	ft
Watershed Slope =	0.020	ft/ft
Watershed Imperviousness =	69.80%	percent
Percentage Hydrologic Soil Group A =	0.0%	percent
Percentage Hydrologic Soil Group B =	47.0%	percent
Percentage Hydrologic Soil Groups C/D =	53.0%	percent
Target WQCV Drain Time =	40.0	hours
Location for 1-hr Rainfall Depths =	Denver - Capitol Building	

After providing required inputs above including 1-hour rainfall depths, click 'Run CUHP' to generate runoff hydrographs using the embedded Colorado Urban Hydrograph Procedure.

			Optional User Overrides	
Water Quality Capture Volume (WQCV) =	0.950	acre-feet		acre-feet
Excess Urban Runoff Volume (EURV) =	2.994	acre-feet		acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	2.978	acre-feet	1.19	inches
5-yr Runoff Volume (P1 = 1.5 in.) =	4.023	acre-feet	1.50	inches
10-yr Runoff Volume (P1 = 1.75 in.) =	4.909	acre-feet	1.75	inches
25-yr Runoff Volume (P1 = 2 in.) =	5.901	acre-feet	2.00	inches
50-yr Runoff Volume (P1 = 2.25 in.) =	6.814	acre-feet	2.25	inches
100-yr Runoff Volume (P1 = 2.52 in.) =	7.881	acre-feet	2.52	inches
500-yr Runoff Volume (P1 = 3.1 in.) =	10.039	acre-feet	3.10	inches
Approximate 2-yr Detention Volume =	2.514	acre-feet		
Approximate 5-yr Detention Volume =	3.436	acre-feet		
Approximate 10-yr Detention Volume =	4.120	acre-feet		
Approximate 25-yr Detention Volume =	4.404	acre-feet		
Approximate 50-yr Detention Volume =	4.552	acre-feet		
Approximate 100-yr Detention Volume =	4.898	acre-feet		

Define Zones and Basin Geometry

Zone 1 Volume (WQCV) =	0.950	acre-feet
Zone 2 Volume (EURV - Zone 1) =	2.043	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	1.905	acre-feet
Total Detention Basin Volume =	4.898	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 = 1.00 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	--	--	--	200	0.005		
	--	1.00	--	--	--	1,000	0.023	600	0.014
	--	2.00	--	--	--	13,000	0.298	7,600	0.174
	--	3.00	--	--	--	40,000	0.918	34,100	0.783
	--	4.00	--	--	--	45,000	1.033	76,600	1.758
	--	5.00	--	--	--	50,000	1.148	124,100	2.849
	--	6.00	--	--	--	55,000	1.263	176,600	4.054
	--	7.00	--	--	--	60,000	1.377	234,100	5.374
	--	8.00	--	--	--	65,000	1.492	296,600	6.809
	--	9.00	--	--	--	70,000	1.607	364,100	8.359
	--	10.00	--	--	--	75,000	1.722	436,600	10.023
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DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.04 (February 2021)

Summary Stage-Area-Volume-Discharge Relationships

The user can create a summary S-A-V-D by entering the desired stage increments and the remainder of the table will populate automatically.

The user should graphically compare the summary S-A-V-D table to the full S-A-V-D table in the chart to confirm it captures all key transition points.

Stage - Storage Description	Stage [ft]	Area [ft ^{2}]	Area [acres]	Volume [ft ^{3}]	Volume [ac-ft]	Total Outflow [cfs]
	1.00	1,000	0.023	600	0.014	0.12
	2.00	13,000	0.298	7,600	0.174	0.24
	3.00	40,000	0.918	34,100	0.783	0.37
	3.19	40,950	0.940	41,790	0.959	0.39
	4.00	45,000	1.033	76,600	1.758	0.93
	5.00	50,000	1.148	124,100	2.849	1.35
	5.13	50,650	1.163	130,642	2.999	1.40
	6.00	55,000	1.263	176,600	4.054	8.70
	7.00	60,000	1.377	234,100	5.374	31.43
	8.00	65,000	1.492	296,600	6.809	33.71
	9.00	70,000	1.607	364,100	8.359	165.44
	10.00	75,000	1.722	436,600	10.023	431.56

For best results, include the stages of all grade slope changes (e.g. ISV and Floor) from the S-A-V table on Sheet 'Basin'.

Also include the inverts of all outlets (e.g. vertical orifice, overflow grate, and spillway, where applicable).

Mesa Ridge MDDP FSD G

Runoff Coeficient and Percent Impervious Calculation

Basin / DP	Basin or DP Area (DP contributing basins)		Soil Type	RLM	Area 1 Land Use			RMH	Area 2 Land Use			OS	Area 3 Land Use			RH	Area 4 Land Use			SC	Area 5 Land Use			Basin % Imperv
				% Imperv	Land Use Area	% Area	Comp Land Use % Imp	% Imperv	Land Use Area	% Area	Comp Land Use % Imp	% Imperv	Land Use Area	% Area	Comp Land Use % Imp	% Imperv	Land Use Area	% Area	Comp Land Use % Imp	% Imperv	Land Use Area	% Area	Comp Land Use % Imp	
1225-B	480,887 sf	11.04ac	B	30%	11.04ac	100%	30%	40%		0%	0%	2%	2.39ac	22%	0%	65%		0%	0%	60%		0%	0%	**30.4%**
1225-C	1,511,698 sf	34.70ac	C	30%	26.41ac	76%	23%	40%		0%	0%	2%	8.29ac	24%	0%	65%		0%	0%	60%		0%	0%	**23.3%**
1011-B	626,495 sf	14.38ac	B	30%		0%	0%	40%	14.38ac	100%	40%	2%		0%	0%	65%		0%	0%	60%		0%	0%	**40.0%**
1210-B	1,512,890 sf	34.73ac	B	30%		0%	0%	40%	32.60ac	94%	38%	2%	2.13ac	6%	0%	65%		0%	0%	60%		0%	0%	**37.7%**
1210-C	241,973 sf	5.55ac	C	30%		0%	0%	40%	2.14ac	38%	15%	2%	3.42ac	62%	1%	65%		0%	0%	60%		0%	0%	**16.6%**
FSD G-DB1225	1225, 1011, 1210	100.41ac	C	30%	35.06ac	35%	10%	40%	49.12ac	49%	20%	2%	16.23ac	16%	0%	65%	0.00ac	0%	0%	60%	0.00ac	0%	0%	**30.4%**

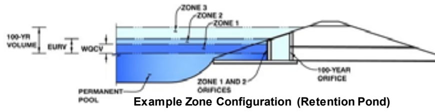
Land Use	Abb	%
Open Space	OS	2%
Large Lot	LL	20%
Residential - Low Density 2-3 DU/AC	RL	25%
Residential - Low/Medium Density 4-6 DU/AC	RLM	30%
Residential - Medium/High Density 4-8 DU/AC	RMH	40%
Residential - High Density 8+ DU/AC	RH	65%
Commercial/Office	OFF	80%
Business Park	BP	80%
School	SC	60%

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.04 (February 2021)

Project: Mesa Ridge MDDP

Basin ID: FSD G&H - 1225



Example Zone Configuration (Retention Pond)

Used for WQCV and EURV only; see HEC-HMS for 100yr Volume

Watershed Information

Selected BMP Type =	**EDB**	
Watershed Area =	100.41	acres
Watershed Length =	2,600	ft
Watershed Length to Centroid =	800	ft
Watershed Slope =	0.025	ft/ft
Watershed Imperviousness =	30.40%	percent
Percentage Hydrologic Soil Group A =	0.0%	percent
Percentage Hydrologic Soil Group B =	48.9%	percent
Percentage Hydrologic Soil Groups C/D =	51.1%	percent
Target WQCV Drain Time =	40.0	hours
Location for 1-hr Rainfall Depths =	Denver - Capitol Building	

After providing required inputs above including 1-hour rainfall depths, click 'Run CUHP' to generate runoff hydrographs using the embedded Colorado Urban Hydrograph Procedure.

			Optional User Overrides	
Water Quality Capture Volume (WQCV) =	1.278	acre-feet		acre-feet
Excess Urban Runoff Volume (EURV) =	2.952	acre-feet		acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	3.451	acre-feet	1.19	inches
5-yr Runoff Volume (P1 = 1.5 in.) =	5.536	acre-feet	1.50	inches
10-yr Runoff Volume (P1 = 1.75 in.) =	7.489	acre-feet	1.75	inches
25-yr Runoff Volume (P1 = 2 in.) =	10.081	acre-feet	2.00	inches
50-yr Runoff Volume (P1 = 2.25 in.) =	12.154	acre-feet	2.25	inches
100-yr Runoff Volume (P1 = 2.52 in.) =	14.888	acre-feet	2.52	inches
500-yr Runoff Volume (P1 = 3.1 in.) =	19.923	acre-feet	3.10	inches
Approximate 2-yr Detention Volume =	2.317	acre-feet		
Approximate 5-yr Detention Volume =	3.600	acre-feet		
Approximate 10-yr Detention Volume =	4.637	acre-feet		
Approximate 25-yr Detention Volume =	5.287	acre-feet		
Approximate 50-yr Detention Volume =	5.548	acre-feet		
Approximate 100-yr Detention Volume =	6.666	acre-feet		

Define Zones and Basin Geometry

Zone 1 Volume (WQCV) =	1.278	acre-feet
Zone 2 Volume (EURV - Zone 1) =	1.674	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	3.714	acre-feet
Total Detention Basin Volume =	6.666	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 = 1.00 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	--	--	--	200	0.005		
	--	1.00	--	--	--	1,000	0.023	600	0.014
	--	2.00	--	--	--	6,000	0.138	4,100	0.094
	--	3.00	--	--	--	60,000	1.377	37,099	0.852
	--	4.00	--	--	--	65,000	1.492	99,599	2.286
	--	5.00	--	--	--	70,000	1.607	167,099	3.836
	--	6.00	--	--	--	75,000	1.722	239,599	5.500
	--	7.00	--	--	--	80,000	1.837	317,099	7.280
	--	8.00	--	--	--	85,000	1.951	399,599	9.174
	--	9.00	--	--	--	90,000	2.066	487,099	11.182
	--	10.00	--	--	--	95,000	2.181	579,599	13.306
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DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.04 (February 2021)

Summary Stage-Area-Volume-Discharge Relationships

The user can create a summary S-A-V-D by entering the desired stage increments and the remainder of the table will populate automatically.

The user should graphically compare the summary S-A-V-D table to the full S-A-V-D table in the chart to confirm it captures all key transition points.

Stage - Storage Description	Stage [ft]	Area [ft^2]	Area [acres]	Volume [ft^3]	Volume [ac-ft]	Total Outflow [cfs]
	1.00	1,000	0.023	600	0.014	0.12
	2.00	6,000	0.138	4,100	0.094	0.17
	3.00	60,000	1.377	37,099	0.852	0.49
	3.31	61,550	1.413	55,940	1.284	0.56
	4.00	65,000	1.492	99,599	2.286	0.68
	4.44	67,200	1.543	128,683	2.954	1.46
	5.00	70,000	1.607	167,099	3.836	1.97
	6.00	75,000	1.722	239,599	5.500	38.45
	7.00	80,000	1.837	317,099	7.280	106.43
	8.00	85,000	1.951	399,599	9.174	136.83
	9.00	90,000	2.066	487,099	11.182	453.97
	10.00	95,000	2.181	579,599	13.306	983.05

For best results, include the stages of all grade slope changes (e.g. ISV and Floor) from the S-A-V table on Sheet 'Basin'.

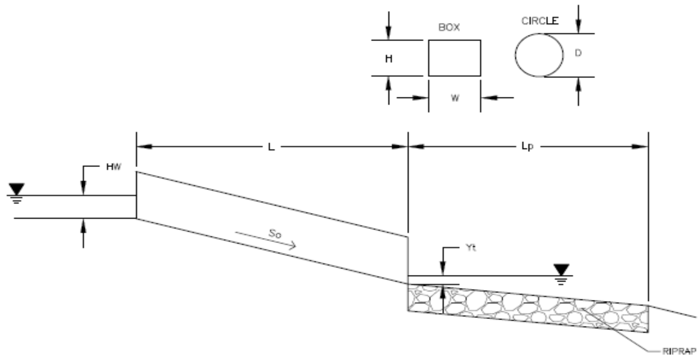
Also include the inverts of all outlets (e.g. vertical orifice, overflow grate, and spillway, where applicable).

APPENDIX E: Culvert Design

DETERMINATION OF CULVERT HEADWATER AND OUTLET PROTECTION

MHFD-Culvert, Version 4.00 (May 2020)

Project: Mesa Ridge MDDP
ID: DP1225 Road Crossing



Soil Type:
Choose One:
○ Sandy
● Non-Sandy

Supercritical Flow! Using Adjusted Rise to calculate protection type.

Design Information:

Design Discharge	Q =	174	cfs
Circular Culvert:			
Barrel Diameter in Inches	D =		inches
Inlet Edge Type (Choose from pull-down list)			
OR:			
Box Culvert:		**OR**	
Barrel Height (Rise) in Feet	H (Rise) =	4	ft
Barrel Width (Span) in Feet	W (Span) =	6	ft
Inlet Edge Type (Choose from pull-down list)	Square Edge w/ 30-75 deg. Flared Wingwall		
Number of Barrels	# Barrels =	1	
Inlet Elevation	Elev IN =	100	ft
Outlet Elevation **OR** Slope	So =	0.02	ft/ft
Culvert Length	L =	80	ft
Manning's Roughness	n =	0.012	
Bend Loss Coefficient	k_b =	0	
Exit Loss Coefficient	k_x =	1	
Tailwater Surface Elevation	$Y_{t,\ Elevation}$ =		ft
Max Allowable Channel Velocity	V =	7	ft/s

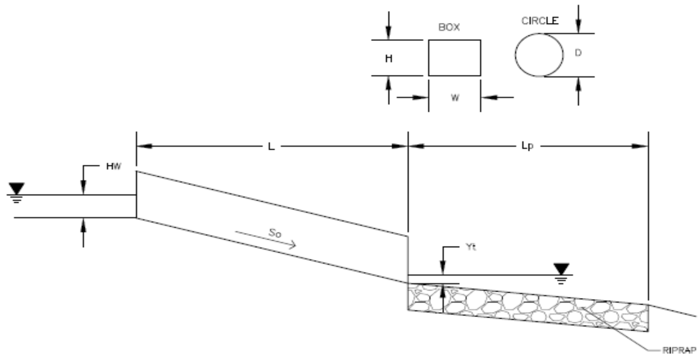
Calculated Results:

Culvert Cross Sectional Area Available	A =	24.00	ft^2
Culvert Normal Depth	Y_n =	1.60	ft
Culvert Critical Depth	Y_c =	2.97	ft
Froude Number	Fr =	2.52	**Supercritical!**
Entrance Loss Coefficient	k_e =	0.20	
Friction Loss Coefficient	k_f =	0.26	
Sum of All Loss Coefficients	k_s =	1.46	ft
Headwater:			
Inlet Control Headwater	HW_I =	4.72	ft
Outlet Control Headwater	HW_O =	3.08	ft
Design Headwater Elevation	**HW =**	**104.72**	**ft**
Headwater/Diameter OR Headwater/Rise Ratio	**HW/H=**	**1.18**	
Outlet Protection:			
Flow/(Span * Rise^1.5)	Q/WH^1.5 =	3.63	$ft^{0.5}/s$
Tailwater Surface Height	Y_t =	1.60	ft
Tailwater/Rise	Yt/H =	0.40	
Expansion Factor	1/(2*tan(Θ)) =	2.76	
Flow Area at Max Channel Velocity	A_t =	24.86	ft^2
Width of Equivalent Conduit for Multiple Barrels	W_{eq} =	-	ft
Length of Riprap Protection	**L_p =**	**27**	**ft**
Width of Riprap Protection at Downstream End	**T =**	**16**	**ft**
Adjusted Rise for Supercritical Flow	Ha =	2.80	ft
Minimum Theoretical Riprap Size	d_{50} min=	5	in
Nominal Riprap Size	d_{50} nominal=	6	in
MHFD Riprap Type	**Type =**	**VL**	

DETERMINATION OF CULVERT HEADWATER AND OUTLET PROTECTION

MHFD-Culvert, Version 4.00 (May 2020)

Project: Mesa Ridge MDDP
ID: DP1250B C&S Road Crossing



Soil Type:
Choose One:
○ Sandy
● Non-Sandy

Supercritical Flow! Using Adjusted Rise to calculate protection type.

Design Information:

Design Discharge	Q =	141	cfs
Circular Culvert:			
Barrel Diameter in Inches	D =		inches
Inlet Edge Type (Choose from pull-down list)			
OR:			
Box Culvert:		**OR**	
Barrel Height (Rise) in Feet	H (Rise) =	4	ft
Barrel Width (Span) in Feet	W (Span) =	4	ft
Inlet Edge Type (Choose from pull-down list)	Square Edge w/ 30-75 deg. Flared Wingwall		
Number of Barrels	# Barrels =	1	
Inlet Elevation	Elev IN =	102	ft
Outlet Elevation **OR** Slope	So =	0.01	ft/ft
Culvert Length	L =	80	ft
Manning's Roughness	n =	0.012	
Bend Loss Coefficient	k_b =	0	
Exit Loss Coefficient	k_x =	1	
Tailwater Surface Elevation	$Y_{t,\ Elevation}$ =	102	ft
Max Allowable Channel Velocity	V =	7	ft/s

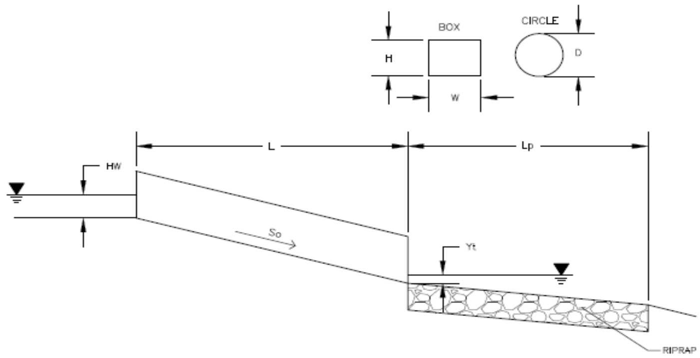
Calculated Results:

Culvert Cross Sectional Area Available	A =	16.00	ft^2
Culvert Normal Depth	Y_n =	2.61	ft
Culvert Critical Depth	Y_c =	3.38	ft
Froude Number	Fr =	1.47	**Supercritical!**
Entrance Loss Coefficient	k_e =	0.20	
Friction Loss Coefficient	k_f =	0.33	
Sum of All Loss Coefficients	k_s =	1.53	ft
Headwater:			
Inlet Control Headwater	HW_I =	5.68	ft
Outlet Control Headwater	HW_O =	4.74	ft
Design Headwater Elevation	**HW =**	**107.68**	**ft**
Headwater/Diameter OR Headwater/Rise Ratio	**HW/H=**	**1.42**	
Outlet Protection:			
Flow/(Span * Rise^1.5)	Q/WH^1.5 =	4.41	$ft^{0.5}/s$
Tailwater Surface Height	Y_t =	0.80	ft
Tailwater/Rise	Yt/H =	0.20	
Expansion Factor	1/(2*tan(Θ)) =	0.64	
Flow Area at Max Channel Velocity	A_t =	20.14	ft^2
Width of Equivalent Conduit for Multiple Barrels	W_{eq} =	-	ft
Length of Riprap Protection	**L_p =**	**14**	**ft**
Width of Riprap Protection at Downstream End	**T =**	**26**	**ft**
Adjusted Rise for Supercritical Flow	Ha =	3.31	ft
Minimum Theoretical Riprap Size	d_{50} min=	13	in
Nominal Riprap Size	d_{50} nominal=	18	in
MHFD Riprap Type	**Type =**	**H**	

DETERMINATION OF CULVERT HEADWATER AND OUTLET PROTECTION

MHFD-Culvert, Version 4.00 (May 2020)

Project: **Mesa Ridge MDDP**
ID: **DP1260 C& S Road Crossing**



Soil Type:
Choose One:
Sandy
Non-Sandy

Supercritical Flow! Using Adjusted Rise to calculate protection type.

Design Information:

Design Discharge	Q =	337	cfs
Circular Culvert:			
Barrel Diameter in Inches	D =		inches
Inlet Edge Type (Choose from pull-down list)			
OR:			
Box Culvert:		**OR**	
Barrel Height (Rise) in Feet	H (Rise) =	4	ft
Barrel Width (Span) in Feet	W (Span) =	5	ft
Inlet Edge Type (Choose from pull-down list)	Square Edge w/ 30-75 deg. Flared Wingwall		
Number of Barrels	# Barrels =	2	
Inlet Elevation	Elev IN =	102	ft
Outlet Elevation **OR** Slope	So =	0.01	ft/ft
Culvert Length	L =	80	ft
Manning's Roughness	n =	0.012	
Bend Loss Coefficient	k_b =	0	
Exit Loss Coefficient	k_x =	1	
Tailwater Surface Elevation	$Y_{t, Elevation}$ =	102	ft
Max Allowable Channel Velocity	V =	7	ft/s

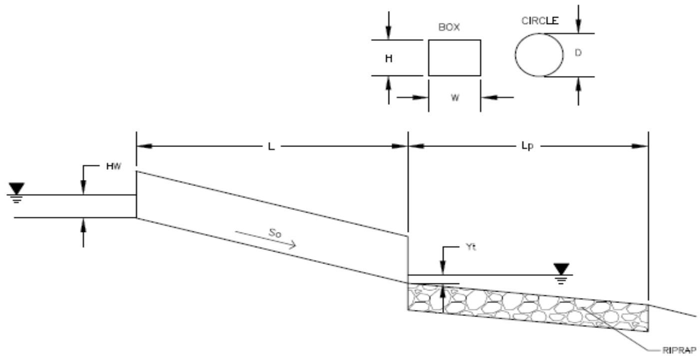
Calculated Results:

Culvert Cross Sectional Area Available	A =	20.00	ft^2
Culvert Normal Depth	Y_n =	2.38	ft
Culvert Critical Depth	Y_c =	3.28	ft
Froude Number	Fr =	1.62	**Supercritical!**
Entrance Loss Coefficient	k_e =	0.20	
Friction Loss Coefficient	k_f =	0.29	
Sum of All Loss Coefficients	k_s =	1.49	ft
Headwater:			
Inlet Control Headwater	HW_I =	5.43	ft
Outlet Control Headwater	HW_O =	4.48	ft
Design Headwater Elevation	**HW =**	**107.43**	**ft**
Headwater/Diameter OR Headwater/Rise Ratio	**HW/H=**	**1.36**	
Outlet Protection:			
Flow/(Span * Rise^1.5)	Q/WH^1.5 =	4.21	$ft^{0.5}/s$
Tailwater Surface Height	Y_t =	0.80	ft
Tailwater/Rise	Yt/H =	0.20	
Expansion Factor	1/(2*tan(Θ)) =	0.66	
Flow Area at Max Channel Velocity	A_t =	48.14	ft^2
Width of Equivalent Conduit for Multiple Barrels	W_{eq} =	10.00	ft
Length of Riprap Protection	**L_p =**	**34**	**ft**
Width of Riprap Protection at Downstream End	**T =**	**62**	**ft**
Adjusted Rise for Supercritical Flow	Ha =	3.19	ft
Minimum Theoretical Riprap Size	d_{50} min=	13	in
Nominal Riprap Size	d_{50} nominal=	18	in
MHFD Riprap Type	**Type =**	**H**	

DETERMINATION OF CULVERT HEADWATER AND OUTLET PROTECTION

MHFD-Culvert, Version 4.00 (May 2020)

Project: Mesa Ridge MDDP
ID: DP3250A Road Crossing



Soil Type:
Choose One:
○ Sandy
● Non-Sandy

Supercritical Flow! Using Adjusted Rise to calculate protection type.

Design Information:

Design Discharge	Q =	451	cfs
Circular Culvert:			
Barrel Diameter in Inches	D =		inches
Inlet Edge Type (Choose from pull-down list)			
OR:		OR	
Box Culvert:			
Barrel Height (Rise) in Feet	H (Rise) =	4	ft
Barrel Width (Span) in Feet	W (Span) =	6	ft
Inlet Edge Type (Choose from pull-down list)	Square Edge w/ 30-75 deg. Flared Wingwall		
Number of Barrels	# Barrels =	2	
Inlet Elevation	Elev IN =	100	ft
Outlet Elevation **OR** Slope	So =	0.01	ft/ft
Culvert Length	L =	80	ft
Manning's Roughness	n =	0.013	
Bend Loss Coefficient	k_b =	0	
Exit Loss Coefficient	k_x =	1	
Tailwater Surface Elevation	$Y_{t,\ Elevation}$ =		ft
Max Allowable Channel Velocity	V =	7	ft/s

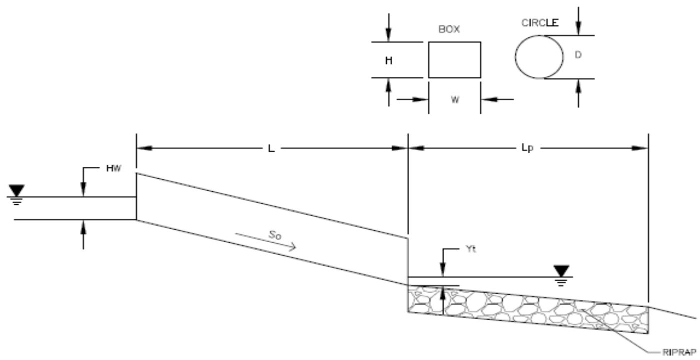
Calculated Results:

Culvert Cross Sectional Area Available	A =	24.00	ft^2
Culvert Normal Depth	Y_n =	2.62	ft
Culvert Critical Depth	Y_c =	3.53	ft
Froude Number	Fr =	1.56	**Supercritical!**
Entrance Loss Coefficient	k_e =	0.20	
Friction Loss Coefficient	k_f =	0.31	
Sum of All Loss Coefficients	k_s =	1.51	ft
Headwater:			
Inlet Control Headwater	HW_I =	6.07	ft
Outlet Control Headwater	HW_O =	5.03	ft
Design Headwater Elevation	**HW =**	**106.07**	**ft**
Headwater/Diameter OR Headwater/Rise Ratio	**HW/H=**	**1.52**	**HW/H > 1.5!**
Outlet Protection:			
Flow/(Span * Rise^1.5)	Q/WH^1.5 =	4.70	$ft^{0.5}/s$
Tailwater Surface Height	Y_t =	1.60	ft
Tailwater/Rise	Yt/H =	0.40	
Expansion Factor	1/(2*tan(Θ)) =	1.86	
Flow Area at Max Channel Velocity	A_t =	64.43	ft^2
Width of Equivalent Conduit for Multiple Barrels	W_{eq} =	12.00	ft
Length of Riprap Protection	**L_p =**	**40**	**ft**
Width of Riprap Protection at Downstream End	**T =**	**34**	**ft**
Adjusted Rise for Supercritical Flow	Ha =	3.31	ft
Minimum Theoretical Riprap Size	d_{50} min=	7	in
Nominal Riprap Size	d_{50} nominal=	9	in
MHFD Riprap Type	**Type =**	**L**	

DETERMINATION OF CULVERT HEADWATER AND OUTLET PROTECTION

MHFD-Culvert, Version 4.00 (May 2020)

Project: Mesa Ridge MDDP
ID: E1270 Road Crossing



Soil Type:
Choose One:
○ Sandy
● Non-Sandy

Supercritical Flow! Using Adjusted Rise to calculate protection type.

Design Information:

Design Discharge	Q =	245	cfs
Circular Culvert:			
Barrel Diameter in Inches	D =		inches
Inlet Edge Type (Choose from pull-down list)			
OR:			
Box Culvert:		**OR**	
Barrel Height (Rise) in Feet	H (Rise) =	5	ft
Barrel Width (Span) in Feet	W (Span) =	5	ft
Inlet Edge Type (Choose from pull-down list)	Square Edge w/ 30-75 deg. Flared Wingwall		
Number of Barrels	# Barrels =	1	
Inlet Elevation	Elev IN =	100	ft
Outlet Elevation **OR** Slope	So =	0.02	ft/ft
Culvert Length	L =	80	ft
Manning's Roughness	n =	0.012	
Bend Loss Coefficient	k_b =	0	
Exit Loss Coefficient	k_x =	1	
Tailwater Surface Elevation	$Y_{t,\ Elevation}$ =		ft
Max Allowable Channel Velocity	V =	7	ft/s

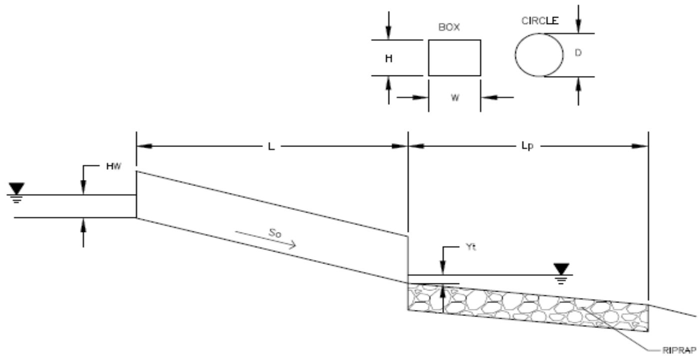
Calculated Results:

Culvert Cross Sectional Area Available	A =	25.00	ft^2
Culvert Normal Depth	Y_n =	2.43	ft
Culvert Critical Depth	Y_c =	4.21	ft
Froude Number	Fr =	2.28	**Supercritical!**
Entrance Loss Coefficient	k_e =	0.20	
Friction Loss Coefficient	k_f =	0.25	
Sum of All Loss Coefficients	k_s =	1.45	ft
Headwater:			
Inlet Control Headwater	HW_I =	7.03	ft
Outlet Control Headwater	HW_O =	5.16	ft
Design Headwater Elevation	**HW =**	**107.03**	**ft**
Headwater/Diameter OR Headwater/Rise Ratio	**HW/H=**	**1.41**	
Outlet Protection:			
Flow/(Span * Rise^1.5)	Q/WH^1.5 =	4.38	$ft^{0.5}/s$
Tailwater Surface Height	Y_t =	2.00	ft
Tailwater/Rise	Yt/H =	0.40	
Expansion Factor	1/(2*tan(Θ)) =	2.03	
Flow Area at Max Channel Velocity	A_t =	35.00	ft^2
Width of Equivalent Conduit for Multiple Barrels	W_{eq} =	-	ft
Length of Riprap Protection	**L_p =**	**26**	**ft**
Width of Riprap Protection at Downstream End	**T =**	**18**	**ft**
Adjusted Rise for Supercritical Flow	Ha =	3.71	ft
Minimum Theoretical Riprap Size	d_{50} min=	8	in
Nominal Riprap Size	d_{50} nominal=	9	in
MHFD Riprap Type	**Type =**	**L**	

DETERMINATION OF CULVERT HEADWATER AND OUTLET PROTECTION

MHFD-Culvert, Version 4.00 (May 2020)

Project: Mesa Ridge MDDP
ID: R1031



Soil Type:
Choose One:
Sandy
Non-Sandy

Supercritical Flow! Using Adjusted Diameter to calculate protection type.

Design Information:

Design Discharge	Q =	44	cfs
Circular Culvert:			
Barrel Diameter in Inches	D =	42	inches
Inlet Edge Type (Choose from pull-down list)	Square Edge with Headwall		
OR:			
Box Culvert:		OR	
Barrel Height (Rise) in Feet	H (Rise) =		ft
Barrel Width (Span) in Feet	W (Span) =		ft
Inlet Edge Type (Choose from pull-down list)			
Number of Barrels	# Barrels =	1	
Inlet Elevation	Elev IN =	100	ft
Outlet Elevation **OR** Slope	So =	0.01	ft/ft
Culvert Length	L =	920	ft
Manning's Roughness	n =	0.012	
Bend Loss Coefficient	k_b =	0	
Exit Loss Coefficient	k_x =	1	
Tailwater Surface Elevation	$Y_{t,\ Elevation}$ =	102	ft
Max Allowable Channel Velocity	V =	7	ft/s

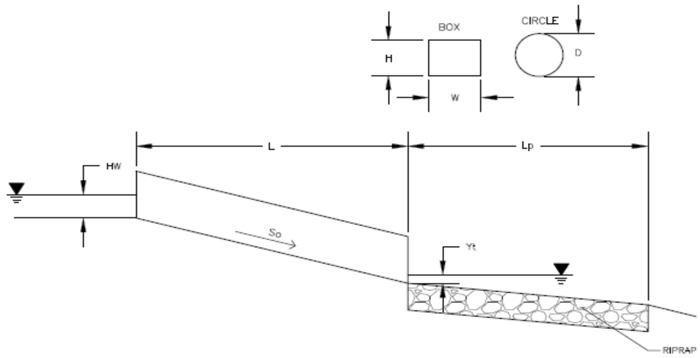
Calculated Results:

Culvert Cross Sectional Area Available	A =	9.62	ft^2
Culvert Normal Depth	Y_n =	1.55	ft
Culvert Critical Depth	Y_c =	2.07	ft
Froude Number	Fr =	1.74	**Supercritical!**
Entrance Loss Coefficient	k_e =	0.50	
Friction Loss Coefficient	k_f =	4.59	
Sum of All Loss Coefficients	k_s =	6.09	ft
Headwater:			
Inlet Control Headwater	HW_I =	3.13	ft
Outlet Control Headwater	HW_O =	3.98	ft
Design Headwater Elevation	**HW =**	**103.98**	**ft**
Headwater/Diameter OR Headwater/Rise Ratio	**HW/D =**	**1.14**	
Outlet Protection:			
Flow/(Diameter^2.5)	Q/D^2.5 =	1.92	$ft^{0.5}/s$
Tailwater Surface Height	Y_t =	11.20	ft
Tailwater/Diameter	Yt/D =	3.20	
Expansion Factor	1/(2*tan(Θ)) =	6.70	
Flow Area at Max Channel Velocity	A_t =	6.29	ft^2
Width of Equivalent Conduit for Multiple Barrels	W_{eq} =	-	ft
Length of Riprap Protection	**L_p =**	**11**	**ft**
Width of Riprap Protection at Downstream End	**T =**	**6**	**ft**
Adjusted Diameter for Supercritical Flow	Da =	2.52	ft
Minimum Theoretical Riprap Size	d_{50} min=	1	in
Nominal Riprap Size	d_{50} nominal=	6	in
MHFD Riprap Type	**Type =**	**VL**	

DETERMINATION OF CULVERT HEADWATER AND OUTLET PROTECTION

MHFD-Culvert, Version 4.00 (May 2020)

Project: Mesa Ridge MDDP
ID: DP1225-Road Crossing



Soil Type:
Choose One:
○ Sandy
● Non-Sandy

Supercritical Flow! Using Adjusted Diameter to calculate protection type.

Design Information:

Design Discharge	Q =	174	cfs
Circular Culvert:			
Barrel Diameter in Inches	D =	60	inches
Inlet Edge Type (Choose from pull-down list)		Square Edge with Headwall	
OR:			
Box Culvert:		**OR**	
Barrel Height (Rise) in Feet	H (Rise) =		ft
Barrel Width (Span) in Feet	W (Span) =		ft
Inlet Edge Type (Choose from pull-down list)			
Number of Barrels	# Barrels =	1	
Inlet Elevation	Elev IN =	100	ft
Outlet Elevation **OR** Slope	So =	0.02	ft/ft
Culvert Length	L =	2600	ft
Manning's Roughness	n =	0.012	
Bend Loss Coefficient	k_b =	0	
Exit Loss Coefficient	k_x =	1	
Tailwater Surface Elevation	$Y_{t,\ Elevation}$ =		ft
Max Allowable Channel Velocity	V =	7	ft/s

Calculated Results:

Culvert Cross Sectional Area Available	A =	19.63	ft^2
Culvert Normal Depth	Y_n =	2.31	ft
Culvert Critical Depth	Y_c =	3.78	ft
Froude Number	Fr =	2.60	**Supercritical!**
Entrance Loss Coefficient	k_e =	0.50	
Friction Loss Coefficient	k_f =	8.06	
Sum of All Loss Coefficients	k_s =	9.56	ft
Headwater:			
Inlet Control Headwater	HW_I =	6.43	ft
Outlet Control Headwater	HW_O =	N/A	ft
Design Headwater Elevation	**HW =**	**106.43**	**ft**
Headwater/Diameter OR Headwater/Rise Ratio	**HW/D =**	**1.29**	

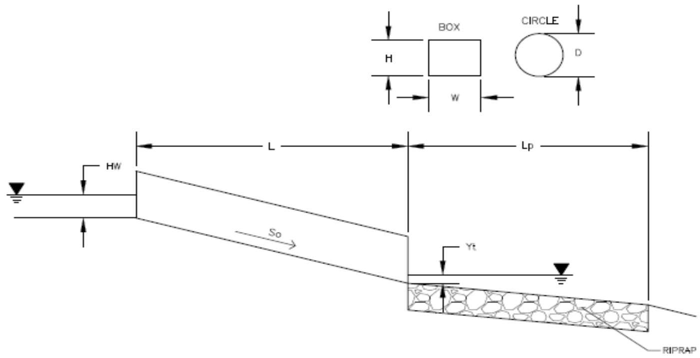
Outlet Control Headwater Approximation Method Inaccurate for Low Flow - Backwater Calculations Required

Outlet Protection:			
Flow/(Diameter^2.5)	Q/D^2.5 =	3.11	$ft^{0.5}/s$
Tailwater Surface Height	Y_t =	2.00	ft
Tailwater/Diameter	Yt/D =	0.40	
Expansion Factor	1/(2*tan(Θ)) =	4.28	
Flow Area at Max Channel Velocity	A_t =	24.86	ft^2
Width of Equivalent Conduit for Multiple Barrels	W_{eq} =	-	ft
Length of Riprap Protection	**L_p =**	**32**	**ft**
Width of Riprap Protection at Downstream End	**T =**	**13**	**ft**
Adjusted Diameter for Supercritical Flow	Da =	3.65	ft
Minimum Theoretical Riprap Size	d_{50} min=	14	in
Nominal Riprap Size	d_{50} nominal=	18	in
MHFD Riprap Type	**Type =**	**H**	

DETERMINATION OF CULVERT HEADWATER AND OUTLET PROTECTION

MHFD-Culvert, Version 4.00 (May 2020)

Project: Mesa Ridge MDDP
ID: SB3265



Soil Type:
Choose One:
○ Sandy
● Non-Sandy

Supercritical Flow! Using Adjusted Rise to calculate protection type.

Design Information:

Design Discharge	Q =	186	cfs
Circular Culvert:			
Barrel Diameter in Inches	D =		inches
Inlet Edge Type (Choose from pull-down list)			
OR:		OR	
Box Culvert:			
Barrel Height (Rise) in Feet	H (Rise) =	4	ft
Barrel Width (Span) in Feet	W (Span) =	6	ft
Inlet Edge Type (Choose from pull-down list)	Square Edge w/ 30-75 deg. Flared Wingwall		
Number of Barrels	# Barrels =	1	
Inlet Elevation	Elev IN =	100	ft
Outlet Elevation **OR** Slope	So =	0.025	ft/ft
Culvert Length	L =	80	ft
Manning's Roughness	n =	0.012	
Bend Loss Coefficient	k_b =	0	
Exit Loss Coefficient	k_x =	1	
Tailwater Surface Elevation	$Y_{t,\ Elevation}$ =	102	ft
Max Allowable Channel Velocity	V =	7	ft/s

Calculated Results:

Culvert Cross Sectional Area Available	A =	24.00	ft^2
Culvert Normal Depth	Y_n =	1.55	ft
Culvert Critical Depth	Y_c =	3.10	ft
Froude Number	Fr =	2.82	**Supercritical!**
Entrance Loss Coefficient	k_e =	0.20	
Friction Loss Coefficient	k_f =	0.26	
Sum of All Loss Coefficients	k_s =	1.46	ft
Headwater:			
Inlet Control Headwater	HW_I =	4.99	ft
Outlet Control Headwater	HW_O =	3.36	ft
Design Headwater Elevation	**HW =**	**104.99**	**ft**
Headwater/Diameter OR Headwater/Rise Ratio	**HW/H=**	**1.25**	
Outlet Protection:			
Flow/(Span * Rise^1.5)	Q/WH^1.5 =	3.88	$ft^{0.5}/s$
Tailwater Surface Height	Y_t =	4.00	ft
Tailwater/Rise	Yt/H =	1.00	
Expansion Factor	1/(2*tan(Θ)) =	6.65	
Flow Area at Max Channel Velocity	A_t =	26.57	ft^2
Width of Equivalent Conduit for Multiple Barrels	W_{eq} =	-	ft
Length of Riprap Protection	**L_p =**	**12**	**ft**
Width of Riprap Protection at Downstream End	**T =**	**8**	**ft**
Adjusted Rise for Supercritical Flow	Ha =	2.78	ft
Minimum Theoretical Riprap Size	d_{50} min=	2	in
Nominal Riprap Size	d_{50} nominal=	6	in
MHFD Riprap Type	**Type =**	**VL**	

Existing twin 24”x34” Arch CMP HY8 Capacity Analysis

DP 1250B and DP1260

Crossing Data - C&S Existing Arch CMP

Crossing Properties

Name: C&S Existing Arch CMP

Parameter	Value	Units
DISCHARGE DATA		
Discharge Method	Minimum, Design, and Maximum	
Minimum Flow	10.000	cfs
Design Flow	70.000	cfs
Maximum Flow	70.000	cfs
TAILWATER DATA		
Channel Type	Trapezoidal Channel	
Bottom Width	10.000	ft
Side Slope (H:V)	3.000	_:1
Channel Slope	0.0200	ft/ft
Manning's n (channel)	0.025	
Channel Invert Elevation	99.000	ft
Rating Curve	View...	
ROADWAY DATA		
Roadway Profile Shape	Constant Roadway Elevation	
First Roadway Station	0.000	ft
Crest Length	35.000	ft
Crest Elevation	104.000	ft
Roadway Surface	Paved	
Top Width	30.000	ft

Culvert Properties

Culvert 1
Culvert 1 (Copy)

Add Culvert | Duplicate Culvert | Delete Culvert

Parameter	Value	Units
CULVERT DATA		
Name	Culvert 1	
Shape	Pipe Arch	
Material	Steel or Aluminum	
Size	Define...	
Span	35.000	in
Rise	24.000	in
Embedment Depth	0.000	in
Manning's n	0.025	
Culvert Type	Straight	
Inlet Configuration	Headwall (Ke=0.5)	
Inlet Depression?	No	
SITE DATA		
Site Data Input Option	Culvert Invert Data	
Inlet Station	20.000	ft
Inlet Elevation	100.000	ft
Outlet Station	57.000	ft
Outlet Elevation	99.000	ft

Help | Click on icon for help on a specific | Low Flow | AOP | Energy Dissipation | Analyze Crossing | OK | Cancel

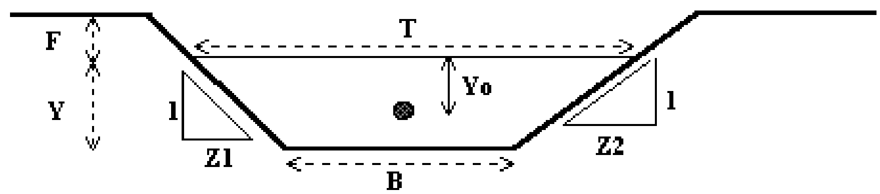
Summary of Flows at Crossing - C&S Existing Arch CMP

Headwater Elevation	Total Discharge	Culvert 1 Discharge	Culvert 1 (Copy)	Roadway Discharge	:eration
100.86	10.00	5.01	5.01	0.00	7
101.46	23.00	11.50	11.50	0.00	3
101.99	36.00	18.00	18.00	0.00	4
102.65	49.00	24.51	24.51	0.00	4
103.52	62.00	31.00	31.00	0.00	4
104.03	70.00	34.16	34.16	1.45	26
104.15	88.00	34.89	34.89	18.06	6
104.22	101.00	35.24	35.24	30.23	4
104.27	114.00	35.56	35.56	42.75	4
104.32	127.00	35.84	35.84	55.27	4
104.37	140.00	36.09	36.09	67.62	3
104.00	67.99	33.99	33.99	0.00	ertoppi

APPENDIX F: Channel Design

Normal Flow Analysis - Trapezoidal Channel

Project:	**Mesa Ridge East MDDP**
Channel ID:	**Channel R1031 - 45cfs (Riprap)**

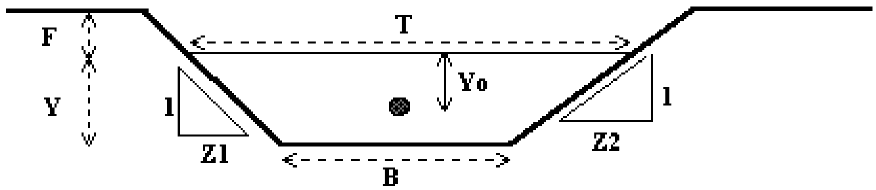


Design Information (Input)			
Channel Invert Slope	So =	0.0290	ft/ft
Manning's n	n =	0.035	
Bottom Width	B =	5.00	ft
Left Side Slope	Z1 =	4.00	ft/ft
Right Side Slope	Z2 =	4.00	ft/ft
Freeboard Height	F =	1.00	ft
Design Water Depth	Y =	**1.00**	ft

Normal Flow Condtion (Calculated)			
Discharge	**Q =**	**50.43**	cfs
Froude Number	**Fr =**	**1.19**	
Flow Velocity	**V =**	**5.60**	fps
Flow Area	A =	9.00	sq ft
Top Width	T =	13.00	ft
Wetted Perimeter	P =	13.25	ft
Hydraulic Radius	R =	0.68	ft
Hydraulic Depth	D =	0.69	ft
Specific Energy	Es =	1.49	ft
Centroid of Flow Area	Yo =	0.42	ft
Specific Force	Fs =	0.79	kip

Normal Flow Analysis - Trapezoidal Channel

Project: Mesa Ridge East MDDP
Channel ID: Channel R1210 - 193cfs (Riprap)

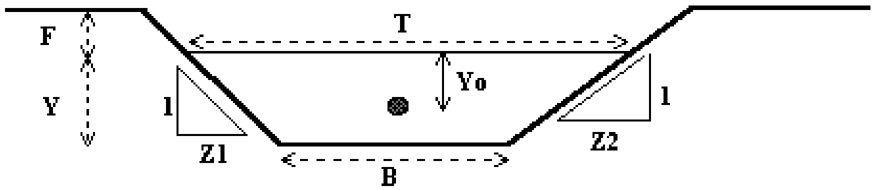


Design Information (Input)			
Channel Invert Slope	So =	0.0200	ft/ft
Manning's n	n =	0.035	
Bottom Width	B =	5.00	ft
Left Side Slope	Z1 =	4.00	ft/ft
Right Side Slope	Z2 =	4.00	ft/ft
Freeboard Height	F =	1.00	ft
Design Water Depth	Y =	**2.10**	ft

Normal Flow Condtion (Calculated)			
Discharge	**Q =**	**197.73**	cfs
Froude Number	**Fr =**	**1.09**	
Flow Velocity	**V =**	**7.03**	fps
Flow Area	A =	28.14	sq ft
Top Width	T =	21.80	ft
Wetted Perimeter	P =	22.32	ft
Hydraulic Radius	R =	1.26	ft
Hydraulic Depth	D =	1.29	ft
Specific Energy	Es =	2.87	ft
Centroid of Flow Area	Yo =	0.83	ft
Specific Force	Fs =	4.15	kip

Normal Flow Analysis - Trapezoidal Channel

Project:	**Mesa Ridge East MDDP**
Channel ID:	**Channel R1211 - 132cfs (Riprap)**

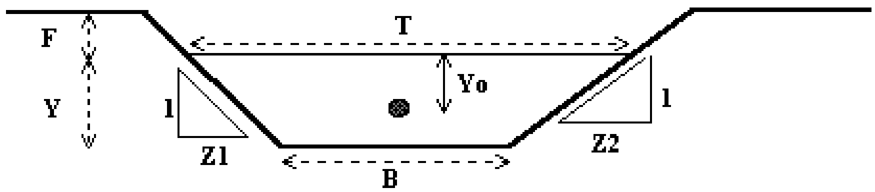


Design Information (Input)			
Channel Invert Slope	So =	0.0220	ft/ft
Manning's n	n =	0.035	
Bottom Width	B =	5.00	ft
Left Side Slope	Z1 =	4.00	ft/ft
Right Side Slope	Z2 =	4.00	ft/ft
Freeboard Height	F =	1.00	ft
Design Water Depth	Y =	**1.75**	ft

Normal Flow Condtion (Calculated)			
Discharge	**Q =**	**139.65**	cfs
Froude Number	**Fr =**	**1.11**	
Flow Velocity	**V =**	**6.65**	fps
Flow Area	A =	21.00	sq ft
Top Width	T =	19.00	ft
Wetted Perimeter	P =	19.43	ft
Hydraulic Radius	R =	1.08	ft
Hydraulic Depth	D =	1.11	ft
Specific Energy	Es =	2.44	ft
Centroid of Flow Area	Yo =	0.70	ft
Specific Force	Fs =	2.72	kip

Normal Flow Analysis - Trapezoidal Channel

Project: Mesa Ridge East MDDP
Channel ID: Channel R3240 - 119cfs (Riprap)



Design Information (Input)

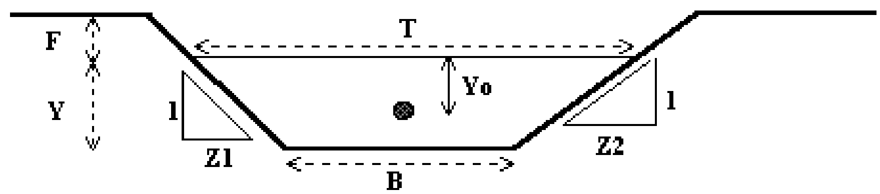
Channel Invert Slope	So =	0.0100	ft/ft
Manning's n	n =	0.035	
Bottom Width	B =	10.00	ft
Left Side Slope	Z1 =	4.00	ft/ft
Right Side Slope	Z2 =	4.00	ft/ft
Freeboard Height	F =	1.00	ft
Design Water Depth	Y =	**1.60**	ft

Normal Flow Condtion (Calculated)

Discharge	**Q =**	**121.29**	cfs
Froude Number	**Fr =**	**0.76**	
Flow Velocity	**V =**	**4.62**	fps
Flow Area	A =	26.24	sq ft
Top Width	T =	22.80	ft
Wetted Perimeter	P =	23.19	ft
Hydraulic Radius	R =	1.13	ft
Hydraulic Depth	D =	1.15	ft
Specific Energy	Es =	1.93	ft
Centroid of Flow Area	Yo =	0.69	ft
Specific Force	Fs =	2.22	kip

Normal Flow Analysis - Trapezoidal Channel

Project: Mesa Ridge East MDDP
Channel ID: Channel R3250 - 419cfs (Riprap)

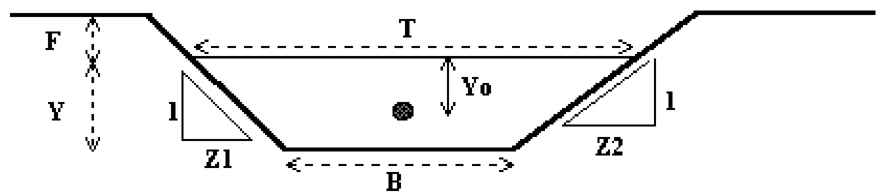


Design Information (Input)			
Channel Invert Slope	So =	0.0120	ft/ft
Manning's n	n =	0.035	
Bottom Width	B =	10.00	ft
Left Side Slope	Z1 =	4.00	ft/ft
Right Side Slope	Z2 =	4.00	ft/ft
Freeboard Height	F =	1.00	ft
Design Water Depth	Y =	**2.84**	ft

Normal Flow Condtion (Calculated)			
Discharge	**Q =**	**420.96**	cfs
Froude Number	**Fr =**	**0.90**	
Flow Velocity	**V =**	**6.94**	fps
Flow Area	A =	60.66	sq ft
Top Width	T =	32.72	ft
Wetted Perimeter	P =	33.42	ft
Hydraulic Radius	R =	1.82	ft
Hydraulic Depth	D =	1.85	ft
Specific Energy	Es =	3.59	ft
Centroid of Flow Area	Yo =	1.16	ft
Specific Force	Fs =	10.07	kip

Normal Flow Analysis - Trapezoidal Channel

Project: Mesa Ridge East MDDP
Channel ID: Channel R3265 - 183cfs (Riprap)



Design Information (Input)			
Channel Invert Slope	So =	0.0120	ft/ft
Manning's n	n =	0.035	
Bottom Width	B =	10.00	ft
Left Side Slope	Z1 =	4.00	ft/ft
Right Side Slope	Z2 =	4.00	ft/ft
Freeboard Height	F =	1.00	ft
Design Water Depth	Y =	**1.90**	ft

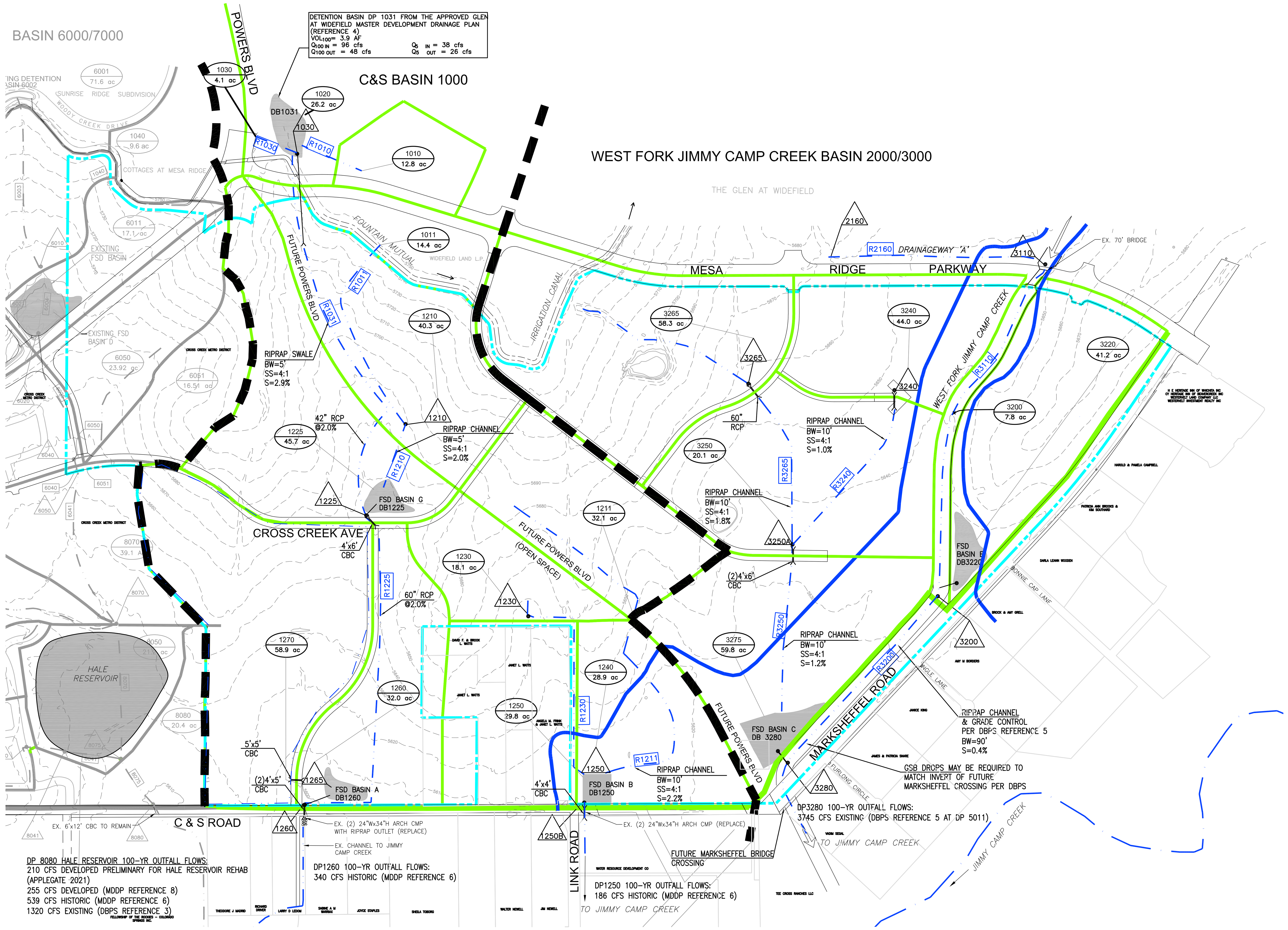
Normal Flow Condtion (Calculated)			
Discharge	**Q =**	**186.02**	cfs
Froude Number	**Fr =**	**0.85**	
Flow Velocity	**V =**	**5.56**	fps
Flow Area	A =	33.44	sq ft
Top Width	T =	25.20	ft
Wetted Perimeter	P =	25.67	ft
Hydraulic Radius	R =	1.30	ft
Hydraulic Depth	D =	1.33	ft
Specific Energy	Es =	2.38	ft
Centroid of Flow Area	Yo =	0.81	ft
Specific Force	Fs =	3.70	kip

APPENDIX G: Exhibits

Exhibit 1 Hydrologic Subbasin Map

Exhibit 2 Proposed Facilities Map

Exhibit 3 Improvement Design Details



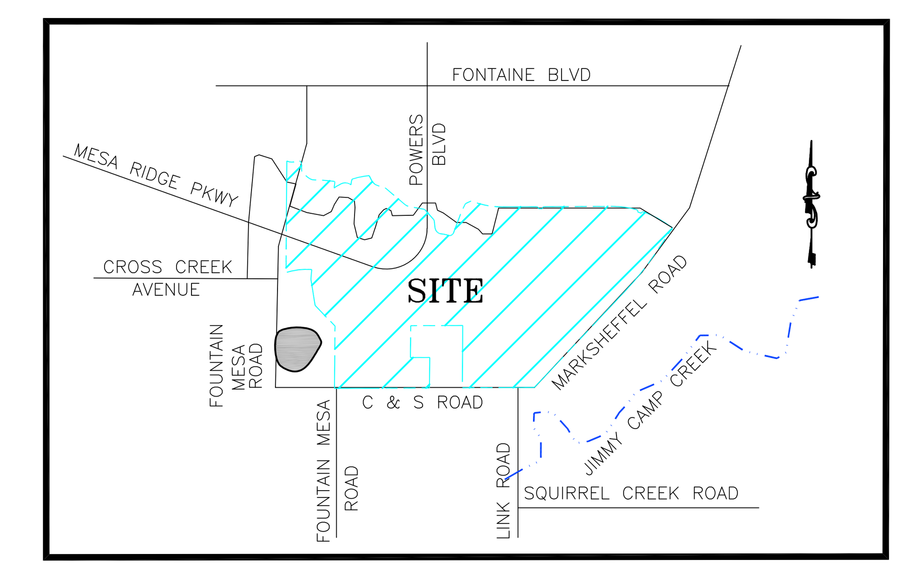
LEGEND

- 1225 — DRAINAGE SUBBASIN DESIGNATION
- 14.68 ac — DRAINAGE SUBBASIN AREA
- DESIGN POINT
- DRAINAGE BASIN BOUNDARY
- DRAINAGE SUBBASIN BOUNDARY
- FLOW DIRECTION
- ROUTING ELEMENT/DRAINAGE CONVEYANCE
- PROPERTY BOUNDARY
- 100 YEAR FEMA FLOODPLAIN

0 500' 1000'

SCALE: 1"=500'

NOTE: TOPOGRAPHY USED IN THIS MDDP MAY NOT REFLECT THE EXISTING CONDITIONS FOR ALL AREAS OF THE DRAINAGE BASINS.



VICINITY MAP
SCALE: NOT TO SCALE

SUMMARY OF PROPOSED FSD BASIN DATA (2-HOUR STORM)

PROPOSED FS DETENTION BASIN A (DB1260)

	Q_5	Q_{100}
IN	119 cfs	372 cfs
OUT	17 cfs	206 cfs

100 yr VOLUME= 8.0 ac–ft
EURV VOLUME= 4.1 ac–ft
WQCV VOLUME= 1.5 ac–ft

PROPOSED FS DETENTION BASIN B (DB1250)

	Q_5	Q_{100}
IN	136 cfs	454 cfs
OUT	23 cfs	148 cfs

100 yr VOLUME= 9.5 ac–ft
EURV VOLUME= 2.5 ac–ft
WQCV VOLUME= 1.2 ac–ft

PROPOSED FS DETENTION BASIN C (DB 3280)

	Q_5	Q_{100}
IN	141 cfs	654 cfs
OUT	4 cfs	177 cfs

100 yr VOLUME= 18.3 ac–ft
EURV VOLUME= 6.1 ac–ft
WQCV VOLUME= 2.5 ac–ft

PROPOSED FS DETENTION BASIN E (DB3220)

	Q_5	Q_{100}
IN	55 cfs	178 cfs
OUT	1 cfs	33 cfs

100 yr VOLUME= 6.4 ac–ft
EURV VOLUME= 3.0 ac–ft
WQCV VOLUME= 1.0 ac–ft

PROPOSED FS DETENTION BASIN G (DB1225)

	Q_5	Q_{100}
IN	121 cfs	412 cfs
OUT	9 cfs	133 cfs

100 yr VOLUME= 8.9 ac–ft
EURV VOLUME= 3.0 ac–ft
WQCV VOLUME= 1.3 ac–ft

SUMMARY OF DEVELOPED DESIGN POINT DISCHARGES (2-HOUR STORM WITH FSD)

DESIGN POINT	LOCATION	DRAINAGE AREA Acres	DRAINAGE AREA Square Miles	5 Year CFS	100 Year CFS
C&S BASIN					
DB 1031	GLEN DETENTION OUTFLOW	43	0.068	15	45
R1031	GLEN DETENTION CONVEYANCE	43	0.068	15	44
DP1210	MESA RIDGE UPPER BASINS	54	0.085	78	241
R1210	MESA RIDGE FLOWS INTO FSD G	54	0.085	74	246
DP1225	CROSS CREEK AVENUE	143	0.224	23	164
R1225	CONVEYANCE FSD G OUTFLOW	143	0.224	23	164
DP1260	C&S ROAD	255	0.366	39	332
DB1250B	C&S ROAD FSD B OUTFLOW	109	0.170	23	148
WEST FORK JIMMY CAMP CREEK BASIN					
DP3110	INLFOW FROM GLEN AND WIDEFIELD	2161	3.376	429	2835
R3110	WEST FORK JIMY CAMP CREEK CONVEYANCE	2161	3.376	428	2794
R3200	WEST FORK JIMY CAMP CREEK CONVEYANCE	2210	3.454	429	2830
DP3280	MARCKSHEFFEL ROAD	2392	3.738	435	2982

SUMMARY OF EXISTING DISCHARGES (2-HOUR STORM)

DESIGN POINT	LOCATION	5 Year	100 Year
3280	WF JIMMY CAMP CREEK @ MARKSHEFFEL ROAD	462 cfs	2988 cfs
1250	@ C & S ROAD	46 cfs	229 cfs
1260	@ C & S ROAD	61 cfs	341 cfs

SUMMARY OF HISTORIC DISCHARGES (24-HOUR STORM)

DESIGN POINT	LOCATION	5 Year	100 Year
3280	WF JIMMY CAMP CREEK @ MARKSHEFFEL ROAD	992 cfs	3745 cfs
1250	@ C & S ROAD	35 cfs	186 cfs
1260	@ C & S ROAD	48 cfs	340 cfs

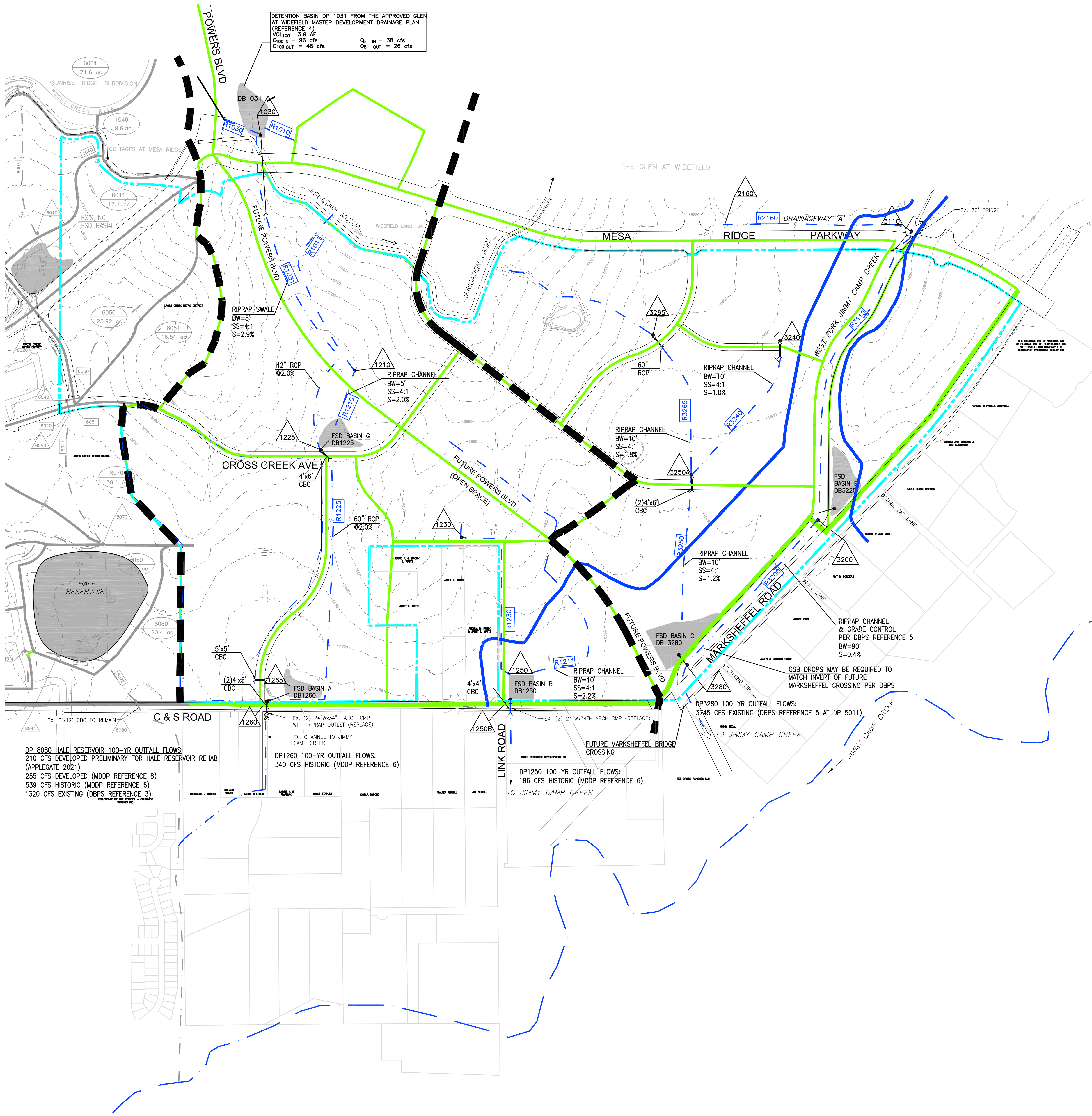
(1) AREA ABOVE FOUNTAIN MUTUAL IRRIGATION CANAL ASSUMED TRIBUTARY TO MESA RIDGE PROPERTY. FMIC CANAL ASSUMED TO CONVEY IRRIGATION FLOW ONLY.

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

MESA RIDGE DEVELOPMENT
MASTER DEVELOPMENT DRAINAGE PLAN
HYDROLOGIC PROPOSED CONDITIONS SUB-BASIN MAP
FOUNTAIN, COLORADO

Project No.: 21027
Date: OCTOBER 12, 2021
Design: SAB
Drawn: MTR
Check: SAB
Revisions:
MAY 20, 2022

EXHIBIT 1



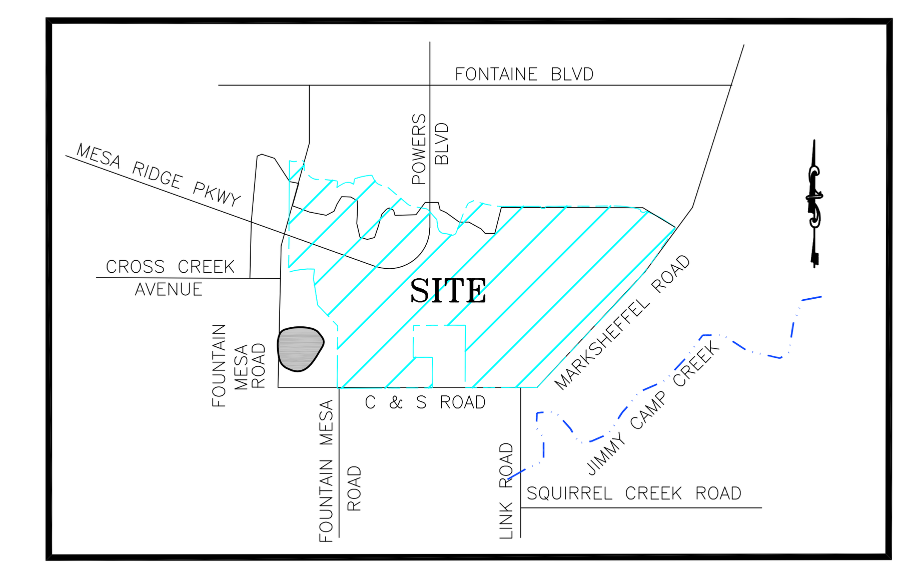
SEE EXHIBIT 3 FOR CONVEYANCE IMPROVEMENT DETAILS

0 500' 1000'
SCALE: 1"=500'

LEGEND

- PROJECT BOUNDARY
- DESIGN POINT
- MAJOR DRAINAGE BASIN BOUNDARY
- DRAINAGE SUBBASIN BOUNDARY
- 100 YR FLOODPLAIN
- FLOW DIRECTION
- DRAINAGE CONVEYANCE

NOTE: TOPOGRAPHY USED IN THIS MDDP MAY NOT REFLECT THE EXISTING CONDITIONS FOR ALL AREAS OF THE DRAINAGE BASINS.



VICINITY MAP
SCALE: NOT TO SCALE

SUMMARY OF DEVELOPED DESIGN POINT DISCHARGES (2-HOUR STORM WITH FSD)

DESIGN POINT	LOCATION	DRAINAGE AREA Acres	DRAINAGE AREA Square Miles	5 Year CFS	100 Year CFS
C&S BASIN					
DB 1031	GLEN DETENTION OUTFLOW	43	0.068	15	45
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DP3280	MARCKSHEFFEL ROAD	2392	3.738	435	2982

SUMMARY OF PROPOSED FSD BASIN DATA (2-HOUR STORM)

PROPOSED FS DETENTION BASIN A (DB1260)

	Q_5	Q_{100}
IN	119 cfs	372 cfs
OUT	17 cfs	206 cfs

100 yr VOLUME= 8.0 ac–ft
EURV VOLUME= 4.1 ac–ft
WQCV VOLUME= 1.5 ac–ft

PROPOSED FS DETENTION BASIN B (DB1250)

	Q_5	Q_{100}
IN	136 cfs	454 cfs
OUT	23 cfs	148 cfs

100 yr VOLUME= 9.5 ac–ft
EURV VOLUME= 2.5 ac–ft
WQCV VOLUME= 1.2 ac–ft

PROPOSED FS DETENTION BASIN C (DB 3280)

	Q_5	Q_{100}
IN	141 cfs	654 cfs
OUT	4 cfs	177 cfs

100 yr VOLUME= 18.3 ac–ft
EURV VOLUME= 6.1 ac–ft
WQCV VOLUME= 2.5 ac–ft

PROPOSED FS DETENTION BASIN E (DB3220)

	Q_5	Q_{100}
IN	55 cfs	178 cfs
OUT	1 cfs	33 cfs

100 yr VOLUME= 6.4 ac–ft
EURV VOLUME= 3.0 ac–ft
WQCV VOLUME= 1.0 ac–ft

PROPOSED FS DETENTION BASIN G (DB1225)

	Q_5	Q_{100}
IN	121 cfs	412 cfs
OUT	9 cfs	133 cfs

100 yr VOLUME= 8.9 ac–ft
EURV VOLUME= 3.0 ac–ft
WQCV VOLUME= 1.3 ac–ft

Kiowa Engineering Corporation
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Lakewood, Colorado 80235
(303) 692-0369

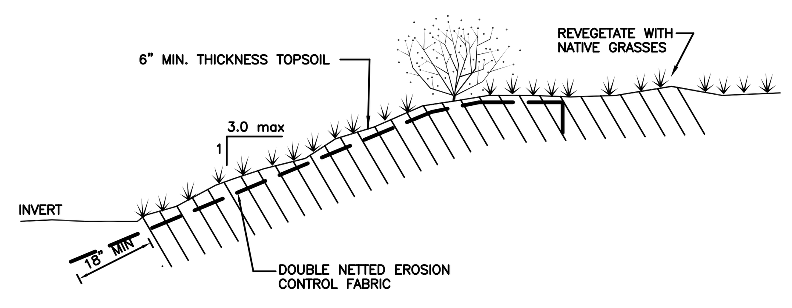
MESA RIDGE DEVELOPMENT
MASTER DEVELOPMENT DRAINAGE PLAN
PROPOSED FACILITIES DESIGN
FOUNTAIN, COLORADO

Project No.:	21027
Date:	OCTOBER 12, 2021
Design:	SAB
Drawn:	MTR
Check:	SAB
Revisions:	MAY 20, 2022

EXHIBIT 2

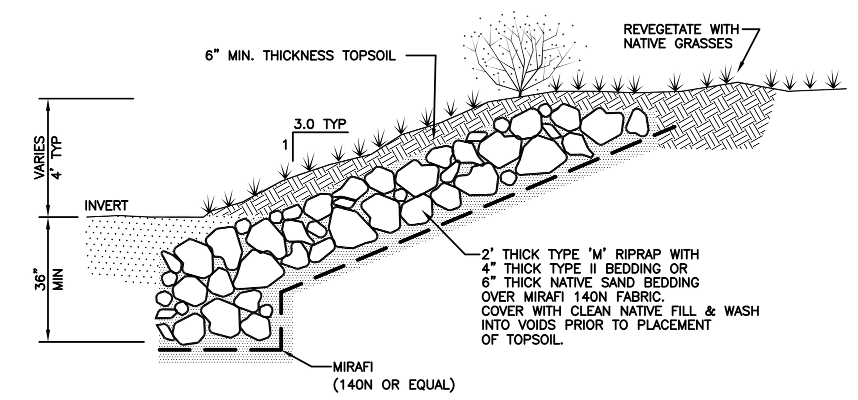
WEST FORK JIMMY CAMP CREEK
CHANNEL EMBANKMENT DETIALS

(PROVIDED FOR INFORMATION, REFER TO WEST FORK JIMMY CAMP CREEK DBPS)



GRASSLINED BANK DETAIL

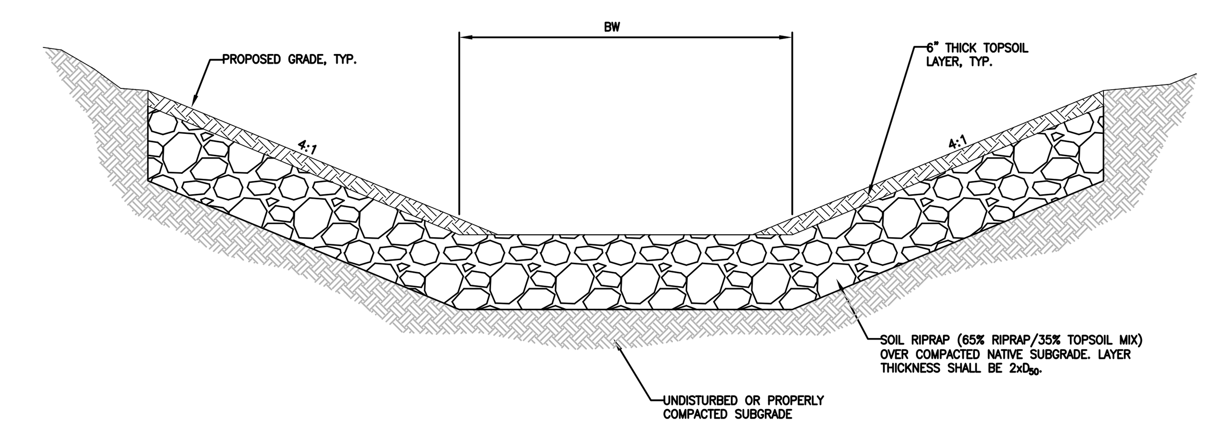
(FROM WEST FORK JIMMY CAMP CREEK DBPS)



RIPRAP BANK LINING DETAIL
NTS

(FROM WEST FORK JIMMY CAMP CREEK DBPS)

MESA RIDGE EAST
CONVEYANCE CHANNELS



RIPRAP CHANNEL LINING DETAIL
NTS

RIPRAP GRADATIONS

TYPE H RIPRAP

INTERMEDIATE ROCK DIMENSION IN INCHES	% SMALLER THAN GIVEN SIZE BY WEIGHT	D_{50} INCHES
30	100	18
24	50–70	
18	35–50	
6	2–10	

TYPE M RIPRAP

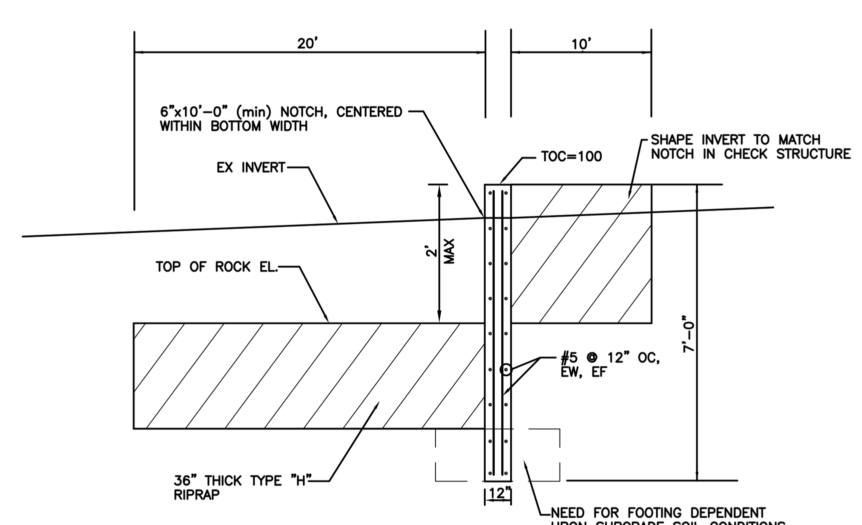
INTERMEDIATE ROCK DIMENSION IN INCHES	% SMALLER THAN GIVEN SIZE BY WEIGHT	D_{50} INCHES
21	100	12
18	50–70	
12	35–50	
4	2–10	

SEED MIX

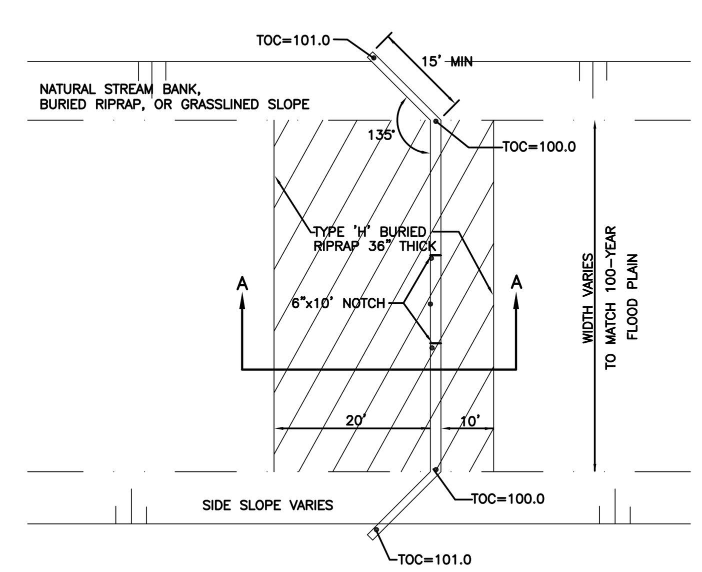
AREAS DISTURBED BY THE EARTHWORK SHALL BE PERMANENTLY REVEGETATED WITH NATIVE GRASSES. NATIVE SEED MIX FOR THIS PROJECT SHALL BE AS FOLLOWS:

NATIVE SEED MIX		pls/acre
BLUE GRAMA	*Chrondrosum hirsuta*	2.0
SIDEOATS GRAMA	*Bouteloua curtipendula*	3.0
SLENDER WHEATGRASS	*Agropyron trachycaulum trachycaulum*	2.0
WESTERN WHEATGRASS	*Agropyron smithii*	4.0
		11.0 lbs

ALTERNATIVE GRADE CONTROL STRUCTURES ARE ACCEPTABLE IF THEY MEET CITY CRITERIA



SECTION A-A



TYPICAL CHECK STRUCTURE PLAN
NO SCALE

(FROM WEST FORK JIMMY CAMP CREEK DBPS)

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MESA RIDGE DEVELOPMENT
MASTER DEVELOPMENT DRAINAGE PLAN
IMPROVEMENT DETAILS
FOUNTAIN, COLORADO

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EXHIBIT 3