PHASE III DRAINAGE REPORT

4480 SOUTH HOLLY STREET
LOT 7, CHARLOU PARK AMENDED
CITY OF CHERRY HILLS VILLAGE
ARAPAHOE COUNTY

Prepared for
Designs by Sundown
6875 S. Santa Fe Dr.
Lakewood, CO 80120

Developer
Kyle Musick and Lacey Musick
4480 S Holly St
Cherry Hills Village, CO 80111

Prepared by
David E. Archer & Associates, Inc.
105 North Wilcox Street
Castle Rock, Colorado 80104

Project No. 20-0420
April 2025
REV #1 July 2025

DAVID E. ARCHER & ASSOCIATES, INC.
LAND DEVELOPMENT CONSULTING
SURVEYING & ENGINEERING
PHONE (303) 688-4642
105 WILCOX ST., CASTLE ROCK, COLORADO 80104

Project No.: 20-0420

ENGINEER'S STATEMENT:

I hereby affirm that this report and plan for the Phase III drainage design of 4480 S Holly St was prepared by me, or under my direct supervision, for the owners thereof, in accordance with the provisions of the City of Cherry Hills Village, *Arapahoe County Stormwater Management Manual* and the Mile High Flood District Urban Storm Drainage Criteria Manual, and approved variances and exceptions thereto. I understand that the City of Cherry Hills Village does not and will not assume liability for drainage facilities designed by others.

SIGNATURE: _____

Registered Professional Engineer
State of Colorado No. 64656

DEVELOPER CERTIFICATION:

Kyle Musick and Lacey Musick hereby certifies that the drainage facilities for 4480 S Holly St shall be constructed according to the design presented in this report. I understand that City of Cherry Hills Village does not and will not assume liability for the drainage facilities designed and/or certified by my engineer and that City of Cherry Hills Village reviews drainage plans pursuant to Colorado Revised Statutes Title 30, Article 28; but cannot, on behalf of *Kyle Musick and Lacey Musick*, guarantee that final drainage design review will absolve *Kyle Musick and Lacey Musick* and/or their successors and/or assigns of future liability for improper design. I further understand that approval of the Final Plat, Final Development Plan, and/or Subdivision Development Plan does not imply approval of my engineer's drainage design.

_____
Name of Developer

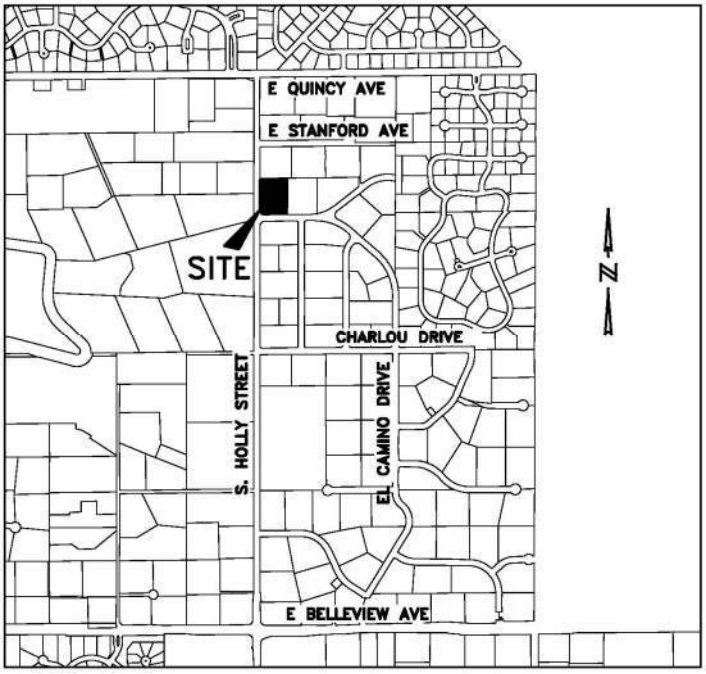
_____
Authorized Signature

TABLE OF CONTENTS

I. GENERAL LOCATION AND DESCRIPTION

A. Site Vicinity Map

1. The site is located at 4480 S Holly Street. with a legal description of Lot 7, Charlou Park Amended. See site Vicinity Map below.



2. Township, Range, Section, and ¼ Section

a) W1/2 of the NW1/4 of Section 8, Township 5 South, Range 67 West of the 6th P.M.

3. Existing and proposed streets, roadways, and highways adjacent to and within the proposed development, or within the area served by the proposed drainage improvements

a) The project site is bounded on the south by El Camino Drive and on the west by South Holly Street. This is a residential lot and there are no proposed streets.

4. Names of surrounding or adjacent developments, including land use or zoning information

a) The project site is located on the west edge of Charlou Park the properties on the north, east, and south are also in Charlou Park. The properties across South

Holly Street from the site are in Cantitoe Subdivision to the south and un-platted to the north. All properties in the surrounding area are zoned R-1.

B. Description of Property

1. Area in Acres

    a) The entirety of the subject site contains approximately 2.08 acres.

2. Ground cover, vegetation, site topography and slopes

    a) The existing site is currently developed with a residence and the areas of the property not covered with hardscape and landscaping are vegetated. The site naturally drains to the south at varying slopes.

3. NRCS Soils Classification Map and discussion

    a) The NRCS Soils classification for 4480 S Holly Street is Hydrologic Group D. The site is comprised of Renohill-Litle-Thedalund (RtE) complex with 1 to 30 percent slope.

4. Major and minor drainageways

    a) The drainage from the site is naturally conveyed overland to the southern boundary of the site. The Blackmer Gulch runs across the southern portion of the site.

5. Floodplains delineated by FHAD studies or on FEMA FIRM Maps

    a) There is a 100-year flood plain and floodway defined across the property per the FIRM Panel 08005C0168K with an effective date of 12/17/2010. See FIRM Panel in the appendices.

6. Existing irrigation canals or ditches

    a) There are no irrigation canals or ditches on the site.

7. Significant geologic features

    a) There are no significant geologic features located on or near 4480 South Holly Street except for the Blackmer Gulch drainage way. The drainageway is not a developed or a natural drainage way. El Camino Road runs down the middle of it. The existing floodplain does not match the existing topography of the site.

8. Proposed land use

    a) The proposed land use will not change with the proposed development. The proposed construction on site will include a sport court and concrete patio. There is to be no change to the existing footprint of the residence.

9. Groundwater Investigations and Discussion

    a) Groundwater was not encountered during the soil boring performed on 5/18/20 by Hollingsworth Associates, Inc. Soil samples were taken down to a depth of 15 and 20 feet in area of the proposed construction. Water was not

encountered at the time of the drilling. Fifteen days later, however one of the holes had water at a depth of 17.6 feet.

II. DRAINAGE BASINS AND SUB-BASINS

A. Major Drainage Basins

1. On-site and off-site major drainage basin characteristics and flow patterns and paths

a) The major basin on this site is the basin for Blackmer Gulch. The flow path for the basin extends east and is generally developed.

2. Existing and proposed land uses within the basins if known

a) The existing and proposed land uses within the major basin is residential development on lots of varying sizes.

3. Discussion of all drainage way planning or floodplain delineation studies that affect the major drainage ways, such as FHAD Studies and Master Planning studies

a) The Blackmer Gulch Tributary FAHD study was completed in 1981. The study identifies that the Holly Street area was modified in the area of the site and the contour information and flood plain was not revised accordingly. The other FAHD studies listed in the area do not include this portion of Blackmer Gulch.

b) A Master Planning study was completed in 1974 – Major Drainageway Planning Little Dry Creek – that included the portion of Blackmer Gulch that runs across the site. The only real discussion of the area was the crossing of South Holly Street. Although the area is mentioned there are no improvements specifically mentioned.

4. Discussion of the condition of any channel within or adjacent to the development, including existing conditions, need for improvements, and impact on the proposed development

a) The existing channel for Blackmer Gulch is essentially a roadway. El Camino Drive runs down the drainage way with developed properties on either side, including fences and landscaping. The floodplain extends into the properties on either side of the ROW. With the floodway and floodplain impact the property all of the development work will be above the floodplain so the proposed residence will not be directly impacted other than the limited location of the house.

5. Discussion of the impacts of the off-site flow patterns and paths, under fully developed conditions

a) Offsite flows are generated by Blackmer Gulch across the southern end of the site. The property immediately north has a detention facility that captures all the drainage from that site and directs it to the roadside ditch along the east side of South Holly, along the west boundary of the site. The basins to the northeast of the site generally stay east of the site until within the floodplain for Blackmer Gulch then flows through the undeveloped southern portion of the site. These flow

patterns are not likely to change as the upstream properties are already fully developed.

B. Minor Drainage Basins

1. On-site and off-site minor drainage basin characteristics and flow patterns and paths under historic and developed conditions

a) The subject site has been analyzed as one basin. There are no significant offsite flows that enter the site prior to entering the Blackmer Gulch basin.

b) The developed site has a proposed imperviousness of 26.79% on 2.08 acres, the equivalent of 24,226 sf of impervious area. The existing site has an impervious area of 19,920 sf. The proposed project will increase the impervious area by 4306 sf.

Basin A

Basin A consists of the entire 2.08 acres of the site and is analyzed at 27.0% imperviousness. Runoff in this basin is conveyed to Blackmer Gulch along the southern boundary of the property before leaving the site. The discharge from Basin A is 2.05 cfs for the 5-year event and 9.23 cfs during the 100-year event. The discharge from this basin is represented by Design Point 1.

Below is the design point table for the site. See the drainage map in the appendices for design point and basin locations.

Design Point Table

Design Point	Contributing Basin(s)	Area (AC.)	Q 5-YR	Q 100-YR
1	A	2.08	2.05	9.23

2. Existing and proposed land uses within the basins

a) The existing land use within the basin will remain the same with this development. The site is currently developed with an existing residence. A sport court is proposed with additional patio areas and walkways.

3. Discussion of irrigation facilities that will influence or be impacted by the site drainage.

a) There are no irrigation facilities on the site. The High Line Canal is downstream of the site and will not be impacted.

4. Discussion of the impacts of the off-site flow patterns and paths, under fully developed conditions

a) *Offsite flows will not enter the developed portion of the site. As noted above, the property to the north has a detention facility that captures all drainage from that site and directs it to the eastern roadside ditch of South Holly Street. Flows from the properties to the northeast and east do not enter the site. And flows from South Holly Street along the west side are captured in the roadside swale and do not enter the site. The southern portion of the site will be inundated during larger storms in the Blackmer Gulch drainage basin. All proposed developments on the site will be above the 100-year floodplain of Blackmer Gulch.*

III.DRAINAGE DESIGN CRITERIA

A. Regulations

1. County criteria and optional provisions selected, when applicable

a) The drainage design outlined in this report follows those regulations outlined in the Arapahoe County Stormwater Management Manual (ACSMM)

2. *MHFD Manual* criteria and optional provisions selected, when applicable

a) The regulations outlined in the ACSMM are consistent with the criteria outlined in the MHFD Urban Storm Drainage Criteria Manual Volumes 1-3.

b) The MHFD Urban Storm Drainage Criteria Manual Volumes 1-3 were used in the design and calculations of this report.

B. Drainage Studies, Master Plans, Site Constraints

1. Discuss previous drainage studies or master plans for the site or project that influence the stormwater facility design

a) A previous drainage report was prepared for the development of the subject site by David E. Archer & Associates dated 11/06/2020. This report was used to further analyze the existing site.

2. Discuss drainage studies for adjacent developments and how those developments affect the stormwater facility design

a) A drainage study prepared for the adjacent to the north, 5650 East Sanford Avenue, indicates that all the drainage from that site will be directed through a detention facility and into the roadside swale along the east side of South Holly Street. Drainage studies for the properties to the northeast and east were not researched as the existing contour information and site visits indicate no flow from these properties enter the site.

3. Discuss MHFD Outfall Systems Plans and how recommendations in those studies affect the design

a) Although Blackmer Gulch runs through the site a review of the MHFD Outfall Systems Plans do not include this area.

4. Discuss impacts to storm water management facility design caused by site constraints, such as streets, utilities, rapid transit, existing structures, etc.

a) The storm water management facility proposed for the site be within the Blackmer Gulch. The proposed facility will improve the existing drainage area for

the Blackmer Gulch. The proposed improvements will utilize the existing inlet and storm sewer network at the intersection of Holly Street and El Camino Dr.

C. Hydrology

1. Runoff calculation method(s)

   a) Runoff from the Basins were calculated using the rational method, as outlined in the ACSMM section 6.3, and Chapter 2 of the MHFD USDCM Vol. 1. Time of concentration was calculated utilizing the UD Rational spreadsheet and NRCS conveyance were determined for each basin.

2. Design storm recurrence intervals

   a) The design storm recurrence intervals used in this hydrologic analysis were the 2, 5, 10, 50, and 100 yr storm events.

3. Design rainfall

   a) The design 1-hour rainfall depths used in this report were determined using the Table 6-1 from the ACSSM.

Storm Event	2-Year	5-Year	10-Year	50-Year	100-Year
1-Hour Depth (in)	0.97	1.38	1.65	2.32	2.67

4. Detention storage calculation method(s)

   a) The stormwater detention facility located on site was sized using the MHFD UD Detention worksheet for full spectrum detention including the WQCV, EURV, and 100yr storm event.

   b) Using the spreadsheet, the maximum allowable detention storage volume was calculated. It was determined that the proposed basin within Blackmer Gulch is capable of detaining a 3.50 acre basin with an imperviousness of 40.0%. The equivalent of 60,984 sf of impervious area. The developed site has a proposed imperviousness of 26.79% on 2.08 acres, the equivalent of 24,226 sf of impervious area. The existing site has an impervious area of 19,920 sf. The proposed project will increase the impervious area by 4306 sf.

   c) The proposed detention facility will provide additional storage and water quality to approximately 36,758 sf of impervious area while increasing the storage volume of the floodplain on site.

   d) The proposed detention facility has a storage capacity of 0.373 ac-ft or 16,247 cubic feet. Using the calculations from Chapter 12 of the Mile High Flood District manual, it was determined that the developed subject site will require a storage

volume of 5,230 cubit feet. The proposed detention facility on site provides an additional 11,017 cubic feet of storage during the 100-year event.

5. Detention storage release rate calculation method

   a) The release rates for the stormwater detention facility located on site were calculated using the MHFD UD Detention worksheet for full spectrum detention including the WQCV, EURV, and 100yr storm event.

   b) The proposed detention facility is designed to provide full spectrum release rates to a 3.50 acre basin with 40% imperviousness while allowing the flows from the Blackmer Gulch to pass as previously designed.

6. Methods used to determine conveyance facility capacities

   a) The stormwater conveyance facilities are existing and will not be altered.

7. Hydraulic grade line calculation method and discussion of loss coefficients

   a) No HGL calculations are required as part of the storm water management plan for the project.

8. Methods used to calculate water surface profiles

   a) Water surface profiles for the channels were calculated for this project. They are included in the report. All water surface elevations proposed by this project will not increase due to the modifications within the roadside swales.

D. Water Quality Enhancement

1. Discuss proposed Best Management Practices

   a) Water quality enhancements of the developed runoff will be provided through the routing of developed storm water through grass buffers, and grass swales to the detention facility, designed with provisions to include the WQCV volume.

   b) Using the MHFD detention spreadsheet WQCV storage volume was calculated. It was determined that the proposed basin within Blackmer Gulch is capable of detaining a 3.50 acre basin with an imperviousness of 40.0%. The equivalent of 60,984 sf of impervious area. The developed site has a proposed imperviousness of 27% on 2.08 acres, the equivalent of 24,417 sf of impervious area. The proposed detention facility will provide additional storage and water

quality to approximately 36,567 sf of impervious area while increasing the storage volume of the floodplain on site.

2. Identify design procedures and WQCV

   a) The WQCV is designed into the Storm Water Management system specifically for the proposed detention facility.

3. Discuss proposed Source Controls for site activities

   a) Source controls will be implemented during the construction phase by following the Storm Water Management Plan prepared separately.

E. Groundwater Investigation

1. Discuss groundwater investigation and results

   a) Groundwater was not encountered during the soil boring performed on 5/18/20 by Hollingsworth Associates, Inc. Soil samples were taken down to a depth of 15 and 20 feet in area of the proposed construction. Water was not encountered at the time of the drilling. Fifteen days later, however one of the hole had water at a depth of 17.6 feet.

2. Identify potential groundwater issues and remediation measures

   a) Ground water is not anticipated to be an issue on the site.

IV. STORMWATER MANAGEMENT FACILITY DESIGN

A. Stormwater Conveyance Facilities

1. Discuss general conveyance concepts

   a) Basin A will utilize grass lined swales and sheet flow for conveyance to the proposed detention facility at the southern boundary of the site. Flows from Basin A will be conveyed offsite using the existing inlet and storm sewer network.

2. Discuss proposed drainage paths and patterns

   a) The general drainage paths are intended to carry runoff from the basin to the existing inlet. The existing inlet and storm sewer system within each basin will

convey the stormwater with the Blackmer Gulch. Discharge from the detention facility will to west via the storm sewers.

3. Discuss storm sewer design, including inlet and pipe locations and sizes, tributary basins and areas, peak flow rates at design points, hydraulic grade lines, etc.

   a) The existing storm sewer and inlet system is to remain. There are no additional storm sewers or inlets proposed with this project.

4. Discuss storm sewer outfall locations and design, including method of energy dissipation

   a) The existing storm sewer and inlet system is to remain. There are no additional storm sewers or inlets proposed with this project.

5. Discuss how runoff is conveyed from all outfalls to the nearest major drainageway, including a discussion of the flow path and capacity downstream of the outfall to the nearest major drainageway

   a) Runoff from the site will follow the historic path to the Blackmer Gulch located along the southern boundary. The proposed discharge from the detention facility within the Blackmer Gulch will follow the historic storm sewer network. The proposed modifications will not increase the flowrate through the inlet within Blackmer Gulch. The existing floodplain capacity will increase with the proposed modifications.

6. Discuss open channel and swale designs, including dimensions, alignments, tributary basins and areas, peak flow rates at design points, stabilization and grade control improvements, low flow or trickle channel capacities, water surface elevations, etc.

   a) The drainage design for the proposed developed portion of the site utilizes sheet flow and concentrated swales to convey the flows to the proposed onsite detention facility. The existing roadside swale on El Camino Dr. and Holly St. will be expanded to increase the volume within the floodplain. The modifications will continue to convey the flows to the existing inlet. The inlet will be modified to provide full spectrum detention to the allowable impervious area. The bottom of the Blackmer Gulch floodplain modifications will have a 2% slope with side slopes between 20% and 25%. The allowable volume within the area of modification will increase due to the proposed improvements.

7. Discuss allowable street capacities

   a) No streets are involved with the design of this project.

8. Discuss maintenance aspects of the design and easements and tracts that are required for stormwater conveyance purposes

   a) The maintenance of all onsite facilities will be the responsibility of the property owner.

9. Discussion of the facilities needed off-site for the conveyance of minor and major flows to the major drainageway

a) There are no new proposed offsite facilities required. All existing offsite facilities will remain.

B. Stormwater Storage Facilities

1. Discuss detention pond designs, including release rates, storage volumes and water surface elevations for the WQCV, EURV, and 100-year and emergency overflow conditions, outlet structure design, emergency spillway design, etc.

a) It was determined that the proposed detention facility within Blackmer Gulch can detain a 3.50-acre basin with an imperviousness of 40.0%. The equivalent of 60,984 sf of impervious area. The developed site has a proposed imperviousness of 26.79% on 2.08 acres, the equivalent of 24,226 sf of impervious area. The existing site has an impervious area of 19,920 sf. The proposed project will increase the impervious area by 4,306 sf.

b) The proposed detention facility will provide additional storage and water quality to approximately 36,567 sf of impervious area while increasing the storage volume and water quality of the floodplain on site. The overflows from the site will continue to flow over the existing Holly Street right-of-way.

2. Discuss pond outfall locations and design, including method of energy dissipation

a) The discharge from the basin will continue flowing through the Blackmer Gulch via the existing storm sewer system that is connected to the existing inlet. No additional modifications to the downstream portion of the existing pipe network are proposed with this development.

3. Discuss how runoff is conveyed from all pond outfalls and emergency spillways to the nearest major drainageway, including a discussion of the flow path and capacity downstream of the outfall to the nearest major drainageway

a) Runoff from the site will follow the historic path to the north via the existing roadside swale along the western boundary of the site.

4. Discuss maintenance aspects of the design and easements and tracts that are required for stormwater storage purposes

a) The maintenance of the facility will be the responsibility of the property owner.

C. Water Quality Enhancement Best Management Practices

1. Discuss the design of all structural water quality Best Management Practices, including tributary areas, sizing, treatment volumes, design features, etc.

a) Water quality will be provided through the existing site vegetation and proposed detention facility.

2. Discuss how runoff is conveyed from all pond outfalls to the nearest major drainageway, including a discussion of the flow path and capacity downstream of the outfall to the nearest major drainageway

a) Runoff from the site will follow the historic path to the south and into the Blackmer Gulch.

3. Discuss the operation and maintenance aspects of the design and easements and tracts that are required for stormwater quality enhancement purposes

a) The maintenance of the facility will be the responsibility of the property owner. An easement will be provided for the maintenance and access to the drainage facilities.

4. Discuss the source controls that are necessary to prevent the potential for illicit discharge from site activities.

a) A Storm Water Management Plan was prepared that will provide the control for construction related activities. The swales and detention pond will be graded during initial phases of construction so that the pond can be used as a sediment basin to collect and provide treatment of all discharge during construction activities.

D. Floodplain Modification

Undesignated Floodplain

1. Discuss resources and methodology for delineation of floodplain.

a) There are no undesignated floodplains within the subject project

Designated Floodplain

1. Discuss the source of the floodplain information and level of detail (Flood Hazard Area Delineation or FEMA Flood Insurance Rate Maps)

a) Blackmer Gulch traverses the southern portion of the site and is indicated on the FIRM panel 08005C0168K with an effective date of 12/17/2010. It appears the flood plain was generated from the Blackmer Gulch Tributary FAHD study completed in 1981.

b) Steady Flow modeling of Little Dry Creek was used to calculate the water surface elevations of the swale. The flowrates from then nearest available cross section located to the west, about 850' downstream from the site, was used for the 100-year and 500-year events. The cross sections of the proposed and existing conditions are included in this report.

2. Discuss details of floodplain modifications, including level of encroachment, velocities, depths, stabilization measures, water surface elevations, etc.

a) The existing floodplain will be modified to increase the volume within the floodplain and increase the water quality through the subject site. Riprap will be provided for bank stabilization.

3. Discuss Conditional Letter of Map Revision (CLOMR) and Letter of Map Revision (LOMR) requirements

a) No CLOMR or LOMR are required with the development of this project.

4. Discuss County floodplain development regulations and Floodplain Development Permit

a) A floodplain development permit through the Cherry Hills Village is required for this project.

E. Groundwater

1. Discuss improvements to mitigate groundwater impacts

a) No improvements will be necessary to mitigate groundwater.

F. Additional Permitting Requirements

1. Section 404 of the Clean Water Act

a) No additional permitting is required with the development of the site

2. The Endangered Species Act

a) No additional permitting is required for the development of the site.

3. Other local, state, or federal requirements

a) No additional permitting is required with the development of the site

G. General

1. Discuss all tables, figures, charts, drawings, etc. that were used in design of stormwater management facilities and describe materials that are included in the appendix of the report

a) Spreadsheet tables outlining the effective impervious percentages utilized in the storm water management calculations have been included in Appendix A of the report.

b) *Spreadsheet tables outlining the detention capacities have been included in Appendix A of the report*.

c) *UD Rational spreadsheets identifying the storm water runoff from each basin have been included in the Appendix A of the report*.

d) UD Detention spread sheets outlining the detention requirements for each basin outlined and have been included in Appendix A of the report.

V. CONCLUSIONS

A. Compliance with Standards

1. Arapahoe County Criteria

    a) The storm water management system of 4480 S Holly St, as outlined in this report complies with those standards regarding storm water management practices, as outlined in the Arapahoe County Stormwater Management Manual

2. MHFD Criteria

    a) The storm water management system of 4480 S Holly St as outlined in this report complies with those standards regarding storm water management practices, as outlined in Urban Drainage and Flood Control District, Urban Drainage Criteria Manuals

3. Master Plans and MHFD Outfall System Plans

    a) *There are no MHFD Outfall system plans which impact the subject site.*

4. Cherry Creek Reservoir Control Regulation No. 72

    a) N/A

B. Variances

1. Identify provisions by section number for which a variance will be requested or has been approved by the County (final version of Drainage Report).

    a) A variance is not required for this project.

2. Provide justification for each variance request

    a) A variance is not required for this project.

C. Drainage Concept

1. Discuss overall effectiveness of stormwater management design to properly convey, store and treat stormwater

    a) *The proposed storm water management plan as outlined in this report adheres to the drainage concepts outlined in the Arapahoe County Storm Water Management Manual. The storm water runoff from the development of 4480 S Holly St does not adversely affect the adjacent properties surrounding the development area. All developed stormwater runoff rates shall not exceed those of the historic development.*

VI. REFERENCES

Arapahoe County. "Arapahoe County Stormwater Management Manual." Drainage Criteria Manual, 2008.

Urban Drainage and Flood Control District. "Urban Storm Drainage Criteria Manual, Volumes 1-3." Drainage Criteria Manual, Denver, 2017 and 2024.

VII. APPENDICES

A. Hydrologic / Hydraulic Computations

1. Effective Impervious Calculations
2. Peak Runoff using Rational Method
3. Mile High Flood District Detention Spreadsheet
4. 100-Year Storage Calculations
5. HEC-RAS flow information for Little Dry Creek Model
6. Swale Hydraulic Cross Sections and Worksheets

B. References

1. Soil Report
2. FIRM Map
3. Drainage Map

Appendices

Effective Imperviousness of Tributary Catchments

Catchment Name: Proposed Site ~ Developed Impervious Percentage

Area Units Used (Acres, sq.ft., other): SQ FT **Designer:** ZET **Date:**

Sub Area ID	Total Area	% Impervious	Impervious Area		Total Effective %Imperv
Roof	7667.00	95.00	7283.65		
Driveway/Concrete	7740.00	95.00	7353.00		
Patio Concrete/Pavers	4687.00	95.00	4452.65		
Sport Court	1800.00	95.00	1710.00		
Vegetation	68542.00	5.00	3427.10		
Totals:	90436.00		24226.40		***26.79***

Effective Imperviousness of Tributary Catchments

Catchment Name: Existing Site ~ Historic Impervious Percentage

Area Units Used (Acres, sq.ft., other): SQ FT **Designer:** ZET **Date:**

Sub Area ID	Total Area	% Impervious	Impervious Area		Total Effective %Imperv
Roof	7667.00	95.00	7283.65		
Driveway/Concrete	7740.00	95.00	7353.00		
Patio Concrete/Pavers	1702.00	95.00	1616.90		
Sport Court	0.00	95.00	0.00		
Vegetation	73327.00	5.00	3666.35		
Totals:	90436.00		19919.90		***22.03***

Calculation of Peak Runoff using Rational Method

Designer: Zach Thatcher
Company: David E Archer & Assoc
Date: 7/22/2025
Project:
Location: 4480 S Holly Street

Version 2.00 released May 2017

Cells of this color are for required user-input
Cells of this color are for optional override values
Cells of this color are for calculated results based on overrides

$$t_i = \frac{0.395(1.1 - C_5)\sqrt{L_i}}{S^{0.33}}$$

$$t_t = \frac{L_t}{60K\sqrt{S_t}} = \frac{L_t}{60V_t}$$

Computed $t_c = t_i + t_t$

Regional $t_c = (26 - 17i) + \frac{L_t}{60(14i + 9)\sqrt{S_t}}$

$t_{minimum} = 5$ (urban)
$t_{minimum} = 10$ (non-urban)

Selected $t_c = \max\{t_{minimum}, \min(\text{Computed } t_c, \text{Regional } t_c)\}$

Select UDFCD location for NOAA Atlas 14 Rainfall Depths from the pulldown list OR enter your own depths obtained from the NOAA website (click this link)

	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr	500-yr
1-hour rainfall depth, P1 (in) =	0.97	1.38	1.65		2.32	2.67	

Rainfall Intensity Equation Coefficients =	a	b	c
	28.50	10.00	0.786

$$I(in/hr) = \frac{a \cdot P_1}{(b + t_c)^c}$$

$$Q(cfs) = CIA$$

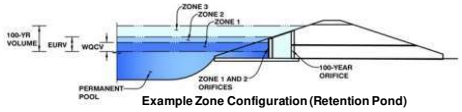
Subcatchment Name	Area (ac)	NRCS Hydrologic Soil Group	Percent Imperviousness	Runoff Coefficient, C							Overland (Initial) Flow Time					Channelized (Travel) Flow Time							Time of Concentration			Rainfall Intensity, I (in/hr)							Peak Flow, Q (cfs)						
				2-yr	5-yr	10-yr	25-yr	50-yr	100-yr	500-yr	Overland Flow Length L_i (ft)	U/S Elevation (ft) (Optional)	D/S Elevation (ft) (Optional)	Overland Flow Slope S_i (ft/ft)	Overland Flow Time t_i (min)	Channelized Flow Length L_t (ft)	U/S Elevation (ft) (Optional)	D/S Elevation (ft) (Optional)	Channelized Flow Slope S_t (ft/ft)	NRCS Conveyance Factor K	Channelized Flow Velocity V_t (ft/sec)	Channelized Flow Time t_t (min)	Computed t_c (min)	Regional t_c (min)	Selected t_c (min)	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr	500-yr	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr	500-yr
A	2.08	D	26.8	0.19	0.25	0.33	0.47	0.53	0.59	0.67	44.10	5474.02	5473.05	0.022	7.83	120.20	5473.05	5470.45	0.022	10	1.47	1.36	9.19	22.51	9.19	2.71	3.86	4.61		6.48	7.46		1.07	2.03	3.16		7.09	9.21	
East Holly	14.67	D	35.0	0.26	0.32	0.39	0.52	0.57	0.63	0.70	300.00	5600.00	5586.00	0.047	14.67	1190.00	5586.00	5527.50	0.049	10	2.22	8.95	23.61	26.49	23.61	1.74	2.48	2.97		4.17	4.80		6.574	11.663	16.950		34.648	44.191	

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)

Project: **4480 S. Holly St**

Basin ID: **Developed Basin**



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	**EDB**	
Watershed Area =	3.50	acres
Watershed Length =	600	ft
Watershed Length to Centroid =	300	ft
Watershed Slope =	0.041	ft/ft
Watershed Imperviousness =	40.00%	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 =	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) =	0.052	acre-feet	acre-feet
Excess Urban Runoff Volume (EURV) =	0.130	acre-feet	acre-feet
2-yr Runoff Volume (P1 = 0.97 in.) =	0.104	acre-feet	0.97 inches
5-yr Runoff Volume (P1 = 1.38 in.) =	0.202	acre-feet	1.38 inches
10-yr Runoff Volume (P1 = 1.65 in.) =	0.275	acre-feet	1.65 inches
25-yr Runoff Volume (P1 = 1.69 in.) =	0.299	acre-feet	inches
50-yr Runoff Volume (P1 = 2.32 in.) =	0.479	acre-feet	2.32 inches
100-yr Runoff Volume (P1 = 2.67 in.) =	0.594	acre-feet	2.67 inches
500-yr Runoff Volume (P1 = 3.14 in.) =	0.732	acre-feet	inches
Approximate 2-yr Detention Volume =	0.092	acre-feet	
Approximate 5-yr Detention Volume =	0.163	acre-feet	
Approximate 10-yr Detention Volume =	0.191	acre-feet	
Approximate 25-yr Detention Volume =	0.188	acre-feet	
Approximate 50-yr Detention Volume =	0.239	acre-feet	
Approximate 100-yr Detention Volume =	0.289	acre-feet	

Define Zones and Basin Geometry

Zone 1 Volume (WQCV) =	0.052	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.078	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	0.159	acre-feet
Total Detention Basin Volume =	0.2892	acre-feet
Initial Surcharge Volume (ISV) =	user	ft^3
Initial Surcharge Depth (ISD) =	user	ft
Total Available Detention Depth (H_{total}) =	user	ft
Depth of Trickle Channel (H_{TC}) =	user	ft
Slope of Trickle Channel (S_{TC}) =	user	ft/ft
Slopes of Main Basin Sides (S_{main}) =	user	H:V
Basin Length-to-Width Ratio ($R_{L/W}$) =	user	

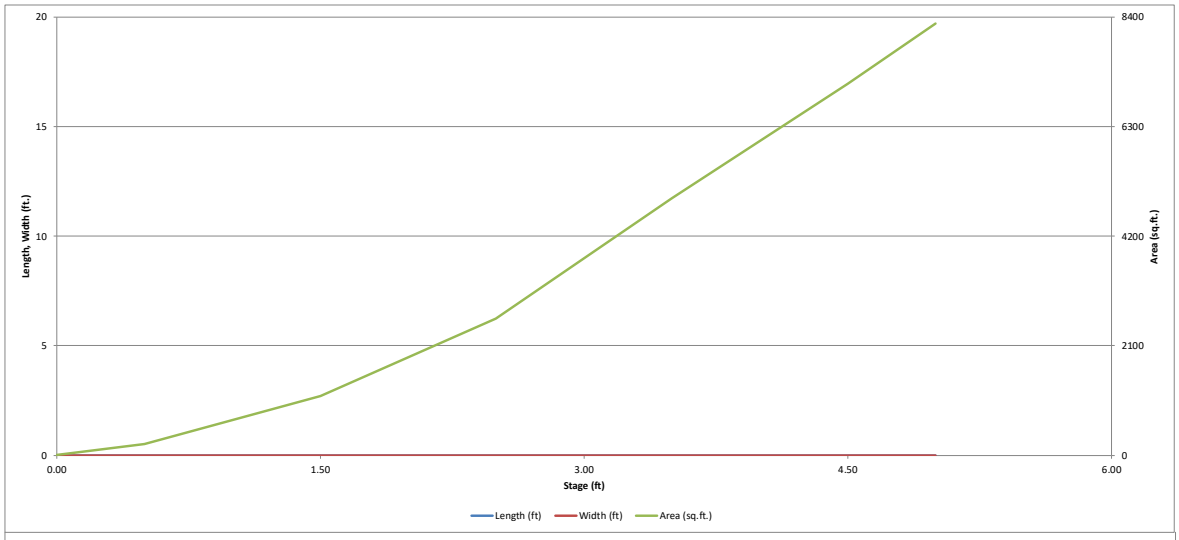
Initial Surcharge Area (A_{ISV}) =	user	ft^2
Surcharge Volume Length (L_{ISV}) =	user	ft
Surcharge Volume Width (W_{ISV}) =	user	ft
Depth of Basin Floor (H_{FLOOR}) =	user	ft
Length of Basin Floor (L_{FLOOR}) =	user	ft
Width of Basin Floor (W_{FLOOR}) =	user	ft
Area of Basin Floor (A_{FLOOR}) =	user	ft^2
Volume of Basin Floor (V_{FLOOR}) =	user	ft^3
Depth of Main Basin (H_{MAIN}) =	user	ft
Length of Main Basin (L_{MAIN}) =	user	ft
Width of Main Basin (W_{MAIN}) =	user	ft
Area of Main Basin (A_{MAIN}) =	user	ft^2
Volume of Main Basin (V_{MAIN}) =	user	ft^3
Calculated Total Basin Volume (V_{total}) =	**user**	acre-feet

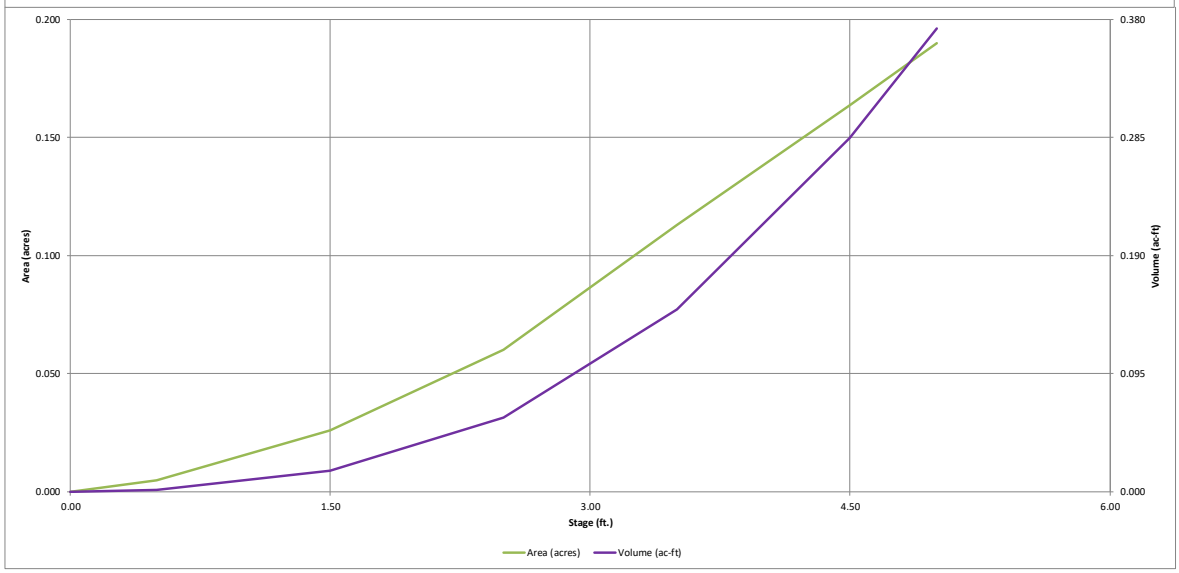
Depth Increment = ft

Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
Top of Micropool	--	0.00	--	--	--	5	0.000		
	--	0.50	--	--	--	213	0.005	54	0.001
	--	1.50	--	--	--	1,135	0.026	728	0.017
	--	2.50	--	--	--	2,622	0.060	2,607	0.060
	--	3.50	--	--	--	4,921	0.113	6,378	0.146
	--	4.50	--	--	--	7,124	0.164	12,401	0.285
	--	5.00	--	--	--	8,280	0.190	16,252	0.373

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)



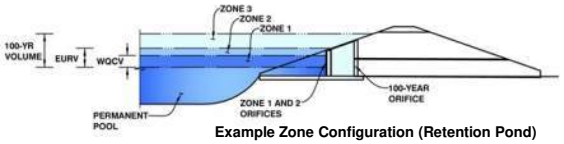


DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)

Project: 4480 S. Holly St

Basin ID: Developed Basin



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	2.38	0.052	Orifice Plate
Zone 2 (EURV)	3.36	0.078	Circular Orifice
Zone 3 (100-year)	4.53	0.159	Weir (No Pipe)
Total (all zones)		0.289	

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

Underdrain Orifice Invert Depth =	N/A	ft (distance below the filtration media surface)	Underdrain Orifice Area =	N/A	ft^2
Underdrain Orifice Diameter =	N/A	inches	Underdrain Orifice Centroid =	N/A	feet

Calculated Parameters for Underdrain

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

Centroid of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)	WQ Orifice Area per Row =	1.451E-03	ft^2
Depth at top of Zone using Orifice Plate =	2.38	ft (relative to basin bottom at Stage = 0 ft)	Elliptical Half-Width =	N/A	feet
Orifice Plate: Orifice Vertical Spacing =	N/A	inches	Elliptical Slot Centroid =	N/A	feet
Orifice Plate: Orifice Area per Row =	0.21	sq. inches (diameter = 1/2 inch)	Elliptical Slot Area =	N/A	ft^2

Calculated Parameters for Plate

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

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00	0.80	1.60					
Orifice Area (sq. inches)	0.21	0.21	0.21					

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

User Input: Vertical Orifice (Circular or Rectangular)

	Zone 2 Circular	Not Selected			Zone 2 Circular	Not Selected	
Invert of Vertical Orifice =	2.38	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Area =	0.02	N/A	ft^2
Depth at top of Zone using Vertical Orifice =	3.36	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Centroid =	0.08	N/A	feet
Vertical Orifice Diameter =	1.83	N/A	inches				

Calculated Parameters for Vertical Orifice

User Input: Overflow Weir (Dropbox with Flat or Sloped Grate and Outlet Pipe OR Rectangular/Trapezoidal Weir and No Outlet Pipe)

	Zone 3 Weir	Not Selected			Zone 3 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	3.55	N/A	ft (relative to basin bottom at Stage = 0 ft)	Height of Grate Upper Edge, H_t =	N/A	N/A	feet
Overflow Weir Bottom Length =	2.00	N/A	feet	Overflow Weir Slope Length =	N/A	N/A	feet
Overflow Weir Side Slopes =	0.00	N/A	H:V	Grate Open Area / 100-yr Orifice Area =	N/A	N/A	
Horiz. Length of Weir Sides =	N/A	N/A	feet	Overflow Grate Open Area w/o Debris =	N/A	N/A	ft^2
Overflow Grate Type =	N/A	N/A		Overflow Grate Open Area w/ Debris =	N/A	N/A	ft^2
Debris Clogging % =	N/A	N/A	%				

Calculated Parameters for Overflow Weir

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

	Not Selected	Not Selected			Not Selected	Not Selected	
Depth to Invert of Outlet Pipe =	N/A	N/A	ft (distance below basin bottom at Stage = 0 ft)	Outlet Orifice Area =	N/A	N/A	ft^2
Circular Orifice Diameter =	N/A	N/A	inches	Outlet Orifice Centroid =	N/A	N/A	feet
				Half-Central Angle of Restrictor Plate on Pipe =	N/A	N/A	radians

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	4.50	ft (relative to basin bottom at Stage = 0 ft)	Spillway Design Flow Depth=	0.36	feet
Spillway Crest Length =	13.00	feet	Stage at Top of Freeboard =	4.86	feet
Spillway End Slopes =	4.00	H:V	Basin Area at Top of Freeboard =	0.18	acres
Freeboard above Max Water Surface =	0.00	feet	Basin Volume at Top of Freeboard =	0.35	acre-ft
Spillway position relative to Overflow Weir =	Overlapping				

Calculated Parameters for Spillway

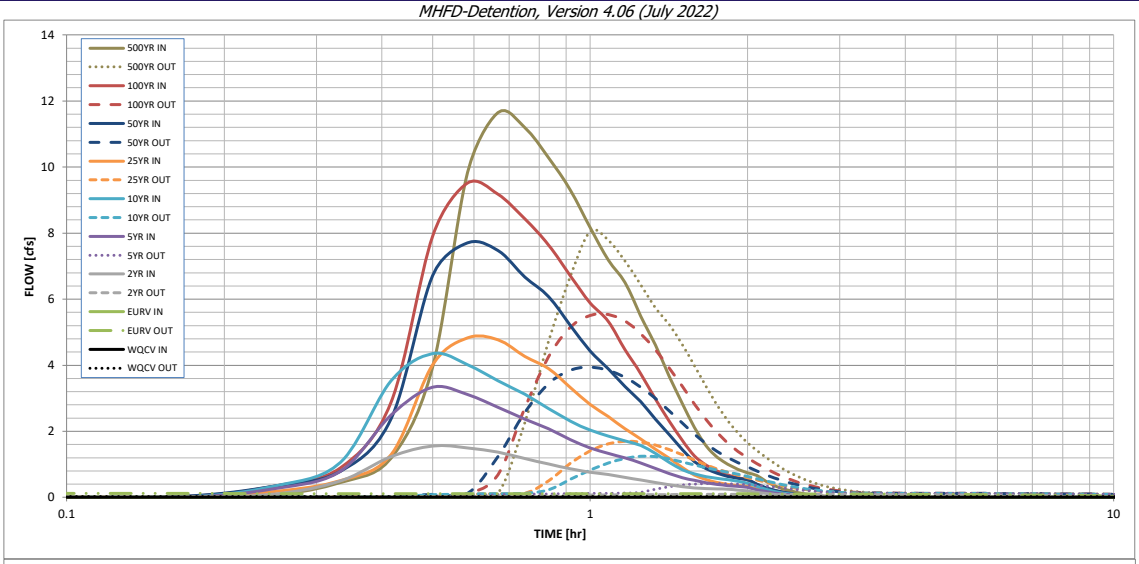
Routed Hydrograph Results

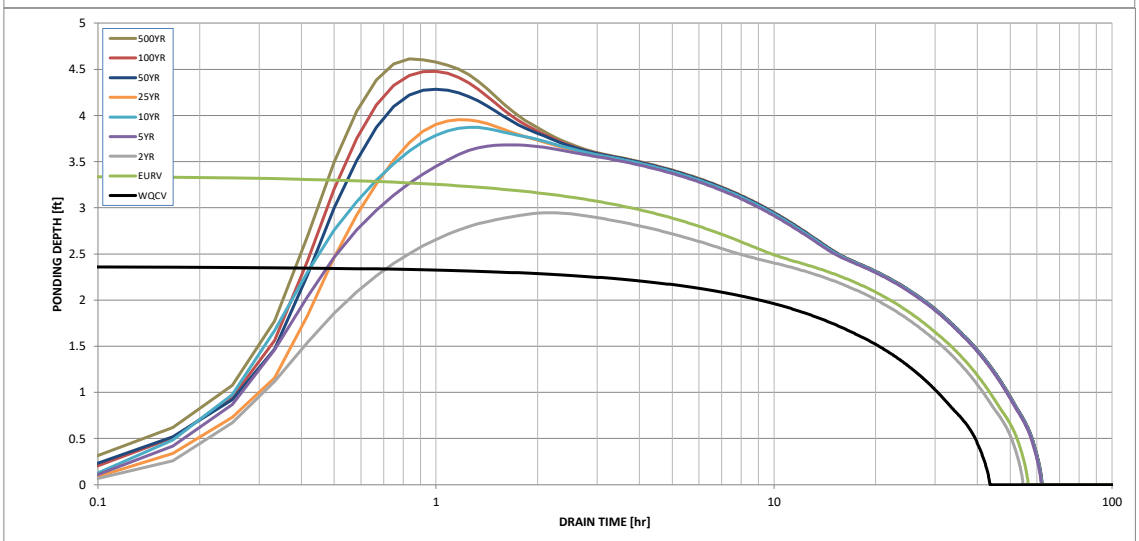
The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AF).

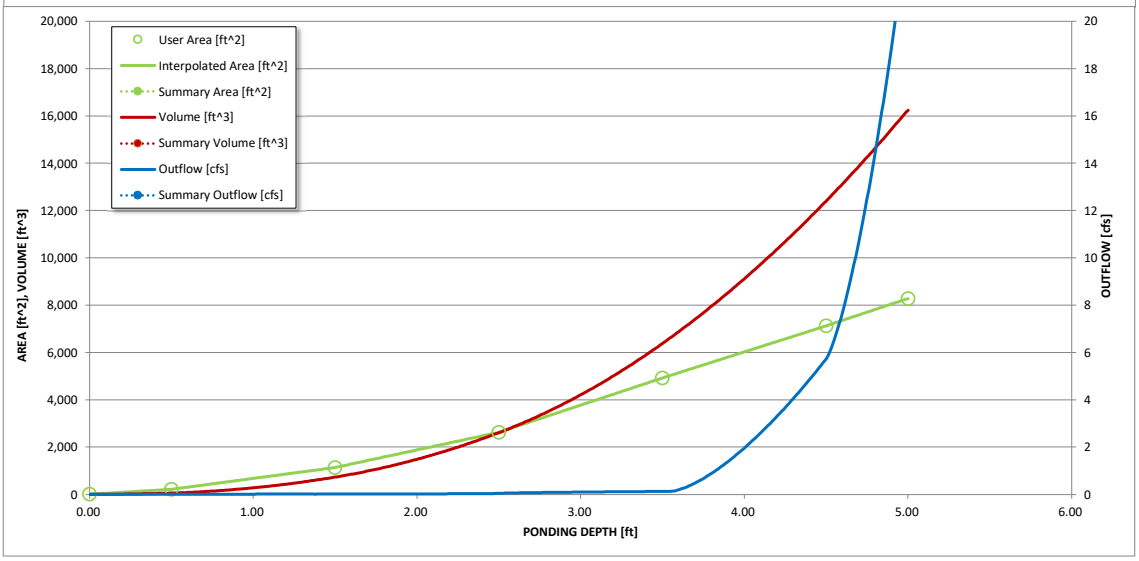
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	0.97	1.38	1.65	1.69	2.32	2.67	3.14
CUHP Runoff Volume (acre-ft) =	0.052	0.130	0.104	0.202	0.275	0.299	0.479	0.594	0.732
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	0.104	0.202	0.275	0.299	0.479	0.594	0.732
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	0.1	1.3	2.0	2.5	4.6	5.8	7.4
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A							
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.03	0.37	0.57	0.73	1.31	1.67	2.11
Peak Inflow Q (cfs) =	N/A	N/A	1.6	3.3	4.4	4.8	7.7	9.5	11.6
Peak Outflow Q (cfs) =	0.0	0.1	0.1	0.4	1.2	1.7	3.9	5.5	8.0
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.3	0.6	0.7	0.9	0.9	1.1
Structure Controlling Flow =	Plate	Vertical Orifice 1	Vertical Orifice 1	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Spillway
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =	39	47	46	49	47	46	41	38	35
Time to Drain 99% of Inflow Volume (hours) =	**41**	52	51	56	55	54	51	50	48
Maximum Ponding Depth (ft) =	2.37	3.35	2.95	3.68	3.87	3.96	4.29	4.48	4.61
Area at Maximum Ponding Depth (acres) =	0.06	0.11	0.08	0.12	0.13	0.14	0.15	0.16	0.17
Maximum Volume Stored (acre-ft) =	0.052	0.130	0.091	0.168	0.192	0.202	0.250	0.280	0.303

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)







S-A-V-D Chart Axis Override	X-axis	Left Y-Axis	Right Y-Axis
minimum bound			
maximum bound			

DETENTION BASIN OUTLET STRUCTURE DESIGN

Outflow Hydrograph Workbook Filename: _____

Inflow Hydrographs

The user can override the calculated inflow hydrographs from this workbook with inflow hydrographs developed in a separate program.

Time Interval	SOURCE	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP
	TIME	WQCV [cfs]	EURV [cfs]	2 Year [cfs]	5 Year [cfs]	10 Year [cfs]	25 Year [cfs]	50 Year [cfs]	100 Year [cfs]	500 Year [cfs]
5.00 min	0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.02	0.07
	0:15:00	0.00	0.00	0.10	0.26	0.35	0.18	0.34	0.35	0.45
	0:20:00	0.00	0.00	0.50	0.79	1.06	0.51	0.78	0.90	1.19
	0:25:00	0.00	0.00	1.24	2.49	3.53	1.29	2.37	2.88	3.95
	0:30:00	0.00	0.00	1.56	3.33	4.35	4.02	6.72	7.91	9.83
	0:35:00	0.00	0.00	1.50	3.11	4.02	4.83	7.71	9.51	11.65
	0:40:00	0.00	0.00	1.37	2.73	3.53	4.77	7.48	9.18	11.20
	0:45:00	0.00	0.00	1.17	2.37	3.12	4.26	6.67	8.43	10.28
	0:50:00	0.00	0.00	1.01	2.07	2.69	3.90	6.08	7.64	9.31
	0:55:00	0.00	0.00	0.87	1.75	2.31	3.32	5.20	6.71	8.17
	1:00:00	0.00	0.00	0.76	1.49	2.03	2.81	4.43	5.89	7.18
	1:05:00	0.00	0.00	0.69	1.33	1.86	2.44	3.89	5.32	6.51
	1:10:00	0.00	0.00	0.60	1.20	1.71	2.08	3.35	4.47	5.49
	1:15:00	0.00	0.00	0.52	1.04	1.57	1.77	2.90	3.74	4.61
	1:20:00	0.00	0.00	0.45	0.88	1.33	1.46	2.37	2.98	3.67
	1:25:00	0.00	0.00	0.38	0.72	1.06	1.18	1.91	2.31	2.84
	1:30:00	0.00	0.00	0.32	0.59	0.84	0.91	1.45	1.73	2.12
	1:35:00	0.00	0.00	0.29	0.52	0.71	0.67	1.08	1.25	1.55
	1:40:00	0.00	0.00	0.27	0.44	0.63	0.53	0.86	0.98	1.22
	1:45:00	0.00	0.00	0.26	0.39	0.57	0.45	0.73	0.80	1.00
	1:50:00	0.00	0.00	0.25	0.36	0.53	0.39	0.64	0.68	0.85
	1:55:00	0.00	0.00	0.22	0.33	0.49	0.36	0.57	0.59	0.74
	2:00:00	0.00	0.00	0.20	0.30	0.43	0.33	0.53	0.53	0.67
	2:05:00	0.00	0.00	0.15	0.23	0.33	0.25	0.40	0.39	0.49
	2:10:00	0.00	0.00	0.12	0.17	0.25	0.19	0.30	0.28	0.35
	2:15:00	0.00	0.00	0.09	0.13	0.18	0.14	0.22	0.21	0.26
	2:20:00	0.00	0.00	0.07	0.10	0.13	0.10	0.16	0.15	0.19
	2:25:00	0.00	0.00	0.05	0.07	0.10	0.08	0.12	0.11	0.14
	2:30:00	0.00	0.00	0.04	0.05	0.07	0.06	0.09	0.08	0.10
	2:35:00	0.00	0.00	0.03	0.04	0.05	0.04	0.06	0.06	0.08
	2:40:00	0.00	0.00	0.02	0.02	0.04	0.03	0.04	0.04	0.05
	2:45:00	0.00	0.00	0.01	0.02	0.02	0.02	0.03	0.03	0.04
	2:50:00	0.00	0.00	0.01	0.01	0.01	0.01	0.02	0.02	0.02
	2:55:00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01
	3:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)

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]

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).

Basin Calculations

	Site
Impervious Area (SQFT)	24226
Imperviousness	26.8%
Basin Size (SQFT)	90436
Rainfall (in) 2-yr	0.97
Rainfall (in) 5-yr	1.38
Rainfall (in) 10-yr	1.65
Rainfall (in) 50-yr	2.32
Rainfall (in) 100-yr	2.67
Watershed Length	405
Watershed Slope	5.3%

Hydrologic Soil Group	
Soil Group A	0%
Soil Group B	0%
Soil Group C/D	100%

100-Year Storage Min.	
V_{100} Watershed in.	0.691
V_{100} ft^3	5209.996
V_{100} acre-feet	0.120

100-Year Volume. A simplified equation can be used to determine the required 100-year full spectrum detention volume for tributary areas less than 10 acres. This volume includes the EURV (and the EURV includes the WQCV). UDFCD does not recommend adding additional volume above that provided in Equation 12-4. The derivation of this equation is documented in a Technical Memorandum entitled *Estimation of Runoff and Storage Volumes for Use with Full Spectrum Detention*, dated January 5, 2017 (available at www.udfcd.org). If a more detailed analysis is desired, see Table 12-5. The 100-year volume in watershed inches is converted to cubic feet or acre-feet by multiplying by watershed area and converting units.

$$V_{100} = P_1\left[\begin{array}{l}(0.806i^{1.225} + 0.109i^{0.225})A\% + (0.412i^{1.371} + 0.371i^{0.371})B\% \\ +(0.341i^{1.389} + 0.398i^{0.389})CD\%\end{array}\right] \qquad \text{Equation 12-4}$$

HEC-RAS Version 3.1.1 May 2003
U.S. Army Corp of Engineers
Hydrologic Engineering Center
609 Second Street, Suite D
Davis, California 95616-4687
(916) 756-1104

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

****

PROJECT DATA
Project Title: Little Dry Creek Steady Flow Model
Project File : LDC2099.prj
Run Date and Time: 8/7/2003 11:32:36 AM

Project in English units

Project Description:
Little Dry Creek & its tributaries U.S. of Clarkson & D.S. of Holly & Englewood
Dam.

****

PLAN DATA

Plan Title: Plan 01
Plan File : L:\2099\UDFCD CD\HECRAS\LDC\Phase B\Existing\LDC2099.p01

Geometry Title: LDC_system with overflows
Geometry File : L:\2099\UDFCD CD\HECRAS\LDC\Phase B\Existing\LDC2099.g02

Flow Title : steady
Flow File : L:\2099\UDFCD CD\HECRAS\LDC\Phase B\Existing\LDC2099.f05

Plan Description:
Little Dry Creek Steady Flow Run

Plan Summary Information:
Number of: Cross Sections = 309 Mulitple Openings = 0

Culverts = 14 Inline Structures = 0
Bridges = 23 Lateral Structures = 1

Computational Information
Water surface calculation tolerance = 0.01
Critical depth calculaton tolerance = 0.01
Maximum number of interations = 20
Maximum difference tolerance = 0.3
Flow tolerance factor = 0.001

Computation Options
Critical depth computed only where necessary
Conveyance Calculation Method: At breaks in n values only
Friction Slope Method: Average Conveyance
Computational Flow Regime: Subcritical Flow

****

FLOW DATA

Flow Title: steady
Flow File : L:\2099\UDFCD CD\HECRAS\LDC\Phase B\Existing\LDC2099.f05

Flow Data (cfs)

River	Reach	RS	100-Yr.	10-Yr.	50-Yr.	500-Yr.
LDC	Prentice	2734.212	811	377	712	1163

* LDC	Greenwood_upper	25528.11*	2112	1058	1842	3225 *
* LDC	Greenwood	21914.89*	2922	1435	2553	4389 *
* LDC	Greenwood	17979.27*	2640	1156	2191	3959 *
* LDC	Quincy_gulch	5222.497*	642	280	538	986 *
* LDC	Blackmer	6803.225*	397	204	381	671 *
* LDC	Blackmer	5294.539*	945	437	839	1505 *
* LDC	Blackmer	3160.530*	985	437	839	1523 *
* LDC	Blackmer_lower	484.393 *	1587	644	1307	2442 *
* LDC	LDC-upper	44367.41*	240	160	170	600 *
* LDC	Willow_creek	4091.633*	560	410	560	780 *
* LDC	Willow_creek	122.892 *	752	476	773	1193 *
* LDC	Greenwood_lower	11642.10*	3291	1256	2557	5014 *
* LDC	Greenwood_lower	5931.511*	2813	1034	2164	4308 *
* LDC	LDC	43477.75*	874	531	874	1316 *
* LDC	LDC	42142.68*	1682	942	1572	2558 *
* LDC	LDC	37135.86*	2109	998	1758	3058 *
* LDC	LDC	29809.75*	2308	1007	1881	3368 *
* LDC	LDC	15179.18*	1934	943	1577	2832 *
* LDC	LDC_lower	9673.015*	3146	1323	2452	4822 *
* LDC	LDC_lower	9161.924*	4581	1845	3633	6855 *

Boundary Conditions

* River	Reach	Profile	* Upstream	Downstream *
* LDC	LDC_lower	100-Yr.	*	Known WS = 5335.4 *
* LDC	LDC_lower	10-Yr.	*	Known WS = 5332.1 *
* LDC	LDC_lower	50-Yr.	*	Known WS = 5334 *
* LDC	LDC_lower	500-Yr.	*	Known WS = 5339.4 *

****

GEOMETRY DATA

Geometry Title: LDC_system with overflows
Geometry File : L:\2099\UDFCD CD\HECRAS\LDC\Phase B\Existing\LDC2099.g02

Reach Connection Table

* River	Reach	* Upstream Boundary	* Downstream Boundary *
* LDC	Prentice	*	* gwg_prentice *
* LDC	Greenwood_upper	*	* gwg_prentice *
* LDC	Greenwood	* gwg_prentice	* gwg_blkmr *
* LDC	Quincy_gulch	*	* blkmr_quincy *
* LDC	Blackmer	*	* blkmr_quincy *
* LDC	Blackmer_lower	* blkmr_quincy	* gwg_blkmr *
* LDC	LDC-upper	*	* ldc_willow *
* LDC	Willow_creek	*	* ldc_willow *
* LDC	Greenwood_lower	* gwg_blkmr	* LDC-GWG *
* LDC	LDC	* ldc_willow	* LDC-GWG *
* LDC	LDC_lower	* LDC-GWG	*

JUNCTION INFORMATION

Name: LDC-GWG
Description: Greenwood Gulch Confluence w/ Little Dry Creek
Energy computation Method

Length across Junction River	Reach		Tributary River	Reach	Length	Angle
LDC	LDC	to LDC	LDC_lower		688.4	
LDC	Greenwood_lower	to LDC	LDC_lower		1225.88	

Name: blkmr_quincy
Description: Quincy Gulch confluence w/ Blackmer Gulch
Energy computation Method

Length across Junction River	Reach		Tributary River	Reach	Length	Angle
LDC	Blackmer	to LDC	Blackmer_lower		439.16	
LDC	Quincy_gulch	to LDC	Blackmer_lower		789	

Name: gwg_blkmr
Description: Blackmer Confluence w/ Greenwood Gulch
Energy computation Method

Length across Junction Tributary

Worksheet for Developed Section "A"-100-yr

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Channel Slope	0.020 ft/ft
Discharge	397.00 cfs

Section Definitions

Station (ft)	Elevation (ft)
0+05	5,535.00
0+33	5,529.40
0+43	5,529.40
0+57	5,533.00
0+63	5,534.10
0+75	5,534.33

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+05, 5,535.00)	(0+33, 5,529.40)	0.035
(0+33, 5,529.40)	(0+43, 5,529.40)	0.030
(0+43, 5,529.40)	(0+63, 5,534.10)	0.035
(0+63, 5,534.10)	(0+75, 5,534.33)	0.016

Options	
Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results	
Normal Depth	28.5 in
Roughness Coefficient	0.034
Elevation	5,531.78 ft
Elevation Range	5,529.4 to 5,535.0 ft
Flow Area	47.8 ft²
Wetted Perimeter	31.3 ft
Hydraulic Radius	18.3 in
Top Width	30.74 ft
Normal Depth	28.5 in
Critical Depth	31.0 in
Critical Slope	0.014 ft/ft
Velocity	8.31 ft/s

Worksheet for Developed Section "A"-100-yr

Results	
Velocity Head	1.07 ft
Specific Energy	3.45 ft
Froude Number	1.175
Flow Type	Supercritical

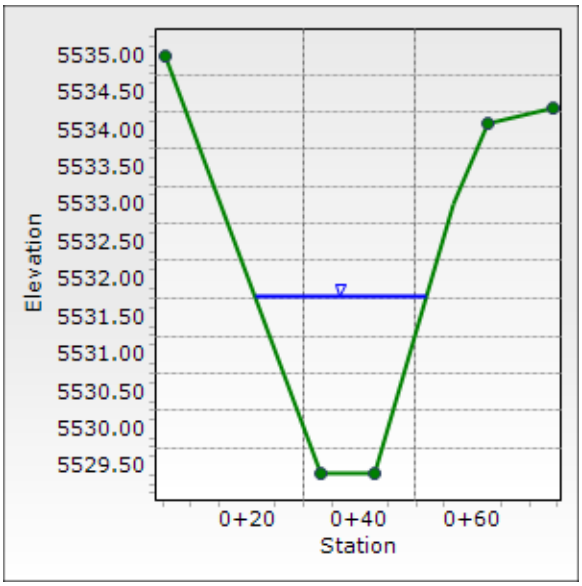
GVF Input Data	
Downstream Depth	0.0 in
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	28.5 in
Critical Depth	31.0 in
Channel Slope	0.020 ft/ft
Critical Slope	0.014 ft/ft

Cross Section for Developed Section "A"-100-yr

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Channel Slope	0.020 ft/ft
Normal Depth	28.5 in
Discharge	397.00 cfs



Worksheet for Developed Section "A"-500-yr

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Channel Slope	0.020 ft/ft
Discharge	671.00 cfs

Section Definitions

Station (ft)	Elevation (ft)
0+05	5,535.00
0+33	5,529.40
0+43	5,529.40
0+57	5,533.00
0+63	5,534.10
0+75	5,534.33

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+05, 5,535.00)	(0+33, 5,529.40)	0.035
(0+33, 5,529.40)	(0+43, 5,529.40)	0.030
(0+43, 5,529.40)	(0+63, 5,534.10)	0.035
(0+63, 5,534.10)	(0+75, 5,534.33)	0.016

Options	
Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results	
Normal Depth	36.7 in
Roughness Coefficient	0.034
Elevation	5,532.45 ft
Elevation Range	5,529.4 to 5,535.0 ft
Flow Area	70.7 ft²
Wetted Perimeter	37.5 ft
Hydraulic Radius	22.6 in
Top Width	36.82 ft
Normal Depth	36.7 in
Critical Depth	40.2 in
Critical Slope	0.013 ft/ft
Velocity	9.49 ft/s

Worksheet for Developed Section "A"-500-yr

Results	
Velocity Head	1.40 ft
Specific Energy	4.45 ft
Froude Number	1.207
Flow Type	Supercritical

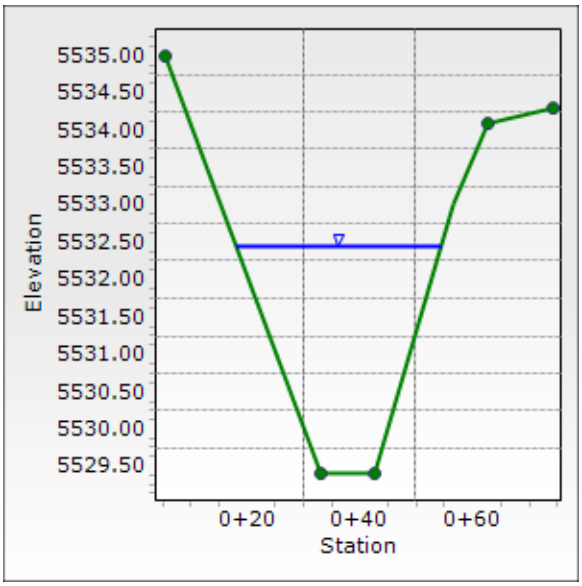
GVF Input Data	
Downstream Depth	0.0 in
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	36.7 in
Critical Depth	40.2 in
Channel Slope	0.020 ft/ft
Critical Slope	0.013 ft/ft

Cross Section for Developed Section "A"-500-yr

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Channel Slope	0.020 ft/ft
Normal Depth	36.7 in
Discharge	671.00 cfs



Worksheet for Existing Section "A"-100-yr

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data		
Channel Slope	0.006	ft/ft
Discharge	397.00	cfs

Section Definitions

Station (ft)	Elevation (ft)
0+05	5,535.02
0+19	5,537.33
0+36	5,532.79
0+45	5,531.99
0+57	5,533.00
0+63	5,533.93
0+75	5,534.33

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+05, 5,535.02)	(0+36, 5,532.79)	0.035
(0+36, 5,532.79)	(0+57, 5,533.00)	0.030
(0+57, 5,533.00)	(0+63, 5,533.93)	0.035
(0+63, 5,533.93)	(0+75, 5,534.33)	0.016

Options	
Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results		
Normal Depth	34.1	in
Roughness Coefficient	0.029	
Elevation	5,534.83	ft
Elevation Range	5,532.0 to 5,537.3	ft
Flow Area	73.8	ft²
Wetted Perimeter	47.3	ft
Hydraulic Radius	18.7	in
Top Width	46.37	ft
Normal Depth	34.1	in
Critical Depth	30.6	in
Critical Slope	0.011	ft/ft

Worksheet for Existing Section "A"-100-yr

Results	
Velocity	5.38 ft/s
Velocity Head	0.45 ft
Specific Energy	3.29 ft
Froude Number	0.752
Flow Type	Subcritical

GVF Input Data	
Downstream Depth	0.0 in
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	0.00 ft/s
Upstream Velocity	0.00 ft/s
Normal Depth	34.1 in
Critical Depth	30.6 in
Channel Slope	0.006 ft/ft
Critical Slope	0.011 ft/ft

Worksheet for Existing Section "A"-100-yr

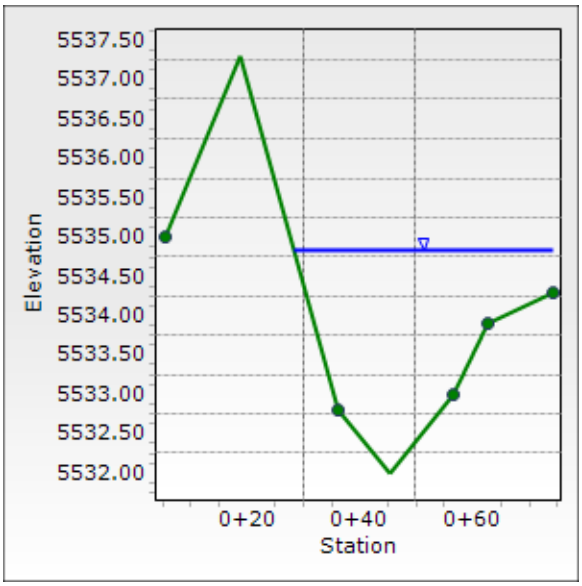
Messages:

Water Surface Elevation exceeds lowest end station by 0.499964556447594ft.

Cross Section for Existing Section "A"-100-yr

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Channel Slope	0.006 ft/ft
Normal Depth	34.1 in
Discharge	397.00 cfs



Worksheet for Existing Section "A"-500-yr

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Channel Slope	0.006 ft/ft
Discharge	671.00 cfs

Section Definitions

Station (ft)	Elevation (ft)
0+05	5,535.02
0+19	5,537.33
0+36	5,532.79
0+45	5,531.99
0+57	5,533.00
0+63	5,533.93
0+75	5,534.33

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+05, 5,535.02)	(0+36, 5,532.79)	0.035
(0+36, 5,532.79)	(0+57, 5,533.00)	0.030
(0+57, 5,533.00)	(0+63, 5,533.93)	0.035
(0+63, 5,533.93)	(0+75, 5,534.33)	0.016

Options	
Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results	
Normal Depth	42.6 in
Roughness Coefficient	0.029
Elevation	5,535.54 ft
Elevation Range	5,532.0 to 5,537.3 ft
Flow Area	108.4 ft²
Wetted Perimeter	54.4 ft
Hydraulic Radius	23.9 in
Top Width	52.14 ft
Normal Depth	42.6 in
Critical Depth	37.6 in
Critical Slope	0.011 ft/ft

Worksheet for Existing Section "A"-500-yr

Results	
Velocity	6.19 ft/s
Velocity Head	0.60 ft
Specific Energy	4.14 ft
Froude Number	0.757
Flow Type	Subcritical

GVF Input Data	
Downstream Depth	0.0 in
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	0.00 ft/s
Upstream Velocity	0.00 ft/s
Normal Depth	42.6 in
Critical Depth	37.6 in
Channel Slope	0.006 ft/ft
Critical Slope	0.011 ft/ft

Worksheet for Existing Section "A"-500-yr

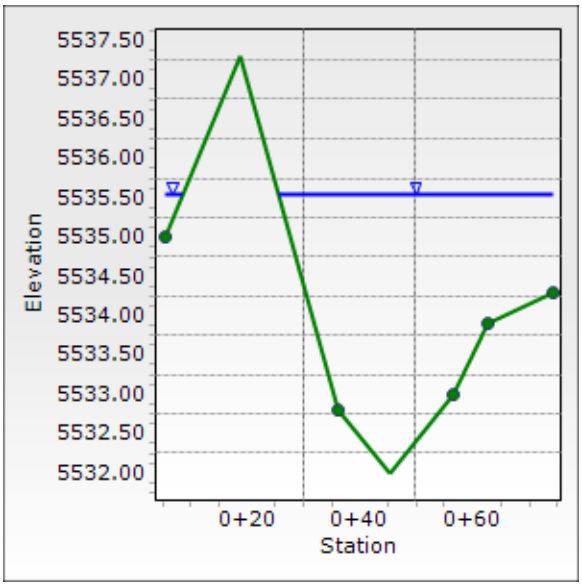
Messages:

Water Surface Elevation exceeds lowest end station by 1.20924330688558ft. Flow is divided.

Cross Section for Existing Section "A"-500-yr

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Channel Slope	0.006 ft/ft
Normal Depth	42.6 in
Discharge	671.00 cfs



Worksheet for Developed Section "B"-100-yr

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Channel Slope	0.020 ft/ft
Discharge	397.00 cfs

Section Definitions

Station (ft)	Elevation (ft)
0+02	5,534.57
0+33	5,528.21
0+40	5,528.21
0+59	5,532.86
0+63	5,533.37
0+75	5,533.55

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+02, 5,534.57)	(0+33, 5,528.21)	0.035
(0+33, 5,528.21)	(0+40, 5,528.21)	0.030
(0+40, 5,528.21)	(0+63, 5,533.37)	0.035
(0+63, 5,533.37)	(0+75, 5,533.55)	0.016

Options	
Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results	
Normal Depth	31.1 in
Roughness Coefficient	0.034
Elevation	5,530.80 ft
Elevation Range	5,528.2 to 5,534.6 ft
Flow Area	47.7 ft²
Wetted Perimeter	30.6 ft
Hydraulic Radius	18.7 in
Top Width	30.02 ft
Normal Depth	31.1 in
Critical Depth	33.4 in
Critical Slope	0.014 ft/ft
Velocity	8.32 ft/s

Worksheet for Developed Section "B"-100-yr

Results	
Velocity Head	1.08 ft
Specific Energy	3.67 ft
Froude Number	1.164
Flow Type	Supercritical

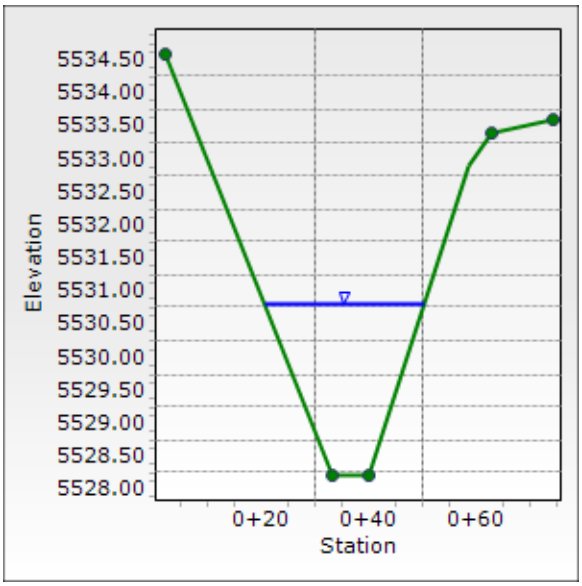
GVF Input Data	
Downstream Depth	0.0 in
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	31.1 in
Critical Depth	33.4 in
Channel Slope	0.020 ft/ft
Critical Slope	0.014 ft/ft

Cross Section for Developed Section "B"-100-yr

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Channel Slope	0.020 ft/ft
Normal Depth	31.1 in
Discharge	397.00 cfs



Worksheet for Developed Section "B"-500-yr

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Channel Slope	0.020 ft/ft
Discharge	671.00 cfs

Section Definitions

Station (ft)	Elevation (ft)
0+02	5,534.57
0+33	5,528.21
0+40	5,528.21
0+59	5,532.86
0+63	5,533.37
0+75	5,533.55

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+02, 5,534.57)	(0+33, 5,528.21)	0.035
(0+33, 5,528.21)	(0+40, 5,528.21)	0.030
(0+40, 5,528.21)	(0+63, 5,533.37)	0.035
(0+63, 5,533.37)	(0+75, 5,533.55)	0.016

Options	
Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results	
Normal Depth	39.4 in
Roughness Coefficient	0.034
Elevation	5,531.49 ft
Elevation Range	5,528.2 to 5,534.6 ft
Flow Area	70.7 ft²
Wetted Perimeter	37.0 ft
Hydraulic Radius	23.0 in
Top Width	36.24 ft
Normal Depth	39.4 in
Critical Depth	42.9 in
Critical Slope	0.014 ft/ft
Velocity	9.49 ft/s

Worksheet for Developed Section "B"-500-yr

Results	
Velocity Head	1.40 ft
Specific Energy	4.68 ft
Froude Number	1.197
Flow Type	Supercritical

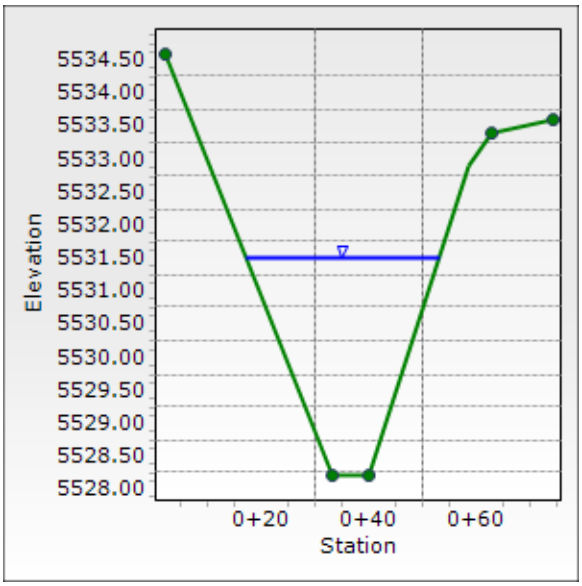
GVF Input Data	
Downstream Depth	0.0 in
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	39.4 in
Critical Depth	42.9 in
Channel Slope	0.020 ft/ft
Critical Slope	0.014 ft/ft

Cross Section for Developed Section "B"-500-yr

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Channel Slope	0.020 ft/ft
Normal Depth	39.4 in
Discharge	671.00 cfs



Worksheet for Existing Section "B"-100-yr

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Channel Slope	0.006 ft/ft
Discharge	397.00 cfs

Section Definitions

Station (ft)	Elevation (ft)
0+02	5,534.57
0+20	5,536.92
0+36	5,532.76
0+46	5,532.27
0+59	5,532.86
0+63	5,533.37
0+75	5,533.55

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+02, 5,534.57)	(0+36, 5,532.76)	0.035
(0+36, 5,532.76)	(0+59, 5,532.86)	0.030
(0+59, 5,532.86)	(0+63, 5,533.37)	0.035
(0+63, 5,533.37)	(0+75, 5,533.55)	0.016

Options	
Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results	
Normal Depth	28.2 in
Roughness Coefficient	0.029
Elevation	5,534.62 ft
Elevation Range	5,532.3 to 5,536.9 ft
Flow Area	73.6 ft²
Wetted Perimeter	47.6 ft
Hydraulic Radius	18.5 in
Top Width	46.24 ft
Normal Depth	28.2 in
Critical Depth	24.6 in
Critical Slope	0.011 ft/ft

Worksheet for Existing Section "B"-100-yr

Results	
Velocity	5.39 ft/s
Velocity Head	0.45 ft
Specific Energy	2.80 ft
Froude Number	0.753
Flow Type	Subcritical

GVF Input Data	
Downstream Depth	0.0 in
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	0.00 ft/s
Upstream Velocity	0.00 ft/s
Normal Depth	28.2 in
Critical Depth	24.6 in
Channel Slope	0.006 ft/ft
Critical Slope	0.011 ft/ft

Worksheet for Existing Section "B"-100-yr

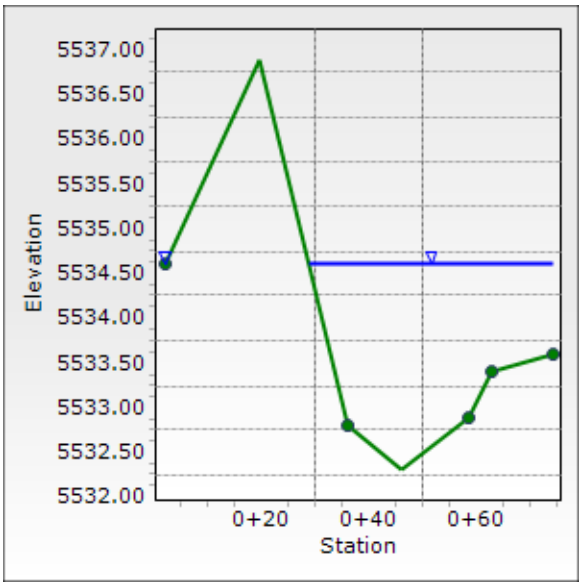
Messages:

Water Surface Elevation exceeds lowest end station by 1.06749398983902ft. Flow is divided.

Cross Section for Existing Section "B"-100-yr

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Channel Slope	0.006 ft/ft
Normal Depth	28.2 in
Discharge	397.00 cfs



Worksheet for Existing Section "B"-500-yr

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Channel Slope	0.006 ft/ft
Discharge	671.00 cfs

Section Definitions

Station (ft)	Elevation (ft)
0+02	5,534.57
0+20	5,536.92
0+36	5,532.76
0+46	5,532.27
0+59	5,532.86
0+63	5,533.37
0+75	5,533.55

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+02, 5,534.57)	(0+36, 5,532.76)	0.035
(0+36, 5,532.76)	(0+59, 5,532.86)	0.030
(0+59, 5,532.86)	(0+63, 5,533.37)	0.035
(0+63, 5,533.37)	(0+75, 5,533.55)	0.016

Options	
Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results	
Normal Depth	37.2 in
Roughness Coefficient	0.030
Elevation	5,535.37 ft
Elevation Range	5,532.3 to 5,536.9 ft
Flow Area	111.5 ft²
Wetted Perimeter	58.0 ft
Hydraulic Radius	23.1 in
Top Width	54.91 ft
Normal Depth	37.2 in
Critical Depth	31.9 in
Critical Slope	0.011 ft/ft

Worksheet for Existing Section "B"-500-yr

Results	
Velocity	6.02 ft/s
Velocity Head	0.56 ft
Specific Energy	3.66 ft
Froude Number	0.745
Flow Type	Subcritical

GVF Input Data	
Downstream Depth	0.0 in
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	0.00 ft/s
Upstream Velocity	0.00 ft/s
Normal Depth	37.2 in
Critical Depth	31.9 in
Channel Slope	0.006 ft/ft
Critical Slope	0.011 ft/ft

Worksheet for Existing Section "B"-500-yr

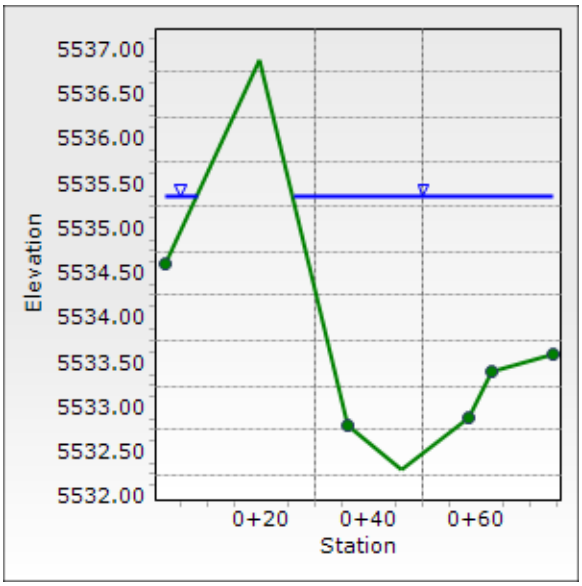
Messages:

Water Surface Elevation exceeds lowest end station by 1.81592398680641ft. Flow is divided.

Cross Section for Existing Section "B"-500-yr

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

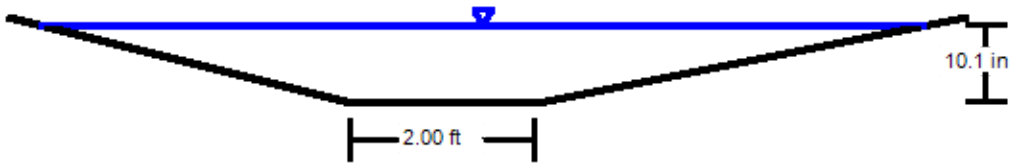
Input Data	
Channel Slope	0.006 ft/ft
Normal Depth	37.2 in
Discharge	671.00 cfs

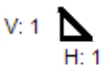


Cross Section for HollyStreet-100yr

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Roughness Coefficient	0.030
Channel Slope	0.085 ft/ft
Normal Depth	10.1 in
Left Side Slope	4.000 H:V
Right Side Slope	5.000 H:V
Bottom Width	2.00 ft
Discharge	44.20 cfs





Worksheet for HollyStreet-100yr

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Roughness Coefficient	0.030
Channel Slope	0.085 ft/ft
Left Side Slope	4.000 H:V
Right Side Slope	5.000 H:V
Bottom Width	2.00 ft
Discharge	44.20 cfs

Results	
Normal Depth	10.1 in
Flow Area	4.9 ft²
Wetted Perimeter	9.8 ft
Hydraulic Radius	6.0 in
Top Width	9.57 ft
Critical Depth	14.7 in
Critical Slope	0.015 ft/ft
Velocity	9.08 ft/s
Velocity Head	1.28 ft
Specific Energy	2.12 ft
Froude Number	2.244
Flow Type	Supercritical

GVF Input Data	
Downstream Depth	0.0 in
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	10.1 in
Critical Depth	14.7 in
Channel Slope	0.085 ft/ft
Critical Slope	0.015 ft/ft

Hydrologic Soil Group—Arapahoe County, Colorado
(4480 S Holly)

Map Scale: 1:698 if printed on A portrait (8.5" x 11") sheet.

N

Meters: 0 10 20 40 60

Feet: 0 30 60 120 180

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

MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

Soil Rating Polygons

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Lines

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Points

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Water Features

- Streams and Canals

Transportation

- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background

- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:20,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

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

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

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

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

Soil Survey Area: Arapahoe County, Colorado
Survey Area Data: Version 16, Jun 4, 2020

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

Date(s) aerial images were photographed: Oct 3, 2018—Dec 4, 2018

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

Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
RtE	Renohill-Litle-Thedalund complex, 9 to 30 percent slopes	D	2.6	100.0%
Totals for Area of Interest			**2.6**	**100.0%**

Description

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

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

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

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

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

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

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

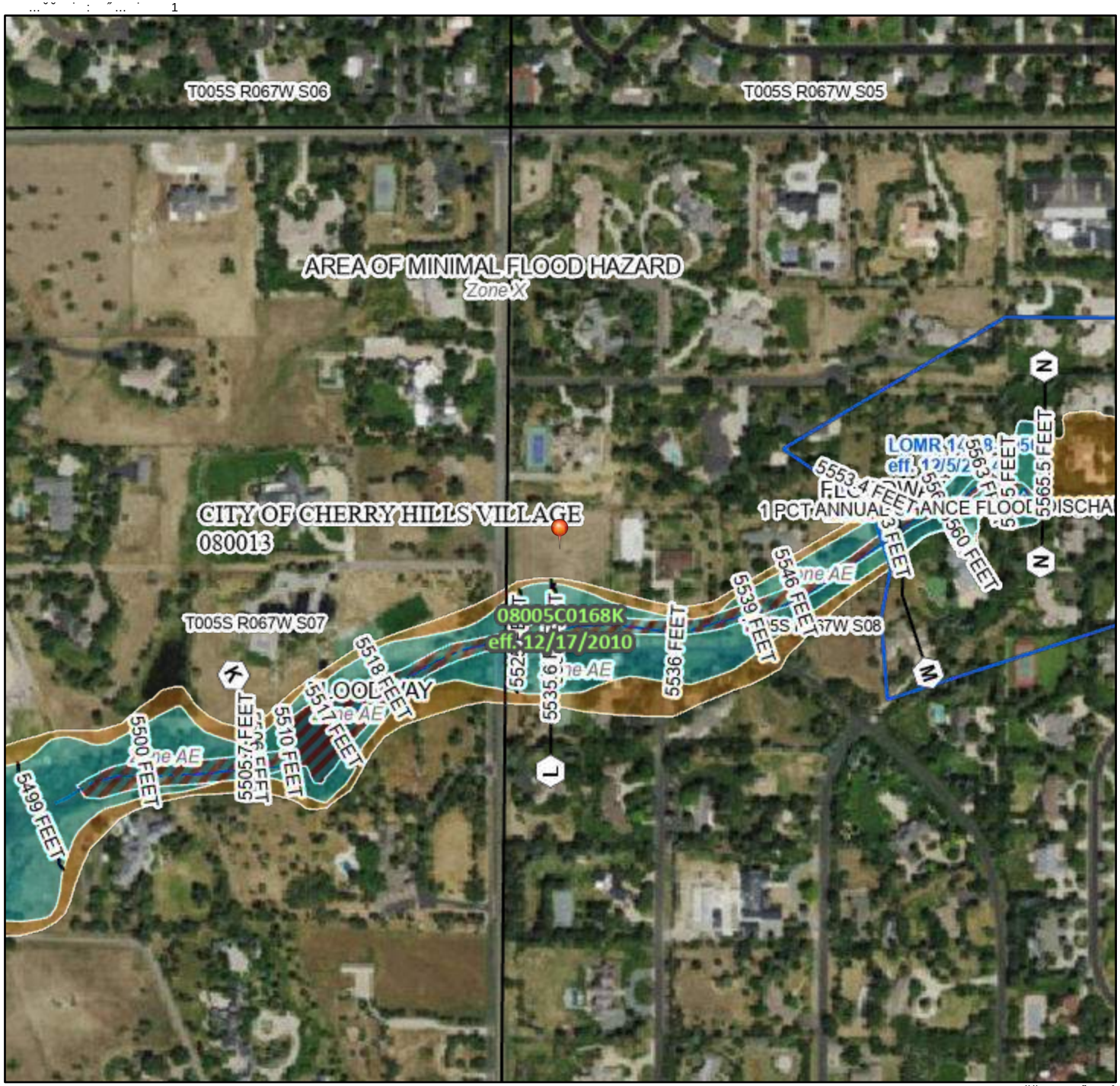
Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

1DWLRQDO)ORRG +D]DUG / FEMA



)HHW

/HJHQG

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RI DQQXDO FKDQFH IO
GHSWK OHVV WKDQ RQH
DUHDV RI OHVV WKDQ RQ
)XWXUH &RQGLWLRQV
&KDQFH)ORRG +D]DUG
$UHD ZLWK 5HGXFHG)OR
/HYHH 6HH 12WHV
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)/22' +$=$5'
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'LJLWDO 'DWD $YDLODEO
1R 'LJLWDO 'DWD $YDLOD
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8QPDSSHG

7KH SLQ GLVSOD\HG RQ WKH
SRLQW VHOHFWHG E\ WKH XV
DQ DXWKRULWDWLYH SURSHU

7KLV PDS FRPSOLHV ZLWK)(0$ V VWDQ
GLJLWDO IORRG PDSV LI LW LV QRW YR
7KH EDVHPDS VKRZQ FRPSOLHV ZLWK)(
DFFXUDF\ VWDQGDUGV

7KH IORRG KD]DUG LQIRUPDWLRQ LV GH
DXWKRULWDWLYH 1)+/ ZHE VHUYLFHV S
ZDV H[SRUWHG RQ DW ^ DQG GHV QRW
UHIOHFW FKDQJHV RU DPHQGPHQWV VX
WLPH 7KH 1)+/ DQG HIIHFWLYH LQIRUP
EHFRPH VXSHUVHGHG E\ QHZ GDWD RYH

7KLV PDS LPDJH LV YRLG LI WKH RQH R
HOHPHQWV GR QRW DSSHDU EDVHPDS
OHJHQG VFDOH EDU PDS FUHDWLRQ G
),50 SDQHO QXPEHU DQG),50 HIIHFWLY
XQPDSSHG DQG XQPRGHUQL]HG DUHDV
UHJXODWRU\ SXUSRVHV

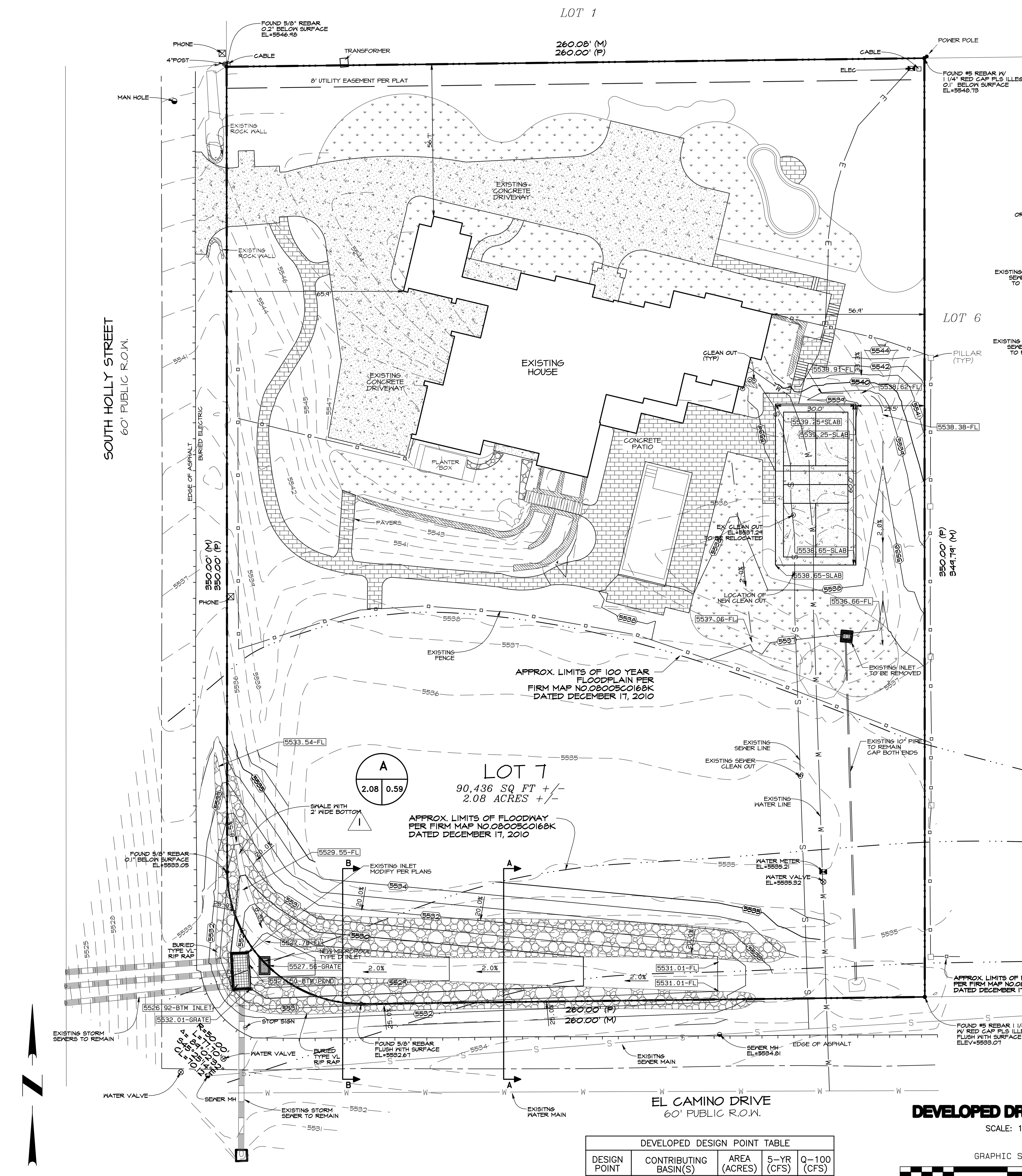
%DVHPDS ,PDJHU\ 6RXUFH¸ 86*6 1DWLRQDO 0DS

LEGEND

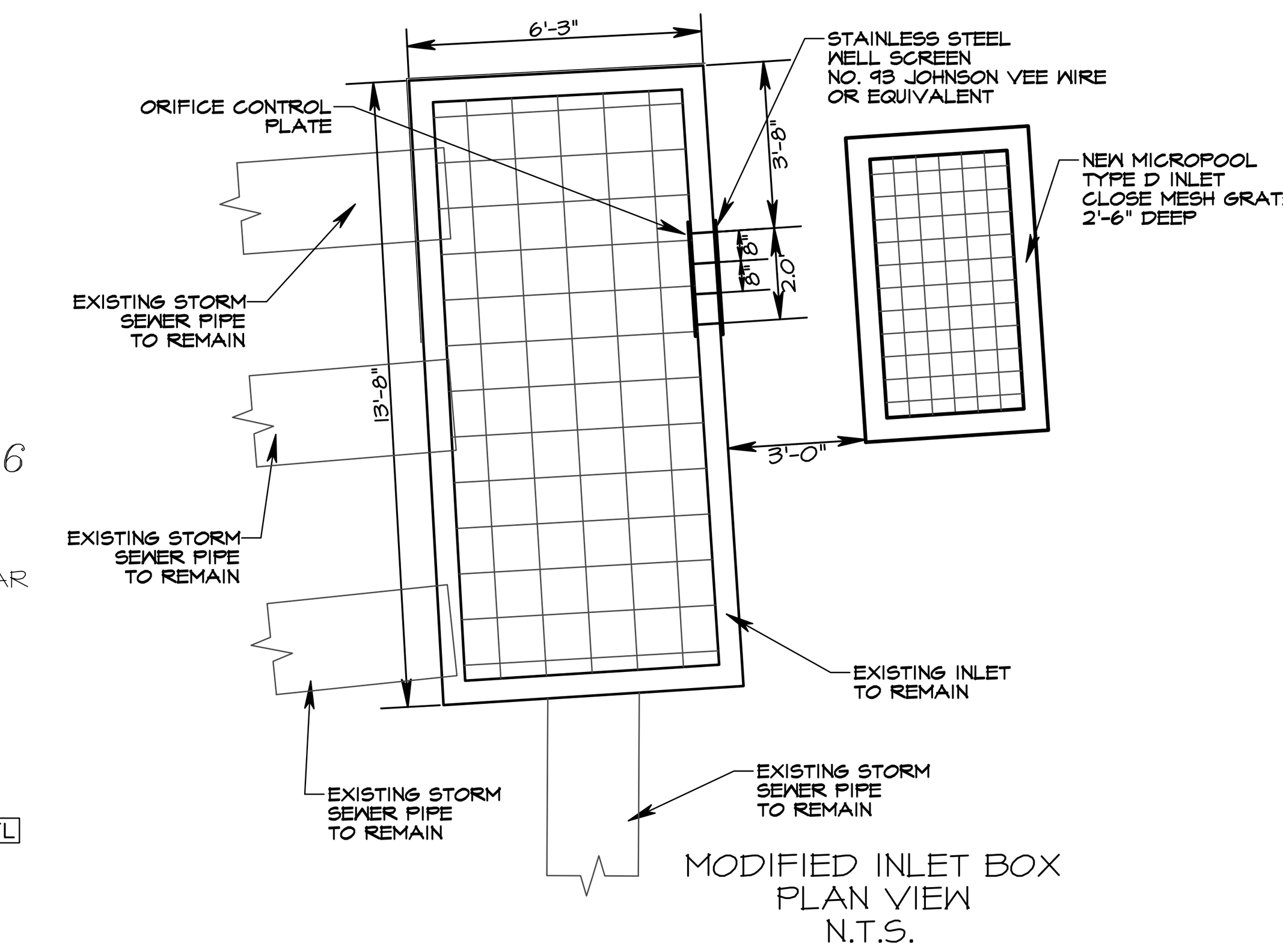
- = BASIN LINE
- = EXISTING CONTOUR (1' INTERVAL)
- = PROPOSED CONTOUR (1' INTERVAL)
- = DRAINAGE DIRECTION
- A-1 / 0.33 / 0.53 = BASIN INFORMATION (BASIN; AREA (ACRES); RUNOFF COEFFICIENT C100)
- 1 = DESIGN POINT

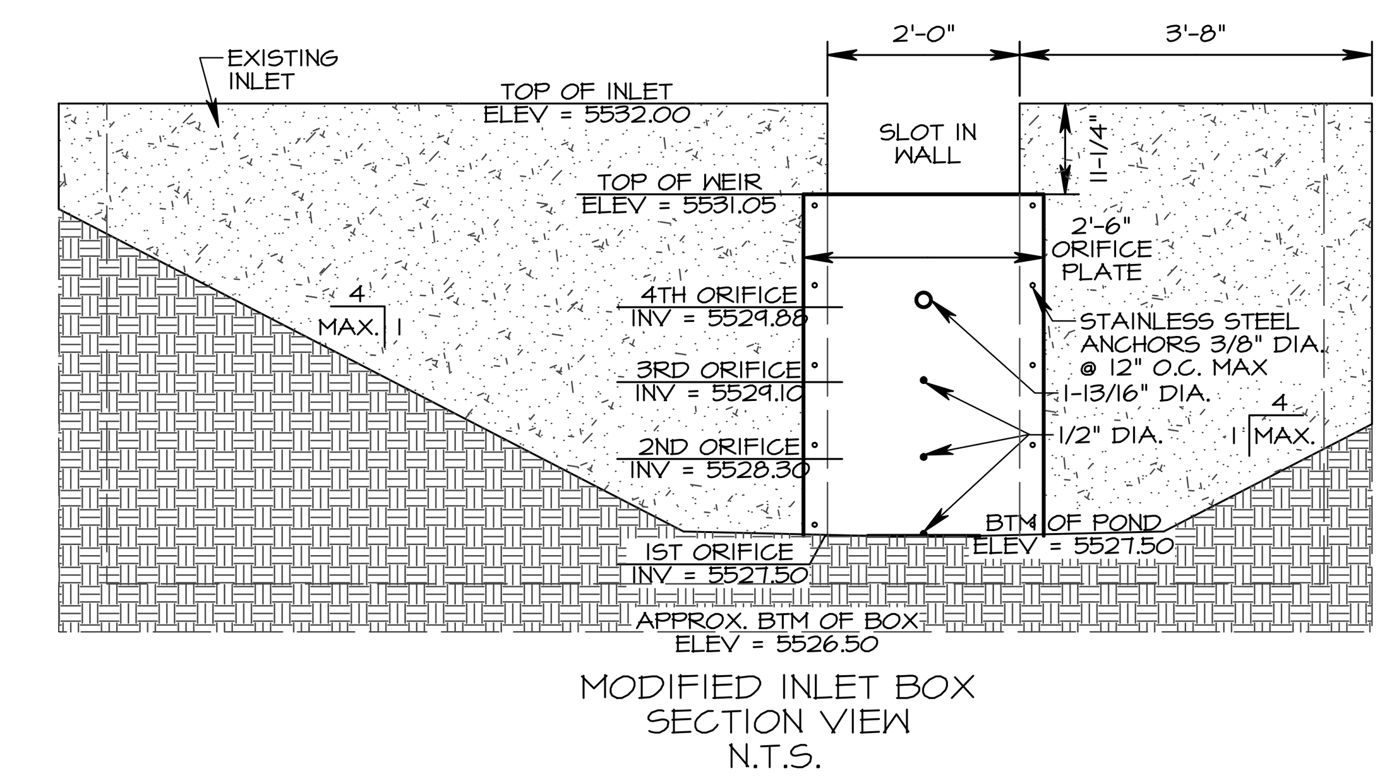
UNCC
UTILITY NOTIFICATION CENTER OF COLORADO
1-800-922-1987
CALL 2-BUSINESS DAYS IN ADVANCE BEFORE YOU DIG, GRADE, OR EXCAVATE FOR THE MARKING OF UNDERGROUND MEMBER UTILITIES.

NOTE
THE IMPROVEMENTS AS SHOWN HEREON LIE WITHIN THE DESIGNATED 100 YEAR FLOOD PLAIN PER FIRM MAP NO. 08005C0168K, DATED DECEMBER 17, 2010.

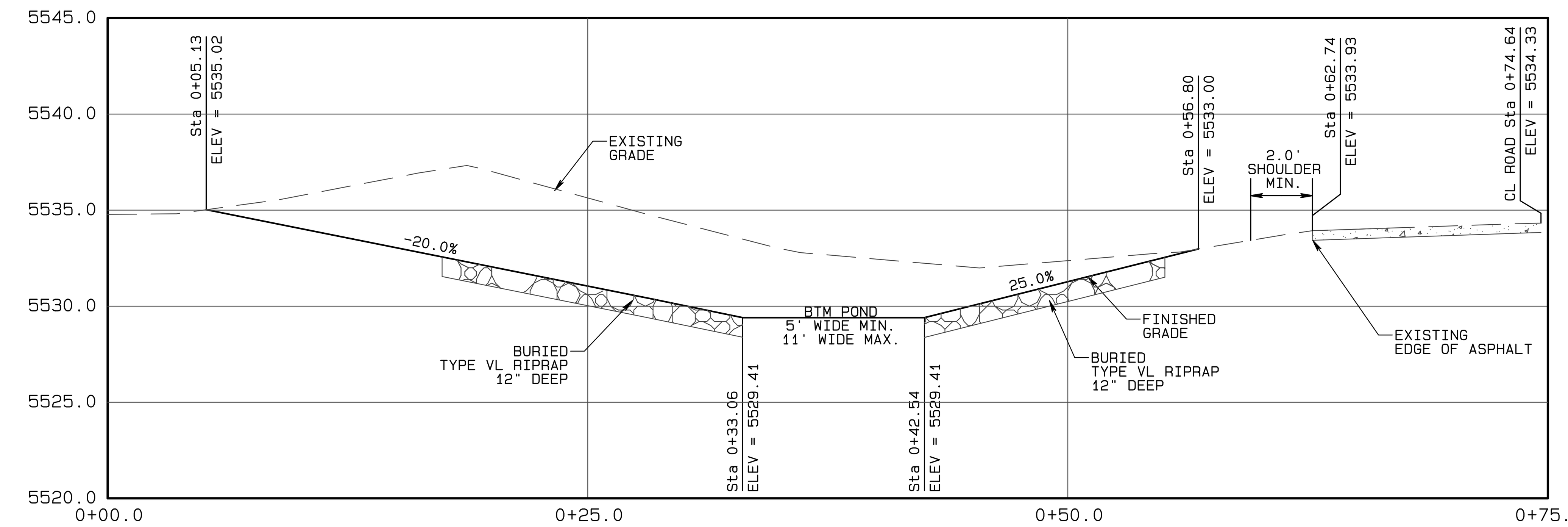


LOT 1
LOT 6
LOT 7
90,436 SQ FT +/-
2.08 ACRES +/-
SOUTH HOLLY STREET
60' PUBLIC R.O.W.
EL CAMINO DRIVE
60' PUBLIC R.O.W.
260.08' (M)
260.00' (P)
350.00' (M)
350.00' (P)
350.00' (P)
349.79' (M)
EXISTING HOUSE
EXISTING CONCRETE DRIVEWAY
CONCRETE PATIO
8' UTILITY EASEMENT PER PLAT
APPROX. LIMITS OF 100 YEAR FLOODPLAIN PER FIRM MAP NO.08005C0168K DATED DECEMBER 17, 2010
APPROX. LIMITS OF FLOODWAY PER FIRM MAP NO.08005C0168K DATED DECEMBER 17, 2010
SWALE WITH 2' WIDE BOTTOM
EXISTING INLET MODIFY PER PLANS
NEW MICROPOOL TYPE D INLET
EXISTING STORM SEWERS TO REMAIN
WATER VALVE
STOP SIGN
EDGE OF ASPHALT



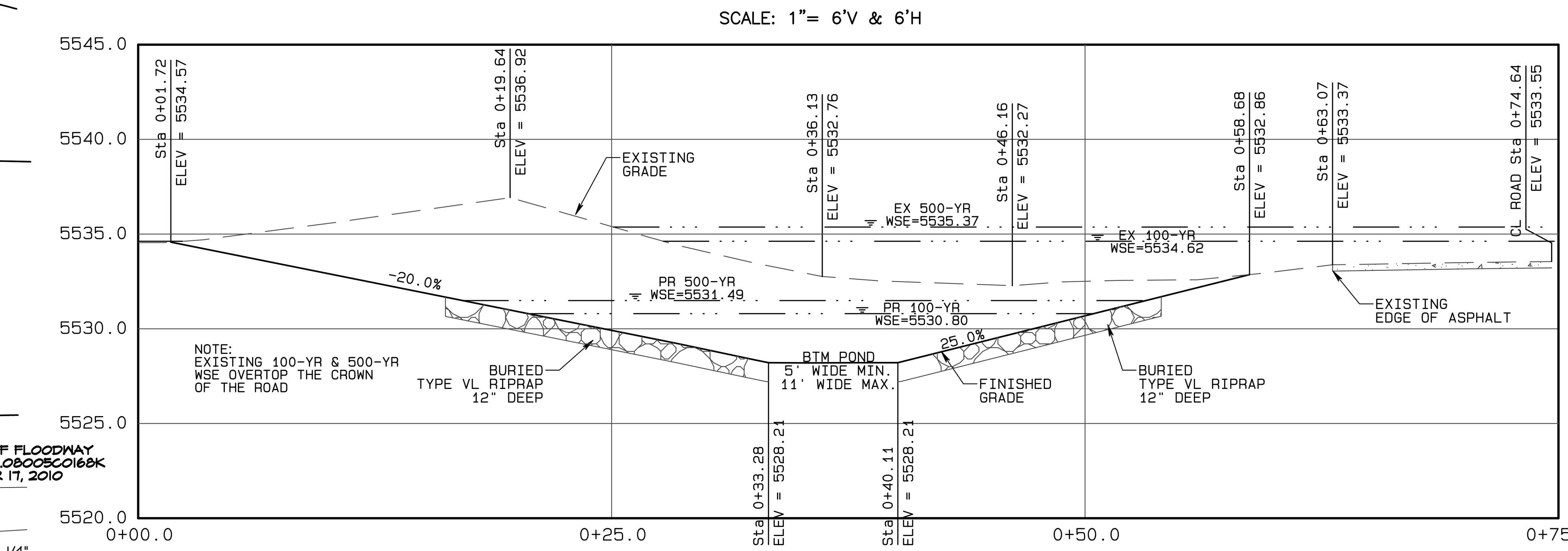


EXISTING INLET
TOP OF INLET ELEV = 5532.00
TOP OF WEIR ELEV = 5531.05
4TH ORIFICE INV = 5529.88
3RD ORIFICE INV = 5529.10
2ND ORIFICE INV = 5528.30
1ST ORIFICE INV = 5527.50
BTM OF POND ELEV = 5527.50
APPROX. BTM OF BOX ELEV = 5526.50
SLOT IN WALL
2'-6" ORIFICE PLATE
STAINLESS STEEL ANCHORS 3/8" DIA. @ 12" O.C. MAX
1-13/16" DIA.
1/2" DIA.
MODIFIED INLET BOX
SECTION VIEW
N.T.S.



POND CROSS SECTION "A"

SCALE: 1"= 6'V & 6'H



EXISTING GRADE
EX 500-YR WSE=5535.37
EX 100-YR WSE=5534.62
PR 500-YR WSE=5531.49
PR 100-YR WSE=5530.80
NOTE: EXISTING 100-YR & 500-YR WSE OVERTOP THE CROWN OF THE ROAD
BTM POND 5' WIDE MIN. 11' WIDE MAX.
FINISHED GRADE
BURIED TYPE VL RIPRAP 12" DEEP
EXISTING EDGE OF ASPHALT

CROSS SECTION "B"

SCALE: 1"= 6'V & 6'H

DEVELOPED DRAINAGE MAP

SCALE: 1"=20'

GRAPHIC SCALE 1"=20'

0 20 40 60

DEVELOPED DESIGN POINT TABLE				
DESIGN POINT	CONTRIBUTING BASIN(S)	AREA (ACRES)	5-YR (CFS)	Q-100 (CFS)
1	A	2.08	2.05	9.23

REVISIONS

DAVID E. ARCHER & ASSOCIATES, INC.
LAND DEVELOPMENT CONSULTING
SURVEYING & ENGINEERING
PHONE (303) 688-4642
105 WILCOX ST. CASTLE ROCK, COLORADO 80104

SCALE	AS SHOWN
DATE	04/03/25
DR'N.	ZET
CKD.	
AP'VD.	

TITLE: DEVELOPED DRAINAGE MAP
4480 South Holly
In Sec. 8, Township 5 South, Range 67 West, 6th P.M., Arapahoe County, Colorado.

CLIENT: Designs By Sundown

JOB NUMBER: 20-0420

Sheet 1 of 1

Tue Jul 22 13:26:43 2025
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